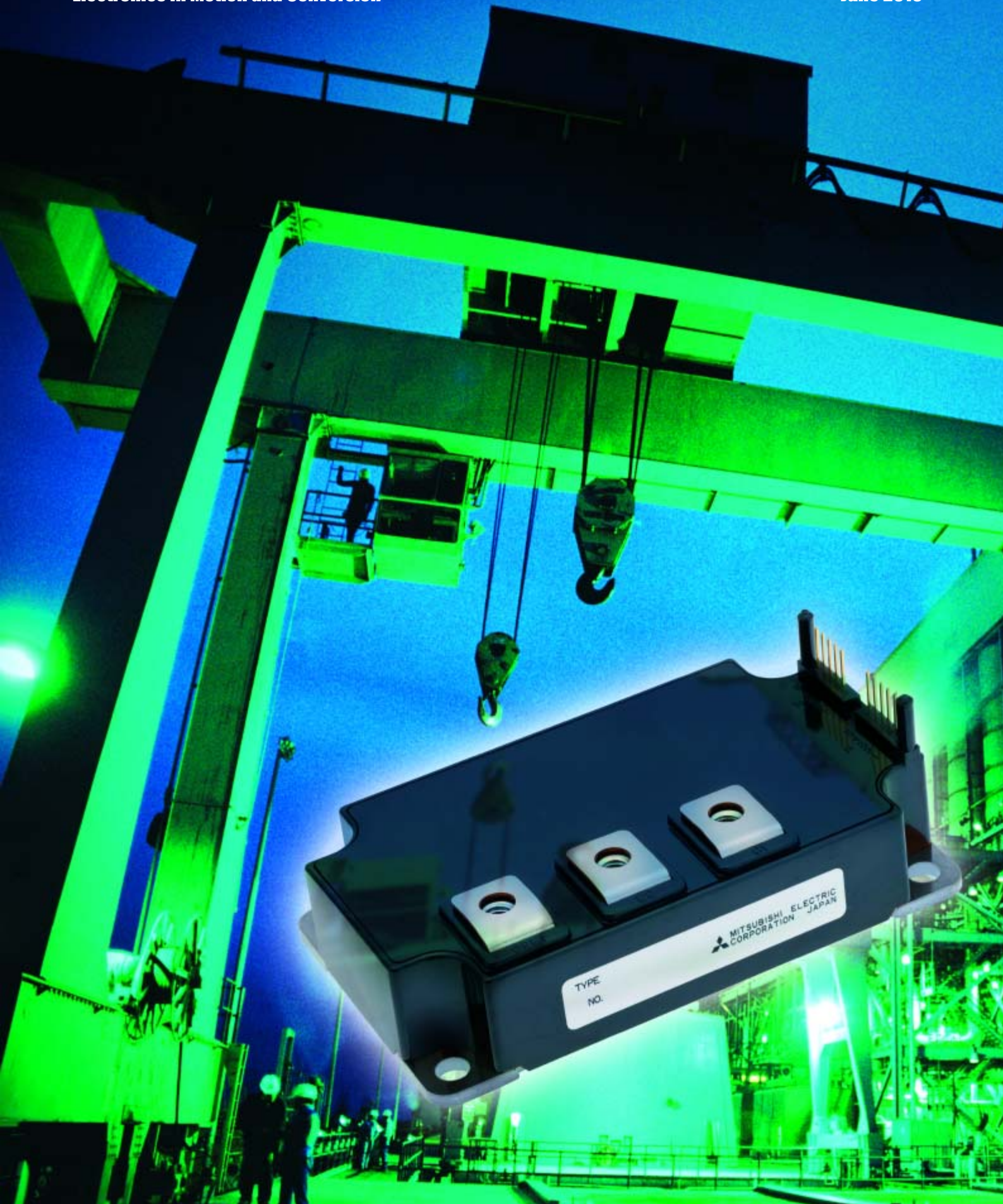


Bodo's Power Systems®

Electronics in Motion and Conversion

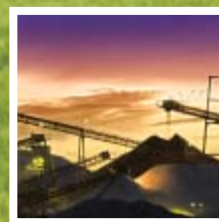
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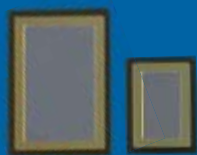
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JUNCTION BARRIER SCHOTTKY DIODES

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or call 800-533-2583.

PART NUMBER	I_F (A)	V_F (V) TYPICAL	I_R (μA) TYPICAL	Q_C (nC) TYPICAL	T_J (°C) MAX
CPW3-1700S010B	10	1.8 @ 25° C 3.2 @ 175° C	10 @ 25° C 20 @ 175° C	80	175
CPW3-1700S025B	25	1.8 @ 25° C 3.2 @ 175° C	25 @ 25° C 50 @ 175° C	210	175



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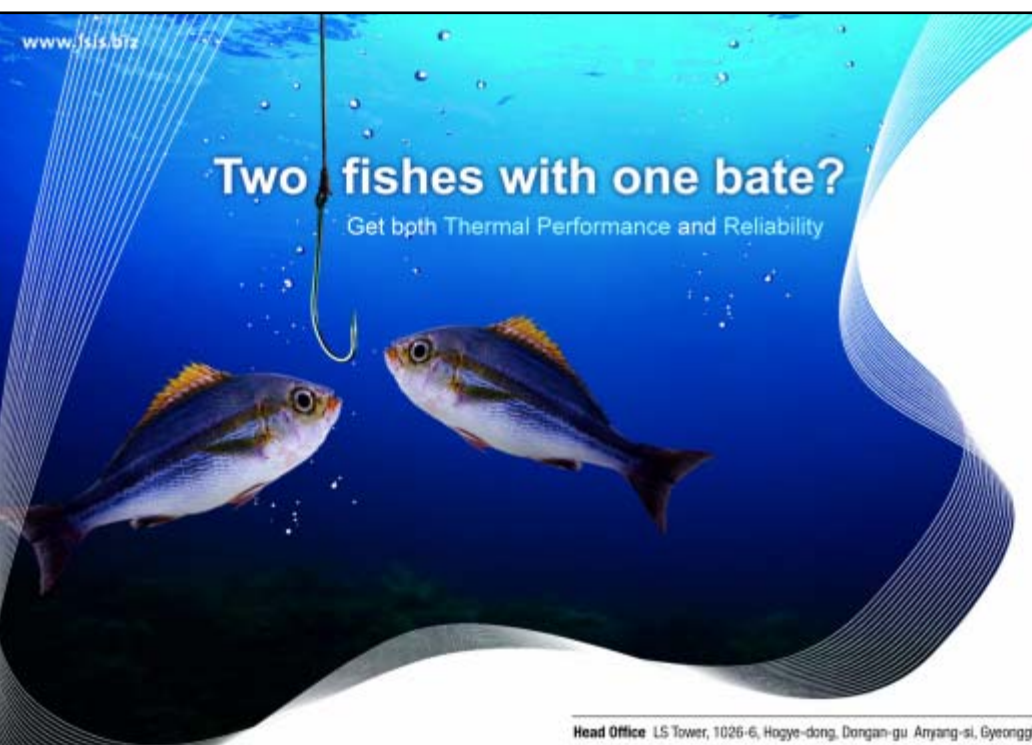
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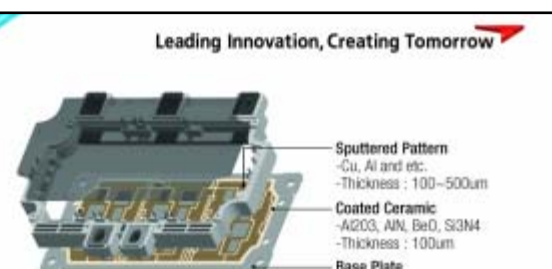
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Performance

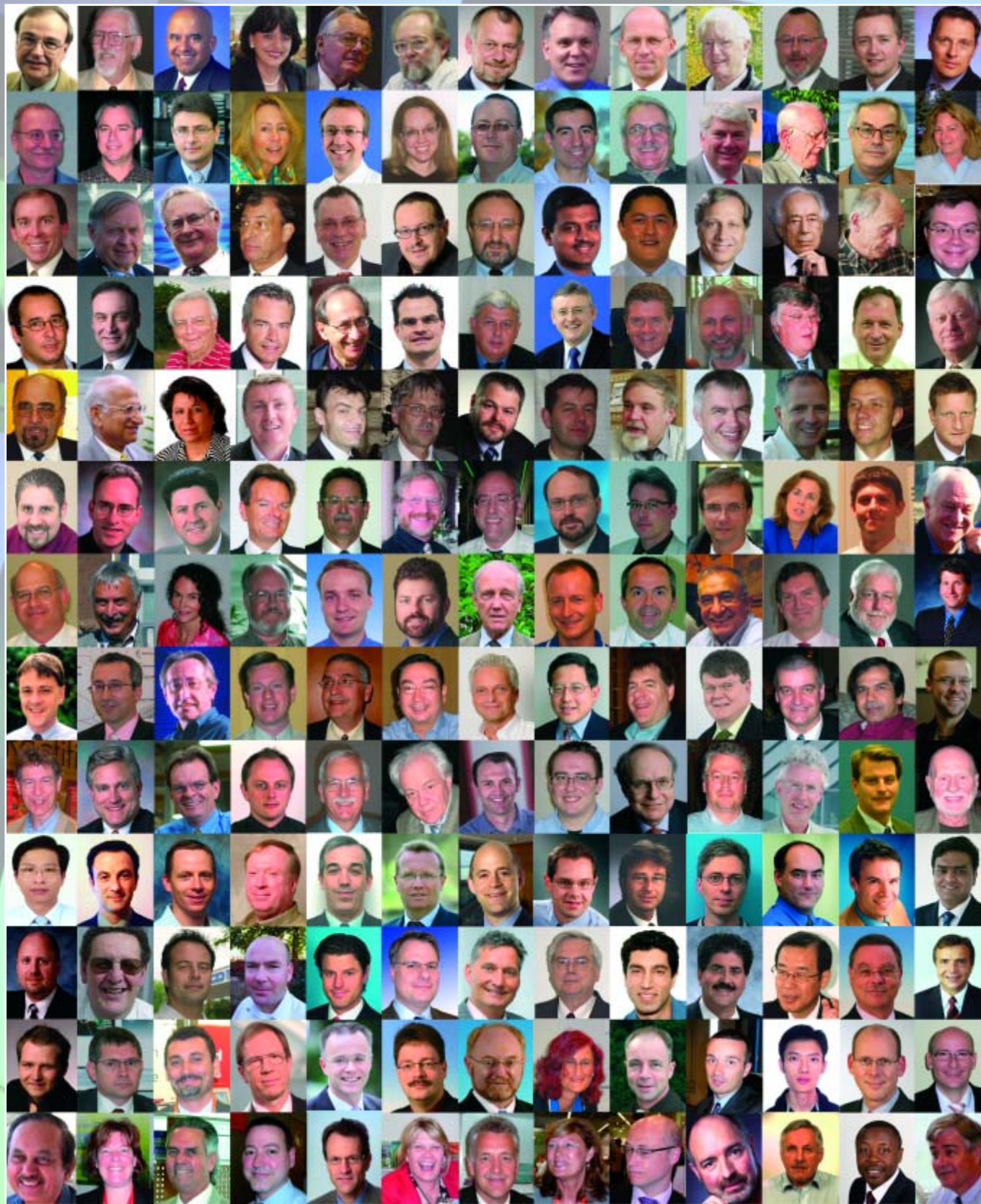
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 - Thick Pattern
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Events

SMT Hybrid Nuremberg Ger.
June 8-10 www.mesago.de

Intersolar Europe 2010 Munich Ger
June 9-11 /www.intersolar.de

Digital Power Asia Taipei
June 14-15 dpfasia.darnell.com

Coilwinding Berlin Ger
June 20-22 www.coilwindingexpo.com

CleanTech Tel Aviv
June 29-30 www.mashovgroup.net

SEMICON West San Francisco USA
July 14-16 www.semiconwest.org

Digital Power Workshops
Stockholm Sweden Aug. 24
www.biricha.com

Solar Energy Valencia Spain Sep. 6-10
www.photovoltic-conference.com

Husum Wind Energy Ger. Sep. 21-25
www.husumwindenergy.com

Innotrans Berlin Ger.
Sep. 21-24 www.innotrans.com

Digital Power Workshops
Munich Ger. Oct. 5 www.biricha.com

Summer Sunshine and Wind

The summer has finally arrived and with it, the joy of sunshine. Where in the past we enjoyed sun and wind for such leisure activities as lying on the beach or sailing, both have now become important and direct generators of electrical power.

The PCIM show was very encouraging. Industry activity showed a significant increase – all of my friends are reporting profitable growth and so to, thankfully, can I. My May issue reached a record 80 page count and including the June edition - delivered, as always, on time – we'll have produced a total of 366 pages this year. For this I'd like to thank all of my supporters around the globe including Asian manufacturers from South Korea who, I'm proud to say, have chosen Bodo's Power for their ad campaigns.

Bodo's Power Systems podium discussion at the PCIM covered a number of significant subjects and successfully introduced one which will develop over time.



Briefing at Bodo's Power Systems Booth

Tim McDonald from IR started the discussion by defining areas enabled by new semiconductor materials in higher frequency and higher temperature system solutions.

Members of the passive device community painted a picture of what will be achieved to help complement these opportunities.



Podium discussion "Passive Components for System Efficiency"



Ed Sawyer (SBE), Kevin G. McGivern (Bicron), Mark Occhionero (CPS) and Arne Albertsen (Jianghai) each presented their perspective for fulfilling the challenging opportunities of the new semiconductor materials. GaN and SiC switches in future designs will definitely run at higher frequency and temperature to fully utilize the capability of both materials. We must develop a totally new mindset for these state-of-the-art materials - without optimized passives, design solutions will not reach their full potential. Passive component development has to keep up with semiconductor improvements. Articles have, and will continue, to highlight these crucial subjects in my publication.

More and more, GaN and SiC semiconductors are being used to increase efficiency. I am just back from Kista, Sweden, having attended the SiC work shop initiated by Transic and Acreo. SiC semiconductor materials make new technologies for use in solar inverters possible. So the next big event is the June Intersolar Europe conference in Munich and in the same week, SMT Hybrid in Nuremberg. Both shows are important for power electronic technology.

Increased efficiency is always the goal.

My Green Power Tip for June:

Water your flowers and plants during the morning or evening. Shade will allow the soil to fully absorb the water and not burn away like a vacationers' skin on the beach.

See you at Intersolar and SMT Hybrid.

Best regards



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For sample requests or more technical information, visit www.cde.com/bodo

CAPACITOR SOLUTIONS FOR POWER ELECTRONICS



Compatibility Agreement for Power MOSFETs

Infineon Technologies and Fairchild Semiconductor announced a packaging partnership for their power MOSFETs in the Infineon PowerStage 3x3 or Fairchild MLP 3x3 (Power33™) packages.

The compatibility agreement is in response to the need for supply security while balancing the drive towards best-in-class efficiency and thermal performance in DC-DC conversion. It takes advantage of the expertise both companies offer for asymmetric, dual and single MOSFETs for DC-DC applications from 3A to 20A.

"Standardizing power packages benefits our customers as we minimize the amount of 'unique' packages available in the market place, while offering solutions that enhance performance levels in smaller form factors than the previous generations," said Richard Kuncic, director and product line manager Low Voltage MOSFETs at Infineon

Technologies.

"Fairchild and Infineon have standardized the pin-out and have complementing performance levels, offering customers two sources for their high efficiency design needs in the computing, telecom and server markets," said John Bendel, Fairchild's senior vice president of Low Voltage Products. "This package alignment is staged to deliver performance leading products in a multi-source, industry standard package."

www.infineon.com/power

www.fairchildsemi.com

Joint Development Agreement for Inductive Components in HEV

Lear Corporation and Premo announced the formation of an agreement for the design and development of cutting edge inductive components and technology for automotive power electronics applications for hybrid vehicles.

The cooperation between both companies will generate a powerful joint of know-how and experience in the automotive sector from the supplier (tier ones) point of view. Three different production facilities (Spain, Tangier and China) and about 800 people together develop and manufacture more than 8 millions complete electronic modules and 80 millions of inductive components. These are delivered to 80

countries globally to 50 different companies: automotive manufacturers, tier ones and secondary suppliers. Due to this, the new green cars projects coming from the big automotive manufacturers will find LEAR and PREMO as the best partners to get solutions for the new environmental challenges.

www.grupopremo.com

www.lear.com

Record Quarterly Revenue and Net Income

Cree announced record revenue of \$234.1 million for its third quarter of fiscal 2010, ended March 28, 2010. This represents a 78% increase compared to revenue of \$131.1 million reported for the third fiscal quarter last year and a 17% increase compared to the second quarter of fiscal 2010. GAAP net income for the third quarter increased more than tenfold year-over-year to \$44.6 million, or \$0.41 per diluted share, compared to GAAP net income of \$4.0 million, or \$0.05 per diluted share, for the third quarter of fiscal 2009. On a non-GAAP basis, net income for the third quarter of fiscal 2010 increased 333% year-over-year to \$51.3 million, or \$0.47 per diluted share,

compared to non-GAAP net income for the third quarter of fiscal 2009 of \$11.8 million or \$0.13 per diluted share.

"We achieved record revenue and net income again in Q3 due to a combination of strong LED demand and solid execution with our factory ramp," stated Chuck Swoboda, Cree chairman and CEO. "The LED lighting revolution continues to gain momentum, and we remain focused on extending our leadership position while we build the scale, cost structure and channels to win in the market."

www.cree.com

Magnetics Supplier



Datatronics Romoland, Inc., is a global leader in advanced custom magnetic component technologies for military, aerospace, medical and other mission-critical applications.

