

Color Levels In Avid Media Composer Import And Export

1. INTRODUCTION

When you import or export picture from Media Composer, (through File->Import or File->Export) you are presented with an option section labeled 'File Pixels To Video Mapping'. It lets you select '601/709' or 'RGB' (with and without dithering).

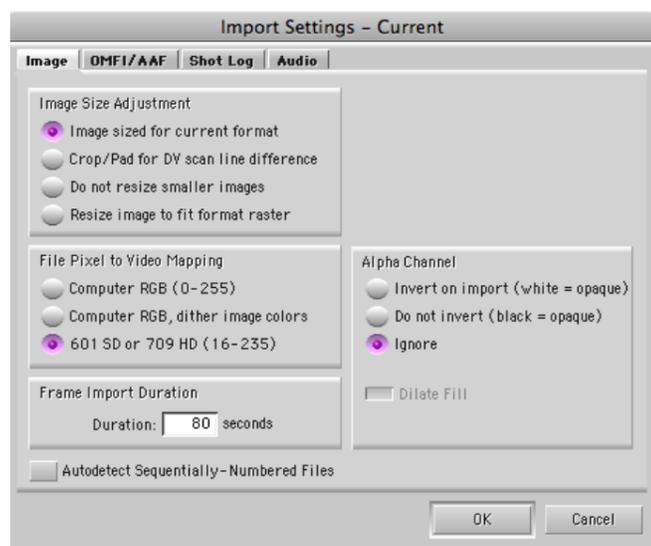
This nomenclature is confusing, as 'RGB' is often used for very different things. What is meant during import is whether or not the source file is already within 'legal' 601/709 levels (16-235 in 8-bit). What is meant during export is whether or not the resulting file should have its levels adjusted for viewing on 'full swing' (0-255) monitors.

*Note that since MC version 8.4, these options were relabeled, and placed in a different order.
"Computer RGB (0-255)" is now labeled "Scale from full range to legal range"
"601 SD or 709 HD (16-235)" is now labeled "Do not modify, treat as legal range"
The middle option to "dither image colors" has been removed.*

Note that the Avid is a video editing application, and is supposed to work in video color space (601/709). So the Avid codec always assumes you are going to end up with something that is supposed to be 601/709 compliant (ergo 16-235). Also note that your client monitors are supposed to be calibrated to 601/709 in order to properly display the video levels you are creating in your Avid.

Also note that the legal 16-235 lives inside a 'regular' digital picture, so if you look at a picture that is 16-235 legal on a computer monitor (that is set up to display 0-255), the images may look dull, washed out, with too little contrast. But that is correct, as the image is not meant to be displayed on such a computer screen, but on a screen that has been calibrated to display 16-235 (like a properly set up client monitor).

Finally, I'll be referring to 0-255 and 16-235. These are 8-bit numbers. In 10bit, it would be 0-1023 and 64-940. For convenience, I'm sticking to 8-bit values.



2. TO REMAP OR NOT TO REMAP

I'd recommend reading the 'RGB' and '601/709' options as follows:

IMPORT:

- RGB: **Remap** 0-255 levels over 16-235 video (blacks lifted, whites reduced)
- 601/709: **Do not remap** (keep levels as they are)

EXPORT:

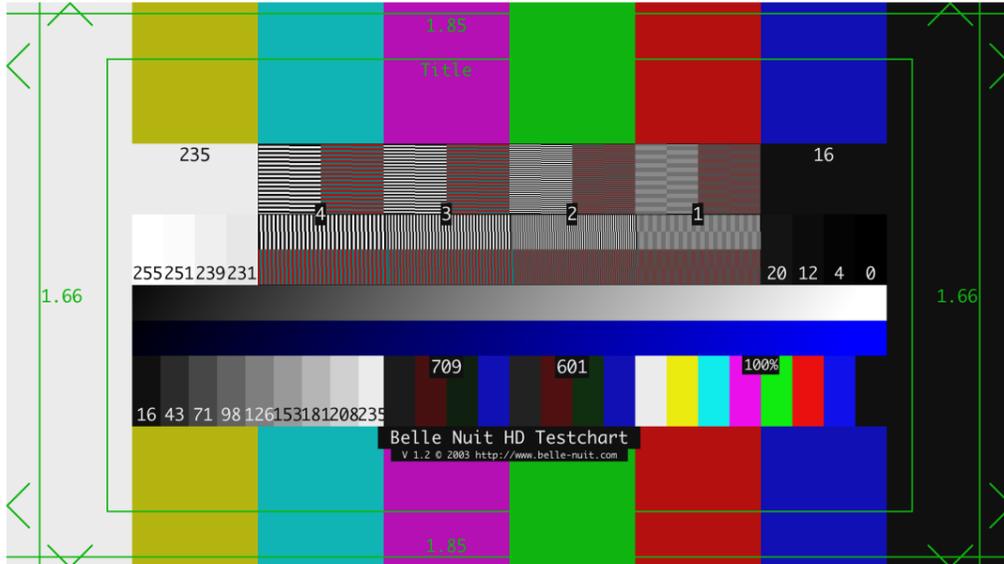
- RGB: Take whatever lives between 16-235 and **remap** to 0-255 (blacks lowered, whites brightened)
- 601/709: **Do not remap** (keep levels as they are)

Note that if you are using the Avid Quicktime codec in Quicktime Pro or other applications, that you also get the choice between 'RGB' and '601/709'. There, it has the same meaning as in the IMPORT situation described above.

To gain some insight on what is happening, it can be useful to do the following tests.

