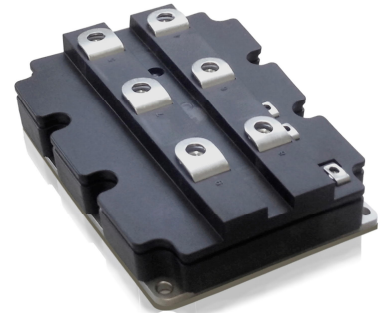


5SNE 1000E330300

HiPak Chopper IGBT Module

 $V_{CE} = 3300 \text{ V}$
 $I_C = 1000 \text{ A}$

Ultra low-loss, rugged SPT+ chip-set
 Smooth switching SPT+ chip-set for good EMC
 AlSiC base-plate for high power cycling capability
 AlN substrate for low thermal resistance
 Improved high reliability package
 Recognized under UL1557, File E196689



Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	V_{CES}	$V_{GE} = 0 \text{ V}$, $T_{vj} \geq 25 \text{ }^{\circ}\text{C}$		3300	V
DC collector current	I_C	$T_C = 100 \text{ }^{\circ}\text{C}$, $T_{vj} = 150 \text{ }^{\circ}\text{C}$		1000	A
Peak collector current	I_{CM}	$t_p = 1 \text{ ms}$		2000	A
Gate-emitter voltage	V_{GES}		-20	20	V
Total power dissipation	P_{tot}	$T_C = 25 \text{ }^{\circ}\text{C}$, $T_{vj} = 150 \text{ }^{\circ}\text{C}$, per switch		9800	W
DC forward current	I_F			1000	A
Peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$		2000	A
Surge current	I_{FSM}	$V_R = 0 \text{ V}$, $T_{vj} = 150 \text{ }^{\circ}\text{C}$, $t_p = 10 \text{ ms}$, half-sinewave		9000	A
IGBT short circuit SOA	t_{psc}	$V_{CC} = 2500 \text{ V}$, $V_{CEM \text{ CHIP}} \leq 3300 \text{ V}$ $V_{GE} \leq 15 \text{ V}$, $T_{vj} \leq 150 \text{ }^{\circ}\text{C}$		10	μs
Isolation voltage	V_{isol}	1 min, $f = 50 \text{ Hz}$		6000	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 ²⁾	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	

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

²⁾ for detailed mounting instructions refer to Document No. 5SYA 2039

IGBT characteristic values ³⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Collector (-emitter) breakdown voltage	V _{(BR)CES}	V _{GE} = 0 V, I _C = 10 mA, T _{vj} = 25 °C	3300			V
Collector-emitter ⁴⁾ saturation voltage	V _{CE sat}	I _C = 1000 A, V _{GE} = 15 V	T _{vj} = 25 °C	2.5	2.9	V
			T _{vj} = 125 °C	3.1	3.4	V
			T _{vj} = 150 °C	3.25		V
Collector cut-off current	I _{CES}	V _{CE} = 3300 V, V _{GE} = 0 V	T _{vj} = 25 °C	0.04	0.67	mA
			T _{vj} = 125 °C	13.5	27	mA
			T _{vj} = 150 °C	67		mA
Gate leakage current	I _{GES}	V _{CE} = 0 V, V _{GE} = ± 20 V, T _{vj} = 125 °C	-500		500	nA
Gate-emitter threshold voltage	V _{GE(th)}	I _C = 160 mA, V _{CE} = V _{GE} , T _{vj} = 25 °C	5		7	V
Gate charge	Q _G	I _C = 1000 A, V _{CE} = 1800 V, V _{GE} = -15 V ..15 V		7.33		μC
Input capacitance	C _{ies}	V _{CE} = 25 V, V _{GE} = 0 V, f = 1 MHz, T _{vj} = 25 °C		101		nF
Output capacitance	C _{oes}			8.4		nF
Reverse transfer capacitance	C _{res}			2.57		nF
Internal gate resistance	R _{Gint}			0.9		Ω
Turn-on delay time	t _{d(on)}	V _{CC} = 1800 V, I _C = 1000 A, R _G = 1.5 Ω, C _{GE} = 220 nF, V _{GE} = ±15 V, L _σ = 100 nH, inductive load	T _{vj} = 25 °C	560		ns
			T _{vj} = 125 °C	530		ns
			T _{vj} = 150 °C	530		ns
Rise time	t _r		T _{vj} = 25 °C	240		ns
			T _{vj} = 125 °C	255		ns
			T _{vj} = 150 °C	260		ns
Turn-off delay time	t _{d(off)}	T _{vj} = 25 °C	1465		ns	
		T _{vj} = 125 °C	1640		ns	
		T _{vj} = 150 °C	1700		ns	
Fall time	t _f	T _{vj} = 25 °C	315		ns	
		T _{vj} = 125 °C	385		ns	
		T _{vj} = 150 °C	400		ns	
Turn-on switching energy	E _{on}	V _{CC} = 1800 V, I _C = 1000 A, R _G = 1.5 Ω, C _{GE} = 220 nF, V _{GE} = ±15 V, L _σ = 100 nH, inductive load	T _{vj} = 25 °C	1250		mJ
			T _{vj} = 125 °C	1640		mJ
			T _{vj} = 150 °C	1800		mJ
Turn-off switching energy	E _{off}	V _{CC} = 1800 V, I _C = 1000 A, R _G = 2.2 Ω, C _{GE} = 220 nF, V _{GE} = ±15 V, L _σ = 100 nH, inductive load	T _{vj} = 25 °C	1240		mJ
			T _{vj} = 125 °C	1730		mJ
			T _{vj} = 150 °C	1870		mJ
Short circuit current	I _{SC}	t _{pSC} ≤ 10 μs, V _{GE} = 15 V, V _{CC} = 2500 V, V _{CEM CHIP} ≤ 3300 V	T _{vj} = 150 °C	4270		A

