

Power semiconductors



Over 100-years ago our journey into power electronics started in Switzerland with the production of mercury-arc rectifiers. Today, we offer one of the most diverse semiconductor offerings including thyristors, diodes, GTOs, IGCTs and IGBTs, manufactured at our Lenzburg, Switzerland and Prague, Czech Republic facilities.

With our research laboratory in Baden-Dättwil, Switzerland developing the next generation power semiconductors, we are set to continue pushing the boundaries of power electronics innovation.

Our advanced semiconductor technology has created almost unlimited control possibilities in HVDC transmission systems. We lie at the heart of traction converters driving high speed trains, metros and diesel-electric locomotives. And the many pumps, fans, roller tables, hoist and winches found through-out industry, rely on us. We are ABB Power Grids – Semiconductors. And, together with you, we can shape the future of a smarter and greener society.

For more information please contact us or visit www.abb.com/semiconductors

Table of contents

Introduction

004 –005	Product outlook
006 –007	Applications
008 –009	SEMIS – Semiconductor simulation tool

IGBT dies and modules

010 –011	IGBT and diode dies
012 –013	Medium-power IGBT modules
014 –023	High-power IGBT and diode modules

Diodes, thyristors, IGCTs and GTO press-packs

024 –033	Diodes
034 –041	Thyristors
042 –043	Integrated gate-commutated thyristors (IGCTs)
044 –045	Gate turn-off thyristors (GTOs)

Test systems

Further information

048 –049	Certificates
050 –050	Product Environmental Compliance Information
051 –051	Symbols
052 –053	Documentation
054 –057	Part numbering structure
058 –059	Perpetual innovation

Worldwide distributors

Product outlook

LoPak with pre-applied thermal interface material (TIM)

A new LoPak with pre-applied TIM allows simpler application and mounting without applying additional thermal conduction material. This enables longer lifetime and lower thermal resistance. These upgraded LoPak devices are suitable for superior thermal conductivity in harsh environments.

Ratings of LoPak with TIM

Availability	Voltage rating	Current rating	Housing
1700 V phase leg IGBT with pre-applied TIM, samples available Q2/2020	1700 V	2 x 225 A, 2 x 300 A, 2 x 450 A	LoPak1



RoadPak

An automotive qualified (AQC 324) highly compact and reliable SiC module for use in e-mobility applications.

The new device is the first molded module from ABB Power Grids specifically for e-mobility applications and is qualified based on AQC 324.

It features:

- 2 MOSFET in low stray inductance setup (< 6nH)
- Pin-fin structure for lowest thermal resistance
- Lowest losses thanks to SiC chipset

Ratings of RoadPak

Availability	Voltage rating	Current rating	Housing
1200 V SiC MOSFET half bridge, samples available Q1/2020	1200 V	580 A, 780 A, 980 A	RoadPak



Thyristor / diode modules

All thyristor / diode modules feature industry standard housings and very low losses together with the highest operating temperatures.

Typical applications are AC motor soft starters, variable speed drives and renewable energies. Features within high-power semiconductors are also used in our thyristor/diode module product line.

The benefits of these features include highest performance, outstanding reliability, increased overload capability and many more. The 60Pak diode-diode (DD) module with 2200 V is available for sampling now. The lineup will be expanded rapidly to different voltages and configurations in the coming years.

Target ratings 50Pak and 60Pak



Voltage (V)	Package	Configuration TT Thy/Thy DD Dio/Dio DT Dio/Thy TD Thy/Dio
6000	60Pak	DD
5000	60Pak	DD
2200	50, 60Pak	DD
1800	50, 60Pak	TT, DD, DT, TD

2500 V reverse-blocking IGCT

With the introduction of the newly developed 2.5 kV reverse-blocking Integrated Gate Commutated Thyristors (RB-IGCT), another powerful device is added to the successful and well-established IGCT product line.

The RB-IGCT is optimized for the lowest conduction losses and highest turn-off current capability. The conduction losses are reduced to less than 1000 W at 1000 A, a record low value for a power semiconductor device in this class.

To achieve the highest turn-off current capability

of 7000 A, the well known and proven HPT⁺ platform is used. Due to its outstanding performance, efficiency and reliability, the new RB-IGCT is the ideal device for Solid State Circuit Breakers (SSCB) used in renewables, transport electrification and modern edge grids.

Rating of 2500 V, RB-IGCT



Device	Availability	Voltage Rating	Turn-off current	Housing
RB-IGCT	Samples Q1/2020	2500 V	7000 A	L size



Applications

ABB Power Grids' semiconductors are key components in a variety of demanding applications in markets like power transmission & distribution, industry, mobility and renewable energy. Customers rely on ABB Power Grids' high quality power semiconductor products and use them in applications in power ranges from 50 kW to 10 GW.



- | | | | |
|---|---|---|--|
| ① | Power transmission and distribution (HVDC, FACTS, STATCOM and others) | ③ | Mobility (rail and subway main and auxiliary drives, trackside power supply / electrical vehicles) |
| ② | Industry (medium and low-voltage drives, soft starters, UPSs, high-power rectifiers, excitation systems and others) | ④ | Renewable energy (converters for pumped hydro, wind turbines and solar) |

SEMIS

Semiconductor power loss simulation tool

SEMIS is ABB Power Grids' semiconductor power loss simulation tool.

This web application enables the selection of the optimal high-power semiconductor by considering thermal losses and device utilization with various topologies, circuit parameters and control strategies to fit customer specific needs.

By selecting the topology and defining the relevant circuit and control parameters, SEMIS analyzes multiple system dependencies. Power losses as well as thermal conditions are evaluated, enabling the verification of semiconductors' device capabilities under various conditions.

Topologies

Available topologies are listed in the respective sub-categories DC-DC, Voltage Source and Current Source converters. Please select according to your requirement.

VSC
Voltage Source Converters

CSC
Current Source Converters

DC-DC
Direct Current Converters

VSC IGBT 3 Ph 2 L	VSC IGBT 3 Ph 3 L NPC	VSC IGBT 3 Ph 2 L	VSC IGBT 3 Ph 3 L NPC / TNPC / ANPC
Rectify Invert Device	Rectify Invert Device	Rectify Invert Device	Rectify Invert Device
VSC IGBT 3 Ph 3 L NPC / TNPC / ANPC	Half Bridge MMC with IGBT	Half Bridge MMC with IGBT	Full Bridge MMC with IGBT
Rectify Invert Device	Rectify Invert Device	Rectify Invert Device	Rectify Invert Device
FACTS Full Bridge MMC with IGBT	FACTS Full Bridge MMC with IGBT		
Rectify Invert Device	Rectify Invert Device		

Three phase three-level VSC with IGBT

SELECT TOPOLOGY: NPC

CONVERTER OPERATION: Inverter

AMBIENT TEMPERATURE: 40 °C

SYSTEM FREQUENCY: 50 Hz

SWITCHING FREQUENCY: 450 Hz

PIAM STRATEGY: Sinusoidal PWM

MODULATION INDEX: 0.8

DC VOLTAGE (VDC2): 2500 V

AC REFERENCE PARAMETER: AC Current

AC SIDE CURRENT (RMS): 1180 A

POWER FACTOR: 0.8

REACTIVE POWER TYPE: Inductive (Converter)

HEAT SINK THERMAL RESISTANCE: 0.008 K/W

IGBT MODULE TYPE: HPM

VOLTAGE RATING: 4.5 kV

MODULE CONFIGURATION: Single IGBT

Matching IGBTs:

- ☐ SGM 2800H50000 690 A
- ☐ SGM 2800H50000 690 A
- ☐ SGM 1200H50000 1300 A
- ☐ SGM 1200H50000 1300 A

NPC DIODE SELECTION: 4.5 kV

☐ SGL 0.0500H50000 2X800 A, 125C

☐ SGL 0.0600H50000 2X800 A, 125C

☒ SGL 0.1200H50000 2X1200 A, 125C

Analysis completed.

High power semiconductor applications are highly complex and, to reduce prototyping, require thermal loss evaluation prior to a detailed circuit analysis to find the best possible semiconductor for customized settings and conditions. More than 35 topologies are listed according to application fields or grouped as VSC, CSC and DC-DC converters. By selecting the topology circuit, the list of definable settings is indicated, enabling the highest flexibility in the definition of the system parameters.

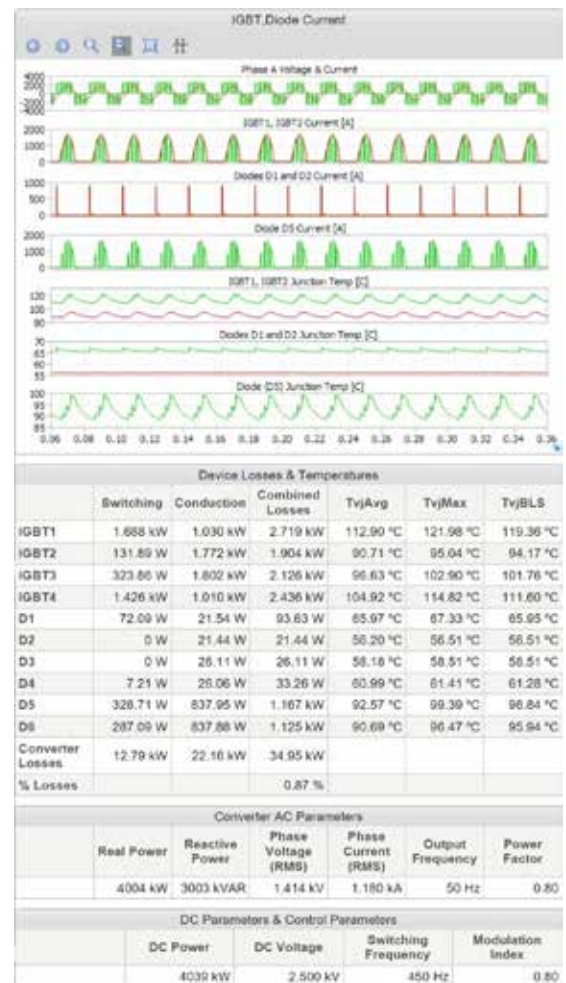
To start the simulation, circuit parameters are defined according to the user specification with significant flexibility enabling the simulations to be adapted to customer needs. With the selection of one or more ABB Power Grids products, the system is ready for analysis.

The thermal impedance path, conduction and switching losses of each element of the topology as well as the control strategy are considered for the calculation of junction temperatures. This reveals critical elements or thermal paths enabling optimizations with the initial approach.

The simulator uses Jacobian steady-state analysis with the Plexim Plecs software to calculate the on-state and dynamic power losses, as well as the resulting thermal variations of semiconductors. If junction temperatures exceed the permissible limits, alert messages are generated to ensure a safe operating area for the specific semiconductor.

Detailed results are displayed as graphs, indicating the thermodynamic and electrical static behavior of each power semiconductor. With the phase voltage and current, the combined converter output is indicated. For each element, the current load indicates the switching.

For detailed analysis, semiconductor specific parameters are tabulated, enabling numerical analysis of each element and parameter for conduction and switching power losses and junction temperatures. Critical elements with the highest thermal load are discovered rapidly, leading to efficient optimization in relation to cost efficiency, power losses and cooling system. For verification of the system efficiency, the converter power effectiveness and the system efficiency are indicated. This reveals the power loss influence of the applied semiconductors in combination with the control strategy. By comparing multiple products and parameter combinations, the influence of varying parameters is revealed.



By providing an efficient and reliable product analysis according to customer requirements, a tailor-made selection of ABB Power Grids products can be made with ease. For customer simulations with more specific topologies and control strategies, the model's data is available in PLECS format for download from ABB Power Grids' website. This enables simulation to the highest customization and adaptation of control strategies.

Simulations exceeding the capabilities of the online SEMIS tool and for simulations of higher complexity, please contact your ABB Power Grids sales agent or ABB Power Grids Semiconductors for further support.

IGBT and diode dies

When looking for chipsets featuring highest switching performance, ruggedness and reliability, ABB Power Grids' IGBT chips with accompanying diodes are certainly the preferred choice.

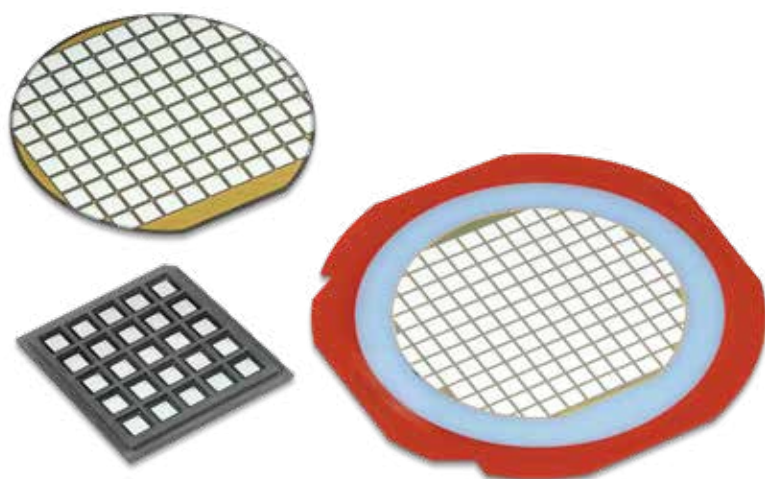


ABB Power Grids' SPT (Soft Punch Through) chipsets and their improved versions with lower losses (SPT⁺ and SPT⁺⁺) are available at 1200 V and 1700 V. They feature highest output power per rated ampere due to a moderate chip shrinkage and thus larger die area compared to others.

Typical applications for 1200 V are power converters for industrial drives, solar energy, battery backup systems (UPS) and electrical vehicles. Applications for 1700 V also include industrial power conversion & drives, wind turbines and traction converters.

ABB Power Grids' 1700 V SPT⁺⁺ chipset is the world's first 1700 V chipset that offers an operational junction temperature of up to 175 °C. This allows the module designer to increase the power density of the IGBT modules significantly.

Diode dies

Part number	Type	Size A x B mm	Thickness μm	V _{PRM} (V)	I _F (A)	V _F (V) typ. 125 °C	Max. dies per wafer (W) or tray (T)
1.2 kV							
5SLY 76E1200 5SLY 86E1200	SPT ⁺	6.3 x 6.3	350	1200	50	1.85	361 (W)
5SLY 76F1200 5SLY 86F1200	SPT ⁺	7.4 x 7.4	350	1200	75	1.85	257 (W)
5SLY 76G1200 5SLY 86G1200	SPT ⁺	8.4 x 8.4	350	1200	100	1.85	198 (W)
5SLY 76J1200 5SLY 86J1200	SPT ⁺	10.0 x 10.0	350	1200	150	1.85	137 (W)

Part number	Type	Size A x B mm	Thickness μm	V_{PRM} (V)	I_F (A)	V_F (V) typ. 125 °C	Max. dies per wafer (W) or tray (T)
1.7 kV							
5SLZ 76E1700	SPT ⁺ /FSA	6.6 x 6.6	370	1700	50	1.75	326 (W)
5SLY 86E1700	SPT ⁺	6.6 x 6.6	390	1700	50	2.1	326 (W)
5SLZ 76F1700	SPT ⁺ /FSA	7.7 x 7.7	370	1700	75	1.75	237 (W)
5SLY 86F1700	SPT ⁺	7.7 x 7.7	390	1700	75	2.1	237 (W)
5SLY 86G1700	SPT ⁺	8.6 x 8.6	390	1700	100	2.1	188 (W)
5SLZ 76G1700	SPT ⁺ /FSA	6.8 x 11.4	370	1700	100	1.75	177 (W)
5SLZ 86J1700	SPT ⁺ /FSA	10.2 x 10.2	370	1700	150	1.75	131 (W)
5SLY 86J1700	SPT ⁺	10.2 x 10.2	390	1700	150	2.1	131 (W)
5SLZ 76L1700	SPT ⁺ /FSA	9.3 x 15.9	370	1700	225	1.75	92 (W)
5SLY 86M1700	SPT ⁺	13.6 x 13.6	390	1700	300	2.1	69 (W)
5SLY 12M1700							25 (T)

