

Creating CalMAN 3D LUTs Overview Guide

This is an overview guide for using the new Intelligent Resolution Profiling™ (IRP), Lightning LUT™, and 3D LUT Retargeting technologies that were introduced in CalMAN version 5.4.0 to create 3D corrective LUTs.

For compatible displays or LUT processors, CalMAN automatically creates a corrective LUT and loads it directly into the controlled display or processor. For imaging software that is compatible with 3D corrective LUTs, CalMAN creates and saves a corrective LUT file that can then be manually loaded into the imaging software.

In the case of DaVinci Resolve and Assimilate SCRATCH, CalMAN can also automatically control the test pattern generator provided within the software, as the test pattern source for 3D LUT creation.

Note: For a more specific guide on using CalMAN to calibrate a 3D LUT for a specific display, LUT processor, or 3D LUT compatible imaging software, see the quick start guides that are available for your specific hardware or software.

<http://calman.spectracal.com/user-guides.html>

Required CalMAN Software Version:

- Version 5.4.0 or newer

Required CalMAN Workflow:

- Color Cube (3D LUT) workflow

Color Cube Workflow Overview

In CalMAN, the Color Cube workflow steps you through the process of creating 3D corrective LUTs for display calibration. There are six sections to the Color Cube workflow, outlined below.

In this guide, we discuss page 4B of the workflow; *3D Cube LUT*.

1. Initial Setup

- A. **Session Setup** - Connect meter, source, and LUT devices to CalMAN.
- B. **Session Options** - Select desired display calibration standards.

2. Display Pre-Test

- A. **Gamma & ColorChecker** - Measure display's pre-calibration gamma, white balance, and color gamut response.
- B. **Performance Analysis** - Measure display's pre-calibration color saturation and luminance linearity.
- C. **Advanced Linearity** - Pass/fail analysis of display's key performance parameters.

3. Display Optimization

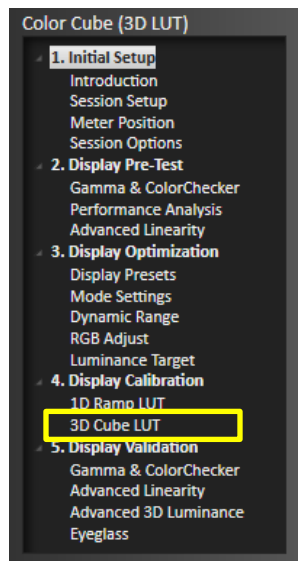
- A. **Display Presets** - Select optimal display presets for picture mode, color space, and automatic image adjustment features.
- B. **Mode Settings** - Select optimal display settings for color temp and gamma.
- C. **Dynamic Range** - Adjust display's black level and white level and test for dynamic range compression.
- D. **RGB Adjust** - Optimize display's RGB white balance controls.
- E. **Luminance Target** - Set display's desired maximum luminance.

4. Display Calibration

- A. **1D Ramp LUT** - Calibrate display's gamma and grayscale tracking with a 1D ramp LUT.
- B. **3D Cube LUT** - Create a 3D cube LUT to correct the display under test.

5. Display Validation

- A. **Gamma & ColorChecker** - Validate display's post-calibration gamma, white balance, and gamut response.
- B. **Advanced Linearity** - Validate display's post-calibration color saturation and luminance linearity.
- C. **Advanced 3D Luminance** - Analyze display's post-calibration luminance response for white, color primaries, and color secondaries (WRGBCMY).
- D. **Eyeglass** - Visually validate display performance with CalMAN Eyeglass.



3D Cube LUT

The *3D Cube LUT* page of the Color Cube workflow (page 4B), is the heart of the Color Cube workflow, where CalMAN creates a 3D corrective LUT for the display under test.

As of version 5.4.0, CalMAN employs three new technologies to create 3D corrective LUTs:

- Intelligent Resolution Profiling™ (IRP)
- Lightning LUT™
- 3D LUT Retargeting

Intelligent Resolution Profiling and Lightning LUT are the new display profiling processes that develop display profile data to feed into CalMAN's targeting engine, which develops correction data to the selected calibration standard and interpolates the correction data out to the desired number of final 3D LUT points. The CalMAN targeting engine now also includes a new 3D LUT retargeting capability.

You select which of the new display profiling processes you wish to use on the 3D Cube LUT page. When you click the *AutoCal* button to initiate the 3D LUT calibration process, the *AutoCal Setup* dialog appears (figure 1).

