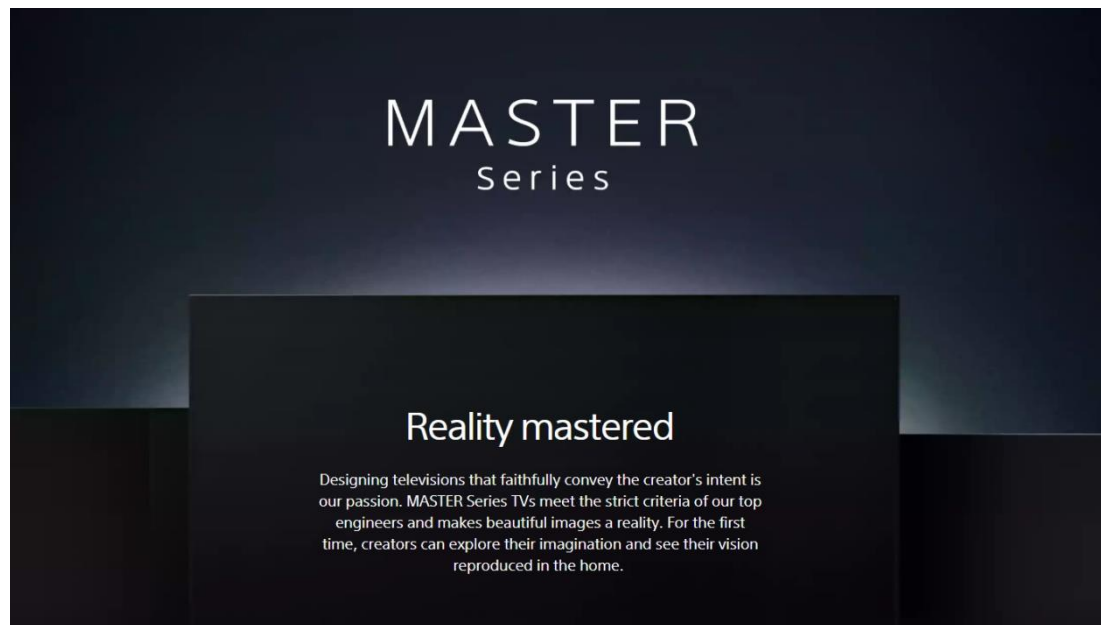


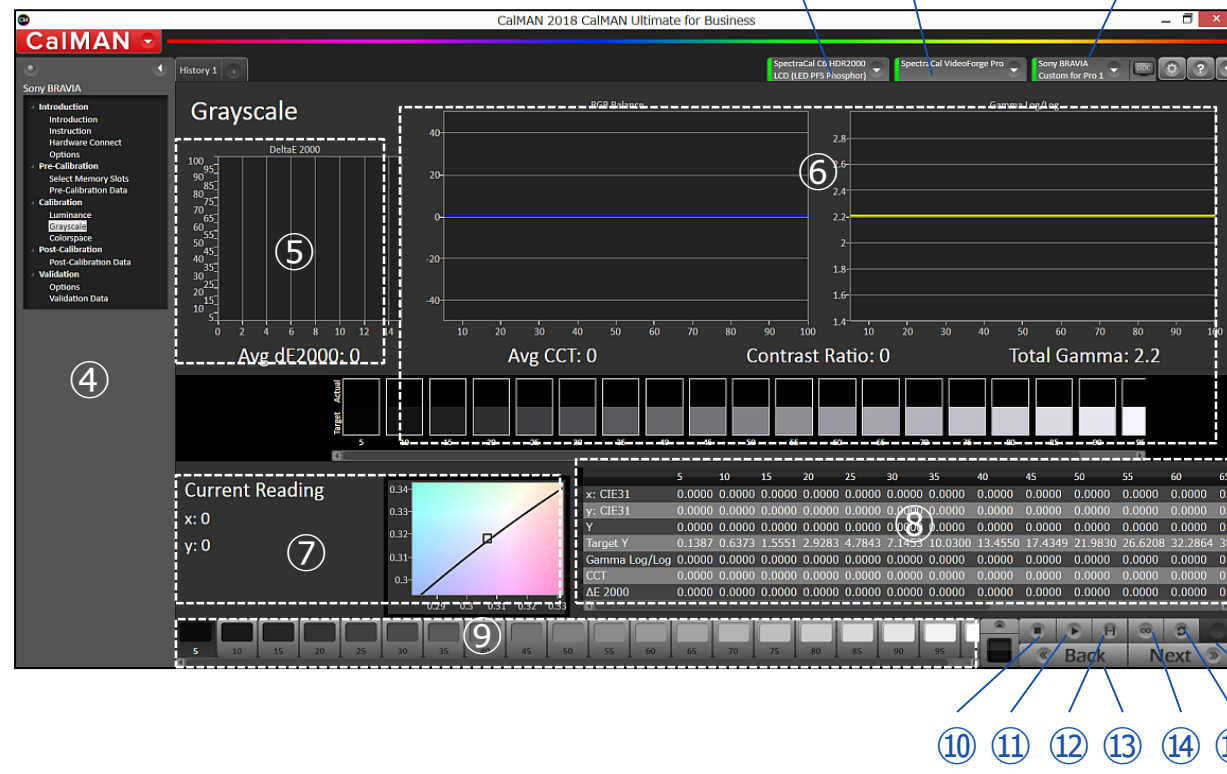
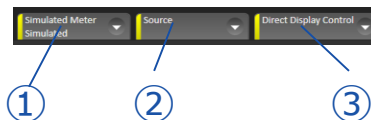
Calibrating BRAVIA with Calman

Calibrating BRAVIA has never been so easy. Our new MASTER Series is now **Calman Ready** with the “**workflow**” specifically made available for calibrating BRAVIA. Pretty much all of the calibration processes will be automated – it will actually take less time to calibrate than to get everything prepared and connected.



<https://calman.spectracal.com/sony-autocal.html>

When the devices are connected and ready to be used, it will be indicated as so in **green**. Otherwise the status indicator will be in **yellow**.



No.	Description
1	Meter (measurement device) Settings tab.
2	Source (Pattern Generator) Settings tab.
3	Display Control tab.
4	Workflow outline pane
5	dE (delta E) indicator. To understand what dE is, here is a good reference: http://zscheussler.github.io/DeltaE/learn/
6	Measurement result indicator (visual)
7	Current reading indicator, numerical and visual (chromaticity)
8	Measurement result indicator (numerical)
9	Source indicator (list of injecting test patterns for measurement)
10	Stop Button: Stops current action
11	Read Single Button: takes one reading after showing a pattern selected from within ⑨
12	Read Series Button: takes readings of all test patterns in ⑨
13	Back Button: goes back a page in a current Workflow
14	Read Continuous Button: Continuously takes readings from the meter while displaying a pattern selected within ⑨ until stopped by the Stop Button
15	AutoCal Button: Performs Auto Calibration for the task defined in the current workflow page. This button will be disabled if for any reason AutoCal is not possible (e.g. Display Device is not connected, unsupported protocol, etc.)
16	Next Button: Moves to the next page in the workflow



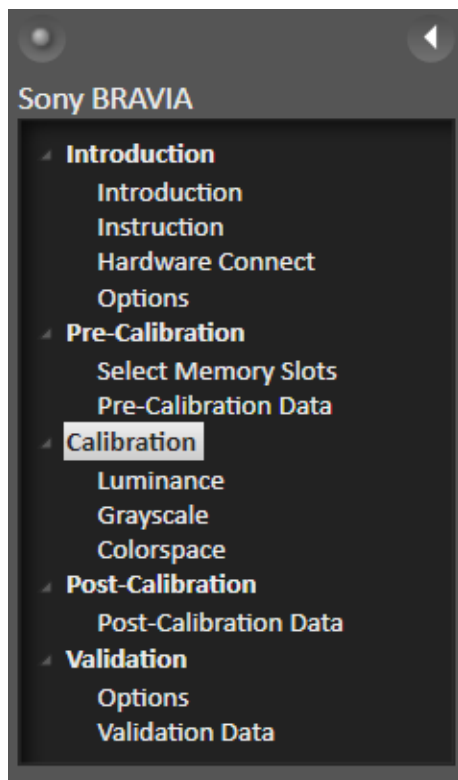
CaIMAN

BRAVIA

Sony Android TV Workflow

This workflow designed to calibrate Sony's upper-end Android TVs including Z9D and subsequent LCD and OLED models. The workflow options are pre-configured so once connected over DDC, you will simply have to click "AutoCal" button on each of the following pages (Luminance, Grayscale, and Colorspace) to calibrate.



