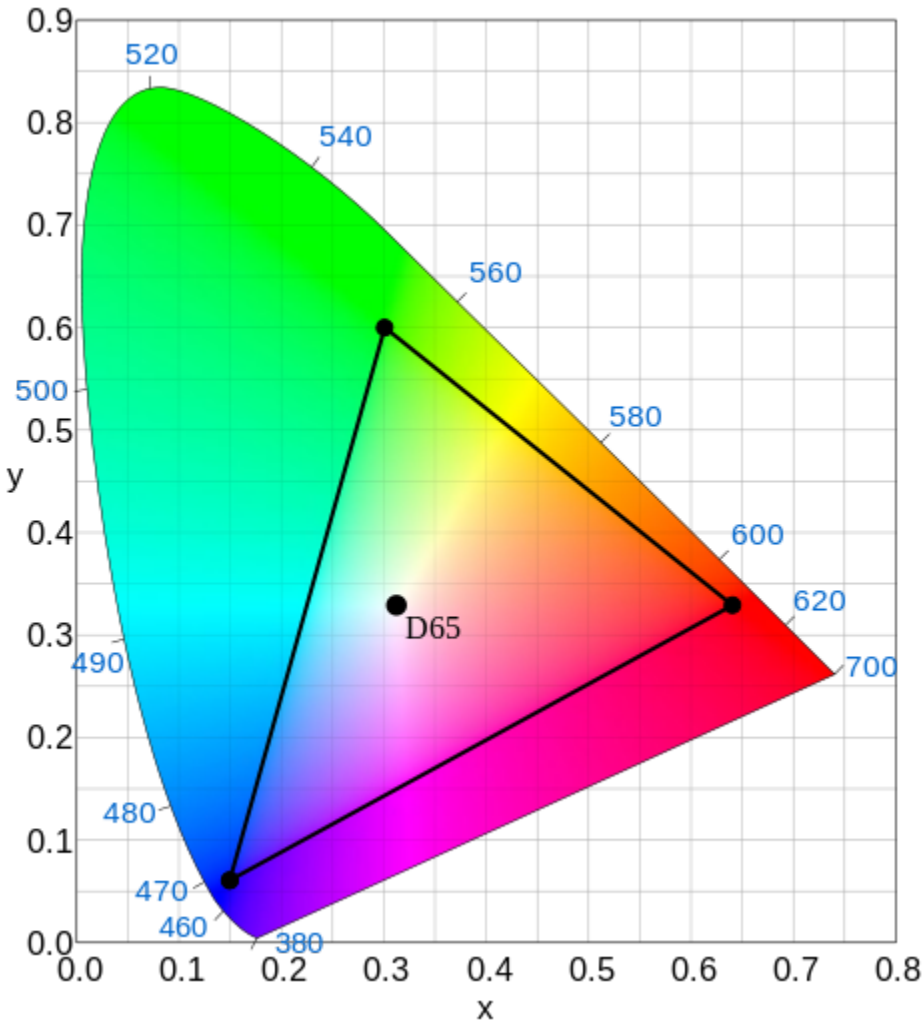
WinDAS White Point Balance Guide

Sony GDM-FW900

Marwan Daar **Guide Version: 0.93** **August 2014**

Why do a White Point Balance?

The primary goal of a white point balance (grayscale) adjustment is to calibrate the unit such that accurate colors are reproduced. It's important to understand that colors are not inherently accurate or inaccurate, and when we use the term "accurate" it is with respect to a particular standard. For example, high definition video content is produced with a particular set of standards, known as BT.709 (also known as Rec 709). All Blu-ray content and high def broadcast video is meant to adhere to BT.709. Some of these standards specify "legal" resolutions and framerates, but the aspect we are most concerned with is the white point, which is specified in conjunction with the color gamut. The color gamut can be visualized as the area bounded by a triangle on the CIE 1931 color space chromaticity diagram (see image below). You can think of chromaticity as color, but independent of luminance. So there are an infinite number of colors that have the same chromaticity, for example the infinite shades of gray, ranging from black to white, and on this diagram, you can think of these infinite shades of gray lying along a line coming out of the page and going through the middle, where it is white. Notice that on this chromaticity diagram, as you move outwards from the center in a given direction, you go from white (or gray) to more colored regions. The further out you go, the more "saturated" these colors become. The particular direction you travel out from the white region dictates the particular "hue".



Another important point is that there are many different "hues" of white. Some whites are yellower and some are bluer. The question of whether there really is a pure white that has no hint of any hue is an interesting one, but it's hard to pin down for a number of reasons beyond the scope of this guide. The white point that Rec 709 specifies is known as D65, and it is an approximation of the chromaticity of a neutral surface when illuminated by the midday sun in certain parts of the world (I think parts of Europe). It is also the chromaticity that would be perceived if this light from the sun struck your eyes directly. It has a correlated color temperature of around 6500 Kelvin (actually 6504 K), which is the temperature of the black body radiator whose chromaticity is closest to D65.

A display that adheres to the color gamut and white point specified in Rec 709 (which, by the way, is identical to the color gamut and white point of sRGB) will have two important features:

1) The primaries of this display will match the corners of the gamut (the triangle in the above figure).

2) The relative luminances of the three primaries are such that, at any given input signal that has equal values of R, G, and B (e.g. [19 19 19] or [255 255 255]), the resulting chromaticity will be D65. If the primaries are at their maximum respective luminances, then the result will be a white D65, and if they're mixed together at a scaled down level of their respective luminances, the result will be a darker shade of D65.

Another way to think of this is that when an RGB signal (in an 8 bit context) of [255 0 0] is sent to the display, a pure bright red will result whose chromaticity matches the red corner of the gamut. When a signal of [255 255 255] is sent, the result will be the brightest possible D65 point. When a signal of [10 10 10] is sent, the result will be a dark shade of gray at the D65 point.

The beauty of having such a standard can be understood through the following scenario: A colorist is color grading some video content at a studio. The display that is rendering the content to her adheres to the gamut and white point specified in Rec 709. Using software, she adjusts the colors of a given scene until it matches her artistic intent. For example, she wants a car to have a particular type of blue, and she wants to change the scene so that the sky is relatively dark compared to the road. When she is satisfied with the result, she saves her progress, and when she has completed everything, the content is mastered. This master will be encoded such that if someone is viewing the mastered content on a display that is calibrated identically to that in the studio, colors will appear identically on this display as they did to the colorist (in Rec 709, min and max luminance are not explicitly specified, so the only thing we can guarantee is the same chromaticity, and not the same absolute luminance of each possible color).

So this is what is meant by accurate colors – being able to render content as it was meant to be viewed, thus preserving artistic intent. You may also discover that with a well calibrated display, there is a new level of realism in images, especially when it comes to flesh tones in content that has been well mastered.

It is also worth noting that while the white point of a display can be adjusted arbitrarily within the color gamut, the gamut itself cannot be extended beyond the physical capabilities of the display. In other words, the most saturated red that a CRT can produce is determined by the chromaticity of the red phosphor when it is struck by electrons, and this will be rendered with a signal of [x 0 0], where x is an integer between 1 and 255. The phosphors used in high end GDM trinitrons are known as SMPTE-C

phosphors, and their chromaticity is based on BT.601, which is a standard associated with SD (standard definition) content. Fortunately, the SD primaries are very close to the HD primaries, so this slight deviation is a non issue. Interestingly, with the advent of HD, many studios continued to use the Sony BVM CRTs, which had the SMPTE-C primaries, even when mastering HD content, which means that a fair chunk of HD content will be more accurately rendered on a GDM display than on a display that has true HD primaries.

Another point that should be understood is that having a perfect white balance and primaries does not guarantee that all 16.7 million RGB combinations will be rendered at the correct color, unless the display combines the three channels with perfect additivity. In many fixed pixel displays, such as LCDs, additivity is compromised due to subpixel leakage (current leaking from one of the three subpixels into another). In such cases, more advanced intervention is required to bring the display into a high degree of accuracy, such as 3D lookup tables (3D LUTs). Fortunately, this form of subpixel leakage is not an issue with CRTs due to the fundamentally different way in which "pixels"operate in a CRT, and because of this, having a good white balance should be highly correlated with accuracy across all RGB combinations. Another great thing about these high end CRTs is that the video amplifiers seem to have great differential gain control, which means that if the white balance is adjusted at just two or three gray levels (typically 30% and 100%), all the other gray levels track beautifully. But CRTs do drift, and this may be due to the variation, across time, of the cathodes' thermionic emission characteristics. As such, they require periodic adjustment. The primaries may also drift, as the physical characteristics of the phosphors change over time, although I imagine that drift due to phosphor aging occurs at a far greater timescale than that due to cathode properties, especially when we consider that the FW900 uses very high end phosphors.

It should be understood that having a good white point balance has very little to do with "balancing" the output of the three electron guns. For one thing, our visual system is not equally sensitive to all wavelengths of light. For example, wavelengths corresponding to the green portion of the spectrum require much less radiant power to stimulate the visual system compared to redder or bluer portions of the spectrum. Secondly, the three phosphors used in these CRTs each have their own radiant efficiency, which means that, given the same intensity of electron bombardment, each phosphor will emit light with a particular radiant flux (power). These considerations mean that having a perceptually balanced output probably doesn't correlate with a balanced load on the electron guns. However, during the WinDAS WPB procedure, you are able to adjust the peak luminiance of the display, and this does have an impact on the health of the tube. Having the peak luminance too high may reduce the lifespan of the phosphors and/or the electron guns, so it's important to ensure this parameter is set to a reasonable level. The WPB procedure also allows you to adjust the minimum luminance, which allows for a restoration of deep blacks, which is critical to good picture quality.

Choosing a measuring instrument.

Unless you have vast resources or access to reference grade spectroradiometers/colorimeters, stick to the DTP-94, or the i1DisplayPro. The DTP-94 is also sold under the name MonacoOptix XR. This is a well built colorimeter but is discontinued and rather old. Nevertheless, it has two things going for it. First, it is calibrated based on the spectral signatures of Sony BVM CRTs, which use the same phosphors as the FW900 monitor. Second, because of its high quality design, it has a reputation for longevity and reliability. A good condition DTP-94 will serve you well with a CRT. There are a number floating around on ebay at the time of writing this guide, and can be bought fairly cheap even when they're brand new. A better option, in my opinion, is the i1DisplayPro, which is a very well

engineered colorimeter and relatively new. With the CRT spectral correction included in the Argyll drivers for this instrument, it reads just as accurately as the DTP-94, with the advantage that it can read at even lower luminances than the DTP-94. It also doesn't suffer black level drift, which means that, unlike the DTP-94, you don't have to periodically calibrate the unit with a dark reading. It is, however, a bit more expensive – expect to pay around $250 for a brand new one.

