TRIMASTER EL

SONY

A Guide to Monitor Setup

Contents

What’s a reference monitor for?

In any system that involves image manipulation, we need a point of reference, a standard against which we can evaluate changes. Without a proper reference, we have no way to see and judge our manipulations. In production, we make both electronic and visual judgments. We use the waveform monitor, histogram, and vectorscope to check electronic properties. We need the reference monitor to confirm visual properties.

We need reference displays to confirm exposure, checking for crushed shadows or clipped highlights. We need to confirm the areas of the image that are in focus and to examine areas that have compression defects. We need to confirm framing, to ascertain that mic booms, light stands and flags are not in the frame. And we need reference displays to evaluate creative decisions about color, lighting, filtration, sets, costumes, hair, makeup and blocking.

While presentation displays and home televisions can be adjusted to make the prettiest pictures, reference monitors should never be. Reference monitors are considered to be test equipment, designed to show any and all visual problems. As such, the reference monitor must conform to specific industry standards. Adjusting for a local or personal look means losing your point of reference and opening up your production to problems.

Current Display Technologies

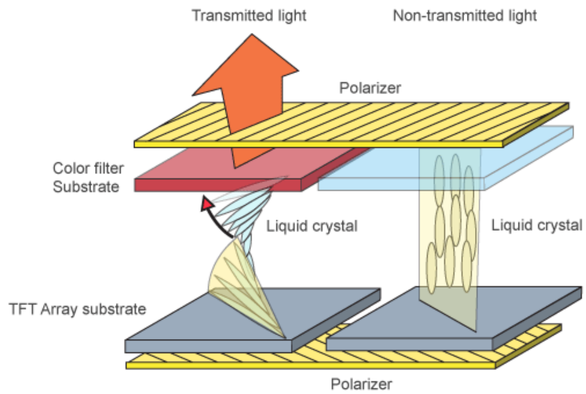
Today’s monitors use three basic display technologies. One of these, the liquid crystal display (LCD), is a transmissive system. It shutters light from an external source. The other two, plasma and organic light-emitting diode (OLED), are emissive. These generate light directly from the pixel element. The long-time workhorse of displays, the cathode ray tube (CRT) was also an emissive technology.

LCD

Since LCD is a transmissive technology. A light source must be placed behind the LCD panel and light rays are blocked or pass through its pixels depending on the twist (alignment angle) of the liquid crystals within each pixel’s electronic static field. There are a number of ways to align the crystal when building an LCD panel. Most common is vertically-aligned (VA) LCD. VA is best for low black levels, but delivers inconsistent brightness when viewed at different angles. The most common panel technology in use for professional LCD monitors is IPS (In-Plane Switching), which is a horizontal LC alignment system. Of all the current LCD technologies, this offers the best balance between black level and viewing angle.

For LCD, light rays from the backlight enter behind the panel. The backlight can be a cold cathode fluorescent light (CCFL), light-emitting diode (LED) array or UV LED driving a quantum dot array. LED backlight designs can either place full panel coverage using a large number of LED elements directly behind the pixel matrix, or edge lit vertical array with bezel-mounted RGB elements that employ a light pipe behind the LCD cells to disperse the light energy across the panel. To reduce manufacturing costs, white LEDs are sometimes used instead of discrete RGB LEDs.

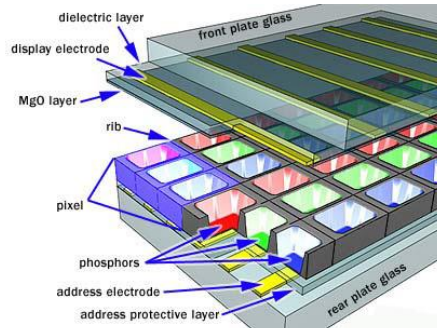
Light from the backlight is first polarized into a single orientation. The alignment angle (twist) of the LC crystals then determines how much light is allowed to pass through the panel. A second polarizer is attached to the front surface of the LCD pixel, completing the light shutter effect. If the polarization angle of the light source matches that of the liquid crystals, light rays will pass through. If the angles are at 90 degrees to each other, no light will pass. Intermediate angles generate intermediate shades of gray.



An inside look at a Liquid Crystal Display

Plasma

AC plasma displays are emissive, generating light by stimulating color phosphors. A CRT also uses phosphors, stimulating them with a high voltage beam of electrons. In contrast, plasma displays discharge high voltage through a mixture of neon and xenon gas. The gases ionize and release electromagnetic energy that contains ultraviolet (UV) light. The UV emission then stimulates the color phosphors to generate visible light.

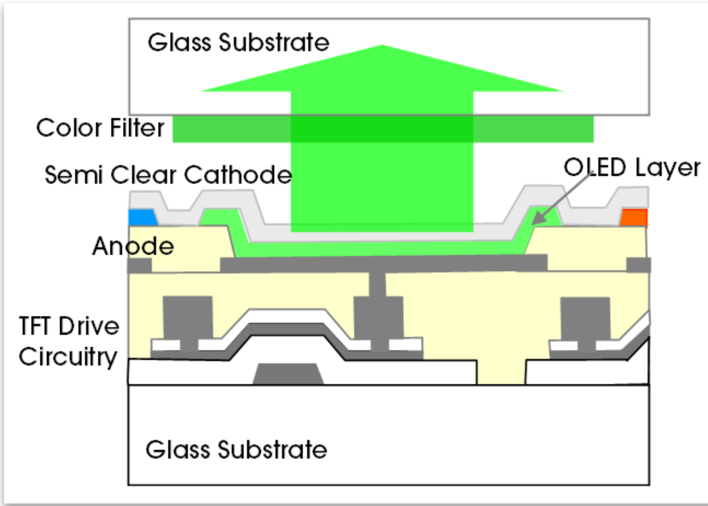


Cutaway diagram of a plasma pan. *Courtesy of PLasmaTVScience.org.*

The AC plasma display normally incorporates two or three electrodes matricing over an open gas cell. Drive of the cell is similar to that of a fluorescent light. The cell is activated by a high charge across a column and row electrode. Once the gas reverts to a plasma state, an electrical current sustains the reaction using a pulse width modulation drive method. To generate shades of gray, longer duty cycles result in larger emissions resulting in a brighter pixel.

OLED

Organic Light Emitting Diode (OLED) is a more recent technology, now available in professional displays. OLED uses layers of organic materials to emit light. The OLED pixel is made up of several layers sandwiched between an anode and cathode. Electrons (negative charges) and holes (positive charges) are brought together and recombined in an emissive layer, activating a phosphor. Shades of gray are generated by varying the current. One distinct advantage of OLED technology is that each pixel can be controlled through its entire range from peak white down to a state of no emission at all (complete black). This results in an essentially infinite contrast ratio, and enables the display of very dark image details.



A cross section of OLED layers.

What’s going in?

Before you can calibrate a monitor, you need to understand what will be feeding it. Using the wrong settings at the beginning of the production risks added cost, and in the worst case, expensive re-shoots.

In the “old days,” we didn’t have to worry about the input signal, as there was a single North American television system standard. However, now there are many variables, and each needs to be considered during setup.

Parameters to consider

Image pixel count	720 x 480, 1280 x 720, 1920 x 1080, 2K, 4K etc.
Frame rate	23.98, 24, 25, 29.97, 30, 48, 50, 59.94, 60, 100, 120, 240
Sampling structure	4:1:1, 4:2:0, 4:2:2 or 4:4:4
Color gamut	ITU-R BT601 (EBU), ITU-R BT709 (HD), SMPTE RP 125 (SMPTE C), SMPTE RP 431-2 (DCI-P3), ITU-R BT2020
EOTF (Gamma)	1.8, 2.2, 2.4 (ITU-R BT1886), 2.6 (SMPTE RP 431-2) Slog, HLG, PQ
Raster scan	Interlace or Progressive
HD-SDI format	3G (SMPTE S425), HDSDI Dual link (SMPTE S372), HDSDI (SMPTE S292)
Bit depth	8, 10, 12

Standard Pixel Counts

4K	3996 x 2160 (1:85 aspect ratio) or 4096 x 1714 (2:39 aspect ratio)
UHDTV	3840 x 2160 (1:78 aspect ratio)
2K	1998 x 1080 (1:85 aspect ratio) or 2048 x 858 (2:39 aspect ratio)
HD	1920 x 1080 (1:78 aspect ratio)
720p	1280 x 720 (1:78 aspect ratio)
NTSC	720 x 480 (1:33 aspect ratio)

SDI Payload ID

Most new monitors come standard with high-speed 3G SDI inputs. These support a digital RGB signal on a single coax cable. In addition to the image and audio content, the signal also includes a "Payload ID," metadata identifying the signal. Payload ID is defined by the SMPTE S352 standard. New monitors can display this information, making it easier to find problems during setup.

Information contained in the Payload ID includes:

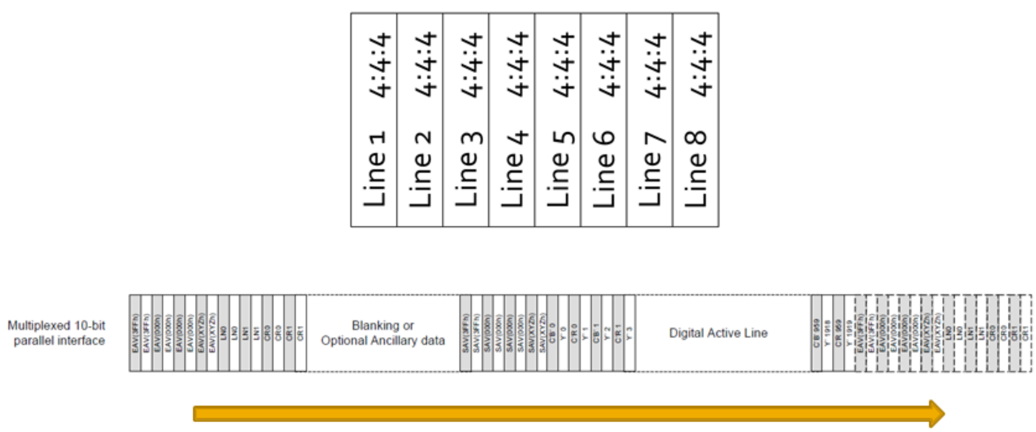
- Interlace or progressive scanning
- Horizontal pixel count
- Frame rate
- Sampling structure
- Image aspect ratio (currently limited to 1:33 or 1:78)

Note that Payload ID only works with 3G signals. Older HDSDI formats don't contain this information, so the display may be blank.

3G Levels

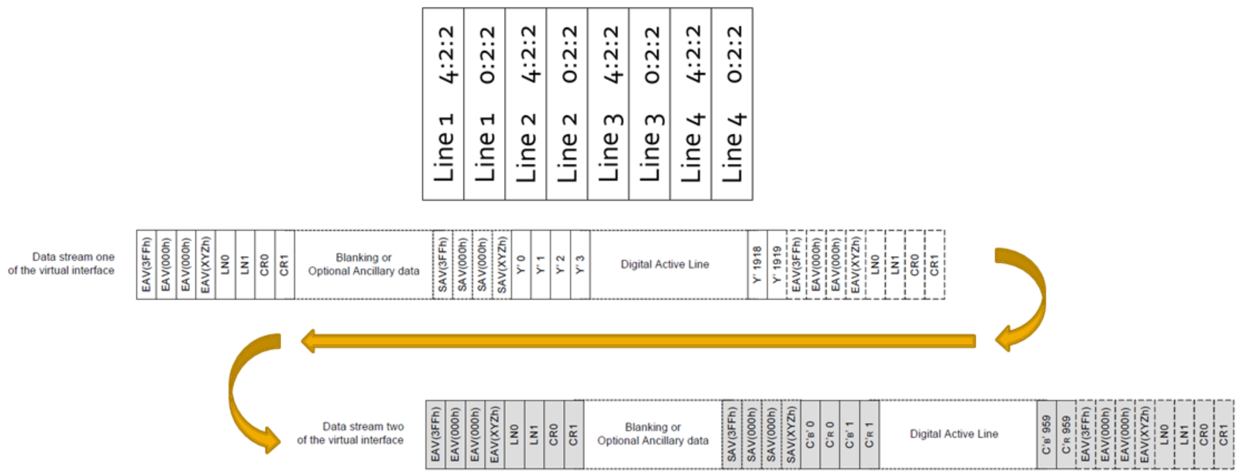
The 3G standard includes two transport methods for image data. Be careful. Some equipment manufacturers only support one of these.

- **Level A Transport** enables direct image mapping. This method delivers 4:4:4 samples as an integrated picture and feeds the monitor as a sequential stream.



Level A

- **Level B Transport** combines the earlier dual link system onto a single wire. This method sends 4:2:2 samples in a first packet and 0:2:2 samples in a second.

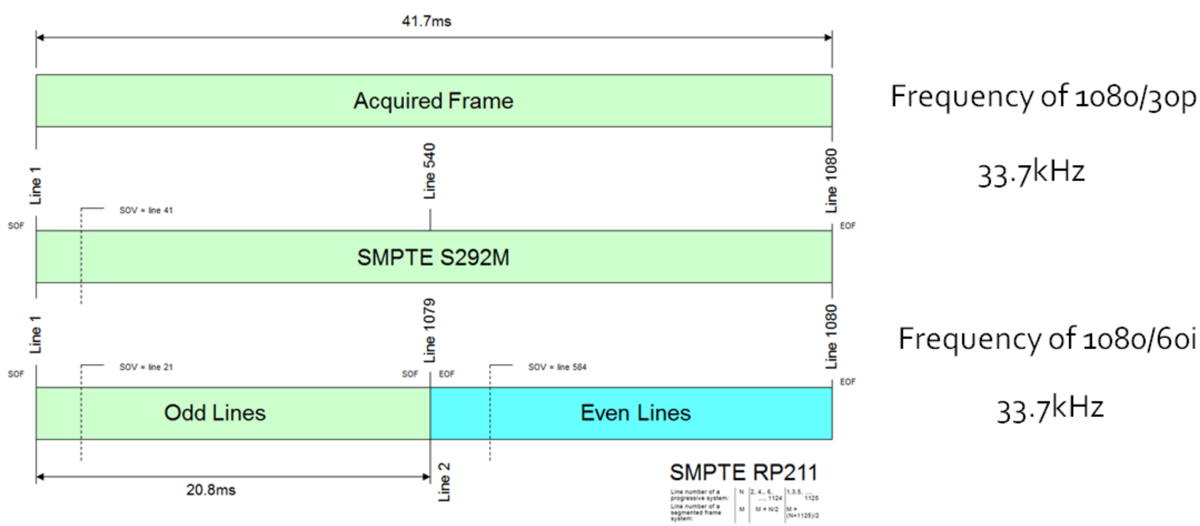


Level B

Psf or just plain P?

When 24 frames per second progressive video (1080/24p) was first proposed, almost all HD facilities had HDSDI infrastructures designed around 1080/59i television. These systems couldn't transport a 24p signal and the CRT monitors of that time couldn't display 24p. The Psf (Progressive Segmented Frame) system was created as a work-around. Psf enabled the 24p signal to be used in the 60i infrastructure. The progressive frame scanned in the camera is broken down into a "segment" of odd scanning lines and another of even scanning lines. The two progressive segments are transported as if they were interlaced fields. When this stream is input to a device downstream, the first, odd-line segment is stored until the even-line segment arrives. Once the entire frame is in storage, the device can reassemble it into a true progressive image.

There is a downside. Many lower-cost displays can't distinguish Psf from interlaced. If confused, the monitor may try to interpret the image as interlace and then apply an interlace-to-progressive conversion that can add artifacts. Avoid using Psf inputs unless you can turn off the monitor's interlace-to-progressive conversion.



RGB or YUV

There are two distinct methods of encoding color in the systems we use. RGB is straightforward, transmitting each color independently. This is usually sent as a 4:4:4 signal.

4:4:4 describes the number of samples taken for each pixel. So in 4:4:4 systems, the frequency of the sampling is 4 times for Red, 4 times for Green, and 4 times for Blue. 4:4:4 is also used for XYZ systems (an issue for another time).

The disadvantage of 4:4:4 RGB is that it requires 50% more bandwidth than 4:2:2. You may either have a more complicated system (using dual link) or can encounter cable length issues (using 3G).

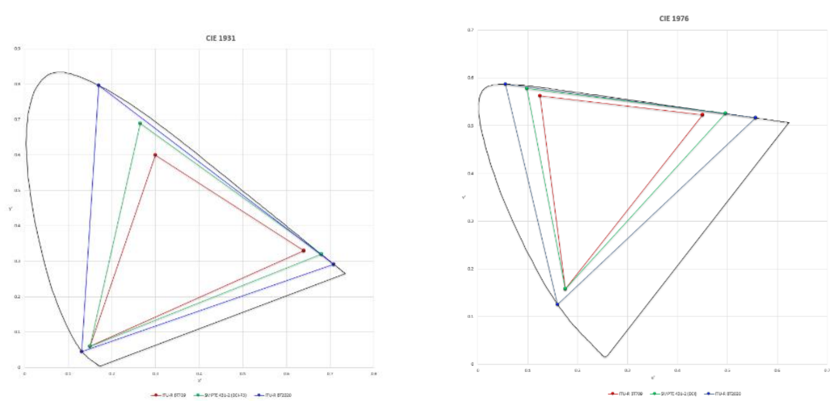
4:2:2 Yuv is almost as good as 4:4:4 RGB, and saves significant bandwidth. There are various designations for Yuv systems: Y R-Y B-Y for analog 525 line systems, Y Pb Pr for analog HD systems and Y Cb Cr for digital HD systems.

4:2:2 Yuv works because the human visual system is much more sensitive to black & white detail than color detail. Through some simple math, we can calculate a luminance value, “Y” from the RGB values. And we transmit this Y sample for every pixel. We then calculate two color difference values (R-Y and B-Y), but only transmit these values for every second pixel. This is called 4:2:2 color subsampling. Going from 4:4:4 to 4:2:2 saves bandwidth, simplifies cabling and enables long cable lengths—all while approaching the quality of a true 4:4:4 image. The advantages of 4:4:4 RGB can be substantial in certain post production processes, but are less perceptible in displays. Where this difference will be significant is in very high detail images. For example an image comprised of alternating black and white pixels will show as black and white with a 4:4:4 input while a 4:2:2 input will be green.

What comes out?

Standard Color Gamuts

A color gamut describes the range of colors the display should represent. Using the wrong gamut will lead to misinterpretation of the scene look. That could mean mistakes and costly color correction in post. The most common gamut is one described under ITU-R BT709, commonly called just “709”. Other gamuts include SMPTE RP431-2 (also called DCI or P3), ITU-R BT2020, SMPTE C (SMPTE RP145), and EBU (ITU-R BT601). Below are two color gamut charts. The left is CIE 1931 which is the original depiction of the standard observer. The chart on the right it is an updated version called CIE 1976. This shows the standard observer in a more linear space so that it’s easier to make color comparisons. In both of these charts, as the area grows, so does the range of possible colors available for display. Differences horizontally or vertically show as hue and saturation shifts on the display.



CIE 1931 and CIE 1976 charts showing various standard color gamuts.

Display Gamma (EOTF)

Gamma is a mathematical function that describes how the camera translates scene light levels into digital quantization levels—and how the monitor translates quantization levels back into light levels. Normally, display gamma is the mathematical inverse of camera gamma.

Display gamma is now called Electro Optical Transfer Function (EOTF). Today there is only one standard dynamic range EOTF display standard. ITU-R BT1886 describes a display gamma of 2.4 power. There is a SMPTE RP (Recommended Practice) that describes a 2.6 power for cinema display.

For on-set use, set the monitor gamma to 2.4 if the content is to be distributed for television, or 2.6 for feature film/theatrical distribution.

We will expand on this as we talk about High Dynamic Range (HDR)

Bit depth: Limited vs. Full

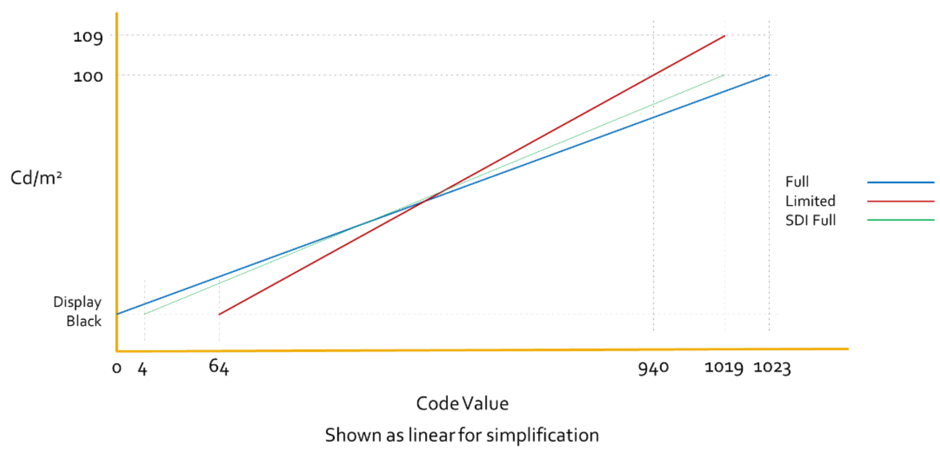
There are three different methods to allocate quantization levels from black to white. The methods specify the monitor's light level output for each input level. For proper evaluation of exposure, you need to confirm that the monitor is set up for the appropriate method.

The current standards are based on television transmission, so some quantization levels are reserved for overshoots. Many think that going into these overshoot regions is illegal. In fact, the overshoot regions can be used for image information, but should be used with caution.

In the 10-bit system, we have 2^{10} or 1024 possible levels, numbered from 0 to 1023. (For a 12-bit system, we have a range from 0 to 4095.) Using the 10-bit system as an example, the first four levels above zero and below 1023 are reserved for sync information and shouldn't be used for any image information.

