news

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ABB Semiconductors
September 2014

Record performance with IGCTs

As more and more intermittent wind and solar power generation capacity is added to the electricity grid, demanding high-power applications like energy storage are gaining in importance. Pumped storage power plants, such as those found in the Swiss Alps, are ideal partners for the expanding use of solar and wind. Storage plants behave like huge batteries, ensuring the necessary balance between production and consumption. Therefore, when power is plentiful, water is pumped from a lower altitude lake to replenish a higher altitude lake, where it can remain stored for a long time. When power is needed, water is released, instantly turning turbines as the water falls to rapidly generate electricity. Pumped storage is playing an increasing role in grid regulation and assuring the continuity of supply.

ABB has installed the world's most powerful frequency converter for variable speed pumped hydropower application to the Grimsel 2 plant in Switzerland. This plant connects the upper reservoir of the glacier water fed Lake Oberaar (2,303 meters above sea level) to the more than 400 m lower Lake Grimsel.
One of the four synchronous generator/motor sets has been upgraded from fixed speed to variable speed by means of more than 1,000 IGCTs in ABB's PCS 8000 power converters. Therefore, the synchronous machine can now operate between 600 and 765 rpm in pump mode and can thus be controlled more quickly and flexibly according to the surplus energy and it uses water more efficiently as a resource for electricity production. **(ch/bb)**

Highlights

Editorial

Grimsel in the Swiss Alps is a nice place to escape the hot summer in Switzerland … This is, obviously, not the reason I am mentioning it here, Grimsel is also a place where the latest record frequency converter from ABB, taking advantage of ABB's great IGCTs, was installed. More than 1,000 IGCTs make sure that the pumped storage power plant Grimsel 2 can operate more flexibly and uses water more efficiently as a resource for electricity production. Consistent with the cover story on the pumped hydro power storage plant Grimsel 2 featuring IGCTs, the "Application in focus", "Technology in focus" and "Product in focus" articles are about demanding high-power applications, the latest IGCT technology HPT+ and the 4.5 kV asymmetric IGCT portfolio on pages 3, 6 and 5, respectively.
In this issue we also proudly present the LinPak, our latest low-inductance, phase-leg module (page 4) which will feature very high current density, excellent paralleling capabilities, an integrated temperature sensor and a dedicated mounting area for a gate drive board.
The application note we summarize in this newsletter is "Mounting instructions for HiPaks" (page 3). You can find the full application note as well as all other 24 ABB application notes on our website at www.abb.com/semiconductors. Go there and take advantage of this huge collection of high-power semiconductor know-how!
Last but not least, don't miss to read Jürgen Winterer's parting words as Local Business Unit Manager ABB Semiconductors in Prague and welcome Mojmír Balous, his successor (both page 2) and Florian Weber, our new Technical Customer Support Engineer (page 3).

