

SONY

■ behind the scenes CineAlta

High
Dynamic
Range
explained

Technology Primer

BVM-X300 OLED

Master Monitor

Academy Award® Winner

Trimaster EL™ OLED

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Bill Baggelaar discusses High Dynamic Range

Interview by Peter Crithary

"It's really compelling to watch the content in high dynamic range. I think it really draws people in and you can watch and experience the movie not just all over again, but experience it in new ways. You can see things that you were never able to see before, things that were kind of hidden and you didn't really notice."

— Bill Baggelaar

Q: Let's start with the background of high dynamic range (HDR).

BILL BAGGELAAR: High dynamic range is not new. It is the way that most of us see the world everyday. Our eyes are high dynamic range and wide color gamut sensitive equipment. On a bright sunny day, they can see cloud highlight details while still being able to see into the shadows. In dark environments, we can start to see detail in extremely low to practically no

Bill Baggelaar is the Senior Vice President of Technology for Colorworks and Post-Production Services at Sony Pictures, where he manages the technology teams for picture and sound finishing. He joined the company in 2011, focusing his efforts on streamlining 4K and 2K workflows from on-set capture to post-production

for DI and mastering. He has been instrumental in driving the transition from tape-based video to the file-based world of IMF (Interoperable Master Format) for UltraHD and HD. Bill has led the team at Sony Pictures to help Sony Electronics develop the world's first 4K video service, Sony's 4K Video Unlimited. Sony Pictures now has over 200 titles (and counting) finished as UHD IMFs. Previously he worked at Warner Bros. Studios for 13 years in feature animation, vfx, DI and video mastering. He holds a BS in Computer Science, is a SMPTE member and represents the studio in various industry technical organizations.

light. Some cameras are at least getting closer to being able to detect some of the same things on those sunny days. But they have also gotten better in the dark, not as good as our eyes, but certainly better as the sensor technology improves. On the other hand, the television sets or other types of displays that we typically have used to watch content has a much lower dynamic range than our eyes or even the cameras that are being used to capture the content. So TV viewing, up to this point, has been what we now call, Standard Dynamic Range (SDR) where we have maybe in the order of seven to nine stops of exposure depending on the display. With these new displays, we are now talking about Ultra-HD (4K/UHD) and High Dynamic Range (HDR) that could potentially go up to 20 stops. But more practically for the consumers, we're talking maybe 12 to 14 stops. We are inherently contrast sensitive beings and so what this increased dynamic range does is it gives us an increased sense of sharpness, detail, clarity, color and saturation; all these things that we see in the real world, but we're not able to realize on today's consumer displays or even in theaters, for that matter. And since we are incredibly adaptable beings, when we're watching a movie or a TV show in a particularly either dark or bright location, our eyes and brain adapt. We may see something right away where

the contrast doesn't necessarily feel right, but we adapt pretty quickly to it and can watch it and not be distracted by it. But now with these higher dynamic range displays, we're able to really start to give people more picture details in order to provide a more immersive experience. As I mentioned, getting better color saturation goes along with this whole wider color gamut piece that is part of HDR. So HDR is not just about contrast, or about resolution; or even about color; it's about being able to combine all three to represent images more accurately on consumer displays. This gives content creators an expanded canvas to represent things that are true to life or they can even go hyper real. For finishing movies for theaters, we work in P3 color space, which is a wider color gamut than the TV standard, Rec. 709. Often times there are very specific colors, particular purples, reds or translucent colors; that cannot be displayed in SDR/Rec.709, so we have to do additional color correction to nicely squash it down into Rec. 709 for consumer displays. There's all sorts of saturated colors whether it goes from blue to orange to purple to green that we can now represent on consumer displays that we've never been able to represent before and that provides something closer to the original artistic vision, representing what the DP and Director originally intended for the viewers to see.



"Annie" in HDR: The increased contrast in this scene allows the overall shadow detail to be held while at the same time reducing the glow effect from the flames. Also the color of the flames can hold their intended saturation and detail, especially with various gas type flames.



"Annie" in SDR: Original SDR image

It maybe hard to see the effects described in these images without seeing them on the proper HDR display.



"Amazing Spiderman 2" in HDR: Highlight detail is retained while also keeping shadow detail. This will retain distant objects like the cables in the bridge. The overall tonal detail that is retained adds to the viewer's sense of immersion into the images. While at the same time keeping the image noise level down so that it does not become distracting.



"Amazing Spiderman 2" in SDR: Original SDR image

Q: So this is basically getting us as close to reality as what's technically possible.

BILL BAGGELAAR: Yes, within certain constraints. There is the reality of staring at the sun on a bright sunny day. It hurts your eyes and we obviously don't want to get that real. We don't want people to be hurt by the content. So, within certain limits, yes. An additional sense of reality is possible, but I don't know that we necessarily need to focus just on the reality piece. I think the content creators can present the vision that they want the consumers to experience more accurately although that sometimes doesn't necessarily mean real. It just means that it's maybe more immersive or maybe going to the level of creating colors that you don't see in the real world that can exist, but you don't necessarily see normally, but we can represent them in a way that we're not able to with today's display technology.

Q: Is it the camera delivering more in order to get that result? Or is it more of a post-production process, or perhaps both?

