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Information DISPLAY

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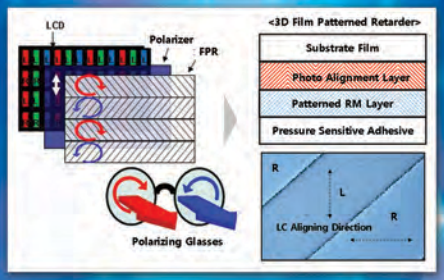
SOCIETY FOR INFORMATION DISPLAY

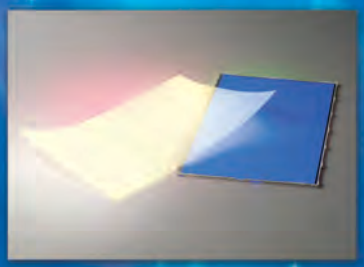
Official Monthly Publication of the Society for Information Display • www.informationdisplay.org

May/June 2012
Vol. 28, Nos. 5 & 6

Display Industry Awards: Recognizing Diversity

SID 50 ANNIVERSARY 1962-2012





Plus

Products on Display at Display Week 2012

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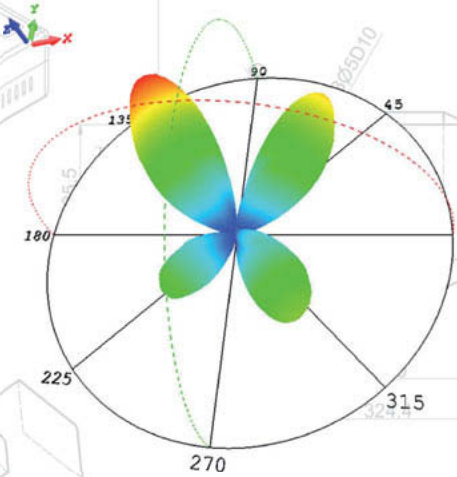
Patent Legislation: Part III

Friends and Colleagues Say Goodbye to Lou Silverstein

Journal of the SID May/June Contents

ELDIM

Viewing Angle & Imaging measurements by ELDIM



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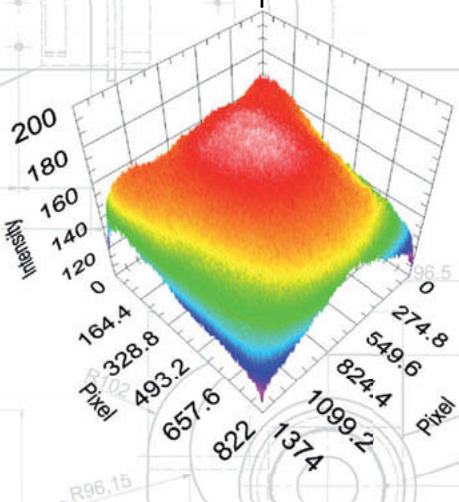

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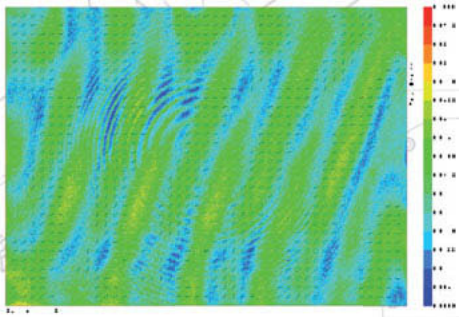

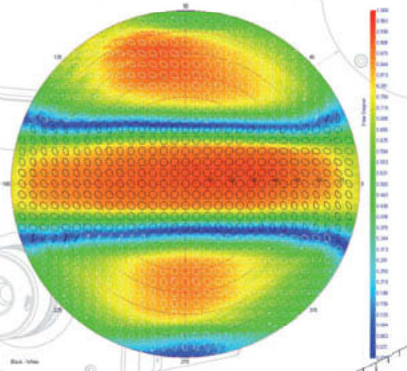

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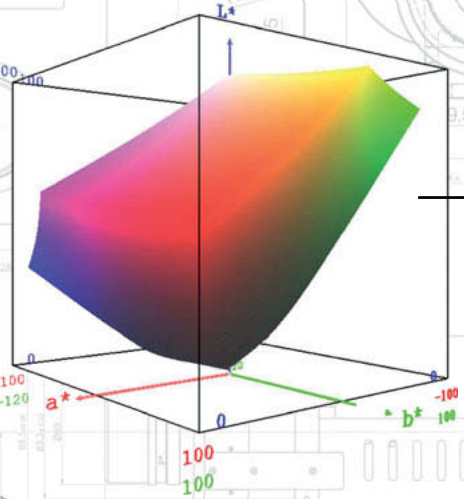

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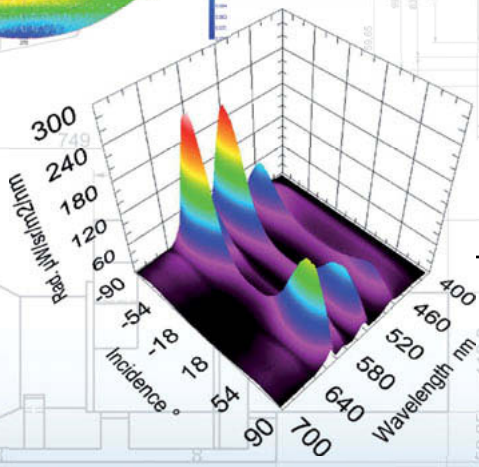

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MAY/JUNE 2012
VOL. 28, NOS. 5 & 6

ON THE COVER: From top left, clockwise: AU Optronics's 55-in. 4K× 2K 2-D/3-D Switchable Glasses-Free TV Display, Perceptive Pixel's 82-in. Projected-Capacitive Unlimited Multi-Touch and Stylus LCD, Samsung's Galaxy Note, Nanosys's Quantum-Dot Enhanced Film (QDEF), and Qualcomm's mirasol Display Technology. Center: LG Chemical's Film Patterned Retarder Incorporating Merck's Proprietary Reactive Mesogen (RM) Layer.

Cover Design: Acapella Studios, Inc.

Next Month in *Information Display*

Display Week 2012 Review Issue

- Display Week in Review
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  - Flexible Displays
  - Touch and Interactivity
  - OLEDs
  - 3-D
- Best-in-Show Awards
- I-Zone Prototype Award Winner
- 50 Years of Information Displays

INFORMATION DISPLAY (ISSN 0362-0972) is published 10 times a year for the Society for Information Display by Palisades Convention Management, 411 Lafayette Street, 2nd Floor, New York, NY 10003; William Klein, President and CEO. EDITORIAL AND BUSINESS OFFICES: Jay Morreale, Editor-in-Chief, Palisades Convention Management, 411 Lafayette Street, 2nd Floor, New York, NY 10003; telephone 212/460-9700. Send manuscripts to the attention of the Editor, *ID*. SID HEADQUARTERS, for correspondence on subscriptions and membership: Society for Information Display, 1475 S. Bascom Ave., Ste. 114, Campbell, CA 95008; telephone 408/879-3901, fax -3833. SUBSCRIPTIONS: *Information Display* is distributed without charge to those qualified and to SID members as a benefit of membership (annual dues $100.00). Subscriptions to others: U.S. & Canada: $75.00 one year, $7.50 single copy; elsewhere: $100.00 one year, $7.50 single copy. PRINTED by Sheridan Printing Company, Alpha, NJ 08865. Third-class postage paid at Lehigh Valley, PA. PERMISSIONS: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limits of the U.S. copyright law for private use of patrons, providing a fee of $2.00 per article is paid to the Copyright Clearance Center, 21 Congress Street, Salem, MA 01970 (reference serial code 0362-0972/12/$1.00 + $0.00). Instructors are permitted to photocopy isolated articles for noncommercial classroom use without fee. This permission does not apply to any special reports or lists published in this magazine. For other copying, reprint or republication permission, write to Society for Information Display, 1475 S. Bascom Ave., Ste. 114, Campbell, CA 95008.

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editorial

Make Your Plans for the Display Event of the Year

by Stephen Atwood

Hello and welcome to Boston for our 49th annual Display Week event. And if you are new to SID, a very special welcome to you! As a veteran of Display Week, I strongly encourage you to look beyond the world-class exhibition and consider all the other things going on during the week, including more than 400 paper presentations, as well as short courses, seminars, the business and investors conferences, the market focus conferences, the keynotes, the awards dinner, and the special event at the Museum of Science.

Getting the most out of Display Week involves some serious planning. I gather the maps and schedules, I mark off the things that are most important to me, I plan my days to minimize down time, and I coordinate with colleagues to make sure the stuff I miss is covered by someone else. Usually, there are a number of events I know I want to attend, but there are also many surprises that I can only discover if I explore as much as possible. You can make this issue of *ID* particularly useful for your planning by reviewing our Products on Display feature, which is assembled each year by our staff to help you get the most out of the exhibition.

This year marks the start of the 50th Anniversary celebrations for the founding of the Society for Information Display. Our Society was formed in September of 1962 by a small group of visionary people right on the campus of the University of California in Los Angeles, CA. The next year, 1963, marked the first annual SID Symposium, Seminar, and Exhibition, which later became the massive and highly acclaimed Display Week. Forty-nine years later, it's amazing to see how much the Society has achieved and all that has happened in this time. Be sure to look around for special exhibits and celebration announcements as the week progresses.

This month, we also mark a 'changing of the guard' event with the retirement of our outgoing Society President, Dr. Munisamy Anandan, and the beginning of our new president's, Brian Berkeley, 2-year term. We're grateful for everything Dr. Anandan has achieved these last 2 years and are also excited to welcome Brian to the office. Please enjoy reading Brian's first President's Corner submission later in this issue.

Meanwhile, we continue this year with our very successful and highly coveted "Best in Show" awards. These awards will highlight the most significant new products and technologies shown on the exhibit floor during Display Week. Our independent panel of display experts will review those products, prototypes, and processes nominated for the awards on the show floor on the opening day (Tuesday for the exhibits). The winning exhibits, which will be named and honored in a lunch time presentation on Wednesday, will be selected for their ability to excite not only our panel but the general public and press as well. We will have complete coverage of the award winners in the August issue of *Information Display*.

Now, if you are one of the unfortunate ones who cannot make it to Display Week, don't despair because our crack team of freelance journalists will be hard at work covering everything they can. We'll have daily blog updates on the *ID* Web site and a full issue of post-show coverage in August. If you have a question about anything on the exhibit floor, just email us at press@sid.org and we'll get your question to the right reporter to see what we can find out.

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How Changes Among LCD Makers Will Affect the Industrial Market

by Jenny Donelan

The numerous mergers, acquisitions, and spinoffs among LCD companies over the past few months raise the question of what it all means for businesses that have relationships with these companies. Certainly, LCD makers have been facing challenges of late. Despite the continued market dominance of LCD technology, profits have been harder to realize for several reasons, including the necessity of lowering prices in order to remain competitive and of investing in new processes and new fabrication plants to meet market demand for ever-larger panels. While all this is happening, alternative display technologies such as OLEDs and e-Paper seem to be gaining traction, at least in the consumer space.

New technologies and mergers make it possible for LCD makers to turn out less-expensive products, but this is not always good news for OEMs and other companies that depend on a steady supply of identical LCD panels for their medical, industrial, and military customers. Customers in these markets have specific demands for products, which often include life cycles as long as 5–7 years.

Information Display recently spoke with Joe Fijak, Vice President for Display Solutions at Avnet Embedded, about the recent changes. Avnet Embedded, a division of Avnet, Inc., is a global electronic products and services provider and integrator that works with numerous OEMs. "There have been challenges," says Fijak, "but also some very positive changes." A certain amount of adjustment was inevitable, considering market conditions, he explains, but companies are doing what they need to do to remain competitive and to be able to continue to invest. He notes that LCDs still represent the majority of business in the vertical markets that the Avnet Display Solutions Group serves. And in those markets, customization, including optical-bonding requirements, high-brightness enhancements, touch integration, and digital signage, has been a huge growth area.

All the recent changes can be difficult to track; therefore, the following list highlights by countries some of the involved companies and what the proposed impact, if any, may be for the industrial market.

Japan

NLT (formerly ***NEC LCD Technologies***) manufactures industrial LCD modules. The company was formed in July 2011 as a joint venture between ***NEC*** and ***Shenzhen AVIC Optoelectronics, Ltd.*** ***Renesas Electronics America*** in Santa Clara, CA, is the exclusive representative of NLT products in North America. In January of 2012, ***AVIC Optoelectronics*** announced changes to the North American sales structure of another of its holdings, Chinese company ***Tianma Microelectronics (USA), Inc.*** As of April 2012, all distribution sales of Tianma products have been supported by the NLT/Renesas structure. An important part of NLT's strategy going forward, notes Fijak, is to continue to promote its TCO (Total Cost of Ownership) model to those companies seeking high-end long-lasting products.

In late 2011, ***Sony***, ***Hitachi***, and ***Toshiba*** agreed to merge their businesses in conjunction with the ***Innovation Network Corporation of Japan (INCJ)***. INCJ, which was formed in 2009 as a temporary entity to promote the competitiveness of Japanese firms, is now the largest shareholder of ***Japan Display, Inc. (JDI)***, a manufacturer of small- and medium-sized TFT modules, with a 70% stake in exchange for a $2.6 billion investment. That leaves Hitachi, Sony, and Toshiba with a 10% share each. Of particular interest to the industrial market, says Fijak, is that JDI has elected to support a number of selected panels from Toshiba's industrial product lineup.

Panasonic announced (in a separate deal) that it has agreed to sell its LCD factory in Mobara, Japan, to Japan Display, Inc. This factory builds large-format and TV panels.

The Japan Display Industry business merger resulted in the formation of a subsidiary named ***Kaohsiung Opto-Electronics (KOA)***. KOE Americas replaces ***Hitachi Electronic Devices (USA), Inc.***, for LCD sales and will sell passive-STN and color TFT displays from 3.5 to 21.3 in.

Sharp Microelectronics America is a Japan-based manufacturer of traditional industrial-sized small, medium, and large (up to 80 in.) panels for industrial signage applications. According to Fijak, Sharp has recently been aggressively redesigning most of its industrial TFT modules from CCFL backlights to LED backlights. In March 2012, Sharp announced that Taiwan-based electronics manufacturer ***Hon Hai Precision Industry Co.*** was buying a 10% share of Sharp Corp. Hon Hai, owner of the Foxconn factories in China, is a key producer of iPads and iPhones for Apple. Hon Hai also bought a 46.5% share of Sharp's Gen 10 facility in Sakai, Japan. Sony Corp. will retain a 7% share of that plant, and Sharp's share will drop from 93% to 46.5%. Says Fijak, "No changes in supply to North America or any significant changes to pricing structures or lead times are expected as a result of this event."

Kyocera Display America, based in Japan, is a recently formed corporation made up of the former Kyocera Electronics America LCD Division and newly purchased LCD manufacturer **Optrex**. Kyocera Display America continues to make panels in industrial sizes as well as monochrome displays for instrumentation. Fijak notes that the company will be introducing about a dozen industrial/medical panels with LED backlighting at Display Week 2012. Kyocera makes panels that range from 5.7 to 15 in. and is particularly strong in the 5.7-in. range and in high-brightness offerings. In addition, Kyocera Display America can continue to support the Mitsubishi products formerly available through Optrex (2.0–19.2-in. panels). ***Seiko Instruments***, once a maker of small- and mid-sized panels, exited the LCD market last year.

China

Tianma Microelectronics (mentioned above) is the largest LCD manufacturer in China. It currently has a Gen 5 fabrication plant and will be opening a state-of-the-art Gen 5.5 plant in late 2012.

Korea

LG Displays (formerly LG Philips) is a Korean-based manufacturer of LCD panels. LG Displays is the manufacturing arm for LCD modules, whereas LG Electronics builds the panels into TVs, industrial monitors, and mobility products for the consumer industry. LG Displays is strong in TVs, notebooks, cellphones, and tablets. The company is recommitting to industrial displays, according to Fijak, and is now offering 3-year life cycles.

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president's corner

Back to Boston

by Brian Berkeley
President, Society for Information Display

Greetings and welcome to Display Week 2012! First, I would like to extend special thanks to Dr. Munisamy Anandan, the outgoing President of the Society for Information Display, for his leadership of SID over the past 2 years. Anand has dedicated many hours of volunteer service to the Society. Volunteers like him, including other members of the SID Executive Committee, the SID Board of Directors, and other key volunteers around the world, are at the core of SID's success. We are here to serve the SID membership.

By the time this issue of *Information Display* is published, SID will be going back to Boston for its annual Display Week Symposium, Seminar, and Exhibition. Boston is a special place with great historical significance. It is home to many top-tier research institutions, including MIT and Harvard, and it boasts a resurgent technology industry. Boston is special to me personally. I lived in Boston's Back Bay during my undergraduate years, then I later served as General Chair for the 2002 Display Week conference held in Boston, and this year I will be taking on the responsibilities of SID President in Boston. Boston is also a special place for SID. As the technology hub of the eastern United States, SID's annual conference has come to Boston many times in the past, including 1997, 2002, and 2005. Some of the most significant industry announcements and technical breakthroughs have been presented at SID conferences in Boston.

Going back 15 years to 1997, the conference covered a mix of the old and the new. The three keynotes celebrated the centennial of the CRT, plus a retrospective on 25 years of active-matrix driving, and then the rise of active-matrix LCDs in Japan. Many technical papers reported developments on active-matrix LCDs, which we now know would become the dominant technology not only for notebooks but also for mainstream desktop and TV applications. Novel technologies were presented as well; for example, interferometric modulation (IMOD) reflective displays were introduced at the 1997 conference by a startup company that would later be purchased by Qualcomm. Then back in Boston in 2002, no fewer than seven sessions were held on OLED displays, foretelling the importance of this emerging technology. There were also two sessions on e-paper and a separate paper on electrophoretic displays, which years later would achieve high volume in the Amazon Kindle. As an interesting side note, 2002 was the first year that the SID Symposium Digest had to be split into two volumes in order to accommodate the ever-increasing number of technical submissions to the conference.

At SID 2005 in Boston, Samsung LCD president Sang-Wan Lee gave his now-famous keynote speech, "LCD Revolution – The Third Wave". As Dr. Paul Drzaic noted in his President's Corner column of March 2010, President Lee made several astonishing predictions. Probably the most significant, if not provocative at the time, was his prediction that production volumes of 100 million LCD TVs per year could be achieved by 2010. Consider that at the time, CRTs had 70% TV market share and 40-in. LCDs cost $2500. Gasps could be heard throughout the keynote session during the presentation, but as we know now, the 100 million/year milestone was actually achieved in 2008, and President Lee's other predictions came true as well.

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2012 SID Display Industry Award Winners

The Society for Information Display's Display Awards Committee has selected six award winners that advanced the state of the art of electronic-display products and technology during 2011 in the categories of Display of the Year, Display Component of the Year, and Display Application of the Year.

Compiled by Jenny Donelan

THIS HAS BEEN a year of exciting developments in many areas of display technology, one which saw several products and materials came of age and finally appear as, or in, commercial products. Perhaps most exciting is the rich array of competing display technologies showing up in each major application space – from e-Readers to televisions and everything in between. This year's crop of winners includes MEMS-based e-Readers and an AMOLED portable communication device, in addition to LCD products that advance the state of 3-D and touch.

Last year, every one of the winning Display Industry Award products was a mobile device or a component of a mobile device. This year, mobile devices are still represented among the winners, but so are displays of other sizes, including an LCD panel measuring 82 in.