Yours, Christoph Holtmann
PG Communications Manager

Jürgen Winterer's parting words

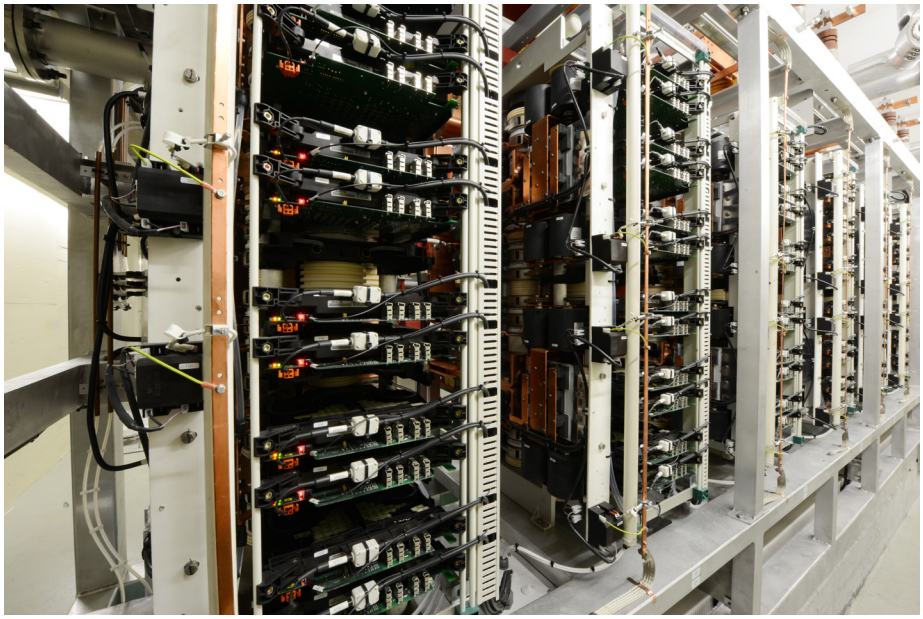
Dear customers, dear colleagues
After being in the role of the local business unit (LBU) manager Semiconductors for Power Systems in Prague, Czech Republic, for the past 4 years, it's time for me to move on. It was an exciting time, starting with the acquisition of a well-established local semiconductor company and its integration into the big ABB world. And then to learn about the customers' needs and products. I had the chance to see most of the markets and to personally meet many interesting and engaged people. Certainly, there have been critical and challenging moments. Nevertheless, we have been able to overcome those with the great know-how and dedication of the team in Prague. In the past 4 years I also had the chance to make some renovations and investments in the Prague unit, leading to what I believe is a state-of-the-art manufacturing today.
I will certainly miss the cooperation, you all and in particular the great team in Prague.
I wish you all good luck and great business for the future.
Please give your continued support to my successor, Mojmír Balous, who formally took over as of September 1st. I'm sure he will lead ABB Semiconductors in Prague to the next level of success!
Yours,
Jürgen Winterer

Welcome Mojmír Balous

We are pleased to inform that Mr. Mojmír Balous has been appointed as LBU Manager Semiconductors for Power Systems, Czech Republic, succeeding Jürgen Winterer who took over a new role within ABB. After a transition phase in July and August, he officially took over responsibility in Prague on September 1st.
Mojmír Balous holds a master's degree in Electrical Power Engineering from the Czech Technical University, Prague, and a Master of Business Administration (MBA) degree from Rochester Institute of Technology, New York. He has more than 15 years of experience in general management and held various top management positions in several Czech and international technical companies before he joined ABB.
Mojmír says: „Reviewing my education and professional career I am coming back to the roots. My first employment was in R&D of power supplies, which also used power semiconductors. Although the technology has progressed significantly since then, the physical principles remain the same and I'm looking forward to my new task!"
In his new role Mojmír reports to Dr. Jürgen Bernauer, Global Product Group Manager Semiconductors in Lenzburg, Switzerland, and to Jaroslav Veselý, Local Division Manager Power Systems in Prague, Czech Republic.
Please join us in thanking Jürgen Winterer for his contributions in the last four years since the acquisition and in wishing Mojmír great success with his new responsibilities in Prague.

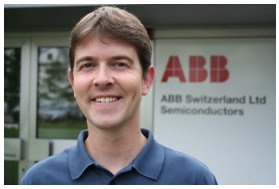
Application in focus
IGCTs for demanding high-power applications

As reported in the cover story, ABB has installed the world's most powerful frequency converter for variable speed pumped hydropower to the Grimsel 2 plant in Switzerland. This Grimsel 2 pumped storage power plant is equipped with four 100 megavolt amperes (MVA) synchronous units. Each unit has a separate Francis turbine and pump on the same shaft to either generate electricity or pump water. Including its dedicated transformers, the 100 MVA converter is around 10 meters long and 7 meters wide and is housed on two floors behind an imposing machine hall. This record converter for Grimsel, however, is only one example of many where the Integrated Gate-Controlled Thyristor (IGCT) is used. The IGCT is the semiconductor of choice also for many other demanding high-power applications such as medium voltage drives (MVD), marine drives, co-generation, wind turbine converters, interties and STATCOMs. With its low on-state voltage drop the IGCT is also an interesting option for high power multi-level converters for various purposes. IGCTs deliver highest power density and reliability and can easily be optimized to feature a low on-state voltage or low switching losses just as required by the particular application (see also "Product in focus" on page 5. **(ch/bb)**



