

Gamma & Density Co. Log Chart System

User's Guide



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The Gamma & Density Log Chart System

Gamma & Density Co. has been producing high-quality calibration and test charts since 1996, beginning with color charts for telecine transfer. The purpose of charts has not changed as the telecine process has faded with decreasing film production. The “modern” telecine for digital cinema cameras has become the DIT (Digital Image Technician), an on-set collaborator for supporting the Cinematographer with the creation and manipulation of digital images.

Similar to the ways a film negative can be processed and interpreted, the digital image is also subject to processing and interpretation through easily accessible tools. Color charts, from the beginning, have been a method of communication between the Cinematographer and Post-Production (telecine, editorial, DI, etc.). This communication helps to ensure the creative intentions of the Cinematographer is present on dailies and into the final color grade.

With new digital cameras changing the way footage is captured, digital cinematography is no longer “what you see, is what you get”. The image seen on monitors during production is rarely the same image that is being captured. This influx of images captured with **Log Gamma Curves** and **RAW capture** create new possibilities for image interpretation, and further reinforce the necessity for a consistent color and exposure benchmark from which DITs and other members of post-production can realize the creative intentions of the Cinematographer.

The **Gamma & Density Co. Log Chart System** aims to provide cinematographers with a benchmark for color and exposure, while providing crucial information to DITs and Post-Production about how the Log or RAW images should be interpreted.

What is the Chart used for?

The **Gamma & Density Co. Log Chart System** can provide critical color and exposure information to DITs and Post-Production, to ensure the integrity of creative choices made by the Cinematographer during production.

Color charts can also be used for objective analysis of technical and aesthetic values of a particular camera system. By creating a visual “standard”, it eliminates many variables between different camera systems and provides the most objective source of information in front of the lens.

Gamma & Density Co. Color Charts have undergone extensive testing and quality control to ensure consistent results between charts and camera systems. Color hue, saturation and density values also undergo a testing process to ensure they conform to specific color standards found in film / television production.

Why do I need to shoot a chart?

Shooting a color chart during production (with film or digital) – either at the head of each scene, camera roll, lighting setup, visual look or in camera prep – assists DITs and Post-Production to understand how the digital image is meant to be interpreted in terms of exposure and color information.

With this information, DITs on-set can begin to create a **LUT (Look-Up Table)**, which is a digital file containing image manipulation data. The LUT can serve many purposes, either technical (matching monitors, creating color space simulations, etc) or aesthetic (designing creative look management, “normalizing” footage for dailies, etc). On-set and during dailies creation, that LUT can be applied to a batch of clips to ensure that all the clips in that batch are processed the same way.

The **LUT** has become a crucial part of working with digital cameras and managing color information throughout the project’s workflow. Shooting a color chart provides the baseline information necessary to create unique LUTs, both technical and aesthetic, specific to the production and desired “look”.

One of the most common applications of a LUT is for “**de-logging**” an image and converting **Log to Linear**. Log gamma formats are designed to help maximize the amount of captured dynamic range in an image, and make that extended range accessible in post-production color grading. The result of the expansion of Log image capture has been cameras recording low-contrast, low-saturation “milky” looking images. These images are undesirable from an aesthetic viewpoint for proper on-set monitoring, dailies and “client approval”.

The **Gamma & Density Co. Log Chart System** is designed to make the Log to Linear process quick, simple, customizable and consistent. Camera manufacturers provide LUTs specific to their cameras for Log to Linear conversions; however, the camera manufacturer in order to “optimize” the look of their camera has created this conversion, and will sometimes produce undesirable aesthetic results.

Using the Gamma & Density Co. Log Chart System, DITs and Post-Production will have specific targets for normal exposure and color reproduction, *regardless* of camera format, in order to create a LUT ideal for use on-set and in dailies.

Shooting a Chart with RAW Capture Cameras – when shooting digital RAW, regardless of the camera format, the possibilities for image adjustments, previously only possible in camera, can now be done by a DIT or Post-Production – which makes shooting a chart even more important. Many RAW images include user-selectable gamma curves to help maximize the amount of visible, captured dynamic range, similar to LOG capture camera formats.

Shooting a color chart with a RAW Capture Camera helps create a baseline for color, exposure and metadata settings – as well as provide key waveform percentage values for converting the RAW gamma curve to linear.



Elements of the Gamma & Density Co. Log Chart System

The **Gamma & Density Co. Log Chart System** has been designed to provide as many useful features for cinematographers on-set and for testing and evaluating cameras.

