Scalable Display Manager 3.10

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1. Overview

Scalable Display Manager is a software-based platform for multi-projector, multi-megapixel display management. Scalable Display Manager brings the ease of automation to the difficult task of manually aligning multi-projector display systems.

This guide provides instructions for setting up a basic simulation environment consisting of a host computer and multiple networked IGs running a Scalable integrated application. It serves as a general guide and overview of the Scalable Display Manager product. However, simulators vary and these instructions may not be appropriate for all installations.

2. Getting Started

This section will give you an overview of PC and display environment preparation for installing and using Scalable Display Manager.

2.1 System Requirements

Scalable Display Manager has specific requirements pertaining to the camera and graphics card. Make sure that your system meets the following requirements before continuing on setting up the system.

2.1.1 Recommended Calibration PC

- Windows® 7 64-bit Home Premium or better (*Home Basic not supported*).
- 6 Gigabytes of RAM.
- OpenGL 2.1 Compatible Graphics Card.
- Intel Core2 Duo 2.6 GHz or better.
- 10 Gigabyte of hard drive space available.

2.1.2 Recommended Hardware

- 2 or more projectors.
- Network Switch.
- Input source capable of outputting a signal with overlap (*GPU, video wall controller, etc*)

2.1.3 Supported Cameras

Additional information on choosing a camera can be found in Setting Up the Camera

Model	Part #	Adapter Model
Canon T1i *(Kiss X3, 500D)*	3818B002	ACK-E8
Canon T2i *(Kiss X4, 550D)*	4462B003	ACK-E8
Canon T3 *(KissX50, 1100D)*	5157B002	ACK-E10
Canon T3i *(KissX5, 600D)*	5169B003	ACK-E8
Canon T4i *(KissX6, 650D)*	6558B001	ACK-E8
Canon T5 *(KissX70, 1200D)*	9126B003	ACK-E10
Canon T5i *(KissX7i, 700D)*	8595B003	ACK-E8

Supported Canon Lenses

Model	Part #	Description
EF-S 18-55mm Lens	2042B002	Usually included with the camera body
EF-S 10-22mm Lens	9518A002	Wide angle lens

2.1.4 Supported Webcams

Camera	Model/Part #
Logitech HD Pro Webcam C910	960-000597
Logitech HD Pro Webcam C920	960-000764

2.2 Setting Up the Projectors

The right placement of the projectors and their right picture settings are essential in order to achieve optimal results in your blended display.

2.2.1 Placing the Projectors

There are several factors to consider when placing the projectors for your system:

- the amount of overlap,
- their alignment,
- the angle at which they hit the screen.

Set the Physical Overlaps

Scalable Display Manager requires an overlap of about 15% between projectors. The higher the overlap, the better the blend will look.


If the screen will be viewed from very wide angles or be rear projected, an overlap of about 25% is recommended for best viewing.

Align the Projectors

To produce the best results, aim the projectors so that they are aligned with each other. While Scalable Display Manager can correct for projector misalignment, extreme angles can result in increased aliasing of the final display.
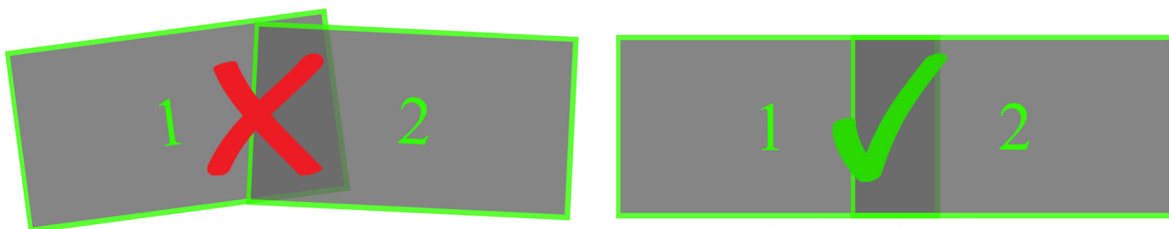
Projectors at extreme angles to the screen will cause straight lines in the content to appear aliased. Projected light falling on curved screens can result in aliasing regardless of position so it is best to anticipate the issue and minimize the aliasing as much as possible.
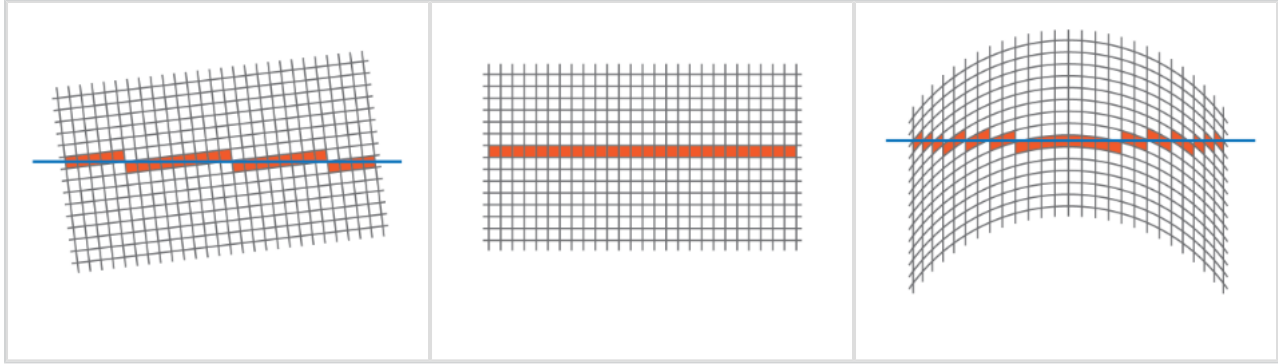
Pay Attention to Lighting

During the display calibration a series of white dots on a black background will be projected. For the camera to be able to discern these patterns dark rooms are strongly recommended during this process. In the event that there is ambient light that cannot be avoided, the projectors must be brighter than any stray light on the screen. Pay particular attention to projected light coming in at odd angles which can result in significant intensity falloffs.

> **Sunlight Is Not Constant**
>
> Sunlight changes over time. Those changes are visible to the camera, even if they are not to the naked eye. Scalable products need relatively constant light in order to calibrate.

2.2.2 Optimizing the Projector Picture

The projector settings can make a noticeable difference in the look of the blend zone. The picture from the projectors should look the same in order to have a seamless edge blend; differences in brightness, color, etc., can result in a visible blend zone.

Adjust the Projectors Settings

The following table shows common projector settings that can affect blending.

| Name	Proper Setting	Description
Gamma	Movie/Film (aka Real, Accurate, 2.2)	Gamma settings that boost brightness, such as "Presentation Mode", often make the blend too bright.
Color Temperature	6,500K	Set the color temperature identically across all projectors. Digital media is normally designed for a color temperature of around 6,500K.
Input Range	0-255 (aka Enhanced, Full)	Some projectors default to a reduced 16-235 (aka Standard, TV) input range when using HDMI cables.
Brilliant Color	Off	Turn off any artificial color enhancements.
Dynamic Black (aka Adaptive Contrast, Auto Iris)	Off	Dynamic Black will continually change the brightness levels based on the input signal, causing poor blends and interfering with color calibrations.
Overscan	Off	Overscan crops input signal and throw away a percentage of pixels around the edge of the screen.
Keystone	Off	Scalable Display Technologies performs geometric correction making keystone correction unnecessary. Having Scalable Display Technologies's warp and the projector's keystone correction applied can reduce the sharpness of the final image.

The projectors should be set to display the video signal from the PC without any boost, crop, or other alteration.

The best blend results are produced when the projectors are configured uniformly.

Adjust the Projectors Saturation

Under or over-saturated projectors are often the cause of poor-looking blend zones. Adjust the projector saturation to correct visible blend zones in the final display. This section and the associated test images will help you identify and correct saturation problems with your projectors.
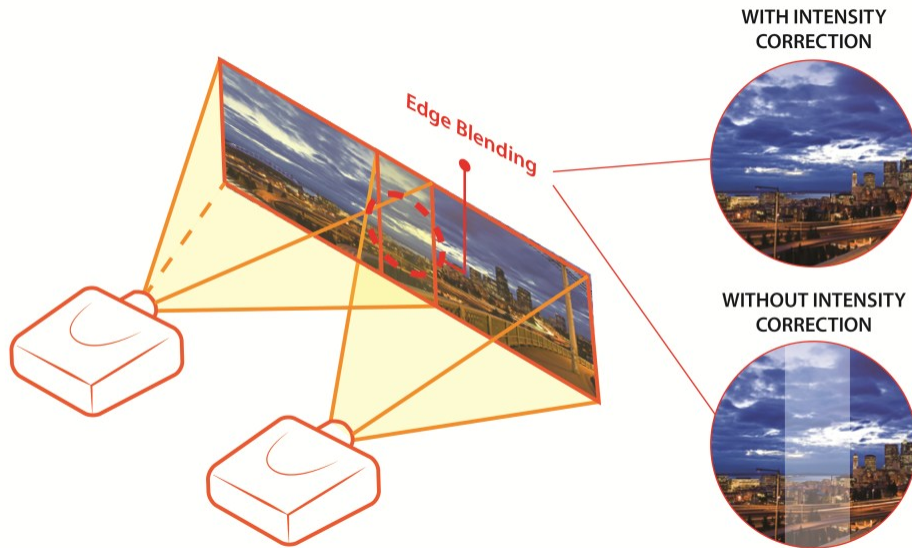
Download the Saturation Test Images

Please download the saturation test images using the following link:

http://www.scalabledisplay.com/downloads/documentation/ancillary/ProjectorSaturation-TestImages.zip

There will be three image files in the zip folder. These will make the blend zone pop to help with the adjustment of a projector.

Open the test images one at a time in any program so that they fill as much of the single projector as possible. It is important to ensure that the warp and blend is off when viewing these images. For easier testing, use one projector at a time.

> If you view these images on a poorly calibrated display, the example images may not look correct.

The goal is to have each projector look like as close as possible to the following:
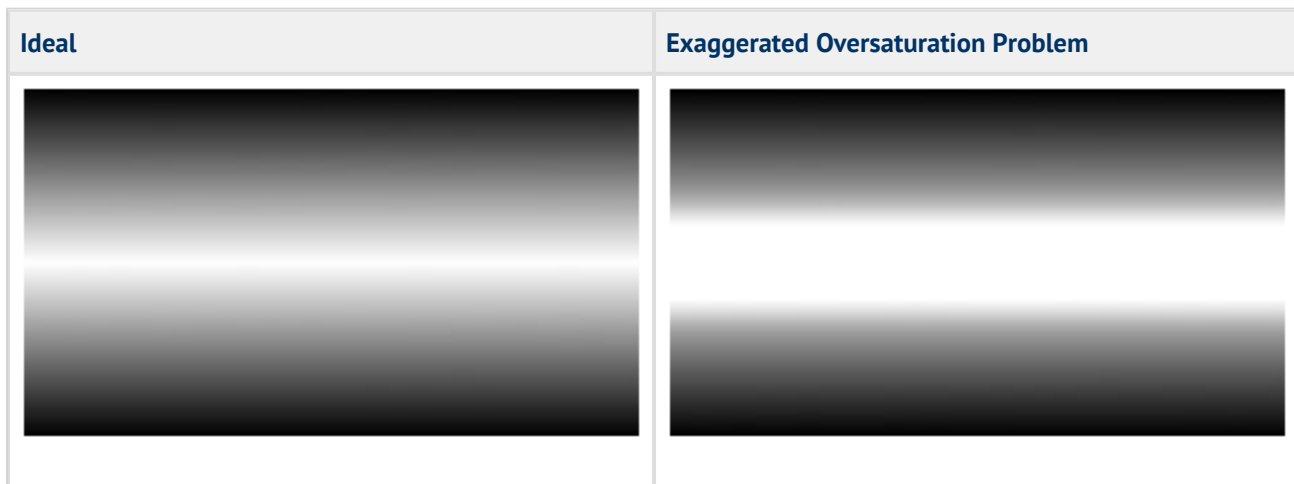
Ideal Brightness (Undersaturation Image)	Ideal Contrast (Oversaturation Image)
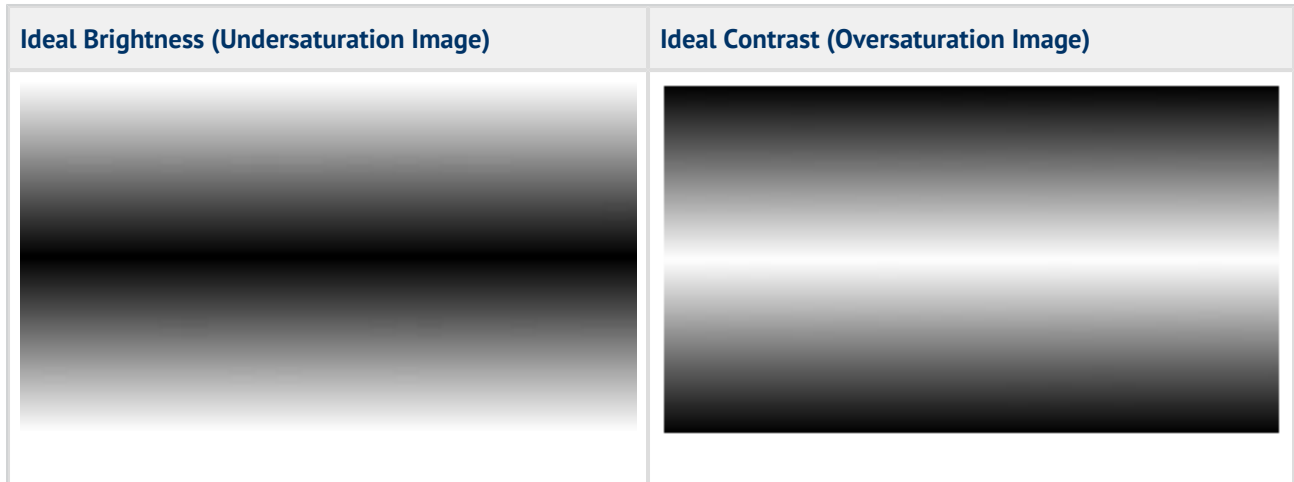
Adjust the Projectors Contrast

To properly adjust the contrast of your projectors:

1. Open the Oversaturation image.
2. Set the contrast very high.
3. Lower it until the bright white band shrinks into a line. If you continue lowering the contrast past this point, the white area will get darker instead of continuing to shrink.

