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# Lumagen Radiance XD

## Video Processor

Doug Blackburn

### Introduction

Lumagen is one of those small companies that demand your respect for what they've been able to accomplish in just eight years in business. Their products set a very high standard for the entire home theatre market. It's remarkable that a small team is able to design and manufacture a product with the nearly endless capabilities of the Radiance XD. This \$4,995 MSRP product does far more than the \$20,000+ line doublers and scalars of yore. I am in awe of what the Radiance XD achieves on a daily basis... the problems it solves and the improvements it makes. All is not absolute perfection, as you will see, but the weaknesses usually have workarounds and really don't interfere with getting the best possible images within the capabilities of your display. It's really more than that, though, the Radiance XD will take your display to levels of accuracy it can't achieve on its own. The relatively compact physical size and very modest electrical-power needs are a surprise in a product so laden with features and flexibility.

The Radiance XD is the Swiss Army Knife of video processors. It will: switch video and audio; convert video formats; de-interlace; provide excellent 24p support; stretch or zoom (both programmable); support an anamorphic lens; fix common problems in SD sources; function as a video signal generator; parametrically adjust gray scale and gamma; ensure you get the right color space and color-decoding matrix for every resolution; support all video formats in common use, including some not often found in home theatre systems; drive two video displays; and much more. I encourage you to have a look at the features list and let it all sink in. There are so many selections and options that it won't be possible to cover everything in this review.

Lumagen decided to not simply pick what they thought was the best video-processing chip on the market and build a product around the chip. They actually evaluated chip capabilities and their own in-house skills and capabilities and only used the chip if the results were as good as or better than their own proprietary processes. They then combined the best functionality of the chip, a Sigma Designs (previously Gennum) VXP, with the best of their own processing capabilities, such as their proprietary No-Ring™ scaling that prevents halos around transitions common with conventional upconversion. Something to keep in mind with video processor chips is that everybody who uses

video chips picks what capabilities they want to use. In some products, you get maybe one third of the chip's capabilities. Sometimes you even get capabilities enabled incorrectly. While everything has not been perfect 100 percent of the time, Lumagen is remarkably responsive to correcting problems, improving functionality, and adding new capabilities via firmware updates.

While the Lumagen Radiance XD can be useful to an owner who is not equipped with calibration tools and software, its real reason for existence is to enable precision calibration of any video display using good calibration tools. It would be a waste of technology to use the Radiance XD only for switching and up-conversion without taking advantage of the calibration potential. You'd be missing out on some of the best things the Radiance XD can do for you.

### Setup And Owner's Manual

It may seem early in the review to start picking on the Radiance XD, but the biggest obstacles owners and calibrators need to overcome are the owner's manual and menu system. The first thing you notice is that the owner's manual isn't nearly as large as you might expect for a product with all the complexity of the Radiance XD, just thirty 8-½ x 11 pages covering setup, configuration, and calibration. This can be attributed to explanations being very "thrifty" word-wise and to the lack of any illustrations, once you get past setup and connection options. For the technically astute, most of the thrifty wording is perfectly adequate, most of the time. The manual is full of mind-numbing strings of menu navigation sequences like Menu>Output>Configs>ConfigX>Color Mgmt>Gray/Gamma>11 points>Point 1>IRE. This happens to be the menu navigation sequence to get to the parametric gray scale adjustment, where you may wish to change the standard 10 percent gray scale step to some other value like 5 percent or 11 percent. Admittedly, this is one of the longest button-press sequences you will encounter, but it doesn't reveal that moving those nine "steps" requires at least 20 button-presses on the remote. It's rather amazing that these thirty pages contain so much useful information. I was expecting major issues trying to use the Radiance XD, but half or more of everything is obvious enough to an experienced calibrator that the manual isn't even needed. Just navigate through the menu system. When you do need an explanation, the manual is clear enough on most points to get you going. Only a few times was more help needed. A downloadable

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The vast majority of ISF dealers are custom installers who specialize in complete system integration. Their services routinely include not only video calibration, but acoustic Real Time Analysis, room treatments and total system control

