THE POSSIBILITIES ARE INFINITE

White Paper

Plasma Facts: A compilation of information to reveal truths and uncover misinformation about plasma display technology
Commissioned by: Fujitsu General America
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Executive summary

Plasma displays raise customers' expectations of picture quality in direct-view TV. Still, many flat-TV customers wonder whether plasma displays will live up to their expectations for long-term performance and reliability. This document will advance understanding of the following topics: How long can you enjoy a plasma display before it loses brightness; to what degree does contrast ratio determine overall picture quality; to what degree does phosphor burn-in (image retention) need to be managed during typical viewing; how might altitude affect quality or reliability; in what ways is plasma superior to flat-panel LCD technology. This document will successfully demystify myths and reveal truths about plasma display screens.

What is Plasma and How Exactly Does It Work?

Big, flat plasma displays are made of a grid of tiny gas-filled chambers. They're called "plasma" displays, because in making the light that forms pictures, the gas in tiny chambers is electrified and changed to "plasma state." In fact, the earliest descriptions of plasma displays were referred to "gas plasma displays."

So what exactly is plasma? Most of us learn that the three common states of matter are "solid," "liquid" and "gas." Scientists also study a fourth state of matter, known as the plasma state, -- a distinct state of matter occurring when gas carries electricity. Neon signs, fluorescent lights, arc welders, and even some air purifiers, all generate plasma to work their magic.

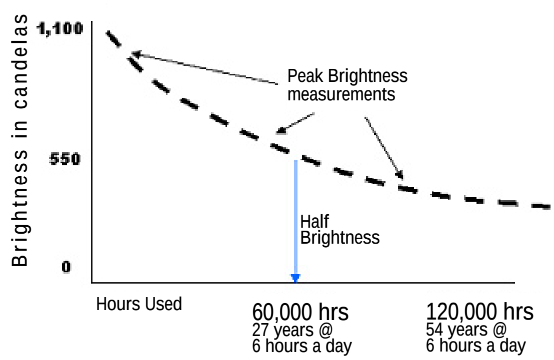
How does a plasma display work? We've all seen how neon lights' pure, vivid colors attract our gaze. Their color varies by the kind of phosphor coating the inside of the glass tube. Imagine shrinking millions of red, green and blue neon lights to the size of less than a millimeter each - and then arranging them in a grid the size of a large TV screen. Next, imagine simultaneously controlling the individual brightness of each one of those lights, relative to all the others, precisely as directed by a video signal. If you could do this, you would be able to show - on a large flat, thin screen - all the color tones, brightness levels and image details we've come to enjoy on smaller, thicker CRT (tube-type) screens.

Plasma LifeSpan

Phosphor-based displays - these include plasma, conventional Cathode-Ray Tube (CRT), rear-screen CRT projectors, and so on - appear quite bright when brand new. Over time, their brightness decreases slightly. At some point, they will be half as bright as when first used. The technical term for this phosphor-brightness trend is "Life to Half Brightness" or LTHB. This term is more accurate than the terms "lifespan" or "half-life" since the phosphors' brightness potential never dims completely. LTHB of a 2005 Fujitsu Plasmavision display is about 60,000 hours. (That's 27 years of typical family TV use.) Compare that to a typical TV, in which LTHB may be as short as 10,000 to 20,000 hours.

Plasmavision Life to Half Brightness

Tested on Fujitsu ALiS 42" Plasmavision Display with AVM Processor



Contrast Ratio

Many factors help determine a customer's satisfaction with a plasma display, including: picture size, peak brightness, color accuracy, signal processing, motion handling, resolution, pixel aperture ratio (fill factor), and contrast ratio. The way you perceive contrast ratio is greatly affected by the light in the room. In a totally dark room, you'll be able to see the benefit of a higher contrast ratio. In a brighter room, a much higher contrast ratio may go unnoticed, dwarfed in importance by other factors such as peak brightness, black levels, and so on.

Contrast ratio (CR) is measured by gauging the energy coming off of different parts of black and white test patterns shown on the set. If the white area is 1000 candelas and the black area is 1 candela, the screen has a contrast ratio of 1000:1. Engineers test CR in pitch-black testing room; otherwise, ambient light lowers the CR measurement. And in typical viewing environments - living rooms, dens, and offices -stray light drops the actual contrast ratio from its "rated" 3,000-to-1 spec, down to a still-satisfying - yet numerically modest - 70-to-1 measured ratio. Meanwhile, human eyes have their own limitations. Our irises dilate and constrict in response to room light changes. More often than not, we will detect contrast ratio no greater than 100:1.

