

# 5SNA 2400N170300

## HiPak IGBT Module

$$V_{CE} = 1700 \text{ V}$$

$$I_C = 2400 \text{ A}$$

Ultra low-loss, rugged SPT+ chip-set  
 Smooth switching SPT+ chip-set for good EMC  
 AISiC base-plate for high power cycling capability  
 AlN substrate for low thermal resistance  
 Improved high reliability package



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

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	$V_{CES}$	$V_{GE} = 0 \text{ V}$ , $T_{vj} \geq 25 \text{ °C}$		1700	V
DC collector current	$I_C$	$T_C = 70 \text{ °C}$ , $T_{vj} = 150 \text{ °C}$		2400	A
Peak collector current	$I_{CM}$	$t_p = 1 \text{ ms}$		4800	A
Gate-emitter voltage	$V_{GES}$		-20	20	V
Total power dissipation	$P_{tot}$	$T_C = 25 \text{ °C}$ , $T_{vj} = 150 \text{ °C}$		11900	W
DC forward current	$I_F$			2400	A
Peak forward current	$I_{FRM}$	$t_p = 1 \text{ ms}$		4800	A
Surge current	$I_{FSM}$	$V_R = 0 \text{ V}$ , $T_{vj} = 150 \text{ °C}$ , $t_p = 10 \text{ ms}$ , half-sinewave		12000	A
IGBT short circuit SOA	$t_{psc}$	$V_{CC} = 1200 \text{ V}$ , $V_{CEM \text{ CHIP}} \leq 1700 \text{ V}$ $V_{GE} \leq 15 \text{ V}$ , $T_{vj \text{ start}} \leq 150 \text{ °C}$		10	$\mu\text{s}$
Isolation voltage	$V_{isol}$	1 min, $f = 50 \text{ Hz}$		4000	V
Junction temperature	$T_{vj}$			175	$^{\circ}\text{C}$
Junction operating temperature	$T_{vj(op)}$		-50	150	$^{\circ}\text{C}$
Case temperature	$T_C$		-50	150	$^{\circ}\text{C}$
Storage temperature	$T_{stg}$		-50	125	$^{\circ}\text{C}$
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. 5SYA 2039

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

Parameter	Symbol	Conditions	min	typ	max	Unit	
Collector (-emitter) breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0 \text{ V}$ , $I_C = 10 \text{ mA}$ , $T_{vj} = 25 \text{ }^\circ\text{C}$	1700			V	
Collector-emitter <sup>4)</sup> saturation voltage	$V_{CE \text{ sat}}$	$I_C = 2400 \text{ A}$ , $V_{GE} = 15 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	2.2	2.5	2.8	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$	2.7	3	3.3	V
			$T_{vj} = 150 \text{ }^\circ\text{C}$		3.1		V
Collector cut-off current	$I_{CES}$	$V_{CE} = 1700 \text{ V}$ , $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		0.02	1	mA
			$T_{vj} = 125 \text{ }^\circ\text{C}$		20	40	mA
			$T_{vj} = 150 \text{ }^\circ\text{C}$		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	$V_{GE(TO)}$	$I_C = 160 \text{ mA}$ , $V_{CE} = V_{GE}$ , $T_{vj} = 25 \text{ }^\circ\text{C}$	5.3		7.3	V	
Gate charge	$Q_{ge}$	$I_C = 2400 \text{ A}$ , $V_{CE} = 900 \text{ V}$ , $V_{GE} = -15 \text{ V} \dots 15 \text{ V}$		14		$\mu\text{C}$	
Internal gate resistance	$R_{Gint}$			0.8		$\Omega$	
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 900 \text{ V}$ , $I_C = 2400 \text{ A}$ , $R_G = 0.9 \text{ W}$ , $C_{GE} = 0 \text{ nF}$ , $V_{GE} = \pm 15 \text{ V}$ , $L_S = 75 \text{ nH}$ , inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$		600		ns
			$T_{vj} = 125 \text{ }^\circ\text{C}$		660		ns
			$T_{vj} = 150 \text{ }^\circ\text{C}$		680		ns
Rise time	$t_r$	$V_{CC} = 900 \text{ V}$ , $I_C = 2400 \text{ A}$ , $R_G = 0.9 \text{ W}$ , $C_{GE} = 0 \text{ nF}$ , $V_{GE} = \pm 15 \text{ V}$ , $L_S = 75 \text{ nH}$ , inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$		330		ns
			$T_{vj} = 125 \text{ }^\circ\text{C}$		350		ns
			$T_{vj} = 150 \text{ }^\circ\text{C}$		360		ns
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 900 \text{ V}$ , $I_C = 2400 \text{ A}$ , $R_G = 0.9 \text{ W}$ , $C_{GE} = 0 \text{ nF}$ , $V_{GE} = \pm 15 \text{ V}$ , $L_S = 75 \text{ nH}$ , inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$		940		ns
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1050		ns
			$T_{vj} = 150 \text{ }^\circ\text{C}$		1080		ns
Fall time	$t_f$	$V_{CC} = 900 \text{ V}$ , $I_C = 2400 \text{ A}$ , $R_G = 0.9 \text{ W}$ , $C_{GE} = 0 \text{ nF}$ , $V_{GE} = \pm 15 \text{ V}$ , $L_S = 75 \text{ nH}$ , inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$		270		ns
			$T_{vj} = 125 \text{ }^\circ\text{C}$		300		ns
			$T_{vj} = 150 \text{ }^\circ\text{C}$		310		ns
Turn-on switching energy	$E_{on}$	$V_{CC} = 900 \text{ V}$ , $I_C = 2400 \text{ A}$ , $R_G = 0.9 \text{ W}$ , $C_{GE} = 0 \text{ nF}$ , $V_{GE} = \pm 15 \text{ V}$ , $L_S = 75 \text{ nH}$ , inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$		780		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1040		mJ
			$T_{vj} = 150 \text{ }^\circ\text{C}$		1130		mJ
Turn-off switching energy	$E_{off}$	$V_{CC} = 900 \text{ V}$ , $I_C = 2400 \text{ A}$ , $R_G = 0.9 \text{ W}$ , $C_{GE} = 0 \text{ nF}$ , $V_{GE} = \pm 15 \text{ V}$ , $L_S = 75 \text{ nH}$ , inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$		760		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		940		mJ
			$T_{vj} = 150 \text{ }^\circ\text{C}$		1020		mJ
Short circuit current	$I_{sc}$	$t_{psc} \leq 10 \text{ } \mu\text{s}$ , $V_{GE} = 15 \text{ V}$ , $V_{CC} = 1200 \text{ V}$ , $V_{CEM \text{ CHIP}} \leq 1700 \text{ V}$	$T_{vj} = 150 \text{ }^\circ\text{C}$		6600		A