BILL BAGGELAAR: A bit of both. Certainly it is better to start with captured images that have more inherent information in them. So the cameras have to be able to capture a wider dynamic range and a wider color gamut in order to truly take advantage of that in post. It doesn't mean that you absolutely have to start

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with wider sources, but there are diminishing returns when starting from "narrower" sources. You're always going to have the potential to get better results when you capture with a camera that has higher resolution, wider dynamic range and wider color gamut than the intended display, which is typically what we do. We've got the Sony cameras that capture in S-Log, one, two or three and we've got S-Gamut, which is a much wider gamut than P3. And as Rec. 2020 comes along, S-Gamut is actually even wider than Rec. 2020. Film has always been very wide as well and many of the other digital cameras have much wider color gamut than the displays that we actually have today or even are being planned for the near future, so starting from a wider color gamut helps to make sure that you can represent those colors on the displays.

"We've got the Sony cameras that capture in S-Log, one, two or three and we've got S-Gamut, which is a much wider gamut than P3. And as Rec. 2020 comes along, S-Gamut is actually even wider than Rec. 2020."

Q: If the information isn't captured to begin with, you can't extract it and work with that in post-production so...

BILL BAGGELAAR: Right. It's definitely important to start from a higher resolution, higher dynamic range and wider color gamut. The Sony cameras are much higher dynamic range and much wider color gamut than we've been able to take advantage of to date, so everything that we've been capturing in RAW we're potentially able to go back and truly apply to these HDR displays in whatever way the creatives decide they want to apply them.

Q: How does motion picture film grain, and digital camera sensor noise play a role in HDR production and post-production?

BILL BAGGELAAR: HDR can enhance film grain and digital camera sensor noise, therefore dealing with grain and noise — if you do not want it — becomes more challenging with HDR in post-production. Today we do not have content specifically shot for HDR, so perhaps results would be different if on the outset of a production, HDR was

in consideration before they start shooting the first frame. With existing catalog content, noise and grain reduction tools can be used to help manage any noise that gets enhanced or exposed due to the new brightness range. But as I mentioned, the lighting and exposure techniques will need to adapt in order to get the most effective HDR finishing in the future.

Q: You’ve done a number of tests with different cameras and in particular with the Sony F55 and the F65, of which both have the S-Log3 with the S-Gamut3 as opposed to the S-Gamut3.cine. S-Gamut3 is wider than Rec.2020, but the S-Gamut3.cine is closer to the P3 space. So I would assume that you are testing with the F55 and F65 in S-Gamut3 and recording in 16-bit RAW, can you elaborate on those results?

BILL BAGGELAAR: Both cameras do a great job of capturing tonal detail in challenging lighting conditions. Recording 16-bit RAW allows us to actually retain all of that information. So the wide color gamut, wide dynamic range and high resolution can be captured in that 16-bit RAW camera file as linear data so that we can make maximum use of it in post. So if we didn’t have a container and have the ability to actually capture it — let’s say we were at 10 bits or we weren’t able to do 4K or we wouldn’t necessarily be able to represent

all of those things simultaneously in the captured image data. Capturing these very high quality files will allow us to go back and re-purpose the content for some future use (HDR, Rec. 2020, etc.) when and if we choose to do so.

Q: So have you seen significant differences in those tests between a 10-bit or 12-bit compared to 16-bit?

BILL BAGGELAAR: Based on our tests and our history of mastering content, we know we need oversampling in order to get high quality results. So, more is better. We have done HDR tests starting from 10-bit sources and from 16-bit sources. We can make HDR versions of the 10-bit content look better than the original SDR version, but there are certain limits on how much detail you can bring out. When we use 16-bit sources, we get dramatically better results. We did some recent HDR tests with clips from a few shows, the recently released feature *Annie*, *The Amazing Spiderman 2* and the TV show *The Blacklist*. *Annie* was shot on the F55 camera and the footage is beautiful. I mean it truly is beautiful. *Amazing Spiderman 2* was shot of film and F65 and we had 4K 16-bit

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scans of the film to capture all of that dynamic range and color fidelity. *The Blacklist* is shot on F55 and we have 16-bit sources on that show as well. The results are stunning. Starting from that wider color gamut, higher dynamic range content on the original RAW is incredibly valuable in being able to create tonal detail that you just don’t get anywhere working from a lower fidelity source.

Q: So then given the fact that if you do the film scans at 16-bit and you’ve got the 16-bit RAW, are we there? Or is there more work to be done?

BILL BAGGELAAR: Well, I think the problem is that right now we have a pretty good idea of how we can take advantage of what we are currently putting in the vault. But we always want “more”, right? Because we don’t know what the future technologies will



“The Blacklist” in HDR: Shadow detail is able to be retained while also keeping the highlights from the overhead lights in check. On an HDR display, you can see into the shadows, whereas on an SDR display this will appear clipped.



“The Blacklist” in SDR: All of the shadow detail is lifted in order to make sure that conventional TV sets can display the scene, but this has an overall effect of making the scene seem brighter than it really was.



"Amazing Spiderman 2" in HDR: The impact of this scene on an HDR display is stunning. You can get increased saturation in Electro's blue translucent skin while still keeping the harsh shadows from his "glow". This makes his eyes stand out a bit more.