³⁾ Characteristic values according to IEC 60747 – 9

⁴⁾ Collector-emitter saturation voltage is given at chip level

Diode characteristic values ⁵⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Forward voltage ⁶⁾	V _F	I _F = 1000 A	T _{vj} = 25 °C	2.05	2.5	V
			T _{vj} = 125 °C	2.25	2.6	V
			T _{vj} = 150 °C	2.20		V
Peak reverse recovery current	I _{RM}	V _{CC} = 1800 V, I _F = 1000 A, V _{GE} = ±15 V, R _G = 1.5 Ω, C _{GE} = 220 nF, di/dt = 4 kA/μs L _σ = 100 nH, inductive load	T _{vj} = 25 °C	1010		A
			T _{vj} = 125 °C	1180		A
			T _{vj} = 150 °C	1230		A
Recovered charge	Q _r		T _{vj} = 25 °C	630		μC
			T _{vj} = 125 °C	1020		μC
			T _{vj} = 150 °C	1180		μC
Reverse recovery time	t _{rr}		T _{vj} = 25 °C	1125		ns
			T _{vj} = 125 °C	1440		ns
			T _{vj} = 150 °C	1630		ns
Reverse recovery energy	E _{rec}		T _{vj} = 25 °C	700		mJ
			T _{vj} = 125 °C	1210		mJ
			T _{vj} = 150 °C	1420		mJ

⁵⁾ Characteristic values according to IEC 60747 – 2

⁶⁾ Forward voltage is given at chip level

Package properties ⁷⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$	per switch			0.013	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.025	K/W
IGBT thermal resistance ²⁾ case to heatsink	$R_{th(c-s)IGBT}$	IGBT per switch, λ grease = 1W/m x K		0.012		K/W
Diode thermal resistance ²⁾ case to heatsink	$R_{th(c-s)DIODE}$	Diode per switch, λ grease = 1W/m x K		0.024		K/W
Partial discharge extinction voltage	V_e	$f = 50\text{ Hz}$, $Q_{PD} \leq 10\text{ pC}$ (acc. To IEC 61287)	3500			V
Comparative tracking index	CTI		600			
Module stray inductance	$L_{\sigma CE}$	per switch		12		nH
Resistance, terminal-chip	$R_{CC'+EE'}$	per switch	$T_C = 25\text{ °C}$	0.083		m Ω
			$T_C = 125\text{ °C}$	0.113		
			$T_C = 150\text{ °C}$	0.120		

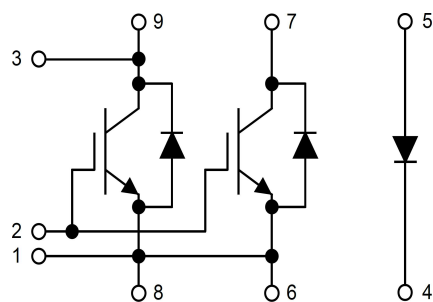
²⁾ For detailed mounting instructions refer to Document No. 5SYA 2039

