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# MONITOR CALIBRATION

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## Profiles

- A file that correlates device color values with corresponding device-independent color values that represent what color people actually see.
- Contains information about the three main variables that describe the behavior of a device:
  - Gamut – the color and brightness of the colorants (phosphors or ink)
  - White Point – the color and brightness of the luminance as it relates to monitor calibration
  - Tone reproduction characteristics of the colorants (gamma curve as it relates to monitor calibration)
- Three different classes:
  - Input profiles – scanners and digital cameras
  - **Display profiles** – monitors and LCD displays
  - Output profiles – printers and presses
- Display profiles are unique in that they act as both input and output devices:
  - When creating or editing a color on your monitor, you're using the monitor as an input device
  - But when you display an image on your screen, it's an output device

## Calibration vs. Profiling

- Calibration is the process of bringing a device back to a target or desired state (**in effect, changing it's behavior**) in order to maintain consistent behavior and enabling the profile that describes it to remain accurate
- Profiling is the process of recording the behavior of a device **without making any changes to its behavior**
- Both processes involve sending a target of known color values (a stimulus) to a device, measuring the color that results (the response) and then feeding the results into some software
- When calibrating a monitor, for instance setting the white point, the calibration software sends a stimulus to the monitor – in this case RGB 255, 255, 255 – examines the response that's detected by the measurement device, and adjusts either the monitor guns (CRT) or the lookup table in the video card (LCD) until the response matches the target white point
  - In this way, so long as we consistently use the same target values, we can continue to bring the monitor back to our target or desired state

## LCD vs. CRT

- With a CRT monitor, typically you have the ability to physically adjust the white luminance (contrast), black luminance (brightness) and color temperature (by means of temperature presets, continuously variable control or separate RGB gain controls); the only adjustment that has to be made in the video LUT is the gamma correction
- With an LCD monitor, you can only adjust the brightness control; all other adjustments are done via the video LUT
  - Some LCDs supply software controls that mimic those found on CRTs, but they're just tweaking the LUT on the video card rather than adjusting the behavior of the monitor itself
  - By leaving the white point setting as "Native," you effectively do not make an adjustment; if you choose any other setting, since a change in this can only be accomplished by filtering the backlight, you are effectively making the change on the video LUT
- Because of the nature of the phosphors in a CRT monitor, it should be calibrated weekly; because the dyes in LCD cells wear at a much slower rate than phosphors, LCD monitors should be calibrated monthly

# Creating A Display\* Profile

\* We use the term “Display” because we are really calibrating and profiling the combination of the video driver, the video card and the actual monitor – the whole display system

- **Stimulus and response**
  - The profile software sends a stimulus in the form of known RGB values for the device to measure
  - The measurement of the colors those RGB values cause the monitor to display is the response
  - The monitor profile then provides the translation from the Profile Color Space (PCS) so colors appear correctly on the monitor.
- **Adjustments**
  - White Luminance – the brightness of the monitor, or the whitest white
  - Temperature – the color of the monitor’s white point
  - Gamma – the tone response curve of the display system
  - Black Luminance – typically only on CRT monitors; the darkness of the monitor, or the blackest black

## The Adjustments

- **White Luminance**
  - For a CRT monitor, the recommended luminance setting is 90 cd/m<sup>2</sup>
  - For an LCD, the recommended luminance setting is 140 cd/m<sup>2</sup>
- **Temperature (white point)**
  - The recommended setting for a CRT is 6500K
  - For an LCD, the recommended setting is “Native”
- **Gamma**
  - The recommended gamma is 2.2

## Before Calibrating

- Warm up the monitor for at least 30 minutes (particularly for a CRT)
- Make sure that all your monitor settings, including resolution, refresh and screen geometry are set
- Clean the screen:
  - **NEVER** use regular glass cleaners on either type of monitor due to the coatings they have; use a cleaning product specifically designed for your type of monitor

