



SiliconGraphics
Computer Systems

Silicon Graphics ColorLock™ User's Guide

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Introduction

Welcome to ColorLock, a Silicon Graphics Technology!

With your Silicon Graphics ColorLock system, you can calibrate and control the color on your flat panel monitor. You specify how your monitor displays color by “locking in” a known set of calibration standards. Your Silicon Graphics 1600SW flat panel monitor retains your specified color space until you choose another set of calibration standards. You can also characterize your display and save an ICC color-matching profile that you can synchronize with Adobe Photoshop 5.

This user’s guide contains instructions that are specific to the ColorLock sensor and ColorLock application software. Information related to your visual workstation, flat panel monitor, and other peripherals is located in the documents that ship with them. Following is a description of each of the sections in this user’s guide.

- “ColorLock QuickStart” shows you how to colorlock your flat panel monitor with a few clicks of the mouse (for experienced users).
- Chapter 1, “Colorlocking Your Flat Panel Monitor,” explains how to use your ColorLock software and sensor to calibrate and characterize your flat panel monitor.
- Chapter 2, “Using ColorLock in a Publications Workflow,” shows how ColorLock Technology can help you make color judgments and decisions in your workflow environment.
- Appendix A, “Color Concepts and Theory,” provides background information on color.
- The “Glossary” defines color-related terms.

ColorLock QuickStart

If you are familiar with color calibration technology, you can quickly colorlock your flat panel monitor to a known set of standards. With just a few clicks of the mouse, ColorLock simplifies the color calibration process.

Note: For a complete system description, including ColorLock's customization features, refer to Chapter 1.

Calibrating and Characterizing Your Monitor

1. Select **Start>Settings>Control Panel** and double-click the ColorLock icon.
2. Choose a calibration setting from the Preset drop-down menu to define your color work space.
3. Right-click the ColorLock Detect icon in the task bar, and then left-click **Properties** to display the ColorLock Detect Properties window.
4. Click the **Synchronize Color Profile** box.
5. Click the **OK** button.
Your monitor's ICC profile will be synchronized with Photoshop 5.
6. Click the **Calibrate Display** button.
7. Using both hands, hang your ColorLock sensor over the top of the monitor, hooking it over the edge of the frame. Be careful not to scratch the flat panel screen.
 - Place the rounded end of the sensor over the center of the Calibration Window.
 - Plug the sensor cable into the sensor port at the back of your flat panel monitor (next to the power port).
8. Click the **Continue** button to run the calibration process and colorlock your monitor to your preset specifications.
9. Gently lift the the sensor off the screen and place it aside.

Chapter 1

Colorlocking Your Flat Panel Monitor

This chapter explains how to calibrate your Silicon Graphics 1600SW flat panel monitor using the Silicon Graphics ColorLock system. It also tells you how to characterize your monitor and create a corresponding International Color Consortium (ICC) profile that you can synchronize with Adobe Photoshop 5. If you're not familiar with color terminology, see "Appendix A" and the "Glossary" at the end of this user's guide.

The complete ColorLock system consists of the following components:

- Silicon Graphics ColorLock Sensor
- Silicon Graphics ColorLock Application Software
- Silicon Graphics 1600SW Flat Panel Monitor
- Silicon Graphics Flat Panel Adapter Card
- Silicon Graphics 320 or Silicon Graphics 540 visual workstation.

If you purchased a flat panel monitor with your system, the adapter card is preinstalled in your Silicon Graphics visual workstation. If you purchased your flat panel monitor and adapter card separately, you must install the adapter card. For adapter card installation instructions, refer to your Silicon Graphics 320 or Silicon Graphics 540 Owner's Guide. The ColorLock software is preinstalled on all Silicon Graphics visual workstations, purchased with or without a flat panel monitor. If you have to reinstall the ColorLock software, you must reinstall all the software on CD 2. You install the ColorLock sensor during the calibration process, as described later in this user's guide.

Calibrating Color

With your ColorLock system, you can calibrate your flat panel monitor to a known set of standards. You can select from a list of preinstalled color specifications or create your own customized settings. Other ColorLock users can copy any of your calibration settings and you can copy theirs. In this way, you can synchronize display output with your entire work group.

Selecting Your Calibration Settings

1. Choose **Start>Programs>ColorLock** to start the ColorLock application. You can also choose **Start>Settings>Control Panel** and double-click the SGI ColorLock icon.

The ColorLock Main Dialog window appears, as shown in Figure 1-1. Unlike other applications, you cannot minimize a ColorLock window or move another window in front of it.

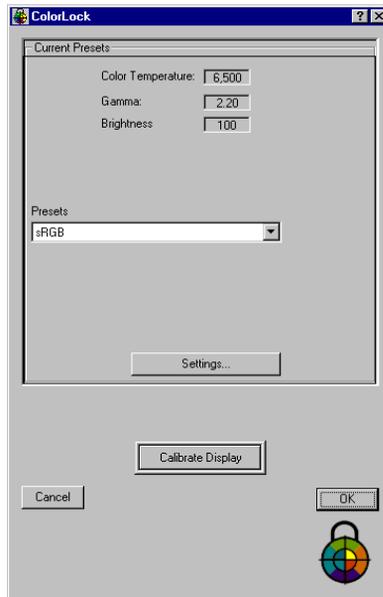


Figure 1-1 ColorLock Main Dialog Window

You also see ColorLock application and ColorLock Detect icons in the task bar at the bottom of your screen, as shown in Figure 1-2. The colored application icon indicates that the ColorLock application is open. The Detect icon at the right side of the task bar (near the clock) appears in gray, which indicates that your system is in the default unlocked state. When you right-click on the ColorLock application icon in the task bar (or in the upper left corner of the Main Dialog window), a popup menu includes a Help option, which refers you to this User's Guide. You'll learn more about ColorLock Detect later in this chapter.



Figure 1-2 ColorLock Icons

The current values for the ColorLock calibration parameters appear at the top of the Main Dialog window, as shown in Figure 1-1. These are called Presets. A **Presets** field with a drop-down menu appears in the middle of the window.

A Preset consists of three calibration parameters: **Color Temperature**, **Gamma**, and **Brightness**, which are described later in this chapter. These are the fundamental color-matching descriptors. sRGB is the default Preset.

2. Click on the down arrow at the right end of the **Presets** field.

The Presets drop-down menu displays five standard calibration settings, as shown in Figure 1-3. When you create your own Presets (described later in this chapter), these also appear in the drop-down menu.

