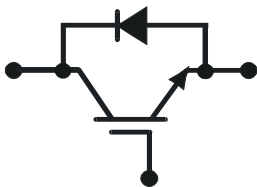


$V_{CE} = 3300\text{ V}$   
 $I_C = 1500\text{ A}$

**ABB HiPak™**

**IGBT Module**  
**5SNA 1500E330300**



Doc. No. 5SYA 1595-00 July 07

- Ultra low-loss, rugged SPT<sup>+</sup> chip-set
- Smooth switching SPT<sup>+</sup> chip-set for good EMC
- Industry standard package
- High power density
- AlSiC base-plate for high power cycling capability
- AlN substrate for low thermal resistance



**Maximum rated values <sup>1)</sup>**

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	$V_{CES}$	$V_{GE} = 0\text{ V}$		3300	V
DC collector current	$I_C$	$T_c = 85\text{ °C}$		1500	A
Peak collector current	$I_{CM}$	$t_p = 1\text{ ms}, T_c = 85\text{ °C}$		3000	A
Gate-emitter voltage	$V_{GES}$		-20	20	V
Total power dissipation	$P_{tot}$	$T_c = 25\text{ °C}$ , per switch (IGBT)		11750	W
DC forward current	$I_F$			1500	A
Peak forward current	$I_{FRM}$			3000	A
Surge current	$I_{FSM}$	$V_R = 0\text{ V}, T_{vj} = 125\text{ °C}$ , $t_p = 10\text{ ms}$ , half-sinewave		14000	A
IGBT short circuit SOA	$t_{psc}$	$V_{CC} = 2500\text{ V}, V_{CEMCHIP} \leq 3300\text{ V}$ $V_{GE} \leq 15\text{ V}, T_{vj} \leq 125\text{ °C}$		10	$\mu\text{s}$
Isolation voltage	$V_{isol}$	1 min, $f = 50\text{ Hz}$		6000	V
Junction temperature	$T_{vj}$			150	°C
Junction operating temperature	$T_{vj(op)}$		-40	125	°C
Case temperature	$T_c$		-40	125	°C
Storage temperature	$T_{stg}$		-40	125	°C
Mounting torques <sup>2)</sup>	$M_s$	Base-heatsink, M6 screws	4	6	Nm
	$M_{t1}$	Main terminals, M8 screws	8	10	
	$M_{t2}$	Auxiliary terminals, M4 screws	2	3	

<sup>1)</sup> Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747

<sup>2)</sup> For detailed mounting instructions refer to ABB Document No. 5SYA2039

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IGBT characteristic values <sup>3)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
Collector (-emitter) breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0 \text{ V}$ , $I_C = 10 \text{ mA}$ , $T_{vj} = 25 \text{ }^\circ\text{C}$	3300			V
Collector-emitter <sup>4)</sup> saturation voltage	$V_{CE \text{ sat}}$	$I_C = 1500 \text{ A}$ , $V_{GE} = 15 \text{ V}$		2.4		V
		$T_{vj} = 25 \text{ }^\circ\text{C}$				
		$T_{vj} = 125 \text{ }^\circ\text{C}$		3.0	3.4	V
Collector cut-off current	$I_{CES}$	$V_{CE} = 3300 \text{ V}$ , $V_{GE} = 0 \text{ V}$			12	mA
		$T_{vj} = 25 \text{ }^\circ\text{C}$				
		$T_{vj} = 125 \text{ }^\circ\text{C}$			120	mA
Gate leakage current	$I_{GES}$	$V_{CE} = 0 \text{ V}$ , $V_{GE} = \pm 20 \text{ V}$ , $T_{vj} = 125 \text{ }^\circ\text{C}$	-500		500	nA
Gate-emitter threshold voltage	$V_{GE(TO)}$	$I_C = 240 \text{ mA}$ , $V_{CE} = V_{GE}$ , $T_{vj} = 25 \text{ }^\circ\text{C}$	4.5		6.5	V
Gate charge	$Q_{ge}$	$I_C = 1500 \text{ A}$ , $V_{CE} = 1800 \text{ V}$ , $V_{GE} = -15 \text{ V} \dots 15 \text{ V}$		11.0		$\mu\text{C}$
Input capacitance	$C_{ies}$	$V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ , $f = 1 \text{ MHz}$ , $T_{vj} = 25 \text{ }^\circ\text{C}$		152		nF
Output capacitance	$C_{oes}$			12.2		
Reverse transfer capacitance	$C_{res}$			3.77		
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 1800 \text{ V}$ , $I_C = 1500 \text{ A}$ , $R_G = 1.0 \text{ } \Omega$ , $C_{GE} = 220 \text{ nF}$ ,		600		ns
		$T_{vj} = 25 \text{ }^\circ\text{C}$				
		$T_{vj} = 125 \text{ }^\circ\text{C}$		570		
Rise time	$t_r$	$V_{GE} = \pm 15 \text{ V}$ , $L_\sigma = 100 \text{ nH}$ , inductive load		220		ns
		$T_{vj} = 25 \text{ }^\circ\text{C}$				
		$T_{vj} = 125 \text{ }^\circ\text{C}$		250		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 1800 \text{ V}$ , $I_C = 1500 \text{ A}$ , $R_G = 1.5 \text{ } \Omega$ , $C_{GE} = 220 \text{ nF}$ ,		1480		ns
		$T_{vj} = 25 \text{ }^\circ\text{C}$				
		$T_{vj} = 125 \text{ }^\circ\text{C}$		1680		
Fall time	$t_f$	$V_{GE} = \pm 15 \text{ V}$ , $L_\sigma = 100 \text{ nH}$ , inductive load		380		ns
		$T_{vj} = 25 \text{ }^\circ\text{C}$				
		$T_{vj} = 125 \text{ }^\circ\text{C}$		470		
Turn-on switching energy	$E_{on}$	$V_{CC} = 1800 \text{ V}$ , $I_C = 1500 \text{ A}$ , $R_G = 1.0 \text{ } \Omega$ , $C_{GE} = 220 \text{ nF}$ , $V_{GE} = \pm 15 \text{ V}$ , $L_\sigma = 100 \text{ nH}$ , inductive load		1380		mJ
		$T_{vj} = 25 \text{ }^\circ\text{C}$				
		$T_{vj} = 125 \text{ }^\circ\text{C}$		2000		
Turn-off switching energy	$E_{off}$	$V_{CC} = 1800 \text{ V}$ , $I_C = 1500 \text{ A}$ , $R_G = 1.5 \text{ } \Omega$ , $C_{GE} = 220 \text{ nF}$ , $V_{GE} = \pm 15 \text{ V}$ , $L_\sigma = 100 \text{ nH}$ , inductive load		1940		mJ
		$T_{vj} = 25 \text{ }^\circ\text{C}$				
		$T_{vj} = 125 \text{ }^\circ\text{C}$		2680		
Short circuit current	$I_{SC}$	$t_{psc} \leq 10 \text{ } \mu\text{s}$ , $V_{GE} = 15 \text{ V}$ , $T_{vj} = 125 \text{ }^\circ\text{C}$ , $V_{CC} = 2500 \text{ V}$ , $V_{CEM \text{ CHIP}} \leq 3300 \text{ V}$		6500		A
Module stray inductance	$L_{\sigma \text{ CE}}$			10		nH
Resistance, terminal-chip	$R_{CC'+EE'}$			0.06		m $\Omega$
		$T_C = 25 \text{ }^\circ\text{C}$				
		$T_C = 125 \text{ }^\circ\text{C}$		0.085		

