

Improved Profiles for Printing Digital Negatives with QuadTone RIP:
Using all seven inks to make negatives results in smoother print tones.

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QuadTone RIP (QTR) is a printer driver that was originally written to improve the ability of Epson printers to print quality black and white images. As it turns out, QTR is also the best available driver for making digital negatives with Epson printers. The reason is that with QTR it is relatively easy to make custom profiles which control the printer's ink settings. With these controls one can adjust the maximum amount of ink laid down (thus setting the contrast range of the negative) as well as adjusting the linearity of tonal distribution between maximum black and pure white. Making these adjustments in the ink settings avoids having to apply distorting correction curves to the image file itself.

We introduced the use of QTR for making digital negatives in Chapter 10 of our recent book, "Digital Negatives: Using Photoshop to Create Digital Negatives for Silver and Alternative Process Printing". Nearly a year has now passed since writing that chapter and during that time I have made hundreds of prints from QTR negatives. I remain convinced that QTR is the best current technology for making digital negatives. But, I also have become aware of a serious problem with QTR negatives made as described in the book. Fortunately, I also have learned the solution to the problem. The purpose of this article is to acquaint you with both the problem and how to fix it.

The Problem. Prints made from QTR negatives as described in the book often show unsightly banding in areas of smooth light tones. It took a while to become aware of the problem because many of my images are of a darker key and the banding does not appear in tones darker than about 50% gray. But occasionally I would try to print an image with a large area of clear sky, and then unsightly dark and light bands would appear in the sky. The bands were spaced about half an inch apart and the periodicity changed as I changed the resolution at which the printer operated. The banding was clearly visible in the negative itself (and not in the computer screen image) and appeared to be due to the printer having difficulty in laying down an even coat of ink as the darkness (and amount) of ink increased. Out of despair I tried printing a negative using the Epson driver and --- the banding disappeared! After all the opprobrium I had heaped upon the Epson driver, was I going to be forced to use it after all to make negatives for high key images?

The Solution. Once again, Roy Harrington to the rescue. Roy wrote the original QTR and tutored me in writing the QTR profiles that we provide elsewhere on this website. Recently I met Roy on a photo trip to Ireland and spent half a day telling him my banding woes. After some thought he opined that the problem might stem from the fact that all the QTR profiles I had written so far used only two inks, K and LK, to print negatives. Perhaps, if I used all seven ink colors (K, LK, M,C,Y,LC and LM) the result would be smoother tones and little or no banding. So, with some further help from Roy, I

learned how to write QTR profiles to print negatives using all seven inks. And I am delighted to report that doing so essentially eliminates the banding problem. In retrospect, this makes total sense because the Epson driver uses all seven colors to print black and white (that is the source of its difficulty in printing good black and white) and it also made unbanded negatives.

Figure 1 shows how the K and LK inks are used in a QTR profile I wrote for the Epson 4000 over a year ago. This profile was designed to make negatives for printing on a palladium emulsion. The light tones (in the negative) are printed solely by the LK ink up to about 38.5% gray. Then the darker matteK ink starts making a contribution. In the darkest negative tones (which correspond to light tones in the print) the majority of the contribution was also from a single ink, the K ink. Apparently the printer is unable to lay down an even coat of a lot of K ink and thus negatives printed with this ink profile show banding in the high print tones.

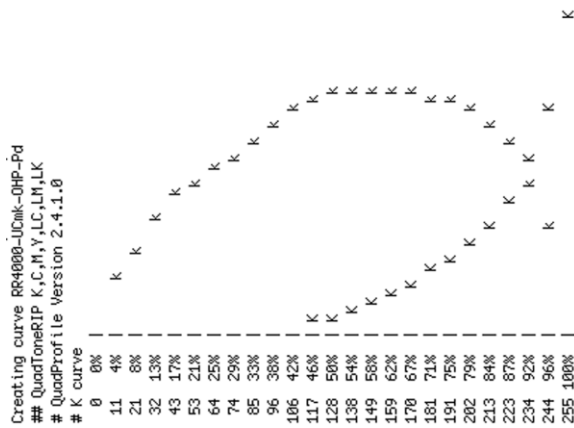


Figure 1. Ink distributions for the QTR profile RR4000-UCmk-OHP-Pd.

