DYAs / SID 2011 SHOW ISSUE

# Information DISPLAY

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

May/June 2011
Vol. 27, No. 5 & 6

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MAY/JUNE 2011
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*ON THE COVER: Every recipient of this year's Display of the Year awards was a participant in the handheld-display marketplace, either as a device manufacturer or as the supplier of a critical component. Despite the many exciting nominations from the large-panel marketplace, the pinnacle of innovation was on the mobile side this year. From left clockwise: Samsung Mobile's Galaxy S smartphone, Apple's iPad, ITRI's flexible substrate, Samsung Mobile Display's On-CellTouch AMOLED display, E Ink's Triton color imaging technology, and Apple's iPhone 4 Retina display.*


***Cover Design:*** Acapella Studios, Inc.
***Credit:*** Samsung Mobile, ITRI, Samsung Mobile Display, E Ink.

**Next Month in *Information Display***

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  - Flexible Displays
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  - 3-D
  - Touch and Interactivity
- Best in Show Awards
- Photonic Crystal Materials
- Optimizing Displays for Outdoor and Harsh Environments

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*. Director of Sales: Michele Klein, Palisades Convention Management, 411 Lafayette Street, 2nd Floor, New York, NY 10003; 212/460-9700. 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 0362-0972/11/$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. Copyright © 2011 Society for Information Display. All rights reserved.

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# editorial

## Display Week: Planning Pays Off

**by Stephen Atwood**

Hello and welcome to Los Angeles. I hope you are reading this while enjoying a short rest at Display Week 2011. Needless to say, with all the parallel conference tracks and events, there is not much free time, but you really need to hang on to this copy of *Information Display* because it is one of the best of the year.

If you are new to SID, welcome! 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 over 500 paper presentations, as well as the short courses, seminars, and applications tutorials. In addition, there are the business, investors, and market focus conferences, the keynote speeches, the awards dinner and luncheon, and also the special event – a baseball game at Dodger Stadium.

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 will find this issue of *ID* particularly useful for your planning if you review our Products on Display feature which is assembled each year by our staff to help you get the most out of the exhibition.

A new feature of this year's exhibition will be the selection of the "Best in Show" awards, highlighting the most significant new products and technologies shown on the exhibit floor during Display Week. These new awards are an addition to the prestigious Display of the Year awards covered extensively in this issue and recognized during the Wednesday luncheon awards ceremony. For Best in Show, 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). Winners will be selected for their ability to excite not only our panel, but the general public and press as well. We will also have complete coverage of the award winners in the August issue of *Information Display*.

Maybe one of the biggest benefits of Display Week is simply the chance to meet so many other colleagues from around the world. My memories of previous events are rich with chance meetings with people from Europe and Asia who have become friends and trusted advisors. Meeting people face-to-face establishes a relationship that e-mail and phone calls cannot do, so Display Week is important for this as well as its many other features. Often it is in those personal interactions and candid conversations that I get my inspiration. I hope it will be the same for you.

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 e-mail us at press@sid.org and we'll get your question to the right reporter to see what we can find out.

This month, we have a great lineup, starting with our cover story on the Display of the Year Awards, in which SID recognizes the most innovative display products and technology from all of 2010. The list of choices for these awards was overflowing

*(continued on page 59)*

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## Sony Plant Shutdown Signals Electronic Media Delays

In March 2011, Sony's Sendai Technology Center in Tagajo, Japan, was badly damaged by the 9.0-magnitude earthquake and subsequent tsunami that struck the northern part of the country. The facility, located about a mile from shore, manufactures the company's Professional Media Products line, used by motion-picture and television professionals.

Although the products affected by the earthquake were not directly connected to the display industry, they easily could have been had another factory been hit instead. The products include HDCAM SR and HDCAM, DVCam, and Betacam SP tapes, as well as Digital Betacam, Betacam IMX, Betacam SX, XDCam, SxS flash cards, DV, and HDV products.

After the disaster, according to a recent article in *TechWorld*, production was initially suspended at 10 Sony sites throughout Japan, but only two remained offline as of the first week in April. One of them, Sony's lithium-ion-battery factory in Motomiya, was scheduled to restart production by the end of April. The second, in Sendai, was still undergoing clean-up operations. The article stated that Sony had yet to make a public appraisal of the damage at the Sendai plant and has no estimate for when it might be back online.[1] From descriptions in the news of the damage in the area, Sony may unfortunately be in for a long clean-up process.

The message in a letter Sony sent to many of its customers makes it clear that the temporary loss of just one plant can have far-reaching effects. The letter explained that "… the majority of the items are being affected by being produced in the Sendai plant which was damaged. In addition, some other Sony items may be affected because even though they are assembled in other parts of the world, components for these items are produced at an affected plant in Japan."

"In some cases, a competing manufacturer such as Maxell or Fuji may have product that is interchangeable with an affected Sony item. However, these manufacturers are also undergoing a huge increase in demand, and we are certain to see resultant shortages occur as they ramp up production…" More of the letter is available online at sites such as *Below the Line* (a publication for motion-picture film, TV, and commercial production industry crews).[2] How deeply such shortages would affect the film and broadcast industry was not yet clear in Q2 '11.

Sony's Sendai plant does not, of course, represent the only major electronics industry setback in Japan. Short-term production slow-downs and shortages have taken their toll and will continue to do so, as the country and the industry rebuild. While the display industry seems to have "dodged the big bullet – this time," in the words of *Information Display* Executive Editor Stephen Atwood (see "A Warning from Sendai for Displays" in the April 2011 issue), clearly the loss of just one electronics factory may have ramifications for the electronics industry in ways that may not even be realized for months to come.

**References**

[1]http://www.techworld.com.au/article/382522/sony_restarts_more_quake-hit_plants_supply_problems_remain/

[2] http://www.btlnews.com/crafts/camera/sony-warns-of-media-shortages/

*—Jenny Donelan*

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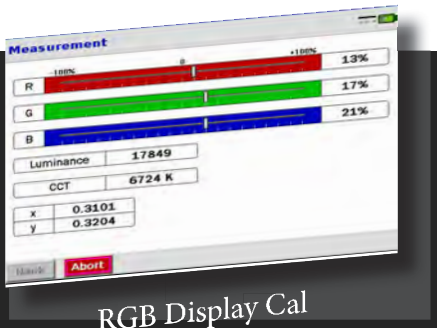

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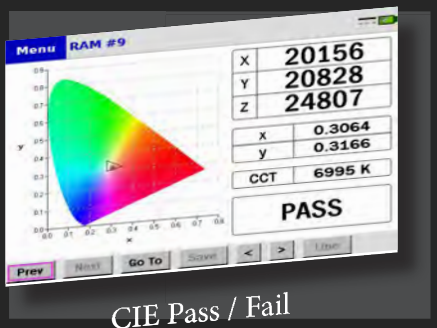

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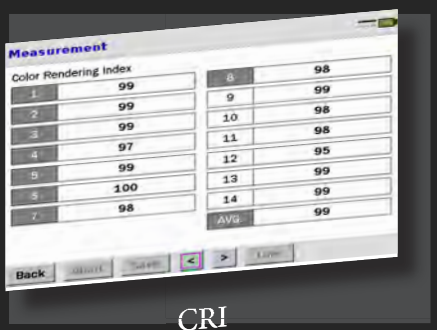

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# 2011 SID Display of the Year Award Winners

*The Society for Information Display's Display of the Year Awards committee has selected six award winners that advanced the state of the art of electronic-display products and technology during 2010 in the categories of Display of the Year, Display Component of the Year, and Display Application of the Year. All of this year's winners are either mobile displays or components for mobile displays.*

by Jenny Donelan

"SMALL IS BEAUTIFUL" could well be the theme for this year's Display of the Year (DYA) awards. Giant television screens will always draw people's attention, but it was exquisite imagery that you can put in your pocket, or at least in your briefcase, that impressed the 2011 Display of the Year Awards Committee. For example, Apple's Retina technology, used in the iPhone 4, employs 326 ppi to create a truly beautiful display. As an aside, the marketing behind the iPhone has affected the rest of the display industry too, making the general public aware of "pixel density as a meaningful differentiator," as Mark Fihn puts it. Fihn is the author of this month's Display Marketplace feature, "Predicting the Future."

Two other smartphone/mobile-phone technologies being honored this year are based on active-matrix organic light-emitting diodes (AMOLEDs). Samsung Mobile Display's On-Cell Touch AMOLED display elegantly enables devices that are thinner and offer far more light transmission than devices built on prior technology. In the area of applications, Samsung's Super AMOLED technology is the basis of the 4-in. displays used in the company's Galaxy S class of mobile phones, which feature superior color quality and a contrast ratio of 100,000:1.

Moving up a bit in size is the iPad from Apple, honored by the committee in the area of applications. It is not the first tablet computer, but it is definitely the first tablet to merge connectivity, multitouch, and a superior display in a way that captured the public's imagination.

The other two winners this year are E Ink's Triton color imaging technology, which brings color to the reflective, sunlight-readable monochrome e-Readers that have become such a commercial success, and a flexible substrate from the Industrial Technology Research Institute (ITRI) that enables the manufacture of flexible displays using the existing TFT infrastructure.

The displays, components, and applications honored this year are varied in terms of their underlying technology – LCD, AMOLED, and electrophoretic – but they all have in common some major advances in both form and function, as well as their portability.

Bob Melcher, the Display of the Year awards chairman, notes that "this year the DYA awards selection was extremely competitive, with several excellent products in contention in each category. The ultimate selection of the six winners demonstrates how innovation continues to drive the display industry."

These products, and the companies that created them, will be honored at a ceremony during the annual SID luncheon, which takes place on Wednesday, May 18, 2011, during Display Week in Los Angeles, California. During the ceremony, the three Gold Award winners will each present a short video on the winning products.

The award-winning displays, components, and applications are described below, based on information supplied by the winning companies.

## 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: Apple's iPhone 4 Retina Display***

By developing pixels only 78 μm wide, Apple engineers and their technology partners were able to pack four times the number of pixels into the same 3.5-in. (diagonal) screen found on earlier iPhone models. The resulting pixel density of the iPhone 4 Retina display – 326 ppi – makes text and graphics look smooth and continuous at any size. The 640 × 960-pixel display set a new benchmark for mobile-display resolution.

The iPhone 4 Retina display uses technology called mobile in-plane switching (IPS) to achieve a viewing angle superior to that of conventional mobile LCDs, enabling users to hold the iPhone 4 in almost any position they want and still get a high-fidelity image. The consistency of gamma over viewing angles provides an enhanced viewing experience to end users in applications such as gaming and photo-sharing.

The LTPS-TFT backplane design is fully customized, including organic passivation and optimized pixel design for maximum trans-

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# DISPLAY OF THE YEAR


***Gold Award:*** *Apple's iPhone 4 Retina display features 326 ppi on a 3.5-in.-diagonal screen and mobile IPS technology, a design that results in exceptionally smooth-looking text and graphics over all viewing angles.*


***Silver Award:*** *Samsung Mobile Display's On-Cell Touch AMOLED display has an integrated touch sensor to provide superior display quality, high performance, multi-touch input capability, the thinnest possible form factor, and exceptional outdoor visibility.*

mittance. Combined with a custom driver IC, this enables high resolution with industry-leading low power consumption.

The brightness of the display is both user-customizable and auto-adjustable, with the latter using ambient light sensing and power-optimized default levels. The full brightness capability ranges up to 500 cd/m$^2$ for readability in bright environments.

Apple and its suppliers developed the advanced IPS compensation polarizer technology to achieve high contrast (800:1) and color consistency at almost all viewing directions. This compensation scheme also enables the high-transmittance pixel required for optimized battery performance. The polarizer design includes a novel sunglasses friendly feature to make the display viewable in any orientation, even through polarizing sunglasses.

The innovation in the iPhone 4 extends beyond the optical performance of the Retina display into mechanical integration as well. Patent-pending features in the color-filter black mask allow for highly accurate alignment to the laminated touch panel and cover glass. The driver IC is ultra-thin with a tiny footprint for enhanced reliability, and the integration of the driver IC and attached flexible printed circuit are optimized for compact product architecture. The backlight architecture is also designed to support the reliability and process demands of the iPhone 4 system.

The iPhone 4 Retina display has native 8-bit color depth, resulting in beautiful images without contouring. It is supported by system-level optimization including pixel pipeline optimizations and software-based color correction.

Working with its technology and manufacturing partners, Apple led the design and development of the iPhone 4 Retina display and set a new benchmark in display resolution, low power consumption, and image quality.

***Silver Award: Samsung Mobile Display's On-Cell Touch AMOLED***

Samsung Mobile Display developed the revolutionary On-Cell Touch AMOLED (OCTA) display for use in mobile applications. The OCTA display has an integrated touch sensor that eliminates the need for an additional touch-screen overlay (Fig. 1). Until now, touch-capable mobile displays have utilized an input sensor fabricated onto a separate glass substrate, which is then laminated as a separate subassembly onto the display. This extra glass layer has resulted in additional weight and product thickness. Furthermore, the extra sensor-to-display interface layer causes a loss of display luminance and is a source of internal reflections that degrade display performance, especially in high-ambient lighting conditions, such as outdoors.

The OCTA display was developed to meet the ever-increasing performance and industrial design demands of today's modern mobile devices. The touch sensor integrated onto the display glass uses projected-capacitive touch-detection technology to deliver multi-touch input capability with the highest possible sensing performance. Additionally, because AMOLED displays are self-emissive, they do not require the thickness, added weight, and expense of a backlight. As a result of this new design approach, the Samsung OCTA display delivers excellent performance and exceptional quality with a highly accurate and sensitivity-optimized touch input in a module that is less than 2 mm thick. The Samsung OCTA has nearly 100% light transmission and outstanding outdoor visibility due to Samsung's elimination of the extra interface layer. Also, its multi-sensor input capability enables gesture recognition for the most advanced mobile devices.

The OCTA display is expanding into a wide range of mobile applications including smartphones, tablets, premium digital cameras, and even conventional mobile phones. The OCTA is the world's first mass-produced AMOLED with an integrated touch sensor.

The advantages of AMOLEDs include:

***Superior Picture Quality.*** With vivid, more life-like colors, wider viewing angles, and much higher contrast ratios compared to that of conventional mobile screens, AMOLED displays dramatically enhance the mobile viewing experience. AMOLED displays process images up to 1000 times faster than conventional displays such as LCDs. Therefore, AMOLED displays deliver superior moving picture performance and feature a 180º angle of view and contrast ratios greater than 1,000,000:1. In addition, the color gamut of AMOLEDs typically exceeds that of other devices with LCD screens.

***Thinner Profile.*** AMOLED screens are much thinner and lighter than other displays due to their innovative structure and the absence of any backlight. AMOLEDs are enabling designers to make sleeker, lighter, and more appealing mobile products, which are more elegant and convenient to use.

***High Power Efficiency.*** AMOLED screens consume less power than other devices when displaying video images. This provides a critical advantage in portable electronics, allowing mobile devices to last longer for a given battery size.

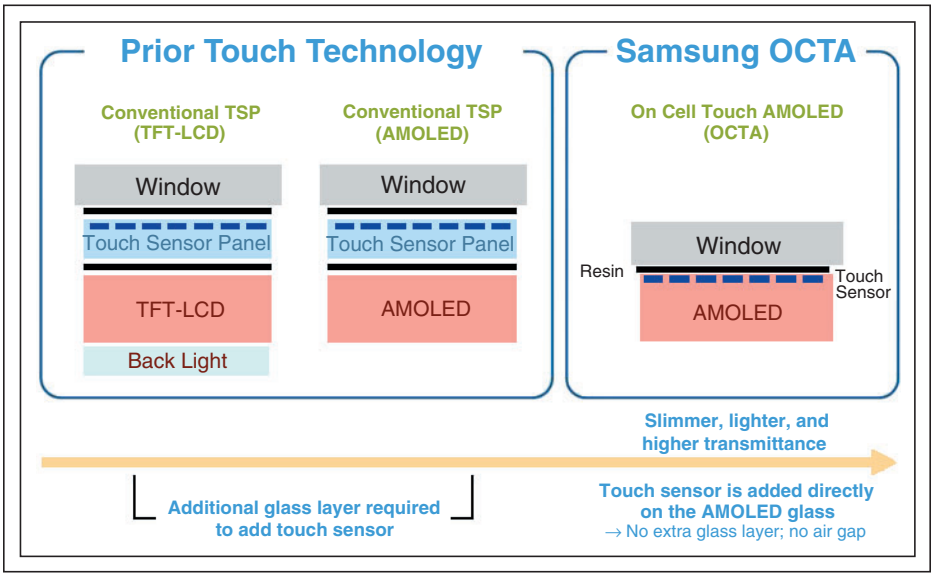



***Fig. 1:*** *The OCTA technology enables a demonstrably thinner touch display.*

## 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: E Ink's Triton

Color e-paper displays enabled by E Ink's Triton color imaging technology deliver high-contrast, sunlight-readable, low-power performance designed to further close the divide between paper and electronic displays.

With the E Ink Triton color configuration, a thin color-filter array (CFA) is added in front of the black-and-white display, which is based on E Ink's Pearl electrophoretic technology. The CFA consists of four subpixels – red, green, blue, and white – that are combined to create a full-color pixel. The result is a low-power, direct-sunlight, readable color e-paper display.

The benefits of E Ink Triton include:

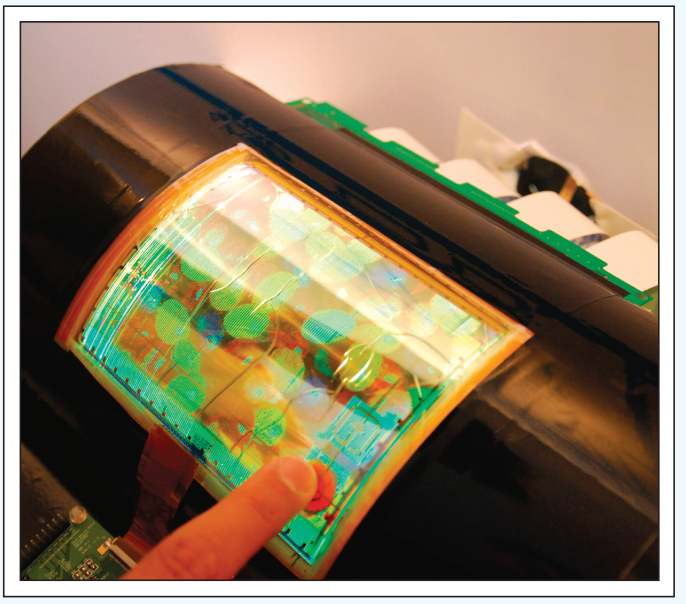
***Color Enhancement.*** In addition to 16 levels of monochrome, Triton is capable of displaying thousands of colors. Just like E Ink's monochrome e-paper products, Triton's crisp text and detailed color graphics are fully viewable in direct sunlight.

***Improved Speed.*** E Ink Triton is 20% faster than previous generations of E Ink displays. This expands the e-paper experience and displays more dynamic content for signage, advertising, or browsing the Internet.

