

# CLEVERDIS

## SPECIAL REPORT

 **IPS**<sup>®</sup>

**Super-IPS**

Wide Viewing Angle  
Technology by:

 **LG.PHILIPS LCD**   
Technology You Can See!

# editor editorials

Richard Barnes, Editor in Chief  
Cleverdis



*Richard Barnes has been working as a journalist and presenter since 1980, winning, in 1984, the Pater Award for radio journalism in Australia. Moving to Europe in 1986, he has worked for numerous media organisations over the past 15 years in the fields of print, radio and TV. His work has included the creation of "Finance and Investment in Monaco". For the past three years, Richard has been part of the steering committee of Cleverdis, and manages the international editions of the Cleverdis Guides.*

Bruce Berkoff, Executive Vice President  
LG.Philips LCD



*Bruce Berkoff is chartered with promoting and positioning LG.Philips LCD's display solutions worldwide. Prior to this, Bruce was General Manager for the software and electronics business unit of Philips Flat Display Systems. Bruce held several senior marketing and management positions with different leading Silicon Valley technology companies, including UMAX Corporation, Radius, SuperMac Technologies and Ziff-Davis Labs. He holds a degree in physics from Princeton and biophysics from the University of California at Berkeley.*

The display industry is evolving so rapidly nowadays that often the most experienced resellers have problems keeping up with the changes. Recently, liquid crystal displays (LCDs) have emerged as the new "flat display" of choice, leaping from the notebook, to the desktop PC and soon to the home TV. In the past few years, the evolution of the plasma display panel (PDP) industry has also seen the development of big, space efficient screens with vastly improved picture quality... coming almost down to prices that are within reach of many average households in North America, Europe and Asia. At the same time, thin film transistor (TFT)-LCD monitors have become larger, and an every-day item in many homes and offices, replacing bulky cathode ray tube (CRT) models. Now, however, a new trend is making itself evident. TFT-LCD is biting into the territory of the bigger screen PDP with some advantages of both quality and economics, and many people are realising that their desktop monitor can also be very useful for watching TV or DVDs. With this convergence and market cross-over, end users on the one hand may become confused, but on the other hand, they will find a whole new world of opportunities opening up to them. In this Special Report, we highlight a specific technology known as Super In-Plane-Switching (S-IPS) (details in Technical section). This technology, which is starting to be adopted by certain TFT-LCD manufacturers, will totally change the abilities of TFT-LCD screens as we've thought of them in the past, thanks to vastly improved viewing angles (this had been one of the major drawbacks of LCD in the past) and color performance. Added to this, the development of better electronics and image handling techniques means that the fuzzy or blurry moving images that have until now greatly marred LCD TVs will be largely overcome. With 42" LCD screens hitting the market, and prices continuing to drop, breath-taking large screen LCD TVs has finally arrived!

LG.Philips LCD has made several important leaps forward recently, which help us to not only address the new growing market for LCD TVs, but also serve our existing customers in the notebook and monitor space with larger and wider screens. By having the world's first Gen 4 factory three years ago, the world's first Gen 5 factory in May 2002 and its second Gen 5 factory in March 2003 (the world's third), LG.Philips LCD became the largest TFT-LCD manufacturer in the world by Q4'02, according to USA analysis firm DisplaySearch\*. With the onset of bigger mother glass, this helps us serve new markets like the new wide and big screen monitor market (17W and 23W for example as well as the emerging market for LCD TV (from 13" to 42W). In 2002, we introduced the 30" LCD TV, and we have now announced the 42" LCD screen, which will be out later in 2003. Bigger factories allow us to produce bigger panels more effectively and open up new markets. Compared to PDPs, LCDs use less power, weigh less and are thinner. One might say that a 42" PDPs don't have to get much thinner, but if you're thinking about installations where you're wanting to slide them in and out of the wall or ceiling, you really can't afford that extra inch or two, nor the extra 100 watts of energy because of the space constraints and too much heating. So with less power, less weight and being less thick, you actually allow for many different types of installations, which will really affect people's living and working spaces. Changes to interior design and furniture will be enabled by LCD TVs. With all the advantages of large screen LCDs, the addition of an incredible wide-viewing angle technology known as Super-IPS, or "S-IPS" will enable higher performance LCD TVs than ever before and will no doubt become a major new deciding factor for purchasers. We hope this Special Report assists you in better understanding the advantages of this great technology.

\* According to Displaysearch's Quarterly Large-Area TFT-LCD Shipment Report Q1'03, by input capacity "area" and "large" unit shipments.