The 3cP – LOG – 1 Chart



chart dimensions: 14.5 inches wide x 10.5 inches tall

The **Log Chart** (pictured above) is the backbone of the Log Chart System. The chart features an 11-step grey scale, 18% key grey target, the **Gamma & Density Co. ERC (Easily Recognizable Colors)**, as well as framing lines for 1.78:1 (HD Standard 16x9) and 2.40:1 (Cinemascope).

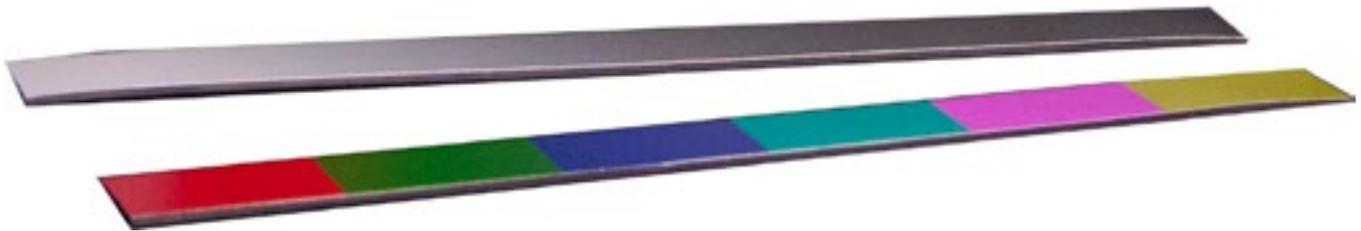
The 11-step grey scale has been printed at specific densities as they relate to reflected luminance values when evenly exposed. Each chart has two black velvet patches for optimal true black density. For reference, above the grey scale are T-stop values that correspond to the amount of reflectance in each step above and below neutral grey. This information is indispensable for testing dynamic range and ISO sensitivities of individual cameras.

In addition to aligning with a reflected (spot) light meter, the grey steps have also been calibrated to line-up with specific percentage values on a waveform monitor. Normally exposing the grey scale will result in “normal” exposure in the captured Log footage, and easily align with Gamma & Density Co.’s recommended **Rec.709** exposure values (more information below: **Data Accessory Strips – Log Strips**).

The **Log Chart** also includes two low-intensity negatively charged magnetic strips for attaching **Data Accessory Strips** to the chart.

Information included on the base **Log Chart** is standardized throughout all cameras, film or digital, and will never be “out-of-date” or require upgrading and will be relevant throughout the life of the chart.

Data Accessory Strips: 709 Colors and B/W Gradient Ramp



Two **Data Accessory Strips** come standard with every **Log Chart** – a Rec709 Color Reference, and a Black to White Gradient Ramp (pictured below). The strips have positively charged magnetic backings, which allow them to be easily mounted or removed from the base **Log Chart**.

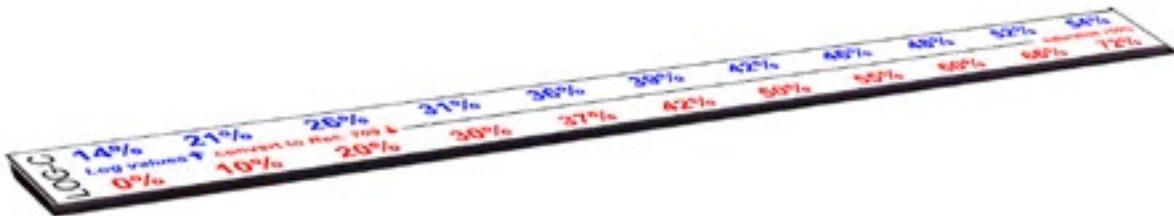
The **Rec. 709** strip features standardized reference colors for the Rec.709 color space: red, green, blue, cyan, magenta and yellow. These colors have been meticulously tested to ensure alignment on a standard Rec.709 Vectorscope (x2 magnification) that include targets for Rec.709 colors. When properly exposed, the color contained on the Rec.709 strip will perfectly align in the direction of the Vectorscope targets (*pictured on page 15*).

As film / television camera technology continues to evolve and image exhibition platforms change to reflect new color space requirements – we plan to update the Rec.709 Color Strip to provide accurate color reference for additional color spaces.