Mechanical properties ⁷⁾

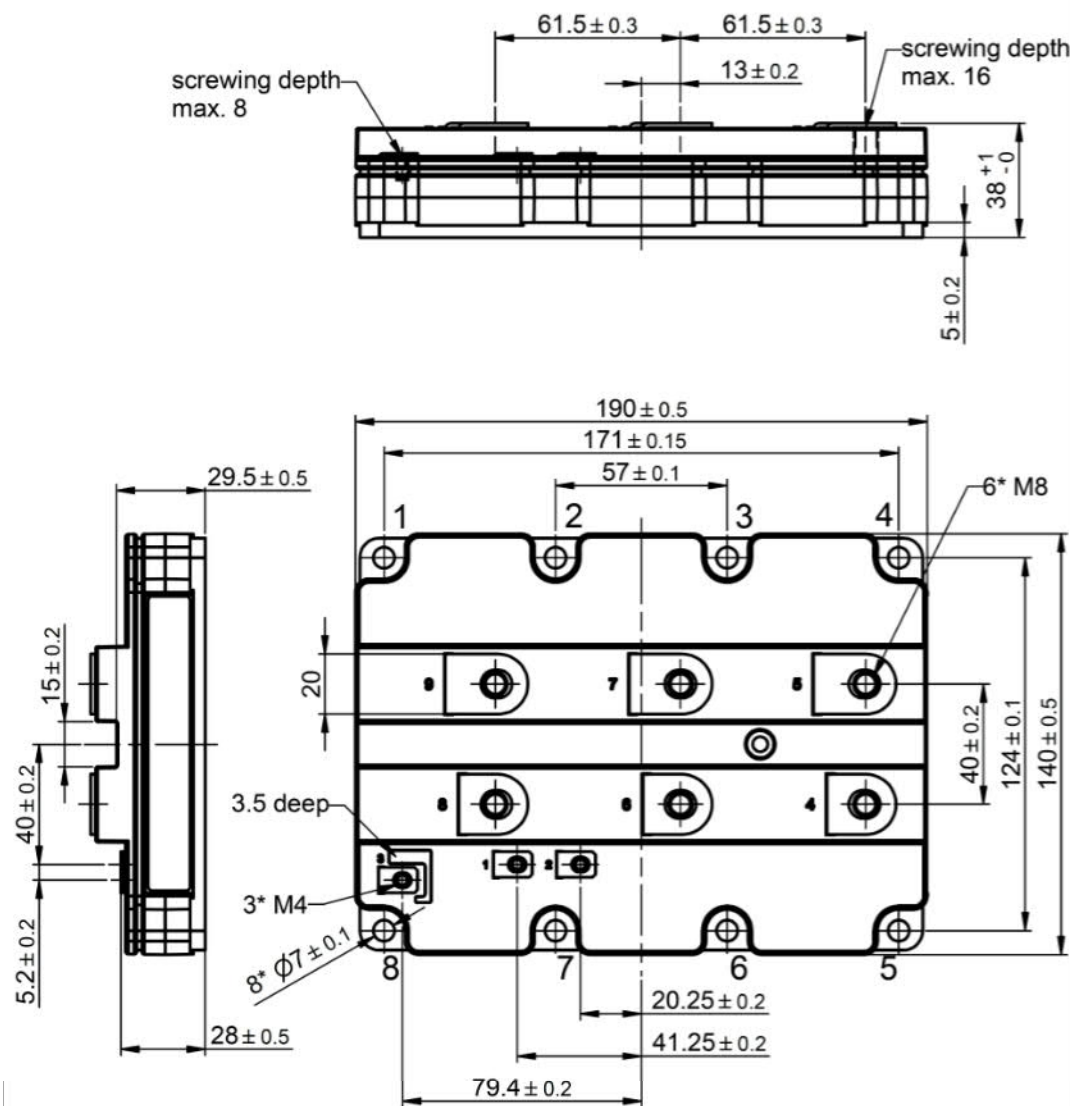
Parameter	Symbol	Conditions	min	typ	max	Unit
Dimensions	L x W x H	Typical	190 x 140 x 38			mm
Clearance distance in air	d_a	according to IEC 60664-1 and EN 50124-1	Term. to base:	19		mm
			Term. to term:	19		
Surface creepage distance	d_s	according to IEC 60664-1 and EN 50124-1	Term. to base:	28.2		mm
			Term. to term:	28.2		
Mass	m			1210		g

⁷⁾ Package and mechanical properties according to IEC 60747 – 15

Electrical configuration



Outline drawing ²⁾



Note: all dimensions are shown in millimeters

²⁾ For detailed mounting instructions refer to 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.

