Featuring

New Lineup of "Vistarich" Amorphous Silicon TFT LCDs and Capacitive Touch Panels

- "Vistarich" wide viewing angle technology
- Monochrome "Vistarich"
- 3D displays and double-screen displays
- Capacitive touch panels

Vistarich

* "Vistarich" is a trademark or a registered trademark in Japan and other countries. Ownership of this trademark was transferred to Sony Corporation from Epson Imaging Systems in association with the transfer of business assets that occurred on December 1, 2009.

In addition to their existing low-temperature polycrystalline silicon (LTPS) TFT LCD products, Sony Mobile Display Corporation (SMD) has now added amorphous silicon (a-Si) TFT LCD and capacitive touch panel products to their product line through the partial business transfer from Epson Imaging Devices Corporation (EID) on December 1, 2009. (See the Side View section in this issue for a related article.)

Improved picture quality displays are drawing increasing attention for use in mobile products, which are becoming increasingly multifunctional, and automotive products as well. In this article, we introduce both the a-Si TFT LCD "Vistarich" technology, which is being developed to provide screens with improved legibility and even richer color reproduction, and touch panel technology that will accelerate the adoption of touch panels in even more products and contribute to improved operability.

"Vistarich" Wide Viewing Angle Technology for 180° Left/Right and Up/Down Viewing

Due to the increasing functionality of mobile equipment and the diversification of display types used in automotive equipment, in addition to requirements for higher difinition, wider viewing angles, and wider color gamuts in displays used in such equipment, there are increasing calls for faster response times, lighter weight, more compact designs, and ultralow power consumption as display device characteristics.

To respond to these needs, up to now Sony has developed, at SMD, the LTPS "VSPEC III"[*1] technology for small-size, high-difinition displays, and EID has developed the "Vistarich" based on a-Si technology for medium size high-resolution displays. Thus Sony now has two wide viewing angle technologies.

Like the LTPS "VSPEC III" technology, the a-Si based "Vistarich" shows minimal color changes as the viewing angle changes and achieves rich, high-quality images. Also, since there is minimal unevenness in the response speed in the middle region of the contrast scale, it can also achieve superb picture quality for moving images. Furthermore, energy savings in the backlight system and even thinner forms will be possible due to efforts to increase the aperture ratio.

Figure 1 "Vistarich" Wide Viewing Angle Technology

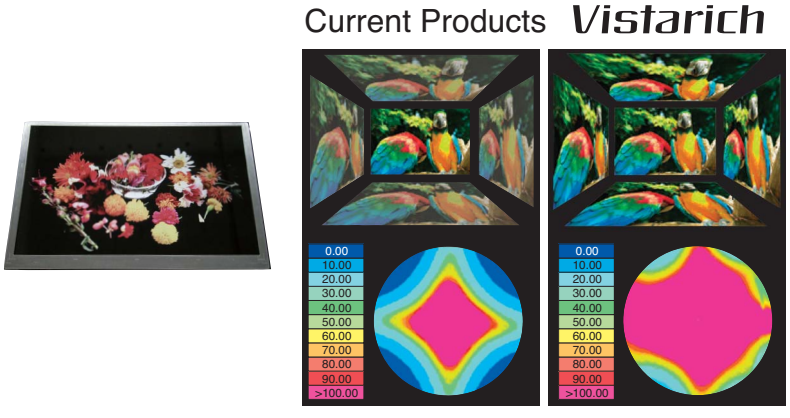
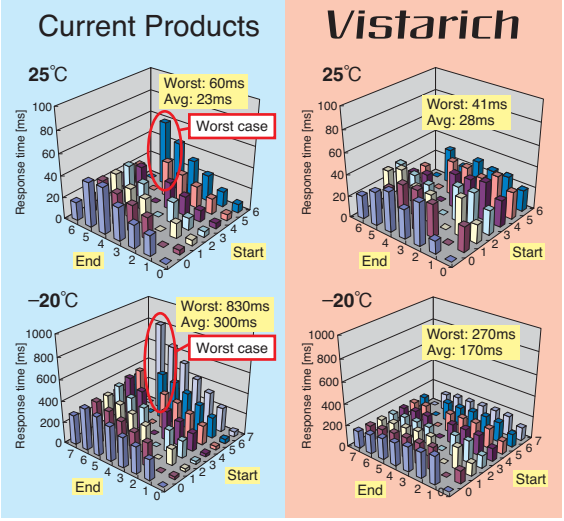