Setting up software.

It is assumed that you have a working copy of WinDAS, a working cable, and know how to connect it to your monitor. It is also assumed that you have made a backup of your monitors EEPROM settings into a dat file. This guide will not cover this step.

Additional (free) software that you'll need:

HCFR (Zoyd's version). The latest version can be downloaded here.
IrfanView. Download the latest version here.
ArgyllCMS. Download the latest version here. Installation instructions here.

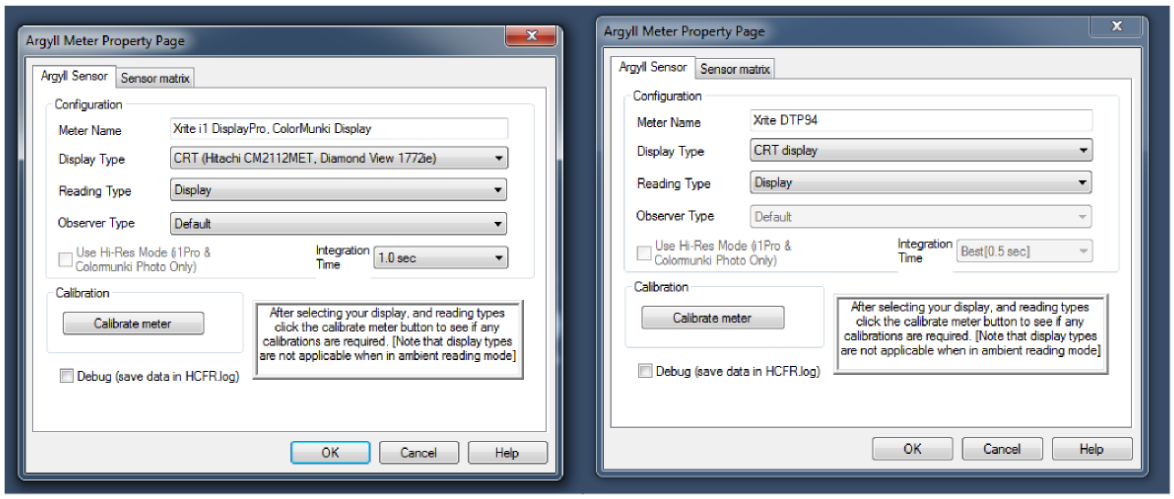
HCFR interfaces with your colorimeter so you can take real time color measurements of your FW900. **Install HCFR on both main PC and laptop.**

IrfanView is a good image viewing program that can be customized to ensure no "extra processing" occurs during the rendering of test patterns. **Install HCFR on main PC.**

ArgyllCMS is a very powerful set of color management tools. It serves two purposes for us. The first is that it provides drivers for the colorimeter, and the second is that it can be used to finely adjust the gamma of the display once the WPB is completed. It will also fine tune the white point with excellent precision. **Install ArgyllCMS on main PC.**

Plug your colorimeter into a USB port, and update the driver manually, by navigating to your \Argyll_Vx.x.x\usb directory and choosing the ArgyllCMS.inf file. This driver file contains information for many instruments, including both colorimeters discussed in the previous section. Place the colorimeter on your screen (doesn't matter where for now, we're just making sure it works). For the i1DisplayPro, make sure the diffuser arm is rotated so that the sensor is exposed.

Load up HCFR, and choose File/New and choose DVD Manual from the pull down menu. Click Next, and make sure your instrument is listed in the Sensor pull down menu list. Make sure "Do not use a meter correction file" is selected. Click Finish, and make sure the following options are selected (left for i1DisplayPro, right for DTP-94). Leave Sensor matrix at its defaults.

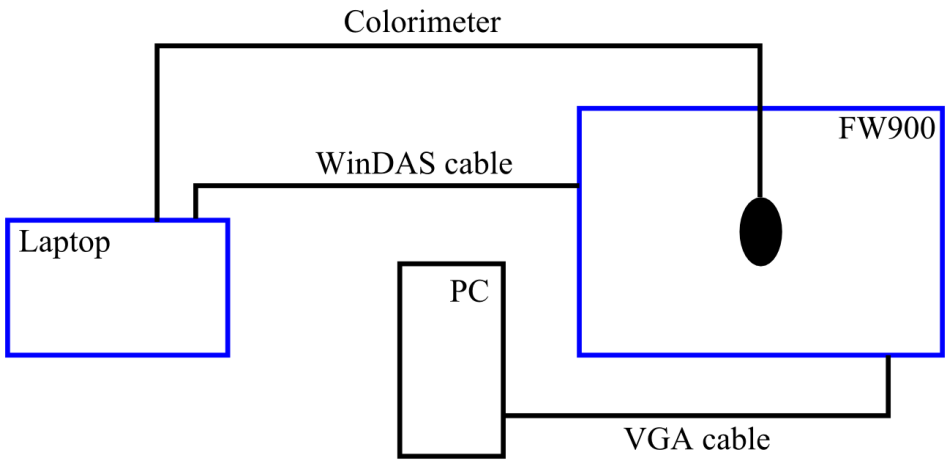


For the DTP-94, it is probably a good idea to calibrate it once at the start of each session. To do this, click the Calibrate meter button, and follow the instructions. I just make sure the sensor is covered by something dark (I turn off the lights and just put it under a dark blanket). The i1DisplayPro doesn't need a calibration, although you can try clicking the button and seeing if it asks you to do anything.

After this, the main HCFR workspace will open. Click the green triangle button. and look at the real time readings on the bottom left to make sure that something is registering. If so, you're good to go!

Setting up the workflow.

The image below shows the basic layout. The PC, which acts as a signal generator, is connected to the FW900 via a VGA cable. The laptop (or another PC) serves two functions. The first is to establish a connection with the FW900 via the WinDAS cable and software, and the other is to take measurements using HCFR and the colorimeter. The basic idea is that the WinDAS software instructs you which patterns to load (which you load with the PC), and then instructs you to adjust sliders until certain chromaticity and luminance targets are met. When you adjust a slider, information is sent through the WinDAS cable which adjusts various voltages inside the FW900. This in turn changes the image in a gradual fashion, which can be viewed real time via the colorimeter using the HCFR software. There are other possible configurations, for example non contact instruments and/or video signal generators, but the basic flow of information is identical.



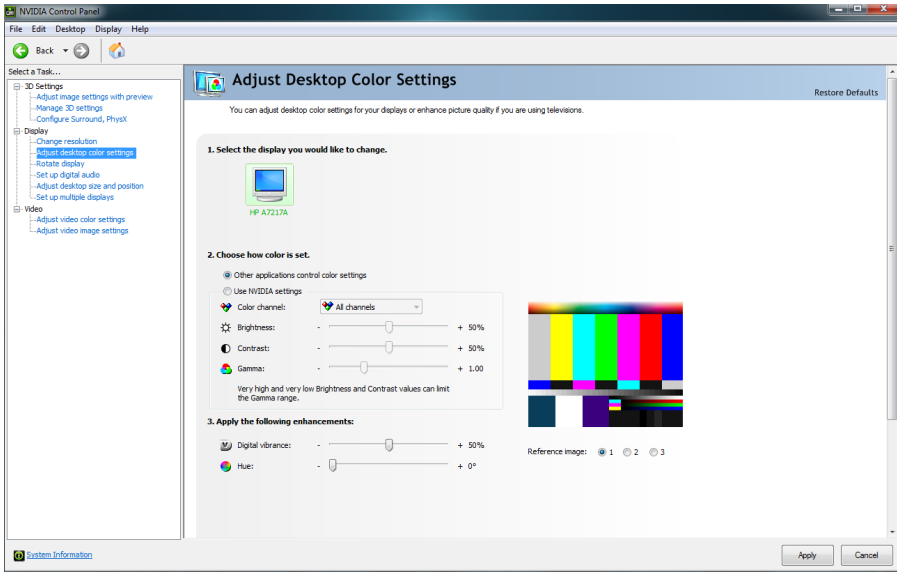
Preparing the PC for signal generation.

Before calibrating your Trinitron, it is wise to ensure that the video LUT (lookup table) is linearized and normalized on all three channels. The LUT maps the video input level (0-255) to a voltage that is sent to your monitor. A normalized, linear, LUT ensures that the voltage received by the monitor is a linear function of the video input level and uses the entire range of available voltage. Typically, in a CRT, the peak to peak voltage (i.e. the difference between the peak and minimum voltage) is around 0.7 volts. What this means is that, with a linear LUT, the highest video input level (255) will correspond to a voltage of just above 0.7 volts, and the minimum input level (0) will correspond to a pedestal voltage of just above 0 volts (video amplifiers don't like 0 volts because of noise issues). The intermediate video input levels will correspond to intermediate voltages that are equally spaced between pedestal and peak. The video amplifiers in the CRT scale up these voltage signals into usable voltages to drive the cathode in the electron gun.

Let's take an extreme example to illustrate the importance of a normalized linear LUT: Suppose that the LUT maps the range of video input level to a compressed range of voltages. So instead of going from 0 to 0.7 volts, it goes from 0 to 0.1 volts. Now, even if the LUT is linear, there are going to be some major issues when trying to calibrate the actual CRT to hit proper luminance targets. Basically, the video amplifiers are going to have to work seven times harder to achieve the same luminance, at any given video input level. This could put undue stress on the circuitry, and it's probably unlikely that you'll even be able to reach the desired luminance range.

Since the LUT controls the mapping for each channel independently, it not only changes the luminance function of the display (i.e. the relationship between video input level and display luminance), but the chromaticity of any given RGB combination. Now, so long as your LUT isn't completely out of whack, it is perfectly possible to hit your desired luminance and chromaticity targets using WinDAS. The problem is that the color accuracy of your display is now contingent upon the particular LUT that was in place during the hardware calibration. It is *much* better practice to start with a normalized, linear, LUT (default), and do your hardware calibration. Changes to the LUT can be applied after this step, in order to fine tune things, such as the luminance function ("gamma").

