ColorPos

Adobe Photoshop* Plug-In
User's Manual for Release 1.00
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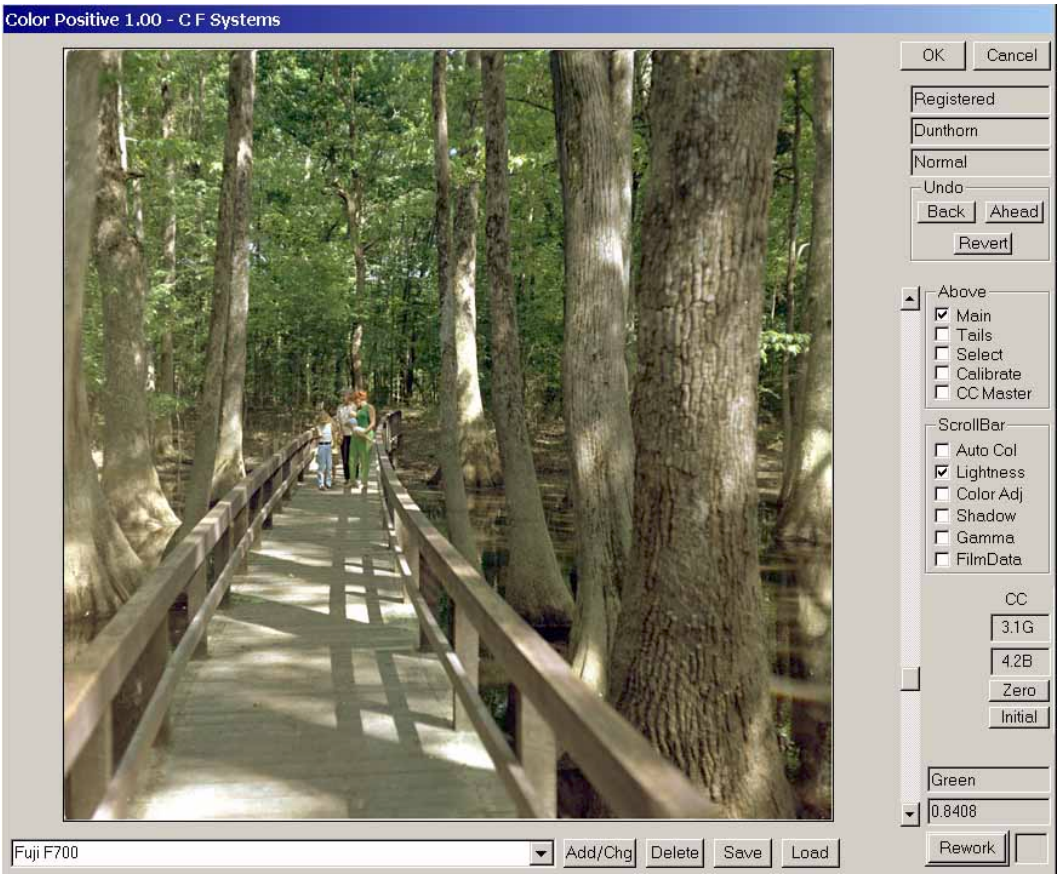
ColorPos 1.0 is an Adobe Photoshop plug-in to deal with maintaining color integrity in scanned color slides and prints and digital camera images.. **ColorPos** is distributed as a fully functional demo version on our web site (http://www.c-f-systems.com/Plug-ins.html). **ColorPos** is much easier to use than our **ColorIntegrity** plug-in and in most cases will produce results that are equivalent or better. **ColorPos** has simple devices that can be to help dealing with problem films. For more critical work there is a comprehensive color balance system with CC (color compensation) filter readouts, familiar to many photographers.



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Contents (Clickable)

Getting Started

Installation

We have not provided an installation program, but have taken the same approach as Adobe has in distributing "RAW" conversion plug-in revisions. You have downloaded a zip file which contains this PDF manual, a ReadMe.txt file, the two data files Normal.colorint and colorintegrity.grayscale, and the plug-in file itself, ColorPos.8bf. All that has to happen is the ColorPos.8bf file needs to be put in the Photoshop filters folder. For an all-default installation, that folder will be
C:\Program Files\Adobe\Photoshop x\Plug-Ins\Filters
where "Photoshop x" specifies the version of Photoshop. If your installation is not the default, you probably already know how to find the corresponding filters folder on your system. If you are unable to find the folder we suggest using the Windows "find files or folders" to locate it. Find files or Search is on the Start menu, and a search for file names of "*.8bf" should locate the folder. The Filters folder should have a number of other files with 8bf extension already in it. Once the ColorPos.8bf file has been placed in the folder, Photoshop will automatically configure for **ColorPos** the next time it is started.

The Starting Image

ColorPos is intended for making the initial, largest corrections to a positive image, such as a scanned image of a color slide or a print, or an image from a digital camera. The working file *must* be in 16-Bits/Channel RGB mode (scanners which scan at 12-Bits/Channel and produce a 16-Bits/Channel file are fine). Most scanners deliver positive scans as "gamma-corrected" images by default. "Linear" scans are also permitted – in fact, encouraged – but are not required. (If the scan is linear, **ColorPos** must be informed by checking the **Linear Input** checkbox – see under **Selection Control Panel**). A linear scan will look very dark or otherwise strange but **ColorPos** will fix that.

Images resulting from **ColorNeg** or **NegPos** are 16-Bits/Channel gamma-encoded, with color integrity. They can be further adjusted if desired using **ColorPos**.

If the original is produced using Photoshop RAW, the objective is to read as 16-Bits/Channel and do as little damage to the image as possible before sending it to **ColorPos**. The image you get will be "gamma-encoded," not linear. Our normal procedure is to set Brightness (which is *not* actually brightness) to 50, which we believe is the most neutral value. Set Contrast, Saturation, Exposure, and Tint to 0. Actually, it is largely immaterial where you set "Temperature" or "Tint" as these appear to merely set the color balance in a way we find particularly awkward. The color balance will be reset when using **ColorPos**. Don't even think about using the "Calibrate" settings in RAW. Set them all to zero. They seem specifically designed to destroy color integrity. If you are having trouble getting highlight detail, set Exposure to a negative value, like –0.5 or –1.0. (See http://www.c-f-systems.com/16BitSecret.html for further details.)

If the scanner or digital camera will not deliver a 16-Bits/Channel image, it is permissible to convert an 8-Bit/Channel image to 16-Bits/Channel using Image→Mode→16-Bits/Channel. (But note that the companion **ColorNeg** filter *requires* 16-Bit/Channel *linear* scans to work properly with color negatives.) If you must convert an 8-bit image, there are several rules which will lead to better results if they are followed. If you plan to use Image→Image Size to *increase* the number of pixels in the image, do so *after* converting to 16 Bits/Channel and *before* using **ColorPos**. Also, if you plan to use sharpening filter treatments and you do *not* plan to increase the pixel count, do some or all of the sharpening *after* converting to 16 Bits/Channel and *before* using **ColorPos**.

Starting ColorPos

Once you have a good 16Bits/Channel image in an active Photoshop window, the rest is simple. From the Photoshop Filter menu: Filter→C F Systems→ColorPos. The C F Systems entry should be near the bottom of the Filter menu. (If ColorPos appears in the menu but is grayed out, you are not in 16-Bits/Channel mode. Please read the paragraph just above.) There will be a short delay as **ColorPos** builds tables describing the image, then a dialog will appear that looks like the one pictured on the first page of this manual.

At this point the image should be nearly correct - sometimes it is satisfactory as is. To explore the next, simple level of **ColorPos** capability, you will see to the right of the scrollbar control a checklist of ScrollBar options. "Lightness" should already be checked. Use the scrollbar to set the approximate lightness you desire for the image. If the color balance needs to be adjusted, the easiest and often most effective method is to find a patch in the preview image that should be gray (colorless) and click on it. "Gray" can be anywhere from quite dark to nearly white but avoid areas that are completely white. If possible, click several gray patches and see what happens to the image, choosing the best result.

With a good positive image, in most cases that is all that is required for satisfactory results. However, **ColorPos** has many features designed to give you a high degree of control over the appearance and quality of your color photographic images while retaining the color integrity of the image. For instance, there are images which do not have well-defined gray patches in them, so the **Auto Col**or and **Color Adj**ust ScrollBar options, described below, take care of them and provide for more critical color balance in general. The remainder of this manual explains **ColorPos** features and how to use them. We recommend using the **Descriptive Table of Contents** as an easy way to understand what **ColorPos** does and to locate what you need.

Descriptive Table of Contents - ColorPos's Capabilities (Clickable)

Besides adjusting color images as required to maintain color integrity, **ColorPos** provides tools to deal with color photographic images with various problems that may have resulted from poor processing or storage. There are also tools for perfectionists who want the best possible results, and tools to help speed the processing and matching the results from image sources that are similar.