**AN ANALYST'S PERSPECTIVE**

*Ken Werner is in a unique position in the industry to be able to comment on different display technologies, and is often consulted by manufacturer and channel alike. His varied activities give him a broad vision on the industry as a whole as well as its future, and also place him in a position of influence within the market.*

*Kenneth I. Werner is the President of Nutmeg Consultants, which provides consulting services to companies in the information display and related industries, as well as to companies using and integrating displays. He is also a founding partner of Chorus Consulting, the Asian-U.S. partnership of display consultants. Nutmeg Consultants provides the editorial staff for Information Display magazine and Information Display On-Line (for both of which Mr. Werner serves as Editor-in-Chief).*



**Ken Werner**

**NUTMEG CONSULTANTS**

2 Shady Brook Lane  
Norwalk, CT 06854  
USA  
+203 853 7069

**Nutmeg** Consultants

analysis

**Cleverdis:** As a long-term observer of display technology and the display industry, you have no doubt been seeing some extraordinary advances in the past couple of years, not the least of which has been the race for bigger sizes in LCDs, but there have been some stumbling blocks in terms of obtaining better viewing quality. LG.Philips LCD has been aggressively promoting its S-IPS, technology. How significant is S-IPS for large-screen, flat-panel TVs?

**KW:** Let me answer that from an historical perspective. Not many years ago, color TFT-LCD panels had fairly narrow viewing angles and slow response times. They were fast enough for notebook computers and professional monitors, but people didn't seriously think about using them for TV and video applications -- moving images just smeared too badly. Then, a new LCD mode was commercialized: in-plane switching (IPS). By arranging for the liquid-crystal molecules to remain parallel to the plane of the display whether they were switched ON or OFF, IPS provided an image that was much more constant, regardless of the angle from which it was viewed. It

therefore provided a wide-viewing angle, with colors that remained much truer than previous LCD technologies when images were viewed off-axis. This was appreciated by people like graphic artists who often needed to show their on-screen work to one or more colleagues, but this original IPS mode was even slower than the twisted nematic (TN)-LCD technology it replaced. It was good for monitors, not televisions. With S-IPS, off-axis color rendition has been improved even more, and has now been combined with an overdrive method that improves response time to the point that smearing of moving images is no longer an issue.

So, since S-IPS allows consumer electronics companies to make LCD TVs with good moving-picture quality, and allows people to watch those TVs from pretty much anywhere in the room without sacrificing color fidelity, it is clearly a significant enabling technology for LCD TVs.

**Cleverdis:** Can you tell us how this wide-viewing angle technology differs from others?

**KW:** Other than S-IPS, there are two basic approaches to wide-viewing angle LCD panels that are suitable for LCD TVs. The first is to use a more-or-less traditional TN panel and increase its viewing angle with compensation films. This works reasonably well, but the films are expensive and there are still color distortions at larger viewing angles. The second approach is multidomain vertical alignment (MVA) technology, which was invented about five years ago. Like IPS, it improves performance by changing the internal configuration of the LCD cell and uses a different liquid-crystal mode, but the configuration is entirely different.

MVA has good response time and good viewing angle though perhaps not as good as S-IPS, but MVA does not seem to maintain true image colors at large viewing angles as well as S-IPS. In addition its structure adds a fabrication step, which increases cost.

Overall, we find S-IPS to be a significant technology for enabling large-size TFT-LCDs to become viable solutions for high-quality flat TVs !

# TFT-LCDs - getting around the drawbacks

## Principle Advantages of IPS

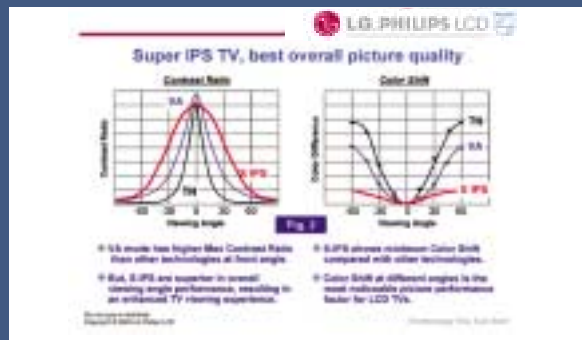
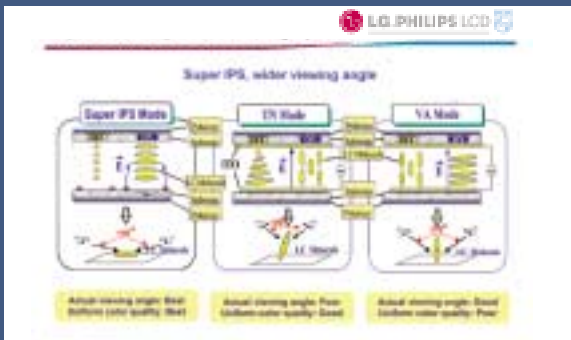
IPS shows good viewing angle characteristics without any optical films. Viewing comfort is enhanced, because IPS shows almost CRT-like properties in terms of viewing angle. In addition, IPS is very advantageous for moving pictures because of its fast response time for all gray levels, especially when combined with an ODC(Over Driving Circuit).