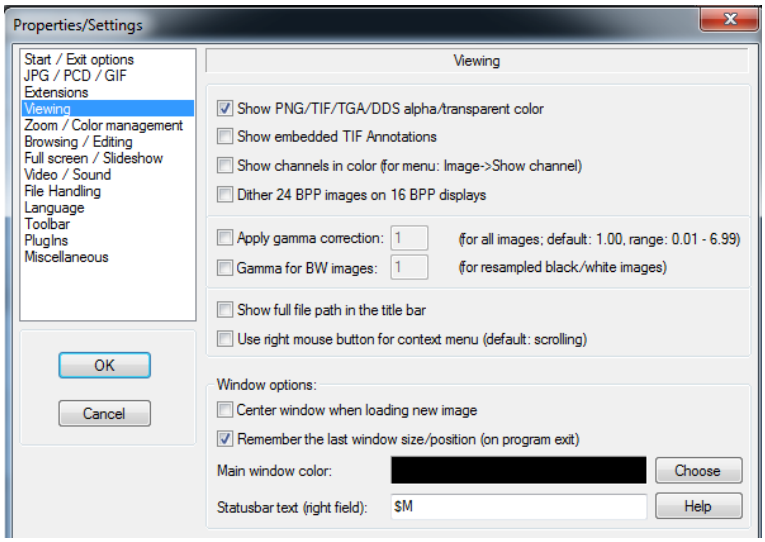
To ensure a default LUT, make sure that the video display settings are at default. In the NVIDIA control panel, this should look like the figure below:

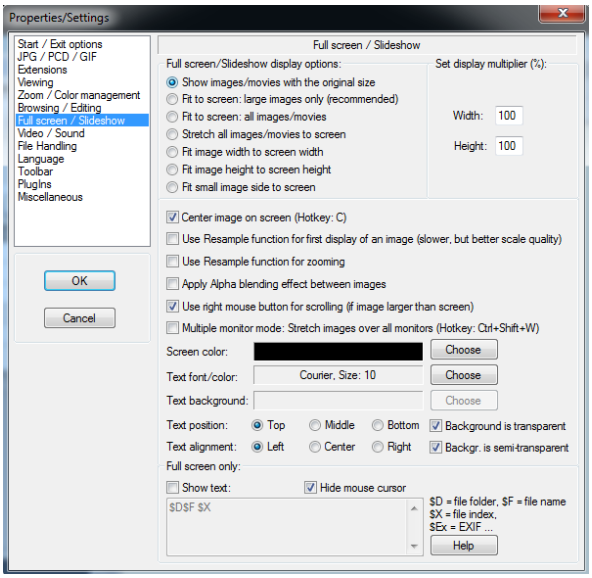


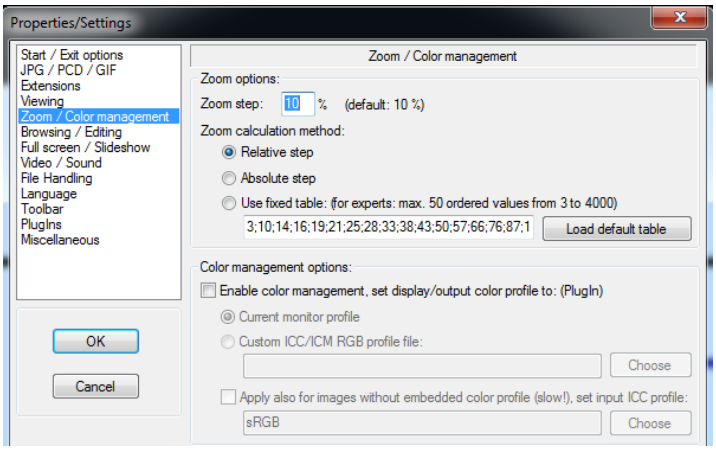
If the settings are different, first click "Use NVIDIA settings" so you can set the sliders to their defaults. After doing so, click "other applications control color setting". This last step is so that you can use ArgyllCMS later on to fine tune the image.

Make sure there are no LUTs being loaded into your system. Things like monitor calibration wizard, adobe gamma loader, etc. should all be disabled. To really ensure things are normalized and linear, open up a command window (start, cmd), and type "dispwin -c" (without quotations). This will reset the video LUT, and if it wasn't reset to begin with, you'll see the colors/brightness of your display change as soon as you hit enter. If the colors *do* change, make sure you figure out what was changing the LUT.

Next, we want to ensure that our image viewer (IrfanView) doesn't apply any gamma correction or color management. By default it doesn't, but it's good to double check. Make sure the settings are as follows:







I've unchecked the apply gamma correction, but it should be the same as checking it and leaving it at 1. You'll also notice I've unchecked the resample function for zooming, as this will preserve the fidelity of test patterns (e.g. sharp edges) used in geometry calibration if you choose to zoom in to inspect the test patterns (not relevant to WPB adjustment).

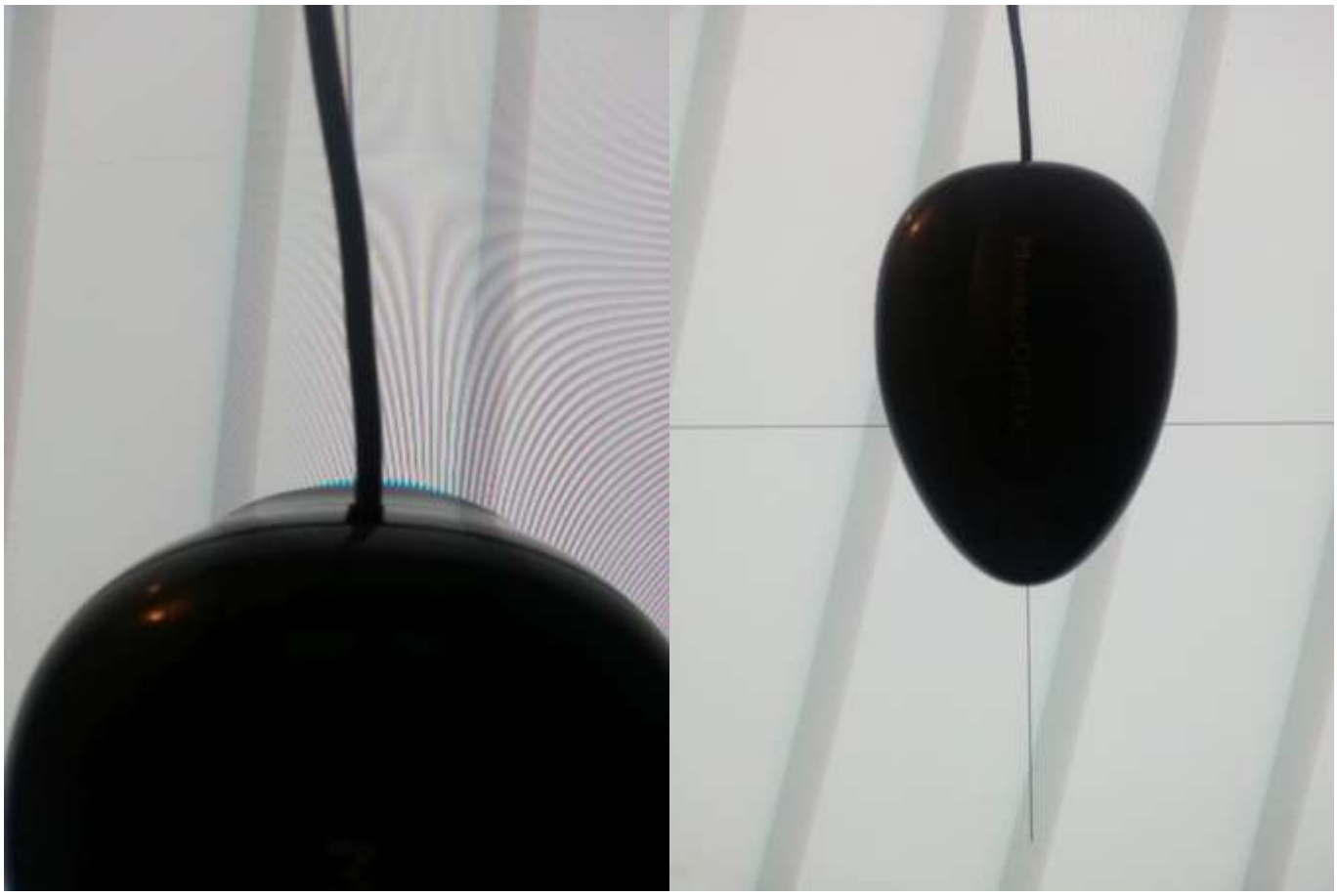
Final preparatory steps

Make sure your display is running in prime mode (1920x1200 @ 85z).

Using a microfiber cloth and a safe cleaning fluid, wipe down the display surface to ensure clean transmission of light.

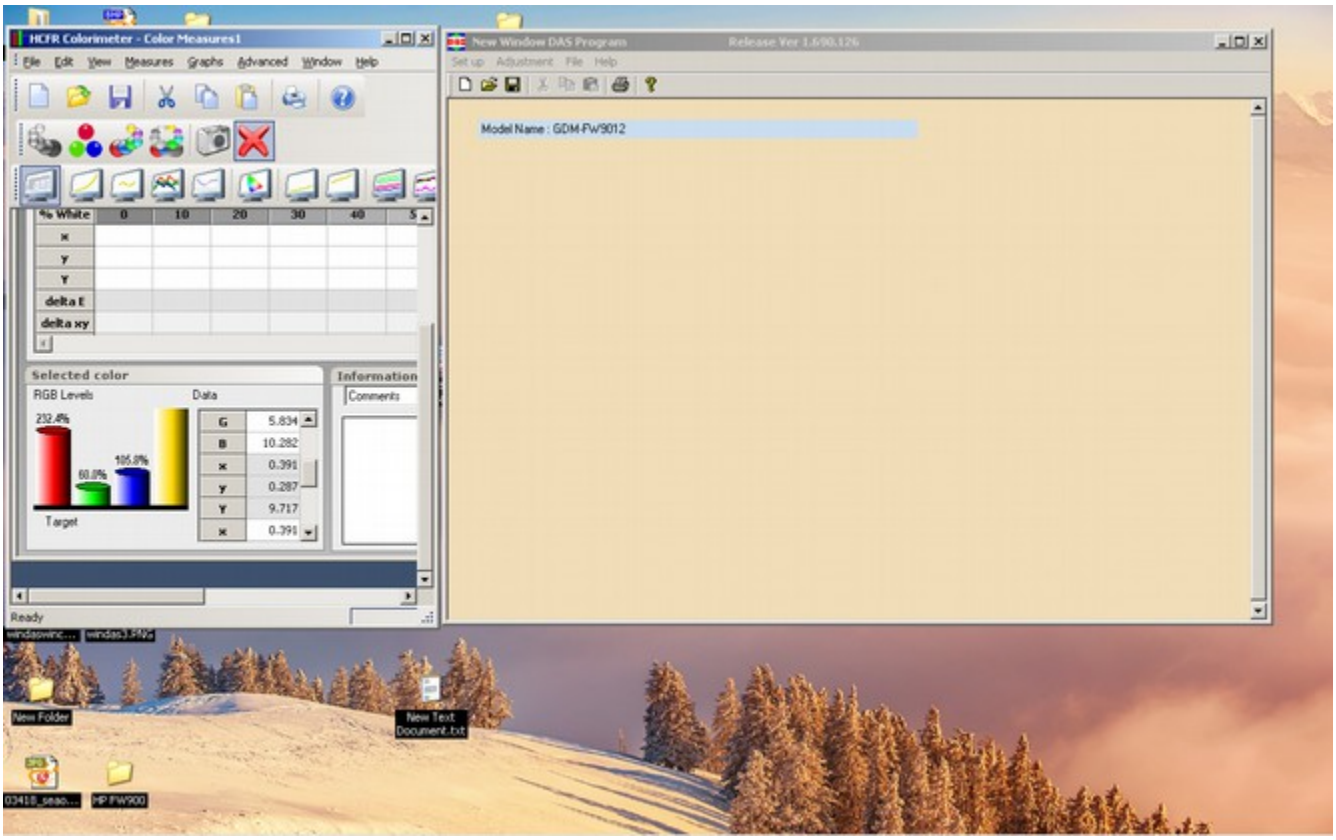
Load up DTP-94_center.png into IrfanView on your main PC. Hit enter to switch into fullscreen mode