According to Display Awards Chair Robert Melcher, "The 2012 SID Display Industry Awards demonstrate again the dynamic diversity of the display industry. Awards are being presented at Display Week 2012 for applications of nanotechnology to displays, for new materials, for large-screen glasses-free 2-D/3-D TV, and for novel display technologies enabling new and enhanced applications".

One of the exciting aspects of the display industry is that the underlying technology keeps evolving and improving, even when we might have thought that impossible. Please join us in saluting this year's Display Industry Award winners.

***Jenny Donelan** is the Managing Editor of* Information Display *Magazine. She can be reached at jdonelan@pcm411.com.*

Display of the Year

This award is granted for a display with novel and outstanding features such as new physical or chemical effects, or a new addressing method.

Gold Award: AU Optronics's 55-in. 4K × 2K 2-D/3-D Switchable Glasses-Free TV Display

AU Optronics's 55-in. 4K × 2K 2-D/3-D switchable glasses-free TV incorporating AUO's proprietary display made its debut in Japan in December 2011 and is currently the world's first 4K × 2K TV display, as well as the largest glasses-free 4K × 2K 3-D TV display commercially available.

This TV's LC display offers an exceptional viewing experience in extreme comfort. The display features a 4K × 2K (or "quad-HD") resolution of 3840 × 2160 for vivid and life-like 2-D images. Meanwhile, a simple switch by the viewer converts the image instantly into 3-D format, with 3-D support for up to nine positions based on the TV's built-in face-tracking camera. Virtually no dead zones exist, ensuring the highest viewing quality possible. This lenticular-lens 3-D technology eliminates the need for 3-D glasses in order to view outstanding 3-D images. Viewers can now choose their preferred viewing positions to enjoy a pleasant and comfortable experience free of added eyewear or dead zones.

For AUO's partners, the glasses-free 3-D solution also allows for ease of incorporating the new panel technology into their current systems. This compatibility heralds the growing commercialization of 4K × 2K 2-D/3-D switchable glasses-free TV displays.

Silver Award: Qualcomm's mirasol Display Technology

Qualcomm mirasol display technology from Qualcomm MEMS Technologies (QMT) is designed to deliver color and interactive content that can easily be viewed in a variety of lighting environments, including bright sunlight, without sacrificing battery life.

The first device featuring a mirasol display, the Kyobo e-Reader, arrived on the market in November 2011. Three more e-Readers quickly followed, and additional products are expected in the coming months. Beyond e-Readers, however, mirasol displays have potential application in a range of commercial and consumer devices.

The core building block of mirasol displays is the iMOD element, a simple MEMS device composed of two conductive plates. One plate is within a thin-film stack on a glass substrate. The other is a reflective membrane suspended over the substrate. The human eye perceives color as certain wavelengths of light amplified with respect to others. The iMOD elements in a mirasol display can switch between color and black by changing the position of the membrane. This is accomplished by applying a voltage between the conductive

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DISPLAY OF THE YEAR

Gold Award: *AU Optronics's 55-in. 4K × 2K 2-D/3-D switchable glasses-free TV display incorporates AUO's proprietary technology and is the world's first 4K × 2K TV display.*

Silver Award: *The first commercially available e-reading device to feature a mirasol display is the Kyobo e-Reader.*

plates. When a voltage is applied, electrostatic forces cause the membrane to deflect. The change in the spacing between the plates results in a change in the wavelengths of light that undergo constructive interference. In the open state, the membrane is positioned to create constructive interference in either the red, green, or blue wavelengths. In the closed state, the membrane is positioned to create constructive interference outside the visible range, causing the element to appear black. A full-color display, meanwhile, is assembled by spatially ordering side-by-side iMOD elements reflecting red, green, and blue wavelengths respectively while in the open state.

The mirasol display is also capable of video. Since visible-light wavelengths operate on the nanometer scale (*i.e.*, 380–780 nm), the deflectable iMOD membrane only has to move a short distance – a few hundred nanometers – in order to switch between two colors. This switching occurs extremely fast, on the order of tens of microseconds, and directly translates to a video-capable display.

The above properties give mirasol significant advantages. Since the display is reflective, the brightness of the display scales naturally with the ambient light level. This results in a consistent and comfortable viewing experience across a wide range of lighting environments, including direct sunlight. To extend the viewable range into dark ambient conditions, an integrated front light is incorporated into the display module. Additionally, the display is bistable, meaning it consumes near-zero power in situations when the display image is unchanged.

Today, consumers are relying on mobile devices for functionality previously addressed by other devices: playing games, reading books, and watching movies – and they want to be able to do these activities anytime, anywhere. All require more display use, which puts greater strain on the battery, and with today's technology, most mobile devices are limited to indoor functionality. Qualcomm mirasol displays offer both outdoor viewability and longer battery life with minimal performance compromises.

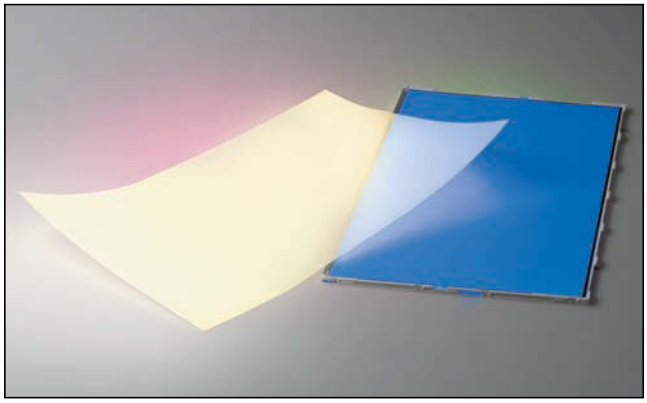
Display Component of the Year

This award is granted for a novel component that has significantly enhanced the performance of a display. A component is sold as a separate part destined to be incorporated into a display. A component may also include display-enhancing materials and/or parts fabricated with new processes.

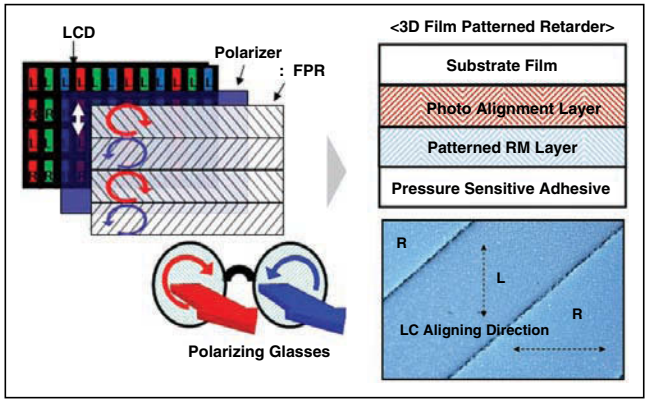
Gold Award: Nanosys's Quantum-Dot Enhanced Film (QDEF)

The recent take off in the popularity of powerful mobile devices such as tablets and

DISPLAY COMPONENT OF THE YEAR



Gold Award: The QDEF product is the glowing sheet on the left. The generic blue backlight is provided for context.



Silver Award: LG Chemical's and Merck's film patterned retarder incorporates a proprietary reactive mesogen (RM) layer.

smartphones offers a tremendous opportunity for display makers in the coming decade. It has become clear that consumers want a richer, more lifelike experience from their devices, and color performance is one area where large gains can be made immediately to meet that demand. The industry has focused on improving nearly every other characteristic of the screen over the years – luminance, contrast, thickness, resolution – often to the detriment of color performance. Color is the next major differentiator in the display market and will bring a stunning new visual experience to the consumer and a great new value proposition to the manufacturer.

The color performance of an LCD screen is determined by two parts of the display: the backlight and the color filters. Nanosys addresses the color issue by offering a new backlight for LCDs. A standard LCD backlight creates white light using a yttrium aluminum garnet (YAG) phosphor. The YAG phosphor produces a two-color light spectrum, dominated by blue accompanied by a broad, yellow component. It lacks strong red and green elements. QDEF uses the unique properties of quantum dots to create a pure-white backlight that is designed specifically for LCDs. This light, made up only of narrow spectral peaks in red, blue, and green wavelengths, allows for wide color-gamut performance when mixing these primary colors at the pixel level. It does this with great efficiency, allowing for a bright display without requiring higher power consumption, thus saving battery life. A quantum dot, which is about the size of a water molecule, can emit any color of light at precise wavelengths. QDEF combines red- and green-emitting quantum dots in a thin, optically clear sheet that emits white light when stimulated by a blue LED light source.

The result is vivid color. High-color displays will allow consumers to enjoy more visceral and truer to life content. And high-color performance displays will make the digital viewing experience of photos, movies, and video games more realistic. Filmmakers and video-game developers will be able to more accurately bring their creative vision to life.

Nanosys invested about a decade of R&D to ensure its quantum dots are of the highest quality and reliability. More than 100 patents have gone into the design of QDEF, and it has been tested to meet industry standard lifetimes for TVs – 50,000 hours or more of use. But engineering the quantum dots to meet display-industry specifications was not enough to offer a powerful product for the LCD market. The dots needed to be easily integrated into current manufacturing operations with minimal impact on display system design. For this reason, Nanosys worked with major display manufacturers to design a simple, drop-in product that does not require line retooling or manufacturing-process changes. QDEF is a replacement for an existing film in LCDs called the diffuser sheet. Manufacturers who have invested billions in equipment for LCD production can simply slip QDEF into their manufacturing process, change their "white" LEDs to blue, and start producing LCD panels with OLED-like color performance and better energy efficiency, at only a fraction of the cost.

Silver Award: LG Chemical's Film Patterned Retarder Incorporating Merck's Proprietary Reactive Mesogen (RM) Layer

A film patterned retarder (FPR) is an optical component attached to a 3-D LCD TV's front polarizer to convert left- and right-eye images to left- and right-circular-polarized light, allowing viewers to enjoy 3-D images through passive-polarized glasses. The FPR consists of a substrate, alignment layer, and a patterned reactive mesogen (RM) film. The novel photoaligning polymer has very high UV sensitivity and a heat stability that is suitable for film process.

The reactive mesogen film used for LG Chemical's FPR is made using Merck KGaA licrivue materials. These RM materials are designed to be coated on a variety of substrates to produce well-aligned birefringent films. For FPR, the licrivue materials are formulated for coating onto flexible plastic substrates by a roll-to-roll coating process. The coated licrivue RM materials align and follow the pattern of the photoalignment layer. This alignment is preserved by UV polymerization of the RM film to form the patterned retarder.

DISPLAY APPLICATION OF THE YEAR

Gold Award: *Samsung's Galaxy Note features a 5.3-in. AMOLED display with a pen-based interface.*

Silver Award: *Perceptive Pixel's 82-in. projected-capacitive LCD panel is already in use on network television stations.*

LG Chemical commercialized this FPR for the first time in the world in 2010. LG Chemical's FPR, which incorporates Merck KGaA licrivue materials, is 10 times thinner and 20 times lighter than glass-based patterned retarders, can be easily mass-produced, and makes enjoyment of 3-D content more convenient. LG Chem has developed various key technologies such as a novel photoaligning polymer, non-contact-type roll-to-roll continuous patterning, and management of the dimensional stability of FPR – all of which help realize superior performance in 3-D displays.

Display Application of the Year

This award is granted for a novel and outstanding application of a display, where the display itself is not necessarily a new device.

Gold Award: Samsung's Galaxy Note

Combining the features of a smartphone and a tablet, the Samsung Galaxy Note offers a large screen and new user input technology, while retaining a pocketable design that allows users to capture, create, and share in new ways. It utilizes AT&T's 4G LTE network to enable a premium user experience.

The Galaxy Note is a portable communication device designed with a 5.3-in. display featuring HD Super AMOLED technology. Its high-resolution (800 × 1280 pixels) screen provides a dynamic, colorful, and comfortable viewing experience for content such as videos, photos, documents, and Web sites. Super AMOLED can depict more dynamic images since it has deeper blacks than LCDs and covers 95% of all natural colors. Also, depending on the screen's white area, AMOLED display adjusts its luminance for eye comfort.

The Galaxy Note includes a creative tool called the S Pen, which delivers fast, responsive, and precise control to create fine lines and detail on the device display, much like an ink pen and pad of paper. The Note also features S Memo, a multimedia application designed to capture all forms of user-created content generated by the S Pen. Pictures, voice recordings, typed text, handwritten notes, or drawings can all be combined via a single application, converted to a 'memo' and shared as desired. An easy screen-capture function also allows users to instantly save any screen. The screens can be personalized with the S Pen before being saved or shared.

The Note comes equipped with a 1.5-GHz dual-core processor, making it extremely fast,

with a smooth and seamless user interface. Meeting extra rigorous security criteria, the Galaxy Note is categorized as a "Samsung Approved for Enterprise" (SAFE) device. The addition of SAFE certifications ensures that any organization's mobile work force can be remotely managed and securely connected to corporate applications and data.

Samsung has also included a smart professional planning tool that makes full use of the device's large screen. The calendar integrates the phone's to-do list and schedule; and control and navigation are intuitive. The Galaxy Note is outfitted with a premium accessories portfolio including a desktop dock. A spare-battery-charging system allows for a convenient backup charging solution.

The Samsung Galaxy Note's large screen and unique input technology enable mobile communications in a more personal, creative way.

Silver Award: Perceptive Pixel's 82-in. Projected-Capacitive Unlimited Multi-Touch and Stylus LCD

Over the last 5 years, multi-touch input, particularly via projective-capacitive sensing, has become ubiquitous for mobile and slate devices. This approach, when implemented properly, can sense an unlimited number of fingers with zero-force sensitivity at high sample rates while preserving excellent display fidelity. Although there are many other types of touch sensors implemented in other types of devices, for better or for worse, the user base has come to expect the "feel" of projective-capacitive touch sensing, and, similarly, developers have come to count on recognizing gestures produced by such devices.

However, projective-capacitive sensing is notoriously difficult to scale to larger displays, so it has been rare to see pro-cap devices larger than 24 in., and these have only been achieved by distancing the sensor glass so far from the display, with such a thick sensor glass, that the resulting parallax makes the device unusable for serious applications, let alone with a stylus. Display characteristics also suffer from such a stack-up due to inter-reflections.

In August of 2011, Perceptive Pixel introduced the first large-scale pro-cap interactive display that achieves the level of fidelity and performance necessary for real productivity. It is the world's largest projective-capacitive multi-touch and stylus display, featuring true full-frame unlimited-finger touch and precision stylus sensing at 120 Hz across a proprietary sensor that is optically bonded to an 82-in. LCD panel. The display utilizes novel state-of-the-art projective-capacitive controller electronics with an unprecedented signal-to-noise ratio (SNR), specifically designed for application at these large dimensions and in optically bonded sensor stack-ups.

This controller is also designed to track multiple (four in this model) high-precision active styluses tracked truly simultaneously along with an arbitrary number of touch contacts on the same sensor substrate. These styluses are true digitizer-class devices, with features such as subpixel precision, pressure sensitivity, hover sensing, and barrel switches. This is only the second controller ever introduced with this capability.

The unit utilizes a proprietary transparent conductor sensor that Perceptive Pixel manufactures in its Portland, Oregon, facility, constructed on a thin 2-mm Gorilla Glass substrate. Perceptive Pixel then optically bonds the giant 82-in. sensor onto the LCD cell, again in its own facility. Though there are incidental benefits in display fidelity, optical bonding was deemed critical to this product's construction because a professional user experience demands an ultra-low parallax between the display plane and the interaction surface, especially when a precision stylus is utilized. This process also greatly enhances the ruggedness of the system, serving as a protective cover glass to the cell against the focused force of a stylus tip.

The Perceptive Pixel 82-in. pro-cap display feels exactly like a mobile touch device, only greatly scaled up. Perhaps, more importantly, all applications designed for mobile devices work. Perceptive Pixel utilizes a unique system architecture that integrates the raw, richer sensor information at a much tighter level with the software frameworks above it, allowing much more sophisticated gesture and contact classification along with a dramatic reduction in latency.

The combination of both multi-touch as well as precision stylus-sensing capabilities opens up new user-interface paradigms that human–computer interaction (HCI) researchers are only beginning to harness. Touch is great for its intuitiveness, power, and non-intrusiveness, but it is not effective for sustained productivity or for precision work, which is why it has not achieved significant penetration beyond consumer markets.

Similarly, as compared to pen-only interfaces, the combination of these two modes in a truly simultaneous manner (not alternating between one and the other) results in a synergistic division of labor between a users' two hands, leading to measurable increases in user efficacy.

This device may allow users to realize a digital replacement for the old analog whiteboard. Perceptive Pixel's 82-in. display can be frequently seen on CNN as well as other networks being used to cover this year's historic presidential primaries and election. ■

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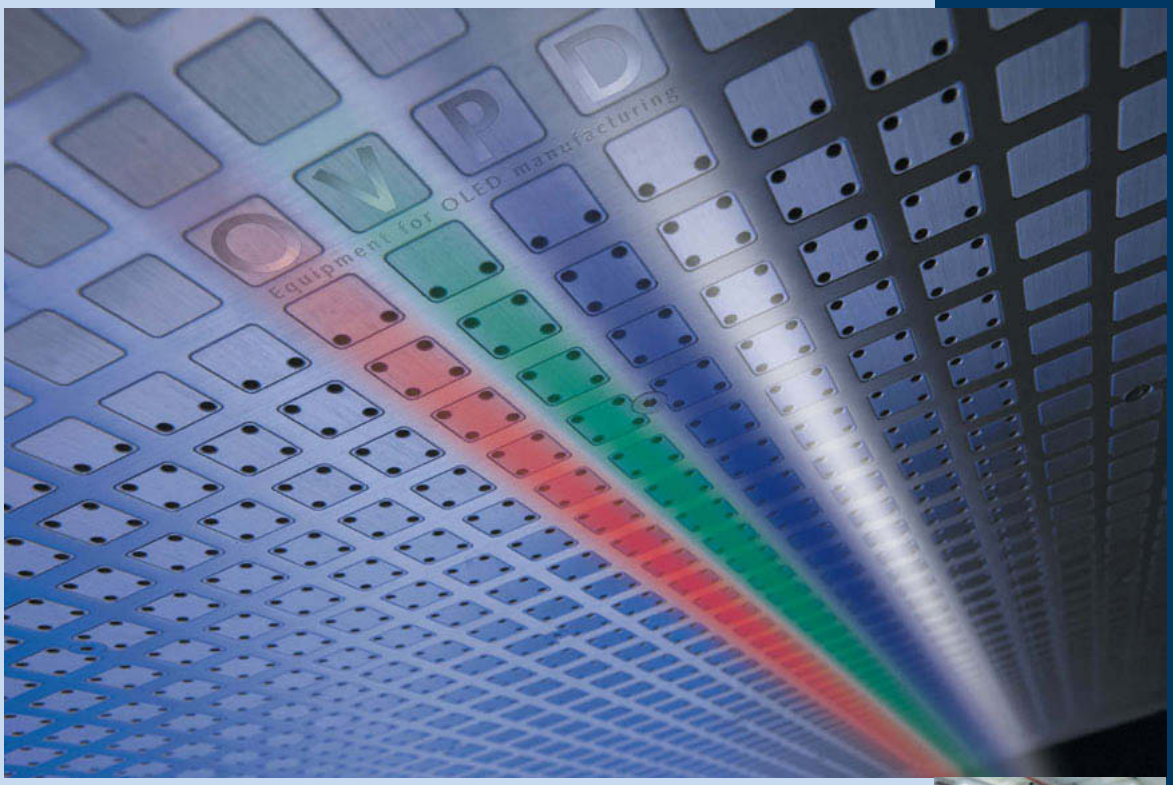

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The Display Industry: Fast to Grow, Slow to Change

The development of the display industry over the past 50 years shows the long development cycles of display technologies, the importance of key applications that supported manufacturing investments, and the role of such investments in determining the location of production. The industry has grown rapidly, but fundamental changes in technology, applications, and production have taken place over many years.

by Paul Semenza

FOR MOST of the Society for Information Display's 50-year history, the display market has been dominated by the cathode-ray tube (CRT), which has been in production for nearly a century. The development cycle of the flat-panel displays that took over at the turn of the 21st century can be measured in decades, with different technologies coming together over time, and significant investments required to move those technologies from demonstration to mass production.