- **Full bit depth** places all usable image information between bit 0 and bit 1023.
- **Limited bit depth,** described in the SMPTE S292 standard, places black at bit 64 and 100% white at bit 940.
- **SDI Full bit depth** is a newer standard used in HDR where bit 4 is black and bit 1019 is 100% white

Why does this matter? The monitor output light levels should correspond to the respective quantization levels. If you are expecting white at 940, then that's when the monitor should output that light level. The same goes for full bit depth settings. Below is a comparison.



Comparison between bit level settings

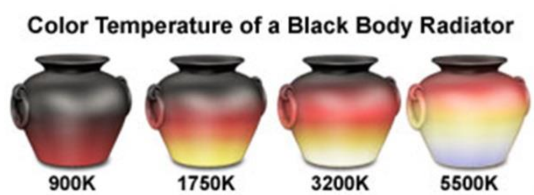
Normally you should match the monitor to your recording device, not the camera. But you also need to be careful. When set to full, you will see everything within the range available. This makes it easier to confirm any clipping. However, during shooting, anything that goes above or below the white and black levels is lost and cannot be recovered if the recording is set the same way. If the system you are using is set to limited, some overshoots may appear crushed or clipped on the monitor, even though the recording may be fine.

White Balance

The human visual system is able to recognize a white sheet of paper as “white” under an incredibly wide range of artificial and natural light, including tungsten, fluorescent, sodium vapor, sunrise, noonday sun or sunset. Called “accommodation,” our ability to adjust to different lighting environments helps us in the real world. It’s also good for presentation monitors, because the eye adjusts to and accepts on-screen colors as “correct.” But it’s a nightmare for evaluation monitors, where images that might look beautiful may be far off industry standards.

For these reasons, evaluation monitors require white balance adjustment provisions to standard color temperatures. Cameras also have white balance procedures, which are fairly simple. But a monitor has more factors to consider, especially when differences in display technologies are involved.

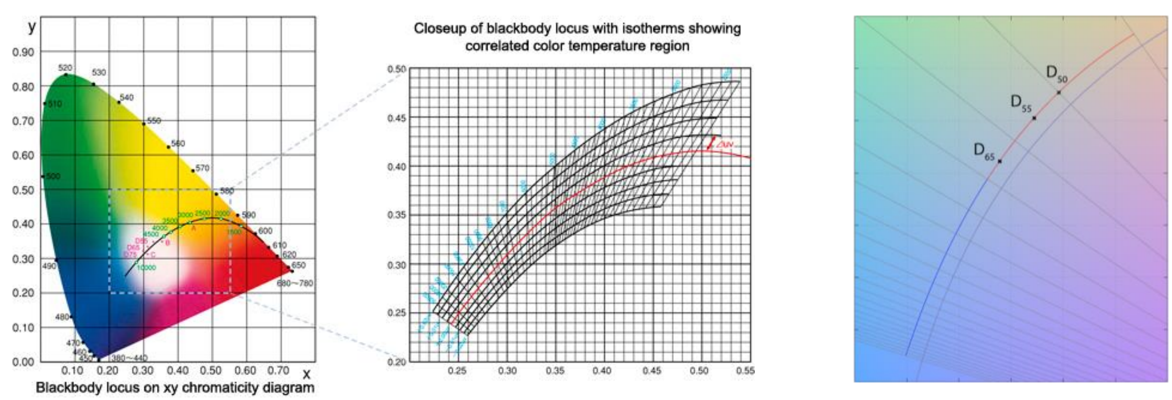
Planck’s law



Physicist Max Planck described the electromagnetic radiation emitted from a black body in thermal equilibrium as a defined temperature. As you heat up a black body radiator (normally a piece of tungsten) it will emit a specific color. So these black body radiators are described in absolute temperature, measured in units of kelvin or K. For reference, °C + 273.15 = K and (°F + 459.67) x 0.556 = K. A common white point value for monitors is 6500 K. This is the color of tungsten when heated to 6500 K°.

However, this can be expressed with fairly large tolerances. Below is a graph showing the Planckian radiator (also called the black body locus) which has lines crossing it called isotherms. The range of variation of the isotherm lines is called a Correlated Color Temperature (CCT).

To make these measurements more accurate, the CIE published a more precise system called the daylight curve (CIE 1976). Values on this curve are designated as D.



The diagram above shows the section where the Planckian radiator resides in CIE 1931. On the right is a comparison between components of the Planckian radiator versus the CIE daylight curve.

Why do we care? A CCT value can reside anywhere on an isotherm line while a daylight value is defined by a unique set of color coordinates.

6500K CCT can be anywhere between x = 0.301, y = 0.396 to x = 0.244, y = 0.248

The daylight value D65 will always be designated as x = 0.3127, y = 0.3290.

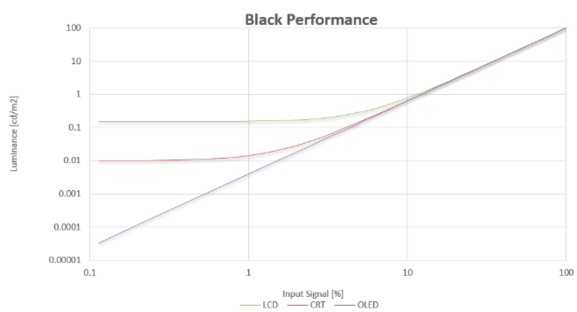
This means two monitors set to the same CCT can look different while two monitors set to D65 will match.

If we’re going to calibrate our monitor’s white point, we need to use a specific coordinate point on the daylight curve. We do not use a CCT value.

Black performance varies by display technology

For a very long time, cameras could capture more dynamic range than a monitor could display. It had been easier to measure a wide range of light levels with a sensor than to build a display that could generate the same range of light levels. Display technology has only recently caught up.

The black level of a display depends largely on the technology used. Below is a graph showing the relationship in black capabilities of LCD, CRT and OLED. (Plasma black levels are similar to CRT.) OLED provides a dramatic improvement.



Black level comparisons between CRT, LED, and OLED

If the monitor can provide the correct black throughout the full range of the image, the results will be exceptional in controlled lighting, such as in a color correction suite. But viewing may be compromised in high ambient light, where eye adaptation will interfere with what is visible. While high ambient light can be an issue in the on-set “video village,” there are workarounds. You can set the monitor up in a CRT emulation mode, or build an outdoor viewing lookup table (LUT). Use this during the shoot to confirm the range of the image and then switch back to a calibrated mode when time allows, and the ambient light levels are better controlled.

What do these numbers mean?

When you get your colorimeter or spectroradiometer, the values that it displays are letters with numbers. These numbers have specific meanings and can easily be misinterpreted.

The numbers that are displayed are based on one or more CIE standards. (CIE stands for Commission Internationale de l'éclairage, being French for the International Commission on Illumination.) There are two specific measurement standards based off the 1931 standard observer: CIE 1931 and CIE 1976. CIE 1976 allows for color difference measurements where 1931 does not. Most meters display CIE 1931. These values are designated as Lxy. CIE 1976 values are designated Luv.

- L will always refer to the luminance value being measured. (Y may sometimes be used; however Y really designates luminance as an electronic value, not an optical value.)

- xy will always designate values under CIE 1931. These are always lowercase[1].
- uv will always designate values under CIE 1976. Again, these will always be lowercase.

Transfer Matrices

From the initial design of color television, the matrix conversion formula has been the same. The Transfer Matrix is simply a 3 x 3 matrix calculation that is used to convert between RGB and YUV values. A video source will have an RGB to YUV matrix and a monitor will have a YUV to RGB matrix. Since everything up to now has been using color gamuts defined in relatively the same area (SMPTE C, ITU-R BT601, and ITU-R BT709 are very close in volume), the matrix has been the same.

Now we're moving into wide color gamut displays and this matrix is not compatible. For wider color rendition, we need to change the spacing of the matrix so that we scale the image over the gamut area correctly. So now we have two matrices we're going to have to deal with. Once is the standard ITU-R BT709 matrix and this should be used for most cases. However for wide gamut production, there may be a case to use the ITU-R Bt2020 matrix. The determining factor is the image source, not the gamut used on the display.

When setting the transfer matrix, you need to know what the camera or image source has for its encoding matrix. So if your camera is shooting wide color gamut, but uses a 709 matrix, the monitor should also be set for the same inverted matrix. If the camera has a 2020 matrix, then the monitor should use the same inverse setting.

High Dynamic Range (HDR)

One of the newest technologies that has effected display design is HDR. HDR uses the extended range of the latest cameras and brighter capable displays to bring more realism to the image. The concept is not to make a brighter image, but to use the newer technologies to extend the range of the image by making use of the added acquisition capabilities and the latest display developments. This adds a new tool for the creative to convey the story.

Example of an HDR Image with HDR on the Left and SDR on the Right

[1] Values XYZ (in capitals) are used, but define color primaries, not measurements.

Flavors of HDR

As of July 2016, there are three standards defining HDR EOTFs. The most well known standard is SMPTE ST2084. This defines the EOTF used for Dolby Vision content and is commonly called “PQ” or Perceptual Quantization”.

The second standard was developed by both the NHK in Japan and is called ARIB B67 This is a version of HLG or “Hybrid Log Gamma” and will normally only be found in productions made in Japan.

A third standard was published in July 2016 and is defined in the ITU-R BT2100 standard. This included a description of ST2084 and includes an alternate version of HLG. This HLG standard adds a function called Ys to control gamma and produces different results from ARIB.

OETF, EOTF and OOTF

We often talk about gamma, but there are version of gamma and with the introduction of HDR, the terms used to describe it needed to be refined.

EOTF

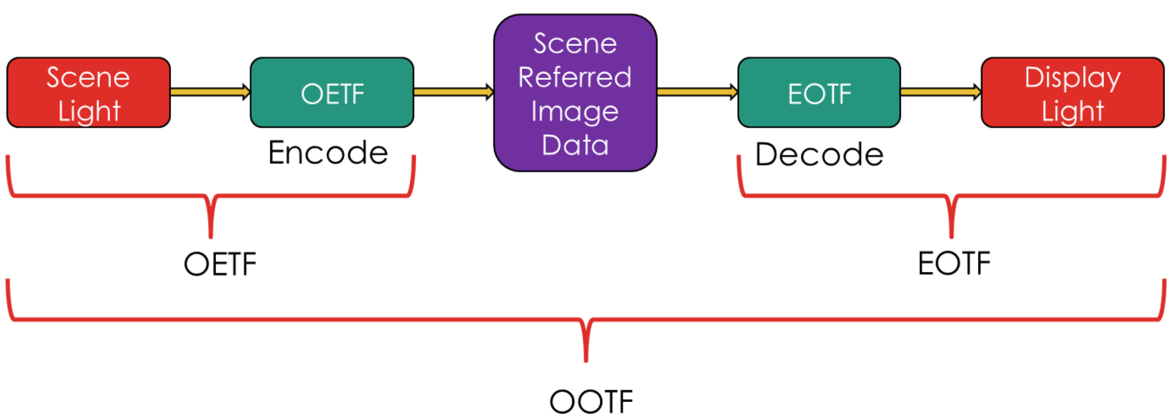
As described briefly in the gamma description, the input transform of the monitor is described as an EOTF or electrical optical transfer function. This is the relationship between the data values input into the monitor and the corresponding light output. However there are other components of this that should be considered

OETF

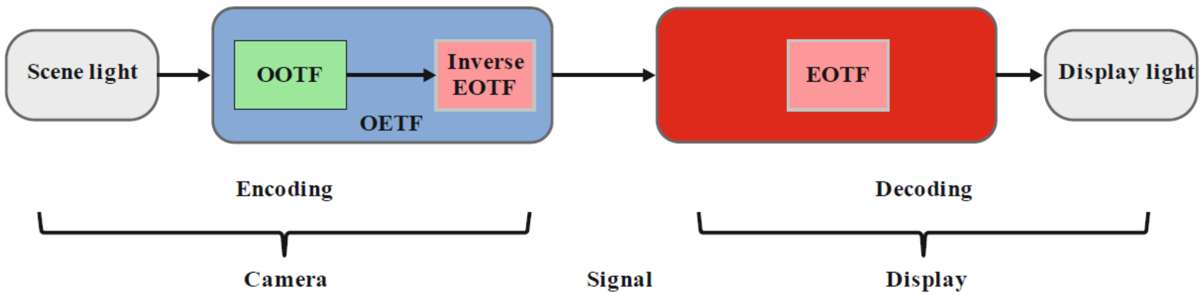
Normally when we talk about gamma, we talk about acquisition. An OETF is just that. It is the Optical to Electronic Transfer Function which describes the conversion in the camera from the light at the imager to the data values exiting the camera.

OOTF

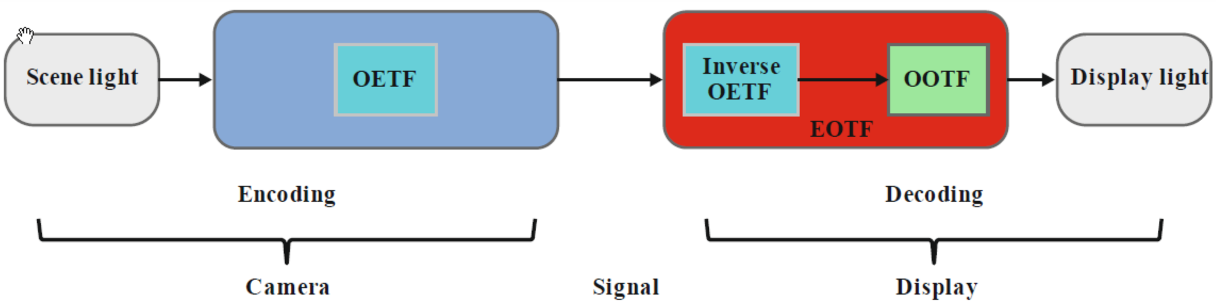
The OOTF or Optical to Optical Transfer Function is the value of the expected complete system conversion. The OOFT is made up of the OETF, artistic adjustments, and the EOTF. The OOTF doesn’t necessarily encompass the entire scene to display a result, but is intended to represent the rendering result of the system.



Generic OOTF System



OOTF as envisioned in the ITU-R BT2100 PQ system



OOTF as envisioned in the ITU-R BT2100 HLG system

What is significant with the system differences is how the OOTF is envisioned. For PQ, there is an assumed OOTF defined at the beginning of the process which may or may not be a product of the system. Since it incorporates input from the creative side, the OOTF is already assumed at the display. For HLG, the system is more conventional and follows the OOTF design that is used for SDR transmissions.

SMPTE ST2084

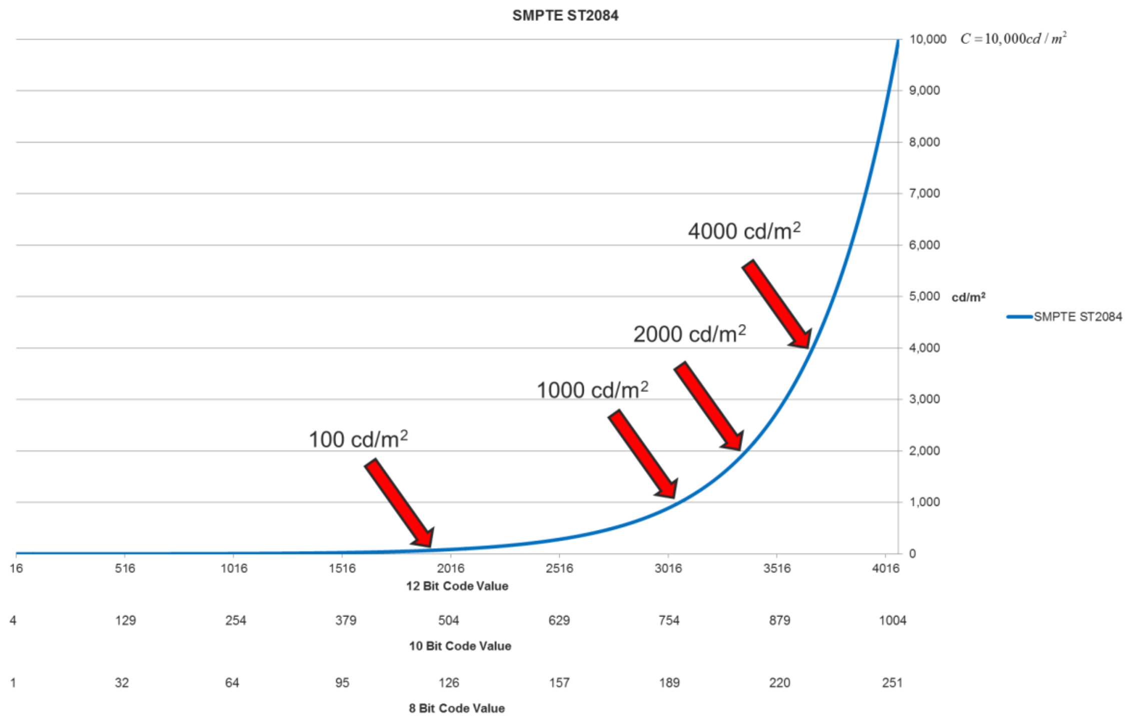
ST2084 was published in September 2014 and describes the EOTF used for the Dolby Vision system. It is also commonly called "PQ" (as it is designed to optimize the quantizing levels of the image data so that a very high range can be displayed without any visible banding effects in shallow gradients. ST2084 is very specific in the relationship between the data value and the light output of the display. It also is based on a maximum display brightness of 10,000 cd/m^2. This is quite bright and at this time there are no displays that have this level of brightness and the capability to show a full ST2084 image (for comparison, displays used for stadiums are typically 5000 to 7000 cd/m^2). Using this standard needs some consideration. The advantage is that the EOTF is very precise, but data values higher than the maximum performance of the display will not be shown correctly. This could be seen either as a compression in the highlights should the display include a slope function or as clipping of your highlights. The clipping could be seen as loss of detail or color shifts if the display RGB channels clip at different levels.

SMPTE ST2084 defines the EOTF in two parts. The first part describes the linearization or how the curve can be transcribed.

$$L = \left(\frac{\max\left[\left(N^{1/m_2} - c_1\right), 0\right]}{c_2 - c_3 N^{1/m_2}} \right)^{1/m_2}$$

Where N is the data (code) value coming into the monitor and L is the color value coming out since this is applied to all three color channels (RGB). The remaining values are all simply constants. The second part multiplies the color value to a max output light level as $C = 10,000L$.

The one thing you need to be aware of is that as you monitor your content, the clipping level of the image is dependent of the maximum light output of the display. Difference displays will show different clipping levels. Some production displays now have functions where higher light levels can be show on lower brightness displays. Always confirm image clipping on the waveform monitor and not the display if working on a PQ HDR project.



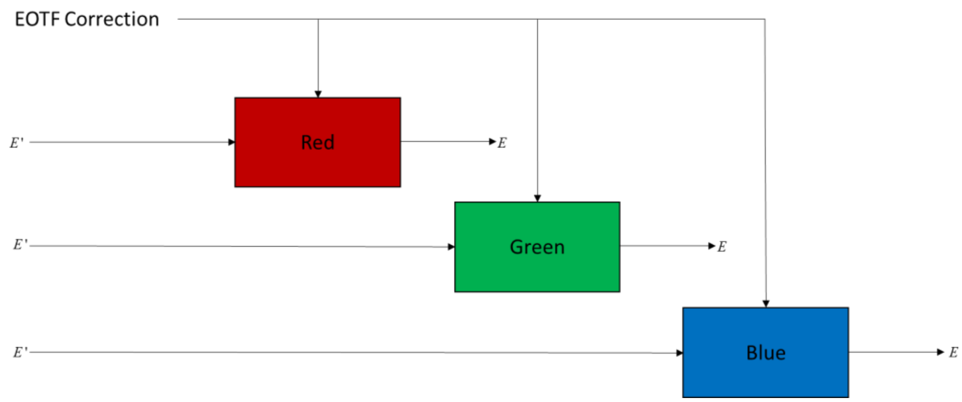
ST 2084 display brightness defined by absolute code value

ARIB B67

Surprisingly, the first HDR gamma to be standardized was NHK's version of HLG (HLG is Hybrid Log Gamma). This is standardized only in Japan. Standard docket B67 describes this HLG process which is very similar to the BBC system (ITU-R BT2100). However there is one large difference in how the EOTF is applied. For ARIB B67, there simply is a fixed 1.2γ power curve. This is directly applied to each color channel (RGB).

The standard describes the gamma as an OETF and assumes that the display will use a direct inverse.

The application of the EOTF can be shown as:

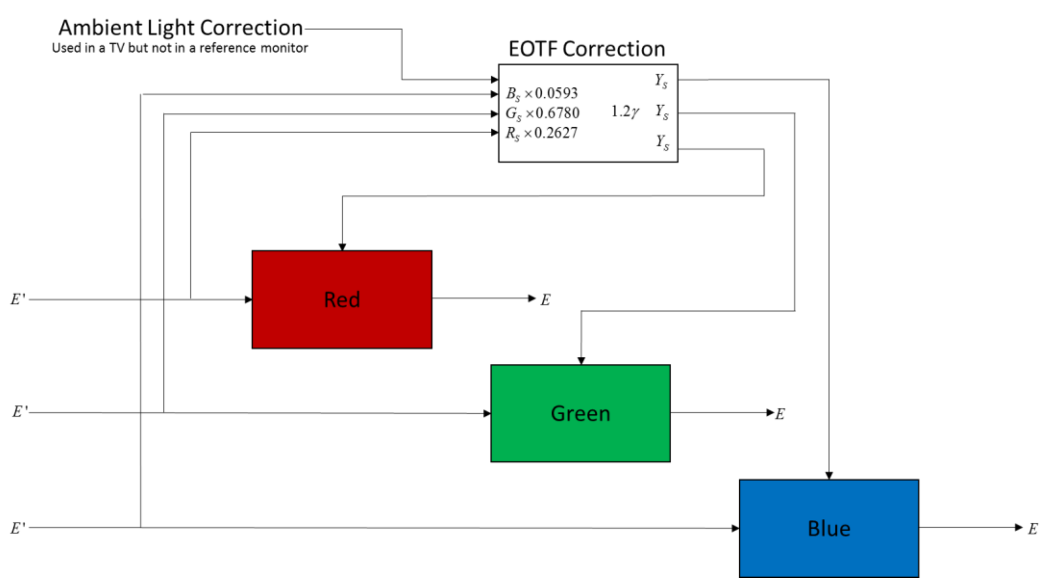


EOTF applied using the ARIB HLG or ST2084 Systems

It is very unlikely you will ever encounter this format. In almost all cases, when someone is talking about HLG, they will be talking about ITU-R BT2100.