The **B/W Gradient Ramp** strip is a basic gradient pattern from pure printed black to pure printed white. On a waveform monitor, the ramp will appear as a sloped line and assists cinematographers in camera evaluation by charting the slope of the line as it approaches black (the “knee” of the contrast curve) and approaches white (the “shoulder” of the contrast curve”).

The **Rec.709** and **B/W Gradient Ramp** strips come standard with the purchase of the Gamma & Density Co. Log Chart System.

Data Accessory Strips: Log Strips



The digital image with log gamma curves is open to a variety of interpretations through different LUTs and post-processing manipulation. The **Log Strips** provide a common baseline throughout every log gamma format and help create some form of “standard” interpretation of a “Rec. 709” image.

The process for interpreting the Rec.709 standard varies wildly between camera manufacturers and “Rec.709” when it comes to the overall image has become equated to “linear” gamma. The **Log Strips** provide information for normally exposing a log image, when viewed in log on a standard waveform monitor, as well as providing a reference to DIT and Post-Production for how that log gamma curve should be converted to “Rec.709” linear when viewed on a standard waveform monitor.

Note: When using the **Log Strips**, the strip must be placed on the magnetic strip **below** the 11-step grey scale in order for the percentage values to properly align to the grey steps.

Log Strips are available for many popular camera formats with their corresponding gamma curve. At the time of release, Log Strips are available for **Arri Log-C** (*Arri Alexa, Amira*), **Canon Log** (*Canon C100/300/500*), **Red Gamma 3 & Red Log Film** (*Red Epic, Scarlet*), **S-Log 2** (*Sony F65, F55, F5*) and **S-Log 3** (*Sony F55, F5*).

Future strips are planned for: **Blackmagic Film Gamma** (*Blackmagic Cinema Camera*), **Red Gamma 4** (*Red Dragon*), **Technicolor Cine Style** (*Canon 5D, 7D*), **Cineform Gamma** (*GoPro Hero3*) and others.

Log Strips are sold separately from the base **Log Chart** and are available as individual strips, or in “packs” specific for each camera manufacturer.

The **Log Strips** have been created through extensive in-house testing conducted by Gamma & Density Co., with camera settings aligned with widely accepted manufacturer recommended values. The tests have not been subject to manufacturer approval and have been gathered in a solely objective manner.

Setting Up the Chart

Color charts, including the **Gamma & Density Co. Log Chart System**, are to be shot during production either at the head of each scene, camera roll, lighting setup, visual look, in camera prep or whenever the Cinematographer chooses. It is very important to take great care in shooting the chart. In order to provide a common baseline, many “variables” must be eliminated to ensure consistency in color and contrast for each time the chart is shot.

At Gamma & Density Co., we recommend shooting charts under 1) even illumination to ensure accurate contrast rendition, and 2) free of color contamination and hue/saturation shifts – this is typically caused by having gel on the lights, using lighting units that do not reproduce full color spectrum (typically LEDs or unbalanced fluorescents), or camera white balance mismatching with lighting color temperature.

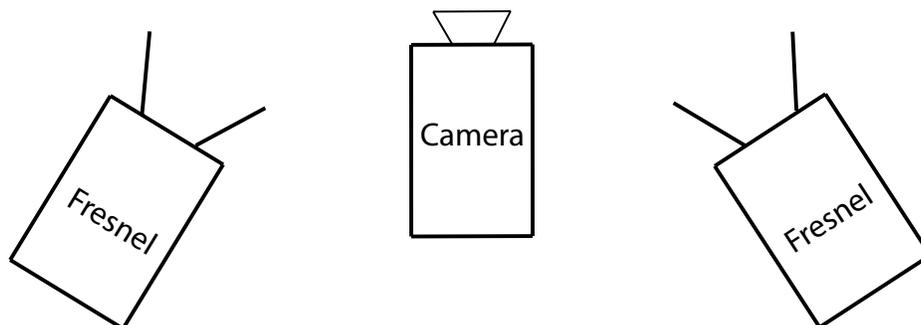
Cinematographers may choose to shoot the chart under any lighting scenario in order to capture a reference for the mood of the scene. However, to produce consistent results between charts, we recommend even illumination and color balance.

Lighting and Exposing the Chart

There are several possible ways to light a reference chart with the common goal of creating even illumination, free of shadows, across the entire chart. Without even illumination, the grey steps will not appear accurately on the waveform monitor and negate the benefits of the **Log Strips**.

