VideoEq Control Panel

VideoEQ™
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Congratulations on the purchase of your new VideoEq Mx advanced color processor. We are confident that you will truly enjoy watching lifelike video with unmatched color accuracy that is possible with the VideoEq products. This guide will walk you through the basics of calibrating and configuring the VideoEq to maximize the performance of your video system.

Requirements

To properly install your VideoEq Mx, you will need the following items:

- VideoEq Mx Advanced Color Processor
- High Definition Video Display with HDMI input (Flat Panel, Projector, etc)
- Power adapter (supplied with VideoEq Mx)
- Two HDMI Cables
- USB Cable
- computer with Windows XP, Vista, or Windows-7 operating system
- VideoEq Tools (available from www.videoeq.com)

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Software

The software is available as a download from the X-Vue VideoEq web site (http://www.videoeq.com/downloads).

Download the Control Panel and the driver package and install the files in a desired directory. After the VideoEq Tools have been installed on your computer, you are ready to start configuring and calibrating the system.

For the remainder of this guide, we will assume that your computer is powered up and running, and has the VideoEq Tools software installed.

Hardware Connections

Power

Connect your VideoEq Mx to power, using the supplied power adapter.

Video

The VideoEq advanced color processors has two HDMI ports, an input and an output. Connect your video source (AV Receiver, Blu-Ray, Set-Top Box, etc) to the VideoEq's "HDMI In". Connect the VideoEq's "HDMI Out" to one of your video display's HDMI inputs.

USB

Finally, attach the VideoEq to your computer using a regular USB cable. Windows will go through the normal sequence for installing hardware and drivers. If you have not already installed the VideoEq Tools software, your computer will not be able to find these drivers.

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Using X-Vue VideoEq Control

When "VideoEq Control Panel" connects to a VideoEq, it will query the unit to find out what it's capabilities are, and configure the application to the individual model. Not all VideoEq models support all options, so if some controls are disabled, it is because your VideoEq does not support them, or the calibration table you are adjusting does not support them.

The "VideoEq Control" application has three main areas: The "Preferences" menu, the "Lookup Table" tab, and the "Color Management" tab.

The "Preferences" Menu

The "Preferences" menu is the last icon displayed when the application starts, it displays information about your VideoEq and allows you to set some model specific options.

Figure 1 below gives a quick reference to the controls available on the Preferences. The Information Window shows detail about your VideoEq, including what options are supported, and how many memories are available for configuration.

On this page, you can control the following options on the VideoEq:

- If the VideoEq Control application was not able to connect to a VideoEq device upon startup, the "Connect to VideoEq" button is enabled to allow the user to connect the VideoEq after the software has started.
- "Use VideoEq's EDID Table" – Normally, the VideoEq mirrors the Display's EDID table back to the source device. Some source devices do not handle this negotiation properly. This option allows the VideoEq to use it's own internal EDID table for negotiation with the source device. Changing this setting requires that the VideoEq be powered down and then powered back up before taking effect.
- "Force 10 Bit Output" – Some display devices are capable of displaying deep color, although their EDID table states that they prefer 8-bit color. This setting forces the VideoEq to output 10 bit color information, regardless of what the display's EDID table requests. NOTE: Setting this option may cause your display to not show any picture, if the display does not support 10 bit input. Changing this setting requires that the VideoEq be power cycled before the change will take effect.
- "Force LED's Off" – This control is available for the VideoEq models that are capable of turning the LEDs on the front panel on and off.

The main page also has controls for saving the current LUT/CMS table to a file, reading a LUT/CMS from a file, and for selecting the table on the VideoEq. When a table is selected with the drop-down menu, it is automatically read into the VideoEq Control application.