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# EQUIPMENT REVIEW

## Lumagen Radiance XD Video Processor

### SPECIFICATIONS

#### Features

- 6 HDMI inputs (audio and video supported for all 6)
- 2 HDMI outputs
- 4 Component inputs supporting SD and HD
- 4 S-Video inputs for NTSC or PAL
- 4 Composite inputs for NTSC or PAL
- 4 stereo analog audio inputs
- 1 RGBHV input using 1 component and 2 composite inputs
- Up to 4 RGBS or SCART inputs using 1 component and 1 composite input
- 2 TosLink optical digital audio inputs
- 6 coax digital audio inputs
- 2 coax digital audio outputs
- 10-bit video processing
- Lumagen proprietary "no ringing" up-scaling
- Video processing is partially Lumagen proprietary processing and partially Sigma Designs VXP processing
- 4 selectable memories for each input
- 8 selectable output resolution memories
- Supports 2-2, 3-2, and 3-3 pull-down for SD and HD film sources
- Per-pixel SD/HD de-interlacing
- Adaptive diagonal filtering
- MPEG compression noise reduction (mosquito and block)
- Temporal noise reduction for HD and SD sources
- Output resolutions selectable from 480p to 1080p
- User programmable non-linear stretch mode
- True Zoom with multiple 5 percent increments (non-distorting)
- Input aspect ratios supported: 4:3, Letterbox, 16:9, 1.85:1, 2.35:1 and non-linear stretch
- Output aspect ratio programmable from 4:3 to 2.35:1
- Anamorphic lens support
- Automatic NTSC, PAL, and SECAM detection
- Extensive internal test patterns
- Parametric gray scale adjustment
- Parametric Gamma calibration
- Programmable color space for inputs and outputs
- Two 12v Trigger outputs
- Programmable Y/C delay
- Up to 7.1 audio at 96 kHz
- IR and RS-232 control
- LVTTL IR format command input
- Universal power supply – input 100 to 240 VAC 50/60 Hz; output 12 VDC @ 5A
- Options: rack ears
- Regular firmware updates include bug fixes and new features (serial cable included for updates)

#### Specifications

- Power consumption – 24 watts operating
- Weight – 11 pounds, 16 pounds shipping weight
- 17 W x 10 D x 3.75 H in inches
- Warranty – one year, parts and labor
- MSRP – \$4,995

#### Manufactured In Oregon By:

Lumagen, Inc.  
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Beaverton, OR 97006  
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saves many button presses, but you still need to navigate many levels back down to where you were working to move on to the next step. And completing the Save requires pressing OK three times. This seems excessive for an operation that needs to be done so often during calibration/setup so you don't lose your progress. The photo of the nested menus shows the header/title for each menu pane. You can see that the Color Gamut menu is five levels down from the top level, and you are about ready to select a primary or complementary color to adjust. Note that the Save command is way up at the top level (Output).

With all the flexibility of the Radiance XD, it seems like there could have been an Auto-Save option that puts all your changes in permanent memory as you make them. Another option would be to have a Save button on the remote so you could save your work as you go, without having to navigate away from the area you are working in to perform the saves. When you're doing the 11-point gray scale with luminance adjustments (to control gamma for each step), it gets pretty annoying to have to navigate through the menus back to Save ten times or more, as you work through each step. The primary and complementary color settings (CMS) are equally frustrating.

I'm no expert in GUI (graphical user interface) development, but it sure seems like there should be a simpler solution. That said, I can't even guess how many menu choices there are, but the count is probably in the thousands if you include every option for every resolution, gray scale step, and primary/secondary color. So any navigation system is going to have some challenges.

Lumagen suggests setting the basic controls on the display (contrast, brightness, color, tint, sharpness, etc.) then using any available controls on the video display to set 100 percent white as accurately as the display allows for the xy or uv coordinates and luminance. Of course, all image "enhancement" controls should be turned off also. The display's color temperature should also be set to the setting that is closest to 6500K. At that point, Lumagen suggests you can either complete the calibration with the Radiance XD controls or use other controls on the video display to improve the rest of the gray scale or other parameters. If you choose to use controls on the display, concentrate on just partial removal of errors without using large adjustments to the display's controls. I typically chose the latter approach, using no more than about one third of the adjustment range of any of the controls on the video display.

One concern with video processors is how you deal with increasingly complex AVR/pre-pro menus. If the AVR/pre-pro isn't in your line of sight, you must be able to see video from the pre-pro so you know what it selected and what you are changing. The Radiance XD doesn't currently offer any clever solutions, you simply connect the video out from the AVR/pre-pro to a Radiance XD input and switch to that input when you need to see the AVR/pre-pro menu system or on-screen controls and settings. Of course that means having to leave your current

36-page manual is available now and Sencore is working on an expanded manual for future release, so the manual situation should improve over time. Downloadable tech tip documents help with some of the issues not covered in great detail in the current owner's manual.

Lumagen's nested menus give you plenty of practice navigating forward and backward to get to the settings you need. All settings are temporary, too. You have to perform a "Save" periodically. If you spend 15 minutes getting several parameters calibrated accurately and neglect to save after finalizing those settings, you could end up losing them and having to repeat your 15 minutes of work. This means if you are eight levels deep in the nested menu system, you have to back up to the top menu level. A shortcut back to Save

input if you want to change anything, so you wouldn't be able to see or hear the results of your change until you switch back to your disc player, or whatever you are using. It would have been very useful to have an "overlay" mode, where the Radiance would put the video coming from the AVR/pre-pro on top of the selected input so you could see the input and the AVR/pre-pro menu at the same time. You could, theoretically, connect all inputs to the AVR/pre-pro, then connect the output of the AVR/pre-pro to the Radiance XD. This would eliminate input switching on the Radiance XD and prevent you from using a fair bit of the Radiance XD's flexibility. But the AVR/pre-pro would take care of overlaying the menu system on each input. There are other complex solutions, like using an HDMI distribution amplifier to produce multiple inputs to the Radiance XD, but even that could interfere with some of the Radiance XD's capabilities, like converting component (or older formats) to HDMI. Lumagen says a future picture-in-picture feature will permit viewing an AVR/pre-pro menu and a source at the same time. This should appear in the form of new downloadable firmware.