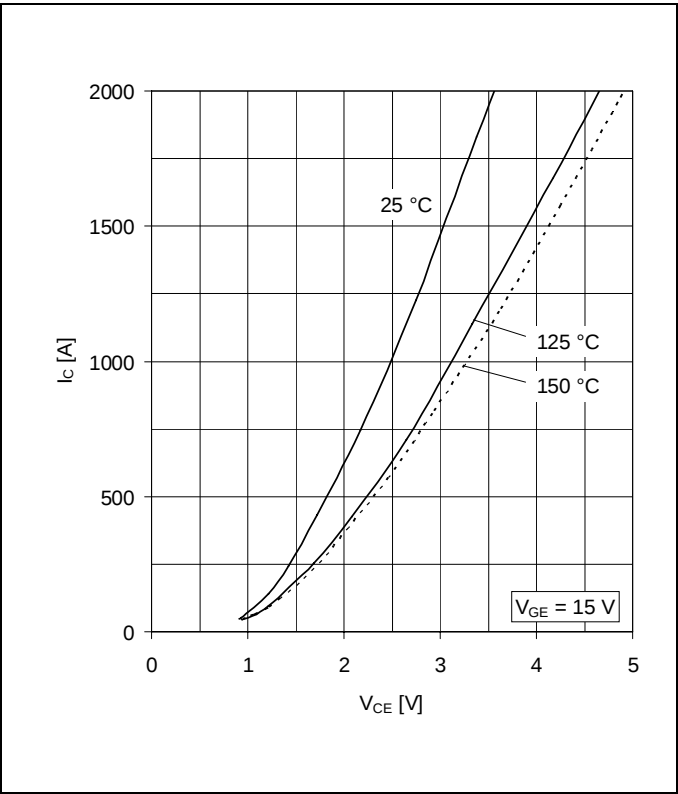


Fig. 1 Typical on-state characteristics, chip level

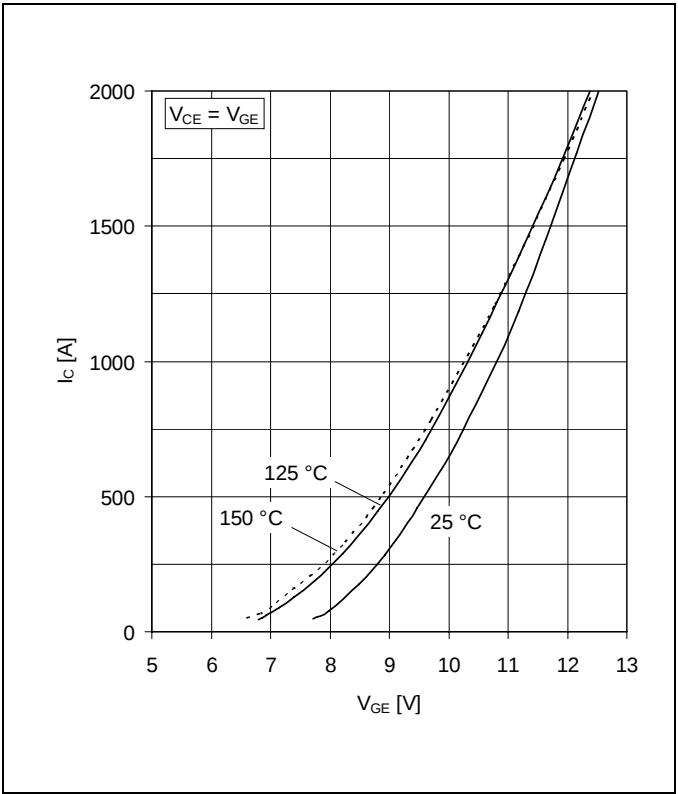


Fig. 2 Typical transfer characteristics, chip level

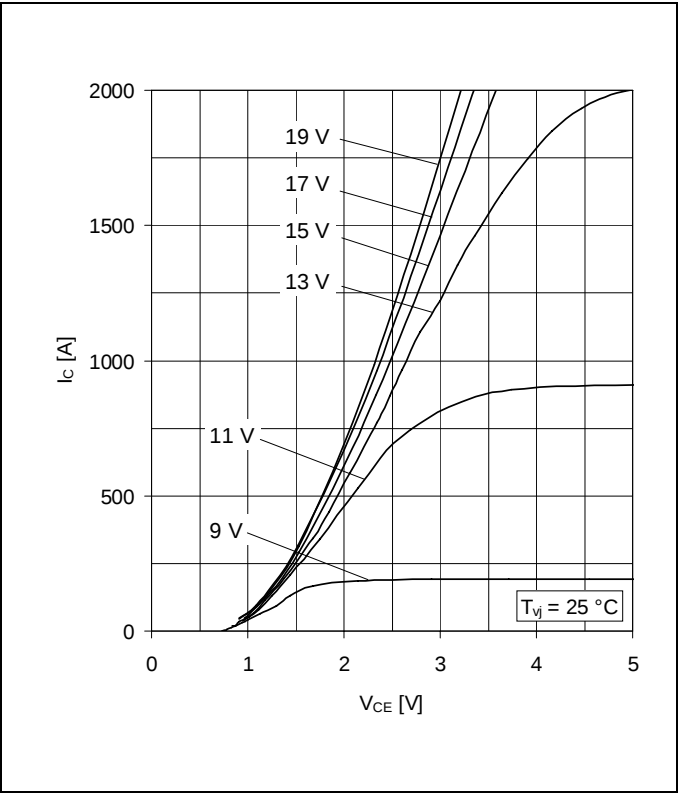


