HONORS AND AWARDS / DYAs / SID 2010 SHOW ISSUE

SID
SOCIETY FOR INFORMATION DISPLAY

Information DISPLAY

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SID's Best and Brightest to Be Honored at Display Week 2010

Plus

The Actuality Story

Intellectual Property

Journal of the SID June Contents

COVER: Top left clockwise to bottom left: RealD's XL Cinema System, LG Display's 47-in. 3-D LCD panel, NVIDIA's 3D Vision wireless active-shutter glasses, N-trig's DuoSense digitizer, Pixel Qi's multimode LCD, Nikon's COOLPIX S100pj compact digital camera with projector. For further details, see the feature article beginning on page 18.

Cover design by Acapella Studios, Inc.
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Plus

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- *Journal of the SID* August and September Contents

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editorial

Make the Most of Display Week

Stephen Atwood

Hello and welcome to Seattle. I hope you are reading this while enjoying a short rest at Display Week 2010. 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. I am glad to be back in Seattle. Not only is it a great city to visit, but it seems to bring the most diverse group of attendees to Display Week. Every time we have come here it has been a spectacular event. Besides the great scenery, the food in Seattle is outstanding – and no matter how busy we are, we all need to eat, right? It would be disloyal to my home state if I did not mention how great Boston will be also when we get there in 2012. But for right now, Seattle is my favorite city. Like most of you, I'll be busy running from session to session, but if you do see me please stop me and say hello. I would really like to know how you like the new format of *ID* and get your thoughts on how we can do even better in future issues.

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 as well, including over 500 paper presentations, as well as short courses, seminars, the business and investors conferences, the market focus conferences, keynotes, application tutorials, awards luncheon and dinner, 3-D cinema event, and special event. 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 try 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.

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, and, therefore, 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.

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

Now, let us take a look at the lineup for this month. We start with a double-feature revealing both the SID Honors and Awards winners for 2010 as well as the Display of the Year award winners from the best of 2009. What could be better reading than a profile of the most distinguished alumni of our industry, followed by the most innovative display products and technology? The list of choices for both sets of awards was overflowing with worthy recipients – these really are the best of the best being recognized. As I have said many times, it's the people who have given so much to the industry for so many years that make it such an honor to be part of it all.

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Information
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industry news

AU Optronics Will Acquire Toshiba Mobile Display Fab in Singapore

In late March 2010, AU Optronics Corp. announced that it had signed a memorandum of understanding with Toshiba Mobile Display Co. to purchase 100% of the shares of AFPD, a subsidiary of TMD in Singapore. AFPD is a manufacturing site for small- and medium-sized LCD panels based on low-temperature polysilicon (LTPS) technology. The Gen 4 facility is also, according to DisplaySearch analysts David Hsieh and Charles Annis, the only LTPS manufacturer in Singapore at this time.[1]

The financial details of the agreement have not been made public, and neither party was able to comment at press time. According to the official announcement from Toshiba, AUO is aiming to strengthen its competence in the high-end display market through the purchase. TMD reports that it will concentrate its resources on displays for mobile devices, including mobile phones and smartphones, and on automotive applications such as car navigation.[2]

Hsieh and Annis wrote in a recent DisplaySearch blog entry that Toshiba is making the sale to counteract decreasing demand for high-value-added panels and also to improve the financial status of its display business unit. They also reported that the Japanese press had indicated that AUO will pay ¥10 billion ($100 million) for the deal.

They wrote: "Reportedly, TMD is bracing for an operating loss of ¥28 billion during the year ending March 31, with sales declining an estimated 18% to ¥210 billion. The sale of the Singapore plant is in-line with Toshiba's efforts to restructure operations in order to improve profitability. Meanwhile, this sale also means that Toshiba will withdraw from the mobile PC panel production business." At press time, the word in the industry was that TMD was indeed discontinuing a number of its LCD panel offerings, several of which represent unique solutions that cannot be easily replaced. As a result, manufacturers were engaging in "last-time buys" and scrambling to find alternatives for the discontinued panels.

Hsieh and Annis offered opinions about AUO's motives: "With the establishment of ChiMei InnoLux, AUO is no longer the largest TFT-LCD maker in Taiwan. AUO is looking for ways to regain leadership, as economic scale is key in competition." They also noted that AFPD is dedicated to LTPS technology, whereas AUO has been struggling with LTPS yield rate for a while, so the acquisition should help AUO in that area.

The proposed transaction is subject to the signing of definitive agreements between AUO and TMD, as well as to any necessary approvals. At press time, a Toshiba spokesperson confirmed that the deal was scheduled to be finalized at the end of April.

References

[1]http://dwsit.egloos.com/5283908

[2]http://www.tmdisplay.com/tm_dsp/press/2010/10-03-31_e.html

Background and analyst commentary for this article were based on the DisplaySearch blog entry dated March 31, 2010 and listed above.

— Jenny Donelan

SID: The Birthplace of Display Technologies

by Munisamy Anandan
President, Society for Information Display

The Society for Information Display has a unique place in modern history: it is where almost all display technologies have had their beginnings. Over the years, inventors from various parts of the world have chosen SID's symposium, exhibition, or publications to promote their inventions. Starting with CRT technology, and following up with plasma, EL, LCD, FED, OLED, and MEMS-based displays, every invention leveraged SID as the main forum for its growth.

The Society has been promoting the science and technology of displays all over the world, from New Zealand to Canada, and from Russia to Brazil, through conferences, seminars, workshops, exhibitions, and publications, since 1962. The breathtaking display technologies we see today in commercial products at the Consumer Electronics Show are those that were growing for the past 20 years or so within SID.

Because the display industry has grown ever more global and dynamic, SID has responded with an increased international presence, and by providing opportunities for companies to expand the display business, all the while keeping the focus on the science and technology of displays. SID has also taken the initiative to grow in areas of the world where the manufacturing of displays has been migrating.

Recently, we experienced a global economic downturn. Many industries and institutions were hit by the tough economy, and the display industry was no exception. Now, as the economy and the display industry rebuild, it is important to remember the continuing role that SID must play in supporting the further success of information-display technology. SID is rich in many ways: in the intellectual capital of its members, in the spirit of its sustaining members, in the innovations of display technology, in knowledge-sharing among members, in growing student members – the future pillars of SID – and in changing the lives of people all over the world by helping them to keep up with the information age.

I would like to propose that as we enter this 48th year of SID's International Symposium, Seminar, and Exhibition, we think about what we might do to maintain and also increase the energy of SID and moving forward. Many of our readers are engaged in the display or display-related activity of their company or academic institution. Some of you are entrepreneurs, some are senior-level executives, some are scientists/engineers/technologists, and some are professors or students. Whoever you are, you all have faced or will face highly challenging tasks in the course of your career. There are those times when you aspire to seize the opportunity of a lifetime and undergo an enormous struggle to achieve success. If you do succeed, it will be due to your knowledge, your hard work, a bit of luck, and perhaps, most importantly, your spontaneous participation in the greater environment of your chosen endeavor. Whatever industry you are in, participation is the key to success. That means not only participation in the workplace, but also in organizations such as SID, which is dedicated to the growth of the display industry, display science, and display technology.

You will continue to need SID to facilitate your growth, and, in turn, SID needs you to maintain its growth. For this birthplace of the display technology to continue to evolve in proportion to the display industry at large, I appeal to you to participate, participate, participate!

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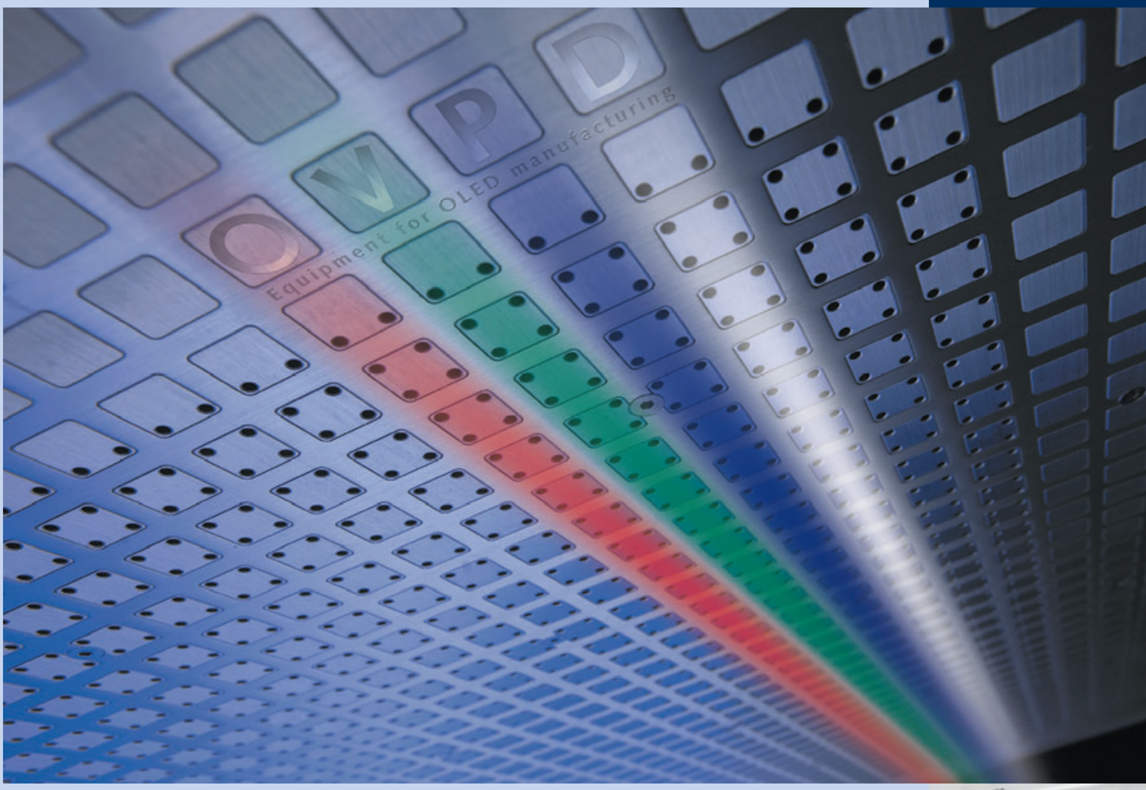

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EMD

2010 SID Honors and Awards

This year's winners of the Society for Information Display's Honors and Awards include Dr. Frederic Kahn, who will receive the Karl Ferdinand Braun Prize for his outstanding and innovative contributions to the development and commercialization of flat-panel LCDs and projection systems; Dr. Dwight Berreman, who will be awarded the Jan Rajchman Prize for his many contributions to the analytical understanding of electro-optic effects in liquid crystals; Dr. Eli Peli, who will receive the Otto Schade Prize for contributions to vision science and its application to image-quality evaluation and enhancement; Dr. Philip Bos, who will be awarded the Slottow-Owaki Prize for his pioneering educational efforts in the field of LCDs; and Mr. Makoto Maeda, who will receive the Lewis & Beatrice Winner Award for his exceptional and sustained service to SID and the Japan Chapter.

by Jenny Donelan

EACH YEAR, the Society for Information Display (SID) honors individual scientists and researchers for outstanding achievements in the field of electronic-information displays and for outstanding service to the Society. Many of this year's recipients are being acknowledged for their work with liquid crystals. LCD technology is so entrenched today that it may seem unlikely that there was ever a time when it was far-off or unappreciated or had any chance of replacing CRTs as the dominant display technology. These visionaries worked long and hard to overcome many of the challenges of LCDs, helping to make LC the technical and commercial success it is today. Whether in liquid crystals or other areas, such as large plasma screens, projection displays, vision science, or in service to the industry as a whole, the winners of these awards worked, in many cases, without ideal conditions, funding, or even much in the way of recognition from the outside world.

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What might seem like overnight success is very often the culmination of many years of hard work, often performed with little encouragement beyond the scientists' own inner drive to see the work through.

There are many such "heroes" in the display industry. Only a small number are nominated for SID honors and fewer still are finally chosen as recipients. Honors and Awards Chair Christopher King, speaking for the members of the SID Honors and Awards Committee, says, "The selection and honoring of the SID Award winners is one of the most rewarding activities that SID undertakes each year." We will honor this year's winners during Display Week 2010 at the annual awards banquet to be held on Monday evening, May 24, prior to the Symposium.

Karl Ferdinand Braun Prize

This award is presented for an outstanding technical achievement in, or contribution to, display technology.

Dr. Frederic J. Kahn, SID fellow and president of Kahn International, has been awarded the Karl Ferdinand Braun Prize *"for his outstanding, innovative contributions to the development and commercialization of flat-panel LCDs and projection systems."*

Dr. Kahn recognized early on the unique physical properties of liquid crystals and their applicability to a broad range of direct-view (flat-panel) and projection displays, as well as to related technologies. He has consistently and successfully followed up and built upon that vision with major contributions to the development of commercial enterprises based on information-display technologies.

At the NEC Central Research Laboratory in Kawasaki, Japan, from 1968 to 1969, he proposed and initiated NEC's liquid-crystal-display R&D, including invention of a field-effect color-change LCD. Starting in 1970, at Bell Telephone Laboratories in Murray Hill, New Jersey, he initiated Bell Labs' LCD R&D; advanced the understanding and control of LC molecular alignment on solid substrates; invented and was the first to publicly disclose (June 30, 1971) a vertically aligned nematic (VAN) LCD that reorients in a preferred direction at low voltage and which, after three decades of additional development

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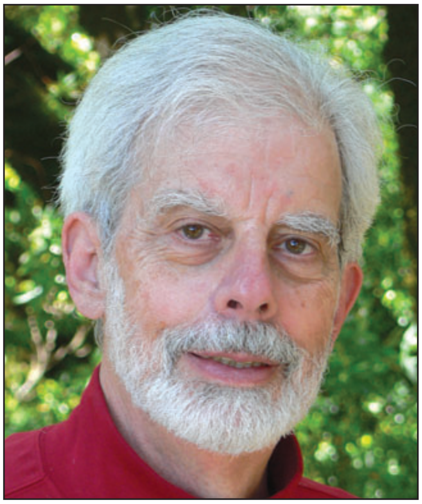


Dr. Frederic J. Kahn

and invention by subsequent workers, is now used in most flat-panel LCD TVs and high-performance LCD projectors; and invented and developed high-resolution LCD projection imaging devices and systems based on laser-addressed smectic-A LCDs.

While Kahn was a project manager for liquid-crystal displays at Hewlett-Packard Laboratories in Palo Alto, California, he led the development of multiplexed TN-LCD technology, which led to HP's first LCD calculator products, including the best-selling HP 12c business calculator, introduced in 1981 and still sold today (2010). He also developed 40-character multiplexed dot-matrix alphanumeric LCDs for portable computers and a computer-interactive high-resolution C-sized engineering drawing display. As department manager for optical materials and polymers and later for storage physics, he also led optical-fiber, IC-lithography, and erasable-optical-memory programs.

Kahn founded Greyhawk Systems in Milpitas, California, in 1984 and served as VP Technology, with operational responsibility for LC light-valve development and manufacturing, as well as for new systems and applications development based on IR laser-addressed smectic-A and real-time photo-addressed (CRT and active-matrix) a-Si LCD projection technology. Greyhawk's products included 7.5-Mpixel 40-in. D and 37.5-Mpixel 144-in. D full-color displays (Softplot and LAD, respectively), an 8.4-Mpixel professional short-run color printer (Ilford Digital Photo Imager), and a 31.5-Mpixel printed-circuit-board exposure and development system (DuPont Seriflash).

According to Dr. S. T. Wu at the College of Optics and Photonics at the University of Central Florida, "Dr. Kahn has made significant scientific and technological contributions in liquid-crystal alignment, especially single-domain vertical alignment, which laid down the foundation for today's liquid-crystal–on–silicon projectors (commercialized by Sony and JVC), thermally addressed electrically erased high-resolution smectic liquid-crystal light valves, and pitch dilation of cholesteric liquid crystals, just to name a few."

From 1990 to the present, as president of Kahn International in Palo Alto, California, Dr. Kahn has helped other companies develop and grow successful display-technology related businesses through technical, business-development, intellectual-property, and expert-witness consulting, seminars, and publications (*Private Line Report*, *Projector Database*).

He has 18 issued U.S. patents and is the author or editor of over 40 technical publications. He has been a Fellow of SID since 1981 and has been General Chairman or Program Chairman of six international display conferences sponsored by SID, SPIE, and/or IEEE. He has also served as an SID International Officer (Secretary).

Dr. Kahn received his B.E.E from Rensselaer Polytechnic Institute in 1962 and his A.M. and Ph. D. in applied physics (solid state) from Harvard University in 1963 and 1968, respectively. He is a National Science Foundation Graduate Fellow.

Jan Rajchman Prize

This award is presented for an outstanding scientific or technical achievement in, or contribution to, research on flat-panel displays.

Dr. Dwight Berreman, recipient of a SID Special Recognition Award in 1987, has received the Jan Rajchman Prize "*for his many contributions to understanding electro-optic effects in liquid crystals and especially for his pioneering work on developing the 4 × 4 matrix method for simulating and optimizing the electro-optical properties of LCDs.*"

After graduating from Cal Tech with a Ph.D. in physics, Dr. Berreman spent a year at Stanford Research Institute, then returned to his undergraduate institution, the University of Oregon, as Assistant Professor of Physics, before joining the Chemical Physics Research Department of AT&T Bell Labs in Murray Hill, New Jersey.

It was at Bell Labs that he was introduced to liquid crystals in 1969 by Dr. Terry Scheffer, who asked him to explain a difficult article on optical modes in cholesteric LCs of homogeneous texture. Failing that, Berreman developed the 4 × 4 transfer-matrix method for computers, which simulates the linear optics of any broad, flat system of layered media, including cholesterics and LC devices. Papers by Berreman and Scheffer described the 4 × 4 method and showed correspondence between computed and measured optical properties of cholesterics. Thereafter, Berreman wrote computer programs to simulate the static and dynamic behavior of LCDs in electric fields.

Over the years, particularly as interest in liquid crystals began to flag at Bell Labs, Berreman conducted research at the Fraunhofer I.A.F. in Freiburg, Germany. He also consulted frequently with a group under Dr. James Larimer at the NASA Ames Lab in Moffett Field, California, and with several groups that used his computer programs for LCD development. The LC group at Kent State University, for example, created a BASIC package that ran his LC simulation programs under Windows and made the input of physical parameters simpler.

The 4 × 4 matrix method for simulating the electro-optical performance of LCDs was a huge accomplishment that paved the way for the rapid optimization of LCDs. It is employed in all commercial LCD simulation

Dr. Dwight Berreman

software that is still being extensively used today. According to SID Honors and Awards Committee member Dr. Allan Kmetz, "Berreman's development of the 4 x 4 method was a great contribution to the evolution of LCDs from the 1970s until today. But his seminal contributions to the understanding of LCD physics go far beyond that fine analytical tool. His physical insights, communicated in many well-known publications, as well as his generous collaborations with many other researchers, underlie the understanding of LC alignment by surface topography, the invention of the supertwist and pi cells, the influence of backflow on LCD switching, and bistable LCDs."

Otto Schade Prize

The Otto Schade Prize is awarded for an outstanding scientific or technical achievement in, or contribution to, the advancement of functional performance and/or image quality of information displays.

Dr. Eli Peli, SID Fellow and a professor at Harvard Medical School, is receiving the Otto Schade Prize "*for his many outstanding contributions to vision science and their application to image-quality evaluation and enhancement, including pioneering efforts in improving display performance for populations with special visual needs.*"

Dr. Peli's principal research interests are image processing in relation to visual function and clinical psychophysics in low-vision rehabilitation, image understanding, image quality, and evaluation of display-vision interaction. He is a consultant to many companies in the ophthalmic area and to manufacturers of displays and in particular head-mounted and stereo displays.

According to Dr. James Larimer, Vision Scientist with Image Metrics, "Displays modified through optical design, signal processing, and/or ergonomic considerations have been crafted by Professor Peli to uniquely meet the needs of the low-vision community. As the world population ages, low vision has become an increasingly prevalent problem worldwide. A commercially focused industry like displays rarely has a concerted effort to serve a niche population such as the low-vision community. It is therefore remarkable and good that Dr. Peli has taken up this challenge within the industry to develop technology and tools to serve this special and growing community."

Dr. Peli embarked on the study of the possibility of using enhancement as a way to improve images based on a model of impaired vision that borrowed much from the approaches originated by Otto Schade, which used a spatial

2010 SID Fellow Awards

The grade of fellow is conferred annually upon SID members of outstanding qualifications and experience as scientists or engineers whose significant contributions to the field of information display have been widely recognized.

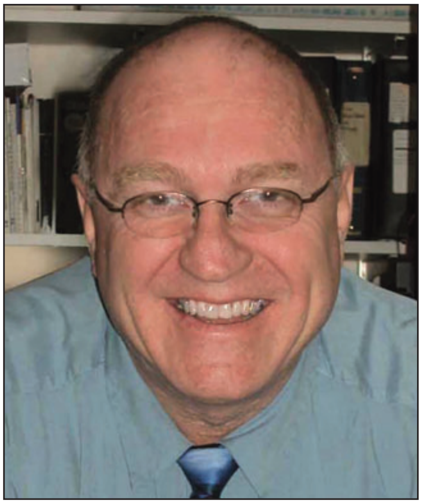
Dr. Wei Chen "*for his many contributions to the advancement of liquid-crystal displays, including the pioneering development and commercialization of high-performance LCD computer monitors, multi-touch displays, and computer displays with LED backlights.*" Dr. Chen is currently DEST (Distinguished Engineer, Scientist or Technologist) and Director, Display Engineering, at Apple, Inc. He received his Ph.D. in physics from University of California at Berkeley.

Dr. Edward F. Kelly "*for his outstanding leadership in the theory, methods, and technology of display metrology and his many contributions to international flat-panel-display standards.*" Dr. Kelly is currently a consultant. He retired from NIST, where he was a guest researcher, in 2009. He holds a Ph.D. in experimental atomic physics from Montana State University.

Dr. Andrew B. Watson "*for his outstanding contributions to both basic and applied-vision science, including applications to image-quality metrics, image compression, and psychophysically based display measurements.*" Dr. Watson is the Senior Scientist for Vision Research at NASA Ames Research Center. He has a Ph.D. in psychology from the University of Pennsylvania.

Dr. Haruhiko Okumura "*for his outstanding contribution to the research and development of TFT-LCD driving technologies, especially overdrive and low-power technologies and for significant contributions to the advancement of the display community.*" Dr. Okumura is Chief Research Scientist for the Human Centric Laboratory, Corporate R&D Center, at Toshiba Corp. He received his Ph.D. in electrical engineering from Waseda University.

Mr. Roger G. Stewart, "*for his many contributions to display science and technology, including the first amorphous-silicon TFT-LCDs with integrated scanners ("SASID"), the first single-crystal-silicon active-matrix EL displays, polysilicon AMLCDs, and compensation circuits for AMOLEDs, and for his creativity in TFT-LCD design.*" Dr. Stewart is President of Sourland Mountain Associates LLC. He holds an M.S. degree in electrical engineering from Lehigh University.



Dr. Eli Peli

frequency-based pre-emphasis model. As soon as the first enhancement approach was developed, he faced the difficult problem of evaluating the benefit of that enhancement – how to measure the improvement of image quality provided by enhancement for these patients. He first applied optical simulation by photography using a camera that was rendered to have the optical properties of an eye with a cataract. This was followed by a series of studies that implemented the optical simulation computationally, and then by patient evaluation studies of the improvement in celebrity-face recognition obtained with enhanced images. Dr. Peli was able to show that image enhancement did improve the celebrity-face recognition of patients with both cataracts and age-related macular degeneration.

The growth of video and imaging technology presents both a great opportunity and a great obstacle for people with impaired vision. As ever more cultural content is delivered through images and video, these members of society find themselves at a great social disadvantage. At the same time, the technology itself can serve as a vehicle to improve their access to content of various sorts. Dr. Eli Peli has made outstanding advances in the area of image quality through his efforts to provide better, more enjoyable, and more useful access to electronic images for a special population.

Dr. Peli received degrees from the Technion-Israel Institute of Technology and a doctorate from the New England College of Optometry. He is the Moakley Scholar in Aging Eye Research and Co-Director of Research at Schepens Eye Research Institute, and Professor of Ophthalmology at Harvard Medical School. He also serves on the faculties of the New England College of Optometry, Tufts University School of Medicine, University of York, UK, and Dalian Maritime University, China. He has been a consultant on many national committees, including the National Institutes of Health, NASA AOS, Aviation Operations Systems advisory committee, U.S. Air Force, Department of Veterans Affairs, U.S. Navy Postdoctoral Fellowships Program, U.S. Army Research Labs, and the U.S. Department of Transportation, Federal Motor Carrier Safety Administration.