If the white band does not shrink all the way down to a line, there may be a projector setting which is cropping out the high end of the input signal.

Ideal	Exaggerated Oversaturation Problem

The appropriate contrast setting may vary greatly even between seemingly identical projectors.

Adjust the Projectors Brightness

To properly adjust the brightness of your projectors:

1. Open the Undersaturation image.
2. Set the brightness very low.
3. Raise it until the black band shrinks to a minimum size. If you continue raising brightness past this point, the black area will get brighter instead of continuing to shrink.

Ideal	Exaggerated Undersaturation Problem
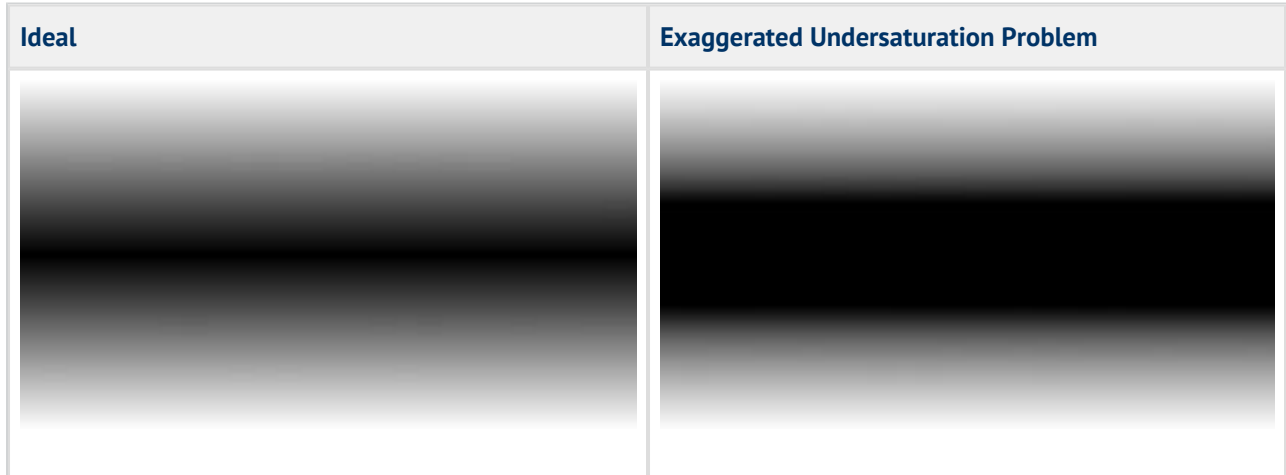
- Unlike the white band showing oversaturation, it is unlikely the black band will shrink down completely to a line.
- The appropriate brightness setting may vary greatly even between seemingly identical projectors.

2.3 Setting Up the Camera

During the calibration process, a series of patterns are projected onto the display and then captured by the camera. Scalable Display Manager uses these patterns to calculate the geometric correction and edge blending for the display. Refer to the sections below for proper camera selection and placement.

2.3.1 Choosing the Right Camera

Scalable Display recommends the high end cameras, such as the Canon Rebel Digtal SLR models, as these cameras fully support all features available in Scalable Display Manager, and produce the highest quality calibrations. With that in mind, not all installations require the expense of a Canon Rebel, and can instead use the more cost effective webcams. When the installation does not require a large viewing angle, has bright projectors in a dark environment and will not be using color calibration the webcam can be used in place of the Canon cameras.

|	Webcam	Camera		Webcam	Camera
Cost Effective	✓	✗	**Wide Viewing Angle**	✗	✓
Realtime Image Update	✓	✗	**High Quality Optics**	✗	✓
High Dynamic Range	✗	✓	**Color Calibration Support**	✗	✓

2.3.2 Placing the Camera

Proper placement of the camera is important for accurate calibrations and the long term stability of the system.

Position the Camera

If the camera cannot see the complete image of all projectors, the calibration process will not be completed.

Follow these best camera practices:

- Place the camera in the center of the screen where it can see the screen in its entirety.
- Ensure the camera is not looking directly into a bright light source.
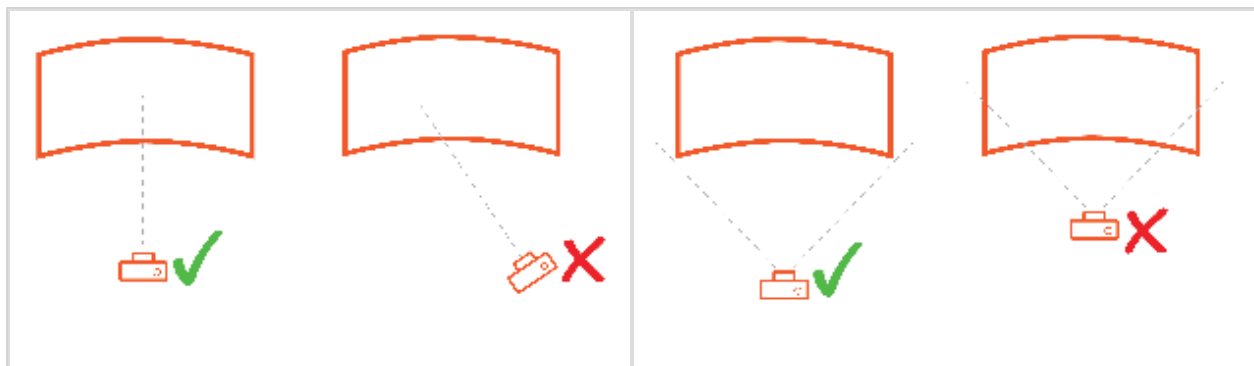
Mount the Camera

Mount the camera firmly to a tripod or another type of camera mount; any movement during the calibration process will result in subpar results.

If you can, have a dedicated camera for each system and leave the camera permanently mounted so you can easily run subsequent calibrations.

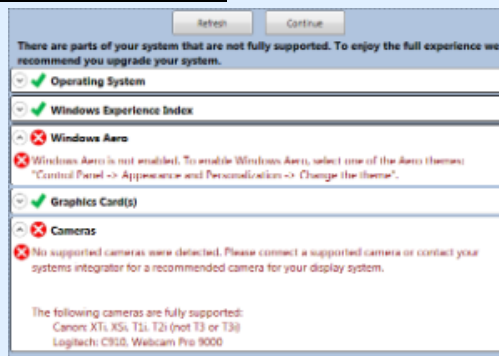# 3. Installing Scalable Display Manager

This section gives you an overview on the download, installation, and licensing of Scalable Display Manager.
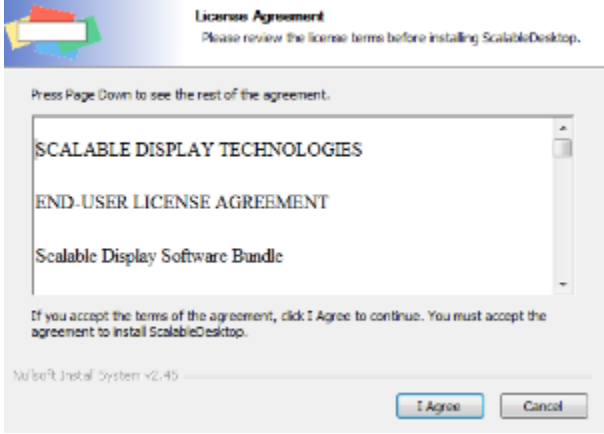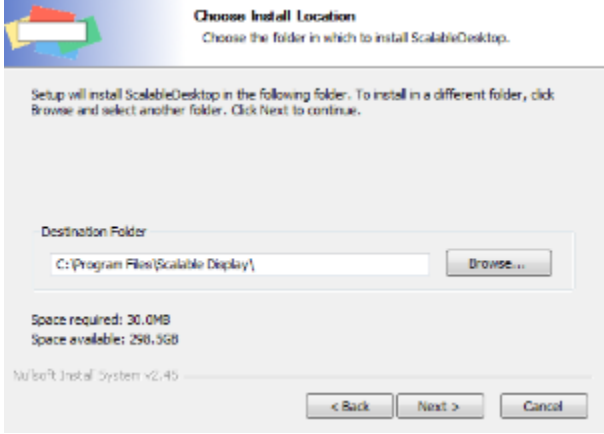
3.1 How to Install

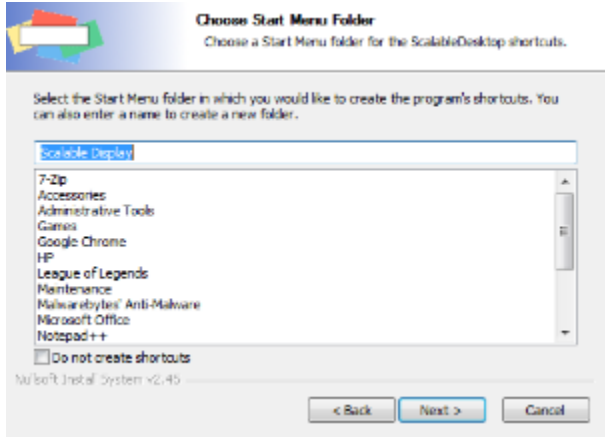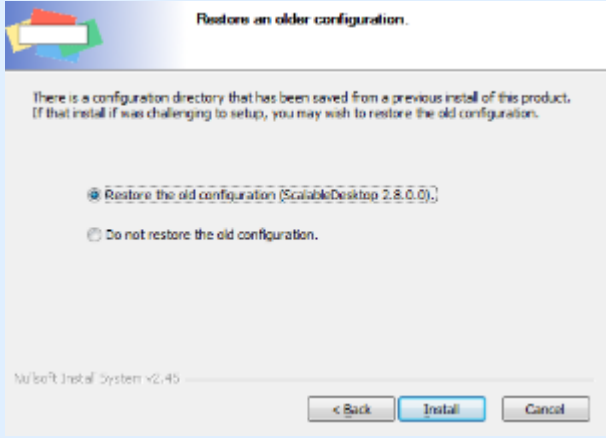Please contact your Scalable representative for the latest version of software.
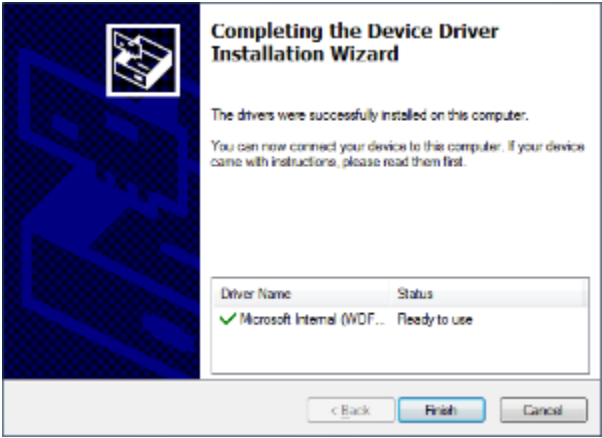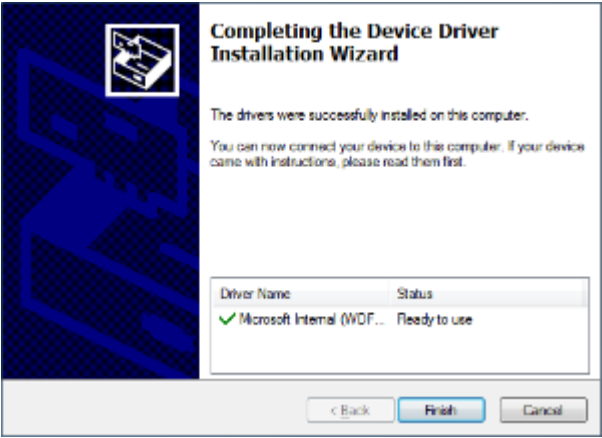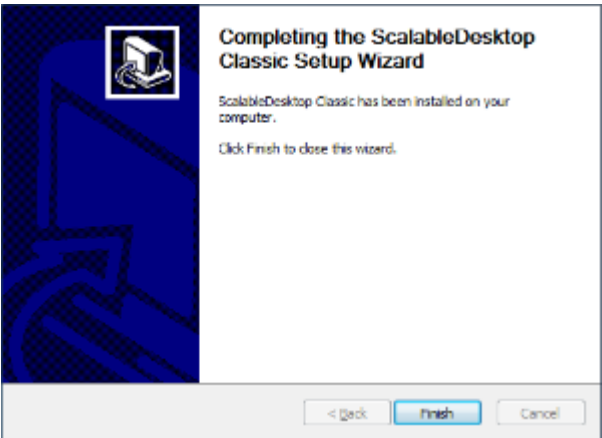
Requirements Validator

If you are prompted with a screen called the Requirements Validator, one or more of the system compatibility checks have failed. Please read the notice for more information. These notices can range from major issues such as an incompatible operating system, to minor issues such as not yet having your calibration camera connected. During the time of installation, you can continue past some of these minor warnings, but <u>any remaining issues must be addressed before calibration</u>.

1. Double-click the Scalable executable file (Scalable Display Manager.exe). You will then be greeted with a Scalable logo followed by a prompt to Please select a language. Please select your desired language and press Ok.

2. In order to install Scalable Display Manager on your system, you are required to accept the *End User License Agreement*. Please review the license terms and then click **I Agree** to continue. If you cannot accept it, please click **Cancel** to exit the installation.

