

Semiconductors



01

01 PCIM 2017 held in Nurember from 16-18 May 2017.

PCIM 2017

The PCIM technical conference held every year in Nuremberg, Germany is an important event where both industry and academia gather to present and discuss next generation technologies and systems for obtaining higher levels of performance in future applications. In the PCIM 2017 conference, the technical program provided a wide range of high quality papers covering many power electronics related topics. ABB always ensures that it maintains a strong presence at this conference while highlighting the latest technological breakthroughs achieved in the company. This year, ABB Switzerland had a record number of papers with up to 12 oral and poster presentations. The focus in this brief summary will be on ABB's technical contributions at the conference while mainly highlighting the latest power semiconductor technologies covering silicon, silicon carbide, packaging and application technologies.

On the silicon IGBT device front, ABB Semiconductors presented the newly developed 4500 V / 3000 A BIGT StakPak which is regarded today as the most powerful IGBT module on the market, with both IGBT and diode functionalities integrated in a single chip. (continued on page 2)

Editorial

Dear Reader!

One should never be afraid to ask questions – and even more important is sharing the most important answers to the power community! With our new ASK portal available on our website, we have a new channel to interact with the community. More information can be found on page 2. Many questions have been asked by visitors at our booth at PCIM 2017 in Nuremberg as well. It has been once again a very successful event for Semiconductors and we would like to share a summary of ABB's technical contribution to the conference.

In this newsletter, you can also find an introduction to our new generation of StakPak modules, the release of the new HiPak Chopper modules and last but not least, an article about ISPSD 2017.

Yours,

Katja Fröhlich, PG Communications Manager

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PCIM 2017

We also presented the recent evolution of the BIGT concept with the demonstration of a 6500 V Plug-In BIGT version requiring no control and gate adaptations while achieving higher power levels and low losses. The next generation Enhanced Trench BIGT with lower losses and higher power levels was also shown in a separate paper with the demonstration of the concept in 3.3 kV HiPak and LinPak modules.

On the IGBT module and packaging technologies, new paralleling results of the new industry standard LinPak module were presented for 1700 V / 1000 A rated modules while showing close to no current miss-sharing during switching transients and short circuit operation. A paper covering the design methodology for ABB's new range of 1700 V LoPak modules highlighted the impact of the optimum design for achieving a high performance module both electrically and thermally. It is also worth noting here that a short article on ABB's recent advances for achieving a high reliability HiPak module was published in the PCIM special edition of Bodo's Power magazine.

ABB also continues to develop the next generation bipolar devices. A paper covered the recent developments of high power thyristors targeting UHVDC systems as well as the third generation of 8.5 kV and 150 mm thyristor showing very high current rat-

ing along with a substantial reduction in conduction losses. Furthermore, the latest 94 mm 4.5 kV and 6.5 kV RC-IGCTs were presented while mainly targeting MMC applications in STATCOM systems along with another paper highlighting the advantages of such a component at system level for an AC-AC railway power supply.

Finally, on silicon carbide device and packaging, ABB's Corporate Research Centre in collaboration with ABB Semiconductors presented a SiC LinPak module concept which was fully populated with 1700 V SiC MOSFETs. A full set of static and dynamic results were provided while highlighting the advantage of the new low inductance module on the switching performance. In addition, a hybrid 62Pak module with both Si-IGBT and SiC diodes was the topic of a separate paper highlighting the strong reliability performance of the module under high voltage, high temperature and high humidity levels. Another paper studied the interconnection technologies for achieving high temperature and high reliability performance for future SiC packages. Finally, a joint paper with ROHM and the characterization of high voltage SiC MOSFETs rated up to 6500 V was also presented.

As discussed above, ABB continues to demonstrate the unique position it holds in the medium to high power semiconductor markets having a wide range of technology and product platforms available for targeting existing and future applications. (mr)

IRIS Certification

Following an audit and assessment on premises in Lenzburg on 27 – 29 March 2017, ABB Semiconductors has been awarded the International Railway Industry Standard (IRIS) Revision 02 with re-certification valid until 24. Juni 2018 for the activity of design, development and manufacturing for the scopes of certification 4 (Power systems), 5 (Propulsion), 6 (Auxiliary systems) of high power semiconductor devices and modules. IRIS is an internationally acknowledged standard that defines the high requirements for all business processes as required by the rail industry. It is based in ISO 9001.