Datatronics Romoland designs and manufactures high reliability custom magnetic components. Products include power transformers, power inductors, switching transformers, telecom, standard and miniature high-voltage transformers, LAN modules/filters, and fine-wire magnetics up to 56 AWG. With a long history supporting high technology programs, magnetic components from Datatronics Romoland have been designed into the Space Shuttle, Space Station, Cruise Missile, Navstar Global Positioning System, SINCGARS Radio, SLAM Anti-Tank Mine, MIL-LINS Navigational System, Night Vision, Implantable Pacemaker/Defibrillators and more.

www.datatronicsromoland.com

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We never sell a product alone
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I _c	1200V	1700V
225A	●	●
300A	●	●
450A	●	●
600A	●	



SiN-DCB & thicker Cu pattern

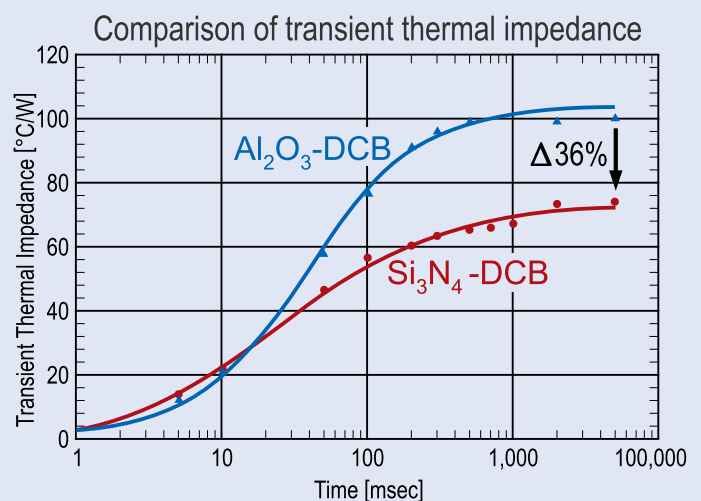


Lower thermal impedance
 Higher bending strength & fracture toughness



Higher thermal cycling capability
 Higher reliability

- ◆ $T_{j(op)} = 150^{\circ}\text{C}$ continuous operation
- ◆ $T_{j(max)} = 175^{\circ}\text{C}$
- ◆ New solder material for higher reliability
- ◆ Low switching losses & low over voltage spike



Start up of Polysilicon Facilities in Burghausen

Additional polycrystalline-silicon production facilities officially came on stream at Wacker Chemie AG's Burghausen site. All "Expansion Stage 8" deposition reactors are already up and running. The plant's full nominal capacity of 10,000 metric tons a year will be

reached before the end of Q2 2010. Wacker is thus half a year ahead of its original, very ambitious schedule. Overall, Wacker is investing around €500 million in this expansion stage, thereby creating some 200 new jobs. Expanding output enables Wacker to

meet rising global demand for hyperpure polycrystalline silicon. The new facilities can manufacture material for both the solar sector and the semiconductor market.

www.wacker.com

Franchise Agreement with IDT

IDT has extended its relationship with Future Electronics by awarding it the franchise to sell its entire portfolio of products across the EMEA (Europe, Middle East and Africa) region.

Previously, Future Electronics was only authorized to sell the Tundra product portfolio that was acquired by IDT in 2009. The new arrangement allows Future Electronics to sell the entire IDT product portfolio, at a pan-European level.

In fact, Future Electronics' success in gaining important new design wins for the former Tundra Semiconductor's product family during 2009 demonstrated to IDT the ability of Future Electronics to successfully promote the entire IDT product portfolio and technical solu-

tions across EMEA.

Future Electronics employs a large team of Field Applications Engineers based in 43 branches around the EMEA region. These FAEs are skilled at helping OEM customers deploy new products and solutions from more than 100 franchised suppliers in order to get to market faster with higher-performance, more valuable products.

www.futureelectronics.com

www.IDT.com

Highest Number of Abstracts for a PV Conference

WIP - Renewable Energies reports that 1,817 research and industry abstracts have been received for the 25th European Photovoltaic Solar Energy Conference and Exhibition / 5th World Conference on Photovoltaic Energy Conversion (25th EU PVSEC / WCPEC-5), taking place from 6-10 September 2010 (Conference 6-10 September 2010 - Exhibition 6-9 September 2010) in Valencia, Spain. This year's 1,817 abstracts represent an increase of 237 in comparison with the previous conference in Hamburg (1,580 abstracts).

The abstracts received reflect the high standard and the significance of the 25th EU PVSEC/ WCPEC-5 for the further development of photovoltaics. The Technical Programme Chairman, Dr. Heinz Ossenbrink from the Joint Research Centre (JRC) - European Commission,

comments: 'This number and the quality of the abstracts confirm the 25th European Photovoltaic Solar Energy Conference and Exhibition / 5th World Conference on Photovoltaic Energy Conversion being the place where the next generation of photovoltaic technologies will be discussed. As an example, the topic 'Advanced Photovoltaics' with 404 abstracts received will show new concepts for photovoltaics and will map out the way towards ultra-high efficiency solar cells for the technologies of tomorrow.'

www.photovoltaic-conference.com

Infineon and Mitsubishi Team Up to Serve the Global Power Electronics Industry

Infineon Technologies and Mitsubishi Electric Corporation agreed to establish a service agreement by which they will both serve the industrial motion controls and drives market worldwide as sources for the advanced IGBT module packages SmartPACKs and SmartPIMs. This revolutionary package concept, recently developed by Infineon Technologies, will be available with the latest generation of power chip technologies from the two leaders.

Under this agreement, Mitsubishi Electric will market its latest generation power chips of various ratings (current range: 15A up to 150A, voltage class: 600V and 1200V) in the Smart-1, -2 and -3 housings of Infineon. As the creator of the new SmartPACK/PIM module concept, Infineon will continue to manufacture and supply the same range of fully compatible products using its own chip technologies and module manufacturing.

www.infineon.com

www.mitsubishichips.com

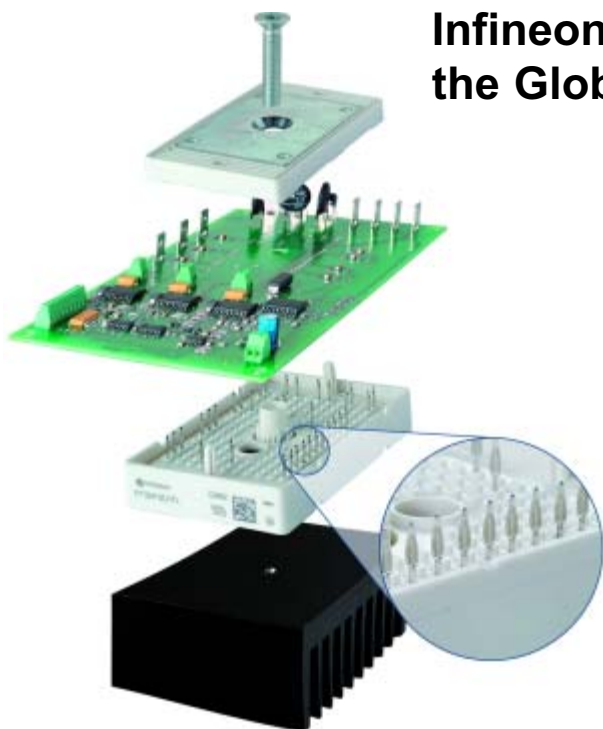


ABB sensor improves inverters efficiency?

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ABB takes care of environment that's why we focus our efforts in order to propose the best current and voltage sensor for higher efficiency of solar inverter. Because applications are more compact and more sensitive to immunity perturbation, we have enhanced the ESM range in term of immunity and dynamic response. In addition to current sensor, we also propose voltage sensor VS, for solar inverter application. Thanks to these products we are able to offer the clearest signal increasing the performance of your equipment. www.abb.com

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Your Global Source for
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Conversion Components

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Online Tool Organizes Ecodesign Directive Efficiency Standards

Power Integrations launched its new EuP Standards Finder, an online tool for power supply designers. Providing immediate access to specific requirements of the European Commission's EuP Ecodesign Directive, this tool eliminates the need for designers to search through volumes of data to figure out what is relevant to them. Hosted on Power Integrations' website, the EuP Standards Finder allows users to select an application from an A-to-Z listing and then immediately view the Tier One and Tier Two limits for standby, active-mode, and no-load power consumption. Links to relevant Power Integrations reference designs are also displayed in the search results. Commentary from energy-efficiency standards guru Mr. Green provides additional insight into how the Ecodesign Directive applies to the specified product. Comments Rich Fassler, manager of energy-efficiency programs at Power Integrations: "The Ecodesign Directive's power consumption limits will ultimately apply to hundreds of end products – from computers and external power supplies to set-top boxes and appliances. The standards are not necessarily organized by application, so figuring out how and when the standards apply to a specific end product can be challenging. Keeping up with changes in the standards further complicates the issue. With the EuP Standards Finder, Power Integrations has dramatically simplified the task of correlating the EC's requirements to specific end products. The designer can simply push a button and get all of the data needed to make an informed decision."



The EuP Standards Finder is available now on the Power Integrations website at www.powerint.com/eup-standards-finder. The tool is frequently updated as Ecodesign Directive requirements evolve and new Power Integrations reference designs become available.

www.powerint.com

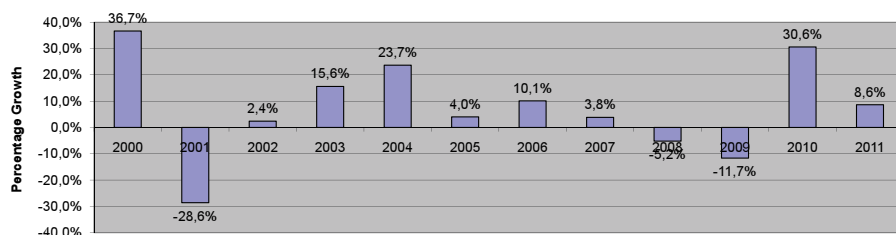
Semiconductor Industry Set For Highest Annual Growth in 10 Years

The last time the global semiconductor industry achieved annual revenue growth greater than 30 percent was when Bill Clinton was president, Gladiator was topping the

box office and the Dot-Com boom was so hot that the merger of AOL and Time Warner actually seemed like a good idea. Now, 10 years after the chip business's

whopping 36.7 percent expansion of 2000, the industry is expected to finally break the 30 percent barrier once again in 2010, with revenue set to rise to \$300.3 billion, up 30.6 percent from \$229.9 billion in 2009. However, unlike the Internet-crazed spike in 2000, growth in chip sales this year will be driven by real fundamental supply/factors that slowly have been gaining momentum during the past 12 months.

iSuppli Figure 1: Annual Percentage Growth in Semiconductor Revenue



www.isuppli.com

CleanTech 29-30 June 2010 TelAviv

14th International Summit and Exhibition for Renewable Energy and Water Technologies, Recycling and Environmental Quality, Infrastructure and Green Building takes place in the Israel Trade Fairs & Conventions Center, Tel Aviv, Israel. CleanTech 2010 is the central meeting point in Europe, Asia and Africa. The geographical location of CleanTech 2010 – in the middle of three continents – Europe, Asia, and Africa – makes it an international magnet for companies to expose their products and services to international customers and traders, and for buyers to

create new commercial contacts. Israeli incentives program for solar photo-voltaic systems: The Israeli Public Utility Authority (PUA) published on June 2nd 2008 the new incentives program for solar photo-voltaic systems. Summary of the program:

- Feed in tariff of 2.01 NIS per each KWh produced.
- Residential systems up to 15KWp, commercial up to 50KWp.
- Contract for 20 years.
- Size of the system is limited to the size of the electricity connection of the site.

Green Building: In recent years there has been a growing awareness of "green construction," that is, building that provides a higher quality of life and healthier environment by cutting back on the overall bad effects on the environment from the process of construction and building use. The exhibition will emphasize the environment as a central factor in the planning and implementation of green construction projects.

www.mashovgroup.net

Solar PV Micro-Inverter Technology for Highest Reliability at Intersolar Europe 2010

Enecsys Limited is to reveal details of its ground-breaking solar PV grid connected micro-inverter technology at Intersolar Europe 2010 in Munich, Germany, June 9 - 11. The company's solar micro-inverter will be on show for the first time, complete with its wireless smart monitoring system. Enecsys will discuss the design innovations that have been used to enhance the reliability of its micro-inverters to the point at which their life expectancy matches that of PV solar modules. The company will also discuss the accelerated life tests that underpin the expected reliability of the product.

The Enecsys micro-inverter was developed in Cambridge, UK, and is manufactured in Europe. It is the first solar PV micro-inverter designed to meet the technical requirements of both European and US markets. There will be a demonstration of the Enecsys smart monitoring software at the booth.

Enecsys will launch its solar micro-inverter and monitoring system at a press conference at Intersolar Europe 2010 on Wednesday, June 9th, Booth B4.444.

www.enecsys.com

Wind: 50% of EU Electricity in 2050

Wind energy will meet 50% of the EU's electricity demand in 2050, top wind energy personalities told Europe's largest wind energy conference and exhibition.

Topping the agenda at the opening day of the European Wind Energy Conference and Exhibition (EWEC 2010) in Warsaw was Europe's long-term energy supply.

"2050 might seem like a long way off, but the decisions we take today will have a big impact on our energy supplies in 40 years' time," said Arthouros Zervos, President of the European Wind Energy Association (EWEA).

With the G8 and EU already committed to an 80% greenhouse gas reduction by 2050, Zervos added: "We can't allow the politicians to make grand statements and leave the serious decisions to the next generation. Given the long life of power plants our vision for 2050 has to be reflected in the construction of new power plants from at least 2020 onwards."

"A fully renewable power sector is the only solution to reaching 80-95% CO2 reductions by 2050," he continued. "The remaining carbon emissions will be needed for other sectors, such as agriculture."

However, we should be talking about a "renewable energy economy" not a low carbon one, Professor Zervos said. "Renewable energies can provide 100% of Europe's power supplies by 2050 without any further contribution from any so-called low-carbon technologies."

www.ewea.org

www.bodospower.com

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- X2 EMI capacitors up to 45 μ F
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- NTC thermistors for temperature measurement and compensation
- PTC thermistors for overcurrent protection
- Ferrite materials with reduced power losses
- SAW filters for advanced metering infrastructure
- Varistors for overvoltage protection
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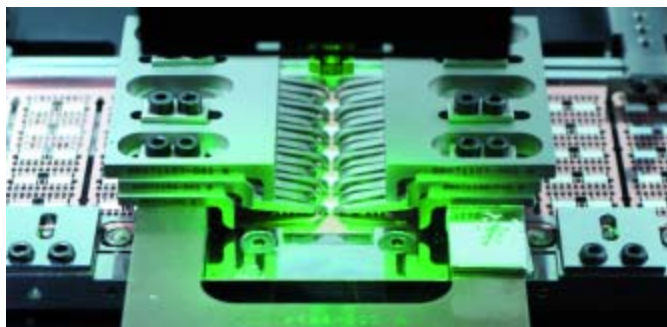
www.tdk-epc.com

Coil Winding (CWIEME Berlin) • Berlin, Germany
June 22 to 24, 2010 • Hall 2.1, Stand 4014

Introduction of HD Series Wire Bonders

Orthodyne Electronics' new High Density Series Wire Bonders are designed to address the demand for smaller, thinner and denser discrete power semiconductor packages such as SO-8, PDFN, PQFN, DSO and DrMos.

The trend to shrink the size of power packages is driven by requirements of space-critical end applications such as hand-held devices, and is enabled by the ongoing substantial improvements in silicon



efficiency. Smaller chip sizes allow multi-chip packaging, which perform functions once done with multiple devices or hybrid circuits. Squeezing more power and functions out of smaller packages increases the complexity of the devices. The number of interconnects increases to carry the elevated current levels which puts pricing pressure on the use of gold wire due to the escalating cost of gold. The advanced leadframe handling and clamping capabilities of the HD Series, in conjunction with Orthodyne's proven PowerRibbon® technology, overcome the interconnect challenges, while providing better electrical performance, higher reliability and lower cost than other interconnect techniques.

The HD Series includes the 7200HD Dual-Head Semiconductor Bonder and the 7600HD Semiconductor Bonder, available in one to four head configurations. Both systems can be equipped with large and small Aluminum wire or PowerRibbon®.

www.orthodyne.com

Acquisition of M. Schneider

Carbone Lorraine is announcing the signature of an agreement concerning the acquisition of the M.Schneider group. Ranking as the fourth-largest player worldwide in German DIN-standard fuses and fuseholders, M.Schneider is a leading force in the German-speaking market and generates annual sales of around €20 million.

Based in Vienna, M.Schneider's manufacturing base is primarily located in Germany and the Czech Republic, and it also owns a joint venture in China. Through this acquisition, Carbone Lorraine is set to become number two worldwide in DIN standard fuses and fusegear. The Group will also consolidate its positions in Germany and Eastern Europe, as well as

in a fast-developing standard that is establishing itself as the benchmark in emerging markets, especially in China. This acquisition will also strengthen the Group's position in the energy sector in China. Capitalizing on the strength of Carbone Lorraine's worldwide sales network, M.Schneider will

rapidly expand its sales in international markets. This acquisition fits perfectly with the Group's growth strategy, which is notably predicated on strengthening its leadership position in its expanding markets.

www.carbonelorraine.com

Automotive-Qualified ICs Deliver Reliable Compact Solution

International Rectifier has introduced the AUIRS2117S and AUIRS2118S 600V ICs for automotive gate drive applications including direct injection, and brushless DC motor drives.

The AUIRS2117S and AUIRS2118S high-side drivers feature very short turn-on and turn-off propagation time to drive the MOSFET or IGBT at a much higher frequency to shrink system size by enabling the use of smaller filtering components.

The AUIRS2117S features output signals in phase with the input signal and CMOS Schmitt-triggered inputs with pull-down. The AUIRS2118S features output signals out of



phase with the input signal and CMOS Schmitt-triggered inputs with pull-up. Both devices provide under-voltage lockout and

offer a gate drive supply range from 10V to 20V.

The new ICs feature proprietary high-voltage integrated circuit (HVIC) and latch immune CMOS technologies to offer ruggedized monolithic construction and benchmark negative voltage spike immunity for reliable operation even under extreme switching conditions and short circuit events. The floating channel can be used to drive an N-channel power MOSFET or IGBT in the high-side configuration, operating up to 600V.

www.irf.com

Solar Installations to Nearly Double in 2010

A surge of sales in Germany combined with plunging prices are set to boost solar demand in 2010, prompting iSuppli Corp. to dramatically upgrade its forecast of installations of Photovoltaic (PV) systems in 2010.

iSuppli predicts solar installations will rise to 13.6 Gigawatts (GW) in 2010, up 93.6 percent from 7.0GW in 2009. The previous forecast,

released in February, called for 8.3GW worth of installations in 2010, up 64 percent from 2009.

The attached figure presents iSuppli's forecast for global PV installations from 2009 through 2011.

www.isuppli.com



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Switch-Mode Battery Chargers with Programmable JEITA Support for Highest System Safety are Industry Firsts

High-efficiency operation delivers shortest charging time, minimizes power dissipation and enables slim industrial designs

Summit Microelectronics has expanded its third-generation programmable battery charger integrated circuit (IC) family for single-cell Li-Ion, Li-Polymer, and Li-FePO₄ powered systems. The SMB328A and SMB328B integrate the largest feature set in the industry, including compatibility with all relevant industry standards: USB 2.0 Specification, USB On-The-Go Supplement, JEITA Safety Guidelines, IEEE1725 Standard, Chinese USB Charging Specification, and others. Both products incorporate innovative functionality that allows automatic matching between the AC/DC adaptor's current capability and the portable device's charging requirements. High-efficiency operation allows for higher, continuous charging current levels, thereby ensuring battery charging even during high system load conditions. Like all Summit's solutions, digital, non-volatile programmability provides design and system flexibility at no additional cost.

both devices, enabling highest charging current levels (up to 750mA from 500mA USB source) from current-limited input power sources.

Like all products in Summit's 3rd generation family, the products provide the means to accomplish true, universal USB charging and to meet the various USB industry standards, without the need for additional hardware and software support. Automatic Input Current Limit (patent pending) detects the maximum current capability of the AC/DC adapter (can be as low as 300mA for Chinese chargers to more than 1.5A per USB charging specification) and automatically programs the device's input current limit accordingly. This unique functionality addresses system issues associated with the fact that "USB" AC/DC adapters can vary widely in current rating, while eliminating the need for additional software support or external components.

