

Spyder® eBook

Color Management Can Be Easy

Quick facts for photographers and videographers

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Chapter Overview

1. Understanding digital color

- Which color measuring instruments you need for color management
- How the digital color world ticks
- Why you should work with RAW data

2. Capture Calibration

- Which tools are available for calibration
- How to obtain evenly-balanced contrast with the SpyderCUBE
- SpyderCHECKR and how it provides color balance
- How to get razor sharp autofocus using SpyderLENSCAL

3. Monitor Calibration

- How to initially calibrate your monitor
- What the colorimeter does for you during calibration
- How to control ambient light
- The options a soft proofing tool can offer you

4. Fine-Tuning Monitors

- How to make extended calibration settings
- What an advanced analysis entails
- How to calibrate two monitors
- What you must pay attention to while calibrating a complete studio and a projector

5. Color Tuned Printing

- What you need to know about printer profiles
- How to check if your printer and the printer driver are working properly
- What to look for when working with a spectrophotometer
- Get insights on how to use printer profiling technology

6. Soft Proofing & Media

- How to proof your images on the monitor
- Printing photos yourself
- What you need to know about monitor proofing during photo printing from a service provider
- What you should consider when printing on paper, canvas and foil

Foreword

What is color management?

You are probably familiar with color management if you've spent time on photography or videography. We often notice the absence of color management in everyday life. We have all taken pictures, ordered prints and noticed that they have a flaw, like a green cast. "That's not what it looked like when I shot the photo!" is the most common reaction. Nobody wants unattractive skin tones; not in their personal photos, and certainly not in professional ones, such as portrait and wedding photos.

Color Management is technology designed to minimize color and brightness inaccuracies.

How does the color discrepancy between perception and print arise?

To understand color management, you first need to take a closer look at the properties of light. White light consists of all of the colors of the visible spectrum. As the composition of light changes, its color temperature changes. For instance, there are more reds in the evening sun than in the midday sun, where the colors have a much more balanced ratio. That means a white sheet of paper should have a warm, neutral, or cool look at different times, but that is not always the case.

What about human vision? The retina of the eye, which is quite comparable with the sensor of a camera, perceives these color differences and redirects these signals to the brain. The brain analyzes this data and completes a white balance based on recent sensory experience. As a result, the sheet of paper mentioned above would then appear white in all cases. This phenomenon is called color constancy.

People also perceive colors at different brightness. Our brains perceive an image that differs from what's actually present. This explains the green-tinged photo: it was probably taken in fluorescent light, and imaging devices do not have the correction techniques of human vision to counteract this.

Color management can reduce this problem

To a certain extent, color management attempts to simulate the brain and corrects the raw data coming from the sensor in order to match the feeling of human perception more closely. Color management can do even more than just that. While a human being represents a closed system (more or less), where everything is finely tuned, this is not the case with modern technology. We combine input devices (camera, smartphone, etc.) and output devices (monitors, printers, etc.), without considering that each device has a different range of capabilities to capture or display colors. Different papers also have their own reflective properties in prints. All devices must be coordinated with each other to prevent any unpleasant surprises. This is why color management is necessary to achieve consistent color across devices and outputs.

Our eBook provides compact and practice-oriented information to answer the question, “What do I have to keep in mind to coordinate color across my workflow?”



1 Understanding digital color

The basics of color management

- ✓ Which color measuring instruments you need for color management
- ✓ How the digital color world works
- ✓ Why you should work with RAW data

Contents

Color Management Using Colorimeters	1/3
What ICC profiles Do	1/7
• Framework	1/9
• ICC in Practice	1/12
Color Model	1/12
Color Space	1/14
Color Profile	1/15
<hr/>	
Photos in RAW Format	1/17
• The Properties of RAW Image Files	1/19
• From the Image to the Workflow	1/21
• Benefits for Photographers	1/29
• Benefits for Graphic Designers	1/30
• Problem Areas	1/31
• DNG (Digital Negative)	1/32
<hr/>	
Glossary	217

Color Management Using Colorimeters

Why use color management equipment?

High-quality color control that is time- and cost-efficient is almost impossible to achieve without color management tools. Anyone who has ever set up their printer for fine art prints and has ended up using an entire ink cartridge and a lot of high-quality paper for test prints will understand this. The concept of color management involves coordinating systems so that once taken, the image on the output side (monitor, printer or other output device) appears as close to the original as possible. This also includes deliberate changes made to image content. In other words, photographic editing needs to be reproduced on the output side as it was carried out on the monitor. Why? Depending on the make and model, digital cameras have different color characteristics that can be corrected using a color calibration tool. What's more, lenses can also introduce color traits, while low-quality lenses even create clearly visible color casts and light falloff. These can be almost impossible to modify.

We can, however, influence the appearance of the digital image on the display. Without corrections, we also see an interpretation of the image that may not be representative of its true colors. This is determined by the electronic components of the display and its age. It gets trickier when it comes to printing images on paper. When we convert the light colors, which have determined the process so far, into printing inks, it can involve distortions and limitations.

The eye is not enough

In short, we are moving between physical worlds of color. We can work with several devices, which each individually interpret the colors for us. If you rely solely on the expertise of your eye and make adjustments according to your vision, you will very quickly reach your limits. Every additional device included in a color workflow will heighten the complexity. To add to this, color variations don't behave in a linear fashion, but differ according to saturation level and the shade of color.

INTERESTING ONLINE FINDS

This article gives a good overview on how human vision works

[More Info](#)

Finally, it is important to keep in mind the color constancy phenomenon. You'll notice how fast your eye compensates for color casts, such as when you change the color profile on your monitor. Our brain adapts for the brightest white in the field of vision. This phenomenon is called color constancy. It means we can't trust our eye to tell us if a display is neutral, as our brains may have "neutralized" it for us.



Sample representation of color temperatures: An image with daylight lighting (6500K), fluorescent, and incandescent lighting.



INTERESTING ONLINE FINDS

The subject of color, our perception of it and its various interactions with our total health is covered within this article

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Additional benefits of hardware-based color management

Some lab professionals – especially in the realm of black and white photography – might manage to color match a monitor and printer without any measuring devices. Yet even viewing digital data on another workstation or outputting images on a different printer will produce unpredictable results. The resulting image usually won't resemble the one the photographer intended to create.

Money spent on test prints would be better invested in an affordable monitor calibration device that works to color standards with other devices, rather than a closed system. The lab tech would also have the option to give his or her data to a print service provider afterwards. This wouldn't be possible if they kept to their non-color managed workflow, because the settings are device-specific and aren't standards-based.



The calibration tool for inks in action: SpyderPRINT compares the printed colors with the reference colors, calculates color differences, and compensates for them.

TIP

It is wiser to leave the measurement of colors to devices designed for this purpose. These, unlike the eye, are objective, and now there are reliable devices available for an affordable price.

[More Info](#)

What kind of equipment is necessary for color management?

You need two electronic devices for color management: a calibration device for the light colors of the monitor, and a profiling device for the material colors of the prints. Depending on the manufacturer, the devices are designed either for CMYK offset printing or an RGB workflow. For an explanation about the differences between CMYK and RGB, see the section “Color models” on page 16.



SpyderX measures the colors on the display, corrects these to reference values and adjusts brightness before creating an ICC profile.

INFO

Videographers, too, will enjoy the benefits of color management: with the SpyderX Elite you can analyze more than just the quality of the monitor. Special calibration targets for videographers are easy to use. An interactive help window makes it easy for beginners, as well.

[More Info](#)

What ICC Profiles Do

An ICC profile (also called a color profile) is a device-independent standardized data set that describes the color space of a color input or color output device, such as a monitor or a printer. Standardization is necessary for using an open system to allow any two devices to be used together with proper color correction from one to the other.



Without ICC profiling, different displays will reproduce the same image with different results.

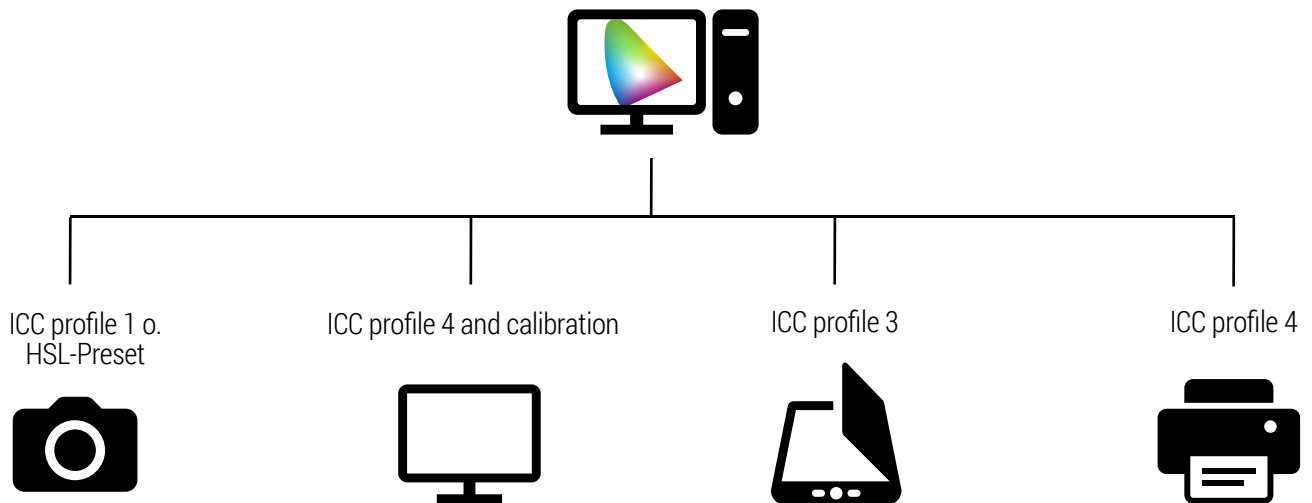
What an ICC profile is and how is it used

But it's not merely the description of the color space alone:

*"An ICC profile is (...) used to describe the properties of a device
for capturing and playing back color
to allow for compensation of errors during color reproduction."*

This definition by Andreas Kunert (from: Color management in digital photography, Bonn 2004) illustrates the principle of the ICC-based color workflow.

This color workflow works as follows:



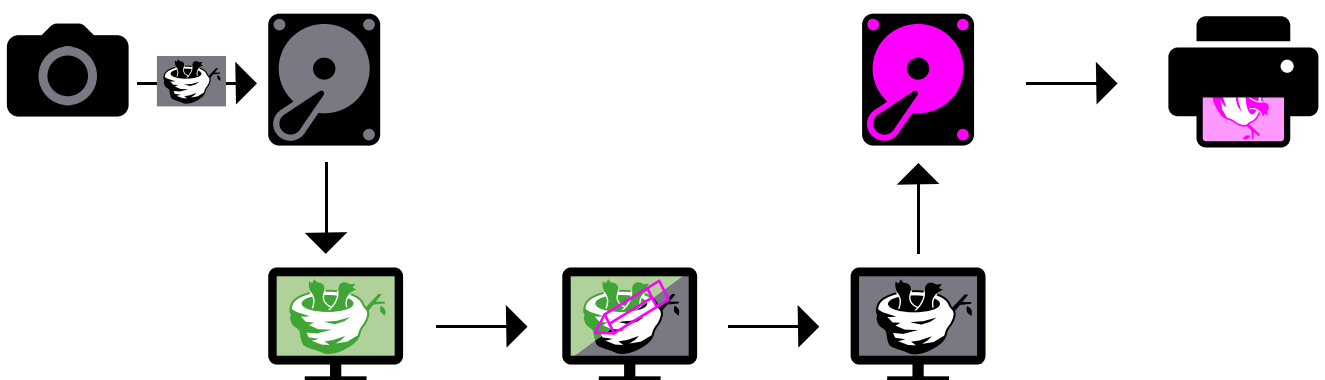
For all connected capture and playback devices (i.e. cameras, scanners, monitors, printers or projectors) - individual ICC-profiles are created. Alternatively, with capture devices, balance tools and HSL-presets can be used.

The color management system now carries out corrections based on the common framework. For example, an image may need to be transferred from one color space to another, like from a monitor screen to a printed image. In this case, so-called gamut mapping is carried out, where the colors of the larger monitor or camera color space are conveyed to the smaller printer color space. This process is done using a choice of rendering intents.

INFO

The ICC standard has now reached version 4.3. You will find more information on the Internet at www.color.org.

[More Info](#)



Error chain in a non-calibrated system: A neutral color image is corrected in an image processing program on a non-calibrated, green-tinged monitor by adding magenta for neutrality on-screen. Once saved, the previously correct image file that was represented incorrectly on the monitor would now contain incorrect values. The result would be prints with a magenta cast.

Why regular profiling is necessary

Unfortunately it is not enough to profile every device once and to then use it in any situation.

- **Digital cameras** must be matched with multiple profiles or HSL-settings in the RAW converter for lenses with different color casts.
- **Monitors** shift out of alignment over time. Regular profiling is necessary to ensure that the color temperature is constant and the color channels remain coordinated. The brightness settings of the display need to be adjusted before starting the profiling process.
- **Printers** are subject to continual wear and tear, which changes their printing characteristics. The printable color space (gamut) is, however, chiefly dependent on the paper and ink used. This makes it necessary to set printer profiles for every paper/ink combination, and to update if the inks or paper chemistry changes.

Framework

Improving the technical quality of color profiles

Important: Don't be alarmed by reduced contrast or saturation on screen while working with color profiles. The goal of profiles is to reproduce colors as they appear in the source file to improve the color accuracy. A highly saturated color display can cause an image to seem dull, or contrast can seem low, in favor of enhanced high-light and shadow detail.

Why is this so? Anyone who has ever compared different computer monitors or televisions in a showroom will know that these devices compete for attention using exaggerated brightness, color saturation, and contrast. Reproducing content as realistically as possible is not the goal, selling displays is. New displays continue to offer ever-higher brightness, making them seem more desirable than older screens. When these screens are calibrated and standardized using a color management system, they then exhibit more accurate, but less punchy, color.

This allows the user to objectively assess the actual color and brightness of an image. If the artistic intent is high contrast and saturation, it can now be added to the file, where it will reach the print, which the punch provided by a display in show-room-mode would not.

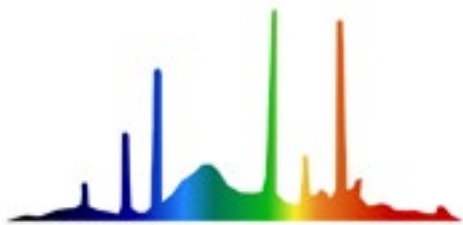
Printers, on the other hand, need correcting due to their limited color capabilities. With cameras, there is yet another significant aspect: scene lighting. Things get more complicated here as attention needs to be paid not only to white point, but to an entire spectrum of light that can vary in its composition.



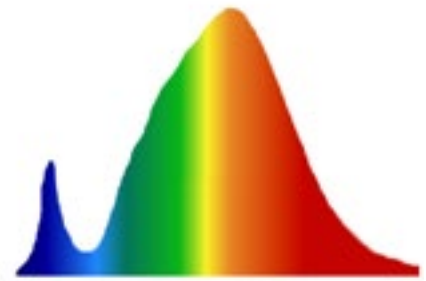
Daylight



Incandescent bulb



Fluorescent bulb



white LED

Light sources have a whole range of spectral compositions and, as a result, different color characteristics.

How to master the color perils of everyday life

In reality, there are other complications. These come about due to the automatic, in-camera editing of the capture, and image editing on the computer by the user. That's why, when photographing in JPEG format, you need profiles for the assorted camera settings and specs for handling color profiles when opening the images. If you work with RAW photos, a highly flexible RAW workflow is added.



The aim of working with ICC profiles is to get the same color results on different output devices. In most cases, the colors displayed should represent the smallest color space in the workflow.

EXPERT INSIGHT



How ICC profiles came about

The acronym ICC refers to the “International Color Consortium,” a panel dealing with digital color hardware and software manufacturers. The starting point of the consortium was an invitation from FOGRA in 1992, at which they wanted to shape the future of color communication in open computer systems.

At that time, there had already been color management solutions. However, the use of “open systems,” allowing a variety of devices from different manufacturers, was new in print media production. Before DTP took over prepress, at the beginning of the digital age in the 80’s, work was done with closed systems whose components were all supplied by a single manufacturer. Lack of competition allowed these products to be expensive, but they were also inflexible. Many offered no way to export files. The first ICC standard was published in 1993, based on, but improving, Apple’s original ColorSync system. The device-independent description of color for different components was forward-thinking, and very successful.

ICC in Practice

What should be considered?

There are many issues and challenges in the world of digital color, such as choosing profiles for various purposes. The problems usually start when users set their custom monitor profile as the RGB working space in Photoshop. Not only does this configuration not solve color issues, it actually makes them worse.

One should differentiate three areas of color management before the practical use of ICC profiles: **color model**, **color space** and **color profile**.

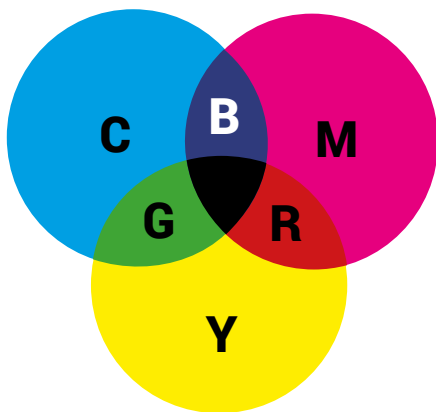
Color Model

First, you need to be clear on which color models you're dealing with when working with images:

- Cameras and monitors use the **RGB model**, in which the color spectrum is made up of the light colors red, green, and blue according to the additive color model used with emissive color, such as light, and back-lit displays.
- When the images are printed, the model is less clear.
 - A) The subtractive (reflective) CMY color model, along with the additional color black (CMYK), are used in offset printing. Black is added as a fourth color for a number of reasons, including cost savings.
 - B) In a classic photo lab a color exposure is made onto light-sensitive photographic paper according to the rules of the additive color model.

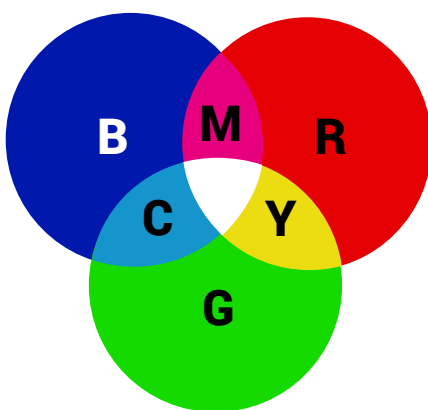
- C) Inkjet printers are a hybrid. Although they work according to the subtractive color model inks, the process varies. Some printers use four colors, others six, others with eight or more. The image data for the output is therefore not prepared in CMYK, but in RGB.

A printer communicates in RGB, and only during the last step between the printer driver and printer automatically converts to device color channels. Such printers are designated as RGB printers even if they print using CMYK+ colors. Because we are primarily looking at the needs of photographers in this series of articles, we will focus on the RGB color workflow.



● Cyan ● Magenta ● Yellow

Cyan/magenta/yellow (CMY) are subtractive colors. They are the complementary colors to the additive colors of red/green/blue (RGB). All three colors combined together filter out all wavelengths of the visible spectrum, resulting in black. The principle of subtractive colors is all around us. A red cherry reflects mostly red wavelengths, and so appears red. Many colors in the visible spectrum can be emulated by mixing the three subtractive base colors. Using more saturated base colors, allows a wider range of target colors to be emulated.



● Red ● Green ● Blue

The additive color model rests on the primary colors red, green and blue (there is no functional color model based on red, yellow, and blue, despite what art instructors may say). The majority of visible colors can be created in RGB. All three combine to create white, as counterintuitive as that sounds.

INTERESTING ONLINE FINDS

Adobe explains why color models are used in order to classify and qualify colors



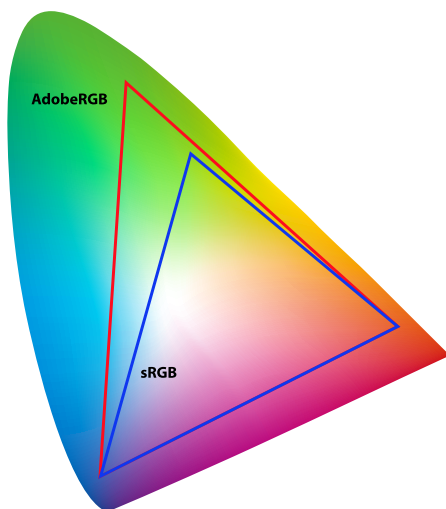
[More Info](#)



Color Space

It's important to note that an RGB color model can include most colors visible to the human eye. Cameras, monitors, inkjet printers and exposure devices can never reach all the colors of the visible color spectrum, only a subset. An RGB working space is specified in many imaging apps and defines the user's focus on a specific part of the whole RGB model. There are as several color workspaces preinstalled in most apps, and more available for download. For photographic purposes, only two color working-spaces have seen wide use: sRGB and Adobe RGB. However, new color spaces like the eciRGBv2, LStar RGB, and Display P3 are finding their way into photography.

- The factory settings on entry-level digital cameras and phones often include only the "sRGB" color space. Anyone who using such cameras who processes their images on the computer, but later either prints them themselves, has them developed by a low-cost photo lab, and/or uploads them to the Internet is well served by the consistency and simplicity of an sRGB workflow.
- Owners of high-quality cameras can choose if they want to take their pictures in the (slightly smaller) sRGB color space or in AdobeRGB. If they have an option for AdobeRGB they should choose this color space as a workspace in Photoshop. The basic rule is that when choosing your working space in Photoshop, orient yourself to the source color space of the input device. Anyone who works primarily as an image editor and deals a lot with outside data should also choose Adobe RGB as their working space.



TIP

Data not supplied in AdobeRGB should not automatically be converted into this color space upon opening, but be left in its original space and converted using Photoshop's Convert to Profile option, if conversion proves necessary.

The Adobe RGB and sRGB color spaces and their position within the CIE color diagram: The horseshoe-shaped boundry maps the human visual range.

Color Profile

The third area of color management is device color profiles. These have the task of balancing the color characteristics of an input or output device when conversions to or from another space are needed.



EXAMPLE

A monitor profile incorporates calibration for the RGB channels including white point, with device descriptions of gamma, whitepoint, and gamut. The color management of the operating system or the application leaves the calibration in place, and applies any needed corrections based on the device description. These color profiles are available to the operating system and can be managed by it. To access the profiles, apps typically use OS calls that supply them.

Inkjet printer data is left in the RGB color space. Multiple profiles are drawn up for these printers -- one for each combination of printer and paper. Those who do not use OEM inks, have even more need for custom profiles for each printer, ink, and paper combination. These profiles are managed by the OS. When it transmits the RGB data to the printer driver, the system applies the selected profile in order to optimize the color separation to the number of inks in that printer model.

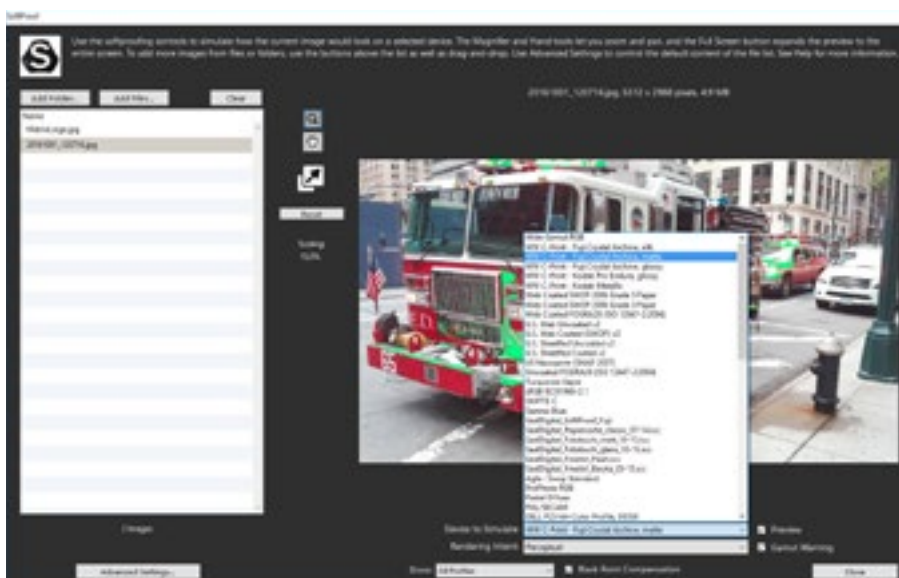


TIP

Programs like Adobe Photoshop and Lightroom, as well as the Datacolor software upgrade SpyderX, use printer color profiles in their soft proof feature and show an emulation of the print colors on screen.



For photos that are taken in RAW mode, it doesn't matter what color space is set in the camera. The application of a color space takes place only when processing the image in the RAW converter.



SpyderX Elite soft proof with the color gamut warning activated. This indicates which colors from the original file are not within the printer gamut.

Photo in RAW Format

Why you should consider working with RAW data



INFO

RAW data or RAW files are recorded onto the storage medium in-camera with practically no in-camera processing.



RAW data is produced mostly on the basis of the Bayer pattern, which resembles a three-color checkerboard. Each CMOS sensor pixel features either a green, blue or red filter. The ratio here is typically 2 : 1 : 1. The Bayer pattern simulates the green-dominated color perception of the human eye.

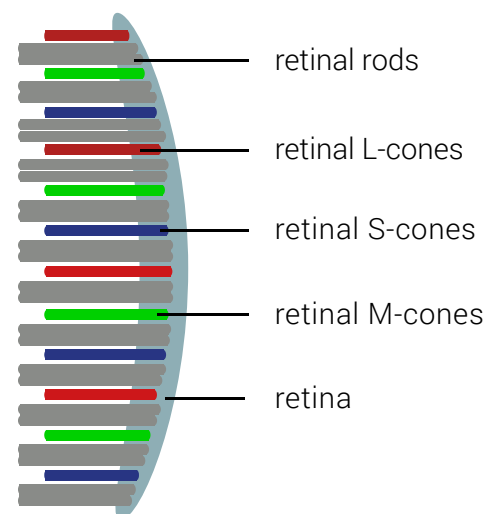
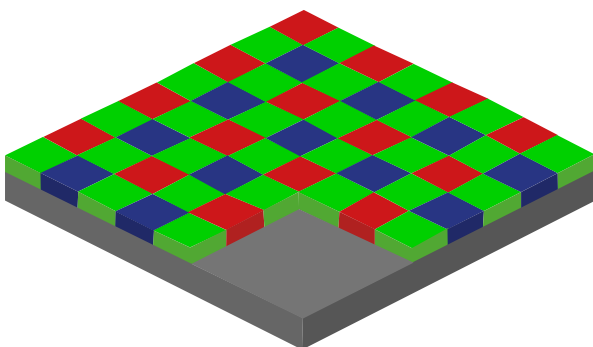


Diagram of a sensor as well as the retina of a human eye: The analogy between the CMOS sensor and retina is easy to spot. Both use the same "technology," the same color model.



INTERESTING ONLINE FINDS

Should you be shooting in RAW? Read why Digital Photography School thinks you should

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Some photographers are still skeptical about working with RAW format and frequently pose arguments like:

- RAW data are larger than JPEGs, so fewer pictures fit on the memory card
- To use RAW formats, you must install additional software from the camera manufacturer onto the computer
- At first glance, RAW images often seem less sharp and unbalanced, compared to the automatically corrected images in JPEG format.

But many of these problems have solutions. For instance, a 32-gigabyte memory cards can be purchased for under \$10US today, so space should no longer be considered a significant issue.

Current versions of Photoshop, as well as the sister applications Photoshop Elements and Photoshop Lightroom, support RAW files from almost all camera models. There are, of course, also special programs from camera manufacturers that include very powerful, workflow-oriented RAW converters, such as Capture One®, DxO® OpticsPro® or AfterShot Pro®.

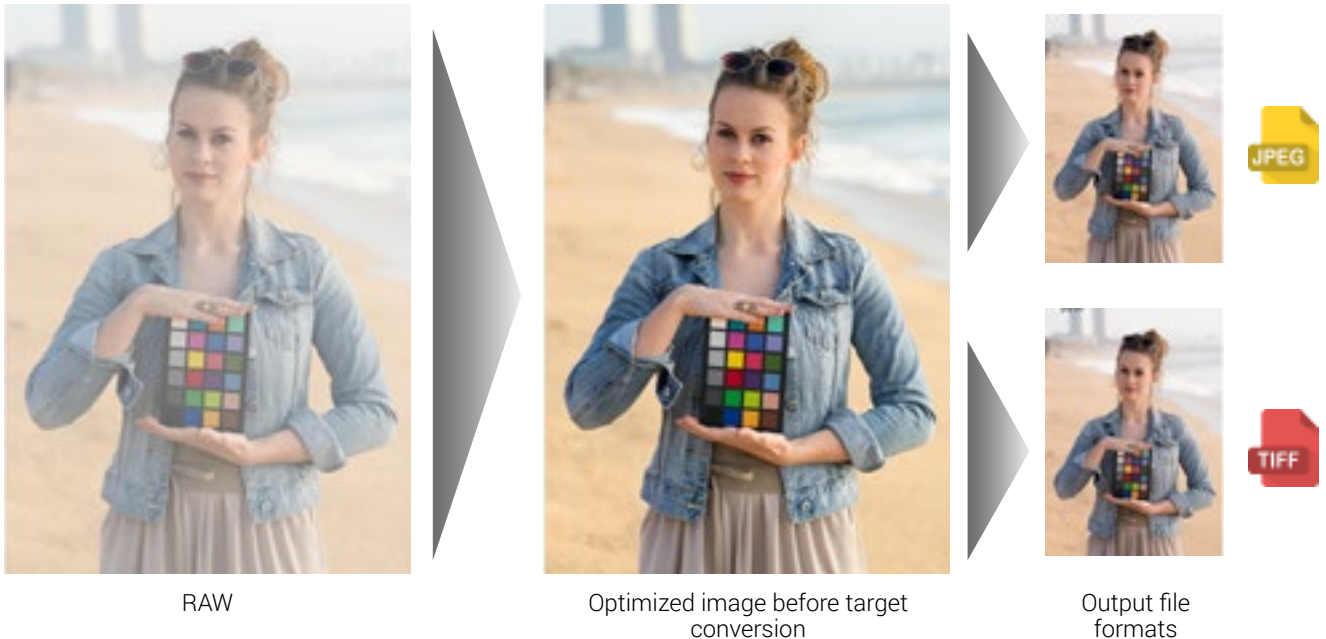
Contrary to first impressions, you get better pictures from RAW data, though it may require more user adjustment. For this reason, photographers are increasingly interested in using “digital negatives”, as RAW is sometimes called.

“The discussion about whether you shoot better in RAW or JPEG, comes up repeatedly in the Photography Network/Nikon Community. We can see here that approximately 70% of our users are basically using the RAW format. Anyone who wants to get the most of his pictures, puts just as much emphasis on color management and calibration of monitor and camera as on the complete control of the individual image data processing steps provided by the RAW format. Arguments like “needs a lot of storage space” are obsolete in today’s world. And if time is a factor, e.g., to meet a deadline, most of our users choose the option that most cameras offer of saving RAW and JPEG at the same time. The benefits of the 12 to 16 bit color depth and greater exposure latitude in RAW shots compensate the bitter pill of time consuming processing work for the majority of our users.”

(Klaus Harms, editor of the Photography Network/Nikon Community)

The Properties of RAW Image Files

RAW, Optimized image before target conversion, JPEG, TIFF



A RAW image file can seem brighter or darker, depending on the image, compared to an output format such as JPEG. The image is optimized either in the camera or after download, using a RAW converter, and eventually converted to the preferred output format.

What you should know about TIFFs, JPEGs and RAWs

To convert an image to common use formats such as JPEG or TIFF, a camera makes multiple correction calculations with its internal image processing after capture. These include:

- **TIFF** (Tagged Image File Format): This format has its origins in pre-press. It supports elements like the CMYK color space, and is able to save layers and offers lossless compression (LZW, ZIP). When converting into TIFF format, 12/16 or 32-bit color can be converted into 8-bit color. It can also be set as a standard format alongside PDF and EPS for the lossless storage of image data.
- **JPEG** (Joint Photographic Expert Group): JPEG compression is a compression method which, depending on the compression rate, can result in more or less lossy data compression all the way to visible data loss at high compression. This is not typically of any consequence in the case of lower compression, so the smaller file size wins out. This format is not recommended for anyone processing images, since every time an image is subsequently opened, processed and saved the compression algorithm and accompanying loss of quality occurs again. JPEG is also available in different color depths.

- **RAW:** Although the images are captured with the same camera, RAW photos provide more image data than JPEG or TIFF files. RAW images contain all the information recorded by the image sensor during the capture. RAWs are barely reprocessed in the camera. In comparison with a TIFF, they require relatively little storage space, because the information is stored according to the Bayer pattern of only one channel and not all three color channels. Thus a RAW file from a 20 megapixel CMOS chip takes up about 20 to 24 megabytes of memory, compared to the 60 megabytes of a later 8-bit TIFF (or 120 megabytes for a 16-bit file). All additional values, such as white balance, color correction or contrast enhancement, are stored with only in text format (EXIF information). With other capture systems without CMOS technology—such as the SuperCCDs from Fuji or the Foveon chips used in the Sigma DSLRs—the memory footprint of RAW photos is larger.



INTERESTING ONLINE FINDS

SLR Lounge sheds some light on the merits of shooting RAW vs. JPEG

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EXPERT INSIGHT

Correction calculations made by the camera for JPEGs and TIFFs

White balance, exposure and sharpening are “baked” into these file formats. First an estimated white balance is applied. Then the software compensates for the Bayer interpolation softness. The color filters require two thirds of the image info to be interpolated. This plus low-pass filters lead to blurry contrast edges that need to be sharpened. So in the next step, the camera computes sharpened results. To make the images more appealing to the viewer, it also amplifies the contrast and increases the saturation. The weaker the electronic and optical camera components are, the more in-camera processing is required.

From the Image to the Workflow

How RAW files simplify your workflow

There is one key benefit of RAW files: When converting a RAW photo, the photographer can adjust almost all capture functions after-the-fact. The basic fundamental limits, such as the lighting, focal length, aperture or shutter speed, cannot be changed. But available correction options go far beyond what was formerly possible in the lab, or even is now possible from a “pre-baked” JPEG or TIFF. The photographer no longer has to go into the darkroom. Instead, they sit in a dimly lit editing space at a “light box”(i.e. a monitor) and “develop” different versions of a photograph with the aid of simple adjustment tools. This also applies for the other image formats, but not with as much latitude.

The RAW workflow of photo professionals: from exposure to output

Here is another application similar to the image sequence shown under “Properties of RAW”, extending the workflow to include printing. In addition to image optimization, many RAW converters have gained a variety of filters. Therefore, the boundaries between basic image adjustment and advanced editing are further blurred. If the work involves layers, masks or advanced retouching, as is often done in beauty photography, an image editor such as Photoshop is used, instead of a photo processing tool such as Lightroom.

DOWNLOAD

Click here to download the reference images

Download



The RAW Workflow of Photo Professionals

From exposure to output



1. Exposure in RAW format, without image optimization in RAW converter. RAW files usually appear less bright.

The RAW Workflow of Photo Professionals

From exposure to output



2a. Image optimized in RAW converter

The RAW Workflow of Photo Professionals

From exposure to output



2b. Alternatively: Advanced editing in Photoshop (subtle vignetting to support a more dramatic look) preferably using an uncompressed image format.

The RAW Workflow of Photo Professionals

From exposure to output



3a. Conversion into a JPEG at a high compression rate with clearly visible posterization (also known as banding)

The RAW Workflow of Photo Professionals

From exposure to output



3b. Image optimized for printing. The colors now appear less bright and saturated due to conversion to the printer's smaller color space.

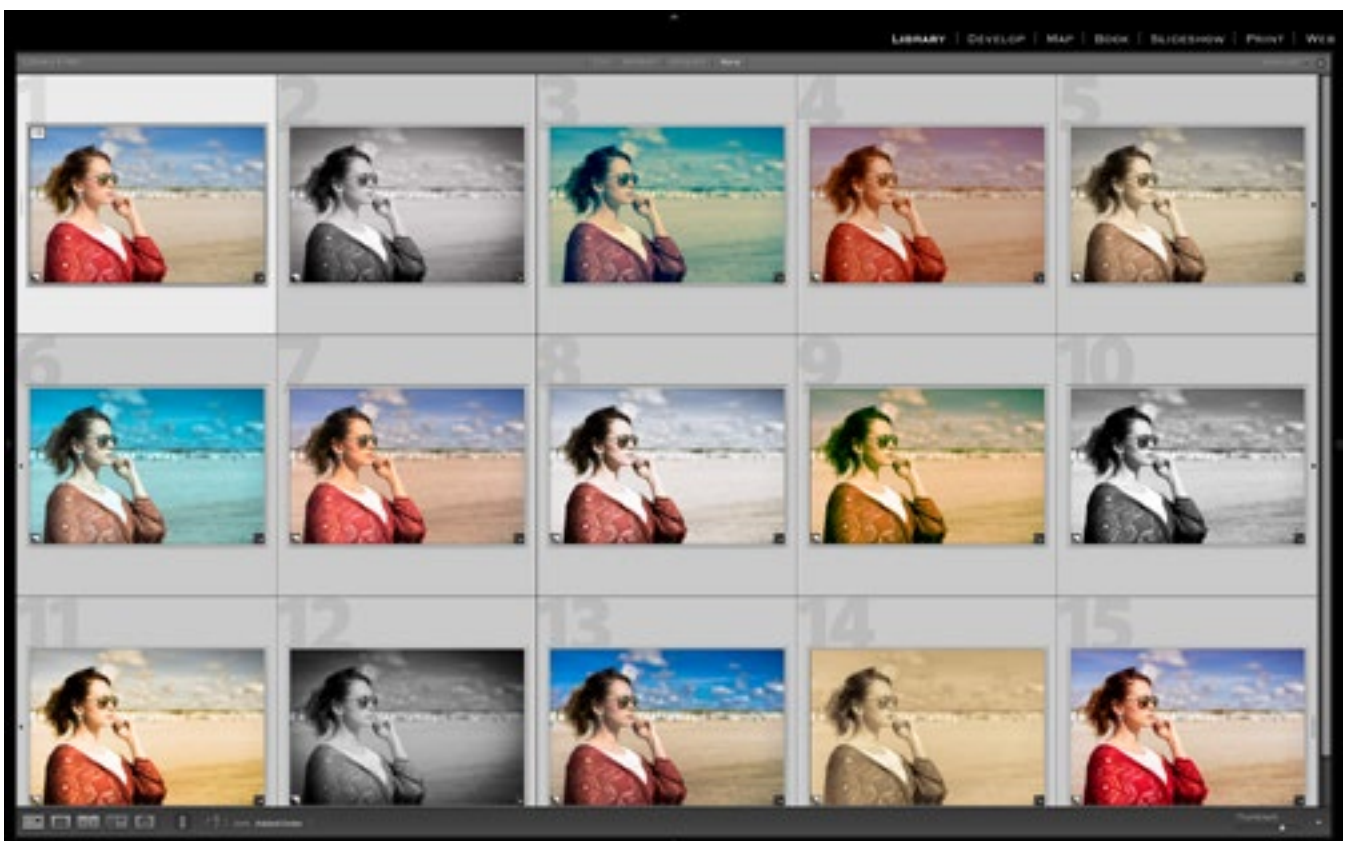
RAW files offer old-school photographers some pleasant secondary aspects

- The RAW format cannot be overwritten. Parameter settings can be changed, but the setting changes do not affect the underlying picture information. This property stops the RAW file from being inadvertently changed, reduced or damaged by repeated compression. Thus the nickname: digital negative.
- You can make various “prints” from the original — just like when using film. Image versions are created depending on the intended use: for output at a lab, an inkjet printer, on use on the Internet, for offset printing, or further processing in Photoshop. A master version, with dust-busting, cropping, and global corrections can be saved, prior to the creation of the various output versions.
- Some RAW converters, such as the programs Capture One and Lightroom, combine this “photo development” with an image management system that radically simplifies the management of prints. The results can be read in a single operation from the camera or memory card, renamed, cropped and labeled according to IPTC conventions. You can also convert them into different target formats and scales, tune the resolution and color depth for output, add ICC color space information, sort them directly into subdirectories and/or add a watermark. All of this works with single images and with batch-mode.



INFO

Since Photoshop CS4, in combination with the file manager Adobe Bridge, you can achieve almost the same functionality as Capture One or Lightroom, though in a less intuitive format.



Working with camera RAW formats not only benefits image quality, but also allows you to create multiple versions of a photo—like here in Lightroom 6 — from an image without taking up extra disk space. These “virtual copies” are saved in your Lightroom catalog and not in the RAW properties of the image.

Benefits for Photographers

How photographers benefit from working with RAW data

Photographers with a high-volume of images can benefit from these workflows in several ways:

- They retain maximum control over the manner that their image is tuned. This is much like a specialty lab in which one works with a very capable lab assistant—only without any loss of time and communication problems.
- With special functions, you can also reduce color noise, compensate for chromatic aberration, remove lens vignetting, and apply color corrections.
- The shots from a job can be converted into different TIFF versions with just a few clicks.
- If you want to create JPEG previews at the same time for your customers, you can send them directly via e-mail or upload to a website.
There is also the option to save conversion profiles for use on similar capture subjects. Such profiles are useful, for example, for studio photographers. They ensure uniformly warm skin tones in portrait series or optimize the color of tabletop structures that are always shot in similar lighting conditions.
- There is another advantage for photographers who are interested in pure image optimization: they can tune their photos via a clearly laid out and functional interface without having to become a Photoshop expert. In Photoshop's Camera Raw, Lightroom, and other RAW converters, you will find all essential settings to control the tonal values, the sharpness and the colors of your images accurately and quickly.

TIP

The RAW workflow can be precisely tailored to your individual needs. This is easy if you invest a little time in getting to know the technology and are open to experimenting.



Benefits for Graphic Designers

How RAW technology improves work in the creative field

Image editors in design fields shift the creative aspects from the capture to the post-production process. This means they photograph individual items for later composite images, rather than single image use. As the quality of output images is not as important for them as for the photographer, JPEG photos are often used as working material. After all, they have the technical know-how to hide image weaknesses with just a few clicks.

What they need first and foremost is a well-tagged image database so that they can quickly find montage elements. The working files are then simply managed in a project folder at system level. Creative photographers, therefore, do not benefit as much from the advantages of RAW technology as the optimization-oriented photographers, although working with RAW data does have some advantages for them:

- The most fundamental of these is the superior quality. When comparing two normally exposed and unmodified shots, there may be little difference to be seen; but as soon as you start to adjust the image you are confronted with “artifacts” that come from the JPEG compression. During compositing, montage items almost always need to be adjusted or matched in terms of color and light, thus the increased adaptability that RAW images offer is significant. Stepping back to the RAW file, readjusting, and exporting a new version that meets the project need allows this.

- Application areas that offer functions in the range of image optimization and creative image editing are very useful: RAW converters are well suited for black and white conversion of color images. Color corrections that relate to the whole image are often easier to control with RAW adjustments than with editing tools. Anyone who works with the Photoshop converters Camera Raw or Lightroom can also use the tools to subtly manipulate the mood of his images with artificial edge shading.



INTERESTING ONLINE FINDS

PetaPixel offers the top eight reasons you should shoot in JPEG

[More Info](#)

Problem Areas

The nuances of working with RAW data

RAW is not in a consistent format, but rather is a generic name. It has nothing to do with Adobe DNG, but is simply the native format for each camera make and model. These formats were not originally intended for end users, though over time, this has become a common function, so newer RAW formats are more adaptable.

If you work with the current version of Photoshop or Lightroom, you will receive support for most current and older cameras' RAW formats automatically. So opening RAW files is not problematic for today's image editing programs; as long as the program version is newer than the camera.

DNG (Digital Negative)

Alternative format for proprietary standards



INFO

Digital negative (extension: DNG) refers to a different kind of RAW image format, developed by Adobe. This open format's goal is to avoid storing images in proprietary file formats of individual camera manufacturers and gradually establish a uniform standard that all manufacturers can resort to.

RAW data can be converted to the DNG standard using Adobe's free DNG Converter and then opened in older versions of editing apps. So one use for DNG, is to launder newer RAW camera files into older imaging software that does not support them. However, with Adobe's subscription model, fewer users find themselves in this bind, since they receive software updates as part of the subscription.

At present, each camera manufacturer is still developing its own format, which may even differ between camera models. As a result, the approach involving a uniform standard is a good one. In practice, however, a few manufacturers have implemented the in-camera DNG but have not done it fully. This means that proprietary formats may have advantages over DNG converted files. Be careful when converting files to DNG format, to be sure all your data is captured. DNG use has not become a standard, or even common at the camera level, and is actually less popular today than when first released. Test DNG as a workflow before committing to it, to be sure it meets your particular needs.

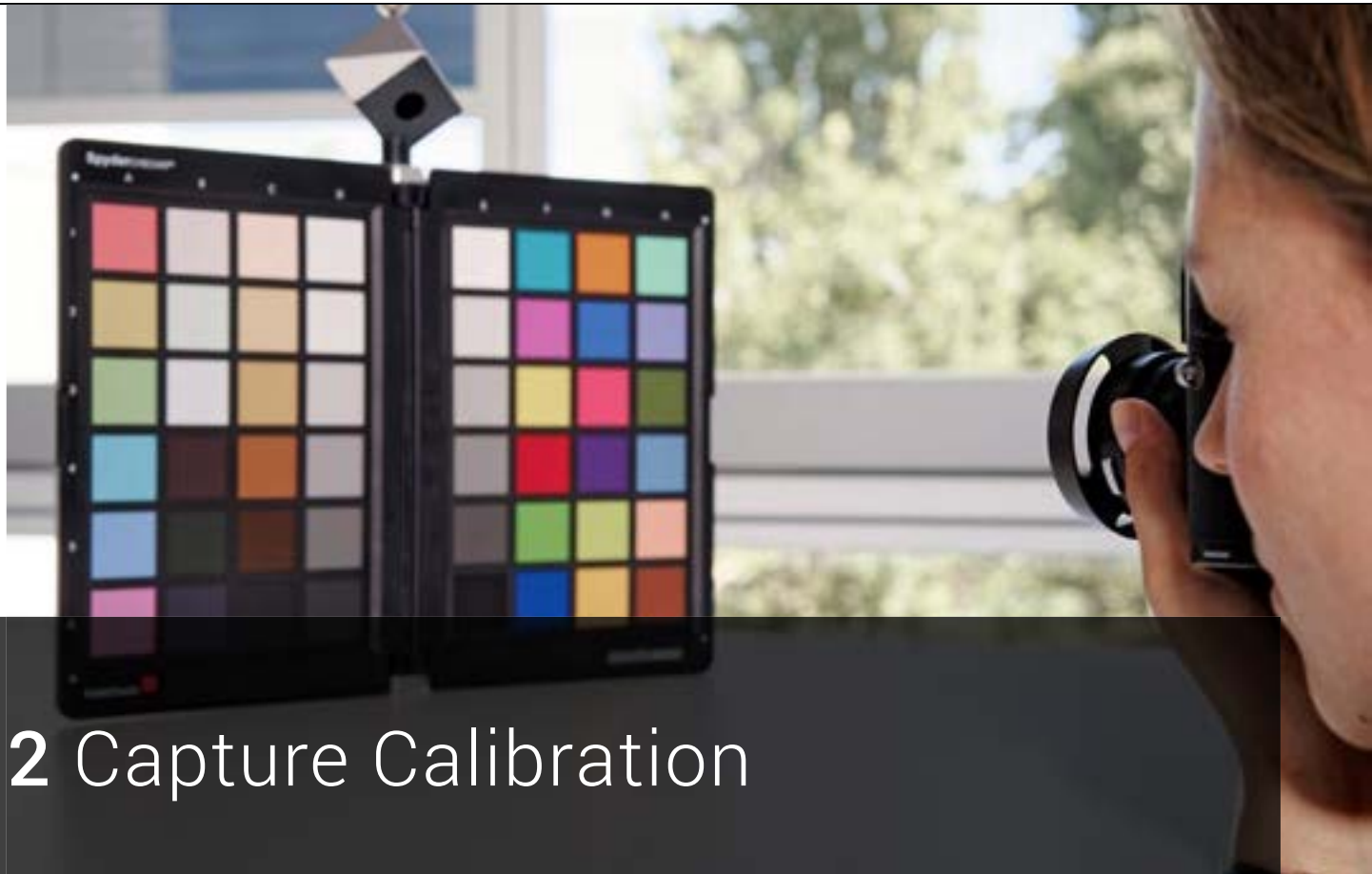
In 2003, the Photoshop RAW plug-in made it possible for the first time to edit many popular RAW formats in a fast, comfortable, and option-rich interface. Today, RAW converters are widely available with frequent improvements to their capabilities.



INTERESTING ONLINE FINDS

PhotoUp provides an interesting comparison of the various file formats that can be used

[More Info](#)



2 Capture Calibration

Camera calibration - the first step in your color workflow

- ✓ Which tools are available for calibration
- ✓ How to obtain optimal exposure with the SpyderCUBE
- ✓ SpyderCHECKR and how it provides color correction
- ✓ How to get razor sharp autofocus using SpyderLENSCAL

Contents

Capture Calibration	2/35
Exposure Optimization	2/37
• Adjusting Exposure Optimization Using SpyderCUBE	2/40
• Using SpyderCUBE	2/42
• White Balance	2/43
• Brightness	2/44
• Black Level	2/45
• Transfer Settings	2/46

Color balance	2/48
• Adjusting Color Balance with SpyderCHECKR	2/49
• Using SpyderCHECKR	2/50
• SpyderCHECKR app	2/51

Adjusting the Autofocus of the Lens and Camera	2/52
• Calibrating AF using SpyderLENSCAL	2/55
• Installing SpyderLENSCAL	2/56

Glossary	217
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Capture Calibration

Why should photographers use color correction settings for cameras?

Color management begins with the exposure. How you manage your color profiles depends on how you process your files. If you're only shooting casually and only look at your images on a display, you may not notice color deviations from the original scene. The creation of profiles and color settings can seem time consuming, plus requiring additional hardware.

Nevertheless, camera calibration is not just for creatives or photographers with time constraints. The importance of camera calibration increases with the degree of engagement in photography, regardless of whether or not photography is your profession. It is important for all photographers to consider that every digital camera model suffers from its own color flavor.

This can be both good and bad. Consumers may appreciate colors that appear stronger than the original scene, because the image seems more colorful. For many professionals and dedicated photographers, however, oversaturated pictures can be a nightmare. Their goal is accurate color from the beginning. Even if the intent is to apply a color effect to the image, that should be done in post-processing, to precorrected images, for the most consistent results.

Why working with a calibrated camera is worthwhile

Camera profiles are always used when it comes down to maximum color integrity. The range of application extends from portraits to catalogue, fashion and product photography, among many others. However, amateur photographers, who not only take pictures for fun but also edit pictures to create high-quality prints or photobooks, also benefit from capture correction. Calibrated capture is the first link in the chain of an optimized color workflow.

Each camera has its own way of interpreting colors, differing between manufacturers, and even models. This is not a linear color error, which can be eliminated with a small correction of a color channel. For example: a camera produces an accurate image of a green plant, but the skin tones within the image are too pink. A linear correction in this case would provide correct skin tones, but with the same setting, the green plants look unnatural. In addition, there is the possibility that the same image, in a different lighting mood, is no longer correctly interpreted by the camera. The simplest solution is a single camera correction for all uses. For maximum color accuracy, you can create

corrections for important shooting sessions. Or you can create a series of corrections for common lighting conditions. Be aware that with this approach, one can only achieve a specific result, and a specific intent; correcting the warmth out of a low-sun shot at a sports event will make it possible to mix the images with those shot earlier in the game, but will take the romance out of a sunset beach shot.

It is worth the extra effort: The color quality of the results is extremely reliable. This is not only relevant for art reproductions and news photos; it also eases the portrait photographer's work when it comes to achieving accurate skin tones.



EXPERT INSIGHT

Coordination of different camera systems

Professional photographers are often tasked with capturing "Behind the Scenes" photos, and sometimes several photographers will work together on an event. Different systems and camera models will likely be used in these cases. Different camera brands often have easily noticed differences in their color output, making mixing images difficult. One can avoid needing to adjust each image in post, and save time and money, if all the cameras are color corrected with the SpyderCHECKR.



INFO

No matter how many cameras are used on a shoot, color harmony is important to help tell a cohesive visual story. Read how SpyderCHECKR and SpyderCHECKR 24 can help make this process easy and precise.

[More Info](#)



DOWNLOAD INFORMATION

We have provided a RAW image of a model holding SpyderCUBE and SpyderCHECKR. Test for yourself how you can optimize your images with just a few clicks.

[Download](#)



Exposure Optimization

Using tools is worthwhile

One of the most important aspects of a technically excellent picture is a balance of contrast range. It is not enough for the camera to capture all of the colors: The camera needs to determine the optimum black and white point, as well as the neutral grey within a lighting situation. However, since the required reference points, are often missing in a scene, almost all cameras have shortcomings in this area. There are tools for neutralization on the market, but what is the best way to use them?

How to ascertain neutral grey with a reference

The eyedroppers in the Photoshop “tonal adjustment” and “gradation curves” dialogues can be a starting point. RAW converters adjust this differently. Ideally you will use these measuring tools to click on a neutral grey (avoid white, as it may be clipped, and give incorrect results) and color casts will be eliminated. The trick is finding an area in the image that contains a true neutral. It is almost impossible to find a grey tone in a picture that can be trusted as a reference value, and most everyday objects shift neutrality under different light sources. You get a best approximation, but never an exact result.



Neutral grey is hard to find in this image. Datacolor Photo Contest Winter 2017, @Jose Lopez

A spectrally neutral grey can only be guaranteed by using a standardized grey card. Many professionals work with grey cards or light trap tools like the SpyderCUBE from Datacolor. The adjustment for an identically lit image series is made with the help of Photoshop CS2 in the Adobe Camera Raw dialogue, and applies the settings to all other opened pictures. It is sufficient to use the grey card or cube in one shot of a photo series under the same lighting conditions.



EXPERT INSIGHT

What is so special about the color grey, such that it always comes up in photography? A spectrally neutral grey offers the perfect balance of red green and blue values, under any lighting. This means that the R, G and B values of any spectrally neutral gray, under any light, will be equal; matching them will correct the ballance of all other colors in the image, as long as there was only one color of light source used. Mixed lighting cannot be fixed by gray balancing; only one of the light sources can be corrected at a time.

Excursion into 18% Gray

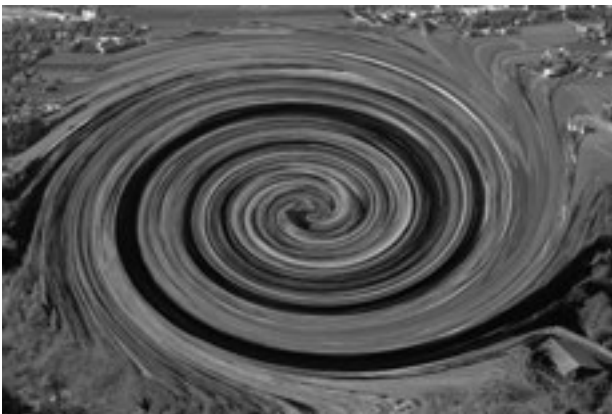
When we measure light we measure light intensities and not colors. This means that depending on the intensity of the light, we move between black and white, with the gray gradations in between. An 18% gray corresponds to the median brightness due to the gamma-like curve of the eye's sensitivity. If you take an average black and white scene and blend the black, white, and grey values, the result will be a 18% gray. The exposure system in a camera uses this value as a reference since it corresponds to the midpoint of most images. High key images, such as a person in front of a snowscape, need to be adjusted, since the white portion predominates and the scene does not correspond to 18% gray. The image deviates from the standard, and without a correction of the measured time / aperture combination, the snow would turn gray and the face of the person too dark. As a result, the exposure is corrected accordingly and a longer exposure time is applied or the aperture is opened by approximately 2 f-stops. Alternatively, you can also use an exposure measurement method such as spot measurement, which has a much smaller measuring field and you can measure the exposure in the image areas more accurately.



Average color scene



How the exposure measurement system is seeing the scene



stirring the black / white values



leads to an 18% grey

Adjusting Exposure Optimization Using SpyderCUBE

Obtaining all exposure references in just one image

The SpyderCUBE is unique, and differs from a conventional gray card because it's equipped with an additional light trap and a chrome ball. The definition of the contrast range can be carried out precisely, which is not possible with a simple selective chart. The SpyderCUBE captures the color temperature, light source data, and primary light source for accurate color matching.

The features in detail:

- two neutral 18% grey surfaces
- two white surfaces
- black surface
- light trap (black hole)
- chrome highlight ball
- Information about light settings

The light trap consists of a small hole in the cube. Penetrating light is "swallowed". Virtually no light is re-emitted, resulting in a nearly perfect black level. Using the black face, content can be adjusted in the shadow areas. With the chrome ball, a specular highlights can be captured, due to its excellent reflective functions. The white and gray faces allow you to control the midtones and near whites, and choose the primary light source to set white/gray balance.



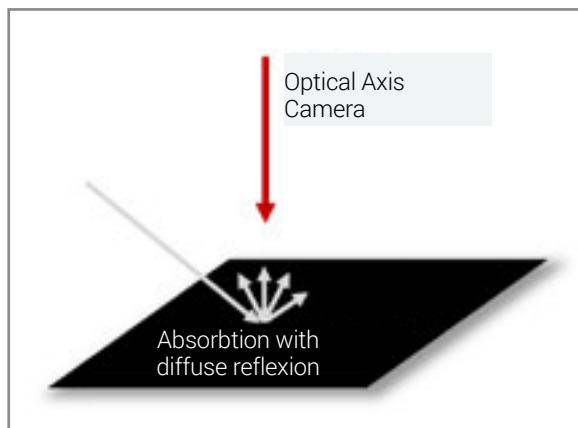
The picture clearly shows all surfaces, the light trap and the chrome ball. A further advantage of the SpyderCUBE is the ability to obtain information about the source lighting, since the two gray/white surfaces capture both the primary and secondary light sources.