***Tier 1 Ecosystem.*** E Ink has partnered with companies such as Epson, Texas Instruments, Marvell, and Freescale Semiconductor to provide a best-in-class ecosystem of supporting electronics products. Its partners are working toward enabling E Ink's newest generation of e-paper displays with technology such as dedicated discrete e-paper controllers and display power-management integrated circuits.

# DISPLAY COMPONENT OF THE YEAR


***Gold Award:*** *E Ink's Triton color imaging technology incorporates a color-filter array built on top of the company's monochrome imaging film.*



***Silver Award:*** *ITRI's flexible substrate enables displays such as this prototype of a flexible touch AMOLED display screen in a curved configuration.*

Triton enables color applications markets including e-books, e-newspapers, e-magazines, e-textbooks, and digital signage.

***Silver Award: ITRI's Flexible Substrate for displays***

The Silver Award was given to the Industrial Technical Research Institute (ITRI) for its novel flexible substrate technology that is compatible with existing TFT infrastructures and processes.

ITRI's Flexible Substrate is an inorganic dominated silica/polyimide (PI) hybrid film in which the silica content can be increased as high as 60 wt.%. The film is suitable for the fabrication of flexible displays in both batch and roll-to-roll processes. [The existence of networks between silica particles in a PI matrix has been confirmed by 3-D tomography (Fig. 2)]. The novel inorganic silica/polyimide (PI) hybrid technology for flexible substrate is a significant step forward in the display field.

For batch-type processes, the flexible substrate is easily prepared by coating a PI solution on glass carriers, followed by fabricating TFT devices on the said substrates. The surface roughness of PI/silica hybrid film as measured by atomic-force microscopy (AFM) is less than 5 nm. It is therefore good enough for the manufacture of flexible displays.

Moreover, the adhesion properties of PI/silica film with silicone oxide, silicone nitride, and ITO are very good without any other primer or surface treatment process needed. The Tg of the PI/silica hybrid film is higher than 400°C due to the inorganic silica dominated phase. Furthermore, the high inorganic content of silica/PI reduces the coefficient of thermal expansion (CTE). The silica content of the film can be increased as high as 60 wt.% while still reaching the desired optical properties.

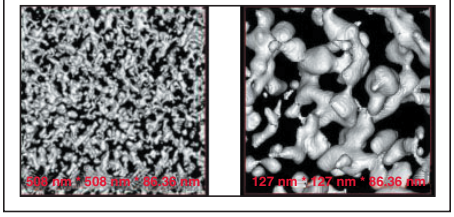


***Fig. 2:*** *Three-dimensional tomography images of ITRI's Flexible Substrate include (left) a low magnification with a dimension of 508 × 508 × 86.4 nm and (right) a high magnification of 3D image with a dimension of 127 × 127 × 86.4 nm.*

# DISPLAY APPLICATION OF THE YEAR

***Gold Award:*** *Apple's iPad features an innovative multi-touch LCD for a mobile device that marks a new era of tablet computing.*


***Silver Award:*** *Samsung Mobile's Galaxy S displays feature the company's vibrant Super AMOLED touch-screen technology.*

For the roll-to-roll fabrication process, the ITRI flexible substrate attains a variety of attractive properties, such as low CTE (20 ppm/°C, high transmittance (around 90%); within a wavelength range of 400–700 nm), excellent flexibility, and high Young's modulus (4.3 Gpa). Additionally, a flexible color-filter active-matrix electrophoretic display (AMEPD) and a flexible touch film were made on ITRI's flexible substrate. The novel inorganic dominated silica/PI hybrid technology is a significant step toward the realization of flexible active-matrix displays.

In the future, networks between dominated silica particles could make a true glass-like substrate possible; the challenge of the water and oxygen barrier properties should continue to be studied. A hybrid with other nano-materials and polymers could also increase the barrier properties significantly. ITRI believes that flexible displays will soon become a viable product. (For more information, see the article, "A Flexible Universal Plane for Displays" in the February 2011 issue of *Information Display*.)

## 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: Apple's iPad

Apple's original iPad shipped in April 2010. Industry experts were initially unsure how the new tablet computer, which was larger than a smartphone and smaller than a laptop, would be received by consumers, but nearly 15 million sold worldwide that first year (http://www.apple.com/pr/library/2011/01/18results.html). The iPad's mobile in-plane switching (IPS) LCD, combined with a multi-touch user interface and iPad system design (it runs on the same iOS as the iPhone) turned out to mark a new era of tablet computing.

The iPad display provides a superior viewing experience, with a minimized gamma shift over viewing angles by using advanced mobile IPS technology. By working closely with display partners on all technical aspects, Apple has customized the design to achieve a total optimization of display pixel structure, LED, backlight, electrical circuits, and software management to maximize the power efficiency. The iPad is able to achieve 9 hours of battery life for 3G Web surfing and 10 hours for WiFi Web surfing by combining this custom-designed LCD with an innovative

product design and power management system – all with an ultra-thin profile.

By leveraging the existing a-Si TFT infrastructure, Apple was able to deliver a product whose impact has been considerable all over the world. The company has said that the iPad revolutionizes the way people interact with computers, changing the way they are used to communicate, consume, and create content, play games, and learn.

***Silver Award: Samsung's Galaxy S***

In June 2010, Samsung Mobile launched its first-ever premium portfolio of smartphones in the company's 15-year history in the U.S. The vibrant display on each device attracted the attention of both media and consumers and allowed the Galaxy S portfolio to succeed in the smartphone market.

Samsung Galaxy S smartphones provide a premium viewing experience with a brilliant 4-in. display powered by Samsung's Super AMOLED touch-screen technology. Super AMOLED technology design yields thinner displays, delivering some of the thinnest, most responsive full-featured smartphones in the industry. Due to its advances in color reproduction, contrast ratio, response time, and viewing angle, Samsung's innovative display technology makes watching movies, viewing videos, and playing games come to life like never before, even in bright light and outdoor environments.

Samsung's Super AMOLED screen offers improved color reproduction that is 40% higher than other leading displays. That means the user sees an incredibly close match between the color quality on the mobile phone and that of the original content source, whether it be film, video, or digital images. Super AMOLED also delivers a contrast ratio of 100,000:1, which is more than 100 times the quality of other leading displays and the closest comparison to HDTV standards. That means the Galaxy S will show the very brightest whites and the very darkest blacks for unmatched vivid colors and clarity.

In terms of response time, Super AMOLED is 2500 times faster than the leading display standard, clocking in at one-hundredth of a millisecond. A rapid response time means the display refreshes video images faster than ever, blocking "ghost" images, eliminating screen freezing and other video distortion. Additionally, Super AMOLED's full 180° viewing angle prevents any blurring or distortion, even while users hold the Galaxy S at eye level.

Samsung Mobile's next-generation technology, Super AMOLED Plus, will bring a new level of viewing experience to the consumer, with a greatly increased subpixel count – 50% more subpixels than the original Super AMOLED. Super AMOLED Plus will complement the mechanics of the human eye to make images look clearer and more detailed than ever before. ■

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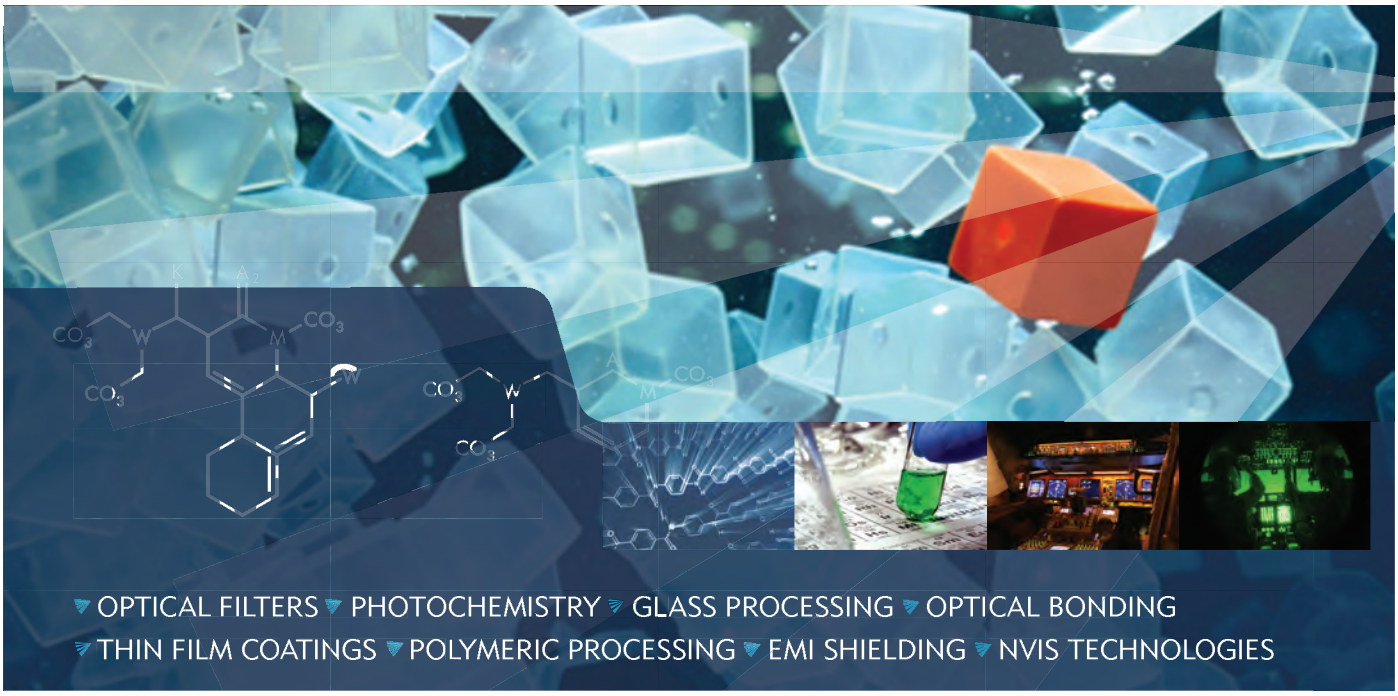


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# The Chinese Display Industry and SID's Beijing Chapter Grow Together

*The manufacturing capacity for displays and the display market itself are both very large in China. The main task of SID's Beijing chapter is to support research and development for the Chinese display industry so that it can continue to grow and prosper as it has for the last 30 years.*

by Baoping Wang

IN THE BEGINNING of the 1980s, the first Chinese color-picture-tube factory was built in Xian Yang, a city in the western part of China. This factory is generally regarded as the starting point of the modern display industry in the country. Over the next 20 years, many cathode-ray-tube (CRT) factories were built in Shanghai, Beijing, and Nanjing, as well as in other large Chinese cities. By the end of the 1990s, China had become the largest manufacturer of CRTs in the world.

During the 1990s, two Gen 5 TFT-LCD product lines were built, one in Beijing and one in Shanghai. This was the beginning of what was to become the now huge flat-panel-display (FPD) industry in China. Apart from TFT-LCDs, other types of FPDs, such as PDPs and OLEDs, are also now being produced. And many Chinese universities and research institutes are immersed in the research and development of new display technologies.

Over the last 10 years, the Chinese economy has developed at a rapid pace. Although a serious economic crisis has affected the global market, the revenue of the Chinese electronic information industry was 5130 billion RMB (yuan) in 2009. It increased 0.1% compared with that in 2008. Table 1 shows the output of some types of electronics in China in the first half of 2010.[1-4]

As shown in Table 1, the production of color TVs increased 16.4% in mainland China during the first half of 2010. In further breakdowns, LCD TVs especially increased by 40.7% during this period. Of the total display production in China, LCD shares are about 71%; PDP, 3%; and CRTs, 26%. Clearly, the LCD is the dominant display product in China.

Sales in China are about as strong as manufacturing. The consumer market is quite large. In the first six months of 2010, about 20 million color TV sets were sold in mainland China. FPDs represented 85% of this market.

**Table 1.** Mobile phones, color TVs, and notebooks were among the electronics produced in the millions during the first half of 2010.

| | Production (millions) | Increment (%) |
|---|---|---|
| Mobile phones | 369.88 | 37.6 |
| Color TVs | 52.991 | 16.4 |
| Notebooks | 88.918 | 41 |
| Monitors | 67.795 | 8.4 |
| Digital cameras | 39.899 | 24 |

## The Development of the FPD Industry in China

Many different FPDs are currently produced in China. In addition to LC, plasma, and OLED displays, e-paper, LCoS, and others are manufactured as well. Most FPD companies are located in Beijing, Tianjing, Shanghai, Jiangsu, Guangdong, Anhui, Sichuan, Hubei, and Shanxi. Some Chinese brands that are known throughout the world include BOE, TCL, Panda, and Changhong. At this time,

*This TFT-LCD factory, owned by BOE Display Technology Company, is one of many in mainland China.*

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there are four Gen 4.5 , four Gen 5 , two Gen 6 , and three Gen 8 TFT-LCD product lines in mainland China. Table 2 provides some details about those them.

Until now, most LCD panels produced in mainland China have been smaller than 26 in. The large LCD panels for TV sets have been imported from Japan, Korea, and Taiwan. However, it is estimated that more than 80 million large LCD panels (46 in. and larger) will be produced in mainland China in 2012. At that point, the number of large LCD panels produced in China should be enough for the requirements of Chinese TV-set factories.

The Chinese government and electronic companies have invested a great deal in developing the key technologies for TFT-LCDs. Chinese companies and research institutes have already applied for more than 5000 patents relating to TFT-LCD technologies. Every year, about 500 patent applications for LCD technology are submitted. Chinese companies are said to already hold strong patent positions in a few key technologies, such as AFFS, ODF, GOA, and local-dimming technologies.

Apart from the TFT-LCD industries, some PDP factories have been built in mainland China. Table 3 shows the main ones.

It is estimated that more than 4.5 million PDP panels (42 in. and larger) can be produced in mainland China in 2012. Therefore, mainland China need not import PDPs from other countries.

Table 4 gives information about the OLED industry in mainland China. In 2012, the passive-matrix OLEDs (PMOLEDs) produced in mainland China will be used primarily in small displays and lighting. The small AMOLED (< 3 in.) will be mass produced starting in 2012.

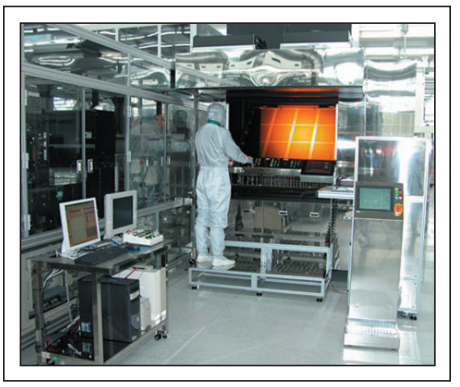
To help maintain the display industry, a few companies producing glass substrates, color filters, and special equipment are also set up in China. Therefore, a complete display industry link has been formed in this country.

**Table 2:** TFT-LCD product lines in mainland China range from Gen 2.5 to Gen 8.5.

| | Company | Generation | Location | Dimension of mother substrate (mm x mm) |
|---|---|---|---|---|
| In production | BOE | 5 | Beijing | 1100 × 1300 |
| | SVA-NEC | 5 | Shanghai | 1100 × 1300 |
| | Infovision | 5 | Kunshan | 1100 × 1300 |
| | Innolux | 5 | Shenzhen | 1200 × 1300 |
| | Tianma | 4.5 | Shanghai | 730 × 920 |
| | BOE | 4.5 | Chengdu | 730 × 920 |
| | Tianma | 4.5 | Chengdu | 730 × 920 |
| | BOE | 6 | Hefei | 1500 × 1850 |
| | Truly | 2.5 | Shanwei | 370 × 470 |
| In construction | Tianma | 4.5 | Wuhan | 730 × 920 |
| | Panda | 6 | Nanjing | 1500 × 1850 |
| | BOE | 8 | Beijing | 2200 × 2500 |
| | Infovision | 7.5 | Kunshan | 1950 × 2250 |
| | TCL | 8.5 | Shenzhen | 2200 × 2500 |

**Table 3:** One major PDP factory is already in production in mainland China, and another is being built.

| | Company | Location | Dimension of substrate |
|---|---|---|---|
| In production | Changhong | Mianyang | 2200 × 2400 |
| In construction | Xinhao | Heifei | 1100 × 1200 |



*Shown here is the interior of a BOE fab in China where TFT-LCDs are made. Chinese companies and research institutes have already applied for more than 5000 patents relating to TFT-LCD technology.*

## Strategy of the SID Beijing Chapter

In 2011, there are about 250 members in the SID Beijing Chapter. Obviously, the scale of this chapter is not in proportion to the scale of the Chinese display industry as a whole. An important task for the SID Beijing Chapter in the next 5 years is to attract new members, especially young people.

SID's mission in China also includes the continuous support of technology development and innovation, including the training of engineers for the Chinese display industry. Members of the Beijing Chapter know that investments in research and development are as important as those in manufacturing,

To support display-industry research in China, the SID Beijing chapter has organized a series of conferences over the last 3 years, including Asia Display '07 in Shanghai and ASID '09 in Guangzhou. In November 2011, the SID Beijing chapter will run Asia Display/China Display in Kunshan. These international conferences will be used as a platform for Chinese engineers to exchange and increase their knowledge.

**Table 4:** Both passive- and active-matrix OLED production lines exist in mainland China.

| | Company | Product Line | Location | Dimension of substrate (mm * mm) |
|---|---|---|---|---|
| In production | Visionox | PMOLED | Kunshan | 370 × 470 |
| In construction | Sinodisplay | AMOLED | Fushan | 730 × 920 |
| | Changhong | PMOLED | Chengdu | 370 × 470 |
| | IRICO | AMOLED | Shunde | 730 × 920 |
| | Tianma | AMOLED | Shanghai | 730 × 920 |

The action points of the SID Beijing chapter are summarized as follows:

- The members of the SID Beijing chapter should be observably scaled up in the next 5 years. It is hoped that there will be more than 500 members of the SID Beijing chapter by 2015.
- The SID Beijing chapter will organize at least one conference every year.
- The SID Beijing chapter will organize seminars to train local engineers.
- The SID Beijing chapter will push its members to attend more conferences and symposiums organized by SID.

## Looking Forward

Since the 1990s, the Chinese display industry has developed quite quickly. It is estimated that this momentum will be maintained at the same level over the next 10–20 years. The central task of SID's Beijing chapter is to support research and development in order to help this dynamic industry continue to grow and thrive.

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# Predicting the Future

*It might be impossible to foresee the future in absolute terms, but experts in a given field can discuss general trends with a degree of accuracy. For this special Display Week issue,* Information Display *invited an expert analyst who has covered the display industry for many years to predict the progress of trends in five key areas: flexible substrates, display standards, 3-D, high resolution, and touch panels. Read on to find out what display capabilities you will be using, buying, and manufacturing in years to come.*

by Mark Fihn

IT IS SOMEWHAT AMAZING to realize that only a decade ago, top display industry analysts had debates about whether or not mobile-phone displays would shift from monochrome to color, TV market pundits debated about whether or not HDTV would become a reality, and even leading computer companies such as Apple scoffed at Microsoft's vision of a world filled with tablet PCs that could be manipulated with touch-based inputs.