"Amazing Spiderman 2" in SDR: Original SDR image – Electro's skin details start to clip to white.

demand. And if we're looking at 10 years out, maybe even 20 years out for the library, we'll be able to take advantage of "more", if we have it. But for now, it seems like 16-bit RAW capture will hold up on current and near future generations of displays with increasing brightness.

Q: So you're future proofing the content now with HDR specific grading, which is a different asset that you're archiving as opposed to the one that you're distributing today.

BILL BAGGELAAR: Right. We haven't started HDR grading beyond testing at the moment. But it certainly starts with the capture. So if we focus on capturing on these high quality cameras then we know that even if we don't master it in HDR today, we know that we can go back and remaster it in HDR whenever we deem the market ready.

"...it certainly starts with the capture. So if we focus on capturing on these high quality cameras then we know that even if we don't master it in HDR today, we know that we can go back and re-master it in HDR whenever we deem the market ready."

Q: You're going back into the archives and remastering 4K for distribution which wasn't around a few years back. So I guess it's along the same lines. Future proof now for what is inevitably coming...

BILL BAGGELAAR: Yes, it is along those same lines. Keeping a high quality source gives us the best chance to be able to create a new viewer experience down the road.

Q: So just touching on the 10-bit versus the 12-bit versus the 16-bit again for a minute. Ideally you would want everything in 16-bit, right? The differences between 10-bit vs 12-bit vs 16-bit.

BILL BAGGELAAR: Oh yes. More bit depth helps in all aspects of finishing the picture. We master everything that we do in 16 bits so that we can retain as much tonal detail as possible. It is clear to the colorists, VFX artists, etc. and others down the line. More bits help to provide subtle details that you can't get back if you've only captured it in 10 or 12 bits, or only finished in 10 bits or 12 bits. And that's the significant thing. Deliveries to the theaters and to consumers are not at 16 bits, but we always want to start with the highest quality master that we can when we go into encoding whether for digital cinema distribution, blu-ray, streaming, etc.

Q: And then there is the richness of the color palette, the gamut; the color filter arrays in these cameras would contribute significantly to the results as well I would think?

BILL BAGGELAAR: Oh absolutely. I mean obviously the ability of the sensor to replicate the colors in whatever way that they are being lit by the director of photography, being able to capture the raw scene information and not bake in LUTs or bake in looks that are irreversible, is a tremendous value.

"More bits help to provide subtle details that you can't get back if you've only captured it in 10 or 12 bits, or only finished in 10 bits or 12 bits. And that's the significant thing."

Q: Does that mean that Cinematographers now need to be aware (when using the right camera that can capture that very large range) of lighting and working in a day to day environment that is optimized for high dynamic range acquisition?

BILL BAGGELAAR: Yes. I think this is going to become one of the learning points on HDR right? What does that mean and how does it affect lighting? What SDR techniques apply and which need to change or adapt?

Q: Yes, that's what I was getting at.

BILL BAGGELAAR: Targeting HDR? And I think that it's going to be different approaches for different situations. If you've got really strong shadows and you're trying to bury details in the shadows that you don't think or want people to see, that may not necessarily be the way it ends up in the capture or in dailies. In post-production, you can always try the normal techniques to diminish that but it is definitely going to be a learning process for people to understand how to light for HDR. Director's and DP's still need to direct the viewers attention where they want them to be looking with lighting cues. So I think it's just going to be a bit of a learning process for all involved.

Q: Let's talk about the consumer displays. How do we identify the televisions that can do it versus the ones that almost can do it versus the ones that can't do it at all?

BILL BAGGELAAR: On the consumer side, that's going to be tough. I see this definitely as a challenge, and the industry is struggling with this right now. We're having conversations over what constitutes high dynamic range. And we have some general agreement, but by no means full

agreement from all studios and CE manufacturers.

Q: Right, so what constitutes HDR?

BILL BAGGELAAR: What's the minimum level? There is no consistency on that in the industry. And I think that is one of the things that the industry has to settle on for this to be successful. This way, we know what level we are going to master our content for and we will then know what the consumer experience will be across the range of displays that will be called HDR. We've made suggestions on what we think high dynamic range should be, which is 1000 nits at minimum, along with contrast ratio and minimum peak brightness suggestions. In the end it will have to be easy for the consumers to understand what they should expect from an HDR experience. There's got to be some sort of minimums to give people the confidence that the industry is helping them to make the right decisions on display technologies.

Q: Well, is Rec. 2020 the benchmark then? If they were to meet that, would that be it?

BILL BAGGELAAR: Rec. 2020 does not specify high dynamic range.

"We've made suggestions on what we think high dynamic range should be, which is 1000 nits at minimum, along with contrast ratio and minimum peak brightness..."

So Rec. 2020 is purely a color gamut and resolution and we've been working to get an expansion of Rec. 2020 to include higher dynamic range language as well as those sort of dynamic range minimum brightness to help further what Rec. 2020 (4K/Ultra HD) will actually mean. But I think that we still have a ways to go to either get consensus that it needs to go into Rec. 2020 or whether it'll be an additional spec that goes alongside it or it becomes part of a larger industry standard.

Q: There is one technique combining multiple exposures, and is used by a particular camera company, and is used also by DSLR manufacturers — is that technique really high dynamic range?