INFO

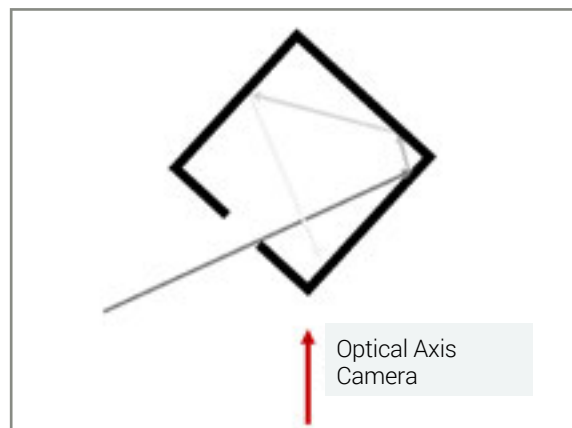
You can use the SpyderCUBE for both RAW and JPEG files. For JPEG files, you should be aware that any image change in this format always involves loss of data.



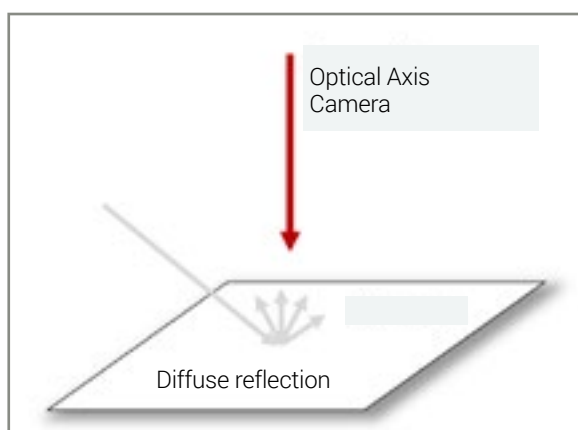
Physical characteristics of the different surfaces:



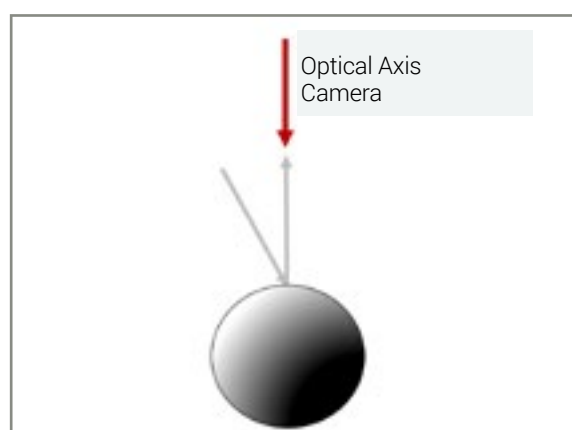
A black matte surface, as used in a gray card, absorbs most of the visible spectrum. However, a small part is diffusely reflected and radiates in the direction of the camera, which leads to a dark gray but never to absolute black. The black surface of a gray card (equivalent of the black surfaces of the SpyderCUBE) is used to determine the image shadow values.



If a light beam is caught in the light trap of the SpyderCUBE, it becomes weaker with every reflection on the inner surfaces of the cube. The likelihood of a light beam being emitted in the direction of the camera is nearly zero. This allows you to measure absolute black.



The white surface of a gray card is intended to reflect as much light as possible without blow-out and is used for the definition of the white value in which detail still present. It is not intended to define specular highlights.

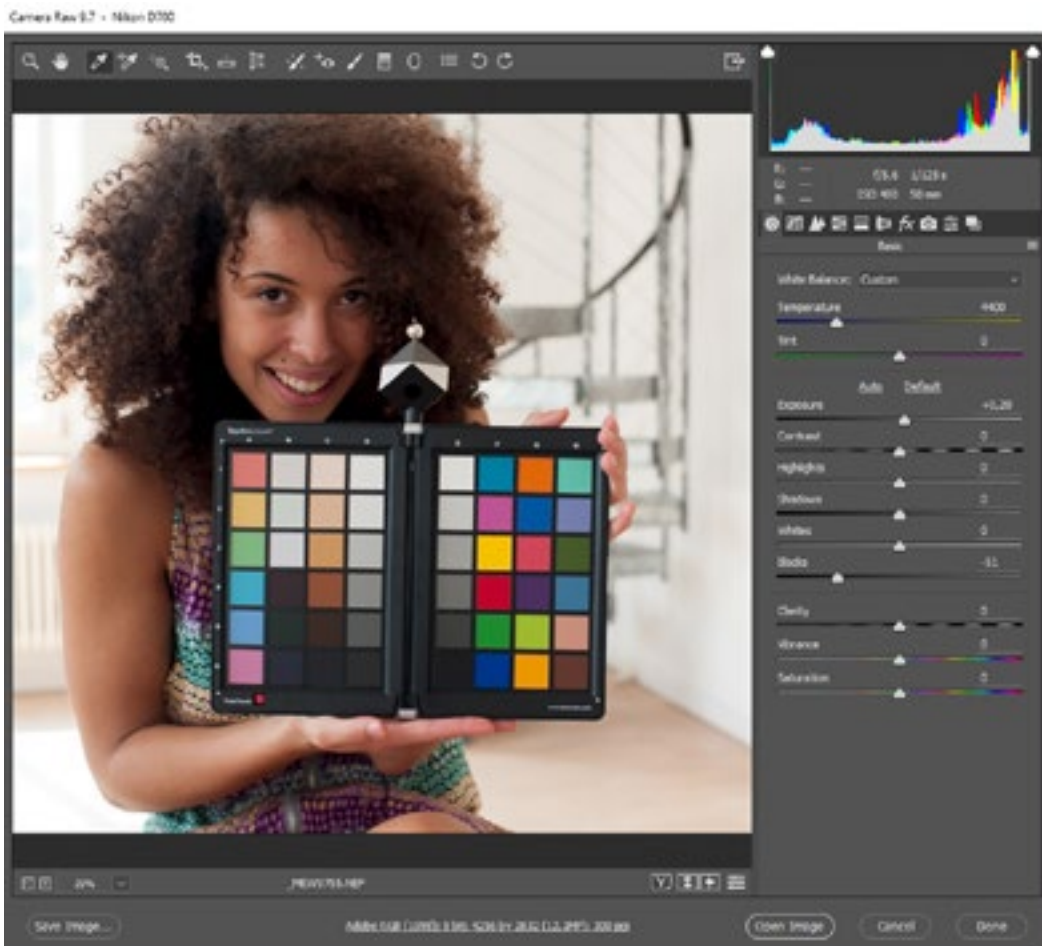


If the light falls on a chrome ball from any angle, the light is reflected toward the camera without appreciable losses. We receive a specular high-light, or blow-out white value.

Using SpyderCUBE

One picture per setting is enough

The SpyderCUBE should be positioned in the picture so that it's visible. Make sure that the light trap on the front is facing the camera. The two white and grey surfaces should also be easy to see. Now all you have to do is take a picture of the SpyderCUBE and you will be able to analyze the lighting of the moment for reference later. After this shot, remove the SpyderCUBE from the scene and begin shooting the subject as planned. It will only be necessary to use the SpyderCUBE again if the lights or lighting conditions change.

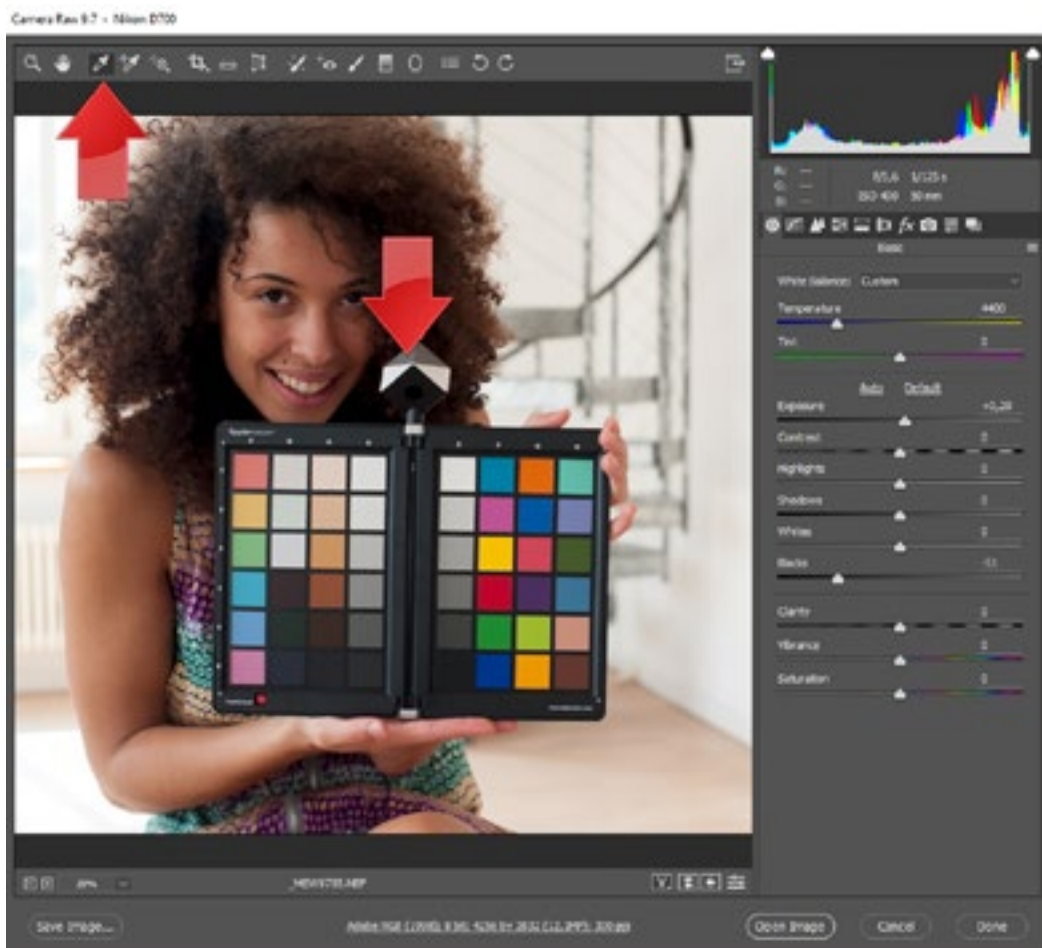


To adjust the contrast range, white balance, and grey balance, load the SpyderCUBE image in Photoshop, Lightroom, or a RAW converter.

White balance

How to activate manual white balance

In a nutshell: In Lightroom, as well as in Photoshop Camera Raw dialogue, you will find a “white balance” tool which can be activated for manual white balance. Place it on the lighter of the two gray surfaces, which will determine your main light source. Redefine the color temperature and color tone with one click. The extent to which this is adjusted can be seen on the corresponding control.

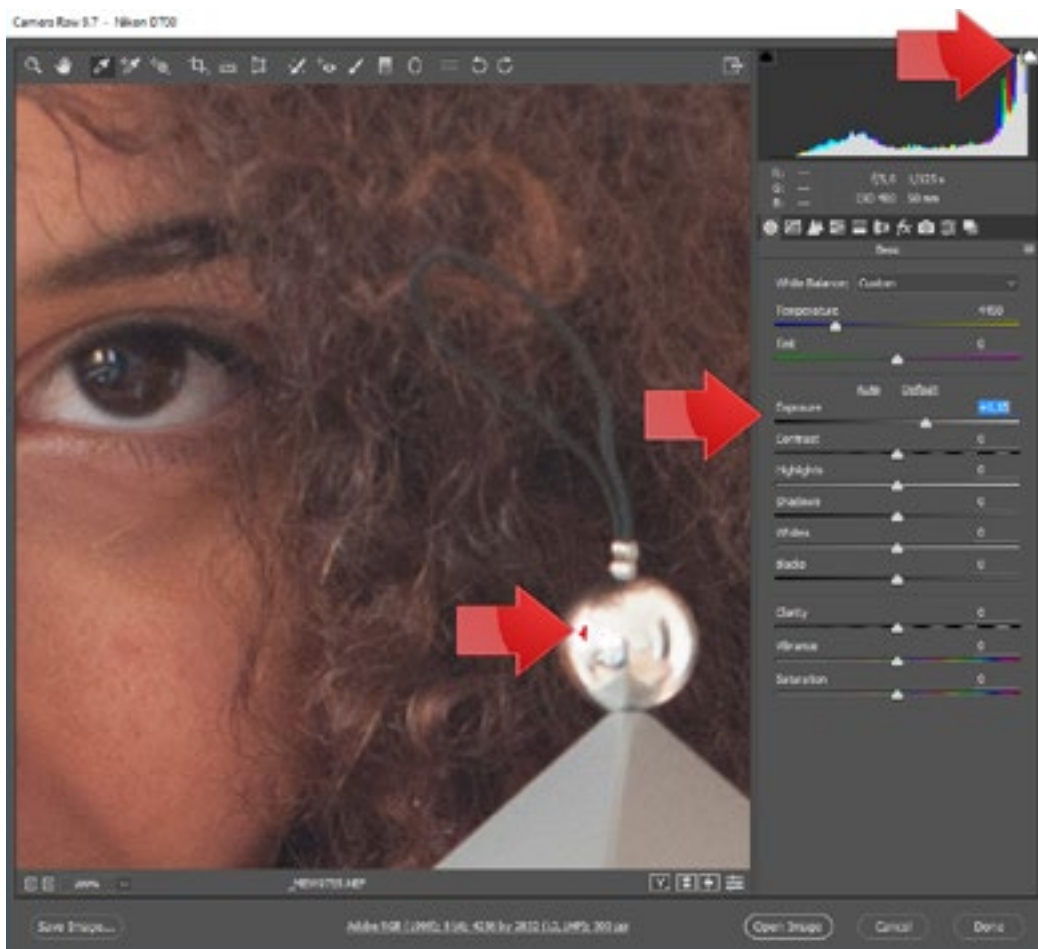


With a click of the eyedropper tool, the color tone of the image changes immediately.

Brightness

Adjust your brightness

Take a look at the histogram display: Adjust the lighting using the slide control so that no color channels in the light or shadows are cut off. Keep the SpyderCUBE in view. If the highlights erode or the shadows clog due to changes in the exposure, you can correct these effects using the exposure control.



The clipping warning tool is an excellent adjustment aid. It is located behind the inconspicuous box in the right and left upper corner of the histogram.

TIP

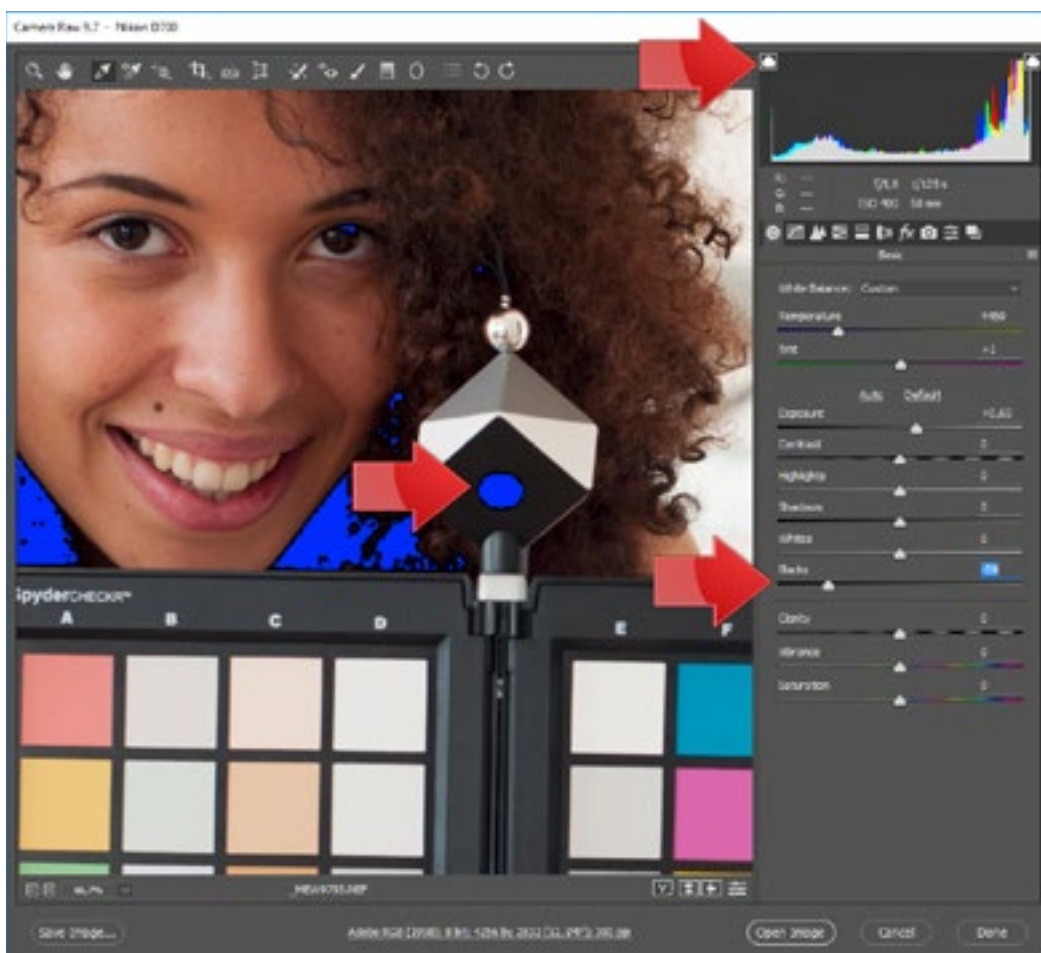
You will find a reference for specular highlights, or blow-out white, in the chrome ball. The white surface, on the other hand, always needs to show detail. Optimum white is 90% saturation, black (directly lit) is 10%, and everything else is 5%.



Black Level

How to adjust pictures to get the right colors

If your software has an extra eyedropper tool for determining the black level, click into the “light trap.” If there is no such tool, as in Photoshop and Lightroom, set the black using the corresponding adjuster so that you can make out a clear difference between the black surface and the black hole. That will adjust the colors in the picture properly. In numbers, the value of the light trap is 0% while the black surface has a value about 5%.



When the clipping warning is on, the black level is adjusted downwards until the surface of the light trap has turned completely blue.

Transfer Settings

How to choose the right approach according to picture volume

To get the best results for all the pictures you have taken under the same lighting conditions, there are different strategies that depend on the software. With Photoshop's Camera Raw dialogue you can choose between **two methods**:

- **Method 1:** Open the picture with the SpyderCUBE, make the adjustments that have already been described, and close the dialogue by clicking the "Done" button. Then switch to Adobe Bridge, the Photoshop picture viewer and open the appropriate list and select the optimized image. Copy from here by right-clicking on the adjusted file for the design settings, then select all files that still need to be adjusted and apply the settings to those files.
- **Method 2:** At the same time, open data in Photoshop Camera Raw. Make the adjustments to one file, then mark all the others and "Synchronize" using the corresponding button. Important: this allows you to transfer only the specified parameters.



TIP

The first method is recommended for working with a large number of pictures, and the second is better for up to 100 photos depending on the RAM available on the computer.



Transfer of settings in Photoshop Camera RAW



INTERESTING ONLINE FINDS

SpyderCUBE is often thought of for controlled conditions and studio work, but it can also be a helpful tool in the field. In this article, David Cardinal shares how he used it while traveling through Cambodia and Myanmar.

[Read Article](#) >

Color Balance

How to balance your colors



Next to tuned exposure, balanced color is the second most important part of color management in photography. Some photographers try to accomplish this goal with color targets without the necessary software. They manually re-measure the colors and use the color correct tool from their preferred RAW converter to create neutral correction settings. This approach is not wrong in theory, however, in practice it is time consuming, and often imprecise.

Adjusting Color Balance with SpyderCHECKR

How a color chart can produce true-to-life colors

There are tools supported by available software to help you achieve consistent results faster. The SpyderCHECKR from Datacolor has a color chart that works as a combination hardware and software solution. The SpyderCHECKR guarantees reliable colors for the RAW workflow, color standards for every camera, and subsequently a reduction in time spent on the finishing process. In addition, it includes functions for equalizing the color balance for skin tones, especially for portrait and fashion shoots. The SpyderCHECKR also offers neutral grey targets and grey shades for the white balance in the camera.

INFO

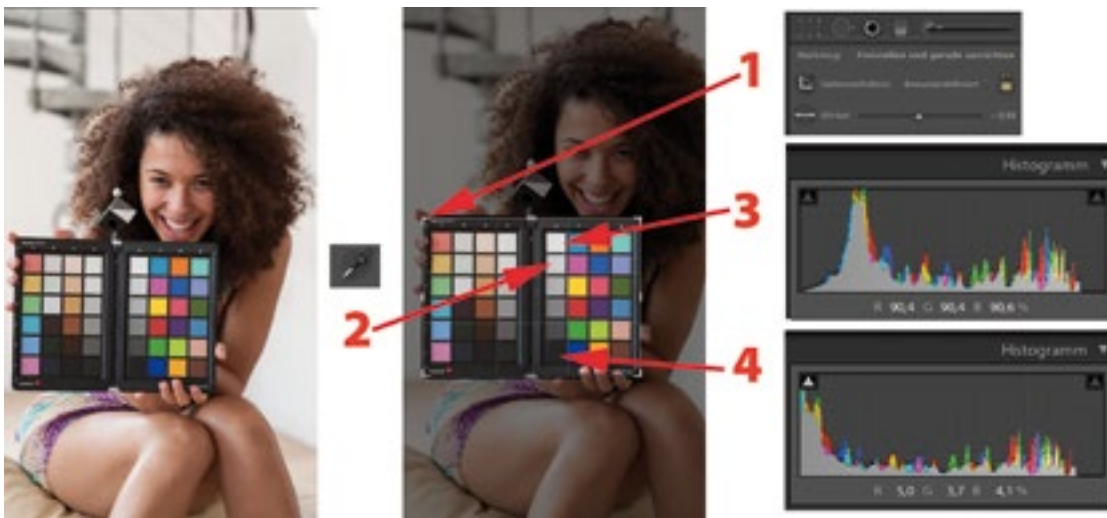


The software included with SpyderCHECKR works with Adobe Photoshop CC, Adobe Photoshop Lightroom CC and Phocus, the Hasselblad RAW converter.

The SpyderCHECKR software builds correction settings using its analysis of photos taken in a specific lighting situation. With these settings, even huge productions can be color balanced with a single click.

Using SpyderCHECKR

Shoot-Specific Color Correction



To provide custom color correction for a photo shoot, place the SpyderCHECKR under the final scene lighting.

- Take a photo of the SpyderCHECKR in an upright position in the final lighting, using RAW mode, before you begin the actual shoot
- Install the SpyderCHECKR software
- Load the RAW image that you shot with the SpyderCHECKR into your image editing software and adjust it there first. In this example, we are using Adobe Lightroom 6
- Next, in the RAW converter, crop the image to the size of the SpyderCHECKR (1)
- Click on the E2 field of the SpyderCHECKR using the “white balance selection” tool, to measure and match the color temperature (2)
- Finally, move the mouse over the E1 field and read the value underneath the histogram (3)
- Now adjust the brightness using the “exposure” control, so that the field displays a brightness of 90% (RGB: 230/230/230)
- Proceed to do the same with the black slide control and field E6 (4). The black level here needs to reach 4% (RGB: 10/10/10)

INFO

The values specified above will not always be achievable. In such cases, you should try to reach an approximation, or a natural average value. The goal of this process is to normalize the target capture.



SpyderCHECKR app

How to define presets

Now transfer the analysis from the color patches to the SpyderCHECKR software in Lightroom. After right-clicking on the image, go to "Edit in" in the context menu. In Photoshop Camera Raw, the application has to be started manually (from the applications folder). The RAW data developed should be saved as a 16-bit TIFF in AdobeRGB and then dragged and dropped to the SpyderCHECKR software or by clicking on the Windows right mouse tab (Use "Apply in..." in Lightroom). After the SpyderCHECKR app starts, position the field overlay by turning and scaling until it covers all fields as evenly as possible.

Then select a mode:

- Colorimetric: produces neutral colors
- Saturation: provides more saturated color tones
- Portrait: reduces red and orange tones so that skin tones appear more pleasing

Finally, save the calibration for the application you would like to use it in later. You can even save multiple settings, one after the other. To use these new presets, you will need to restart Lightroom. The color settings based on the CHECKR analysis are applied in the HSL field of the application.



INTERESTING ONLINE FINDS

Check out a quick tutorial showing how to use SpyderCHECKR and SpyderCUBE

[Watch Video](#)

Adjusting the Autofocus of the Lens and Camera

Advantages and disadvantages of using autofocus



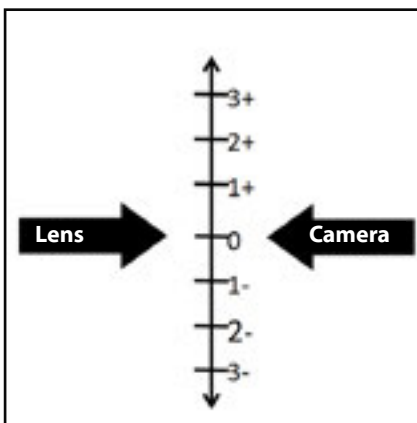
Autofocus is now an integral part of today's photography world. Especially when working at a quick pace, photos are sharp because the automated technology reacts faster and works more precisely than humans.

But there are also disadvantages. Many photographers have been complaining since the development of autofocus that it is not always precise and does not work reliably in every situation.

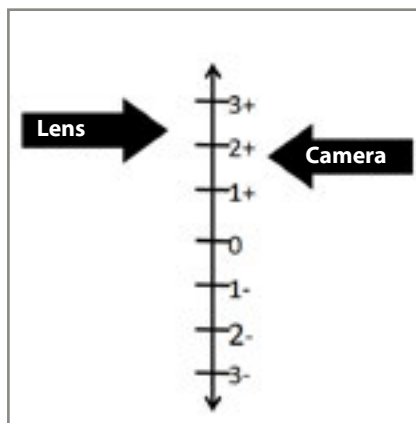


The AF sensor field in image 1 is targeting the second pointer but the focus is slightly behind (back focus).
© Jan Luca Colla

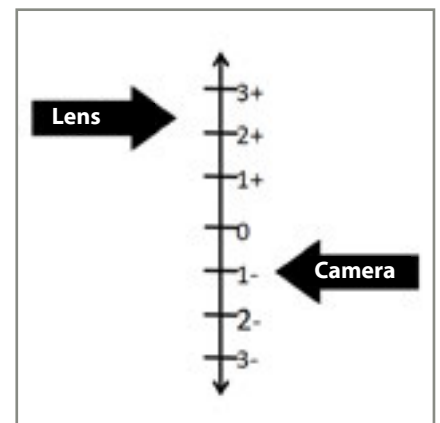
The most frequent cause for photographer annoyance is auto-focus error. This is often explained by the camera choosing the wrong object or the wrong point on the object as the focal point. But there is another possibility - one that we do not like to consider in light of the cost of purchasing such a high-end camera. The interplay of the camera and lens tolerances could be at fault. DSLR cameras often have their AF sensor in the camera bottom and not on the sensor level. The light beam is directed to the AF sensor via a mirror. The system is more complex due to the interchangeable lens, and thus more susceptible to errors. This phenomenon is referred to as back focus or front focus when the AF sensor informs the camera that the focus is right, but in reality, it is slightly behind or in front of the target focus point. This problem has intensified with the growing number of high-resolution cameras and high sharpness lenses. The resulting high-performance of modern DSLR cameras exposes the problem. Camera/lens tolerance issues could be to blame, which in practice means that the camera/lens combination needs to be custom-adjusted.



Zero tolerance for camera and lens would be optimal, but is unrealistic.



It is possible that the tolerances of the camera and the lens are mutually leveled.



Conversely, the tolerances of the camera and the lens can also intensify, leading to blurring.

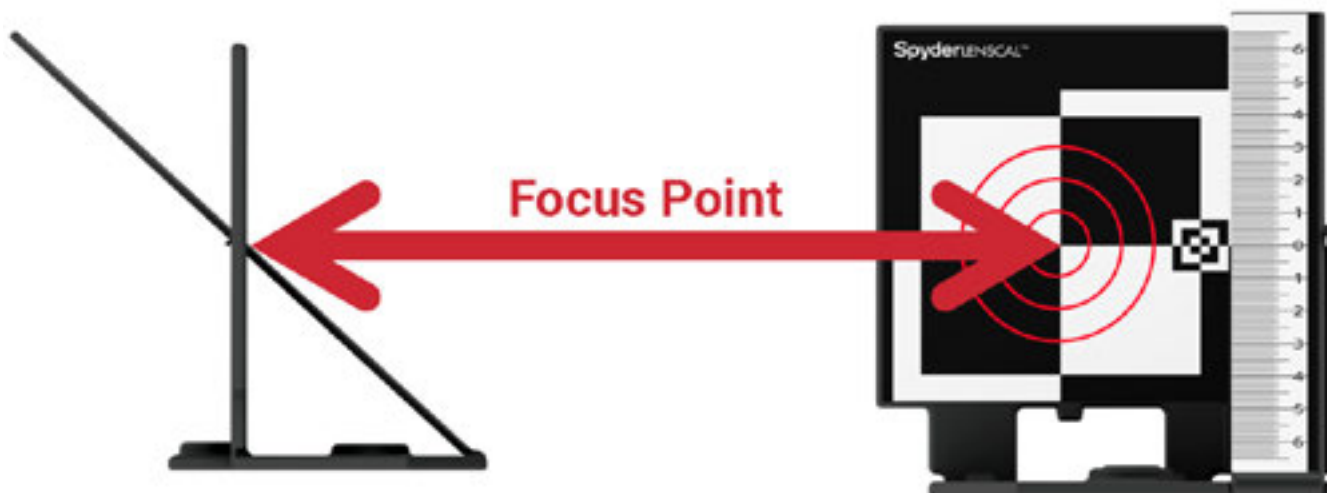
INFO

Datacolor tested the systems (camera / lens) of 1,040 visitors during the market launch of the SpyderLENSCAL at Photokina 2010. It turned out that about 650 of the tested systems had imprecise autofocus systems.



How to test your autofocus

It is easy to find out if this problem affects one or more of your lenses. Take a picture of a flat object in an upright position. Then shoot multiple shots in manual focus, while moving the focus slightly. If any of the manual shots beat the automatic one, then your camera, your lens, or that a combination of the two, tends to focus a bit too far to the front or back.



The distance between camera and SpyderLENSCAL should be about 25-50 times the focal length of the lens. The focal point should be at the center of the chart.

Calibrating AF using SpyderLENSCAL

How to get razor-sharp autofocus

The SpyderLENSCAL is one measuring device that is easy-to-use to precisely determine the extent and direction of AF fails. If a photographer is aware of this failure, the focus can be adjusted in many DSLR and a few compact camera models through the camera menu's AF micro-adjust controls.



Left: The SpyderLENSCAL is ready for use. Right: The SpyderLENSCAL in collapsed position. It's easy to see the scale of the SpyderLENSCAL in both.

Installing SpyderLENSCAL

How to calibrate your autofocus

- First, mount your camera on a stable tripod. Do the same with the SpyderLENSCAL on a second tripod or light stand. Adjust the SpyderLENSCAL with the scale integrated in the SpyderLENSCAL so that it is in line with the optical axis. Alternatively, position the SpyderLENSCAL on a firm, level surface, like a dining table at the height of the camera lens.
- Set a small ISO value to minimize noise.
- Use an open aperture: f1.4, f2.8, or lens max.
- Focus the middle of the field of view with the AF. Trigger the shutter.
- Check the photo on your camera's display. To find where the focus point is, zoom in on the zero value of the scale level and check whether the center of focus is at zero
 - If this is the case, your system focuses perfectly. You will need to look somewhere else for the solution to any sharpness issues.
 - If your camera is still not focusing, correct the settings in your camera's firmware to the determined value (keywords: AF fine-tuning or Micro-adjust) and then take a new test shot.



The SpyderLENSCAL and the camera should be aligned along the optical axis.



For a calibrated system, the focus point should be on the zero line of the scale.



Corrections for a misfocused system can be made in the user interface of the camera.



INTERESTING ONLINE FINDS

Jay P. Morgan, from The Slanted Lens, does a great job showing how the SpyderLENSCAL works so you can make sure your autofocus is always spot on.

[Watch Video](#) >

Take a look at a Datacolor tutorial, which explains in a few steps how to use the SpyderLENSCAL.

[Watch Video](#) >

Cameras with AF calibration

The AF fine-tuning feature is integrated in a growing number of DSLR camera and high-end lenses. Here we have compiled a list of camera and lens models that have integrated the AF adjustment. This list should not be considered exhaustive. Some DSLR cameras from the mid-price category are equipped with this function, however, you should be sure to check manufacturers' websites.

Manufacturer	Model
Canon	50D, 70D, 6D, 7D, 5DS, 5DS R, 7DMkII, 5DMkII, 5DMkIII, 5DMkIV, 1DMkIII, 1DMkIV, 1DsMkIII, 1Dx, 1DxMkII, 1Dc
Nikon	D7000, D7100, D7200, D300, D300s, D600, D610, D700, D750, D800, D800E, D810, D3, D3s, D3x, D4, D5
Pentax	K5-II, K5-IIs, K-20D, K-30, K-5, K-7D, K-2000/K-m, K200D, 645D, K-x, K-3
Sony	A850, A900, A77, a7R II, a7S II, a7 II, a7 R, a7 S, a7, a99, a68
Olympus	E-30, E-620, E-5
Sigma	Art Series



TIP

You can find a selection of more cameras with AF fine-tuning here.

[More Info](#) >



3 Monitor Calibration

The window into your image

- ✓ Initial calibration of your monitor
- ✓ The colorimeter's role during calibration
- ✓ Controlling ambient light
- ✓ SpyderProof analysis of your display's state

Contents

The monitor as a window into the image	3/60
Initial Calibration	3/67
• Software Installation	3/69
• Initializing the Software	3/69
• Adjusting Monitor Settings	3/70
• Display Type	3/71
• Display Technology	3/72
• Controlling Brightness and Contrast	3/74
• Controlling Color	3/78
• Calibration Settings	3/79
• Advanced Calibration Settings	3/80

Measuring Color	3/81
• Placing the Meter	3/84
• Measuring	3/85
• Measuring Ambient Light	3/86
• Ambient Light Analysis	3/87
• Readjustments	3/88
• Side Note: Ambient Light	3/89
• Profile Name	3/93
• Storage Location	3/94
• Switching Profiles on Windows	3/95
• Switching Profiles on macOS	3/96
• SpyderProof	3/97
• Profile Overview	3/101

Glossary	217
-----------------	-----

The monitor as a window into the image

Why calibrate your monitor?



Until a photo is printed, the monitor is its “frame.” It is the basis for your assessment - the window into your image file- comparable to a light table with standard lighting used in the analog era. At events we’re often asked, “Is it even necessary to calibrate a monitor? The images already look really good.” If you are working in isolation and view images exclusively on your display, this may seem sufficient. But those who edit their images on an uncalibrated monitor with a color cast are unwittingly building color errors into the image file, based on inaccuracies on the monitor. If you then edit large quantities of image data in batch processing mode using this incorrect basis for assessment, you are destroying your image files – particularly if you don’t create copies or if you don’t use the RAW format as the starting point for your workflow. Only when you choose to display your images elsewhere (different display, photo album, fine art print, etc.) will you realize that the wrong colors are being shown in your photo. This is why it’s so crucial to calibrate your monitor as part of your digital photo workflow.

That's why it's so crucial to calibrate your monitor as part of your digital photo workflow. This of course also applies to models in lower price ranges – a question we are frequently asked.



INTERESTING ONLINE FINDS

Before we go into greater depth about the technical details of monitor calibration, we'd like to take this opportunity to let you know about JP Danko's interesting SpyderX test.

[Read Article >](#)

Quote:

"If you're an advanced hobbyist, a professional photographer, film maker, designer or anyone who relies on a screen as part of their work, there really is no excuse not to use a display calibration system."

JP Danko, DIY Photography

5 reasons you should calibrate your monitor.

- Every monitor displays colors differently. Monitors are shipped uncalibrated or pre-adjusted, but their colors continuously change over time.
- You can't simply rely on your own eyes to find the correct settings for your monitor. The way you see colors depends on factors like the time of day, the ambient light and your level of fatigue.
- Image colors are not true to life. Without calibration, the colors of your photos on your screen will not be properly displayed; the skin tones won't be quite right, the whites will have a hint of color and the blues may look cyan.
- Software-based monitor calibration, such as using the setting options included with the monitor's firmware or graphics card, can only provide linear correction at best. It does not take into account color variations that depend on how the LCD is adjusted.
- As a window into your image file, the monitor is uncalibrated - like assessing the colors in your images while wearing tinted sunglasses. This means that everyone sees colors differently if they don't have the same glasses. You can imagine the effects this has on prints at a printing company or even from your own printer.

This is why you should calibrate regularly

If your screen is set to be color-neutral, you can rely on how the colors are displayed – at least for a while. All monitors age with use and their color characteristics are constantly changing. To combat this, a monitor used daily should have its profile adjusted every two weeks. Depending on the device, these variations may occur to a greater or lesser extent and may not even be perceptible to the naked eye without a direct comparison. Anyone wanting to err on the side of caution when doing critical color work should nevertheless calibrate their monitor, ideally before each important project.



The eye is particularly demanding about skin tones, so you may see jarring differences between calibrated and uncalibrated displays. No one enjoys a green skintone!

How to calibrate your monitor

There are two options for creating your own color profile for your monitor: **Visually controlled software-only calibration** and **Calibration using a meter**.



Hardware-based monitor calibration with a colorimeter.

- **Software-based calibration:** You can roughly adjust the settings using software-based calibration by eye. A corresponding color control panel, which is included in the macOS system, guides you through the calibration process using a wizard, producing a visually customized monitor profile. This profile displays colors as neutrally as users themselves have judged and set. However, this process lacks primary color linearization or correction for non-neutral environments. It's merely a visual gamma optimization process, possibly with some white point adjustment.
- **Hardware-based calibration:** For most accurate and consistent results, a colorimeter, such as the SpyderX by Datacolor, is used. This is a sensor that you apply to the screen. The sensor precisely identifies the colors displayed and renders a correction profile using the included software. These kinds of colorimeters are available in different price ranges. Those looking to profile different color spaces, or even print their own pictures, should invest in a colorimeter with a room light sensor. Only through regular calibration can continuous color accuracy be guaranteed, even when working with these devices.

This means that borrowing a colorimeter or having a service provider set up your workflow once is not enough. Below we'll show you how to perform a monitor calibration using the SpyderX.

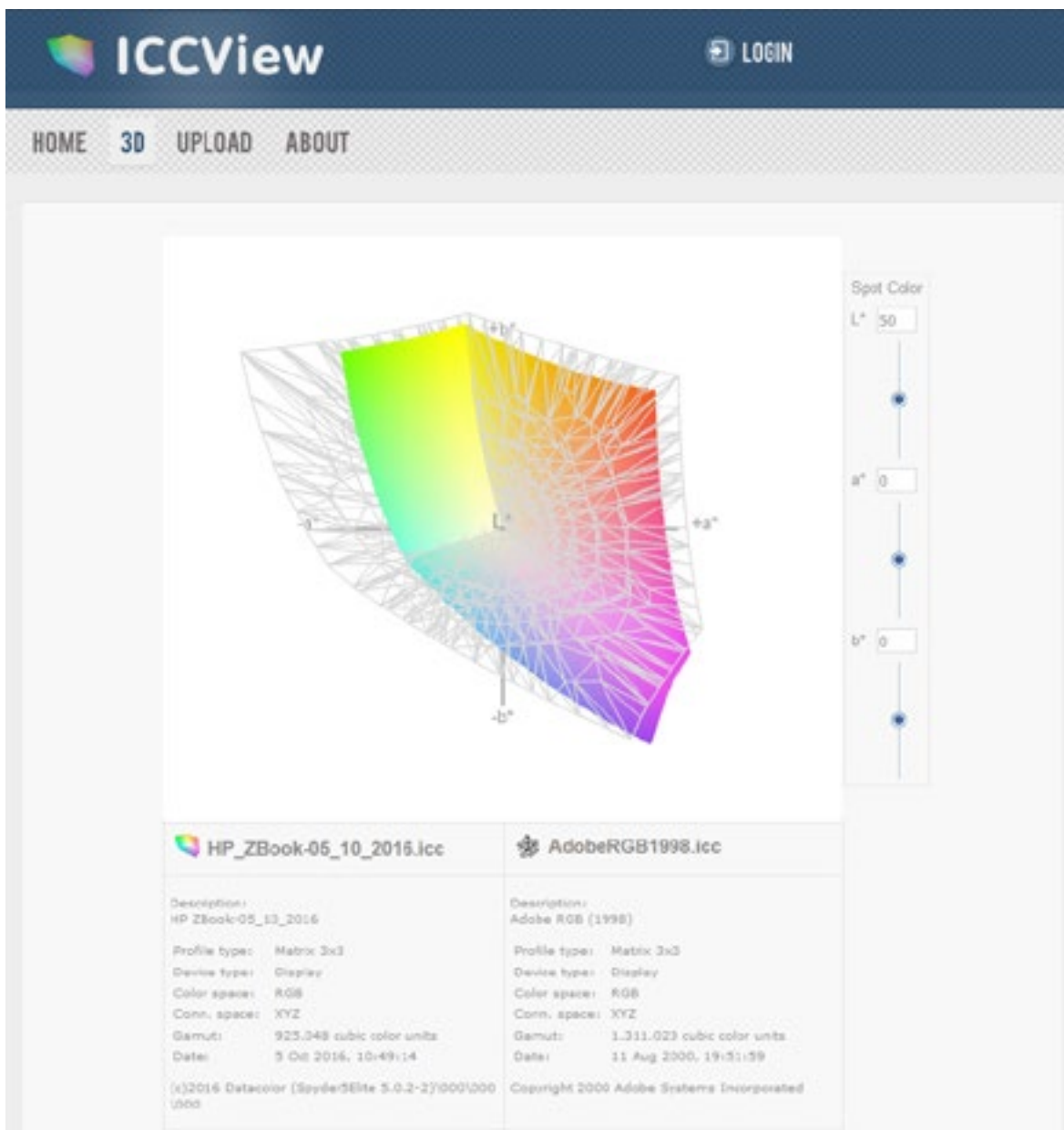


Menu window in macOS for software-based adjustment



TIP

A program for graphically displaying ICC profiles is available in Apple's Toolkit: the ColorSync Utility. For Windows users, there are websites you can use to visualize your profile, such as: www.iccview.de



In this example, the displayable color space of a standard commercial laptop is shown in the AdobeRGB (1998) color space using ICCView.de.

Initial Calibration

What you need to know

Initial calibration refers to the first time a monitor is measured and adjusted. To ensure the monitor presets are taken into account, the software has to know what display type it's calibrating: is it a desktop monitor, a laptop display, or a projector? These device types have been developed for differing uses, and different calibration targets are necessary.

- **Laptop:** Laptop displays are used in changing ambient light conditions, which is why they are usually calibrated to display as bright as possible.
- **Desktop:** It is also common for desktop monitors to be calibrated for brightness to interpret the dynamic range of printed images. Calibration solutions, such as the PRO or ELITE versions of SpyderX, can use a room light sensor to measure the brightness of the monitor's environment and use these values to align the monitor's brightness settings. For example, prints would no longer be too dark due to the display being too bright during editing.
- **Projectors:** Calibrating projectors involves the linearization of primary colors. This is particularly important for AV shows in order to ensure the correct colors and density, even in shadow areas, and to match color from one projector to another.



Simplified chart to demonstrate the calibration process

Things to consider

Low-end screens often offer only a limited range of options for adjusting settings for contrast and brightness. Some professional monitors, however, have a number of controls in the on-screen display (OSD) to adjust the contrast and color display settings. If something is clearly wrong with the display configuration, the profile generated during calibration will not lead to a satisfactory result. You should then reset your monitor settings to the factory default using its "Reset" option.

LCD monitors sometimes have other drawbacks as well. For example, they often offer "dynamic" modes that continuously and automatically adjust the brightness to the ambient light. When taken together with a hardware-based calibration, the results can be disastrous, since these dynamic changes take place within the monitor and this information is not forwarded on to the operating system. These kinds of automatic functions should always be disabled for color-critical work such as image editing, and especially during calibration.



INTERESTING ONLINE FINDS

Before we go any further with the software, here's another interesting blog post about how to calibrate a monitor.

[Read Article >](#)

Quote:

"Calibrating your monitor is a simple task and one that benefits you on many fronts. Aside from more accurate looking images and less strain on your eyes, calibrating your monitor will also help ensure your prints match your display. There is no reason you have to stick with the settings your monitor came with."

Jon Martindale, Digital Trends

Software Installation

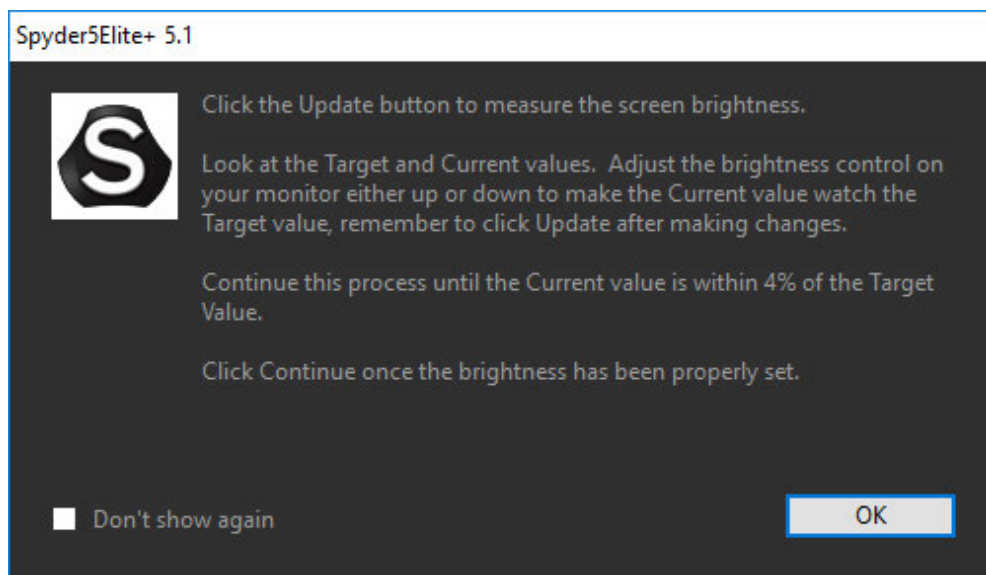
The first steps

The SpyderX comes with a serial number and a download link to our software. This software carries out the calibration process for you in a largely automated way. Install the software and follow the instructions on the screen. If you've opted for the standard setup, a "Datacolor" folder is then added to your application files. Under Windows, start the program for the first calibration process using the Start menu; on a Mac, launch from the Spyder icon in the Menu bar.

Initializing the Software

The next steps are easy

SpyderX utilizes two apps. The first, "SpyderUtility," will initialize in the background each time you start your computer after installation. It monitors the amount of time between calibrations and ensures the monitor profile generated through the measurement process is really being used by your system. This control function is important, whenever the correction data must be reloaded to the graphics card, such as when the computer comes out of standby mode. SpyderUtility also generates an icon in the Windows tray (to the right below the taskbar) and on the toolbar in MacOS. You can use this icon to launch the calibration software. In the SpyderX PRO and ELITE versions, you can also measure the room light. Do not quit this Utility, or your color management may not continue to be correct.



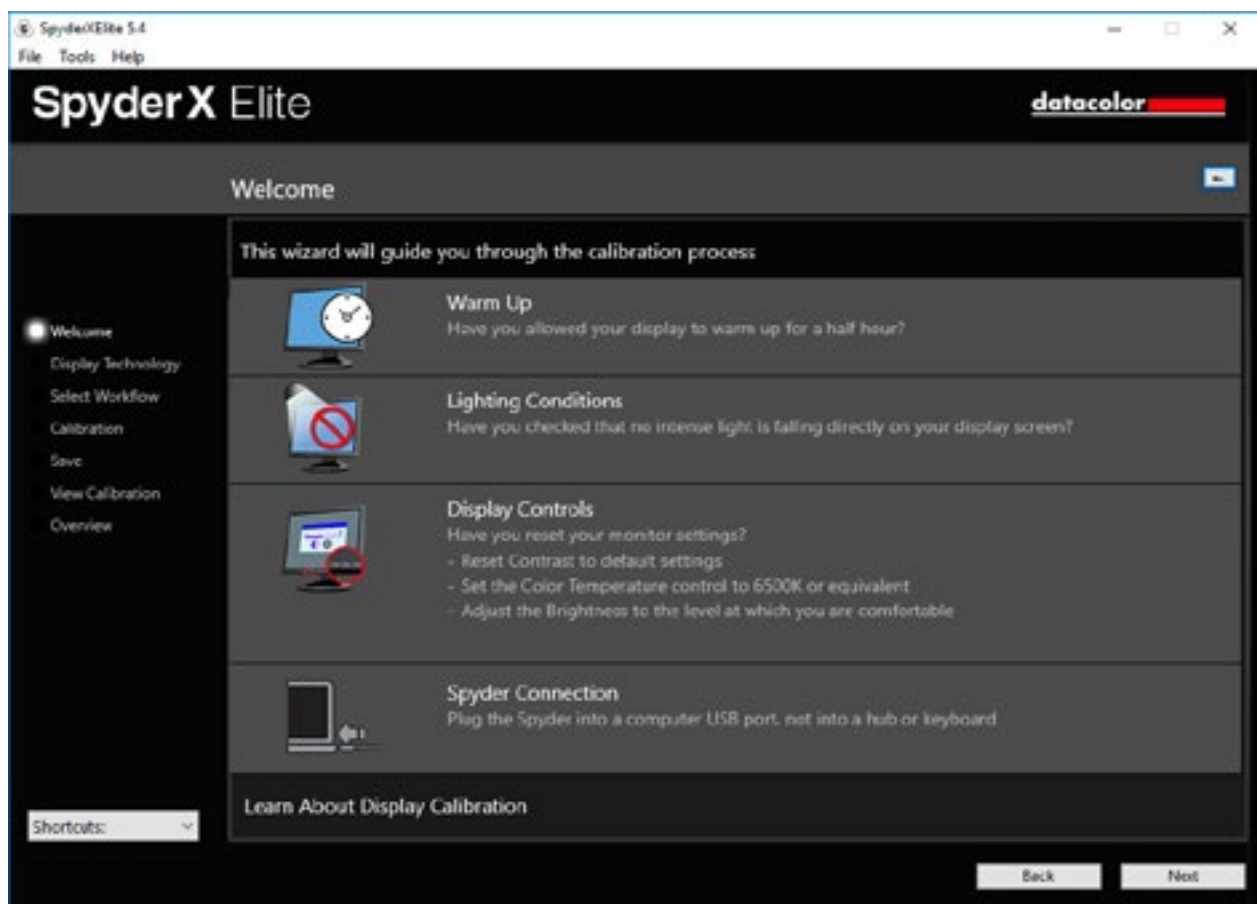
SpyderUtility is a small yet important tool that uses almost no system resources

Adjusting Monitor Settings

Preliminary Considerations

Please take into account the following before calibration, in order to prevent inaccuracies during the process:

- Let your monitor “warm up” for about half an hour
- Disable any automatic modes (dynamic brightness/contrast) in the monitor menu
- Avoid direct light sources on or close to your monitor



The wizard guides you through the calibration process in just a few steps

TIP

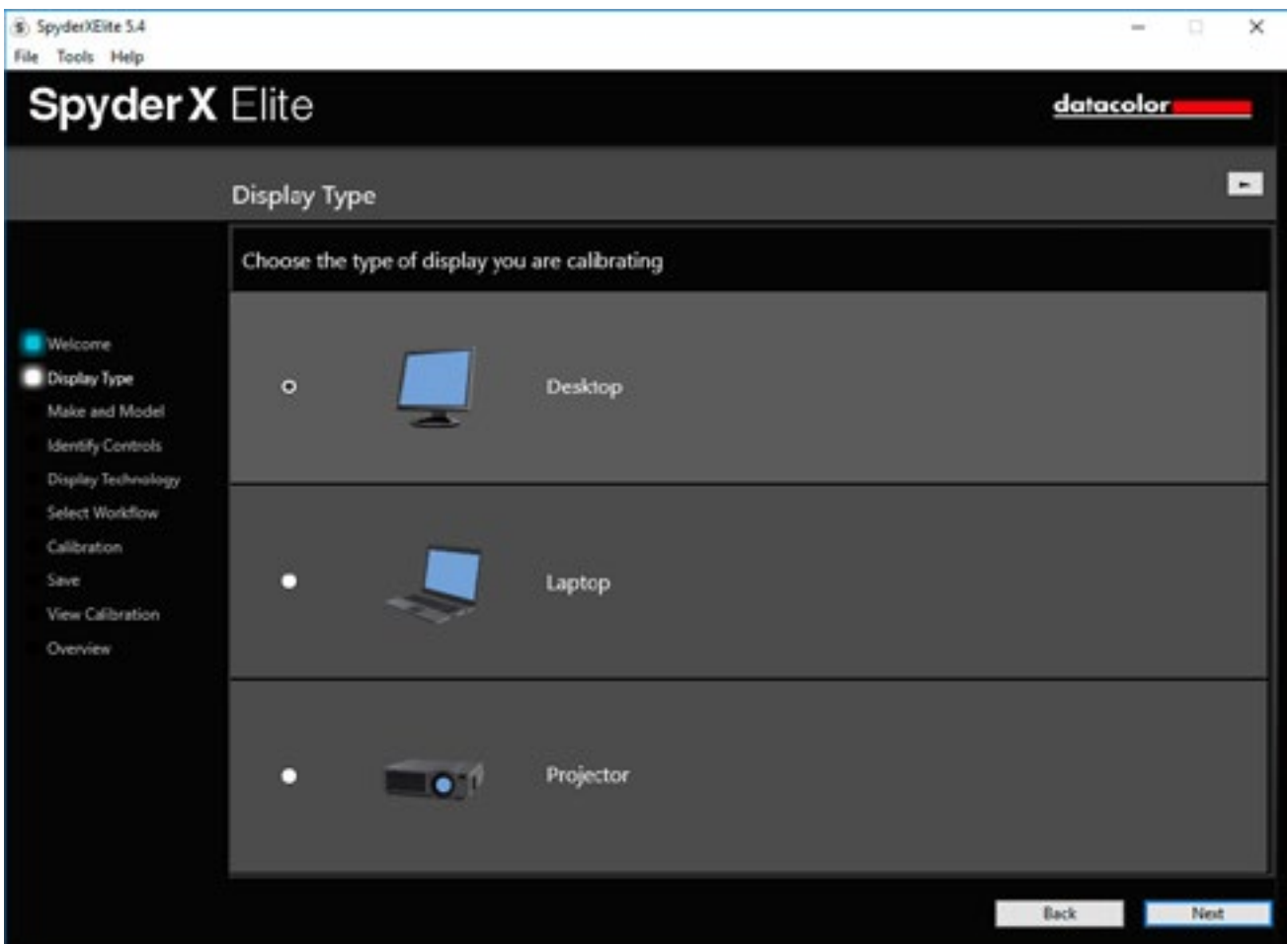
If your aim is consistent color at all times, we recommend switching off “energy management” to guarantee a stable operating temperature in your monitor.



Display Type

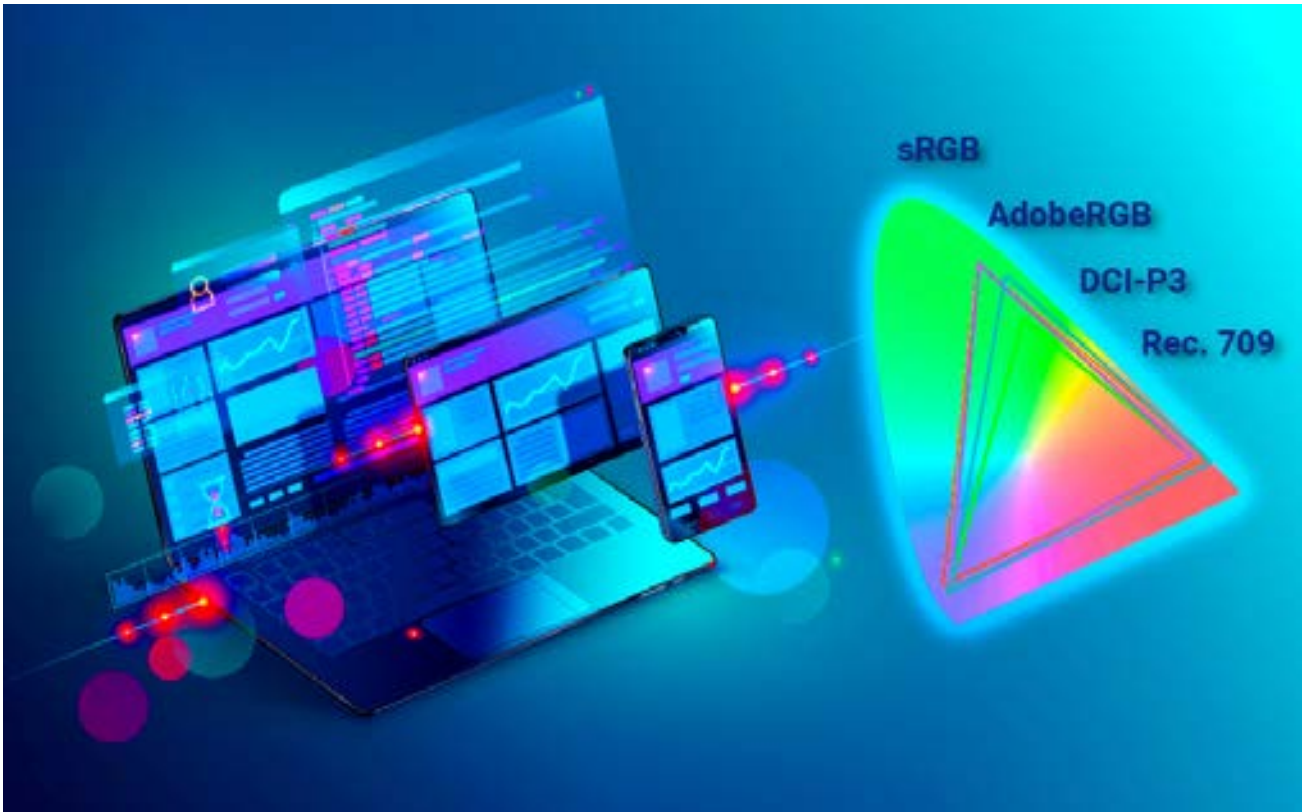
Select the right device type

Here you'll select what type of device you'd like to calibrate. The more specialized task of calibrating a projector is available in "Fine-tuning Your Monitor."