3. Scalable Display Manager will be installed under the default path: C:\Program Files\Scalable Display. If you want to change the location, please click **Browse,** set the installation path, and click **Next** to continue.

> It is strongly recommended that Scalable Display Manager be installed in the default location. Errors may occur if files cannot be found in their default location.

4. Scalable Display Manager will be installed under the default Start Menu folder titled *Scalable Display*. If you want to change the Start Menu folder, enter the new name and click **Next** to continue.

5. Click **Install.**

Restore an Older Configuration

If you have had a previous version of Scalable Display Manager installed on your PC, you will be prompted to ask whether you want to discard or restore the old configuration. By default, restore the old configuration is selected. However, if you don't want to keep your previous calibration and settings, choose Do not restore the old configuration.

|	
	6. Partway through the installation you will be prompted by the *Device Driver Installation Wizard*. Press **Next** to continue.
	7. Once the *Device Driver Installation Wizard* is complete, click **Finish** to continue the installation of Scalable Display Manager.
	8. After a few moments you will be notified that the installation has completed. Click **Finish** to close the window.

3.2 Licensing

All Scalable Display products require either a software or a hardware license. The fastest and easiest way to obtain a license is through the License Helper application. It requires only a little information about your setup. Once completed and processed, the license will be emailed to you.
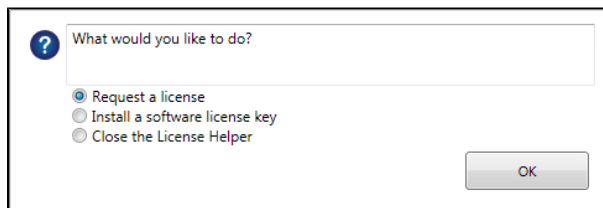
3.2.1 Request a License

The license is tied to a particular computer and therefore the request must be made from the computer on which you will calibrate the display.
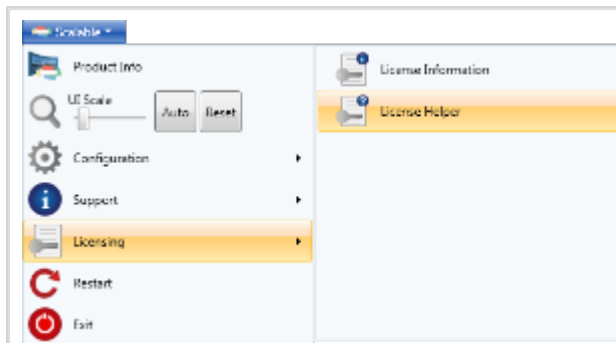
Initial Installation

If this is the initial installation of Scalable's software on this computer, you will be prompted to request a license upon launching the program the first time.

1. In order to access the *License Request Tool*, open the Scalable Display software, and click the **Scalable** button on the top left corner of the screen. Select Licensing **> License Helper**

2. The License Helper will open in a new window. Select *Request a license* and click **Ok**.

3. You will be asked if *this is the computer on which you will calibrate the display*. If that is true, select **Yes** and you will be able to proceed. However, if you are making the request from a different PC, select **No** and you will be instructed to make the request from the computer on which you will calibrate the display.

4. Confirm that the date on your computer is correct. An incorrect time will render your license unusable.

5. Complete the form with your personal contact information. The email address used here is where the license will be sent.

6. Complete the form with descriptive information about your project.

7. Lastly, you will be asked how you prefer to upload this license information to Scalable. If you are on a computer with an active internet connection, it is recommended that you choose *Email request* which will seamlessly send the file to Scalable.

> If the requesting PC does not have internet, you can save the request and email it using a different PC.

8. Please wait for Scalable to send your license via email. If the need is urgent, please contact your Scalable representative to expedite the license processing.

3.2.2 Install a License

> You will receive the license from Scalable in the email from which the request was sent.
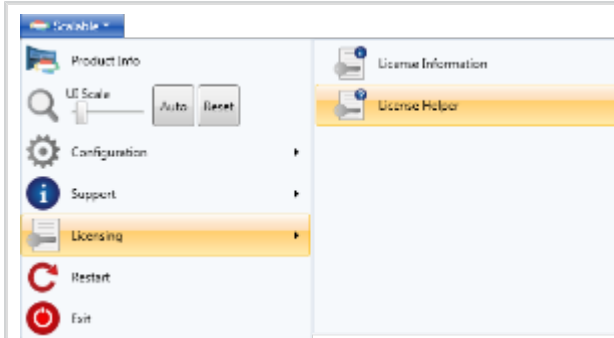
	1. Open the email you received from Scalable and download the attached XML file to your local computer. 2. Open the Scalable Display software, click the **Scalable** button on the top left corner of the screen. Select Licensing **> License Helper.**
	3. The *License Helper* will open in a new window. Select *Install a software license key* and click **Ok**.
	4. This will open a file browser. From here, navigate to the location in which your license file was downloaded. Select the file and click **Open**. 5. This will automatically place the license file in the appropriate location within Scalable's Program Files directory.
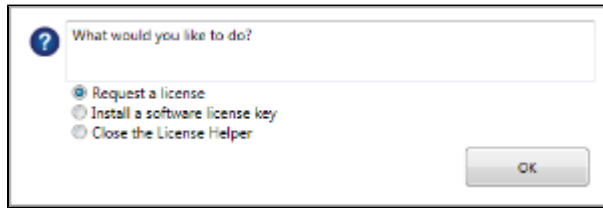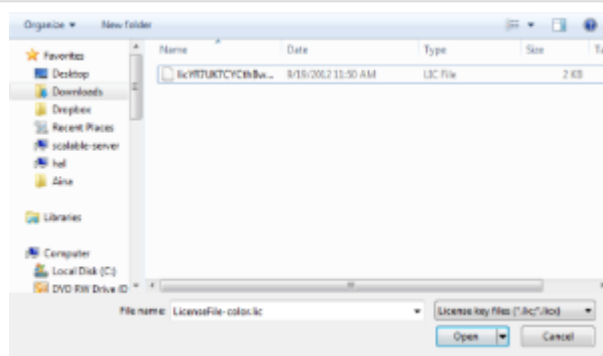
4. Scalable Display Manager

The Scalable Display Manager user interface guides you through the calibration process while allowing you to directly access any enabled panel at any time. The interface also provides important status information and context sensitive help in every panel.
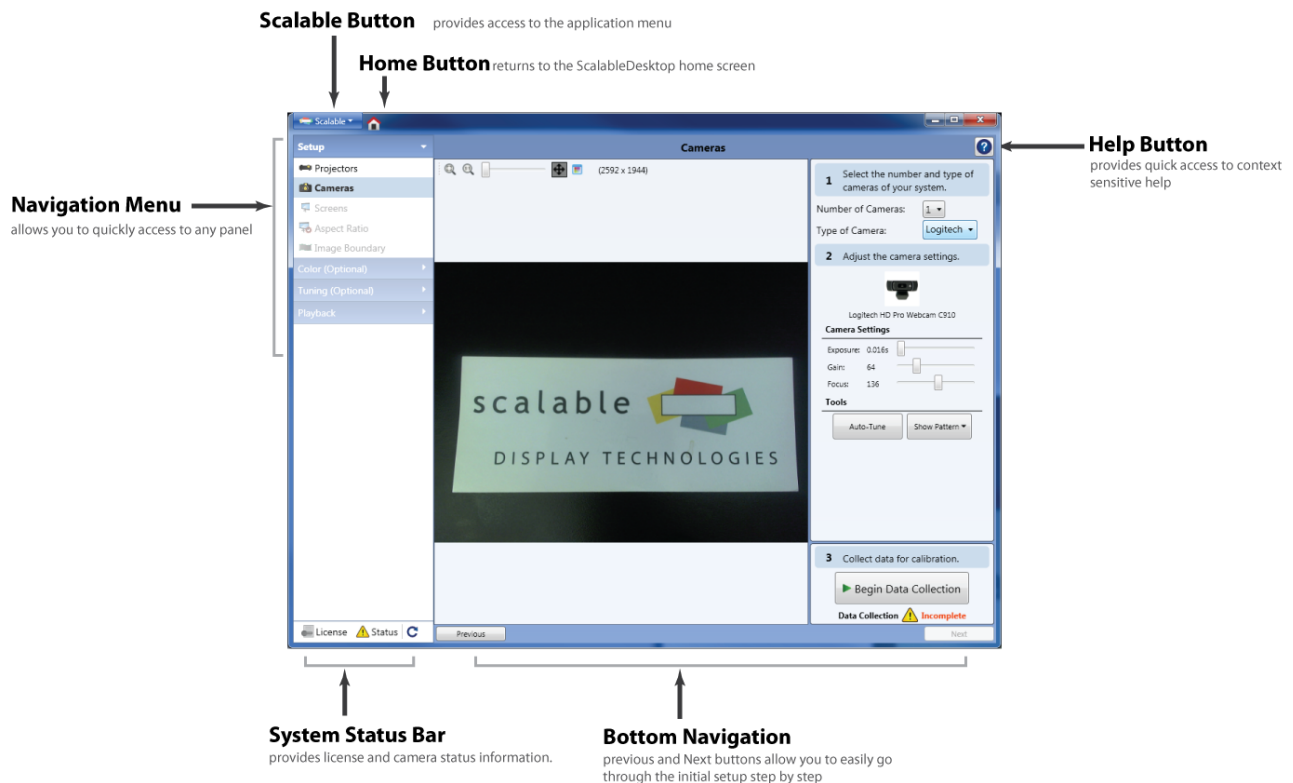
4.1 Component Setup

4.1.1 Display Clients Panel

The Display Clients panel presents an interface that allows you to setup the connections to the remote computers. The right side of the panel shows the displays connected to the current system, while the left side shows all available Display Clients.
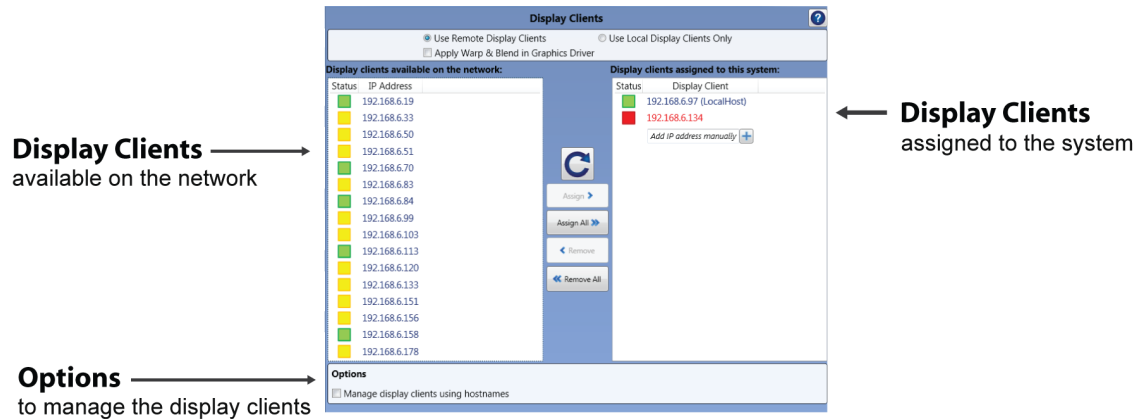
Use the Display Client on the Local Computer

If the computer running Scalable Display Manager is the only computer used in the system select the radio button **Use Local Display Clients Only**. No additional setup is required on the Display Clients panel.

Use the Display Client on Remote Computers

If in your system there is one or more computers other than the one running Scalable Display Manager, select the radio button for **Use Remote Display Clients**. Additional configuration of both the remote computers and the system are required.

Set Up Remote Computers

All remote computers must have the Display Client running to show up in the available on network list. The easiest way to install the Display Client is by installing the full Scalable Display Manager software on each remote computer. The installer will set the Display Client to start on boot.

1. Install Scalable Display Manager on each remote computer.
2. Ensure all remote computers are on the same network subnet.
3. Add a firewall exception for Ports 30001 - 30002 for both TCP and UDP.

One of my Display Clients is not showing as a client available on the network

Display Clients are detected on the network using multicast. Standard network troubleshooting is appropriate when they do not appear in the Display Clients available on the network list. Make sure that:

- Scalable Display Manager is running on the remote Display Client.
- The Display Client is pingable on the network.
- The firewall is disabled.
- The Display Client is on the same subnet.

Add a Display Client to the System

Scalable Display Manager automatically detects all the Display Client on the network subnet. The status of each Display Client is displayed in a colored square to the left of their name.

Symbol	Status of the Display Client
	Unable to connect to the Display Client.
	The Display Client is in use by another system.
	The Display Client is available.

Display Clients on the right hand list will be part of the system.

The computer you are using to calibrate the display is automatically assigned to the system with the name LocalHost. If the Calibration PC will not be driving a display remove LocalHost from the *Display clients assigned to the system* list.

1. Click to highlight one of the clients in your system.
2. Click **Assign >** to move the clients into the system.
3. *Repeat for all remaining clients.*

Apply Warp & Blend in Graphics Driver

Scalable Display Manager will by default output a scalable mesh file, if instead you would like to directly apply the warp and blend in the graphics driver check the option **Apply Warp & Blend in Graphics Driver**.

Warping and Blending in the graphics card requires Nvidia Premium Mosaic Mode. As of release the latest supported Nvidia Driver was 348.07. It is recommended to use that version or greater.

Make	Model	Part Number
Quadro	K1200	VCQK1200DP-PB
Quadro	K4200	VCQK4200-PB
Quadro	K5200	VCQK5200-PB
Quadro	K6000	VCQK6000-PB
Quadro	K5000	VCQK5000-PB
Quadro	M6000	VCQM6000-PB

4.1.2 Projectors Panel

Projectors — resolution and layout of the connected displays

Projector Resolution — verify the auto-detected resolution

Projector Arrangement — physical layout of the displays

Size of projector array — in rows and columns, making up the display system

The projectors panel should accurately reflect the number and resolution of the displays connected to your computer, however Scalable Display Manager can only auto-detect certain common resolutions. If it is unable to detect the current resolution of your display(s), the most common response is that it will simply show a single display at the combined resolution of all your projectors.