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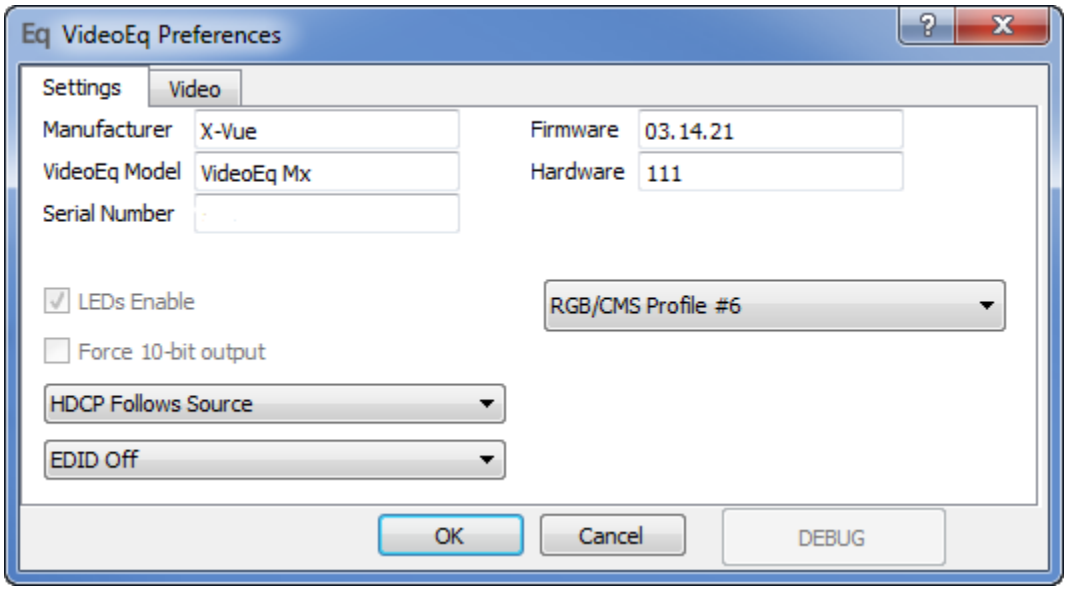

Figure 1 - Config/Info Tab Overview

The Lookup Table Tab

The Lookup Table tab provides controls over how the input video levels are adjusted on the output side of the VideoEq. Using this set of controls, it is possible to adjust the white balance and overall gamma of a video display to near perfection. Figure 2 below gives a quick reference to the controls and options available on this tab.

The main part of this tab is the table that controls the output level at 11 points ranging from video black level to video white level. The RGB will be enabled depending on what type of calibration table is selected. RGB controls are available for "Custom" tables and "Luma" tables are available for the "Preset" tables. When calibrating a "Custom" table, the Luma controls make changes in all of the Red, Green, and Blue components as a convenience to the calibrator.

You can initialize a new setup clicking the "Initialize LUT…". The "Measured Gamma" and "Target Gamma" fields allow the calibrator to enter both the actual gamma that the display is producing and the value that the calibrator wishes the display to output. Individual gamma controls are available for Red, Green, and Blue in Custom tables. This can be used when one color dominates the mid-range (for example Blue). As with the LUT controls, when calibrating a Custom table, the Luma gamma controls act as a shortcut for setting all three Red, Green, and Blue controls.

The Video Levels checkbox selects the limits on the top and bottom range of the adjustments. These limits are summarized in the table below:

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Video Levels Enabled	Range is limited to 64-940, with each endpoint "anchored" to it's absolute limit (0 => 0, and 1023 => 1023). This essentially makes the LUT control 13 points: Zero, the 11 adjustment points, and 1023.	
Video Levels Disabled	The range is set to the absolute limit (0 and 1023), the output levels at each point are determined by the values in the LUT controls.	

The Spline selection drop down menu controls what algorithm is used to interpolate values between the control points. The default is Akima, which does a reasonable job at minimizing the overshoot sometimes obtained with cubic splines. The cubic spline option is included for compatibility with previous versions of the software and with other software programs. The "linear" option does not try to smooth between segments, but instead assumes a straight line segment between control points.