Three device categories can be calibrated with SpyderX ELITE.

Display Technology



Choose the right display technology.

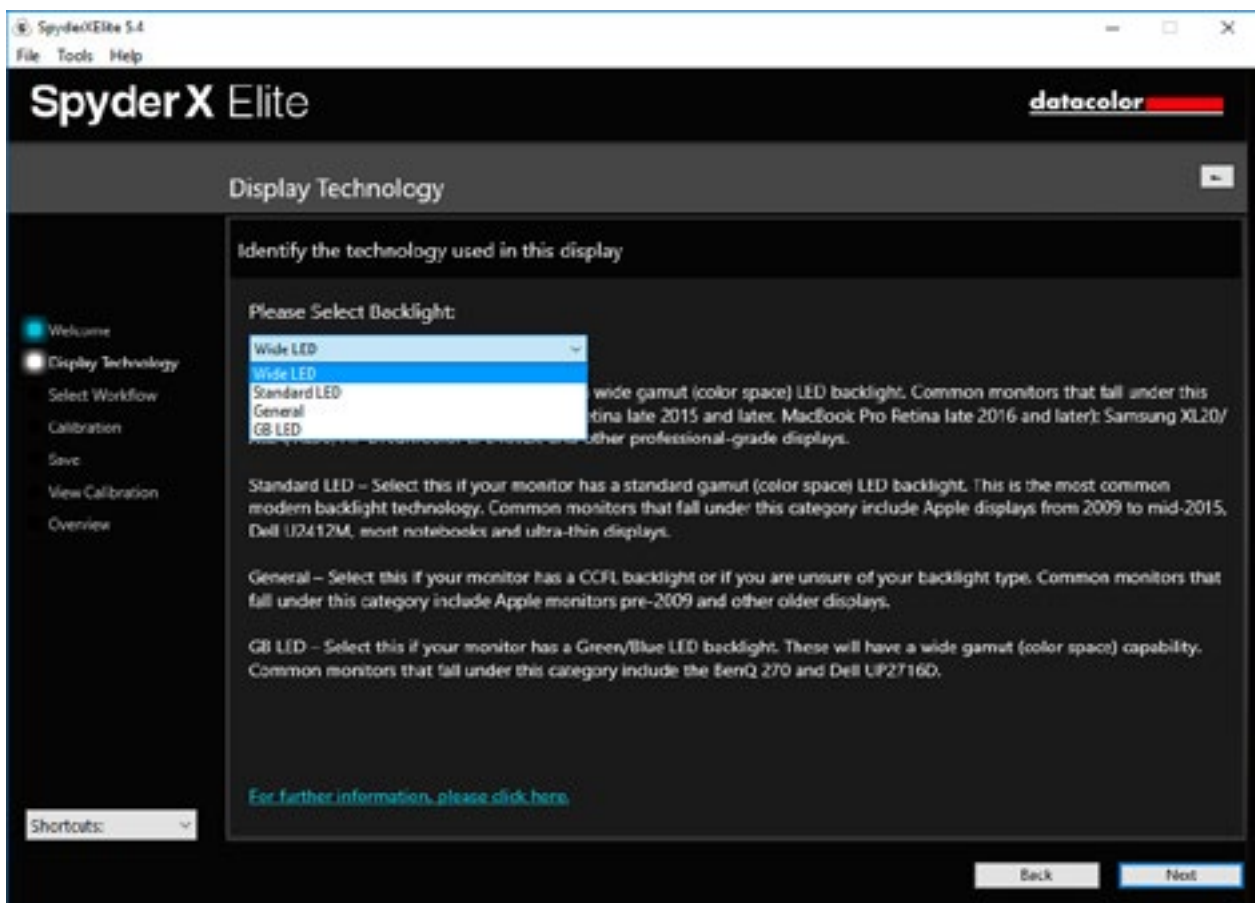
New monitor technologies: In the last ten years, a variety of new monitor technologies have been introduced. Most are variations on LED displays, with some completely new systems emerging, such as OLEDs.

Manufacturing of OLED displays for monitors is slow, making their price point prohibitively expensive for all but the highest end professional user. Many of these new display types have been developed to provide a wider color gamut, deeper blacks, brighter whites, and other visual improvements.



INFO

Starting with the SpyderX version of the Spyder software, it is possible to pre-select your monitor technology. The white point is adjusted according to the device class selected. The software provides a description of the individual device classes, including those with the latest advances in monitor technologies. There are numerous suppliers who offer monitors with a wide gamut color space in affordable price ranges.



The SpyderX software distinguishes between four device classes: LED (wide), LED (standard), General and GB LED, and provides clear details on how to determine device class for your monitor.



INTERESTING ONLINE FINDS

In the blog post „SpyderX and new monitor technologies“ on our SpyderBLOG, C. David C. Tobie addresses this topic in depth.

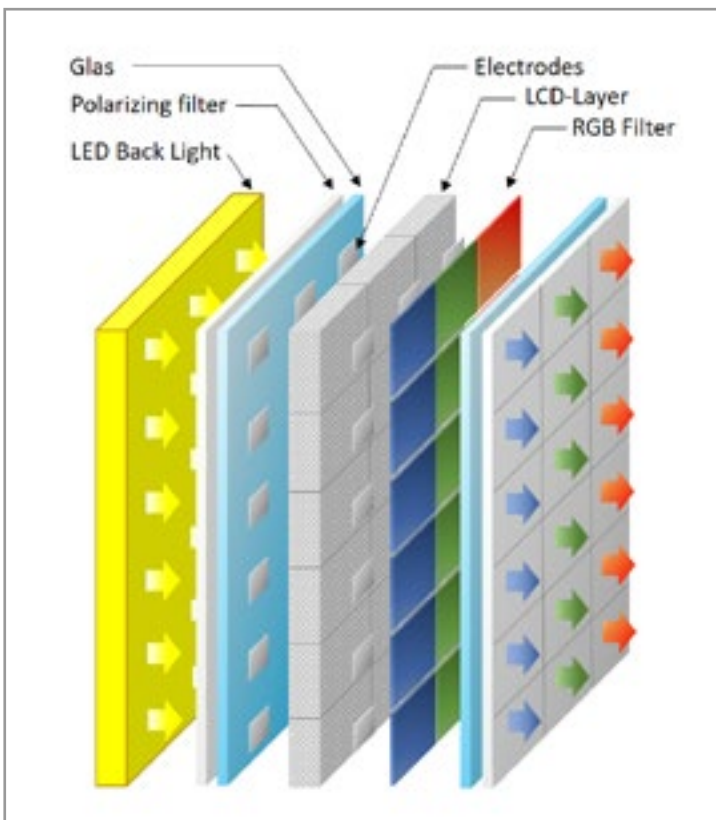
Mehr Info



Controlling Brightness and Contrast

How to proceed

Misunderstandings can lead to mistakes, so it's important understand how an LED display works. Different controls are provided with various internal or external displays which claim to adjust the "brightness." This graphic provides an optimum illustration of the problem. It is essential when calibrating the display to adjust the brightness on the monitor itself (also commonly accessible via the operating system) instead of an adjustment to the graphics card driver.



Operating an LED display. The second layer with LCD pixels can be controlled electronically, and regulates the transmission of light for each color pixel.

Backlight illumination: Use the backlight illumination to change the luminance. This involves a flat projector, in our case consisting of a number of LEDs. The background illumination is controlled by the hardware and on older displays can be adjusted either directly through an on-screen display (OSD) on the display itself or using a tool in the operating system.

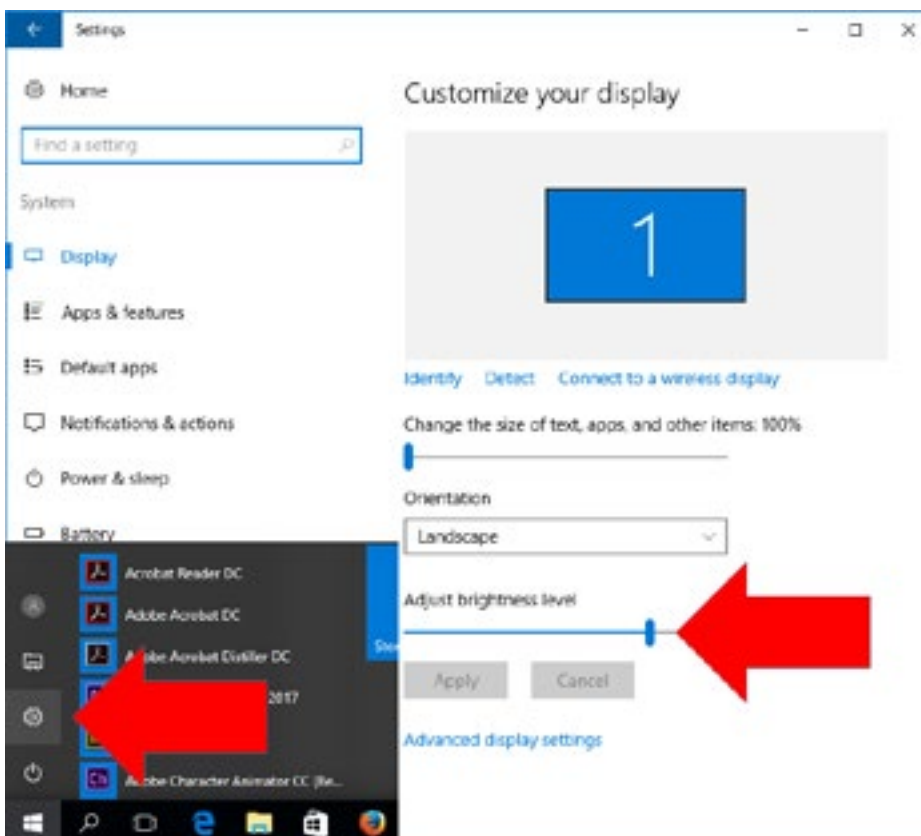
Note! This is the only place you can actually adjust the display luminance (brightness).

LCD layer/polarizing filter and RGB filter: Pixels are created at this stage. The liquid crystal diodes (LCD) are partially (pixel by pixel) controlled by the electrodes so that the LCDs change the direction of their polarization depending on the voltage applied. In conjunction with the polarizing filters, the system works like a light valve so that the intensity can be controlled for each color pixel. This is where the graphics card driver brightness adjustments occur, but this is also where the correction values from color management are applied. If you allow adjustments (such as brightness settings) from the graphics card, these will overwrite the monitor calibration corrections.

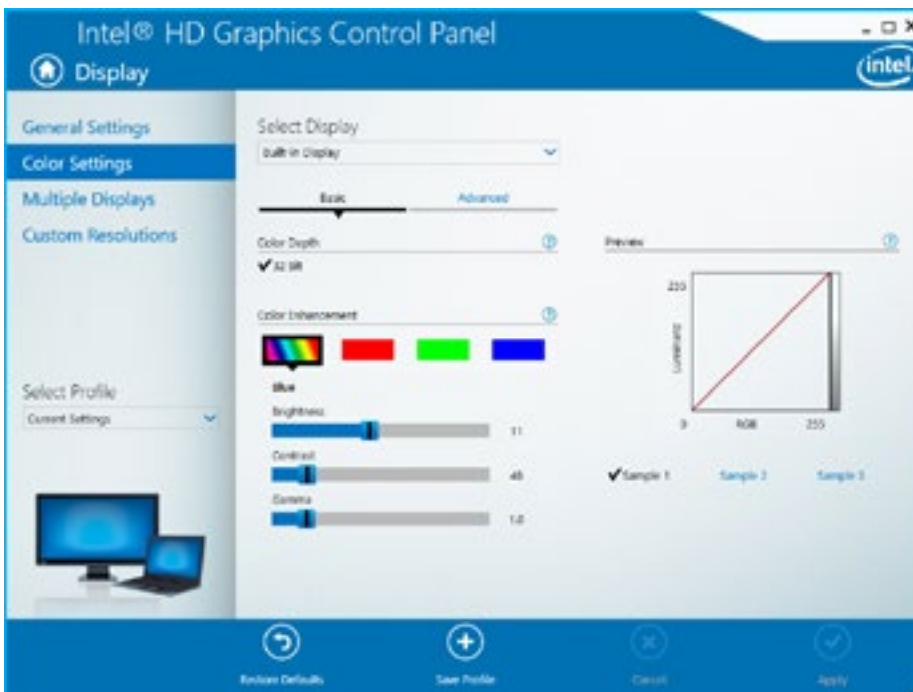
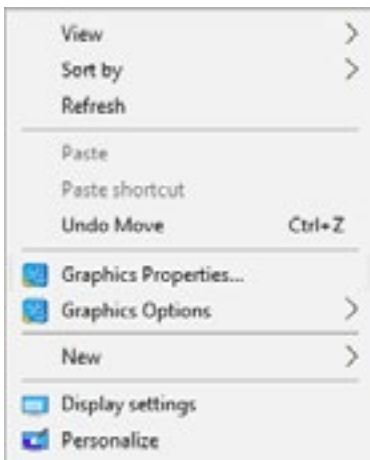


TIP

To reduce the luminance, please use the backlight control. The backlight control is also called the brightness control on some monitors. As a test, lower this control to the lowest value and watch the menu that is displayed by the monitor itself. If this OSD menu also gets darker, you're dealing with a true backlight control. However, if this menu stays as bright as it was when you started, while the rest of the screen behind it gets darker, this really is a brightness control, and should not be used to dim the display. Dimming a screen to 1/3 its maximum brightness with a brightness control can limit the number of colors the screen can display to 1/3 the usual number, causing visible banding.



Luminance is corrected on a free-standing monitor using the **OSD**. However, in Windows you can also correct this via the Start menu, as illustrated here. For laptops, there is usually the option to control the luminance using your keyboard (PC: Fn key plus brightness symbol key; Mac: F1/F2 keys, for finer control F1/F2 plus Shift and Option keys (for iMacs as well as Apple laptops.)

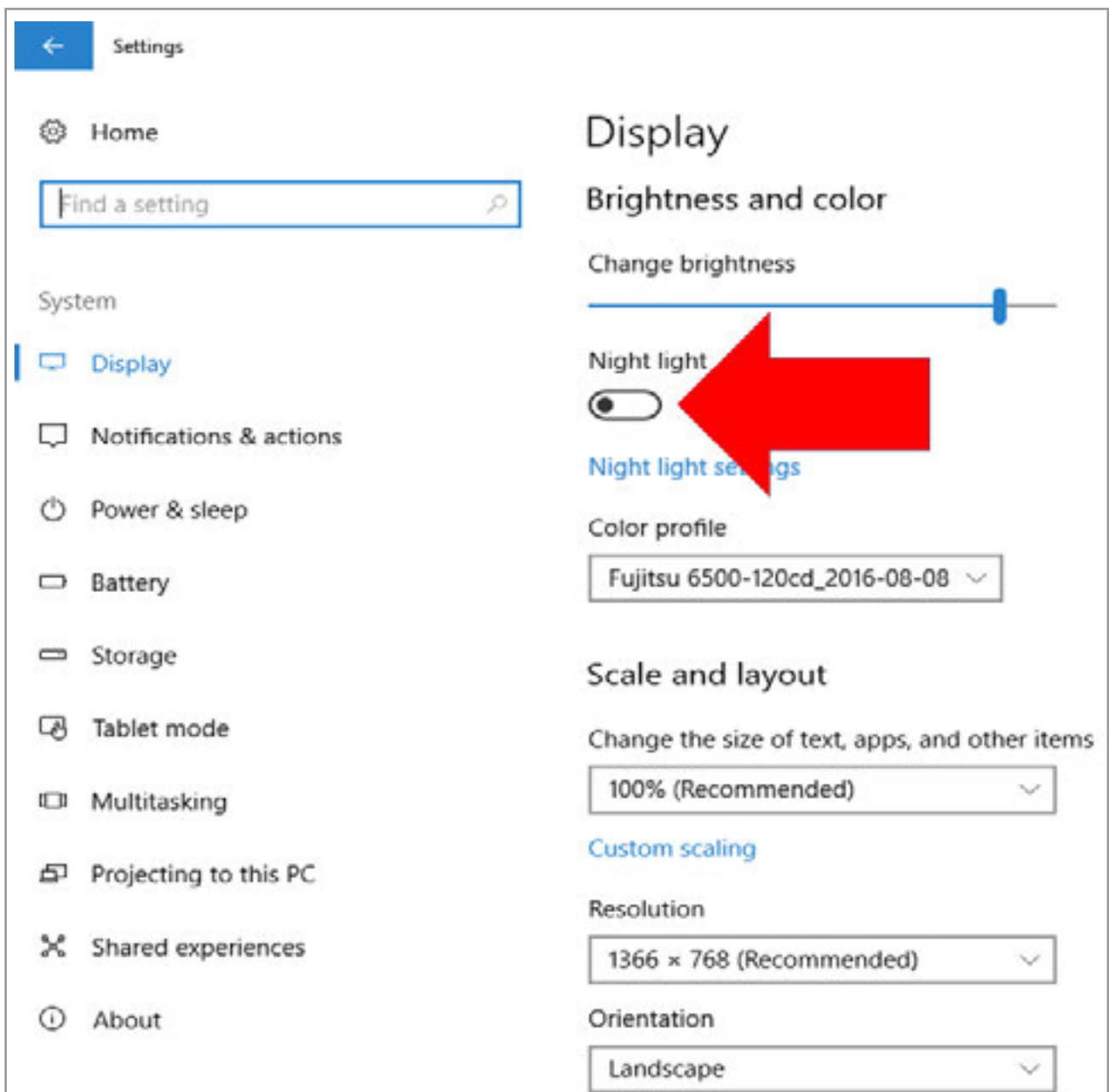


For Windows: Use the right mouse button to find the video card driver. The settings here should be set to "Standard," i.e. brightness = 0, contrast = 50 and gamma = 1.0; where possible, graphics card driver tools and utilities should be deactivated. Otherwise, you'll lose the corrective values for the color management system when these are overwritten.

EXPERT INSIGHT



Windows 10 Creators update: there is now a "Night Mode" function that can adjust the monitor's color temperature depending on the time of day or the sunrise/sunset specific to your location. This function must remain switched off since it will overwrite all calibration data, as well as present incorrect color. For Macs beginning with macOS 10.12.4, a similar "Night Shift" mode is available at the top of the Displays window of System Prefs. Be sure it is not enabled.



Night mode (night light) function on the Windows 10 Creators operating system must be turned off.

Controlling Color

Settings to adjust

Color and color temperature settings are also adjusted using the OSD. These can be accessed in different ways, depending on the display. The better the contrast, color temperature, etc. presets are to the calibration target, the more flexible and high quality the end result will be with the profile.



The RGB primaries can be corrected individually using the graphics card driver tool for brightness, contrast and gamma. When carrying out a visual correction without using a colorimeter, you make adjustments by eye. However, always make sure these settings are set to "Standard" if you want to calibrate the display with a colorimeter.

INFO

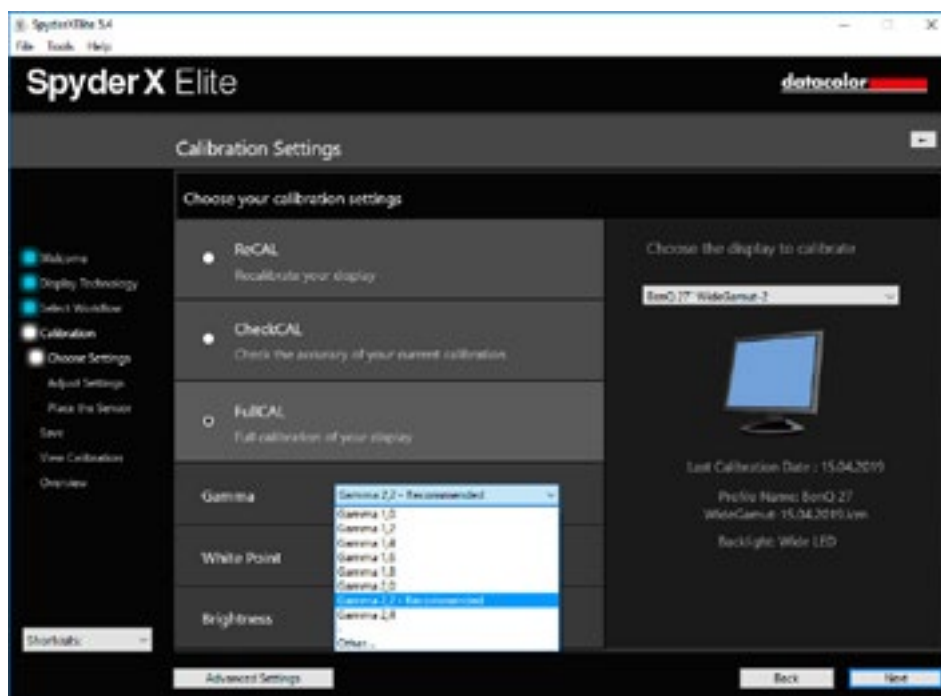
If your monitor has a visible color cast, you can use the PRO and ELITE versions of SpyderX to control the RGB parameters. This function is activated through the Spyder software settings (under "Advanced Settings"). The internal color depth on many monitors is usually 10-12Bit per channel. At this point, the RGB pre-calibration option uses the monitor's greater color depth to enable a pre-adjustment of the color temperature without any visible losses to color smoothness.



Calibration Settings

Set a target

Before calibrating, you need to decide the target points for your device. You can choose parameters for “gamma,” “white point,” and “brightness.” If you aren’t sure exactly how you need to calibrate your monitor, use the default recommendations. These are designed to work for the vast majority of users, who are not doing specialized work in unusual color spaces.



You can choose between full calibration or re-calibration in the SpyderX software menu, and you can also adjust the gamma, white point and brightness.

EXPERT INSIGHT

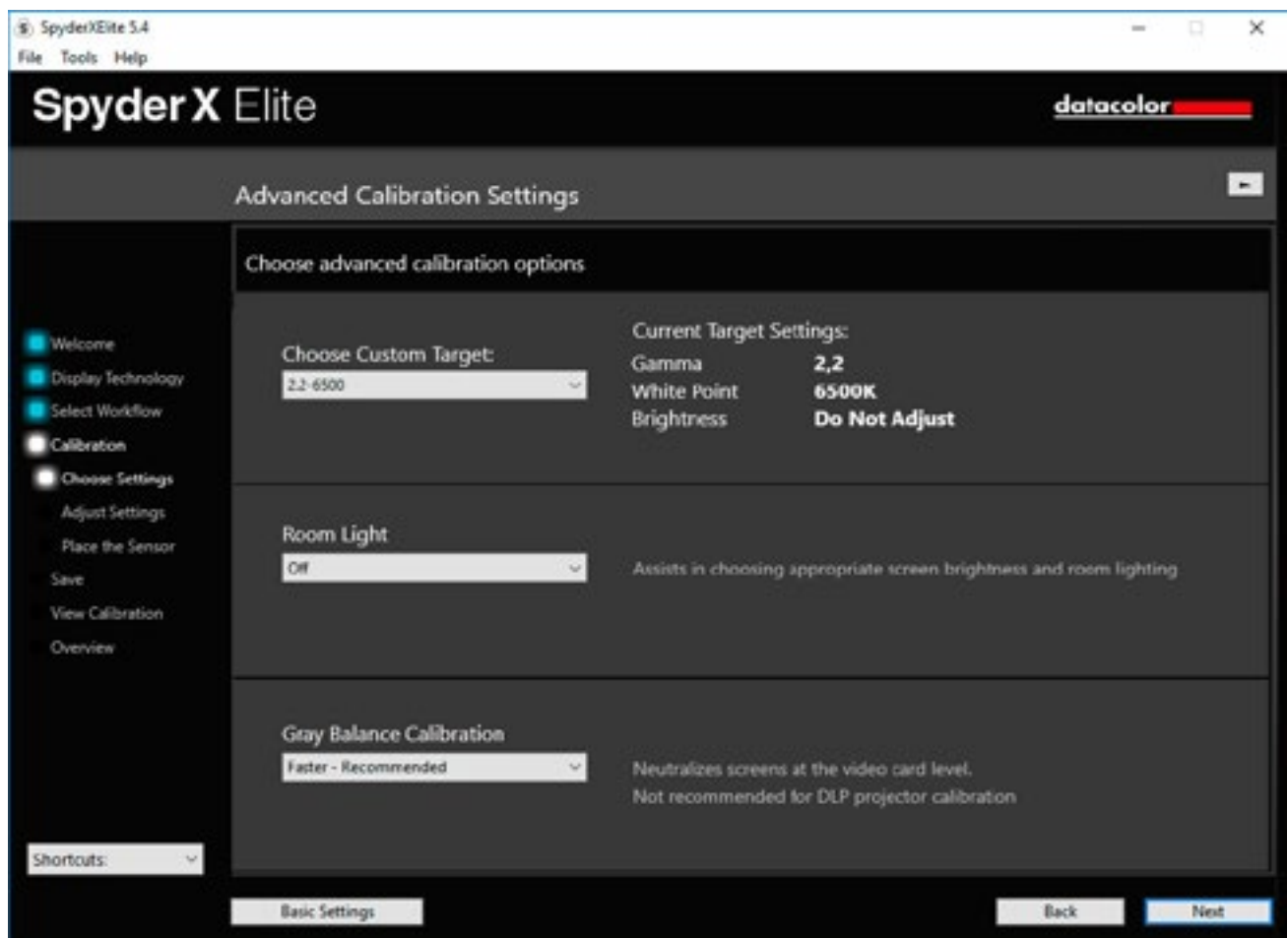


For a long time, monitor calibration apps made no distinction between initial calibration and follow-up measuring processes. Each time a profile was identified, the user had to work through all of the settings again and again, even though the same hardware was usually being measured under the same conditions. User-friendly programs now work in a more convenient manner. With SpyderX software, these functions are called ReCAL, CheckCAL and FullCAL.

Advanced Calibration Settings

Professional specifications

Clicking the “Advanced Settings” button opens a somewhat more technical dialog box that allows you to access three additional software functions. You can select a combination preset for the adjustment parameters for the previous dialog box, particularly calibration targets for video editing, or non-gamma targets. You also have the option of activating or deactivating the “Ambient light compensation” and “Gray balance calibration” functions. Learn more about what you can do with this and how these features optimize your calibration in “Fine tuning your monitor.”



In the advanced calibration settings you have the option to select gamma, white point and brightness for a wide variety of color spaces. The following are available: AdobeRGB (1998), sRGB, ITU-R Rec. BT.2020, ITU-R Rec. BT.709, L-Star-6500, NTSC and PAL SECAM.

Measuring Color

What the meter does for you

Here's where the colorimeter comes in. Once you've completed the preliminary steps in the software wizard, SpyderX takes over communication with the monitor. Ideally you'll spend just a few more minutes by your computer. You then save the your new display profile under a meaningful name.



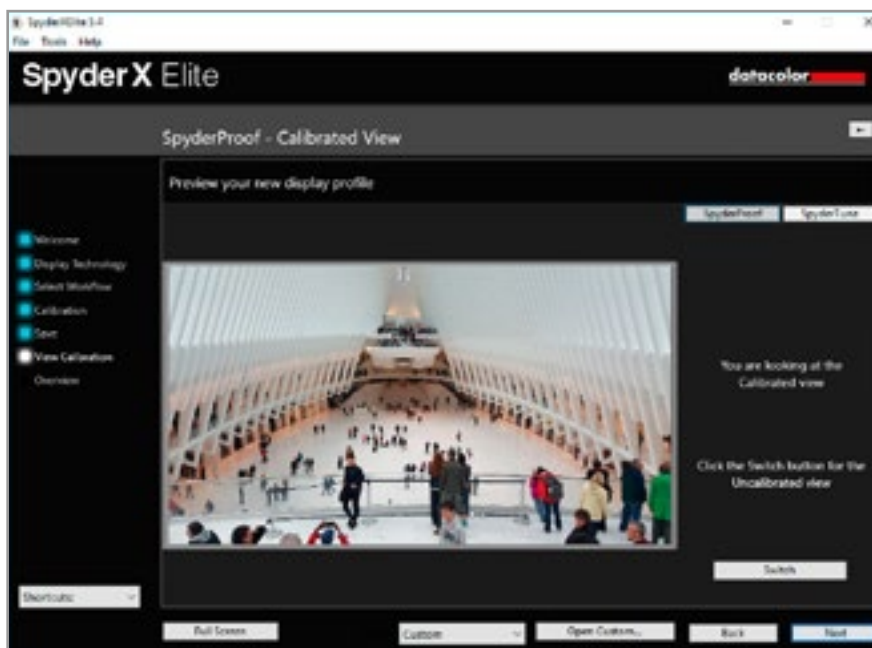
SpyderX sensor at work (time for a coffee break!)

What you can see once you've created a profile

Different display options show you how the calibration has changed compared to the device's standard settings. Previously, there was usually a single before/after image. However, the SpyderX software shows you a number of different kinds of photos. These give you a much more precise picture of how photo content and colors display differently. SpyderX PRO and SpyderX ELITE also give the software the option for you to include your own photos at this point. With SpyderX ELITE, you can also display the test images in full screen mode to compare the calibrated view with the uncalibrated one in detail.



A range of different image types arranged in a matrix make for a good basis for assessment



With SpyderX PRO and SpyderX ELITE you can also upload your own images so you can better assess your type of work using the before/after function.



With SpyderX ELITE you can then view your images in full screen mode.



TIP

Don't be surprised: Following calibration, images don't always look prettier at first glance. However, you'll almost always see more detail in the images. Calibrating a monitor or display does not mean displaying colors in a way that pleases you. Instead it means bringing the display characteristics into line with an imaging standard (ICC), which we learned about in the previous section on camera calibration. It's important for you to see exactly what's in the file on your monitor. On this basis, you can then further edit images digitally or make them more saturated or higher contrast, if you prefer.

Placing the Colorimeter

How to correctly mount the colorimeter



With SpyderX, you use the protective cap as a counterweight to ensure the sensor can be securely positioned on the display's surface.

- Hang the SpyderX in front of the monitor
- Move the counterweight along the cable so that it hangs down behind the monitor. This is how you'll hold the SpyderX in the necessary position
- Lay the SpyderX flat on the clean surface of the monitor. To facilitate this flat positioning, tilt the display back slightly if possible. This will stabilize the position of the SpyderX with its own weight.

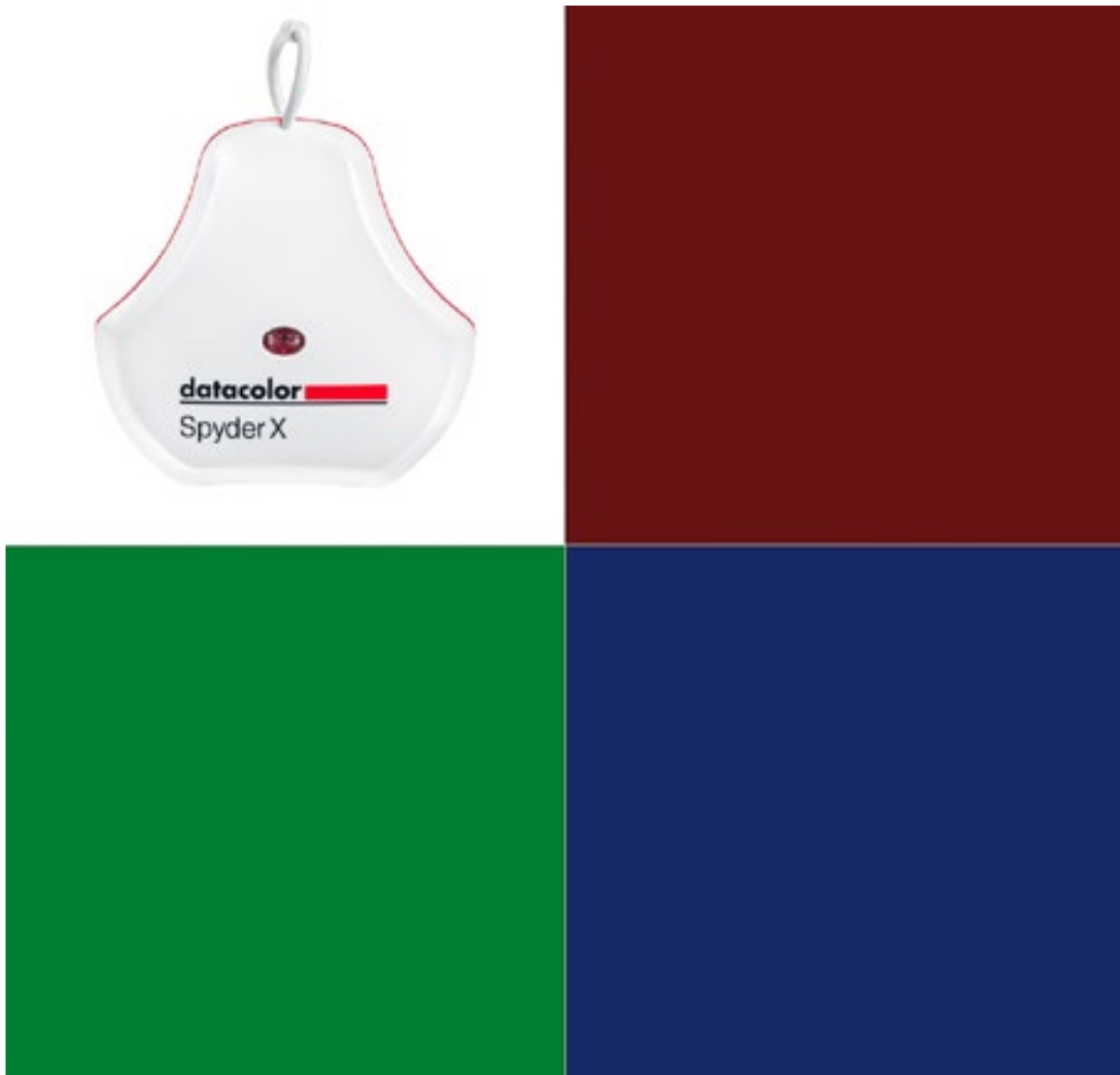


Once the setup is complete, the software shows you where to position the sensor.

Measuring

What you'll see during calibration

Expect to spend about five minutes on the first calibration: During this time, the colorimeter determines the ICC profile for your monitor together with the software. Meanwhile, the target area in the middle of the monitor will display red, green, blue and gray tones. Once the measurement is completed, remove the SpyderX from the monitor. If you've activated the "Ambient light compensation" function, there are additional dialog fields that will be discussed below.

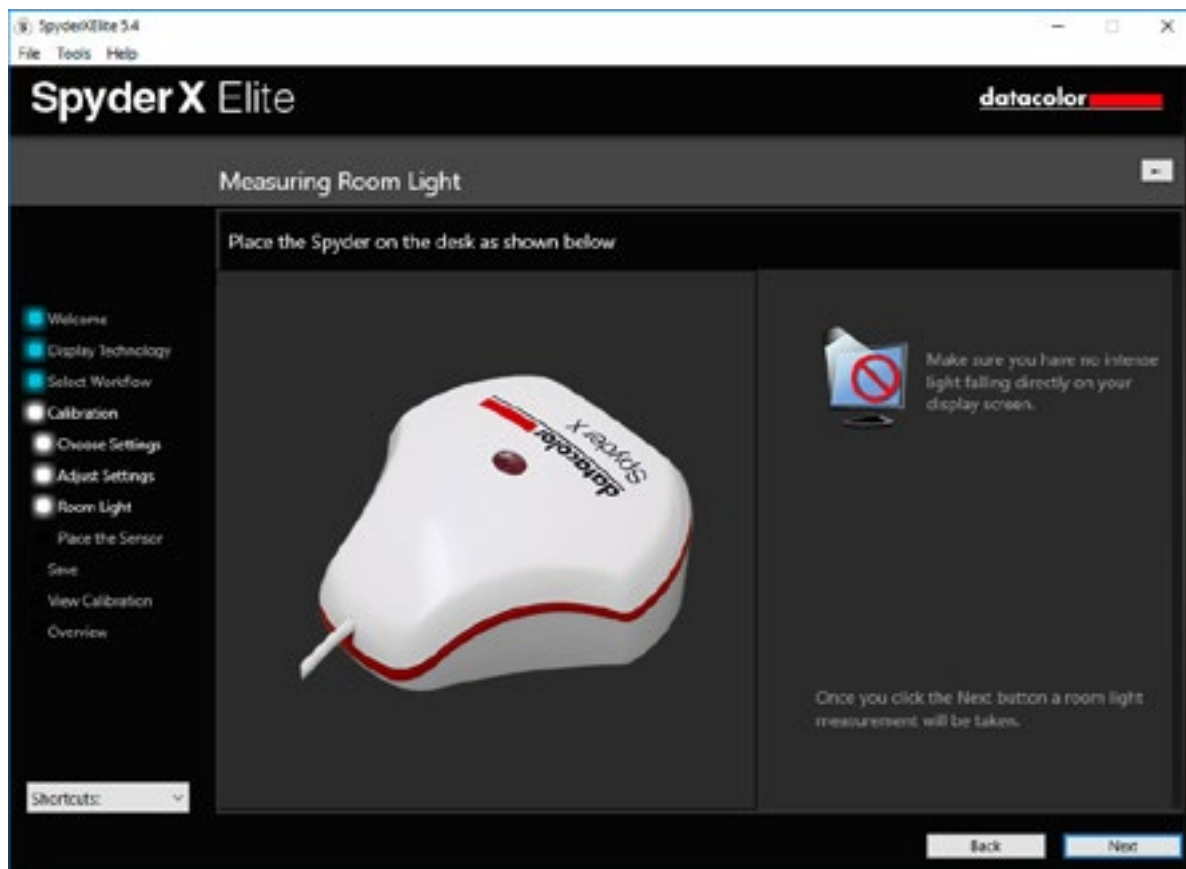


The sensor then measures a series of reference colors.

Measuring Ambient Light

How to proceed

The lighting conditions at your work station are important for calibrating your monitor. That's why an ambient light sensor has been placed on the top of the SpyderX. Activate the "Ambient light," function if you are calibrating a desktop computer. If you're calibrating a laptop, deactivate the "Ambient light" function, since you'd typically be working in various light conditions. However, if you tend to use your laptop in one place, we'd recommend activating the function as you would with a desktop computer. The ambient light is then continually measured when you connect the SpyderX. You can find the status under the SpyderUtility symbol in the menu bar or the Start menu.



SpyderX software menu window for measuring ambient illumination.

TIP

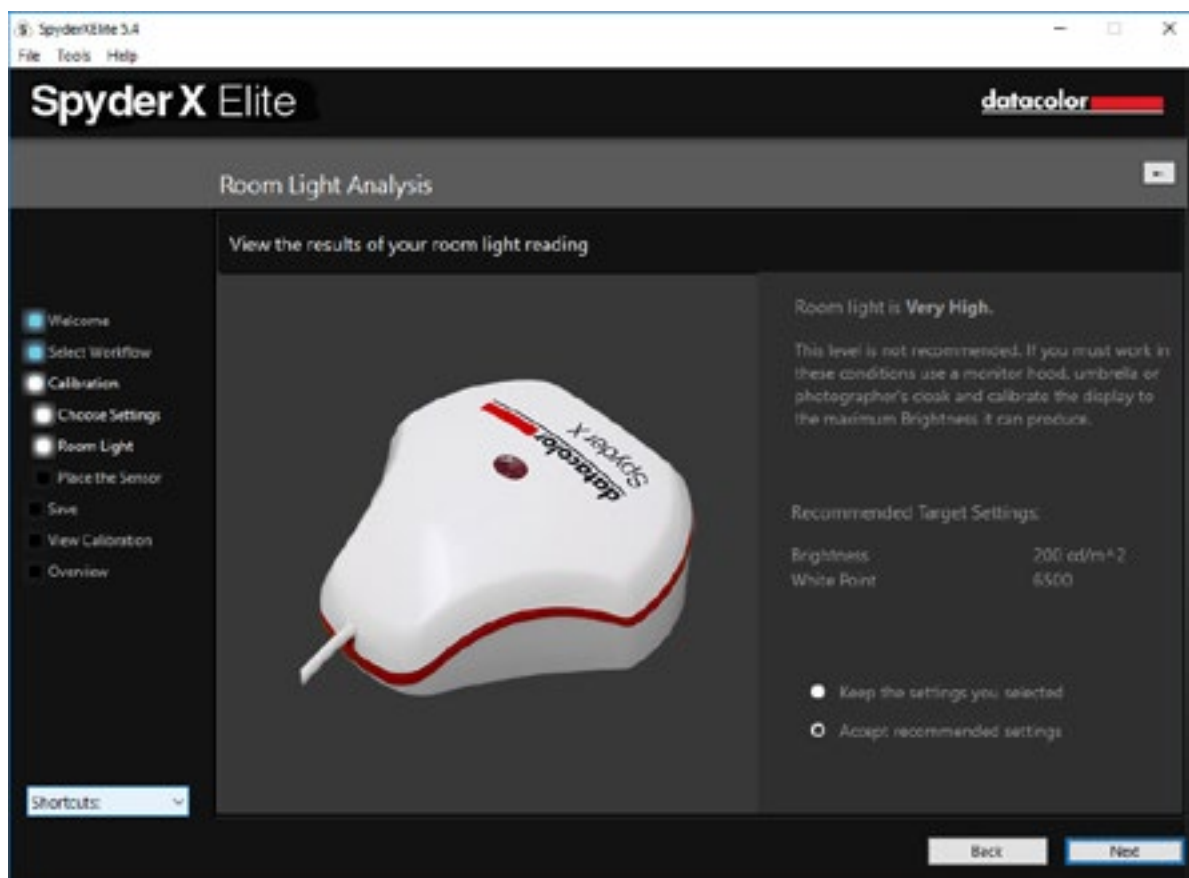
During this process, ensure no direct light falls on the screen or the SpyderX.



Ambient Light Analysis

How the wizard helps with optimization

Once lighting has been measured, the wizard will show you the results. Depending on the results, possible actions are displayed on your screen. These include suggestions for darkening or brightening the room. If that's not possible, consider an anti-glare device such as a hood. The wizard also provides you with target values for luminance and white point in order to achieve a more suitable brightness level and color temperature in your specific lighting situation.

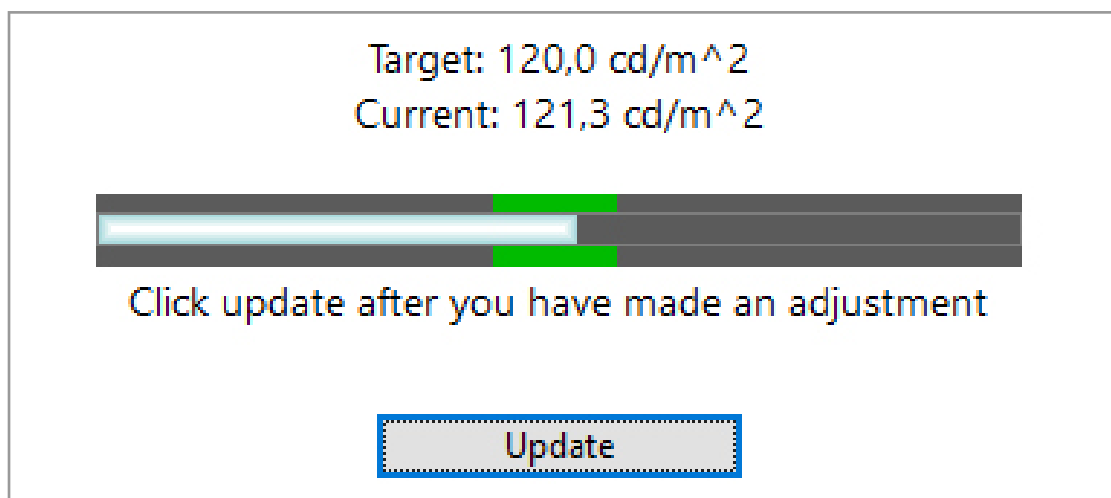
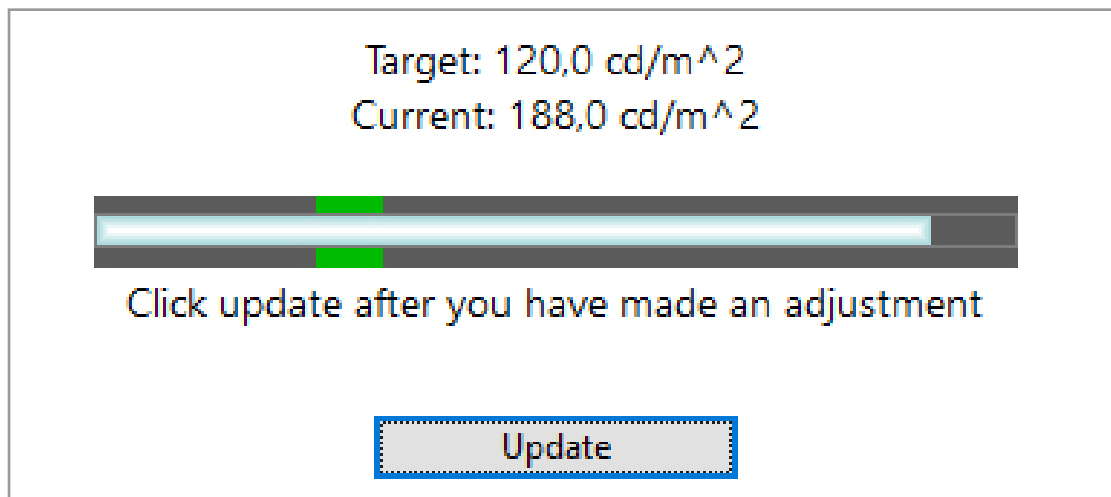


Once the measurement has been completed, the software recommends specific target settings.

Readjustments

It's easy to make readjustments

You can accept the recommendations or keep your original settings. Then place the meter back on the screen and continue with calibration. This visibly measures the white luminance. If the value does not match the tolerance range of the values generated by the wizard, proceed as follows: Adjust the display to the required brightness level using the device-specific OSD settings or using the OS brightness control and click "Update." Please note the basic principles we went over in the "Brightness and Contrast" section.



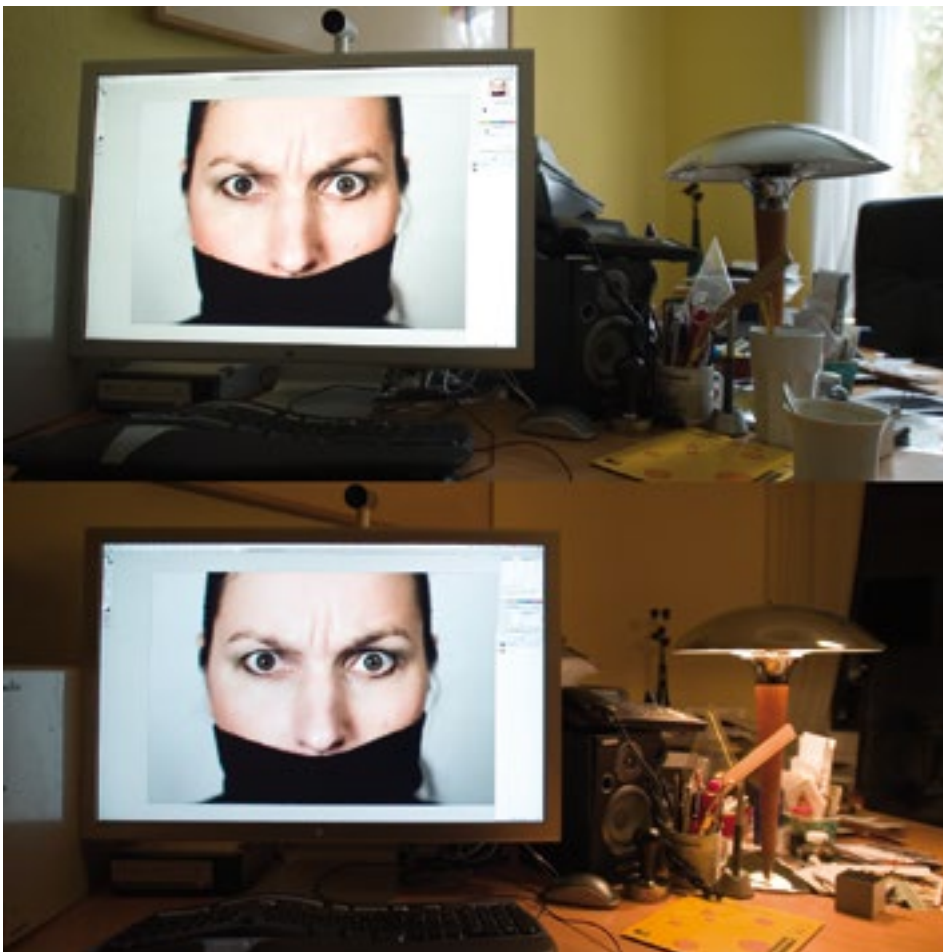
Once you have adjusted the brightness on the system, measure again with the sensor. The measurement results, including the tolerance range, will be displayed after measurement. On Mac screens, using Option-Shift while pressing the Brightness Up and Down buttons allows finer adjustment of the screen luminance.

Side Note: Ambient Light and the Ambient Light Sensor

What to consider

Your working environment is a key factor that is often forgotten during calibration. Constant light and temperature conditions are ideal, such as in air-conditioned rooms without natural light. If you edit images in a normally heated room with natural light, please be aware of the following:

- Place your monitor as far away from the window as possible.
- Turn the monitor away from the window to prevent reflections.
- Use blinds on windows and a dark display background, both of which reduce any side effects of light.
- Low, indirect lamplight is suitable in the morning and evening hours.



Simulation of the human eye's color response: the same image under different lighting conditions

The importance of an ambient light sensor

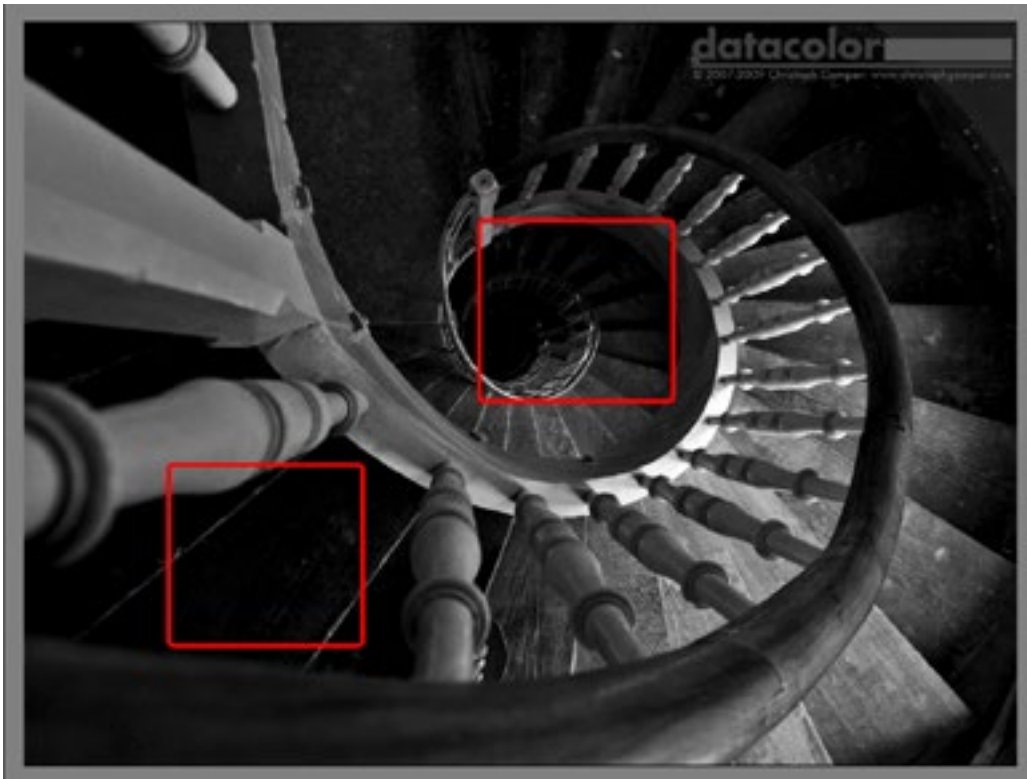


The ambient light sensor, marked with a red sun on the image, is available with the SpyderX PRO and SpyderX ELITE.

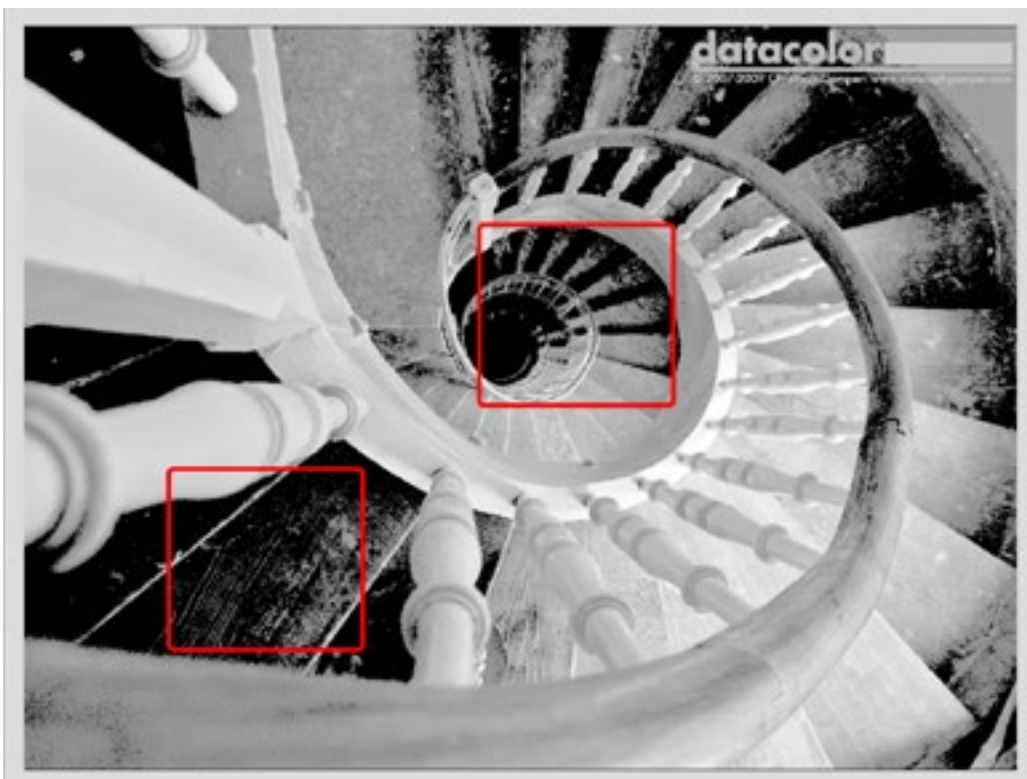
You may wonder if you really need an ambient light sensor, but we believe it is an absolute necessity.

Two key reasons why it's necessary to measure ambient light during calibration

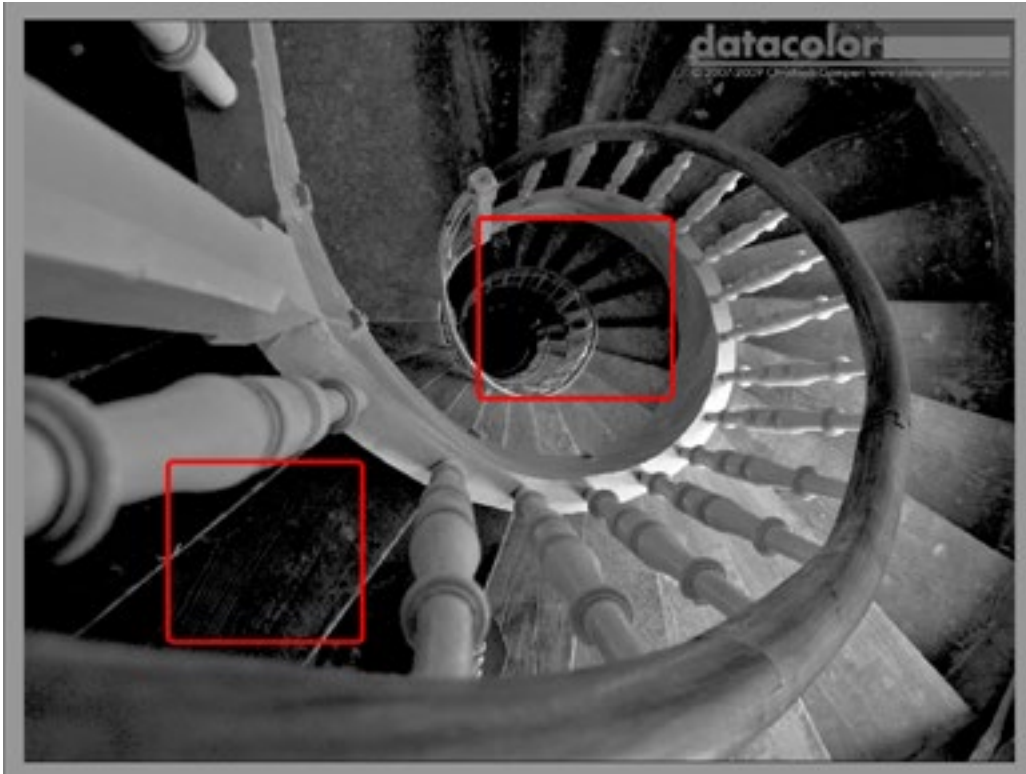
- **Differences in the contrast dynamics:** The monitor is a light source against a print that only reflects light. Images viewed on a monitor usually have much greater contrast than prints, since the white on the screen has a much greater brightness than the paper white of a printed image. If you don't calibrate the luminance of your monitor using an ambient light sensor, you will interpret the brightness of your images incorrectly and you'll edit the image file according to the brightness of your screen. In practice this means that you'll adjust the image densities down until you're satisfied with the result on your screen. The resulting print, inevitably, will be too dark.
- **Affects of ambient light changes:** Brightness is globally measured across the eye's field of view. This means that dilation of the pupil and the perceived changes to the brightness of light depends on the overall amount of light reflected into the eye, including the ambient background. If we change the lighting conditions by reducing the ambient light, the iris compensates by enlarging the pupil. In our case, this means we now perceive the monitor area to be brighter, even though the monitor was not part of the change in brightness to the ambient light. This changes the assessment basis on which we adjust our images. We think the image is too bright and correct for this; the result is an image that is too dark.