(we'll be using fullscreen for all our test patterns). Position the DTP-94 so that when your line of sight is collinear with the top edge (i.e. when you look along the top edge), you can *barely* make out the magenta near the cyan border. It's important that you bring your eyes right up close and align them correctly to avoid parallax error. Doing so will ensure that the sensor of the instrument is vertically centered. Use the crosshair to ensure horizontal alignment. Make sure the instrument is securely placed. I like to place a heavy object (like a book) on top of the monitor to hold down the cord so that the weight of the instrument doesn't pull it through the groove in the suction cup. It also prevents the instrument from falling off if the suction cup fails (this has happened to me). You can adapt the use of this pattern for other instruments, such as the i1Display pro. The key is to use the pattern so that the sensor is in a consistent position every time you use it.



Now load up the white pattern (White_1920x1200.png), and ensure fullscreen mode is on. Let the monitor warm up for an hour or two (if your monitor has already been on for a few hours, don't worry about this step). However, allow the instrument to remain in position for 10-15 minutes to warm up. Also be aware that if you are planning on backing up the EEPROM of your monitor into a dat file, you will need to re-warm up your display after doing so.

Connect the WinDAS cable to the laptop, and place the laptop in a convenient spot. On your laptop, load up HCFR, and go through the same steps outlined earlier, up to and including hitting the green play button. Load up WinDAS. Arrange the windows so that it looks like the following:



Notice that I have scrolled down in the Data section of HCFR so that I can clearly see x,y,and Y.

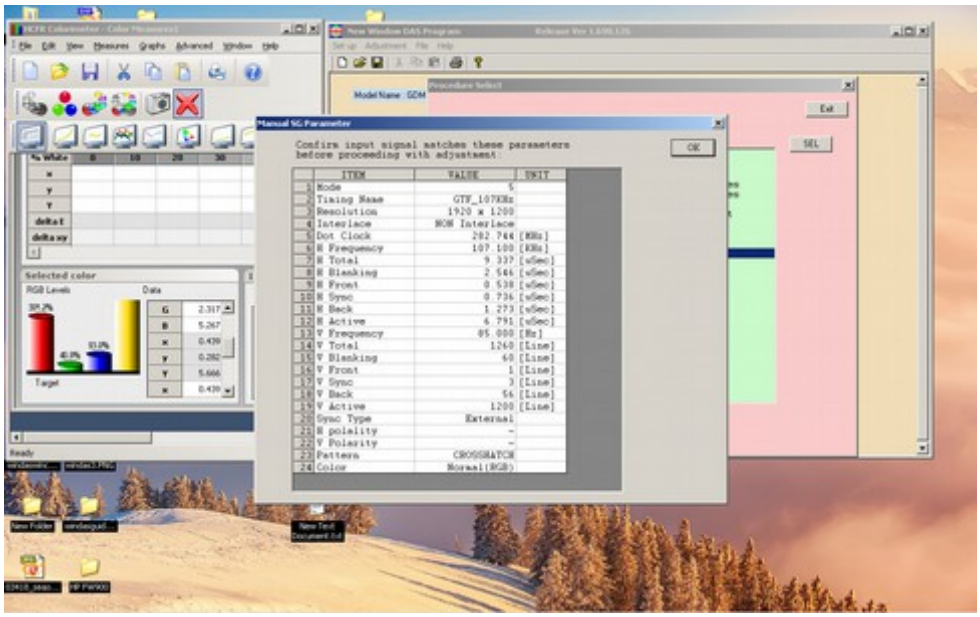
x and y are chromaticity coordinates, and Y is luminance.

Turn off all the lights – this will ensure that the colorimeter is measuring light from the display only, and not other ambient reflections. Even though the instrument is in contact with the display, reflections do get through. You can test this yourself if you like by noting how the readings change when you turn the lights on and off. Make sure the light from the laptop is not hitting the screen. Place a towel over the laptop if necessary.

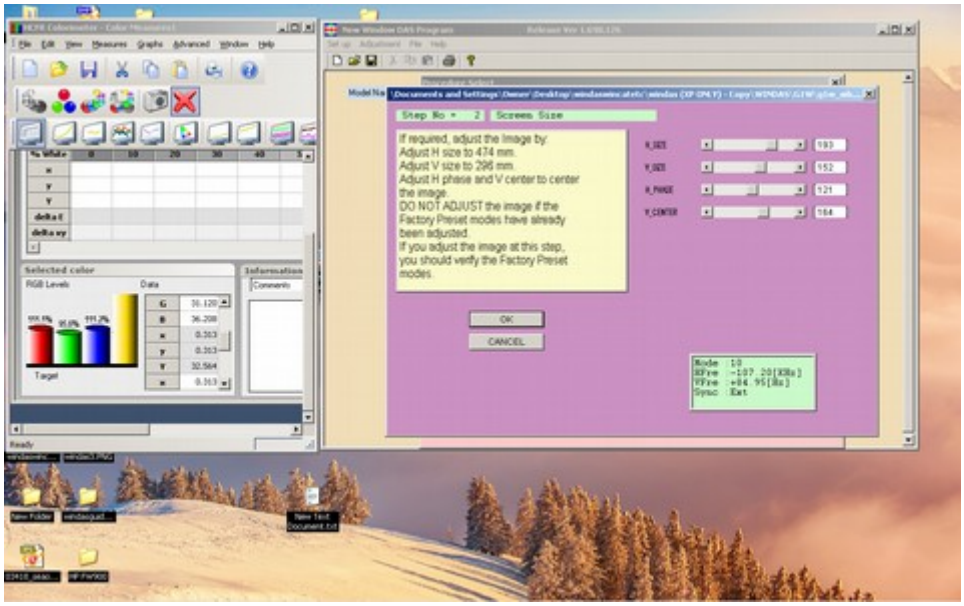
We are now ready to begin...

WinDAS WPB steps

In the file menu, select procedure, and then select White Balance Adjustment. A window will pop up with signal generator parameters. Since this isn't a geometry guide, I will not be covering the precise signal parameters, such as polarity, front porch, etc. You will be fine so long as you are displaying the desired video input signal. This next step is the only geometry part of the WPB calibration, and will not require much work if you already have your image size correctly adjusted.



Load up the crosshatch pattern (crosshatch_1920.png), and click OK.



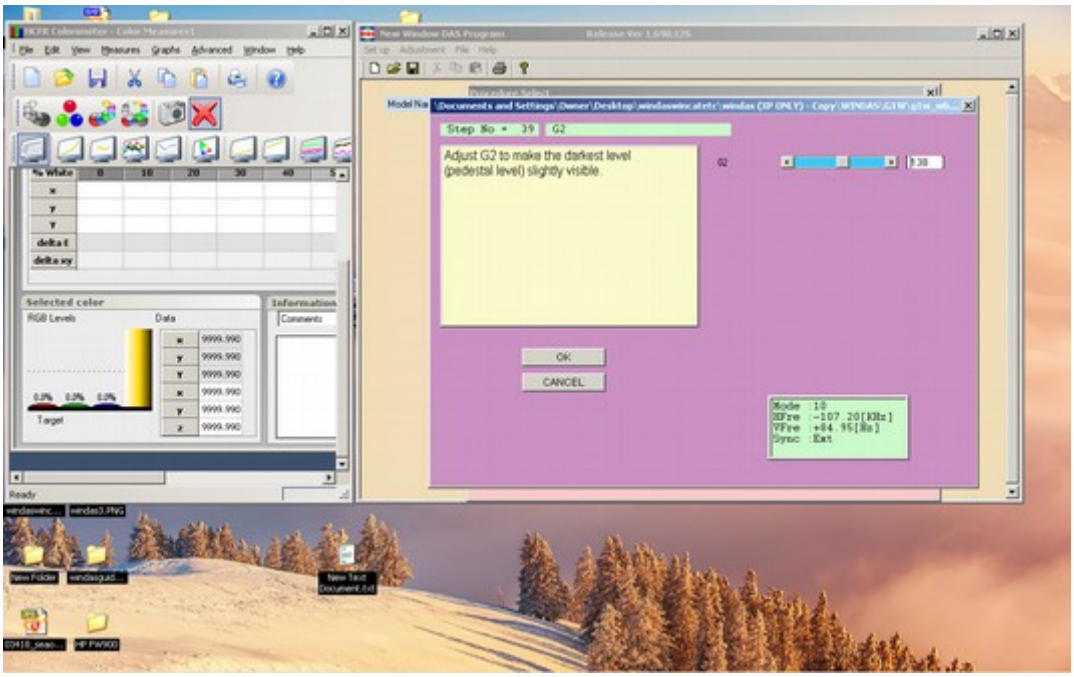
Follow the instructions, using a tape measure. Be sure to measure carefully to avoid parallax errors. Ideally, you'll have already performed a geometry and convergence adjustment prior to a WPB, so you may not need to adjust anything.

Click OK. It will ask you to load up a white pattern and warm up for an hour. This is unnecessary as we have already done this, so just skip through the steps until you reach step 6, at which point click BYPASS. The next few steps are information screens. Read them, but don't worry too much about this, as the information will be repeated during the actual calibration steps, and we will be using the RGB levels in HCFR to help guide us.

Keep clicking through until you get to step 35, and then click OK to start wtih the 9300K adjustment.

This is the G2 voltage adjustment, and when I update this guide, I'll include detailed information about the physics of this step and why it's important. For now, just follow the instructions.