The "Initialize Table" button then calculates the proper values for the lookup table based on the values entered in the gamma fields, Video levels, and the interpolation method selected.

The "Fine LUT Adjustments" checkbox controls how much each of the LUT controls changes the values in the table. When enabled, the adjustments are single units (+/- 1), when disabled, the adjustments are +/- 10 units.

At any time, the calibrator can click on the "Save to VideoEq" button or the "Read from VideoEq" button. These buttons either write the table in the control fields to the VideoEq, or populate the control fields with the values in the VideoEq. When changes are made in the VideoEq GUI, the "Save to VideoEq" turns orange to reflect the fact that these changes have not been saved to the VideoEq yet.

There are four sliders visible between the visual and the numerical representation of the LUT information. These sliders allow unique control for each R,G,B and the overall Luminance.

The "Master" RGB/L controls allow the calibrator to adjust all of the color or luminance points up or down, for quickly adjusting a major color shift. When calibrating a Custom table with RGB controls, the Luma control makes the appropriate adjustment in all three (RGB) fields. For example, to increase the overall brightness (luminance) in a Custom table, simly click on the "Master Luma +" button, all of the values in the table will increase appropriately.

The individual RGB/L controls allow the calibrator to adjust the white balance or luminance level at an individual color point. When calibrating a Custom table with RGB controls, the Luma control makes the appropriate adjustment in all three (RGB) fields.

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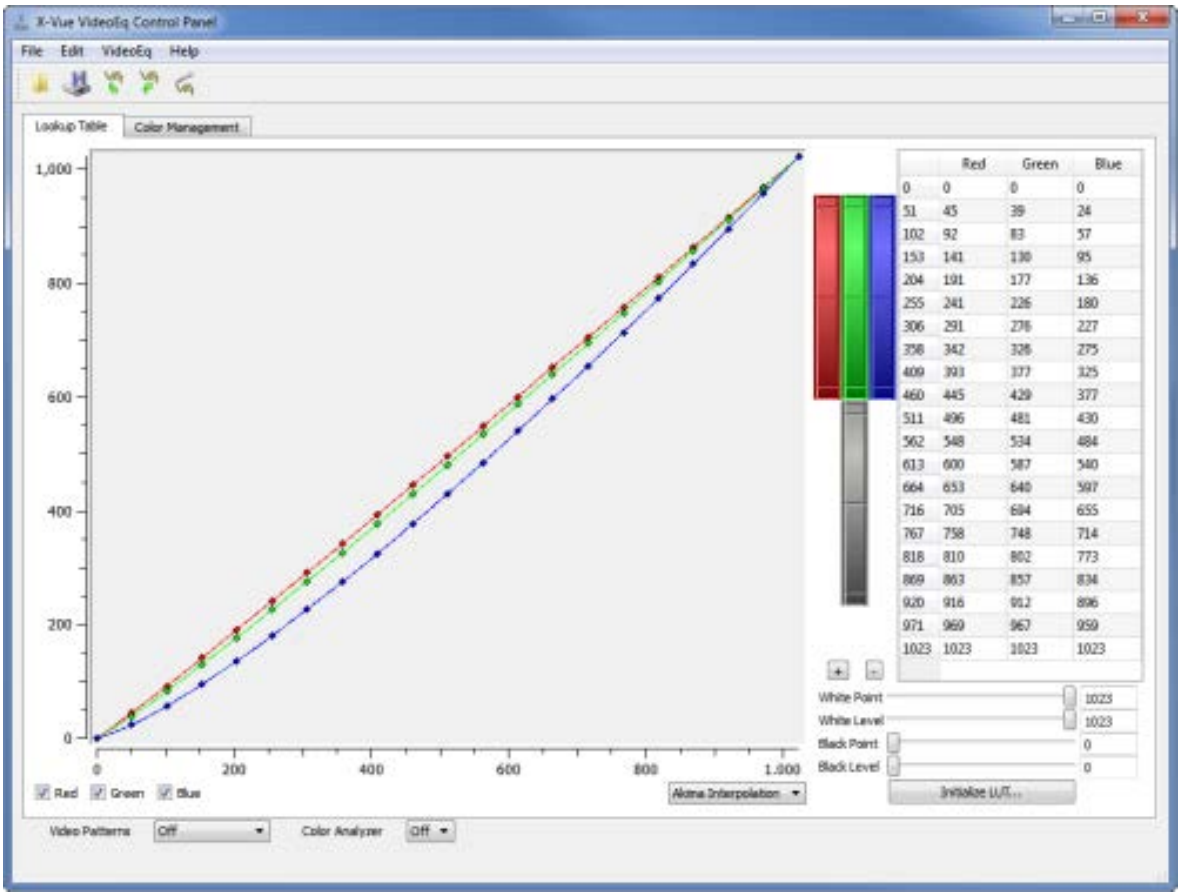