A classic black and white image with graphic structures and a lot of different gray levels. The areas marked in red typically define two critical zones that are prone to “blurring” when a monitor is not set up correctly, i.e. the structures in the shadows are no longer displayed even though they are there in the file.



The same image with an excessive gray balance in the black zone for illustration purposes. The grain on the stairs is clearly seen, as are additional stairs that appear out of the dark.



The same image, but the structures are balanced better here. We're not increasing the precision of our fine art friends who use the zone system. The fact that you're even seeing these structures is what makes the ambient light sensor useful, through its precise control of the monitor. It is a prerequisite for accurate correction. It also means you don't have to poke around blindly in the dark.

TIP

For all those who appreciate even the finest details, we'd like to recommend to recommend a discussion of the zone system in photography that Ansel Adams developed in the 1940s.



[More Info](#)



Profile Name

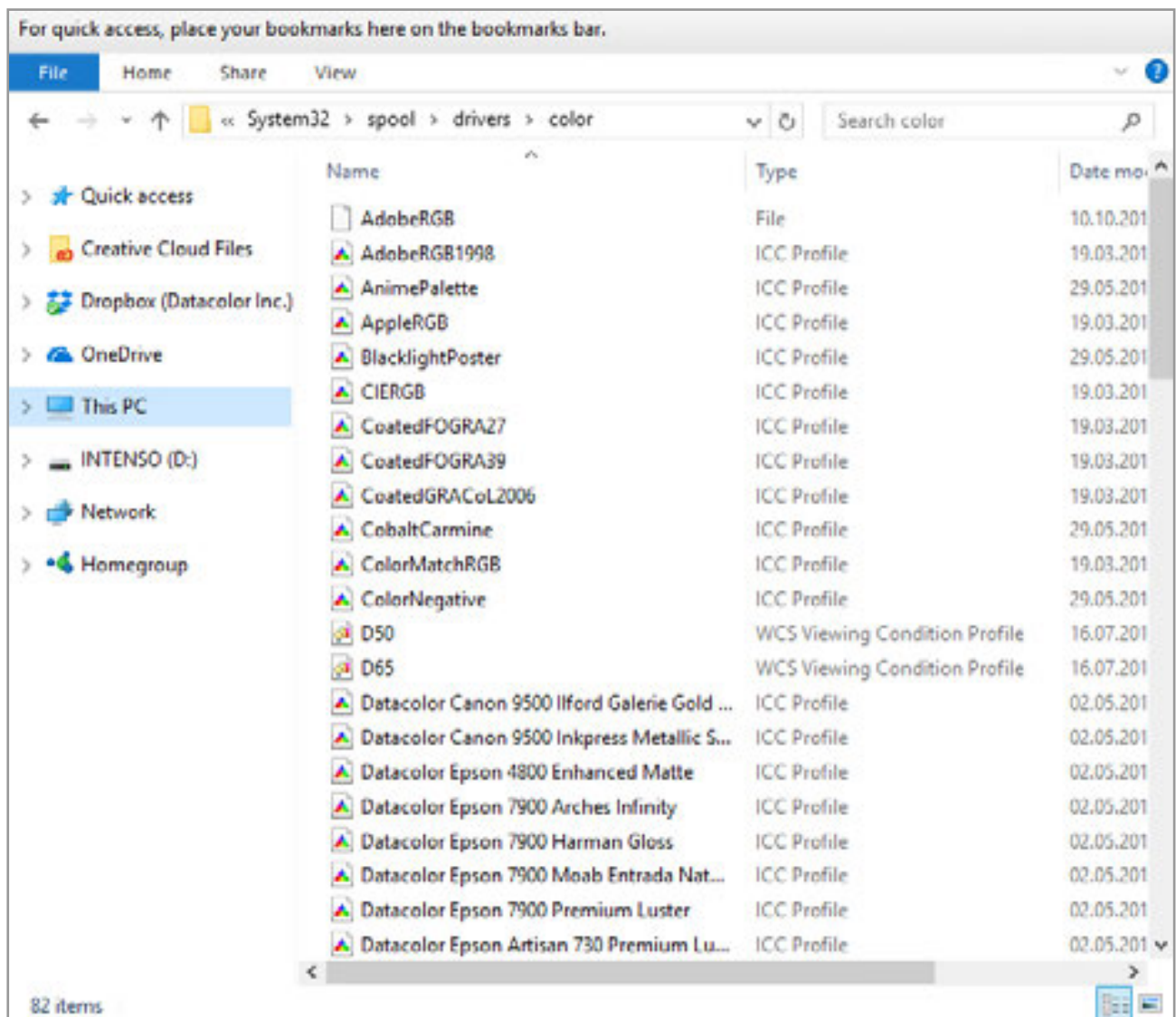
The smart way to proceed

Give your measurement profile a name in this dialog field. We recommend not using the same name or similar names over time. Instead, use the creation date in the file name. Alternatively, you can record information on the lighting conditions in the file name. This will enable you to quickly find the right profile when switching profiles in future. You can also use this to compare a profile with previous profiles to gain an impression of the color variations on your monitor.

Storage Location

Where your profile is saved

On Windows systems, the directory for any ICC profile is stored under “C:\Windows\System32\Spool\Drivers\Color” and for macOS systems, they are stored in the “User/Library/ColorSync/Profiles/” folder. When in doubt, you should restart Windows computers following any manual interventions. You can use the “ProfileChooser” tool in Windows to switch between different Spyder profiles. Profiles can be switched in System Prefs/Displays/Color on the Mac.



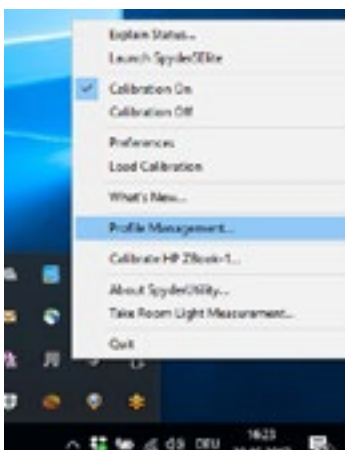
Color profile folder in the “Color” system files folder.

Switching Profiles on Windows

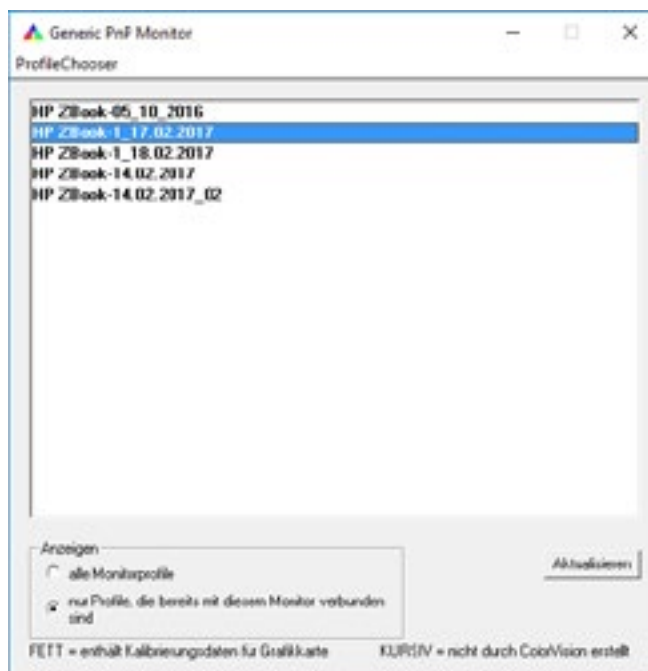
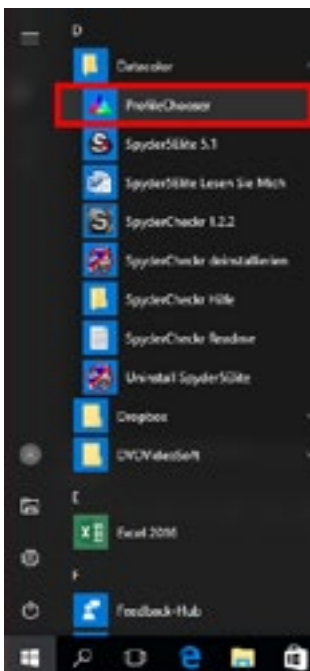
A step-by-step guide

The SpyderX software automatically archives the color profile generated in the right place in the system so you can switch between profiles.

- To do so, open the add quotations menu and navigate to “Settings>Control Panel>Display” to open the dialog to configure your monitor and select the “Settings” tab.
- Clicking the “Advanced” button will make another dialog appear. Its “Color Management” tab lets you select different profiles. With Win10, this should also update the VLUTs to match the selected profile.
- Alternatively, you can also use the Datacolor “ProfileChooser” tool, to assure VLUTs are updated.



SpyderX PRO and SpyderX ELITE offer a profile management tool via SpyderUtility



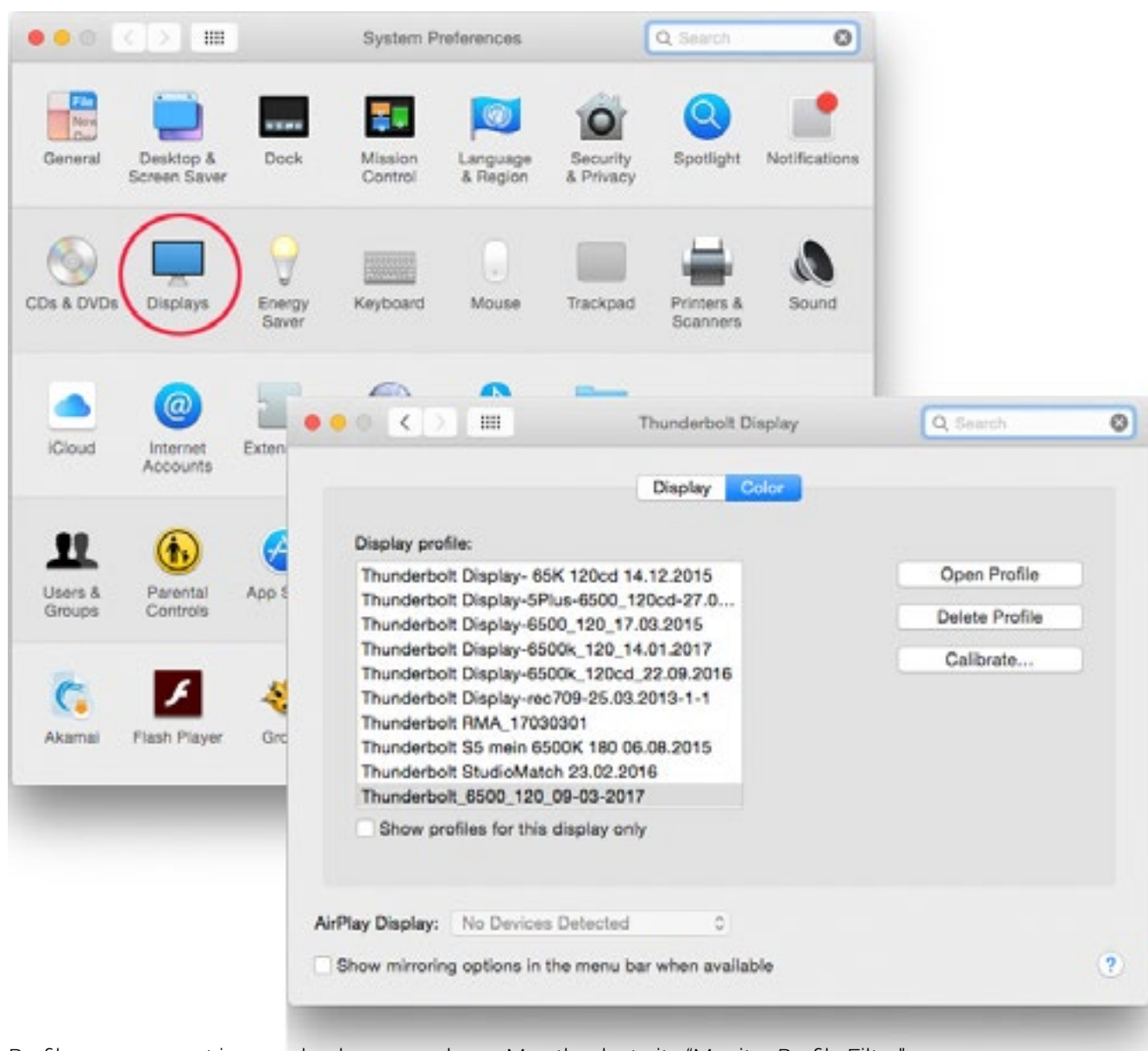
The ProfileChooser is located in the Windows Start menu in the Datacolor folder

Switching Profiles on macOS

How to easily switch profiles

The procedure is more user friendly on a Mac:

- Use the Apple menu to open “System Preferences,” click “Displays” and select the “Color” tab at the top.
- There, click the profile you want to choose and immediately see the effects of this profile setting.



Profile management is very clearly arranged on a Mac thanks to its “Monitor Profile Filter”

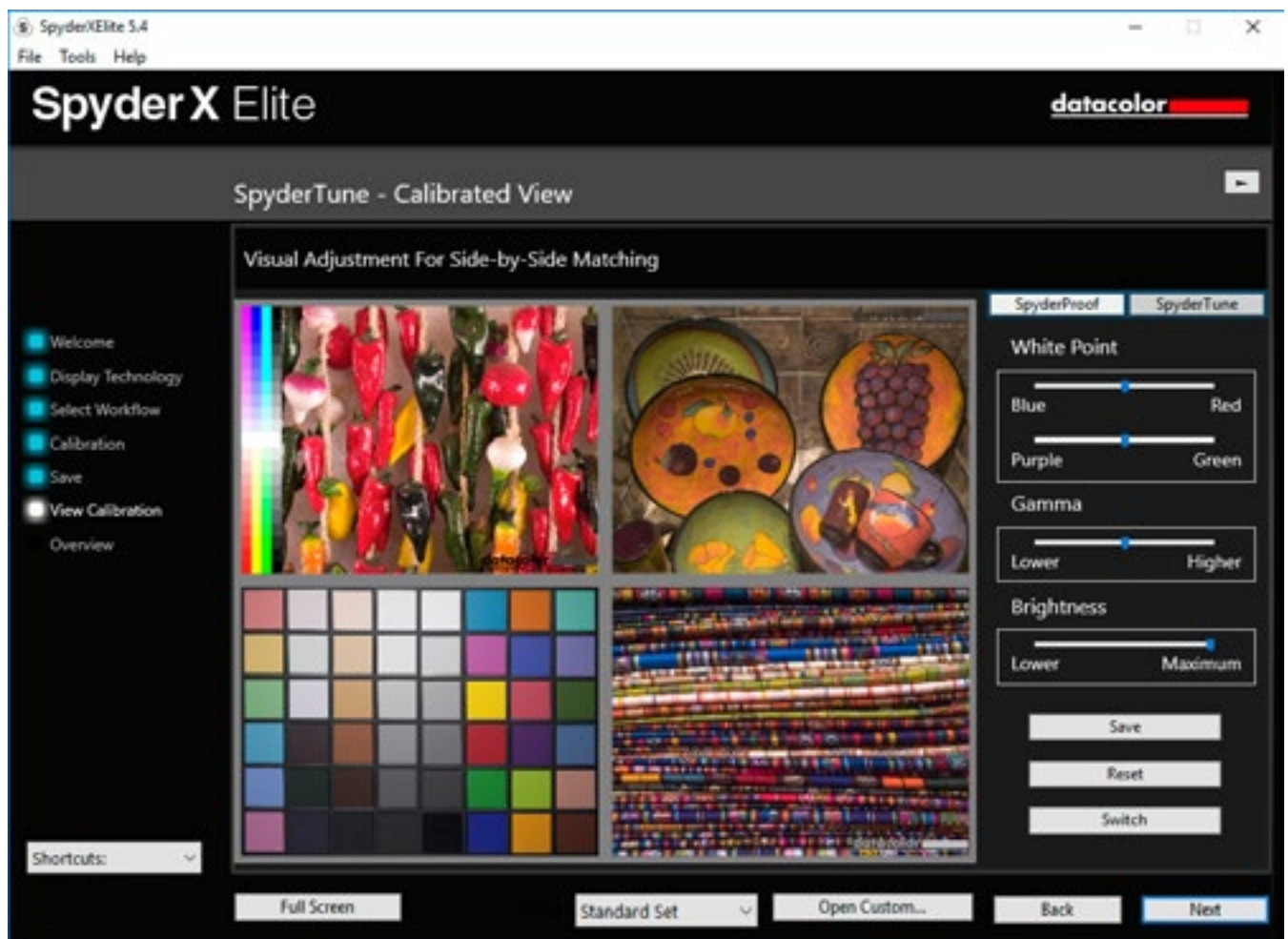
SpyderProof

How to analyze your display's state



INFO

The calibrated state of your display consists of the hardware adjustments you have made to the display, the viewing conditions surrounding your display, and video corrections (VLUTs) applied to your video card, and the ICC profile used by your OS and applications.



The SpyderProof images are not randomly selected, but provide a cross section of typical photographic types.

The “SpyderProof” tool provides you with a series of selected images so you are better able to analyze the state of your display. It is available for each attached display. But how does SpyderProof work?

- The calibrated view first shows you the “after,” i.e. how the image sample looks with your most recent calibration and profile.
- Clicking “Switch” shows the uncalibrated view of the image. But please note: “Uncalibrated” does not refer to the previous calibration and profile, but instead refers to a “zero correction” setting, i.e. it is displayed with your monitor’s native colors. Displaying the image with the previous profile would require also require readjusting all hardware settings to their previous settings, which would be impractical.

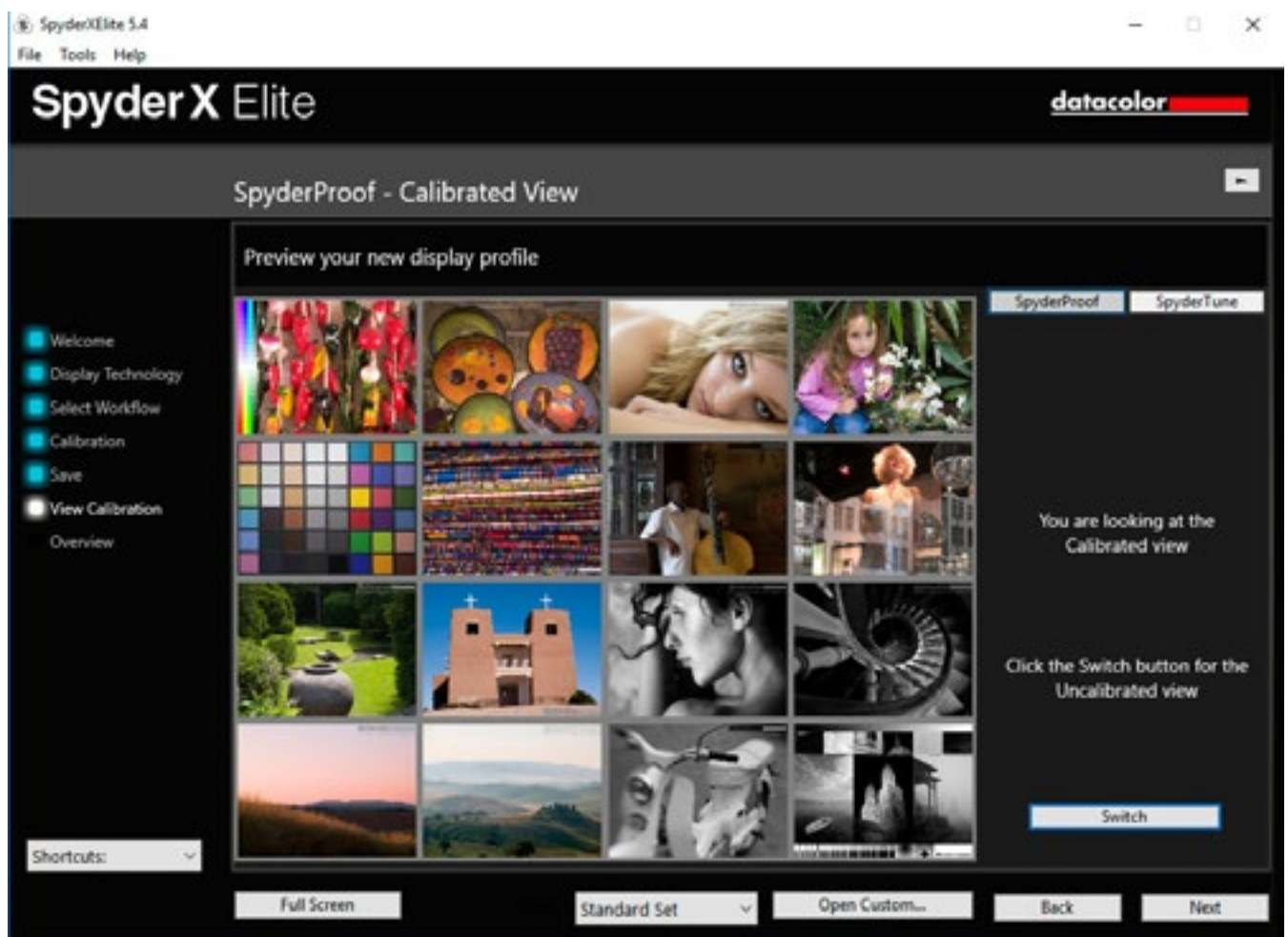


TIP

A calibrated display may appear somewhat unnatural to if your eyes are adapted to the uncalibrated state. Wait a few minutes for your eyes to adjust to the calibrated mode.

How these 16 images can help you

You can use each of these 16 images to view specific characteristics. These are explained in a way that is both detailed and easy to understand in the program's online help section. You can zoom in on the subject areas or "quadrants" with just a click. The first click on the quadrants shows you a zoomed in view of the associated four images. A second click enlarges an individual image so that it fills the field. Clicking "Switch" switches between Calibrated and Uncalibrated.



SpyderProof displays a total of 16 images divided into four quadrants for you to zoom in on: saturated colors (upper left), skin tones (upper right), landscapes and gradients (lower left), and black and white (lower right).

The two most important images

Two of these 16 images are particularly useful when working on photographs:

- The upper left image shows the synthetic step gradients of magenta, blue, cyan, red, yellow, green and black. These gradients are useful when checking the system for any “out-of-gamut” colors. This tells you what color nuances the monitor can display in combination with the profile.
- At the bottom right you’ll find Datacolor’s “B&W test image,” which contains a wide range of photo and graphic elements. Review the enlarged details above each image for highlights and shadows.



These two images cover the main aspects of image analysis.



TIP

The PRO and ELITE versions of SpyderX enable you to view a before/after view of your own images. To do so, open each image in the SpyderProof tool using the “Custom” button. Clicking on “Switch” switches the view between the uncalibrated and the newly calibrated views. Accessing SpyderProof from the ShortCuts menu at the lower left of the window will display SpyderProof, but until you perform a calibration, and save an ICC profile, no data is available to perform calibrated/uncalibrated comparisons.

Profile Overview

The options offered by the profile overview

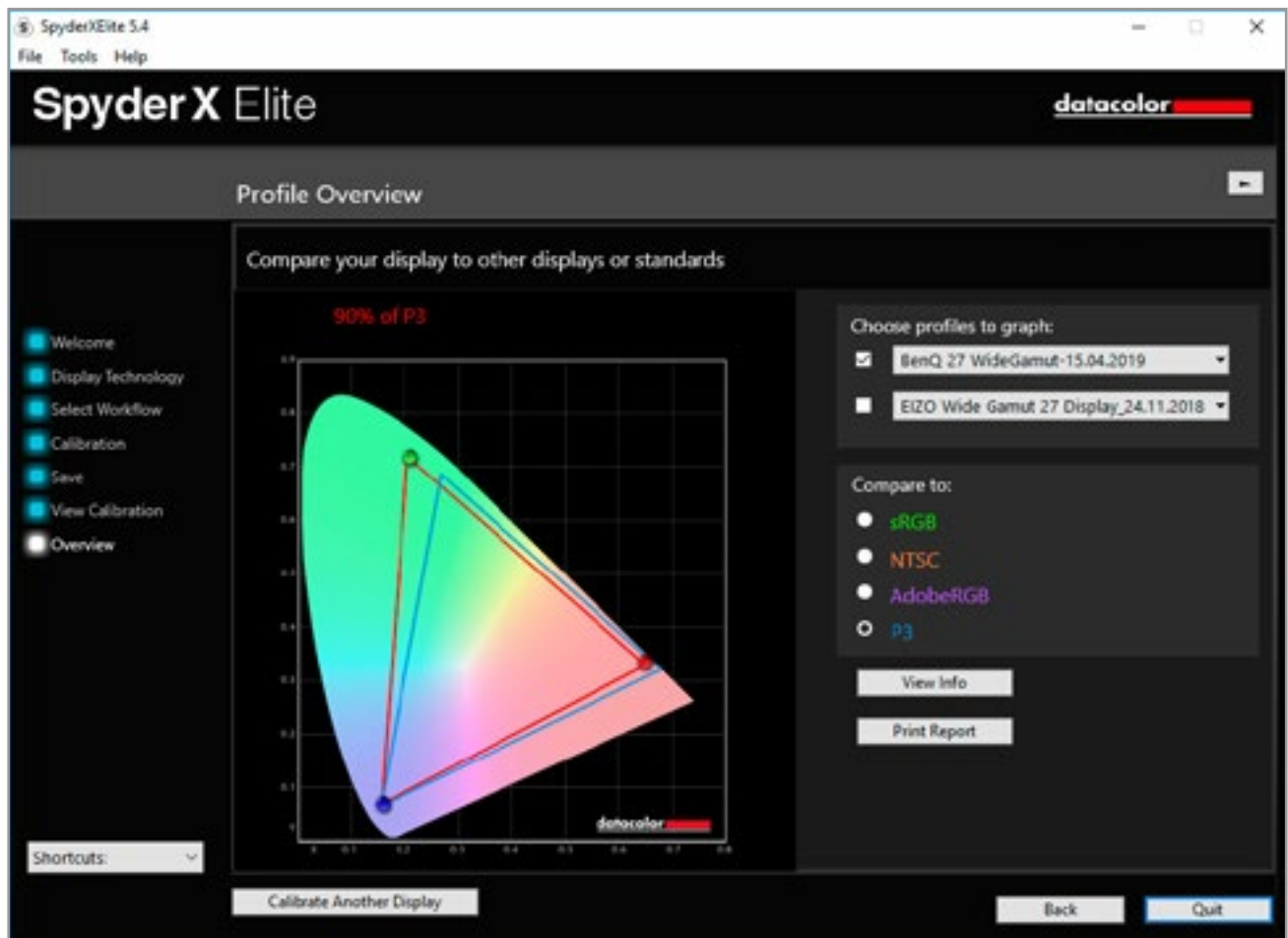
Every monitor calibration ends with a profile overview. You can see the viewable color space for the current display on the screen and compare it with the sRGB, Adobe RGB and NTSC industry standards.

TIP

Your data can be printed for future reference.



Has your profile overview brought up further questions about things like calibrating an entire studio? Read the solutions in “Fine Tuning Your Monitor.”



It's clear to see that the calibrated laptop can only display a color space that is close to the sRGB color space.



4 Fine-Tuning Monitors

Display calibration for experts

- ✓ Developing expert calibration settings
- ✓ What advanced analysis involves
- ✓ How to calibrate two monitors
- ✓ Techniques for calibrating a complete studio and projector

Contents

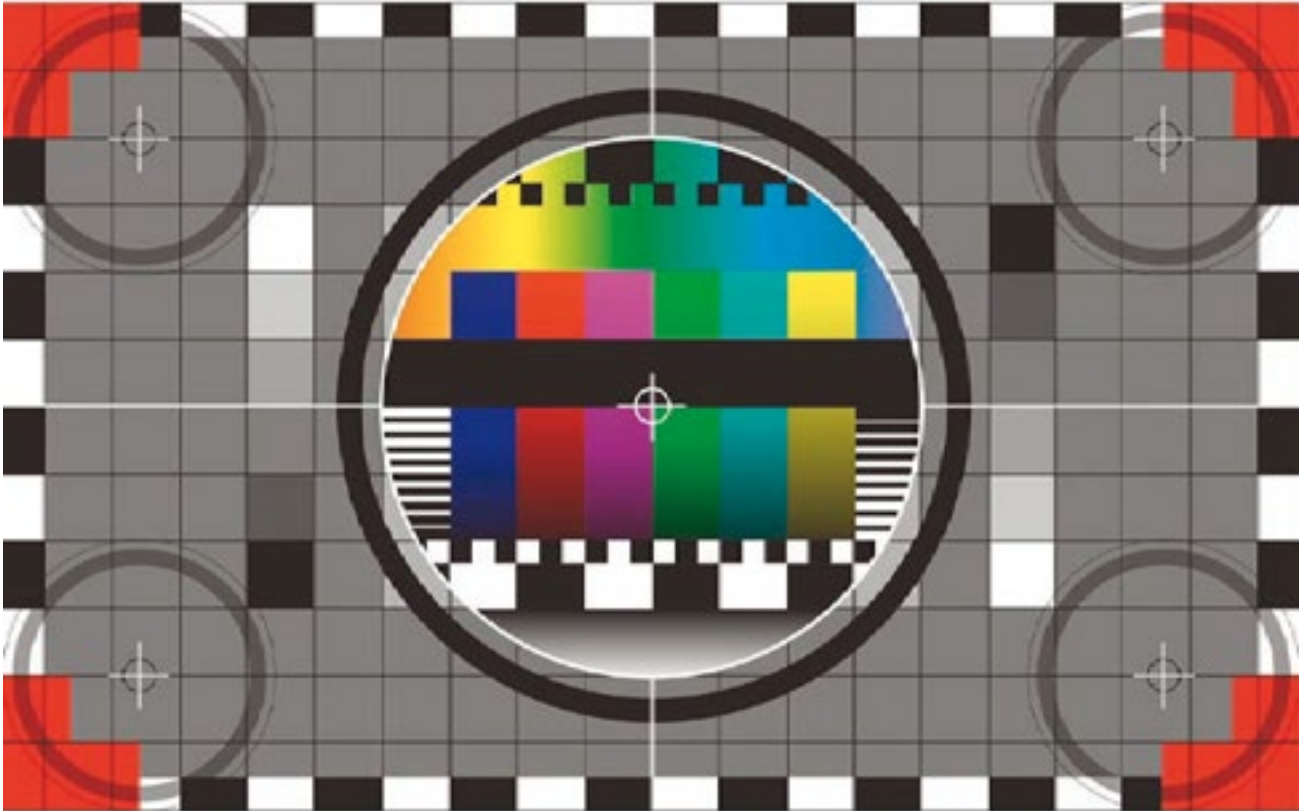
Calibration Specs	4/104
• Target Values Specs	4/106
• Pro Specs: Gamma	4/107
• Pro Specs: User Gamma Values	4/110
• Pro Specs: White Point	4/113
• Pro Specs: Luminance	4/115
• Pro Specs: Gray Balance Calibration	4/117
• Pro Specs: Room Light Compensation	4/118
• New Calibration Functions	4/120
• Expert Console	4/121
• Curves	4/122
• Information	4/123
• Colorimeter	4/125
• History	4/125

Advanced Analysis	4/126
• Advanced Analysis Dialog	4/127
• Gamut	4/128
• Tone Response, Brightness, Contrast, and OSD settings	4/129
• Uniformity	4/131
• Color Accuracy	4/133

Calibrating Two Displays	4/135
Calibrating a Studio	4/140
Calibrating a Projector	4/142

Glossary	217
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Calibration Specs



Things to consider

Simply stated: A monitor is not calibrated in isolation, instead, the calibration is always aimed at a target. This calibration target depends on the workflow and needs of the image processor. It is defined in the calibration specs.

It is relatively easy for people who use their monitor exclusively as a photographer to correct images, which are then printed directly to an ink jet printer or a photo lab. The color space of the workflow defines the calibration target. The default settings are for the standard photographic workflow. It targets a gamma (gray density) of 2.2 and a white point (color tint) of 6,500 Kelvin. The same standards work for those who publish their images on the Internet.

When multiple monitor profiles are required

It is more complex if one prepares photos for self-printing or lab-printing as well as offset printing such as magazines, books or newspapers. In this case, you should work with two monitor profiles, which target different white points. This allows you to integrate applications that lack color management. A photo-oriented monitor profile is then used for the photographic workflow and a press-emulation profile is used to evaluate the images for offset printing.

These two monitor profiles are necessary due to the differing industry standards. It is not enough that the colors are displayed correctly just for your system. They must also be displayed for the service providers who come later in the process. These workflows use differing color spaces with different gamma and whitepoint values.

Anyone who wants to prepare their images for video may need a further monitor profile. This will be oriented toward a video color standard, such as Rec 709 or Rec 2020. There are also special applications in other fields, which in turn require calibration to other industry standards.

The following example shows how you can define calibration requirements.

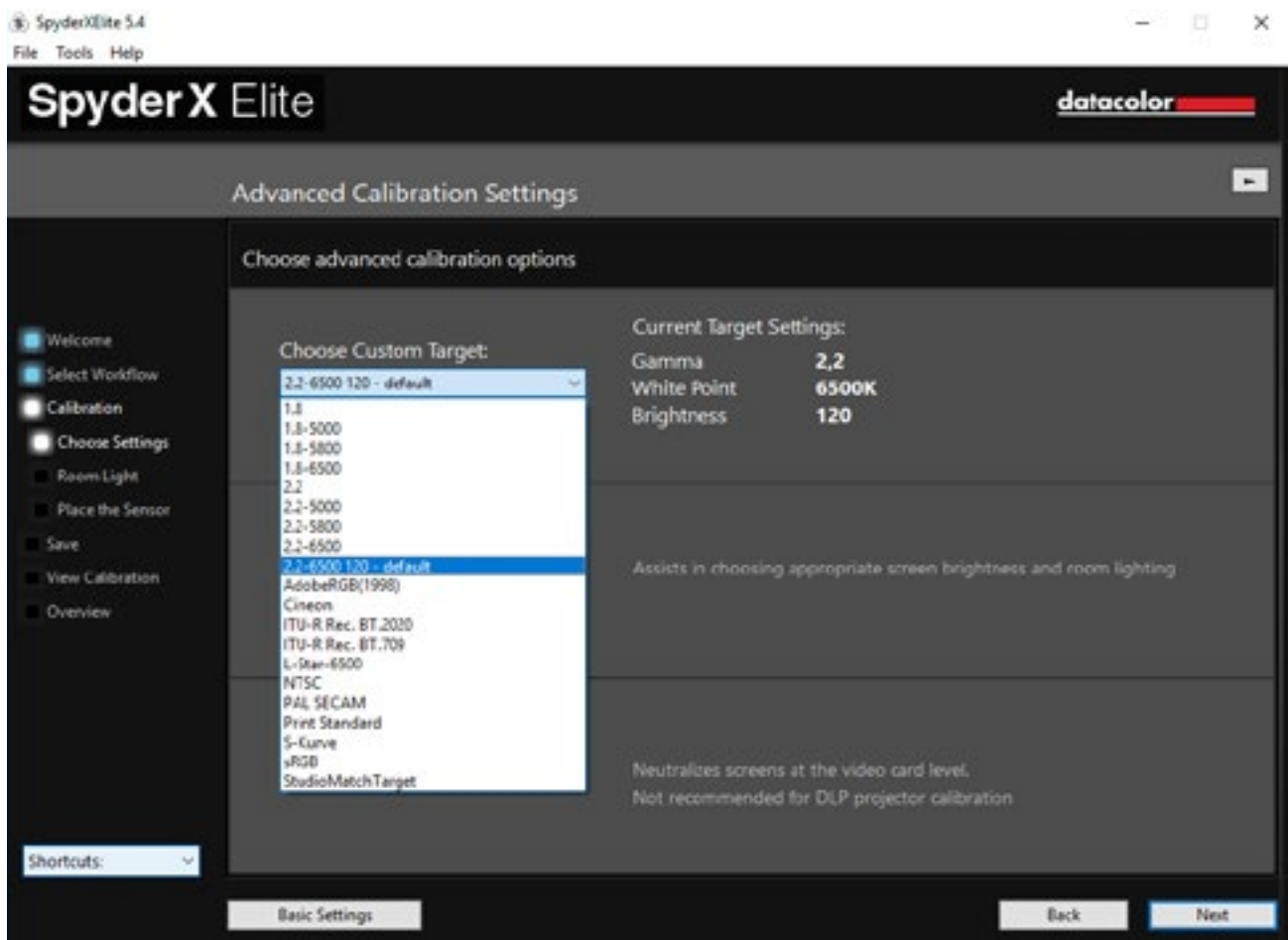
TIP

For more information on "Advanced Settings" with SpyderX, read the previous article "Calibrating Monitors", which explains the basic handling of the software.



Target Values Specs

What you can set here



In this dialog you see the list of available standards. You can use this to define the combination of the color temperature - the setting of how warm or how cool colors display - and the gamma - the density of colors. Photographers use a combination of 6,500 Kelvin (K) color temperature for sRGB and Adobe RGB - roughly equivalent to daylight at noon - and a gamma of 2.2. Those who work in the prepress process use the D50 standard and select a slightly yellowish 5,000 K temperature, and a gamma of 1.8. Clicking on "Advanced" allows for further adjustments.

Pro Specs: Gamma

What you should know about gamma



INFO

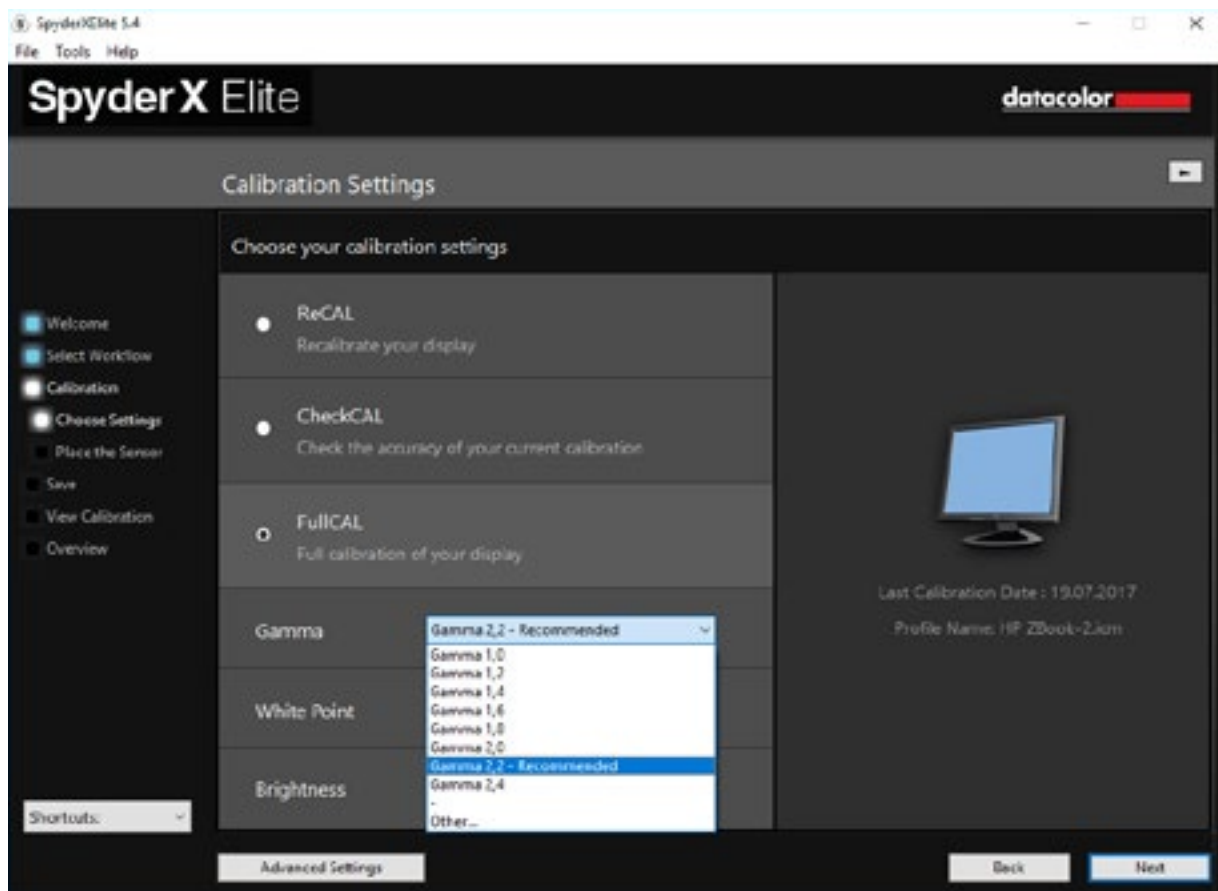
The gamma curve describes the density of the mid tones in the image. Black remains black, white remains white, and the range in between runs either linearly with Gamma 1.0, which is the very low contrast, linear, density ramp that measurement devices create or in a curve. The deeper the curve, the higher the gamma value and the higher the contrast.





For illustration, we have set three different gamma values using the monitor's OSD controls. The contrast increase is clearly seen with the higher gamma values.

In most cases, the gamma is set to 2.2. This is also the default value of Windows and macOS, and a fairly good representation of the response of the human eye. In the pre-press process, however, to get more details into the shadows, one returns to a gamma of 1.8, which allows for more “dot gain” or ink spread on press. Higher gamma values primarily result in more saturated colors. This is more difficult to implement with four colors in offset printing than with the high saturation colors of an ink jet printer or photo lab.

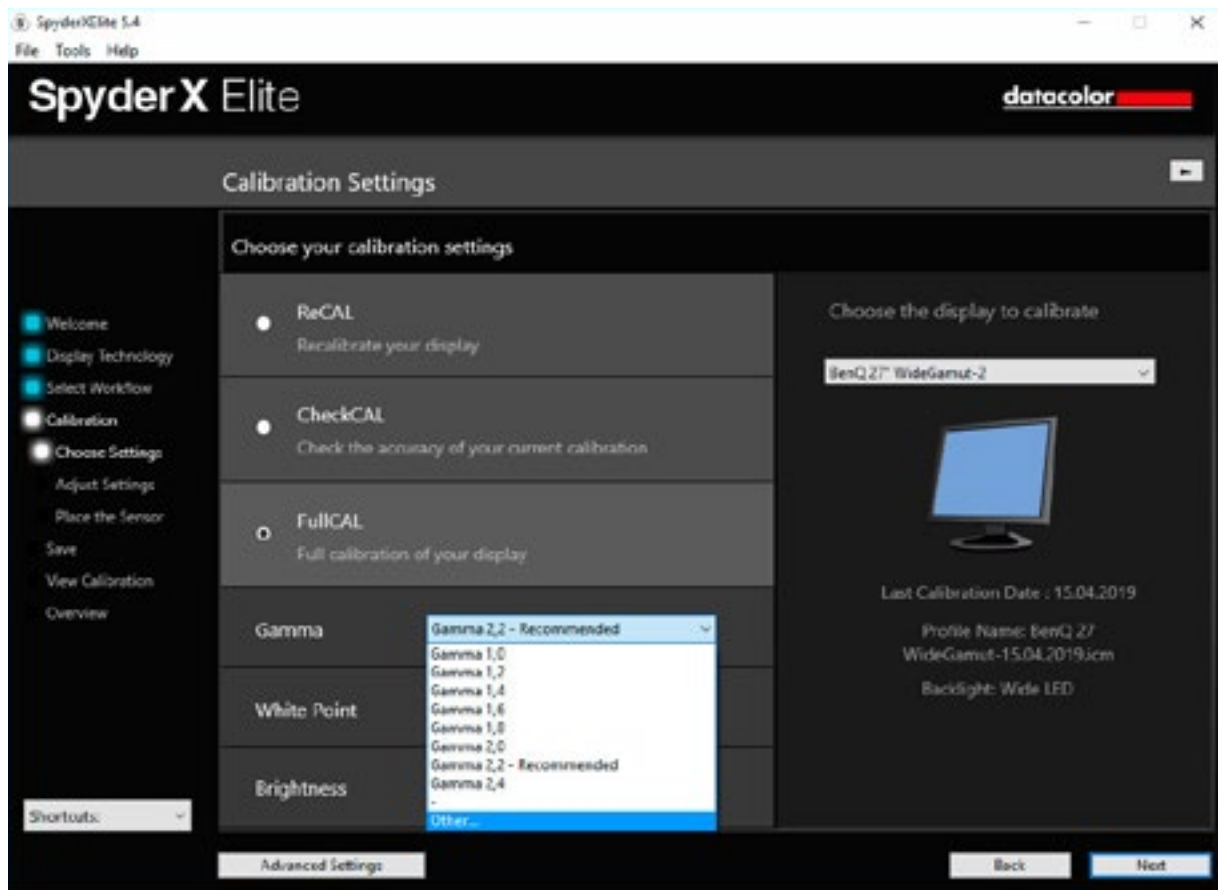


Different gamma values can be selected via the pull-down menu.

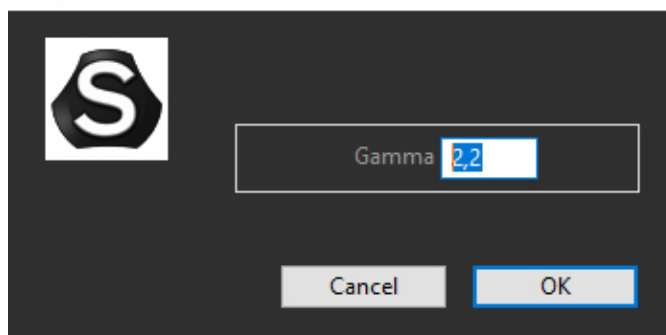
Pro Specs: User Gamma Values

How to enter your own gamma values

In addition, it is possible to specify a gamma beyond the range 1.0 to 2.4 or with higher precision. To do this, click on the “Advanced” button on the SpyderX ELITE and define the gamma value by means of a keyboard input. The value range for the selection ranges between 0.5 and 3.0. In addition, the inputs can be specified with up to two digits behind the decimal point, for example “2.65”.



Custom Gamma

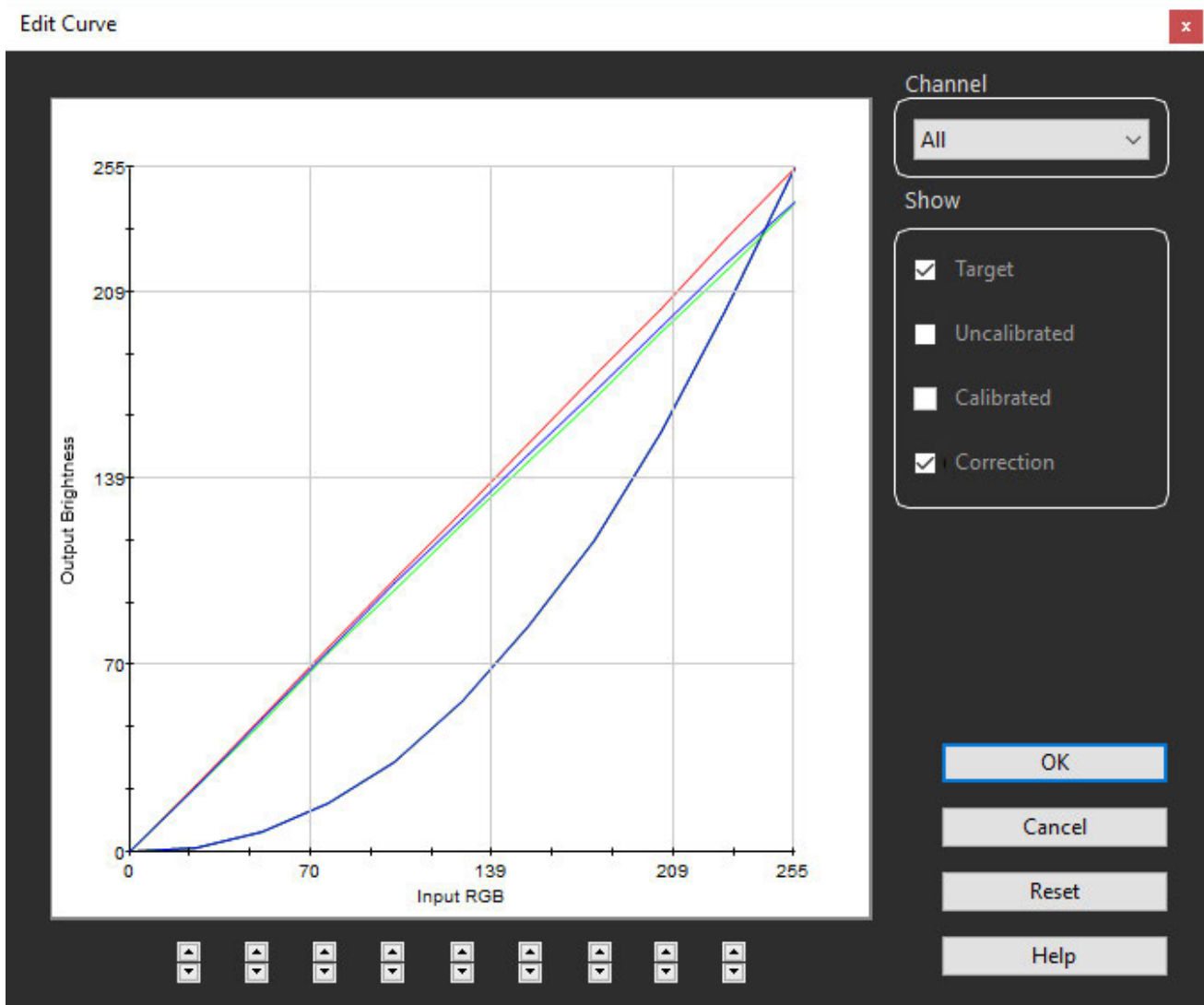


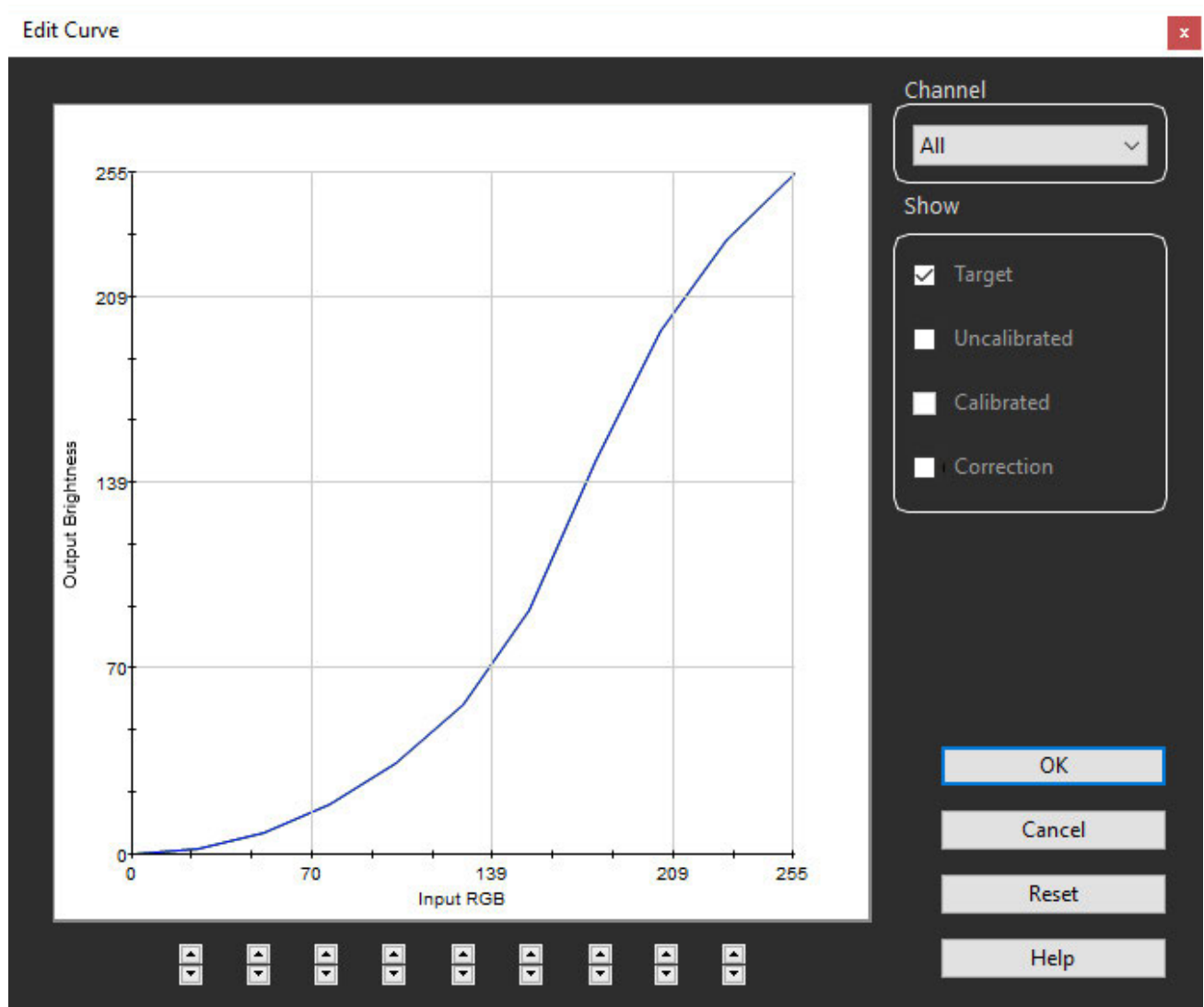


EXPERT INSIGHT

Create a non-gamma curve

The SpyderX ELITE software also allows you to create your own non-gamma curves. This is a special feature and is of interest to experts. To generate your own non-gamma curve go to the application menu bar and select Tools/Edit Curves. Here you can create custom curves for the individual color channels. These can be saved and selected using the gamma drop-down menu.



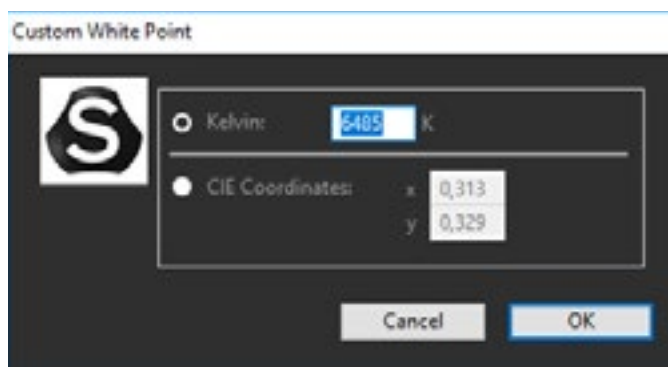
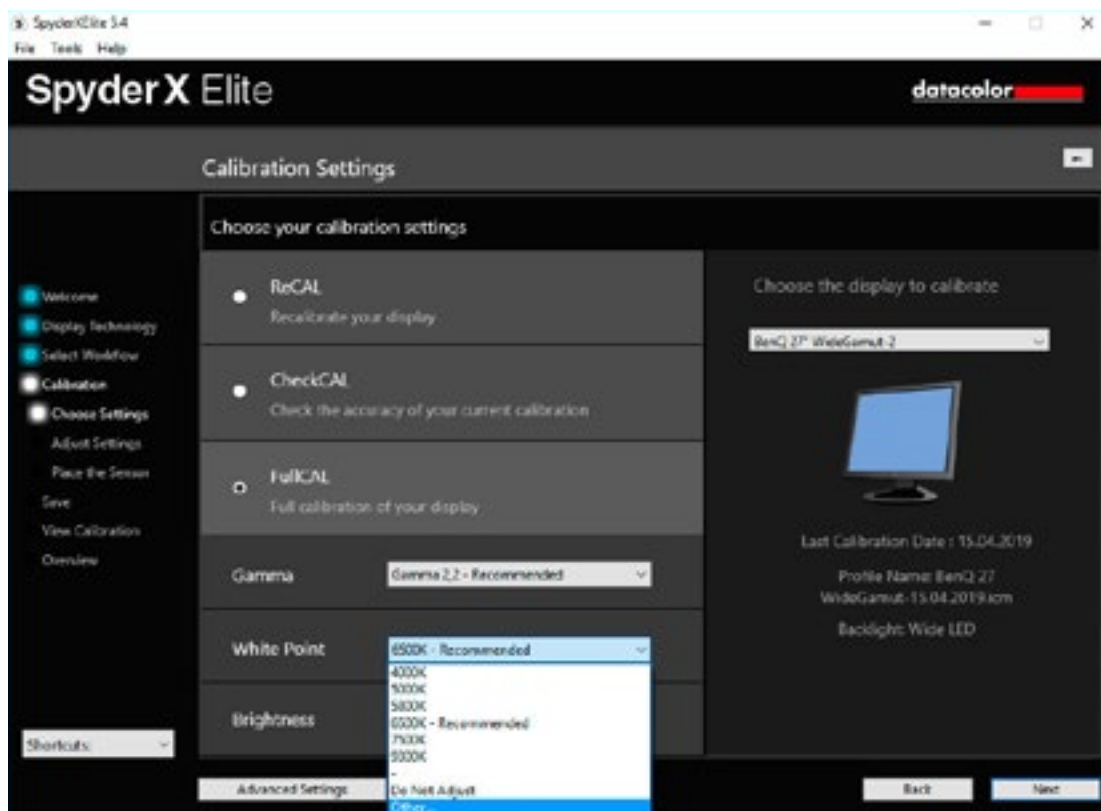


When you use this function, the gamma curve currently selected in the calibration settings will be displayed for you, as a starting point, to create your own non-gamma curve. The non-gamma L-Star curve can be loaded by selecting the L-Star-6500 target from the Expert Console.

