

RGB Scanning

For Color Management

Version 18, July 2002

Introduction

A good RGB scan for use in a color-managed workflow should maintain all the tonal values and color variations in the original, but should look a little flat and de-saturated when first opened in Photoshop. The default settings of many scanners give bright, saturated, RGB scans that look pleasing without further work, but are generally unsuitable for high-quality applications because they have already 'clipped' or distorted certain colors or tones beyond recovery.

This paper teaches some universal rules of RGB scanning that can be applied to virtually any scanner and gives detailed instructions for a few high-end scanners. It also discusses how production color management scanning differs from traditional CMYK scanning, how to make Photoshop's un-sharp-masking look as good as any drum scanner, and how to overcome some of the limitations of today's scanner profiling tools for even better shadow detail.

Limitations of accuracy & technical support

This information is offered freely on an "as-is" basis but may be incomplete or inaccurate in many areas. Please do not ask for technical support or advice unless you are a client of Hutcheson Consulting in good standing.

Getting help

To enquire about RGB training tailored to the needs of professional pre-press and creative users, contact Hutcheson Consulting at www.hutchcolor.com.

CASUAL USERS BEWARE! This paper does not try to 'simplify' color management. It was written to help experienced scanner operators and color professionals get the most out of their investment. The following pages can be highly technical. You have been warned.

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RGB scanning

for color management

RGB scanner setup

This section describes how to get the best possible image from a scanner whose natural domain is RGB. If your scanner can only deliver CMYK files, go to the section ‘RGB from CMYK scanners’.

Basic goals

The basic goals when setting up an RGB scanner for color management are to;

- Set white and black end point sensitivities to the widest density range possible for that material.
- Create an ideal tone response curve (see **Ideal Tone Curve**).
- Eliminate any built-in color correction or color management.
- Eliminate any automated functions, such as finding white and black, cast removal, etc.

White & black density settings

The range of tones a scanner will pick up is largely defined by its highlight and shadow settings. Prior to color management, highlight and shadow were set separately for each original, but with color management the scanner should NOT be adjusted for each scan, as that may invalidate a profile created with other settings.

All your color management scans should be made with exactly the same white and black settings as when the profile was created. Better scanners allow the white and black settings to be manually defined in terms of white and black densities. To be safe, these densities should slightly exceed the widest possible range of any original, for example:

	Highlight density	Shadow density
Reflection	0.00	3.0
Transmission	0.10	4.0

Measuring scanner tone response curve

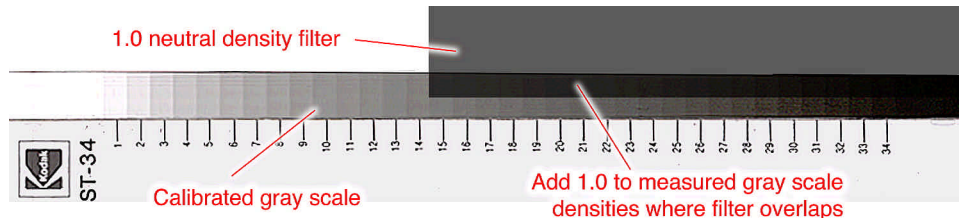
Your scanner must also have a suitable tone response curve (TRC.) This can be tested several ways, e.g:

- Mount and scan a carbon or dye gray scale (e.g. a Kodak ST-34).
- Open the RGB scan in Photoshop and write down the RGB values for every second step.
- Plot the RGB values on graph paper against the density values¹ of each step.

¹ For most accuracy, measure your own scale on an accurately calibrated densitometer to get the density values, otherwise divide the step numbers of the ST-34 by ten to get the approximate density of each step.

Testing densities up to 4.0 or higher

Many slide films produce dye densities as high as 3.8 or 4.0, but most gray scales only go as high as about 3.2, making them unsuitable for testing the response of a scanner in dark black areas. To study tone response up to 4.0 density or higher, cover one side of the gray scale with a 1.0 or 2.0 Kodak Wratten ND filter and add 1.0 (or 2.0) to the marked densities.



Extending a 3.2 density gray scale past 4.0

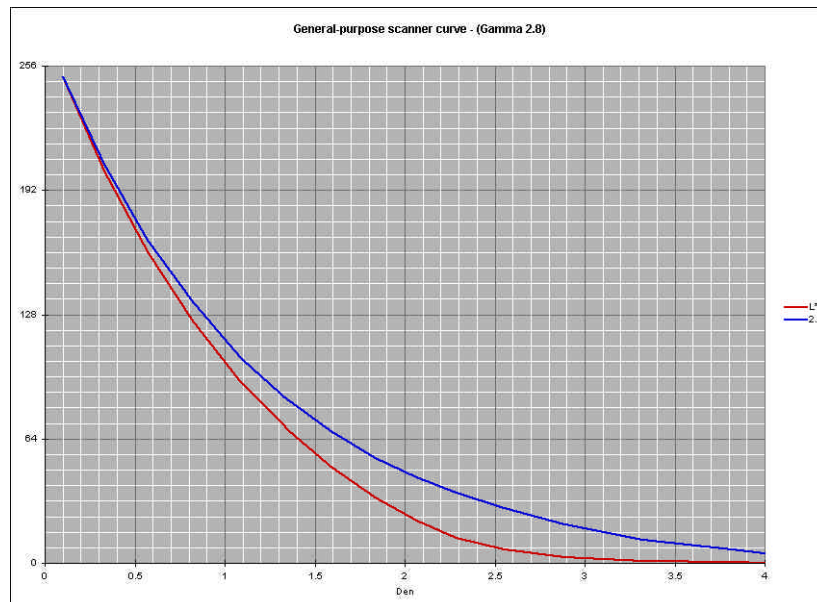
Determining a scanner's "D-max"

- Scan the gray scale or scale/filter sandwich and open the resulting file in Photoshop
- In the Levels dialog, move the right-hand slider (white point) almost all the way to the left
- The density at which no further separation is visible between scale steps represents the limit of sensitivity or "D-max" of your scanner.

