WHERE YOUR VALUE CREATION BEGINS
LCD is becoming increasingly pervasive in our everyday lives. From notebook computers, desktop monitors and televisions, to public information displays, mobile phones and other automotive and entertainment appliances, LCDs have become an integral part of our everyday lives. But with this, confusion continues to reign about the quality of the displays themselves. The average sales representative is hard pressed to explain the difference between brands, and for the consumer, choosing can be a real minefield. In this SPECIAL report we aim to demystify LCD technology with a close-up look at LG Display, formerly known as LG.Philips LCD. As a global leader in the display market, LG Display takes its role of “educator” seriously, informing market players as to the facts when it comes to new LCD technologies. To this end, in the past, Cleverdis was already commissioned to compile two SPECIAL reports explaining how the technology works, and what differentiates product from this company.

Indeed, when you’re buying an LCD TV or monitor, what’s inside DOES count. Quality is not only judged by such things as response time and “declared” contrast ratios. Colour-shift at different viewing angles and moving image blurring are still issues, depending upon by whom the LCD panel is made and what technology is used to produce it. LG Display produce TFT-LCD using “IPS” (In-Plane Switching) technology, which demonstrates a number of benefits compared to some other technologies. The following pages outline these advantages.
How would you describe the philosophy of LG Display when it comes to manufacturing LCD displays?

At LG Display, we believe that a picture is worth a thousand words, and that flat panel displays are enabling rich and expressive images to be incorporated into even more areas of our lives. Whether your display is a large and wide full HD TV, a set of high-resolution monitors or a wide-format notebook PC, it is important that viewers see the best looking image possible.

LG Display has a long history of being on the cutting-edge of the flat panel industry’s technical developments, introducing new products and technology to meet the needs of its superior customer base. Tell us about some of the benchmarks in your history of panel making.

In Q3 ’97 we launched the world’s first 14.1-inch XGA notebook panel, in Q4 ’01 we brought to market the world’s first 20-inch UXGA monitor panel and in Q4 ’03 we launched the world’s first 42-inch wide XGA HDTV panel. In addition, we have received the SID Display of the Year Gold award in ’03–’04. In ’06, we launched a 100” TFT LCD as the world’s largest LCD panel, and in ’07, our Flexible OLED was selected as one of Time’s “best inventions of the year.” This trend of production innovation is something our customers have come to expect and trust us to deliver.

What are the most important things in the development of LCD technology at the moment?

One of the factors is that the LCD industry has gone through tremendous growth in such a short amount of time and that it has satisfied both customers’ desire for fancy design and high quality display. The most important thing in the development of LCD technology is to understand customers’ needs and bring products to market at an affordable price. For example, laptop users want portability and long battery life. That is why LGD is focusing on an LED backlit product, which is slim and light with low power consumption.

For LCD TV, customers want a sharp and vivid picture. In order to satisfy these needs, LGD has commercialised a DFR (Double Frame Rate) product for the first time, which also has a cost advantage. As the design factor will be increasingly important for TVs in the future, we have also launched slim and narrow products for the first time.

How is LG Display creating added-value for TV manufacturers?

The most important thing in creating added-value for our customers is to understand their needs and provide products with a competitive price at the right time. For this, LGD is focusing on developing collaborative products with major strategic partners. In the case of IPS, LGD’s differentiated technology; we are currently undertaking a number of co-marketing programs to increase sales for the customers who are using our IPS panels in their LCD TVs and monitors, by promoting the superiority of IPS.
What do you see as being the main trends in the LCD TV market at the moment?

I think there are three overall trends that we are seeing. In general, people are worried about motion blur, motion estimation, and motion compensation in LCD TVs. They want better contrast and colour, and they’re increasingly concerned about the environment.

Isn’t motion compensation just a matter of response rate?

No, it needs a lot more than that. In order to have a better display quality, LG Display for example introduced the scanning backlight with 120 Hz response rate, which means turning on and off the backlight sequentially. This helps produce better sharpness and distinctiveness display quality. Until recently, scanning backlight technology had difficulties in being commercialised due to high costs.

How else are images being improved?

Through what’s termed “image enhancement”... technical improvements such as the IPS panel with an LCD picture improvement solution internally. With this, you start combining colour solutions and enhancements inside the controller in the panel to adjust very minor details that really help enhance things such as skin tone and making the colours really pop out! These are things you can only do when you combine the electronics inside the panel. Of course, there has been a lot of discussion about new types of backlights. LED backlights give you the chance to go almost infinite in contrast ratio. It’s another spec number people talk about: 1,000:1, 10,000:1, 1,000,000:1, but this is meaningless because you have zero emission at one point and this means you can have infinite contrast ratio.

There’s a big move towards “green” products. Are LCD’s improving in this sense?