He has published more than 140 peer-reviewed journal papers and has been awarded eight U.S. patents. He also edited a book entitled *Visual Models for Target Detection*, with special emphasis on military applications, and co-authored a book entitled *Driving with Confidence: A Practical Guide to Driving with Low Vision* (co-authored with Doron Peli).

Slottow-Owaki Prize

The Slottow-Owaki Prize is awarded for outstanding contributions to the education and training of students and professionals in the field of information display.

Dr. Philip Bos, a SID Fellow and professor of chemical physics and the Associate Director of the Liquid Crystal Institute at Kent State University, is receiving the Slottow-Owaki Prize "*for his pioneering educational efforts in the field of LCDs, including the development of curriculum and student research topics for the latest LCD-technology innovations for high-speed response, bistable operation, the design of wide-viewing-angle films, and diffractive devices.*"

Dr. Philip Bos's field of interest is the applications of liquid crystals. As a researcher, he recognized the importance of the coupling of flow and director reorientation in speeding the relaxation of the director field in nematic devices. Consequently, he invented the pi-cell device, which has been used for commercially successful applications in the area of field-sequential color and stereoscopic viewing systems. He also clarified the importance of the symmetry of the director configuration when designing electro-optical effects with wide angle of view and invented an optically self-compensating director configuration.

In addition, Dr. Bos invented polarization-independent electro-optical diffraction grating based on optical activity rather than optical-path-length difference. This resulted in the ability to demonstrate low-voltage high-performance liquid-crystal electro-optical effects for transmissive projection devices.

According to Oleg D. Lavrentovich, Director of the Liquid Crystal Institute at Kent State University, "The field of liquid-crystal applications is impossible to imagine without the contributions of Professor Bos. Over the last three decades, he has made seminal inventions such as high-speed switching of the liquid crystal through a delicate balance of director reorientation and hydrodynamic flows and enhanced the viewing angle and contrast of nematic displays through compensating films. He has also developed efficient diffractive and beam-steering devices."

In addition, Lavrentovich continues, "His contribution to the field is multifaceted; he is also a wonderful teacher, who has advised numerous Ph.D. graduates at Kent State who now work at companies such as Apple, Inc., 3M, Hewlett Packard, Kent Displays, Hana Microdisplays, and others. As an Associate Director of the Liquid Crystal Institute, Professor Bos oversees the Industrial Partnership Program, which provides our Institute with a vital link to the global industrial world and assists our colleagues from industry with an access to the Institute's rich intellectual and instrumental resources."

Dr. Philip Bos

2010 SID Special Recognition Awards

Presented to members of the technical, scientific, and business community (not necessarily SID members) for distinguished and valued contributions to the information-display field.

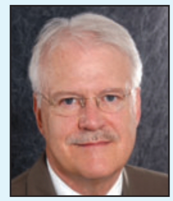
Mr. Kenji Awamoto *"for his outstanding contribution to the development and commercialization of super-large-area film-type display, utilizing technology that incorporates an array of plasma tubes."* He is the Corporate Officer of Technology Development, Quality Control, and Intelligent Properties at Shinoda Plasma Co. He received his M.E. in electrical engineering from Okayama University.

Dr. Joyce Farrell *"for her outstanding contributions to the human factors of imaging systems and technology, including the development of the first successful quantitative metric for display flicker and for her exceptional service to the Society for Information Display."* Dr. Farrell is a senior research associate at the Stanford School of Engineering and the Executive Director of the Stanford Center for Image Systems Engineering (SCIEN). She received her Ph.D. in psychology, specializing in visual perception and psychophysics, from Stanford University.

Dr. Hiroki Hamada *"for his outstanding contributions to the development of display devices, including red laser diodes and polysilicon TFT-LCD light valves for projectors."* Dr. Hamada is a Senior Manager with Sanyo Electric Co. He received his Ph.D. in electronic engineering from Kinki University.

Mr. Manabu Ishimoto *"for his outstanding contribution to the development and commercialization of super-large-area film-type displays, utilizing technology that incorporates an array of plasma tubes."* He is the Corporate Officer of Finance, Sales, and Production Technology Development at Shinoda Plasma Co. He received his B.E. in material science from Waseda University.

Dr. Michio Kitamura *"for leading technical and entrepreneurial contributions in putting simulation techniques to practical use as a standard tool for designing LCDs."* Dr. Kitamura is the founder of Shintech. He received his Doctor of Science degree from the Tokyo University of Science.



Dr. James Larimer *"for his many contributions to vision science related to displays and image quality, including the development of display-performance algorithms."* Dr. Larimer is a vision scientist with Image Metrics. He received his Ph.D. in experimental psychology and quantitative methods from Purdue University.

Mr. Ryuichi Murai *"for his leading contributions to the research and development of large-sized plasma displays, especially his commercialization of the 103-in.-diagonal PDP."* Mr. Murai is a researcher at Panasonic. He graduated from Osaka University with an M.S. degree in the engineering of plasma diagnostics.

Dr. Helge Seetzen *"for the technical and commercial development of high-dynamic-range displays and the pioneering of local-dimming display technology."* Dr. Helge Seetzen is CEO of TandemLaunch Technologies in Westmont, Canada. He received his Ph.D. in interdisciplinary imaging technology from the University of British Columbia.

Dr. Tsutae Shinoda *"for his outstanding contribution to the development and commercialization of super-large-area film-type display, utilizing technology that incorporates an array of plasma tubes."* He is Chairman and President of Shinoda Plasma Co. He received his Ph.D. in electro-communication engineering from Tohoku University.

Mr. Gregory Ward *"for the technical and commercial development of high-dynamic-range displays and the pioneering of local-dimming display technology."* Gregory Ward is currently working as a consultant to Dolby Canada Corp. He holds an M.S. degree in computer science from San Francisco State University.

Dr. Lorne A. Whitehead *"for the technical and commercial development of high-dynamic-range displays and the pioneering of local-dimming display technology."* Lorne Whitehead is a professor, NSERC/3M Industrial Research Chair, and University Leader of Education Innovation at the University of British Columbia. He received his Ph.D. in applied optics from the University of British Columbia.

Dr. Bos has authored more than 100 papers in the field of liquid crystals and liquid-crystal displays and holds more than 25 issued patents. He received his Ph.D in physics from Kent State in 1978 and was a principal scientist in the Display Research Laboratory of Tektronix, Inc., before returning to Kent State in 1994 to teach and conduct research.

Lewis and Beatrice Winner Award

Awarded for exceptional and sustained service to SID.

Mr. Makoto Maeda, a SID Fellow and Special Recognition Recipient, has earned this award "*for his exceptional and sustained service to the Society for Information Display, especially his outstanding leadership as Chapter Chairman, Director, and Regional Vice-President, all of which contributed significantly to the growth of the Japan Chapter.*"

Mr. Makoto Maeda

In 1965, Mr. Makoto Maeda began his involvement with CRT development at Sony, and contributed to the development of the Trinitron Color CRT in 1968. In 1974, he facilitated a new CRT production plant in San Diego as a quality-assurance manager, going on to develop and launch a flat monochrome 2-in. CRT. In 1990, he developed a 0.7-in. polysilicon TFT-LCD panel for a viewfinder, which was later put into production.

In addition to his technical contributions, Mr. Maeda has been a particularly active and involved member of SID. His first activities for the society were performed as a member of the SID Program CRT subcommittee. From 1998 to 2000, he was Japan Chapter Chair and contributed to increasing the chapter membership by 30% from 650 to 850. During those years, he nominated many chapter members for SID Awards, and as a result, 20 out of 31 special recognition awards and fellow grades went to Japan Chapter members. Based on his activities, chapter membership also grew to more than 1000 in 2008.

"His friendly smile combined with a strong will," says Dr. Shigeo Mikoshiba, a member of the Honors and Awards Committee and also a past president of SID, "not only promoted Sony's CRT business, but the SID Japan Chapter, SID Asia Region, and the entire SID community."

From 2000 to 2003, he served as Japan Chair Director, and from 2003 to 2004, as Regional Vice President Asia. From 2003 to the present, he has been a member of the Japan Chapter Executive Committee and continues to be a strong supporter of SID activities.

Mr. Maeda graduated with a degree in physics from Kyoto University in 1965. ■

The Society for Information Display is indebted to the following companies, who each donated $2000 to sponsor a prize:

Braun Prize
AU Optronics Corp.

Rajchman Prize
Sharp Corp.

Otto Schade Prize
Samsung Mobile Display

Slottow-Owaki Prize
Fujitsu, Ltd., and Dr. Tsutae Shinoda

2010 SID Display of the Year Award Winners

The Society for Information Display's Display of the Year Awards committee has selected six 2010 award winners that advanced the state of the art of electronic-display products and technology during 2009 in the categories of Display of the Year, Display Component of the Year, and Display Application of the Year.

by Jenny Donelan

"THE electronic-display industry continues to demonstrate a remarkable ability to invent, develop, and bring to market innovative and valuable new display concepts and products," notes Bob Melcher, Display of the Year Awards (DYAs) committee chairman. "The committee had to choose from an impressive list of nominees from three continents. The winners represent contributions to some of the hottest topics in the display industry today, including 3-D, touch, low power, and pico-projectors."

A definite synergy exists between most of this year's award winners and the new special topics of focus for the 2010 Display Week Symposium. Among these topics are 3-D, touch, and green technology. Three products – LG's 3-D LCD panel, RealD's XL Cinema System, and NVIDIA's 3D Vision active-shutter glasses – are designed to further the progress of 3-D, a technology that is definitely living up to its commercial promise. Another winner, N-trig's DuoSense Solution, is designed for pen and multi-touch. And another, Pixel Qi's 3Qi Multimode LCD, uses reflective technology in conjunction with LC to save energy, which is an important part of the symposium's new green-technology focus.

The sixth product, Nikon's CoolPIX S1000pj, a compact digital camera with a built-in VGA liquid-crystal–on–silicon (LCOS) projector, is also exciting because those of us in the display industry have been excited about the commercial potential for pico-projectors for a long time. Now, this technology is being put to use as part of a shipping product that costs less than $500.

These products, and the companies that created them, will be honored at a ceremony during the annual SID luncheon, which takes place on May 26, 2010, during Display Week in Seattle, Washington. 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.

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

Display of the Year

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

Gold Award: LG Display's 47-in. 3-D LCD Panel

LG Display's 47-in. 3-D LCD Panel is the first commercially available TFT-LCD module for 3-D televisions in the mid-40-in. range. The panel works with polarized glasses to provide bright, high-quality 3-D imagery (and vivid 2-D imagery as well) that is comfortable for viewing, without the crosstalk or flicker that can cause dizziness and eye strain.

LG Display has been researching and developing 3-D LCD panels in both stereoscopic (viewed with glasses) and autostereoscopic (no glasses) versions for several years. To create the 3-D LCD, the company developed a new patterned retarder and its own special process of glass lamination.

The patterned retarder separates the polarization states between the odd and even lines so that right- and left-eye images can be seen completely separately. Right-eye images are presented by the odd lines and left images by the even lines. Viewers' right and left eyes, therefore, see different images with the polarized glasses, making the images appear three dimensional. The retarder, in combination with the special glass lamination process, enables a low surface reflection with no moiré pattern, greatly improved luminance, and crosstalk-free imagery.

Crosstalk, which breaks down the stereoscopic effect, refers to any degradation between the optical separation of the right- and left-eye images as viewed by the observer. The lesser the crosstalk value, the more realistically and comfortably people should be able to view imagery on the 3-D panel.

The panel also uses in-plane switching (IPS) for superior viewing. It employs LG Display's proprietary technology to realize clear imagery and is the brightest of any currently available 3-D LCD panels that use glasses. Moreover, the 3-D viewing works with low-priced polarized glasses. Many other types of 3-D LCD panels require special "shutter" glasses that are relatively expensive. Unlike shutter glasses, polarized glasses have a simple structure without components such as batteries and electronic control units. They are lightweight, stylish, and allow users to

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DISPLAY OF THE YEAR

Gold Award: *LG Display's 47-in. 3-D LCD Panel is the first commercially available TFT-LCD module for 3-D televisions in the mid-40-in. range. The panel works with polarized glasses to provide high-quality 3-D imagery.*

Silver Award: *Pixel Qi's 3Qi Multimode LCD is visible indoors and out, delivering color, video, and a clear and crisp reading experience wherever it is viewed.*

comfortably watch 3-D images in the same viewing environment as 2-D.

LG Display's 47-in. 3-D LCD panel provides excellent visual depth while making viewing remarkably comfortable. In addition, it represents a new emphasis for the company and the industry. LG Display CTO and Executive Vice President In-Jae Chung remarks, "The display industry players are shifting their focus from two- to three-dimensional technologies in order to deliver more vibrant and true images. LG Display will step up development of 3-D technologies and products to provide customers and consumers with differentiated value."

Silver Award: Pixel Qi's 3Qi Multimode LCD

Active-matrix liquid-crystal-display (AMLCD) technology is the technology of choice for many applications, from mobile devices to large HDTVs. But there are areas where today's LCD is lacking: it is power hungry, particularly when the display is optimized for high luminance; it is not easily viewable in brilliant ambient light; and it is not considered an ideal medium for comfortable, long-term reading.

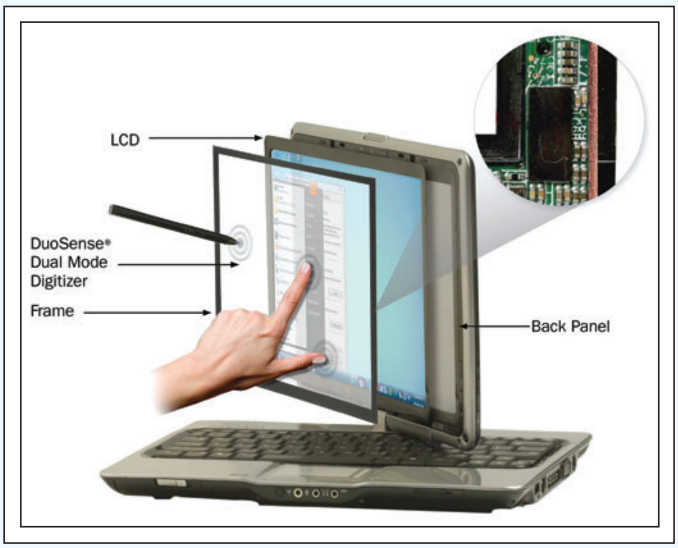
These are the challenges tackled by Pixel Qi, a California and Taipei start-up company founded in 2008 by Dr. Mary Lou Jepsen. Jepsen previously co-founded the One Laptop Per Child program, for which she developed an earlier generation of the 3Qi screen. Today's version builds on her experience in delivering sunlight-readable screens for children in less technologically developed countries – from Peru to Nigeria to Nepal.

In developing the newer 3Qi multimode LCD technology, Pixel Qi added another requirement: the display had to be manufactured in existing LCD fabs. The use of standard manufacturing processes and materials enabled rapid ramp-up to volume production of reliable displays at competitive costs: Pixel Qi has been making strides as a genuinely fab-less screen developer.

The 3Qi display has all the advantages of a standard backlit LCD: rendering quality, full-color images and full-motion video, and high screen luminance using regular backlights. But unlike standard displays, in high ambient light levels such as in an office or home, the 3Qi display's reflective mode contributes to the rendered image, allowing the backlight to be turned down or off, which delivers significant power savings and makes for an attractive screen and comfortable reading experience – with exceptionally high resolution. Outdoors, the 3Qi display really shines: its reflective mode renders a crisp image with the look of the best electrophoretic displays. This is the "next generation" of transflective LCDs – each pixel is mainly reflective, enabling high reflectance, but has about the same transmissive efficiency as a standard LCD. The user experiences an excellent reading experience in any light, plus color and video.

This ability to achieve excellence in these multiple modes sets a new standard for LCDs. To achieve this, Pixel Qi has built a strong portfolio of inventions and has nearly 70 patents in process. The first of the 3Qi displays in production is a 10.1-in. WSVGA panel targeted at netbooks, tablets, and

DISPLAY COMPONENT OF THE YEAR



Gold Award: N-trig's DuoSense Solution, a dual-mode pen and true multi-touch capacitive digitizer, is changing the way users connect with their computers by offering an intuitive hands-on approach to performing a wide variety of tasks on various computing devices.

Silver Award: The RealD XL Cinema System mounts to a commercial projector to provide, in conjunction with polarizing eyewear, cinematic-quality 3-D imagery.

e-readers. Backlit, this 600 × 1024 × 3 resolution panel exceeds the typical specification for these targeted applications, with a contrast ratio of 100:1, a wide viewing angle, a color gamut greater than 45% NTSC, and response times supporting full video rates at 60 Hz. The power consumption drops by 80% in reflective mode, while the display delivers a contrast ratio of 10:1 and a hemispheric reflectance approaching 30% – typical of today's best electrophoretic displays.

Additional 3Qi displays will follow, targeting portable devices from smart phones and digital cameras to mid-sized tablets and e-readers, with color in reflective mode as an option.

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: N-trig's DuoSense Solution (for pen and multi-touch)

Touch is one of the primary channels through which we experience our world and manipulate the objects making up our environment. In order to create a way for people to interact more naturally with their computers, N-trig created the DuoSense Solution, a dual-mode pen and true multi-touch capacitive digitizer, combining all forms of input into a single device for performing tasks with a wide variety of personal-computing devices. Users can employ the pen to annotate on the screen or engage with two or more fingers to manipulate objects directly on the computing device.

N-trig's dual-mode digitizer uses both pen and zero-pressure capacitive touch to provide the company's true hands-on computing experience for mobile computers with a single device. It consists of the following:

- ***The DuoSense Digitizer:*** A customized capacitive sensor module, mounted on top of the LCD, which enables direct on-screen manipulation using pen and multiple simultaneous touch inputs, and enhances the overall user experience.
- ***The DuoSense Pen:*** Enables users to annotate, draw, and point to objects directly on the screen, complementing the inherent multi-touch capabilities. The DuoSense pen is available as either an electrostatic batteryless pen or a battery-powered Digital Pencil, both of which correspond to the same unique hardware.
  - ***The DuoSense electromagnetic pen*** requires no external power source. Using a conductive capacitor that is built into the pen, it connects to an electromagnetic field generated by an excitation coil in the digitizer. The frequencies of the conducted electromagnetic waves are controlled by the computer system.
  - ***The Digital Pencil*** is a wireless electronic pen that uses a standard AAAA battery. The DuoSense software identifies the position of the pencil and the pressure level, removing the need for

an integral excitation coil within the DuoSense digitizer and enabling it to be used with any DuoSense-enabled computer.

While N-trig engineers were developing the DuoSense Solution, they faced a number of obstacles with regard to making pen and capacitive touch easy and intuitive to use. One was palm rejection, which involved building a digitizer connection to the computer so the system could understand the difference between a user's palm resting on the screen and intentional finger commands. Another was pen and finger coordination: creating an interface that not only allowed the use of both pen and fingers, but differentiated between the two so that consumers could work with them at the same time. The last was subpixel touch accuracy: ensuring a high degree of precision so that the technology was a fit for both intricate business operations and general consumer use.

While addressing the technical obstacles, N-trig designers found that one of the greater challenges to the adoption of multi-touch was the comfort zone of a conventional mouse and keyboard. Initial meetings to promote pen and multi-touch capabilities were met with skepticism by users who did not believe that anyone would want to directly interact with their computer screen – beyond simple commands. Slowly, this skepticism turned to acceptance, as N-trig demonstrated how natural and easy hands-on computing could be. Today, touch displays are an expected part of computers and are gaining rapid acceptance within education, health-care, business, gaming, social-media, and consumer markets.

Pen and multi-touch screen displays are a natural progression of the way the computing industry is changing and developing, and have become a strategic weapon for manufacturers seeking a competitive edge. Fully compatible with various operating systems, N-trig's DuoSense is a highly technologically advanced system, driving an ecosystem built for the successful adoption of multi-touch and helping create new opportunities for the display industry to transform conventional computer interaction from impersonal input to an intuitive, human exchange.

Silver Award: RealD's XL Cinema System

The RealD XL Cinema System is an efficient polarization modulator that mounts externally to a digital-cinema projector. It works in concert with passive, circular-polarizing eyewear to produce cinematic-quality 3-D images. The product was inspired by the need to present 3-D images on larger screens. Single projector 3-D systems, at the time (around 2006) removed large portions of the available light by using absorbing linear polarizers or spectral division. The XL surpassed competing technologies by employing polarization recovery to double the light throughput of 3-D presentations. A single digital-cinema projector with XL is capable of showing 3-D movies at screen sizes up to 80 ft. in width.

Polarization recovery has been utilized in illumination optics for some time. Scientists working on RealD's 3-D cinema technology met in 2006 to discuss applying recovery principles to the original RealD Cinema System technology. A program was initiated in Boulder, Colorado, currently RealD's center for research and development, to design a polarization recovery modulator. Several months later, two XL prototypes were completed and successfully demonstrated. The prototypes were so well-received that they were promptly packaged and deployed at the *Beowulf* 3-D movie premieres in Hollywood and London.

The XL design was required to double the polarized light output of the system and, additionally, perform under the conditions of digital cinema. The system is robust in high optical flux (>30,000 lm), as considerable time was spent on process development for each component and subassembly. To maintain cinematic resolution, a careful optical implementation overlays images to extremely tight pixel tolerances. Simple and intuitive overlay adjustments minimize installation time. Once aligned and locked, the system does not require readjustment over its lifetime.

The unit, additionally, could not be too heavy, large, or cumbersome because typical cinema installations are tightly constrained. The XL fits between the projection lens and port window. A simple sliding rail system allows the XL to be removed for 2-D presentations and reinserted in the optical path for 3-D presentations.

The high efficiency of the XL offers many advantages. There is no need to change the projector lamp (or lamp power) for 2-D and 3-D presentations. Lamp power and lifetime are conserved for a greener and more cost-effective theater. 2-D to 3-D changeover is as simple as sliding the unit in or out of the projection beam. And larger screen sizes allow audiences to enjoy movies, live content, and special events in a more immersive environment. Coupled with low-cost reusable and recyclable eyewear, the RealD XL Cinema System provides unmatched efficiency and value in the 3-D cinema industry.

The XL is currently deployed worldwide, and its technology can be utilized across professional and home-theater markets. As the swelling tide of 3-D continues, the XL and the technology behind it can look forward to a very "bright" future.

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: Nikon's COOLPIX S1000pj

The COOLPIX S1000pj is the first compact digital camera to feature a built-in projector. With a simple touch of a button, the camera projects photos or movie clips at up to 40 in. in size on any flat surface. Pictures can be projected individually or as slide shows complete with music and added effects that enhance the experience.

This capability to project still images or movie clips gives birth to an entirely new form of communication, as all participants can share imagery together. For example, the COOLPIX S1000pj can be used to capture photos on a family vacation, then serve double-duty as a personal theater in the evening as everyone enjoys viewing the highlights of the day projected on a wall or a ceiling.

The pico-projector unit, which was minimized in order to be integrated with the digital camera, is based on white-LED illumination optics and incorporates polarizing beam-splitters, a reflective liquid-crystal–on–silicon (LCOS) microdisplay, and projection optics. In order to utilize the light efficiently, Nikon developed optimized illumination optics that include a type of free-form-surface optical element. The projector's specifications include the following:

- ***Brightness***: Up to 10 lm (Measurement, measuring conditions, and method of notation all comply with ISO 21118.)
- ***Image size:*** 5–40 in.
- ***Throw distance:*** Approximately 10 in. to 6 ft., 6 in.
- ***Battery life:*** Approximately 1 hour (Based on continuous use of a fully charged EN-EL12 battery at 25°C/77°F.)
- ***Output resolution:*** VGA equivalent

DISPLAY APPLICATION OF THE YEAR

Gold Award: *Nikon's COOLPIX S1000pj is the first compact digital camera to feature a built-in projector.*

Silver Award: *NVIDIA's 3D Vision wireless active-shutter glasses have been designed with top-of-the-line optics and offer ultra-wide viewing angles.*

A projector stand is included, as is a remote control that can be used to operate the projector, release the shutter, and perform other tasks. Also featured are the precision optics of a 5× zoom NIKKOR lens that provides the compositional freedom of 28-mm wide-angle coverage and macro shooting ability from as close as 3 cm (1.2 in.). This combines with the image quality and performance benefits of Nikon's innovative EXPEED digital image-processing concept to help ensure consistently clear, high-quality results are produced at the high resolution of 12.1 effective megapixels.

