

SIM2 Crystal 4 Sh SuperHybrid Widescreen REVIEW



*“For a high-performance home theatre system,
you can’t do better than the Crystal 4 Sh
projector in 2021”*

Doug Blackburn -
Widescreen Review



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SIM2 Crystal 4 Sh SuperHybrid Widescreen REVIEW - Part 1

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REVIEW**

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SIM2 Crystal 4 SH

SuperHybrid Laser-Phosphor Projector

Part 1

Doug Blackburn

SIM2 is a high-end projector company located in Pordenone, Italy, making projectors for home theatre and commercial use. Their current consumer offerings include the conventional Nero Series of projectors with UHP projection lamps. A short throw laser projector, xTV, is available as a standalone device, or it can be configured to install in a piece of furniture. A third version is configured for installation in the ceiling. The Crystal 4 projector is a UHP-lamp version of the Crystal 4 SuperHybrid reviewed here. The Domino 4 projector is a version of the Crystal 4 that is set up for smaller rooms than the other models. I reviewed the SIM2 Nero 4S projector in 2019 and found it to be a worthy competitor at that time. The Crystal 4 SH projector arrived too late to complete an entire review for this issue. Part 1 will include all the projector details and initial operational notes. More detailed image quality observations, control setting recommendations, and measurements will appear in Part 2 in the next issue of *Widescreen Review & Custom Home Theatre Design*.

SIM2 projectors are sold primarily by home theatre companies that design and install, integrate, update, or otherwise construct entire dedicated home theatre systems. The Crystal 4 SuperHybrid, or Crystal 4 SH, is SIM2's first projector with this new type of laser-phosphor illumination system. It has two significant differences compared to other laser-phosphor illumination sys-

tems: A newly formulated yellow + green phosphor on the phosphor wheel; and a cooling system for the phosphor wheel that does not rely on liquid coolant as fitted to other brands of high-end laser-phosphor projectors. Conventional laser-phosphor light engines have multiple blue lasers (I've encountered as few as 8 and up to ~50) aimed at a spinning yellow phosphor wheel. In the Crystal 4 SH, the phosphor wheel has a clear area that allows powerful blue laser light through the phosphor wheel directly to the light engine. The lasers "hitting" the rotating phosphor area of the wheel cause the phosphor to glow brightly. In conventional laser-phosphor projectors, the yellow light is split into red and green light. In the new generation of laser-phosphor light engine used in the Crystal 4 SH, the yellow phosphors are combined with green phosphors to produce more green light in the output of the light engine. This increases the color gamut of the Crystal 4 SH projector compared to earlier laser-phosphor light engines using only yellow phosphor. UHP projection lamps have the smallest color gamut of these illumination systems.

As with all single-chip DLP projectors, the Crystal 4 SH has a color filter wheel. Some brands of DLP projectors have a white (clear) segment in the color wheel. That allows them to advertise higher light output, but there is a cost. With one of the filter segments being white, the projector cannot produce color for part of

EQUIPMENT REVIEW

SIM2 Crystal 4 SH SuperHybrid Laser-Phosphor Projector Part 1

each color filter wheel rotation. That reduces the range of colors the projector can produce. SIM2 avoids that by using a four-segment color wheel with no white segment. Instead, SIM2 uses red, green, blue, and yellow segments.

The Nero 4/Crystal 4/Domino 4 projectors all share styling with geometric vents on the left and right sides, and black glass on the back, top, and front of the projector. White glass is an extra cost option. The design, to my eyes, is quite attractive. The black glass on the back of the Crystal 4 SH is hinged. If the projector is right-side-up, it lifts up from the bottom. The glass panel can be propped open or closed if you have cables with 90-degree heads on them to route them down. There is an IEC socket for the power cord. If you choose to replace the supplied AC power cord, something with a 90-degree connector on the projector end would be a big help in being able to keep the hinged rear cover closed completely for a clean-looking installation. There are Ethernet and RS-232 ports on the back for control systems. The HDMI ports are “split” with HDM-1 being a version 1.4 port that will display video up to 3840x2160 at 30 Hz. HDMI-2 is version 2.0a with HDCP 2.2 supporting up to 3840x2160 at 60 Hz. There is a USB-A port that provides power-only for devices like fiber-optic HDMI cable receivers. A second USB port is for service use or for firmware updates, should there be any. There is a connector for SP/DIF TOSlink for audio output only. The final rear panel connection is for the 12 VDC trigger. There is a set of operating control buttons on the back of the Crystal 4 SH as well.

The Crystal 4 SH has four crystal-clear feet. The front pair are adjustable for height. There are four options for how the Crystal 4 SH presents video. Two of those are for rear-projection (low and right side up or high and right side up). The other two settings are for front projection with one supporting a low position right-side up, while the high position supports upside-down mounting in a ceiling mount. I use a rack because projectors come and go with regularity. But the Crystal 4 SH has no option for that positioning. I had to place the Crystal 4S SH upside down on the rack simulating a ceiling mount. This worked fine for the review.

I was a bit surprised that the Crystal 4 SH does not have motorized focus, zoom, or vertical shift. All of these are manual adjustments. The vertical height adjustment is an Allen screw on the “top” of the projector when the feet are “down” on a table. SIM2 ships an Allen wrench for this adjustment with each projector. The Zoom adjustment is a lever on the “bottom” of the projector just below the lens. Focus is achieved by turning the outer-ring of the lens. Those who may want to use zoom, vertical position, and focus with lens position memories to produce constant image height presentations on a 2.35:1 screen cannot do that with the Crystal 4 SH. But all is not lost. SIM2 says their Electronic Perfect Fit (EPF) system can perform this job for those who prefer not to have to use an anamorphic lens. For the review, the projector was set up for a 16:9 screen and that was never changed. The screen used was the 1.0 gain, reference-quality, Stewart Filmscreen LuminEsse StudioTek 100 solid-mounted, minimal-bezel screen. It is 82 inches wide, but viewed at 7 feet, the viewing angle is larger than a 120-inch wide screen at 12 feet.