To achieve even illumination, a common method is to use two Fresnel lighting units, each an equal distance away from the chart and directed inward at a 45-degree angle (*pictured below*).

Begin by turning on only one of the two lights. Use an incident light meter to measure the intensity of light falling on the chart (or a waveform monitor by using the grey chart border as a reference). Measure the light levels on the entirety of the chart with the goal of having the same intensity value (f/stop or footcandles) throughout the entire chart. You may need to reposition the light's angle, height, pan or tilt in order to create even illumination. Once the first light is set, turn it off and repeat the same process with the second light. When both lights have been set, turn on both light units and double-check intensity using the incident light meter – the chart should now be evenly illuminated.



Tip: Using larger light sources at a greater distance away from the chart or by using “soft” light sources will help achieve even illumination quicker.

In order to determine exposure for the chart, you must use either a reflected “spot” light meter (an incident light meter will **not** work) or a waveform monitor with **Log Strips** on the chart.

1) **Spot Meter**: Set your light meter to match the ISO / EI value of the camera, the shutter speed and shutter angle. Once the meter is properly setup, take a reading of the area in the center of the chart labeled “**KEY Grey**”. Set the t/stop of the camera lens to match the reading from the light meter, and you will achieve perfect exposure of the chart.

2) **Waveform Monitor**: To determine proper “normal” exposure using a waveform monitor with **Log Strips** on the chart, you must set the camera to send the “log” image out to the waveform monitor. Commonly, a log image on a waveform monitor will have elevated blacks and suppressed whites, and fit within a 50-60% high/low range.

When viewing the Log image on the waveform, adjust the lens iris so that the **center grey strip** on the 11-step grey scale matches the corresponding waveform percentage value shown on the **Log Strip** that matches the camera’s log gamma curve. You can also double-check even illumination by checking if the other percentage values on the **Log Strip** match the percentage values on other grey steps on the waveform monitor.



Using the Chart with Waveform and Vectorscope

Once the chart is evenly lit and properly exposed, cinematographers, DITs and Post-Production will be able to use test instruments to evaluate the image and create a baseline LUT.

The basic **waveform monitor** is a tool for evaluating luminance values (brightness) throughout the image. The most common unit of measurement on a waveform monitor's vertical axis is a percentage value on a scale of 0% (pure black) to 100% (pure white). Percentage values are similar to standard IRE values as the unit of measurement. Some waveform monitors display millivolt (mV) values on the vertical axis. For using the **Gamma & Density Co. Log Chart System** on a millivolt calibrated waveform monitor, a reference Universal Exposure conversion table is available at: <http://gammadensity.com/learn>

When using a waveform monitor with the **Gamma & Density Co. Log Chart System** and the proper **Log Strip**, you will be able to evaluate important exposure information and provide a reference for normal exposure in log gamma. This allows DITs and/or Post-Production to follow the corresponding Rec.709 percentage values on the chart for creating linear gamma LUTs and Dailies.

A **vectorscope** is a tool for measuring color present in the image by showing a circular graph of hue and saturation values. The center of the graph represents zero saturation and zero hue. On the graph will be "targets" representing Rec.709 hue values as they correspond to SMPTE color bars and calibrated color charts. The targets represent specific hue directions on the graph, and the farther the point is away from the center of the graph, the greater the color saturation.

When using the vectorscope with the **Gamma & Density Co. Log Chart System**, the **Rec.709** color strip features specifically calibrated hue values that will point in the direction of corresponding targets on the vectorscope. By adjusting the hue of the overall image so that the dots on the vectorscope corresponding to the **Rec.709** color strip point accurately toward the targets, you will be able to create perfect color alignment. We recommend viewing the vectorscope at 2x magnification when making these adjustments.

Note: *Saturation and Printed Charts* – the SMPTE standard for Rec.709 color saturation (as indicated on the vectorscope targets) is beyond the saturation range of printer technology for accurate reproduction. On the Log Strips there are “recommended” saturation increase values corresponding to each log gamma format, which create “comfortable” amounts of color saturation that are far less saturated than the vectorscope targets.

By aligning the **Gamma & Density Co. Log Chart System** to the waveform and vectorscope, the chart along with applicable strips, will provide a consistent “baseline” image to the DIT and Post-Production so a common, standard and easily reproducible method for interpreting the log image into linear can be created.