To have color integrity in a color photographic image, four considerations are necessary. First, it is necessary to get the image into Photoshop without damaging or altering it in uncorrectable ways. See **The Starting Image** for the basics on using a scanner or Photoshop RAW in preparation for **ColorPos**. This is the most likely source of trouble if **ColorPos** consistently does not work well on good test sources. If you are having trouble with scanning, there is information on specific scanners and software on: http://www.c-f-systems.com/Scanners.html.
This page is specifically targeted toward color negatives, but the same techniques will work with color positives. While desirable, it is not normally *necessary* to get a linear scan or a 16-Bits/Channel scan for positive images.

Second, the image source must be properly characterized. If the positive image source looks correct to begin with or only color balance is required, this is not a problem. If there is a problem, **ColorPos** provides several ways of dealing with it. Source images that have not been processed or stored properly can sometimes be brought to proper characterization as explained under the **Gamma** ScrollBar control. For more extreme cases, try the **Film Type** ScrollBar control, as explained in **Film Type Scrolling**. For the ultimate in characterization, see the **Calibration Feature**. Using calibration the source may be directly characterized with the aid of a grayscale with known gray values (see **Known Calibration**), a grayscale for which the gray values are not known (see **Approximate Calibration**) or even with a grayscale composed of gray elements within a normal scene (see **Natural Grayscale Calibration**).

Third, the image lightness must be properly set. As described in **Lightness**, this is done automatically by **ColorPos**, but the setting sometimes can be improved using the Lightness ScrollBar control. The setting for automatic lightness can be adjusted - see **Tails Control Panel**.

Fourth, although **ColorPos** makes an initial guess at proper color balance, if a color cast remains in the image, the color balance must be adjusted. Frequently this is as simple as clicking a gray patch within the preview image - see **Color Balance by Preview Image Click**. For images in which there is no convenient gray patch, the **Auto Color** ScrollBar control systematically takes you through a range of settings that should produce good color balance for your image. Finally, **Color Adjustment** explains how to use the ScrollBar control to directly adjust the color balance, monitoring the result with the CC filter pack readout.

ColorPos also has a comprehensive CC (color conversion) filter system including both readouts in terms of CC filter packs and the ability to save color correction and shadow settings for use on series of similar image sources. See **CC Master Control Panel** for complete details including **A Brief CC (Color Correction) Filter Tutorial** for those who are unfamiliar with this, an extremely useful concept that has largely gone missing from digital imaging.

The **Problems and Comments** section deals with what to do with images that do not respond to normal treatment with sections on **Color Balance Extreme Problems**, **Different Lighting**, **Color Balance Differs in the Shadows and Highlights**, **Setting the Color Balance** (in Photoshop proper), and **Color Management**.

By default **ColorPos** applies an S-curve to highlights and shadows. Normally this does an excellent job of preventing blocked shadows and blown highlights. Like all tricks, however, it can sometimes cause problems. If you are having a problem with highlight or shadow blocking or other problems in those areas, the section on the **Tails Control Panel** explains how the highlights and shadow curves are controlled.

ColorPos allows different treatment of the inversion inside and outside a feathered selection. See **Selection Control Panel** for details and **Feathered Selections** and **How to Make Selections** for hints on how to effectively use this feature. Also placed in the otherwise empty **Selection Control Panel** are the option for including the image edges in the histograms that control **ColorPos** and a place where the effective system gamma, normally 2.2 for PCs, can be changed if necessary. These options are rarely changed but **Linear Input** needs to be checked if linear scans are used.

Introduction

This manual is not necessary to start using **ColorPos**, although you will need to read the ReadMe.txt file or the **Getting Started** section to learn about the 16-Bits/Channel images that are the starting point for **ColorPos**. But **ColorPos** is a very powerful system and this manual explains how to use its many features when you become more familiar with it. We especially recommend reviewing the **Descriptive Table of Contents**, which both explains **ColorPos** and helps locate the information you want.

The demo version of **ColorPos** embeds a gridwork in the images it produces. In general, this gridwork is not obtrusive enough to prevent evaluating the results and in fact we expect that some less critical users may find the results usable as is. To unlock the demo version and eliminate the gridwork, a key code may be purchased via a secure link from our web site:
http://www.c-f-systems.com/Plug-ins.html

At this point **ColorPos** will only work on PCs, not Macs. But we now have a Mac PowerPC with Photoshop for software development and **ColorPos** was written to better collect what we have learned before producing a Mac version. Please understand that **ColorNeg** and **ColorPos** have been written more in the nature of a hobby, done as we find the time. E-mail showing interest from Mac users really will influence how quickly we prepare the Mac version.

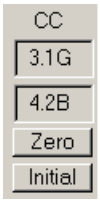
Legal Notice

Preview Image Clicking for Color Balance

When you click a point in the preview image in **ColorPos**, the image is adjusted to make the clicked point gray (colorless) while keeping the image lightness approximately the same. This is the preferred tool for setting a color balance of an image; that is, for removing any color casts. If there is a good gray area, mid-tone, light, or dark *and* if the image has color integrity this is sufficient to remove any color cast from the image. In general areas that are pure white or nearly so may not work very well for setting the color balance. Note that this is not the case with **ColorNeg**,

Three things must be recognized in using this tool. First, color photographic images can be quite grainy and images of real gray objects may be uneven, so take several clicks to be certain that the gray patch reading is stable. Second, while **ColorPos** has a primary goal of preserving color integrity, this requires that the source image have color integrity or that the source be correctly characterized. If your image has different color casts in the shadows, mid-tones, and highlights it does not have color integrity, which usually means that image is incorrectly characterized. See the "Second" condition in the **Descriptive Table of Contents** to learn how to deal with this problem. Third, with natural objects, what you think is gray may not quite be gray. It is always better to try several different "gray" objects to see how the image changes.

CC (Color Compensation) Filter Readout



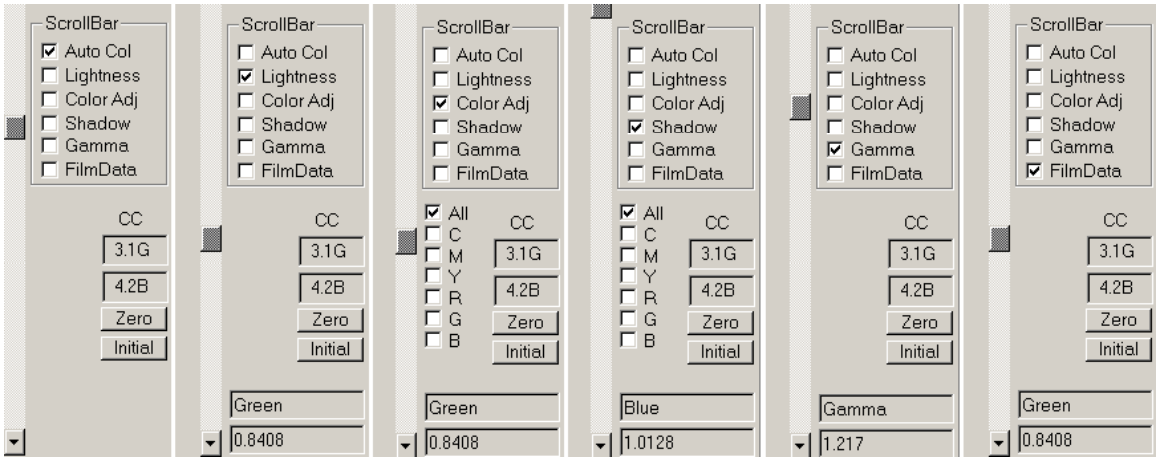
ColorPos uses the concept of CC (color correction) filter controls. During ScrollBar operations or clicking gray patches the CC filter equivalent of the current settings is shown to the right of the scrollbar. The CC filter pack is an important concept in color photography that has been largely lost in the digital imaging world. For those unfamiliar with CC filters, their use in **ColorPos** is explained in detail in the section on the **CC Master Control Panel**.

Rework and Linear Input Indicator

Any time **ColorPos** is used on an image for a second time - any time after the first - press the **Rework** button. This cancels the initial automatic blackpoint and color balance corrections that are normally made. It also cancels Linear Input if that mode has been selected. However, the cancellation is only in effect for the current session and Linear Input will be restored for the next image (but only if it had been selected at the start of this session). If Linear Input is in effect there will be an "L" in the gray box to the right of the Rework button. Otherwise the box is empty.

ScrollBar Controls

In **Getting Started** we briefly used ScrollBar controls. The complete set of six is as follows:



Note that some dialog elements change for the different scrollbar controls.