BILL BAGGELAAR: As far as taking multiple exposures goes, that can work in some situations, but the current systems have issues with moving camera or moving subject. There are several tests underway to help move that technology along. The technique itself works well on still images.

"...it is definitely going to be a learning process for people to understand how to light for HDR."



"The Blacklist" in HDR: The increased contrast in HDR lets you create more saturated colors. This can translate into more realistic looking blue skys and many other everyday scenes. The increased contract also provides more apparent resolution. This is supposed to be late on a wintery day with harsh shadows from the sun going down.



"The Blacklist" in SDR: This is the original image, which feels a bit brighter and flatter overall.



“Annie” in HDR: Again, the increased contrast adds to a sense of realism and immersion for the viewer. Retaining sky and cloud detail information while also keeping the shadow details has long been a desire for many creative professionals.



“Annie” in SDR: Original image, shadow information is lifted to avoid losing all of the city details and at the same time, the highlight information is clipped due to the limitations of conventional displays.

Q: Isn't that compensating for the fact that the stills cameras are not processing what the sensor is capable of doing?

BILL BAGGELAAR: Sure, because if it were practical, you would have a 16-bit sensor and capture 16-bit RAW stills in order to preserve the dynamic range of the scene. Multiple simultaneous exposures allow you to elicit a higher dynamic range image in a single combined final image. But even that technique is limited by the SDR display technologies that we currently have. I can squash more shadow or highlight information into an SDR image on an SDR display, but that does not provide the same depth and detail than an HDR image will evoke on an actual HDR display.

Q: And what about in the theater?

BILL BAGGELAAR: In the theater, solutions are coming out that will basically give you, probably 14 to 16 stops of dynamic range, which is pretty incredible. But the good thing is if we're starting on cinema content and if we're starting from a theatrical grade in HDR, it certainly makes it easier to get HDR content into the downstream consumer distribution channels.

Q: Has that happened yet?

BILL BAGGELAAR: No. Those systems are just becoming available for the marketplace. They're still small in number so we have not targeted one yet. But I would imagine that it will happen

soon. And that's why I believe our content is well suited to take advantage of the technologies, when the time is right.

Q: You've done these high dynamic range tests with imagery across the board. You've tested all of the high end digital motion picture cameras?

BILL BAGGELAAR: No. We haven't tested all of them, but we've certainly dealt with all of the major cameras that are being used, ARRI, RED, and Sony. And while we have used all of the major cameras for producing our content, we haven't specifically done HDR testing on all of them. We've dealt with them enough to know what their dynamic range capabilities are because we're starting — when we're doing a DI, TV or camera tests in general, we are starting from a RAW source to begin with, so we know all of the information that the camera is able to give us as our starting point.

Q: What results have you found between the different ones? I mean where do they stack?

BILL BAGGELAAR: Well, the Sony F65 definitely has the best resolution, dynamic range and

color fidelity, it's amazing. Probably the F55 and the Alexa are pretty close as the next in line for those things. Obviously the F55 has higher resolution than the Alexa based on the sensor specs and the image detail that comes out. The others do not have the same dynamic range or color fidelity as those three cameras. You can still make great looking content on them though; everything comes down to creative intent, as well.

Q: So to conclude I think it sounds like the best results you're going to get will really be determined in the DI process at the end of the day.

BILL BAGGELAAR: Again, you have to start with the capture, but the ability to take advantage of what you've captured is huge. The DI or TV finishing workflows that maintain the highest quality throughout are going to provide the best results. High quality (floating point) color processing, along with 16-bit EXR VFX workflows will retain as much dynamic range that was in the original capture for use down the road. Being able to maintain all of the color information, resolution

“if we're starting from a theatrical grade in HDR, it certainly makes it easier to get HDR content into the downstream consumer distribution channels.”

and dynamic range is why we have been leading the 4K/UHD revolution in the first place. We want Sony content available to be repurposed down the road and not locking ourselves only into the delivery mechanism of today. We actually have an archive that can go back and be repurposed into making these other versions that we can foresee. But Grover Crisp and our asset management group has been doing that for a long time now with our restoration and remastering efforts in both 2K/HD and 4K/UHD.

Q: What monitors are you using for grading, because obviously the DI suite needs to have the monitoring capable to see what you're doing to achieve the best results. What are you using to be monitoring the high dynamic range?

BILL BAGGELAAR: For high dynamic range testing today we are working in SMPTE PQ and in ACES color (Academy Color Encoding Space) on a Baselight system. We have a process where we use a Dolby PRM 4200 working at 600 nits. We don't actually clip any of the luminance values; we keep all of the dynamic range, resolution and color in an ACES EXR file. Then we can check the content on scopes and 1000 nit Sony consumer displays. If we need to do a trim pass on a brighter HDR display like a 4000 nit Dolby Pulsar or a 5000 nit Sim

2, we can do that as well. So our workflow is very scalable, very flexible and that way we don't lock ourselves into only targeting one particular thing. The upcoming 1000 nit Sony BVM-X300 is also an exciting prospect.

Q: Working in PQ — Perceptually Quantized — can you explain?