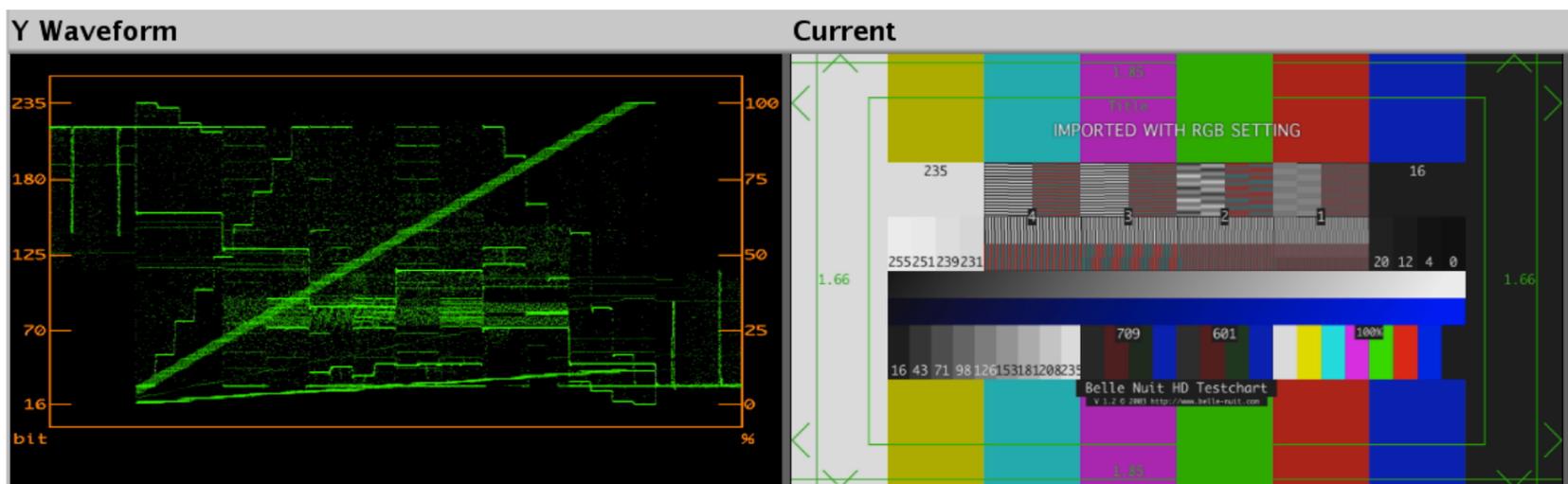
3. IMPORT TEST

First, let's get a test file. One that is very nice is Belle-Nuit's TestChart (<http://www.belle-nuit.com/testchart.html>). It features legal bars plus superwhites and superblacks, so various legal and illegal levels are represented. The nice thing is that the boxes have numbers with their 8-bit values, as created in a graphics application.



Next we perform two imports into Media Composer, one with 'RGB' selected, one with '601/709' selected. Then we open the results in the Color Correction Tool, and display a Y-Waveform, so we can easily determine the color levels we end up with.

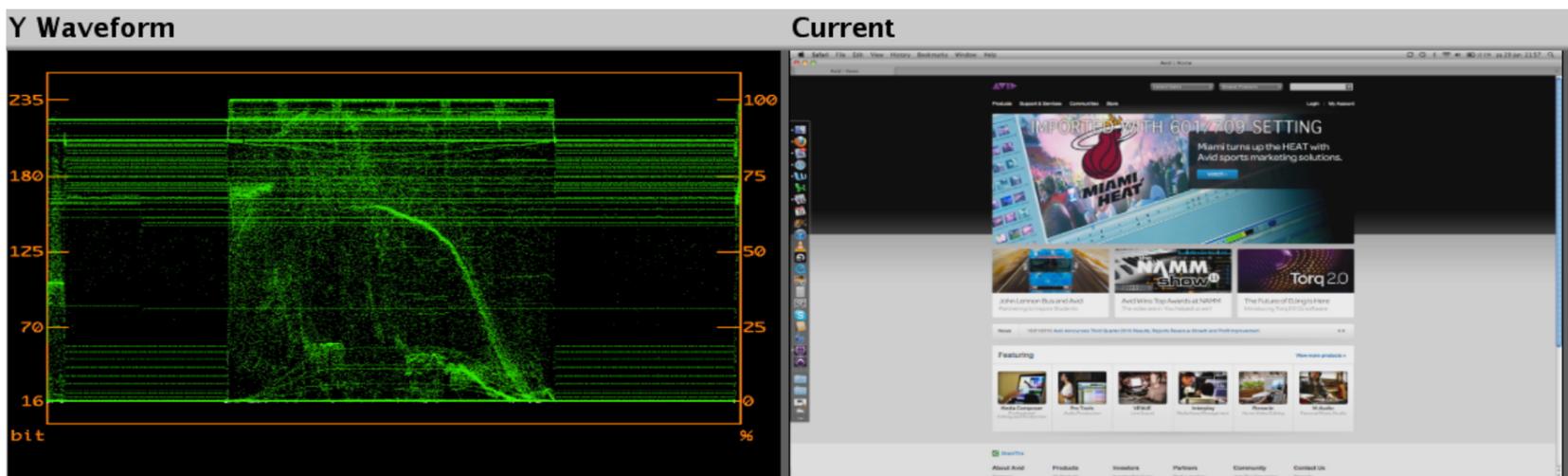
3A. First, let's import with the 'RGB' option selected:



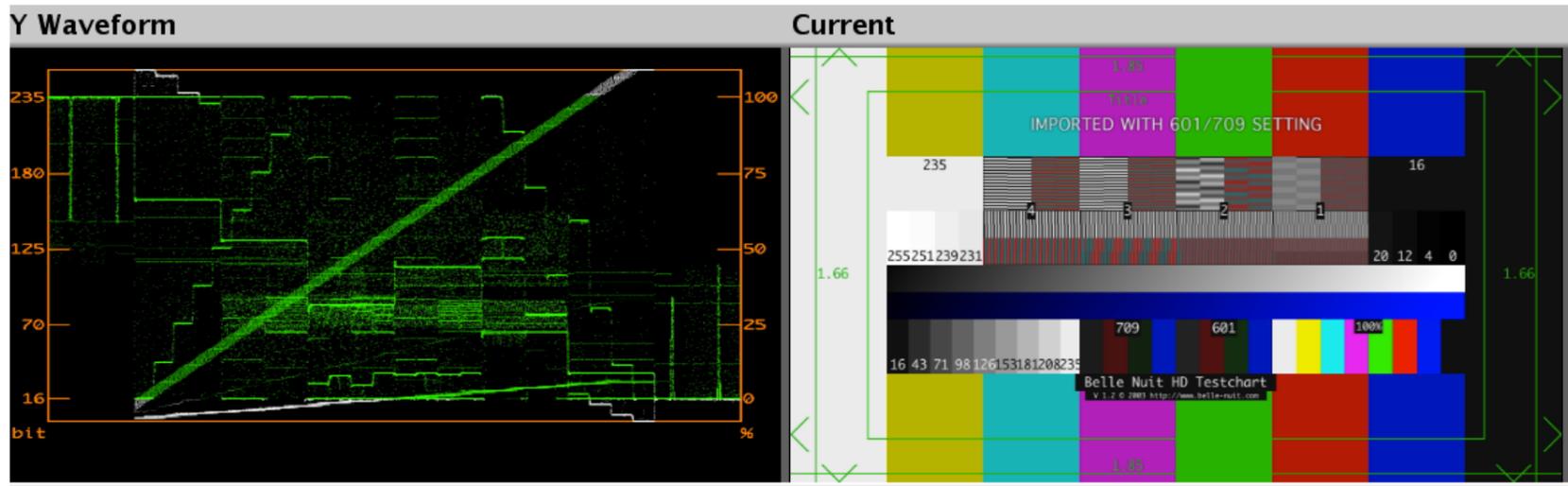
As you can see, when importing with the 'RGB' option selected, Media Composer will remap all values between 0-255 over 16-235, so no signals over 235 or under 16 are seen on the WFM. Note that this now means that the white box with the number '255' no longer measures an 8-bit value of 255 on the WFM, but of 235. And similarly, the box labeled '0' now measures a value of 16.

Remember, inside Media Composer is meant to work in 16-235, so when you tell it your source is 'RGB', you are actually asking it to convert your 0-255 source file into a 16-235 compliant video signal.

This would be helpful if you are importing screen grabs from a computer, or photo camera stills, which usually will consist of levels between 0-255, so an uncorrected import would result in illegal video levels. For example, here's a screen grab of the Avid website, imported with the 'RGB' option selected. Note that the blacks are at 16, the whites at 235.