Auto Color

Auto Color is used when there are no suitable gray patches in the preview image or clicking does not seem to give a satisfactory result. Check the "Auto Col" option and use the scrollbar. Over the range of the scroll the image will go through the settings most likely to produce a good color balance. Finer control of the scrollbar can be had by using the PageUp/PageDown or Up/Down Arrow keys. Once the color is set, select the "Lightness" option again for fine tuning. Two different methods based upon gray balances internal to the image are used, one in the lower half of the scrollbar and another in the upper half. Scrolling through these settings is often very uneven, with long scrolls through very similar settings followed by a fairly rapid change of settings. There even may be a range where the color balance is extremely far off. This is normal and the behavior will typically be somewhat different for each image. The actual amount of color change is tracked in the CC boxes in terms of a CC filter pack (see the section **CC (Color Correction) Filters** for a full explanation). In our experience if the image is properly characterized or calibrated Auto Color will locate a near-ideal color balance in the vast majority of cases, but be aware that like any short-cut there will be rare instances where it does not work. For such cases you will need to use **Color Adjustment**, which is also useful for critical fine tuning of Auto Color results. See **Problems and Comments** at the end of this manual for dealing with particularly difficult cases.

Lightness

Lightness is the most fundamental control in **ColorPos** controlling the overall lightness or darkness of the image. **ColorPos** makes an initial guess at image lightness. This guess can be controlled somewhat (see **Tails Control Panel**) or set precisely for a series

of similar image sources (see **CC Master Control Panel**). Lightness is equivalent to "exposure" in traditional printing, so this control preserves the color integrity of the image. When using Lightness you will see two boxes at the lower right of the scrollbar; in the illustration above, these contain "Green" and "0.8408." Lightness, the exposure adjustment, effectively drives some portion of the image to saturation. In the example, more Red pixels have been driven to saturation than either Green or Blue, and 0.8408% of the Red pixels been driven to saturation. However, recognize that **ColorPos** curves the saturated regions just as color printing paper does, so that actual saturated ("blown") highlights will represent considerably less than 0.8408% of pixels and highlight detail will be retained (See **Tails Control Panel**).

Color Adjustment

Color Adjustment is the **Lightness** control applied individually to the primary colors, which can be selected using the checkboxes for the subtractive primaries Cyan, Magenta, Yellow, or the additive primaries Red, Green, Blue. The subtractive primaries each gang together two additive primaries, so that Cyan simultaneously adjusts Blue and Green, Magenta simultaneously adjusts Red and Blue, and Yellow simultaneously adjusts Red and Green. The All checkbox simultaneously adjusts Red, Green, and Blue so that when All is checked, Color Adjustment is exactly the same as Lightness.

The use of Color Adjustment is exactly equivalent to applying CC filters to the image. This effect can be seen in the two CC boxes to the right of the color selection checkboxes (see the section **CC (Color Compensation) Filter Readout** for a full explanation). Being equivalent to CC filter adjustment, this control preserves the color integrity of the image. Use this control to fine tune a color balance made by clicking the preview or using **Auto Color**, or to find a correct color balance for the rare cases that the automatic methods cannot handle. The two boxes at the lower right of the scrollbar behave as described above for **Lightness**.

The **Problems and Comments** section at the end of this manual describes an easy method for color balancing or checking the color balance of images that have color integrity.

Shadow

The **Shadow** adjustment allows setting the blackness of the shadow areas while preserving the color integrity of the image as well as possible. Adjusting the shadows also has an apparent effect on image contrast. The shadows adjustment in the Photoshop Levels tool behaves very poorly with regard to color integrity, so it is important to make any necessary shadow adjustments in **ColorPos**. **ColorPos** makes an initial guess at shadow darkness and this guess can be controlled somewhat (see **Tails Control Panel**). Further Shadow adjustments are not routinely required. When they are needed, use the **Shadow** control, typically with the All checkbox checked, which simultaneously adjusts Red, Green, and Blue. In cases where the deep shadows have an undesirable color cast after the overall image color has been set, a shadow adjustment of one of the primary

colors may be required. These colors can be selected using the checkboxes for the subtractive primaries Cyan, Magenta, Yellow, or the additive primaries Red, Green, Blue. The subtractive primaries each gang together two additive primaries, so that Cyan simultaneously adjusts Blue and Green, Magenta simultaneously adjusts Red and Blue, and Yellow simultaneously adjusts Red and Green.

When using the **Shadow** control you will see two boxes at the lower right of the scrollbar; in the above example they contain "Blue" and "1.0128." The Shadows adjustment effectively drives some portion of the image to pure black. In the example, more Blue pixels have been driven to black than Green or Red pixels, and 1.0128% of the Blue pixels been driven to black. When you use the Shadows control, this is a measure of what is happening to the shadow areas of your image. However, recognize that **ColorPos** curves the deep shadow regions just as color printing paper does, so that actual pure black shadows will be considerably less than indicated (1.0128% of pixels in the above example) and shadow detail is retained. See **Tails Control Panel** and **CC Master Control Panel** for details on this and the several methods of shadow control.

Gamma

Gamma adjustments are equivalent to the "middle gray" slider in the Photoshop Levels tool. In that form gamma adjustment is the single control most responsible for the loss of color integrity in digital images. Thus it is with some reluctance that we include a gamma control here, however, the **Gamma** adjustment done by **ColorPos** is more accurate than the one in Photoshop Levels. Short of calibration, a ganged gamma adjustment is the best correction for film images known to be over- or under-developed, resulting from time, temperature, or developer strength errors; the most common processing problem. If you believe that your film may have been poorly processed, use the **Gamma** control to adjust the image to have a more natural look, but do not go beyond this. If you are working with images delivered directly from a digital camera (i. e., not RAW) a **Gamma** adjustment, normally to some value less than 1, may help. We encourage using calibration for such sources. If your intent is to enhance the image to be either more flat or more bold than it would naturally be, we suggest that you use our **GamSat** plug-in instead or put the image into Lab Mode, as this will preserve color integrity as much as possible while doing this.

Gamma gang-adjusts Red, Green, and Blue simultaneously and as shown in the illustration above, will display a single mean value of gamma as this takes place. You may also see the CC values change as you adjust **Gamma**. Please understand that such changes do not represent true CC filter pack changes as is the case with **Lightness** adjustments. With the **Gamma** adjustment you are effectively changing the assumed characteristics of the image source, not its color balance.

The Gamma adjustment is also used to assist in making "Apprx" calibrations.

Film Type (Image Source)

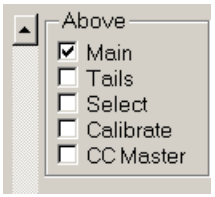
The **Film Type** ScrollBar control is a tool which can be used to characterize the image. The **Film Type** name is a bit misleading here but has been kept for this tool to be consistent with the **ColorNeg** plug-in. This control works by scrolling continuously through characteristics which are commonly encountered. The preview image must be carefully observed during this scrolling and gray patches in the preview image frequently clicked to keep the image in the best color balance possible. Look for the point in scrolling where the whole image seems to be most natural in color. In particular, any color cast should be similar in the shadows, mid-tones, and highlights. Preferably there should be no color cast at all in any of these.

After a suitable **Film Type** has been scrolled, if the image seems too flat or too contrasty, that can be tweaked using the **Gamma** ScrollBar control. In general it is not wise to have the average gamma go above 1.5 or below 0.6 when doing this.

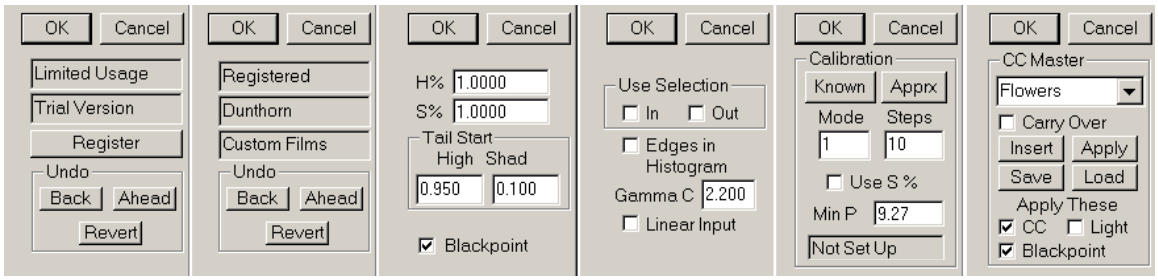
The results of the **Film Type** scrolling can be Added to the image source characterization list either under the current name or a new name can be entered. The results can be permanently saved to a file as described under **Image Source Select Feature**. The results of this characterization can then be used for other images which are believed to be of the same source.