Choosing the Right Strips

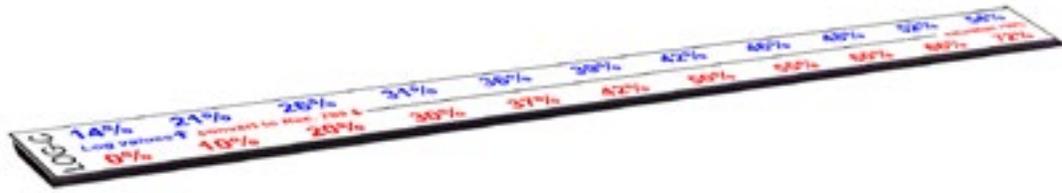
One of the unique features of the **Gamma & Density Co. Log Chart System** is the ability for users to “customize” the chart to display information most relevant to their project or test. The modular strips feature also makes the chart system “future-proof” against the changes in camera technology. As future cameras announce new log gamma curves, Gamma & Density Co. will produce an updated **Log Strip** corresponding to the new format. With new color space requirements will come new calibrated color strips to provide a consistent reference for your base **Log Chart**. With this unique modular system, you will be able to provided consistent color and contrast reference on-set for many years to come.

For use in production, we recommend outfitting the chart with the **Rec.709** strip and corresponding **Log Strip** matching the cameras log gamma curve. This setup will provide optimal information to a DIT or Post-Production for creating LUTs with a common exposure and color balance.

For camera testing and matching, we recommend outfitting the chart with the **Rec.709** strip and the **Black/White Gradient Ramp**. This arrangement will allow you to evaluate color reproduction and inherent contrast present in the captured image. Comparing the slope of the gradient ramp between different camera systems will allow users to analyze the method of log gamma encoding being used.

Note: When using the **Log Strips**, the strip must be placed on the magnetic strip *below* the 11-step grey scale in order for the percentage values to properly align to the grey steps.

Using the Log Data Strips



The purpose of the Log Data strips is to provide a common, consistent baseline for creating LUTs (Look-Up-Tables) for converting log into linear. There are many ways for a log image to be interpreted and converted in post-production, with very few solutions for creating a standard way of conversion.

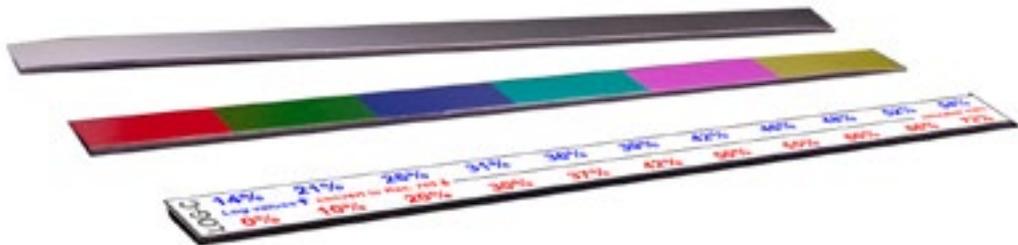
Camera manufacturers sometimes provide LUTs specific to their cameras log format, which serves as one possible way of converting the image to linear. However, this method can present some challenges because there is no one universal file format of LUT (unlike the ASC CDL), and every DIT or post-production color program has its own unique LUT file format. Aesthetically, camera manufacturer provided LUTs also might create challenges for the aesthetic of the image, depending on how “aggressive” the LUT renders highlights, shadows and saturation of the image.

The **Gamma & Density Co. Log Chart System’s Log Strips** are designed to create a standard “non-aggressive” interpretation of linear Rec.709. This linear standard is true regardless of camera gamma format, and is a perfect system for attempting to match the look of different camera log formats in post-production.

Through providing the proper exposure and color information to the DIT and Post-Production, a custom LUT can be created to convert the image to linear by adjusting the luminance values of the grey steps in the chart to match the “target” percentages on the **Log Strip**. This custom LUT can be created in the file format is needed for use on-set or in the digital intermediate. The custom LUT can be used on-set monitoring, importing a “look” into camera and creating linear dailies. The custom LUT can be used in the digital intermediate as either a “first-pass” color correction or as a reference to help guide the colorist to the desired look.

