

## Semiconductor Assemblies for US Weather Radar

The typical applications of our semiconductor modules such as HVDC and traction are well known, but some projects are a bit more unusual: Semiconductor assemblies for the weather radar in the US to ensure precise severe weather warnings for example. Local tornados and severe weather are now observed with the help of ABB Semiconductors assemblies. These assemblies encompass a stack of mounted semiconductor modules with integrated cooling and control technology. A first prototype was built already in 2002 for a well-known university in the US and tested in operation for several years. This trial period proved that the new GCT switch technology has, compared to the current solution of another

supplier, clear advantages regarding lifetime and reliability of the radar installation.

A first large order followed in 2007 as a replacement for thyatron tubes in flight radar units in the US. The implemented semiconductor assemblies are in service monitoring the flight traffic until today without any failures.

In the meantime the properties of our supplied assemblies with the fast turn on GCT technology gained momentum so that another American national institution ordered our products. Two of our devices were already tested beforehand by the institution but proof of reliability in an existing installation is always much appreciated. (continued on page 3)

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## Editorial

Dear reader!

Before we leave for our well-deserved Christmas break, it is time to review 2016 and have an outlook on the upcoming year 2017 with an article written by Jürgen Bernauer on page 2. In 2016, our semiconductor assemblies were used for a bit more exotic applications: Our cover story tells us how our GCT technology ensures precise severe weather warnings for US radar installations. In another example, our StakPak was used for an application in cancer treatment (see page 6): Our customer Ampegon even won the Swiss Technology Award 2016 for the development of the modulator! Focusing on our internal news, a special week on safety took place worldwide at all ABB locations. In Lenzburg, they were called Semi Days and focused also on topics regarding quality improvement (see page 4). More on the technical side, the 3<sup>rd</sup> Expert Day took place in Lenzburg, where 80 technical experts and managers attended. All details can be found on page 5. We also would like to officially announce two new distributors in Germany on page 4: Hauber&Graf and Finpower are both experts in the medium power segment. Last but not least we have various updates on the products on page 4 and 6 and the application note on page 5.

I hope, that while reading our newsletter, you are enjoying some Christmas cookies as well. In that sense: I wish you a Merry Christmas and a Happy New Year!



Yours, Katja Fröhlich  
PG Communications Manager

## Jürgen Bernauer, Review and Outlook

Dear Readers

screening my folders I found out that this is my fifth contribution to the year-end newsletter while noticing that my memory has converted many abbreviations - which I learned differently in my professional life before - into semiconductor one's. Looking back, I had again many opportunities to visit customers and receive customer delegations in Lenzburg and Prague. This helps to get direct feedback without making exhaustive marketing surveys.

I personally think that our semiconductor product group has progressed in our ambition to be a recognized leader in high power semiconductors and in future in medium power semiconductors. The license to be successful is our operational excellence. Referring to our key indicators, we have improved in all operational aspects: Lead time, on-time delivery and quality. This is also confirmed by numerous customer interactions.

Having been present on all relevant fairs, exhibitions and conferences, our ABB innovation community presented great ideas for future semiconductors. Accordingly, we presented at PCIM 2016 examples of our innovation highlights like BGCT, BiGT, TSPT+ and SiC. It's been also interesting to see how SiC changed from a hype more into the question "where is the business case". On low voltage and high frequency applications SiC MOSEFT's are already

present. The way into high voltage and high power is much more demanding. And Silicon is getting better year-by-year. This will be an interesting race the coming years.

As market leader in welding diodes you can be definitely sure that we have great new ideas in the pipeline for the next generation of welding applications.

I'm also proud on my team concerning new products. LinPak is definitely the star and got attracted by numerous customers. The sampling rate is rather high confirming the big interest. 62Pak and the coming LoPak1 are also gaining customer's attention as we believe in being a differentiator on reliability and performance.

My goals for 2017 are as every year: Good Health, Safety and a lot of business for all of us. To achieve the goals we have to act: Do some sports, don't look the other way and fight for orders. Looking forward to a successful and interesting Year 2017.

Sincerely



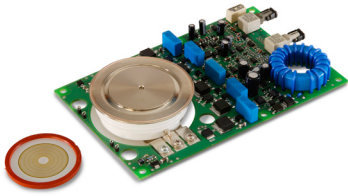
Jürgen Bernauer, Managing Director  
Power Semiconductors

## Rudy Veitz retires end of December

Rudy Veitz, the current leader of information systems and test systems at Semiconductors will retire after 39 years at ABB on the 31<sup>st</sup> of December 2016. Jürgen Bernauer will lead the areas „Information Systems“ and „Test Systems“ ad interim.