> **Wrong Number of Projectors or Incorrect Resolution**
>
> If the number of projectors or their resolution is different from the actual system, manually choose or enter the resolution of a single projector under custom resolution.
>
> 1. Click **resolution per projector** drop down.
> 2. Select the **Width** and **Height** to the resolution of a *single* projector in pixels (*e.g. 1920 x 1080*)
>   a. OR Select **Custom.**
>   b. Set the **Width** and **Height** to the resolution of a *single* projector in pixels.
>   c. Click **OK**
> 3. Click **Redetect Displays.**

Enter the Projector Arrangement

1. Select the physical arrangement of the projectors: **Tiled,** if the projectors are next to each other, or **Stacked**, if the projectors are on top of each other.
2. Select the number of projectors in a **row**.
3. Select the number of projectors in a **column**.
4. Click **Redetect Displays** to save the settings.

Order the Display Clients (If using Display Clients)

The order of the display clients will have an effect on what projector is 1st. To properly order projectors, set the displays such that the most left projectors is the first in the list. To change the order click the arrow key to move the computer IP up or down.

.

| 192.168.6.174 |
| 192.168.6.253 |

4.1.3 Cameras Panel

Zoom to check fine detail of your camera's image

Type of Camera
connected to the system

Camera Settings
for manually adjusting the image

Image
captured by the camera

Show Pattern
displays various test patterns

Auto-Tune
automatically adjust the camera image

Begin Data Collection
collects the data for the calibration
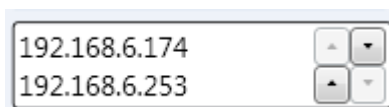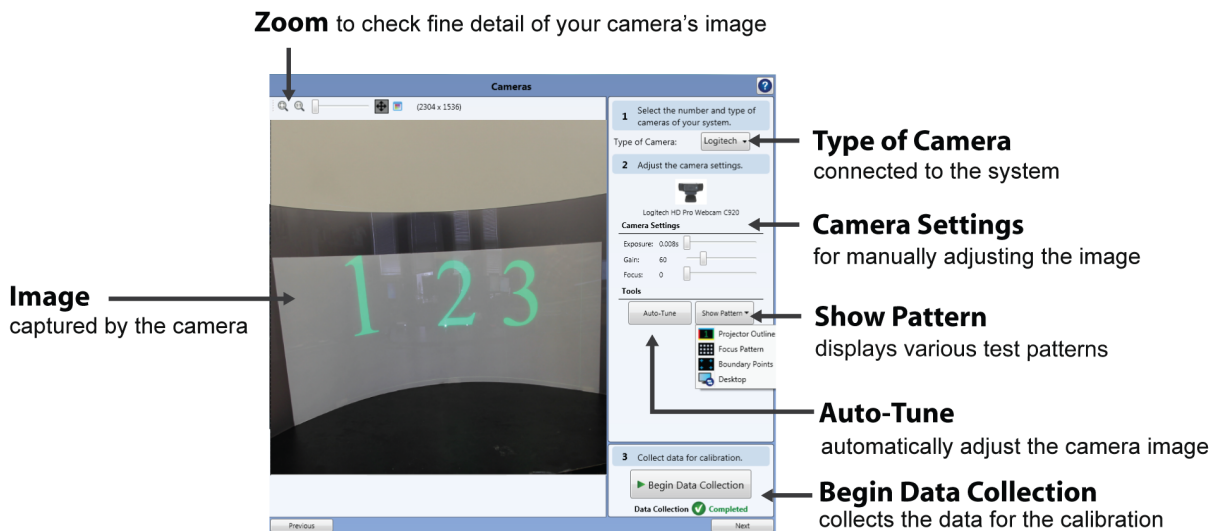
Select the Number and Type of Cameras of Your System

Verify that the number and type of camera detected by Scalable Display Manager correspond to your system. If the Automatic type doesn't detect your camera please manually choose your camera type.

> If multiple cameras types are connected to the computer, make sure to select the camera type with which you wish to calibrate.

Adjust the Camera Settings

For a proper calibration, it is necessary to focus the camera and adjust its brightness.

Focus the Canon Rebel Camera

Focus the Canon Rebel camera by rotating the barrel of the lens until areas of fine detail are in focus.

1. Switch the camera to the **manual focus** setting by changing the switch on the top left of the lens to **MF** (see the photo below).
2. Rotate the barrel of the lens until the image is focused in the viewfinder.
3. Click **Take Picture** within the software interface to update the image and check your results.

Focus the GigE Camera

Focus the GigE camera by rotating the barrel of the lens until areas of fine detail are in focus.

1. Rotate the barrel of the lens until the camera picture is sharp and in focus.
2. Using the Scalable Display Manager interface, zoom into an area of the picture with fine detail in the center of the screen and verify that it is not blurry or out of focus.

Focus the Logitech Webcam

Focusing the Logitech webcam is performed through the Scalable Display Manager interface.

1. Adjust the **Focus** slider under **Camera Settings** until the camera picture is sharp and in focus.
2. Using the Scalable Display Manager interface, zoom into an area of the picture with fine detail in the center of the screen and verify that it is not blurry or out of focus.

Camera Brightness

> The projectors must appear to be brighter than the ambient light on the screen. If the projectors are coming in at odd angles and have a significant intensity falloff, then the darkest portions of the projectors should be much brighter than any stray light on the screen.

Scalable Display Manager requires the image to appear with a normal saturation in order to properly detect the patterns displayed during calibration. If the image presented to Scalable Display Manager is over or undersaturated, it will result in an error or produce an incorrect geometry calibration. The camera's brightness needs to be set so that there is enough contrast between the light and dark areas of the screen to see the calibration patterns. The image preview window should look similar to how you see the image in real life.
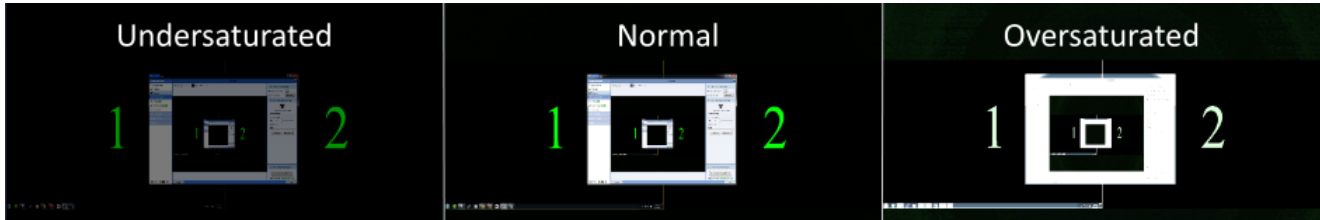
If after manual adjustment the image brightness still has saturation problems, click the **Auto Tune** button. A series of pictures will be taken to auto-adjust the camera. If the image is not normally saturated after the **Auto Tune**, you may need to manually adjust the camera's brightness. Follow the instructions below for your particular camera.

Set Brightness with the Canon Rebel

Adjust the camera's brightness by using the sliders in the Camera Settings section.

1. Click **Show Patterns** > **Focus Pattern** to display a sample data collection pattern.
2. Set the **ISO** to 100[*].
3. Set the **Aperture** to f7[*].
4. Set the **Exposure** Time so the camera is at the proper brightness.

[*] *Recommended value for most lighting conditions*.

Setting	Recommended Value	Description
Exposure Time	Can be set to any value.	Length of time the shutter will be open for a picture.
Aperture	f/7 - f/11	Size of the adjustable opening allowing light in.
ISO	100-200	Sensitivity of the camera to light.

Set Brightness with the Logitech Webcam

Adjust the exposure and gain by moving the sliders on the right until the camera is at the proper brightness.

Adjust the Exposure Setting First

Use the exposure settings rather than the gain whenever possible with the Logitech webcams. Gain is a software boost to the image brightness (similar to increasing brightness and contrast in a photo editor). Though it will make the image brighter, you will lose detail and significantly reduce the image's dynamic range.

If colored lines appear over the camera image, this will cause distortions during the data collection process. Increase your exposure so that the camera's image appears normal.
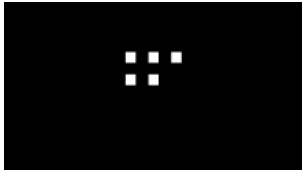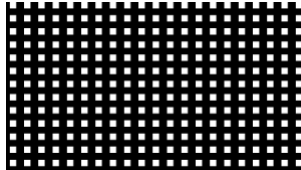

Begin Data Collection
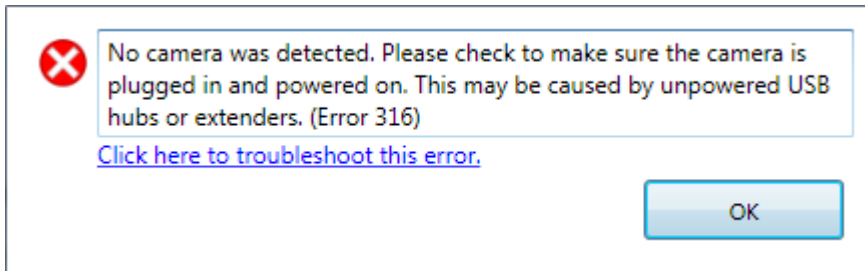
Click **Begin Data Collection.**

The data collection process will begin by showing a solid, white image on each projector, starting with the first projector and going in order to the last. The white image is used to see the area that each projector is covering.

Next, two images will be displayed on each projector, starting again with the first projector and going in order to the last. The first image will be a 5-dot pattern which is used to determine the orientation and location of the projected image. The second image displayed is the grid pattern which is used to map where the pixels are falling on the screen.

White Pattern	5 Dot Pattern	Grid Pattern

What to do if an Error Occurs

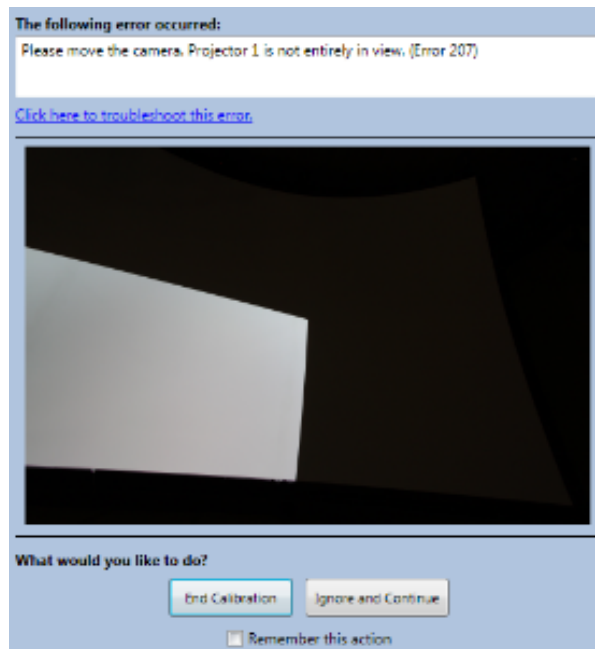You may run into a variety of problems during the calibration process. Most commonly, they are related to the camera positioning, saturation, and its ability to detect the spot patterns being displayed. If you are faced with an error message, click on the link labeled **Click here to troubleshoot this error** on the error message window. This will open a browser with the suggested solutions for this particular problem.

> ❌ No camera was detected. Please check to make sure the camera is plugged in and powered on. This may be caused by unpowered USB hubs or extenders. (Error 316)
>
> Click here to troubleshoot this error.
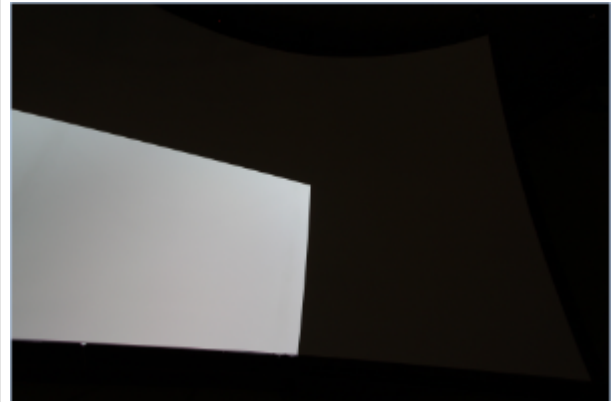>
> [OK]

Data Collection Error Actions

Some of the most common errors encountered during the data collection process have been included in the Error Actions. Error actions allow you to ignore issues with the data collection images which do not inhibit the data collection.

The error action below will be displayed when a camera cannot fully see a projected image. You are given the choice to "End Calibration" or "Ignore and Continue". If you are expecting that the entire projected image will not be seen, Ignore and Continue. However, if you are not seeing the entire projected image for other reasons, you should **End Calibration** and correct the error at its source.

> The following error occurred:
>
> Please move the camera. Projector 1 is not entirely in view. (Error 207)
>
> Click here to troubleshoot this error.
>
> What would you like to do?
>
> [End Calibration] [Ignore and Continue]
>
> ☐ Remember this action

The software can not discern the difference between a projected image that does not fill the screen and one that fills the screen but spills off.