Throughout the 1960s, work at several research laboratories was conducted on various types of passively addressed liquid-crystal displays (LCDs), building on the fundamental discovery of the twisted-nematic liquid-crystal (TN-LC) mode dating back to as early as 1911. These efforts converged to produce the first demonstration of an active-matrix display reported in 1971. In 1983, Seiko-Epson became the first company to manufacture thin-film-transistor liquid-crystal displays (TFT-LCDs). While TFT-LCDs were used in applications such as pocket TVs in the late 1980s, it was not until laptop computers took off in the early 1990s that the TFT-LCD industry reached $1 billion in revenues. By the end of the 1990s, it grew to $10 billion dollars, as desktop monitors added to the demand from laptops.

It was not until 2002 that LCD revenues passed those of CRTs, but the first decade of the 21st century saw the takeoff of LCD TVs, driving the industry to the $100 billion dollar level in 2010. While "large-screen" LCD panels for TVs had been developed for years – for example, Sharp demonstrated a 14-in. panel in 1988 and a 29-in. version in 1996 – mass production lagged by about a decade because it required large investments in manufacturing equipment and time to achieve sufficient levels of cumulative volumes produced. Because these investments meant that the cost of producing TV panels would be prohibitively high compared to that of CRTs, an application was required to justify the initial investments that ultimately enabled LCD-TV production. The application in this case was the laptop computer, for which LCDs had no effective competition. In addition, the cost of the panel could be built in to the overall laptop cost.

In 1964, the first plasma displays were demonstrated, but due to the fact that they consumed large amounts of power and were only capable of low resolution and were relatively large, the technology had limited applications. Further development starting in the 1970s ultimately led to the introduction of 42-in. plasma displays in 1997. In the late 1990s and early 2000s, plasma filled a niche in the high end of the flat-panel TV business, and the plasma industry reached $1 billion dollars in 2002. However, investments in Gen 6 and higher plants enabled TFT-LCDs to overtake the plasma market in 40-plus-in. TVs, and plasma revenues peaked at $7.5 billion in 2006.

While work in organic electroluminescence had gone on for a few decades, conductive organic polymers were first reported in 1977, and the first OLED devices were developed by Kodak in 1987. In 1997, Pioneer began production of passive-matrix OLED (PMOLED) displays, and Sanyo-Kodak began producing active-matrix OLED (AMOLED) displays in 2002. In 2007, Sony began production of the first OLED TVs, 11 in. in diagonal. However, due to low production volumes and yield rates, along with high materials costs, the manufacturing cost of the display was prohibitively high (the retail price was approximately $1400) and the product did not succeed in the market. OLED makers, particularly Samsung, focused instead on small displays for mobile devices, which provided critical mass for the technology. Active-matrix OLED (AMOLED) revenues reached

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$1 billion in 2010 and are expected to pass $10 billion in 2013. This momentum has reinvigorated the development of large-sized panels for TVs; in early 2012, Samsung and LG Display demonstrated 55-in. OLED TVs and announced their intention to produce them within the year (Fig. 1).

Many other display technologies have been developed, including various forms of LCDs, other emissive technologies such as field emission and reflective technologies. The latter have been developed in the form of microdisplays, such as liquid crystal on silicon and digital micromirror devices, a type of MEMS technology. Direct-view reflective displays, which offer the promise of low-power operation, have taken many forms, with the most prevalent being electrophoretic; recently, direct-view MEMS and electrowetting displays have also come into the market.

Flat-Panel Market: Four Killer Apps

The first 15 years of the TFT-LCD industry were dominated by PC applications – first notebooks, then desktop monitors, the first CRT replacement market. The period 2005–2010 can be seen as the LCD-TV era, with tremendous growth due to replacement of CRT TVs (driven by shut-off of analog broadcasts and falling LCD prices) and growth in average screen size and sets per household worldwide. The value of LCDs sold for TVs grew from just over $12 billion to more than $55 billion during this period. The second decade of the 21st century is shaping up to be the mobile era – with mobile PCs (including tablet PCs) and mobile phones (driven by smartphones) expected to triple from less than $26 billion to over $76 billion. This growth will be shared between TFT-LCD and active-matrix OLED technology (Fig. 2).

Growth of Flat-Panel Production: Geographies and Generations

While most of the fundamental developments in flat-panel-display technologies during the 1960s and 1970s were made in the U.S. and Europe, nearly all of the companies where the breakthroughs occurred – such as RCA and Westinghouse – chose not to pursue them, despite their being in the TV and other electronics businesses. In the 1980s and 1990s, several start-up companies were formed to try to commercialize flat-panel technologies in the U.S., but none were able to move into mass production and compete in the global market. Philips and Thomson built some production in Europe, but did not become significant manufacturers in their home bases; Philips had significant presence through joint ventures with Hosiden in Japan and then LG Electronics in Korea, but eventually exited the display industry.

In the 1990s, the flat-panel-display business was dominated by Japanese LCD makers, led by Sharp, NEC, Hitachi, and DTI – a joint venture between IBM Japan and Toshiba – followed by several other Japanese firms. Korean companies identified TFT-LCD as a key technology due to its potential to replace the CRT and its overlap with semiconductor manufacturing, both important businesses to these firms. Taiwanese companies viewed TFT-LCD as a critical component technology for personal-computer assembly, the most important business for those companies. While Korean and Taiwanese firms began production of TFT-LCDs in the mid-1990s,

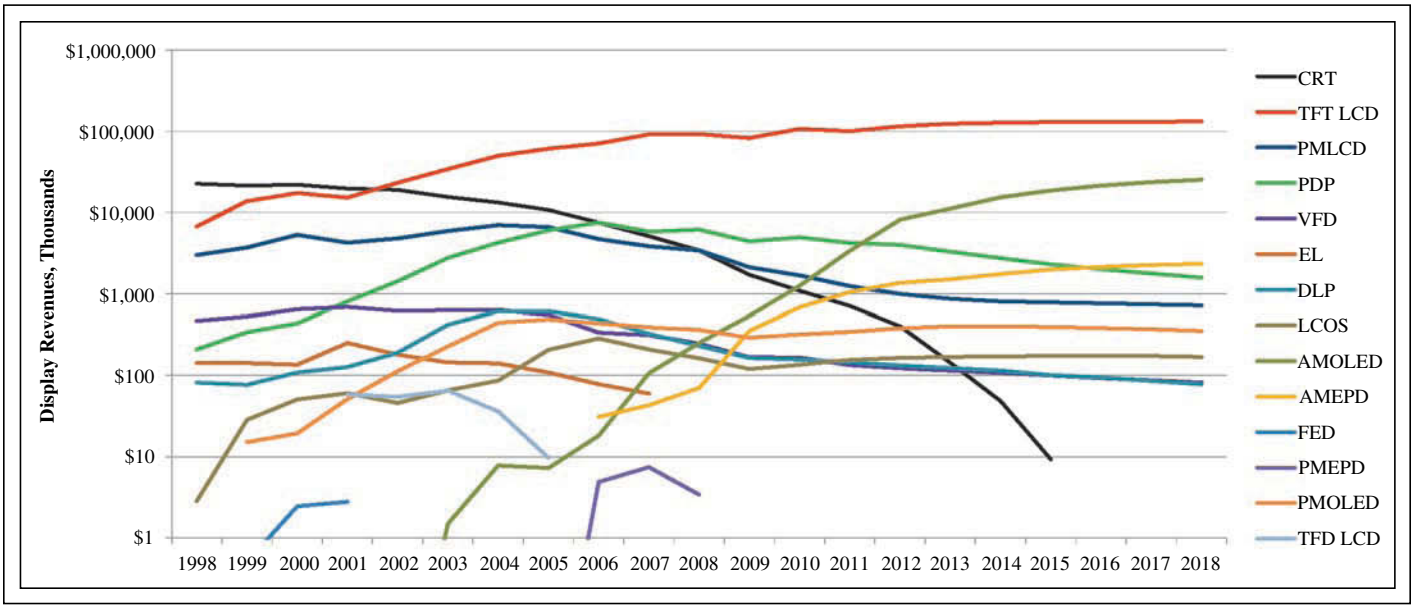

Fig. 1: *Numerous display technologies have been developed, and several have been produced in commercial quantities. The biggest transition to date has been the replacement of CRTs by flat-panel TFT-LCDs. Active-matrix LCDs, OLEDs, and EPDs are expected to see continued growth, while plasma, passive-matrix flat panels, and microdisplays are not expected to grow. (CRT = cathode-ray tube; TFT-LCD = thin-film-transistor LCD; PMLCD = passive-matrix LCD; PDP = plasma-display panel; VFD = vacuum fluorescent display; EL = electroluminescent; DLP = digital light processing; LCOS = liquid crystal on silicon; AMOLED = active-matrix organic light-emitting diode; AMEPD = active-matrix electrophoretic display; FED = field-emission display; PMEPD = passive-matrix electrophoretic display; PMOLED = passive-matrix OLED; TFD-LCD = thin-film diode LCD.) Source: DisplaySearch Quarterly Worldwide FPD Shipment and Forecast Report.*

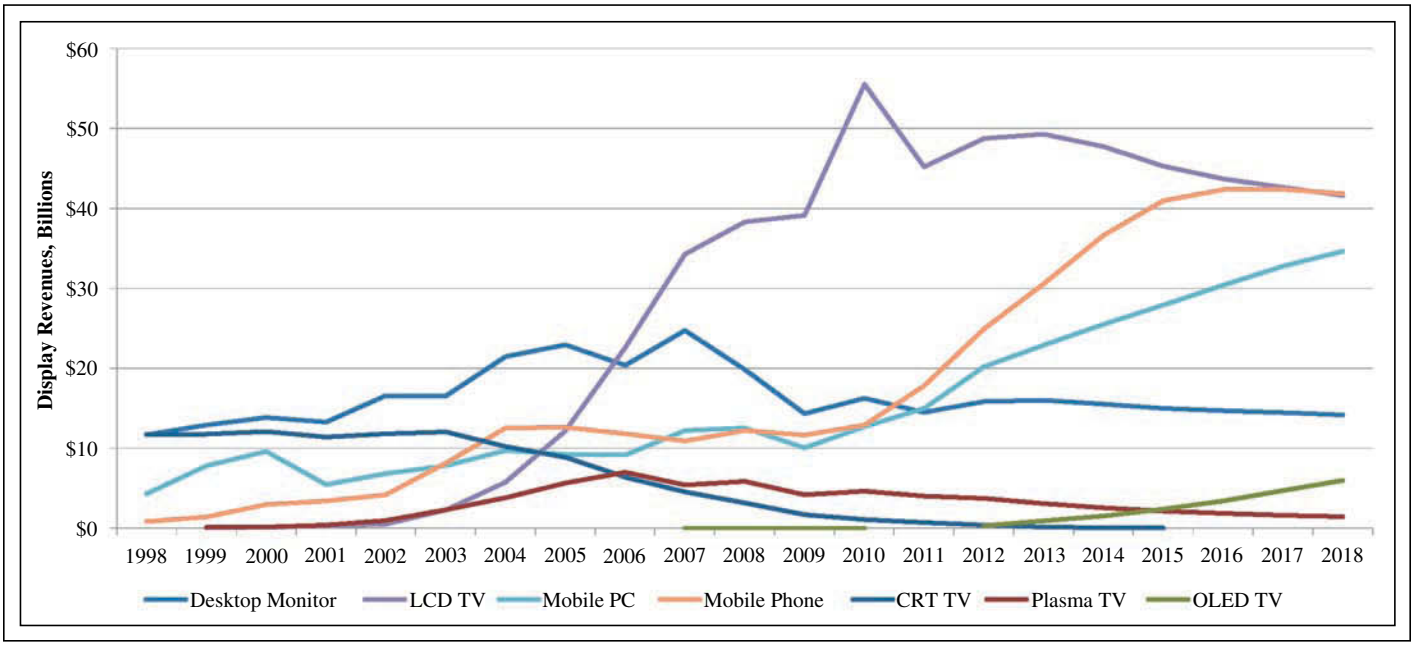

Fig. 2: *The display industry has grown around four key applications: TVs (first CRT and then flat panel), mobile PCs, desktop monitors, and mobile phones. Revenues for LCDs used in TVs peaked in 2010, but TV is likely to remain the dominant application due to growth in emerging markets. By the end of this decade, mobile applications are expected to pass TVs in terms of revenues. Source: DisplaySearch Quarterly Worldwide FPD Shipment and Forecast Report.*

their ability to invest was curtailed by the financial crisis that impacted Asia in 1997. By 1999, these companies had re-structured and were investing rapidly in TFT-LCD production. At the same time, most Japanese companies pulled back on TFT-LCD investments in the late 1990s, as an extended economic slowdown took hold. Instead, some Japanese firms entered into technology transfer/supply agreements with emerging Taiwanese manufacturers (Fig. 3).

Throughout the early 2000s, Korean and Taiwanese production grew very rapidly, and production from the two countries was evenly matched. In 2003, Korea emerged as the top supplier of TFT-LCDs, a position it has held ever since. The global economic slowdown that started in 2008 had a particularly strong impact on Taiwanese suppliers, as their lack of vertical integration meant that they were relegated to second-source status by brands that had their own panel production. While there was some development of TFT-LCD production in China in the early 2000s, some via joint ventures with Japanese makers, the country only began to emerge as a significant source of supply in 2011 and is expected to pass Japan in terms of capacity in 2012.

The manufacturing infrastructure for TFT-LCDs has proceeded fairly steadily in the first two decades of mass production, with a new "generation" of fabs (defined by a range of substrate sizes) coming into being every 2–3 years. Generations 1–3 were centered in Japan in the 1990s, but starting with Gen 4 in 2000, and in particular Gen 5 in 2002, Korean

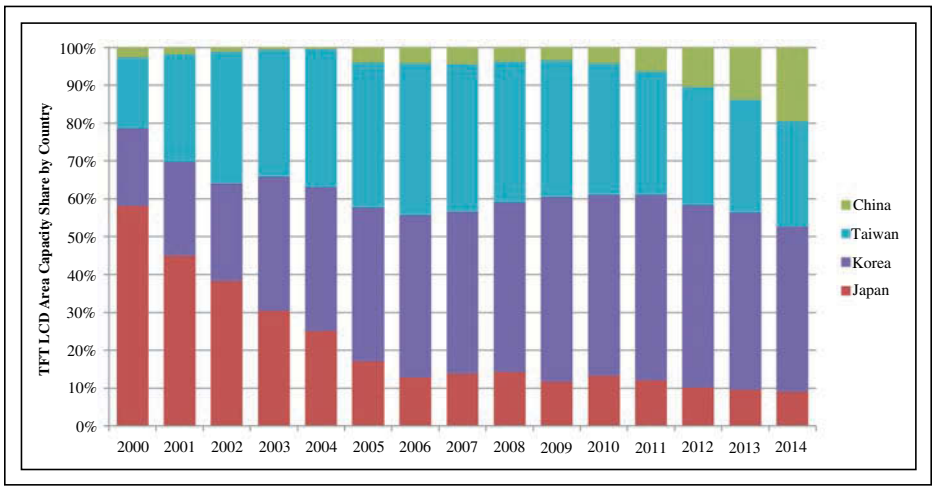

Fig. 3: *After dominating TFT-LCD production throughout the 1990s, Japanese companies did not invest at the same pace as Taiwanese and Korean companies, leading to Japan losing its number one position in 2003. Samsung and LG Display have emerged as the dominant manufacturers over the past decade. Source: DisplaySearch Quarterly FPD Supply/Demand & Capital Spending Report.*

and Taiwanese firms took the lead. While Sharp was the first firm to start production in Gen 6 in 2004, Korean and Taiwanese firms quickly passed Japan in production. Like Gen 5, Japanese firms skipped Gen 7, and Sharp was first to start Gen 8 production in 2006, maintaining a lead for 2 years until Korean firms built multiple lines in 2008 (Fig. 4).

Sharp once again was the first to build a Gen 10 line, in 2009, but this time no other firms have followed. While the huge substrate size (2880 × 3130 mm) can produce six 70-in. panels, the demand for such large screen sizes has so far been insufficient to justify even one factory, and the Gen 10 must compete with multiple Gen 8 lines that can produce 52-in. panels at only a slightly lower rate (6 per substrate as opposed to 8 per substrate on Gen 10). Thus the cycle of a new generation every 2–3 years has at least temporarily come to a halt.

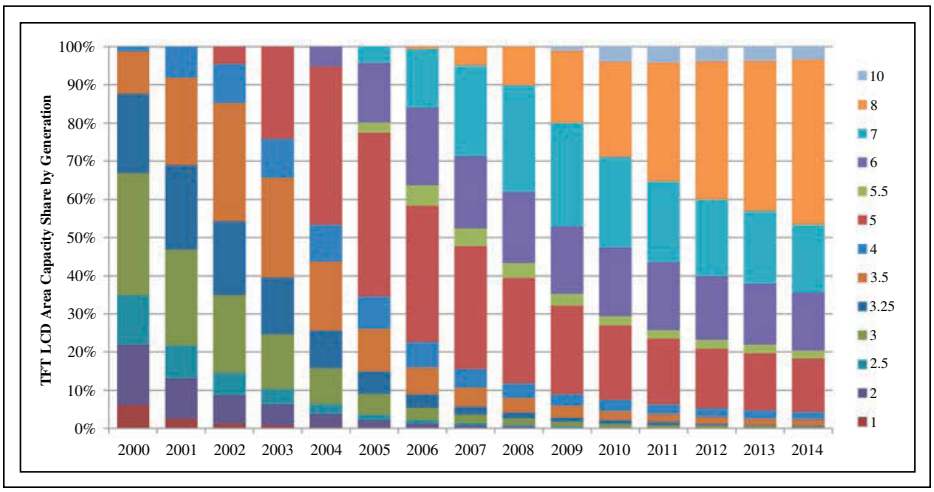

Fig. 4: Production of TFT-LCDs has proceeded along generations, which are defined by a range of substrate sizes. Every 2–3 years, a new generation is developed, with multiple factories and a common supply chain. Expansion past the Gen 10 is uncertain. Source: DisplaySearch Quarterly FPD Supply/Demand & Capital Spending Report.