LOG-C	RED GAMMA3	RED LogFilm	CANON LOG	S-Log 2 F5 / 55	S-Log 3 F5 / 55	S-Log 2 F65
0%	0%	0%	0%	0%	0%	0%
14%	7%	15%	11%	14%	12%	13%
21%	11%	20%	15%	18%	22%	16%
10%	10%	10%	10%	10%	10%	10%

Note: Matching Cameras – the **Log Strips** will help to normalize the exposure information between different log gamma formats, however, it will not be able to perfectly match color discrepancies between camera formats. Each camera manufacturer has their own unique color science and method for reproducing colors. The chart will help provided a common color reference with the Rec.709 strip, but for perfectly matching color balance between cameras, users will have to employ sophisticated secondary color corrections to compensate for the different color sciences.



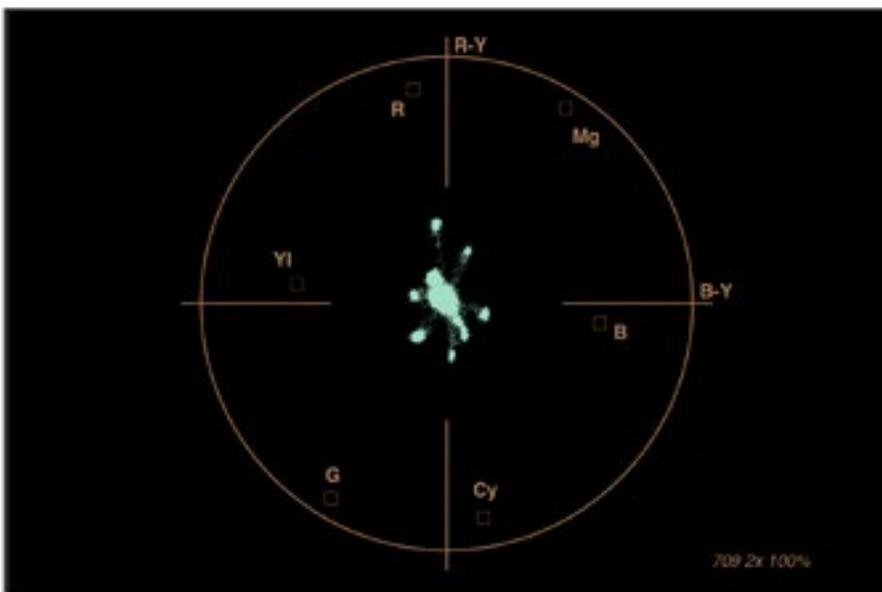
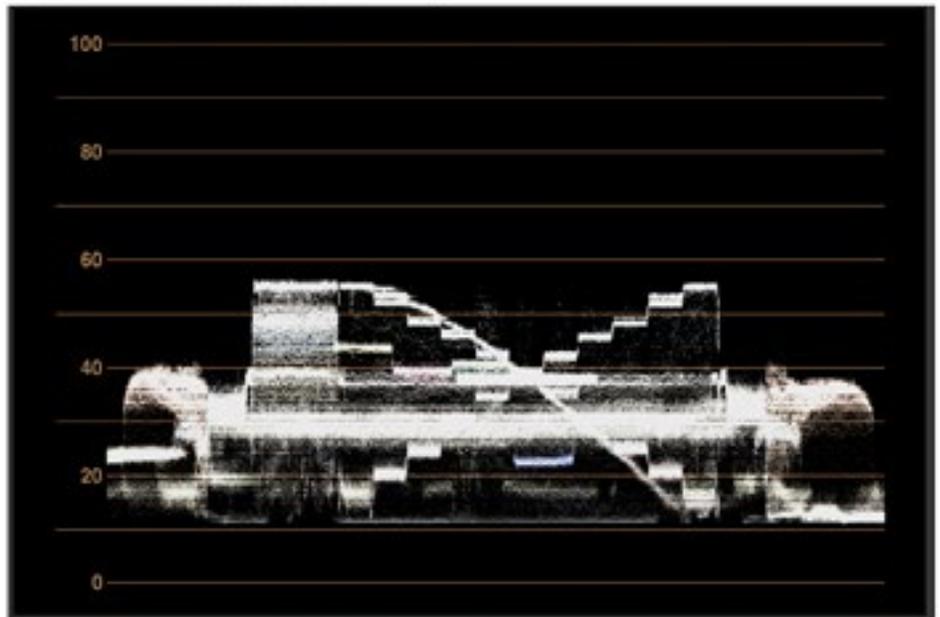
Sample Scopes Before / After with the Gamma & Density Log Chart System