Figure 2 - RGB-LUT Tab Overview

The CMS Tab

The CMS Tab gives the calibrator complete control over the VideoEq's Independent 6-Axis Color Management System. These controls give control over all of the primary and secondary color points, without affecting the other colors. Figure 3 below gives a quick reference guide to the controls on the CMS tab.

You can enter precise numbers to the fields to assign values to corresponding primaries and secondarys.

The "Reset to Neutral" button resets the controls to 0/100/100 for each of the color points. This allows a quick way to return to the baseline setting.

The "Read from VideoEq" and "Save to VideoEq" buttons below the control tab allow the calibrator to read/save the values from the VideoEq attached to the system. The "Save to VideoEq" button turns Orange to indicate that there are changes pending that have not yet been saved to the VideoEq.

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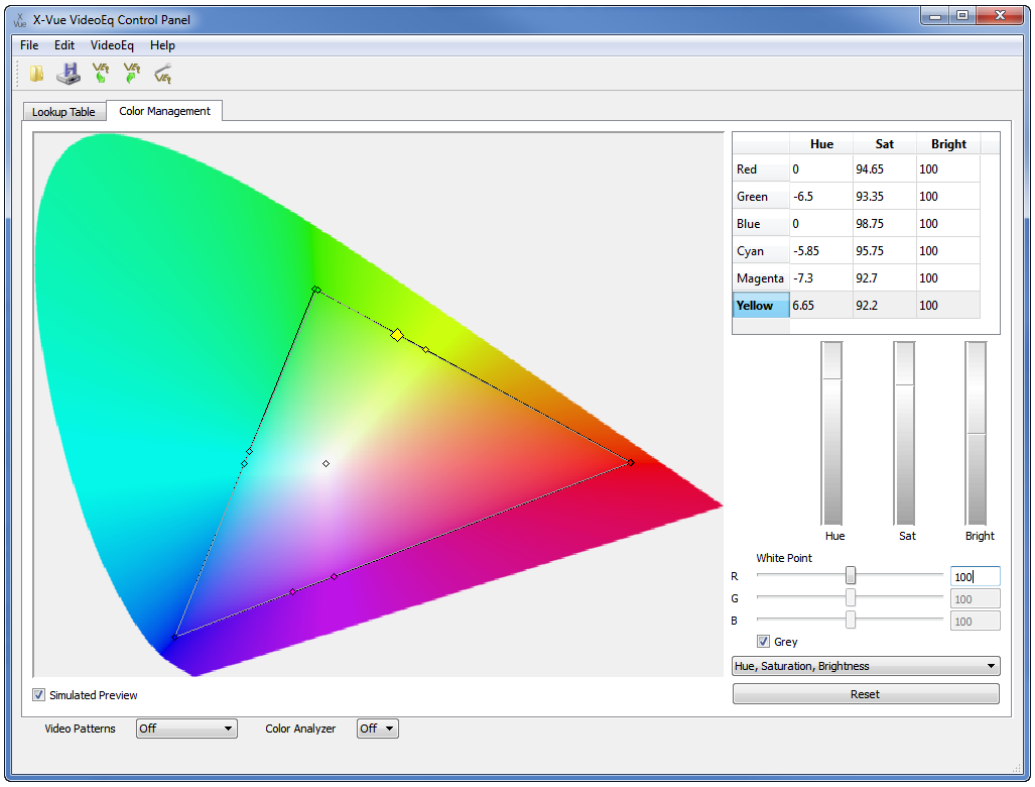