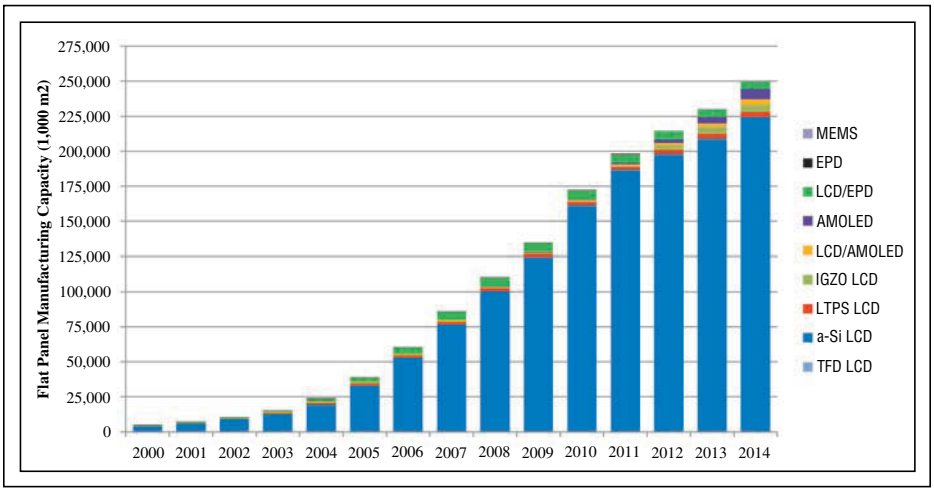

Fig. 5: Flat-panel-display manufacturing is dominated by a-Si TFT-LCD. However, much investment going forward will be in other forms of TFT, such as LTPS and IGZO, which can be used for OLED as well as LCD. Source: DisplaySearch Quarterly FPD Supply/Demand & Capital Spending Report.

The Next Era

It is likely that most investment over the next several years will be in Gen 8 TFT-LCD production, particularly in China, and in technologies other than the standard a-Si TFT, particularly LTPS and IGZO, mostly for AMOLED but also for LCD. However, the installed base of 20 years of a-Si TFT-LCD capacity will make it the dominant technology for years to come (Fig. 5).

Over the past decade, TV has been the driving force for flat-panel investments. Entry of multiple suppliers and the similarity of the panels have driven down prices, and combined with very high investment cost, has resulted in low or negative profitability for panel makers (taken as a whole, the TFT-LCD panel industry lost money during the second half of 2010 and throughout 2011). While TV will continue to be a key market, and the largest measured by area demand, it is likely that in the second decade of the 21st century, high-performance displays for mobile applications will be the area of focus. A key driver is the ability to view high-information-content information – particularly data and video – under a variety of conditions. This requires high resolution, wide viewing angle, and broad-color-gamut performance in a very slim package that consumes little power.

A related characteristic of these applications is that they tend to require customized designs, which enables panel makers to differentiate their products and compete less on price. However, this type of demand calls for different manufacturing investments and could result in the adoption of new technologies; for example, flexible form factors. It is likely that the industry structure will change along with the shifts in market demand and technology, but if history is any guide, such structural changes will take years to come about. ■

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Part III: What Companies Need to Know about the Leahy–Smith America Invents Act (AIA) Patent Reform Legislation

The America Invents Act, the most significant change to the U.S. patent system since 1952, was signed into law on September 16, 2011. This series of articles focuses on selected provisions which are likely to be the most relevant to companies in the display industry. Part III examines the changeover from a "first-to-invent" to a "first-to-file" system.

by Clark A. Jablon

THE MOST SIGNIFICANT change to the U.S. patent system since 1952 was signed into law on September 16, 2011. In Part I of this series of articles, I discussed many of the key litigation-related provisions and provided a brief summary of the new changeover from a "first-to-invent" to a "first-to-file" system. In Part II, I discussed key provisions of the AIA that relate to U. S. Patent & Trademark Office (USPTO) and patent examination provisions. These included a new prioritized examination process, fee surcharges, and a new "micro entity" designation for patent applications that allow for significantly reduced government fees, as well as new USPTO validity review proceedings, including a new post-grant review process (opposition proceeding). In Part III, I discuss the changeover from a "first-to-invent" to a "first-to-file" system in more detail.

Clark Jablon is a Partner and Registered Patent Attorney at Panitch Schwarze Belisario & Nadel LLP (PSB&N) in Philadelphia, PA. His practice involves the preparation and prosecution of patent applications, enforcement, and litigation of patents, and opinion work on patent validity, infringement, and patentability. He is a degreed electrical engineer and has worked as a patent practitioner for more than 28 years. He can be reached at cjablon@panitchlaw.com. The opinions expressed herein are those of the author and not necessarily those of PSB&N.

Overview: From "First-to-Invent" to "First-to-File"

Presently, and until March 15, 2013, the first of two different sets of inventive entities (inventors) who file an application for the same patentable invention is entitled to a patent "interference proceeding" wherein the patent will be awarded to the inventor who can prove through documents and other evidence that he or she invented the invention first in time, regardless of which inventor filed the application first. For inventions filed on or after March 16, 2013, with certain exceptions described below, the patent will be awarded to the inventor who filed the application first in time, regardless of when the inventor actually invented the invention. The primary exception to this new "bright line" rule is if the second-to-file inventor presents evidence that the first-to-file inventor derived the invention from the second-to-file inventor, such as by stealing it. In this case, the USPTO will conduct a "derivation proceeding" to ensure that the first inventor to file the application is actually an "original inventor" and that the application was not derived from the second inventor. (Only "original inventors" are entitled to obtain a valid, enforceable patent.)

"First-to-File" a Misnomer

"First-to-file" is actually a misnomer – the new system has been termed by some as a "first-to-disclose" system. Probably the most

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0362-0972/06/2012-024$1.00 + .00 © SID 2012

misunderstood and unappreciated aspect of this changeover is that it creates a race in which the first inventor to disclose the invention wins the race for the patent, assuming that the first discloser files a patent application in a timely manner, either concurrently with the disclosure or shortly thereafter and that the invention is patentable. To illustrate how this works, consider the following scenario, wherein the word "entity" is used to represent either an individual inventor or a company:

1. Entity A invents a new widget on June 1, 2013, and proceeds in a timely fashion to prepare and file a patent application on September 1, 2013, for the new widget. Entity A does not make any public disclosure of the invention until after September 1, 2013.
2. Entity B independently invents the same new widget as entity A and makes a public disclosure of the invention on August 1, 2013. Entity B files a patent application on the new widget on July 30, 2014, within the 1-year grace period after entity B's disclosure (also, referred to as the "statutory bar deadline").

Here, entity B disclosed the invention first, but filed after entity A. However, entity B is entitled to the patent, despite filing after entity A because entity B disclosed the invention first. Thus, in this instance, the new law is not technically a "first-to-file" rule but a "first-to-disclose" rule. The disclosure may be in the form of a patent application (which could be a U.S. provisional application, a U.S. non-provisional application, or a foreign application), or a public disclosure of the invention, with a subsequent patent application filing that is made within the 1-year grace period.

Furthermore, if entity B never followed up the public disclosure with a patent-application filing, entity A would still be blocked from getting a patent because entity B's public disclosure will be "prior art" against entity A's patent application, and entity A will not be allowed to prove that it actually invented the invention before entity B, which it can do under the present law.

In the scenario above, if entity A filed a patent application before the August 1, 2013, public disclosure by entity B, then entity A would be entitled to the patent because the filing of the patent application constitutes a disclosure for purposes of priority battles.

> ***. . . the "first to invent" is entitled to whatever patent rights may be available under the new "first-to-file" rules, as long as the "first to invent" is also the "first to disclose."***

Thus, the "first-to-invent" may still get the patent rights under the new "first-to-file" rules, as long as the first inventor makes a public disclosure and/or files a patent application before another entity files a patent application filing and/or makes a public disclosure of the same invention. Stated more simply, the "first-to-invent" is entitled to whatever patent rights may be available under the new "first-to-file" rules, as long as the "first-to-invent" is also the "first-to-disclose."

The new law eliminates the "swear behind" option that is currently available to first inventors, where documentation of the first inventor's invention date may be submitted to remove a later publication of the invention by another entity from being "prior art" that can be used against the first inventor. Presently, the U.S. is the only country in the world that retains this rule, and the law change is meant to harmonize U.S. patent law with the patent laws of other countries. The law change was also put forth as a way to potentially reduce the costs of patent prosecution and patent litigation. Expensive battles over priority are sometimes fought in USPTO interference proceedings or in court battles when references that are less than 1 year prior to the filing date of an application or patent are asserted as invalidating prior art.

New "Derivation" Proceeding

The discussion above regarding who wins the invention priority presumes that each of the entities independently invented the same new widget. However, if entity A loses the priority battle to entity B, but believes that entity B stole the invention from entity A, then entity A may request a derivation proceeding in an effort to prove that entity B derived the invention from entity A. This is an administrative proceeding that occurs in the USPTO under rules that are similar in many respects to the current interference proceedings.

What Constitutes a "Public Disclosure" for Purposes of Being the First Inventor?

The AIA statutes do not clearly answer this question, but the legislative history makes it clear that conventional types of public disclosures count, such as having the invention described in a printed publication, placing the invention in public use, or on sale, or otherwise being made available to the public anywhere in the world. In contrast to these public activities, secret public use, private offers, and private sales may not qualify as public disclosures for purposes of being the first inventor. Thus, if a company wishes to solidify its stake in the ground as being the first inventor of an invention, without immediately filing a patent

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application, the company should be careful not to rely upon non-public types of activities for locking in this right.

What Changes Do Companies Need to Make Under the New Laws and Rules?

For many companies, the answer is simply "none." The law and new rules are not likely to negatively affect a company's ability to patent its inventions for at least the following two reasons:

1. True simultaneous invention scenarios are extremely rare.
2. Under the existing law, the first-to-file inventor is usually determined to be the first to invent in interference proceedings, and it is likely that going forward, the "first-to-file" will often turn out to be the "first to disclose." This is especially true because to be the "first-to-disclose," the disclosure must be an "enabling" disclosure; namely, it must provide sufficient detail so as to enable one of ordinary skill (in the technology to which the invention pertains) to build the invention without undue experimentation and without engaging in any inventive efforts. Enablement is a standard that must be met in a properly prepared patent application, but is often not met by many types of public disclosures, such as sales and marketing materials.

Also, foreign companies, and U.S. companies that wish to preserve their rights to foreign patent protection, already file patent applications before any public disclosures occur so as to avoid novelty bar problems in foreign countries, and thus are accustomed to early filing of inventions. These companies might wish to file even earlier, if possible, but in most instances, practical considerations will preclude any earlier filing. Thus, for many companies, it is important to be aware of these new rules, but no changes in procedures may be necessary.

Provisionals, Provisionals, and More Provisionals

The most common strategic advice being given by patent professionals to respond to the new "first-to-file" world is to file a provisional application as soon as possible if it is believed that patent protection might be sought for an invention. A provisional application will qualify as a disclosure of the invention as long it provides an "enabling" disclosure.

One advantage of this strategy is that if the company decides not to pursue the invention, it can abandon the patent application upon the 1-year expiration date of the provisional application, thereby avoiding the full expense of preparing a regular non-provisional application. The provisional application does not become public, and thus any invention details in the provisional application will remain secret. Alternatively, the company may wish to file a non-provisional application based on the provisional application as inexpensively as possible. Upon publication of the non-provisional application, the provisional application will block another company that makes a subsequent disclosure from obtaining patent protection on the same invention. This potentially provides the company with limited "freedom to operate" with respect to the invention by another company that files a patent application later for the same invention, regardless of when that other company made the same invention.

Another advantage of this strategy is that multiple provisional applications may be filed before the priority year ends as the invention continues to be developed, thereby locking in new disclosures to meet the "first-to-disclose" rule, and then the non-provisional application can include all of the subject matter of the multiple provisional applications.

While this strategy meets the "better safe than sorry" test, it may still not be practical for many companies because preparing a provisional application still requires company time and expense and should be prepared with the assistance of a patent professional. However, this strategy can be applied selectively by companies so that only certain high-profile inventions incur this extra cost, while other inventions can be handled in the conventional manner.

> ***"True simultaneous invention scenarios are extremely rare."***

Large companies often have lengthy procedures for processing Employee Invention Disclosures, including periodic committee reviews to decide which inventions to file on. Budget considerations sometimes delay approved Invention Disclosures from being turned into patent applications in a timely manner. It is not uncommon for a 2-year period to pass from submission of an Employee Invention Disclosure to the filing of a patent application on the invention. Under current law, the company can rely upon the Employee Invention Disclosure as evidence of prior invention to swear behind another disclosure or application filed by a different company that was invented after the first company's invention date. However, after March 15, 2013, companies will not have the luxury of sitting on invention disclosures and filing them at their convenience because the other company's disclosure or application will trump their earlier invention date. Thus, large companies should consider revamping their procedures to reduce the time frame between invention submission and invention disclosure.

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Heightened Diligence Should Suffice

The new "first-to-file"/"first-to-disclose" law and rules introduce a new risk that patent rights may be lost due to delays in filing a patent application or delays in disclosing the invention. While the author is not suggesting that these are "much ado about nothing," for most companies, a reasonable amount of heightened due diligence is all that is required to respond to this rule change.

The USPTO has an information Web page regarding the AIA at http://www.uspto.gov/aia_implementation/index.jsp that provides links to specific details of the AIA.

Parts I and II of this patent series appeared in the February/March and April 2012 issues of *Information Display*, respectively. ■

Products on Display at Display Week 2012

Some of the products on display at North America's largest electronic-information-display exhibition are previewed.

by The Editorial Staff

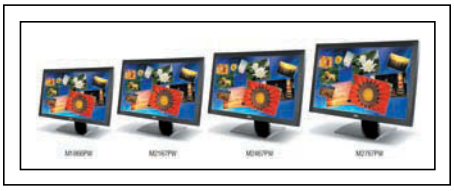
THE SID 2012 International Symposium, Seminar, and Exhibition (Display Week 2012) will be held at the Boston Convention and Exhibition Center in Boston, Massachusetts, the week of June 3. For 3 days, June 5–7, leading manufacturers will present the latest displays, display components, and display systems. To present a preview of the show, we invited the exhibitors to highlight their offerings. The following is based on their responses.

3M TOUCH SYSTEMS

St. Paul, MN 651/733-9103
www.3M.com
Booth 151

Multi-Touch Desktop Displays

3M™ Multi-Touch Desktop Displays take interactivity to the next level by combining uncompromising multi-touch performance, brilliant high-definition graphics, wide viewing angles, and elegant product design into a fully integrated easy-to-use plug-and-play multi-touch desktop device. Featuring 3M's high-performance Projected-Capacitive Technology (3M PCT), these displays offer up to 40 simultaneous touches, each at an ultrafast 6–10-msec response time, enabling users to naturally interact with digital multimedia and to easily collaborate with multiple users. These displays come in 18.5-, 21.5-, 24-, and 27-in. sizes and are available for sale at shop3m.com.



ABRISA TECHNOLOGIES

Santa Paula, CA 877/622-7472
www.abrisatechnologies.com
Booth 769

Ultra-Thin Glass for Display Applications

High-Ion-Exchange (HIE) chemically strengthened thin glass is extremely durable, making it ideal for electronic-display and touch-screen applications. The ion-exchange process creates a deep compression layer on the surface of the glass structure, resulting in a highly scratch, shock, and impact-resistant end product. Easy-to-clean, HIE glass is available in thicknesses of 0.5–2.0 mm and can be fabricated with custom edge treatments, screen-printed and custom-cut with drilling of holes. Thin-film ITO and IMITO coatings can be applied for EMI shielding and heater panels for displays in medical and defense environments.

AVNET EMBEDDED

Phoenix, AZ 480/643-2000
www.em.avnet.com/pmk

Display Performance Matched Kits

The Avnet Embedded Performance Matched Kits (PMK) program offers a complete out-of-the-box experience simplifying the evaluation and integration of system boards and LCDs. Avnet's PMK program is the technical alignment of displays and system boards, ensuring compatibility between the devices. Avnet's engineering experts address all of the complex connectivity and firmware issues between these two product sets and deliver a fully vetted set of displays and system-board bill of materials, including the cabling and other support hardware. PMKs, developed using products from industry leading manufacturers, enable faster application development, speed time-to-market, and save time and money in logistics and supply-chain costs for purchasing groups.

BENEQ

Vantaa, Finland +358-9-759-9530
www.beneq.com
Booth 578

Stronger Class with Thin Films

Beneq, supplier of production and research equipment for thin-film coatings, proudly presents a new approach to strengthened glass for electronic devices. By applying a dense but transparent thin film on the surface of glass, the cracking resistance increases by up to 40%. This patented technology strengthens any type of glass and can be applied to

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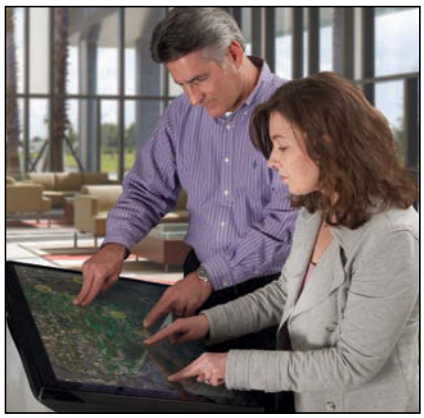
both motherglass and cut-size glass. Beneq offers production equipment for Strengthened Glass™ for batch coating cut-size glass and full-size motherglass sheets. Throughput ranges from 0.7M to 7M pieces per year.

BERGQUIST COMPANY

Chanhassen, MN 1-800-949-4021
www.bergquistcompany.com
Booth 574

Large-Format Projected-Capacitive Touch panels

Multi-touch panels are not just for your smart phones anymore! The Bergquist Company is happy to present new large-format projected-capacitive multi-touch panels. With up to ten simultaneous touches on panels up to 24 in., and dual-touch on panels up to 32 in. (with up to ten touches coming soon), more than one person can interact together on the same screen.

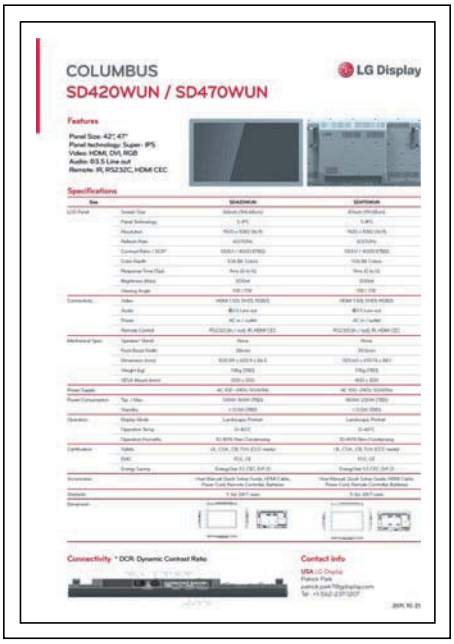


BI-SEARCH, INC.

Tustin, CA 714/258-4500
www.bisearch.com
Booth 375

Commercial Panels

Bi-Search is a authorized distributor and value-add center for LG Displays' new line of products for the commercial industry. The 42- and 47-in. Columbus panels (SD420WUN and SD470WUN) both utilize LG's super-IPS (in-place switching) technology, are high resolution (1920 × 1080), and have a wide range of interfaces available – HDMI, DVI, and RGB. Columbus products also consume low power, making them more cost-effective, energy-friendly due to the automatic backlight control system, and low power. With a brightness of 500 nits, these products can be used in homes, retail, and advertisement, featuring its ability to display in landscape or portrait mode.