SIM2 rates the light output at 3,600 lumens. That’s less than the 6,000 lumen rating of SIM2’s Nero 4S with a powerful UHP lamp. The projection lamp can’t be dimmed or even turned off completely for black screens. The single Texas Instruments DMD (DLP) device is .66 inches diagonal and displays 3840x2160 pixels per frame by flashing two half-frames for each full-frame. The lens is

Features—SIM2 Crystal 4 SH Projector

Super high-definition all-glass lens
1-chip DMD (DLP device)
UHD image resolution
4 HDR presets for different screen sizes
Fully automated SDR-HDR-SDR transitions
Full color volume adjustments
Live Color Calibration software (LCC)
1.6x zoom lens
Remote info function (SIM2 Customer Care 4)
Factory light output spec of 3600 lumens
Laser-Phosphor light engine featuring new yellow+green phosphor wheel
4-Segment color filter wheel — RGBY
Connections: IEC power cord socket; one D-sub 15 VGA-type; one HDMI 1.4 up to 3840x2160 at 30Hz; one HDMI 2.0 up to 3840x2160 at 60Hz; Ethernet (command/control); 1 USB (firmware updates); 1 USB for power only; RS-232 (control); one 12 VDC trigger
LAN control for: Crestron, Extron, PJLink, AMX, HTTP, Telnet
IR remote control included
Front and rear IR receivers
Manual controls on back of projector

Specifications

Dimensions: 20 W x 7.125 H x 15.4 D (inches)
Weight: 32 (pounds)
Power requirement: 100-240 VAC; 50/60 Hz
Power consumption: Operating 280-340; maximum 395;
Standby <0.5 (Watts)
Lens Zoom Ratio: 1.6:1
Lens f-number: 2.5 (wide) to 3.26 (tele)
Throw ratio: 1.4:1 to 2.24:1
BTU/hr: 1,350
Lumens: 3,600 (factory spec)
Vertical refresh rate: 24 to 120 Hz
Designed In: Italy
Assembled In: Italy
Warranty: 3 years
MSRP: \$18,000 with black finish; \$19,000 for white finish

Manufactured By:

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Sunrise, Florida 33351
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designed with all-glass elements. The maximum refresh rate of the projector is 120 Hz. As usual, the motion quality of the DLP DMD imager is as good as motion gets in projectors. The universal power supply adapts to 100-240 VAC and 50 or 60 Hz. Power consumption maximum is 395 Watts. In typical operation, power consumption is 280-340 Watts for average movie or TV content.

Some of the laser-phosphor projectors that have been here in the past have had an “extra” noise that stands out from the lamp-cooling fan we hear in conventional projectors. This turned out to be the liquid cooling system with a pump to move the coolant. In those other projectors, the noise was pretty much what you would expect from a small pump moving liquid from one place to another—not very loud, certainly not louder than the fan, but a second noise distinctive from the fan noise. Cooling in the Crystal 4 SH is

accomplished with a large heat pipe that relies on convection. That means there's no extra pump or extra fan needed. So far, I'm not hearing much from the Crystal 4 SH even though it is just 6 to 7 feet behind my seat. It's not 100 percent silent, but it is definitely very quiet.

Projectors have some challenges with HDR because the source material is being mastered at 1,000 nits or 4,000 nits, when a really bright projector produces more like 300 nits. Many consumer-level TVs produce no more than 600 nits, with some below 500 nits. Other TVs are for sale right now with as many as 3,000 nits. All projectors have to deal with this light-output issue. It is not a SIM2 issue alone. How the engineers and designers deal with this discrepancy is one of the primary deciding factors about how good the projector's images look with HDR sources. My initial impressions are that SIM2 has done a very good job of using the available luminance range to produce some fine-looking HDR images. No, they aren't as vibrant as a TV with 3,000 nits. But the projection experience and big TV experience are different. The largest TVs capable of HDR have gotten close to popular projection screen sizes, but their cost is still quite high, even more than a high-quality projector with a five-figure price tag and a screen with a four-figure price tag. For many home theatre fans, it's just not a home theatre without projection, so having entertaining HDR performance is really important in order to remain satisfied with your projector choice for a decent number of years. SIM2 has hit a sweet spot that gives you a satisfying HDR experience that is more impressive than HDR-capable projectors from 2020 or 2019 that I've seen.

SIM2 includes the option to use LCC 4.0 software to calibrate your projector. This software runs on your PC. You connect both the projector and your colorimeter or spectrophotometer to the computer. You can make manual adjustments with the graphic user interface or let the software calibrate the projector automatically.

SIM2 has some customers who are quite noise-averse in the theatres where the projector placement is close to the viewer(s). To make them happy, SIM2 keeps the fan noise quite low. Without the noise of a cooling system, the Crystal 4 SH is one of the quietest projectors that has been here in some time. This is not to say that the Crystal 4 SH is silent in operation, but it is very quiet. SIM2 even includes a laser modulation setting where you can set the maximum output of the lasers from 100 percent to 50 percent. There may be combinations of settings and environment that cause some audible resonances in the high-current driver for the blue lasers. Reducing maximum laser output power can reduce or eliminate the resonances. I have not heard noise from the high-current driver so far, but warmer temperatures that are on the way may reveal something different.

The Crystal 4 SH supports HDR-10 and HLG formats for HDR, and the tuning options are extensive. The settings for Gamma operate in HDR mode and do the same thing Gamma does for Rec.709 content—except UHD video has no gamma. Instead, UHD relies on EOTF (electro-optical transfer function). The Gamma settings make the midrange of both HD and UHD video brighter or darker. SIM2 recommends using the "Video" setting with HD content and the "Film" setting for UHD content. You also have two display modes for HDR-10 called HDR and BrightHDR. SIM2 recommends BrightHDR for most theatres, but it's nice to have options. For HLG sources, you have HLG mode and BrightHLG mode. For HD content, you have Dynamic, Bright, Cinema, Sport, Natural.

