

DLP PROJECTOR

Plus Piano HE-3100

Steven Stone

What's smaller than a football, lighter than a medicine ball, and more fun than an 8-ball? The Plus HE-3100 projector. How tiny is it? Try 9.3 by 3.6 by 7.8 inches and 4.4 lbs. Some DVD boxed sets are bigger and heavier. Heck, even its manual is larger than the HE-3100. If small size, weight, and price determine a projector's worth, the Plus HE-3100 is an outrageous value. However, issues of ergonomics and image quality have to be taken into account. Does the Plus HE-3100 leave CRT and rear-projection monitors in the dust, or is it just another lightweight home-theater wannabe?

The Digital Engine that Could

The Plus Corporation began life in 1948 as the Chiyoda Stationery company, and took its present name in 1959. Plus has more than 1600 employees, their principal products are video projectors for the industrial and educational markets, and they are the largest volume user of DLP chips of any Japanese manufacturer licensed to use the TI technology. The HE-3100—which Plus also refers to as the Piano—is the company's first foray into the wonderful world of home theater. While most of the DLP and LCD projectors I've reviewed in the past have had the audio inputs and built-in speakers that indicate their roots in industrial presentation, the HE-3100 lacks such vestigial fea-

tures. It is designed to be, first and foremost, a home-theater display device.

The HE-3100 employs TI's latest DLP widescreen component set. Its heart is a single TI 848×600 Digital Micromirror Device (DMD) and a 240Hz color-scan rate, six-section color wheel. The DMD is used in

848×480 mode when the projector is set to 16:9, and 800×600 in the 4:3 setting. The HE-3100's custom-designed lens is a fixed-focus, multicoated, all-glass design. A 130W UHP (ultra-high-pressure) bulb serves as the light source. Silicon Image's SIL 503 chip handles deinterlacing duties as well as horizontal

SPECIFICATIONS

Piano HE-3100 single-chip Digital Light Processing video projector

DMD panel: 0.7" 508,800 pixels (848×600)

Lens: 23mm, manual focus F3.0

Lamp: 130W high-performance compact lamp, rated life 1000 hours

Image size: minimum 36" (throw distance 3.9'), maximum 200" (throw distance 22.6')

Color reproduction: full color, 16.7 million colors simultaneously

Light output: 450 ANSI lumens

Contrast ratio: 700:1 (full on/off)

Scanning frequency: 15–85kHz horizontal, 50–85Hz vertical

Digital RGB input: TMDS-compliant (single link only) on DVI-D 24-pin terminal

RGB signal: VGA (640×480) enlarged, SVGA (800×600) full, XGA (1024×768) compressed

Video input: Component, S-video, composite; 480i only

Horizontal resolution: NTSC 400 lines minimum

Power requirement: 100–240V AC, 50/60Hz

Power consumption: 200W (18W in standby)

Dimensions: 9.3"×3.6"×7.8" (W×H×D)

Weight: 4.4 lbs

Warranty: 2 years parts & labor, excluding bulb

Color options: silver, black, white, red, blue

Price: \$2999

Manufacturer

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PLUS HE-3100



scaling, color look-up tables, chroma upsampling, 3:2 pulldown, color-space conversion, and advanced motion and source corrections. TI's DMD chip and the SIL 503 are the only internal parts of the HE-3100 not manufactured or designed by Plus. Ignition, a Texas firm, designed the external case.

A quick tour of the HE-3100's exterior: composite, S-video, component, and DVI (digital video) inputs populate the projector's rear; an On/Off button, AC connector, and lens occupy the front. The left side of the HE-3100 has a removable door, behind which lies the replaceable lamp housing. Vents for air intake are located on the right side, while the outflow is on the left. A complete set of operating controls is on the top, right behind the focusing wheel.

The HE-3100 has comprehensive setup and adjustment onscreen menus. The Picture 1 menu has slightly different controls for DVI sources than for analog video. For DVI you can adjust Brightness, Contrast, and Color Temperature. Additional controls—Tint, Color, and Sharpness—are available for the analog video inputs. The color-temperature setting offers four choices: Low, Normal, High, and Custom. The last permits separate control of red, green, and blue at the top end of the brightness

scale (gain) but no adjustment at the bottom (bias). Tom Norton put the HE-3100 through its paces before he sent it to me for review, and he had adjusted the Custom settings to Red -0, Green -8, and Blue -12. I tried other settings, but kept coming back to his choices. The Low and High color-temperature modes are especially unappealing. Low renders everything jaundice yellow, and High is way too blue.