# Calibration\*

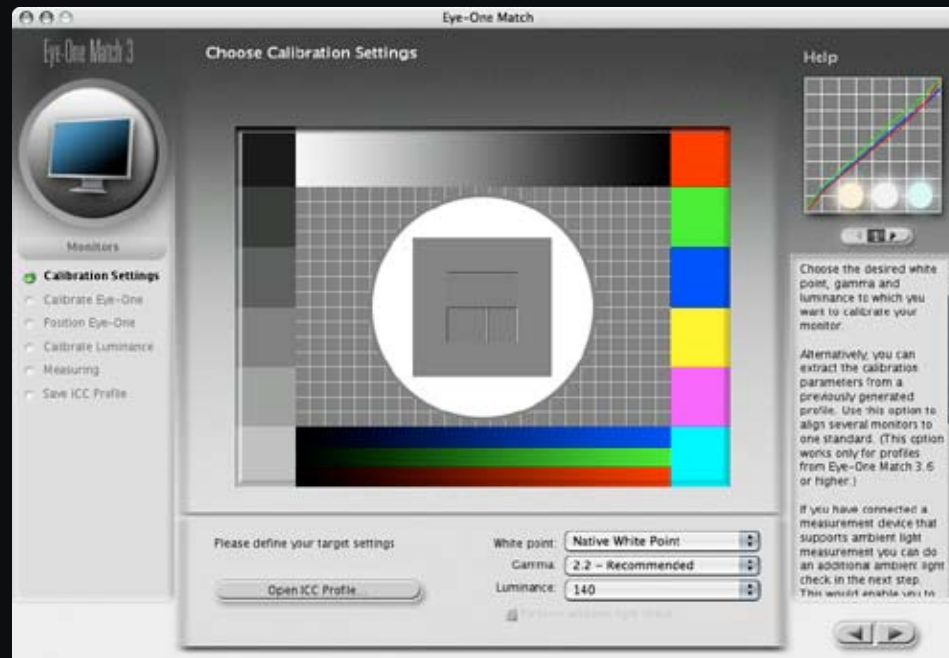
\* Screen captures are from using an LCD monitor with Gretag Macbeth Match v3.6 software

- Make sure the measurement device is plugged into the computer before beginning and then launch the software
- Select the monitor device and choose the Advanced mode, which will allow us to set the parameters we've discussed



## Calibration (CONTINUED)

- Set the white point, gamma and white luminance



- At this point you can measure the ambient luminance if you have attached the ambient lighthead to the EyeOne Display device – this is a good thing to do once to get an idea of the surrounding temperature of your work environment

## Calibration (CONTINUED)

- Calibrate the EyeOne Display device



## Calibration (CONTINUED)

- Place the device on the monitor

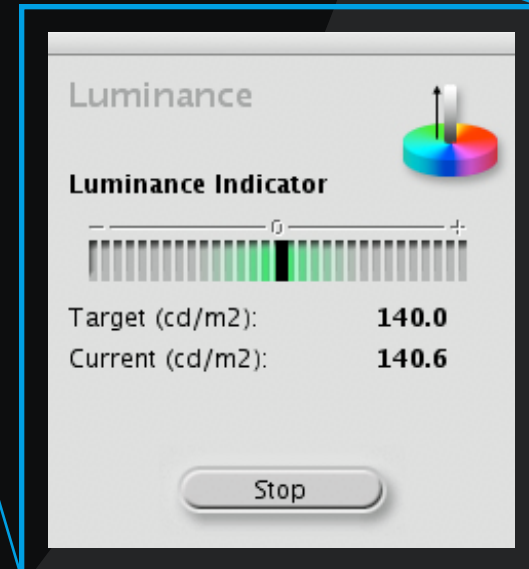


## Calibration (CONTINUED)

- Adjust the brightness of the monitor using the display settings via the OS or the physical monitor controls