There is also a User mode that can be set up for anything special the customer needs.

The Sharpness control produces artifacts even when set as low as "2". I left it on its lowest setting "1" for all content. Another control called Detail Enhancer does enhance edges, and as long as you are conservative with your setting, this option does what it sounds like it should do without artifacts as long as you stay with medium or low settings. Calibration controls include: hue, saturation, and luminance for the primaries and secondaries; and RGB Gain and Bias. Color Temperature settings have useful names like D55, D65, D75, D82, D93, and Native.

Something about the way SIM2 approaches video projection and writes about it on their Web site, in emails, and in the Owner's Manual causes me to not be so obsessed with what is accurate (the engineer-technical side of me) and just relax and enjoy the lyrical images SIM2 projectors produce using their video-as-art sensibility. Most of the settings SIM2 offers that other manufacturers haven't, so far, delve into the art of the image rather than being purely for accuracy. This is a little different than the usual projector that's distinctly just-the-facts. There is something about the Italian way of doing things that turns out products people say are imbued with more passion than products from other countries. I'm not sure that's exactly what it is. For the Crystal 4 SH projector, the feeling is close to seduction by art instead of a single hard-focus point on accuracy. This produces a sense of relaxation that is enhanced by high-quality motion compared to LCD/LCoS options. The black levels for this DMD are the best I've seen from a DLP video display. It is getting difficult to understand exactly what the real black level of a video display is these days because manufacturers are getting so good at developing light engines, like the laser-phosphor light engine in the Crystal 4 SH. These new light engines based on LEDs or lasers, or both in some cases, allow the projector to raise and lower the brightness of each pixel. The Crystal 4 SH has an observable black level that is not pure black in the bars at the top of 2.35-2.40 aspect movies on 16:9 screens. But when you select the right combination of settings in the Setup menu, when the entire movie or TV image goes to black, the room is plunged into 100 percent deep, dark, total black. If you don't want the room or the screen to get that dark, other settings avoid that total blackout on "black frames" in TV or movies.

The lens used in the Crystal 4 SH has a 1.6x zoom range, a bit smaller than the zoom range in the Nero 4S projector (2.0x zoom range). In my room, the Crystal 4 SH wanted to be a couple of feet closer to the screen than other projectors I've used with five-figure price tags. This is almost inconsequential, though. Once you set up the projector, this is not something you will even think about. But you may need to plan a bit. I usually position projectors about 15 feet from the screen. The Crystal 4 SH needed to be closer to 13 feet in my setup. The provided remote control works well. It is strongly backlit and activates when you press any button. There is a Light button that will turn on the backlight without sending a signal to the projector. The 28-button remote includes buttons to access a number of settings without having to navigate menus. The menus themselves can be set to time out automatically and disappear or to never disappear until dismissed with the remote control. **WSR**



SIM2 Crystal 4 Sh

SuperHybrid Laser-Phosphor Projector

Part 2

Doug Blackburn

In Part 1 published in the previous issue, Issue 255 May/June 2021, of *Widescreen Review & Custom Home Theatre Design*, details about the design and operation of the Crystal 4 Sh were described in detail. A quick summary: At \$18,000 (in black with black glass, \$19,000 in white with white glass), the Crystal 4 Sh is more than 50 percent brighter than Sony's VPL-VW885ES, a \$25,000 laser phosphor projector that was recently discontinued after a near 2-year production run. The Crystal 4 Sh has a new-generation, laser-phosphor illumination system. The final hardened phosphor coating on the phosphor wheel is formed from combined and mixed green and yellow powdered phosphors. Previously, all home theatre laser-phosphor projectors only had yellow phosphors on the phosphor wheel. The new formulation produces more green light and expands the color gamut the Crystal 4 Sh can reproduce. One segment of the spinning phosphor wheel is transparent to allow blue light from multiple lasers to be used in the creation of images. Green and red light are separated out of the green and yellow light produced by the phosphor wheel. The design of the Crystal 4 Sh incorporates an air cooling system for this new illumination system so it does not have the additional noise of a liquid coolant pump operating at the same time as the traditional cooling fan. That makes the Crystal 4 Sh the quietest laser-phosphor projector I've experienced. The Crystal 4 Sh projector has the latest Texas Instruments DLP chip set for projectors. It has half the pixels of UHD resolution, but the pixels are

the proper size (small) so the two-flash-per-frame system produces a visible pixel grid on screen with pixels as tiny as pixels from any projector with native UHD imagers. Getting all that luminance and tech into a projector they can sell for less than \$20,000 meant leaving out motorized control of lens functions. Focus, zoom, and vertical height are all manually adjusted. The visually appealing styling of the Crystal 4 Sh makes it almost a piece of art to look at even before it makes images.

After hundreds of hours of viewing content, making measurements, and discussing projector design issues in the age of UHD and HDR with Domenico Toffoli, the character and value of the Crystal 4 Sh have become very clear. A general summary would be that for HD content in standard dynamic range, the Crystal 4 Sh can deliver near perfection in measurements with all the "fancy stuff" turned off. Of course operating the Crystal 4 Sh that way reveals that the black level of DLP projection is less-black than projectors with LCoS imagers. But you don't have to settle for a gray-ish black level. SIM2 has added features that modulate the lasers to allow darker blacks without compromising the luminance of images. As you use SIM2's settings designed to improve the appearance of images in regards to black level, color, detail, motion, and dynamic range, traditional measurements can't reveal the subjective image quality improvements these settings provide. This "wow" factor in images is not possible without using the adjustments/settings available in the Crystal 4 Sh.

