ISSN: 1863-5598

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Electronics in Motion and Conversion

April 2014

GVA Power Electronics
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Live at PCIM Europe
Hall 9, Stand 207

Flexible power based on a modular concept: VARIS™ – the modular inverter system

All information from page 20 on

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o-f.de

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- **MV IGBT / Thyristor control**
- **MV current loop feed power supply**

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Read online and search for key subjects from all articles in Bodo's Power Systems by going to Powerguru: www.powerguru.org

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www.we-online.com PCIM Europe hall 7 stand 419

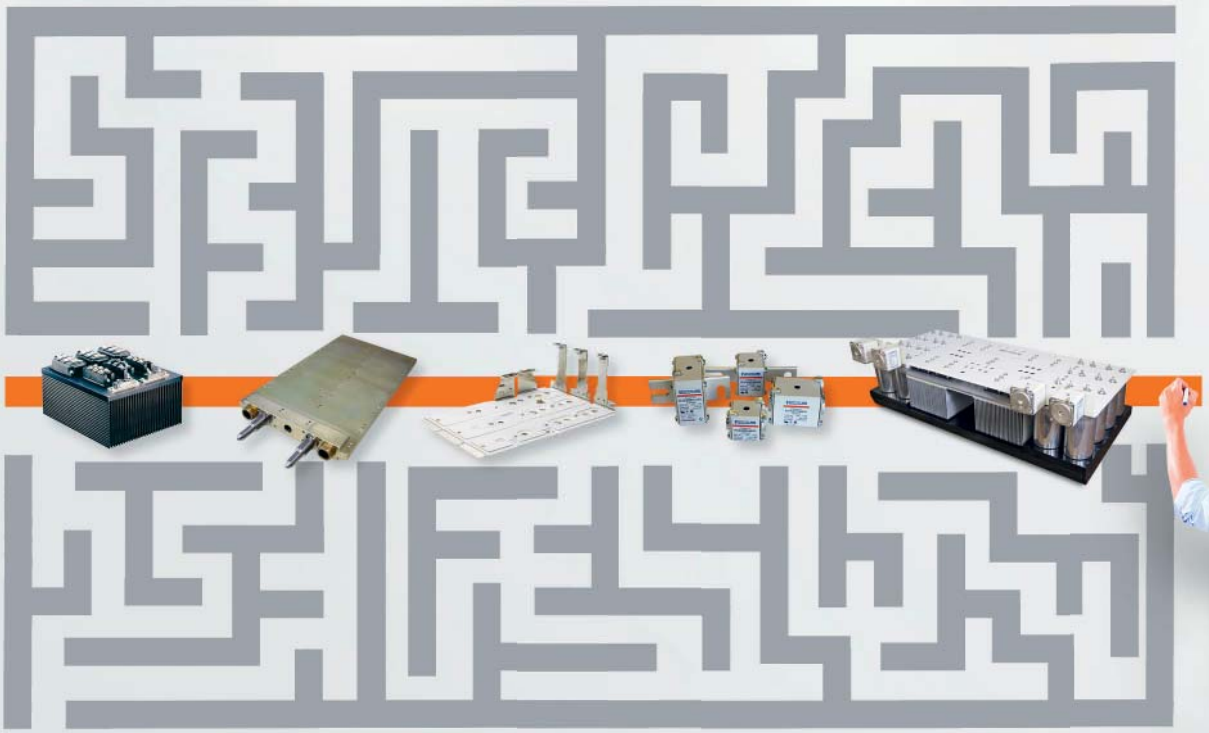
The Gallery

Straight to the optimized design

Cooling systems

Laminated bus bars

Fuses for the protection of power semiconductors



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Free Subscription to qualified readers

Bodo´s Power Systems
is available for the following
subscription charges:
Annual charge (12 issues)
is 150 € world wide
Single issue is 18 €
subscription@bodospower.com

circulation ASC audit since 09/2006 print run 24 000

Printing by:
Druckhaus Main-Echo GmbH & Co KG
63741 Aschaffenburg, Germany
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Enjoy Spring Time

It is April and, in the Northern Hemisphere, a great time to see nature waking up. Finally, we can enjoy the outdoors again. Only three years ago, APEC was in Fort Worth, a great place, and APEC has returned quickly. The last time I attended APEC here, Spring was here as well - wonderful.
In upcoming issues we'll be covering the new developments and trends that will presented and discussed there, will be. For sure, news of wide band-gap semiconductors will be included, as they move into applications in volume. It is just now that we see a ramp-up in new designs introduced to the market. The impetus to increase efficiency and reduce weight is unavoidable.

Having had a great steak in Fort Worth during APEC, I am also looking forward to Nuremberg in May and fresh white asparagus. It'll be at the height of the season for fresh asparagus from the local Franconia region of Germany. As will be the next big conference, PCIM Europe. Besides the high-level technical papers at these conferences, we need to enjoy the region and the local food.

A tradition for some years now, I again will moderate a podium discussion at PCIM Europe.
This year I have chosen the subject "Mature Wide Band Gap Semiconductors." Experts from the industry will highlight the status of development, advanced solutions, and steps made to support the new designs in volume. All of this is at the Industry Forum Booth 461 in Hall 9 on Wednesday the 21st of May from 12:20 to 13:20. I look forward to seeing you there, and hope for a lively discussion with the panel.

Communication is the only way to progress. We delivered twelve issues last year, each month, on time, every time. With this April issue we have published 42 technical articles amongst 256 pages so far this year. They are all archived and retrievable at PowerGuru. As a media partner, Bodo's Power Systems serves readers across the globe. If you speak the language, or just want to have a look, don't miss our Chinese version: www.bodospowerchina.com.

My Green Power Tip for April:
Get a waterproof smart phone. It will insure that you can continue using it after it has been fallen into the WC. A real possibility, as a client of my wife found out. With her phone no longer working, the person left the office in a panic. So keep your phone safe while using the washroom, or get waterproof model.

See you soon at PCIM in Nuremberg, and around the world.

Best Regards

Events

Energy Storage Forum,
London, UK, April 1-4
www.energystorageforum.com/

ExpoElectronica 2014,
Moscow Russia, April15-17
http://expoelectronica.primexpo.ru/en/

SMT Hybrid 2104,
Nuremberg, Germany, May 6-8
http://www.mesago.de/en/SMT/home.htm

PCIM Europe 2014,
Nuremberg, Germany, May 20-22
http://www.mesago.de/en/PCIM/home.htm

ISiCPEAW 2014,
Stockholm, Sweden, May 25-27,
www.acreo.se

eCarTec 2014, Paris, France
May 20-22 www.ecartec.de

Sensor + Test 2014,
Nuremberg, Germany, June 2-5
/www.sensor-test.com/press

Intersolar 2014,
Munich, Germany, June 2-6
www.intersolar.de/de/intersolar-europe.html

PCIM Asia 2014,
Schanghai, China, June 17-19
www.mesago.de/en/PCC/home.htm

Utility Energy Storage Europe,
London, UK June, 18-19
www.smi-online.co.uk/utility/uk/conference/distributed-energy-storage

Thermal Management 2014,
Denver CO, August, 6-7
www.thermalnews.com/conferences/

EPE ECCE 2014,
Lappeenranta, Finland, August 26-28
www.epe2014.com/

ECCE 2014,
Pittsburg, PA, September 15-18
www.ieee.org/conferences_events/conferences/conferencedetails/index.html?Conf_ID=21325

INNOTRANS 2014,
Berlin, Germany, September 23-26
www.innotrans.de/

PCIM Europe 2014
Hall 9-204

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The perfect fit for your design: a cost-effective current transducer that out-performs shunts in every way. The compact package of the HLSR requires only 387 mm^2, less board area than many shunt solutions. Large clearance/creepage distances ensure safety, and high performance produces accurate measurements across a wide temperature range of -40°C to +105°C. The LEM HLSR – a single compact device that eliminates complexity in your design.

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Würth Elektronik eiSos Appoints Managers for its Connector Division

Würth Elektronik eiSos GmbH & Co. KG announced the names of the people in charge of its rapidly growing connector division. The connector division will be jointly managed by: Romain Jugy, who will be responsible for production and development as Head of Product Management.

Josef Wörner, who will be responsible for the global sales of connectors in his position as Head of Sales. Both managers have been working successfully for the company for many years. Romain Jugy was heavily involved in the initial development of the plug connector programme and has since taken on the role of joint managing director of Würth Elektronik France SAS in Lyon. Josef Wörner has until now managed connector sales for the German market. He will also continue to hold this position following his appointment as Head of Sales. The duo is set to head up the global expansion of the connector division. With three logistics hubs in Waldenburg (Germany), Lyon (France) and Hong Kong, as well as many other storage locations, the company is already well-positioned and can deliver catalogue products within 24-48 hours worldwide. The added value concept at Würth Elektronik eiSos guarantees delivery from stock, availability within 48 hours, free delivery of samples, design kits with free refills and design-in support from technical sales staff in 50 countries worldwide.

www.we-online.com

State-of-the-Art Ultra-Thin Wafer Processing Facility in Singapore

International Rectifier, IR® announced that the company has commenced initial production at its new state-of-the-art ultra-thin wafer processing facility in Singapore (IRSG).

Wafer thinning, metallization, testing and additional proprietary wafer level processing are undertaken at the new 60,000 square foot manufacturing site which receives processed wafers from IR's internal fabs and foundry partners. The facility, which will employ approximately 135 people in the initial phase, will process a variety of products, including the company's latest generation power MOSFETs and IGBTs.

"IRSG will help improve IR's flexibility and production cycle time by providing advanced wafer processing for wafers manufactured internally or at our foundry partners. Furthermore, IRSG will allow IR to consolidate final wafer processing in close proximity to our major assembly locations," stated IR's President and Chief Executive Officer, Oleg Khaykin.

"As one of the top 5 companies in advanced power management technology globally, we are happy that IR has chosen to locate its latest wafer finishing facility in Singapore. IRSG is a welcome addition to Singapore's power electronics industry, which continues to be a key growth area. Beyond being a trusted manufacturing location in Asia, IRSG will be able to tap on Singapore's strong base of talent and reputable research institutes and for R&D collaboration opportunities," said Terence Gan, Director for Electronics, Singapore's Economic Development Board (EDB).

www.irf.com

Custom Design and Manufacturing Capabilities to European Market

Vicor Corporation announced the launch of Vicor Custom Europe, extending the company's sophisticated custom power system design and manufacturing capabilities to the European market. With this new service offering, customers across Europe can take advantage of Vicor's advanced design engineering, prototyping, and manufacturing services to minimize design risks and accelerate time to market with high performance power systems that meet their unique power requirements.

Vicor Custom Europe is a one-stop destination for customers seeking the highest levels of power system development agility. The service enables customers to tailor their power systems for application-specific power needs and/or unique form factor specifications leveraging Vicor's full portfolio of high efficiency, high density power modules and components. Vicor's customised power solutions give customers the flexibility to quickly and easily deploy highly-integrated power system assemblies at any stage in the power chain, from AC and DC sources to the point of load.

"Since its inception in 1995, the Vicor Custom service model has proven invaluable to customers in the United States, and has earned a reputation for providing world-class product quality and customer support," said Felice Caccavale, VP EMEA, Vicor. "With the introduction of Vicor Custom Europe, we're extending this value proposition to the European market and giving our customers in Europe more options than ever before to accelerate the development of their differentiated power systems."

www.vicorpower.com

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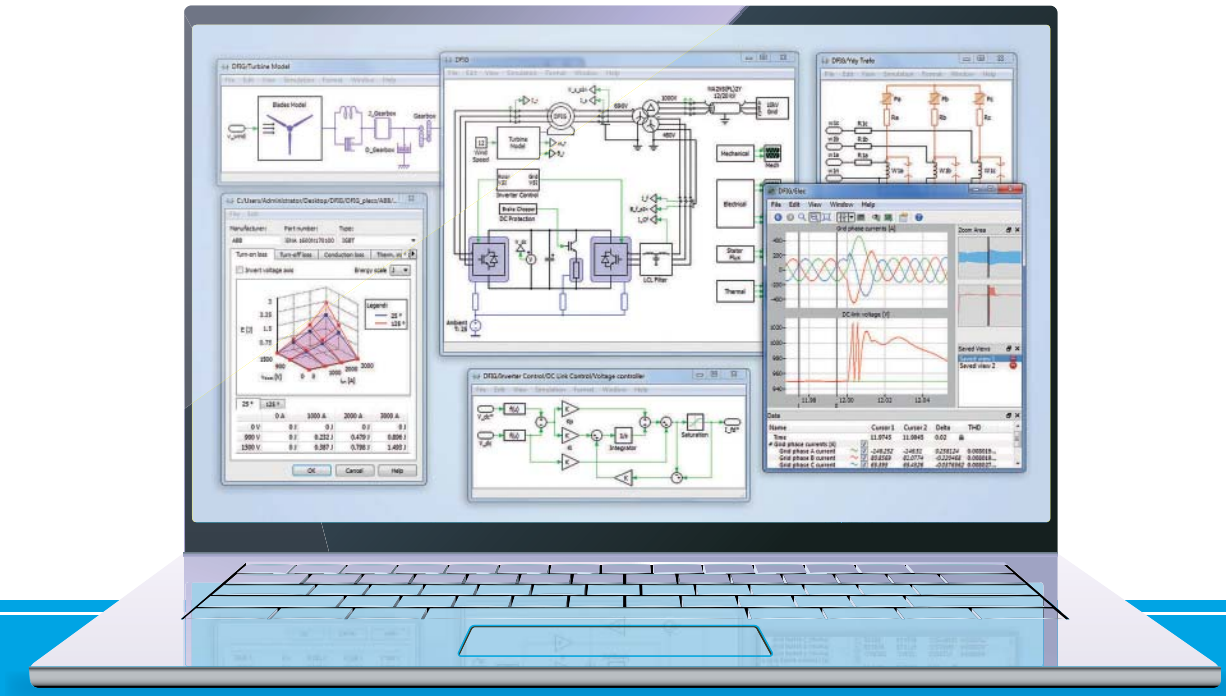

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EPE 2014 ECCE Europe: 26 – 28 August, Lappeenranta - Finland

The **16th European Conference on Power Electronics and Applications, EPE'14-ECCE Europe,** will take place in Finland, at Lappeenranta University, from 26 to 28 August 2014.

www.epe2014.com

Tony Astley appointed as Director European Operations

GaN Systems Inc has announced the appointment of Tony Astley as Director of European Operations, with immediate effect. Astley will have overall responsibility for all aspects of GaN Systems' business in Europe, the Middle East and Africa and will further develop its presence in the region, which represents about 20% of the world's total market for power device sales.

GaN Systems' cost-effective, high power gallium nitride transistors feature its proprietary Island Technology™ and overcome the limitations of today's silicon-based semiconductors, bringing significantly better performance and efficiency to power conversion applications such as alternative energy products and electric and hybrid vehicles. EMEA is a world leader in industrial and automotive technologies and Astley's role will encompass broad-based customers across the region as well as large OEMs in the industrial, power and automotive sectors.

Girvan Patterson, CEO of GaN Systems stated: "We're very excited to have Tony on board to drive growth in a key region. This year GaN Systems will commercialize its broad range of GaN-on-silicon products and European customers, who are long time global leaders in the industrial and automotive electronics segments, will be some of our earliest adopters."

Astley comments, "GaN Systems' technology is truly exciting and customer interest unprecedented, especially in this important region, so I'm very excited to be joining the team and look forward to continuing my passion for providing innovative solutions and breakthrough results to customers' application challenges."

www.gansystems.com

Stack Communication System to Improve IGBT Reliability

AgileSwitch LLC has developed a new serial communication protocol that will allow better monitoring of IGBTs for improved performance and reliability. Current standards in IGBT Power Stacks limit information flow to the host controller, restricting the ability to adequately monitor all aspects of the Power Stack.

Agile Switch is proposing the use of a serial – rather than parallel – interface between the IGBT gate drive board system and controller. This system would enable 45 unique points of fault controls, monitoring and reporting, including, for each IGBT Half Bridge (both HI and LO), Dsat, Overshoot/Active Clamping, UVLO, Gate Acknowledge, Cross Latch/Shoot Thru, DC Link Overvoltage, Overcurrent, Over temp, DC Link Voltage, Current, and Temperature. The company is proposing connection options in various levels of complexity, depending on customer requirements. Each serial interface option is able to support single or multiple power stack applications and supports star or daisy chain interconnect configurations.

The new proposed interface solution will transmit detailed fault and monitor values over a full duplex differential serial interface at up to 5Mb/S data rate. A presentation of the new protocol has been delivered by AgileSwitch chief technical officer, Albert Charpentier at the Applied Power Electronics Conference in Fort Worth, Texas.

www.agileswitch.com

Mersen Acquires a Majority Stake in Cirprotec

Mersen has announced an agreement to acquire a majority stake in Cirprotec, located in Terrassa, Spain and specializing in lightning and surge protection.

Marc Vinet, Group Vice-President Electrical Power and a member of the Management Board, said, "We are warmly welcoming Cirprotec's team. Our powerful network and our ability to leverage sales in new markets combined with Cirprotec's product portfolio and world-class surge test platform will offer our customers the benefits of a unique expertise in power quality".

"The acquisition is an important step in our strategy," said Dean Cousins, Vice President, Strategy, Marketing & Innovation for Mersen Electrical Power. "Cirprotec's expertise strengthens a market-leading global platform to support our customers and channel partners."

"This new alliance with Mersen presents a new opportunity to expand the international market reach of Cirprotec," said Carles Pons, founder of Cirprotec. "Additionally, the combination of our organizations brings an excitement to launch innovative new product initiatives."

Performing a critical function in electrical protection, Surge Protection Devices (SPDs) provide protection against damaging transient overvoltages in electrical installations and equipment. They are installed in electrical power distribution and controls to mitigate the growing problems associated with power quality by protecting increasingly sensitive and critical applications, in particular in automation, medical, or photovoltaic energy.

Cirprotec is a pioneering company involved in the design and manufacture of lightning and surge protection devices, and is a leading player in this sector. CPT does also provide consulting services and customized solutions.

www.ep.mersen.com

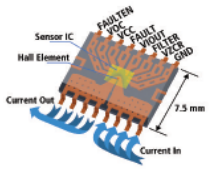
Innovative Current Sensor ICs with Integrated Conductors and Galvanic Isolation

Small Form Factor, High Bandwidth Hall-Effect Sensor IC Solutions

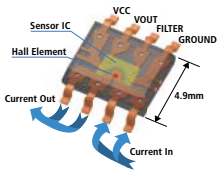
Allegro has developed a line of high bandwidth fully integrated Hall-effect current sensor ICs and Hall-effect linear ICs that provide highly accurate, low noise output voltage signals that are proportional to an applied AC or DC current. Sensor configurations are available for sensing current in the range of 5 A to 200 A in the fully integrated packages and up to 2000 A using a linear Hall IC in a core configuration.

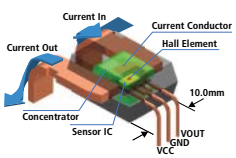
Advanced circuitry and packaging combine to provide improved performance that allow design engineers to easily integrate Hall-effect based current sensor ICs in applications where increased energy efficiency or new operating features are required.

Wherever current sensing is needed, an Allegro sensor IC can provide a solution.

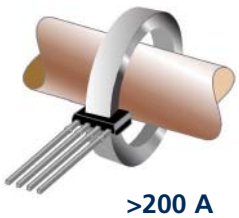


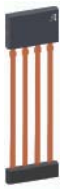
5 to 40 A





50 to 200 A





>200 A

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- 1 mm thin KT package provides maximum coupling
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- Programmable gain temperature coefficient
- Programmable unipolar or bipolar output
- 120 kHz bandwidth

Key Applications

- Motor / pump / compressor control
- Power supply control
- Inverters in alternative energy systems
- Hybrid electric vehicle power systems

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Call for Papers SEMICON Europa 2014

SEMICON Europa organizes over 40 programs and events held in conjunction with the exposition. You are invited to submit an abstract for one of the following conferences.

- 16th European Manufacturing Test Conference (EMTC)
- International MEMS Industry Forum
- Advanced Packaging Conference (APC)
- 450mm Session - Semiconductor Technology Conference

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- Opportunity to share your knowledge, experiences and practical expertise as a thought leader
- Reach to new audience in Grenoble, France (new venue in 2014!)

www.semi.org

SMT Hybrid Packaging 2014 – Symbiosis of Exhibition and Conference

This year, the SMT Hybrid Packaging, taking place from 6 - 8 May 2014, is on the best way to reach last year's result. Many new exhibitors and long-time exhibitors will participate to present to the visitors the latest developments in the fields of PCB manufacturing, surface mount, micro-assembly or testing strategies.

smthybridpackaging

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für Systemintegration in der Mikroelektronik
Nürnberg, 06. – 08.05.2014

Joint stands provide targeted information

- „Industry 4.0 - With new technologies towards lot size 1" is demonstrated by the application center at Fraunhofer IZM on the production line in hall 6. Visitors can participate in a live guide for free.
- The Research Association Molded Interconnect Devices 3-D MID e.V. informs about the current state of MID technology and new series applications from all relevant technology sectors at the forum in hall 7.
- „Optics Meets Electronics", is the name of the joint stand in hall 6, which is supported by Fraunhofer IZM Berlin. The focus is on Photonic System Integration and the importance of optical technologies in the field of electronics.
- The exhibitors of the joint stand „EMS Intersection" offer comprehensive services. Visitors have the opportunity to seek advice from the electronics manufacturing up to material management.
- On the third day of the exhibition, ZVEI e.V. with its "Services in EMS initiative" takes up the subject „Materials Management – Reliable provisioning guaranteed" in panel discussions at the forum in hall 9.