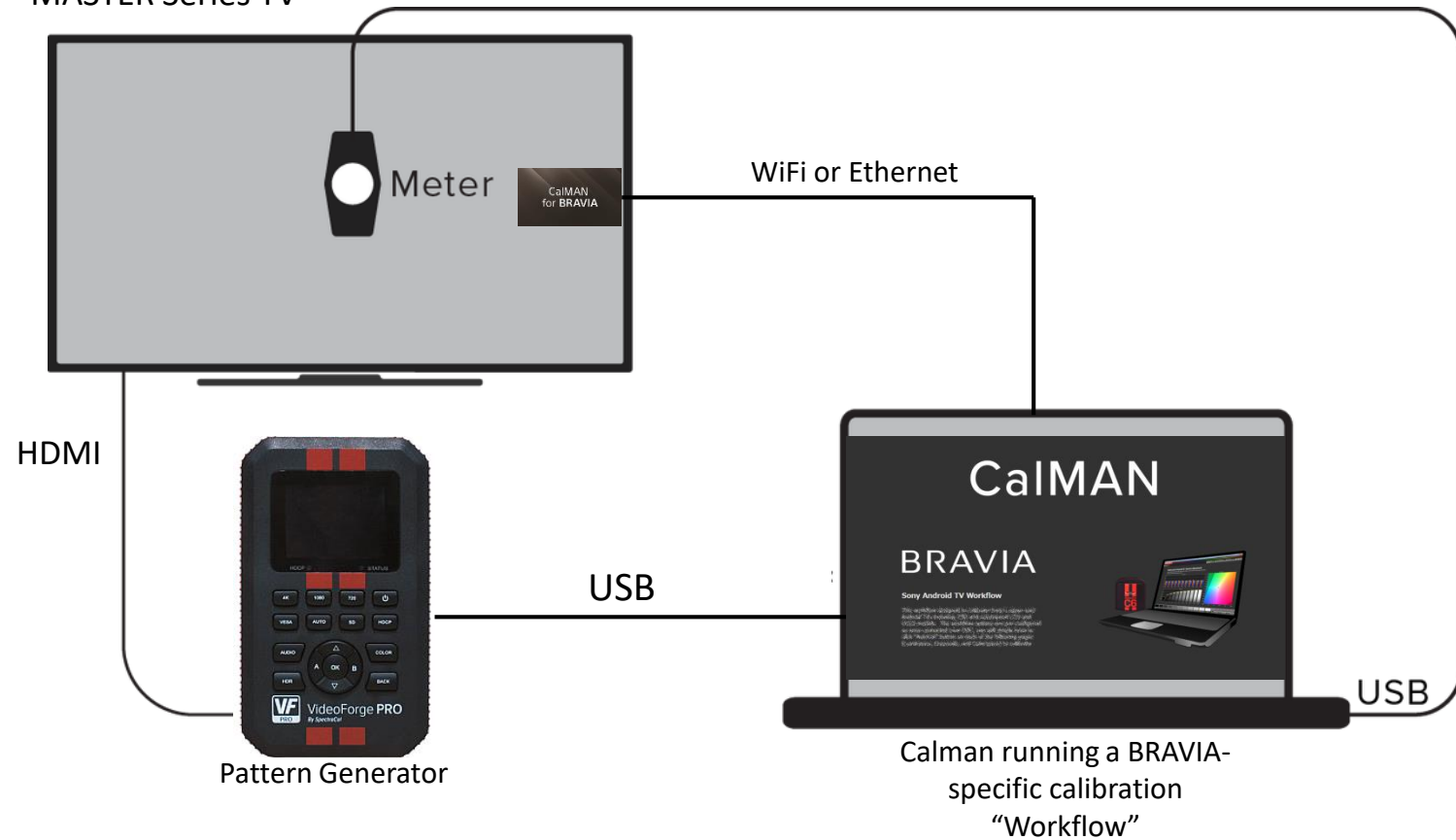


Simple and Easy Steps

Sony BRAVIA Workflow will be released along with Calman's RC3 Release scheduled in late September, 2018.

Page Title	Description
Introduction	Title Page
Instruction	A page that gives step-by-step instructions of what to do
Hardware Connect	A page to let the user to connect Calman to a meter, a pattern generator, and a TV
Options (under "Introduction")	Sets calibration targets
Select Memory Slots	Sets where calibration data is stored
Pre-Calibration Data	A page to take measurements before running calibration
Luminance	Calibration: Luminance
Grayscale	Calibration: white balance and gamma
Color Space	Calibration: color space
Post-Calibration Data	A page to take measurements after calibrating
Options	Sets validation options (e.g. different gamma formula, etc.)
Validation Data	A page to take measurements with, e.g., modified gamma target.

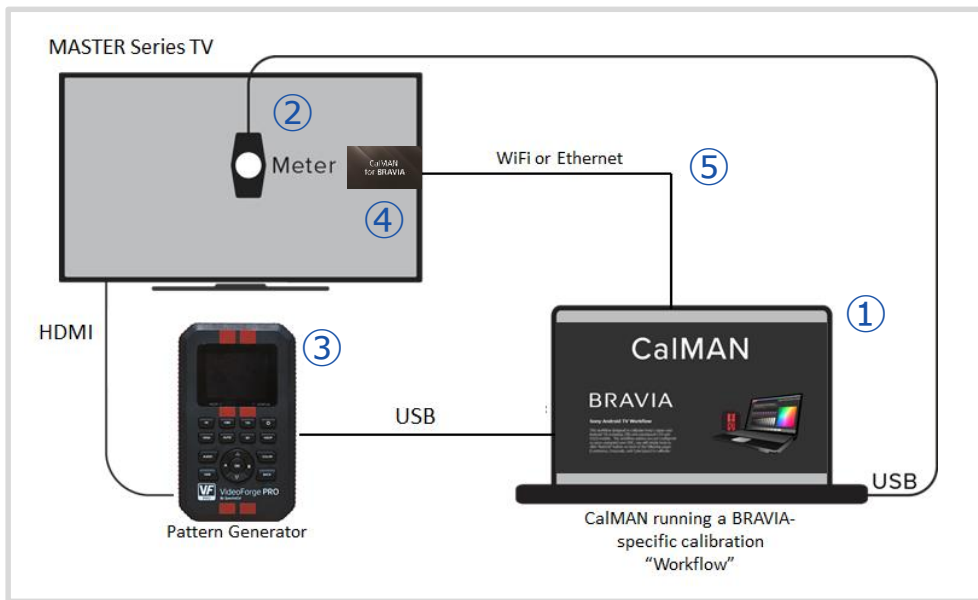
MASTER Series TV



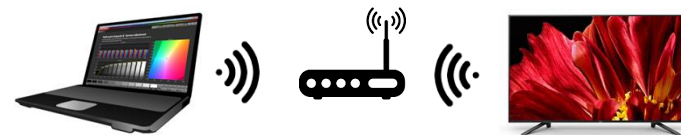
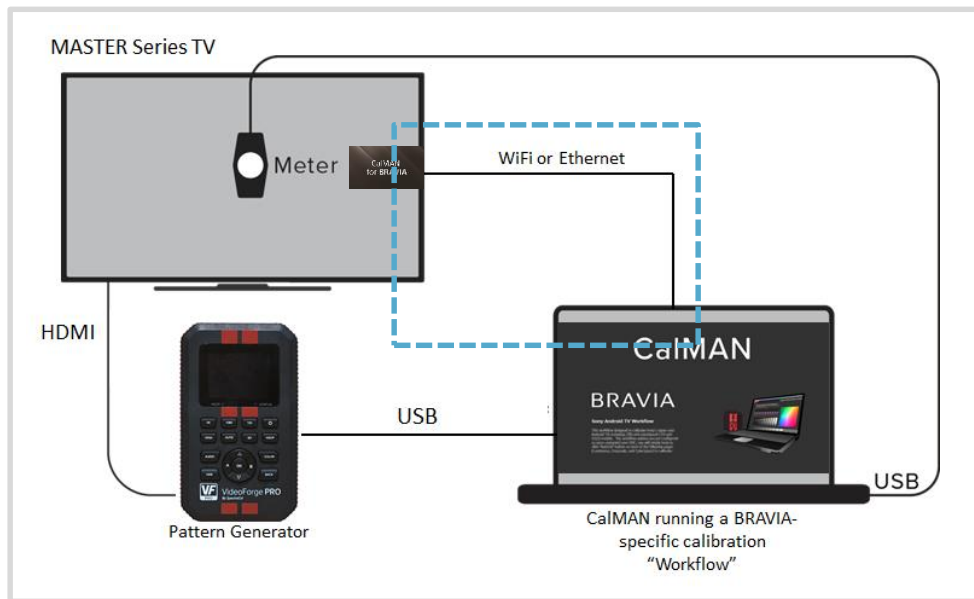
Pattern Generator

Calman running a BRAVIA-specific calibration
"Workflow"

What you need



- ① **Calman** running on a PC
- ② **Measurement Device** (Colorimeter or Spectroradiometer)
- ③ **Pattern Generator**
 - For BRAVIA workflow there is no need pattern generators capable of injecting HDR metadata, but if you would like to verify calibration in HDR, you would need a generator capable of generating HDR patterns or a device such as HDFury for injecting metadata into infotext.
- ④ App running on BRAVIA (**Calman for BRAVIA**)
- ⑤ Network that connects Calman and BRAVIA
- ⑥ Miscellaneous
 - An HDMI cable
 - USB cables (having a **USB extension cable** will be helpful because the cable for measurement devices are usually not that long).



Option 1: Have them both connected to the same WiFi access point



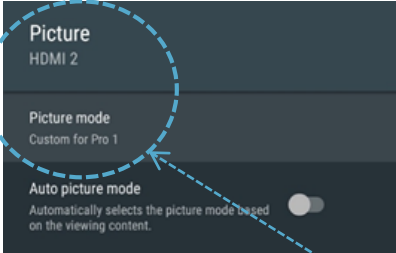
Option 2: Have them both wired (Ethernet) to the same hub



Option 3: Have them connected directly with a single straight (not crossover) CAT cable

Calibration Memory Slots

You can check current Input/Picture Mode combination from the “picture adjustment” menu.



Parameter 1
Parameter 2
Parameter 3
...
Brightness (Luminance)

There are a set of parameters associated with the combination of Input & Picture Mode. Even if the same Picture Mode (e.g. Custom for Pro 1) is set for both HDMI 1 and 2, the luminance control will be separate.



HDMI 1

HDMI 2

Custom for Pro 1 (or 2)

HDMI 3

HDMI 4

Parameter 1
Parameter 2
CMS (HSL for RGBCMY)
...
Color Temperature (Expert 1)

CMS will be managed per picture mode. For the time being, CMS can be auto-calibrated only on Custom for Pro 1 and 2 modes.

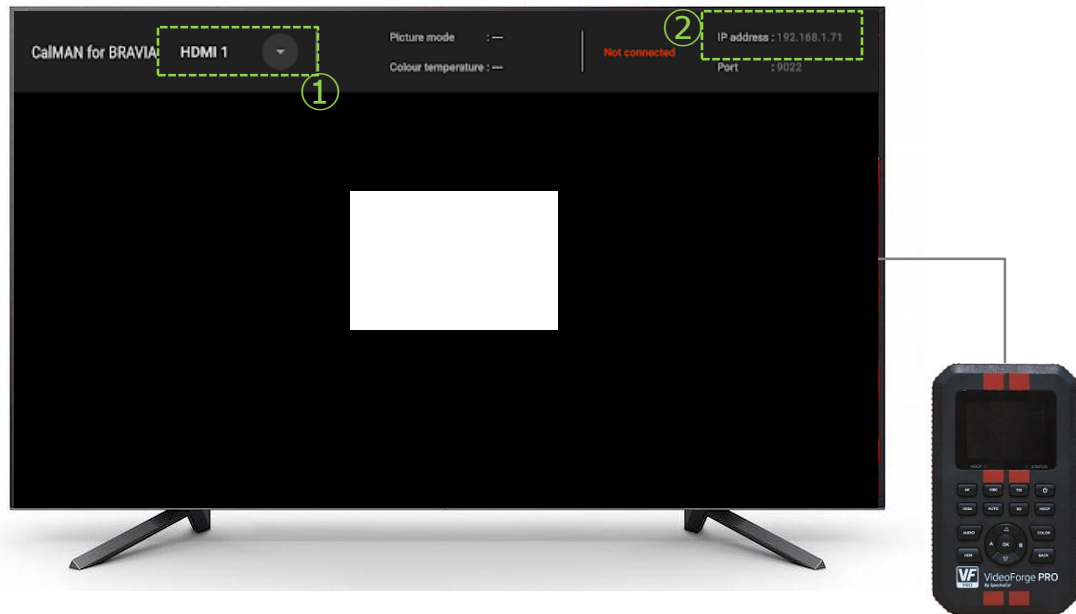
Grayscale calibration is per color temperature mode. Whatever input or picture mode being selected, **so long as Expert 1 or 2 Color Temperature is selected** the grayscale calibration results will be intact.