This article draws on many years of participation, observation, and writing about the display industry. While unlikely to serve as a predictive tool, many of the ensuing observations attempt to draw attention to those areas where it is desirable for display performance to better mimic the human visual experience. The article is divided into five segments, drawing from insights gained through Veritas et Visus publications that cover flexible substrates, display standards, 3-D, high resolution, and touch panels. Each segment, somewhat provocatively, suggests five trends to watch for in the future – a total of 25 predictions in all.

***Mark Fihn*** *is publisher of the Veritas et Visus newsletters, focused on the technologies and markets related to flexible displays, display-related standards and regulations, 3-D displays, high-performance displays, and touch screens. He can be reached at 254/791-0603 or mark@veritasetvisus.com.*

## Flexible Substrates

The notion of a flexible display is fascinating, with many forward-thinking people envisioning a world where displays essentially displace paper both in function and form. Over the years, however, the appeal of flexible displays has largely been overshadowed by a focus on enabling electronic devices to be manufactured on flexible substrates. With displays at the top end of the electronics food chain, recent attention related to flexible substrates has shifted to somewhat simpler devices such as sensors, ID tags, batteries, lighting, and photovoltaics. While flexible displays still evoke considerable interest, simpler devices are already starting to lead what is going to be a fundamental shift in the way electronic devices are manufactured and used.

**1.** ***In the race to enable big images from small packages, pico-projectors are winning.*** The original promise of flexible-display technologies was to unfold or unroll a small device so that a much larger image might be displayed. Although pico-projection still has some hurdles, it is becoming increasingly clear that at least for the next few years, the promise of big images from tiny devices is best fulfilled by projection technologies and not by rollable or foldable displays.

**2.** ***The Kindle/Nook stand-alone e-Book phenomenon will fade.*** Certainly, monochrome e-Book readers are going to put up a good fight against the likes of the iPad, but the era of single-function devices is coming to an end. e-Book makers must quickly recognize the desire by users to not only read books, but to browse the Internet, play games, jot down notes, show off photo albums, link to TVs, etc. These multiple demands on the device make it particularly difficult to shift to flexible displays. Ever seen a rollable DVD drive?

**3.** ***Integrated devices.*** To this point in the electronics industry, most devices have remained stand-alone solutions. Processors have remained processors; memory has remained memory; mass storage, optical

> ***... the promise of big images from tiny devices is best fulfilled by projection technologies and not by rollable or foldable displays.***



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storage, batteries, input devices, *etc.*, have all been manufactured independently from one another, and then combined by another party to create a PC, or a TV, or a mobile phone. The new manufacturing processes being developed in the emerging printed electronics industry will increasingly enable several of these devices to be manufactured simultaneously. The "system-on-glass" process that has been proposed by several LCD makers over the past decade will be fulfilled, not on glass, but on substrates that utilize printing processes similar to those used to print on paper.

**4.** ***Wearable displays.*** While evening gowns with interwoven optical fibers and t-shirts that brightly proclaim your emotions might not suit everyone, there is no question that wearable electronics is coming very quickly. And this will certainly include displays. Think of military clothing that enables adjustable camouflage; clothing accessories that can change color depending on the outfit; clothing with embedded ID badges; or clothing that reacts to dangerous situations by changing color in the presence of a certain chemical or a certain medical condition.

**5.** ***e-skins.*** One of the most exciting developments in the world of displays is related to e-skin technology. The ability to change a surface electronically, from one color to another, or even in a matrix of colors, really serves to redefine the notion of a "display." This is much more than changing the color of the casing on your mobile phone; it ultimately includes the ability to change almost any surface. If wallpaper, upholstery, carpeting, flooring, and indeed paint itself can be changed with the push of a button, or based on the time of day or the intensity of the sun, it suddenly becomes hard to put a limit on what we describe as a display. Such solutions, however, will not emerge out of multi-billion-dollar fabs based on glass substrates dependent on vacuum deposition and photolithographic processes. e-skins belong to the world of printed electronics, utilizing flexible substrates that someday will be printable in an inexpensive home environment.

## Display Standards

Discussions about standards usually make their way into the press either when a standard fails or when conflicting "standards" result in a "war." Display-related standards and regulations fall into a broad range of activities – from metrology to performance, to environmental considerations, to interface factors, to industry-specific documentation, and to government-specific political aims. In most cases, the biggest issues related to standardization arise because of too many standards bodies and not because the world lacks standards.

**1.** ***The ICDM will improve, but not solve, display-related specsmanship issues.*** Specsmanship involves the creative use of standards to overstate performance. In the display industry, specsmanship has made a meaningless hash out of performance parameters such as contrast ratio, color gamut, viewing angle, brightness, and numerous other measures. Although the long-awaited ICDM metrology specifications should help reduce the specsmanship, it is greatly feared that the creativity of marketers will continue to confuse the marketplace, rather than providing users with meaningful performance comparisons.

**2.** ***The battle for a unified digital interface.*** For decades, displays relied on an analog interface, which has some benefits, but has become increasingly cumbersome in a digital world. The CE industry has largely migrated to the HDMI digital solution, with devices counting not if HDMI is supported, but how many HDMI ports are included on each device. Until recently, the telecommunications industry has not really needed much in the way of external interfaces, but now with cameras, video, e-mail access, *etc.*, mobile phones seem to be migrating to some form of the HDMI standard. The PC industry, however, continues to flounder with a mishmash of analog and digital solutions. VGA, HDMI, and DisplayPort co-exist on many PCs, (along with a huge variety of dongles to connect one interface to another). The PC industry seems intent on making it difficult to interoperate with CE and telecommunications devices, to the detriment of consumers. As more and more CE and telecommunications companies start to compete in the PC space (watch the tablet space carefully), one of the predictable results is that traditional PC companies are going to find it increasingly difficult to compete simply because they make it so awkward to interoperate with CE and telecommunications devices. Traditional PC companies such as Dell and HP have tried and failed in the TV space and are not faring well in the mobile-phone space. As a result, traditional CE companies such as Sony and Samsung (and perhaps newly Apple), which are enabling interoperability across very broad product lines, are likely to really start encroaching into the PC space.

> ***"... the era of single-function devices is coming to an end."***

**3.** ***"Green."*** It is often noted that a company's declarations about "green" technologies and caretaking of our environment seem to be largely marketing tools rather than major development efforts. The point is becoming increasingly moot, as it seems clear that voluntary efforts to develop green products will be trumped by government mandate. There will undoubtedly be howling by many companies about such regulatory efforts (particularly when the efforts are not unified from country to country), but the smart companies will recognize that "green" is here to stay and that they will best benefit by turning their green marketing hype into product reality.

**4.** ***The politics of e-waste.*** A potent part of the green revolution has to do with the handling of e-waste. The practice of first-world countries exporting electronic waste to third-world countries will not be tolerated much longer. Smart companies will not only develop energy-efficient products made in environmentally friendly factories, but they will also strive to create ways to easily and profitably recycle and dispose of their older products. This, too, will be mandated, and delaying the inevitable will be a costly mistake.

**5.** ***Political interests will diminish display-related innovation.*** The recent U.S. Justice Department actions against numerous LCD manufacturers for price-fixing has certainly succeeded in improving the bank accounts of a good many attorneys and has supposedly benefited the American consumer in the form of some $900+ million in fines. The litigation has now spread to other jurisdictions – with numerous U.S. states, at least two class-action suits, and some suits by specific companies – all claiming damages from LCD manufacturers. Now the legislation has crossed the Atlantic to the EU, and it is expected that other courts around the world will also stake their claims.

> ***While price-fixing regulations are probably appropriate in order to protect the consumer from monopolistic pricing practices, prices will increase and profitability will shift from innovation to litigation avoidance.***

While price-fixing regulations are probably appropriate in order to protect the consumer from monopolistic pricing practices, the predictable consequence of substantial fines, enormous energies spent in courts, and the imprisonment of key executives in the display industry is that prices will increase and profitability will shift from innovation to litigation avoidance.

## Third Dimension

Representing 3-D images on a 2-D surface is inherently problematic, often resulting in criticism of the results. But we live in a 3-D world, such that 3-D displays are inevitable as a primary viewing technology. Once relegated to niche markets (medical imaging, bio-science, CAD/CAM, system design, and petroleum exploration), 3-D displays are moving quickly into the cinema, home television, PCs, mobile phones, gaming systems, and really virtually all display-based systems. While there are specific applications that do not benefit from 3-D imaging, a 3-D mode will almost certainly be a feature that is offered on most devices within the next few years.

**1.** ***The 3-D invasion is unstoppable.*** Despite more than a little negative press highlighting some of the issues related to stereoscopic 3-D, both in the cinema and the home, it is mostly noise – akin to those who dismissed talking movies as never being able to find a significant position against silent movies, or to those who predicted that color TV would be short-lived due to the lack of color content. 3-D is coming, to most applications, and faster than even the most aggressive tend to imagine. And the improvements in both the science and the art of 3-D will be continuous and very impressive.

**2.** ***The "battle of the glasses" ignores the real issue.*** Considerable debate has recently ensued in the press about the competing technologies related to glasses for 3-D TV (passive polarized solutions *vs*. active shutter-glass solutions). Both camps make compelling arguments, but the reality of the situation is that as long as glasses continue to be required at all (which is likely to be for another 8–10 years or more), the debate about glasses needs to be restructured. The problem with glasses in the living room is that not all viewers can give their exclusive attention to the TV; when wearing glasses, the 3-D TV serves as a 3-D TV, but when the glasses come off, the viewer needs to see the 3-D TV in 2-D. The need is not for switchable 2-D to 3-D, but for simultaneous 2-D and 3-D (one with glasses, one without). The first solution to enable simultaneous 2-D and 3-D will win the battle of the glasses.

**3.** ***Poor-quality 3-D filmmaking will not kill 3-D cinema.*** A common theme from both dissenters and advocates of stereoscopic 3-D cinema is that poor production quality will kill the popularity of 3-D. Do not believe it! Recall from your youth the hours you spent watching a TV channel with absolutely horrible reception. Did such headache-creating, stomach-churning poor quality result in the demise of TV? Hardly – you actually learned to better appreciate good quality. And most of us have a fascination with the occasional roller-coaster ride, even if it might leave us a bit queasy. To deny the occasional pop-out effect because it creates an uncomfortable negative parallax is not necessarily the right thing to do.

**4.** ***Real-time holography.*** The famous sequence from *Star Wars* of Princess Leia standing in front of R2D2 in the form of a holographic video (although in violation of the laws of physics in this example) is still quite compelling to anyone thinking of 3-D. This sort of real-time video holography is not so far away, and it will be great fun to follow as the technology starts to emerge in the next couple of years.

**5.** ***3-D is not just displays.*** 3-D technologies extend far beyond the world of displays, encompassing hardware and software developments that are continuously advancing the industry. Capture devices such as 3-D cameras, videocams, and scanners; interaction devices such as 3-D mice and haptic gloves; motion-sensing tools; and output devices such as stereo-lithographic printers, lenticular printers, and architectural and scientific renderings all combine to complement the growth of 3-D displays. The peripheral technologies for 2-D displays will all see enormous innovation as they increasingly emerge to support 3-D displays.

## High Resolution

This author has been a champion of high-resolution displays for many years, and in fact has been completely wrong about the growth of high-resolution displays in the PC industry for the better part of a decade. That the PC industry seems stuck at the 100-ppi level is a marvel – when the benefits of increased productivity, improved performance, and overall enhanced communications effectiveness are so easily demonstrated at higher pixel densities. But 100 ppi is about to change – finally!

**1.** ***The iPhone 4 will inspire "Retina"-like displays in virtually all applications.*** Apple's iPhone 4 is a beautiful display, which at 326 ppi and cleverly dubbed the "Retina display," has convinced the general consumer that pixel density is a meaningful differentiator. Not only can we increasingly expect > 300-ppi

> ***3-D is coming, to most applications, and faster than even the most aggressive tend to imagine.***

pixel densities on mobile phones, we will soon be seeing >150-ppi pixel densities on the desktop and >100-ppi pixel densities in the living room.

**2.** ***Stereoscopic displays will demand higher-than-"Retina" performance.*** For us to effectively view the world in 3-D, we will need even more pixels. Adding depth to an image increases our demand for enhanced image quality.

**3.** ***HDTV is just the tip of the iceberg.*** It is been less than 3 years since the industry had serious debates suggesting that 720*p* was entirely suitable; that 1080*p* was just a waste of pixels. You can still occasionally read commentaries about how Blu-ray adds little over DVDs. The "science" used to justify these claims seems sorely lacking because it is truly the rare individual that cannot discern enormous differences, even at considerable viewing distances, between devices with different pixel densities. And this differentiation has not yet come close to the point of diminishing returns – we will certainly see more and more quad-HD (3840 × 2160), and then UHD (7680 × 4320). As always, bandwidth will be an issue, but do not pay attention to the market "experts" who try to tell you that today's Blu-ray is perfectly adequate. It's not.

**4.** ***Color does not matter.*** OK, color does matter, but it is not a question of how many colors – it is the range of colors that can be displayed on a screen. A display that shows 1 trillion different colors is meaningless if all of them are a different shade of blue. Likewise, a display that covers "90% of the CIE curve" is meaningless if it skips one key color group. Since the human visual system cannot distinguish anywhere close to 1 billion colors, let alone 1 trillion colors, the industry's current focus on bit count needs to be displaced with a focus on extending the range of colors that are reliably depicted on a display.

**5.** ***Multicolor primary displays.*** RGB stripes within a square box have been a great way to create flat-panel displays to this point. Moving forward, there is little question that we will increasingly see multicolor primary displays that utilize a variety of subpixel structures. Things like RGBW, RGBY, the PenTile Matrix, and a broad array of novel pixel structures will increasingly enable performance differentiation and offer improvements to our visual experience.

> ***"The need is not for switchable 2-D to 3-D, but for simultaneous 2-D and 3-D … ."***

> ***"… we'll soon be seeing >150 ppi pixel densitites on the desktop and >100 ppi pixel densities in the living room."***

## Touch Panels

When we started the *Touch Panel* newsletter about 6 years ago, one well-known industry analyst suggested that we would have no subscribers and that the topic was simply too narrow and very "boring." "You just cannot make a resistive touch screen seem interesting to anyone but an engineer who has been told their job depends on creating a touch-based device that almost no one will want." We ignored this pundit, and today the *Touch Panel* newsletter is the most popular of all our newsletters.

**1.** ***Explosion of hybrid touch-technology offerings.*** One of the reasons that so many touch technologies are currently competing for a position in the market is because none of the existing technologies perfectly satisfies the needs of the application. As such, numerous developments are under way to combine more than one touch technology into a single solution – thereby broadening the usage model. For example, the popular projected-capacitive technology used in Apple's iPhone and iPad does not enable pen-input and does not function with gloved hands or if the surface is wet. Likewise, the traditional tablet PC requires a stylus and does not allow for finger input. Hybrid solutions that combine digitizers with projected-capacitive touch technologies to enable both pen and finger operability are becoming popular. Another example is the recent emergence of analog multi-touch resistive (AMR, also called hybrid analog-digital). Both are alternatives to projected-capacitive technology that utilize the familiar resistive technology. There also have been recent announcements related to hybrid voltage-sensing and charge-sensing in-cell touch technologies. It is quite predictable that in the absence of technology breakthroughs that satisfy all user needs, hybrid approaches will continue to be introduced to the market.

**2.** ***Haptic feedback.*** Studies indicate that the human sense of touch is enhanced significantly by both audio and force-feedback cues. Without such extra-sensory feedback, touching a glass-like surface is unappealing (which helps explain the appeal of the sounds we receive from a typewriter and the keystroke responses of a typical computer keyboard). Even the sound of a pencil on a sheet of paper provides feedback cues that are helpful to the user. Most touch technologies fail to provide these natural feedback cues – making it difficult to make many inputs that we are accustomed to making with our fingers or pen-based input devices. As such, it is very likely that the touch-screen market will increasingly include haptic feedback technologies. Such solutions have been demonstrated to improve both the user's experience and the efficiency of the touch technology. Haptics have clearly been demonstrated to speed up touch recognition, reduce user errors, improve safety in mission-critical applications, and increase touch confidence in distractive environments. Moreover, haptics can help reduce screen size in applications that demand small displays – by enabling a confirming feedback cue in a small space. There are several haptic technologies competing for a share of this growing market and there will be a bit of a battle to identify the best haptic solutions for the future.

**3.** ***Non-touch interactivity.*** The popularity of Nintendo's Wii has demonstrated a need for enhanced motion recognition and digital interaction with display devices. Both Sony (with its newly released Move) and Microsoft (with Kinect) have signaled a substantial

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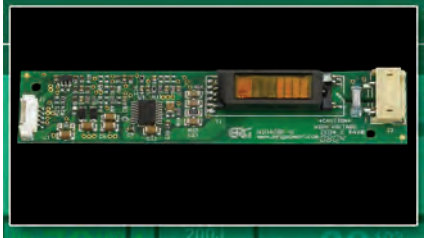

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> ***Haptics have clearly been demonstrated to speed up touch recognition, reduce user errors, improve safety in mission-critical applications, and increase touch confidence in distractive environments.***

response to the Wii – enabling much more sophisticated interactive capabilities. We will almost certainly see these sorts of gestural solutions gain favor in the home and the workplace – ultimately replacing the traditional remote control, and perhaps even making inroads into the mouse market.

**4.** ***Indirect touch solutions.*** The notion of "touch-screen" technology predisposes one to consider touch technologies that directly address the surface of the display. But there are many surfaces besides the front of the screen that can be utilized to manipulate data on the screen. Consider the back side of a smart phone. Rather than obscuring the images on the display with your fingers, the touch interaction could be easily shifted to the back surface of the phone – functioning to some extent like a mouse. Many of the issues associated with fingerprints, transmissivity, scratch resistance, *etc*., disappear when a different surface is used. Or consider the dashboard in an automobile, including sound-system controls, air controls, GPS, *etc*., all of which require some level of reaching out and touching a button or knob to adjust the settings. There is no reason that these distracting touch-based interactions cannot all take place on the steering column using indirect touch solutions. Such examples of indirect touch are likely to expand even faster than solutions in which the user directly touches the display surface.

**5.** ***Interaction with 3-D displays.*** Stereoscopic 3-D display technologies have recently gained mass-market attention, particularly in the TV space, but also in various PC announcements. One of the biggest challenges associated with 3-D displays is that most user-interface technologies (including touch screens) register in only x/y space. Manipulating images in 3-D space has not been developed in concert with the emergence of the 3-D display market. Although 3-D mice and camera-based solutions have been developed to recognize user inputs in 3-D space, the technology is still in its infancy. It is predictable that in the coming years, we will see more and more developments related to interacting in 3-D space – across all applications.