Electronic Circuits World Convention after 12 years for the first time back in Germany

Parallel to the exhibition, the 13th Electronic Circuits World Convention (ECWC13) will take place from 7- 9 May 2014. On three conference days, in 26 sessions with 123 presentations, ECWC13 examines new processes, current technologies and changing market dynamics of the printed circuit board industry. The organizer is the European Institute of Printed Circuits (EIPC) as a member of the World Electronic Circuits Council (WECC). Its members have been holding the ECWC for more than 35 years, every three years alternately in Asia, Europe and the USA. The conference will start on Wednesday, 7 May 2014.

www.smt-exhibition.com

Complete Power Electronics Design and Test Solution

Powersim and Typhoon-HIL are pleased to announce the strategic partnership to offer a complete power electronics model based development, simulation, rapid prototyping, and test platform.

Typhoon HIL is the technology leader in ultra-high fidelity hardware-in-the-loop (HIL) emulators for power electronics and motor drive applications. Typhoon HIL systems, enable the most comprehensive testing of controller hardware/firmware/software in Hardware-in-the-Loop configuration, with the power stage simulated in real-time with extreme fidelity. In addition, to facilitate controller implementation, Typhoon provides a DSP Interface Board and DSP micro-Grid Interface Board, based on TI F2833x/2803x DSP, to run and test control code before the controller hardware is developed, i.e. rapid control prototyping. With the PSIM-Typhoon HIL complete solution, one can design and extensively simulate the whole system off-line in PSIM first. Then use PSIM's auto code generation capability to generate the control code automatically, and port the code on either the customers real-controller hardware or Typhoon's DSP Interface Board that is directly interfaced with HIL that simulates power stage in real-time.

Powersim – Typhoon HIL complete power electronics development, rapid prototyping, and test solution will help power electronics engineers to significantly accelerate development and test cycle, improve the quality of the controller software, reduce development costs, and minimize time-to-market.

www.powersimtech.com

www.typhoon-hil.com

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Smallest 10A and 30A power solutions in the industry

Perfect for power designs requiring high power efficiency in a small solution size

- Highest density – 10A in 180 mm² footprint
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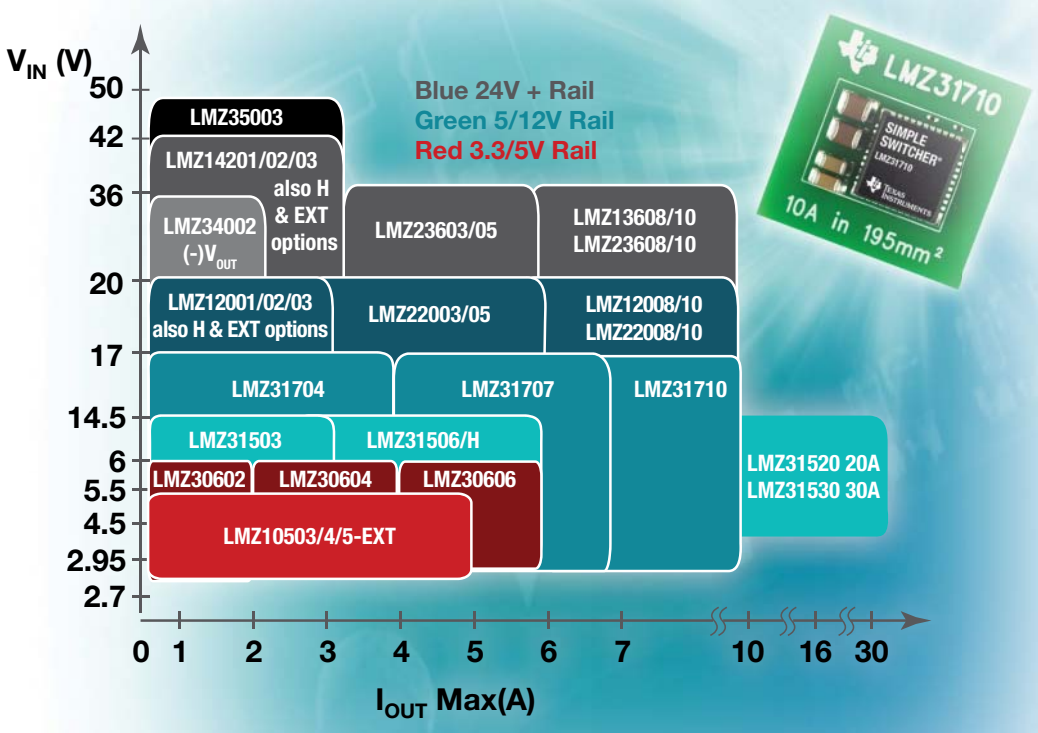
SIMPLE SWITCHER® Power Module Portfolio



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Texas Instruments

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60A Digital Point-of-Load Series Based on New Power Topology

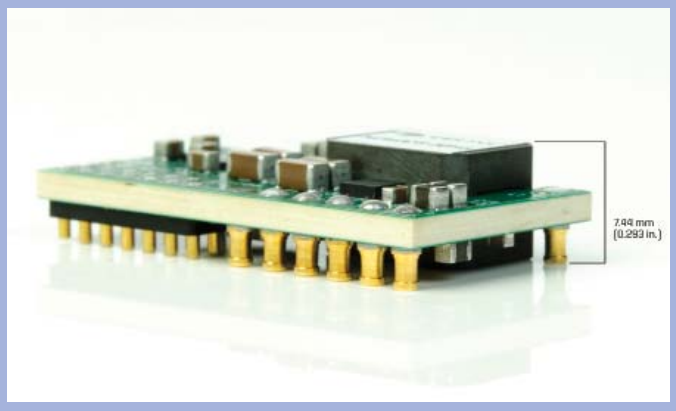
SEPIC-fed Buck Topology allows for higher power density, higher efficiency for "greener" systems, faster transient response, and lower EMI

CUI Inc announced a family of digital point of load dc-dc modules that set performance benchmarks in efficiency, power density, and transient response to address the rapidly-rising power challenges in distributed power architectures. The NDM3ZS-60 is a non-isolated module outputting 60A in ultra low-profile vertical and horizontal packages. The series is the first non-isolated design to incorporate CUI's patented Solus® Power Topology which integrates a conventional buck converter into a SEPIC converter to form a SEPIC-fed buck converter; a single stage topology with one magnetic element, one control switch and two commutation switches that are optimally controlled by pulse-width modulation (PWM). With lower voltage and current stresses in the topology coupled with an inherent gate charge extraction (GCE) process, the topology is able to reduce switching turn-on losses by 75% and switching turn-off losses by 99% on the control FET when compared to a conventional buck converter. The Solus Topology further increases total efficiency by distributing the energy delivery into multiple paths, reducing circuit conduction losses by nearly 50%.

The new topology allows the NDM3ZS-60 to hit the performance metrics quickly which is imperative in today's advanced designs. Efficiency peaks at 91.3% at 12Vdc in to 1.0Vdc out, 50% load. Efficiency remains high up to full load at 88.5%. Transient response is also greatly improved with the SEPIC-fed buck. At 12Vdc in to 1Vdc out with a 30A load step (from 15A to 45A) and a 10A/µs slew rate, peak voltage is a mere 16mV with typical external capacitance required.

The NDM3ZS-60 is also the first released module to use Intersil's newest digital power controller, the ZL8800, incorporating a range of advanced digital features. The ZL8800's ChargeMode™ Control technology further enhances the module's transient response performance by responding to a transient load step in a single switching cycle. With zero compensation required, the modules autonomously balance the trade-offs between dynamic performance and system stability on a continuous basis. With this feature, designers are able to bypass the traditional practice of building-in margins to account for factors such as component ageing, manufacturing variations, and temperature, which inevitably lead to higher component cost and longer design cycles. The NDM3ZS's zero compensation feature allows the module to dynamically set optimum stability in real time as conditions change.

The NDM3ZS-60 series is available with an input range of 7.2~14Vdc and a programmable output range of 0.6~1.5Vdc. Additional features include voltage sequencing, voltage tracking, synchronization and phase spreading, programmable soft start and stop, as well as a host of monitoring capabilities. All features are dynamically programmable via PMBus commands or through CUI's simple, easy to use Novum ACE™ GUI.



The family is available in three compact configurations, a through-hole vertical version measuring 33.02 (L) X 8.92 (W) X 18.11 (H) mm and a horizontal version measuring 33.02 x 18.11 x 7.44 mm that is offered in surface mount or through-hole configurations. For added flexibility during the development process, the modules are footprint nested to accommodate dual layout needs in the event that design requirements change. Additionally, the NDMZ3S-60 is footprint compatible with 40A and 50A digital modules currently available from CUI and other manufacturers, providing up to a 50% increase in power density over existing solutions.

"We are very excited to announce the release of our first non-isolated POL module based on the Solus Power Topology," said Mark Adams, CUI's Senior Vice President. "Our networking customers have hit a ceiling with existing POL topologies as the challenges of powering today's advanced ICs have increased. Our NDM3ZS-60 addresses these efficiency, power density, and transient challenges head-on."

Engineering samples are available immediately for select customers.

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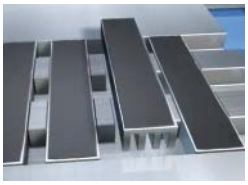

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Thermal Materials • **Thermal Substrates** • **Fans and Blowers**

An Alpine Village and the Big, Wide World

By Petra Haarburger, President of Mesago Messe Frankfurt

My work involves a great deal of travel. I enjoy organizing our exhibitions and congresses together with people from other countries and cultures. However, I prefer my vacations to be rather more down to earth. I spent my last vacation on an organic farm in the Tyrol. My hosts – two farmers – are active, happy people of a similar age to myself, and have both their feet planted firmly in the here and now. Especially the here. Because they told me that, in 20 years, they have never ventured any further from their farm than an occasional trip to the state capital, Innsbruck – barely 50 kilometers away! As they were talking to me, they showed me some old pictures of the village they live in and, at the same time, photos of their daughter's class trip to Japan – on a state-of-the-art iPad.

We live in a world of great contrasts. I don't want to call them contradictions as that would have a negative touch. But the scope of what there is and what goes on has never been as vast as in recent years. And at all social, political, cultural, and economic levels. Never before have there been so many super-rich and, at the same time, so much mass poverty. Never before has knowledge been so readily accessible, and yet the level of education in developed western societies in particular is declining rapidly. Many regions of the world are experiencing a gratifyingly long period of sustained peace and prosperity, and yet we repeatedly see how fragile both are, and how much we have to place our hope and trust in the prudence of often only a few people.

A pair of opposites that frequently occupies my thoughts is the fact that, on the one hand, we constantly think big and, on the other hand, we always want to make things smaller. We build aircraft that accommodate nearly a thousand people, and yet the control units that guide them around the globe are no bigger than a fingernail. We construct buildings that soar a kilometer into the sky, and inside them, engineers develop nanorobots that will soon be able to "repair damage" inside the human body. We have 500-horse power supercars that use less fuel than a conventional family car did 30 years ago.

The engine of all developments is technology – and at an increasing rate. It is becoming a dominant driver of human culture. It shows what is possible and what direction visions are taking. It brings knowledge and images into the Tyrolean farmhouse. And into the high-rise office blocks of Shanghai and New York. And into the deserts of Mongolia and the savannas of Africa.

However, if technology only exists in the minds of engineers, it vanishes without any use. Technology requires a mantle that not infrequently combines several technologies and only brings them fully to bear as an ensemble. These then become the products that we all know, from cars to smartphones. And products need to be produced.

But something is changing here. Whereas we believed for a long time that we should produce wherever the labor is cheapest, we now know that this capitalist maxim is barely able to meet the economic demands of the 21st century. Not only does it fly in the face of many environmental and social aspects, it frequently also fails to satisfy customers' requirements of the products themselves. Because these can vary considerably from one region to another. In terms of features, design, function, and quality. Therefore, many companies produce – and develop – their products where they will also sell them. For a long time, the automotive industry was the pioneer in this regard.

As a company that is dedicated to organizing exhibitions and congresses relating to industry-oriented technology topics, we are also monitoring this development very closely. And responding accordingly. A good example of this is PCIM – Exhibition and Conference for Power Electronics, Intelligent Motion, Renewable Energy, and Energy Management. What began as a very modest event in the late 1970s has since developed to become the world's leading meeting place in its field of specialization. And it is not restricted to Germany. Since 2002, there has been a PCIM in China which, as PCIM Asia with a clear focus on the Asian market, showcases the latest trends in power electronics. The youngest member of the PCIM family is PCIM South America, which has been staged in Sao Paulo since 2012. The aim of holding our events in other countries and on other continents is not to expand for the sake of expansion, but to support the kind of local production I described above.

I began with farmers who seldom leave their village in the Tyrol. Their son wants to become an electrical engineer. I'm sure that, one day, I'll be able to welcome him to one of our events. But in which country, I just can't say. We live in a world of great contrasts – and excellent opportunities.

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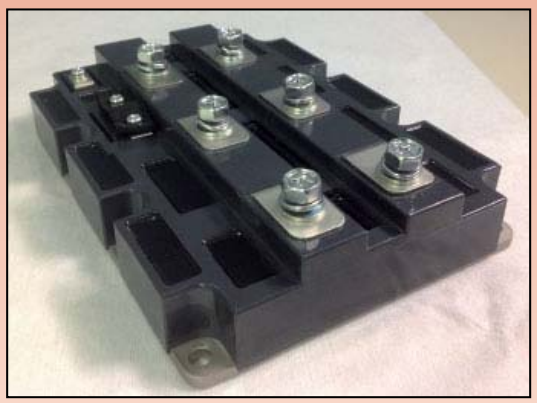

CCS-MD-20N33A70, 2000A, 3.3kV, single switch

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Electronics Industry Digest

By Aubrey Dunford, Europartners

Worldwide Consumer Electronic (CE) manufacturing revenue will fall to $ 250 billion in 2014, down 2 percent from 2013, so IHS. This will mark the fourth consecutive year of decline for the CE market. In a dramatic illustration of this trend, global factory revenue for smartphones and tablets in 2013 rose to be larger than for the entire CE market—the first time this has ever occurred. While exciting new technologies such as UHD LCD TV sets and wearable devices were being shown at CES, it will take a few years until these products attain enough of a volume to drive the growth of the overall CE market, said IHS.

SEMICONDUCTORS

Worldwide semiconductor sales for 2013 reached $ 305.6 billion, the industry's highest-ever annual total and an increase of 4.8 percent from the 2012 total, so the WSTS. Global sales for December 2013 reached $ 26.6 billion, marking the strongest December on record. Fourth quarter global sales of $ 79.9 billion were 7.7 percent higher than in from the fourth quarter of 2012. The industry saw strong demand in several product segments during 2013.
Microchip Technology, a provider of microcontroller, mixed-signal, analog and Flash-IP solutions, has signed a definitive agreement to acquire Supertex for $ 33 per share in cash, which represents a total equity value of about $ 394 M, and a total enterprise value of about $ 246 M, after excluding Supertex's cash and investments on its balance sheet of approximately $ 148 M. Supertex's deep domain knowledge in high voltage analog and mixed signal technologies, and strong position in the medical, industrial and lighting markets, complement many of Microchip initiatives in these areas, said Microchip.
STMicroelectronics net revenues for the full year 2013 decreased 4.8 percent to $ 8.08 billion mainly reflecting lower WPS (former ST-Ericsson products) sales. ST'SAM (Serviceable Available Market) was down 1.7 percent in 2013, at $ 139 billion.
Renesas Electronics will transfer a 300 mm semiconductor manufacturing facility and related equipment at the Tsuruoka Factory to Sony. The fab will serve as a new production site for CMOS image sensors, and Sony plans to engage in capital investment in order to increase image sensor production capacity.
Semtech, a supplier of analog and mixed-signal semiconductors, announced a reduction in its workforce by approximately 6 percent as part of a restructuring effort due to the significant reduction in demand in the second half of its fiscal year 2014.
Micron Technology is set to cut about 419 jobs out of 1,028 people in its Italian operation, according to local media reports. The cuts are part of a 5 percent job reduction plan announced in August 2013. As Micron's global workforce is around 30,000, that meant less than 1,500 Micron employees would lose their jobs.
Analog/mixed-signal foundry group X-FAB Silicon Foundries announced its collaboration with Belgian-based micro-and nanoelectronics research centre imec to offer multi-project wafer runs through imec's Europractice IC Service for X-FAB's 0.18 micrometer SOI HV process and a junction-isolated HV process.
At the SEMI Industry Strategy Symposium Europe (ISS Europe 2014) on February 23-25 in Salzburg, semiconductor industry executives have examined the conditions required to achieve the EU's 10/100/20 strategy — 20 percent market share of global semiconductor manufacturing by 2020. Presenters from ASML, ASMI, Deutsche Bank, GlobalFoundries, Infineon, Nomura Research, NXP, STM, and more will lead a discussion of the strategic measures needed to strengthen Europe's competitiveness and sustainability and determine the boundary conditions to achieve the EC's ambitious goal.

OPTOELECTRONICS

Osram Opto Semiconductors is switching its fabrication of red, orange and yellow light emitting diodes to 6-inch wafers. The German high-tech company is therefore extending the fabrication of all large-wafer LEDs to the indium-gallium-aluminum-phosphide (InGaAlP) material system and therefore expanding its production capacity. The company began switching fabrication of blue LED chips back in 2011. Red and yellow LEDs are used in virtually every sector: as turn indicators, brake lights and interior vehicle lighting in the automotive sector, in displays, for projection, for signage and for color mixing systems in general illumination.

PASSIVE COMPONENTS

North American PCB bookings fell again in December to 8.0 percent year over year, which reduced the year's order growth to -1.1 percent below 2012, so IPC. December bookings jumped 17.7 percent over the prior month. Total North American PCB shipments increased 2.2 percent in December 2013 from December 2012. Year-to-date shipment growth, at -1.9 percent, is still negative compared to the same period in 2012, but has been steadily improving. December sales were up 6.6 percent over the prior month.

OTHER COMPONENTS

Japanese company JSR announced that JM Energy, a 100 percent subsidiary focusing on lithium ion capacitors technology (LIC), has decided to expand its existing commercial operation with a high-volume production plant to meet the growing market demands. While the new plant's capacity will reach 3 million cells per year, the total investment amount is estimated at $ 60 M. The completion of the plant is scheduled for January 2015 and first shipments to customers from this plant are expected June 2015. JM Energy's LICs are being increasingly employed for rapid charge-and-discharge, energy regeneration, peak assist, and electrical power leveling.

DISTRIBUTION

BEC Distribution has announced a new partnership in UK with Stontronics, a supplier of power supplies, transformers and adaptors. The Stontronics portfolio ranges from battery chargers, AC adaptors and DC-DC converters through to UPS systems.

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:

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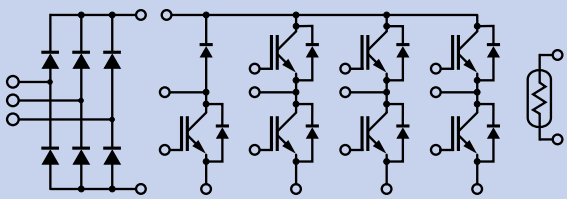

With solder pins

Package	I_C	600V	1200V
	10A	●	●
	15A	●	●
	20A	●	
	30A	●	
	15A		●
	25A		●
	35A		●
	50A	●	

With PressFit contacts

Package	I_C	600V	1200V
	10A	●	●
	15A	●	●
	20A	●	
	30A	●	
	15A		●
	25A		●
	35A		●
	50A	●	

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Digital Power Market Growth in Detail

By Richard Ruiz, Analyst, Darnell Group

The digital power conversion market will experience substantial growth over the next several years as users demand more advanced features and functions in their products. Darnell Group's just-released fifth-edition analysis of "***Digital Power Electronics Market Trends and Forecasts***" finds that this growth will be led by a surge in 2014 and settle down into a pattern of rapid growth for the next five years. Driven by growth across a number of sectors including communications, computers, solid-state lighting and a growing smart grid and energy management sector, the combined external ac-dc, embedded ac-dc and dc-dc converter modules markets will reach nearly $10 billion dollars in 2019.

Over 35 tables and graphs are presented in this report covering the external ac-dc power supply market, the embedded ac-dc power supply market and the dc-dc converter module power supply market. The report only looks at the original equipment manufacturer (OEM) market. The focus of this comprehensive analysis will be to provide decision makers with a detailed and insightful look at the current and future opportunities available in the digital power supply market.

The value of digital power has always been the functions it can provide, and that functionality has become more defined and focused over the past several years as users demand a number of specific features and operations such as auto-compensation, PMBus capabilities, loop control, monitoring and reporting, parameter setting, OTP memory capability, etc. Although these features and functions vary by industry, there are a number of common requirements identified. Among these, auto-compensation was cited as one of the of the more desired features of digital power as it eliminates a substantial burden from the power supply design and results in a more robust power supply for the life of the power supply.

Applications have already been identified that favor digital control, and products have been developed that meet those requirements or offer certain features that are critical to updated system designs. These are the so-called "legacy" applications for digital power management and control. They are large markets that will keep the traditional distributed power architectures in use for many years, with many of them incorporating digital control at some level. In contrast, new power architectures identified in this report incorporate digital power right from the beginning, and that makes them different from the legacy architectures.