The Picture 2 menu has adjustments for a Video (noise) Filter, Zoom Filter (for letterbox transfers—I didn't find either filter particularly useful), ProScan (an oddly named control that sets film 3:2 pulldown recognition either on automatic or off), Color System (NTSC, PAL, etc.), and four gamma modes: Video, Film, Graphics, and Custom. I found that Film worked best with DVD sources. The Video mode is slightly less contrasty and might work well with VHS tapes. Again, when you select a DVI source, your options are less extensive; only Zoom Filter, Pan (moves the position of the image within the frame), and Gamma adjustments are available.

The Setup menu has controls for Keystone, Installation (which selects the orientation of the projector: Floor/Front, Ceiling/Front, Floor/Rear, or Ceiling/Rear), Background (blue or black), Auto Power Off (which puts

the HE-3100 in standby mode if no signal is received for five minutes), and LED On/Off.

The Option menu lets you choose among English, German, French, Italian, Swedish, Chinese, and Japanese as the onscreen language. Menu Position and Onscreen Display Duration complete the possible selections.

Finally, the Info screen has user memory save options, a default setting so you can return everything to factory presets, and lamp life information so you can see how many hours the lamp has been in opera-

REVIEW SYSTEM

Source

Toshiba SD-6200 DVD player
Marantz DV7100 DVD player

Display

Sèleco Millennium 800 CRT projector
Stewart StudioTek 130 screen (4:3, 91" diagonal, 1.3 gain)

Video Cables

Monster M-1000 component
Straight Wire Silver Link RGB

Misc.

Monster Entech Power Center 5000 power conditioner
PS Audio PowerStation 300 power conditioner (input sources only)

PLUS HE-3100

tion. You can also reset the timer when you put in a new lamp. Once again, the DVI input has fewer options; in this case, it lacks the ability to save your settings in user memory. Super-tweaks in the audience will be disappointed to find that we could locate no ultra-secret installer or service menus or additional adjustments beyond what you'll find in the user menus.

Installation Insights

I ruptured an Achilles' tendon a week before the HE-3100 arrived, so installing anything bigger than a Tylenol became extremely problematic. Luckily, William Eggleston and Dr. Wayne Prather from WEGG3 arrived to set up their new Lunare speaker system in

my upstairs listening room. Later, they kindly volunteered their brawn and brains to get the HE-3100 up and running.

Because the HE-3100 has a fixed focal length rather than a zoom lens, the size of the projected image is determined purely by the distance from the projector to the screen. For my 6-foot-wide (91-inch-diagonal), 4:3 screen, the proper projector distance proved to be 10' 5". Unfortunately, in my usual viewing seat this placed the projector in my lap, rendering floor- or table-mounting impossible. Ceiling-mounting was hindered by the fact that a Sèleco Millennium 800 CRT projector was already hung there. Fortunately, the HE-3100 is so tiny that Eggleston and Prather were able to

position it above the Sèleco, wedged tightly between the ceiling and the 800.

Sometimes God smiles on temporarily crippled video reviewers. My screen proved to be exactly the right height for this projector setup—no keystone adjustment was needed. I did try the keystone adjustment and discovered that, unlike the Sharp XV-DW100U LCD projector, whose internal digital keystone adjustment is virtually useless because it introduces jagged artifacts to vertical lines, the HE-3100's keystone adjustment is quite excellent. I saw no keystone-induced jaggies within $\pm 20^\circ$ of correction. The keystone adjustment is also more flexible than most, because it has two modes. In Normal mode, both the top and bottom of

