TruVue eeColor™Application User Guide

Revision 10.0

March 14, 2011

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TruVue eeColor™ Application User Guide

Introduction

The TruVue eeColor™ Application is a 32 bit Window's XP (Home or Pro Edition) or Window's 7 application that goes with the TruVue eeColor™ Processor for accurate calibration of video displays, and for easy downloading of 3D eeColor™ tables. It can also be used on a Mac PC with standard Windows Emulation. 3D eeColor™ tables use patent pending, perceptual models of visual adaptivity and ambient light losses for given viewing environments, to improve colorfulness, contrast and brightness of displayed media. For a full description of the power of 3D eeColor™ tables the user is referenced to www.eecolor.com.

The application provides full video display calibration that includes; 1) displaying test targets for measurement and verification, 2) input of measured chromaticities and brightness values for primary colors, 3) input of measured brightness values for each color level, 4) calculation of color calibration matrices for both D65 and Native white points, 5) calculation of 1D, RGB display linearity tables, and 6) downloading of the color calibration matrices and 1D linearity tables to the TruVue eeColor™ Processor. Alternate test target display and measurement applications can also be used by making sure that the digital count values for the alternate target application measurements are the same as those used in the TruVue eeColor™ Application. The color primary and linearity calibration can be performed on any video display device.

This documentation will provide, 1) an overview of the application, 2) detailed calibration procedures and user interface screens and 3) an appendices containing sample plots and graphs, common problems and troubleshooting, setup recommendations, data formats for recorded data and workflow procedures.

To install the TruVue eeColor™ Application the user is referred to the "TruVue eeColor™ Application Installation Instructions" available on www.eecolor.com.

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Application Functions

Main Application

This section is the main application interface and it allows the user to choose individual target, calibration and download functions and access help.

Target Display

This provides the user the ability to display red, green, blue or grey targets using the Windows application computer. In order to display the targets, the Windows application computer must have an HDMI connection to the display. The color targets have 21 predefined digital values that are used in the subsequent calibration sections. To ensure that the target digital values are displayed correctly, it is important for the user to set the Windows display controls to a gamma of 1.0. The digital values can be changed or the user can display targets from another application by ensuring the target digital values are the same as used in the TruVue eeColor™ Application.

Linearity Calibration

This section provides the user the ability to measure and calibrate the linearity of the display by creating 1D gamma tables for each color, and downloading them to the TruVue eeColor™ Processor. The baseline 1D tables for the eeColor™ Processor, without linearity calibration, are the standard inverse 2.20 gamma tables designed for CCIR 709 encoding.

Color Primary and White Point Calibration

This section provides the user the ability to measure and calibrate the primary colors of the display by calculating the appropriate matrix transformations for D65 and Native white points, and downloading them to the TruVue eeColor™ Processor. The primary and white point matrix transformations are performed in the standard 2.20 gamma display brightness space in the TruVue eeColor™ Processor. The baseline display primary colors, without color calibration, are currently CCIR709 or common RGB LED primaries with a D65 white point. These primary color gamuts are also supported by selectable 3D eeColor™ tables. Entertainment Experience will add other primary color gamuts, such as laser primaries, in the future. The TruVue eeColor™ Processor supports the selection of D65 or Native white points using the remote control.

Calibration and 3D eeColor™ Table Download

This section provides the user the ability to download calibration results and 3D eeColor™ tables to the TruVue eeColor™ Processor via a tethered USB connection. 3D eeColor™ tables are provided with the application for RGB LED displays, non-RGB LED displays and the TruVue Vango LED Projector from Entertainment Experience. Additional tables will be included in future releases of the TruVue eeColor™ Application and available for download on the www.eecolor.com website.

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Main Application

Description

The TruVue eeColor™ Main Application interface allows the user to choose individual target, calibration and download functions.

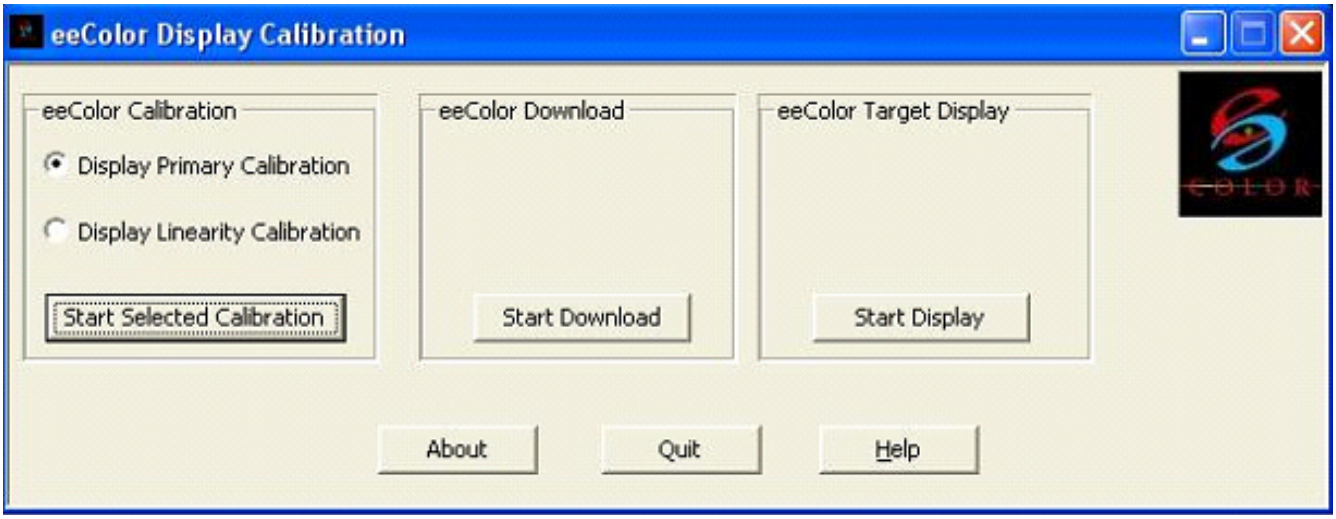
Usage

To initiate the main application, select the eeColor™ application icon placed on the Window's application computer desktop after installation. Referring to the user interface below, the user can initiate any of the application functions. For Target Display, the user can select the "Start Display" function to display the RGB or grey target values, or use a separate target display application. For calibration, the user can choose to do a "Display Primary Calibration", a "Display Linearity Calibration" or both. Appendix E describes the recommended display and measurement setup. Appendix G describes the recommended workflow with the "Display Linearity Calibration" being the first recommended calibration step. For Download, the user selects "Start Download" and can independently download display primary or display linearity calibration data or 3D eeColor™ tables.

The About and Help icons allow the user to view information about the current application and a detailed user guide. The Quit icon exits the TruVue eeColor™ Application.

Note: Measured and calculated data can be named and saved when the application is closed for reference and future use. It is important to complete a calibration session, including the data download to the TruVue eeColor™ Processor, before quitting the application.

The user is referred to Appendix K for Troubleshooting issues.



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Target Display

Description

The Truvue eeColor™ Target Display provides the ability to display red, green, blue or grey targets using the Windows application computer. In order to display the target colors, the Windows application computer must be set to 720p or 1080p with a display gamma value of 1.0, and have an HDMI connection to the display. There are twenty-one (21) predefined digital color values that are used in the calibration calculations. They are 0, 48, 74, 94, 111, 125, 138, 149, 160, 170, 180, 189, 197, 206, 213, 221, 228, 235, 242, 249, 255. All twenty one digital values are used to measure the gamma response of the display for red, green and blue color. The maximum digital value, step 21, is used to measure the color primaries for White Point and Color Primary Calibration unless the display exhibits a non-gamma response in the bright region and a lower step value is recommended for the maximum White Point and Color Primary Calibration. The display supports two target sizes; 1) full screen, or 2) center screen if there are concerns about brightness affects from active areas on the display periphery. Appendix F provides additional details. A separate target application can also be used, but the target digital values must be the same as those in the Truvue eeColor™ Application.

The target displays can also be used to verify newly downloaded calibration results by connecting the Truvue eeColor™ Processor and measuring the target displays as described in subsequent sections.

Usage

To initiate this application section select “eeColor Target Display” on the Main Application interface and then select "Start Display". The color target interface, shown below, will be displayed. The user selects red, green, blue or grayscale in the "Color Selection" panel to choose the specific target color. "Start" will display the first digital value. "Previous" will display the previous digital value. "Next" will display the next digital value. "End" will display the last digital value. The number of the target color being displayed is indicated to the left of the "Goto" button. The user can also enter any desired target color number in the “Goto” window and press the “GoTo” button to have that target color number displayed. The standard target size is a centered square that is 10% of the width and height of the screen resolution. The user can also select the “Full Screen” option in the “Target Size” panel to have the target fill the screen. "Exit" quits the Target Display section. Color measurements are made from the target areas and entered into the Display Color and White Point Calibration and the Linearity Calibration as described in the next sections. The user is referred to Appendix K for Troubleshooting issues.

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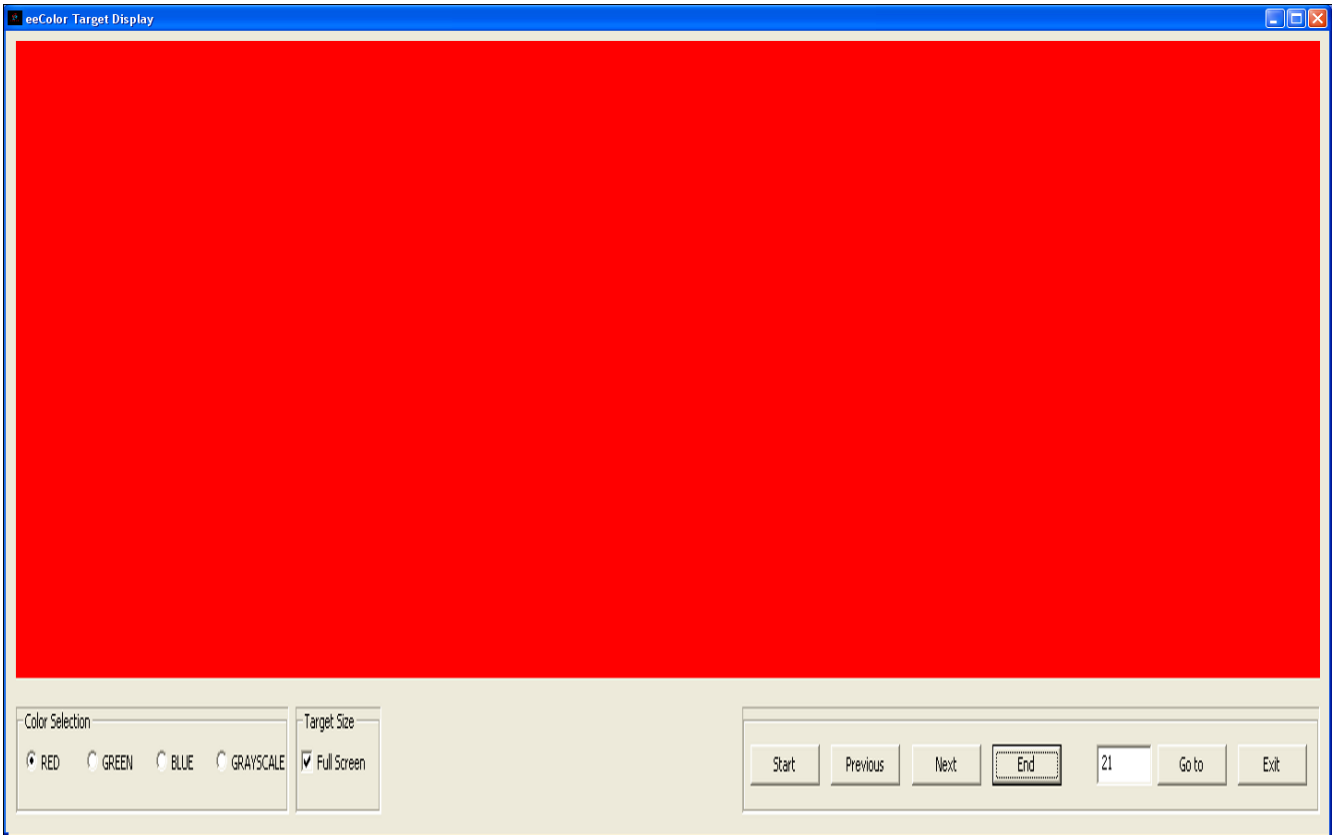