Silver Award: NVIDIA's 3D Vision

A transition to 3-D across all major digital media and entertainment platforms is happening now. With its NVIDIA 3D Vision technology, consisting of software and wireless active-shutter glasses, NVIDIA is helping to bring this technology to consumers, delivering ultra-realistic games, high-definition video playback, a rich movie experience, and crisp photos – all in 3-D with ultra-wide viewing angles. 3D Vision has been designed with top-of-the line optics that are used in conjunction with 120-Hz LCD panels to enable two 1080-pixel full-resolution images per eye in 3-D mode running at 60 Hz per eye. They are comfortable to wear and modeled after modern sunglasses, offering a lightweight alternative to conventional 3-D glasses. 3D Vision eyewear is a fully un-tethered solution, enabling free range of motion and up to 40 ft. of wireless 3-D viewing.

3D Vision works with any 120-Hz certified display, including the newest 3-D HDTVs, computer LCDs, notebook computers, and 3-D projectors. The included NVIDIA software automatically converts over 450 games to work in 3-D stereo out of the box, without the need for special game patches. 3D Vision is also the only stereoscopic 3-D gaming solution to fully support NVIDIA SLI, NVIDIA PhysX, and Microsoft DirectX 11 technologies.

A single charge using a standard USB cable enables over 40 hours of continuous 3-D stereoscopic gaming. Intelligent circuit design built into the glasses automatically shuts them off after 10 minutes of inactivity to preserve battery life.

Powered by NVIDIA GeForce GPUs, 3D Vision is among the world's highest-quality stereoscopic 3-D consumer solution for desktop and notebooks PCs. It forms a foundation for the new consumer 3-D stereo ecosystem for gaming and digital-entertainment PCs, unlocking clear, flicker-free 3-D stereo imagery for driving new experiences in 3-D gaming, movies, photography, and Web-streaming. ■

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The Actuality Story

Perspecta, a 360º volumetric autostereoscopic display, was the flagship product for the Massachusetts-based Actuality Systems, and an invention that may have been ahead of its time. Inventor Gregg Favalora first began creating 3-D displays as a teenager in the basement of his New Jersey home and went on to found Actuality Systems, which had a 12-year run before being acquired in 2009.

by Jenny Donelan

ACTUALITY SYSTEMS, which was founded in 1997 by inventor Gregg Favalora and others, had basically one product, but it was a standout: a 360º autostereoscopic display that allowed users to view volumetric imagery in real time. Perspecta looked like something out of a science fiction movie – a transparent dome with a three-dimensional image floating inside (Fig. 1). The product was real, however, and useful, too. One application allowed medical professionals to view patients' internal organs in the round, enabling the physicians to better pinpoint locations for procedures such as radiation. The Society for Information Display awarded Perspecta a 2007 Gold Display of the Year Award for Display Application of the Year, for being the first high-resolution volumetric display to be used in preclinical studies for cancer treatment.

Despite the promise of Perspecta, however, Actuality Systems ceased operations in April 2009. The patents for various versions of the display, as well as for Actuality's flat-panel autostereoscopic display designs, were acquired that year by a product-design firm called Optics for Hire, for which Favalora now works. Favalora is optimistic about a new chapter for Perspecta and Actuality's collection of quasi-holographic technologies, especially now that 3-D is emerging as one of the hottest technologies in the market, with many commercial applications. The recent success of stereoscopic (with glasses) 3-D cinema seems to have sparked interest in autostereoscopic (without glasses) displays as well.

However, it is difficult for anyone who has founded a company that lasted a little over a decade to look back without at least some regret. Actuality Systems was based on great

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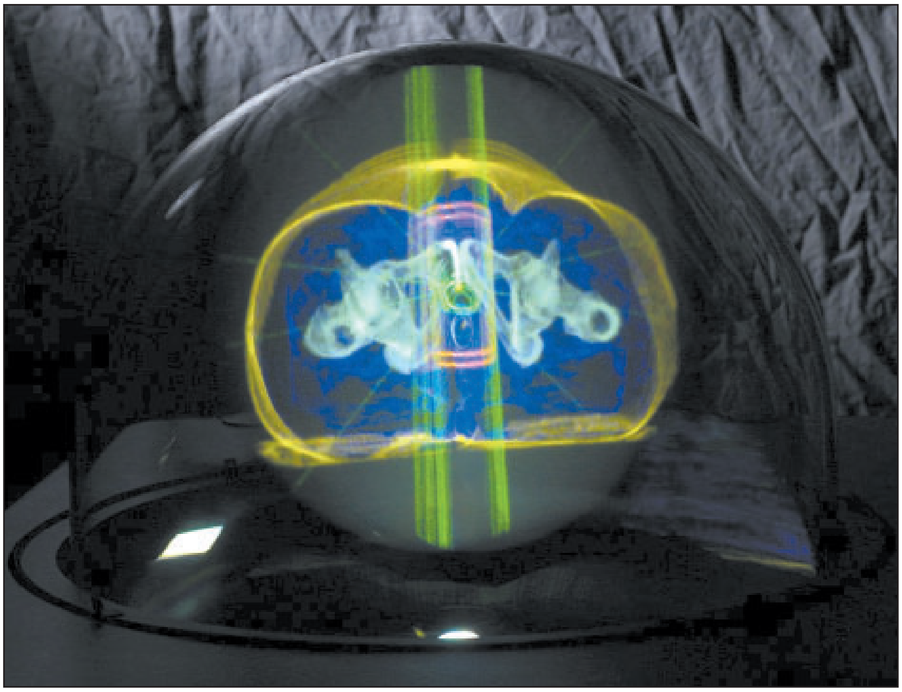

***Fig. 1:** Viewers could see all the way around the Perspecta dome display, which provided a 360º view of the volumetric image within.*

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scientific invention and high aspiration, and if it did well due to the youthful enthusiasm of its team, it also foundered for part of the same reason. In fact, one aspect of the story of Actuality, says Favalora, is how the best idea in the world may not succeed if the market is not ready. "Perspecta was a great idea," says Chris Chinnock, President of display-market-research and consulting firm Insight Media. "They pushed the technology as far as they could at the time. They were innovators, and they were just a little early."

Inventive Beginnings

Favalora was raised in northern New Jersey, in an entrepreneurial family with interests in both engineering and heavy construction. "I grew up surrounded by lenses and resistors and oscilloscopes," he says. "One day when I was in junior high, my father left his pipe-leveling laser in our basement, and I began playing around with it." As a result, Favalora started developing volumetric displays and continued to do so through high school, and then as an undergraduate at Yale. There, he created a sort of prototype for Perspecta, which he believes was at the time one of the world's highest-resolution volumetric displays. It worked by shining light onto a rotating piece of plexiglass. "The projector used 32 laser diodes, and the only thing I could do on a student budget was repurpose the laser diodes in penlights," he says. His professor designed drive circuitry to make the lasers run "faster than they should have," says Favalora, and the finished student project ended up in a display case at Yale, where it ran (to Favalora's surprise) for over 10 years.

While enrolled in graduate work at Harvard, Favalora won $10,000 in an MIT business-plan writing contest, so he left school and founded Actuality, along with high-tech entrepreneur Rob Ryan and several Harvard computer-science undergraduates. The company began in the basement of a Cambridge apartment Favalora shared with four students. The aim was to produce professional-quality volumetric displays, and the founders shared the assumption that people in mechanical CAD (computer-aided design) or pharmaceutical design would find them useful.

Financial, Technical, and Marketing Challenges

One of the first orders of business was to raise money – difficult to do during the height of the dot.com boom, says Favalora, because the emphasis was then on Web applications. "Everyone was talking about the Internet and we were making display hardware."

The team faced technical challenges as well. Perspecta's basic design featured focused light projected onto a rapidly spinning flat imaging plane. The projector, mounted in the base of the unit, worked with mirrors to relay 198 "slices" of a 3-D volume onto the spinning screen (see Fig. 2).

An early challenge was getting the pixels, which were actually voxels (volumetric pixels), to line up properly in order to draw an image. This was a problem that had not yet been solved in a volumetric display with a spinning screen. The design team therefore had to invent the algorithms to get the voxels to line up in the 3-D space. "We ended up

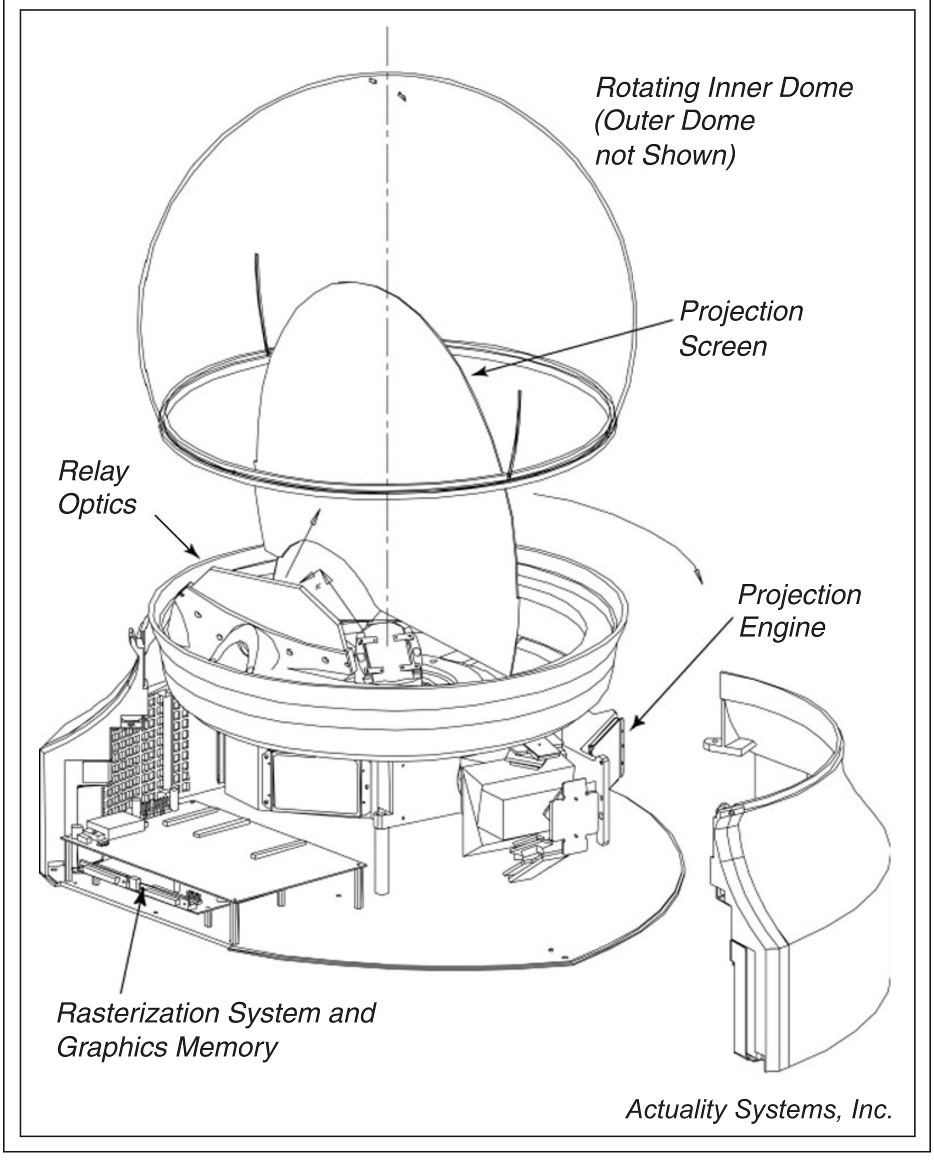

***Fig. 2:** To provide volumetric imagery, the Perspecta display projects a series of 198 2-D patterns, called slices, onto an optimized diffuser rotating at or above 900 rpm. The display sweeps the entire volume twice for every complete screen revolution, resulting in a visual refresh rate of 30 Hz.*

getting quite a few patents in that technology," says Favalora.

Favalora points out that almost all of the firm's early technical challenges would be easier to address now, due to the availability of fast graphics processing units (GPUs) and light modulators. For example, early on, Actuality successfully overcame an electrical engineering challenge, which was that in order to create an image with 100 million pixels that changed 30 times per second, the product required a projector that could change 6000 times per second. The only technology capable of that in 1999 was the TI Digital Light Processing technology. But DLP was not available as a standalone component and had no published specifications. Texas Instruments was not releasing that sort of information back then, says Favalora. So the team figured out how to control the chips themselves, hooking up with a company in New York that had already done the first half of the job. "By 2000, we were one of the only companies in the world that could drive a TI DLP at 6000 frames per second. Six young engineers in Massachusetts were getting contacted by huge companies about it – but we were required to keep the results to ourselves," says Favalora.

The final technical challenge was to design the optics and the mechanics to make it all work together. That was done, and Perspecta went on the market in 2002. There was nothing else like it. "As far as the actual viewer experienced it, it was quite nice, like gazing into a crystal ball," says Brian Schowengerdt, this year's SID Technical Program Vice-Chair for 3-D and a Senior Research Scientist in the Department of Mechanical Engineering at the University of Washington. Two of the great advantages of the display, he notes, was that multiple users could view it simultaneously and, because of the way it created the 3-D effect, it did not cause eye fatigue, as do many stereoscopic displays. A potential drawback, he adds, was that the imagery, due to its diffuse screen, had a "ghostly," translucent appearance, which was a quality that made it very suitable for certain applications (such as some types of medical visualization), but less so for others. Actuality's later solution for this issue – replacing the diffuse screen with a reflector – made the cover of *Applied Optics* in 2007.

Actuality did fill orders from universities that wanted displays to do volumetric research. But there was not a widespread market for a volumetric display costing $40,000 and upwards in 2002. Earlier on, Favalora (Fig. 3) says he had realized that "I was more technically minded at the time than business minded." He agreed with the board to bring in some seasoned managers as soon as the development work was done.

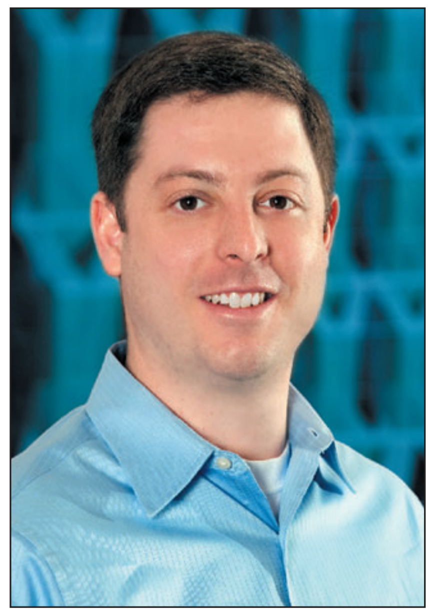

Fig. 3: *Actuality Systems' founder Gregg Favalora began creating volumetric displays as a hobby in high school. Image courtesy Sara Forrest Photography.*

The first of these was Cameron Lewis, who had come from Netscape. He established a mandate to support continuing development of the product while also figuring out what market it could possibly be used for. Although Actuality's principals had talked about how Perspecta might be applicable to molecular visualization or medical visualization, they had not talked to many customers yet, and Lewis thought they should. So Favalora and some associates packed a Perspecta into a special crate and carted it in a van from San Diego to Seattle, visiting 30 companies in 2 weeks. They learned a great deal from this trip – not least that there was not quite as much interest in the display as they had thought. They learned quickly that molecular visualization was not the right market. They learned that venture capitalists in 2002 were hesitant to invest in display technologies. And they learned that there was potential for using the display in medical imaging. This last discovery was a theme that would persist throughout the life of the company.

Evolution and Funding

Because venture capital was first of all focused on Internet applications at the time, and venture capitalists were leery of display technology, Actuality ended up surviving on the generosity of "angel" investors. "The company had over 80 individual investors, which is astounding," says Favalora. All these people believed in the value of floating 3-D images, he says. At the time, Actuality was also receiving funding from NIST for work on floating imagery outside of a flat screen.

With NIST's backing, Actuality's mission expanded to develop technologies that would permit replacing any display surface with an autostereoscopic display. The team developed a broad collection of these "quasi-holographic" displays, which projected high-resolution imagery visible from a wide field of view. For the most part, flat-screen autostereoscopic displays had previously suffered from banding, low resolution, or small images. Actuality's engineers tackled all three issues, using fast TI DLP projection technology with a variety of beam-steering methods to produce floating 3-D images from a single workstation. These included prototypes and concepts for tabletop, handheld, and desktop 3-D.

Final Years

In 2005 (see Fig. 4), former iFire CEO Michael Goldstein was recruited by Actuality's board to run the company. Actuality began participation in a three-hospital 30-patient cancer study that looked at whether a 3-D volumentric display would help doctors plan cancer treatment. "We finished that study and, resoundingly, the display allowed doctors to derive better plans." (This was the application that earned Perspecta a SID Display of the Year Display Application of the Year award). But as it turned out, explains Favalora, investors were more interested in a company that could improve cancer treatment using just software.

Since the team had gained so much knowledge about medical systems, around 2007, the company completely changed direction and became Actuality Medical, a software developer for prostate-cancer procedures. "During the last 2 years of the company, we would wake up in the morning, put on scrubs, and go into the OR to record prostate-cancer procedures," says Favalora.

Investors were patient through the financial crisis of 2008, he explains, but in 2009, he was asked to return as CEO. Shortly after that, seeing that there was very little money left, he laid off the staff and shut down the company. At its height, there had been 23 engineers and manufacturing personnel at the company's Burlington, Massachusetts, headquarters.

***Fig. 4:** The team at Actuality Systems poses near a Perspecta display (center) in 2005.*

Lessons Learned

"If I had to do it again," says Favalora, "I would not underestimate the importance of a product marketing plan. I would hire additional people who are really brilliant at product marketing so we could understand exactly what the customer wanted and then build that instead of building something and then trying to find customers." From the beginning, Favalora thought it was obvious that a 3-D display was needed and wanted. "And almost universally," he recalls, people's reaction on seeing Perspecta would be to say, " 'wow, that is the coolest thing I've ever seen.' " Or people got excited because the display allowed them to see their data immediately, without having to fiddle around for 15 minutes before they could understand it. But those things did not translate to volume sales.

"There were also comments that we needed to offer more software applications," says Favalora. He thought they were fulfilling that need by offering a software development kit. But people did not want to have to create new software and systems to use the display. "Another lesson we learned was to provide a system rather than a component," he says. It was the equivalent of selling an engine when people wanted a whole car.

The Future

Perspecta itself was a technical success in many ways. The display seldom failed to fascinate, and, at trade shows, Actuality's booth would be swamped. About 25 Perspecta displays are still out in the field, mostly at universities. A graduate student recently earned his Ph.D. with award-winning work involving one.

And then there are the patents – 19 of them, and six pending. Actuality started with the idea for Perspecta and ended up with an extensive portfolio covering prototype-proven 3-D autostereoscopic technologies in volumetric displays, image computing, and quasi-holographic displays. They were acquired by Optics for Hire in 2009 and are now being represented by IP broker Quinn Pacific. Favalora notes a "land-grab" for autostereoscopic 3-D technologies, as consumer electronics and entertainment firms struggle to make sure they do not lose their market positions. Videos explaining several of the patents and their applications are now online at www.youtube.com/user/opticsforhire.

Is there really a market for a device like Perspecta now? Favalora is confident that autostereoscopic products will become widespread, in step with interest in stereo 3-D. And he notes that it is possible to make Perspecta-type displays available at prices ranging from $1000 to $10,000 apiece, and quasi-holographic systems based on Actuality IP for even less.

Schowengerdt believes that a lower price point could make Perspecta a viable prospect for applications such as gaming, particularly in arcade or other public environments. "It would be an excellent platform, especially for multiplayer games," he says, adding that advertising is another possible area for exploration. So time will tell if new market conditions (and patent buyers) will bring Perspecta and the other Actuality Systems IP-based products back to life again. If so, the story might turn out very differently. "It would be a new game for someone entering this territory now because affordable components are finally meeting up with consumer demand," says Favalora. ■

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Optical Enhancement and EMI Shielding for Touch Screens

The demand for touch technology has infiltrated almost every device involving a display. As such, engineers are being asked to incorporate touch screens into designs for an ever increasing range of applications and environments. Successful projects will provide the optimum balance of readability and electromagnetic compatibility.

by Brian E. Herr, Jeff Blake, and Richard D. Paynton

ELECTRONIC DISPLAYS with touch-screen interfaces are now commonplace in marine, military, and mobile applications. In these demanding environments, the necessary high-ambient-light readability and electromagnetic compatibility (EMC) can be most efficiently achieved through enhancements to commercial-off-the-shelf (COTS) components. System designers must maintain EMC and enhance COTS touch screens that otherwise would degrade the high-ambient readability of the display to an unusable level. Electromagnetic radiation emitted by the device, or electromagnetic susceptibility to radiation somewhere in the environment, are also present significant challenges because the face of the display still needs to be transparent. The term EMC in general denotes the ability of an electronic system to function within its operational environment without emitting unacceptable levels of electromagnetic radiation or failing to perform due to the influence of an external electromagnetic field in its working environment.

The technology to modify display systems for both high-ambient-light readability and EMC compliance is readily available. Touch screens integrated into display assemblies can be configured to provide an electromagnetic interference (EMI) shielding conductive ground plane and contrast-enhancement features to address these issues. The enhancements described in this article focus on resistive touch-screen technology and its integration into high-ambient-light-readable liquid-crystal-display (LCD) assemblies, but are applicable to other touch-screen technologies as well.

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High-Ambient-Light Readability

High-ambient-light readability is a performance characteristic of a display system that is directly dependent upon three factors: the available luminance of the display, the amount of ambient illuminance in the environment, and the amount of ambient light reflected by the display and front optical components, including the touch screen. To be truly labeled as "high ambient readable," the display system, when energized, must be readable in the worst-case conditions for the product's intended use (*e.g.*, direct sunlight). Surface reflections, which occur at interfaces between mediums of differing refractive indices, degrade contrast by reflecting the incident light. For instance, plain, clear, uncoated glass in air has a photopic reflectance of 4.25% on each surface due to the difference in refractive index between the glass and air. The even higher-refractive-index conductive coatings used in constructing most resistive touch screens can reflect up to 8–10% per resistive layer due to the high refractive index of the conductive layer and the quarter-wave effect of the thin-film coating stack. Consequently, the performance loss of a resistive COTS touch-screen assembly can exceed 24% due to the reflection caused by index-mismatch issues and the optical stack configuration (Fig. 1).

Contrast Issues with COTS Displays and Touch Screens

Using the VESA (Video Electronic Standards Association) Flat Panel Display Measurement (FPDM 2.0) standard and military standard MIL-L-85762A as a basis for the test procedures, the optical performance profile of the display can be accurately quantified. (Many commercial procedures and practices do not allow for direct comparisons and correlations between products and companies.) A good contrast measurement will quantify the disparity between the activated or "on" areas of the display and the dark or "off" areas in a standardized high-ambient-light environment. Contrast will decrease significantly with increased reflections in the display system (*e.g.*, the insertion of a highly reflective touch screen) [see Eq. (1)].

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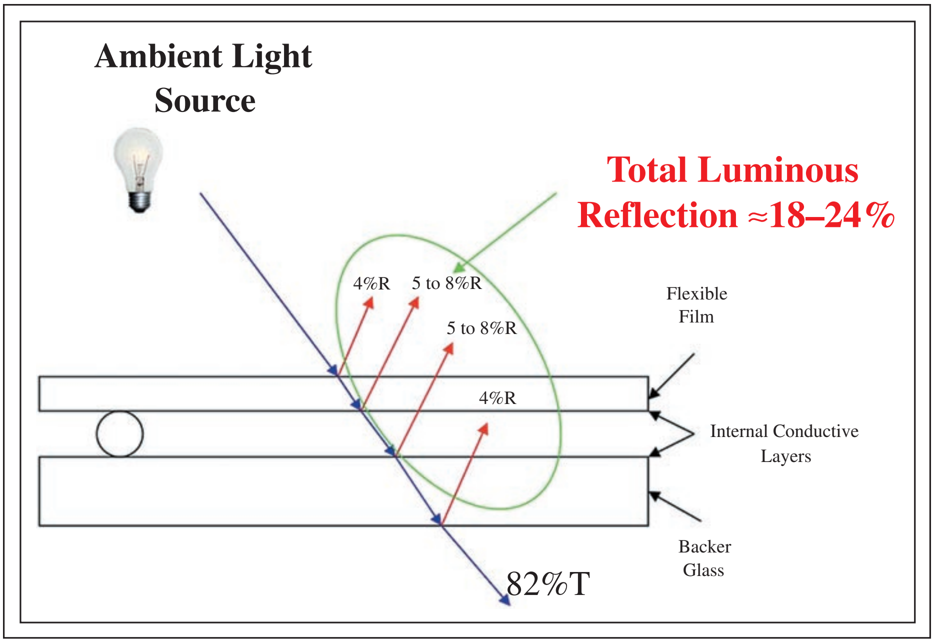


Fig. 1: Luminous reflection is shown in a standard resistive touch-screen construction.