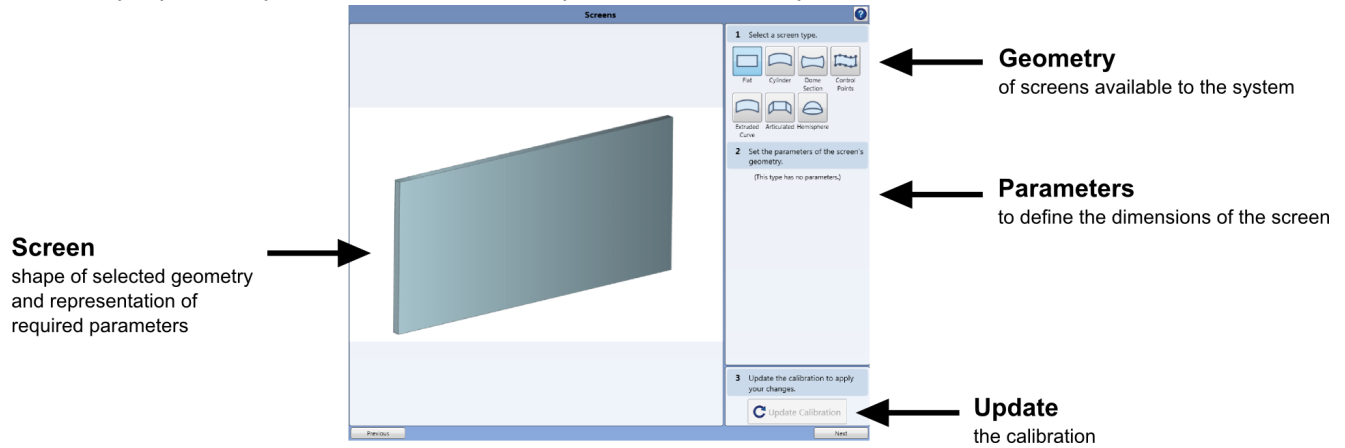|	
End Calibration: In this case, the calibration should be stopped so that the camera can be re-positioned to see the entire projected image.	
Ignore and Continue: The error action is expected and triggered because the projector is overshooting the screen.Continuing will not cause any issues.	
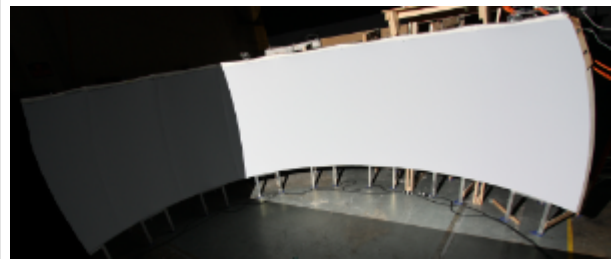
Remember Error Actions

You can chose to remember your selection by checking the "Remember this action" checkbox which will give you the following options:

| Choice	Description
Remember this action for this projector for session	Do not stop the calibration for this error on **this** projector until the software is restarted
Remember this action for this projector forever	Never stop the calibration for this error on **this** projector
Remember this action for all projectors for session	Do not stop the calibration for this error on **any** projector until the software is restarted
Remember this action for all projectors forever	Never stop the calibration for this error on **any** projector

4.2 Screen Specifications

4.2.1 Screens Panel

The Screen's Panel shows the geometries available to your system. Select from the list the geometry that most accurately represents your screen and enter the parameters necessary to define it.

Geometry
of screens available to the system

Parameters
to define the dimensions of the screen

Screen
shape of selected geometry and representation of required parameters

Update
the calibration

The following table gives an overview of some of the characteristics of each geometry.

	Shape	Easy Setup	No Dimensions	Partial Screen	Multi-cam	Milsim Accurate
Flat		✓	✓	✓	✓	✓
Cylinder		✗	✗	✓	✓	✓
Dome Section		✗	✗	✓	✓	✓
Control Points		✓	✓	✗	✗	✗
Extruded Curve		✓	✗	✗	✗	✗
Articulated		✗	✗	✓	✗	✓
Dome		✗	✗	✗	✗	✓

SDM2 Flat Screen

The Flat screen is the most basic geometry supported. Flat screen does not require any parameters to be input.
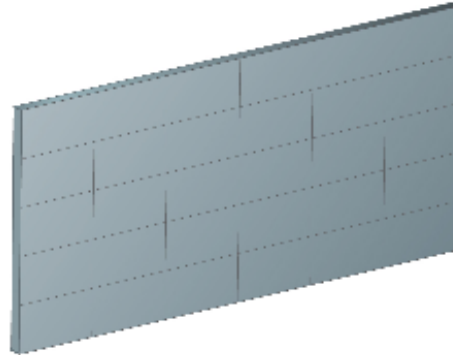
SDM2 Cylinder Screen

Measurements provided by the screen manufacturer are the best source for the information needed to set the screen parameters; however, you can measure the screen yourself.

> Keep in mind that the radius of the cylinder is for the entire imaginary cylinder, not from the edges to the center.

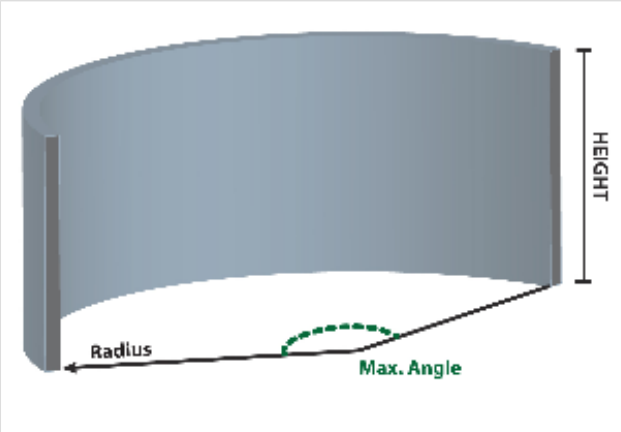If you are not using the entire physical screen for your display, enter the dimensions of the smaller area you want mapped onto the screen surface. For example, if your physical screen is 3 meters high, but you are only filling 1.5 meters, set the Height value to 1.5.

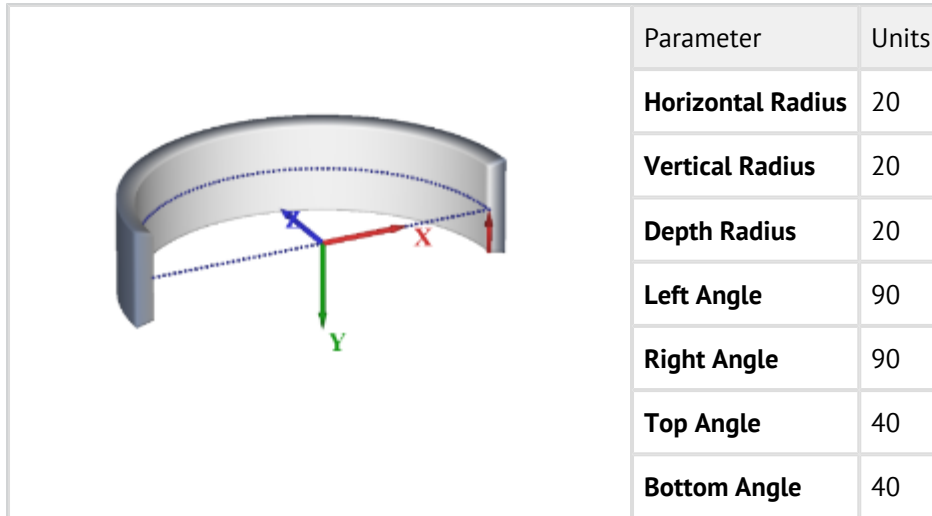| Parameter	Units
Cylinder Height	Relative
Cylinder Radius	Relative
Maximum Angle	Degrees

> All dimensions are relative. Any values should be input in the same units. With the exception of the max angle, which is always in degrees.

Screen Preview

Upon inputting screen dimensions, the panel will show a preview of what the screen will look like with the current information. After entering all of the information please use this as a reference to your actual screen.

Parameter	Units
Horizontal Radius	20
Vertical Radius	20
Depth Radius	20
Left Angle	90
Right Angle	90
Top Angle	40
Bottom Angle	40

SDM2 Dome Section Screen

Dome Section Screen Radii

If you have a spherical section the three radii: horizontal, vertical and depth should be set to the same number. Consult your screen dimensions for further information about setting the major axis of a non-perfect spherical or ellipsoid dome section.

Dome Section Screen Angles

All the angles are determined by measuring the angles from the center of the dome section. This can be conceptualized by picturing the dome section from the top while standing at the center of the dome section.
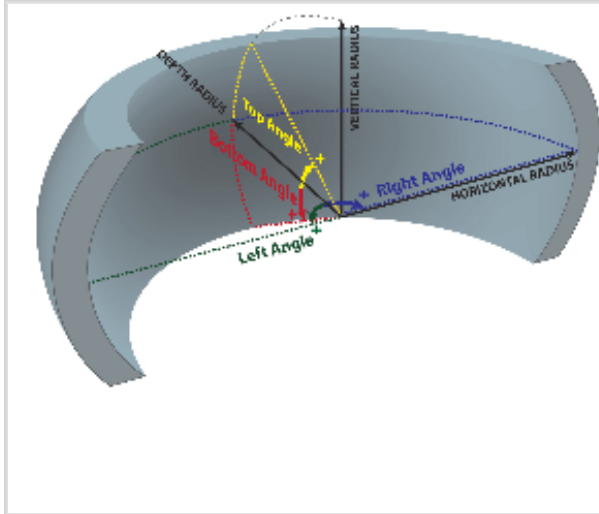
Four angles need to be entered:

- **Left** and **Right** angles (horizontal angles)
- **Top** and **Bottom** angles (vertical angles)

All four angles should be entered in degrees and as a positive number.

> Keep in mind that the radius and angles of the dome section are for the entire imaginary dome, not from the edges to the center.
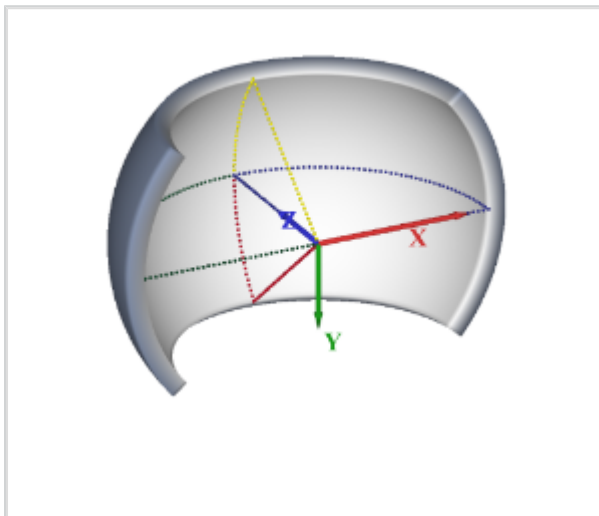
If you are only filling a smaller amount of the physical screen, adjust your angles to the value of the screen that is filled.

Parameter	Units
Horizontal Radius	Relative
Vertical Radius	Relative
Depth Radius	Relative
Left Angle	Degrees
Right Angle	Degrees
Top Angle	Degrees
Bottom Angle	Degrees

Screen Preview

Upon inputting screen dimensions, the panel will show a preview of what the screen will look like with the current information. After entering all of the information please use this as a reference to your actual screen.


Parameter	Units
Horizontal Radius	20
Vertical Radius	20
Depth Radius	20
Left Angle	90
Right Angle	90
Top Angle	40
Bottom Angle	40

Control Points

The Control Points screen geometry type is designed to offer a simplified setup for Cylinder screens. Dimensions are not required, and the shape of the screen is inferred from control point placement and pictures of the screen. Control Point geometry should only be used when doing rapid prototyping, or if you do not know the exact dimensions of your screen.

While the resulting image can appear to conform to the screen, it is not technically geometrically accurate and should be only considered for general display applications where precision is not important.
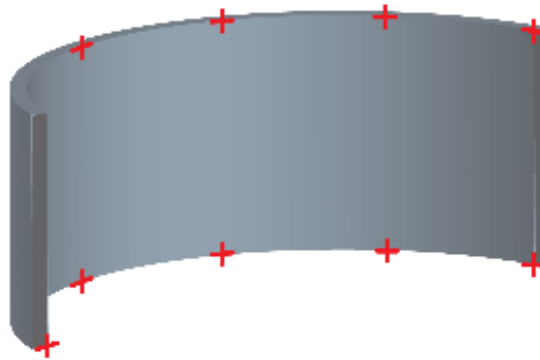
SDM2 Extruded Curve
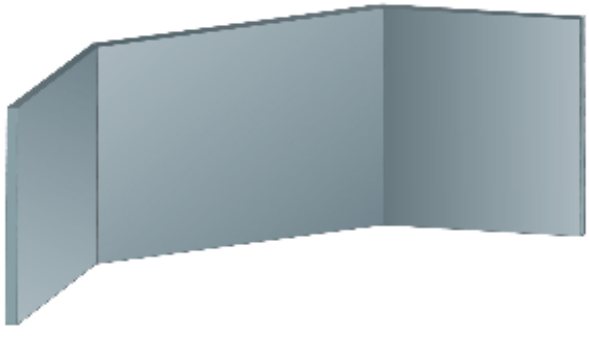
This screen type can be used to accurately fit cylindrical using a minimal amount of information. It can only be used with single-camera systems where the camera is able to see the entire screen.

If you are filling a region smaller than the physical screen, adjust height and width to the values of the screen that is filled.

Parameter	Units
Screen Width	Relative
Screen Height	Relative
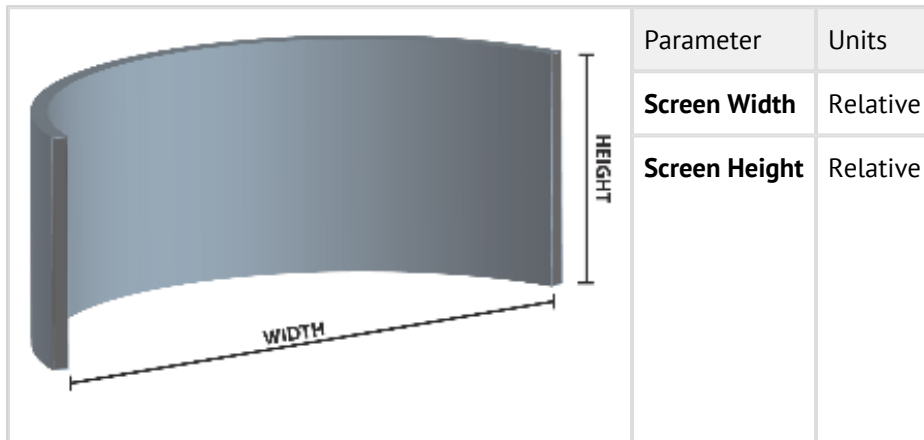
SDM2 Articulated Screen

The Articulated Screen is the combination of many flat facets connecting in vertical joints.