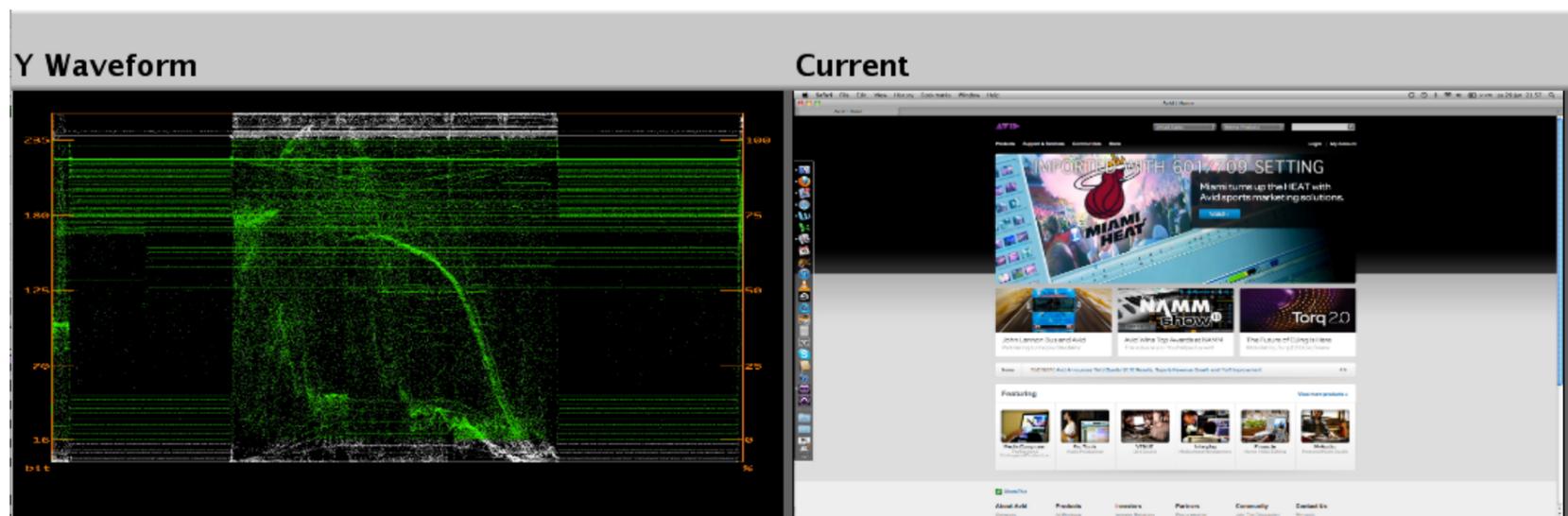


3B. So let's do the same test, but now import the TestChart with the '601/709' option selected. First, the TestChart:

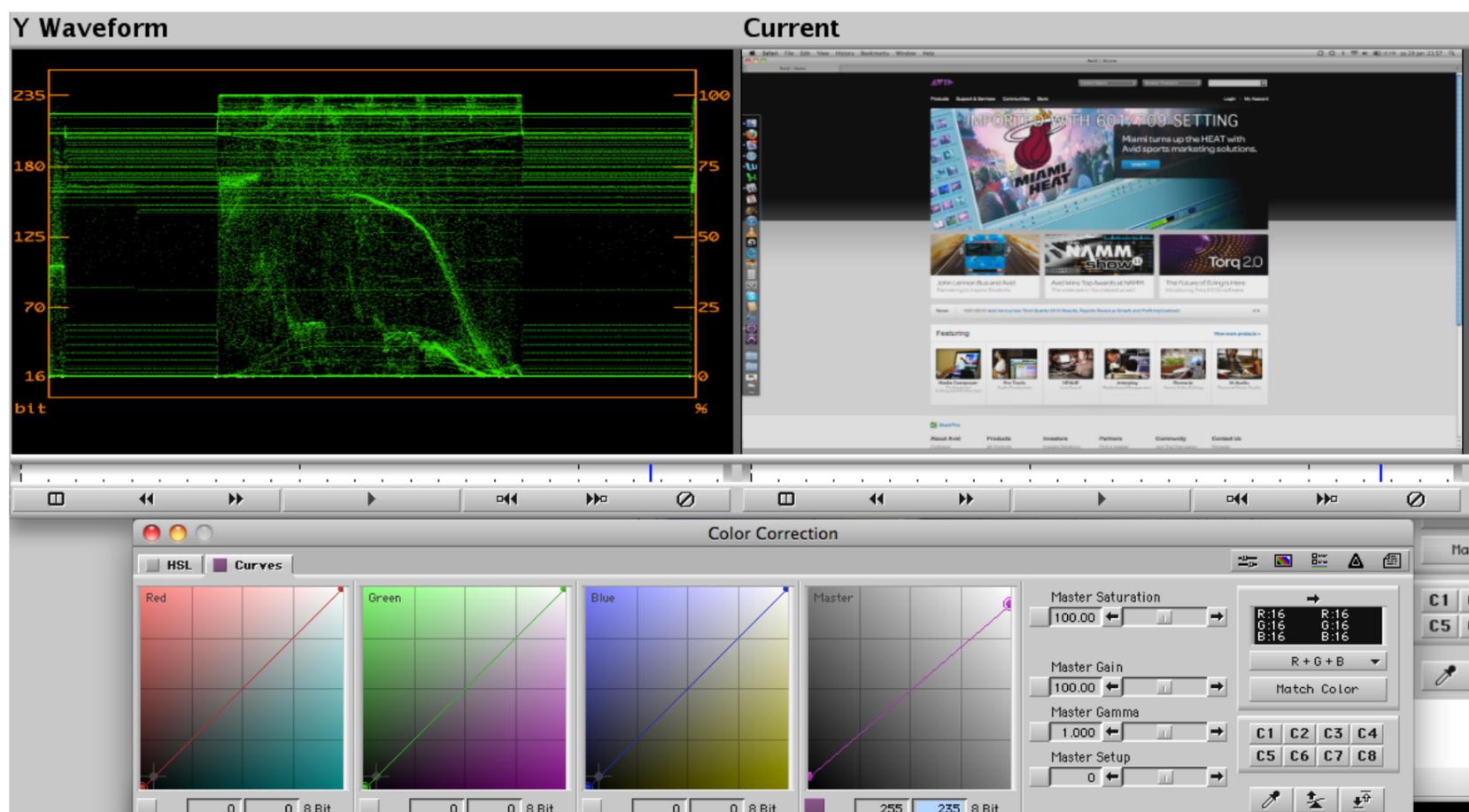


As stated earlier, the Avid needs to work in 601/709, so if you tell it that your source already is made up for 16-235, it will leave the levels of the source files as they are. So now we see on the WFM that there are some illegal levels (the white stuff), which is of course caused by the superblacks and superwhites (in the boxes and in the grey scale). So we can see that whatever was 16 is still 16, whatever was 235 is still 235. But also, what used to be 0 is still zero and what used to be 255 is still 255.

