

Mac Tutorial for QuadTone RIP

(this approach can also be used with Windows)

Overview

This document is written primarily for Mac OSX users who are interested in creating, modifying, repurposing and using profiles in QuadTone RIP, (henceforth referred to as QTR). Windows users have the QTR GUI interface, which provides convenience not available to the Mac user. Mac users must rely on text files to create QTR inking profiles. Both platforms can use the methods detailed in this document, but it is indispensable for people working on Macs.

This tutorial is specifically aimed at building QTR profiles using the Epson 1400 with the Epson OEM Claria inkset (K, C, M, Y, c, m). Most dyes fade rapidly, but the 1400 Claria inkset purportedly has good light fastness and fade resistance. It generally does not have any bronzing or gloss differential issues on photo type papers and has excellent color gamut and Dmax, or maximum black density. (There has been some discussion on various fora as to whether Claria is *straight* dye ink, or whether it has some pigment blended in. Also, some papers specifically designed for use with dyes perform poorly with Claria, and exhibit bronzing, weak Dmax, poor ink penetration and slow drying. So not all ‘dye compatible’ papers work well with Claria. Ilford Classic Pearl and HP Soft Gloss are two examples of papers that perform poorly with Claria.) Dyes generally work fine on matte fine art papers too, but don’t offer much in the way of advantages over pigment inks, at least on most matte papers. There are exceptions where the Claria inkset provides excellent gamut and Dmax on matte papers (Red River Polar Matte is one example of a great paper/ink combination). The standard Claria inkset does NOT have light black or gray inks, so QTR or another RIP is necessary if you want good control over neutrality.

There are other approaches to creating and modifying profiles, but this is mine. I will try to explain logically and clearly, what I do and why I do it the way I do. There may be faster, easier, or better ways of creating profiles, but I wanted to consolidate my approach, for my own future reference and for others.

Starting Assumptions

I will assume you are on a Mac using OSX, that you have successfully installed QTR, that you have a program such as Photoshop or Photoshop Elements, and you have a decent inkjet printer (all examples herein use the Epson 1400 with the Claria 6-color OEM inkset). This tutorial does *not* discuss dedicated “quad” insets, though much of the information is still relevant to profiling these inksets.

As of this writing, I am using OSX 10.6.8 (snow leopard) and Adobe Photoshop CS4. You may be aware that Apple has changed the print stream in their recent operating systems, which can sometimes have serious implications. I’m no expert on the matter, but it appears Apple’s Colorsync makes it difficult or impossible to *easily* print “raw targets” for profiling, which is a requirement for creating profiles. I will address the printing of targets in PSCS4 shortly. I will assume you know your way around the Mac, know how to use TextEdit (Mac’s built in text editor), have a spectrophotometer (or densitometer) and a copy of XRite’s MeasureTool. MeasureTool is a part of XRite’s ProfileMaker5 package, and while most of the

package requires a license and dongle to use, the MeasureTool component of ProfileMaker works without any purchase, fee or dongle.

Though I use the Eye-One Pro Spectrophotometer and MeasureTool, Carl Schofield, who uses a ColorMunki had the following to add:

Xrite ColorMunki users can also participate. They can use the file entitled "munki-21steps.tif", which is supplied with QTR and located in the Applications > QuadToneRIP > Eye-One folder. ColorMunki users do NOT need Measuretool. The included Xrite ColorPicker app works fine as an alternate. See the QTR tutorial for ColorMunki by Keith Cooper http://www.northlight-images.co.uk/article_pages/bw_printing/bw_print_colormunki.html

Note for ColorMunki and Xrite Colorpicker: Currently, the QTR scripts for linearization and icc build do not recognize the txt file export format from Xrite Colorpicker, so when one exports a csv txt file from ColorPicker you also get all of the unwanted spectral data. The solution is to import the csv file into any spreadsheet and then export a stripped down csv txt file that the QTR scripts understand.

Creating New QTR Profiles for a New Paper

We'll start with the most difficult assignment first...creating new profiles from scratch....not to discourage you, but only because it encompasses most of the things you need to know anyway. There are many ways to create profiles in QTR, but this is my favored approach (much of which I borrowed from other QTR users, especially Paul Roark and Carl Schofield). I personally favor building a "Neutral" profile as a starting point. A neutral profile, using my definition, is essentially neutral gray throughout the tonal scale (ideally, +/- 0.5 on the Lab a*/b* scale), however I do allow the paper color to influence the Hue of the highlights and quarter tones at the light end of the tonal scale. If "paper white" reads as 96L*/-1.0a*/-2.0b* (L*a*b* reading...this is a bright white, with a slight bluish-cyan paper base), I will allow the highlights and quarter tones to lean toward the bluish end of the spectrum, moving gradually toward neutral as I approach the mid-tones. If I am creating a neutral profile for a warm paper, (e.g., 97L*/0a*/2.5b*), I follow the same basic approach, but I am inclined to allow the warmth of the paper extend into the mid tones and even into the 3/4 tones. Your preference may differ.

The goal in creating ink curves in QTR is to lay down just the right amount of black and colored inks at each step in the tonal scale to achieve the desired density and color from white to black, and to maximize the black (Dmax) the paper/ink combination is capable of achieving. Unfortunately, this is NOT a linear function. QTR has a built in "curve generator" which is capable of constructing smooth curves that deposit ink smoothly and evenly along the tonal scale. You can vary the ink limit, density, gamma and curvature with a few simple parameters. I have come to prefer the flexibility QTR controls offer when defining the black (K) ink curve. It provides flexibility and quick adjustments on the fly.

QTR also allows the user to draw curves *manually*, using X/Y coordinates, with the X axis being gray scale target densities from 0K to 100K, and the Y axis being the amount of ink deposited at each point. This method provides precise and infinite control over the shape of the curve, but is more work (don't worry, the curve shapes have been predefined and are included with this tutorial). I use this approach for all my colored inks to accurately define the curve shapes I want. I have tried different curve shapes and combinations, but at the present, I have settled on a single curve which is identical for ALL the colored

inks (C/M/Y/c/m). These curves generally increase from white to the deep shadows (75K to 80K on the tonal scale), then drop back to zero at 100K. This curve shape works well for many papers and applies a fairly even toning adjustment from highlights to shadows. The deep shadows (85K to 100K) don't really need more ink, and even if the color in this region is not precise, it is generally invisible to the eye, so who cares?

My general approach is to use either the dark cyan and magenta inks, *or* the light cyan and magenta inks, but not both. At present, I am using the dark inks, because they deposit less ink in the shadows and seem to work fine in the highlights. There is only one Yellow, so that is used when warm or sepia profiles are required. (I try to avoid using much or any yellow when possible, since yellow inks tend to cause more metamerism than other inks.)

So, to recap, I use the QTR curve generation controls to draw the K curve, but define my own C/M/Y/c/m shapes myself using manual coordinates. Remember, this tutorial is based on the Epson 1400 using the Claria inkset (K/C/M/Y/c/m). I have already defined these shapes, so you can use them as is (of course, feel free to change or improve them as desired). OK, let's get started.

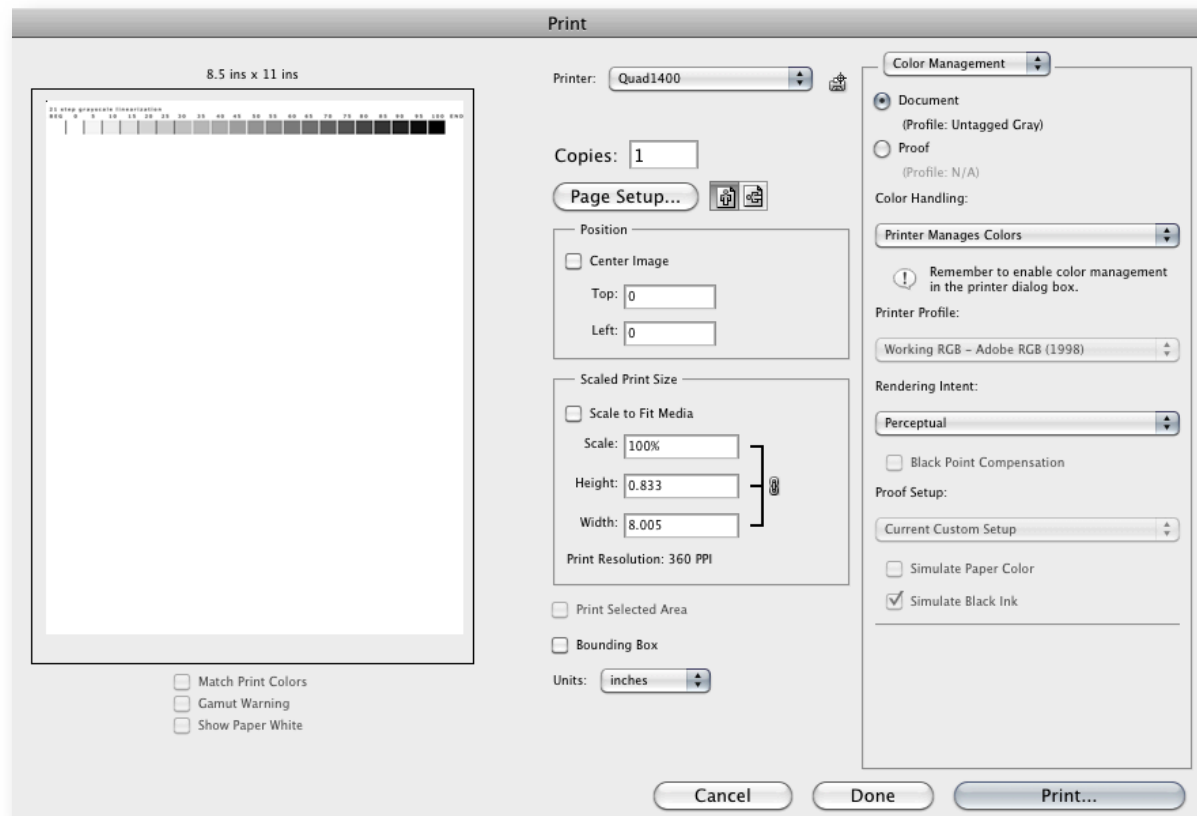
1. Establish Total Ink Limit

First, place the file ***“BO-100InkLimit.txt”***, (included with this tutorial), in your *Applications/QuadToneRIP/Profiles/1400-CL* Folder. This folder is specific to the Epson 1400 using the OEM Claria inkset. (If you are using a different printer and/or inkset, select the appropriate folder and place the file in that folder.) This is a very simple file that allows you to print using “black ink only” from 0 to 100% of the printer's ink flow from the black ink cartridge. It prints in a *linear* fashion, so don't be surprised if the print comes out mostly dark or black. Inside that same folder, you will see a file called, “Install1400.command” (if in a different folder, it will have a different name for your printer model). Double-click on the “Install1400.command” file and the data in the above TXT file will be converted into a QTR profile (inking recipe) and will be installed in the System/Library/Printers/QTR/Quadtone/Quad1400 folder. This is the actual profile that QTR uses for printing. You *always* have to “install” new or modified TXT files in this manner before you can use them in QTR.

2. Open Photoshop (I am using PSCS4 on OSX 10.6.8). Open the file called ***“Step-21-Gray.TIF”***. This is a 21-step grayscale image (grayscale in 5% increments from white to black) and is designed to be read by an EyeOne Pro Spectrophotometer in scanning mode (it has gaps between each step as separators to allow the spectro to notice when each step ends). If your spectro or software are different, look for a similar 21 step grayscale file that is appropriate for your workflow. BE SURE TO OPEN THE 21 STEP GRAYSCALE IMAGE ***“UNTAGGED-DO NOT COLOR MANAGE”*** IN PHOTOSHOP. Do not assign or convert to any profile. Leave it UNtagged as a grayscale image (not RGB, not CMYK).

3. The instructions in this paragraph are specific to PSCS4 and OSX 10.6.8 (who knows what Apple and Adobe have done or will do with other versions of their software as they fight their color management wars). I can tell you for sure that printing from PSCS4 using “No Color Management” is broken....it don't work, folks (you can probably thank Apple for this, though there is plenty of blame to go around). I tried every possible combination, and the one method that always works reliably (at least in PSCS4 and 10.6.8) is to select ***“Document”*** and ***“Printer Manages Color”*** in the PS print dialog box (see figure below). When you click the Print button, the values in your original file will pass directly to the printer without

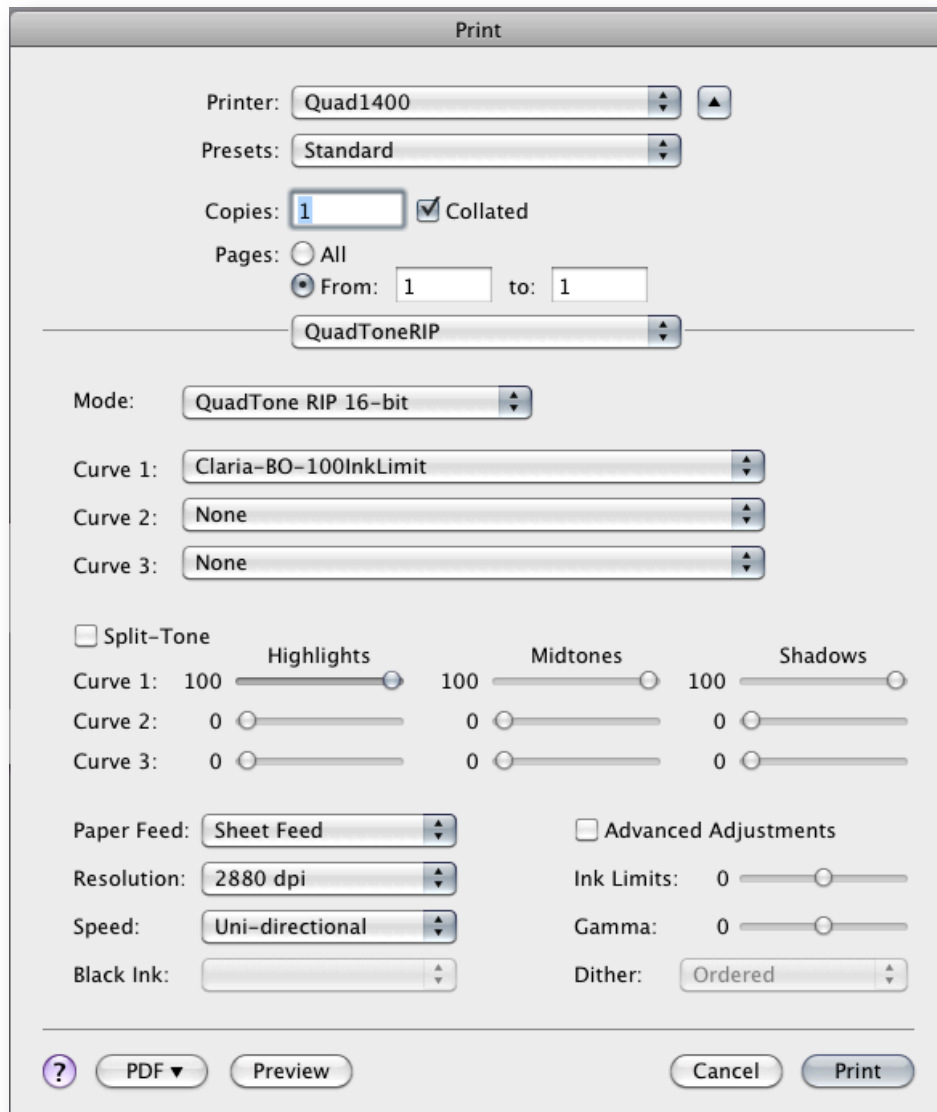
any modification, zippo, nada, nuthin' changed. (I tested this multiple ways, including printing to Adobe PDF instead of a printer, then opening the resulting files in PSCS4 and comparing the output to the original data). This is the **ONLY** method I found in PSCS4 that works reliably **ALL** the time for printing *raw target data without changing the numbers in the file*. I can't speak for other versions of OSX or Photoshop, so test for yourself if you are unsure.