<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 <sub>F</sub>	I <sub>F</sub> = 2400 A	T <sub>vj</sub> = 25 °C	1.85	2.2	V
			T <sub>vj</sub> = 125 °C	1.95	2.3	V
			T <sub>vj</sub> = 150 °C	1.9		V
Peak reverse recovery current	I <sub>RM</sub>		T <sub>vj</sub> = 25 °C	1190		A
			T <sub>vj</sub> = 125 °C	1390		A
			T <sub>vj</sub> = 150 °C	1470		A
Recovered charge	Q <sub>rr</sub>	V <sub>CC</sub> = 900 V, I <sub>F</sub> = 2400 A, V <sub>GE</sub> = ±15 V, R <sub>G</sub> = 0.9 W, C <sub>GE</sub> = 0 nF, L <sub>S</sub> = 75 nH, inductive load	T <sub>vj</sub> = 25 °C	610		μC
			T <sub>vj</sub> = 125 °C	1000		μC
			T <sub>vj</sub> = 150 °C	1180		μC
Reverse recovery time	t <sub>rr</sub>		T <sub>vj</sub> = 25 °C	1050		ns
			T <sub>vj</sub> = 125 °C	1430		ns
			T <sub>vj</sub> = 150 °C	1540		ns
Reverse recovery energy	E <sub>rec</sub>		T <sub>vj</sub> = 25 °C	360		mJ
			T <sub>vj</sub> = 125 °C	610		mJ
			T <sub>vj</sub> = 150 °C	720		mJ

<sup>5)</sup> Characteristic values according to IEC 60747 - 15

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

### Package properties <sup>7)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
IGBT thermal resistance junction to case	R <sub>th(j-c)IGBT</sub>				0.011	K/W
Diode thermal resistance junction to case	R <sub>th(j-c)DIODE</sub>				0.018	K/W
IGBT thermal resistance <sup>2)</sup> case to heatsink	R <sub>th(c-s)IGBT</sub>	IGBT per switch, l grease = 1W/m x K		0.012		K/W
Diode thermal resistance <sup>2)</sup> case to heatsink	R <sub>th(c-s)DIODE</sub>	Diode per switch, l grease = 1W/m x K		0.024		K/W
Comparative tracking index	CTI		600			
Module stray inductance	L <sub>σ CE</sub>			12		nH
Resistance, terminal-chip	R <sub>CC'+EE'</sub>		T <sub>C</sub> = 25 °C	0.082		mΩ
			T <sub>C</sub> = 125 °C	0.113		
			T <sub>C</sub> = 150 °C	0.120		

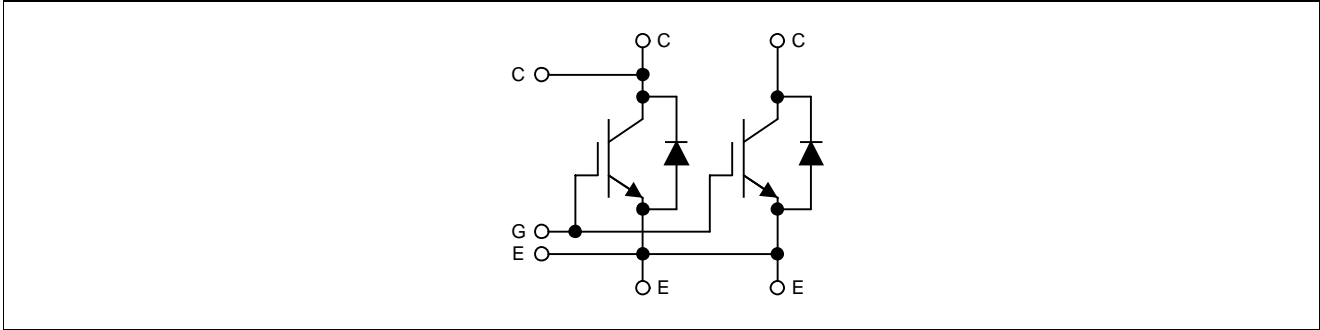
<sup>2)</sup> For detailed mounting instructions refer to ABB Document No. 5SYA 2039