Based on these trends, Darnell Group has identified the current "best" markets for digital power. Some have emerged from the slow-but-inevitable march toward a "Smart Grid"; others come from standards and the demand for increased energy efficiency.

The further adoption of digital power technology to smart grid and other energy measurement/management applications presents a host of opportunities. In fact, these applications face implementation challenges that are both business- and technology-related. For example, digital control of power allows reductions of power consumption of the installed equipment base and, at the same time, offers telemetry and the ability to monitor, control and alert to tampering and energy theft, and respond to tampering in various ways. As a result, robust telemetry, monitoring and anti-tampering capabilities, along with securing the grid, are all critical.

The adoption of digital power technology will play an especially important role in the dc-dc converter module market, with applications ranging from information and communications technology (ICT) to portable applications and electronic devices. Although the dc-dc converter module segment will maintain a smaller unit market than either the embedded ac-dc or external ac-dc market, it will record the highest degree of digital penetration among its applications throughout the forecast period. It is also projected to grow three and a have times as fast as the overall dc-dc converter module unit market.

Combined, the communications and computer segments are projected to make up about 85.0% of the overall digital dc-dc converter module unit market over the forecast period. Both of these segments will benefit from the growing trend towards digital power management and control. In fact, both of these areas are considered early digital power adopters, as applications in each segment such as telecom and servers both draw lots of power and feature sophisticated and/or complicated power management structures.

Traditionally, external ac-dc power supplies have not been considered the "best" market for digital power management and control. Composed of adapters and battery chargers primarily for portable devices, they are not part of the high-end, distributed power systems, which are better suited to digital control. However, due to the sheer size of overall of the external ac-dc power supply market it is an attractive opportunity for digital power supply manufacturers and will result in the largest unit market over the forecast period.

Drivers for digitally controlled external ac-dc power supplies are coming primarily from standards and regulations mandating stricter power supply requirements. With the emphasis on increased energy efficiency, manufacturers have the flexibility to offer power adapters that can communicate changes in power requirements, such as higher or lower voltage, or to shut off completely when not in use.

Digital power management and control has also made substantial progress in embedded ac-dc power supplies over the past several years, especially in the area of solid-state lighting. Early digital products were focused primarily in the area of semiconductors, however, the technology has evolved and more companies are now actively introducing power supply products that incorporate digital power management and control solutions. Digital power is also more efficient in applications featuring PFC and in applications that require voltage and current profiling which are better implemented in digital rather than analog. Used primarily in higher-end applications, digital power has created a number of new design considerations in this area.

Although both the external and embedded ac-dc power supply markets have much lower digital penetration rates throughout the forecast period, the sheer unit size of both of these markets result in their maintaining the largest unit and dollar markets by the end of the forecast period. In fact, the year-to-year dollar growth rates for both external and embedded ac-dc markets will be much higher than the dc-dc converter module market over the entire forecast period. In addition, both the digital external and embedded units markets will each grow over four times faster than their respective overall power supply markets.

Over 35 tables and graphs are presented in this report covering the external ac-dc power supply market, the embedded ac-dc power supply market and the dc-dc converter module power supply market. The report only looks at the original equipment manufacturer (OEM) market. The focus of this comprehensive analysis will be to provide decision makers with a detailed and insightful look at the current and future opportunities available in the digital power supply market.

www.darnell.com

Flexible Power Based on a Modular Concept

Ready-to-use inverters from the most varied manufacturers in diverse power classes simplify the realisation of projects because no expensive development of the electronic output stage is required. The user receives a complete and qualified solution, but variability and consideration of specific wishes are often neglected. VARIS™, the new modular inverter system, has the appropriate response.

By Erik Rehmann, Marketing Manager, and Daniel Rückert, Product Manager, GvA Leistungselektronik GmbH

A modular system, in which individual phase components are defined as a standard and can be combined with one another depending on the power required, is a new and innovative conceptual approach. It is precisely this concept that has recently been pursued by the Mannheim-based GvA Leistungselektronik GmbH under the brand name VARIS™. The distributor, developer and producer of customer-specific power electronics considers this the ideal approach to flexibly address customer wishes despite standardisation. As in a modular system, individual phase components can be configured flexibly. Individual half-bridge modules are configured to form single-phase or three-phase inverter topologies and are connected in parallel depending on the required total power. This ensures scalability to various power classes. Step-up and step-down converters, as well as rectifier components are available, too. Air or water cooling can be chosen as required. With this concept, a high degree of sustainability is achieved through the use of standard components, which can also be easily replaced at a later date if necessary. This ensures a high degree of economic efficiency.

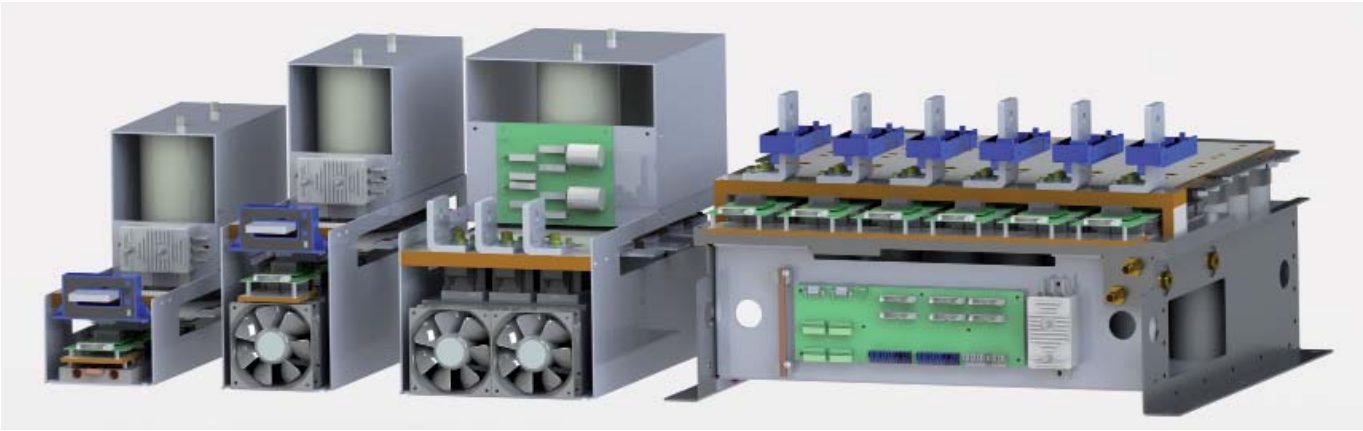

Figure 1: The modular VARIS™ inverter system offers flexible power from a modular concept

"Black box thinking", in which the individual components are not clearly recognisable or can't even be replaced, is no longer up to date. Instead, the wish is for a certain degree of flexibility and influenceability with respect to the individual requirements for the usage of the reliable system components. And nonetheless, the power electronics output stage should already have been tested and be immediately useable. The user now only needs to connect his controller and the system is ready to use.

Small components with big power

The smallest basic unit of VARIS™ consists of an IGBT half-bridge module available in the familiar PrimePACK™ housings in various power classes.

The basic unit already includes the necessary DC link capacitors, the cooling unit, the IGBT driver and the current sensor. An optional voltage sensor may also be included. VARIS™ is available with air or water cooling. Maximum power density is achieved through the individual cooling of each individual IGBT module and optimised heat dissipation. Control signal transmission for activation and error reporting may be implemented both optically and electrically as required.

Figure 2: The modular concept enables flexibility, economic efficiency and sustainability

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Designers face the challenge of decreasing overall system costs and miniaturizing the system. Infineon's full system solution for cordless power tools offers space optimized designs and cost optimized solutions enabling highest power density, high system efficiency and optimized power efficiency due to technology and precision control.

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Power Tools

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Application Kit

In order to build, for example, a common 3-phase inverter, three, at 22kg relatively light, VARIS™ units are now simply connected in parallel. The units are connected with the standard interlinking system. In case of maintenance, this also enables easy replacement of individual units from an installed system. The power range of the 3-phase VARIS™ versions starts at approx. 150kW and extends to 1.4MW with water cooling and the most powerful IGBT modules.

Figure 3: The link system facilitates the connection of the units into a 3-phase inverter extremely

The technical details of VARIS™ in brief:

- IGBT modules in PrimePACK™ housing
- IGBT voltage classes: 1200V or 1700V
- IGBT current classes: up to 1400A
- Capacity of the capacitors: up to 3900µF per module (expandable with external capacitor bank)
- Parallel connectability of the modules
- Air or water cooling
- Use of plug & play drivers (optional with Amantys Power Insight™; transmission and real-time analysis of IGBT operating data)
- Variable supply voltage, DC link voltage, frequency and output frequency

VARIS™ R – rectification made easy

If necessary, the user also has a suitable rectifier available, which fits seamlessly into the VARIS™ family - in uncontrolled, semi-controlled or fully-controlled versions as required. Sensibly, a choice can also be made here between air or water cooling. As standard, the control unit for the secure firing of the thyristors, the suppressor circuit and the DC filter capacitors suitable for the entire system.

Figure 4: The appropriate VARIS™ R (left) rectifier docks easily onto the existing inverter

VARIS™ XT – the compact high-performance unit

VARIS™ XT is the choice if high power density is required in very confined space. Depending on the ambient conditions, power values of up to 2.0MW may be reached with one module.

Figure 5: VARIS™ XT delivers a lot of power with a very compact design

In contrast to VARIS™, six PrimePACK™ IGBTs are positioned compactly on a highly efficient water cooling unit and either directly or softly connected in parallel as two separate inverters. 21 capacitors ensure the necessary capacity of up to 24000µF in the DC link. Possible connection topologies are: a 3-phase inverter with two IGBT modules connected in parallel, two individual 3-phase inverters, single exclusively as an active front end (AFE) or as a complete back-to-back converter. All AC inputs or outputs have an actual current value acquisition of their own. As standard, the DC link voltage is recorded, too.

As with the basic version VARIS™, parallel connection of the VARIS™ XT components is easy to realise with the interlinking system, thus multiplying the power values. Up to 2MW are possible with a back-to-back configuration with two VARIS™ XT units connected in parallel and up to 4MW with an active front end configuration.

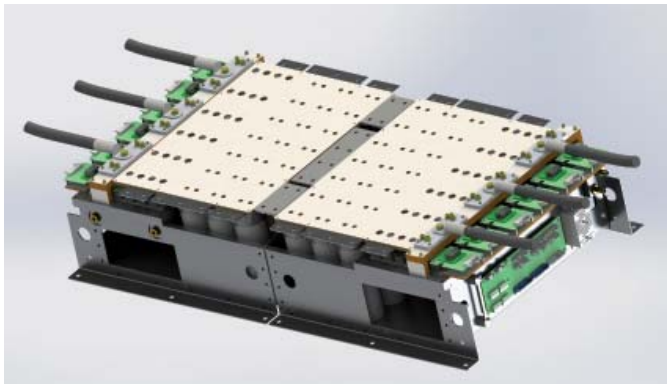

Figure 6: VARIS™ XT, too, convinces with its variety of variants – here in a back-to-back configuration

High level of information depth, also in terms of activation

The GvA plug & play driver for the PrimePACK™ modules, which has proven itself in practical use, has already long been available on the market. It is also used in the standard version of VARIS™. In addition to the actual driver functions, it is also equipped with an analog or pulse-width-modulated temperature output for thermal monitoring of the IGBTs. Moreover the driver features short-circuit disconnection and status feedback of the individual IGBTs to the user's control system. The signal transmission may be either optical or electrical. An optional interface board gathers all measurement signals (current,

voltage, temperature) and IGBT activation and status signals, thus simplifying connection to the user's system.

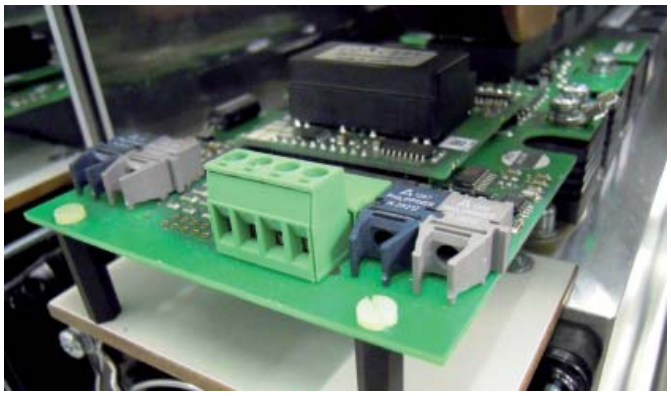

Figure 7: The plug & play driver for the PrimePACK™ modules is a development of GvA

Alternatively, the Amantys Power Drive™ plug & play drivers for VARIS™ are available. With Power Insight™ IGBT data can be received online in real time, operating statuses visualised, long term measurements or remote and fault diagnoses carried out.
The user receives real-time data on the performance of the system and, if necessary, can take targeted preventive measures, regardless of whether the system is close by or, as in the case of an offshore wind turbine, difficult to reach. This makes diagnosis or maintenance planning very comfortable and cost-efficient even from a distance.

Type	Output / Input Voltage [V_{rms}]	Cooling	Output Phase Current [A_{rms}]*	System Power 3-phase [kW]*
VARIS-06-12-A	400V	forced air	440	289
VARIS-14-12-A	400V	forced air	747	491
VARIS-06-17-A	690V	forced air	292	332
VARIS-10-17-A	690V	forced air	464	527
VARIS-06-12-W	400V	water	827	545
VARIS-14-12-W	400V	water	1619	1065
VARIS-06-17-W	690V	water	671	762
VARIS-10-17-W	690V	water	1056	1199
VARIS-14-17-W	690V	water	1242	1410
VARIS XT-14-12-W	400V	water	1619	2130
VARIS XT-10-17-W	690V	water	1056	2398
VARIS XT-14-17-W	690V	water	1242	2820
VARIS R-580-U	400V / 690V	air / water	suitable for all	VARIS™ types
VARIS R-400-H	400V / 690V	air / water	suitable for all	VARIS™ types
VARIS R-400-C	400V / 690V	air / water	suitable for all	VARIS™ types

* Values at f_{sw}=2kHz, T_{inlet}/T_{amb}=25°C, cos(φ)=0.95

Figure 8: Overview of the VARIS™ family

Welcome to the PCIM

Initial feedback is already corroborating the market attractiveness and diverse usage possibilities of the VARIS™ family. At the upcoming PCIM Europe in Nuremberg, the individual family members will be presented to an interested specialist public from 20 to 22 May at the GvA stand 9-207.

www.gva-leistungselektronik.de/VARIS

Note: PrimePACK™ is a registered trademark of Infineon Technology AG; Amantys Power Drive™ and Power Insight™ are registered trademarks of Amantys Ltd.

State-of-the-Art Intelligent Power Modules for Appliance Motor Drives

The latest report into the World Market for Major Home Appliances, by IHS, predicts the industry will spend $3.8 billion on semiconductors by 2017, as new generations of products become more sophisticated and feature-rich.

By Alberto Guerra, International Rectifier Corporation

The fastest growing sector will be power semiconductors including Intelligent Power Modules (IPMs) used in electronic motor controls, which are needed to meet the eco-design targets now effective in various territories worldwide.

IR's iMotion™ integrated design platform is currently one of the most successful portfolios for electronic motor control, and has enabled the Major Home Appliance (MHA) industry to deliver energy-saving products within tight cost and time-to-market constraints. Bringing together all the digital, analogue and power devices required, as well as motor-control algorithms, development software and design tools, iMotion enables a complete motor drive comprising the IPM and a digital control IC with a small number of external components to turn a motor for evaluation within days instead of weeks. Today, however, changing design priorities and new energy-saving standards are driving demands for enhancements such as smaller size, lower cost and greater scalability.

IPMs for energy saving EC Fan and Compressor Solutions

The key to reducing system cost is generally to increase semiconductor integration while also reducing IC size to benefit from smaller PCB dimensions and easier mechanical design. The arrival of IR's latest µIPM™ family enables smaller and more competitively priced applications such as heating and ventilation fans or water-circulation pumps up to 200W meeting the most recent energy standards.

The modules are packaged as Power QFN (PQFN) devices, making them the industry's first fully integrated inverters to utilise the PCB as a heatsink. Drawing on the principles of point-of-load and VRM modules, adapted for high-voltage applications, these modules are up to 60% smaller than existing 3-phase motor-control power ICs. Inside the module, 500V FredFet power switches and the High-Voltage IC (HVIC) die are bonded to an exposed lead-frame, which is soldered to the PCB. Various 3-phase and single-phase (half-bridge) configurations are available, within extremely small package dimensions, as shown in figure 1.

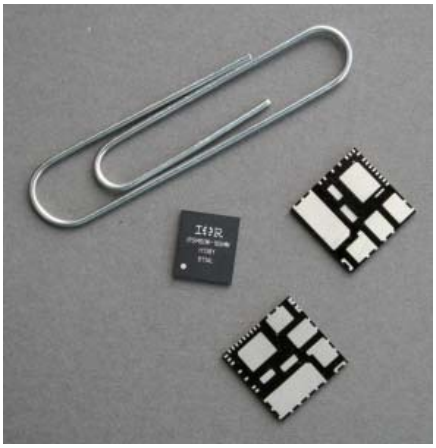

Figure 1: µIPMTM 2-phase and 3-phase modules in PQFN packages

Figure 2: Designing with µIPM allows engineers to realise extremely compact motor drivers

Figure 2 shows the driver for a 60W condenser fan used in a 2.2kW air-conditioning split system. By providing a complete 500V 3-phase inverter system in one single 12mm x 12mm QFN package, µIPM enables a heatsink-free design and helps reduce component count from 91 to 31 components. PCB cost/area is 43% lower, while assembly and test cycle times are shorter and test coverage is increased.

In order to address higher-power applications in the MHA segment, the µIPM family has expanded with new 7mm x 8mm x 0.9mm and 8mm x 9mm x 0.9mm modules in half-bridge configuration with voltage ratings up to 40V and current rating increased to 10A for the 500V version and up to 30A for the 40V version. This splitting of the integrated 3-phase inverter into three individual half-bridges delivers several benefits, most importantly by distributing the power dissipation across a larger PCB area to improve thermal performance.

Designing with µIPM QFN

The tiny dimensions of the µIPM QFN IC, and the use of the PCB as a primary channel for dissipating power, call for a different approach to some aspects of motor-drive design, in order to maximise performance.

In general, IPM current capability depends on the DC-bus voltage, the ambient temperature, and the switching frequency. As each of these parameters are increased, so too are losses, the complexity of the modulation scheme (from 3-Phase to 2-Phase), dV/dt of phase voltage, and critical FET characteristics such as RDSON and IREC.

For a surface-mount µIPM driver, the current capability also depends on the PCB design; specifically the copper thickness, copper pad areas, number of layers and ultimately the

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Benefits

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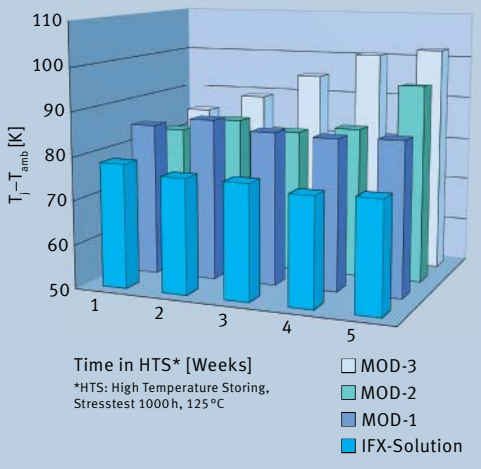
- Simplified mounting
- Increased system reliability
- Increased system lifetime
- Optimized thermal management
- Improved handling in case of maintenance



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maximum allowable PCB temperature. In practice, the maximum junction temperature of the power semiconductors is less critical than the maximum PCB temperature. Increasing the copper thickness reduces the overall junction-to-ambient thermal resistance thereby also reducing PCB temperature and hence enabling higher current capability.

Figure 3 illustrates the effects of PCB-copper thickness and heat-spreader area on the current capability of a 300W compressor drive with an inverter stage comprising three IRSM807-105MH half-bridge modules. Output current capability increases with higher ΔTCA and also increases when a 2-phase modulation versus a 3-phase modulation scheme is used. Similarly, reducing switching losses by lowering the switching frequency enables higher output current. Adding a top-mounted heat-spreader can further reduce the temperature. By using a set of µIPM half-bridge modules, the overall compressor-driver board dimensions were reduced by 40% to 10cm x 7.7cm.

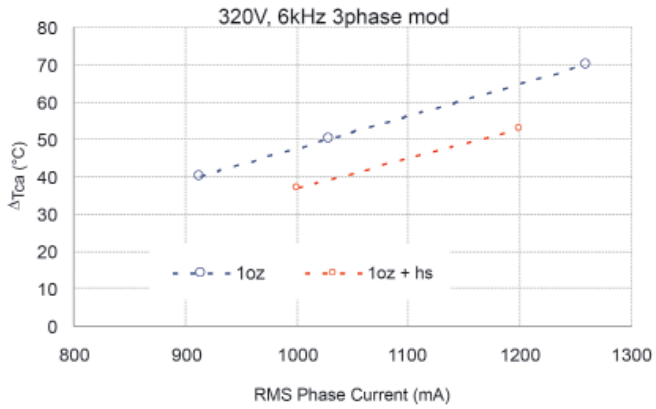

Figure 3: Effect of copper thickness on thermal performance

In addition to revealing the µIPM PQFN family, IR has also extended its dual-inline (DiP µIPM) family for the vast number of applications based on more traditional design and assembly technologies. Designed for use with a heatsink, the DiP µIPM family allows designers to create several products supporting different power output by adjusting heatsink rating. Featuring the same chipset of the µIPM surface-mount family in a DIP26/SOP26 package, these DIP µIPMs give designers freedom to choose the optimum solution for each application.