<sup>3)</sup> Characteristic values according to IEC 60747 – 9<sup>4)</sup> Collector-emitter saturation voltage is given at chip level

**Diode characteristic values**<sup>5)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
Forward voltage <sup>6)</sup>	$V_F$	$I_F = 1500 \text{ A}$	$T_{vj} = 25 \text{ °C}$	2.0		V
			$T_{vj} = 125 \text{ °C}$		2.1	
Reverse recovery current	$I_{rr}$	$V_{CC} = 1800 \text{ V},$ $I_F = 1500 \text{ A},$ $V_{GE} = \pm 15 \text{ V},$ $R_G = 1.0 \text{ } \Omega,$ $C_{GE} = 220 \text{ nF},$ $L_\sigma = 100 \text{ nH}$ inductive load	$T_{vj} = 25 \text{ °C}$	1850		A
			$T_{vj} = 125 \text{ °C}$	2100		
Recovered charge	$Q_{rr}$		$T_{vj} = 25 \text{ °C}$	960		$\mu\text{C}$
			$T_{vj} = 125 \text{ °C}$	1590		
Reverse recovery time	$t_{rr}$		$T_{vj} = 25 \text{ °C}$	750		ns
			$T_{vj} = 125 \text{ °C}$	1160		
Reverse recovery energy	$E_{rec}$		$T_{vj} = 25 \text{ °C}$	1200		mJ
			$T_{vj} = 125 \text{ °C}$	2030		

<sup>5)</sup> Characteristic values according to IEC 60747 – 2

<sup>6)</sup> Forward voltage is given at chip level

**Thermal properties**<sup>7)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$				0.0085	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.017	K/W
IGBT thermal resistance case to heatsink <sup>2)</sup>	$R_{th(c-s)IGBT}$	IGBT per switch, $\lambda$ grease = $1\text{W/m}^2 \times \text{K}$		0.009		K/W
Diode thermal resistance case to heatsink <sup>7)</sup>	$R_{th(c-s)DIODE}$	Diode per switch, $\lambda$ grease = $1\text{W/m}^2 \times \text{K}$		0.018		K/W

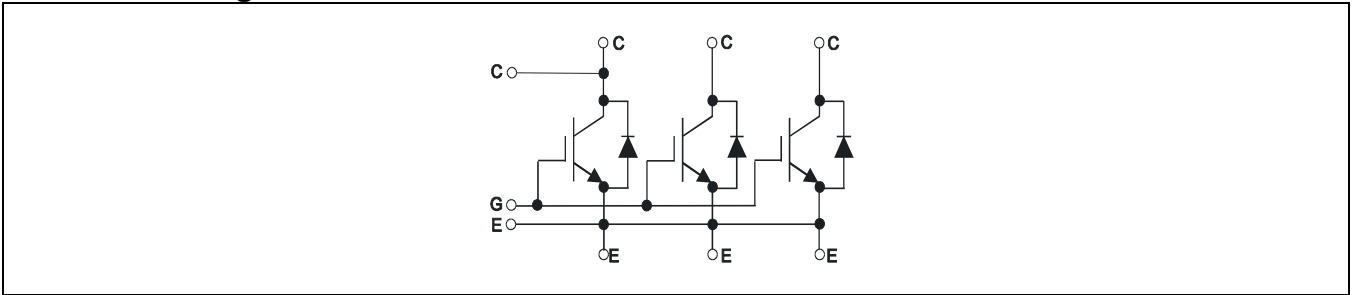
<sup>2)</sup> For detailed mounting instructions refer to ABB Document No. 5SYA2039