COLUMBUS
SD420WUN / SD470WUN
LG Display
Features
Specifications
Connectivity * DCR: Dynamic Contrast Ratio
Contact info

CAPSTONE VISUAL PRODUCT DEVELOPMENT

Exeter, RI 401/392-1023
www.capstonevisual.com
Booth 754

Custom Video Controllers

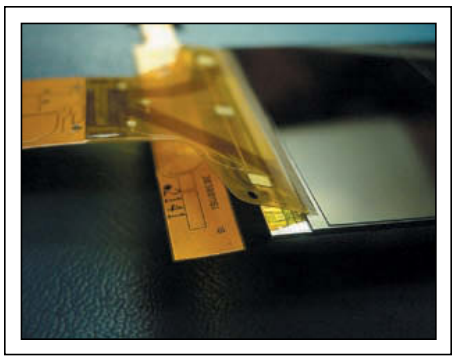
Capstone Visual Product Development, exhibiting their custom video controllers, will showcase a 5.6-in. broadcast-quality high-brightness monitor designed for use with Digital SLR cameras and videography applications. This monitor has a custom controller that receives video up to full-HD (1920 × 1080P60) digitally as HDMI and SDI as well as analog YPbPr. Standard NTSC signals are also accepted. This monitor has built-in HDMI to SDI conversion in order to interface DSLR equipment to broadcast industry SDI devices as well as SDI-to-SDI viewing and past-thru. GUI functions are provided for a host of filming support features such as user-defined markers and color exposure mode. All controls are directly accessible via front-panel buttons in order to allow adjustments on-the-fly so the perfect shot can be captured.

CHIMEI-INNOLUX CORP.

Miaoli, Taiwan +886-37-586-393
www.chimei-innolux.com
Booth 953

Complete Display/Touch/Window Solution

Chimei-Innolux (CMI) will demonstrate a fully TOD™ solution for reducing thickness and for better optical performance at Display Week 2012. Key value drivers for TOD™ include true single-layer ITO touch, true multi-touch without ghosting, touch on thinned bi-pane process, touch scan frequencies up to 150 Hz, and 2D and 2.5D shaped windows. The display technology is independent of display modes (TN, VA, IPS, and AMOLED). No user calibration is required.



CIRCLE TWELVE, INC.

Framingham, MA 508/620-5360
www.circletwelve.com
Booth 374

Multi-User Touch Technology

DiamondTouch™ is a tabletop computer interface designed to support small-group face-to-face collaboration. It is "multi-touch," meaning that it sup-

ports multiple touch points and hand postures as input. But the thing that makes DiamondTouch different is that it is "multi-user" – meaning that multiple people can touch simultaneously, and DiamondTouch can identify who is who. DiamondTouch lets you operate any standard Windows application with your hands instead of a keyboard and mouse. And there is a built-in multi-user annotation tool so that people can make white-board-style mark-ups together, which is good for collaboration and brainstorming.

CORNING INCORPORATED

Corning, NY 607/974-9000
www.corning.com
Booth 123

Ultra-Slim Flexible Glass

Corning's ultra-slim flexible glass is a thin and flexible display-grade glass that has benefits for a variety of electronic devices. Flexible glass will help enable thin, light, and cost-efficient applications including today's ultra-sleek displays, tomorrow's flexible solar cells and lighting, and the smart surfaces of the future. Flexible glass leverages our proprietary fusion technology, providing glass of superior surface quality, flatness, and thermal stability.

DAWAR TECHNOLOGIES

Pittsburgh, PA 412/322-9900
www.dawar.com
Booth 463

Multi-Touch Projected-Capacitive Touch Screens

Dawar Touch introduces its new Multi-Touch Projected Capacitive Touch technology. Our PCT sensors are designed, manufactured, and supported in the USA at Dawar's Pittsburgh, PA factory. Constructed as an all-glass solution, our touch screens provide extreme durability and superior optics. The new product features multi-touch functionality, gesture support, and enhanced sensitivity for a light touch and effortless input with your finger, glove, or conductive stylus. We offer a standard product line from 4.3 to 24 in. as well as custom solutions to meet your application requirements. Dawar's PCT is the perfect choice for your medical, instrumentation, or industrial application.

DELO INDUSTRIAL ADHESIVES

Sudbury, MA 978-254-5275
www.delo.us
Booth 514

Adhesives for Display Bonding

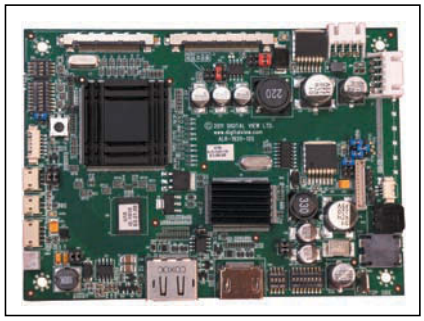
DELO has developed new optically clear light-curing liquid adhesives that combine very good adhesion and durability with high transparency. They enable a fast and flexible bonding of touch panels or cover glasses directly onto LCDs. Thanks to their dual-curing capability, they do not only cure by exposure to UV or visible light. In shadow areas, *e.g.* under black masks, they reliably cure by means of a second curing mechanism through a reaction with moisture in the air. Delo's optically clear adhesives drastically reduce internal reflections and improve the shock and vibration performance. Furthermore, fogging, condensation, or other contaminations are avoided.

DIGITAL VIEW

Morgan Hill, CA 408/782-7773
www.digitalview.com
Booth 860

Compact Low-Profile LCD Controllers

With support for 120-Hz panels up to 1920 × 1200 resolution, the ALR-1920-120 is a compact, low-profile LCD controller solution for display system builders. Inputs include HDMI and DisplayPort. TFT panel connection with VESA and JEIDA LVDS. Controls include button menu controls, IR, RS-232, and DDC-Ci. Power input is 12/24-V DC. Other features include PWM and DPMS backlight brightness control.



DIMENCO

Veldoven, The Netherlands +31-6-3432-6600
www.dimenco.eu
Booth 848

Switchable Autostereoscopic 3-D monitor

The Dimenco 23-in. 3-D monitor requires no glasses to experience high-quality 3-D without compromising 2-D image quality. The switchable lens consists of an additional LC layer on top of the lenticular lens to realize either a refractive index that creates a stunning 3-D image or a crisp 2-D image. The unique lens design makes it further possible to either experience the monitor in a non-glasses stereo-mode (two-view) with face-tracking or to use it in the non-glasses multi-view mode (28 views), enabling the sharpest 3-D images.

DONTECH, INC.

Doylestown, PA 215/348-5010
www.dontech.com
Booth 368

Precision Glass Optical Filters

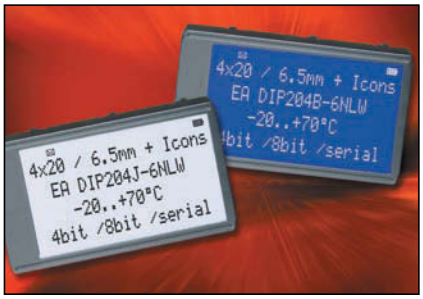
Utilizing the latest in-glass fabrication and thin-film vacuum deposition technology, Dontech's VCG-Series™ glass filters provide exceptional optical transparency and environmental durability. The precision glass optical filters are utilized in demanding military, medical, industrial, and avionics applications. For high-end display programs, VCG-Series™ filters optimize display clarity and high ambient light contrast (*e.g.*, sunlight readability). VCG-Series™ filters can be fabricated from a variety of glass substrates, such as chemically strengthened (soda lime, Corning® Gorilla®, Asahi Dragontrail™), borosilicate, fused silica and optical glasses (*e.g.*, Schott nBk-7). VCG-Series™ filter customization options include high-energy vacuum-deposited coatings such as antireflective, transparent conductive (EMI shielding, transparent heaters), and IR or NIR blocking.

ELECTRONIC ASSEMBLY GmbH

Gilching, Germany +49-8105-77-80-90
www.lcd-module.com
Booth 1373

Alphanumeric Display Module

The EA DIP204-6 LCD module made by the display specialist Electronic Assembly features LCD supertwist technology, a razor-sharp image, and very simple mounting. The EA DIP204-6 can display four lines containing 20 characters each. It is available with white characters on a blue background or black characters on a white background. The display is the ideal solution for attractively designed HMIs on electrical equipment and machinery. The on-board KS0073 controller manages user-friendly communications with the outside world. Besides the character set containing 240 alphanumeric characters, the unit can also display 16 icons such as arrows or technical symbols, considerably simplifying operation of the equipment on which the display is installed. System developers can also define up to eight symbols of their own which can be stored and displayed just like alphanumeric characters. The display has a parallel data bus and a SPI port for data transfer with the control circuitry. The EA DIP204-6 is extremely compact (only 75 mm wide). No complicated installation is necessary because the unit can easily be soldered directly onto the PCB. The display can simply be plugged into a socket connector. The EA DIP128-6 with a resolution of 128 × 64 pixels is a graphic-enabled alternative to the EA DIP204-6. It is supplied in the same housing as the EA DIP204-6.



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Please send all press releases and new product announcements to:

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New York, NY 10003
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e-mail: jdonelan@pcm411.com

eGALAX_EMPIA TECHNOLOGY INC. (EETI)

Taipei City, Taiwan +886-2-8751-5191
www.eeti.com
Booth 381

Touch Solutions

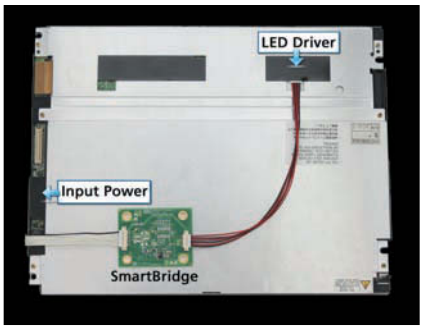
EETI designs, develops, and markets a wide portfolio of standard solutions such as resistive, surface capacitive, surface acoustic wave, and infrared solution as well as leading-edge solutions such as a projected-capacitive touch controller for Microsoft Windows 7 and 8 Logo devices. EETI partners with worldwide sensor makers and tier brand suppliers to provide a broad-base solution for its customers.

ENDICOTT RESEARCH GROUP (ERG)

Endicott, NY 607/754-9187 x3058
www.ergpower.com
Booth 563

LED Driver Connectivity

Switching from CCFL to LED backlighting? The new SmartBridge module from ERG integrates the power supply of your existing design to the LED driver incorporated in the display with one simple swap. Remove inverter, plug in SmartBridge, and connect between input power or controller and LED driver for fast, easy, and economical DC/DC conversion and analog to PWM signal generation. Saves time and money. 5- and 12-V models available.



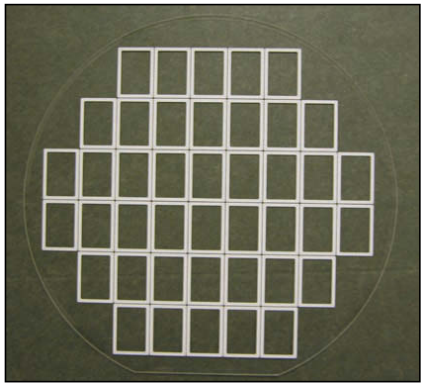
EPOXY TECHNOLOGY

Billerica, MA 978/667-3895
www.epotek.com
Booth 745

Epoxy Paste

Epoxy Technology is showcasing EPO-TEK® OG159-2, a one-component high-viscosity UV-cured screen-printable epoxy paste for perimeter

and gasket sealing in the LCD, OLED, and display industries. This state-of-the-art adhesive paste enables OLED packaging via either glass or top film with thicknesses ranging from 6 to 20 µm, while maintaining a very low WVTR. EPO-TEK® OG159-2 is compatible with OLED electrolytes and liquid-crystal polymers. Epoxy Technology can also provide custom formulating services for your unique application requirements.



EUROPTEC USA

Clarksburg, WV 216/447-8498
www.europtecusa.com
Booth 431

Anti-glare glass

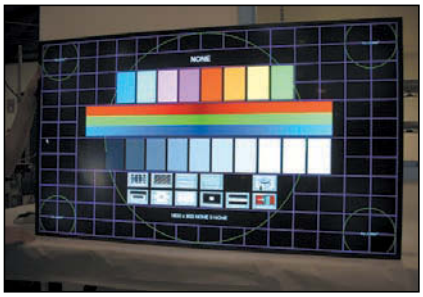
EagleEtch® XS has the best anti-glare properties in an extra-thin sheet of glass for display applications. The ultra-lightweight glass is ideal for portable devices such as cell phones, global positioning systems, and the increasingly popular tablet PCs. Although EagleEtch® XS boasts an extra-thin design, the glass maintains EuropTec's reputation for anti-glare performance and durability in even the harshest environments. Unlike coating or spray-on solutions, EagleEtch® XS is able to withstand downstream processing such as chemical strengthening.

EYESAVER INTERNATIONAL (ESI)

Hanover, MA 781/829-0808
www.eyesaverinternational.com
Booth 867

Optical Bonding

Eyesaver International, Inc., (ESI), a leader in LCD optical bonding, can accommodate display sizes ranging from 3.5 to 70 in. on the diagonal. ESI's proprietary bonding solution is the most environmentally durable, optically clear solution on the market. Our optical bonding is an ideal solution for sunlight readability on outdoor displays as well as medical, military, and industrial display applications. Our optical bonding is performed in a clean-room controlled environment. ESI also manufactures a line of display filters for every industrial and outdoor display need. This display has an IR/heat-rejecting vandal-resistant filter optically bonded to a 46-in. LCD.



FLABEG DEUTSCHLAND GmbH

Nuemburg, Germany +49-9-11-9645-6249
www.flabeg.com
Booth 1313

TControl Glass

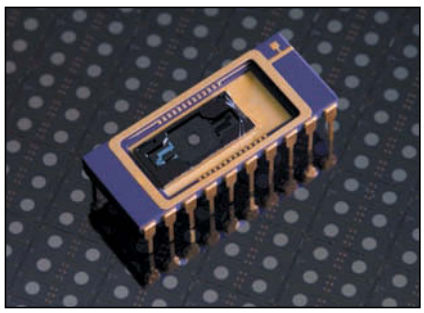
Innovative product development, strict safety standards, and a strong focus on user-friendliness are just some of the factors that should influence your choice of the right glass for your display and imaging applications. Flabeg's Tcontrol, our newest innovation, has a heat-temperable high-performance anti-reflection coating that has optical clarity, is precision-retained after strengthening, has brilliant transmission virtually free of reflection, is qualified for use both indoors and outdoors use, and is easy to clean even with standard glass-cleaning agents. TControl also survives the harshest environments. It meets all the DIN ISO 9211-3 C hardness requirements and is resistant to chemical exposure in accordance with ISO/DIN 16750-5.

FRAUNHOFER IPMS

Dresden, Germany +49-35-1882-3238
www.ipms.fraunhofer.de
Booth 1371

Micro-Scanning-Mirrors for Beam Steering and Pico-Projector Displays

Various applications require dynamic deflection of light with micro scanning mirrors as cutting-edge technology to provide robust and cost-efficient scanning capabilities for ultra-mobile and low-power applications. The novel device concept LinScan by Fraunhofer IPMS allows for low frequency linear scanning in one axis plus fast resonant scanning in the second axis, which enables linewise writing of images in pico-laser-projection displays with up to SVGA resolution. LinScan devices use the electrostatic driving principle and hence consume significantly less power than competitive electromagnetic micro scanning mirrors with a comparable performance level.



FUJIFILM DIMATIX

Santa Clara, CA 408/565-9150
www.dimatix.com
Booth 966

Materials Printer

The DMP-2831 is a low-cost cartridge-based piezo ink-jet-printing system that enables direct deposition of functional fluids, including nanoparticle-based metallic and organic materials, onto virtually any surface over an area of 200 × 300 mm. It is designed to minimize waste of expensive fluid materials and eliminate the cost and complexity associated with conventional product development and prototyping. The platen can be heated to 60˚C to thermally manage substrates during printing. An integrated drop watcher lets researchers capture and analyze in-flight droplet formation and firing. It uses 16-jet printhead cartridges available in 1- and 10-pL drop volumes.

GAMMA SCIENTIFIC

San Diego, CA 858/279-8034
www.gamma-sci.com
Booth 637

Goniometer System

The GS-940-7X Display Measurement Goniometer System from Gamma Scientific is the fastest and easiest way to perform high-accuracy angular measurements for any sized display. With a six-axis robotic arm and high-speed spectroradiometer, the GS-940-7X scans screens from virtually any angle with 70-µm accuracy. The GS-940-7X is push-button simple to operate and program by a single technician. Unlike conventional goniometers, the GS-940-7X keeps displays stationary during testing and can test multiple, unique displays at once. The GS-940-7x can withstand the rigors of 24/7 production-floor environments, while still featuring a compact footprint and wheel-mounted design for maximum mobility.

GJM CO., LTD.

Chungcheongnam-do, Korea +82-41-561-9194
www.gjm.kr
Booth 730

Evaporation Solution for OLEDs and Thin-Film (CIGS) Photovoltaic Cells

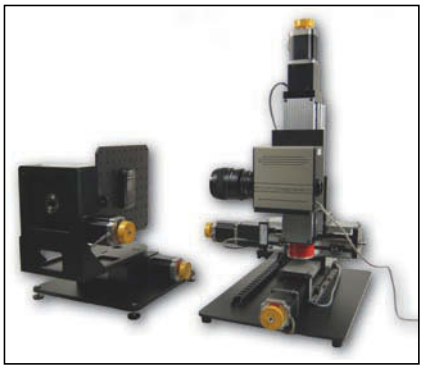
GJM is a manufacturer of large-sized Linear Brick Cell Sources (~5.5 G, 1300 mm) for OLEDs and thin-film (CIGS) photovoltaic cells and innovative organic material purifiers. Our simulation (DSMC – Direct Simulation Monte Carlo) for molecular behavior under a vacuum environment has a function to optimize process specifications such as thin-film uniformity, material consumption rate, *etc.* Moreover, GJM had developed a new concept purification system for large-quantity production (10 kg) of organic material.

GOOCH & HOUSEGO

Orlando, FL 407/422-3171
www.goochandhousego.com
Booth 212

Automatic Display Measurement System

The Life Sciences and Instrumentation Division of Gooch and Housego offers the OL 770-ADMS, a modular, motion-control platform suitable for a variety of automated measurement applications, including display testing. The system features our OL 770 high-speed multichannel spectroradiometer for a complete, robust, and flexible tool. The motion system is expandable up to five axes (x, y, z, horizontal, and vertical). Powerful software allows users to create scripted automation and integrate other measurement tools for fully automated parameter testing.



GRAFTECH INTERNATIONAL

Parma, OH 216/529-3777
www.graftech.com
Booth 831

Heat Spreaders

GrafTech International is one of the world's largest manufacturers of graphite and carbon-based products, with customers in 80 countries. At Display Week 2012, GrafTech will exhibit eGRAF heat spreaders that have improved displays for over 10 years.

HANVON

Haidian District, China +86-10-8279-6651
www.hanwang.com
Booth 409

ERT Components

Hanwang ERT components utilize electromagnetic resonance technology to implement powerful non-contact handwriting input for intelligent equipment such as e-books, GPS navigation devices, MP4, MID, tablet PCs, netbooks, notebook computers, mobile phones, *etc*. Compared to resistive-type and capacitive-type touch technology, the EM module eliminates the influence of surface stains or abrasion and avoids erroneous input. Thus, the operational lifetime of intelligent equipment can be greatly lengthened. Another advantage of EM modules is that they do not reduce the transparency of the display, particularly for EPDs. Therefore, it is an appropriate input device for e-books.