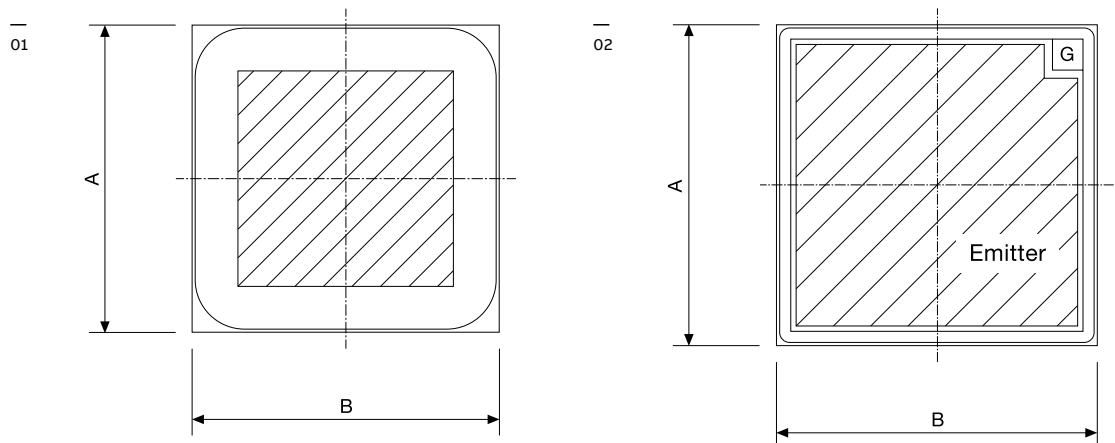
IGBT dies

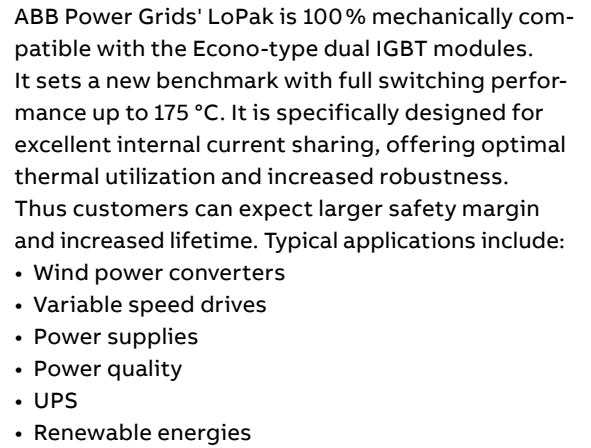
Part number	Type	Size A x B mm	Thickness μm	V _{CES} (V)	I _c (A)	I _{CM} (A)	V _{CESat} (V) typ. 125 °C	Max. dies per wafer (W) or tray (T)
1.2 kV								
5SMY 76H1280 5SMY 86H1280	SPT ⁺	9.1 x 9.1	140	1200	57	114	2.1	166 (W)
5SMY 76J1280 5SMY 86J1280	SPT ⁺	10.2 x 10.2	140	1200	75	150	2.1	130 (W)
5SMY 76K1280 5SMY 86K1280	SPT ⁺	11.2 x 11.9	140	1200	100	200	2.1	98 (W)
5SMY 76M1280 5SMY 86M1280	SPT ⁺	13.5 x 13.5	140	1200	150	300	2.2	71 (W)
1.7 kV								
5SMY 86G1721	SPT ⁺	8.6 x 8.6	209	1700	50	100	3.0	186 (W)
5SMY 86J1722	SPT ⁺	10 x 10	209	1700	75	150	3.0	132 (W)
5SMY 76J1732 5SMY 86J1732	SPT ⁺	10 x 10	190	1700	75	150	2.55	132 (W)
5SMY 76K1722 5SMY 86K1722	SPT ⁺	11.3 x 11.3	209	1700	100	200	3.0	104 (W)
5SMY 76K1732 5SMY 86K1732	SPT ⁺⁺	11.3 x 11.3	190	1700	100	200	2.55	104 (W)
5SMY 86L1731	SPT ⁺⁺	7.4 x 19.9	190	1700	120	240	2.7	86 (W)
5SMY 86M1721	SPT ⁺	13.6 x 13.6	209	1700	150	300	3.0	69 (W)
5SMY 86M1730	SPT ⁺⁺	13.6 x 13.6	190	1700	150	300	2.55	69 (W)
5SMY 86M1731	SPT ⁺⁺	13.9 x 14.0	190	1700	160	320	2.55	66 (W)
5SMY 76P1730	SPT ⁺⁺	15.9 x 16.9	190	1700	225	450	2.55	46 (W)

Please refer to page 54 for part numbering structure.

01 Diode dies

02 IGBT dies





Please refer to page 55 for part numbering structure.
Configurations on page 20

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Dimensions in mm

High-power IGBT and diode modules

ABB Power Grids offers two categories of high-power IGBT and diode modules: Insulated and press-pack modules.

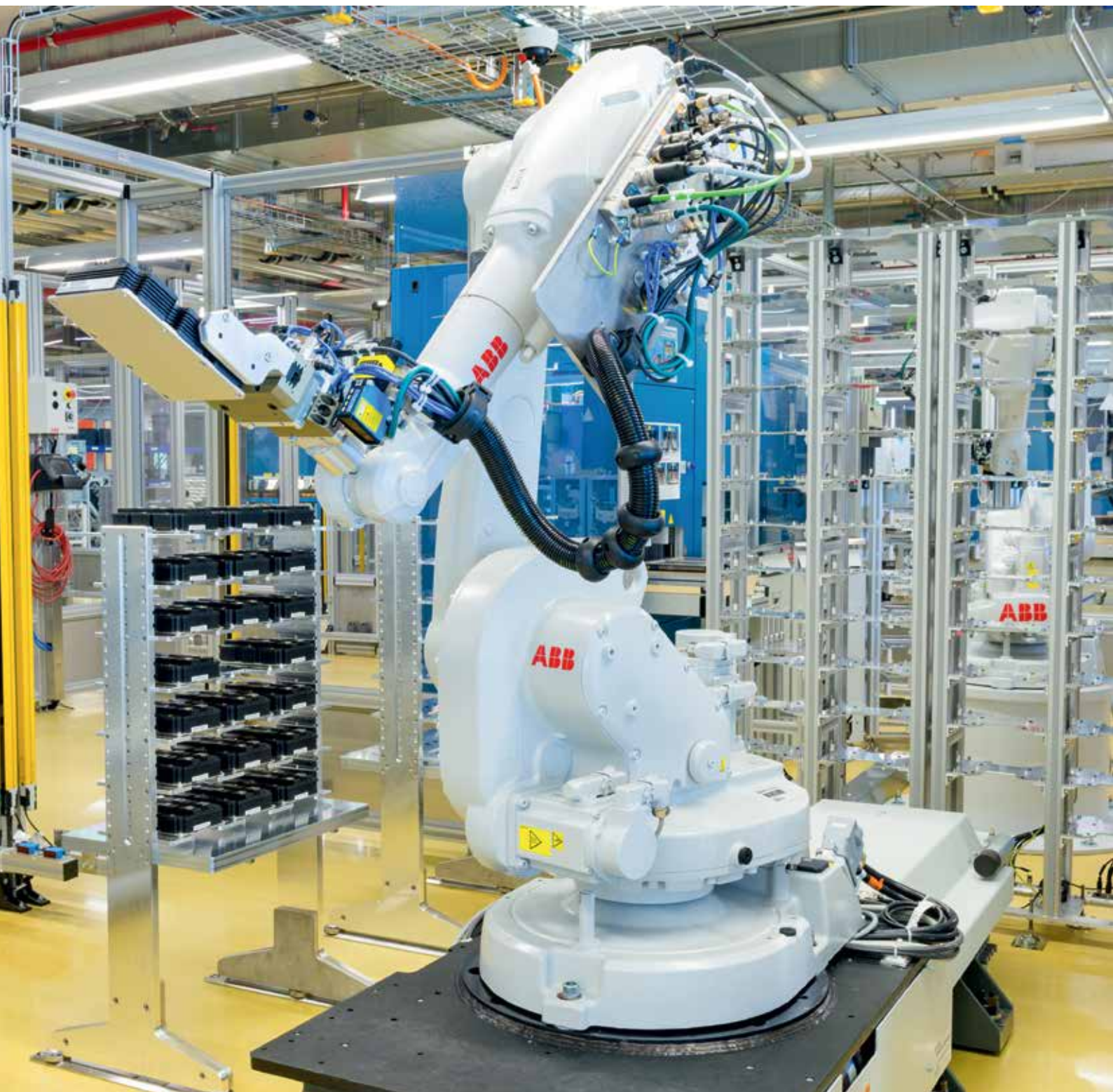
Insulated modules consist of the new innovative, low inductive phase leg LinPak and the well-established HiPak lineup with more than 15 years of successful track record.

Press-pack modules are a range of pressure contact IGBT modules also known as StakPak. StakPaks are ABB Power Grids' flagship with record power ratings up to 4500 V and 3000 A.

ABB Power Grids' high-power IGBT and diode module families are:

- LinPak IGBT & SiC MOSFET modules page 16
- HiPak IGBT and diode modules page 18
- StakPak IGBT press-pack modules page 22





LinPak IGBT & SiC MOSFET modules

The LinPak is a new innovative solution for all power conversion applications. It enables the design of converters with lowest overall inductance, thus fast low switching loss chipsets can be used for the first time also in high-current applications.

These applications include amongst others traction, converters for wind turbines or other renewables, industrial drives, as well as power electronics for FACTS applications. In addition, the LinPak allows very easy parallel connection, thus the current rating of the inverters can be scaled up with just one article number.

This makes the supply chain and initial device design-in efforts significantly more efficient.

Thanks to its exceptional low stray inductance, the LinPak is the ideal package to demonstrate the performance of high-power SiC. ABB Power Grids offers a SiC demonstrator module for customers to evaluate the SiC performance.

ABB Power Grids' LinPak modules feature lowest switching losses and excellent robustness thanks to its low inductance.

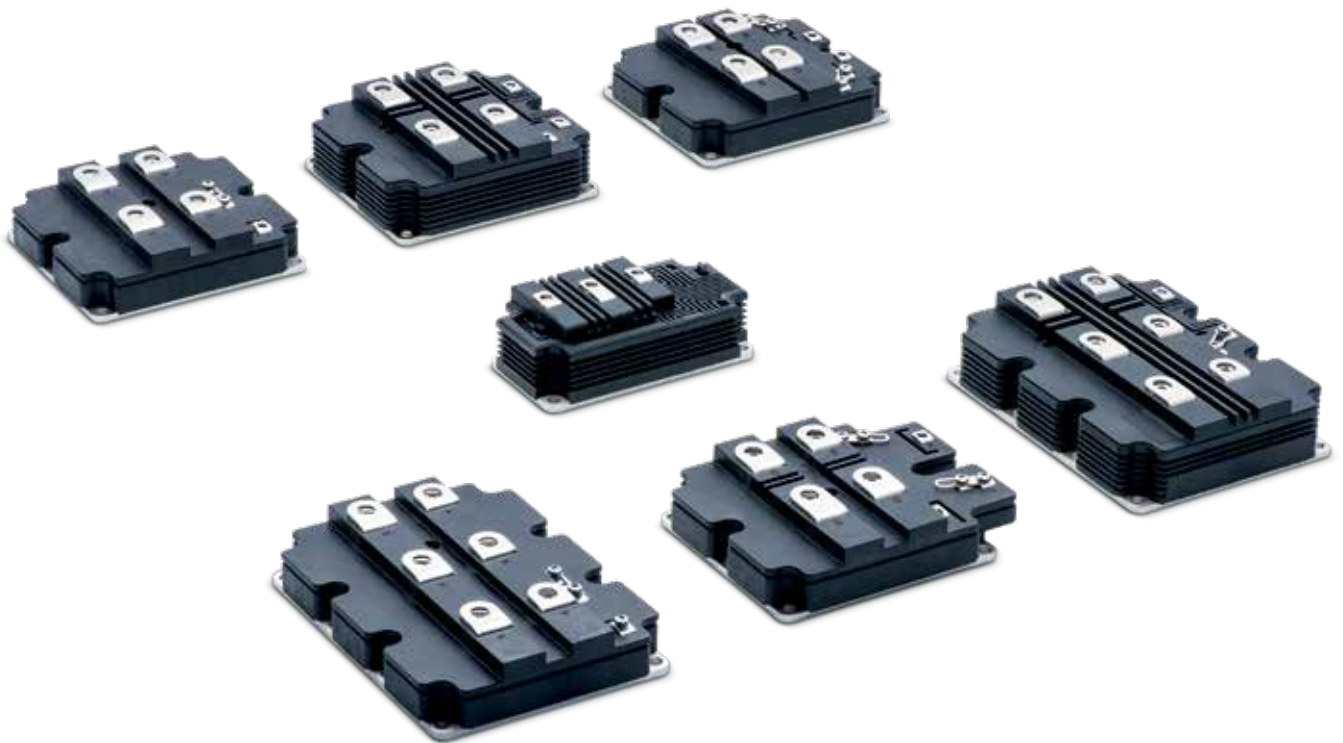


HiPak IGBT and diode modules

Demanding high-power applications such as traction inverters, medium-voltage drives, wind turbine converters, HVDC or FACTS are looking for the highest reliability IGBT modules.

ABB Power Grids' HiPak family of IGBT modules is the best fit to demanding applications, continuing to set new standards of robustness.

ABB Power Grids' HiPak IGBT modules are available from 1700 V to 6500 V in various configurations. They all feature low losses combined with soft-switching performance and record-breaking Safe Operating Area (SOA).

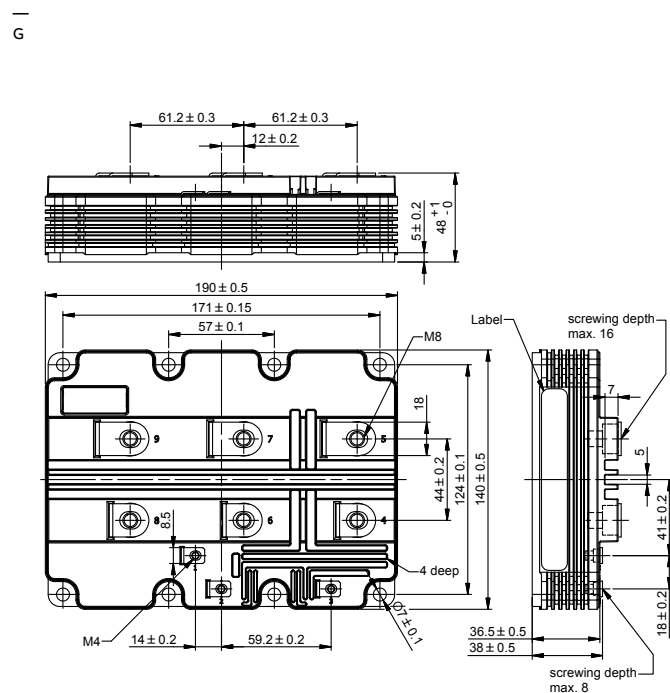
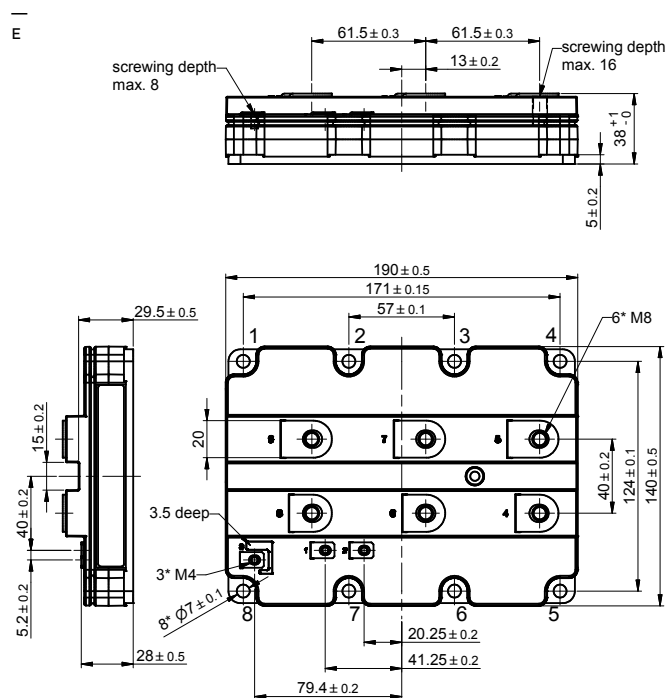
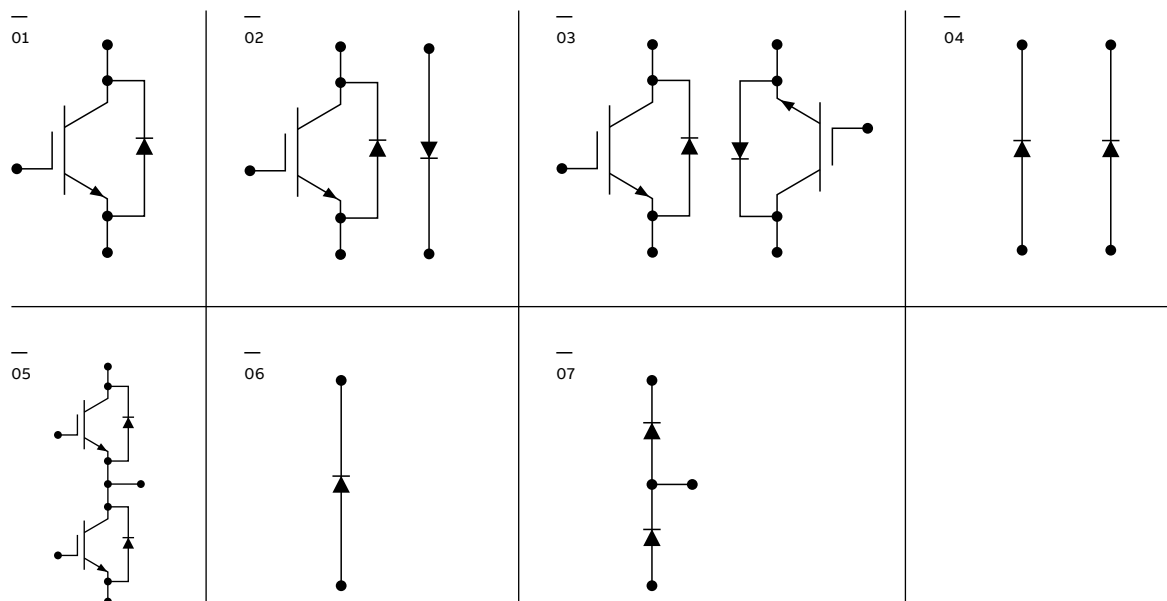