	Parameters
	Number of Vertical Joins

SDM2 Hemisphere Screen
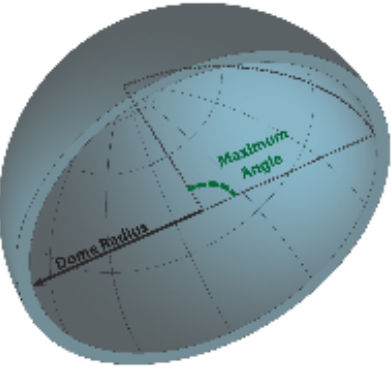
The Hemisphere Screen is the hollow half of a sphere.

	Parameter	Units
	Dome Radius	Relative
	Maximum Angle	Degrees

> The *Maximum angle* value should be input in degrees. Any unit is valid for *Dome radius*.

4.2.2 Image Boundary Panel

The Image Boundary panel allows you to set the **image boundary points** of your display and complete the calibration. The image boundary points determine how images will be mapped onto the screen.

Parameters to set the number of points used to define the display

Points used to define the screen

Reset Point Locations to return the points to their default locations

Toggle Preview to turn on the real time preview of the geometry

Complete the calibration

**Preview Images** to display a specific image
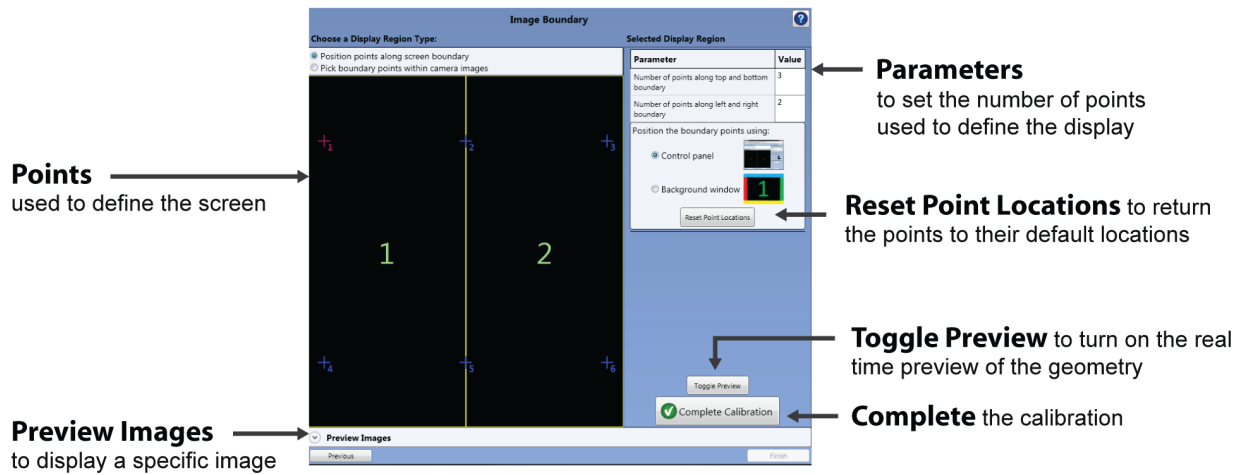
Setting the Number of Points

The number of image boundary points to use depends on the physical screen. When using a non-flat screen, it is recommended to use the least amount of points possible (3 across the top and 3 along the bottom) to minimize mistakes. When evenly spaced seams are present in the screen it may be easier to set the number of points to coincide with the seams.

Control Panel vs Background Window

Scalable provides two different interfaces to set the image boundary points location. The default option is through the Scalable Control Panel. The second hides the interface and allows manually setting the points on a black background.
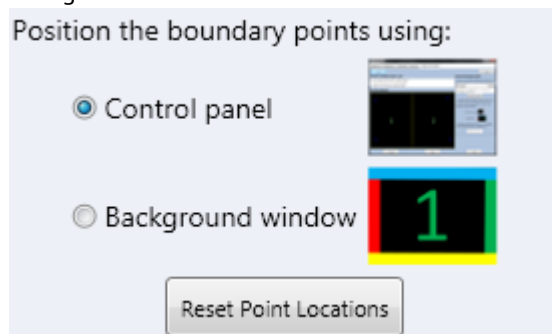
The Control Panel is designed for large movements of points and to place them in their relative locations. This can be particularly useful if the projectors are overshooting and points are not being displayed on the physical screen. However, this method is not as great for smaller movements that need to be more accurately made. In those situations it is often easier to use the Background Window to place the points in the exact desired location.

Placing Image Boundary Points

Use the points to define the area of the screen. Each point should be evenly spaced across the borders of the screen and vertically in line with its neighbor below.

1. Click the point to select it.
2. Drag the point to the corner of the screens in the camera image.
3. Repeat for the remaining points.

> Click the **Toggle Preview** button to turn on/off the real time preview of the warp.

Using the Keyboard

Accurate placement of the points can also be achieved using the keyboard.

1. Enter the number of the point you would like to move (e.g. 2 for the second point or 13 for the thirteenth point).
2. Use the arrow keys to move the point.

> Hold shift for faster boundary point movement.

| Key	Action
Arrow Key	Move the selected boundary point
Shift + Arrow Key	Fast movement of the selected boundary point
N	Change selection to the next boundary point
Number Key	Change selection to the numbered boundary point
P	Change selection to the previous boundary point
ESC	Exit the background window

SDM2 Image Boundary for Flat Screen

Use the four points to define the area of your screen. When placing your image boundary points, make sure that they are parallel and perpendicular to each other in order to avoid creating aliasing effects on the final warped image.
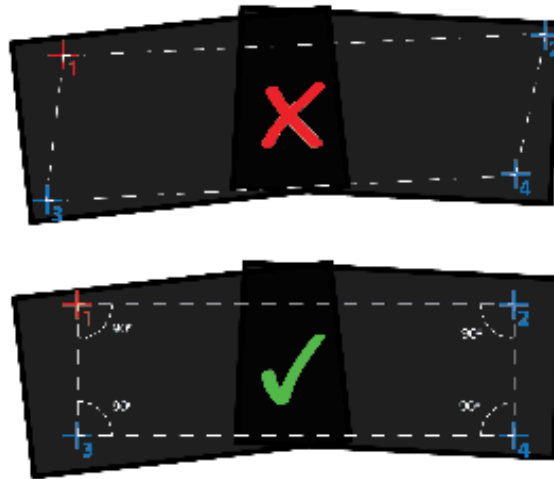
SDM2 Cylinder Screen Image Boundary

Boundary Points for cylinder screens are used to determine how images are mapped onto the screen using their position relative to the camera. When calibrating cylinder screens, these points might not perfectly map to the borders of the final image.
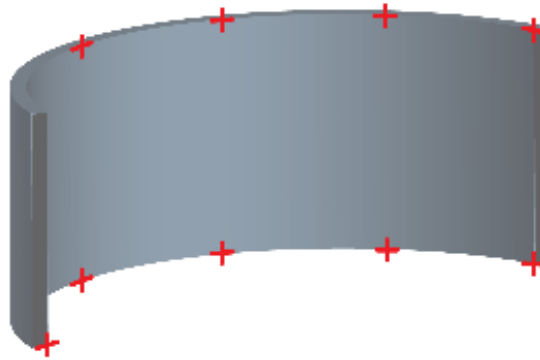

Image Boundary Points for Dome Section Screen

The Dome Section geometry requires that four points be placed at the four corners of the physical screen. One more point at the center of the top edge and another one at the center of the bottom edge.
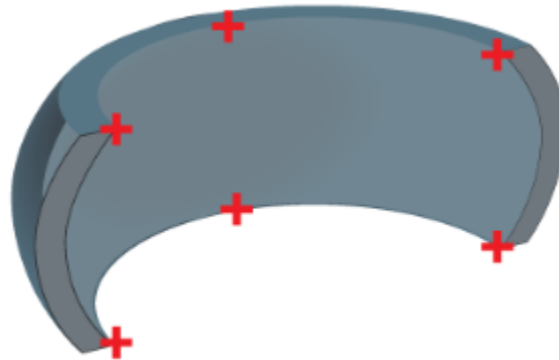
If one of your vertical angles goes to 90° while another goes to any value less than 90° you will need to set the points to the same amount of degrees from top to bottom. In this special case there is no logical way to place points at 90°, to correct for this you should mirror the remaining points. For example if the bottom is at +45° and the top of the dome is -90° the top should <u>not</u> be set to -90°, but instead should mirror the bottom and be set at -45°.
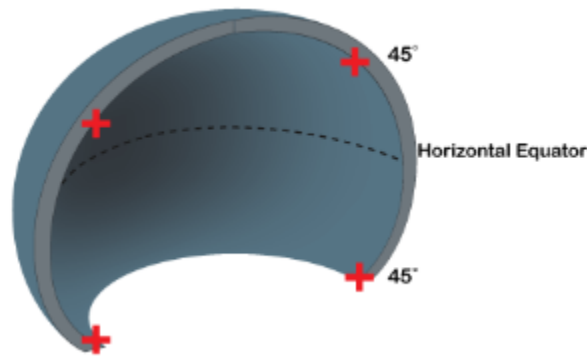

SDM2 Control Points Screen Image Boundary Panel

The Control Points Geometry is more sensitive to point placement than any other geometry, so take extra care to evenly space the boundary points and place them directly in line with the points below them.

Five boundary points across the top and bottom is the default setting. If you decide to change this number, keep in mind that the risk of errors increases with the introduction of more points.

SDM2 Extruded Curve Screen Image Boundary
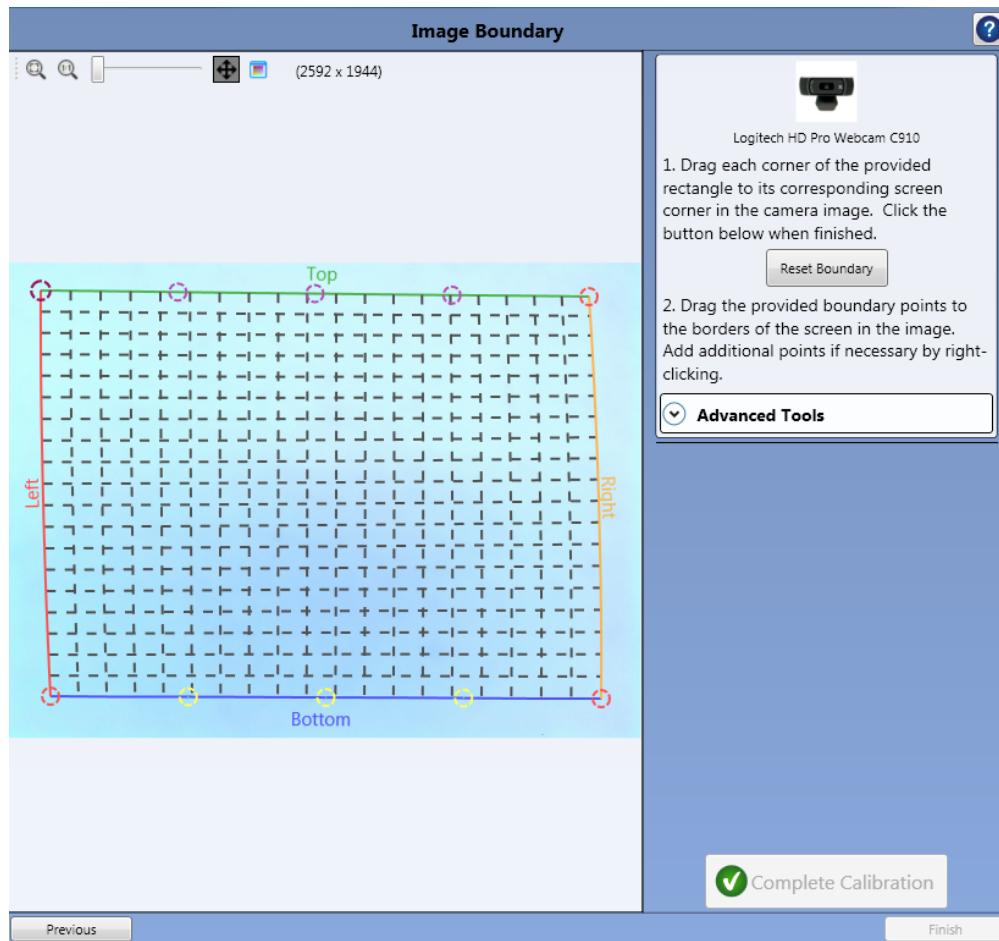
Place the Corners

1. Click and drag the top left corner of the rectangle and place it at the corner of your screen.
2. Zoom into the image and align the corner as accurately as possible to the physical corner of the screen.
3. *Repeat for the remaining three corners.*
4. Click **Complete**.

Place the Remaining Boundary Points

Additional points will now appear on the top and bottom of boundaries of the rectangle. Move these points so they follow the physical border of your screen.

1. Starting from the top of the screen, move each boundary point until it is on top of the physical edge of the screen.
2. Move the boundary points on the bottom of the screen until they are on top of the edges of the screen.