Contrast Ratio or Luminance Ratio = Total luminance of the image, including any background or reflected light, as measured in the specified lighting conditions divided by the luminance of the background, or dimmer area, including any reflected light and any stray display emissions, measured in the specified lighting conditions. Eq. (1)

Dark Ambient:
Contrast Ratio = Light Area of Display / Dark Area of Display = Light / Dark

High Ambient:
D_L = Lambertian Component of the Diffuse Reflection, S = Specular Reflection, D_H = Haze Component of the Diffuse Reflection.

Contrast Ratio = (Light + Reflections) / (Dark + Reflections) = (Light + D_L + S + D_H) / (Dark + D_L + S + D_H) = (Light + D + S) / (Dark + D + S).

Resistive touch screens have four major interfaces, each of which either goes from air to an optical medium or, conversely, from an optical medium to air, all of which are sources of reflections. Reflection problems are further compounded because the resistive touch screen comprises plastic substrates with hard coatings and thin-film coatings on both rigid and flexible optical materials (either glass or plastic) that create additional material interfaces and sources of reflection. Hard coatings are thick-film coatings (typically > 0.012 mm in thickness) that improve the durability of polymer layers (*e.g.*, abrasion-resistant coatings) and are typically applied as a wet chemistry. Thin-film coatings, used to convert reflected light to transmitted light and to create transparent conductive coatings, are typically 100–3000 Å in thickness and are either applied by sol-gel (chemical solution deposition) or high-vacuum-coating processes. A better understanding of the cumulative effects of the surface reflections for the bulk or thick-film materials can be attained using the Fresnel equation for normal reflections:

$R = R_S = R_P = [(n_1 - n_2)/(n_1 + n_2)]^2$. Eq. (2)
R_S = S polarization component
R_P = P polarization component
n = index of refraction

When applied for normal incident light to the first surface interface where the initial medium is air ($n_1 = 1.0$) and the exit medium is an acrylic hard coating ($n_2 = 1.5$), the result is a value of 4% for the first surface reflection. The reflection increases due to refractive index differences between the conductive thin-film coating (*i.e.*, the active conductive layer inside the touch screen), the substrate, and air. The reflection can be reduced by "index matching" of the conductive coatings (*e.g.*, adding a dielectric layer to the conductive coating to lower its reflection compo-

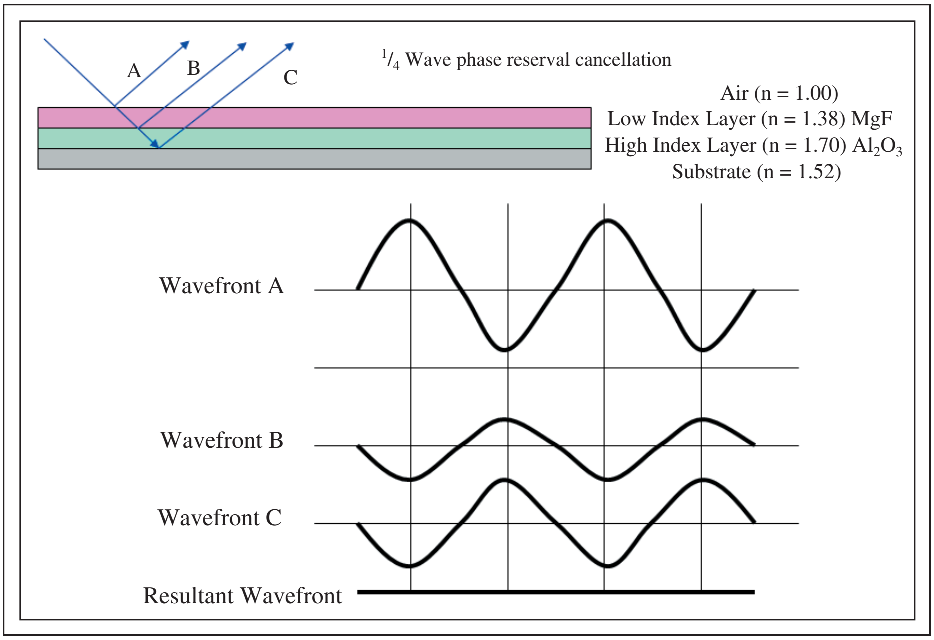


Fig. 2: Above is an example of a basic index-matching coating to air.

nents). For a resistive touch screen, the conductive layers can only be partially optimized or index-matched (see Fig. 2) because the surfaces of the active portion of the touch screen must remain conductive.

Design Considerations: Optical Enhancements to Touch Screens

Antireflective, antiglare coatings, polarizers, and optical bonding:

In order to reduce the surface reflections in a touch-screen display system, each interface must be considered. By lowering the refractive index of the touch-screen surfaces, an antireflective coating on both the front and rear surface can reduce surface reflections by approximately 7% by reducing the inherent 4.25% reflection per surface to less than 0.75%. The total reflections for the outer surfaces will be reduced from 8.5% to < 1.5%. However, there can be a wide range of internal reflections in a COTS touch screen (*i.e.*, < 2% to > 8% per interface). A thin-film antireflective coating cannot be directly deposited in a vacuum to the completed COTS resistive touch screen. The deposition process would cause the air gap between the flexible membrane and the rigid support layer to collapse, which would result in varying degrees of plastic deformation around the spacers and the degradation of the touch screen's optical and electrical integrity. For this reason, it is common to apply a conductive coating to an optical substrate, then to laminate it onto the surface of the touch screen. The most cost-effective method is to apply a flexible-film lamination (0.003–0.009 in. in total thickness) to one or both surfaces of the touch screen. Common optical substrates include polyethylene terephthalate (PET), cellulose triacetate (TAC), and glass. The flexible substrates can be coated with acrylic or silane-based hard coatings to improve mechanical durability and antiglare coatings to scatter specularly reflected light. Considerations for carrier film selection are index of refraction, durability, cost, and birefringent properties.

Optically coupling the rear surface of the touch screen with the front surface of the display using an index-match bonding adhesive is becoming an increasingly popular method to improve high-ambient-light readability. By using optical bonding, two reflective surfaces are eliminated, thereby increasing contrast. Additional benefits include elimination of internal surfaces where condensation can occur as well as better shock and vibration performance.

As shown in Fig. 3, internal reflections, coupled with ambient light reflected from the front surface of the display or rear surface of the touch screen, will reduce contrast and viewability. To address this issue, a circular polarizer (CP) can be integrated into the front surface membrane of the resistive touch screen to suppress internal reflections. The CP is a linear polarizer combined with a quarter-wave retarder. Unpolarized ambient light entering the display from the outside first passes through a linear polarizer (the first layer of the circular polarizer). When the light, now linearly polarized, passes through the quarter-wave retarder, it is separated into two equal components that are one quarter wavelength out of phase with one another (*i.e.*, the phase relationship is such that the leading component is one quarter wavelength ahead of the lagging component). When this

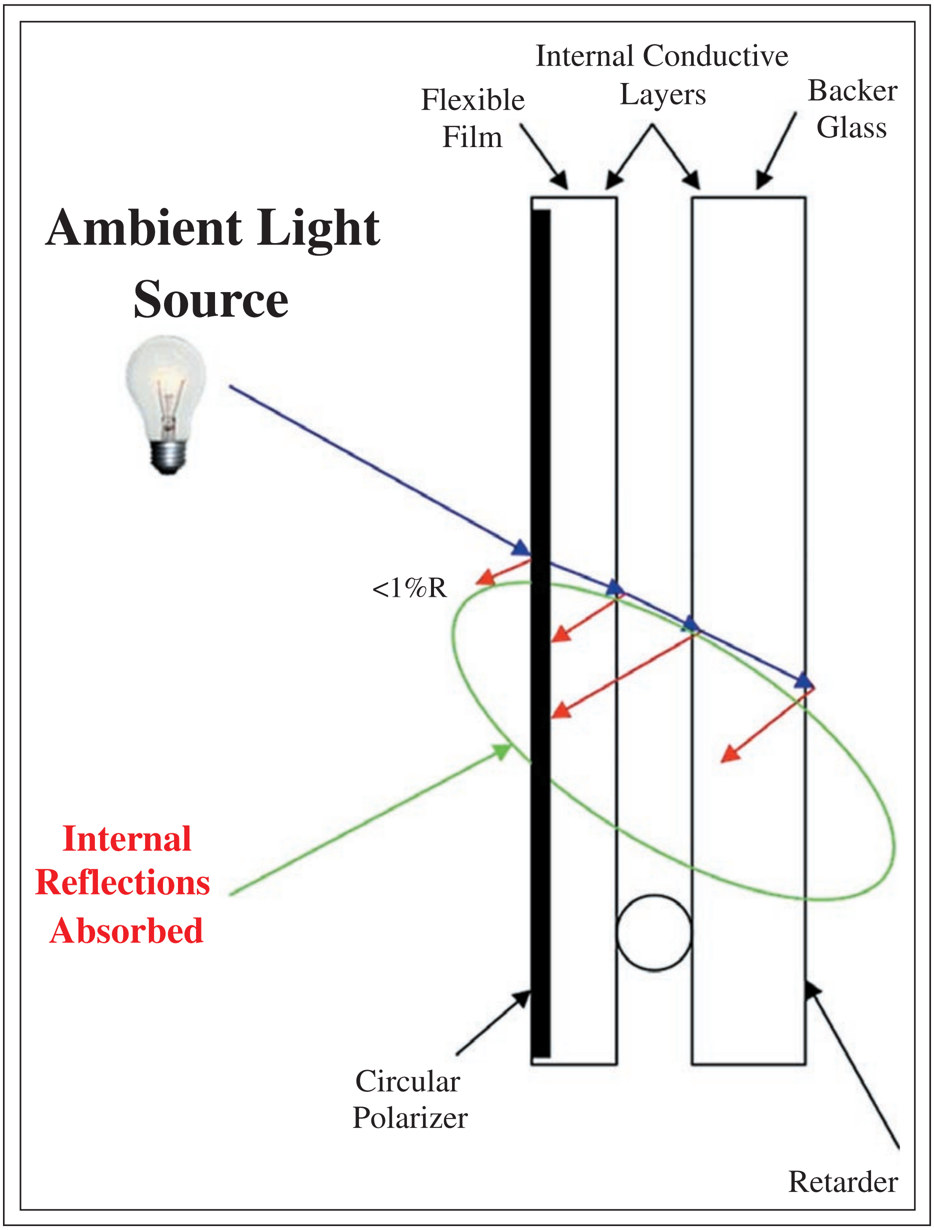


***Fig. 3:** Polarized construction details show where internal reflections are absorbed.*

light strikes a specularly reflecting surface (*e.g.*, the conductively coated internal layer of a resistive touch panel) and is reflected, the phase relationship between the two wave components is reversed. Therefore, the previously lagging component is now one quarter-wavelength in front. It then re-enters the retarder. The retarder realigns the two components and the resultant light is oriented 90º from the original light. Thus, when it then passes through the linear polarizer again, it is blocked because it is 90º opposite to the linear polarizer. In this way, unwanted reflected ambient light originating outside the display is separated from the desired light emitted by the display. This methodology can eliminate almost all (99%) internal reflections by introducing a phase shift of the orthogonal components of the polarized light that is reflected off the internal layers of the touch screen.

By minimizing reflection loss, contrast and therefore high ambient readability of the display is greatly increased. When integrating a CP into a touch screen, the polarization angle must be aligned with the polarization angle of the display. Unfortunately, birefringent materials used in touch-screen construction (*i.e.*, PET) may interfere with the function of the CP and should be addressed earlier in the design.

Electromagnetic-Interference Shielding

For EMI shielding, a typical touch-screen-enabled display assembly is constructed with a Faraday cage – a continuous electrically conductive enclosure that surrounds the equipment and attenuates transmitting electric fields to a desired level. Metalized enclosures form most of the Faraday cage in typical display assemblies, but obviously must leave the display face open and viewable. Therefore, conductive ground planes (CGPs) with satisfactory transparent properties must be installed in the display's optical path to complete the Faraday cage and function as an EMI shield. If this element of the Faraday cage is not properly terminated (*e.g.*, the shielded touch screen is only terminated on one or two corners) this portion of the shield could act as an antenna and re-radiate an undesired electrical field.

Common EMI shielding techniques for adding conductive properties to an optical substrate include integration of transparent conductive coatings or a fine conductive grid of wires. Electrically conductive, optically transparent ground planes pass the dominant portion of the visible spectrum (*i.e.*, 380–780 nm). The properties of transmittance and conductance can be adjusted or tuned to fit a specific application. All transparent conductive materials require an optical substrate as a carrier. To avoid the potential for birefringence and moiré (see Fig. 6), it is important to review and understand the properties of the materials and components that compose a COTS touch-screen display assembly as well as the CGP, due to the interrelationships between the optical and shielding performance of the system. The EMI shields will attenuate the visual light transmittance from 3% to 55%, depending on the specific technology and configuration employed.

Transparent Thin-Film Conductive Coatings

Transparent thin-film conductive coatings offer excellent optical and moderate EMI shielding properties. Typical transparent conductive films include transparent conductive oxides (TCOs) such as indium tin oxide (ITO) and metal alloyed films (*e.g.*, alternating layers consisting of Ag and ITO). Increasing the conductivity of the coating will increase the average EMI attenuation level over the frequency range of 100 kHz – 20 GHz. Typical conductivities for transparent thin-film conductive coatings for this purposed range from 1 to 100 Ω/sq. Unfortunately, there is an inverse relationship between light transmittance and conductivity. Metal alloyed films offer better cost/performance options over TCOs, especially when applied to plastics. They can be cost-effectively deposited on plastics in resistances down to <3 Ω/sq. while maintaining moderate total luminous light transmittance performance (*i.e.*, >68%TL). However, the photopic transmission of metallic coatings quickly decreases as the conductivity increases due to the high absorption component and increased reflection as compared to TCOs. (100% = Absorption + Reflection + Transmission). For example, a 10-Ω/sq. dielectrically enhanced TCO (ITO) coating has <3% photopic absorption and <0.5% photopic reflection, providing a total luminous transmittance of >96%. The metallic coating equivalent transmittance is only nominally 83% due to the >3% reflection and approximate 13% absorption. Additionally, metal alloys have an inferior mechanical and galvanic durability.

By contrast, TCOs become costly to apply to plastics for resistances below 30 Ω/sq., but can be applied to glass to values below 1 Ω/sq. A low-resistance coating on glass will offer high performance but will cost more because it is deposited in a batch vacuum process rather than a web or continuous process. Additionally, most TCOs can be fully integrated into a multi-layer dielectric stack as part of a broadband antireflection (AR) coating. This is commonly referred to as "index matching." An AR coating reduces surface reflection losses and increases transmitted light. A fully enhanced TCO can have a total luminous reflection of a broadband white light source (*e.g.*, illuminant D65) of less than 0.25%. Furthermore, the photopic absorption of TCOs tends to be very low, often less than a few percent at fairly high conductivities (i.e., <10 Ω/sq.), allowing a total luminous transmittance (TL) of > 95%.

Fine Conductive Grids (FCGs)

FCGs are CGPs that offer excellent EMI shielding and good optical properties (see Table 1 for relative shielding properties).

A typical fine-conductive grid pattern is made of plated woven stainless-steel or copper mesh, or with a patterned metal coating on the surface of a substrate. Both technologies have high open areas and excellent conductivities (*e.g.*, 100 to < 3 mΩ/sq.). Plain-weave

Table 1: The typical shielding effectiveness of two different technologies – indium tin oxide and plated wire mesh – is compared.

Frequency	10 Ω/sq. ITO (db)	80 Mesh Plated (db)
H Field		
100 kHz	0	15
1 MHz	1	32
E Field		
100 kHz	72	86
10 MHz	36	81
Plane Wave		
100 MHz	24	71
1 GHz	25	58
10 GHz	18	34

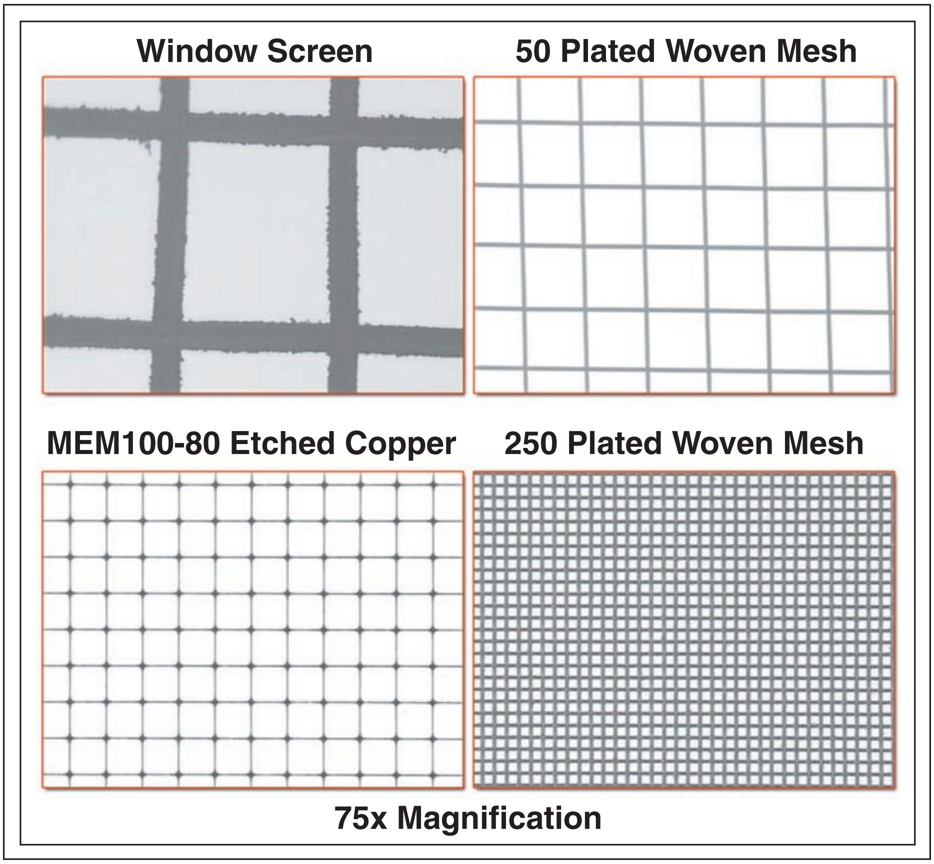


Fig. 4: For purposes of comparison, a typical window screen mesh (left) is shown alongside three different fine-wire plated woven and etched meshes, at right. All are shown at 75× magnification.

mesh is constructed with fine wires (*e.g.*, 0.0005–0.002 in.) crossing alternately over and then under one another with adjacent wires 180º out of phase (similar in construction to a window screen but significantly finer), as shown in Fig. 4.

For highest shielding applications, the mesh must be conductively plated (*e.g.*, silver conductive plating) to fuse the wire crossovers. The mesh can then be blackened with a conductive, corrosion-resistant plating to improve galvanic stability and optical performance (by reducing reflections). Patterned conductive grids are typically produced by depositing a conductive ink or etching a metalized coating on a substrate. Wire diameters can be produced as fine as 0.0005 in. and therefore provide a higher open area as compared to their woven equivalents. The surface resistance of the material typically drives the shielding effectiveness over the RF spectrum; the more conductive the material, the better the shielding effectiveness. Additionally, as the open area increases, the shielding effectiveness will be reduced. Figure 5 shows a typical touch-screen construction which can be configured with either thin-film coating or fine-conductive-grid options.

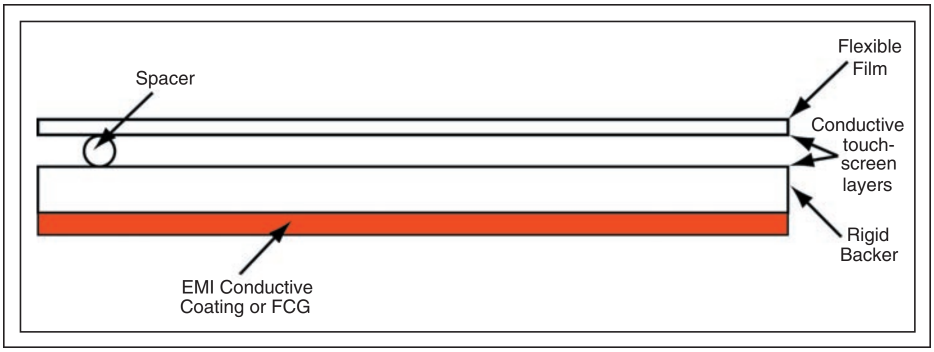


Fig. 5: Touch-screen constructions are shown with thin-film coating or fine-conductive-grid options.

Fine-conductive grids are typically specified by line pitch (*e.g.*, the number of strands per inch in the x and y directions. For example, a mesh with 80 lines per inch in both the x and y directions would have lines spaced 0.0125 in. or 0.3175 mm and simply be called “80 mesh” for shorthand since the spacing is the same in both axes. Alternatively, it can be specified in terms of openings per inch (OPI). Standard mesh pitches range from 50 to 255 lines per inch (lpi). Different line pitches are available for increased shielding needs and for moiré control options. (See Table 2 for a comparison of transmittance, reflection, and shielding properties between coating and mesh technologies.)

EMI-shielding design

The EMI shield can be applied to the front or rear surfaces of the touch screen. Care must be taken not to interfere with the resolution or sensitivity of the touch screen if the touch screen itself must be shielded (*i.e.*, the CGP is on the outermost surface). Thin-film conductive coatings applied to the rear surface of the touch screen offer a simple, cost-effective way to achieve EMI attenuation but they do not prevent susceptibility or radiation of the touch screen itself. The degree of index matching of the rear surface is dependent upon the contrast required or the amount of rear surface reflection that can be tolerated.

Grounding the conductive coating can readily be achieved by using an electrically conductive pressure-sensitive adhesive (PSA) and attaching the touch screen to a metal LCD frame, bezel, or housing to complete the Faraday cage. A conductive adhesive or gasket can also be used to terminate the CGP.

Table 2: Thin-film conductive coatings and fine-wire mesh are compared in terms of transmittance, reflection, and shielding. Note: etched mesh with a wire width of 0.0005 in.

CGP	Transmittance (%)	Reflection (%)	Shielding
10-Ω/sq. Metal Alloy	80	7 to 8	Low
10-Ω/sq. ITO	88	7 to 8	Low
10-Ω/sq. IMITO	≥ 96	< 0.5	Low
2-Ω/sq. ITO	78	10	Fair
2-Ω/sq. IMITO	≥ 87	< 1.0	Fair
50 Mesh	80-85	0.15 to 0.35	Good
80 Mesh	77-83	0.15 to 0.35	Good
MEM100-80	81-86	< 0.6	Fair-Good
100 Mesh	66-69	0.15 to 0.35	Good
255 Mesh	40-44	0.15 to 0.35	Superior

Whenever two light-transmitting matrices are overlaid, there is a potential for a moiré pattern to be generated. If the spatial frequency of the matrix is close to that of the display's pixels, the resulting moiré pattern (Fig. 6) will hinder display readability. Therefore, a touch screen with a fine-grid CGP must be optically fitted, by adjusting the grid orientation, to the specific electronic display (*e.g.*, LCD) to minimize or eliminate this phenomenon. EMI/EMC performance will not change when the grid orientation is adjusted. The necessity of creating a good "optical fit" makes the remote design process more challenging compared to designing with transparent film processes. Empirical optical testing may be required.

Conclusion

Touch screens are becoming more and more prevalent as the user interface of choice for high-ambient-light readability applications. COTS touch screens can be optimized to improve both environmental and optical properties. Knowing that the performance of COTS touch screens can vary, it is best to start with a product that has properties close to those required in the end application and to select touch-screen attributes that will not interfere with any required enhancements. To minimize EMI in the final product, shielding enhancements can be readily incorporated into either the front or rear surface of the touch screen using a lamination process of secondary materials (although a conductive ground plane is more readily applied to the rear of the touch screen). Transparent thin-film conductive coatings are recommended for applications requiring low levels of EMI shielding, low package thickness, and low cost. Fine conductive grids are the material of choice for very high levels of shielding (Table 3).

Both technologies should be considered for moderate levels of shielding. Because there is not one solution that works best for all applications, each should be considered unique and the particular EMI enhancement should be selected for specific end-program suitability. ■

Table 3: Design considerations involved in selecting a touch-screen optimization technology include cost, shielding needs, and appearance.