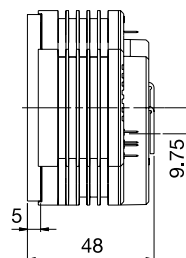
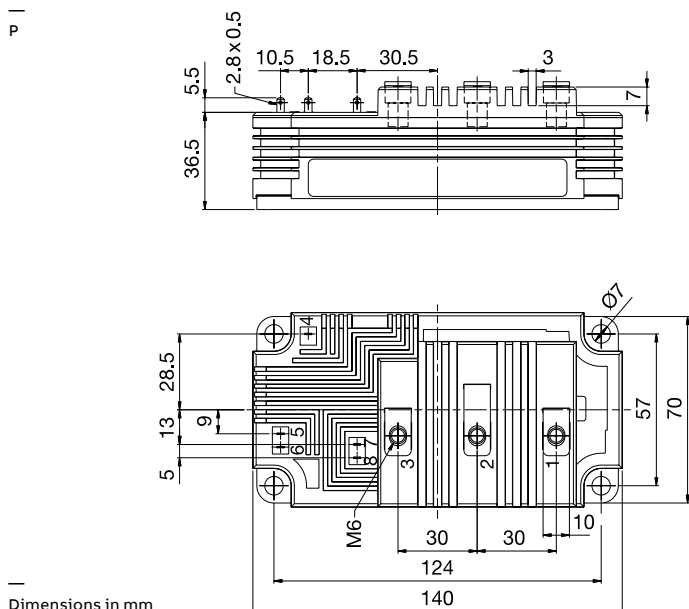
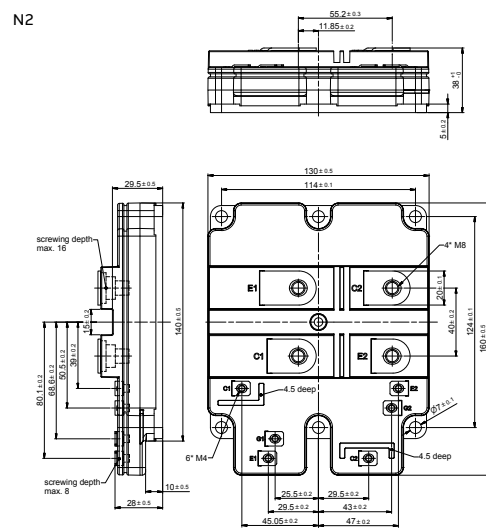
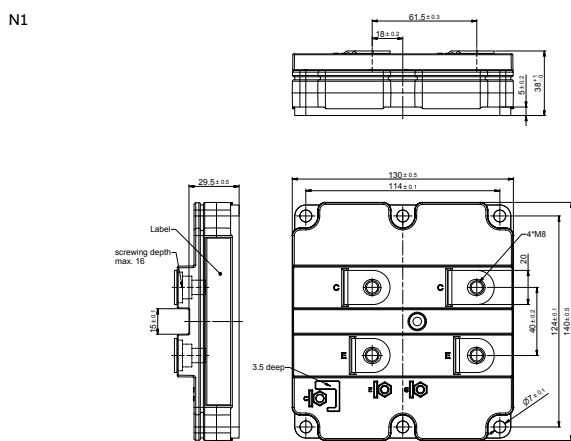
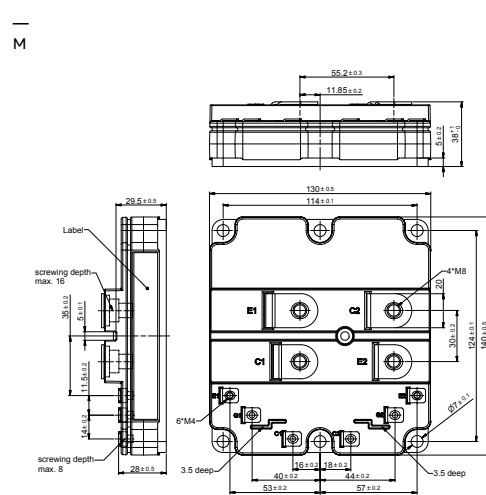
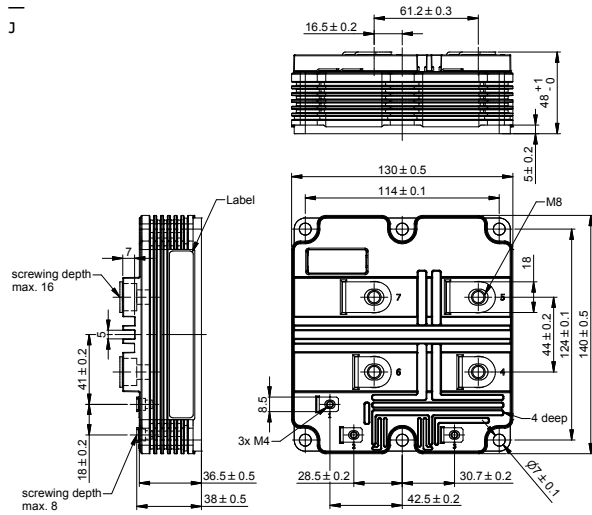
Part number T _{vj} (operational) up to 125 °C	Voltage V _{CEs} (V)	Current I _c (A)	Configuration	V _{CEsat} (V) typ. 125 °C	V _F (V) typ. 125 °C	Housing
1.7 kV						
5SND 0800M170100	1700	2 x 800	(3) – Dual IGBT	2.6	1.7	M
5SNE 0800M170100	1700	800	(2) – Chopper	2.6	1.7	M
5SNA 1600N170100	1700	1600	(1) – Single IGBT	2.6	1.7	N1
5SNA 1600N170300	1700	1600	(1) – Single IGBT	2.4	1.67	N1
5SNE 1600E170300	1700	1600	(2) – Chopper	2.4	1.67	E
5SNA 1800E170100	1700	1800	(1) – Single IGBT	2.6	1.7	E
5SNA 2400E170100*	1700	2400	(1) – Single IGBT	2.6	1.7	E
5SNA 2400N170300	1700	2400	(1) – Single IGBT	3.0	1.95	N1
5SNA 2400E170305	1700	2400	(1) – Single IGBT	2.4	1.67	E
5SNE 2400E170300	1700	2400	(2) – Chopper	3.0	1.95	E
5SLA 3600E170300	1700	3600	(6) – Single Diode	–	1.95	E
5SNA 3600E170300	1700	3600	(1) – Single IGBT	3.0	1.95	E
3.3 kV						
5SNG 0250P330305	3300	2 x 250	(5) – Phase leg IGBT	3.1	2.25	P
5SND 0500N330300	3300	2 x 500	(3) – Dual IGBT	3.1	2.25	N2
5SLG 0500P330300	3300	2 x 500	(7) – Phase leg Diode	–	2.25	P
5SNA 0800N330100	3300	800	(1) – Single IGBT	3.8	2.35	N1
5SNE 0800E330100	3300	800	(2) – Chopper	3.8	2.35	E
5SNA 1000N330300	3300	1000	(1) – Single IGBT	3.1	2.25	N1
5SNE 1000E330300	3300	1000	(2) – Chopper	3.1	2.25	E
5SLD 1000N330300	3300	2 x 1000	(4) – Dual Diode	–	2.25	N1
5SNA 1200E330100	3300	1200	(1) – Single IGBT	3.8	2.35	E
5SNA 1200G330100	3300	1200	(1) – Single IGBT	3.85	2.35	G
5SLD 1200J330100	3300	2 x 1200	(4) – Dual Diode	–	2.35	J
5SNA 1500E330305	3300	1500	(1) – Single IGBT	3.1	2.25	E
5SNA 1800E330400 New	3300	1800	(1) – Single IGBT	2.9	2.20	E
4.5 kV						
5SNG 0150P450300	4500	2 x 150	(5) – Phase leg IGBT	3.5	3.45	P
5SLG 0600P450300	4500	2 x 600	(7) – Phase leg Diode	–	3.5	P
5SNA 0650J450300	4500	650	(1) – Single IGBT	3.7	3.4	J
5SLD 0650J450300	4500	2 x 650	(4) – Dual Diode	–	3.4	J
5SNA 0800J450300	4500	800	(1) – Single IGBT	3.55	3.5	J
5SNE 0800G450300	4500	800	(2) – Chopper	3.55	3.5	G
5SNA 1200G450300	4500	1200	(1) – Single IGBT	3.55	3.5	G
5SNA 1200G450350	4500	1200	(1) – Single IGBT	3.55	3.5	G
5SLD 1200J450350	4500	2 x 1200	(4) – Dual Diode	–	3.5	J
6.5 kV						
5SNA 0400J650100	6500	400	(1) – Single IGBT	5.4	3.4	J
5SNA 0500J650300	6500	500	(1) – Single IGBT	3.9	3.4	J
5SNA 0600G650100	6500	600	(1) – Single IGBT	5.4	3.4	G
5SLD 0600J650100	6500	2 x 600	(4) – Dual Diode	–	3.4	J
5SNA 0750G650300	6500	750	(1) – Single IGBT	3.9	3.4	G
5SNA 1000G650300	6500	1000	(1) – Single IGBT	4.1	3.3	G

Please refer to page 55 for part numbering structure.

* not for new designs

Configurations





Dimensions in mm

StakPak IGBT press-pack modules

To enhance reliability and reduce cost in systems that require redundancy and series-connected IGBT modules, one should consider using ABB Power Grids' StakPaks.

ABB Power Grids' StakPak family uses a well proven concept in IGBT press-pack technology that:

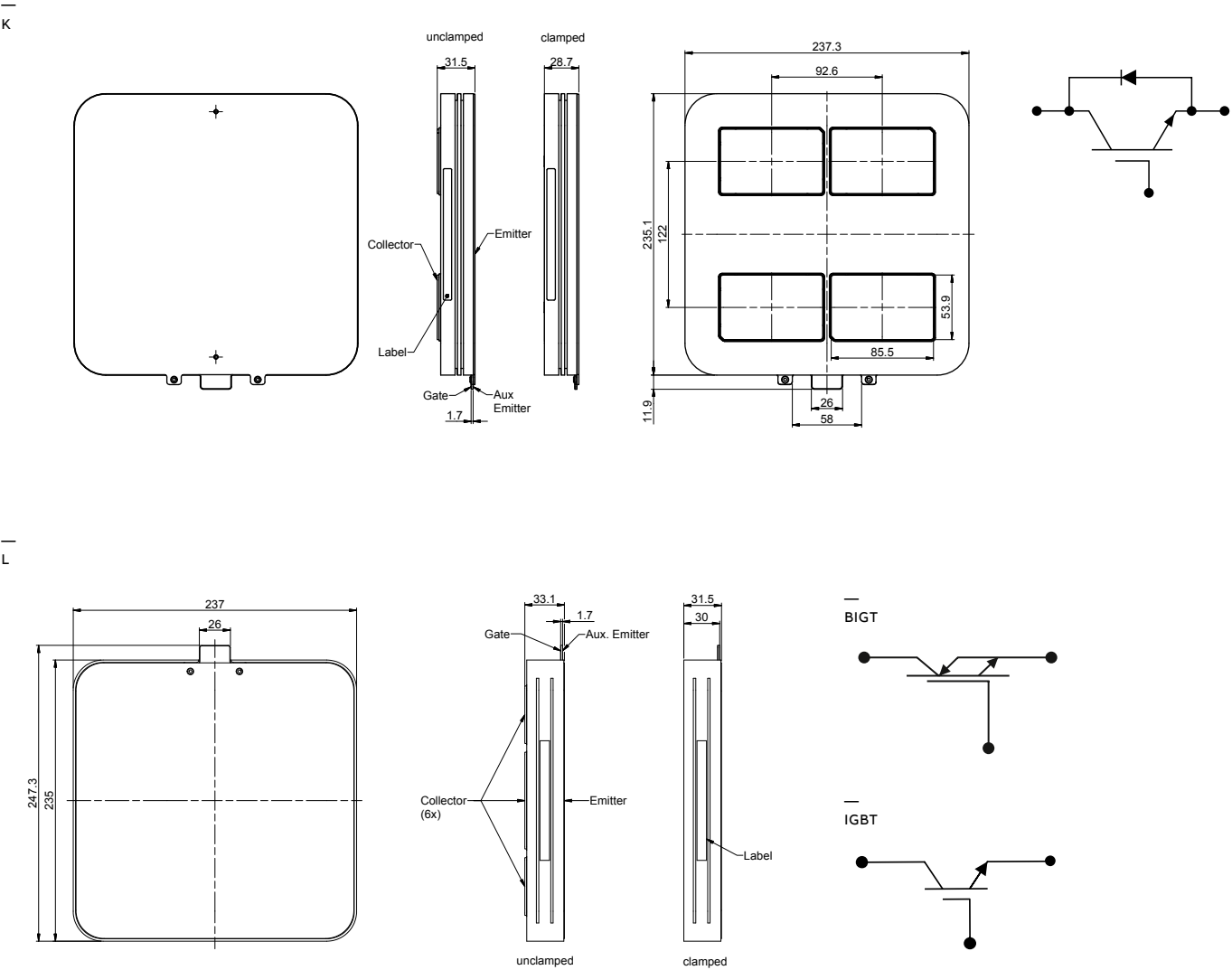
- allows for easy mechanical and electrical series connection
- allows for easy stack design thanks to high tolerance for inhomogeneous mounting pressure
- guarantees a uniform chip pressure in multiple-device stacks
- provides a stable shorted state in case of failure
- long-term short-circuit failure mode (SCFM) available

ABB Power Grids' StakPak IGBT modules are therefore a perfect match for applications like HVDC, FACTS, breakers and pulsed power.



Part number	Voltage V_{CES} (V)	Current I_C (A)	V_{CESat} (V) typ. 125 °C	V_F (V) typ. 125 °C	IGBT-to-diode ratio	Housings	SCFM rating
5SNA 1300K450300	4500	1300	3.4	2.4	1:1	K	Yes
5SNA 2000K450300	4500	2000	3.4	2.4	1:1	K	Yes
5SNA 2000K451300	4500	2000	3.65	3.0	2:1	K	Yes
5SNA 2000K452300	4500	2000	3.65	3.0	2:1	K	No
5SNA 3000K452300	4500	3000	3.65	3.0	2:1	K	No
5SMA 3000L450300 New	4500	3000	3.1	–	1:0	L	No
5SJA 3000L520300	5200	3000	3.1	2.5	1:1 (BIGT)	L	No

Please refer to page 55 for part numbering structure.