The resulting improved user experience translates into fewer service calls, fewer merchandise returns and increased subscriber revenue for wireless carriers. Both products also support poorly regulated wall adapters by providing built-in input over-voltage protection and "pre-loading bias" to aid voltage regulation of such adapters.

The SMB328A and SMB328B incorporate the industry's widest range of safety features for the battery and the system. Both products adhere to the Japan Electronics and Information Technology Association (JEITA) safety guidelines, by preventing high charging voltage levels during certain low and high temperature ranges. Going a step further, battery pack temperature limits and charging voltage compensation levels are programmable, resulting in optimized operation for a given battery. In addition, the SMB328A and SMB328B

support IEEE1725 by including dual redundant protection for input/output current and voltage, chip and battery thermal protection, hardware and software safety timers, battery missing detection and a variety of status and fault registers.

"Summit's commitment to enable designs to adhere to the latest efficiency and safety industry standards and to utilize the latest technologies continues with the introduction of the SMB328A and SMB328B battery charging ICs. Both products support LiFePO₄ battery technologies, provide energy-efficient battery charging and incorporate unparalleled design support for exceeding the JEITA safety guidelines," stated George Paparrizos, Summit Marketing Director.

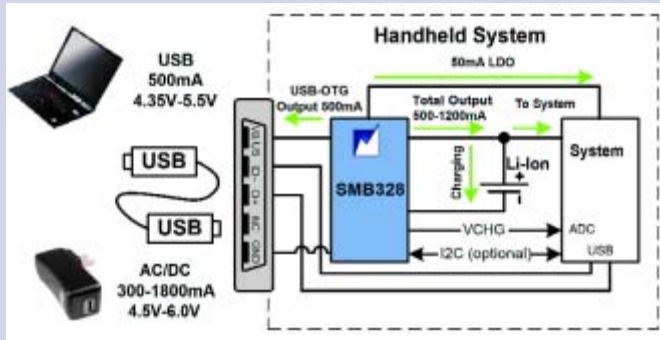


Features

The SMB328A and SMB328B enable companies to create slim industrial designs with significantly faster charging times; two valuable differentiating factors for smart phones and other portable consumer products.

The devices are based on a 3MHz, switch-mode architecture, with minimal external components, which results in very efficient power delivery and extremely compact solution size. The SMB328A allows for I²C control of parametric and functional performance, while the SMB328B operates in a GPIO-controlled configuration. Summit's proprietary TurboCharge™ patent-pending technology is incorporated in

"Competing JEITA implementations typically provide fixed temperature limits and charging voltage adjustment levels, thereby creating a one-size-fits-all solution which does not optimize safety and performance."



The SMB328A and SMB328B also incorporate an LDO that can provide instant-on power from the input source to critical system components, allowing them to wake-up and perform system functions, even with a deeply discharged (dead), or missing battery. Both products also allow the host to directly measure charge current in real-time, thereby allowing the system to recognize the operating mode it is in, and making necessary adjustments for increasing battery life, monitoring for safety and communicating information to the user. The SMB328A and SMB328B are also capable of supporting USB On-The-Go, by providing 5V and up to 500mA to VBUS, thereby also exceeding the requirements set by the USB OTG Supplemental Specification.

Applications

The SMB328A and SMB328B are ideal for a wide range of portable devices such as mobile phones, smartphones, portable media/MP3 players (PMP), portable GPS navigation equipment, portable game consoles, and digital cameras/camcorders (DSC/DCC). The features and integration of the SMB328A and SMB328B make them especially suited for devices that include a USB interface because they allow a tiny, low-cost industry-standard micro USB connector to be the primary data and power/charging interface.

The SMB328A and SMB328B operate with an input range from +3.5V to +6.2V input and safely withstand continuous input over-voltage up to +20V (non-operating), while protecting downstream circuitry. Both products are offered in a tiny 2.2mm x 2.0mm, 20-ball, lead-free chip-scale (CSP) package with an operating temperature range of -30C to +85C.

Pricing and Availability

Available now in production quantities, the SMB328A is priced at \$1.28 and the SMB328B is priced at \$1.23 each in quantities of 10,000 units.

Design Software and Programmer for Prototype Development

To speed user product development, Summit offers customers the SMB328EV companion evaluation board and a graphical user interface (GUI) software (SMB328A only) so designers can quickly see the features and benefits and design a prototype battery charging solution with the SMB328A and SMB328B. This is a complete development tool that lets designers easily manipulate the characteristics of their systems. The SMB328EV design kit includes menu-driven Microsoft Windows (R) GUI software to automate programming tasks and also includes all necessary hardware to interface to the USB port of a laptop or PC.

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Once a user completes design and prototyping, the SMB328EV automatically generates a HEX data file that can be transmitted to Summit for review and approval. Summit then assigns a unique customer identification code to the HEX file and programs the customer's production devices prior to final electrical test operations. This ensures that the device will operate properly in the end application.

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Summit Microelectronics actively supports industry efforts towards creating a greener planet. The Company's MobileGreen™ technologies significantly reduce the energy consumption and waste material footprint in our customers' products.

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Summit Microelectronics is the leader in flexible, mixed-signal integrated power management solutions, for the consumer, communications and computing markets, combining high-performance analog power with powerful digital control in a single chip. This integration and flexibility combined with a simple GUI-based development tool and non-volatile configuration yields the lowest total BoM cost while reducing system design time and effort.

www.summitmicro.com

Optimum Overvoltage-Protection – not only for Solar-Invertors

By Pero Nilovic, Nilotec in Halver, Germany

Connected in series or in parallel of Photovoltaic elements with solar modules, the deployment of solar invertors is unavoidable. The additional paralleling of other modules will provide increased performance.

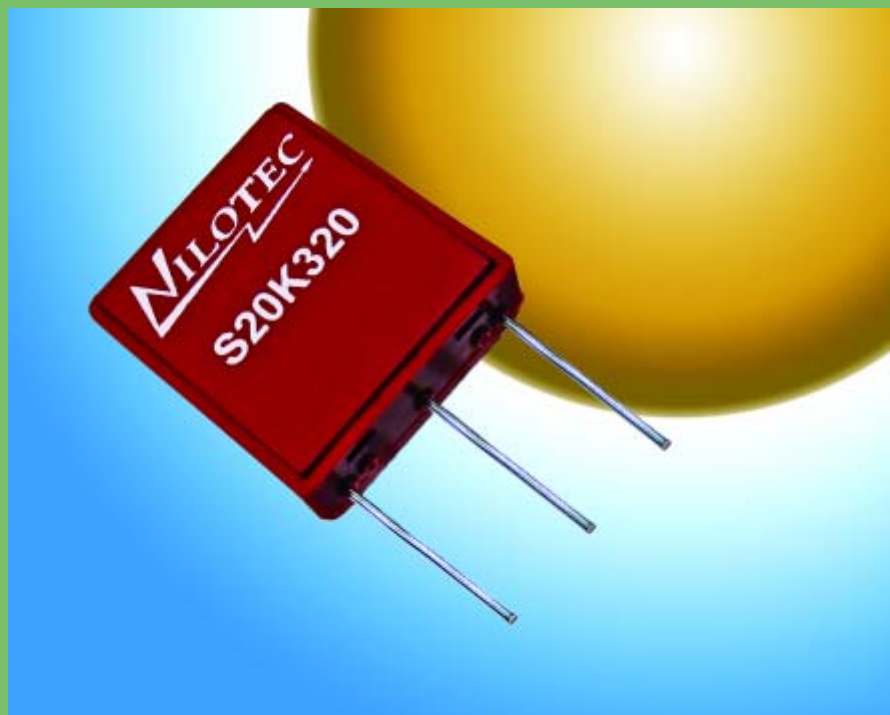
sensors do not take the matter of reliability and serviceability into enough consideration and do not always provide a suitable dynamic protection. Especially with solar protection systems with high DC voltages which require a safe and reliable physical disconnect, any failure

in dynamic performance will clearly make developers quickly unsure. Down-times due to repairs increase costs not only of the service technicians but also for the whole system.

The requirements for the new Smart-Protect-Varistor-System – the Solar Protector of the Platinum®-Series- evolved from discussions with engineers working on Converters and Solar Invertors and were taken over into the design of this new device.

This new series can be characterised as follows:

- Utilizes all standard disk Varistors up to 20mm with voltage ratings up to 1200 Volts
- Thermal and dynamic separation in a single device
- A monitorable failure signalisation (3 connections)
- An optical failure indication that does not require voltage to enable a clear indication even when the system is switched off!
- A galvanic separation of 8mm between the connections
- Pitches with 7.5; 10.0 and 12.0mm available



New Solar Protector from the Platinum®-Series

For this reason solar invertors are exposed to so many over voltages on their inputs and outputs. Typical input voltages of solar invertors depending upon the application are between 200VDC and 900VDC. For the operation on mains lines additional protection components for 230Vac will be necessary – for example the Nilotec S20K300.

Many new standards (e.g. UL®) state that only a varistor can be used as the primary protection component. In the past it was common to solder simple Varistors directly to the PCB, today however so-called varistor-systems solutions combining thermal monitoring are being used. Failures in conventional Varistors go often unnoticed as there is no reliable method of detecting failures in the field. Although this problem is partially addressed with thermo-protected Varistors with signals via a third pin to a microprocessor, they do not provide any unpowered optical signal to show that the protection is no longer available. A second disadvantage of conventional solutions is clearly the poor serviceability and the resulting lengthy down-time. Even for certified service engineers the removal of solder components is a no-go area. Improved solutions allow the varistor or varistor module to be simply inserted into receptacles and clamped on the PCB. Hence, many varistor-solutions with physically coupled temperature

- Two different housings for all standard disc varistors up to 20mm diameter
- Standard colour of the housing is red
- But on request - the housing, for ease of identification - voltage classes –can be supplied in different colours (simplifying serviceability)
- Solderable or insertion (clamp) connections available
- Customised variations (voltage/printing/aso.) available on request.

The Platinum®-Series dramatically reduces service costs and increases the returns on Solar Invertors with improved availability through reduced down-times. As already mentioned in the title, this would also apply in the use of industrial converters where the periods of shut down can be substantially reduced. Over the operative life time of invertors, this solution will provide clear advantages in service costs.

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PCIM Europe 2010 – Keeping a Finger on the Industry's Pulse

"The market is expanding...", "Turnover is rising..." - these and other similarly positive statements are now frequently appearing in the press. ZVEI, the German Electrical and Electronic Manufacturers' Association is expecting the domestic electronics industry to grow by 5% this year. And according to SIA, the Semiconductor Industry Association, worldwide semiconductor sales increased by 58% in March compared to 2009.

This optimistic outlook for the future was also in evidence at PCIM Europe 2010, the leading exhibition and conference on power electronics, intelligent motion and power quality. The positive mood, great business opportunities for the exhibitors and an increase in visitor numbers reflected the upward trend being seen in the industry. Discussions with exhibitors revealed that this was one of the most successful shows in recent years. Moreover, most of the exhibitors expressed their strong support for the show and emphasized its significance for the power electronics market.

PCIM Europe's role as the leading exhibition in the sector was confirmed by the record figures of 255 exhibitors and 69 represented companies. The global market is almost completely represented, making the show a good barometer of the industry. In addition to major global players such as Fairchild, Fuji Electric, Infineon, International Rectifier, Mitsubishi and Semikron, many aspiring young companies took the opportunity to present their new ideas and solutions to the trade visitors this year. With 20 new exhibitors, PCIM Europe continues to prove that it is fresh and innovative.

The worldwide significance of this event was evident in the large percentage of international exhibitors (58%). As in previous years, the majority of the international exhibitors came from the USA, Italy, Great Britain and France. The number of Asian companies is on the rise, a logical consequence in an increasingly global market. PCIM Europe will continue to attract high numbers of international exhibitors.



For the visitors, the opportunity to take an overview of the worldwide market in one place is an obvious attraction, and on all three days, the booths and aisles were packed with people. The high quality of the visitors was noted by the exhibitors. The visitor survey supports this view as well, with 48% of the visitors working as development engineers and 20% in corporate management.

The forum also plays its part in enabling the all important exchanges between the specialists. Vendor presentations, panel discussions and a round table provided the audience with additional information about the latest products and services on offer at the booths.

Alongside the technological highlights, solutions for contemporary problems such as the lack of engineers, which remains a challenge and not just for the power electronics industry, feature highly at the show. The show supports companies and institutions through its cooperation with a major jobs platform for electronics engineers. Furthermore, the student day on Thursday, organized by ECPE,

the European Center for Power Electronics, attracted a large number of future high flyers in the field. PCIM Europe will continue in its efforts to promote young engineers.

The PCIM Europe conference takes place in parallel to the exhibition. This year it offered a great variety of speeches on various aspects of the main topic "Energy Savings and Sustainability". Over 170 previously unpublished papers were presented to the 619 delegates (18% up on last year). The link between science and industry is what makes this conference wholly unique. The close proximity of the conference to the exhibition enabled the delegates to find practical solutions to theoretical questions as soon as the sessions were over. The tutorials as well as key note speeches are notable highlights and established elements of the conference.

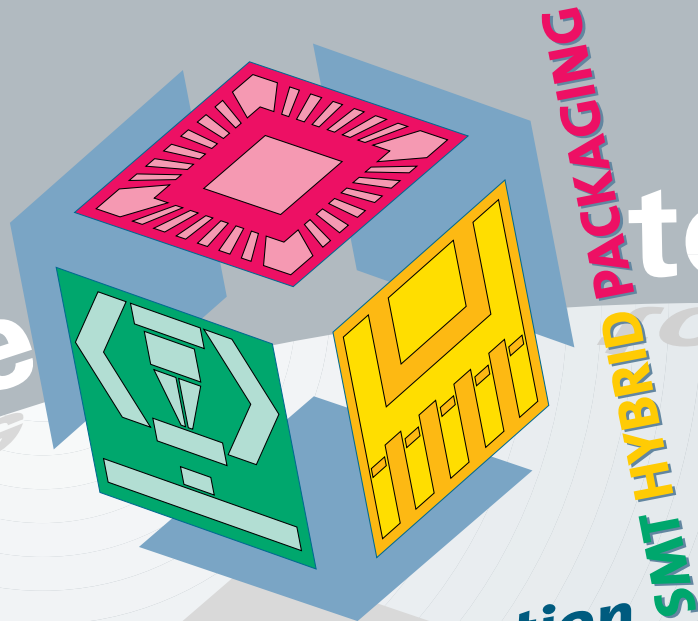
Through the Young Engineer Award, the conference encourages young talent to contribute to the development of the electronics sector by submitting scientific papers. Established a few years ago, the Young Engineer Award is now an integral part of the event and important for the industry.

The conference has been setting standards for years and provides considerable impetus to new developments in the industry. Its practice orientation enables engineers to adapt the theoretical findings instantly to their every day work.

On the basis of this year's experience, the outlook for the coming year is positive - especially with the rising demand for power electronics and intelligent motion solutions from regenerative energy sources such as solar and wind power and a growing need for higher energy efficiency throughout all industries. Thus, PCIM Europe has again set the tone and continues to be the most important platform for the future success of this industry.

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ELECTRONICS INDUSTRY DIGEST

By Aubrey Dunford, Europartners



GENERAL

Electric vehicles are set to hit the consumer market at the end of 2010, and will achieve widespread distribution in 2011. ABI Research projects a fast-growing market for charging station infrastructure,

with worldwide revenues reaching \$ 11.75 billion for the installation of 3 million charging stations by 2015, up from just over 20,000 stations installed in 2010. The US will represent 54 percent of the world market of installed charging stations by 2015, followed by China (23 percent) and the rest of the world (23 percent).

SEMICONDUCTORS

The microcontroller market is expected to reach \$ 12.3 billion dollars in revenue this year, up 14 percent from 2009, so Data-beans. Microcontrollers suffered a 21 percent loss in revenue in 2009, due in large part to the struggling economy. However, with their wide variety of uses, including automotive, computer, consumer, communications and industrial uses.

After falling 16 percent in 2009, power transistor sales are expected to climb 31 percent in 2010 and reach a new record high of \$ 10.96 billion, so IC Insights. Power transistor sales are forecast to reach \$ 14.5 billion in 2014 compared to \$ 8.4 billion in 2009, representing a compound annual growth rate of nearly 12 percent. Power transistor unit shipments are expected to grow at a CAGR of 14 percent in the five-year forecast period to 71.3 billion compared to 37.1 billion in 2009. Power transistor sales accounted for 55 percent of the \$ 15.2 billion total discrete semiconductor market in 2009. In 2014, power transistors are forecast to represent 58 percent of the \$ 25.1 billion discrete market.

Donald Macleod was named chairman of the board of National Semiconductor effective May 31, 2010 following the retirement of its current chairman, Brian Halla on May 30, 2010. Macleod currently serves as National's CEO. National Semiconductor, a supplier in analog power management technology, reported sales of \$ 1.46 billion for fiscal 2009.

IDT, a provider of mixed signal semiconductor solutions that enrich the digital media experience, has acquired the assets of IKOR, a former subsidiary of iWatt that manufactures power module VRM solutions for high performance computing.

Accent, an Italian specialist in semiconductor integration of communications and metering technologies, is opening a Wireless IP development centre in Sophia-Antipolis, France.

International Rectifier, a supplier in power management technology, announced the opening of its new state-of-the-art manufacturing facility in San Jose, California, dedicated to the design and manufacture of high reliability ruggedized hybrid DC-DC converters for space, aerospace, military and heavy duty industrial applications.

Fairchild Semiconductor and Infineon Technologies announced a packaging partnership for their power MOSFETs in the MLP 3x3 (Power33 or S308) and PowerStage 3x3 packages.

Bosch (Division Automotive Electronics), Freescale Semiconductor, Infineon, NXP Semiconductors and STMicroelectronics have formed a consortium to jointly investigate and standardize the acceptance of alternatives for high-lead solder for attaching die to semiconductor packages during manufacturing. The five company consortium is known as the DA5 (Die Attach 5). The DA5 consortium aims to reduce the qualification time needed by its customers and provide lead-free and environmentally friendly solutions as quickly as possible. At this moment, there is no expectation of a substitute for a high-lead solder die attach before 2014.

OPTOELECTRONICS

To meet strong demand for LCD panels for TVs, Sharp will double current production capacity at its LCD panel plant located in Sakai City, Osaka Prefecture, Japan, to 72,000 substrates per month in July.

PASSIVE COMPONENTS

January revenues for Germany's PCB industry were up 17.2 percent year-on-year, so the ZVEI. This was mainly driven by the increasing demand from the industry, as well as replenishment of stocks. Compared to the

same month last year, incoming orders were up 106.4 percent in January.

OTHER COMPONENTS

Harman International and Research In Motion (RIM) have reached an agreement for RIM to acquire QNX Software Systems. Based in Ottawa, Ontario, QNX was founded in 1980 and acquired by Harman International in 2004. The unit's QNX Neutrino open platform operating system is deployed across multiple sectors including automotive, industrial, telecommunications, medical, defense, and aerospace.