RGB Offset, Point 1
RGB Offset, Point 2
...
...
RGB Offset, Point 20

Download and Install “The App”

There is an Android app called [Calman for BRAVIA](#) available on Google Play. Search, download, and install the app onto your BRAVIA. This app not only handles the communication with Calman, **but it also serves as a key** to enable designated picture modes for calibration ([Custom for Pro 1 and 2](#)) and [20-Point grayscale](#) calibration instead of just 10 points. The 10 to 20 point expansion will occur when the 1st attempt is made to have Calman connected with BRAVIA.

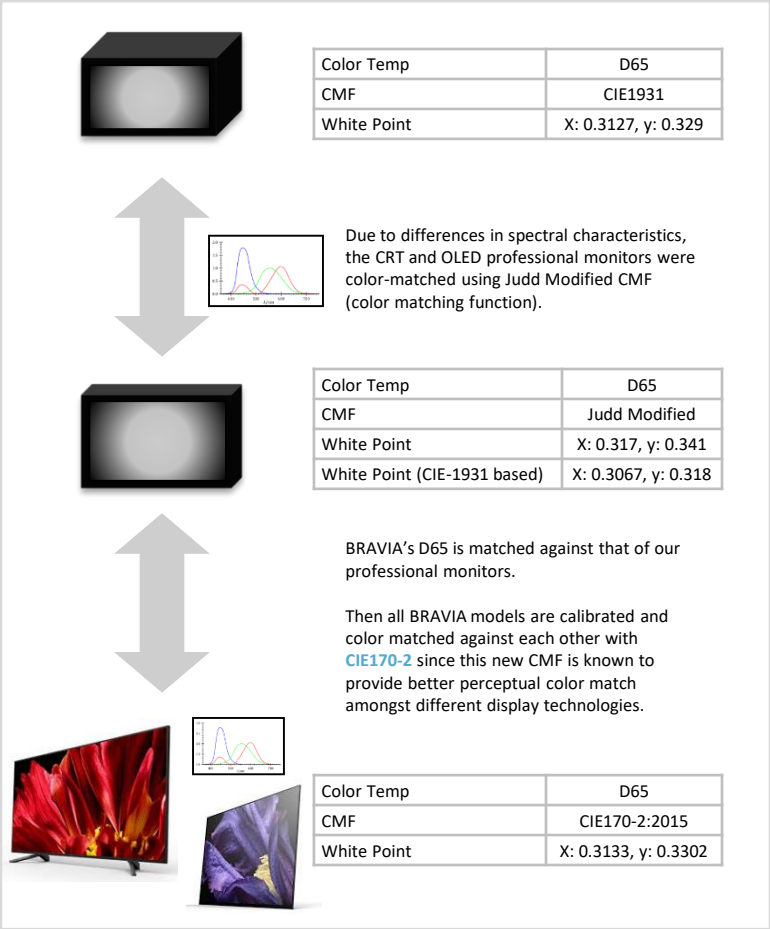
CalMAN
for BRAVIA



Before you move on, check the following:

- When you have a test pattern connected to the TV but nothing is shown on the screen, **change the input switch in ① with your remote controller.**
- If no **IP address** is shown at a box in ②, re-check the network settings (cable connection, WiFi module on/off, etc.)

BRAVIA Calibration Concept



Calibrate SDR Only

You would just have to calibrate BRAVIA in **SDR** for the following gamma, white balance, and color space targets. Once calibrated for these targets, you are all set for other gamma formulas (e.g. 2.4, and even for HDR) and color spaces. BRAVIA will take care of the rest since it's all about calculation and conversion. The following values have already been selected as default in **Calman's "Options" Page**.

Color Space	Rec. 709
Color Temperature (white point)	D65
Gamma Formula	Power 2.2

About Sony D65

As described and illustrated to the left, BRAVIA's D65 traces back to the "look" of standard D65 (CIE01931) on Sony's CRT professional monitors. To compensate for spectral differences and to achieve perceptual color match, BRAVIA's D65 is slightly different from that of CRT monitors based on CIE1931. Most of the measurement devices out there today are being configured for CIE1931 and using alternate CMF for calibration isn't going to be that easy. If you are calibrating your monitor to the standard D65, use default settings. If you would like to restore BRAVIA's factory calibration or to match against Sony's professional monitors, follow the instructions on p.19~20 and edit target white point values (x and y) accordingly.

https://www.jeti.com/cms/images/jeti_com/down/papers/lux_2017.pdf
https://www.sony.jp/products/catalog/FUN_WhitePaper_OLED_ColorMatching_V1_00.pdf

Prepare for Calibration

Calibrating BRAVIA with Calman

Prepare

Select

Calibrate Luminance

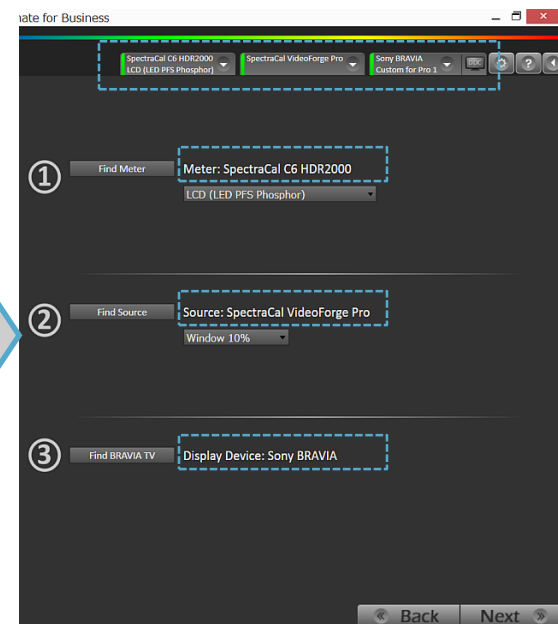
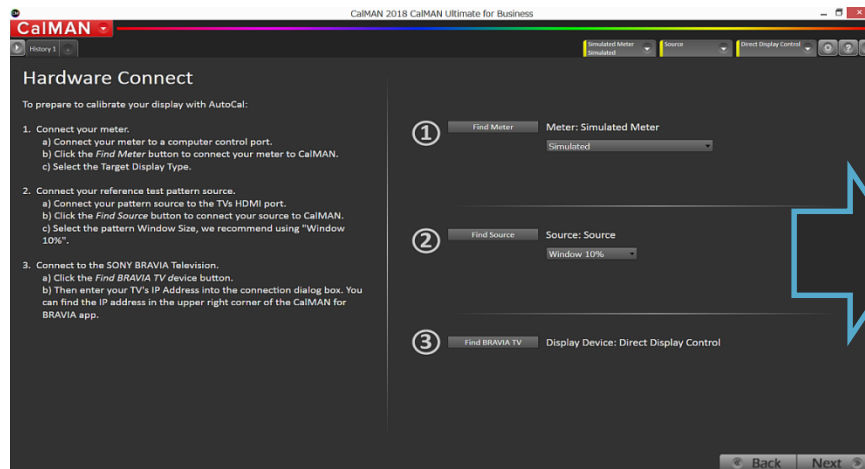
Calibrate Grayscale

Calibrate CMS

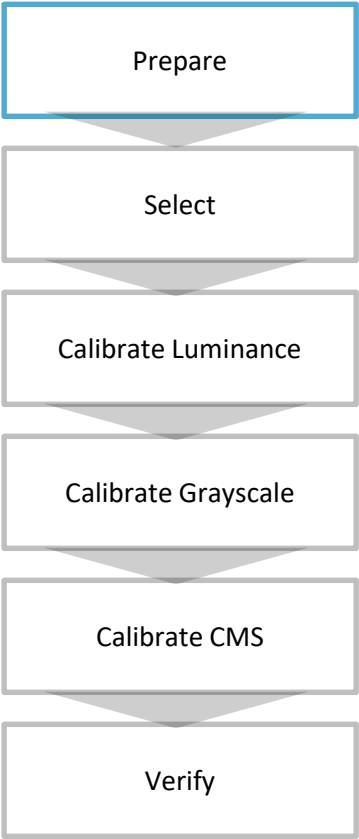
Verify

Get devices connected both Physically and at Software Level

After having everything connected physically as described in **Pages 6~8**, make sure Calman is communicate. Follow the instructions on “**Hardware Connect**” page carefully and press “**Find Meter**”, “**Find Source**”, and “**Find BRAVIA TV**” buttons in order. Everything should be “green-lighted” and correct device names should be indicated after this process.

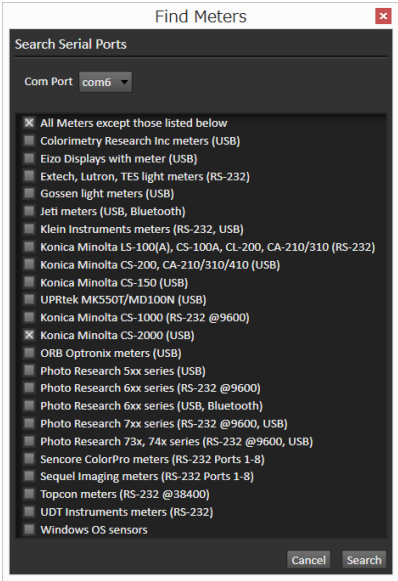


Calibrating BRAVIA with Calman



Find Meter

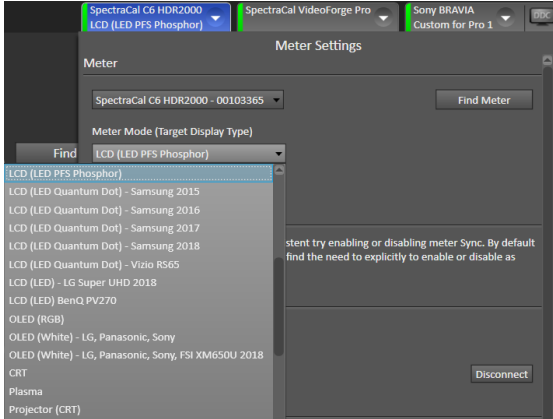
When hitting “**Find Meter**” button, there will be a popup with a list of measuring device names. If the **Com Port** number happens to be empty, please check if you have the driver pack installed or not. You should be able to locate and connect with the device by simply hitting “**Search**”.



