news

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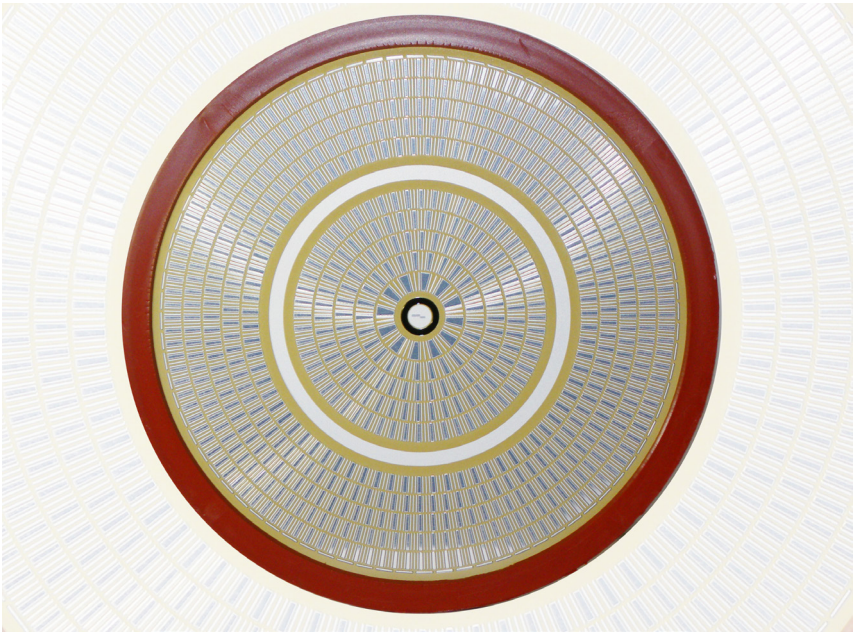
ABB Semiconductors
March 2016



Bi-mode capability expanding to the IGCT

The integrated gate-commutated thyristor or IGCT is in principle a thyristor based device concept, which has since its evolution from the gate turn-off thyristor (GTO) in the mid 1990`s established itself as the device of choice for industrial medium voltage drives (MVD) and has also been used in many other systems such as wind-power conversion, STATCOMs, and interties to name a few. Due to the integration with a low inductive gate unit, this hard driven device conducts like a low-loss thyristor and turns off hard like a transistor. ABB has developed over the past 20 years many variants of the IGCT including the asymmetric, reverse conducting (RC), and reverse blocking IGCT (RB) with maximum current and voltage ratings reaching up to 10 kA and 10 kV, respectively. In particular, the conventional RC-IGCT combines the GCT and diode functionality on a single wafer for enabling better component integration in terms of process and reduced parts count at the system level. However, in an RC-IGCT the GCT and diode are still fully separated from each other. Consequently, the utilization of the silicon area is limited in the GCT region when operating in GCT mode and in the diode region when operating in the diode mode. To follow on the IGBT integration development trend with the introduction of the bi-mode insulated gate transistor or BiGT, ABB today is developing a new fully integrated device concept, which is referred to as the bi-mode gate commutated thyristor or BGCT. (continued on page 2)

Highlights

Editorial

Dear reader!

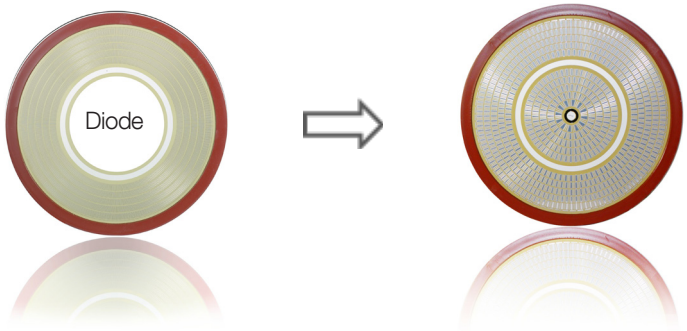
Bi-mode is the buzzword in this 18th ABB Semiconductors Newsletter. The cover is about the "bi-mode IGCT", the BGCT. Similar to the BiGT (bi-mode IGBT), the novel BGCT also integrates a GCT and diode into a single structure in an interdigitated integration scheme. Both, the BGCT and the BiGT will be presented and highlighted at PCIM in Nuremberg in May and in Shanghai in June. See the detailed programs on pages 5 and 4, respectively. Besides this focus subject, but still related to IGCTs, we summarize the application note "Applying IGCT gate units" on page 3. In this and the next two or three newsletters we will give you some insights into our quality related activities, starting with the field of applications of failure analysis capabilities at ABB Semiconductors on page 3. Twenty-five years ago, ABB Semiconductors Ltd. was established in Lenzburg, Switzerland. Marco Rossinelli, who started at ABB in 1983, ie at BBC at that time, retires end of this month. Read the brief review of his past 25 years at ABB Semiconductors on page 6.