Figure 3 - CMS Tab Overview

RGB Lookup Table Calibration

Calibrating a video display's greyscale involves two quantities. First the gamma, and second the individual RGB values. Figure 4 below shows a graphical representation of the Lookup table calibration. The Lookup table maps an input video color level to an output level. If the LUT is programmed as a 1 to 1 mapping, then the effect is that whatever is input is output by the VideoEq, or effectively the VideoEq does no processing. The magic of the VideoEq's LUT processor is when our Video Display does not produce an accurate grey scale or have a uniform gamma. The VideoEq's internal LUT table can be programmed to compensate for the way the display produces images to correct for these deficiencies.

Let's look at a quick calibration on a VideoEq's Custom table. To calibrate a display's white balance using the controls on the "RGB-LUT" tab, first measure the display's gamma using your video calibration package (such as CalMAN). Enter this value in the "Measured Gamma" field, for this example; let's say that this measured value is 1.9. Let's assume that we want the display to have an output gamma of 2.4. Enter this value into the "Target Gamma" field. Now press the "Initialize Table" button. This will populate the table controls with initial values to compensate for the difference in the measured gamma and the target gamma.

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Note that these values are dependent on how the display handles the input levels. It is possible that the calculated values will be too high or too low for the specific make and model display you have. But these should provide a reasonable starting point for the calibration. Now re-measure your gamma value. If the new measured gamma is not the target gamma, adjust the "Target Gamma" field up or down to compensate for the display. For example, say that our second gamma measurement is 2.3 instead of the desired 2.4. In this case, enter 2.5 as a Target Gamma.

NOTE: putting the newly measured gamma in the "Measured Gamma" field will cause the VideoEq to reduce the amount of correction. In the example case above, if we had entered the new 2.3 value into the "measured gamma", and re-calculated, the correction would be the difference between 2.4 and 2.3, applied to the display's native gamma of 1.9.

After the gamma has been calibrated, we can move on to tuning the white balance. Using your color calibration software, measure the greyscale tracking of your display. Now use the individual (or master) controls to offset any color shifts that the display may have. For example, let's say that our greyscale measurements show a green tint at 30% and 40%, and a yellow tint at 80% and 90%. In this case we will reduce the green control at 30% and 40% and increase the blue control at 80% and 90%.

NOTE: The size of the adjustments needed will vary per display. A 10-count adjustment on a particular display may make an obvious change, while another model might require 50-counts to show the same effect. Additionally, because of the display gamma, a 10-count change at the low end will have more of an impact than a 10-count change near the white point.

There is some interaction between the white balance and the overall display gamma, to it is important to review the gamma setting after the white balance has been done. This may show that you need to further fine-tune the colors.

Calibrating a "Preset" table is similar, but does not allow for adjustment of the individual color components, only the overall luminance output.