The range of output refresh rates is 23.94 Hz to 120 Hz. The default is 59.94 Hz. Some resolutions may not support every refresh rate. Because of the per-resolution memories, you can set different refresh rates for different resolutions. Lumagen recommends using your display's pixel-for-pixel mode at all times, since the Radiance

to achieve anything you want to achieve. You have to keep a very clear mental image of the output configurations (memories) and input memories to use the Radiance XD effectively. The HDMI outputs (two of them) share eight separate output configuration memories.

Each input has four memories (MemA-MemD) that will store frequently used setups that are recalled with a single remote control button press. Adjustments can be made to black level, white level, color format (RGB or YCbCr), color decoder adjustments (color and hue offset, color and hue red, and color and hue green adjustments), YC Delay adjustments (separate delays for Cr and Cb), aspect ratio, deinterlace and genlock controls, and enhancement controls (horizontal, vertical and diagonal adjustments for both sharpness and texture, plus noise reduction, and adaptive contrast). To make things even more flexible, you also have a memory for each resolution. The possible permutations for input, output, and resolution memories are staggering. There's also a "hidden" ISF memory location, where a calibrator can place a specific calibration that will not appear in the normal Radiance XD menu system unless the steps are followed to unlock that memory area. This offers an additional layer of "protection" for that calibration, since it would be unlikely the calibration could be inadvertently changed by someone moving through the Radiance XD's menus. Incredibly, each of the eight input resolution

***"In my experience, there is nothing out there that converts SD to HD as well as the Radiance XD."***

XD will output the display's native resolution. For cases where the display requires very specific pixel timings, the Radiance XD will support the requirement with a flexible pixel timing setup. The output color format options are: RGB with PC (0 to 255) or Video (16 to 235) levels; and YCbCr 4:2:2 or 4:4:4. Lumagen says YCbCr 4:2:2 is the optimum output setting if your display supports that mode. There's also support for some less-common video connections, like RGBHV, RGsB, RGsB, and SCART. A masking feature lets you blank one or more lines of pixels along each edge of the picture individually. The blanked lines can be black or a programmable gray level. Cropping is also supported, with the cropped image scaled back to the display's native resolution.

The Radiance XD will provide extensive information about the input signal and output signal. The info windows can be directly accessed by pressing the "OK" button on the remote or by navigating through the menus. The Radiance XD software version and serial number are displayed at the top of the data window. Resolution, refresh rate, color format (RGB, YCbCr), and HDCP (on/off) are displayed for the active input and for both Output 1 and Output 2. This makes it fairly easy to see what's going on with your video. Pressing "OK" on the remote moves you to Page 2 of the Info function. There you find the input assigned for the audio, input and output aspect ratio, Zoom (0 percent if no zoom is active), scaler on/off and input/output resolutions (horizontal and vertical), and Genlock status (off/auto).

The only video outputs on the Radiance XD are HDMI. If you need DVI, you will need to provide an adapter or HDMI-to-DVI cable. If you need component video, you will need to provide an HDMI-to-component video converter.

### Thanks For the Memories and Firmware Updates

The Radiance XD really shines when it comes to the flexibility of input and output memory capabilities. It would be difficult to imagine an installation where you wouldn't have more than enough memories

settings has a separate memory also. That's up to thirty-two input memories available. The input resolutions are listed below in the Format Conversion section.

There is a lifesaver "Copy" function that is quite well thought-out and useful for copying settings across resolutions, inputs, or output configurations.

There have been fairly regular firmware updates. Some fix obscure issues with very specific setup needs or something that is needed for production/manufacturing. Occasionally, features are added or improved. For example, I thought the two window pattern size selections for the gray scale steps and color gamut settings were either too large or too small for plasma panels, and like magic, one of the firmware updates made the larger of the two window sizes just the right size. I also noticed (and reported) a problem with how the Gamma Compensation control was working at levels below 10 percent, and checking it again for this review, I found that one of the firmware updates apparently fixed that glitch also.

Installing firmware updates is quite straightforward. Lumagen supplies the right type of serial cable in the box with the Radiance XD. Many newer computers have no serial port, but Keyspan makes a USB-to-Serial adapter that works seamlessly. I never experienced a setup or communication problem using a Keyspan device with my laptop. You download the firmware update from the Radiance XD support site. Once it is on your computer, you connect to the Radiance XD and execute the update file. It establishes communication with the Radiance XD and automatically performs the entire update. Once done, you can delete the downloaded update from your computer. I never lost any settings after an update, but Lumagen recommends recording all settings so they can be restored in the event of a problem during the update. There is a feature that will save all the current setup info to a file on your computer. This file can be downloaded to any Radiance making it useful for repeat setups, as well as a means of backup without having to manually write down settings.