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

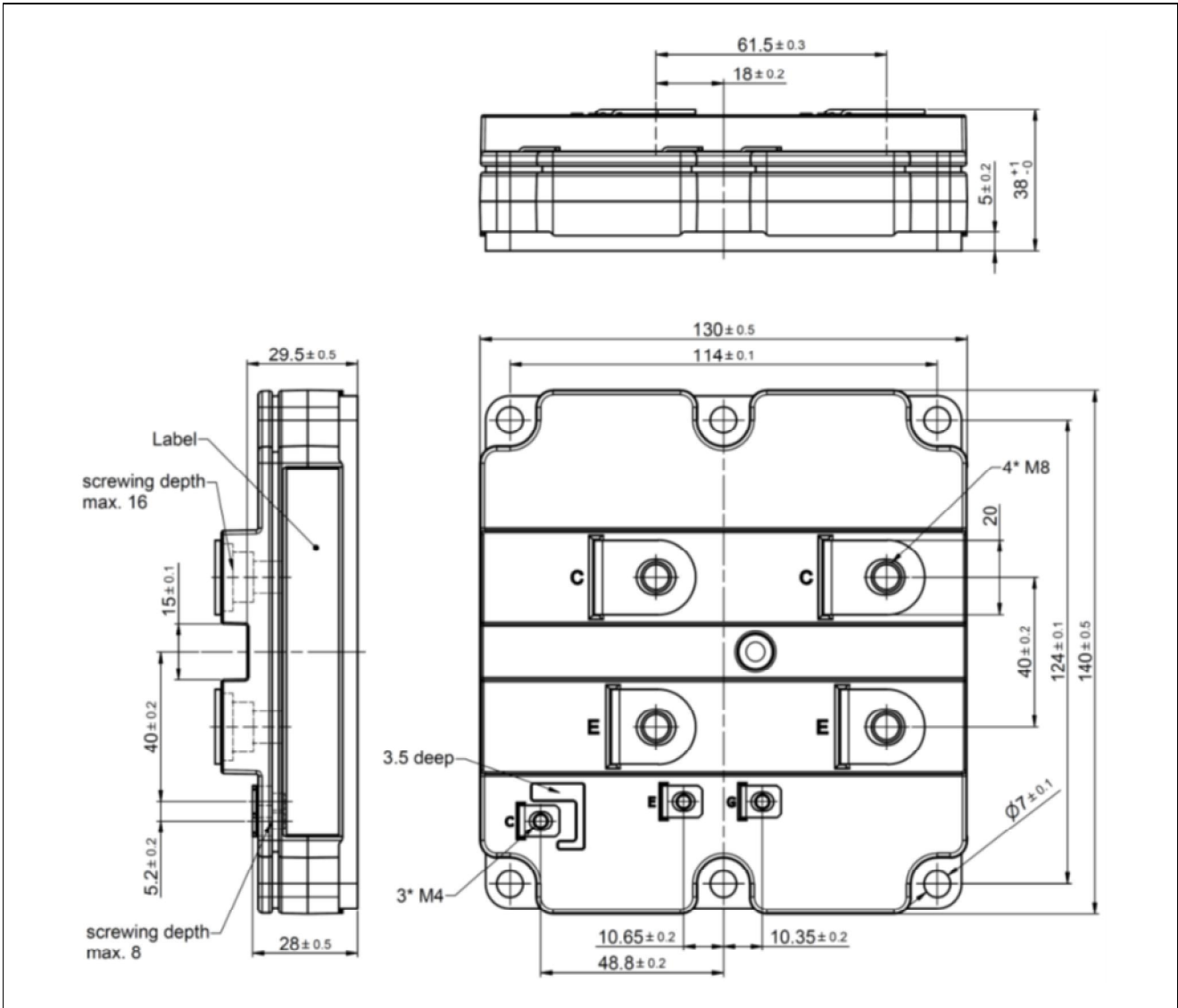
Parameter	Symbol	Conditions	min	typ	max	Unit
Dimensions	L x W x H	Typical		130 x 140 x 38		mm
Clearance distance in air	d <sub>a</sub>	according to IEC 60664-1 and EN 50124-1	Term. to base:	19		mm
			Term. to term:	19		
Surface creepage distance	d <sub>s</sub>	according to IEC 60664-1 and EN 50124-1	Term. to base:	28.2		mm
			Term. to term:	28.2		
Mass	m			820		g

<sup>7)</sup> Package and mechanical properties according to IEC 60747 - 15

## Electrical configuration



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



Note: all dimensions are shown in millimeters

<sup>2)</sup> For detailed mounting instructions refer to ABB Document No. 5SYA 2039

This is an electrostatic sensitive device, please observe the international standard IEC 60747-1, chap. VIII. This product has been designed and qualified for Industrial Level.