BILL BAGGELAAR: SMPTE PQ is a significant development that gives us a luminance curve that actually lends itself to these higher dynamic range displays. Gamma encoding doesn't hold up at these very bright levels we are discussing. We are working in PQ to make sure that we are not artificially limiting the luminance of the actual content that we are creating for our masters and our archive.

Q: Conclusions?

BILL BAGGELAAR: For demonstration at CES this year, we have created some HDR clips from *The Amazing Spiderman 2*, *Annie* and *The Blacklist*. All have been regraded in HDR from the original 16-bit P3 theatrical master renders and rendered out in PQ Rec. 2020. Across the board, the content is stunning. I think there's a renewed vigor in watching it. It's really compelling to watch the content in high dynamic range. I think it really draws people in and you can watch and experience the movie not just all over again, but experience it in new ways. You can see things that you were never able to see before,

things that were kind of hidden and you didn't really notice. You also get a sense of immersion that I think goes beyond what we've been able to show with current display technology. So I think HDR has a really bright future.

Q: That's a great way to finish it, thank you very much. ■

"I think there's a renewed vigor in watching it. It's really compelling to watch the content in high dynamic range. I think it really draws people in and you can watch and experience the movie not just all over again, but experience it in new ways. You can see things that you were never able to see before, things that were kind of hidden and you didn't really notice... So I think HDR has a really bright future."

To read further about Sony S-Gamut [click here.](#)



"Amazing Spiderman 2" in HDR: Shadow detail from the Times Square surrounding environment is able to be kept while also retaining the highlight and saturation from the bright signs and lights. Harsh shadows exist and it adds to the viewers experience by keeping some sense of realism in a very "unreal" scene.



"Amazing Spiderman 2" in SDR: Original SDR image – much flatter overall. The overall balance of highlights to shadow are thrown off in a scene like this in order to allow a viewer to see more of the details on a conventional SDR display.

BVM-X300 OLED MASTER MONITOR

By Senior Product Manager Gary Mandle



High dynamic range cameras have been around for a while, but until now, it's been impossible to really view an image from a camera like the F5, F55 or F65 as it was originally captured. The best you could hope for was to archive the raw content and wait for the display technology to catch up.

Now, there is a solution that allows direct viewing at full range without the need to make any conversion LUTs or changes to the native image.

Sony's BVM-X300 is a monitor that has been in design and development for more than 5 years. It made its official debut at the 2014 Hollywood Post Alliance (HPA) Technology Retreat at Indian Wells Calif.

The BVM-X300 solves a majority of issues that previously required "work-arounds" when using the latest HDR cameras. Issues like black levels, wide color gamut, and 14 stop dynamic ranges all had to be compromised when using currently available technologies.

4K

Many projects are now required to be shot in 4K, but there is still a lot of confusion on what the definition of 4K really is. Look at the DCI specification and also the SMPTE recommended practice for cinema, and you will see that the pixel matrix is 4096 x 2160 pixels at a 1.89:1 aspect ratio. Most “4K” monitors available now use consumer panels based on the Ultra HD (UHD) TV standard, not the cinema standard, so they use a 3840 x 2160 pixel matrix at a 1.77:1 aspect ratio. Why is this distinction important? Most movie projects are authored in scope or flat aspect ratios. Scope is defined by a pixel matrix of 4096 x 1714 pixels (2.39:1), while flat would be a 3996 x 2160 pixel matrix. The entire design of the cinema mapping system works so that you don’t need to scale the image if the panel is a 4096 x 2160 matrix. However, if the panel is a 3840 x 2160 matrix, both flat and scope images must be scaled as 11/12ths to fit the panel. This can hide image artifacts and create scaling artifacts in the picture. Both will affect the next stages of the production.

The BVM-X300 uses a true 1.89 4K panel so scaling is not needed to show any format — UHDTV or Cinema 4K.

The image shows a large 4K monitor displaying a scene from a movie. Overlaid on the left side of the monitor are three diagrams illustrating different image formats and their scaling on a 1.89:1 panel.

Diagram 1 (Top): A light blue rectangle labeled "Pixel Counts" with a yellow border. The text "Scope image displayed on a 1.89:1 panel" is below it. The top right corner of the rectangle contains the text "4096 x 1714 (2.39:1) Scope".

Diagram 2 (Middle): A light blue rectangle labeled "Pixel Counts" with a yellow border. The text "Flat image displayed on a 1.89:1 panel" is below it. The top right corner of the rectangle contains the text "3996 x 2160 (1.89:1) Flat".

Diagram 3 (Bottom): A light blue rectangle labeled "Pixel Counts" with a yellow border. The text "UHDTV image on a 1.89:1 panel" is below it. The top right corner of the rectangle contains the text "3840 x 2160 (1.77:1) UHDTV".