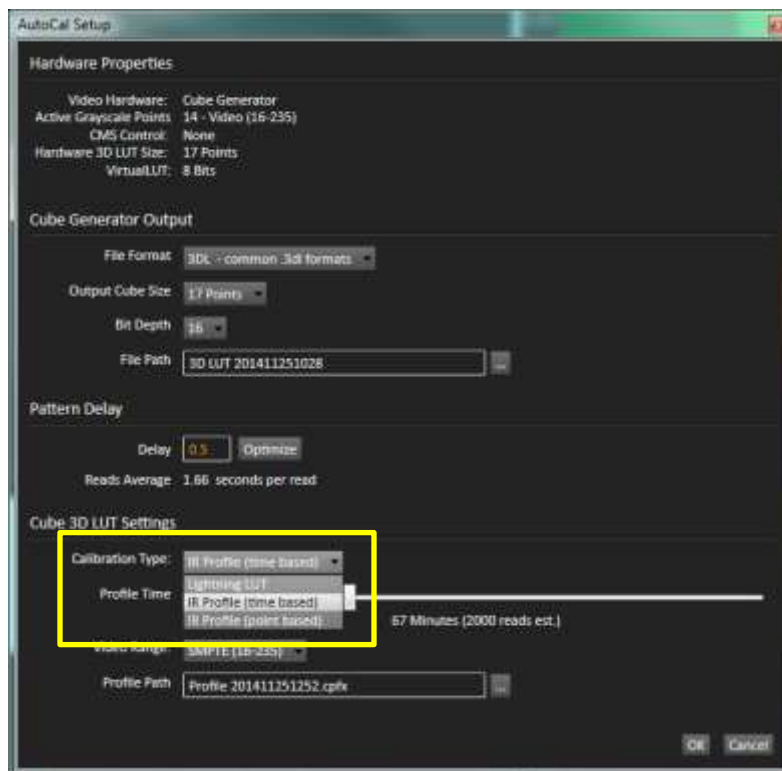


Figure 1: From the Calibration Type selection box, on the AutoCal Setup dialog, you select which of CalMAN's display profiling processes to use.

Under *Calibration Type*, there are three selections for the desired type of 3D LUT calibration profiling, IR Profile (both time-based and point-based), and Lightning LUT. The default calibration type is IR Profile (time based), which is the most powerful and versatile profiling process for correcting all display errors and nonlinearities.

Display Profiling

CalMAN now provides two display profiling algorithms, Intelligent Resolution Profiling (IRP) and Lightning LUT, for profiling a display's color rendering performance and creating a corrective 3D LUT.

- **Intelligent Resolution Profiling™ (IRP)**

The new Intelligent Resolution Profiling algorithm is CalMAN's highest quality method of creating 3D LUT display correction data. If you have from one to four hours available to run a 2000 to 3000 point display profile, the IR Profile process is your best choice for producing accurate 3D LUT correction data.

Every display has some nonlinearity, and IRP is the best 3D LUT process available for correcting nonlinearity. The IRP algorithm, which incorporates proven Dynamic Linearity Correction (DLC) technology, produces more accurate results, with a more efficient process, with a user-friendly process.

The IRP algorithm uses DLC to analyze the display linearity with a small profile of color sample points, then runs a heuristic analysis to evaluate the degree of linearity error that can be corrected within the selected time or with the selected number of measurement points. The IRP algorithm then measures predetermined and DLC-determined color points, develops correction data to the selected calibration standard, and interpolates the correction data out to the desired number of final 3D LUT points. The final display calibration LUT has the highest accuracy possible within the selected time or point limit, for incredible accuracy with any RGB or video display.

IRP provides maximum correction for gamma, grayscale balance, RGB crosstalk, and color gamut, plus it corrects luminance and saturation nonlinearities to the maximum extent possible within the selected time or point limit.

- **IR Profile (time based)**

The "IR Profile (time based)" Calibration Type is the default display profiling process, which is your best and most user-friendly choice to calibrate most displays.

1. On the *AutoCal Setup* dialog, under *Calibration Type*, select "IR Profile (time based)" (figure 2).
2. Then, use the *Profile Time* slider, to select how much display quality you have time for, anywhere from 30 minutes to maximum display quality (6,000 points max).
3. Click the *OK* button to begin the Intelligent Resolution Profiling process.

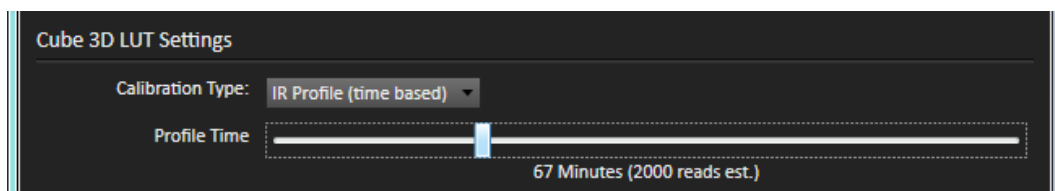


Figure 2: The IR Profile (time based) process allows you to select how much display quality you have time for, then searches out the most nonlinear color space areas and corrects those first.

