Version
1.1.12

SpectraView™ II

User's Guide

NEC

Software Updates and Feedback

Occasionally updates and enhancements to the SpectraView software will be made available. Visit the SpectraView II section of the NEC DISPLAY SOLUTIONS Internet web site to check for availability.

NEC DISPLAY SOLUTIONS welcomes feedback and suggestions for product improvements. Please use the feedback from on the SpectraView section of the NEC DISPLAY SOLUTIONS Internet web site.

Within Australia and New Zealand, please visit the NEC Australia web site, www.spectraview.nec.com.au.

Technical Support

For technical support with the SpectraView II product, please visit the SpectraView II section of the NEC DISPLAY SOLUTIONS Internet web site and check for any Frequently Asked Questions that may help to solve the issue. An online feedback form is available for submitting questions and feedback.

For technical Support within Australia and New Zealand, please visit the NEC Australia web site, www.spectraview.nec.com.au, or by email to spectraview.support@nec.com.au. Sales support Tel : 131 632.

Trademarks and Copyright

SpectraView is a registered trademark of NEC Display Solutions of America, Inc.

Adobe, the Adobe logo, Acrobat and Photoshop, are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States and/or other countries.

Apple, Macintosh, ColorSync, Mac and the Mac logo are trademarks of Apple Computer, Inc., registered in the U.S. and other countries.

Microsoft, Excel and Windows are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

Copyright © 2003-13 NEC Display Solutions, Ltd.

The content of this manual is furnished for informational use only, is subject to change without notice, and should not be construed as a commitment by NEC Display Solutions, Ltd. NEC Display Solutions, Ltd. assumes no responsibility or liability for any errors or inaccuracies that may appear in this manual.

All rights reserved. Your rights of ownership are subject to the limitations and restrictions imposed by the copyright laws as outlined below.

It is against the law to copy, reproduce or transmit, including without limitation electronic transmission over any network, any part of the manual except as permitted by the Copyright Act of the United States, Title 17, United States Code. Under the law, copying includes translation into another language or format.

The above is not an inclusive statement of the restrictions imposed on you under the Copyright Act.

For a complete statement of the restrictions imposed on you under the copyright laws of the United States of America, see Title 17, United States Code.

USA and Canada: www.necdisplay.com

Australia: www.spectraview.nec.com.au

Revision 130102

HARDWARE LIMITED WARRANTY

NEC DISPLAY SOLUTIONS warrants the SpectraView II Color Sensor Hardware (hereinafter "Product" or "Products") to be free from defects in material and workmanship and, subject to the conditions set forth below, agrees to repair or replace (at NEC DISPLAY SOLUTIONS's sole option) any part of the enclosed unit which proves defective for a period of one (1) year from the date of first consumer purchase. Spare parts are warranted for ninety (90) days. Replacement parts or unit may be new or refurbished and will meet specifications of the original parts or unit.

This warranty gives you specific legal rights and you may also have other rights, which vary from state to state. This warranty is limited to the original purchaser of the Product and is not transferable. This warranty covers only NEC DISPLAY SOLUTIONS-supplied components. Service required as a result of third party components is not covered under this warranty. Service required as a result of abuse or improper usage is also not covered under this warranty. In order to be covered under this warranty, the Product must have been purchased in the U.S.A. or Canada by the original purchaser. This warranty only covers Product distribution in the U.S.A. or Canada by NEC DISPLAY SOLUTIONS No warranty service is provided outside of the U.S.A. or Canada. Proof of Purchase will be required by NEC DISPLAY SOLUTIONS to substantiate date of purchase. Such proof of purchase must be an original bill of sale or receipt containing name and address of seller, purchaser, and the serial number of the product.

NEC DISPLAY SOLUTIONS SHALL NOT BE LIABLE FOR DIRECT, INDIRECT, INCIDENTAL, CONSEQUENTIAL, OR OTHER TYPES OF DAMAGES RESULTING FROM THE USE OF ANY NEC DISPLAY SOLUTIONS PRODUCT OTHER THAN THE LIABILITY STATED ABOVE. THESE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. SOME STATES DO NOT ALLOW THE EXCLUSION OF IMPLIED WARRANTIES OR THE LIMITATION OR EXCLUSION OF LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES SO THE ABOVE EXCLUSIONS OR LIMITATIONS MAY NOT APPLY TO YOU.

This Product is warranted in accordance with the terms of this limited warranty. Consumers are cautioned that Product performance is affected by system configuration, software, the application, customer data, and operator control of the system, among other factors. While NEC DISPLAY SOLUTIONS Products are considered to be compatible with many systems, specific functional implementation by the customers of the Product may vary. Therefore, suitability of a Product for a specific purpose or application must be determined by consumer and is not warranted by NEC DISPLAY SOLUTIONS.

Federal Communications Commission (FCC) Notice (U.S. Only)

WARNING: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received including interference that may cause undesired operation.

Contents

Precautions: 6
Note: 6
Supported Display Monitors 7
System Requirements 8

1 Introduction to SpectraView II 9
Overview 9
Main Features and benefits 9

2 Dialogs, Settings and Menus 11
Main SpectraView II window 11
Display Configuration dialog 13
Edit Calibration Target Configuration dialog 14
Custom Color Gamut dialog 17
Custom Gamma Curve dialog 18
Custom White Point dialog 19
Preferences dialog 20
Preferences dialog - Calibration Sensor tab 20
Preferences dialog - Calibration tab 21
Preferences dialog - ICC Profile tab 22
Preferences dialog - Interface tab 23
Preferences dialog - Display tab. 24
Information window. 25
Information window - Summary tab 25
Information window - Color Gamut tab 27
Information window - Curves tab 28
Information window - Color Tracking tab 29
Information window - DICOM Conformance tab. . . 30
Colorimeter window 32
Ambient Light Measurement window 33
Monitor Settings window. 34
Menus 35
File menu 35
Edit menu 35
Tools menu 35
Help menu 35
Introduction to display monitor calibration 37

3 Calibration Overview 37
About Targets 39
Gamma and Tone Response Curves (TRC) 39
White Point 39

4 Using SpectraView 42
Launching. 42
Selecting a calibration Target 42
Modifying Targets 42
Calibrating and Profiling the Display 43
Profiling the Display 43
Validating the current Calibration 43

5 Outside of SpectraView 44
Using ICC/ColorSync Monitor Profiles 44
Adobe Photoshop Overview. 44

6	**Frequently Asked Questions**	**45**
	Calibration	45
7	**Troubleshooting**	**48**
	Installation and Setup	48
	Using SpectraView with NaViSet Administrator . . .	51
8	**NaViSet Administrator**	**51**
9	**Test Pattern Guide**	**52**
10	**MultiSync PA Series Information**	**53**
11	**Using 6 Axis Color Trim**	**54**
Glossary		**55**

Precautions:

- **The LCD display monitor screen is fragile and can be easily damaged if force is applied. Never use suction cups to attach a color sensor to the display. Always use the supplied cable or sling and counterweight to gently rest the color sensor on the face of the display.**

- **During the display calibration procedure, highly sensitive light measurements are made on the screen using the color sensor. High ambient light levels such as direct sunlight on the screen, may affect measurements and cause an inaccurate display calibration. Changes in ambient lighting can alter how images on the screen are perceived. Locate the display away from bright direct lighting whenever possible and keep a constant ambient lighting level.**

- **Always store the color sensor in the holder when not in use.**

- **Never touch the measurement window in the color sensor.**

- **Never disconnect the color sensor while the SpectraView software is running.**

- **Always allow the display to warm up for at least 30 minutes before calibrating.**

- **Do not adjust the monitor color, brightness or contrast controls once it has been calibrated, otherwise the color calibration of the monitor may become invalid.**

- (Mac OS only) **Do not use the ColorSync control panel to switch between different display monitor calibrations by selecting different monitor color profiles. Always use the SpectraView application to load a previous monitor calibration. This is because all of the necessary color adjustments, including the Look Up Tables, are stored in the display monitor and these must be set by SpectraView. The ColorSync profiles generated by SpectraView contain linear Look Up Tables for the video graphics adapter.**

Note:

This document covers both the Mac OS and Windows versions of the SpectraView II software. The features and functions of both versions are identical unless noted otherwise. The majority of the User Interface screen images in this document show the Mac OS version, however the Windows version is identical in layout unless noted otherwise.

Supported Display Monitors

SpectraView II supports the following NEC display monitor models:

- **LCD1980SXi – 19" LCD monitor**
- **LCD1980FXi – 19" LCD monitor**
- **LCD1990SX – 19" LCD monitor**
- **LCD1990SXi – 19" LCD monitor**
- **LCD1990SXp – 19" LCD monitor**
- **LCD2090UXi – 20" LCD monitor**
- **LCD2180UX – 21" LCD monitor**
- **LCD2180WG-LED – 21" LED wide color gamut LCD monitor**
- **LCD2190UXi – 21" LCD monitor**
- **LCD2190UXp – 21" LCD monitor**
- **LCD2490WUXi – 24" LCD monitor**
- **LCD2490WUXi2 – 24" LCD monitor**
- **LCD2690WUXi – 26" wide color gamut LCD monitor**
- **LCD2690WUXi2 – 26" wide color gamut LCD monitor**
- **LCD3090WQXi – 30" wide color gamut LCD monitor**
- **LCD4020 – 40" LCD monitor**
- **LCD4620 – 46" LCD monitor**
- **LCD5220 – 52" LCD monitor**
- **LCD6520 – 65" LCD monitor**
- **M40, M40B, and M40-2 – 40" LCD monitors**
- **M46, M46B, and M46-2 – 46" LCD monitors**
- **X431BT – 43" LCD monitor**
- **X461UN – 46" LCD monitor**
- **X462UN – 46" LCD monitor**
- **X461HB – 46" LCD monitor**
- **P401 – 40" LCD monitor**
- **P461 – 46" LCD monitor**
- **P521 – 52" LCD monitor**
- **P551 – 55" LCD monitor**
- **P701 – 70" LCD monitor**
- **P221W – 22" wide color gamut LCD monitor**
- **P241W – 24" LCD monitor**
- **P232W – 23" LCD monitor**
- **PA231W – 23" LCD monitor**
- **PA241W – 24" wide color gamut LCD monitor**
- **PA271W – 27" wide color gamut LCD monitor**
- **PA301W – 30" wide color gamut LCD monitor**

System Requirements

SpectraView has the following system requirements:

	Mac OS	Microsoft Windows
Operating System	Intel based Apple Mac with OS X v10.5 or higher. See README file for details. PPC based Macs are no longer supported as of version 1.1.11.	Microsoft Windows XP, XP x64, Server 2003, Vista and Vista x64, Windows 7, Windows 7 x64, Windows 8, and Windows 8 x64.
Video Graphics Adapter	All Apple standard video graphics cards, including most newer PowerBooks. Digital (DVI or DisplayPort) output is highly recommended. See the README file and NEC website for the latest information on Macs with DisplayPort video output.	Most recent ATI, Nvidia, Matrox, S3 Graphics, and Intel graphics adapters. Digital (DVI or DisplayPort) output is highly recommended. See README file for details.
Video Color Depth	At least 24 bit color (Millions of colors).	At least 24 bit color.
Video Resolution	Displays native resolution highly recommended (1280x1024, 1600x1200, 1680x1050, 1920x1080, 1920x1200, 2560x1440 or 2560x1600 depending on monitor)	Displays native resolution highly recommended (1280x1024, 1600x1200, 1680x1050, 1920x1080, 1920x1200, 2560x1440 or 2560x1600 depending on monitor)
Supported Calibration Sensors	• GretagMacbeth Eye-One Display V1 • X-Rite/GretagMacbeth Eye-One Display V2 • X-Rite/GretagMacbeth Eye-One Monitor, Eye-One Pro. • X-Rite iOne Pro2. • X-Rite ColorMunki. • X-Rite iOneDisplay Pro • NEC SpectraSensor Pro • NEC MDSVSensor • Monaco OptixXR (X-Rite DTP 94). • ColorVision/Datacolor Spyder 2. • Datacolor Spyder 3 and Spyder 4. • BasICColor Discus.	• GretagMacbeth Eye-One Display V1 • X-Rite/GretagMacbeth Eye-One Display V2 • X-Rite/GretagMacbeth Eye-One Monitor, Eye-One Pro. • X-Rite iOne Pro2. • X-Rite ColorMunki. • X-Rite iOneDisplay Pro • NEC SpectraSensor Pro • NEC MDSVSensor • Monaco OptixXR (X-Rite DTP 94). • ColorVision/Datacolor Spyder 2. • Datacolor Spyder 3 and Spyder 4. • BasICColor Discus.
USB	At least one available USB port for Color Sensor, or display USB connection (MultiSync PA Series and newer desktop P series only).	At least one available USB port for Color Sensor, or display USB connection (MultiSync PA Series and newer desktop P series only).

1 Introduction to SpectraView II

Overview

Designed for professionals with color critical applications, SpectraView II combines the award winning NEC display monitor technology with a color measurement sensor and sophisticated software. The result is highly accurate, reliable, repeatable, and feature rich display calibration and profiling solution.

The SpectraView system uses a color sensor to take color measurements of the display screen during calibration. The software analyzes these measurements and sends color adjustment commands directly to the display monitor. This means that color adjustments are made in the monitor rather than in the video graphics adapter, resulting in full use of the number of colors available on the graphics adapter and a much brighter image with the maximum possible color gamut. With SpectraView, the video graphics adapter is not used at all to make any gamma or Tone Response Curve corrections to the display, so the full color resolution and fidelity of the system is maintained.

Main Features and benefits

SpectraView provides the following features and benefits:

- **Automatic calibration -** SpectraView communicates with the display monitors using Display Data Channel - Command Interface (DDC/CI) which is a two-way communications link between the video graphics adapter and display monitor using the normal video signal cable. No extra cables are necessary. All adjustments to the monitor settings are done automatically using this communications link. A USB connection between the host PC and display can also be used on MultiSync PA Series models only. It is not necessary to manually configure the monitor as all of the necessary settings are made by the software.
- **High bit depth internal Look Up Tables (LUTs) -** each LCD display monitor supported by SpectraView II features three internal 10, 12 or 14 bit LUTs (depending on the model). These tables allow very precise adjustments to be made to the display's Tone Response Curve without reducing the number of displayable colors or introducing color banding artifacts.
- **Multiple Calibration Sets -** Different display monitor calibrations can be instantly loaded allowing quick and easy switching between different calibration settings without the need to re-calibrate the display. Each time a calibration set is loaded, the necessary monitor settings and ICC/ColorSync profiles are automatically updated.
- **Informative -** At the end of each display monitor calibration, an information window is displayed which shows the results of the calibration and includes a wealth of information about the display such as the measured color gamut, grayscale color tracking, Delta-E, and luminance values. Additional information about the display monitor such as the model name, serial number and the total number of hours that it has been in use are also displayed.
- **Calibration status validation -** SpectraView will query each calibrated monitor to see if any controls have changed since the last calibration. If anything has changed, the previous calibrated state can be restored automatically.
- **Flexible -** SpectraView provides many features and options that make it flexible enough to be used in a large variety of applications, including full DICOM support for medical imaging. The display luminance can be adjusted to either a specific value or to the maximum possible that the display can achieve.
- **Network support (Windows only) -** SpectraView integrates with the NEC NaViSet Administrator network software (available separately from your NEC representative.) to provide remote network access

and monitoring of display monitors. NaViSet Administrator is able to read, display, and log the current calibration settings and status of displays on a LAN. This feature is particularly useful for large installations where central monitoring and asset management is needed.

- **Monitor locking -** Once calibrated the OSD (On Screen Display) controls for the display monitors can be locked to prevent accidental or unauthorized adjustment which may invalidate the calibrated state of the monitor.

- **Monitor Profiling -** After calibration, the display is automatically profiled and highly accurate ICC/ ColorSync color profiles are generated and automatically registered with the Color Management System. These profiles use the Bradford Chromaticity Adaptation matrix.

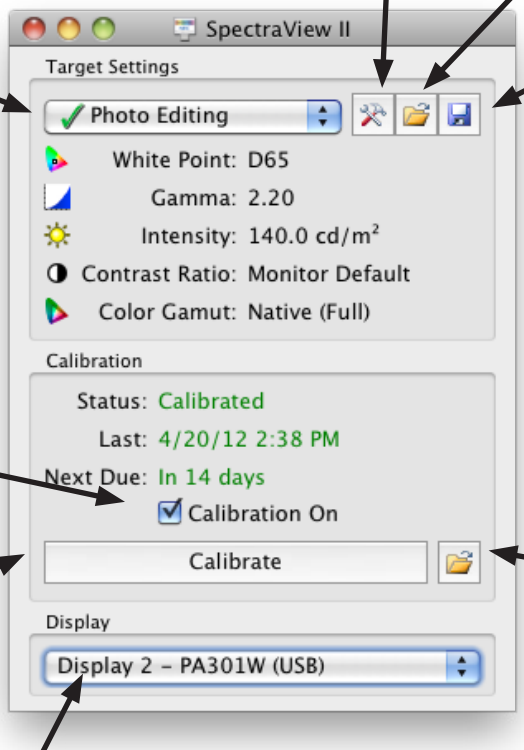
- **Colorimeter function -** The software features a Colorimeter function which allows direct measurements to be taken by the color sensor and the results displayed in a variety of different formats.

- **Ambient Light Measurement function -** Allows measurements to be taken of the ambient light of the viewing environment surrounding the display monitor. This is useful in determining the optimal viewing conditions for the display monitor so that the ambient light level and color do not influence the viewing of images on the screen.

2 Dialogs, Settings and Menus

Main SpectraView II window

The ***SpectraView II*** window shows the current settings and status of the display calibration. All of the features of SpectraView are accessed from this window and the menus.



Edit Target
Opens the *Calibration Target Configuration* dialog box used to modify Target settings.

Open Target
Opens a *Calibration Target* file.

Targets listbox
Selects an existing *Target* setting. Targets that have been calibrated have green check mark.

Save Target
Saves the current Target Settings to a *Calibration Target* file.

Calibration On
Turns the display calibration on or off.

Open Previous Monitor Calibration
Previous calibrations can be loaded and viewed. The display settings and ICC/ColorSync profile for the display will be set automatically.

Calibrate
Calibrates the currently selected display to the currently selected *Target Settings*.

Display listbox
Selects which display to calibrate if more than one display is present.