# EQUIPMENT REVIEW

## Lumagen Radiance XD Video Processor

### Format Conversion

The Radiance XD has very flexible assignment of video and audio. You select both input and output resolutions. Input choices include about what you expect: 480; 576; 720p; 1080i50 and 1080i60; 1080p24 and 1080p60; plus a wild card "Other" setting that catches anything that doesn't match one of the other choices. Output resolution settings include the usual choices, plus: 540p50 and 60; 576p; 720p50 and 60; 768p; 1080i50 and 60; 1080p24, sf24, 48, 50 and 60; 1024 x 768; 1280 x 768; 1360 x 768; 1366 x 768; 1280 x 1024; and 1400 x 1050. All input resolutions can be converted to any output resolution.

### Audio

Most source components are going to have audio associated with them, and the Radiance XD is often going to be the "switcher" instead of the AVR/pre-pro, so the Radiance XD has comprehensive audio-handling capabilities. Analog stereo audio inputs are converted to PCM and moved over to HDMI or digital coax. If the incoming audio is in bitstream format (any of the Dolby® Digital or DTS® formats), it can be left in that format and passed on to the AVR/pre-pro. Because of the complexities of EDID (Extended Display Identification Data) and "the handshake" in general, you can run into problems when you connect an output of the Radiance XD to an AVR/pre-pro at the same time you have an output from the AVR/pre-pro connected to an input of the Radiance XD. Lumagen has provided enough options that I was able to overcome problems like no audio every time it cropped up with four different setups. Working through these complexities, using only the info in the owner's manual didn't quite work for me. I needed a little help from a Radiance XD support forum, but the answer came quickly and it got me right on track.

The Radiance XD can handle up to 7.1 channels of audio at up to 96 kHz sampling rate. There are six HDMI inputs with audio, six digital coax inputs, two optical TosLink inputs, and four stereo analog inputs. There is no multi-channel analog input because converting 5.1 or 7.1 analog to PCM would require three or four stereo analog-to-digital converters. Stereo audio conversion requires just a single stereo analog-to-digital converter. There were no detectable audio-quality differences with the Radiance XD inserted in the audio signal path for either HDMI, analog stereo, or digital coax inputs.

### Color

The Radiance XD allows full control of all three coordinates for each primary and complementary color, plus white. Lumagen recommends starting calibration by getting a reasonable average gamma, then making the Color Gamut controls correct, then adjusting gray scale, then re-checking the Color Gamut controls and gray scale controls again to ensure everything remains where you want it. Lumagen says the way they implemented the gray scale and gamut adjustments, they don't interact with each other, and I found that to be true. But checking your work sometimes turns up a surprise or two so it's always a good idea. When you select the By Color option, the Radiance lets you select white, plus the six primary and complimentary colors, one at a time. Left to its own devices, the Radiance XD will display a 100 percent window or full-screen pattern for these adjustments. That's not a good stimulus level to use for plasma panels, and there is a way to force the Radiance XD to display a more appropriate 75 percent window pattern for each color and white, but it requires a lot of button presses and menu navigation, and it's not a "sticky" mode, so each time you change to any other color or white, you have to repeat the whole process to get the 75 percent window back. Fortunately, the Radiance XD also has an option for no pattern to be displayed, allowing calibrators to use 75 percent window patterns from their signal generator or from a

test/setup disc in a disc. There may be reasons you need or want to use 100 percent window patterns, but Lumagen has recently re-thought whether 75 percent or 100 percent windows make the most sense for gamut adjustments and is favoring 75 percent again.

Taking red as an example for primary colors, the Radiance XD offers three controls... SubR, AddG, and AddB. The AddG and AddB controls do what you expect... move the red point towards green or towards blue or towards both at the same time. This allows you to tame oversaturated red (outside the reference color space triangle) quite easily, and the adjustment range is very large, with 1,024 steps available on each control. SubR (subtract red) is a luminance control for red. Luminance can only be reduced, however. So if you have a situation where one primary is darker than it should be, you may have to fiddle with other colors, or white, to get that color's luminance higher... if that is even possible. SubR also has 1,024 adjustment steps for very fine control over luminance.

### Gray Scale And Gamma

Gray scale adjustments have options for two points, five points, or 11 points. It seems unlikely a calibrator or serious enthusiast would want to use anything other than the 11-point adjustment (0 percent to 100 percent). I used the 11-point adjustment exclusively. When you enter the gray scale adjustment area, you are in a submenu that allows access to each gray scale step individually. Each of the 11 points has adjustments for Red, Green, and Blue, so an essentially perfect neutral can be set for each step. The 11 gray scale steps are referred to as Point 0-10 with defaults of 0 percent, 10 percent, 20 percent... 90 percent, 100 percent. However, if you want to use different steps, the Radiance XD allows Points 1-9 to be adjusted to different IRE (really "percent" white as used here) levels. Point 1 is normally 10 percent, but you can change this to 5 percent or 11 percent, or any other number in that neighborhood. With Point 2 set to 20 percent white, the adjustment range for Point 1 is 0.5 percent to 19.5 percent. Zero percent and 100 percent cannot be changed to other luminance levels. Because of the adjustability of Points 1-9, Lumagen refers to their gray scale adjustments as being parametric... meaning the adjustment points can be changed to suit the user or calibrator.