ITU-R BT2100

This is the latest HDR standard and is all inclusive of both the Dolby PQ system and the BBC version of HLG. The description of the PQ system is identical to the one described in SMPTE ST2084. HLG's primary motivation was to have an HDR system compatible with new HDR TVs and older SDR TVs without the need for conversion. In this system, there is consideration for differences in light levels for the viewing environment. Meaning that if the light level rises during viewing, the HLG system will compensate for it in the TV. They way this is done is by summing the RGB channels into a separate luminance channel. The EOTF correction is applied there and then summed back into each RGB channel.



EOTF applied using the ITU-R BT2100 HLG System

Included with the standard is a reference EOTF definition. So for mastering, we don't need to worry about this variable system.

The description is a bit complicated, but the operation is not.

To put this together we need to define some items.

F_D	Output luminance of the display
E'	Our OETF
E	Our EOTF
$R_D G_D B_D$	Color brightness output of the display. $F_D = \sum R_D G_D B_D$ (also called display referred)
$R_S G_S B_S$	Brightness of light going into the camera (also called scene referred)
L_W	Reference white brightness level
β	Our black level and also defined as L_B
α	Our brightness difference $\alpha = (L_W - L_B)/1.2^{\gamma}$
γ	Gamma (1.2 referenced to 1000 cd/m^2)
Y_S	Our luminance matrix
a,b,c	Simple numerical constants

We need to construct a luminance channel. This is a simple sum of each component so we can say

$$Y_S = 0.2627R_S + 0.6780G_S + 0.0593B_S$$

The EOTF is defined as an inverse of the OETF, so to define it we would use:

$$E = OETF^{-1}[E'] = \begin{cases} 4E'^2 & 0 \le E' \le \tfrac{1}{2} \\ \exp\left((E'-c)/a\right)+b & \tfrac{1}{2} < E' \end{cases}$$

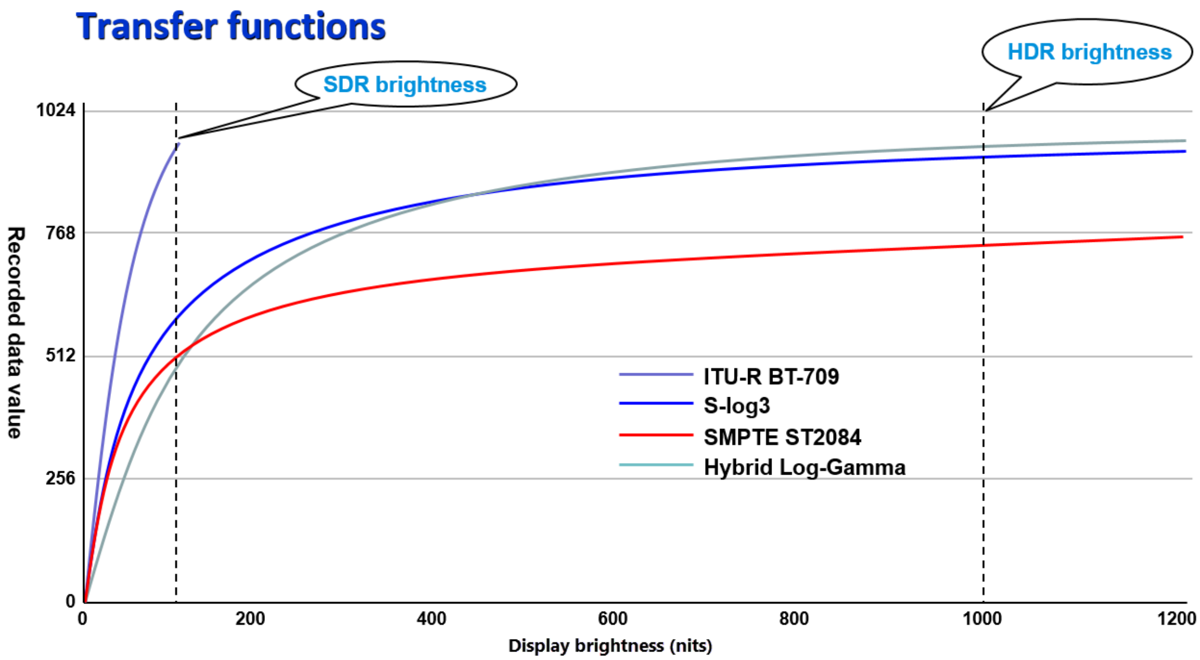
The light output for a given input level would be

$$F_D = OOTF[E] = OOTF\left[OETF^{-1}[E']\right]$$

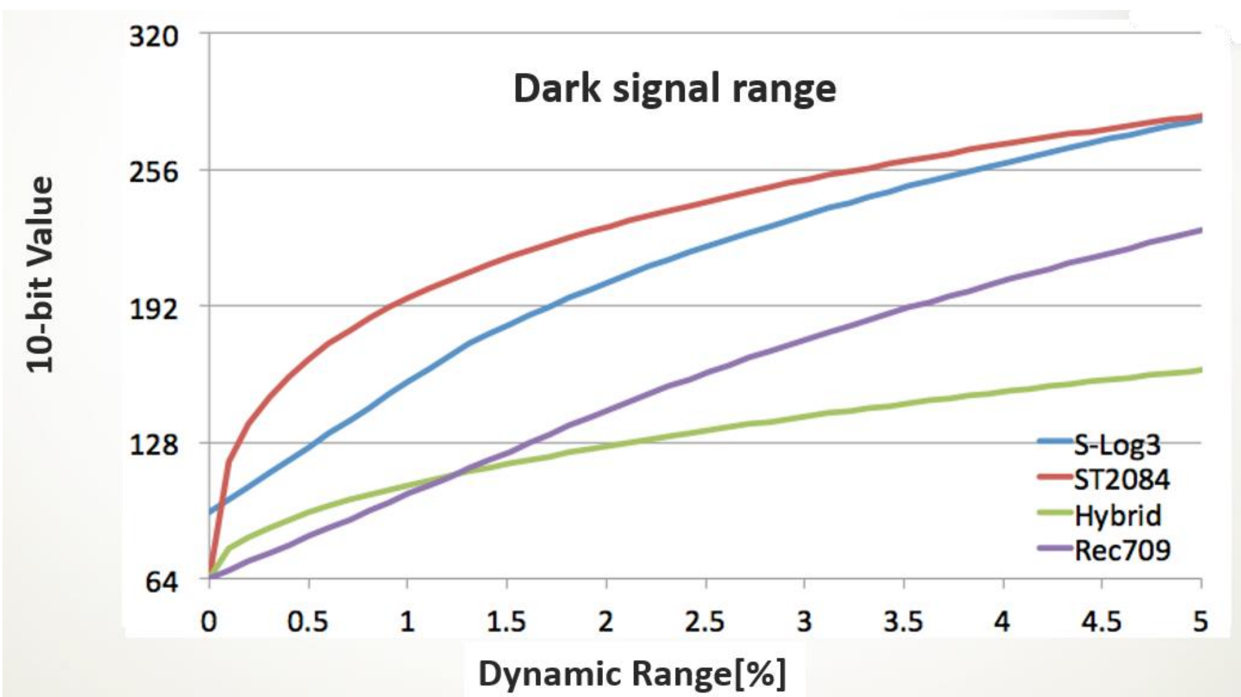
Or we can say

$$R_D = \alpha Y_S^{\gamma-1} R_S + \beta$$
$$G_D = \alpha Y_S^{\gamma-1} G_S + \beta$$
$$B_D = \alpha Y_S^{\gamma-1} B_S + \beta$$

Working in HLG still has some issues. While it will work well on displays up to 1200 cd/m^2, you still need to confirm how it would look on a SDR display. This is all new and there are still a lot of things to be discovered as you develop you content.



Comparison of the different HDR & SDR EOTFs.



Different EOTFs performance in dark image areas.

Setting up a monitor

While on the surface it seems fairly simple to set a monitor correctly, different formats, bit rates encoding and image format all must be considered to get the right result.

Things to consider

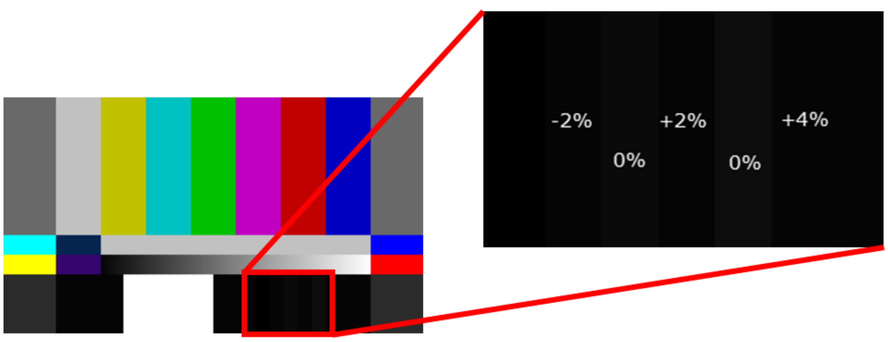
- Input signal (3G, HDSDI, HDMI?)
- Image resolution Theatrical or Television?
- Image aspect ratio
- Frame rate
- SDR or HDR display
- Progressive or interlace input signal
- Bit depth and sampling (8, 10, 12 - 4:2:2 or 4:4:4)
- RGB or luminance/color difference format
- Color Gamut
- EOTF (gamma)
- White point
- Color difference to RGB matrixing (if the input is a color difference format)
- Image division format (for 4K work)

Test Patterns

Test patterns are essential tools in monitor calibration. As technologies change, so does the choice and implementation of these patterns.

Color Bars

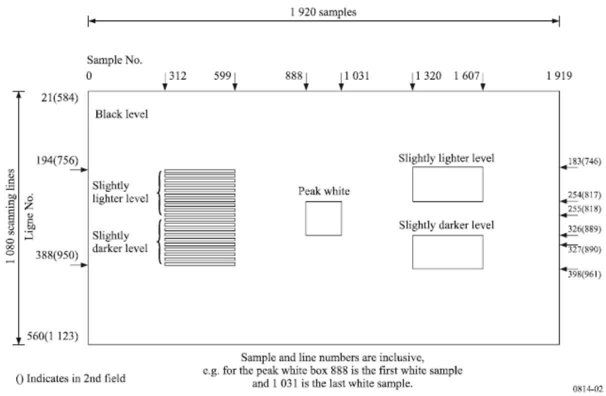
The most common test pattern used today is Color Bars. There are a number of flavors, but the most current version is defined under SMPTE RP219. These were specifically designed for high definition displays and systems.

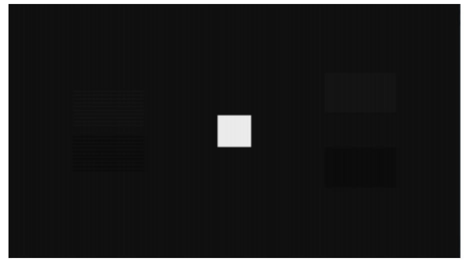


The SMPTE RP219 test pattern, with a blow-up of the pluge section.

There are a couple of issues with using this chart, especially adjusting black using the Picture Lineup Generation Equipment (pluge) pattern. This uses a patch set to -2% next to a 0% patch, next to a +2% patch, next to another 0% patch and finally on the right a +4% patch. Notice the area marked by the red box. Unfortunately, the pluge pattern is directly adjacent to the grey scale test bar. Particularly with CRT and plasma monitors, flare from the brightly lit gray scale bar can spill onto the pluge area, slightly raising the black level. Often it’s not possible to get a truly accurate adjustment.

ITU-R BT814





A better method would be to use a full field pluge pattern, as with the ITU-R BT814. This eliminates flare issues and has a very low average picture level, making adjustment much easier and more accurate.

Full Field White or Window

To set your white level, it's best to use a white pattern given the room environment. If the area that the monitor where the monitor is used has a higher light level, better results will come from using a full white screen test image. By using the entire screen, this enables you to meter around glare points and have more versatility in getting a good measurement. If there is reasonable light control around the monitor, use a windowed pattern with a 100% white square centered on the screen at between 10% and 18% picture area.

20% Grey

A good tool for setting black balance is a 20% grey field. This works well because the brighter the sample, the more accurate your meter becomes. While inappropriate for setting black level, 20% grey is good for setting black balance. Especially with newer, completely digital technologies, changes in tracking are negligible as the image becomes darker. So a very dark test signal only makes the adjustment more difficult. Note that in many of the new digital monitors, adjustment of bias levels may not be necessary.

Common Setups

Below is a table of the most common SDR monitor configurations

	Gamma (EOTF)	*Phase & Sat*	*White Pt.*	*White Level*
Std Def TV	2.2	Cal to bars	D65	100 cd/m^2
HD TV	2.4	Cal to bars	D65	100 cd/m^2
Theatrical	2.6	Not Required	x=0.314, y=0.351	48 cd/m^2
Theatrical using ACES workflow	2.6	Not Required	x=0.322, y=0.338	48 cd/m^2

Phase/Saturation/Brightness/Contrast

Almost all monitors have controls for Phase, Saturation, Brightness and Contrast. Each of these has a specific function and in some conditions they are not (or should not be) operable.

What works when

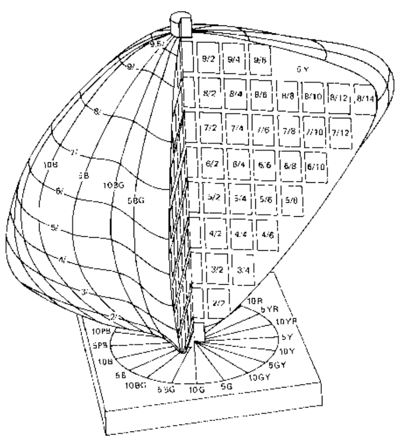
If the monitor is properly designed, then the four controls should work only when the input signal conforms to a video system that allows adjustment. The table below shows when each control should be active. Controls that are active when they shouldn't be are a sign that the signal system in the monitor is not designed correctly and that the image may have a calibration issue.

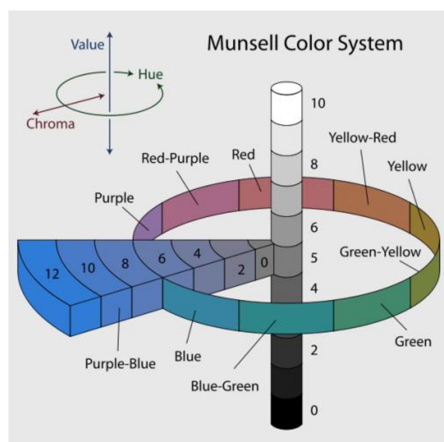
	NTSC	*PAL*	*Yuv*	*RGB*	*XYZ*
Phase	O	X	X	X	X
Saturation	O	O	O	X	X
Brightness	O	O	O	O	X
Contrast	O	O	O	O	O

O= active X=disabled

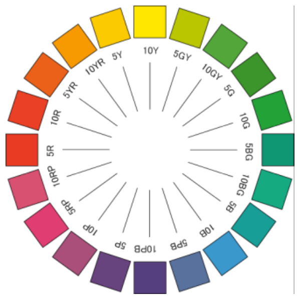
Munsell, vectorscopes, phase and saturation

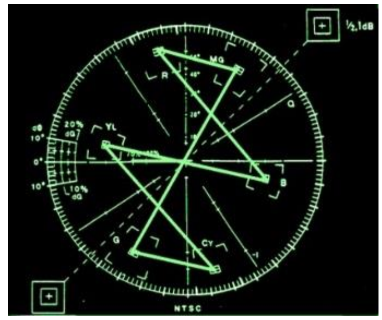
To understand phase and saturation adjustments, it helps to take a step back and consider the "Munsell Color System." One of the pioneers of color, Albert Munsell developed a color notation system in 1905 and in 1915 published a paper defining how people see color. This was the Munsell Color System.





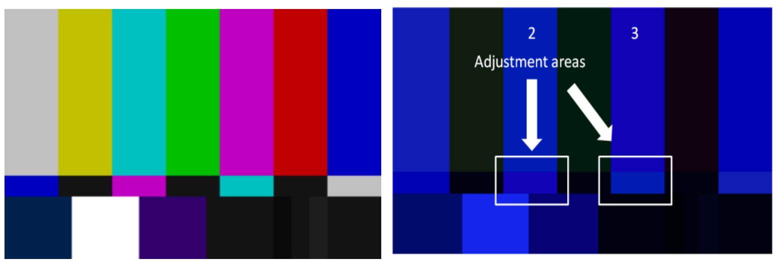
Munsell described three sensations. The first is light and dark, which he plotted in his model as the central, vertical axis. The second sensation was saturation (color intensity). This is shown on the model as increasing intensity the further you travel from the central Light/Dark axis. The third component was hue. This is described as the shift in color as you orbit around the axis. The vectorscope is based on this model.





Phase

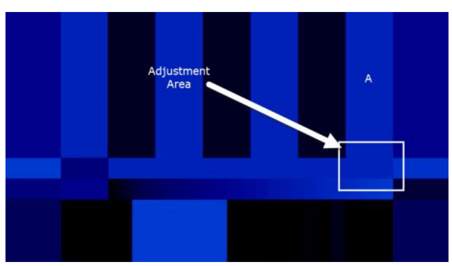
If you are looking at the vectorscope, phase would be used to rotate the colors around the center axis. Phase is only active with an NTSC composite input. For all other signal formats it is (or should be) inactive. To adjust phase, simply display a color bar signal and select the “Blue Only” mode on the monitor. If the monitor doesn’t have a blue only mode, you can place a blue gel across the face of the monitor. To adjust phase, set the magenta and cyan chips in the middle strip to match bars 2 & 3.



On the left, color bars used for NTSC. On the right, color bars in Blue Only Mode.

Saturation

Color saturation is simply amplifying the level of color in the picture. Again, if you were to look at the vectorscope, increasing saturation would move the outer primary colors further away from the center. To adjust saturation, you again would put up a color bar signal. If the input is NTSC or PAL, adjust bars 1 and 4 until they match. If the input is HD 4:2:2, then you use the SMPTE RP 219 bars and adjust until bar “A’ matches the color chip underneath.



SMPTE RP219 shown in blue only mode.

Brightness & Contrast

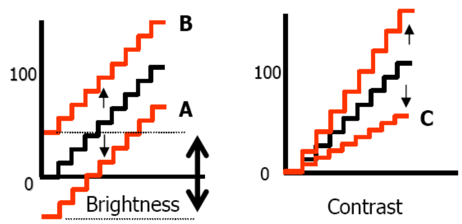
Brightness is used to set your dark level. Contrast is used to set your white level. These two are critical. Getting brightness and contrast wrong does more damage to your image than any other mis-adjustment.

Gamma	20% Grey	100% White
2.2	2.41 cd/m²	100 cd/m²
2.4	1.73 cd/m²	100 cd/m²
2.6	1.24 cd/m²	48 cd/m²

Dark values are confirmed using a 20% gray input signal. Luminance levels are in units of candelas per square meter, abbreviated as cd/m².

We strongly recommend that you leave the brightness adjustment at preset for any reference monitor. Back in the day of CRTs, your perception of blacks was based on the ambient light in the viewing room. This is the reason for having a brightness control, which raised the black areas above the ambient light level by increasing the gun drive in the monitor.

An LCD display is very different. Since the transmissive mechanism is blocking light rather than emitting, there is a limiting point past which the LCD material can no longer stop the backlight from leaking through. This is the lowest light level the monitor can obtain. No adjustment of the brightness control can lower the black levels any further. If you do persist in lowering the brightness control, bad things happen.



The effects of brightness and contrast in a digital signal path.

When we examine the effects of brightness and contrast controls in the digital signal path, we note several things.

First, in some cases, lowering blacks can put image data below zero. The blacks will appear crushed, when in reality, it's the monitor causing the problem. It's tempting to make this adjustment on an LCD monitor, thinking you're lowering the actual light output, when in reality you are adjusting image data below the black level of the monitor. You end up chasing a problem that doesn't exist.

Second, brightness will change contrast, but contrast shouldn't change brightness.

We should point out that while the black level output on the LCD may be higher than on the CRT, image detail is actually more easily seen on the LCD. Also, the LCD has tables for gamma compensation that scale with changes of the brightness settings. With the CRT, the image gamma is constantly changing as black levels are adjusted.

BackLights

Some LCD monitors will allow adjustment of both brightness and the backlight luminance. This can cause several issues. If the backlight is too high, then the black level of the monitor will be elevated. If it's set too low, then black detail will not be visible regardless of the brightness setting.

The best method to adjust the backlight is to place the brightness control at mid-range and then display a stair step grey scale pattern on the monitor. The more steps, the better. Set the backlight to its highest value. Adjust brightness so that all of the steps in the lower levels are visible and that all detail is shown in the image. Then lower the backlight level so that you have the lowest black on screen without losing any black detail. Once that's set, you will have to readjust contrast for the correct white level.

What white balance values do I use?

The table below shows which values are used for different production standards.

	CIE 1931		*CIE 1976*	
	x	y	u'	v'
D55	0.3324	0.3474	0.2044	0.4807
D60	0.3217	0.3378	0.2007	0.4743
D61	0.3180	0.3346	0.1993	0.4720
D65	0.3127	0.3290	0.1978	0.4683
SMPTE S431 (DCI)	0.3140	0.3510	0.1907	0.4797

White balance adjustments

People have their own preferred techniques for making this adjustment. The following method is just one suggestion. Many methods work and what really matters is where you end up.

Note when looking at CIE 1931, red runs just about parallel to the x axis. Also note that the y axis is somewhat parallel to green. Blue will change both values and even small adjustments have a very large effect on the color.