When you use the projector with UHD/HDR sources, the “all adjustments off” configuration produces fairly typical measurements for UHD/HDR from any projector. But as with HD content, SIM2’s combination of image-improvement settings push the projector’s image quality to levels much higher than the “no enhancement settings” mode required to make measurements. For UHD/HDR content, there are no standards set for how projectors should “behave” with their limited luminance range compared to flat panel TVs. Manufacturers usually provide controls and settings that are “safe” so that you never experience a momentary “oops” during challenging content. Projectors that produce only “safe” images look boring for the other 99.9 percent of content by comparison.

The closest thing to compare SIM2’s image enhancement settings to are high-performance exotic cars with a range of computer-controlled features that make people who can’t drive like a racecar driver relatively safe while traveling at potentially deadly high speeds—hopefully, on a race track rather than on streets. You can disable these safety enhancement features for fast driving on a race track or turn them all on for “daily driving” comfort and safety. The exotic car with driver-assist settings keeps the driver safe, even if they are not very good racecar drivers. Turn off all the settings that keep you safe in cars that can exceed 200 mph and a well-skilled driver can have the most fun with the car. But there are no safety nets if the driver makes a mistake with all the driver-assists disabled. The Crystal 4 Sh allows you to make settings that are so “strong” they make UHD/HDR images look much better than most projectors, but challenging video content can reveal a “defect” that only happens because SIM2 pushes the envelope to make the most of UHD/HDR content within the limited luminance range you get with projectors. That doesn’t mean the projector is broken or compromised. It merely means that the specific content you are viewing is just a bit too challenging for the more aggressive settings in the projector. “Turning down” one or more settings to make them less aggressive allows you to still use the feature but bypasses the problem seen with a higher setting. Not only did SIM2 engineer these controls to push the envelope to make UHD/HDR images look great on their projector, they put a lot of thought into making the projector brighter than many competing laser-phosphor projectors. The result of that extra luminance and the settings that may not give the very best results with the most extreme scene content is that 99.9 percent of the time, the UHD/HDR images you get with the Crystal 4 Sh projector are better looking than projectors that always play it safe with controls to improve the appearance of UHD/HDR content. Remember, there are no standards for UHD/HDR on projectors, so each projector manufacturer should be working out how to make UHD/HDR look as good as possible on their projectors. SIM2 accomplished that with the Crystal 4 Sh. Other manufacturers’ projectors that I’ve reviewed have always been very boring when viewing UHD/HDR content. The Crystal 4 Sh *never* makes boring UHD/HDR images. An example of this will help clarify my point. There are two controls that SIM2 has engineered to improve the black level substantially compared to just the basic settings: SuperHybrid Mode and Auto Adaptive Contrast. Improving perceived black level isn’t all these settings do, but I’m going to focus on that for this example. Auto Adaptive Contrast changes image contrast based on image content and it can be set to On or Off. SuperHybrid Mode controls how much laser modulation can be used to darken or brighten the lasers. SuperHybrid mode’s settings are Off, Standard, Enhanced, and DeepBlack. When set to off, the lasers never dim making projected UHD/HDR images boring. Both settings work together to do their best to expand the apparent dynamic range in projected images. With these two enhancement settings set to my prefer-

Features

Super high-definition, all-glass lens
1-chip DMD (DLP device)
UHD image resolution
4 HDR presets for different screen sizes
Fully automated SDR-HDR-SDR transitions
Full color volume adjustments
Live Color Calibration software (LCC)
1.6x zoom lens
Remote info function (SIM2 Customer Care 4)
Factory light output spec of 3600 lumens
Laser-Phosphor light engine featuring new yellow+green phosphor wheel
4-Segment color filter wheel -- RGBY
Connections: IEC power cord socket; one D-sub 15 VGA-type; one HDMI 1.4 up to 3840x2160 at 30Hz; one HDMI 2.0 up to 3840x2160 at 60Hz; Ethernet (command/control); 1 USB (firmware updates); 1 USB for power only; RS-232 (control); one 12 VDC trigger
LAN control for: Crestron, Extron, PJLink, AMX, HTTP, Telnet
IR remote control included
Front and rear IR receivers
Manual controls on back of projector

Specifications

Dimensions: 20 W x 7.125 H x 15.4 D (inches)
Weight: 32 (pounds)
Power requirement: 100-240 VAC; 50/60 Hz
Power consumption: Operating 280-340; maximum 395;
Standby <0.5 (watts)
Lens Zoom Ratio: 1.6:1
Lens f-number: 2.5 (wide) to 3.26 (tele)
Throw ratio: 1.4:1 to 2.24:1
BTU/hr: 1350
Lumens: 3600 (factory spec)
Vertical refresh rate: 24 to 120 Hz
Designed In: Italy
Assembled In: Italy
Warranty: 3 years
MSRP: \$18,000 with black finish; \$19,000 for white finish

Manufactured By:

SIM2 USA Inc.
10216 NW 47th Street
Sunrise, Florida 33351
Phone: 954 442 2999
Web site: SIM2.com

ence (On and DeepBlack), some content that has very dark scenes can suddenly go very black with very little image still visible. This happens because the largest adjustments can “stack up” and may push the projector so far that there just aren’t enough digital levels and laser modulation available to reproduce the most demanding scenes without fail. Some might argue that that’s a design error, but they would be wrong. It was not a mistake on SIM2’s part to offer settings that push the envelope to improve most UHD/HDR images so much that you never want to watch them without these two features doing as much as they can. It was actually brave and strategic for SIM2 to let you use aggressive enhancement features like these. If you want a “safe” projector that you can’t push into problems with any settings, there are plenty of these on the market already. All of them are boring and make you question whether you should be using a projector for UHD/HDR content. SIM2 intentionally made the enhancement set-

SIM2 Crystal 4 Sh SuperHybrid Laser-Phosphor Projector Part 2

things work so well that with some of the most demanding content, like the previously mentioned very dark scenes, you actually “run out of room” for digital steps and control of the lasers at low luminance output. So when the scene goes very dark, almost completely black, while you are using DeepBlack mode, it is not a sign of a “bad projector” it’s just a sign that the biggest adjustments the projector can make are a little bit too big for the scene you are watching now. The next movie or TV show may be fine all the way through with DeepBlack. SIM2 could have chosen not to offer DeepBlack. That would make the projector “safe,” but it would also make the projector’s images boring compared to the images you get with Auto Adaptive Contrast On and SuperHybrid Mode set to DeepBlack. To view the extra dark scene properly, setting SuperHybrid Mode to Enhanced did the trick for me every time. If there were not a lot of dark scenes in the content, DeepBlack was fine.