This additional IRIS certification, together with ISO 9001, ISO 14001 and BS OHS 18001, confirms ABB's compliance with international standards in the manufacturing of high power semiconductor components and highlights ABB's cross-divisional offering for the rail sector. (kf)

ASK

Semiconductors is often approached for specific questions regarding our power semiconductors and their applications. Until recently, these questions have been received by our general customer support, either as phone calls or emails.

But what if we shared the outcome of our discussions on a publicly available platform instead of one-to-one conversations? An open platform means that people can see and share answers to questions with the whole online community. It allows customers, suppliers and other stakeholders to have direct contact with our experts to address any questions. And, even better, people can share our passion for semiconductor technology on a public space.

You can already find answers to the most frequently asked questions on ABB's power semiconductors on the site. Now, it's your turn: just ASK your question! (kf)

Products in the pipeline				
Part nr.	Voltage	Current	Housing	Description
5SNG 0225R170300	1700	2 x 225	LoPak1	LoPak1: low profile phase leg module
5SNG 0300R170300	1700	2 x 300	LoPak1	LoPak1: low profile phase leg module
5SNG 0450R170300	1700	2 x 450	LoPak1	LoPak1: low profile phase leg module
5SNG 0450X330300	3300	2 x 450	LinPak	Ultra low inductive phase leg module
5SED 0520S2240	2200	450	50Pak	Dual diode in 50 mm standard package
5SED 0890T2240	2200	890	60Pak	Dual diode in 60 mm standard package
5SHX 30L4520	4500	3000	L	Reverse conducting integrated IGCT
5STP 33U8500	8500	3310	U	Phase control thyristor

Product features

1700 V / 2 x 225 .. 450 A LoPak1

- Industry standard compatibility, compact and low-profile phase leg module with copper baseplate
- Excellent switching behavior
- 1700 V SPT⁺⁺ chipset featuring lowest losses and highest ruggedness up to 175 °C operation temperature
- Customer sampling with frozen design starting in Q3 2017

3300 V LinPak

- Ultra low inductive module for fast low-loss IGBT/diode chipsets
- Modular thanks to easy paralleling with negligible derating
- 1700 V SPT⁺⁺ chipset featuring lowest losses and highest ruggedness up to 175 °C operation temperature
- 3300 V SPT⁺ chipset offers lowest losses and unrivaled robustness up to 150 °C
- LinPak 3300 V is in final sampling. Mass production planned for Q4 2017

2200 V dual diode modules

- Pressure contact technology modules with the highest reliability and quality in terms of power

cycling capabilities insulated baseplate with aluminum nitride ceramic achieves excellent heat transfer and high insulation voltage

4500 V RC-IGCT

- Optimized for the use in applications like industrial MVD, wind-power conversion, STAT-COMs, power quality and railway inerties, to name a few
- Main advantages are the very low on-state losses provided by the thyristor structure, the negligible turn-on losses in the semiconductor and the high reliability of the devices
- The HPT⁺ IGCT cell leads to increased performance at high junction temperatures. Changes to the package led to a great reduction of the thermal resistance as well as the inherent capacity for handling surge currents

8500 V phase control thyristor

- Latest high performance thyristor generation, developed with focus on minimizing the losses and maximizing the power rating
- Addressing demanding high-end industrial applications such as pumped hydro, drives and SVC

Product change notifications	Part nr.	Subject	PCN issuing date
IGBT 17-02	All StakPaks	Change in adhesive tape for cover mounting	May 2015
IGBT 17-03	All wafer and bare die products (12, 76 and 86)	New labels including 2D code	May 2015
GTO 17-01	GTOs in H and J housing	Additional housing supplier	Februar 2017

New qualified products

Part nr.	Voltage	Current	Housing	Description
5SLZ 12L1700	1700	100	G-size	Diode die 11.4 x 6.8 mm ²
5SLZ 12L1700	1700	225	L-size	Diode die 9.3 x 15.9 mm ²
5SMY 12P1730	1700	225	P-size	IGBT die 16.9 x 15.9 mm ²
5SNG 1000X170300	1700	2 x 1000	LinPak	LinPak: ultra low inductive phase leg module
5SNE 0800G450300	4500	800	G	HiPak Chopper module
5STP 48Y7200	7200	4840	Y	Phase control thyristor
5STP 45Y8500	8500	4260	Y	Phase control thyristor

Product features

1700V SPT⁺⁺/FSA new chip sizes

- New chip-sizes featuring the latest SPT⁺⁺/FSA technology
- Lowest losses
- Up to 175 °C operation temperature