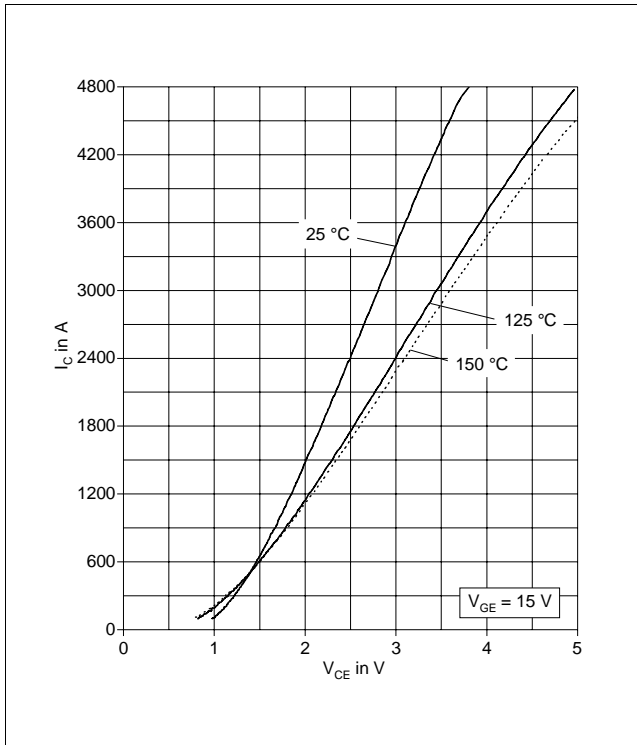


Fig. 1 Typical on-state characteristics, chip level

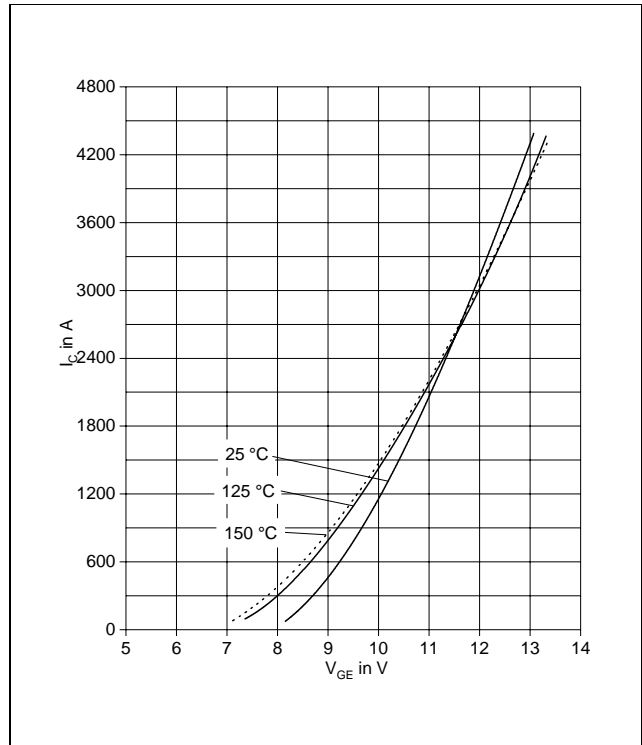


Fig. 2 Typical transfer characteristics, chip level

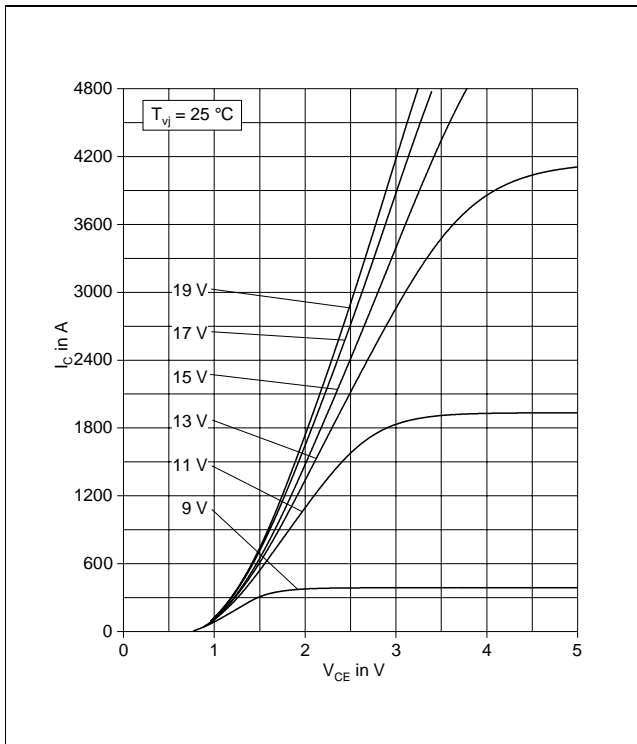


Fig. 3 Typical output characteristics, chip level

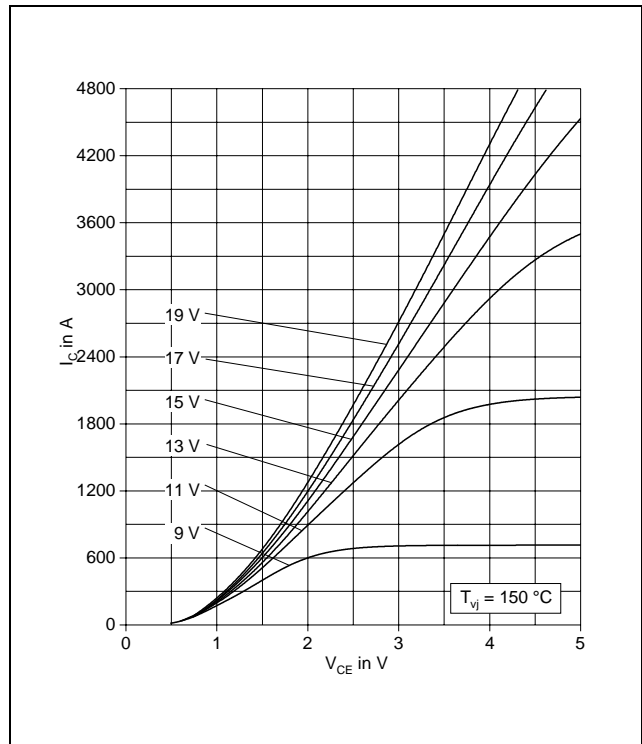