Points Behaving Erratically

Extruded curve is very sensitive, if your boundary points differ from your screen by large amounts it can appear distorted. Move the points back to the screen or press reset boundary to go back to the beginning.
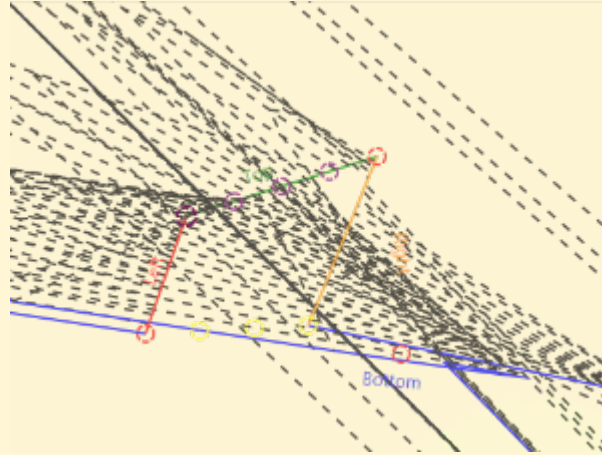

Adjust the Screen Fit (Optional)

Real world screens do not always conform to a perfect cylinder, and due to this the boundary point lines of the cylinder might not perfectly follow the edges of the physical screen. To correct for this difference you can add additional points.

1. Right click where the boundary point line is deviating from the physical screen
2. Click **Add Point**.
3. A new point will appear under your cursor, drag it to the edge of the physical screen.
4. *Repeat for other areas of the screen that need better alignment*.

## Adjust the Overall Alignment (Optional)

When the screen's physical dimensions as entered on the screens panel differ from the real screen, the lines on the inside of the cylinder may not appear to align perfectly vertical. If this occurs, you can straighten them using the **Advanced Tools** section.

1. Click **Advanced Tools** to display the *Image Uniformity Tweaker*.
2. Move the slider until the lines appear perfectly vertical.

| Before fine tuning using the Image Uniformity Tweaker	After adjustment the lines appear perfectly straight
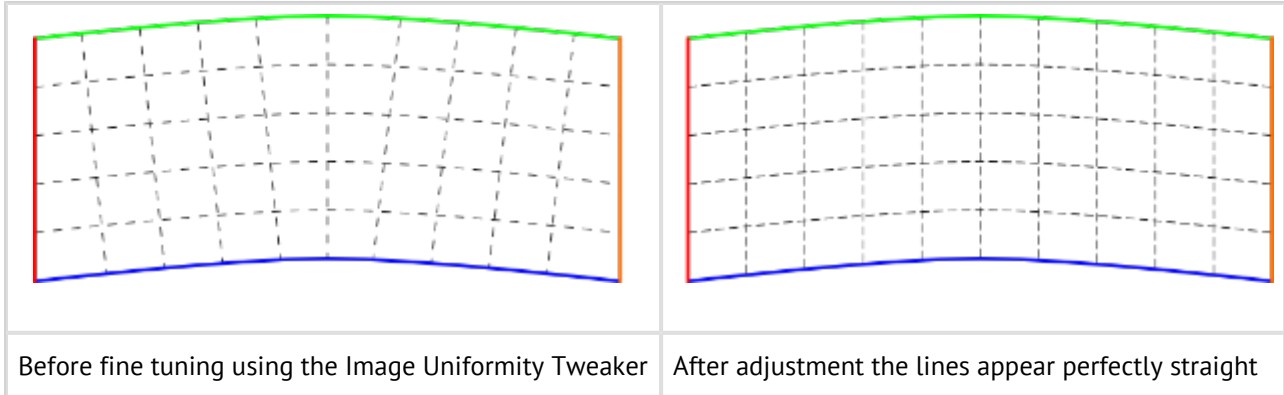
SDM2 Image Boundary Points for Articulated Screen

The Boundary Points for the the Articulated Screen are used to define the 4 corners and each vertical join.
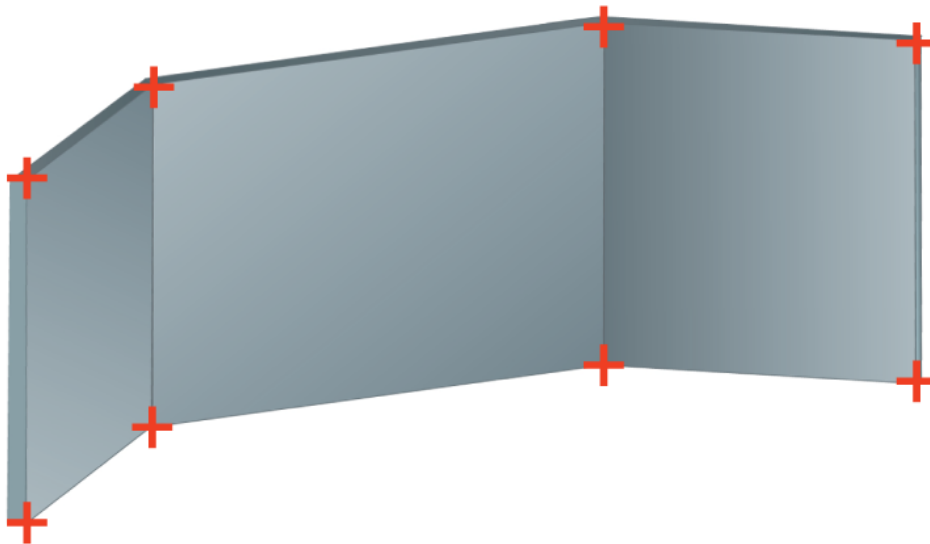
SDM2 Image Boundary Points for Dome Screen

The Boundary Points for the dome screen are used to orient the display. Each point allows you to define the azimuth and the cardinal directions.
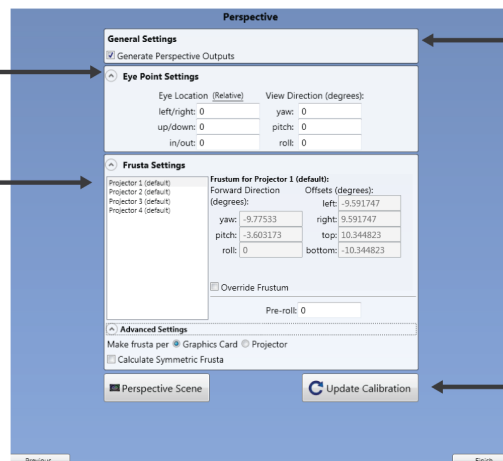
Boundary Point	Location
1	Dome Center (Azimuth)
2	West
3	East
4	South
5	North
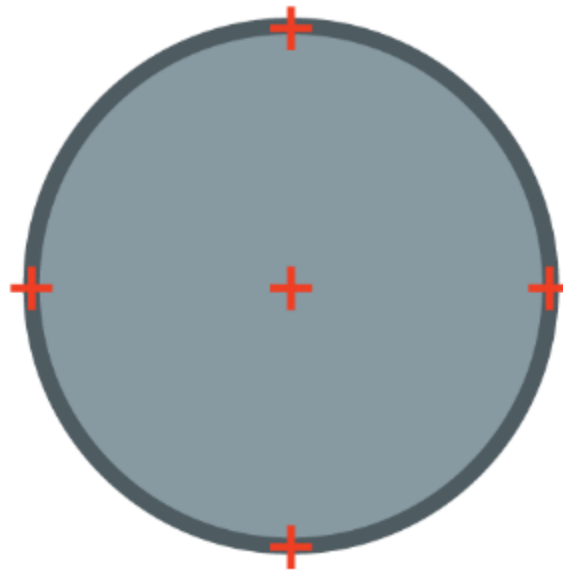
4.2.3 Perspective Panel

Eye Point Settings
to set the location of the viewer

**Frusta Settings**
the frustum template files

General Settings
to generate the perspective outputs

Update calibration

The Perspective panel allows you to generate perspective meshes to display the content. Perspective meshes are required only for certain types of content. For more information continue onto Choosing Between Orthographic and Perspective.

Choosing Between Orthographic and Perspective

The default mesh file produced by Scalable Display Manager is an Orthographic mesh, which is used to display rectangular content such as video or the Windows desktop. Perspective meshes are for three dimensional scenes that take into account the viewers location like in image generators. Perspective meshes produce a more accurate representation of the real world, where objects in the distance appear smaller than closer objects, while Orthographic has all objects appear the same size regardless of the distance.

Orthographic   Perspective
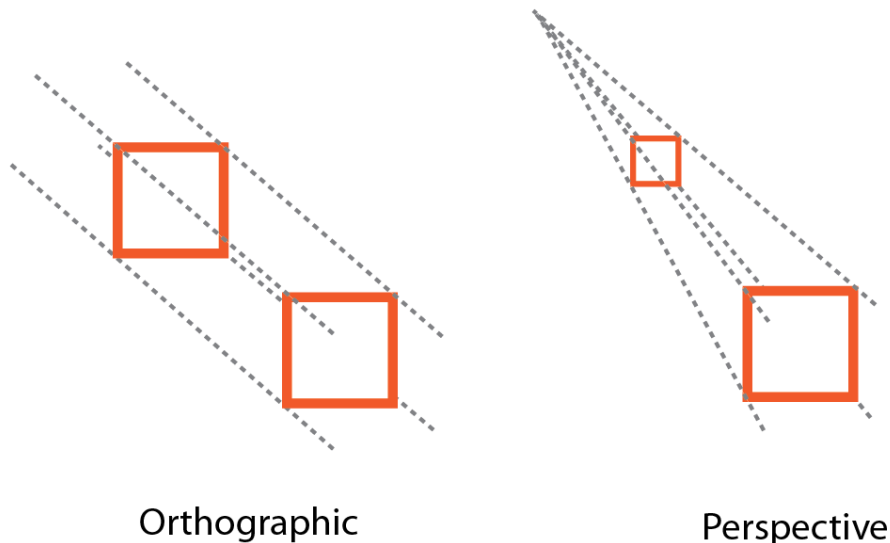
Set the Location of the Eye Point

The eye point is the intended location of the viewer with respect to the physical screen. The software calculates the perspective correction so that everything will look geometrically accurate from that point. If you move your head away from that point, straight lines will look curved, circles will look like ovals, etc.

By default Scalable Display Manager will use the geometric center of the screen as the eyepoint. For a dome section screen type this is the center of curvature (center of the sphere if it's spherical). This will not necessarily be the midpoint of the screen.

If your intended viewing location is off center, for instance if you have a low cockpit, you will need to adjust the eyepoint.

- Measure the location of the intended viewers head with respect to the geometric center of the screen
- Use the same units you used to set your dimensions on the Screens panel
- Right, Down, and In are positive numbers. Left, Up, and Out are negative numbers.

To change your eyepoint, enter the appropriate values and then click **Update Calibration**

Setting the Eye Point Example

If you have a system with a cockpit that is located a half meter behind, one meter to the left, and half a meter below the geometric center of the screen, you would enter the following values:

left/right	-1
up/down	0.5
in/out	-0.5
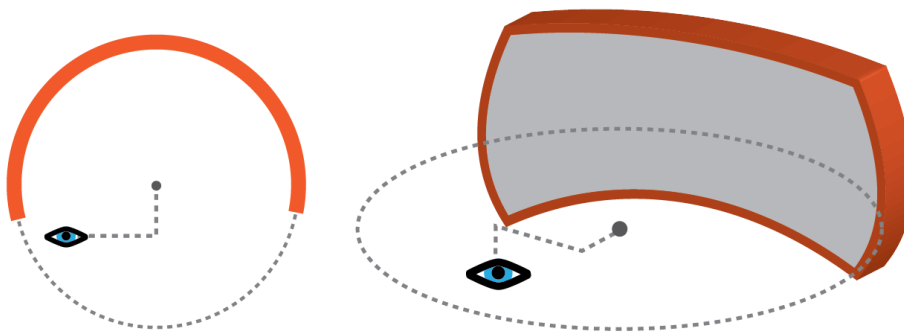
Perspective Eye Point vs Virtual Camera Location

People often confuse what we call the "eye point" with the location of the virtual camera in the simulated environment of the IG. If the viewer actually moves forward and stands closer to the screen, you will want to change the eyepoint so that the program can calculate the perspective correction for the new viewing location. If you want to "move the view forward" and don't intend the viewer to actually stand up and walk closer to the screen, then you want to adjust the location of the virtual camera in the IG, **not** the eyepoint in Scalable.

Advanced Frusta Settings

The Frusta Settings show the automatically generated frusta information of your screen with respect to the eye point. This information is useful if you must manually enter the frusta settings into an image generator or other system.

My IG Requires a Mesh File for Each Projector

Scalable Display Manager defaults to generating a mesh file for each discrete graphics card, if your image generator instead requires a single mesh per projector you can change this in the Advanced Settings section of the Perspective panel.

1. Click **Advanced Settings** to reveal additional settings.
2. Select **Projector** under *Make frusta per*.
3. Click **Update Calibration** to generate the new mesh files.

Frustum

After completing perspective calibration, frustum information will appear. Depending on whether Per Graphics card or Per Projector was chosen there will be a list of Projectors/Graphics cards and corresponding frustum information.

Overriding the Frustum

Overriding the frustum is possible by checking of **Override Frustum**, and a **Pre-roll** can be added but it is recommended not to do any of these unless instructed by Scalable.
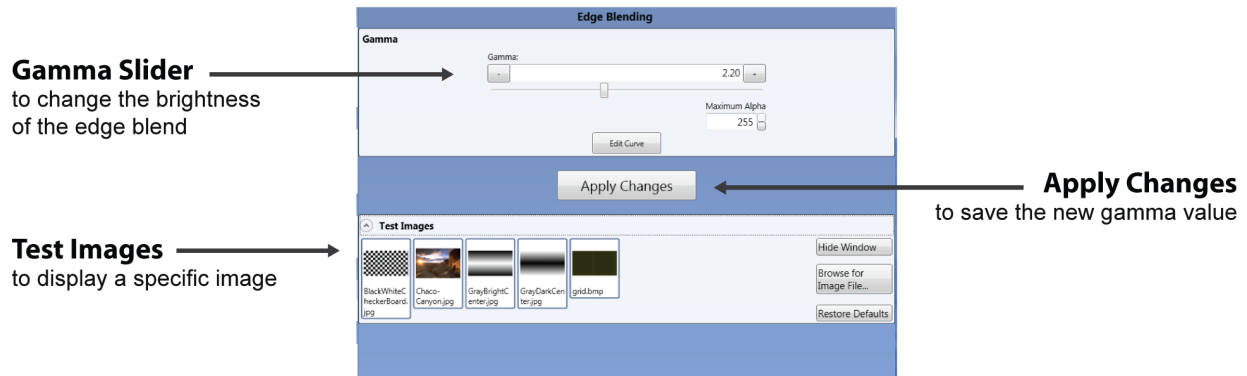
4.3 Tuning

Scalable Display Manager provides additional tuning features that allow the tweaking of edge blends and the refinement of the displays border. These panels should only be used after the projectors and screen geometry have been setup as best as they can.