Fig. 3 Typical output characteristics, chip level

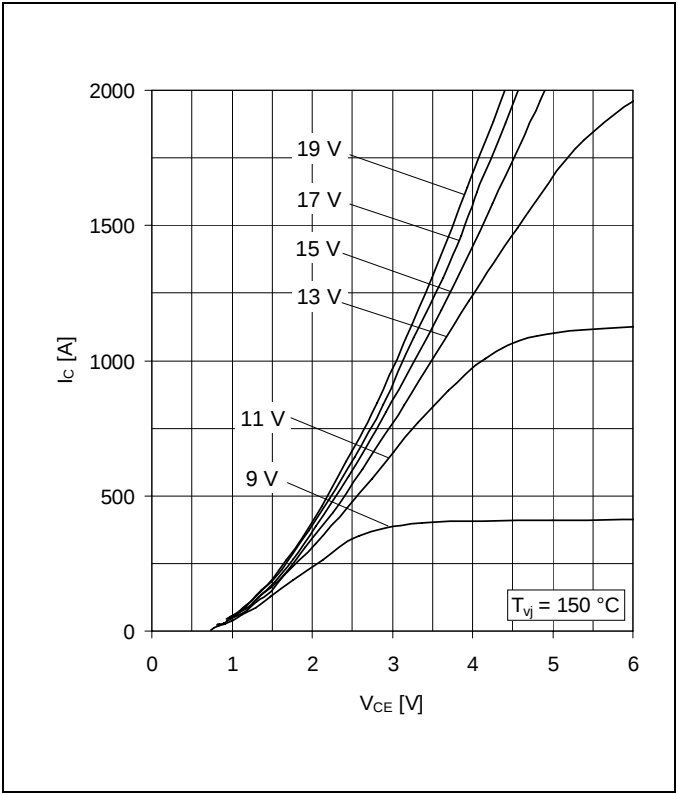


Fig. 4 Typical output characteristics, chip level

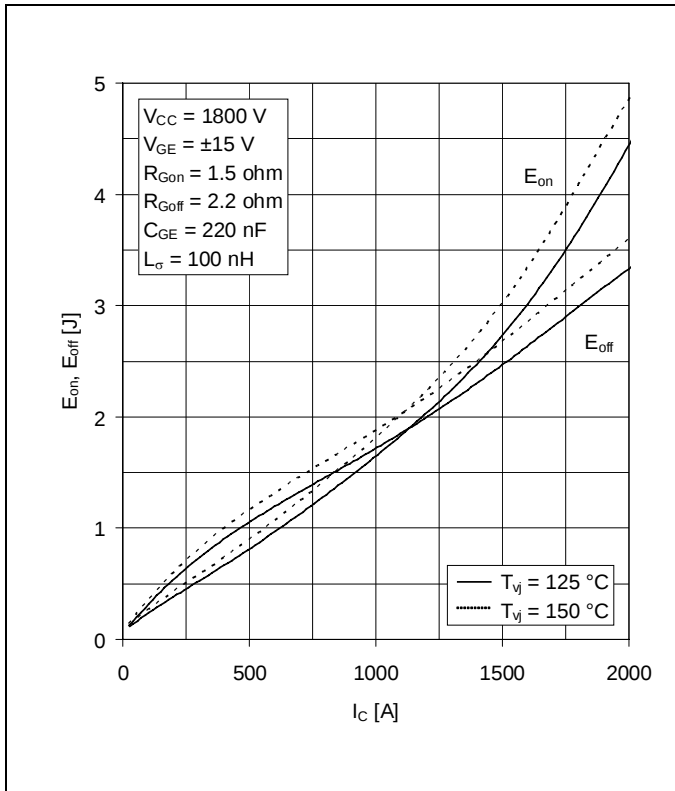


