5K + LC, LM, & Y Inkset

Epson 4000

(& Other Epson 8-ink printers with QTR support)

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6-2012c

This is a modification of the 6K Plus carbon-based black and white inkset approach discussed at http://www.paulroark.com/BW-Info/4000-6K-Plus.pdf . In this version, yellow color ink is added (in the MK position). As such, I've traded matte paper compatibility for the ability to control the OBAs (Optical Brightening Agents) on glossy paper. Because I use Eboni-6 in a 7800 for matte paper printing[1] and because the 4000 has a relatively weak matte paper dmax, this makes much more sense for me than it would if one had no other matte printer. Note that in some printers both capabilities would be available.

The basic approach here stresses maximum carbon pigment use, with 5 carbon pigments instead of 3 in the usual K3 setups. It gives full Lab A and B control from sepia to neutral-cool, simply and economically.

All of the carbon inks are "off the shelf" MIS Associates/InkSupply.com carbon, and the color inks are standard LM and LC – open source and readily available. The yellow is used only for OBA control, and, as such, could be any number of types, as long as compatible with the others. I use the Noritsu yellow dye, in part, due to having it. MIS also has yellow inks that would work just as well for this purpose. In fact, MIS yellow dye might be better. Matching the fade rate of the OBA dyes is the goal, so longevity is not wanted in the yellow position.

The approach will only work with a "rip" ("raster image processor" – printer utility). QuadToneRip (QTR)[2] is the logical one for most B&W printers. I use a Windows 7 computer, and the PC/Windows QTR interface and method of printing are a bit different than that with Macs. My comments in this PDF are with respect to using QTR in the Windows environment.[3]

Note that this inkset approach and profiling are somewhat consistent with the standard K3 color inkset arrangement if MIS carbon is used. That is, any k3 printer that uses MIS glossy carbon inks as well as LM, LC, and Y inks that are similar will probably be able to use the QTR profiles that are generated, with only minor position changes and re-

[1] Eboni-6 remains the top choice for the most neutral 100% carbon inkset on matte inkjet paper. The glossy carbon used in the 6K+ inkset is quite warm on coated papers. Note also that the larger-drop printers are make slightly more neutral carbon-pigment prints than do the 1.5 pl printers such as the 1400. See http://www.paulroark.com/BW-Info/Eboni-6.pdf for Eboni-6.

[2] See http://www.quadtonerip.com/html/QTRoverview.html

[3] For support with using QTR, see http://tech.groups.yahoo.com/group/QuadtoneRIP/messages . Many if not most QTR users are on an Apple platform.

linearization. This inkset will simply have more carbon pigment positions for smoother printing. The basic approach, however, is to have a 100% carbon pigment core or backbone to the image and then tone as needed with standard, open source LM and LC inks, using the least possible color to maximize print lightfastness and color constancy.

Epson 4000, 6K Plus Ink Setup[4]

Five 100% **carbon core** inks in descending order of density:

Ink	*Position*
K4-PK[5]	PK (The 4000 has separate K positions but no LLK position)
UT7-C[6]	C
K4-LK[7]	LK
UT7-LC[8]	M
K4-LLK[9]	Y

Plus **color** toners/inks:

Ink	*Position*
- LC[10]	LC
- LM[11]	LM
- Y[12]	MK

Ink location was influenced mostly by where pre-loaded, standard carts would fit.[13] Since I am not using the printer for matte paper, I don't need the MK. Also, I am using the yellow only for OBA control, and is applied to the paper in an initial pass, before the