So:

- To adjust x, use Red
- To adjust y, use Green

Just remember that green will make significant changes to luminance (L).

This method works with the white level and your dark level. Note for dark adjustment, use the 20% grey field, not black.

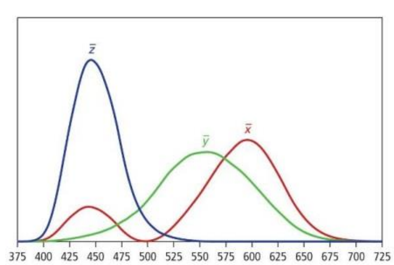
You will also find that for higher quality digital processing monitors, it's best to leave the bias adjustments alone as these designs offer better grey scale tracking.

Spectral distributions and Judd

CRT and plasma have an advantage in that the output spectrum is very flat. This gave us fairly repeatable setups for matching displays. But CRT and plasma couldn't display wide color gamut images like those necessary for cinema and/or HDR. New display technologies can do this since they use more narrow spectrum primaries.

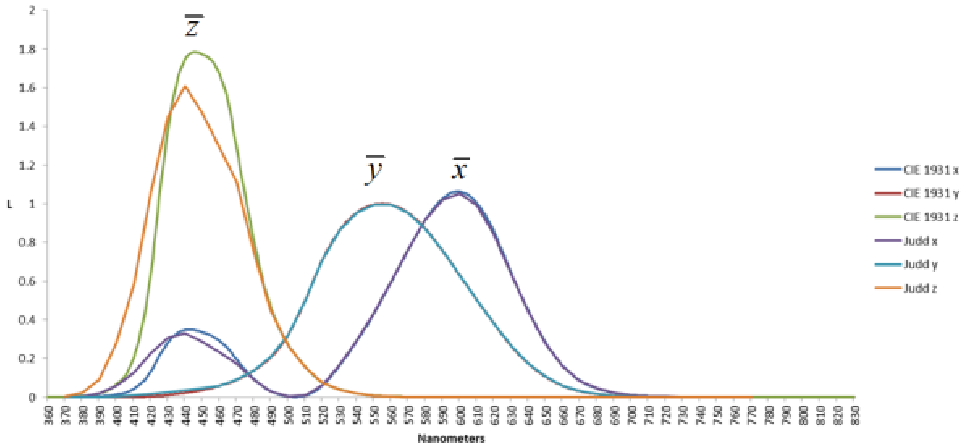
Spectral radiometers and tristimulus light meters all have to base their results on the math defined by the CIE, most notably the standard CIE 1931/ISO 10527 which defines "The 2° Standard Observer." This is the basis of all modern colorimetry. The purpose of this was not to make a standard that describes what everyone would see, but to define a vision model that could be used as a color comparative reference. Whether it describes what you see is irrelevant. It is simply a model.

The acceptance response diagram below defines the CIE 1931 Standard Observer. The horizontal scale is light wavelength in nanometers (nm). The peaks represent the frequencies where the human retina's cone cells are most sensitive.



Since this was standardized, numerous studies have refined the original work of Guild-Wright which is the basis of CIE 1931.

One of these studies was performed in 1951 by Deane Judd of Kodak and called the “Judd Modification.” Judd proposed a change to CIE 1931 for wavelengths that are shorter than 460 nm. This modification has been confirmed by other studies performed by Stiles (1955), Ishak and Teele (1955) and Vos (1978).

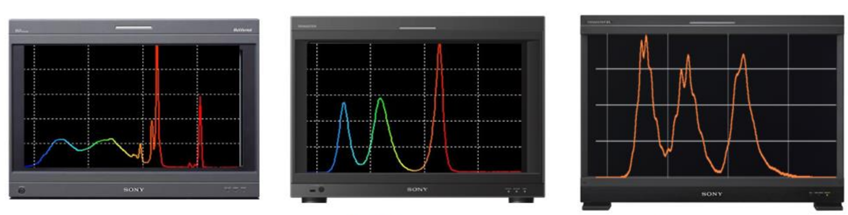


CIE 1931 Standard with Judd Modification

For practical reasons, the CIE has not applied the Judd Modification to the standard. This is why Judd isn’t found in any light meter instruments.

In the illustration below, note that the blue and blue-green area of the spectrum (below 460 nm) is quite flat on the CRT when compared to green and red. However on the LCD/LED and the OLED displays, there is substantial energy for the light probe to measure. Sony feels that conventional CIE 1931 measurements produce less than satisfactory results with OLED and LCD/LED. We believe that applying the Judd Modification to OLED and LCD/LED greatly improves matching among the different technologies.

Sony feels that this modification greatly increases the accuracy of the alignment for any monitor technologies that are using spectrally segregated emissions. These can include LCD using LED backlights but more specifically applies to our TRIMASTER EL® OLED models.



CRT Spectrum **LED Spectrum** **OLED Spectrum**

Spectral differences between display technologies displaying 100% white.

Applying Judd

The theory described above is intended as background information only. In practical terms, the Judd Modification requires simple offsets to the white balance measurement. These offsets have been developed around the spectrum of Sony’s RGB OLEDs. They may not work satisfactorily on all narrow band display technologies.

For different color coordinates used should be:

All but PVM X550	CIE 1931 Coordinates		Judd Corrected	
	x	y	x	y
D93	0.2831	0.2971	0.2771	0.2861
D65	0.3127	0.3290	0.3067	0.3180
D61	0.3198	0.3360	0.3138	0.3250
D55	0.3324	0.3474	0.3264	0.3364
DCI White	0.3140	0.3510	0.3080	0.3400

For PVM X550	CIE 1931 Coordinates		Judd Corrected	
	x	y	x	y
D93	0.2831	0.2971	0.2751	0.2851
D65	0.3127	0.3290	0.3047	0.3170
D61	0.3198	0.3360	0.3118	0.3240
D55	0.3324	0.3474	0.3244	0.3354
DCI White	0.3140	0.3510	0.3060	0.3390

Processes other than Judd

One might ask why the CIE (the governing body for color measurement) would let this go and not work on a solution. In reality they have recognized this and have done a significant amount of work to remedy the math errors in CIE 1931. However, since our vision turns out to be far more complicated than what was originally thought back in the 1930's, more studies and testing have been required. The latest CIE report is a two book description of vision using studies from such researchers as Stiles and Burch, Hemholtz, Vos and Walraven, Smith and Pokorny, Stockman and many others. This is far more extensive than the original Wright Guild studies that formed CIE 1924 and CIE 1931. The latest report is CIE 170-1 and CIE 170-2. In particular CIE 170-1 defines a new 2 degree and new 10 degree standard observer. Preliminary tests show that this does correct many of the problems found today. While tests are not finalized, many of the probe manufacturers are looking into this as a replacement or supplement for CIE 1931. If it is proved to work and adopted, we should be able to align any type of display technology without the need for corrections such as Judd.

HDR Setups

For the most part, setting for an HDR display will be similar to those used for SDR display. The two significant differences will be for color gamut and EOTF. The EOTF will also be the reference for the display brightness, so setting a peak white adjustment value is not necessary. For calibration purposes, the white level should be adjusted to 100 cd/m2 with an SDR input. The monitor will then calculate the correct white level given the stand used for your EOTF setting.

	White Point	Color Gamut	EOTF	Transfer matrix
ITU-R BT2100	D65	ITU-R BT2020	ITU-R BT.2100	Source[2]
ST 2084	D65	ITU-R BT2020	ST2084	Source[2]
ARIB	D93	ITU-R BT2020	HLG ST1.2	Source[2]
HDR 10	D65	ITU-R BT2020	ST2084	Source[2]
Dolby Vision	D65	ITU-R BT2020	ST2084	Source[2]

[2] Transfer Matrix is dependent on the matrix used to acquire the content. If the source is using an ITU-R BT709 matrix, then the monitor should be set to the same.

Intricacies of Sony Monitor Types

BVM E Series

As of this writing, the current BVM E models include the BVM E171 and BVM E251. These models share the same menu system as earlier units starting with the BVM 20E1U in 1995.

Control System

There are no controls on the monitor cabinet. Instead, a remote panel is used to make any changes to the configuration or to make adjustments. Compatible control panels include the BVM 15R, BKM 16R, and BKM17R.

BKM 15R

BKM 16R

BKM 17R

Control Panel Layout

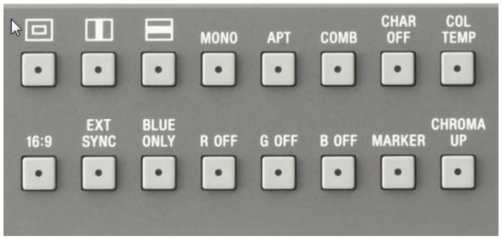
Memory

Starting on the left, for BKM 15R and 16R panels, is a Sony Memory Stick slot used to insert a memory card for storage of configuration files, system backup files and screen captures using the “Capture” button. The capture file is a 16 bit tiff captured at the very front of the signal path into the monitor. For the BKM 17R, this memory slot was changed to a standard USB port.

Memory slot on the BKM 17R

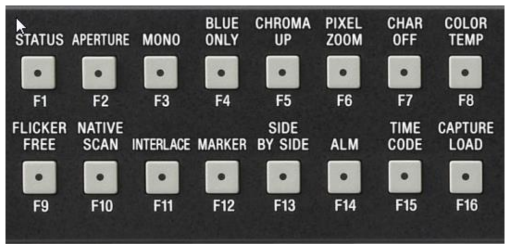
Function Controls

Next to the memory slot are function keys to control typical evaluation and monitoring functions. For the BKM 15R, these are fixed and cannot be changed. For the BKM 16R and BKM 17R, these can be changed through settings in the control panel menu.



BKM 15R

BKM 16R



BKM 17R

Menu Navigation

All three control panels use the same button configuration. Menu will display the menu or back up to a previous menu item. In addition, the PHASE knob can be used to quickly move to menu settings and adjustments. Enter will save menu settings and the up and down buttons navigate to each item in the menus. Pressing menu at any menu item will back out without saving the new data as long as entered has not been pressed.

Menu Navigation

Knob Adjustment

There are four knob adjustments to make changes to image output and are also used for adjustment and navigation. During normal operation the operation of these knobs conform to the type of input signal used.

	NTSC	*PAL*	*Yuv*	*RGB*	*XYZ*
Phase	O	X	X	X	X
Saturation	O	O	O	X	X
Brightness	O	O	O	O	X
Contrast	O	O	O	O	O

Below each knob is a button labeled Manual. When pressed, the knob becomes active. This button is also useful as when making adjustments, it can be pressed to revert the related adjustment back to the previous value. This is useful when adjusting white balance, as if one adjustment goes too far, it can easily be reset back to the last memory value by simply pressing MANUAL.

Monitor Selection Control

Since the BKM control panel talks to the monitor via Ethernet, a separate LAN system can be constructed to control multiple monitors in a system. Up to 32 monitors can be controlled by up to 32 control panels. These can be organized into groups. In addition, files and screen grabs can be shared across the network and used or displayed on other BVM monitors within the system.

Monitor and Input Selection

To select a monitor, simply press SINGLE, then the number of the monitor you want to control, and then press enter (either the enter key in menu selection or the one on the 10 key will work). You should now have control of that monitor.

Group selection works the same way, but instead of selecting SINGLE, you would select GROUP.

Notes on operation.

1. If the window with the monitor number is dashes, then either the monitor or the control panel have the PEER to PEER/LAN switch in PEER to PEER mode.
2. If parts of the menus are greyed out, then either the monitor or control panel are selected to LAN. Items involving LAN and updates must be done with a direct connection and both units set to PEER to PEER.
3. There are two IP addresses in the monitor. For PEER to PEER, the IP number cannot be changed. It is fixed at 192.168.0.1

Peer to Peer/LAN selection on the monitor

Peer to Peer/LAN selection on the control panel

Control Panel Connection

Power for the BKM 15R is from wither an internal power source inside the cabinet, or from a 5V source from the monitor. Not some monitors are 12 V DC! If so, then use only the internal power.

For the BKM 16R and BKM 17R, the power supply is a separate module that is packaged with the control panel on delivery.

The power supply and connection cables are different between the BKM 16R and BKM 17R.

The part number for the BKM 16R power supply is 1-480-408-13.

The part number for the BKM 17R power supply is 1-493-244-11

The cables used to connect the BKM 16R and BKM 17R are also different. This is because the power connector on the control panels are different.

BKM 16R Power Connector

BKM 17R Power Connector

There are two cable version available for each control panel that allow power and communication from connections directly to the monitor.

For the BKM 16R

3 Meter	1-830-578-12
5 meter	1-830-578-22 (SMF 700)

For BKM 17R

3 Meter	SMF-17R3

LAN Configuration

To setup a set of monitors in a LAN control system, all settings must be performed in PEER to PEER. If the LAN and IP settings are grayed out, then either the control panel or monitor are set to LAN.

Configuration of both the control panel and the monitor are performed through the monitor. Since the IP address for Peer to peer cannot be changed, any errors in configuration can be fixed easily by going back to the Peer to Peer connection settings.

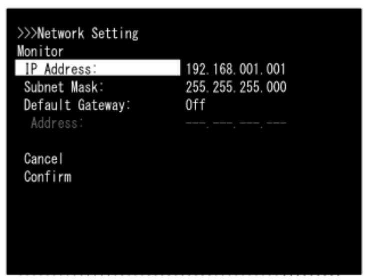
Monitor IP setting

From the monitor

1. Press the “Menu” key on the control panel and display the main menu
2. Select “System Configuration”
3. Select “Network”
4. The menu below should be visible.

There are three settings that must be made to make it possible to control the monitor by the BKM control panel.

5. Monitor ID must be different for every monitor on the network. This is the number you would press to select the monitor to be controlled.
6. Group ID would be for a number of monitors that would be controlled by the same command. One example of this might be to have a set of monitors switch to a specific marker setting all at once.
7. Once these are set, proceed to Network Settings.

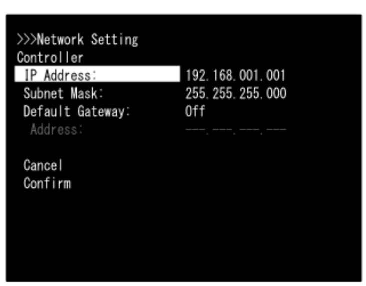


8. Input the correct IP address and subnet mask. If a default gateway is needed, then select “ON” and the address selection should become available.
    a. Do not press “Enter”. If you press “Enter”, the new address is not saved.
9. Navigate to “Confirm” and press “Enter”.

Controller IP setting

Setting controller IP is also through the menu system in the monitor.

1. Press the “Menu” key on the control panel and display the main menu
2. Select “System Configuration”
3. Select “Controller”
4. Select “Network”
5. Select “Network Setting”



6. Input the correct IP address and subnet mask. If a default gateway is needed, then select “ON” and the address selection should become available.
    a. Do not press “Enter”. If you press “Enter”, the new address is not saved.
7. Navigate to “Confirm” and press “Enter”.

Controlling Each Monitor

Once monitor ID, group ID, Monitor IP address, Monitor subnet, Controller IP, and Controller Subnet are set, select LAN on the back of both the monitor and controller. Disconnect both and connect them to the network.

To confirm operation

1. On the controller, the window should have a number displayed, not any dashed lines.
2. Press “Single” on the control panel
3. Select the number of the monitor (this is the same number assigned in the monitor IP menu window.
4. Press “Enter”
5. The number will flash. Once it stops flashing, communication has been established.
6. You should now be able to get menus, switch inputs and perform any operation on that monitor.
7. If there is no communication, the number will continue to flash. If so, you can switch everything back to Peer to Peer and reconfigure the monitor and/or controller.

Monitor Calibration

Configuration architecture

The BVM E series uses both memories and menu settings to properly display an image. The “Channel Configuration” menu assigns which memories and settings are active with each input selection. These configurations are selected on the 10 key area to the right of the BKM Control panel. One button selection is used to active a complete configuration of the monitor.

Monitor Preset Alignment

Adjustment items include

- Phase (for NTSC input only), Chroma (Saturation), Brightness, and Contrast.
- White Point

This is done from the “Adjustment” Menu which is at the top of the home menu.

For Phase, Chroma, Brightness and Contrast, there are memories for different configurations.

- Preset. Which includes the Contrast, Brightness, Saturation, and Phase settings.
    - These are held in 6 separate memories
    - Preset 1, Preset 2, Preset 3, Preset 4, Preset 5 and Preset DCI

Path for Preset Adjustment

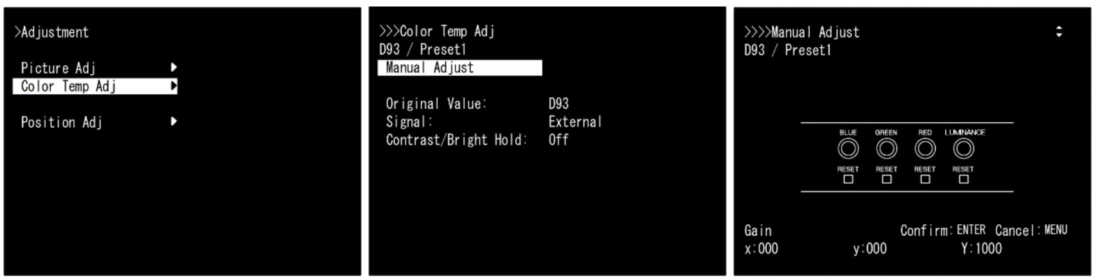
Preset adjustment can be performed in several ways.

1. It can be automatically set by inputting the correct color bar signal into the monitor and selecting the “Auto” process.
    a. For an NTSC input, use SMPTE EG-1 1990 pattern
    b. For PAL or Secam inputs, use Full Field 8 Bar 100% saturation
    c. For High Definition, use SMPTE RP219 pattern
2. It can be adjusted manually
3. It can be copied from another of the preset memories.
4. It can be copied from another BVM E171 or BVM E251 monitor connected by the LAN system.
    a. Preset files cannot be used on any PVM models.
5. It can be copied from a file on a Sony Memorystick™ (BKM 16R) or USB memory (BKM 17R).

- To reset an adjustment back to the previous value, simply press the “Manual” button below the adjustment knob.
- The on screen characters can be removed if one of the BKM function keys is set for “Char Off”

Monitor White Balance Alignment

Adjustment of white balance



White Balance Adjustment Path

The white balance values can be set in a couple of different ways.

1. Using a factory preset.
    a. Presets include factory adjustment for D93, D65, D61, D55, and DCI V1.2.
    b. All factory presets are adjusted with Judd offsets values included
    c. If an asterisk is displayed next to a factory preset label, then that reset has been adjusted differently than the original factory values. An example would be (D93*)
2. User Memory
    a. There are four user memories labeled as User1, User2, User3, and User4
3. Copied from another BVM E171 or BVM E251 monitor connected by the LAN system from a memory on another monitor
4. Copied from a file on a Sony Memorystick™ (BKM 16R) or USB memory (BKM 17R).
5. Manually adjusted using an external colorimeter or spectroradiometer
6. Automatically adjusted using Sony’s PC application[3].

- Note that the upper left of the screen will always show which white point memory and which preset memory are being changed.
- Knob assignments are:
    - Phase = Blue
    - Chroma = Green
    - Brightness = Red
    - Contrast = Luminance

These will all work with any composite, YUV or RGB input. However, if the input is XYZ, a separate set of memories are used.

[3] See the section in this manual “Using the Sony Auto Setup Software”

These memories are labeled DCI XYZ, UserXYZ1, UserXYZ2, UserXYZ3, UserXYZ4 and UserXYZ5.

Contrast/Brightness Hold

One additional selection is Contrast/Brightness Hold. In many cases, the adjustment of brightness and contrast have been set previously to adjusting white balance. With this setting set to “ON”, these settings will return to their original values once the white balance adjustment has been completed. If set to “Off” then any changes in white and black levels after white balance setup will remain.

Also to be noted, it is highly recommended not to use “Gain” and “Bias” controls to set brightness and contrast levels. This can cause many problems including odd EOTF (gamma) performance.

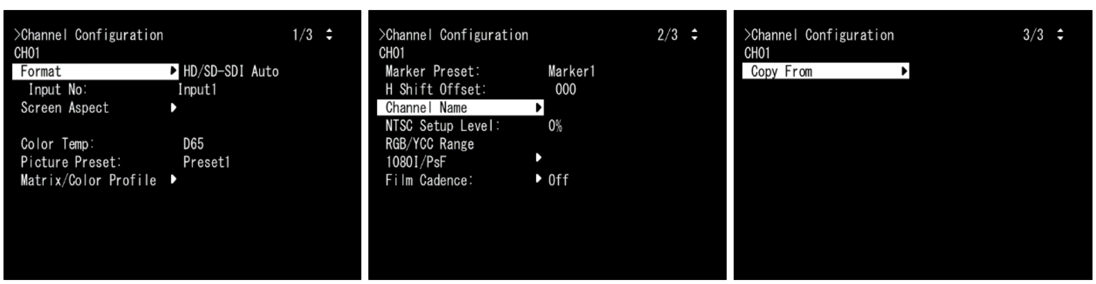
If brightness and contrast have not been completed before white balance alignment, then Contrast and Brightness hold should be set to “Off” and both brightness and contrast should be readjusted from the “Picture Adjustment” menus.

Channel Configuration

Once each adjustment is finished, they still will not display unless each channel is configured to use the appropriate memory. To do this, each channel needs to be configured using the “Channel Configuration” menu. This menu is made up of 3 pages.

Items set in the Channel Configuration menu include:

- Input data format for SDI or HDMI
- Single Link or Dual Link connection
- Input connector number
- Image aspect ratio
- Image color temperature memory used
- Contrast, Brightness, saturation and Phase memory used
- Signal matrix and color gamut setting
- Marker presets
- Tools to name the channel
- Assignment of bit level ranges
- Identification of common frequency interlace and progressive formats



Assigning Memories

Page one of the Channel Configuration menu has the majority of optical settings.