**Mechanical properties**<sup>7)</sup>

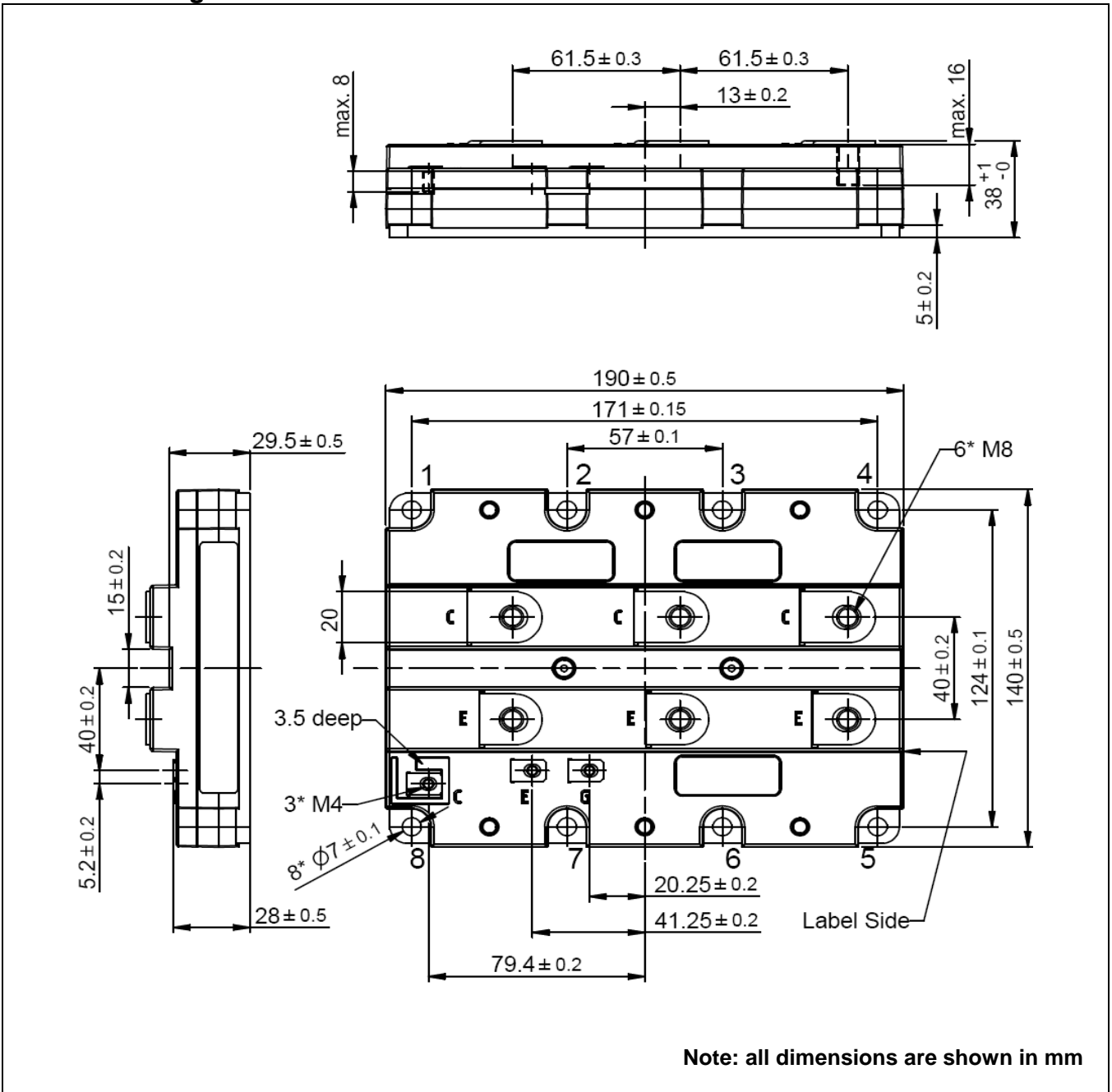
Parameter	Symbol	Conditions	min	typ	max	Unit
Dimensions	$L \times W \times H$	Typical , see outline drawing	190 x 140 x 38			mm
Clearance distance in air	$d_a$	according to IEC 60664-1 and EN 50124-1	Term. to base:	23		mm
			Term. to term:	19		
Surface creepage distance	$d_s$	according to IEC 60664-1 and EN 50124-1	Term. to base:	33		mm
			Term. to term:	32		
Mass	$m$			1380		g

<sup>7)</sup> Thermal and mechanical properties according to IEC 60747 – 15

### Electrical configuration



### Outline drawing <sup>2)</sup>

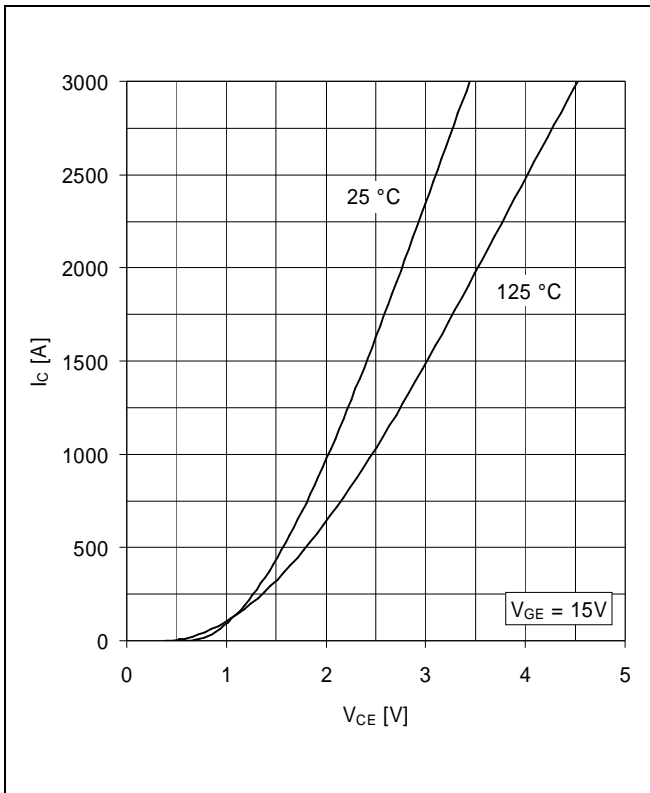


<sup>2)</sup> For detailed mounting instructions refer to ABB Document No. 5SYA2039