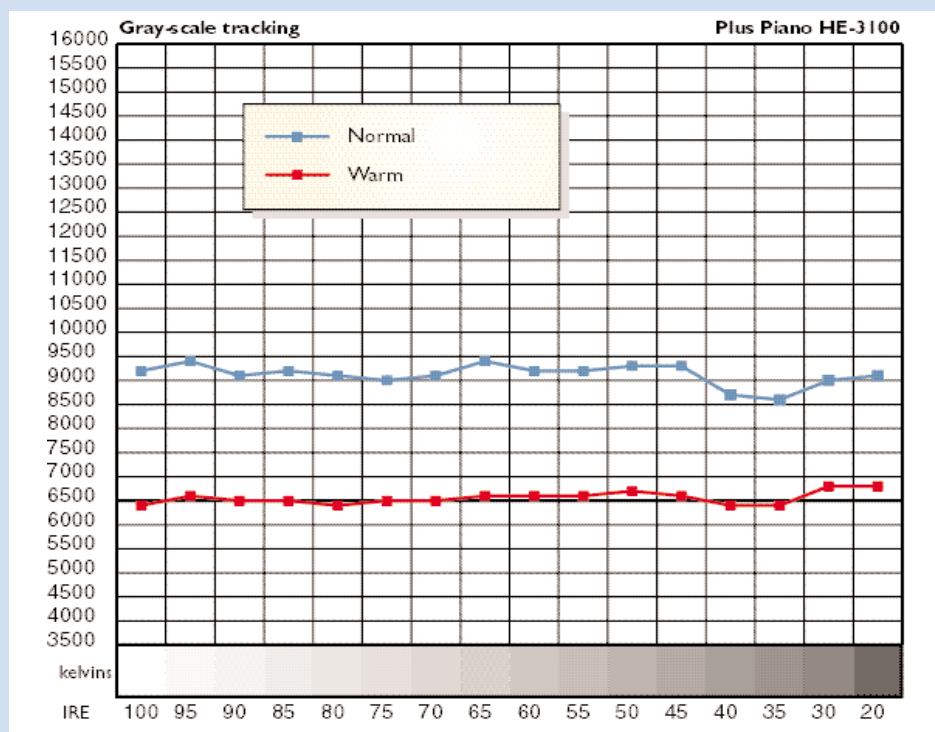
MEASUREMENTS

These measurements were made on a 72-inch-wide Da-Lite Cinema Vision screen with 1.3 gain—and with the Photo Research PR-650 SpectraColorimeter, which in previous articles I had mistakenly called a SpectroRadiometer. As with our other recent fixed-pixel measurements, these figures include the performance of the screen.

At first, I set the Plus HE-3100's Contrast to the manufacturer default of "0" and dialed Brightness down to -10, in order to correctly display the PLUGE pattern on *Video Essentials* 17-5 (title 17, chapter 5). In our previous experience with fixed-pixel projectors, the default Contrast has usually been just at or above the projector's limit. After reviewing the initial dismal peak-white measurements, TJN asked me to re-visit the HE-3100. Indeed, the HE-3100's default Contrast setting is not anywhere near the unit's peak output. I was able to increase contrast to +100 while adjusting the Brightness to +10 in order to allow the proper rendering of blacks.

With the default Contrast setting, peak white measured slightly higher while displaying a full white field than with only a 100 IRE window pattern. Light output measured 5.55 foot-lamberts on *Video Essentials* 18-14, and 5.4 ft-L on 17-10. Using the ANSI checkerboard pattern (17-28), the best-case real-world contrast ratio was 62:1, but would be a whopping 555:1 using the Full On/Off method preferred by numbers-happy manufacturers.

With the higher Contrast settings, peak white measured 12.5 ft-L on the 100 IRE window, 12.3 full-screen. Contrast-ratio numbers increased as well, to 100:1 on the ANSI checkerboard and



just over 600:1 Full On/Off. This is quite a difference, and shocking— with the video settings at their default settings, Plus doesn't push the HE-3100 to its maximum capability.

The color temperature of Normal is what we expect from many consumer sets. On the HE-3100, color temperature hovered at around 9000 kelvins, which would make the image decidedly bluish but very exciting. If this were the only option, I'd argue against a recommendation for home-theater use—but Plus redeems itself by including a Warm color-temperature

setting that exactly nails the NTSC standard of 6500K. It does this at a much better tolerance, too—Warm is only $\pm 170K$, while Normal deviates in each direction by 400K. This difference in accuracy is hard to understand; my conclusion is that Plus engineered-in the Normal inaccuracies for some reason.