Pro Specs: White Point

What should be considered when making a WP selection

For setting the display white point, SpyderX ELITE contains a list with the most common values between 4,000 and 9,300 K. In addition, you can access the white point presets of your monitor manufacturer via “Do not adjust”, and then setting in the OSD before the calibration process. If you select “Other”, a dialog will appear in which you enter either a numerical Kelvin value or a CIE-xy value via the keyboard. The option is usually 6,500 K for a photographic workflow or 5,000 K for a prepress workflow.



The white point setting simply defines the desired color tint of the monitor.

Table of calibration values (example table Oli)

	Gamma	White Point
AdobeRGB(1998)	2.2	6500K
sRGB	Non-gamma (approx 2.2)	6500K
ECI RGB	1.8	5000K
Apple RGB	1.8	6500K
Wide Gamut RGB	2.2	5000K
eciRGBv2	Non-gamma (L-Star)	5000K

As an example, here are the gammas and white points for the most common color spaces.



INTERESTING ONLINE FINDS

If you want to learn more about individual color spaces, you should take a look at SLR Lounge. All of the color schemes and their uses are described there.

[Read Article](#) >

Pro Specs: Luminance

What options you have here

INFO



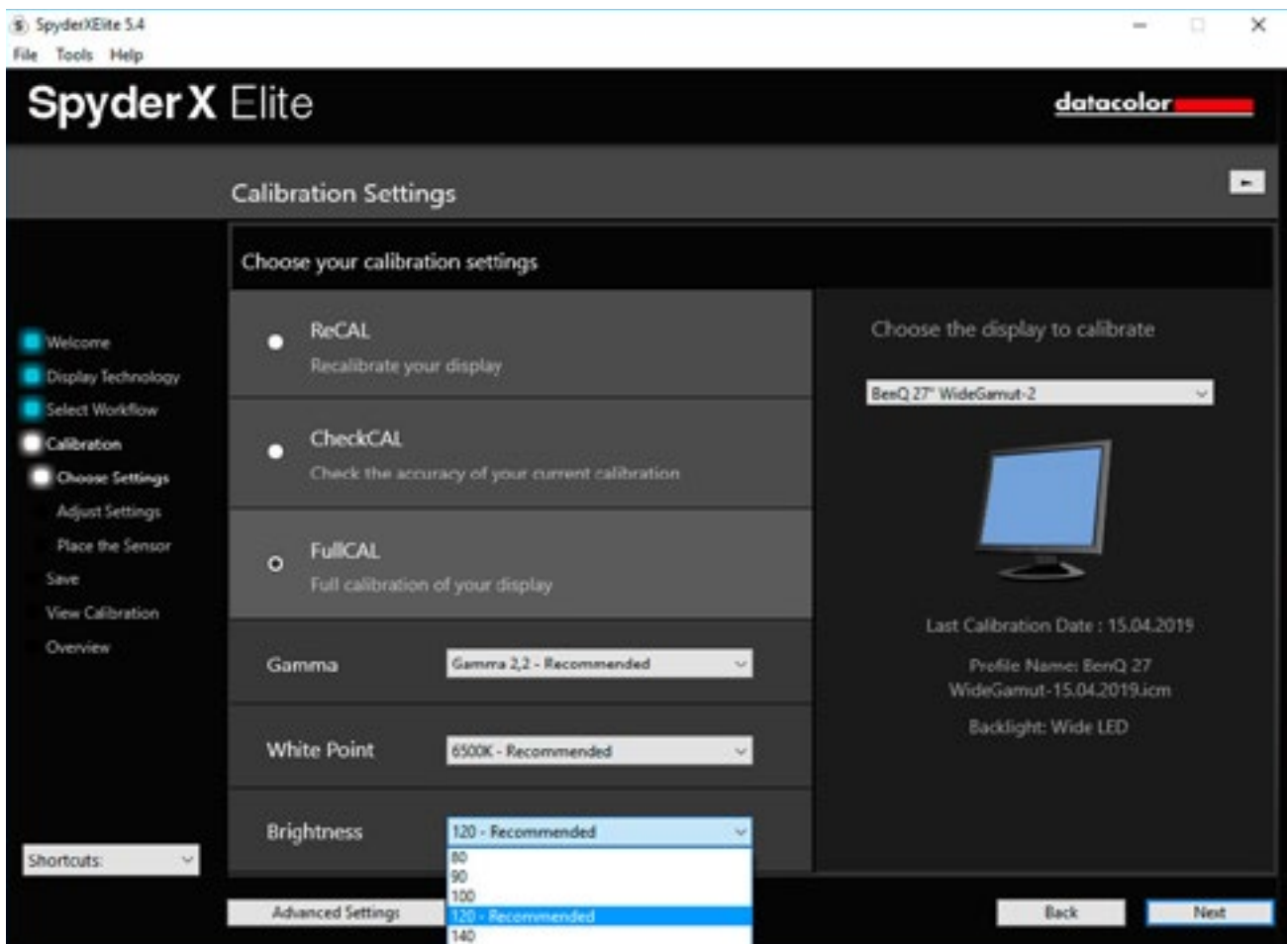
Luminance is the brightness of the light source behind the panel. To visualize this, please refer to the diagram of a structure of an LED display in Chapter 3.

For best results use LCD monitors in dim and rooms with stable lighting. This is how you create optimal conditions for reduced glare, improved contrast and correct color perception. As a rule, LCD monitors should be calibrated to a luminance of 120 cd/m². For setting the desired brightness, SpyderX ELITE provides commonly used values between 80 and 180 cd/m². Use the “Do not adjust” option to keep the luminance provided by the selected target and not change it to reflect current room lighting.

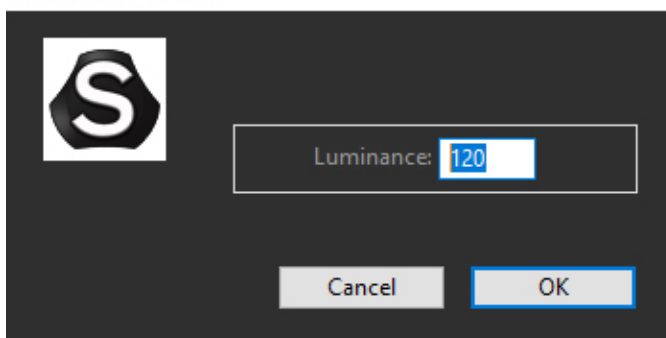
TIP



To ensure reliable color perception avoid having colored surfaces around the monitor. The desk surface, the wall behind the monitor, and the objects in the immediate vicinity of the screen should ideally be neutral; white, gray or black. This also applies to clothes. A brightly colored shirt in front of the screen effects color perception, by reflecting color on the surfaces around the display.



Custom Luminance

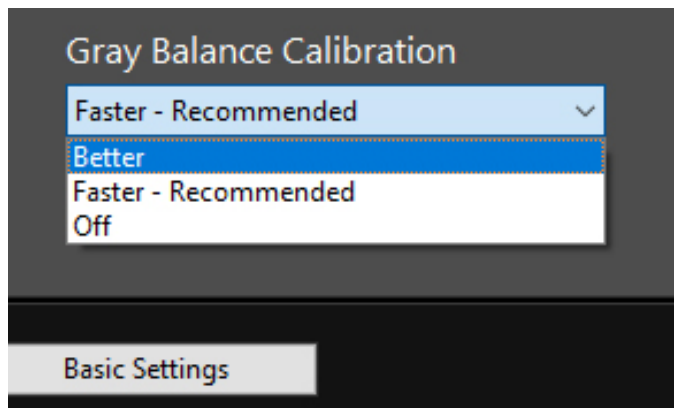


Brightness adjustment plays a key role outside of display color calibration. It's most important value is in avoiding unintentionally dark prints.

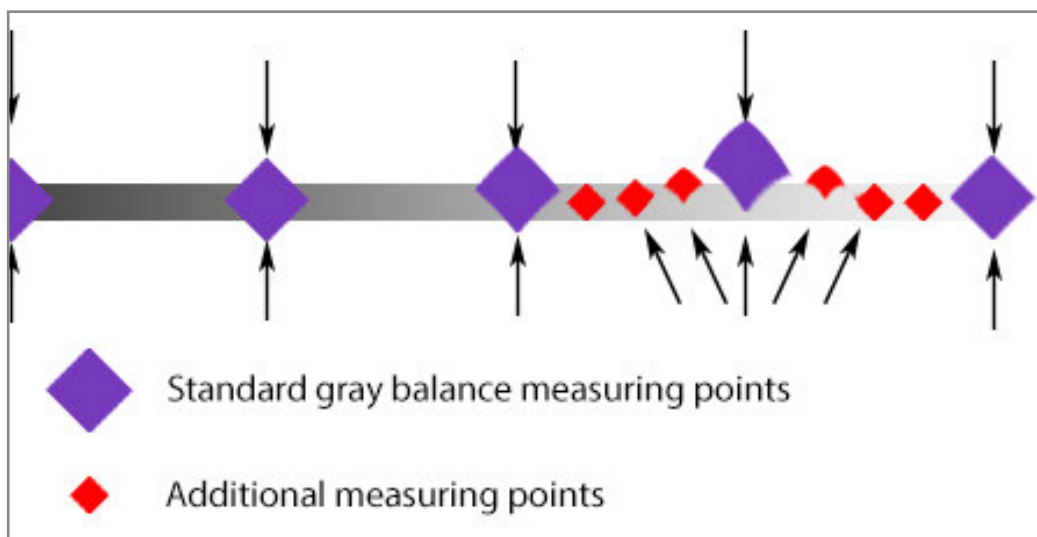
Pro Specs: Gray Balance Calibration

What should be taken into account

With SpyderX ELITE's "Gray Balance Calibration", LCD displays can produce especially neutral grays. The setting is enabled by default for all devices. Shutting it off should only occur in special cases. Take a look at the "Better" option: This optimized measurement can lead to measurements lasting several minutes, particularly for low-quality monitors. As a result, however, very accurate profiles are produced. LCD Projectors function best with the gray balance function switched on; but DLP projectors require turning this feature off.



Iterative Gray Balance is accessed in the Gray Balance Calibration Menu, via the "Better" option.



Additional measuring points due to Iterative Gray Balance to adjust standard measuring point.



EXPERT INSIGHT

Iterative Gray Balance – A facelift for older and cheaper monitors

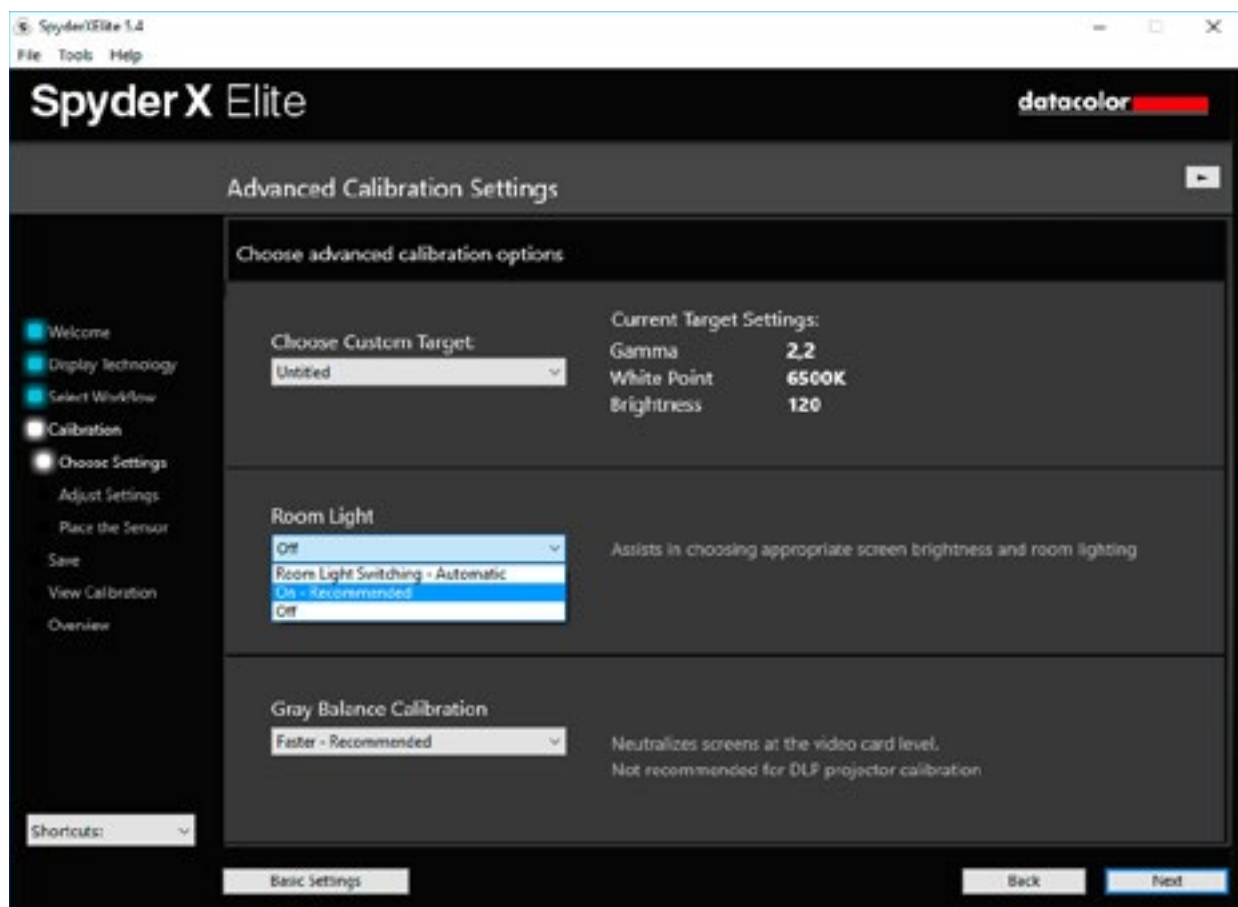
“Iterative Gray Balance” is very inconspicuous in the SpyderX ELITE software, hidden in the pull down menu for gray balance calibration under the term “Better”. This is a very powerful and innovative technology from which older monitors or lower-priced monitors especially can benefit. The idea behind it is to make iterative corrections per color channel at points where the color reproduction of the monitor deviates more strongly from the ideal curve. This gives a higher degree of precision in the three color channels. This results in more accurate correction curves and more neutral grays.

Pro Specs: Room Light Compensation

When this option is relevant

Room light compensation balances the brightness of the monitor and the room. Time of day, weather conditions, and room lights all influence the ambient light. Such fluctuations have an effect on the sensitivity of the eye to color and brightness. As a result, the colors, and above all the brightness, of the same image are perceived differently. The room light sensor measures the brightness of the light in order to set the optimum brightness of the monitor in a given room. The SpyderX provides this option in the PRO and ELITE versions.

What happens when you enable this feature? The program measures the light that is present in the room and suggests corrections of the target values for the calibration. You should therefore create profiles for multiple light situations at daylight workstations, where the brightness set for the monitor must be adjusted manually.

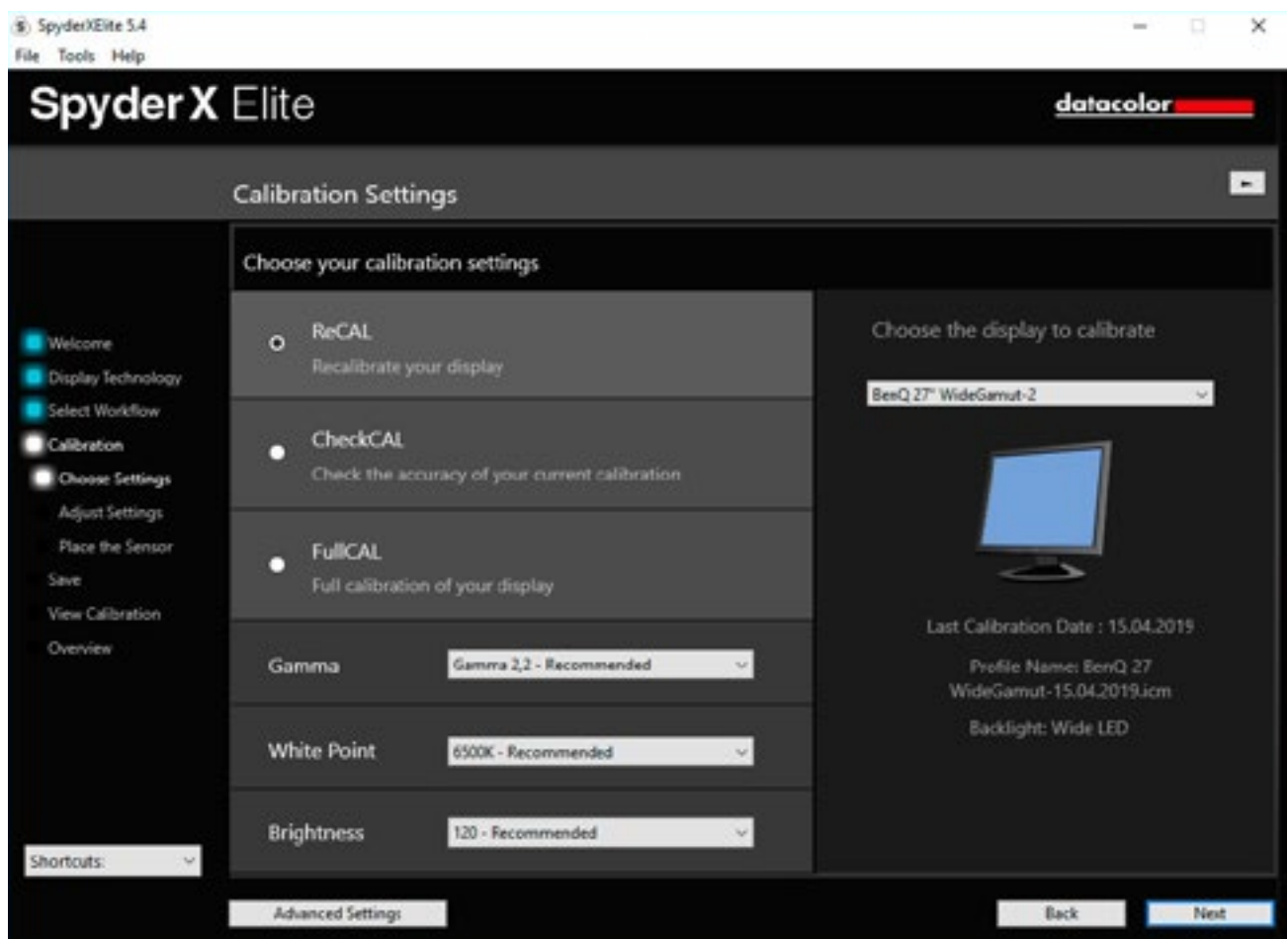


When selecting Desktop Display mode, the ambient light option is recommended.

New Calibration Functions

How quickly recalibration occurs

Once the monitor has been calibrated, the SpyderX PRO and ELITE actions can be reduced to a minimum with functions such as ReCAL and CheckCAL. You can check your display calibration in about one minute, remeasuring gamma, white point, black value and white value. These measurements are compared to the previous values. This determines if a full recalibration is required.

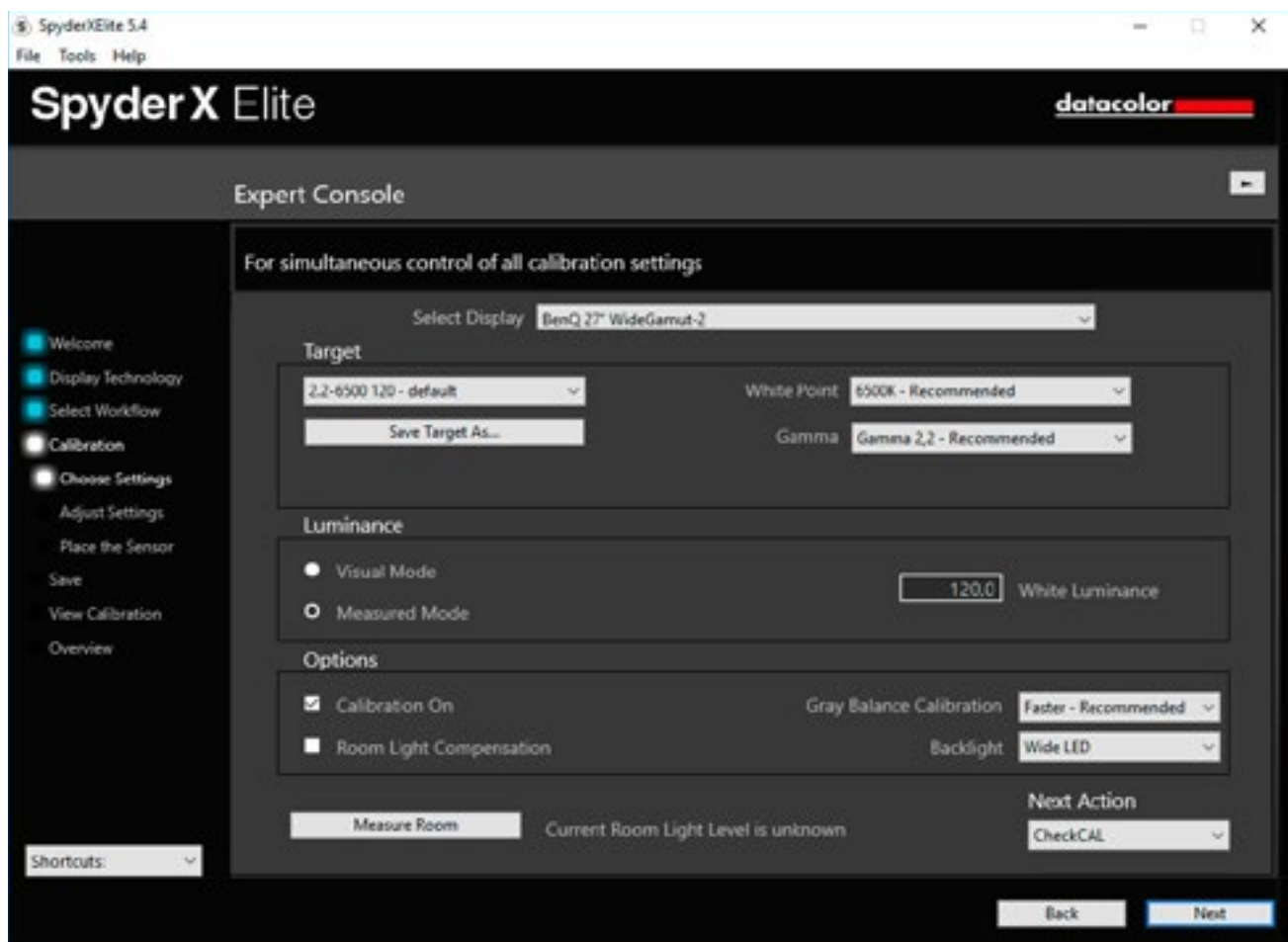


The choice of calibration function is simple and clear

Expert Console

For when you don't want a wizard

If you know exactly what you want and do not need a wizard workflow, the “Expert Console” is your home screen for SpyderX ELITE. It controls many different settings from a single window. The console reflects earlier software design, when calibration was performed only by technicians, for advanced users.

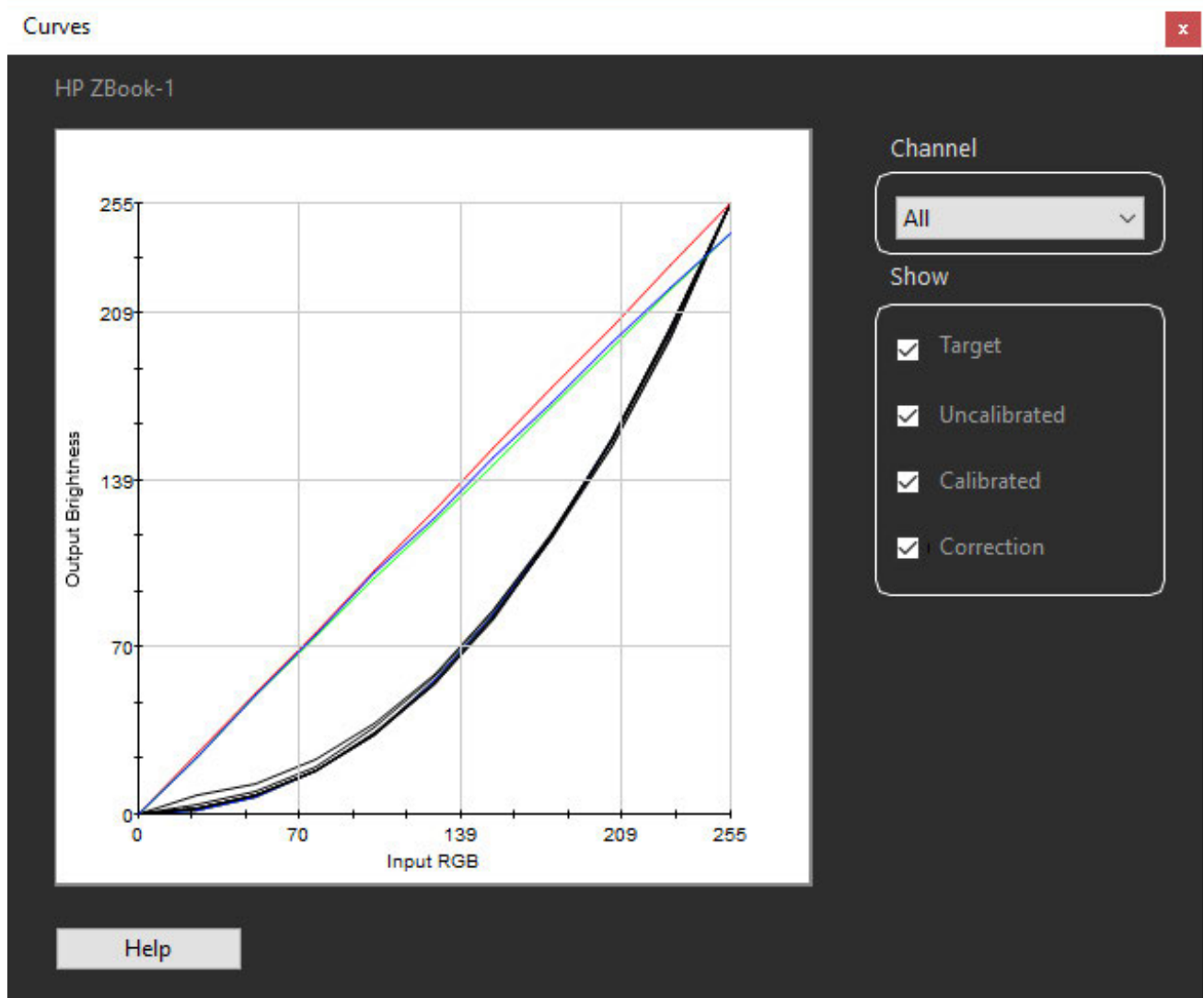


All possible settings at a glance

Curves

What you can see here

The curve dialog allows you to compare output, ideal, and target curve representations of all or individual channels. This provides a technical view of the adjustments made during calibration and profile creation. It is possible to see how far the output curves deviate from the ideal gamma spec, and to what extent the calibration corrects them.



Clicking on "Correction" shows which channels had to be trimmed to reach the target white point.

Information

What useful info you can find in this window

In the “Information” floating window you will find measurements and computations from your display . This includes data about black and the white point – before and after calibration, plus the targeted values. This provides key information about the aging of a display. If the candela value of an LCD used for color-critical work drops much below 100c/m², start planning to replace it soon.

Information x

EIZO CS2420 ▼

Brightness (Candelas):

	Black	White
Uncalibrated	0,20	122,7
Target	0,26	119,0
Calibrated	0,20	120,4

White Point (CIE xy):

Uncalibrated	0,313	0,329
Target	0,313	0,329
Calibrated	0,313	0,329

Primaries (CIE xy):

Red	0,682	0,307
Green	0,182	0,732
Blue	0,147	0,046

DeltaE (Lab):

White Point	0,5
50% Gray	0,1

Gamma:

Uncalibrated	2,19 (0,00)
Target	2,20 (0,00)
Calibrated	2,18 (0,00)

Help

It also displays the Delta E deviation for white and 50% gray. With a good calibration this deviation should not be higher than 3.0.

TIP

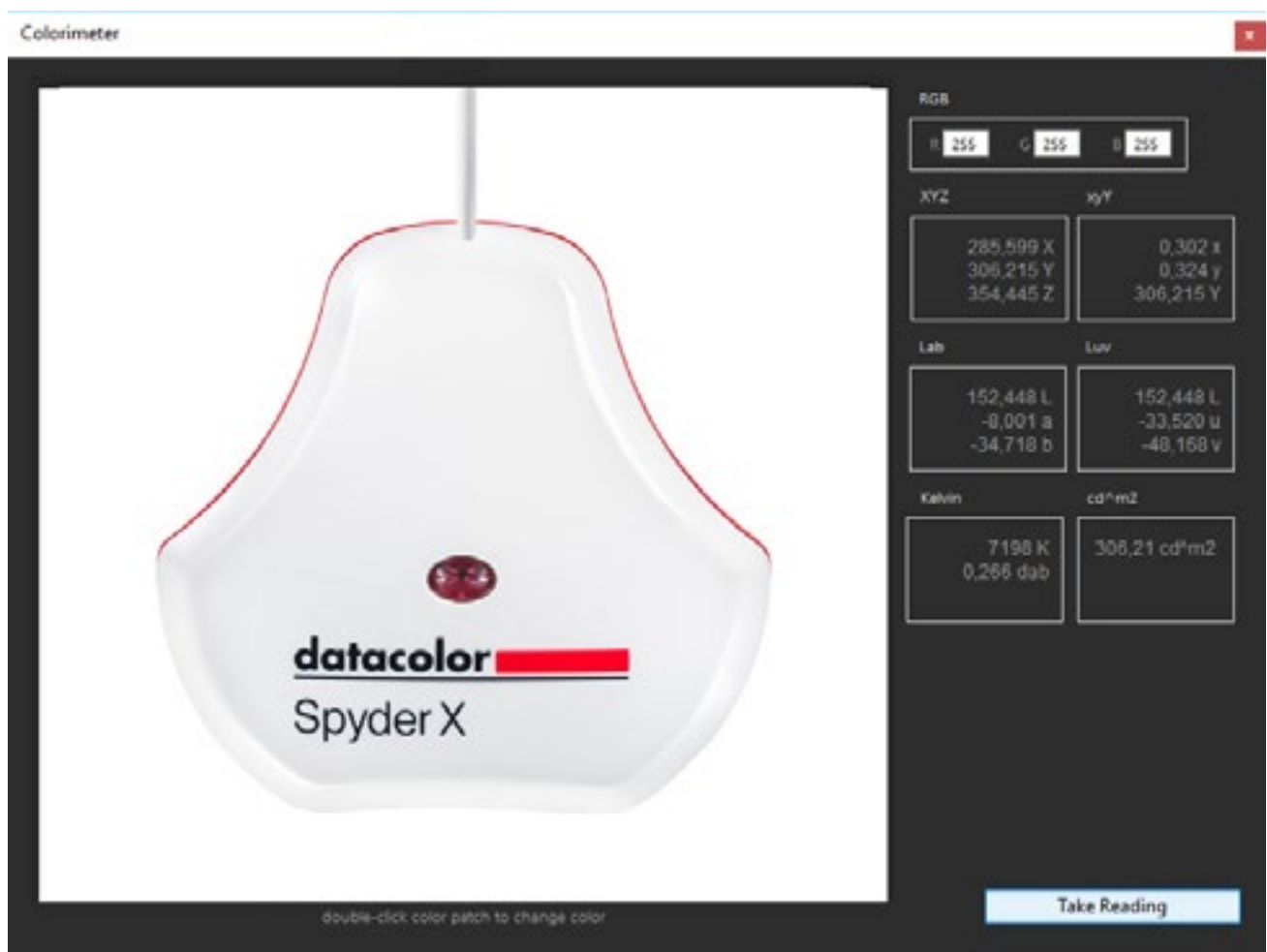
This info can be printed using the “Print information” command in the “File” menu.



Colorimeter

What this meter can measure

The colorimeter measures any color that has been entered as an RGB value or, after clicking on the measurement field, by color selector as shown on the monitor. This can, for example, be used to check the brightness drop of the monitor toward the edges or corners. Choose pure white as the color (RGB 255/255/255). Then measure the field, not only in the center of the screen, but also moved to the edges or corners. Any drop indicates non-uniformity in the screen. Low-quality monitors show more variation than more expensive displays. Such variations cannot be corrected with color profiles, as profiles deal with the screen as a whole, not local variations.

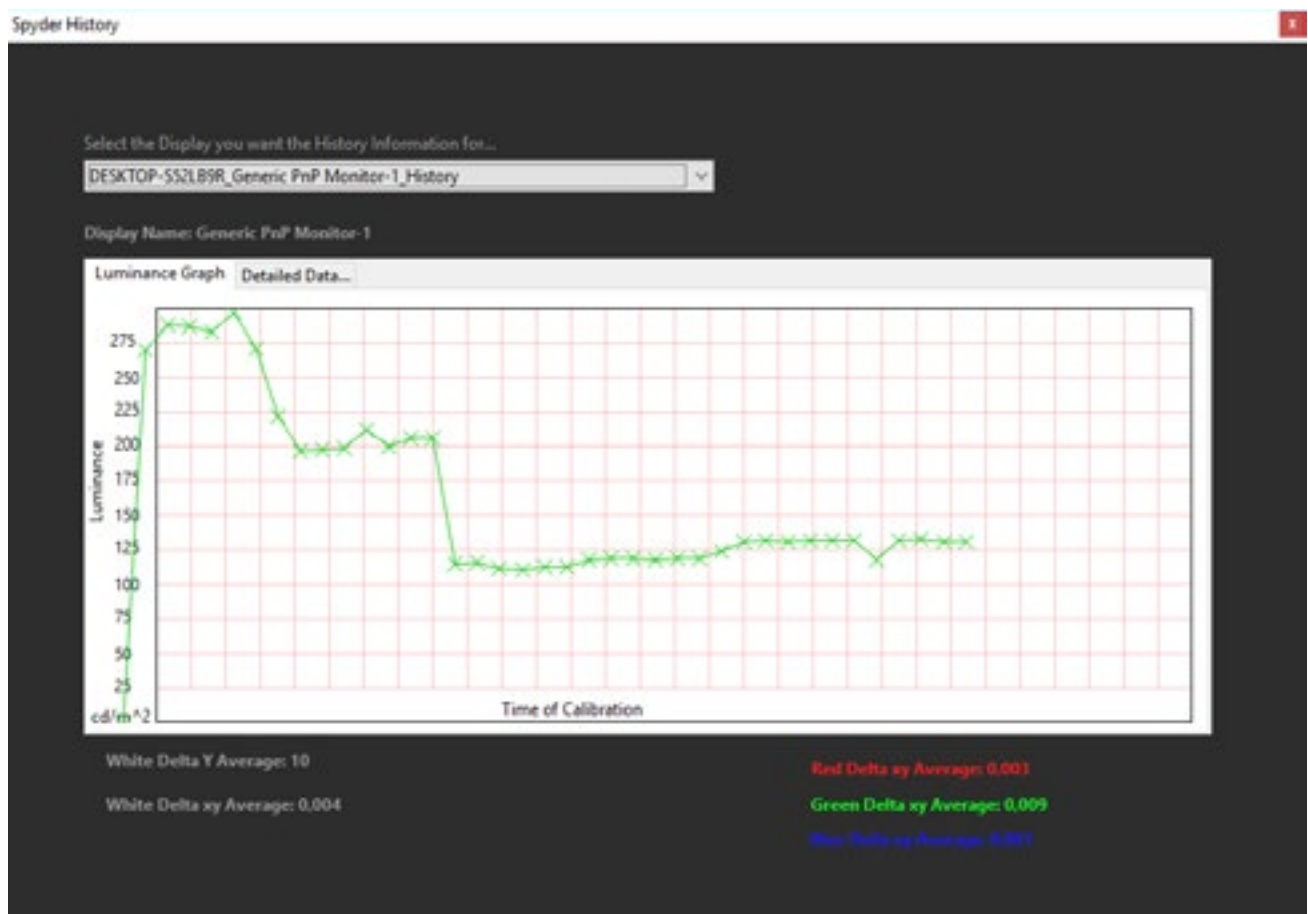


The colorimeter window can be moved around on screen

History

What can be read from this diagram

The “History” graph illustrates the gradual changes in the display device. This means the history visualizes the gradual loss of quality through use. Correspondingly, the graph drops down and to the right over time. But what do up and down fluctuations in the diagram show? These are probably signs that the measurement was not made on a “warm” monitor, which ran for at least an hour, but was measured immediately on start-up. For users who prefer to keep the pure numbers, there is an additional “Detailed Data” window, which shows the values as a table.



Example of several measurements. The decrease in luminance over time is clearly visible here.

Advanced Analysis

What your monitor shows after calibration

Monitor calibration is based on the ICC standard. The goal is to relate the colors of the individual devices involved in the color workflow to one another. As a rule, the output target is a printed medium, and after calibration the colors and brightness values on the display should be shown as they are look in the print. However, there are also other applications such as video, offset printing or medical analysis using the display. A display needs be adapted to the appropriate use; but what if it cannot?

Professionals usually knows what to expect from a monitor of a certain quality. Beyond that, they know that a monitor is rarely uniform across the entire screen. Most displays darken at the edges and do not show exactly the same brightness and color everywhere. Over time, screens show reduced luminance, color uniformity, and contrast. While this is not as rapid in LCD screens as with old-style CRT displays, where deterioration was easily seen month to month, elements of modern LCD screens still age.

In short: If you want color accuracy, you need to track your monitor's characteristics. In the next sections you will learn about the capabilities for this offered by SpyderX ELITE.



Display Analysis

What your monitor can do



The Display Analysis screen

On the “Display Analysis” screen, there are six different test options. With these you can use your monitor to analyze:

- Gamut
- Tone Response
- Brightness and Contrast
- White point at Different OSD Settings
- Screen Uniformity
- Color Accuracy

The tests can be carried out individually or as a series. Important: Depending on the system, the SpyderX only takes 4-5 minutes to complete the test, rather than the previous 15 minutes with the predecessor Spyder5. But in return, you get a very detailed analysis of your monitor’s capabilities.

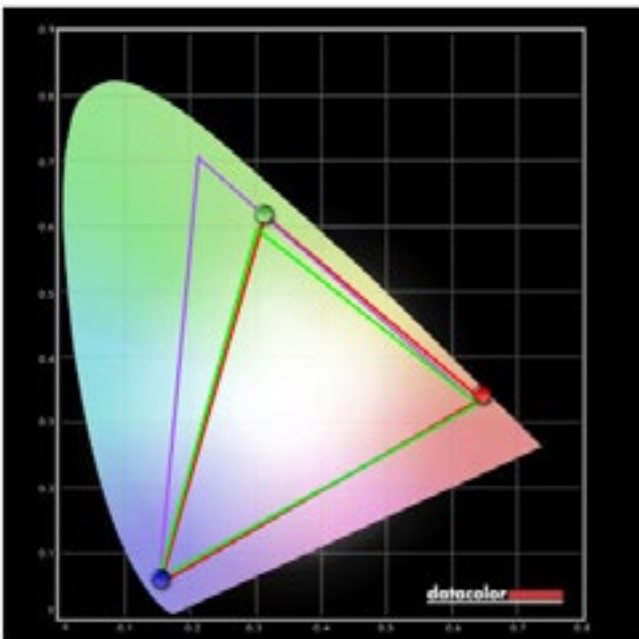
Gamut

How this changes over time



For all monitors, the color capabilities decrease with time. This development is primarily due to backlight aging. As a result, we no longer see colors as intensely as when new. The luminance and contrast are also reduced by the decreasing brightness. Test results are expressed as a percentage of the target gamut.

Color Gamut of display



The green triangle shows the sRGB color space, the purple triangle shows the AdobeRGB color space. The measured display can represent 97% of the sRGB and 75% of the AdobeRGB color space, and would be considered an "sRGB Display".

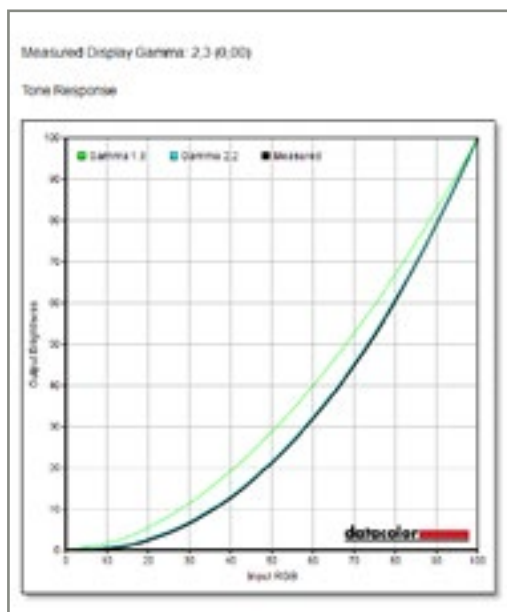
97% of sRGB 75% of AdobeRGB

Tone Response, Brightness, Contrast, and OSD settings

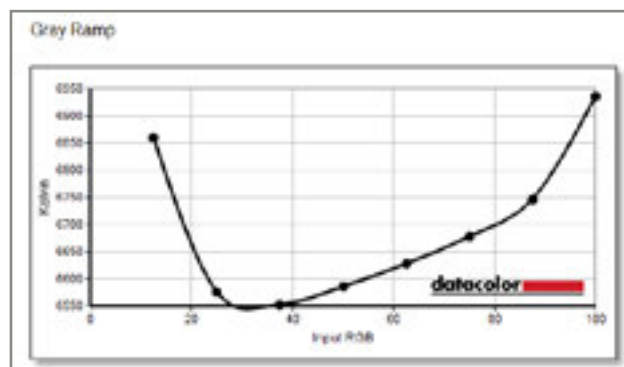


What can be determined with these tests

There are three tests of tone response, brightness, contrast, and on screen display (OSD) settings. Their results illustrate the aging process, as well as optimal settings. The measurement of the white point at different OSD settings is particularly important. OSDs allow the adjustment of the monitor firmware. For many models, you can set presets for videos, games, office, photos, or other uses. These presets are primarily aimed at the typical consumer who does not calibrate displays. But they also offer an important aid to color professionals: the analysis function. This function can determine which OSD setting is closest to the calibration target. What happens when you select this preset? The calibration must then compensate for the smallest differences and can obtain the maximum tonal gradations from the monitor hardware. The result is less extreme profile corrections leaving more levels for on-screen display.



This diagram shows the gamma curve of your display compared to gamma curves of 1.8 and 2.2.



This diagram shows the color temperature in Kelvin on the Y axis and the gradually rising level control of the RGB channels of the display on the X axis.

Brightness, Contrast and White Point At Different Brightness Settings

Setting	Brightness	Black	Contrast	White Point
0 %	132,3	0,20	650 : 1	6500 (0,305,0,329)
25 %	132,3	0,20	650 : 1	6900 (0,305,0,329)
50 %	132,3	0,20	650 : 1	6900 (0,305,0,329)
75 %	132,3	0,20	650 : 1	6900 (0,305,0,329)
100 %	132,3	0,20	650 : 1	6900 (0,305,0,329)

Brightness, Contrast and White Point At Different Presets

Setting	Brightness	Black	Contrast	White Point
OSD Preset1	131,3	0,20	650 : 1	7000 (0,305,0,329)

Data shown as tables

TIP

If you know the uniformity of a monitor, you can better judge the brightness of an image at the corners. In order to be able to evaluate important video footage, transfer it to the center of the screen.



Screen Uniformity

Why you should know your screen's evenness

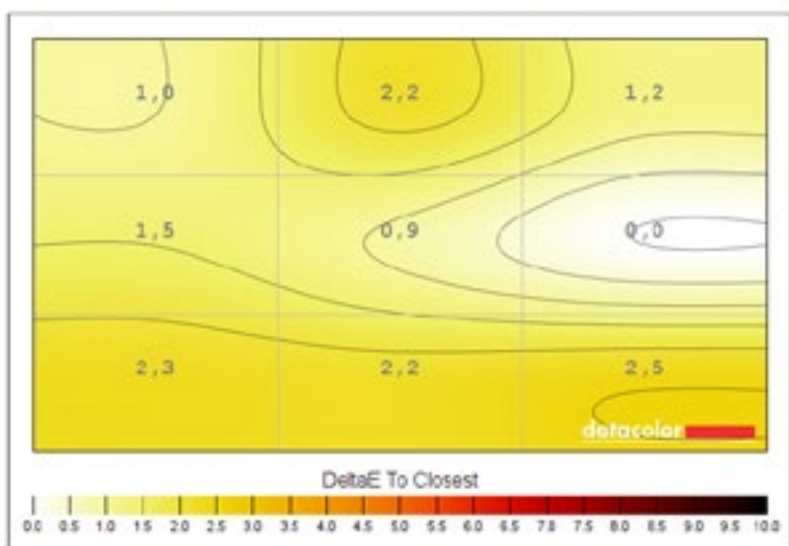


In a monitor, uniformity refers to the brightness variation from the center to its edges and corners. This depends on the quality and uniformity of the backlight. It is important to know your monitor's degree of variation, in order to be able to assess the color and luminance of an image.

Color homogeneity for brightness 100%

Quadrant	Color (Lab)			DeltaE To Closest
1	00,95,	4,79,	,70	1,0
2	0,09,	4,11,	,00	2,2
3	09,44,	4,18,	1,12	1,2
4	9,40,	4,47,	1,39	1,5
5	10,24,	4,21,	1,81	0,9
6 (Closest To D65)	00,09,	4,19,	,91	0,0
7	10,56,	4,19,	1,23	2,3
8	09,48,	,08,	1,14	2,2
9	10,17,	3,97,	1,37	2,5

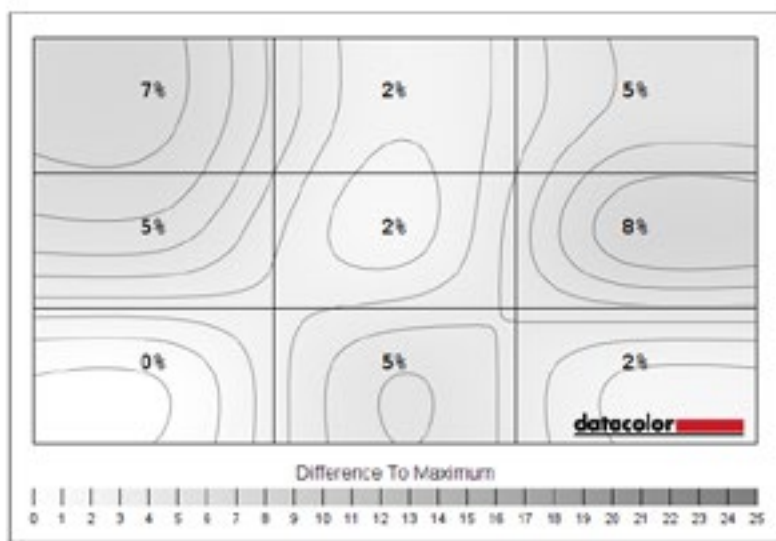
Color Uniformity at 100% brightness. This test is performed at four different brightness levels



Luminance homogeneity for brightness 100%

Quadrant	Luminance (cd/m ²)	Difference To Maximum
1	125,2	7%
2	132,2	2%
3	128,1	5%
4	127,9	5%
5	133,1	2%
6	124,9	6%
7 (maximum)	135,2	0%
8	126,4	5%
9	132,7	2%

Luminance Uniformity at 100% brightness. This test is performed at four different brightness levels.



TIP

Color fidelity and uniformity are monitor-specific properties which you must adapt to. They cannot be “calibrated”, since no calibration system can adjust different zones or individual pixels, only the entire display. By being aware of the limitations of the screen, you can adapt, avoiding the cost of a more uniform display.



Color Accuracy

Determine which colors you can trust on-screen




































When speaking about the color accuracy, there are problems similar to those with luminance. In particular, very cost-effective monitors often have color errors with certain shades due to physical limitations. In this test, 12, 24 or 48 color fields are measured as requested by the user. This produces an evaluation that shows the deviation for each color. The longer the bar, the greater the error. Following all tests, there is a monitor quality evaluation.

Color Accuracy

ID	Patch Lab	Result Lab	Delta-E	1	2	3	4	5	6	7
1E	96,04 2,16 2,60	96,25 1,95 1,79	00,00							
2E	80,44 1,17 2,05	80,44 1,40 2,31	00,00							
3E	65,50 0,69 1,86	65,35 0,92 1,14	00,00							
4E	49,62 0,58 1,56	49,90 0,98 1,19	00,00							
5E	33,55 0,35 1,40	34,50 0,00 1,20	00,00							
6E	16,91 1,43 -0,81	18,03 1,13 -0,72	00,00							
1F	47,12 -32,52 -28,75	49,10 -19,60 -25,23	6,00							
2F	50,49 53,45 -13,55	50,87 52,21 -13,11	00,00							
3F	83,61 3,36 87,02	83,53 1,65 87,38	00,00							
4F	41,05 60,75 31,17	41,11 60,59 29,84	00,00							
5F	54,14 -40,76 34,75	54,19 -40,05 33,76	00,00							
6F	24,75 13,78 -49,48	25,93 11,55 -47,77	1,00							
1G	60,94 38,21 61,31	61,36 38,30 61,60	00,00							
2G	37,80 7,30 -43,04	38,44 6,47 -42,06	00,00							
3G	49,81 48,50 15,76	50,19 47,29 15,56	00,00							
4G	28,88 19,36 -24,48	30,00 18,03 -24,09	1,00							
5G	72,45 -23,57 60,47	72,28 -23,50 59,30	00,00							
6G	71,65 23,74 72,28	71,40 24,82 71,87	00,00							
1H	70,19 -31,85 1,98	70,05 -31,35 1,84	00,00							
2H	54,38 8,84 -25,71	54,34 9,32 -25,71	00,00							
3H	42,03 -15,78 22,93	42,51 -15,74 22,23	00,00							
4H	48,82 -5,11 -23,08	49,07 -4,98 -22,91	00,00							
5H	45,10 18,14 18,68	45,18 18,39 18,08	00,00							
6H	36,13 14,15 15,78	36,75 13,37 14,51	00,00							
		Min:	00,00							
		Max:	6,00							
		Average:	00,00							

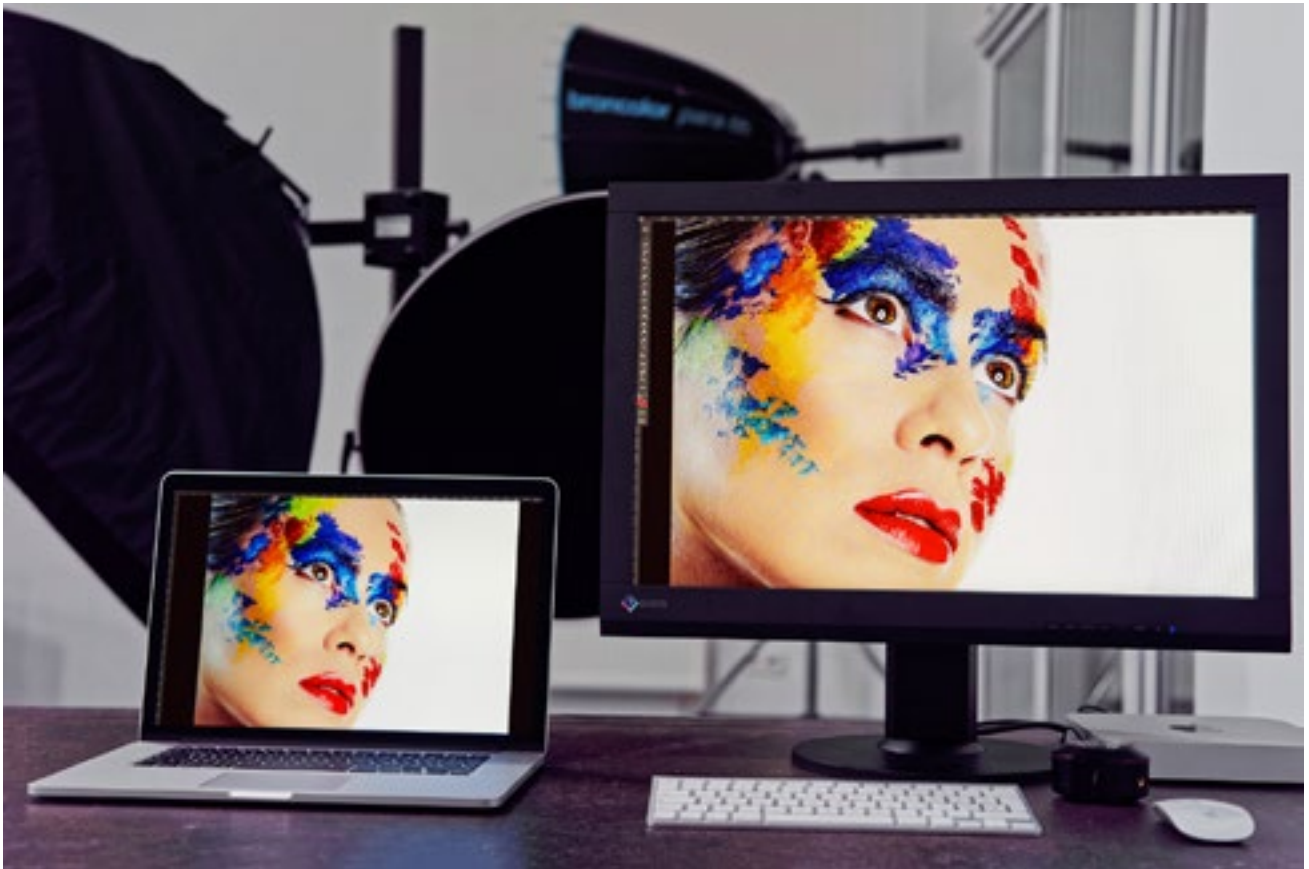
It can be clearly seen that the measured display has a delta E = 6 when displaying cyan. Cyan is a color that many LED displays have difficulty displaying correctly.

Monitor evaluation

Category	Rating	1	2	3	4	5
Gamut	5,0					
Tone Response	3,0					
White Point	3,0					
Contrast	5,0					
Luminance Uniformity	2,5					
Color Uniformity	4,5					
Color Accuracy	5,0					
Overall Rating	4,0					

Monitor evaluation – On completion of the tests a report is produced, with a simple graphic depiction on the display's quality in each category.

Side Note: Calibrating Multiple Displays



Special considerations

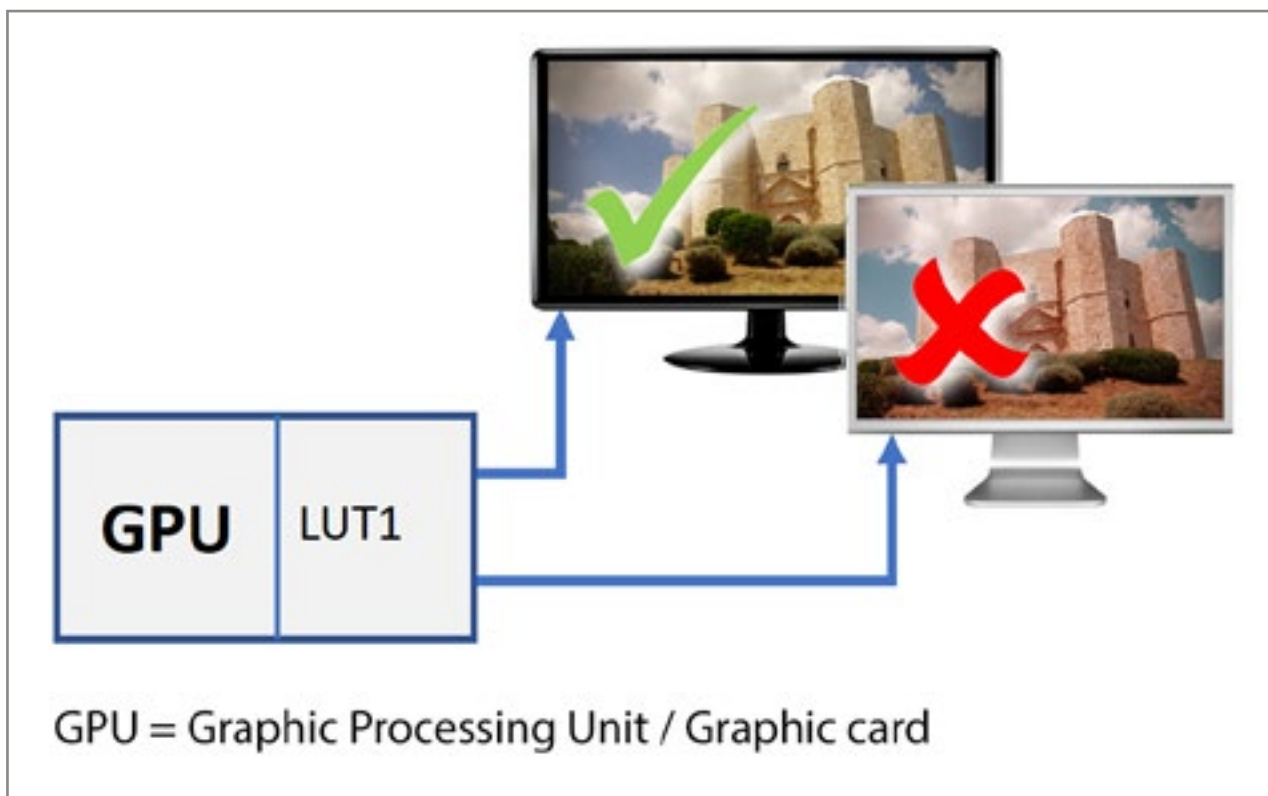
Many photo editors and graphic designers work with multiple monitors: one monitor shows the photo or the layout, the second monitor offers direct access to image processing and graphics tools.