Besides the RGB controls for each gray scale step, there's also a luminance control for each step. Using appropriate calibration software like Sencore's CP6000 ColorPro, CalMAN Professional or AccuPel's free-to-download manual calibration calculator (see the firmware download section at [www.accupel.com](http://www.accupel.com)), you can input a target gamma you'd like to have, plus a reference-white measurement (xyY usually, but other color spaces may be used in different software), and your software or the AccuPel calculator will tell you what the target luminance value is for each gray scale step. Since the step-by-step luminance value changes for different gammas, it is important you know in advance what your target gamma will be. If you make the luminance adjustments in the Radiance XD, you end up with essentially "perfect" gamma for each step from 10 percent to 90 percent. If you do anything that changes your white luminance in the gray scale adjustments, or elsewhere, you may throw off your gamma, so re-check your work as you use various settings in the Radiance XD if you think you may have changed the 100 percent (or other level you used) white luminance, while making other adjustments.

Radiance XD offers a gamma adjustment they call Gamma Compensation that allows you to adjust the gamma up or down, based on your reference settings you entered in the gray scale luminance controls. The default setting for Gamma Compensation is 1.00. There are three lower settings—0.95, 0.90, and 0.85. These, very logically, produce increasingly lower gammas. If you want Gamma higher than the target you set in the gray scale controls, the Gamma Compensation control has six settings from 1.05 to 1.30. Gamma



# EQUIPMENT REVIEW

## Lumagen Radiance XD Video Processor

remains nicely consistent when you make changes to the Gamma Compensation control. Lumagen recommends adjusting Gamma Compensation to achieve an average gamma close to your desired target before doing gray scale or gamut calibrations. For displays that have a gamma adjustment, you could set the "close" gamma in the display and leave Gamma Compensation at the default 1.00 value.

From about 40 percent to 100 percent, the RGB adjustments for each gray scale step have very fine granularity, and you can achieve incredibly low dEs if you are so inclined. It's quite possible for all dEs from 40 percent to 100 percent to be 0.5 or lower if you wish to take the time to get them that low. Since it is generally accepted that dEs in the 1 to 2 range are at or below the threshold of detectability by human vision, there's a pretty strong argument for not taking extra time to get the dEs lower than 1.9... but you can if you are so inclined. Starting around 30 percent, you begin to notice that the RGB (and luminance) adjustment steps are getting larger. Each "click" makes a bigger change than a single click from the previous gray scale step. At 10 percent, you experience the largest changes for single-adjustment "clicks." At the 10 percent step, a single "click" for any color can upset the color balance by 4 percent to 7 percent. This looks like a problem when you consider how fine your control is over higher luminance steps, but in real-world images, there's no visible problem with the granularity of the adjustments being that coarse. Ten percent is dark, and small color errors are hard for human vision to spot.

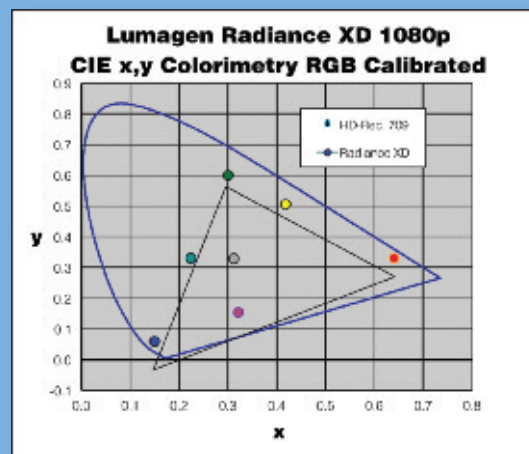
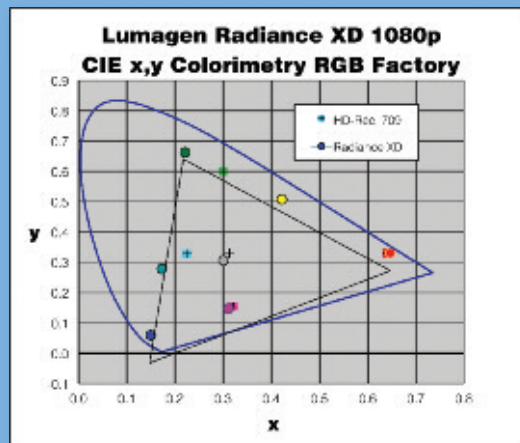
There is remarkably little interaction between gray scale steps or with the color controls. Everything should always be rechecked and touched up after making adjustments anywhere, but you'll probably find that only small adjustments are needed. I never had to do more than just a single touch up in more than a dozen calibrations. The need for many iterations to get closer and closer to the reference points seems to not exist as long as you stick with Lumagen's adjustment sequence recommendations.