## Summary

As a practical matter, it is impossible to consistently predict the future with any meaningful accuracy, even based on the rather broad generalizations highlighted in this article. Nevertheless, certainly some of these prognostications, and perhaps even most of them, will hit the target. One thing is for sure – in the world of displays, betting against the overall capabilities and demands of the human visual system is likely to be a bad bet. Whatever display is used today will be eclipsed in terms of performance by the display used tomorrow. ■

> ***... there are many surfaces besides the front of the screen that can be utilized to manipulate data on the screen.***

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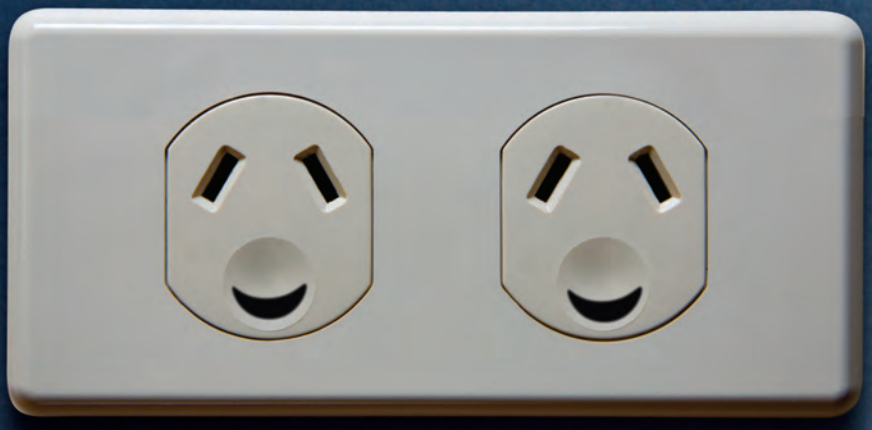

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# Optical Bonding Makes Its Mark with Touch Panels and Other Displays

*Smart phones, tablet PCs, ultra-thin TVs, laptop computers – they have all pushed the optical bonding process out of the shadows and into the mainstream. Once a specialty process, optical bonding is now critical to many of today's most popular electronic devices.*

by Larry Mozdzyn and Michael Rudolph

WHILE optical bonding of protective glass or a touch panel to liquid-crystal displays (LCDs) has been performed for at least 10 years, recent advancements in adhesive materials and bonding process technologies have resulted in significant growth. Optical bonding has evolved from its role in specialty display markets to a place in a broad number of mainstream markets and applications. Bonded displays are being produced in diagonal sizes ranging from 2 to 82 in. Moreover, processes producing bond-line thicknesses from 50 µm to 5 mm have been employed. Improvements also have been realized in the optical performance and durability of adhesives, as well as their compatibility with new bonding processes. As new display-based devices have been developed, additional benefits of optical bonding, including structural integrity, design flexibility, and functional and aesthetic properties, have also been realized.

While there are no industry figures for the number of optically bonded displays or touch panels that are being produced, there is strong evidence of growth. Anecdotal market information indicates the installed base of liquid-adhesive-based automated bonding equipment has grown to more than 100 systems in 2011. Devices employing projected-capacitive (pro-cap) displays such as smart phones and tablet devices, as well as ultra-thin TVs, laptop computers, and large-format 3-D displays, are all benefiting from optical bonding because it enhances aesthetic and functional capabilities.

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## Bonding Basics

Literally in the middle of the optical bonding process is a clear adhesive that affixes multiple surfaces that need to be optically clear. Examples include bonding the layers of a touch-sensor panel or some sort of cover substrate (glass, touch sensor, or other functional material) to a display. This adhesive is applied uniformly over the entire surface of the layers that are being bonded together. The adhesive can be a liquid that is subsequently cured or a solid or semi-solid optical tape that may not require further curing. Whatever the adhesive material, it is typically index-matched to minimize or eliminate reflections caused by the different indices of refraction for the various materials in the assembly and to improve optical performance.

Optical bonding should be distinguished from an alternative process that has been deployed in the industry. Although not technically considered optical bonding, this process typically involves retaining an air gap between the display and the protective cover plate or touch panel. An adhesive tape or gasket material is applied around the perimeter of the display and the cover substrate is suspended above the display with an air gap between the cover and the display. In some cases, other methods of affixing the cover materials above the display have been employed, but these are not common. Designs involving an air gap can compromise the optical performance of the unit. Without anti-reflection coatings, light reflects back to the eye off the cover substrate surfaces in the assembly, essentially lowering the effective brightness and contrast ratio of the display.

## Process Details

To ensure high-quality assemblies with optimum display performance, concerted attention to the details of each process step is a prerequisite (Fig. 1).

A new wider range of devices is taking advantage of the increased optical performance, rugged durability, and design flexibility inherent in the optical bonding process. The popularity of smart phones indicates that consumers like the attributes of optically bonded pro-cap displays. Now, the bonding process is being employed on larger screens (touch and otherwise) in a wider range of applications, including medical devices, point-



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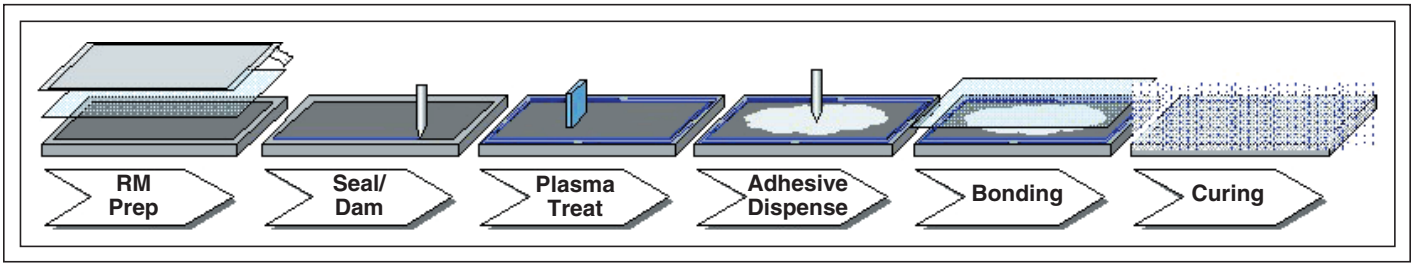


***Fig. 1:*** *Critical optical bonding process steps utilizing liquid optical adhesives begin with raw material preparation (left) and end with curing (right).*

of-sale terminals, GPS systems, industrial control applications, and tablet PCs.

The following are the major steps in the optical bonding process, including some of the details that manufacturers must pay attention to.

***Material Choices:*** While there is a large range of liquid optical-adhesive materials, not all are ideally suited for bonding substrates directly to an LCD. For this application, acrylic- or silicone-based materials are most commonly used. Epoxy-based materials are not typically employed because they do not provide the requisite adhesive mechanical properties and the two-part chemistry is much more difficult to handle in a production environment. Urethanes also are not used because of their mechanical properties as well as their tendency to yellow over time. While several curing methods can be employed with acrylic systems, far and away the most commonly utilized are UV-initiated systems. Silicone adhesive materials can be cured via thermal, ultraviolet (UV) light, or moisture mechanisms, and while each has its advantages, thermal systems are very common.

***Materials Preparation***: To ensure the overall quality of an optical bonding process and the long-term performance of manufactured assemblies, incoming materials must be suitably prepared. Following industry accepted clean room practices is essential to exclude foreign particles that would impact display quality. Typically, bonding operations are maintained in ISO class 1K clean rooms or better. Touch panels, displays, and cover materials should undergo incoming quality inspection and they must be completely cleaned and packaged in clean room appropriate packaging. Pre-conditioning of displays and other components at high temperatures can be employed to eliminate any entrapped moisture. Adhesives should be handled according to manufacturers' specifications and retained in original packaging. Liquid adhesives should be filtered prior to or during dispensing. Liquid adhesives also may contain dissolved gasses or volatile components; therefore, a degassing step prior to dispensing is generally employed.

***Adhesive Application:*** For the vast majority of applications, automated systems are used to dispense or apply adhesives to the bonding surfaces. With systems using liquid adhesives, any of several methods for applying the adhesive are in use today, depending on the application and display size. These methods include dispensing via single or multiple nozzles or various coating processes.

Precise placement of the adhesive, including pattern and volume control, is essential to ensure the desired results (Fig. 2). In some cases, a second high-viscosity adhesive material can be employed to form a support structure for a cover substrate and act as a control for the placement and flow of the adhesive (Fig. 3).

***Bonding:*** Several approaches are used for bonding with liquid adhesives under either atmospheric pressure or vacuum conditions. Either manual or automated methods are employed to precisely place a cover on a display or touch panel and to accurately control adhesive flow, resulting in a consistently uniform bonding gap. Other methods have been developed in which the adhesive is dispensed onto the cover and the cover material is then lowered onto the second surface. Many automated and manual bonding process methodologies have been developed to support

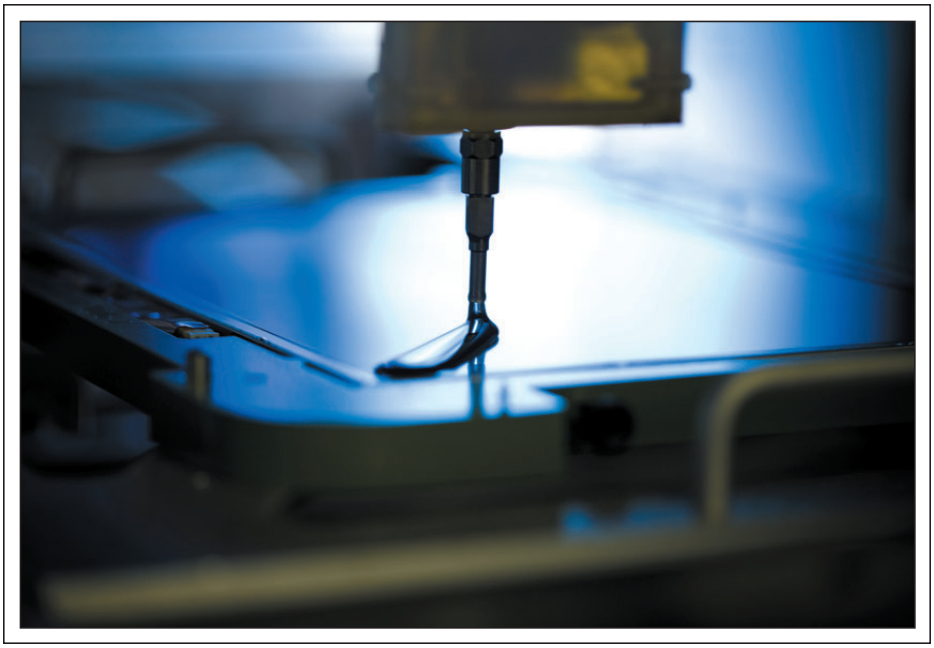

***Fig. 2:*** *Dispensing pattern and quantity are critical for optimum bonding quality.*

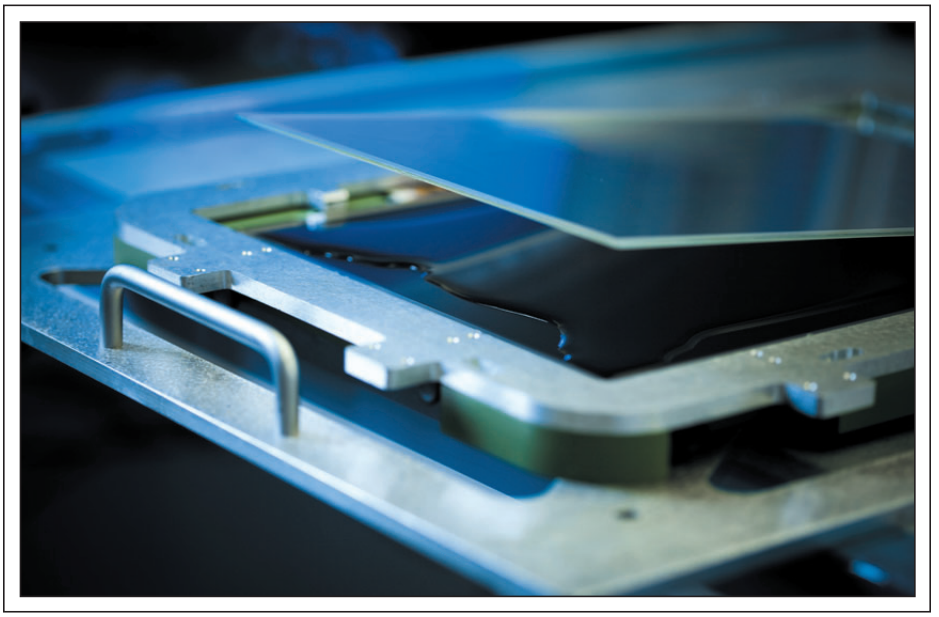

*Fig. 3: Fixtures assist in locating the glass during manual placement. Glass placement and adhesive flow-out properties are important to both automated and manual bonding processes.*

the various devices and applications. Both atmospheric- and vacuum-based bonding equipment can produce the same high-quality results. The type of equipment employed by a particular manufacturer in large part will depend on the preferences of the manufacturer, fabricators' needs, and specific display application.

Both mechanical and optical positioning systems have been developed to ensure the accurate placement of bonding surfaces. Just how accurate the placement must be will depend upon the end-use requirements. Equipment costs and complexities will vary proportionally with placement accuracy. Some optical-bonding systems are capable of accuracies along the X and Y axes as precise as ± 5 μm; however, most applications do not require this degree of precision. Rather, many applications only require precision in the range of ± 100 μm or greater. Similarly, accuracy on the Z axis (thickness) can be very precise across a range of bond gaps for displays that vary in size from small-format mobile devices to large-format TVs.

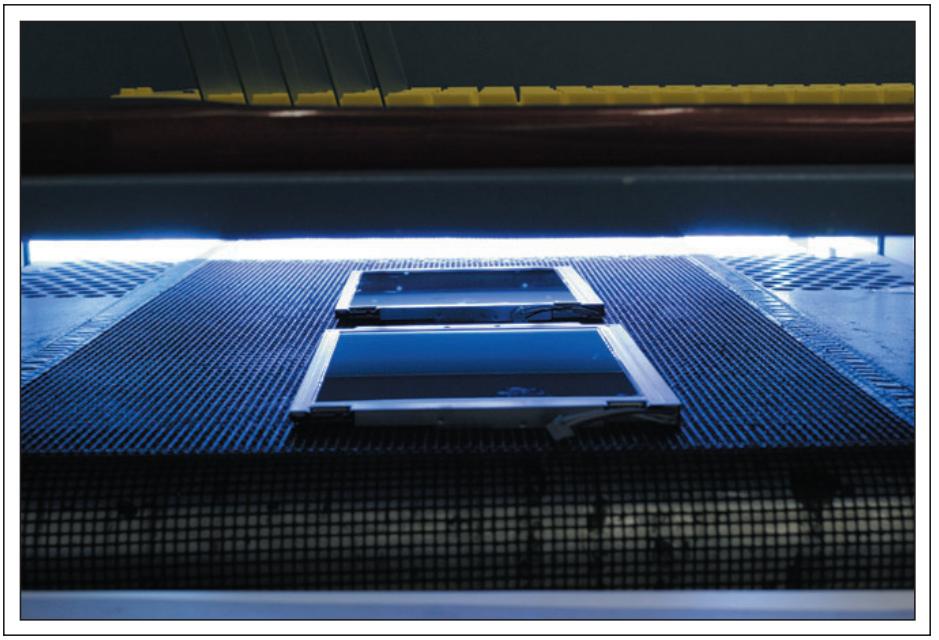

*Fig. 4: Curing parameters including spectral conditions, intensity, and total energy must be optimized to achieve appropriate adhesive properties.*

***Curing:*** The final step in many optical-bonding processes involves curing or crosslinking the adhesive (Fig. 4). Crosslinking is a chemical reaction in which smaller molecular components in the adhesive react and bond together to form a complex large molecule that will provide the desired adhesive and mechanical properties. This curing reaction can be initiated by UV light, heat, or moisture. Since curing is a chemical reaction, it is sensitive to the typical kinetic parameters of reactions, such as temperature, time, concentration of reactive species, and, in the case of UV curing, intensity of the light, spectral composition, and the total actinic energy dose.

Systems that incorporate UV curing have the advantage of full automation and very short total assembly cycle times (TACTs). However, special steps are sometimes needed for designs that include opaque components that may prevent UV transmission. Process expertise and the appropriate bonding techniques can overcome these challenges. Materials employing other curing mechanisms also may be appropriate when UV curing is problematic. These materials typically take longer to complete the curing process and, as a result, they extend total assembly cycle time. With thermal curing, significant care must be taken to properly store and handle the adhesive to prevent unwanted and premature crosslinking.

## Adhesive Property Considerations

In addition to their optical characteristics, mechanical attributes are perhaps the next most essential properties of an optical adhesive. Different material attributes can have a significant impact on the end-use properties when the adhesive is applied to an LCD. Adhesive and cohesive behavior, tensile strength, and the hardness of the adhesive

material are all critical and can significantly impact display performance. Tensile strength and adhesion ensure the durability and ruggedness of the assembled display. While impact and scratch resistance are more a function of the cover substrate than the adhesive, it is generally understood that the hardness of an optical adhesive can impart some shock absorption qualities that contribute to the shock resistance of a display. Hardness and tensile properties also can affect pressure-induced defects such as glow marks and pooling, which are manifested as discoloration in the image when external pressure alters the liquid-crystal path length. A properly formulated adhesive can minimize or eliminate these effects and others, such as light leakage, which occurs when backlight escapes around the edges of a display.

Moreover, liquid adhesives have a range of viscosities, and the viscosity of a particular adhesive will affect certain bonding process parameters such as dispensing, flow-out (wetting), and degassing properties. These will impact overall process TACT, quality, and ease of use.

Vacuum bonding equipment places another set of requirements on both adhesives and displays. Low pressure can cause the components in some adhesive formulations to volatilize, which could bring about bubbling, splattering, and weight loss during bonding, which in turn can have an adverse effect on bonding quality and overall manufacturability. Aligning the spectral sensitivity of the photoinitiators of UV-curable adhesives with the light source and the light sensitivity of an adhesive is also critical to a successful material curing.

## Product-Design Considerations

Of course, the design requirements of the product that an optically bonded display will end up in must be considered. For example, the structural integrity of some products relies upon the strength of a bonded display. The optically bonded display becomes a key structural part of the entire device. In addition, the zero-bezel look of products such as certain smart phones and tablet PCs is only possible by optically bonding cover glass to a pro-cap touch panel. Design freedoms like these are not possible without optical bonding.

Another important consideration dictated by the nature of the product is the possible need for rework or repair. Nothing is indestructible and consumer devices are often dropped or accidentally left in places where they can be damaged. The characteristics of an adhesive can determine how easily the components in an optically bonded display can be separated, cleaned, and either repaired or replaced should the product be damaged in use. Other factors play into the "reworkability" of a bonded display, such as the thickness of the adhesive layer between the substrates, the size of the display, and the extent to which the display supports the structural integrity of the device. Recently, rework techniques have improved significantly, to the point where the repair success rate can reach as high as 95%. Although reducing warranty repair and service-related costs has been the chief impetus behind these improvements, more effective rework processes also can improve production yields.