4. After clicking Print in the PSCS4 print dialog window, the ***QTR printer driver window*** opens. Select Quad1400 (or your printer, if different).

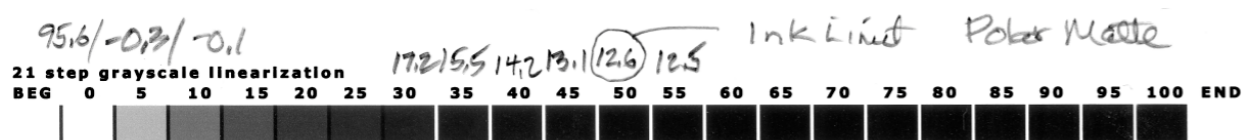
Select “QuadTone RIP” from the drop down box. Also select QTR RIP 16 bit, 2880 dpi, Uni-directional, and the *BO-100InkLimit* file as “Curve 1”. (If you want to use different settings, feel free to try them, but be sure to use the settings used to create your profiles when you begin printing images with your profiles in the future. Different settings can lay down different amounts of ink and affect density and color.)

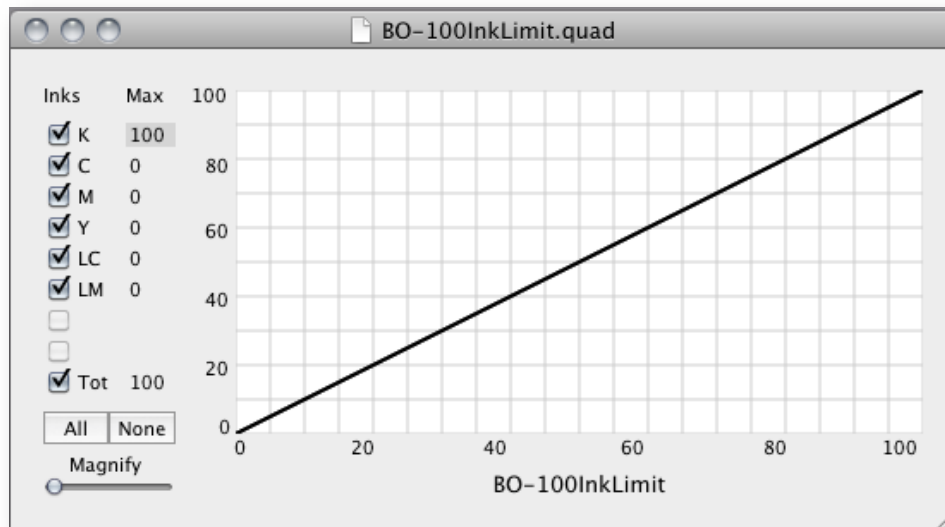
Also, select the “Printer Features” drop down box, then choose either *matte* or *photo* paper, depending on which you are using.



5. Put a sheet of 8.5X11 or A4 paper in your printer and click Print. (I am assuming you used Page Setup in the previous PSCS4 window to select the proper paper size, orientation and printer. I am also assuming you decided to place your 21-step grayscale image at the top of the paper in portrait mode to conserve space. You'll be printing more of this target as you work through the process.)

6. 16-bit, 2880 dpi, Uni-directional printing is SLOW, but the quality is high. I recommend it for all your QTR work. After the target is printed, either allow it to dry for about 30 minutes, or blow it with a hair dryer for about 30 seconds). Claria inks seem to stabilize and reach their final densities fairly quickly, but they still dry down over time. Using the hair dryer is fine at this stage in the process. It ought to look somewhat like this (without the writing, of course):



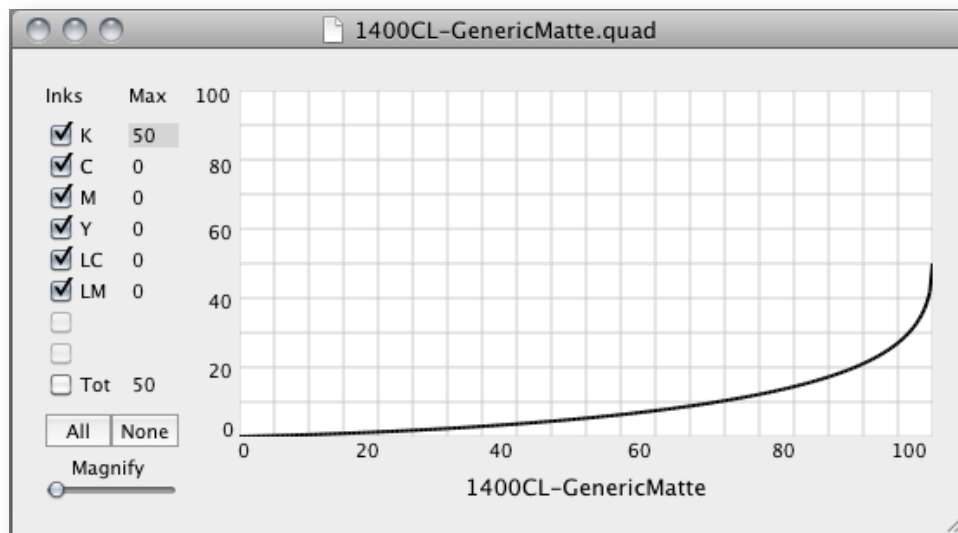


The above shows the straight-line ink *curve* used to print this black mess. This *curve* is linear, so at 0K you have 0% ink, at 50K you have 50% ink, and at 100K you have 100% ink. Still, this curve, (*BO-100InkLimit*), is useful in helping us establish our black ink limit. (I won't be discussing the partitioning multiple black inks in this tutorial. If you are interested in partitioning, read "GettingStarted.rtf" and "Calibration.pdf" in your Applications > QuadToneRIP > CurveDesign folder.)

7. Open Xrite MeasureTool (free download from Xrite and no license, dongle or payment required to use the MeasureTool module of ProfileMaker Pro). Click the configuration tab and select EyeOne Pro (or whatever spectro you have), *Reflection*, and UNcheck *Spectral*. Set MT (Measure Tool) to take **SPOT** readings (if your spectro supports it, future test strips can be *scanned* for faster readings, but this first test strip is largely black, so strip mode won't work). MT will instruct you to calibrate your spectrophotometer, and will then be ready to read.

Looking at the above example, you can see that from about 35K to 100K, all the steps look pretty darn black to the eye. You can also see that 25K and 30K are lighter than solid black, so start taking spot readings in the dark grays and write your L* (or density readings, if using a densitometer) above each patch. Continue taking readings until you reach the highest density or the lowest L* reading. For Red River Polar Matte with Claria Black ink, my Epson 1400 gives me the above readings. While I was at it, I also recorded paper white (bright and very neutral). The readings at 50K and 55K are essentially the same, so I circled 50K (L* 12.6) as the maximum black (Dmax) for this paper, at least with this printer and this black ink. Any more than 50% black ink will be counterproductive. Even if you should find a reading of 12.3 or 12.4 further into the blacks, don't use it. You should also note that the readings are closely bunched together from 35K to 50K.

8. OK, it's time to create your first curve. Now that we have established a black ink limit (50K maximum), it is time to reprint the above test strip with a new black limit and a more even distribution of tones from white to maximum black (for this paper/printer/ink combination). We're looking for a "Black Only" (BO) curve that looks more like the one below.



In the above curve, (this actually *is a curve*), you can see that at 0K, we have zero ink, and at 100K we have 50% ink (the ink limit we established in our last test). But, this is certainly NOT a linear curve. In order to get better separation between steps at the shadow end, we need a pretty rapid reduction in ink flow, so the tones don't all pile up on one another (ie, plugged shadows). At 80K the above curve uses only about 12% ink, and at 50% it uses only about 5-6%. From 0K to 50K, the curve is a *bit* more linear.

There are many QTR controls that can help us generate the above curve shape, but the primary ones are listed below, with a brief description of what they do. Each one requires a value after “=”.

DEFAULT_INK_LIMIT=

Default Ink Limit sets the maximum amount of ink used for all colors (K,C,M,Y,c,m) *if there is no specific ink limit specified for the individual ink (in other words, it is left blank)*. So, if you set default ink limit to 100, and the Cyan ink limit is left blank, it will use the default, in this case 100. For this reason, I always make sure EVERY individual ink has a value, even if it is zero. Leave default at 100.

LIMIT_K=

Limit_K is the Black ink limit. For the above curve, I set LIMIT_K=30, which is well below the 50% ink needed to attain Dmax. This ink limit provides the basis for the above curve. I set all the other individual inks to 0. I picked 30 because it is the first patch that is obviously NOT solid black. That's a great starting point for you default black ink limit. If you chose 50 for the black ink limit, you'd end up with way too much ink and plugged up shadows. The next command will take care of Dmax.

BOOST_K=

Boost_K is typically used to increase the amount of ink *selectively at the black end of the curve*, without affecting the rest of the curve. For the above curve, I set BOOST_K=50. This **boosts** the black ink rapidly, which is partly what is responsible for the very steep slope of the above curve between 95K and 100K. Without BOOST_K=50, the above curve would have maxed out at 30% (the black ink limit).

GRAY_GAMMA=

Gray_Gamma is the same as grabbing the 50% point in a Photoshop curve and dragging it straight up or down, creating a curve (which is also the same as using the middle gamma slider in Levels). If it is set to 1, there will be no effect on the shape of the curve. Higher values will make the curve lighter overall. The larger the number, the more pronounced the curve will be, resulting in less ink being deposited. I used Gray_Gamma=1 on the above curve, which introduced no curvature at all. If there were no other controls at our disposal, we'd have a straight line, line the original curve used to establish ink limit. But, we do have other controls, which will be discussed next. Sometimes we need more ink reduction and curvature to our curve than these other controls provide, so you may need to increase the gamma to 1.5 or even 2 on some papers.

GRAY_HIGHLIGHT=

Gray_Highlight is used to *selectively* to add curvature and lighten primarily light half of the curve. It does not appreciably affect the shadow end of the curve. If it is left blank, QTR will insert it's default value of 4. I used GRAY_HIGHLIGHT=10 for the above curve, which introduced quite a bit of curvature. It affected the light end of the curve more than it did the dark end. As you increase this number, there will be more curvature and a greater lightening effect in the highlights. However, the effect begins tapering off when the value gets much above 10 or 12. So try values up to 10, 12, 14, or perhaps as high as 20. Going any higher than that is pointless. If that doesn't give you enough lightening, then try a lower black ink limit or increase the gamma to 1.5 or higher.

GRAY_SHADOW=

Gray_Shadow is the counterpart to Gray_Highlight, but it acts primarily on the shadow end of the curve. So, if the highlights look great, but the shadows need adjustment, you can change this value. I used a value of 12. Using GRAY_HIGHLIGHT and GRAY_SHADOW, you have a lot of control over the shape of the curve above. Gamma affects the entire curve, where these two controls apply their effect in their respective portions of the curve.

9. Building the first profile. OK, now you have some understanding of what the above numbers do to the shape of the curve. Let's input them into an actual text file and build the profile so we can print our test strip with it. I am supplying some starting profiles with this tutorial, so open the template file called **"1400CL-GenericMatte.txt"** using Text Edit. If you are building a Neutral profile for Red River Polar Matte paper, immediately SAVE AS "1400CL-RRPM-Neutral.txt" or whatever name you prefer. This way you won't overwrite the template file accidentally. Be sure to save it in your Applications > QuadToneRIP > Profiles > 1400-CL folder. (By the way, the CL refers to the Epson OEM Claria inkset.)

OK, edit the file in TextEdit as follows. *Any statement with a # sign preceding it is recognized as a comment and ignored.* This allows you to insert informative comments into a file. You can also use it to disable a command and have QTR treat it as a comment). There should be **no spaces** or illegal characters in command lines. **Only letters, numbers, dashes and underscores are permitted.** Change the stuff highlighted in Red. Leave the rest alone for now. All other inks should have their ink limits set to 0.

Notes: This profile is based on 2880 dpi, uni-directional, 16-bit, matte paper selections in QTR driver.