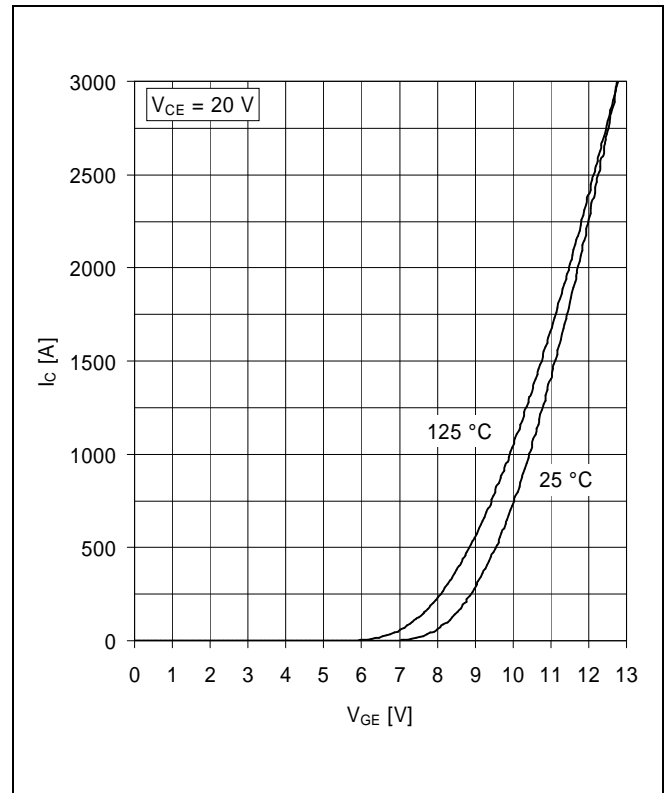
**This is an electrostatic sensitive device, please observe the international standard IEC 60747-1, chap. IX.**

**This product has been designed and qualified for Industrial Level.**

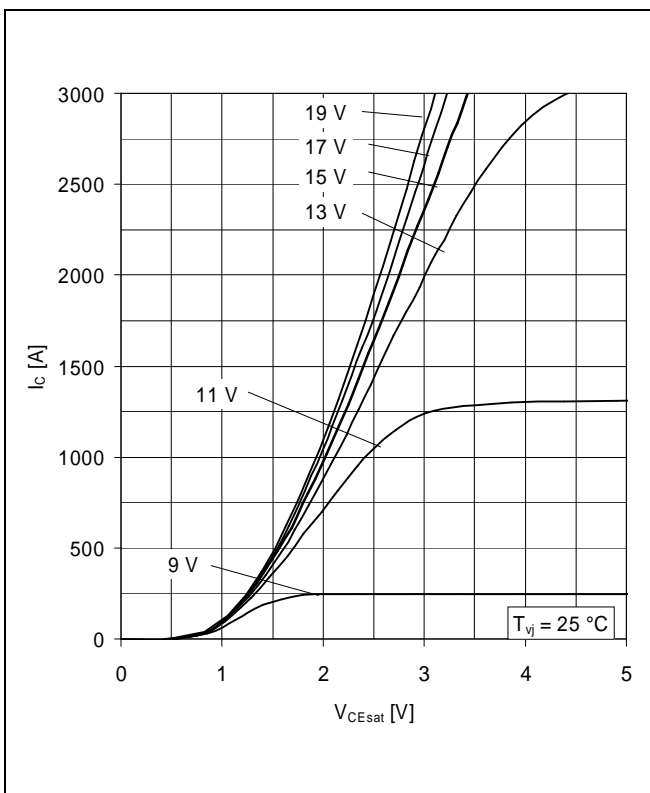
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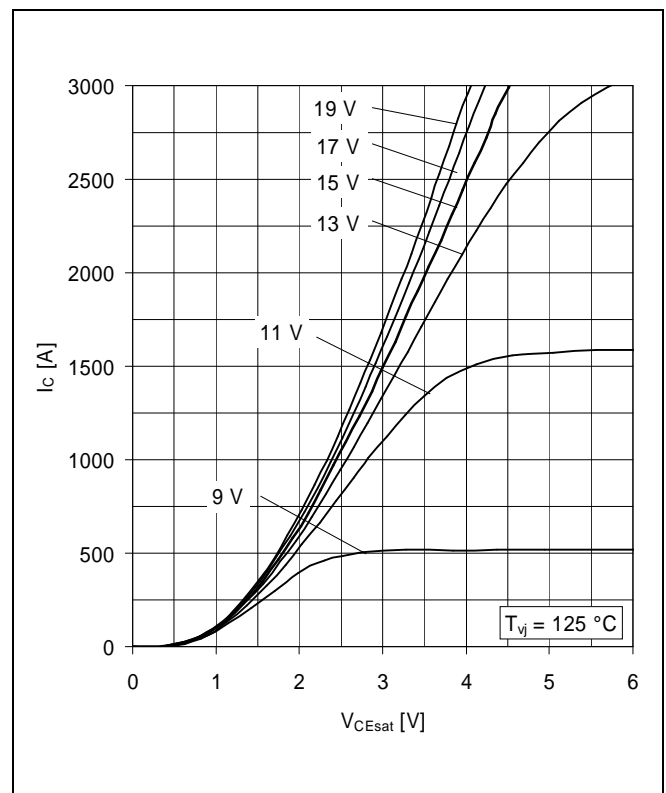
**Fig. 1** Typical on-state characteristics, chip level