Burn-In

Burn- in mars the screen when unchanging images stay on the screen for a long time. Burn-in can happen on any phosphor-based display. You've probably noticed it on ATM screens, airport flight info monitors, arcade game screens and computer screens. Burn- in can happen also on plasma sets. Techs who work on flat-panel LCD screens say these displays can also burn-in if abused.

The most common cause of burn-in is viewing old-fashion TV shows, in their square-ish 4x3 aspect ratio, centered in the middle of a 16x9 -aspect screen, with black bars on the left and right side of the image. This cause of burn-in was more common when wide-screen plasma displays (and rear-projection widescreen displays) first came on the market. Nowadays, customers use Plasmavision display's wide modes to stretch 4x3 -shaped TV pictures to fill the whole 16x9 screen, virtually eliminating this cause of burn-in.

Station logos, subtitles, and video game scores also drive burn-in worries. Plasmavision display features such as video orbiter (which moves the entire image an inch or two every hour) and an automatic white screen setting (a screen refresh feature - exclusive to Plasmavision sets -which bathes all pixels equally in white, for a minute or so, when you turn off the source signal) eliminate these worries for home theater viewers.

Plasma Vs. LCD

Plasma and flat-panel LCD offer some of the same benefits. (Both boast a flat, thin form factor and undistorted, fixed-pixel image rendering.) Still, plasma consistently satisfies home theater enthusiasts. The reason is simple - plasma makes pictures differently than LCD, and this difference lets plasma make bigger and better pictures.

The main difference is the light source of each pixel. In Plasma's emissive method, each pixel generates its own red, green and blue light, shining directly from the phosphors to our eyeball retinas.

In LCD, white fluorescent light shines through individual LCD subpixels; the job of each subpixel is to remove color wave-lengths and pass remaining wavelengths that approximate primary colors of red, green or blue. LCD's transmissive method limits color range.

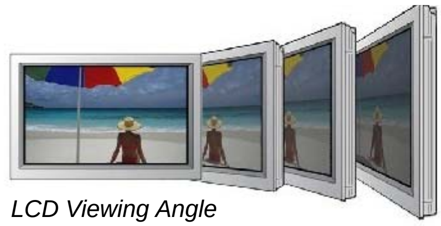
Plasma Vs. LCD: Viewing Angle

Everyone can enjoy a Plasmavision monitor's excellent color and brightness from every part of the room.

Plasma Viewing Angle

Plasma catches your eye from nearly every angle - you can stand almost all the way to the side (or above and below) and still see all the rich colors, brightness and black level as if you were standing directly in front of the plasma. That's because plasma's viewing angle is about 160 degrees.

By contrast, LCD flat panel displays start to drop in brightness and black level when you're just slightly to the side - noticeable at 30° to 45° off axis. At greater angles, the dimming is much more severe.



LCD Viewing Angle

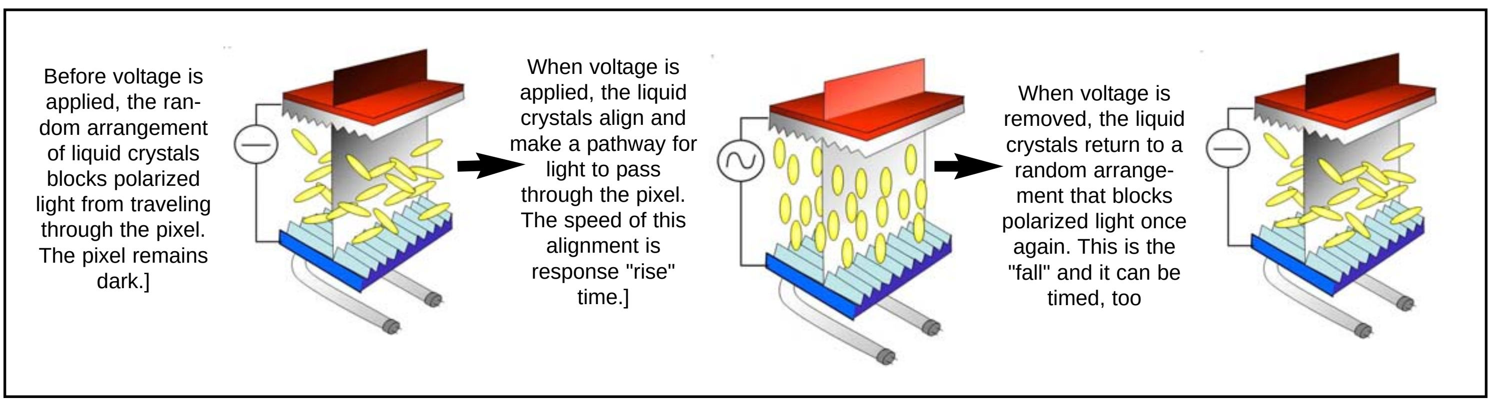
Plasma remains the best choice for customers who seek premium-quality, large-screen flat-panel display devices. The benefits of plasma displays can be summarized as follows: Larger screen sizes are available in mass production, more accurate image reproduction delivers better color accuracy, contrast and brightness, superior motion without artifacts makes sports and action much more enjoyable, stunning brightness from any viewing angle, and better pixel reliability serves up unblemished images over the long term.