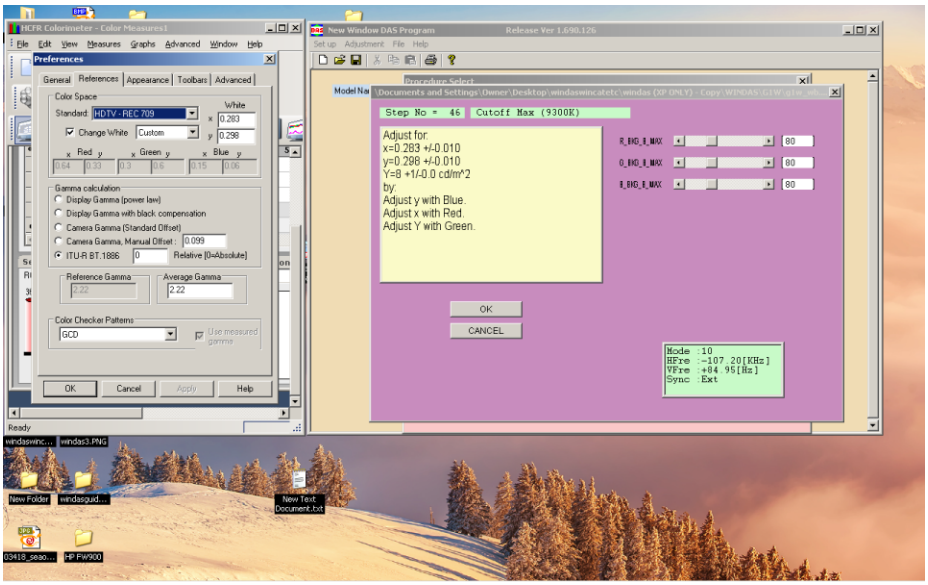
It asks for a grayscale pattern, but I prefer to use a pure black pattern. So go ahead and load up 0_1920x1200.png and make sure it's fullscreen. Click OK.



Now because this next step is a psychophysical step (i.e. you are measuring your own sensory system's response to a change in stimulus), you want to ensure that you are adapted for optimal performance. Make sure you dark adapt your eyes for about 10 minutes, so cover your laptop, and try to reduce any other sources of illumination in your room. When you are ready, start turning down the G2 slider until you can't detect a change in the display. It is helpful if you can make these adjustments without experiencing the glare from your laptop screen. One technique to make these adjustments, based on a proposal from another user, is to click in the blue space to the left of the slider. Clicking there once should lower the value by 20 units. So if you start at 140, and click in the blue space, it will immediately lower the value to 120. If you notice that the screen gets darker when you do this, repeat the same thing but from 139. Continue until you don't notice a change in the display when clicking in that blank space, and choose that value. So if you notice a tiny change from 101 to 81, but no change from 100 to 80, stick with 100. You may need to pause and move your eyes around between adjustments. Click OK. For those of you who wish to use the grayscale pattern, I've included a couple with this guide. The one labeled Grayscale_16_bars_1920.png is the standard grayscale pattern. If you use this, adjust the G2 slider until the first two levels are indistinguishable. I've also included a 2 bar version that just has the first two levels from the 16 bar pattern. This may be useful to prevent light adaptation from the brighter bars in the 16 bar pattern (which would reduce your sensitivity to light and make it harder to distinguish levels).

The next step is very similar to the previous step, except that it adjust the blanking level of the green gun for the central brightness value (future edition of this guide may describe the logic behind this step). Repeat the same procedure as that described in the G2 adjustment, and click OK. It will ask you to load up a black pattern, and as you already have this pattern loaded, just click OK.

For this next step, you will be asked to adjust values until certain chromaticity and luminance targets are met. Because we are adjusting for 9300K, we'll need to change our reference in HCFR to reflect this so that we can use the RGB levels as a guide.

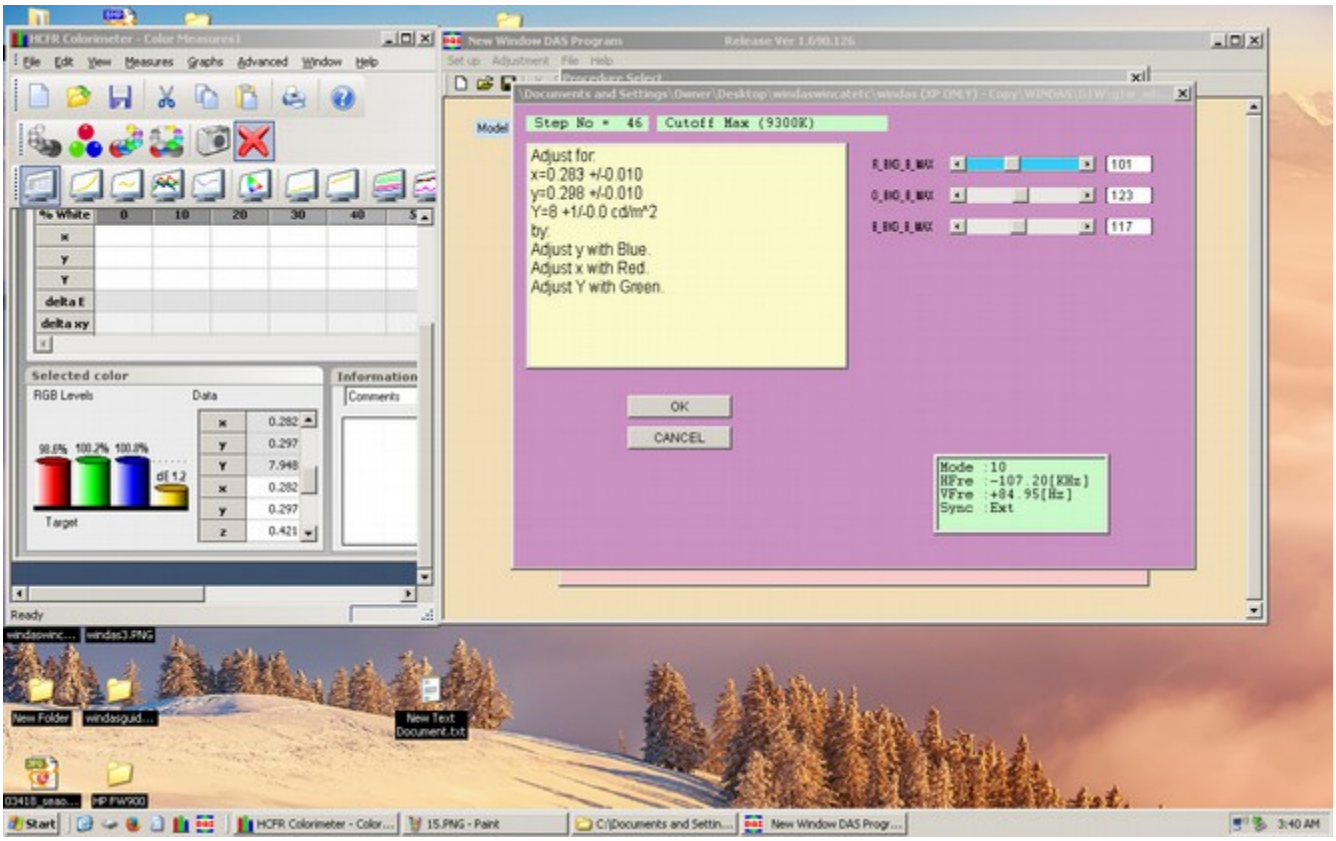


In HCFR, click on advanced, preferences, and click on the References tab. Check the "Change White" button, and choose "Custom" from the pulldown menu (keep the Standard at HDTV – REC 709, although this doesn't really matter). Click Apply, and that should allow you to input custom chromaticity coordinates. Go ahead and input 0.283 and 0.298 for x and y, respectively, and click Apply and then OK (in HCFR, not in WinDAS!).

Now adjust the sliders until your luminance and chromaticity targets are met. Notice that changing Y will have a major impact on luminance, while the red and blue sliders will not have a major impact on luminance, so you'll have to perform a balancing act. Use the delta E level and RGB levels in HCFR as your primary guides for chromaticty. This takes some experience, so play around a bit, and notice the nature of the interdepencies. If your RGB levels are perfect (all at 100 percent), the chromaticity values will be on target, and the delta E level will be close to 0. If your luminance is off, then you can just adjust the three sliders in WinDAS up or down by the same amount. For example, if your chromaticity is spot on, but your luminance is at 5 cd/m^2, then nudge each of the sliders up by a few clicks (same number of clicks for each). Due to the linearity of the video amplifiers' differential gain control, the chromaticity should be preserved. If it's not, then adjust as necessary. If you have to choose between different compromises of imperfect RGB levels, choose the one that minimizes delta E. Delta E is a formulation that takes into account human perception, and as such, it is the gold standard metric for color calibration.

You may notice that the reported chromaticty doesn't stabilize immediately. This is due to a couple things. First, the CRT takes a second or two to stabilize after a voltage adjustment. Second, depending on the instrument, readings can take some time to register and stabilize. With the i1Display pro, unless the luminance is very low, a stable reading can be registered in as little as half a second. Coupled with the second or two for the CRT to stabilize, this means you can read off a reliable measurement within 2-3 seconds of adjusting a slider value. In my experience, the DTP-94 takes a bit longer to register. Experiment a bit and pay attention and you will discover the rules.

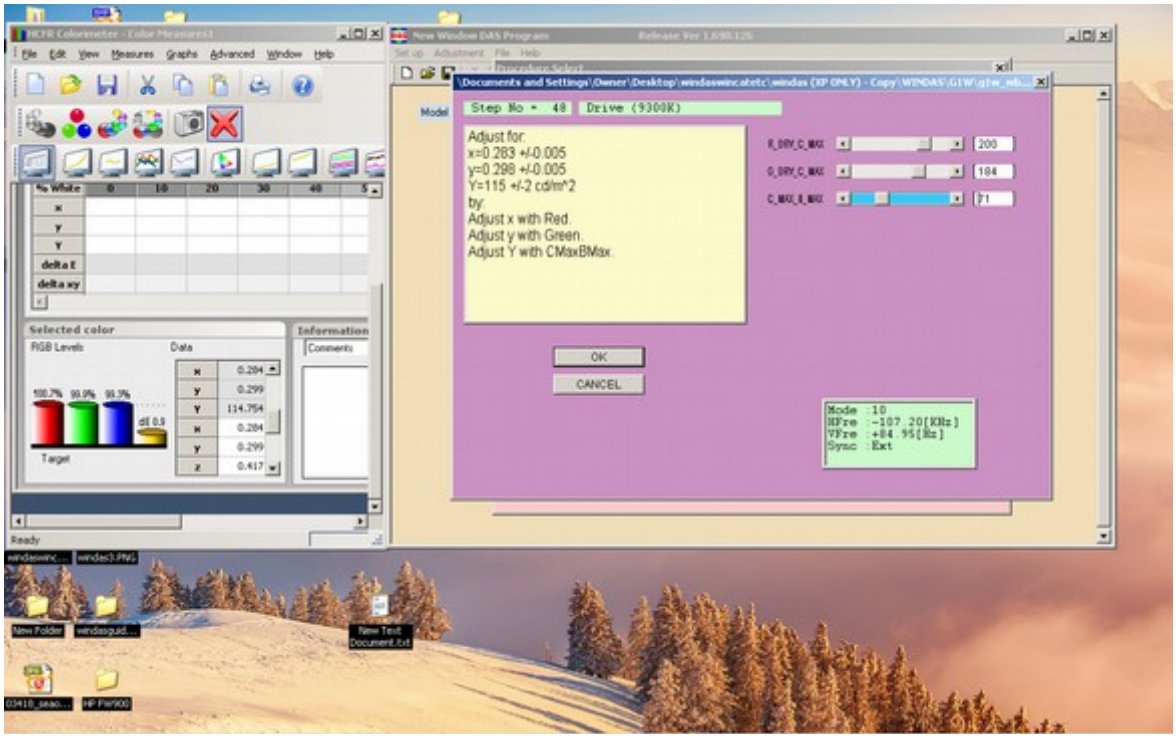
Below is what things should look like when you have completed this step.