Like the PQFN family, the DiP µIPMs are available with a choice of power stages built around IR's 500V or 250V trench FREDFET MOSFET. In addition, a version using 600V Trench IGBT and Pt diode targets higher power requirements up to 250W. Built-in bootstrap functionality and integrated temperature feedback via NTC, which allows for full protection redundancy, are common to all versions.

IPMs for Main Driver Applications

For higher-current applications such as the main drivers of washing machines and air-conditioning systems, IR's System-in-Package SiP IRAM Gen2 IGBT-based IPMs introduce enhancements that meet appliance-market demands for higher efficiency and wider operating temperature ranges. The new design features an exposed (yet fully isolated) substrate with superior dielectric transition temperature, which permits operating case temperature of up to 140°C. New copper heat-spreaders for both the trench IGBT and FRED freewheeling diode improve junction-to-case thermal resistance by up to 30%. Transient thermal impedance is also greatly reduced, which increases reliability during overload conditions.

The combination of thermal-mechanical improvements, optimised Trench IGBTs, and advanced HVIC three-phase gate driver has yielded a 20% increase in current-handling capability and a 33% increase in maximum case operating temperature. Devices with current rating of up to 20A are available. On the other hand, retaining identical mechanical dimensions and pin-to-pin compatibility allows designers to upgrade established motor-drive designs relatively easily for use in higher performing products that require increased motor current.

The motor-driver board shown in figure 4 has been upgraded from 700W to cover up to 850W motor specification without any fundamental redesign and by maintaining similar heatsink dimensions, so delivering economic advantages and faster time-to-market.

Figure 4: Appliance control board upgraded to 850W using SiP IRAM Gen2 IPM

Cost-Optimised Modules

The market is also demanding more cost-optimised IPMs for lower-power opportunities. IR's new DiP-IRAM platform addresses this demand by packaging the power semiconductors and HVIC in a lead-frame based, fully transfer molded Dual-Inline Package (DIP) meeting the industry-standard 24mm x 38mm form factor. This enables a lower-cost solution, compared to the SiP-IRAM Gen2 substrate-based system-in-package, and requires only a few external components to cover current ratings from 6A to 15A.

Conclusion

IR's iMotion integrated design platform has enabled designers to realise energy-efficient appliance and industrial motor drives at affordable prices. The latest iMotion IPMs deliver all-round performance improvements and extra package choices that simplify upgrading of existing designs.

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Envelope Tracking for Cellular RF Power Amplifiers

Mobile device functionality has evolved dramatically over the past decade and continues to expand with applications such as social media, music and video streaming, gaming, cloud storage, and connectivity with other devices.

By Juha Pennanen, John Hoversten and Sasa Radovanovic, Texas Instruments

The redefined user experience requires high data rates offered by long term evolution (LTE) technology. High data rates, achieved with complex RF modulation and higher average output power, reduce the efficiency of traditional RF power amplifiers (PA) to unacceptable levels, both for the thermal dissipation and the battery lifetime of existing smartphone designs. Envelope tracking (ET) is a new power management technology for RF PAs that increases efficiency, minimizing heat generation and extending battery life. High data rates with longer battery life time increases the overall LTE user experience.

LTE impact on RF PA efficiency

LTE requires the RF PA to transmit at 9 dB to 15 dB higher power levels to maintain sufficient energy per bit. Despite increased LTE spectral efficiency, the larger amount of transmitted data also requires more power.

Existence of more than 20 distinct LTE bands increases RF front-end complexity for switch, filter and tuner networks. PA-to-antenna losses are increased, which in turn require more PA output power. Up-link carrier aggregation further increases complexity for future RF front-ends, continuing the upward PA output power trend. The large number of LTE bands requires multi-mode multi-band (MMMB) PAs, which are less efficient than single-band PAs.

LTE signals have a very high peak-to-average power ratio (PAR). LTE uses single-carrier frequency division multiple access (SC-FDMA) for uplink communication. SC-FDMA modulation PAR (6-7dB) is higher than that of W-CDMA (3-4 dB) and GSM (0dB). Note that HSPA can have high PAR in some cases, making for similar PA efficiency challenges.

RF PA transistors optimized for high PAR and high power are much less efficient at reduced power levels, for example, when the user is close to a base station or during low data-rate transmission. This inefficiency results in increased PA heating and reduced battery lifetime, compared to 3G and 2G legacy systems. Envelope tracking is an RF PA power management technology that can improve system efficiency at high power levels with high-PAR signals in any band or with any LTE bandwidth..

ETPS

Average power tracking (APT) is a widely-implemented approach to reduce unnecessary power consumption in RF PAs. An efficient DC/DC converter connected between the battery and PA supply voltage (PAVCC) dynamically changes PAVCC based on the PA average output power. When the PA output power is below maximum the PA supply voltage is reduced and improves PA efficiency. Adjustments in PAVCC occur whenever average output power changes. This can be as frequently as once per 3G transmit time slot or LTE frame. A high-conversion-efficiency DC/DC converter is required in order to achieve the lowest system-level current consumption.

Unfortunately, APT does not address the key challenges of LTE transmission: high PAR and high average output power. This limitation exists because the average PAVCC at full output power cannot be reduced without sacrificing linearity. Envelope tracking uses a dynamic PAVCC, which tracks the RF modulation amplitude (the instantaneous output power level) instead of the average output power level. An envelope-tracking power supply (ETPS) is used as a dynamic power supply for the RF PA, adjusting PAVCC at the speed of 3G/LTE modulation and optimizing RF PA efficiency for every point of time. Thus, ET improves efficiency for high-PAR modulation at high average output power. An ETPS significantly reduces worst case PA heating, recovers PA linearity (enhancing ACLR), and raises maximum average output power capability due to the enhanced PA efficiency and linearity.

Figure 1 shows the PAVCC for an RF PA at full power (left), and reduced output power (right). The reduction in PAVCC correlates with the PA efficiency in each case.

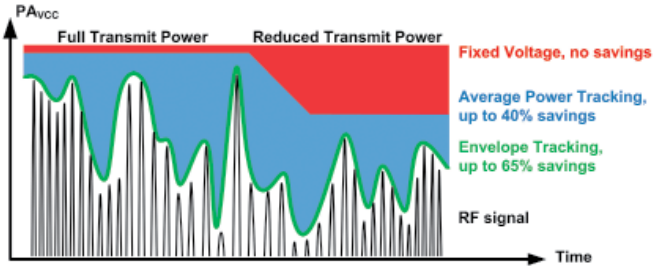

Figure 1: Power amplifier supply voltage for fixed voltage, APT and ET

Envelope-tracking benefits vs. average power tracking

Higher efficiency

The primary benefit of ET is an increase in PA efficiency. For example, system efficiency improvement of more than 23% (from 30% APT to 39% ET) is achieved at +28 dBm PA average output power (Figure 2). The efficiency benefit, or lift, extends to average output power

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levels as low as +20 dBm today. As system components continue to improve, ET lift will be realized at even lower average output power levels. Figure 2a shows a system efficiency measurement using a 3.8V battery voltage and a 25RB QPSK LTE signal with a prototype ET MMMB RF PA operating in LTE band 1. ET operation at +28 dBm reduces current from a 3.8V battery by more than 125 mA compared to APT operation.

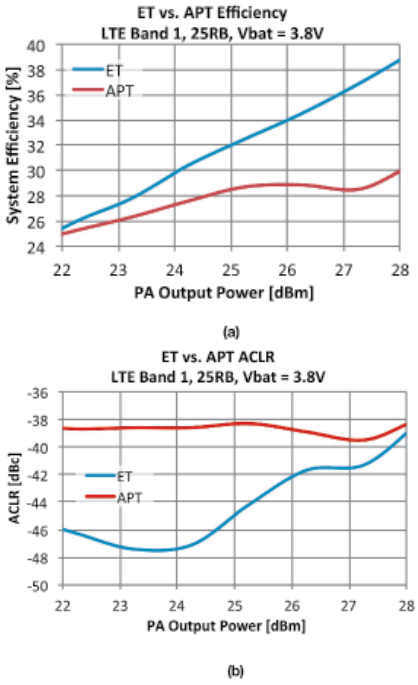

Figure 2: Measurements of ET and APT system efficiency (a) and linearity (b)

Heat reduction

In the same measurement used for Figure 2 the PA operating temperature is reduced by 20°C (Figure 3). The reduction in PA heating significantly eases the thermal design of thin small form factor devices such as phones and tablets.

enables 3 dB higher PA output power than APT. Therefore, relaxation of transmit power requirements, known as maximum power reduction (MPR), is no longer needed. By avoiding MPR the ET system can maintain maximum data rates in all situations, even with low battery voltage. This capability is becoming increasingly important with emerging low-voltage batteries and more complex (higher loss) RF front-ends.

Figure 4 shows a system efficiency measurement using 3V battery voltage and 25RB QPSK LTE signal. A prototype ET MMMB PA is used

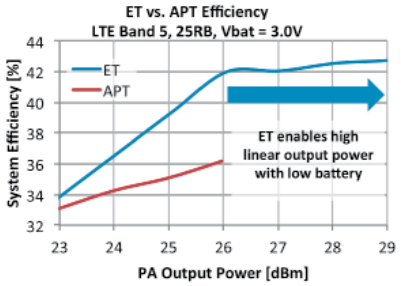

Figure 4: ET and APT system efficiency compared

Reduced receive-band noise

In frequency division duplex (FDD) systems like FDD LTE transmit and receive paths operate simultaneously, making it critical to ensure that out-of-band noise generated by the transmitter does not degrade the receiver's sensitivity. Although transmit and receive circuits are separated in frequency and isolated by a duplex filter, there is still coupling (often on the order of –50 dB) between transmit and receive paths, requiring limits on noise at the PA output. Typical receive-band noise (RxBN) at the PA output should be below –130 dBm/Hz.

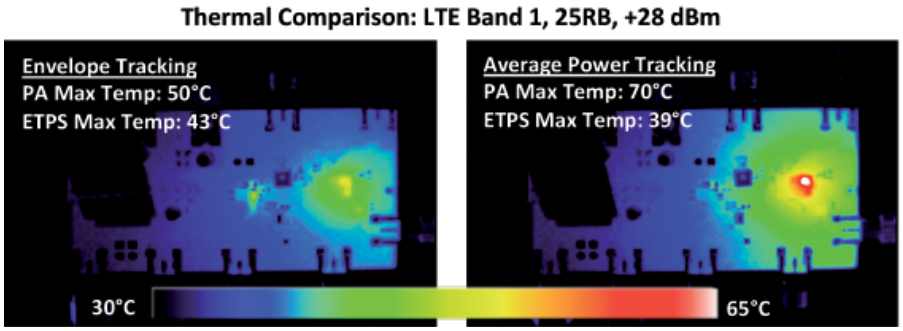

Figure 3. PCB temperature measured with thermal camera for APT and ET at POUT = +28 dBm

High output power levels

Some ET power supplies such as TI's LM3290/91 provide optimized supply voltage to PA, even when PAVCC is above battery voltage. Figure 4 shows that ET operation

The added complexity of envelope signal computation and noise from ETPS complicates achieving good RxBN. RxBN in ET operation can be higher or lower than in APT operation, depending on LTE operating condition, given a sufficiently low-noise ETPS. Figure 5 shows a measurement with 25RBs Band1 for high power levels. ET noise level is only 2-3 dB higher than APT noise. The overall ET noise is below –130 dBm/Hz, meeting typical ET system requirements.

Increased linearity

An ET system with a high-fidelity, high-peak voltage ETPS can improve PA ACLR performance (Figure 2). If not needed, the excess ACLR performance can be easily traded for improved system efficiency, or it can be used to maintain acceptable ACLR if it is degraded, for example, due to antenna mismatch.

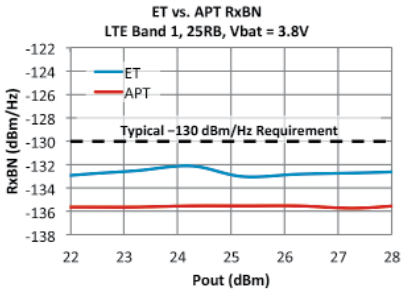

Figure 5: PA output noise with ET and APT

ET versus APT: system level implementations

APT and ET systems are conceptually similar. Both consist of a chipset, PA power management component, and an RF PA (Figure 6). Both adjust RF PA supply voltage level over time. But ET operates at the bandwidth of RF modulation causing different system level requirements. This section presents the key blocks and their requirements in an ET system versus an APT implementation.

ET System

An ET system comprises a transceiver supporting ET, PAs optimized for ET, and an ETPS.

A transceiver supporting ET must generate 3G/LTE RF signals while simultaneously providing a corresponding envelope reference signal to the ETPS. The ETPS supplies the PA supply voltage PAVCC. Due to the high bandwidth of the envelope reference signal it cannot be transmitted using the MIPI RFFE interface as in an APT system. Instead, a differential analog interface called eTrakTM is employed

(Figure 6). eTrak is a new MIPI® Alliance standard for connecting ET-capable transceivers to EMs, and is being adopted by major platform suppliers. The transceiver must maintain an optimum timing alignment between the envelope signal and RF signal paths to prevent degradation of PA linearity and output noise.

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Envelope-tracking PAs are different from average power tracking PAs. While one can try ET with normal APT PAs, such attempts suffer from performance limitations because PAs were never designed to operate in ET mode. High-speed PAVCC modulation requires low PA supply network capacitance to prevent nonlinearity and reduced efficiency. Many ET PAs have fairly flat insertion phase and gain dependency on PAVCC. This minimizes signal distortion, which can impact EVM, ACLR and RxBN. Alternatively, phase and gain variation may be compensated with pre-distortion techniques. Third, the linear gain of an ET PA must be increased with respect to the APT-optimized PA, since the ET PA is operated in compression throughout most of the output power range to increase PA efficiency. Compression increases the susceptibility of PA output to PAVCC noise feedthrough. As a result, a very low-noise PA supply is required to keep PA output noise low. These properties do not exist in APT PAs.

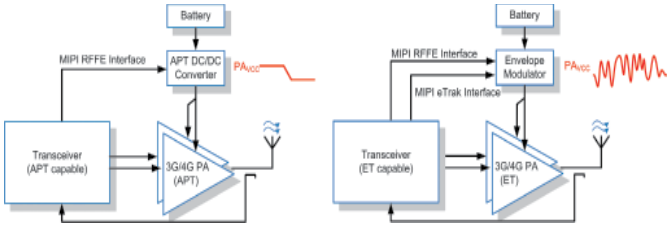

Figure 6: Simplified APT (left) and ET (right) block diagrams

The relationship between PA supply voltage and input RF power impacts many system-level performance metrics. For example, a higher ratio of PA supply voltage to RF input power leads to increased PA gain, reduced PA supply noise sensitivity, and impacts ET linearity. Therefore, ET system performance is not just a function of the PA. Instead, it is a function of all system components and the signal processing method used to generate the PAVCC waveform.

The ETPS adjusts the PA supply voltage constantly. This is unlike an APT DC/DC, which adjusts the PA supply voltage only when the average output power level changes. This causes significant differences and design challenges in modulator bandwidth, output noise, and efficiency.

Bandwidth

To accurately track the amplitude of RF signal modulation without introducing distortion requires a power supply with one to two times the bandwidth of the RF modulation. The envelope bandwidth depends on the actual transmitted signal. For example, the required 20 MHz to 40 MHz LTE signal bandwidth is more than 200 times the bandwidth of APT DC/DC converters.

ETPS output noise

The ET PA operates in compression, has very small supply bypass capacitance, and is more sensitive to supply noise than an APT PA. To meet RxBN system requirements of –130 dBm/Hz, ETPS output noise needs to be below –135 dBm/Hz (referenced to a 50-Ohm system). This is a very stringent, but feasible design challenge for the ETPS. In an APT system, the RF DC/DC converter noise requirements are more relaxed as a large bypass capacitance on APT PA supply attenuates PA supply noise.

Efficiency

The high-bandwidth and low-noise characteristics of an ETPS must be combined with high efficiency. While an APT DC/DC can reach 95% efficiency levels, ETPSs operate with reduced conversion efficiency to achieve higher bandwidth and lower output noise performance requirements. Reduced ETPS efficiency (compared to the APT DC/DC converter) is compensated on the system level by increased PA efficiency in ET operation (versus the PA in APT operation). ETPS efficiency in the range of 80%-90% is required.

Envelope-tracking power supply supports average power tracking

ET is an efficient method of powering RF PAs when the transmitted signal has high average output power and high PAR. For lower average PA output power levels APT becomes a more efficient option. Therefore, an ETPS must support two operating modes: ET and APT, as shown in Figure 7.

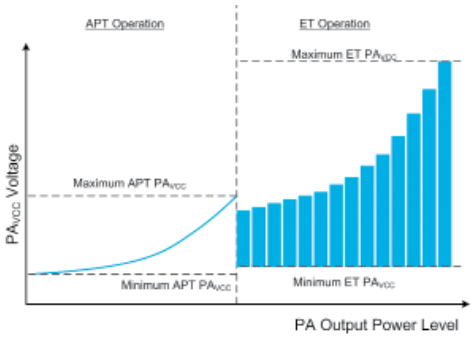

Figure 7: ET and APT operating modes of an EM

In a dual-mode ETPS the ability to switch between APT and ET operation seamlessly is critical; otherwise the RF output signal will be distorted when changing operating modes. Figure 8 shows a seamless transition from APT to ET and back to APT mode using Texas Instruments' LM3290/91 ETPS. The chipset controls the transitions via the MIPI RFFE interface to ensure system synchronization to RF signal and transmission frames or slots.

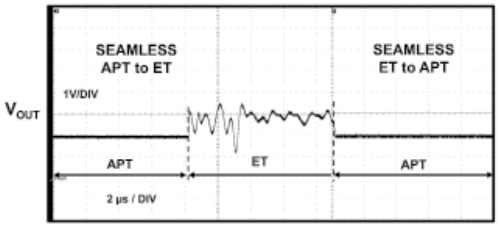

Figure 8: EM mode changes APT-ET-APT

Conclusion

Envelope tracking is a new power management technology that significantly improves the PA efficiency of LTE transmitters. ET provides longer battery life and significantly reduced PA operating temperature. Additional benefits include improved linearity (ACLR), increased output power capability and – with boost capability – elimination of MPR at low battery voltages. At low PA output power levels high-performance average power tracking is a necessary feature for best overall system efficiency. Therefore, a dual-mode ET/APT RF PA power management solution is needed.

Implementation of ET requires a complete ecosystem: An ET-capable chipset, an ET-optimized PA and an efficient, low-noise and high-bandwidth ETPS that supports both APT and ET modes. The system components are already available from leading LTE component vendors such as the LM3290/91 ETPS from Texas Instruments.

References

Download for the datasheets: www.ti.com/lm3290-ca, and www.ti.com/lm3291-ca .

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Investigating Effects of Non-Idealities of Current Sensors and Powertrain on the Performance of an EV System using PLECS Simulation Software

Drive system applications experience a significant coupling between the controls, electrical and mechanical domains. To fully understand the behavior of the entire electromechanical system, the characteristics of the individual domains and their effects on the overall system must be taken into account. PLECS is a simulation tool developed for drives engineers that allows for very efficient and robust modeling of such systems with multi-physical domains and their associated controls. In this study, an electric vehicle has been modeled and the effects of non-ideal components have been investigated in detail using PLECS.

By Munadir Ahmed, Beat Arnet, and Kristofer Eberle, Plexim Inc.