Figure 2 Response Speed



■ Features of the "Vistarich" Technology

1. High contrast and minimal color changes even with a narrow viewing angle

In the conventional TN (twisted nematic)*2 narrow viewing angle displays, there is an extremely large degradation in image contrast as one moves one's viewing angle away from directly perpendicular to the screen. Also, from the standpoint of tonal reproducibility, when one views these displays from an angle, the brightness of the middle tones increases and there is an inversion of tonal levels.
In contrast, the "Vistarich" displays can maintain a contrast of 100:1 even from a viewpoint slanted at up to 80° in any direction and can display the midtones correctly. As a result, these displays can achieve truly gorgeous images with color variations held to a minimum.

2. Lower power consumption due to high aperture ratio and transmittance

Progress is being made in improvements to "Vistarich" in areas such as pixel rules and the LCD horizontal orientation, and these devices achieve a high aperture ratio and transmittance. This reduces the power required by the backlight, which is responsible for most of an LCD module's power consumption, and contributes to energy savings.

3. Minimal variations in response speed at each tonal level

Compared to earlier products, "Vistarich" displays have minimal variations in response speeds not only in room temperature environments, but in low-temperature environments as well. This can minimize residual images from motion display. Thus these are optimal displays for mobile equipment in which video playback functions, such as One-Seg and DVD, have become standard, and for car navigation equipment.

*1 "VSPEC III" is a trademark of Sony Corporation.

*2 In TN displays, the liquid crystal molecules, which are sandwiched between two layers of glass, are oriented so that they twist 90° and those liquid crystal molecules pass light when they stand vertically. This is the most common LCD structure.

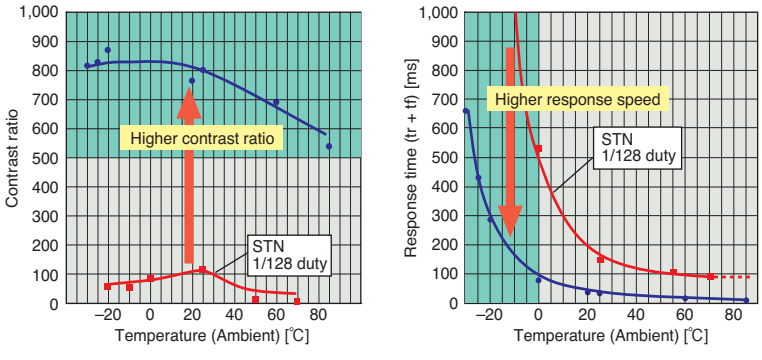
Deployment of Monochrome "Vistarich"

In addition to the color "Vistarich" deployed for mobile equipment and car navigation equipment, we are also actively developing monochrome "Vistarich". This monochrome "Vistarich" is being increasingly deployed in automotive applications, and is used in the cluster (the area that includes the speedometer and tachometer) where it displays large amounts of information about the car's state (such as the current gear) and simplified navigation information while minimizing the driver's need to change where he/she looks.
Since automotive applications are expected to be used in a wide range of environments worldwide, from places with temperatures below -20°C to desert regions with temperatures over 50°C, reliability and specifications over a wide temperature range is strongly desired. While STN (super twisted nematic)*3 LCD displays have been the mainstream in monochrome displays until now, their contrast, crosstalk, narrow viewing angles, and low-temperature response characteristics have been major problems. SMD has achieved wide viewing angles by adopting the "Vistarich" technology, has achieved strong blacks with that technology's high contrast, and has achieved significant improvement in response speed at lower temperatures. Thus "Vistarich" is achieving radical improvements in display legibility.
SMD is moving forward with sales promotion aimed at persuading customers to use monochrome "Vistarich" in place of monochrome STN with and then deploying this technology in applications other than automotive ones.