The maximum shadow limit can be difficult to determine, as shadow sensitivity usually degenerates slowly over a range of densities. The effective D-max is the point at which useful detail is lost.

Ideal tone curve

The ideal RGB tone curve can be produced by setting the scanner to a gamma of 2.8 (if available), as shown in the blue (upper) line in the following graph. The red (lower) line shows the compressed shadow detail provided by traditional drum scanners, which typically translate density linearly into L*.



Blue (upper) line: Optimum tone curve for CMS scanning Red (lower) line: Typical scanner curve

What's behind this curve?

In theory, the 'ideal' scanner tone curve should distribute all 256 levels in an 8 bit image evenly throughout the Lightness (L*) range, and decrease linearly as lightness is reduced. However a true L* graph (shown by the red line) provides too little shadow detail for many transparencies and has a sudden contrast change at high densities which can cause problems in profiles or CMMs.

A simple gamma number of 2.8 (blue line) produces smoother, more open shadow detail and avoids the sudden contrast change, yet preserves virtually the same highlight-to-middle tone contrast as L*. Other gamma values can also give good results.

Many scanners cannot 'see' shadow densities all the way up to 4.0. This graph and suggested gamma setting is only a guide.

Typical RGB vs Density numbers

Typical 8-bit digital values are given below for gamma values from 1.8 to 3.0, and neutral densities from 0.10 --a typical transparency minimum density--to 4.0, which is the highest density ever likely to be seen in a transparency. CIE L* and CIE Y values are also given, to make the chart useful for a gray scale calibrated in density (e.g. the Kodak ST-34) or a scale calibrated in L* or XYZ (e.g. the gray scale of an IT8 or HCT target.)

NOTE: You do NOT need to match these numbers exactly! A reasonable match at just two or three points on the curve should be enough to produce a good tone curve, even if it differs from the theoretical ideal.

Y	L*	Density	Gamma:						
			3	2.8	2.6	2.4	2.2	2	1.8
79.433	91.4	0.10	250	250	250	250	250	250	250
47.863	74.7	0.32	210	208	205	202	199	194	189
28.84	60.6	0.54	175	171	167	162	156	150	142
16.982	48.2	0.77	145	140	135	129	122	115	106
9.772	37.4	1.01	119	114	108	102	95	87	78
5.623	28.4	1.25	97	92	86	80	74	66	58
3.236	21	1.49	79	74	69	63	57	50	43
1.862	14.7	1.73	64	60	55	50	45	39	33
1.122	9.97	1.95	53	49	45	40	35	30	25
0.708	6.4	2.15	44	41	37	33	29	24	20
0.427	3.86	2.37	36	33	30	26	23	19	16
0.229	2.07	2.64	28	25	23	20	18	15	12
0.107	0.97	2.97	20	18	16	14	13	11	9
0.041	0.37	3.39	12	11	10	9	8	8	7
0.014	0.13	3.85	7	6	6	6	6	5	5
0.01	0.09	4.00	5	5	5	5	5	5	5

Typical RGB 8-bit values vs density & L* at various gamma numbers

Plotting L* tone curve

To plot scanner tone curve in L* units, convert each gray scale step density to L* with the following table.

Den	L*	Den	L*	Den	L*	Den	L*	Den	L*
0.00	100.00	1.00	37.84	2.00	8.991	3.00	0.9033	4.00	0.0903
0.10	91.43	1.10	33.86	2.10	7.175	3.10	0.7175	4.10	0.0718
0.20	83.49	1.20	30.18	2.20	5.699	3.20	0.5699	4.20	0.0570
0.30	76.14	1.30	26.77	2.30	4.527	3.30	0.4527	4.30	0.0453
0.40	69.33	1.40	23.61	2.40	3.596	3.40	0.3596	4.40	0.0360
0.50	63.03	1.50	20.68	2.50	2.856	3.50	0.2856	4.50	0.0286
0.60	57.19	1.60	17.97	2.60	2.269	3.60	0.2269	4.60	0.0227
0.70	51.78	1.70	15.46	2.70	1.802	3.70	0.1802	4.70	0.0180
0.80	46.78	1.80	13.14	2.80	1.432	3.80	0.1432	4.80	0.0143
0.90	42.14	1.90	10.99	2.90	1.137	3.90	0.1137	4.90	0.0114

Density to L* conversion chart

Testing L* response with an HCT or IT8 target

You can also plot L* response by scanning an HCT or IT8 transparent scanner profiling target as follows, however with a minimum L* of about 0.7 – 0.43 (D 3.0 - 3.3), the IT8 is a poor test of shadow response

- Open the RGB scan in Photoshop and write down the RGB values for every gray scale step
- Plot the RGB values on graph paper against the L* values listed for each step in the target reference file²

If you don't have time to plot a proper tone curve, just look for the following approximate values in the IT8 scan.

A good IT8 scan should have RGB values roughly as follows:

IT8 gray scale patch	RGB
GS0	235 - 250
GS11	100 - 128
GS23	5 - 25

Adjusting scanner tone curve

If your scanner's tone response curve deviates too far from the suggested curve, you can alter it by adjusting the tone controls and/or internal setup functions, as available. For detailed instructions see your scanner manual or contact the manufacturer.

² To read the L* values, open the reference file in Microsoft Excel or a text editing program like BBEdit.

