



PHOTO CD INFORMATION BULLETIN

Fully Utilizing Photo CD Images Maintaining Color Consistency When Creating KODAK Photo CD Portfolio Discs

Article No. 5

This article is the fifth in a series in which we will discuss selected topics covering the imaging science of the Photo CD system. The goals of this series are to further your understanding of the Photo CD system and to provide you with information helpful in producing the maximum quality for each Photo CD image.

In this article we describe some image quality issues and recommendations to use when creating Kodak Photo CD Portfolio discs.

Background

Initially, all Photo CD discs (i.e., KODAK Photo CD Master and KODAK Pro Photo CD Master) were created on a dedicated system where the only input was film. With proper lab practices, all Photo CD images exhibit similar tone and color reproduction making them “compatible” with each other.

With the introduction of Portfolio Photo CD, users can store any computer-created or computer-modified files to a KODAK Photo CD Portfolio Disc. In most cases, the color and tone reproduction of these images is expected to be compatible with images on all other KODAK Photo CD Discs on the market (i.e., KODAK Photo CD Master Disc, KODAK Pro Photo CD Master Disc, etc.).

In a typical “multimedia” workflow, customers will use creative packages (e.g., KODAK Photo CD Access Plus Software, ADOBE PHOTOSHOP Software, ALDUS PHOTOSTYLER Software, KODAK Create-It Photo CD Presentation Software, etc.) to produce graphics or modify existing images. These images will be saved in files and become assets for software products

(e.g., KODAK Arrange-It Photo CD Portfolio Layout Software or KODAK Create-It Photo CD Presentation Software) where the user interactivity is added.

This interactivity includes image sequencing, audio, and branching through menu selections. After completing this creative step, a script is written and sent with the images and audio to a service bureau that can write KODAK Photo CD Portfolio Discs. Using the KODAK Build-It Photo CD Portfolio Disc Production Software, this service provider creates a Photo CD Portfolio Disc from these “assets.” This disc can be played on computer platforms, KODAK Photo CD Players, CD-I players and 3DO players. Furthermore, the disc could be submitted to a disc mastering company for mass replication of inexpensive pressed discs.

Another use of Portfolio Photo CD is the storage of any digital image in the Photo CD format. These images can be modified images from Photo CD Master Discs, computer-generated images, images scanned from film, etc. For example, you can read an image from a KODAK Photo CD Master Disc into ADOBE PHOTOSHOP Software using the KODAK Photo CD Acquire Module and combine it with other images, text or graphics. After this creative work, the image can be saved in either TIFF or PICT format and delivered to the service provider for conversion to a Photo CD disc. By converting to a Photo CD Portfolio Disc, you can leverage the multiplatform capabilities of the Photo CD format and the wide variety of Photo CD enabled products.

Including images from a wide variety of sources or input devices creates a potential for inconsistent image quality. Similar to preparing image data for devices such as printers, the Photo CD Portfolio image must be properly prepared so the data is consistent with other Photo CD discs. This article will focus on the issues

and recommendations required for maintaining the image's color and tone reproduction quality.

Build-It Version 1 Color Encoding Expectations

One of the functions of the KODAK Build-It Photo CD Portfolio Disc Production Software is to read RGB or PHOTOYCC files in TIFF or PICT format, convert them to PHOTOYCC, and store them as IMAGE PAC Files on a Photo CD Portfolio disc. To convert images from one device to another, it is critical to have the data describing the color aspects of the source device to achieve high-quality results. Currently, there are no universally implemented methods of storing an image's reference color information in a digital file. Some improved methods are becoming available, but the vast majority of files today have "RGB" information with no additional information specifying the origin of that data.

In KODAK Build-It Photo CD Portfolio Disc Production Software, Version 1, two color metrics can be used. A color metric is the set of three values that describes the color information in a pixel. Most useful metrics have a specific color definition which allows subsequent software or hardware products to produce a high quality image. The first metric used by Build-It is RGB (in either TIFF or PICT format), where it is assumed that the RGB is consistent with a gamma 2.2 monitor, D6500 white point, and monitor phosphors defined in the CCIR 709 standard. These criteria allow a simple conversion to PHOTOYCC. If an RGB TIFF file is created on a system with a significant departure from these criteria (e.g., gamma 1.8), the images will retain that undesired bias. For example, in the "gamma 1.8" condition, the user would obtain a Photo CD image which would have a higher contrast or gamma than desired because the TIFF data was originally intended for a lower gamma monitor.