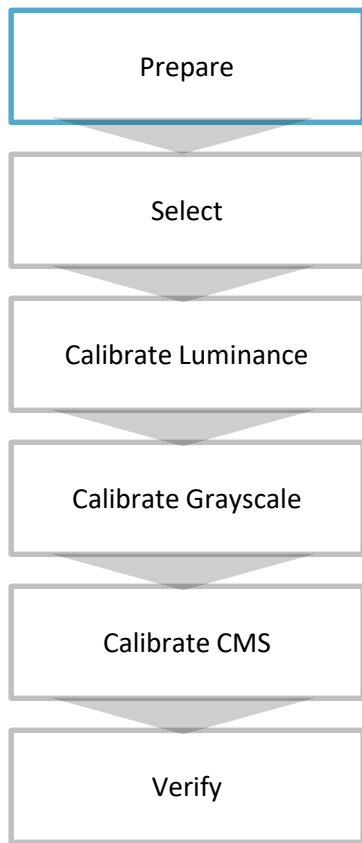
Check “Meter Mode”

After the meter is connected, make sure to select the right or the closest EDR (emissive display reference, indicated on Calman as “**Meter Mode**”) for the technology of the display device you are calibrating. For MASTER Series models, choose the following Meter Modes from the dropdown list.

Model	Meter Mode
A9F	OLED (White)
Z9F	LCD (LED PFS Phosphor)

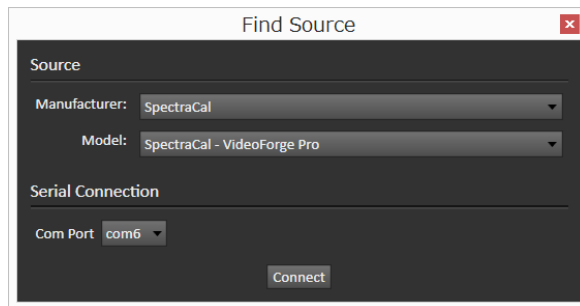


Calibrating BRAVIA with Calman



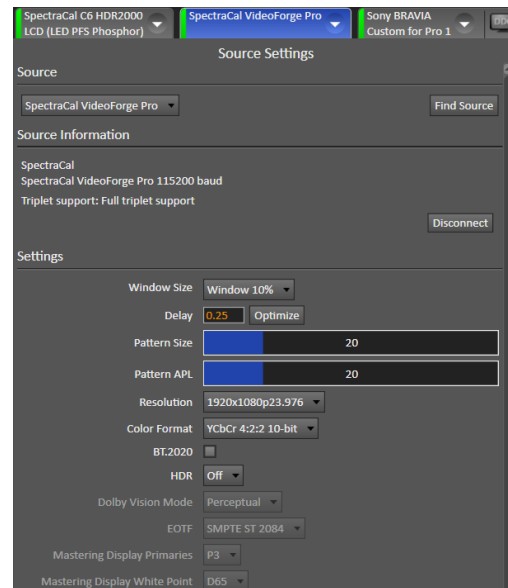
Find Source

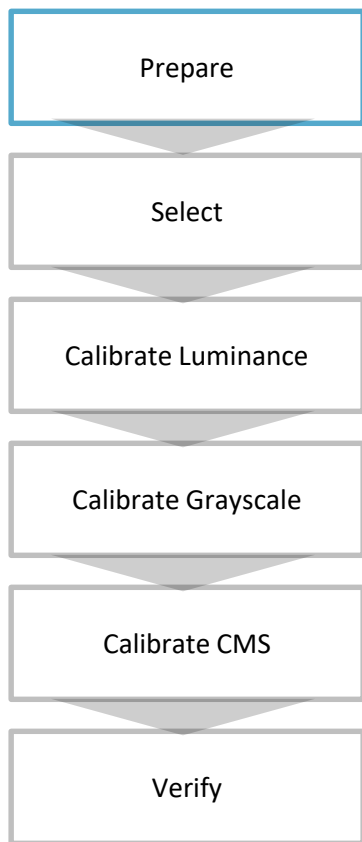
After hitting “**Find Source**” button, select manufacturer and model names from the drop-down. If the **Com Port** number happens to be empty, please check if you have the driver pack installed or not. You might need to install the driver that came with the device you purchased. Hit “Connect” to connect.



Color Format, Window Size, Delay

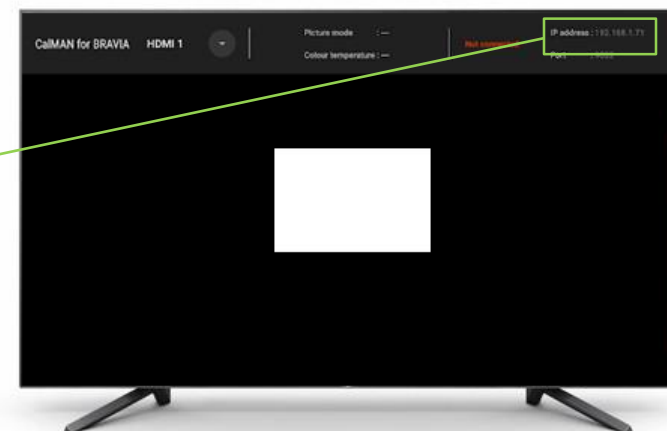
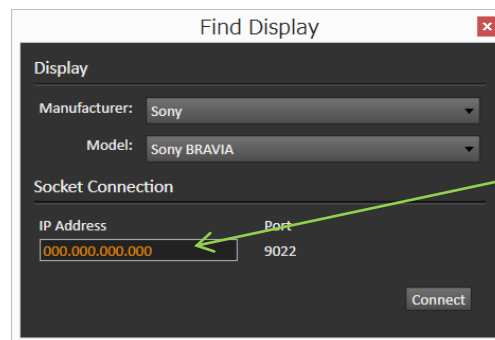
For pattern generators, our recommendations are to have **Color Format** set to **YCbCr Limited 10 bit**, and the **Window Size** being set to **10%** throughout the calibration process. “**Delay**” affects the time required for the entire calibration process – you may want to hit “**Optimize**” to see what works the best for the target display device.



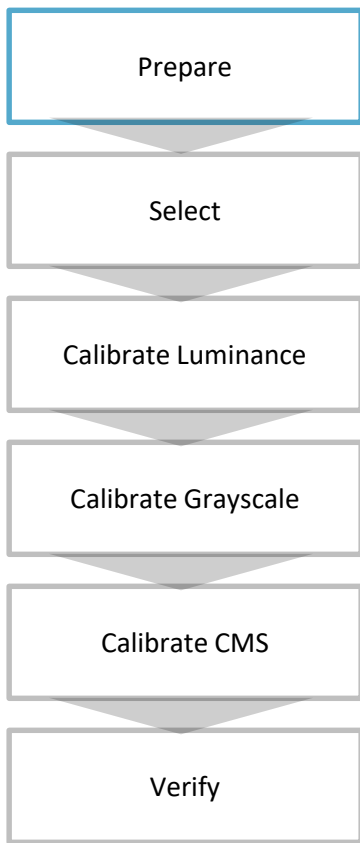


Launch the App, and Get the TV Connected

Launch **Calman for BRAVIA** app on your TV. When launched, as described in Page 10, the **IP address** of your TV will be shown on the top-right corner. Type that IP address into Calman's **Find Display** box, and hit "Connect". Once connected, GUI of the app will disappear so it won't affect the calibration. At this point, TV and Calman are connected and ready to communicate over **DDC (Direct Display Control) Protocol**.



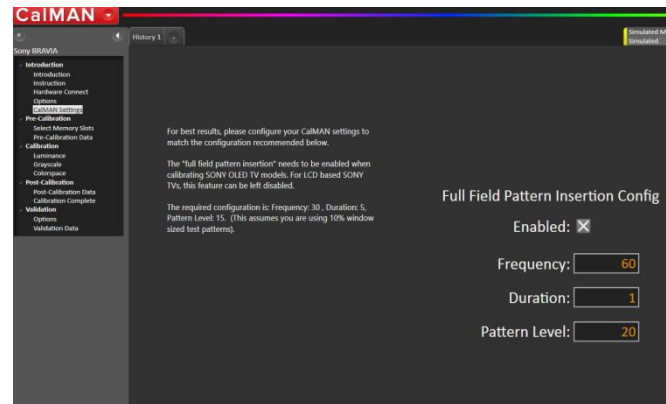
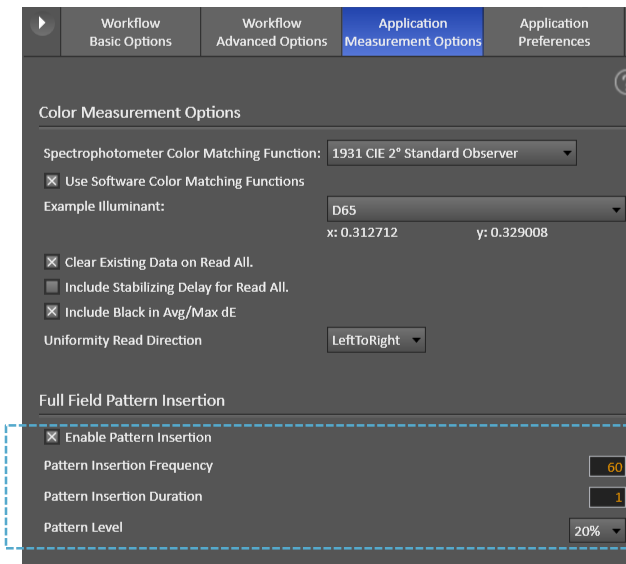
Calibrating BRAVIA with Calman