RGB from CMYK scanners

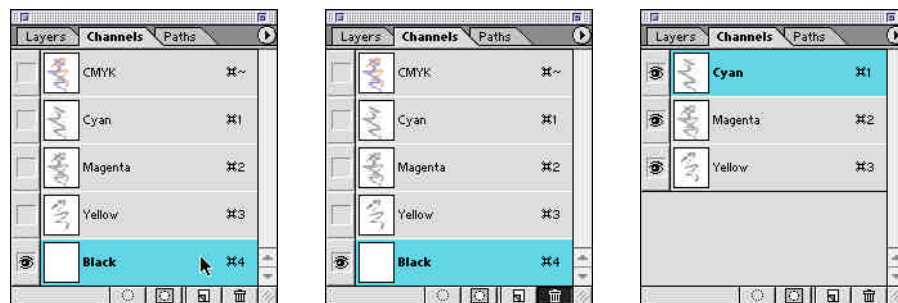
The RGB option on some older CMYK scanners creates a 'processed' RGB file from CMYK values which may lose some of the original RGB data. The following procedure should deliver a more faithful, or 'raw' RGB file. If your scanner's RGB option already produces raw RGB then ignore these instructions.

To force RGB from a CMYK color computer

- Neutralize gray balance, (make C, M and Y signals equal on neutral grays)
- Disable GCR, UCR and UCA, so that C, M and Y reach 100% in the darkest black areas
- Disable all color correction or color tables
- Create a tone curve with more shadow detail than normal (see **Ideal Tone Curve**)
- Save the image as a CMYK file then convert to RGB by **stripping the black channel** (see below)

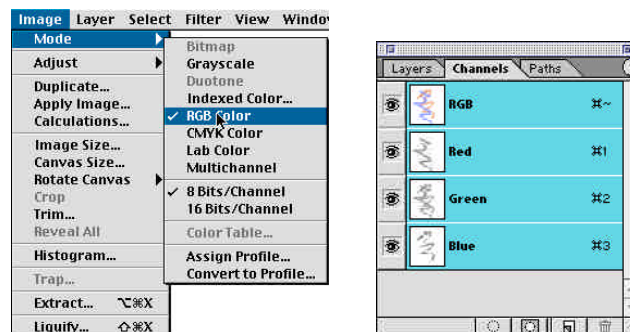
Stripping the black channel

- Open the CMYK file in Photoshop and select **Window ... Palettes ... Show Channels**
- Drag the black channel from the list into the trash can at the bottom of the palette



Dragging the black channel to the trash can in the Channels window

- Select **File ... Mode ... RGB**. (This simply renames the CMY channels as RGB.)



After 'Mode-RGB' the CMY channels change to RGB

- Save the new RGB image under the same name.

IMPORTANT: If used for profiling, this process must also be used for production scans.

Specific scanner settings

Heidelberg 3000 series

There are two ways to set up Hell 3000-series scanners for true RGB scanning. The 'Direct-RGB' method exports an RGB file directly but eliminates any possibility to alter the 16 - 8 bit curve applied inside the scanner, apart from end densities. The 'Strip-K' method lets you modify the internal curve but yields a CMYK file from which you have to strip the K channel to get true RGB. Although the 'Strip-K' method seems clumsy, the conversion from CMYK to RGB is very fast and can be applied as an action or with a scripted hot folder.

Both methods are in common use and deliver virtually identical results. The choice simply depends on your workflow goals. If you want to eliminate all decisions prior to scanning and have a common setup for all originals, then the 'Direct-RGB' method is simplest and slightly faster. If you plan on using different setups, for example a special curve to improve extremely underexposed originals, then use the 'Strip-K' method.

Heidelberg 3000 series – 'Direct-RGB' method

The following method (thanks to Tommy Scarborough, RRD Dallas) produces an RGB file directly but eliminates any possibility to alter the internal scanner curve except for end densities. For more control of the internal scanner curve, use the 'Strip-K' method described below.

- Select the **H110-TIFF-R-DIA** setup supplied with the scanner
- Set White density to 30 (transmission) or 25 (reflection) for 0%
- Set Black density to 300 (transmission) or 280 (reflection) for 100%

NOTE: In the TIFF-R mode, a White density setting of 30 is equivalent to a highlight density of about 0.08 and a Black density setting of 300 is equivalent to a shadow density of about 4.00. Don't ask me why!

- In the USM dialog, switch the first two values (white line and black line) to zero
- TRANSMISSION: Perform a transmission 'Basic alignment' on the clear drum, or through the oil and overlay film, (if oil-mounting)
- REFLECTION: Perform a reflection 'Basic alignment' on two layers of super-smooth, high-brightness (97 or higher) Laser-printer paper, or equivalent
- Scan the target and save it as a **TIFF RGB** file
- Open the RGB image of the target in Photoshop
- CHECK WHITE DENSITY: If R, G or B reads 250 or higher in the white patch of the target, reduce the White density by 5 (e.g. from 30 to 25) and repeat the scan
- CHECK BLACK DENSITY: If R, G or B reads 5 or lower in the infinite density patch, increase the Black density value by 10 (e.g. from 300 to 310) and repeat the scan
- SAVE THE FINAL SETUP for future use

Heidelberg 3000 series – 'Strip-K' method

The following method 'smuggles' raw RGB data out of the scanner inside a CMYK file from which the black channel is 'stripped' and the CMY channels are inverted to produce an RGB file. The advantage of this method is that it allows you to alter the scanner's internal 16-8 bit curve as well as end densities.