Plus recommends that the HE-3100 should not be used with the Stewart Grayhawk or the Da-Lite High Power screens. I disagree. The Plus puts out enough light and needs the gray material to keep its grays closer to true black. —JJG

PLUS HE-3100



the image move in a way that maintains the original aspect ratio, while in Full mode only the width of the top changes.

An unusual and not particularly desirable feature of the HE-3100 is that as long as the On/Off button on the front of the unit is engaged, the internal cooling fan is on, even if the projector is in Standby mode. The only way to disengage the fan is by turning the unit off via its On/Off button or by cutting its AC power. If the HE-3100 is mounted on the ceiling, getting to the button may be impossible, making it necessary to either physically unplug the projector or turn it off via a switched AC socket. With a ceiling AC box, physically disconnecting the AC cord is just as difficult as reaching the On/Off switch. With a switched ceiling outlet, someone might accidentally turn off the projector while it is still operating, which would severely shorten its bulb life. The fan is not particularly loud either in full operation or in Standby, so many owners may just opt to live with a continuous low-level whir. But anyone who puts in any music-only time with their home-theater system will need to devise some way of turning the projector off completely.

Unlike some early DLP projectors, the HE-3100 has no problem with light spilling

from its ventilation ports. In addition, you can even turn off its LED display so that it will not intrude on your home theater's ambient light level. The HE-3100's LEDs aren't terribly bright; it surprised me that Plus was sufficiently concerned with their output to include this turn-off feature. But without the LEDs to alert you, it might be hard to tell whether the HE-3100 is fully on or merely in Standby mode when your video input source is displaying a black screen or has turned itself off (as many DVD players do after five minutes of inactivity). With no LED status display, you could mistakenly cut the AC power to the HE-3100 while it's still fully powered, again with the result of substantially shortening the bulb's life. I suggest that you leave the LEDs on.

As with many home-theater devices, the HE-3100 uses a standard IEC AC connection for its power cord. Its location—on the front of the projector, right under the lens—forces the use of an AC cord with a 90° bend, otherwise the cord will stick out too far. Plus supplies a 5' 9" AC cord with the necessary angle, but devotees of premium AC cables with straight IEC connectors might find them difficult to use with the HE-3100.

Because the HE-3100 will wind up on the ceiling in most home theaters, the

ergonomics of its remote-control system are important. The remote itself is small, with logically placed buttons. Unfortunately, the remote is not illuminated, but the buttons are well-situated; after a few days, I was using it without resorting to my Mag Light. All control functions can be performed by the remote alone, which is as it should be. The only problem with the HE-3100's remote system is that the sensor on the projector is located on the unit's rear. All attempts to control the projector by bouncing remote signals off your screen will be fruitless. Unless you are especially fortunate, trying to bounce signals off your back wall may also be futile. Without line-of-sight between the remote sensor on the back of the HE-3100 and your seating position, the remote may not work very well. Because the HE-3100 was tucked up above my Sèleco Millennium 800, I had to get up out of my seat and walk to the back of my home theater (tough for a tyro on crutches) to get the HE-3100 to respond to its remote. I hope Plus's next generation of home-theater projectors include a second sensor on the front.

Because of its display options, a 4:3-aspect-ratio screen is by far the best choice with the HE-3100. The "16:9" (anamorphic) mode produces an image slightly wider than

PLUS HE-3100

the "Full 4:3" mode, which scales up the image to nearly fill a 4:3 screen. The "16:9 Letterbox," Real, and Thru modes all produce images that have substantially smaller dimensions than the "16:9" and Full modes, but none of them produces an image small enough to fit into a 16:9 screen if the projector is set up to completely fill the screen area when it's in 16:9 mode. If you intend to watch 4:3 material without cutting off part of the picture area, you must have a 4:3 screen. *[I also found that when I set up the Plus to use the full width of the screen in Full mode with an anamorphic or enhanced-for-widescreen DVD, the image was several inches short of filling the screen on both sides when I switched to normal letterbox mode. And since the projection lens has no zoom capability, the only options are to either accept the short-fall or physically move the projector.—TJN]*

While on the subject of screens, Stewart has come out with a screen material called Grayhawk, specifically made for DLP and LCD projectors whose light outputs are at least 750 ANSI lumens. As indicated by its name, a Grayhawk screen is light gray instead of pure white, with a gain of less than 1.0. This does produce deeper blacks.