LEM, a Swiss provider in solutions for measuring electrical parameters, has appointed François Gabella as CEO. He will take over from Paul Van Iseghem who will retire by the end of this year. François Gabella will join the company on July 1, 2010. LEM's current and voltage transducers are used in a broad range of applications in industrial, traction, energy & automation and automotive markets. LEM has production plants in Switzerland, Denmark, Japan and China.

DISTRIBUTION

IDT has extended its relationship with Future Electronics by awarding it the franchise to sell its entire portfolio of products across the EMEA (Europe, Middle East and Africa) region. Previously, Future Electronics was only authorized to sell the Tundra product portfolio that was acquired by IDT in 2009. The new arrangement allows Future Electronics to sell the entire IDT product portfolio, at a pan-European level. Future Electronics has also entered into a worldwide franchise distribution agreement with Powercast to distribute its full line of receivers and transmitters.

Digi-Key launched its new Sensor Solutions Technology Zone, a website dedicated to providing comprehensive sensor design resources for engineers.

This is the comprehensive power related extract from the « Electronics Industry Digest », the successor of The Lennox Report. For a full subscription of the report contact: eid@europartners.eu.com or by fax 44/1494 563503.

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LEDs Shine Bright at LightFair 2010

By Jeff Shepard, President Darnell

aLED lighting was clearly the dominant trend at this year's LightFair in Las Vegas. More news was generated regarding advances in LED lighting than all other announcements combined. And the trend is global, companies from Asia, Europe and North America all made announcements related to LEDs at LightFair. Two primary areas of development were high-wattage applications such as street lights and dimmable drivers for interior lighting.

Several companies were pre-announcing products that will not ship until later in the year. Excelsys pre-announced a new line of dimmable LED power supplies. NXP announced the UBA2027 family of driver ICs that will not be available until September. Zenario was demonstrating LED power supplies that will not enter production until at least October. Power Vector revealed a prototype LED power supply based on a reference design from Osram Opto Semiconductors.

Advances in high-wattage LED designs revealed at LightFair are moving the technology closer to wide-spread adoption in street light applications. Carmanah, Dialight, BetaLED and Power Vector were among the companies demonstrating the latest developments related to the use of LEDs in street light luminaires.

Carmanah introduced its newest EverGEN solar LED light, the EverGEN 1720. The company's highest output self-contained solar LED light to-date, the EverGEN 1720 leverages the slim form factor of the EverGEN 1710 while providing nearly twice the typical lumen output. In ideal solar conditions with tailored operating profiles, light output of up to 10,000 lumens is achievable. In more typical conditions, output of 5,000 lumens is common.

Targeted for parking lot, residential roadway, sign, perimeter and other site lighting applications, the 1720 expands the applications for the compact 1700 series solar LED lights. The 1700 series of EverGEN lights have also been designed for installation in 30 minutes or less, saving time and money.

"The Carmanah EverGEN naturally eliminates the need to trench or install conduit during lighting installation," explained Ted Lattimore, Carmanah CEO. "With the EverGEN 1700 series, installation time and cost are further reduced through the ability to stage the entire system on the ground and hoist it into place on the pole as one complete unit."

Dialight announced that its StreetSENSE™ SL Series LED Street Light has achieved the qualifications of the Designlights™ Consortium's Solid State Lighting Fixtures Qualified Products List. This recognition is attributed to the StreetSENSE luminaire's energy efficiency and lighting efficacy for roadway lighting applications.

The DLC's Qualified Products List serves as a resource guide for program administrators to determine which lighting products meet established energy efficiency guidelines currently not addressed in

the US Department of Energy's Energy Star program. The goal is to ensure that high-quality, energy-efficient lighting design becomes commonplace in all lighting installations. The program is operated by the Northeast Energy Efficiency Partnership and sponsored by numerous utility companies, energy research and public service organizations.

The BetaLED division of Ruud Lighting extended its LEDway street light family with the LEDway SLM. The LEDway SLM (single light module) is a low-profile luminaire designed for use on residential streets. The new luminaire offers over 90 lumens per watt and uses a new generation LED chip package coupled with advanced optical design techniques. Compatible with existing pole mounting configurations, the LEDway SLM can also be mounted to a vertical or horizontal tenon. These scalable light modules can be configured with up to 60 LEDs to provide tailored illumination levels and maximize energy efficiency.

Power Vector introduced its 1072 series LED power supply designed to the specifications of a reference design from Osram Opto Semiconductors. The modular 1072 power supplies deliver up to 4 channels of 50W each, for a maximum rated power of 200W. Each channel provides a constant current output variable from 100 to 500 mA to optimize efficacy, energy savings and light output. The modular design enables the new power supply to be used in LED applications replacing traditional HID and low-pressure sodium luminaires rated for 70W, 100W, 150W, 250W and even 400W. Efficiency is over 90% at 350 mA of output current and is above 85% over the entire output current range.

Dimming ballasts were the second area of focus for LED power at this year's LightFair. Lutron, Excelsys, Zenaro, American Ballast and NXP were among the companies exhibiting dimmable ballasts in Las Vegas. Except for NXP, these companies were highlighting dimmable LED ballasts. NXP pre-announced a new dimmable controller for compact fluorescent lamp (CFL) applications that can provide dimming to less than 10% lighting level with no flicker.

Lutron Electronics announced the Hi-lume A-Series LED drivers that feature smooth, continuous, 1% dimming for virtually any LED fixture up to 40W – whether it requires constant current or constant voltage. These ballasts support constant-current reduction (CCR) or pulse-width modulation (PWM) dimming options for constant current LED loads to dim continuously from 100% to 1% lighting level. With an input voltage range of 120 to 277 Vac, these ballasts include micro-processor control, and integral thermal management deliver energy savings and extended product life.

High efficiency, high reliability LED driver power supplies for the outdoor and indoor lighting market were the focus at the Excelsys booth. During LightFair, Excelsys pre-announced that they will be releasing a number of extensions to their product range over the coming 6



months, including additional constant current drivers range from 75W up to 150W and a range of dimming LED driver power supplies from 25W to 100W. Production is anticipated in the third quarter.

Zenaro, an alliance between Everlight Electronics and Aphos Lighting, announced a series of four LED ballasts rated for 54W, 66W, 102W and 132W. The entire series has passed ENEC certification. The efficiency performance of Zenaro's electronic power supplies is greater than 92%. With different dimming control options, Zenaro give users variety while using or designing different LED Indoor/Outdoor lights. Several US versions including UL approval will also be available by the third quarter of 2010.

American Ballast, a division of China's Phihong Technology, was featuring a line of dimmable LED ballasts from 9W to 120W with input voltages of 100-277Vac. With the ability to dim down to 10% lighting level, these ballasts offer a variety of dimming techniques including: triac dimming, trailing edge dimming, analog (0-10V) dimming and pulse-width-modulation dimming.

NXP was the exception to the general rule that LED drivers were dominant at LightFair. After recently extending its line of LED drivers, the news from NPX at LightFair 2010 was the pre-announcement of the UBA2027 fully dimmable CFL drivers. These new drivers are fully integrated (including the power switches) and offer dimming to less than 10% lighting level with no flicker. The devices are an extension of the existing UBA2024/UBA2028 product family. Production is scheduled for September 2010.

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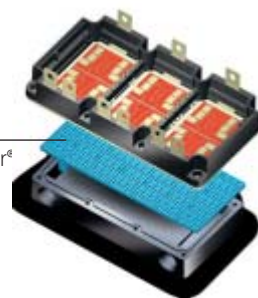
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*By Nishida Nobuya, Uota Shiori, Yoneyama Rei, Tametani Fumitaka and Orita Shoichi
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Introduction

Intelligent Power Modules (IPM) have been widely used to reach a higher degree of integration and to reduce the complexity of the gate and protection functions for users. Over the last decade IPM technology has undergone a massive change in terms of functionality and protection functions. The IPM's of today help the photocoupler interface to reduce dv/dt influences and control signal oscillations and, by introduction of full gate (FG) CSTBT™ chip technology the loss / SCSOA tradeoff has been tuned to reach lower loss while maintaining the SC robustness by a dedicated integrated control IC (LVIC). On chip temperature sensing as part of the IPM's topology allows individual protection of IGBT chips. Thus, today an Intelligent Power Module employs features and advantages that hardly can be implemented in a conventional drive stage for an IGBT being remotely connected. Those advantageous technology features have already been employed into the 6 in 1 and 7 in 1 “L1 and S1” series IPM to cover ratings of up to 150A/1200V and 300A/600V, but similar state-of-the-art solutions for higher inverter ratings have lacked so far. The development of the V1-series IPM is closing this gap and extends this superior performance and protection functionality to 2 in 1 IPMs of 450A/1200V rating. Mature Dual IPM's of V-series and S-series being still equipped with planar chips are succeeded by the new V1 IPM technology. Terminal location and package outline of V1-series are compatible with V-series. However, internal structures differ in V1-series and V-series. V1-series changed the internal main electrode, and has added a special negative feedback wiring line at the Emitter of the IGBT.

The small package covers a module rating of 200A to 450A in 1200V and 400A to 600A in 600V technology. Figure 1 reveals the well-



Figure 1: Small package of V1-series

proven 5 pin count interface for P- and N-side. The gold plated connector is compatible with previous generations of connectors for 2 in 1 IPMs and employs 0,63mm square shape terminals which are arranged in a 2,54mm pitch. The large package as shown in Figure 2 is planned for up to 600A/1200V and up to 900A/600V.



Figure 2: Large package type of V1-series

Previous V-series IPMs only detected the case temperature (base plate temperature), and once the threshold temperature of the substrate mounted temperature sensor was reached the control IC intercepted the gate signal and protected IGBT.

However this mature thermal protection has certain disadvantages because the acquisition of the temperature is remote from the IGBT chip and also reacts slowly because of the involved thermal time constants of the various constructional layers of the module. As a consequence the temperature sensor's information does not reflect the real temperature of the junction and has a certain time delay. Base plate temperature based protection may prevent from over temperature failures caused by fan outage or thermal grease problems, but it would provide only insufficient protection in case of locked rotor or low output frequency situations. Even though the temperature protection of the latest IPM can detect the temperature of an IGBT chip already on surface level and protect it, the location of the sensor was implemented at the boundary of the chip.

Further investigations have proven that depending on the location of the temperature sensor on the surface of a chip, a substantial difference of temperatures between the sensor location and the real maximum temperature of the surface of the IGBT chip can be observed. Hence assuming an offset temperature from sensor position to the found maximum temperature could have been one option, but the load dependency of this offset would unfortunately prevent a highly precise protection level. Ideally the experimentally confirmed "hot spot" on the CSTBT™ should match with the location of the temperature sensor. The new V1-series IPM has realized this more accurate temperature sensor position and utilizes CSTBT™ chips employing the temperature sensor at the centre of the chip.

Short Circuit (SC)

Short circuit protection is an essential feature of modern drives. Several sources can generate a SC condition that creates extraordinary thermal stress on an IGBT. Load short circuit or system controller malfunction resulting in arm shoot through can be the root cause for SC conditions. The IPMs built-in short circuit protection function has to prevent the IGBTs from being damaged then. As previously mentioned Mirror Emitter technology allows to monitor the current flowing being itself only an image of the totally flowing Collector current. Thus, on a "small signal" level and much different from dV/dt stressed conventional desaturation detection methods, the control IC notices abnormal levels of current and takes immediate action. As a consequence of a SC detection a controlled shutdown is initiated and a fault output is generated at a dedicated pin (Fo) of the IPM. As the

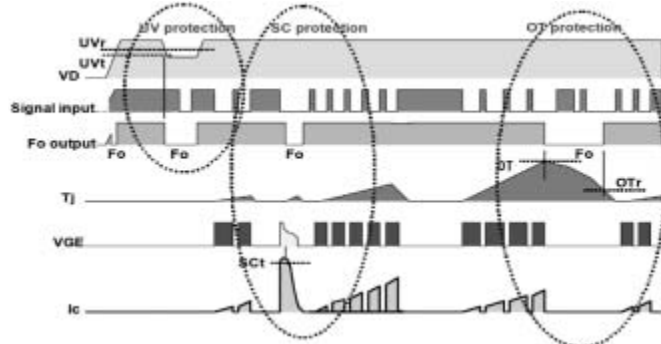


Figure 4: Timing Chart of control and protection of V1-series

SC protection is also implemented in the P-side IGBTs, a protection against Earth fault is possible. Additionally the V1-series IPM contains a well tuned negative feedback in the emitter line of the IGBT,

which reduces the peak of the short-circuit current. The timing chart of the protection function is shown in Figure 4.

Electrical Characteristics

Switching behavior is besides switching loss an important feature of an IGBT technology estimate the filtering effort to conform to EMI standards. A switching test has been performed at $V_{cc}=600V$, V_D (supply)=15V, $T_j=125^\circ C$ application conditions in Figure 5. The indicated result shows a well controlled turn on and turn-off avoiding oscillations and keeping at the same time the loss targets of the previous generation of L1-series IPMs which is also employing FG CSTBT™. The switching of V1-series is adjusted so that it becomes similar to L1-series. Figure 5 reveals that even at comparatively small pulse width does not generate oscillations. Comparing the new V1-series' IPM data profile with its predecessor's performance and features it turns out that the progress in chip technology of more than 13 years has lead to crucial reduction of the loss performance of this IPM family. Along with the improvements of silicon technology the packaging and manufacturing technology has been updated to reach state-of-the-art performance. In detail the power cycling capability of the new V1-series has been increased by introducing a new wire bonding process technology.

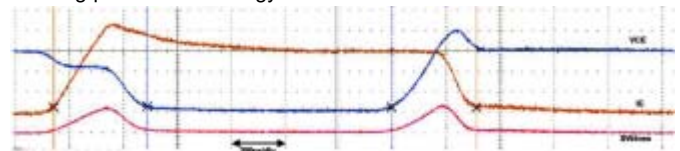


Figure 5: Waveform of Switching of V1-series, $V_{cc}=600V$, $V_D=15V$, $T_j=125^\circ C$, IC: 100A/div VCE:200V/div

Table 2 contains this information of the older V-series while table 3 reveals the latest achievements of V1-series IPM.

Item	V-series	
Vces	600V	1200V
Vce(sat) $T_j=125^\circ C$	2,55V	2,6V
OT acquisition	NTC/substrate	NTC/substrate
Power cycling	standard	standard

Table 2: Data profile of V-series (mature technology)

Item	V1-series	
Vces	600V	1200V
Vce(sat) $T_j=125^\circ C$	1,75V	1,85V
OT acquisition	on chip	on chip
Power cycling	improved	improved

Table 3: Data profile of V1-series (New IPM family)

Furthermore the previously described innovations of the short circuit detection circuitry have been tested even beyond the typical SCSOA limits of an IGBT. Presenting the conservative approach of the specification a short circuit test on one device has been executed under $V_{cc}=800V$, $V_D=16,5V$ and $T_{j,start} = 125^\circ C$. The result of this test is indicated in Figure 6. Even at the high junction temperature before the SC operation and the high DC-link voltage the SC is turned off safely. This permissible range of parameter being relevant for the SC handling is specified as $V_{cc,prot}$ indicating the max. level of DC-link voltage that ensures a safe turn-off of the IPM.

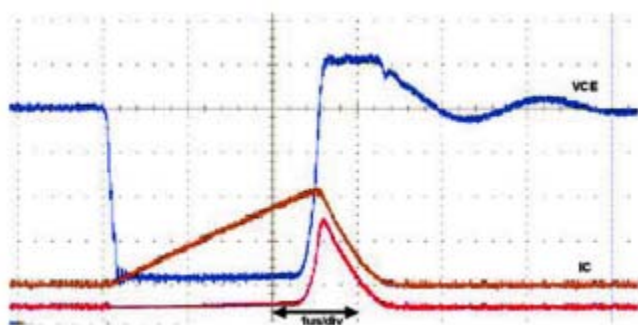


Figure 6: Waveform of Short Circuit Current of V1-series
IC:1000A/div VCE:200V/div

This outstanding short circuit behavior is a result of the Gate to Emitter voltage (V_{ge}) reduction which is imposed by the internal signal trace setup on the substrate. Such kind of negative feedback reduces the driver output stage voltage and limits the short circuit peak current efficiently. Figure 6 moreover allows to derive an information on the stress of the IGBT during the SC situation. The instantaneous power dissipation as product of Collector – Emitter voltage (V_{ce}) and the flowing Collector current (I_c) is in an IPM low as an expected result of the mirror Emitter current information. The overlap area of V_{ce} and I_c , e.g. the information of the short circuit energy dissipated in the IGBT is exceptionally small. This reduces the temperature rise of T_j during the short circuit and decreases the stress. In conventional driver stages this overlapping area is usually kept for a few μsec ($4\mu\text{sec} \dots 6\mu\text{sec}$) called “blanking time” to avoid wrong detections of the desaturation detection circuitry. Hence, the imposed stress on IGBTs utilized in conventional driver stages during SC is by far higher than in IPM designs. Of course this feature has got a crucial influence on system reliability. The IPM has been operated in an industrial drive system and the output waveform has been recorded. The results are represented in Figure 7.

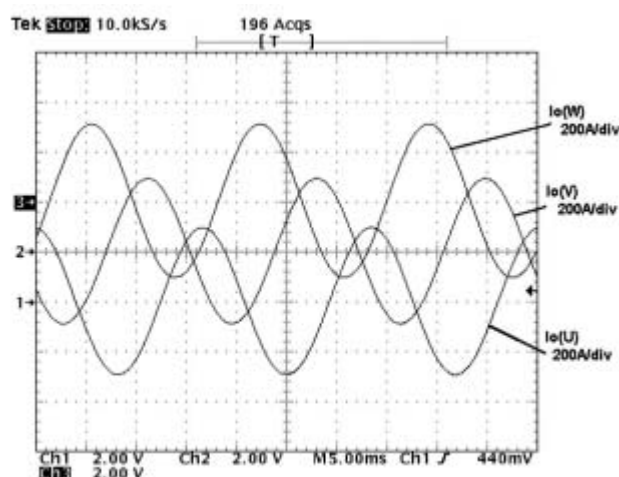


Figure 7: Waveform of Output Current at Motor Drive Operation of V1-series conditions: $V_{cc}=600\text{V}$, $I_o=300\text{Apeak}$, $V_D=15\text{V}$, $f_c=5\text{kHz}$, $f_o=60\text{Hz}$

Power Loss Simulation

A loss simulation of the inverter operation of V1-series was carried out and it was compared with L-series which is the currently only IPM module that is covering current ranges of 300A/1200V and 450A/1200V. Although the L-series IPM already employs CSTBT™ of the 5th generation, the current density of a chip utilized in L-series IPM is lower than the fifth generation CSTBT™ of V1-series. More-

over, since the baseplate surface area of V1-series is larger than a single segment of one phase of the L-series IPM – providing about 20% more surface – the elevation of case temperature also becomes lower and results in an improvement of reliability reflected in thermal and power cycling. Figure 8 shows the arrangement of 3 pieces V1-series IPM (2in1) versus one L-series IPM (6in1). Looking at a system, e.g. including also the heatsink into these considerations, this increase of highly conductive Copper baseplate material surface eases the thermal energy transfer into the heatsink and reduces heat concentration effects.

