Plasma vs. LCD: Round II

A Pioneer Elite Kuro plasma and a Samsung LED-driven LCD duke it out in this extreme techno-battle of HDTVs.

By Rob Sabin • Photos by Tony Cordoza • February 2008

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The Samsung LN-T5281F LCD and Pioneer Elite PRO-110FD Kuro plasma, face to face.

Three years ago, *Sound & Vision* staged the first of its HDTV technology face-offs when we put a 37-inch Samsung plasma alongside a like-sized Sharp LCD, tuned them to the hilt, then fed them the same programs to see which was king of the HDTV hill ("Plasma vs. LCD," February/March 2005). In those days, flat-panel TVs were still an expensive oddity. But even then, the question "Which is better: plasma or LCD?" burned hard in the hearts of our enthusiast readers. Not surprisingly, that's now the No. 1 question we're asked about HDTV.

The results of that first battle were decisive. The Samsung plasma beat the Sharp LCD in virtually every key area, including contrast, color accuracy, picture uniformity, and picture detail. But much has changed. While plasma has continued to advance, set-makers have also worked hard to address LCD's most serious shortcomings. One of these is motion lag — obvious trails on moving objects created by the panel's relatively slow response time to the video signal. Another major issue is LCD's inability to reproduce deep blacks — a critical element for delivering natural, saturated colors and striking, lifelike contrast that adds depth and dimension to the image.

By early 2007, we began seeing LCDs that could finally hold a candle to the better plasmas. New panels with fast response times, coupled in some cases with 120-Hz

screen-refresh circuitry (twice the conventional 60-Hz rate), have virtually eliminated motion lag. And throughout last year, contrast seemed to improve on every LCD we tested. But none of them, frankly, suggested that they had finally caught up enough to the best plasmas to warrant another side-by-side look. Until now.

The Technologies

From the outside, flat-panel LCD and plasma displays look identical. But while the best of both breeds all have the 2 million or so pixels that constitute a "full HD" 1080p image, the similarities stop there.

Plasmas break those pixels into sealed red, green, and blue subpixels (or "cells") that contain an inert gas. When an electrical current — that is, a derivative of the video signal — excites the gas, it causes the colored phosphors in each subpixel to glow. By driving each subpixel to the desired level, the signal determines the pixel's exact color and brightness. Put enough of these pixels close enough together, and you get an image.

With an LCD (liquid-crystal display), a backlight — typically a fluorescent lamp — sits behind the pixel grid and shines through to the viewer. As with plasma, each pixel is broken into red, green, and blue subpixels, but the phosphors are replaced with colored filters. The video signal is processed to address each subpixel, causing its liquid-crystal structure to open and close like a shutter. This allows light to pass at the appropriate brightness and with the correct color to create the image.

With this tech lesson in mind, this was an auspicious time to gather the best plasma and LCD sets we could find. One reason is that plasma panels with 1080p resolution have recently become more common, essentially putting plasma on a par with LCD in the critical area of picture detail. But even the advance hype didn't prepare us for the leap taken by Pioneer's new Kuro-series plasmas. At a time when LCD seems to be taking over the HDTV market and getting cheaper all the time, Pioneer has retooled its plasmas to command a premium in this competitive business. As Al Griffin pointed out in his review of the 50-inch PDP-5010FD (November 2007), these pricey sets are designed to deliver the deepest blacks of any consumer display, period. "Kuro" means "black" in Japanese, so there should be no mistaking the intention.

But this is no small feat. To stay ready to respond to the signal, plasma cells remain partially on at all times — meaning that some light is inevitable, even when the signal tells the cell it wants black. Pioneer reengineered its sets to reduce this "idling" brightness by a claimed 80%. No argument: the 5010FD pumped out the blackest blacks we'd ever seen on a flat-panel. It followed naturally that the higher end Elite PRO-110FD could represent state-of-the-art plasma.