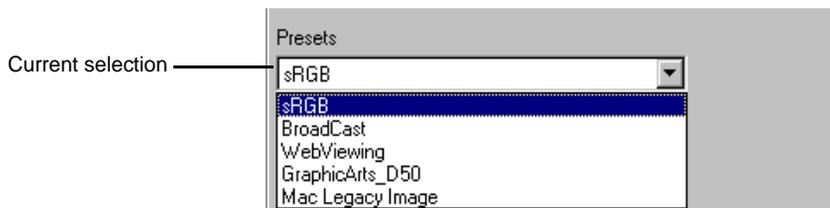


Figure 1-3 Presets Drop-Down Menu

The following calibration settings are preinstalled:

sRGB

HDTV broadcast specifications. It also approximates the average PC monitor. Because of its limited gamut, sRGB is not a good choice for prepress work.

BroadCast

SMPTE-C standard for broadcast television in the U.S.

WebViewing

Same specifications as sRGB for optimum Web viewing.

GraphicArts_D50

Graphics arts specification that displays images with a warm yellowish tint. This is a standard for prepress work.

Mac Legacy Image

Macintosh display specification.

Table 1-1 ColorLock Preset Values for Standard Calibration Settings

ColorLock Preset	Color Temperature	Gamma	Brightness
sRGB	6500	2.20	100
Broadcast	6500	2.20	100
GraphicArts_D50	5000	1.80	100
Mac Legacy Image	6500	1.80	100
WebViewing	6500	2.20	100

3. Choose a Preset to define your color work space.

The current preset values change in the Main Dialog window, reflecting your selection. The displayed color now matches the preset specifications. If you are satisfied with the displayed color, continue with the instructions on the next page. If the displayed color does not meet your requirements, you can try another preset or create customized settings, as described later in this chapter.

Synchronizing an ICC Profile

ColorLock automatically characterizes your monitor and saves an International Color Consortium (ICC) color-matching profile during the calibration process (unless you disable this capability, as described later in this chapter). You can synchronize your monitor's ICC profile with Photoshop 5 to preview your images as specified by your current Preset. If you want to synchronize your monitor's profile with Photoshop, follow these steps before you run the calibration process.

1. Right-click the ColorLock Detect icon in the task bar, and then left-click **Properties**, as shown in Figure 1-4.



Figure 1-4 ColorLock Detect Menu

The ColorLock Detect Properties window appears.

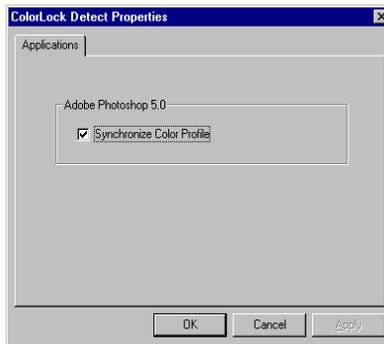


Figure 1-5 ColorLock Detect Properties Window (Synchronization On)

2. Click the **Synchronize Color Profile** box to enter a check mark, as shown in Figure 1-5 (the default entry is unchecked).
3. Click the **OK** button.

When you run the calibration process, ColorLock synchronizes your monitor's ICC profile with Photoshop 5.

Running the Calibration Process

1. Click the **Calibrate Display** button in the Main Dialog window.
The Mount Sensor window appears, with an area in its center for aligning your sensor, as shown in Figure 1-6.

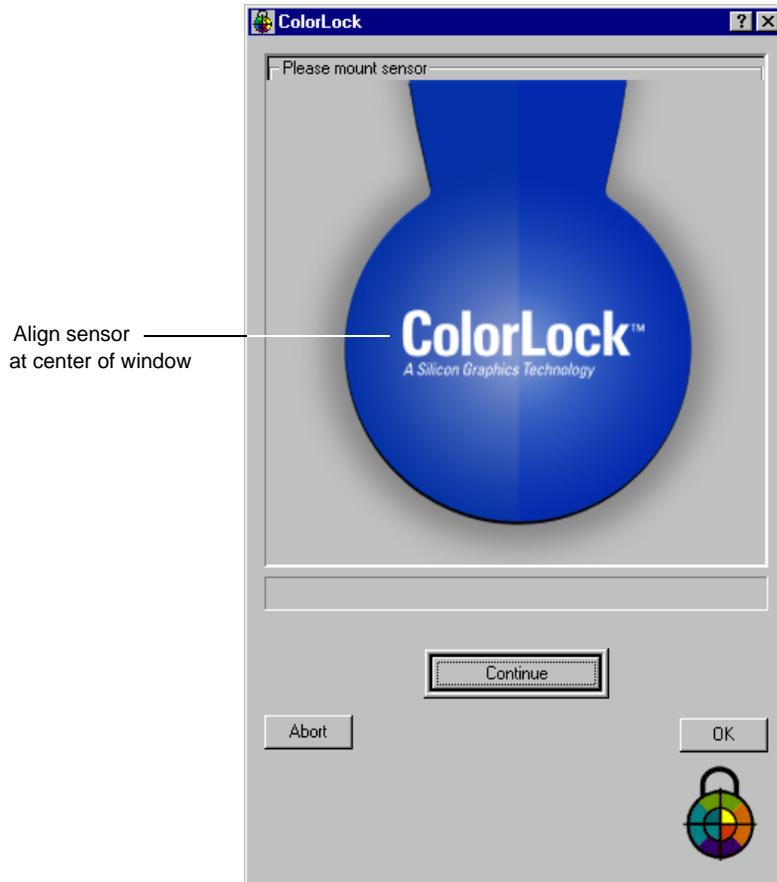


Figure 1-6 Mount Sensor Window

2. Using both hands, hang the sensor over the top of the monitor, hooking it over the edge of the frame, as shown in Figure 1-7. Be careful not to scratch the flat panel screen.
 - Place the rounded end of the sensor over the center of the Mount Sensor window. Do not move the calibration window because the calibration procedure works best when the window and the sensor are at the center of the screen.
 - Tilt the monitor forward and make sure the raised bump on the back of the sensor snaps into one of the vent holes on the back. You should hear it snap into place.
 - Plug the sensor cable into the sensor port at the back of the monitor (next to the power port), then tilt the monitor back to the viewing position.