- “Format” selects how the monitor will identify and read the input signal information. If the Format selection is set to “Auto”, and the signal format is a 3G HDSDI format (SMPTE ST424) then it will read the payload ID and display the image. If the Format setting is set to a specific format, then an image will only appear if it is truly that format. If is not, then no image will be displayed.
- “Input No.” sets which connector the monitor uses to display the image.
- “Screen Aspect” will preconfigure the raster for the image. If the image is sent as anamorphic, then the monitor will map it to the aspect ratio selected here.
- “Color Temp” is the memory assigned to that channel configuration
- “Picture Preset” is the memory assigned to that channel configuration
- “Matrix/Color Profile” includes values for signal matrix, colorspace, and EOTF (gamma). There are memories that bundle normal values into one setting. If these bundles are not what is

required, then there are “user” memories that allow them to be separated and selected independently. One user memory is assigned to each channel configuration.

Matrix Values

The matrix is used to convert the values of a Y C_b C_r into the correct RGB values. If the input is RGB or XYZ, then these settings are not used.

Selections are available for ITU-R BT.709, ITU-R BT601, SMPTE 240M, and ITU-R BT2020.

ITU-R BT.709

Used for any high definition images including ITU-R BT709-5, SMPTE ST274, and SMPTE ST296

ITU-R BT.601

Used for NTSC and PAL video systems

SMPTE 240M

Used for the older1125 line HD system

ITU-R BT2020

Used when the source material was generated using a ITU-R BT2020 matrix. Note that on older cameras, the matrix used was ITU-R BT.709. If the material was generated using a 709 matrix, then this setting should also be set to ITU-R BT.709, not ITU-R BT.2020.

Color Profiles For BVM E251 & BVM E171

	Color Space	*EOTF (Gamma)*
BVM SMPTE C	SMPTE RP145-2004	2.2[4]
BVM EBU	ITU-R BT601-7	2.2[4]
ITU-R BT.709	ITU-R BT.709-6	2.4
DCI	SMPTE RP431-2	2.6
ITU-R BT.2020	ITU-R BT.2020-2	2.4
S-Gamut/S-Log2	Sony F65-F55 S-Gamut	S-Log 2[5]
S-Gamut3.Cine/S-Log3	Sony F65-F55 S-Gamut.Cine	S-Log 3[5]
S-Gamut3/S-Log3	Sony F65-F55 S-Gamut	S-Log 3[5]

Color Profiles For BVM E171 with BVML HE171 HDR license installed

	Color Space	*EOTF (Gamma)*
BVM SMPTE C	SMPTE RP145-2004	CRT BVM[6]
BVM EBU	ITU-R BT601-7	CRT BVM[6]
ITU-R BT.709	ITU-R BT.709-6	2.4
DCI	SMPTE RP431-2	2.6
ITU-R BT.2020	ITU-R BT.2020-2	2.4
S-Gamut/S-Log2	Sony F65-F55 S-Gamut	S-Log 2(HDR)[7]
S-Gamut3.Cine/S-Log3	Sony F65-F55 S-Gamut.Cine	S-Log 3(HDR)[7]

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[4] The gamma on CRT monitors was never a true power. This settling includes deviations that were present in actual CRT image performance

[5] Shown within the 100 cd/m^2 limits of the monitor

[6] The gamma on CRT monitors was never a true power. This setting includes deviations that were present in actual CRT image performance

[7] Shown within the 650 cd/m^2 limits of the monitor

S-Gamut3/S-Log3	Sony F65-F55 S-Gamut	S-Log 3(HDR)[7]
SMPTE ST2084	ITU-R BT.2020	SMPTE ST2084 (PQ)
ITU-R BT.2100	ITU-R BT.2020	ITU-R Bt.2100 (HLG)
S-Log3 (Live HDR)	ITU-R BT.2020	S-Log3 Live[8]

Color Profiles For BVM E171 with BVML HE171 HDR license installed

Selecting a Configuration

Configurations are switched using the 10 key panel on the BKM control panel. Up to 89 configurations can be memorized.

The channel configuration is shown at the upper left of the screen.

This can be changed at any time during setup without the need to move between other menus.

HDR License

The BVM E171 has the capability to display HDR images at brightness as high as 650 cd/m^2. The BVM E251 does not have any capability to display images brighter than 109 cd/m^2.

For the BVM E171 to display HDR images, a license must be purchased separately from the monitor.

There are three methods to acquire a license

1. If the license is purchased at the same time as when the monitor was purchased, it can be preinstalled at the factory
2. The license can be purchased from an authorized Sony dealer
3. The license can be purchased directly off the Sony license website

Monitor Firmware

The BVM E171 must have version 1.10 firmware or higher. If your monitor has a lower version, it must be upgraded. For monitors with V1.00, this upgrade must be performed at a Sony repair center.

Definitions

- License Purchase Key
    - The license purchase key is a set of numbers that is used to identify that you have bought a license for the monitor. It is not the number that will be used to install the new HDR functions.
    - You will receive this either as an email or as a printed sheet of paper.
- Unique Device ID
    - This is the number ID of the monitor (Not the serial number) that is used to match the monitor to the license installation key.
- License Installation Key
    - This is the file that will be used to activate the extra features of the monitor
    - This is a set of folders that you will download from Sony's License key website
    - The website can be found at https://www.ecspert.sony.biz

[8] S-Log3 Live provides a gamma sum of 1.2 versus S-Log3 which sums at 1.0

Obtaining the License Purchase key

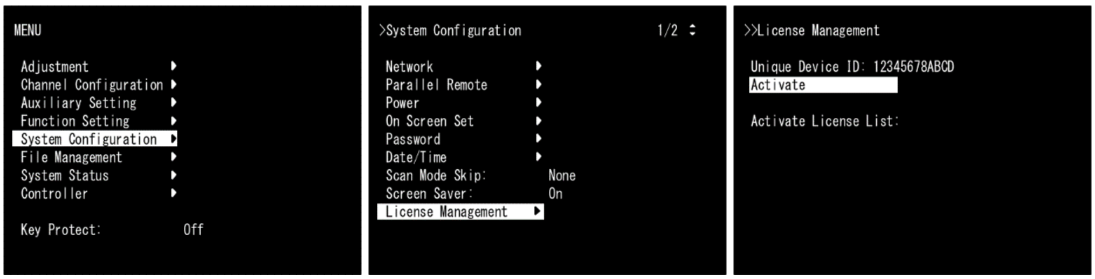
If you have purchased the license from a Sony reseller, then you will get a letter which includes the Purchase Key. It will contain an exclusive 16 character code. One code is good for one key. If you were to buy multiple licenses, then you would get a corresponding number of License Purchase keys.

You can also obtain both the License Purchase key and the License Installation key directly from the Sony ECspert website. You must register with the site before buying any licenses.

Finding the Unique Device ID

The monitor uses an ID number exclusive to that particular unit. Each License Installation key is specific to the monitor chassis and the License Purchase key.

To find the Unique Device ID, power the monitor and navigate to the “System Configuration” menu.



License Menus

At the bottom of the menu selections will be a prompt “License Management”. Open this selection and several items will be made available to you.

At the top of the menu is the monitor’s “Unique Device ID”. Write that down and have it available when you go to the Sony ECspert website.

Downloading the License Installation Key

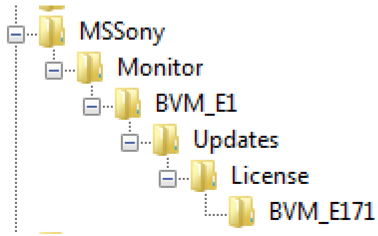
To get the License Installation key, you will need both the Purchase License and the Unique Device ID. You also must be a registered user on the Sony ECspert website. https://www.ecspert.sony.biz

1. Once you have logged in, you will be presented with a screen with selection on the left. The top selection is “Key Issue” with a sub section “Install-Key”. Press enter to continue.
2. The first window you will see will be asking for the “Purchase Key” number. Make sure this is exactly the same number as given to you. Any mistake will generate an unusable key that won’t work in the monitor. <u>This number is case sensitive!</u>
3. Once you press enter, the model number of the product should appear in a window below. This should read “BVM L HE171”. Click on > to continue.
4. A new submenu should appear below. “Install Key Issue”. Click on this button.
5. A new window will appear with the model name and Purchase Key number. Below will be a window asking to input the “Unique Device ID”. This must be input correctly or the Install Key will not work. <u>It number is case sensitive</u>!
6. Do not change the quantity.
7. The License Install Key is a text file. If can be printed out from the site and also downloaded as a pdf file, but is not usable for activating the license. Downloading is usually more successful.
8. Click “Install Key Creation”.
9. Confirm all of the information is correct. Once the key is generated, any mistakes cannot be corrected and the monitor will have to be sent into service to have a new key installed.
10. Click “OK”.
11. At the bottom of the screen, click “Install Key”. The key will be downloaded to your computer.

Loading and activating the License Installation Key into the monitor

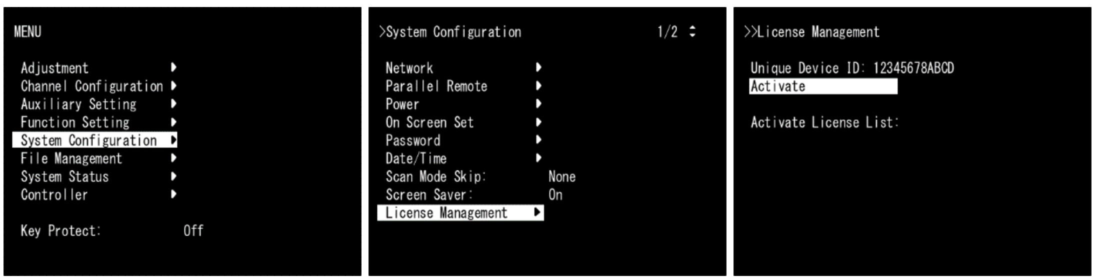
Once you have the Install key, it must be loaded onto a Sony Memorystick™ or USB memory. This would depend on which control panel you plan to use.

1. The memory should be formatted as FAT32
2. The key must be in a specific folder within several folders so that the monitor can recognize it.



Proper Folder Configuration

3. The MSSony folder must be at the root of the memory.
4. Do not change anything in the license file.
5. The license should be placed in the BVM_E171 folder
6. The monitor and control panel must be in Peer to Peer to activate the license.
7. Place the memory in the slot on the control panel. Do not remove it during the process.



8. Navigate back to the “License Management” menu.
9. Highlight “Activate” and press “Enter”
10. The monitor will go through a restart process. Once it’s finished, BVML-HE171 HDR should appear under the “Activate License List”

BVM X300

Monitor Versions

There are two versions of the BVM X300. The /1 offers a four BNC input which can be used as 4 HDSDI inputs or tied together as a quad 4K input. The /2 version adds a second 3G HDSDI Quad array and a single HDMI input. Both versions used the same firmware. Items not compatible in the /1 version are shown in the menus as black characters. A kit is available from Sony Service that can add the extra inputs to a /1 model.

As of this writing V2.2 firmware is the latest version.

BVM X300/1

BVM X300/2

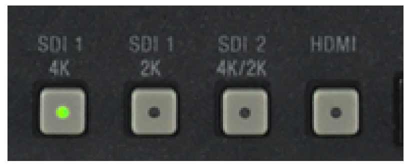
For /1 versions, the loop out is simply an active output with re-clocking. For the /2 output is a monitor selection output. Meaning that this output can either be from the SDI 1 or SDI 2 input. This is changed using the input selection on the front control panel.

Controls

The BVM X300 has the controls integrated into the chassis. There is an Ethernet connection that can communicate with the BKM control panels. There is no power connector for the control panel and Peer to Peer/LAN selection is in the menu system.

There are some differences between the /1 and /2 control panels due to the added inputs. Below are the input selections for each version.

BVM X300/1



BVM X300/2

Control Panel Layout

There are basically four sections of controls on the monitor. At the left are the input selections. Center are seven “F” function keys that can be programmed for various operations. To program them, simply press and hold the “F” key you want to change. A menu will appear that lets you select the operation that key should perform. To see what each F key is set to, simply press the navigation knob when no menu is displayed.

F key Label Display

To the right of the “F” keys are the main image controls including brightness and contrast. Note that Aperture has replaced Phase on the left since the BVM X300 is not capable of displaying an NTSC image.

To the far right are the menu controls. The “Menu button is used to display the menu. The first menu to display will be one of the status pages. To remove the menu screen from the display, simply press the “menu” key.

Items on the status page cannot be changed and are there to inform you of how the monitor is set and what input formats it recognizes.

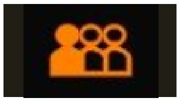
Navigation to specific menu items is performed by using the “Select/Enter” knob. Turning the knob moves the cursor through the menu tree while pressing it sets the adjustment. The back key moves the cursor backwards through the menu selections.

Menu Navigation

Menu navigation uses icons instead of line items as in the BVM E series. Each icon opens a set of menus for specific adjustment or settings.

Status Pages

These include items such as monitor adjustment settings, input signal payload ID, and firmware versions. None of the items under this menu can be changed.



User Preset Settings

This includes color temperature memory assignment, contrast, and brightness settings.

Color Temp

This is the set of menu selections for adjusting User Color Temperature memories.

User Configuration

Menu selections include system settings, input configurations, and “F” key assignments.

Serial Remote

Menu settings for the Ethernet input and configuration of the BKM control panel if attached.

Security

This menu sets password assignments to the menu settings

Memory Architecture

The monitor will use two memory types in order to adjust to the correct image values. The first memory will be called “User Preset” and includes the color temperature memory assignment (not the adjustment), Contrast and Brightness settings, Chroma (if appropriate), Aperture, and Marker Preset assignment.

There are 5 User Preset Memories and one User Preset Memory for XYZ inputs.

The second memory will be the input configuration memory which is set in the User Configuration menus under “Input Configuration”.

There are 8 “Input Setting” memories per input and resolution for SDI and 4 Input Setting memories for HDMI.

Input	*Resolution*	*User Preset Memories*	*Input Setting Memories*
SDI 1	4K	5	8
	2K	5	8
SDI 2	4K	5	8
	2K	5	8
HDMI		5	4

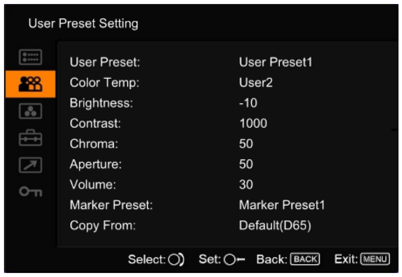
Available Configuration Memories

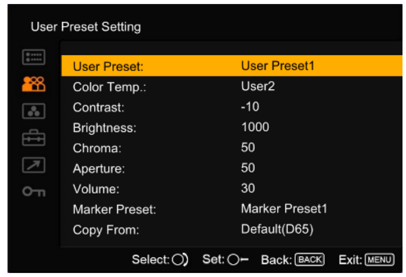
Memory Configuration

There are two steps in configuring each memory. The first is setting the values and the second is assigning that memory to an input. If one or the other is not properly set, the monitor will not display an accurate image.

Setting a User Preset Configuration

The top item on the menu is the memory location. Values under that top item are saved to that memory as they are adjusted. Always confirm that the values you are changing are under the right User Preset memory.





Assignment of the White Balance Memory

Each user memory has an assignment for the white balance memory to be used. With five User Preset Memories, this gives you one different White Balance setting per preset.

Available selections for White Balance include

Factory Preset Memories include D65, D93, D61, D55. DCI (SMPTE ST431-1), and DCI XYZ[9]

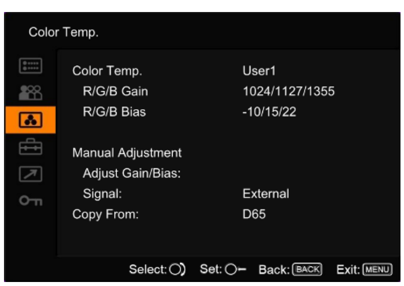
There are an additional five User White Balance Memories that can be adjusted in the Color Temp menus.

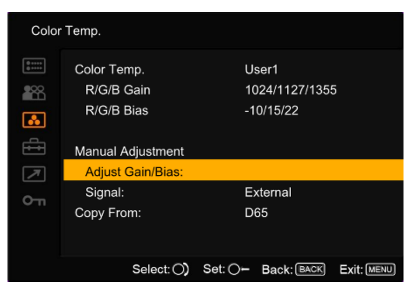
Note that each factory white balance memory includes the Judd Offset, so they will measure as:

BVM X300	*CIE 1931 Coordinates*		*Actual Factory Values*	
	x	y	x	y
D93	0.2831	0.2971	0.2771	0.2861
D65	0.3127	0.3290	0.3067	0.3180
D61	0.3198	0.3360	0.3138	0.3250
D55	0.3324	0.3474	0.3264	0.3364
DCI White	0.3140	0.3510	0.3080	0.3400

Adjusting User White Points

Factory white balance settings cannot be adjusted. For custom white point adjustment, the user memories are available under the “Color Temp” menu settings.

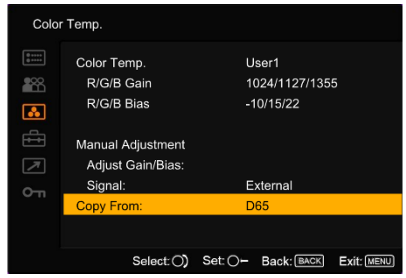




[9] DCI and DCI XYZ will measure to the same values. However a different signal process is required for XYZ inputs requiring a different white point memory.

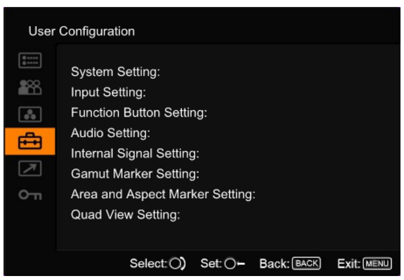
Before trying to adjust the User memory, make sure that the White Point memory is already assigned to the correct (of selected) User Preset memory. If it is not, no changes in the adjustment may be visible when completed.

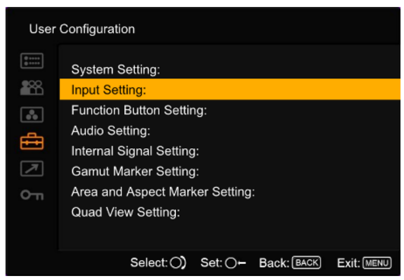
To help speed adjustment, any of the factory white point memories can be copied and used as a basis for the User white point adjustment.

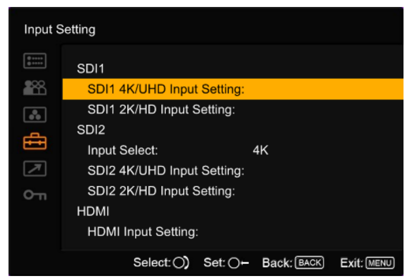


Setting an Input Configuration

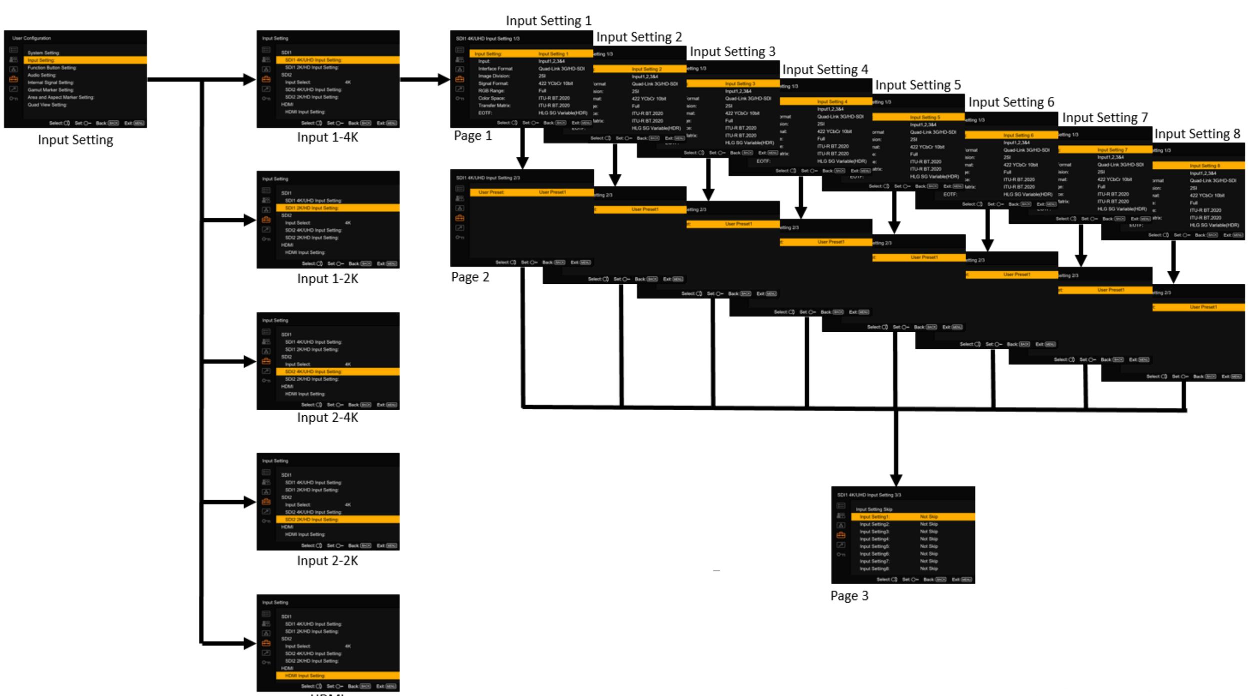
The input configurations are located under the “User Configuration” menus. To get to them, follow the path





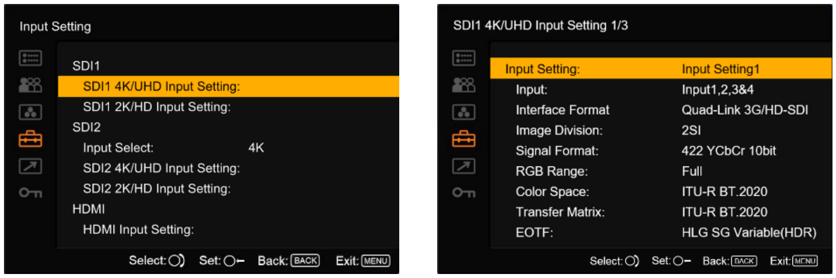


The memory tree for Input 1-4K looks like:



The trees for “Input 1 2K”, “Input 2 4K”, “Input 2 2K”, and HDMI all have their own eight memory locations.