### SD/DVD Capabilities

The Radiance XD can fix one of my pet peeves... SD reds that are reproduced much too orange on HD displays. Too often, familiar colors of red (London buses, Coke advertising, American flag red, etc.) are clearly too orange because the color-decoding matrix was not used correctly. It is becoming obvious that there aren't a lot of disc players or video displays handling SD-to-HD color properly. The Radiance allows you to set the Bt.601 (aka Rec 601) color-decoding matrix for any resolution, per input. You can set all 480i or 480p input resolutions to Bt.601, and you'll get the correct decoding of reds when the Radiance XD is set to output an HD resolution with Bt. 709 (aka Rec 709) selected. If you up-convert to 1080p elsewhere, you can specify that 1080p input also uses the Bt.601 color-decoding matrix, so you can still get the proper decoding, though it would be a mistake to up-convert anywhere but in the Radiance XD itself. Examining familiar DVD scenes confirmed that reds from DVDs were being reproduced properly... at last. The first Austin Powers movie is a great example. There are scenes with London buses, Coke advertising, a British Royal Guard in the familiar red jacket, Union Jack and U.S. flag reds, London phone booths, and even an "Underground" sign. It was quite clear viewing this disc that the reds were being reproduced properly.

In my experience, there is nothing out there that converts SD to HD as well as the Radiance XD. Lumagen's proprietary up-conversion is excellent. As good as the best Gennum VXP and Silicon Optix HQV processors are, the Radiance XD has a clear (pun intended) advantage in the quality of up-conversion. Add Lumagen's three separate sharpness controls (horizontal, vertical, and diagonal), plus Lumagen's three "texture" controls (horizontal, vertical, and diagonal), and three noise-reduction controls, and you'll never see DVD images that look better. There are no miracles here. With an appropriate

PERFORMANCE



viewing angle for HD movies or HDTV, DVDs still look like a standard-definition source, but they are the best standard definition you'll see on an HD video display. Problems that exist in the discs can't be fixed, though. Grainy DVDs will still look grainy. Those with edge enhancement still have it, though, it can be softened a bit without significant side effects. And you still see some slight aliasing on diagonals. If the DVD lacks detail in the background, you can't force any detail to be visible without doing serious damage to other parts of the image. I found that keeping the sharpness and texture adjustments to no more than one third of their adjustment range allowed a visible improvement in images without creating visible problems in moving images or test patterns. Since the Radiance XD saves settings per each resolution, you can limit the use of these adjustments to only 480i and 480p. The per-resolution capability allows you to have all of these controls set differently for HD resolutions... zero for Blu-ray Discs™ and very low settings for 1080i from cable or satellite services.

Robots looked great played back on an older Pioneer DVD player at 480i, via component video, to the Radiance XD. In fact, I consistently had a slight preference for 480i via component vs. 480i via HDMI. Images looked just a bit smoother, with the faults of DVD just slightly less obvious. The images were such eye candy that I ended up watching the entire movie rather than just scanning specific scenes. Colors were vibrant and highly detailed with the older, banged-up robots having incredibly realistic patinas. The bright and shiny Robot City was amazingly dimensional in many scenes, something you don't see often in DVD playback on HD displays. *Austin Powers: The Spy Who Shagged Me* on DVD looked better than I've

# EQUIPMENT REVIEW

## Lumagen Radiance XD Video Processor

ever seen it. The detail visible in textiles, macramé, and hair was excellent. Quite a few times I forgot I was watching a DVD... and that never happens without the Radiance XD. Contact has some problems with completely washed-out detail in the backgrounds of some scenes, and special effects that don't look particularly special. The Radiance XD wasn't able to help me forget those problems... they were right there for all to see. But there were some scenes that looked better than ever in spite of the sharpness and detail that tend to come and go throughout this movie. The scene where Ellie is trying to get funding for SETI research at the VLA never looked so good. The wood desk never drifted towards orange. The detail in the building through the window (across the street) was the best I've ever seen. The pattern in Ellie's wool jacket was more stable with less scintillating/moiré than I've ever seen before. The star fields and effects at the end of the wormhole were considerably more impressive than I've ever seen them from this DVD before.

### HD/Blu-ray™ Capabilities

I often worry about the effect of controls used to improve SD programming once I switch to HD programming or to Blu-ray Discs. The Radiance XD will use completely separate settings for all the enhancement controls, for each supported resolution. I generally left all the enhancements off for Blu-ray. The Radiance allowed me to set 1080i inputs from DISH Network to use some of the three noise-reduction settings, which did tame some of the MPEG compression artifacts present in all HD cable/satellite programming to one degree or another. Don't expect miracles, though, there's only so much a video processor can do when an explosion, or 5,000 flamingos taking flight at the same time, kick in the MPEG compression to the max. The results were the best HD programming and Blu-ray playback I've seen on any of the displays I worked with (listed below).