Notice that it is not perfect, but it was as close as I could get it during this particular adjustment. Don't kill yourself, especially if you're not planning on using 9300K. There are physical limitations here: WinDAS allows adjusment with only 8 bits of precision, so it's rare to get exact matches with all your adjustments.

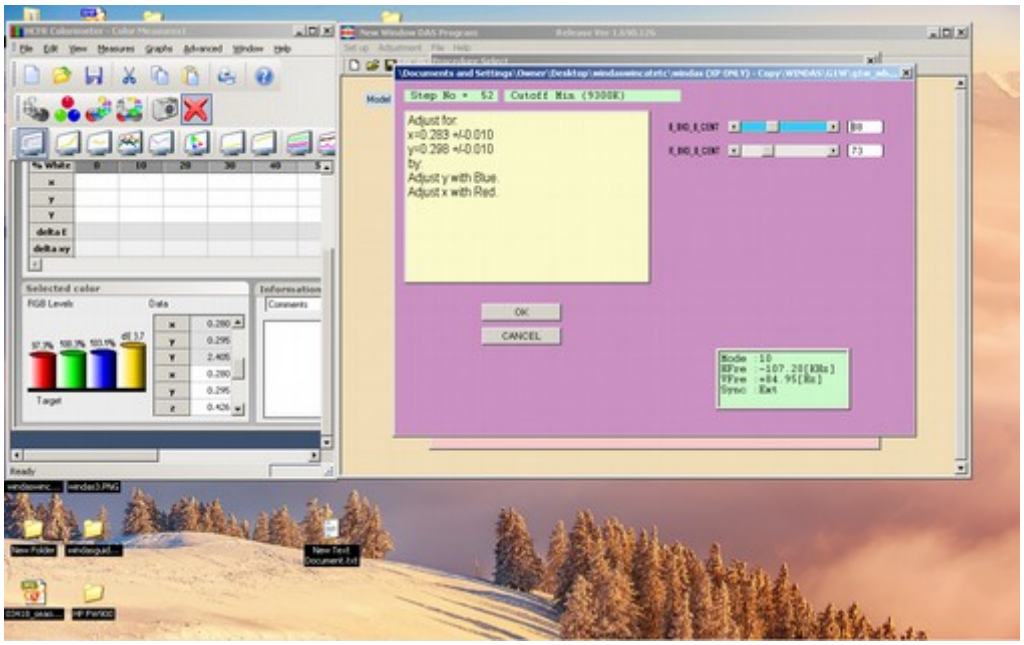
Click OK, and load up the White pattern as instructed (remember to ensure the pattern is fullscreen).

In this next step, do your best to meet the white point target using the first two sliders, and use the bottom slider (C_MAX_B_MAX) to hit the desired luminance target (115 cd/m^2).

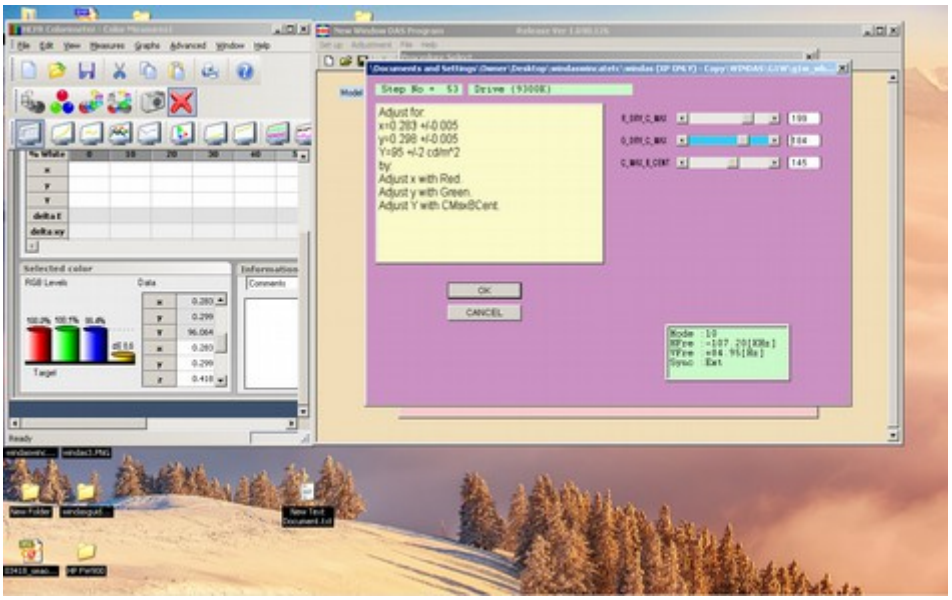


Click OK, and load up the 30 IRE pattern as instructed (note that a true 30 IRE pattern would have an RGB value of [76.5 76.5 76.5], but as we are limited to 8 bit precision, I could only use integer values, so I chose [77 77 77]. This means that the pattern is a touch brighter than it should be, but well within the margins of error for the requirements of WinDAS). The file is called 30_IRE_1920x1200.png.

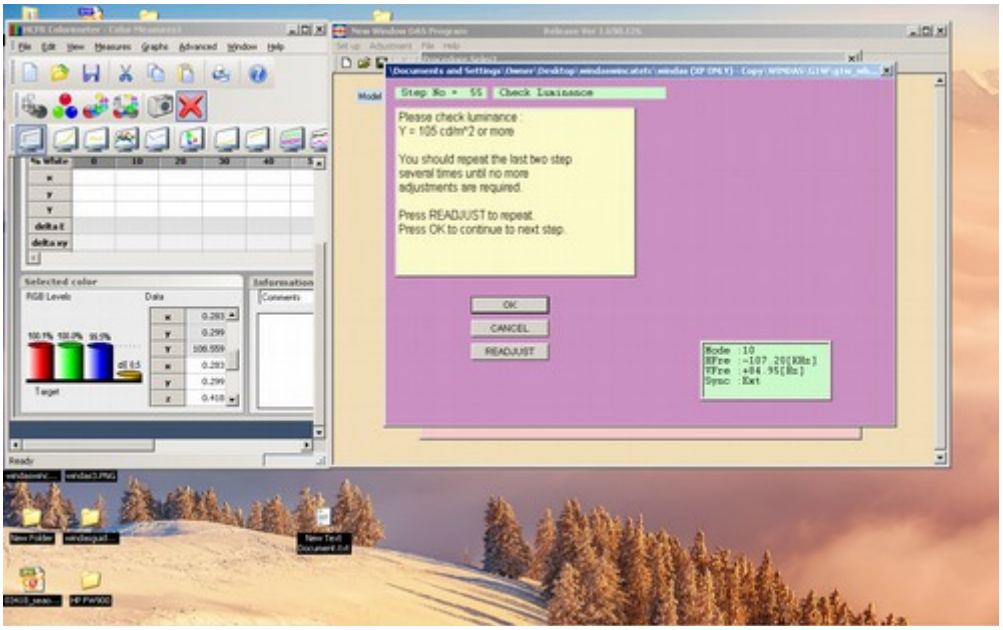
These next few adjustments are iterative, so don't worry if you don't hit your chromaticity targets the first time round. For example, in the image below, I had a delta E of 3.7 the first time round using the 30 IRE pattern.



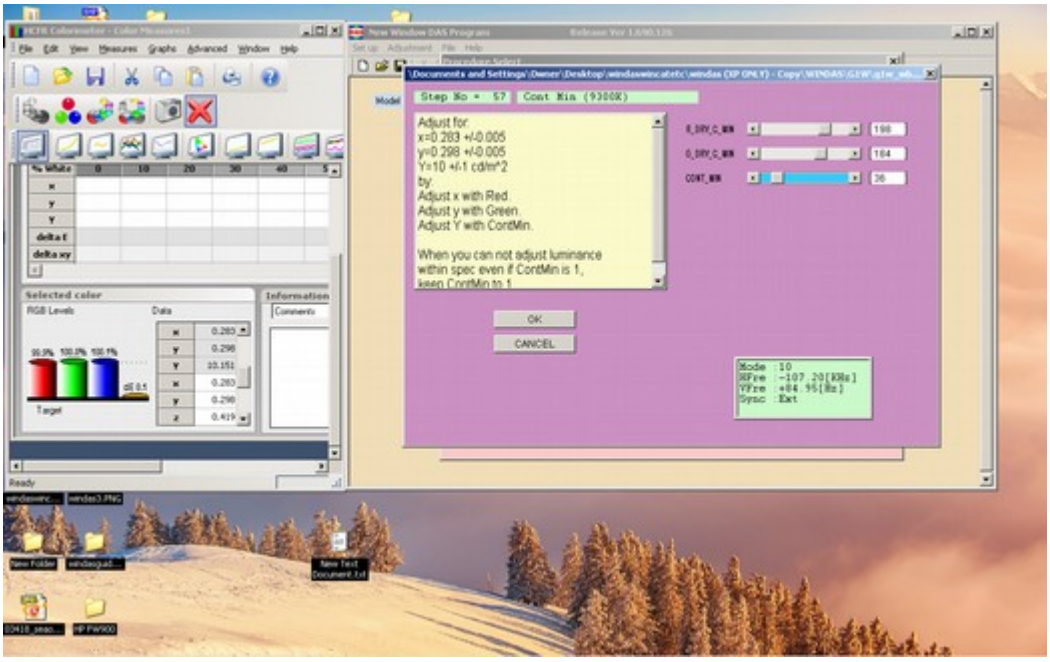
After adjusting step 52 to the best of your ability, click OK, and load up the white pattern (100 IRE) as instructed. Notice the luminance target is now 95 cd/m^2.