The setting of each memory is similar to the method used for User Presets.

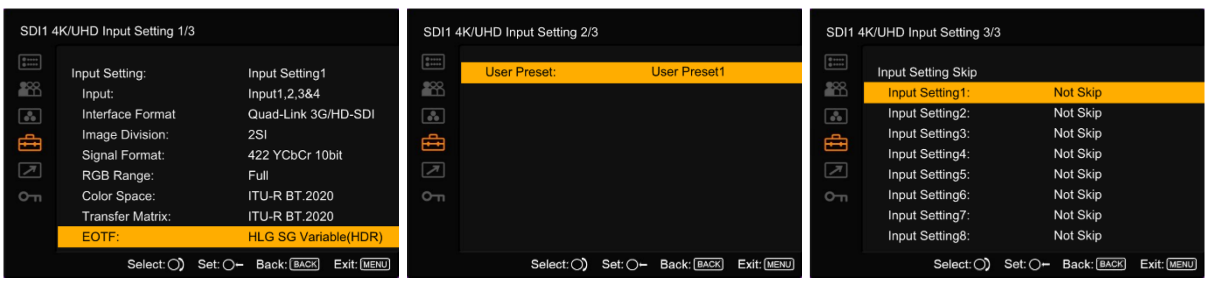


Input Memory Settings

There are eight memories for each input and resolution. The resolution memories are shown on the first menu and memory number is identified as “Input Setting #” on the following menu.

4K Setting Input Configuration

The input settings menus include three pages of settings. The page number of each menu is located at the end of the menu title.

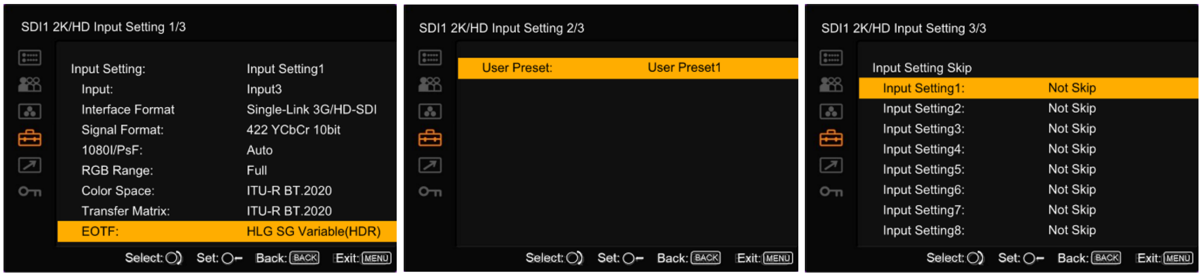


4K Input Setting Menus

- Input Setting is the memory number used to call up the values set on the menu page
- Input is the BNC connector used to display an image. Each connector supports a 3G HDSDI input.
  - For a 4K RGB image, this would be set to use all four input connectors
  - For 6G dual link input, this can be set for 1 & 2 or 3 & 4
  - For 2K and HD images can be any of the four connectors.
- Interface Format sets is used for 4K inputs and switches between Dual Link and Quadlink inputs
- Image Division sets the segmentation of the 4K image.
  - Quad sets the scan so that each quadrant of the screen is fed by a quarter image
  - 2SI uses all four inputs, but is looking for a 2 SI segmentation
- Signal Format is setting the sampling, and color formatting of the input data
- RGB range sets which bit levels are used to define white and black levels
- Color Space sets the range of the color gamut that is displayed
- Transfer Matrix sets which 3 x 3 matrix is used for conversion of an YCbCr input to the correct RGB values to be displayed.
- EOTF is the gamma power or HDR gamma used for display.

2K Setting Input Configuration

The 2K menus are very similar to the 4K menus, but with settings for the different requirements used in 2K imaging. The menu system is shown below.



2K Input Setting Menus

The 2K menus are very similar to the 4K with changes to the Input assignment and handling of interlace inputs. There is no Quad display setting available as the monitor will pixel map any 2K image as a times 4 image. So a 1920 input would be displayed as a 3840 image and a 2048 input will be displayed as 4096.

This is no scaling as in a TV, but simply multiplying each pixel by four to fit the screen. Note HD and 3840 images will be pixel mapped, not scaled so that not all of the panel is filled. There will be side bars on each side of the image.

Tying User Preset and Input Settings Together

Both sets of memories can be selected individually, but this can lead to mistakes. These presets can be tied together on the second page of the Input Settings menu.

By selecting the corresponding User Preset, switching to the Input Setting memory will bring along that User preset memory with it.

Memory Selection

Selecting User presets and Input Setting memories can be accomplished in two ways.

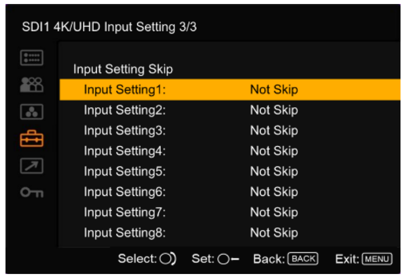
1. Assign the Input Setting number to one of the F keys on the front panel.

2. Cycle through each Input preset memory by successive pressing of the input button.
   a. SDI 1 4K sequences through all SDI 1 4K Input Setting memories
   b. SDI 1 2K sequences through all SDI 1 2K Input Setting memories
   c. SDI 2 4K/2K sequences through all SDI 2 4K Input Setting memories and then through all SDI 2 2K Input Setting memories.

Memory Skip

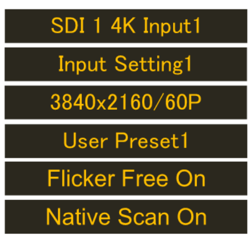
In some cases, not all eight memories may be needed and sequential pressing of the button could cause confusion on which memory is used.

On page three of the Input Settings menu is a list of memories that are marked as "Not Skip". By changing the memory number in the menu to "Skip", that memory will not be available through the sequential selection of the input button.



Confirming You're Using the Right Memory

Whenever the monitor is required to identify the input format, a window in the upper right of the screen will show which memory and input parameters the monitor is using. Both User Preset and Input Setting memory numbers can be confirmed anytime the input is switched or the signal has an interruption of sync.

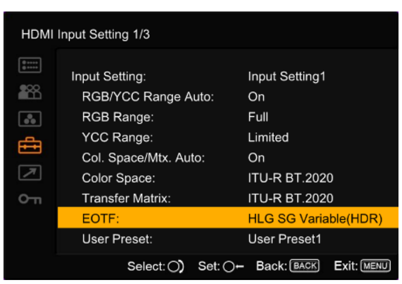


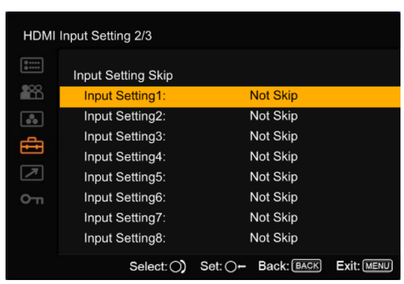
Information Window for a 4K input

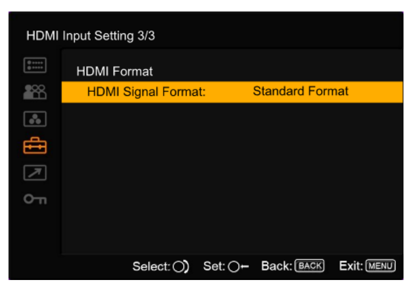
Information Window for a 2K input

HDMI Settings

The HDMI menus are similar to the SDI menus. However for some settings, the HDMI metadata can change limited image selections.







HDMI Input Setting Menu pages

Page one includes the selection of standard signal parameters memorized under the Input Settings memory. Included is a place to assign the selection of a User Preset.

There are two settings that allow assignment from the HDMI metadata

- "RGB/YCC Range Auto". If set to "On" will use the HDMI input metadata to select colorspace mapping. This can conform to the xvYCC color space data mapping.

- “Col.Space/Mtx. Auto”. If set to “On” will use the HDMI metadata to set the monitor’s colorspace and transfer matrix.

Page two is the same type of Input Setting ‘Skip” settings as with the other inputs.

Page three has a setting called “HDMI Signal Format”. This selection allows display of older HDMI standards or recognize the data sent using the newer formats.

- When set to Standard Format, the HDMI input recognizes metadata and imaging as type 1 format.
- When set to Enhanced Format, the HDMI input follows the HDMI type 2 formats allowing HDR and higher frame rate signals.

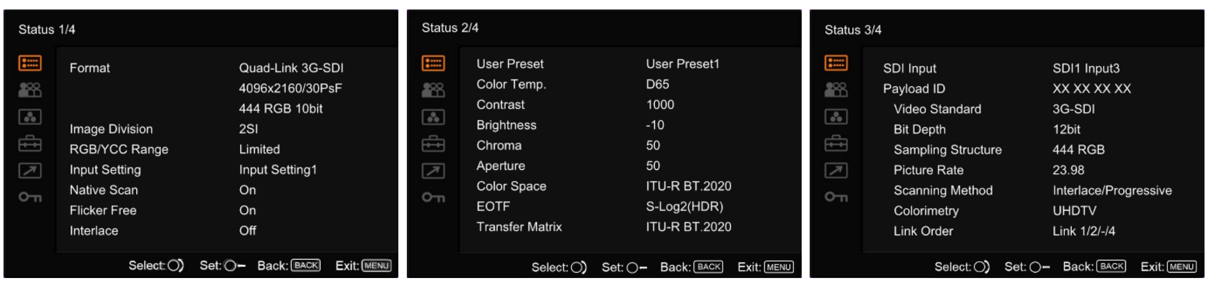
Note that the HDMI input is not completely compliant with the HDMI specification and is why the version is not specified. However, the speed is sufficient to display images as fast as 4096 x 2160 60P 4:4:4 8 bit, 4096 x 2160 60P 4:2:2 12 bit or 4096 x 2160 24P 4:4:4 12 bit.

Some settings that are not supported include:

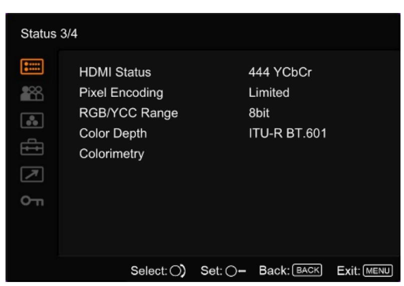
- 3D Imaging
- Extended Audio de-multiplexing
- Dynamic Lip Sync
- 21:9 aspect ratio display
- Automatic EOTF selection

Status

There may be times when it’s necessary to confirm that the signal parameters feeding the monitor are as expected. This is done through the Status pages. These are displayed first when the “Select/Enter” button is pressed. There are three pages which list the image parameters the monitor is reading from the signal payload ID or judging from the horizontal line period timing if payload ID isn’t sent. It also includes indications of the monitor settings.

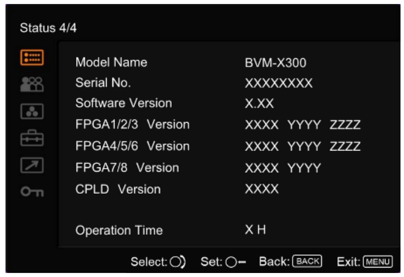


SDI Status



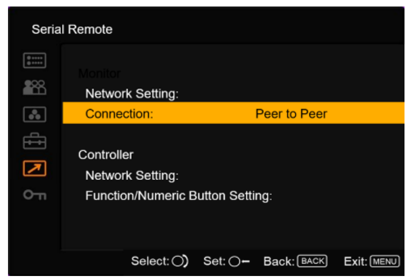
HDMI Status

Page four has details of the monitor’s software versions and operation time.



BKM Operation

The BKM 16R and BKM 17R will work with the BVM X300 and provide a simpler interface that can be located closer to the operator (BKM 15R is not recommended). Setup for the BKM control panel is performed through the Serial Remote menus.



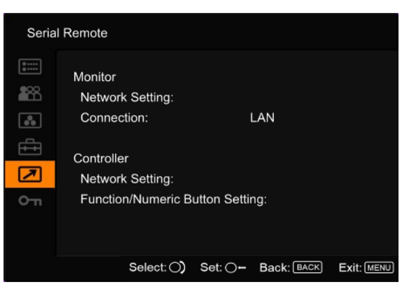
Selection of Peer to Peer or LAN is accessed under the “Connection” prompt. This setting has to match the switch position on the back of the BKM control panel.

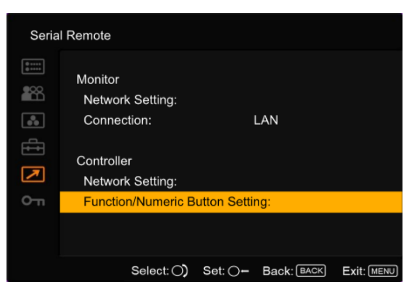
Operation of the inputs is different than with the BVM E series. Input configurations are not valid on the BVM X300, so each input selection number has a preprogramed function.

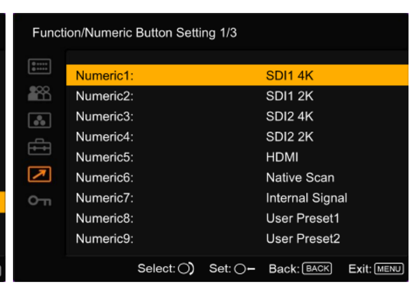
Button Operation

1. Selects Input 1-4K, Sequential pressing will cycle through Input Settings
2. Selects Input 1-2K, Sequential pressing will cycle through Input Settings
3. Selects Input 2-4K, Sequential pressing will cycle through Input Settings
4. Selects Input 2-2K, Sequential pressing will cycle through Input Settings
5. Selects the HDMI input, Sequential pressing will cycle through Input Settings

These can be changed in the “Remote” menus







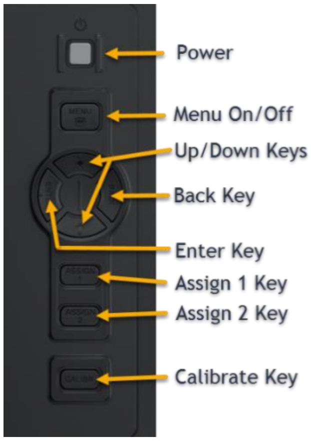
PVM X550

Controls

The PVM X550 has the controls integrated into the chassis on the right side of the bezel. There is an Ethernet connection that can communicate with the BKM control panels. There is no power connector for the control panel and Peer to Peer/LAN selection is in the menu system.

Using a BKM 16R or BKM 17R is highly recommended.

If a control panel is not connected, menu operations can be conducted using the bezel controls.



The top grey button is power

The upper button is the menu button which puts the menu window on screen

The circular buttons allow for menu navigation and memorizing settings

The buttons below the menu navigation keys are two function keys that can have different functions assigned to them.

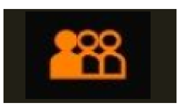
The button on the bottom is used to calibrate screen uniformity

Menu Navigation

Menu navigation uses icons instead of line items as in the BVM E series. Each icon opens a set of menus for specific adjustment or settings. Firmware version V2.0 is the latest as of this writing.

Status Pages

These include items such as monitor adjustment settings, input signal payload ID, and firmware versions. None of the items under this menu can be changed.



User Preset Settings

This includes color temperature memory assignment, contrast, and brightness settings.

Color Temp

This is the set of menu selections for adjusting User Color Temperature memories.

User Configuration

Menu selections include system settings, input configurations, and “F” key assignments.

Serial Remote

Menu settings for the Ethernet input and configuration of the BKM control panel if attached.

Security

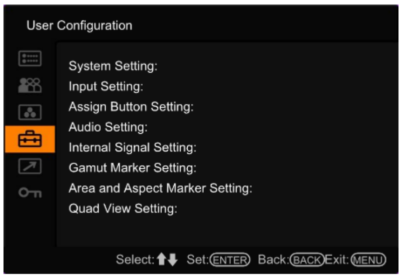
This menu sets password assignments to the menu settings

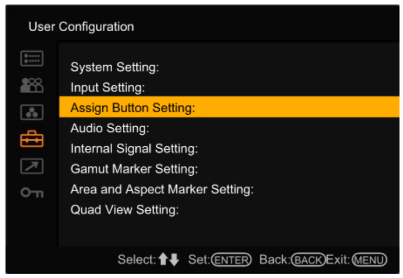
Assigning functions to the Assign Keys

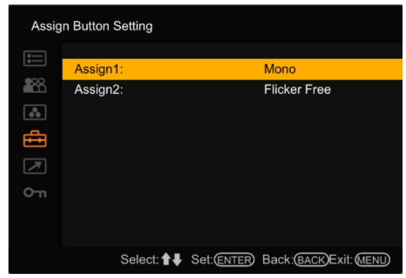
There are two keys called “Assign 1” and Assign 2” which can be used to activate shortcuts or features for alignment and input switching.

At delivery, Assign 1 is set to select inputs. Pressing it brings up a prompt “Input Select/Input Setting”. Select Input Select to change both the input and the input setting memory.

To change the function of either button, navigate to the User Configuration menu







Memory Architecture

The monitor will use two memory types in order to adjust to the correct image values. The first memory will be called “User Preset” and includes the color temperature memory assignment (not the adjustment), Contrast and Brightness settings, Chroma (if appropriate), Aperture, and Marker Preset assignment.

There are 5 User Preset Memories and one User Preset Memory for XYZ inputs.

The second memory will be the input configuration memory which is set in the User Configuration menus under “Input Configuration”.

There are 8 “Input Setting” memories per input and resolution for SDI and 4 Input Setting memories for HDMI.

Input	*Resolution*	*User Preset Memories*	*Input Setting Memories*
SDI 1	4K	5	8
	2K	5	8
SDI 2	4K	5	8
	2K	5	8
HDMI		5	4

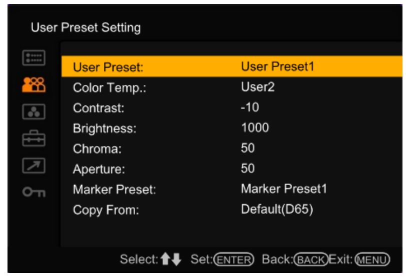
Available Configuration Memories

Memory Configuration

There are two steps in configuring each memory. The first is setting the values and the second is assigning that memory to an input. If one or the other is not properly set, the monitor will not display an accurate image.

Setting a User Preset Configuration

The top item on the menu is the memory location. Values under that top item are saved to that memory as they are adjusted. Always confirm that the values you are changing are under the right User Preset memory.



Assignment of the White Balance Memory

Each user memory has an assignment for a white balance memory. With five User Preset Memories, this gives you one different White Balance setting per preset.

Available selections for factory White Balance settings include:

Factory Preset Memories include D65, D93, D61, D55. DCI (SMPTE ST431-1), and DCI XYZ[10]

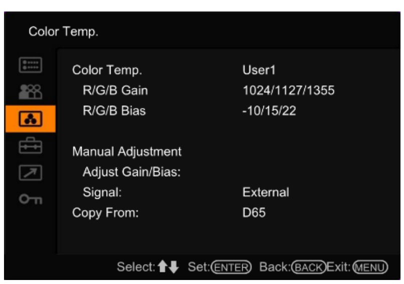
There are an additional five User White Balance Memories that can be adjusted in the Color Temp menus.

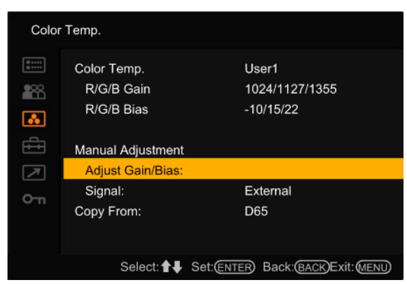
Note that each factory white balance memory includes the Judd Offset, so they will measure as:

PVM X550	*CIE 1931 Coordinates*		*Actual Factory Values*	
	x	y	x	y
D93	0.2831	0.2971	0.2751	0.2851
D65	0.3127	0.3290	0.3047	0.3170
D61	0.3198	0.3360	0.3118	0.3240
D55	0.3324	0.3474	0.3244	0.3354
DCI White	0.3140	0.3510	0.3060	0.3390

Adjusting User White Points

Factory white balance settings cannot be adjusted. For custom white point adjustment, the user memories are available under the “Color Temp” menu settings.

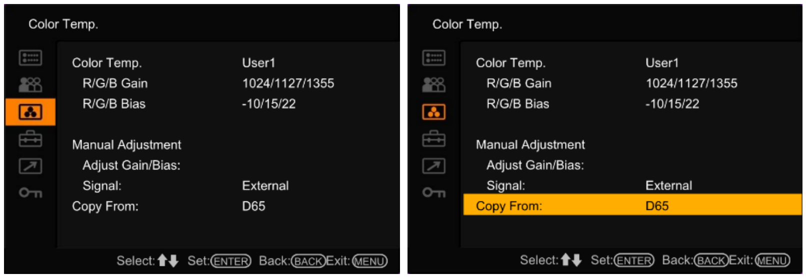




Before trying to adjust the User memory, make sure that the White Point memory is already assigned to the correct (of selected) User Preset memory. If it is not, no changes in the adjustment may be visible when completed.