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Linearity Calibration

Description

The TruVue eeColor™ Linearity Calibration section provides the user the ability to linearize the output display to produce a 2.20 gamma response by generating smooth 1D gamma tables from twenty one (21) measured luminance (Y) values for each color. A Linearity Calibration is highly recommended even if the owner prefers to use different gamma settings to view media. By setting the display to a 2.20 gamma or using the standard setup and doing this calibration, the 2.20 standard baseline will be established for accurate viewing at different gammas. Typical luminance units are candela per meter squared (cd/m2). The range allowed for measured luminance values is from 0 to 10**7 with four decimal places of precision. The "TruVue eeColor™ Target Display" interface is used to generate the twenty (21) target displays for measurement. The stored digital values for these target steps are used to create the 1D tables for each color. The brightness steps of these digital values are chosen to accommodate a smooth fit to the measured data that is relatively insensitive to measurement noise while having enough data points to accurately represent typical display gamma responses. It is essential that the digital values for alternate target applications are the same as those in the eeColor™ Application. It is recommended that multiple measurements be made at various place on the display and averaged. This will help with display non-uniformity and reduce measurement noise. It is also recommended that a high quality measurement device be used with at least a 1000:1 brightness range. The TruVue eeColor™ Linearity Calibration section also provides the user the ability to perform a post calibration linearity check.

Usage

To initiate this application select the "Display Linearity Calibration" under "eeColor Calibration" in the Main Application interface and click on "Start Selected Calibration". Referring to the "TruVue eeColor™ Display Linearity Calibration" interface shown below, enter the measured Y values for each color. The arrow keys can be used to move from one input field to the next. When all the measured values have been entered, click on the "Apply" button to show the gamma plots for each color. The plots are color coded with red=R, green=G and blue=B. The measured data points are denoted by an "x" symbol. The user can select the color plots to be displayed by selecting the appropriate colors in the "Plot Control" panel. The "Measured Display Gamma" panel displays the average, red, green and blue gamma values.

The gamma plots should be smooth curves that increase monotonically and pass through or close to the measured data points. If a measured data point is not close to the gamma fit, the user should check for measurement or data entry errors. In addition, if any color does not follow a gamma function response for high brightness values and the visual error defined by L* (add a footnote reference) is large, a message will appear in the "Status" panel warning the user to adjust the display setup for one or more of the colors to produce a gamma function response. That adjustment is usually a contrast adjustment for the color(s) that do not conform to a gamma function response. If display adjustment is not possible, it is recommended that the user select the "Bright Region Correction" in the "Display Error Compensation" panel. The "Bright Region Correction" option uses L* error to remove high value data

points for each color that does not conform to a gamma function. By selecting “Apply”, the gamma plots will be redone with these high visual error points eliminated. The highest RGB code value and step that used in these new gamma plots for each color will be displayed in the “Primary Calibration Target Value” panel. If the Color Primary and White Point Calibration has already be done using 255 values for RGB, it is essential that it be redone using this highest RGB code value and step. This will be the new maximum D65 white point for the display with a guaranteed gamma response for each color. The user is also provided a choice “Clip Bright Region” in the “Display Error Compensation” panel whether to clip the input digital values above this highest code value or allow the gamma-linearized digital values to be passed to the display even though one or more colors will not be able to produce the required brightness. Clipping will lose levels above this highest code value but preserve the white point. Passing the gamma-linearized digital values will allow levels above this highest code value but introduce slight color tints in bright regions consistent with the display setup.

The “Status” panel will also indicate whether large L* visual errors occur in the dark region of the gamma function fit. These can occur do to noisy measurements or data entry errors. If there are no data entry errors, it is recommended that additional measurements be made and averaged to reduce measurement noise. If large L* errors remain after doing new gamma fits, the “Status” panel will recommend choosing the “Noise Reduction” option in the “Advanced Linearization” panel. This option minimizes L* visual error by removing data points in the dark measurement region that appear to be affected by noise. Selecting “Apply” will redo the gamma plots with these data points eliminated.

When the user is satisfied that the gamma function results are accurately fitting the remaining measured data points over the largest digital count range, the measured values and chosen options can be named and saved for future use by selecting “Save” located in the “Data Control” panel and entering the file name. Previously saved values can be recalled for linearity calibration by selecting “Load” located in the “Data Control” panel. The user can save the 1D gamma tables for download to the TruVue eeColor™ Processor by selecting “Save” located at the bottom of the application window. If the save is successful, this application section will exit automatically.

The user is referred to Appendix A for Sample Display Linearity Results, Appendix K for further Troubleshooting, Appendix D for a description of the file format for the stored values and Appendix J for the instructions on how to perform a post calibration linearity check.

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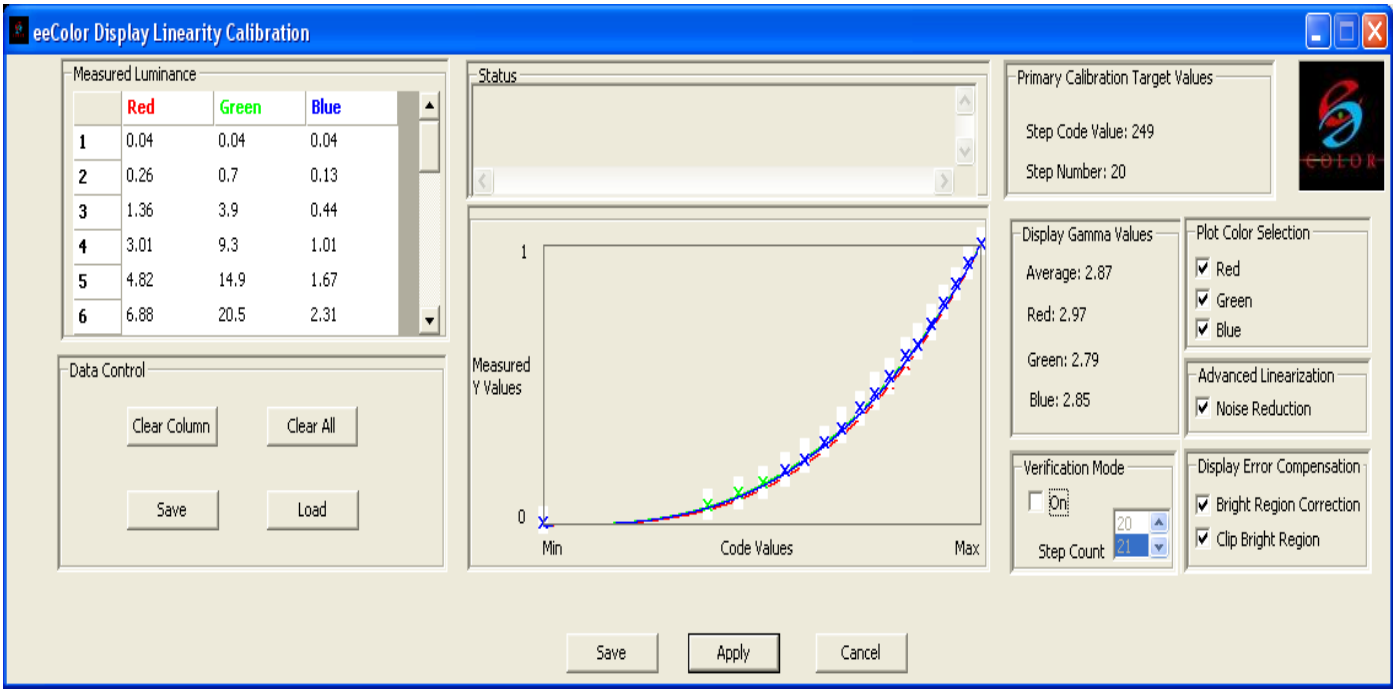

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Color Primary and White Point Calibration

Description

The TruVue eeColor™ Color Primary and White Point Calibration section provides the user the ability to measure and calibrate the primary colors of the display device by creating matrix transformations and downloading them to the TruVue eeColor™ Processor. Calibration matrices are calculated and downloaded for both Native and D65 white points, which can be chosen using the TruVue eeColor™ Processor remote control. The digital values that are measured from the Target Display function are the red, green and blue 8-bit maximum values (255,0,0), (0,255,0) (0,0,255), or step number recommended during the linearity calibration step if the display is determined to be a non-standard device with color clipping or a non-gamma response in the bright color values. The required measurements are the x and y chromaticity and Y luminance of each color. It is recommended that multiple measurements be made at various place on the display and averaged. This will help with display non-uniformity and reduce measurement noise. It is also recommended that a high quality color measurement device be used that has at least a 1000:1 brightness range.

Usage

To initiate this application select the "Display Primary Calibration" under "eeColor Calibration" in the Main Application interface and click on "Start Selected Calibration". Referring to the "TruVue eeColor™ Display Primary Calibration" interface shown below, enter the x,y,Y measured values for each color. You must select the display device type you are calibrating in the "Display Type" panel to ensure the right calibration matrix is calculated. The range allowed for x and y is 0 to 1.0 with 7 decimal places of precision. The range allowed for luminance measured values is from 0 to 10**7 with three decimal places of precision. You can use the tab key to move from one input field to the next. When you have entered all values click on "Apply" to see the chromaticity plot. The laser chromaticity plot, i.e., colored horseshoe-shaped region, and the HDTV CCIR709 chromaticity plot is provided for reference. The measured chromaticity plot should be inside the laser chromaticity plot. If it is not, then check the values that were entered for errors. The measured chromaticity plot should also be reasonably close to the HDTV CCIR709 triangle for standard televisions or projectors. For larger color gamut televisions or projectors, i.e., RGB LED projectors, the chromaticity plot will be larger than the HDTV CCIR709 plot. The "Calibration Matrices" window will show the calculated D65 and Native calibration matrices for reference, and the "Status" window will display any error messages.