We would like to thank Rudy for his great contribution and his tireless commitment during his long time at ABB and wish him all the best for the future! **(kf)**

## Semiconductor Assemblies for US Weather Radar (cont. from cover page)



4.5 kV GCT

Additionally, the approach to actively support our customer's specific assemblies is the key to win these long term projects. The semiconductor element for radar applications is our 4.5 kV GCT, which was developed together with a special gate unit for fast turn-on with a high  $di/dt$ .

The radar assembly was built in a clamping system with 3 in series ( $n_s=3$ ) connected GCTs with an optimized integrated gate unit for the fast turn-on. The assembly was designed for a continuous operation at 5.6 kV DC and pulsed power up to 1,200 A. The switch has the main function to discharge the pulse

forming network (PFN), which is often used in the radar technology to drive pulses up to frequency of 1,350 Hz. These installations are in service for 24h for 365 days a year for the weather observation.

Each GCT was tested individually and these tests were carried out with the help of highly specialized test systems which are also built by ABB Semiconductors. Additionally, the assemblies have been checked visually to ensure high mechanical quality of the components.

Last but not least the weight of the assemblies was a logistic challenge as well: 3.5 tons in total needed to be shipped to the end customer! Thanks to a great collaboration between sales and our US distributor, we achieved a secure and cost-efficient delivery without any damage. **(rl, rn, kf)**

## Semi Days at Semiconductors

The safety week at Semiconductors in Lenzburg was split in 4 Semi Days, where all 600 employees joined for a three-hour tour from post to post in the main building. The event not only focused on safety, but also included information about our Zero Defects quality strategy, our products and their applications. Our group started motivated at the first post, where we got a refresher of the evacuation procedure in case of an emergency. To never lose the focus where our semiconductor modules are applied, we enjoyed listening to examples of our products being implemented in HVDC for example. On the tour, we also learned how dangerous using our mobile phones while going downstairs is – the shown statistics made every one of us holding the handrails afterwards. We ended the tour by visiting the Quality Department to work on a task related to the continuous quality improvement of our products (Zero Defects program). With the help of our

“Swiss Cheese” Model we learned how failures on products may result in field failures at our customers and how all of us can contribute and work on preventing these quality issues.

Also the semiconductors facility in Prague spent the safety week training emergency situations at the workplace. The theoretical lectures followed a practical chemical safety training. But the highlight for most people was waiting outside: Everyone was eager to do the training in the use of fire extinguishers. After this week, all employees are even more committed to don't look the other way! **(kf)**



## Eastern European Distributors Sales Meeting

The event took place in Prague, Czech Republic, on October 26-27<sup>th</sup>, and was a great opportunity to meet our Distributors (representatives from Protek, Tunkr, Dacpol, Budaker and ZTS Eltop joined) personally and discuss the market situation.

The meeting started with a factory tour of the Prague facilities. In the afternoon, it was time for team building and we headed towards the city center to visit the first modern waste water treatment plant situated in the Czech Republic. The meeting on the second day included presentations from ABB about integrity, a business overview of PG Semiconductors, market trends in Eastern Europe and updates of the new products in the pipeline. Detailed inputs about the current market situation and opportunities were then given by each distributor in a short presentation. This was a great closing of the two-day meeting, where all participants gained a lot of new information and ideas. **(kf)**

## Publications calendar

- Bodo's Power Systems Europe and China, July and September 2016 respectively, “LinPak, the new standard expands to 3,300 V and shows excellent parallel operation as well as SiC readiness”
- Bodo's Power Systems, November 2016  
“A new RC-IGCT platform”
- Bodo's Power Systems, December 2016  
“The rugged 62Pak IGBT module range employing the next Generation 1700V SPT++ chip set for 175°C operation”
- Product catalog 2017, Februar 2017

All published publications are available for download on [www.abb.com/semiconductors](http://www.abb.com/semiconductors).