More than 1,000 IGCTs enable the pumped storage power plant Grimsel 2 to operate more flexibly and efficiently.

New technical customer support engineer



We are pleased to announce the appointment of Florian Weber as new Technical Customer Support Engineer for ABB Semiconductors, effective June 1st, 2014.
He provides application support to our customers and distributors, leads design-in projects and advises our internal sales team of technical questions.
Florian holds a degree in Electrical Engineering from University of Applied Sciences (UAS) Aargau, Switzerland. Before joining ABB Semiconductors he was working for 11 years in power hardware development at ABB MV Drives.

Application note
Mounting instructions for HiPaks

Ever wondered how to build an inverter around ABB HiPak modules? Then we strongly recommend to read the application note "Mounting instructions for HiPak modules", which is summarized here and covers the following topics:

1. ESD considerations
The mounting instructions start with general ESD handling considerations. It is important to avoid ESD related damages when handling IGBT modules in the workshop or lab.

2. Terminal connection and SOA
Guidelines on a proper busbar design are presented in order enable low-inductive and homogenous electrical connections, which are crucial to operate the IGBT within its safe operation area (SOA). In addition, mechanical design guidelines are presented to prevent mechanical overstress of the modules even under shock and vibration conditions.

3. Gate drive
Some basic design rules for gate drive design are proposed including active clamping to limit the voltage stress onto the IGBTs.

4. Application of thermal paste
Very crucial for a reliable operation over the whole lifetime is good deheating of IGBT modules. In this chapter the proper application of thermal paste is described including good practice examples.

5. Mounting the module
Did you know that it is important to keep a dedicated sequence to torque the mounting screws, and that the required torque has to stay within certain limits? Like for your car, you don't want to lose a wheel during driving, you do not like to lose connection to an IGBT on a train. The mounting instructions tell you how to screw the module safely onto the heat sink and the busbar. Finally, the maximum forces allowed to be applied during the mounting process of the module are given. Reading carefully the mounting instruction prior to the first inverter design is strongly recommended. Following the mounting instruction guidelines solves a majority of possible later field problems, which are quite often due to simple connection issues or inadequate designs of connections. **(rs)**

New qualified products BiMOS and bipolar

Part nr.	Voltage	Current	Description	Housing
5STF 23H2040	2,000 V	2,322 A	fast switching thyristor	H housing
5STF 28H2060	2,000 V	2,667 A	fast switching thyristor	H housing
5SDD 55L5500	5,500 V	5,370 A	rectifier diode	L housing
5SDD 55M5500	5,500 V	4,850	rectifier diode	M housing

Product features

2,000 V fast thyristors in H housing

- Special cathode pattern with amplifying gate structure and lifetime control for low turn-on and turn-off losses
- Low on-state voltage drop together with alloyed technology for excellent current rating
- Two optimised types: 2,700 A / 60 µs and 2,300 A / 40 µs (I_{TAV}/t_q)
- Target market: 10 MW range induction melting, pulse power and fast switching applications

5,500 V diode:

- Alloyed technology with excellent surge current ratings
- Operating temperature from -40 °C up to 190 °C
- Reduced clamping force requirements due to smaller diode diameter
- Target market: industry and traction

Products in the pipeline BiMOS and bipolar

Part nr.	Voltage	Current	Description	Housing
5SDF 20L4521	4,500 V	1,950 A	IGBT diode	L housing
5SHZ 15H6500	6,500 V	1,500 A	Reverse blocking IGCT	H housing