Additional challenges will arise should the product design call for optically bonding a cover substrate on top of a touch panel. The performance of the touch panel must be a critical consideration and a layer of adhesive can act as an insulating dielectric that might impede the projection of capacitive electrical fields in a pro-cap panel. As a result, the characteristics of the adhesive, the thickness of its application in the finished product, and the flatness of the substrate surfaces are critical to the performance of the touch panel. Understanding the tensile strength of an adhesive as well as its structural limitations also is very important to achieving a robust mechanical assembly that can be durable and rugged. Ultimately, even complex three-dimensional injection-molded cover substrates can be optically bonded to touch panels and displays, but a certain level of expertise and understanding of the materials and processes is required.

## All Together Now

Optical bonding has changed over the last few years, and the results have been a dramatic increase in adoption and demand for the process in the marketplace. A broader range of materials, including adhesives and substrates, as well as new, more sophisticated automated-bonding-process technologies, are spurring rapid growth into new applications and new types of products that have previously not benefited from optically bonded displays and touch panels. ■


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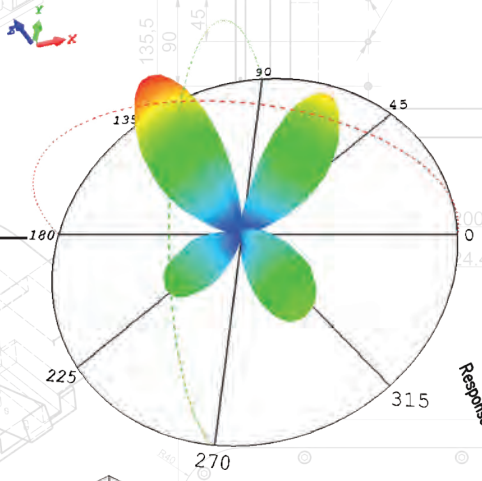


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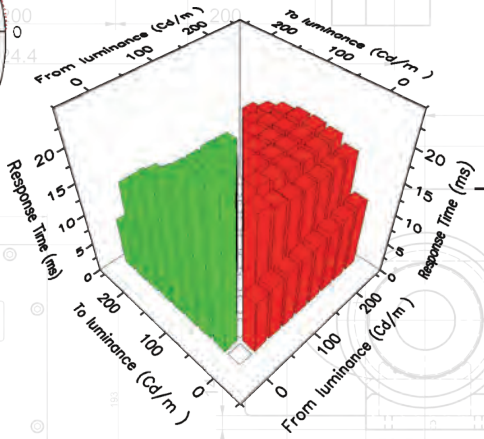


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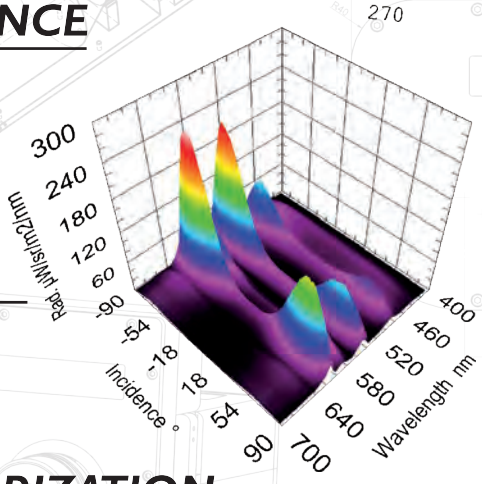


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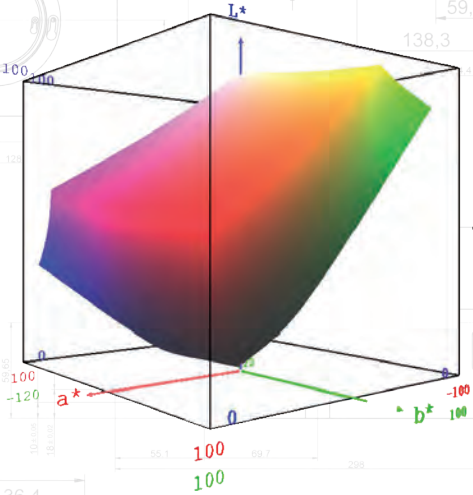


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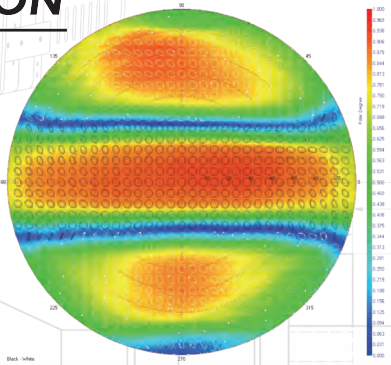

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ELDIM

# Products on Display at Display Week 2011

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

## by The Editorial Staff

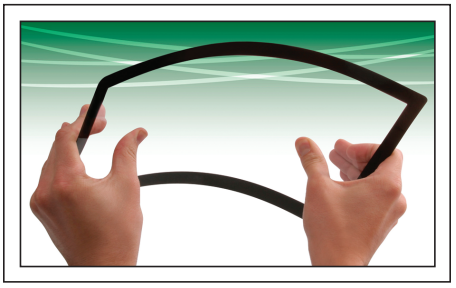
THE SID 2011 International Symposium, Seminar, and Exhibition (Display Week 2011) will be held at the Los Angeles Convention Center in Los Angeles, California, the week of May 15. For 3 days, May 17–19, leading manufacturers will present the latest displays, display components, and display systems. To present a preview of the show, we invited the exhibitors to highlight their offerings. The following is based on their responses.

### ABRISA TECHNOLOGIES

Santa Paula, CA 877/622-7472
www.abrisatechnologies.com
Booth 1206

**Chemically Strengthened Thin Glass**

Abrisa Technologies has chemically strengthened thin glass per ASTM 1422 processing and ASTM C 158 testing. This process does not affect the optical quality of the glass, making it an ideal solution for display-panel and touch-screen applications. The process can make glass up to 8 times stronger than annealed float glass. This strengthening process works well for soda-lime glass or other thin glass having a high sodium oxide content and a thickness of less than 3 mm and can be performed on glass substrates of up to 28 × 36 in. Strengthened glass improves transmission, provides greater impact strength, is scratch and abrasion resistance, and increases bending strength and temperature stability.

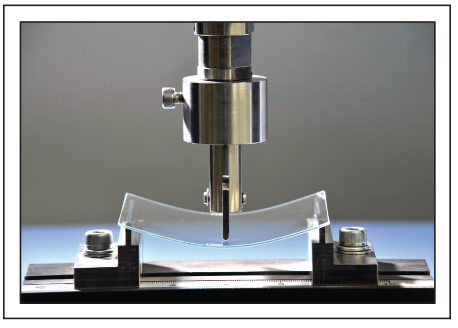


### AGC ASAHI GLASS

Tokyo, Japan +81-3-3218-5370
www.agc.co.jp
Booth 506

**Chemically Strengthened Specialized Glass**

Chemically strengthened Dragontrail is six times stronger than conventional soda-lime glass, highly resistant to scratches, and features a beautiful pristine finish compared with resin. Dragontrail, developed from market-proven raw glass for chemical strengthening, is free of environmentally harmful materials such as arsenic, lead, and antimony. AGC uses a highly efficient float process to manufacture Dragontrail by utilizing the company's extensive technical expertise in producing specialized glass for electronics acquired through manufacturing TFT glass substrates. The superior production efficiency of this manufacturing process ensures a stable supply of cover glass for the growing global mobile-device market.

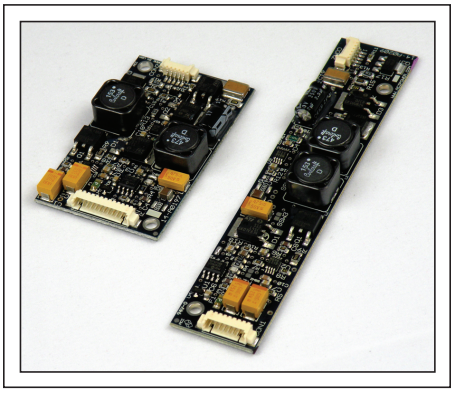


### APPLIED CONCEPTS

Tully, NY 315/696-6676
www.adhesivesresearch.com
Booth 1331

**Advanced LED Drivers**

Applied Concepts, Inc., (ACI) introduces advanced LED driver features for its full line of I-Drive™ LED drivers, offered both for ACI's Radiance™ Sunlight-Readable Displays as well for OEM LED-backlit LCDs. This cutting-edge technology showcases the following capabilities: (1) User downloadable features allow customizations of LED driver software including dimming curves (linear or logarithmic), button *vs.* analog dimming control, and ambient light sensing. (2) Black-box data storage of voltage and current, LED driver temperature, configuration code, and hours of operation for diagnostic and failure-mode analysis. Mixed-mode dimming (amplitude/PWM) supports ultra-wide dimming requirements (50,000:1).



### BERGQUIST COMPANY

Chanhassen, MN 1-800-949-4021
www.bergquistcompany.com
Booth 1634

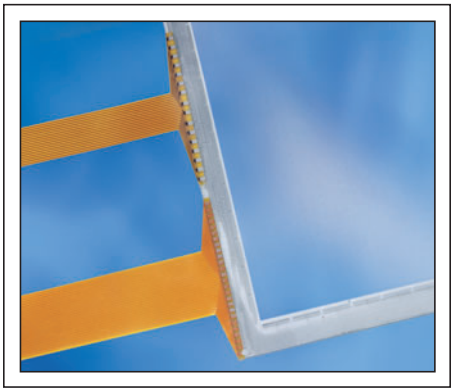
**Multi-Touch Technology**

Bergquist has ruggedized multi-touch for military and harsh-environment applications. Adding multi-touch technology to ruggedized applications increases usability. Bergquist offers not only great durability that meets MIL and IP requirements, but also the flexibility to choose underlying touch technology. Bergquist is a full solutions touch-screen



0362-0972/05/2011-034$1.00 + .00 © SID 2011

provider, with options including EMI, polarizer, optical bonding, and many more. Bergquist products are domestically designed, built, and supported.

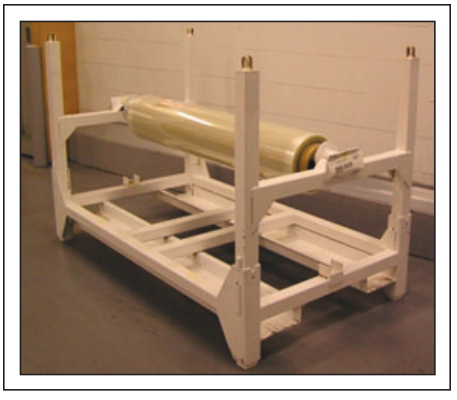


## CARESTREAM ADVANCED MATERIALS

Oakdale, MN 651/393-1106
www.carestream.com
Booth 1427

**Transparent Conductive Film**

Electronic-display manufacturers searching for ITO alternatives can look no further than the new FLEXX product line which addresses flexibility, durability, and affordability issues associated with ITO films. By employing precision roll-to-roll coating, FLEXX features a patented silver nanowire technology allowing exceptional conductance and superior optical performance. FLEXX is offered at 100 and 300 Ω/□ with optional hardcoat, FLEXX target touch panels, OLED lighting, and flexible displays. FLEXX overcomes the drawbacks of ITO including brittleness, high cost, low durability, and price/supply swings. In touch-panel processing, it allows shortened annealing times, with etching using standard wet and dry methods on existing equipment.



## CHROMA USA

Irvine, CA 949/421-0355
www.chromaus.com
Booth 746

**3-D Pattern Generator**

The Chroma 22294 3-D pattern generator is a 3-D multi-functional generator that complies with HDMI v1.4 standards for 3-D testing applications. It has high-resolution test quality and three HDMI output support that meets the test requirements for multimedia display industries such as LCD monitors, LCD TVs, PDPs, and projectors for today and in the future.

## CORNING INCORPORATED

Corning, NY 607/974-7557
www.corning.com
Booth 825

**Damage-Resistant Cover Glass**

Corning Gorilla® Glass is a damage-resistant cover glass that protects today's most sophisticated electronic devices from the scratches, drops, and bumps of everyday use. Elegant and lightweight, Gorilla Glass is durable enough to resist many real-world events that commonly cause glass failure, enabling exciting new applications in technology and design. Exceptionally thin, Gorilla Glass enables high sensitivity and accurate responses for the most sophisticated touch technology. And it is tough enough to handle the ongoing contact intrinsic to these devices. Corning Gorilla Glass is currently featured on hundreds of smart phones, tablets, PCs, and TVs.


## CYPRESS SEMICONDUCTOR

San Jose, CA 510/290-0807
www.cypress.com
Booth 1129

**Projected-Capacitive Touch Screen**

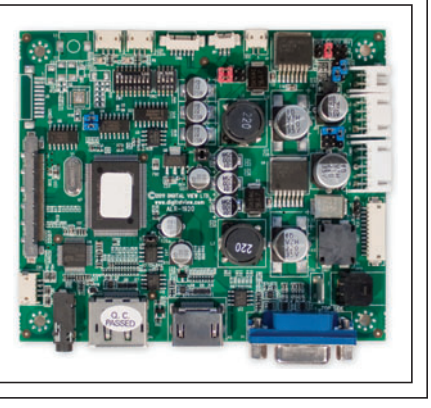
Cypress Semiconductor, a leader in capacitive touch sensing, is revolutionizing the touch-screen market with TrueTouch™ projected-capacitive solutions for screens up to 14 in. Powered by Cypress's PSoC® technology, TrueTouch offers unmatched flexibility and reliability, low power consumption, and legendary noise immunity as well as last-minute design flexibility. TrueTouch precisely tracks more than 10 fingers on a screen simultaneously, supporting all forms of gestures and innovative gaming functions. It also supports advanced technologies including hover, stylus, and proximity detection along with water rejection. Cypress design wins include products from Acer, Samsung, Fujitsu, HTC, Garmin, HP, and many more.

## DIGITAL VIEW

Morgan Hill, CA 408/782-7773
www.digitalview.com
Booth 961

**LCD Controllers**

The new ALR-1920 is the latest model in the ALR series of compact, multi-purpose LCD controllers by Digital View. It provides three market-leading video interfaces: VGA, HMDI, and DisplayPort and will support LCD panels from VGA (640 × 480) up to WUXGA (1920 × 1200) resolution. It is compatible with over 700 LCD panels from all major manufacturers. Audio support is provided for HDMI, DisplayPort, and (optional) Digital View HD/3G-SDI interfaces. The ALR-1920 accepts either 12- or 24-input and offers full control via RS-232. Digital Views proven controller technology ensures high reliability with an MTBF rating > 200,000 hours and a 3-year warranty.

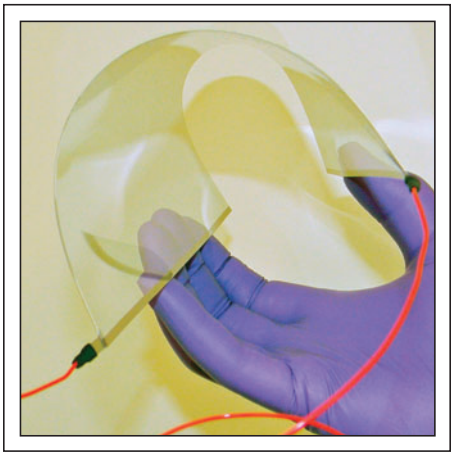


## DONTECH, INC.

Doylestown, PA 215/348-5010
www.dontech.com
Booth 1045

**Transparent Heaters**

Dontech's Therma Klear Flex™ Series of thin flexible transparent heaters extend the lower thermal range of LCDs, touch screens, optical sensors, and camera windows used in outdoor, military, or avionic applications. They are used for anti-fog and anti-icing applications. Therma Klear Flex™ heaters are constructed utilizing Dontech's VC Series visually transparent conductive coatings applied to flexible optical-grade polyester. The conductive coatings are single- or multiple-layered sputtered thin-film coatings with a resistance from 5 to 200 Ω/□. The heaters are typically 0.007 in. thick, and with dielectric enhancements the light transmission of Therma Klear Flex™ heaters can exceed 90%.



## DUPONT DISPLAYS

Research Triangle Park, NC 919/248-5707
www.usa.dupont.com
Booth 1135

**OLED materials**

DuPont Displays has developed a full set of OLED materials and solution-processing technology to enable cost-effective manufacturing of OLED displays. The photo shows a 4.3-in.-diagonal 128-ppi display that is being featured at Display Week. It was made by nozzle printing using DuPont OLED materials.

VISIT
INFORMATION
DISPLAY ON-LINE
www.informationdisplay.org

## E INK CORP.

Cambridge, MA 617/499-6000
www.eink.com
Booth 727

**Sunlight-Readable Color eReaders**

E Ink Triton™ enables color ePaper solutions, enhancing the visual experience for ePublishing markets such as eBooks, eNewspapers, eMagazines, and eTextbooks. Triton delivers enhanced readability, improved speed, and the lowest power of any reflective display on the market. In addition to 16 levels of gray scale, Triton is capable of displaying thousands of colors. And just like E Ink's gray-scale ePaper products, Triton's crisp text and detailed color graphics are fully viewable in direct sunlight.


## EMERGING DISPLAY TECHNOLOGIES (EDT)

Burlington, MA 781/425-5260
www.edtc.com
Booth 1205

**PolyTouch™ Capacitive Touch Series**

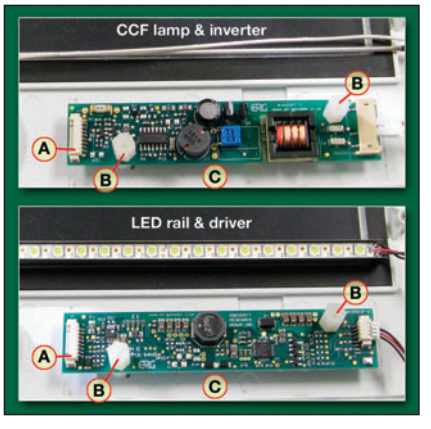
As the demand for advanced user interfaces continues to evolve, EDT is proud to present its newest innovation in capacitive touch technologies. EDT is introducing the EDT PolyTouch™ capacitive touch solution, an alternative to touch sensory design that is both easy to implement and highly reliable. Unlike conventional resistive panels, EDT PolyTouch™ technology utilizes unique structural design that omits the need for sensory film, allowing a much more durable composition and wider operating environments.