The same happens when we import the screen grab of the website:



We now see that most of the black lives below 16 and a lot of the whites live above 235. You could of course compensate for that in the Color Correction Tool, by choosing to change the white and black points in the Master Curve (note that in the Master Curve of the Color Correction Tool the black point at 0 is raised to 16 and the white point at 255 is lowered from to 235):

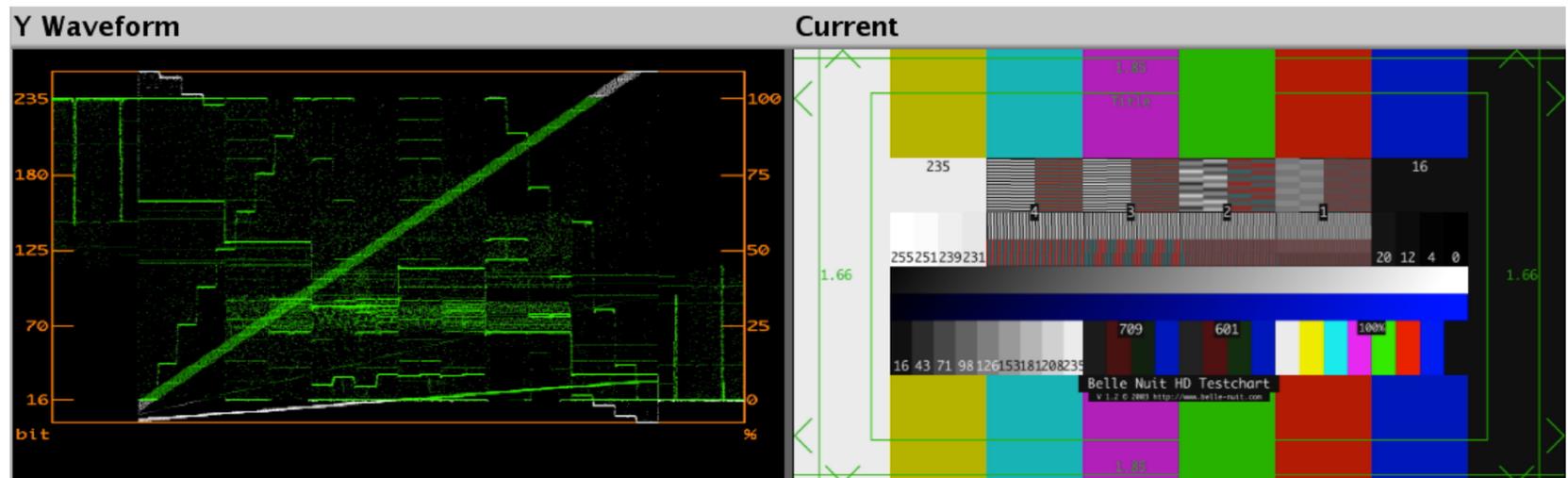


So in effect, you may 'cheat' Media Composer into thinking the source is already in 16-235, thereby keeping the original (legal and illegal) color levels, which you may correct for with the Color Correction Tool. Or you can keep them as they are, all the way through, effectively cheating the Avid into working in 0-255.

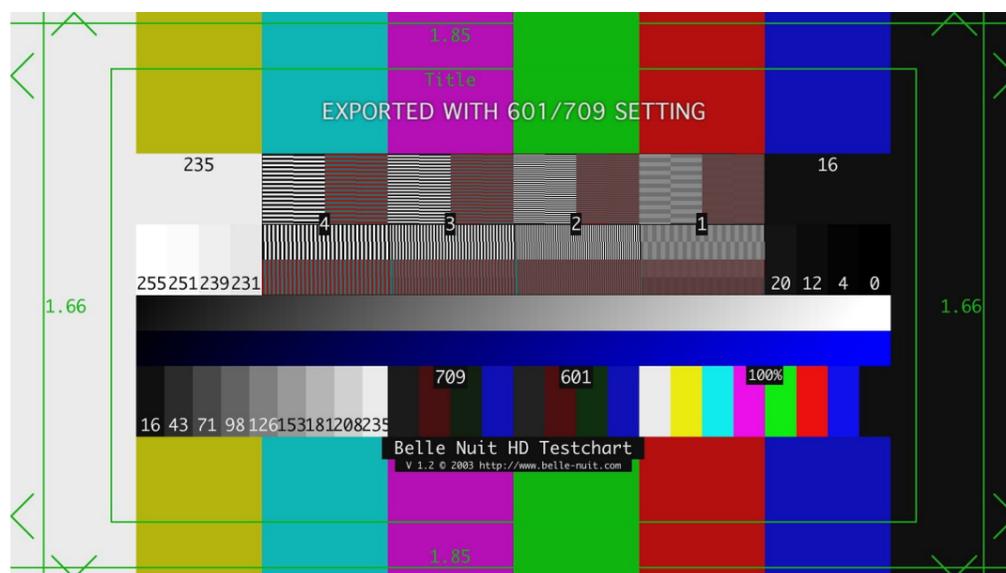
4. EXPORT TEST

So what happens if we export *from* the Avid to a file? Well, we then also get the option to either remap or leave the levels untouched.

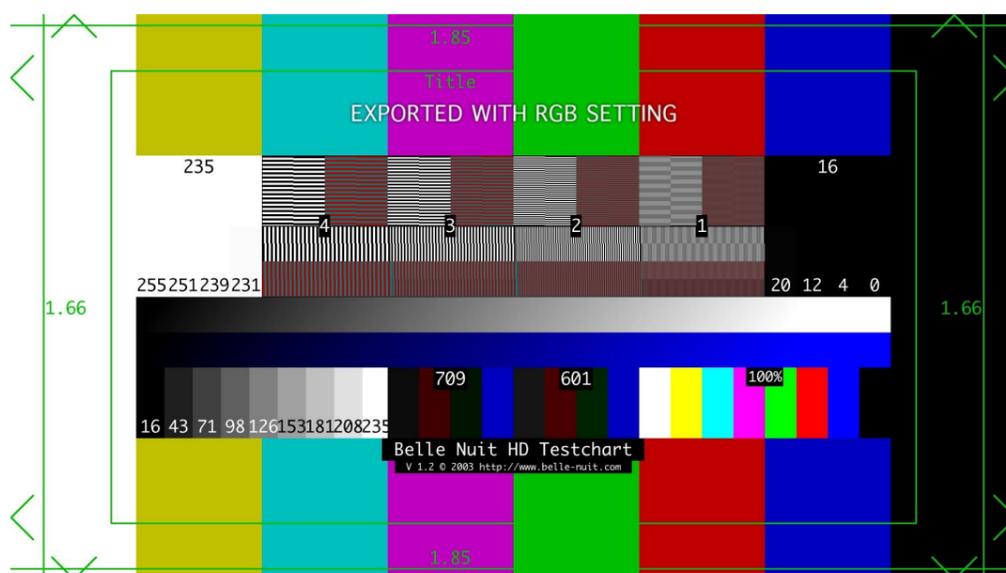
Let's start off with the Belle-Nuit Test Chart, at its original levels. Never mind the way these have been imported, what matters now is that we have a test file that has a lot of legal and some illegal levels, so we can easily determine what is happening when we export.