Panel Controls

ColorPos has some very powerful features that are initially hidden from view. The panel just under the OK and Cancel button at the upper right of the dialog has several different faces that are selected using the checkboxes marked **Above,** to the right of the upper scrollbar:

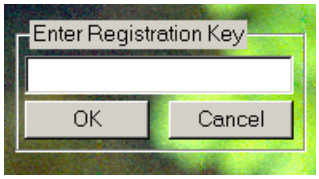


Each of these checkboxes causes one of the following controls to appear:



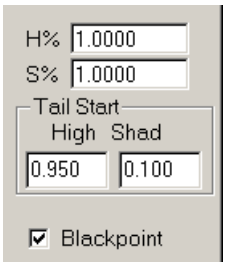
Main Control Panel - Registration

ColorPos first comes up showing the Main Control Panel, which will look like the Panel on the far left. Undo will allow you to cycle back and ahead through the previous twenty steps. Understanding exactly what "step" means requires some experience using Undo. The "Register" button will appear until a purchased key code has been entered. Pressing the Register button brings up a dialog box:



Enter the key code (we strongly suggest using copy and paste) and press OK, then OK out of **ColorPos** to complete the registration. The next time you call up **ColorPos**, the Main Control Panel will change to the second version shown above. The two upper text boxes will contain the registration name and replacing the "Register" button will be a box that contains the name of the current *.colorint file if one has been selected (see **Image Source Select Feature** below).

Tails Control Panel



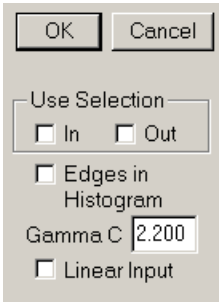
When **ColorPos** starts it ordinarily makes its first guess at Lightness and Shadow settings according the percentage of pixels at the allowed to saturate in the highlights (H%) and the percentage of pixels allowed to go completely black in the shadows (S%). The default for these percentages is 1% but may be adjusted to any reasonable percentage. If your images are routinely too dark, try a higher value for H%. Too light, a lower value.

ColorPos does not actually allow the H% of pixels to go into saturation or S% to go into complete blackness, but applies an S-Curve so that the image gracefully goes into saturation just as would be the case with an image printed on photographic print paper. The "Tail Start" figures show the point in image lightness at which the S-curves begin to be applied. Typically values of 0.90 or 0.95 and 0.05 or 0.10 are used for this, the fractional start points being based on the image as adjusted for system gamma. That is, at the default values shown above the shadow curve will start at 0.1 x 255 = 25 and the highlights curve will start at 0.95 x 255 = 242 in the final image.

The tail curves work with no problems for most images, but can sometimes misbehave. If you experience poor behavior in the highlights or deep shadows, adjusting the tail start values can help. Setting "High" to 1.0 or "Shad" to 0.0 will completely turn off the tail and allow you to tell for sure if it is causing a problem.

The need for blackpoint adjustment arises from imperfections and non-ideal behavior of photographic materials and equipment. As such, a blackpoint setting is normally *required*, but the "correct" setting for blackpoint is not easily defined. The choice of blackpoint will affect both overall saturation and color integrity. **ColorPos** is designed to minimize the effect of blackpoint selection on color integrity, limiting its effects to the darkest shadows insofar as possible. Normally Blackpoint should be left checked. If an image is entered into **ColorPos** for a second time, normally the automatic blackpoint correction is not desired. However, in such cases we recommend using the **Rework** button instead of unchecking blackpoint. **Rework** cancels the automatic blackpoint and highlight color balance corrections both that are normally made to a new image.

Selection Control Panel



First, the **Selection Control Panel** also has three orphaned, more rarely used items in addition to selections. Scans of images can have light leaks around the edges, and such light leaks can seriously distort the **ColorPos's** analysis of the image. For this reason a 10% border around the edges of the image is routinely ignored in the analysis. In cases where this is undesirable, check **Edges in Histogram** and the edges will be included.

The **Gamma C** value is the normal system gamma in which gamma-adjusted images are stored for your system. It is normally 2.2 for PC systems and 1.8 for Macintosh (which we currently cannot serve). Unless you specifically know that your system gamma is other than 2.2, leave this value alone. It is *not* intended for individual image adjustment purposes.

Linear Input

ColorPos normally operates on images that have been "gamma-encoded" (as is the case for nearly all images stored on computers). However, getting a clean, unaltered scan can be difficult to do and may only be possible by doing a linear scan. **ColorNeg** and **NegPos** *require* linear scans, so you may already be familiar with this route for obtaining clean, unaltered images. If you use linear scans for input, check the **Linear Input** box. There is also a small, gray box next to the **Rework** button at the bottom right of the dialog. If Linear Input has been selected that box will show an "L" and will otherwise be blank. If you are normally working in **Linear Input** mode and you use **ColorPos** to rework an image a second time, when you press the **Rework** button the **Linear Input** mode will be cancelled for that session. However, **Linear Input** mode will be automatically restored for the next image processed.

Feathered Selections

ColorPos allows the use of feathered selections. Feathered selections can often be used to bring out this detail in a way that the eye still sees as normal. To use this feature, select an area or areas that are brightly lighted, as when sunlight falls directly on part of a scene while the remainder is in shadow. Feather the selection suitably for a smooth transition - choosing the right amount of feathering varies with every image and comes with experience. Then in **ColorPos**, work on the entire image adjusting lightness, adjusting the color balance, etc. until the most prominent part of the image looks good.

Then click either In or Out under **Use Selection** to work on the area in the selection or outside the selection. Start with whichever part you paid least attention to as you worked on the entire image. When you have that part adjusted to your liking, change from In to Out (or vice versa) and adjust the other part so that the balance between In and Out is smooth. It may take going back and forth a few times. When viewing a real scene, the eye naturally accommodates as you gaze at bright and dark areas and the brain blends it, so the result of working on selections like this can appear quite natural. Feathered selections are also very useful in dealing with an image where two parts of the image are under different lighting conditions. You will find that **Auto Color** is less useful in working with selections, but clicking a gray patch in the work area will still work. Still, it is best to get a good color balance before starting on the selections. After you start using selections, the CC filter pack will reflect the color balance inside or outside the selection, whichever is the active mode. In addition, if you save or insert CC filter packs while using selections, only the filter packs for the active mode will be saved. Note that it is possible to save filter packs for both inside and outside the selection by switching from In to Out and using different names when saving the two filter packs.

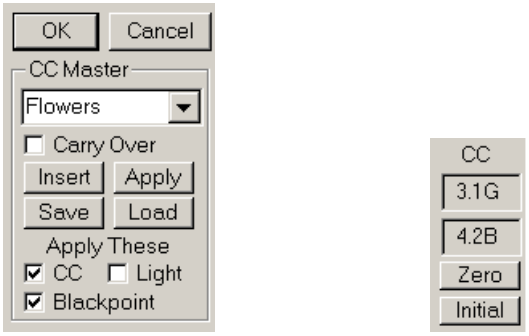
Feathered selections are especially useful on 16-Bits/Channel images which have been intentionally darkened to preserve highlight detail. The source can be a scanner or a Photoshop RAW conversion done with Exposure set to a negative value (See http://www.c-f-systems.com/16BitSecret.html for further details).

NOTE: Once you start to use selections, there is no going back. You will no longer be able to work on the entire image without restarting **ColorPos**. Undo will not go back past the start of using selections, either. Additionally, calibration uses selections in an entirely different way. Any time you call up **ColorPos** with an image that has selections you can try to run a calibration *or* work with selections as explained above, but you will not be able to do both.

How to Make Selections

If you are working with Photoshop 7 or earlier, you may want to convert the positive to 8-Bit/Channel first so that the magic wand and other aids are available in making the selection. Once you have accurately made the selection, save the selection *in a new file*: Select→Save Selection. Make sure the Document: pulldown says New and give the selection a Name: - anything convenient. When you OK this will save the selection in a separate image, typically Untitled-1. Now you can revert if you haven't overrun the History list, or reload the original image and Select→Load Selection to put the selection over the image. In doing this remember to save the image first if there is any chance you might overrun the History list in making your selection.

CC Master Control Panel



ColorPos includes the concept of CC (color correction) filter controls. During ScrollBar operations or clicking gray patches the current CC filter equivalent of the chosen settings is shown to the right of the scrollbar. Color correction filters or color density filters have been a part of color photography since the beginning, and with very good reason. They are equivalent to changes in the color of the lighting of a scene and thus represent the most physically natural adjustments of color. In addition to monitoring the application of color corrections to a single image, the concept of CC filters can be used to match the color correction treatment of similar images. As many photographers already know, images from the same roll or emulsion of film that are taken under similar lighting conditions will normally require the same color corrections.

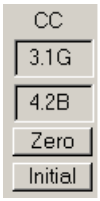
A Brief CC (Color Correction) Filter Tutorial

The concept of CC filters has been missing from digital photography not because they were no longer believed necessary or useful but apparently because there was a lack of understanding of how to program the equivalent of CC filters. Thus CC filters may be an unfamiliar concept to some but we strongly believe that digital photographers will benefit greatly from understanding and using CC filter equivalents in assessing their images.