Target Settings

The ***Target Settings*** group shows the current calibration Target parameters for the currently selected display monitor. The Target Settings can be modified, saved and loaded using the Edit, Open and Save buttons.

The Target listbox shows all of the available Targets. When the display has been calibrated to a particular Target, a green check mark appears next to the Target name, indicating that the calibration is available. Different calibrations can be automatically restored by selecting different Targets that have been calibrated. This makes it easy to quickly change between different calibrated Target settings. The green check mark will change to yellow once the calibration for that Target has passed the recommended recalibration time, indicating it is time to recalibrate that particular Target.

White Point shows the Target White Point.

Gamma shows the Target gamma or Tone Response Curve type.

Intensity shows the Target display intensity value.

Contrast Ratio shows the Target contrast ratio.

Color Gamut shows the Target color gamut for display models that support gamut adjustment. This will be grayed out if the currently selected display does not support color gamut adjustment.

Calibration

The ***Calibration*** group shows the current calibration status of the currently selected display monitor and is where the monitor calibration process is started.

The display monitor can be calibrated to the current ***Target Settings*** by clicking the ***Calibrate*** button. Note that this ***Calibrate*** button will be disabled if either no supported color sensor or display monitor was detected. See the ***Troubleshooting*** section for more information.

Status shows the current calibration status of the display monitor, either ***Calibrated***, ***Uncalibrated***, or ***Calibration Off***.

Last shows the date and time that the display monitor was last calibrated.

Next Due shows the number of days until the display is next due for recalibration, or the number of days past when it was last due for recalibration. This is based on the date of last calibration, and the ***Recalibration Reminder Period*** in the ***Preferences*** dialog.

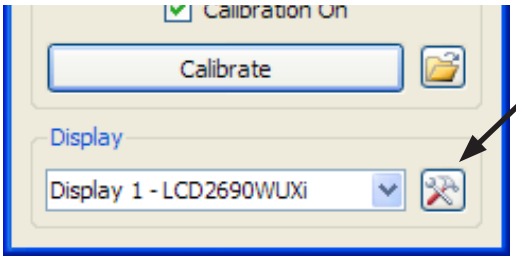
If the display is not currently in a calibrated state the ***Calibration On*** checkbox will be unchecked. If the monitor OSD controls are locked using the ***Lock OSD Controls*** option in the ***Preferences*** dialog, the OSD controls will be automatically unlocked when the ***Calibration On*** checkbox is cleared. Selecting the checkbox will automatically re-configure the display monitor to its previously calibrated state.

The ***Open*** button will open the ***Previous Monitor Calibration*** dialog which shows all of the previous calibrations that have been performed. It is possible to view the detailed results of each calibration, as well as manually selecting a previous calibration to load. Loading a previous Monitor Calibration will automatically configure the display and re-generate the ICC/ColorSync profile, if one was generated when the calibration was performed. This feature can be used to manually switch between different monitor calibrations with different Target settings, or to restore a particular calibration.

Note: The Monitor Calibrations are specific to each individual display monitor and can not be used to load the calibrated settings of one display monitor into another, even if they are the same model. This is because of the individual tolerances and characteristics of each display monitor.

Display

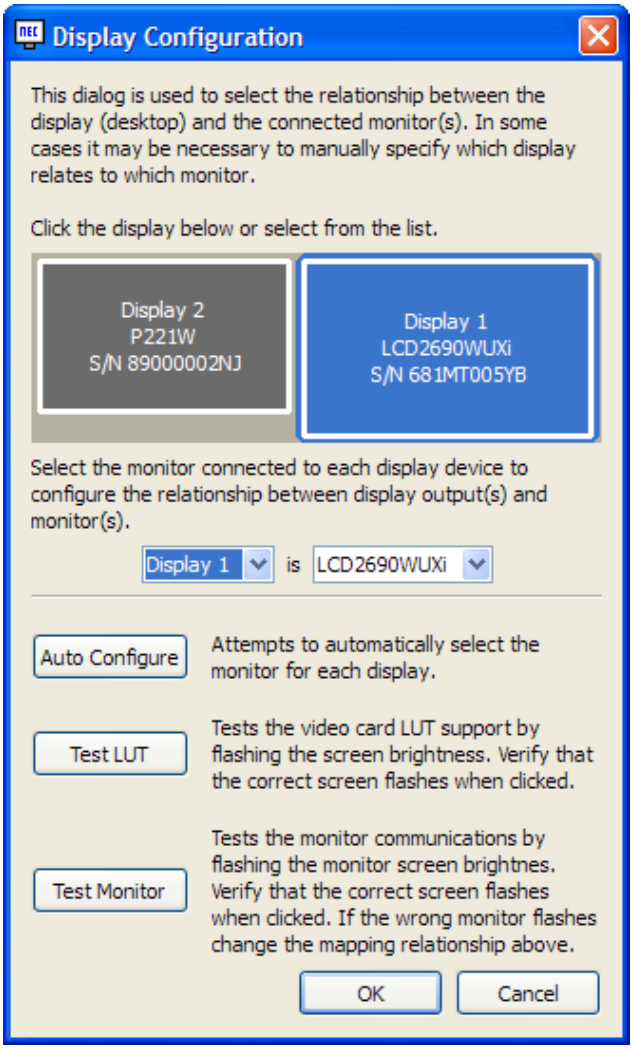
The ***Display*** group is used to select the display monitor to calibrate if more than one display is present on the system. Displays can be selected from the listbox and the ***Target Settings*** and ***Calibration*** status will be



automatically updated. Note that ***Target Settings*** are independent for each monitor when multiple monitors are used, so each display monitor can be calibrated to different Target settings if desired.

Display Configuration button (Windows version only) opens the ***Display Configuration*** dialog which is used to configure SpectraView II if more than one display is used on the system. See the following section.

Display Configuration dialog (Windows version only)



This ***Display Configuration*** dialog is accessed either from the ***Edit*** menu, or by clicking on the ***Display: Configure*** button in the main SpectraView window.

If more than one display is being used on Windows, it may be necessary to manually configure the relationship between the display layout on the Windows desktop, and the display monitors that are connected to the system. Correct configuration of this relationship is necessary so that the display monitor adjustments are sent to the correct monitor, and that the calibration is performed on the correct part of the desktop.

A diagram depicting the display desktop layout is shown and the display monitors associated with each desktop screen is shown. The monitor associated with each display can be selected using the listboxes.

Clicking on the display rectangles will also select different displays on the Windows desktop.

If a USB connection is made to the display (MultiSync PA Series only), the USB connection will be shown and can be selected instead of the DDC/CI connection.

Note: Some video graphics adapters may show several duplicate displays due to issues with the video drivers for that adapter. In this case the duplicate displays can be selected to "None".

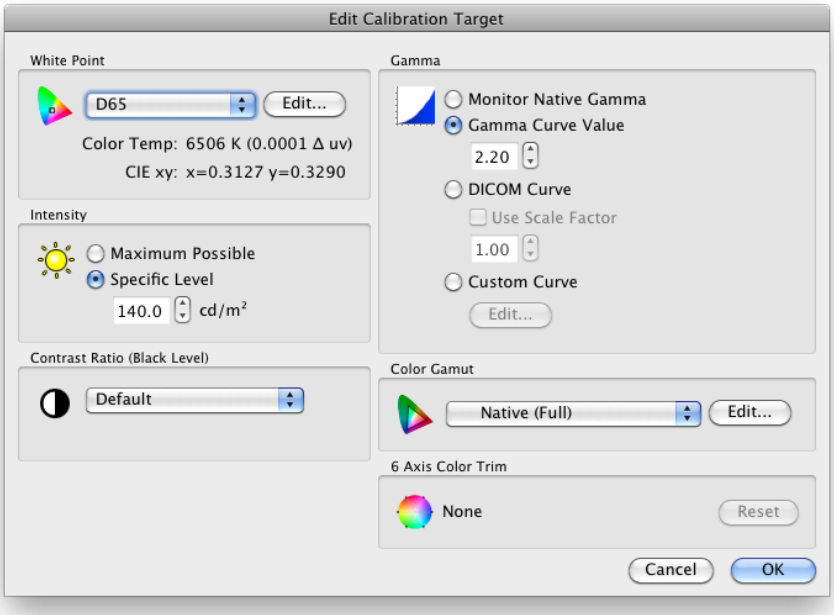
Auto Configure - Attempts to automatically detect and configure the display monitors to the display layout on the Windows desktop. In most cases this will correctly configure the correct relationship, but in some cases it may be necessary to manually configure.

Test LUT - Tests that the video graphics adapter card LUT (Look Up Table) can be correctly set. Clicking this button with flash the screen brightness by setting the LUT in the video graphics adapter card for the currently selected display. Verify that the correct screen flashes when this button is clicked.

Note: Since SpectraView applies all correction curves to the 10 or 12 bit LUT inside the monitor, the video graphics adapter card LUT is always set to linear.

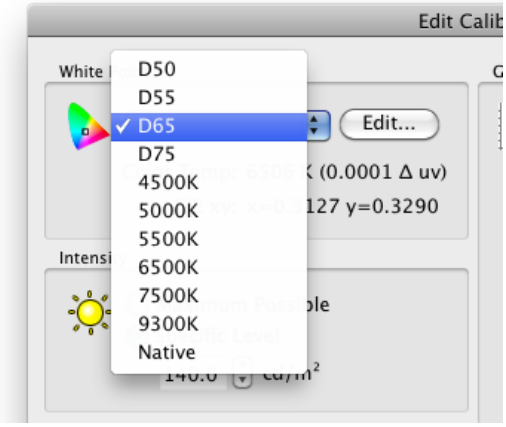
Test Monitor - Tests the communications with the currently selected display monitor. Clicking this button will send a command to flash the monitor's screen brightness. If the wrong display monitor flashes then change the monitor associated with each display can be selected using the listboxes.

Edit Calibration Target Configuration dialog



The Edit ***Edit Calibration Target*** dialog is accessed by clicking the ***Edit Target*** button on the main SpectraView II window, or by selecting ***Target*** from the ***Edit*** menu. Custom Targets can be created using this dialog. After a new Target has been created, the display must be Calibrated to it. It is possible to share Target files with other users of SpectraView on both Windows and Mac OS platforms.

White Point



White Point selects the Target white point for the calibration. Several popular industry standard White Point values, such as D50 and D65, are provided.

A Native option is available that can be used to leave the White Point at the display's native characteristic white point. This is useful when the maximum possible luminance is desired but the white point is not critical.

A custom white point can be specified by clicking the ***Edit...*** button to open up the ***Custom Color Temperature*** dialog.

Gamma Curve

Gamma Curve selects the desired tone response curve of the calibrated display. Options are:

- ***Monitor Native Gamma*** - No correction is applied and the display's Look Up Tables are set to linear.
- ***Gamma Curve Value*** - The response curve will follow a simple gamma curve. Values between 1.0 and 3.0 can be entered. A gamma value of 2.2 is the most popular for most applications.

- ***DICOM Curve*** - The response curve follows the DICOM (Digital Imaging and Communications in Medicine) specification. This response curve is aimed at medical use, however it can be used for other applications. The goal of the DICOM response curve is to have a visually linear display response.

  Use Scale Factor - The DICOM response curve shape is based on the measured black level and Intensity. If the black level or Intensity of the display changes, then the shape of the DICOM response curve also changes. If a display is not expected to be re-calibrated for a period of several months, this feature can be used to increase the longevity of the DICOM calibration using the knowledge that the displays brightness will decrease slightly as it ages. By scaling the black level and Intensity values used to calculate the DICOM response curve, using the Use Scale Factor value, the response curve can be based on the lower future black level and Intensity. The value used will depend on the display, its usage, and the time interval until it is expected to next be re-calibrated.

- ***Custom Curve*** - Advanced and custom response curves can be selected from presets or created by importing a table of values. Click the ***Edit...*** button to open the ***Custom Gamma Curve*** dialog.

Intensity

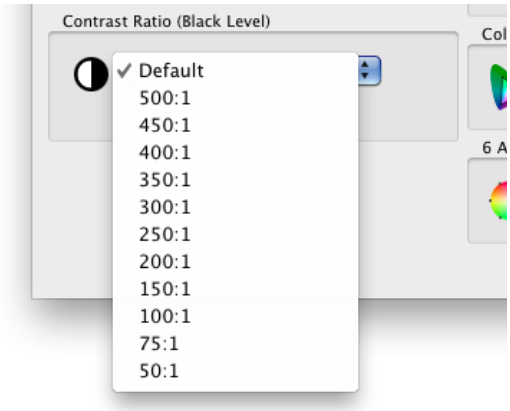
The ***Intensity*** selects the luminance or "brightness" of white for the calibration. Options are:

- ***Maximum possible*** - calibrates the display to the maximum possible luminance that it can achieve. The actual value achieved will depend on the display's type, its age and the white point used. This is not recommended when trying to exactly match two or more displays, since there may be a difference between what Intensity each display can achieve.

- ***Specific Level*** - calibrates the display's Intensity to a specified target value. If the display can not achieve the specified value, it will be calibrated to the closest possible Intensity, and a message will be displayed after the calibration has completed.

*Note: If you are unsure about what level to use for the Specific Level for a particular application, it is possible to interactively adjust both the White Point and Intensity using the **Visual Match** feature in the **Custom White Point** dialog.*

Contrast Ratio



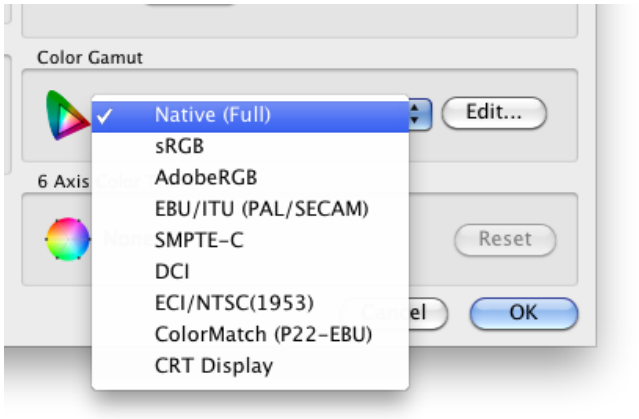
Contrast Ratio allows a particular contrast ratio to be used if necessary. The contrast ratio is the ratio of white to black luminance.

Selecting ***Monitor Default*** will calibrate the display to the highest possible contrast ratio, which is limited by the display technology, the selected White Point, Intensity value, and other factors.

In some applications, such as simulating low contrast images such as in newsprint, it is useful to have a lower contrast ratio than the display's native value. Contrast Ratios in the range of 50:1 to 500:1 can be selected.

*Note: If the selected contrast ratio is higher than what the display is actually capable of achieving, then the display will calibrate to the highest possible contrast ratio. If a specific **Contrast Ratio** is selected, it is recommended that the number of **Calibration and Measurement Steps** be set to at least 32 in the **Preferences** dialog.*

Color Gamut



Color Gamut allows a particular color gamut to be selected if the display supports color gamut adjustment. The color gamut is the range of colors that can be displayed by the monitor, and is defined and bounded by the red, green and blue primaries which together make up all other colors.

*Note: Depending on the display model, this control may be disabled or limited to **Native** and **sRGB**.*

For advanced models such as the MultiSync PA series, the color gamut can be fully controlled and customized, and the internal SpectraView engine will manipulate the primary colors in order to display different colorspaces.

Several preset Color Gamuts are available in the list, or a custom gamut can be created. Click the ***Edit..*** button to open the ***Custom Color Gamut*** dialog.

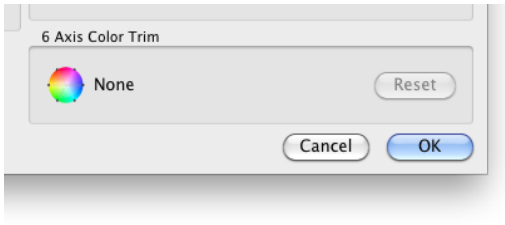
By using the ***Native (Full)*** setting, the color gamut will be that of the LCD panel which will result in the widest possible color gamut. Use this setting if you are using color managed applications such as Adobe Photoshop which use a Color Management System to correctly convert colors for display.

Examples of typical usage scenarios when using a non-native color gamut can be beneficial:

Video Editing: When editing video in an application that is not color managed. In this case the video is typically encoded and intended to be viewed on a display that either has SMPTE-C or ITU-R BT.709 color primaries. Since the video editing application is not color managed, no color conversion is made between the colorspace of the encoded video, and that of the display. If the display was set to the Native color gamut, video images would appear over-saturated because they are being displayed directly on the wide color gamut display without any kind of compensation. By setting the Color Gamut of the calibration Target to that of the encoded video, the display will handle the color conversion that would have normally been done if the video was color managed, and will be displayed correctly without being over-saturated.

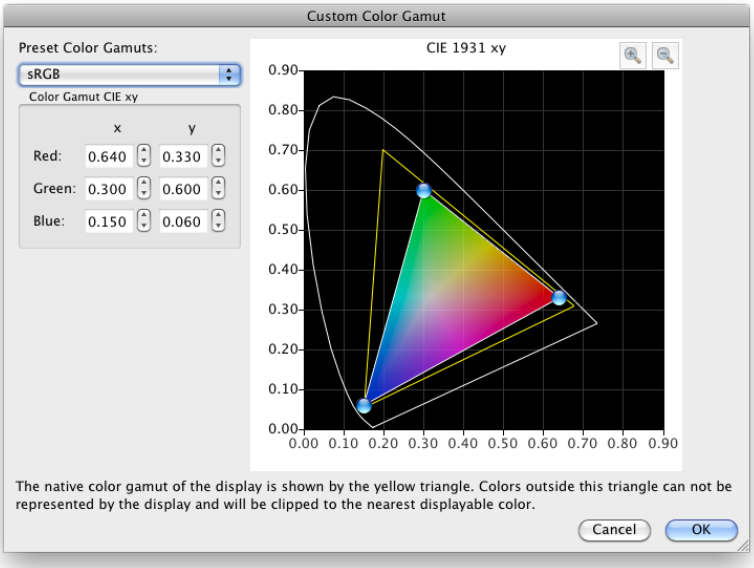
Web Viewing: When viewing web pages using a web browser application and system that are not color managed, images and graphics would otherwise appear over-saturated since they were probably intended to be viewed on a typical sRGB gamut display. In this case using the sRGB Color Gamut as a Target will assign the display to handle the color conversion so it appears to be an sRGB colorspace display, even though it is actually a wide color gamut LCD panel.