Diodes

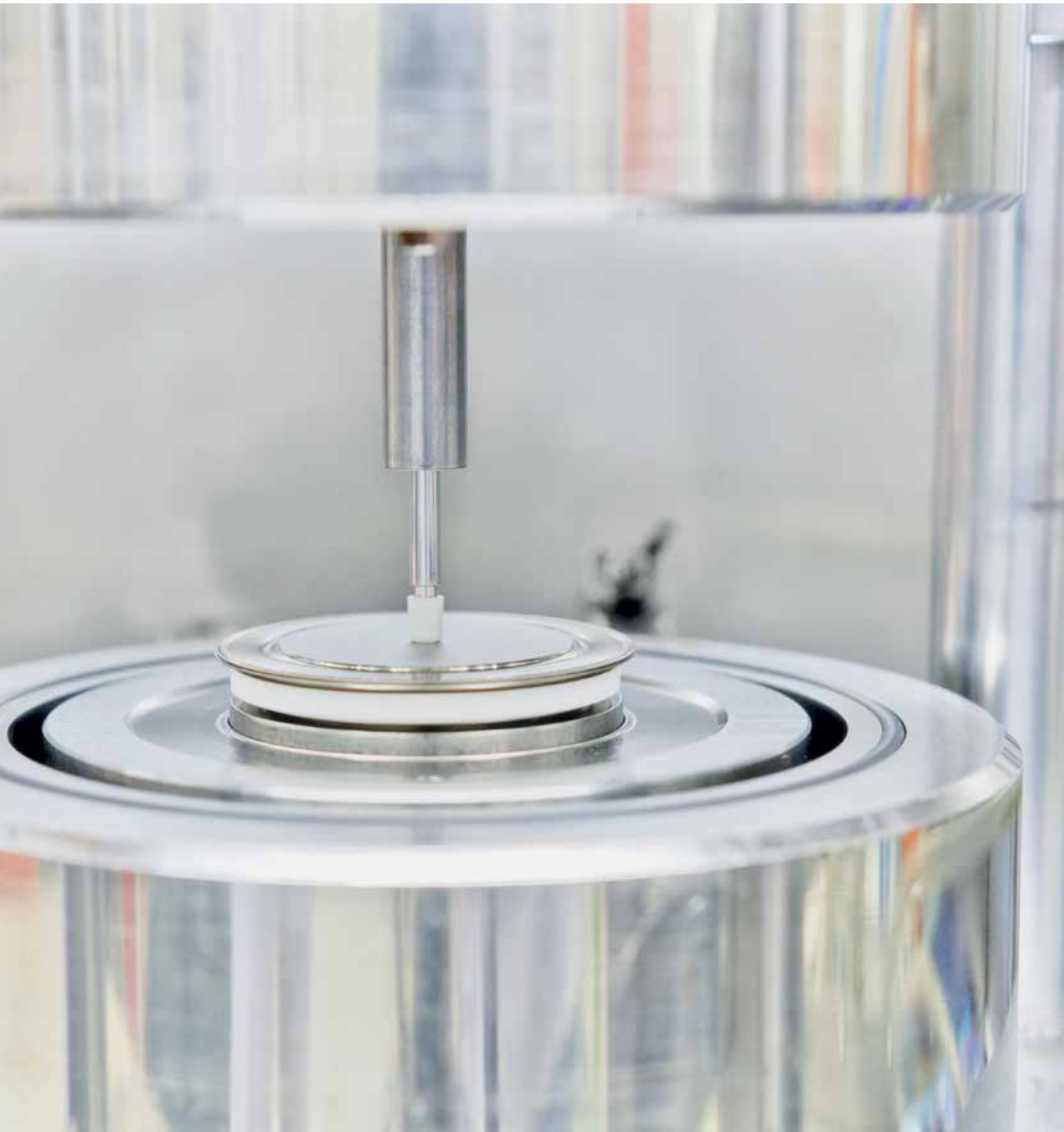
Diodes are used in a number of different applications. Each of these applications sets different requirements on the diodes' characteristics.

Inverter applications ask for fast recovery diodes with soft-switching characteristics, high-current rectifiers demand diodes with low on-state losses, medium-power rectifiers benefit from diodes with avalanche capability and welding rectifiers require highest current in the smallest package.

ABB Power Grids offers four press-pack diode families that meet these requirements:

- Fast recovery diodes page 26
- Standard rectifier and avalanche diodes page 28
- Welding diodes page 32





Fast recovery diodes

ABB Power Grids' comprehensive family of fast recovery diodes is optimized for enhanced Safe Operating Area (SOA) and controlled (soft) turn-off recovery. This makes these diodes very well suited for all converter applications.



The diodes are typically used in combination with IGBTs and GTOs as free-wheeling and clamp diodes, thus enabling full IGBT and GTO performance.

Our L-housing fast recovery diodes optimally match press-pack IGBT and IEGT applications where a di/dt of up to 5 kA/ μ s is required.

Fast recovery diode recommendations for various applications can be found in the application note – Applying fast recovery diodes. The latest version is available at www.abb.com/semiconductors.

GTO free-wheeling diodes

Part number	V _{RRM}	V _{DC}	I _{FAVM}	I _{FSM}		V _{F0}	r _F	I _{rr}	Q _{rr}	T _{VJM}	R _{thJC}	R _{thCH}	F _m	Housing
			T _C = 85 °C	1 ms	10 ms	T _{VJM}	di dt = 300 A/μs							
				T _{VJM}	T _{VJM}		T _{VJM}							
	V	V	A	kA	kA	V	mΩ	A	μC	°C	K/kW	K/kW	kN	
5SDF 13H4501	4500	2800	1200	60.0	25.0	1.30	0.48	800	3000	125	12	3	40	H1
5SDF 10H6004	6000	3800	1100	44.0	18.0	1.50	0.60	1000	6000	125	12	3	40	H1

Drawings see page 30.

Please refer to page 57 for part numbering structure.

IGBT diodes

Part number	V_{RRM}	V_{DC}	I_{FAVM}	I_{FSM}	V_{FO}	r_F	I_{rr}	Q_{rr}	T_{VJM}	R_{thJC}	R_{thCH}	F_m	Housing
			$T_c = 70\text{ °C}$	10 ms	T_{VJM}		$di/dt = 5000\text{ A/}\mu\text{s}$						
				T_{VJM}			T_{VJM}						
	V	V	A	kA	V	mΩ	A	μC	°C	K/kW	K/kW	kN	
5SDF 20L4521	4500	2800	1950	45.0	1.70	0.80	3600	5300	140	6	3	40	L2
5SDF 28L4521	4500	2800	2620	56.0	1.10	0.47	4100	10100	140	6	3	40	L2

IGCT diodes

Part number	V _{RRM}	V _{DC}	I _{FAVM}	I _{FSM}		V _{FO}	r _F	I _{rr}	di/dt	T _{VJM}	R _{thJC}	R _{thCH}	F _m	Housing
			T _C = 70 °C	1 ms	10 ms	T _{VJM}		max.						
				T _{VJM}	T _{VJM}									
	V	V	A	kA	kA	V	mΩ	A	A/μs	°C	K/kW	K/kW	kN	
5SDF 03D4502	4500	2800	275	10.0	5.0	2.15	2.80	355	300	115	40	8	16	D
5SDF 05F4502	4500	2800	435	32.0	16.0	2.42	2.10	610	430	115	17	5	20	F
5SDF 10H4503	4500	2800	1100	47.0	20.0	1.75	0.88	1520	600	125	12	3	40	H1
5SDF 20L4520	4500	2800	1970	–	45.0	1.56	0.80	2400	1200	140	6	3	40	L2
5SDF 28L4520	4500	2800	2620	–	56.0	1.10	0.47	2800	1000	140	6	3	40	L2
5SDF 02D6004	5500	3300	175	8.0	3.0	3.35	7.20	300	220	115	40	8	16	D
5SDF 04F6004	5500	3300	380	22.0	10.0	2.70	2.80	600	340	115	22	5	20	F
5SDF 08H6005	5500	3300	585	40.0	18.0	4.50	1.30	900	440	115	12	3	40	H1

Drawings see page 30.

Please refer to page 57 for part numbering structure.

Standard rectifier and avalanche diodes

ABB Power Grids' two families of high-power rectifier diodes – standard rectifier diodes and avalanche diodes – are well-known for their outstanding reliability and excellent nominal and surge current capabilities.



The standard rectifier diodes are optimized for line frequency and low on-state losses. Their main applications are rectifiers for large AC drives, aluminum smelting and other metal refining as well as trackside supply.

The avalanche diodes are self-protected against transient overvoltages, offer reduced snubber requirements and feature maximum avalanche power dissipation. They are frequently used for input rectifiers in traction converters or high-voltage power rectifiers.

For safe and easy parallel or series connection, both types of diodes are available in groups of similar V_F or Q_{rr} , respectively.

Avalanche diodes

Part number	V_{RRM}	I_{FAVM}	I_{FSM}	V_{FO}	r_F	P_{RSM}	T_{VJM}	R_{thJC}	R_{thCH}	F_m	Housing
		$T_c = 85^\circ\text{C}$	10 ms T_{VJM}	T_{VJM}		20 μs T_{VJM}					
	V	A	kA	V	m Ω	kw	$^\circ\text{C}$	K/kW	K/kW	kN	
5SDA 11D1702	1700	1310	15.0	0.74	0.21	50	160	40	10	11	D
5SDA 27F2002	2000	2700	31.0	0.79	0.09	100	160	20	5	22	F
5SDA 10D2303	2300	1140	13.5	0.83	0.30	50	160	40	10	11	D
5SDA 24F2303	2300	2350	29.0	0.84	0.13	75	160	20	5	22	F
5SDA 09D2604	2600	1020	11.5	0.87	0.39	50	160	40	10	11	D
5SDA 08D3205	3200	910	9.2	0.93	0.52	50	160	40	10	11	D
5SDA 21F3204	3200	2110	26.0	0.89	0.17	75	160	20	5	22	F
5SDA 07D3806	3800	790	7.6	1.01	0.72	50	160	40	10	11	D
5SDA 16F3806	3800	1620	20.5	1.03	0.32	50	160	20	5	22	F
5SDA 06D5007	5000	690	7.0	1.10	1.01	50	160	40	10	11	D
5SDA 14F5007	5000	1410	17.5	1.13	0.44	50	160	20	5	22	F

Drawings see page 30.

Please refer to page 57 for part numbering structure.

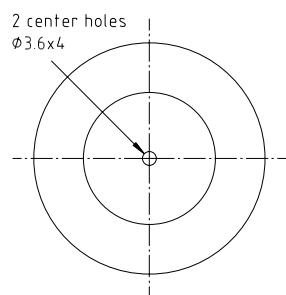
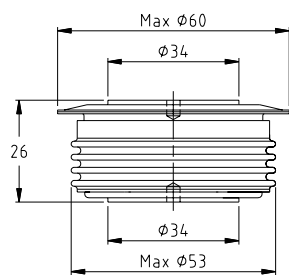
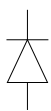
Standard recovery diodes

Part number	V_{RSM}	V_{RRM}	I_{FAVM}	I_{FSM}	V_{TO}	r_T	T_{VJM}	R_{thJC}	R_{thCH}	F_m	Housing
				10 ms T_{VJM}	T_{VJM}						
	V	A	A	kA	V	mΩ	°C	K/kW	K/kW	kN	
5SDD 70H2000	2000	2000	7030	65.0	0.861	0.046	190	8.0	2.5	50	H2
5SDD 65H2400	2400	2400	6520	59.0	0.870	0.057	190	8.0	2.5	50	H2
5SDD 51L2800	2800	2000	5380	65.0	0.770	0.082	175	8.0	3.0	70	L1
5SDD 60N2800	2800	2000	6830	87.0	0.800	0.050	160	5.7	1.0	90	N
5SDD 60Q2800	2800	2000	7385	87.0	0.800	0.050	160	5.0	1.0	90	Q
5SDD 11T2800	2800	2800	1285	15.0	0.933	0.242	160	32.0	8.0	10	T
5SDD 11D2800	2800	2800	1285	15.0	0.933	0.242	160	32.0	8.0	10	D
5SDD 24F2800	2800	2800	2596	30.0	0.906	0.135	160	15.0	4.0	22	F
5SDD 48H3200	3200	3200	4708	61.0	0.992	0.067	160	8.0	2.5	50	H2
5SDD 54N4000	4000	3600	5200	85.0	0.800	0.086	150	5.7	1.0	90	N
5SDD 40H4000	4000	4000	3847	46.0	0.900	0.133	160	8.0	2.5	50	H2
5SDD 08D5000	5000	5000	1028	12.0	0.894	0.487	160	32.0	8.0	10	D
5SDD 08T5000	5000	5000	1028	12.0	0.894	0.487	160	32.0	8.0	10	T
5SDD 20F5000	5000	5000	1978	24.0	0.940	0.284	160	15.0	4.0	22	F
5SDD 38H5000	5000	5000	3814	45.0	0.903	0.136	160	8.0	2.5	50	H2
5SDD 36K5000	5000	5000	3638	45.0	0.903	0.136	160	9.2	2.5	50	K
5SDD 33L5500	5500	5000	3480	46.0	0.940	0.147	150	7.0	1.5	70	L1
5SDD 50N5500	5500	5000	4570	73.0	0.800	0.107	150	5.7	1.0	90	N
5SDD 06D6000	6000	6000	662	10.5	1.066	0.778	150	42.0	8.0	11	D
5SDD 10F6000	6000	6000	1363	17.5	1.015	0.407	150	20.0	5.0	22	F
5SDD 14F6000	6000	6000	1363	17.5	1.015	0.407	150	20.0	5.0	22	F
5SDD 31H6000	6000	6000	3201	40.0	0.944	0.166	150	8.0	2.5	50	H2
5SDD 50N6000	6000	6000	4210	71.2	0.800	0.134	150	5.7	1.0	90	N

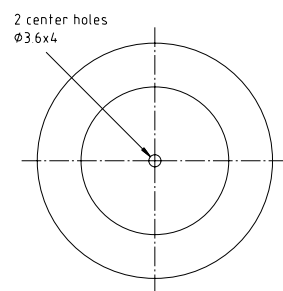
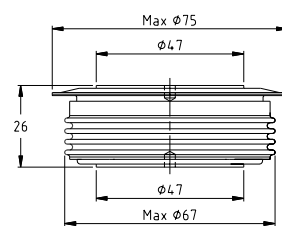
Drawings see page 30.

Please refer to page 57 for part numbering structure.

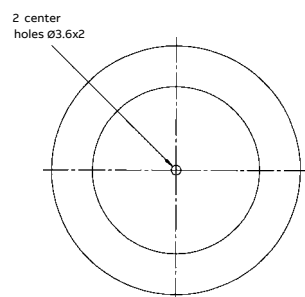
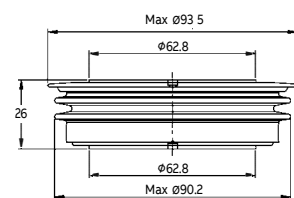
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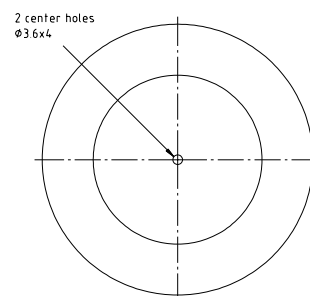
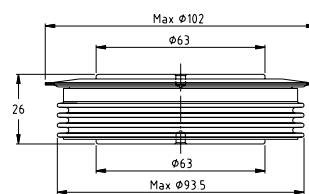
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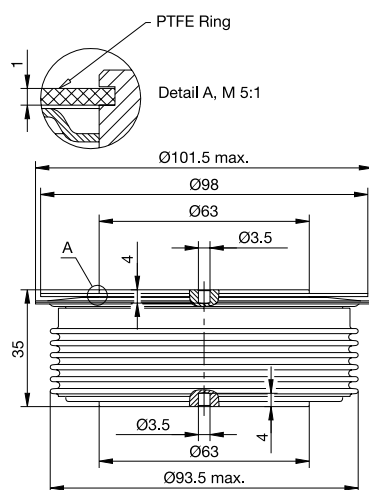
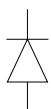
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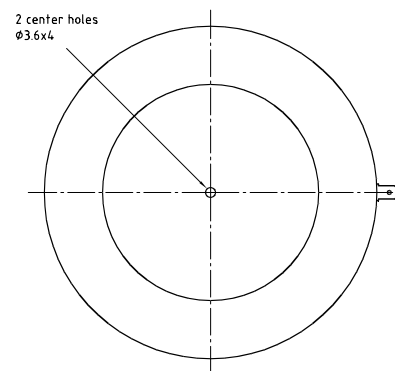
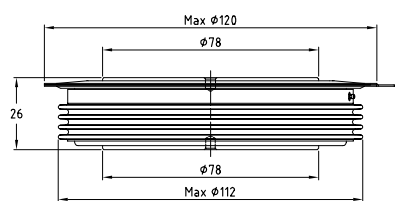
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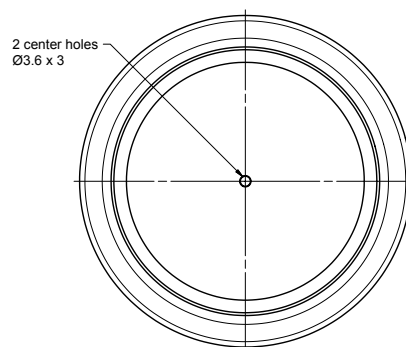
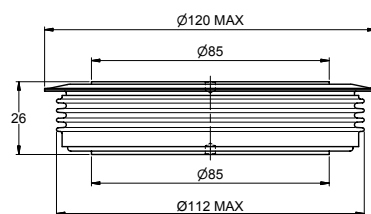
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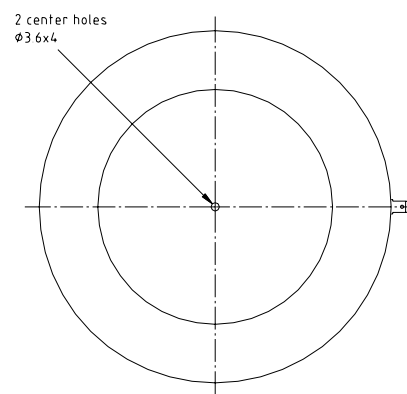
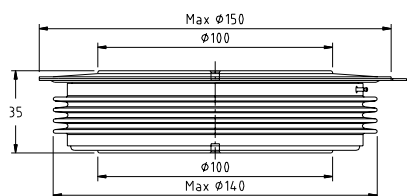
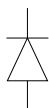
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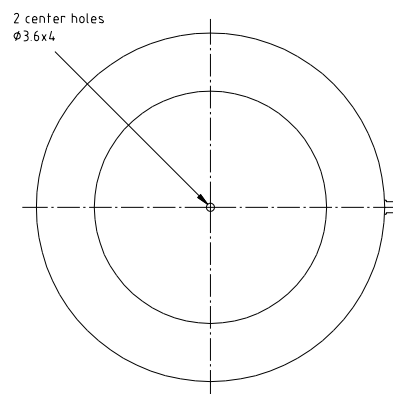
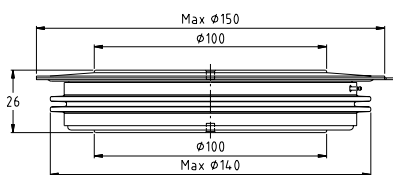
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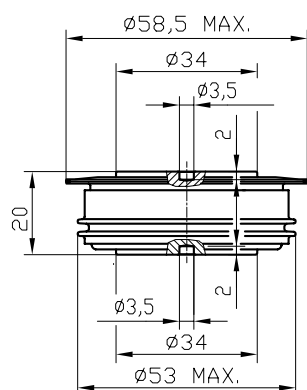
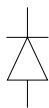
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Welding diodes

Almost every second car driving in Europe has been fabricated using ABB Power Grids welding diodes, as most of the major welding equipment manufacturers rely on ABB Power Grids' quality, reliability and performance.