When satisfied that the measured and entered values are correct, the user can name and save the measured values for future use by selecting "Save" located in the "Measured Chromaticity Values and Measured Luminance" panel and entering the file name. Previously saved values can be recalled for calibration by selecting "Load" located in the "Measured Chromaticity Values and Measured Luminance" panel and following the instructions to load a stored measurement file. The user can save the calibration matrices for download to the TruVue eeColor™ Processor by selecting "Save" located at the bottom of the application window. If the save is successful, this application section will exit automatically.

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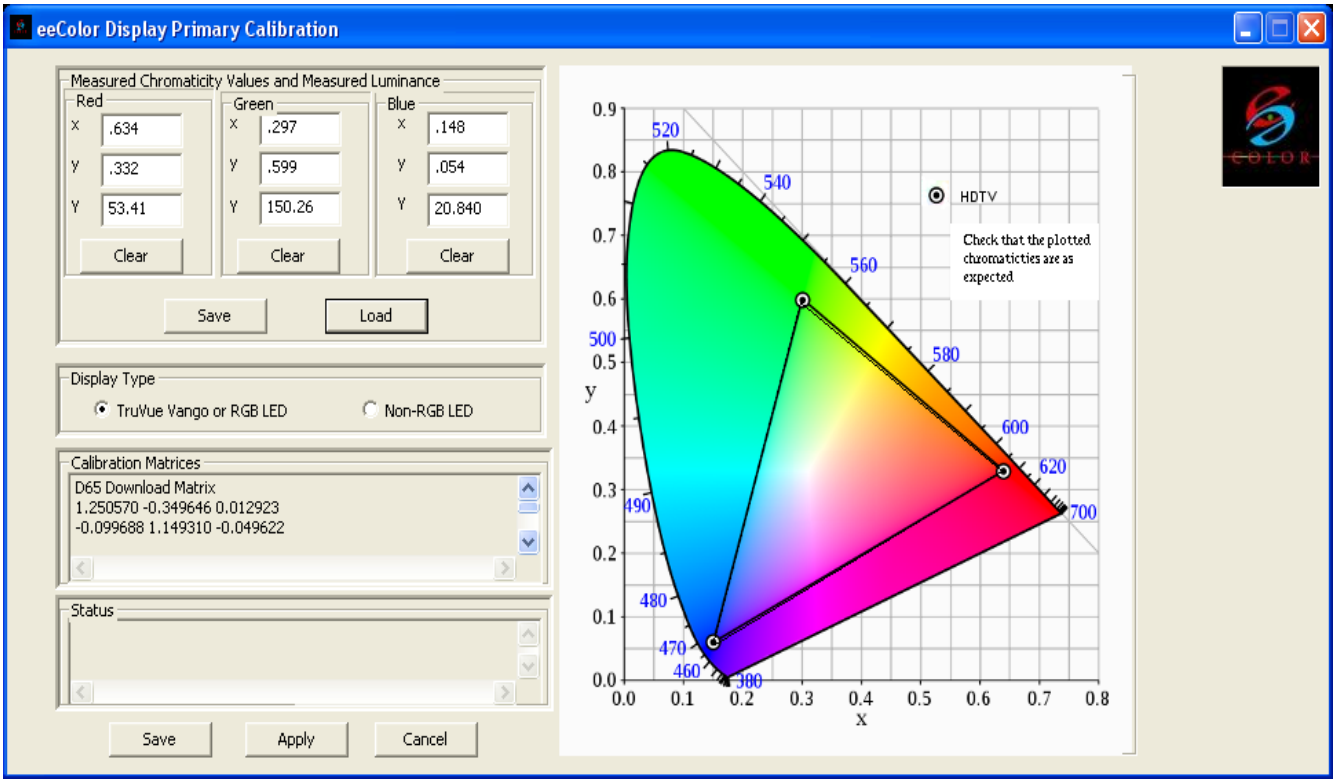
Once the Display Primary Calibration data has been downloaded to the TruVue eeColor™ Processor the Target Display section can be used to display the 21st step white target area or the recommended maximum grey level step from the Linearity Calibration to measure and verify the D65 and Native white point calibration. The remote control of the TruVue eeColor™ Processor can be use to switch between D65 and Native white when making these verification measurements. Appendix E provides additional details.

The user is referred to Appendix B for Sample Display Color Primary Results, Appendix K for further Troubleshooting and Appendix C for a description of the file format for the stored values.



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Calibration and eeColor™ 3D Table Download

Description

The eeColor Download Application supports the download of TruVue eeColor™ 3D tables, default or new display primary calibration matrices or default or new display linearity tables. Users can choose which TruVue eeColor™ 3D color tables to download by choosing the appropriate display type and choosing the desired 3D eeColor™ table by name. The display types currently supported are; 1) TruVue Vango LED Projector, 2) RGB LED Displays and 3) Standard non-RGB LED Displays. These displays have significantly different color gamut's, and therefore require different 3D eeColor™ tables. It is important to note that even though a television uses LED light sources, it very likely uses white LED's and not RGB LED's meaning it has a standard non-RGB LED display color gamut. A very large portion of installed displays would use the Standard non-RGB LED Display eeColor™ tables. The eeColor™ tables are supplied in sets of six (6) with all six tables downloaded to the eeColor™ Processor on selection. Users can also select a set of 6 unity tables for eeColor™ table download which is important when calibrating to remove any eeColor™ table processing. The download process takes approximately 2 – 6 minutes to complete depending upon what items have been selected for download.

Usage

To initiate this application, select "Start Download" under "eeColor Download" in the Main Application interface. Referring to the "TruVue eeColor™ Download" interface shown below the user can download any combination of new or default Display Primary Calibration data and Display Linearity Calibration data. The user must however select TruVue eeColor™ 3D tables to download or the download function will not be activated. This is to ensure that the correct display type is defined.

The "Display Primary Calibration" panel allows the user to select "Default" or "New" calibration data. Selecting "Default" will download the color primaries matrices that come with the TruVue eeColor™ Application. The default matrices for the native color primaries preserve the native colors of the display. The default matrix to produce a D65 white point for the TruVue Vango Projector will convert the projector to a D65 white point based on manufacturing measurements of the primary colors. For any other display the default matrix for a D65 white point assumes the display is setup to a standard D65 and is therefore the identity matrix. To achieve a D65 white point for a particular TruVue Vango projector or any other display that is not set up to D65 using the TruVue eeColor™ Processor, a full display primary calibration must be performed. Selecting "New" will download the last, saved calibration from the measured display color primaries.

The "Display Linearity Calibration" panel allows the user to select "Default" or "New" calibration data. Selecting "Default" will download the linearity 1D tables that come with the TruVue eeColor™ Application. The default 1D tables assume that the display non-linearity, i.e., gamma, is 2.20 for both the TruVue Vango LED Projector and other displays. It is highly recommended that the Linearity Calibration be performed even is the user wishes to view media at different gamma levels. Setting the display to a 2.20 gamma then doing the Linearity Calibration will ensure that the standard 2.20 gamma

is established and that other viewing gammas will be accurate relative to 2.20. Selecting "New" will download the last, saved calibration from the measured display linearity.

The "Display Type and TruVue eeColor™ 3D Tables" panel allows the user to choose the display type among the TruVue Vango LED Projector, RGB LED Display or Standard Non-RGB LED display, and to choose the room lighting and color intent for the set of six (6) eeColor™ 3D tables. Currently there are two color intents for the TruVue Vango LED Projector, namely Max Color and Max Brightness, for three (3) different room lightings. Max Color uses RGB primaries and produces the most colorful video. Max Brightness uses RGBCY primaries to increase the brightness 25% for large screen viewing with a slight decrease in colorfulness. The user can select either Std Skin Tones or Warm Skin Tones for the Max Color eeColor™ 3D tables. For all other display types there is three color intents, namely General, Cinema and Vivid Color, for two (2) different room lightings. The user can click on the (+) icon to see the display type and color intent options. The user must choose the eeColor™ 3D tables to ensure the correct display type is used in the download. Once the eeColor™ 3D Tables are selected the "Download" button will be enabled.

To complete the download, the USB cable provided with the eeColor Processor must be connected to the Window's Application PC. When satisfied that the desired Display Primary Calibration, Display Linearity Calibration and eeColor™ 3D Tables have been selected, the user selects the "Download" icon and the download will begin. The TruVue eeColor™ Processor data will updated and verified. Status messages will be displayed in the "Status"' panel during the download which will take 2-6 minutes depending in the download selections. The download can be canceled at anytime by selecting the "Cancel" icon. If, however, the download is canceled prior to completion, the TruVue eeColor™ Processor will be unusable until a successful download is completed. A successful download will be indicated in the "Status" panel and a completion tone will sound.

The user is referred to Appendix K for further Troubleshooting.

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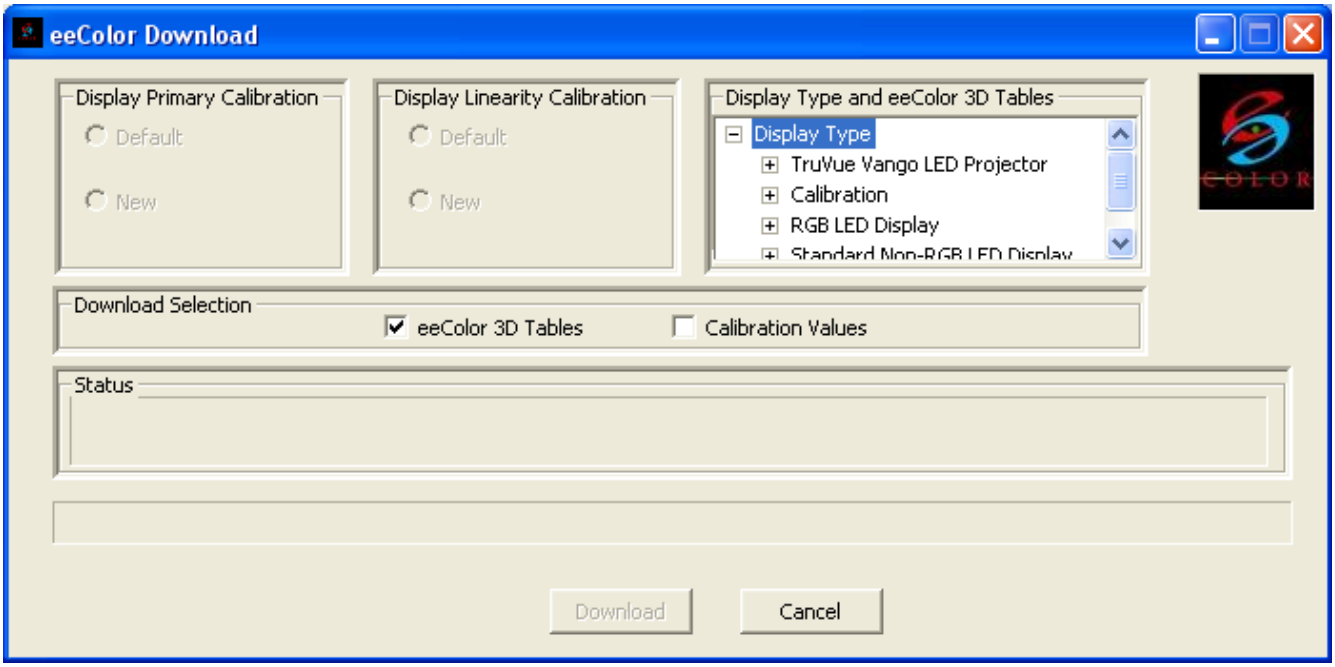