Priority	Recommended Designs
Cost	*Film*
Shielding needs	*Conductive grids (woven and etched mesh)*
Visual appearance	*Film (Film is continuous; all conductive grids present the possibility of moiré generation, and require optical fitting); Etched mesh (near-perfect uniformity)*

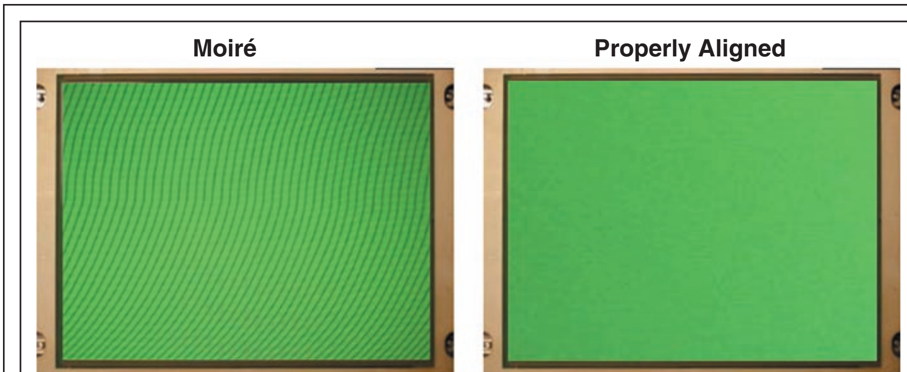


Fig. 6: *The moiré effect is illustrated with incorrectly fitted (left) and properly optically fitted (right) fine-conductive grids.*

Navigating through Display Options

Jeff Ittel
Senior Vice President

When it comes to choosing the right display, engineers must navigate through an obstacle course of options before making the right decision. Once you have scaled the colossal wall of display options to choose from and locked down the environment that the display will be used in, you have to jump though the hoops of system requirements and juggle the projected life cycle for the display – all the while facing the ticking clock of time-to-market pressures. Fortunately, there are resources available to help guide you through the process and make sure you come out on top. Many engineers choose to involve value-added distributors, such as Avnet, in their selection and implementation process – taking full advantage of the additional support they provide. Not only will design engineers have a wide array of products from leading manufacturers to choose from, but they also receive the added benefit of a robust portfolio of services designed to help expedite the product-development process. To make the process feel less like an obstacle course, I have outlined three easy steps to help take the guesswork out of choosing and implementing a display.

Get The Inside Track

Once the display requirements for an application are defined, the next step is evaluating manufacturer offerings to see who provides the solution that best matches your specific requirements. Every brand has its strengths and offers unique features designed to support a particular market or application. Further, the total solution must be considered, including inverters, controllers, cabling, touch screens, and related accessories. To avoid trying to fit a square peg into a round hole, input from a trusted advisor with exposure to a wide range of options is beneficial. Avnet's technical teams, deployed across all local markets, have been trained directly by the manufacturer – attending the same training as the manufacturer's own technical support personnel - and offer a variety of solutions in an unbiased manner and also discuss the various manufacturer product roadmaps. Designers not only benefit from the comparison of today's available solutions, but also get a first-hand look at what technology will be available in the near future. This allows designers to differentiate their product and ensure their competitive advantage is sustained in the future.

Choose the Right Manufacturer

The added information you get from a value-added distributor such as Avnet will help narrow down your search for the right manufacturer whose products will fit the needs of your application. Avnet enjoys strong relationships with many leading display providers - including Optrex, Renesas Electronics (formerly NEC LCD Technologies), Sharp Microelectronics, and Toshiba Electronics. Each of these companies is a recognized leader and innovator in the display technology space. Here are some of the distinguishing characteristics for each of these companies:

Optrex: An LCD manufacturer with over 30 years of experience, Optrex offers:

- Super-high-bright LED and CCFL backlights for outdoor applications, allowing for clear visibility in direct sunlight. Backlighting is available up to 1500 nits with full factory warranty.
- Multiple touch-screen solutions: 4- and 5-wire resistive touch or capacitive touch switch.
- Factory optical / glass bonding options are now available on select modules.
- Long-term product support. Long product life cycle with backward compatibility with new product launches.
- The most complete industrial TFT-LCD line; 2.0-in. QVGA up to 17.5-in. WXGA. Long product life and field-replaceable LED backlights.
- Vivid color. Patented NCM (Natural Color Matrix) technology for a more-true color reproduction.
- Robust design: High performance in any challenging environment; wide temperature range; wide viewing angle; high shock and vibration standard.

Renesas Electronics: A leading provider of high-quality innovative, active-matrix liquid-crystal display (AMLCD) modules for the industrial and high-end monitor markets.

- Modules that range in size from 2.7 to 23 in.
- A variety of resolutions: Quarter video graphics array (QVGA) to quad super-extended graphics array (QSXGA).
- Multiple technologies: transmissive, transflective, SOG, SFT, and more.
- Ideal for a large spectrum of applications, including PDAs, medical equipment, point-of-sale (POS), and gaming.
- Four core technologies:
  - Super-fine TFT (SFT) for ultra-wide viewing.
  - Natural light TFT (NLT) for viewing in a variety of ambient-light environments.
  - Value-integrated TFT (VIT) for compact designs with low energy consumption and multi-functionality adaptive design technology.
  - Adaptive technology.

Sharp Microelectronics: Technology, innovation, and support are the recognized traits of Sharp Microelectronics with products covering the gamut of LCD and panel displays.

- Long-term support of the LCD industrial market with typical life span of 3–5 years. Rugged, high-quality displays for a variety of industrial applications.
- Broad breadth of industrial-application LCDs offering from 1.3- to 28-in.-diagonal sizes.
- Extensive North-American-based technical sales and application support to aid in design-related challenges.

Leading Innovation

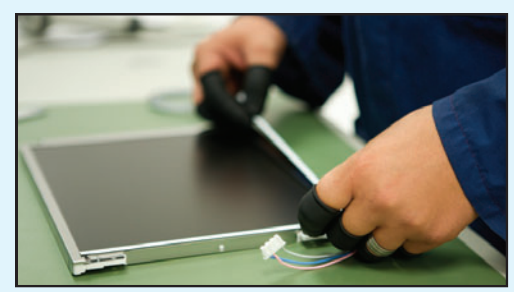
Toshiba Electronics: The company has been developing its leading-edge LCD technology since 1968, for a wide range of applications which include automotive, industrial, and handheld products, including cell phones, medical products, electronic books, in-flight entertainment, MP3 players, and other mobile devices.

- Low-temperature polysilicon TFT (p-Si) technology.
- 100,000-hours MTBF LED-backlight system.
- Low power.
- Wide viewing angles.
- Wide operating temperatures.

As a premier value-added distribution partner for each of these companies, Avnet is ideally suited to offer the correct display for your application. A complete listing of Avnet's display and embedded computing offering can be found at http://em.avnet.com/embedded. We have also just released their online display solutions guide at http://www.displaysolutionsguide.com/landing.php. This guide includes our complete line of supplier panels matched to peripheral part numbers from the manufacturers on our line card, saving time and ensuring that you have the complete solution you need.

Tie It Together With Integration Services

Once the display is selected, making it function in your application is the next critical step in completing the design. Avnet has in-house display-enhancement expertise and industry partners are global leaders and innovators in the field of display enhancement. Regardless of whether the application uses a CRT, LCD, FED, ATM machine, plasma display, touch screen, or projection display, Avnet can help. A custom solution can be tailored to individual requirements, resulting in both time and cost savings.



Panel integration includes cabling and other accessories.

Panel-Enhancement Offerings:

- Film Enhancements (Passive)
- Backlight Enhancements (Active)
- Glass and Film Laminations
- Optical Bonding
- Heaters
- EMI Shielding
- Night-Vision Image Sensing
- Sunlight-Readable Touch Screens
- Rugged LCD Monitors
- Display Integration (Including Enclosures)
- Custom Electronics (Controller Boards)

Avnet also provides a high degree of quality assurance through our Global Integration Center located in Chandler, Arizona. In addition to maintaining ISO 9001:2000, 13485 medical compliance and 14001 environmental management system certifications, the Global Integration Center fosters a culture of continuous improvement. In addition, Avnet regularly conducts end-to-end value stream process mapping and improvement and implements numerous quality programs.

While there is no way to side-step the inevitable constraints that come with choosing a display, Avnet can be an invaluable asset in navigating through some of your biggest design hurdles. To find out more, visit http://em.avnet.com/embedded and view a brief video highlighting Avnet's complete portfolio of display products and integration services.

Avnet's state-of-the-art Global Integration Center.

Special Advertorial

A New Chapter for the Display Market

The Great Recession of 2008–2009, combined with maturity in key market segments, has moved the display industry into a new, slower growth phase. The impacts are already being felt.

by Paul Semenza

THE DISPLAY MARKET has gone through several stages of growth. As detailed in Figs. 1 and 2, the market grew rapidly over the past decade, driven by expansion in TFT-LCD production. What had been until the late 1990s a relatfively small industry focused primarily on the growing notebook-PC market expanded dramatically, first into desktop-PC monitors and then into televisions. In both cases, the advantages of TFT-LCD technology over the incumbent CRT technology were quite obvious, with improvements in volume, weight, potential screen sizes, and resolutions, and, eventually, in image quality.

The challenge was in bringing the price down to an acceptable level, which was achieved through massive investments in successive generations of TFT-LCD manufacturing and in the materials and equipment that round out the supply chain. These investments led to significant declines in price, as well as dramatic increases in screen sizes (Figs. 3 and 4).

However, as Figs. 1 and 2 indicate, after growing rapidly throughout the 2000s, industry revenues declined in both 2008 and 2009. While the immediate cause of this decline was the global recession, the display industry has also entered a mature phase. With notebook PCs and desktop monitors completely penetrated by TFT-LCDs, much of the growth in recent years has come from the TV market. Despite the recession, flat-panel-TV shipments grew on the order of 30% per year in 2008 and 2009. However, this growth is leading to high penetration rates, even in formerly emerging markets, such as China, and will push the flat-panel share of the TV market past 90% in 2011. This high penetration, combined with increasing pressure on prices, will lead to slower revenue growth, particularly for TFT-LCDs.

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New Market Conditions Drive Consolidation

In key areas of the display industry, there is an ongoing trend toward increased consolidation. In the large-area TFT-LCD market, five panel makers now dominate revenues (Fig. 5).

This has come about through aggressive investments and mergers. There are now two large TFT-LCD manufacturers in Korea (Samsung and LG Display), two in Taiwan (Chimei Innolux and AUO), and two in Japan (Sharp and Panasonic, which owns IPS Alpha). For plasma manufacturers, there are three major producers (Panasonic, Samsung, and LG Electronics), and in active-matrix OLED-display manufacturing, Samsung Mobile Display has a commanding share of the market. Even in small-to-medium displays, a category that has traditionally been fragmented due to the customized nature of the products, there is

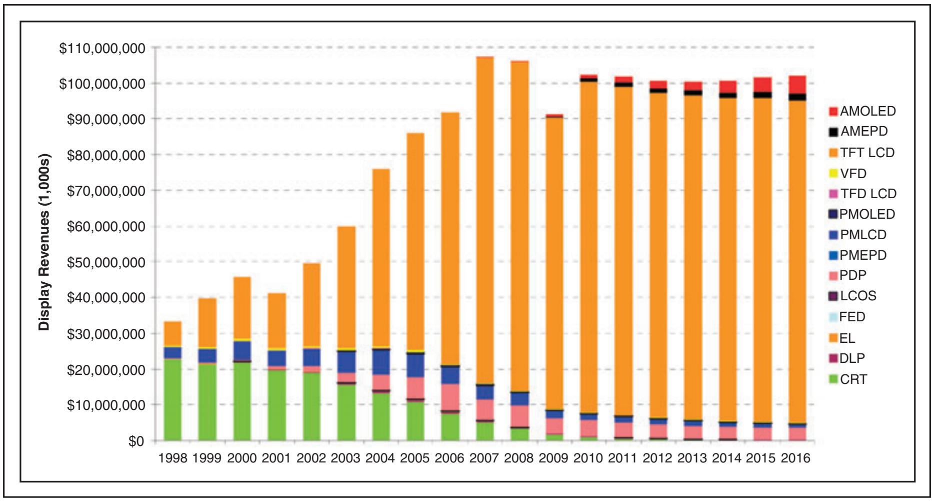

__Fig. 1:__ Display revenues grew rapidly in the 2000s, as TFT-LCD technology displaced lower-cost technologies in television, computing, and communications applications. However, display revenues fell in 2008 and 2009, and while growth is expected to resume in 2010, it is not clear when revenues will surpass 2007 levels. All charts courtesy DisplaySearch.

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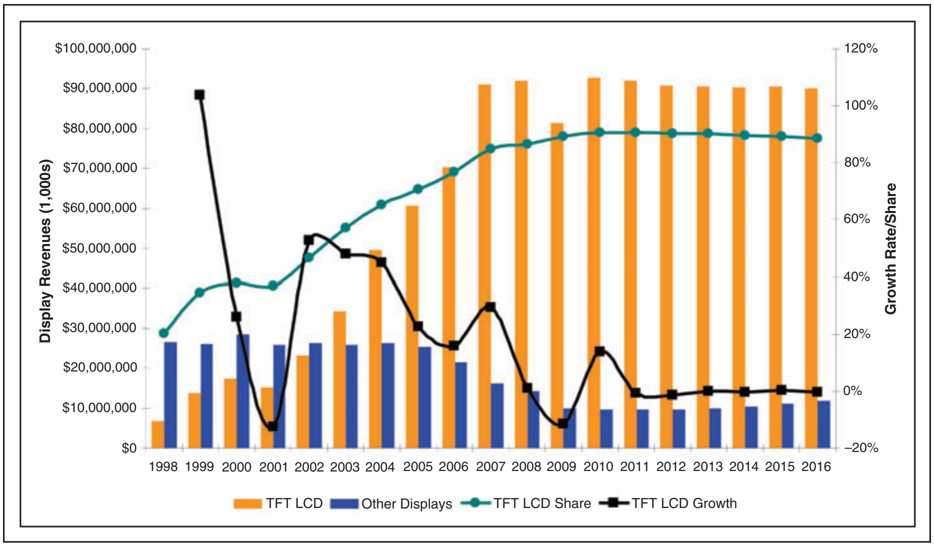

Fig. 2: The early growth phase of the TFT-LCD market following the financial crisis of 1998 was curtailed by the dot-com crash. The CRT-replacement period of 2002–2007 was marked by very strong growth. The recession of 2008–2009 coincided with a high level of saturation of TFT-LCDs in key markets: TV, desktop monitors, notebook PCs, and mobile phones. 2010 is likely to be the start of a period of maturity, with slow growth.

increasing concentration, with TPO, a low-temperature-polysilicon (LTPS) manufacturer, now part of Chimei Innolux. Japanese panel makers, traditionally the leaders in small and medium displays, are scaling back, as exemplified by Epson, Hitachi, NEC, and Toshiba.

Going forward, there are likely to be significant investments in TFT-LCD manufacturing in China, but whether this reduces concentration depends upon the nature of the companies making the investments. In some cases, they may be wholly or partially owned by Taiwanese, Korean, or Japanese panel makers. In addition, the plants in China are likely to be limited to Gen 8 for several years, due both to restrictions on technology transfer by foreign governments, but also due to the focus on cost reduction for 20–40-in. screen sizes, rather than a continued push to the upper limits of screen size. It may be some time before any company joins Sharp at Gen 10 or larger-sized substrates. The basis for competition will be shifting from having the largest fab to being the first to address emerging applications and having the lowest manufacturing cost and the most efficient supply chain.

Pursuing Premium Markets

With continuing price pressure, it is increasingly important for display makers to capture any opportunity to charge a premium price. The most common approach is to exploit a new technology or feature and be the first mover. The move to LED-backlit LCDs for TVs is an ongoing example of this; at both the panel and set level, there were healthy margins for such products in 2009. As the LCD-TV market rapidly adopts LED backlights, such premiums will erode. The next hope for premium pricing is 3-D TV, in which high-frame-rate (120 Hz and higher) panels can be used in conjunction with additional video-processing electronics and shutter glasses to produce a premium product. Display makers can add more value to their products in other ways as well; for example, by integrating touch or other forms of interactivity.

Reducing Manufacturing Costs

Much of the cost reduction over the past decade has been driven by investment in TFT-LCD factories. Larger substrates, higher throughput equipment, and the learning that comes from cumulative production have driven down the cost of producing the LCD "cell" – the TFT array and color-filter plates combined with the liquid-crystal layer and polarizers. The success of these efforts to drive down costs has put a spotlight on other aspects of display manufacturing; in particular, the backlight. The conventional CCFL tubes used in backlights are very mature and thus do not have a high rate of cost decline. In large panels, the backlight can account for 25% of manufacturing cost.

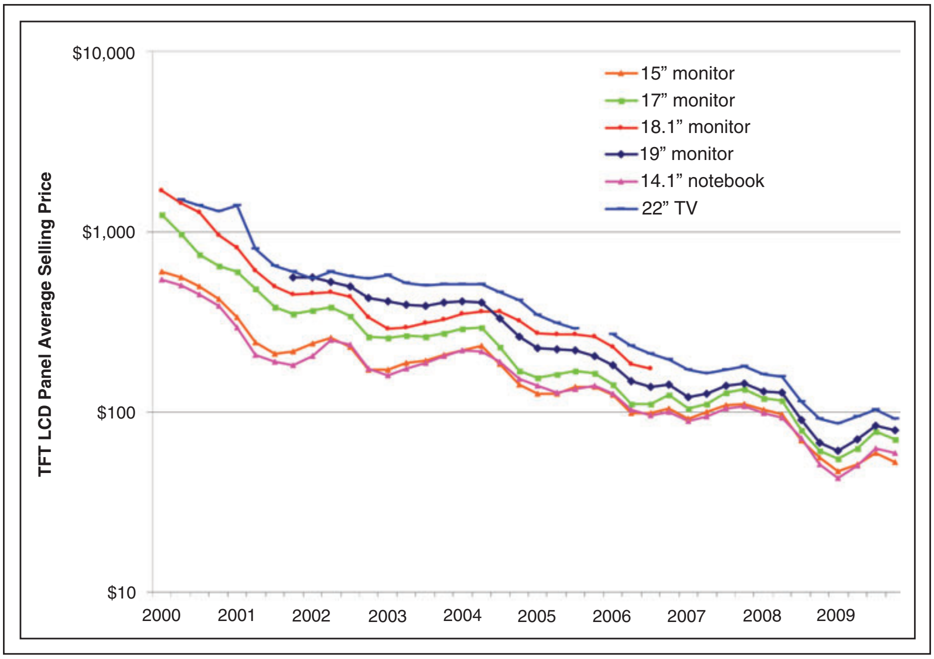

Fig. 3: The prices of TFT-LCD panels fell by a factor of 10 during the 2000s.

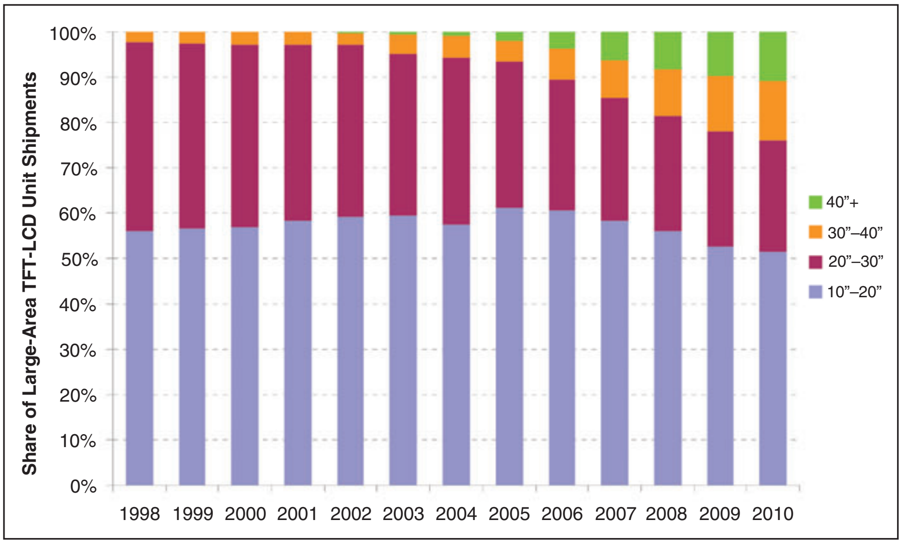

Fig. 4: The expansion in TFT-LCD manufacturing capacity has led to rapid growth in 30-in. and larger panels.

There are two broad approaches to lowering the backlight cost: reducing the cost of the light sources and improving the efficiency of the panel, thus requiring less light to be produced by the backlight. The first approach has involved moving from CCFL to LED sources. While initially more expensive than CCFL backlights, LED backlights are rapidly declining in price, driven by a massive increase in LED chip production, which results in lower costs and higher efficiencies. In addition, LEDs are enabling the use of new backlight designs that have the potential for lower costs. Improving optical transmission has involved innovations in the array, color filter, and cell processes.[1]

Vertical Integration

There is a great deal of vertical integration in the LCD-TV supply chain, from panel makers vertically integrating more LCD components to LCD-TV set makers vertically integrating LCD-module assembly. LCD-TV set makers, especially in China, have started to invest in LCD-module assembly lines. Due to a lack of experience with LCD-module processes, most are working with panel makers, and in many cases have formed joint ventures. For example:

- Skyworth has invested in LG Display's LCD-module factory and established its own LCD-module assembly line.
- Hisense and Konka have set up LCD-module assembly lines with the help of CMO; TCL set up an LCD-module assembly line using know-how transmitted from Samsung.
- AUO and Changhong jointly invested in an LCD-module line.
- LG Display formed an alliance with AmTRAN to set up an LCD-module and LCD-TV-set assembly line and set up a joint venture with TPV for LCD-module lines.
- AUO and TPV are jointly establishing an LCD-module line in Eastern Europe.

An extension of vertical integration is "module in backlight," which refers to the integration of LCD modules and backlights. As more LCD-TV makers enter LCD-module assembly and gain experience, they are finding that they can take on another labor-intensive process: backlight units. Some backlight suppliers have also set up their own LCD-module lines and penetrated the LCD-module assembly business. Re-engineering efforts help to create a compact design, which can reduce components. The ultimate trend is total integration. Since there are many similarities between the LCD module and the TV chassis, companies will begin to integrate these. In the future, panel makers may just ship the cell to an integrated assembly line, which will assemble a hybrid module consisting of an LCD module, backlight, bezel, and LCD-TV chassis, and turn out a complete LCD-TV set. The supply chain lead time would be significantly reduced for faster entry into the market.

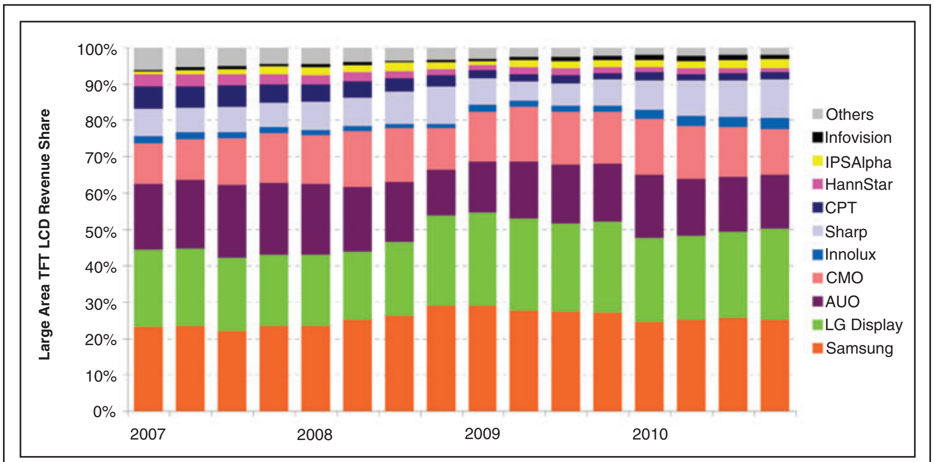

Fig. 5: Concentration in large-area TFT-LCD revenues has been increasing. With the Chimei–Innolux merger, the top five panel makers account for more than 90% of revenues.

Looking Ahead

With the key markets in mobile devices, PCs, and TVs converted to high-performance flat-panel displays, the display industry will likely be entering a period of slow revenue growth, even as there is continued unit growth in TV, portable computing, and mobile devices. The ongoing trend of consolidation and focus on manufacturing efficiency is a logical reaction to the market conditions. Looking forward, we can expect new applications to emerge as drivers of revenue growth, particularly as cost savings are reflected in market pricing. Such applications could address a variety of markets, including public displays, as the cost of large-area displays drops; electronic reading devices, as flexible and lightweight displays become available; and "re-usable" displays, for applications such as restaurant menus and performance playbills.

References

[1]C. Annis and P. Semenza, "Better Transmission: TFT LCD Manufacturing Advances Reduce Cost and Energy Consumption," *Information Display* **12** (December 2009). ■

Capacitive Touch Panel Controller
with Highest Integration

SSD2531 from Solomon Systech is an all-in-one capacitive touch panel controller that integrated power circuits, driving and sensing circuits into a single chip. It can drive capacitive touch panel up to WVGA display resolution. Its DSP-based architecture supports up to four fingers simultaneous detection. It also supports stylus detection, auto calibration for each cross-over point and has embedded noise rejection correlator for better signal-to-noise ratio. Four additional sensing button pins allow more flexible product designs.