The "IR Profile (time based)" calibration type uses Intelligent Resolution Profiling to search out the most nonlinear color space areas and correct those first. It then creates the best quality display calibration 3D LUT possible within the selected period of time.

– **IR Profile (point based)**

The “IR Profile (point based)” Calibration Type is an alternate IRP process that allows you to limit the display profile by the number of profiled color points, rather than by the total measurement time.

1. On the *AutoCal Setup* dialog, under *Calibration Type*, select “IR Profile (point based)” (figure 3).
2. Then, in the *Profile Points* edit box, enter the number of color points that you wish to measure on the display, anywhere from 1000 points to 10,000 points for maximum display quality.
3. Click the *OK* button to begin the Intelligent Resolution Profiling process.

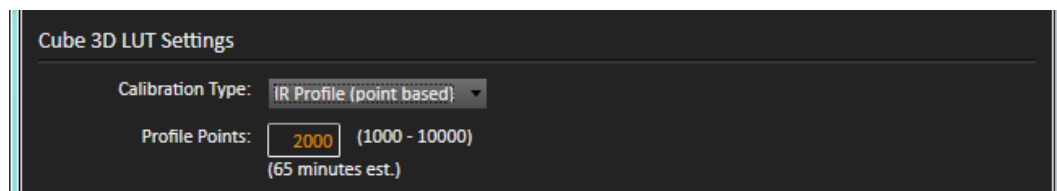


Figure 3: The IR Profile (point based) process allows you select the number of display color points that you wish to profile, then searches out the most nonlinear color space areas and corrects those first.

The “IR Profile (point based)” calibration type uses Intelligent Resolution Profiling to search out the most nonlinear color space areas and correct those first. It then creates the best quality display calibration 3D LUT possible by profiling the selected number of color points.

• **Lightning LUT**

If you don’t have the time for the full linearity correction of an IR Profile and need a 3D calibration LUT very quickly, run Lightning LUT, to check whether it is appropriate for the display being calibrated. The revolutionary new Lightning LUT process in CalMAN produces a high quality display calibration LUT for most professional displays, usually in five minutes or less.

1. On the *AutoCal Setup* dialog, under *Calibration Type*, select “Lightning LUT” (figure 4).
2. Click the *OK* button to begin the Lightning LUT process.

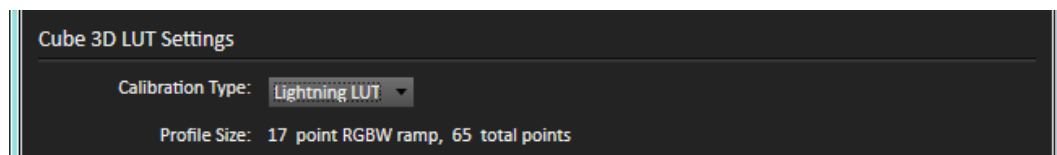


Figure 4: The Lightning LUT process uses an innovative conversion matrix algorithm to produce a high quality calibration LUT in just five minutes or less.

With just 65 to 75 RGBW luminance ramp measurements, Lightning LUT produces a display calibration 3D LUT that rivals the accuracy of CalMAN’s previous 2,000 point DLC calibration, for displays with moderate linearity. An innovative conversion matrix algorithm exploits the full significance of the data at adjacent color points to deliver a very high quality result on most professional displays.

Lightning LUT corrects gamma, grayscale balance, RGB crosstalk, moderate saturation and luminance nonlinearities, and reduces a large gamut volume to a smaller target volume.

However, displays with significant saturation or luminance nonlinearity may produce marginal results with Lightning LUT. Be sure to perform the *Advanced Linearity* validation step in the Color Cube workflow after creating a Lightning LUT to check for high errors due to display nonlinearity.

Displays with significant nonlinearity can be accurately profiled with one of the Intelligent Resolution Profiling processes.

3D LUT Retargeting

The CalMAN targeting engine accepts an arbitrary number of profiled color points from either the Intelligent Resolution Profiling or Lightning LUT profiling process. The targeting engine computes the desired colorimetric values for each of the color points in the selected output LUT (5x5x5 up to 65x65x65), for the selected color space target. It then interpolates the signal values required at each color point to correct the display's native response to the target color space response (e.g. Rec. 709, D65, DCI, sRGB, etc.).

Once you have created a 3D corrective LUT for a display with one set of display calibration targets, CalMAN can very easily retarget the original display profile to create one or more additional LUTs, with different calibration targets, without performing additional display measurements. You can retarget existing display profile data to a different color space in as little as 30 seconds, depending on the output LUT size.

1. On the CalMAN *Display Control* tab, click the "Retarget LUT From Profile" button (figure 5).
2. On the file explorer window that opens, select the desired display profile .cpfx file.
3. On the *Import 3D LUT* dialog that opens (figure 6), select the desired colorspace and gamma targets for your new 3D LUT.