Meanwhile, shortly after we tested the PDP-5010FD, Samsung delivered the 46-inch LN-T4681F (January), the first of its affordable LED-backlit LCD panels. No less critical an advance for LCD, these sets replace the fluorescent backlight with an LED array. Samsung's processing allows the normally full-frame, full-on backlight to be turned off or dimmed on the fly in certain areas of the screen to accommodate the dark parts of the

image. That means less light leakage through the liquid crystals in their shuttered state — which means blacker blacks.

The LN-T4681F delivered, by a considerable margin, the deepest shadows we've seen from an LCD. So with the Pioneer Elite Kuro waiting in the wings, Samsung's 52-inch LN-T5281F ($4,500) was brought in to represent LCD in a Battle of the Blacks.

Prepped and Ready

As with our previous technology face-offs, both TVs had to be calibrated to deliver their absolute best image. Al Griffin, our technical editor, took on this task — one made easier by the fact that he'd recently tested similar versions of the same TVs. To make things absolutely fair, both sets were fed the same video signals through an HDMI splitter, allowing us to match their brightness to a comfortable level in our darkened studio. Thanks to Al's finely honed eye and his attention to detail, the TVs looked remarkably close on much of the initial program material we auditioned — by far the closest we've ever gotten contenders to look in a face-off.

To get a handle on the sets' performance, we used the HDMI splitter to simultaneously feed them test patterns from our HDTV signal generator as well as scenes from four demanding reference discs. If you haven't seen it, the HD DVD version of the delightfully goofy Adam Sandler movie *Happy Gilmore* is chock full of bright colors, including garden and golf-course greenery in every shade — a sure indicator of a TV's ability to reproduce a natural green palette. We also checked out the high-altitude climbing drama *Vertical Limit*, whose Blu-ray Disc edition, fittingly enough, helped us evaluate the TVs' reproduction of blue.

In addition, the snow scenes in Vertical Limit helped us see how the sets handled bright images. And the Blu-ray Disc of *Black Book*, a tense story that follows Nazi resisters during World War II, has many dark and shadowy scenes to check black reproduction, not to mention brightly colored period costumes to check color.

Of course, if you really want deep blacks, there might be none deeper ever committed to video than the outer-space scenes on the new high-def transfer of Stanley Kubrick's *2001: A Space Odyssey* (available on both Blu-ray and HD DVD). Picture the hyper-white, sun-drenched spaceship models used for the film's pre-CGI effects shots set against a blanket of utter darkness that's sprinkled liberally with tiny points of bright light to impart the look of distant stars. It's hard to imagine anything more demanding for video, or any display that could reproduce the full impact of what you'd see while watching it on film.

Thus armed, we turned down the lights, called in contributing technical editor (and TV reviewer) Michael Trei to complete our trio of panelists, and got to work.

Good color in an HDTV starts largely with two things: the ability to generate accurate red, green, and blue primary colors (those from which all other colors are derived) and the ability to consistently reproduce an industry-standard white (actually, a mix of red, green, and blue) across the entire brightness range from full-off to full-on. This last bit is what we call grayscale tracking, and the ideal "white" that's supposed to remain constant is defined on a chromaticity diagram as 6,500 kelvin, an essentially neutral (if slightly reddish to most eyes) gray. Too often, a set's color temperature for white will vary widely as you raise or lower the brightness, resulting in color-shifting between bright and dark portions of a scene. Or, it won't track close enough to 6,500 K to be called neutral, instead leaning more toward the "cool" icy blue favored on retail floors or a pink tinge when the temperature is too "warm."

Fortunately, the primary colors of both TVs were virtually dead-on — a rarity indeed. And both had fairly accurate color decoders that should theoretically translate to accurate colors overall.

Grayscale was another matter. Out of the box, both TVs were off the 6,500-K standard, though calibration brought them in line. But the measurements also revealed that, while the calibrated Pioneer plasma adhered fairly closely to 6,500 K across the full brightness range, the Samsung LCD exhibited some of the variations we often see with this technology, especially at the darkest and lightest limits of the brightness range (see Test Bench).