HENKEL CORP.

Rocky Hill, CT 860/571-5128
www.henkel.com
Booth 336

Liquid Optically Clear Adhesive

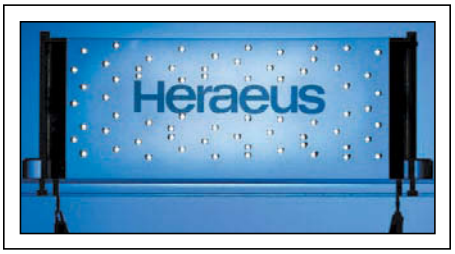
Henkel Corp. has introduced Loctite® 5192, a groundbreaking dual-cure silicone liquid optically clear adhesive (LOCA) that cures in seconds on exposure to UV light. This unique adhesive's secondary moisture cure allows full cure in shadowed areas without any additional processing. It resists temperatures in excess of 100ºC and eliminates mura due to its ultra-low shrinkage (<0.5%). Loctite® 5192 is optimized for TP1 applications, but has also proven to work well for TP2 applications on smart phones, tablets, monitors, and televisions.

HERAEOUS PRECIOUS METALS GmbH

Leverkasen, Germany +49-22-14302-6718
www.heraeus.com
Booth 742

Conductive Polymer Demonstrator

The highly conductive PEDOT:PSS formulation Clevios™ FET has been coated on a curved PET substrate. The Clevios PEDOT:PSS has then been structured into strips using the special etchant Clevios™ Etch and masking agent Clevios SET. The non-conductive and conductive areas have the same transparent appearance. The adjacent conductive segments are electrically bridged with LEDs. The result is clear electrical illumination with no apparent electrical connections. The benefits of using Clevios™ include high transmission, flexibility, land long-term stability combined with the creation of a unique lighting appearance.



INCOM

Charlton, MA 508/765-9151 x217
www.incomusa.com
Booth 613

Fiber-Optic Faceplates

Incom's fiber-optic faceplates transfer an image from one surface to another, enabling seamless and dynamic programmable digital displays with tactile feedback. The fiber-optic image conduits enhance the user interface visually as well as reduce the complexity of numerous buttons. This technology was introduced in high-end professional audio mixing equipment. The end user coined the term SLICK (Self-Labeling Illuminated Customizable Keys) for the technology used in their application. The second user of this technology was a major producer for casino-gaming systems.

INSTEC, INC.

Boulder, CO 303/444-4608
www.instec.com
Booth 622

Automated Liquid-Crystal Tester

Instec's Automatic Liquid Crystal Tester (ALCT) measures a wide range of parameters for LCDs or LC materials, including ion impurities, VHR, RDC, resistivity, rotational viscosity, elastic constants, dielectric constants, turn-on and turn-off response time, V–T curves, and Δn . The ALCT can simultaneously measure up to eight samples with the eight-channel IVM option. Ion measurement for real TFT panels is also available. A high-precision temperature-control LCD panel or cell is also available. The thermal plate could be as large as 800 × 1000 mm.

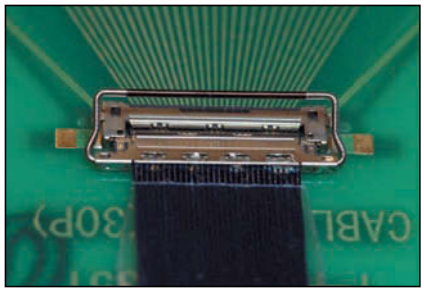
I-PEX USA

Austin, TX 512/297-6750
www.ipex-us.com
Booth 721

Locking Display Connector

The I-PEX Cabline-CA was designed as the smallest outline connector for the increasingly high data rates and is used in mass production on the trans-

mission lines and display as a high data rate (graphics) and control signal connection for the thinnest display panel assemblies. The locking feature provides a highly reliable assembly that eliminates the "back-out" aspect of the display connector during high shock and vibration conditions. Also, additional internal and external grounding connections were provided which deliver quiet, clear signal quality when used for the higher data rates.

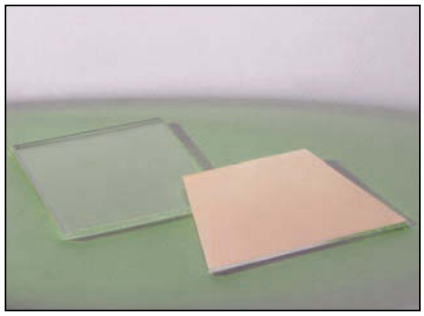


IRIDIAN SPECTRAL TECHNOLOGIES, INC.

Ontario, Canada 613/741-4513
www.iridian.ca
Booth 507

Optical-Filter Solutions

Iridian Spectral Technologies, a leader in optical filter solutions, has recently introduced new capabilities enabling us to provide high-transmission (>99%) anti-reflection (AR) coatings with optional anti-smudge (AS) coatings for use in touch-screen or other display applications. These new capabilities enhance our existing wavelength-selective display product offerings such as hot or cold mirrors, filters for night-vision (NVIS) compatibility, 3-D glasses and projector wheels, coatings on plastics, and beam-splitter cubes. Iridian works closely with our OEM customers to customize optical filter solutions to meet their specific functional requirements.



IRTOUCH SYSTEMS CO., LTD.

Boston, CA 978/204-2338
www.irtouchusa
Booth 351

IR and Optical Touch panels

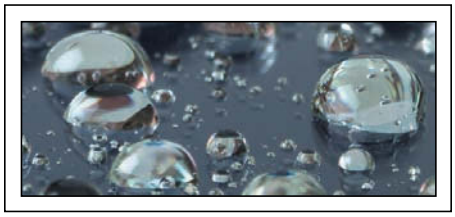
As a leading infrared touch screen manufacturer, IRTOUCH will showcase infrared and optical touch panels with newly introduced multi-touch gesture support and solar-immunity enhancement. Our slim-profile infrared touch screens are easily integrated into displays from 6.4 to over 120 in. on the diagonal. The robust infrared technology offers high resolution with superior clarity and scratch-free, drift-free, and shock-resistance touch solutions. It is ideal for public access, rugged, and demanding environments. Allowing glove /hand/ any object activation with much longer product lifetime, the infrared touch solutions have been deployed for POS, ATM, industrial control, kiosks, digital signage, medical, gaming, in-vehicle displays, and marine or aerospace applications.

JDSU

Milpitas, CA 408/546-5000
www.jdsu.com
Booth 736

Anti-Reflective Oleophobic Coating

Touch screen displays are intuitive, easy, and fun to use. The one improvement long needed has been an anti-reflection coating. This has been a challenge because fingerprint oils are so difficult to remove from any anti-reflective surface. JDSU and SCHOTT have teamed to develop a solution: We now offer a durable anti-reflective oleophobic coating that can withstand over 450,000 rubs! It is finally possible to have an anti-reflection coating for advanced touch-screen applications. Come and see a demonstration at SID and try out the first durable coating combining anti-reflective and oleophobic characteristics – the breakthrough for any touch application.



KOPIN CORP

Westborough, MA 508/870-5959
www.kopin.com
Booth 177

Color-Filter AMLCD

Kopin's CyberDisplay® 720p is a color-filter active-matrix liquid-crystal display (AMLCD) with a resolution of 1280 × 720. The CyberDisplay 720p utilizes high-performance single-crystal-silicon transistors and is the smallest (0.49-in. diagonal) transmissive AMLCD for the resolution. The transmissive CyberDisplay 720p has the same display architecture as the industry-standard LCD monitor or TV. The ultra-compact Cyberdisplay 720p is ideal for high-end consumer or professional portable devices.

KUGLER OF AMERICA, LTD.

Somers, CT 860/749-6400
www.kugler-precision.com
Booth 669

Precision Machining Systems

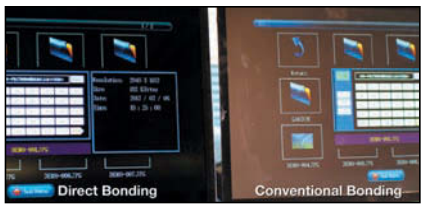
Providers of Micromachining Systems for combined optical, micromechanical, and laser micromachining Fly-Cutters for optical and structured surfaces in master templates. Drum Turning Systems for optical film replication are also available. Optical surface quality is what you can expect when using a KUGLER 5-axis milling center for the micromachining of suitable metals. MICRO-GANTRY® or MICROMASTER®, aerostatic or hydrostatic bearing concepts. Machine tools offered in several configurations. Large-area optical Fly-Cutting and Micro Structuring of optical surfaces with Micro Tools or a laser all on one machine in one setting.

KYOCERA DISPLAY AMERICA, INC.

Plymouth, MI 734/416-8500
www.kyocera-display.com
Booth 619

Robust TFT-LCDs

Kyocera Display America has developed a series of robust new TFT-LCDs with chemically strengthened cover glass optically bonded to the LCD with no air gap between the LCD surface and the cover glass, in sizes ranging from 9.0 to 25 in. on the diagonal. Readable under direct sunlight, impervious to rain, cleaning solvents, heat, and pressure, they are ideal for outdoor digital-signage applications. The 23.6-in. diagonal model shown features 1920 × 1080 resolution, 300 nits of brightness, a 1000:1 contrast ratio, and 80/80/60/80 viewing angles.



KYORITSU CHEMICAL CO., LTD.

Tokyo, Japan +81-3-3500-2421
www.kyoritsu-chem.com
Booth 711

High-Performance Adhesive Products

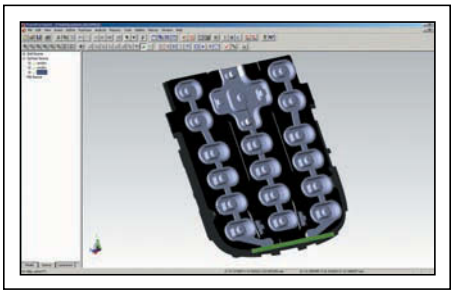
Kyoritsu Chemical Co., Ltd., is a Japanese enterprise specializing in the research, development, and manufacturing of high-performance adhesive products. This is the debut of Kyoritsu Chemical Co., Ltd, at the SID exhibition. The company will present a variety of technology aspects that can be applied to flat-panel displays. A series of technologies, including technical solutions, visibility improvements, power saving, sealing technologies, *etc.,* will be covered. Kyoritsu Chemical will present laminated displays that use HRJ resin along with an introduction of the engineering process.

LAMBDA RESEARCH CORP.

Littleton, MA 978/486-0766
www.lambdares.com
Booth 101

3-D Illumination Display Design Software

Lambda Research's TracePro is the easiest to use 3-D illumination display design software available today. TracePro decreases prototyping time by combining a 3-D CAD interface, multiple utilities, and complete interoperability with other programs to streamline the design process. Our 3-D interactive optimizer excels at illumination display design by combining a sketch utility for quick CAD modeling, interactive ray tracing for design verification, and multiple optimization routines. This utility gives users better initial designs and provides an interface to monitor the entire optimization process step by step. This provides better and faster answers when compared with other black-box optimization software products.



LG DISPLAY CO., LTD.

Seoul, Korea +82-23-777-1022
www.lgdisplay.com
Booth 143

55-in. OLED TV Panel

LG Display's 55-in. OLED TV panel produces remarkable image quality with no after image due to its high reaction velocity, as well as a high contrast ratio of over 100,000:1 and a wider color gamut than that produced by LCD panels. With no need for a special light source, LG Display's 55-in. OLED TV panel is also able to utilize a simplified structure thinner than that of a pen (5 mm) and lighter than LCD panels. The panel's thin structure also allows for the realization of unique design elements.

LITEMAX TECHNOLOGY, INC.

Fremont, CA 510/509-7506
www.litemax.com
Booth 282

Transparent LCDs

Litemax Technology will showcase their new Transpixel™ Technology at Display Week 2012. The STA1712 is the latest development in turnkey solutions for the digital-signage retail market. Customers can see the promotional message on the front transparent LCD while seeing the real product behind it. Content can be updated via USB or CAT5 and can be remotely managed on a preset schedule.

LOGIC AMERICAS

Kenilworth, Ontario, Canada 519/848-2555
www.logicamericas.com
Booth 756

Smart Display Modules

Smart Display Modules (SDMs) offer all-in-one compact touch-display computer solutions ready for use. The SDMs are designed for rapid implementation into industrial equipment, appliances, vending machines, and medical and monitoring equipment.

Color TFTs with a PCAP multi-touch or resistive single-touch screen along with optical bonding options for 4.3–15.4-in. displays with LED backlights are also available. A Freescale ARM-based processor and a Software Board Support Package are embedded. High reliability interfaces are easily modified with tailored mechanical mounting and integration.

MICROVISION

Auburn, CA 530/888-8344
www.microvsn.com
Booth 450

Display Measurement Systems

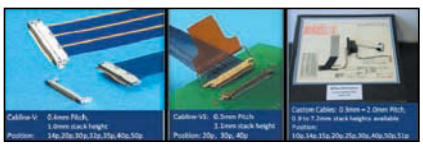
Microvision will showcase their latest version of the SS430 Display Measurement system that includes new laptop and cooled spectrometer options. Also demonstrated will be Microvision's Ergonomic Test Suites that measure according to ISO 9241-300 and TCO 5.2 standards. Also shown will be the latest innovation in automated display testing systems, the SS445. This device utilizes a pan/tilt mechanism to allow fully automatic testing of large screen and projection displays.

MITAS ELECTRONICS

Round Rock, TX 512/251-0389
www.mitaselectronics.com
Booth 820

Custom Micro-Coaxial Cable Assemblies

Mitas's micro-coaxial (MCX) custom cable assemblies are precision engineered to provide superior flexibility and reliability for use in military and medical equipment, high-end automated video test equipment (*e.g.,* Display Port), and security applications. In addition, MCX cables are being used at an accelerated rate as wiring components in display applications such as in PC notebooks, LCDs, FPDs, PDAs, digital video cameras, and cellular phones.



NANOFILM

Valley View, OH 1-800-883-6266
www.nanofilmtechnology.com
Booth 715

Clarity Ultraseal Nanocoatings

Clarity Ultraseal Nanocoatings provide performance enhancement and surface protection for glass and anti-reflective (AR) coated glass surfaces. It is optically clear; repels water, oils, and dirt; makes fingerprints easier to remove; requires less effort to clean; protects against aggressive environmental influences; maintains the clarity and appearance of the display longer; prevents marking and stains; and enhances scratch resistance.

NANOSYS

Palo Alto, CA 650/331-2101
www.nanosysinc.com
Booth 674

Quantum-Dot Enhancement Film

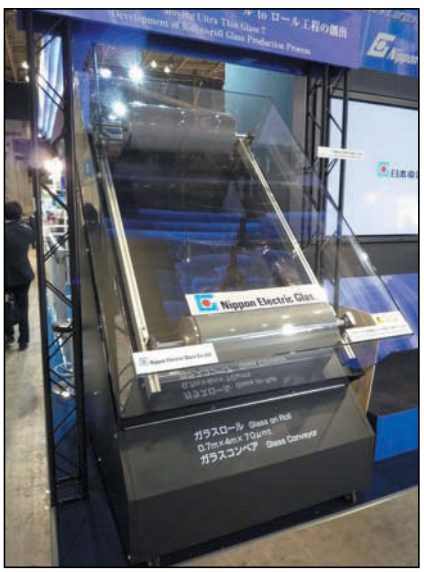
Nanosys Quantum-Dot Enhancement Film (QDEF™) enables wide-color-gamut LCDs, allowing consumers to enjoy more visceral, more impactful, and truer-to-life content. QDEF is an optical-film component for LCDs capable of producing 50% more color than conventional technology. Wide-color-gamut performance displays will make our experience of movies and videogames more lifelike. Filmmakers and video-game developers will be able to more accurately bring their vision to life. Browsing through photos on a QDEF tablet will be more like holding a stack of high-quality professional prints.

NIPPON ELECTRIC GLASS CO., LTD.

Osaka, Japan +81-6399-2711
www.neg.co.jp/EN
Booth 605

Ultra-Thin Glass

Ultra Thin Glass and Roll-to-Roll Conveyor Nippon Electric Glass enhances roll-to-roll processing in the production of displays. To manufacture Ultra Thin Glass at thicknesses below 100 µm, we developed an advanced overflow technology to form glass substrates for LCDs. This new method allows thinner-glass production, and we can supply the glass in rolls. Ultra Thin Glass was developed as a result of our continued challenge to obtain the ultimate thinness. If you witness our roll-to-roll glass conveyor in our booth, you will be able to imagine the future of the production displays more clearly.



nTACT/FAS HOLDINGS GROUP

Dallas, TX 214/343-5300
www.ntact.com
Booth 310

Slot-Die Cooling Systems

The nRad line is a series of small, low-priced slot-

die coating systems built upon nTact's patented technology and engineered for use in R&D and pre-production environments. The nRad's simple yet flexible design provides accurate deposition of a wide range of materials for a variety of applications. The systems are compatible with inert-gas glove-boxes and laboratory benchtops. The nRad is designed for processing 150- and 200-mm square substrates, with options for wafers up to 200 mm or panels up to A4 size. The new nRad2 is available for substrates up to 370 × 470 mm, as well as 300-mm wafers.

N-TRIG

Kfar Saba, Israel +972-9-799-9616
www.n-trig.com
Booth 305

Pen and Multi-Touch Functionality

N-trig DuoSense® is a single-device solution that combines pen and multi-touch functionality. The active pen enables users to annotate on screen much as on paper, and the multi-touch capabilities allow users to perform actions directly on screen. DuoSense advances standard touch technology, enhancing the touch experience from passive to active Hands-on® computing. DuoSense supports multiple operating systems and can be implemented across a variety of form factors and screen sizes. N-trig digitizers are easily integrated into existing platforms, support all LCDs and keep devices slim and light. N-trig has offices in Israel, the U.S., Taiwan, China, and Japan.

OCULAR LCD, INC.

Dallas, TX 972/437-3888
www.ocularlcd.com
Booth 855

Multi-Touch Projected-Capacitive Touch Panel

Ocular's Crystal Touch line of projected-capacitive touch panels has expanded standard product offerings to include a 17.0-in. TRUE multi-touch interface. Ranging in size from 3.5 to 17.0 in., Crystal Touch can now be incorporated into even more applications requiring a large, durable touch panel. Crystal Touch is designed for extreme environments and can withstand harsh chemicals, cleaning agents, and extreme temperatures. The all-glass construction provides a smooth, scratch-resistant surface that increases optical clarity, extends the life span of the device, and enhances the overall look and feel. Available in both single and TRUE multi-touch, Crystal Touch provides up to 16 simultaneous touch points with a sophisticated touch solution that can distinguish and disregard unintended touches.

OPTICAL FILTERS

Meadville, PA 814/333-2222
www.opticalfiltersusa.com
Booth 173

Optical Shielding Products

Optical Filters has expanded its range of EmiClare optical shielding products to include a non-birefringent MicroMesh for the electromagnetic shielding of circular and linear polarized displays. This innovation provides consistent 60-dB shielding, no moiré fringing, and exceptional light transmission, making MicroMesh superior to conventional woven wire mesh or ITO coatings. It is ideal for sunlight-readable applications such as avionics or portable hand-held equipment. Optical Filters offers the widest range of EMI shielding and heater options for display enhancement.