PRINTER=Quad1400

Curve by (PUT YOUR NAME AND DATE HERE)

(ENTER THE NAME OF THE PAPER HERE, ALONG WITH ANY RELEVANT NOTES)

(BELOW, USE A CURVE_NAME THAT DESCRIBES THE INKSET, PAPER AND TONE, CHANGE AS NEEDED. NO SPACES)

CURVE_NAME=1400CL-RRPM-Neutral-ACV

GRAPH_CURVE=YES

N_OF_INKS=6

DEFAULT_INK_LIMIT=100

BOOST_K=50

LIMIT_K=30

LIMIT_C=0

LIMIT_M=0

LIMIT_Y=0

LIMIT_LC=0

LIMIT_LM=0

This section determines the shape of the black ink curve

N_OF_GRAY_PARTS=1

GRAY_INK_1=K

GRAY_VAL_1=100

GRAY_HIGHLIGHT=10

GRAY_SHADOW=12

GRAY_OVERLAP=

GRAY_GAMMA=1

GRAY_CURVE=

If toner inks are used (they typically aren't with the Claria inkset) you would use this section.

I have made this section inactive. If using toners, activate by removing the pound signs

Toner Partition Information

#

N_OF_TONER_PARTS=0

TONER_INK_1=

TONER_VAL_1=

TONER_INK_2=

TONER_VAL_2=

TONER_HIGHLIGHT=10

TONER_SHADOW=10

TONER_GAMMA=2

TONER_CURVE=

N_OF_TONER_2_PARTS=0

TONER_2_HIGHLIGHT=10

TONER_2_SHADOW=10

TONER_2_GAMMA=1

TONER_2_CURVE=

N_OF_UNUSED=

UNUSED_INK_1=

```
UNUSED_INK_2=
UNUSED_INK_3=
UNUSED_INK_4=
UNUSED_INK_5=
```

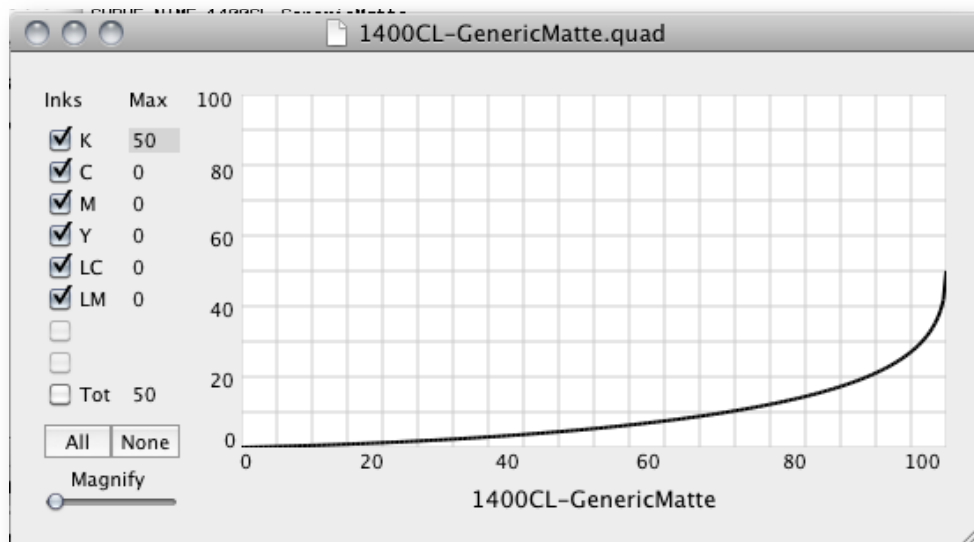
```
# The following are manually defined curve shapes for the colored curves
# You can change curves by changing the X/Y coordinates. First coordinate is 0-100K on the tone scale,
the 2nd point is the ink used)
# Below curve is Roy's tone-curve.acv, but I have lowered the maximum ink from 94 to 20 at 80K for
finer control
```

```
CURVE_C="0;0 15;2.5 40;9 62;17 80;20 88;17 94;10.6 100;0"
COPY_CURVE_M=C
COPY_CURVE_Y=C
COPY_CURVE_LC=C
COPY_CURVE_LM=C
```

There are a lot of lines of information in the above file, but most of them will not need to be touched. These extra lines are included to maintain standardization with other users, and for more advanced users as they try different approaches, or work with other inksets.

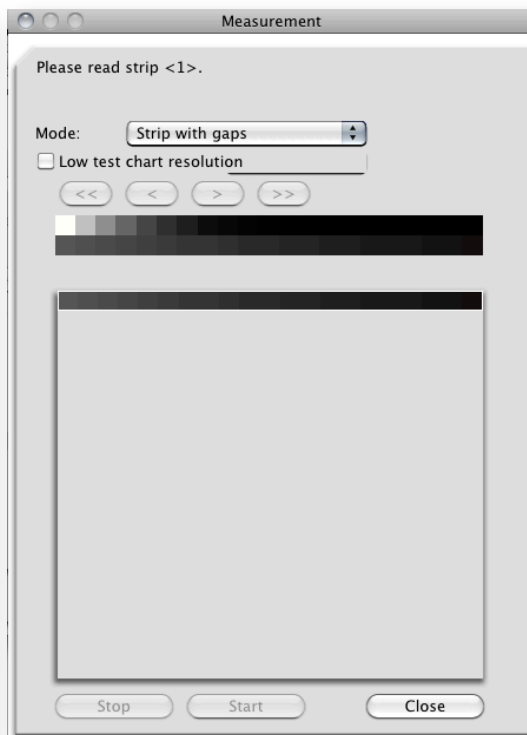
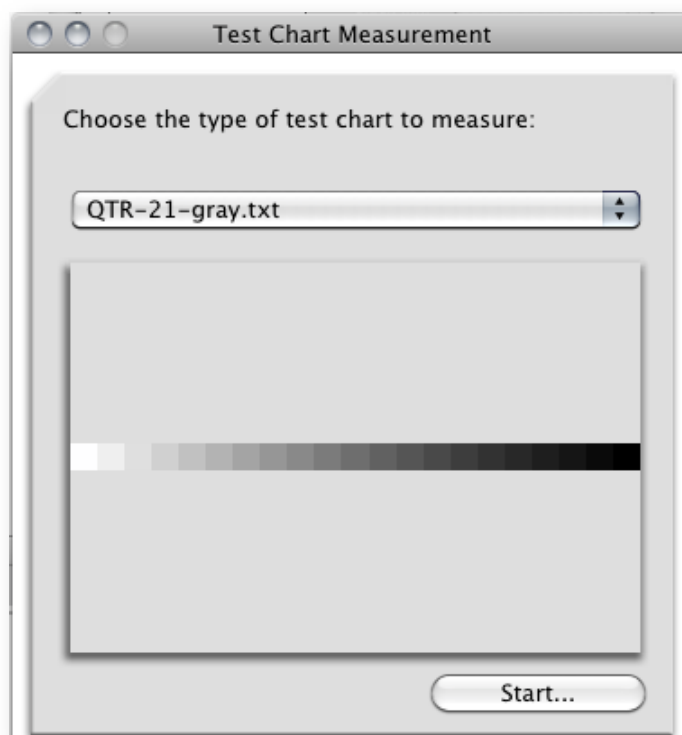
When you have made the above changes, save the file. Now, navigate to your Applications > QuadToneRIP > Profiles > 1400-CL folder. There is a file there called “**Install1400.command**”. When you double click this file, your Mac will launch the OSX *Terminal* program and automatically convert this text file into a real, live QTR profile. Your text file will remain as you previously saved it, but QTR will save a profile with the same name, but with a “*quad*” file extension in a different folder. If your text file was named 1400CL-RRPM-Neutral.txt, the profile will be named 1400CL-RRPM-Neutral.quad. It will be saved to the **MacHD > Library > Printers > QTR > quadtone > Quad1400 folder**. Be sure you don’t have any spaces or illegal characters when you save your TXT file, otherwise, your profile will not be created.

When Terminal is done converting your text file into a profile, it will leave a window open on your screen. You can view the information generated by terminal to be sure your file saved properly and didn’t generate any errors. If there are no error messages, close the Terminal message window. ***Every time you modify or create a new profile (ie, txt file), you must run the Install1400.command script to install and use your profile.*** If you wish to see a graphical representation of your curve, find your new “quad” file in the above folder and double click on it. That’s where this file came from:



10. Print the 21 patch step wedge again on the same sheet of paper using the same exact Photoshop settings as last time, but move it down 1 inch so you don't print over the first test strip. Or better yet, cut off the first test strip with a paper cutter to prevent the possibility of getting half dried in on your printer rollers (Paul Roark says this does sometimes happen and affects later prints). ***When printing this time, be SURE to select the new profile you just created in the QTR driver!***

With MeasureTool, read the the new strip (30 seconds with a hair dryer first). If your spectro supports it, you can now read in strip mode (much faster), since you no longer have a nearly solid black test strip.



SAVE the data to a file on your desktop (you'll probably trash these files eventually, but name them for now so you don't get hopelessly confused). Since this test strip used only black ink on RR Polar Matte, you could name it "1400-BO-RRPM.txt" (or whatever works for you).

11. Open the file using Mac's TextEdit program (simple text editor). Look at the column of L*, a* and b* values. Here are the measurements of the 2nd test target, made using the profile created above.

Step	L*	a*	b*
0.00	95.81	-0.39	-0.12
5.00	91.93	-0.48	-0.08
10.00	87.49	-0.58	-0.00
15.00	82.23	-0.68	0.06
20.00	76.87	-0.77	0.12
25.00	71.73	-0.87	0.15
30.00	66.29	-0.93	0.19
35.00	61.21	-0.95	0.22
40.00	55.95	-0.96	0.26
45.00	51.51	-0.93	0.30
50.00	46.67	-0.89	0.29
55.00	42.53	-0.84	0.26
60.00	38.18	-0.75	0.25
65.00	34.64	-0.65	0.19
70.00	31.52	-0.57	0.17
75.00	27.59	-0.35	0.18
80.00	23.22	-0.10	0.24
85.00	19.69	0.21	0.44
90.00	16.79	0.56	0.45
95.00	13.24	0.95	0.52
100.00	12.11	1.15	0.60

Certainly not perfect, but not bad either, especially right off the bat. QTR generated the above curve using the controls outlined above. It's not unusual for values to be fairly close together at the black end of the curve, but *you need a minimum difference in luminance of about 1.0L* between steps*, otherwise you will get a lousy profile, (and besides QTR will reject the data and refuse to build you a curve!). You will see a "linearization error message" when Terminal tries to generate the profile (using the Install1400.command). We could tweak our settings further to refine the black curve, but this will work. By the time we're done, we'll have a great curve.

Now, look at the color information (a* and b* numbers). Notice that at 0K, the paper measures 95.81L* (bright paper), -0.39a* (very neutral on the green/magenta axis, but with a *very* slight greenish bias), and -0.12b* (just about dead neutral on the blue/yellow axis, with a teeny blue bias). Notice what happens as you approach about 50K in the tone scale—it becomes more green and slightly more yellow, at least on this paper. This is worth noting, because if it is off too much, we may want to correct the color cast as we proceed. The b* readings above (blue/yellow) are just about perfect. But, it looks like the *Claria black ink has a slight greenish bias* (which I have found generally to be true on all papers). So, we may want to add a little Magenta ink to help neutralize the green bias of the Black ink. But, black only (BO) is pretty respectable on this paper. It's not entirely neutral, and the tones are not evenly distributed from white to black, so there is still work to do.

12. Creating a Neutral Profile

Creating a Neutral profile from scratch (especially using color inks) is one of the most difficult profile you are likely to build. That's why I chose it as my initial tutorial example. The files included with this tutorial will cut out much of the work and get you close. We will also discuss "repurposing profiles" shortly, and that process is MUCH less work.

If you are happy with the above color for your "Neutral" profile, then you are almost done. You might want to append "BO" (black only) or "Neutral" to the file name, but you still need to linearize it. For now, we will assume you are *not* satisfied, since this is meant to be a tutorial.

Looking at the slightly green cast above, I'm going to try adding some LM to see if that helps. I'll only show the portion of the file I intend to change, with changes shown in red below. Everything else remains as it was in the previous version. After saving this txt file, *remember to reinstall the profile* by double clicking the Install1400.command. As long as you didn't change the file name, it will overwrite the original profile.

```
CURVE_NAME=1400CL-GenericMatte
GRAPH_CURVE=YES
N_OF_INKS=6
DEFAULT_INK_LIMIT=100
BOOST_K=50
LIMIT_K=30
LIMIT_C=0
LIMIT_M=0
LIMIT_Y=0
LIMIT_LC=0
LIMIT_LM=2
```

Print the test strip a 3rd time (be sure to use the new profile...same name), dry and read it. How'd we do?

```

LGOROWLENGTH 1
CREATED "7/22/2011" # Time: 13:07
INSTRUMENTATION "Eye-One Pro"
MEASUREMENT_SOURCE "Illumination=D50 ObserverAngle=2° WhiteBase=Absolute Filter=UVcut"
KEYWORD "SampleID"
KEYWORD "SAMPLE_NAME"
NUMBER_OF_FIELDS 9
BEGIN_DATA_FORMAT
SampleID SAMPLE_NAME GRAY XYZ_X XYZ_Y XYZ_Z LAB_L LAB_A LAB_B
END_DATA_FORMAT
NUMBER_OF_SETS 21
BEGIN_DATA
1 A1 0.00 86.21 89.56 73.93 95.81 -0.26 -0.05
2 B1 5.00 77.46 80.45 66.51 91.88 -0.21 -0.14
3 C1 10.00 68.34 70.99 58.75 87.48 -0.24 -0.20
4 D1 15.00 58.40 60.73 50.26 82.23 -0.36 -0.19
5 E1 20.00 49.55 51.55 42.67 77.01 -0.42 -0.18
6 F1 25.00 42.02 43.71 36.23 72.04 -0.40 -0.24
7 G1 30.00 34.52 35.90 29.80 66.44 -0.31 -0.31
8 H1 35.00 28.29 29.38 24.48 61.11 -0.14 -0.44
9 I1 40.00 23.43 24.30 20.30 56.39 0.02 -0.54
10 J1 45.00 19.04 19.73 16.51 51.53 0.06 -0.55
11 K1 50.00 15.06 15.61 13.09 46.46 0.03 -0.57
12 L1 55.00 12.12 12.56 10.55 42.09 0.05 -0.61
13 M1 60.00 9.64 9.99 8.40 37.83 0.02 -0.59
14 N1 65.00 7.81 8.11 6.82 34.21 -0.04 -0.54
15 O1 70.00 6.55 6.80 5.72 31.35 -0.07 -0.51
16 P1 75.00 5.14 5.34 4.48 27.67 -0.06 -0.45
17 Q1 80.00 3.89 4.04 3.36 23.81 -0.02 -0.21
18 R1 85.00 3.04 3.14 2.59 20.60 0.11 0.05
19 S1 90.00 2.41 2.48 2.01 17.83 0.37 0.37
20 T1 95.00 1.79 1.82 1.45 14.50 0.90 0.60
21 U1 100.00 1.51 1.52 1.21 12.77 1.16 0.63
END_DATA

```

Above is a screenshot of MeasureTool's output using our new profile (my printer/my ink/my paper). The last three columns on the right are L/a/b. The light magenta ink helped counteract the green cast, particularly in the highlights and midtones. It also cooled off the b* channel somewhat and moved it in a negative direction. If you wanted, you could add a teeny bit of yellow to counteract the coolness in the blue channel and bring it closer to dead neutral (0 on the a* and b* scales are neutral). If so, do another iteration. But, we are mighty close to neutral and our goal of +/- 0.5 on the a*/b* scale. Besides, I prefer *not* to use yellow inks unless necessary, since they are a bit more metameric than the other inks, and besides, this paper is slightly cool to begin with. The color looks like a wrap to me!