The second metric is PHOTOYCC where Y is stored in the R channel, C1 is stored in the G channel and C2 is stored in the B channel. If your creative system can convert your image to PHOTOYCC, the data can be stored on a Photo CD disc without any additional color conversion. In the future, a set of industry-defined TIFF tags, which enable the storage and recognition of PHOTOYCC, will be used. Very few systems today

have been updated with these TIFF tags, however there are workarounds that can be used immediately. By converting to PHOTOYCC, the image originator can use all of the benefits of this color encoding metric. These benefits include a color gamut and dynamic range which can encompass all film and scene colors, and thus not be limited by today's typical monitor-based RGB metrics.

Monitor Calibration

In order to use the computer monitor as an accurate color reference, it should be calibrated to a specific white point and gamma setting. If these variables are not controlled, the state of the monitor may introduce a bias which could be carried through to the Photo CD Portfolio Disc or any other output device (e.g., printers or film writers).

To minimize these problems, a monitor calibration system must be used. Several manufacturers produce devices that measure the characteristics of a monitor and download information to a display board to bring the monitor to a known position. For those who require very high precision, they should purchase monitors which are hardware calibrated close to where they will be used, otherwise the software calibration may introduce undesired artifacts (e.g., quantization) in extreme cases.

At the very least, the user should use some type of visual adjustment tools (e.g., Knoll Gamma INIT for APPLE Macintosh Computers) to place the monitor closer to the aim position. These tools are not perfect but are better than using uncalibrated "out of the box" equipment.

When using creative packages to prepare files for Photo CD Portfolio Discs, the user should set the calibration tool and software preferences for gamma 2.2, D6500. By doing this, they are working with and viewing the image in an RGB space which is consistent with the RGB that Build-It expects.

Viewing Conditions

Monitor viewing conditions are as important to consistent quality as monitor calibration. Many users examine their creative work in viewing conditions that may bias their results. The biggest factor is viewing flare. Flare is caused by ambient lights which shine on the monitor surface, thus reducing the image's apparent contrast. Typically, the user will raise the contrast of the image and will then be disappointed when the print or Photo CD Portfolio Disc has too much contrast. Colored illuminants will affect the color appearance of the image on the screen.

Monitors should be used in subdued lighting so that the image shadows are controlled by the CRT and not affected by the glare from the room lights. One example of poor lighting is standard office environments which use bright fluorescent overhead lights that have a greenish cast. Another example is to position a monitor near a window where sunlight illuminates the monitor. In this case, the user will obtain different results depending on the time of day or the weather outside.

In general, the room lighting should be subdued, but should allow one to work safely and efficiently. Use indirect lights of approximately 5 lux (i.e., eliminating reflections on the monitor surface). As a reference, typical office lighting can be 30–100 times this recommendation. Color temperature of these lights should approximate daylight. Cool White Deluxe fluorescent tubes are suitable. To avoid colored reflections, surrounding surfaces should be a matte neutral gray, and users should avoid wearing white or brightly colored clothing.

Using KODAK Photo CD Master Discs in Creative Applications

When using Photo CD discs as input in applications that will eventually result in a Photo CD Portfolio Disc, keep the following in mind:

First, follow the suggestions mentioned in the previous sections. Otherwise the images will retain some undesired monitor or viewing environment bias.

Next, be aware that there are an ever-increasing variety of software and hardware products that can display a Photo CD image. Many of these products have user adjustments that attempt to compensate for the monitor and viewing conditions which will cause problems when creating a Photo CD Portfolio Disc.

For example, the KODAK Photo CD Acquire Module for ADOBE PHOTOSHOP Software and KODAK Photo CD Access Plus Software provide a variety of look-up tables which "shape" an image for a particular monitor. Unfortunately, a high contrast look-up table may be fine on this specific monitor, but when the image created by this table is sent to another device that doesn't compensate for this bias, a poor result will be obtained. A new table has been created which minimizes the adjustment for monitor characteristics and is recommended for use when reading Photo CD discs for Portfolio use. This table is called PORTFOLIO and is more consistent with the RGB color metric expected by KODAK Build-It Software. Images should look pleasing on a monitor set to gamma 2.2 and D6500. This new table is available on CompuServe (GO KODAK) and Internet. Using the other plug-in tables to improve poor original images is fine as long as the monitor is setup to gamma 2.2 and D6500.

Many applications which do not document their RGB rendering produce images in which highlight information has been lost and at times could cause coloration in bright areas (i.e., sometimes this RGB is called "Video RGB"). Fortunately, the mid-scale contrast is consistent with the RGB that Build-It expects and will serve for less demanding applications. This same mid-scale contrast may not be appropriate for use in more critical applications.

Some applications incorporate the KODAK Precision Color Management System for accessing Photo CD images such as the KODAK Color Management System Photo CD plug-in shipped with ADOBE PHOTOSHOP 2.5.1 Software. It allows the user to customize the conversion from YCC to a variety of color spaces by selecting Precision Transforms (PT) for both *source* and *destination*.

