

# Film Color Space

## Color Space Heaven

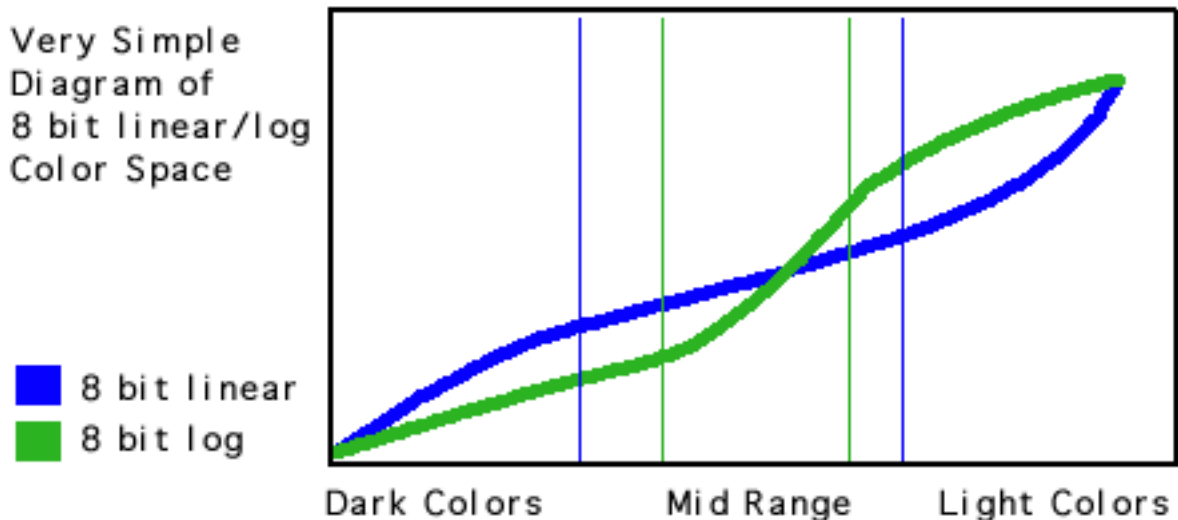
Digital bits are used to describe variations of color in several ways. The simplest concept that will help you understand how color is described by a computer is to remember this: binary digital bits (0s and 1s) describe VARIETY, not color.

Remember that each binary digit can only represent a 0 or 1. But 2 digits can display  $2^2$  varieties, and 8 bits can describe  $2^8$  or 256 varieties. This means that 24 bit RGB color space can describe 8 bits of each RGB, or  $256 \times 256 \times 256$  variations of color, or 16.7 million different values.

But don't assume that the 16.7 million colors are a sampling of the entire spectrum of color; you could choose to have 16 million shades of red, and the remainder in shades of blue. This wouldn't buy you a very nice photorealistic image, but if you were really keen on red and blue, you would have some gorgeous tones.

## Linear versus Log Color

If the color space being described is a linear color space, then an equal portion of the bits is used to describe colors in each section of color spectrum. In a logarithmic color space, the same bits can be used to emphasize details in the white and black areas of an image. Logarithmic color mapping is a more accurate way of describing the great detail that is captured by a piece of film, which is highly responsive in areas of extreme dark and light.



In the diagram above we are trying to illustrate the usage of bits to describe colors. In the linear color space, an equal number of bits are used to represent the dark, mid, and light colors; in the log color space, more bits are used to focus on the dark and light colors, with fewer spent on the midrange.

Log color is ideal for preserving higher color fidelity from sources such as film. However, it is a relatively complex file format to deal with: your monitor lookup table needs to be hacked to reflect this log color space (otherwise everything on your monitor is really off-kilter), and you should avoid making any color corrections to the image, since most Mac and NT graphics applications aren't equipped to deal with the signal.

## Color Space Catchwords

**RGB Space:** color is described based on how much red, green, and blue is in the image. This is the most common way for computers to describe color, since most monitors and graphic architectures refer to color by their RGB components.

**YUV Space:** television broadcast signals and video signals are in YUV space, where Y is luminance and U+V are color differentials. Different sampling rates such as 4:2:2 refer to the spatial sampling of color, where 8 bit or 10 bit refers to how many bits are used to describe the color channel.

**CMYK Space:** ink builds up on paper very differently than light builds up on a monitor. CMYK refers to the cyan, magenta, yellow, and black that is used in printing color images.

**HSL Space:** HSL refers to the hue, saturation, and lightness of a color. This is a useful color space for finding color, since it is much simpler to deal with -- it resembles our childhood memories of crayons as opposed to a theoretical mathematical cube.

**8 bit linear:** the common Mac and PC color space, also referred to as 24 bit color.

**8 bit log:** the format promoted by Quantel and several facilities, wherein only 8 bits is used, but by mapping the information on a logarithmic scale, better accuracy is maintained in the blacks and whites.

**10 bit log:** the Kodak Cineon standard, which captures a whopping amount of detail in the total spectrum. This is 10 bits per channel (30 total) and logarithmic.

**10, 12, 16 bit linear:** less complex variations used to capture film dynamic response within linear space that is 10-16 bits per channel (30-48bits total). When the alpha channel is included in the total, you can end up with a 64 bit file (16\*4 channels).