OSD DISPLAYS

Orland, FL 321/948-3751
www.onestopdisplays.net
Booth 871

3-in. OLED Display with 1RU Compatibility

Professional rack-system manufacturers are enthusiastically considering the OSDOSD25664P914-10 display. This display features a 1RU vertical-size compatibility to modernize the appearance of many rack-unit systems. OSD has already received a wide-range of interest from professional audio/video, military, telecom, broadcast, and various computing applications. The display offers compatibility with 8-bit CPU (both i80 and 68xx), and 3-/4-wire SPI interfaces via a standard ZIF-style 0.5-mm-pitch flex "connector-type" interface. The display can support 7 bits per pixel PWM for "gray-scale" image depth. The display is a relatively large OLED display offered at 3.1 in. @ 88.0 × 27.8 × 2.0-mm outline dimensions.

PHOTO RESEARCH

Chatsworth, CA 818/725-9750
www.photoresearch.com
Booth 523

Spectroradiometer

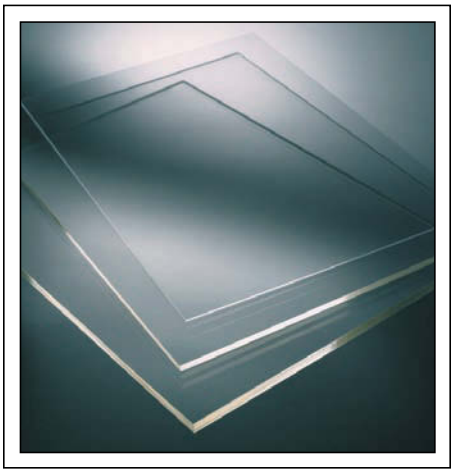
With eight measuring apertures, 5×10^{-6}-fL luminance sensitivity, variable bandwidth (automated selection between 2, 4, and 8 nm), virtually non-existent polarization error (< 0.2%), and 512 thermoelectrically cooled detectors, the PR-740 is the most sensitive and fastest spectroradiometer offered by Photo Research. The PR-740 can measure 0.01 fL in just 3 sec, making production testing more productive. Other features include a full-color touch-screen display; USB, Bluetooth, and RS232 interfaces; battery-powered operation; and SD-card storage. An extended version, the PR-745, covers a broader spectrum from 380 to 1080 nm.

PIEDMONT PLASTICS

Charlotte, NC 704/597-8200
www.piedmontplastics.com
Booth 210

Optical Plastic Sheets

Piedmont Plastics carries the best brands and breadth of products to service your plastic needs. Piedmont is proud to offer PSS-3000 optical sheet manufactured by PPG Industries. PSS-3000 Optical Sheet is a technologically advanced transparent plastic. It offers a unique balance of superior optical properties, rugged durability, chemical resistance and lightweight performance. PSS-3000 Optical Sheet is available in clear, colors, and low-glare textures. Piedmont can fabricate the sheets to print on gauges ranging from 0.5 to 6mm.



POLYIC GmbH & CO. KG

Furth, Germany +49-911-202-49-81-22
www.polyic.com
Booth 1374

Transparent and Conductive Films

PolyTC® films enable a multitude of new applications for touch-sensor solutions and several further applications. The shift away from mechanical keys and switches and towards capacitive touch sensors can be seen throughout the electronics and automotive sector. PolyTC® films can be used to manufacture very thin, flexible, transparent touch sensors which can be easily integrated into many applications and can be controlled using conventional electronic components. Some examples are touch screens, on/off buttons, slide controls, and dials. PolyTC® provides an ideal replacement for flexible conductor plates in touch-sensor applications or for indium-tin-oxide layers in touch screens.

PRYSM

San Jose, CA 408/656-3570
www.prysm.com
Booth 945

Laser Phosphor Display Platform

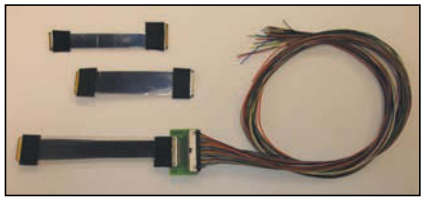
Prysm, Inc., has invented a new display platform based on the Laser Phosphor Display (LPD) technology that it owns entirely. LPD is a large-format display platform that can be organized in any size or shape to support a wide range of complete solutions for a variety of commercial markets. When compared to traditional technologies, LPD offers brilliant lifelike and lifesize displays that deliver truly immersive experiences, while offering the lowest cost of ownership and meeting the highest standards of environmental impact. In addition, LPD offers viewing angles of nearly 180°, unmatched uniformity, and the smallest seams in the industry. Prysm is based in Silicon Valley, with sales offices in Dubai, London, Moscow, New York, San Jose and Toronto.

QUADRANGLE PRODUCTS

Englishtown, NJ 732/792-8035
www.quadrangleproducts.com
Booth 618

Micro Coaxial Cable Assemblies and Interconnects

Quadrangle Products supports Micro Coaxial Cable Assemblies and Interconnects for panels, motherboards, and other various components. From start to finish, Quadrangle's engineers will help to educate and guide customers through the various design challenges associated with micro coax cable designs and micro coax transitions. Our Micro Coax product line is constantly growing as we add new parts, designs, and solutions. We now support complete custom micro coaxial cable assemblies, micro coax to standard hookup wire (28 AWG) transition boards, micro-coax to 28 AWG flying leads (via transition board), support of popular connector manufacturers, free engineering support/low MOQs on new products.



QUINN PACIFIC

Los Angeles, CA 905/426-3921
www.quinnpacific.com
Booth 239

Air Gesture Touch Interfaces

Azoteq's ProxSense takes touch to the third dimension. The next evolution in touch interfaces is the addition of Air Gestures. Many user-interface functions can be done with air gestures. Air Gestures include proximity wakeup, proximity menu activation, wave left/right and up/down to page or scroll, and proximity hold to switch modes. Capacitive Air Gestures offer several advantages over other technologies such as lower power consumption and lower system cost. Applications for Air Gestures include lighting controls, printer, copiers, desktop phones, TVs, e-Readers, tablets, and mobile phones.

RitFAST CORP.

Hsinchu, Taiwan +886-3-598-9999
www.ritfast.com
Booth 461

Capacitive Touch Panels

RitFast is a professional capacitive touch panel manufacturer. Capable in G/G, OGS, and TOL solutions for mobile devices and instruments.

SAMSAUNG MOBILE DISPLAY

San Jose, CA 408/544-4246
www.ssi.samsung.com
Booth 163

Samsung OLED Technology

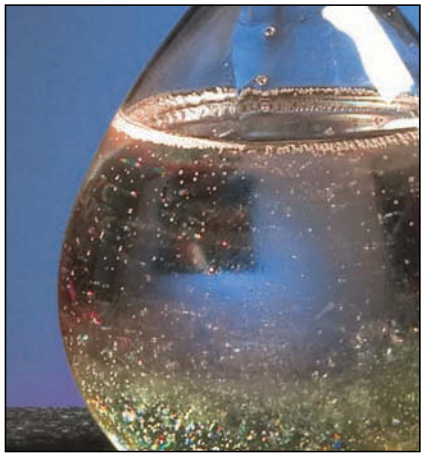
The 5.3-in. HD Super AMOLED used in the Samsung Galaxy Note provides exceptional touch sensitivity and features a large-sized screen that has been optimized for multimedia use. Further, the world's largest (55-in.) Super OLED TV delivers the best image quality anywhere, with distinct advantages such as strikingly vivid colors, wide viewing angle, extremely fast response time, and the thinnest TV panel structure available. Samsung OLED technology as featured in the 5.3-in. HD Super AMOLED display in the Samsung Galaxy Note and Samsung's 55-in. Super OLED TV will take you far beyond the limits of traditional displays, beginning later this year.

SARTOMER USA, LLC

Exton, PA 610/363-4195
www.sartomer.com
Booth 748

Oleophobic Curable Resins

The CN4000 series of oleophobic exterior-grade ultraviolet and electron-beam-energy curable resins provide excellent protection for polyester, polycarbonate, and acrylic films. Accelerated weathering testing proves the materials can take the abuse of a wide range of climates for top-coating highly transparent films and glass. The low refractive index provides anti-reflective properties for interlayer coating or adhesive reducing the loss of light transmission between layers and the top-coated surfaces while maintaining excellent physical and color stability.

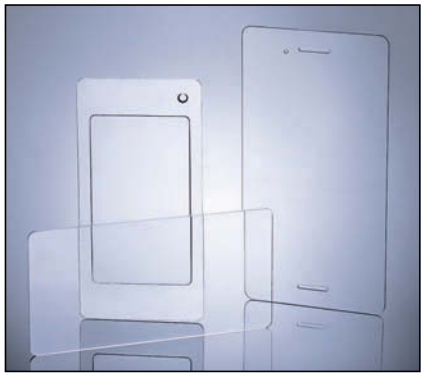


SCHOTT

Louisville, KY 502/657-4417
www.us.schott.com
Booth 443

Glass for Capacitive Touch Technologies

With over 125 years of experience, SCHOTT specializes in specialty glasses and materials. With its new Xensation™ family of products, including super-strong Xensation™ Cover, SCHOTT is unique in offering the broadest range of high-quality glass types for all cover and touch applications. Strong, reliable, sensitive, lightweight, and elegant.



SEMTECH CORP.

Camarillo, CA 805/498-2111
www.semtech.com
Booth 606

Resistive Touch-Screen Controller Platform

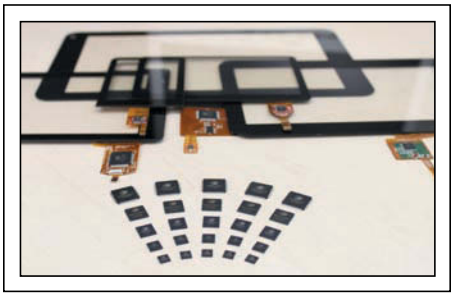
Semtech's 4D-Touch™ is the world's first resistive touch-screen controller platform that detects proximity and pressure with haptics feedback. Semtech Corp. is a leading supplier of analog and mixed-signal semiconductors for high-end consumer, computing, communications, and industrial equipment.

SOLOMON SYSTECH LTD.

ShaTin, NT, Hong Kong +852-2207-1560
www.solomon-systech.com
Booth 111

Projected-Capacitive Touch Panel Controllers

To capture the surging worldwide touch panel market, Solomon Systech proudly presents a series of "single chip" projected-capacitive touch panel controllers with up to 10 points of multi-touch and large object detection support, capable of driving full-HD capacitive touch panels of up to 11 in. on the diagonal. This series of controllers supports self-capacitance or mutual-capacitance sensing schemes. They can support sensor-on-lens touch panels without a shielding layer. The integrated DSP+16-bit MCU has excellent anti-noise capability. It also boosts a high report rate, good linearity, and excellent waterproof capability. Inheriting the general LCD driver design, Solomon Systech's touch controllers can fine-tune touch-panel performance via changing register settings. They are easy to use with excellent cost performance and are the perfect match for smartphones and tablets.

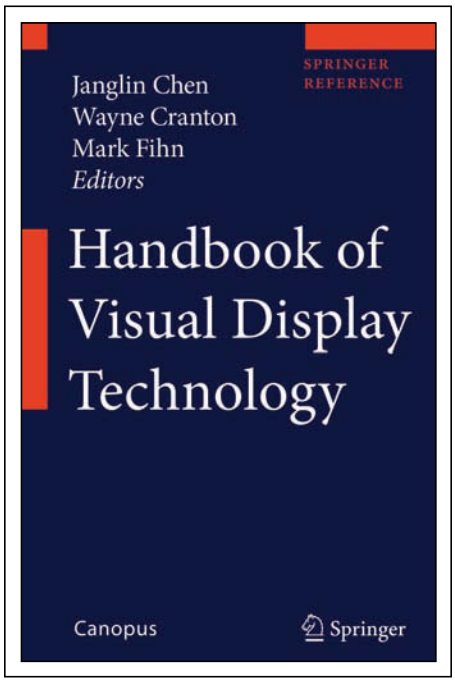


SPRINGER-VERLAG

Heidelberg, Germany +49-6221-487-86-45
www.springer.com
Booth 1315

Handbook of Display Technology

The four-volume *Handbook of Visual Display Technology* is a unique work offering a comprehensive description of the science, technology, economic, and human–interface factors associated with the displays industry. An invaluable compilation of information, the Handbook will serve as a single reference source with expert contributions from over 150 international display professionals and academic researchers. All classes of display device are covered, including LCDs, reflective displays, flexible solutions, and emissive devices such as OLEDs and plasma displays, with discussion of established principles, emergent technologies, and particular areas of application. The wide-ranging content also encompasses the fundamental science of light and vision, image manipulation, core materials and processing techniques, display driving, and metrology.



SUN-TEC AMERICA

Scottsdale, AZ 480/922-5344
www.sun-tec.net
Booth 661

Rigid-to-Rigid Lamination Machine

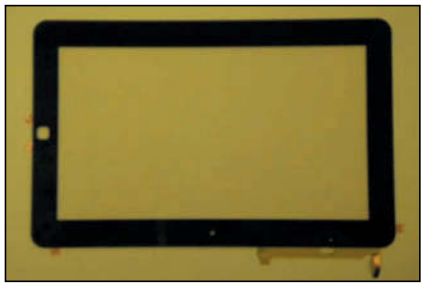
Sun-Tec America will display the TMS-SA-P1 lamination machine for laminating rigid-to-rigid substrates for touch panel and cover glass lamination as well as film lamination. It can laminate substrate sizes from 10 to 22 in. Usually, rigid-to-rigid lamination process requires lamination in a vacuum chamber to prevent air being trapped between the panels being laminated. As an alternative method, Sun-Tec developed the TMS-SA-P1 which uses a tail stopper to keep the substrates separate during lamination to minimize air entrapment. For laminating films, the tail stopper can be turned off. The TMS-SA-P1 maintains Sun-Tec's high production standards and placement accuracy of 0.2 mm.

TFD, INC.

Anaheim, CA 714/630-7127
www.tfdinc.com
Booth 543

Energy-Free Capacitive Touch Panel

TFD, Inc., is introducing a highly efficient solar cell on the peripheral of a projected-capacitive touch panel. The appearance of the color (black) is similar to that of the black mask. The solar cell is manufactured by using a combination of organic photovoltaic and dye cell technology. The 10.1-in. cell can energize 1.5 W/hour at 450 mAh to the existing battery.

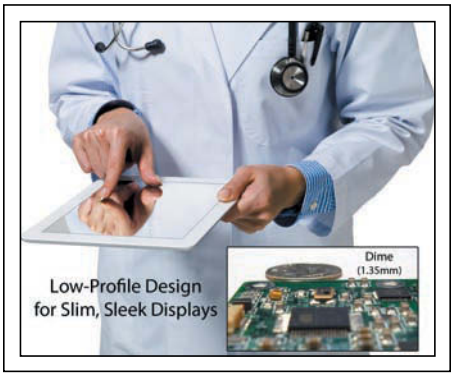


TOUCH INTERNATIONAL

Austin, TX 512/832-8292
www.touchinternational.com
Booth 749

Ultra-Thin PCB Board

The MulTI-Touch Projected Capacitive Ultra-Thin PCB Controller Line from Touch International gives display makers a low-profile durable board for slim designs and the added noise resistance found with chip-on-flex. By providing a direct electrical interface between the touch-screen flex circuit and the board, Touch International ensures that the product's connection is mechanically and electrically robust. Supporting projected-capacitive displays up to 15.6 in., with up to 9 mm of cover glass, the MulTI-Touch Controller Line gives customers the same design flexibility and customization that Touch International is known for, without the high NRE fees.



UNIVERSAL DISPLAY CORP.

Ewing, NJ 609/671-0980 x206
www.universaldisplay.com
Booth 649

OLED Technologies and Phosphorescent OLED Materials

Universal Display is a leading developer of OLED technologies and materials for displays and lighting. UDC will exhibit the company's product line of energy-efficient UniversalPHOLED® phosphorescent OLED materials, UniversalP2OLED® Ink Systems for solution-processing and prototypes showcasing other proprietary technologies, including its WOLED® White OLED, flexible OLED, barrier, and advanced patterning process technologies. With a highly talented team, we also offer technology development and technology transfer services to support the smooth adoption of our technology and materials.

WAMCO

Vancouver, WA 714/545-5560
www.wamco.com
Booth 581

Wide-Viewing-Angle TFT Displays

Wamco will introduce a product line of wide-viewing-angle TFT displays with robust construction and ruggedized for harsh environment in 8.4, 10.4, 12.1, and 15.0 in. sizes. High-reliability solid-state backlighting with integrated redundancy and a dual backlight, these display modules are NVIS compliant and sunlight readable as defined by Military requirements. Products can be further enhanced to integrate a high-performance single-piece EMI-heater element, directional filter, and/or touch screen. Leveraging Wamco's expertise in material science and optical filters, this LCD product line integrates the latest optical technologies and will support a wide range of military and industrial applications.

WESTAR DISPLAY TECHNOLOGIES

Saint Charles, MO 636/300-5112
www.westardisplaytechnologies.com
Booth 755

Electro-Optical Characterization of Mobile Displays

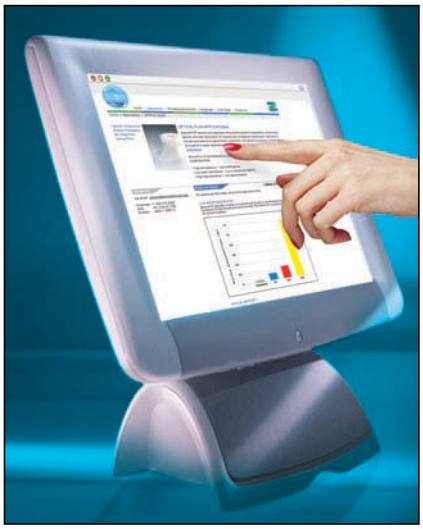
Westar Display Technologies is showcasing their PanelTest™, an automated test system for the electro-optical characterization of mobile displays from cell phones up to 17 in. panels. PanelTest™ includes three sensors: a camera, spectrometer, and real-time photodetector to measure uniformity, color, contrast, luminance, cross-talk, response time, flicker, and more. The system is self-contained and includes a video test-pattern generator and industrial computer with PanelTest™ software. PanelTest™ software allows the user to easily create custom test scripts. PanelTest™ can be extended with several options, including viewing-angle imager, X-Y motion, and custom display fixtures.

ZEON CHEMICALS

Louisville, KY 502/775-2000
www.zeonex.com
Booth 181

Coatable Organic Insulator for Low-Power-Consuming Highly-Reliable Displays

ZEOCOAT™ coatable organic insulator provides multiple benefits for the construction of LC and OLED displays. Its stability in high-humidity environments and low out-gassing contributes to high reliability for cutting-edge designs. Its high transparency, fine-pattern processability, and low dielectric constant results in reduced power consumption. By incorporating ZEON's expertise in cyclo-olefin polymer (COP) technology, ZEOCOAT provides value to next-generation displays.