4A. So now we do an export with the '601/709' option selected, and the levels should all remain the same. Whatever is legal, and living between 16-235, is still legal, and whatever is illegal, is still illegal:



4B. And when we export with the 'RGB' option selected, the levels will change, since we are telling the Avid to take whatever lives between 16-235 and remap that over 0-255. Note that this will crush all blacks below 16 and clip all whites above 235:



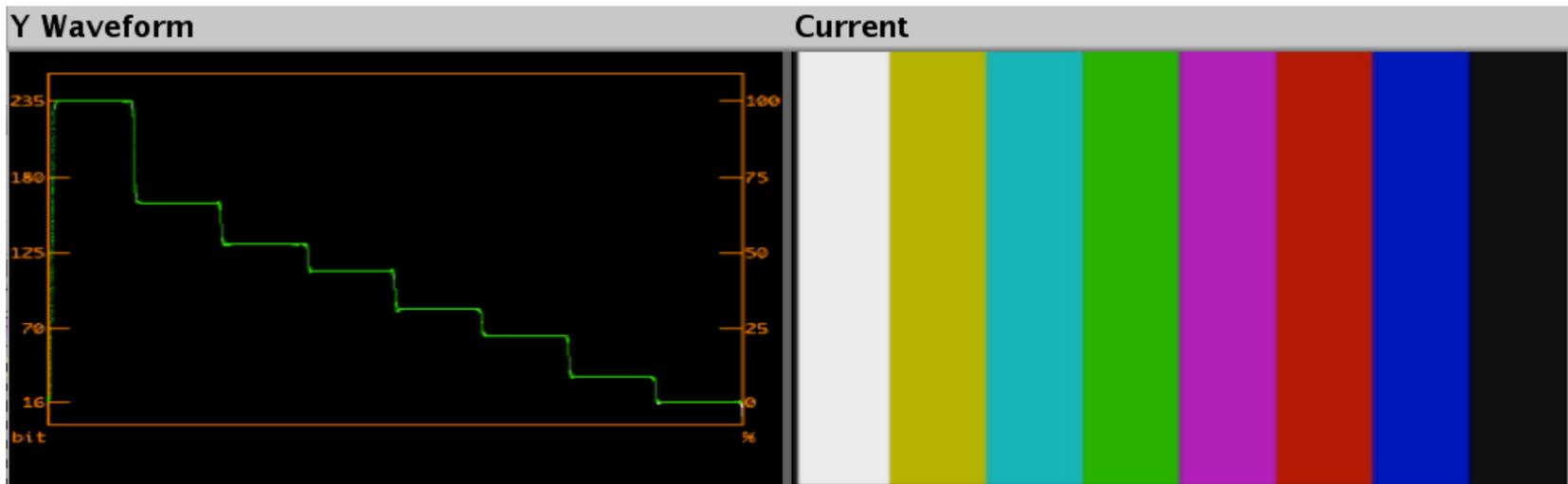
It's easy to see that the 255 box is just as white as the 251, 239 and 235 boxes, and the 16, 12, 4, and 0 boxes all have the same level. This means that all black details below 16 have been crushed, and all white details above 235 have been clipped, while all legal values between 16-235 have now been 'stretched out' over 0-255. So whatever was legal within our show, not has been expanded to be watched on computer monitors..

5. WHEN TO USE WHAT

So when should you use what? In general, you only export with the 'RGB' option selected (remapping the levels), when the content in your Avid is within legal range (16-235) and you need to export a file that needs to be viewed on a computer screen (web exports and such). And you would only import with the 'RGB' option if you need to remap color levels of a 0-255 file during import (rather than in color correction).

5A. ROUNDTIPPING

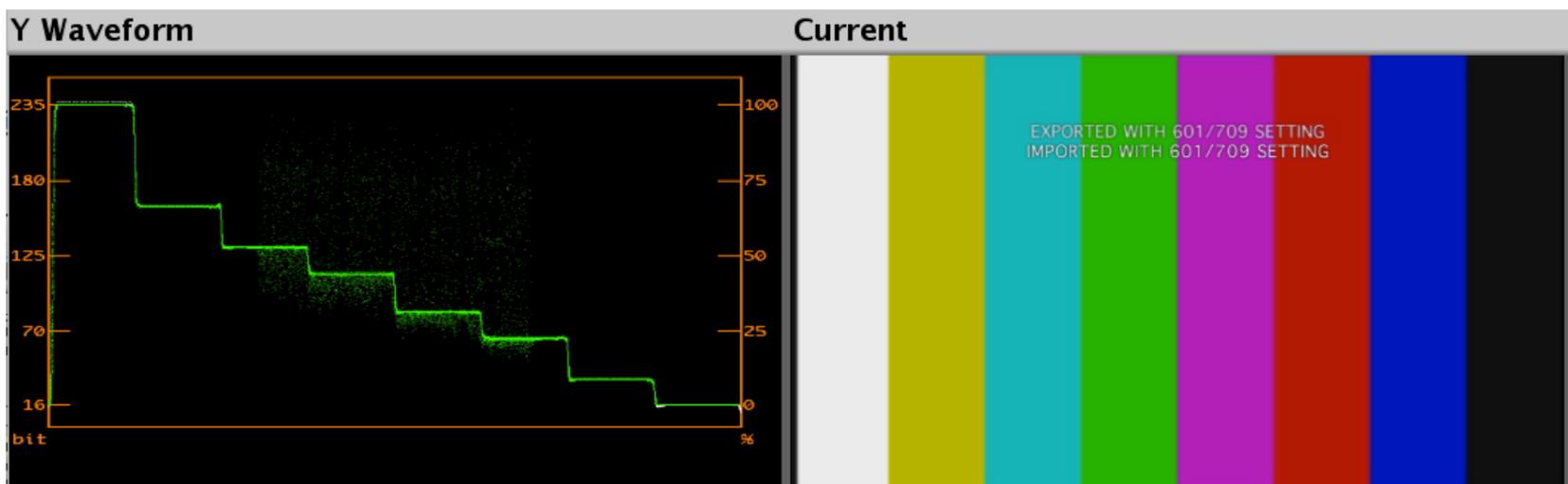
Sometimes, it seems to matter less, as long as you are consistent. For example, here's a set of legal color bars inside the Avid:



If we export this image with the '601/709' option selected, we see the following image on the computer:



If we then import this exported image back into Media Composer with '601/709' selected, we get a picture with the correct levels:



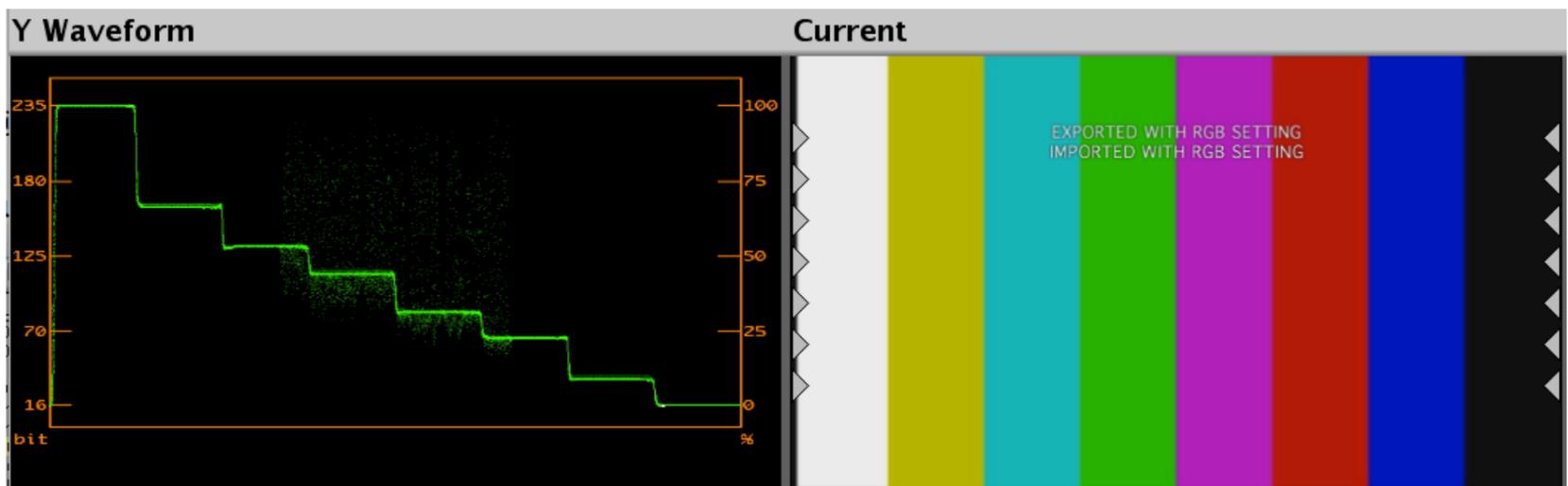
N.B.: The noise that has entered the picture is the caption I added).

Next, we will perform a 'roundtrip' with selected 'RGB'. First, an export:



Note that this image looks 'nicer' more contrasty, on the computer monitor, compared to the '601/709' export we just did. Again, we have stretched whatever lived between 16-235 in Avid and stretched it over 0-255.

And then we reimport this 'RGB' export with 'RGB' selected during import. Which makes sense, as we need to get back to legal levels, so we need the Avid to remap 0-255 onto 16-235.



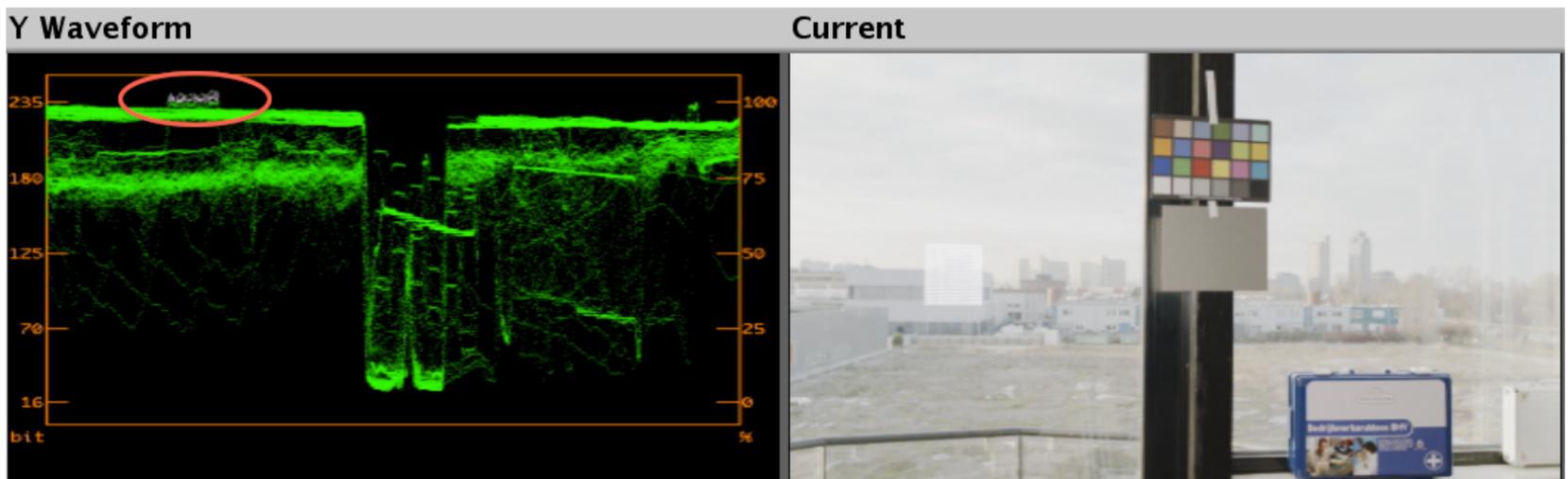
N.B.: The noise that has entered the picture is the caption I added).

So in this case, the result of the roundtrip is the same, as no illegal levels were present in the original image.

However, the 'RGB' roundtrip has basically had two 'color corrections' applied to it, one undoing the other. With the chance of rounding errors during the double remapping.

5B. CAMERA HEADROOM AND COLOR GRADING

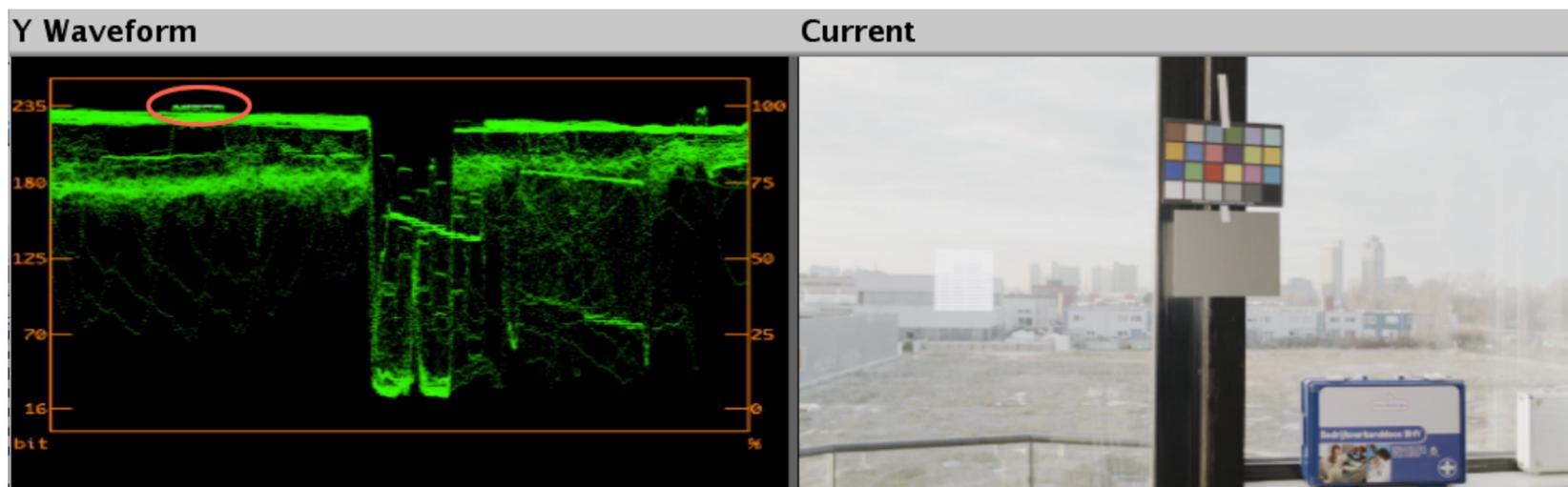
A lot of modern digital video cameras, even though they are set up for 601/709, they will use some of the headroom between 235 and 255 for capturing top whites, effectively enlarging the dynamic range when shooting. See the tiny bit of white peaks in this screengrab:



When you capture or import these files, maintaining their levels, you are keeping all that extra information, and you may use it when color correcting (it will give you more details in skies and clouds for instance).