The Gamma & Density Co.
Log Chart - Base Chart

Alexa (Log-C gamma)
no LUT applied

Waveform Monitor:
Log-C image sent
from camera



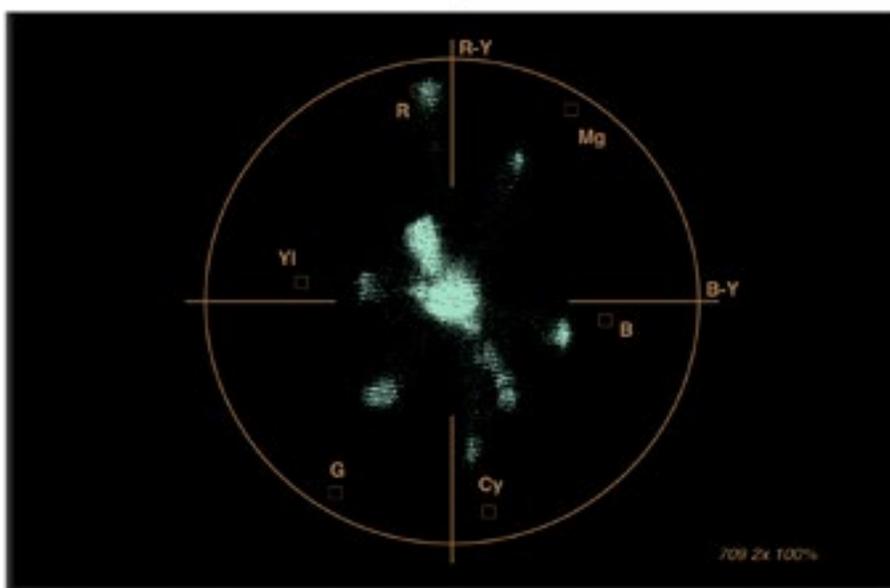
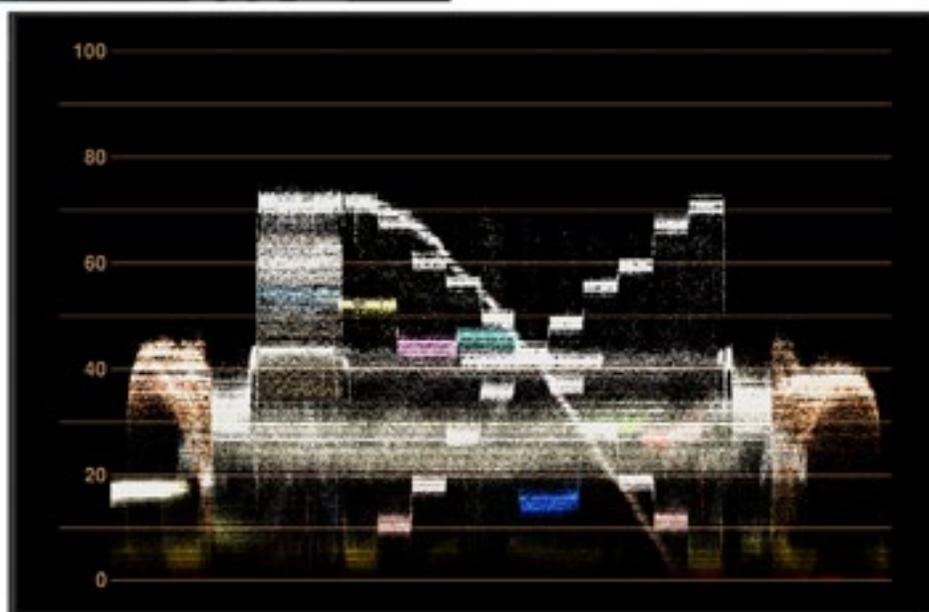
Vectorscope Monitor:
Log-C image sent
from camera



The Gamma & Density Co.
Log Chart - Base Chart

Alexa (Log-C gamma)
*custom LUT created with
Log Strip info applied to
convert to Rec.709 (linear)*

Waveform Monitor:
Target image with
custom LUT applied



Vectorscope Monitor:
Target image with
custom LUT applied

Creating LUTs for DPs, DITs and Post-Production

There are many methods for creating LUTs but we recommend products from Gamma & Density Co. designed to streamline your LUT creation and workflow process.

Gamma & Density Co. 3cP SET + POST (desktop / laptop software for Mac)
3cP SET + POST was the original all-in-one DIT on-set software solution designed to consolidate all the tasks of a DIT into one program. 3cP has tools for color correction and balancing color charts, all while viewing the reference image on a real-time waveform monitor and vectorscope. The program also has a “digital spot-meter” tool that can sample a part of the image and translate the exposure information into waveform percentage values (very useful with the **Log Strips**).