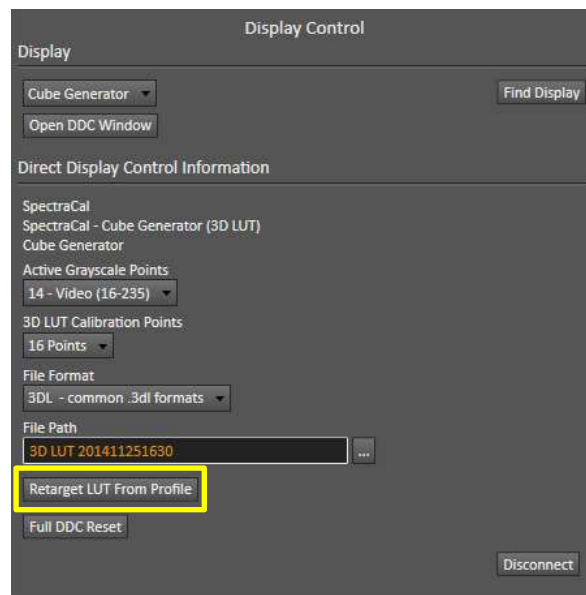


Figure 5: On the CalMAN Display Control tab, click the "Retarget LUT From Profile" button to create an additional LUT with different calibration targets.

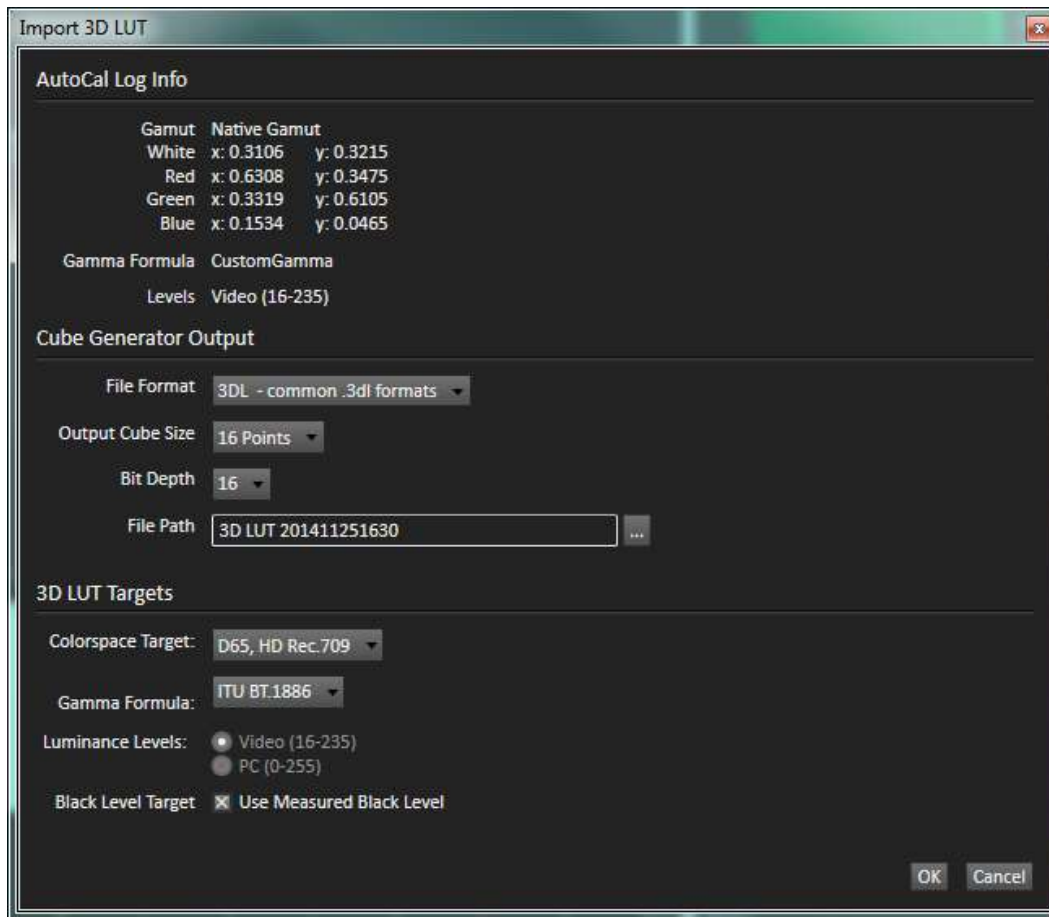


Figure 6: On the Import 3D LUT dialog, select the desired colorspace and gamma targets for your new 3D LUT.

The new 3D LUT retargeting function simply accesses the original saved display profile, re-computes a 3D LUT interpolation to the new color space, and writes a new LUT file.

In just minutes you can have an additional 3D LUT to retarget your display to a new color space.