But the 450 ANSI lumen HE-3100 should not be used with a Grayhawk screen. Instead, Plus recommends a 1.3-gain screen such as the Stewart StudioTek 130—which is exactly what I used for my evaluations.

A Small World

Every sub-\$4k projector I've seen in the past has produced a picture that basically sucked—except for the Plus HE-3100. It's the first single-chip, DLP projector for less than \$4k—for less than \$10k—that I've experienced whose picture was good enough that I could watch an entire movie without flinching. That alone is a major breakthrough. I don't mean to say that the HE-3100's picture was without flaws, but that the cumulative effect of all its shortcomings still didn't add up to an objectionable final result.

If you've already spent the extra money to get a DVD player with a progressive-component output, you might be chagrined to learn that the HE-3100 does not accept progressive signals, only interlaced. But unlike budget-priced projectors that supply nothing in the way of image-enhancing features, the built-in Silicon Image line scaler, with its 3:2 pulldown recognition, is a very good

one. Your TV or VCR feed can be attached to the Plus's composite input, a laserdisc player hooked up to its S-video, and your DVD player connected to the component input. All of these sources will receive the same image processing to optimize their quality.

Light output, measured in ANSI lumens, is the projector equivalent of automobile horsepower: By looking at most manufacturers' specification sheets, you'd assume that more is always better. But this is really valid only for environments with high levels of ambient light. In a dedicated home-theater room, in which the light can be controlled, many DLP projectors originally created for presentations actually put out too much light to produce convincing blacks. Because the light source in fixed-pixel projectors like DLPs is never shut off, only redirected within the projector case, they are not able to produce an absolute black, only a relative black. Higher contrast ratios can make blacks *appear* blacker, but due to the nature of the DLP technology, they are never entirely black.

The HE-3100 was not immune to this phenomenon. It could not produce a black that rivaled a CRT projector's, but its high contrast ratio of 700:1 did allow it to pro-



PLUS HE-3100

duce an image that had surprising internal image contrast. Its blacks were a rich, dark charcoal-gray that possessed fine shadow detail. Even a brief shot of backlit cheerleaders in *Any Given Sunday* had excellent tonal separation and textural content. I reviewed both the now-discontinued Marantz VP8100 DLP and SharpVision XV-DW100U LCD projectors in the past year (March/April 2001 and December 2000, respectively), and while neither was still available for direct comparison, I believe that the HE-3100 produced black levels that were comparable, if not superior, to either of those far more expensive projectors.

Every single-chip DLP projector uses a color wheel to produce the full spectrum of colors. Industrial and presentation projectors use a four-color wheel with red, green,