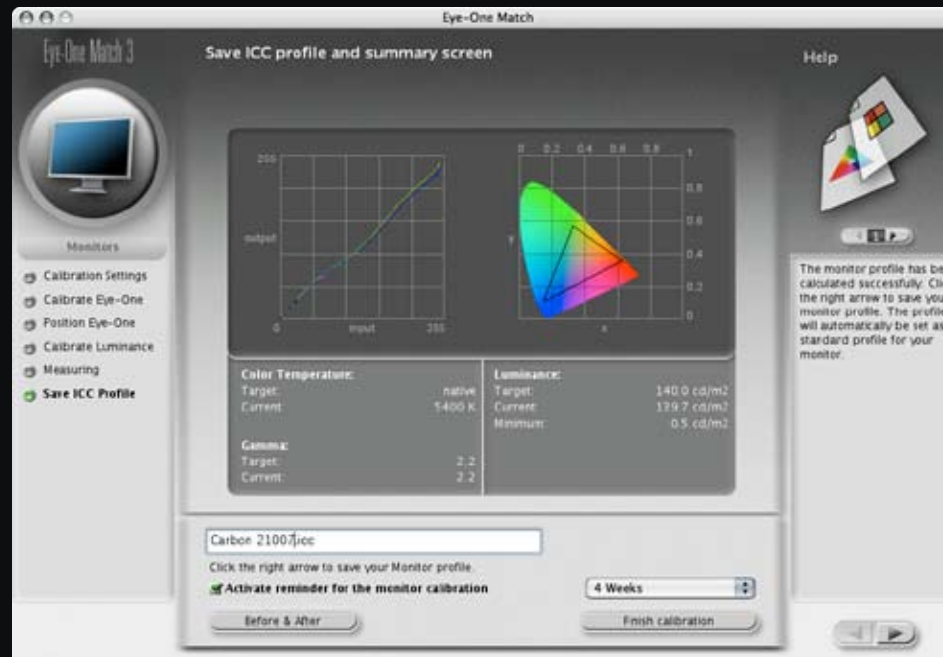


- Line up the black bar in the middle of the graph as shown at right



## Calibration (CONTINUED)

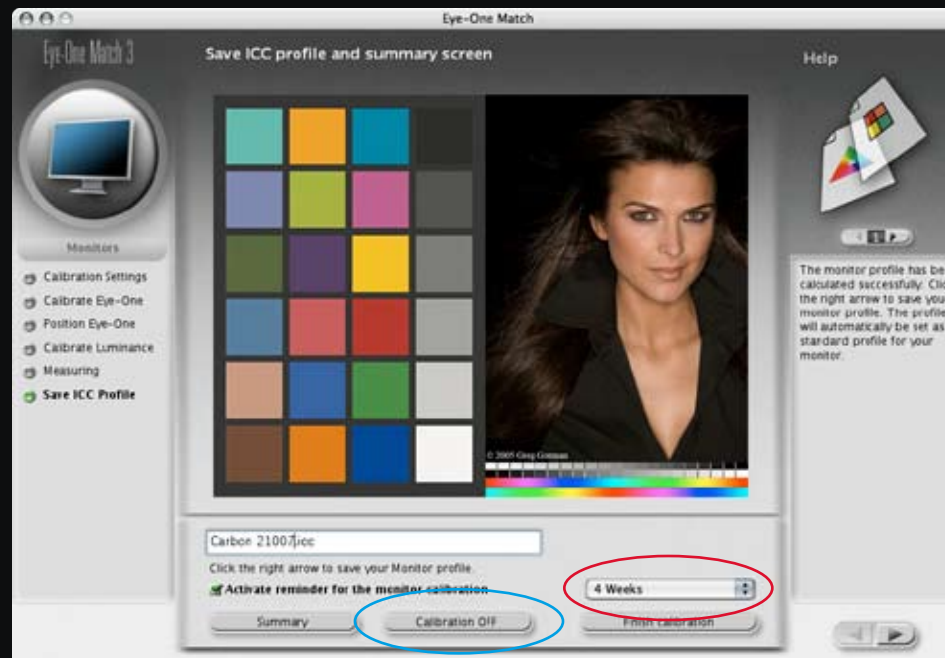
- Once the luminance is set and you choose to proceed, the software will begin spitting out those known RGB values for the device to read and – once finished – will automatically create the display profile



- Above, we see our profile summary, which displays the target and current values for our three parameters: Luminance, Temperature and Gamma

## Calibration (CONTINUED)

- Finally, we can actually view a comparison of before/after the calibration by toggling the **Calibration OFF/ON** button
  - Keep in mind it is normal to see subtle differences from one calibration to the next, even when keeping the parameters the same



- In addition, we can also set a **reminder** for when we want to calibrate next

## CRT Calibration

- **Setting White Luminance**
  - Use the recommended setting of 90 cd/m<sup>2</sup> and avoid cranking up the luminance to get the maximum possible contrast ratio because, in doing so, you will be shortening the life of the monitor
  - The software should walk you through this, but if not (or even if so) this is done by turning the Contrast up to 100% and the Brightness to 0%
- **Setting Black Luminance** (if available)
  - Keep in mind that if you set this too low in an effort to get a higher dynamic range, you may end up clipping some shadow levels; in addition, the light output of CRT monitors gets progressively less stable the closer it gets to black
  - You adjust the black luminance by way of the Brightness control
- **Setting Color Temperature**
  - Adjust either to the closest preset (if that is the only option) or using the RGB gain controls to get as close as possible to the desired target, usually aided by a visual graph provided by the software; this may take some getting used to!

## Saving the Profile

- There are two approaches to this:
  - Saving the profile each time (usually including the date in the filename)
    - this is really a matter of preference, but keep in mind that the condition of the monitor that previous profiles described no longer exists since the monitor has been recalibrated, so they're not of much use)
  - Overwriting the profile with a common name
- The software should save the profile automatically to the correct location – it is best not to tamper with this; if it doesn't, however, use the following:
  - Mac OS 9 – save to the ColorSync Profiles folder in the System Folder
  - Mac OS X (as Admin) – save to /Library/ColorSync/Profiles/Displays (the profile is then available to all users)
  - Mac OS X (as User) – save to ~/Library/ColorSync/Profiles/Displays where “~” is your Home folder (thus, the profile is only available to you)
  - Windows98 – save to Windows/System/Color
  - Windows XP, 2000 and ME – save to WinNT/System/Spool/Drivers/Color
  - Windows NT – save to WinNT/System32/Color
  - Windows Vista – System32/Spool/Drivers/Color