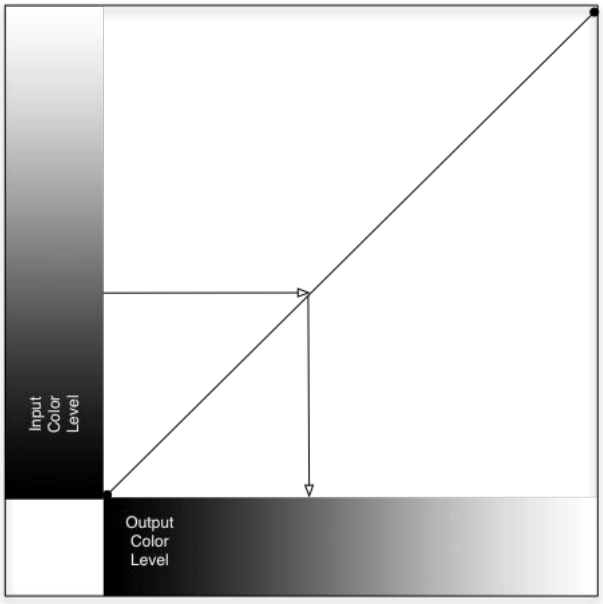

Figure 4 - LUT Calibration

Color Management Controls

The VideoEq color management system is unlike any other system available today. The control over individual primary and secondary is not available on any other processor on the market. This section gives a brief introduction to calibrating the primary and secondary color points of a display using the VideoEq CMS system.

After the greyscale and white balance have been calibrated, we can move on to calibrating the primary and secondary color points. Again, we start by measuring the primary and secondary color points using our video calibration software.

Now, calibrate each primary and secondary color in sequence. Unlike White Balance calibration, where we add or subtract Red, Green, or Blue levels to achieve the proper calibration, with the CMS controls, we adjust Hue, Saturation, and Brightness of each color point.

When we measure the individual colors, we will end up with three different possibilities. Hue controls the color shift of the primary or secondary. For example, our Green may be shifted too much toward Blue. Using the Hue control, we can adjust this back to its proper position on the CIE diagram.

Secondly, the color may be too saturated, shown on the CIE diagram by the color being outside the Color Reference triangle (i.e. Rec709 or Rec601). We can use the saturation control to move the color point closer the reference triangle.

Finally, the color point may be too bright overall. Using the brightness control, we can reduce the intensity of the color point and bring it to the reference standard.

Figure 5 below shows how the Hue and Saturation controls affect a display's color point.

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NOTE: Some displays may show "posterization" or a worse picture when calibrated to the reference standard. This is because the display's native output is far outside the reference standard and when the controls are reduced to make an accurate color, the display no longer has enough range to blend the colors smoothly. The VideoEq gives the calibrator enough flexibility to make an accurate picture, but because of display limitations, the accurate picture is not always the best visibly. The experienced calibrator will know how to balance a numerically accurate picture with what the display is capable of showing.