LCD and Image Lag

LCD image lag can leave "streaks" or "trails" in its wake. LCD image lag cuts into your enjoyment of TV sports action and fast-paced motion picture movement like dances, car chases and fight scenes. Image lag can be especially fatiguing as you scroll down web pages and documents.

LCD's pixels take time to brighten and then dark again. In fact, the time it takes a pixel to brighten from black to white (its "rise") and darken again (its "fall") is called "response time" and technicians list it in milliseconds (sometimes it's called "pixel refresh rate.") . LCD computer monitor makers routinely publish response time; the VESA standards association publishes technical standards for response time.   Note, however, that some manufacturers publish only the "rise" time or "fall" time; and unless they refer to VESA in their specs, they may not be telling the whole - that is, rise AND fall - truth.

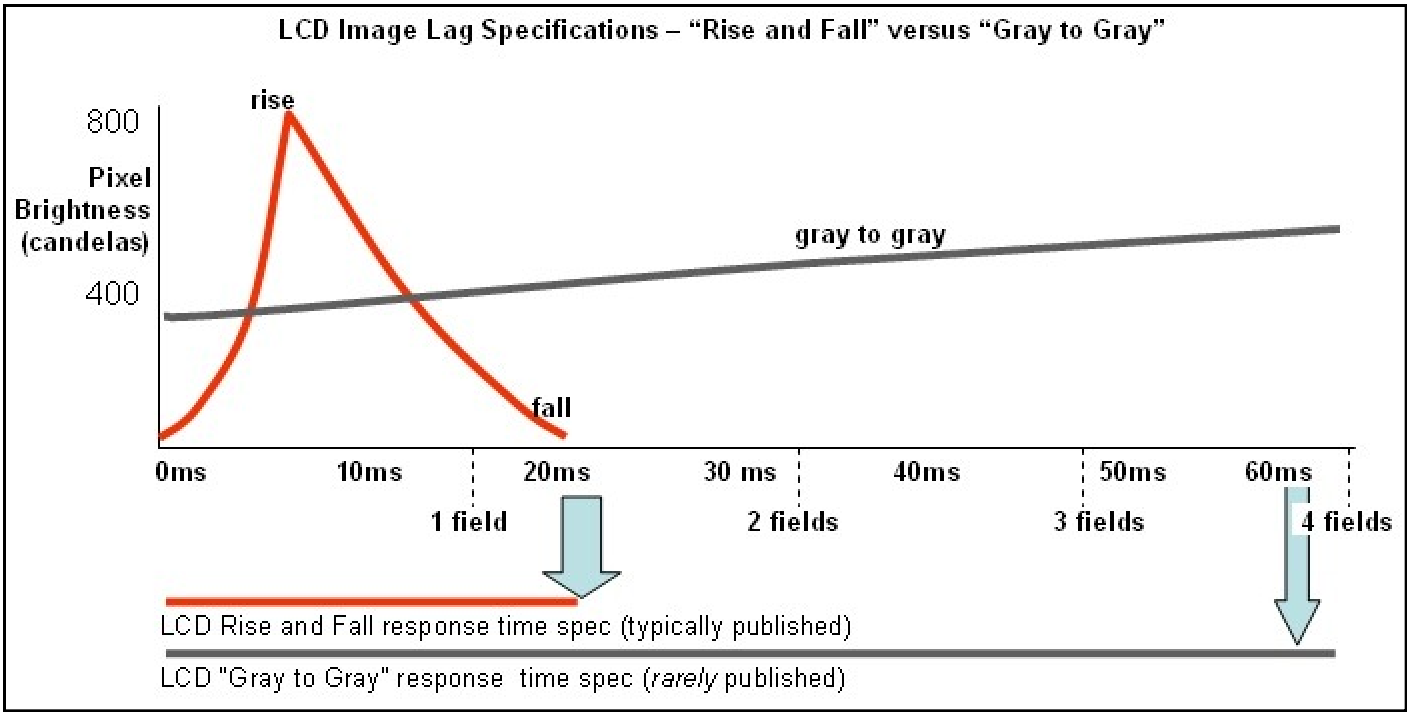
Many of today's larger LCD screens spec out at response times that sometimes exceed 25ms - long enough to smear motion.   Any response time longer than 16 2/3 ms will smear TV's 60 fields-per-second video.