- Select the base settings '**H110-TIFF-RGB DIA**'.
- Set White density to 10 (0.10) for 0%
- Set Black density to between 400 (4.00) and 450 (4.50) for 98%
- OPTIONAL: On the Separation Gradation curve, change the output value for density 1.00 from 47% to 55% for a darker basic scan, or make any other desired curve change
- In the USM dialog, switch the first two values (white line and black line) to zero

- TRANSMISSION: Perform a transmission 'Basic alignment' on the clear drum, or through the oil and overlay film, (if oil-mounting)
- REFLECTION: Perform a reflection 'Basic alignment' on two layers of super-smooth, high-brightness (97 or higher) Laser-printer paper, or equivalent
- Scan the target and save it as a **TIFF CMYK** file
- Open the CMYK file in Photoshop and select **Window ... Palettes ... Show Channels**.
- Drag the black channel from the list into the trash can at the bottom of the palette
- Select **File ... Mode ... RGB**. (This simply renames the CMY channels as RGB)
- Save the new RGB image under the same name
- CHECK WHITE DENSITY: If R, G or B reads 253 or higher in the white patch of the target, reduce the White density by 2 (e.g. from 10 to 8) and repeat the scan
- CHECK BLACK DENSITY: If R, G or B reads 5 or lower in the infinite density patch, increase the Black density value by 10 (e.g. from 400 to 410) or reduce the Black % value (e.g. from 98% to 96%) and repeat the scan
- SAVE THE FINAL SETUP for future use

IMPORTANT: When using the H110-TIFF-RGB-DIA setup you must save the scan as **TIFF CMYK**, not **TIFF RGB**. If you save an RGB file direct from the scanner (as implied by the manufacturer's default RGB setup), the results will be unacceptable for color management work! Note also that all production images must be scanned identically and must also have the black channel stripped, as above.

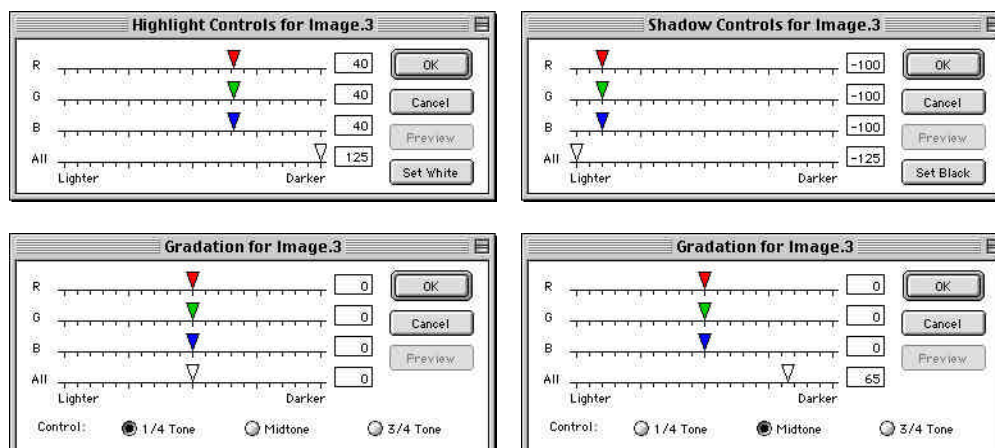
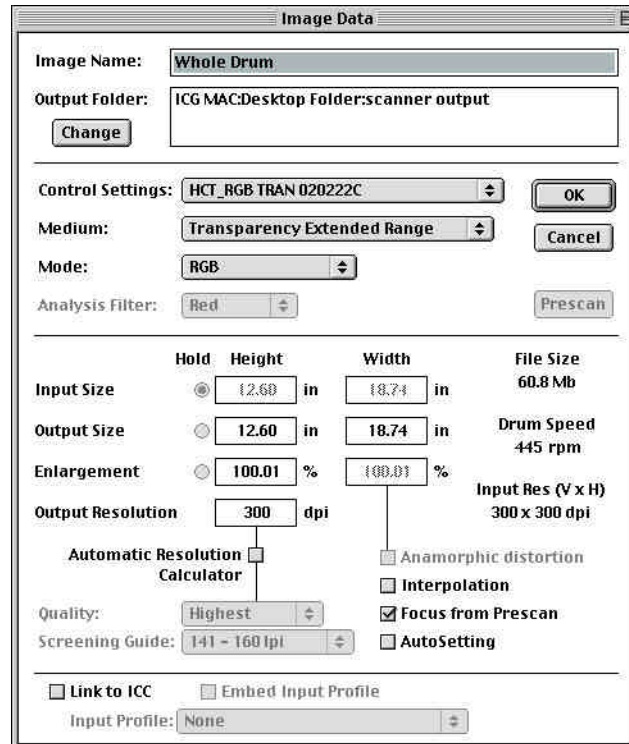
Scanning from LinoColor or NewColor

Profile the scanner using the 'Calibration scan to disk' function. Software settings will depend on available variables and the particular scanner, but the goals remain the same, i.e. use no color correction or USM and try to obtain a good tone curve from the deepest shadows to the lightest catchlights. See the manufacturer's instructions for your software.

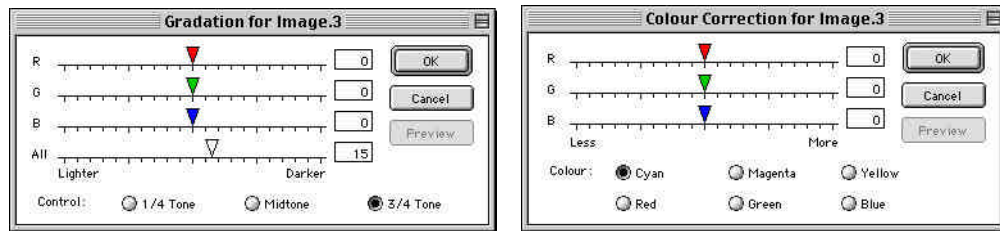
ICG 360i – ScanXact software (latest version)

The following control settings have produced excellent transparency scans on ICG 360i scanners using the latest software version available as of February 2002. The new software version produces dramatically improved shadow detail in raw RGB scans. Older software should be up-graded before using ICG scanners for ICC / RGB work.

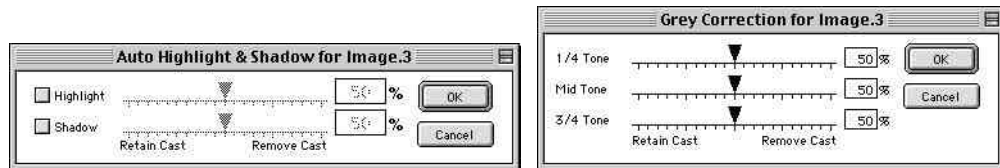
Reflection settings may vary slightly (untested at this writing.)