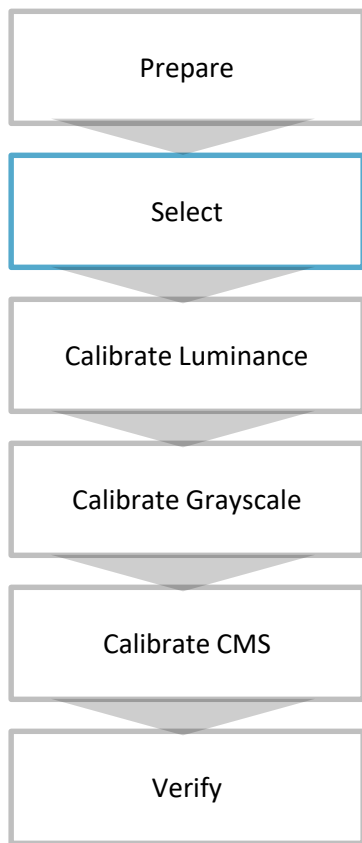
Preventing Auto Dimming during Calibration

To prevent auto-dimming (on OLED models) function from kicking in, make sure to have the “**Full Field Pattern Insertion**” feature enabled. You can change the configuration of the feature either from the designated page (“Calman Settings” page) in the workflow or from “Application Measurement Options” tab. The default numbers should be fine. ISF’s preferences are as follows:

- Pattern Insertion Frequency: 30
- Pattern Insertion Duration: 2
- Pattern Level: 5%.

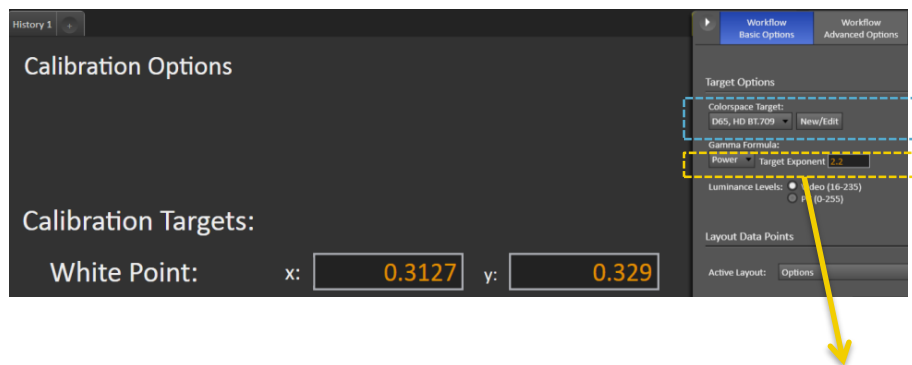


Calibrating BRAVIA with Calman

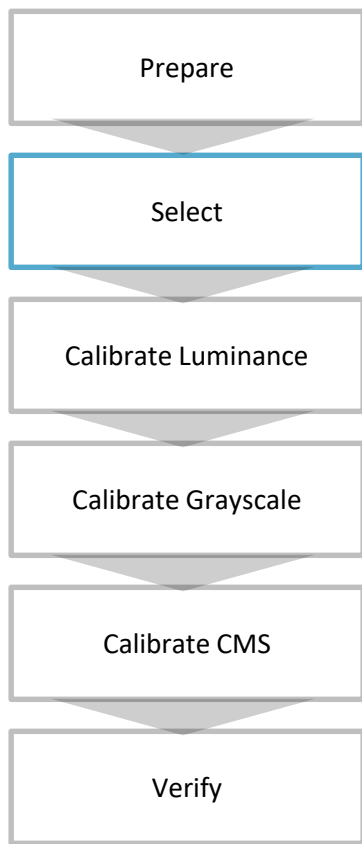


Set Calibration Options

As explained earlier in Page 11, you would only have to calibrate BRAVIA in **SDR** at D65, Gamma 2.2, and BT.709, and those values are set as Workflow defaults. You can verify them in “**Options**” Page. For the white point target, the current default value is the standard D65 (CIE1931) because that’s by far the most commonly used target.



Double check the **gamma formula** setting in Workflow Basic Options. Unless absolutely needed for your display usage purposes, please leave this set at Power 2.2, especially if you are using the display for viewing HDR contents.

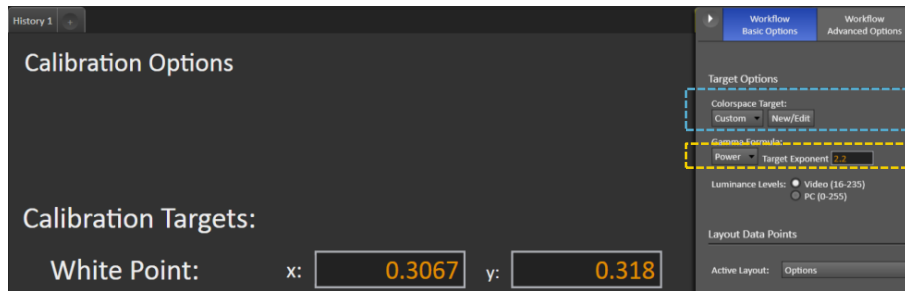


Set Calibration Options Cont.

In creative environment, if you are trying to **color-match** against a professional monitor, **measure x/y** on that monitor with a meter, type in those numbers in the White Point fields, and calibrate using that very same meter used for measurement.

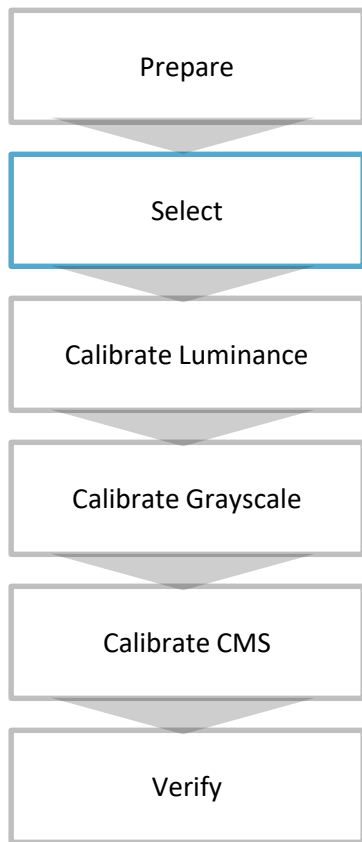
If you are calibrating to **restore BRAVIA's factory calibration**, the best option would be to get a meter/probe calibrated for **CIE170-2:2015** (e.g. Konica Minolta CA-410's CA-P427C and CA-P410C) and use **x:0.3133, y:3302** for the target white point.

If you have no access to such meters and are using CIE1931 colorimeter such as SpectraCal C6-HDR, the next best thing you can do is to edit White Point boxes as **x:0.3067, y:0.318**. White OLED displays should be pretty close. For the LCD models, it should be close as well, but won't be as close as when using CIE170-2 meters. When you edit these boxes, the "Colorspace Target in **Workflow Basic Options** will change to "Custom".



If you are color-matching against professional monitors, check the gamma formula applied to that monitor, and change this field accordingly before running AutoCal.

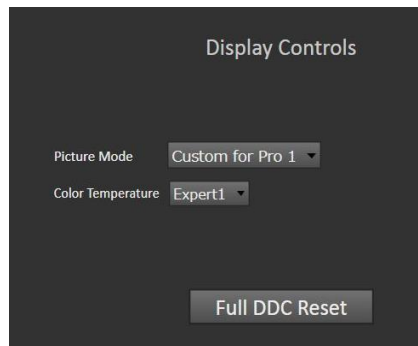
https://www.konicaminolta.com/instruments/download/catalog/display/pdf/cap427_410c_catalog_eng.pdf



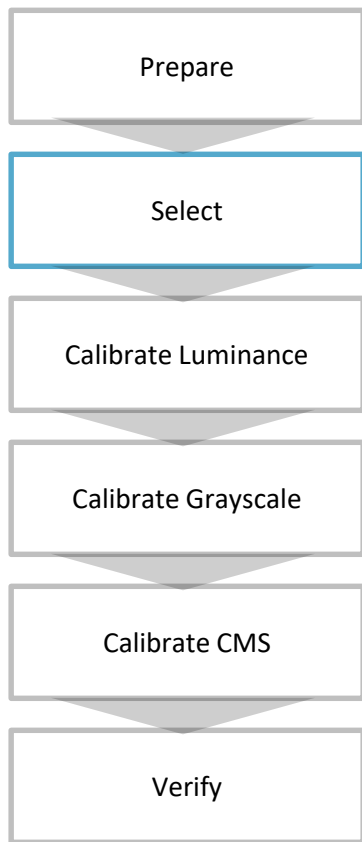
Select Memory Slots

As described in Page 9, BRAVIA's memory slot architecture is rather complicated – so we prepared a designated page called “[Select Memory Slots](#)” within the workflow to remind you where you will be storing calibration data. The same controls are also available on DDC Window (will become available after TV and Calman are connected over the DDC Protocol). Remember the following. It's extremely important which input and mode you are calibrating.

- Luminance control is associated with a [combination](#) of [Input \(HDMI\)](#) and [Picture Mode](#)
- Grayscale controls are associated with [Color Temperature](#) mode
- Color Space (CMS) is associated with [Picture Mode](#)



Calibrating BRAVIA with Calman



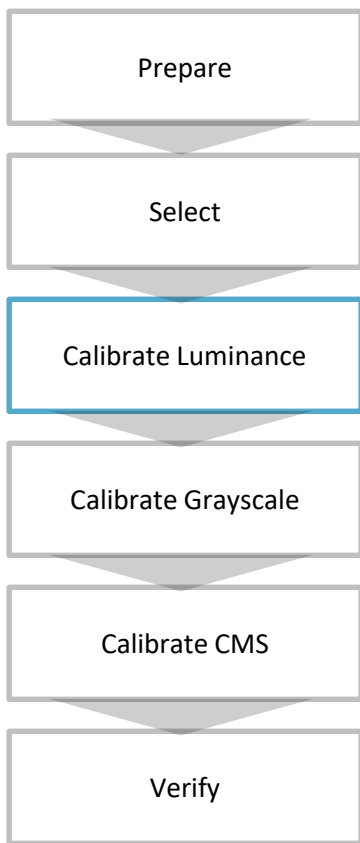
Double-Check

There are certain parameters that would/could affect calibration. When Calman connects to BRAVIA [Calman for BRAVIA app](#) will set the values of these parameters to where they need to be for performing display calibration. Remember the following parameters and values just in case if you opt to calibrate BRAVIA manually.