With a highly compact and competitive design, SSD2531 enables touch panel in portable devices such as mobile phones, PNDs, digital still cameras and more.

Advantages of SSD2531

Strong ESD protection	8kV ESD on IC level *
True Multi-touch	4 points absolute position (Adaptive solution for mobile application)
Sophisticated Noise Control Algorithm	No shielding layer required
Super High Touch Scanning Rate	Max. 200Hz
Adaptive Touch Detection Scheme	Mutual cap. sensing and faultless with water droplet
Low Power Standby Mode	Support touch key wake up for low power operation
Easy to Use	Built-in DSP for touch analysis and detection, no extra effort on firmware development
Excellent Cost-Performance Ratio	Ideal for consumer electronics market

* 8kV ESD protection on panel connection pins and 5kV on other pins.

Solomon Systech's Touch Panel Controller - SSD2531
Touch Panel Demo supports maximum four fingers detection

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See Us at Display Week 2010 in Seattle Booth 935

Understanding Patents

While the patent application process can be lengthy, it is entirely necessary in order for inventors to protect their valuable intellectual property. This article is the first in a series of four from the associates of the law firm Panitch Schwarze Belisario & Nadel LLP.

by Bijal Shah-Creamer

PATENTS ARE ESSENTIAL to an inventor for protection of property rights in an invention. Just as individuals or companies would not leave their physical property unsecured, they should avoid leaving their intellectual property unprotected.

A patent for an invention is the grant of a property right to the inventor, issued by the United States Patent and Trademark Office (USPTO). A patent provides the patent holder with exclusive and negative rights; *i.e.*, the right to stop others from making, using, importing, selling, or offering to sell the patented invention in the United States (some activities abroad can also be implicated). A patent essentially gives the patent holder a monopoly over the patented invention for the life of the patent, which provides inventors with an incentive for discovering, researching, creating, and developing new inventions, and also encourages public and detailed disclosure of new inventions. As it says in the Constitution, rights are secured to inventors "to promote the Progress of Science and Useful Arts."

***Bijal Shah-Creamer** is an Associate at Panitch Schwarze Belisario & Nadel LLP located in Philadelphia, Pennsylvannia. Her practice involves the preparation and prosecution of patent applications, opinion work on patent validity and infringement, due diligence, and patentability analyses. She is a member of the New Jersey and Pennsylvania Bars and is registered to practice before the United States Patent & Trademark Office. She can be reached at bshah@panitchlaw.com.*

Design Patents and Utility Patents

Two primary types of patents that may be obtained from the USPTO and that are discussed in this article are design patents and utility patents. Design patents have an effective term of 14 years from the issue date of the patent and cover "any new, original, and ornamental design for an article of manufacture" (35 U.S.C. § 171). They do not protect any of the functional features of the article. A design patent may, however, protect computer-generated icons as long as the icons are contained in an article of manufacture, such as a computer screen, monitor, or other type of display panel. For example, it is possible to obtain design patent protection for the appearance of a software program's graphical user interface.

Utility patents are the most common type of patents. They have an effective term of 20 years from the application filing date (though the exact terms can vary) and cover the functional or useful aspects of an invention. Utility patents may be granted for any "new and useful machine, manufacture, or composition of matter, or any new and useful improvement thereof" (35 U.S.C. § 101). Abstract ideas, laws of nature, and physical phenomena are not eligible for patent protection.

Patent Eligibility

The first step in the patent process is to assess whether the invention constitutes "patentable subject matter." To be available for patent protection, inventions must also be useful, new, and non-obvious to "one of ordinary skill in the art." In other words, an invention cannot have been an obvious development to a person with average levels of skill and knowledge in the field of the invention. One of ordinary skill in the art is not an expert, but is also not a person with no knowledge in the field.

To be deemed useful, an invention must be developed and have a practical value or application. The usefulness issue does not often figure into the patent process.

An invention is considered new (or novel) only if it is truly innovative and was not previously publicly known or used. For novelty and non-obviousness determinations, the invention must be analyzed in view of the prior art, which is information that was publicly available prior to or at the time of the invention. Prior art may take several forms, such as a tangible publication (*e.g.*, a patent or published patent application), a public presentation, or a public use or application. If each claimed feature of the invention is disclosed in a single prior art reference, the invention is deemed as being anticipated by, or not novel compared to, that single prior art reference, and thus the invention will not be patentable. If it would have been obvious to one of ordinary skill in the art to combine different aspects of two or more prior art references, and the combination has each of the claimed features, the invention is considered as being obvious based on the combination of these prior art references.

Next Steps: A Study and the Application

Before filing a patent application, a company should have its patent attorney conduct a

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patentability study. This study entails a search of the prior art for disclosures relating to the invention and an evaluation of the identified prior art to determine if the invention is new and non-obvious. The study may also be helpful in homing in on any particular aspects of the invention that may be patentable, even if other aspects are found to have already been publicly known. The patent attorney will then provide an opinion on whether or not any features of the invention may be entitled to patent protection. A patentability study is not a prerequisite to filing an application, but is generally a wise step considering the relatively high costs associated with filing and prosecuting a utility patent application.

If the patentability opinion is positive, the next step in the process is preparing and filing a patent application with the USPTO. Drafting a patent application is a collaborative effort between the inventor and his or her patent attorney. Specifically, the patent attorney needs the inventors' technical knowledge of the invention in order to draft the application, but the patent attorney's legal and technical knowledge is also necessary for development of a robust and legally sound application.

A provisional or a non-provisional application may be filed. A provisional application is less formal and detailed than the latter. However, a patent will not issue from a provisional application and further discussion of a provisional application is not warranted here. A non-provisional utility patent application must include certain components in order to be considered complete. For example, each application must include a title, a description of the background of the invention, a detailed description of the invention, drawings (if necessary), and claims. The application must be sufficiently detailed and comprehensive enough to convey to one skilled in the art how the invention may be made and used. A patent applicant may not secure a valid patent while keeping secret an important aspect of the invention. The application must also set forth the best mode of carrying out the invention as contemplated by the inventor.

The claims are the most important part of the application. They define the scope of coverage of any patent that may issue from the application. Though the application as a whole may provide great detail about an invention, only the features recited in the claims are entitled to patent protection. Thus, whether or not a patent is infringed is determined by looking at the claims. Great care and thought should therefore be put into their drafting and phrasing. It is often estimated that almost half of the time spent in preparing an application is spent on the claims.

Applicants should also take care to properly identify who exactly should be named as an inventor. Any individual who conceived and developed any of the claimed features of the invention must be named as an inventor. Since the conception and development of an invention is often a collaborative effort, many patents name joint inventors. The decision as to who should be named as an inventor should be discussed in detail with the patent attorney because inventorship is a legal question that could have a significant impact on the strength of a patent for the invention. For example, if the wrong individuals are named as inventors or if all of the legitimate inventors are not identified, the patent may later be challenged and possibly invalidated by a third party desirous of making, using, or selling the patented invention.

The Application Review Process

Filing a patent application with the USPTO does not mean that applicants will receive a patent for their invention. There is still a long road ahead. The filed application is assigned to a patent examiner and the prosecution stage of the patent process begins. The examiner will evaluate the application to determine whether or not the application meets all of the criteria for patentability and will conduct an independent search of the prior art. The inventor and/or the patent attorney are obligated to inform the examiner of all information known to them that bears on the patentability of the invention (commonly known as the "duty of disclosure"). If the examiner immediately determines that the claimed invention is patentable, which is very rare, he/she will issue a notice of allowance, which means that the application has been allowed.

More likely, however, upon an initial review of the application, the examiner will find that the claimed invention is not patentable in view of the prior art and will issue an office action in which some or all of the claims are rejected in view of the prior art. In an office action, the examiner may also object to the application for formal matters, such as for not providing an enabling disclosure. The patent applicant, working with his or her attorney, must then respond to the office action. Throughout the entire prosecution stage, the patent attorney works with and

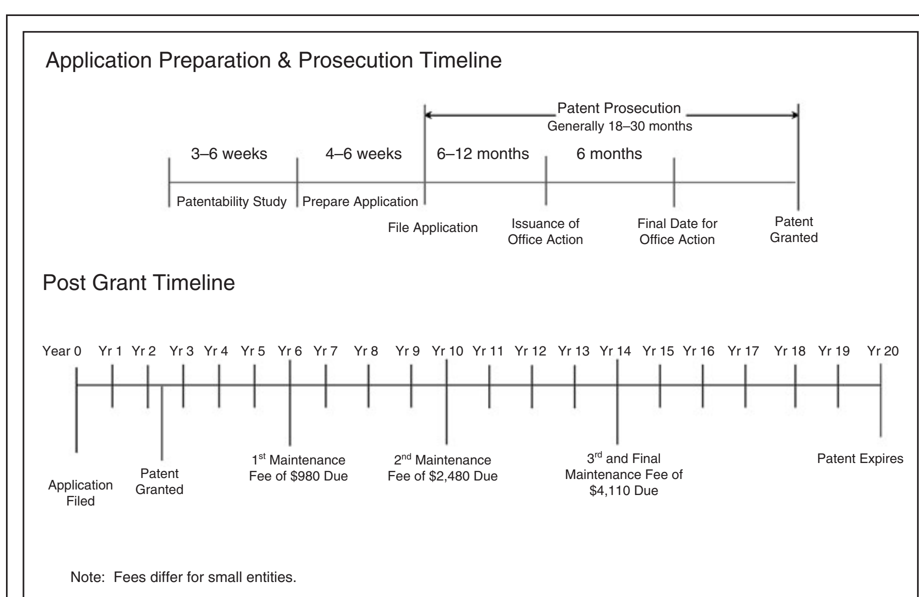


Fig. 1: *The patent application phase (top) typically lasts from about a year and a half to two and a half years. Once the patent is granted (bottom), a series of maintenance fees must be paid throughout the life of the patent.*

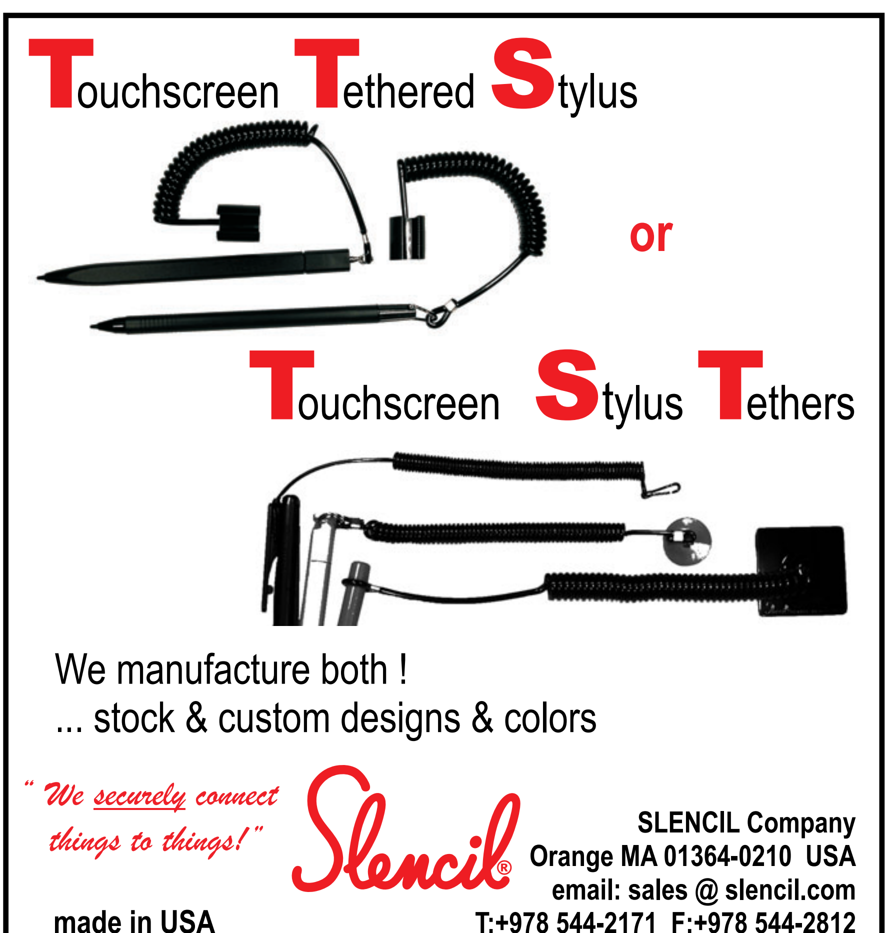
under the direction of the applicant to prove to the examiner that the claimed invention is novel and would not have been obvious in view of the prior art. A response to an office action may include technical and/or legal arguments, as well as revisions (or amendments) of the claims in an effort to overcome the prior art rejections and the objections. Because of these possible amendments to the claims, the scope of the claimed invention may change during prosecution of the application. The prosecution process typically involves many such back-and forth communications between the examiner and the patent attorney.

Because the examination of an application is subjective to an extent, based on the views and interpretation of the examiner, the prosecution process varies across the board. The prosecution of one application will never progress exactly as another. Also, the prosecution process may take several years to complete, depending upon the complexity of the invention, the amount of relevant and material prior art, *etc.* (see Fig. 1 for a timeline of the overall patent process).

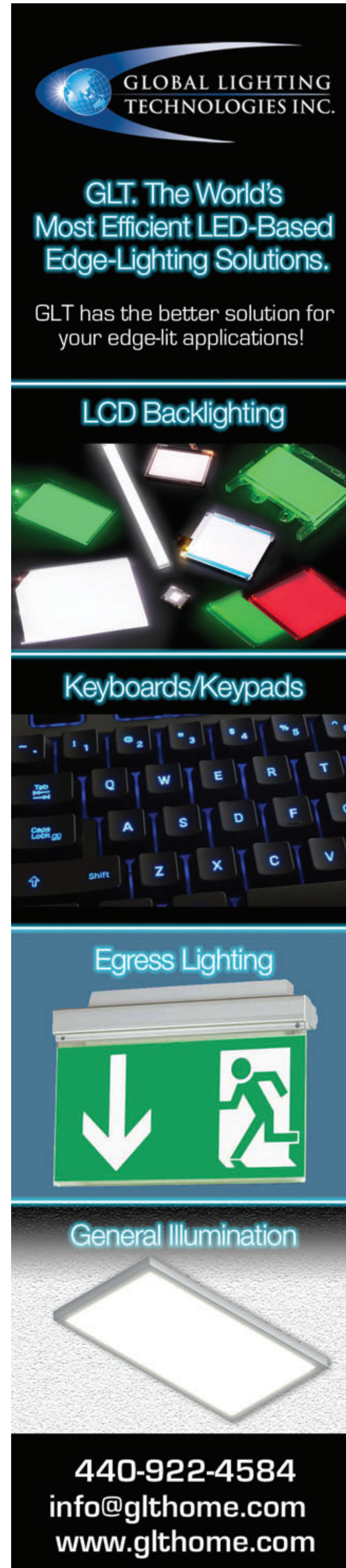
If the examiner ultimately finds that the claimed invention is useful, novel, and non-obvious, the examiner will then issue a notice of allowance and the patent will issue once the issuance fee is paid. During the life of a utility patent, there are also maintenance fees that must be paid at specific time intervals.

Patents clearly play a significant role in all industries, particularly technology-based ones, and can give companies and individuals the competitive edge they need to be successful. Much time and expense goes into developing an invention for commercial sale, and companies and individuals need to make the effort to protect their valuable investments. Patent holders have the significant advantage of being able to protect their patented inventions from infringement by their competitors and usually have the upper hand in competitive situations. Those who do not protect their inventions by securing patents will often find that their inventions are vulnerable to exploitation by competitors, and that they are left without any recourse to protect their hard work and investments. Thus, while the process of getting a patent may sometimes feel long and drawn-out, it is important to keep in mind the end goal of a patent and all of the associated advantages and rights to which the patent's holder will be entitled. ■

See Us at Display Week 2010 in Seattle Booth 505



See Us at Display Week 2010 in Seattle Booth 865



See Us at Display Week 2010 in Seattle Booth 1424

Products on Display at SID 2010

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

by The Editorial Staff

THE SID 2010 International Symposium, Seminar, and Exhibition (Display Week 2010) will be held at the Washington State Convention Center in Seattle, Washington, the week of May 23. For 3 days, May 25–27, 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.

3D-MICROMAC AG INTERNATIONAL
Chemnitz, Germany +49-(0)-371-400-43-26
www.3d-micromac.com
Booth 417-3

Production solutions for OLED processing

Based on established laser micromachining systems, 3D-Micromac AG has developed an innovative manufacturing concept – microSTRUCT-OLED – for laser structuring of OLEDs. The integration of an ultra-short pulsed laser into the system guarantees a gentle selective structuring of anode layers without material damage at the substrate level. A special highlight is the processing of variable and scalable substrate sizes realized by an innovative software controlled scanner machining concept that achieves a structuring speed of up to 1 m/sec.

3M OPTICAL SYSTEMS
Saint Paul, MN 1-800/553-9215
www.3m.com
Booth 205

Optical-enhancement products

3M™ Optically Clear Adhesives are highly specialized optically clear free-film adhesives offering excellent clarity and adhesion to various types of transparent substrates. These adhesives are easy to convert and have improved resistance to bubbling and delamination in laminates exposed to high temperature and high humidity. 3M™ Contrast Enhancement Film is designed for assembly of critical display parts, including the attachment of touch-interface layers and gap filling between the LCD and lens to improve brightness and contrast. 3M™ is offering three different products: 3M™ Contrast Enhancement Film, 3M™ Liquid Optically Clear Adhesive, and 3M™ Broadband Anti-Reflection Film.

3M™ Touch Systems
Methuen, MA 978/659-9000
www.3m.com
Booth 231

Multi-touch display

The 3M™ Display M2256PW combines "full" multi-touch technology, which supports up to 40 simultaneous contact points and a 22-in. high-definition wide-viewing-angle LCD to deliver revolutionary performance designed to exceed the requirements of the most demanding professional applications. The M2256PW display features 3M™ Projected Capacitive Technology with less than 6-msec response time for more than 10 simultaneous touches. This means fast, accurate touch response over the entire touch surface. This multi-touch display is Windows 7 compatible with 3M™ drivers available for Windows XP, Linux, Mac OS and enhanced Windows 7 capabilities.

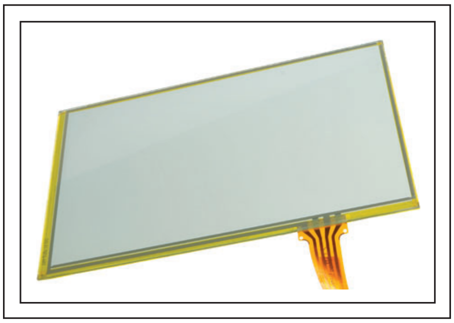
A D METRO
Ottawa, Ontario, Canada 613/742-5545
www.admetro.com
Booth 1312

Sunlight-readable armored resistive touch sensor

A D Metro's ULTRA CP touch screens combine the strength and durability of its patented armored glass/film/glass resistive touch screens with the outdoor sunlight visibility of a circular polarizer. A D Metro has produced the ideal touch solution for environments requiring crystal-clear visibility in bright sunlight with durable and tough rugged field performance. ULTRA CP carries over all the bene-

0362-0972/05/2010-050$1.00 + .00 © SID 2010

fits from the ULTRA touch screen, including high resistance to scratches, expanded temperature operation, while remaining pressure activated by stylus, gloved hand, or other implements.



ADHESIVES RESEARCH
Glen Rock, PA 717/235-7979
www.adhesivesresearch.com
Booth 301

Electronically conductive pressure-sensitive adhesives

Electrically conductive PSAs from Adhesives Research are used in the electronics field for electrical interconnection and assembly, thermal management, EMI/RFI shielding and grounding, static dissipation and control. The PSAs instantly provide a thin, uniform bond line to increase the functionality of products by delivering the essential bonding and conductive properties needed for projects. With easy-to-use safe bonding options, these PSA tapes may be customized by modifying the adhesive chemistry, forms, and constructions; adhesive thickness; and release liner selection.

ADVANCED LINK PHOTONICS
Tustin, CA 714/730-6728
www.alpincorp.com
Booth 1015

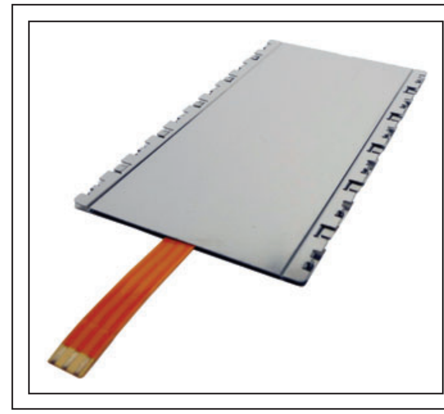
Sunlight-readable technology

Advanced Link Photonics and RayShine Photonics, pioneers in the field of optical technology, introduce to SID 2010 their latest innovation in sunlight-readable technology: the DRT-TRIO Touch™ and the 4H polarizer. The DRT-TRIO Touch™, based on the RT-TRIO Touch (sunlight-readable touch panel) from RayShine, offers unparalleled sunlight-readable performance (<4% reflection) and great durability, being impervious to flames, dirt, water, chemical solvents, and fingerprints, with a surface hardness of up to 8H. The 4H polarizer's durability makes it suitable for almost any rugged outdoor environment, and it is compatible with most LCD sizes.

ARTIFICIAL MUSCLE
Sunnyvale, CA 408/215-7350
www.artificialmuscle.com
Booth 1400

HIC module for haptic battery shaker

AMI introduces an actuator module to shake the mass of a battery in a handheld device to provide high-fidelity haptic feedback with minimal integration and size addition. The reference integration uses the 1-mm-thick HIC module to shake a battery tray, thus allowing reliable connections to the battery to be maintained. The HIC module that was originally designed for moving touch-screen haptics can provide a latency of less than 5 msec, high acceleration of >1g for a 150g handheld device, and fully customizable effects all in a low-power-consumption system.



AXON' CABLE & INTERCONNECT
Schaumburg, IL 972/516-2966
www.axoncable.com
Booth 1118

LVDS shielded flat flexible cables

Axon' is offering the FDC100®, LVDS flat flexible cables designed to connect HD displays to LVDS electrical signaling systems. FFC LVDS is made of a 100-Ω shielded flat flexible cable and connectors compatible with board-mount FI-R connectors.

Submit Your News Releases
Please send all press releases and new product announcements to:
Jenny Donelan
Information Display Magazine
411 Lafayette Street, Suite 201
New York, NY 10003
Fax: 212.460.5460
e-mail: jdonelan@pcm411.com

BIGBYTE CORP.
Fremont, CA 510/824-3001
www.bigbytecorp.com
Booth 1607

Flat-panel-display tester

The BB-3000 is a second-generation flat-panel-display tester that is designed to address the needs of display-repair companies, LCD distributors, and manufacturers of LCD and plasma displays. The platform is built on a highly customizable infrastructure to ensure long-term sustainability. It is capable of handling a variety of panel geometries and operating environments and can be quickly re-configured to address interfaces ranging from legacy TTL, LVDS, DVI/HDMI, and DisplayPort protocols. Critical items such as data collection, easy script management, and infinite interface configurations are just a few of the many rich features the BB3000 includes.

BI-SEARCH INTERNATIONAL
Tustin, CA 714/258-4500
www.bisearch.com
Booth1413

Sunlight-readable TFT-LCD

Bi-Search International (BSI) is an authorized distributor of LG Display TFT-LCDs as well as an authorized enhancement center. Products include high-bright CCFLs and LED-backlit LCDs, touch integration, open-frame solutions, fully enclosed panel PC solutions, and custom LCD solutions. Featuring a sunlight-readable 15-in. XGA 1000-nit LED-backlit wide-temperature-range TFT-LCD.

CORNING INCORPORATED
Corning, NY 607/974-8741
www.corning.com
Booth 641

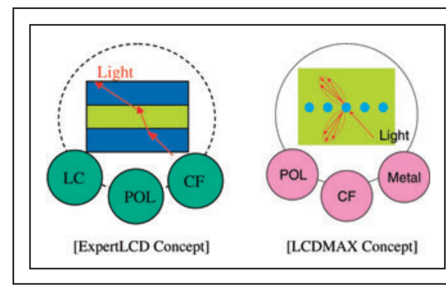
Environmentally friendly glass

Corning will feature Gorilla® glass, an environmentally friendly thin sheet glass that is a highly durable, scratch-resistant LCD protective cover glass that is compatible with touch-screen devices. Gorilla glass protects the lifespan of portable display devices, without compromising clarity.