Product features

4,500 V fast diode for IGBT operation

- Optimized for IGBT operation
- High RBSOA up to high di/dt
- Optimized for low switching losses
- Cosmic radiation withstand rating
- Target market: developed to operate safely in power electronic circuits employing IGBT and IEGT press-packs, where di/dts up to 5 kA/µs are especially required. This is possible thanks to a doping profile of the silicon wafer, optimized for a wide range of current densities and di/dts

6,500 V reverse blocking (RB) IGCT

- Capable of blocking reverse voltage (symmetrical IGCT)
- Low on-state losses and highest power density
- Highest inverter efficiencies
- Target market: The RB-IGCT is the power switch of choice for CSI e.g. for medium voltage drive systems as well for breaker applications

Process change notifications

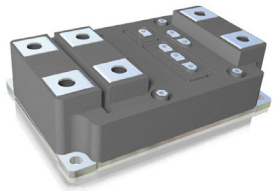
PCN nr.	Part nr.	Subject	PCN issuing date
IGBT 14-06	5SNA 3600E170300 / 5SNA 2400E170305 and adapted standards	substrate RG integrated in chip	5 Aug 2014
PCT 14-04	5STP 03D6500, 5STP 08F6500	Back end production line	19 Sep 2014

LinPak

ABB presents the LinPak, a new IGBT phase-leg module outline which features

- Very low inductance
- High current density
- Excellent paralleling capabilities
- Integrated temperature sensor
- Dedicated mounting area for gate drive board

The first modules to be developed will be 1,700 V / 2 x 900 A (samples in 2015) and 3,300 V / 2 x 450 A rated AlSiC-based LinPaks for demanding traction applications. Cu-based industrial LinPaks with 1,700 V / 2 x 900 A and 1,200 V / 2 x 1,000 A ratings as well as 4.5 kV and 6.5 kV high-voltage traction versions with the same footprint, but rearranged electrical connections in order to cope with higher clearance and creepage requirements will be introduced next.
For more information about the new LinPak please call or email, or visit our website at www.abb.com/semiconductors. **(rs)**