6 Axis Color Trim



The ***Six Axis Color Trim*** function allows the screen colors to be adjusted after calibration. Adjustments are made in the Six Axis Color Trim dialog, available on the Tools menu. Any adjustments to the settings for the current Target can be reset by clicking the ***Reset*** button. See the *Using 6 Axis Color Trim* chapter for more information on using this feature.

Custom Color Gamut dialog



The ***Custom Color Gamut*** dialog is accessed by clicking the ***Edit..*** button in the ***Color Gamut*** section of the ***Edit Calibration Target*** dialog.

Note: This feature is only available on MultiSync PA series models and P241W.

The color gamut of the monitor can be altered by changing the positions of the red, green and blue primary colors. This can be done by either clicking and dragging the positioning controls on the CIE xy diagram, or by modifying the CIE xy values for each primary color.

The native color gamut of the monitor is shown as a yellow triangle on the CIE xy chromaticity diagram in the dialog. This triangle represents the limits for displayable colors, and colors outside it can not be represented correctly by the display.

The LCD panels used in the NEC MultiSync PA Series (except the PA231W and P241W) are known as wide color gamut panels, meaning they can display a much wider range of colors than typical monitors.

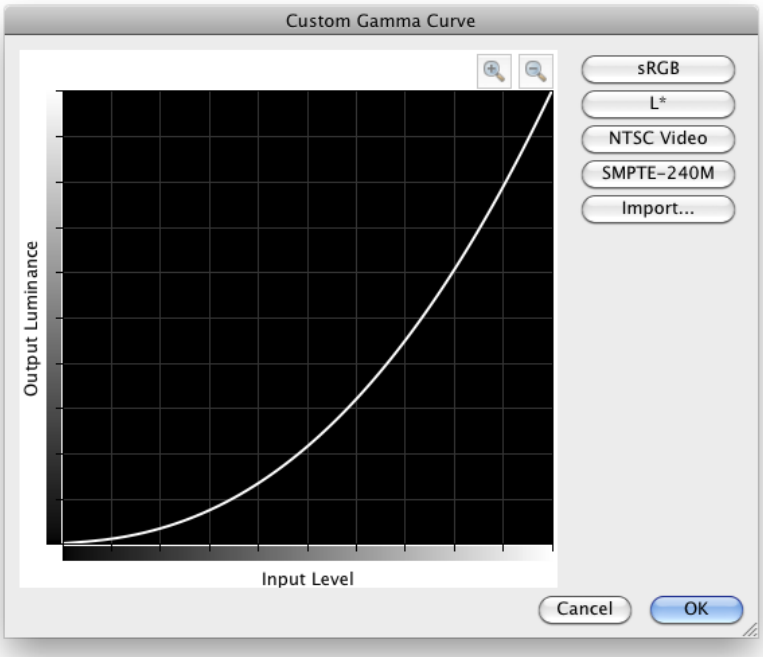
However, for some applications, it is not desirable to use such a wide color gamut, and in these cases, the Color Gamut control can be used to manipulate the color gamut size and shape.

In other instances it is desirable for the monitor to behave as though it has an even larger color gamut than it actually has. In this case colors that lie outside the displayable range of the LCD panel will be automatically converted to the nearest displayable color. An example is the DCI colorspace used for Digital Cinema applications. Parts of this colorspace lie outside the range of displayable colors, but it is still advantageous to have the display appear as DCI color gamut for all of the parts of the colorspace which lie within the displayable color range.

Advanced Note: When the Color Gamut setting is set to anything other than ***Native***, the ICC/ColorSync profiles generated by SpectraView will automatically use the color primary chromaticity values calculated by the display's internal SpectraView engine, rather than measurements taken by the color sensor if the current ***Source of primary color chromaticities for ICC Profile*** setting in the ***Preferences*** is set to ***Automatic*** (default). This feature allows the use of color gamuts that are larger than that which the display actually has, and encodes the correct color primary chromaticity values within the ICC/ColorSync profile, even though they may not all be actually be displayable and measurable.

If desired, this behavior can be changed by selecting ***Calibration Sensor*** in the ***Preferences***, however note that if a color gamut larger than that of the display is used, the color primary chromaticity values within the ICC/ColorSync profile will not correctly represent the Target color gamut.

Custom Gamma Curve dialog



The ***Custom Gamma Curve*** dialog is accessed by clicking the ***Edit..*** button in the ***Gamma Curve*** section of the ***Edit Calibration Target*** dialog.

Advanced response curves can be selected from presets or custom curves can be created by importing a table of values.

The following preset curves are available:

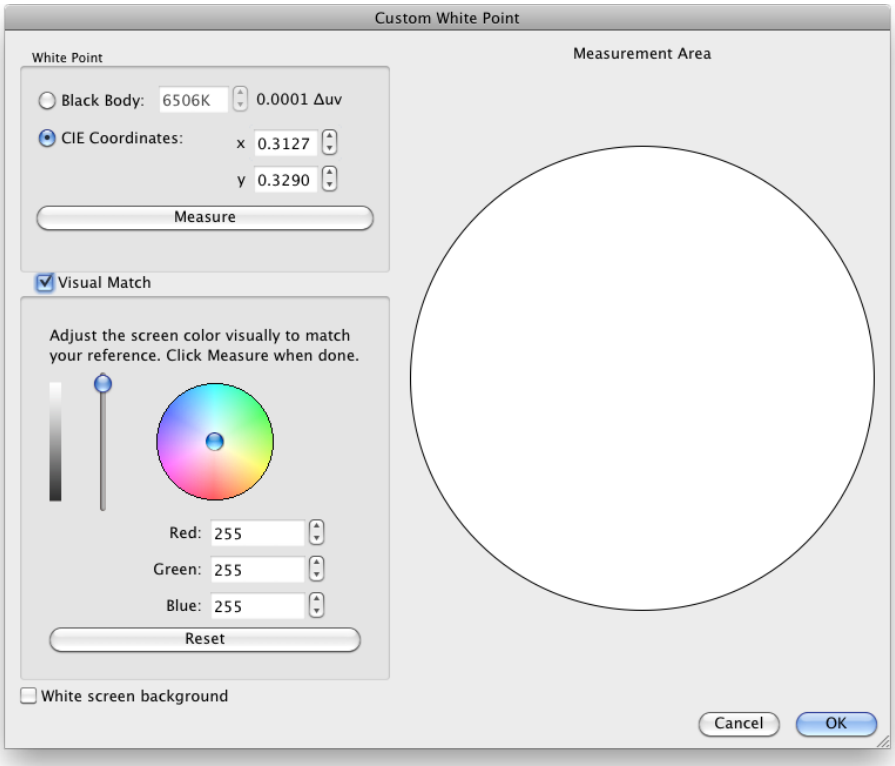
- **sRGB** - A curve based on the sRGB specification that includes the offset, transition and slope components.
- **L*** - A curve based on L* in the Lab specification. The L* curve is intended to be more perceptually uniform than a simple gamma value curve.
- **NTSC Video** - A curve based on the SMPTE-170M specification for NTSC that includes the offset, transition and slope components.
- **SMPTE-240M** - A curve based on the SMPTE-240M specification for 1125 line HD video that includes the offset, transition and slope components.

Custom curves can be created and imported into SpectraView by creating a text file with a list of numerical values. The text file must conform to the following specifications:

- Must contain between 3 and 256 values.
- Each value must be on a separate line.
- The first value must be 0.
- Values must be monotonically increasing.

When imported, the values will be automatically scaled and interpolated to create a Target curve.

Custom White Point dialog



The ***Custom White Point*** dialog is accessed by clicking the ***Edit..*** button in the ***White Point*** section of the ***Edit Calibration Target*** dialog.

A custom White Point can be created by either specifying it as a ***Black Body*** radiator temperature in Kelvin, as ***CIE (xy chromaticity) Coordinates***, or by interactive visual adjustment and measurement.

Values between 2500K and 10000K may be entered in the Black Body K field. The corresponding CIE xy coordinates are automatically calculated and displayed for reference.

CIE xy chromaticity coordinates can be entered by selecting the ***CIE Coordinates*** radio button and entering the x and y values. The corresponding correlated black body radiator temperature and Δuv (Delta-uv) values are automatically calculated and displayed for reference. The Delta-uv value indicates how far the xy coordinates entered are from the black body radiator locus.

A custom White Point may be measured using the calibration sensor, and automatically entered in the CIE xy chromaticity coordinate fields by clicking the ***Measure*** button. This is useful for "cloning" the white point of another monitor.

The color sensor can be placed over the white circle on the right of the dialog in order to take a measurement of the white point by clicking the ***Measure*** button. The circle can also be used to visually compare the white point to another reference such as a lightbox. If a larger area of white reference is needed, selecting ***White Screen Background*** will fill the entire screen background with white.

The luminance and color of the display can be interactively adjusted to visually match a reference if necessary. To interactively adjust the color of the display, click and drag within the color circle or use the arrow keys. Use the vertical slider control to adjust the Intensity. Specific Red, Green and Blue values can also be entered.

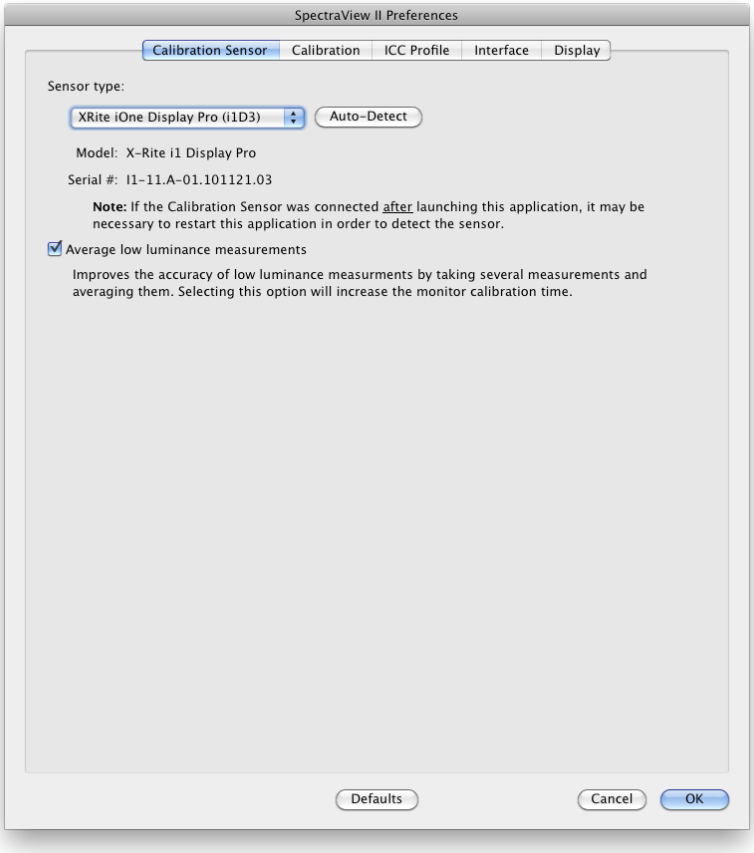
Once a visual match is found, the adjusted white point must be measured by clicking the ***Measure*** button and measuring the white circle with the color sensor. This will update the Target white point values with the new White Point values.

Note: Due to the technology limitations of the color sensor compared to the human eye, for some applications, it is sometimes better to visually match a white point using this interactive method, and then measure it using the color sensor.

Preferences dialog

The ***Preferences*** dialog is accessed from the ***Edit*** menu (Windows) and ***SpectraView II*** application menu (Mac OS). It is divided into 5 different tabs.

The default settings for the entire Preferences can be restored by clicking the ***Defaults*** button.



Preferences dialog - Calibration Sensor tab

Sensor Type - selects the model of calibration sensor to use, and shows the current model being used.

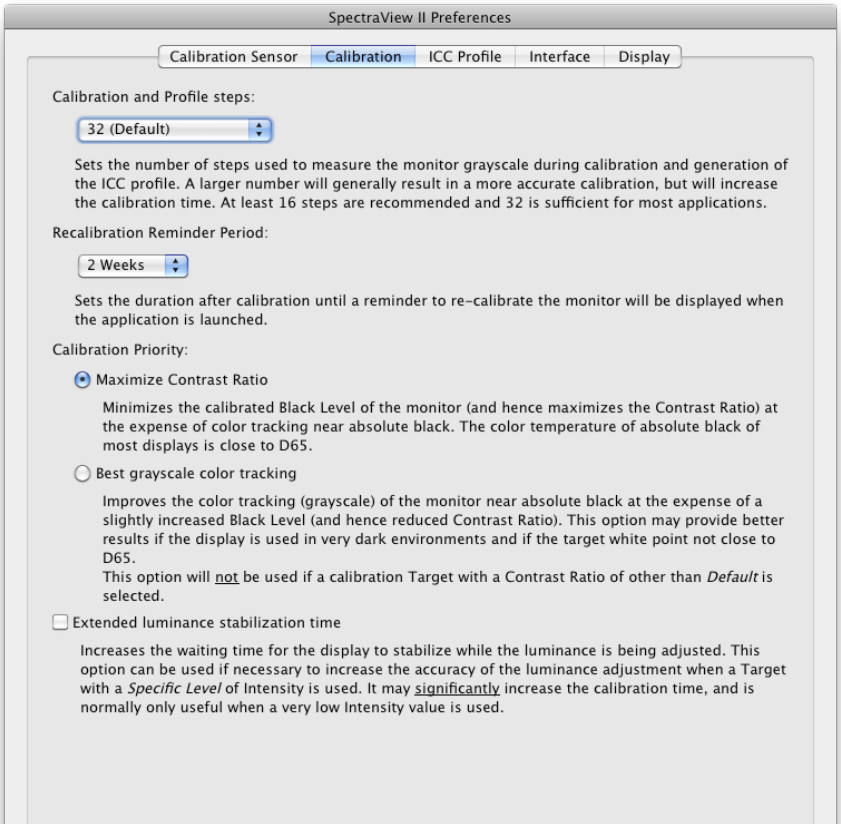
Auto-Detect - attempts to detect the selected model of calibration sensor. SpectraView will automatically detect the calibration sensor when the application is started, however if the sensor was not connected at that time, or if it was being used by another application, then it may be necessary to re-detect it.

Note: If the sensor was not attached when SpectraView was launched, then it may be necessary to exit the SpectraView application and launch it again.

Model and ***Serial #*** - shows the model and serial number of the currently selected calibration sensor device.

Average low light measurements - will average several color sensor measurements to improve the accuracy of low luminance measurements (below 10 cd/m²). Selecting this option will increase the monitor calibration time.

Preferences dialog - Calibration tab



Calibration and Profile Steps - selects the number of measurement steps to take when calibrating and profiling the display. A larger number of steps will generally result in a more accurate grayscale calibration, but will increase the calibration time. 32 steps is the recommended setting for most applications.

Recalibration Reminder Period - sets the interval after the display is calibrated until a calibration reminder message is displayed. The default value is 2 weeks. Select ***Never*** if you do not want to be reminded to recalibrate the display.

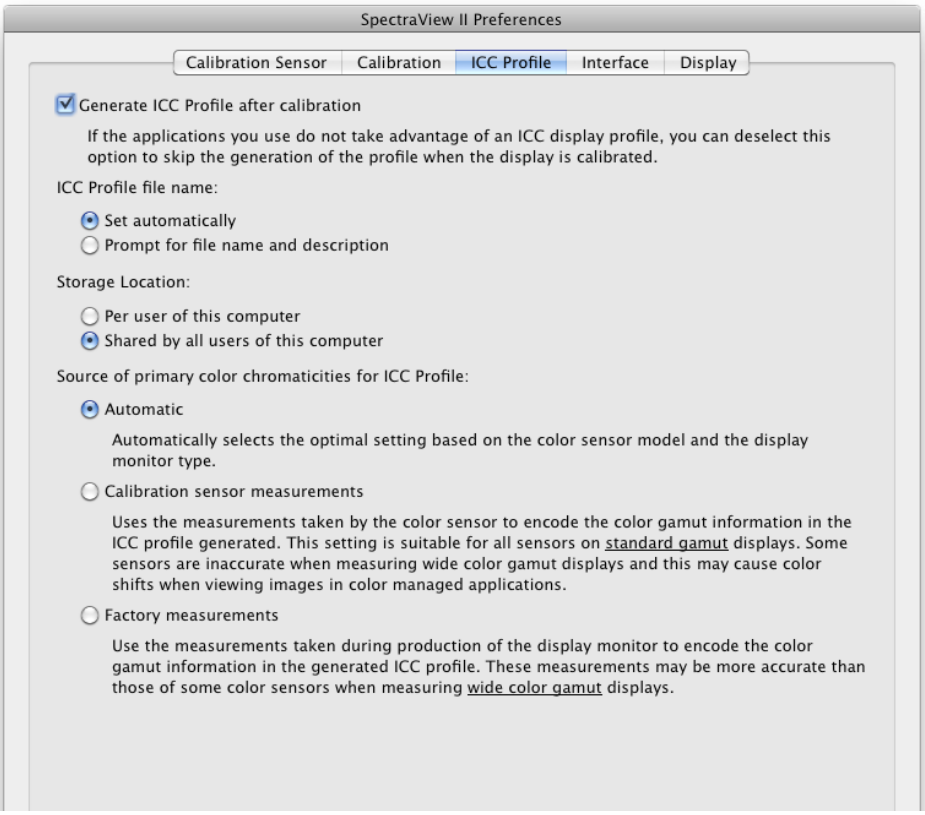
Calibration Priority - selects the algorithm used to calculate the display's response curve. Options are:

- ***Maximize Contrast Ratio*** - will maximize the display's contrast ratio by making black as dark as possible at the expense of grayscale color tracking near black.
- ***Best grayscale color tracking*** - will generate the best grayscale color tracking in the black areas, at the expense of a slightly reduced contrast ratio. This option will not be used if a calibration Target with a Contrast Ratio of other than Default is used.

Note: This setting does not have any impact on the calibration of the MultiSync PA series displays and will be disabled if no relevant displays are connected.

Extended luminance stabilization time - increases the waiting time for the display to stabilize while the luminance is being adjusted. This option can be used if necessary to increase the accuracy of the luminance adjustment when a Target with a Specific Level of Intensity is being used. It may significantly increase the calibration time, and is normally only useful when a very low intensity value is used. Try selecting this option if the calibrated Intensity is significantly different than the Target value due to the display stabilizing during the calibration and profiling steps.

