

Practical handout for assessing the Set capability of 4K monitors 02.2021

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1. Introduction

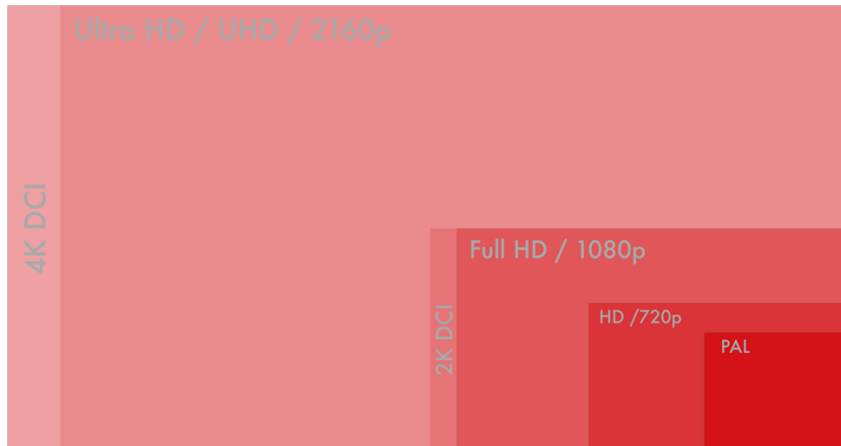
This handout serves as a guideline for the decision about the use of current 4K monitors on set. We describe the monitor's practical handling and quality, assuming terms from feature film, television and cinema industry and will nevertheless try to exclude knowledge of deep and advanced media technology.

As the heading says, this handout is aimed at those who work directly with monitors, such as cameramen, camera assistants, DITs and video operators and sometimes also editors and editing assistants.

As part of the switch from HD to 4K workflows, expectations are increasing - not only for monitors in post-production, but also for monitors on the set.

The name 4K Workflow is the vernacular description for the resolution in which videos are recorded and processed. In the meantime, 4K / UHD can also be found in the "consumer" area, but we will only go into the areas of broadcast, film and cinema, TV advertising here.

Talking about resolution, we mean the pixels of the digital image, see Fig.



When high-resolution sensors were introduced in digital cameras, the internal processing of the video signal was not yet sufficiently developed for the high-resolution signal to be reproduced via cable or radio. The so-called video feedback, the term comes from the days of film cameras and is still the general term for the video image for the film crew, was initially output to the monitors on the set in low-resolution signals such as PAL or HD.

However, the high-resolution image from the camera is converted, i.e. calculated smaller, so that the image on the monitors is not seen with the original number of pixels.

4K monitors in the professional sector are becoming “more affordable” and should find their way to the film set. Radio links can now also transmit this resolution, making it possible to assess the original 4K image on set even without a cable.

Another aspect we are investigating is the color accuracy of the monitors. We will not go into details of the color spaces in this elaboration, as this would go beyond the scope.

2. Approach

A so-called colorimeter, also known as a probe, is used to measure the luminance and color of a monitor. With suitable programs that generate readable results from the measured data, it is not only possible to assess how bright such a monitor is, but also how accurately it can reproduce individual brightness and color values.

Despite the native 4K color space of REC.2020, we are dealing with the REC.709 specified by television and a 4K signal in order to assess the resolution and sharpness of the monitor.

For this purpose, we use:

- X-Rite i1Pro 2
- Phabrix Sx Pattern Generator
- Portrait Display Calman Studio calibration software



The test setup is outlined in this figure.

The Calman program sends information to the pattern generator (Phabrix) which, as a calibrated measuring device, sends certain images to the monitor, which the i1 Pro, hereinafter referred to as the probe, measures. The probe forwards the data to the program. The difference between the ideal values of the target image, i.e. the generated image, and the measured values of the image reproduced by the monitor is called "delta". There are different tables for this delta, here is a link¹.

We use the table from Delta E2000. The greater the delta, i.e. the difference between the target and actual values, the greater the deviation of the display on the monitor. This can then result in brightness, contrast or even color shifts. The smaller the difference, the more suitable the monitor is for assessing the image. A DeltaE value of less than 1 defines a reference monitor, our goal for monitors that are suitable for a set is a DeltaE value of less than 4.

¹ <https://www.displaycalibration.de/knowledgebase/delta-e/> or <https://www.lightspace.lightillusion.com/delta-e.html>

*all prices exclude VAT

*errors and changes excepted

*changes without prior notification

2.a The monitortest

We tested the following monitor models:

- SmallHD Cine24
- SmallHD OLED22
- TvLogic LUM-242H
- TvLogic LUM-310R
- Atomos Neon 24
- Sony PVM-X1800
- Sony PVM-X2400

General workflow:

We first read in the monitor with the factory settings and save them. This can be a first indication of panel quality and monitor setting. Depending on the quality management of the respective manufacturer, the monitors can be used on the set without calibration or have weaknesses in color rendering.