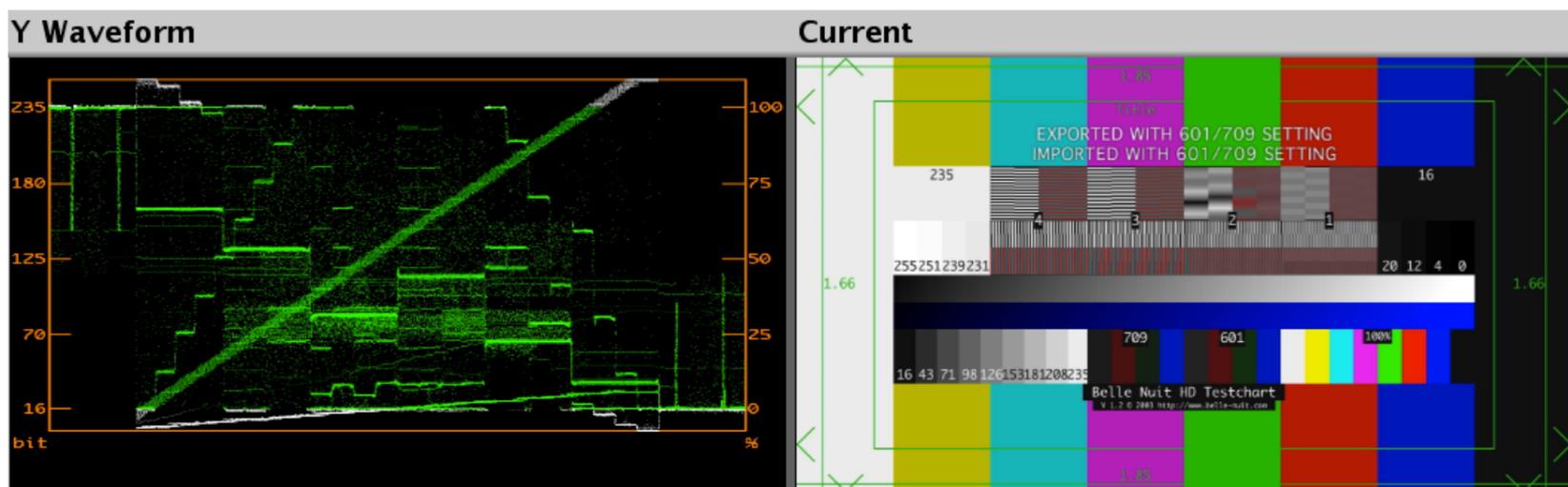
However, when you were to export the original, untreated footage, with its 235-255 superwhite information, and you would export with the 'RGB' option, you would effectively clip all that information to one and the same white value, thereby destroying all the peak white details. Not something you would want to do when exporting to a color correction facility!

Here's a WFM screengrab with the same image, but now first exported with the 'RGB' option (remapping 16-235 onto 0-255) selected, then reimported with the 'RGB' option selected (remapping 0-255 onto 16-235), a 'round trip' through the 'RGB' option. Note that the superwhites have now been clipped.

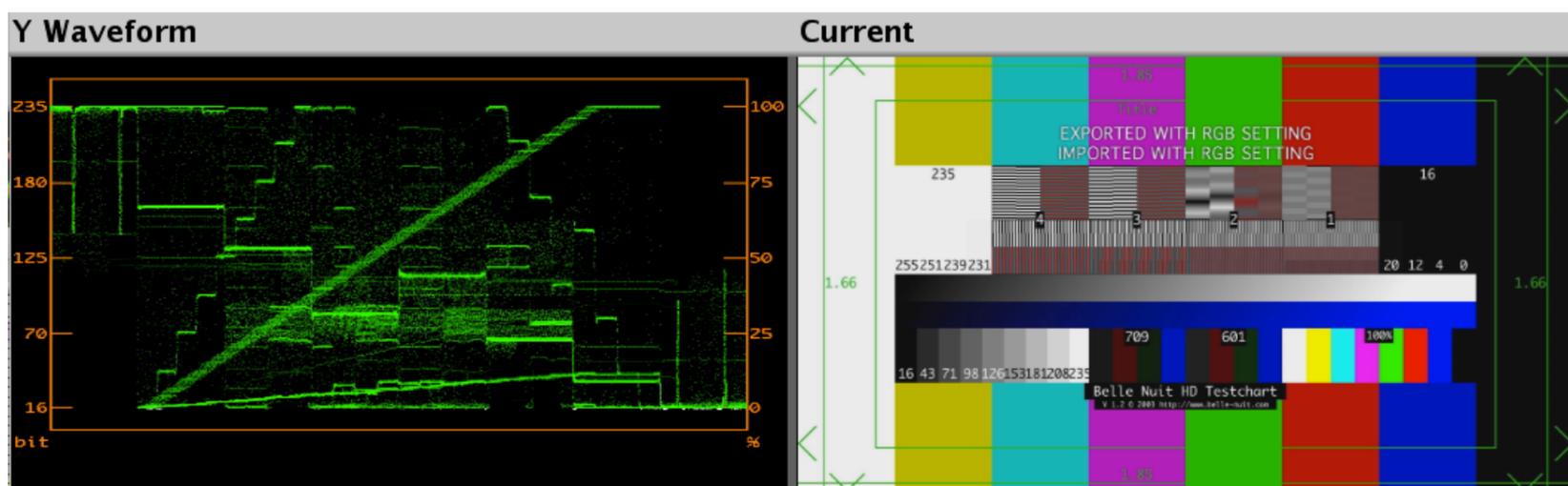


This is even more clear when we do an 'RGB' roundtrip with our original test file.

1. A roundtrip through '601/709':



2. A roundtrip through 'RGB'



Again, clearly a lot of crushing and clipping has happened in that 'RGB' roundtrip; although all the legal values are still legal and correct, the superblacks and superwhites have disappeared.

5B. EXPORTING FOR VIDEO DISCS

So what to do when you have a finished show on your timeline, and you need to export a file that will be the source for a DVD or BD encoding program?