At this point, I would like to thank you for your interest in the ABB Semiconductors Newsletter, which is a special newsletter for me as it is my last one. Effective June 1, I will fully focus on export controls. A successor in my role as Communications Manager at ABB Semiconductors will be announced in due course. Thanks again and all the best!

Yours, Christoph Holtmann
PG Communications Manager

Bi-mode capability expanding to the IGCT (continued from cover page)

Similar to the bi-mode insulated gate transistor (BiGT), the novel bi-mode gate-commutated thyristor (BGCT) also integrates a GCT and diode into a single structure but it targets to utilize all the silicon volume in both GCT and diode modes when compared to the conventional RC-IGCT. The main design approach is to employ an **interdigitated integration scheme** where each individual segment is designed to act either as GCT cathode or as diode anode. Furthermore, on optimum shorting layout design is introduced on the wafer backside, which provides the device also with very soft performance. Lifetime reduction methods are added in the final stages to fine-tune the static and dynamic losses in both GCT and diode modes of operation. The first 38 millimeter 4,500 volt prototype BGCTs were demonstrated successfully in 2014 while recently 91 millimeter 4,500 volt samples have also been completed and are currently undergoing full electrical test and characterization. When combined with other IGCT ongoing developments such as higher operational temperatures up to 140 °C, optimized losses for a given application, a wider range of voltage ratings (2.5 – 10 kilovolt) and larger areas up to 150 millimeter, the BGCT will offer power electronics system designers more options to explore the potential performance advantages of the IGCT platform for future high power applications.
The BGCT is being developed in close collaboration with ABB`s Corporate Research Centre in Baden-Dättwil, Switzerland and the University of Cambridge, United Kingdom. **(mra)**



RC-IGCT **BGCT**

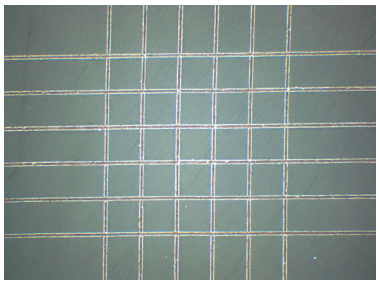
Product change notifications BiMOS and bipolar

PCN nr.	Part nr.	Subject	PCN issuing date
IGBT 16-01	5SNA 0600G650100 and adapted standards	improved HV HiPak housing	January 2016
IGBT 16-02	all 76 wafer un-sawn products	sealed shipping box	March 2016
IGBT 16-03	5SNA 1200G450300, 5SNA 1200G450350 and adapted standards	improved HV HiPak housing	March 2016
PCT 16-01	5STP 07D1800, 5STP 18F1800	back end production line for PCTs	January 2016
PCT 16-03	5STP 04D5200	back end production line for PCTs	January 2016

Special:
Failure analysis – fields of application

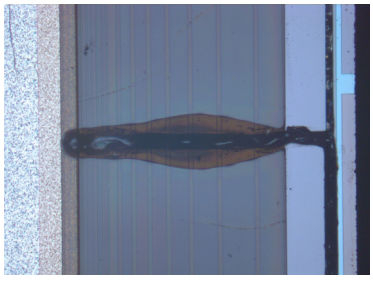
The responsibility for quality is something that is owned in ABB by every person, business and location. There are many dimensions in which ABB can compete, but none of these are meaningful for our customers without a foundation of quality. We are pushing to be the best and most forward-looking performer in our markets when it's about quality and reliability. Failure analysis (FA) capabilities at ABB Semiconductors are manifold, covering fields like raw material, product development, production and returns from customers. Here a few examples:

Raw material



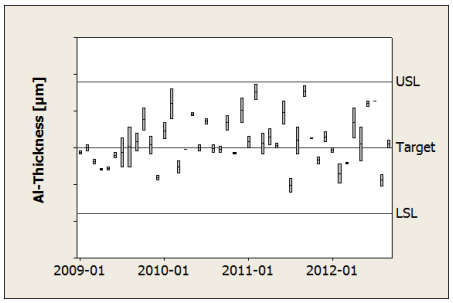
One of the application areas of failure analysis is the inspection and qualification of incoming raw material. One example is the scratch test; a technique to test the adhesion of the nickel layer, which is plated on the StakPak module's baseplate.