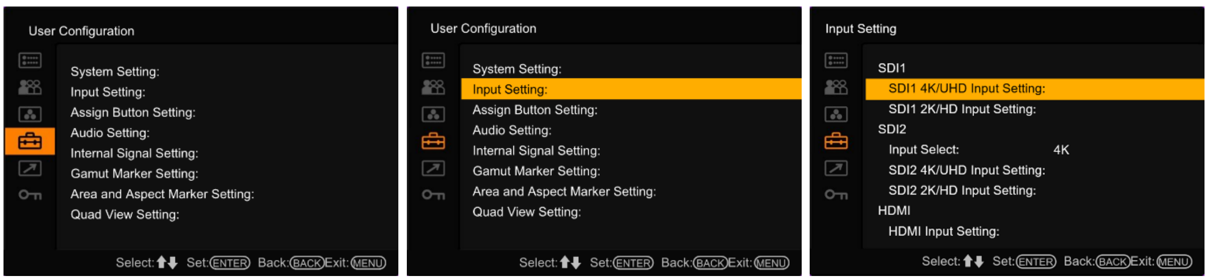
[10] DCI and DCI XYZ will measure to the same values. However a different signal process is required for XYZ inputs requiring a different white point memory.

To help speed adjustment, any of the factory white point memories can be copied and used as a basis for the User white point adjustment.

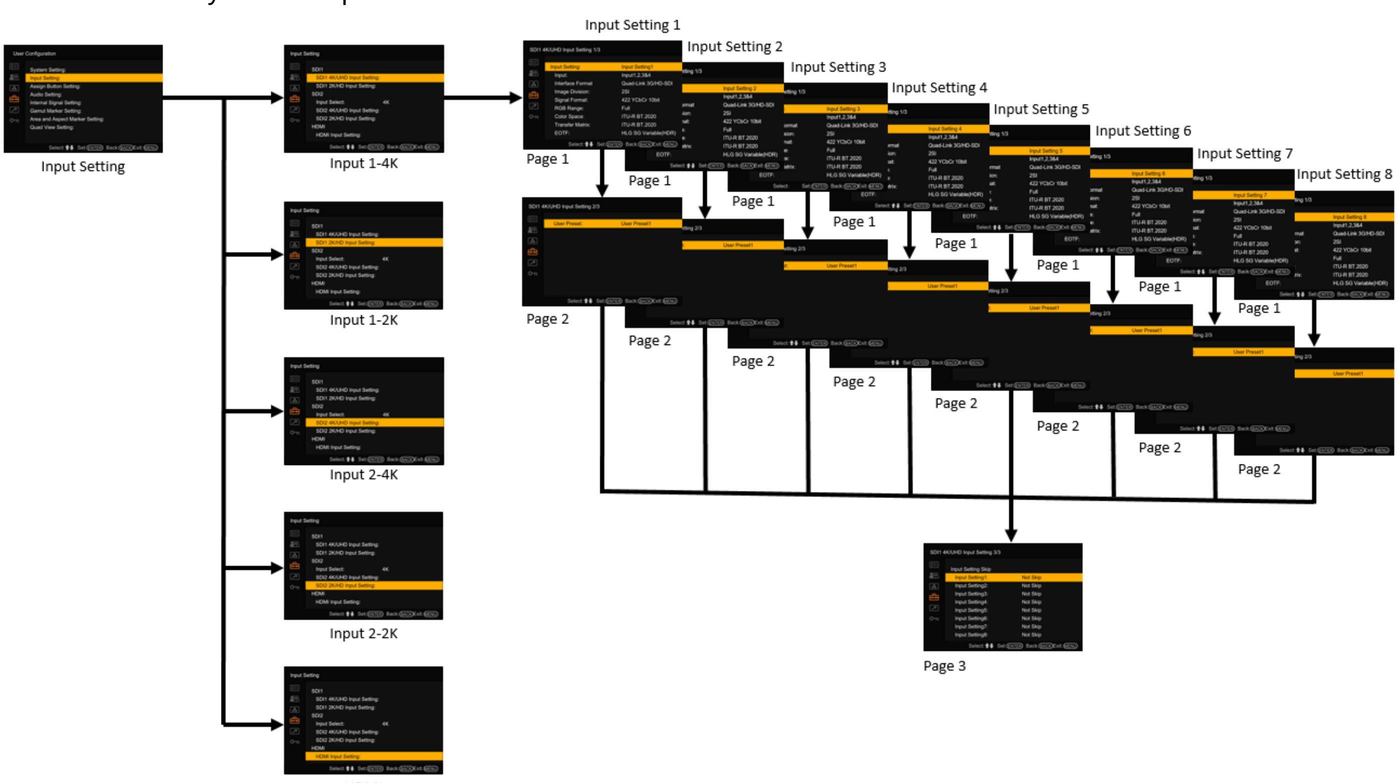


Setting an Input Configuration

The input configurations are located under the "User Configuration" menus. To get to them, follow the path

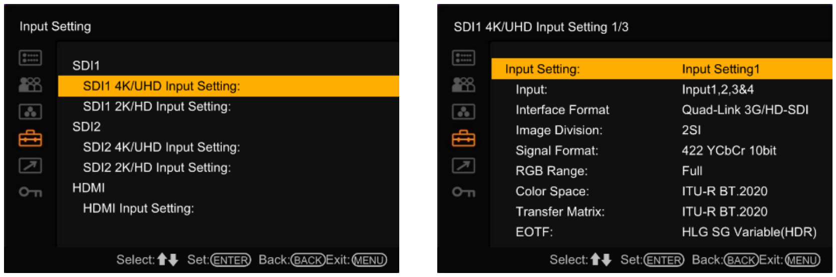


The memory tree for Input 1-4K looks like:



The trees for "Input 1 2K", "Input 2 4K", "Input 2 2K", and HDMI all have their own eight memory locations.

The setting of each memory is similar to the method used for User Presets.

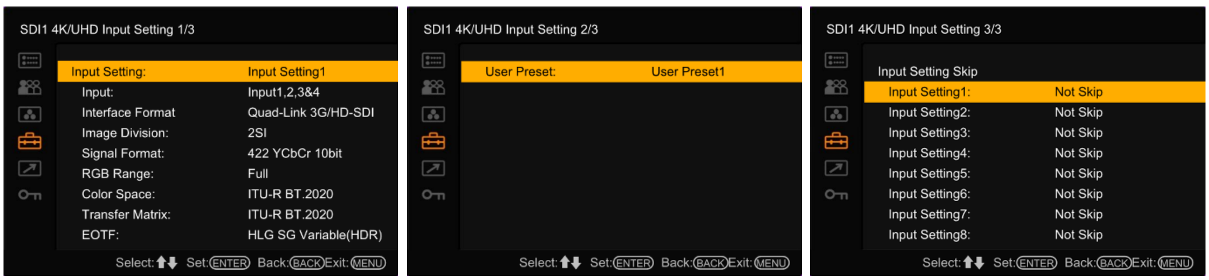


Input Memory Settings

There are eight memories for each input and resolution. The resolution memories are shown on the first menu and memory number is identified as "Input Setting #" on the following menu.

4K Setting Input Configuration

The input settings menus include three pages of settings. The page number of each menu is located at the end of the menu title.

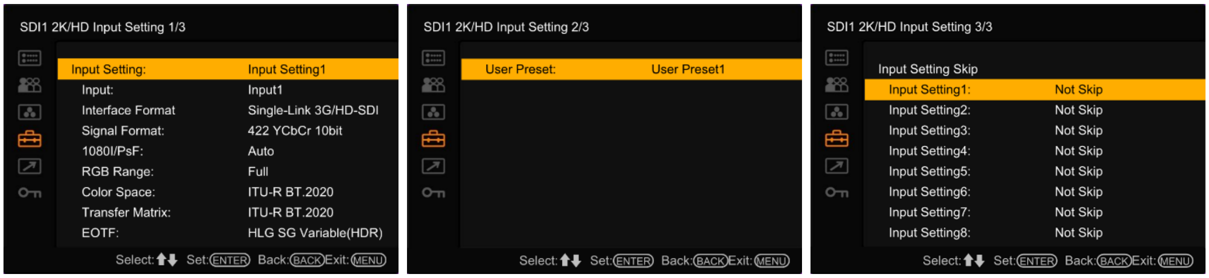


4K Input Setting Menus

- Input Setting is the memory number used to call up the values set on the menu page
- Input is the BNC connector used to display an image. Each connector supports a 3G HDSDI input.
  - For a 4K RGB image, this would be set to use all four input connectors
  - For 6G dual link input, this can be set for 1 & 2 or 3 & 4
  - For 2K and HD images can be any of the four connectors.
- Interface Format sets is used for 4K inputs and switches between Dual Link and Quadlink inputs
- Image Division sets the segmentation of the 4K image.
  - Quad sets the scan so that each quadrant of the screen is fed by a quarter image
  - 2SI uses all four inputs, but is looking for a 2 SI segmentation
- Signal Format is setting the sampling, and color formatting of the input data
- RGB range sets which bit levels are used to define white and black levels
- Color Space sets the range of the color gamut that is displayed
- Transfer Matrix sets which 3 x 3 matrix is used for conversion of an YCbCr input to the correct RGB values to be displayed.
- EOTF is the gamma power or HDR gamma used for display.

2K Setting Input Configuration

The 2K menus are very similar to the 4K menus, but with settings for the different requirements used in 2K imaging. The menu system is shown below.



2K Input Setting Menus

The 2K menus are very similar to the 4K with changes to the Input assignment and handling of interlace inputs. There is no Quad display setting available as the monitor will pixel map any 2K image as a times 4 image. So a 1920 input would be displayed as a 3840 image and a 2048 input will be displayed as 4096.

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Tying User Preset and Input Settings Together

Both sets of memories can be selected individually, but this can lead to mistakes. These presets can be tied together on the second page of the Input Settings menu.

By selecting the corresponding User Preset, switching to the Input Setting memory will bring along that User preset memory with it.

Memory Selection

Selecting User presets and Input Setting memories can be accomplished in two ways.

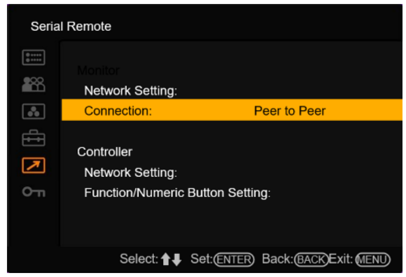
1. Set one of the Assign keys to “Input Select/Input Setting”. Then sequential pressing of that button to cycle through each Input Setting memory

Controls on the right side bezel

2. Connect a BKM control panel to the monitor and select memories directly from that.

BKM Operation

The BKM 16R and BKM 17R will work with the PVM X550 and provide a simpler interface that can be located closer to the operator (BKM 15R is not recommended). Setup for the BKM control panel is performed through the Serial Remote menus.



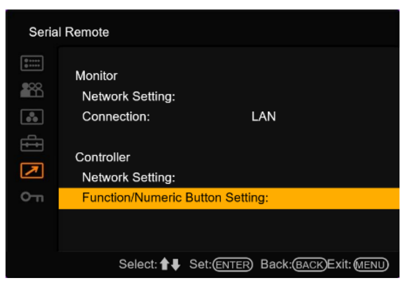
Selection of Peer to Peer or LAN is accessed under the “Connection” prompt. This setting has to match the switch position on the back of the BKM control panel.

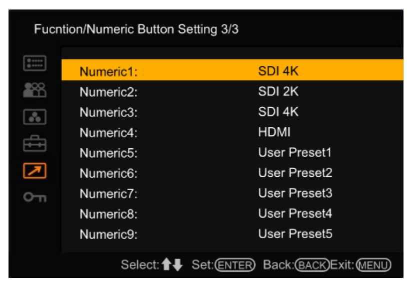
Operation of the inputs is different than with the BVM E series. Input configurations are not valid on the PVM X550, so each input selection number has a preprogramed function.

Button Operation

1. Selects Input 1-4K, Sequential pressing will cycle through Input Settings
2. Selects Input 1-2K, Sequential pressing will cycle through Input Settings
3. Selects Input 2-4K, Sequential pressing will cycle through Input Settings
4. Selects Input 2-2K, Sequential pressing will cycle through Input Settings
5. Selects the HDMI input, Sequential pressing will cycle through Input Settings

These can be changed in the “Remote” menus





Memory Skip

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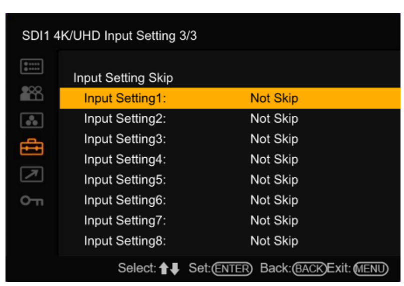
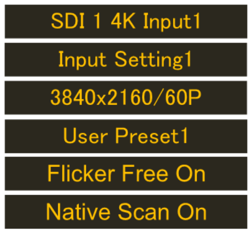
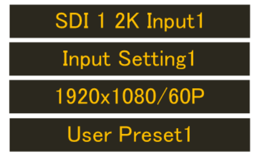


Confirming You’re Using the Right Memory

Whenever the monitor is required to identify the input format, a window in the upper right of the screen will show which memory and input parameters the monitor is using. Both User Preset and Input Setting memory numbers can be confirmed anytime the input is switched or the signal has an interruption of sync.



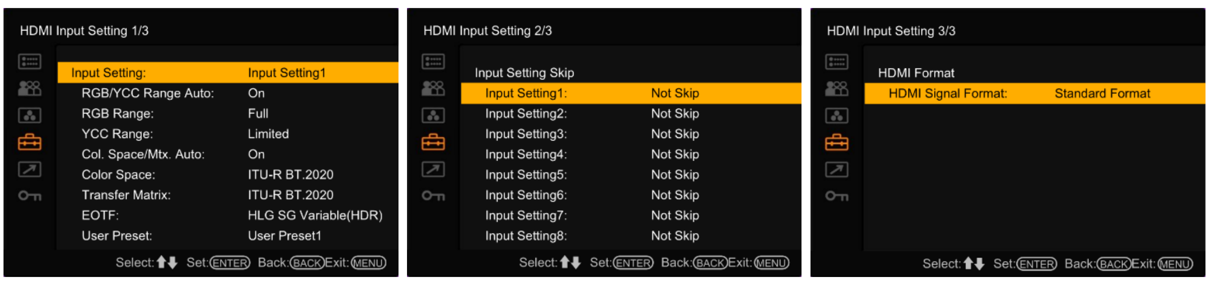
Information Window for a 4K input



Information Window for a 2K input

HDMI Settings

The HDMI menus are similar to the SDI menus. However for some settings, the HDMI metadata can change limited image selections.



HDMI Input Setting Menu pages

Page one includes the selection of standard signal parameters memorized under the Input Settings memory shown in the first selection. Included is a place to assign the selection of a User Preset.

There are two settings that allow assignment from the HDMI metadata

- “RGB/YCC Range Auto”. If set to “On” will use the HDMI input metadata to select colorspace mapping. This can conform to the xvYCC color space data mapping.
- “Col.Space/Mtx. Auto”. If set to “On” will use the HDMI metadata to set the monitor’s colorspace and transfer matrix.

Page two is the same type of Input Setting ‘Skip” settings as with the other inputs.

Page three has a setting called “HDMI Signal Format”. This selection allows display of older HDMI standards or recognize the data sent using the newer formats.

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Note that the HDMI input is not completely compliant with the HDMI specification and this is why the version is not specified. However, the speed is sufficient to display images as fast as 4096 x 2160 60P 4:4:4 8 bit, 4096 x 2160 60P 4:2:2 12 bit or 4096 x 2160 24P 4:4:4 12 bit.

Some settings that are not supported include:

- 3D Imaging
- Extended Audio de-multiplexing

- Dynamic Lip Sync
- 21:9 aspect ratio display
- Automatic EOTF selection

Quad View Settings

One unique tool available in the PVM X550 is called Quad View. What this can do is display four independent 2K or HD images on screen at once with completely independent image settings. These include different colorspace, EOTF, and white balance settings. This is useful for QC and comparison of different deliverables.

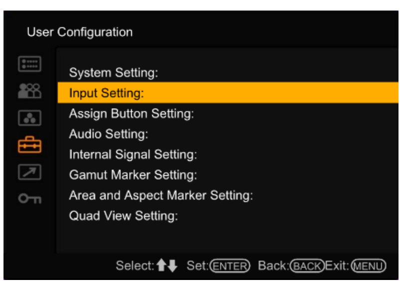
Quad View Display

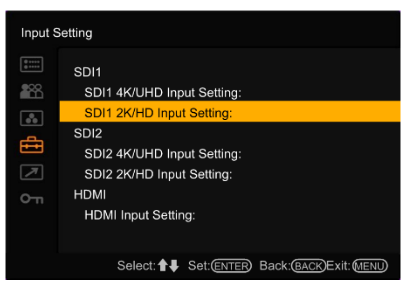
Quad View Setup

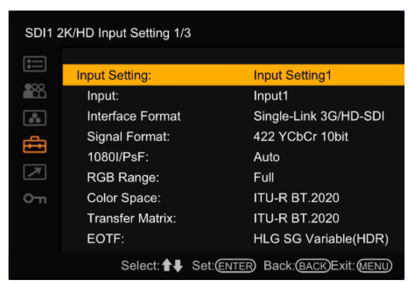
To operate Quad View, each input setting for each quadrant must be configured first. Quad View works with both the HDSDI and HDMI inputs, so one quadrant can be from the HDMI input.

Procedure

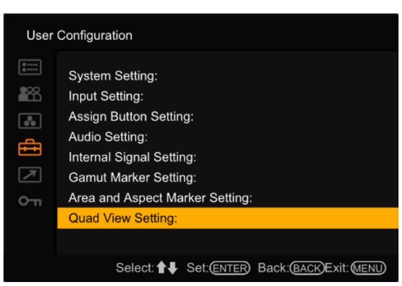
1. Use four input setting memories to configure each input for display just as you would for a single image.
    a. 4K images cannot be displayed in a quadrant even if the input is configured as a 2SI signal format
    b. Only SDI 2K or HDMI inputs are assignable to a quadrant.
    c. Quad View cannot be turned on from the BKM control panel

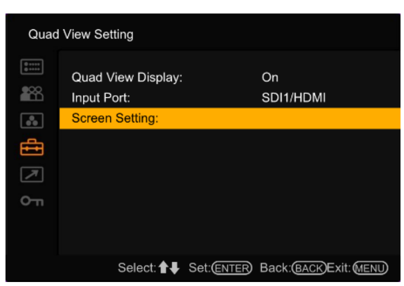


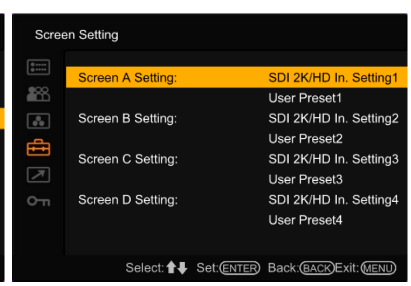




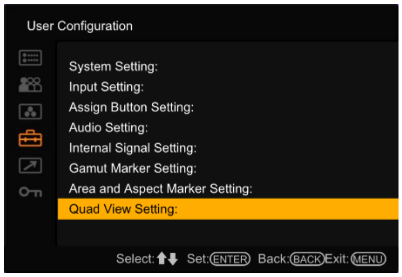
2. Assign each Input Setting to a quadrant.

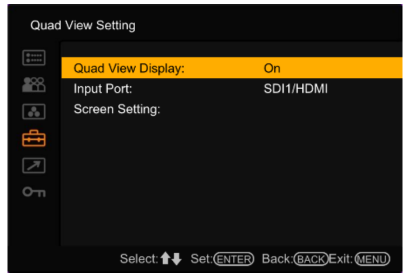






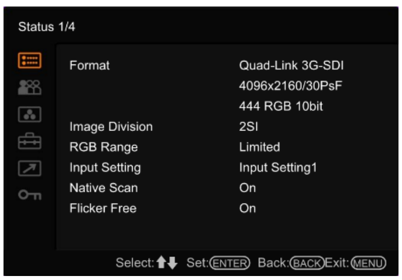
3. Turn on Quad View

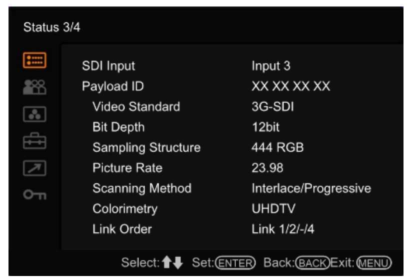




Status for a Single Image

There may be times when it's necessary to confirm that the signal parameters feeding the monitor are as expected. This is done through the Status pages. These are displayed first when the "Select/Enter" button is pressed ether on the side bezel panel or the BKM Control Panel. There are three pages which list the image parameters the monitor is reading from the signal payload ID or judging from the horizontal line period timing if payload ID isn't sent. It also includes indications of the monitor settings.

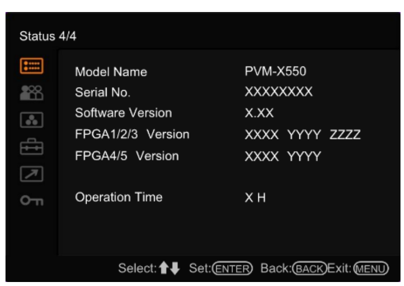




SDI Status

HDMI Status

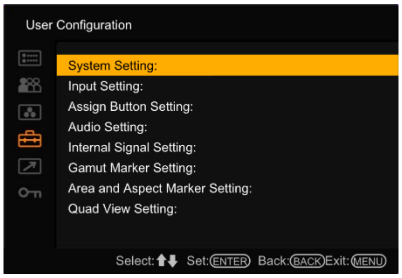
Page four has details of the monitor's software versions and operation time.

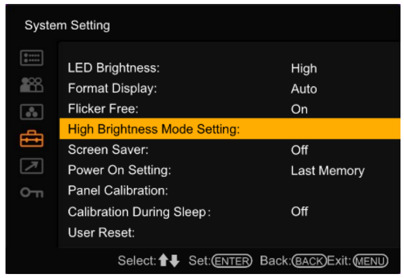


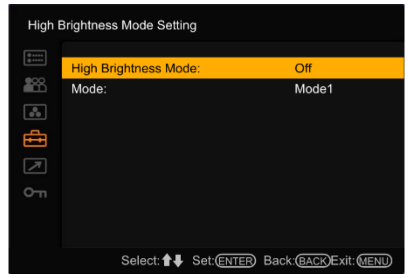
High Brightness Mode

The PVM X550 as delivered will display a maximum brightness of 400 cd/m^2. Higher than this will show minor deviations in color accuracy. However when working on HDR modes and in particular when working with a ST2084 EOTF, clipping can become objectionable.