[4] See http://www.paulroark.com/BW-Info/4000-5K-Plus-ver-1.pdf for the version that uses an EZW ink and only 5 carbon inks. This version expands the carbon ink count to 6.
[5] http://www.inksupply.com/product-details.cfm?pn=K4-4-PK
[6] http://www.inksupply.com/ut7_7600.cfm
[7] http://www.inksupply.com/product-details.cfm?pn=K4-4-LK or http://www.inksupply.com/product-details.cfm?pn=MP-T5437-LK for pre-loaded cart.
[8] http://www.inksupply.com/ut7_7600.cfm
[9] http://www.inksupply.com/product-details.cfm?pn=K4-4-LLK
[10] http://www.inksupply.com/product-details.cfm?pn=MP-T5435-LC for MIS LC; http://www.atlex.com/epson-ultrachrome-ink-light-cyan-110ml-for-stylus-pro-4000-7600-9600.html for Epson version.
[11] http://www.inksupply.com/product-details.cfm?pn=MP-T5436-LM for MIS version; http://www.atlex.com/epson-ultrachrome-ink-light-magenta-110ml-for-stylus-pro-4000-7600-9600.html for Epson K3.
[12] MIS has suitable yellow inks. If the yellow is for darker sepia than the glossy carbon, pigments are recommended. If for OBA control, dyes might be more appropriate. Check with MIS for dye compatibility with MIS pigments. I use Noritsu dyes, in part, just because I have more of it than I can use in other printing. See http://www.paulroark.com/BW-Info/BW-Dye.pdf, Appendix A for Noritsu suppliers.
[13] Newer Epson K3 printers may want the LLK in the LLK position. QTR profiles can usually have the positions of inks switched and work with a re-linearization.

carbon image is printed. The yellow does not need to register well. It's a very light and feathered application that is intended to be inconspicuous. At any rate, for my uses the MK position works for the yellow. In more modern printers, the yellow position may be more appropriate.

Because the Epson driver will not work with this setup, being compatible with that driver was not a concern. Four of these inks are available in pre-loaded cartridges for the Epson 4000 (which uses 7600 carts). The others must be loaded into empty carts.[14]

There are no blends of more than one type of pigment in any position. Blends have been known to separate in wide format printers.[15]

My original and specific purpose for this inkset and its predecessor 6K+ was to be able to print neutral B&W images on glossy papers. No practical 100% carbon solution exists that can do this at the size and with the quality I am interested in. The glossy carbon pigments that form the backbone of this inkset are much warmer on glossy paper than the Eboni-based inksets are on matte paper. To offset the warmth of these glossy carbon pigments, Light Cyan and Light Magenta pigments are needed. These are open-source positions where any number of LC and LM inks can be used. For economy, MIS is recommended. For best longevity Epson LC and LM pigments are recommended.[16] I have the Epson LC and LM pigments installed in my 4000.

The primary weakness of this approach in terms of lightfastness and longevity relates to the faster and differential fading of the color pigments used. Carbon pigments are extremely lightfast. In selecting the Epson LC and LM, I relied on, among other things, accelerated lightfastness tests conducted and published by Aardenburg Imaging & Archives.[17] The Epson pigments appeared to do extremely well on the papers that are the primary targets of this inkset.[18]

The primary weakness I ran into with the predecessor 6K+ inkset was that there are very few glossy papers that do not have OBAs. The bright white borders of brightened paper distract from the image and nearby B&W photos on natural paper. Thus, to expand my paper choice, I needed the ability to control the OBAs in brightened glossy papers. Adding the yellow allows this to be done.

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[14] See http://www.inksupply.com/printer_products.cfm/p/Epson_Stylus~Pro_4000.html for empty cartridges.

[15] See http://www.paulroark.com/BW-Info/Wide-format-tone-shifts.pdf

[16] The generic pigment base mix will probably dilute the Epson M and C to make a more economical source of the LM and LC toners. See http://www.paulroark.com/BW-Info/Ink-Mixing.pdf and http://www.inksupply.com/searchresults.cfm?q=c6b+base&x=12&y=4 for the pre-mixed base.

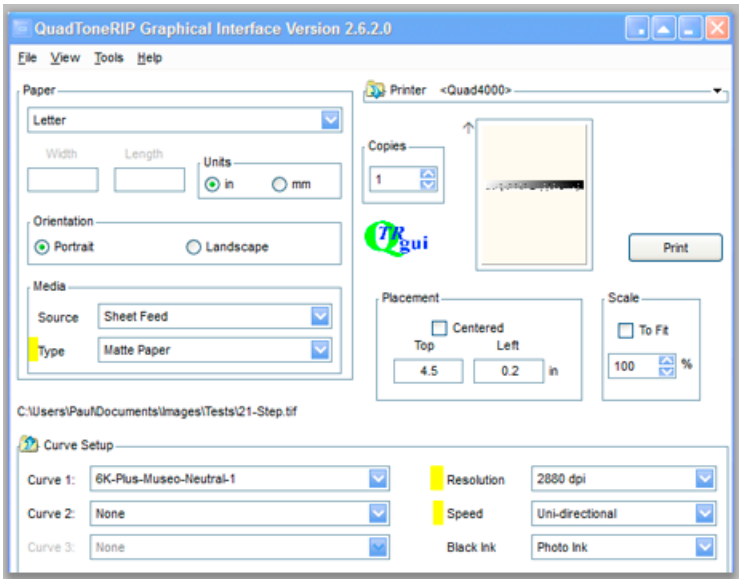
[17] See http://www.aardenburg-imaging.com/