Development



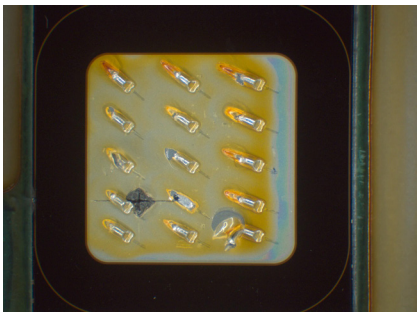
During the verification and qualification phases of the product development process, failure analysis provides essential feedback to designers. A short circuit is a common failure mode during high temperature reverse bias (HTRB) reliability testing. Typically, the FA shows a melted path (picture) on the junction termination of a diode chip.

Production



In addition to FA's support of product & process engineering and testing, an extensive quality monitoring program (QMP) for a variety of process parameters is performed. One example of a controlled parameter in a QMP is the aluminum thickness of the IGBT's metallization layer.

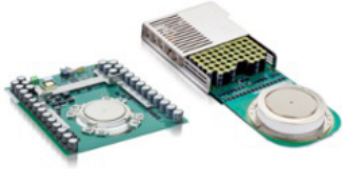
Customer



On demand, ABB also provides in-depth failure analysis services to external customers. The picture from a customer return shows a diode chip which failed due to operation outside of the safe operating area. The provision of such information helps customers to optimize their designs and systems. **(ch, tg)**

Application note
Applying IGCT gate units

Power semiconductors like IGBT modules or thyristors and their corresponding gate units (GU) are often bought from different suppliers. Therefore, design engineers must have quite some knowledge of the power semiconductor's control parameters like turn-on and turn-off pulse amplitudes, pulse width and rate of rise, gate circuit inductance or back-porch current when designing new drives, rectifiers or other equipment. ABB's integrated gate-commutated thyristor, the IGCT, is a GCT integrated into its own GU and tested and supplied as one unit. Control interface discussions between converter design engineers and the power semiconductor manufacturer can be reduced to the specification of power supply, control signal transfer and mechanical assembly leading to a reduction of development costs and time. As a result, the power semiconductor technologies are made available to a broader group of users.
The application note "Applying IGCT gate units" explains basic design rules and handling / application recommendations for IGCT gate units regarding power supply, insulation interface, optical interface, control and diagnostic functionality during normal operation and during fault occurrences. Furthermore, environmental issues such as electromagnetic immunity, vibration compliance and thermal management are briefly described.
The application note covers the gate units of several IGCT types and includes all GU generations. Within a generation, the gate units are very similar in circuitry and functionality. They only differ in mechanical size and the dimensioning of the gate drive circuit.
We strongly recommend reading the application note before using IGCTs. It is available for download on our website at www.abb.com/semiconductors. **(ch)**



Products in the pipeline
BiMOS and bipolar

Part nr. Bipolar	Voltage	Current	Description	Housing
5SED 0520S2240	2,200 V	520 A	dual diode module in 50 mm standard package	50Pak
5SED 0890T2240	2,200 V	889 A	dual diode module in 60 mm standard package	60Pak
5SED 0650T5040	5,000 V	651 A	dual diode module in 60 mm standard package	60Pak
5SED 0480T6040	6,000 V	481 A	dual diode module in 60 mm standard package	60Pak
5STP 48Y7200	7,200 V	4,800 A	phase control thyristor	Y
5STP 27N8500	8,500 V	2,650 A	phase control thyristor	N
5STP 27Q8500	8,500 V	2, 900 A	phase control thyristor	Q
5STP 45Y8500	8,500 V	4,545 A	phase control thyristor	Y
Part nr. BiMOS				
5SNG 0300Q170300	1,700 V	2 x 300 A	phase leg medium power IGBT with SPT^{++} chipset	62Pak
5SNG 0200Q170300	1,700 V	2 x 200 A	phase leg medium power IGBT with SPT^{++} chipset	62Pak
5SNG 0150Q170300	1,700 V	2 x 150 A	phase leg medium power IGBT with SPT^{++} chipset	62Pak

Product features

1,700 V phase leg medium power IGBT

- The Industry standard 62Pak combines the well established copper base-plate technology for industrial applications with the well-known reliability and quality of the ABB HiPak IGBT modules.
- The 1,700 V SPT^{++} chipset offers lowest switching losses and operation temperature range up to 175 °C.
- The line-up consists of three module ratings: 2 x 300 A, 2 x 200 A and 2 x 150 A.
- Final samples are available. Product release for serial production is scheduled for end of April 2016.