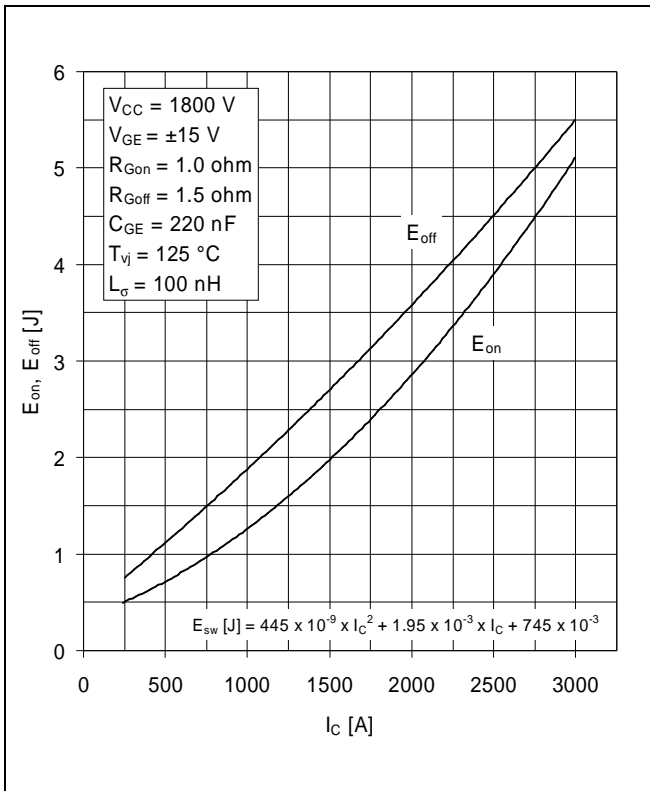
**Fig. 2** Typical transfer characteristics, chip level



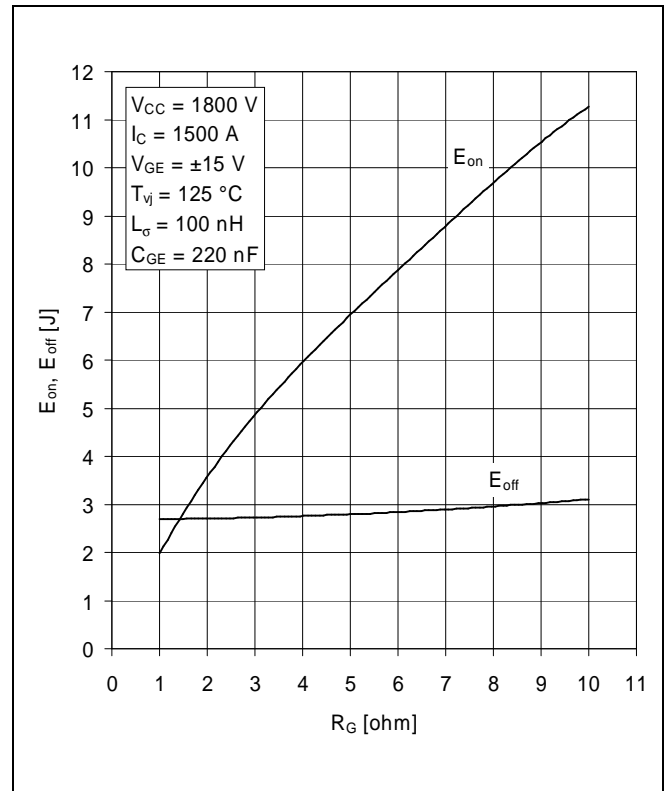
**Fig. 3** Typical output characteristics, chip level



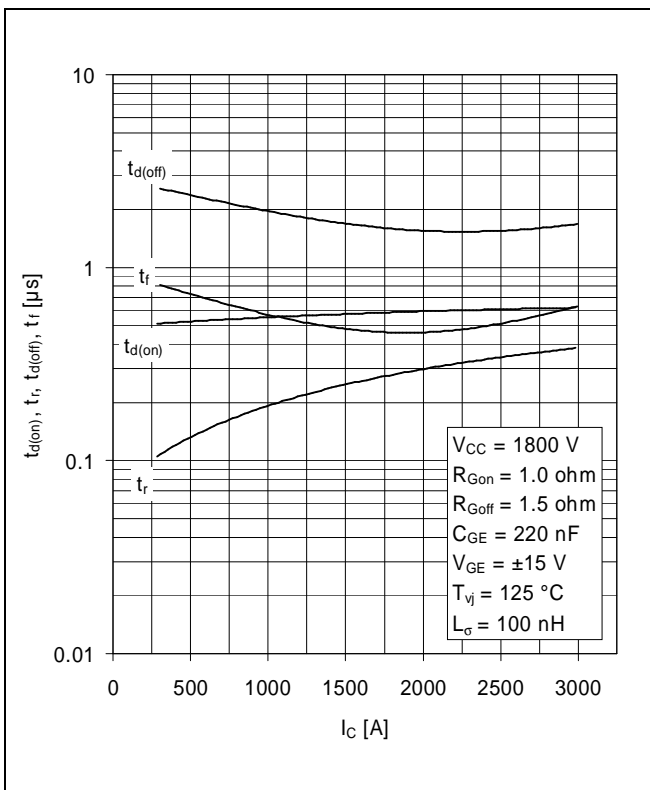
**Fig. 4** Typical output characteristics, chip level