## Products in the pipeline BiMOS and bipolar

Part nr.	Voltage	Current	Description	Housing
5SNG 0450R170300	1,700 V	2 x 450 A	LoPak1: low profile phase leg module	LoPak1
5SNG 1000X170300	1,700 V	2 x 1,000 A	LinPak: ultra low inductive phase leg module	LinPak
5SED 0520S2240	2,200 V	450 A	dual diode module in 50 mm standard package	50Pak
5SED 0890T2240	2,200 V	890 A	dual diode module in 60 mm standard package	60Pak
5SED 0480T6040	6,000 V	480 A	dual diode module in 60 mm standard package	60Pak
5SHX 30L4520	4,500 V	3'000 A	reverse conducting integrated gate-commutated thyristor (RC-IGCT)	L
5STP 33U8500	8,500 V	3,310 A	phase control thyristor	U

## Product features

### 1,700 V / 2 x 450 A LoPak1

- Industry standard compatible, compact and low-profile phase leg module with copper baseplate
- Excellent switching behavior
- 1,700 V SPT++ chipset featuring lowest losses and highest ruggedness up to 175 °C operation temperature
- Production ramp-up scheduled for 2<sup>nd</sup> half of 2017

### 1,700 V / 2 x 1,000 A LinPak

- Ultra low inductive module for fast low-loss IGBT/diode chipsets
- Modular thanks to easy paralleling with negligible derating
- 1,700 V SPT++ chipset featuring lowest losses and highest ruggedness up to 175 °C operation temperature
- Production start scheduled for Q1 2017

### 2,200 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

### 4,500 V RC-IGCT

- Optimized for the use in applications like industrial MVD, wind-power conversion, STATCOMs, power quality and railway interties, 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<sup>+</sup> 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

### 8,500 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 as pumped hydro, drives and SVC

## Hauber & Graf New Distribution Partner in Germany

Hauber & Graf Electronics based in Steinheim/Murr, close to Stuttgart, sells power electronics since 1998. The company was spun-off in November 2003 as an independent company from the Lighting Company Hauber & Graf to sell power electronics into the German market. The portfolio includes EMI components, heat sinks, voltage and current sensors, passive components like capacitors, resistors and inductors as well as semiconductors and driver. As a member of Distripool Hauber & Graf can also supply other components required by customers.

Germany is a very important market for power semiconductor components. Hauber & Graf was identified as a distribution partner because of the market knowledge in the medium power segment, which was gained by selling products of a medium power competitor in the past. **(rs)**

## Finepower New Distribution Partner in Germany

Finepower is an Ismaning/Munich based distribution and engineering company established in 2001 with branch offices in Hannover and Shenzhen (China). Finepower focuses on engineering services and sales of power components to the low power market. With their experience in automotive and renewable applications, Finepower is an ideal partner to explore applications and customers not addressed by ABB Semiconductors so far.

With the addition of ABB Semiconductors to their line card, Finepower will extend their activities and help customers to design products in the 1,200 V and 1,700 V medium power range. **(rs)**



## Power Semiconductors 3<sup>rd</sup> Expert Day Innovation, Technology Leadership and Operational Excellence



Following on two successful Power Semiconductors Expert Day events, the third iteration was organized and took place in Lenzburg on the 3<sup>rd</sup> of November 2016. The full day workshop was again well attended with more than 80 technical experts and managers from ABB's Power Semiconductors Product Group including speakers from ABB's Medium Voltage Drives and the Corporate Research Centre in Switzerland. For this year, the selected topics were in relation to Innovation, Technology Leadership and Operational Excellence. Jürgen Bernauer, Managing Director Power Semiconductors, emphasized in his opening words the importance of the focus themes with respect to ABB's future vision and targets as outlined in the company's Next Level Strategy. Thereafter, a total of 15 presentations covering a wide range of related topics were presented including two talks given by Gerald Scheuer, the Head of Technology at Medium Voltage Drives and Peter Steimer from ABB's Corporate Research Centre. The main focus of both talks was on the impact of the power semiconductor device and the role it plays for future ABB power electronics systems. Both speakers highlighted the fact that the power semiconductor is of clear strategic value for ABB and will continue to play a major role for enabling the next generation power electronics systems for a wide range of applications. Four main ses-

sions with the first focusing on Technology Innovation at device level for both our IGBT and bipolar platforms. The presentations covered IGBTs, diodes, IGCTs and PCTs and the improvements achieved over the past five years while outlining potential future developments for maintaining market leadership in our core technologies. The second session was in relation to innovation and project execution. Four important projects were selected including the next generation StakPak, the new standard LinPak module, the 94 mm RC-IGCT and finally the medium power segment modules. The third session included two presentations related to operational excellence projects with respect to automation, cost optimization and capacity utilization. The final session included two presentations from the Corporate Research Centre highlighting the latest development of wide band gap semiconductors at both device and package levels emphasizing the recent SiC MOSFET and diode performance advantages and their application in advanced packages developed in the research centre. Overall, the Expert Day presentations generated lively discussions and provided a good platform for our technical experts to share knowledge while taking into account the diverse technologies and projects involved in our core businesses. **(mr)**