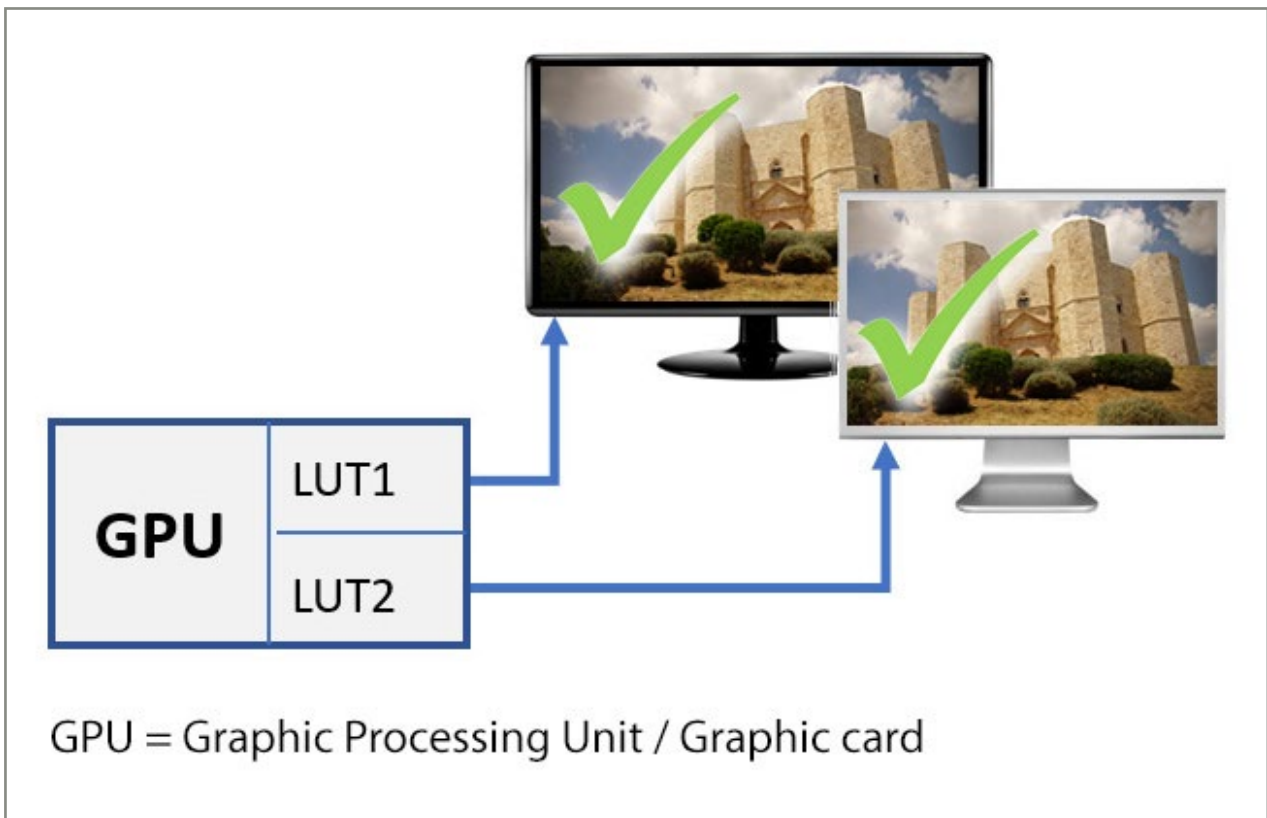
Even two identical screens do not match visually without being calibrated and profiled. But what is needed for the color correction of two monitors with two different characteristics? This requires a graphics card that is designed for operation with two monitors and which can manage two different Color Look-Up Tables. Alternatively, one can also work with two graphics cards, which should, at least for use with older Windows systems, be identical. Unfortunately, some low cost so-called dual-head cards support only one color profile, even though they output to two displays.



EXPERT INSIGHT

Some Dual-head cards have only one memory slot for a Color Look-Up Table (CLUT), which is overwritten when the second monitor is calibrated, so it only displays correct color on one display. More modern cards work with two or more CLUTs.





Schematic diagram of a graphics card with one or two CLUTs

If there are any problems, first check whether you are working with the latest version of the graphics card driver.

INFO



The operation of several color managed monitors – apart from the noted hardware issues – has been provided for since Windows XP. For Apple computers there were never problems, except for Snow Leopard (10.6) where OS color control can cause issues. More recent macOS versions work reliably.

Important: For both monitors, the same target values (i.e. the same color temperature and the same gamma value) must be set.

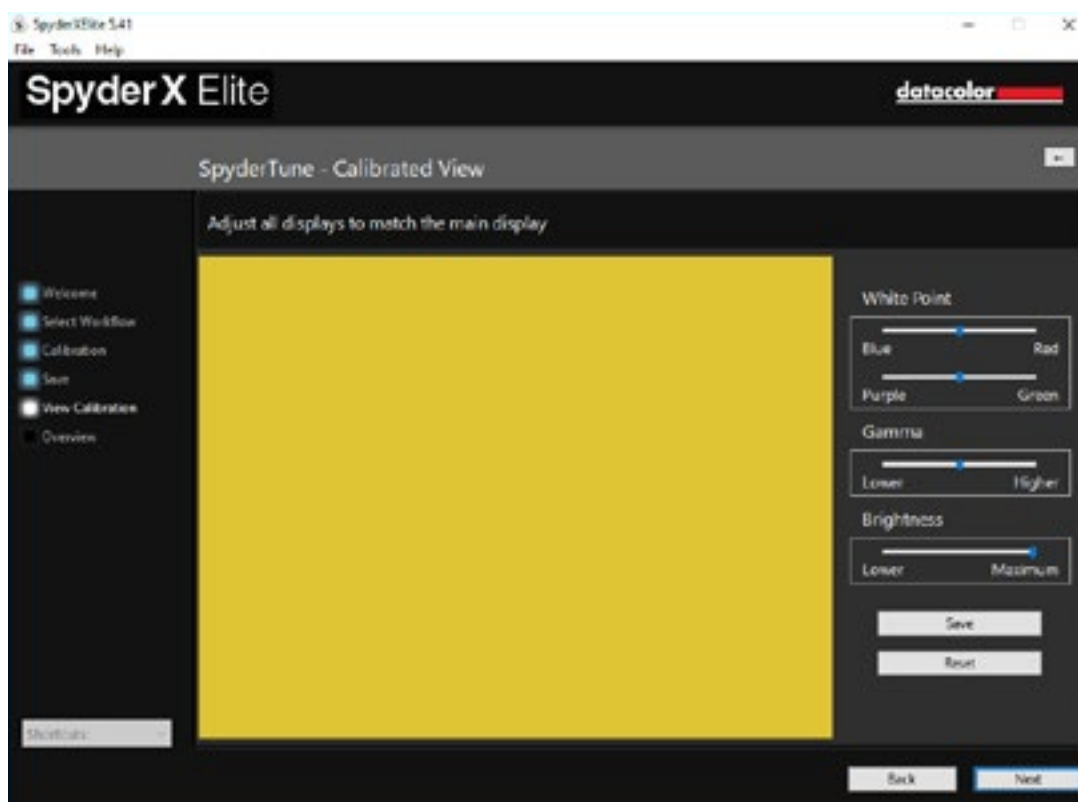


TIP

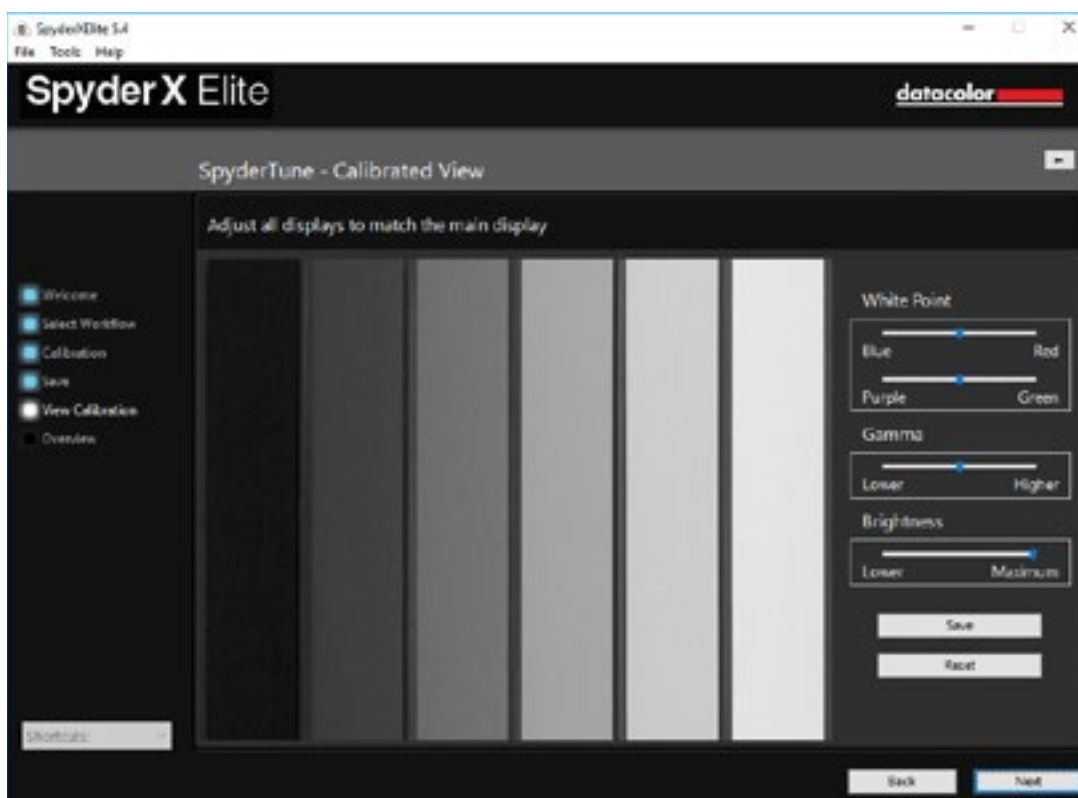
If the system or the hardware cannot manage two different profiles, here's a workaround: simply calibrate the image editing screen. The tool palettes are then displayed on the unmanaged screen. Be sure the palettes display is dimmer than the main display, so its unmanaged whitepoint does not influence your eye.

SpyderTune / StudioMatch

The “SpyderTune” function allows you to manually adjust two monitors that are already calibrated, but which differ slightly to the eye because of the different types of light source (white LED, RGB LED or CCFL background display). With the SpyderX upgrade the SpyderTune function has been expanded once again. With it, two displays can be even more precisely matched. After both monitors have completed the calibration process, final corrections can be made manually. You should ensure that the second monitor is matched to the main monitor and not the other way around. SpyderTune guides you through the yellow, magenta and cyan color fields, which you adjust accordingly. Afterwards, you can fine-tune the white point, the gamma and the brightness using a gray ramp.



The software screen with yellow, magenta and cyan is displayed on both displays for fine tuning.



The screen for white point, gamma and brightness tweaking follows.

Side Note: Calibrating a Studio



Things to keep in mind

A studio usually has several computers and monitors. In a typical situation, there are three basic groups: one or multiple relatively new, high-speed workstations with high-quality monitors; one or more out-of-the-box computers with older displays that mainly handle batch processing and printing jobs; and one or more laptops for image review and remote presentations. These devices will display the photos quite differently – even if they have been calibrated. There are technical reasons for this. High-quality and newer monitors often have a larger color gamut and softer color transitions. The calibration does not improve the hardware, but neutralizes the display and assures colors are not too saturated on the high saturation screens. A low quality calibrated display will be neutral, but may not be as smooth and will not offer highly saturated colors. This means that variations are to be expected, based on display quality.

It is possible to force nearly identical display of images on all these monitors. But to achieve this goal, one has to reduce the gamut and dynamic range to that of the weakest display. In order for all monitors to display the same color, the brightness of the better monitors are limited by adjusting their black and white values to make them match the weakest.

How to proceed

A sample Studio Match calibration works as follows:

- Start the “StudioMatch” module of the software
- This automatically measures the brightness of the monitors to be adjusted, in order to bring them to a level all can reach
- Subsequently, all monitors display the same contrast range based on the weakest monitor

TIP

Carefully consider which monitors you include in the group. Older laptops and office grade monitors are best calibrated separately.





Side Note: Calibrating a Projector

That's how easy it is

Calibrating a projector is similar to LCD screen calibration. However, calibration of projectors requires a totally dark room. If a calibrated projector is moved to another computer, it should ideally be recalibrated and profiled. It is possible to copy the projector profile from one computer to another – especially with Macs, in which the video standards are very consistent.

SpyderX ELITE is the most flexible Spyder for projector calibration:

- First, the Spyder is fixed with its tripod thread on a tripod and placed about 35 cm (one foot) in front of the screen. The main sensors of the SpyderX ELITE, and the honeycomb filter, point toward the screen, not the projector.
- In this orientation SpyderX ELITE measures not only the color from the projector, but also the color characteristics of the screen.
- When a projector is calibrated, the software projects a crosshair on the screen. This allows the sensor to be easily aligned. The fact that the SpyderX ELITE throws a shadow on the screen is not a problem, since a much larger area of the screen is being measured.

TIP

Different profiles can be created for different lighting levels. However, the best results are achieved by calibrating in a completely darkened room.





5 Color Tuned Printing

How to set up your printer for better prints

- ✓ What you need to know about printer profiles
- ✓ How to check if your printer and the printer driver are working properly
- ✓ What to observe when working with a spectrophotometer
- ✓ Instructions on measuring technique

Contents

User-Created Printer Profiles 5/146

- Page Setup 5/151
 - Printer Selection 5/153
 - Print Quality Check 5/154
 - Media Setting Check 5/158
-

The Profile Creation Process 5/169

- Initiating Profile Creation 5/169
 - Selection of Target Size 5/170
 - Preview 5/171
 - Device Calibration 5/172
 - Measurement Backup 5/173
 - Measuring 5/174
 - SpyderProof 5/175
 - Profile Setup 5/178
-

Glossary 217

User-Created Printer Profiles



If your monitor displays colors consistently and accurately, then profiling the printer is the next step. Unlike monitors, printers are relatively consistent over time. The only exceptions requiring reprofiling are changes in your ink or media, or print head wear.

INFO



Profiling works only as long as you work with the same inks and the same paper that has been used during the profiling process; and these materials remain consistent. Manufacturers are getting better, over time, about not changing paper coatings or ink formulations without warning users, but it does happen.

Typically, glossy photo papers are used when printing photos on ink-jet printers; matte art papers or canvas are used for fine art prints; and proofing papers are used for simulating offset printing results. These differing paper types are mixed and matched as needed. For example, a photographer could use a photo-gloss paper for a customer's prints, then work with handmade paper to print the same images for their own portfolio or gallery prints.



INTERESTING ONLINE FINDS

For more insights we recommend to visit John Paul Caponigro blog post [17 Top Printing Tips For Making Great Fine Art Prints](#)

[Read Article >](#)

Why do you need profiles for different types of paper?

You must create profiles for the types of paper when working with different papers on a high-quality photo printer. It is not enough to simply define profiles for smooth, matte and uncoated paper. You need separate profiles for the slightest differences in paper type or coating. Why is that? Just think about how differently a drop of ink acts on open-pore newsprint in contrast to resin-coated photographic paper. Once the drop contacts the photo paper, it retains its shape and stays at the surface. On newsprint, the drop sinks in and expands to a spot with imprecise edges. You must consider these differences multiplied a thousand times when creating profiles. In addition, four, six or even eight colors merge with each other. This gives you an idea of what occurs during the printing process and why tiny differences between paper coatings can have a significant effect on the resulting color and density.

What effect does the ink have?

Do not forget the influence of the ink on the color. The printer's original ink often produces more powerful colors than third party ink. Varying inks react differently depending on the assorted types of paper, as well.

EXAMPLE

If you work with four different types of paper and two types of ink on two different printers, you need a total of 16 printer profiles. Profile needs multiply quickly!



Why the printer-ink-paper combination is relevant

For beginners, the easiest way to work is with OEM inks, the OEM papers, and the printer manufacturer's supplied profiles. These are perfectly suited to each other (at least with a relatively new printer), and they provide relatively reliable results in combination with a calibrated monitor.

However, if you want to get the best results from your printer and it does not come with profiles, or you are using ink and/or specialty paper from other suppliers, or age has changed the print heads or media combinations, you must create profiles yourself. Custom tuning profiles for softproofing and image editing for a given printer is another reason for custom profiling. There are free profiles online that can be downloaded for some printer/paper combinations and they improve results. Nevertheless, the most accurate results are achieved with user-created profiles. These take into account the individual properties of your own printer and can be adjusted as needed. This is the most precise way to perform color correction for the printer.

A step-by-step guide to printer adjustment

The technical procedure for the printer profiling is simple. You print out a special target image and then read the printed colors, and the target values are compared with the actual values using special software, resulting in a printer profile. Pre-print image adjustments and final printing is then done using this profile.

Professionals rely on the precision of profile creation and work with a spectrophotometer or spectrophotometer to create printer profiles. We describe this approach in detail on the following pages. Depending on the precision requirement, measurement charts can be printed with 225 or 729 color patches, plus 238 gray scale patches to increase the measurement density around the gray axis. Following a drying time of about 30-60 minutes, the printed color targets are measured with a spectro, such as SpyderPRINT.



Some effort is required to create custom printer profiles. The color targets must be measured strip by strip.

SpyderPRINT has a minimum requirement of Windows 7 or macOS 10.7. Following installation, you can launch SpyderPRINT from your applications folder. Its best to let the program automatically check for updates, to ensure you're working with the latest version.

EXPERT INSIGHT

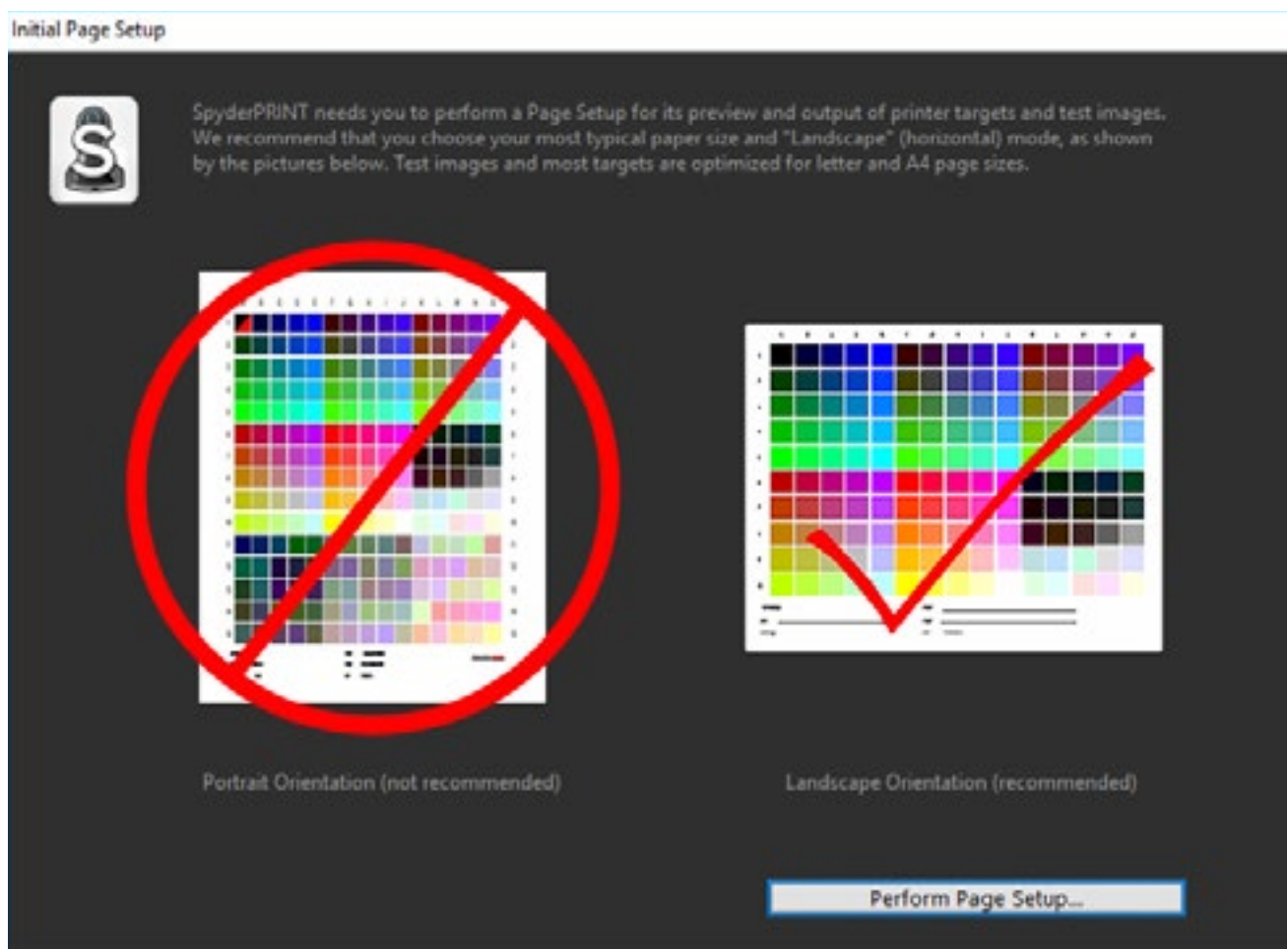


There are a number of reasons your print shows differences compared with your monitor, despite careful printer profile creation. For example, many monitors show open shadows when running at high brightness. You can reduce the brightness during calibration to a reasonable level (120 candela is ideal). A monitor has completely different contrast characteristics than paper. Enable the "Simulate Paper Color" softproofing option in Photoshop to make your monitor more closely emulate the paper. The Softproof feature in SpyderX ELITE automatically simulates paper color and contrast.

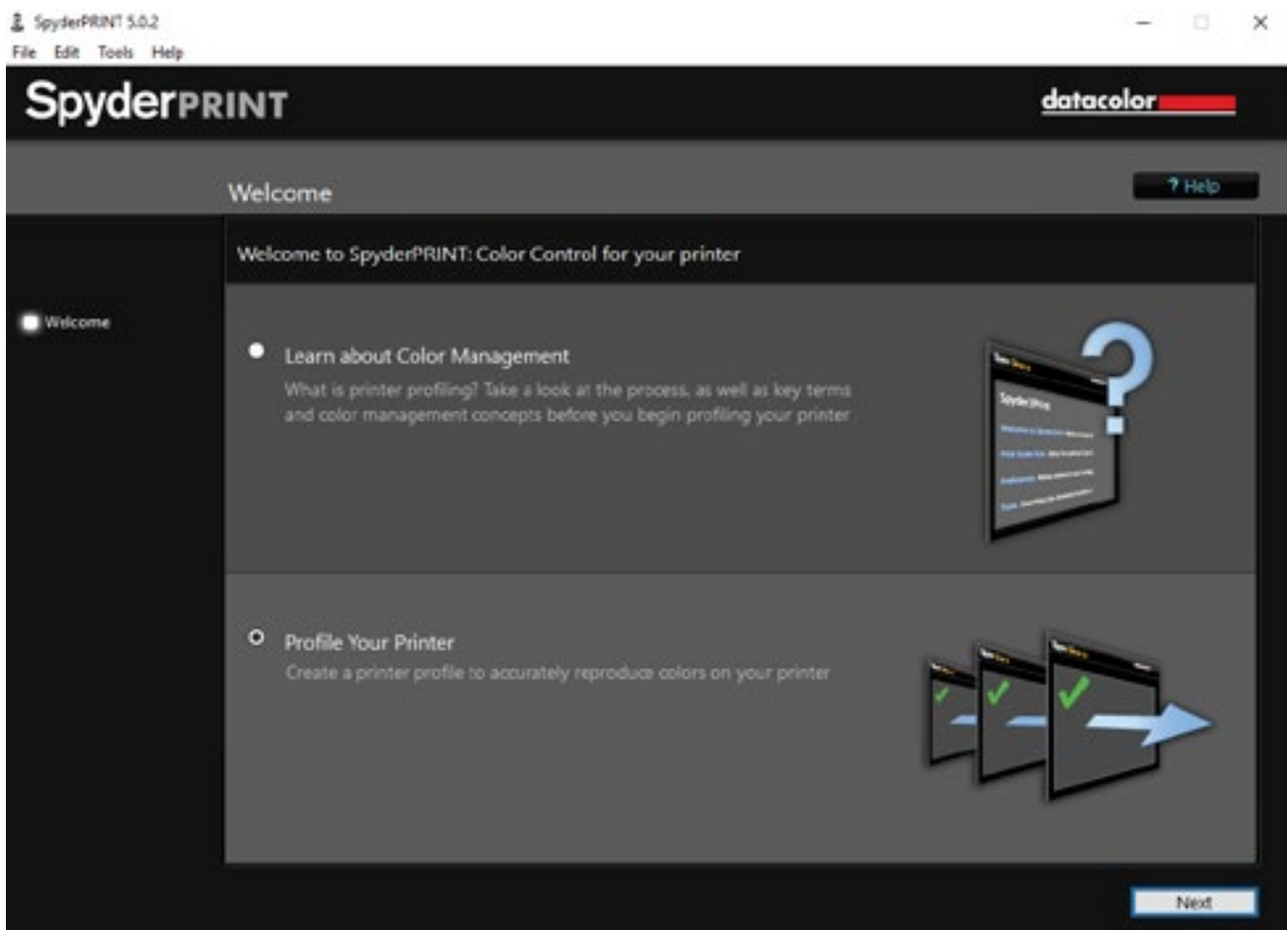
Page setup

Here's how easy it is

During initial setup, the software prompts you to set the page orientation of your printer to the landscape orientation. This ensures the optimum size of the color patches and makes strip reading easier. In the second step, you can choose between a primer on printer color management or the start of the profile creation wizard, which leads you step-by-step through the printing and color measurement process.



Step 1: Initial page setup: the menu navigation is intuitive and simple



Step 2: Continue your profiling process by choosing Profile Your Printer.

Printer Selection

What you need to know

When selecting the printer, you enter the information that is important for the planned target print, which will be displayed later on the printout. Normally, it is sufficient to specify the following three key details:

- What **printer**?
- What **paper**?
- What **inkset**?

Important: The date and time are supplied by the operating system.

SpyderPRINT 5.0.2

File Edit Tools Help

SpyderPRINT datacolor

Before You Begin ? Help

Printer description and other options

Welcome
Printer Description
Profiling
Finish

Printer Name: Canon Pixma Pro-1
Paper or Media Name: Canon Pro Platinum PT-101
Ink or Colorant Used: OEM Ink (Canon)
Driver Media Setting: Glossy Paper
Date: 02.10.2017, 09:23

(This information will be used to label your targets and measurement sets, to help keep them organized. You can leave these empty, if you wish, and hand-label your targets after printing)

Print Quality Check ?
Print this test page to check inks

Media Setting Check ?
Print this test page to check media/paper settings

Back Next

This information is used to label both targets and resulting profiles.



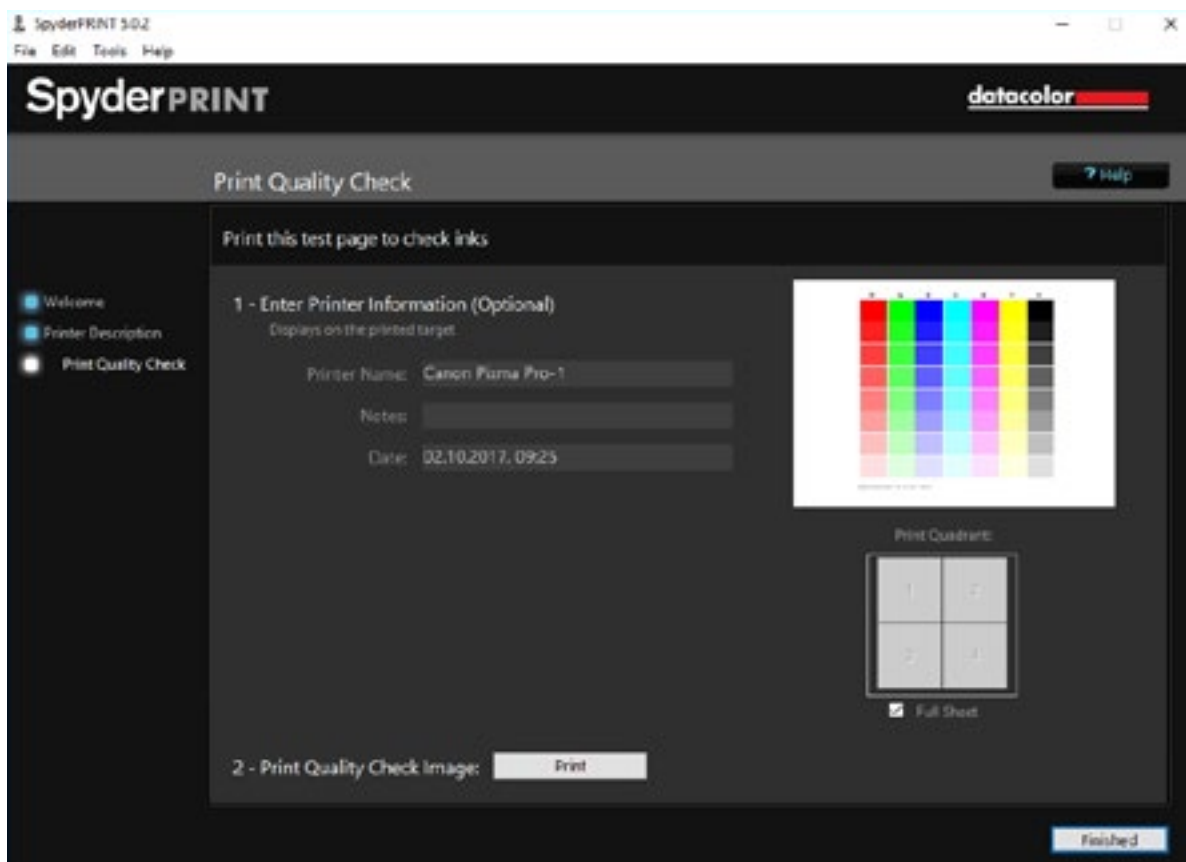
INFO

If you profile regularly and routinely, click the “Next” button. This will skip the following two dialogs.

Print Quality Check

What this test will teach you

If you have not printed for a prolonged period of time, it is worthwhile to make a quality test print before creating the profiles. This is how you recognize problems beforehand. You can print either on the whole page or in one section of it. The latter allows multiple prints on a single sheet of paper, saving materials.

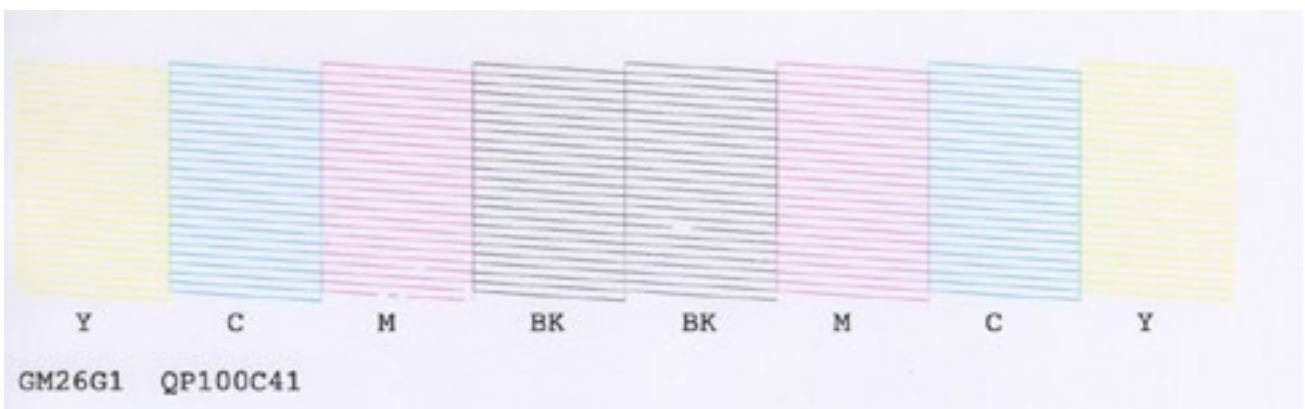


User interface "Print Quality Check." Click on the test chart to enlarge the image.



INFO

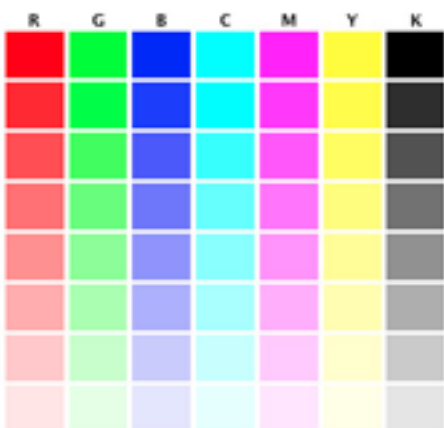
The most precise jet test is the nozzle check in your printer driver. Here, the nozzles are individually checked and a nozzle step pattern is created. This shows very clearly if a nozzle is blocked and if nozzle cleaning must be carried out. However, entire colors can sometimes be missing from this print at either end, without the user being aware of it.



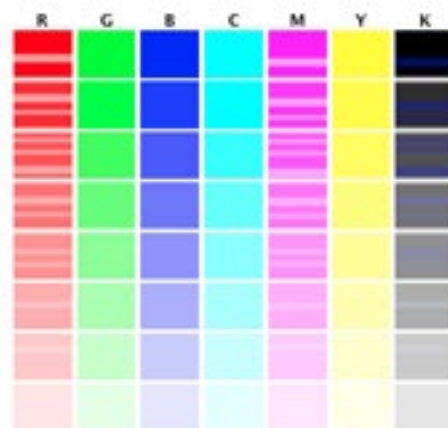
A typical example of an inkjet test chart, as provided by printer manufacturers.

Determining irregularities in prints using a SpyderPRINT test chart

In case you notice irregularities when printing the test chart, please try to rectify them by using the print driver's cleaning command; or if needed and available, the deep cleaning option.



Correct quality check print - no skips, no missing ink colors



Quality check print with misfiring jets



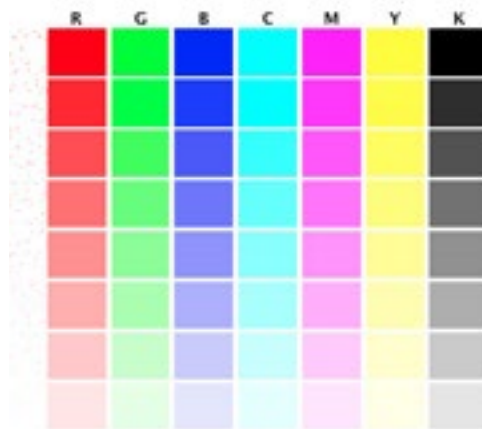
The image above illustrates the type of result you would see with the light magenta ink empty or not printing. Note that only part of the magenta ramp is blank, and that the color of other (secondary) ramp is also affected.



The image above illustrates the type of result you would see with the dark cyan ink empty or not printing. Note that it effects far less of the print than a light ink failure. It is important to look at the color initials at the top of the check print and be sure that they match the colors printed below them; here they do not.



The image above illustrates the type of result you would see with the black ink empty or not printing. Note that it affects far less of the print than either a light or dark Ink failure. Printer problems with light black inks can be difficult to detect. Pay attention to the 'K' ramp to ensure that it gradates properly.

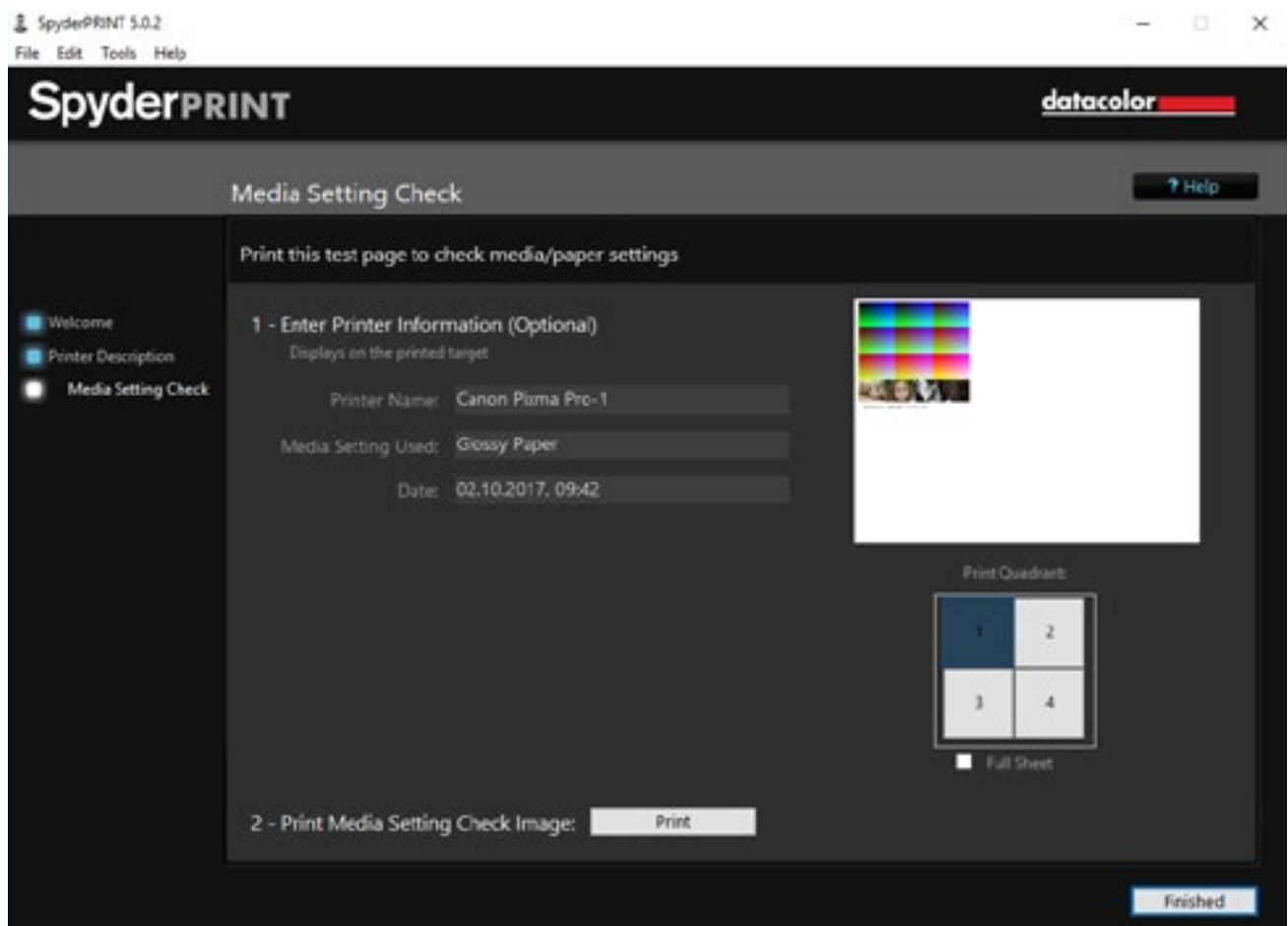


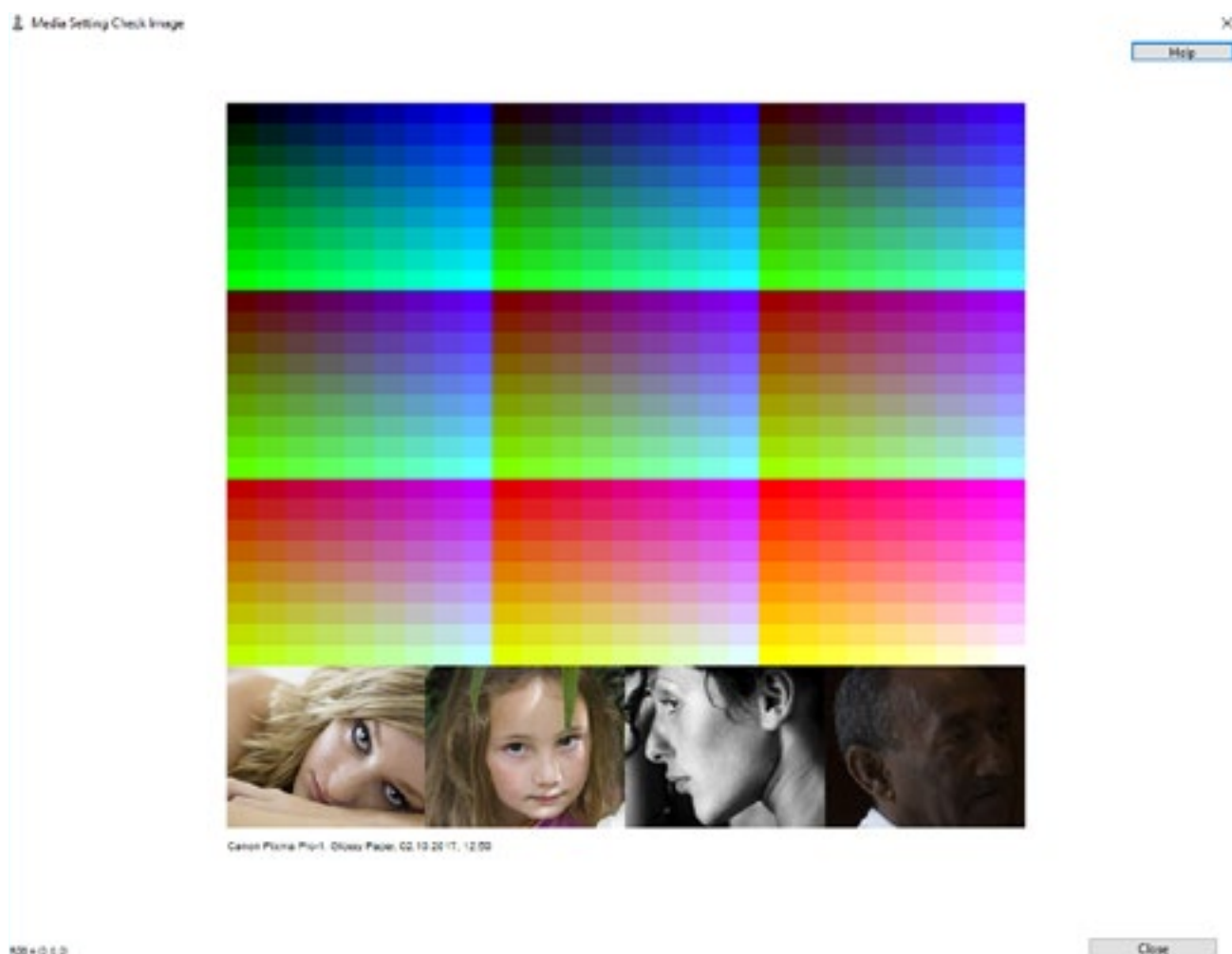
The image above illustrates the type of result you would see if the jets were misfiring, and therefore printing color in areas that should be white. While it is worth cleaning a printer that is showing these symptoms, it is likely that you will need to replace the print heads.

Media Setting Check

How best to do this

Your printer driver provides the option to select appropriate settings for different media types. With the Media Setting Check, you can print up to four test prints to one sheet. This allows you to see which default paper type setting gives the best print in terms of the amount of ink used. The best media preset is not always the one with the most obvious name. You should also try out presets that seem counterintuitive, such as "semi-gloss" for semi-matte paper. For visual evaluation, look for too high or too low color application to exclude driver presets.



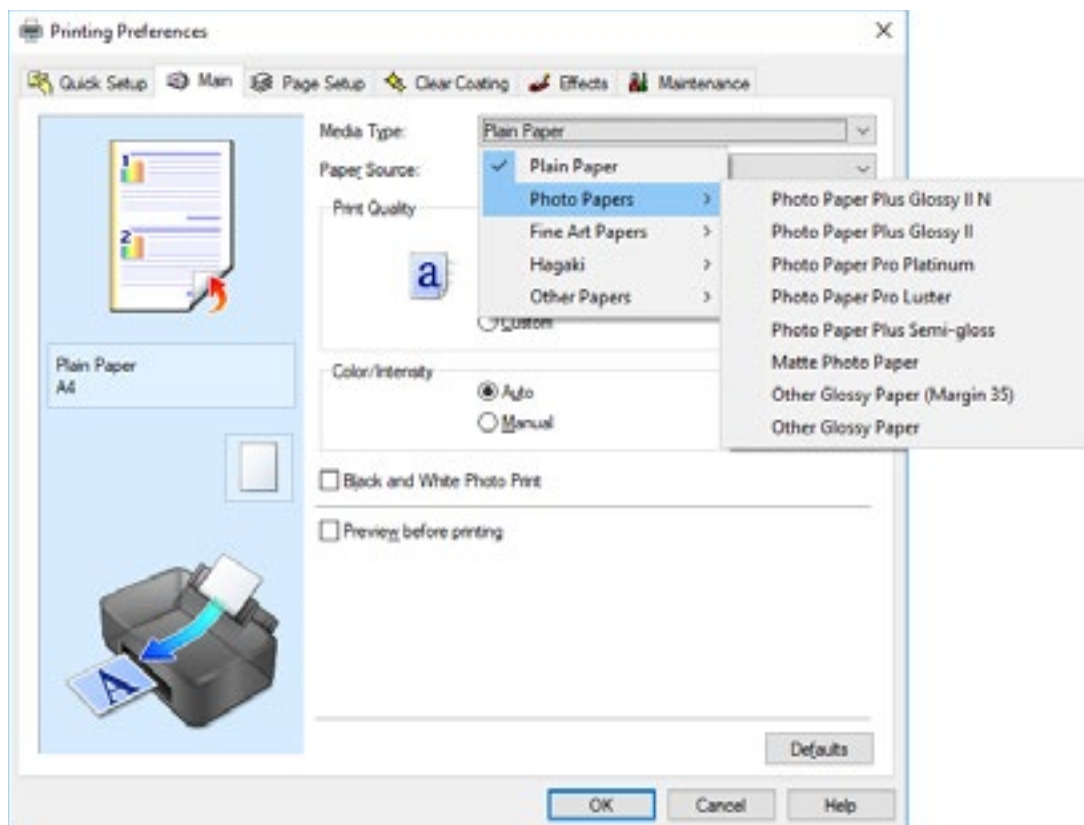


User interface "Media Setting Check." Click on the test chart to enlarge the image.

To generate four test prints on one piece of paper:

Click on the first quadrant in the section “Print Quadrant”

- Enter the driver media type used in the text box. To do so, open the print driver and check the media type dropdown list
- Load your preferred paper and start a test print
- Go back to Print Quadrant and chose the next quarter to print on
- Again, click on “Print” and adjust the media type in your print driver. Type the name of the media type chosen in the text field “Media Setting Used”.
- Load the same piece of paper in the same orientation and start the print job
- You can repeat this process up to four times per sheet



By referring to this Canon print driver, one gets an idea of the plethora of papers available to choose from. The naming doesn't follow a standard. It may be necessary to do several test runs with different media type settings in order to decide on the optimal setting for the selected paper.



Once you get through four print runs, you'll have four test charts for varying media type settings on one sheet of paper. The entered information indicates what setting each represents, taking the guesswork out of selecting a media setting.

TIP



Color density slider: some inkjet printers come with a color density slider, allowing for adjustment of the overall density of ink. Since these printers generally aim for good color density, you usually do not need to adjust this slider's settings for great printing results. This also means not having to remember the slider's settings and adjust when printing. When using custom profiles most print driver setting options are deactivated – with the exception of the color density slider – once color correction options are selected.

How to check test prints

The optimal media setting for profiling and printing on a particular paper may not be the media setting with the most likely name. It is worth testing a range of media settings to determine which one will actually perform best with your combination of settings, colorants, and media. The “Media Setting Check Print” shows the entire color universe of your printer, colorant, and media combination in nine slices of nine steps by nine steps. You can print this image at different driver media (paper type) settings to assist you in determining which is most suitable for your combination of printer, colorant, paper, and settings. Photographic content is included at the bottom of the check print to assist in determining the photographic qualities of different media settings. Different media settings will lay down different densities of ink in the various sections of the check print, and offer varying degrees of linearity (consistency) in the steps between adjacent patches. Printers that offer smoother, more linear, gradients in the check print require fewer patches in the final profiling target. Printers with significant local variations require more patches to profile effectively.



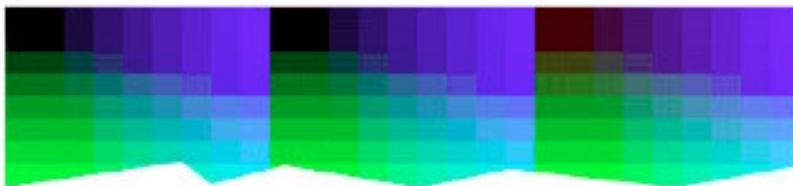
INFO

These test charts are not involved in profiling a printer. They are solely used for visual determinations of optimal media settings.

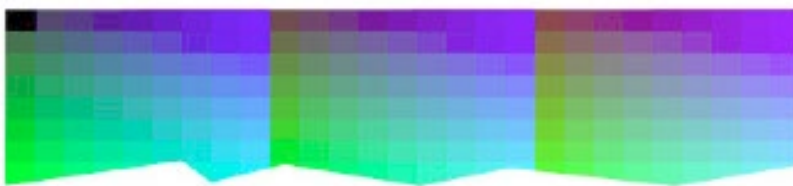
Near black colors



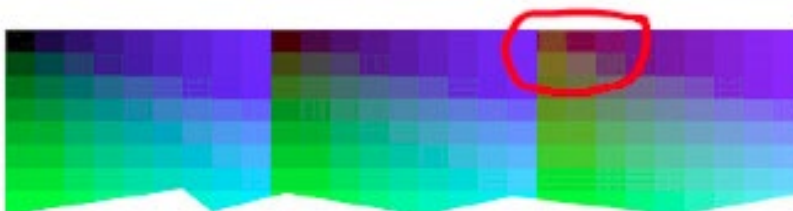
Near black patch locations: a smooth gradation to black, this is ideally what you want to see.



Clogged near blacks: avoid settings that print too many near black patches, blocking up entire groups of patches.



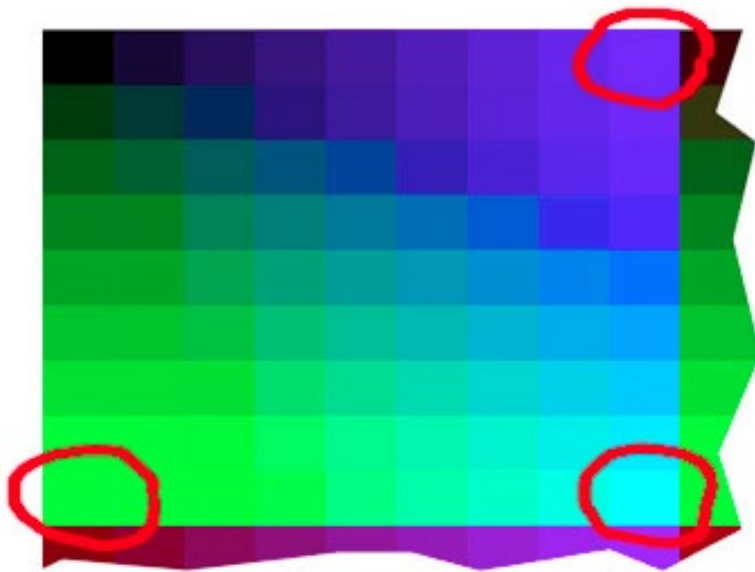
Weak near blacks: avoid settings that have a lack of near black patches, jumping directly to medium grays from black.



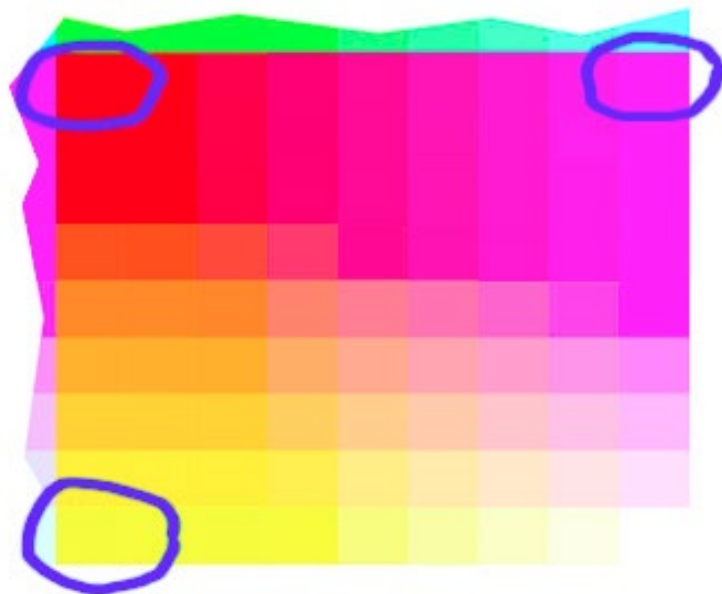
Off-color near blacks: avoid settings that have excessively off-color near black patches, often occurring in the third section. This is not as significant as other black issues, but should be considered.

Primary colors

Check how your printer, colorant, and media combination work with the particular media setting to create near primary colors. The primary and secondary colors, circled in these images, may vary with different media settings.



Green, cyan, and blue primaries occur in the same section as black



Yellow, red, and magenta primaries occur in the same section as white

Comparing Settings

To compare a range of media settings, look for the following elements:

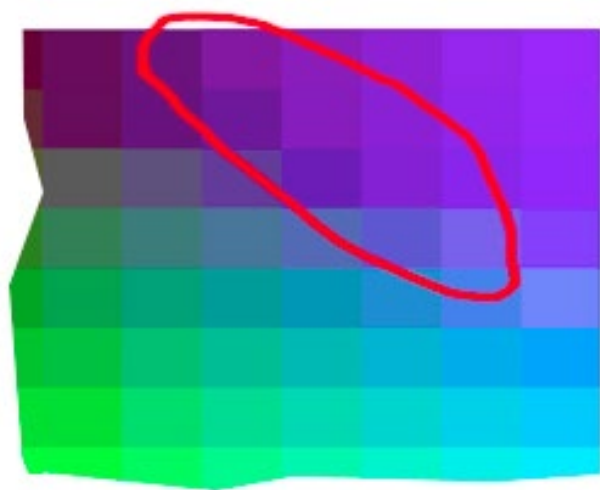
- Bright primary colors, without over-inking
- Good color range and brightness in other colors in the image
- Good gradation from primary colors into the rest of the color space



This image shows a good gradation from blue to black, with distinct patches throughout.



This image shows a problematic gradient from blue to black, with excess inking, which causes several of the patches to print full blue, with no visible steps. A media setting that causes results such as this is best avoided, even though it offers bright primaries.

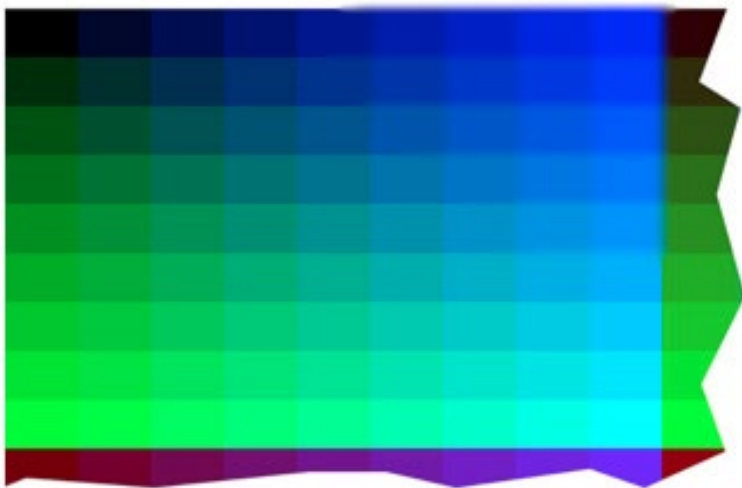


This image shows a problematic gradient between blue and green, which results in a visible stairstep pattern. This type of break is not as undesirable as over-inked primaries, but should be avoided if possible.

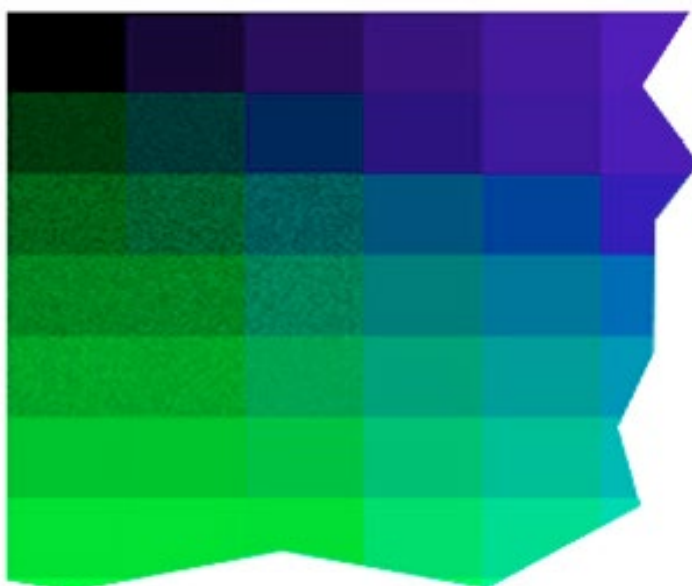
Inking Issues

There are a range of possible inking issues that a particular combination of printer, colorant, and media may cause. Inking issues assume that you are using an ink-based printer, though excess colorant and other related issues are also possible with other printer types. Look for the following signs:

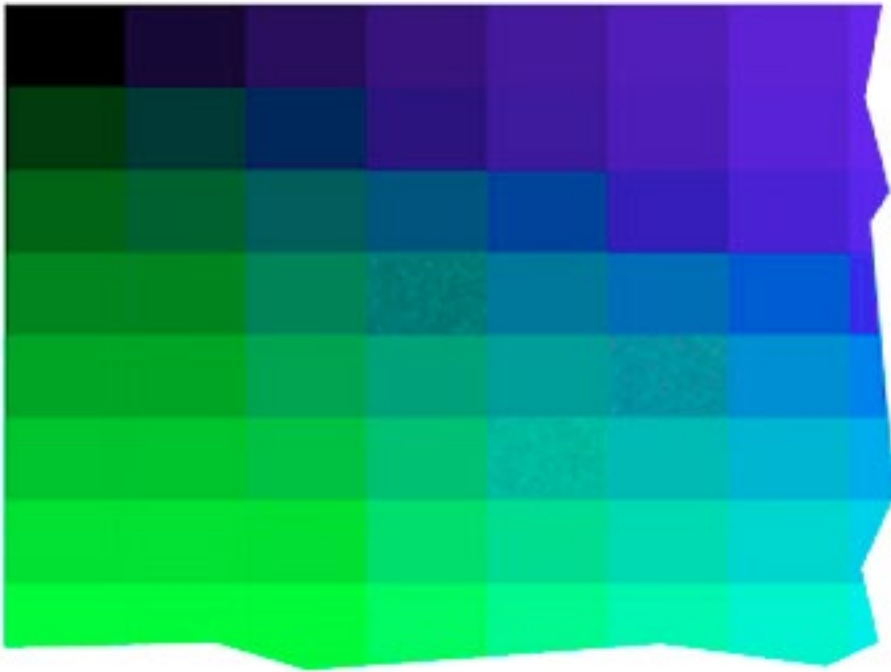
- Over-inking, is most commonly noticeable as lack of patch distinction, as shown above, but also results in many of the other problems noted below.
- Bleeding of inks outside their patch boundaries, blurring one patch to another, or bleeding into the white surround.



