CalMAN Calibration of Dolby Vision

The CalMAN Dolby Vision workflow allows users to calibrate your VIZIO SmartCast P-Series Home Theater Display.

Dolby Vision has several key differentiators that are essential to understand in order to characterize devices. First, when using the Dolby Vision workflow, it is important to note that Dolby Vision works with absolute luminance values in cd/m² instead of relative values. Dolby Vision supports very large color volumes with luminance levels ranging from 0.0 (absolute black) to 10,000 cd/m² and wider color gamuts such as Rec.2020 color. As common display devices are unlikely to support the full extent of this range, the P-Series maps content in real-time from this large input color volume to the color volume of the actual display. This process preserves as much of the fidelity of the original source color volume as possible.

Additionally, unlike today’s systems that use Gamma curves, Dolby Vision utilizes a new tone response curve (also called ‘EOTF’), and bit depths of 10 Bits or higher. This helps to avoid any potential quantization errors that can cause image artifacts such as contouring or ‘banding’. The new EOTF is described in SMPTE standard ST.2084.

For calibration, there are some conceptual changes that are different for Dolby Vision. The goal of a calibration is not to closely match the performance of a TV to an industry standard color description such as Rec.709. Instead, due to the intelligent real-time mapping of the large input color volume to the display’s capabilities, characterization and calibration are carried out against a ‘Golden Reference’. The ‘Golden Reference’ describes the full capabilities unique to this display model and has to be selected before starting any measurement.
Requirements:

- A license for SpectraCal CalMAN version 5.6 or greater
- A Windows® based PC with HDMI® port. The HDMI output has to be capable of providing a Full HD (1920x1080) RGB signal at 4:4:4 color
- A capable measurement device (e.g. Konica-Minolta CS2000, Photo Research PR740, Klein K10A, Jeti Specbos 1211, SpectraCal C6 Colorimeter).
- A dark room to avoid the influence of stray ambient light when measuring. Ideally, use a contact measurement probe or a frustum tube in front of a spot measurement device.

To begin calibrating your P-Series Display:

1. **CalMAN Dolby Vision Workflow:**

After starting CalMAN, the Dolby Vision workflow presents itself with a landing page introducing its general concept.

Select **Next** to continue.

2. **Connect devices to CalMAN**

Follow the on-screen instructions to properly connect the hardware components needed for CalMAN.

When you are finished, select **Next** to continue.

3. **Verify TV is in Dolby Vision Mode**

Follow the on-screen instructions to verify that the TV is in Dolby Vision mode.

Select **Troubleshooting** for a few helpful tips if you are having trouble.

When you are finished, select **Next** to continue.
4. Pre-Calibration Settings

Before you begin with the calibration of the display, it is important that you verify that all the settings in your display’s GUI (Graphical User Interface) match the ones provided with the ‘Golden Reference’. This is necessary as the calibration profile of the Dolby Vision you selected on the previous workflow page is unique to that of the VIZIO P-Series Display. Incorrect GUI settings can bias characterization results and ultimately affect picture quality. Therefore, when characterizing the display for the first time, please verify that the settings match those of the ‘Golden Reference’.

If you have already carried out a calibration and have custom values set in your Display, it is advised to write down the ‘As Found’ GUI settings accordingly before proceeding with this workflow. This will give you a reference of your settings before starting the characterization and calibration process.

Similar to recording the P-Series ‘As found’ GUI settings, it is beneficial to measure key parameters of the display as reference. This will help in the following step when comparing the effectiveness of any calibration. As with traditional CalMAN workflows, press the Read Series button ( ) in the lower right to automatically measure all key parameters, such as luminance distribution, gray scale performance as well as color primaries and secondaries.

When you are finished, select Next to continue.
5. Determining the White-Balance

The white point of the VIZIO P-Series Display is D65 (which describes a correlated color temperature of 6504 Kelvin). Changing the white-point of an imaging system can have an impact on the maximum luminance. Therefore, the white-point needs to be verified first before continuing with any further measurements.

When you are finished, select **Next** to continue.
6. Determining the Absolute System Black and White Levels

Display Minimum and Maximum Luminance
Dual modulation or ‘local dimming’ displays usually have a grid of light sources (usually LEDs) behind the LCD panel. This enables the display to selectively emit light behind specific, bright parts of the image, while simultaneously dimming the LEDs behind dark parts of the image. This is different than today’s legacy monitors that use ‘globally’ backlit or edge-lit displays, where the full backlight is constantly on (or globally dimmed).

This dual modulation technology enables the display to simultaneously increase the available contrast, leading to deeper blacks, while at the same time providing crisp and bright highlights, both of which are highly beneficial to maximize the benefits when watching Dolby Vision content.

This workflow step identifies the luminance capabilities of the P-Series display by measuring the intensity levels of three distinct measurement targets: This target size provides an assessment of the display’s capabilities to render small bright areas or highlights in images with a low average picture level.