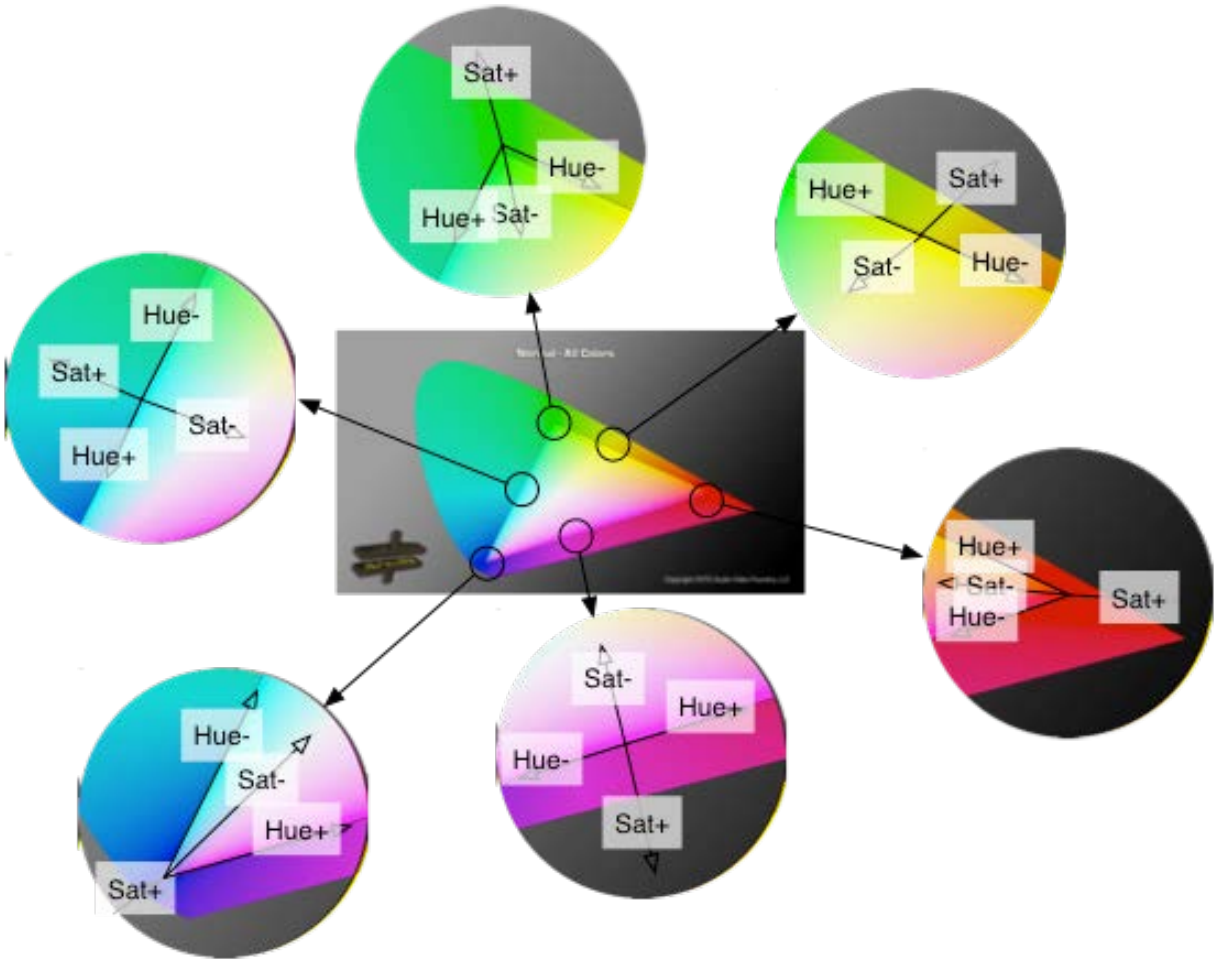

Figure 5 - CMS Controls

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Frequently Asked Questions

1. Is the VideoEq Mx a 1-D or a 3-D Lookup Table?

The VideoEq Mx, is a 1-D lookup table with a CMS matrix that enables all of the control of a 3-D lookup table, without the complexity of creating the tables.

2. How do I copy one table (say Custom 1) to another table (say Custom 2)?

The VideoEq Control application will automatically read the selected table from the VideoEq. Therefore, to copy one table to another, perform the following steps. For this example, we will be copying "Custom 1" to "Custom 2"

1) Select the source table (Custom 1)
2) Save the table to a File (say Custom1.veq)
3) Select the destination table (Custom2)
4) Read the file back into the application (Custom1.veq)
5) Save both the LUT and CMS tables to the VideoEq by selecting each tab and clicking on the "Save to VideoEq" button.

3. Will my display be able to produce an accurate standard colorspace (i.e. Rec 601 or Rec 709)?

The VideoEq provides enough control that you should be able to get very close to a reference standard, provided that you display has a wide enough "native gamut". The "native gamut" refers to the position of the red, green, and blue color points that the display produces with no external processing. The primary color points (red, green, and blue) define a triangle on the CIE diagram. Using any combination of the primaries, the system can produce any color within the triangle. It is not possible to produce a color "outside the triangle".

There are two scenarios where the VideoEq will not be able to achieve the reference standard: 1) One or more of the native primaries are "inside the reference triangle", and 2) if there is not enough bit-resolution to make adjustments.

Strictly speaking, in case #2, it may be possible to calibrate the system to the reference standard, but by doing so, we have reduced the amount of range available to the display and may see some posterization or banding in smooth gradients.

To put it another way, the VideoEq cannot drive your display beyond it's physical limits.