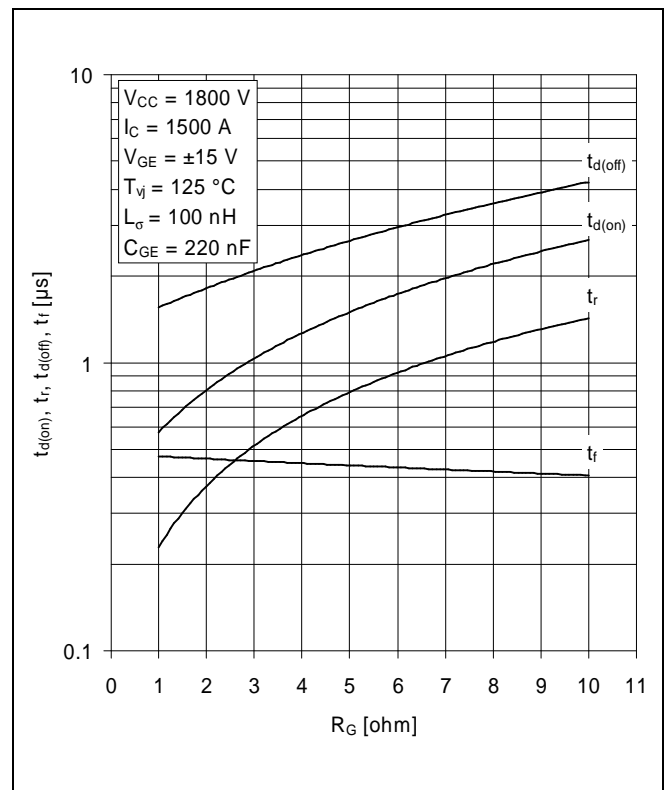
**Fig. 5** Typical switching energies per pulse vs collector current



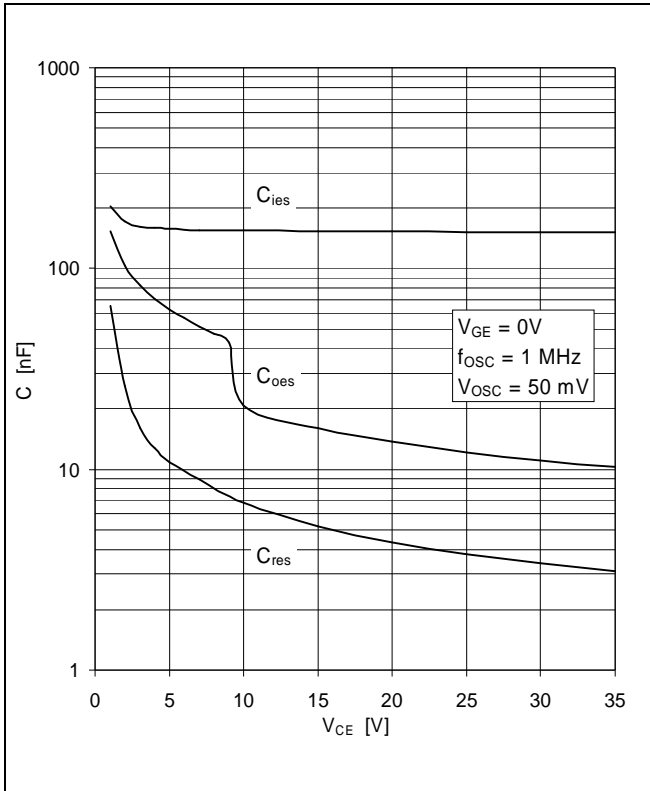
**Fig. 6** Typical switching energies per pulse vs gate resistor



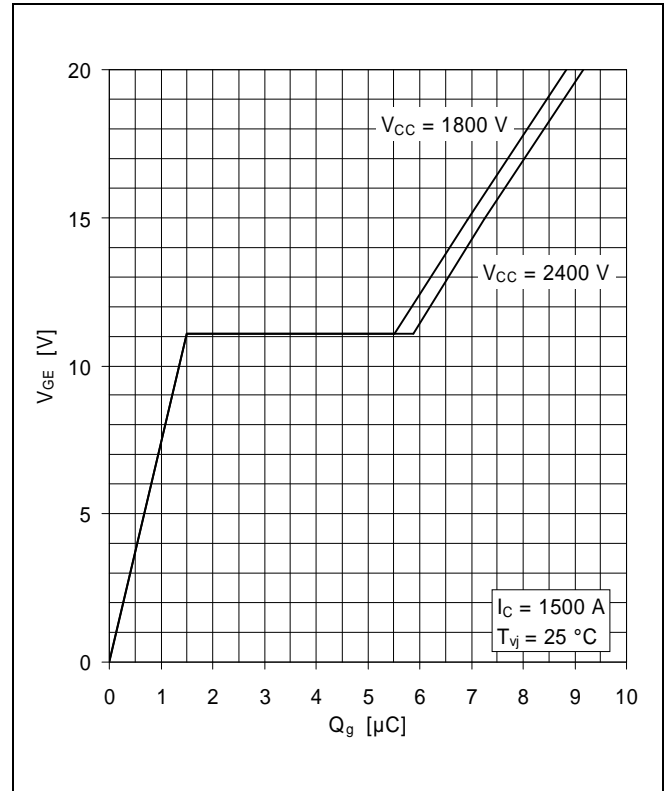
**Fig. 7** Typical switching times vs collector current