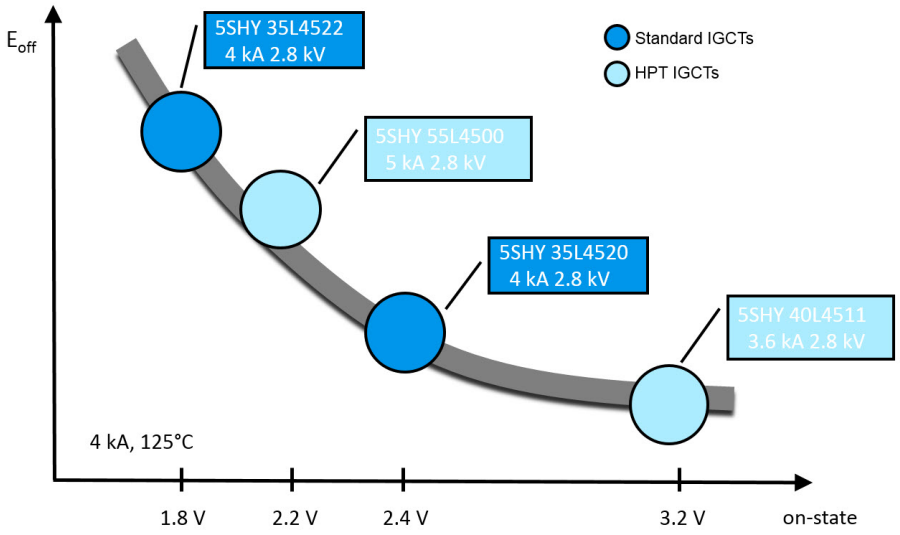


Phased-out products BiMOS and bipolar

Material	Last deliveries
5SDD 10T1800	Dec 2014
5SDD 38F2000	Dec 2014
5SDD 17F6000	Dec 2014
5SDD 92Z0200	Dec 2014
5SDD 92Z0400	Dec 2014
5SDD 0105Z0400	Dec 2014
5SDD 0135Z0200	Dec 2014
5SDD 0135Z0400	Dec 2014
5SDF 90Z0400	Dec 2014
5SDF 0103Z0400	Dec 2014
5SDF 0131Z0400	Dec 2014
5SMX 12L2520	Nov. 2014
5SLX 12L2510	Nov 2014
5SMX 12/76/86E1280	Sep 2016
5SMX 12/76/86H1280	Sep 2016
5SMX 12/76/86K1280	Sep 2016
5SMX 12/76/86L1280	Sep 2016

Product in focus
Asymmetric 4.5 kV IGCTs

Since different applications require different medium voltage drive characteristics, the installed power semiconductors need to be differently tuned to have the right trade-off between conduction and turn-off losses for the given use. The basic phenomenon making the tuning possible is that the operation of bipolar power devices, like IGCTs, is based on the injection of charged carriers (electrons and holes) into the base regions, where they recombine and annihilate after a certain time called carrier lifetime. This lifetime can be reduced by electron or ion (proton or helium) irradiation. When the processed IGCT wafer leaves the wafer manufacturing it has a long life time meaning that it in its original state has a low on-state voltage but high turn-off losses. By selecting the irradiation dose (number of impinging electrons or ions per device area and time), the concentration of generated point defects in the silicon bulk can be controlled and the required lifetime achieved. Higher irradiation doses achieve lower turn-off losses and high ruggedness during fast switching at the price of increased on-state voltage.
For the commonly used 4.5 kV asymmetric IGCT ABB offers four predefined standard devices. Two with the standard technology and two with the HPT technology featuring an increased turn-off capability. The difference between the two technologies is the improved switching capability for the HPT technology. Each of these devices has its unique irradiation scheme giving four devices with different electrical characteristics making it easy to find the device needed for a specific application. The figure below shows the four standard IGCTs in their respective position on the conduction (on-state) versus turn-off (Eoff) losses trade-off curve. For applications with a high switching frequency the 5SHY 40L4511 would normally be the device of choice whereas the 5SHY 35L4522 is tailored for applications with a low switching frequency. The devices 5SHY 55L4500 and 35L4520 are aiming for the golden mean. In special cases where it would be advantageous to have a device located somewhere in-between the predefined standard devices a customer specific solution can easily be realized to optimize the trade-off for its given application. Adjusting the on-state voltage and turn-off losses impacts other parameters, such as surge current, but there are no fundamental differences caused by the irradiation. Due to this it is possible to use the same gate unit for all four standard devices and possible customer specific devices in-between without the need for device dependent adjustments. **(ch/bb)**



Trade-off curve for ABBs standard 4.5 kV asymmetric IGCTs.

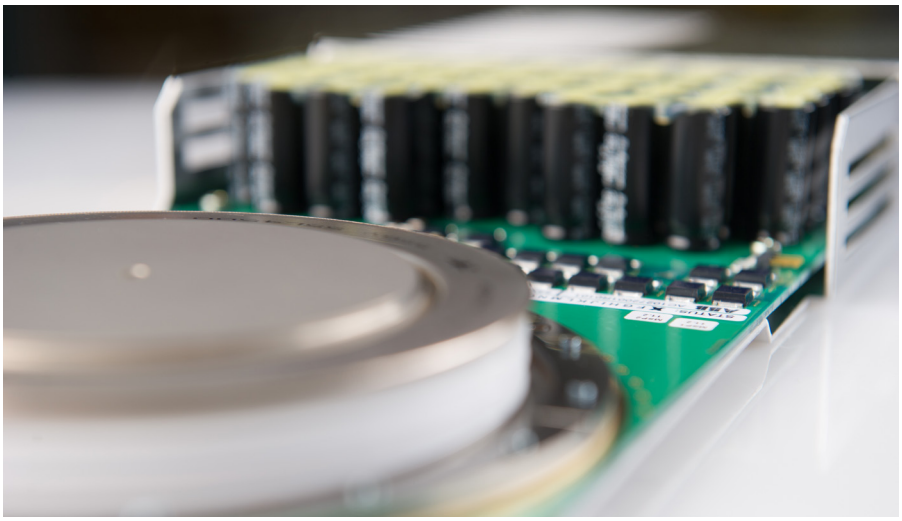
Portrait:
ABB distributor
NIEC-Nihon Inter Electronics Corporation