[18] For example, on Museo Silver Rag paper, the Epson 4800 Magenta and Cyan test patches had I* Color ratings of 100.0 (the top possible) after 100 Mlux-hrs of light exposure. As far as I know, this is the best performance for color pigments after that amount of exposure. There was no evidence of a green shift, as seen with third party neutralized carbon + color blended inksets. See Aardenburg-Imaging test sample # AaI_20071218_SN005.

Printing and Profiles

The only workflow I will use with this inkset relies on QTR. My QTR profiles will be posted at http://www.paulroark.com/BW-Info/4000-6K-Plus-Profiles.zip . All of the 6K+ profiles for glossy paper work in this 5K+cmy inkset. The 6K+ matte paper profiles do not work. The yellow OBA control is done with totally different profiles that are marked clearly. I use the 4000 UC folder in QTR for the profiles. My comments relate to the Windows environment.

The following highlighted settings are assumed for all profiles I make:



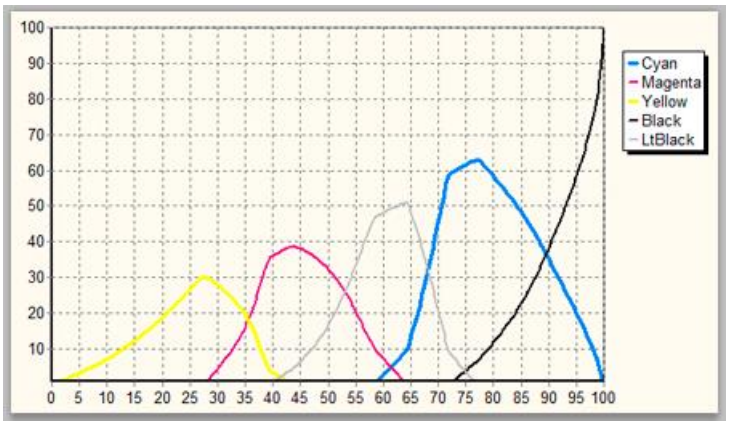
OBA Control with Yellow Ink

To apply the yellow ink the "Black ink" box is switched to Matte, which is where the yellow ink is in my 4000 setup. Printing a page of 100% black after switching and before printing with the new type of ink assures any residual ink is out of the head.

To determine that amount of yellow needed, print a 21-step test print with the K-0-5 profile. As an example, a gray with an L = 89 results in a relatively neutral paper white with Red River Arctic Polar Pearl, which otherwise is quite bright. On a new layer, I paint the entire area with this gray value, and then erase the areas where I want the eye to be attracted by the "brighter" looked underlying paper shade.

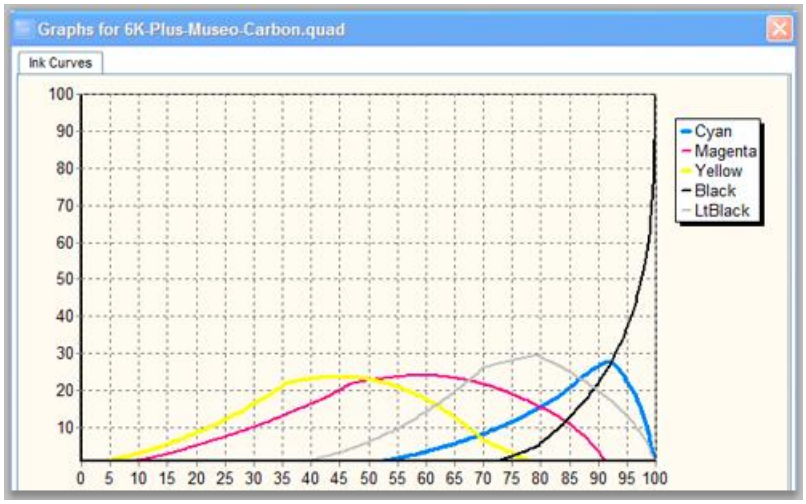
Carbon Core Partitioning

I use two different styles for partitioning the carbon core or backbone of the inkset. The standard, single-channel, serial partitioning results in an ink distribution like the one below, which is for Arches watercolor paper.