ABB Power Grids' comprehensive product range offers medium frequency (up to 2 kHz) and high frequency (up to 10 kHz) welding diodes. They all feature very low on-state voltage and very low thermal resistance. In addition, they are available in light package, thin and hermetically sealed ceramic housings or even housing-less, another welcomed feature for equipment that is mounted directly on robot arms.

Medium frequency

Part number	V_{RRM}	V_{Fmin}	V_{FMAX}	I_{FAVM}	I_{FSM}	V_{F0}	r_F	T_{VJM}	R_{thJC}	R_{thCH}	F_m	Housing
		$T_j = 25\text{ }^{\circ}\text{C},$ $I_F = 5000\text{ A}$		$T_c = 85\text{ }^{\circ}\text{C}$		T_{VJM}	T_{VJM}					
	V	V	V	A	kA	V	mΩ	°C	K/kW	K/kW	kN	
5SDD 71X0200	200	–	1.05	7110	55	0.74	0.026	170	10.0	5.0	22	X
5SDD 71B0200	200	–	1.05	7110	55	0.74	0.026	170	10.0	5.0	22	B
5SDD 0120C0200	200	–	0.92 *	11000	85	0.75	0.020	170	6.0	3.0	37.5	C
5SDD 71X0400	400	0.95	1.00	7110	55	0.74	0.026	170	10.0	5.0	22	X
5SDD 71B0400	400	–	1.05	7110	55	0.74	0.026	170	10.0	5.0	22	B
5SDD 0120C0400	400	0.83 *	0.88 *	11350	85	0.74	0.018	170	6.0	3.0	37.5	C
5SDD 92Z0401	400	–	1.03 *	9244	60	0.78	0.031	180	5.6	3.6	36	Z1
5SDD 0105Z0401	400	–	1.01 *	10502	70	0.812	0.026	180	5.0	2.5	40	Z2
5SDD 0135Z0401	400	–	0.92 *	13526	85	0.758	0.021	180	3.9	2.6	52.5	Z3

* at 8000 A, T_{VJM}

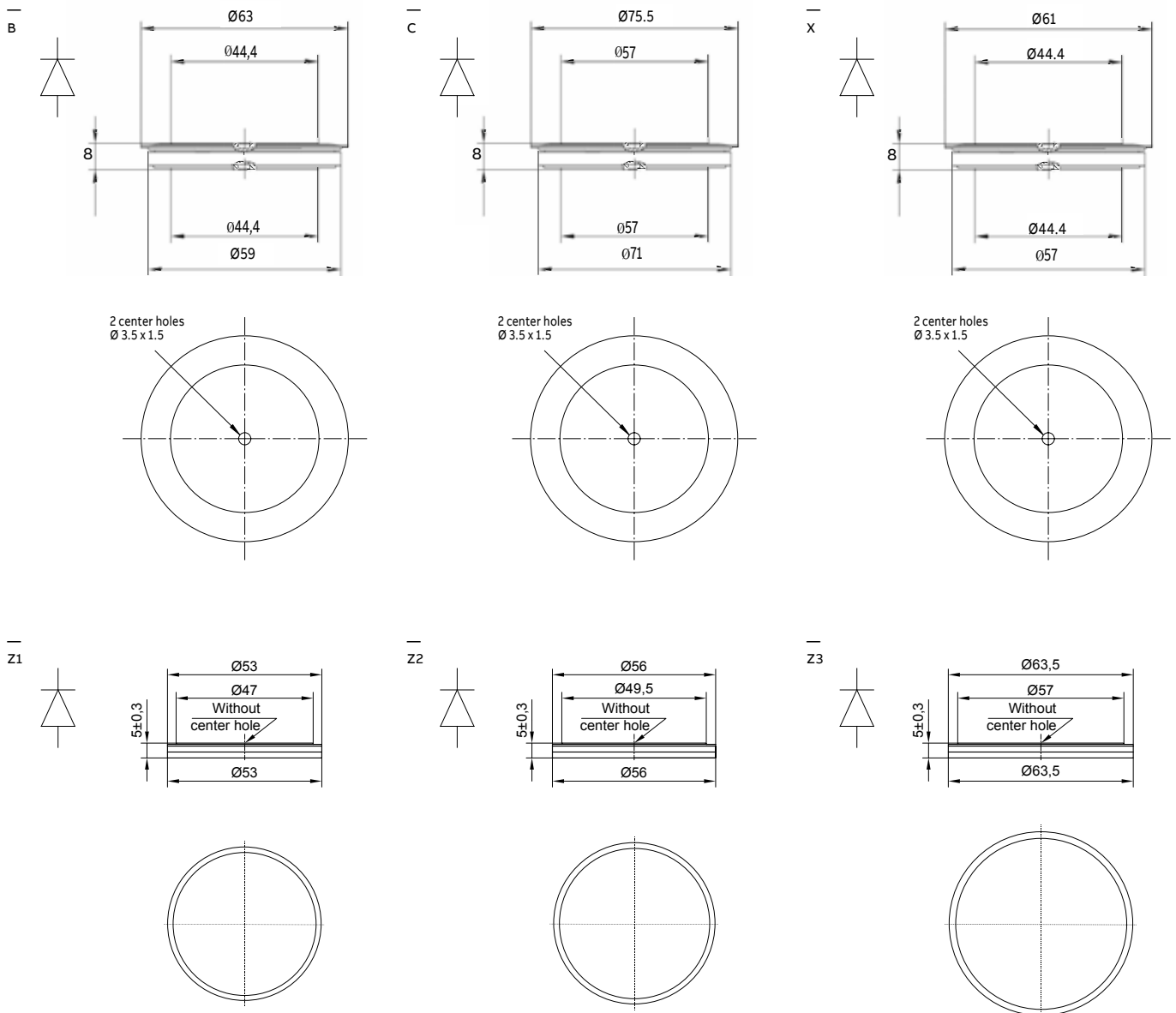
Please refer to page 57 for part numbering structure.

High frequency

Part number	V_{RRM}	V_{FMAX}	I_{FAVM}	I_{FSM}	V_{FO}	r_F	Q_{rr}	T_{VJM}	R_{thJC}	R_{thCH}	F_m	Housing
		T_{VJM} $I_F = 5000\text{ A}$	$T_c = 85\text{ °C}$	10 ms T_{VJM}	T_{VJM}	T_{VJM}	T_{VJM}					
	V	V	A	kA	V	mΩ	μC	°C	K/kW	K/kW	kN	
5SDF 63B0400	400	1.14	6266	44	0.962	0.036	180	190	10.0	5.0	22	B
5SDF 63X0400	400	1.14	6266	44	0.962	0.036	180	190	10.0	5.0	22	X
5SDF 90Z0401	400	1.13	9041	48	0.979	0.032	200	190	5.6	3.6	36.0	Z1
5SDF 0102C0400	400	1.14 *	10159	70	0.977	0.022	300	190	6.0	3.0	37.5	C
5SDF 0103Z0401	400	1.20 *	10266	54	0.998	0.027	230	190	5.0	2.5	40.0	Z2
5SDF 0131Z0401	400	1.14 *	13058	70	0.977	0.022	300	190	3.9	2.6	52.5	Z3

* at 8000 A

Please refer to page 57 for part numbering structure.



Dimensions in mm

Thyristors

High-power thyristors are used in applications ranging from 100 kW drives up to HVDC stations rated above 10 GW.

Since many applications use antiparallel connected thyristors, we introduced the bi-directionally controlled thyristor (BCT), which consists of two integrated antiparallel thyristor functions on one silicon wafer.

ABB Power Grids offers the following thyristor families:

- Phase control thyristors (PCTs) page 35
- Bi-directionally controlled thyristors (BCTs) page 40



PCTs

Phase control thyristors

Phase control thyristor has been the backbone of the high-power electronics industry since its introduction almost 50 years ago and has set benchmark reliability records over many years.



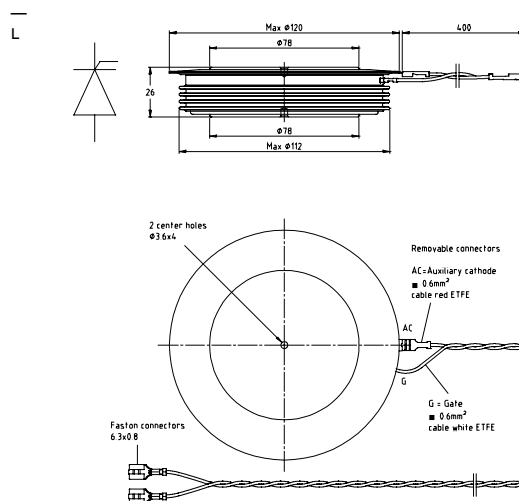
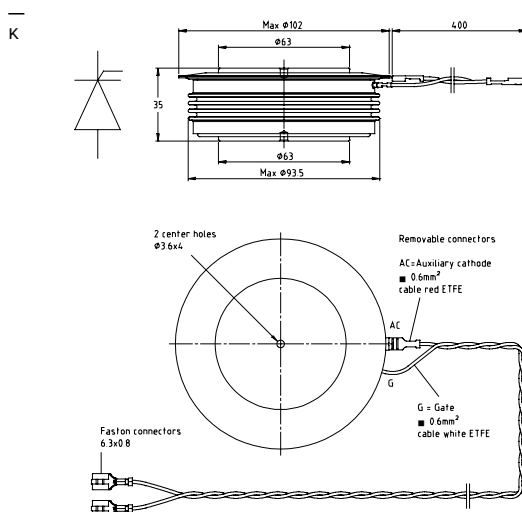
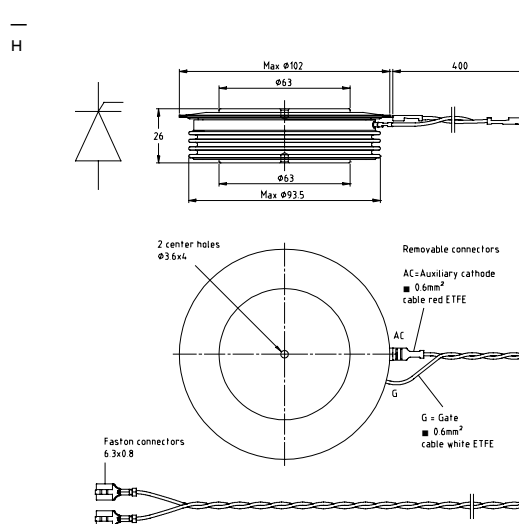
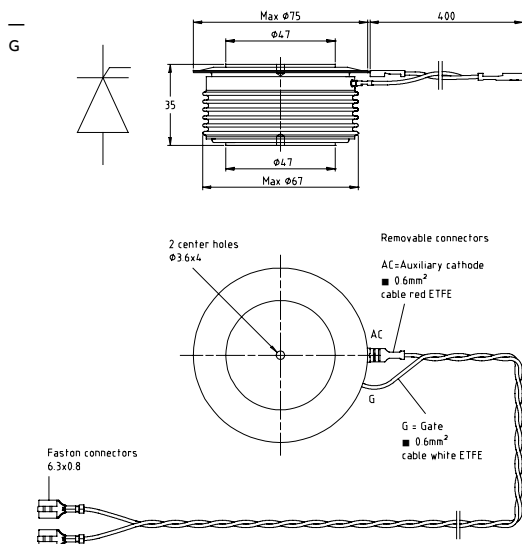
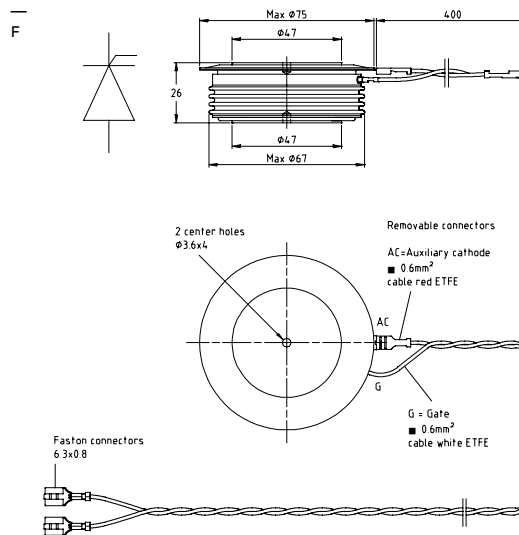
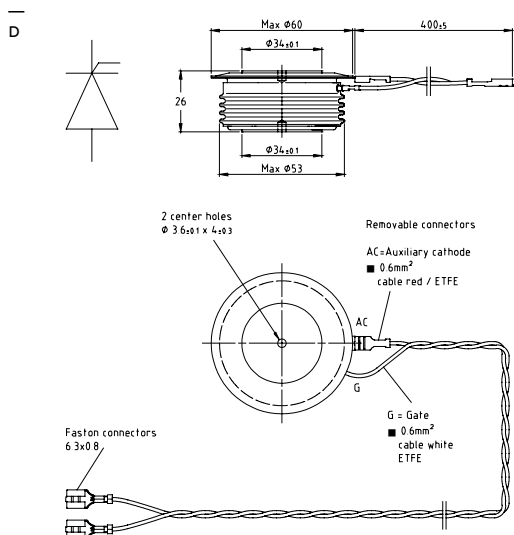
The field of PCT applications ranges from kW drives and MW rated line commutated frequency converters to GW converters for HVDC transmission.