## ENDICOTT RESEARCH GROUP (ERG)

Endicott, NY 607/754-9187
www.ergpower.com
Booth 1319

**LED Drivers**

Display-power-supply specialist Endicott Research Group (ERG) has developed new LED driver package configurations that offer footprint compatibility with existing CCFL inverter designs. The new DR series is designed in the same form factor as DC–AC inverters already in the field. These drop-in replacements allow for a fast, easy upgrade to LED lighting without re-designing or re-tooling the mounting hardware. The LED drivers are pin-for-pin compatible with the inverters and have the same length and width dimensions as their counterparts, as well as matching input connects and mounting holes.



## ENTERTAINMENT EXPERIENCE

Reno, NV 415/279-8293
www.eecdor.com
Booth 1539

**3D Color Video Processor**

eeColor™ is the world's first and only 3D multi-dimensional color video technology with the capability of full modeling of color space, device characteristics, viewing environment, visual perception, and adaptation. This patent-pending technology is available in the HDMI plug-and-play TruVue eeColor Processor. Over the past decade, technology and image rendering has progressed for televisions and video displays. However, digital color standards have not changed since the 1970s and color quality has remained unchanged. The color gamut of most modern devices extends beyond these current standards. The TruVue eeColor Processor takes advantage of that increased color capability to improve the viewing experience for any display.

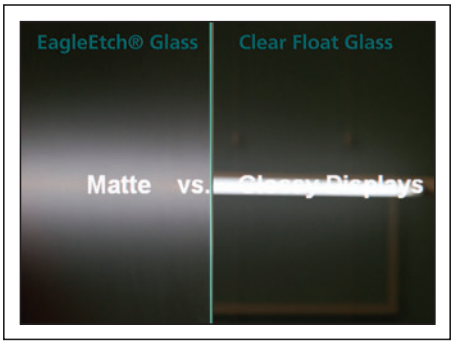
## EUROPTEC USA

Clarksburg, WV 216/447-8498
www.europtec.com
Booth 741

**Anti-glare glass**

EuropTec will feature EagleEtch® and EagleEtch Plus™ anti-glare glass. The subtractive etching process makes the glass ideal for high-resolution applications in adverse conditions that require the best in anti-glare properties, low sparkle, low haze, and improved clarity. EagleEtch® glass is unmatched for tight gloss control, ultra-high resolution, consistency of the etched surface, and very low sparkle. Unlike coatings or spray-on solutions, EagleEtch® offers durability in the harshest environments. EagleEtch Plus™ includes an anti-reflective coating giving the glass the lowest possible reflection and light diffusion.

**For Industry News, New Products, Forthcoming Articles, and Continually Updated Conference Calendar, see www.sid.org**




## F-ORIGIN, INC.

Morrisville, NC 919/455-3175
www.f-origin.com
Booth 1057

**Force-Based Touch Technology**

F-Origin is the developer of the "force-based" proprietary touch technology zTouch™ which not only registers touch coordinates but also the added input dimension force amplitude. zTouch™ employs virtually any type of rigid input and lens material for unequalled system-design flexibility, robustness, and reliability. Other benefits of zTouch™ include its ability to register touches from any item, for even more flexibility. This makes zTouch™ ideal for applications that require wear-resistance and any touch input, such as medical systems, appliances, ATMs, kiosks, POS/POI units, *etc*.

## FUJIFILM DIMATIX, INC.

Santa Clara, CA 408/565-0670
www.dimatix.com
Booth 1241

**Ink-Jet Deposition System**

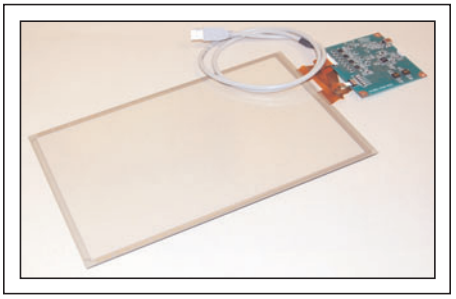
FUJIFILM Dimatix has developed an R&D printer, the DMP-3000, to complement its existing DMP-2831 to aid industrial and university laboratories in making breakthroughs in materials science for display fabrication techniques using solution chemistry and ink-jet printing. Successfully meeting major design specifications, the DMP-3000 is an ink-jet deposition system that is capable of printing a wide range of inorganic, organic, and hybrid functional fluids from both experimental cartridge-based printheads with small volumes and high-performance printheads appropriate for industrial and high-throughput applications. It is easy-to-use which allows new products to enter the market more rapidly for displays, wearable electronics, and flexible circuits.


## FUJITSU COMPONENTS AMERICA

Sunnyvale, CA 408/745-4900
www.fcai.fujitsu.com
Booth 942

**Windows-7-Certified Resistive Multi-Input Touch Panels**

The FID1530 is the only Windows-7-certified, resistive, multi-input touch panel series available as a standard product. These touch panels register single-tap, multi-touch input (pinch, pull, rotate, flick, swipe, and scroll gestures) and handwriting, using any object, such as a gloved or bare finger, pen cap, or the corner of a credit card. They feature high accuracy, fast tracking, consistent inking, low-power consumption, and are available with a light-touch force option. A single-axis compact flex tail simplifies mechanical design, offers improved reliability, and reduces potential EMI and ESD effects.

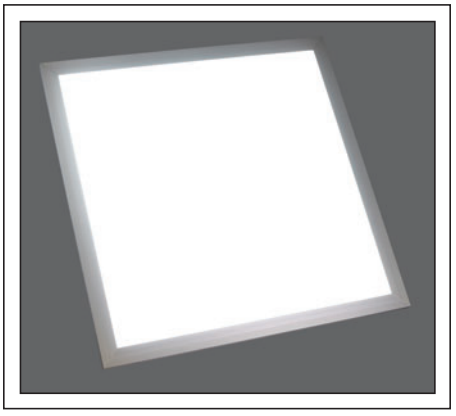


## GLOBAL LIGHTING TECHNOLOGIES (GLT)

Brecksville, OH 440/922-4584
www.glthome.com
Booth 1413

**Highly Efficient LED-Based Edge Lighting**

GLT offers highly efficient LED-based edge lighting technology, providing the slimmest, most efficient and cost-effective backlighting and general illumination solutions available. GLT's unique light-extraction features and high-volume, cost-efficient manufacturing processes at four locations worldwide create extremely thin, highly efficient light guides that can be custom designed for a wide variety of applications and sizes.



## GM NAMEPLATE, INC.

Seattle, WA 206/301-1178
www.gmnaneplate.com
Booth 858

**Optical Bonding**

The part pictured in the photo is for an agriculture-industry customer who needed a unit suitable for harsh conditions. The unit includes a 5-wire resistive touch screen, a 10.4-in. TFT-LCD, and molded and painted bezels. GM Nameplate provides the complete interface – assembled, tested, and ready for installation. Custom automated inspection capability was developed to test the unit after optical bonding, as the unit can be salvaged and reworked. Optical bonding enhances impact resistance, improves sunlight readability, clarity, contrast ratio and condensation resistance.

## GOOCH & HOUSEGO

Orlando, FL 407/422-3171
www.goochandhousego.com
Booth 1300

**Night-Vision-Display Test and Measurement System**

The OL 770-NVS night-vision display test and measurement system offers a complete solution for the measurement of NVG-compatible lighting and displays. The system features multi-channel detection for ultra-fast measurements while exceeding all MIL-L-85762A Appendix B requirements. It is portable and lightweight and offers a choice of measurement modes. The software is capable of all calculations currently required and is easily extended to new requirements. Seamless integration with Microsoft Excel and Word provides powerful extensions to data collecting and reporting. The Windows 2000/XP compatible software allows for turnkey automated operation.

SAVE THIS DATE!!
June 3–8, 2012 Boston, MA, USA
Display Week 2012

## HALATION TECHNOLOGY CO.

Jiangsu, P.R. China +86-512-6956 x1804
www.halation.com
Booth 1615

**Electronic shelf labels**

Halation ESL has developed Whiteon™ technology, which replaces the paper price tags used in the retail industry, featuring black and white paper-like reading performance; no power consumption to keep static information; high reflectivity without the use of a polarizer or backlighting; and a dot-matrix display that is easy for showing 1D or 2D barcodes, any fonts, flexible design of display composition, etc; flexible custom design in resolution and pixel size; easy to integrate into current in-store marketing solutions; wireless compatibility; and long life.


## INSTEC, INC.

Boulder, CO 303/444-4608
www.instec.com
Booth 1405

**Liquid-Crystal Tester**

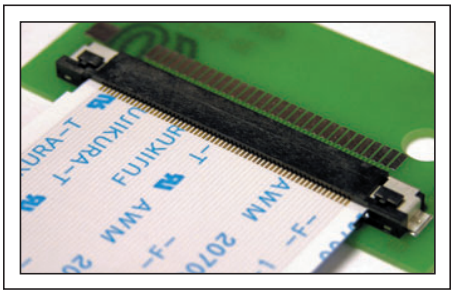
Instec's ALCT Automatic Liquid Crystal Tester (ALCT) measures a wide range of parameters for LCDs or LC materials, including ion impurities, VHR, RDC, resistivity, rotational viscosity, elastic constants, dielectric constants, turn-on and turn-off response time, $V$–$T$ curves, and $\Delta n$. The ALCT 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 744

**Shielded one-piece connector**

EvaFlex5 is currently used in the mass production of new television sets as a high-data-rate (graphics) transmission bridge because the solution provides the best transmission performance for the lowest cost. Historically, a two-piece connector solution was necessary, whereas EvaFlex5 (41p and 51p) is a shielded one-piece connector solution which is a valuable cost reduction, and the PCB footprint pattern is compatible with the JAE-type FI-RE or the I-PEX Cableline-TL connectors.



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**www.informationdisplay.org**

## IRTOUCH SYSTEMS CO., LTD.

Santa Clara, CA 650/585-2195
www.irtouchusa
Booth 952

**IR Touch Screens**

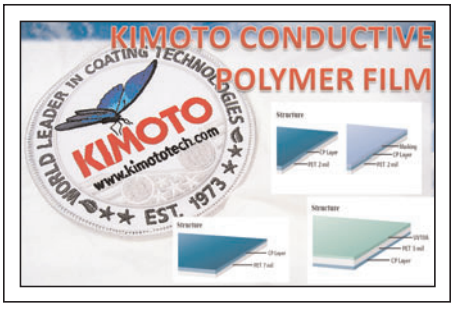
IRTOUCH Systems will showcase their infrared touch-screen product series with newly introduced design capabilities including gesture support and solar-immunity enhancement for outdoor applications. The slim-profile infrared touch screens can be easily integrated into LCDs with sizes ranging from 6.4 to over 120 in. The robust infrared touch-screen technology offers high resolution with superior optical clarity, scratch-free, drift-free, shock-resistance touch solutions. It is ideal for rugged and demanding environments. These touch screens allow glove/hand/any object activation and generally yield much longer product lifetime. The infrared touch offers ideal support for POS, ATM, industrial control, kiosks, digital signage, medical, gaming, in-vehicle displays, and marine or aerospace applications.


## KIMOTO TECH, INC.

Carson, CA 310/522-5911
www.kimototech.com
Booth 1503

**Conductive Polymer Coating**

Kimoto Tech is proud to introduce a conductive polymer coating to its line of custom coating options. Conductive film has been developed for applications requiring a combination of lower conductive resistivity, good water resistivity, and superior flex life, such as for flexible-display applications. Kimoto's surface engineering technology adds benefits to flexible conductive film such as consistent glossy/anti-glare surface, hard coated/scratch resistant surface, and attractive appearance.

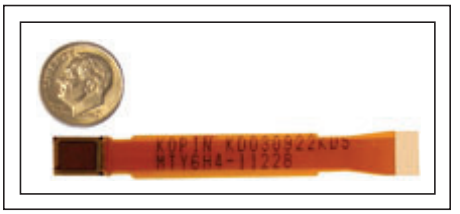



## KOPIN CORP.

Westborough, MA 508/870-5959
www.kopin.com
Booth 1502

**Smallest VGA Display**

Kopin's new CyberDisplay® VGA LCD, with a 0.26-in.-diagonal image area, is the smallest color VGA display (640 × 480 resolution) in the LCD industry. Compared with Kopin's commercially available VGA display (0.44-in.-diagonal and consuming ~100 mW), the new VGA LCD has a 65% smaller area and consumes less than 10 mW of power. The CyberDisplay VGA LCD exhibits remarkably sharp color images and is targeted for video eyewear and viewfinder applications.



## KUGLER OF AMERICA, LTD.

Somers, CT 860/749-6400
www.kugler-precision.com
Booth 1259

**Optical and Micromaching Systems**

Kugler will feature optical and micromachining systems that combine optical, micromechanical, and laser micromachining tools, including fly-cutters for optical and structured surfaces in master templates and drum-turning tools for structured optical foil replication. Kugler's five-axis milling center provides micromachining of suitable metals, resulting in high optical surface quality. MICROGANTRY® or MICROMASTER® machine tools used for aerostatic or hydrostatic bearing concepts are offered in several configurations. Large-surface-area optical fly-cutting and micro-structuring of optical surfaces using micromachine tools or a laser can be performed by using Kugler micromachining systems.

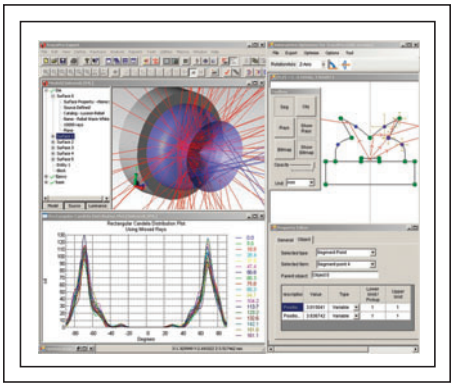

## LAMBDA RESEARCH CORP.

Littleton, MA 978/486-0766
www.lambdares.com
Booth 1201

**3-D Opto-Mechanical Software**

Lambda Research Corp. provides optical and illumination design software and hardware. The TracePro® 3D opto-mechanical software is differentiated by its ease of use, CAD interface, and accuracy in illumination design. The TracePro Bridge™ is a fully integrated seamless add-on for Solidworks. Lambda also distributes the ScatterMaster ScatterScope3D™ scatterometer for fast and accu-

rate surface measurement and the Opsira line of metrology systems for both display and LED measurement, including goniometers and luminaire test systems.

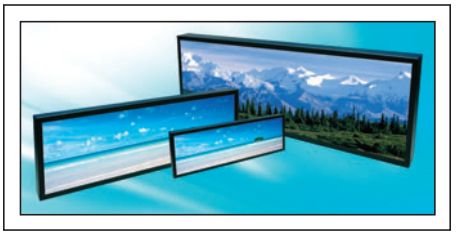


## LITEMAX ELECTRONICS, INC.

New Taipei, Taiwan +31-4025-90100
www.litemax.com
Booth 1535

**Digital Signage Displays**

Litemax will feature the SPANPIXEL series of digital-signage displays having specific ratios for digital-signage applications. The series features new LED-backlit LCD panels with specific aspect ratios. The displays come in sizes from 15 to 39 in. on the diagonal and are sunlight readable. SPANPIXEL displays can display high-quality video with efficient power when incorporated with the AD control board and are used in public transportation systems, exhibition halls, department stores, and vending machines

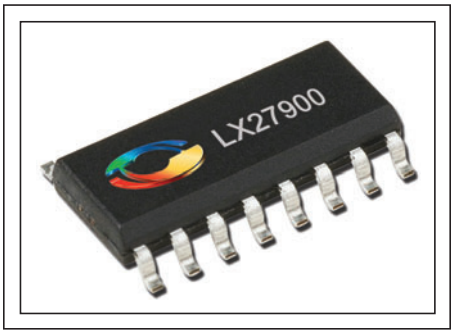


## MICROSEMI CORP.

Garden Grove, CA 714/898-8121
www.microsemi.com
Booth 801

**High-Performance LED Backlight Driver**

Microsemi's new LX27900 global dimming LED backlight driver delivers a 7–9% improvement in backlight efficiency versus conventional current-source-based backlight drivers. By applying a reactive balancing technique first pioneered by Microsemi for CCFL backlighting, the LX27900 greatly improves efficiency by allowing non-dissipative current balancing between strings. By eliminating the need for an intermediate DC-DC regulator, the LX27900 allows further improvements in efficiency. The LX27900 also brings to market a new innovative non-dissipative dimming technology that has the added advantage of precise dimming at low brightness levels.

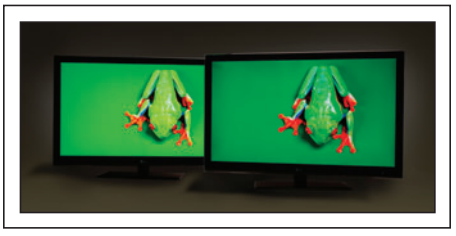



## NANOSYS

Palo Alto, CA 650/331-2100
www.nanosysinc.com
Booth 759

**Quantum-Dot Technology**

Nanosys will feature their quantum-dot technology that creates a visual experience that is truer to reality by enabling LCDs to display about 50% more color than they can today. This means richer, more viscerally alive reds, a deeper palette of greens (the color the human eye literally sees more than any other color), and vivid blues.



## NICROTEK CO., LTD.

Jiangsu, China +86-512-6289-6551
www.nicrotek.com
Booth 1528

**Notebook Keyboard Backlight**

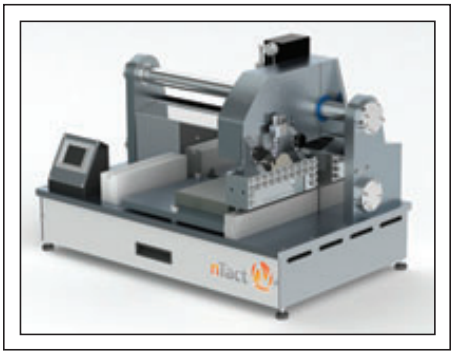
Nicrotek will demonstrate illuminated keyboards for notebooks and netbooks in smaller and thinner shapes. Features include a slim light-guide plate (0.18T, 0.25T, 0.4T), large size, and rolling fabrication (for high efficiency).

## nTACT/FAS

Dallas, TX 214/343-5300
www.fas.com
Booth 1242

**Slot-Die Coating System**

nTact will feature nRad, a small, low-cost, slot-die coating system 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 system is compatible with most standard glove boxes and laboratory benchtops in a standard configuration for processing 150- and 200-mm square substrates, with options for 150- and 200-mm wafers or panels up to A4 (210 × 300 mm) size.

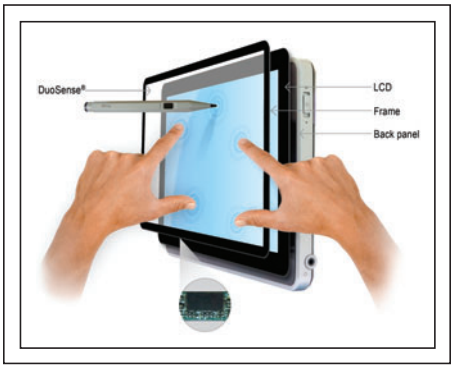


## N-TRIG

Kfar Saba IL, Israel +972-9-799-616
www.n-trig.com
Booth 1507

**Digitizers**

The N-trig DuoSense® solution provides a combined pen and true multi-touch interface that is changing how we interact with our computing devices. DuoSense multi-touch capabilities enables the manipulation of items directly on the screen for up to four fingers and together with the pen functionality enables easy and efficient annotation. N-trig sets the stage for OEMs and ISVs to introduce new computer products and applications for an intuitive Hands-on® experience. DuoSense digitizers are easily integrated into existing technologies for all LCDs, and keep devices slim and light.