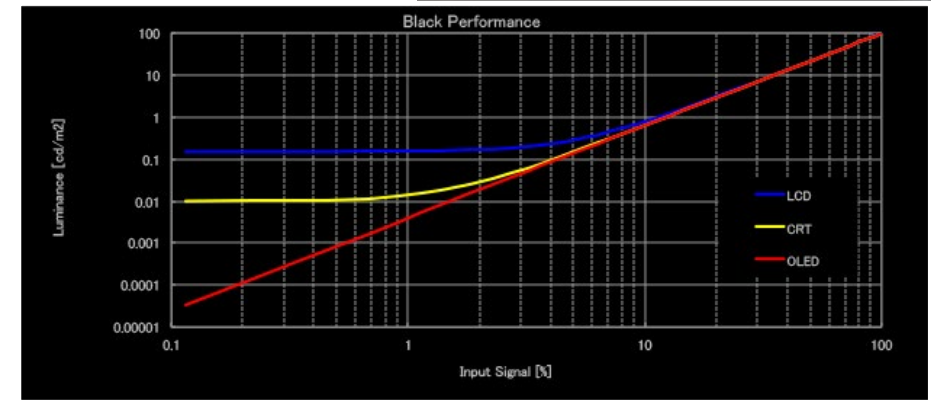
Advantages of using an OLED display technology

While it's had success in diverse professional applications, OLED is still a relatively new technology for master monitoring. It offers image performance beyond that of the long-time standard — CRT — and, even better, the same engineers who designed the BVM CRTs are the same ones that designed the BVM-X300. The OLED panel designed for this monitor is controlled by a proprietary system designed by Sony engineers called Trimaster, which is employed across Sony's high-end monitor line. So you can understand the level of performance that this monitor is expected to deliver.

Accurate Blacks

If the signal specifies a zero level, the Trimaster EL OLED technology allows for each pixel to be turned completely off, with no light emitted. There is none of the backlight leakage you would expect in an LCD monitor.

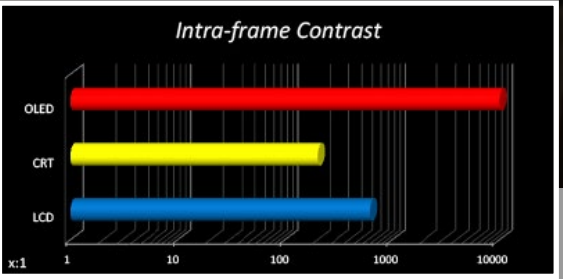
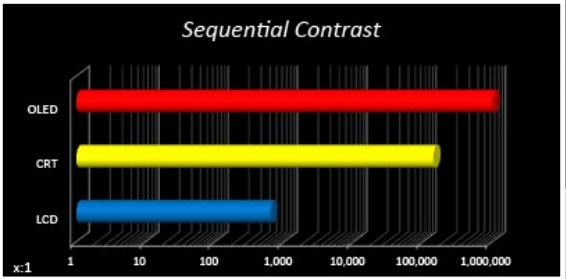
The blue line in the graph shows the black performance of a top-grade LCD. The yellow line is from a Sony BVM CRT monitor and red shows the black performance of a Trimaster EL OLED monitor. This doesn't mean that the monitor is too black. Aside from this graph are controls in



the monitor to set the EOTF (gamma) to what is defined by the imaging standard. The black you get is a calibrated result. If you need to elevate this, then there are handle provided in the monitor's control that can do this. One simple and repeatable solution is to use the CRT emulation EOTF in the monitor presets. This elevates black to perform as shown in the yellow line.

TRIMASTER EL

"If the signal specifies a zero level, the Trimaster EL OLED technology allows for each pixel to be turned completely off, with no light emitted."



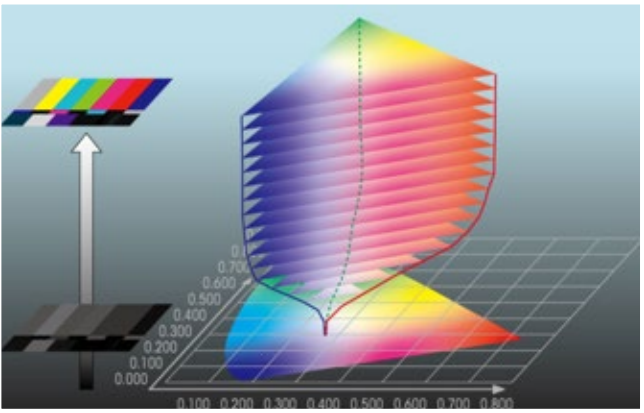
Sequential contrast measured using full white and black fields. Intra Frame contrast measured using the IEC 62341 standard.

Contrast

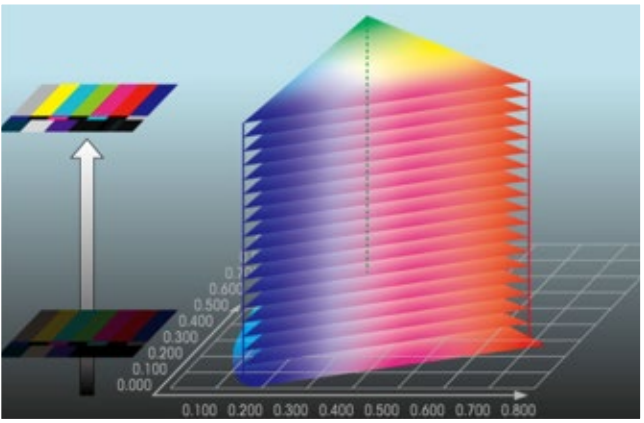
While the BVM-X300's panel can now display HDR images, it must also have a system in place to match input bit number to a precise light output, and do this over 26½ million red, green, and blue pixels. The BVM-X300 can accept 12-bit video inputs and has the processing power to accurately range them for perfect gamma performance, either as a standard dynamic range or in high dynamic range. The contrast range is larger than any other available display technology and the signal process is optimized for EOTF accuracy.