The default *source* PTs are selected based on the type of original and how it was scanned (Negative vs.

Universal E-6 EKTACHROME). The default *destination* PTs included with PHOTOSHOP are targeted at PHOTOSHOP RGB with a Gamma 1.8 and D5000 white point or at PHOTOSHOP L*a*b*. Optional *destination* PTs can be added to the KPCMS folder and allow for conversion directly to CMYK as well as to other target RGBs. KODAK's CMS Group will release a Portfolio (Gamma 2.2, D6500) *destination* PT which can be used to open YCC images into a space which is consistent with the RGB expected by Build-it. This PT will be posted in KODAK's AOL and CompuServe (GO KODAK) forum libraries.

Another option occurs when the image manipulations are restricted to cropping, padding, resizing and cloning. In these situations, the color and tonal content of the images is NOT being adjusted. To maximize the final image quality, we recommend accessing images by using the PHOTOYCC metric available in the KODAK Photo CD Acquire Module for ADOBE PHOTOSHOP Software or KODAK Photo CD Access Plus. The luma information (Y) is read into the Red channel and the chroma information (C1 and C2) are read into the Green and Blue channels. The image will look greenish and quite unusual but, by examining the Red channel (i.e., luma), one can usually perform all of the noted image manipulations. By working in PHOTOYCC, one retains all of the inherent color and tonal range. After work is complete, store the image in a TIFF file and be sure to write down which files are in the PHOTOYCC metric. When the files are dropped off to a Build-It service provider, include this written information so the provider can process the images properly.

Some handy PHOTOYCC values for padding images include:

	Y	C1	C2
Highlight white	255	156	137
Diffuse white	225	156	137
20% gray	79	156	137
Black	0	156	137

Using Other Image Sources in Creative Applications

When working with images from sources other than Photo CD master discs, many of the same guidelines are important. The monitor should be set to D6500 and gamma 2.2 so that the resultant RGB images are consistent with the metrics that KODAK Build-It uses. Further, as mentioned earlier, the viewing conditions should be maintained so that they don't influence your color or tone reproduction decisions. Finally, any scanner attached to the system should be setup so that it converts the scanned data to a gamma 2.2, D6500 display system.

For computers that utilize the KODAK Precision Color Management System, output profiles will be developed to convert the displayed images to metrics that are consistent with KODAK Build-It Software. These profiles will allow one to work with any supported monitor setup and produce compatible output files. Other color management systems may allow for conversion from your preferred monitor setup (e.g., D5000, gamma 1.8) to the setup that Kodak Build-It Software expects.

After editing the image for a pleasing reproduction, it should be stored as a RGB TIFF file and delivered to the service provider. This RGB TIFF file will be converted to PHOTOYCC format and stored as an IMAGE PAC file onto a Photo CD Portfolio disc.

Summary of Recommendations

When doing creative work that will be subsequently used on a Photo CD Portfolio Disc and compatibility with other Photo CD discs is desired:

- Use a monitor calibration tool and set the monitor to a gamma of 2.2 with a white point of D6500.
- Use subdued lighting for your computer system.
- Avoid windows or bright overhead fluorescent lights as they will influence the appearance of the image on the monitor.
- When using Access Plus or ADOBE PHOTOSHOP Software /KODAK Photo CD Acquire Module 2.0.1, choose the PORTFOLIO look-up table.
- When using KODAK Precision CMS to open your images in PHOTOSHOP or PHOTOSTYLER Software, a new Destination Transform should be used that will be available in the future. The current transform to RGB in PHOTOSHOP is not recommended.
- If performing spatial operations such as resizing, cropping, padding and even cloning, access the image in the PHOTOYCC metric for better image quality. Though the image has an unusual appearance, all of the color and dynamic range of PHOTOYCC format is retained.
- When obtaining data from other devices (e.g., scanners) first adjust their settings to produce data consistent with a gamma 2.2, D6500 display device, whenever possible.
- When using an image from a device whose specifications are known to be anything other than gamma 2.2 and a white point of D6500, examine the image on a system setup to gamma 2.2/D6500 and modify the image as required.

Industry Directions

As color management capabilities become part of every computer operating system, many of these issues will become transparent to the user. Ideally, these systems will know the characteristics of your scanner, monitor and output device. With this information, consistent color should be maintained. Today, there are some standalone systems which provide this capability. For example, the KODAK KEPS PCS100 Imaging Station provides color management aimed at the printing and publishing market for an APPLE MACINTOSH System.

Summary

By following the outlined recommendations, the open environment of Photo CD Portfolio discs can produce discs which are consistent with all other Photo CD formats. Using these guidelines will help maximize quality and minimize your frustration.

References

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