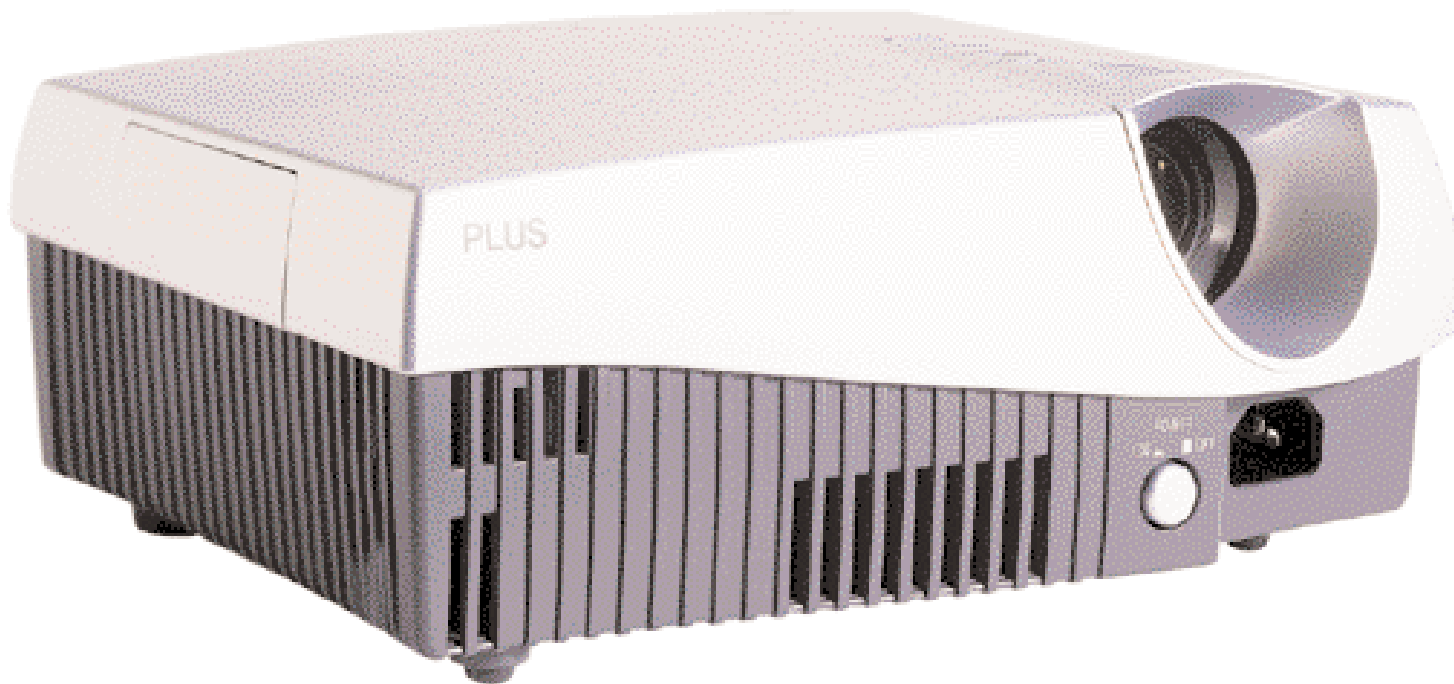
rainbow-like rays emanating from highlights. I'm sensitive enough to the rainbow effect that I can stand only about 10 minutes with a DLP projector that has a three-section color wheel before I have to turn it off for fear of sparking a migraine headache.

The HE-3100's six-section wheel reduced the rainbow effect to the point that I could make it through a whole movie without reaching for the Off switch or the Percodan. The rainbow effect was still there—especially when there was a spectral highlight on a dark field, as in a film's closing credits—but much less so than with earlier DLP projectors, such as the Marantz VP8100.

The HE-3100's color fidelity was good but not great. Even though its specifications boast 16.7 million simultaneous colors, reds seemed to have an especially limited

dan Fraser's white coat in *Bedazzled*, high key textures vanished into solid blocks of white. Highly saturated reds also suffered from reduced detail. Elizabeth Hurley's red dress in her first scene in *Bedazzled* lacked any texture. Gone were the diagonal ridges of fabric that are easily discernible through the Sèleco Millennium 800 CRT.

Extreme high key areas that should have been a neutral white displayed incorrect color shifts through the HE-3100. Spectral highlights were slightly magenta, while whites in shadow areas went a bit yellow. At the beginning of the drug-kingpin scene in *Bedazzled*, Brendan Fraser wakes up in a large white bed. As he leans over his bride, the white brocade bedsheets change from a warmish to a yellowish tone as his shadow moves across them. No amount of adjust-



blue, and clear sections. The clear sector boosts the overall light output because it allows the full spectrum of light to pass through it. First-generation, dedicated home-theater DLPs eliminated the clear section not only because the added light output was totally unnecessary, but also because the white section made it more difficult to produce good blacks. The latest home-theater DLPs use six-section wheels. Doubling the number of sections accomplishes the same visual effect as doubling the color wheel's speed, and increasing the wheel's speed reduces the "rainbow effect"—those

palette. Whitney Houston and Mary J. Blige wear slightly different-colored red leather outfits during their duet number on *VH-1 Divas Live!99*, but through the HE-3100 they appeared to be the same hue. Greens had a slightly iridescent quality through the HE-3100. In *Any Given Sunday*, football fields looked like Astro Turf instead of natural grass.

Highlights were the HE-3100's weak point. Areas that should have been full of texture blocked up into featureless masses. Whether it was the highlights of Al Pacino's craggy brow in *Any Given Sunday* or Bren-

ment of the Custom color-temperature or color-saturation settings could correct these aberrations.