## Desired Technical Characteristics

- Wide Viewing Angle > 180 (L/R, U/D)
- Full Motion Picture < 16ms
- High Brightness > 250~500nit
- Natural Color > 72%
- Long Reliability > 50,000 hours
- High Contrast > 400:1

## Advantages Compared to CRT

- Low power consumption
- Space saving
- Vivid picture quality
- Sleek industrial designs



**Super IPS for a Super LCD TV viewing experience!**

## Actual Color Shift Comparison - Horizontal

<60 degrees LEFT>      <FRONT>      <60 degrees RIGHT>

**Super IPS**

**VA**

**Fig. 3**

Do not copy or distribute. Copyright © 2003 LG Philips LCD *Technology You Can See!*

## “The Importance of S-IPS Technology for LCD TVs”

The following is an extract from a White Paper by Ken Werner from whom we heard earlier in this Special Report. In this specific section, we have extracted an important commentary regarding refresh rates – something that is vitally important to the future of LCDs, but which is difficult to grasp for the layman. The full text of the White Paper may be obtained upon request to LG.Philips LCD.

### What S-IPS Does

The kinds of LCDs that are used in TV sets work by changing the polarization of light waves as the light passes through the liquid-crystal material, and then blocking more or less of the light depending on the change in polarization. Traditional LC materials – called TN materials – change the polarization of the light by tilting their molecules out of the plane of the display (see fig. 1b). This mechanism is fine for laptop computers that are normally viewed head on, but light that passes through the display at angles that aren't small is changed in a different way from light that goes through the display at a right angle. This is what gives rise to brightness, contrast, and color distortions.

S-IPS solves these problems by using a switching mode that keeps all of the molecules in the plane of the display at all times (see fig. 1a), and does it in such a way that light passing through the display at an angle is not treated very differently than light passing straight through the display. As a result, brightness, contrast and color rendition are much more constant, regardless of where in the room a viewer is sitting (see fig. 2).

### 12 Milliseconds Gray-to-Gray Response Time

S-IPS dramatically improves viewing angle and off-axis color fidelity, but does not by itself cure the smearing of moving images. LCD designers have worked hard for years to bring the total response time of an LCD down to below 16.67 milliseconds, which would theoretically allow the LCD to faithfully follow all standard video signals (the time for 1 frame of 60 frames/second film). They first measured the switching time from black to white to black because that was the easiest thing to measure but it is not representative of the video content most people watch.

With some more research, it became obvious that switching times from one gray level to another are generally more useful in predicting real front of screen image quality and performance with real video content. To minimize smearing, it is necessary to get most gray-to-gray switching times down below 17 milliseconds. Through a combination of optimizing the liquid-crystal material and designing a new electronic drive system based on a proprietary ODC. LG.Philips LCD engineers have succeeded in reducing gray-to-gray switching times to about 12 milliseconds.

### What It Means

A well-designed LCD TV set incorporating an S-IPS LCD panel with ODC display images with a wide- viewing angle, no color shift and a 12 milliseconds gray-to-gray response time for no-smear motion video. This is finally a premium television that's truly premium.

Of course, there are technologies that are attempting to compete with S-IPS LCD TVs. There are two other “wide-viewing angle” LCD technologies. The first, sometimes called “wide-view twisted nematic” (WVTN) LCD, is a more-or-less traditional TN panel with its viewing angle increased with compensation films. This works reasonably well for notebook computers and small-screen TVs, but the films are expensive and there are still brightness, gray-level-inversion, contrast and color distortions at larger viewing angles.

The other large-screen LCD technology is a MVA LCD. Invented about five years ago MVA, like IPS, improves on the performance of traditional LCDs by changing the internal configuration of the LCD cell and uses a different liquid-crystal mode. But the MVA configuration still switches by changing the tilt angle of the LC molecules, and it still requires expensive compensation films. It does a good job of maintaining brightness and contrast at large viewing angles, but color distortions can be severe (see fig. 3).