Preferences dialog - ICC Profile tab



Generate ICC Profile after calibration - selecting this will automatically generate an ICC/ColorSync monitor profile after the display is calibrated. This option should be checked for most applications.

Set as Windows Color Management System Monitor Profile (Windows version only) - selecting this will automatically associate the generated ICC monitor profile with the Windows Color Management System. This option should be checked for most applications.

ICC Profile file name - selects how the ICC Profile file is named when an ICC Profile is generated, for example after calibration.

- ***Set Automatically*** - the profile will be automatically given a name and description. This is the default setting as it is not normally necessary to manually name the profile file.
- ***Prompt for file name and description*** - a prompt will appear and the file name and description can be entered manually.

Storage Location (Mac OS 10.6 and earlier only. Disabled in OS 10.7 and defaults to ***Per User of this computer*** due to system folder permissons.) - specifies where the generated ICC/ColorSync profiles are stored. Options are:

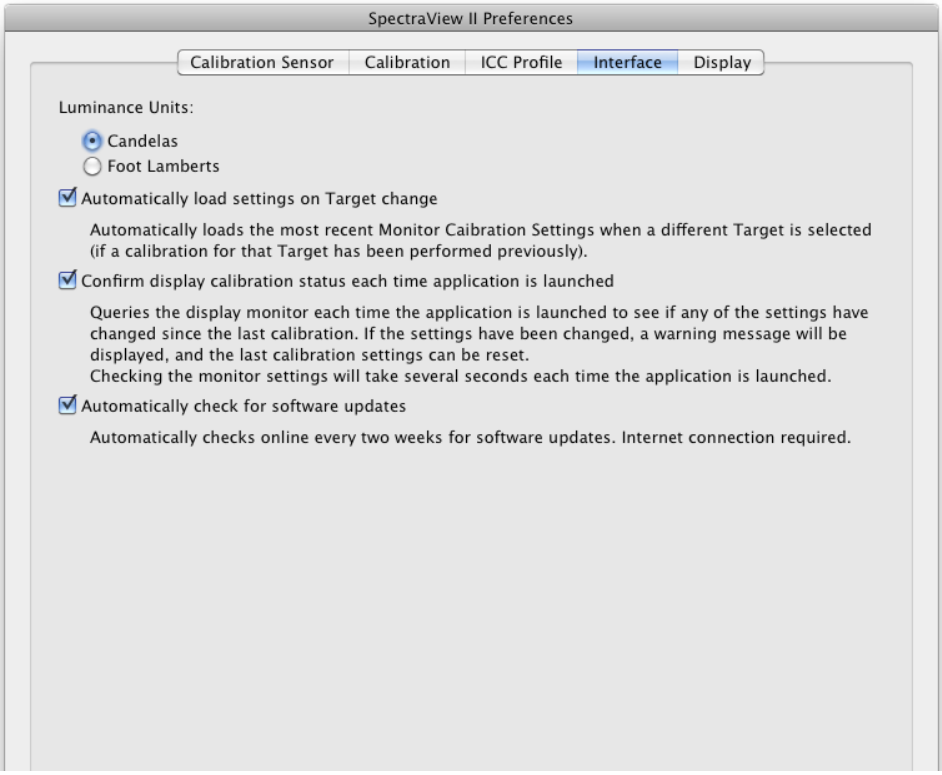
- ***Per User of this computer*** - the profile is stored in the User's profile folder. Profiles in this folder are typically not accessible from other user accounts.
- ***Shared by all users of this computer*** - the profile is stored in the shared profile folder that is accessible by all user accounts.

Source of primary color chromaticities for ICC Profile - selects what values are used for the Primary Color Chromaticities that are encoded in the ICC/ColorSync monitor profile. The values are used to describe the color gamut of the display.

Options are:

- ***Automatic*** - the optimal setting based on the color sensor model and the display monitor type is automatically used. It is recommended to use this setting.
- ***Calibration Sensor*** - uses the values measured by the calibration sensor. For normal color gamut displays this is the recommended option since the calibration sensor can accurately measure these primary colors. For wide color gamut displays some colorimeter based calibration sensors may not be able to accurately measure the primary colors and it is recommended to use the Factory Measurement option. For spectral based calibration sensors, either option can be used.
- ***Factory Measurements*** - uses the measurements taken during production of the display monitor to encode the color gamut information in the generated ICC Profile. These measurements may be more accurate than those of some color sensors when measuring wide gamut displays such as the PA241W, PA271W, PA301W, P221W, LCD2180WG-LED, LCD2690WUXi, LCD2690WUXi2, and LCD3090WQXi.

Preferences dialog - Interface tab



Luminance Units - selects the units that luminance values are displayed in. Options are:

- **Candelas (cd/m²)**
- **Foot Lamberts (fL)**

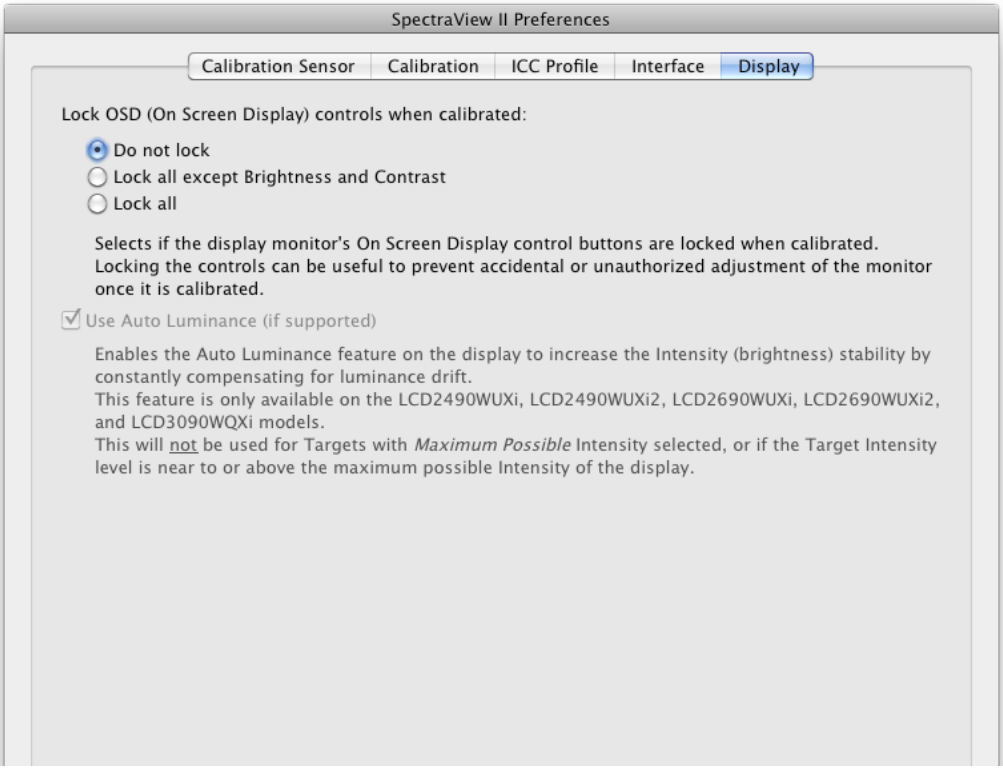
Automatically load settings on Target change - automatically loads the most recent Monitor Calibration Settings when a different Target is selected, and will generate a new corresponding ICC Profile. Using this option allows different Targets to be selected and the monitor will be automatically configured.

Confirm display calibration status each time application is launched - selects if the current monitor settings should be checked and compared with the settings for the last calibration when SpectraView is launched. If the monitor settings are different a warning message will be displayed, and the last calibration settings can be reset. This checking operation will take several seconds each time SpectraView is launched.

Delay loading of SpectraView II Gamma loader on Windows Startup (Windows version only) - selecting this will delay the loading of the SpectraView II Gamma Loader when Windows starts by 60 seconds in order to allow other applications and utilities to initialize first. Select this option if you are experiencing monitor detection or video blanking issues only when the SpectraView II Gamma Loader runs as Windows starts.

Automatically check for software updates - when selected the software will automatically check for any software updates every two weeks when the software is launched. An Internet connection is required.

Preferences dialog - Display tab



Lock OSD (On Screen Display) controls when calibrated - selects if the monitor's On Screen Display control buttons are locked when the monitor is calibrated. Locking the controls can be useful to prevent accidental or unauthorized adjustment of the monitor once it is calibrated. Options are:

- ***Don't lock***
- ***Lock all except Bright and Contrast***
- ***Lock all***

Note: The controls will be unlocked if the calibration is turned off in the main window.

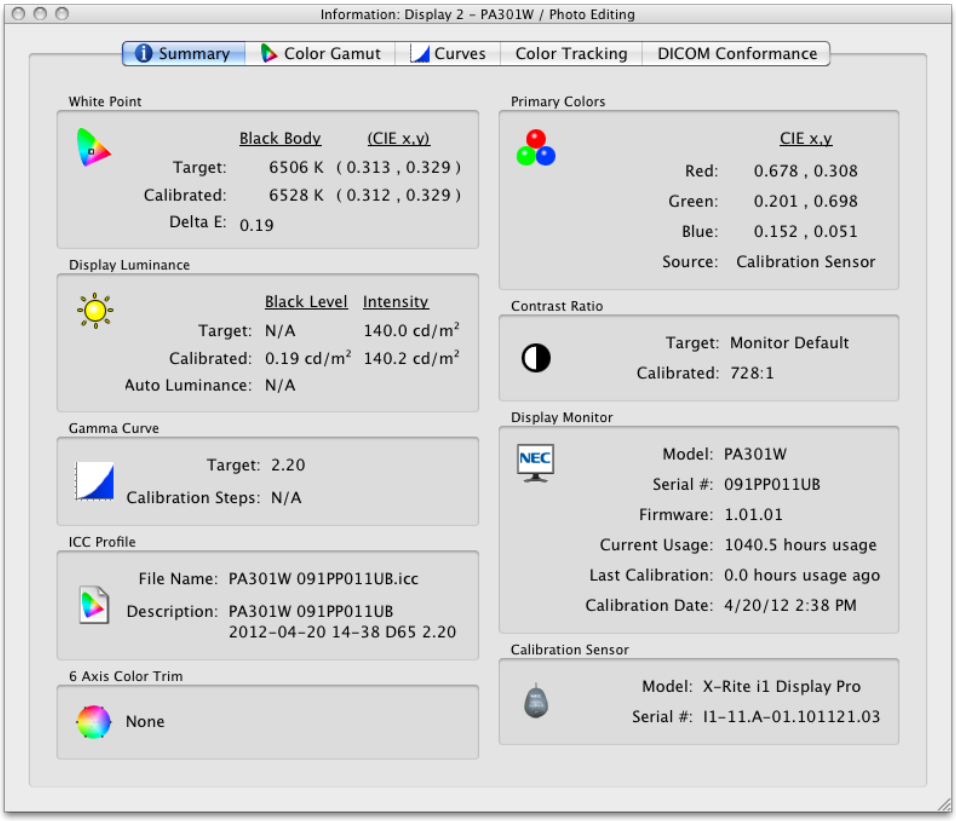
Use Auto Luminance (if supported) - enables the Auto Luminance sensor circuit inside the display monitor to increase the Intensity (brightness) stability as the display ages and warms up. This feature will not be used for Targets with "Maximum Possible" Intensity selected, or if the Target Intensity falls outside the range that the Auto Luminance circuit is capable of controlling. This feature is only available on the following models: LCD2490WUXi, LCD2490WUXi2, LCD2690WUXi, LCD2690WUXi2, and LCD3090WQXi.

The MultiSync PA Series of displays (except the PA231W) automatically always use Auto Luminance to maintain the stability of the monitor. The PA231W does not support Auto Luminance.

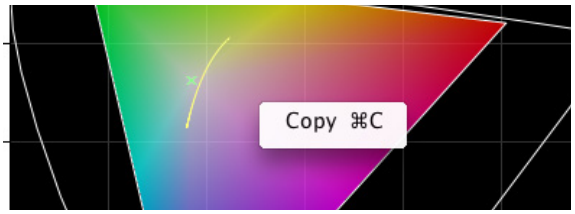
Note: This setting will be disabled if no relevant displays are connected.

Information window

The ***Information*** window is accessed from the ***Tools*** menu. It will also be automatically displayed after a display calibration is completed.



*Note: The graphs shown in the **Information** window can be panned, zoomed and scaled. Click and drag to select a zoom area. Use the arrow keys to pan. Size the dialog to scale the graphs.*



*The graphs and information can also be copied to the clipboard and pasted into other document and image editing applications by right-clicking and selecting **Copy**. This is useful for sharing and documenting various results*

Information window - Summary tab

White Point

The ***Target*** values are the currently selected Target's White Point. The ***Calibrated*** values show the actual measured White Point after the display has been calibrated.

The ***Delta E*** value is the calculated color difference between the ***Target*** and ***Calibrated*** White Point using both the color and luminance. This is calculated using the Delta E CIE 94 color formula. A Delta E value of 1 is considered just perceptible to 50% of users. Values under 3 are generally considered excellent for display calibration.

Primary Colors

Red, Green and Blue CIE x,y - shows the measured color coordinates of the display's primary colors. These values represent the color gamut of the display. The ***Source*** of the color measurements indicates if the Red, Green and Blue values came from either the Calibration Sensor or Factory Measurements, and will depend on the ***Primary Colors Chromaticity Source*** setting in the ***Preferences*** dialog.

Display Luminance

The ***Target*** values show the currently selected Target's ***Black Level*** and ***Intensity***.

The ***Calibrated*** values show the actual measured ***Black Level*** and ***Intensity*** after the display has been calibrated.

Contrast Ratio

The ***Contrast Ratio*** is the ratio of the ***Intensity*** to the ***Black Level***. The ***Target*** value shows the currently selected Target's Contrast Ratio. For LCD display monitors, this is set to "N/A" since the monitor's Black Level is fixed.

The ***Calibrated*** values show the actual contrast ratio calculated using the actual measured ***Black Level*** and ***Intensity*** after the display has been calibrated.

Gamma Curve

Target shows the type or gamma value of the Target Gamma Curve.

Calibration Steps - shows the number of calibration steps used to measure the grayscale when the calibration was performed.

ICC Profile

File Name shows the name of the ICC/ColorSync profile, if one was generated after the display was calibrated.

Description shows the description tag text of the ICC/ColorSync profile, if one was generated after the display was calibrated.

Display Monitor

Model shows the model name of the currently selected display.

Serial # - shows the serial number of the currently selected display.

Firmware - shows the internal firmware version of the currently selected display.

Current Usage shows the total number of hours that the currently selected display has been in use.

Last Calibration shows the number of hours that the currently selected display has been used since it was last calibrated.

Calibration Date shows the date and time that the monitor was last calibrated to the currently selected target.

6 Axis Color Trim

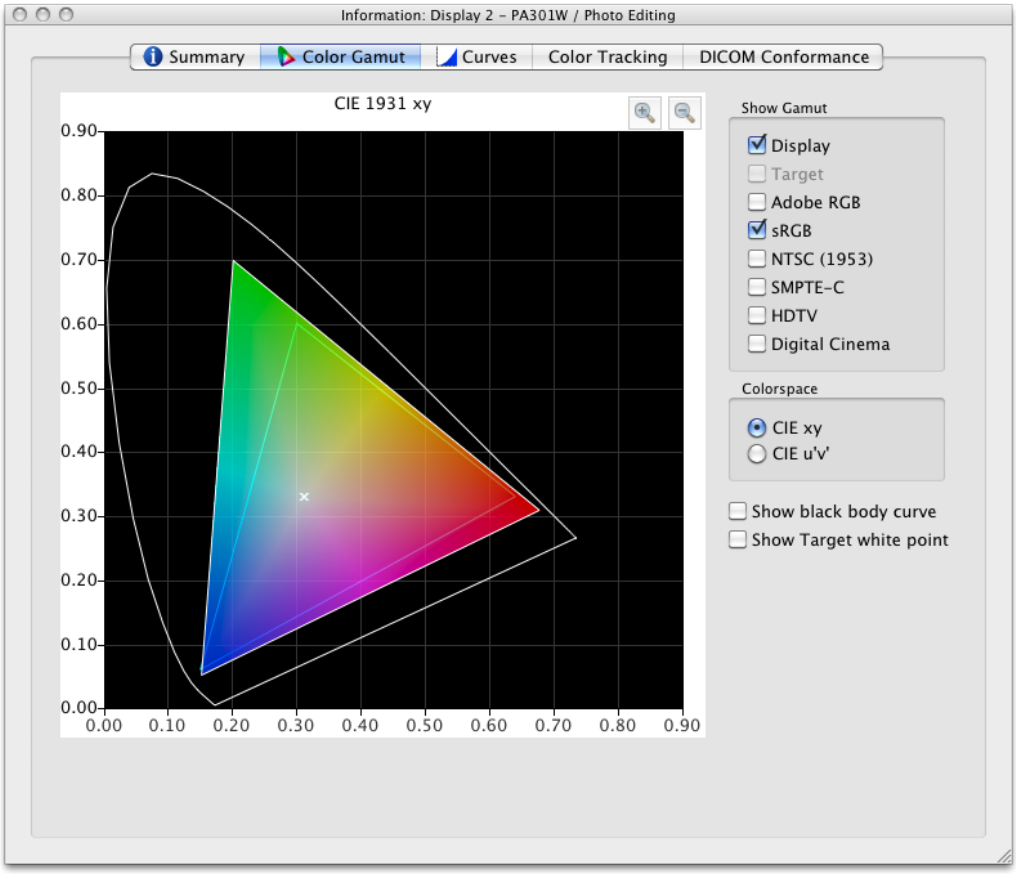
Shows the 6 axis color trim adjustments, if any, that are applied to the currently selected Target. See the *Using 6 Axis Color Trim* chapter for more information on using this feature.

Calibration Sensor

Model shows the model name of the calibration sensor used when the calibration was performed.

Serial # - shows the serial number of the calibration sensor used when the calibration was performed.

Information window - Color Gamut tab



The Color Gamut tab graphically illustrates the color gamut of the display for comparison purposes as a 2D representation of the 3D color gamut volume. The display's color gamut can be compared to the color gamut of several popular color spaces.

The source of the color measurements for the display's color gamut will depend on the ***Primary Colors Chromaticity Source*** setting in the ***Preferences*** dialog.