In the deep shadows, it is common to see the a* and b* numbers pick up a color cast, but it is nearly impossible for the eye to detect any color cast, even it a fairly heavy one, at 80K to 100K, so I ignore that if the rest of the colors look good.

One last check, before we proceed. Do we have decent separation between all the L* levels (ie, luminance)? We have, at minimum, a 1.0L* difference between every level. It looks like the closest two steps are 95K and 100K, and there, the difference is 1.73. Fantastic! We're ready for the final step in creating a nice, linear, neutral profile.

13. Linearization

OK...you have neutral profile and you have adequate and reasonable separation between steps, but this profile is NOT linear. We want the steps between shades of gray to be perfectly even so our images reproduce smoothly, with all the tones mapped properly. We want a smooth, lovely print. This is where linearization comes into play.

You saved your last test strip measurement on your desktop, right? Good. If not, measure again and save.

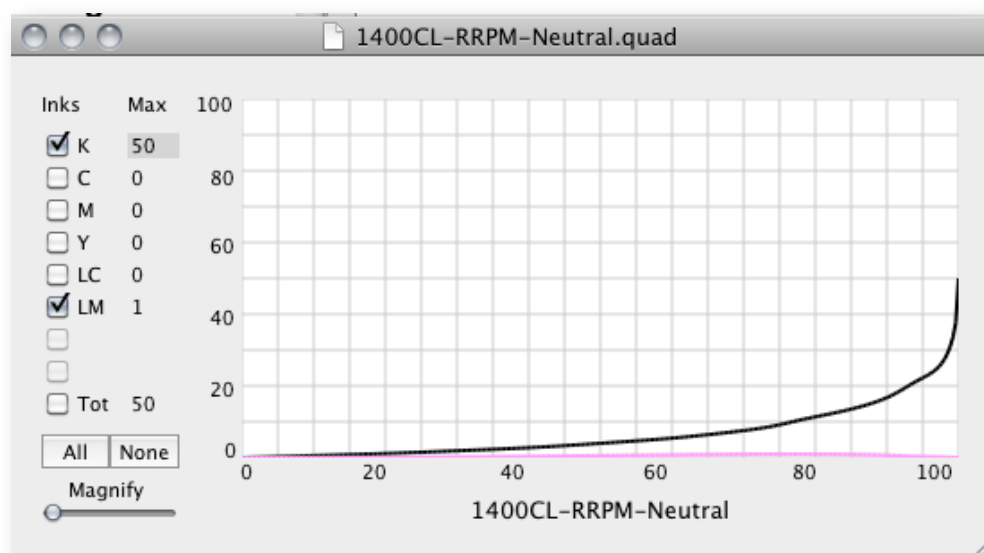
In the main QTR folder, you will find a 'droplet' program called **"QTR-Linearize-Data.app"**. I dragged this icon to my dock to make it readily available at a moment's notice. Now, drag your saved TXT file from the desktop onto the QTR-Linearize-Data icon in your dock, and the program will automatically create a new text file of the same name with the suffix "-OUT" at the end of the file name. This file should immediately open up on your screen automatically. If not, open in TextEdit.

This nifty file shows you the Lab values for each step on the tone scale, with a graphic representation of where a* and b* numbers fall relative to the neutral axis.

The very last line in this file is linearization data and will look something like this:

LINEARIZE="95.81 91.88 87.48 82.23 77.01 72.04 66.44 61.11 56.39 51.53 46.46 42.09 37.83 34.21 31.35 27.67 23.81 20.6 17.83 14.5 12.77"

Copy this entire line, including the quotation marks, then paste it into your Neutral Profile TXT file as the very last line. This is the linearization data that will smooth out the tone scale so your tones are evenly spaced. After pasting this into your file as the last line, save the file, run the Install1400.command program again, and your profile is complete! Done! If you want to see your final profile, double click on the "quad" file, and a graphical representation will be displayed. Here it is:



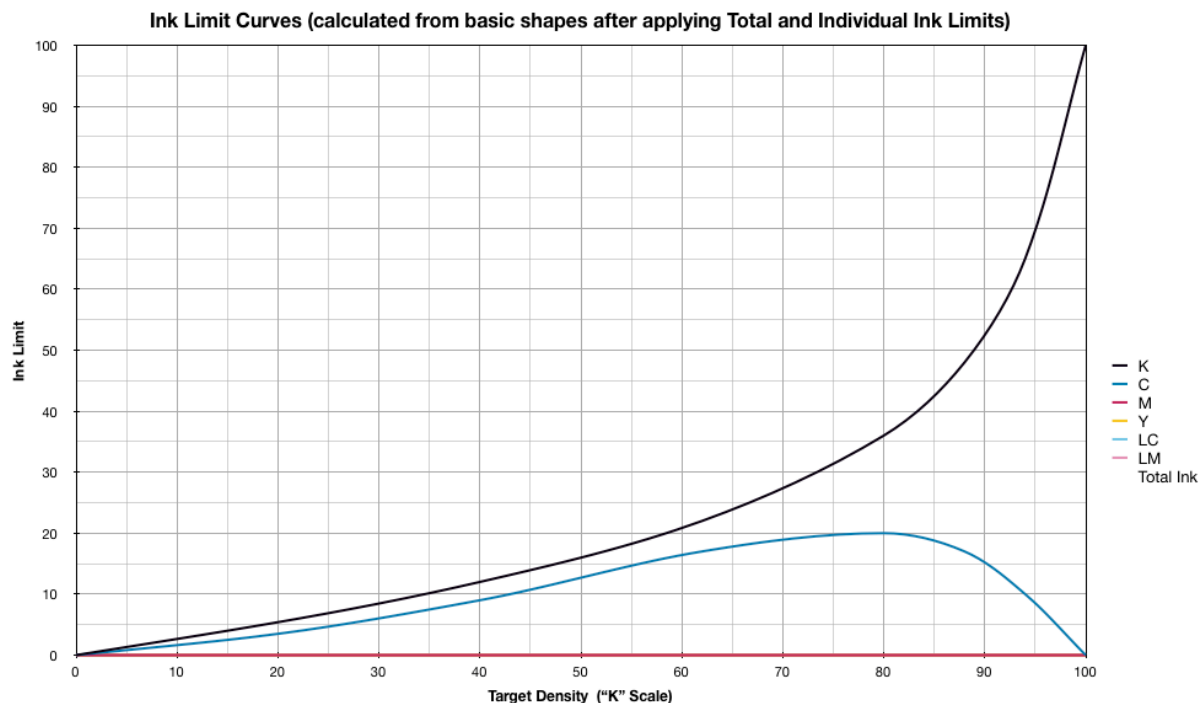
It shows both the black curve shape and a hint of LM ink to counteract the greenies. Whatever controls or tools you use, your final Neutral profile for this printer/paper/ink combination will need to look very close to the above.

Yes, it was quit a bit of work, but the Neutral profile is by far the hardest one to build, since we have to work hard to get a good (not perfect) gray balance. And...this was a very detailed explanation.

Once you have a good Neutral profile, you can print with it as is, and won't need to blend cool and warm profiles to get a neutral print. You can also use your Neutral profile as a starting point to **quickly** build Warm, Cool, Selenium, Brown, Sepia or any other profiles you want for this paper. I usually build a family of profiles, which includes BO (black only), Neutral, Warm, Cool and Selenium. I often crank the color up more than I want, since I can blend them with Neutral or other profiles when printing to get anywhere from neutral to very warm or very cool, or whatever. You can also do split toned prints.

Manually created curve shapes

Before moving on, I'd like to talk about the manually created curve shapes for the color inks. You don't have to do it this way, but I like the flexibility and control manual shapes provide, especially for color inks. And if you like this approach, I've already created curve shapes you can use, or modify.



The above screen shot is from a *Numbers* Spreadsheet I created (Apple iWork suite). I'll show you the numbers in a minute. I am using QTR to generate the black curve, so the black ink is shown above as a general reference and point of comparison only. I initially defined the black curve by coordinates, but I decided it was too much work manually adjusting the black curve numbers all the time to get the shape I wanted on different papers. QTR offers some great controls to change the black curve. But, you can do the same with the black ink as with the colored inks, if desired.

You only see two color inks above, K (black) and C (cyan). I chose to hide the other colors, (M/Y/c/m), since their shapes are "identical" to Cyan. You can see that at 0K (paper white), the C deposits 0% ink. As

the tonal scale gets gradually darker, more C ink is deposited on the paper (if we choose to use it). At about 50% (where dot gain is usually at its maximum), the curve starts changing directions and turns South instead of North. It peaks at about 80K on the tone scale and begins a rapid descent to 0 ink at 100K. Why? Well, if we need cyan ink to neutralize the black, or add a cool tone, we want to gradually add more cyan as we add more black ink, in roughly equal proportions. But, as we approach the 3/4 tones, and especially the deep shadows, the last thing we need is more ink! That's where we usually have too much ink, causing tonal values to lose separation (plugged shadows). And since it is also very difficult to detect a color cast in deep shadows (85K to 100K), we choose to reduce the colored inks and prevent an overload of ink. We'd rather use black and limit the colored inks in at this point, since black has more density and should give us a better Dmax.

That explains the shape of the Cyan curve. But why are they all the same? The simple answer is to track the black. Since we use colored inks to neutralize and/or tone the black inks, we want them to have the same shape (until we reach those dark shadow areas, where the extra ink is a detriment instead of an asset). So, using one single curve shape, we can add colored inks to influence the coloration of our profile throughout the entire tonal scale.

When I need cyan or magenta inks to neutralize or tone a profile, ***I try to use ONLY the Dark Cyan and Dark Magenta inks, if possible, and avoid the light cyan and light magenta inks.*** The Epson 1400 has light cyan and light magenta inks also, as do most higher quality inkjet printers. Why the darker inks? Initially, I was concerned that the dark inks might not work very well in the highlights, being darker inks. Light cyan and light magenta seemed like better candidates for the light end of the print. However, at the dark end, I wanted to use as little ink as possible, and this suggested the use of the dark cyan and dark magenta inks. I considered constructing curves, or Toners, that blended light and dark inks at different portions of the tone scale, but I was unable to find a way to reduce ink usage at the dark end. So, I tried the darker inks and found that they worked fine in the highlights as well as the shadows, at least with the fine dot pattern of the Epson 1400. So, to keep ink usage down (for practical, as well as economical reasons), I chose the dark cyan and dark magenta inks for my profiles. They have worked out well in my profiles up to this point. (Since the curves are identical for ALL color curves, one can substitute the light inks if they wish, but more will be required for the same effect).

So, how did these curves come about? I used Roy Harrington's toner curves, but reduced the amplitude. His toner curves used a maximum ink of 94% at the 80K point, but I wanted finer control. I decided I would never need anything close to that much ink, so I arbitrarily chose to lower the maximum ink at 80K to 20%. I kept the shapes but reduced the scale. So, even if you use 100% ink in the magenta curve in a profile, that will equate to 100% of the curve, which is only 20% ink at the 80K point. If you choose an ink limit of 10% M, you will really only be using 2% ink at 80K, and correspondingly less at the other points on the curve. Setting the max ink to 20% gave me very fine control indeed. If you set the ink limit of Magenta to 1, that is only 0.2% ink at 80K, and less at 50K, 25K, etc.

The above curves are built into the templates provided with this tutorial. So remember, when you type in an ink limit for any of the colors, you are really only getting 20% of that amount (or 1/5th), and that is only at the peak point on the curve, which is 80K.

Perhaps there is a way to do this with the standard QTR controls, but I haven't figured out to do it. The Epson Ultrachrome (UC) inkset has both K and LK inks, and when partitioning these two inks, QTR

creates an LK curve similar to curve shapes I have defined and displayed above. If there is a way to do it and apply adjustments, like we did earlier with the K ink, feel free to use it. However, manually generated curves can be adjusted into nearly any shape.

Below are the numbers used to create the curves on the spreadsheet display above (and included as predefined curve shapes in the sample templates). The Black curve is only typical data, since I use QTR controls to generate the curve. But the colored inks are all identical in shape and peak at 20% ink (if you set the ink limit at 100).

Den.	K	Den.	CM	Den.	LC LM	Den.	Y
0	0	0	0	0	0	0	0
15	4	15	2.5	15	2.5	15	2.5
40	12	40	9	40	9	40	9
62	22	62	17	62	17	62	17
80	36	80	20	80	20	80	20
88	48	88	17	88	17	88	17
94	65	94	10	94	10	94	10
100	100	100	0	100	0	100	0

Creating an ICC Profile for Soft Proofing (Optional, but recommended÷÷÷)

Most photographers and printers are familiar with the term “*profile*”. The word *profile* usually refers to *ICC profiles*, which are used to characterize a monitor, scanner, digital camera, printer, press or other device. An ICC profile contains information on white and black points, color gamut, and color translation tables (or curves) that allow us to convert and match our monitor to our print. All of this assumes we have accurately calibrated and profiled monitors, printers, and acceptable room lighting (color, quality and intensity) for print viewing and evaluation. ICC (International Color Consortium) profiles are standardized and follow ICC specifications. They can be used to preview and print images with a fairly high degree of accuracy (again, assuming we have our devices properly calibrated and profiled).