I use an OLED TV and a 2000 nit LCD/LED TV to view a lot of UHD/HDR content so I have a good “fix” on what UHD/HDR images *can* look like with properly bright displays. This makes it easy for me to determine whether a projector is delivering on the promise of UHD/HDR or whether the images are barely better than SDR. I constantly found myself using the DeepBlack setting for SuperHybrid Mode because during scene transitions, the screen will go completely black giving an impression of “infinite black” because there is no visible black level during an all-black scene transition. When I switched to Enhanced mode or Standard mode, the black level would move up to an obvious dark gray and the completely black screen during scene transitions would no longer be perfectly black. The DeepBlack setting brings out life in images that you don’t normally get from projectors due to the limited luminance of projectors compared to flat-panel TVs. I would always start a movie like *Valerian And The City Of A 1000 Planets* or *Kingsman: The Golden Circle* with the DeepBlack setting and only change the DeepBlack setting if there was more than a couple of seconds of “trouble” in a movie. The Crystal 4 Sh is the high-performance exotic car of the projector world. It will keep you “safe” when you use all the controls in their “safe” modes. But as you use more and more of the image enhancement settings, the experience of viewing UHD/HDR images becomes more and more exciting. Of course, a bad driver who turns off all the driver-assist settings that keep him safe can die in a crash. With the highest performance settings active, the Crystal 4 Sh can only get you into a little trouble in the highlights or shadows, so nothing disastrous. The Crystal 4 Sh would have been just another boring projector for UHD/HDR without SIM2’s brave decision to let the operating range of the controls create some visible problems with some content. With DeepBlack and Auto Adaptive Contrast, the Crystal 4 Sh has the best-looking and least boring UHD/HDR images I’ve seen from any projector so far.

Consider that projection still has no standards established for UHD/HDR, and it’s possible that there may never be official standards for projection and UHD/HDR because of the vast difference in luminance between even OLED TVs and projectors. Most OLED TVs’ peak white level is 600 nits or thereabouts. The Crystal 4 Sh can deliver up to 140 nits, close to 40 foot-Lamberts (fL), on an 82-inch wide screen with 1.0 gain depending on your zoom setting/projection distance. That’s brighter than any projector I’ve used under \$20,000. That amount of brightness/luminance gives the Crystal 4 Sh another big advantage over projectors with less luminance capability. Even if another projector had “edgy” control

settings like the Crystal 4 Sh, it would be outputting less light and, for that reason alone, the UHD/HDR images would be less impressive on the dimmer projector.

In HD/SDR mode, there are a number of picture mode options: Natural, Dynamic, Bright, Cinema, Sport and User. Natural and User seemed to be either identical or very similar. Cinema was a little different but still close to Natural and User. For UHD/HDR content, the only setting options are HDR or Bright HDR. SIM2 recommended BrightHDR and I concur. The additional luminance of BrightHDR makes HDR images look much more alive and satisfying.

The Crystal 4 Sh supports HDR10 and HLG modes for HDR content. While I will focus on settings for HDR10 content, in several places SIM2 offers settings specifically for HLG. The installer/calibrator will be able to dial in both modes and use combinations of settings optimized for both methods of delivering HDR content. HLG is not too common in the United States’ streaming services, where you find HDR10 dominates with some Dolby Vision and some HDR10+ beginning to appear. There are no issues viewing content with Dolby Vision or HDR10+ because both of those formats are designed to play properly in HDR10 mode when DV or HDR10+ are not available.

There is an HDR setting with a number of choices that alter the EOTF curve, not to make it more accurate but to make adjustments that make images look better in spite of the luminance limitations of projectors. There are also modes that are labeled as being for screens larger than a specific dimension. These modes include: Auto (selects between HDR1, 2, 3, or HDR4 modes based on content); there is a forced SDR setting just in case; HDR1 mode is for smaller screens (SIM2 says 100 inches) or screens with some gain and with the projection lens set to wide angle mode. HDR2 does the same for images on a 120-inch wide screen; HDR3 mode is optimized for projection screens up to 140 inches; HDR4 is for projection screens 160 inches or larger.

The basic settings were generally fine where the factory set them. Sharpness was best when set to the lowest setting, “1.” There is a Gamma control that turned out to be useful in both HD/SDR where there really is a Gamma curve and UHD/HDR where Gamma as we knew it from HD/SDR and earlier does not exist, but this control still does in UHD/HDR mode what it does in HD/SDR mode. That is, it anchors the gamma curve at 0 percent white and 100 percent white and moves luminance up and down without moving the white point and black point. This produces the largest changes in the midtones. Higher (numeric) Gamma Settings make midtones darker while lower Gamma settings make midtones brighter. It may seem odd to have the Gamma control functioning in UHD/HDR mode, but it can actually be useful in some cases. Gamma settings include: Film; Video (nominally 2.6 gamma, darker midtones); Graphics (not useful for home cinema); Standard (nominal 2.2 gamma); and numeric settings labeled 1.8 (very bright midtones), 2.0, and 2.4. SIM2 recommended using the Gamma-Film setting for UHD/HDR and the Gamma-Video setting for HD/SDR mode. I took that advice and saw no need to use different settings during the review. Some gray scale tweaks were needed during calibration, of course, but Film (UHD) and Video (HD) settings were good starting points.