Paper white 100% Black

On glossy papers, however, where printing artifacts may show more easily, I find that 2 parallel channels of carbon inks can often make a smoother print. The partitioned carbon core of such a profile, shown below, looks complex, but is actually rather easy to make. The first half of the carbon core is composed of a standard LLK (yellow position), LK, and K progression. The second half of the carbon core, the UT7-LC (M position in the 4000 setup) and UT7-C (C position) inks, are profiled as a "toner."



The LLK-LK and UT7 LC-C parts of the carbon core must have their ink limits adjusted, as QTR does not automatically limit the total of the Gray and Toner channels (or manual curves) so that they do not overwhelm the paper. Simply cutting the dilute carbon ink limits in half is the simple way to do this. The ink limits can be further manually tweaked if necessary to get a reasonably good pre-linearization grayscale ramp, which is recommended.

Color Toner Controls

Although the use of the standard QTR toner curves might work well for some papers and tones, for a more even, neutral color distribution across the grayscale ramp I have found manually drawn color toner curves are usually needed. Specifically, for neutral prints, it is hard to get the deep shadows neutral with the built-in QTR toner shapes.

For simplicity, I recommend simply copying the toner curve points from a similar paper. From this starting curve the ink limits and minor individual point moves often appears to be sufficient.

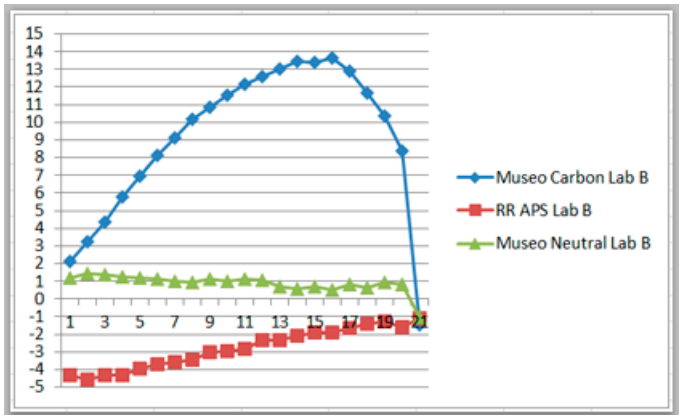
Initially and sometimes for the final profile also, I just have the LM curve be a copy of the LC curve.

In profiling, I adjust the Lab B values first. Adding more LM and LC by increasing their ink limits cools the print – that is, it lowers the Lab B values.[19]

The Lab A values are initially controlled by the relative ink limits of the LM and LC. If the Lab A value is too low, increase the LM ink limit and lower the LC ink limit by the same amount. If the values need local adjustment, both of the color toner curves can be point lists. That way individual points on the curves can be adjusted to correct local variances.

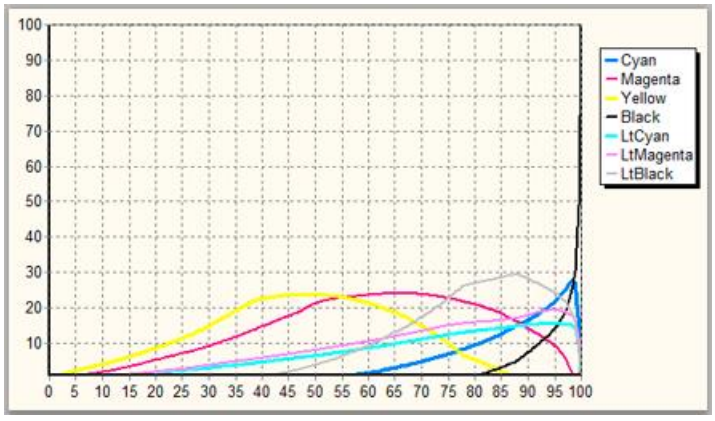
With glossy papers the 100% carbon image is a light sepia tone, with a Lab B up to almost 14. So, glossy papers need a fair amount of color ink to be neutral. So far, my profiling suggests that the standard LM and LC inks have sufficient gamut to neutralize the glossy carbon warmth on most papers. See the Lab B graphs, below, comparing the Museo Silver Rag 100% carbon profile, as measured by Lab B, with a Museo test strip make with a neutral QTR profile for Museo, and finally with the Lab B of a Red River Arctic Polar Satin neutral test strip, representative of a good paper with a brighten (high OBA) base. In each case the LM and LC were able to control the print tones without any sign of overloading the paper. As the graph, below, shows, glossy papers are capable of a huge range of tones with this inkset.