4.3.1 Edge Blending Panel

The edge blending panel allows the editing of the gamma curve.

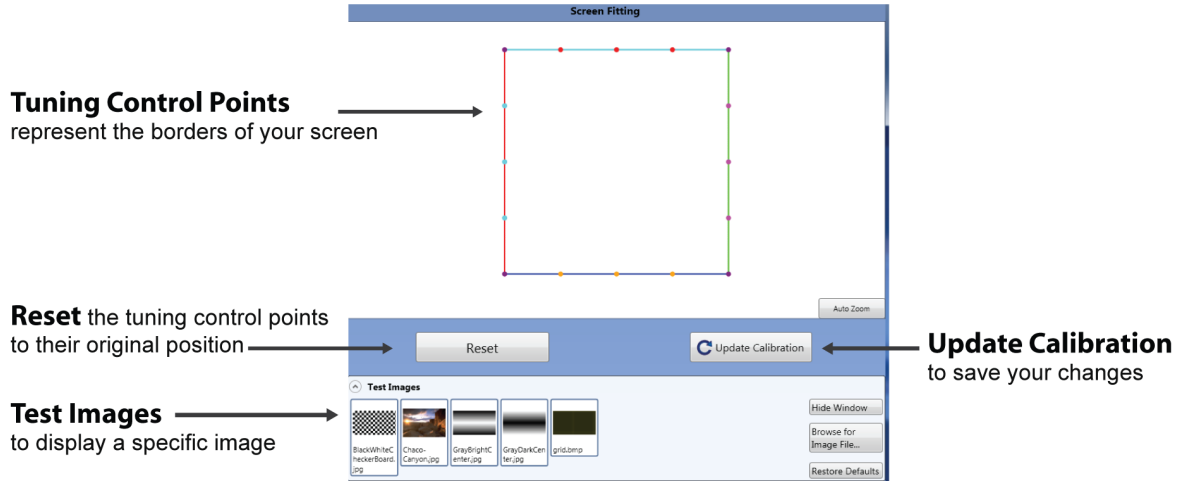## Change the Edge Blends Gamma Curve

> Manually changing the gamma curve should only be done after the projectors are properly setup and can no longer be calibrated to produce more accurate color. See the Setting Up the Projectors section for more information.

Many projectors do not have a consistent luminescence across all output ranges. This can result in the edge blend appearing brighter or darker than expected. To correct for this, manually adjust the gamma curve until the edge blend is no longer visible.

1. Move the slider to the right to lighten the blend zone or left to darken it.
2. Click **Apply Changes**.
3. **Re-engage** the warp to see the changes.
4. *Repeat until the desired curve is achieved*.

4.3.2 Screen Fitting Panel

The screen fitting panel allows refinement of the edges of the screen, beyond boundary point placement. Screen fitting is used for compensating for a physical screen that is not uniform, and should not be used in place of refining boundary points.

Tuning Control Points
represent the borders of your screen

Reset the tuning control points
to their original position

Update Calibration
to save your changes

Test Images
to display a specific image

Refine the Screen Borders

Drag the points of the square until the images borders line up with the physical screen.

1. Click and drag a point of the square towards the physical edge of the screen.
2. *Repeat for all borders that are not aligned.*
3. Click **Update Calibration** to save your changes to the mesh file.

Fine Movements

Use the mouse wheel to zoom in on the square. As you zoom in, the points will move in finer increments.
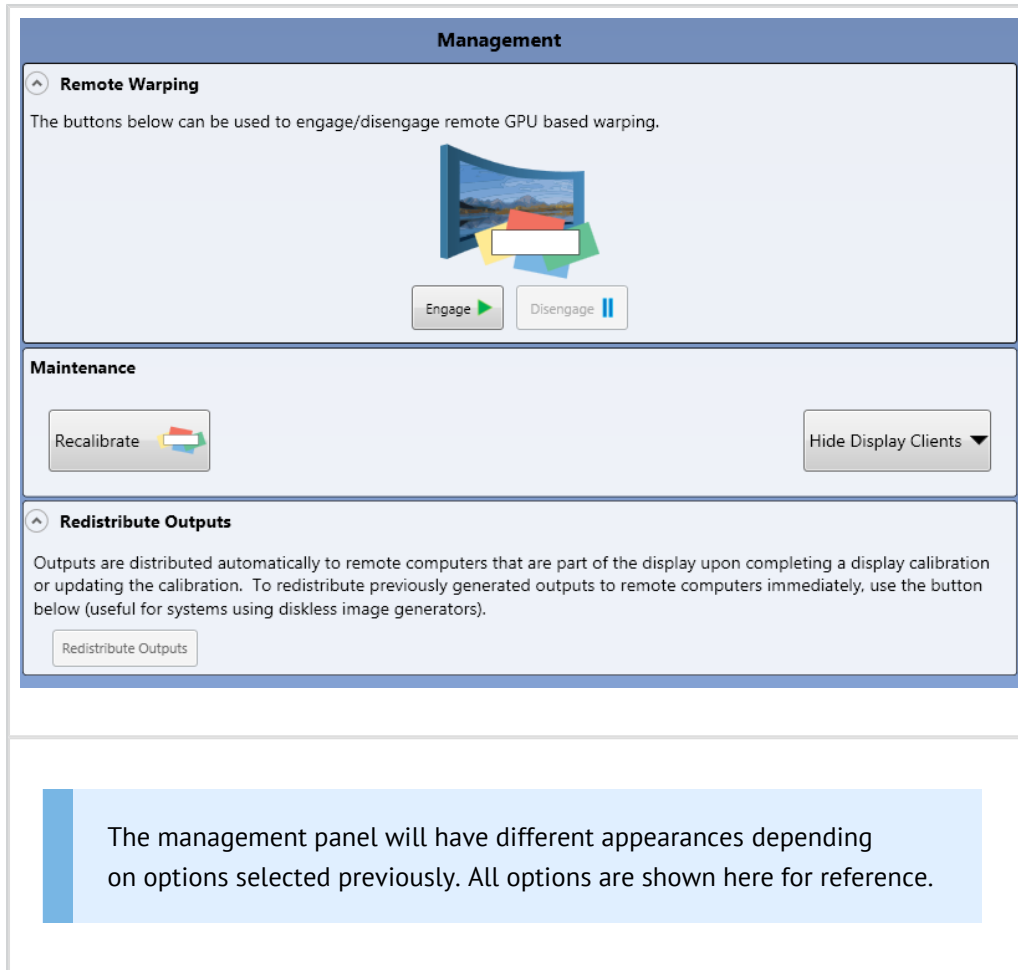
Add an Additional Point

To more accurately follow the border of the screen, add a new control point.

1. Right click on one of the squares lines, closest to where you want to add a point.
2. Click **Add Control Point**.

4.4 Playback

4.4.1 Management Panel

The Management Panel allows you to quickly manage your calibrated display.

The management panel will have different appearances depending on options selected previously. All options are shown here for reference.

Warping Hardware

Use the **Engage** or **Disengage** buttons to enable and disable the desktop warp.

Maintenance

Click the **Recalibrate** button to reset the calibration.

When to recalibrate

Whenever the screen or projectors move (even slightly) the sub-pixel alignment in your edge blend will no longer be correctly registered. This will be appear as a fuzziness or complete misalignment in the overlap area of the projectors. As long as the settings have not changed, which include camera positioning and the ambient lighting environment, the system can simply be recalibrated.

Maintenance

Click the **Recalibrate** button to initiate a calibration.

> **When to recalibrate**
>
> Whenever the screen or projectors move (even slightly) the sub-pixel alignment in your edge blend will no longer be correctly registered. This will be appear as a fuzziness or complete misalignment in the overlap area of the projectors. As long as the settings have not changed, which include camera positioning and the ambient lighting environment, the system can simply be recalibrated.

Redistribute Outputs

To manually distribute the mesh files to all remote display nodes click **Redistribute Outputs**.

4.4.2 Test Images Panel

The Test Images panel provides a few simple test patterns to determine geometric accuracy.
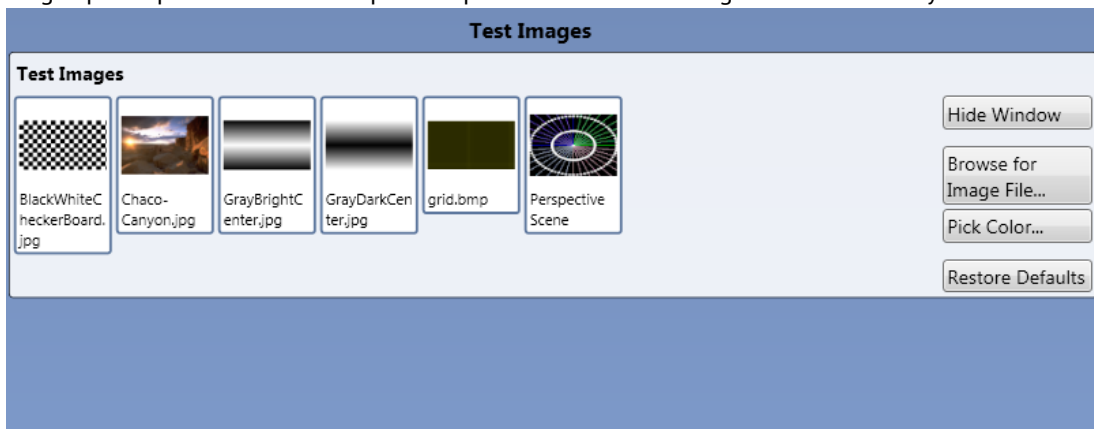
Click one of the image icons to display the test pattern across all of the displays. You can also use your own image by browsing your computer and locating an image file, or you can select a solid color with the color picker.

5. Support

If after reading this guide, you have any outstanding questions or support issues that you were unable to answer yourself, please do not hesitate to contact the Scalable Support Team.

They can be reached at (617) 864-9300 or at support@scalabledisplay.com.

5.1 Upload Scalable Service Information

It is helpful if you upload your calibration data, known as Scalable Service Information, when you are done configuring your system or if you have any issues you are unable to resolve yourself in the Troubleshooting section below. We will often reference this data during any support calls or system questions and it is helpful to have it at hand. We will discuss where to locate the necessary files, and how to upload them to the Scalable Display Support Team.

The Service Information folder contains the information necessary for Scalable employees to emulate your system. The folder is located here:
"C:\ScalableDisplay\ScalableServiceInformation"
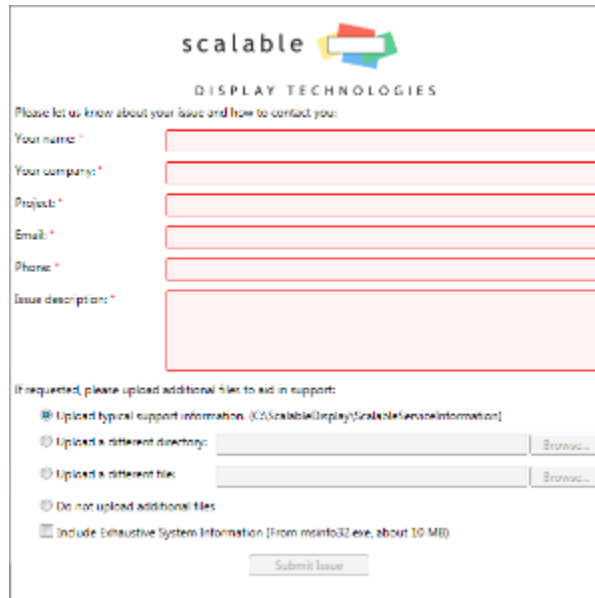
5.1.1 How To Upload Data

The software provides a simplified data upload system that automatically compresses and uploads your Service Information folder to the Scalable FTP site.

Please click the **Scalable Button** and go to Support > **Report Issue.**
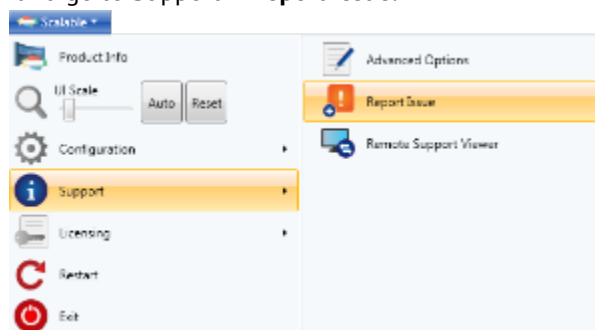
You will be presented with a form. Please fill this out accurately and input as much relevant information as possible, including:

- Current setup of the system (number of projectors, type of projectors, projector layout, video card, Windows version, etc.)
- Detailed information about the specific problem you are encountering.
- Full transcript of any error messages the software is showing.

Additional Data

The Service Information folder allows us to see a representation of your screen, but it does have limitations.
Support times can be dramatically reduced by providing additional information.
If you have any of the following please include them:

- Pictures of the screen
  - Wide overview
  - Close ups of the issue
  - Multiple angles
- Engineering diagrams of the screen and projector layout
- Intended content to be displayed

Additional support data can be emailed to salessupport@scalabledisplay.com