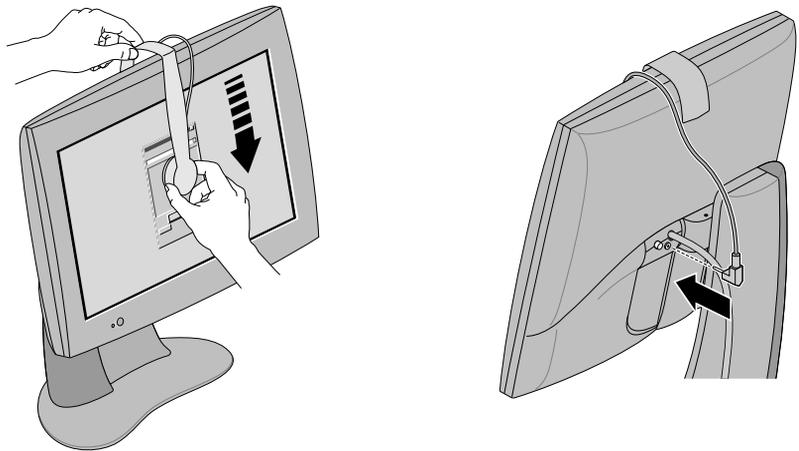


Figure 1-7 Align and Connect Sensor

3. Click the **Continue** button.

You see flashes of red, green, and blue light and a range of other colors as the ColorLock sensor and software process your monitor's RGB information. A progress bar appears at the bottom of the window, as shown in Figure 1-8.

If you click the Continue button and your sensor is not mounted, an error message appears.

You can stop the calibration process at any time by clicking the **Abort** button.

Caution: Do not move the sensor during the calibration process.

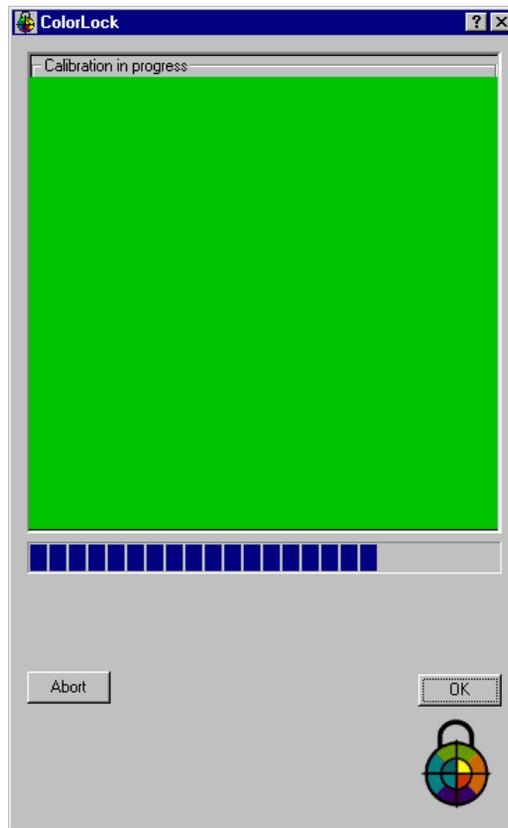


Figure 1-8 Calibration Progress Window

When the progress bar disappears, your calibration is complete, as shown in Figure 1-9.

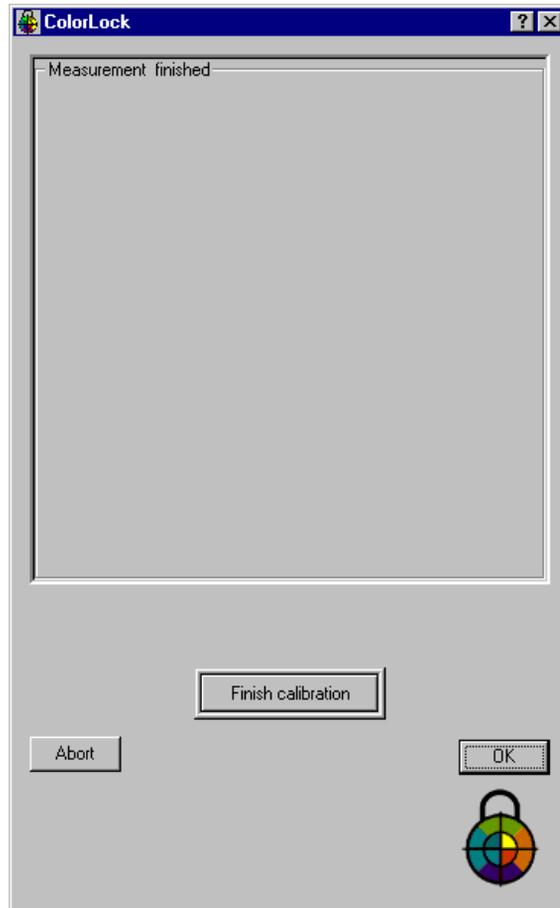


Figure 1-9 Measurement Finished Window

Your flat panel monitor is now colorlocked! The ColorLock system calibrated and characterized your flat panel monitor and saved an ICC monitor profile.

4. Click the **Finish calibration** button to return to the Main Dialog window or the **OK** button to exit the ColorLock application.

In the task bar, the ColorLock Detect icon changes from gray to color, which indicates that your system is colorlocked, as shown in Figure 1-10.

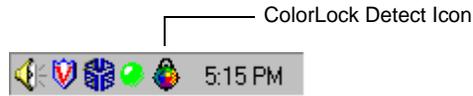


Figure 1-10 ColorLock Detect Icon (Locked)

5. Remove the sensor with both hands, as shown in Figure 1-11.
 - Pull the back of the sensor out of the vent hole with one hand.
 - Lift the rounded end of the sensor away from the screen with your other hand.
 - Remove the sensor by lifting it off the top of the monitor (be careful not to scratch the flat panel screen).

The sensor can remain connected for future calibrations or you can unplug it.

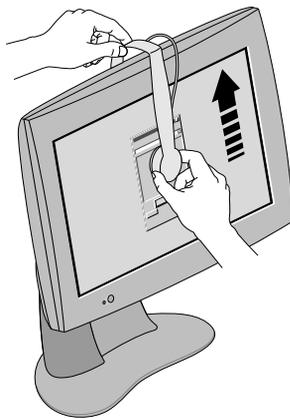


Figure 1-11 Remove Sensor

Displaying and Customizing Settings

You can graphically display your current calibration settings and create a custom Preset as follows:

1. Click the **Settings** button in the Main Dialog window.

The Settings window appears, as shown in the example in Figure 1-12 for the current preset, sRGB.

2. Notice the horseshoe-shaped chromaticity diagram that shows the gamut and white point of the current Preset (sRGB). The current gamut appears within a triangular border with a small circle that marks the white point.

You also see slider buttons and current values for color temperature, brightness, and gamma. RGB curves show an approximate correlation between each red, green, and blue component's gray-scale level and its luminance. The current luminance value appears above the rectangular Gray Scale Indicator at the right side of the window.

At this point, you can just view your current settings and click the **Cancel** button to return to the Main Dialog window. If you require color-matching parameters that are not specified by any of the standard Presets, you can create custom settings, as described next.