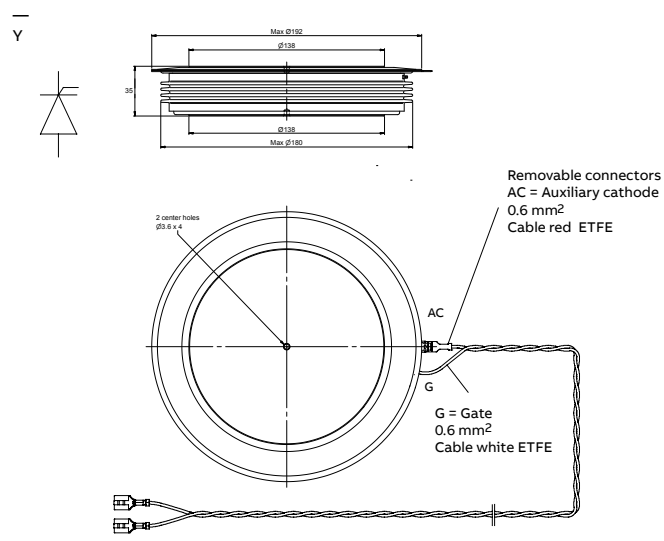
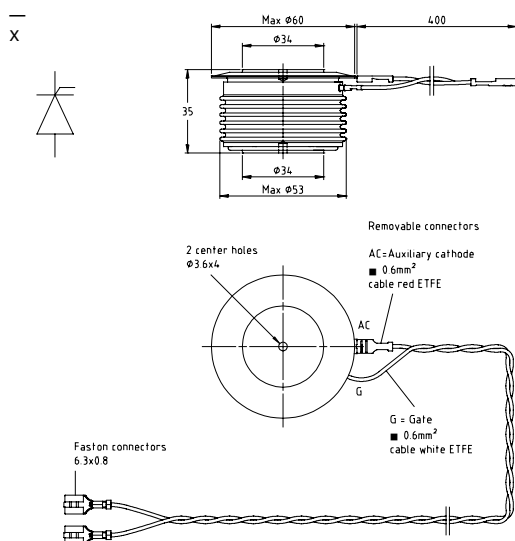
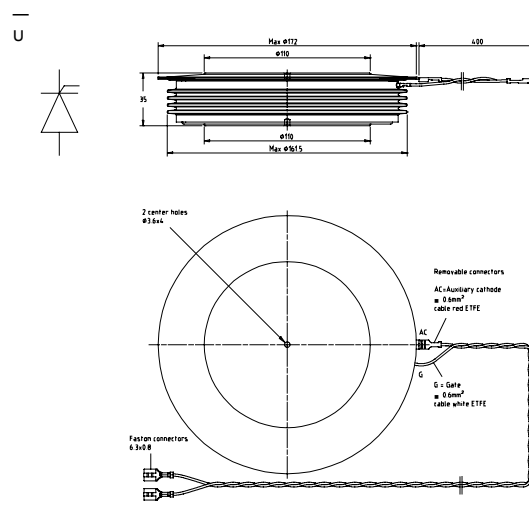
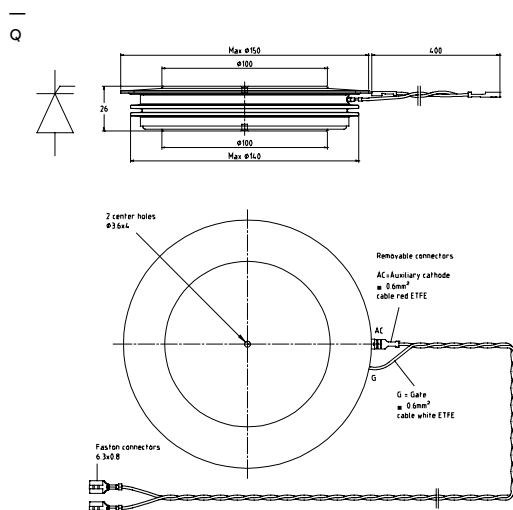
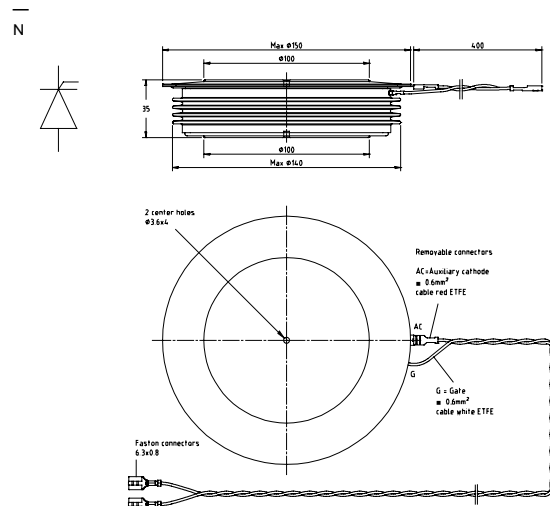
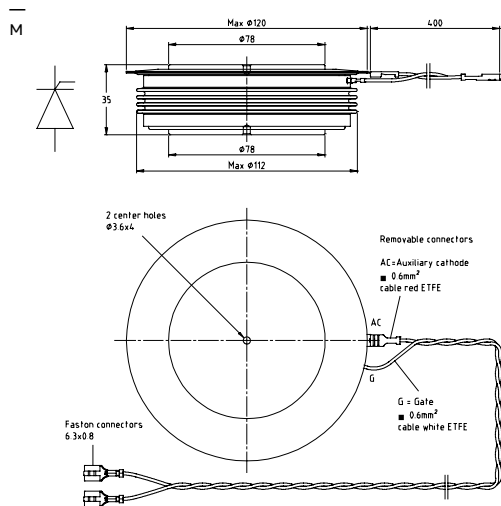
ABB Power Grids offers the most complete range of high-power thyristors, including 6" devices. New products continue to be developed with focus on minimizing overall losses and maximizing power ratings.

Applications using two antiparallel thyristors can take advantage of ABB Power Grids' innovative bi-directionally controlled thyristors (BCTs) that incorporate two antiparallel thyristors in a single housing (see page 40).

Part number	$V_{\text{DRM}}, V_{\text{RRM}}$	I_{TAVM}	I_{TSM}	V_{TO}	r_{T}	T_{VJM}	R_{thJC}	R_{thCH}	F_{m}	Housing
	T_{VJM}	$T_{\text{c}} = 70^{\circ}\text{C}$	10 ms / T_{VJM}	T_{VJM}						
	V	A	kA	V	mΩ	°C	K/kW	K/kW	kN	
5STP 07D1800	1800	730	9.0	0.80	0.540	125	36.0	7.5	10	D
5STP 18F1800	1800	1660	21.0	0.83	0.230	125	17.0	4.0	22	F
5STP 27H1800	1800	3000	50.5	0.88	0.103	125	10.0	2.0	50	H
5STP 42L1800	1800	4170	64.0	0.85	0.082	125	7.0	1.5	70	L
5STP 50Q1800	1800	6100	94.0	0.90	0.050	125	5.0	1.0	90	Q
5STP 06D2800	2800	620	8.8	0.92	0.780	125	36.0	7.5	10	D
5STP 16F2800	2800	1400	18.0	0.82	0.370	125	17.0	4.0	22	F
5STP 24H2800	2800	2625	43.0	0.85	0.160	125	10.0	2.0	50	H
5STP 33L2800	2800	3740	65.5	0.95	0.100	125	7.0	1.5	70	L
5STP 45N2800	2800	5080	77.0	0.86	0.070	125	5.7	1.0	90	N
5STP 45Q2800	2800	5490	77.0	0.86	0.070	125	5.0	1.0	90	Q
5STP 04D4200	4200	470	7.1	1.00	1.500	125	36.0	7.5	10	D
5STP 12F4200	4200	1150	17.3	0.95	0.575	125	17.0	4.0	22	F
5STP 18H4200	4200	2192	32.0	1.25	0.191	125	10.0	3.0	50	H
5STP 28L4200	4200	3170	54.0	0.97	0.158	125	7.0	1.5	70	L
5STP 38N4200	4200	3960	64.5	0.95	0.130	125	5.7	1.0	90	N
5STP 38Q4200	4200	4275	64.5	0.95	0.130	125	5.0	1.0	90	Q
5STP 04D5200	5200	440	6.1	1.20	1.600	125	36.0	7.5	10	D
5STP 17H5200	5200	1975	34.0	1.02	0.320	125	10.0	2.0	50	H
5STP 25L5200	5200	2760	50.5	1.00	0.225	125	7.0	1.5	70	L
5STP 25M5200	5200	2379	50.5	1.00	0.225	125	9.0	1.5	70	M
5STP 34N5200	5200	3600	63.0	1.03	0.160	125	5.7	1.0	90	N
5STP 34Q5200	5200	3875	63.0	1.03	0.160	125	5.0	1.0	90	Q
5STP 52U5200	5200	5120	99.0	1.04	0.115	125	4.0	0.8	135	U
5STP 03D6500	6500	380	4.7	1.20	2.300	125	36.0	7.5	10	D
5STP 03X6500	6500	350	4.7	1.20	2.300	125	45.0	7.5	10	X
5STP 08F6500	6500	830	15.1	1.24	1.015	125	17.0	4.0	22	F
5STP 08G6500	6500	720	15.1	1.24	1.015	125	22.0	4.0	22	G
5STP 12K6500	6500	1370	31.5	1.18	0.632	125	11.0	2.0	50	K
5STP 18M6500	6500	1800	47.5	1.20	0.430	125	9.0	1.5	70	M
5STP 26N6500	6500	2810	65.0	1.12	0.290	125	5.7	1.0	90	N
5STP 42U6500	6500	4250	86.0	1.24	0.162	125	4.0	0.8	135	U
5STP 48Y7200	7200	4840	92.0	1.06	0.115	110	3.0	0.6	190	Y
5STP 27N8500 New	8500	2450	64.0	1.09	0.420	125	5.7	1.0	90	N
5STP 27Q8500 New	8500	2630	64.0	1.09	0.420	125	5.0	1.0	90	Q
5STP 45Y8500	8500	4240	90.0	1.10	0.160	110	3.0	0.6	190	Y

Please refer to page 56 for part numbering structure.







BCTs

Bi-directionally controlled thyristors

Improved volume consumption and reduced part count for SVC, 4-quadrant DC-drive or soft starter equipment in the magnitude of 25 percent compared with equally rated PCT-solutions are possible with ABB Power Grids' BCTs – without jeopardizing reliability and performance.

ABB Power Grids' innovative bi-directionally controlled thyristor (BCT) features two monolithically integrated antiparallel thyristors in a single housing. The two thyristor halves are individually triggered and have a separation region enabling the design of high-voltage devices with the dynamic capability of discrete devices.

The BCT is designed, manufactured and tested using the same philosophy, technology and equipment as the well-established PCT (page 35), thus reaching the same levels of performance and reliability.

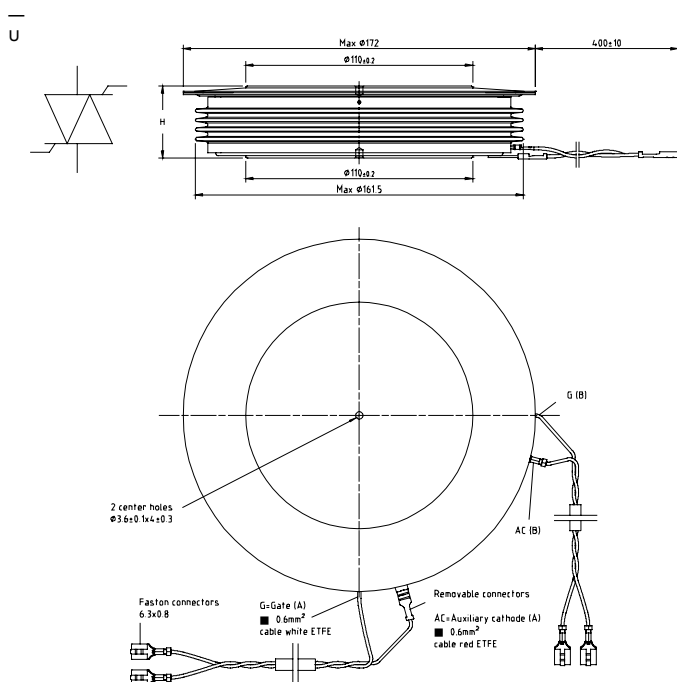
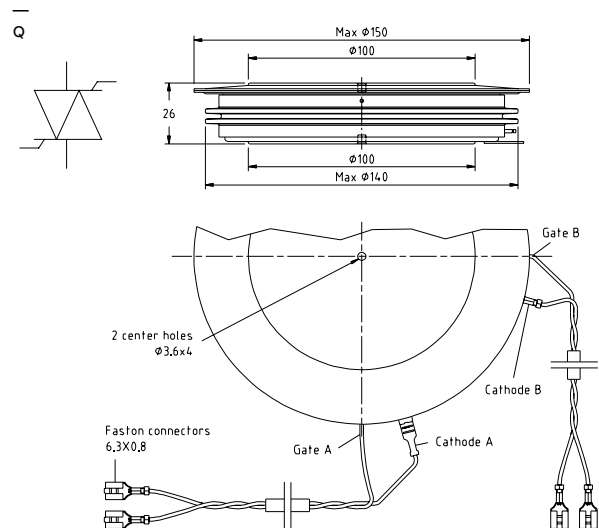
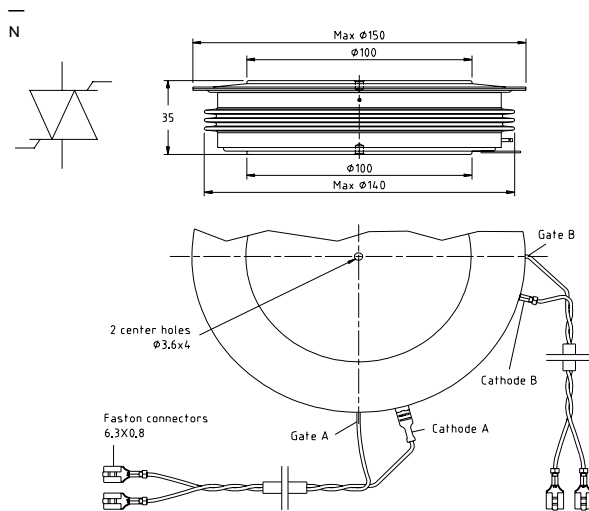
A table of replacement of PCTs by BCTs is given in the BCT application note which can be found at www.abb.com/semiconductors.



Part number	V_{RM}	I_{TRMS}^*	I_{TAVM}	I_{TSM}	V_{TO}	r_T	T_{VJM}	R_{thJC}	R_{thCH}	F_m	Housing
	T_{VJM}	$T_C = 70^\circ C$	$T_C = 70^\circ C$	10 ms T_{VJM}	T_{VJM}						
	V	A	A	kA	V	m Ω	$^\circ C$	K/kW	K/kW	kN	
5STB 24N2800	2800	5400	2430	43.0	0.85	0.160	125	11.4	2.0	90	N
5STB 24Q2800	2800	5840	2630	43.0	0.85	0.160	125	10.0	2.0	90	Q
5STB 18N4200	4200	4260	1920	32.0	0.96	0.285	125	11.4	2.0	90	N
5STB 17N5200	5200	4000	1800	29.0	1.02	0.320	125	11.4	2.0	90	N
5STB 25U5200	5200	4400	1980	42.0	1.06	0.219	110	8.5	1.6	135	U
5STB 13N6500	6500	3120	1405	22.0	1.20	0.600	125	11.4	2.0	90	N
5STB 18U6500	6500	3510	1580	29.7	1.20	0.458	110	8.5	1.6	135	U

* AC full-wave

Please refer to page 56 for part numbering structure.



Dimensions in mm

IGCTs

Integrated gate-commutated thyristors

Within 20 years of its introduction, the IGCT has established itself as the semiconductor of choice for high-power frequency converters by meeting the requirements of today's demanding applications.

ABB Power Grids' IGCTs are used in a multitude of applications due to their versatility, efficiency and cost-effectiveness. With their low on-state voltage, they achieve the lowest running costs by reaching inverter efficiencies of 99.6 percent and more.

Single inverters of over 15 MVA can be realized without series or parallel connection, thus achieving the highest inverter power densities in the industry.

The number of applications featuring IGCTs is manifold: medium-voltage drives (MVDs), marine drives, co-generation, wind power converters and STATCOMs, to name just a few.

The latest record performance using IGCTs was achieved with the world's most powerful frequency converter (100 MVA) for variable speed pumped hydropower application installed in the Grimsel 2 power plant in the Swiss Alps.