Adjust until targets are met, and then click OK.

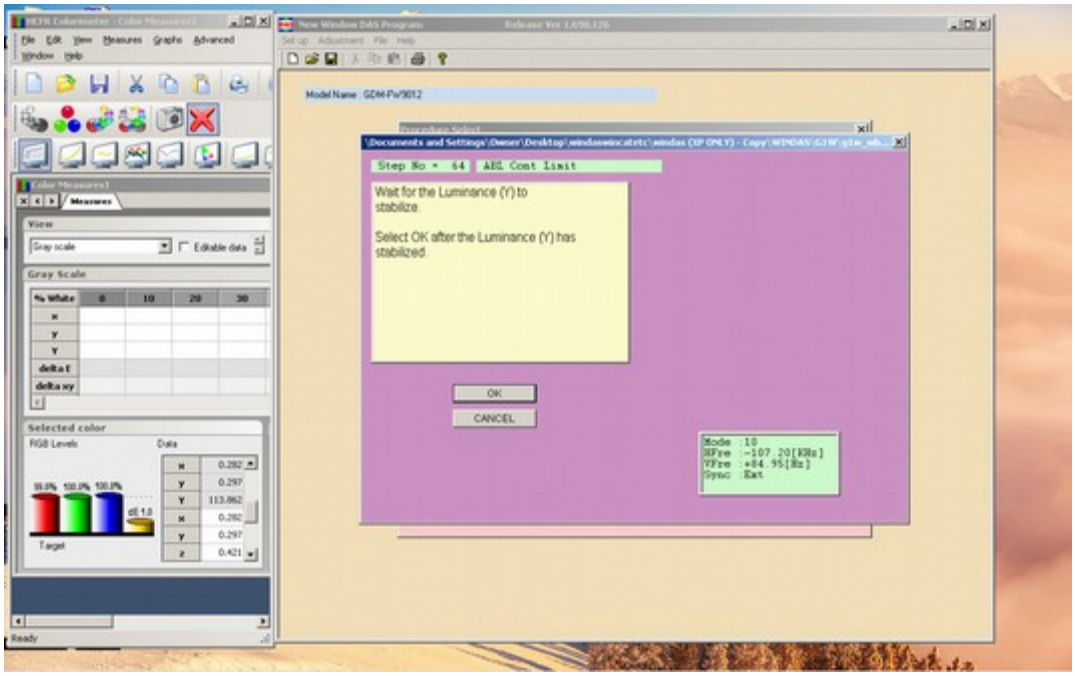


Check that the reported luminance is 105 cd/m^2 or above. Click Readjust, and load up the 30 IRE pattern. Continue iteratively adjusting these steps until you have done the best you can. Again, don't agonize. ArgyllCMS can fine tune things later with much more precision. Once you are satisfied, click OK in step 55 to adjust at minimum contrast.

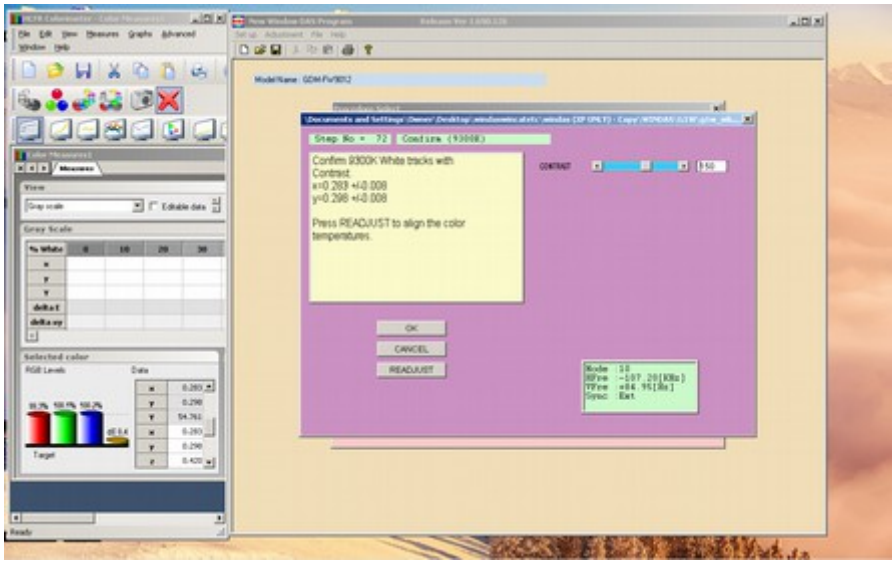


Adjust the sliders as instructed, and click OK.

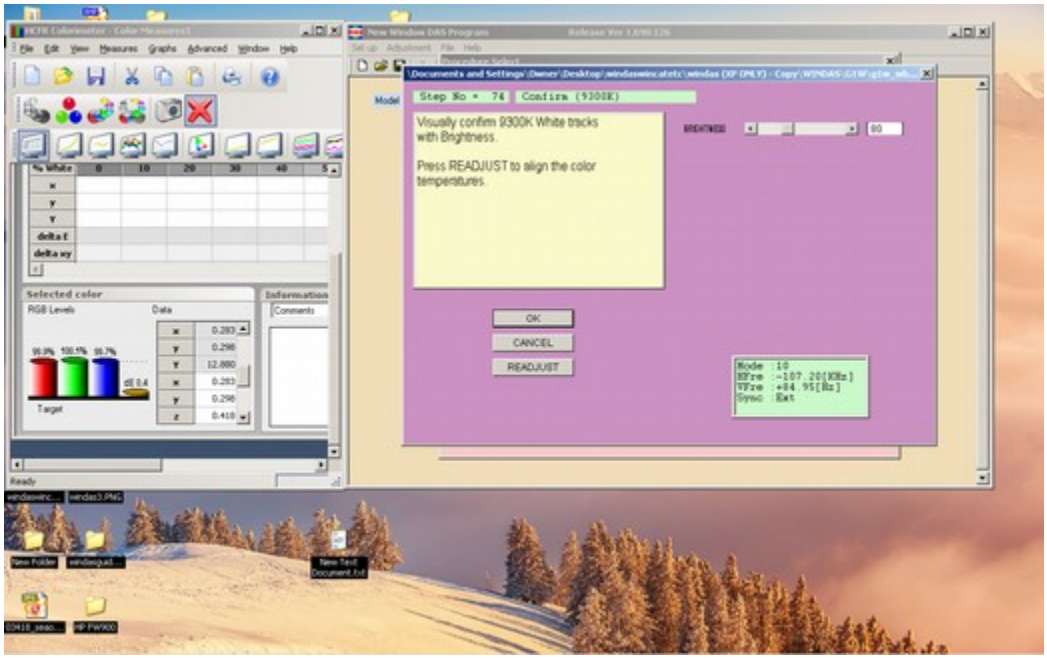
At this point, WinDAS will ask you to wait until the luminance is stabilized. Pay attention to the Y value in HCFR and when you think things are stable, click OK. I usually wait a couple minutes.



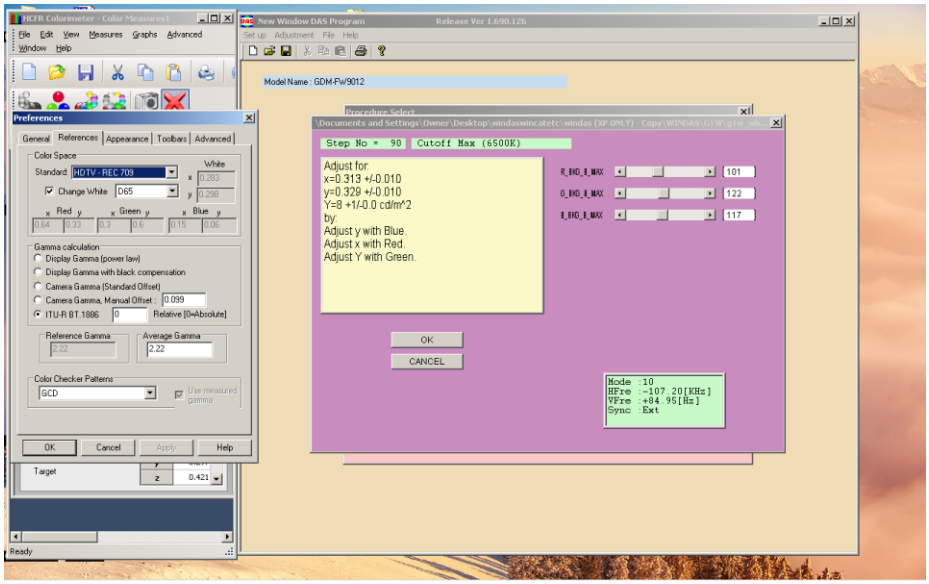
The next two steps are verification steps. In the first one, adjust the slider up and down, and make sure that your delta E levels are low across the range. Again, be sure to wait a few seconds after adjusting the slider to read stable readings.



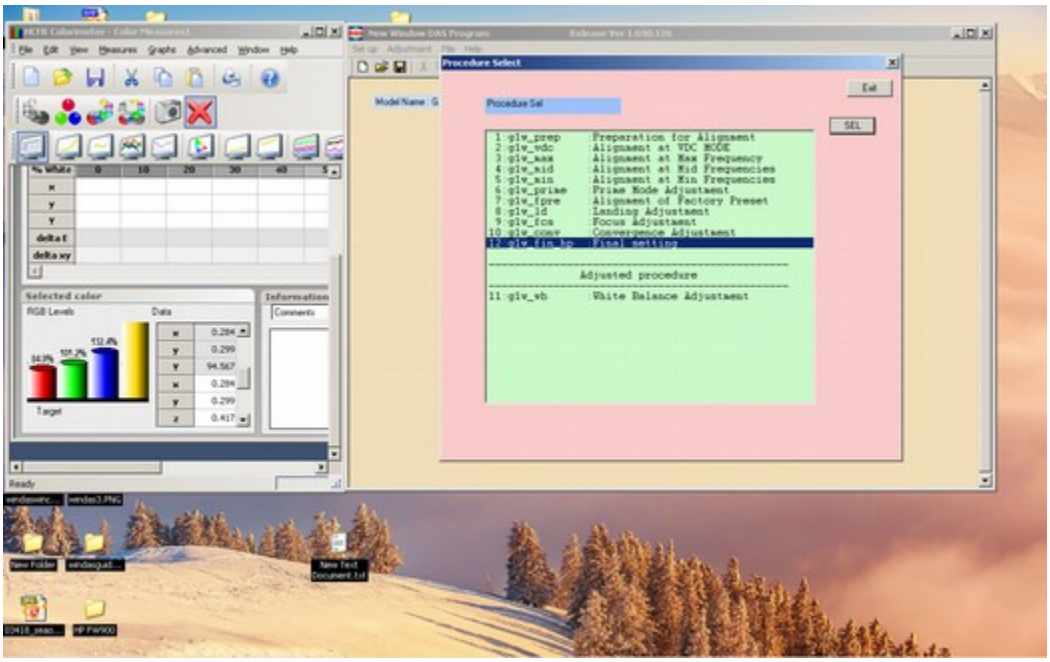
If things went smoothly earlier on, then the delta E should be fairly low across the range. Click OK to continue, and load up the grayscale pattern as instructed (Grayscale_16_bars_1920.png).