Unfortunately, the same word...*profile*...is used to define what I call the “*inking recipes*” we use to print our images in QTR. These “inking recipes” translate our image file’s RGB or Grayscale numbers into precise instructions that the printer driver can use lay down the correct combination of ink dots in the correct locations. These *recipes* are NOT ICC Profiles at all, and cannot be used in the same way as standard ICC profiles. You cannot use them for soft proofing, conversion, etc. They are simply instructions to the QTR print driver to control how your printer lays down dots.

The QTR package does, however, include tools that allow you to generate *true ICC profiles* that can be helpful in soft proofing or even converting your files before or during printing. You don't need to create these to get fantastic prints, but they have their uses, and my experience shows you will get more accurate previews and prints if you do so. Here's how you create and use them.

Once you have created a final, *linearized* QTR profile (ink recipe) that provides the neutrality and coloration you want, print a final 21-step grayscale using that profile in QTR. Print it exactly the same as you printed your original test targets when you were creating your inking recipes. I generally like to print this target on a virgin piece of paper that hasn't been run through my printer rollers half a dozen times. I also prefer to let it dry naturally, but you can help it along with a hair dryer. (A microwave seems to cook paper and may change how the ink and paper react, especially on RC coatings, and especially if it is done over and over). When the ink has stabilized, read the target, as described earlier, with your spectrophotometer and MT and save it as a TXT file on your desktop. (Densitometers, ColorMunki's and other devices are fine as long as you can save to a usable txt format). *Name this TXT file **precisely**, since this same name will be used to generate the name of your final ICC profile.* Drag your saved TXT file onto the droplet application called **"QTR-Create-ICC"** (which can be found in your main QTR folder where you found the QTR-Linearize-Data program). Voila...an *ICC profile* describing the tonal scale and colors in your printed step wedge will automatically be generated and saved to your desktop. Simply copy and paste this ICC profile into your ColorSync/Profiles folder so you can use it in Photoshop. You may have to restart Photoshop so it is able to see the file (though I find I personally do not). If it doesn't show up inside Photoshop, simply close down PS and restart. I'll discuss how to use ICC profiles further along in this tutorial.

RBG vs Grayscale ICC Profiles

You can create Grayscale, RGB ICC profiles, or both with QTR. If printing from Photoshop, either one works fine, whether you are soft proofing or printing grayscale or RGB images. I haven't seen any difference. A grayscale ICC profile is created by using the **"QTR-Create-ICC"** droplet application. An RGB ICC profile is created by using the **"QTR-Create-ICC-RGB"** droplet application. They both use the exact same source data (the linearized TXT file described above), and both have the same white point, black point, tonality and color information. Both will soft proof the tonal scale *and color* of your RGB or grayscale image identically. So, why have both?

When printing from some programs, they require an RGB file (Qimage and LightRoom are examples. Actually, I believe LightRoom will print grayscale images, but they are first converted to RGB by LR, so you need an RGB ICC profile to do so). If you start with either a grayscale or RGB image, then "Convert" it using a grayscale ICC profile, the result will be a single channel grayscale image. If you start with either a grayscale or RGB image and "Convert" it using an RGB ICC profile, the result will be an RGB image with red, green and blue channels. So, if you want your single channel grayscale to be converted, but you want it to *remain* a single channel, grayscale image, create an ICC profile with "QTR-Create-ICC". If you tend to work in RGB and want your images to *remain* three channel RGB files, then use an RGB ICC profile created with "QTR-Create-ICC-RGB".

Since Mac users can print directly from Photoshop, this is not as big a deal. We can select either profile and "convert on the fly" from the PS print dialog window (discussed shortly). PC users need to print from a stand-alone QTR program, and may want or need to convert to a profile in Photoshop and then import

the converted file into the QTR program for printing. (I think that is the way it still works, but I haven't used a PC in awhile.) Having both grayscale and RGB ICC profiles provides flexibility, but again, you don't need either to get beautiful, B&W or toned prints from QTR..

Generic QTR Profiles (supplied with QTR)

Roy Harrington developed some “generic” ICC profiles, (which are installed with QTR), which work very well. They do NOT provide a preview of color (warm, cool, sepia, etc), but other than that, they work extremely well. If you don't care about previewing color, you can avoid creating ICC profiles entirely and just used Roy's generic profiles. They'll allow you to soft proof the tonality of the image and edit it in Photoshop before printing, so you should get the tone scale you expect.

The generic profiles work great because all properly built QTR Profiles (inking recipes) are linearized along the same $L^*a^*b^*$ scale. Most matte papers have a pretty similar Dmax and Paper brightness and their tonal scales are pretty close, so a single “Gray-Matte-Paper.ICC” profile works well for matte papers. Roy also developed an RGB version, “RGB-Matte-Paper.ICC”.

The same is true of photo type papers (glossy, luster, satin, etc). A single profile works well for pretty much any photo paper, either “Gray-Photo-Paper.ICC” or “RGB-Photo-Paper.ICC” for RGB images.

There is a final profile called “Gray-LAB,ICC”, or the RGB version, “RGB-Lab.ICC”. These make great working spaces for grayscale or RGB images, since they work hand in glove with the matte and photo paper profiles.

Whether you use the QTR supplied ICC profiles or custom ICC profiles you make yourself, they are used the same way. I will discuss their use for soft proofing and printing shortly. First, let's build some toned profiles.

Building Toned Profiles (Warm, Cool, etc)

OK....you did the hardest part already—creating a neutral profile from scratch. Once you have a neutral profile, it's relatively quick and easy to create a family of Warm, Cool, Sepia, Selenium, Brown or other toned profiles for that paper. (If you prefer, you can start with a BO (black only) profile. In fact, some QTR users *never* build neutral profiles, and just blend cool and warm profiles when printing to get a neutral print. I prefer having a Neutral profile in the family. Here are the steps.

First, open your Neutral or BO TXT file for your profile in TextEdit. Remove the entire “LINEARIZE=” line at the end of the text file before you start printing new targets. Since you will be adding and/or removing ink as you tone your previous Neutral or BO profile, the tone scale will be altered and the old linearization will no longer be valid. After removing this line, *immediately ‘Save As’*, using a new file name so you don't accidentally overwrite your Neutral profile. For example, open the file named “1400CL-RRPM-Neutral.txt” and SAVE AS “1400CL-RRPM-Warm.txt”. After you have saved the file with your new name, you can change the curve name, comments, and values freely.

If you already have a printed copy of your Neutral or BO 21-step grayscale using the linearized Neutral profile for this paper, read it with MT and save it to your desktop. Take a look at the a^* and b^* values. If it

is a neutral profile, your a^* and b^* values should mostly be within \pm about 0.5 in value. Don't worry if the deep shadows and blacks show a fairly significant color cast (at L^* 85 and darker), since it is very hard to see color casts as you approach black.

Take a look at the next table in this document. These are the a^* and b^* Lab coordinates from some toning algorithms from a Photoshop plugin called PhotoKit, by Pixel Genius. I converted a 21-step grayscale to sRGB, applied the standard PhotoKit toning formulas, then read the $L^*a^*b^*$ values in Photoshop using the eyedropper and the Info Palette. If nothing else, they can serve as a general guide as you modify your profiles. At white and black, you can see that the a/b values are 0/0. You won't be able to achieve this since we are dealing with paper, base paper color, ink, dot gain and imperfect curves, but it is worth noting that the coloration of the profile is most pronounced in steps 12 & 13 (ie, 55% and 60% K), and decreases as you approach white or black. You can use this table as a general guide for toning, or create your own formulas.

Let's say you want to create a Warm profile. My personal preference is something between Medium Sepia2 and Brown (your taste may vary). I find Sepia a bit too yellow, and Brown a bit too red, but somewhere in the middle is about right (to my taste). So, looking at the toning chart at the 60%K values, I see that Med Sepia reads $1a^*/8b^*$, and Brown is $4a^*.8b^*$. So, I typically shoot for around $3a^*$ and $9b^*$ for my Warm profile at the 55K-60%K value, which is where the profile has the most saturated color. It ramps down as you move toward both black and white ends of the scale. (Unfortunately, Photoshop rounds all Lab values in the info palette to the nearest integer, so a value of 1.6 will be displayed as 2, and a value of 1.4 will show as 1. Still, the following table is a useful guide or starting point.

I often make my toned profiles a little more intensely toned than I plan to use in my final print. When printing, I can tone them down by in fine increments by blending them with a Neutral or other profiles in the QTR driver. This way I can choose as much or little toning as I want from Neutral to to colorful. I can also choose to "split tone" my print by choosing a cool, neutral and warm profile, and blending them in varying amounts in the highlights, midtones and shadows.

PhotoKit Toning a* / b*Values on 21 step grayscale

a* / b* readings Taken with i1 UV Spectro and MeasureTool

			Mild	Med	Heavy		Mild	Med	Heavy	
Step	%K	Platinum	Sepia1	Sepia2	Sepia3	Brown	Cold1	Cold2	Cold3	Selenium
1	0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2	5	0/0	0/0	0/0	0/1	0/2	0/0	0/0	0/0	1/-2
3	10	0/0	0/0	0/1	0/2	1/3	0/0	0/0	0/-1	1/-2
4	15	0/1	0/1	0/2	0/3	3/5	0/0	0/-1	0/-2	1/-2
5	20	0/1	0/1	0/2	1/4	3/6	0/0	0/-1	0/-3	1/-2
6	25	0/1	0/1	0/3	1/5	3/6	0/0	0/-2	0/-4	1/-2
7	30	0/1	0/2	0/3	1/7	3/7	0/-1	0/-2	1/-5	2/-3
8	35	0/2	0/2	1/4	1/8	3/7	0/-1	0/-3	1/-6	2/-3
9	40	1/2	0/2	1/5	1/9	4/7	0/-1	1/-3	1/-7	2/-2
10	45	0/3	0/3	1/5	2/11	3/7	0/-1	1/-4	1/-8	2/-2
11	50	0/3	0/3	1/6	2/12	3/8	0/-2	0/-4	1/-9	2/-3
12	55	1/3	0/4	1/7	2/14	4/8	0/-2	1/-5	2/-11	2/-3
13	60	1/3	0/4	1/8	2/15	4/8	0/-2	1/-5	2/-12	3/-3
14	65	0/3	0/3	1/7	2/13	3/9	0/-2	0/-5	1/-10	3/-3
15	70	0/3	0/3	1/6	2/12	4/8	0/-1	0/-4	1/-9	3/-3
16	75	1/3	0/3	1/5	2/11	4/8	0/-1	1/-4	1/-8	3/-3
17	80	1/2	0/2	1/5	1/9	4/8	0/-1	0/-3	1/-7	3/-3
18	85	0/2	0/2	1/4	1/7	4/8	0/-1	0/-3	1/-5	3/-4
19	90	0/1	0/1	0/2	1/5	4/7	0/-1	0/-1	1/-4	3/-3
20	95	0/1	0/1	0/1	0/2	2/3	0/0	0/-1	0/-1	3/-2
21	100	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0

Above PhotoKit settings applied to a 21-step gray scale image that was converted to sRGB.

Note that all L*a*b* readings in Photoshop are rounded to the nearest integer, so smooth data as desired.

Brown tone has a fairly strong reddish hue.

Heavy Sepia3 and Heavy Cold3 probably need to be blended with a neutral profile, since they are quite strong.

Medium Sepia2 and Medium Cold2 are probably better choices if not blending with a Neutral profile.

Platinum is very mild but very nice as is.

Selenium is probably fine as is.

To arrive at your target colors in your toned profile, start by comparing the *actual* a* and b* values in your Neutral (or BO) printed target to your desired values (either from the above table or another source). For a Warm profile, you will probably need to reduce the use of Cyan throughout the profile. So, start by reducing or eliminating C entirely. What if you don't have any C in your existing profile? Then, you will have to add its opposite, which is Red. (M+Y=Red). Since you probably want more Yellow than Red in your warm profile, you may end up adding 3%Y and 1%M to your profile's ink limits. Save your TXT file and run the "Install1400.command" file (or the Install program appropriate for your printer model).

Reprint the 21-step grayscale using your new warm profile, read it in MT and see how your a* and b* values look from white to black. If you did well, you will see the strongest coloration in the mid tones of your profile, with saturation coming back closer to neutral as you approach white and black. I generally try to work *with* the color of the paper instead of fighting it. Some papers are warm toned (e.g., 95L/0a/3b). In this case, I allow the highlights to be influenced by the paper color and remain a bit warm (even in

a cool profile). Since the paper color itself plays a major role in highlights, I find it can look unnatural to *force* the highlights too much. If I am using a cold toned paper (e.g., 97L/-1a/-3b), I won't force the highlights to be warm or neutral near paper white (ie, 5K, 10K, etc), since it also tends to look a bit unnatural. You may have a few iterations as you try to perfect your toned profile and get a reasonable Hue from one end of the tone scale to the other. Again, Hue in the deep blacks (especially 85K and higher) will generally be unnoticeable to the eye, so don't sweat it. They will often have a color cast, but who cares if you can't see it and it doesn't affect Dmax?

You will be working with C, M and Y inks to tone the entire tonal scale and modify the coloration of black ink on paper. If you are using the predefined curves I created (remember, CMY all have the same exact curve shape and a 20% maximum), you should only be using 1 or 2 inks for toning, not 3. Why? $C + M + Y = K$. Why use three inks to get black when you can use one? Of course, if you modify curve shapes so they are all different, to get things exactly right, that's a different story. Have at it!

If you are just adding a *little* colored ink here and there, you won't be adding much to your total ink load, so you can probably leave your black ink set where it was with your Neutral or BO profile. But, if your black ink limit was set to 20% and you add 2% C and 3% M, (5% total), that represents a LOT of extra ink, (25% more.... $5 \div 20 = 25\%$). All this extra ink will darken your tonal scale from 0K to 100K. In this case, it is wise to back off a bit on your black ink limit to get your ink load closer to the original 20%. This black ink reduction has two distinct benefits. First, it keeps from overloading the paper with ink at the dark end and blocking up shadows. Second, if you use less black ink, then the color inks you do use will have more color impact for the same amount of ink used. Those are both good things.