[Contrast](#) will be a bit tricky. You should have the keep the default value while adjusting luminance and CMS, but set it to **100** when calibrating grayscale so [signal levels and adjustment points are aligned accurately](#).

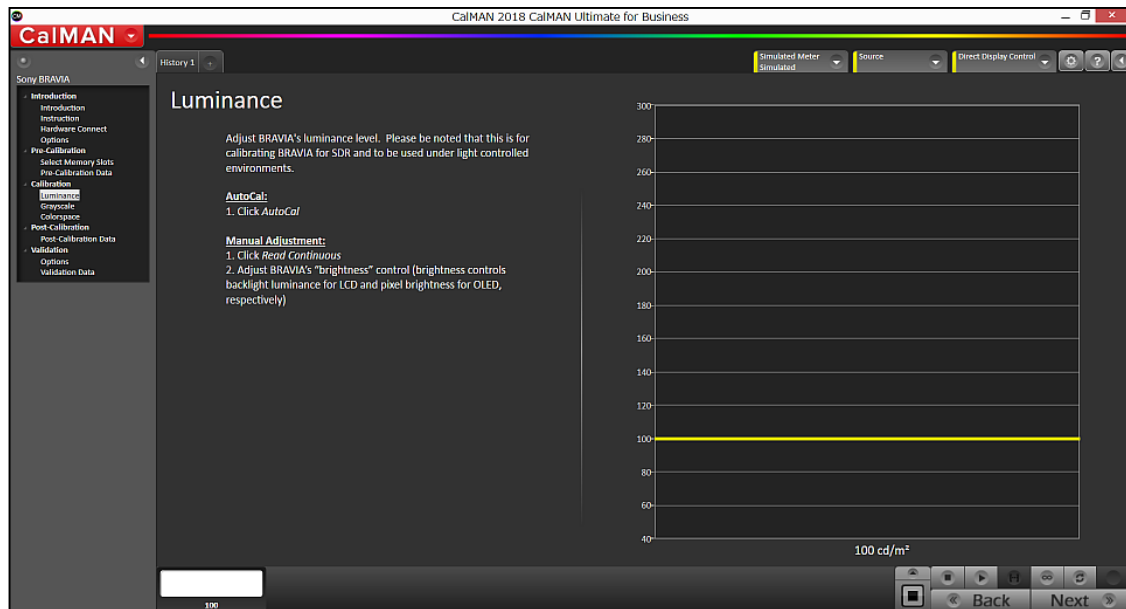
Parameter	LCD	OLED	Set to
Light Sensor	●	●	Off
HDR Mode	●	●	Off
Color Space	●	●	sRGB/BT.709
X-Tended Dynamic Range	●		Off
Auto Local Dimming	●		Off
Peak Luminance		●	Mid
Contrast **	●	●	100
Gamma Offset	●	●	0
Color Temperature	●	●	Expert 1 or 2
Auto Picture Mode	●	●	Off
Motion Flow	●	●	Off

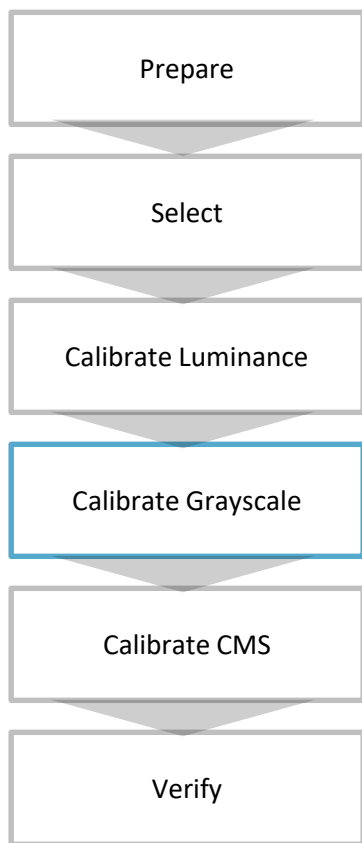
Calibrating BRAVIA with Calman



Calibrate Luminance

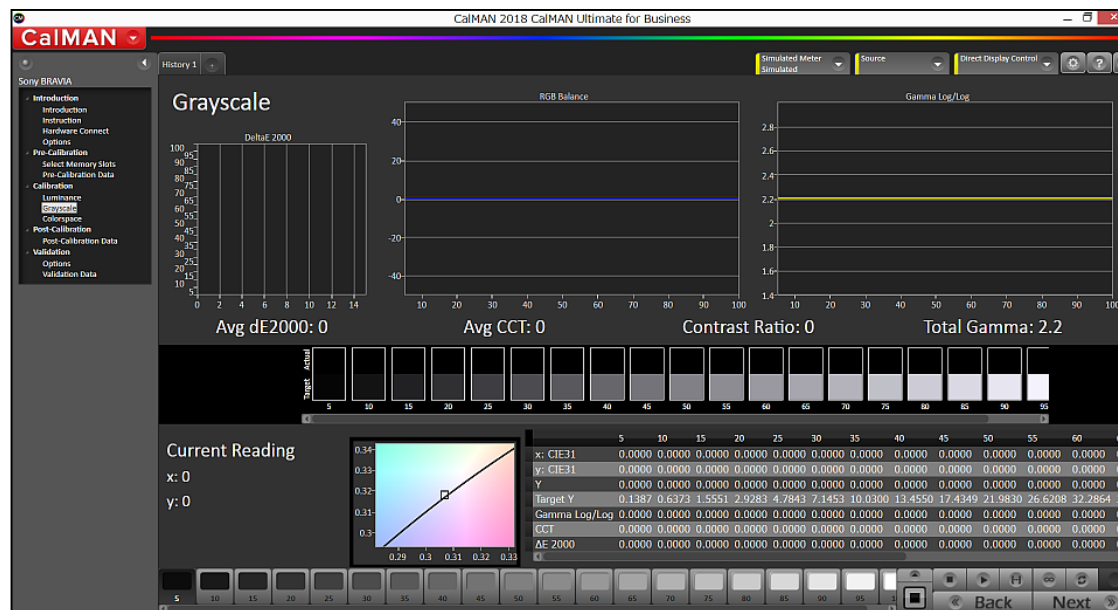
Once everything is set, you can move onto [Luminance Page](#) and simply hit “[AutoCal](#)” button. In the dialog box, you can specify the target luminance value. For dark rooms like home theater and post production color bay, you should set it to [100 nits](#). For bright-lit rooms, you may want to set this to higher value (but try to stay within your TV’s capability). You can skip luminance calibration and just do [Grayscale](#) and [CMS](#) if you opt to do so. In that case, however, make sure you have “[Use Measured White Level](#)” enabled in [Advanced Workflow Options](#).





Calibrate Grayscale (WB and Gamma)

Move onto [Grayscale Page](#) and hit “AutoCal” button. It will take approximately 3~5 minutes for adjusting all 20 points (depending on how fast your meter can measure and what “Delay” value is set).