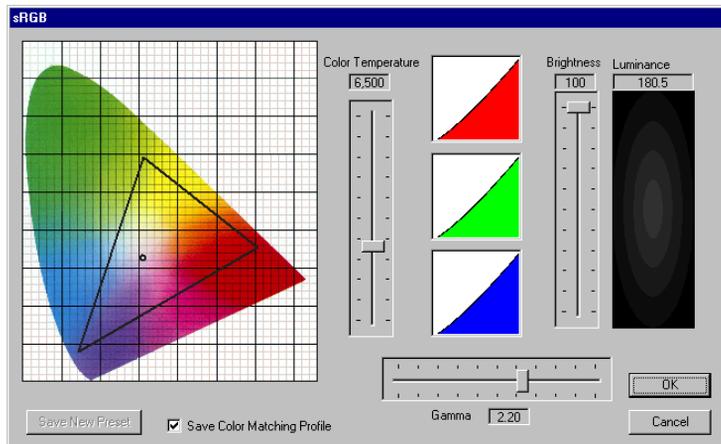


Figure 1-12 Settings Window (Current Preset)

Setting the Color Temperature (White Point)

The Color Temperature control specifies how your monitor displays the color white. It is specified in degrees Kelvin (K), which equals the temperature in Celsius plus 273.15. This reference point is the most important setting affecting color judgment because your flat panel monitor uses the additive properties of color mixing to display colors. The color temperature specifies a white point that corresponds to CIE daylight locus coordinates to match most modern color specifications. You can set the color temperature to any value between 5000 degrees K and 7000 degrees K.

1. Change the white point by moving the Color Temperature slider up or down.
2. Notice how the displayed color changes as you move the slider.

The color on your flat panel monitor now corresponds to a different point on the CIE daylight locus. The white point indicator moves, which shows how the coordinates shift with changes to the color temperature. The luminance value changes, which now shows the brightness of white at your selected color temperature.

The triangular border now defines the gamut for your customized Preset, and the **Save New Preset** button is activated, as shown in Figure 1-13.

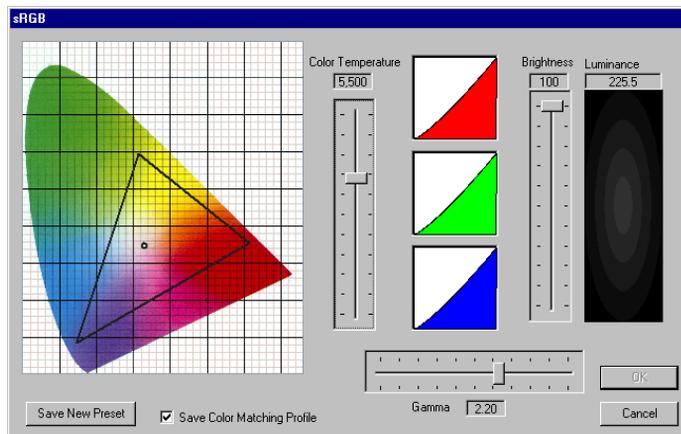


Figure 1-13 Settings Window (After Changing the Color Temperature)

Note: After you modify the color temperature (white point), you have to recalibrate your flat panel monitor. You can recalibrate before or after adjusting the brightness and gamma. When you save an ICC color-matching profile as described later in this chapter, your monitor is characterized with the modified white point.

Setting the Brightness

The Brightness control sets the intensity of the backlight. When you change your monitor's white point, this can affect brightness. ColorLock usually sets the backlight at the brightest level for the selected color temperature. After you establish a new white point, you can adjust the brightness with the slider, but in most cases you can only decrease the current level.

1. Adjust the brightness by moving the Brightness slider up or down.
2. Notice how your monitor's brightness changes as you move the slider.

The current luminance value changes, reflecting your selected brightness level.

The rectangular Gray Scale indicator shows how the changes in brightness affect the displayed shadow details.

Note: You do not have to recalibrate your flat panel monitor after adjusting the brightness.

Luminance

The Settings window also displays a value for luminance, which represents the brightness of white at the current color temperature.

Setting the Gamma

The Gamma control specifies the amount of contrast applied to the midtones of the displayed image. When you increase the gamma, your image appears more vibrant. A low gamma results in a flatter image.

1. Adjust the gamma by moving the Gamma slider left or right.
2. Notice how your monitor's gamma changes as you move the slider.

The system modifies the gamma by loading the appropriate correction function on your system's graphics controller board.

In the Settings window, the RGB curves change, which updates the correlation between each red, green, and blue component's gray-scale level and its luminance.

You do not have to recalibrate your flat panel monitor after adjusting the gamma.

Saving a Color-Matching Profile

At the bottom of the Settings window, a check box indicates whether your system saves a color matching profile during the calibration process. This box is checked by default, which means ColorLock characterizes your monitor and creates a corresponding ICC profile that you can synchronize with Adobe Photoshop. If you uncheck the box, your system does not save an ICC profile.

Canceling Your Custom Settings

To cancel your custom settings and restore your previous calibration parameters, click the **Cancel** button. If you want to save your new settings as a custom Preset, follow the steps on the next page.

Saving Your Custom Settings

1. Save your custom settings by clicking the **Save New Preset** button.

A Save As dialog box appears, as shown in Figure 1-14.

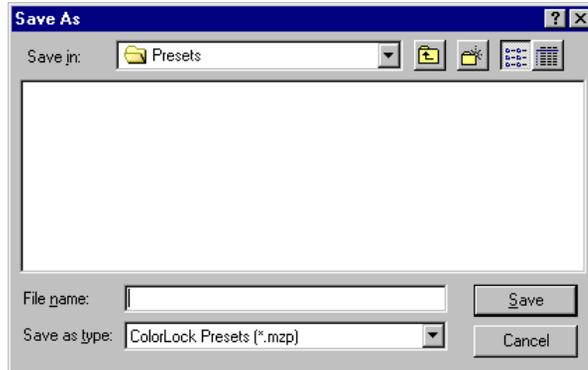


Figure 1-14 Save a New Preset

2. Enter a name for your new Preset and click the **Save** button.

The system saves your custom settings as an .mzp file type in the Presets folder.

You can exchange custom settings with other ColorLock users. Just make copies of the desired files from one system's Presets folder and copy the files into the other system's Presets folder. The path to the presets folder is Winnt> system32> Color>ColorLock> Presets.

3. Select the **OK** button in the Settings window.

Another Save as dialog box appears.

4. Enter a name for your new ICC profile and click the **Save** button.

When you run the calibration process, the system saves your new ICC profile as an .icm file type in the Color folder.

You can exchange custom ICC profiles with other ColorLock users. Just make copies of the desired files from one system's Color folder and copy the files into the other system's Color folder. The path to the Color folder is Winnt> system32> Color.