The High Brightness mode increases the display brightness to 650 cd/m^2 for HDR work and will display detail to match a BVM X300 up to a 650 cd/m^2 brightness. Turning High Brightness on and off is found in the User Configuration Menus.





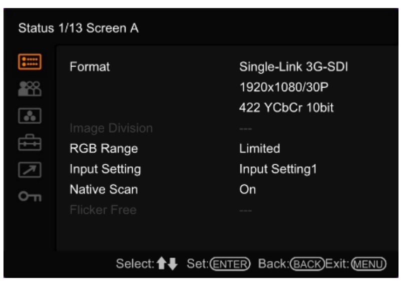


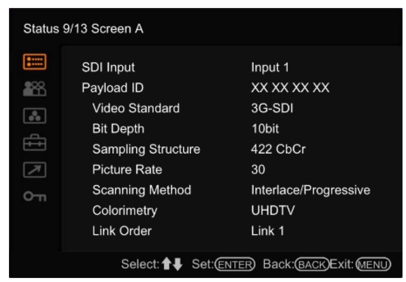
Mode 1 limits brightness to 650 cd/m^2 with minimal change in accuracy

Mode 2 removes any limits and the panel will display up to its maximum brightness. However color accuracy is questionable.

Status for Quad View

Status information is also available when the monitor is set to Quad View and can show details of each image. Note that in Quad View, there are 13 pages of information.





Navigating through each page is simplified by using the Phase knob on the BKM control panel. By rotating the knob, each menu can be viewed much more quickly.

Screen Calibration

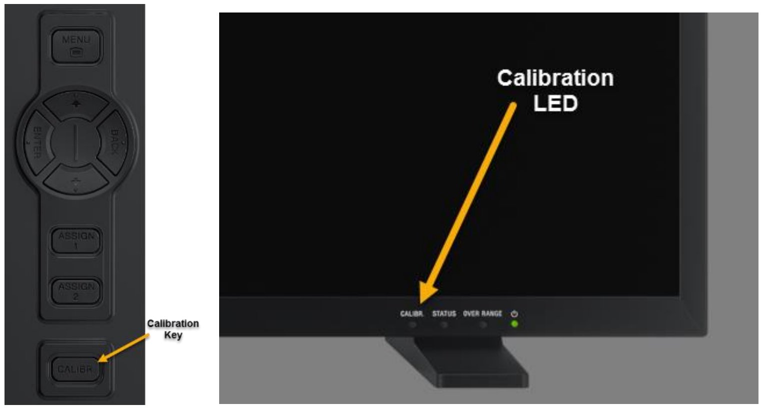
Operating Calibration

On the right side bezel area at the bottom of the controls is a key marked “Calibration”. This is not an automatic process that aligns the white balance.

In some cases over time, uniformity of the monitor may change. This is normal with this technology, and is not an issue to make improvements.

Pressing the “Calibration” button starts a process that refreshes the panel and returns the uniformity back to its original quality. The process takes about 10 minutes and the monitor cannot be used during that time. The screen will go black and the yellow “CALIBR” LED in the bezel will flash.

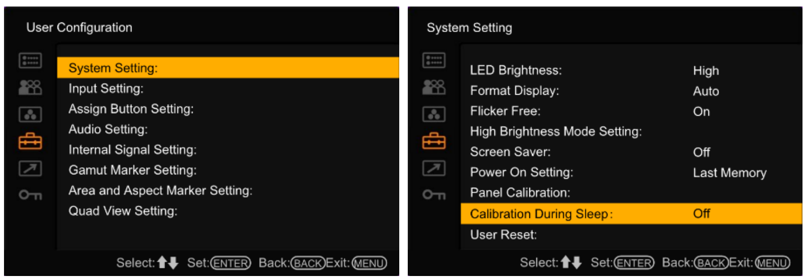
Once the process is finished the monitor will put itself into “Sleep” mode.



Calibration Key & LED Indicator

Automatic Calibration

This process can be automated when a BKM 16R or BKM 17R control panel is connected to the monitor.



Navigate to the System Settings menu and then to Calibration during Sleep. By turning this on, the PVM X550 will enter the calibration mode before shutting off. This will happen each time the monitor is turned off using the power key on the BKM Control Panel. Operating Calibration will not age the panel.

Using the Sony Auto Setup Software

All BVM, PVM and most LMD models will work with Sony's Auto Setup Software. This software package is provided at no charge from our website. Please go to www.sony.com/promonitors and view the "Resources" tab. Under that tab is a link to the software.

The latest version as of this writing is V1.5

Auto Setup Operating System Requirements

- Microsoft Windows 7 Professional Edition or Ultimate Edition 64 versions with SP1
- Microsoft Windows 10 Professional Edition or Ultimate Edition 64 or versions
- Windows .NET Framework 3.5 SP1 or later

Auto Setup Hardware Requirements

- Intel® Celeron® 1GHz processor
- 512MB memory
- USB 2.0
- 100MB storage
- Ethernet connection

Compatible Light Probes

Colorimetry Research	CR 250
Jeti	Specbos 1211 & Spectraval 1510/1511
Klein Optical	K-10 & K10A
Konica Minolta	CA 210, CA 310, & CA 410
Photo Research	PR 655 & PR 670
X-Rite	i1Pro & i1Pro2

USB Drivers

X-Rite	**http://www.xrite.com/product_overview.aspx?ID=1014&Action=support&SoftwareID=768** **http://www.xrite.com/product_overview.aspx?ID=1912&Action=Support**
Konica Minolta	http://www.konicaminolta.com/instruments/download/software/light/cs-200/ http://www.konicaminolta.com/instruments/download/software/display/ca2d-sdk/index.html
Photo Research	http://www.photoresearch.com/
Klein Optical	http://www.ftdichip.com/Drivers/VCP.htm
Jeti Specbos	http://www.ftdichip.com/Drivers/VCP.htm

Compatible Models

Monitor Model Series	**Model**	**Description**
BVM	BVM E170, BVM E170A, BVM F170, BVM F170A, BVM E171	17 inch OLED reference monitors
	BVM E250, BVM E250A, BVM F250, BVM F250A, BVM E251	25 inch OLED reference monitors
	BVM X300	30 inch OLED reference monitors
PVM	PVM 740, PVM 741	7 inch OLED field monitor
	PVM 1741, PVM 1741A, PVM A170	17 inch OLED production monitor
	PVM 2541, PVM 2541A, PVM A250	25 inch OLED production monitor
	PVM X550[11]	55 inch OLED production monitor
LMD	LMD 940W, LMD 941W	7 inch LCD field monitor
	LMD 1541W	15 inch LCD production monitor
	LMD 1751W, LMD A170	17 inch LCD production monitor
	LMD 2041W, LMD 2051W	20 inch LCD production monitor
	LMD A220	22 inch LCD production monitor
	LMD 2341W	23 inch LCD production monitor
	LMD 2451W, LMD A240	24 inch LCD production monitor
	LMD 4251TD	42 inch LCD production monitor

[11] Requires V1.5 and above Auto Setup Software

Monitor Connection Setup

NOTE: The BVM-E170, BVM-E170A, BVM-F170 and BVM-F170A have an internal optical alignment system and don't need to use this software. In their menu system is an internal auto cal. White balance is performed by an internal process which doesn't require a light probe of outside control.

The system can run as peer to peer or on a wired/wireless LAN system.

If you are using a LAN to control the monitor, the monitors must have the identifiers and IP address set first.

The way the monitors are identified in a LAN system is not by IP address, but by monitor number. So while the monitor must have an IP address and subnet setting, it also will need a monitor number assignment and optionally a group number assignment if you want to operate several monitors off one controller at once.

Skip the description below if you plan on working in peer to peer.

For BVM models

1) Note that the BVM E170, BVM E170A, BVM F170, & BVM F170A all have internal calibration systems, so this process isn't necessary.
2) All the monitors can be aligned as Peer to Peer or on a LAN. Monitor ID numbers and IP addresses must be set first before the alignment system will recognize them.

For PVM

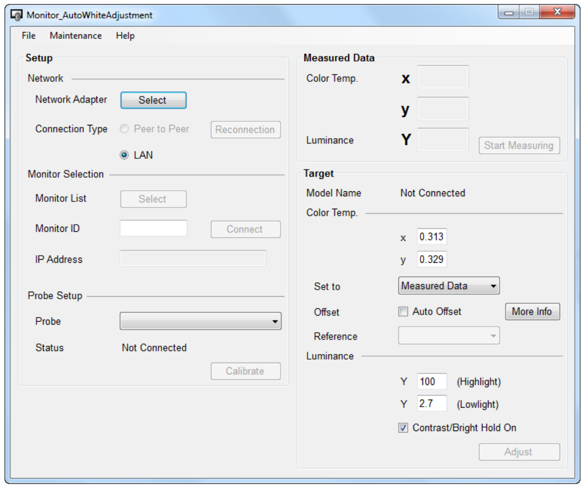
1) Make sure there is an active video source connected to the monitor.
2) Navigate to the network menu. This has the icon of the arrow in a box.
3) Select "Serial Remote."
4) Set the IP address, Subnet, and Monitor ID number.
5) Turn ON the serial remote input.
6) Select "Confirm" to set the new values.
7) Make sure all the F key lights are dark.

Connection is fairly simple. Each probe will connect to the computer through the USB port. Monitor connection can be peer to peer through Ethernet or can also connect to the monitor LAN as wired or as wireless.

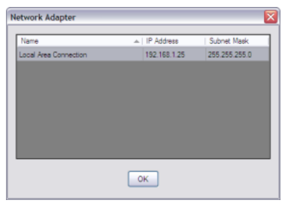
Automatic Operation

Once the software is opened, the main window will have most items greyed out. As each function is completed, the next function will go black and become available. It's best to start at the top left of the menu screen and complete each setting top to bottom. Then go to the right side settings to complete the settings for the alignment.

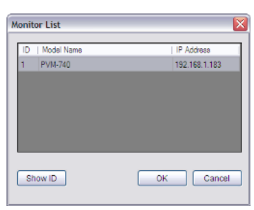
Below is the main window.



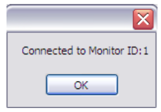
1) Click on the SELECT button next to Network Adapter. This will show the IP address of the controlling computer,



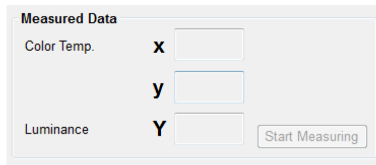
2) For CONNECTION TYPE, select either LAN or Peer to Peer.
   a) The PVM XX41 series must have the Ethernet connector turned on before it can talk with the computer.
      i) On the monitor select
         (1) Remote Setup
         (2) Serial Remote to "Ethernet"
         (3) Confirm the monitor IP address
         (4) Select LAN or Peer to Peer depending on the connection
      ii) For LAN connection, the monitor also requires a monitor number to be set. This number is used to call out the unit to be adjusted. This saves having to remember a long IP address.
   b) For the PVM A170, PVM A250, and LMD A series the Ethernet port is just turned on.
   c) Next to MONITOR LIST, click "SELECT."
      i) The auto setup software will look out onto the LAN and find any monitors.
      ii) The list will itemize the following:
         (1) Monitor ID number
         (2) Monitor model name (e.g., PVM-A250)
         (3) Monitor IP address



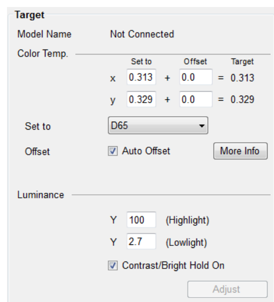
      iii) If there is more than one monitor on the LAN, use the SHOW ID button in the Monitor List.
   d) Once the software has finished its search, the IP settings and model name of each monitor will be displayed. Select the monitor you would like to adjust. A window will pop up confirming the monitor number that will be adjusted.



3) Select PROBE and from the pull down list select the model probe you have connected.
4) The I1Pro and Konica Minolta CA meters will need to be calibrated. This is done by closing off the light input to the probe and selecting calibration. If calibration is grayed out, then it means that the probe you are using doesn't use this procedure.
5) If you would like to use the software to measure another monitor, then simply select "Start Measuring", then the values marked as xyY under the Measured Data area will be displayed. To stop just hit the same soft key.



6) To continue with the auto setup, you will need to select the proper coordinates. This is done in the "Targets" area.



7) You can type in the values you want or you can use the "Set To" pull down menu.
8) Under the "Set to" menu are the following coordinates:

CIE 1931 Coordinates

	x	y
Measured Data	Measured x	Measured y
D93	0.2831	0.2971
D65	0.3127	0.3290
D61	0.3198	0.3360
D55	0.3324	0.3474
D-Cine	0.3140	0.3510

9) Note that this doesn't change the target luminance values. If you want to have a different luminance value, then you can input that into the "Y Highlight" box. Note that for BVM setup, the "Y Lowlight" value will default to a setting comparable to the "Y Highlight" setting so that you maintain an accurate gamma.
10) There is a box marked "Offset". By selecting this box, you can apply the Judd offsets. These are added automatically to the target vales.
11) At this point, select "Adjust" and the monitor will use its own internal test patterns to align itself. The operation normally takes less than a minute.

12) If the adjustment fails, check for any external light landing on the face of the monitor. Removing this will fix any errors.

Note on Flicker Free

On PVM-1741, 1741A, 2541 and 2541A, the flicker free setting changes the black level even after adjustment. This is due to the fact that these models only had one memory for the black level setting. Depending on where you use this or not, you will need to set the black level for either Flicker Free On or Off.

Menu Operations – Where Things Are

BVM E171 & BVM E251

Brightness, Contrast, Chroma, and Phase presets

Color Temperature Adjustment

Color Temperature Copy

Preset Memory Adjustment

Bit Level Range (Limited or Full)

Bit Resolution 8, 10, 12 bits

Channel Copy

Displayed Aspect Ratio

Interlace or Progressive/Segmented Display

Marker Preset Assignment

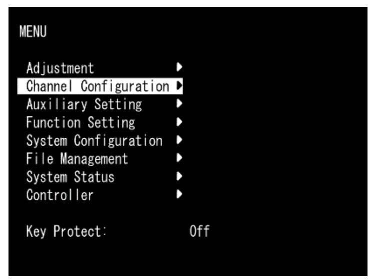
Sampling 4:2:2, 4:4:4,

SDI Format (3G, HDSDI, SDI, Dual Link)

Setting Channel Name

White Point, Color Space, Transfer Matrix, and EOTF

Y C_bC_r, RGB, XYZ Display

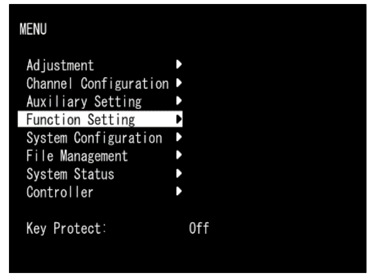


Aperture Settings

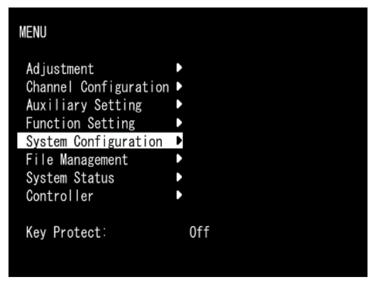
Native Scan Size

Peak White On/Off

Function Activation (On/Off)
Image Capture Settings
Internal Test Signal Settings
Marker Copy
Marker Setup
Multiple Picture Settings
Out of Gamut Marker Settings
Pixel Zoom Settings



Audio Level Meter Settings
Closed Caption Settings
License Management and Activation (BVM E171 only)
Monitor and Group ID
Monitor Firmware Upgrades
Network Settings
Parallel Remote Pin Assignments
Password Settings
Scan Mode Operation Settings
SDCP Settings
Time and Date Setting
Time Code Display Settings



Load Maintenance Settings
Load Setup Files
Move Setup Files
Save Maintenance Settings
Save Setup Files

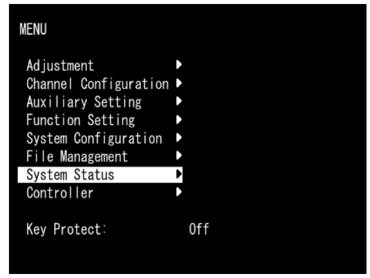
Control Panel Firmware Version and Serial Number

Display of SDI Payload ID

HDMI Input Parameter Status

Indication of Channel Settings

Monitor Firmware Version, Serial Number and Run Time



BKM 16R or BKM 17R Controller Network Settings

BKM Function Key Assignment

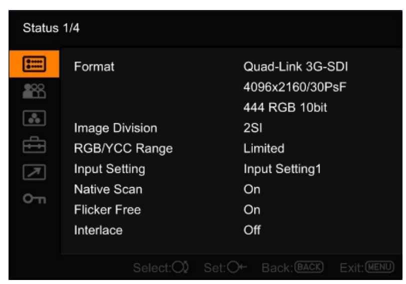
Control Panel Firmware Upgrade

Monitor ID Display

BVM X300

Nothing can be changed in this set of menus.

This is information only



Audio Volume Preset

Color Temperature Memory Assignment

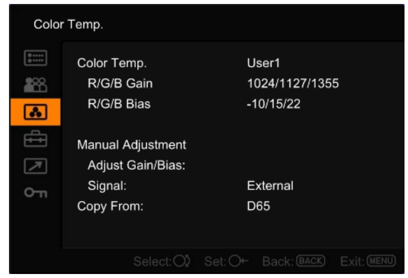
Contrast, Brightness, Chroma, and Aperture Presets

Marker Preset Memory Assignment

Settings for Each User Preset Memory

Adjustment of User Color Temperature Memories

Internal or External Test Signal Display



Audio Demux Channel Assignment

Bit Level Range (Limited or Full)

Color Space, Transfer Matrix, and EOTF Settings

Format Display Settings

Flicker Free On/Off

Function Key Assignment

Input Settings Memories

Input Settings Skip Selection

Interlace or Progressive/Segmented Display

Internal Test Signal Selection

LED Brightness

Marker Memory Settings

Out of Gamut Marker Settings

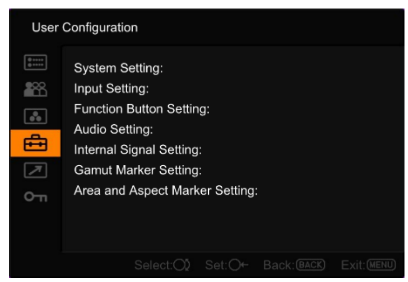
Power On Settings

Signal Source Configuration

Time Code Settings

User Memory Reset

User Preset Assignment

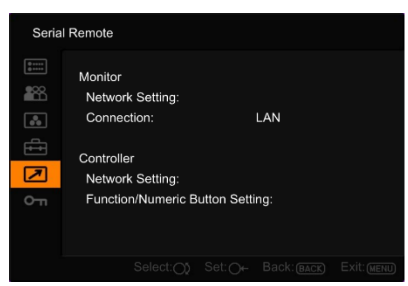


Controller Function Key Assignment

Controller LAN Settings

Monitor LAN Settings

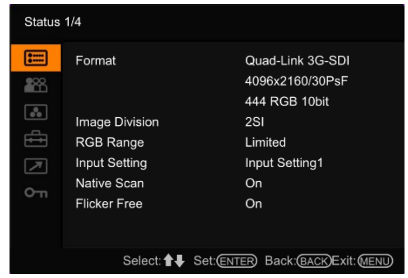
Numerical Key Function Assignment



PVM X550

Nothing can be changed in this set of menus.

This is information only



Color Temperature Memory Assignment

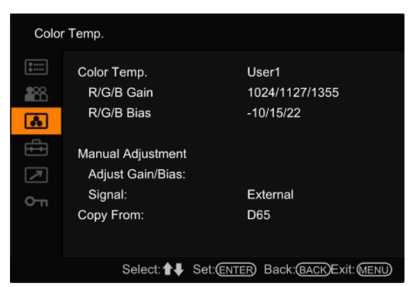
Contrast, Brightness, Chroma, and Aperture Presets

Marker Preset Memory Assignment

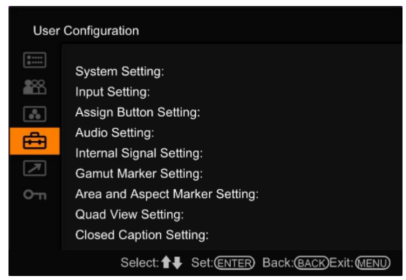
Settings for Each User Preset Memory

Adjustment of User Color Temperature Memories

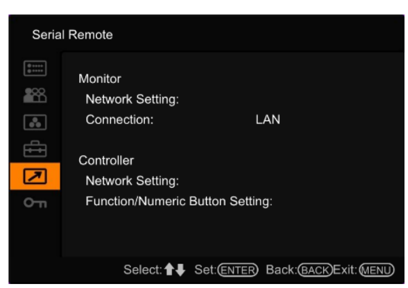
Internal or External Test Signal Display



Assign Key Function Assignment
Audio Demux Channel Assignment
Bit Level Range (Limited or Full)
Calibration during Sleep Settings
Closed Caption Display Settings
Color Space, Transfer Matrix, and EOTF Settings
Flicker Free On/Off
Format Display Settings
Function Key Assignment
High Brightness Mode Settings
Input Settings Memories
Input Settings Skip Selection
Interlace or Progressive/Segmented Display
Internal Test Signal Selection
LED Brightness Settings
Marker Preset Memory Settings
Panel Calibration
Power On Settings
Quad View Settings
Out of Gamut Marker Settings
Screen Saver Settings
Signal Source Configuration
Time Code Settings
User Preset Assignment
User Memory Reset
User Reset



Controller Function Key Assignment
Controller LAN Settings
Monitor LAN Settings
Numerical Key Function Assignment



Version 7.0.0; March, 2018

SONY

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