If a Target Color Gamut other than ***Native*** is being used, then selecting ***Target*** will show the Target color gamut. This will be disabled if the Native color gamut is used since it will depend on each individual display.

Selecting a reference color space will overlay the color gamut onto the display's.

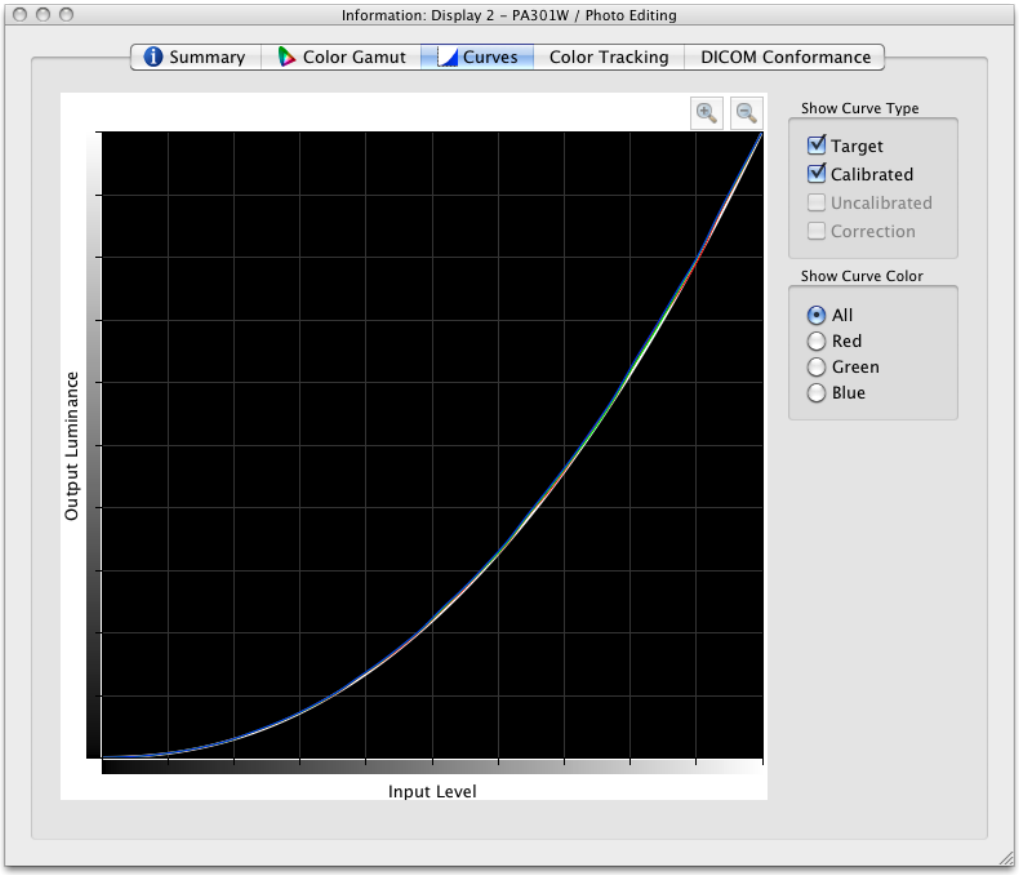
Colorspace

- ***CIE xy*** **-** shows the gamut projected in CIE xy colorspace. This is probably more familiar to most users, however it does not allow color differences to be easily judged because this projection overemphasizes differences in green colors, and underemphasizes differences in blue colors.
- ***CIE u'v'*** **-** shows the gamut projected in CIE u'v' colorspace. This is projection is an improvement over CIE xy in that different colors are more equally represented in scale.

Show black body curve - shows the black body locus as yellow curve.

Show Target white point - shows the White Point of the currently selected target as a green X.

Information window - Curves tab



The ***Curves*** tab graphically illustrates the various tone response and correction curves measured and generated during the calibration process.

Show Curve Type

Target - illustrates the target tonal response curve of the currently selected Target. This display will be calibrated to match this curve. This curve will be disabled and not shown if the Target Gamma is set to ***Monitor Native Gamma***.

Calibrated - illustrates the actual measured tonal response curves of the calibrated display. These curves are generated from measurements taken while generating an ICC/ColorSync monitor profile of the display. If no ICC/ColorSync profile was generated after the monitor was calibrated, then this checkbox will be disabled.

Uncalibrated - illustrates the actual measured tonal response curves of the uncalibrated display, without any corrections applied to the Look Up Tables. These curves are generated from measurements taken during the calibration process.

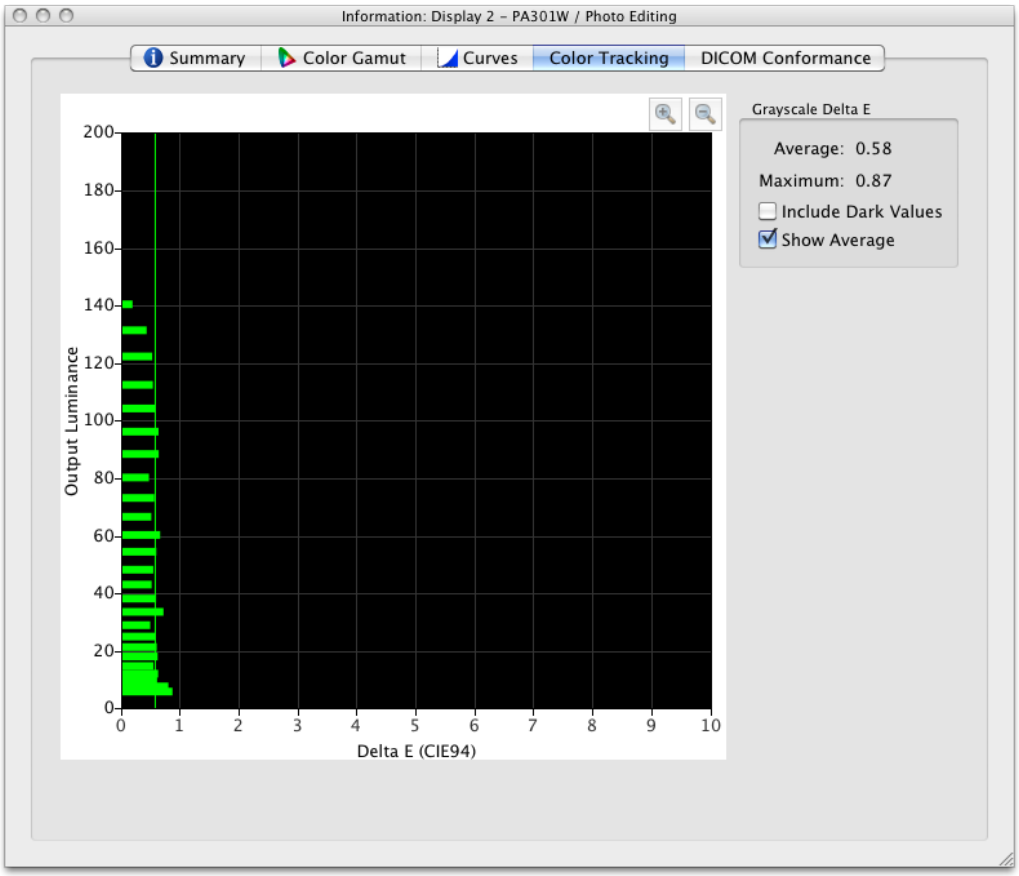
Correction - illustrates the correction that is applied to the display's Look Up Tables in order to achieve the selected Target tonal response curve characteristics.

Note: The Uncalibrated and Correction curves are not available with the MultiSync PA series displays because they are calculated within the display automatically.

Show Curve Color

The ***All, Red, Green*** and ***Blue*** buttons select which curve colors are displayed on the graph.

Information window - Color Tracking tab



The ***Color Tracking*** tab shows graphically how well the grayscale (colors from black to white) of the display is conforming to the currently selected Target. Ideally all points along a grayscale measured on the display should have the same white point (chromaticity) and should follow the luminance curve of the Target.

Deviations from this ideal can result in grayscale color tracking errors which can be seen as shifts in chromaticity along the grayscale, and/or shifts in luminance. The Delta E values are a mathematical measure of these deviations. A Delta E value of 1 is considered to be just perceptible to 50% of users. Values under 3 are generally considered excellent for display calibration. Values above 3 will be highlighted in yellow or red and may indicate a problem with the display's calibration.

The graph shows the displays actual measured grayscale color tracking using measurements taken while generating an ICC/ColorSync monitor profile of the display.

The horizontal axis shows the ***Delta E*** values for each measured point on the grayscale. The vertical axis shows the luminance for each of the measured points on the grayscale.

Note: Since the Delta E values are calculated based on the currently selected Target, if a Target using ***Intensity: Specific Level*** *is being used, and the display was not able to actually achieve the Target's specified Intensity value, then this will result in large Delta E values.*

Delta E

Average - shows the average of all the calculated Delta E values.

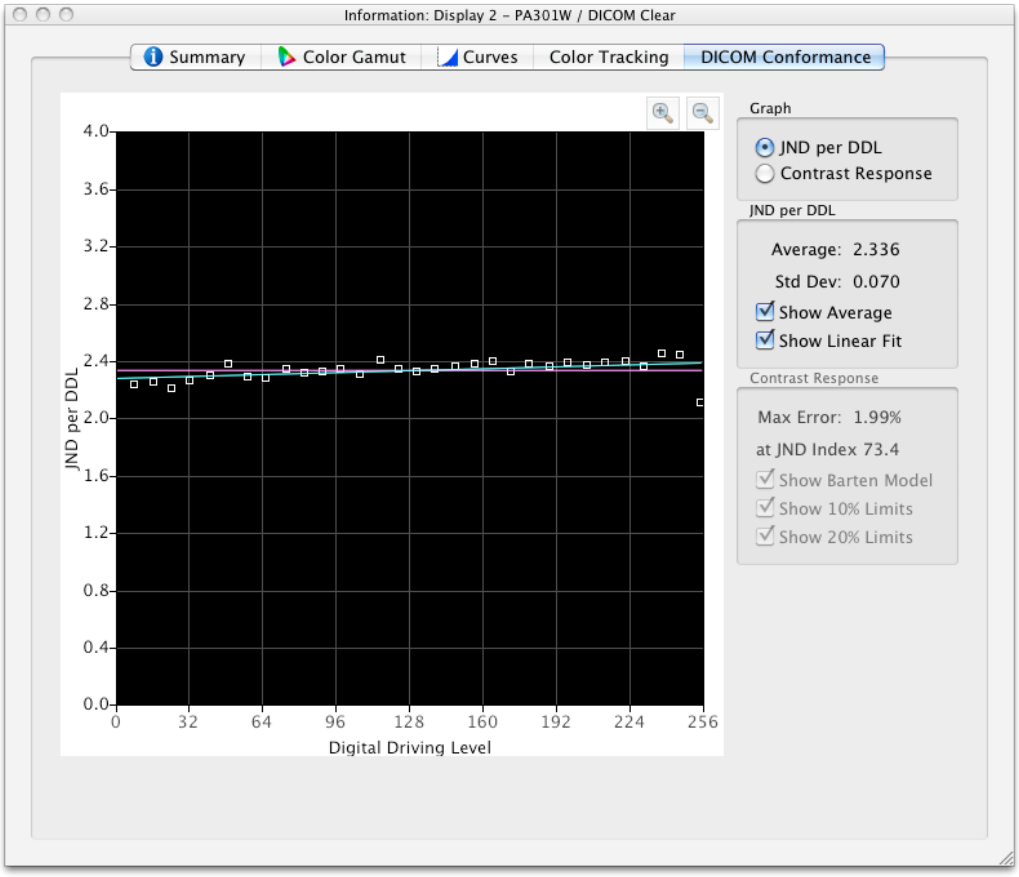
Maximum - shows the maximum of all the calculated Delta E values.

Include Dark Values - selects if the graph and average Delta E value calculation include measurements taken near absolute black (having a luminance of less than 5 cd/m²) on the display. Typically these values are not included since the low luminance can cause measurement errors that may cause artificially high

Delta E values to be shown. Selecting this option will cause all measured values to be included.

Show Average - shows the average Delta E value as a vertical line on the graph display.

Information window - DICOM Conformance tab



The ***DICOM Conformance*** tab shows graphically and numerically how well the calibrated display conforms to the ideal DICOM (Digital Imaging and Communications in Medicine) response when a DICOM Target curve of is used.

The aim of the DICOM response is to have a perceptually linear luminance response. Each step along the display's grayscale should have an equally perceptive increase in luminance. The actual shape of the DICOM response curve is based on the display's measured Black Level and Intensity, since the DICOM response considers the human eye's non-linear response to light.

In DICOM terminology, the grayscale level is called the ***Digital Driving Level*** and represents the digital output video level, from 0 to 255. Each step in Digital Driving Level, should result in an equal step in perceived luminance. In DICOM terminology, a change in luminance that is just perceptible, is considered to be 1 ***JND (Just Noticeable Difference)***. So, ideally, each step in Digital Driving Level should result in an equal change in Just Noticeable Difference value. The JND values are calculated using a complex formula from two measured luminance values.

The display calibration results can be viewed in two different types of graphs, ***JND per DDL***, and ***Contrast Response***, by selecting the corresponding graph type.

JND per DDL (Just Noticeable Difference per Digital Driving Level)

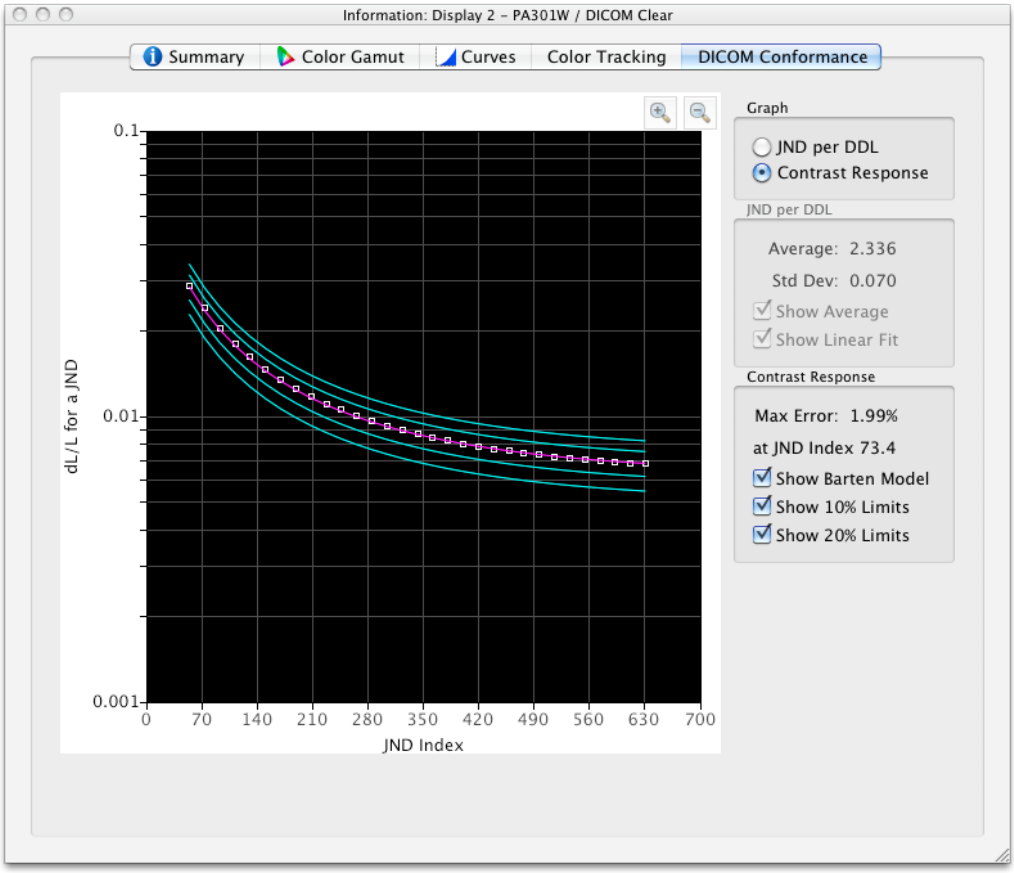
Average - shows the average JND per DDL value. The actual value will depend on the Black Level and

Intensity of the display.

Std Dev - shows the standard deviation of all of the calculated JND per DDL values.

Show Average - shows the average JND per DDL value as a horizontal line on the graph.

Show Linear Fit - shows the best fit line between all the calculated JND per DDL values as a line on the graph. Ideally this line should be horizontal, indicating equal steps in JDN per DDL along the display's grayscale.



Contrast Response

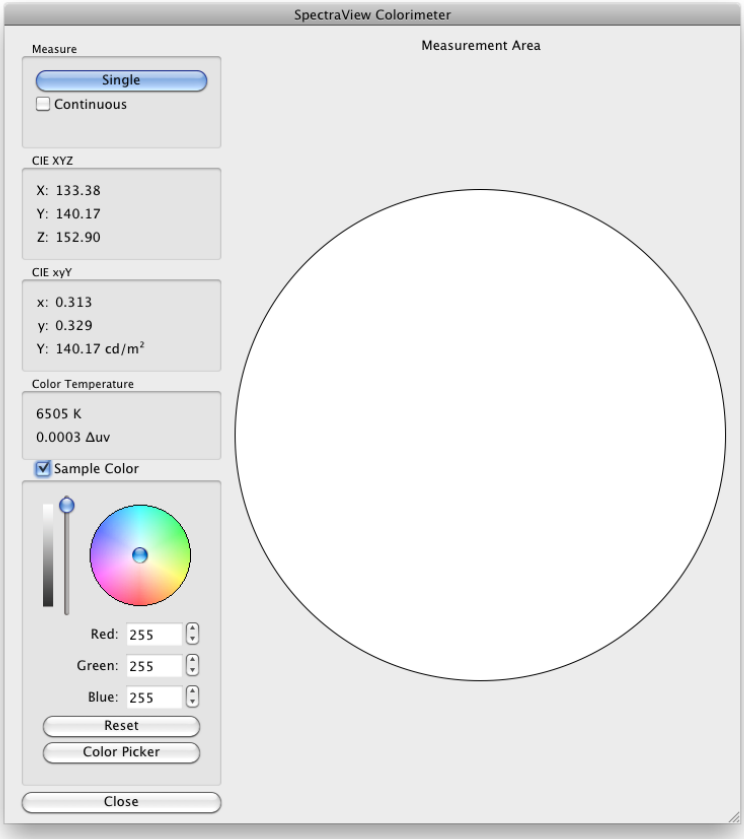
Max error - shows the highest percentage error deviation from the Barten Model curve, as well as the JND Index of the highest error point.