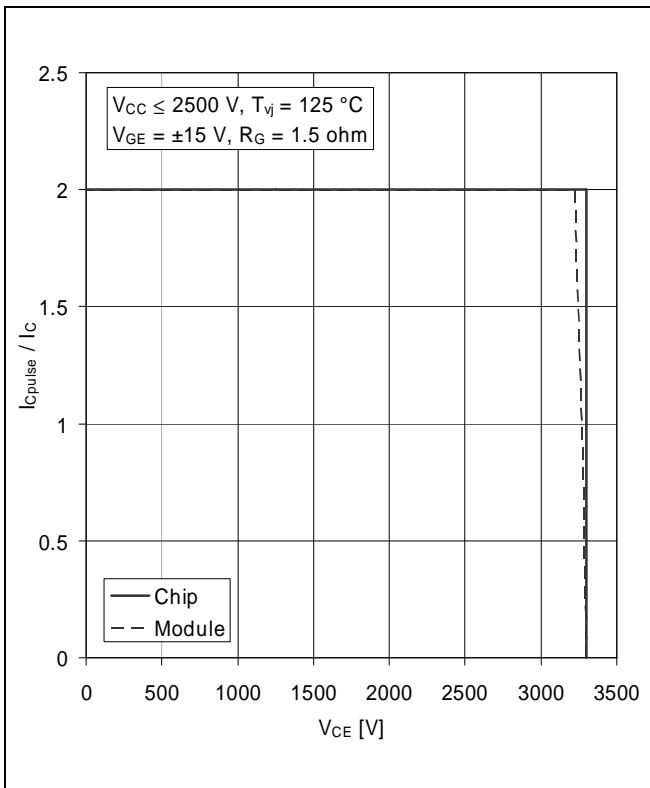
**Fig. 8** Typical switching times vs gate resistor



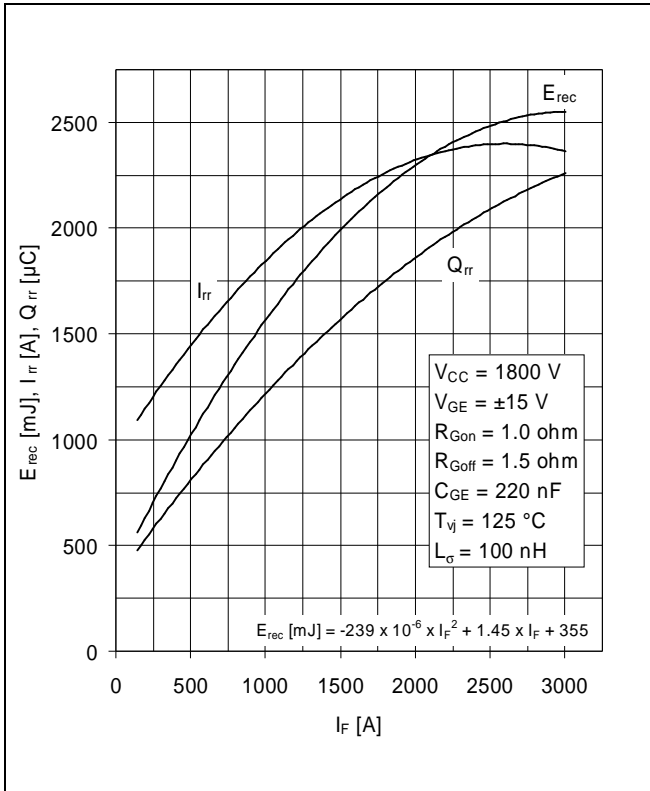
**Fig. 9** Typical capacitances vs collector-emitter voltage



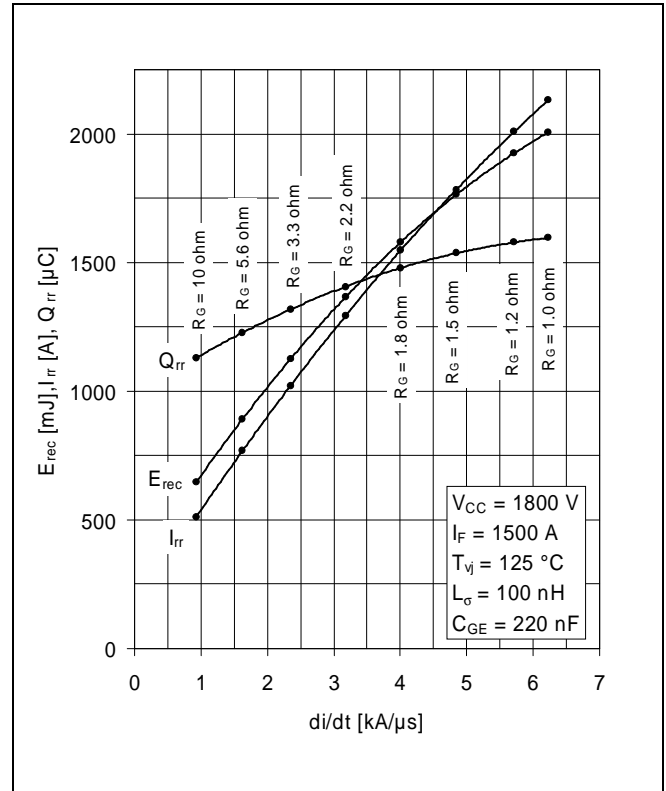
**Fig. 10** Typical gate charge characteristics