Please note something important here (and probably confusing too). The above example talks about adding 2% C to the ink load. In order to add that much ink, you need to insert "10" in the Cyan ink limit in your text file. Huh? Why? Because I chose to create color curves which max out at 20% ink instead of 100% ink at the 80K point on the curve. The difference between 20 and 100 is a factor of 5X. So, $10 \div 5 = 2\%$. Using 20% as the maximum amount of color you can add provides much finer control, which is often needed in tailoring your profiles with some precision. To reiterate, if you plug 10 into the C ink limit, you have actually added a maximum of 2% ink at 80K on the curve. In this case, try lowering the black ink limit by 1-2% to compensate for the 2% extra cyan ink you are adding. If you add an *additional* 2% M (a value of 10 in your text file), consider lowering the black limit another 1-2%. It works and keeps ink limits as low as possible, without any detriment to Dmax.

Below are ***starting points*** for ink limits to create Warm, Cool and Selenium profiles from a Neutral profile. These settings may be more appropriate for **matte papers with 30K** and 50 Boost.

Tone	Target	Boost	K	Highlight	Shadow	Gamma	C	M	Y
Neutral	0a/0b	50	30	10	12	1.0	0	2	0
Warm	3a/9b	50	26	10	12	1.0	0	12	15
Cool	0a/-7b	50	26	10	12	1.0	14	12	0
Selenium	3a/-7b	50	26	10	12	1.0	14	18	0

Photo papers usually require less ink than matte papers, so the ink settings are usually different. Use these as *starting points* for creating Warm, Cool and Selenium profiles from a Neutral profile.

Tone	Target	Boost	K	Highlight	Shadow	Gamma	C	M	Y
Neutral	0a/0b	25	20	4	10	1.5	0	2	0
Warm	3a/9b	25	17	4	10	1.5	0	6	7
Cool	0a/-7b	25	17	4	10	1.5	7	7	0
Selenium	3a/-7b	25	17	4	10	1.5	7	10	0

The above tables show the numbers I used for a matte paper (1st table is Red River Polar Matte), and a photo paper (2nd table is Red River Ultra Pro Satin). My starting point was a Neutral profile for each paper. To build my toned profile, I increased the CMY numbers as marked in red, then lowered my black ink limit a bit to compensate for the extra colored inks. You can see I used less colored ink for the photo papers than I did for the matte papers. The reason is that photo papers require less ink to reach density than matte papers, so the colored inks required are also less. Looks like we are dealing in percentages to arrive at our toned ink formulas. The numbers in these tables came very close to my targets (target color refers to the color found in the midtones, in the 50K to 60K region of the curve, where it will be always be strongest).

If you are *repurposing files* from another paper, (next topic), you may choose to start there and ignore the above. Of course, feel free to choose different targets for toning to suit your taste.

When you find that your toning is where you want it to be, **relinearize your profile**. You deleted the entire line that starts with LINEARIZE="..." when you started toning this profile, right? Just follow the linearization steps provided earlier to smooth the steps and bumps in your profile and you are set to go.

Repurposing Profiles

Building good profiles from scratch involves time, work and is usually an iterative process, with some tweaking to get what you want. The good news is that you can often take profiles from a similar paper and **repurpose** them (i.e., quickly modify them) for use on another paper. In fact, sometimes, papers are similar enough that the same exact profile works fine, just as it is (especially in a pinch). Similar papers (especially if from the same manufacturer and using the same coating often respond similarly (or almost identically) to the same to ink.

I recently built a family of profiles for Red River Polar Matte paper on an Epson 1400 (OEM Claria inkset). I also have some Red River Premium Matte Plus paper. I used the Polar Matte Neutral profile and printed a 21 step grayscale onto the Premium Matte Plus paper. I read it with my spectro and it was nearly identical. Nothing at all to do here, except relinearize the profile (and even that wasn't critical in this case). Since the Neutral profile was dead on, the others will likely look great too. Neutral is always the most difficult challenge.

Let's say we need a profile for Innova Smooth White (matte fine art paper). I'd first look to see if I have a good profile for another matte fine art paper using the same inkset and printer. In this case, I have the profile for Red River Polar Matte, which is the same type of paper. The closer the characteristics between the two papers, the more you stack the deck in your favor.

You could simply try printing an image on the Innova paper with the RRPM profile and see how it does. If you are happy with the results, just use that profile and be done with it. But if your tonal scale or color don't look like you want or the shadows are plugged, you may need to *repurpose* your profile. Different papers often have different ink limits, different paper white colors (cold, neutral, warm), and often respond differently to ink, in terms of both density and color. It depends on how much work you want to do, but the following will generally yield the best results.

Print the 21-step grayscale with the 0-100% BO profile (the first profile we used when creating profiles from scratch). Read the step wedge and find the best Dmax. Let's say your Innova paper has a Dmax of 40% (RRPM is 50% with Claria ink on my 1400). Open the RRPM profile and change the BOOST to 40 and try lowering the K Ink Limit from 30 to 25. *Strip out the entire line that has the Linearization data.* Change the notes, paper name, profile name, etc, 'Save As' with your new profile name, install the profile (Install1400.command) and reprint the 21 step scale with the resulting profile. Read it with MT and double check the colors and the tone scale to make sure it looks okay. Since you lowered the K ink limit from 50% to 40%, there is a good chance you may also have to reduce the ink limits on the other colors (if used) by a similar percentage. Remember, different papers sometimes respond differently to a given inkset. If you're lucky, you'll hit the mark the first time. If you need to make adjustments, repeat.

Once the colors and densities look good, read your printed target with MT, save the measurement data as a txt file, and drag it to the QTR-Linearize-Data program. This will generate a new txt file with Linearization data. Copy the entire linearization line (including quotation marks), paste it into your repurposed profile, save, re-install the profile, Done! You now have a Neutral profile for Innova Smooth Cotton Matte paper with very little work. Of course, you are free to tweak and adjust all you want.

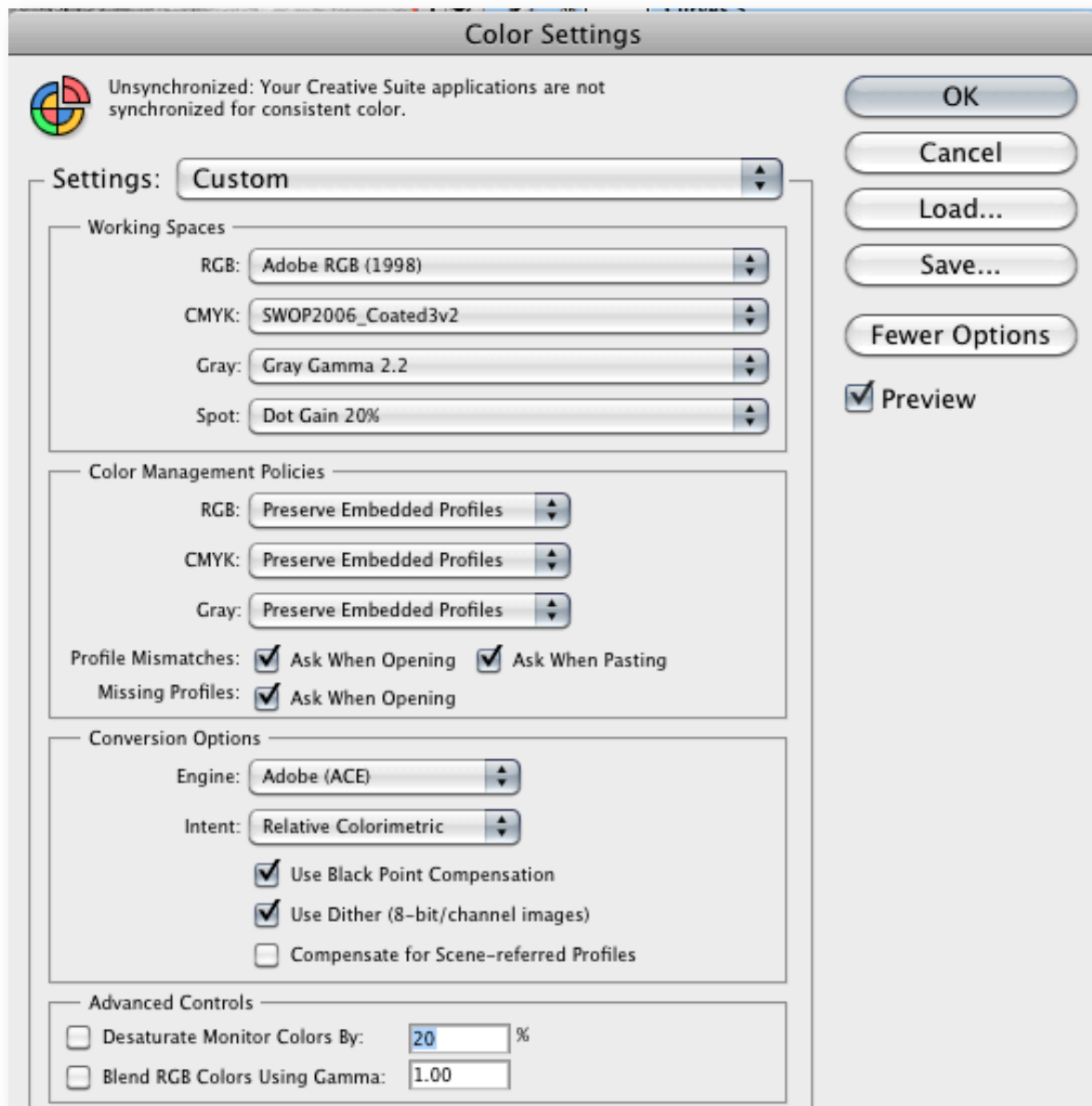
If you are building an entire family of profiles (warm, cool, etc), you can compare the ink limit settings in your RRPM family and use them as a guide to tweak the ink limits for each color. Since you now have a great Neutral profile for Innova Smooth Cotton, you can probably make similar adjustments to the toned profiles very quickly and simply relinearize.

Repurposing gives you great profiles fast. Of course, if a RRPM profile works perfectly on a different paper, no repurposing is required. Just print.

Printing & Soft-Proofing Images on the Mac

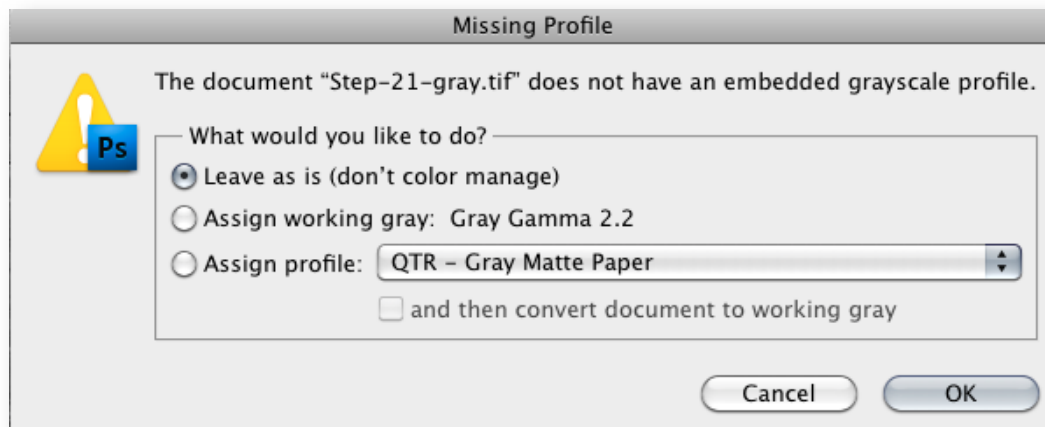
The Mac allows you to install QTR as a printer driver, so you can print directly from Photoshop to QTR. In fact, you can print from any Mac application to QTR. I haven't used a PC in a few years, but I know I had to open a stand-alone QTR program in order to print. So, Windows required me to save my QTR files in the proper format and with the proper data in order to print properly and reliably. I usually converted my file to my final profile before importing into the QTR print module. The Mac simplifies the ability to print images. I will use PSCS4 in the following examples.

First, a little theory on how Photoshop handles color management. Take a look at the following image, which is a snapshot of the Photoshop *Color Settings* dialog box.



I have my default RGB space set to Adobe RGB (sRGB is also good for monochrome printing), and my default gray space set to Gray Gamma 2.2. All of my color management policies are set to “Preserve Embedded Profiles” and the profile mismatch warnings are checked. I recommend you set your *color management policies* as I have, so you know exactly what is going on when opening files. You don’t want surprise conversions happening behind the scenes without your knowledge.

I also recommend Gray Gamma 2.2 for grayscale, and either Adobe RGB (better yet, sRGB) for your RGB profile, at least for QTR related work. If you are new to color management, use these settings. People who are experienced color managers can choose whatever settings they feel are appropriate. Open the 21-step-grayscale.tif image in Photoshop. If you have your PS color settings per the above, you will be alerted the the file you are opening does NOT have an embedded profile, as shown below:



Make sure you select “Leave as is (don’t color manage)” and click OK. Your image now displays on your monitor as you expect.....or does it?

Photoshop cannot display a file without *assuming* some profile. It needs information (source and destination profile) so it knows how to interpret the numbers in your file and display them on your screen. To display an image accurately, you need a source profile (the profile tagged to your image) and a destination profile (in this case, an accurate monitor profile). Even though this file is untagged, and you have chosen not to color manage your file when you opened it, *Photoshop is still assuming (i.e., assigning) a profile to your image*. It must do this so it can interpret the file. This assumed or assigned profile does NOT alter the numbers in your file, but it does affect how the file is displayed.

So, what profile does it use? Since no profile is embedded in this file, PS uses the *only* logical choice...the default profile you chose in your Color Settings dialog box. And since you opened a grayscale file, Photoshop chooses your default grayscale profile (gray gamma 2.2, in my case, since this is *my* default gray working space). If you have your default gray space set to dot gain 20%, then dot gain 20% will be used to interpret the information and display the file on your monitor.