Calibrating BRAVIA with Calman

Prepare

Select

Calibrate Luminance

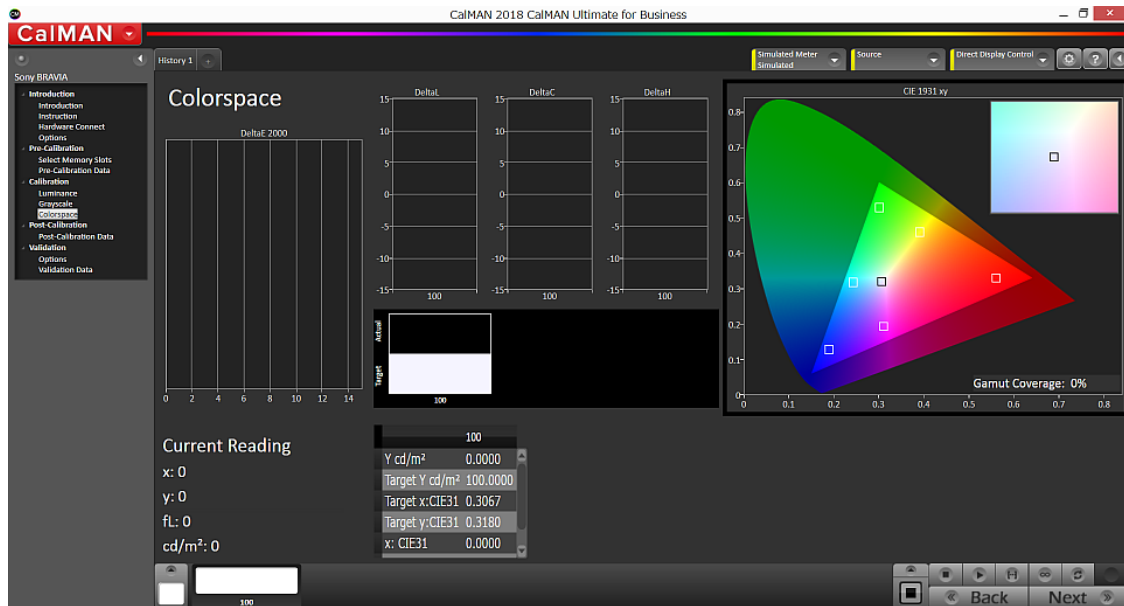
Calibrate Grayscale

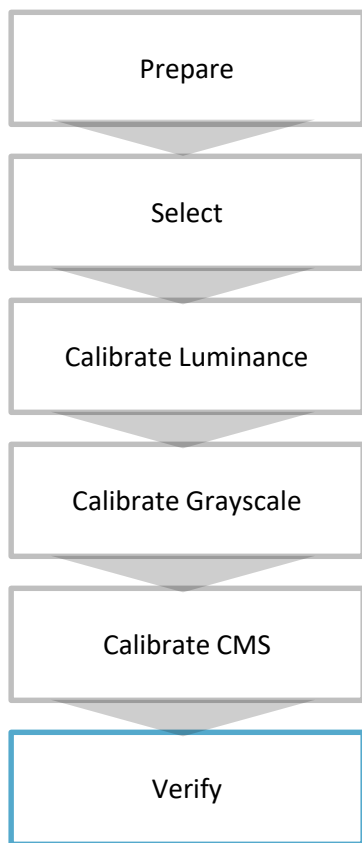
Calibrate CMS

Verify

Calibrate CMS

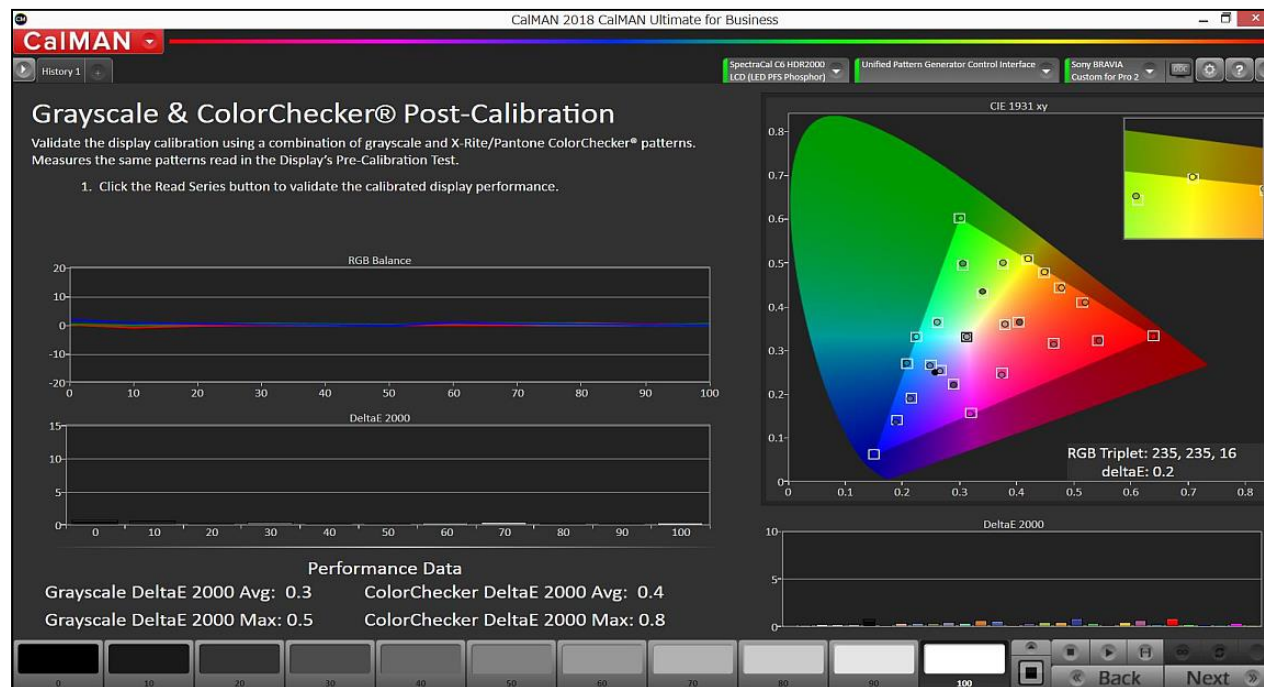
Move onto [Colorspace Page](#) and hit “AutoCal” button. It will take less than a minute for the process (depending on how fast your meter is). Our recommendation is to calibrate at **75%** saturation because it provides the best results in terms of calibrating both mid-tones and the edges.



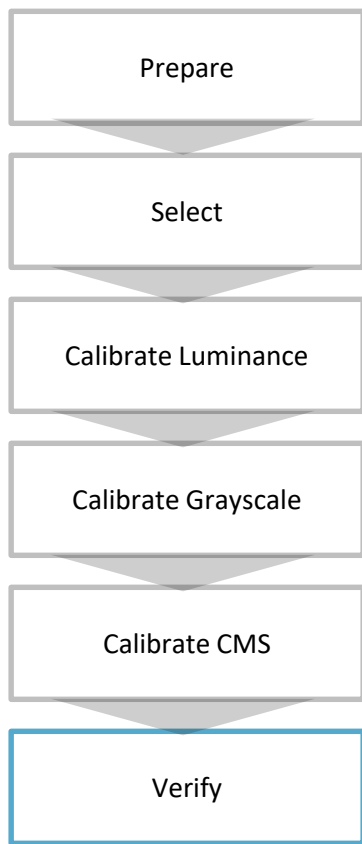


Validating Calibration

Move onto “**Post-Calibration Data**” page and hit Read-Series. If the **average delta-E values** for both **Grayscale** and **Color-Checker** end up being under **0.5**, your calibration is good. The calibration result shown below is ideal – near perfect white balance and color-checker being well within the range.



Calibrating BRAVIA with Calman

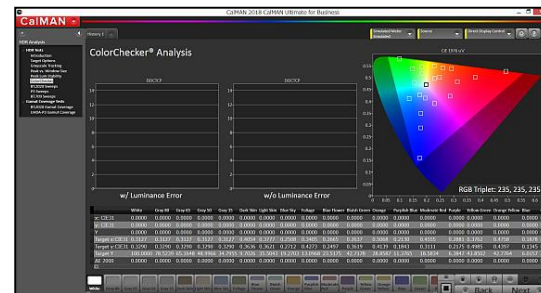
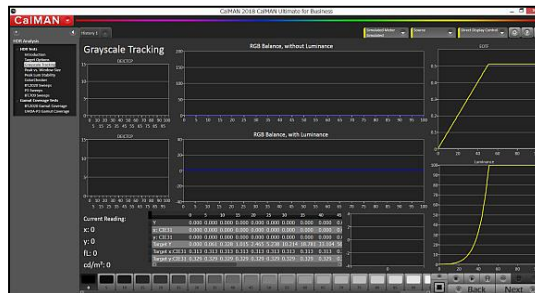


Validating with Other Gamma

Move onto [Validation Options](#) page and enter the value other than the number used as calibration target. Then go to [Validation Data](#) page, and hit [Read Series](#). Again, the [average delta-E values](#) for both [Grayscale](#) and [Color-Checker](#) being under [0.5](#) indicates that your calibration is good. Please note that these “Validation” pages [will disappear if non-power gamma formula](#) is selected for calibration.

Validating HDR Calibration

For Validating HDR Calibration, please open “[HDR Analysis](#)” Workflow. After making sure that BRAVIA is still connected with Calman, open [DDC Window](#), and change the “[HDR](#)” setting to either “[HDR10](#)” or “[HLG](#)” depending on the HDR mode of your choice. Likewise from [DDC Window](#), change “[Colorspace](#)” to either “[BT.2020](#)” or to “[DCI](#)” (P3). What you want to check in “[HDR Analysis](#)” Workflow is basically two things: [Grayscale Tracking](#) (EOTF Tracking) and [Color Checker](#). Just do “[Read Series](#)” on those pages. Please make sure your pattern generator is **capable of generating HDR patterns**.



Set Your HDR Parameters Correctly

When used in HDR, in addition to setting HDR Mode and Color Space parameters, make sure to have other parameters set accordingly to get most out of BRAVIA's capabilities.

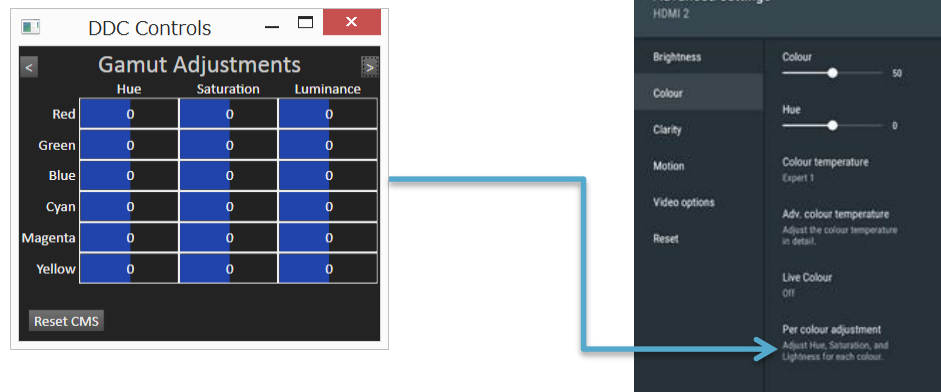
Parameter	Set to
HDR Mode	HDR10, HLG, or Auto
Color Space	BT.2020 or DCI (P3), or Auto
X-Tended Dynamic Range (for LCD models)	High
Auto Local Dimming (for LCD models)	Mid
Peak Luminance (for OLED models)	High

By default, LCD models are configured with **X-Tended Dynamic Range (XDR)** being **High** and **Auto Local Dimming** being **Mid**. This takes advantage of local dimming to reproduce deep black and shadow details while achieving maximum brightness the device is capable of.

You can set **Auto Local Dimming** to **off** or **low** to mimic **single dimming** or **under-achieving local dimming** TVs abundantly available in the market as "HDR" TVs. If you set Auto Local Dimming to either off or low, the TV won't hit the device's maximum capable luminance because LEDs will be lit in blacks and shadows, and there will be no power left to be injected into whites.

Calibrating CMS for Picture Modes other than “Custom for Pro 1 and 2”

You may opt to use the low-latency **Game Mode** for your development and verification. Or you may want to calibrate hue and saturation on **Netflix Calibrated Mode**. Due to only “Custom for Pro 1 and 2” being unlocked for Calman AutoCal, colors (hue and saturation) for picture modes other than those two cannot be auto-calibrated. If you wish to do so, you will have to insert test patterns while TV is set to the Picture Mode of your choice, use Calman as a measurement tool, and adjust HSL from TV’s menu by remote controller. Another way is to copy auto-calibrated HSL values for Custom for Pro 1 over to the picture mode of your choice. The menu item on the TV is called “**Per Color Adjustment**”.



For Grayscale, the calibration will be effective so long as the Expert 1 or 2 (whichever you calibrated Grayscale with) is selected as Color Temperature for the Picture Mode you will be using.