S-IPS is an impressive technology that enables LCD TV to deliver a premium, wide-screen viewing experience.

# The Importance of S-IPS Technology for LCD Televisions



**Eddie Yeo**

**LG.PHILIPS LCD**

17th Floor, LG Twin Towers  
20, Yoido-dong,  
Youngdungpo-gu  
150-721 Seoul - Korea  
+82 2 3777 0707  
www.lgphilips-lcd.com

*Mr. Eddie Yeo is responsible for the technology and development of TFT-LCD for monitors and TV applications. He is credited with successfully developing the company's 15-inch , 18.1-inch and 20-inch UXGA TFT-LCDs for desktop monitors, its 20-inch and 30-inch wide XGA for LCD TVs , as well as the world's first 52-inch TFT-LCD for TVs. Before joining LG.Philips LCD, he spent 20 years developing CRT monitors and televisions.*



interview



**Peter Brunklaus**

**PHILIPS CONSUMER ELECTRONICS**

PO. Box 80002,  
5600 JB Eindhoven  
The Netherlands  
+31 40 273 5373  
www.philips.com

*Peter Brunklaus has been part of the Philips Television Group since 1995. He was responsible for different product segments before taking the responsibility for 'Flat TV' within Philips Consumer Electronics in 2000. Flat TV is the trademark of Philips consisting of Plasma and LCD TV.*



interview

**Cleverdis:** Tell us about how and why S-IPS was chosen by LG.Philips LCD.

**EY:** LG.Philips LCD has had extensive experience in mass-producing all available technologies – namely TN, VA, and IPS – and after a comprehensive examination of each technology, LG.Philips LCD decided to go with IPS technology for its high-end products because of the display performance superiority. When LCD usage trends moved from notebook applications to monitors and TV applications, we investigated which viewing angle technology could enable us to compete with other displays like CRTs and later PDPs. We decided to adopt the IPS technology because of its CRT-like viewing angle characteristics.

**Cleverdis:** What does this really mean for end users?

**EY:** Simply put, IPS provides the best display performance for LCD TVs - bar none. The widest viewing angles, the sharpest images, the best response times, and the least color distortion from any angle. People are used to the image quality of CRTs, which have been the most popular display technology until now. People want to enjoy the benefits that a flat panel display-like LCD brings, but they don't expect any viewing disadvantages with an LCD. Considering that narrow viewing angle is one of an LCD's main disadvantages, IPS is a unique solution that makes customers much more satisfied with LCD TVs. LG.Philips LCD is constantly improving and updating our technology, and our new Super-IPS has the best performance yet, which we will incorporate in all of our large and wide TFT-LCDs this year, from 17" wide up through 42" wide.

**Cleverdis:** Philips LG.Philips LCD's LCD panels for its LCD TVs. What is the value-add in this?

**PB:** There's great value in working vertically aligned. LG.Philips LCD is one of the top producers of TFT-LCD panels, and we are working closely together with them shaping the market with new and advanced LCD TV products with high performance and quality. The secure supply line is a great value, not only for Philips, but also for our retailers and of course the end user.

**Cleverdis:** To this end, what has the feedback been, and how is LG.Philips LCD dealing with this?

**PB:** One of the main issues in the past with LCD screens was the poor viewing angles. It's great if you're just in front of the screen, but if you're off to the side, the image is poor and lacking color and quality. Another problem is the speed of the panels resulting in moving artifacts and blur. LG.Philips LCD took this feedback very seriously and developed the S-IPS technology, which is the best technological solution to solve these problems. Next to this, Philips will add the PixelPlus Technology, also to their LCD TVs, which increases the quality of the picture and takes away remaining motion artifacts.

**Cleverdis:** How does Philips see the future of LCD-TV?

**PB:** It's definitely the future for TV. From market research we know that consumers love Flat TVs: "The Wall hanging TV". This development will give a boost to the TV and to the TFT-LCD industry. We are expecting the product range quickly to include screen sizes between 13" and 52". It is of course important to reach prices which are in reach of the broad public. Philips and LG.Philips LCD are investing to make this possible.

Mr Tajima is responsible for the Business Planning Div. for Hitachi Displays, Ltd. He joined Hitachi as Department Manager in the Electron Tube Division. He was then promoted to Product Manager for the Electron Tube & Devices Division before assuming the responsibilities of Product Manager for Displays.