Fig. 4 Typical output characteristics, chip level

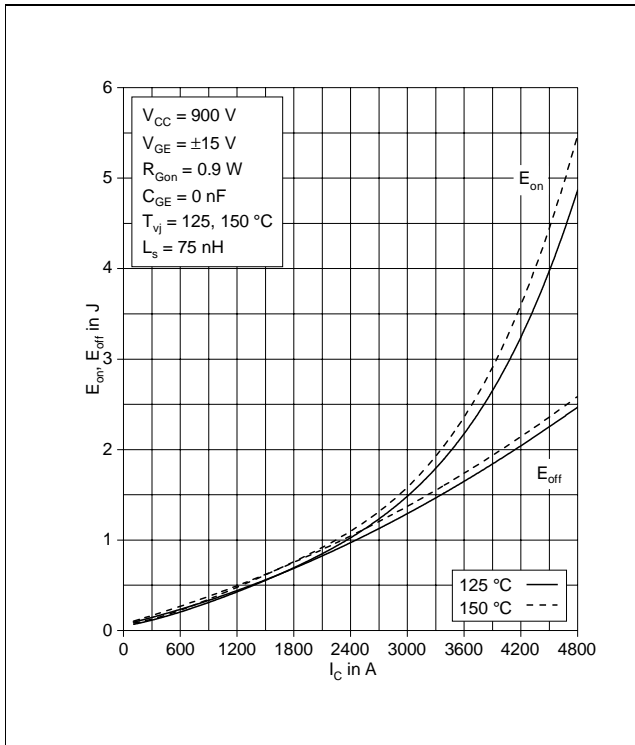


Fig. 5 Typical switching energies per pulse vs. collector current

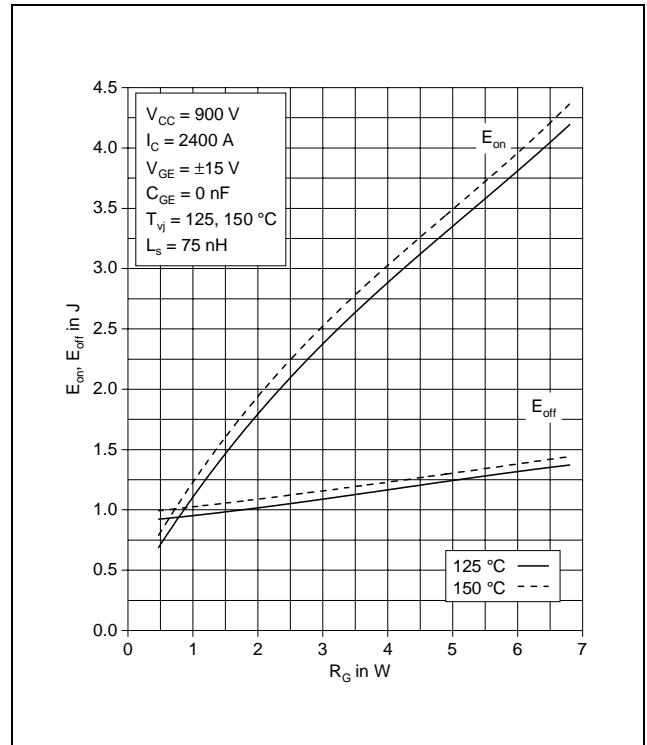


Fig. 6 Typical switching energies per pulse vs. gate resistor

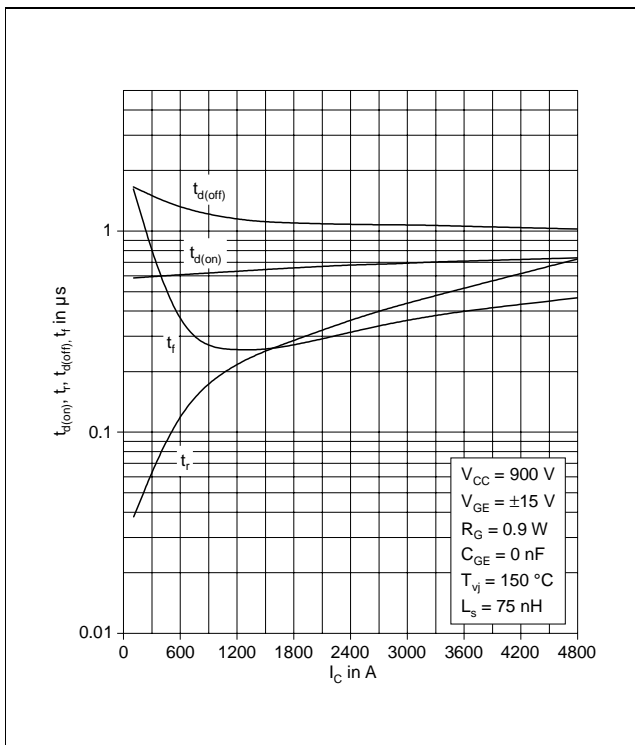