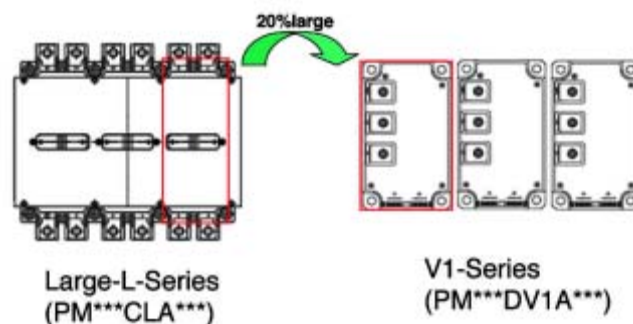


Figure 8: Comparison L-series and V1-series

These two solutions for higher power inverters are compared especially under variations of switching frequencies. Figure 9 summarizes the result of this simulation indicating the key parameter based on 300A/1200V modules.

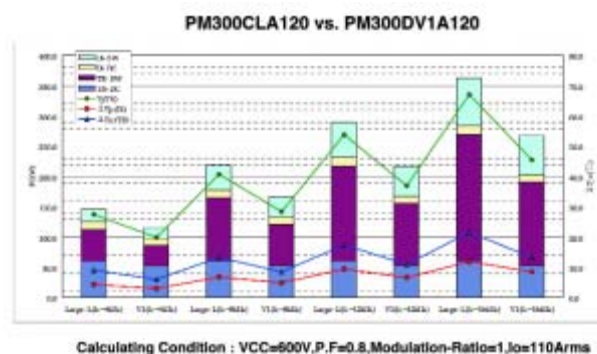


Figure 9: Calculation Result of Power Loss of L-series and V1-series

Conclusion

A new family of IPMs in 2in1 package has been developed utilizing latest full gate (FG) technology. Mirror Emitter technology reduces the stress on the IGBT chips during short circuit efficiently and packaging and process technology increase the reliability of the V1-series IPM efficiently. Loss and thermal performance have been improved substantially and reached state-of-the-art levels.

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Thermal Interface – An Inconvenient Truth

Conductivity of the interface is not a constant parameter

Increasing the power density along with extended life-time expectation is an omnipresent demand in inverter designs. While chip manufacturers strive to increase the current carrying capabilities of silicon, inverter designers try to reduce the physical volume of the drive. Reduction of the heat sink's volume in combination with increased local power densities leads to higher demands on the thermal interface connecting power electronic components to the heat sink.

By Dr. Martin Schulz, Infineon Technologies, Warstein, Germany

The Truth about Datasheet Values

Thermal interface materials (TIM) are used to improve the conduction of heat from a power semiconductor to the heat sink. It is expected that a higher conductivity leads to a better thermal transfer. In power electronic designs, however, this is a misleading conclusion. A paste-like TIM-layer below a module never shows a homogenous thickness. Below the power semiconductor an area with metal to metal contact should remain because the largest portion of heat flows through this area. The TIM's datasheet values describing the conductivity are given for a homogenous layer but solid sheets that provide homogenous thicknesses prevent the metal to metal contact thus eliminating the best portion of the heat transfer path. Additionally, the conductivity of the interface is not a constant parameter. It degrades over time if the material desiccates or separates caused e.g. by capillary effects on surfaces or as a consequence of thermo-mechanical movement.

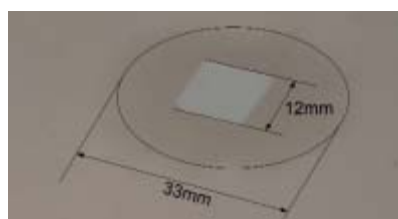


Figure 1: Desiccation and separation of TIM due to capillary effect

Any material used as a thermal interface has to be closely examined regarding the complex interrelations that are often underestimated or even neglected. The datasheet value "Thermal Conductivity" is an indication but not hard evidence.

In combination with good thermal conductivity, the material has to fulfill further requirements. Besides the demand of not being silicone-based, the material has to conform to RoHS and should be easy to apply in production and easy to remove in case of maintenance or replacement. A good adhesive property together with small particle sizes regarding the thermally active materials is mandatory. Ideally, the material should be electrically non-conductive.

The material's reliability over the lifetime of a design can only be validated in long-term experiments. Infineon has done extensive tests of

different materials to find a recommendable solution. Figure 2 depicts the measured results from a power-cycling test that was conducted over a period of eight months.

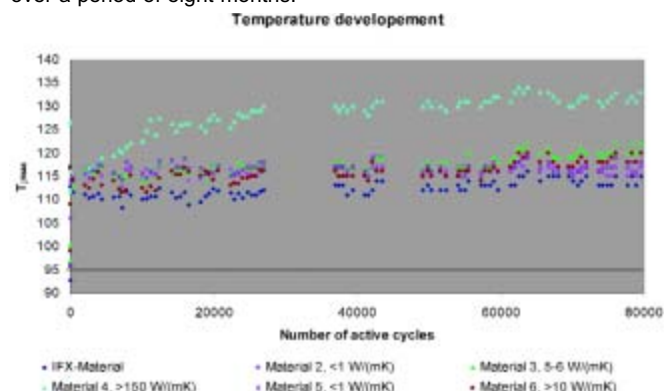


Figure 2: Chip-temperature development during Power-cycling Test, DUT: FF450R12ME4 @ 180A; Ton=1 min, Toff=2 min, 80.000 Cycles done

Six modules with TIM applied were mounted to heat sinks and active heating cycles were done under identical conditions. Figure 2 shows a noteworthy difference regarding the temperature development caused by the different TIMs in use. It can also be concluded that there is no obvious correlation between the thermal conductivity stated in the datasheets and the temperature development inside the power electronic module.

The Truth about Imprints

It is a common habit to apply TIM to a module, mount the module to a heat sink and disassemble the setup after a certain time or a certain number of thermal stress cycles to determine the quality of the thermal interface. As an example Figure 3 shows the result of a test done this way:

From the optical inspection the conclusion was simple: This particular material was obviously insufficient as it did not spread to cover the whole baseplate of the module. In spite of this impression, actual measurement of the junction temperature during the active cycling revealed an excellent thermal connection. This observation led to the conclusion, that interpreting imprints is of very low significance

regarding thermal aspects. It only allows a statement towards the mechanical spreading of TIM.

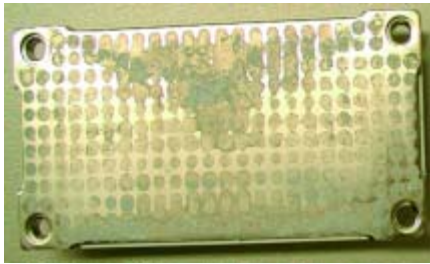


Figure 3: Imprint of TIM showing almost no spreading

An alternative often used is to mount the module to a glass plate and watch the TIM spreading. As a glass plate does not allow thermal stress, the results gathered here are just as misleading.

The limiting factors in power electronic designs are junction temperature along with temperature swing. The only trustworthy information is gathered by observing the chip's temperature during operation. This can be achieved by K-type thermo elements mounted to the chips surface. Due to a temperature gradient across the chip, however, this does not necessarily give the highest temperature. Using a thermographic camera allows an exact determination of the highest chip temperature in a given area. This can be seen from Figure 4.

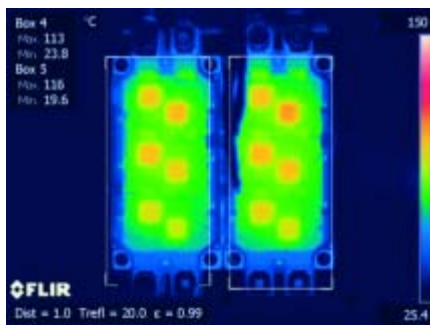


Figure 4: Thermographic analysis of the junction temperature

The truth about mounting

Applying thermal grease often is considered a simple process. Just apply some TIM to a module and tighten the screws. The module will close the gaps mechanically and presses out the material that is not needed so the rest can form the thermal interface. This often heard statement is far from being true. "The more, the better" may apply for a lot of things but definitely not for thermal grease. Care has to be taken to apply the correct amount of grease to the place where it is needed. Even with the same material in use, large differences regarding the thermal properties can occur depending on the process of application. The preferred way to apply thermal grease is an automated stencil printing as it constitutes a procedure that can closely be monitored and reproduced. Adapting the stencil's geometry allows to fine tune it to a given module family. This way, amount and alignment of the thermally active component are defined by the stencil printing process.

Some Facts about Phase Change Materials (PCM)

Phase change materials have been around for quite some time but have not, for good reasons widely penetrated the power electronic market. PCM-Foils, for the reasons explained earlier, have proven not to form the perfect thermal interface. Most PCM loose in volume when going to the liquid state. If additionally material from foils gets pressed out from below the modules during the first heat up, re-torquing of the screws holding the power module needs to be done. Both, burn in and re-torquing are processes highly unwanted in assembly lines.

Still PCM holds some advantages but only if not applied as a solid sheet. If properly applied to the module, PCM can be designed to be mechanically more robust than usual greases achieving convenient methods for transport and handling. Choosing highly conductive filler materials results

in excellent thermal conductivity. The grain size can be reduced to achieve large contact areas and the thinnest possible layers between module and heat sink. A special PCM was designed according to IFX specification to overcome the disadvantages known from common materials. It is applied to the module in similar ways as usual grease but offered to the customer as a solid, ready to mount TIM as shown in figure 5.

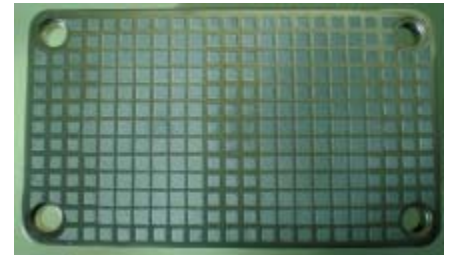


Figure 5: An Infineon 62mm-Module with PCM-based TIM ready to use

In addition to the excellent thermal and mechanical properties, the material does not suffer from drying effects and is resistant to capillary influences. Either is mandatory to achieve the desired long term stability.

Future Prospect

During the process of finding a recommendable material to build an adequate thermal interface for power electronic modules it became obvious that simply having access to a qualified material is necessary but not sufficient. The process of applying the material and the control of the process itself are sources of negative influences that can only be avoided if TIM and module are considered as a combined unit. To support thermal design Infineon offers stencil geometries for all IGBT modules. Furthermore, Infineon is currently evaluating methods to offer power electronic modules that feature a base plate with thermal interface material applied.

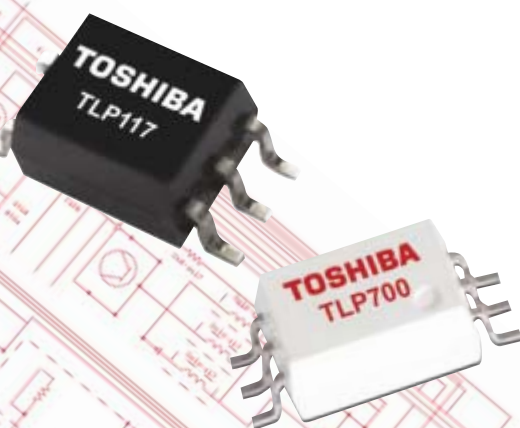
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By Paolo Chiavieri, Cierre, Via A. Moro 7, 44030 Serravalle (FE) Italy

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Figure 1: Renato Chiavieri, CEO Cierre

In the 80's, Cierre increased its customer base by forming long term partnerships, integrating increased service feature adding electrical wiring of both and signal power circuits and introducing the technology of coating cables. A new building added 400

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Figure 2: PCB board

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Figure 3: Cable assembly

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Figure 4: Modules in Systems

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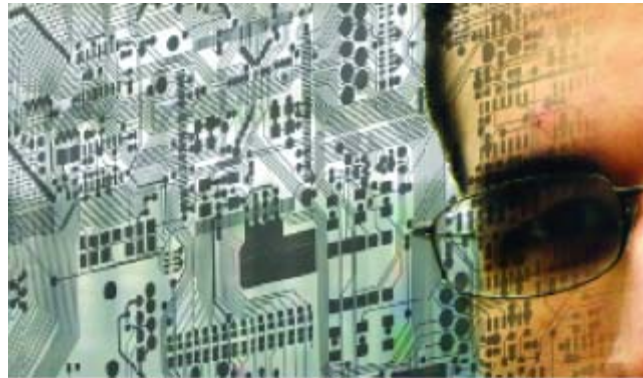


Figure 5: Design Support

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GaN – the New Frontier for Power Conversion

Due to its advantages GaN will probably become the dominant technology

GaN also has a much higher critical electric field than silicon which enables this new class of devices to withstand much greater voltage from drain to source with much less penalty in on-resistance

By Alex Lidow PhD, CEO Efficient Power Conversion Corporation

GaN fundamentals

In June 2009 Efficient Power Conversion Corporation (EPC) introduced the first enhancement-mode GaN on silicon power transistors designed specifically as power MOSFET replacements. These products were designed to be produced in high-volume at low cost using standard silicon manufacturing technology and facilities. The structure is relatively simple as shown in figures 1 and 2 (For a more detailed overview of this technology, go to www.epc-co.com/epc/Tool-andDesignSupport/ProductTraining.aspx)



Figure 1: GaN on silicon devices have a very simple structure similar to a lateral DMOS device and can be built in a standard CMOS foundry

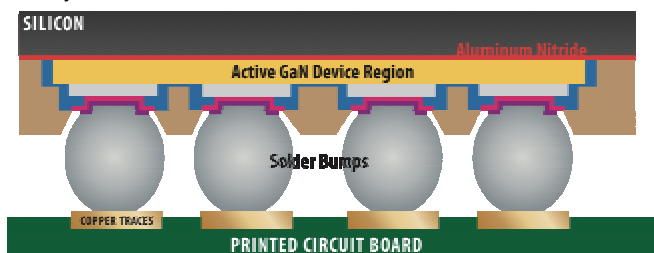


Figure 2: EPC's enhancement mode GaN transistors are sold as flip-chips. This gives the designer the ability to reduce system footprints, reduce parasitic inductances and resistances, and, due to the isolated silicon surface, attach the transistors directly to a heatsink without further isolation.

New capabilities compared with silicon

The most significant new capabilities enabled by enhancement mode GaN HEMT (High Electron Mobility Transistor) devices stem from the disruptive improvement in switching performance and overall device bandwidth. GaN also has a much higher critical electric field than silicon which enables this new class of devices to withstand much greater voltage from drain to source with much less penalty in on-resistance (see Figure 3).

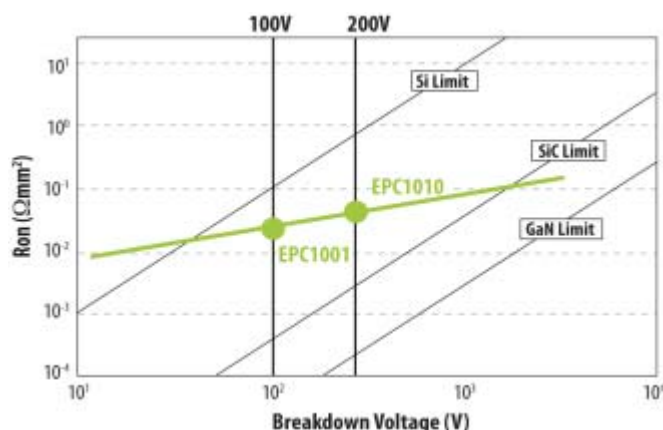


Figure 3: Theoretical resistance times die area vs breakdown voltage for silicon, silicon carbide, and GaN compared with EPC's first generation product

In power MOSFETs there is a basic tradeoff between the conductivity of a part and the amount of charge required to take the device from the ON to the OFF state (Or from the OFF to the ON state). From this tradeoff comes the figure of merit called RQ product. This is defined as a device's on-resistance multiplied by the total charge that must be supplied to the gate to switch the device at operating voltages and current. Improvements in this RQ product have been shown to translate into improved conversion efficiency in high frequency DC-DC converters. The absolute value of RQ is also indicative of the minimum pulse widths achievable in a practical circuit. Whereas there have been great improvements in RQ product over

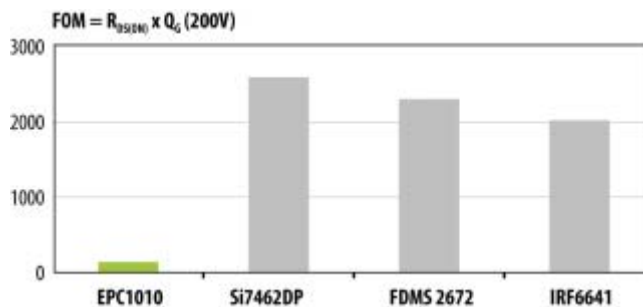


Figure 4: RQ product for 200V benchmark silicon compared with EPC's GaN

the last several years, silicon cannot come close to the figure of merit achieved in first-generation eHEMT (enhancement mode HEMT) devices already on the market. Figure 4 shows a comparison between benchmark silicon devices and GaN devices rated at 200V.

Much work has been done to circumvent the poor switching capabilities of the silicon MOSFET. Gate charge, reverse recovery charge, output charge, and common source inductance all limit a MOSFET's ability to be efficient at high frequency. For example,

transistors offer, this tradeoff will have to be reevaluated. All these characteristics allow the increase of switching frequency (both for hard and soft switching). The question then becomes how can the use of hard switching be traded for an improvement in bandwidth and a reduction in circulating energy? Are there two isolated islands of hard and soft switching, or is there some bridge that can exploit the best of both worlds?

In Table 1 are listed some of the early applications for EPC's enhancement mode GaN transistors.

Application	Key Benefit	Other Benefits	Key GaN Attributes
Buck Converters	Higher Vin/Vout ratio	Lower system cost, improved efficiency, less board space	Fast switching, high frequency capability, narrow and repeatable pulse width, zero diode reverse recovery
LED Drivers	Higher dimming ratio	Improves contrast ratio, reduces space, saves energy	Fast switching, high frequency capability, narrow and repeatable pulse width, zero diode reverse recovery
Power Over Ethernet (POE)	Higher power density	Smaller system volume, higher efficiency	Very low RQ product, zero diode reverse recovery
Bus Converters/ Bus Transformers	Higher power density	Smaller system volume, higher efficiency	Very low RQ product, zero diode reverse recovery
Synchronous Rectification	Higher efficiency	Smaller system volume, higher efficiency	Very low RQ product, zero diode reverse recovery
Class D Audio	Very low distortion (thd)	Higher sound quality, higher efficiency, smaller system volume	Fast switching, high frequency capability, narrow and repeatable pulse width, zero diode reverse recovery
Cell Phone	Longer battery Life	Lower system cost, fewer components, smaller form factors	High frequency capability with high voltage capability. Complete circuitry easily integrated.
Base Station	Lower System Cost	Fewer components, less energy consumption	High frequency capability with high voltage capability. Complete circuitry easily integrated.