Viewing my perennial Blu-ray reference, *Casino Royale*, I have a hard time telling you exactly what was better about the presentation. But I caught myself many times thinking "WOW!" that never looked like that before. Yet there was no one thing to point at for being responsible. It was a build up of improvements in gamma, gray scale accuracy, and primary/complimentary color accuracy. Everything simply looked more real, more solid, more believable... more like the real thing. The problematic shot at twilight from above the train headed to Montenegro... I've seen this reproduced in so many ways that, at times, it has appeared to be late afternoon, and other times, almost dark. With the accuracy of the Radiance XD, the scene is clearly intended to be a twilight shot, and it looks "perfect." The shots around Lake Como are deliciously "right"—I could imagine myself standing right there. The dimensionality of the view out of the hotel window to St. Mark's square in Venice set new marks for perfection. The sunlight, tones of beige and buff, shadows, and rows and rows of columns... it was almost 3D. The interior scenes suffer from quite a bit of yellow in the lighting, but the improved gamut and gray scale revealed subtle shading on walls and hallways that was only hinted at without the Radiance XD in the system. Night scenes were more detailed, with excellent shadow penetration. There was no sense that the shadows were artificially light so detail would hold up. The shadows were as dark as they should be, but detail was still visible. Of course, this required a dark room to evaluate just how "perfect" (that word again!) the dark end of the luminance scale was.

Animation has always looked spectacular from Blu-ray, but for the first time, *Cars* and *Ratatouille* seemed more like real movies, with objects and characters that really exist moving through real spaces. It was a bit disconcerting to see. Logically, I know nothing in those movies ever existed outside of a computer, but the shadings, reflections, lighting effects, surfaces, and detail in the images processed

by the Radiance XD were enough to make the characters seem "real." There was a sense of total transparency between viewer and movie action. Too often, it seems as though I watch movies like these through a clean glass window. The images from the Radiance XD don't have the feel that there's a window there. The color, particularly in *Cars*, was just mesmerizing. But again, nothing you could put your finger on, other than to acknowledge that it was just fantastic looking.



### Video Display Results

The Radiance XD never failed to deliver exactly the gamma and gray scale accuracy I wanted. A very pesky Sony XBR2 SXRD RPTV (KDS-R60XBR2) was completely tamed by the Radiance XD. Gray scale results became essentially "perfect," with all dEs below 1.5 from 10 percent to 100 percent. Without the Radiance XD, the best I could do at 10 percent was a dE in the 20-25 range. The Radiance XD was able to tune out just about all of that error. This display, while impressive two and a half years ago, has obvious problems with inaccurate primaries and complementaries, and color luminance errors. The gray scale errors aren't too bad (except 10 percent as mentioned above), but there's nothing spectacular about the results either. After calibration with the Radiance XD, every parameter of the images was close to perfect. Amazingly flat gray scale, perfect 2.3 gamma at each step, the measured primary and complimentary color points were nearly perfect in all three dimensions (xyY or uvL). This display was a revelation with the Radiance XD. It has never looked this good and never could look this good without the Radiance XD.

With the Pioneer Elite PRO-111FD 50-inch plasma display, the Radiance XD produced the most outstanding video images I have ever seen. Every parameter measured by both ColorFacts Professional and CalMAN Professional software was spectacularly accurate... primaries, complementaries, gray scale, and gamma. Dark as the Pioneer Elite panel is, a Gamma of 2.35 (range was 2.33 to 2.36) produced incredible images in a dark room, with the peak white level set to about 32 foot-Lamberts (fL). The Radiance XD even did a better job of up-converting DVDs than the Pioneer Elite's native processing which is excellent by any standard.

The Toshiba 52XV545 52-inch 120Hz LCD panel has a strongly oversaturated green point that cannot be corrected with Toshiba's CMS, without serious damage to image quality (extreme contouring and block artifacting). Turning off the Toshiba's CMS and using the Radiance XD to move green to the correct reference point worked perfectly. In addition, the Toshiba's cyan and magenta points were way off (both towards blue) and yellow was off towards green. Red was slightly oversaturated, and blue was pretty accurate. After using the Radiance controls, all the colors' xy (or uv) coordinates were essentially "perfect," and the luminance for each color was nearly perfect. The Toshiba had fairly small gray scale errors, with 10 percent being the largest. All gray scale points were adjusted to produce dEs of 1.5, or less, with most steps being under 0.75 dE.

In Greg Rogers' Marantz VP-11S2 DLP review (Issue 132, June 2008), he was able to achieve gray scale dEs of 0 to 3 for each step. A calibration customer's Marantz VP-11S2/Lumagen Radiance XD combo achieved dEs of 0 to 1.3 for all steps. While dEs of two or less



are considered nearly negligible, there may or may not be value in being "more perfect" with the lower dEs the Radiance XD allowed. Greg's review showed small errors for each color at 1080p. My post-calibration results produced near-perfect xyY/uvL coordinates, with dEs of 0 to 3 for every color. Greg's review sample revealed gamma settings that each had some kind of issue... many were too low, but the best gamma choice was not consistent for each gray scale step. The VP-11S2/Radiance XD combo's calibrated gamma ranged from

## "The Radiance XD is an amazing product."

2.23 to 2.27. The Radiance XD allowed changes to this gamma up and down, to compensate for differences in source components or movies. The images from the calibrated Radiance XD/VP-11S2 combo used with a Stewart Filmscreen StudioTek 2.35:1 screen were the most perfect projected images I have seen to date, in terms of gray scale accuracy, color accuracy, and gamma uniformity.

### Measurement Results

Measurements were made with a Konica-Minolta CS-200 Chroma Meter, CalMAN Professional software, and with test patterns from the Radiance XD or from an AccuPel HDG-4000 video signal generator.