Yes, we believe that LCD’s are already the display technology of choice as they use the least power to build, use, and dispose of. But there are different types of LCD and despite the fact they use less power than CRT or Plasma, some perform much better than others. In a recent demonstration in Las Vegas, several LCD displays were lined up alongside each other. They each had a watt-metre and were all displaying the same video. A certain type of VA panel used 153 watts, whereas the IPS panel, thanks to its higher transmittance and the use of external electrode fluorescent lighting has 20% better power savings. Then if you look at Optimal Power Control by adjusting the backlight based on the video content, you can get from 30-50% better power savings. So there are ways to cut what’s already the lowest power display technology to lower still. No matter how good we are, we need to get better. Energy is expensive and carbon emissions are not good for the environment, so we need to constantly challenge our engineers to get better... and LCD’s are meeting that challenge.
Firstly, please explain to us in simple terms, what IPS is...

IPS (In-Plane Switching) is a kind of LCD technology that enables wide viewing angle and rapid response time. It is based on the principle of aligning liquid crystal molecules in a horizontal direction. In particular, the IPS technology of LG Display enables constant generation of clear images at any angle within 179 degrees in left and right as well as the display of further vivid, realistic moving images.

What is the background to IPS technology?

LCD (Liquid Crystal Display) was discovered for the first time in Germany in 1854. In 1971, the first LCD made with TN (Twisted Nematic) technique was developed in Switzerland and it formed the foundation of what would become the LCD monitor. Since then, TN was widely used for TFT-LCD production in the late 1980’s and the early 1990’s. At that time, however, TN technology had numerous problems such as narrow viewing angle against angle, gray inversion, particularly at the upper and lower sides, and slow response time, etc. In the mid 1990’s, technologies focusing on large-sized panels for monitors were developed. The representative technologies among those were IPS and VA. IPS, based on the principle of the horizontally aligning liquid crystal molecules, resulted in broad viewing angle, rapid response time, and simple pixel structure. While VA has a broader viewing angle than that of TN, nonetheless, it has a complicated structure, with multi-domain technology dividing a pixel into few sub-pixels in order to widen the viewing angles. LG Display thus completed research on both IPS and VA and then concentrated on IPS due to the drawbacks in VA related to reliability, as well as its disadvantages in image quality, such as image sticking left from moving images, and lightning pattern on dark images.

Where are we headed?

In the future display market, TV-oriented products equipped with vividly clear image quality, larger screen size while realising light and slim feature are expected to be the spotlight. LG Display is making every endeavour in research and development of various next-generation display products such as Touch screen, E-book, AMOLED, 3D and Flexible displays capable of providing interactive functions in ubiquitous environment by achieving technical development for high image quality, eco-friendly technology, advanced technology and display in the future based on our advanced IPS technical leadership.

Vivid and clear moving pictures are becoming increasingly important for consumers. How does LG Display’s IPS technology help here?

IPS panels have rapid response time and an optimum structure to process a large number of signals without losing data by utilising copper lines known to have low resistance. This is beneficial cost-wise, since the number of source D-IC is small due to its simple pixel structure compared to the competitors. Excellent “Moving Picture Response Time” (MPRT) means no image distortion such as blurring (image shadow trail) in a dark image because of the rapid response time and short gap between maximum and minimum standard deviation. “Moving Picture Colour Shift” (MPCS) is also optimal, meaning minimal changing and spreading of colour in a rapidly moving image. Thirdly, there is no occurrence of image sticking “Moving Picture Image Sticking” (MPIS) when touching a moving image, while severe image sticking happens in VA panel and lasts long after the image is changed to a still cut. With 120 Hz Technology and scanning backlight, we have the same result as a 240 Hz screen! We call it the 240 Hz effect.

In today’s “tactile” world, touch-screens are becoming increasingly prevalent. Often, when one touches an LCD screen, it distorts the image and leaves a big white patch around where the screen has been touched. Can you get around this issue?
Absolutely. The IPS panel has the advantage as a touch screen of being capable of providing important interactive functions that allow the display of future-oriented devices. Since it displays a very stable image while the VA panel has a decisive disadvantage in the function of a touch screen, as a severe image sticking left like the image of glittering lightning at the moment of touching the screen. This is due to the structure of the liquid crystal. Liquid crystal cells in IPS are aligned horizontally and when touched are not deviated from their original location, but VA has an unstable vertical alignment structure which is highly affected when touched. The liquid crystal cells of IPS also have 10 times faster restitution to their original location than VA.

“Colour Wash” at different viewing angles was often a problem for LCD TVs before. How does IPS face-up to this test?

With flying colours! There is “No Colour Wash” – as IPS provides vivid colour from any viewing angle, from upper, lower, left and right sides. Colour shift refers to the colour inversion based on viewing angle. Based on a 60° angle, IPS and VA have 0.018 and 0.037 respectively. Our panels also provide excellent gamma shift, which refers to the change of brightness as the screen is viewed from an angle. When it comes to Gamma Shift Ratio (on a basis of 60 degrees) IPS is less than 1% while VA has more than 40%.