ICG ScanXact windows



Note that all six color correction panels should look identical (only Cyan is shown here.)



More ScanXact windows

Fuji Celsis drum scanners (recent software versions)

The following setup has produced excellent results on the latest Fuji Celsis drum scanners. Note that your software and menu options may differ. If you cannot find the settings or files named here, contact your service provider for help.

Colour Correction

Sample Correction

Initial value: Cyan 0, Magenta 0, Yellow 0, Black 0

Current value: Cyan 0, Magenta 0, Yellow 0, Black 0

Effected colour: Red

Cal 12 Values

	Red	Yellow	Green	Cyan	Violet	Magenta
Yellow	0.00	0.00	0.00	0.00	0.00	0.00
Magenta	0.00	0.00	0.00	0.00	0.00	0.00
Cyan	0.00	0.00	0.00	0.00	0.00	0.00
Black	0.00	0.00	0.00	0.00	0.00	0.00

☐ Show current differences

Level 1 Cancel OK

Limiters

Dot %

	White	Black
Cyan	-10	110
Magenta	-10	110
Yellow	-10	110
Black	0	0

Cancel OK

Black Printer

Black Offset (Cal 11) 0.00

☐ Active Black at EB

Black Dot % at Enter Black 0

Black Slope (Cal 11) 0.00

3 Colour DMax (Cal 514) 1.49

4 Colour DMax (Cal 514) 1.92

Additivity (Cal 514) 2.00

Cancel OK

Luminosity

Luminosity Curve (Cal 503)

Step	Value	Step	Value
1	10.00	9	1.32
2	6.64	10	1.15
3	4.61	11	1.01
4	3.40	12	0.90
5	2.64	13	0.80
6	2.14	14	0.72
7	1.79	15	0.66
8	1.52	16	0.60

Curve Description: 1/4 1/2 3/4

User Defined

Cancel OK

Grey Balance & PD

Print Density (Cal 504)

Step	Value
1	-0.25
2	0.07
3	0.14
4	0.21
5	0.29
6	0.36
7	0.43
8	0.57
9	0.71
10	0.86
11	1.00
12	1.14
13	1.21
14	1.29
15	1.36
16	2.50

Grey Balance (Cal 13)

	C	M	Y	K
-19	5	5	5	0
-18	10	10	10	1
-17	15	15	15	2
-16	20	20	20	3
-15	25	25	25	4
-14	30	30	30	5
-13	40	40	40	6
-12	50	50	50	7
-11	60	60	60	8
-10	70	70	70	9
-9	80	80	80	10
-8	85	85	85	11
-7	90	90	90	12
-6	95	95	95	13
-5	176	176	176	29

6 B Window (Cal 506) 1.00

Cancel OK

Enter White & Black

Image Range

Enter White: Man Enter Black: Man

Mode of Entry: Man

Separation: Lowest Highest

Original Density

	Cyan	Yellow	Magenta	Black
0.00	0.10	2.50	4.00	
0.10	0.10	2.50	4.00	
0.20	0.10	2.50	4.00	
0.30	0.10	2.50	4.00	
0.40	0.10	2.50	4.00	
0.50	0.10	2.50	4.00	
0.60	0.10	2.50	4.00	
0.70	0.10	2.50	4.00	
0.80	0.10	2.50	4.00	
0.90	0.10	2.50	4.00	
1.00	0.10	2.50	4.00	
1.10	0.10	2.50	4.00	
1.20	0.10	2.50	4.00	
1.30	0.10	2.50	4.00	
1.40	0.10	2.50	4.00	
1.50	0.10	2.50	4.00	
1.60	0.10	2.50	4.00	
1.70	0.10	2.50	4.00	
1.80	0.10	2.50	4.00	
1.90	0.10	2.50	4.00	
2.00	0.10	2.50	4.00	

Dot %

	Cyan	Yellow	Magenta	Black
0	0	0	98	98
10	0	0	98	98
20	0	0	98	98
30	0	0	98	98
40	0	0	98	98
50	0	0	98	98
60	0	0	98	98
70	0	0	98	98
80	0	0	98	98
90	0	0	98	98
100	0	0	98	98

Auto EW Correction 0.00

Select EW/EB Point

Level 2 Cancel OK

Main Celsis settings

- Save these settings for use whenever scanning RGB images. You will need at least two setups, one for transparency and one for reflection scanning.
- Scan with these settings but always manually check the White & Black density values, as the saving and recalling of these is known to be unreliable on many versions of Celsis software.
- Perform an 'Autobalance' on the clear drum (or through the oil and overlay film, if oil-mounting.)
- Do NOT set any tone or color parameters, and scan with USM off.
- In recent Celsis software it is safe to export the file as RGB, however if this is an older Crosfield scanner, or if there is any doubt, export it as CMYK and strip the black channel as described earlier.

Note: It may be necessary to darken or lighten middletone controls in addition to these settings.

Crosfield drum scanners (older software versions)

Older Crosfield scanners that are programmed from the keyboard instead of from the Mac may require a different setup, depending on firmware & hardware versions. This setup assumes you will scan to a CMYK file and then strip off the black channel in Photoshop, as described earlier.

Note: It may be necessary to darken or lighten middletone controls in addition to these settings.