Fig. 5 Typical switching energies per pulse vs. collector current

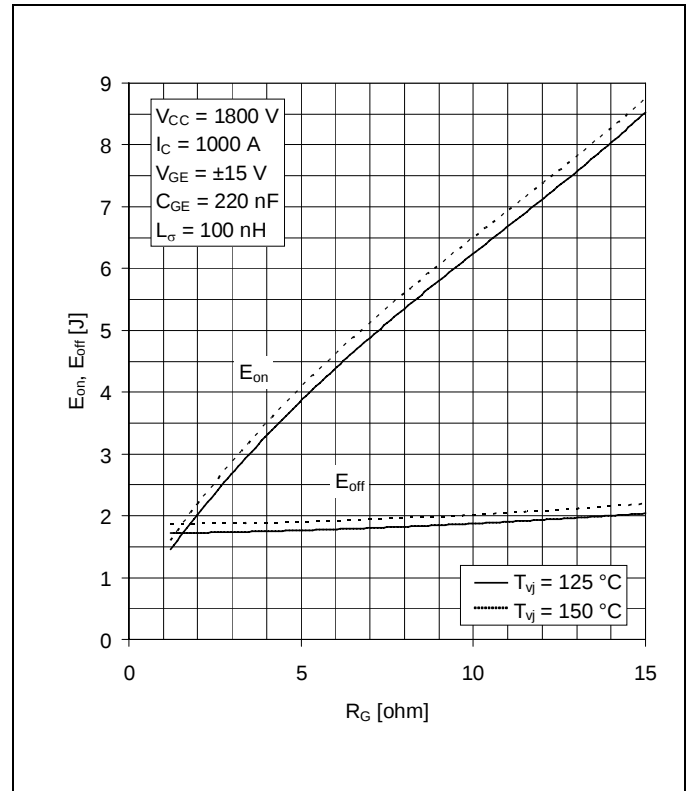


Fig. 6 Typical switching energies per pulse vs. gate resistor

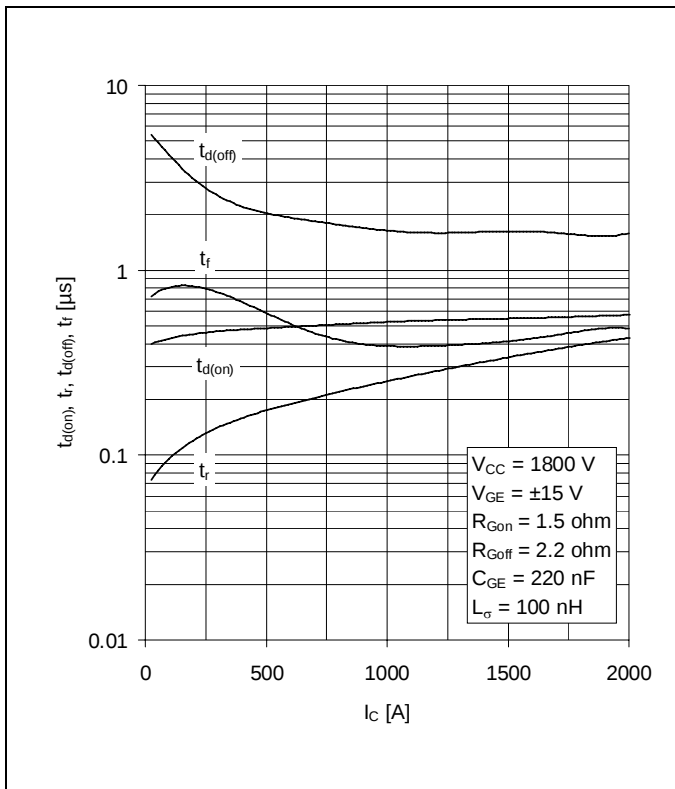