*3 STN is a liquid crystal structure that increases contrast by twisting the liquid crystal molecule orientation more than in TN LCDs, i.e 180° to 270°. It is used in comparatively simple displays.

Figure 3 Monochrome "Vistarich"

Figure 4 High Contrast and Fast Response Achieved by Monochrome "Vistarich"



3D Displays and Double-Screen Displays

Recently, 3D video has become increasingly popular, both in movies and on TV. While 3D video is experienced on TV and in movies by wearing special 3D glasses, SMD is working on the development of a naked eye (direct viewing) 3D display for automotive applications for small and medium size displays. This 3D display is based on the combination of LCD and parallax barrier technologies shown in figure 7. Increasing the number of viewpoints and the barrier structure will be critical elements in the future to achieve high picture quality 3D video. While the legibility of 3D display is improved by increasing the number of viewpoints, this also reduces display brightness. Thus it will be necessary to select the number of viewpoints according to the application in which the display will be used.

There are two structures used for the parallax barrier, which is the other important element in a 3D display. Whereas in the stripe structure the resolution is degraded by 1/2 only the horizontal direction, in the step structure, the degradation is distributed evenly and is $1/\sqrt{2}$ in both the horizontal and vertical direction. The human eye is said to be extremely sensitive to resolution in the horizontal direction, but is also said to be, inversely, relatively insensitive to degradation in the vertical direction. Still, the step structure can achieve 3D video in which image degradation is relatively suppressed. SMD is actively developing displays for mass production with optimal numbers of viewpoints and barriers to match various applications, such as portable information terminals and portable AV players.

It is also possible to implement double-screen display using a similar structure to that of 3D displays and mass production has already begun for use in car navigation systems.

In these double-screen displays, the step structure, which holds to a minimum the degradation in resolution due to the image separation of the parallax barrier in the same manner as in 3D displays, is used. In combination with backlight improvements, SMD is making it possible to display optimal images to the left and right, for example such a display can show a navigation screen to the driver and a DVD or other video to the passenger.

Capacitive Touch Panels

Due to their ability to provide intuitive interfaces, touch panels are used in a wide variety of products such as cellular phones. There are several types of touch panel, including resistive membrane and digitizer systems, but the method that is the focus of attention for use in cellular phones and is expected to show phenomenal growth is the projective capacitive method.

Figure 5 Principles of 3D Display Operation

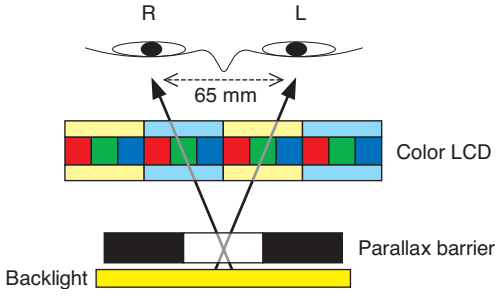


Figure 7 Parallax Barrier

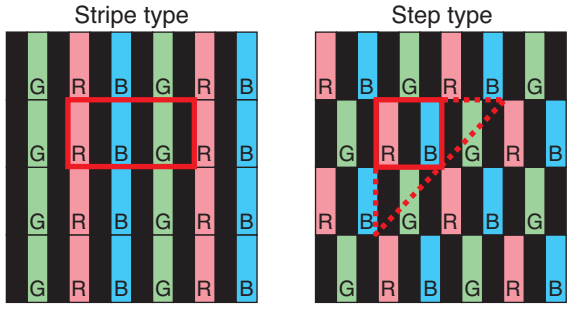
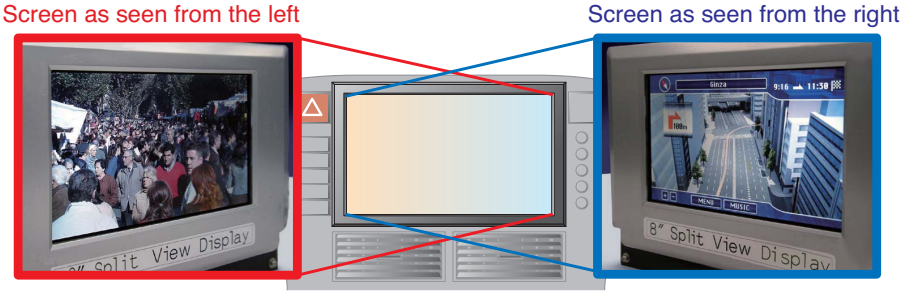