Now, an experiment. In PS, go to the menu and select Edit > Assign Profile, then cycle through half a dozen different gray profiles. Try Dot Gain 10%, 20%, 30%, Gamma 1.8, QTR Gray Lab, QTR Matte, etc. Toggle the Preview button on and off, and you will see that the appearance of your image changes, sometimes dramatically. (By the way, if you select gray gamma 2.2, or whatever your default gray profile is, you will not see any change at all, because PS already assumed that when you opened the file.)

So, the profile that is assigned to the file can change the *appearance* of the image on your monitor, even though the numbers are not altered. Even though your file is “*untagged and not color managed*”, it is impossible to completely turn off color management in Photoshop. It has to *assume something* just to display your file. So, selecting the correct profile for displaying your image is half the equation in getting a good monitor to print match (assuming your monitor and printer are properly calibrated, of course). The only time we generally *want* an untagged image, is when we print a target for profiling.

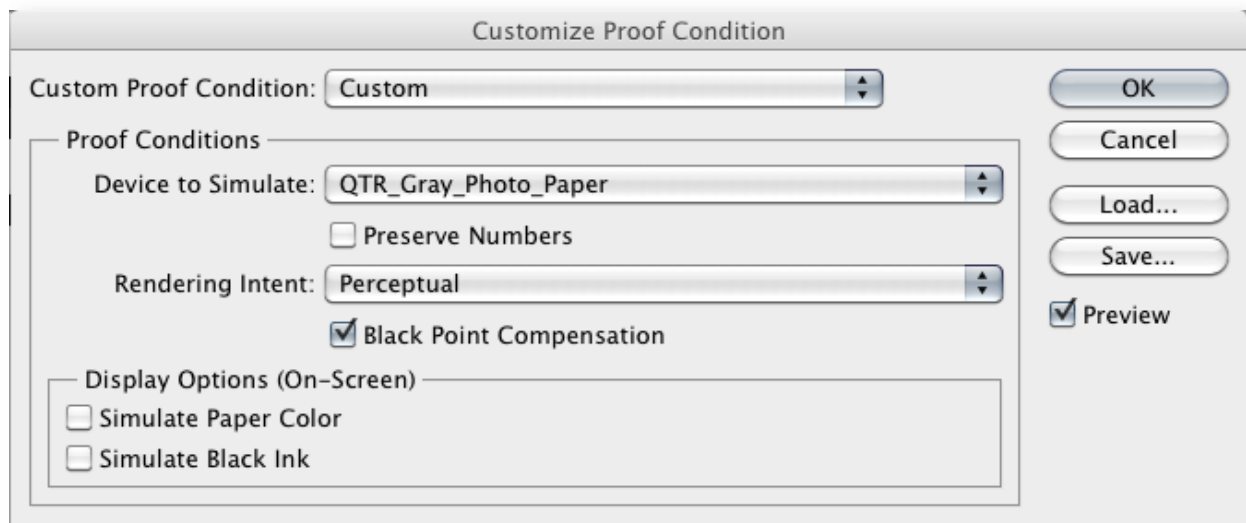
The other half of the equation is having accurate printer profiles (both ICC profile and inking recipe) and using them properly. Photoshop needs both a source profile (working space) and destination profiles (monitor and printer profiles) in order to match monitor to print. It also needs a translator (a Color Management Module) in the middle that can communicate between the source and destination profiles.

We can simulate the final print in Photoshop by “Soft Proofing”, where the monitor simulates the final output. A good soft proof relies on properly calibrated and accurately profiled monitors and printers. It also requires that your viewing light is appropriate in terms of intensity, color and quality. We’ll assume this is the case. At it’s best, a *perfect* soft proof is probably impossible, due the differences between transmitted RGB light, and CMYK inks on paper, but we can get mighty close.

Soft Proofing

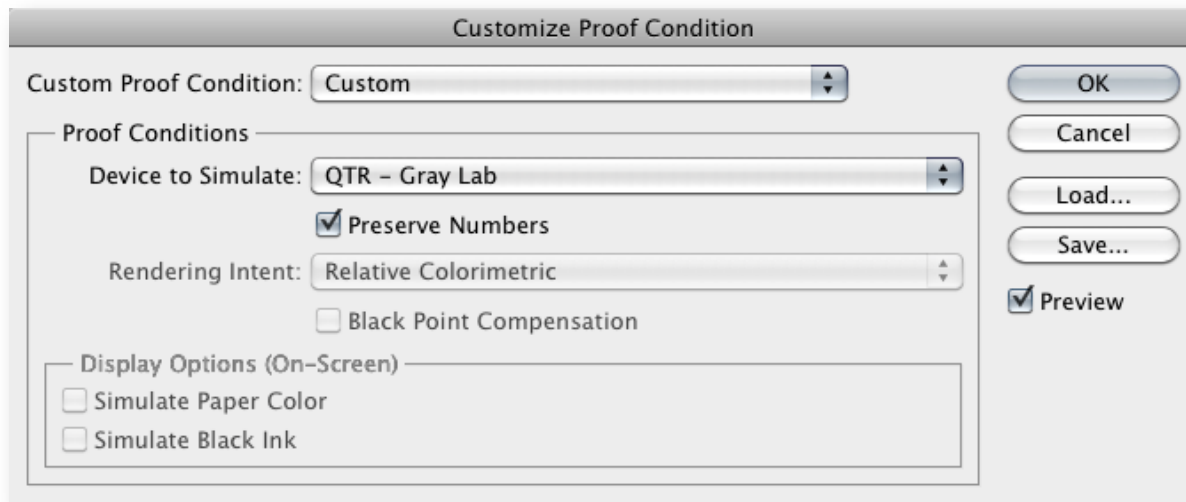
OK, enough theory. Let’s soft proof an image in Photoshop. Use the 21-step grayscale image for now, since it is easy to see changes in the distinct steps. Open the file and choose “Leave as is (don’t color manage)” when opening. Remember, PS will *assign* your default gray working space, though it does not change the numbers inside your file. This working space, whether assigned or embedded, will affect how the image is displayed on your monitor.

In the PS menu bar, select View > Proof Setup > Custom. The following window will appear:



If you choose QTR_Gray_Photo_Paper, Perceptual and Black Point Compensation (as above), your monitor will show a simulation of your final print, ***if you convert to these settings*** (whether you convert manually before printing, as in Windows, or *on the fly* when printing via the Print dialog box on the Mac). When you “convert” to a profile, you change the numbers in the file in order to preserve the appearance. If you choose Photoshop Manages Colors in the PS Print window and use the above settings, the numbers will be converted *on the fly* as they are being transmitted to your printer driver (the numbers in the physical file will remain unchanged).

Now look at the below window, which is the same, except that the “Preserve Numbers” box is checked.



When you check “Preserve Numbers”, this disables the rendering intent, then gives you a preview of what your print will look like *assuming you do NOT convert the numbers in the file*. This is the same as choosing “Printer Manages Colors” in the PS print dialog box, which allows the numbers to pass through to the printer driver completely unchanged.

So, which do you choose?

Preserve Numbers turned on (box checked)

If you want to see how your image will print without any color management (i.e., sending the numbers in the file directly to QTR), then **check the Preserve Numbers** box in the soft proof dialog window. If you don’t like what you see, you can then edit the file (i.e., change the numbers) with the soft proof active until you *do* like what you see. Then, when you print, be sure to select “**Printer Manages Colors**” in the PS print window. Just remember, with this approach, you are editing the above file *so it looks right on a specific paper*. If you leave Preserve Numbers checked and toggle between QTR Gray Matte and QTR Gray Photo, you will see a shift in the density of the tonal scale. Gray Photo will look darker, because photo papers can achieve a higher Dmax, so all the tones in the image will be remapped accordingly. So, to summarize, Preserve Numbers shows how the file will print on a given paper, assuming you do *not* convert the numbers in the file (either manually, or on the fly).

Perceptual with BPC checked (Preserve Numbers turned OFF)

The other approach is to edit the file once and get it the way you like it on your monitor. For soft proof, select either QTR-Gray-Photo-Paper or QTR Gray-Matte-Paper, (or your own custom ICC profile), leave **Preserve Numbers unchecked**, select **Perceptual** and **Black Point Compensation**. This shows how your image will look like if you print with “**Photoshop Manages Colors**”, assuming you use the same profile, Perceptual and BPC as you used in the soft proof. In this case, the numbers **WILL** be converted on the fly when PS sends data to the QTR printer driver.

Yes, there are differences between photo paper and matte papers, and there will be some differences in the print too. Matte papers have a lower Dmax and less dynamic range, so your blacks won’t be as deep. So, you may wish to gently tweak your image while soft proofing (curves typically work best, though Levels

also work well) to make it look its best on your targeted paper. I usually do this on an separate adjustment layer to preserve the unaltered master image on the background.

If printing directly from Photoshop (ie, from a Mac), *this is the method I prefer*. It's easy on the Mac. Above, I used QTR's generic matte and photo paper profiles. But, if you have built your own QTR ICC profiles, just use them instead.

Simulate Black Ink and Simulate Paper Color

What about these checkboxes?

Simulate Black Ink is Adobe's attempt to simulate the look of limited Dmax of the paper you are printing on. The impact is minimal or invisible on high Dmax Photo type papers. It is much more noticeable on lower Dmax matte papers. The less the Dmax, the more noticeable the effect. Should you turn it on or off?

For photo papers, I leave it off. The high Dmax of photo papers results in very little loss, so I find I get a more accurate proof preview with it off. Then again, turning it on has so little effect, you can leave it on.

For matte papers....well....it's a bit more hit and miss. I usually toggle Simulate Black Ink on and off, and I find the final print usually lands somewhere in between. I'm not sure how accurate these simulations are, but a lot has to do with having a perfectly calibrated monitor, correct room lighting level and learning to 'interpret' the shifts mentally. The black point of the monitor is critical, and even if off just a tad, it can affect the accuracy of Simulate Black Ink. On my system, the print usually ends up between having it checked or unchecked. Not a very good answer, but that is my experience. You'll just have to print some images and then preview the effect to see which is closer. And be aware that the intensity of the viewing light will alter the perception of your print's tonality. Your mileage may vary, so do what seems to work best for you.

Simulate Paper Color modifies the dark colors, the same as Simulate Black Ink, but it also looks at the printer profile and factors in the color and brightness of your paper (the other end of the spectrum). If you thought your monitor preview looked like crap when checking Simulate Black Ink with low Dmax matte papers, wait until you try Simulate Paper Color. You will lose some dynamic range at the light end of the paper, and if you have an off white paper, that effect will also kick in, showing the effect on coloration. If you are printing on an off white paper, you may choose to try Simulate Paper Color to see the impact on color (as well as overall dynamic range). It can sometimes be a shock to see the change from the normal monitor view to a soft proof with Simulate Paper Color turned on, especially with warm, low Dmax matte papers. But, it can sometimes be helpful when editing to look at this view. Again, your system and mileage may vary. It can also be helpful if you decide to alter color a little bit (by blending profiles in the QTR printer driver (next section).

Even though the Black Ink and Paper Color check boxes look awful on screen (at least on matte papers), remember you are doing an *A:B comparison*. Also, if you have any bright or white elements on your monitor, or in your field of vision, you end up seeing your image as very flat in comparison. So, if you use these check boxes, turn off any white elements on your monitor, including the Rulers in PS.

When you finally do print your image, you will be viewing it in isolation, so it usually looks a lot better than toggling back and forth on your monitor.

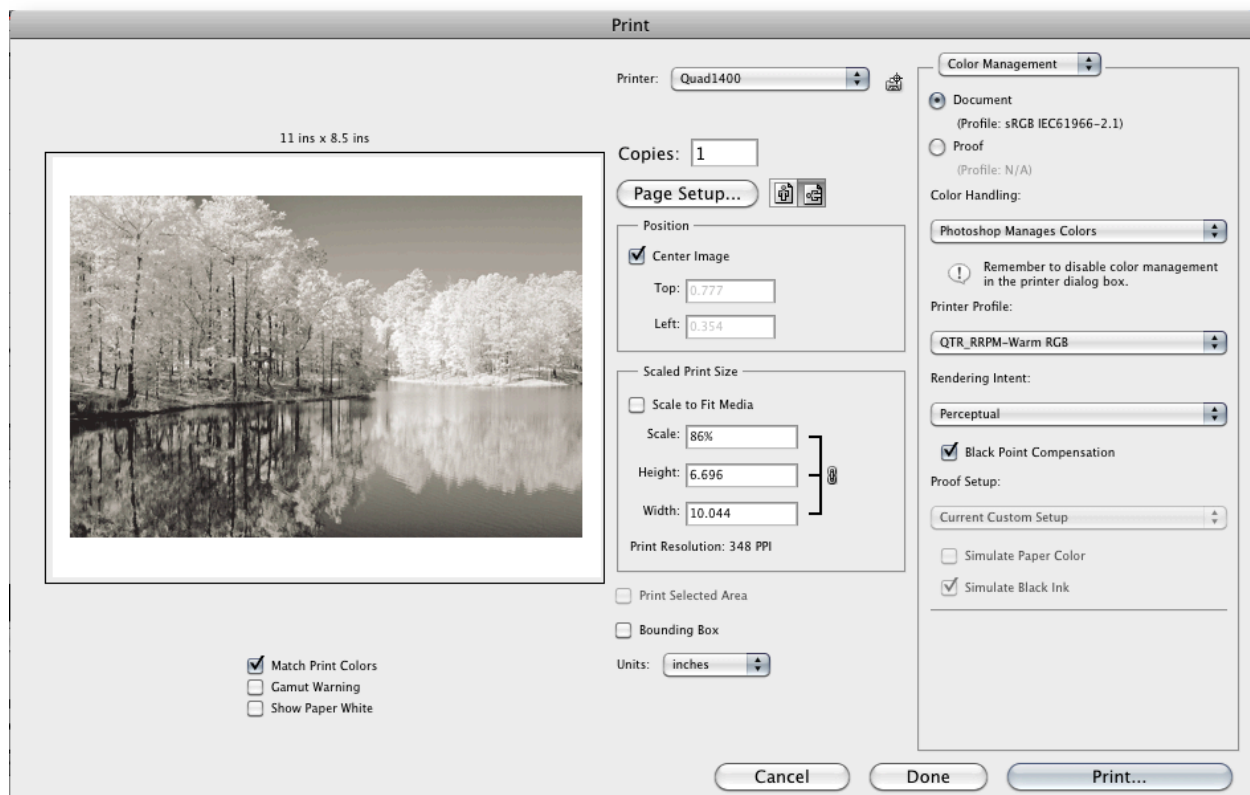
PSCS4 Print Dialog Box and QTR driver

I'm being specific here....PSCS4 and OSX 10.6.8. Why? Because between Apple and Adobe, they keep screwing up the print stream. I'm fairly certain Apple is the culprit, but the issue seems to be complex, from the discussions I have read on the forums.