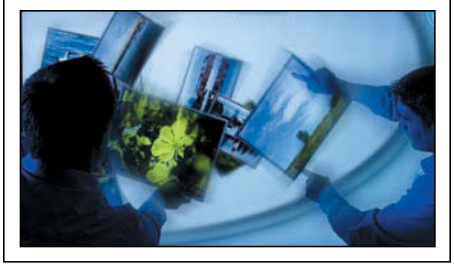


ZYTRONIC

Blaydon-on-Tyne, UK +44-191-4145-511
www.zytronic.co.uk
Booth 761

Multi-Touch Projected-Capacitive Touch Screens

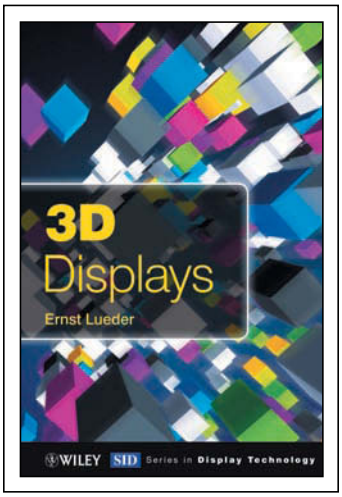
At Display Week 2012, Zytronic will be exclusively launching its new large-format, rugged, multi-touch projected-capacitive touch screens. Based on its proprietary PCT™ touch-sensing technology, these screens are designed specifically for demanding self-service digital signage and gaming applications. Utilizing its latest ZXY200 touch controller, the sensors can accurately and rapidly detect 10 independent points of touch through 4 mm of toughened glass, making them ideal for "real world" public facing deployments. In the booth will be a selection of 22, 32, and 46-in. screens showcasing the products' outstanding capability. ■



book reviews

3D Displays

by Ernst Lueder
Reviewed by Brian Schowengerdt
SID–Wiley Series



3D is one of the hottest topics in the display industry today. With the commercial success of stereoscopic films, television manufacturers have moved quickly to introduce stereoscopic TVs, attempting to channel that success into the home-entertainment market. For the past few years at the SID International Symposia, the 3D technology track has been by far the largest at the conference, showcasing a staggeringly diverse array of work in the field.

Ernst Lueder's latest book in the SID–Wiley series, *3D Displays*, does an excellent job of taking the incredible diversity of 3D display development and distilling it into key sub-areas. The book presents a broad survey of work in 3D displays, from the glasses-based stereoscopic displays that currently dominate the home market to cutting-edge holographic and volumetric developments that are paving the way to displays on the horizon. As such, it provides an excellent reference for a reader interested in a broad education in 3D technologies.

The author also wrote *Liquid Crystal Displays: Addressing Schemes and Electro-Optical Effects*, which has sold more books than any other in the SID-Wiley series. As befits his extensive expertise in LC flat-panel displays and underlying drive electronics, *3D Displays* provides particularly rich and deep discussions of 3D displays built upon flat-panel-display technologies. The chapters on stereoscopic, autostereoscopic, and integral-imaging displays especially have benefited from this knowledge base.

Presenting a detailed taxonomy of the glasses-based stereoscopic display, the author discusses area-multiplexed and time-multiplexed approaches in some depth. In addition to physical and optical characterizations, he presents the circuits, driving schemes, and algorithms powering these displays. A similar treatment is given to glasses-free autostereoscopic displays, discussing spatially multiplexed approaches using barriers and lenticulars, time-sequential approaches with directional backlights, switchable 2D/3D displays, and the markedly different approach of depth-fused displays. The chapter on autostereoscopic displays also includes a brief discussion of a head-worn near-to-eye 3D display – though this would have been more at home in a chapter dedicated to helmet-mounted, head-worn, and other near-to-eye displays, which is the one major category of 3D displays not treated explicitly in the book.

On some topics outside of flat-panel-based 3D displays, such as some of the technologies presented in the chapter on volumetric displays, or regarding details of interaction between 3D displays and the human-visual system, the footing is a bit less stable. Though the chapter on the human-visual system and 3D perception provides a concise and useful summary of basic processes, the section addressing accommodation–vergence mismatch would have benefited from the inclusion of some of the latest work from, *e.g.*, Martin Banks's lab at UC Berkeley, which has made significant inroads toward quantifying the effect of this mismatch in displays on the human-visual system. On a related topic, the book suggests that integral-imaging displays, such as volumetric displays, produce congruent cues to accommodation and vergence. While this can be argued for some particular configurations of integral-imaging displays, it does not apply to the class as a whole. However, these minor quibbles are easy to overlook in an otherwise excellent text that has taken on the Herculean task of summarizing such a broad body of work.

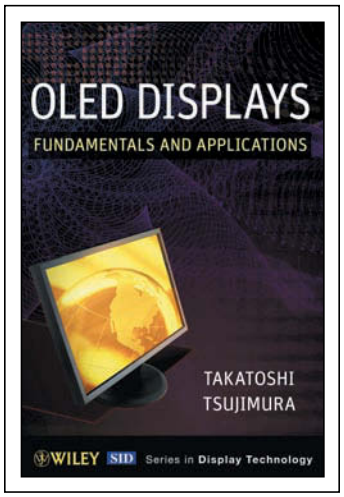
In addition to discussing core 3D display technologies, the author has provided an extensive discussion of techniques and metrics to assess the quality of 3D displays. This discussion segues from a thorough discussion of various algorithms used to extract depth information from stereoscopic images for quality analysis, to a strong treatment of 2D-to-3D conversion algorithms to tap the large body of existing 2D media for 3D content.

In summary, *3D Displays* is encyclopedic in scope, a great reference, and a recommended purchase.

Brian Schowengerdt is the Guest Editor for 3D technology for ID *magazine, SID's Program Vice Chair for 3D, and an Associate Editor of the* Journal of the SID. *He is a senior research scientist at the University of Washington's Human Photonics Lab.*

OLED Displays: Fundamentals and Applications

by Takatoshi Tsujimura
Reviewed by Denis Y. Kondakov
SID–Wiley Series



Arguably, no other display technology can compete with OLEDs with respect to how fast the field is growing. There is a lot of excitement about OLEDs in both the industry and the academic world. This fast growth and excitement go hand in hand with the rapid pace of research and development in nearly orthogonal subfields ranging from OLED display design and manufacturing to OLED material design, and from OLED device architecture to design and implementation of OLED display components. There is no question that OLEDs are a remarkably challenging field to follow in their entirety, especially if one relies on publications such as

papers and conference proceedings. It is particularly challenging (or, perhaps, even more so) for someone who is just starting in this field or trying to expand their area of expertise to adjacent subfields.

Generally speaking, books are indispensable in science and technology when learning about a new field and OLEDs are no exception. However, practically none of the OLED-related books published so far provides more than mostly arbitrarily selected and fragmentary topics of interest arranged in a manner similar to what is usually found in scientific review papers. In sharp contrast, *OLED Displays: Fundamentals and Applications* aims to cover the entire field of OLEDs in a coherent manner. Being written by a sole author – T. Tsujimura – it is clearly effective in the creation of a consistent and internally logical framework. Chapter by chapter, Tsujimura systematically covers most if not all aspects of OLEDs. Many important subjects are covered in great detail, with enough technical depth to be valuable to more sophisticated readers. In the spirit of the adage "a single picture is worth a thousand words," the book has many useful graphics that effectively communicate the subject matter.

Some subjects receive a briefer treatment, which is not surprising considering the sheer size of the field being covered. There are some rather abbreviated topics, such as the section on OLED materials. A few fundamental concepts and mainstream designs – doped charge-transport layers, charge-generation layers, and hole-injection interfaces – are missing. And there are some unfortunate choices of representative examples, such as picking a non-fluorescent coumarin (its derivatives are indeed highly fluorescent) to demonstrate light-emitting material.

Overall however, despite a few shortcomings, this work will be a valuable and currently unique resource for anyone interested in learning about OLEDs in general and of particular interest to engineers, managers, and other industry professionals entering the field or expanding their areas of expertise.

In 1991, Denis Y. Kondakov received his doctorate from St. Petersburg University, Russia, working in the area of free-radical chemistry of organometallics. After post-doctoral research in the field of early transition metal complexes mediated synthesis with T. Takahashi at IMS, Okazaki, Japan, and E. Negishi at Purdue University, U.S., he joined Eastman Kodak Company to work on reaction mechanisms and photochemistry of azomethine photographic dyes. Since 2001, his work has focused on device physics, photochemistry, and material design of small-molecule-based OLED devices. In 2011, he joined DuPont to work on printed OLED technologies. ■

continued from page 3

Products that ***Samsung*** supports within the industrial market are 3.5–8-in. mobile displays, 18.5–27-in. monitor displays, and large-format (22–82-in.) panels for digital-signage applications. The company's highly successful LCD business was recently spun off from ***Samsung Electronics*** into a new entity, ***Samsung Display Company***. For more about the new company, see "Samsung Announces LCD 'Spin-off' " in the April 2012 issue of *Information Display*.

Korean TFT-LCD manufacturer ***Hydis Technologies*** was acquired by e-paper developer ***E Ink*** in 2007. Hydis has several unique panels that support the industrial market.

Taiwan

AU Optronics' strength is in TFT-LCD panels for the commercial market, says Fijak. It does not make TVs but does make panels for TVs. "Recently, they have made significant strides in the industrial market, with a wide range of LED backlit products, including several projected-capacitive touch (all developed in house) and high-brightness options," says Fijak. AUO is also now offering 3-year minimum life cycles for its products, with a range from industrial sizes (4.3–24 in.) to large-format (26–65 in.) industrial panels for digital signage.

Taiwanese company ***Prime View International***, a small- and medium-sized display maker, acquired e-paper developer ***E Ink*** in 2009 and became ***E Ink Holdings*** in 2010. Prime View offers a variety of industrial panels with 3-year life support.

Chimei-Innolux is Taiwan's largest LCD maker. In December 2010, Chimei-Innolux announced it would be partnering with ***Foxconn*** to bring its displays to the Chinese market. Chimei makes a modest number of panels for the industrial market.

Fijak, who has 30 years in the electronics business, (20 in the display and embedded industries), says he has seen turbulent times with positive outcomes before. In this current market, he believes the need for customization and long life cycles will keep many customers doing a brisk business. In fact, in the near future, Avnet will increase its internal capabilities to deepen the level of touch integration, high brightness, and other value-added services it now provides. The company plans to expand to a Class-10,000 clean room facility that measures upwards of 4000 sq. ft.

"Some 80% of customers are looking for value added to the panel, whether it be film lamination, high brightness, touch integration, or other customization," he says, adding that "One of the things we see happening more and more is the marriage between LCDs and single-board computers." Other features of importance to customers that many companies are now offering include 50,000–100,000 hour specs (to half-brightness), wider temperature specs, wider viewing angles and aspect ratios, "greener" components and performance, and higher resolutions. Many of these features are being optimized through the use of LED backlighting. "LCDs with LEDs [backlighting], and also with touch, is still by far the dominant request that we see," says Fijak. ■

Journal of the
Society for Information Display

SID
SOCIETY FOR INFORMATION DISPLAY

The following papers appear in the May 2012 (Vol. 20/5) issue of *JSID*. For a preview of the papers go to sid.org/jsid.html.

Contributed Papers

The following papers appear in the June 2012 (Vol. 20/6) issue of *JSID*. For a preview of the papers go to sid.org/jsid.html.

Letters

Contributed Papers

Special Section on Optically Isotropic Liquid Crystal and Devices

continued from page 2

This month we have a great lineup, starting with our cover story on the Display Industry Awards, which recognize the most innovative display products and technology from all of 2011. The list of choices for these awards was overflowing with worthy recipients and I can honestly tell you as a member of the DIA committee that the final selections were really the best of the best. It's exciting that this year's awards recognize a wide variety of technologies, applications, and components that in turn represent a sample of all that has happened over the last 50 years in this industry. Trying to tell that story would seem to be an impossible task, but frequent contributor Paul Semenza has done a great job in his Display Marketplace feature entitled "The Display Industry: Fast to Grow, Slow to Change," in which he attempts to summarize the evolution of the major display technology developments over the last half-century. As Paul shows in countless examples, the pace of growth has been rapid, but the evolution of the technology has been slow and deliberate, with a few fundamental paradigm shifts along the way. These shifts, such as the growth of the notebook market, helped to launch LCD panels into the commercial mainstream, achieving suitable manufacturing infrastructure and costs and getting us to the world of LCD TVs we have today.

We bring to you this month the third installment of our special three-part series on "What Companies Need to Know about the Leahy–Smith America Invents Act (AIA) Patent Reform Legislation" from attorney Clark Jablon. This month Clark examines the changeover from a "first-to-invent" to a "first-to-file" system and what it means to your future strategy for growth of your company's intellectual property portfolio.

Along with these features we also have monthly installments of SID News, Industry News, and also reviews of some new books being published as part of the SID–Wiley book series edited by past SID president Tony Lowe.

Finally, just before this issue went to press, we received the terribly sad news of the passing of Dr. Louis Silverstein. For many of us in the display industry, Dr. Silverstein's lifetime of work wove an invaluable fabric of knowledge into our understanding of vision science and how it can and should be applied to displays. Lou was always available to help anyone who asked – he consulted with many of the best-known companies in our industry – and contributed many times to this publication as author and technical advisor. I've been aware of Lou's work for most of my professional career. A good measure of my success in designing display systems is due to what I learned from Lou's very engaging seminars and papers. To read more about Dr. Lou Silverstein's life and work, look at the SID News column of this issue for our memorial article.

So, although this piece ends on a sad note, I welcome you all to Boston, my home city, for Display Week 2012 and the home base of the New England Chapter of SID. Don't forget to try the clam chowder and the lobster. ■

Dr. Louis D. Silverstein 1950–2012

Compiled by Friends and Colleagues

Lou Silverstein, a leader and innovator of flat-panel-display technology, passed away unexpectedly working at his desk in his home office in Scottsdale, AZ, on the evening of May 1, 2012. Lou is survived by his wife of 39 years, Marla Silverstein, and his sister, Michele Endich.

Lou was well known to many in the display industry for his pioneering work on pixel layouts, anti-aliasing and tone scale, viewing-angle performance, color control and reconstruction, smooth motion, flicker, and sunlight legibility. He was a leading advocate for optimizing displays based on human-visual-system characteristics. Lou developed predictive models of display performance that directly linked engineering tradeoffs to human-vision and perception science. He was known to his many friends as an insightful, funny, and engaging colleague. His deep insights and the humor he used to convey them will be missed.

Lou received his B.S., M.S., and Ph.D. degrees from the University of Florida. In his dissertation research, he applied psycho-physiological methods to study repetition and distribution effects on memory. He received his doctorate degree in 1977. For the next 2 years, Lou conducted research on psycho-physiological correlates of memory, attention, and sleep processes as an NIH Post-Doctoral Scholar at the University of Wisconsin. Lou then joined Rockwell International beginning his long career in information display.

At Rockwell, Lou began a research program on the human factors of avionic displays. He continued this work a year later at the Boeing Airplane Company where he worked with a team of engineers developing the first aircraft "glass" cockpit using electronic color displays to replace mechanical avionic gauges. Lou's work in determining the visual requirements and measurement criteria for the displays drove the development of the Electronic Flight Instrument System color-CRT hardware and display specifications and lead to the certification of CRTs on the 767 in 1982. Much of this work was captured in technical documents still referenced by the industry today. For this work, Lou was awarded the Alexander C. Williams, Jr., Award from the Human Factors Society in 1993 and a SID Special Recognition Award in 2004.

In 1983, Lou joined General Physics and shortly thereafter the Sperry/Honeywell Corporation's Technology Center in Phoenix. While he continued to work on color avionic displays, he also applied his expertise in vision research and human factors to simulate, design, and evaluate new display technologies, including active-matrix liquid-crystal displays (AMLCDs), laser projection displays, and stereoscopic displays.

Lou formed VCD Sciences, Inc., in 1990, which enabled him to work with companies at the cutting edge of display technologies, pushing forward inventions in thin crystal films, holographic polymer-dispersed liquid crystals (H-PDLC), polymer-stabilized cholesteric-texture liquid crystals (PSCT), field-emissive displays (FEDs), full-color subtractive light-valve displays, super-twisted-nematic displays, near-to-eye virtual displays, and many other new display devices. Not only did Lou understand and contribute to these technologies, he also believed that human vision was the key to understanding the engineering tradeoffs that would result in the best display possible given the limits of technology and manufacturing. Throughout his career, Lou was noted for his passionate views about technology and design criteria that often led to cost-effective innovations and more beautiful products.

Lou published over 120 journal articles, book chapters, and technical papers, and he was awarded 30 patents for innovations in liquid-crystal displays and liquid-crystal-based image-capture devices. He was an adjunct professor of engineering at the Georgia Institute of Technology and a visiting scholar in the Department of Medical Imaging at the University of Arizona. He received many honors and awards, becoming a SID Fellow in 1997, the Macbeth Award from the Inter-Society Color Council in 2004 for his outstanding contributions in the field of full-color electronic displays, and the Otto Schade Prize from SID in 2008 for outstanding contributions related to display image quality and performance.

Lou was noted for his extensive service to the display community. He was an active member of SID and served on the program committee since 1984. He was on the editorial boards of several technical journals and served as a peer reviewer on many additional journals ranging over topics from photonics to human vision. Lou served on the National Research Council's Committee on Vision whose role it is to define public interest issues related to the science and technology of visual communications. He chaired the annual International SID Symposium in 1993 and was the technical program chair in 1991. He was also one of the leaders in creating the Color Imaging Conference, co-sponsored by SID and IS&T, that will celebrate its 20th conference this year. During his long active period at SID, Lou always looked for ways to improve the International Symposium. He recruited young promising scientists and engineers to become active in the industry and on SID program subcommittees. For many years, he taught the display engineering community at SID how to connect basic color vision science to display-engineering issues in a course that was always popular and well-received.

Lou was a man of great personal integrity, a wonderful friend, and a mentor to many young engineers and scientists entering the field. For those who were lucky enough to know Lou or work with him, his absence will forever be felt. His influence in the field of displays will be with us for many years to come.

SID Participates in FPD China

by H. S. Kwok

The Society for Information Display, in co-operation with Semiconductor Equipment and Materials International (SEMI), helped organize the most recent FPD China exhibition, held in March of this year in Shanghai. SID's participation involved the assembly of a 2-day symposium at FPD in return for shared revenues and a chance to increase SID membership in China. SEMI ran the exhibition, which included three simultaneous events: FPD China, SEMICON, and SOLARCON.

The symposium featured 40 speakers, 22 of which were from overseas. China's research institutions presented papers, and China's two largest display manufacturers, BOE and Tianma, sent their COO and SVP, respectively, to present plenary talks. Both representatives painted a bright future for the expansion of China's display market. BOE and Tianma both have five Gen 4.5 or higher production lines currently in operation or under construction. Tianma, which showed its 4.3-in. AMOLED display for cell phones and a 12-in. AMOLED at the exhibition, is building a Gen 4.5 LTPS line in Xiamen.

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president's corner

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This year, we will be celebrating the golden anniversary of SID as we get back to Boston. The Society will turn 50 on September 29, 2012, and later this year there will be a commemoration of the first meeting of SID that was held in UCLA's Boelter Hall, which was also the birthplace of the Internet. As this is a historically significant year for SID, it is fitting that Display Week 2012 is being held back in Boston. What new announcements will be made and what technologies will be shown that will once again serve as a compass for the future of displays? As always, Display Week will be the place to find out. The Display Week 2012 show portends some of the most amazing exhibits ever. Rumor has it that there will be "big things" on the show floor. Look for a large presence in OLED displays and make sure not to miss the prototypes in the Innovation Zone.

Congratulations to all on 50 successful years for SID! ■

SID news

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This was the second year that SID organized the FPD China symposium. Last year, a total of 300 people attended, and the SID Beijing Chapter was able to increase its membership by 102 (plus 5 student members.) This year, attendance increased to 604. The number of new SID members was still being tallied at press time. ■

Hoi-Sing Kwok is VP of SID's Asia Region.

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