Show Barten Model - shows the Barten Model curve on the graph. The Barten Model curve is calculated based on the measured Intensity (white luminance) and black level values.

Show 10% Limits - shows two lines representing 10% error deviations from the Barten Model curve. Medical displays used for Primary Class image viewing should be within the 10% deviation curves.

Show 20% Limits - shows two lines representing 20% error deviations from the Barten Model curve. Medical displays used for Secondary Class image viewing should be within the 20% deviation curves.

Colorimeter window



The ***Colorimeter*** tool allows measurements of colors displayed on the screen to be taken with the calibration sensor, and is accessed from the ***Tools*** menu. The measurement results are displayed in a variety of useful formats.

To take color measurements using the Colorimeter, place the calibration sensor to the screen so that it is centered on the large white area in the Colorimeter window.

Measure:

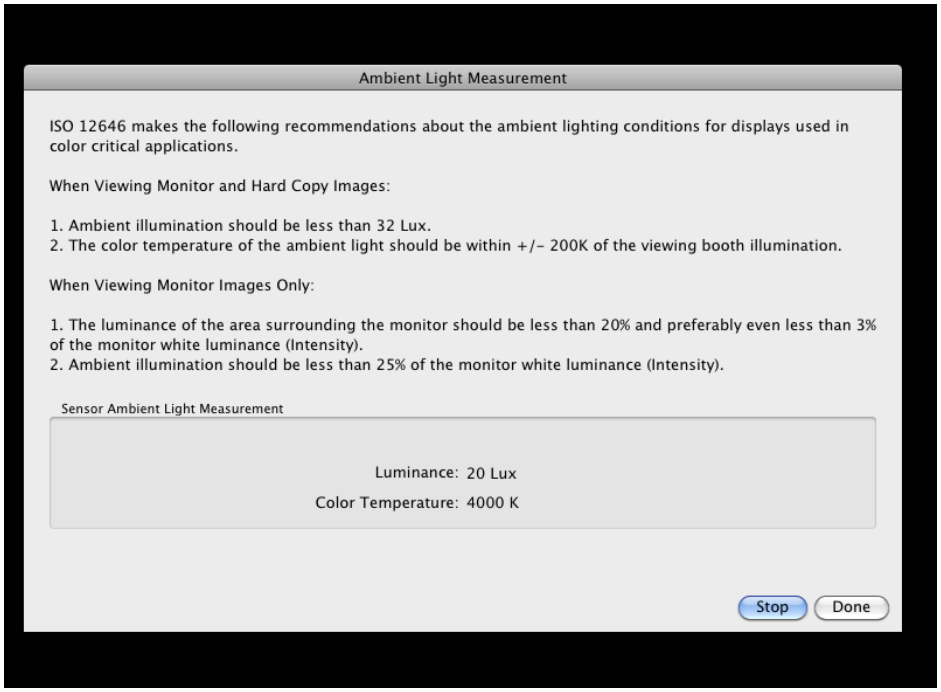
- ***Single -*** clicking this button will take a single color measurement and display the results.
- ***Continuous -*** selecting this will take repeated measurements automatically and display the results.

The ***CIE XYZ*** and ***xyY*** fields show the calibration sensor's measurements translated into each of the respective color spaces. These color spaces are device independent color spaces, which means that they are not relative to any specific device, as opposed to dependent color spaces, such as RGB, which is relative to the device that is displaying the color.

The ***Color Temp*** field shows the corresponding correlated black body radiator temperature of the measurement in ***Kelvin***. The ***Δuv*** (Delta-uv) value indicates how far the measurement is from the black body radiator locus. The Kelvin value is only meaningful for colors that are near the black body radiator locus, such as most shades of white.

Sample Color: By selecting this group a custom color can be shown in the measurement area. To interactively adjust the color, click and drag within the color circle or use the arrow keys. Use the vertical slider control to adjust the Intensity. Specific Red, Green and Blue values can also be entered.

Ambient Light Measurement window



The ***Ambient Light Measurement*** tool allows measurements to be taken of the ambient light of the viewing environment around the display monitor. This feature is only available when using a supported color sensor.

Currently supported color sensors are:

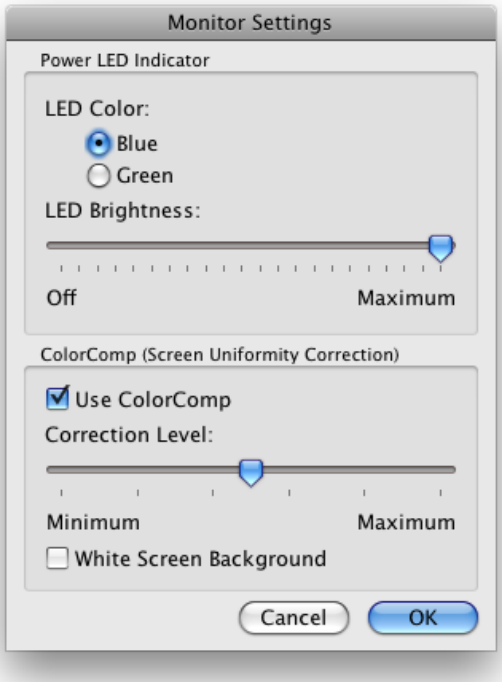
- **X-Rite/GretagMacbeth Eye-One Display V2**
- **X-Rite/GretagMacbeth Eye-One Pro**
- **X-Rite iOne Pro2**
- **X-Rite iOneDisplay Pro / NEC SpectraSensor Pro**
- **X-Rite ColorMunki**
- **Datacolor Spyder3 and Spyder4**
- **BasICColor Discus**

These measurements are useful in determining the optimal viewing conditions for the area surrounding the display monitor. Ideally the ambient light level and color temperature should not influence the viewing of images on the display screen.

Follow the instructions on-screen for configuring the color sensor for Ambient Light measurement mode. Measurements are taken every few seconds and updated on the display as both a Luminance value and approximate color temperature value.

Note: The Datacolor Spyder3 and Spyder4 ambient light sensor measures luminance only and not color temperature.

Monitor Settings window



The ***Monitor Settings*** window provides access to some of the display monitor control settings, if supported by the display.

The Power LED Indicator controls can be used to change the color of the LED, and also adjust the brightness. The brightness can be reduced as necessary in dim environments if the LED is distracting.

The ColorComp control adjusts the screen uniformity correction applied to the display in order to improve the screen luminance and color uniformity. This compensation is done at the expense of some screen brightness. A higher level of correction will give a more uniform screen, but the maximum Intensity (brightness) that can be achieved will be lower.

It is recommended to recalibrate if the ColorComp setting is changed.

Menus

File menu

Open Target... - opens a Target file. This is the same as clicking the ***Target Settings: Open*** button.

Save Target As... - saves the current Target Settings to a file. This is the same as clicking the ***Target Settings: Save*** button.

Calibrate... - starts the display monitor calibration routine for the currently selected display using the currently selected Target Settings. This is the same as clicking the Calibrate button.

Generate ICC Profile... - starts the process of creating an ICC/ColorSync monitor profile for the currently selected display in its current state without calibrating.

Validate Calibration... - measures the current state of the display monitor and compares to the currently selected Target in order to quickly determine if the current calibration is still accurate, or if the display should be recalibrated.

Open previous calibration.. - Opens a previous Monitor Calibration Settings file. This is the same as clicking the ***Calibration: Open*** button.

Edit menu

Preferences... - opens the ***Preferences*** dialog. (Mac shown on the Application menu on Mac OS)

Display Configuration... - (Windows only) opens the ***Display Configuration*** dialog. This is the same as clicking the ***Display: Configure*** button.

Target... - opens the ***Edit Calibration Target*** dialog.

Tools menu

Information Window... - opens the ***Information*** window.

Colorimeter Window... - opens the ***Colorimeter*** window.

Test Pattern - displays a variety of test patterns on the screen that can be used to evaluate the status of the monitor calibration and performance. Click the left and right arrow buttons to select different test patterns, or use the ***[*** and ***]*** keyboard keys. Select this menu again to turn off the test pattern, or click the X button.

Ambient Light Measurement... - opens the ***Ambient Light Measurement*** window and is used to measure the ambient light of the viewing environment around the display monitor. This feature is only available when using sensors that support this measuring ambient light.

Monitor Settings... - opens the ***Monitor Settings*** window and is used to access some settings on the display monitor.

6 Axis Color Trim... - opens the ***6 Axis Color Trim*** window and is only available when using MultiSync PA and P241W models. See the *Using 6 Axis Color Trim* chapter for more information on using this feature.

Help menu

About... - displays the ***About*** dialog box which shows the software version number. (Mac shown on the Application menu on Mac OS)

Check for updates... - contacts the NEC Display Solutions website and checks to see if a newer version of

SpectraView is available. If a newer version is available, information about the version and download links will be shown. An Internet connection is required for this feature to operate.

Diagnostics... - runs a series of tests and collects various operating parameters that are useful in diagnosing problems. If requested by NEC support personnel, please run these diagnostics and save the resulting report file and sent it back to NEC to assist with any troubleshooting.

3 Calibration Overview

Introduction to display monitor calibration

Computer display monitors display images by giving off light from the screen. On LCD display monitors, light is emitted from a backlight source such as fluorescent lamps or array of LEDs (Light Emitting Diodes) and passes through individual red, green and blue filters for each pixel on the screen.

Combining red, green, and blue light, known as additive primary colors, creates the color that appears as an image on the screen. Different colors are displayed by varying the relative brightness of the three additive primary colors. The range of colors that can be represented on a display is known as the color gamut.

Printers create images by applying inks or dyes known as colorants to paper. These colorants absorb or subtract light of certain wavelengths, stopping it from being reflected. Cyan, magenta, and yellow colorants, known as subtractive primary colors, are used to create color prints. Each colorant absorbs light of its color complement. For example, magenta ink absorbs green light, while cyan ink absorbs red light, and yellow ink absorbs blue light. Sometimes an additional black colorant is used to improve the overall color gamut possible with a printer.

It is because of these fundamental differences between displaying an image on a computer display monitor and printed media that a Color Management System such as Apple ColorSync or Microsoft Image Color Management and a color calibrated display monitor are necessary. The Color Management System ensures that what is displayed on a monitor, is representative of what will be printed.

In order to accurately view and exchange images with others with confidence that the images look identical when displayed on different systems and at different locations, the display monitors used should be calibrated to a known state. The Color Management System being used must also know the current state of the monitor so that it can determine how to accurately display images on that particular monitor.

Once the display has been calibrated and the Color Management System knows the color characteristics (via the use of the ICC/ColorSync monitor profile), the display can be used to preview or soft proof what images will look like when printed. In order to do this, the Color Management System must also know the color printing characteristics of the printer being used. This is usually done by an ICC printer profile or Printer Color Separation Tables supplied by either the printer manufacturer or a third party. Various desktop publishing and image editing software packages, such as Adobe Photoshop, have CMYK preview modes to soft proof images.

It is important to be aware of the limitations of soft proofing. Many factors will limit the accuracy to which prints will match what is displayed on the screen. The accuracy of the printer profile or color separation tables as well as the type of inks and paper used all affect how accurate the final prints will be. The lighting conditions used when viewing the final print is also absolutely critical and the use of a calibrated lightbox is highly recommended. Be aware that it is almost impossible to get an absolute perfect match under all conditions on any color management system or display.

Before calibrating the SpectraView display, the desired color characteristics of the calibrated monitor must be selected. In SpectraView, these characteristics are called Targets. SpectraView then adjusts the monitor to the color characteristics in the selected Target. Once the calibration is complete, SpectraView can then re-measure the display and create an ICC/ColorSync profile of the monitor, which contains information used by the Color Management System to retain the various color characteristics of the calibrated monitor. The calibration target used will depend on the application.

SpectraView includes several industry standard targets for a variety of applications:

Target Name	Application	White Point CIE (x,y)	Tone Response Curve (Gamma)	Color Gamut
Print Standard	Commonly referred to as Proofing Standard. Used widely for the proofing of color transparencies or press output.	D50 (0.346, 0.359)	1.8	Native (Full)
Photo Editing	Used for editing and previewing images in a controlled lighting environment. An Intensity of 140 candelas (cd/m²) is used.	D65 (0.313, 0.329)	2.2	Native (Full)
Broadcast Video	Used for editing images and video intended to be displayed on televisions using the NTSC, PAL, or SECAM standards.	D65 (0.313, 0.329)	2.2	SMPTE-C
sRGB Emulation	Digital images, printing and the Internet	D65 (0.313, 0.329)	2.2	sRGB
DICOM Blue	Medical Imaging using blue-base film.	(0.265, 0.320)	DICOM Curve	Native (Full)
DICOM White	Medical Imaging.	(0.292, 0.321)	DICOM Curve	Native (Full)
Digital Cinema	Images and video intended for cinematic projection.	(0.314, 0.351)	2.6	DCI

Note 1:

- *Color Gamuts other than **Native (Full)** and **sRGB** are only available on the MultiSync PA series displays. When used on other display models that do not support color gamut control the Color Gamut setting will be ignored.*

*Note 2: When using the **sRGB Emulation** target*

- *This is a special target that is only available when using a supported wide color gamut display. This target will switch the display into the sRGB Emulation mode which reduces the color gamut to approximate that of sRGB.*
- *The Factory Preset white point is used on the following models: LCD2690WUXi, LCD3090WQXi and P221W. It is not possible to adjust the white point of the sRGB Emulation mode on these models. The calibration will only adjust the Intensity and generate an ICC/ColorSync profile of the display on these models. The resulting Delta-E values may be higher than normal because the white point is not adjusted using the calibration sensor.*
- *The range of Intensity values that the display can be calibrated to using the sRGB Emulation target is limited on the LCD2690WUXi. It may not be possible to achieve low Intensity values (below roughly 120-150 cd/m²).*
- *The P241W, PA231W, PA241W, PA271W, PA301W, and LCD2690WUXi2 will adjust the white point as well as the Intensity.*

Note 3: When using the Broadcast Video target with MultiSync PA series displays

- *This target preset uses the SMPTE-C color gamut primaries typically used for NTSC video.*
- *For applications using HDTV, the color gamut can be modified to use the sRGB preset color gamut which is the same as ITU-R BT.709.*
- *For applications using PAL or SECAM, the color gamut can be modified to use the EBU/ITU (PAL/SECAM) preset color gamut.*

About Targets

SpectraView can also create custom Targets, which can then be exchanged with other SpectraView display users, providing identical calibrated displays.

A Target consists of up to six specifications that describe the color characteristics of the display:

- **Gamma or Tone Response Curve (TRC)**
- **White Point**
- **Intensity**
- **Contrast Ratio**
- **Color Gamut**
- **6 Axis Color Trim**

Gamma and Tone Response Curves (TRC)

The Gamma or Tone Response Curve of a display is the relationship between the video input signal level and the light output ("brightness") displayed on the monitor. The display monitor is a nonlinear display device. In simple terms, this means that doubling the level of the video input signal to the display does not double the light output. For CRT based displays, the light output follows a mathematical power function of the input video signal. This power function has an exponent called gamma, which is commonly used to describe the relationship between the video input signal and light output of the screen.

A gamma value of 1 would result in a perfectly linear display (doubling the signal level doubles the light output) and the Tone Response Curves would be straight lines. The particular Tone Response Curves of a display will change with the display color settings and may vary from one display to the next. If accurate color matching is to be performed, the display's Tone Response Curves must be accurately measured and compensated for. SpectraView uses the color sensor to automatically measure the Tone Response Curves of the display.

Note: If you are unsure what gamma value to use for a Target, try 2.2 which is the most popular on Windows, and on Macs for most applications. A value of 1.8 is popular for some printing applications on Macs.

Normally, a standard Gamma value is required when working with images. For example, the sRGB standard color space target specifies a display Gamma value of 2.2. Since the Gamma value of the display may be different than the required Gamma value, a correction needs to be applied so that the apparent display Gamma matches that of the required Target. In SpectraView, this correction is applied to the LUTs (Look Up Tables) inside the monitor. SpectraView also uses the monitor's LUTs for targets that have Tone Response Curves which do not follow a normal Gamma curve. An example is DICOM, which uses a curve that changes shape based on how bright the display is.

White Point

The White Point specifies the color of pure "white" on a display. Since there is no unique perceptual or physical definition of what "white" is, it must be defined in terms of a standard or device-independent color space to be measured and reproduced.

There are several methods of specifying a white point, including using a blackbody radiator color temperature or as a location in a device-independent color space. SpectraView allows the white point to be specified either as a black body radiator color temperature in Kelvin, as a CIE standard illuminant, or as CIE xy chromaticity coordinates.

A White Point expressed as a black body radiator color temperature in Kelvin represents the light given off by an object, known as a blackbody, as it is heated to a given temperature. Low color temperatures, such as 5000K, are reddish, while higher color temperatures, such as 9300K, are bluish. A color temperature of 6500K is considered to be "neutral" white.

A CIE Standard Illuminant is a defined white color based on a known light source. In SpectraView the D or Daylight

Illuminant series can be used to specify a white point. Daylight Illuminants are named according to their corresponding correlated color temperature. For example, D50 is very close in color to a 5000K blackbody radiator.

Intensity

Intensity specifies the luminance or "brightness" of white when displayed on the screen. The maximum Intensity value of the display will depend on the color temperature of the White Point selected, the type of monitor and its age.

The choice of Intensity value will depend on the application and viewing environment. If the display is being used in a very bright environment and there is no visual reference (such as a proof in a lightbox), then the Intensity generally can be selected to the maximum possible setting.

However if the display is being used in controlled lighting environment and there is a visual reference being used, then normally a lower specific Intensity value is used. Using a specific value will allow the display to be calibrated to the same value each time, provided it is within the capable range of the display.

Contrast Ratio

The Contrast Ratio of the display is the ratio of the measured Intensity to the measured Black Level. The Black Level is the luminance or "brightness" of black when displayed on the screen. For LCD monitors the minimum or *native* Black Level is typically fixed in ratio to the Intensity value due to the display technology.