The "before" measurements came from a completely uncalibrated video display—one with some significant "issues" in out-of-the-box condition. There are service menu gray scale controls and user menu CMS (Color Management System) controls that improve this video display (Toshiba 52XV545U, full review coming soon) considerably. But I thought it would be more indicative of what the Radiance XD is capable of by making it do all the heavy lifting to make the gray scale, primaries/complementaries, and gamma just about perfect, with no help from the video display itself. The brightness control was adjusted to get the correct black level. Sharpness and other "enhancement" controls were turned down or off, and warm color temperature was selected because it was closest to 6500K. But no other adjustments were made to the display. Before calibration, the Toshiba's gray scale dEs ranged from 45 at 5 percent, to 19 at 70 percent, to 100 percent. After calibration with the Radiance XD, dEs were 3 at 5 percent, 1 at 10 percent to 30 percent, and 0 from 40 percent to 100 percent. That's an amazing result.

Before calibration, gamma was a bit lumpy—from a high of 2.43 at 10 percent, to a low of 2.16 at 70 percent. After calibration, gamma was much more consistent, with a range of 2.19 to 2.21.

Color adjustments were equally impressive. Color dEs generally include luminance in the dE calculation (gray scale dEs do not). 75 percent windows were used for measuring white and colors. White's dE started at 19. The primary color dEs were 13 (red), 2 (blue), and 33 (green). Complimentary color dEs were 19 (magenta), 1 (yellow), and 43 (cyan). After calibration with the Radiance XD, white's dE was 1, and primaries were 0 (red), 1 (blue), and 7 (green). Complimentary colors were 0 (magenta), 1 (yellow), and 3 (cyan)—another stunning improvement. The only reason green's dE was as high was because green was too dark, and the Radiance XD has no capability to make a primary color brighter (only darker). Green's xy coordinates were a perfect match for the reference xy coordinates.

This torture test was close to a worst-case scenario for the Radiance XD... no help at all from controls in the video display, and I didn't even try to make 100 percent white accurate with the Toshiba's controls, per Lumagen's recommendation. Calibration results are just as fine when the video display isn't off as much as this one was prior to the Radiance XD calibration.

### Final Thoughts

The Radiance XD is an amazing product. It will elevate the performance of any video display beyond what is possible with the display's internal controls. The results are amazing for video displays in any and every price range. While it might seem silly to run a \$1,500 plasma display or circa \$2,000 LCD panel on a \$4,500 Radiance XD video processor, the results show you how capable those inexpensive displays

are—when all their "issues" can be adjusted away. Of course, the Radiance XD can't overcome the fundamental properties of the video display. Black levels are not improved. If the display can't display below black or above white, the Radiance XD won't change that—though Lumagen has a "cheat" that will show you data below 16 or above 235 by moving that data inside the display's hard limits. If the display has noticeable motion problems, the Radiance XD may or may not be able to help with that (depends on the nature of the problem). But beyond those few native-to-the-display items, the Radiance XD makes everything else we currently measure perfect, or very close to it. The only room for improvement that comes to mind would be if there were 11-step (or 21-step) adjustments for red, green, and blue, rather than a single luminance adjustment point, and perhaps a 21-step gray scale option that retains the parametric adjustment capability.

Lumagen has partnered with Sencore for sales and support help. One of the stated goals of this partnership is strong integration of Sencore calibration hardware and Sencore software with the Lumagen Radiance processors. There are third-party software solutions supporting the Radiance processors also, like CalMAN Professional, that will communicate with the Radiance to display appropriate test patterns and take automated readings from a variety of meters. Competition only helps the owner's and calibrators of Radiance processors get the on-going support they need to keep Radiance-based systems working at peak accuracy.

The Radiance XD is as good as video processing gets these days. While it is expensive, the features and capabilities put to shame the five-figure scalars and line doublers of the past. Using good instrumentation with software like CalMAN that has built-in step-by-step gamma calculations and helpful CMS capabilities eliminates frustrating manual entry of data into a spreadsheet or the AccuPel calibration calculator. Some software makes it difficult, annoying, or impossible to get all the info/data you need to use all the Radiance XD's capabilities. I can't see owning a Radiance XD without either spending a few thousand (minimum) on instrumentation and software and investing a hundred or more hours, learning how to calibrate, or by getting to know your local ISF- or THX®-certified video calibrator and having him take care of the Radiance XD setup for you.

While the Radiance XD may not be a perfect product, the problems are mostly navigational in nature and in no way do they compromise the audio or video performance. The results achievable are more perfect than I've been able to achieve with any video display or chip-equipped disc player or AVR so far. If your goal is the most accurate images currently possible from whatever video display you choose to use, the Radiance XD will deliver.

Note: At press time, Lumagen had just announced the Radiance XE as a replacement for the Radiance XD. The only change is that the Radiance XE is HDMI 1.3a compliant, while the Radiance XD is HDMI 1.2 compliant. All other features and functions are identical across the two models, and the MSRP has not changed. The Radiance XE's MSRP increases to \$5,995. **WSR**