After the first measurement, we optimize the color balance of the monitors using the 2pt grayscale method. Therefore, the red, green and blue values are adjusted in 100% white with the gain settings, in 30% gray with the bias settings of the monitors.

Then we check the luminance. If our REC.709 gamma 2.4 target is $100\text{cd} / \text{m}^2$, it is advisable to measure the monitor at a brightness of $120\text{cd} / \text{m}^2$ before the adjustment, as a little of brightness goes lost during the measurement.

The program measures the color values and analyzes the deviations. Based on this deviation, Calman creates a lookup table (LUT²), which we can load into the monitor in the appropriate format.

Using this LUT, the colors with the deviations are reproduced on the panel in such a way that there are no major differences to the reference and the reproduction is as accurate as possible.

² <https://www.lightspace.lightillusion.com/luts.html>

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3. Impressions

SmallHD CINE24



Externally, the monitor looks very good, it is slim, lightweight, has mounting options all around and a handle for carrying. It seems durable and, thanks to a rail on the back, it has the option of adding a double battery plate (V-Mount or Gold-Mount), for example. Only the holes in the Vesa mount are badly placed, as they cover the fan directly. The 2-pin Lemo power-out connections are very positive - for example, to power wireless transmission devices directly from the monitor - this is a unique feature.

The first look at the panel is a bit disappointing, as the viewing angle is anything but consistent and shows different colors and brightness even when the head is tilted slightly. However, if you look orthogonally at the display, you get a good visual impression if you can also see a noticeable magenta and gamma shift.

The first measured values are unfortunately unsatisfying, which is not surprising given the first visual impression. The manual setting of gain and bias is a bit inconvenient due to the menu navigation, as you have to click back and forth a lot and the menus are sometimes in the way of the probe. A setting would be helpful here, e.g., to be able to position the menu at the edge of the screen.

Once you have come to terms with this, we come to the second measurement result, which also differs significantly from the first due to the LUT being invited. The test values almost suggest the class of reference monitors, but the very limited viewing angle does not hold up to this comparison.

Set capability of 4K monitors



www.bandpro.de

SmallHD is constantly developing its monitors. They have announced a dual and quad split, which will be unlocked along with other functions later this year.

Retail price: CINE24 app. 5.750€ net

Pro

4x 12G SDI In and 4x 12G SDI Out
HDMI In and Out
lightweight, good mounting options
12V DC In
Power-Out Connections

Con

Viewing angle
Menu setting during calibration
Crops 4K DCI signal

*all prices exclude VAT

*errors and changes excepted

*changes without prior notification

SmallHD OLED22



The workmanship and impression are the same as with the CINE24, since the monitors are identical except for the 2" size difference.

The panel looks neat and quite bright for an OLED. However, you can also see a slightly misaligned color balance here.

The first measured values underline the impression very much. The hardware calibration is just as laborious as that of the CINE24, since the same monitor operating system is processed here as well.

After the LUT creation and the second measured values, we come much closer to the comparison with a reference display. In a direct comparison with e.g., a Sony PVM-A250 V2.0, you can hardly see any difference.

As with the Cine24, SmallHD have announced a dual and quad split, which will be unlocked along with other functions later this year.

Retail price: OLED22 app. 11.350€ net

Pro

4x 12G SDI In and 4x 12G SDI Out
HDMI In and Out
lightweight, good mounting options
12V DC In
Power-Out Connections
OLED (perfect black, high dynamic range)
Reference Image

Con

price
Menu setting during calibration
Crops 4K DCI signal

TvLogic LUM-242H



As it is typical for the company, the 24 "TvLogic monitor comes with a yoke mount and unfortunately no handle, which would be very desirable given the size and weight of the monitor.

The monitor has various fans, which unfortunately make it very loud during operation. On a set where sound is recorded, we consider it questionable whether the volume is still acceptable.

The panel already makes a good impression at the factory, it looks balanced in terms of color, only a few color fringes can be recognized by the local dimming.

The measured values ex works are decent for a broadcast monitor and allow immediate use on the set.

The hardware calibration is typically kept simple and functional for TvLogic and the monitor can be adjusted quickly.

The second measured values with LUT then already go towards the reference monitor, even if it is not quite below a DeltaE of 1.

Retail price: LUM-242H app. 5.800€ net

Pro

Price-performance ratio

Good image quality

2x 12G SDI In and 2x 12G SDI Out

2x 3G SDI In and 2x 3G SDI Out

1x HDMI In

Con

Only 24V DC In

Loud

No HDMI Loop-Through

TvLogic LUM-310R



The first impression and handling is similar to that of its little brother.

This monitor also has various fans and is noisy. Due to its size of 31 ″, it will probably not be placed directly on the set, which is why the volume here could be considered more acceptable.

The panel is of good quality and the measured values are very similar to those of the 242H. With this monitor, too, we can achieve good measurement values after calibration that come close to values on a reference display.