Zenzo Tajima

**HITACHI**

Nippon Bldg., 6-2, Otemachi 2-chome, Chiyoda-ku Tokyo, 100-0004 - Japan  
+81 3 4226 6803  
www.hitachi.com

**HITACHI**  
Inspire the Next

interview

As Zenith's Senior Product Manager, Vinay Awasthi manages the company's LCD and Plasma TV lines. He is credited with starting the LCD and Plasma lines for Zenith, and is responsible for growing these lines to one of the broadest in the industry. Prior to joining Zenith, Awasthi worked for LG in Korea.



Vinay Awasthi

**ZENITH**

1000 Sylvan Ave, Englewood Cliffs, NJ - 07632 - USA  
www.zenith.com

zenith

interview

**Cleverdis:** What direction do you see flat (thin) screen TVs taking in the next couple of years?

**ZT:** The Flat screen TV market is taking off. Today PDP, are dominant for large sized flat TVs (>30"), but LCD technology has improved its performance to introduce IPS technology and peripheral technologies, for example over drive and impulse drive technologies. LCDs will compete with PDPs in large-sized flat TVs in the near future.

**Cleverdis:** How will Hitachi be integrating LCDs into TVs?

**ZT:** Hitachi Displays is trying to introduce high performance LCDs (Advanced S-IPS) to the market. Hitachi, Ltd. introduced the first high performance LCD TV without blurring using impulse drive. The LCD used in this TV set is our Advanced S-IPS LCD.

**Cleverdis:** How important are S-IPS (and other technological advances) by LG.Philips LCD are in moving LCDs into this domain?

**ZT:** We are very happy that LG.Philips LCD is using our developed technology. We expect LG.Philips LCD to be a good partner in promoting S-IPS technology.

**Cleverdis:** How do you see sales progressing in this field?

**ZT:** S-IPS will become the de facto standard of LCD for TV applications. This technology will compete with other LCD technologies like VA and TN. We expect S-IPS sales to steadily progress in this field.

**Cleverdis:** How does LCD TV fit into your equation?

**VA:** LCD TVs are one of the cornerstones of Zenith's Digital strategy. Zenith's parent company and technology partner, LG Electronics, is one of the few companies in the world today that has core competencies in both Plasma and LCD making us a complete flat panel provider. In 2003, we offer one of the widest range of flat panels including more than ten LCD models ranging from 13" to 30", covering both standard and wide formats. We will add 42" and 52" LCDs in 2004.

**Cleverdis:** Until now, what have been some of the drawbacks of LCD TVs?

**VA:** LCDs, in its initial lifecycle stage, were handicapped primarily on response times, viewing angle and size. LCD were perceived to be a small TV product that could be mostly used for personal viewing. As LCDs come of age, we see major manufacturers offering large sized panels (even larger than 40" or 50") with incredible viewing angles (LG.Philips LCD panels have the widest 176 degree viewing angles) and response times (effectively less than 15 milliseconds for some LG.Philips LCD panels!). This will herald the arrival of LCDs into mainstream TV viewing.

**Cleverdis:** With LG.Philips LCD developing panels using S-IPS technology, this means much better viewing angles. What does this mean now for the user?

**VA:** The viewer can start using LCDs for their "main TV" and thus a larger audience- families can sit in front of their LCD TVs and watch a program without having to fight for the central spot! We will see LCDs moving into applications that were so far reserved for other technologies LCDs will be placed in bedrooms, living rooms and even home theatre systems without any limitation. Higher viewing angles, picture performances and the sleek profiles of LCDs will give consumers a lot of life style choices.

# LG.Philips LCD brings you a full line up of large & wide LCD TV modules, all with Super-IPS!



- First to develop and mass produce 14.1" XGA, 18.1" SXGA, 20.1" UXGA, 22" WSXGA, 23" WUXGA, 30" WXGA

- World's No.1 large-area supplier in all of 2002\* and No.1 overall in Q4 '02 and Q1 '03\*\*

- World's No. 1 monitor module supplier for over 3 years and No.1 in 15" notebook today\*\*

- Highest rated LCD manufacturer for 2002 and 2003\*\*\*

- World's first 4<sup>th</sup> Generation LCD factory in 2000  
- World's first and third 5<sup>th</sup> Generation LCD factories in 2002 and 2003

According to DisplaySearch :

\* Quarterly Large-Area TFT-LCD Shipment Report, Q1 '03, by input capacity "area"

\*\* The Display Monitor Newsletter, April '03, DisplaySearch, by units

\*\*\* Customer Satisfaction Award (March 2002, April 2003)



**LG.PHILIPS LCD**