5. Select the **OK** button in the Settings window.

The ColorLock Main Dialog window displays your custom settings and the Presets drop-down menu displays the name of your new Preset. You can now select these settings as you do any other Preset.

6. Calibrate your flat panel monitor using your custom settings (see *Calibrating Color*, earlier in this chapter). If you do not calibrate your monitor, the previous calibration settings remain in place.

Chapter 2

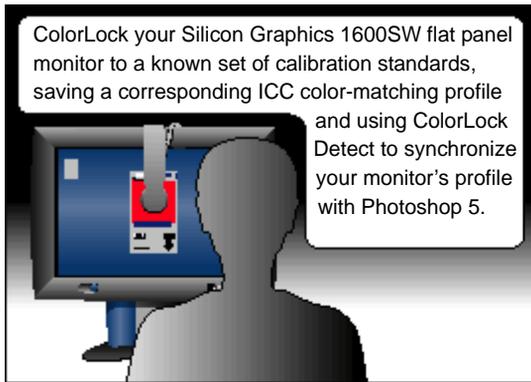
Using ColorLock in a Publications Workflow

This chapter explains how ColorLock interacts with other applications to facilitate your color workflow process. The publications workflow involves many software applications, hardware devices, and output media. ColorLock Technology allows you to use your Silicon Graphics 1600SW flat panel monitor as a workflow proofing tool where you can make all color judgments and decisions. You can synchronize color output with all the devices you use to capture and reproduce color.

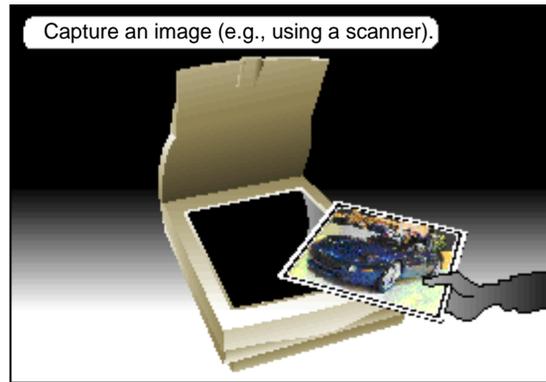
ColorLock, Photoshop, and Color Management

As discussed in Chapter 1, your ColorLock system allows you to save an ICC monitor profile that you can use with Adobe Photoshop 5. Photoshop automatically references your Silicon Graphics 1600SW monitor profile to preview images that you can tag with Photoshop color-matching profiles.

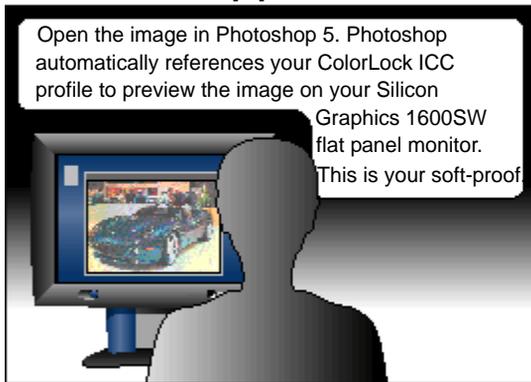
The creation of the 1600SW monitor profile and its synchronization with Photoshop are two very important steps in the workflow process. These profiles establish the fundamental color descriptors that are automatically translated between ICC-compliant applications and between devices by color management systems (CMS). A CMS can be a standalone application or resident in an operating system (ICM in Windows NT). It performs the necessary color adjustments as your image moves from device to device within a workflow. Figure 2-1 shows how ColorLock Technology facilitates the publications workflow. In Figure 2-2, a ColorLock global work group synchronizes color output on a wide area network.



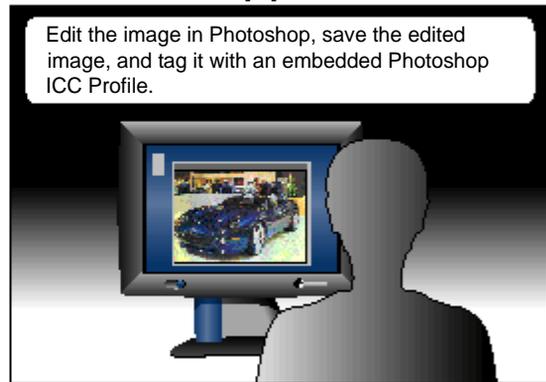
[1]



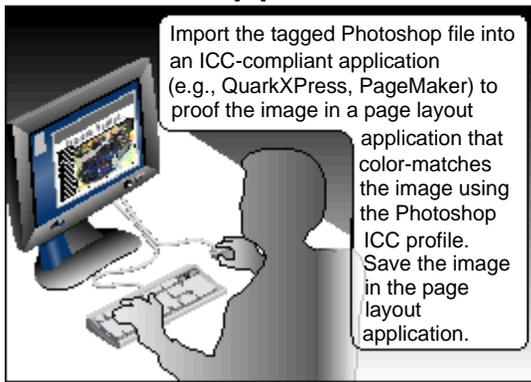
[2]



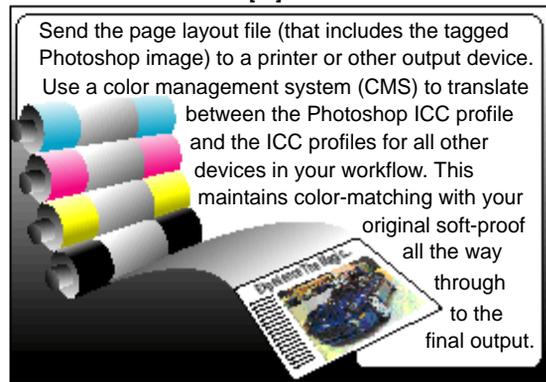
[3]



[4]



[5]



[6]