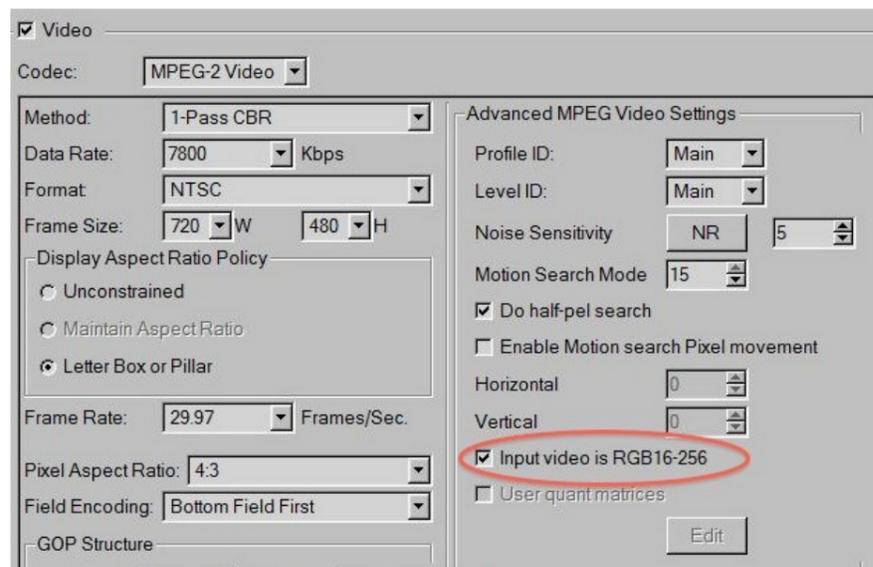
First note that DVD and BD are supposed to have 16-235 levels, as the players need to produce legal video signals.

So, ideally, we would not need to remap the color levels to 0-255 upon export, we would rather maintain the legal color values that our show is already in.

A lot of DVD/BD encoding applications, however, seem to assume that all incoming sources are 0-255. This means that these applications perform a remapping on all incoming sources, elevating the blacks, and lowering the whites.

So if you export from Media Composer to a file, with the '601/709' option selected, and you would open this file in the DVD/BD encoding application, the file would incorrectly be regarded as 0-255, and its blacks would be elevated, and its whites reduced, resulting in a dull looking image, with too little contrast.

A way around that is to use Sorensen Squeeze (part of the 3rd party application bundle Avid is selling as the Production Suite, with a huge discount). Squeeze, in its Advanced encoding settings, has an option that lets you tell it that the source file is already in 16-235 color space, and Squeeze will then leave the levels as they are.



Job ter Burg, Jan 2011.

ADDENDUM DEC 2012: SAME-AS-SOURCE QT EXPORTS

A note came up on the Avid Forums: <http://community.avid.com/forums/p/115377/666952.aspx#666952>

When you export DNxHD media to Quicktime, using Same As Source, the 'RGB' and '601/709' options behave slightly different. The remapped luma levels are then NOT baked into the export, but rather tell QT player how to display the luma levels.

* Export with the '601/709' option will make QT player display all luma levels unchanged (so all levels <16 and >235 are displayed)

* Export with the 'RGB' option will make QT player remap luma levels (everything 16 and below will be displayed as full 0 black and everything 235 and over will be displayed as full 255 white).

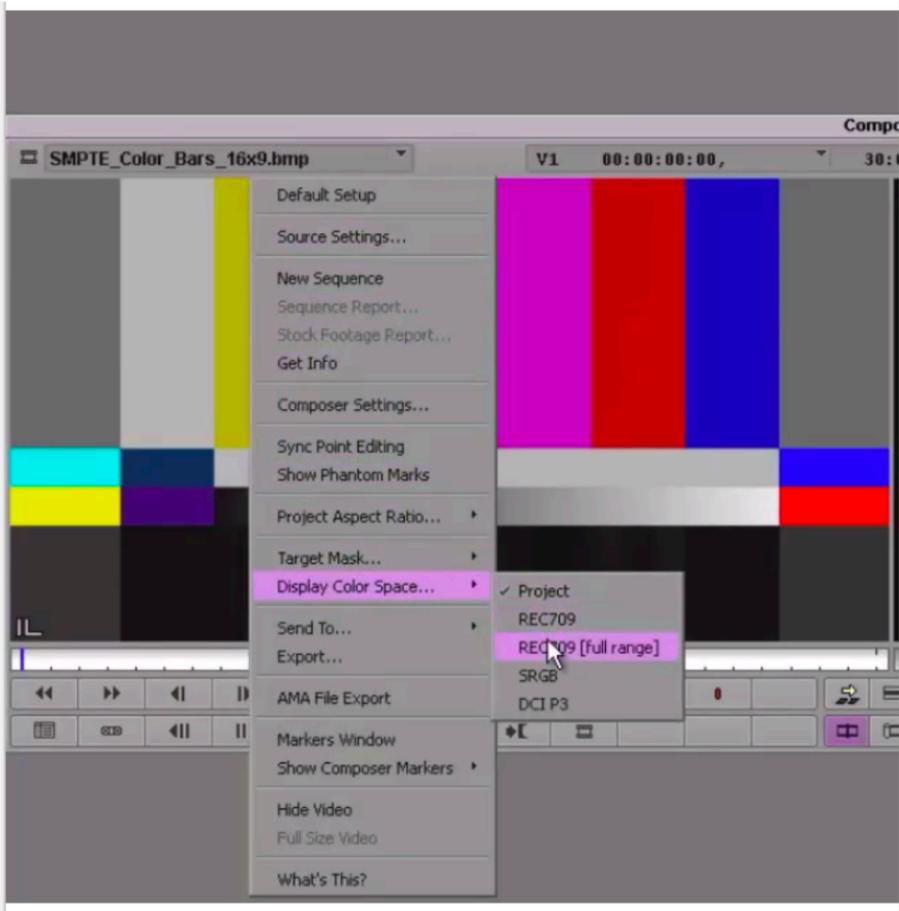
However, if you re-import either of these two exports with the '709' option checked, the full original levels are restored.

This would be 'normal', expected behavior if you exported at 601/709 and re-imported at 601/709 (no remapping on the way out, no remapping on the way in). But the same thing happens when you export at RGB: for Same-As-Source exports, the levels will not be hard clipped/crushed in the exported file, and all original levels (even <16 and >235) will re-appear if you re-import that export at 709.

If you export Same-As-Source at RGB, then re-import at RGB, the levels below 16 and over 235 WILL be gone, though.

ADDENDUM FEB 2019:

In older version of Media Composer, the Source and Record monitors would always assume that your computer displays were calibrated to Rec709 legal (16-235 @8bit). Obviously, most if not all systems use regular computer monitors that tend to be calibrated for sRGB. This means that inside Media Composer, legal blacks (16) would look greyish, and legal whites (235) would look less than full white. It also means you were able to see any illegal levels.



In current versions of Media Composer (8.3 and later), MC has the ability to set the Display Color Space for your Source and Record monitors — and for your Full Screen Display.

When you right-click in your Source or Record monitor (or open your Full Screen Display settings), you will find an option to set the Display Color Space.

It is important to understand that what you set here needs to match the standard to which your computer monitor is calibrated.

The setting defaults to 'Project', which behaves exactly as it used to be in older versions. It assumes your computer monitor is calibrated to Rec709 Legal, and therefore on a regular computer screen, the image will look 'washed out'.

You can change this setting, and tell MC what your monitor is calibrated for, and MC will then correct for that, changing gamma and luminance levels — essentially adding a display LUT to the Source/Record/FullScreen monitor.