Fig. 7 Typical switching times vs. collector current

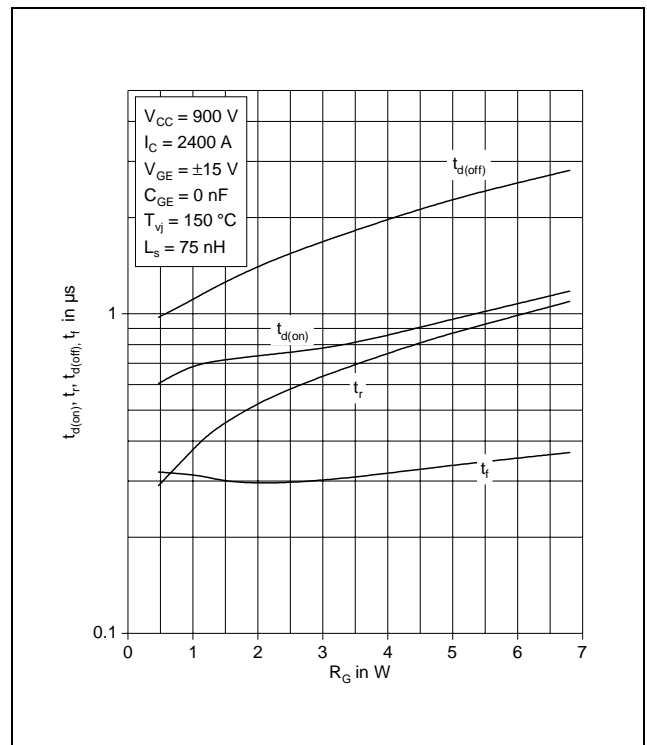


Fig. 8 Typical switching times vs. gate resistor

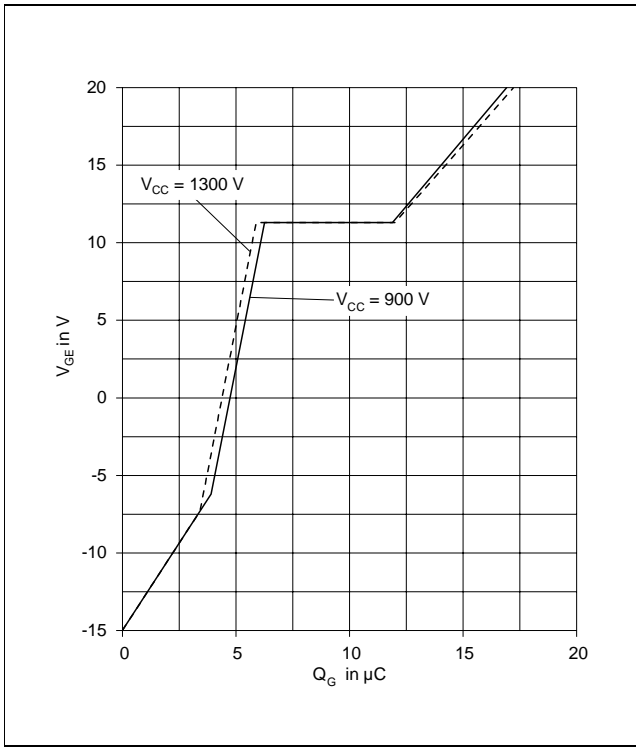


Fig. 9 Typical gate charge characteristics

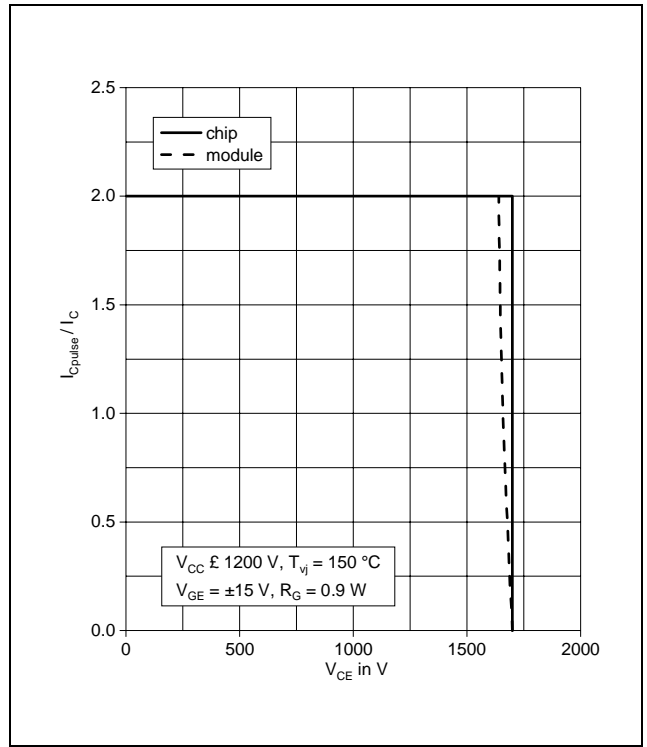


Fig. 10 Turn-off safe operating area (RBSOA)