Table 1: Early applications for EPC's enhancement mode GaN transistors

resonant DC-DC converters have become standard in bus converters where both size and efficiency are important. As with all resonant topologies, the tradeoff for improved switching losses is increased circulating energy with higher peak currents and increased RMS conduction losses. This migration to resonant topologies also comes at the cost of dynamic performance as the control bandwidth is orders of magnitude less than other hard switching topologies such as fixed frequency or constant on/off time PWMs. This limits the use of these "MOSFET saving" topologies to applications where an additional low-frequency hard-switching converter (placed either before or after the bus converter) will be there to handle dynamic transients. With improved hard switching performance, and the reduced input and output capacitances (Ciss and Coss) that EPC's enhancement mode GaN

GaN readiness

The cumulative reliability information available on silicon power MOSFETs is staggering. Many years of work have gone into understanding failure mechanisms, controlling and refining processes, and designing products that have distinguished themselves as the highly-reliable backbone of any power conversion system.

GaN on silicon transistors are just beginning this journey. Preliminary results, however, are encouraging. As of the date of this writing, EPC has established the basic capability of enhancement mode GaN on silicon transistors. Tested devices are stable after 1000 hour stresses of the gate, the drain-source, and when exposed to high humidity with bias. EPC also put devices into 48 V - 1 V DC-DC converters and operated them at maximum stress for 1000 hours without fail-

ure. To see the entire EPC GaN readiness report, go to www.epc-co.com/epc/documents/product-training/EPC_relreport_030510_finalfinal.pdf

There is still much to be done to understand the various failure mechanisms associated with this new technology. Nevertheless, the data we have so far suggests this technology is today capable of performing at acceptable levels of reliability in commercial applications.

The future

The GaN journey is just beginning. There are many large improvements that can be made in basic device performance as measured by the RQ figure of merit. As we learn more about the material and the process, a factor of two improvement can be reasonably expected over the next three years and a factor of ten over the next 10 years.

We can also expect devices to emerge with much higher breakdown voltages as EPC plans to introduce 600 V devices in the second half of 2010 and other companies have discussed openly their intentions in this area. Higher voltage GaN transistors will eventually displace silicon IGBTs and even SiC-based transistors due to the lower manufacturing costs and lower conduction losses.

Perhaps the greatest opportunity for GaN to impact the performance of power conversion systems comes from the intrinsic ability to integrate both power-level and signal-level devices on the same substrate. GaN on silicon, much like SOI (silicon on insulator), has no significant parasitic interaction between components. This capability opens the door to power system-on-chip products where the entire power section is integrated with full control and drive circuitry.

Summary

The traditional power MOSFET is not dead, but is nearing the end of major improvements in performance and cost. GaN will probably become the dominant technology over the next decade due to its large advantages in both performance and cost; advantage gaps that promise to widen as we quickly climb the learning curve.

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Degradation of Heavy Wire Bond Interfaces

Tested on Power Semiconductors during Active Power Cycling

The recent improvements in power module reliability by using the low temperature joining technique for the die attach and substituting the base plate and its solder technology by a pressure contact design have led to a situation in which the reliability of the wire bond is now the main lifetime determining factor [1, 2, 3]. In order to extract a lifetime model for the wire bond the degradation process in the interface region between the wire and the power semiconductor during temperature cycling must be studied at single bond level. Module designers and quality engineers are then able to use this lifetime model in combination with electro-thermal simulations of their package to calculate wire bond lifetime in advance.

By Jens Goehre, Martin Schneider-Ramelow and Klaus-Dieter Lang, Fraunhofer IZM and Ute Geißler, Berlin University of Technology, Berlin, Germany

Failure Mechanism

The difference in the coefficients of thermal expansion (CTE) between the Si of the power semiconductor ($\text{CTE} = 3 \cdot 10^{-6} \text{K}^{-1}$) and the Al of the bond wire ($\text{CTE} = 24 \cdot 10^{-6} \text{K}^{-1}$) leads to periodic plastic and elastic strains in the interface region during temperature cycling. As a result the well bonded interface is successively destroyed by the growth of cracks from either end of the wire bond, Figure 1. When these two cracks meet in the center the complete wire lifts off and loses its electrical function.



Figure 1: Cross section of a bond showing cracks growing from either end of the wire towards the center of the bond

Thorough analysis of the crack path revealed that the crack does not travel along the bond interface as one might expect. Instead, the crack path lays approximately 10-20 μm above the bond interface in the wire material, Figure 2. Microstructure analysis of the interface region using EBSD and FIB showed that the crack travels along grain boundaries where the grain size above the crack is much greater than below it [4, 5]. These small grains are the result of the bonding process where the bond force leads to hardening effects while the ultrasonic power leads to dynamic recrystallization and softening effects. It is believed that the hardening effects prevail so that the crack propagates outside of this zone. This however, needs to be verified by future measurements.

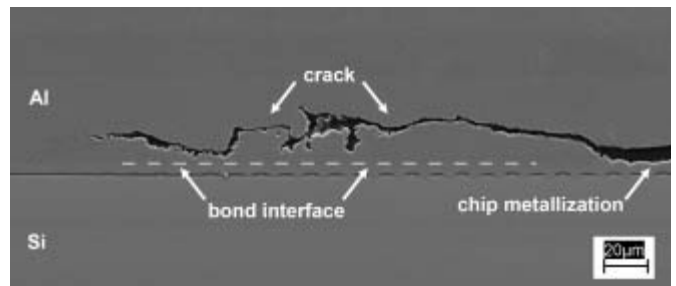


Figure 2: Crack grows 10-20 μm above the bond interface

Experiment

The specimen consisted of power MOS-FETs (Infineon CoolMOS, 5 μm AlSi1Cu0.5 metallization) on a DCB substrate. The chips were bonded with 400 μm Al heavy wire (Heraeus Al-H11, 25 bonds per chip).

Initial bond quality was optimized by shear tests. During the shear test a shear tool is shearing through the bond at a defined height (10% of wire diameter) above the interface. The measured shear force and the coverage of the shear site with wire material were recorded. The optimized bonds had an average shear force of 2700 cN and a standard deviation of 130 cN. The complete shear site was covered with wire material (shear through, Figure 3a).

The specimen were mounted on a water cooler (10°C) and heated by the electrical losses of the semiconductor (active power cycling). The test bench was designed in such a way that the minimum and maximum temperatures of each cycle were constant. Heating times were fixed to 1.8 seconds. The exact cycling period was dependent on the time for cooling. Typical cycling periods were in the range of 3 seconds. More details about the self developed test bench can be found in [6].

There were two groups of experiments. The specimens of the first group were exposed to different temperature swing amplitudes while the medium temperature $T_{med} = \frac{1}{2}(T_{min} + T_{max})$ stayed the same (90°C). This group was used to study the effects of the temperature swing amplitude.

The specimens of the second group were exposed to the same temperature amplitude (60K) but different medium temperatures. This group was used to study whether it makes a difference to cycle at a lower or a higher medium temperature.

After a defined number of cycles the specimen were removed from the test bench and all 25 wires of one chip were destructively tested by the shear test. A decrease of the shear forces and decreasing coverage of the shear site with wire material were an indicator for the advance of the cracks, Figure 3.

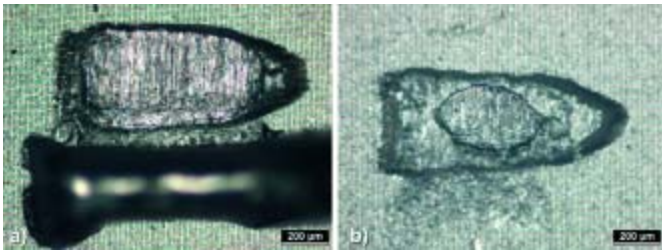


Figure 3: Shear site a) in initial state and b) after 100,000 cycles $\Delta T = 60$ K

Results

First, the effects of the temperature amplitude have been studied (group 1). Figure 4 shows the average shear forces versus the number of cycles for different temperature amplitudes. The tests were run up to 1 million cycles. The initial bond quality was the same for all specimens.

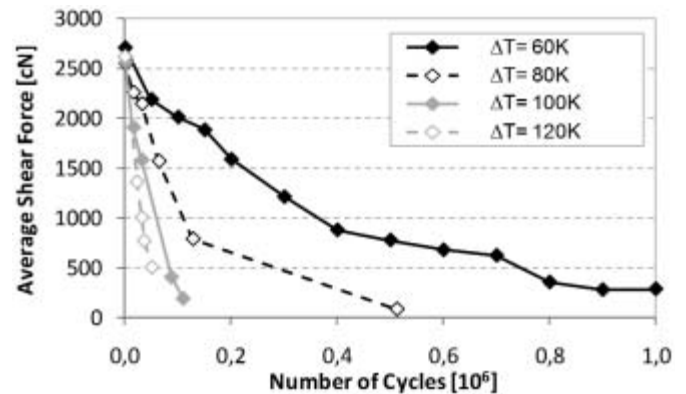


Figure 4 Shear Force vs. Number of Cycles for different temperature amplitudes

In all experiments the measured shear force decreases with increasing numbers of cycles. The decrease rate is dependent on the temperature amplitude. Higher temperature amplitudes lead to higher degradation rates. This underlines the importance of the temperature swing amplitude for the lifetime of the wire bonds.

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With the definition of a minimal acceptable shear force the cycles to failure for a particular temperature swing can be extracted from the curves of Figure 4. As an example, after approximately 400,000 cycles the shear forces for the bonds with a temperature swing of 60 K decreased to approximately 1000 cN. The bonds cycled at a temperature swing of 120 K already reached this value after approximately 30,000 cycles. This means it took more than 10 times longer for the bonds cycled with 60 K to reach the same level of degradation as the bonds with 120 K temperature swing.

With these results the parameters for a Coffin-Manson based life-time model can be determined by fitting the extracted cycles to failure to the calculated plastic strains per cycle of the interface region [4]. This model makes it possible to calculate the number of cycles until the wire bonds reach the defined level of degradation.

The second group of experiments focused on the effect of different medium temperatures onto the wire bond lifetime. Although large differences in the medium temperatures had been selected for the test there were no distinct differences in the degradation curves, Figure 5.

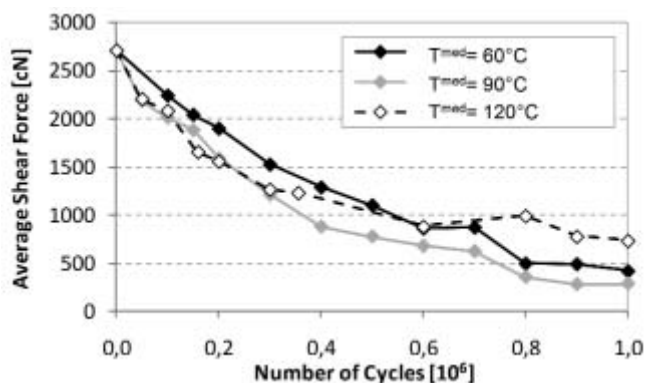


Figure 5 Shear Force vs. Number of Cycles for different medium temperatures

This leads to the conclusion, that the medium temperature does not have an effect on the lifetime of the wire bonds. This finding is in contradiction to the results of previous investigations which showed that the medium temperature significantly affected power module reliability [7]. The explanation for this is the fact that the different degradation mechanisms that take place in a common power module during temperature cycling interact with each other. For instance, ongoing solder layer degradation (which is known to depend on medium temperature) will increase thermal resistance of the package which increases the chip temperature and the temperature amplitudes for the wire bond interfaces leading to earlier lift-offs. In this case the medium temperature has an effect on wire bond lifetime.

In the study presented here the wire bond failure was isolated from the influences of the other degradation mechanisms for lifetime modelling purposes. The results clearly show that the medium temperature in the range that was investigated here does not affect wire bond lifetime.

Summary

Power cycling experiments have been carried out with 400 μm wire bonds on power semiconductors. The degradation of the wire bonds was monitored by using the shear test to destructively measure the shear force that the cycled bonds can withstand in regular intervals. This is a different approach compared to most previous investigations, where only the final result of the degradation, a lift off, was evaluated.

It could be shown that the shear forces decrease with increasing number of cycles and that there is a strong dependence on the magnitude of the temperature swing but no dependence on the medium temperature of the cycles.

The isolation of the wire bond degradation from other degradation processes in a power module allows a deeper understanding of the lifetime limiting factors of power electronics. In order to reach the goal of an enhanced lifetime model for wire bonds additional technology parameters such as wire size and bonding parameter as well as different materials will be included in future investigations

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Heavy Wire Bonder Platform with 30% Increased Productivity

The wire bonder sets a benchmark

An increase in produced parts per hour at reduced production costs and same or better quality is a continuous demand for the development of new manufacturing equipment. These demands have given the direction for the development of the new series Bondjet BJ93x, which will set the benchmark for heavy wire bonding, also from a throughput point of view.

By Herbert Stürmann, Hesse & Knipps Paderborn

A significant proportion of the cycle time for wedge bonding, especially in the largest wire diameter applications, is used for the ultrasonic welding process. For this reason it is a big challenge to achieve a 30% increase in productivity. Each element of the bonder series BJ92x had to be questioned for means of optimization. Consistent reduction of the moving mass, integration of highly dynamic linear motors and the proven axis control system of the BJ82x bonder series have lead to double acceleration values of all axes. The bondhead with 20% reduced mass was equipped with a new set of actuators, optimized for low moment of inertia. Big emphasis was also put on the selection of components which are maintenance free or mostly wear free in their application.

The new machine generation is based on long term experience in the development and design of ultrasonic wedge-wedge bonders, the consistent application of mechatronic design principles and the integration of micro technology for sensors and actuators in the new bondhead generation. The new machine generation uses our ultrasonic generators based on DDS technology – already field proven from the fine wire bonders - and optimally matching amplifiers and transducers.

At the Productronica 2009 the Bondjets BJ935 and BJ939 had been presented, setting a benchmark for the processing speed as well as precision and low maintenance requirements. This claims worldwide technological leadership under the heavy wire bonders, as with the fully automatic Wedge-Wedge Thin Wire Bonders series BJ820.

Machine Generation Bondjet BJ935 and BJ939

The Bondjets BJ935 and BJ939 deliver the basis for a new machine generation with proven technology and innovative development for the processing of aluminum wire, copper and ribbons.



Figure 1: Heavy Wire bonder Bj 935

The application of proven technology and innovative solutions means:

- Gantry kinematics with linear motors for current and future requirements on precision and repeatability with working areas up to 350mm x 500mm
- Reduced mass bondhead with integrated, non-destructive pull test.
- Active cutter system, decoupled from the Z axis

- E-box, optical setting assistance for cutter, wire guide and wedge tool (patented)
- PiQC, process integrated quality control for stress-free monitoring of each bond (patented, patent application)

With features such as active cutter, E-box and PiQC, Hesse & Knipps already set essential trends and henceforth sets the benchmark for the cost of ownership. The power of innovation lies with the combination of dynamic drives, optimized axis control concepts, high speed compliant kinematics for all axes and innovative bondheads, optimized for high functionality and low mass. Productivity increase of 30% compared to the current machine generation BJ920 have been reached during evaluations with IGBT modules, confirming that the set target was reached in full.

Concerning the achievable bond quality, the new machine generation is also setting new benchmarks: The touchdown of the wedge tool on the chip or substrate can be executed with highest sensitivity. Placement accuracy is increased 3 to 4 times compared to the series BJ92x bonders. The repeatability of looping is $\pm \frac{1}{2}$ wire diameter as a general thumb rule. With these properties the new machine generation is well prepared for ever smaller bond pads and ever thinner and therefore more sensitive contact layers on the semiconductors.

Established features such as frontcut-backcut retrofit within minutes, fast bondhead exchange including wedge calibration, easy integration in production lines, universal or customer specific automation were taken over as well as the user friendly software.

The new machine series can be integrated into existing production lines and existing automation can be easily adapted.

The extra large working area of up to 350mm x 500mm allows smart automation concepts or processing of extra large substrates.

Quality control – the state of the art

For the prediction of bond quality it is common to measure the transducer current or the electrical progression of admittance or impedance respectively and the progression of wire deformation. The recent introduction of digital ultrasonic generators has allowed the resonance frequency to be added to the measurement. This frequency is subject to small variations during the bond process. To judge the bond quality, all of the measured signals are compared to the expected target progressions for deformation, current and frequency after the bond was formed. The above mentioned measurements allow detection of several likely bond defects, a complete detection of all possible defects however is not possible because the expected signal progressions are only necessary, but not sufficiently determining properties of the bond quality. To explain this in an example: A progression of wire deformation outside the expected target progression will immediately give evidence to a poor quality bond. On the other hand bonds on a contaminated surface will often exhibit a deformation progression within the target range, even so the bond is of insufficient quality. The expected target progression of the wire deformation is therefore not a sufficiently determining quality criteria. This simple example furthermore shows that a closed-loop control forcing the wire deformation into an expected progression by altering the force and / or ultrasonic output during bonding will not solve the fundamental problem of the above example and is therefore useless. The existing methods for quality control allow the operator to monitor the bond process within defined process parameters through a defined process window.

The ultrasonic output follows a predefined profile during bonding. This guarantees that there is always the same amount of energy available to carry out the welding. For this reason there is no triggering of ultrasonic change by deformation with Hesse & Knipps bonders.

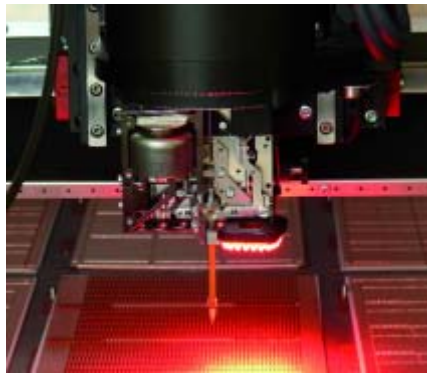


Figure 2: Bondhead with integrated non-destructive pulltest and PiQC (patented, patent application)

PiQC, the world wide unique process integrated quality control

With PiQC, Hesse & Knipps introduced a quality control system which uses additional sensors to open up a wider range of process parameters to be added to the quality evaluation. Such parameters are the mechanical impedance, the velocity of the wedge tip and the friction value between the wire and the bond surface, which is the point where the energy for welding is applied. For heavy wire bonders, non-destructive tests are required in fully automatic production which enable 100% control and ideally detect all quality errors. Despite the high bond speed, all Hesse & Knipps bonders can compute a



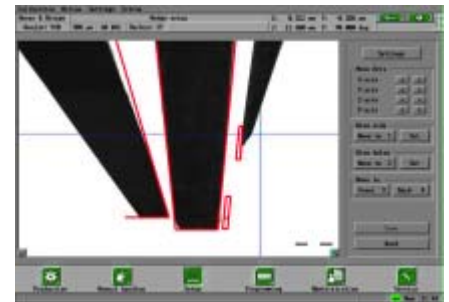
Figure 3: E-Box patented (US-07461768 B2 and DE103 38 809-B4)

vast amount of process data in real-time parallel to the welding process without compromising the machine productivity.