Asymmetric IGCTs

Part number	V _{DRM}	V _{DC}	V _{RRM}	I _{TGQM}	I _{TAVM}	I _{TSM}	V _T	V _{T0}	r _T	T _{VJM}	R _{thJC}	R _{thCH}	F _m	V _{GIN}	Outline	
					T _C = 85 °C	3 ms T _{VJM}	10 ms T _{VJM}	4000 A T _{VJM}	T _{VJM}	T _{VJM}						
	V	V	V	A	A	kA	kA	V	V	mΩ	°C	K/kW	K/kW	kN		V
5SHY 35L4520	4500	2800	17	4000	1700	50	32	2.70	1.40	0.33	125	8.5	3	40	28-40	Fig. 1
5SHY 35L4522	4500	2800	17	4000	2100	56	35	2.00	1.15	0.21	125	8.5	3	40	28-40	Fig. 1
5SHY 45L4520	4500	2800	17	4500	1430	39	28	2.60*	1.70	0.45	125	8.5	3	40	28-40	Fig. 1
5SHY 55L4500	4500	2800	17	5000	1870	50	33	2.35	1.22	0.28	125	8.5	3	40	28-40	Fig. 1
5SHY 50L5500	5500	3300	17	3600	1290	40	26	4.10	1.66	0.62	125	8.5	3	40	28-40	Fig. 1
5SHY 42L6500	6500	4000	17	3800	1290	40	26	4.10	1.88	0.56	125	8.5	3	40	28-40	Fig. 1

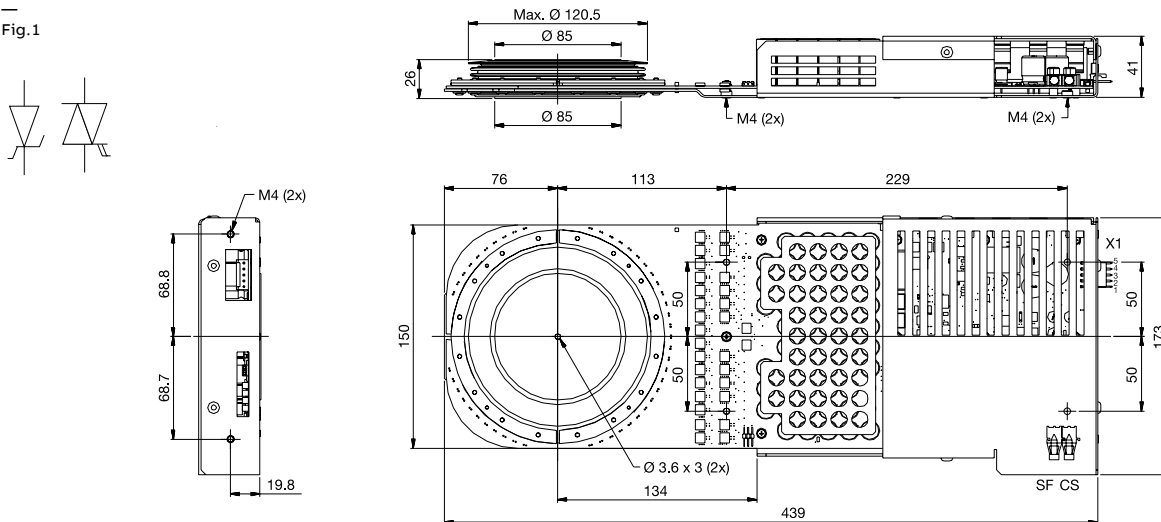
- Optimized for snubberless turn-off
- Contact factory for series connection
* at 2000 A

Reverse conducting IGCTs

Part number	V_{DRM}	V_{DC}	I_{TGQM}	I_{TAVM}/I_{FAVM}	I_{TSM}/I_{FSM}	V_T/V_F	V_{TO}/V_{FO}	r_T/r_F	T_{VJM}	R_{thJC}	F_m	V_{GIN}	Outline
				$T_c = 85^\circ C$	10 ms								
	V	V	A	A	kA	V	V	mΩ	°C	K/kW	kN	V	
5SHX 26L4520 GCT	4500	2800	2200	1010	17.0	2.95	1.80	0.53		13		28-40	Fig. 1
Diode part				390	10.6	5.40	2.70	1.24	125	26	44	28-40	Fig. 1
5SHX 19L6020 GCT	5500	3300	1800	840	18.0	3.45	1.90	0.90		13		28-40	Fig. 1
Diode part				340	7.7	6.40	2.70	2.23	125	26	44	28-40	Fig. 1
5SHX 36L4520 * New	4500	2800	3600	1040	15.0	2.70	1.59	0.74	125	11		28-40	Fig. 1
Diode part				730		3.60	1.88	1.15	125	14	44	28-40	Fig. 1
5SHX 36L4521 * New	4500	2800	3600	1280	20.0	2.00	1.24	0.51	125	11		28-40	Fig. 1
Diode part				910	20.0	2.60	1.46	0.76	125	14	44	28-40	Fig. 1

- Monolithically integrated free-wheeling diode optimized for snubberless turn-off
Please refer to page 56 for part numbering structure.
*Contact factory

Fig. 1



Fast recovery diode recommendation

For all asymmetric and reverse conducting IGCTs, ABB Power Grids offers matching free-wheeling, neutral point (NPC) and clamp diodes.

The actual choice of the diode depends on the specific application. Please see application note 5SYA 2064, Applying fast recovery diodes, on www.abb.com/semiconductors.

GTOs

Gate turn-off thyristors

One might be assuming that the rapid advance of the IGBT would spell an equally rapid end to the GTO era. The demand for these devices, however, is still strong today.



ABB Power Grids offers a broad portfolio of asymmetric GTOs with proven field reliability in various traction and industrial applications.

Asymmetric GTOs are divided in two categories: Fine pattern and standard. Fine pattern GTOs with buffer layer have exceptionally low on-state and dynamic losses and are optimized for fast switching.

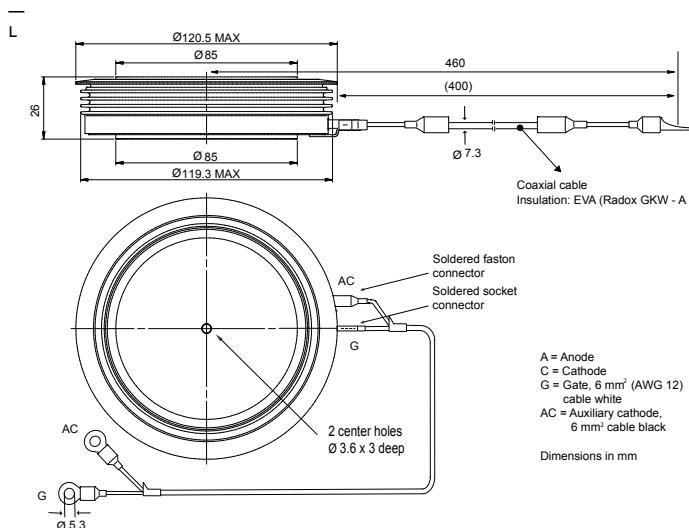
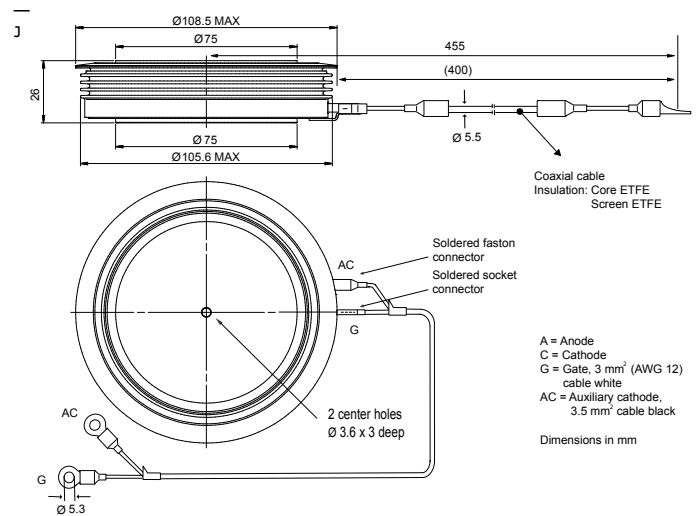
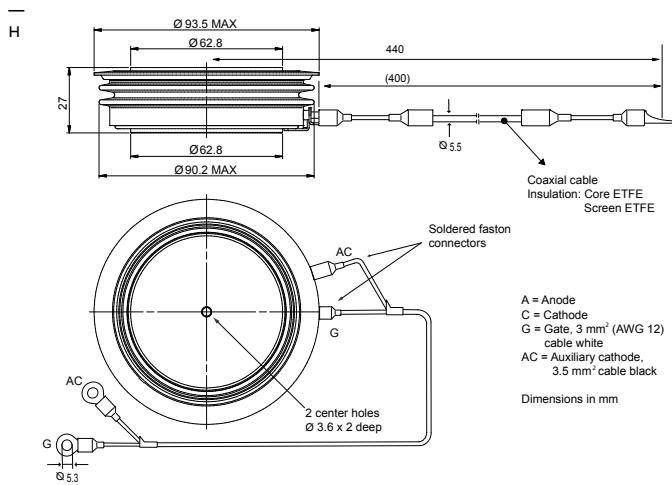
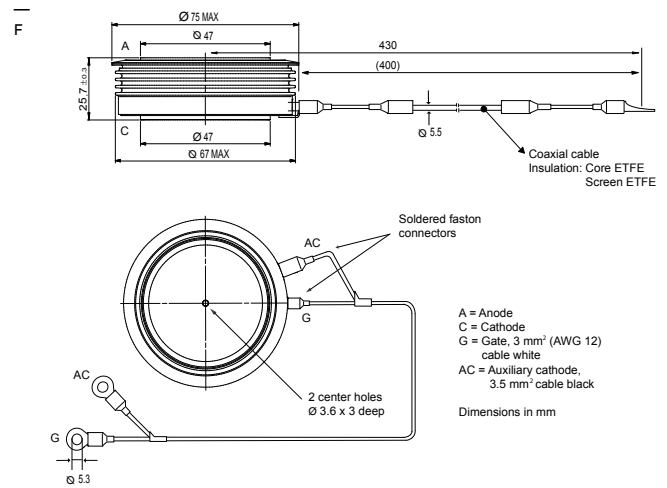
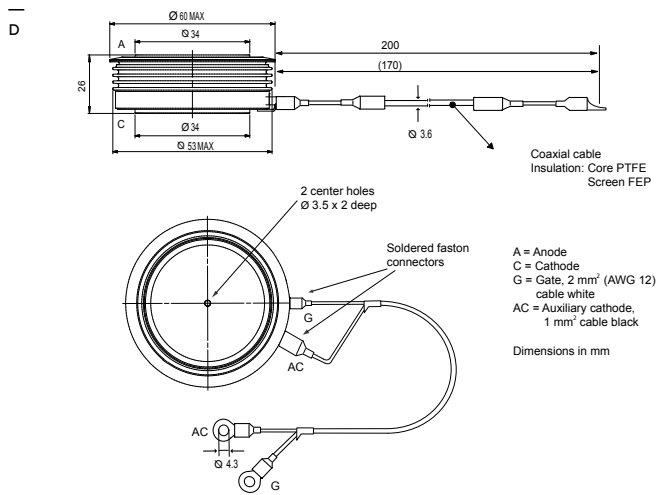
Asymmetric GTOs

Part number	V_{DRM}	V_{DC}	V_{RRM}	I_{TGQM} at C_s		I_{TAVM}	I_{TSM}	V_T	V_{TO}	r_T	T_{VJM}	R_{thJC}	R_{thCH}	F_m	Outline
						$T_c = 85^\circ C$	10 ms								
	V	V	V	A	μF	A	kA	I_{TGQM} T_{VJM}	T_{VJM}	m Ω	$^\circ C$	K/kW	K/kW	kN	
5SGA 15F2502	2500	1400	17	1500	3	570	10.0	2.80	1.45	0.90	125	27	8	15	F
5SGA 20H2501	2500	1400	17	2000	4	830	16.0	2.80	1.66	0.57	125	17	5	20	H
5SGA 25H2501	2500	1400	17	2500	6	830	16.0	3.10	1.66	0.57	125	17	5	20	H
5SGA 30J2501	2500	1400	17	3000	5	1300	30.0	2.50	1.50	0.33	125	12	3	40	J
5SGA 06D4502	4500	2800	17	600	1	210	3.0	4.00	1.90	3.50	125	50	8	11	D
5SGA 20H4502	4500	2200	17	2000	4	710	13.0	3.50	1.80	0.85	125	17	5	20	H
5SGA 30J4502	4500	2800	17	3000	6	930	24.0	4.00	2.20	0.60	125	12	3	40	J
5SGA 40L4501	4500	2800	17	4000	6	1000	25.0	4.40	2.10	0.58	125	11	3	40	L

Asymmetric fine pattern GTOs with buffer layer

5SGF 30J4502	4500	3000	17	3000	3	960	24.0	3.90	1.80	0.70	125	12	3	33	J
5SGF 40L4502	4500	2800	17	4000	6	1180	25.0	3.80	1.20	0.65	125	11	3	33	L

Please refer to page 56 for part numbering structure.



Fast recovery diode recommendation

For all GTO types, ABB Power Grids offers matching free-wheeling and snubber diodes. The actual choice of the diode depends on the specific application. Please see application note 5SYA 2064, Applying fast recovery diodes, on www.abb.com/semiconductors.

Test systems for high-power semiconductors

ABB Power Grids designs, manufactures and offers CE compliant customized power semiconductor test systems.

ABB Power Grids offers test systems for various environments like research & development, laboratory, production or failure analysis. Highest quality assurance, safe handling, as well as remote or on-site service capability are guaranteed.

High-power semiconductor test systems

ABB Power Grids offers static and dynamic production test systems for most types of power semiconductor devices like diodes, PCTs, BCTs, GTOs, IGCTs and IGBTs. They can handle dies, substrates, submodules, modules, wafers and press-pack devices. Also reliability test systems for high temperature reverse bias, intermittent operating life or surge current tests are available. Auxiliary tester parts include clamping, capacitor discharge, pre-heating, data acquisition and parameter extraction units as well as programmable IGBT and thyristor gate units.

Parameters

The ABB Power Grids test systems cover the range of up to 14 kV and 10 kA and use configurable stray inductances down to 60 nH. During testing, the clamped device under test (DUT) can be precisely heated up to 200 °C for production systems or cooled down to -40 °C in an environmental chamber for engineering systems. The clamping units can handle devices up to 240 mm in diameter and can apply a clamping force of up to 240 kN.

Automation

Our test systems are designed for easy integration into automated handling equipment. The test system's software is compatible to commercial control systems such as manufacturing execution systems (MES) and computer-aided quality assurance (CAQ).





	Blocking voltage AC or DC	Gate characteristics	On-state, forward voltage	Reverse recovery charge	Critical dV/dt	Circuit-commutated turn-off time	$V_{\text{ceat}} / V_{\text{pinch-off}}$	Turn-on / turn-off
BiPolar test systems 4.5 kV								
Thyristor and diode static / dynamic	X	X	X	X	X	X		
GTO and diode static	X	X	X					X
GTO and diode dynamic	X			X				X
IGBT test systems								
IGBT and diode dies static	X	X					X	
IGBT and diode substrates static / dynamic	X	X		X			X	X
IGBT and diode modules static	X	X					X	
IGBT and diode modules dynamic				X				X
Baseplates flatness								

Reliability test systems

- High temperature reverse bias
- Intermittent operating life
- Surge current

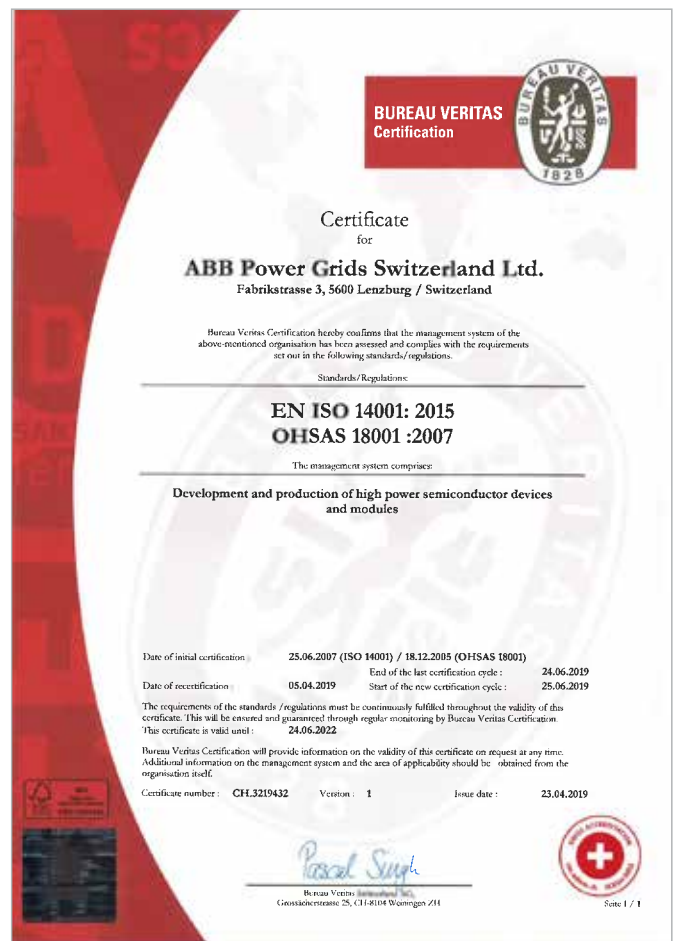
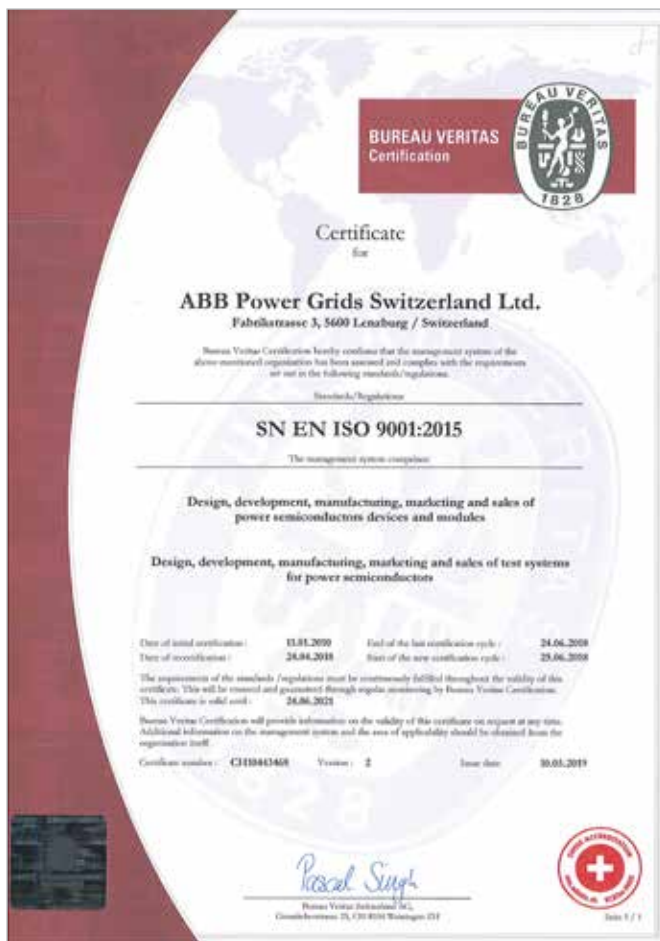
Auxiliary unit

- Clamping unit
- Capacitor discharge unit
- Pre-heating unit
- Programmable IGBT and thyristor gate units
- Data acquisition and parameter extraction units

Further information

Certificates

ABB Power Grids' is committed to the highest ethical, environmental and business standards. ABB Power Grids' has been awarded the ISO certifications for manufacturing, design and development of high-power semiconductor devices and modules (ISO 9001, 14001 and OHSAS 18001).