Color Gamut Accuracy

Most competitive monitors will show the range of the color gamut measured using the full brightness of the display. The more energy that can be output, the better the gamut will test. But most production applications seldom require using the brightness part of the image when making color decisions.



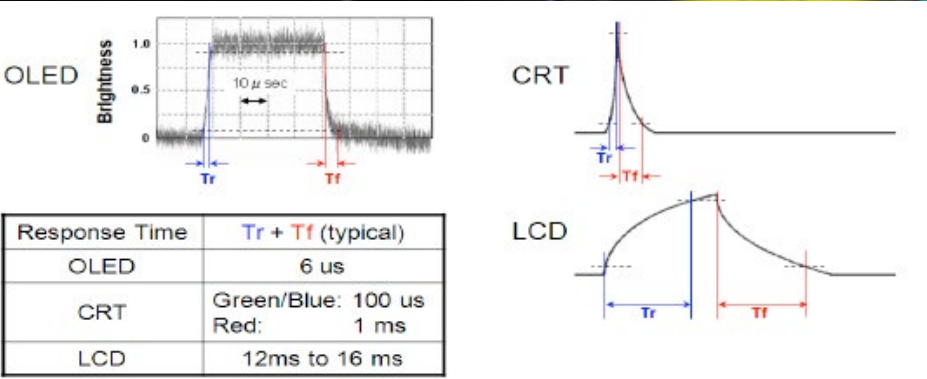
LCD & CRT Gamut Performance



Trimaster EL Gamut Performance

Above are diagrams based on CIE 1931 color space. The top set of triangles shows the size of the displayed color gamut at maximum brightness. The bottom shows the size of the color gamut displayed at low brightness levels. In many cases, with LCD, Plasma, and CRT technology, the lower luminance images will turn to monochrome in the very dark part of the image.

“In many cases, with LCD, Plasma, and CRT technology, the lower luminance images will turn to monochrome in the very dark part of the image.”



Pixel Switching Speed

The Trimaster EL OLED panels can switch between a “full on” to “full off” state very quickly. In fact it can switch several hundredths of a second faster than LCD, eliminating image smear when areas of the picture move quickly. This speed is so fast that it can induce flicker if not properly managed. The BVM-X300 has settings to control this flicker and not cause temporal image changes. Below is a comparison between an LCD panel and the Sony Trimaster EL OLED panel. The OLED switch is far faster and much more uniform than these older technologies.

HDR

High Dynamic Range is new to the display world. It's one thing to convert light to electrons, but it's a whole new ballgame to convert electrons into light, especially if it has to be a particular light that must meet set standards. Until now, the monitor would be calibrated to 100 cd/m² for reference brightness, while for television you may have highlights up to 109 cd/m². Given that the camera is recording highlights as much as 100 times this level makes for some compromise. The Sony cameras output one of three versions of S-Log. When using the BVM-E250 OLED monitor for example, you needed to build a LUT to bring the range back to within 100 cd/m² or use one of the S-Log settings in the monitor which will either compress the image into this range or clip the image to retain a proper S-Log EOTF. The BVM-X300 panel design displays images far brighter than the previous models. Now the image can be displayed in the same range that the camera captured it, eliminating the need for these image modifiers. No more need to compress or guess just what you have captured. Settings for S-Log 2 and S-Log 3 let you see the image exactly as captured without the need for any manipulation.

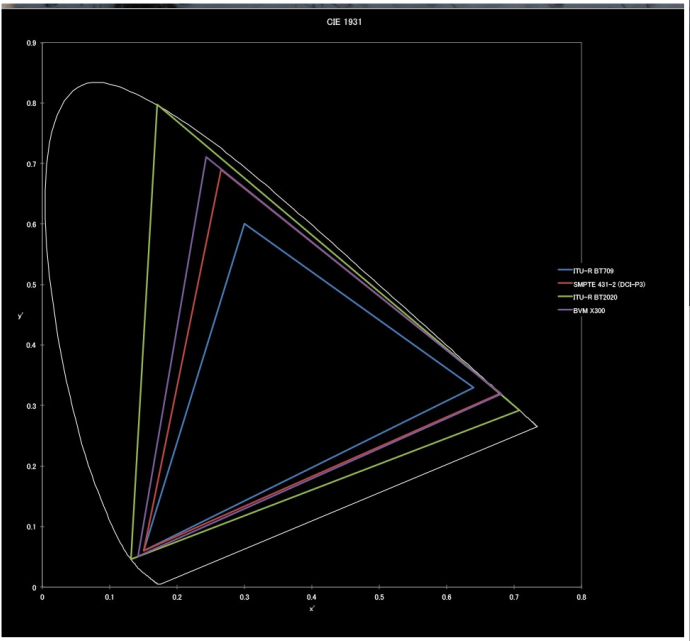


“The BVM-X300 panel design displays images far brighter than the previous models. Now the image can be displayed in the same range that the camera captured it, eliminating the need for these image modifiers.”