Whether it was the differences in grayscale or a combination of factors, there was definitely a subtle difference between the color balance of the two sets. Both TVs had outstanding color reproduction, with a vibrancy and richness that pulled you into the picture. But side-by-side with the plasma, the LCD had reds that were slightly more saturated, as evidenced in the pinker, less natural facial tones of the title character in an early scene in Happy Gilmore. Similarly, the green grass and shrubbery of his grandmother's lawn looked just a bit punched-up compared with the same image on the plasma, which we all agreed looked more natural.

There were other subtle color variations. For instance, the bright white railing of the wooden porch steps in this scene had a barely detectable yellow hue that wasn't visible on the more neutral plasma. And in a close-up of a furniture mover, I noticed that the crew neck of his gray/white undershirt had a slight green/yellow tinge that affected only the brighter portion of the narrow band that wasn't in a light shadow. On the plasma, the shirt's color remained consistent both above and below that crease.

To get a gander at some true blue, we popped in *Vertical Limit* and checked out the gorgeous vistas of the sun-drenched Himalayas. Here again, the LCD image of the blue sky had a very slight yellow tinge that, while hard to see, just wasn't there on the plasma.

I have to stress again, though, how incredibly close these pictures were in most respects. After discussion, we agreed to award the LCD a solid 8 on a scale of 1 to 10 for color accuracy. But it couldn't match the 9½ we awarded the near-perfect plasma.

Picture Detail
The Samsung LCD was slightly better at cleanly reproducing the highest-resolution portion of 1080i and 1080p test patterns, while the Pioneer plasma introduced a bit of noise in that area — a not uncommon phenomenon that we comment on from time to time in our reviews. This isn't display-technology related, and it usually doesn't result in any visible loss of detail on program material — which was the case here. Both TVs delivered the ultra-sharp pictures we've come to expect from 1080p sets driven by high-quality HD signals. Each got a 10 for picture detail.

Picture Uniformity
Referring to the TV's ability to perform consistently across the height and width of its screen, picture uniformity covers a lot of criteria. Most of these are easily checked with test patterns. For example, picture geometry: Does a black background overlaid with a white grid reproduce as straight, parallel lines? Gray-field consistency: Do pure, full-screen test patterns reproduce at the same brightness across the entire screen? Horizontal viewing angle: As you move off-axis from the center of the screen, does the brightness, contrast, or color begin to shift noticeably — and does the TV pick up an inordinate amount of ambient light, creating glare that fights with the image? Motion rendition: Do fast-moving objects progress smoothly and without trails or other artifacts from one side of the screen to the other?

We looked at all of these things, with some interesting results. Both TVs were essentially perfect on gray-field consistency — a result that was expected for the plasma but a nice surprise with the LCD. I credit the Samsung's LED-array backlight, which should provide more even distribution of light than fluorescent bulbs.

Both sets did well with motion rendition. This was a bigger concern on the LCD, and at one point we engaged the Samsung's LED Motion Plus option. But even with it turned off, the LCD did a fine job with the action sports we watched from our cable box.

Where the LCD fell off the rails, though, was with its horizontal viewing angle. As we moved off-center, even from 6 or 7 feet away, picture contrast began to drop the moment you went beyond the left or right edge of the screen. (The same thing happened with the 46-inch version Al reviewed earlier.) The viewing angle was so narrow that it was impossible for the three of us to evaluate the LCD while sitting on the same couch centered between the two sets. Only the guy sitting on the end toward the LCD got a good picture — and it wasn't as good as what you saw directly in front of the TV. The plasma, by comparison, had a very wide viewing window with a consistent image that began to drop off only at very extreme angles.

We conjectured that this viewing-angle problem might be technology-related. The translucent filters and protective layers used over the pixel grid have an impact on an LCD's viewing angle, and manufacturers sometimes make tradeoffs for the sake of better light transmission or contrast. LCDs have traditionally suffered from limited viewing

angle. But given that we've seen a number come through lately that had relatively wide windows — notably the 47-inch JVC reviewed in December 2007 — it's reasonable to wonder if Samsung didn't make a tradeoff to extract the absolute blackest blacks from these LED-driven LCDs.