Figure 2-1 Publications Workflow

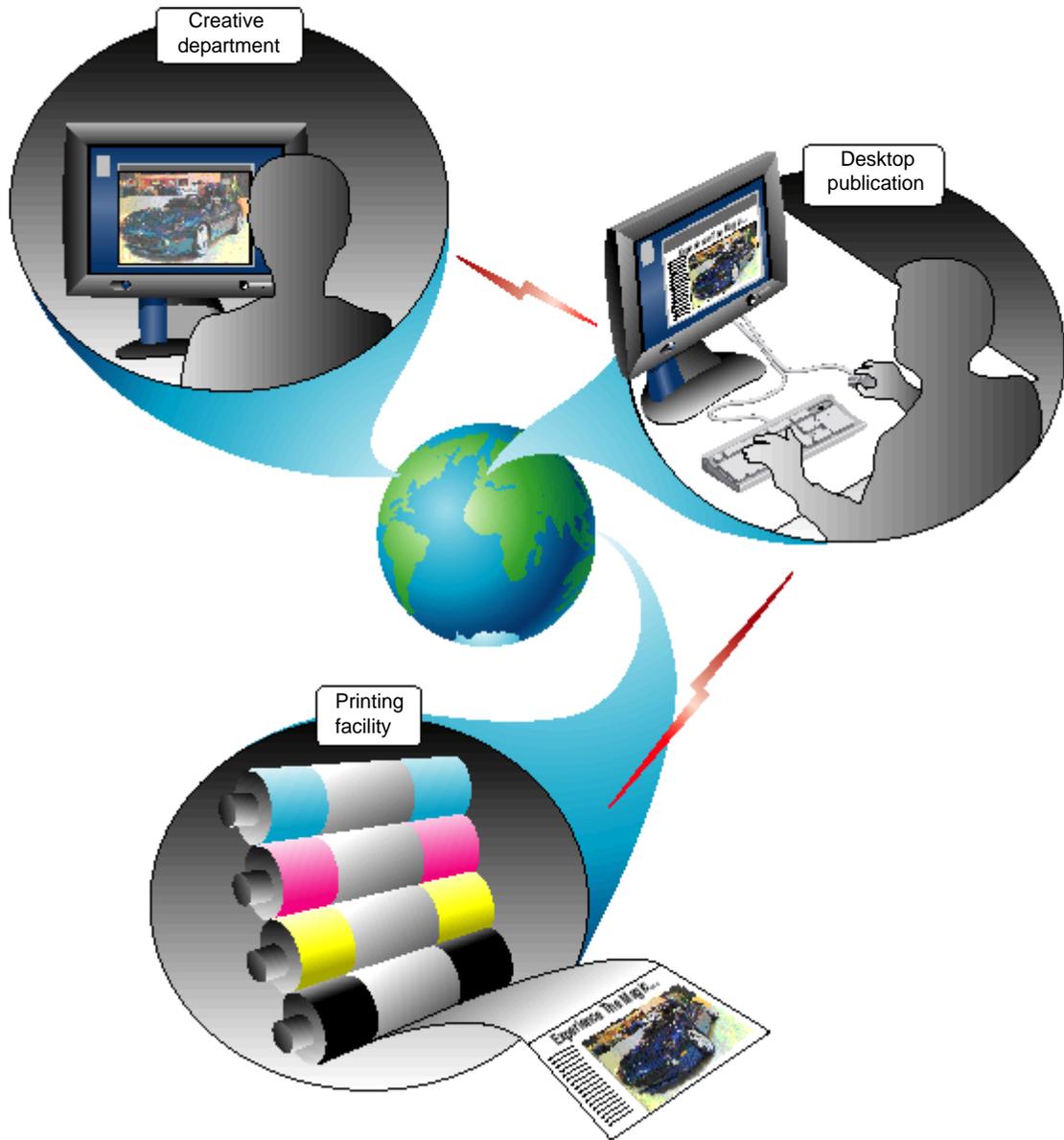


Figure 2-2 ColorLock Global Work Group

Comparing Images

Be very careful when you are viewing and matching color-critical images. When you change your viewing angle, the contrast ratio also changes. Unlike CRTs, which have phosphor-coated screens that emit uniformly scattered light, liquid crystal displays can change their chromaticity when viewed at large off-axis angles. Your Silicon Graphics 1600SW flat panel monitor is equipped with several optical elements to help compensate for this effect without sacrificing other important features such as switching speed and brightness. However, when you view or compare images on one monitor or on two separate monitors, proceed as follows:

1. Compare the two images by placing them side by side (horizontally) rather than above and below each other (vertically).

Color shifts in the horizontal axis are symmetrical and less severe.

2. Compare your images.
 - Position your viewing perspective between the two images.
 - Look at the first image and then compare the images by moving your head at right angles to the display face.

Note: For more information on recommended use and viewing angles, see your *Silicon Graphics 1600SW Owner's Guide*.

Appendix A

Color Concepts and Theory

This appendix describes some of the color concepts and theory behind the Silicon Graphics ColorLock system. This information is included as background material that may help you during the creative process. If you require additional information on color, see the list of color-related Web sites and other recommended reading at the end of this appendix.

Color and Light

In the seventeenth century, Sir Isaac Newton passed a beam of sunlight (white light) through a prism and discovered that the light dispersed into a rainbow of colors. He called this dispersion a *spectrum* to describe its ghostly appearance. Newton experimented further by using a very narrow slit to isolate a single color from the spectrum. When he passed that color through another prism, it retained its characteristics. From these experiments, Newton concluded that white light is composed of a mixture of pure colored light.

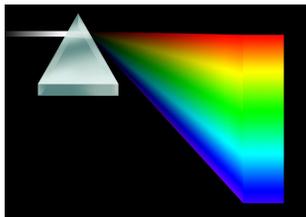


Figure A-1 White Light Passing through a Prism

Light is electromagnetic radiation, which is a wave-like form of energy that is measured by wavelength. The full range of electromagnetic radiation is called the *electromagnetic spectrum*, which also includes radio waves, radar, infrared light, ultraviolet light, and x-rays. Light is the visible area of the electromagnetic spectrum, which ranges in wavelength from about 400 nm to 700 nm. The word *color* describes how the human eye perceives the wavelength of the radiation in the middle of the electromagnetic spectrum. These colors begin with violet at the low end of the visible wavelengths and progress through blue, green, yellow, and orange to red at the high end of the visible wavelengths.

Color Vision

The human eye detects light using two types of physical receptors (sensors), called rods and cones. Rods are sensitive to low levels of light but are not sensitive to the color of light. They provide night vision. There are three types of cones, each sensitive to red, green or blue light. The amount of stimulation received by each cone determines how the brain perceives all color. The science of colorimetry describes all color in terms of three numerical values that relate to the eyes' sensitivities to the red, green, and blue bands of the visible spectrum. This is called the tristimulus theory of color vision.

Perceptual Attributes of Color

The perception of color is also influenced by the intensity and purity of light. The wavelength of light is often referred to as its hue, the intensity as brightness, and the purity as saturation. Pure red light looks highly saturated whether it is bright or dark. If blue light and green light mix with red light, it appears less saturated. When red light, green light, and blue light mix in equal quantities, the eyes perceive completely desaturated light, which is a shade of gray.

- Hue is the essence of a color.
- Brightness (sometimes called value or lightness) is the intensity of light (the lightness or darkness of a hue).
- Saturation (also called chroma) is the purity of a color or the colorfulness or intensity of a hue.