 Meanwhile, plasma display's pixel response time is virtually instantaneous, limited only by the speed of the video processing engine.

Black-to-white response time, often published to help compare model to model, tells only part of the story. Another kind of image lag, caused by slow "gray-to-gray" response time, can bring an unnatural, "paint-by-numbers" look to moving images on LCD screens. The reason is that a voltage change from one shade of gray to another is very subtle - and the liquid crystals take longer to react to subtle voltage shifts than they do to dramatic white-black-white voltage changes.

Viewers notice the gray-to-gray image lag "paint-by-numbers" effect during close-ups of human faces, panoramic sweeps of sky and landscape, and smooth-surfaced images (shiny automobile hoods, for example; also gaming images) as they move across the screen. Gray to gray image lag is a sore subject among serious gamers, too. LCD makers discuss gray-to-gray response time at the engineering level, and concede it can be 4 times longer than rise-fall response time. Since there's no industry standard, specs rarely make it into the world of consumer info. Instead, compare moving images on LCD to simultaneous content fed to phospher-based displays such as plasma and tube type CRT, neither of which suffers from image response lag.

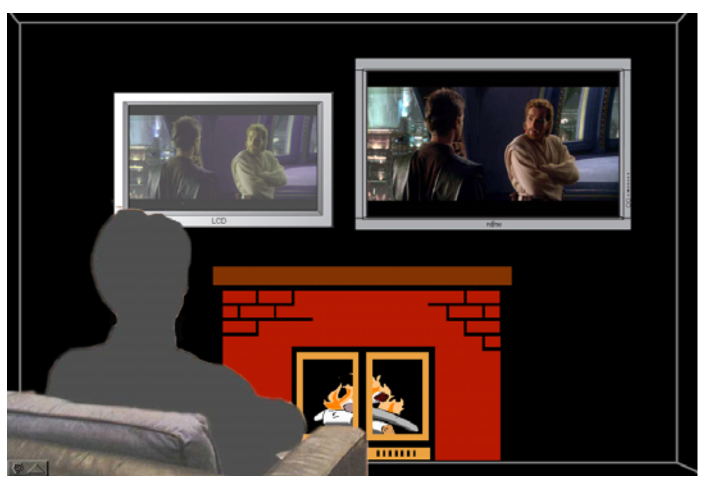


While "Rise and Fall" response times have improved, gray-to-gray response time remains as much as 4 times as lengthy, spanning up to 4 video fields or more.

LCD and Black Levels

The ever-rising brightness specs claimed by both plasma and LCD makers divert attention from another display attribute known as "black level." While both LCD and plasma can claim satisfying brightness, only plasma delivers satisfying black levels. Better black levels drive intangible picture quality aspects like "depth," "detail," "richness," and "pop." The darker the blacks, the more satisfying the picture will be - especially in controlled lighting environments.

The darkest images on Plasmavision sets can be as dark as 1/3 candela - that's the brightness of a turned-off phosphor In a dark room, that is essentially "black," in the sense that the human eye sees nothing darker in the room. Meanwhile, today's LCD flat panel displays cannot generate an image darker than 3 candelas - 9 times brighter than plasma's blacks - when watching the LCD set at a 90-degree, dead-center viewing angle. At a more oblique angle, the black level (or as some put more precisely, "dark blue level") rises.



LCD (left) and plasma both deliver bright images. However, in a dark room environment, plasma displays' rich black levels help deliver a more satisfying picture.

In considering your display screen, be sure to weigh the kind of lighting, time of day, and primary content. If these elements vary widely, you will want a screen that delivers satisfying images among the widest range of conditions.

We're fortunate to have more than one flat panel display category to choose among. Today, LCD sets dominate the smaller choices, Plasma the larger sizes, with an overlap at the 42-to-45 inch range. Your choice will best be made with your primary application in mind. Smaller sizes with high resolutions are wise to consider if your primary application is nose-to-the-screen computer work, web surfing and personal gaming. Small screens also make sense for individual, on-the-go entertainment. LCD's brings its advantages to that kind of user. Meanwhile, larger screens make better sense for family viewing, interactive gaming, and home entertainment. Screens best suited for home entertainment content - movies, sports, and competitive gaming - are today's big, bright, eye-popping plasma displays.

Conclusion

Home entertainment display purchasers find that the package of benefits delivered by plasma displays eclipses all other display categories. More affordable than ever before, this technology brings large screen sizes, bright picture, high contrast ratios, excellent black levels, freedom from burn-in through normal use, wide viewing angles, and crisp motion handling. Additionally, plasma is a field-tested technology backed by over a dozen years of customer satisfaction. No other flat display technology carries this set of benefits to the market.