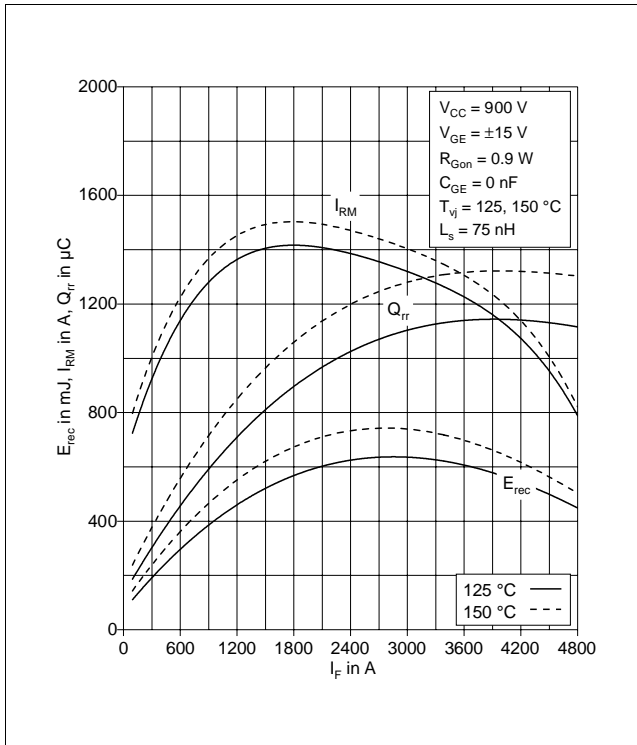


Fig. 11 Typical reverse recovery characteristics vs. forward current

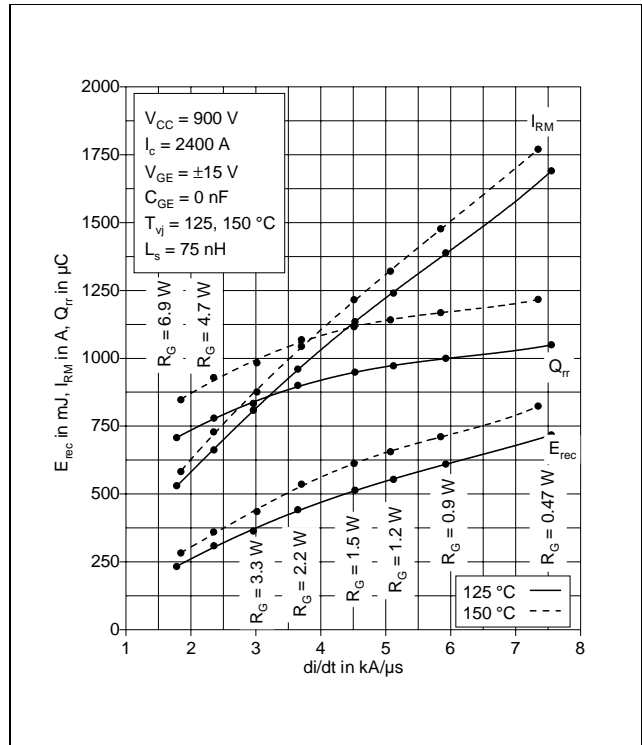


Fig. 12 Typical reverse recovery characteristics vs. di/dt

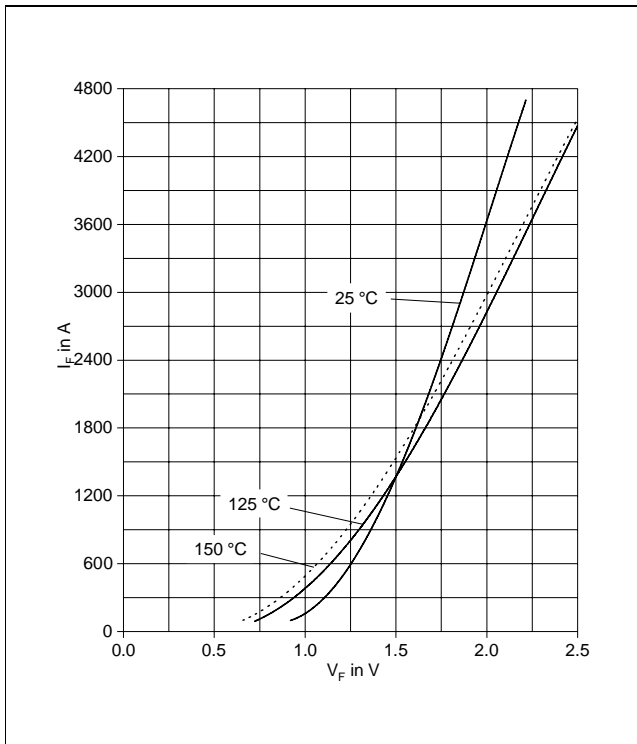


Fig. 13 Typical diode forward characteristics chip level

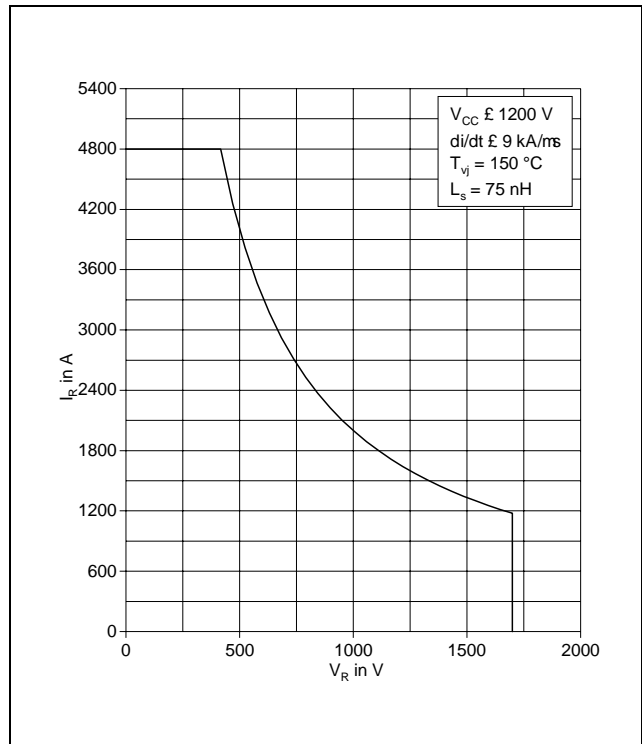


Fig. 14 Safe operating area diode (SOA)



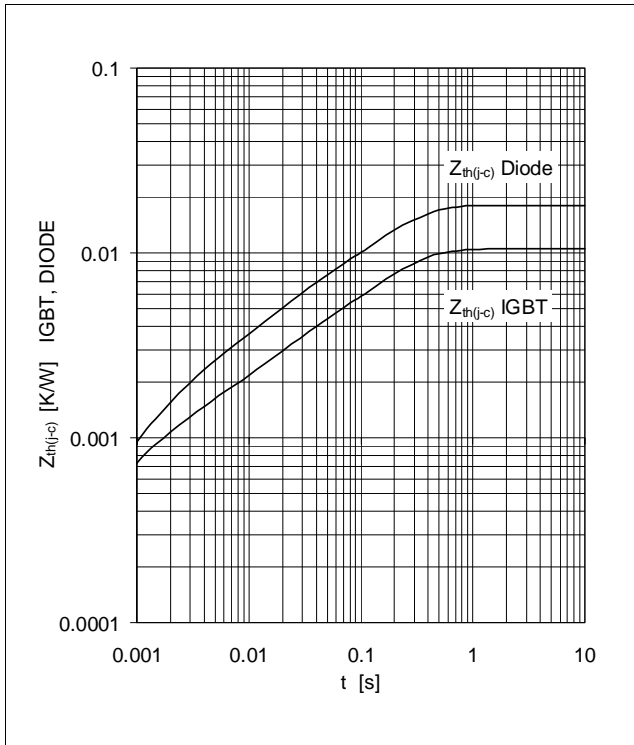


Fig. 15 Thermal impedance vs. time

Analytical function for transient thermal impedance:

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

i	1	2	3	4	5	
IGBT	Ri(K/kW)	7.59	1.8	0.743	0.369	
	ti(ms)	202	20.3	2.01	0.52	
DIODE	Ri(K/kW)	12.6	2.89	1.3	1.26	
	ti(ms)	210	29.6	7.01	1.49	

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**Related documents:**

- 5SYA 2042 Failure rates of HiPak modules due to cosmic rays
- 5SYA 2043 Load - cycle capability of HiPaks
- 5SYA 2045 Thermal runaway during blocking
- 5SYA 2053 Applying IGBT
- 5SYA 2057 IGBT diode safe operating area (SOA)
- 5SYA 2058 Surge currents for IGBT diodes
- 5SYA 2093 Thermal design of IGBT modules
- 5SYA 2098 Paralleling of IGBT modules
- 5SYA 2039 Mounting Instructions for HiPak modules
- 5SZK 9111 Specification of environmental class for HiPak Storage
- 5SZK 9112 Specification of environmental class for HiPak Transportation
- 5SZK 9113 Specification of environmental class for HiPak Operation (Industry)
- 5SZK 9120 Specification of environmental class for HiPak

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