The "Multiburst" test from the *Avia* test disc revealed that the HE-3100 was quite capable of reproducing a clean 5MHz signal. The sharpness chart was also rendered right up to the resolution limits of a DVD player. Even though the HE-3100 seemed almost capable of high-definition levels, it's *not* an HDTV device; any HDTV signal will need to be downconverted to 480i before the HE-3100 can display it.

Other tests from the *Avia* disc revealed

PLUS HE-3100

other areas in which the HE-3100's performance was less than stellar. The 30-frame-per-second zone-plate test revealed many motion artifacts, clearly visible during close-ups on the *VH-1 Divas Live/99* DVD. Tina Turner's face developed a bad case of sparkles during close-ups, when the camera panned down slowly. And when the camera moved across the auditorium, the edges of the large TV monitors on stage became rather untidy. Diagonal jaggies and scan lines were minimal, however. The ideal seating distance with the HE-3100 is approximately 6 inches behind the front of the projector. Here you can enjoy the maximum image size without being bothered by visible pixels from the micromirror grid pattern.

Pixel cropping and overscan tests



demonstrated that the HE-3100 crops a DVD image more severely than any projector I've ever tested. On the pixel test, the readings were all well over 20 pixels on every side. Usually, I see results between 0 and 5! This means that, with 4:3-aspect-ratio sources, you can expect to lose part of the outside of the image on all four sides. With a 16:9 widescreen source, the left and right sides of the frame will be cropped.

LCD projectors often suffer from magenta and green splotches that make watching black-and-white films especially difficult. The otherwise excellent Sharp XV-DW100U suffered from a severe magenta-to-green shift across its entire image area. DLP projectors have different gray-scale difficulties: They often have different color tints, depending on whether tones are light, middle, or dark. The HE-3100 had magenta highlights, greenish mid-tones, and neutral shadow areas. These variations were obvious during the first half of *Pleasantville*.

Video noise, which manifests itself as added image grain and texture, is often present with less-than-top-of-the-line deinterlacers and scalers. The HE-3100's internal Silicon Image/iScan chip did a superb job of producing an image almost completely free of noise and grain, and which was exceedingly filmlike. Instead of video noise, I could see the grain textures of the *film*. The surfaces of images in such slick productions as *Shakespeare in Love* looked positively creamy.

With only 450 ANSI lumens maximum brightness, the HE-3100 will be most unsatisfactory if you install it in a bright room and try to watch movies during daylight hours. Its brightness level also limits the size of the image you can expect it to produce with optimum quality. While its specifications suggest that you can set up the HE-3100 for a 4:3 image size of 13.3 by 10 feet with a throw distance of 22.6 feet, I strongly recommend that you limit the image size to no more than 6.6 by 5 feet for a maximum throw distance of 11.5 feet.

So far, I've enumerated the HE-3100's every wart and wrinkle, and at this point you might be wondering, "Why should I be interested in this thing?" Despite all its flaws, the HE-3100 produced an image that was essentially cinematic. When properly set up and used within its limitations of image size and ambient light, none of its



flaws was so overbearing that it interfered with my movie experience.

The View from the Top

Here's my standard response to any manufacturer who asks me what it takes to break into the high-end theater market: "Make a product that offers the same performance as the market leader at half the price, or offer twice the performance at the same price."

Plus Corp. has managed to do both at once. Before the HE-3100, you had to spend at least \$8k to get a decent projector, be it a CRT, DLP, or LCD. Now, for less than half that amount, you can have a surprisingly good single-chip DLP projector with a truly infinitesimal physical footprint. That's progress. The HE-3100 is especially ideal for audiophiles who've wanted to add video capabilities to their surround-sound systems but refuse to sacrifice any physical space for their installation. Mounted on the ceiling, the HE-3100 is the epitome of unobtrusive.

The HE-3100 is a mega-value that substantially raises the bar for what we can expect in terms of performance and price from all future single-chip DLP projectors. At less than \$3000, it even challenges most rear-projection TVs now on the market. Why settle for a hulking box that delivers a flawed 62-inch-diagonal picture when you can have a 6-foot-wide picture that's as smooth as silk? The HE-3100 promises to bring a true movie experience to many budget-conscious videophiles who could not have considered a projector before. In short, the Plus HE-3100 is a benchmark display product that almost anyone can afford. Is this a great time to be alive or what? 