I can say this with certainty, because I have tested it on PSCS4 and OSX 10.6.8....the **ONLY** reliable way to send *unaltered raw data* to the print driver is to select "Printer Manages Colors" in the PSCS4 print dialog window. This passes the data in the file directly through to the printer driver without change. That is the way I print ALL my targets when profiling and linearizing.

I can also say with certainty that "No Color Management" with this combination IS BROKEN. It doesn't work. It alters the numbers, which it should not do. It appears Apple decided that a profile must ALWAYS be used when printing a file, (even if you don't want one), so they forced that behavior within the O/S. (I apologize if it is more of an Adobe problem, but indications are that it is an Apple issue.) Anyway, the above is why I print all my profiling targets using "Printer Manages Colors", so I get raw numbers passed through to the driver. I can't vouch for other versions of OSX or Photoshop, so a little testing may be in order to find the approach that works properly. Just be forewarned.

The good news is that when using color management, which is how I print all my real images, things work just fine. Take a look at the CS4 Print window below:

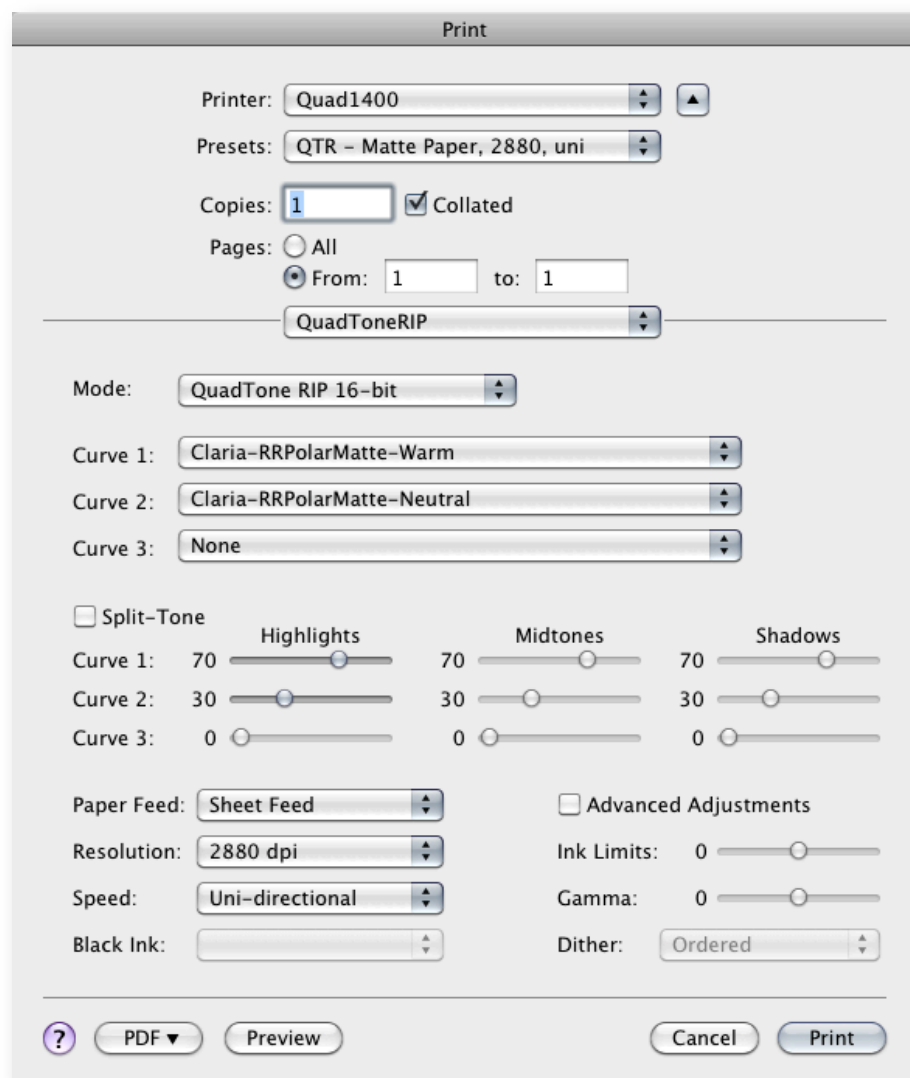


This is a typical setup I use when printing an image from PS using QTR. The printer is set to **Quad1400** (QTR's driver for the Epson 1400), you can see that my original file is sRGB, I have selected **Photoshop Manages Colors, Perceptual and BPC**. I am printing this image using an ICC profile I created myself, which is for Red River Polar Matte (RRPM) Warm. The profile name is **QTR_RRPM_WARM RGB**. I also checked the box "Match Print Colors" under the image. This previews the color of the final image in the little image window, but it has no effect on the final print. It's for display only.

The above setup will *convert* the numbers in the file on the fly. The numbers in my open PS file will not be changed at all, but the driver will receive the data it needs to give me a good monitor to print match.

If you don't have or don't wish to use a custom QTR ICC profile, simply substitute QTR_MATTE_PAPER if printing on a matte paper, or QTR_PHOTO_PAPER if printing on a photo paper. (These are provided as part of the standard QTR installation.)

Use the Page Setup button to change paper size, orientation, etc. When everything in the PS Print Window is set, click on the "Print" button. When you do, Photoshop will convert your file's numbers as instructed and open the QTR Print Driver window, below:



Above is the *QTR Print Driver Window*. We've left Photoshop now, and the QTR driver is ready to rock. I create all my personal profiles for 16 bit, 2880 dpi, Uni-directional printing. It's very slow, but the quality is high. If your profiles were created for 1440 dpi and bi-directional printing, be sure to use those settings.

It is important that you use the same settings that were used to create the original profile.

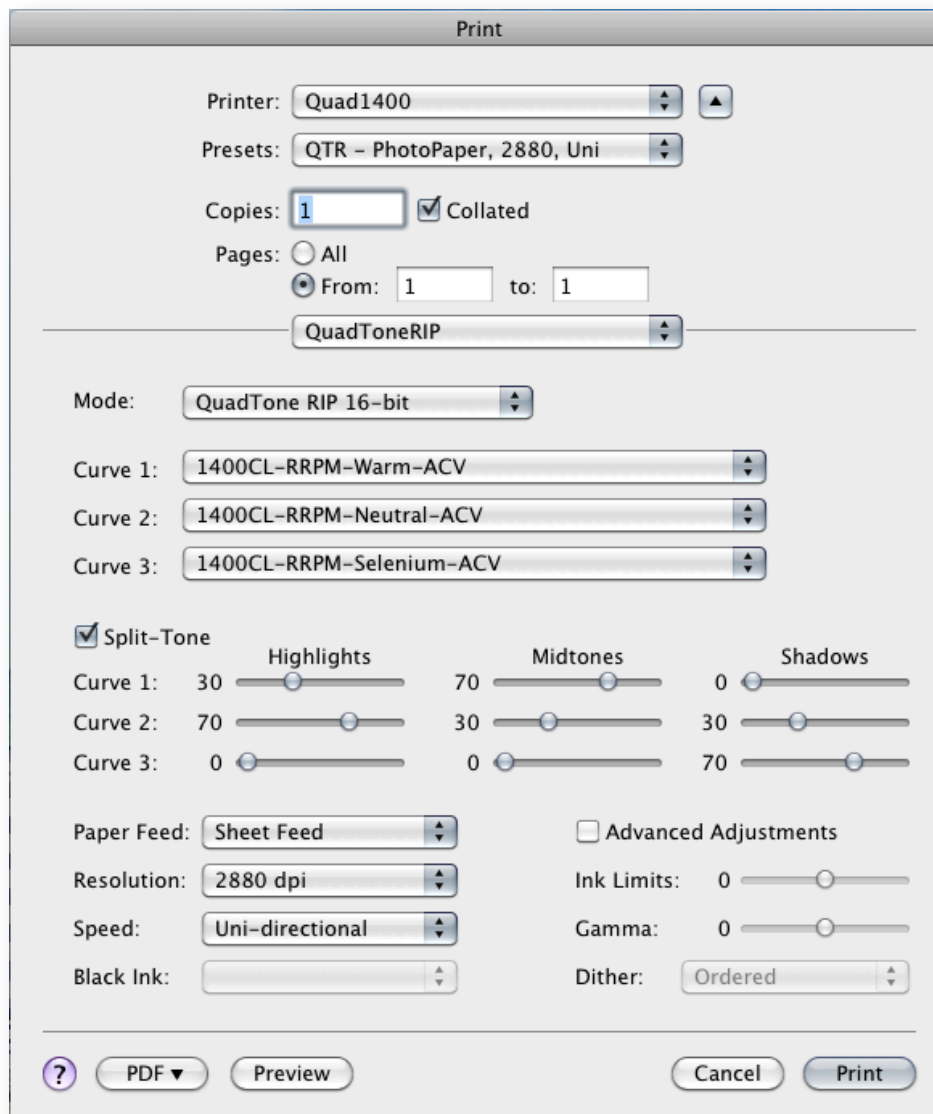
In Curve 1, I chose my RRPM Warm profile (inking recipe). Even Roy calls it "Curve 1" in the dialog box, since the "*profile*" is a bunch of curves that control how much of each ink to spit out at each point along the tonal scale. This inking profile has a nice warm tone. If I want a little less warmth, I can blend it with a Neutral profile, which I have done above. For Curve 2, I selected my RRPM Neutral profile. I decided to blend 70% warm with 30% Neutral, so the Warm profile will control 70% of the ink flow, and the Neutral profile the other 30%. A 50/50 split will be a little less warm. If you don't want to blend at all, just select an ink profile for Curve 1 and leave the others set to None.

Click Print and go have a cup of coffee or another glass of wine. When done, you will have a lovely toned print that should closely match your soft proof preview, at least in terms of tonality. If your soft proof displayed using a Neutral profile, the Gray_Matte_Paper profile, or a warm profile, the tonal scale will match, but the color will not (since it will preview as 100% gray or 100% warm). If you used a custom WARM profile for your soft proof, the monitor will show a warmer print than what comes off the printer (since you chose to blend a Warm and Neutral profile). Of course, you can create an ICC profile for 70% Warm and 30% Neutral too, but that starts getting too anal, even for me (that's saying something, I can assure you).

Split Toning

The QTR driver window also has a check box labeled "Split-Tone", which is very cool. With this box checked, you could, for example add a little warmth in the highlights, a bit more warmth in the midtones and some cool selenium shadows. Select Warm for Curve1, Neutral for Curve2, and Selenium for Curve3. Now, you can selectively move the sliders in the Highlights, Midtones and Shadows. You might Select 30% Warm and 70% Neutral in the highlights, 70% warm and 30% Neutral in the midtones, and 70% Selenium and 30% Neutral in the shadows. This example is shown in the following illustration.

Voila, a split toned print tailored to your requirements. Having a family of toned profiles makes this possible, and QTR makes it easy. This is one reason I choose to make my toned profiles a bit more colorful than I might otherwise.



Summary

The purpose of this tutorial is to help people get up and running with QTR on the Mac. It cannot and does not cover some of things that you may want or need to know, but hopefully, it will plant your feet firmly on the ground and acquaint you with some of QTR's many powerful tools.

Windows users have a very nice graphical user interface (GUI) and some great tools that are not available to Mac users. If I were on Windows, I might build profiles differently. There are some neat controls and conveniences built into the PC interface. If you are a Windows user, you can employ the same basic approach as discussed in this paper, but you may have to do a few things differently, mainly due to the different (better) interface and tools.

The approach I have taken has a lot of flexibility, and since I am controlling the color curves shapes directly, I know *exactly* what I am doing. I could easily do the same with the Black ink curve, but I found

I liked the controls Roy built into QTR for altering the black curve shape and amplitude. Maybe all these things can be done better and easier using different QTR tools, controls or methods. It wouldn't surprise me at all. QTR is a rich and varied program and there is a lot of flexibility to work the way you wish. You may prefer a different approach, whether you are on Windows or a Mac. Everything ultimately boils down to the final curves you create, regardless of the path you take to get there. If the final curve is the same, the print will be the same.

This tutorial comes with some spreadsheets, profiles, curves, templates and other information. Check them out. You may find a family of curves for your printer/paper/ink combination. The tutorial is based on profiles created with the 6-color Claria inkset with a single black ink, not on quad inksets (multiple blacks). I have used the Epson 1400 and the OEM Claria color inkset for all the examples, since I prefer to stick with the OEM color inkset. It keeps my life simple. Since this inkset has only one black ink, and does not have lighter shades of black and gray, I did not discuss the partitioning of multiple gray inks. This is well covered in other papers and in the documentation provided with QTR.

This paper is long, because I strove to anticipate questions and provide clear direction and detailed examples. I'm sure I have missed things along the way, left some important things unsaid, and even made some gross mistakes. I certainly don't know all there is to know about QTR or building great profiles. There may be better or more efficient ways of building profiles, so if you have one, please share it with the community.

If you find any *gross errors*, please let me know and I will make the appropriate corrections. (please don't bother me with typos and inconsequential errors...just ignore them). I hope you found this tutorial helpful and instructive.

My thanks and gratitude to Roy Harrington for developing QTR and making it so readily available to the print community at such an incredibly cheap price. It is an awesome product with a lot of flexibility and power. The results speak for themselves. Thanks also to the author of GimpPrint, the engine behind the program, so graciously donated to the public. I also wish to thank Paul Roark and Carl Schofield, from whom I learned so much (including much of the approach outlined herein).

Best regards and happy printing!

Lou Dina

www.DinaGraphics.com