- | | |
|--|---|
| <p>1 Perform a full Magnascan boot procedure</p> <p>2 CAL 199 ENTER (recall full?)
YES</p> <p>3 CAL 12 ENTER
0 ENTER
0 ENTER
... (repeat a total of 24 times)</p> <p>4 C CAL 13 ENTER
0 ENTER
5 ENTER
10 ENTER
15 ENTER
20 ENTER
25 ENTER
30 ENTER
40 ENTER
50 ENTER
60 ENTER
70 ENTER
80 ENTER
85 ENTER
90 ENTER
95 ENTER
100 ENTER</p> <p>5 M CAL 13 ENTER
0 ENTER
5 ENTER
... (etc. - same as step 4, above)</p> <p>6 Y CAL 13 ENTER
0 ENTER
5 ENTER
... (etc. - same as step 4, above)</p> | <p>7 CAL 28 ENTER
0.12 ENTER
0.12 ENTER
0.12 ENTER

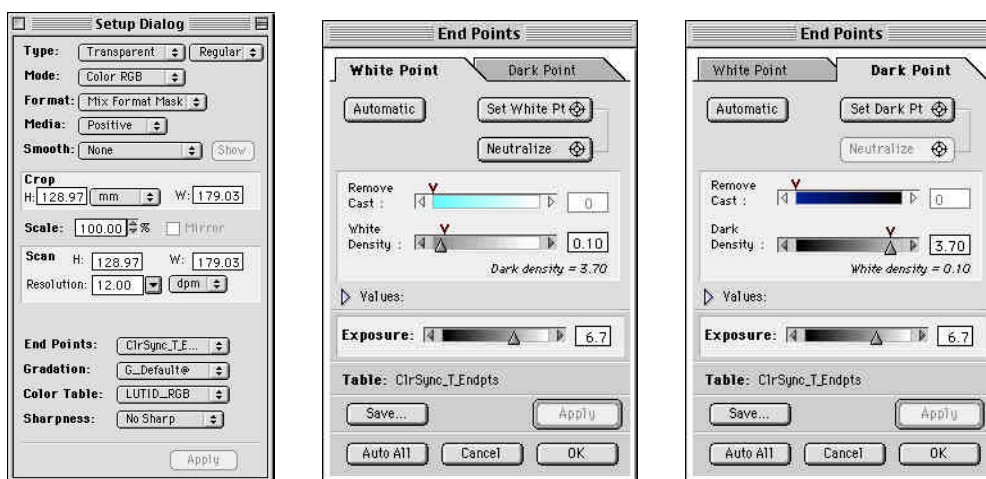
(0.05 if oil mounted)
(0.00 for reflection work)
0.0 ENTER</p> <p>8 CAL 29 ENTER
3.90 ENTER
3.90 ENTER
3.90 ENTER

(2.50 for reflection work)
100 ENTER</p> <p>9 CAL 503 ENTER
10 ENTER
7.55 ENTER
5.75 ENTER
4.50 ENTER
3.55 ENTER
2.90 ENTER
2.45 ENTER
2.09 ENTER
1.80 ENTER
1.54 ENTER
1.33 ENTER
1.15 ENTER
1.01 ENTER
0.89 ENTER
0.79 ENTER
0.70 ENTER</p> <p>10 USM 0 ENTER 0 ENTER</p> <p>11 Save the above CV in a spare memory</p> |
|--|---|

Scitex EverSmart™ - Transparency

The following setup has produced excellent results on Scitex EverSmart™ flat bed scanners. These settings were last tested in March 2000. Your software and menu options may differ.

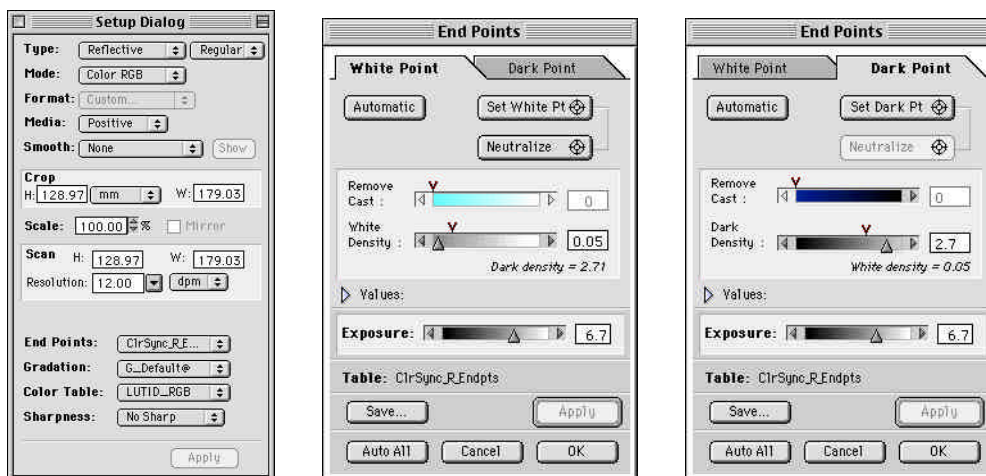
- In the general setup window, select Gradation, Color Table & Sharpness settings shown below (left). Other fields may be different. Make a transmission pre-scan.
-
- Click the Black/White icon and set up the end densities as shown below (center and right.)
- Save the End Points with a name like 'ClrSync_T_Endpts', return to the Setup Dialog then make sure the End Points setting is the same name you just saved.
- Save the setup under an easily recognized name, like 'ColorSync_Tran_RGB'.



Scitex transmission scan settings

Load this setup every time a transmission original is scanned and check the end points are as saved. If not, correct them before scanning, but NEVER adjust the scanner's controls to suit the original.

Scitex EverSmart™ - Reflection



Scitex reflection scan settings

- Make a reflection pre-scan with the settings shown above.