1700 V LinPak

- Ultra low inductive module for fast low-loss IGBT/diode chipsets
- Modular thanks to easy paralleling with negligible derating 1700 V SPT⁺⁺ chipset featuring lowest losses and highest ruggedness up to 175 °C operation temperature
- 1700 V SPT⁺⁺ chipset featuring lowest losses and highest ruggedness up to 175 °C operation temperature

4500 V HiPak Chopper module

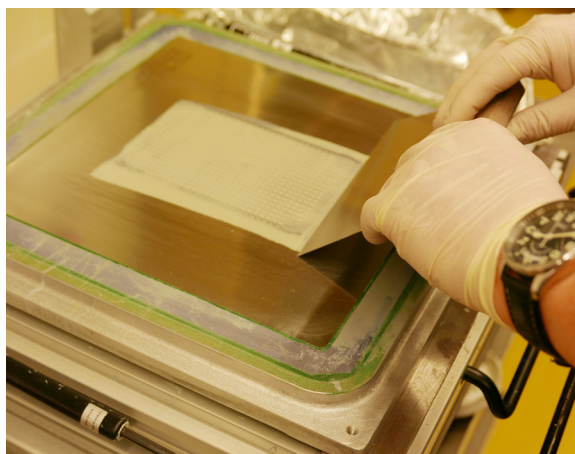
- Module for Chopper application featuring the latest improved HiPak technologies
- 4500 V 800 A SPT⁺ IGBT including free-wheeling diode plus reversed 800 A SPT⁺ Diode for free-wheeling of the load

7200 V and 8500 V PCTs

- Latest high performance thyristor generation, developed with focus on minimizing the losses and maximizing the power rating
- Addressing demanding high-end industrial applications such as pumped hydro, drives and SVC

New Application note Mounting instructions for LinPak

02 Applying the paste onto the stencil using a scraper



02

We recently released the 1700 V LinPak for mass-production and the 3300 V LinPak is in sampling phase with the final design. The LinPak is an innovative new product that is highly scalable and features excellent reliability. A proper usage of the LinPak ensures our customers all the benefits offered by this new module. Thus the application note Mounting Instructions for LinPak gives clear guidance on how to assemble the LinPak module

into a converter, but as well gives guidelines for a proper converter design maximizing the usage of the module. The application note "Mounting instructions for LinPak modules" deals with the following topics:

Converter design

- Gate-drive design recommendations
- Mechanical design recommendations for bus-bar and heat sink
- Considerations about climatic conditions

Assembly guidelines

- Application of thermal grease for optimal heat-transfer including stencil drawings for stencil printing
- Proper mounting procedures including torque values and limitation of terminal forces
- ESD protection considerations

The best practice procedures and design recommendations given in the mounting instruction help the user to design the power inverter right from the beginning and set-up his inverter assembly process in order to avoid early field failures due to module mishandling. Also proper assembly instructions help our customer to start with highest assembly yields and thus lower his manufacturing costs.

The full application note 5SYA 2107 is available for download on www.abb.com/semiconductors. (rs)

New generation of StakPak modules

— 03 New 4.5 kV StakPak module, the first commercially available high voltage module equipped with BIGT-chips.

— 04 New HiPak modules in Chopper configuration for 3300 V and 4500 V.

ABB introduces the next generation of StakPak modules employing 4500 V BIGT chips which combine both IGBT and diode mode operations in a single structure. This newly developed chip has been optimized for hard switching applications, which together with the improved StakPak module layout yields the most powerful IGBT-based device up to date with a current rating of 3000 A. One of the most important features of this device is its high surge current capability, which is achieved independently of the gate-driving conditions.

With the new BIGT chip, the current rating can be increased while having a better diode capability if compared with the diode capability offered by the 1:1 chip ratio. The 4 submodules version of the 4500 V BIGT StakPak can be rated up to 2000 A (500 A per submodule) and a 6 submodules version will achieve 3000 A without sacrificing diode performance.