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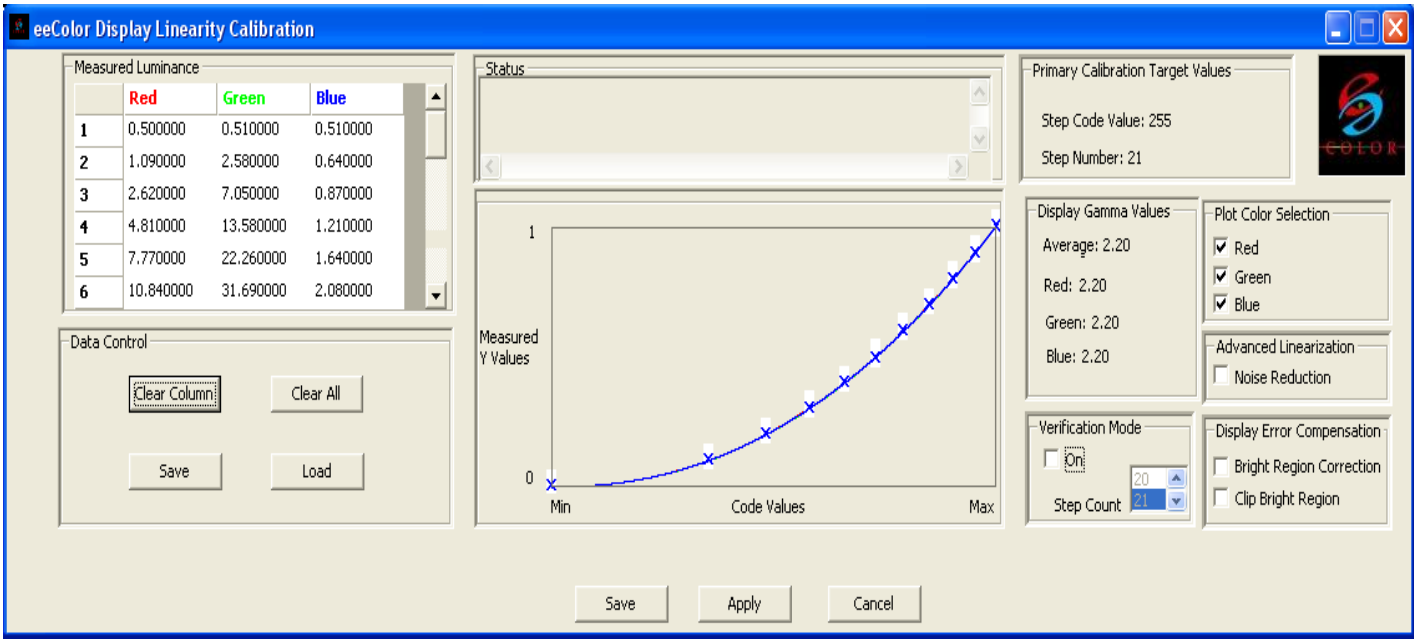
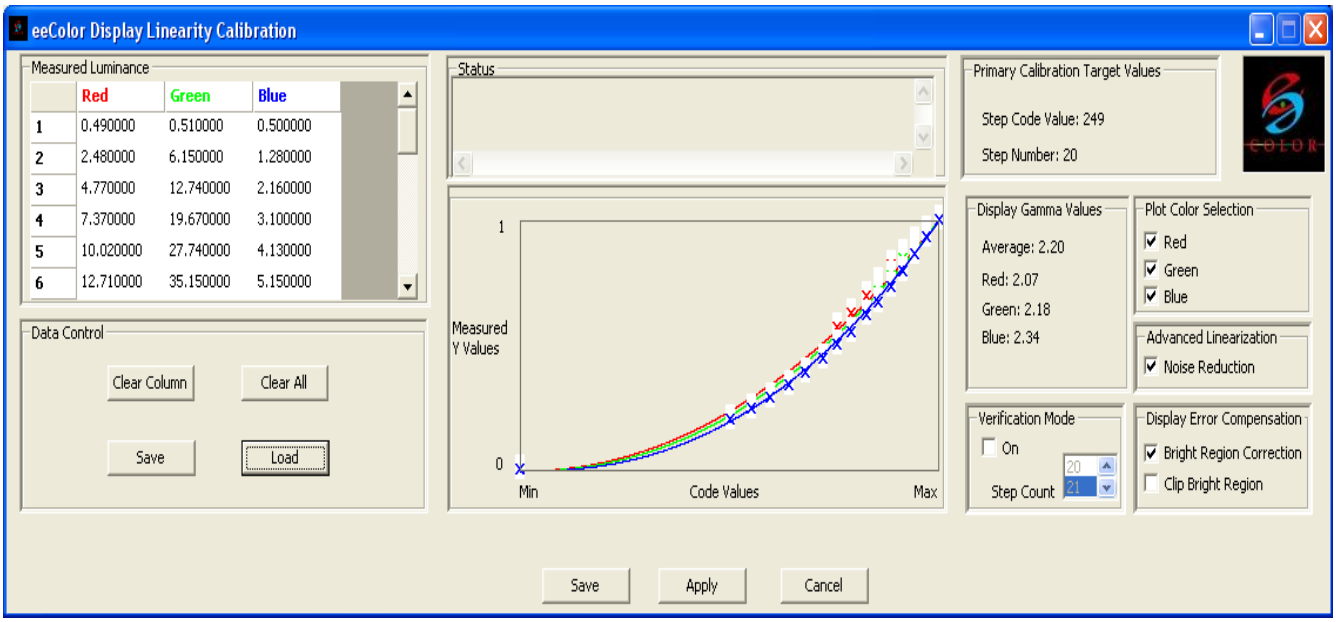
Appendix A - Sample Display Linearity Results

The following illustration shows a typical red, green and blue linearity curves for a gamma 2.20 display. The curves should always increase monotonically and smoothly. Also the linearity curves for red, green and blue will be quite similar and generally overlap as in the illustration. If the curves are not smooth or the red, green and blue curves are widely different, it is recommended that the user check the measured values and the data entries. The "Status" panel will also provide recommendations for display setup and the use of the "Advanced Linearization" options.



The following illustration shows a linearity curve for blue that has a gamma that differs greatly from the green and red channels. If this happens check the measurement data and the data entries. The "Status" panel will provide warnings and recommendations on display setup and the use of the "Advanced Linearization" options. Appendix K will also provide additional Troubleshooting.