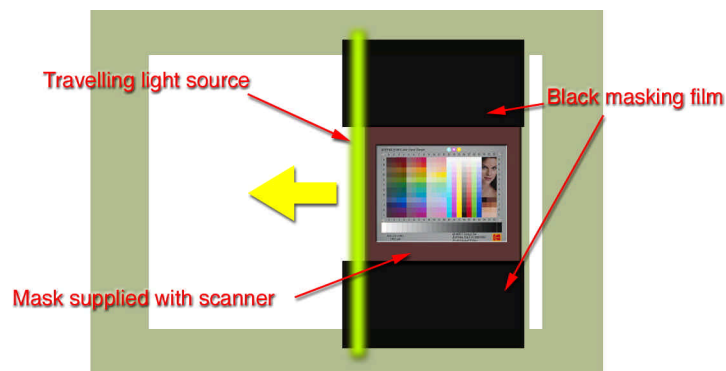
- Click the Black/White icon and set up the end densities as shown (center and right.)
- Save the End Points with a name like 'Clrsync_R_Endpts' and return to the Setup Dialog.
- Save the setup under an easily recognized name, like 'ColorSync_Ref_RGB'.

Load this setup every time a transmission original is scanned and check the end points are as saved. If not, correct them before scanning, but NEVER adjust the scanner's controls to suit the original.

Minimizing optical flare in flat-bed scanners

Like all flat bed scanners, scans made on an EverSmart may suffer from unpredictable variations in shadow density due to flare in the optical system. This flare can make the shadow density of a specific scan appear lighter or darker after applying a profile that was made with a different amount of flare.

To minimize flare, mask off any clear glass to the sides of the chrome to prevent unwanted light shining onto the lens, keep the optics clean, especially mirror and lens surfaces & maintain a clean environment with little or no airborne dust or powder



Minimizing flare on a flat-bed scanner

Other scanners

If your scanner is not listed here, contact your service provider and ask how to achieve the guidelines described in this document. Note that the settings shown here may change with software or hardware revisions. If you do not recognize the settings or files, contact your manufacturer for help.

Creating a scanner profile

These notes are a general guide covering those aspects of profiling that relate to scanner setup and capturing the target image. See your software's documentation for detailed instructions.

Setting up the scanner

Scan the IT8 target or the HutchColor HCT target as follows;

- Mount the transparent target as you would for production scanning. Avoid Newton's rings, dust or dirt. If you scan images in oil, mount the target in oil too.
- Focus and select the aperture recommended, then calibrate the scanner on the clear drum³. If you mounted in oil, calibrate through the oil and any overlay film.
- For reflection work, mount a reflective IT8 or HCT target as you would for production scanning and calibrate on a double thickness of smooth, matte, white, high-brightness laser printer paper or similar material.

Note: On drum scanners, the surface of the double-thickness paper must be the same height as the surface of the original, otherwise illumination may not be correct. If necessary, add additional layers or use only a single layer of paper until the brightness of the paper is as bright or brighter than the whitest area of the original.

- Crop the original and set enlargement for about 1000 pixels in the long target side.

Target size	resolution (ppi)	x	enlargement	= approx. pixels (long side)
4' x 5' (trans.)	300		70%	1000
5' x 7' (ref.)	300		50%	1000
35mm (trans.)	300		225%	1000

- Set zero unsharp masking (also recommended for production color management scans).
- Select the saved CMS setup. DO NOT set white and black and DO NOT try to 'improve' the target.

Creating the target scan

- Scan the target and save it as a TIFF file (CMYK or RGB, depending on the type of scanner.)
- If the target scan is CMYK, open it in Photoshop and use the EXACT procedure described under 'Converting CMYK scans to RGB (stripping the black channel)' to convert it to RGB.

Cleaning up the target scan

- Check the scan in Photoshop for noticeable scratches, dust or blemishes in the target patches.
- Carefully retouch out any serious marks using the clone brush, taking care not to copy color from one patch into another.
- Do NOT make any tone, contrast or color changes to the raw scan.
- Save the retouched target scan over the original.

Creating the profile

Run the profiling software according to its own instructions.

³ Calibration is variously known as 'Autobalance', 'Zero', 'Reset', 'Basic Alignment', etc, on different scanners. On some scanners this is an automatic function with no user control.

Extended range profiles

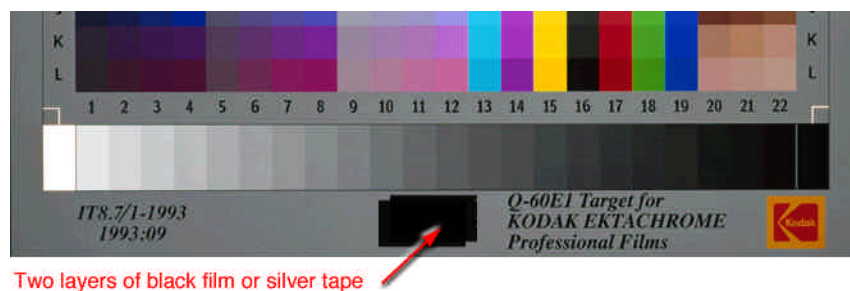
If the transparent target⁴ has a lower D-max than typical slide film (often the case) then the scanner profile made from that target will fail to 'see' very dark shadow details in extremely dark or under-exposed transparencies. This problem is greatest in IT8.7/1 targets but may also be seen to a smaller extent with the HCT target due to emulsion-batch and processing differences.

A crude but effective way of solving this is to modify the TIFF file of the transparent target to 'fool' the software into thinking the target had a longer density range.

This procedure does NOT truly characterize the scanner at higher densities, but it does yield a profile that will at least accept RGB values up to the scanner's maximum sensitivity.

Add an 'Infinite density' patch

- Prior to scanning the target, add a double thickness of blackened litho film, Scotch Type 850 Silver tape, or some other highly opaque material in the scan area, to represent infinite black density.



Adding an 'infinite density' patch to the target

- Set up the scanner and create the target scan as described earlier.

Modify the raw RGB scan

- Open the target scan in Photoshop and compare the RGB values in the infinite black patch to those in the blackest step of the target gray scale.