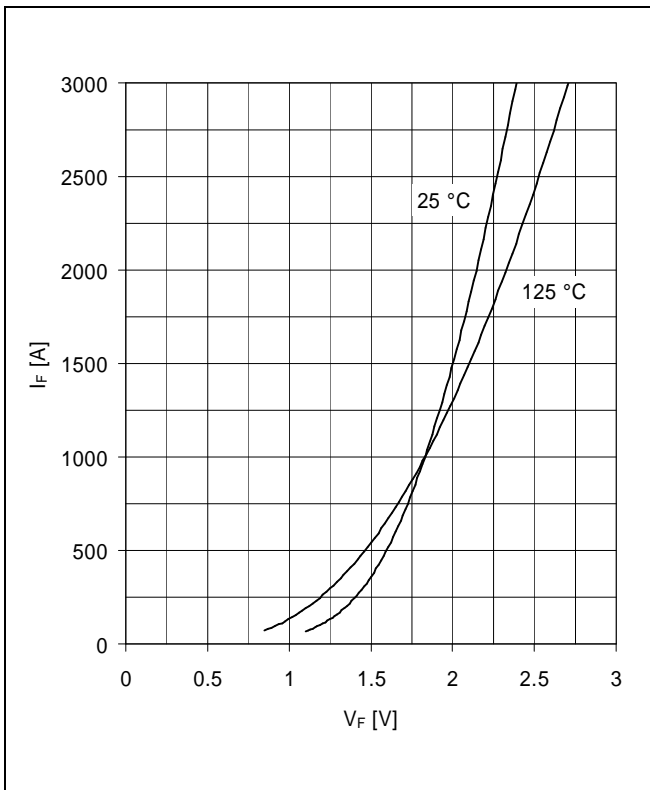
**Fig. 11** Turn-off safe operating area (RBSOA)



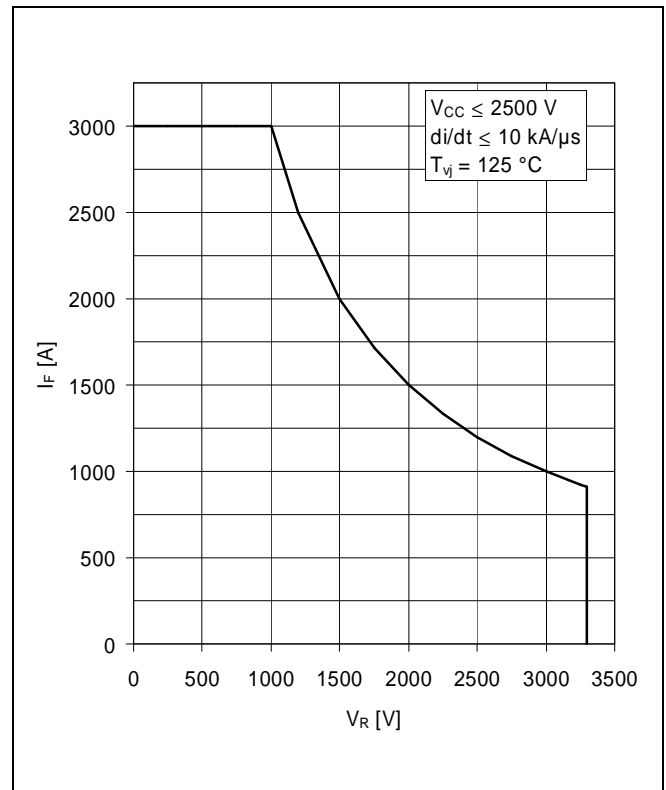
**Fig. 12** Typical reverse recovery characteristics vs forward current



**Fig. 13** Typical reverse recovery characteristics vs di/dt

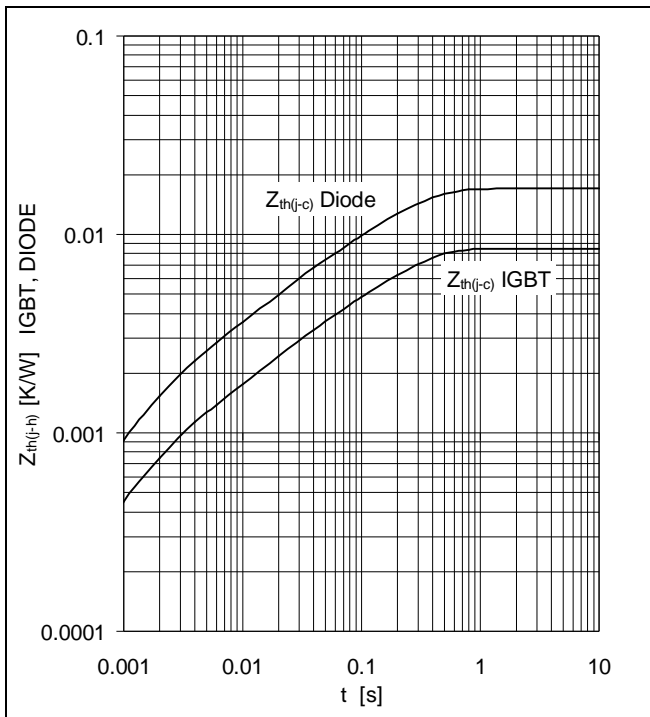


**Fig. 14** Typical diode forward characteristics, chip level



**Fig. 15** Safe operating area diode (SOA)





**Fig. 16** Thermal impedance vs time

**Analytical function for transient thermal impedance:**

$$Z_{th(j-c)}(t) = \sum_{i=1}^n R_i (1 - e^{-t/\tau_i})$$

	i	1	2	3	4	
IGBT	$R_i$ (K/kW)	5.854	1.375	0.641	0.632	
	$\tau_i$ (ms)	207.4	30.1	7.55	1.57	
DIODE	$R_i$ (K/kW)	11.54	2.887	1.229	1.295	
	$\tau_i$ (ms)	203.6	30.1	7.53	1.57	

For detailed information refer to:

- 5SYA 2042-02 Failure rates of HiPak modules due to cosmic rays
- 5SYA 2043-01 Load – cycle capability of HiPaks
- 5SZK 9120-00 Specification of environmental class for HiPak (available upon request)

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