Here the blue areas have bled between patches and beyond the edge of the chart.



Mottling of inks within patches, showing grainy, uneven areas where the ink is heaviest, often where two or more colors are mixed at high-ink levels. This illustration shows what mottling might look like if it occurred where dark cyan, yellow, and black inks were all being used to create deep greens.



Worming may look similar to mottling, but it occurs within the dither pattern of the printer. Larger, often worm-like, shapes may occur in the printer's dithering pattern in certain flat color patches. Worming affects only flat color areas, so it typically does not cause problems in photographic images, unless flat areas such as clear skies display the problem.

Further Effects

- Bronzing is an effect that can be caused by excess ink in the near blacks. Bronzing occurs as a difference in color tone between black and near black areas of a print when viewed at an angle to the light source, often showing a bronze sheen. In some cases, the only solution to bronzing is choosing a different paper or inkset. In other cases, a lighter inking media setting can improve results.
- Gloss differential is similar in nature to bronzing, but occurs in the lighter areas of prints. It is a difference in the glossiness of uninked paper and adjacent inked areas. It is only an issue with gloss and luster surfaces. A few printer models offer a gloss optimizer option, which applies an unpigmented ink to blank areas to reduce gloss differential. Other modern printers utilize high-gloss inks, which also minimize the difference in gloss between printed and unprinted areas. Gloss differential cannot be controlled through choice of media settings, nor through using ICC profiles. If your gloss and luster prints exhibit gloss differential, and you find it undesirable, then consider changing papers, inks, or printers to find a more acceptable result; or spray your prints with a quality archival fixative overspray after printing. This reduces gloss differential, while at the same time providing increased water resistance, and in most cases longer print life.

Analyzing Photo-Content

The photo content in the “Media Setting Check Print” allows for checking how well a media setting’s gradations and densities represent photographic content. A color cast is not important here, as that can be corrected with the profiling process, but problems with blown out highlights, over-inked dark areas, or posterization (visible steps where none should be present) are more difficult for a profile to compensate for.



The above image shows good photo content.



This version of the photo content shows blown out highlights.



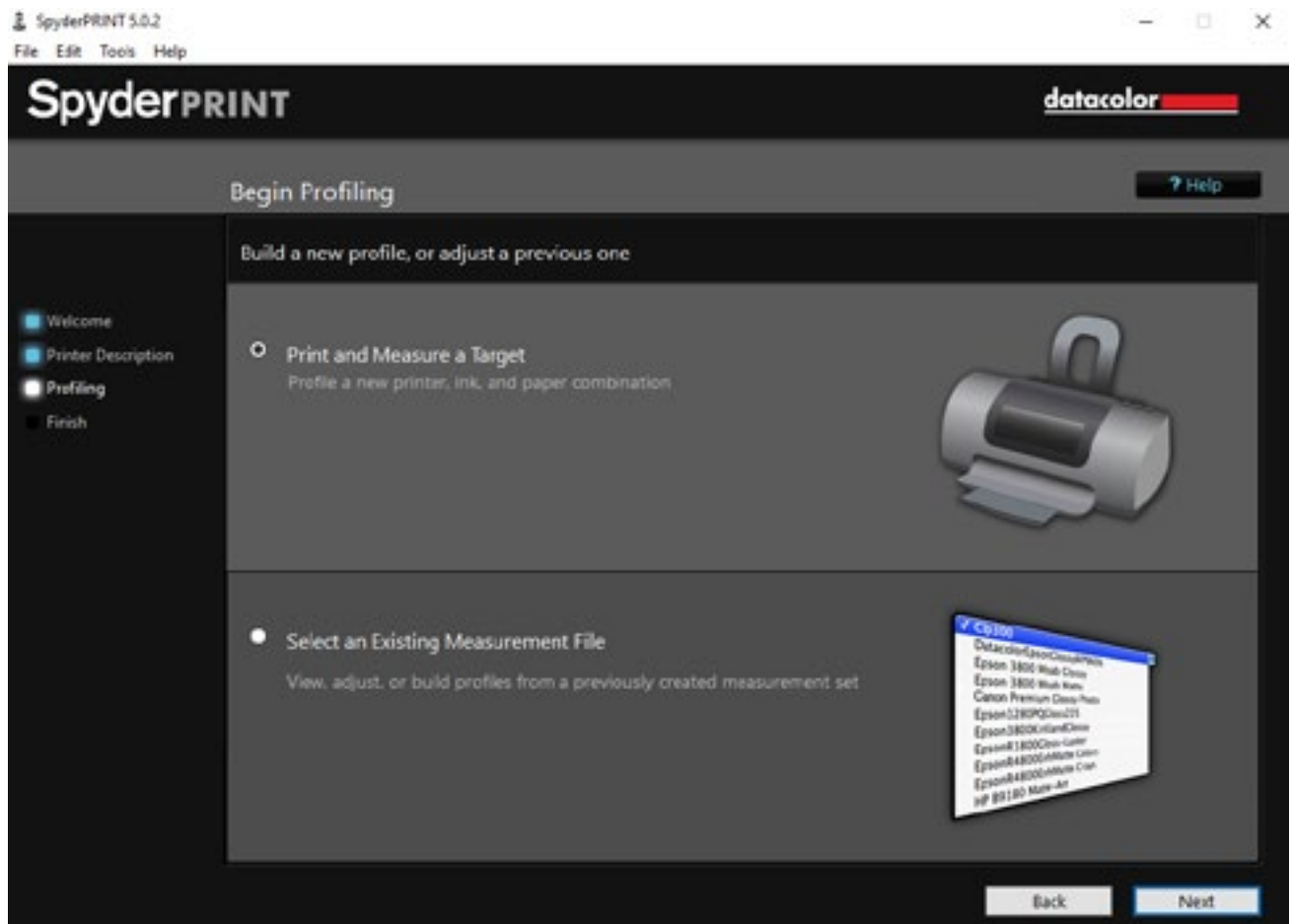
This version of the photo content shows clogged shadows.



This version of the photo content shows posterization.

The Profile Creation Process

Initiating profile creation



What options do you have?

After checking that your printer, and possibly the printer driver, are working properly you can decide in this dialog:

- if you want to print out the target and then measure it, or
- if you want to access a an existing measurement file for completion or reworking.

EXAMPLE

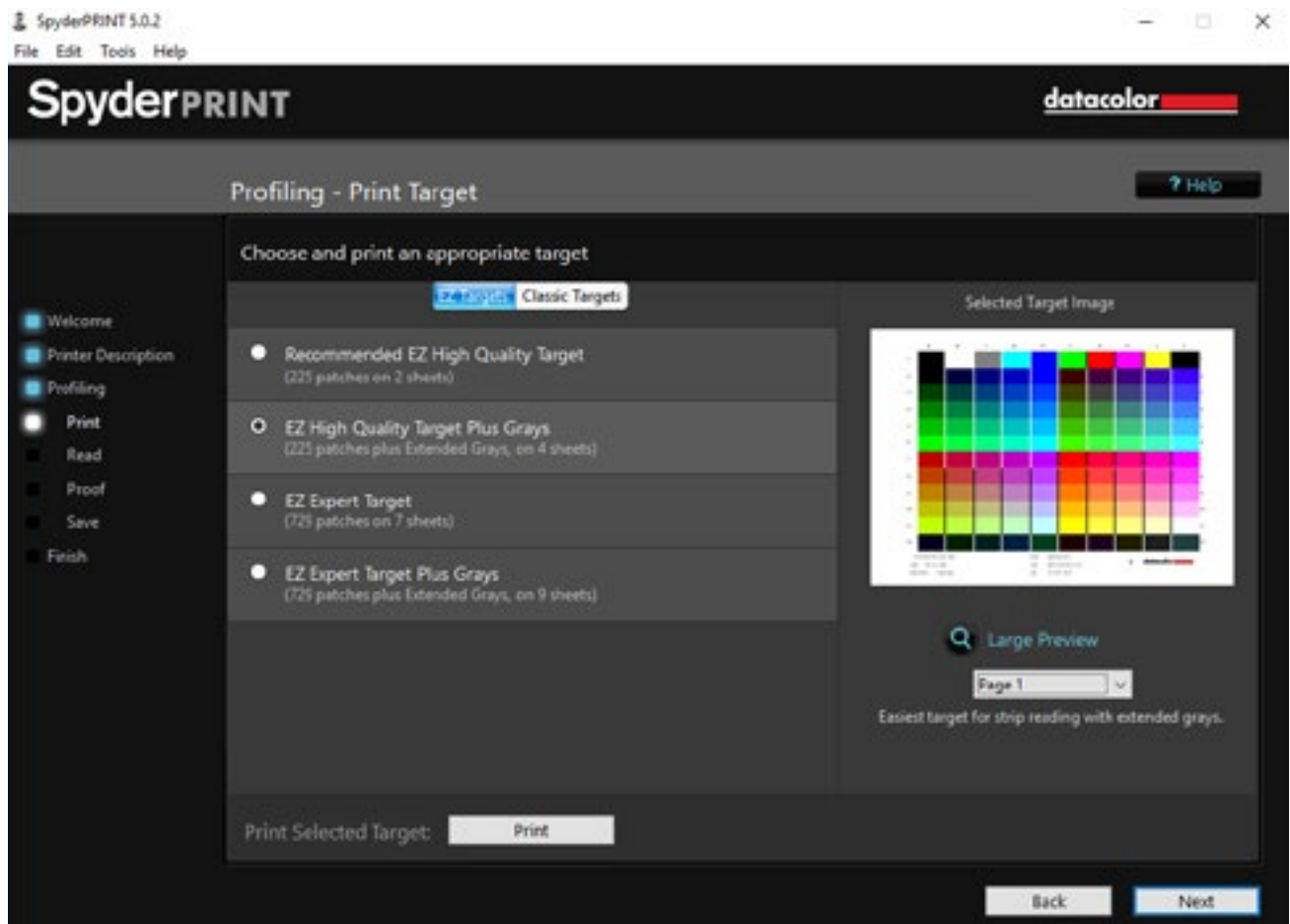
You may choose to work with an existing measurement file if you discover patch errors from incorrect measurements that you wish to correct, producing an improved profile.



Selection of Target Size

Choosing the number of patches

In this dialog you specify how many color patches will be used for profile creation. Most advanced users prefer profiles that are based on 729 fields. But 225 patches is fine for very linear printers. Fans of black-and-white prints should choose a target with the "extended gray scale" to improve neutrality in the near gray zone. "EZ targets" are prepared for faster strip reading with fewer errors. So-called "classic targets" are more suitable for reading one patch at a time, instead of in strip reading mode. This requires significantly more time, but saves paper.

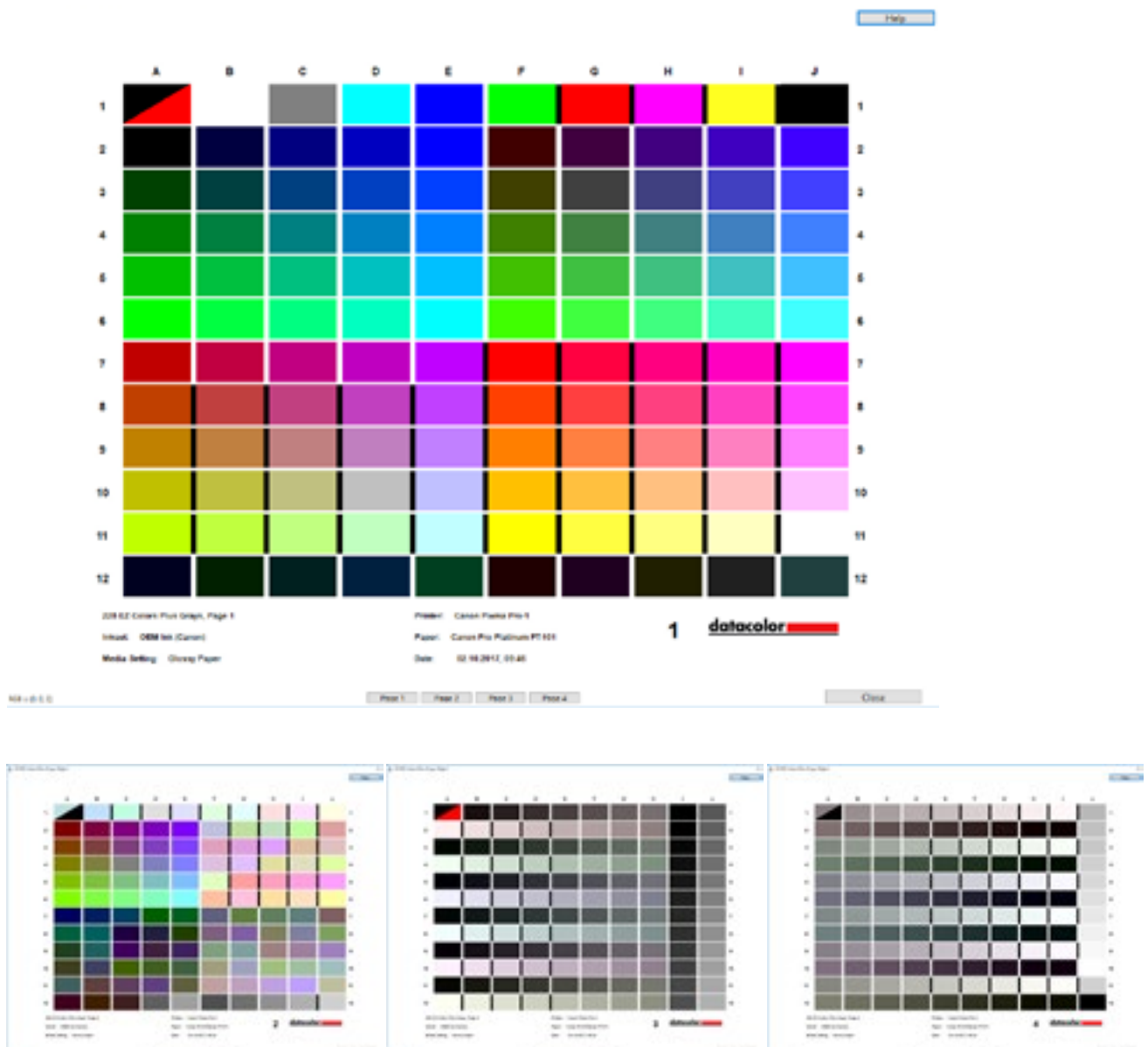


225 target patches will do for most use cases

Preview

Enables a visual check of targets

The preview function on the right side of the dialog box is very useful. You can use it to get an accurate picture of what each target page looks like, at which setting. For example, to get an impression of the measuring ranges of the "extended gray scale", first select "page 3". If you want to view other pages in this mode, you can use the buttons at the bottom of the menu to jump between the pages.



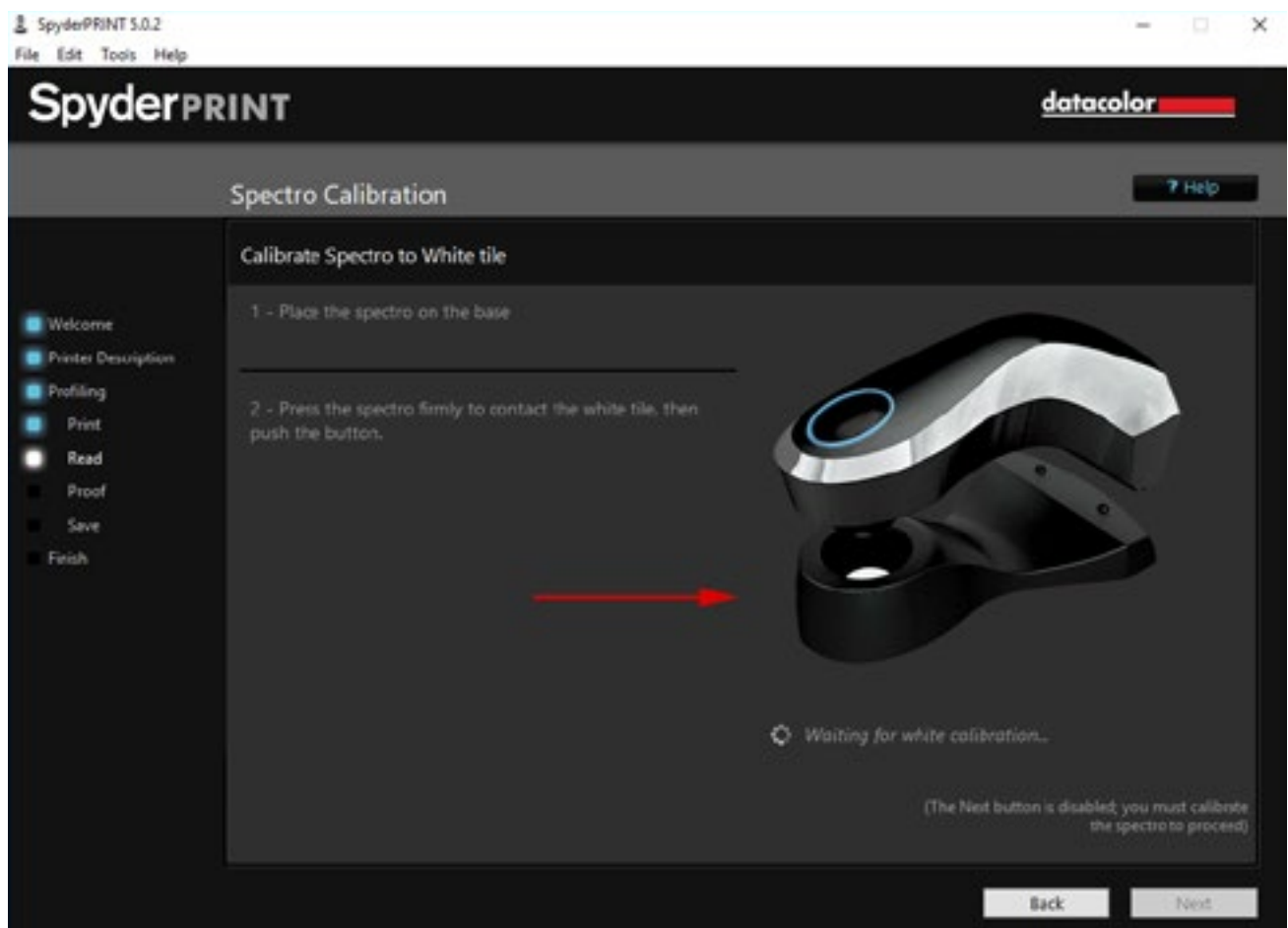
Test charts with 225 target patches

Device calibration

Follow this sequence

You must first calibrate the spectrophotometer before using it:

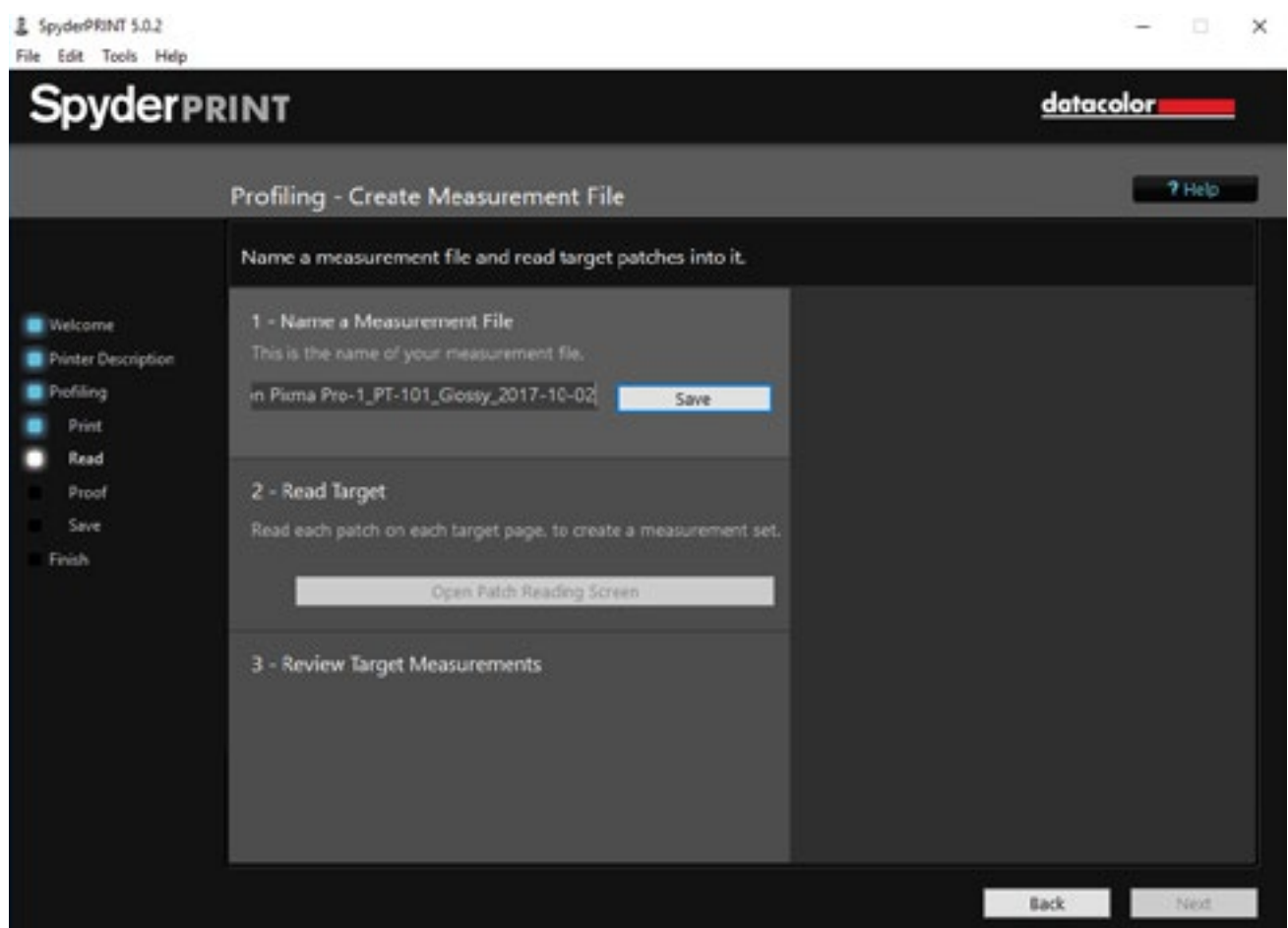
- Position it on the calibration base provided
- Place the probe on the white calibration tile in the station
- Make sure that the rear part of the spectrophotometer rests flat between the plastic knobs for alignment
- Then, briefly press the switch once on the front of the device, while pressing the measuring nose into the opening of the calibration tile
- A “click” sound confirms the completion of successful measurement



The user interface is intuitive and walks you through each step.

Measurement Backup

Before you measure the targets, you should define the name for the measurement file. The file is stored in SpyderPRINT's program directory in the XML format and can be accessed at any time for later profile building or measurement adjustments. In order to back up your measurement files in the long term, you should regularly include this folder in your system backup.



Entering a profile name



INFO

Note: In the application folder of SpyderPRINT only the lists with the measurement results are stored, not the color profiles themselves. However, the profiles can be easily recalculated using the XML measurement files.

All measurements carried out can be selected below the "Select existing measurement files" menu item.

Measuring

How to get a brief tutorial

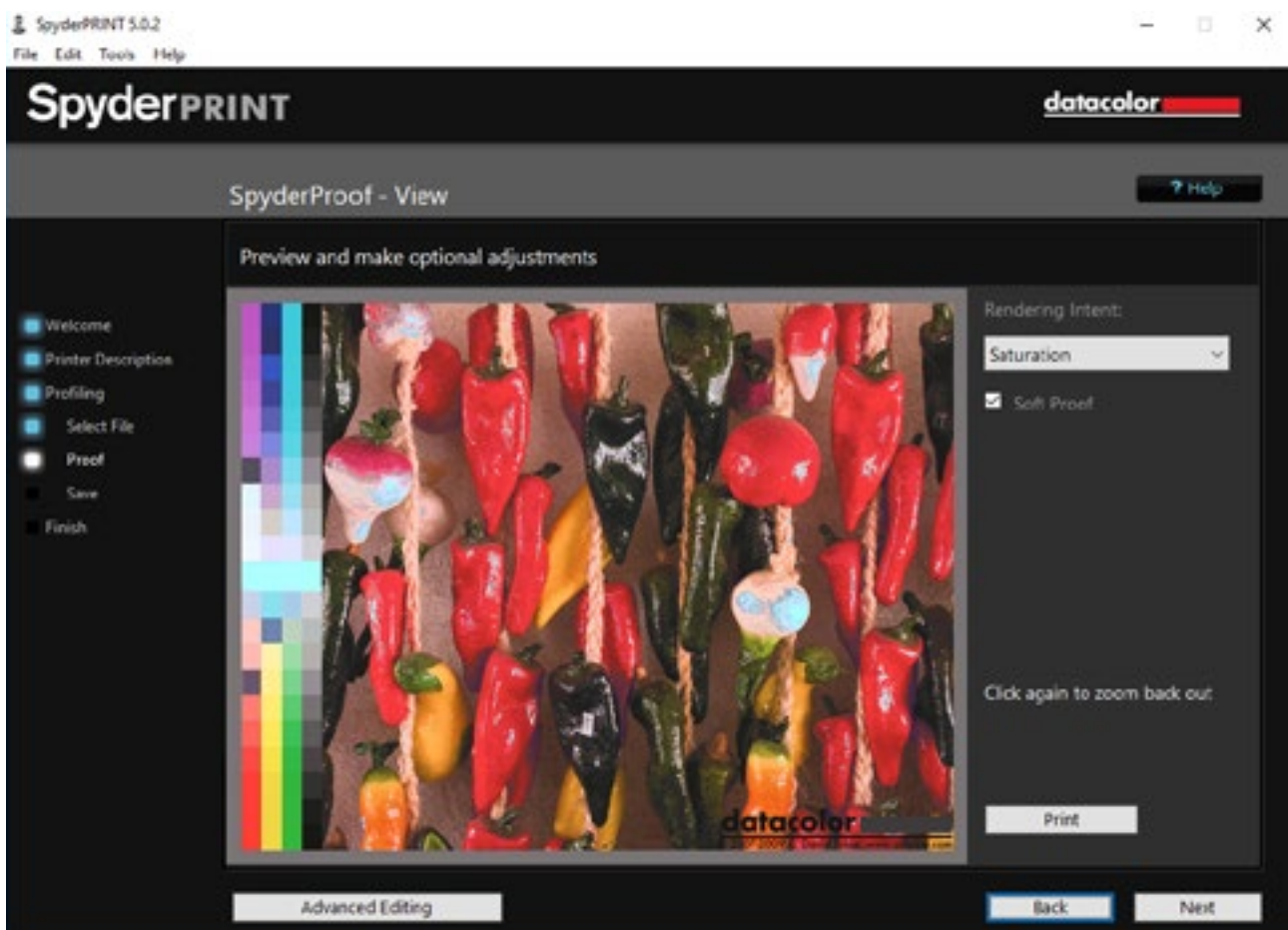
After clicking on the "Open Target Reading Screen" button, a software wizard asks you if you would like to be briefly instructed on strip reading technique. If this is your first time using the device, choose yes and watch the short animated demo. This shows you the technique and speed at which you move the spectro over the target to avoid measuring errors.



SpyderProof

What options do you have?

You have the opportunity to print the SpyderProof test images, which are covered in the "Monitor Calibration" chapter with your newly created printer profile and various rendering intents.



Choose the rendering intent in the pull-down menu to your right

Rendering Intent

Rendering Intents are various ways of fitting the image color into the printer colorspace. The conversion of an image from one color space into another is called gamut mapping. For example, the printing color space tends to be much smaller than the RGB color space of a camera. Since the image was recorded in a large color space and has a range of colors that are not in the color space of the printing system, the goal is to convert the image so the same image in the new color space corresponds as well as possible to the original. For this reason, the ICC has defined four rendering intents for the most commonly used areas of application, which in turn are divided into two application-specific groups.

Division of rendering intents:

Re-purposing (other applications)	Re-targeting (print output/proof)
<p>a. Saturation This intent is ideal for obtaining rich colors in presentations or charts. Datacolor also uses this intent for photographic images when color saturation is important; it maps primary colors directly to their ink tank color, for maximum vibrancy.</p> <p>b. Perceptual A perceptual compression from one color space to another is the goal here. However, due to a weakness in the ICC theory, color must be blindly compressed without knowledge of content or need, so Datacolor avoids perceptual compression, and uses this intent for a blend between Saturation and Colorimetric intents.</p>	<p>c. Absolute Colorimetric This method uses the mathematically closest match, without consideration of what they may look like. It leads to loss of detail in the case of colors outside the target color space, but precisely reproduces the colors that lie within the target color space. This method is usually used for emulating one printer or paper on another, such as press proofs. The white point is not adjusted.</p> <p>d. Relative Colorimetric The conversion here resembles the absolute colorimetric method. The paper white is included in the calculation to make it more flexible. This method can reduce accuracy losses in the conversion from larger to smaller color spaces, and is often set as default in image processing programs.</p>

Which intent is the best?

There is no broad-brush response to this question. However, one can say as a rule that it depends on the color saturation of the initial image.

Relative Colorimetric lets you obtain moderately saturated colors and the pictures remain quite colorful. However, if there are strongly saturated colors, such as a blue sky in the image, the blue can quickly slip to a purple with this intent. In this case, moving to Perceptual should be tested. If colors still lack punch, move to the Saturation Intent.

INFO



Since the Perceptual Intent has flaws in its function, Datacolor has assigned a different calculation method to this intent. The Perceptual intent in the profiles of SpyderPRINT is based on a calculation method that is somewhere between Relative Colorimetric and Saturation.

INTERESTING ONLINE FINDS



You can find more information about rendering intents on Steve's Digicams Website.

[Read Article](#)

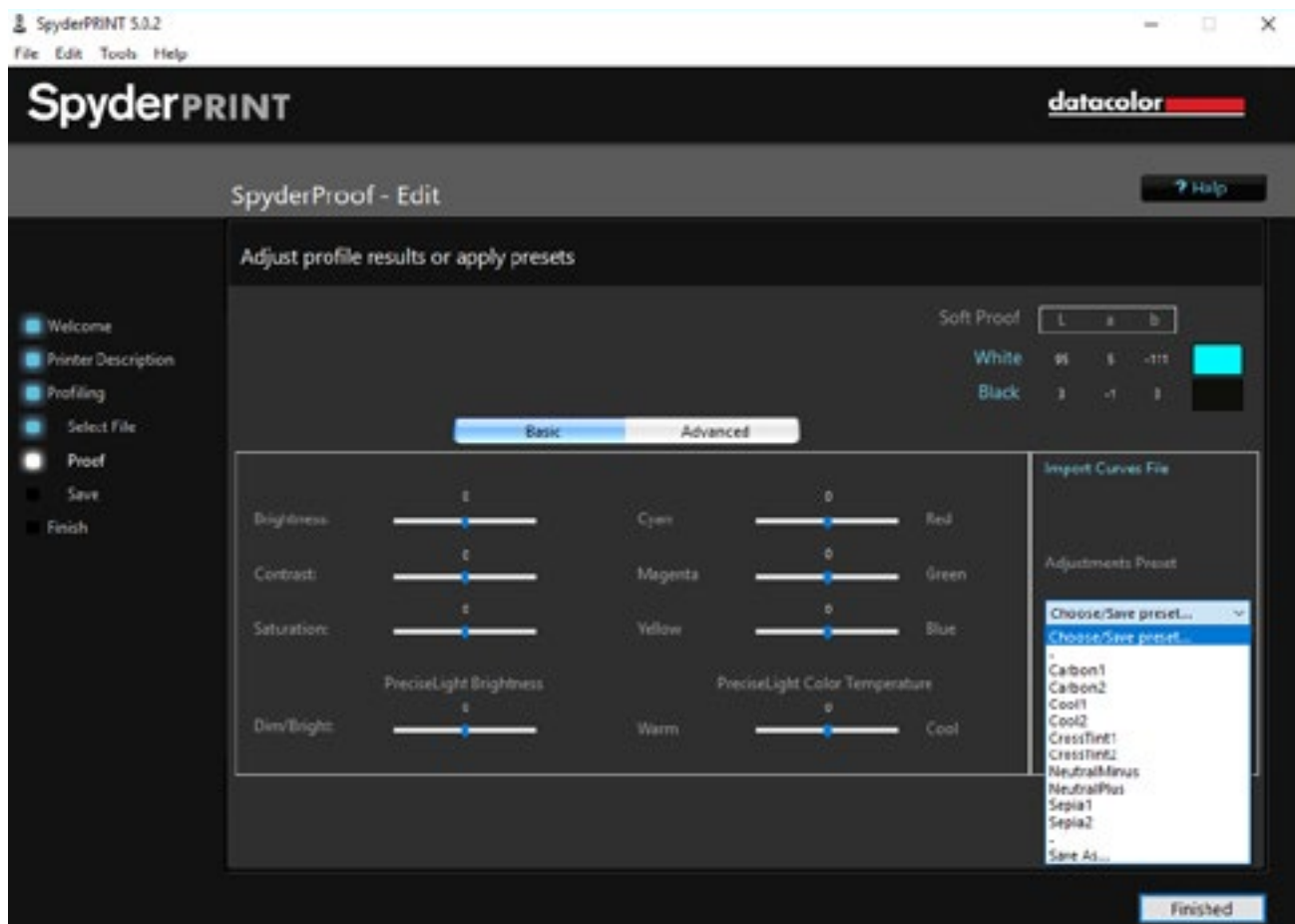
In addition, we would like to refer to Colorwiki for more detailed explanations on the rendering intent.

[Read Article](#)

Profile Setup

How to edit color profiles

You can modify the color profile by clicking the "Advanced Editing" button. On one hand, this is used to adjust images for special viewing environments, such as dark club rooms or cold neon lighting. But you can also make aesthetic adjustments, as the list of presets shows. There are some sepia tones or cross-tone effects. If you are interested in the options, you should click the online help section in the SpyderPRINT software. This provides complete information for each function.



SpyderProof – user interface to fine-tune a color profile



6 Soft Proofing & Media

How to set up your monitor for accurate image proofing

- ✓ How to proof your images on your monitor
- ✓ Printing your photos yourself
- ✓ What you need to know about soft proofing when getting prints from a service provider
- ✓ What you should consider when printing on paper, canvas, and film

Contents

Soft Proofing	6/181
• Color Settings in Photoshop	6/182
• Data Transfer Settings	6/186
• Using the Soft Proof Function	6/192
• Post-Processing in Soft Proof View	6/194
• Gamut Warning	6/195
• Web Proofing	6/197
• Soft Proofing in Adobe Lightroom	6/198

The Quality of User-Printing	6/201
• The Art of Printing Images Yourself	6/203
• RGB Print Output	6/203

Prints From a Service Provider	6/205
---------------------------------------	-------

Paper, Canvas and Film	6/207
• High-Gloss	6/209
• Matte	6/210
• Handmade Paper	6/211
• Fine Art Paper	6/212
• Canvas	6/213
• Film	6/215

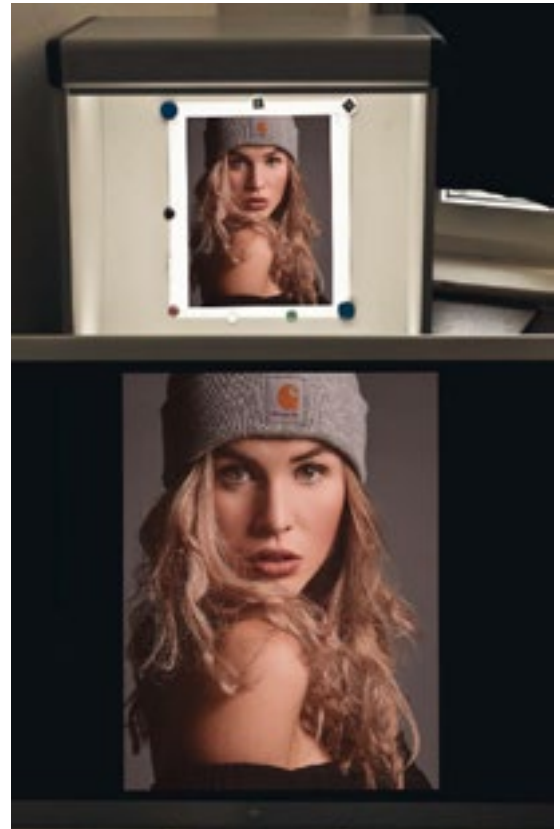
Glossary	217
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Soft Proofing

Pitfalls in the assessment of images on the screen

Assessing images on the monitor appears easy at first glance, but this is not necessarily the case, especially for users with limited experience in image processing, as they're apt to make incorrect assumptions about photos on screen. After all, what appears to be excellent, even on a calibrated monitor, may prove to be disappointing when printed. This happens because:

- Colors may change, to fit the printer's gamut
- Images print darker than they display on screen
- Details that show in shadow areas on the monitor disappear in print
- Odd dither patterns sometimes occur in flat areas
- Image contrast may dissolve into an indeterminate gray
- Colors may lose their luminance and saturation

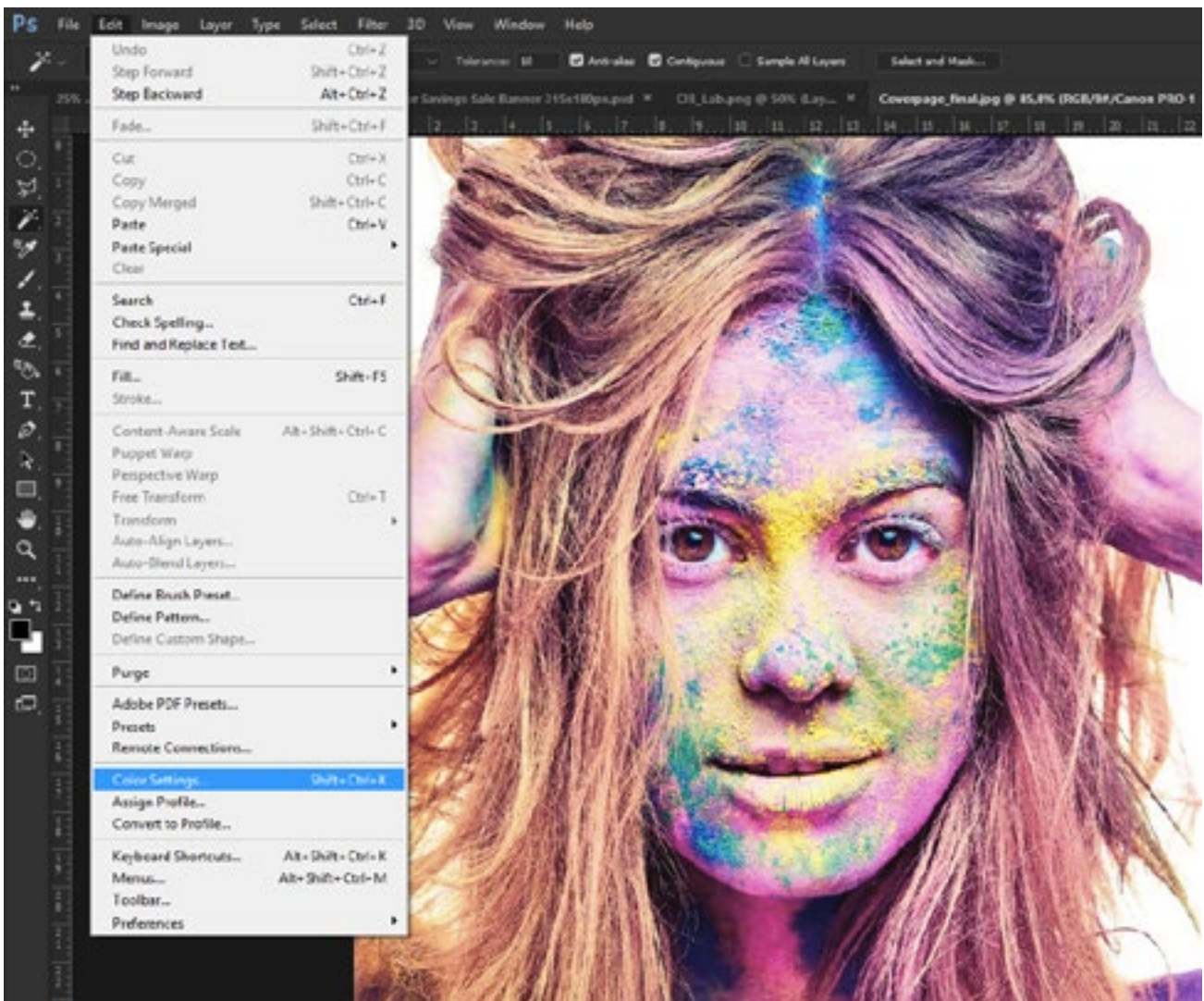


The tool that can help

Technology comes to your aid: with advanced imaging apps, you can not only display the original RGB version of your images, but also simulate a printer, ink, and paper version. In contrast to paper or film press proofs, types of hard proofs, the version on screen is called a soft proof.

Color Settings in Photoshop

Using color spaces



In Photoshop under the “Edit” menu there are color setting options.

Once you have generated a monitor profile, the display is managed through the system’s internal color management, under both Windows and Mac. Select a working color space when converting your RAW files. It is also recommended to select the same color space in the Photoshop color settings to avoid unnecessary warnings.

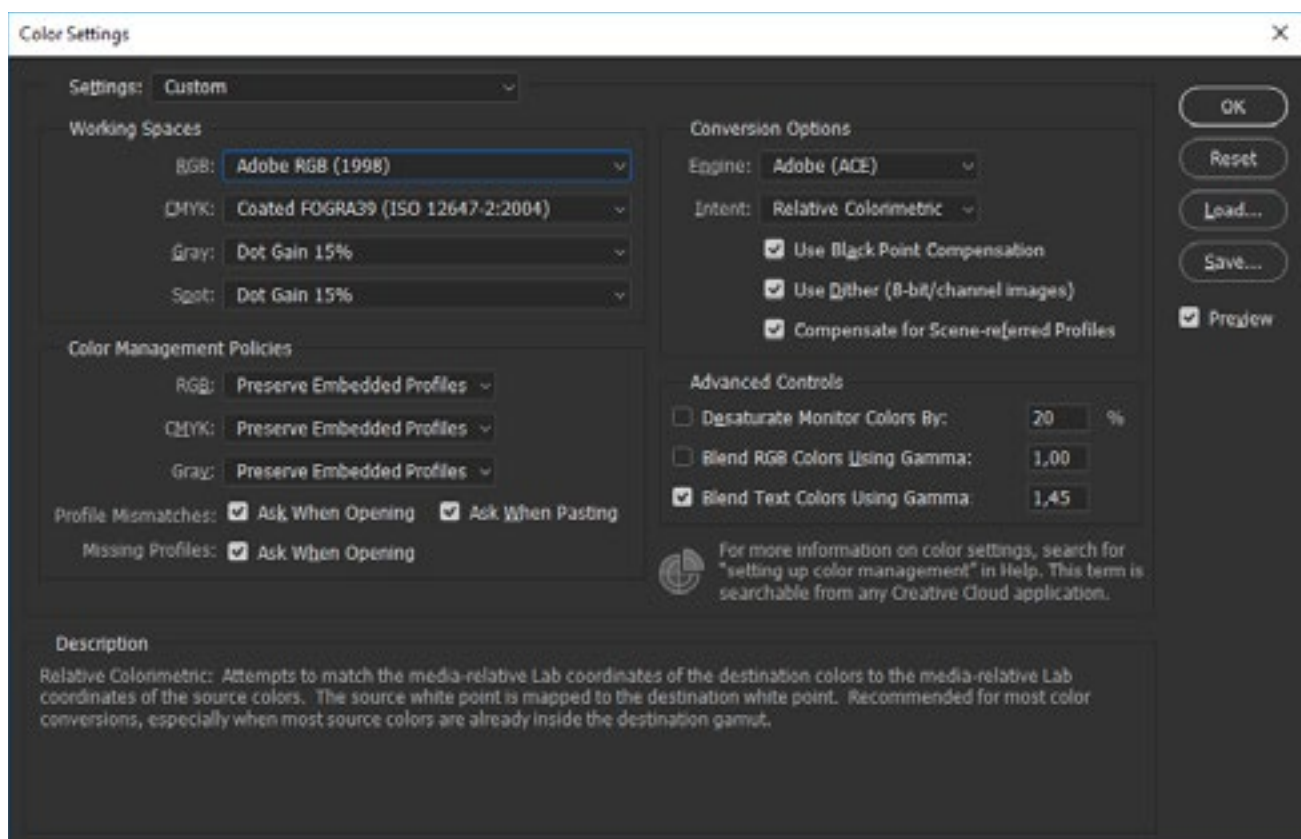


TIP

It is important that you do not randomly convert back and forth between different color spaces, because color data is lost during each conversion, especially when different gammas are involved.

Photoshop's Color Settings menu

Here we go into more detail on the color settings menu. We do not describe all menu items in the user interface, however, there is a brief description at the bottom of the menu window for each item.



The Color Settings options in Photoshop's Edit menu.

Working Space

RGB: Here you set your preferred working space. This should be at least large enough for the type of output you create. Web-only users may select sRGB, but AdobeRGB is more flexible for multiple uses. For high-quality camera models, set AdobeRGB in-camera for JPGs; RAW images will be converted to your working space on import.

CMYK: Here you set the standard color space for a CMYK workflow, if you use one. Ask your print service provider which standard they use. Gray choices can be made for your own grayscale work, or for service provider needs. You can also activate softproof functions for these spaces in the menu bar under “View / Check Color”.

Color Management Policies:

At this point we have defined the color spaces for RGB, CMYK and Gray, and how to handle the color space of an image file when we load it in Photoshop. From here, you have a few further choices.

- Turn off color management: In this case, the image is simply displayed in the color space of the monitor. Be careful, as any attached color profile is removed.
- Preserve embedded profile: You should use this setting to retain full control.
- Convert to RGB working space: Choose this option if you want to include and process image files from sources with a different color space in your workflow. For example, you may want to paste an object from a picture you made with your phone into one of your pictures. In this case, this setting ensures correct color conversion.
- Profile Mismatches & Missing Profiles: definitely check this box, so you will be asked when opening an image file which of the first three options you prefer.

Conversion Options:

- **Engine:** Here you can choose between Adobe Color Engine(ACE) Adobe CMM, or a few other choices. ACE is preferred, as this engine is used in all Adobe programs.
- **Intent:** Please see Chapter 5 for more information on different rendering intents.

INTERESTING ONLINE FINDS

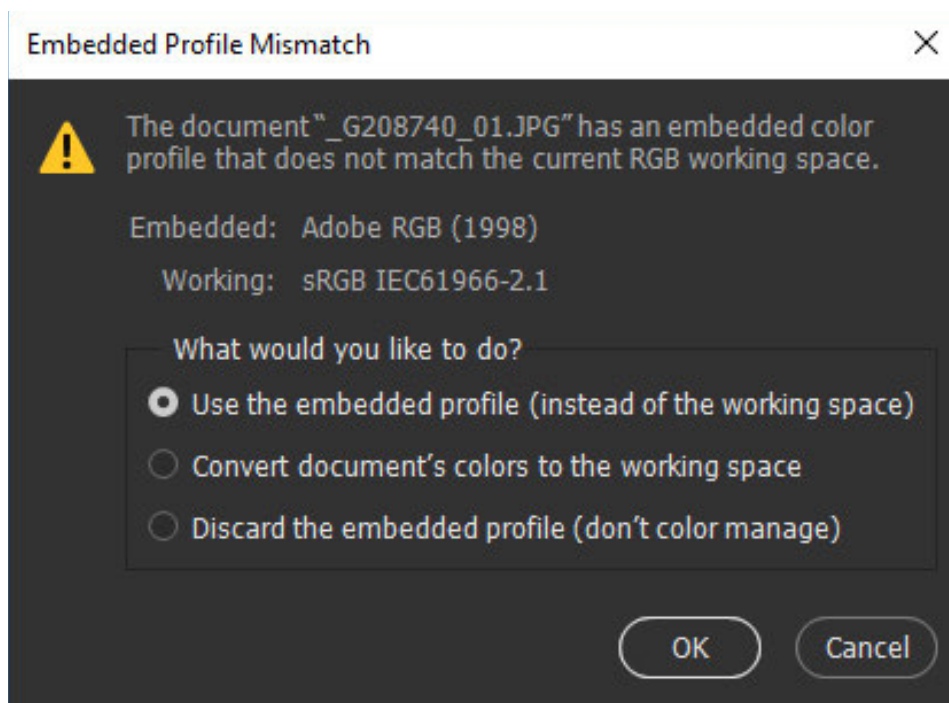
Read this article from Adobe to learn more about color settings.

[Read Article](#)

Conversion Settings

What's best in this case

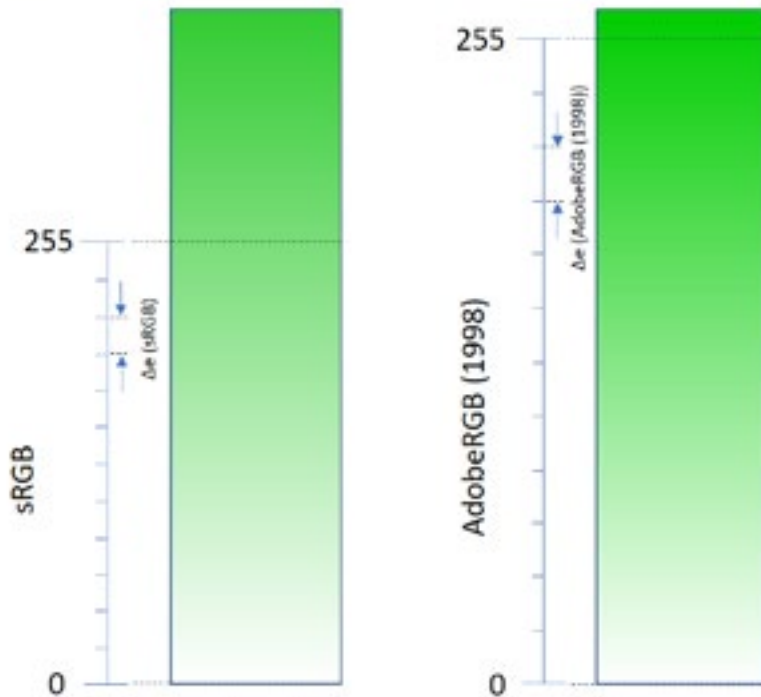
If you have defined your working space, you may open image files that were created in another RGB color space. In these cases, a warning message appears asking you to select a color space. **Typically, maintain the embedded color space of the file.** If necessary, convert to another working space using Photoshop's Convert to Profile function in the Edit menu.



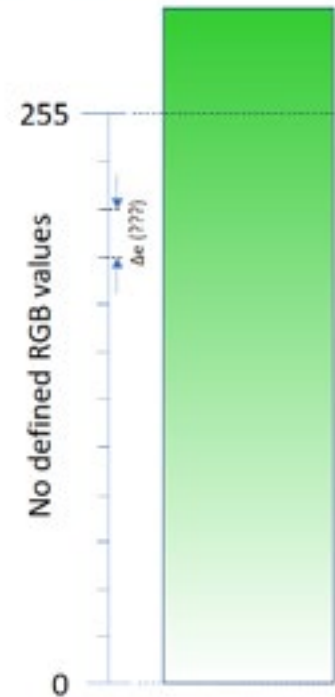
This warning message appears each time you open an image in Photoshop, provided that you have activated this feature in the color settings, and the image has a different color space than the working space.

Typically, keep the embedded color space of the file. If you load an image that does not have a profile, open it without using color management. In this case, Photoshop displays the image in the device color space (meaning the space of your monitor). If necessary, tag a working space using Photoshop's Assign Profile feature. This option can be found in the "Edit" menu.

Standardised color spaces



Device-specific color space

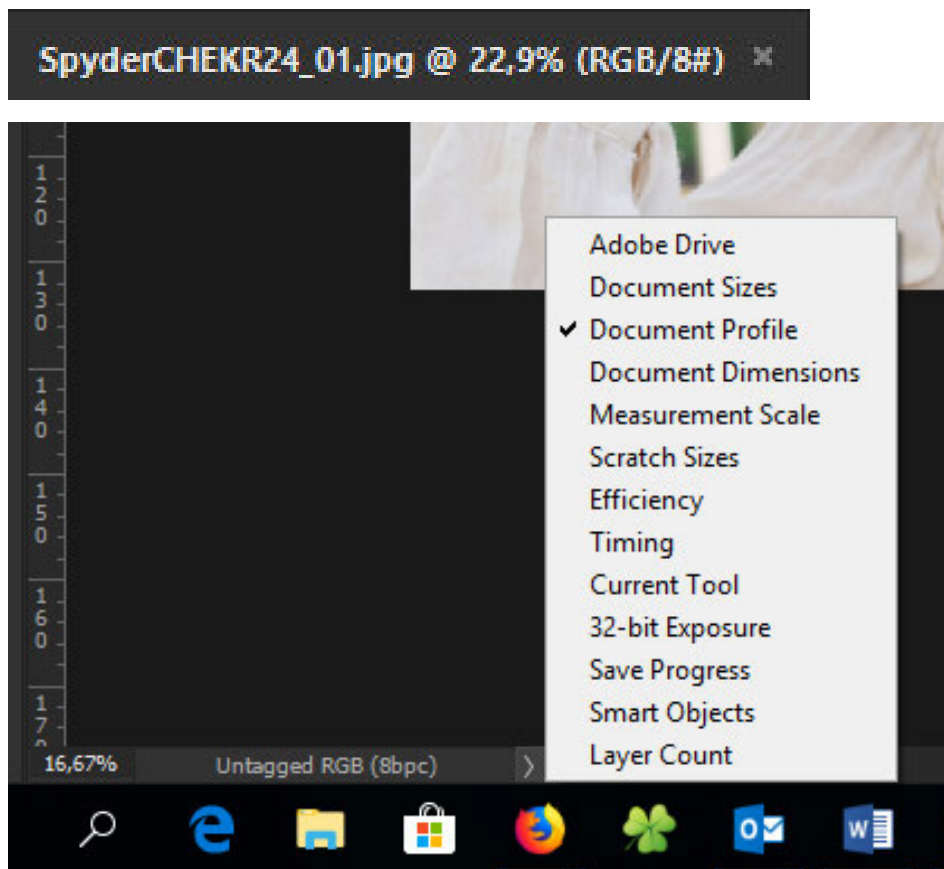


In this graphic, we contrasted the standard color spaces sRGB and AdobeRGB with a device color space. The latter is different from device to device and thus arbitrary. Preparing images for printing in device color is always risky.

TIP

You may have wondered why Photoshop displays a diamond or asterisk in the file name of the open image. For example, "Filename.jpg @ 16.7% (RGB / 8 #)." % Indicates the magnification state, RGB the color model, 8 represents the bit depth, in this case 8 bit/channel and the # indicates that your image does not contain a profile. If an * is displayed, it means that a profile has been assigned.





Additional information that Photoshop displays with an open image. At the bottom left of Photoshop's workspace, more detailed information about the file can be found.

The difference between Convert to Profile and Assign Profile

The difference between the two is best explained as follows:

Convert to Profile: 16 km > 10 miles (the numeric value is converted according to the unit). Applied to color, this means that the visual color is maintained as much as possible, by converting the RGB values. Used for color accurate conversions.