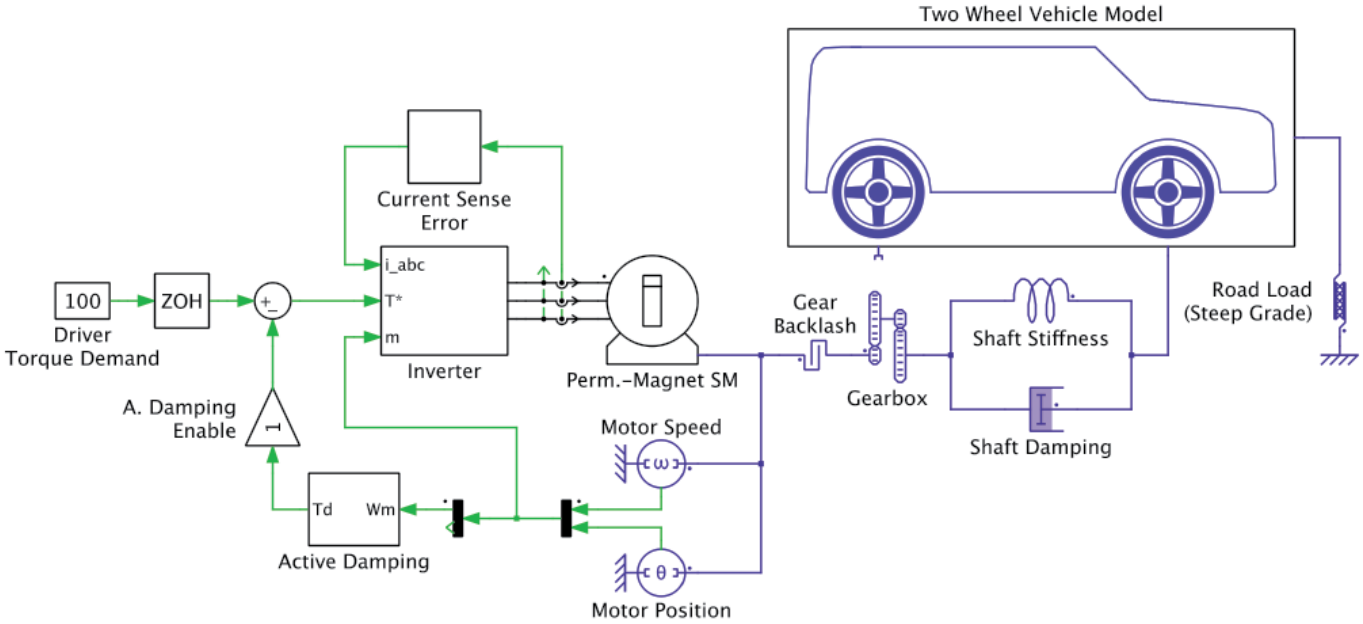

Figure 1: Schematic of the EV drive model in PLECS

Introduction

The turn of the century has seen a push towards vehicle electrification to improve fuel economy and reduce dependence on conventional transportation fuels. Major car manufacturers have added plug-in hybrid electric vehicles (PHEVs) and electric vehicles (EVs) to their fleets. The field of power electronics is becoming increasingly important in the auto industry with applications from motor drives for vehicle propulsion to battery charging. With drive applications, a significant coupling exists between the controls, electrical and mechanical aspects. It is important for drive system engineers to model the influence of the different areas on overall electromechanical system performance. System simulations using computer tools are crucial to understanding these interactions.

PLECS is a simulation platform developed for engineers designing power electronic and motor drive systems. It provides an easy-to-use interface for modeling such systems and examining their behavior. In this study, the effects of non-idealities of the rotor shaft and current sensor on the performance of an EV system are investigated. Further, a possible controls solution to mitigate the observed issue is proposed and the overall system performance is compared before and after a damping algorithm is added.

Electric vehicle system modeling in PLECS

Figure 1 shows a schematic of a front-wheel drive EV system, developed in PLECS using its control, electrical and mechanical modeling domains. The EV implementation consists of two slip-based wheel models. This two-wheel model incorporates the effect of speed and acceleration on the front and rear axle weight distribution, and thus, the effect on the front and rear wheel traction forces. The wheels are modeled using the advanced slip-based tire models proposed in [1]. The two-wheel vehicle model is shown in Figure 2.

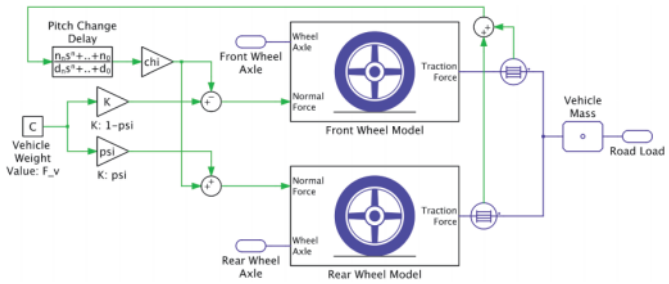

Figure 2: Two-wheel vehicle modeled in the PLECS mechanical domain

The EV is propelled by a wye-connected permanent magnet synchronous machine (PMSM) attached to a single-speed gearbox. The damping and stiffness properties of the half-shafts connecting the gearbox and differential to the EV's front wheels are incorporated in the system model. A backlash component is used to model the mechanical play in the gearbox (engagement and disengagement of gears). A simple field-oriented controller is used to regulate a two-level voltage source inverter that drives the PMSM.

Excitation of powertrain natural frequency

A sudden step change in motor torque leads to oscillation of the motor inertia. This windup effect occurs due to excitation of a natural frequency (f_0) of the powertrain, given by:

$$f_0 = \frac{1}{2\pi G}\sqrt{\frac{K_s}{J_m}},$$

where K_s is the shaft stiffness coefficient, G is the gear ratio and J_m is the rotor inertia. The inertia of the wheel/vehicle system is neglected because it is assumed to be significantly larger than the motor inertia.

When modeling electric drives it is often assumed that all measurements are ideal and accurate. However, in reality some amount of offset and gain errors are present in all sensors. It can be shown that gain errors of the current measurement may lead to torque oscillation at twice the fundamental frequency of the phase currents. This torque ripple can excite the natural frequency of the mechanical system (at low speeds) as described above, and reduce vehicle driveability.

Mechanical damping

A possible solution to reducing the windup and torque ripple effect is to change the natural frequency and damping factor of the rotor shaft, by adding an additional inertia onto the rotating shaft. However, this is not practical as it requires increasing overall vehicle weight and cost, and would adversely affect performance.

Active damping

A more realistic solution to minimize drivetrain oscillations is to actively control the torque demand on the PMSM [2]. In this model, a basic damping algorithm has been implemented based on the measured rotor speed using a digital PI controller with an anti-windup mechanism that generates a correction torque. This correction torque, along with the torque demand of the driver, is used to modify the torque setpoint that is fed into the torque controller.

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Simulation results

In the simulation, an EV is modeled to start from standstill on a steep slope and accelerate to steady-state speed over the course of 6 seconds. A gain error in the measurement of two of the phase currents has been modeled, with one phase current overestimated by 5% and another underestimated by 5%. The simulation results in Figure 3 show the vehicular system response to a torque demand of 100 Nm. The simulation is first run for an EV system without an active damping algorithm. The system is then simulated with the simple active damping algorithm enabled and the results are overlaid on top of the previous results. The blue trace corresponds to the undamped system, while the red trace corresponds to the actively damped system.

As seen in Figure 3, for the undamped system, the step change in torque results in the rotor speed quickly increasing from standstill to 790 rpm. The rotor then reverses its motion with a maximum speed of 230 rpm in the opposite direction. Additionally, the gain error of two of the phase current measurements results in a low frequency oscillation of the generated motor torque that translates to a sustained low frequency oscillation in the motor speed. The peak-to-peak amplitude of the low frequency motor speed oscillation is 81% of the average motor speed.

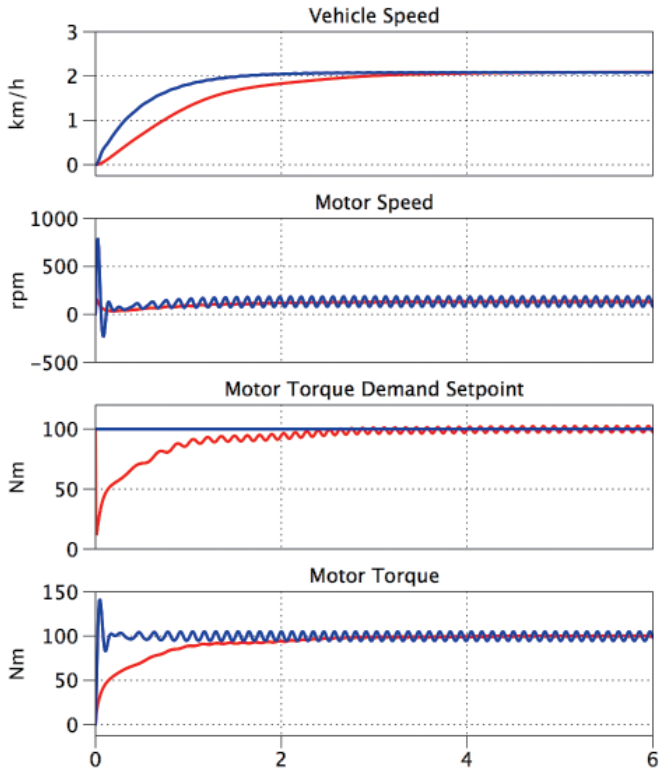

Figure 3: Simulation results for an undamped (blue trace) and actively damped (red trace) system

The active damping controller adjusts the torque demand signal that is fed into the torque controller. This results in a significant reduction of the windup effects that occur without any damping. The low frequency oscillation of the motor speed arising from the current sensor measurement error is also mitigated through active damping. The feedback of the motor speed results in a low frequency adjustment in the steady-state torque demand setpoint. This translates to a reduction in the amplitude of the motor's peak-to-peak low frequency speed oscillation to 7.5% of the average motor speed at steady state.

The maximum steady-state powertrain oscillation due to current sensor error occurs when the vehicle is traveling at a velocity v_0 where the motor torque excites the natural frequency f_0 of the system. The steady-state speed oscillation is reduced by deviating from this velocity, as can be seen in the undamped system in Figure 4. In practice, EV drivetrain oscillations are most prevalent at low speeds and high torque commands. The red trace corresponds to a vehicle moving at a steady speed v_0, while the blue trace is for a vehicle moving at $2v_0$.

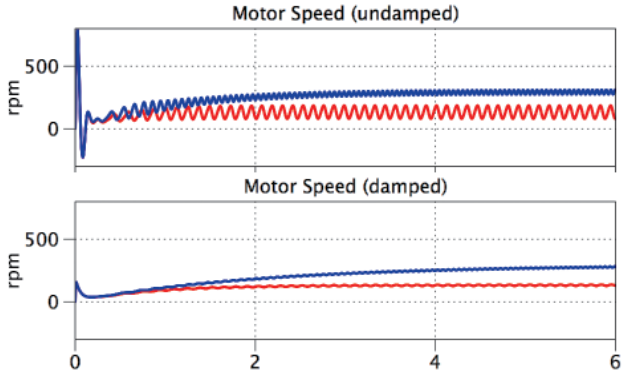

Figure 4: Motor speed oscillation for undamped and damped systems at multiple steady-state speeds

For a system regulated with the active damping algorithm described above, the magnitude of the peak-to-peak steady-state oscillation is significantly reduced (81% vs. 13%), as shown in Figure 4. The algorithm reduces motor speed oscillations to 7.5% for the vehicle moving at v_0, while the oscillation is reduced to 5% for the vehicle moving at $2v_0$.

Conclusion

In a real vehicle, the windup effect due to the powertrain resonance excitation and the low frequency speed oscillation may significantly reduce vehicle driveability. It is important for drive systems engineers to model overall system performance issues that may arise due to mechanical components and measurement devices, and develop possible solutions to mitigate these concerns. With PLECS, these multi-domain effects can be evaluated in a single system model without excessive simulation times, providing an effective and accurate means to investigate and address issues related to real world system non-idealities. Such fully integrated models provide power electronic designers and engineers with more insight into a system before components (such as sensors) are selected and hardware is built, reducing time and cost. The model discussed in this article is provided as a PLECS demo model and can be further explored using the Demo Mode of PLECS Standalone. To obtain this free download, visit Plexim's website:

www.plexim.com/download/standalone

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[1] Pacejka, H.B.: Tire and Vehicle Dynamics, 3rd Edition, Butterworth-Heinemann, Oxford, 2012, Chapters: 1, 4, 7, and 8.

[2] Menne, M.: Drehschwingungen im Antriebsstrang von Elektrostraßenfahrzeugen, 2001, Aachen University of Technology

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Superior Thermal Stability for Power Modules Achieved by Enhanced Base Plate Design and Optimized Thermal Interface Material

Power semiconductors need to be thermally connected to a heat sink. Besides the mounting process, the thermal interface materials used as well as base plate design have a combined influence on the thermal transfer. In addition to an initial state, the change of the thermal transfer under dynamic load is observed. Micro-movements as a consequence of thermal expansion possibly lead to degradation of the thermal interface due to pump-out effects.

By Martin Schulz, Infineon Technologies AG

New developments in power electronic components focus on three major aspects. Electric improvements target the reduction of switching- and static losses along with EMI behavior. Mechanical changes in the design cope with the improvement of the mechanical robustness. Mechanical design also is the key to improve the module's thermal performance.

There is a noteworthy difference within these three subjects. Electrical tuning and internal improvements of the overall construction of the power module are done by the semiconductor manufacturer. Thermal aspects however heavily depend on the assembling at the user's site. The added thermal interface component and the process of application itself have a large impact on the module's performance. Care has to be taken to thoroughly consider mounting aspects, the interconnection of the module to the according heat sink and subsequent thermo mechanical effects throughout the predicted lifetime of the final inverter. Using the example of a module with a larger base plate reveals how various approaches can help to optimize the module's base plate to achieve outstanding thermal performance to support the development of highly reliable, long lasting inverter systems.

Thermo Mechanics

Power modules as larger compounds suffer from high temperature swing during operation. The internal structure of a power semiconductor consists of a stack formed from different materials with different coefficients of thermal expansion (CTE). In combination with the macroscopic geometric topologies of the base plate, thermal mechanical movement is induced during operation, leading to a reduction in the volume available between the module and the heat sink as depicted in figure 1.

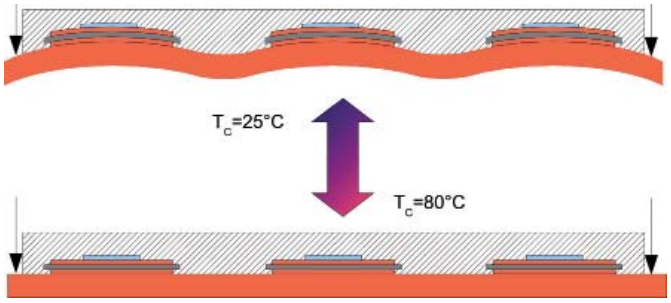

Figure 1: Change in shape of a base plate due to temperature difference, Arrows denote screw forces

This reduction of volume is the core reason for the pressure that is applied to thermal grease during high temperature operation. Since the structure relaxes during cool-down, the effect reoccurs with every thermal cycle.

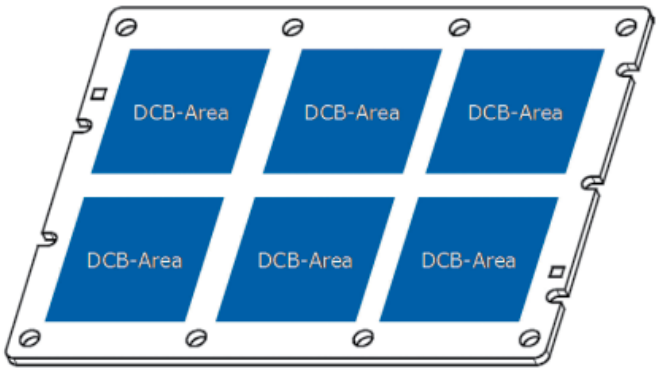

Figure 2: Base plate and DCB-Location for stamping

From the picture, it can be concluded, that the initial state of the base plate in cold condition has an influence on the thermally induced movement. However, judging the thermal performance of a module by evaluating the shape of the base plate in cold condition will result in misleading interpretations.

The gaps remaining between the base plate and the heat sink at high temperature levels have to be as small as possible to improve the thermal coupling. Optimization has to take the initial shape, preforming and the thermal processes during production into account. The

design target is to increase the area of the base plate that is thermally active in the final design. In addition to the methods described in the literature, well-directed, local compacting of metal in certain areas of the base plates is a viable option. During the development phase of the EconoPACK™ + D-Series, different approaches were evaluated. Stamping was done in the areas that later carry the DCB-Material as indicated in figure 2.

To evaluate the influences of thermal performance and the magnitude of the pump-out effect, a test bench was set up to achieve reproducible and comparable results in an active thermal stress test.

Test bench and experimental results

The test system consists of a power module mounted to a proper heat sink featuring forced air cooling. Mounting was done according to the recommendations made in the corresponding Application Notes. All IGBT-Chips inside the module are activated and series connected to achieve homogeneous current sharing and homogeneous temperature development respectively. This way, the temperature distribution inside the power module correlates closely to the real application, leading to credible experimental results. As the pump-out effect to be observed becomes more prominent in vertically mounted systems due to gravitational pull, this mounting direction is chosen for the test. Monitoring the experiment includes measuring the voltage across the DUT while the power source is configured to provide a constant current. Thermally, the setup is observed using an IR-Camera to detect even small changes in the temperature distribution. The setup as it was used in the lab is displayed in figure 3.

The current through the module is controlled by an external power source; the turn-on timing is done by a microcontroller that is also used to count the cycles done in this test. A cycle of 120 seconds is chosen with an on/off ratio of 1. Finally, two different base plate designs were tested with widely different results, summarized in figure 4.

Figure 3: Test bench to evaluate thermally induced pump-out effects

The device under test is a D-Series EconoPACK™ +, FS450R17OE4 consisting of three half bridges and featuring a base plate size of 160mm × 123mm. Due to the vertical mounting, the grease follows the gravitational pull. Therefore, the top part of the module is prone to lose the thermal transfer path first. It can be observed, that the tem-

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perature in this part of the module increases rapidly. For the chosen solution of grease, base plate with Stamp A and forced air cooled heat sink, the temperature rise was 20K in less than 35 hours of testing. Though the pumping itself is a consequence of the changing volumes below the module's base plate, the thermal interface component in use plays a major part as well. It depends on several physical parameters to what extent a thermal compound reacts on the pressure applied. Creeping and wetting abilities along with the surface tension in high temperature conditions matter but are difficult to pinpoint in numbers.

Figure 4: Left side - Stamp A after 45 cycles with massive pump-out. Right side - Stamp B after 1200 cycles with reduced pump-out effect

Recently, a new Thermal Interface Material (TIM) was developed especially dedicated to power modules. This new material was tested using this same setup, with outstanding results. The graph in figure 5 indicates that after thousands of hours in the test, the chip temperature increase was almost negligible.

In this series of tests, two general purpose greases (GPG) that were tested failed without reaching the target set for the qualification. Infineon's newly designed solution achieved the lowest chip temperature in this test and remained stable for about 4000 hours. No pump-out was observed and the test was discontinued without failure.

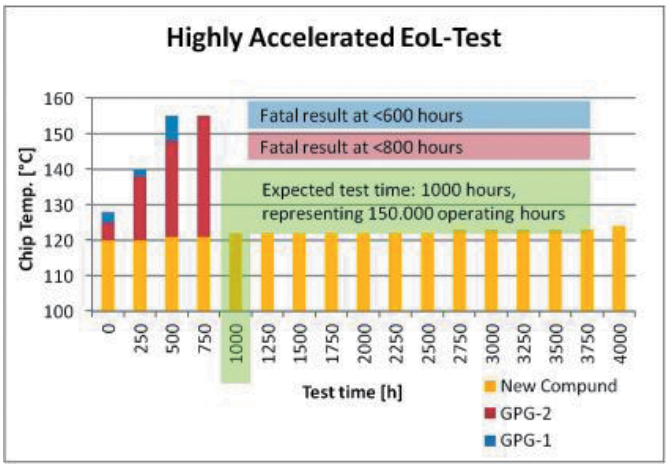

Figure 5: Comparing different thermal interface materials regarding degradation due to pump-out effect

Conclusion

Optimizing the base plate of a power module is a necessary step to achieve the desired thermal performance. However, the base plate, the thermal interface material and the application requirements have to be considered as a complete system that has to work properly under specified thermal conditions. Optimizing has to take every part involved into consideration to achieve the best possible result.

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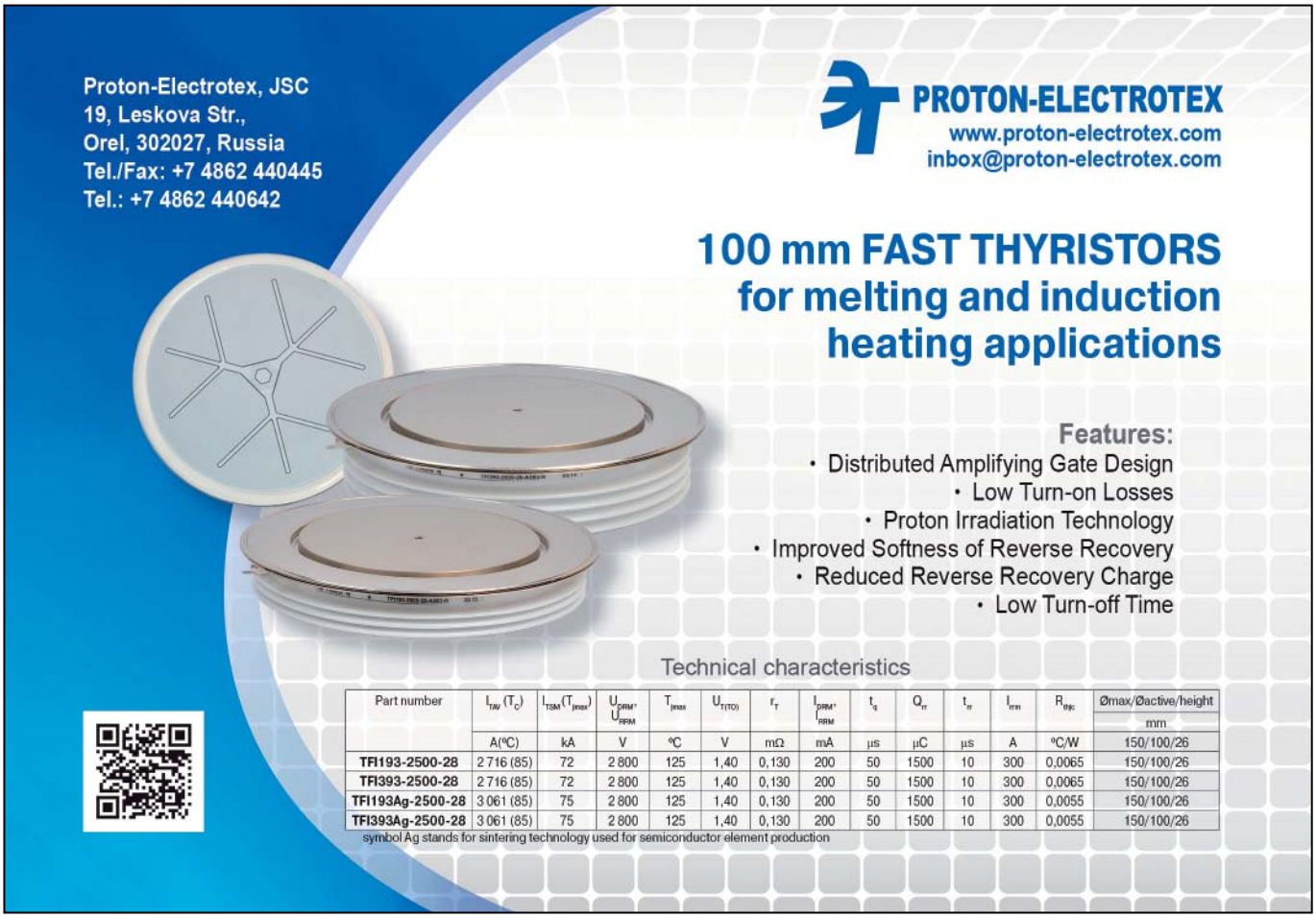


Super Capacitors, the Unknown Capacity Giants

The unit of capacitance farad (F) has been known only in combination with the prefixes micro, nano and pico for a long time. Nowadays, however, kilofarads have become possible. How do these new super capacitors work, which base on a principle that was discovered 160 years ago?