2,200 V, 5,000 V and 6,000 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.

7,200 V and 8,500 V phase control thyristors

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

ABB at Hanover Fair 2016

Also in 2016, ABB will be exhibiting at the world's largest industrial trade fair, Hanover Fair in Germany, with a major stand from April 25 – 29, in hall 11, stand A35. Those who will be visiting the exhibition will be able to catch an exciting glimpse of the company's complete portfolio of power and automation products for utilities, industry, transport and infrastructure. ABB's latest semiconductor developments, a new type of transistor called BiGTs (bi-mode insulated gate transistors) and a new type of low-loss thyristor will be showcased, too.
Free entry tickets to Hanover Fair can be downloaded from ABB's Hanover Fair microsite: http://new.abb.com/events/hannover-messe.

Phased-out products
BiMOS and bipolar

Material	Last deliveries
5SMX 12/76/86E1280	Sep 2016
5SMX 12/76/86H1280	Sep 2016
5SMX 12/76/86K1280	Sep 2016
5SMX 12/76/86L1280	Sep 2016

This year ABB Semiconductors exhibits at both, PCIM Europe and PCIM Asia

Our PCIM highlights this year will be LinPak, the new open standard IGBT phase leg module, on the 62Pak and LoPak1 medium-power modules and on the high-power devices like the 3 kA BiGT StakPak module and the new 8.5 kV industrial thyristors.

PCIM Europe, Nuremberg, May 10 - 12, hall 9, stand 203

We will be presenting a number of technical papers at the PCIM conference and at the Exhibition Forum as follows:

Conference presentations:

- Tue, 10.05.2016, 15:30, Poster Dialogue Session, PP018 “Cathode emitter vs. carrier lifetime engineering of thyristors for industrial applications” Jan Vobecky, Marco Bellini, Karlheinz Stiegler, ABB Switzerland

- Tue, 10.05.2016, 15:30, Poster Dialogue Session, PP019 “Experimental results of a large area (91mm) 4.5kv »bi-mode gate commutated thyristor« (BGCT)”, Thomas Stiasny, Umamaheswara Reddy Vemulapati, Martin Arnold, Munaf Rahimo, Jan Vobecky, ABB Switzerland, Christian Kahr, Norbert Hofmann, University of Applied Sciences Nordwestschweiz, Switzerland

- Tue, 10.05.2016, 15:30, Poster Dialogue Session, PP023 “The LinPak high power density design and its switching behaviour at 1.7 kV and 3.3 kV” Samuel Hartmann, Fabian Fischer, Andreas Baschnagel, Harald Beyer, Raffael Schnell, ABB Switzerland

- Wed, 11.05.2016, 11:00, Oral Session, Room München 2, “The 62Pak IGBT module range employing the 3rd generation 1,700 V SPT++ chipset for 175 °C operation”, Sven Matthias, Chiara Corvasce, Charalampos Papadopoulos, Arnost Kopta, Silvan Geissmann, Raffael Schnell, Munaf Rahimo, ABB Switzerland

Exhibitor Forum presentation:

- Tue, 10.05.2016, 15:40, Exhibitor Forum, hall 9, stand 461, “Improved performance of fast switching thyristors for induction heating”, Ladislav Radvan, ABB s.r.o. - Semiconductors, Czech Republic

PCIM Asia, Shanghai, June 28 - 30, hall 4, stand C39

We will be presenting the following technical papers:

Conference presentations:

- Tue, 28.06.2016, 09:30, Oral Session, Room 2, “The next generation high voltage package and IGBT/diode technologies”, Raffael Schnell, ABB Switzerland

- Tue, 28.06.2016, 11:25, Oral Session, Room 11, “The 62Pak IGBT module range employing the next generation 1,700 V SPT++ chipset for 175 °C operation”, Sven Matthias, ABB Switzerland

- Tue, 28.06.2016, 11:25, Poster Session, Room 2, “StakPak 4,500 V / 3,000 A IGBT module for high power HVDC and DC-breaker application”, Makan Chen, ABB Switzerland

- Wed, 29.06.2016, 14:25, Oral Session, Room 2, “StakPak 4,500 V / 3,000 A IGBT module for high power HVDC and DC-breaker application” Makan Chen, ABB Switzerland

For an appointment at either exhibition, please contact your ABB sales person or send an e-mail to abbsem@ch.abb.com or just come to our booth. We are looking forward to discussing our latest innovations.