## OCULAR LCD, INC.

Dallas, TX 972/437-3888
www.ocularlcd.com
Booth 955

**Multi-Touch Projected-Capacitive Touch Panels**

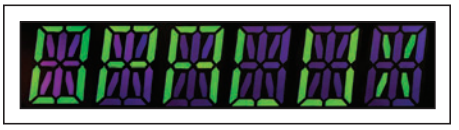
Ocular's Crystal Touch:Multi-Touch projected-capacitive touch panels give system designers the ability to combine the vibrant optical quality of a TFT display, the robust functionality of a true multi-touch panel, and the extreme durability of projected-capacitive technology required by demanding embedded applications. By utilizing Atmel maXTouch™ solutions, Crystal Touch:Multi-Touch allows for up to 10 simultaneous touch points, and the sophistication of maXTouch™ technology creates a smart interface that can ignore unintended touches. Crystal Touch:Multi-Touch panels are available in multiple sizes, give products a leading-edge look, and provide an ultra-rugged touch panel that can be used in a wide variety of applications.

## OPALUX, INC.

Toronto, Ontario, Canada 416/978-6722
www.opalux.com
Booth 1548

**P-Ink Alphanumeric Display Devices**

Opalux will feature alphanumeric P-Ink display devices. The device shown in the accompanying photograph is sequentially switched to spell out "OPALUX" as shown under ambient office lighting conditions. The precisely defined green color of the switched areas was achieved by applying a controlled voltage to specific pixels. As can be seen, reflective colors are extremely bright and uniform.



## OPTICAL FILTERS USA

Meadville, PA 814/333-2222
www.opticalfiltersusa.co.uk
Booth 1305

**Non-Birefringent MicroMesh**

Optical Filters has expanded its range of EmiClare optical shielding products to include a non-birefringent MicroMesh for the electro-magnetic 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.

## OPTREX AMERICA, INC.

Plymouth, MI 734/416-8500
www.optrexusa
Booth 1435

**Automotive Displays**

Optrex recently introduced Advanced Black Nematic (ABN) technology to the industrial marketplace. ABN was originally developed by Optrex to compete with vacuum-florescent-display (VFD) technology in automotive applications. It delivers superior performance over VFD with a true black background. This is accomplished by dramatically reducing light leakage. The result is very high contrast ratios up to 1000:1, super wide viewing angles, and minimal color shift. The first standard ABN product – C-55605GNFU-LW-AAN – is a $20 \times 2$ character display with 600 cd/m$^2$ brightness, a contrast ratio of 550:1, and standard 8-bit parallel interface.


## PHOTO RESEARCH

Chatsworth, CA 818/725-9750 x175
www.photoresearch.com
Booth 901

**Spectroradiometer**

With eight measuring apertures, $1 \times 10^{-6}$-fL luminance sensitivity, variable bandwidth (automated selection between 2, 4 and 8 nm), virtually non-existent polarization error (< 0.2%), 512 thermo-electrically cooled detectors, and over 67 years of expertise, 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.

## QUADRANGLE

Englishtown, NJ 732/792-1234
www.quadrangleproducts.com
Booth 1160

**LVDS Cable Assemblies**

Low-Voltage Differential Signaling (LVDS) has become a cornerstone in the digital-signage world. LVDS can be transmitted over distances ranging from a few inches up to several meters. Quadrangle Products has built a reputation for supporting customers with the prototyping stages of a design and continuing that support when a project reaches production. Quadrangle's engineering team will help to ensure that each cable design is best suited for each customer's unique application. Quadrangle also supports high-voltage backlight, inverter, FFC, FPC, and other various types of custom cables.

SAVE THIS DATE!!
June 3–8, 2012 Boston, MA, USA
Display Week 2012

## SAMSUNG ELECTRONICS CO., LTD.

San Jose, CA 408/544-4212
www.ssi.samsung.com
Booth 707

**A 7.9-mm-thick 55-in. 240-Hz FHD LED 3D TV**

Samsung is one of the first to bring 3D, cinema-like quality viewing into the home. The unit is 55 in. on the diagonal and 7.9 mm thick, Samsung's 3D active glasses sync up with the TV display so that TV shows can be transformed to 3D in real time for the ultimate in "reality" TV. The state-of-the-art display offers 1920 × 1080 full-high-definition resolution (1080 horizontal lines) that creates exceptionally sharp details and crystal-clear, smooth motion for the brightest, boldest colors, and most realistic picture available.

## SAN TECHNOLOGY

San Diego, CA 858/278-7300
www.santekus.com
Booth 855

**Ultra-bright sunlight-readable TFT-LCD modules**

San Technology (Santek) will feature ultra-bright (sunlight-readable) TFT-LCD modules which utilize super-bright LED backlights and are readable under direct sunlight. Solving the issues concerning brightness and glare are two major factors because the sunlight absorbs much of the illumination from the backlight, and the contrast ratio is drastically lowered due to surface reflection. Santek's ultra-bright LCDs are ideal for use in any high-ambient-light condition and will provide the required intensity and brilliance.

## SARTOMER USA, LLC

Exton, PA 610/363-4195
www.sartomer/com
Booth 948

**Curable resins**

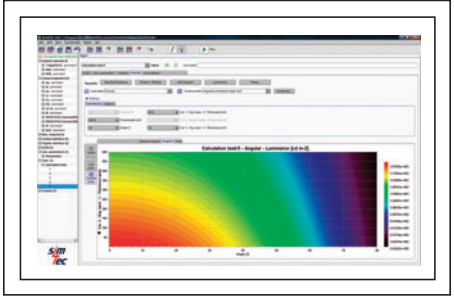
The CN4000 series oleophobic exterior-grade ultraviolet and electron-beam-energy curable resins provide excellent protection for polyester, polycarbonate, and acrylic films. Accelerated weathering testing proves the materials can take the abuse of a wide range of climates for top coating highly transparent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

## sim4tec GmbH

Dresden, Germany +49-(0)-51-4466-499
www.sim4tec.com
German Pavilion, Booth 1019

**OLED simulation software**

sim4tec will introduce a brand new version of its OLED simulation software SimOLED®. It includes the module SimOLED® FITTING, a revolution in enabling electrical simulation. Organic material parameters such as HOMO, LUMO, and mobilities are of paramount importance for a compelling electrical OLED simulation. sim4tec is offering, for the first time, an innovative automated fitting software to generate physical organic material parameters based on simple experimental data such as *I–V* curves. In conjunction with the well-proven optical and electrical SimOLED modules, almost any OLED characteristics can be simulated.



## SMK ELECTRONICS CO.

Chula Vista, CA 619/216-6477
Booth 1449

**Capacitive Touch Panel for Automotive Applications**

SMK will introduce its latest projected-capacitive touch panel that meets the demand for multi-touch operations with a fully flat structure for automotive navigation systems and consoles. Features include meeting automotive high-heat operating and storage temperature requirements; a reflectance as low as 1.5% for improved visibility under direct sunlight; zero-force input for easy scrolling, flick, drag-and-drop, and multi-touch operations; the addition of a decorative film layer for a fully flat surface level with the housing; panel sizes from 6.1 to 8.0 in.; an operating temperature from –30 to +85°C; a storage temperature from –40 to +95°C; a typical transparency of 90% maximum; a typical reflectance of 1.5% minimum; and an input force of 0 N.

## SOLOMON SYSTECH LTD.

Shatin, NT, Hong Kong +852-2207-1552
www.solomon-systech.com
Booth 1101

**Capacitive touch-panel controller**

The new SSD2533 is an all-in-one capacitive touch-panel controller from Solomon Systech that integrates power circuits, 23 driving and 41 sensing, into one single chip. It supports display panels up to 11 in. on the diagonal, full-high-definition resolution, with true multi-touch functionality. The SSD2533 has a DSP+MCU architecture that supports detection points for up to 10 fingers simultaneously. It embeds one 16-bit MCU and internal ROM/RAM to support gesture reporting such as zoom in/out and rotation. It also provides stronger noise immunity for both AC-VCOM and DC-VCOM TFT-LCDs.


## SOLUTIA PERFORMANCE FILMS

Saint Louis, MO 314/674-1230
www.solutia.com
Booth 1208

**Broadband Anti-Reflective Film**

Available in both conductive and non-conductive versions, Flexvue AR Films offer less than 0.5% reflection and more than 94% light transmission. Anti-smudge properties can be incorporated into the film without compromising optical performance or 3H surface hardness. Flexvue anti-reflective films are the ideal solution to enhance the optical performance of mobile devices, automotive displays, digital signage, kiosks, and many other display applications.


## SUN-TEC AMERICA LLC

Scottsdale, AZ 480/922-5344
www.sun-tec.net
Booth 735

**Rigid-to-Rigid Panel 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. Previous rigid-to-rigid lamination methods required lamination in a vacuum chamber to prevent trapping air between the panels being laminated. To solve this problem, Sun-Tec developed the TMS-SA-P1 that does not use a vacuum chamber reducing the floor space required and production costs. The TMS-SA-P1 maintains Sun-Tec's high-production standards and placement accuracy of 0.2 mm.

## TIANMA MICROELECTRONICS USA, INC.

Chino, CA 909/590-5833
www.tianma.com
Booth 1513

**7-in. WVGA TFT-LCD**

Tianma Microelectronics will highlight one of its hottest products this year – the new 7-in. TFT WVGA (800 × 480) display with an LED backlight and an optional touch panel (TM070RDH12). This high-quality display is suitable for many application bases including consumer, medical, industrial, home automation, retail, and office-environment products.

## TOSHIBA AMERICA ELECTRONICS COMPONENT

San Jose, CA 408/526-2454
www.taec.toshiba.com
Booth 1119

**Autostereoscopic high-definition display**

Toshiba America Electronic Components, Inc., will feature its 21-in. autostereoscopic high-definition display for use in next-generation 3D monitors. The new 21-in. display employs an integral imaging system (a so-called "light field" display) to reproduce a real object as a 3D image that can be viewed without glasses over a wide range of viewing angles. The integral imaging system offers a significant reduction in eye fatigue during long periods of viewing and features a multi-parallax design that enables motion parallax, which cannot be achieved by systems using glasses. The 21-in. display features low power usage and can be viewed in either a horizontal or vertical position.

## TOUCH INTERNATIONAL, INC.

Austin, TX 512/832-8292
www.touchinternational.com
Booth 1418

**Customized Touch Screens**

Building on a legacy of high-quality and lasting reliability, Touch International's industry leading touch screens use state-of-the-art technology and can be customized based on application requirements to ensure optimal performance. Showcasing its full line of touch screen and display-enhancement capabilities at Display Week 2011, Touch International will highlight its customized touch screen. From high-tech military systems navigating the battlefield, to point-of-sale displays streamlining retail sales, Touch International's touch panels are specifically designed and engineered to improve processes and increase productivity while satisfying strict regulatory standards.

## TOUCH REVOLUTION

Redwood City, CA 415/615-4940
www.touchrev.com
Booth 1555

**Touch Monitors**

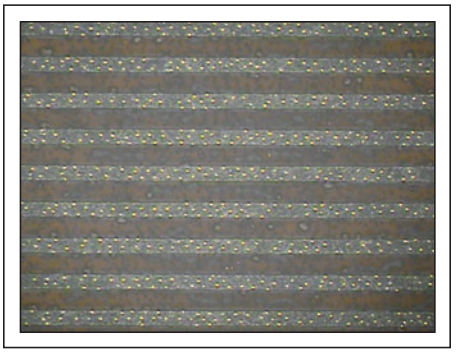
Touch Revolution's innovative projected-capacitive touch (P-Cap) products allow OEMs and system integrators to quickly and easily add a great touch interface to their products. As part of TPK Holding Co., Touch Revolution delivers state-of-the-art touch-screen products through the world's highest-capacity projected-capacitive manufacturing facilities. TRu™ touch monitors are a revolutionary line of desktop and open-frame projected-capacitive touch monitors from 15 to 32 in., designed for users to explore and free their imaginations in new ways.

## TRILLION SCIENCE, INC.

Fremont, CA 510/818-8588
www.trillionscience.com
Booth 1630

**Anisotropic Conductive Adhesive Film**

Ultra-fine-pitch anisotropic conductive adhesive film with a fixed array of conductive particles has been developed and manufactured by Trillion Science. This novel ACF has demonstrated superb performance for a pitch less than 10 mm in LCD driver-IC bonding. Conductive particles are arranged in an array pattern, providing uniform contact resistance with reliable performance.



## UNIVERSAL DISPLAY CORP.

Ewing, NJ 609/671-0980x206
www.universaldisplay.com
Booth 1212

**Phosphorescent OLED Materials and Technology**

Energy efficient and environmentally friendly, award-winning UniversalPHOLED™ phosphorescent OLED materials and technology enable manufacturers to produce OLEDs with dramatically higher power efficiency compared to conventional OLEDs and LCDs. Available in many colors, PHOLEDs offer excellent performance for displays and white lighting. Universal Display, a leading developer and licensor of OLED technologies, will also exhibit prototypes showcasing other proprietary technologies, including FOLED® Flexible OLED, TOLED® Transparent OLED, and WOLED™ white OLED technologies.

## US MICRO PRODUCTS

Austin, TX 512/385-9000 x1127
www.usmicroproducts.com
Booth 728

**Bright Long-Life OLEDs**

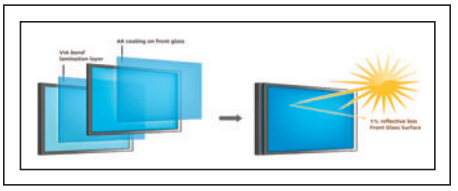
US Micro Products will feature new and improved OLEDs that demonstrate a 35% increase in life and a 66% increase in brightness. Process improvements in OLED manufacturing are providing design engineers with new options in OLED life and OLED brightness. US Micro Products now has available yellow OLEDs with the options of a life and brightness of 67,500 hours at 80 nits or a 45,000-hour half-life at 120 nits. White and blue OLEDs are also available with improved life and brightness. Standard off-the-shelf displays as well as custom solutions are available for a variety of applications.


## VIA OPTRONICS

Hillsboro, OR 603/690-2460
www.via-optronics.com
Booth 613

**Adhesive Material and Optical Bonding**

Via Optronics delivers various display solutions such as custom-designed ruggedized displays for industrial and military applications meeting stringent qualification and reliability standards or optical bonding services for all market segments to enable sunlight-readable displays. Via's core technology centers around our patented, proprietary, and commercially available Viabond adhesive material and MaxVu™ optical bonding processes. Working with any display, we can virtually eliminate major reflection points by combining anti-reflective treatments and index-matching bonding of a front panel, be it glass, a touch sensor, *etc.* In addition to the optical benefits, the resulting display stack-up is substantially more robust.

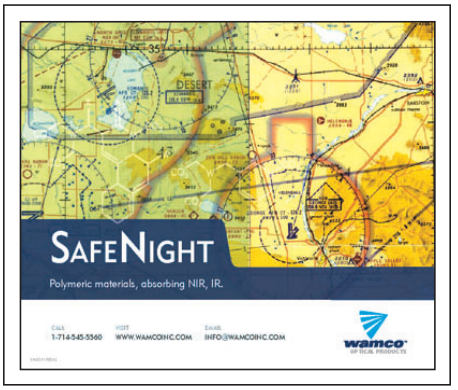


## WAMCO, INC.

Fountain Valley, CA 360/896-9833
www.wamco.com
Booth 752

**Polymeric Materials**

Wamco has developed a series of proprietary polymeric chemical formulations specifically designed to filter particular energy in the near-infrared and infrared region. These unique materials are manufactured using an innovative processes resulting in materials available in a broad array of thicknesses and sizes. It is marketed under the name SafeNight. SafeNight films are critical for those needing to filter AMLCDs in portable devices where touch compatibility still needs to be maintained. SafeNight materials not only allow for touch compatibility, including low surface friction, but are also compliant to MIL-STD-3009 and Secure Lighting recommendations, compatible with various types of optical coatings (AR, AG), compliant to FAA flammability requirements, and neutral in chromaticity.

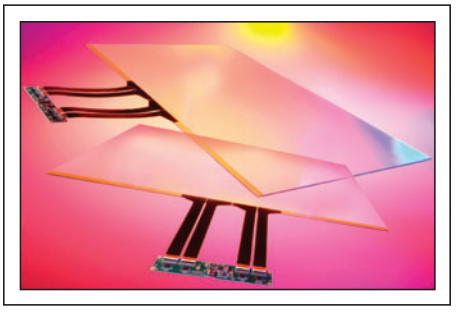



## ZYTRONIC

Blaydon on Tyne, UK +44-191-4145-511
www.zytronic.co.uk
Booth 701

**50-in. Projected-Capacitive Touch Screen**

Zytronic, a leading developer of projected-capacitive-technology touch-screen products for public and industrial applications, is showcasing a 50-in. touch screen utilizing a ZYPROFILM® touch sensor coupled with its latest ZXY100/128 channel touch-sensor controller. The ZXY100/128 provides dual-touch output for linkage to multi-touch or gesture recognition software and Windows® 7 plug-and-play compatibility. It provides a platform for innovative touch functionality in large form/factor applications such as digital signage. The ZXY100/128 is fully compatible with all of Zytronic's PCT touch sensors, including large ZYBRID®, ZYTOUCH®, and flexible ZYFILM® and ZYPROFILM® sensors. ■



Display Week 2012

Photo courtesy of the Greater Boston Convention & Visitors Bureau

SID International Symposium, Seminar & Exhibition

June 3–8, 2012
Boston, MA, USA

# A bright idea,
## right at your fingertips.


## Self-Labeling Illuminated Keys


Incom's fiber optics transfer an image from one surface to another, enabling seamless and dynamic digital displays with tactile feedback.

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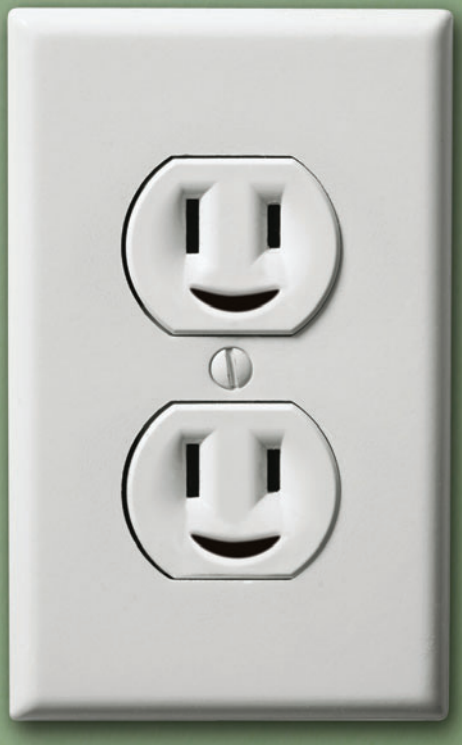
# Monitors with 3M Films Use 30% Less Power.