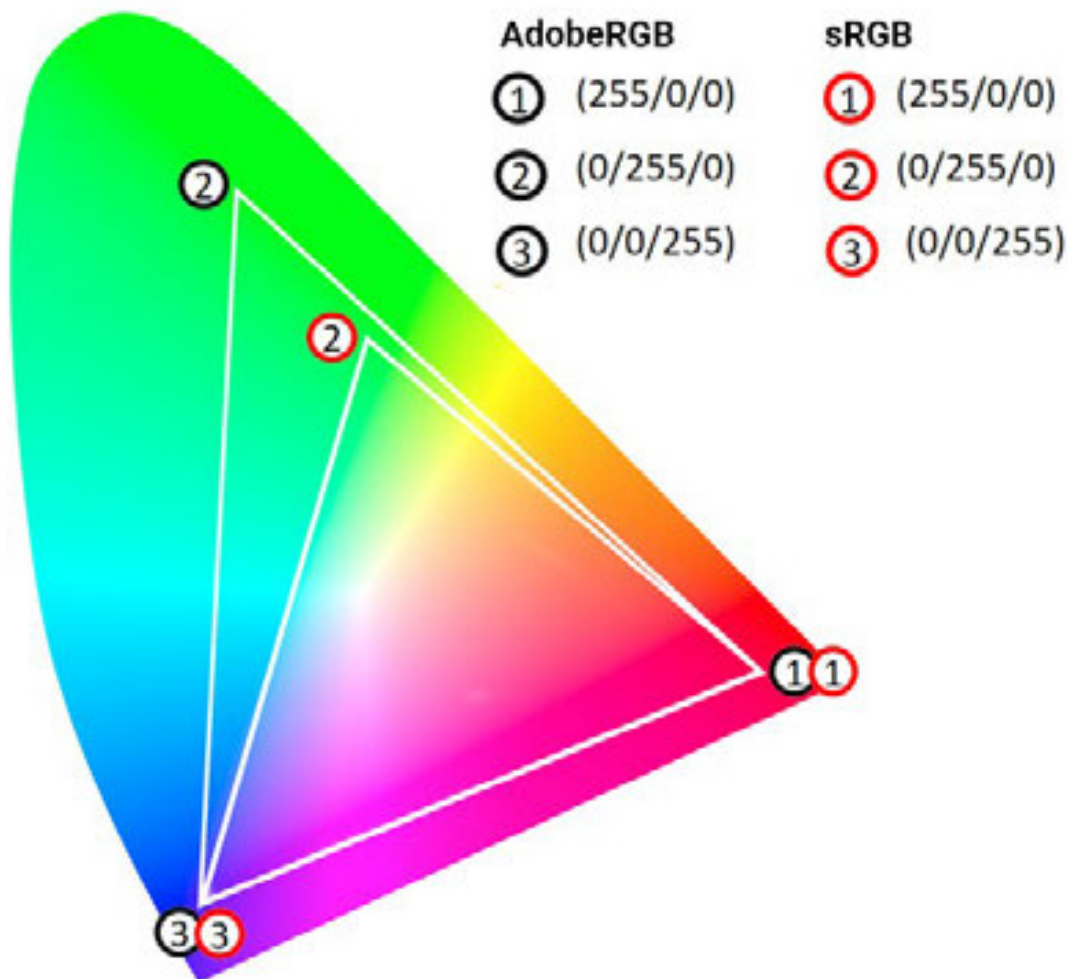
Assign profile: 16 km > 16 miles (the assigned unit is changed but the numeric value is not adjusted). Applied to color, this means that the RGB values are maintained, but the visual color changes. Used when the existing color profile tag is incorrect, or to maintain smooth graphic gradients, at the cost of exact color.



INFO

For the colors, visually, to remain the same, use the Convert to Profile option.

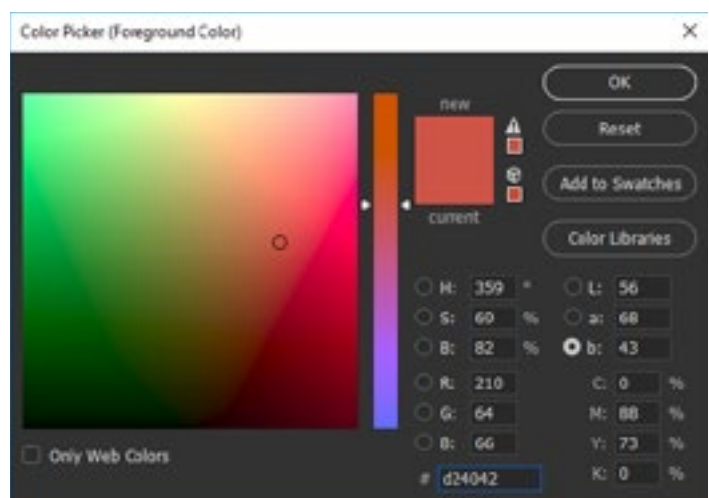
Reference colors in AdobeRGB and sRGB
(Red/Green/Blue)



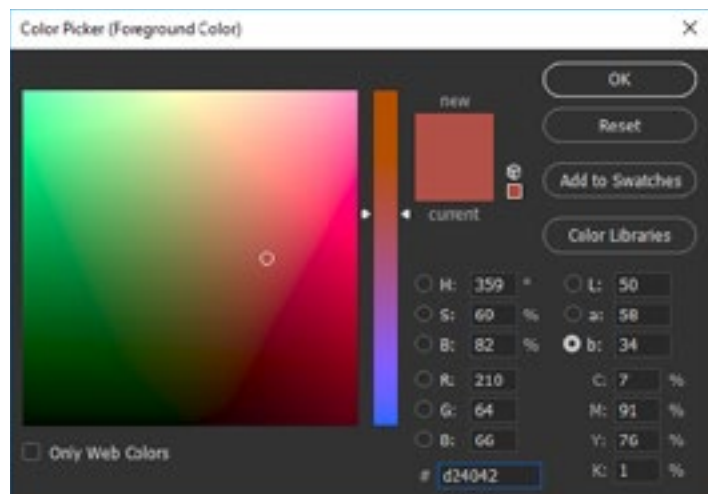
CIE-Lab color model and the positioning of the sRGB and AdobeRGB color space.

Admittedly, it is difficult to understand **Convert to Profile** and **Assign Profile** at first glance. At this point, a graphic that shows the color space sRGB and AdobeRGB in the CIE-Lab horseshoe and whose primary colors are assigned the device RGB values should help. Both color spaces can be selected in Photoshop and if you have a Wide Gamut monitor, the latter can also be displayed.

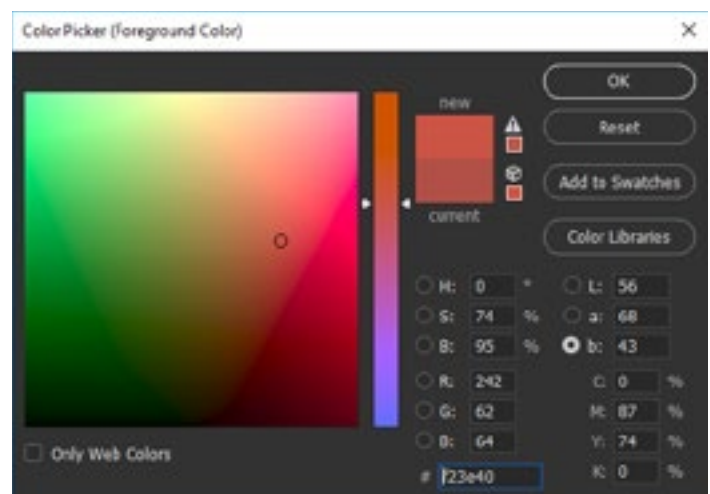
Take for example, the primary color green with the RGB values (0/255/0). It is obvious that the green in the AdobeRGB color space is a different green than in the sRGB color space, even though in both cases the RGB values are the same. For the “transform profiles” and “assign profiles” options there are two scenarios. Either the color remains visually the same, but then the RGB value adapts to the color space, or the RGB value remains the same, but then the color changes visually due to the changed color locations in the CIE-Lab color model.



The original image was shot in AdobeRGB. The color values refer to the color field F4 of the SpyderCHECKR.



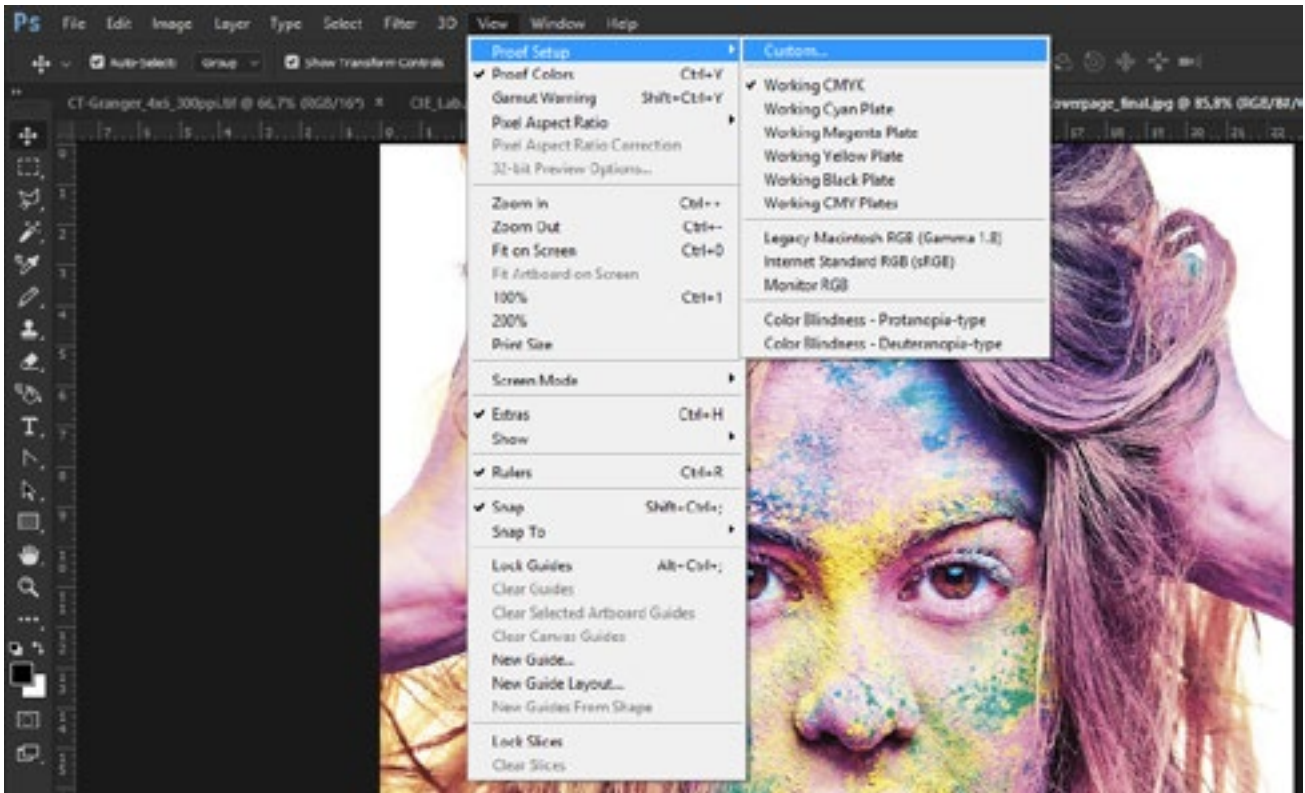
After the image was transferred to the sRGB color space using Assign Profile, the Lab values changed and the RGB values remained the same: same numbers, different colors.



Here the command Convert to Profile was used, to change the AdobeRGB image to sRGB and the colors was retained; the CIE-Lab values remained the same while the RGB values changed.

Using the Soft Proofing Function

The soft proof feature simulates your print taking into account the unique characteristics of the printer, inks, and the paper used.



You can access the Proof Colors function via the View menu. There you can select the output profile for your soft proof.

Making soft proofing simple

Use the Custom command under Proof Setup in the View menu, to define the printer profile for your print output.

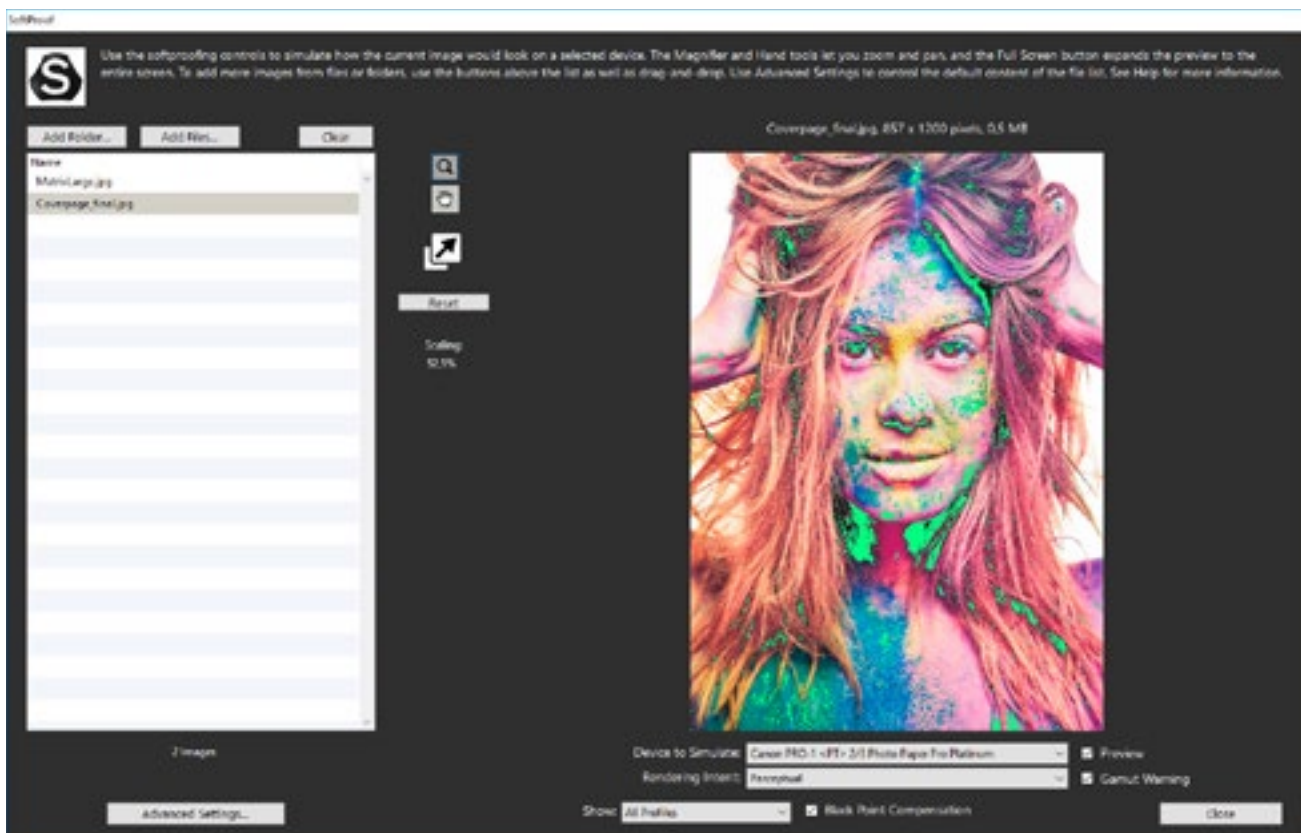
Make sure that the Color Range Warning is enabled, so you can see which colors will change most. This function is particularly helpful for editors with less experience.

Finally, you must develop a feeling for which colors can be printed without losses. If you want the soft proof on screen and the final print to be as closely matched as possible, select Simulate Paper Color and get an Absolute Colorimetric print preview. Not only is the paper color simulated here, but also the contrast range is reduced to such an extent that it looks very close to the color contrast on a paper; which can be discouraging, but also useful.

Include service providers' profiles

We recommend SpyderX ELITE, which offers a very easy-to-printer soft proofing simulation. If you would like to assess the printing colors of a service provider before sending out for prints, download the corresponding profiles from their website. There should be profiles available for each paper type offered. With a size of approximately 1 MB, the ICC / ICM files can be quickly downloaded. For them to be used for printer color simulation, they must be installed in the correct system folder. The SpyderX ELITE software makes this process particularly easy.

Just click on Install Profiles and select the downloaded profile files in the opened file browser. After clicking on Next, the external printer profile is already integrated and can now be used in the Soft Proofing function. To view your own images via the print preview, simply drag and drop the image file into the left-hand image list. Here the Color Range warning is selectable and a subfolder can also be selected in Advanced Settings.



Soft Proofing with the Datacolor SpyderX ELITE + software

Postprocessing in profiled view

The options you have

Since you can also edit images in this print preview, the effects of color or filter corrections can be assessed in a final way. This allows you to:

- Fine-tune an image copy (never the original) specifically for a specific print media
- Saturate or desaturate critical colors before printing
- Intervene in the event of unexpected color or contrast shifts

EXPERT KNOWLEDGE

In contrast to editing after a CMYK conversion, all filters and dialogues that only work in RGB, such as Same Color, are available here.



Gamut Warning

What this notice means

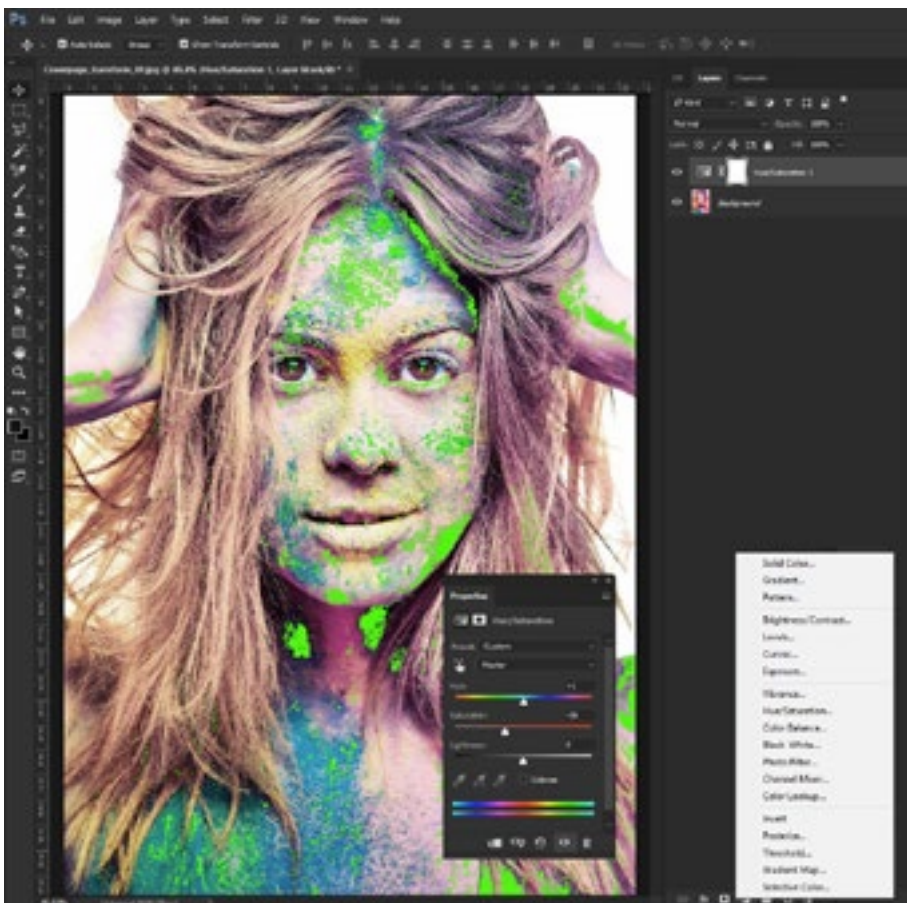
In the case of minor changes, the Gamut Warning function from the View menu shows the problem areas that arise when converting to the printer color space. In this case, an indicator color overlays all areas of the file that cannot be printed as intended. You can define this indicator color in Photoshop's settings under Transparency and Gamut Warning. In the SpyderX ELITE software, this is done under Advanced Settings.



We compared the original image with two soft proof images and their gamut warnings. FOGRA39 (ISO 12647-2: 2004), a widely used standard in offset printing is used. The second profile belongs to the Canon Pixma Pro1 on Pro Platinum paper. It is a 12-color photo printer. Clearly, the Canon printer can display more of the original colors from the AdobeRGB color space.

How to transfer unprintable colors into the output color space

The moment you activate the gamut alert and see some areas that cannot be printed, you immediately ask yourself what to do with the unprintable colors? In principle, it is quite simple, but it certainly requires some practice and experience. If you use the tools for image optimization such as saturation, exposure, hue, etc, you can immediately see how the areas highlighted in color by the Gamut Alert change. It is not necessary to banish the targeted colors completely from your picture; they should no longer be totally flat, even if some small details still exceed the printer gamut.



After eliminating the target areas as much as possible through the image enhancement tools (here: Hue, Saturation, Brightness), it is best to save the image under a unique name; perhaps indicating the printer and paper it is adjusted for.



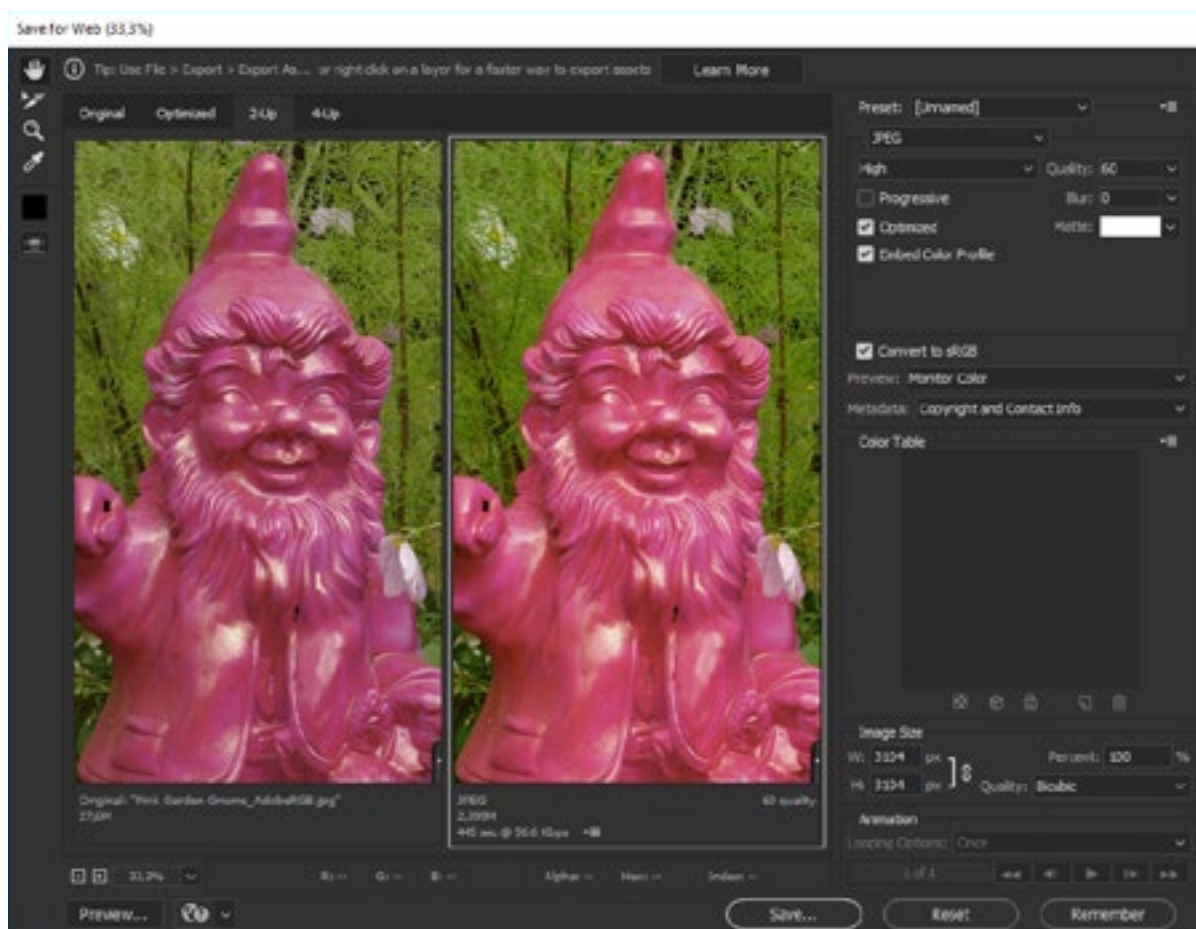
TIP

For image enhancement in Adobe Photoshop, use smart objects. These can be found in an array of small icons in the lower right area of the desktop. The benefit is that you can make changes to the image without changing the source file data. On the other hand, if you edit your image using the tools that you access via the "Image / Adjustments" menu bar, this is destructive and irreversible; so a new copy must be saved.

Web-Proofing

What you should observe

The colors of your images can look very different online. This depends on the operating system and monitor you are using. The three preview variants are shown in "View> Proof Setup> Macintosh RGB, Windows RGB, Monitor RGB." For use on the Internet, you should always work in the sRGB color space and, if necessary, convert the images from the original color space to sRGB. In the Save for Web dialogue of the Photoshop Export options, you will find a Convert to sRGB option which you can use. In the same window, please also enable the option Embed Color Profile, such that the JPG file saved contains the information that the color values are in sRGB. For correct color prediction, you must switch to Internet Standard RGB in the preview. Because only then do you get a realistic impression of how others view the images.

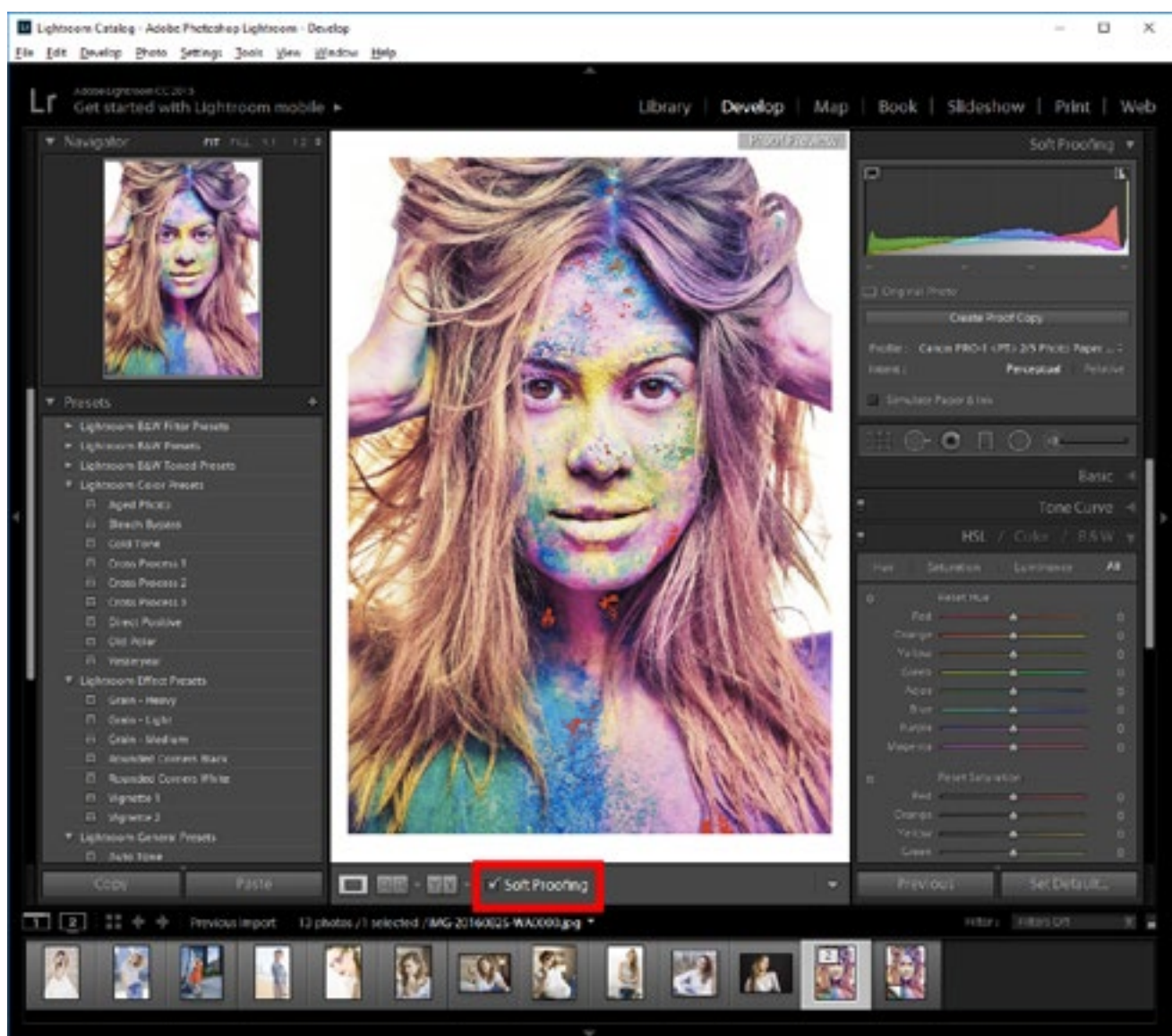


You can clearly see the different pink tones in the original and in the image converted to the sRGB color space.

Soft Proofing in Lightroom

Setting up soft proofing

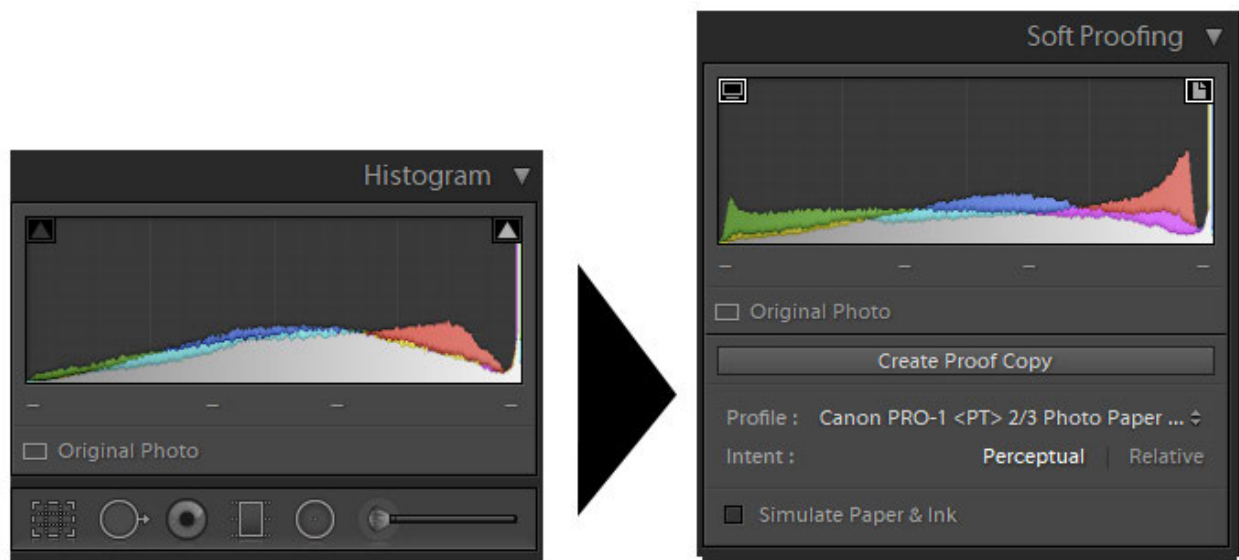
Starting from Version 4, Lightroom has a very good soft proofing function. You activate this by clicking the Softproofing checkbox in the Develop Module at the bottom of the work window. You can now display the preview based on profiles and choose between two rendering intents. This is how you enable the monitor proofing view:



The checkbox of the softproof function is outlined in red in the picture.

- Select the Develop module. Click on the checkbox which is located at the bottom of the Develop screen
- Then, the Histogram section is changed to Soft Proof
- Now, you can assign a profile, select the rendering intent, and enable the simulation of paper and ink

The changes have a direct effect on the display of the image in the preview window, which is now marked "Proof Preview."



After activating the checkbox "Softproofing" the histogram of the output format will be displayed. In this setting, you can select the desired output settings.

TIP

If you make changes to the image in the proof preview, you can save this image variation as a virtual copy.



Gamut warning options

To check whether the colors in the image are changed during screen or print preview, activate the two warnings for the target color range and monitor color range by clicking on the icons in the histogram, or from the View menu under Soft Proofing.



The buttons to activate the gamut warnings are very inconspicuous, but important.



INTERESTING ONLINE FINDS

Check out this tutorial on soft proofing with Lightroom Softproofing.

[Read Article](#)



The Art of User-Printing

What you should know



For a long time, inkjet printers were barely able to print photos of the same quality as those from a photo lab. The quality of user-printed photos became acceptable only with the advent of six to twelve color printers. Now there are an increasing number of papers that can absorb all that ink with baryta prints, the benchmark used in the analog lab.



The Canon Pixma-Pro-1 is a 12-color fine art inkjet printer. It is representative of this device class. Inkjet printers with 12 inks can print colors far beyond the traditional CMYK offset printing gamut, so are excellent for fine art printing.

This output technology is equally interesting for both advanced amateurs and professionals. Hobby photographers spare themselves hours in the darkroom, and achieve their goal faster and more reproducibly, due to digital image processing. Professional photographers need less space because the darkroom is replaced by a desk. Here, they can implement corrections or editing requests from customers – even in front of them. Digital saves a lot of time, as well, thanks to the direct processes, which do not require any development or drying.

INFO



Unfortunately, what can be captured by the camera and displayed on the monitor cannot be physically transferred to the print. Such restrictions are not new to photographers; even with negatives, only half the captured image information ended up on the paper. In contrast to the digital process, it was much more difficult, even for experienced photographers, to predict accurately which colors and which details would make it to paper and which would not.

The Technique of Printing Your Own

How to get high quality images

If you follow the steps below while working on a computer, you will be able to achieve results with inexpensive photo printers, which would previously have only been possible for an expert photo specialist:

- Create your **profile** carefully
- Do not scrimp on **paper quality**
- Correct images in **soft proof mode**
- Compensate for **sharpness losses** when printing, using your experience or a specialty tool

However, for the perfect print, some settings details explained on the following pages must also be considered.

RGB Print Output

What to look out for

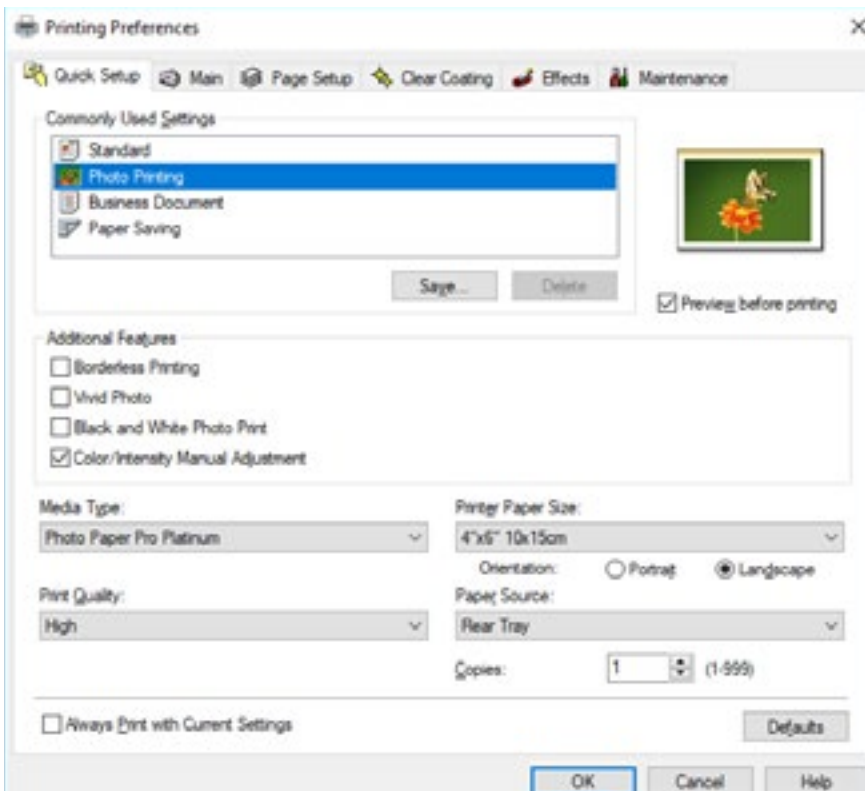
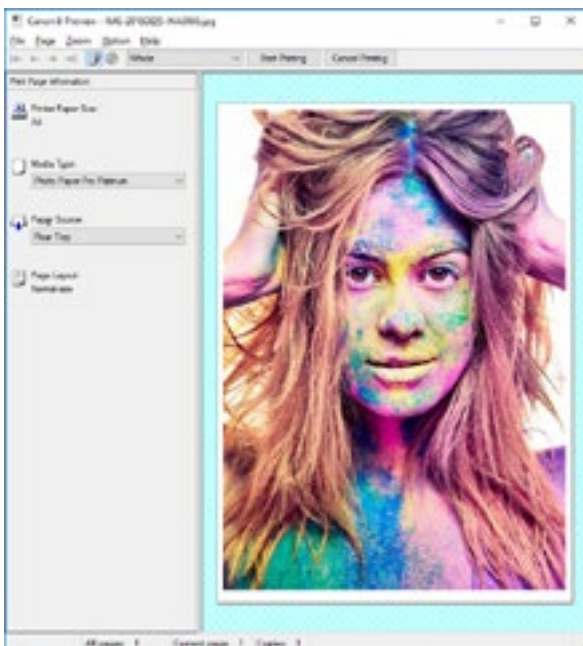
If you are printing your images on a photo printer, the photos must be sent to the printer in RGB. This is not a printing space, but a color mode, that meets the needs of RGB printers to correctly process to the ink colors. The final ink channels separation is carried out by the printer driver. All you have to do is specify the settings in the Photoshop Print dialogue, and make sure that the following is set in the options:

- Color handling – colors managed by Photoshop
- Printer profile – the generic profile for your paper, or, better, your user-created profile
- The same for rendering intent that you selected under Soft Proofing



TIP

Note that the printer driver default setting is used to disable its own color adjustments.



This image shows Print Preview in the printer driver, as well as the disabled color adjustment in the advanced setting of the printer driver.

Service Provider Prints

Save money and avoid disappointment

Nowadays, print service providers offer a variety of products that one could not have imagined 10 years ago, and were formerly reserved for professionals. They were known, if at all, only from galleries. The range includes high-quality photo books, photo prints on clear acrylic, aluminum dibond or canvas, and other options. The number of formats has also become confusing and even includes large panorama formats. This wide range photographic products also show photography's popularity, that it is no longer just a means of capturing memories. Many people now use photography as an expression of their individuality, and they hang up personal, detailed, elaborate images of gallery quality on their own walls.

As beautiful as these products are, there is a high risk that the colors and details that have been developed through painstaking work will not be reflected in the final images as desired. Not to mention the money invested, which can quickly run into hundreds of dollars.



INTERESTING ONLINE FINDS

This guide from Breathing Color lays out how to choose the right paper for printing – what papers work best for certain images, what papers are top quality, and more.

[Read Article](#)

Color management and print service providers

Premium print service providers understand that there is no way for them to be competitive without color management. Complaints arise when an expensive image does not live up to expectations. Quality service providers now offer ICC profiles to download for your use, so you can soft proof on your own screen. This is a step in the right direction.

Three issues can still lead to dissatisfaction:

- The higher the quality of the ordered image, the greater the likelihood that the image has been digitally reworked. If this happens on an uncalibrated monitor, the colors are assessed and processed blindly. It is not clear which colors resulted. It is like wearing tinted sunglasses to assess your images. Soft proofing on the unmanged monitor, using the ICC printer profiles of the service provider, offers only half the solution .
- The customer may not bother to softproof with the ICC profiles of the service provider, despite having calibrated monitor; perhaps assuming that calibrating the monitor is all that's needed.
- The printed image is too dark and the shadows are clogged. Most users are unaware that a monitor has a contrast range as much at ten times are large as a print. Because of this, if the brightness of the monitor has not been reduced to a level relative to the printer, screen details which cannot be reproduced in print will be lost. Monitor calibration with ambient light analysis by tools like SpyderX PRO or SpyderX ELITE is needed.



INTERESTING ONLINE FINDS

A survey conducted together with the Systemkamera-Forum, the Leica Forum and the Fujifilm Forum revealed the following:

61% of the 750 participants had already used a print service. Of these, 57% had already ordered a photo book and 41% ordered larger formats on aluminum dibond or similar material.

However, it was interesting to note that 23% had problems with color and 17% complained about clogged shadows.

The complete report can be viewed here:

[Read Article](#)

Paper, Canvas and Film



© Fujifilm

How different print media affect photo printing

At one time, photo orders were like take-out food orders: “Please print 18 copies of number 13.” The only query was: “Glossy or matte?” Even today, most photographers opt for glossy. Why? Because they have little or no experience at all with matte media. Their reasoning is that the colors should be as brilliant as possible in the image; that the additional brilliance of gloss can’t hurt. If you follow this logic, you will get good, but not always optimal, prints. What is often overlooked is that sunny images must shine, but the surface gloss does not always emphasize the intent of the image content. Prints of a rough landscape look more impressive when presented on textured materials, such as canvas or watercolor paper. The choice of the print media is about print size and image content – at least for those who understand the nuances and use them to create more powerful prints.



EXAMPLE

Fine art prints seldom involve glossy paper surfaces. The artist wants to produce as much detail as possible. The shiny surface is not optimal for this, since it acts as a subtle contrast enhancement. Fine art printing is based on matte media, but there are many different products with subtle variations that are hard to distinguish at first glance.

What papers should you use for photo printing?

In the past, the home printer in their darkroom would have to choose between only glossy, satin, or matte, when creating chemical photo prints. One additional option was baryta paper, which is complicated to process and has to be heated in a dry press in order to produce its surface. All other materials, such as canvas, rice paper or watercolor paper were only available to insiders and specialized laboratories because of the high costs.

Today, owners of inkjet printers can print photos on any flat surface. Dedicated inkjet papers are recommended for most uses. But even here, the selection is larger than ever before. Apart from the classic glossy and matte style papers, there are also other choices, including canvas, felted and film. These are available in several different options, and weights.

Materials your own printer can use depend on:

- Whether the inks are compatible with the coating
- Whether the printer can handle very heavy or very light papers



INFO

Which papers you choose depends on image content and are a matter of experience. The more exposure you have, the more confident you will be in your choice of materials.

High-Gloss



What you should consider with glossy inkjet papers

Glossy papers are available in several gradations between high-gloss and silky. The high-gloss type is the most common for photo printing. The prints are very close to the appearance and texture of conventional photo prints.

Glossy papers allow the deepest blacks, highly saturated colors, maximum ink coverage, and a high maximum density. This produces crisp contrast. Unfortunately, these papers are very sensitive to fingerprints with their lacquer-like surface. For this reason, you should only touch them with gloves or have a non-printed border on the paper during photo printing. A glossy surface hinders the applied ink from entering the paper quickly. This means high-quality glossies can take longer to print (as the printer builds in drying time) and to cure after printing before stacking. While some papers are less problematic, others still require the slower unidirectional printing mode, in which printing is carried out only in one direction of the print head. This function must be selected in the driver interface, and profiles should be built specifically for this mode.

TIP

Glossy papers usually involve a coated polyester carrier layer. When hanging gloss images consider how their reflections of lights and windows in the shiny surface may impact viewability.



Matte



Matte photo paper offers you a range of possibilities

Matte papers appear much more reserved than high-gloss and thus give a more elegant impression. These surfaces can depict very delicate details. Because of their large printable color space and the excellent light and detail characteristics, matte media count among the

favorite papers of many top photographers. They allow images shot at high ISO settings, to display sensor noise much like analog film grain, which can be very satisfying.

However, surfaces tend to be sensitive to moisture, which limits their durability. You should fix the prints manually with spray, if the printer does not do this automatically. Matte papers are available in matte, semi-matte, satin and pearl designs. The last three categories are moving toward glossy, though pearl extends the dull surface effect with a haptic structure.

Due to their ink absorption potential, matte papers allow ink to dry faster. If such prints are hung up to the wall, light reflections are not an issue, since the dull surface has a reflection-reducing effect. Fingerprints are not problematic with matte papers, which unlike their glossy counterparts, do not have a coated polyester carrier.

INFO



Matte papers require a special black for high-quality prints. Some printers require switching the matte and gloss black inks, others keep both inks ready at the same time.

Handmade Paper



What you should consider when working with handmade paper

Most people do not know that handmade paper can be used as photo paper. It is matte and often has a slightly structured surface. Originally, the term "handmade paper" was understood as consisting exclusively of paper that was made by a manual pulp process. Now, it can

be produced using machines, which has made it more affordable. Due to the structure of the handmade paper, photo prints are given a particular feel and color aesthetic. Handmade paper is usually made from wood pulp, and is acid-balanced through buffering. It's ideal for artistic work. Rag paper consists of 100% of cotton, usually recycled, and requires no buffering. While rag paper is the finest and most expensive paper type, its share of total paper production is only about 2%.

Since handmade paper is available with various surface textures, this leads to uncertainty among some photographers: It is not easy to find out which surface works best for each print. If you are uncertain here, you should concentrate less on the textures of the varieties. Only a few photo styles benefit from a heavy paper texture. The interplay of colors usually determines the image impression and the subtleties brought to paper.

Fine Art Paper



What this type of paper is suited for

If you do not like typical glossy prints and prefer matte paper qualities, the world of fine art papers might be of interest. These are often heavy papers, the surface of which may have a more natural tone without artificial brighteners. Often very expensive, such papers usually have a fine, soft texture as well as a special touch. They can depict the finest details and are ideal for printing black-and-white as well as color photographs, and are used for art reproductions with high image depth.

For art photographers, it is an absolute must to print their work on materials that meet the highest standards. In recent years, there has been an almost unmanageable variety of papers in the high-profile segment that are presented as fine art papers. The best of them make a print from an original, that you would not only like to view behind glass, but also one that has tactile qualities. However, central to a fine art paper is print-life. Many years of color stability should be possible. Current inks do not all manage this, even if they promise a durability of at least several years.

Canvas

What you should know about canvas during photo printing



In the history of photography, there have been many attempts to establish textiles as photo media. But these fabrics only reached a significant market with the development of inkjet technology.

Genuine canvas is made of cotton without polyester content. There are two weave types:

- The typical **Linen** weave uses warp threads and weft threads interwoven with each other.
- **Twill** weave uses weft threads alternating over two or more warp threads, creating a herringbone pattern.

MORE INFO



Polyester-blend canvas is more affordable and available than cotton canvas. It has varying cotton/poly blends in typical weights of 10 to 12 ounces.

Canvas is usually matte, but glossy fabric coatings are also produced. However: inkjet printed canvas must not be heavily stretched, as it is when creating painting canvasses, or the inkjet coating will crack. Photo canvasses are very lightly stretched onto their backing. Canvasses are not protected by glass, so an additional protective spray or brush-on coating is important for protecting the ink.

EXPERT INSIGHT



Inkjet canvas is often used for oil or acrylic painting reproductions. There are processes in which special scanners with a custom artwork lighting unit produce digital scans of artwork. The results are then output on canvas and produce a very good imitation of the original work. Inkjet-coated watercolor paper is similarly used in reproduction of paper paintings.

Films

Film options for inkjet



Backlit films are a very common type. These polyester films can also be printed with inkjets. They receive their color saturation only through their translucency. Without a backlight, their look dull and unsaturated. Films can compete with paper for detail and dynamic range. Color saturation of films often exceeds that of paper. Consequently, backlit films are finding more and more followers in commercial POS, but also private, uses. Color accuracy in backlit films is problematic. A color shift occurs in the magenta and black layers due to the different thickness of the inks. You should therefore work with the special ICC profiles, which are designed for the material. Backlit film is usually printed on the back surface. This allows scratch-resistant fronts suitable for outdoor as well as indoor use. Indoor versions last about a year before excessive fading. Outdoor films utilize different solvents and curing systems for up to three years of life, but tend to have a lower scratch resistance.

There are also interesting **special forms of backlit film**:

- The first special form refers to self-adhesive, clear films that look brilliant on their own when they are adhered to white acrylic. Backlighting intensifies the effect but is not absolutely necessary. Such films are used mainly in bright interior spaces which are also utilized at night.
- Self-adhesive window films constitute another special form, and are best known from Christmas decorations. They can be used to dress up unattractive spaces by partially or completely covering the windows to resemble stained glass. The films can be used several times, so that decorations can be changed with the seasons.

There are also **metal films**, typically in copper or aluminum, that produce the effect of old or very high-quality photographic processes.

Glossary

AdobeRGB (1998):

The AdobeRGB color space was specified by Adobe in 1998. The objective was to create a color space from which the CMYK color space of a color printer could be adapted to the RGB color space of a monitor. It is larger than the sRGB color space.

Bayer filter:

Photo sensor named after its inventor Bryce E. Bayer. The sensor is overlaid with green, blue and red filters, which are in a ratio of 50 % green, 25 % blue and 25 % red. In this way, it approximates the sensitivity of the human eye, in which green accounts for the greatest share of the perception of brightness.

Border shadowing:

See objective vignetting.

CCFL display:

This is a first generation flat screen. CCFL stands for Cold Cathode Fluorescent Lamp. In contrast to today's monitors, which are illuminated with LEDs, the CCFL displays produce light using neon tubes.

Cd/Candela:

Candela is the SI unit of the SI basic variable of luminosity.

CEPS tools:

CEPS stands for Color Electronic Page Setting. In photography, this involves photo retouching or photo editing with the aid of image editing programs such as Adobe Photoshop or Adobe Lightroom.

CIE-xy color space:

The CIE standard valence system has been defined by the International Commission on Illumination (Commission internationale de l'éclairage). It is the link between human perception and physical causes.

CMOS technology:

CMOS stands for Complementary Metal Oxide Semiconductor. This involves semi-conductor technology, which has become widespread in photo sensors, etc. CMOS sensors are primarily characterized by low power consumption and short switching times.

Color balance:

The color balance determines the ratio of the colors to each other. For example, if the colors in a recorded image are not reproduced as they are in the original, the colors are not in balance.

Color fidelity:

Color fidelity is the measure of the deviation or the similarity of colors during recording and output. Color management systems are normally used to achieve maximum color fidelity.

Color fringes:

Color fringes, also called chromatic aberrations, occur in images because of deviations of optical lenses. Because the individual wavelengths of the visible spectrum in a lens are refracted differently, each wavelength range has its own focal point. In practice, this leads to color fringes, which are particularly visible on the contours and edges of an image. This error can be corrected using additional lenses, which are attuned to the respective wavelengths.

Color homogeneity:

The color homogeneity describes the color consistency or the color deviations from a set point over an area, e.g. the surface of a display. In the case of poor color homogeneity, the same color value is reproduced differently on the surface of the display. For example, this could cause a green tint on the upper right and a red tint on the bottom left corner.

Color noise:

Color noise, or image noise, describes the deterioration of image quality due to structures, which themselves do not carry any image information. The impacted image sections deviate from the actual image information in terms of color and brightness, and are especially visible in dark areas of the image in which the signal-to-noise ratio is very low.

Color separation:

In the prepress stage, this means the conversion of the colors of a wide variety of image datasets, mostly to the CMYK color model. The colors are separated into the print colors cyan, magenta, yellow and black.

Color space:

A color space is a defined range of colors. The best-known color spaces from the RGB color model are sRGB and AdobeRGB (1998), as well as the CMYK color model, Euroscale Coated v2, Fogra39 and ISO Coated v2.

Color temperature:

The color temperature describes the light mood and is specified in Kelvin. A cooler light mood (bluish) prevails, for example, in a cloudy sky, than in sunshine (yellowish).

Contrast:

Contrast is the ratio of the brightest to the darkest area of an image.

Contrast balance:

Is the ratio of the brightest and darkest areas and defines from where the light is being drawn.

Cross-effect:

The cross-effect originally came from analogue photography, in which a slide film was combined with a negative development process or a negative film with a reverse development. The colors are artificial and the contrasts are higher. This effect is often used for artistic styling and is imitated today by digital techniques.

Contrast ratio:

See contrast.

DLP projector:

DLP stands for Digital Light Processing and it is a technology developed by Texas Instruments where the image is created by an array of micro mirrors within the optical path. A special feature is that the red, green and blue pixels are not generated simultaneously (as in LCD projectors), but quick alternate flashing through a rotating color filter wheel.

Glossary

ECI RGB:

The ECI (European Color Initiative) RGB is a standardized RGB color space, which covers a large part of the printing processes, as well as all currently known display technologies. Thus, it is a color space that is designed especially for the needs of the graphic arts and prepress.

eciRGBv2:

Further development of ECI RGB. It has been optimized in terms of the visual equidistance, as is known from the CIE-L a*b* color space. This results in a minimization of banding and clipping errors, as with the L-Star color space. The ECI recommends using the color space as early as data creation, for example when converting RAW data or 16-bit material to 8-bit color depth.

EXIF information:

The Exchangeable Image File Format (EXIF) is a standard format for saving metadata in digital images. EXIF information can be, among other things, a camera model, shutter speed, ISO value, aperture or date and is written to the header of the image file.

Fine Art Printer:

There is no uniform definition for the term Fine Art Printing. All Fine Art printers attempt to create an image which most closely resembles a one-of-a-kind or work of art, in terms of its properties, selected motif, and post-editing, and in the use of the best photographic materials.

Gamma:

In relation to a monitor, gamma refers to the modulation of an input signal to a desired output signal. In practice, this means that a low-contrast image is obtained by correction of the output signal to contrast.

Gamut:

Is the description of the color range which can be reproduced by a technology or a technical device.

Gray balance:

"Achromatic" colors are the gray shades that lie between white and black. These are produced by equal proportions of the respective primary colors such as cyan, magenta and yellow (CMY) in the print or red, green, blue (RGB) in self-luminaires. If the primary colors change to equal proportions, a gray may become brighter or darker, but remains neutral gray. If the color components are no longer in the same proportion, one can immediately perceive a gray tint and gray balance is no longer maintained.

High-Key Image:

In high-key photography bright tones, few contrasts and soft light lend style to an image.

ICC profile:

An ICC profile describes the color space of input and output devices such as printers, scanners, digital cameras or monitors and refers to the reference values.

IPTC conventions:

IPTC is the acronym for International Press Telecommunications Council. As per the IPTC convention, metadata is saved to the header of an image file for improved classification. The metadata contains such things as parameters such as file format, file size, filename, height and width in pixels of a file, date recorded and the description of the contents.

Kelvin:

Kelvin is an SI unit of temperature measurement. It is also used for measuring the color temperature.

L*a*b* color space:

Is a device-independent color space and describes all perceivable colors equally, so that color deviations can be described by a Delta E.

LCD:

This refers to Liquid Crystal Display. The liquid crystals regulate the light impermeability per color channel. LED monitors are also LC displays, but irradiate the color filters from the rear with LEDs instead of fluorescent tubes.

LCD projectors:

The white light of the projector lamp is split into 3 basic colors by a prism and then sent through 3 LC displays, which control the image information per color channel. Subsequently, the image is put together by another prism. LCD projectors are characterized by a smaller contrast range, but can reproduce the colors very differently.

Low-pass filter:

With image files, so-called Moiré effects may occur instead of very fine recurring structures, which are at the limit of the sensor's resolution. These small, colored structures have a specific pattern, but are not part of the image information. Low-pass filters are used to prevent these phenomena.

L-Star RGB:

A modern color space, which combines the advantages of a higher color resolving power of the human visual sense of the CIE-LAB color space with the usual RGB color spaces like AdobeRGB and ECI-RGB. Banding and color tipper errors are reduced to a minimum when viewed on a display and in printing.

Luminance:

The luminance describes the brightness of image points

Luminance homogeneity:

Describes uniformity of brightness for a defined area. A poor luminance homogeneity of a monitor can be seen as vignetting, although all image areas must be equally bright.

LookUp table:

IT term. LookUp table (also called LUT) are tables in which application-specific values are stored which are used in a program routine.

Glossary

LUT:

See LookUp table.

Luv color space:

A color space that is calculated from the CIE-XY system, similar to the L*a*b* color space. This system is mainly used for the evaluation of light sources or monitors.

LED backlight:

This refers to a flat radiator that consists of many light emitting diodes and is used for the background lighting of an LED display.

Low-Key image:

In contrast to high-key photography, low-key photography uses little light as a stylistic device. Light is used consciously to accentuate highlight contours and the few details that are important for the image. Many sections of the image often remain in the dark. This lends a certain amount of drama to this type of image, a familiar sight in theatrical or stage photography.

Objective vignetting:

Vignetting refers to the shadowing of the image to its borders, which can be highlighted by components of the objective, such as lens mounts, and by filters or lens hoods. The effect itself is originally unwanted, but it is also used as a stylistic device.

Offset printing:

A printing method, in which the pressure roller does not directly contact the printed product, but the printing is transferred indirectly by a rubber roll. This is the most common method for printing books, newspapers, and packaging.

OSD:

Stands for On Screen Display and describes an input menu window of a monitor, which is shown on the display.

Primary colors:

Primary colors are the basic colors that compose secondary colors. Thus, the colors that a monitor can display are composed of the colors red, green and blue. The same applies to cyan/magenta/yellow, by means of which all colors which can be displayed by the process are mixed in printing.

Polarization layer:

A polarization layer, as used in LE and LC displays, ensures that light is polarized, which means only the fractions that oscillate in a plane are transmitted. This is the prerequisite for the option of regulating the light quantity per pixel with LCs.

Reflection idiosyncrasies:

Printing paper and photo paper have a large number of surface properties. The bandwidth ranges from matte and glossy to a wide variety of textures and materials. Every surface and material has very specific characteristics, with regard to how they absorb and reflect light. These must be taken into consideration when setting up a color workflow.

Rendering Intent:

The way in which the colors must be converted from one color model into another.

Softproof:

In a softproof, the colors on a monitor are simulated as they will appear on the selected output material. Also known as ink color simulation.

sRGB:

Standard RGB is also a color space developed by Hewlett-Packard and Microsoft. It is widespread, but smaller than the AdobeRGB (1998) color space.

THM file:

THM files are miniature view video files, which are used to create a thumbnail image (miniature image) of the video file for improved orientation.

Tonal value:

The tonal value describes the measure of tone scales. For example, a digital camera with 8 bits per color channel has a tonal value reduction of $2^8 = 256$ steps per color channel.

White balance:

In the case of a white balance, a camera should be set to the color temperature of the recorded scene to keep the color balance neutral. This is also done by the human eye, which evaluates colors in a largely neutral manner.

White luminance:

White luminance is the maximum brightness of a white point that can be displayed by a monitor.

White point:

The white point defines the white of a monitor with full control.

Wide gamut:

Gamut is the displayable color space of a monitor. Wide gamut features a device class that is characterized by a very large color space that is close to AdobeRGB (1998) or even slightly more. Monitors with wide gamut are typically used in image editing.

Workflow:

A workflow in photography includes all devices and technologies, which are used in the processing of the final image. A typical workflow includes a digital camera, image editing software, display units/monitors, and printers.

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Color management can be easy

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