Retail price: LUM-310R app. 33.750€ net

Pro

4K DCI Resolution
Good image quality
2x 12G SDI In and 2x 12G SDI Out
2x 3G SDI In and 2x 3G SDI Out
1x HDMI In

Con

Loud
Because of size not a good set monitor
No DC in
Price-performance ratio
No HDMI Loop-Through

Atomos Neon 24



The NEON24 comes across as very powerful and durable. It has convenient mounting options on the top and on the sides. First of all, it is irritating that it has a huge power supply unit and only one button - Atomos also completely dispenses with connections, these can be adapted - the modules for hard drive and HDMI In / Out and another module for 12G SDI In / Out can be plugged in and enable the monitor to record signals. A curse and a blessing, because on the one hand a lot is being adapted, but here you are also able to use future adapters.

The monitor can currently only be controlled with an app for iOS and MacOS, which is both a blessing and a curse. On the one hand, the app reacts very quickly, and you don't have to stand directly at the monitor, but you are dependent on another device and unable to control the monitor without an Apple mobile phone or tablet. The Bluetooth connection is also not secured; a new connection with another device overwrites the existing one - a master, slave variant would be desirable here.

Atomos told us that they will be launching the "Atomos Button Bar Remote (BBRCU)" in the second quarter 2021, which is supposed to provide haptic support for the app as a hardware monitor control.

There is a special feature when it comes to calibration: Atomos provides free software (Atomos Calibrator 2) for Mac and Windows with which the Neon can be used in combination with the X-Rite i1 Display Pro (Plus) Probe and the Atomos Serial - USB Cable should be calibrated very easily. They don't promise too much - if you have the right components at hand, it is self-explanatory to calibrate this monitor, unfortunately this is only possible with the two tools mentioned, other (even more professional) probes are not supported. It's a shame because you can calibrate the monitor so well, but we achieved better results with our workflow and the import of the LUT into the monitor via the recording SSD. The panel therefore gives more than what is teased out by its own calibration tool.

Retail price: Neon 24 app. 5.999€ net

Pro

Good image quality
4K DCI Resolution
Future proof I/O
Mounting Options
Recording option

Con

2x 12G SDI In/Out only via adapter
1x HDMI In/Out only via adapter
No buttons except Power
Usable only via app or additional hardware
modules (for now)
No DC In

Sony PVM-X1800 and PVM-X2400



The two monitors can be summarized very well under one point, as they are absolutely identical except for the size of the display. They are robust made of hard plastic and metal and have feet and a handle. Due to the overall depth, suitable mounting options must be ensured.

The panel seems to be perfectly illuminated and without having measured the monitors, they reproduce the test images very well.

After the first measurement and the values going in the reference direction, the hardware calibration convinces with extraordinary accuracy. The monitors can also be brought to the reference level without a LUT. The LUT does the rest, and we arrive at first-class values, DeltaE of less than 1.

Sony itself advertises that this monitor series fits perfectly on their mastering monitor BVM-HX310 (32,500 €). We were able to confirm this on the base of the measured values.

Retail price: X1800 app. 8.950€ net, X2400 app. 10.500€ net

Pro

Price-performance ratio

Image quality reference level

2x 12G SDI In and 2x 12G SDI Out

2x 3G SDI In and 2x 3G SDI Out

1x HDMI In

Quad Split

Con

Only 24V DC In

Big monitors

No HDMI Loop-Through

4. Conclusion

The monitors we tested are very different despite their similar equipment and hardware. Formats like native 4K are handled well by all monitors. Only the SmallHDs zoom into the 4K DCI material, so that a few lines of pixels are cut away at the top and bottom. (UPDATE: SmallHD has announced that it will change this in a firmware update; this update should also enable 4 signals to be displayed at the same time.)

With all other monitors you can set, whether you zoom in or look at the complete transmitted image with black bars on the left and right.

Basically, you cannot form a clear ranking for the monitors, because the monitors are very far apart in terms of price. But do you get something for your money?

Starting with the affordable models SmallHD CINE24, TvLogic LUM-242H and Atomos NEON 24, it can be said that good panels are installed when looking at the image and the measured values straight away - the CINE24 scores with its haptics and is the most suitable for set, in contrast to the NEON 24, which is a bit lost here due to the large number of extensions and the lack of the possibility of powering via a battery. On the other hand, the CINE24 is only suitable to a limited extent due to the very limited viewing angle. Even in this price range, the aspect of the viewing angle can be described as unsatisfying, especially since it takes the monitor's many strengths into the background. The LUM-242H not only offers a good picture impression but can be easily installed on a tripod or in a flight case with a yoke mount. Its loudness could be problematic in sets with sound, but it is the price / performance winner in this price range.

The Sonys set the price much higher, but you get a set monitor that is perfect, except the construction depth. The first-class image that is at reference level and the various mounting options make the monitor very flexible.

The SmallHD OLED22 is priced slightly above the Sonys with the OLED technology and combines the advantages of the CINE24 with a very good panel.

The TvLogic LUM-310R is the most expensive and should be rated as a mastering monitor. According to our measurements, it doesn't even match the image of the Sonys, which is why we ask ourselves whether the 310R is also sufficient as a mastering monitor.