Figure 6 3D Display

Figure 8 Double-Screen Display Concept



Two years have passed since the development of SMD's capacitive touch panel, and they have been adopted in major cellular phone products in the Japanese domestic market and in smart phones outside Japan, achieving strong sales.
In the remainder of this article, we present the features of this technology.

■ Good Legibility and Superb Optical Characteristics

Since touch panels are normally placed on top of the display device, it is important that they provide good legibility and superb optical characteristics.
Even if the display itself is bright, attractive, and easy to view, the display's image quality can be seriously degraded when viewed through the touch panel sensor, since the touch panel sensor pattern may be visible, the brightness may be reduced, and ambient light may be reflected.
To resolve these problems, SMD's capacitive touch panels adopt LCD technology to achieve excellent legibility and superb optical characteristics.

Improved Legibility

- The sensor pattern has been made narrower by optimal pattern design and leading-edge patterning technology.
- Development of a jumper process that makes it possible to locate the sensor pattern in the same layer.
- Application of optimized thin-film technology

As a result of the above technology developments, SMD succeeded in reducing the loss in brightness to a level such that the difference in transmittance is not visually detectable. (When there are differences in transmittance between different parts of the pattern, or when there are visually detectable differences in transmittance between sections where there is sensor pattern, and were there is no sensor pattern, the sensor pattern form becomes visible and the overall legibility is decreased.)

Superb Optical Characteristics

- Superb transmittance and surface planarity are achieved by using a glass substrate.
- Development of a technology for bonding the touch panel to the cover lens

These technologies make high transmittance, low reflectivity, and low dispersion possible.

■ Wide Touch Sensitive Area

While display sizes are slowly increasing, as can be seen in current smart phone products, the outer dimensions of these products are not changing significantly due to the requirements that they be easy to hold and portable. Thus there are demands to make the touch panel, which is used along with the display, as large as possible without changing the size of the end product itself. This means that how short the distance from the outer edge of the end product to the edge of the touch panel can be made is an important issue for these devices.
SMD has succeeded in assuring a wider touch sensitive area by adopting LCD interconnect design and forming processes to achieve a fine electrode interconnect pitch that is 1/10 that of the film type capacitive touch panel.

■ High Quality and Reliability as a Comprehensive Manufacturer of Small and Medium Size TFT LCDs

It is natural that equal, or even higher, physical quality and reliability than that required in displays, is required in the touch panels used along with the display. SMD supplies products that our customers can use with confidence by applying the same high quality control management standards to touch panels.

Figure 9 Capacitive Touch Panel Layer Structure

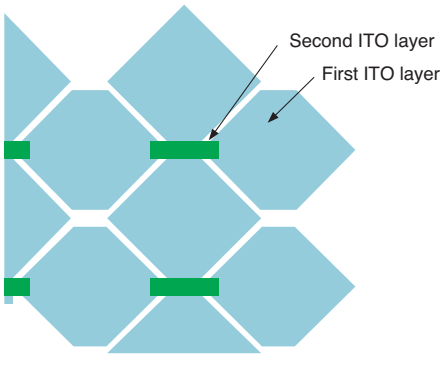


Figure 10 Form in which Capacitive Touch Panels are Supplied