A 10R CC filter is of a light red color and passes all red light while having a density of 0.1 to both blue light and green light. Physically this means the 10R adjusts the lighting by passing 100% of red light while passing only about 80% of green light and 80% of blue light. The filter has a red color and by convention the 0.1 density is multiplied by 100 in naming the filter "10R." CC filters densities of the same color are additive, so that two sandwiched 10R filters are equivalent to 20R. In traditional color photography color adjustments are made using combinations of CC filters, for example 10R 5B, called a "filter pack." CC filters of different primary (RGB) colors are not additive, so a filter pack may be 10R 5G. A filter pack of equal density in all three primary colors appears gray. For example 10R 10G 10B, appears gray has a "neutral density" of 0.1. Since neutral density is equivalent to a simple exposure change, by convention such combinations are subtracted out before reporting CC filter packs. Thus a filter pack 10R 15G 5B would have 5R 5G 5B subtracted from it and be reported simply as 5R 10G. In this way, filter packs never contain CC filters of more than two of the three primary

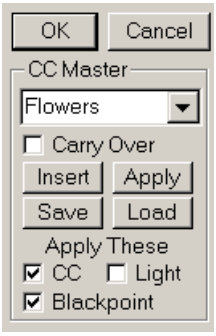
(RGB) colors. The filter pack is thus a good measure of what is happening to the color balance of an image independent of overall lightness.

The CC Reference and the Zero and Initial Buttons



The CC filter pack is by nature a *comparison*, rather than an *absolute* measure. With positive images it is obvious that the comparison should be with the starting image as reference and that is what **ColorPos** uses. However, it is often helpful to change the reference point for easier CC comparisons. At any time the reference may be set to the current image colors by pressing the **Zero** button. This will cause the CC readout to become zero and further CC comparisons will refer to the current state of the image. To get an overall view of color changes it is also possible at any time to go back to using the initial state of the image as reference by pressing the **Initial** button.

Matching a Series of Similar Images



Often a series of photographic images has been taken under very similar lighting conditions using the same film and processing or the same digital camera. In such cases the CC filter pack can be identical for all images in the series. **ColorPos** makes it easy to match such a series. Start with a typical image and make any adjustments necessary to have it come out as you want it. Then, press the **Zero** button to make the current filter pack the current CC reference as described above. Click the "CC Master" button in the **Above** checklist to show the CC Master control. The pulldown (showing "Flowers" above) is a list of ten names. Select one of the existing names to hold your CC data. You can leave the selected name or enter a new one. There is a twelve character limit on the length of the name. (Initially all the names start with "Z" so new names you add will be at the top of the list. Press the **Insert** button and the current CC reference will be saved under that name. Note again that prior to pressing **Insert**, you need to press the **Zero** button to make the current CC reference the same as the current preview image. The

Insert action also records your current **Shadow** settings as part of the CC record stored under the chosen name.

Once a CC Master has been saved it can be applied to other images by selecting the name in the CC Master pulldown and pressing the **Apply** button. This will apply the color correction to the current image so that it will match the reference image and the CC readout will report how much the image has been changed.

The "Apply These" checkboxes govern exactly which correction will be applied when the **Apply** button is pressed. The "CC" option will apply the color correction settings without altering the lightness of the image. The "Light" option will apply just the Lightness setting of the reference image without altering the color correction. The "Blackpoint" option will apply just the Shadow settings of the reference image. These three options can be used in any combination. If you did not do a special **Shadow** adjustment to the reference image, don't apply blackpoint. Whether to use the Light option along with the CC option will depend largely on how the pictures were taken. It is a simple matter to change which options are checked and press **Apply** again to see how the image changes.

The changes you make to the CC Master, changing names and CC data for any of the ten names, will automatically be recorded for use on the next image when you press the OK button to exit **ColorPos**. Note that the changes are *not* saved if you Cancel out of **ColorPos**.

You can arrange to have adjustments automatically made to the next image by checking the "Carry Over" box. Whichever CC name is selected when you exit **ColorPos** using OK will be automatically applied to the next image, using whichever options were last checked.

For systematic photographers, the CC Master settings from one batch of films may also be a good starting point for another batch. Remember, however, that applying a CC Master does *not* affect the Image Source setting. Make sure that the proper Image Source has been selected *before* applying a CC Master.

CC Master settings naturally become obsolete as one batch of film is finished and we move on to another. Thus the ten CC Master name slots provided should be enough for most operations. Nonetheless the **Save** and **Load** buttons provide the means for saving and reloading CC Master settings. These buttons bring up standard file open/save dialog boxes and save the settings as tab-delimited text files with the extension *.poscc. Except for the chosen names, the data in these files will not in general be comprehensible to the user. CC Master names are always written as the entire group of ten and **Load** expects to find ten records. This somewhat complicates the reuse of saved CC Master names but of course the user is free to use a text editor to cobble together a *.poscc file with a group of ten records selected from different saved files. We suggest that any such put-together file be read into and written back out of **ColorPos** to be compared with the original and be sure it is being interpreted correctly.

Image Source Select Feature

ColorPos has a pull-down select that allows easy saving and setting of characterizations - gammas - of different image sources; film, scanner, and digital camera:

The data for the source gamma pull-down is kept in a text file with a *.colorint extension. This file may be located anywhere the user wishes, and there may be more than one such file. A file Normal.colorint is supplied that contains some example lines representing gammas we have found for a couple of digital cameras. We have no idea if this information transfers to other similar cameras and in any case it will depend on the methods used to enter the image data into the computer. These gammas are normally found through calibration. As explained in the **Calibration** section below, calibrations can also be done for slide film types and in some cases, even prints. The file is a standard tab-delimited text file and may be altered and edited using any text editor capable of saving the file in pure text format. For example, the first two lines in Normal.colorint are:

1.000 0.920 0.940 Fuji F700
0.700 0.750 0.760 Olympus C750

Which are the red, green, and blue gammas followed by the name that is to appear in the pull-down. The items are separated by tabs.

When the pull-down is activated and an item selected:

the characterization gammas from that selection replace the values in **ColorPos**.

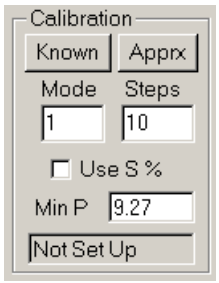
The **Add/Chg** button is used to add or change values in the film list. When this button is pressed, the current, active **ColorPos** gamma values will be entered into the film list, replacing the current values if the film name is already on the list or making a new entry if the name is a new one. Normally this is only done immediately after a calibration has been completed. To create a new entry, simply edit the film name in the pull-down edit box, perform the calibration to generate the gamma values in place and then press **Add/Chg**. With **ColorPos** it is not possible to type in gammas that you have calculated other than with calibration. The easiest way is to use a text editor to operate directly on the *.colorint file, although it is possible to use advanced **ColorIntegrity** to enter such gammas. ***Please note:*** Both Add/Chg and Delete affect *only* the list currently in use ***internally*** by **ColorPos**. This list will be *lost* when **ColorPos** is exited. ***Changes do not become permanent until the* Save *button is pressed.***

The **Delete** button will delete the named entry from the film list (if the name exists on the list).

The **Save** button brings up a standard file save dialog allowing the user to pick the name and location of the *.colorint file to be saved and will save the entire Image Source list under the chosen name. Similarly, the **Load** button brings up a file open dialog allowing the user to select a *.colorint file from any location. After **ColorPos** has been registered, the name of the currently active *.colorint file (or as much of the name as will fit) will be shown in the Main Control Panel area at the upper right of the **ColorPos** dialog, under the registration data.

Calibration Feature

As you can guess from the length of this section dealing with it, calibration requires dedication and attention to detail to do correctly. Calibration is not necessary to the successful use of **ColorPos**, but when properly mastered it can make a significant difference in the quality of your work. Calibration is operated mainly through a single box that appears in the Control Panel area at the upper right corner of the dialog when Calibration is checked in the **Above** box:



The calibrations will be performed in accord with Dunthorn Calibration as explained on our web page http://www.c-f-systems.com/DunthornCalibration.html. This web page explains why grayscale calibration is both *necessary and sufficient* for three color RGB or CMY systems like color negatives, slides, or digital camera images. Calibration is possible using scanned or digital camera images of a known grayscale (where the target values of each grayscale step are known) or images of an unknown grayscale or even from regular images in which various elements of the image have been selected to function as a grayscale. We recommend making a Dunthorn grayscale for this purpose, using the method described in
http://www.c-f-systems.com/DunthornCalibration.html
or in
http://www.c-f-systems.com/AlternateGrayscale.html.
The pixel values of this grayscale are built-in as the "Known" grayscale for **ColorPos**, but **ColorPos** also has the ability to calibrate using known grayscales other than the Dunthorn grayscale. For any known grayscale, including the Dunthorn grayscale, the target values must be in a file named colorintegrity.grayscale and that file must be in the same folder as the *.colorint file currently in use. Each time a *.colorint is opened or Loaded an attempt is made to load colorintegrity.grayscale from the same folder. Thus it is

possible to use several different colorintegrity.grayscale files in different folders. The colorintegrity.grayscale file provided with **ColorNeg** contains the values for the Dunthorn grayscale in comma-delimited text format:

13, 38, 64, 89, 115, 140, 166, 191, 217, 242

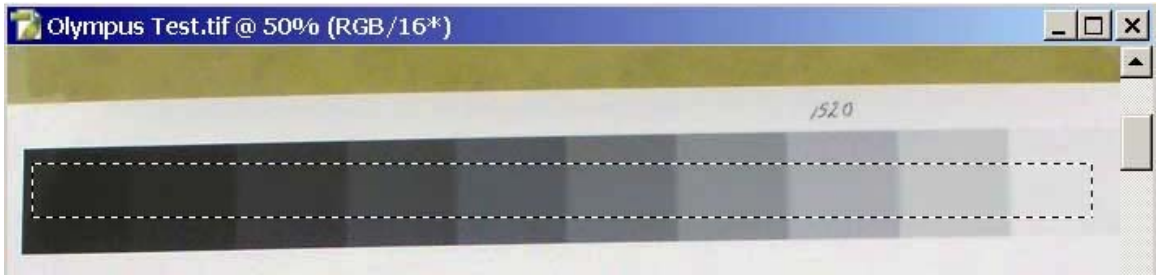
If some other known grayscale is being used, its values may be entered into a colorintegrity.grayscale file and used. The values should be on the 0 to 255 pixel value scale and values near 0 or near 255 should be avoided. If the end steps of the target grayscale are considered to be black = 0 or white = 255, omit those steps from the list in the file and also *do not* include them in the selection area when preparing the image for calibration. The number of grayscale steps is arbitrary, but needs to be at least four. The number of steps detected in the file will appear under "Steps" in the Calibration box on entry to **ColorNeg**.

In addition, any grayscales or even a natural grayscale from within an image can be used for the "Apprx" calibration.

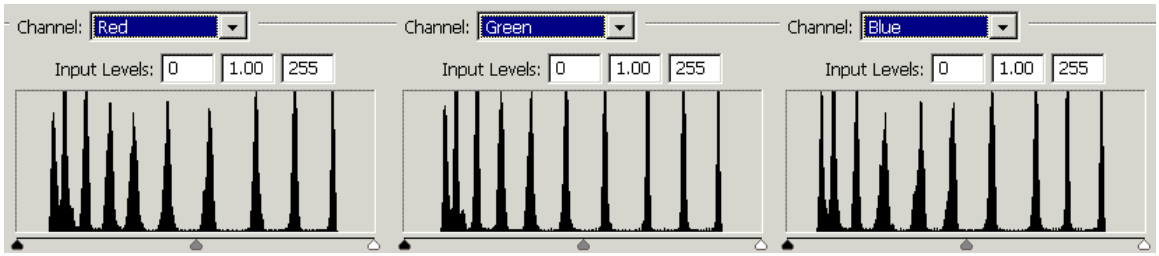
In general, we do not encourage calibration in the case of scanned prints. While quality processing of slides and even color negatives may be consistent enough to make calibration possible, the added step of printing makes it too variable for calibration to be useful. That said, if you have a fair number of old prints that seem to be from the same source and to be of fairly consistent appearance or if a single old print has sufficient gray areas, you may wish to try Natural Grayscale Calibration to see if it is useful.

We do not suggest that calibration is easy even with the tools provided here. It will require using the tools enough to become familiar with them and it will require attention to detail to determine whether the results of a calibration are valid or not. We *do* suggest that these skills can be readily learned and are well worth the effort.

To calibrate, there must *always* be a selection. If there is no selection (or if the image is monochrome) the calibration box will indicate "Not Set Up" (as shown above) and will not function. (Selections may be used either for doing calibrations as described here *or* for making different adjustments inside and outside the selected area as described in the **Selection Control Panel** section above, but not for both purposes at the same time.) The selection should be the portions of the image to be used as a grayscale. In many cases the selected portion will actually be an image of a grayscale. For best results - or at least less confusing results - the image should not be closely cropped. The complete image surrounding the grayscale should be used, but with a selection made that includes only the grayscale:



This image must be a 16-bit/channel scan or digital camera image, as required for **ColorPos** in general. It can be an 8-bit/channel image if that is all that is possible, but convert to 16-bits/channel (Image→Mode→16 Bits/Channel) *prior to the blurring operation* described next. It is *very* important that the image to be blurred be 16-bits/channel. The histogram from such a selection may not show sharp peaks, especially in a high resolution image. For proper calibration it normally is necessary to sharpen the peaks using Filter→Blur→Gaussian Blur. (Yes, that's right. Use blur to *increase* the sharpness of histogram peaks.) We have found that a radius of 3-10 pixels normally will produce nicely sharpened peaks, but that will vary with the scanner resolution being used. The resulting histograms in the Image→Adjustments→Levels tool may look like this:

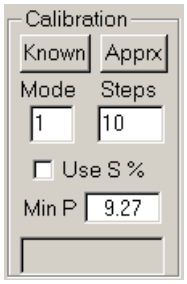


If the histograms are hard to evaluate, with all the peaks slid over toward the dark end, the peaks may be expanded for examination. Using the levels tool on each of the three colors, slide the highlights slider (white, at right in the above histograms) until it almost hits the area with histogram data. OK out of the Levels tool and then call up the Levels tool again, with a result that should be similar to the above.

Here we can see that each of the three colors has ten quite distinct peaks corresponding to the ten steps of the grayscale. For calibration to work best, the peaks must be reasonably distinct and separate, as in the above. Even though calibration often will work with peaks that are partly merged into one another and that have more uneven spires than the above, for good, consistent results, try to produce histograms as distinct as the above. Do not expect good results from a poor gray scale pattern. Poor patterns may result from incorrect exposure, uneven lighting with shadows or reflections on the grayscale, poor processing, etc. The radius chosen for Gaussian Blur will have an effect on this, but it is not a cure-all. If too large a radius is chosen, adjacent steps will start to blend in with one another; also, blur-blending itself becomes a questionable process when more than a small amount of blending is required.

Once you have examined the peaks, be sure you undo any Levels adjustment done so that you could see the peaks better before using the **ColorPos** tool.

When you start **ColorPos** to do a calibration, the image initially displayed may (or may not) be poorly expressed because the selected areas are initially analyzed by the same method normally used for complete scenes. Look again at the calibration box:



When **ColorPos** is entered with a color image having a selection, it is properly set up to attempt a calibration and the message box at the bottom will be blank. The calibration can be either against a grayscale with **Known** exact target values or it can be an **Apprx** calibration in which the target values are not known.

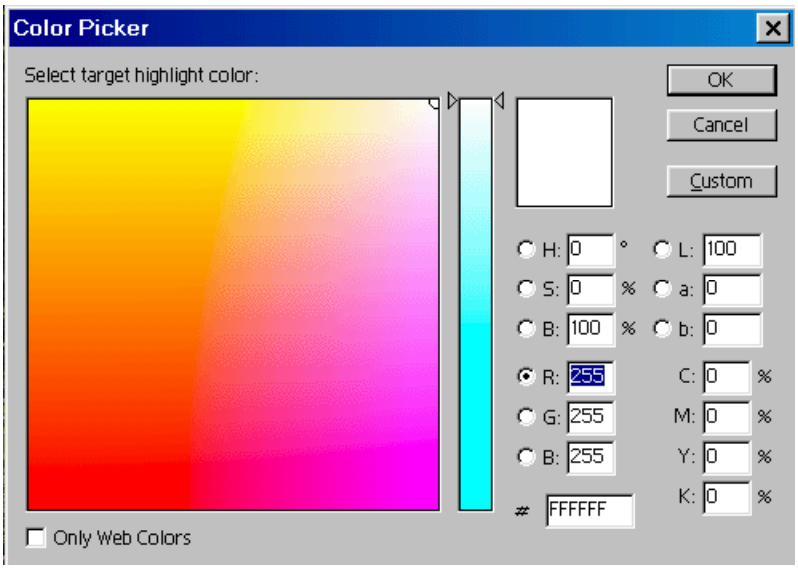
Known Calibration

For a known grayscale, the target values must be in a file named colorintegrity.grayscale and that file must be in the same folder as the *.colorint file currently in use. Each time a *.colorint is opened or Loaded an attempt is made to load colorintegrity.grayscale from the same folder. Thus it is possible to use several different colorintegrity.grayscale files in different folders. If no colorintegrity.grayscale file is found, **ColorPos** reverts to built-in values for the Dunthorn grayscale.

13, 38, 64, 89, 115, 140, 166, 191, 217, 242

and the number of Steps is set to 10 to correspond to this grayscale.