Color Gamuts

Most monitors in the field today have settings for the ITU-R BT709 color gamut. This is the range of colors that the display can present. Some monitors are better than others at hitting the color primaries. This accuracy of this will have a direct effect on what you perceive. Inaccuracies in the color primaries can lead to color errors that are not in the content. Chasing these errors can cost the production needlessly.

The BVM-X300's completely new panel design not only allows the monitor to display HDR content, it also expands the range of colors that



can be displayed. This is the first 4K monitor to do this. The BVM-X300 has presets for ITU-R BT709 and R BT2020. It also has a preset for DCI P3. These primaries are more accurate than our previous BVM series and give an exact representation of the content.

New Chassis Design

New to the BVM-X300 is the layout and menu structure of the chassis, which is simplified from previous designs. The control panel has been integrated into the chassis. The slot structure of the older design is removed and emphasis is placed on the quality of the signal process, the accuracy of the image and the stability of the monitor. With a design this sophisticated, it wouldn't be uncommon to go for months without needing to calibrate it. This new design has multiple stability feedback circuits that monitor the light output of the monitor. These maintain its accuracy over long periods of operation. This also provides the confidence that the monitor is right even though it may not have been checked in recent days. This also gives the production the confidence that the monitor used on the other side of the world looks the same as the one they have on set of in post. Everyone is always seeing the same image regardless of location or age of the monitor.

The control panel has been simplified as well as the menu system. We've removed many of the settings that previously caused confusion in setup. A new menu tree lets you navigate through the monitor quickly and make configurations very simple. Configurations can be combined and stored, and can be assigned to one of the seven function keys on the control panel for instant recall. These configurations can be password protected so that they are always correct.



Power consumption is also significantly reduced when displaying an HDR image. So much so, that in a typical configuration displaying an 1000 cd/m² HDR image, the power consumption is as low as 200 watts.

Operation

Time is at a premium during production. Sitting around a monitor trying to get the image right is tedious and costly. The first menu to display is a status window telling you everything from the monitor settings to the signal input format and even software versions and time in use.

Buttons under each manual control take the control out of preset so they can be adjusted. There is a light showing that this control is not in calibration. When setting these for the user configurations, they can be used to bring back the setting to a previous value in case they have been misadjusted.

Menu navigation is through one knob and two buttons. The knob allows selection and entry of a memory setting. A back button lets you step back one level and a menu button turns the menu on or off.

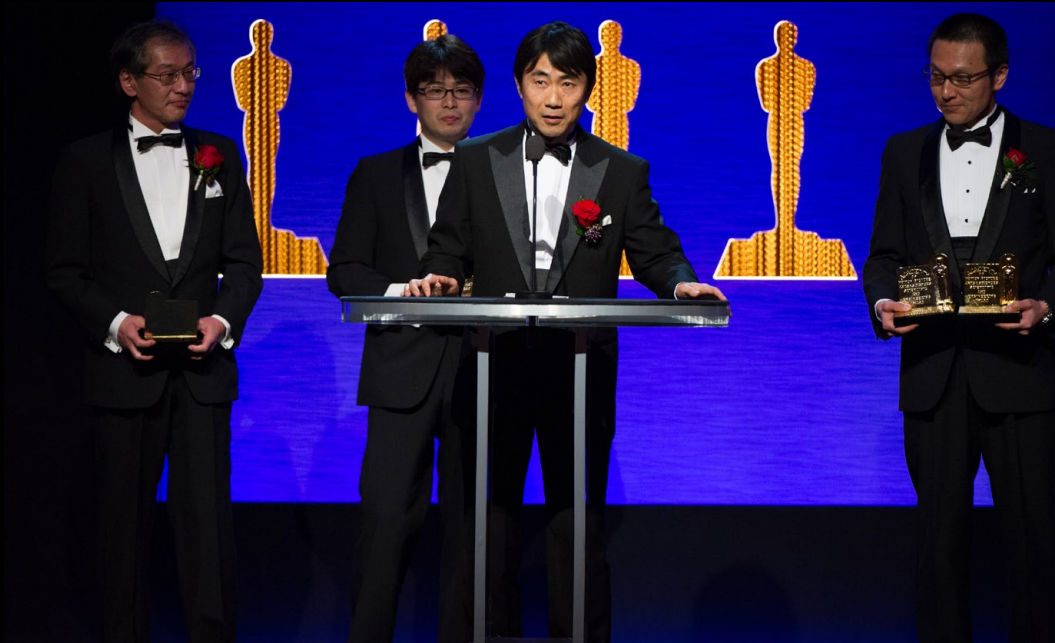
Upgrades

One worry on any purchase is the issue of obsolescence. It's guaranteed that there will always be something new. The BVM-X300 uses a new firmware system that lets you update the monitor. There is no need to bring it in for service or to have someone come to your location to install these updates. The tool and software are available off the web and at no charge. So as the BVM-X300 evolves, so do your production capabilities. ■



New BVM-X300 Control Panel

Congratulations to the team. Sony OLED Trimaster EL Series
Professional Monitoring Technology
Honored with Scientific and Technical Academy Award®.



Left to right: Ichiro Tsutsui, Mitsuru Asano, Masahiro Take (at podium)
Mitsuyasu Tamura

Photographer: Michael Yada / © A.M.P.A.S.

SONY

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