Nihon Inter Electronics Corporation

Nihon Inter Electronics Corp (NIEC), established in Kanagawa, Japan, in 1957, now listed on the second section of the Tokyo Stock Exchange, is specialized in R&D, manufacturing and selling of power semiconductor devices to power supply, renewable energy and automotive applications as well as distributing electrical components (units). Since 1995, NIEC distributes ABB Semiconductors' products to Japanese customers. NIEC has seven subsidiaries in Japan and around East Asia with over 500 employees. One of the subsidiaries manufactures POWER STACK using ABB products and has many assembly delivery records.
As the power semiconductor pioneer in Japan, NIEC provides discrete and power module devices to the wide range of markets as industrial, automotive and renewable energy. We have a good relationship with main manufacturers of electrical power conversion companies in Japan. With experience and know-how of more than 55 years in the global semiconductor market, we provide the most suitable devices, with the best quality and in a timely manner to the customers.
We have the certification and accreditation of ISO 9001:2008, ISO/TS 16949:2002 and ISO 14001:2004 and also have received best quality awards two years in a row for our high-quality products and services from one of the Japanese automotive component companies.
Our goal is to enhance our technologies to offer higher power conversion efficiency to the customers for their satisfaction and success. **(ni)**

Technology in focus
HPT+

Increasing or stabilizing the maximum controllable current in an IGCT involves work in two directions. On one hand, a classic electrical engineering effort is required to minimize stray impedance in the gate circuit – parallelizing current paths and bringing antiparallel currents close together. This ascertains that the gate signal distributes quickly to all parts of the device – which gets more difficult for large-area devices.
The other approach targets the current handling capability of the semiconductor switching cell – the "local capability". ABB showed the effects of modulating the p-base in 2007 with the introduction of HPT technology. Particularly, guiding the current using doping concentration gradients below the thyristor segments was extremely beneficial for balancing the large-area effect on current capability. The HPT technology improved the device capability over the whole operating temperature range, particularly at low temperatures.
The wishes to further increase the current capability at higher temperatures, facilitate a higher maximum junction temperature and to additionally reduce the switching losses triggered the development of an advanced HPT platform: the HPT+ platform.
ABB introduced the HPT+ technology in 2011. The fine-tuning of doping concentration profiles below the thyristor segments avoided current crowding within the electric field that establishes during turn-off. A weaker anode design lowered the switching losses. ABB now adapts the HPT+ technology for reverse-conducting IGCTs. The technology is already available for implementation in upcoming asymmetric IGCTs with increased junction temperature specifications. **(tw/ma)**



Lead time indicator

While availability for diodes, thyristors, GTOs, IGCTs and dies remain on short lead times, the availability for low power bipolar diodes / thyristors as well as for HiPaks and StakPaks remain on significantly longer lead times.
For exact lead time information please contact your ABB Semiconductors sales contact or local distributor.

Publications calendar

- Bodo's Power Systems, May 2014
  "Record performance with IGCTs, cool"
- Power Electronic Europe, July 2014
  "Fast thyristors. When burning for induction heating solutions"
- Power Electronic Europe, October 2014
  "Thyristors for >10 GW Power Transmission"

Impressum

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