Pressing the Known button will match the grayscale image against the known grayscale values and will produce a set of gammas for R, G, and B that best fit the grayscale. It will also adjust the shadow and highlight percentages to approximately match the blackpoint and color balance determined as part of the matching. These gammas can then be recorded as representing a particular film type or digital camera (the advanced version of **ColorPos** provides for saving sets of calibration gamma results in a convenient pull-down list). If you then OK out of **ColorPos**, the resulting grayscale image should be fairly close to the known grayscale. It may be necessary to scale the image according to the brightest cell for best agreement. To do this, activate the Levels tool Image→Adjust→Levels. There are three eye-dropper buttons at the lower right. Double-click the rightmost (highlight) dropper button and the Color Picker dialog box will appear:

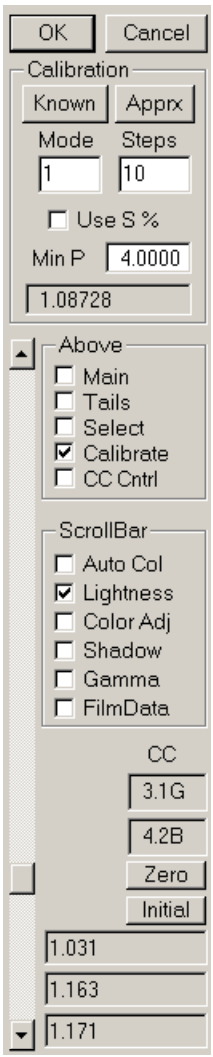


R, G, and B, show the value of 255 above. Enter a value of 242 for each of these and click OK. The mouse cursor appears as a dropper. Use it to select areas in the lightest square of the grayscale image. Pick several points and stop when the Levels histogram seems to bounce about the least.

Now OK the Levels dialog. Probably a message box will inquire whether you wish to save the new target colors as defaults. Answer **No.** This adjustment is effectively an overall lightness adjustment and the pixel values in the steps of the grayscale will now match the target values fairly closely if the calibration is a good one. *If the match is not good, the calibration is not good - do not use a calibration that does not check out well.*

The most frequent difficulty with grayscale images is in the dark end. If this happens, exclude the darkest cell or cells in the selection for calibration and in **ColorPos** change the number of steps to the number of steps remaining after the exclusion. This will automatically ignore the correct darkest cells in doing a Known calibration.

After each successful calibration trial a number will appear in the box at the bottom of the calibration area and a value will appear in the "Min P" box:



This number in the gray box in the Calibration area is a surrogate for the standard deviation of the grayscale match and we will call it "sigma". In general, you should target smaller numbers here, preferably less than one. We really do not have enough data on this to generalize but as a very rough guideline, you should start to be more suspicious as this number gets much larger than one, although sigmas in the units or even low tens may be valid, especially for "natural" grayscales. The three color gamma values will be listed to the lower right of the scrollbar, Red, Green, and Blue from top to bottom as in the above illustration (i. e. the Red gamma is 1.031). The calibrations calculates the three color gammas and we have observed gammas as low as 0.5 and as high as 1.5 that appeared to be "real" in working with positive images, but our experience is limited. If a message appears in the box rather than a number it means that the calibration attempt has been rejected by the system and it will be necessary to re-examine what you have done and try again. The "Min P" number is the minimum spacing allowed between peaks. Normally the program determines this, but if you enter a value in the "Min P" box, it will be used as the minimum permitted spacing between peaks for the next calibration calculation. The spacing is based on a 0-255 scale and is applied to "gamma-corrected" values even if the image is entered in linear form. Note: A Min P value of 3.0 means that

no two peaks are closer than 3 (of 255) apart. However, it does *not* mean that any two peaks are anywhere near that close together - they usually are spaced much further apart.

Approximate Calibration

It is usually possible to do a good calibration even when the target values for the grayscale steps are unknown, first tying down the calibration by fixing one of the color gammas. For positive images, it is normally best to set an average gamma of 1.0 in the absence of information allowing a better estimate. For Apprx calibration, the Red Gamma is first fixed at the chosen gamma value. The blue and green gammas, as well as the blackpoints and color balance, are then calculated assuming the red gamma is correct. The number of steps in the grayscale (Steps) can be more freely set in doing an Apprx calibration than was the case for Known. If Steps is set at 5, then for Apprx, the five tallest peaks will be selected for each color. Since we are working with gray steps, the five (or whatever number) tallest peaks will usually correspond to one another across R, G, and B. In fact, it can be useful to see what happens to the gammas when different numbers of steps are taken into account and thus see how stable the calibration is.

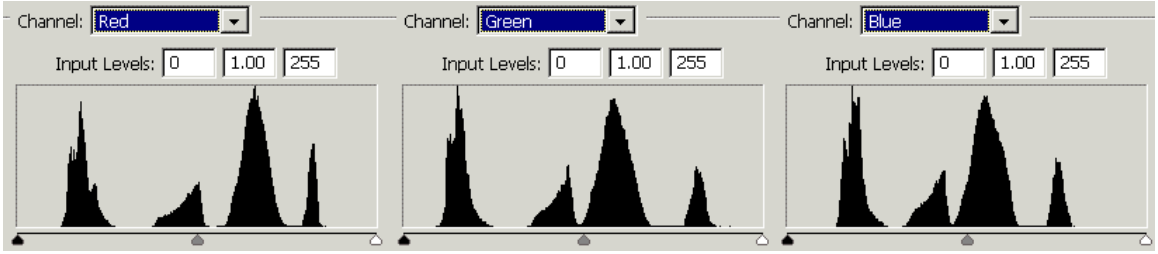
The number in the "sigma" box will normally be less for an Apprx calibration versus a Known calibration of the same grayscale and does *not* mean that the Apprx calibration is better. The reason for this will be obvious to anyone who understands the concept of "degrees of freedom" but too involved to explain here otherwise. Again the calibration becomes more suspect as this number gets much larger than one. See below for more general comments on sigma. If a message appears in the box rather than a number it means that the calibration attempt has been rejected by the system and it will be necessary to re-examine what you have done and try again. In any case check to see that the grays are really gray before accepting the calibration. *If the grays are not gray, the calibration is not good - do not use a calibration that does not check out well.*

Natural Grayscale Calibration

As more fully explained on the Dunthorn Calibration web page, it is often possible to calibrate an image of a natural scene which does not contain a grayscale image as such. This is particularly useful for old slides and prints where it is impossible to make new grayscale calibration images. The idea is to select a number of areas in an image which are fairly even in tone and which are known or believed to be nearly neutral in color. Objects such as white shirts, blacktop roads, white houses, sand, tree bark, branches, etc. can be used to form a natural grayscale. Consider the following image:

Try to select areas which are evenly toned and have tones which range up the tonal scale. The Info window helps in showing the pixel values of areas to be selected. Make sure the different areas selected have distinctly different values than the other choices for all three colors - if one color shows nearly the same pixel values in two different selected areas it will have one less peak in its histogram than the other colors. If you look carefully at the above picture you will find that four areas have been selected and that two of these were selected at least partially with the "magic wand." The magic wand can be very helpful because it can limit the selected pixels to all be within a narrow range in color

After making gaussian blur and highlight slider adjustments as explained above, the Levels histograms for these selections is as follows:



This set of peaks is adequate - but only barely adequate - to use for an Apprx calibration with 4 Steps. Selecting a good natural grayscale is not particularly easy and it can be quite difficult to get even the minimum four or five representative areas. Experimentation with different gaussian blur pixel radii may be required. Fortunately, when calibrating to a natural grayscale it usually is evident from the result when it is not working well. Gammas very much above or below one should be suspect. In any case several images from the same film type or digital camera should be tried and compared.

A natural grayscale will normally be inferior to a specially produced grayscale - the steps will vary more from a true neutral. It very likely will require some practice before you will be able to select acceptable surrogate grayscales from natural images, but if you

work at all with old pictures, it is worth the effort. Be sure to select fairly small uniformly colored areas. Use the magic wand to assist, but you will usually want to remove parts of magic wand selections before they are used. The sigma number can be of considerable help in getting a good natural gray scale. Because there is more uncertainty in the grays, sigma will normally be a little higher than for true grayscales and may range up toward ten or more even in some successful cases although sigmas that high typically signal a bad choice for at least one grayscale step. Look at the Levels histograms for all three colors. If there is a step that seems out of place with the rest, identify it, remove it from the selection, and try again. In any case, always check to see that the gray patches are reasonably gray after calibration. *If the grays are not gray, the calibration is not good - do not use a calibration that does not check out well.* The usual cause for this is using areas which really are not gray, but there are other causes.