Portrait: Protek Teknik

Protek Teknik was founded in Istanbul in 1992. Since then, Protek Teknik has outgrown its modest beginnings to become a market leader in the field of supplying semiconductors, capacitors, fuses etc. Our Quality Management System combined with customer’s feedback ensure that the most effective solutions are always available to the market to reach “unconditional customer satisfaction”. And to enhance our services in the Turkish market, we got plenty of business partners and dealers all over Turkey.

Since the Turkish industrial market has shown remarkable performance with its steady growth over the last decade, there are a lot of ongoing projects in which Protek Teknik can offer services to the wide range of customers. Turkey being a bridge to the Middle East countries allows us to expand our services to include Middle Eastern markets.

Turkey has national advanced technological projects such as establishing high speed train systems or SVC and STATCOM implementations at MV level. Moreover, Turkey has new investments of renewable energy systems to receive at least 5.000 MW of solar investments by the year 2023, whereas Turkish companies are designing PV inverter systems at all voltage levels. Meanwhile, Protek Teknik emphatically continues its cooperation with the Governmental Scientific and Technological Research Council of Turkey in the field of HVDC and crowbar projects. Protek Teknik is also focusing on other industries such as welding, induction and UPS.

We would like to thank our colleagues at ABB for their support and cooperation.

25 years ABB Semiconductors
Review from Marco Rossinelli

Twenty-five years ago, ABB Semiconductors Ltd. was established in Lenzburg, Switzerland. Marco Rossinelli, who started at ABB in 1983, ie at BBC at that time, retires end of this month. Being so many years at ABB he gained a huge amount of experience. Here, he now shares a brief review of his past 25 years at ABB Semiconductors:

I came to work in Lenzburg in 1991, after spending 8 years at the ABB Research Center in Dättwil. When I started in Lenzburg we were, in total, about 100 people and part of the ABB Drives division. ABB had just "repositioned" the semiconductor activities between Västerås in Sweden, Lampertheim in Germany and Lenzburg in Switzerland.
In 1993, ABB closed the activities in Västerås and transferred the production of phase control thyristors to Lenzburg. Under a new director, Anders Nilarp, there were major investments in production, and a phase of strong growth followed. The strategic importance of PCTs for power systems was never questioned, nevertheless an effort in the development and production of GTOs was clearly seen as fundamental for the future of the company. With the development of high voltage PCTs, of GTOs and of fast recovery diodes as priority, resources were not available to sustain other product lines that therefore had to be abandoned, eg reverse conducting thyristors and break over diodes. In 1995, we started a collaboration with Polovodiče in Prague, Czech Republic, with the aim of outsourcing the production of press-pack diodes and surge voltage suppressors. The successful collaboration continued and grew until, in 2010, Polovodiče a.s. was acquired by ABB. The transfer was a very interesting task, not only from the technical and commercial point of view, but also insofar as it gave me the opportunity of making friends with several people from a different background. These friendships last until today.
Already in the early nineties, it became evident that IGBTs were going to shape the future of power electronics. A team of ABB engineers started working on the development of IGBTs and related diodes. One of the first products was a fast recovery diode in a TO220 housing: the wafers were produced at International Rectifiers in California, diced in Tijuana, sent for encapsulation and final test to Portugal and finally dispatched to the customers from Lenzburg. Having first devices from our own development activities helped move along the approval for the construction of a new production facility in Lenzburg, which was opened in 1998.

The commitment of ABB to the development and production of high-power semiconductors has been clearly demonstrated in the last ten years by further, substantial investments: an upgrade of the BiMOS wafer fab, a substantial extension of the production lines for IGBT modules and a complete upgrade of the bipolar wafer fab. The ABB investments in the activities in Lenzburg remain strong: it is up to us to continue a success story. (**mro)**

Publications calendar

- Product catalog 2016, February 2016 (hardcopy)
- Bodo's Power Systems, Feb. 2016 "IGCT - A highly efficient device with continuing great success in high power applications"
- Bodo's Power Systems, March 2016 "LinPak – the new standard phase leg module with exceptional low inductance"
- Power semiconductors product brochure, April 2016
- Bodo's Power Systems, May 2016 "Recent advancements in IGCT technologies for high power electronics applications"

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

Impressum

The ABB Semiconductors Newsletter is published four times a year in English. It is available in the pdf format. The newsletter archive can be found at www.abb.com/semiconductors.

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