By Wolf-Dieter Roth, HY-LINE Power Components

Super capacitors have become known by the name of gold caps after their market launch. These were capacitors that were capable of carrying only low voltages but providing sufficient capacity to replace backup batteries of RAM retention or real time chips. They were also used for LED tail lights of bicycles and astonished people seeing a bicycle stopping at a traffic light whose tail light was still shining for minutes and no battery to be seen. Initially, these super capacitors featured only a low peak current but a relatively high equivalent serial resistance.

In the mean time, however, their technology has been very much advanced. Today, even mass produced super capacitors up to 7,000 F are offered (figure 1). With respect to their storage capacity they can compete with smaller accumulators. The physics of super capacitors, however, differs from the one of accumulators. That is why they have a completely different electrical behaviour.

Figure 1: 3,000 F super capacitor from SPSCAP compared in size to a 9 volt battery (Photo: HY-LINE Power Components)

To begin with, super capacitors are basically capacitors: their capacity is determined by two opposing conductive surfaces. The larger the surface, the smaller the clearance between the surfaces and the higher the dielectric constant – the higher is the capacity. The formula for that is:

$$C = \varepsilon \cdot \frac{A}{d}$$

where C = capacitance, A = area, d = distance and ε = dielectric constant.

Increasing capacitance values

So an air or vacuum capacitor has a lower capacitance value, because d is high whereas ε and A are low. But a high dielectric strength is achieved.

A film capacitor, however, has a markedly higher capacity because it has a larger surface and a higher dielectric constant. In addition to that the film allows for reducing clearance without compromising dielectric strength. Depending on the dielectric constant of the materials used, ceramic capacitors feature even higher capacities but accompanied by a possibly reduced voltage persistance and capacitance stability.

E capacitors have an even increased capacity because there is no mechanically manufactured dielectric but a thin chemically generated oxide layer instead. A rough base material results in a larger surface and higher capacity. Dielectric strength is lower and the capacitor requires the user to observe the correct polarity. Improper handling such as reverse polarity, overvoltage, overcurrent and overtemperature can lead to capacitor failure.

Super capacitors are double layer capacitors whose working principle bases on the Helmholtz double layers and has been known for more than 130 years. These layers have a thickness of only a few molecules, that is to say in the nanometer range, which results in an increased capacity compared with E capacitors of up to factor 10,000 and a lower dielectric strength which, in comparison with the state-of-the-art technology, ranges for individual cells under 3 V. For higher voltages the cells may be connected in series as it is the case with batteries. More than two cells which reach a peak operating voltage of 5 up to 5.5 V require that measures for a symmetrical voltage division are to be taken.

The alternative to accumulators

Electrochemical reactions as they occur in batteries and accumulators lead to wear and tear of the electrode material. They only play a minor part with double layer capacitors and contribute to the capacity of state-of-the-art super capacitors in the percent range.

What is of some relevance, however, is ionic shift and the formation of ions in the double layer. That is why super capacitors are also known as electrochemical capacitors and the reason for the exceptionally high field strengths of up to 5,000 kV/mm in the double layer which would lead to electrical breakdown in a normal dielectric.

Charge and discharge currents of double layer capacitors can be very high, whereas deep discharge is no problem. 100,000 charge and discharge cycles and even more are possible which means a life of more than 20 years. The capacities already lie at 1/10 of those of accumulators. Consequently, super capacitors have a far better performance in cyclic operations than accumulators. Even racing cars or means of public transport such as electric buses, which are being recharged during a short stop at the bus stop, can be powered by these capacitors. The Fraunhofer Institute, for instance, had hybrid buses manufactured in Dresden, which after having been recharged for 15 seconds at the bus stop were able to reach the next charging station 2 km away with this charge.

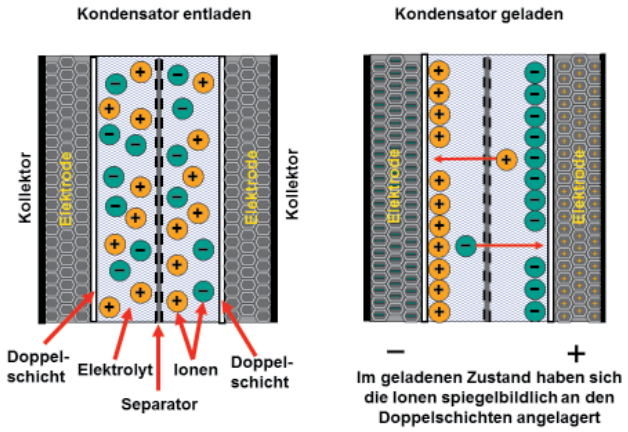


Figure 2: Charging principle of double layer capacitors (Photo: Wikipedia/Elcap)

The principles of E and super capacitors were discovered almost at the same time: in 1875 by Eugène Adrien Ducrete (E capacitor) and even some time before in 1853 by Hermann von Helmholtz (Super-cap) who also detected the double layer effect in 1879. But while the aluminium E capacitor was industrially used from 1892 and from 1931 onwards manufactured in the known technology of today, the super capacitor was ignored for many years. The first patents occurred

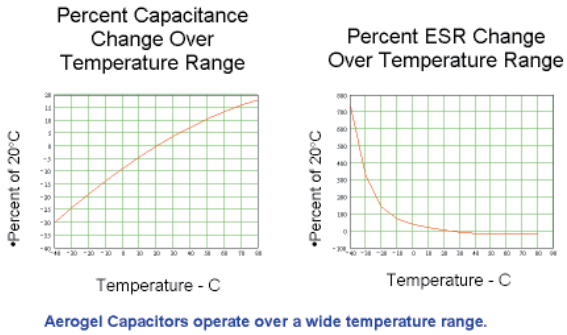
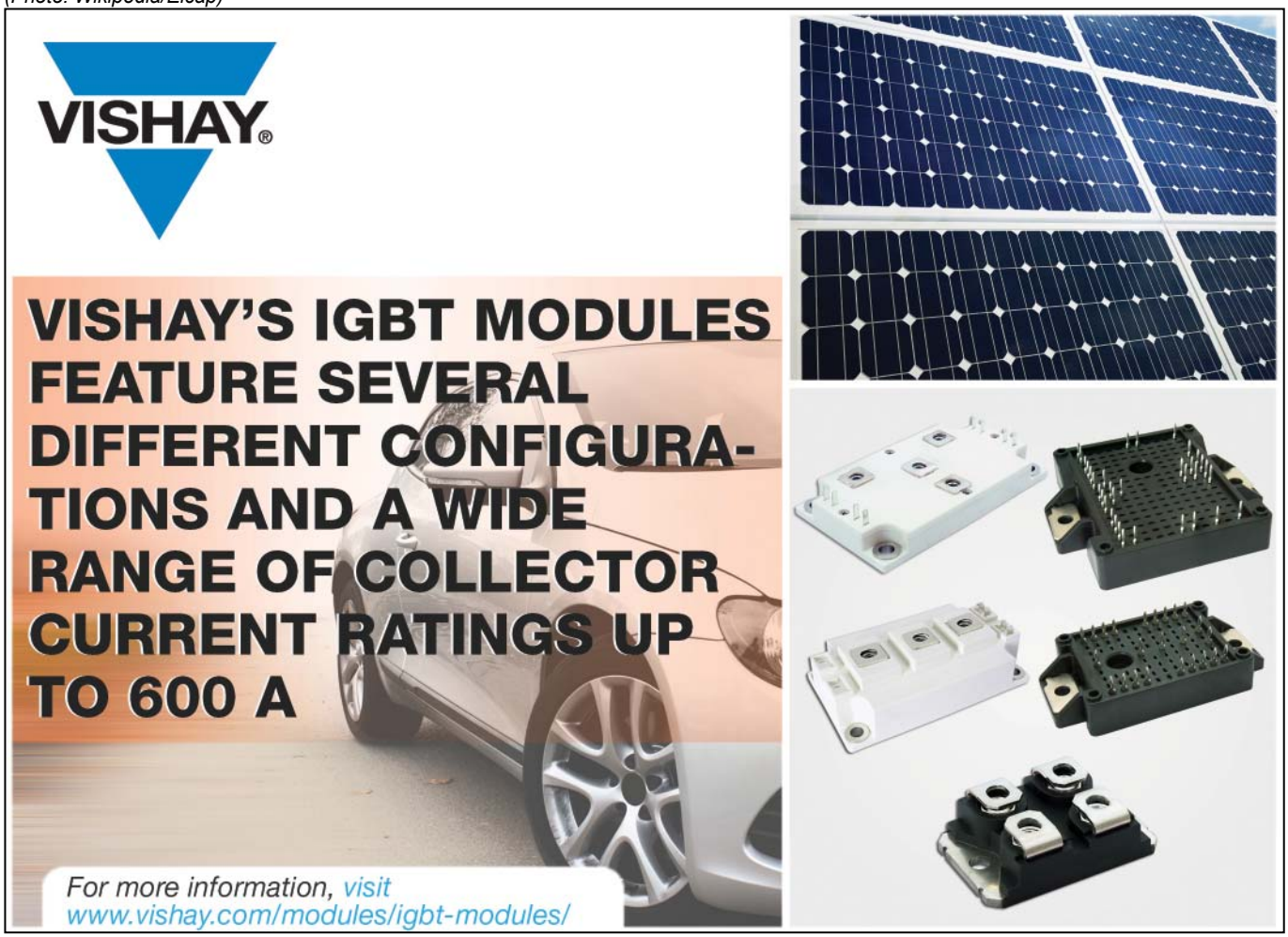


Figure 3: Temperature Characteristics

in 1957 and in 1962 a canoe of Standard Oil powered by a super capacitor, which had the size of a car battery, made a demonstration for ten minutes on a lake in Ohio. Standard Oil, however, decided that there was no market chance for the capacitor and sold the patents to NEC. At the time even the developers of super capacitors did not know the difference from the principle of E capacitors. Thus Standard Oil regarded them as E capacitors. In 1971 NEC launched the first market-ready products and in 1978 they were followed by Pana-



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sonic's 10 F "Goldcap" versions. Since 1992 capacities of 1,000 F have been available. Epcos went out of the super capacitor business end of 2006.
Super capacitors have a higher temperature resistance (see figure 3) and a much better performance at low temperatures than accumulators. Certain limit values, however, must not be exceeded lest the electrolyte evaporates. At the end of its life there is a 30% loss of capacity or a doubling of the internal resistance. When used properly total failure of a super capacitor is seldom.

Combination with batteries
Besides the extremely thin insulation layer the high capacity of super capacitors is gained by the fact that super capacitors use carbon electrodes. They are very porous and rough – mostly active coal is used. With only one gram carbon powder a surface of 3,000 square metres can be realised.

Super capacitors are no filters like normal and E capacitors – they are primarily energy storages. The internal resistance at higher frequencies makes them unsuitable for sieving especially with switched-mode power supplies and converters – already at 10 Hz only a fraction of the super capacitor's capacity is effective. This is due to the fact that the ions of the double layer do not move fast enough and the internal resistance is generally higher than the one of E capacitors. As a consequence the use of super capacitors as filter and smoothing capacitor is far from satisfactory and may even result in overheating and failure of the capacitor. However, in uninterruptible power supplies they are capable of bridging a potential power failure for several seconds without the need for permanent maintenance and inspection as is the case with a battery-powered UPS. They can even be used as starters of cars because in contrast to conventional starter batteries their capacity does not drop at low temperatures. Only the price for their use in these applications is still too high and therefore not yet competitive.
Likewise super capacitors are suitable for use as backup (see figure 4) if the device such as an optical smoke detector, despite the fact that it is supplied by batteries, draws current rather discontinuously. In this case the ESR of the batteries becomes too high, especially during the continuous discharge of the batteries.
With a super capacitor connected in parallel, however, these batteries can be used much longer before transients are able to cause undervoltages. Alternatively, long term high capacity lithium ion batteries can be used instead of the high current alkaline batteries.

Electrical characteristics
Super capacitors are used exclusively as secondary storage components. Even though they feature high capacity and a low self-discharge, they are not suited for use as an independent power supply of equipment for several months. Their self-discharge, however, is low enough for bridging days and even weeks.
For safety reasons, super capacitors are not delivered charged like accumulators, and are not mounted as plug-in or replaceable components. Peak currents caused by improper handling (short-circuit) would be very high and could do some serious damage.
Unlike batteries or accumulators, super capacitors do not supply voltage which is chemically defined and constant for some time, and rapidly drops at discharge end, but like every capacitor supply constantly decreasing voltage at constant current drain. By using voltage regulators the output voltage of

a UPS powered by super capacitors can be kept constant. However, when the capacitor voltage drops to half of its initial value, three quarters of the stored energy will be discharged. Consequently it is not worth while using wide range converters for discharging further.

Deep discharge is principally no problem for super capacitors, and you need not be afraid of a sudden failure when the electrical storage component has reached the discharge voltage.

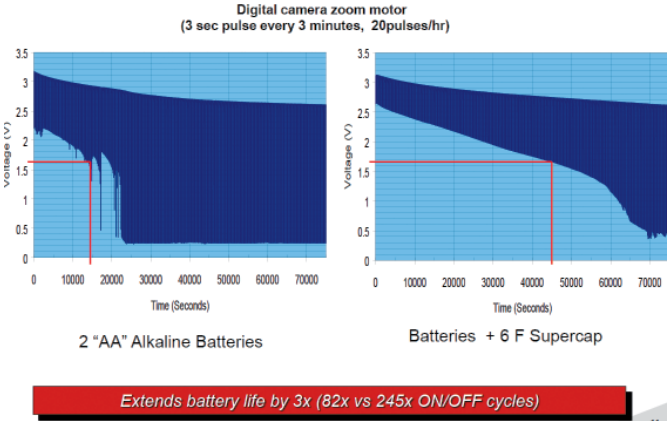

Figure 4: With an additional 6 F super capacitor a digital camera supplied by two alkaline mignon (AA) batteries can be operated three times as long (Photo: Powerstor)

Calculating super capacitor arrays

The end of life of a super capacitor is defined by a reduction of capacity to 70 per cent of the initial capacity and/or an increase of ESR to 200 per cent. Thus a circuit designed to supply a certain voltage and capacity by means of a super capacitor array is to be dimensioned with sufficient reserve capacities. If a discharge within seconds instead of hours is planned, the internal resistance will result in a drop of voltage which has to be compensated by a higher charging voltage and several super capacitors connected in series. The series circuitry, however, will lead to a reduction of capacity. A correct dimensioning of the individual capacitors will be calculated with end-of-life parameters instead of parameters of a brand new super capacitor. Only this way the long term operation of the circuit within its working limits is ensured.

The rule of thumb is that the life of a super capacitor is increased by a factor of 2.2 when:

- the operating voltage is reduced by 0.2 V
- the ambient temperature drops by 10 °C

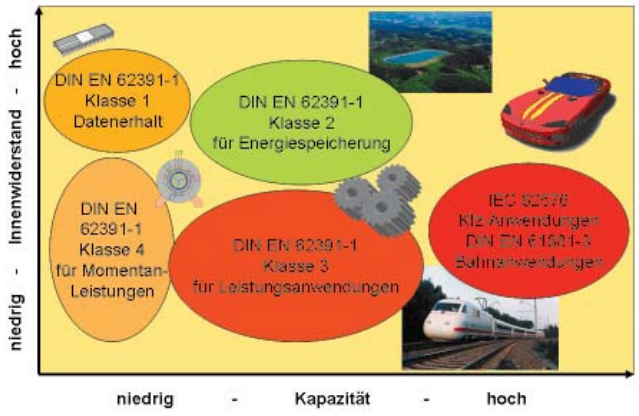

Figure 5: The 4 classes of double layer capacitors (Photo: Wikipedia/Elcap)

Consequently, if you want the capacitor to have an especially long life, it is best to use it at reduced voltage and not too high temperatures. Likewise, it is necessary to prevent overvoltages and incorrect polarity, since this will cause decomposition of the electrolyte as well as capacitor gassing as it is the case with E capacitors.

When used within a wide temperature range, it is to be taken into consideration that the ESR will increase considerably below 0 °C whereas the capacity will be slightly reduced (see figure 5), however not to a level as it is usual with common accumulators.

Applications for super capacitors

There are mainly four fields of application (see figure 5):

Low – internal resistance – high
Low – capacity – high

Class 1
Data preservation
Class 2
For energy storage
Class 3
For power applications
Class 4
For instantaneous power

IEC 62576
Automotive applications
DIN EN 61881-3
Railway applications

Class 1: Characterized by low capacities and slow discharge. This type is designed for storage retention and uninterruptible power supply of real-time chips. They feature 0.1 up to 1 F capacity and low leak current values. Typical of this category are the Powerstor B, HB, and K series as well as the SPSCAP-SCV series.

Class 2: Characterized by low to medium capacities and slow discharge. This type is used for energy storage and power supply of torch lights, toys, emergency exit lights, small electrical tools, tail lights of bicycles, solar lamps, and for shutting down machines in case of a blackout. They come with capacities from 5 to 400 F. Typical for this category are the Powerstor XB and XV series as well as the SPSCAP-SCE series.

Class 3: This type of capacitor is marked by high capacities and strong discharge. They are typically used for electric vehicles (energy recovery, starting aid, start-stop systems), renewables (wind turbines and PV installations), x-ray devices and construction machines. They come with capacities from 100 to 5,000 F. Typical of this category is the SPSCAP-SCP series.

Class 4: These capacitors feature only low capacities but short transients. Their capacity ranges from 1 to 22 F and their ESR values are low. Typical of this category are the Powerstor HV and M series.

The first super capacitors introduced to the market belonged to class 1, whereas under class 3 fell all capacitors that were used for all kinds of vehicles. Class 2 capacitors are much cheaper if there is no need for the extremely high current ratings of class 3 capacitors, whereas class 4 capacitors are only poorly represented in the market.

With some applications it is difficult to see the possibilities they open up for capacitors as, for instance, their use in wind turbines: Here they are used among other things to quickly move the blades out of the wind in the event of a mains failure, before they get damaged. Other most obvious applications such as energy recovery during elevator operation have not been realised yet because of the aging of accumulators. With super capacitors, however, this has become possible.

Even a combination of different application modes is possible. One such example is the emergency power supply whose first task is to immediately shut down a high-power installation and after that to ensure its storage retention by way of supplying low current for long periods of time. Contrary to conventional battery-supported backup systems, there is no need for maintenance and the regular replacement of batteries with super capacitors and the temperature dependence of the installation is much lower. This is highly beneficial for traffic lights, data centres, telecommunications systems, or one-armed bandits, where a failure due to grid perturbations does not endanger lives but, nevertheless, can cause a lot of annoyance. A further advantage is that, after returning of the power supply, a super capacitor UPS system can be rapidly recharged and is capable of handling disturbances occurring anew.

More generally, it should be noted that some parameters increase the capacitor's capacitance density and others its energy density. High capacitance density is required for class 3 and 4 applications, whereas high energy density is important to class 2 and 3 applications. Thus porous active carbon layers, for instance, ensure a higher capacity but the expanded surface area and the resulting longer ways will increase the ESR and thus reduce the capacitor's energy density.