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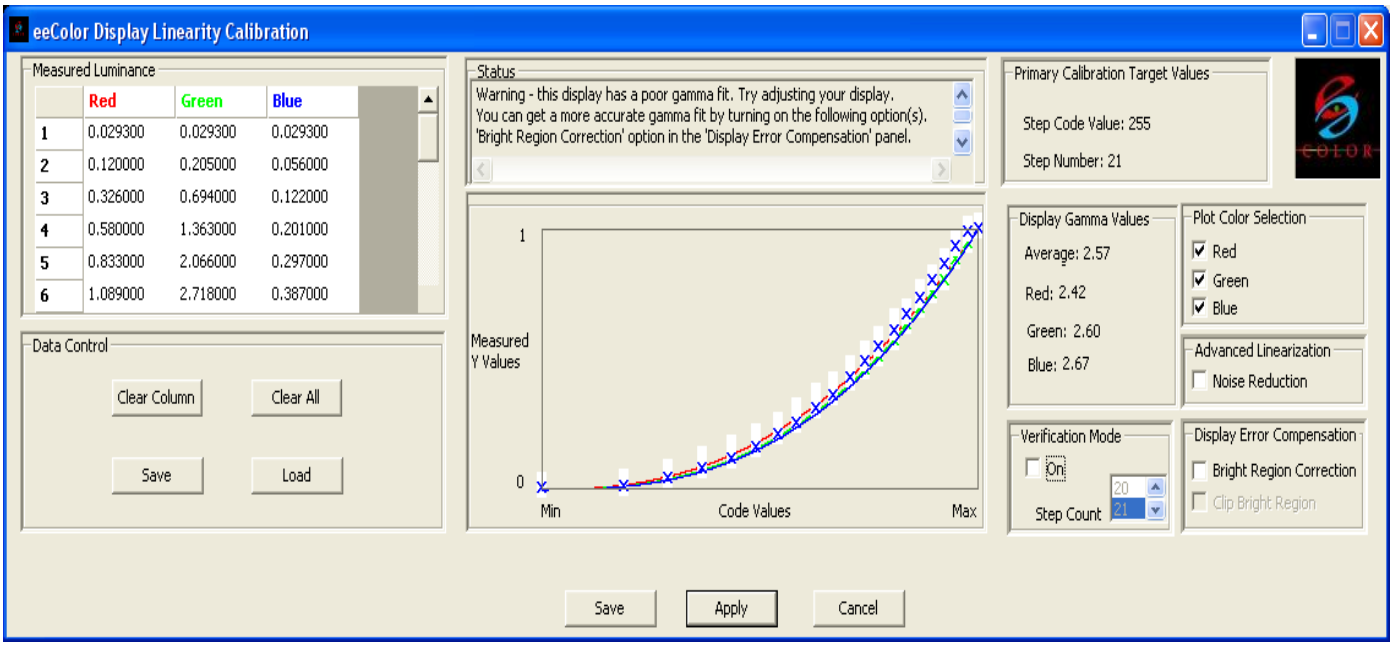
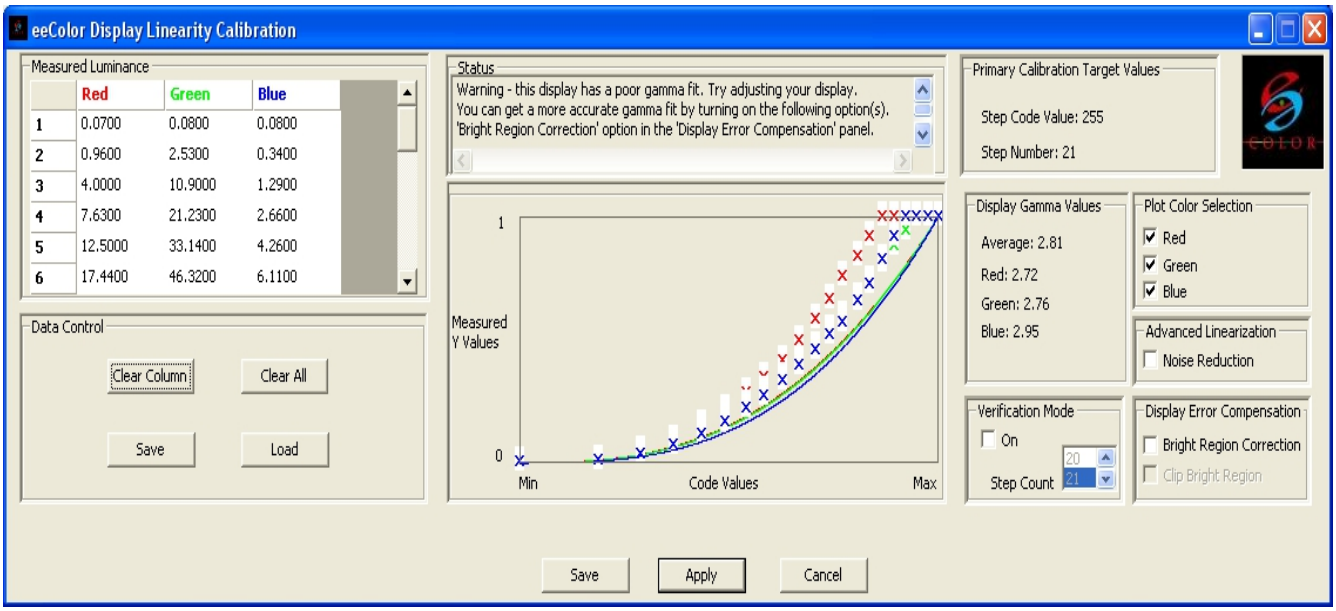
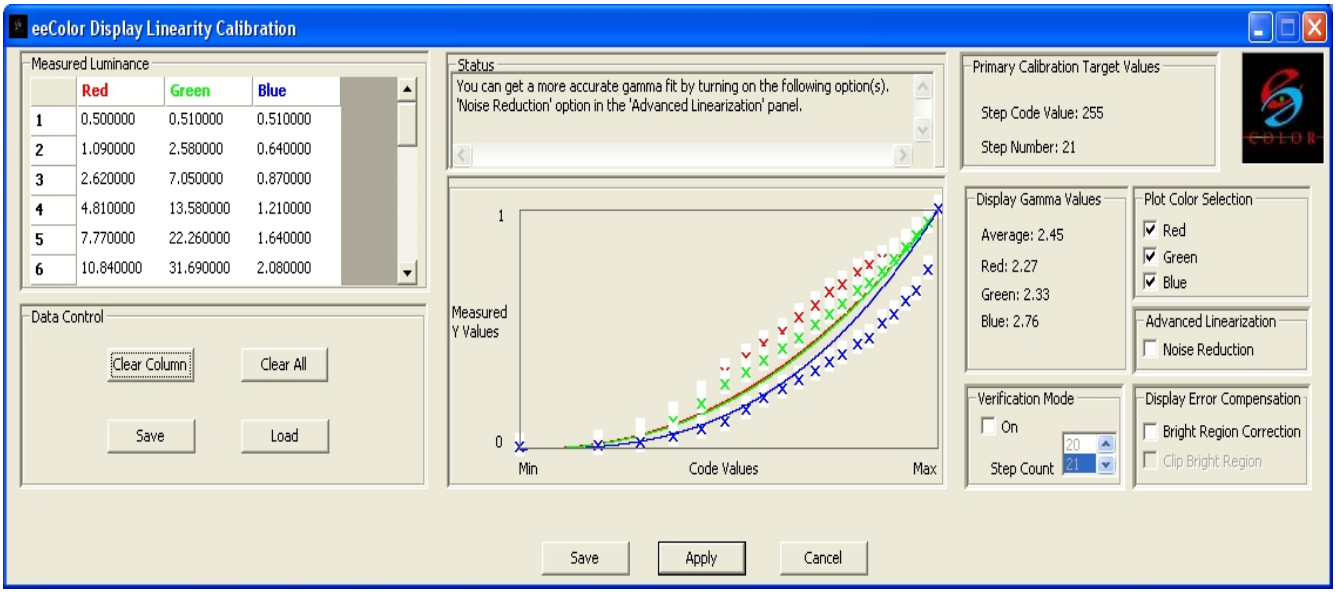
The following illustration shows an example where the display's bright region data points were not progressing in a predictable monotonic fashion. The "Status" panel will provide suggestions on how to adjust the settings of the display to produce a gamma response for all colors prior to using the "Bright Region Correction" option.



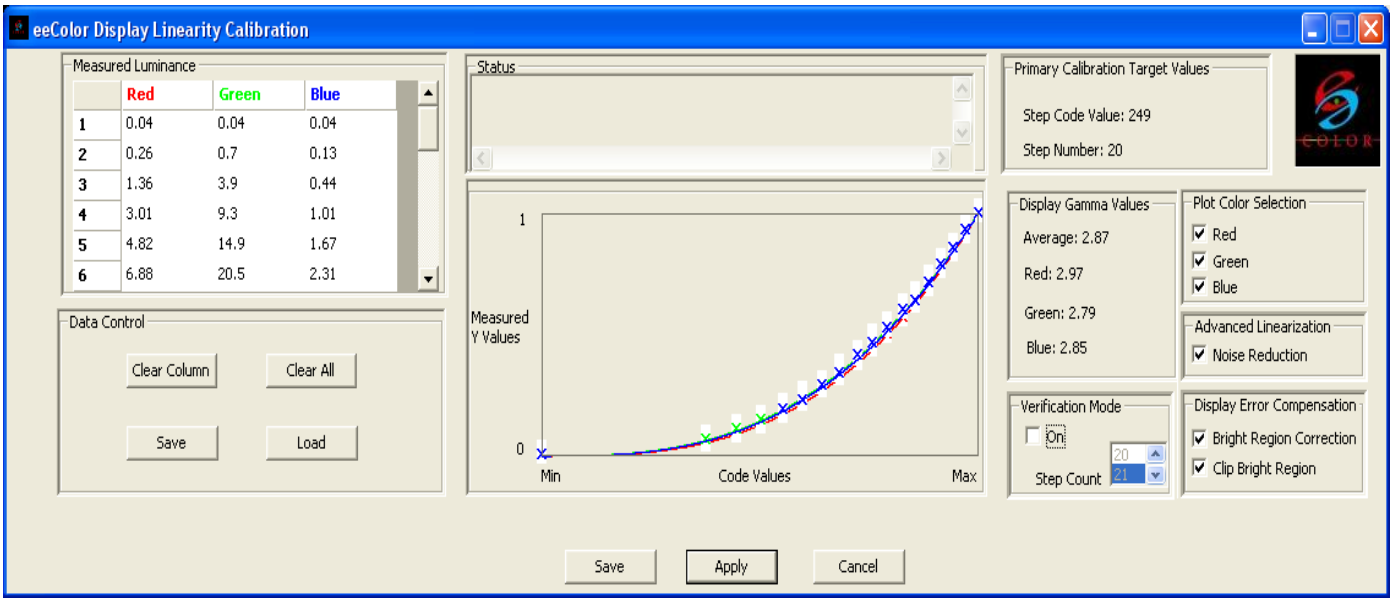
The following illustration shows an example where the display's bright region data points were not progressing in a predictable monotonic fashion and the data points were also not following a gamma like curve.



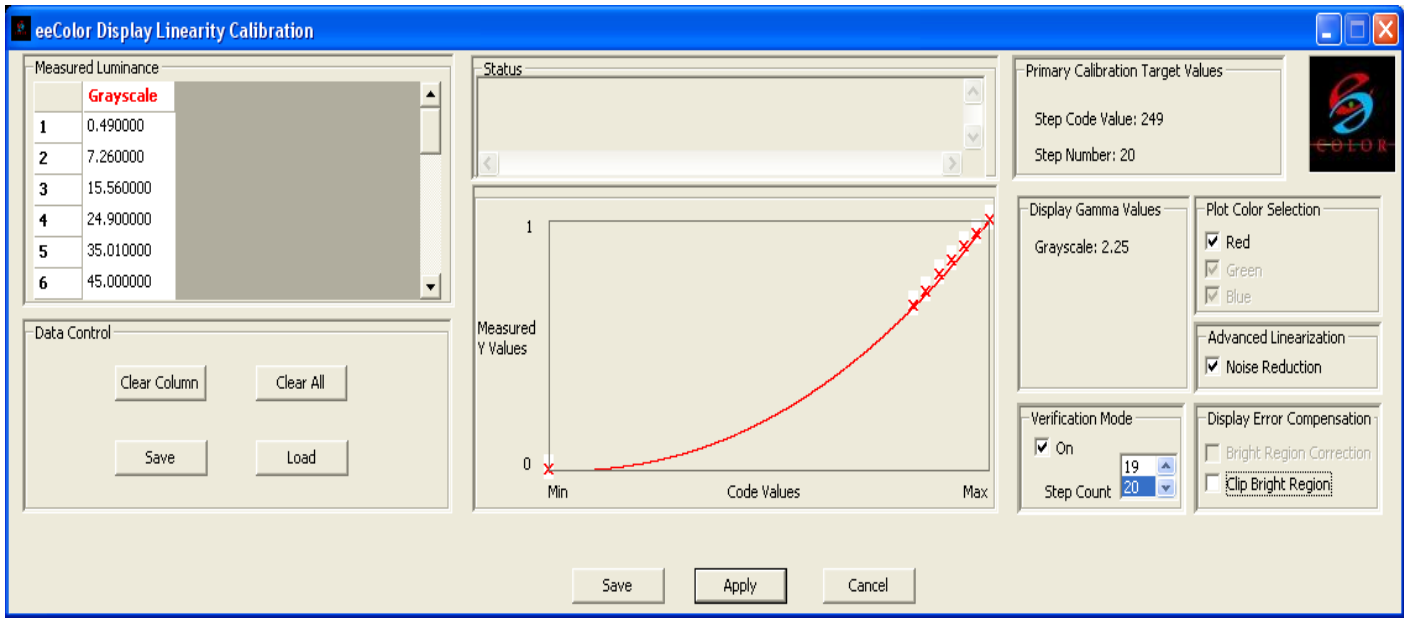
The following illustration shows an example where the display's data points were not following a gamma like curve.



The following illustration shows an example where the display's bright region data points were not progressing in a predictable monotonic fashion and the "Bright Region Correction" option was enabled to compensate for the display's behavior.



The following illustration shows an example where a linearity calibration check was performed by entering the 21 grayscale steps measured luminance values and then plotting the gamma curve and calculating the gamma without using the 21 step.