SpectraView allows the Contrast Ratio to be selected for applications that require a specific contrast ratio. However the calibrated contrast ratio can not be higher than the native contrast ratio, since the minimum Black Level that the display can achieve is limited by the display technology.

For most applications the highest possible Contrast Ratio is most suitable and can be achieved by selecting ***Monitor Default*** as the ***Contrast Ratio***.

Specific Contrast Ratios in the range 50:1 to 500:1 can be selected.

Note: If the selected contrast ratio is higher than what the display is actually capable of achieving, then the display will calibrate to the highest possible contrast ratio. For example if you select 500:1, but the display only capable of say 320:1 with the current Target settings, then the resulting calibration will have a contrast ratio of 320:1.

Color Gamut

The color gamut is the range of colors that can be displayed by the monitor. The color gamut of a monitor is defined and bounded by the red, green and blue primaries which together make up all other colors.

Depending on the display model being used, the Color Gamut can be fully customized for specialized applications. See the ***Color Gamut*** section for more information on selecting and configuring the Color Gamut.

The choice of Color Gamut will depend on the applications and operating system being used.

Typically if a color managed application is being used, then the Native (Full) color gamut should be used since this will allow the application to make full use of the color capabilities of the display. This applies even if the image, document, etc. is intended for another color gamut such as sRGB or AdobeRGB. The color gamut should not normally be set to that of the color workspace of the application, if it is color managed. Likewise the color workspace should not normally be set to the color gamut of the display.

For non-color managed applications a specific color gamut such as sRGB can be selected to make the display appear as if it has such a color gamut. In this case, all of the necessary color conversions are done automatically within the display.

6 Axis Color Trim

The 6 Axis Color Trim is an advanced feature that allows screen colors to be adjusted after the display has been calibrated. The color adjustments only impact a specific range of colors, and each range can be adjusted in Hue, Saturation, and Offset (Brightness).

This feature is only available with the MultiSync PA series and P241 models.

See the *Using 6 Axis Color Trim* chapter for more information on using this feature.

4 Using SpectraView

Launching

(Mac OS)

Double click the ***SpectraView II*** application icon in the ***Applications*** folder.

(Windows)

Select ***SpectraView II*** from the ***NEC Display Solutions*** program group on the Windows ***Start*** menu.

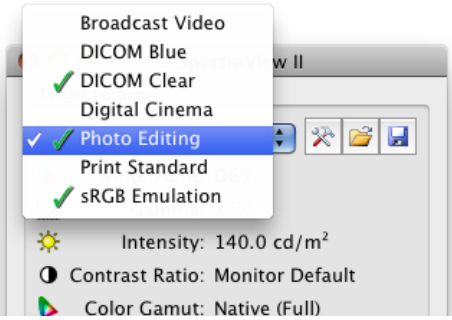
As SpectraView launches, it will automatically search for any supported displays, and a supported color sensor.

If SpectraView is unable to detect either a supported display or the last selected color sensor, an error message will be displayed and the Calibrate button will be disabled. Refer to the ***Troubleshooting*** section of this manual.

Selecting a calibration Target

A ***Target*** specifies the color characteristics of the display for the calibration process. A Target can be either predefined, or custom defined.

Existing Targets can be selected in the main SpectraView II window from the ***Target*** listbox.



Selecting a Target will automatically configure the White Point, Tone Response Curves, Intensity and Black Level (if applicable).

The choice of Target depends on the particular application and viewing conditions such as the ambient light level.

Modifying Targets

The parameters of Targets can be modified using the ***Edit Target*** button which will display the ***Edit Target*** dialog. Note that modifying a Target will require the display monitor to be recalibrated to the new Target parameters.

Calibrating and Profiling the Display

If more than one supported display monitor is connected, select the display to be calibrated from the ***Display*** listbox. Note that each display has an independent Target.

Click the ***Calibrate*** button to start the calibration process. The software will provide instructions for placing the calibration sensor on the screen and provide updates as the calibration progresses.

Once the calibration process has been completed, an ICC/ColorSync profile will be generated if the ***Generate profile after calibration*** option in the ***Preferences*** dialog is selected. The profile will automatically be associated with the system's Color Management System.

The results of the calibration process will then be displayed in the ***Information*** window.

It is also good practice to use the Test Patterns to quickly visually verify the integrity of the calibration.

Profiling the Display

An ICC/ColorSync monitor profile of the display can be generated without calibrating the display by selecting ***Generate ICC Profile..*** from the ***File*** menu. Non-SpectraView displays can be profiled but not calibrated by SpectraView.

Validating the current Calibration

The current state of the display monitor can be measured and compared to the currently selected Target in order to quickly determine if the current calibration is still accurate, or if the display should be recalibrated. A series of measurements will be taken on the display and a brief report will be shown of the results. The Information window will also be updated with a more detailed analysis of the results.

Note: Several factors can influence the results of the validation process and a Delta-E values of 3-5 do not always indicate that the display needs to be recalibrated. Even very slight differences in the positioning of the sensor from when it was calibrated, and the length of time the monitor has been powered on, and the basic measurement repeatability accuracy of the sensor itself, all impact the results. Also keep in mind that the Delta-E value is comprised of the luminance and color difference. Differences in color are much more critical than a difference in relative luminance.

5 Outside of SpectraView

Using ICC/ColorSync Monitor Profiles

The ICC/ColorSync monitor profiles generated by SpectraView are used to inform the Color Management System of the color characteristics of the display monitor.

Color Management Systems use this information to determine how to display images on-screen. Depending on the image editing software package being used, profiles for printers and scanners can also be utilized to create accurate image prints and scans.

The exact method of loading ICC monitor profiles into the Color Management System will depend on the software application being used. Most software applications rely on the operating system (Mac OS or Microsoft Windows) to provide the current profile information. However some applications may have a color management setup where the display monitor profile can be selected.

SpectraView will automatically select and associate the generated ICC/ColorSync monitor profiles with the system's Color Management System.

Refer to the instructions for the particular software package being used to determine how to correctly load and use the ICC/ColorSync monitor profiles generated by SpectraView.

Adobe Photoshop Overview

When combined with accurate printer profiles, Photoshop can perform accurate CMYK previews or *soft proofs* of what an image will look like when printed.

The hardware based calibration of the SpectraView display monitor will provide superior results compared to the basic visual calibration offered by the Photoshop or ColorSync Control Panels.

Note that it is not necessary to perform any of the monitor settings in the Adobe Gamma Control Panel since all of the necessary monitor calibration and measurements will be done by SpectraView.

In Photoshop, images are manipulated in what is known as an image color workspace. This color workspace is independent of the display monitor color characteristics, allowing images to be transferred between systems with different monitor settings without loosing any color information or restricting the color gamut of the image. Photoshop will convert colors on the fly when it displays the image on the SpectraView monitor, so the colors you see accurately reflect the file's working color space.

The selection of an RGB color workspace will depend on the application. For details of the standard color workspaces included in Photoshop, consult the online help in Photoshop. Note that typically the color workspace will be different to that of the display monitor. Do not attempt to load the ICC/ColorSync monitor profile as the color workspace in Photoshop.

When editing an image in CMYK format, Photoshop uses the monitor color characteristics to perform the CMYK-to-RGB conversion necessary to display the image accurately on the display monitor, which uses a RGB device dependent color space.

When editing or viewing an image in RGB format, Photoshop also uses the display monitor color characteristics, together with a set of printer separation tables or printer ICC/ColorSync profile to perform the RGB-to-CMYK conversion necessary to preview or soft proof a print the image. Printer separation tables are usually provided by the printer manufacturer or other third party, or can be generated using a 3rd party printer profiling application.

6 Frequently Asked Questions

Calibration

Question 1: How often do I need to calibrate my monitor?

Answer: The answer will depend on how critical a color accuracy is necessary, how long the monitor is used per day, environmental conditions and the characteristics of each individual monitor. Some users working in highly critical color applications may calibrate their displays every couple of days. Others may only need to do it once a month. The recommended and default re-calibration period is every 2 weeks. The ***Validate Calibration*** feature can always be used to verify the display's white point and Intensity and determine if the monitor needs to be re-calibrated. Always remember to allow the monitor sufficient time to warm up and reach optimum color performance before performing any color critical work or calibrating the display.

Question: (Mac Mac OS only) Why can't I use the ColorSync control panel to switch between different display calibrations like I can do with other monitors?

Answer: When used with the SpectraView software, NEC display monitors store all of the necessary color adjustments internally, including the 10 or 12 bit Look Up Tables. The ColorSync utility switches the display color settings by changing the Look Up Tables in the video graphics adapter. The ColorSync profiles generated by SpectraView contain linear Look Up Tables for the video graphics adapter. Therefore the SpectraView software must be used to update the display monitor.

Question 2: (Mac Mac OS only) I'm using a wide color gamut display together with the standard gamut screen on my MacBook. Colors in Safari look oversaturated when the window is on the wide gamut display. What is wrong?

Answer: The color management in Safari and some other Mac applications will only apply color correction for the primary display (the display with the menu bar). When a window is moved to the secondary display, the correct color correction for that display is not applied. This causes the images to be oversaturated on the secondary display. To display colors correctly on the wide color gamut display it must be made the primary display. Use the Mac OS System Preferences - Displays to configure the display as the primary.

Question 3: I'm using two different displays and calibrating both to the same target, however the white points do not match exactly. What can I do to improve this?

Answer: This issue can be caused by the different spectral outputs of the two displays causing the human eye to see color differences differently than the color sensor used to calibrate the displays. In this case the numerical measurements from the color sensor are identical on both displays, but they do not visually match. Manually visually matching one display to another can usually avoid this issue. The basic steps to take are as follows:

1. Calibrate both displays.

2. Pick one of the displays to be a reference. Call this display #1.

3. Select display #2 in SpectraView, open the Edit Calibration Target dialog then open the Custom White Point dialog by clicking on the Edit... button. Use the Visual Match tool to adjust the white color so it visually matches white shown on display #1.

4. When a visual match is achieved, put the sensor over the measurement area and click Measure. This will enter the value that the sensor perceives into the White Point. Save this as a new Target.

5. Recalibrate display #2 with this new Target. From now on always use the respective Target to calibrate each display.

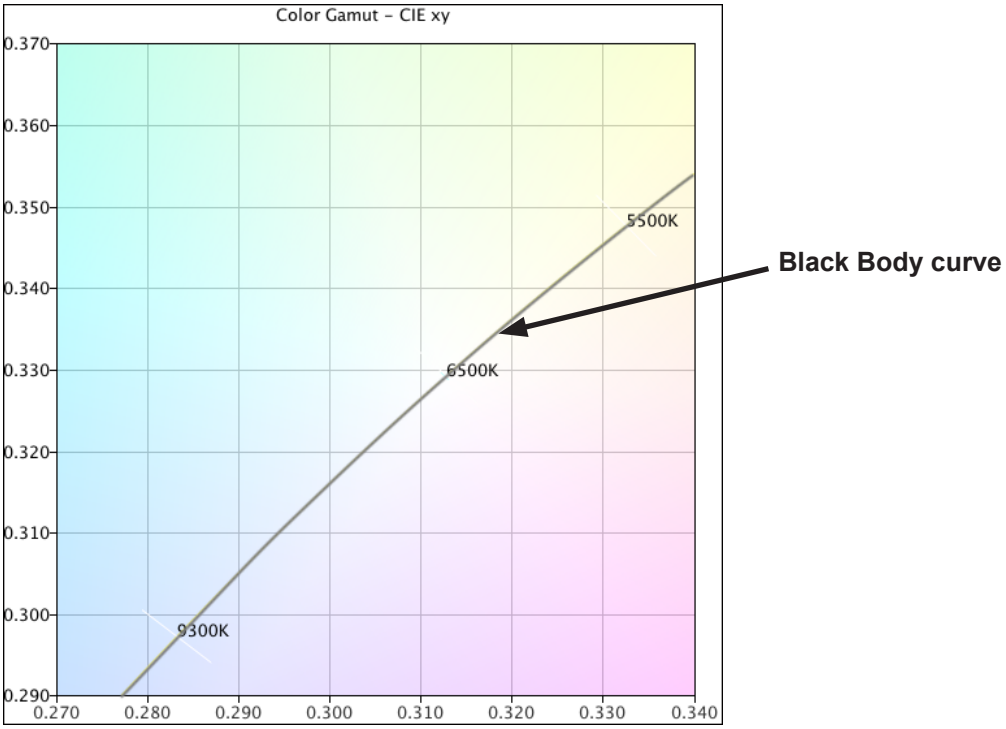
Question 4: I'm trying to match my display to my prints in order to soft proof, however after calibrating using a standard Target white point such as D65 or D50, the screen still appears too pink/magenta/green compared to the print. What can I do to make them match?

Answer: Depending on many factors such as the lighting conditions used to view the prints, paper type, and the printer profiles used for the soft proofing, the display white point may not visually match that of the paper. It is important to remember that the preset white points such as D65 are not magic numbers that must be used regardless. The calibration Target white point can be adjusted as necessary in this scenario. This is especially true if a standard viewing environment such as a light box is not being used to view the prints.

Adjusting the white point using a Kelvin or Daylight value alone is adjusting the white point along the fixed Black Body curve as viewed on a CIE xy diagram, and can vary the white point from *cool* to *warm*.

However, the color cast between the print and display may be at right angles to this curve, so in this case no Kelvin value will be able to fully compensate. A white point that lies off the standard Black Body curve can be entered by specifying it in terms of CIE xy instead of as a Kelvin or Daylight value.

To get an idea of how CIE xy values relate to the actual White Point color, try zooming in on the Color Gamut diagram on the Information window. In the example below, the Black Body curve is shown. If for example the display appears to be too green, then the white point should be moved slightly towards the lower right - this corresponds to increasing the CIE x value, and decreasing the y value slightly. Modify the Target White Point values by making small adjustment (for example increments of +/-0.003) and recalibrate the display. Several iterations may be required to find the best values. In addition to this method, the Visual Match tool described in the previous answer can be used to interactively find a visual match between the print and display.



Question 5: Each time I calibrate my monitor I receive a different Delta-E result. Should I recalibrate again if I receive a value that is high?

Answer: For Delta-E values of less than 2 there is almost certainly no need to recalibrate. For values higher than 3 it is important to understand what the cause is, and if it is significant.

The calibration and adjustment process has inherent variability due to many factors such as the repeatability of color sensor measurements, and changes within the display as it is adjusted. The basic accuracy and repeatability specifications for most sensors is typically +/- 0.002 or higher for CIE xy, and +/- 2% for luminance. These variances alone can give rise to Delta-E values of up to 2 or 3.

When a specific Intensity value is being used for the calibration, the Delta-E value is comprised of the luminance and color differences. Differences in color are much more critical than a difference in relative luminance. Look at the results of the calibration shown in the Information window to determine if the high Delta-E value is caused mainly by a shift in color or in luminance.

High Delta-E values can also occur if a specific Intensity value is being used for the calibration and the display is not capable of achieving the specified Intensity value. The calibration will always aim to achieve the specified White Point, even if the Intensity value could not be reached. If the display can not be calibrated to achieve the specified Intensity value modify the value accordingly.

In some situations, the display Intensity will drift slightly for several minutes after it is adjusted. Since the measured value used to calculate the final Delta-E result is taken up to one or two minutes after the display was adjusted, a higher Delta-E value may be shown, even though the calibration process achieved the specified Target values during the calibration process. Selecting the *Extended luminance stabilization time* option in the *Preferences* can be used to try and minimize this effect.

Question 6: The Delta-E result values shown in SpectraView are higher than those shown in other display calibration applications. Does that mean they are better at calibrating the display than SpectraView?

Answer: No. SpectraView calculates the Delta-E values using both the luminance and color differences for more realistic and accurate values. Other applications may calculate Delta-E differently.

Question 7: After calibration I manually adjusted some of the monitor controls to get a better color match for my particular application. What happens the next time I calibrate the monitor?

Answer: The manual adjustments will be reset by the calibration process.

In general it is not a good idea to manually adjust the monitor after calibration because it not only invalidates the calibration and ICC/ColorSync profile, but also means that the adjustments will be lost the next time the monitor is calibrated.

If you still feel it is necessary to *tweak* the display after calibration, a much better approach is to create a new Target file based from the measurements of the display after it has been manually adjusted. That way the monitor will be automatically calibrated to that particular set of characteristics the next time it is calibrated. Use the Custom White Point tool to measure and set the white point and Intensity values.

7 Troubleshooting

Installation and Setup

Problem: Calibrate button is disabled.

Solution: The calibrate button is disabled for either of the following reasons:

- No supported calibration sensor was detected.
- No supported display monitor was detected.

See the following sections for further explanations.

Problem: No supported monitor was detected.

Solution:

- Verify that the display monitor connected is a model supported by this version of SpectraView II. Check if a newer version of the software is available from NEC.
- If more than one video output is present on the computer, try connecting to the other output connector.
- Always use a DVI or DisplayPort video output if possible.
- Connect a USB cable between display to the host PC (MultiSync PA Series only) and restart SpectraView.

Mac OS:

- See the README file included with the software for further information about any specific incompatibilities or issues. Note that some Macs require at least OS 10.5.2 in order support the functionality necessary with SpectraView.

Windows:

- Some video graphics adapter cards may not support the necessary functions for SpectraView to communicate with the display monitor. For Windows systems, verify that the video graphics adapter is supported by SpectraView by checking the Windows Graphics Chipset Compatibility Information. See the README file included with the software for further information.
- Install the latest video drivers for the video graphics adapter card.
- Communications with the display monitor requires a special driver to be installed. This is installed and configured when SpectraView is installed, however any of the following changes may necessitate that SpectraView be re-installed to re-configure the driver:
    - Updating the video graphics adapter card driver.
    - Changing the monitor model
    - Changing the video port that the monitor is connected to.
- Check the display configuration by clicking the ***Display Configuration*** button. In the Display Configuration dialog, confirm that your model of display monitor is listed. If it is not listed, then there is a problem communicating with and detecting the display monitor. If it is listed, confirm that the monitor is associated with the correct Windows desktop display.

Problem: No supported calibration sensor was detected.

Solution:

- Try reconnecting the calibration sensor and click the ***Auto Detect*** button in the ***Preferences*** dialog to re-detect the sensor.
- It may be necessary to close and re-launch the SpectraView application.
- **(Windows)** It may be necessary to install the drivers for the color sensor device. Note that only the drivers for the X-Rite iOne devices are installed by the SpectraView setup application. Drivers for other devices must be installed manually.