The Crystal 4 Sh has the DLP Brilliant Color™ setting with customization by SIM2. This is an On/Off setting, and SIM2 says that it enables a color-processing algorithm that enables higher image brightness than other color enhancement settings. That’s especially useful in UHD/HDR mode to help keep images as bright as pos-

“The Crystal 4 Sh Never Makes Boring UHD/HDR Images.”

sible. If the movie you are viewing is already very colorful, like *Aladdin* (2019) or *Spider-Man: Into The Spider Verse*, this setting is probably not going to be very appealing. But you may find times when you enjoy using this setting when the content is less obviously vibrantly colored. The difference between On and Off is fairly significant. I think most anybody looking for this setting's effect on images won't have any trouble seeing what it does when turned on. I used this setting sparingly during the review. Most of the content I viewed in UHD/HDR was already colorful. For HD/SDR content, I preferred the more subtle changes available with the Enhanced Color setting.

The Color Temperature setting is quite similar in function to most every projector I've used in the last five years or so. There are settings for: D55, D65, D75, D83, D94 and a Native setting. The Native setting produces the largest color shift, but it is also pretty obviously one of the settings to use if you are looking for the absolute maximum amount of light the projector can produce (along with Dynamic Picture Mode). You won't get the best-looking images because of the “off” color you get with Native mode. I can't recommend using Native mode for anything, but it is there for experiments if you think you would ever go that far with a projector. D65 was certainly closest to D65, but it measured a little too blue, around 6800-6900 degrees K. Using the internal calibration controls easily got the D65 mode measurements into the 6400-6600 range, nicely balanced for both HD and UHD content.

A Color Gamut setting is useful for putting the projector into the best color mode for various purposes. Native mode produces all the color the projector can produce natively without calibration or concern for image accuracy. This is not a mode people would normally use for viewing home video content from any normal source. HDTV mode would be the setting for viewing normal home theatre content from most any “normal” source for home entertainment. LCC mode is exclusively for use with SIM2's Live Color Calibration software that runs on a Windows PC connected to your Crystal 4 Sh. You must provide a compatible light meter for the measurements. So this is another mode that would not be used for viewing normal entertainment content. User mode is the best choice for calibrated Crystal 4 Sh projectors, as User mode will use the gray scale and color CMS adjustments. Cinema mode closely replicates DLP Cinema color that has a different white point (more green) than the standard for home video contents. Unless you are viewing DLP Cinema content at home (very unusual), this mode will not be used by most owners. SIM2 notes in the Owner's Manual that you can achieve the original factory calibration settings on a new Crystal 4 Sh projector by selecting the HDTV color gamut, Natural for the Display Mode, HDR or HLG or SDR mode, Color Temperature D65, and the 2.2 Gamma setting. I found that combination to be a very good starting point, and many owners would be perfectly happy with that factory result as long as their projection screen does not introduce a color shift.

SIM2's CMS controls rely on the x and y coordinates on the CIE

chart to set the color. The x Offset control generally moves the color left or right on the CIE chart. The y Offset control generally moves the color vertically on the CIE chart. As with all video displays, sometimes the measurements “drift” a little in unwanted directions, but for the most part, you can get each color quite close to the reference coordinates for each color, even in the larger UHD/HDR color space of DCI/P3/Rec.2020. My color calibration results produced almost 100 percent of the color gamut for UHD/HDR content when calibrated, a pretty spectacular result. For Rec.709 color space, the Crystal 4 Sh had no trouble reproducing 100 percent of that gamut with extremely low errors. A third CMS control is called Brightness and it does a good job of keeping color luminance accurate as you make adjustments to x and y Offsets. At times, I found myself kind of “circling” the reference point I was trying to hit during calibration before spiraling into the perfect measurement over several iterations of x, y, and Brightness adjustments—nothing too different from most video display calibration controls.

The Crystal 4 Sh gray scale calibration controls are called RGB Gain/Bias. This is a very typical two-zone gray scale adjustment with Gain controls adjusting the gray scale from about 30 percent white to 100 percent white. The Bias controls adjust gray scale from 0 percent white to about 70 percent white. If you need or want more precise gray scale calibration, use an external video processor with 20 or 21 point gray scale adjustments and/or a 17x17 or larger LUT matrix that corrects color and luminance of gray scale and RGBCMY throughout the 3D color space. An extra \$5,000 or so for a Lumagen Radiance Pro video processor or equivalent can produce uncannily accurate gray scale and color, though, it would take a pretty picky owner to notice the difference between a “perfect” video processor calibration and using the internal controls in the Crystal 4 Sh. I don't think you “need” a video processor to make the Crystal 4 Sh projector a good projector. But the picky owner may find the results of the Radiance Pro calibration quite nice.

SIM2's Color Space control was left in Auto mode during the review with no reason to change it to anything else. The other settings are forced RGB 0-255, forced RGB 16-235, and YUV (aka YCbCr). Unless you run into trouble with color looking very strange (very green and very magenta with no blue or black is one example), there's no reason to set the Crystal 4 Sh to one of the “forced” modes.

There is a group of controls for control of analog video signals coming to the projector as RGB or Component video. In 2021, not many people will need these settings for most home theatre systems that are “all digital.” But someone who is a “format collector” may still have video tapes, D-VHS, LaserDisc, or other analog video formats that need a little help here or there. That's where these controls could come in handy. The controls allow adjustment of frequency, phase, horizontal position, vertical position, or Automatic for times when you don't need specific settings.

SIM2 Crystal 4 Sh SuperHybrid Laser-Phosphor Projector Part 2

SIM2 has provided an adjustment for HDMI Equalization that defaults to a setting of “4”. This setting applies EQ to the incoming video signal. Cable length is one of the primary reasons you might want some EQ applied to the video signal. If you do experience a problem that might be related to signal EQ, you can try each of the EQ options to see if any of them improve your problem.

For times when you want to intentionally limit the light output of the projector, there is a Laser Modulation setting that allows you to set the laser from 50 percent power to 100 percent power in 5 percent steps. This specialty control won't be used in most home theatre systems, but it's there for the few installations where it is needed.