- IQNet -
THE INTERNATIONAL CERTIFICATION NETWORK
CERTIFICATE

CQS has issued an IQNet recognized certificate that the organization:

ABB Power Grids Czech Republic s.r.o.
Průmyslová 137, Dolní Staré Město, 541 01 Trutnov, Czech Republic

Local product group Semiconductors
Novodvorská 1768/138a, 142 21 Praha 4, Czech Republic

has implemented and maintains a
Quality Management System
for the following scope:

- Design, development and manufacturing of:
- silicon single crystals, wafers and special products
- high power semiconductor devices and modules

which fulfils the requirements of the following standard:

ISO 9001:2015

Issued on: 2019 - 10 - 01
Expires on: 2022 - 08 - 13

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Registration Number: CZ - 2104/2019


Alex Stoichitov
 President of IQNet


Tomáš Hruška
 President of CQS



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Novodvorská 1768/138a, 142 21 Praha 4, Czech Republic

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- high power semiconductor devices and modules

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ISO 14001:2015

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Alex Stoichitov
 President of IQNet


Tomáš Hruška
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ABB Power Grids Czech Republic s.r.o.
Průmyslová 137, Dolní Staré Město, 541 01 Trutnov, Czech Republic

Local product group Semiconductors
Novodvorská 1768/138a, 142 21 Praha 4, Czech Republic

has implemented and maintains a
Occupational Health and Safety Management System
for the following scope:

- Design, development and manufacturing of:
- silicon single crystals, wafers and special products
- high power semiconductor devices and modules

which fulfils the requirements of the following standard:

ISO 45001:2018

Issued on: 2019 - 10 - 01
Expires on: 2022 - 08 - 13

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 President of IQNet


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 President of CQS



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Further information

Product Environmental Compliance Information

With reference to the Regulation (EC) N° 1907/2006, issued by the European Union for the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), please be aware that:

- during normal and reasonably foreseeable conditions of use, products and related accessories, which are articles according to REACH, manufactured by ABB Power Grids Switzerland Ltd., Semiconductors and/or ABB Power Grids Czech Republic s.r.o. do not intentionally release any substance or preparation (mixtures);
- ABB Power Grids Switzerland Ltd., Semiconductors and/or ABB Power Grids Czech Republic s.r.o. continuously assess their products for content of Substances of Very High Concern (SVHC), as included in the "Candidate List" by the European Chemicals Agency (ECHA);
- ABB Power Grids Switzerland Ltd., Semiconductors and/or ABB Power Grids Czech Republic s.r.o. continuously undertake communications throughout their supply chain in order to collect information about suppliers' compliance with REACH Regulation.

For further information about product specific environmental compliance information, please contact us: abbsem@ch.abb.com.

ABB Power Grids Switzerland Ltd., Semiconductors

Further information

Symbols

Symbol	Description
C_s	Snubber capacitance
di/dt_{max}	Maximum rate of rise or decline of on-state current
dV/dt	Maximum rate of rise of off-state voltage
F_m	Mounting force
I_c	DC collector current
I_{CM}	Peak collector current
I_F	Diode nominal mean forward current
I_{FAVM}	Max. average forward current (180° sine wave)
I_{FSM}	Max. surge peak forward current for a 180° sine wave; no voltage reapplied after surge
I_{RM}	Max. peak avalanche current for a single 180° sine wave pulse
I_{RMS}	Max. rms on-state current (AC full wave)
I_{rr}	Max. (typ. for IGBT diode) reverse recovery current
I_T	Forward current
I_{TAVM}	Max. average on-state current (180° sine wave)
I_{TGQM}	Max. turn-off current
I_{TSM}	Max. surge peak on-state current for a 180° sine wave; no voltage reapplied after surge
P_{RSM}	Max. surge avalanche power dissipation (single pulse)
Q_{rr}	Max. reverse recovery charge
r_F	Forward slope resistance
r_T	On-state slope resistance
R_{thCH}	Thermal resistance case to heatsink
R_{thJC}	Thermal resistance junction to case
R_{thJH}	Thermal resistance junction to heatsink
T_c	Case temperature
t_q	Turn-off time
T_{VJ}	Junction temperature
T_{VJM}	Max. junction temperature
V_{CES}	IGBT collector-emitter voltage
V_{CEsat}	Collector-emitter saturation voltage
V_{DC}	Max. DC voltage rating for 100 FIT, 100 percent duty
V_{DRM}	Max. repetitive peak forward blocking voltage
V_F	Forward voltage drop
V_{F0}	Forward threshold voltage
V_{Fmax}	Max. forward voltage drop
V_{Fmin}	Min. forward voltage drop
V_{GIN}	Input voltage of IGCT gate drive
V_R	Symmetrical peak avalanche voltage at a sinusoidal current pulse with 20 A peak, 10 µs pulse width and 60 °C junction temperature
V_{RM}	Max. repetitive peak blocking voltage
V_{RRM}	Max. repetitive peak reverse blocking voltage
V_{RSM}	Max. surge peak reverse blocking voltage
V_T	On-state voltage drop
V_{T0}	On-state threshold voltage

Further information

Documentation

IGBT dies and modules

Document title	Document number
Mounting instructions for StakPaks	5SYA 2037
Mounting instructions for HiPak modules	5SYA 2039
Failure rates of IGBT due to cosmic rays	5SYA 2042
Load-cycling capability of HiPak IGBT modules	5SYA 2043
Thermal runaway during blocking	5SYA 2045
Voltage ratings of high-power semiconductors	5SYA 2051
Applying IGBTs	5SYA 2053
IGBT diode safe operating area	5SYA 2057
Surge currents for IGBT diodes	5SYA 2058
Applying IGBT and diode dies	5SYA 2059
Thermal design and temperature ratings of IGBT modules	5SYA 2093
Paralleling of IGBT modules	5SYA 2098
Mounting Instructions for 62Pak	5SYA 2106
Mounting instructions for LinPak modules	5SYA 2107

Diodes

Document title	Document number
High-current rectifier diodes for welding applications	5SYA 2013
Design of RC snubbers for phase control applications	5SYA 2020
High-power rectifier diodes	5SYA 2029
Mechanical clamping of press-pack high-power semiconductors	5SYA 2036
Field measurements on high-power press-pack semiconductors	5SYA 2048
Voltage ratings of high-power semiconductors	5SYA 2051
Failure rates of fast recovery diodes due to cosmic rays	5SYA 2061
Applying fast recovery diodes	5SYA 2064
Parameter selection of high-power semiconductor for series and parallel connection	5SYA 2091

Thyristors

Document title	Document number
Bi-directionally controlled thyristors	5SYA 2006
Design of RC snubbers for phase control applications	5SYA 2020
Gate-drive recommendations for phase control and bi-directionally controlled thyristors	5SYA 2034
Mechanical clamping of press-pack high-power semiconductors	5SYA 2036
Field measurements on high-power press-pack semiconductors	5SYA 2048
Voltage definitions for phase control and bi-directionally controlled thyristors	5SYA 2049
Voltage ratings of high-power semiconductors	5SYA 2051
Switching losses for phase control and bi-directionally controlled thyristors	5SYA 2055
Parameter selection of high-power semiconductor for series and parallel connection	5SYA 2091
Surge currents for phase control thyristors	5SYA 2102

IGCTs

Document title	Document number
Applying IGCT gate units	5SYA 2031
Applying IGCTs	5SYA 2032
Mechanical clamping of press-pack high-power semiconductors	5SYA 2036
Failure rates of IGCTs due to cosmic rays	5SYA 2046
Field measurements on high-power press-pack semiconductors	5SYA 2048
Voltage ratings of high-power semiconductors	5SYA 2051

GTOs

Document title	Document number
Mechanical clamping of press-pack high-power semiconductors	5SYA 2036
Field measurements on high-power press-pack semiconductors	5SYA 2048
Voltage ratings of high-power semiconductors	5SYA 2051

Environmental specifications

Document title	Document number
Storage of diodes, PCTs, GTOs	5SZK 9104
Transport of diodes, PCTs and GTOs	5SZK 9105
Operation of pressure contact IGCTs	5SZK 9107
Storage of IGCTs	5SZK 9109
Transport of IGCTs	5SZK 9110
Storage of HiPaks	5SZK 9111
Transport of HiPaks	5SZK 9112
Operation of industry HiPaks	5SZK 9113
Handling, packing and storage conditions for sawn wafer dies and bare dies	5SZK 9114
Operation of industry press-pack diodes, PCTs and GTOs	5SZK 9115
Operation of traction press-pack diodes, PCTs and GTOs	5SZK 9116
Operation of traction HiPaks	5SZK 9120

Further information

Part numbering structure

IGBT and diode dies

Product group

5SM = IGBT

5SL = Diode

Technology

X = SPT / Y = SPT⁺ and SPT⁺⁺ / Z = Enhanced trench / FSA, FCE diode

Type

76 = Unsawn wafer die / 86 = Sawn wafer die

12 = Picked die (waffle pack)

Die size in mm²

A	4	–	8.99 mm ²
B	9	–	15.99 mm ²
C	16	–	24.99 mm ²
D	25	–	35.99 mm ²
E	36	–	48.99 mm ²
F	49	–	63.99 mm ²
G	64	–	80.99 mm ²
H	81	–	99.99 mm ²
J	100	–	120.99 mm ²
K	121	–	143.99 mm ²
L	144	–	168.99 mm ²
M	169	–	195.99 mm ²
N	196	–	224.99 mm ²
O	225	–	255.99 mm ²
P	256	–	288.99 mm ²
Q	289	–	323.99 mm ²
R	324	–	360.99 mm ²
S	361	–	399.99 mm ²

Blocking voltage (V/100)

Version number

5SM Y 86 M 12 80

IGBT and diode modules

5SN D 0800 M 17 0 1 00

Product group

5SF = SiC MOSFET

5SJ = BIGT

5SL = Diode

5SM = IGBT

5SN = IGBT and diode

Configuration

A = Single device (can include diode)

D = Dual switch in one package

E = Chopper, switch on low side

G = Phase leg

Nominal collector current rating (A)**Housing**

E = HiPak2, 40 mm

G = HiPak2 HV, 44 mm

H = Press-pack

J = HiPak1 HV, 44 mm

K = Press-pack

L = Press-pack

M = HiPak1, 30 mm

N1 & N2 = HiPak1, 40 mm

P = HiPak0

Q = 62Pak

R = LoPak1

S = LoPak3

X = LinPak

Blocking voltage (V/100)**Package variation**

0 = Standard

Technology variation1 = SPT / 3 = SPT⁺ and SPT⁺⁺ / 4 = TSPT⁺ (Enhanced trench cell technology)**Version number**

—

IGCT

5SHY35L4520

Product group

5SHX = Reverse conducting IGCT
5SHY = Asymmetric IGCT

Max. turn-off current (I/100)

Housing

Blocking voltage (V/100)

Version number

—

GTO

5SGA20H2501

Product group

5SGA = Asymmetric GTO
5SGF = Fine pattern GTO

Max. turn-off current (I/100)

Housing

Blocking voltage (V/100)

Version number

—

Phase control thyristors

5STP26N6500

Product group

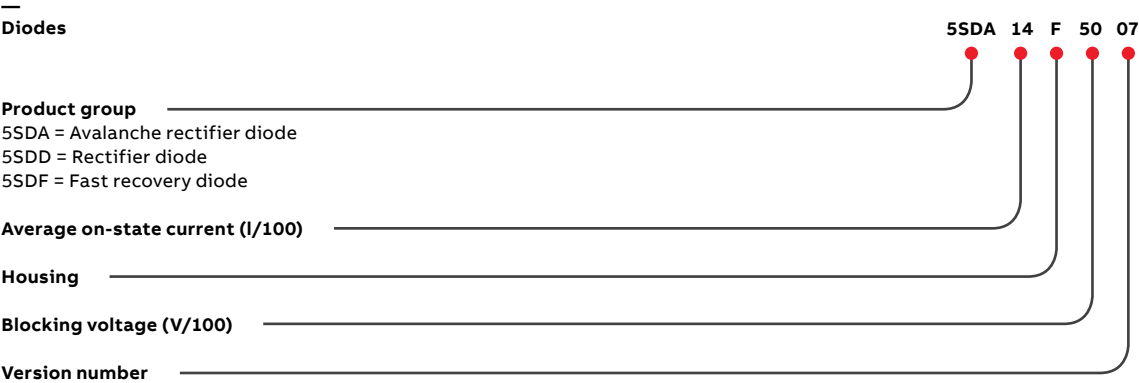
5STP = Phase control thyristors
5STB = Bi-directionally controlled thyristors

Average on-state current (I/100)

Housing

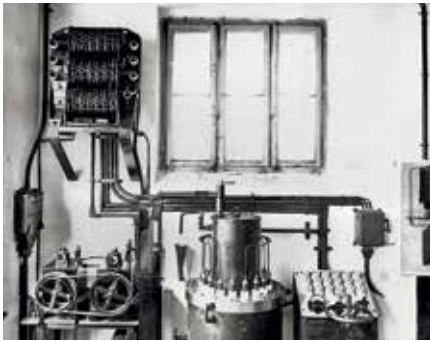
Blocking voltage (V/100)

Version number

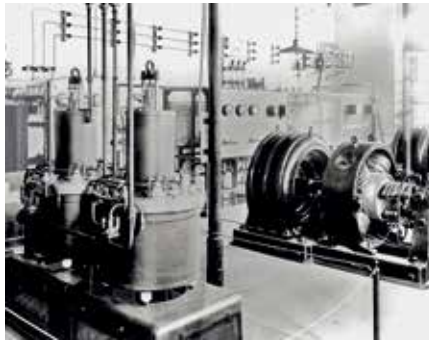


Further information

Perpetual innovation



1913
BBC begins development and production of mercury-arc rectifiers



1915
BBC mercury-arc rectifiers used in the Limmattal tramline Zurich – Dietikon, Switzerland



1938
First locomotive using multianode mercury-arc rectifiers from BBC Mannheim, Germany



1939
First HVDC transmission line (pilot installation) Wettingen – Zurich, Switzerland



1954
BBC develops the first germanium diode



1954
First commercial HVDC transmission line connecting Gotland island with the Swedish mainland (ASEA)



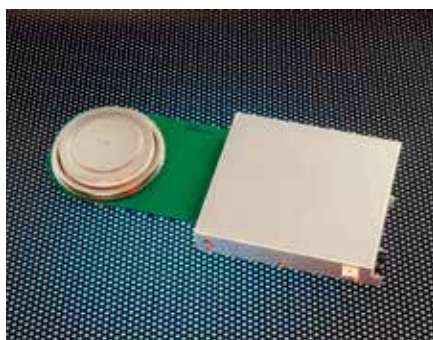
1964
First locomotive using BBC silicon diodes (RE 4/4 Series 161, BLS)



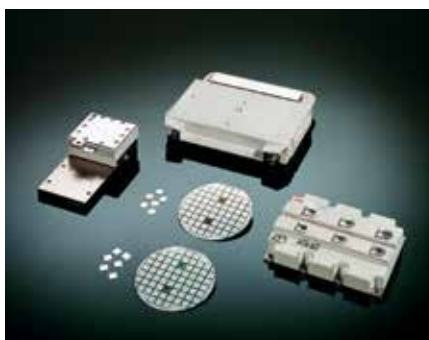
1981
Inauguration of BBC high power semiconductor factory in Lenzburg, Switzerland



1988
ASEA (Sweden) and BBC (Switzerland) merge to form ABB (Asea Brown Boveri)



1996
ABB begins production of IGBT in Lenzburg, Switzerland



1998
Opening of ABB production facility for BiMOS in Lenzburg, Switzerland



2010
Inauguration of expanded production facility at ABB Semiconductors in Lenzburg, Switzerland



2012
Successful design and development of ABB's hybrid HVDC breaker



2014
Inauguration of ABB's new power electronics advanced research lab in Dättwil, Switzerland



2016
62Pak - Medium-power IGBT modules and BiGT StakPak



2017
Release of 1.7 kV and 3.3 kV LinPaks



2018
Full automation of the IGBT back-end process

Further information

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