Figure 2 shows ink distributions for a profile I recently wrote that uses all seven of the printer's inks (matteK, LK, C, M, Y, LC, and LM). In this profile the curve which defines how the LK ink is used is copied over and also used to control the use of both the LC and LM inks. Since the ink limits are set slightly different for each of these inks the curves have the same general shape but do not superimpose (the ink limits were chosen rather arbitrarily and other limits would probably work just as well). Likewise, the curve that controls the distribution of the matteK ink was copied over and used to also control the distribution of the C, M, and Y inks (again, the ink limits for the C, M, and Y inks were chosen rather arbitrarily).

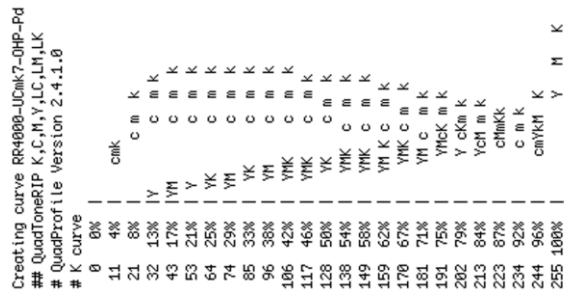


Figure 2. Ink distributions for the QTR profile RR4000-UCmk7-OHP-Pd which uses all seven inks.

Once I had all inks contributing, I printed out a test step tablet with the default ink limit set rather high (75%) and got a surprise. The darkest step of the tablet had an optical density in the UV of 4.6. This is the highest UV density I have ever seen on a digital negative. Apparently combining all the inks can lead to extremely high UV densities. The UV density that is needed to print pure white on a palladium emulsion is only about 3.2. So I kept dialling the default ink limit down until I reached a setting of 44% -- which gave me a UV density in the darkest step of just over 3.2. This QTR profile prints negatives that yield the smoothest tones on a palladium emulsion that I have ever been able to achieve. I conclude that an additional reason why this profile prints such smooth tones is that no one ink is used to a very high amount. But together they easily achieve the needed UV density.

I will now go through the textfile for a QTR profile named RR4000-UCmk7-OHP-Pd, designed to use all seven inks on the Epson 4000 to print negatives on Pictorico OHP destined for making palladium prints. I will try to explain the function of each line of instructions. Lines of textfile are in regular type. My comments on the textfile instructions are in italics.

```
# QuadToneRIP curve descriptor file
#
# for Epson4000 using matte black and all seven inks
```

Placing a # sign at the beginning of a line turns that line off. Thus, these lines are just for your information and convey no instructions to the printer.

```
PRINTER=Quad4000
CALIBRATION=NO
GRAPH_CURVE=YES
```

Specifies the printer, says that this profile is not for calibration purposes, and arranges that an ink distribution graph (like those shown in Figures 2 and 3, above) will be drawn each time the profile is installed.

```
#
#number of inks must be 4, 6, or 7
```

#the ink limits are percentages
#usually they are all the same but they can be individually set

#

N_OF_INKS=7 *Specifies the total number of inks being used.*
DEFAULT_INK_LIMIT=44 *This is a very important number. It sets the maximum amount of any one ink that can be deposited and thus controls the contrast range of the negative. This number is altered empirically until the darkest patch on a negative will just print as pure white on the emulsion being used.*

LIMIT_K= *On this and succeeding lines an ink limit can be individually specified for each ink. If the number specified is 0, then the ink is effectively turned off. If the specification is left blank, then the limit for that ink is controlled by the DEFAULT INK LIMIT.*

BOOST_K= *The BOOST function is useful in making black and white digital prints but is not useful for making digital negatives. Leave it blank which effectively turns it off.*

LIMIT_C=24
LIMIT_M=32
LIMIT_Y=24
LIMIT_LC=24
LIMIT_LM=32 *The limits on the C, M, Y, LC, and LM inks are fairly arbitrary. I just wanted them high enough they would all make a significant contribution to the overall negative density.*

LIMIT_LK= *Again, leaving this blank means that the limit of the LK ink is specified by the DEFAULT INK LIMIT.*

Gray Partitioning Information
#

N_OF_GRAY_PARTS=2 *Two gray inks, K and LK, will be used.*
GRAY_INK_1=K
GRAY_VAL_1=100

GRAY_INK_2=LK
GRAY_INK_2=38.5

The above four lines specify that the LK ink will be used exclusively to print tones from 0 to 38.5% black. Beyond 38.5% black the K ink will make an increasing contribution until only the K ink is used at 100% black. This is the ink usage that is graphed in Figure 1, above, when only the two gray inks are used. The number 38.5 comes from the fact that the LK ink, printed at the maximum the printer can print, has an optical density in the UV equivalent to the K ink printed at 38.5%. Instructions for determining this number for other printers and inksets are given in the tutorials that download with QTR.