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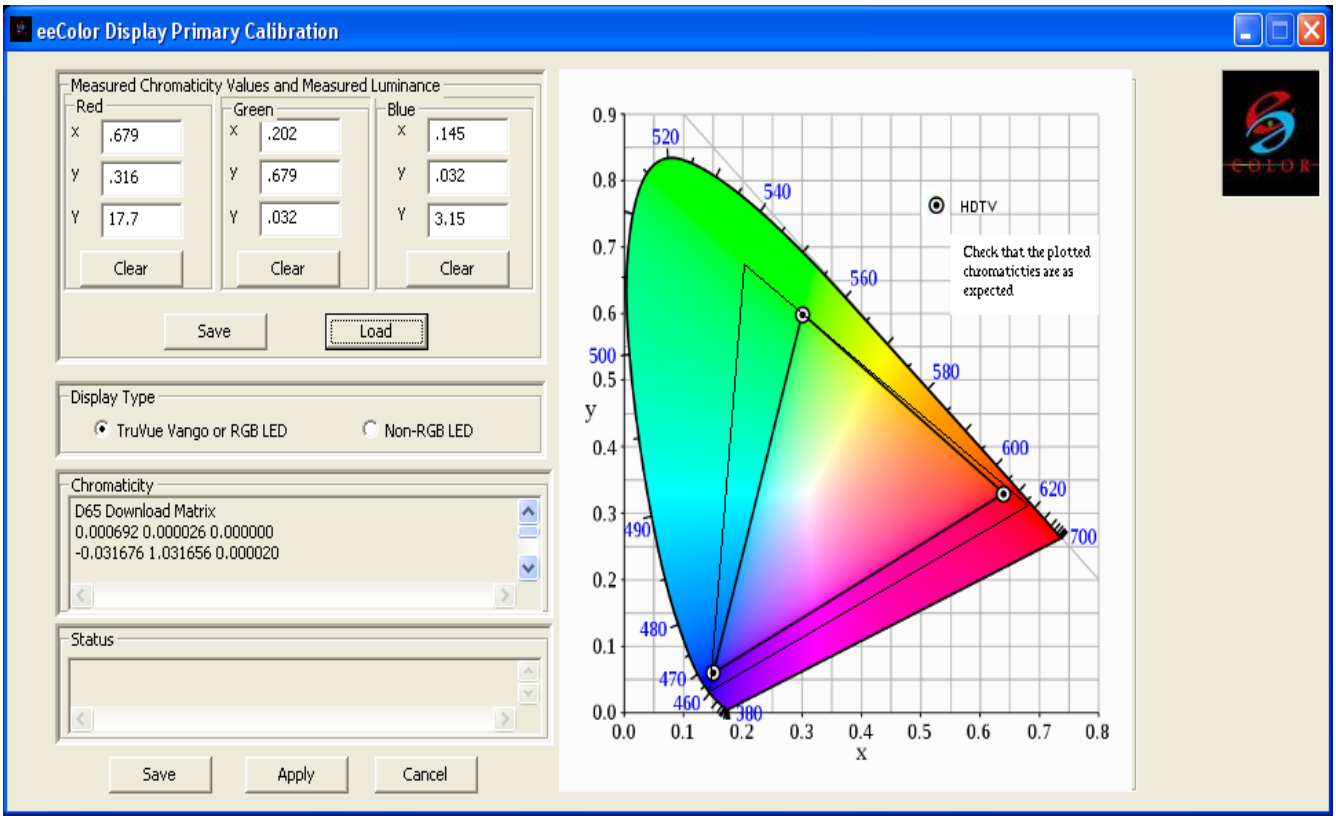
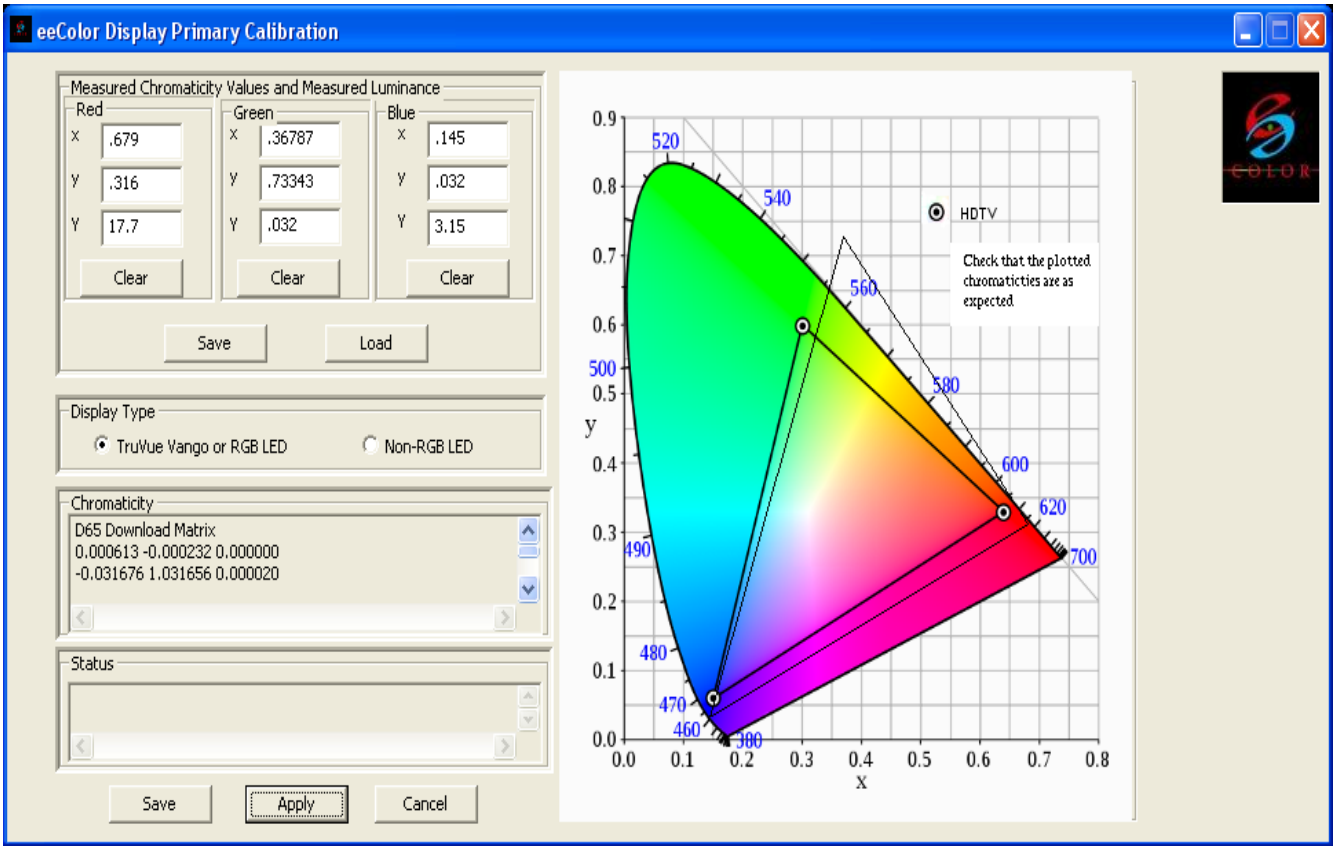
Appendix B - Sample Display Color Primary Results

The following illustration shows typical chromaticity data and the chromaticity plot for the TruVue Vango LED projector. Notice the plot fits inside the colored laser horseshoe plot and in this case is larger than the HDTV reference because the TruVue Vango projector uses RGB LED light sources. Other display chromaticity plots should be close to the HDTV reference.



The following illustration shows an invalid chromaticity plot where the measured green chromaticity goes outside the color laser horseshoe plot. This cannot happen with any real display. If this happens check the measurement data and the data entries. For additional recommendations the user is referred to the Troubleshooting section in Appendix K



Appendix C – Measured Primaries File Format

The file format used to store the measured primaries x, y, Y values is:

MEASURED_DATA_RED=Red x, Red y, Red Luminance

MEASURED_DATA_GREEN=Green x, Green y, Green Luminance

MEASURED_DATA_BLUE=Blue x, Blue y. Blue Luminance

An example file's content follows:

.[DATA]

MEASURED_DATA_RED=.679, .316, 17.7

MEASURED_DATA_GREEN=.202, .679, .032

MEASURED_DATA_BLUE=.145, .032, 3.15

[PARAMETERS]

VERSION=1.00

DISPLAY_TYPE=RGB_LED_DISPLAY

Appendix D – Measured Luminance File Format

The file format used to store row order measured luminance values is:

MEASURED_DATA_1=Red 1, Green 1, Blue 1
o
o
o
MEASURED_DATA_21=Red 21, Green 21, Blue 21

An example file's content follows:

[DATA]

MEASURED_DATA_1=0.070000, 0.070000, 0.070000

MEASURED_DATA_2=1.230000, 4.290000, 1.150000

MEASURED_DATA_3=3.330000, 10.810000, 2.190000

MEASURED_DATA_4=5.830000, 18.000000, 3.150000

MEASURED_DATA_5=9.710000, 27.860000, 4.090000

MEASURED_DATA_6=13.690000, 38.320000, 5.070000

MEASURED_DATA_7=17.040000, 47.440000, 6.250000

MEASURED_DATA_8=20.710000, 55.670000, 7.590000

MEASURED_DATA_9=23.690000, 63.320000, 8.700000

MEASURED_DATA_10=27.290000, 71.350000, 9.430000

MEASURED_DATA_11=30.480000, 79.910000, 10.370000

MEASURED_DATA_12=34.150000, 87.950000, 11.290000

MEASURED_DATA_13=36.530000, 96.250000, 12.130000

MEASURED_DATA_14=39.980000, 102.870000, 13.180000

MEASURED_DATA_15=41.730000, 109.150000, 14.020000

Appendix D – Measured Luminance File Format – continued…

MEASURED_DATA_16=45.010000, 116.620000, 14.790000

MEASURED_DATA_17=47.330000, 123.090000, 15.420000

MEASURED_DATA_18=50.050000, 131.090000, 16.510000

MEASURED_DATA_19=52.360000, 137.930000, 17.300000

MEASURED_DATA_20=55.350000, 145.190000, 18.590000

MEASURED_DATA_21=56.200000, 154.180000, 20.900000

[PARAMETERS]

VERSION=1.00

NOISE_REDUCTION=OFF

BRIGHT_REGION_CORRECTION=OFF

CLIP_BRIGHT_REGION=OFF

VERIFICATION_CHECK_BOX=OFF

VERIFICATION_STEP=21

Appendix E – Display and Measurement Calibration Setup

The recommended display setup, if available, is as follows:

1. Gamma – set to 2.20 or the standard setup if a specific gamma cannot be chosen (If a different gamma is preferred visually, it is still highly recommended that a linearity calibration to a 2.20 gamma is performed to establish the standard 2.20 gamma response as the baseline for more accurate viewing at other gammas. If the user sets the display to other gammas for linearity calibration, the calibration will set it back to 2.20.)

2. Color Space – RGB (Full/PC, where code values go from 0 - 255).

3. White Point – Native.

4. Color Gamut - Native RGB.

5. All other options set to their factory defaults.

6. **Note**: Often consumer televisions and some projectors are set up for the brightest video without regard to maintaining the standard D65 white point or having a 2.20 gamma response for each color. In these cases the linearity measurement data will not be the same for each color and also will not be gamma responses. One or more of the colors will be reduced from a gamma response in the high brightness values. Adjusting the display contrast for those colors will generally eliminate this non-standard response and allow the display to be calibrated.