After the conversion adjustments have been made, the custom “look” can be saved as a preset profile and applied to a batch of clips, saved to an HDLinkPro LUT box for live on-set color correction, exported as a LUT files for post-production, and baked into dailies deliverables.

For more information about 3cP SET + POST, visit <http://gammadensity.com/3cp>
To download a free demo of the program, visit <http://gammadensity.com/demo>

Gamma & Density Co. Image Control Pro (App for Apple iPad)

Image Control Pro for Apple iPad is a mobile table based system for color correcting still frames extracted from motion clips, creating a LUT and exporting the LUT file via email or Dropbox to an on-set DIT or post-production color system.

The system is very similar to the 3cP Desktop program, but utilizes touch screen technology to bring a “control surface” feel to mobile color correction. The app includes live reference waveform and vectorscope monitors for matching percentage values seen on the chart’s **Log Strip**.

To learn more about the app, visit: <http://gammadensity.com/imagecontrol>

Gamma & Density Co. ExpressColor (App for Apple iPhone)

This simple application is a quick, easy solution for creating LUTs and distributing the look to the DIT and Post-Production. Users import still images from their camera roll, do a color grade using color wheels and preset profiles, then export the grade image along with the LUT for use elsewhere in production and post. ExpressColor is not ideal for use with the Gamma & Density Co. Log Chart System since it lacks test instruments, however, in a pinch it could be used to create a quick LUT by eye.

To learn more about the app, visit: <http://gammadensity.com/expresscolor>

ExpressColor for iPhone

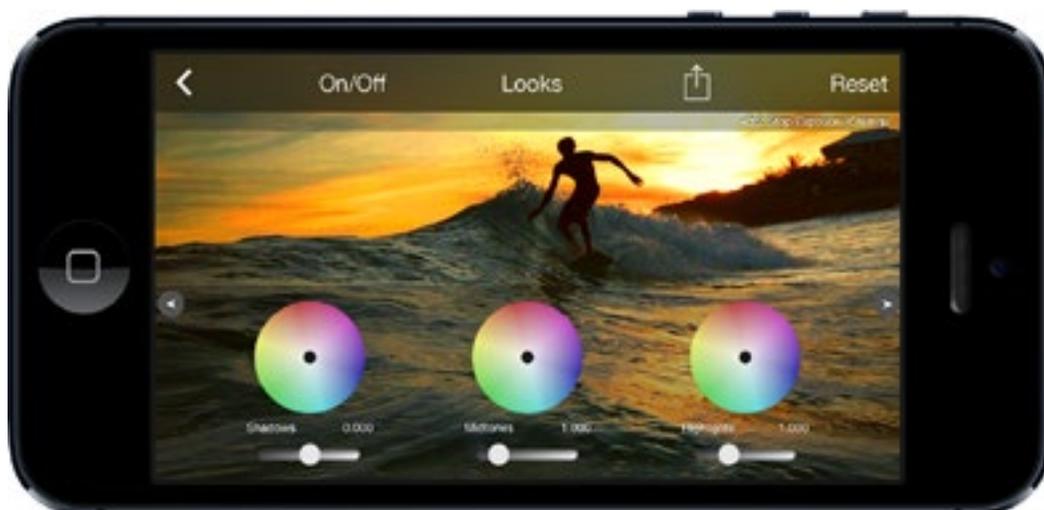
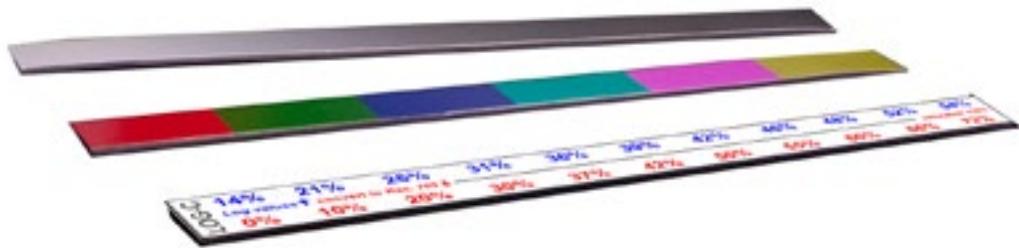


Image Control Pro for iPad





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