For reasons not clear to me, overlap of the K and LK inks changes dramatically when the profile is written to use all seven inks (see the graph in Figure 2, above) even though the above four lines of instructions did not change.

The next 10 lines, GRAY_INK_3= through to GRAY_VAL_7= may be dispensable but I have not yet had the courage to delete them. Leave 'em alone.

GRAY_INK_3=
GRAY_VAL_3=

GRAY_INK_4=
GRAY_VAL_4=

GRAY_INK_5=
GRAY_VAL_5=

GRAY_INK_6=
GRAY_VAL_6=

GRAY_INK_7=
GRAY_VAL_7=

GRAY_HIGHLIGHT=0
GRAY_SHADOW=6

GRAY HIGHLIGHT controls tones in the highlights of the negative (or the shadows of the final print). Increasing the number lightens the negative and darkens the print. GRAY SHADOW controls tone in the shadows of the negative (or highlights of the print). Higher numbers lighten negative density.

GRAY_GAMMA=1.1

GRAY GAMMA controls midtones of the negative, higher numbers making them lighter, lower numbers making them darker. When writing a new QTR profile, the usual procedure is to play with GRAY HIGHLIGHT, SHADOW, and GAMMA, largely by trial and error, to make a negative that yields a print with a reasonably linear tonal distribution. Then you turn on GRAY CURVE (below) and use that function to complete the linearization process. Instructions for how to do this are given in Chapter 10 of our book.

GRAY_CURVE="0;0 2;10 6;30 15;50 47;70 72;80 83;85 95;90 98;95 100;100"

The paired values in GRAY CURVE essentially describe a PhotoShop curve that completes the linearization process.

COPY_CURVE_C=K
COPY_CURVE_M=K
COPY_CURVE_Y=K

These three lines of instruction tell the printer to use the distribution curve for the K ink to determine the distribution of the C, M, and Y inks as well.

COPY_CURVE_LC=LK
COPY_CURVE_LM=LK

These two lines tell the printer to use the distribution curve for the LK ink to determine the distribution of the LC and LM inks as well.

I believe that using QTR to print negatives with all seven inks represents the current pinnacle of technology for making negatives with a desktop inkjet printer. When such negatives are used to make platinum/palladium prints on a matte surfaced fine art paper, and are viewed at normal viewing distances, I think the prints rival anything made from an in camera negative. In short, I think we have arrived at the point where we can stop worrying about the quality of ink jet negatives and get on with the primary business of making beautiful, expressive prints. And, even though I am pleased with the current quality of ink jet negatives, it is certainly possible that they will get even better in the near future. Printer manufacturers may continue to improve the quality of their print heads, someone may find an even better substrate than Pictorico OHP, who knows where the next advance will come from? But for now I intend to concentrate on trying to make some good images.

What about other printers and inksets? I expect there are a number of printer-inkset combinations out there that will make excellent negatives. I am only biased toward the Epson printers because I find QTR to be so useful and at present QTR is only written for Epson printers. As to inksets, most of my experience is with the Ultrachrome inkset used by older printers such as the 2200 and the 4000. I am certain, however that equally good negatives can be made with the K3 ink set used by the newer 2400, 4800, and 7800 printers. The K3 inset has a third gray ink, LLK, which is said to produce smoother light tones in digital black and white prints. Unfortunately, the LLK ink would be contributing to smoother tones in the shadow areas of a digital negative, and I kind of doubt that any improvement it might make would be visible on the final print. But it certainly would not hurt. QTR profiles have also been written for the K7 Piezography inkset that uses seven different gray inks to print black and white. I have not used the K7 inkset but I expect it could also be programmed to make excellent digital negatives.