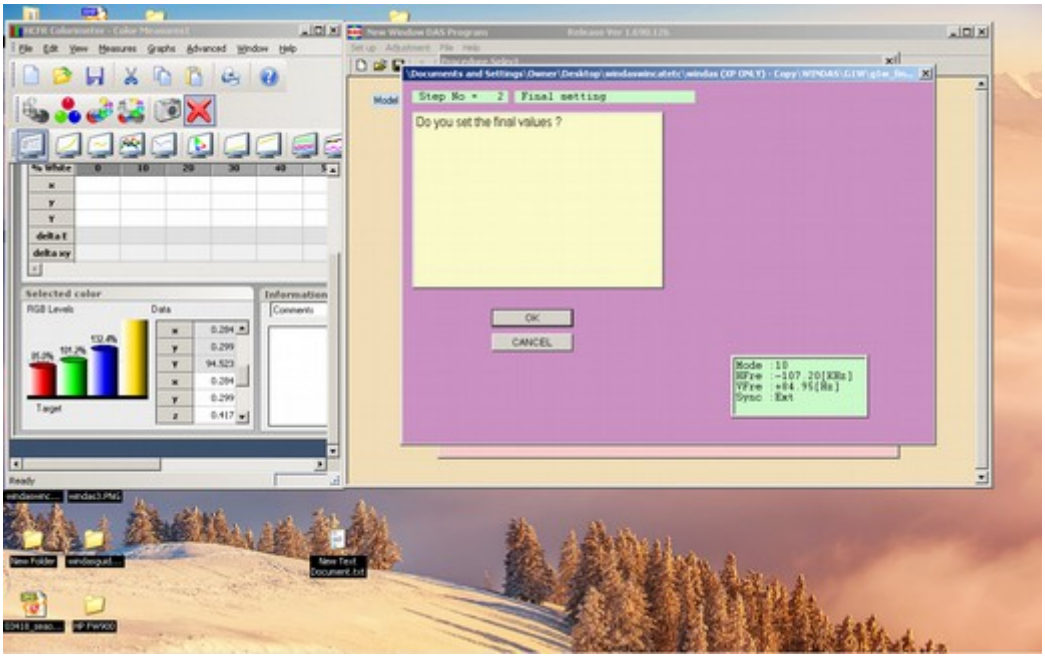


Adjust the slider up and down and visually confirm that the hue of gray remains stable. Click OK to continue, and you will now be repeated the exact same steps as before, but for 6500K. Be sure to change the white point reference in HCFR so you can use the RGB and delta E levels as a guide. You can either input the chromaticity coordinates manually, or choose D65 from the pulldown menu (see image below). I prefer to choose D65 from the pulldown menu as it specifies the chromaticity with more precision than three decimal places. After 6500K is done, do the same for 5000K (choose D50 from pulldown menu).



Once you have completed the 5000K step, WinDAS will do some weird blinking stuff with the monitor, and ask you to adjust for sRGB. Just follow the instructions (you only have to meet a luminance target) – it's very straightforward. Once the procedure is complete, choose Procedure from the Adjustment menut in WinDAS, and choose final setting. Click OK when it asks: "Do you set the final values?".

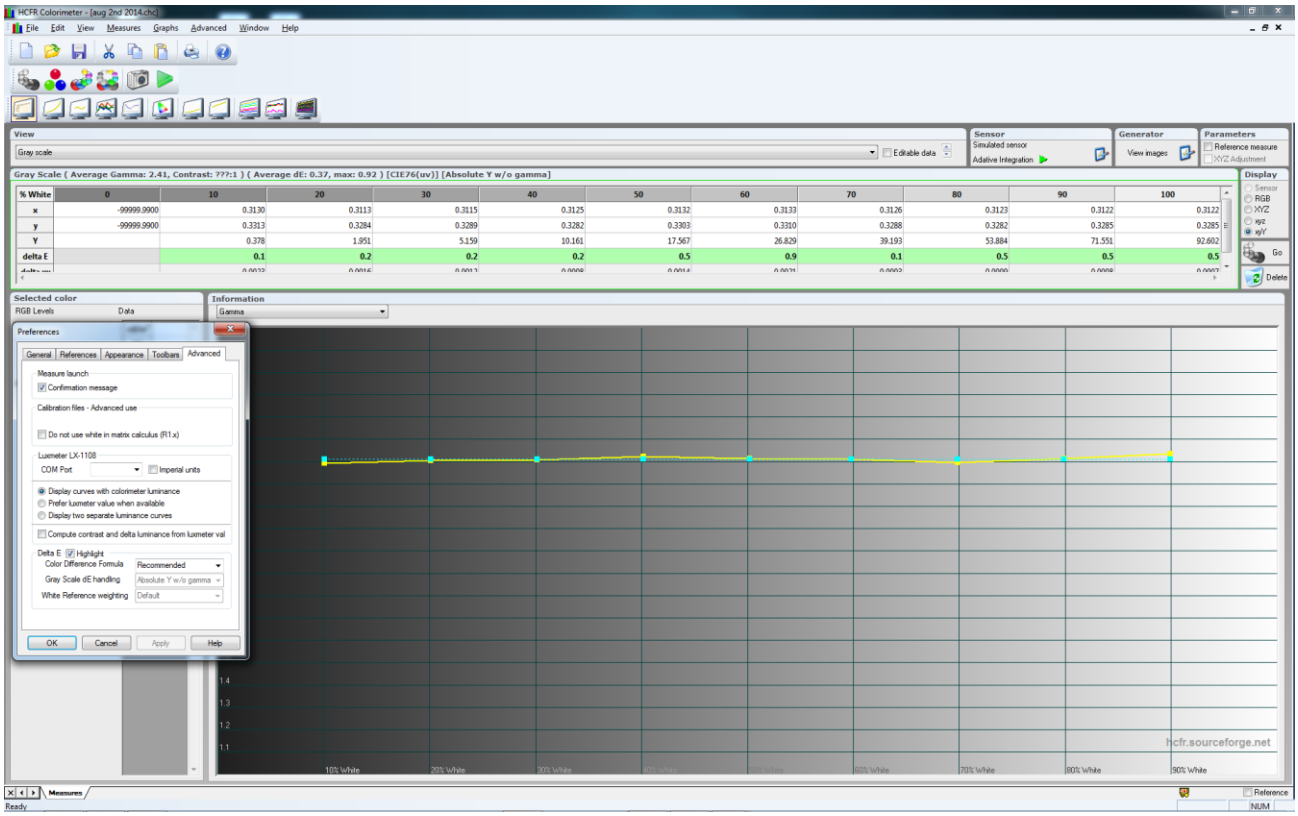




That's it, you're done! Now to confirm the settings have "stuck". Exit WinDAS, and in the OSD

(onscreen display), choose color, easy, and 6500K. Do not touch brightness or contrast (they should be at 31/90).

Load up HCFR on your main PC, and switch the colorimeter cable from the laptop to PC. This time, in HCFR, choose "view images" from the "select a generator" pulldown menu. Make sure the reference is D65. Also, in advanced, make sure "recommended" is chosen for the Delta E color difference formula (see image below). Don't hit the green play button, but instead, click on the Measures menu, and choose Gray Scale. Wait until the readings are complete, and the in the graphs menu click Measures. Make sure your delta E values are relatively low for the different gray levels (the first few may be unreadable because the black level is so low). If the errors are higher than they were during your WPB in WinDAS, then the EEPROM may not have saved correctly, and you may need to repeat the WPB. In the information window, choose Gamma from the pulldown menu (see image below). If you set the G2 voltage according to the instructions in this guide, your blacks should be very low, but your gamma will be very high (which means the overall image is extremely dark and crushed). This will be reflected by the blue line which shows the average gamma. It may be as high as 3.0! (in image below, I've already done an ArgyllCMS adjustment so my gamma is 2.4).



So now you have great white point balance, and fantastic blacks, but the image is severely crushed. We need to tweak our luminance function. One very easy way to do this is just to adjust the gamma slider in your video card properties. If you're not overly concerned about meeting precise HDTV standards, and you find the image acceptable after adjusting the gamma slider, you're fine. You can even re-measure your grayscale in HCFR to see how the gamma changed as a result. For those who want to really fine tune things, read on.

Fine tuning the LUT with ArgyllCMS

For best results, keep the colorimeter on the screen. If you removed it before this step, use the centering pattern to reposition it. Also keep in mind that these instructions assume that you have set the black level very low. A higher black level would require slightly different instructions.

Load up a command window, turn off the lights, and type:

dispcal -m -qm -J -F -v3 -g2.4 -f1 -k0 -A16 mylutname

where mylutname is the name you want to assign to your custom LUT. This should take some time (might take an hour or so), so you may want to leave your room and do something else. Remember, lights need to be off for this to work properly.

(if you are curious about what these switches do, you can learn more here)

Once this is complete, you'll have a file on your hard drive called **mylutname.cal** (or whatever you called it). To load it, type:

dispwin mylutname.cal

Once it's loaded, re-run the gray scale measurements in HCFR, and compare results. You may notice that ArgyllCMS has raised the black level slightly. This is a result of your display's black level being way below the instrument's ability to read. This should not be a major issue, however.

To ensure that this LUT is loaded when you boot into windows, you can create a text file that has the dispwin command inside of it, and name the file "name.bat". You can then copy this file to your startup folder. I also keep a copy of the file on my desktop in case I need to manually activate the LUT (sometimes it might not load upon bootup or some other program, like a game, may overwrite it).

When watching video content, you should be able to configure your video card and video player to allow the video card LUT to be respected during playback.

If you like, you can create another LUT based on a 2.2 gamma, as some content may be mastered for 2.2 gamma. 2.2 gamma may also be more appropriate if operating your display in more brightly lit environments. If you choose to do this, just run dispcal again, but change -g2.4 to -g2.2, and name your LUT file accordingly.

All done, now turn your lights off, set up a bias light if possible, and enjoy your display!