Small Patch Maximum White Measurement
A common approach to identify the maximum luminance of a dual modulation display is to measure a white L20 patch on a black background. This target size provides a solid benchmark assessment of the display’s capabilities to render small bright areas or highlights.

Full Screen White Measurement
Depending on the way the display is designed, the full screen maximum luminance can vary from a smaller L20 patch measurement. This can, for example, be due to energy saving or internal thermal management reasons. Therefore, full screen white is measured and reported in addition to the L20 white.
Black Level

The final measurement is to identify the black level of the display. The P-Series displays switch off their backlight if they receive a full or mostly black image. The benefit of this is that the display is not visible in a fully darkened room. However, this is a special case, which usually only happens with fades to and from black\(^1\). As soon as there are any lighter (non-black) pixel areas in the image, Active LED control, when enabled, takes over.

Therefore, to measure a more ‘realistic’ black level with a dual modulation display, CalMAN uses the corner box black level target\(^2\). This approach stops the display from switching off its backlight and therefore provides a better measurement of what black levels can be achieved with normal, not fully black content.

When you are finished, select Next to continue.

7. Check Gray-Tracking

Here you will find tools to measure and correct the gray scale performance of the P-Series. Similar to the gray scale calibration in other CalMAN workflows, the goal is to align the white-points of a gray ramp, which is D65 in the Dolby Vision system. Further, in the Dolby Vision workflow, the gray-scale calibration is carried out in PQ instead of Gamma.

When you are finished, select Next to continue.

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\(^1\) This happens when the content fades to a full black screen e.g. at the end of a movie or from black at the beginning.
\(^2\) Further information about the test targets can be found in the SID/ICDM Information Display Measurements Standard v1.3. 5.13 CORNER-BOX CONTRAST.
8. Calibrate Color Management Systems

This workflow step helps to assess and potentially correct deviations of the P-Series’ display primary and secondary colors from the Golden Reference.

The Golden Reference primaries, secondaries and white point are depicted in the color gamut plot as open squares. Their measured counterparts are shown as open circles. Ideally, the circles lie inside the squares, which indicates that there is a match between Golden Reference and measurements. If they do not match, then the color settings of the display require adjustment, usually by using the display’s color management system (CMS).

A more comprehensive tool to assess any deviation between reference and measurement is provided by error bar plots (using the industry standard DeltaE 2000 color difference metric). Those plots are separated into luminance, saturation and hue error, simplifying fine-tuning using the CMS. Here, the lower the bar (or the closer to 0.0), the closer the match to the Golden Reference.

Please refer to the CalMAN user manual for further explanation.

When you are finished, select Next to continue.

9. Verify Measurements

This final step of the workflow provides an overview of the effect of any new settings after all the calibration steps have been carried out. To get an assessment of how the Display calibration has improved, the result from this workflow step can be compared with the measurement from the pre-test.
10. Post Calibration Settings

Please record the new GUI settings after a successful calibration has been carried out.

11. Generate Report

After the Dolby Vision workflow has been carried out, CalMAN can generate a report, illustrating all findings. This is very similar to other CalMAN workflows. Please refer to the CalMAN user manual for further explanation.

The VIZIO P-Series Display performs to its design specifications when the deviation to its Golden Reference is minimal.

Further information about Dolby Vision and its technical concepts can be found under:

- Dolby Vision Website
- Dolby Vision Whitepaper

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About VIZIO

VIZIO’s mission is to deliver the ultimate entertainment experience through our community of connected consumers, advertisers and media content providers. Through our connected entertainment platform, VIZIO is transforming the way consumers discover and experience media content. Since our founding in California in 2002, VIZIO has built an industry-leading brand and sold over 65 million products, including televisions, sound bars and other devices. VIZIO has achieved significant U.S. market share and held the #1 unit share position in the U.S. sound bar industry¹ and the #2 unit share position in the U.S. Smart HDTV industry in 2014². VIZIO product leadership is highlighted by a number of industry reviews and awards including a 2015 CNET Editors’ Rating of 4 stars for a review of our E-Series Smart TVs³, 2015 Editors’ Choice award from Reviewed.com for our M-Series 4K Ultra HD Smart TVs⁴ and Sound & Vision’s Top Picks of 2014 for 42” and 54” Home Theater Sound Bar Systems. For more information, please call 888-VIZIOCE or visit www.VIZIO.com.

¹ The NPD Group/Retail Tracking Service, sound bar units sold in the U.S., January 2013—December 2015.
² The NPD Group/Retail Tracking Service, LCD TV units with Apps included and display resolution of 1336 x 768 and higher, total units sold in the U.S., January 2015—December 2015.
³ Visit cnet.com for the full 2015 VIZIO E-Series Review, published 6/6/15
⁴ Visit reviewed.com for the full 2015 VIZIO M-Series Review, published 6/29/15