Ambient Light

The surrounding light in all environments also affects the perception of color. This ambient light mixes with the color on a printed page or on a display monitor, so identical colors can look different when the lighting changes. For example, the color of daylight changes during the day, with a bluish cast in the early morning and a yellowish tint in the late afternoon. The color of daylight also varies with changes in weather and atmospheric conditions. When the sky is blue and the sun is shining, color looks different than it does on a gray rainy day. This is why color tools measure the characteristics of the light source illuminating the image.

You also have to consider other effects of ambient light when you color-match images. Room lighting affects the shadow details in an image. When you view images on a display monitor in a darkly lit environment you see many more details than you do in bright surroundings.

Measuring Color

In today's digital environment, computer users must characterize devices that reproduce color to obtain repeatable results. During the production process, content creators want to preview their images to be sure that the color they see on their screens is the same color produced by the final output device. It is critical that these users have hardware and software that is capable of characterizing their displays and setting specific viewing parameters. With your Silicon Graphics ColorLock system, you can specify how your monitor displays color by locking in your desired color environment.

Color Model

A color model is a dimensional coordinate system that numerically defines colors. In 1931, the CIE (Commission Internationale de l'Éclairage) set the standards for color and color measurement of the visible spectrum. This international standard for color is based on precise psychophysical color-matching experiments, described below. The CIE established a theoretical standard observer with color-matching characteristics that represent all people with normal color vision. This CIE standard aids the development of professional colorimetry tools such as the Silicon Graphics ColorLock system.

Colorimetry

Colorimetry relates the measurement of spectral content to the visual perception (trichromatic responses) of the standard observer. Colorimetry tools specify colors in digital imaging devices. There are numerous factors that influence color perception, but many studies show that most people perceive any specific mixture of red, green, and blue (RGB) light as the same color. This is based on CIE color-matching experiments that required test subjects to adjust a mixture of red, green, and blue light sources to match a reference color. In these experiments, each subject adjusted the light sources to the same value to match a given reference color (within the limits of experimental errors). The amounts of the RGB primaries required to match the reference color are called the tristimulus values of the reference color.

Color Space

The red, green, and blue values define a three-dimensional color space, which is called the CIE RGB space. Sometimes it is useful to define pure color with no reference to lightness. In this case, the RGB space is mathematically converted to the XYZ space, where X and Z (which define the color) have no specific perceptual correlates, but Y represents luminance (an approximate correlate to the perception of brightness). Another useful transformation yields brightness-independent x and y values. Plotting these values produces a CIE chromaticity diagram, which is displayed in the ColorLock Settings window (see the example in Chapter 1).

Color Temperature and White Point

Color temperature defines how a monitor displays the color white, with chromaticity coordinates that can exist somewhere in color space from red-white to blue-white. It is specified in degrees Kelvin ($K = \text{degrees Celsius} + 273.15$). The white point corresponds to the color temperature of white light. Computer monitors form white light by mixing equal amounts of red, green, and blue light. Mixing different intensities of red, green, and blue to produce white can give the light a shade from warm yellow at or below 5000 degrees K to cold blue for higher color temperatures, for example 7000 degrees K. This color range corresponds to different shades of daylight, as perceived by the human eye.

CIE Daylight Locus

The CIE daylight locus is a line in a chromaticity diagram that connects the points representing the chromaticities of the various shades of daylight at different color temperatures.

Capturing Images

To reproduce color accurately, color output media and devices capture images trichromatically. For example, scanners convert printed images, photographs, transparencies, and so on, into digital form by reflecting or transmitting light onto an array of detectors, each sensitive to red, green, or blue light. Scanners must be characterized so output devices can interpret the RGB values and reproduce the scanned image. All image-producing methods use additive or subtractive color systems.

Additive Color

In additive color reproduction, red, green, and blue light combine in various intensities to produce all the other colors. Mixing the full intensities of red, green, and blue produces white. Computer monitors and other video devices generate various intensities of red, green, and blue light to display color images.

Subtractive Color

In subtractive color reproduction, three or more dyes, inks, or pigments absorb some light of different wavelengths to reflect color images. The standard four-color printing process applies cyan, magenta, and yellow inks on paper. Cyan absorbs red, magenta absorbs green, and yellow absorbs blue. Mixing various quantities of the individual inks produces all colors. For example, a mixture of cyan and magenta produces blue because the inks absorb all colors except blue. Mixing the full intensities of cyan, magenta, and yellow produces muddy blacks, so the printing process adds black (K) ink to produce crisp, clean blacks. Cyan, magenta, yellow, and black are often referred to as process inks.

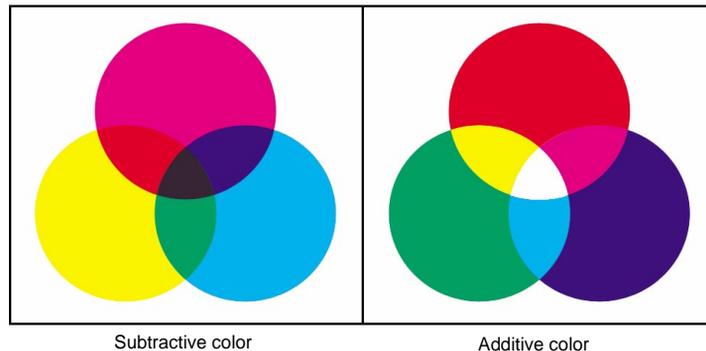


Figure A-2 Subtractive and Additive Color Systems

Device Gamut

Device gamut specifies the range of colors that a device (such as a monitor, scanner, camera, or printer) can capture or reproduce. Figure A-3 shows the gamut areas for various devices as compared with the standard observer's color space. This example shows that none of the devices can reproduce all of the colors perceived by the human eye. You can restrict your flat panel monitor to a subset of colors that does not exceed the gamut of your final output device. This locks in a set of color-matching parameters, which allows you to synchronize your monitor's color output with the color produced by your final output device. This means you can preview (or soft-proof) your final images using your Silicon Graphics 1600SW flat panel monitor.