The recommended measurement meter setup is as follows:

1. Measure the center of screen at a fixed location for all measurements with all additional lighting turned off. For meters with a view of the area that is measured, ensure that the area is uniform with no shadows or other visible structure.

2. Place the measurement meter on a tripod if possible to maintain the same area of measurement.

3. Point the meter as perpendicular to the projector or television screen as possible without introducing shadows. Move the meter slightly to achieve the highest reading, then lock it in a fixed position for all measurements.

4. Measure multiple times and average the data, particularly for low brightness values, to ensure the measurement noise is as small as possible.

5. Record all the measurement data prior to entry into the Truvue eeColor™ Application. Future versions of the Application will support automatic data entry.

Appendix F – Target Display Computer Setup

In order to use the Target Display option in the TruVue eeColor™ Application the computer that is used to send the targets to the display via the HDMI connection must be setup as follows:

1. Connection - the HDMI cable must be attached between the computer and the display.

2. Gamma – set to 1.0 so the test target code values are sent to the display unchanged. The gamma can be changed for the HDMI output connection by going to the control panel and setting up the computer for dual output mode and setting the output for the HDMI display to a gamma of 1.0.

3. Color Space – make sure the computer is set to RGB PC (or RGB Full where the code values go from 0-255). This is the default for most PCs.

4. Resolution – use either 720p or 1080p for best results.

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Appendix G – Calibration Workflow

The recommended calibration sequence is to perform the linearity calibration followed by the color primary and white point calibration. The workflow for the TruVue eeColor™ Application calibration is as follows:

1. Setup the display device, see Appendix E for details.

2. Setup the computer used to display the step target, see Appendix F for details.

3. For Linearity Calibration enter the measured values for the 21 step targets for each color. Plot the gammas curves for each color channel. If prompted selected the recommended options and plot the gammas curves again. If the "Bright Region Correction" option is used, record the step number displayed in the "Primary Target Values" panel which will be used later for the color primaries and white point calibration. Save the measurement data for future use. Save the linearity calibration values. See section "Linearity Calibration" for more details.

4. For Color Primary and White Point calibration enter the measured values for Red. Green and Blue from step 21 or the step number recorded during the Linearity Calibration if the "Bright Region Correction" is used. Save the measurement data for future use. Save the primary calibration values. See section "Color Primary and White Point Calibration" for more details.

5. Download the Linearity Calibration values and the Color Primary Calibration values and the "Calibration" display device's "Unity" 3D tables to the TruVue eeColor™ Processor. See section "Calibration and eeColor™ Table Download" for details.

6. Connect the computer to the TruVue eeColor™ Processor's HDMI input and the display to the eeColor™ processor's HDMI output.

7. Using the eeColor™ Processor's remote control, choose eeColor™ 3D tables C1. The Processor's lcd display will show a one (1).

8. Use the "Target Display" section of the eeColor™ Application choose step 21 or the step number recorded in the Linearity Calibration if the "Bright Region Correction" option is used.

9. Using the TruVue eeColor™ Processor's remote turn on/off "D65 WP" and "Max WP". In "Max WP" the display will show its native white point. In "D65 WP" the display will show the eeColor™ Application calibrated white point. If the native white point of the display was visibly different than D65, the user will see the correction to D65. Measurements of the chromaticities of this white point step should be within 2% of the D65 chromaticities.

10. The TruVue eeColor™ Processor is now providing the calibration for your display and the eeColor™ 3D tables for different room lighting and color intent. CONGRATULATIONS !

11. Once you are done remember to download the 3D color tables for your display. Refer to "Calibration and eeColor™ 3D Table Download" section for more information and make sure the "Calibration Values" checkbox in not checked before starting the download.

Appendix H – Display Linearity Load/Save Data Examples

The measured values and the associated gamma advanced linearization options and display error compensation options can be stored and retrieved for later review. This is useful when recalling a specific linearity calibration done for a display device. We suggest you give meaningful names to these files that indicate the customer and the display that was calibrated. When you select the "Save" button in the "Data Control " panel you will be asked for a name for the file that will store the measured values and the parameters associated with the calibration. When you want to recall a stored linear calibration you select the "Load" button in the "Data Control" panel and select the file to be loaded. The measured values will be loaded, the gamma options will be selected and applied and the plot will be automatically updated. Examples of the Load and Save screens are shown below for reference.

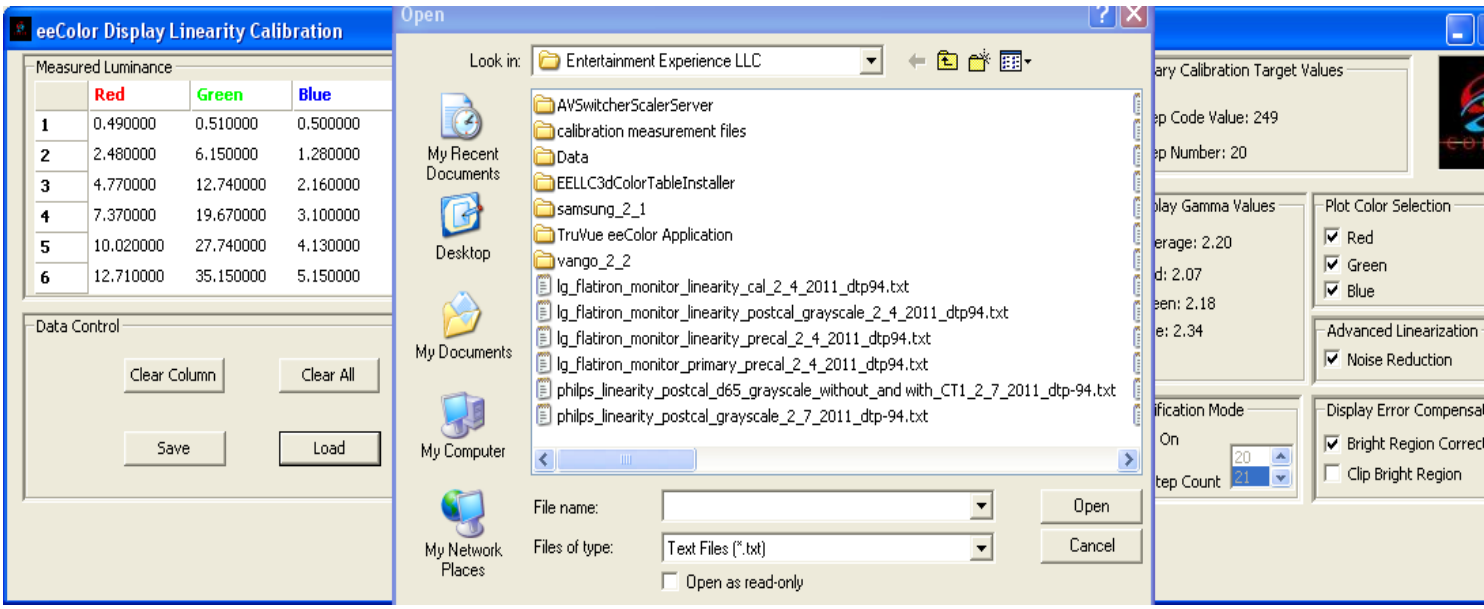

Figure 1 - Load

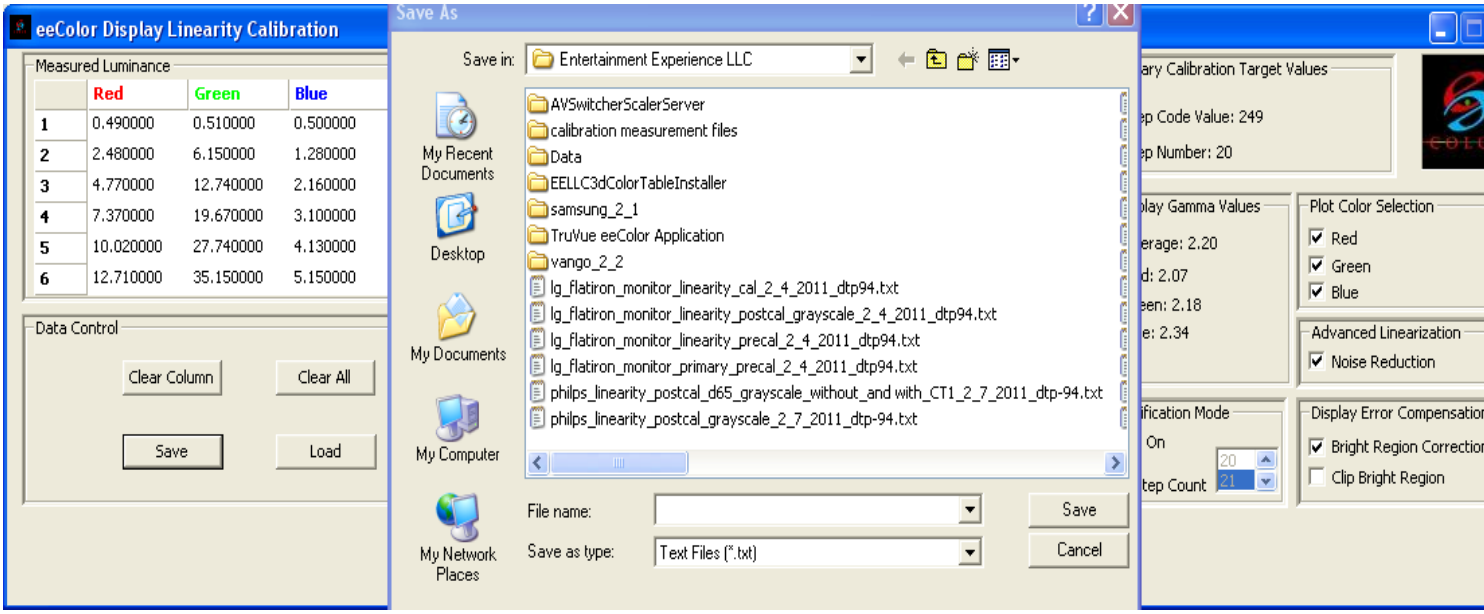

Figure 2- Save

Appendix I – Display Color Primary Load/Save Data Examples

The measured values and the associated display type options can be stored and retrieved for later review: This is useful when recalling a specific primary calibration done for a display device. We suggest you give meaningful names to these files that indicate the customer and the display that was calibrated. When you select the "Save" button in the "Measured Chromaticity Values and Measured Luminance" panel you will be asked for a name for the file that will store the measured values and the parameters associated with the calibration. When you want to recall a stored primary calibration you select the "Load" button in the "Measured Chromaticity Values and Measured Luminance" panel and select the file to be loaded. The measured values will be loaded, the display type will be selected and applied and the plot will be automatically updated. Examples of the Load and Save screens are shown below for reference.