Comparing the 'infinite density' and the darkest gray scale RGB values

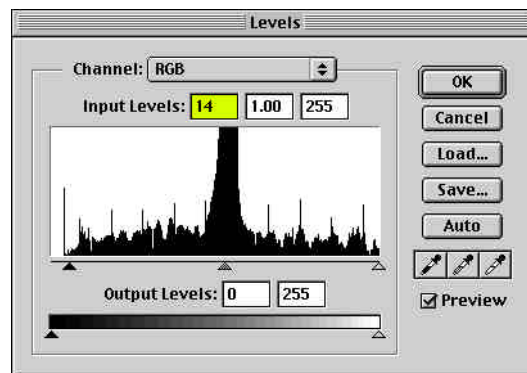
⁴ This trick is not necessary with reflective targets.

- Subtract the black film RGB values from the RGB values measured in the blackest step of the gray scale to get three numbers indicating the R, G and B differences.

e.g. (in the example shown above)

Target black	-	Infinite density	=	Difference
R 21	-	3	=	17
G 22	-	3	=	18
B 17	-	3	=	14

- In Image – Levels, enter the smallest of the R, G and B differences in the top left box, then click OK.



Adjusting contrast in Levels

- Save the modified target scan with the suffix 'xt' (for 'extended'.)

Create an 'Extended' profile

- In the scanner profiling software, use the extended target file to create the scanner profile. Also build a normal profile for use with good originals that need no shadow expansion.

CAUTION: This profile will reproduce shadow detail and very deep shadow colors more effectively than a profile made from a plain IT8 scan, and in most cases will produce improved results. However it is technically less accurate than a 'normal' profile. A normal profile may produce better results when exactly matching a large format transparency.

Production CMS scanning

Basic rules

- The scanner must be set up exactly the same way in production as when the profile target was scanned.
- Always calibrate on the clear glass or drum before each scanning session.
- Remember that the scanner's controls must not be adjusted at all to suit the output device, nor to correct for over- or under-exposure or color casts⁵.

RGB image editing

For best results, highest efficiency and greatest long-term value, keep the image in RGB during all image editing stages and archive the edited image in RG, not CMYK.

All traditional scanner adjustments such as setting highlight and shadow, cast removal, color correction, sharpening, etc. should be done in Photoshop 6 or later.

For a quick and efficient transition from CMYK methods to an all-RGB workflow, contact Hutcheson Consulting (www.hutchcolor.com) for a custom training course.

Rendering intent

When converting from RGB to CMYK, a good rule of thumb is to use **Perceptual** for transparencies and **Relative** (with Black Point Compensation on) for reflective originals. When in doubt, use **Perceptual** with Black Point Compensation off. Note that the two intents may produce different density and contrast curves, depending on the software used to make the scanner and printer profiles. Experiment to find the settings that work best for your work.

Unsharp masking (USM)

To maximize the value of RGB scanning, un-sharp masking (USM) should NOT be applied at scan time. Scanning without USM makes your RGB file more valuable, especially if it may be output on more than one device or at more than one size. The best time to apply sharpening is after image editing, either immediately before, or just after the image is converted to CMYK. This implies sharpening in Photoshop.

Sharpening in Photoshop

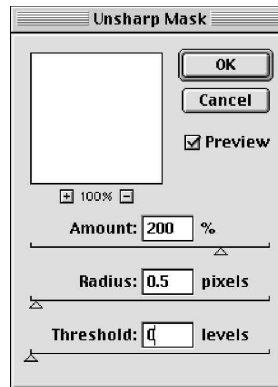
Some traditional drum scanner operators will swear their hardware-based USM is better than Photoshop's but in the end, the differences are much smaller than they realize and the advantages of previewing USM on a screen display and being able to change sharpness after scanning outweigh any theoretical advantages of scanner sharpening. Many successful printers and separators have switched over to Photoshop sharpening without any of their clients noticing!

Amount, Radius & Threshold

A good general rule for Photoshop sharpening is to use the **SMALLEST RADIUS** that generates useful sharpness and the **HIGHEST AMOUNT** the image can stand. Feel free to use high Amount values - even 500%, except on flesh-tones, which may need a lower amount. Keep the radius small, typically **LESS THAN 1.0**, unless the original is actually out of focus or enlarged to about 800% or more.

⁵ These edits will be made later in an ICC-aware editing application like Photoshop 6.

Keep Threshold at 0 for normal work. Many people try to eliminate grain with the Threshold control. Values up to 6 can sometimes be effective, but if used too much, the Threshold variable can actually degrade an image. Grainy originals often reproduce best when NO attempt is made to eliminate grain!



Good default USM settings for Photoshop

Viewing sharpening at 50%

One of the big advantages of sharpening in Photoshop is the ability to preview the result on screen. The best way to view USM in Photoshop is at a screen magnification of 50%, as this most closely approximates the resolution of the printed page. The simple explanation is that printing a 300 dpi image through a 150 lpi screen reduces fine detail by about 50%, which is also what happens when you view a file in Photoshop at 50% magnification.

If you view a sharpened image at 100% magnification the ‘halo’ or ‘fringe’ will appear more aggressive on screen than on paper. Enlargements between 50% and 100% should not be used (to judge sharpening) as the screen image will be aliased (jagged). Enlargements below 50% will fail to show the full effect of USM.

Why not sharpen the RGB image?

- Pre-sharpening the RGB file reduces the archival value of the raw RGB file because the maximum enlargement range will be limited. For example, a halo width that is acceptable at 200% will be unacceptable at 400%.
- Pre-applied USM demands a re-scan if the client requests a lower amount.

About the author

Don Hutcheson (don@hutchcolor.com) is an independent consultant who develops and installs ICC-based color management systems. Over thirty years of color scanning help him bridge the learning gap between traditional CMYK color separation and modern color methods. He teaches color management at GATF (Graphic Arts Technical Foundation – www.GATF.org) and at individual user sites. Clients include some of the world’s best commercial and fine art printers, separators, publishers, photolabs, movie studios, art galleries, image banks, billboard printers, magazines, newspapers and manufacturers of color management software and hardware.