There is an Advanced settings sub menu that contains several more controls that influence image quality. Enhanced Detail settings are Off, 1, 2, and 3. I found the 3 setting looked “over-processed” often enough that I most often used the 1 setting to avoid seeing anything obvious happening to images. The 1 setting produces a gentle edge enhancement that does not lead to artifacts like those you get from the Sharpness control when it is set above 1. I found the trick to using this control is to pause a sharp image in a movie or TV program then adjust the control so you can see what is happening in the stationary image as you change from Off to 1 to 2 to 3. I think most picky users will be good with 1, while some will be fine with 2.

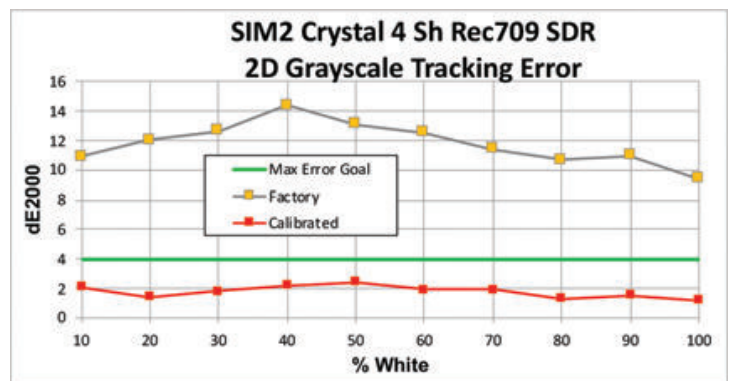
The Enhanced Colors control in the Advanced settings menu is similar to Enhanced Detail. Settings are Off, 1, 2, and 3. Here, too, pausing an image with lots of colors in a range of luminance values will help you decide which setting you prefer. This is the setting I mentioned that I preferred to the Brilliant Color setting for HD/SDR content. I would leave Brilliant Color Off and set Enhanced Colors to 1 to get a small boost in color. For UHD/HDR content, SIM2 says Enhanced Color will reduce the available light, while the Brilliant Color function will enhance colors without loss of overall luminance.

The final setting in the Advanced Settings menu is Motion Compensation. This is frame interpolation. Using this setting introduces input lag that gamers will hate. So, off for gaming and on for movies or TV shows. DLP projectors have enjoyed the best motion quality performance of any digital video imaging system for over a decade since color wheel artifacts have been banished for the most part. So why do DLP video displays need Motion Compensation/frame interpolation? Because 24p and 30p video sources are naturally blurry because of slow shutter speeds. Frame interpolation takes two blurry frames and can make a “third” or “fourth” or “fifth” image that moves over the screen in smooth increments that are all sharper than the original frames with the blurred motion. A basketball flying through the air looks like a comet on the original video because 24p or 30p is NOT enough to follow fast motion without blur. 240p would be close to fast enough to eliminate motion blur in the original content. So think of this control as improving the original content, not as a fix for motion problems in the video display. But the “I hate soap opera effect” crowd doesn't understand that “soap opera effect” is nothing but the effect of more frames per second and less blur in each frame. 24p is a *horrible* standard for video and some day with enough bandwidth and commitment from studios, we will FINALLY get away from slow frame rates forever and people will ask, “How the heck could anybody back then tolerate that horrid blurry motion while complaining about images with less blurry motion?” 24p arose in the 1920s/1930s. It is past time to move on to something faster.

48p and 60p have been discussed most often as being the next video standard. Once there's enough bandwidth for 48p or 60p, video will move into its next big transition period on the way to better video than we have ever experienced. Frame interpolation has become rather magical in what it can accomplish to ban motion blur from the sources. It is quite possible that frame interpolation will remain with us, even after video moves on to 48p or 60p since it can still make those higher frame rates look even more clear/sharp.

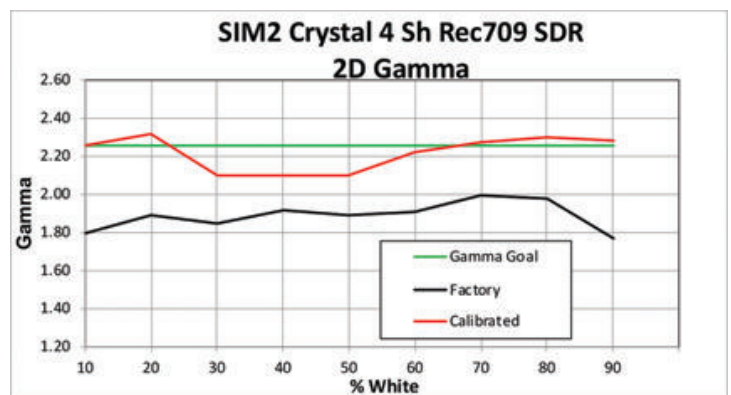
Measurements

The initial gray scale errors in Figure 1 may look bad on this graph, but most of that error was excess blue causing the color temperature to measure in the 7200-7600 degrees Kelvin range.



Most people without calibration software and a meter would not notice the extra blue. Of all the errors to have, a little extra blue “disappears” as content is viewed. Adjusting the gray scale with the Gain and Bias/Offset settings to remove the excess blue produced excellent gray scale accuracy. The RGB Balance graph (not shown here) also looked good with colors staying within +/- 2.5-percent of perfect color balance through the gray scale from 5 percent to 100 percent.