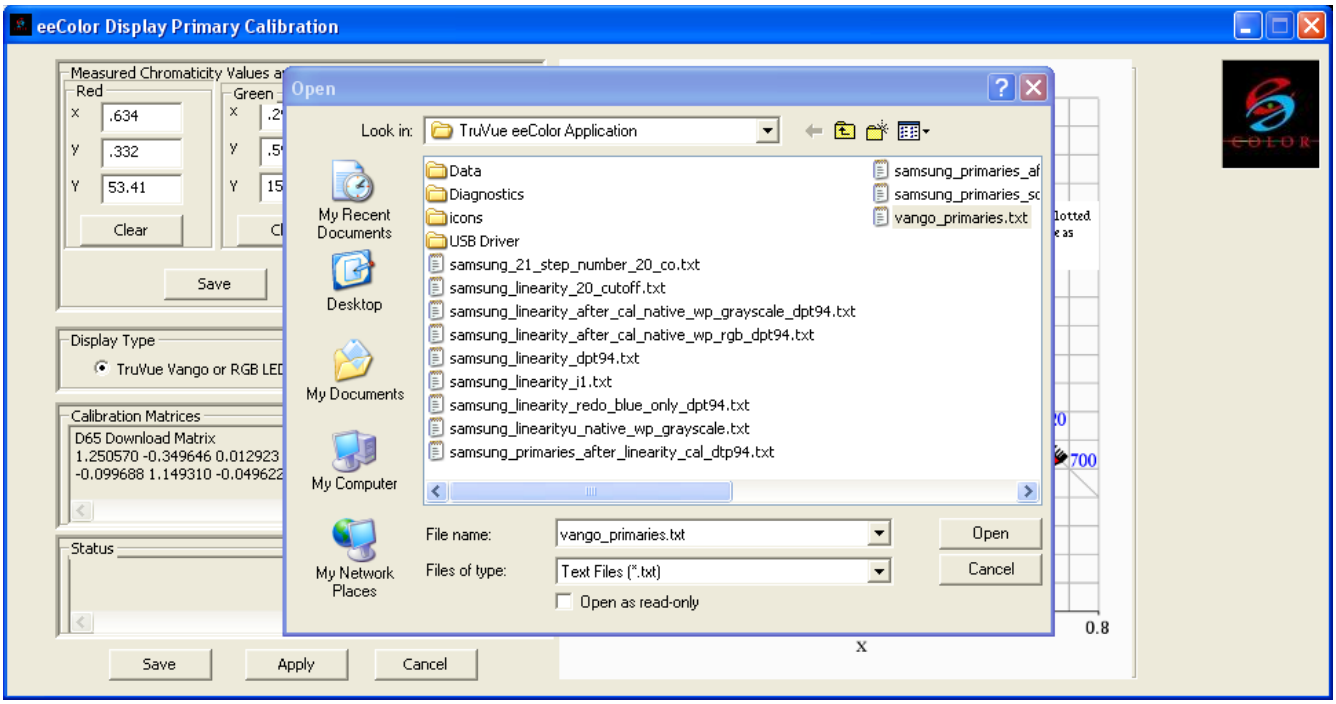

Figure 1 - Load

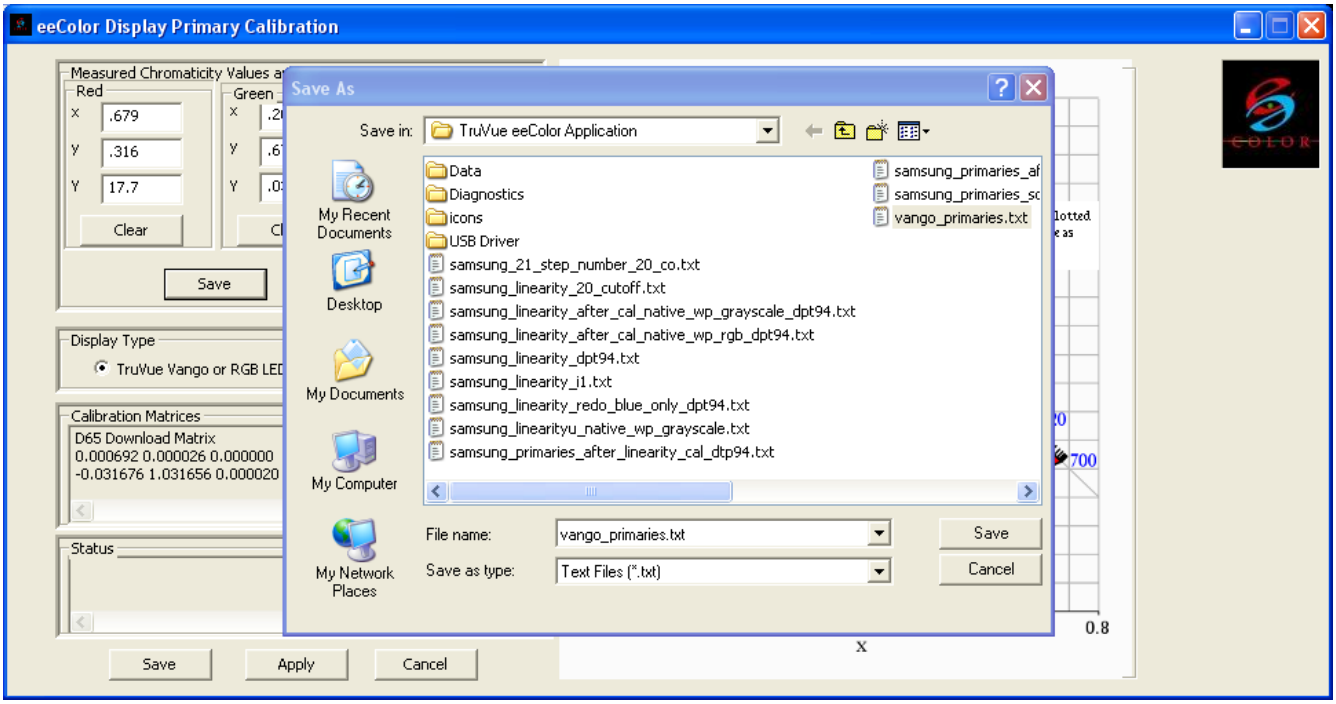

Figure 2- Save

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Appendix J – Post Calibration Linearity Check

After the linearity and primary calibrations have been performed and the new calibration values have been downloaded to the TruVue eeColor™ Processor a check of the corrected linearity can be performed by plotting the gamma curve and calculating the gamma for the grayscale targets. The following steps describe how to perform the linearity check:

1. Turn on the TruVue eeColor™ Processor and connect the USB cable between the PC and the TruVue eeColor™ Processor.

2. Referring to "Calibration and eeColor™ 3D Table Download" section download the "Calibration" display device's "Unity" 3D tables to the TruVue eeColor™ Processor and make sure the "Calibration Values" checkbox in not checked before starting the download.

3. After download has completed remove the USB cable between the PC and TruVue eeColor™ Processor before continuing.

4. Setup the display device, see Appendix E for details.

5. Setup the computer used to display the step target, see Appendix F for details.

6. Using the TruVue eeColor™ Processor's remote control, set the white point to "Max WP".

7. Using the TruVue eeColor™ Processor's remote control, choose eeColor™ 3D tables C1. The Processor's lcd display will show a one (1).

8. Using the "Display Linearity Calibration" application, in the "Verification Mode" panel check the "On" check box and set the "Step Count" to the step number recorded when the Linearity Calibration was performed. In the "Advanced Linearization" panel check the "Noise Reduction" checkbox. Note – the "Measured Luminance" panel will contain a single data entry column named "Grayscale". **Important** - do not uncheck the "Verification Mode" panel's"On" check box as the "Grayscale" data entry column will be replaced by the "Red", "Green" and "Blue" data entry columns and all entered measured data will be lost.

9. Using the "Target Display" application cycle through grayscale steps 1-21 and record the measured values in the "Measured Luminance" panel of the "Display Linearity Calibration" application.

10. Once all the measured values have been entered click on the "Apply" button located on the bottom of the "Display Linearity Calibration" application's main window to plot the grayscale gamma curve and display the associated gamma value. If you do not have a smooth gamma curve or a gamma value close to 2.20 try adjusting you display and perform the linearity and primary calibration again.

11. You can save the measured data by clicking on the “Save” button in the “Data Control” panel of the “Display Linearity Calibration” application. See Appendix I for more details.

12. Once you are done remember to download the 3D color tables for your display. Refer to “Calibration and eeColor™ 3D Table Download” section for more information and make sure the “Calibration Values” checkbox in not checked before starting the download.

Appendix K - Troubleshooting

Problem - Application Installation does not complete successfully.

Solution - Refer to the installation error messages.

Problem - Target display does not display or change color target correctly.

Solution - Check to ensure the 720p or 1080p dual display setup is correct, the gamma for the HDMI output is set to 1.0 and the HDMI cable is connected between the PC and the output display device.

Problem - The Color Primary and White Point Calibration application results in chromaticity plots outside the range of lasers or significantly different than the HDTV example.

Solution - Check the measured values and data entries for errors, and review the measurement meter instructions. If no errors are found, re-measure multiple times at various places on the display and average the results. Also make sure the measurement meter is calibrated and pointed directly at the projector or television screen for each measurement by rotating the meter to obtain the highest reading.

Problem - The Linearity Calibration application results in red, green and blue curves that are not smooth, continuously increasing or not similar.

Solution - Check the measured values and data entries for errors, and review the measurement meter instructions. If no errors are found, re-measure multiple times at various places on the display and average the results. Also make sure the measurement meter is calibrated and pointed directly at the projector or television screen in the same location for each measurement. Rotating the meter to obtain the highest reading will also reduce the affect of measurement noise. If the problem persists, it is likely that the measurement meter is not calibrated, lacks the required brightness sensitivity range of 1000:1 or is faulty, or the display is not setup to produce consistent gamma responses for each color.

Problem - The download application does not initiate or complete successfully.

Solution - Check to ensure the USB cable is connected between the PC and the TruVue eeColor™ Processor. Check that the TruVue eeColor™ Processor is powered on.

Problem - The display shows artifacts when using the eeColor 3D Tables, such as inversions in bright colors or white where these image regions appear to get darker rather than brighter, low contrast or very dark shadows with loss of detail.

Solution - This is related to the display and media player being set up to different HDMI RGB standards. Bright color or white inversion and dark shadows occur when the media player is set to full-range or pc (0-255) and the display is incorrectly set to limited or video (16-235). Low contrast occurs when the media player is set to limited or video (16-235) and the display is incorrectly set to full-range or pc (0-255). Check to ensure that both the media player and display are set to the same HDMI RGB standard.

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Support - for additional support visit http;//www.entexpinc.com/truvue or send email to support@entexpinc.com. When contacting support via email please send the following information:

1. Window's operating system.
2. TruVue eeColor™ Calibration Application version number.
3. USB FTDI drivers version number.
4. TruVue eeColor™ Processor serial number.
5. TruVue eeColor™ Vango LED projector serial number.
6. Color and Luminance Measurement Meter model.
7. Screen shots if possible.
8. Detailed problem description.