Also, this LCD has an unusually glossy screen surface — again, just like that of the 46-inch version we tested earlier. And like that model, it picks up a lot of screen glare in rooms with bright ambient light. The plasma was better here, but only by a little. We'd strongly recommend controlled lighting for both of these TVs.

It became clear that the slight edge the plasma enjoyed in most areas of picture uniformity became a blowout once we factored in the LCD's highly restrictive viewing angle. Plasma 9½, LCD 7.

Contrast

Drumroll, please: We spend so much of our time yakking about blacks because, when well reproduced, they add something special to a TV image. In bright shots, the extra contrast provided by solid black reproduction results in exceptionally vibrant and saturated colors. In shots with bright and dark areas, such as sunlit scenes with highlights and shadows, the wider range of dynamic contrast adds a pop to the image that's visible as depth. In very dark scenes, that extra bit of deep black on a properly adjusted set lets you see realistic shadow details without sacrificing overall contrast, as you would if you just turned up the brightness (that is, black level) control. Black isn't everything in a TV, but it's a lot.

We started this final part of the face-off by cueing up a couple of nighttime and dark interior scenes from *Black Book*. In an early scene where a black sedan pulls up to a red-brick building's circular drive as night descends, there were some obvious differences between the TVs. As the car moved through the near-darkness, the Samsung LCD looked pretty good, delivering substantial blacks in the car itself and the letterbox bars that framed the screen.

But when we looked over at the Pioneer, we immediately knew we were seeing something special. The same features were so deep that it made the blacks on the LCD look gray — even though this Samsung had the best blacks we've ever seen from an LCD. On the plasma, the car appeared more etched and dimensional against the dark background, thanks to the extra low-level detail, and the letterbox bars virtually disappeared into the set's black frame.

To the LCD's credit, its less-deep black made for more shadow detail: You could better see the brickwork of the mansion than on the plasma, and there was more detail in a large tree in front of the building. We couldn't have achieved that on the plasma without adjustments that would have sacrificed some of the richness of its black reproduction. But even in this relatively dark, shadowy scene, the plasma's extra image depth was fairly obvious.

Other scenes with different lighting produced more similar results. A bright scene from *Vertical Limit* shot on a snow-crested peak revealed more detail in the undulating snow on the Samsung LCD, with dark areas looking about the same as on the Pioneer plasma. But with the most challenging material, the plasma trounced the LCD again and again. And when Al hit the button to jump to the opening scene of the Jupiter Mission in *2001: A Space Odyssey*, the sight of the bright white spaceship against its blanket of black made all three of us gasp. The image was indeed film-like, and it imparted a nearly three-dimensional depth. When we watched a daylight scene with the film's ape men, the black hair on the costumes had a bit more detail on the LCD. But the realism and contrast of the much deeper black on the plasma delivered a dimensionality and punch to other colors that we preferred.

We would have liked this part of the test to be closer, but it wasn't to be. In giving the plasma a 9½ for contrast, the best we could muster for this still very fine LCD was a generous 8.

Bottom Line
We saw some pretty impressive pictures from both TVs in this face-off. But in the end, there was no question that the plasma was our winner, based largely on the incredible strength of its reproduction of blacks.

It's hard to know what LCD might have up its sleeve. I've seen some outstanding LCD prototypes in the last year that suggest the technology has a lot richer blacks to offer than we've seen to date. And I do know there will soon be more LED-driven panels that should improve on this first-generation model. **But for now at least, with Pioneer continuing to drive the state of the HDTV art, one more round goes to plasma.**

Al Griffin, Technical Editor
A fresh comparison of flat-panel TVs is something we've had sitting on the back burner for a while now. Why? Because it took Samsung's 46-inch LN-T4681F to give us the confidence that a current LCD display could hold its own against plasma, much less the best plasma TV on the market.

After tweaking both TVs, I was awestruck by how closely matched their pictures were — the Samsung's really looked that good. It was only with detailed comparisons that we noted some of the LCD's flaws — a reddish cast to faces in Black Book, slightly toxic greens on the golf course in Happy Gilmore, a yellow tinge to snow-capped peaks in Vertical Limit (prompting the inevitable Frank Zappa joke from Mike Trei). In comparison, the Pioneer's color balance was close to perfect.