As is the case with the above mentioned available methods, the additional signals from the bond process (when viewed isolated) are also not able to deliver a determining quality criteria for a welding process. The collective sum of all parameters which are now available for analysis does provide such

a criteria. In other words: there has not yet been any bond defect observed, which did not trigger at least one of the parameters to respond with an outlier. PiQC therefore provides a reliable bond quality criteria for the first time world wide. Large scale parallel computing – main algorithms are implemented in VHDL – provides the result in real-time, allowing PiQC to be applied as a 100% quality control. The necessity of statistical process control by destructive testing can be reduced significantly and – in an optimized production process – be even basically eliminated.

PiQC provides a quality control system which does not apply any mechanical stress to the bonds. This is a significant advantage over partially applied mechanical non-destructive inline test systems, which clamp the wire after bonding and apply a pre-defined force to the bond. Bond defects such as non-sticks can be detected by such methods, however the mechanical stress and the time of such tests are significant disadvantages. PiQC does not limit the machine productivity because the test is carried out parallel to the bond process. PiQC can therefore be activated for every bond and is – as already mentioned – free from feedback to the welding process. A more extensive quality system than the patented PiQC is world wide unknown.



Cost of ownership and quality are decisive attributes for production machines in the power electronics. The new machine generation BJ935 and BJ939 satisfy this demand in every aspect.

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Ballast Control IC for Industrial HID Lighting Applications



International Rectifier introduced the full-featured IRS2573DS High-Intensity Discharge (HID) electronic ballast control IC for low-, medium- and high-power general purpose industrial HID applications including retail store spotlights, general outdoor lighting applications and outdoor street lighting.

The IRS2573DS 600V IC combines a high-side, dual-mode buck controller together with a full-bridge driver. The device's novel buck circuitry enables continuous-conduction mode control during lamp warm-up and critical-conduction mode during steady state running. The full-bridge driver includes all high- and low-side gate driver outputs as well as integrated bootstrap MOSFETs for the high-side supply voltages.

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CAPZero? ICs Discharge X Capacitors, Eliminating Losses in EMI Filters

Power Integrations launched CAPZero, a family of innovative, two-terminal, automatic X capacitor discharge ICs that eliminate power losses while allowing power supplies to comply with safety standards.



X capacitors are typically positioned across a power supply's input terminals to filter differential EMI noise. Alone, these components could present a safety hazard because they can store unsafe levels of high-voltage energy for long periods of time after the AC is disconnected. To meet safety standards, resistors are commonly used in parallel with the X capacitor and across the AC line to provide a discharge path. However, these discharge resistors produce a constant power loss while the AC is connected and are a significant contributor to no-load and standby input power consumption.

CAPZero acts as a smart high-voltage switch when placed in series with discharge resistors. When AC voltage is applied, CAPZero blocks current flow in the X capacitor safety discharge resistors, reducing the power wasted in these components to zero at 230 VAC. When the AC voltage is disconnected, CAPZero automatically and safely discharges the X capacitor by closing the circuit through the bleed resistors and directing the energy away from the exposed AC plug.

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LED-Lamp Reference Board for Dimmable Offline Lighting

TI's technology and Lemnis Lighting's application experience are bringing LED lighting home

Texas Instruments introduced a complete LED lighting driver reference board in collaboration with Lemnis Lighting to help address three important issues: cost, dimming and efficacy. The TPS92010

LED-lamp Reference Board applies TI's semiconductor technology for general LED lighting and Lemnis Lighting's expertise in dimmable lighting applications. The board can help speed adoption of energy-saving retrofit LED light bulbs. The reference board will be available in mid-second quarter and is accompanied by a user's guide that contains the schematics, bill of materials and test results needed to design a dimmable LED lamp. For details see:

www.ti.com/tps92010referenceboard-preu.

The reference board is based on TI's new TPS92010 LED lighting controller. The TPS92010 offline LED lighting controller implements quasi-resonant flyback power converters to achieve high efficiency of up to 87 percent, small size and lower cost for AC/DC LED lighting drivers. The TPS92010's control technique allows designers to develop replacement light bulbs in tight, small form factors, and helps reduce overall system cost. The device's system-level features, such as overvoltage detection and shutdown, prevent system damage caused by an open LED string. Its over-temperature shutdown feature protects against excessive heat in the system.



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12-Bit Absolute Encoder is Compact



CUI Inc has added a new absolute encoder to its high resolution, low-cost AMT modular encoder line. The AMT203 outputs 12 bits of absolute position information in a very

small (1.35"x1.13"x 0.45") modular package. Unique among its peers, the AMT203 generates absolute position information using CUI's patented, capacitive code generation system coupled with a proprietary ASIC, creating a reliable, economical and durable control and positioning solution. The AMT203 consumes a maximum 10 mA

at 5 Vdc making it ideal for applications where power consumption is a concern. Available options include nine mounting patterns and ten bore sizes, creating a flexible platform that is able to mate with many industry standard motors.

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3W Shuen LED Family

Everlight is offering slim package, high power, and high luminosity for advanced lighting.

Shuen [Xuan] is the English translation for the Chinese word meaning Bright and Shiny. Both words are relevant descriptions of this Everlight LED series. The modern, adaptive Chinese definition of the word represents that which is New, Extravagant, and Highly Sought After.



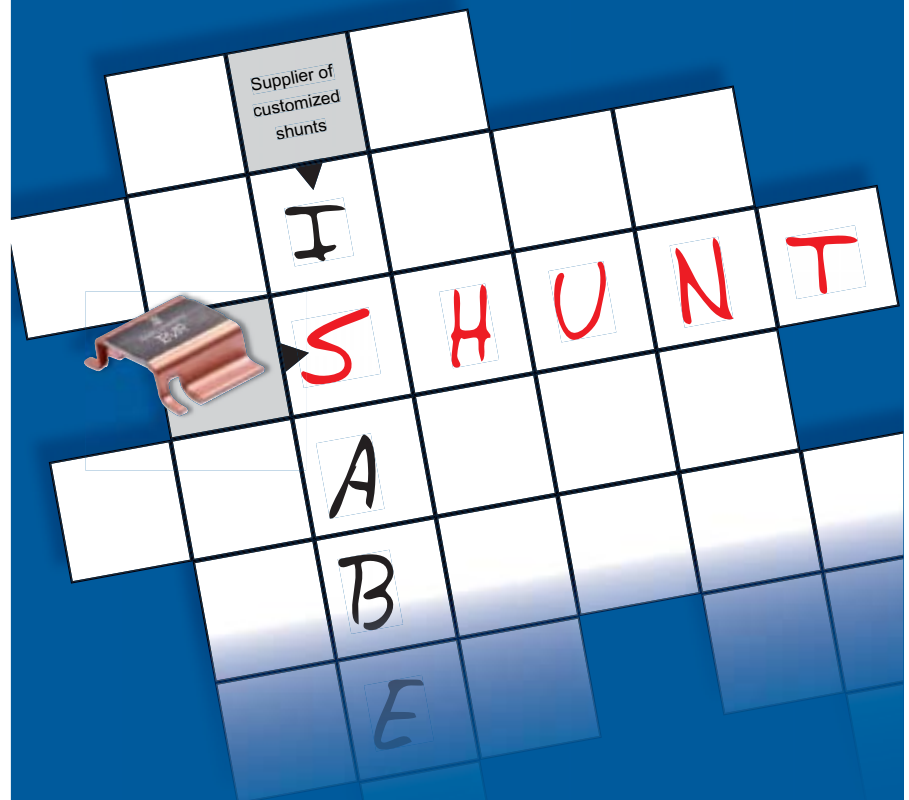
Adding to the performance and popularity of Everlight's 1W Shuen series High Power LED with a luminous flux up to 100 lm at 350 mA, Everlight Electronics Co., Ltd.

(TSE:2393) announces the 3W Shuen High Power LED with up to 170 lm when driving at 700 mA.

Both 1W and 3W Shuen packages are surface-mount high-power devices offering high brightness in a compact and slim form factor, making them suitable for different lighting applications including general illumination, flash, spot, signal, industrial and commercial lighting. The thermal pad of both the 1W and 3W Shuen Series are electrically isolated providing for improved thermal and electrical characteristics.

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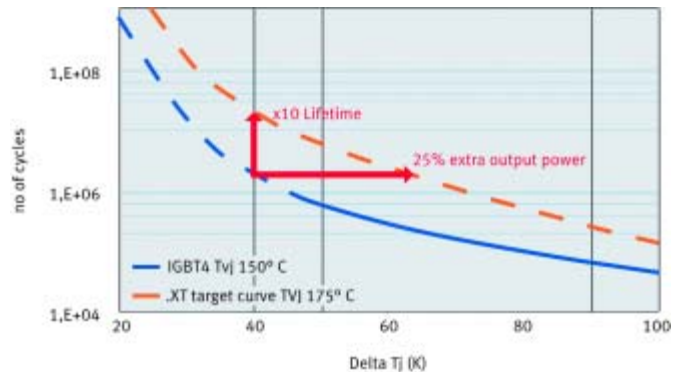
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Innovation from tradition

XT-Technology Significantly Increases Lifetime of IGBT Modules

Infineon Technologies at PCIM Europe 2010 in Nuremberg (May 4-6, 2010) introduces an innovative IGBT internal packaging technology, which significantly increases the lifetime of IGBT modules. The new .XT technology optimizes all interconnections within an IGBT module in regard of lifetime. With these new packaging technologies Infineon addresses the requirement of emerging applications with regard to higher power cycling capabilities and open the path as well to increase power density and higher junction operation temperature. The new .XT technology increases the lifetime of IGBT modules by a factor of 10 compared to existing technologies. Alternatively the output power can be increased by 25 percent. The new technology supports junction temperatures up to 200°C.

Power cycling results in temperature changes and leads to mechanical stress for the interconnections within an IGBT module. The different coefficients of thermal expansion of the single layers result in thermal stress, which can lead to material fatigue and wear. The new .XT technology covers all critical areas on power cycling capability within an IGBT module: bond wiring on the chip front side, soldering on the chip back side (die to DCB) and the DCB (Direct Copper Bond) to base plate soldering.

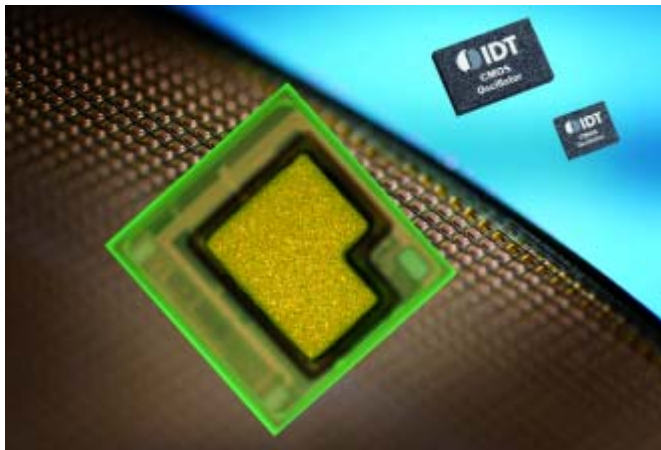


The new set of interconnection technology has been developed to fit into most of the existing Infineon packages as well as into new module packages. All three new joining technologies are adaptable to the standard processes and very suitable for high volume production.

www.infineon.com/power

High-Accuracy All-Silicon CMOS Oscillators

Integrated Device Technology, Inc. announced the availability of its all-silicon CMOS oscillators, the MM8202 and the MM8102 in wafer



and package forms, making IDT the only company to offer quartz-crystal-level performance with a CMOS oscillator in both forms. These ICs eliminate quartz-based resonators and oscillators in consumer, computation and storage applications with small form factor requirements and offer excellent link performance for all generations of common serial wireline interfaces, including S-ATA, PCIe, USB 2.0 and USB 3.0. The wafer form availability of the product enables chip-on-board (CoB) and multi-chip module (MCM) assembly designs for significant space savings.

The MM8202 and MM8102 are built on standard CMOS technology and do not require any mechanical frequency references, be it quartz or MEMS, offering IDT customers a fully integrated alternative to quartz-based resonators and oscillators. In addition, the MM8202 is ideal for thin profile consumer devices, such as high-capacity SIM cards and USB Flash drives.

www.idt.com/go/CMOS-Oscillators

Intelligent Power Modules for Solar Inverters

Mitsubishi Electric Corporation is introducing its new "PV Series" of intelligent power modules (IPMs), which is mainly intended for use in residential photovoltaic (PV) inverters. The six different modules which are also well-suited for inverters in fuel cell systems, are



integrated in packages with a footprint of just 90mm x 50mm.

Compared to Mitsubishi Electric's current PV series IPMs, which were launched already in 2005 these new modules require 30% less board space. Therefore, the new PV IPMs from Mitsubishi Electric provide a significant contribution to making PV inverters smaller. Six New PV IPMs: In order to suit the various types of IPMs needed in PV inverters Mitsubishi Electric has developed six different modules within its new PV IPM series. This means that the new devices are well-suited for single-output inverters without chopper or with one or two choppers.

All the devices are rated for a collector-emitter voltage of 600V with a collector-emitter

saturation voltage of $V_{CE(sat)} = 1.9V$ (typ.) @ $T_j = 25^\circ C$ and a FWD_i forward voltage of $V_f = 1.7V$ @ $T_j = 25^\circ C$. While the models PM50B4L1C060 (inverter part only), PM50B5L1C060 (+ 1 chopper) and PM50B6L1C060 (+ 2 choppers) are specified for collector currents of 50A, the models PM75B4L1C060 (inverter part only), PM75B5L1C060 (+ 1 chopper) and PM75B6L1C060 (+ 2 choppers) are specified for collector currents of 75A. All IPMs are protected against short circuit, undervoltage and overtemperature.

www.mitsubishichips.com

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Miniature 3-Watt High Power LED

Avago Technologies announced one of the industry's smallest, most energy efficient 3-Watt (3W) high power LEDs with high color rendering index (CRI) for use in a wide range of solid-state lighting applications.



With dimensions of 5 mm by 4 mm by 1.85 mm thick, Avago's compact 3W ASMT-Jx33 is packaged in a 6-leaded small outline package (SOP) and capable of being driven to up to 700 mA to provide high flux output performance.

The ASMT-Jx33 has a wide viewing angle of 140-degrees to meet the needs of designers who require good color uniformity. This LED provides a high typical CRI of 80 for cool white and 90 for warm white. Avago's 3W emitter is a high performance LED designed to handle high thermal and high drive currents. By delivering a high flux output of 70 lumens (lm) at 350 mA, this new 3W LED emitter is ideal for use in general lighting applications such as medical lighting, merchandise display lighting and museum lighting. Additionally, this LED features a maximum allowable junction temperature of 135 degrees-C thus providing lighting designers with more design flexibility

www.avagotechlighting.com

Line of Liquid-Cooled Cold Plates

To enable shorter design cycle times in a reliable and cost-effective manner, Richardson Electronics now supplies MaxQ Technology's new line of liquid-cooled cold plates.



The new cold plates provide drop-in mounting capability for the many of the popular Microsemi, Mitsubishi, Powerex, and Semikron power modules used in high power density applications, such as electric vehicle (EV), hybrid electric vehicle (HEV), plug-in hybrid vehicle (PHEV), wind turbines, and

industrial motor control. The drop-in mounting capability eliminates the need for time-intensive designing and testing of a custom cold plate solution. Each of the new cold plates is a proven design with predictable performance, providing very low thermal resistance, low pressure drop, and a robust and reliable metallurgical seal.

With an effective cooling capacity of up to 0.85 °C-cm²/W, designers will be pleased with these smaller, lightweight cold plates. From a hydraulic perspective, the low pressure drop (less than 1.6 PSI at 8 LPM flow rate - on the MQT1617) enables a lower pressure pump requirement. These features are made possible with MaxQ's patent pending Q-Chill™ technology. Each cold plate's size is driven by the module footprint for which it is designed, rather than the cold plate cooling limitations.

www.rell.com

LS Research's Wireless Modules and Developer Kits

Richardson Electronics, Ltd. whose new website features the latest products from top manufacturers for the most important RF/Wireless and Power Conversion applications, announced it has signed a global distribution agreement with longtime engineering partner LS Research to distribute its line of innovative embedded solutions products. LS Research offers a unique combination of FCC pre-certified wireless modules, gateways and development kits based on 802.11 b/g/n, ZigBee®/802.15.4 and 900 MHz Technology. The ModFLEX™ modules share a

common design and footprint to give designers the flexibility of choosing a wireless platform. All LS Research ModFLEX™ modules work with LS Research gateway products, which will be released later this year. The gateways provide simple, low-cost connectivity for Ethernet and USB. Additionally, clients can choose from purchasing the certified modules or licensing the design files for complete control.

www.rell.com

www.lsr.com

www.bodospower.com

June 2010



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- Multi-Range configuration
- +5 V Single Supply
- Low offset and gain drift
- High Accuracy @ +85°C
- Access to Voltage Reference
- Analog Voltage output

www.lem.com

At the heart of power electronics.



3-Level Phase Leg IGBT Modules

Infineon Technologies introduces a complete family of 3-level phase leg IGBT modules ranging from 30 A up to 300 A. The modules are available in Easy 1B, Easy 2B and EconoPACK™4 housing. Relying on Press-FIT technology, fast and solder-less assembly combined with highest reliability levels are achieved. Low inductive designs facilitate the design process and optimise system performance.

3-level phase leg modules are ideally suited for power supply, solar and industrial drives



applications. Highest levels of efficiency and optimised filter cost can be realised. The Easy 2B and EconoPACK™4 modules rely on 650 V chip technology. Hence, all modules offer an excellent setup for systems even with high DC link voltages at excellent system cost.

EconoPACK™4 modules in 3-level configuration feature screw power main terminals – ideal for high current capability.

www.infineon.com/power

High-Speed, High-Efficiency MOSFETs in DPAK Package

Toshiba Electronics Europe has further expanded its family of power MOSFETs by introducing new surface mount devices with voltage ratings up to 600V. Supplied in a compact DPAK package, the new TKxP MOSFETs will be ideal for lighting ballasts, battery chargers and other power supply applications requiring currents up to 7A.

The new power MOSFETs combine the compact DPAK form factor with Toshiba's 8-MOS VII semiconductor process. The result is a range of devices that offer high efficiency, fast switching characteristics, reduced gate charge (Qg) and capacitance, improved on resistance (RDS(ON)) and better cost/performance ratios when compared with

previous generations of devices. In addition, the avalanche durability of all of the MOSFETs is guaranteed.

Offering a VDSS voltage rating of 500V, the TK3P50D, TK4P50D, TK5P50D and



TK7P50D have current ratings (ID) of 3A, 4A, 5A and 7A respectively. The TK5P53D and TK6P53D are rated to 525V and offer respective current ratings of 5A and 6A. At the 500V voltage level the TK3P55DA, TK4P55DA and the TK4P55 D deliver respective currents of 2.5A, 3.5A and 4A. Respective current ratings for the 600V TK2P60D, TK4P60DA and TK4P60DB are 2A, 3.5A and 3.7A.