DAOU XILICON TECHNOLOGY CO.
Gyeonggi-do, Korea +82-19-9159-7966
www.daouxilicon.com
Booth 1014

Optically based LCD simulator

Daou Xilion Technology will feature the LCDMAX simulator which provides a complete optically based simulation environment. It can estimate the optical properties and mura of LCDs for scattering, diffraction, lens system, *etc*. For a decade, ExpertLCD has provided a complete physically based simulation environment. It can not only estimate liquid-crystal dynamics and optics, but also the electrical properties of liquid-crystal displays such as those from TN to PSA mode. ExpertOLED can estimate not only the electroluminance dynamics and optics, but also the optical properties of flexible OLED displays. A commercial OLED display can be analyzed and modeled by using ExpertOLED.



DELO INDUSTRIAL ADHESIVES
Windach, Germany +49-8193-9900-264
www.DELO.de
Booth 939

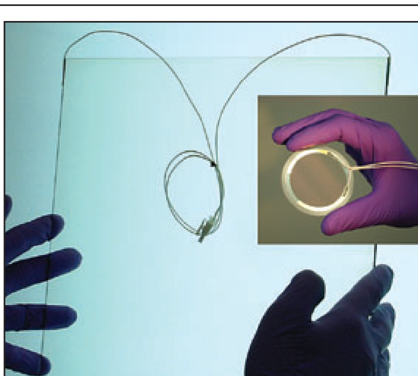
Adhesives for e-Readers

DELO Industrial Adhesives will feature newly developed adhesives, with optimized properties for display manufacturers, that are used in electrophoretic displays. The temperature- and humidity-stable adhesives serve as an edge sealant and protects displays against humidity for a longer lifetime. DELO improved the sealants by reducing the viscosity while keeping the flexibility and a low permeation for water vapor (WVTR value), resulting in an easier lamination as well as faster dispensing. Because of their high flexibility, the sealants can be used for future rugged and flexible e-Readers. Further applications include organic photovoltaics and the fabrication of barrier films or OLED area sealing.

DONTECH, INC.
Doylestown, PA 215/348-5010
www.dontech.com
Booth 771

Transparent Heaters

Dontech Therma Klear™ transparent heaters provide the warmth necessary to extend the operating temperature of LCDs in cold environments (*e.g.*, from 0° to below –40°C) and for the anti-fog, anti-icing, and de-icing of optics and optical camera, sensor, and display assemblies. A Therma Klear™ heater is composed of an electrically conductive thin-film coating on a visually transparent substrate. Dontech manufactures heaters using different types of crystalline materials (*e.g.*, zinc sulfide or germanium), glass, acrylic, and polycarbonate substrates. Applications include avionic displays, vehicle displays, mobile computers, kiosks, and handheld devices. Custom shapes are available in sizes up to 24-in. diameters.



DUPONT DISPLAY ENHANCEMENTS
Torrance, CA 310/320-9768
www.vertak.dupont.com
Booth 741

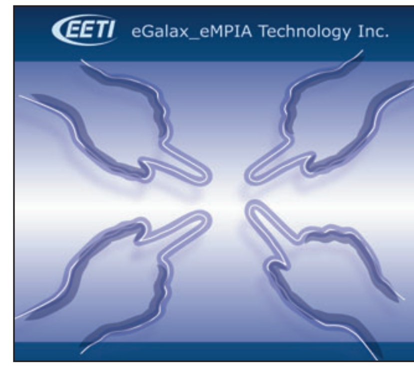
Re-workable optical bonding adhesives

New for 2010, DuPont Display Enhancements has added four new products to its industry-leading Vertak® family of re-workable optical bonding adhesives. Developed for use in the most challenging application environments, DuPont™ Vertak® adhesives are ideal for bonding glass, plastics, and touch sensors in varying levels of manufacturing sophistication. From manual samples to semi-automated bonding processes, DuPont Display Enhancements offers DBA2110 and DBA2210 for fully automated direct-bonding equipment, specifically designed to meet high-volume consumer-application throughput requirements. Also offering higher viscosity DBA2120 and DBA2220.

eGALAX_eMPIA TECHNOLOGY
Taipei, Taiwan +886-2-8751-5191
www.eeti.com
Booth 1303

Multi-touch technology

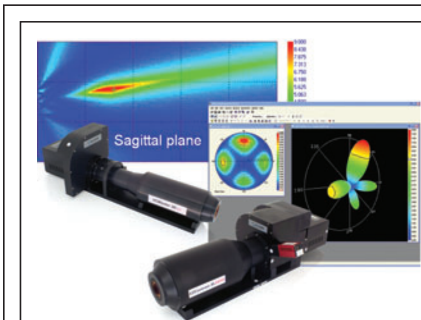
EETI offers a comprehensive selection of touch technologies that drives today's market momentum, focusing on the development of projected-capacitive touch and analog matrix resistive touch used in end products, such as mobile phones, MIDs, tablet PCs, notebooks and all-in-one PCs. Applicable in Window, Linux, and Mac operating systems.



ELDIM S.A.
Herouville, Saint Clair, France +33-2-31-94-76-00
www.eldim.fr
Booth 646

Optical characterization of 3-D displays

Even if all types of 3-D displays provide the depth perception by dispatching two different images in the left and right eyes of the observer, the method to achieve this task is very dependent on the display type. This is why optical characterization techniques must be adapted to each type of display. ELDIM proposes different instruments dedicated to autostereoscopic, polarization-based, and shutter-glasses 3-D displays. The VCMaster3D Fourier-optics viewing-angle instrument is well adapted for autostereoscopic 3-D displays because of its extremely high angular resolution. EZContrastMS, which can measure directly the polarization state of the light, is used for polarization-based stereoscopic displays. The OptiscopeSA, which measures the temporal behavior, is used for shutter-glasses displays.



ELMOS SEMICONDUCTOR AG
Dortmund, Germany +49-(0)-231-7549
www.elmos.de
Booth 417-5

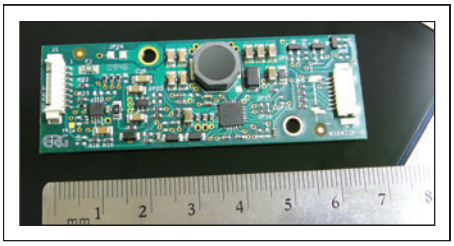
IR-based optical system

ELMOS will introduce HALIOS® (high-ambient-light-independent system), an active infrared-based optical system which allows HMI control by detecting non-touch gestures and motion. The system is also suitable for switch-input architectures located behind the IR translucent and sealed surfaces. Because HALIOS® is not affected by ambient light and can be placed behind translucent surfaces, the system can be used as a HMI input in harsh-environment applications

ENDICOTT RESEARCH GROUP (ERG)
Endicott, NY 607/754-9187
www.ergpower.com
Booth 341

New plug-and-play LED Driver modules

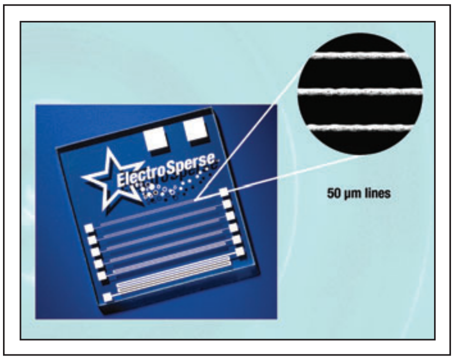
ERG is offering new enhancements to its industry-leading range of Smart Force™ plug-and-play LED driver solutions. The new SFDMD Series offers enhanced performance features for high-power high-brightness mid-sized LED-backlit displays. Designed for applications that require a small footprint with high efficiency and brightness stability over a wide input-voltage range, SFDMD Series drivers are less than 5 mm high and are mounting-hole compatible with ERG's existing SFDM (Mini) Series and have the FPC connector as an output option. The onboard PWM dimming can generate ratios of up to 255:1 and SFDMD Series modules operate at a very high efficiency (~90%).



FIVE STAR TECHNOLOGIES
Independence, OH 216/447-8498
www.fivestartech.com
Booth 1127

Conductive inks and pastes

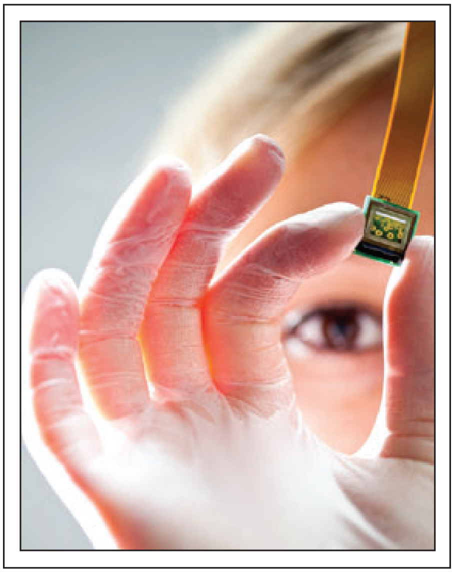
Five Star Technologies will be introducing a series of new additions to its ElectroSperse™ line of conductive inks and pastes. The new ElectroSperse grades are polymer thick-film pastes designed specifically to hold tight dimensional control when screen-printing fine lines in tight pitch arrays. Five Star notes that 60-µm lines in 120-µm pitch arrays have been achieved with excellent line-width control. The products are ideally suited for use as electrodes and interconnects in capacitive and resistive touch sensors, flex circuit connectors, and hybrid microcircuits.



FRAUNHOFER INSTITUTE FOR PHOTONIC MICROSYSTEMS (FRAUNHOFER IPMS)
Dresden, Germany +49-35-1882-3238
www.ipms.fraunhofer.de
Booth 431-1 (German Pavillion)

OLED microdisplay for multimedia applications

Multimedia content is being consumed by using portable consumer-electronic devices. However, the integrated display of such appliances is typically not large enough to present the content to the user in an adequate manner. Solutions to overcome this dilemma which are currently favored include head-mounted displays as well as micro-projection units. Both approaches require miniaturized displays, which offer high-resolution image displays while preserving a rather small size. The development of a new type of OLED microdisplays is the goal of European research project HYPOLED (FP7, ICT-2007.3.2-217067) which is coordinated by Fraunhofer IPMS. The results of HYPOLED project will be available during SID DisplayWeek 2010.



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

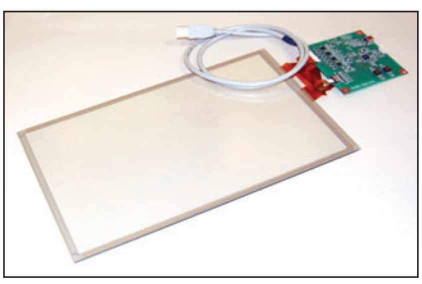
R&D ink-jet printer for display materials

FUJIFILM Dimatix has developed a new 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 print heads with small volumes and high-performance print heads appropriate for industrial and high-throughput applications.

FUJITSU COMPONENTS AMERICA
Sunnyvale, CA 408/745-4924
www.fcai.fujitsu.com
Booth 764

Multi-input resistive touch panel

Fujitsu Components America will be demonstrating its new, multi-input resistive touch panels. These panels offer the following features: accepts single-tap and multi-touch input; accepts stylus handwriting and two-finger input; pinch, push, rotate, and scroll functionality; highly durability for rugged applications; capable of large-sized panel designs; proprietary Fujitsu design (patent pending); 5–12-in. panel sizes; Windows 7 logo approved; controller and driver IC support; in production since January 2010.



GAMMA SCIENTIFIC
San Diego, CA 858/279-8034
www.gamma-sci.com
Booth 638

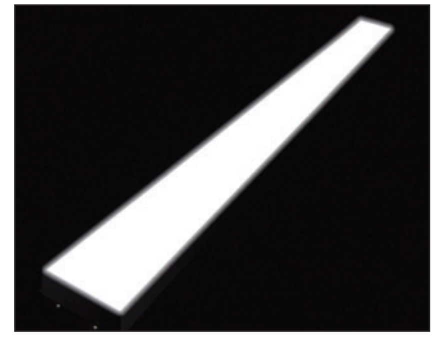
Portable colorimeter

Gamma Scientific and UDT Instruments’ New SLS 9400 FC Plus Colorimeter is a simple, precise, portable, and affordable instrument designed for the measurement and color characterization of both flat-panel displays and CRTs. The SLS-9400 FC Plus is a battery-operated portable device designed for field or production environment use and can be custom or field calibrated for any display-measurement application. It has a superior luminance range of from 0.2 to 1500 cd/m^2 for accurately calculating contrast and measuring black screens. The four-filter design with polarization de-coupler reduces measurement error and enhances the instrument’s accuracy and repeatability over competitive products.

GLOBAL LIGHTING TECHNOLOGIES (GLT)
Brecksville, OH 440/922-4584
www.glthome.com
Booth 1424

New LED-based edge-lighting solutions

GLT is offering new LED-based high-performance ultra-thin light guides for the edge-lit backlighting of LCDs, keyboards, and keypads, as well as egress lighting, downlighting, under-cabinet, splash, and desk task lighting, and refrigeration and cabinet illumination. GLT has developed a new range of edge-lighting solutions utilizing the world’s most efficient LED-based edge-lighting technology for maximum brightness with optimum uniformity and superior color mixing. GLT edge lighting employs widely spaced, high-output LEDs that focus light into a high-performance backlight, or light guide. Because the LEDs are located on the edge of the light guide, there is better optical control, fewer LEDs needed, better repeatability, and the thinnest possible backlight. Having three manufacturing facilities in the Far East, GLT can provide low-cost manufacturing and quick turnaround.



GOOCH & HOUSEGO
Orlando, FL 407/422-3171
www.goochandhousego.com
Booth 505

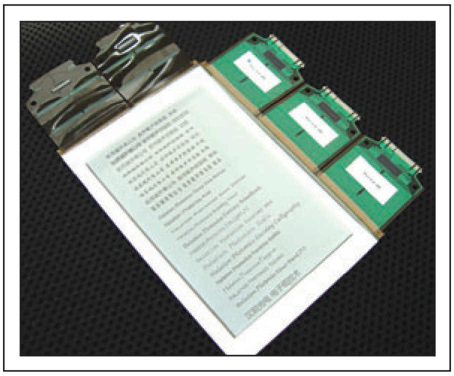
Automated display measurement system

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

HALATION TECHNOLOGY CO.
Being, China +86-10-6841-9438-606
www.halation.com
Booth 138

e-paper screen

Halation Photonics has successfully made multi-stable liquid-crystal-technology-based e-paper screens. The MS-LC e-paper achieves e-ink-like performance. This new-generation e-paper has many advantages in contrast, reflectivity, response time, colorization, and other parameters. In addition, the cost of Halation's e-paper screens is much lower. The main characteristics include paper-like performance; no damage to the eyes; no power consumption needed without changing the status; flexible screen with full color; can be read directly under sunlight; maximum of 256 gray scales; screen size ranging from 2 to 22 ft.



IMMERSION CORPORATION
San Jose, CA 408/467-1900
www.immersion.com
Booth 135

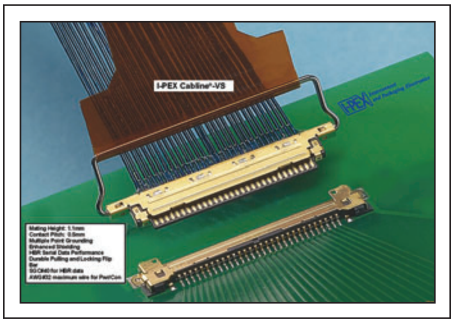
Haptic-enabled user interfaces

Immersion's TouchSense® 2100 solution provides haptic-enabled user interfaces for touch screens, touch panels, and touch surfaces in consumer-electronics devices. Expanding on the capabilities of the TouchSense 2000 for simpler interfaces, TouchSense 2100 provides a broader palette of haptic effects and integrates well with screen and gesture-based inputs. Haptic feedback enables Touchpad feedback, replacing mechanical feedback; capacitive button confirmation; touch-screen feedback; virtual keyboards; improved GUI elements; the restoration of "feel" to the interface. Target devices include PMPs, smartbooks/netbooks, portable POS, digital cameras, printers, portable, medical, appliances/white goods, PNDs, and IP phones.

I-PEX USA
Austin, TX 512/297-6750
www.ipex-us.com
Booth 1004

Notebook-panel standard

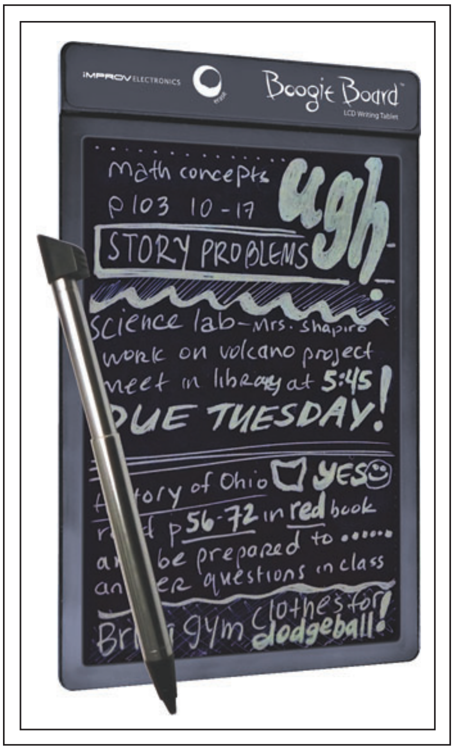
The Video Electronics Standards Association selected the I-PEX Cabline®–VS connector as the standard for the 16:9 notebook-panel standard that applies to LCD assemblies that utilize LED backlight units. Flat-panel-display integrators require the high-bit-rate serial-data electrical transmission performance of the small outline, low-profile interconnection, as well as the easy to mate/un-mate, durability, and locking design features. System integrators have determined that the connector performs well for "embedded DisplayPort" eDP™ serial data rates called HBR1 at 2.7 Gbps. I-PEX testing claims compliance with the electrical performance of the higher speed eDP™ HBR2 and "internal DisplayPort" iDP™ requirements.



KENT DISPLAYS
Kent, OH 330/673-8784 x161
www.kentdisplays.com
Booth 437

LCD writing tablet

The Boogie Board LCD writing tablet is the tree-friendly, electronic alternative to paper, pencils, and pens – and it's just as easy to use! Simply write or draw with the included stylus or other suitable instrument (even your finger) to create an image and then erase with the push of a button. The first product sold by Improv Electronics, a Kent Displays company, the Boogie Board tablet utilizes a Reflex™ No Power LCD with pressure sensitivity for the writing surface. The LCDs are mass produced exclusively in the U.S. on the world's first roll-to-roll line for fabrication of flexible LCDs.



KOPIN CORP
Westborough, MA 508/870-5959
www.kopin.com
Booth 545

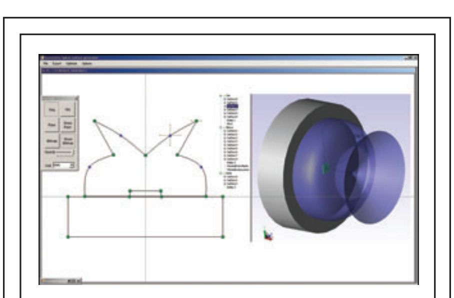
Hands-free wireless computing

Golden-i™ provides "hands-free" mobile computing and communications, ideal for industrial, medical, and construction applications. Golden-i™ integrates Kopin's award-winning microdisplay technology with advanced speech recognition, multiple wireless radios, and multiple high-performance mobile processors running on a Microsoft Windows operating system, enabling “hands-free” wireless remote control over an array of host devices, including cellular phones, PCs, company networks, and wireless systems. Golden-i is designed to also accept conventional user interfaces such as touch screens, keyboards, or a wireless mouse from any wireless host device.

LAMBDA RESEARCH CORP.
Littleton, MA 978/486-0766
www.lambdares.com
Booth 128

Interactive optimizer

Lambda Research Corp. will introduce an interactive optimizer specifically designed to optimize LED display applications. This new utility works inside of TracePro, Lambda’s award winning illumination program to create innovative solutions for both display and lightpipe designs using both LED and fluorescent sources. The interactive optimizer allows users to digitize an idea, specify the varying parameters in the design, create a target output, and let the optimizer iterate towards a solution. Users can pick from seven different merit functions for targets, including flux, illuminance, intensity, candela profiles, and color targets.



LIQUAVISTA
Eindhoven, The Netherlands +31-4025-90100
www.liquavista.com
Booth 405

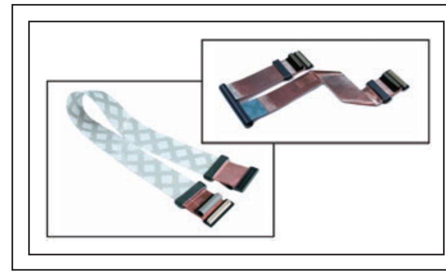
Full-color reflective e-Reader display

LiquavistaColor, the first high-performance full-color display and a natural evolution of the LiquavistaBright solution, combines color-filter technology with advanced algorithms for improved color management. Using technology now referred to as “LCD 2.0,” LiquavistaColor is a very attractive solution for the large sunlight-readable handheld or mobile devices specified for heterogeneous and high-rate stream of content; not for only reading books or feeds or newspapers, but also for browsing photos and clips, and social networking. Consumers can enjoy magazine-quality performance with bright, full-color low-power video with high contrast, excellent viewing angles, and full-sunlight readability.

MERITEC
Painesville, OH 440/354-2100
www.meritec.com
Booth 1010

FPD cables and connectors

Meritec will feature special shielding on flat flex cable assemblies developed to solve EMI issues for improved impedance matching and ultimate flexibility in the box and to pass through the hinge of the laptop-style application. Available in many configurations, including FPDI-1 31, 41, and 51 position assemblies, LVDS cabling utilizing DF-19-FI-X and DVI Connectors in a variety of sizes. Also available are ZIF and Meritec’s ZIFLOC™ insert molded Zif terminations in industry-standard pitches and conductor counts.



NANO-MASTER, INC.
Austin, TX 512/385-4552
www.nanomaster.com
Booth 107

Large-substrate cleaner

Nano-Master is introducing Large-Substrate Cleaning (LSC) systems (21-in. OD or 15 × 15 in.) for state-of-the-art damage-free megasonic cleaning of delicate patterned or unpatterned substrates. Nano-Master cleaners offer an array of options. A variable-speed PVA brush system provides a mechanical means of removing stains and resist residues on unpatterned substrates. The ozonated DI water option allows removal of organics without the use of aggressive chemicals. Piranha Cleaning as well as SC1 and SC2 cleaning is also available. Our optional hydrogenated DI water system in conjunction with Megasonic energy makes removal of nano-scale particles possible.

NEW WAY AIR BEARINGS
Aston, PA 610/202-8892
www.newwayairbearings.com
Booth 531

Conveyor air bearings

The New Way C-Series conveyor air bearing provides non-contact control for FPD or PV glass handling, increasing throughput and yield. This new hybrid design combines the best performance characteristics of the company's H-Series (high speed) and L-Series (low airflow) conveyors. Air pressure issues from millions of sub-micron-sized holes across the bearing surface, virtually eliminating glass contact. A vacuum groove controls the glass, while enabling a 20–120-μm fly-height range (with a stability of ±5 μm). The C-Series is also engineered to reduce system and operating costs.

NEXTWINDOW
Pleasanton, CA 925/272-4521
www.nextwindow.com
Booth 941

Touch-screen overlay

Optical touch-screen technology for displays, kiosks, and interactive whiteboards from 30 to 120 in. and for desktop PCs from 15 to 30 in. has been NextWindow's development focus since 2000. The 2700 Series touch-screen overlay, NextWindow's newest product, transforms existing 30–82-in. displays into high-performance touch displays. This lightweight, user-installed overlay allows users to take advantage of native Windows 7 multi-touch features and is ideal for public-facing applications such as interactive digital signage, conference rooms, and classrooms.

NISSHA USA
Schaumburg, IL 847/778-6770
www.nisshausa.com
Booth 1324

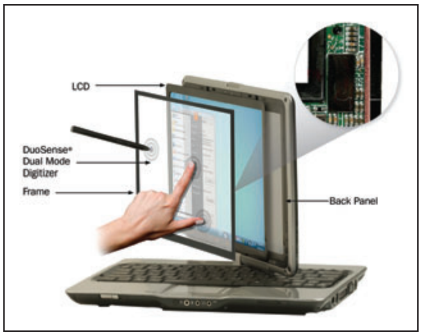
Touch input devices

Nissha's touch input devices are highly regarded for their high-precision technology and functionality. Nissha uses state-of-the-art photomechanical process techniques to create touch input devices. Nissha expands the degree of freedom in product design by an approach unique only to a printing company from flat to 3-D, small-to-large format. By capitalizing on our technology, Nissha will continue to develop new products going beyond the limits of touch-input devices.