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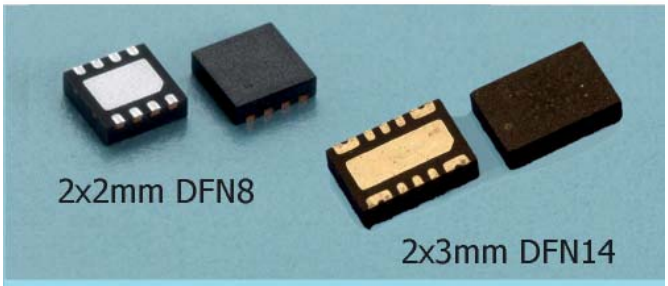

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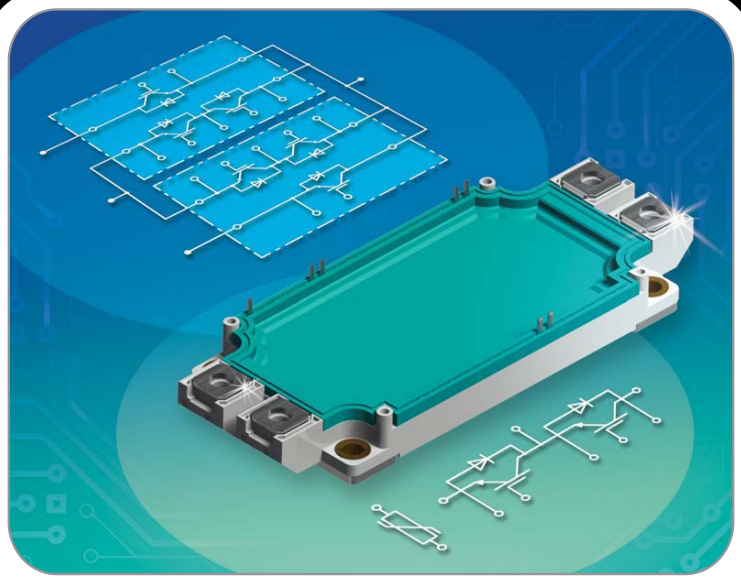

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MIXA600PF1200TSF	1200	600	Coming soon
MIXA600PF650TSF	650	490	
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MIXA225RF1200TSF	1200	250	
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Choosing the right electrolyte

Today's customary super capacitors use either propylene carbonate or acetonitrile as electrolytes. The formula of propylene carbonate is $C_4H_6O_3$. It is a water-soluble carbon acid ester which becomes liquid at -48.8 °C and boils at 242 °C. Although falling under the German Ordinance on Hazardous Substances it is regarded as an unproblematic and environmentally friendly material – as a solvent it has replaced more hazardous substances. Super capacitors using it as an electrolyte can be operated without limitation at temperatures ranging from -25 °C to +70 °C. There are, however, limitations at temperatures up to +85 °C (due to voltage and power derating). At temperatures below -25 °C the capacitors cannot be operated any longer because the electrolyte freezes. Powerstor A, B, HB, P, K and XB capacitor series use propylene carbonate as electrolyte. There are series, however, where you have a choice as for SCV-P (propylene carbonate) or SCV-A (acetonitrile).

The formula of acetonitrile is C_2H_3N. It has a higher conductivity, so capacitors using it as electrolyte have a somewhat lower ESR. It is, however, highly flammable. It becomes liquid at -45 °C and boils at +82 °C. It is deemed more critical in environmental terms and might cause poisoning because it undergoes decomposition and finally forms hydrogen cyanide (HCN) in case of fire or when swallowed. The small quantity of acetonitrile in the enclosure of the super capacitor, however, does not pose a threat to anybody. The formerly existing dangerous goods regulations related to super capacitors filled with acetonitrile no longer apply except for certain limitations or transport regulations with regard to the generally high capacitance density of super capacitors, as is the case with lithium batteries.

The Powerstor HV, PHV and XV series use actonitrile as electrolyte, whereas the M and PM series use a mixture of 50% propylene carbonate and 50% acetonitrile. Super capacitors filled with acetonitrile can already be used at -40 °C but not above +65 °C, because this is not far from boiling point. With 2.7 V instead of 2.5 V the permissible voltage might be slightly higher, which is not due to the electrolyte but to the upper limiting temperature. If it is limited at +65 °C the 2.7 V can also be realized with propylene carbonate. Which of the two electrolytes is more appropriate for a certain application must be assessed case by case. In most cases, however, propylene carbonate is the more cost-effective solution.

Round or square?

In order to exploit a specified volume to the maximum square capacitors seem to be more beneficial at first. No different from film capacitors, round windings have a superior performance and are cheaper to produce in the case of super capacitors. Compared with dense packed square capacitors, arrays are much easier to cool. Although square designs for special applications such as the SPP series from SPSCAP (see figure 6) are available, round designs are principally the better choice.

For further reference

Double layer (interfacial) http://en.wikipedia.org/wiki/Double_layer_%28interfacial%29
Excel spread sheet for calculating super capacitor UPS http://www.hy-line.de/supercapcalc
SPSCAP super capacitors http://www.hy-line.de/spscap
Powerstor super capacitors http://www.hy-line.de/powerstor

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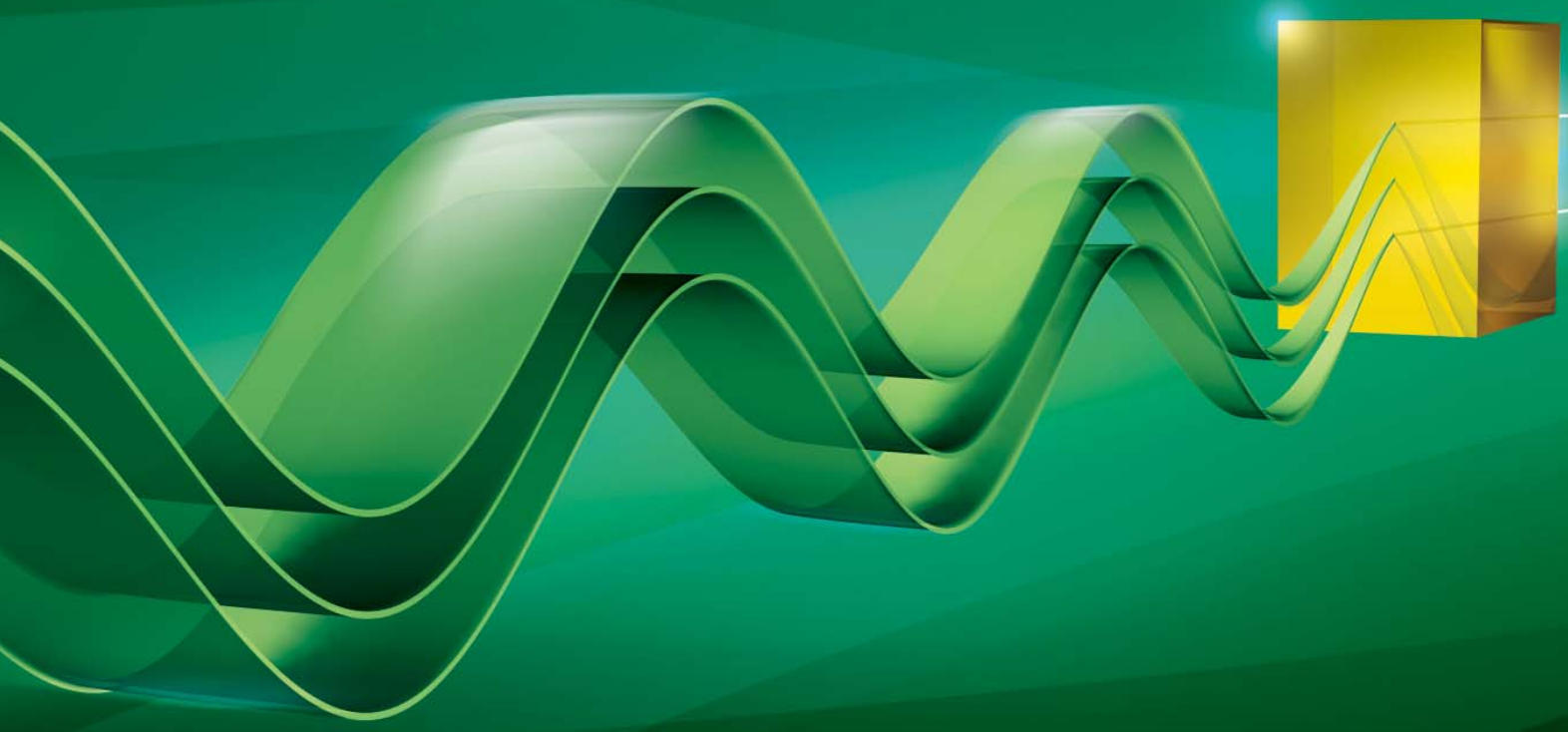

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Ultra-low Power EnerChip™ RTC with Integrated Battery

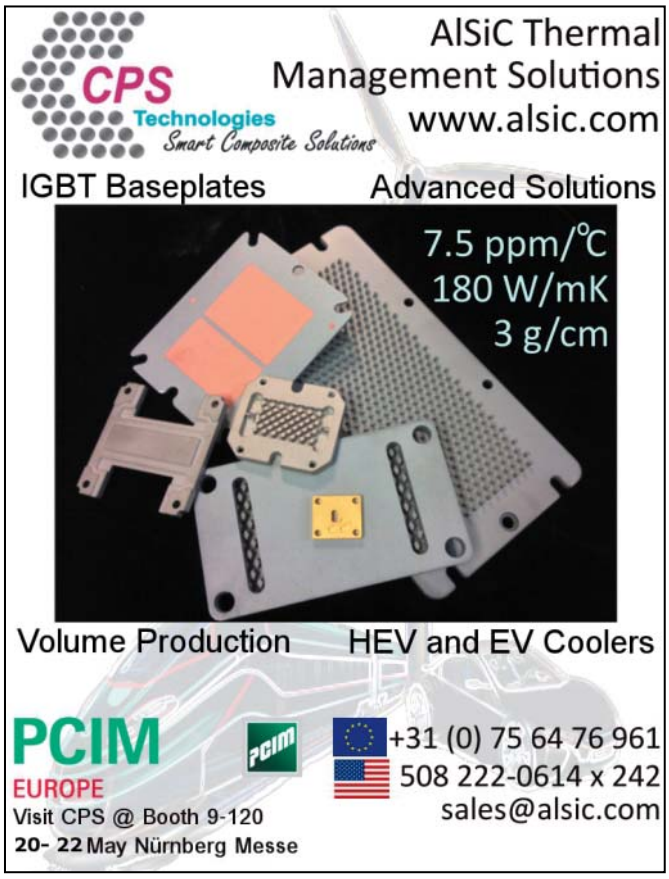
Cymbet Corporation announced the commercial release of the EnerChip™ RTC product family that combines an ultra-low power Real Time Clock with a rechargeable solid state battery and power management IC in a single 5mm x 5mm plastic package. The EnerChip RTC is the world's smallest RTC with integrated power holdover. This is accomplished by utilizing bare die RTC, EnerChip battery and PMIC devices combined into a single package that uses Surface Mount Technology (SMT) and reflow solder processes. EnerChip RTCs provide from 30 to over 100 hours of RTC power back-up per charge with thousands of recharge cycles. The EnerChip RTC is an ideal replacement for bulky and troublesome coin cell batteries and supercapacitors.

The first three devices in the EnerChip RTC product family are:

- CBC34123 that combines an NXP RTC with the EnerChip and PMIC for 30 hours power holdover and supports SPI-bus.
- CBC34803 that that combines an Ambiq RTC with the EnerChip and PMIC for 100 hours power holdover and supports I2C-bus
- CBC34813 that that combines an Ambiq RTC with the EnerChip and PMIC for 100 hours power holdover and supports SPI-bus

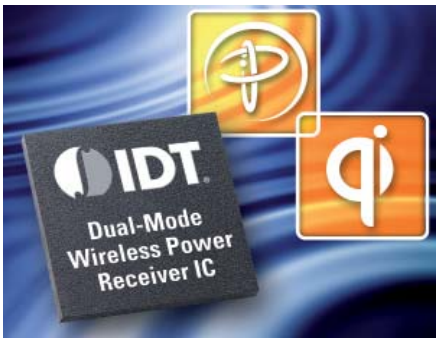
The various EnerChip RTC configurations support: Alarm and timer functions, General Purpose Outputs, XT Oscillator, 256B RAM, Calibration/Auto-calibration, RC Oscillator, Watchdog, External Interrupts, a VBAT switch, and on-chip battery charge control with power management.

www.cymbet.com



First WPC 1.1 and PMA 1.1 Dual-mode Wireless Power Receiver

Integrated Device Technology, Inc. (IDT®) announced the industry's first dual-mode wireless power receiver compatible with both the Wireless Power Consortium's (WPC) 1.1 Qi standard, as well as the Power Matter's Alliance (PMA) 1.1 standard. The innovative solution enables OEMs to use a single wireless power receiver IC to develop mobile devices fully compatible with the latest versions of both Qi and PMA charging bases. The IDTP9023 is a WPC 1.1- and PMA 1.1-compliant single-chip wireless power receiver consisting of a synchronous full-bridge rectifier, high-efficiency synchronous buck converter, and embedded microcontroller used to optimize power delivery to the mobile device's load, while minimizing application footprint, component count, and thermal dissipation. The new wireless power receiver



supports all WPC and PMA receiver coils, as well as proprietary and PCB-based coils for maximum versatility in a wide range of applications, including smart phones, tablets, sleeves, and other accessories.

"We are proud to continue our wireless power technology leadership by announcing the industry's first single-chip WPC 1.1 and PMA 1.1 dual-mode wireless power receiver solution," said Arman Naghavi, vice president and general manager of the Analog and Power Division at IDT. "Following the industry's first dual-mode solution IDT announced last year, our new device gives customers a clear upgrade path to meet the latest magnetic induction standards requirements and offer consumers full compatibility with any Qi- or PMA-certified charging base currently on the market. The chip's high-efficiency and small application footprint make it well-suited for tomorrow's ultra-thin, lightweight, and compact portable devices and accessories."

www.idt.com

High Frequency eGaN® Power Transistor Family

Efficient Power Conversion Corporation extends its family of high-speed, high performance transistors with the EPC8010 power transistor. Sold in die form, the EPC8010 is a mere 1.75 mm2 with 100 VDS. Optimized for high speed switching, the EPC8010 has a maximum $R_{DS(on)}$ of 160 milliohms and input gate charge in the hundreds of pico-coulombs.

This device has switching transition speeds in the sub nano-second range, making it uniquely capable of hard-switching applications above 10 MHz. Even beyond the 10MHz for which they were designed, this product exhibits very good small signal RF performance with high gain well into the low GHz range, making them a competitive choice for RF applications.

Applications benefiting from the low power, compact, high frequency EPC8010 include hard-switching power converters operating in the multi-megahertz range for envelope tracking, RF power amplifiers, and highly resonant wireless power transfer systems for wireless charging of mobile devices.

Additionally, an EPC9030 development board featuring two EPC8010 devices in a half-bridge configuration with minimum switching frequency of 500 kHz is available now. The purpose of this development board is to simplify the evaluation process of the EPC8010, providing a single board that can be easily connected into any existing converter.

www.epc-co.com

High-Isolation DC/DC Converters for IGBT Systems

Richardson RFPD, Inc. announced availability and full design support capabilities for a large portfolio of high-isolation DC-to-DC converters from RECOM Power, Inc. (RECOM).

Designed specifically for insulated-gate bipolar transistor (IGBT) systems, the converters' asymmetric outputs of +15V and -9V make them ideal to power IGBT drivers, replacing the need for two converters.

The devices are available with input voltages of 5VDC, 12VDC and 24VDC and offer up to 6.4kVDC/1sec isolation. The converters operate reliably at temperatures between -40 °C and +90 °C without derating, and with an efficiency of up to 85%. To meet the requirements of various IGBT applications, the devices feature a variety of pin-outs and packages (single in-line and dual in-line). They are also available with short circuit protection. All of the converters are EN60950-1 certified.

www.richardsonrfpd.com

Reverse Conducting IGBT Optimized for Induction Cooking

Infineon Technologies complements its portfolio of Reverse Conducting (RC) Soft Switching IGBT (Insulated Gate Bipolar Transistor) introducing a 1350V device with a monolithic integrated reverse conduction diode in 20A current class. The new 20A RC-H5 devices extend Infineon`s performance leadership of the RC-H family, focusing on system efficiency and demanding reliability requirements for Induction Cooking applications.

The RC-H5 provides up to 30% reduction in switching losses compared to previous generations, allowing designers to use higher frequencies of up to 30KHz. Thus, the efficiency of the system with an RC-H5 device is improved by 0.5% leading to an overall performance of the system of more than 92%. Lowered overall system costs can also be realized by using smaller inductor choices with less copper. The RC-H5 discrete IGBT is based on the ground breaking technology of the RC-H3 which remains available for existing designs.

With the RC-H5, reliability has once again been improved by reducing power dissipation and a better thermal performance, even under higher ambient temperatures of up to 175°C. Additionally the turn-on spike current has been cut by 10% which leads to less

stress on passive components in the system increasing reliability. Improved EMI behaviour is an additional benefit. As a consequence there are less filtering requirements and lower system costs for the designers.

www.infineon.com/rch5

Current Sensor with Integrated Redundancy for High-Voltage Batteries in Electric and Hybrid Vehicles

Compact size, clear cost savings and high-precision, redundant current measurement for consistently efficient energy control – the new ICB-M current sensor from Isabellenhütte satisfies the key battery management criteria for future-proof vehicle design. Using its many years of experience in battery management for electric and hybrid vehicles, Isabellenhütte has developed this current measurement system for batteries in alternative drive concepts. The new ICB-M features

two mutually independent measurement channels, which are galvanically isolated and have a separate power supply, setting it apart from the competition.

The first channel, a high-precision current sensor, ensures high measurement accuracy through direct shunt-based measurement. The measurement values are determined within a 24-bit range. The current sensor features an output rate of 1 kHz. CAN 2.0 is used for communication, with a data rate of up to 1 Mbit/s. A CAN Database Container (DBC) facilitates rapid system integration. The ICB-M provides a digital measurement channel (Channel 1) as well as an analogue Channel 2, completely galvanic isolated from the first, that relies on a magnetic measurement method and analyses the magnetic field generated by the current flow in the conductor, providing a voltage-level output in a measurement range of +/- 300 amperes.

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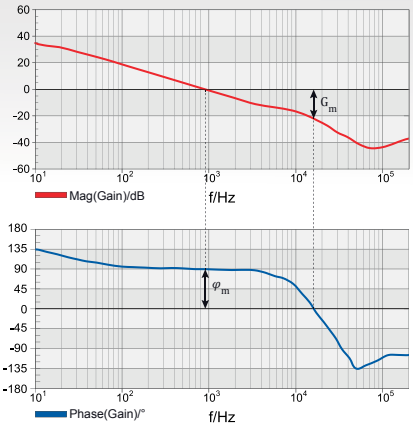

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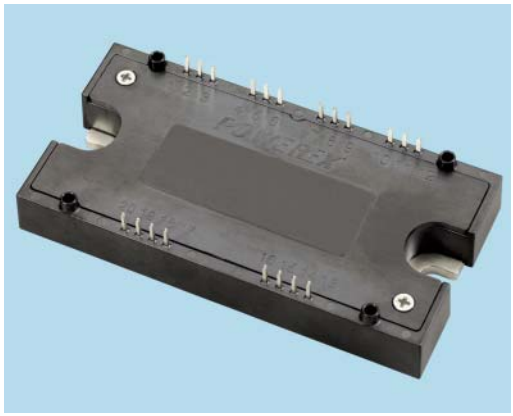

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www.pwrx.com

Wireless Power Charging Coils

Würth Elektronik eiSos has added three new wireless power charging coils to its range of wireless power transfer coils. The charging coils are characterized by a self-adhesive film on the back.
This is a distinct advantage over other coils, because it makes assembly much easier for the user.

The coils are unique with flexible ferrite shielding and are extremely thin at only 1 mm. The thin and flexible carrier material is perfectly suited for the suppression of interference above 1MHz. The new charging coils have a high Q-factor and very low DC resistance, meaning that they are recommended for maximum efficiency power transfer of up to 5W. The coils allow space-saving charging solutions in applications. Würth Elektronik eiSos will also be working in the future on new wireless power transfer coils, for both the transmitter and receiver sides. This will ensure the wide range of applications in a variety of industries can be provided with the right coils. All charging coils were evaluated and approved with chipsets from Texas Instruments and are Qi compliant.

www.we-online.com

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Vincotech, a supplier of module-based solutions for power electronics, has rolled out SiC-based products for ultra efficient, high-frequency operation in solar inverter, UPS, and battery management applications. This generation flow SiC 0 modules come in two versions. One is a flow3xPHASE 0 SiC three-phase inverter module with 3x BUCK/BOOST and split output topology; the other is the flow3xBOOST 0 SiC with three-channel boost circuits.