Maximum on resistance (RDS(ON)) ratings range from just 1.22 Ω to 4.3 Ω depending on the device chosen.

www.toshiba-components.com

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Precision Isolation Amplifiers for Industrial Motor Control



Avago Technologies announced three Miniature Precision Isolation Amplifiers with increased accuracy, bandwidth and high insulation made possible by proprietary optical isolation technology.

Based on sigma-delta analog-to-digital converters and chopper stabilized amplifiers, the new isolation amplifiers feature high gain accuracy, low temperature drift, 3.3 V/5 V output supply operation and a wide -

40 to +105°C operating temperature range. These features are delivered in a stretched SO-8 package that has a footprint 30% smaller than the standard DIP-8 package. When mounted on a PCB, it occupies a space that is a fraction of that for a traditional Hall Effect or

transformer based isolation amplifier.

The series is implemented with a fully differential circuit topology with a gain accuracy of $\pm 0.5\%$ (ACPL-C79B), $\pm 1\%$ (ACPL-C79A), and $\pm 3\%$ (ACPL-C790). Normalized gain drift is 50 ppm/°C. With a 200 kHz bandwidth and 1.6 μ s response time, the ACPL-C79x captures transients during short circuit and overload conditions. Operating from a single 5 V supply, the isolation amplifier series features an excellent nonlinearity of 0.05% and a SNR of 60 dB.

The ACPL-C79x high common-mode transient immunity of 15 kV/ μ s provides the precision and stability needed to accurately monitor current in high noise motor control environments. This ensures smoother control with less "torque ripple" in many motor control applications.

www.avagotech.com/optocoupler

CUI Announces New Level V Line-Up

CUI Inc's power line, V-Infinity, announces a new line-up of high efficiency external power adapters. CUI's latest release includes 12



and 24 W wall adapters and a 12 W desktop adapter. All meet Level V efficiency standards, are Energy Star version 2.0 certified, and exceed the current US EISA 2007 efficiency regulations. Offered in a wide range of output voltages, these high efficiency adapters are the first in an expanded line-up of Level V products planned for 2010.

The EPSA and ETSA series include UL safety approvals and can operate off a universal input (90-264 Vac). Output voltages sup-

ported are: a) 5 V, 6 V, 9 V, 12 V, 15 V, 18 V, and 24 V (12 W desktop); b) 5 V, 6 V, 9 V, and 12 V (12 W wall); and c) 12 V, 15 V, and 24 V (24 W wall). Short-circuit and over-voltage protections are included. With typical efficiency above 82% and no load power consumption <0.3 W, this series is ideal for applications where power consumption is a critical consideration.

www.cui.com

Halogen-Free Pb-Free Solder Paste

Indium8.9HF Solder Paste is a halogen-free Pb-free solder paste with unsurpassed print transfer efficiency and response-to-pause printing. The advanced rheology of Indium8.9HF is ideally suited for today's advanced 0.4mm pitch and 0201 technologies.

As a truly halogen-free solder paste (tested per EN14582 test method), Indium8.9HF possesses a unique activator package and outstanding oxidation barrier, which allows it to coalesce and wet as good as, or better than, its halogen-containing counterparts. The oxidation barrier also ensures there is no graping on small passives.

Additionally, the combination of outstanding oxidation barrier and high slump resistance allows Indium8.9HF to effectively eliminate head-in-pillow defects.

Indium8.9HF can be manufactured with SnPb powder so it can be used on products currently exempt from RoHS. Using Indium8.9HF in a SnPb process offers high thermal stability and very low voiding in mixed alloy applications. It also eliminates the need to change solder paste chemistry when transitioning to a RoHS-compliant environment.

Indium will be exhibiting at Booth 7-430 at SMT Hybrid.

www.halogen-free.com



Intelligent Power Modules with High Output Power

Mitsubishi Electric has launched the new V1-Series as part of the IPM (Intelligent Power Module) line-up. V1-Series is a new intelligent power module which is mainly developed to increase the efficiency of motor drives and power supplies like DC/DC converters. The V1-Series IPM is focussing on applications in the two digit kW-class offering a respective line-up of 200A/300A/450A in 1200V and 400A/600A in 600V.

For this purpose several new technologies have been implemented such as a new full gate CSTBTM chip and a newly developed dedicated control IC. The short circuit detection is realised by a Mirror Emitter technology. With this technology the stress during



short circuit could be efficiently reduced, compared to a conventional desaturation detection method.

Chip technology and structure improvements reduce the effective junction temperature

and increase the power and thermal cycling capability of this family of IPMs while keeping the mechanical compatibility with the previous 2 in1 V-Series IPMs. Compared to its predecessors of the V-Series the new V1-Series IPMs reduce power losses by approximately 20% as the collector-emitter saturation voltage of the new V1-Series is specified with just 1.85V @125°C.

Protection functions against short circuit (SC), control supply under voltage (UV) and over temperature (OT) are implemented. The OT sensor is part of the surface of the IGBT chip.

www.mitsubishichips.com

Tunable Inductors with Non-Magnetic Cores

The new JLC series of high-Q variable coils from Johanson Manufacturing offers a wide tuning range of 30-133 nH and self-resonant frequencies of 700-1500 MHz, which make them ideal tuning devices for many RF applications. Datasheets and the JMC-SMTCOIL-KIT are available now from Richardson Electronics. These coils also feature a non-magnetic core for use in MRI systems or other magnetically sensitive circuits. Sample kits (JMC-SMTCOIL-KIT), which include 3 pieces

each of 6 different Johanson variable coils (surface mount) and a tuning tool, are available from stock to simplify the component selection process. In addition to the MRI applications, these coils are used in RF amplifiers, RF test and measurement systems, and defense electronics systems. With an overall height of only 0.35 inches, these variable inductors are ideal for applications where low-profile circuit boards are essential. Tuning is done by means of a

threaded PTFE and non-magnetic copper alloy core. The coils and their cores are indeed made to precise specifications. As such, they guarantee a constant winding pitch and consistent relationship to the printed circuit board. Each Johanson variable coil is RoHS compliant.

www.rell.com/RFPD

CeramCool Made from Aluminum Nitride Ceramic Cools 75W / cm²

CeramCool Liquid Cooling made from the aluminum nitride ceramic Alunit cools packing densities of up to 75W / cm². Until now the elongated, rod-shaped heat-sink has only been manufactured using the alumina material Rubalit (322W/mK); extruding linear shapes was not possible with the more thermally conductive aluminum nitride ceramic material Alunit (3170W/mK). Now CeramTec has developed an aluminum nitride that makes series extrusion possible, enabling the production of linear cavities, which double cooling capacity compared to Al₂O₃. For example, CeramCool Liquid Cooling using the alumina ceramic Rubalit cools 290W on 120mm; with Alunit, it is an impressive 640W on the same construction. No other design can achieve this and still assure such a long lifetime. The new geometry features three cooling channels to provide a homogeneous LED temperature.



The ceramic heat-sink is perfectly electrically insulating, inert and resistant to salt, acids and lye. This allows the trouble-free use of more than just standard coolants. On all sides of the heat sink, electrical circuits can be directly metallized and populated with advanced components without creating any thermal barriers. The miniaturization of a heat-sink with a high packing density and an extreme performance range makes Alunit both thermally necessary and economically viable.

www.ceramtec.com



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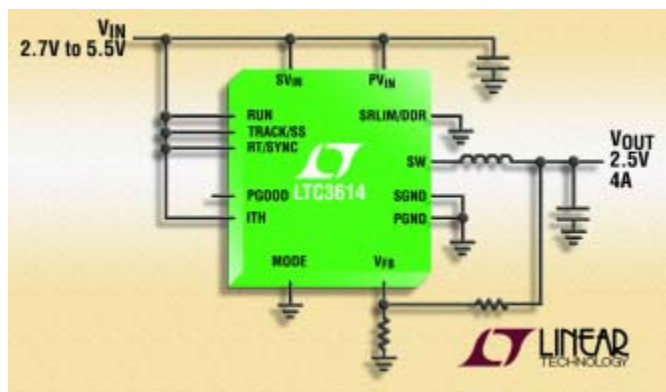
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4A, 4MHz, Synchronous Step-Down Regulator

The LTC3614 is a high efficiency synchronous buck regulator from Linear Technology that incorporates a constant frequency, current mode architecture capable of switching frequencies up to 4MHz. Low resistance internal switches allow the LTC3614 to deliver up to 4A of



continuous output current from a 3mm x 5mm QFN package, and its low dropout operation allows the output voltage to range from 0.6V to just millivolts below VIN. The LTC3614 operates over an input voltage range of 2.25V to 5.5V, making it ideal for single-cell Li-Ion applications as well as 3.3V or 5V intermediate bus systems. Its switching frequency is user programmable from 300kHz to 4MHz, enabling the use of tiny, low cost capacitors and inductors.

The LTC3614 uses internal switches with RDS(ON) of only 25mOhms and 35mOhms to deliver efficiencies of up to 95%. Burst Mode® operation reduces no-load quiescent current to only 75µA, maximizing both light-load efficiency and run time in battery-powered applications. An adjustable Burst Mode clamp enables designers to optimize light load efficiency. For applications requiring the lowest possible noise, the LTC3614 can be configured to run in either pulse-skipping or forced continuous mode, reducing noise and potential RF interference.

www.linear.com

PFC Portable Measuring Equipment for Grid Analysis

TDK-EPC, a group company of the TDK Corporation, presents a complete measurement system from EPCOS for the measurement and storage of electrical parameters in 3-phase low voltage grids. The MC7000-3 is designed for measuring voltages in the ranges from 3 x 30 V AC to 440 V AC (L-N) and 3 x 50 V AC to 690 V AC (L-L) at 50 Hz or 60 Hz.

Currents of up to 3000 A can be recorded with the aid of a clamp-on ammeter.

In addition to measuring voltage, current and



line frequency, the MC7000-3 is designed especially to determine the reactive, apparent and real power as well as the power factor. It also records the voltage and current harmonics. All data and readings are shown on a 28 x 64-pixel display either numerically or graphically. The unit also features an oscilloscope function.

The standard menu languages are English, German, Russian, Spanish and Turkish.

www.epcos.com/pfc

Solar Array Simulator Enhances Inverter Testing



AMETEK's TerraSAS Solar Array Simulator
Enhances Micro-Inverter Testing

AMETEK
PROGRAMMABLE POWER

The Elgar brand TerraSAS Solar Array Simulator from AMETEK Programmable Power offers a fully integrated solution for the design, development and production testing of inverters and micro-inverters for domestic and industrial solar energy systems. The TerraSAS simulates photovoltaic (PV) dynamic solar irradiance and temperature characteristics over a range of weather conditions from clear to cloudy and over a specified time interval to produce the current / voltage (IV) characteris-

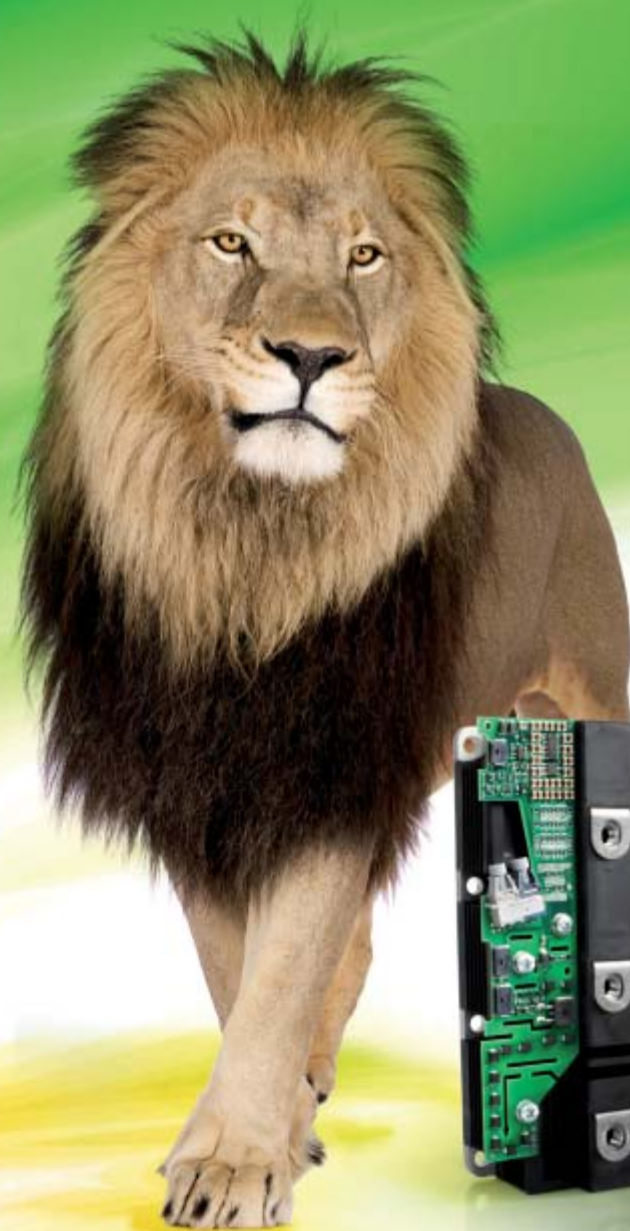
tics for the specified PV array for those conditions.

For ease of use, the system's simulation engine is able to download data from the National Renewable Energy Laboratory (NREL) Solar Advisor Model database defining key parameters - open circuit voltage (Voc), short circuit current (Isc) and maximum power point voltage (Vmpp) at 25 degrees C and 1000 W/m2 irradiance - so that the IV curve can be calculated according to a standard solar cell model for virtually any fill factor or solar material. Other PV panel IV curves can be entered manually. Systems with multiple panels with different characteristics resulting in "multiple hump" IV curves also can be simulated. In addition, the TerraSAS is capable of simultaneously simulating up to 24 parallel channels for use with micro-inverters.

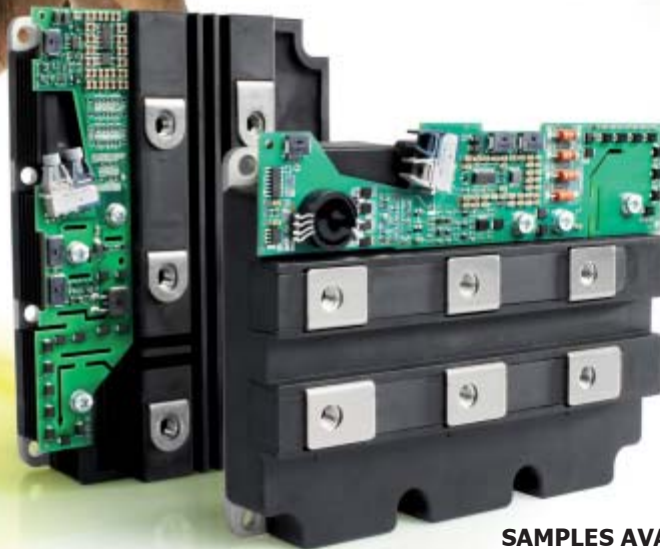
www.programmablepower.com

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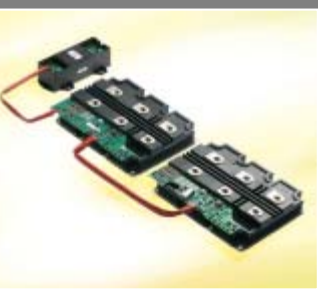
ABB France	9	EPE	37	LS Industries	1
Bicron	25	Fuji Electric	7	Richardson	9
Biricha	23+36	GVA	3	Semicon West	21
CDE	5	Husum Wind	13	SMT	19
Cree	C2	International Rectifier	C4	TDK Epcos	11
CT Concept Technologie	C3	Intersolar	17	Toshiba	29
CUI Europe	35	Isabellenhütte	41	Tyco Electronics	47
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electronica	45	Lem	43		



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Paralleling with 1SP0335

► New High Power Driver

Launching the next generation of high voltage IGBT gate drivers, CONCEPT introduces two new top class products – **1SP0635** and **1SP0335** - with an outstanding performance to cost ratio. Consequent integration enables **cost down by 40%** compared to the first SCALE generation and significantly increased reliability. At the same time enhanced functionality, such as direct paralleling capability and Dynamic Advanced Active Clamping (DA²C) assures excellent electrical performance and operation within the SOA of the IGBT. Designed to fit all international standards these drivers are the perfect choice for high performance traction application, high power inverter and medium voltage drives.

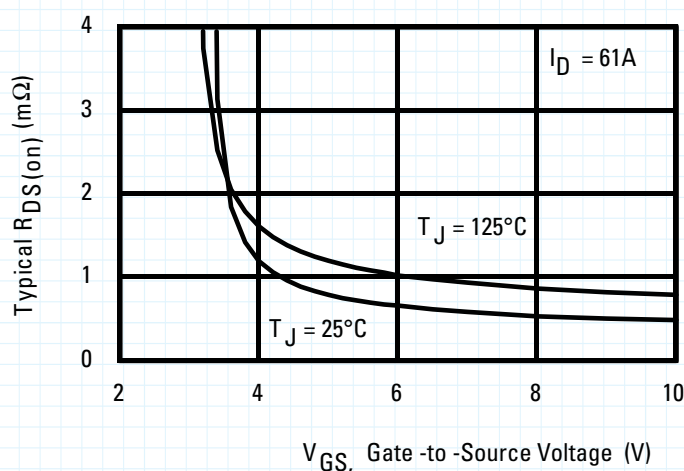
► Features

- Plug-and-Play solution
- For 1.2-3.3kV IGBT – 1SP0635
- For 3.3-6.5kV IGBT – 1SP0335
- Direct paralleling
- DA²C
- Gate voltage monitoring
- Supply voltage monitoring
- Duty cycle 0..100%
- Superior EMC behaviour
- 2-level and multilevel topologies
- Meets EN50124 and IEC60077
- Long service life



IR's IRF6718 Large Can DirectFET® MOSFET Delivers Industry's Lowest $R_{DS(on)}$ *

Optimized for Active ORing and Hot Swap Applications



The IRF6718L2 features IR's latest generation silicon technology in a new large can DirectFET® package delivering extremely low $R_{DS(on)}$ of only 0.5mΩ (typical) at 10V V_{GS} in a 60% smaller footprint and 85% lower profile than a D²PAK. The IRF6718L2 significantly reduces conduction losses associated with the pass element in ORing or hot swap applications to dramatically improve the efficiency of the entire system.

FEATURES

- Industry Lowest $R_{DS(on)}$ for Reduced Conduction Losses
- Superior electrical and thermal performance in smaller footprint than D²Pak
- Dual-sided Cooling Compatible
- Reduces component count and board space compared to competing solutions
- Compatible with existing Surface Mount Techniques
- RoHS Compliant Containing no Lead or Bromide

Part Number	Package Size (mm x mm)	$R_{DS(on)}$ @10V typ. (mΩ)	I_D @ $T_A = 25^\circ C$ (A)
IRF6718	7.1 x 9.1	0.5	270
Competitor 1	10.7 x 15.9	0.7	180
Competitor 2	5.1 x 6.1	0.95	60
Competitor 3	5.1 x 6.1	1.5	65

* Based on data compiled September 2009

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