Figure 2 shows the Gamma measurements for the Crystal 4 Sh. You can see that the projector was initially a bit brighter than ideal with gamma averaging about 1.85. While that's not ideal, it is very difficult to detect in moving images without a side-by-side reference. The ending gamma averaged very close to 2.2. I could

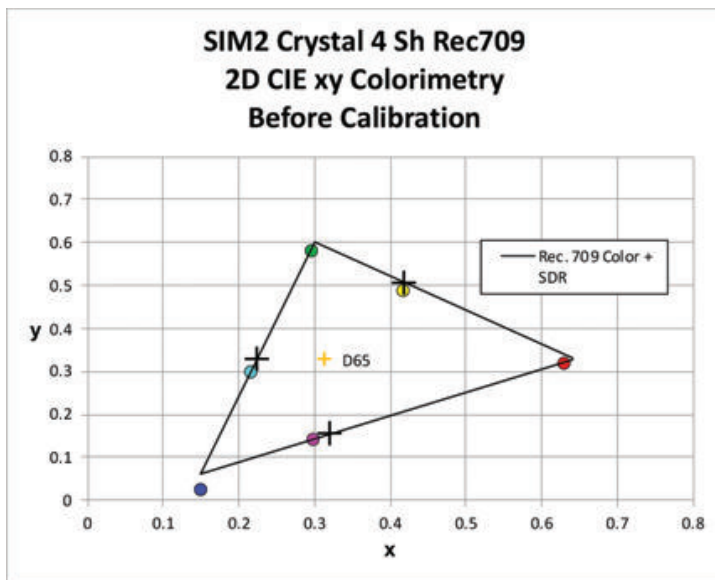


move the calibrated gamma darker or lighter easily with the Crystal 4 Sh's Gamma setting. I used the setting of 2.2 for calibration and was able to achieve that easily with the calibration controls.

Color Temperature before calibration ranged from 7225K to

7567K due to the extra blue in the uncalibrated projector. As mentioned above, this plus-blue error is small enough that most people would never notice it. After calibration, I was able to get the measured color temperature to stay in the range of 6382 to 6757. Errors that small are inconsequential to video image quality.

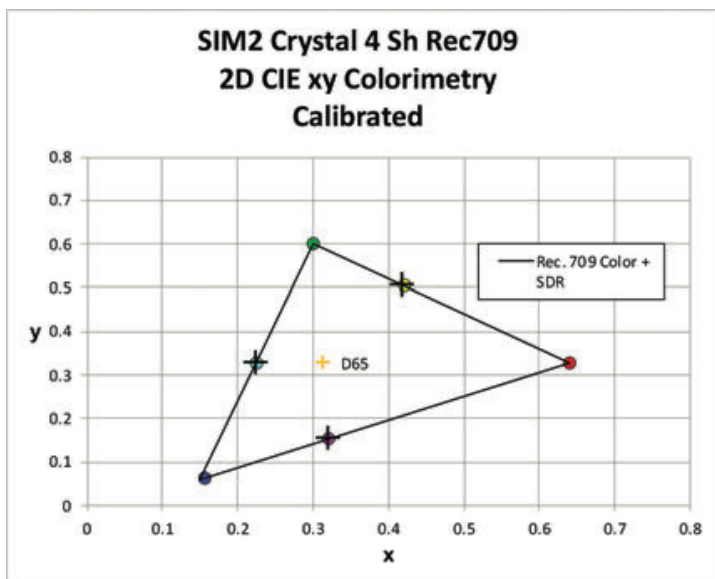
The before calibration color measurements in Figure 3 show all six measured colors (RGBCMY) offset towards blue, and blue itself is oversaturated. This is reflected in the initial color temperatures and the ΔE_{2000} gray scale chart also. Ideal performance for RGB using this graph is when each color is precisely on top of the three points of the triangle. The secondary colors should be perfectly



centered on the + symbol marking the reference coordinates for CMY.

After calibration, colorimetry is very nearly perfect. Not much to say about this other than this is a great result.

I decided for this review, and potentially for all future reviews of projectors, to not include measurements for UHD/HDR content due to those measurements and standards not being intended for projectors. As mentioned earlier, on my 82-inch wide 1.0 gain reference screen, Stewart Filmscreen's StudioTek 100 screen material, I measured about 140 nits or 40 fL for peak white in UHD/HDR



mode after calibration. The projector will produce more light than that, but you have to use some of the less accurate settings like Dynamic mode, and that ultimately makes the images look worse. UHD/HDR projector measurements as we know them today, would *never* be able to reveal what I was seeing on-screen with DeepBlack Super Hybrid mode and Auto Adaptive Contrast enabled along with some of the other settings that also do things to enhance the appearance of UHD/HDR images. Measuring the projector with those, and other controls in operation would just be a waste of time. Since there are no standards for projecting UHD/HDR due to the lower light output than flat panel TVs, there are no measurements that correlate with the compelling UHD/HDR images I got from the Crystal 4 Sh. I wish I had measurements that would show you why I found the UHD/HDR images from the Crystal 4 Sh to be more captivating than other high-end projectors. When the projector is producing these great UHD/HDR images, it is analyzing each frame of the source video and deciding how to change that image to make it look really great. The next frame will have different adjustments... and so on as the content changes. We just do not have means of measuring video that is being altered in each frame specifically to make it look impressive on a UHD/HDR projector. When you don't process the video frame by frame and just display the unaltered content; well, nobody wants to view unaltered UHD/HDR on a projector because it looks dull and uninteresting. The settings SIM2 includes here are where the UHD/HDR magic lives in the Crystal 4 Sh projector.

Conclusion

The Crystal 4 Sh projector is expensive, but it is also the first projector I can say showed me UHD/HDR content that was satisfying after being familiar with UHD/HDR on OLED and LCD/LED TVs. Other laser-phosphor projectors did so little to make UHD/HDR images look good that I was beginning to wonder if I was going to ever see a UHD/HDR projector that would make me want to watch UHD/HDR content. The Crystal 4 Sh is that projector. If you are committing to projection in your home theatre, and you want images that will make you smile, the Crystal 4 Sh projector is the projector that can do it. The super-quiet operation of the projector is an added bonus. DLP motion quality outshines anything you'll get from LCD or LCoS projectors. And with 3200 lumens of peak light output, the extra brightness the Crystal 4 Sh can produce is another advantage when making satisfying projected UHD/HDR images. For a high-performance home theatre system, you can't do better than the Crystal 4 Sh projector in 2021. **WSR**

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