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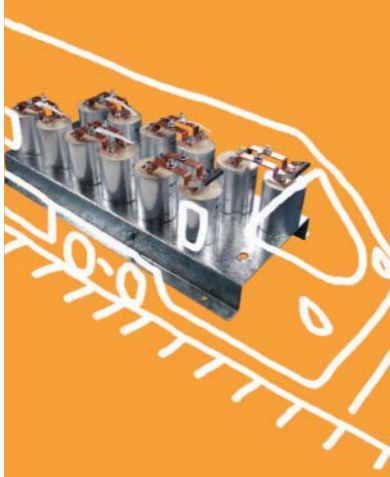

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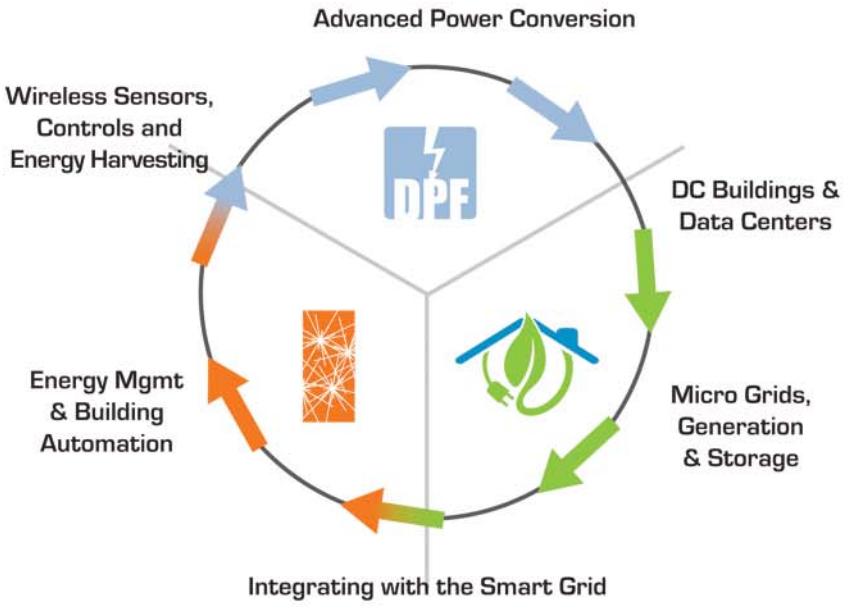

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Touch Panel Displays enable Gloved Operation in Industrial Applications

Mitsubishi Electric announced the development of two new touch-panel displays capable of intuitive, precise operation even with gloved hands.

The two wide-aspect screens feature diagonals of 7.0 inch (19 cm) with WVGA resolution and 12.1 inch (30.7 cm) with WXGA resolution. Both models feature excellent clarity through ultra-thin, highly conductive sensor lines with proprietary TFT array technologies along with durable cover glass. For excellent reliability in industrial environments, the TFT-LCD modules with PCAP touch panels, cover glass and touch panel controller are factory-installed in a proven, proprietary process.

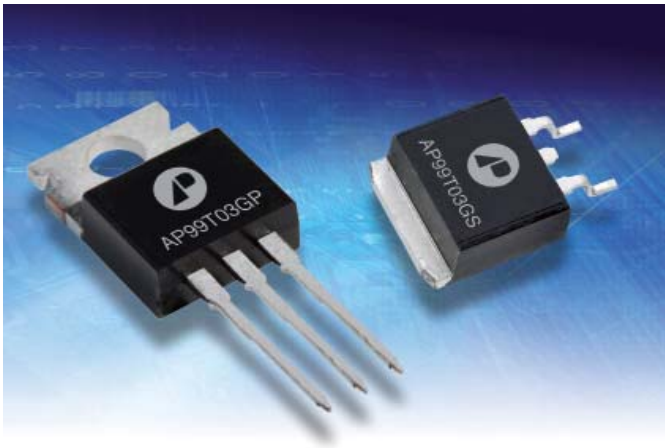
To adapt to diversified operational environments, many options are available, including optical bonding (resin bonding between the TFT-LCD module, touch-panel sensor and cover glass) for clearer images in bright environments, tempered cover glass and anti-reflection/anti-smudge surface treatments.

With the two panels, Mitsubishi Electric's lineup comprises ten different display sizes, covering the diagonal range from 6.5 to 19 inches.

www.mitsubishichips.eu/

Power MOSFETs Offer Fast Switching and Low On-Resistance

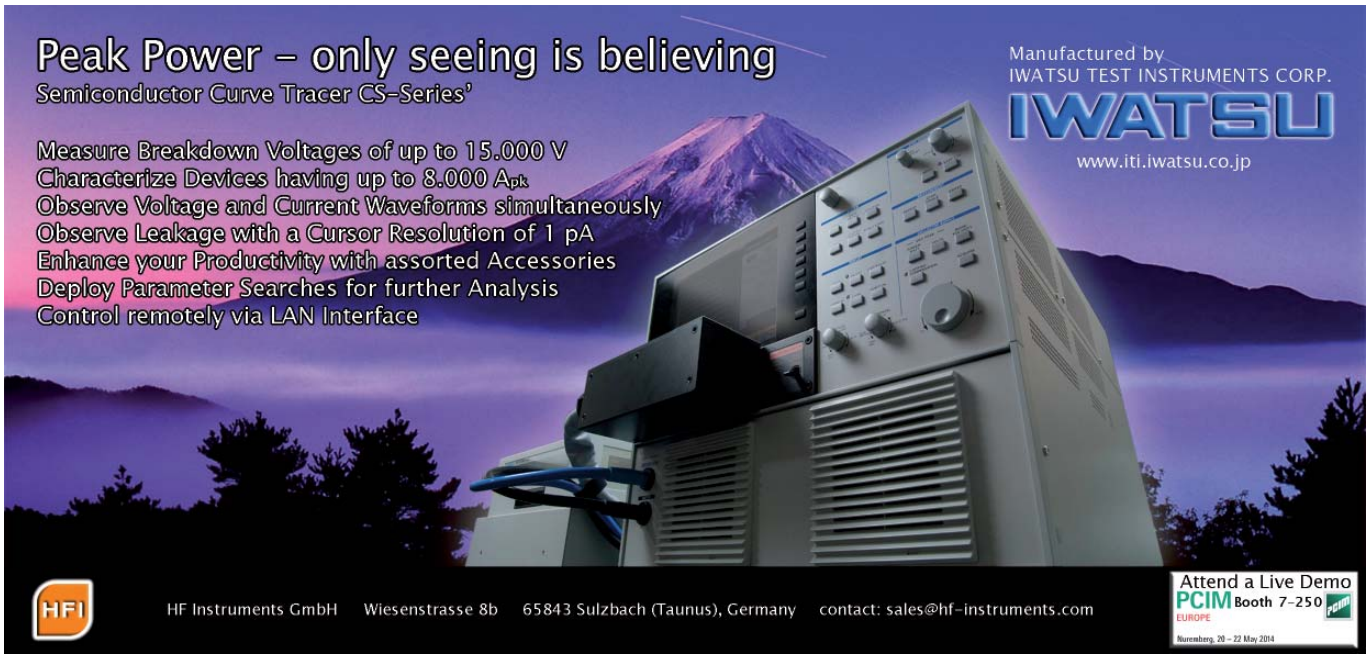
Advanced Power Electronics Corp. (USA), a leading Taiwanese manufacturer of MOS power semiconductors for DC-DC power conversion applications, has recently launched new cost-effective N-channel enhancement-mode power MOSFETs offering a fast switching performance and very low on-resistance.



The AP99T03GS-HF-3 MOSFET comes in a TO-263 package, which is widely used for commercial and industrial surface-mount applications. Devices are well-suited for low voltage applications such as DC/DC converters, and are also available as the AP99T03GP-HF-3 in a TO-220 through-hole package which is ideal for applications where a small PCB footprint or an attached heatsink is required.

Both MOSFETs benefit from simple drive requirements and offer a fast switching performance, very low on-resistance of only 2.5mΩ, a drain-source breakdown voltage of 30V, and a continuous drain current of 120A. The components are halogen-free and fully RoHS-compliant.

www.a-powerusa.com/docs/AP99T03GPS-3.pdf



8-bit PIC® Microcontroller Portfolio with 3 High-Resolution 16-bit PWMs in 8-Pin Packages

Microchip announces an expansion of its 8-bit PIC® microcontroller (MCU) portfolio with the PIC12(L)F157X family, which features multiple 16-bit PWMs with an assortment of analogue peripherals and serial communications in an 8-pin package. These MCUs deliver three full-featured 16-bit PWMs with independent timers, for applications where high resolution is needed, such as LED lighting, stepper motors, battery charging and other general-purpose applications. In addition to standard and centre-aligned PWM output modes, the peripheral also has four compare modes and can serve as an additional 16-bit timer.

The Complementary Waveform Generator (CWG), in combination with the 16-bit PWMs, can be used to create half-bridge and full-bridge drive control. The CWG is a powerful waveform generator, which can generate complementary waveforms with fine control of key parameters such as polarity, dead band and emergency shutdown states. It provides a cost-effective solution, saving both board space and component cost when driving FETs in motor-control and power-conversion applications. The CWG and 16-bit PWMs are Core Independent Peripherals (CIP) which are coupled with the 10-bit ADCs, comparator and 5-bit DAC Analogue Peripherals to enable closed-loop feedback and control. The PIC12F157X MCUs are well suited for a wide range of applications, such as indoor/outdoor LED lighting, and RGB LED colour mixing; consumer applications such as electric razors and radio-control toys; and automotive interior LED lighting.

http://www.microchip.com/get/G6RB

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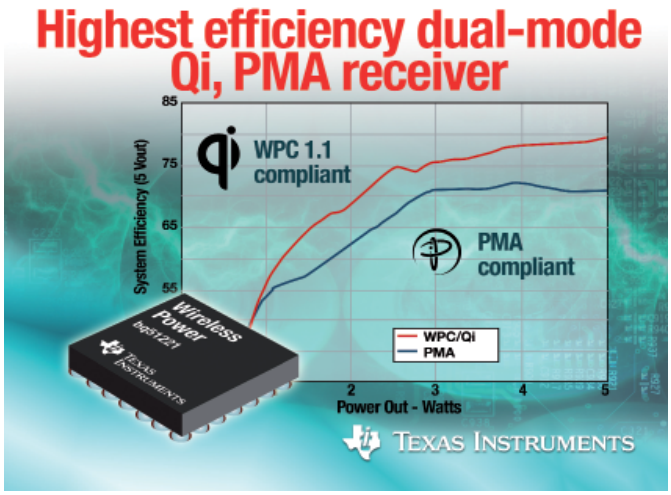
Highest Efficiency Dual-Mode Qi, PMA Wireless Power Receiver

Improving the mobile charging experience, Texas Instruments announced it is shipping in volume production the industry's smallest, most efficient wireless power receiver to support both the Wireless Power Consortium's (WPC) Qi 1.1 and Power Matters Alliance (PMA) specifications. The bq51221 inductor-less, 5-watt receiver's high efficiency and programmable output reduces power loss by as much as 50 percent compared to existing receiver solutions, allowing consumers to more efficiently and quickly charge their mobile phones, headsets and power banks from a Qi or PMA charging station. To order samples and a development kit, visit: http://www.ti.com/bq51221-pr-eu.



Features and benefits of bq51221:

Dual-mode, 5-watt receiver: Compliant with Qi 1.1 and PMA communication and control.

High efficiency for fast charge time: Achieves up to 96 percent power efficiency, and the device's adjustable output voltage helps reduce power loss by as much as 50 percent.

Industry's smallest, thinnest solution: 3.6-mm by 2.9-mm by 0.5-mm single-chip wireless power receiver achieves a solution size of 75 mm2 without the need for an inductor.

In addition to the dual-mode receiver, TI also introduced its bq51010B next-generation Qi 1.1-compliant receiver with an integrated 7-V regulated supply and foreign object detection. The single-chip receiver, also shipping in volume production, achieves 93 percent power efficiency and ensures the lowest possible power dissipation when charging a Qi-compliant smartphone.

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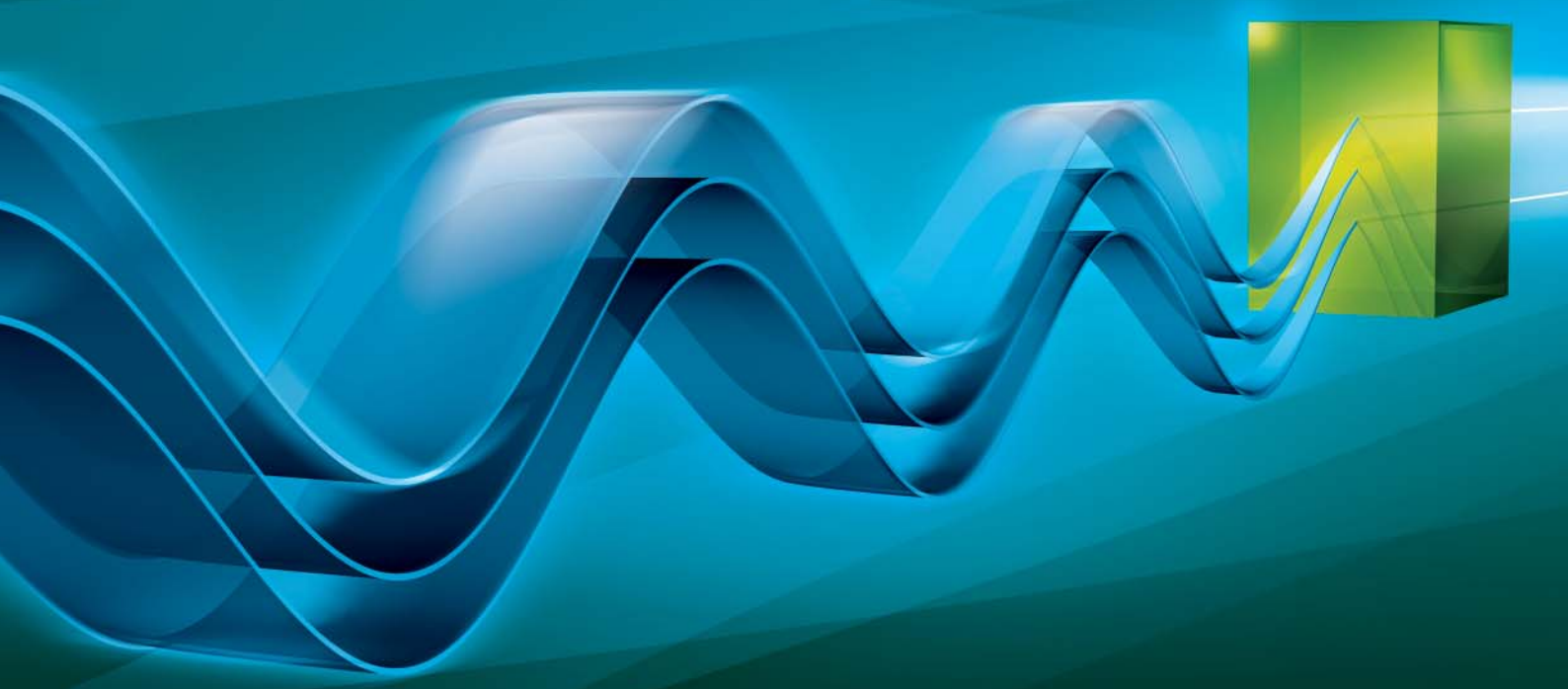

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Rugged, Reliable Ultra-fast 1400V IGBT Optimized for Induction Heating

International Rectifier has introduced a rugged, reliable ultra-fast 1400V Trench Insulated Gate Bipolar Transistor (IGBT) optimized for soft switching applications including induction cooktops and microwave ovens.

Co-packaged with an ultra-low forward voltage diode, the IRG7PK35UD1PbF utilizes IR's Gen7 thin-wafer trench technology to deliver extremely low VCE(ON) and ultra-fast switching to offer lowest conduction and switching losses for high system efficiency in induction heating applications. Expanding the voltage range of the device to 1400V enables the design of higher power single-ended parallel resonant power converters and offers additional guard band for more robust designs.

The IRG7PK35UD1PbF expands IR's proven family of IGBTs for soft-switching applications to 1400V, extending the power range of induction heating systems. IR's focus on power applications allows for optimization of devices to meet the technical requirements of various power systems.

www.irf.com

Hybrid Polymer-Aluminum Electrolytic Capacitors

Cornell Dubilier Electronics, Inc. (CDE) announced the release of type HZA Hybrid Polymer-Aluminum electrolytic capacitors. Combining the advantages of each technology, type HZA has the ultra-low ESR characteristics of conductive aluminum polymer capacitors packaged in a V-chip, SMT case with high capacitance and voltage ratings previously available only in aluminum electrolytic technology.

Capacitance values for type HZA range from 10 to 330 µF at voltage ratings from 25 to 80VDC and ripple current values exceeding 2000mA on some of larger chip sizes. When operated at their rated temperature of 105°C and rated voltage at full ripple current load, type HZA capacitors have an exceedingly long life of 10,000 hrs.

"The hybrid series gives the design engineer the best of both worlds" says Holly Good, Product Manager. "They also have superior smoothing performance at higher switching frequencies and lower temperatures." Good continued.

For inquiries, contact: Holly Good, Product Marketing Manager, hgood@cde.com, Phone: (508) 996-8561 x 136

www.cde.com

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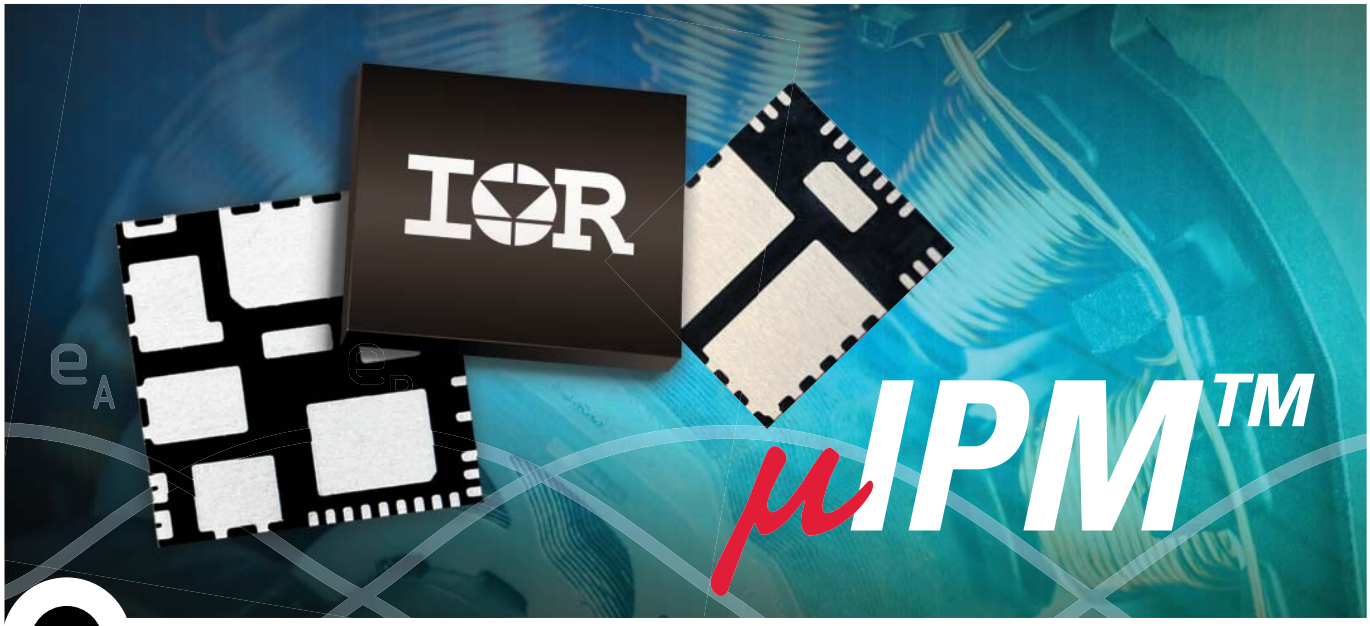

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Specifications:

Part Number	Size (mm)	Voltage	IO (DC@ 25°C)	Motor Current**		Motor Power VO=150/75VRMS	Topology
				w/o HS	w/HS		
IRSM836-024MA	12x12	250V	2A	470mA	550mA	60W/72W	3P Open Source
IRSM836-044MA	12x12	250V	4A	750mA	850mA	95W/110W	3P Open Source
IRSM836-025MA	12x12	500V	2A	360mA	440mA	93W/114W	3P Open Source
IRSM836-035MB	12x12	500V	3A	420mA	510mA	108W/135W	3P Common Source
IRSM836-035MA	12x12	500V	3A	420mA	510mA	100W/130W	3P Open Source
IRSM836-045MA	12x12	500V	4A	550mA	750mA	145W/195W	3P Open Source
IRSM808-105MH	8x9	500V	10A	1.1A	1.3A	285W/390W	Half-Bridge
IRSM807-105MH	8x9	500V	10A	1.1A	1.3A	285W/390W	Half-Bridge

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- Integrated Gate Driver IC
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- DC current ratings from 2A to 10A
- Voltage range of 250V – 500V

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- Shortens design time
- Shrinks board space requirements
- Simplicity - Eliminates Heat Sink
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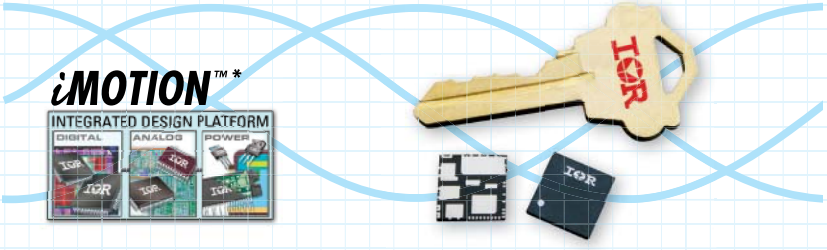
- Slashes assembly time and cost
- Simplifies procurement and inventory management
- Reference design kits available for quick evaluation on any 3-phase motor



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