The Samsung set delivered the deepest shadows of any LCD I've tested. It's just that the Pioneer's blacks were appreciably deeper. In fact, the Pioneer's all-around knockout performance found us nodding to each other in the darkened room, uttering "Kuro" in hushed, reverent tones. Samsung has dramatically raised the bar for LCD TV performance, but the technology still has further to go.

Michael Trei, Contributing Technical Editor
From the minute I walked into the room, I was impressed by how closely Al had matched the images on these two very different sets. Particularly with brighter scenes, the differences were subtle enough that they would be tough to spot under any circumstances — except in a side-by-side shootout like this one.

With most material, the Samsung LCD had a bit more punch in bright areas, but at the same time it tended to hype the color a bit — especially reds and greens. The Pioneer plasma couldn't quite match the LCD's dynamic pop, but its colors were clearly more subtle and realistic-looking. Once we moved to a few night scenes, though, it soon became clear that the plasma could deliver a substantially darker shade of black. The LCD was particularly sensitive to viewing angle as well, and the image quickly washed out as you moved off axis. While I clearly preferred the image the plasma could deliver in our light-controlled video lab, the LCD's added punch would probably be a plus in a room with a lot of light — that is, if the TV's shiny reflective screen surface weren't such a problem. Add it all up, and there's no question that plasma won the day.

Rob Sabin, Executive Editor
As you've read, by the end of our several hours of evaluation, Al, Mike, and I all agreed that the plasma handily beat the LCD — especially in the key area of contrast. I'd also have to agree that LCD as a technology has plenty more growing to do, and hasn't yet shown us the best of what it's got.

But **I think our results here have to be viewed in the context of the tremendous feat that Pioneer has accomplished with its new Kuro sets. The three of us evaluate HDTVs for a living, and we were all blown away by how virtually perfect this 50-inch Elite set was in its execution of every torture test we threw at it. "Best TV — ever" was a phrase heard more than once that day as it began to sink in just how good the darn thing was.**

We have to throw a big bone to Samsung — in fact, a really big bone — for driving forward the state of the LCD art in a significant way, and for bringing a critical new advance (LED backlighting) down to an affordable price. That said, Samsung and all other flat-panel manufacturers in both disciplines now have a new gold standard by which to measure their work going forward. Kudos to Kuro.

Test Bench

Neither TV initially tracked terribly close to the 6,500-K spec for color temperature. In its Movie mode with Low color temp and Color Space Mode 2 settings, the Pioneer plasma ran as high as +1,599 K on the brightest 100-IRE window (that is, quite blue) and +436 K from 20 to 90 IRE. (See our full lab numbers on the Web.) The Samsung LCD, in Movie mode with Warm 2 color temp and Auto Color Space settings, tracked up to +995 K from 20 to 100 IRE, and +752 K from 30 to 100 IRE. Calibration by technical editor Al Griffin brought both to within about ±220 K at 100 IRE and within 150 K from 30 to 90 IRE —

though in typical LCD fashion, the Samsung had more ups and downs and fell further off in the darkest 20-IRE window.

For our comparison, test gear was used to match both panels to a post-calibration brightness of 35 ftL, a comfortable setting for viewing in a dark room. It's worth noting that the Samsung LCD had the edge here in its inherent ability to pump out a bright image, though Al kept it reigned in to make things fair.

Primary colors for both sets measured essentially perfect across the board — a rarity for one TV, much less two. And color decoders were accurate, too, with both TVs showing a minor +2.5% error for red.

Although it didn't count in our face-off rankings, we noted a slight geometry aberration on the Samsung in its "bit-for-bit" Just Scan mode, with about 1 to 2% overscan evident on only the right side of its screen; the Pioneer plasma measured 0% all around. We also ran the Silicon Optix Benchmark tests on Blu-ray Disc and standard-definition DVD, and found the Pioneer's processing superior for deinterlacing both 1080i and 480i signals via HDMI.

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