[19] If the QTR toner curves are used, the lower the "Density" number of the toner curve, the more the peak of the toner curve moves toward the paper white; higher Density values move the curve's peak toward the black end of the scale.

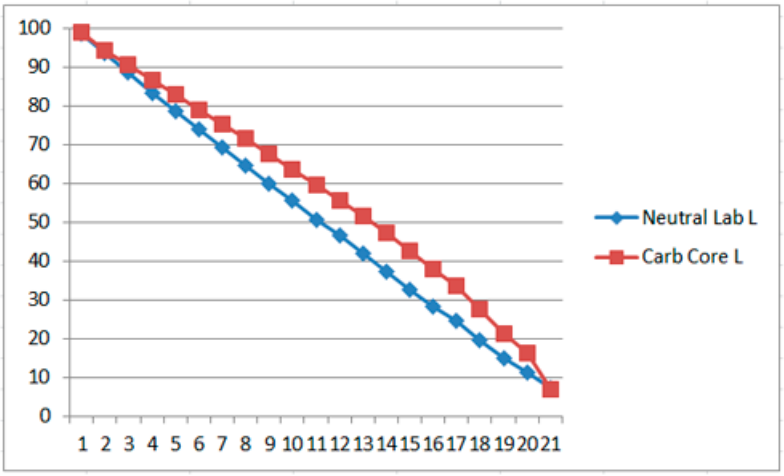


Paper White 100% black

The QTR graphs below for the Museo neutral profile show the amount of color toners needed. The LM and LC ink lines represent those colors. The LM peaks at an ink load of about 20 (vertical axis) at 95% black (horizontal axis).



The graph below compares the Lab L values of Museo test prints with and without the color toners in the profile mix .



Although the LM and LC density fade, by itself, may not be much of a risk, the tone shift due to differential fading of the two color toners could be significant over time. If the LM fades faster than the LC, the print will take on a green hue that most viewers find rather unpleasant. How well matched the LM and LC color pigments are in terms of their rates of fading becomes a significant issue for image stability.[20]

Printing

My digital or scanned originals are either Adobe RGB or Gray Gamma 2.2, which is a subset of Adobe RGB. I prefer to keep my files in this most popular workspace. Because QTR is not a "color managed" workflow and uses a linear workspace that is different than Gray Gamma 2.2, the files I edit must be converted to QTR's space in order to have the prints match the monitor's relative density display. Although there are a number of ways to handle this issue, I use a Photoshop curve to convert the image. This curve, "GG22-to-QTR.avc," is in the profiles zip file. I simply apply it to my final Tiff file for printing only, and save that file to the Desktop. There it can be dragged and dropped into QTR for printing (Windows platform). After printing I recycle that printing-only copy of the image file.

(This project was put on hold due to my 4000 being converted to dyes, which I consider to have a unique glossy look and no artifacts. See http://www.paulroark.com/BW-Info/4000-Noritsu-2K.pdf)

[20] Some black and white test prints have shifted into a negative Lab A (greenish) after the equivalent of only 3 years of typical commercial gallery light exposure. Repeating fn 14, on Museo Silver Rag paper, the Epson 4800 Magenta and Cyan test patches had I* Color ratings of 100.0 (the top possible – no visible change) after 100 Mlux-hrs of light exposure. As far as I know, this is the best performance for color pigments after that amount of exposure. Paper and other factors can make a difference, of course. See Aardenburg-Imaging test sample # AaI_20071218_SN005.