## Application note High power rectifier diodes

When designing a converter using high power rectifier diodes, a careful selection of the appropriate semiconductor device is decisive. There are two main parameters that are crucial for a successful design: The diode blocking voltage rating and, in case of paralleling of devices, the current sharing factor. The appropriate protection of the converter has to be considered as well when parallel device connection is used. This is often done by putting fuses in series to each diode. Transient over-voltages occur regularly especially in an industrial environment. The diode shall be selected to handle most over-voltages without the need of expensive external over-voltage protection.

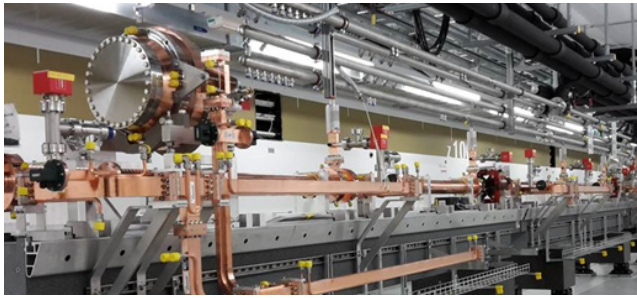
When the required output current of a converter is too high for a single diode, then paralleling of devices is needed. A number of measures must be taken to avoid poor current sharing. The main objective is to achieve similar resistance and inductance values in all parallel current paths. Differences in the current paths will lead to uneven current sharing forcing one or more diodes to operate at a higher temperature than the rest. This in turn can lead to diode destruction due to overheating or to an uneconomical solution since the other parallel-connected diode will be underrated.

For detailed guidelines about high power rectifier diodes, the application note 5SYA 2029 is available for download on [www.abb.com/semiconductors](http://www.abb.com/semiconductors) in the section 'Links and downloads'. **(cw)**



DC-Arc furnace is a typical application for high power rectifier diodes

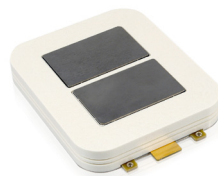
## ABB StakPak From HVDC to cancer treatment



Accelerator at SwissFEL

Most of us know that HVDC is the main application for our StakPak modules. Only a few people know that the modules are also used in medical and chemical applications. On November 24<sup>th</sup>, our customer Ampegon won the Swiss Technology Award 2016 in the category "Innovation Leaders", the most important technology prize for innovation and technology transfer in Switzerland. Ampegon has developed an innovative short pulse modulator used for research facilities such as SwissFEL (free electron laser) at the Paul Scherrer Institute (PSI) and for medical applications (cancer treatment) and industrial processes (liquid sterilization). The jury honored the modulator for its high level of technological innovation, combining both economic and social benefits. ([www.swiss-innovation.com/award](http://www.swiss-innovation.com/award)). The modulators centerpiece are two special versions of the 4.5 kV StakPak module. Each modulator uses 12 modules per type in parallel. The modulator generates a

pulse at 3 kV. This signal is fed into the cathode of a klystron. A klystron is a high frequency source, which generates a pulsed 5.7 GHz signal. This signal is then transformed up to 370 kV and 340 A with a 6  $\mu$ s duration. This 370 kV pulse can be repeated every 10 ms with a voltage accuracy of 100  $\mu$ V. The special versions were designed in close cooperation with Ampegon Dortmund, the technical University in Zurich and the Paul Scherrer Institute for their X-ray free-electron laser. In 2013, the first modulator was designed, assembled and tested. After the successful test, Ampegon received the order from the Swiss Government to design, build and deliver the complete solution for the Paul Scherrer Institute's SwissFEL ([www.psi.ch/swissfel](http://www.psi.ch/swissfel)). (rs)



ABB's StakPak

## New qualified products BiMOS and bipolar

Part nr.	Voltage	Current	Description	Housing
5STP 48Y7200	7,200 V	4,840 A	phase control thyristor	Y
5STP 45Y8500	8,500 V	4,260 A	phase control thyristor	Y
5STP 27N8500	8,500 V	2,450 A	phase control thyristor	N
5STP 27Q8500	8,500 V	2,630 A	phase control thyristor	Q

### 7,200 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

## 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

### 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](http://www.abb.com/semiconductors). Next issue: March 2017.

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