N-TRIG
Kfar Saba IL, Israel +972-9-799-616
www.n-trig.com
Booth 1519

Digitizers

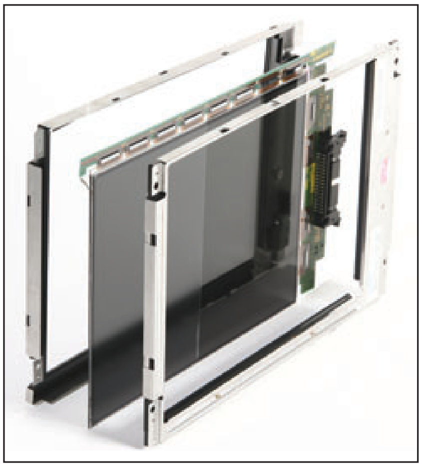
The N-trig DuoSense® solution provides a combined pen and true multi-touch interface that is changing how we interact with our computing devices. DuoSense multi-touch capabilities enables the manipulation of items directly on the screen for up to four fingers and together with the pen functionality enables 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.



OPTICAL FILTERS
Thame, Oxon, U.K. +44-(0)-1844-260377
www.opticalfilters.co.uk
Booth 859

Bonding process

ViZ-Bond is a newly developed process by Optical Filters for the direct bonding to flat-panel displays and the enhancement of touch screens with EMI shielding or transparent heaters. The benefits of ViZ-Bond include an incredibly stable and index-matched adhesive, an eliminated risk of process failure and loss of expensive components, consistent high quality and high yields, ability to process screens ranging in size from 3.7 to 60 in., with production in Meadville, USA, and Thame, U.K. ViZ-Bond is a complimentary process to the existing dry film and PSA processes.



OPTREX AMERICA
Plymouth, MI 734/416-8500
www.optrexusa
Booth 772

White-LED-backlit TFT-LCDs

Optrex has developed one of the broadest lines of TFT-LCDs with white-LED backlights for industry applications. These displays feature longer lifetimes (an average 60,000 hours), front-of-screen brightness levels ranging from 400 to 700 cd/m^2 for indoor use and from 800 to 1500 cd/m^2 for outdoor applications. Additional features include wide viewing angles up to 160°, high contrast ratios up to 1000:1, and wide operating and storage temperature ranges. Display sizes include 3.5, 4.3, 5.0, 5.7, 6.5, 8.4, 10.4, 12.1, and 15.0 in. on the diagonal, in a variety of resolutions.

PHOTO RESEARCH
Chatsworth, CA 818/725-9750 x175
www.photoresearch.com
Booth 120

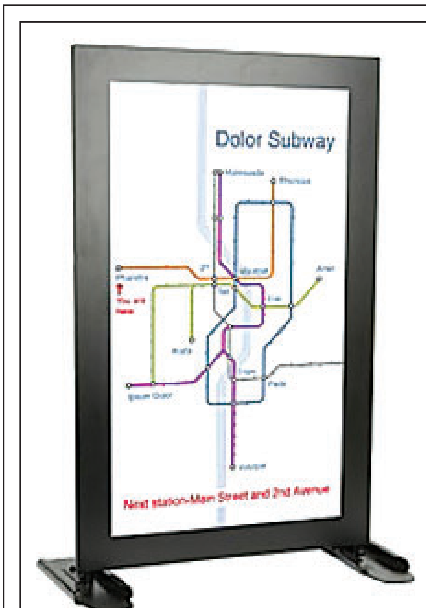
Spectroradiometer

With eight measuring apertures, 0.0001-fL luminance sensitivity, variable bandwidth (automated selection between 2, 4, and 8 nm), virtually non-existent polarization error (< 0.2%), and 512 thermo-electrically cooled detectors, the PR-730 is the best yet. Other features include full-color touch-screen display, USB, Bluetooth, and RS232 interfaces, battery-powered operation, and SD card storage. An extended version, the PR-735, covers a broader spectrum from 380 to 1080 nm.

PLANAR SYSTEMS
Beaverton, OR 503/748-5886
www.planar.com
Booth 1601

LED-backlit ultra-thin display

Planar Systems will feature its LB3251W 32-in. HD-resolution display, offering an ultra-thin bezel – less than 0.5-in.-thick for flush-wall-mount capability. LED backlighting provides energy-efficient high-brightness illumination and longer life, along with vandal-resistant bezel and safety-glass options. The noise-immune fiber-optic interface with optional passive loop-through provides functionality for up to eight displays from a single source. The 32-in. display offers standardized serial command protocol over a fiber-optic interface.



QUALCOMM
San Diego, CA 858/651-0686
www.qualcomm.com
Booth 863

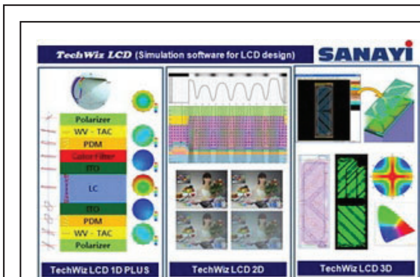
MEMS display for mobile devices

Qualcomm MEMS Technologies has developed the industry's first MEMS display for mobile devices, a true technological innovation that offers low power consumption and superb viewing quality in a wide range of environmental conditions, including bright sunlight. The display works by reflecting light so that specific wavelengths interfere with each other to create color. The phenomenon that makes butterfly's wings shimmer is the same process used in Qualcomm's mirasol displays.

SANAYI SYSTEM CO.
Incheon, Korea +82-32-254-2520
www.sanayisystem.com
Booth 519

Simulation software

Sanayi System Co. provides TechWiz LCD simulation software. Products and services cover the design and optimization of all the electrical and optical characteristics of LCDs. Data-exchange functions can be used with various measurement instruments for higher reliability. TechWiz LCD 1D PLUS, TechWiz LCD 2D, and TechWiz LCD 3D also available.



SAN TECHNOLOGY
San Diego, CA 858/278-7300
www.santekus.com
Booth 1524

TFT wide-screen LCDs

Santek offers a family of 7-in. TFT wide-screen 800 x 480 resolution LCDs, including the ST0700I6-RBSLW-F (250 cd/m^2, no touch), ST0700I6Y-RBSLW-F (with touch panel), and ST0700I6W-RSHLW-F (1400 cd/m^2, sunlight readable). The ST0700I6W-RSHLW-F is "actively" enhanced. This technique involves adding lamps to the backlight and increasing its output to an overall display measurement of 1400 nits. The technique is superior to both "passive" and "in-cell transflective" methods of sunlight readability because it effectively overcomes glare and sunlight while preserving overall color saturation. Sunlight-readable and touch-panel options, plus attractive prices, make these display versions a highly desired combination for a user-interface device.

sim4tec GmbH
Dresden, Germany +49-(0)-51-4466-499
www.sim4tec.com
Booth 419

OLED simulation software

sim4tec will show the brand new version 3.0 of its OLED simulation software SimOLED® which can be used to model the complete optoelectrical characteristics (*e.g.*, current density, luminance, and efficiency) of multilayered multi-emitter OLEDs. Version 3.0 comes, for the first time, with a fully combined optical and electrical simulation module, enabling the user to calculate key figures such as color, power, and quantum efficiencies as a function of electrical parameters such as voltage or mobility. SimOLED's fast computation and predictive power will greatly reduce R&D costs of OLED designers and manufactures. Applications include OLED displays, OLED lighting, and plastic electronics.

SOLOMON SYSTECH
Pak Shek Kok NT, Hong Kong +852-2207-1560
www.solomon-systech.com
Booth 935

Capacitive touch-panel controller

The SSD2531 from Solomon Systech is an all-in-one capacitive touch-panel controller that integrates power circuits, driving circuits, and sensing circuits into a single chip. It can drive a capacitive touch panel up to WVGA display resolution. Its DSP-based architecture supports up to four fingers simultaneous detection. It also supports stylus detection, auto calibration for each cross-over point, and has an embedded noise-rejection correlator for better signal-to-noise ratio. Four additional sensing button pins allow for more flexible product designs. With a highly compact and competitive design, the SSD2531 enables the use of a touch panel in portable devices such as mobile phones, PNDs, digital still cameras, and more.

SUN-TEC AMERICA
Scottsdale, AZ 480/922-5344
www.sun-tec.net
Booth 1009

Film-lamination equipment

The TMS-SA film lamination machine is used for laminating films to various substrates used in the display industry. It can laminate substrate sizes from 10 to 22 in. Lamination machines for substrates up to 65 in. are available. The TMS-SA series of lamination machines are designed to be affordably priced for R&D and low-to-medium volume production without sacrificing the performance of more expensive models. The TMS-SA maintains Sun-Tec's high production standards and assures bubble-free lamination with placement accuracy of up to 0.2 mm. Options include a table for laminating substrates with flex circuits, deionizer, Hepa filter, safety light curtain, and lamination rollers suitable for a variety of products.

Display Week 2011
Los Angeles, California, U.S.A.
May 22–27, 2011

THILMANY PAPERS
Kaukauan, WI 920/766-4611
www.thilmany.com
Booth 939

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UNIVERSAL DISPLAY CORP.
Ewing, NJ 609/671-0980x206
www.universaldisplay.com
Booth 1213

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 MICRPOPRODUCTS
Austin, TX 512/385-9000 x1127
www.usmicroproducts.com
Booth 841

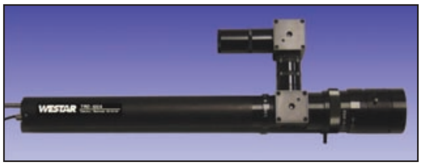
Custom projective-capacitive multi-touch

US Micro Products offers the leading projective capacitive multi-touch solutions. Multi-touch is the best that touch technology has to offer. Multi-touch makes it easier to interact with devices by allowing the user to have gesture control and all-point multi-touch interaction, without requiring Windows 7. Custom sizes produced to specifications. Corning's Gorilla Glass is designed specifically to function as a protective window for portable display devices and is available as an option with our multi-touch.

WESTAR DISPLAY TECHNOLOGIES
Saint Charles, MO 636/300-5100
www.westardisplaytechnologies.com
Booth 541

Temporal response detector

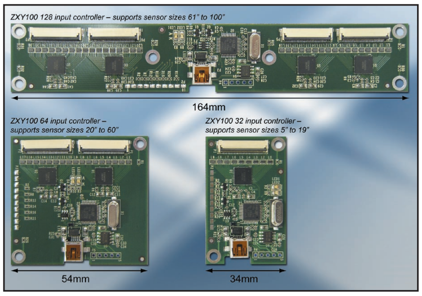
Westar Display Technologies will introduce the TRD-100A-SAO PMT-based Temporal Response Detector with integrated "Slit Aperture Optics." By reshaping the optical aperture to a horizontal slit, this smart sensor avoids "signal smear" caused by non-trival spot refresh times characteristic of large circular apertures. This smart sensor includes programmable gain and a CCD view port and is used to measure response time, gray-to-gray transition times, and flicker on LCD products with switching speeds down to 0.1 msec.



ZYTRONIC
Blaydon on Tyne, UK +44-191-4145-511
www.zytronic.co.uk
Booth 509

Projected-capacitive controller

Zytronic's next-generation ZXY100 touch controllers, for use with its proprietary Projective Capacitive Technology (PCT™) touch sensors, will be unveiled at SID 2010. The controllers improve touch-screen speed and accuracy, add exciting new functionality, and significantly reduce the PCB footprint. Driven by a 32-bit ARM microprocessor and custom ASIC, the ZXY100 controllers are compatible with ZYPOS®, ZYBRID®, ZYTOUCH®, ZYFILM,® and ZYPROFILM® sensors. An accompanying new Zytronic driver includes innovative features, such as in-field firmware updating. The controller firmware also supports Microsoft® Windows® 7 HID driver, enabling plug-and-play operation with single- or dual-point touch, and linkage to the system's gesturing recognition. ■



Journal of the

SOCIETY FOR INFORMATION DISPLAY

The following papers appear in the June 2010 (Vol. 18/6) issue of *JSID*.
For a preview of the papers go to sid.org/jsid.html.

2009 JSID Outstanding Student Paper Award

Each year, the *Journal of the Society for Information Display* (*JSID*) recognizes a published student paper on the basis of originality, significance of results, organization, and clarity. The 2009 award goes to "Color-Breakup Suppression and Low-Power Consumption by Using the Stencil-FSC method in Field-sequential LCDs" by Fang-Cheng Lin, Assistant Professor Pai Huang, Ching-Ming Wei, and Professor Han-Ping D. Shieh of National Chiao Tung University (NCTU) in Hsinchu, Taiwan.

Now that LCDs have reached a certain maturity and dominance in the marketplace, most research efforts are aimed at refining rather than redefining them, and, in particular, at creating LCDs that use less power. The authors' award-winning paper focuses on creating a new method for frame-sequential color (FSC) on an LCD by applying a technique they call the "stencil" method.

Field-sequential color is a well-understood process for making full-color images by sequentially flashing the red, green, and blue fields quickly enough so that they merge together when observed. In the case of single-panel DLP projection and other types of systems, a very high field rate on the order of 540 Hz is used to prevent the undesirable phenomenon of color breakup (CBU) – basically, the primary-color fields being individually observable by the user of the display. For large-area LCD panels, high field rates are not achievable, so the authors have proposed the use of their stencil field-sequential-color (Stencil-FSC) method, which incorporates local color-backlight-dimming technology at a much lower field rate of 240 Hz, which they report significantly reduces CBU effects.

This methodology is applied to a high-resolution large-area AMLCD without color filters. Color filters cut the light emission of an LCD panel by a factor of three because each color filter for a primary color absorbs the light of the other two primary colors. Because FSC allows the color filters to be eliminated, the luminous efficacy of the LCD can theoretically increase by as much as three times.

The authors propose the insertion of a fourth field in the normal three-field sequence of the FSC process. This fourth field is a full spatial but low-color-resolution sub-frame that can be achieved by properly addressing the full-color two-dimensional dimming backlight. By using the first sub-frame to show a multi-color image with high luminance and rough color content, the luminance of the other three primary-color images was greatly reduced, making CBU almost imperceptible. The first sub-frame would be compiled by a low-resolution color image utilizing a locally controlled RGB-LED backlight and a high-resolution LC image. Therefore, the Stencil-FSC method not only reduced CBU, but also increased dynamic contrast and lowered power consumption.

"Field-sequential color is one of the major ways that future LCDs can cut power consumption, but the CBU problem has stalled its adoption," says Larry Weber, a member of the review panel that chose the winning paper. "The stencil method could be the needed breakthrough."

To prove the theory, the Stencil-FSC method was implemented on a 32-in. FSC-LCD TV that yielded a dynamic contrast of 27,050:1, with an average power consumption of less than 40 W, a color gamut of 114% NTSC, and imperceptible CBU. The authors propose that this low-power FSC-LCD TV without CBU holds promise for the next-generation of "green" LCD-TV applications.

— *Information Display Staff*

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Information Display Magazine
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Fax: 212.460.5460
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editorial

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We begin this month with what I hope will be a long-lasting marketing relationship with the well-known electronics distributor Avnet. At *Information Display*, we're looking for ways to help product engineers do more with display technology every day, and Avnet is one of the leading suppliers of display components and solutions in North America. We plan to bring *ID* to a larger segment of the applications community through Avnet and in turn we hope you will give Avnet's product lines a look when you need to find solutions. We believe this relationship will help all our advertisers with a larger target audience and more prospects for future business. At the end of the day, that would be a win-win for everyone in the industry.

One of the things I like to do at least once a year is open the history books and chronicle the story of a leading company, person, or technology innovation from our past, like the story of Plasmaco from last year's Display Week issue. I'm really pleased to bring you this story of Actuality Systems and its founder Gregg Favalora. I can personally attest to the humility and genuine inventiveness of Gregg, having met him many years ago at his dorm in Cambridge, Massachusetts. Right away and without fanfare, he took me to the basement where, yes indeed, he had a 3-D volumetric display prototype running right next to the dusty furnace and the old discarded furniture. It was a brilliant demonstration even then, and I knew it would grow into an amazing product that would find much acclaim and recognition in the years ahead. You probably know the ending by now, that Gregg's company has closed its doors, and the assets have been acquired, but I think this is just a small speed-bump in the future of his unique 3-D projection technology and that we will see much to come from his innovative work. Please read this inspiring story. I hope you enjoy it as much as I did.

As I said earlier, this is a very full issue. After all the above, we still have two great features to introduce. The first is this month's article on Making Displays Work for You, which discusses the state of the art in "Optical Enhancements and EMI Filters for Touch Screens" by Brian E. Herr, Jeff Blake, and Richard D. Paynton from Dontech, Inc. A lot of progress has been made in this subject area and I can personally attest to the performance improvements in EMI shielding achieved in recent years.

Our other monthly feature looks at the display marketplace. Author and analyst Paul Semenza provides a cautiously optimistic view of the future as the industry emerges from the recession. I really like his article, "A New Chapter for the Display Market," because it not only covers the high-level view across all the technologies and applications, but also drills down into enough detail to let you appreciate why the author thinks things will play out the way he is forecasting. Of course, for more details you can always sign up for the SID Business Conference co-sponsored by Paul's company, DisplaySearch. We expect this to be the premier event for strategic planning and marketing executives involved in the display industry. Presentations from leading market analysts and key display-industry participants will provide a comprehensive view of the technology and market challenges and opportunities facing all of us.

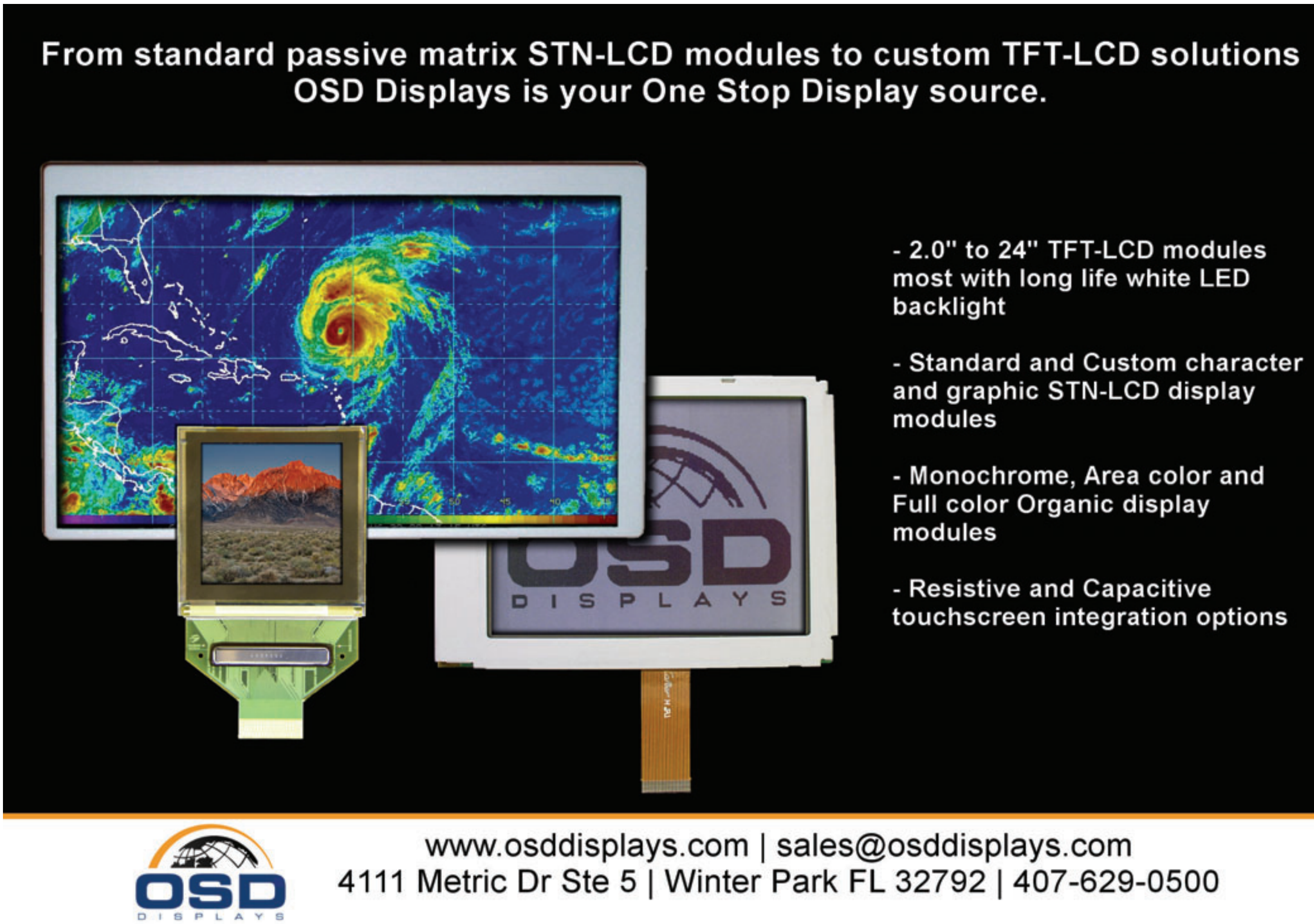
With that, and some news thrown in, I think this issue is a wrap. It's great seeing you all in Seattle, and while you are here, please take the time to thank our outstanding *Information Display* staff, including Jay Morreale, Jenny Donelan, Michele Klein, and all the members of the Palisades Convention Management team who work relentlessly to bring Display Week to you every year and likely do not get any sleep between March and May.

Last, but definitely not least, I urge you again to take the time to look around and see what's new at Display Week 2010. You just might discover some cutting-edge technology – the equivalent of a new volumetric 3-D display – or learn something that will make the pivotal difference in your company's research. None of us ever really knows how or when the next hot technology will show up. But one thing I do know is that if it has to do with displays, it usually shows up here first. ■

president's corner

continued from page 4

Lastly, as incoming President, I would like to thank my fellow members and sponsors for their support and the opportunity they have given me to serve. I thank the outgoing President Paul Drzaic for introducing me in his previous column in *Information Display* magazine. He and the past presidents, including Aris Silzars, Allan Kmetz, Shigeo Mikoshiba, and Larry Weber, have provided the utmost dedicated service to SID. Because of their efforts we are proud of what we are today. ■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110 ☐ Yes 111 ☐ No

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212 ☐ Engineering Systems (Evaluation, OC, Stds.)
213 ☐ Basic Research
214 ☐ Manufacturing /Production
215 ☐ Purchasing /Procurement
216 ☐ Marketing /Sales
217 ☐ Advertising /Public Relations
218 ☐ Consulting
219 ☐ College or University Education
220 ☐ Other *(please be specific)*

____

3. What is the organization's primary end product or service? (check one)

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311 ☐ Electroluminescent Displays
312 ☐ Field-emission Displays
313 ☐ Liquid-crystal Displays & Modules
314 ☐ Plasma Display Panels
315 ☐ Displays (Other)
316 ☐ Display Components, Hardware, Subassemblies
317 ☐ Display Manufacturing Equipment, Materials, Services
318 ☐ Printing /Reproduction / Facsimile Equipment
319 ☐ Color Services /Systems
320 ☐ Communications Systems / Equipment
321 ☐ Computer Monitors /Peripherals
322 ☐ Computers
323 ☐ Consulting Services, Technical
324 ☐ Consulting Services, Management /Marketing
325 ☐ Education
326 ☐ Industrial Controls, Systems, Equipment, Robotics
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330 ☐ Oceanography & Support Equipment
331 ☐ Office & Business Machines
332 ☐ Television Systems /Broadcast Equipment
333 ☐ Television Receivers, Consumer Electronics, Appliances
334 ☐ Test, Measurement, & Instrumentation Equipment
335 ☐ Transportation, Commercial Signage
336 ☐ Other *(please be specific)*

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4. What is your purchasing influence?

410 ☐ I make the final decision.
411 ☐ I strongly influence the final decision.
412 ☐ I specify products/services that we need.
413 ☐ I do not make purchasing decisions.

5. What is your highest degree?

510 ☐ A.A., A.S., or equivalent
511 ☐ B.A., B.S., or equivalent
512 ☐ M.A., M.S., or equivalent
513 ☐ Ph.D. or equivalent

6. What is the subject area of your highest degree?

610 ☐ Electrical /Electronics Engineering
611 ☐ Engineering, other
612 ☐ Computer /Information Science
613 ☐ Chemistry
614 ☐ Materials Science
615 ☐ Physics
616 ☐ Management /Marketing
617 ☐ Other *(please be specific)*

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7. Please check the publications that you receive personally addressed to you by mail (check all that apply):

710 ☐ *EE Times*
711 ☐ *Electronic Design News*
712 ☐ *Solid State Technology*
713 ☐ *Laser Focus World*
714 ☐ *IEEE Spectrum*

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