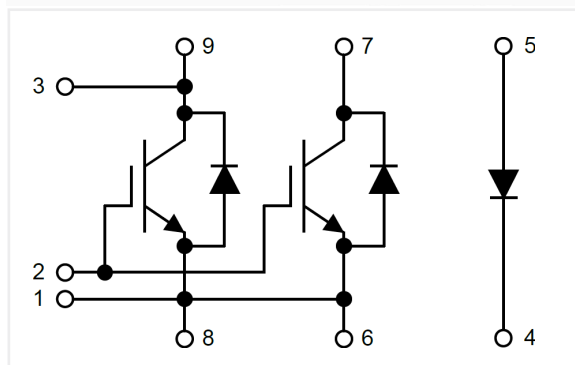
This StakPak devices enable the development of a

new generation of ABB HVDC Light systems with power rating of 3 GW, lower losses and better performance. The same devices can be used for DC-breaker applications. (et)



03

Release of the new HiPak Chopper modules



04

ABB introduces two new Chopper modules to its HiPak family. The new products feature the well established reliability of the ABB HiPak power modules with highest load-cycling capability. The new HiPak Chopper modules feature an IGBT with antiparallel free-wheeling diode and an additional separate diode to free-wheel the copper impedance or serve as a neutral point diode in three level inverters. This modules are an ideal solution for resistive voltage limiting Choppers or to simplify the built of three level converters.

The new chopper modules are available as 4500 V version with a current rating of 800 A and 3300 V with a current rating of 1000 A. Both versions feature the highly rugged and low loss SPT+ chip technology that has proven its quality in numerous demanding applications such as in traction, in T&D and in renewables.

The new modules can be ordered with the following part numbers:

- 4500V 800A Chopper: 5SNE 0800G450300
- 3300V 1000A Chopper: 5SNE 1000E330300 (rs)



05

ABB Semiconductors at the ISPSD 2017

05 29th ISPSD 2017 in Sapporo, from May 28 – June 1, 2017.

International Symposium on Power Semiconductor Devices and ICs is the most important technical forum presenting the latest achievements in power semiconductors. 225 papers were submitted from 22 countries. 41 papers were selected for oral (18 %) and 76 for poster presentations (overall 52 %). 568 participants is the new record of the event. ABB Semiconductors and Corporate Research presented the following papers:

- M. Rahimo, C. Papadopoulos, C. Corvasce, A. Kopta, “An Advanced Bimode Insulated Gate Transistor BIGT with Low Diode Conduction Losses under a Positive Gate Bias”.

The latest development of our 3.3 kV RCIGBT called

Plug-in BIGT, which newly provides a close to superior performance of the internal diode. Consequently, standard IGBTs can be replaced by the Pi-BIGTs without any arrangements in gate control.

- P. Diaz Reigosa, F. Iannuzo, M. Rahimo, “TCAD Analysis of Short-Circuit Oscillations in IGBTs”. This poster analysis the 3.3 kV IGBT operation under short circuit conditions which might lead to gate voltage oscillatory effects caused by peculiar storage effects.

- A. Mihaila, E. Bianda, L. Knoll, U. Vermulapati, L. Kranz, G. Alfieri, V. Soler, P. Godignon, C. Papadopoulos, M. Rahimo, “Experimental investigation of SiC 6.5 kV JBS diode Safe Operating Area”. Comparison of dynamic performance of the Si and SiC diodes up to the 5 kV DC link voltage. Parallel operation of six SiC chips provides the maximal turn-off current capability of 40 A per chip.

- L. Knoll, A. Mihaila, F. Bauer, V. Sundamoorthy, E. Bianda, R. Minimisawa, L. Kranz, M. Bellini, U. Vermulapati, H. Bartolf, S. Kicin, S. Skibin, C. Papadopoulos, M. Rahimo, “Robust 3.3 kV Silicon Carbide MOSFETs with Surge and Short Circuit Capability”.

Demonstration of the outstanding robustness of our SiC MOSFET technology. The best in class SC capability of 10 μ s demonstrated up to the $V_D = 1.8$ kV.

While the IGBT papers confirmed the long-term competence on silicon, the SiC papers have demonstrated the new competence coming along with the low inductance packaging concept LINPAK. We are looking forward to the next ISPSD, which will be held in Chicago in May 2018. (jv)

Publications calendar

- Bodo’s Power Systems, February 2017
“The Next Generation Bimode Insulated Gate Transistors Based on Enhanced Trench Technology”
- Bodo’s Power Systems, March 2017
” High current welding diodes for demanding industrial applications”
- Product catalog 2017, Februar 2017
- Product brochure 2017, April 2017
- Bodo’s Power Systems, May 2017

“High Humidity Robustness of ABB’s IGBTs and Diodes”

- Bodo’s Power Systems, July 2017
“A New Thyristor Platform Optimized for 10 GW UHVDC Transmission”

All published publications are available for download on www.abb.com/semiconductors.

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