As we stated in our calibration web page, it is not strictly necessary that the grayscale be "gray," only that it be even-toned and not very deficient in any of the three colors. Gray is best, but alternatives may be useful in trying to produce natural gray scales. For instance, if there are flesh tones from a single individual that show sufficient differences in shading and are even toned, it can be possible to form a "Gray" scale and calibrate on those. In doing this, however, remember that **ColorPos** will be trying to make the tonal scale gray and it will be necessary to color balance back to flesh tones (using highlights adjustment) afterwards.

Sigma and the "Best" Calibration

In technical terms (which you need not understand) these calibrations involve non-linear least squares fitting of function combinations that are ill-behaved due to cross-talk. As explained in our calibration web page the behavior of blackpoint and gamma is confounded. Due to this, it can be difficult to know whether a gamma of 1.5 is significantly better than a gamma of 1.0 in setting a calibration. However, the three color gammas will *track* one another; that is, a calibration producing a red gamma of 1.5 will also require higher green and blue gammas than the calibration giving a red gamma of 1.0. In fact, the three gammas will normally track closely with the method used by **ColorPos** for the gamma scroll.

If an **Apprx** calibration is done using two different gammas, say 1.0 and 1.5 again, it normally is *not* correct to assume that if the sigma reported for 1.5 is less than the sigma for 1.0 then the 1.5 calibration is better. The design of **Apprx** is such that it cannot validly compare the two.

You will also find slight variation between two calibrations that ought to be identical. For example, if you do a Known calibration to a grayscale and then do an Apprx calibration without changing the gamma, the results should be identical. Similarly, if you do a calibration of either type and then repeat the calibration with "Use S%" checked, leaving the Shadow %s as the calibration set them, the results should be identical. In either of these cases, there will actually be small changes in the values so that they are not

exactly identical. This has to do with such factors as the granularity of the histograms, is normal, and is not of consequence.

Calibration Modes

The calibration area has a Mode box. This selects exactly how differences are weighed in matching the calibration. Mode 1 is the normal mode in which the "gamma-corrected" pixel values are used. In Mode 3, the linear pixel intensities are used, and Mode 2 is halfway in between. Here "gamma-corrected" refers to the system gamma, called "Gamma C" in **ColorPos**. Normally the difference in the results of the three weighting systems will be small and it is usually an indication of a marginal grayscale if the differences are large. This control is largely intended for our own testing.

Problems and Comments

General Problems

We must repeat that a good source image is absolutely necessary for good results. Bad scans or bad RAW conversions are the most likely source of trouble if **ColorPos** consistently does not work well on good test images. See the section on **The Starting Image** and the scanner page on our web site:
http://www.c-f-systems.com/Scanners.html.

Color Balance Extreme Problems

There will be will be a small number of images do not have gray patches suitable for preview click color balance and which also do not respond well to the **Auto** procedure. In our experience this is nearly always because one color (Red, Green, or Blue) is missing from the highest highlights. In those rare cases when color balance is way off, use **Color Adjust** to scroll the color that seems to be missing. That is, if the image has a strong cyan (blue-green) cast, adjust Red, for a strong magenta (red-blue) cast, adjust green and for a yellow cast, adjust Blue. Very likely you will be able to scroll to a reasonable color balance, and normally a major adjustment of only one color will be required (followed by an **Lightness** adjustment). If the color balance seems to be still off a bit, try the suggestion for **Setting the Color Balance** below, in Photoshop.

Different Lighting in Different Parts of an Image

Normal color balance depends directly on lighting, so if the primary source of light is different in parts of an image, the parts may require different color balance. **ColorPos** can deal directly with this when there are only two parts with different lighting - see **Selection Control Panel** including **Feathered Selections** and **How to Make Selections**. In the rare cases where there are more than two principal light sources, these same sections can be of help, but see **Setting the Color Balance** below for an explanation of how to do the color balance within Photoshop itself, where multiple selections can be

handled. It is important to realize that in images with more than one principal light source it may be undesirable to completely color balance all the parts of the image as this may not be what the eye would see. For instance an image that is partly in sunlight and partly in shade (with a large influence of blue sky) might actually look worse if the two parts of the image were each fully color balanced. **ColorPos** makes it easy to move partway to a full color balance using the CC filter pack readout, but working with multiple parts of the image in Photoshop will not have this capability.

Color Balance Differs in the Shadows and Highlights

For an image that has been properly characterized color balance is normally an easy task. The principal symptom of a poorly characterized images is that the color balance will be different in the shadows, mid-tones, and highlights and none of the color balance methods will fix this. For example, when the bright tones of an image look OK the dark areas are magenta. Particularly if you are having serious problems color balancing several images from the same source there is a good chance that the images are not properly characterized. This can be because the processing differed from the manufacturer's spec, the film was stored poorly, or any of the numerous other problems that can occur in film handling. In such cases - especially if there are several similar images - it is worth trying to characterize the source using the method described for the **Film Type** ScrollBar. If the best results from that are still unsatisfactory, take those best results and set the color balance for the lighter areas of the image as best they can be. Then use the methods described for the **Shadow** ScrollBar to bring the shadow areas into color balance.

Finally, remember that you can't make a silk purse from a sow's ear. There are images with problems serious enough that they never will produce a good result.

Setting the Color Balance

For images with color integrity - such as carefully scanned images or careful RAW conversions or negatives properly inverted using **ColorNeg** - it is normally very easy to do a precise color balance within Photoshop in those cases where the balance produced in **ColorPos** itself seems off or where it is necessary to separately color balance several different areas in an image. The technique is based on the same principles as the method used when clicking on the preview image in **ColorPos.** In most cases there will be a gray patch somewhere in the image that will be satisfactory and it can be easier to find such patches in Photoshop than in the **ColorPos** preview. Our page http://www.c-f-systems.com/RoutineBalance.html includes a target with shades of flesh tones and sky colors to use in color balancing in place of the gray, but it is trickier to use than grays from the image itself.

When gray patches can be found, with the image loaded into Photoshop, use the Image→Adjust→Levels command and double-click the highlights dropper to bring up the Color Picker window. Look for an area in the image that should be gray, anything from almost white (but with no pixel above about 245-250) to quite dark gray. (Yes, for

an image with color integrity the "highlights" adjustment is appropriate for dark gray as well as true highlights.) White or gray clothing, asphalt, concrete, tree bark are often good targets if really gray. Put the cursor over that area or click on it. Watch the pixel numbers that appear in the color picker and be sure they are fairly consistent. Now pick the middle value of R, G, or B in the color picker window and type that same number in for the other two colors so they are all the same. OK out of the Color Picker and click the highlight dropper cursor on the same area you picked for the gray previously, again. The calibrated image has been color balanced. If you are not satisfied with the result, pick another apparently gray area and try again. In doing this you may wish to add a little to the Color Picker numbers to lighten an image or subtract a little to darken an image, but we do not recommend doing any major changes in tone depth. When you exit out of Levels, it may ask if you want to save the settings you have selected with the Color Picker. You do not, as they will only lead to confusion later.

Perhaps you have noticed that here we exclude white from the "grays" that can be picked. This is because in the positive image the white areas will tend either to have gone into saturation or to be S-curved as **ColorPos** does.

Once the image has reached this stage – and not before – we recommend using our **GamSat** plug-in for any major color or contrast enhancing that is to be done. Such enhancements move the image away from color integrity, but **GamSat** will preserve color integrity insofar as is possible. If **GamSat** is not able to make the desired changes, we suggest that any major adjustments of contrast enhancement, lightening, darkening, etc. be done by first converting the image to Lab mode and using the Curves tool to make the adjustments. Lab mode also preserves color integrity insofar as possible, but of course can do so only after color integrity has been established, as we have here. The curves tool can be used to minimize the loss of highlight and shadow detail.

Color Management

Any "color management" applied to images prior to their being delivered to **ColorPos** is more likely to hurt than to help. The first order of business is to deliver a clean, unaltered, 16-Bits/Channel image for **ColorPos** to use.

As to what color management should be done after **ColorPos**, it is a matter of what appears to work best for you. We normally assign Adobe RGB, by default. This appears to be a casual, unreasoned answer, but that is not the case. By the time a color slide gets into positive digital form it has gone through primary color separation via the three (or more) sensitized silver halide layers in the film, is then expressed by the primary colors in the cyan, magenta, and yellow dyes of the film, goes again through primary color separation according to the sensitivities of the scanner, and will finally be expressed as a positive image using yet another set of primaries. Added to this are the variations in film gamma caused by processing differences. Even in the best scenario, for different films and different scanners each of these steps will behave a little differently and the detailed characteristics for the steps are not generally available. With digital cameras, the image will have gone through unknown digital processing which may try to "enhance" the

image or make up for shortcomings of the sensor. The spectral sensitivity of the sensor is in general not known nor are the spectral characteristics of the bayer filters used. That the system works at all is due only to the fact that the designers of these system have, over the years, aimed at similar - but not identical - targets. All in all this makes the choice between profiles such as Adobe RGB and sRGB a matter of preference rather than accuracy.