By refracting and recycling light that normally goes to waste, 3M Display Films can significantly boost the energy efficiency of LCD monitors. In fact, when Vikuiti™ Dual Brightness Enhancement Film (DBEF) and Vikuiti™ Brightness Enhancement Film (BEF) are used together, LCD monitors require an average of 30% less energy. The films enable monitors to operate with two bulbs instead of four *with no reduction in performance*. A 19″ monitor with Vikuiti DBEF and BEF, for example, can run on 10 fewer watts. Find out more about making displays more energy efficient at 3M.com/displayfilms.

Making displays more energy efficient since 1993.

3M.com/displayfilms

**See Us at Display Week 2011, Booth 807**

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Journal of the
SOCIETY FOR INFORMATION DISPLAY

SID
SOCIETY FOR INFORMATION DISPLAY

The following papers appear in the May 2011 (Vol. 19/5) issue of *JSID*.
For a preview of the papers go to sid.org/jsid.html.

## Contributed Papers



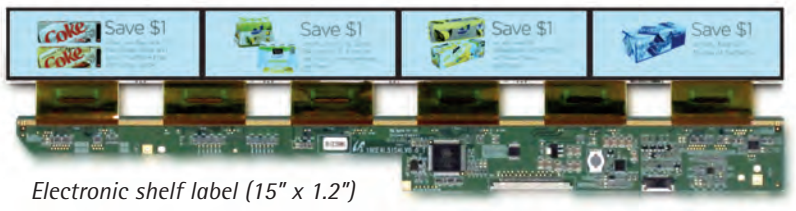
## Special Section on Nano-Technology in FPDs

# RESIZING LCDs FOR CUSTOM APPLICATIONS

## We Will Cut an LCD to Fit Almost Anywhere!

*YOU CAN TOO! Get a License, booth #1420*


*Digital signage for over subway door 36" (4.5:1) LCD*




*Electronic shelf label (15" x 1.2")*

*5 ATI aircraft instrument (4.2" x 4.2")*


**The resizing process has a high yield and is cost effective. Where possible, the resizing process preserves all of the LCD components, such as LC material, polarizers and attached electronics. Only the pixels remaining in contact with the row and column drivers continue to function. The performance and reliability of the original display is maintained and warranty is maintained.**

FOR INFORMATION:

**Tannas Electronic Displays, Inc, Orange, CA**

Custom Resized LCD Glass and Licenses

www.tannas.com

**Larry Tannas, President**

*L.tannas@tannas.com*

**phone 714.633.7874 / cell 714.342.7067**

**See Us at SID '11 Booth 1420**

**Licensee: Symbolic Displays, Inc. (SDI), Santa Ana, CA**

SDI has proven in-house resizing facilities. SDI sells resized LCDs to the industry and uses LCDs in their simulator product line.

www.symbolicdisplays.com

*Tony Lopez, Director of Sales*

*tonyl@symbolicdisplays.com*

**714.258.2811 x105 / Cell: 714.585.4847**

**Licensee: SGB Enterprises, Inc., Valencia, CA**

Custom LCD resizing and backlighting

www.sgbent.com

*Joe Padula, VP Business Development*

*joe@sgbent.com*

**661.294.8306**

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LEADING GLASS TECHNOLOGY

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**Photonic Ink**

**Display Week 2011, Booth 1548**
With introduction by
Dr. Andre Arsenault at Session 5.2

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opalux.com

**EuroDisplay 2011**

**31st International Display Research Conference (IDRC '11)**

**September 19–22, 2011**

**Bordeaux-Arcachon, France**

## Imagine the possibilities...

From custom painted cover glass and touch screen manufacturing, to optical bonding and system integration, Touch International specializes in the value-added components that make your display a success.

**Multi-Touch**
- Resistive
- Projected Capacitive

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- Infrared Filters
- Transparent Heaters

**Ruggedization**
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**Functionality**
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- Haptic Response
- LCD/LED Backlighting

**Optical Performance**
- Color Filters
- Polarizing Films
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Call us today or stop by booth #1418 at DisplayWeek to learn how our in-house display services can improve your project while saving you time and money!

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TouchInternational

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or

## Touchscreen Stylus Tethers

We manufacture both !
... stock & custom designs & colors

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## Optically Clear Adhesives

*For Display and Touch Panel Bonding*

- High transmission / no yellowing
- Excellent humidity resistance
- Optional 2nd curing mechanism for shadow curing

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Los Angeles / USA
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See Us at Display Week 2011, Booth 1155

*Journal of the*
SOCIETY FOR INFORMATION DISPLAY

The most comprehensive, scientific/technical publication exclusively devoted to electronic displays

# Announcement

of

# Topical Special Sections

to be published

# in 2011

- **Nano-Technology in Flat-Panel Displays**
  **Prof. Shunsuke Kobayashi, Guest Editor**
  (Deadline for paper submission is past)
- **Vehicle Displays**
  **Dr. Allan Sobel, Guest Editor**
  (Deadline for paper submission is past)
- **Cognitive Engineering and Interactive Displays**
  **Mr. Robert Patterson and Mr. Jason Moore, Guest Editors**
- **Green Technologies, Design, Manufacturing, and Operations**
  **Mr. Don Carkner, Guest Editor**
- **Solid-State Lighting**
  **Dr. Daniel den Engelsen and Dr. Kalil Kalantar, Guest Editors**

**Interested authors:**
**Please obtain more information on each of these by clicking on the titles of Special Sections or by sending an e-mail to editor@sid.org**

SID
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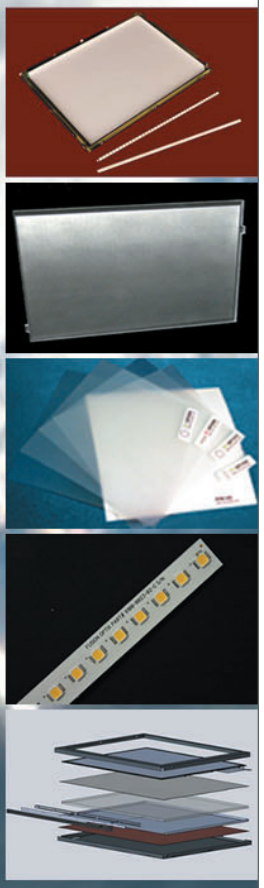

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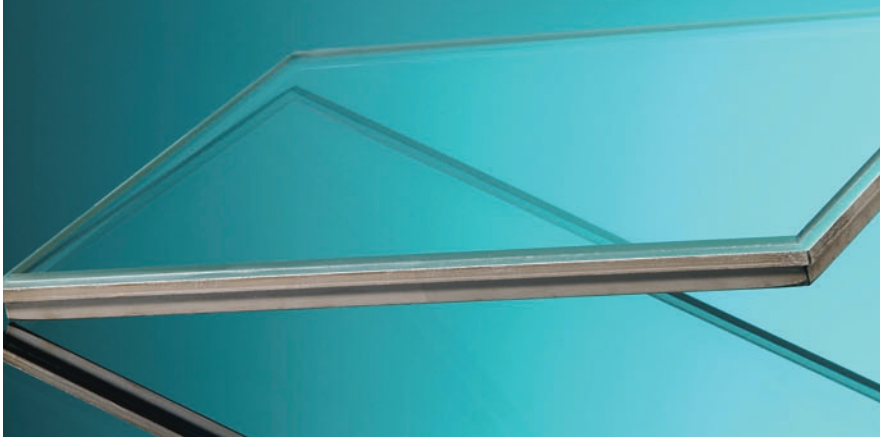

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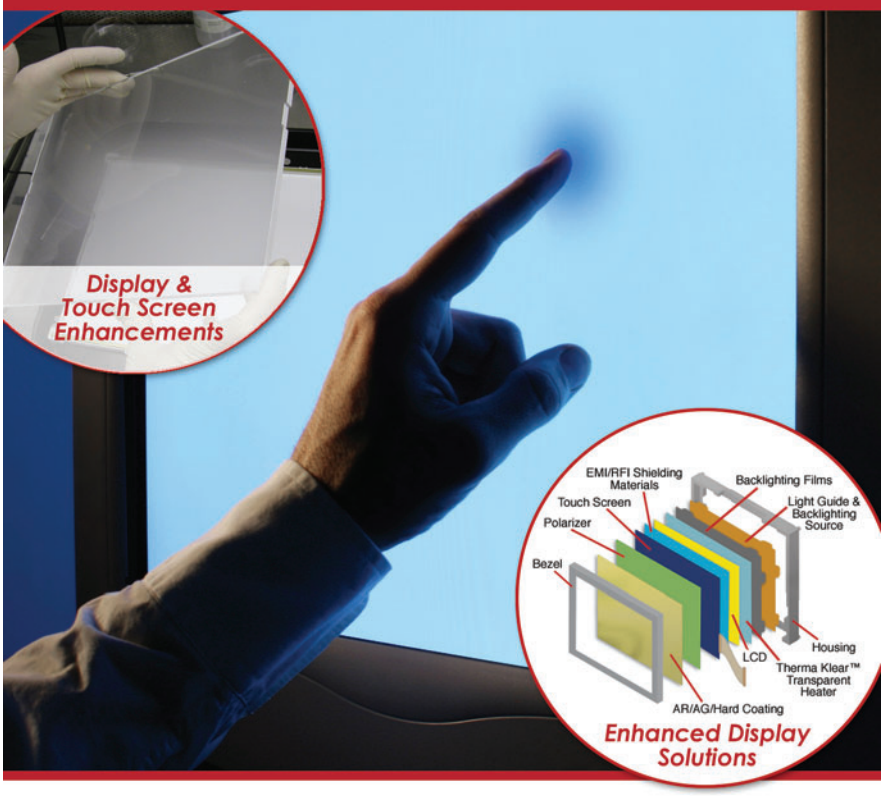


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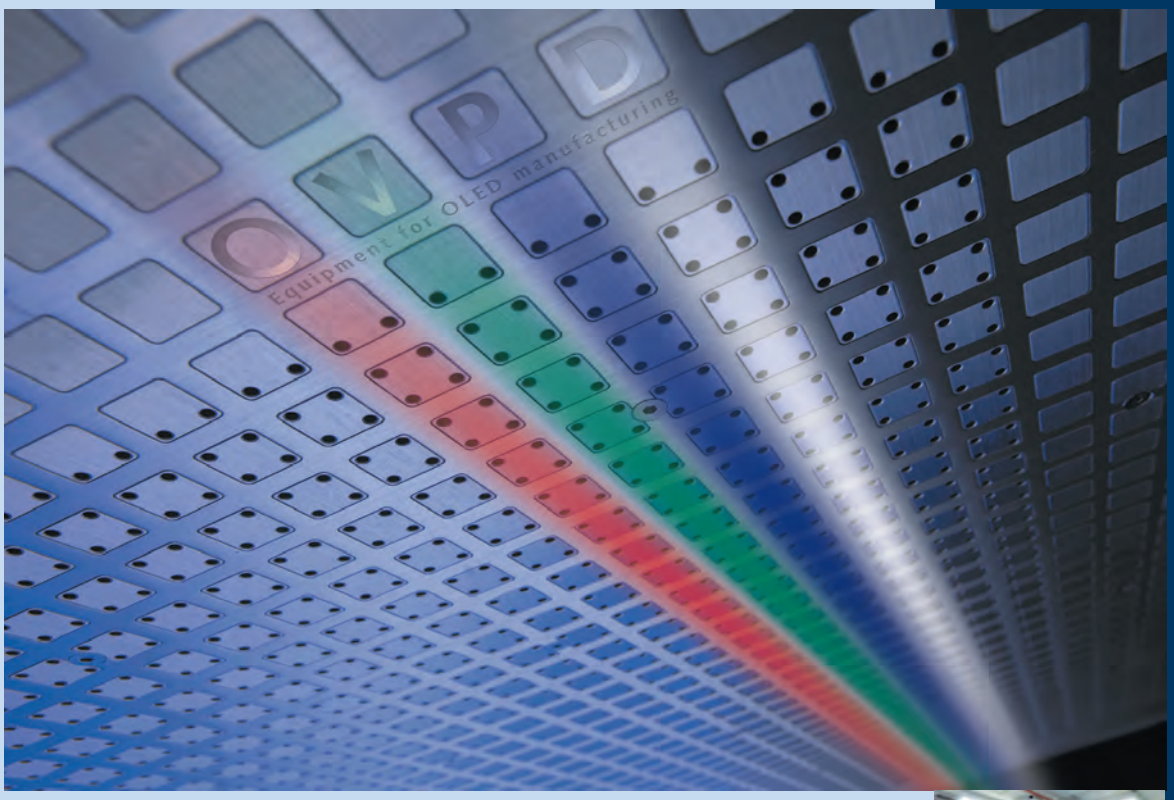


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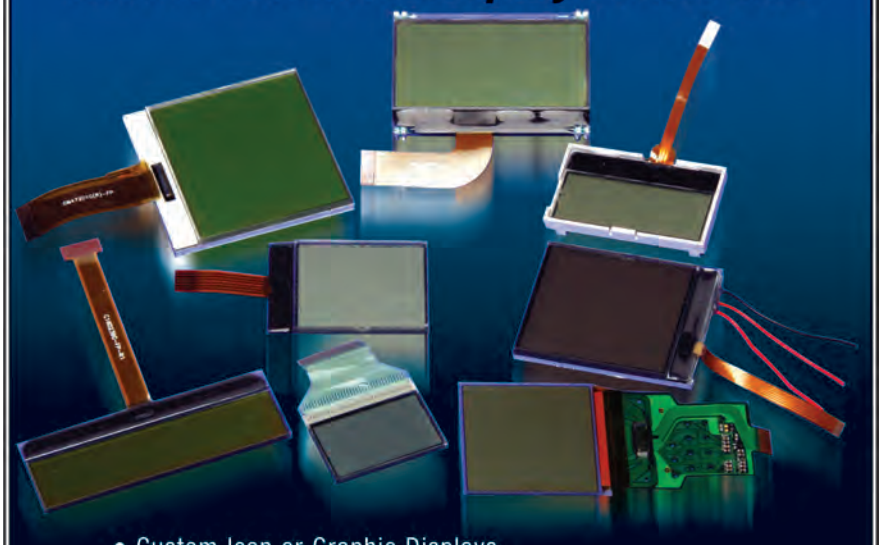

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*continued from page 2*

with worthy recipients and I can honestly tell you as a member of the DYA committee that the final selections were really the best of the best. You can read all the details in the article, but one thing I want to point out is that every recipient this year was a direct participant in the handheld display marketplace, either as a device manufacturer or as the supplier of a critical component. Despite the many exciting nominations from the large-panel marketplace, the pinnacle of innovation was really on the mobile side this year.

Along with this insight about the scale of commercial innovation in the mobile space came a rather stunning discovery when I reviewed the final draft of author Baoping Wang's feature entitled, "The Chinese Display Industry and SID's Beijing Chapter Grow Together." In this article, Dr. Wang provides a very interesting review of the scope of display product manufacturing growth in China over the last few years. Despite the recent economic downturn there was rather amazing growth in the production volumes of many display products and especially surprising was the total volume of cell phones manufactured – over 700 million handsets in 2010 alone. Yes, that's the real number. In 1 year, Chinese manufacturers alone made enough cell phones to equip about 10% of the entire world's population. Actually, that is not the real point of Dr. Wang's article; rather it is how the growth of manufacturing in China has occurred and how the SID Beijing chapter is working hard to increase R&D activities in China to keep pace. I really applaud these great efforts and encourage all of you to lend whatever time and support you can to help the Beijing chapter.

Looking at the Display Marketplace this month is well-known industry analyst Mark Fihn, who really puts himself out on a limb by making numerous insightful observations and predictions for the coming years. Mark takes on a number of current topics, including flexible substrates, 3-D, touch panels, standards, and that familiar controversial subject of resolution – how much do we really need? I appreciate Mark's approach and I think you will find it thought provoking as well.

And, last but not least, this month's offering of Making Displays Work for You brings a comprehensive review of the nuts and bolts of optical bonding technology. We worked together with authors Larry Mozdzyn from Ocular LCD, Inc., and Michael Rudolph from DuPont Display Enhancements to provide a full picture of the process, materials, and design considerations involved in achieving a highly successful optically bonded display product. Does this stuff work? I can tell you firsthand that optically bonded displays have raised the bar for sunlight readability and high-contrast performance in a variety of applications, including public kiosks, retail displays, industrial instruments, and numerous military display products.

So, with that, it's a wrap for May 2011. Next year, we will all gather in Boston, my home city, for Display Week 2012. I can't wait to bring everyone to my neck of the woods, where there is also a lot of great display work going on, but for right now, let's all enjoy LA! ■

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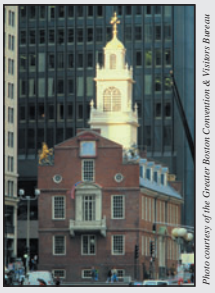

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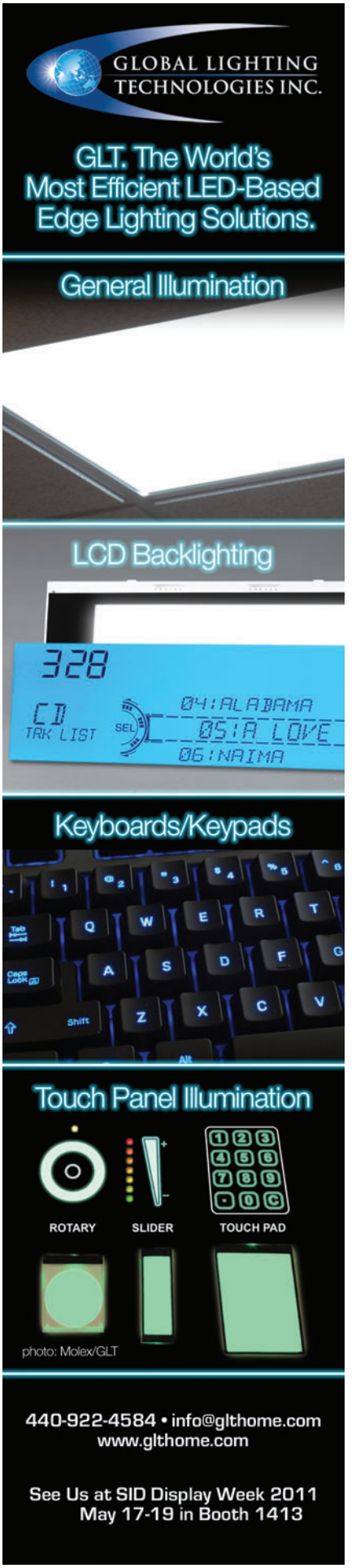

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