Calibrating BRAVIA with Calman Netflix Video Monitor Calibration

How to Calibrate BRAVIA for Netflix Workflow



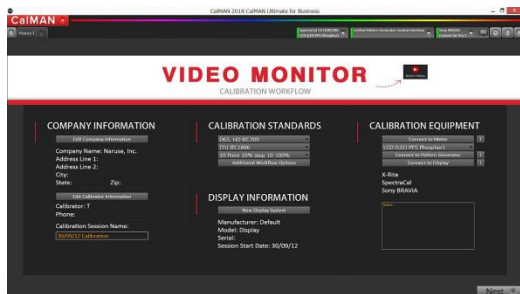
Netflix partner vendors (Netflix Preferred Fulfillment Partners and Netflix Post Partner Program members) are required by Netflix to have their TVs and displays calibrated periodically (at least every 90 days). We would like to suggest the following for complying with the Netflix's requirements.

1. Calibrate using BRAVIA Workflow

Netflix requires luminance, grayscale, and CMS to be calibrated just like our Workflow. The only difference is the gamma formula option. Refer to the next page on how to modify the calibration options in particular with Netflix.

2. Verify with Netflix Video Monitor Workflow

For issuing calibration reports, verify (run Read Series) on certain pages of the Netflix Video Monitor Workflow.



<https://partnerhelp.netflixstudios.com/hc/en-us/articles/215669787-Display-Calibration-Best-Practices>
<https://npfp.netflixstudios.com>
<https://np3.netflixstudios.com/>

Calibrating BRAVIA with Calman

Prepare

Select

Calibrate Luminance

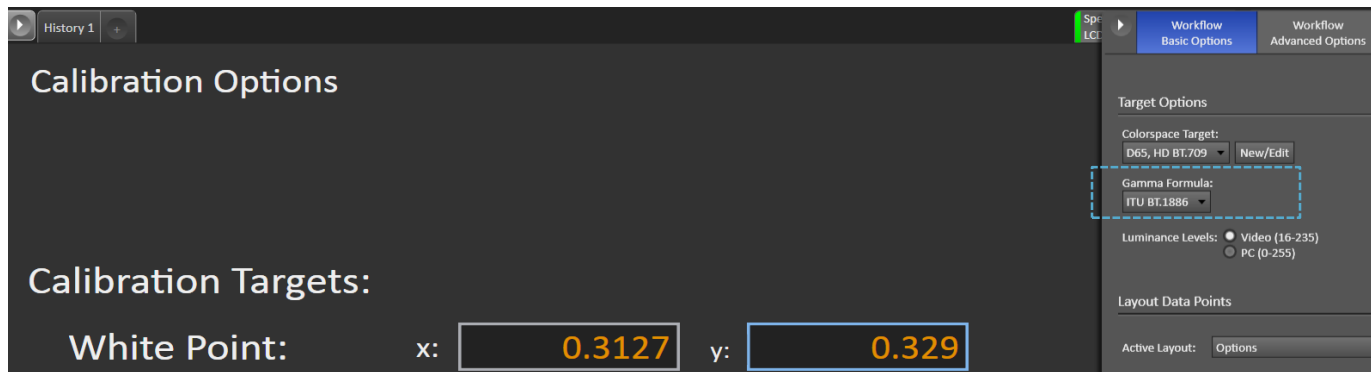
Calibrate Grayscale

Calibrate CMS

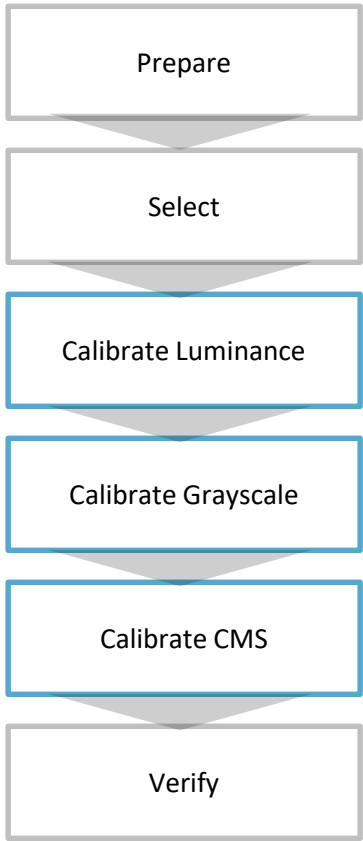
Verify

Change Gamma Formula

BRAVIA is calibrated with Gamma 2.2 and our Workflow is also configured to calibrated to Gamma 2.2 as well. For Netflix calibration, however, change Gamma formula to BT.1886 since that's what's required by Netflix. Open "[Workflow Basic Options](#)" tab, and select "[ITU BT.1886](#)" from the Gamma Formula drop down. The White Point x/y values in the Options page should still read as 0.3127/0.329.

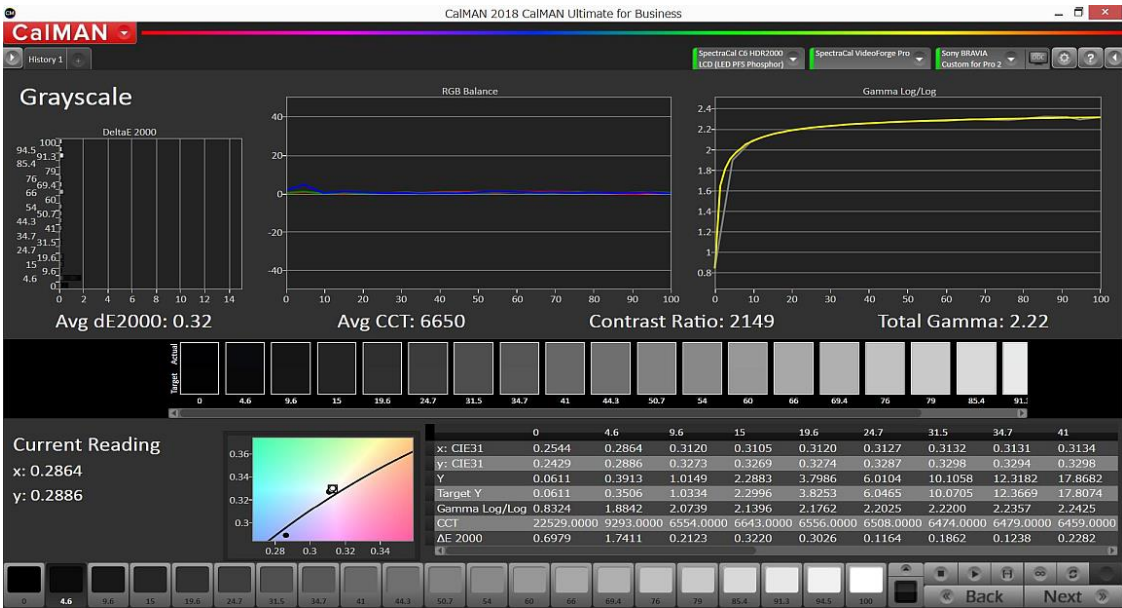


Calibrating BRAVIA with Calman



Auto Calibrate

Move onto [Luminance, Grayscale, and Colorspace Pages](#) and hit “AutoCal” button. The following is the screenshot for the grayscale calibration with gamma formula being set to BT.1886. Notice that Gamma Log/Log curve looks differently from that of the normal power gamma.



Calibrating BRAVIA with Calman

Prepare

Select

Calibrate Luminance

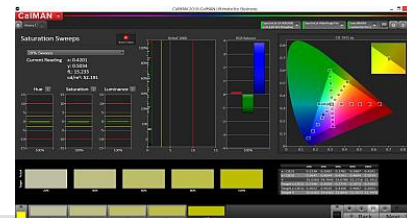
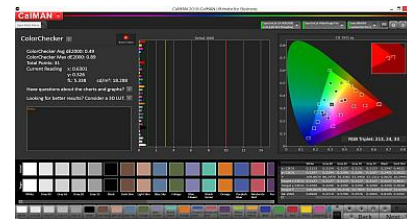
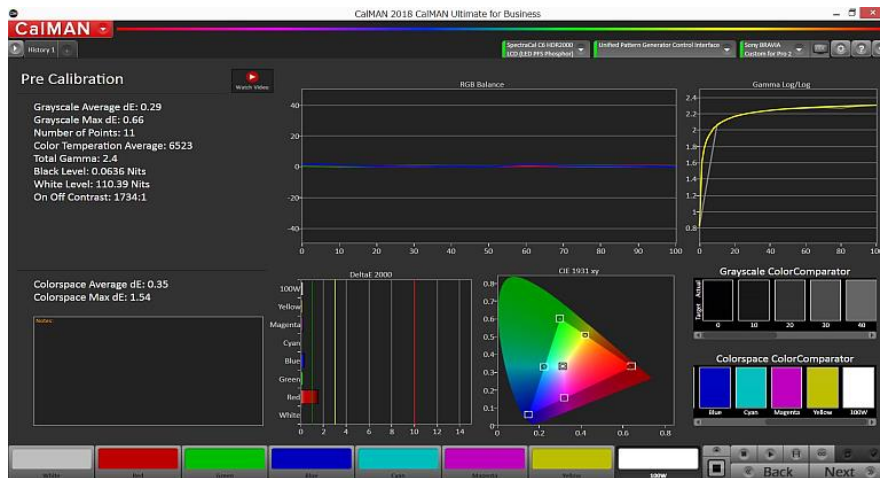
Calibrate Grayscale

Calibrate CMS

Verify

Validating Calibration

Open [Netflix Video Monitor Calibration](#) Workflow, and move onto “[Pre-Calibration Data](#)” page and hit Read-Series. If the [average delta-E values](#) for both [Grayscale](#) and [CMS](#) should fit well within the range after being auto-calibrated with the BRAVIA workflow. Taking pre-calibration measurement should be enough for reporting, but you can go ahead and take readings from other pages to populate the pages for a full report.



	2016	2017	2018	2019	2020
LCD	Z9D/ZD9	X95E/XE95	Z9F/ZF9	Z9G/ZG9	Z8H/ZH8
		X94E/XE94	X90F/XF90	X95G/XG95	X95H/XH95
		X93E/XE93	X85F/XF85	X85G/XG85	X90H/XH92/XH90
		X90E/XE90	X83F/XF83	X80G/XG80	X80H/XH81/XH80
			X80F/XF80		
			X75F/XF75		
OLED		A1	A9F/AF9	A9G/AG9	A9S/A9
			A8F/AF8	A8G/AG8	A8H/A8

※ Models with bold font = white balance 20points adjust, 6 color adjust, 2 picture modes(Custom for Pro1/2) for calibration available.
 The other models = white balance 10points adjust, 1 picture mode(Custom) for calibration available.