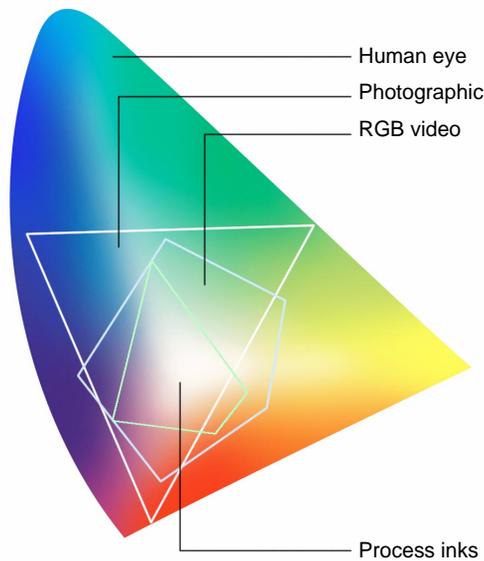


Figure A-3 Device Gamuts

ICC Profiles and ColorLock

The International Color Consortium (ICC) developed the ICC profile as a set of values that characterize how specific devices reproduce color. Color management systems reference ICC profiles to reconcile color spaces and gamuts between devices in a workflow. When a color value specified for one device falls outside the color gamut of another device, the gamuts must be scaled to maintain color-matching from device to device.

Your ColorLock system is an essential component within the workflow because it provides the fundamental and necessary color-matching descriptors, as described in Chapter 2. You view your images on a high-resolution (110 dpi) flat panel monitor, which displays proof-quality output. During the manufacturing process, the actual colorimetric profile of your individual monitor is loaded into the monitor's onboard memory. This allows ColorLock to track the aging of your monitor's flat panel lamps, so the calibration accuracy does not degrade over time.

ColorLock Technology automatically generates an ICC monitor profile that you can use with Photoshop 5. This means Photoshop references this profile to preview your images in its working color space. When you save your image in Photoshop, you can tag it with an embedded ICC profile of your working color space. If you import your Photoshop files into another ICC-compliant application, you retain your working color space. When you use professional color management tools, such as your Silicon Graphics ColorLock system, you can calibrate and characterize your display, and reproduce color images accurately.

Sources of Color Information on the Web

Charles Poynton's Color FAQ site:

<http://home.inforamp.net/~poynton/>

Stephen Westland's Color Physics FAQ:

<http://www.colourware.co.uk/cpfaq.html>

Adobe information on Photoshop and Color Management:

<http://www.adobe.com/supportservice/custsupport/TECHGUIDE/PSHOP/Main.HTML>

Sequel Imaging Tech Center Technical Papers on Color Temperature and Embedded Monitor Control by Tom Lianza:

<http://www.sequelimaging.com>

Dan Evanicky's White Paper on the Silicon Graphics 1600SW flat panel monitor: <http://visual.sgi.com> (In the Research Center)

The International Color Consortium Home Page:

<http://www.color.org>

Books on Color

Giorgianni, E. J., and Madden, T. E.

Digital Color Management, Addison Wesley (1998)

Jackson, R., MacDonald, L., and Freeman, K.

Computer Generated Color, John Wiley and Sons (1994)

Glossary

Additive color

Color produced by mixing light from a set of primary light sources, usually red, green, and blue.

Brightness

An attribute of visual sensation according to which an area appears to exhibit more or less light.

Calibration

Color correction procedure that corrects any deviation from a standard.

Characterization

Procedure that defines the color characteristics for a representative operating model of an input or output device.

Chroma

The colorfulness of an area judged in proportion to the brightness of a similarly illuminated area that appears to be white or highly transmitting.

Chromaticity

The property of a color stimulus defined by its chromaticity coordinates (its CIE x and y values).

Chromaticity diagram

A two-dimensional diagram with points specified by chromaticity coordinates that represent the chromaticities of color stimuli.

CIE (Commission Internationale de l'Eclairage)

The International Commission on Lighting. This organization is responsible for international recommendations for photometry and colorimetry.

CIE Colorimetry

Measuring color according to the spectral responsivities of a CIE standard observer.

CIE Standard Observer

An ideal colorimetric observer with color-matching functions.

CIE tristimulus values

The X, Y, and Z values determined according to the color-matching properties of the CIE standard observer.

CIEXYZ color space

A color space defined in terms of X, Y, and Z values that are determined according to the color-matching properties of the CIE standard observer.

CMY/CMYK

Abbreviations for cyan (C), magenta (M), yellow (Y), and black (K) dyes or inks used in the subtractive imaging process.

Colorfulness

Attribute of a visual sensation according to which an area appears to exhibit more or less of its hue.

Color gamut

The limits or range of colors that can be produced by a specific device or process.

Colorimeter

An instrument (for example, ColorLock Sensor) that measures color stimuli usually by direct measurement of light at several specific wavelengths.

Color management

The hardware, software, and methodology used to control and adjust color.

Color space

A three-dimensional mathematical space defined by the three tristimulus values it requires to describe any color.

Color temperature (white point)

The measurement of the coolness or warmth of white light. It is specified in degrees Kelvin ($K = \text{degrees Celsius} + 273.15$).

Cones

The photoreceptors in the retina that react to the amount of red, green, and blue components in any color light.

D illuminants

CIE standard illuminants defined by the color temperature of the white illuminating light that represents daylight with different color temperatures. D50 (5000 K) and D65 (6500 K) are the most widely used standards.

Daylight locus

The locus of points in a chromaticity diagram that represent the chromaticities of the various shades of daylight with different color temperatures.

Gamma

The measured contrast in an image.

Gamut. *See* color gamut.

Hue

The essence of a color.

ICC

International Color Consortium, an industry group formed in 1993 to promote interoperability among color-imaging systems.

ICC profile

A set of values that define how specific devices reproduce color.

Illuminant

A light, which may or may not be physically realizable as a source, defined in terms of its spectral power distribution.

Kelvin

Unit of temperature used to express color temperature. The temperature in Kelvin (K) is equal to the temperature in Celsius plus 273.15.

Light

Electromagnetic radiant energy that is visible to the human eye.

Light Source

A physically realizable emitter of light.

Luminance

An absolute measure of the intensity of a light source weighted by the color matching function of the visual system which most closely correlates with the monochromatic sensation of brightness.

Monochromatic

Electromagnetic radiation consisting of one wavelength or a very small range of wavelengths.

Photometry

A measurement of light, typically counting photons.

RGB (red, green, and blue)

A three-dimensional color space that represents all color in terms of its red, green, and blue components. Colorimetry devices, scanners, and the human eye all perceive color in terms of its RGB components. Video displays and flat panel displays show color by emitting (and combining) different amounts of red, green, and blue light.

Saturation

The colorfulness of an area judged in proportion to its brightness.

Spectrum Locus. *See* daylight locus.

Subtractive color

Color formed by the subtraction of light by the process of absorption.

tristimulus values. *See* CIE tristimulus values.

Wavelength

The distance between two points (having the same phase) on a periodic waveform. The wavelength of visible light is measured in nanometers (nm).

White point

The color temperature of the white light from a video or flat panel display. Although white light is formed from equal amounts of red, green and blue light, the individual components can give the light a shade from warm yellow to a cold bluish cast.

x,y diagram. *See* chromaticity diagram.

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