We heard Bruce Berkoff from the LCD-TV Association explaining that LCD was becoming “greener”, or more efficient. Can you expand on that?

LG Display has been able to make an about 30% reduction in power consumption by developing the OPC, or Optimal Power Control algorithm which automatically adjusts backlight brightness by measuring image brightness input.

**GREEN VISION FOR A CLEARER AND CLEANER FUTURE**

**LG DISPLAY IS HELPING TO CREATE A MORE ENVIRONMENTALLY FRIENDLY INDUSTRY**

LG Display is committed to promoting sustainability in all areas of operations. As far back as 2004, they (then LPL) became the first TFT-LCD manufacturer to gain Environmental Product Declaration Certification from the Swedish Environmental Management Council. This certification enables them to provide internationally recognised environmental information about a product instantly upon a customer’s request. As such inquiries have risen sharply recently and eco-friendliness of products has become a rising priority, LG Display is strongly competitive in this area. LGD operates an integrated ESH (Environment, Safety and Health) Management System built on sound policies to reduce environmental loads and safety risk factors generated from all the operational processes. The policies, abiding by pertinent laws and requirements, have been thoroughly implemented to prevent pertinent pollution and reduce safety-health risk factors.

**ECO-FRIENDLINESS - PART OF LGD PHILOSOPHY...**

At LG Display, blending eco-friendliness in a product is as much a prime consideration as product quality. To reduce the environmental impact of all its products throughout their life cycles, the company’s product management activities mainly focus on three fronts: reduction of hazardous substances, raw materials, and energy consumption. To achieve this goal, the company develops new technologies and systems that can be applied in all its production processes, while operating the Eco LCD Information System, an integrated and easy-to-use online environmental tool.

**THE FUTURE OF LCD HERE TODAY**

LG Display brings you the future today, with direct view 3D displays, touch technology integrated into the LCD panel itself and triple-directional view realisation by 3D based technology... just to name a few!! AMOLED (Amorphous Organic Light Emitting Diode) based on amorphous silicon TFT, is soon set to go into mass production for TV... watch this channel for more details!
CONCLUSION
GÉRARD LEFEBVRE
CLEVERDIS PRESIDENT

Rarely has a baseline ever been as well adapted or true as that of LG Display: “Where your value creation begins.” Cleverdis has been a partner of LG Display for more than 12 years and ever since our first meeting in Korea with the management of this company, we have felt that this enterprise carried a certain number of values very high – those of “the greats” of the business.

The current management particularly underlines:
• the respect of the client and the respect of customer demands;
• the respect of employees;
• the will to be affirmed as No. 1 worldwide in quantitative as well as in qualitative terms;
• a firm determination to innovate, to break-down technological barriers and for technological excellence;
• constant efforts toward overall reform of their business structure

In a period when many companies doubt the future, these fundamentals preserve LG Display. Young Soo Kwon, CEO of LG Display, confirmed this during the last presentation of results for LG Display at the end of June 2008, with breath-taking figures:

• Sales in the second quarter of 2008 increased by 4% in the first quarter of 2008, and increased by 26% compared to in the second quarter of 2007;
• Operating profit in the second quarter of 2008 was KRW 889 billion compared to an operating profit of KRW 881 billion in the first quarter of 2008, and an operating profit of KRW 150 billion in the second quarter of 2007;
• EBITDA in the second quarter of 2008 was an increase of 1% from in the first quarter of 2008, and a year-on-year increase of 90% from in the second quarter of 2007;
• Net income in the second quarter of 2008 was a profit of KRW 759 billion compared to a profit of KRW 717 billion in the first quarter of 2008 and a profit of KRW 228 billion in the second quarter of 2007.

This comes as no surprise to us, as Cleverdis already had the pleasure of compiling two SPECIAL report for the company in the past five years. Already then, we were impressed by their technological offering. Today the technological advances presented in this SPECIAL report lead one to believe that the sky is the limit when it comes to the formidable progression of LGD. Carried forward by industrialists such as this, LCD has many bright days ahead!

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LG Display—where your value creation begins

- Setting the world's standards
- Production facilities: World's first 4th & 5th generation fabs
- Products: First to develop Full HD 109", 55", 47", 42", 27WUXGA, 22WUXGA, 20.1"UXGA, 20.1"VGA, etc.
- Technologies: Innovative technologies including Super IPS, Copper Bus Line and EEL/L Backlight
- Increased productivity to customers
- Sales and representative offices worldwide: US, Japan, Germany, Taiwan, China, Singapore and Turkey
- Back-end module assembly plants: China and Poland

Global recognition
- Collaborative customer relationship, DisplaySearch Customer Satisfaction Awards (2012-16)
- Product & technology leadership, SID Display of the Year Awards (2014-16)
- Leading environment standards, EDP (16), EPD (16)