Problem: Severe color banding appears after calibrating on images and when the test pattern is shown.

Solution:

- Always use a DVI video output if possible.
- If an analog video signal must be used perform the following steps once prior to calibration:

1. Display something on the screen that has both full black and full white, such as the Test Pattern in SpectraView.

2. On the monitor's On Screen Display, select and operate the ***AUTO CONTRAST*** control.

3. Proceed with the calibration.

Problem (Windows): The ICC profile generated by SpectraView does not appear to be correctly installed and recognized in Windows.

Solution:

- This problem may occur especially when using a multi-monitor configuration. In some cases updating the video driver may fix this issue.
- The profile can be manually assigned if necessary as follows:

1. In the Windows ***Display Properties*** control panel, select the ***Settings*** tab and click ***Advanced***.

2. Select the ***Color Management*** tab on the ***Display Properties*** dialog.

3. Find the color profile generated by SpectraView and use *Set As* ***Default***.

- A more advanced control panel is available from Microsoft for Windows XP which is much more reliable for checking the assigned monitor profile. On the www.microsoft.com website, search for "Color Control Panel Applet".

Problem (Windows): SpectraView is unable to save the generated ICC profile.

Solution: If SpectraView is unable to save the ICC profile for this reason it will prompt you with the name and location of the file that needs to be manually deleted in order to replace it with a new profile.

- This issue may occur if there are multiple users assigned to the machine. An ICC profile created by a user can normally only be updated and replaced by that user, or an administrator. Starting with Windows Vista, even if you are currently an Administrator, applications do not normally allow full administrative privileges by default.

You can either delete the current ICC profile manually (in which case Windows will ask for administrative level credentials or permissions), or you can re-run SpectraView "as Administrator" by right-clicking the

application icon and selecting “Run as administrator”. This process needs to be done once each time the user who created the last ICC profile for the display is changed.

- This issue may also occur if another application is currently using the ICC profile. For example if the Windows Advanced Display Settings control panel is open, the ICC profile may be locked. Be sure to close any applications that may be using the profile.

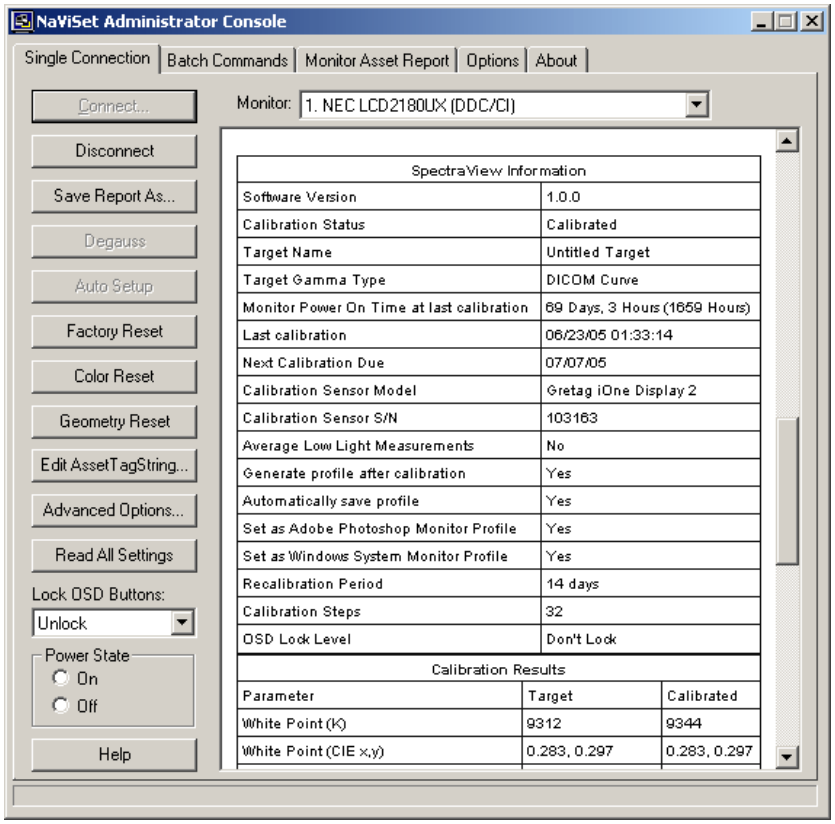
8 NaViSet Administrator

Using SpectraView with NaViSet Administrator (Windows version only)

The SpectraView II software integrates with the NEC DISPLAY SOLUTIONS ***NaViSet Administrator*** software to provide remote administration of the display monitors on networked machines. NaViSet Administrator will report all of the current SpectraView settings and the current calibration status within the ***NaViSet Administrator Console*** application.

When using the ***Single Connection*** feature of NaViSet Administrator to administer a remote machine, the SpectraView information will be shown in the ***monitor metadata report***.

When using the ***Monitor Asset Report*** feature to poll and gather information about the display monitors on multiple remote machines, the SpectraView information can be included in the ***Output Monitor Asset Report*** file by selecting the items to include in the report in the ***Configuration Wizard***.



Example metadata report showing the SpectraView settings using the Single Connection feature.

9 Test Pattern Guide

The SpectraView II software includes several test patterns that are useful in evaluating the monitor calibration. It is also good practice to use the Test Patterns to quickly visually verify the integrity of the calibration.

A pattern based on the DICOM TG18-GC test pattern has a number of useful features that allow very detailed analysis of the monitor grayscale performance in one pattern. The main features of this pattern are described below.

Line-pair patterns for resolution evaluation, having pixel values of 0-255 and 128-130.

256 level grayscale with 2 lines per level.

Grey background of pixel value 128.

Sixteen luminance patches with pixel values varying from 8 to 248 for luminance response evaluation. Each patch contains four small 10x10 pixel corner patches at ±4 of pixel value difference from the background, +4 in upper-left and lower-right, -4 in lower-left and upper-right. The small patches are used for visual assessment of luminance response.

"QUALITY CONTROL" characters with decreasing contrasts at minimum, mid-point, and maximum pixel values for simple low-contrast evaluation at three luminance levels.

Two patches of minimum and maximum pixel value with 13, and 242 pixel value internal patches, similar to 5% and 95% areas in the SMPTE test pattern.

Several other patterns are available in SpectraView and can be selected using the buttons at the top left of the screen, or using the [and] keys.

10 MultiSync PA Series Information

The SpectraView II software supports the MultiSync P241W, PA231W, PA241W, PA271W and PA301W monitors. These models feature a custom-designed color processor called the SpectraView Engine. This sophisticated processor, combined with internal luminance, temperature and time monitoring of the monitor, and individual characterization and calibration of each unit during production, results in an unparalleled level of color control, accuracy and stability.

When SpectraView II is used to calibrate these models:

- The 5th of the 5 selectable Picture Modes is always automatically selected and used to store the calibration made by SpectraView II.
- The Custom 3 memory location is always used to store the calibration. This location will be automatically named *SpectraViewII*.
- The Color Gamut of the display can be adjusted by configuring the Target and re-calibrating.
- The SpectraView II software can be used together with the NEC MultiProfiler software. When MultiProfiler is used with SpectraView II, the ICC/ColorSync profile generated by SpectraView will always be activated by MultiProfiler when the Picture Mode calibrated by SpectraView II is selected. For all other Picture Modes, the ICC/ColorSync profiles generated by MulitProfiler will be used.
- The number of *Calibration and Profile steps* (set in the Preferences) does not increase or decrease the accuracy of the grayscale calibration or ICC/ColorSync profile when calibrating the display. This is because the monitor's internal calibration is used.
- Communications with the display can be via either DDC/CI or USB. To use USB, connect a USB cable between the host PC and one of the USB inputs on the display. Make sure the correct USB input is selected on the OSD, or using the MultiProfiler application. On the Mac OS version of SpectraView II, the USB connection will automatically be used when detected. On the Windows version, the USB connection can be manually selected using the Display Configuration dialog.

The MultiProfiler software is available for free from NEC at www.necdisplay.com/multiprofiler.

11 Using 6 Axis Color Trim

The *6 Axis Color Trim* is an advanced feature that allows screen colors to be adjusted *after* the display has been calibrated. The color adjustments only impact a specific range of colors, and each range can be adjusted in Hue, Saturation, and Offset (Brightness). The color ranges that can be adjusted are the primary colors (red, green, and blue), and the secondary colors (yellow, cyan, and magenta).

This feature is intended as an expert level control and can be useful in situations when certain ranges of colors do not match exactly as expected. For example if the hue of yellows appear slightly off when evaluating a test print, the yellow hue can be adjusted slightly to improve the matching.

Note 1: Adjustments only impact saturated colors, and not the white point of the display, or any neutral colors.

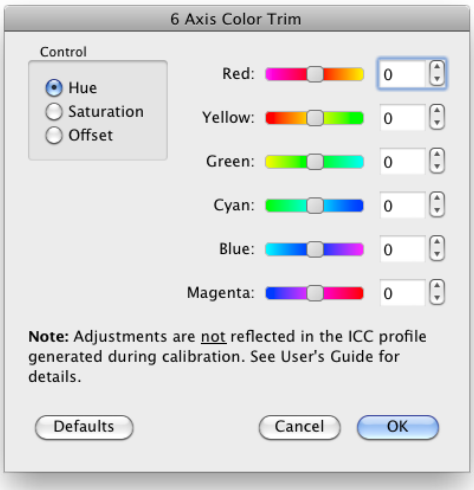
Note 2: Adjustments are intentionally applied *after* the display has been calibrated and the ICC/ColorSync profile has been generated, so any adjustments made using the 6 Axis Color Trim are not reflected in the ICC/ColorSync profile.

Note 3: This feature is only available with the MultiSync PA series and P241 models.

Note 4: This feature is not intended as a substitute for accurate output device ICC/ColorSync profiles. It should be used only to make minor adjustments when necessary.

The recommended workflow for using this feature is as follows:

1. First calibrate with no 6 Axis Color Trim applied.
2. Visually evaluate the screen image with whatever test image is being used. Be sure to use the *Proof Colors* or *Softproof* feature in the image editing application if available. Using a test image with a broad range of colors and saturations is recommended.
3. If necessary make any necessary adjustments in the 6 Axis Color Trim dialog.
4. Save the modified Target file.
5. Use this Target the next time the display is recalibrated. The same trim adjustments will automatically be applied.



Glossary

Achromatic – Neutral in color (having no hue).

Additive Primaries – Red, green, and blue light that when combined in different relative intensities produces different colors. (See also Subtractive Primaries)

Backlight – the internal light source for a Liquid Crystal Display, such as fluorescent lamps or array of LEDs (Light Emitting Diodes).

Black body – A hypothetical object that absorbs all incident radiation, thus any radiation (e.g. light) coming from a blackbody must be emitted from it and not reflected.

Blackbody Radiator Locus – The curved formed when the color of light radiated from a blackbody is plotted at different temperatures on a color space such as CIE xy.

Black Level – The luminance or "brightness" of black when displayed on the screen.

Calibration – The process of bringing a device such as a display monitor to an absolute standard to ensure consistency over time and with other similarly calibrated devices.

Candelas (cd) – An international unit of light intensity. Luminance can be described in units of Candelas per meter squared (cd/m^2) but is often referred to as just Candelas or Nits for sake of brevity.

CIE – The Commission Internationale d'Eclairage (International Commission on Illumination). An organization that sets many of the standards used in color and color measurement.

CIE Lab – A color space that is relative to a reference white point. The L value represents lightness, a represents Red/Green and b represents Yellow/Blue. Lab is almost perceptually uniform in that differences between colors expressed in Lab correlate to equally perceived color differences.

CIE uv chromaticity coordinates – Coordinates in the CIE uv color space which are derived directly from CIE xyY color space. CIE uv is more perceptually uniform than CIE xy.

CIE xy chromaticity coordinates – Coordinates in the CIE xyY color space representing color independent of luminance.

CIE xyY – A standard color space in which the Y component represents luminance. The x and y components represent color.

Color Gamut – (See Gamut)

Colorimeter – An optical measurement device used to measure color that responds to light by separating it into red, green, and blue components.

Color Management System (CMS) – Software used to control the handling of color between scanner, monitor, and printer. ColorSync is an example of a CMS used on the Macintosh. Microsoft Image Color Management (ICM) is an example of a CMS used on Windows systems.

Color Separation – The separating of a color image into the cyan, magenta, yellow, and black color layers used for printing.

Color Separation Tables – A set of conversion tables used to calculate the separating of RGB images into the CMYK layers necessary for printing.

Color Space – A three dimensional representation of colors. Examples are RGB, CIE xyY, and CIE Lab.

ColorSync – The Color Management System built into the Macintosh Operating System (Mac OS).

Color Temperature – The color of light given off by an object, known as a blackbody, as it is heated to a given temperature in degrees Kelvin. Low color temperatures such as 5000K are reddish, whilst higher color temperatures such as 9300K are bluish. A color temperature of 6500K is considered to be "neutral" white.

Contrast Ratio – The ratio of the white luminance (Intensity) and black luminance (Black Level) of the display.

Correlated Color Temperature – The closest matching color, expressed in Kelvin, of a white point that does not lie exactly on the blackbody locus.

CMYK – The subtractive colors used in printing: Cyan, Magenta, Yellow, and Black. Note that Black is referred to using "K" to avoid confusion with "blue".

D Illuminants – CIE Daylight Standard Illuminants based on approximating daylight. The subscript denotes the correlated color temperature of the illuminant. For example, D50 has a correlated color temperature of 5000K.

Delta-E (Δ-E) – A measurement of how different two colors are to each other. In SpectraView, Delta-E values are derived by calculating the distance between two colors in Lab color space using the CIE 94 formula. A Delta-E value of 1 indicates a just perceptual difference between two colors.

Delta-uv (Δ-uv) – A measure of how different two colors are, irrespective of luminance. In SpectraView Delta-uv values are used to indicate how far a white point is from the blackbody locus. CIE uv color space is used instead of CIE xy because it is more perceptually uniform or linear.

Device Dependent Color – A color space that is tied to the color rendering capabilities of a specific device. Examples are RGB color spaces that depend on the phosphor or filter colors used on the display. Another example is CMYK color spaces that are dependent on the types of inks and paper used.

Device Gamut – The range of colors that a device can produce.

Device Independent Color – A color space that can describe color independently of the capabilities of a specific device. An example is the CIE xy color space.

DDC/CI – Display Data Channel Command Interface is a two-way communications link between the video graphics adapter and display monitor using the video signal cable.

DICOM – Digital Imaging and Communications in Medicine.

Foot Lamberts (fL) – A unit of luminance. One foot Lambert is equal to 1 Candela per meter squared divided by 10.76/π (approximately 3.43) .

Gamma – The relationship between the input video signal to a display monitor and the screen output luminance. Typically the screen luminance follows a mathematical power function of the input video signal, the exponent of which is called the gamma.

Gamut – The range of colors that can be reproduced on a particular device such as a monitor or printer, or that can be distinguished by a sensing device such as a scanner or the human eye.

Hue – The basic attribute of color such as red, green, yellow, blue or purple.

ICC – International Color Consortium, a color industry group working on standards for color management technology.

ICC Profile – A file conforming to the standards set by the ICC that contains a description of the color characteristics of a device such as a monitor, printer, or scanner. In Windows ICC profiles have the file extension ".icm".

Image Color Management (ICM) – The Color Management System built into the Microsoft Windows operating systems.

Intensity – Intensity specifies the luminance or brightness of white when displayed on the screen.

Kelvin – An absolute temperature scale denoted by K. Zero Kelvin (0K) is equivalent to –273° Celsius.

Lab – (See CIE Lab)

LED – Light Emitting Diode.

LCD – Liquid Crystal Display.

Lightbox – An enclosure with controlled lighting conditions used to evaluate proofs, transparencies and other printed materials. Typically a lightbox is illuminated to approximate a standard illuminant such as D50 or D65.

Luminance – A measure of the brightness or intensity of light, usually expressed in units of Candelas per meter squared (cd/m^2) or foot Lamberts.

Look Up Table (LUT) – A table used to translate input values to output values. SpectraView displays use 10 or 12 bit internal LUTs to apply Gamma corrections and Tone Response Curves.

MCS (Monitor Calibration Settings) file – A file used by SpectraView II to store the results of the calibration, including the monitor settings and measurements.

Metamerism – A phenomenon in which two color samples appear to match in color under certain lighting conditions but not in others.

MPCD (Minimum Perceptible Color Difference) – A unit of measure, developed by the CIE, to define the change in light and color required to be just noticeable to the human eye.

Nit – A unit of luminance equal to Candelas per meter squared (cd/m^2).

NTSC – National Television Standards Committee. A standard for encoding video signals used widely in North America and Japan.

PAL – Phase Alternation by Line. A standard for encoding video signals used in Western Europe and parts of Asia.

Phosphors – Materials that emit light when struck by radiation of certain wavelengths. CRT displays use phosphors that give off red, green, and blue light to display an image on the screen.

Profile – A file containing a description of the color characteristics of a device such as a monitor, printer, or scanner.

Refresh Rate – The number of times the display screen is electronically scanned or "painted" each second. Expressed in Hertz (Hz).

Saturation – An expression of the amount a color deviates from being achromatic (neutral in color, such as gray). For example, red is a saturated color, while pink is less saturated, and white has no saturation.

SECAM – Sequentiel Couleur Avec Mémoire (Sequential Color with Memory). A standard for encoding video signals used mainly in France and Eastern Europe.

Soft Proof – Previewing on a display monitor what an image will actually look like when printed on a particular printer.

Subtractive Primaries – Cyan, magenta, and yellow colors, such as dyes or inks that subtract light reflecting off objects giving the appearance of color. For example magenta ink subtracts green light. When combined together, cyan, magenta, and yellow produce black.

Tone Response Curve – A graph representing the relationship between the input and output of a system or device. In SpectraView, Tone Response Curves represent the relationship between the intensity of a color within an application and the light intensity displayed on the monitor.

USB – Universal Serial Bus. A communication bus used to connect up to 127 devices such as keyboards, mice, scanners, color sensors, etc.

Viewing Booth – (See Lightbox)

White point – Specifies the color of pure "white" on a display, usually as a Color Temperature expressed in Kelvin or as CIE xy chromaticity coordinates.

Copyright © 2003-13 NEC Display Solutions, Ltd. All rights reserved.

USA and Canada: www.necdisplay.com

Australia: www.spectraview.nec.com.au