Fig. 7 Typical switching times vs. collector current

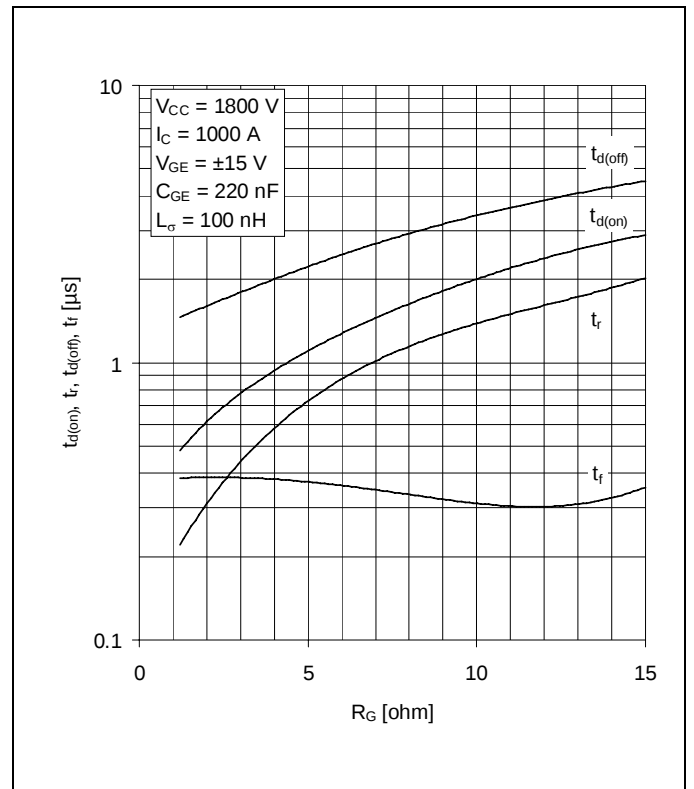


Fig. 8 Typical switching times vs. gate resistor

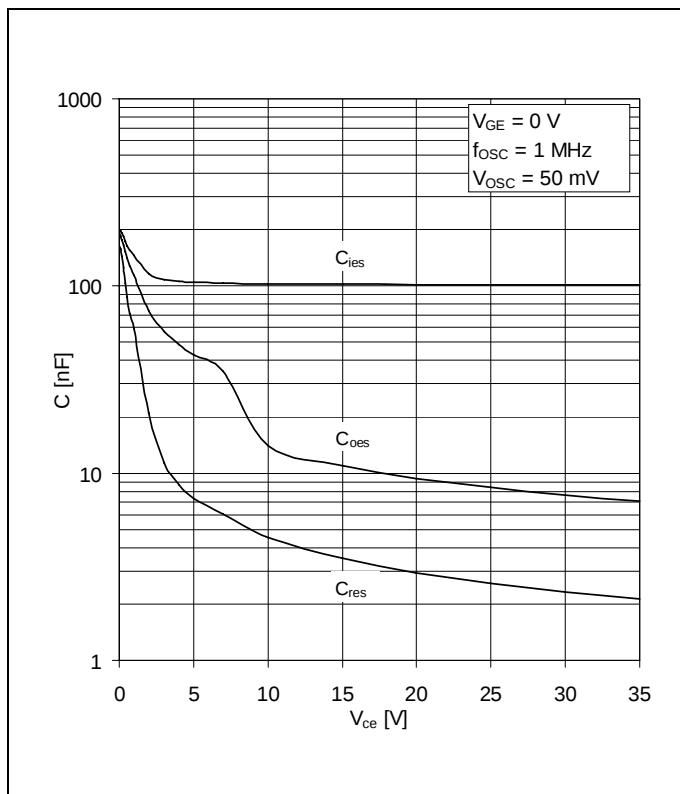


Fig. 9 Typical capacitances vs. collector-emitter voltage

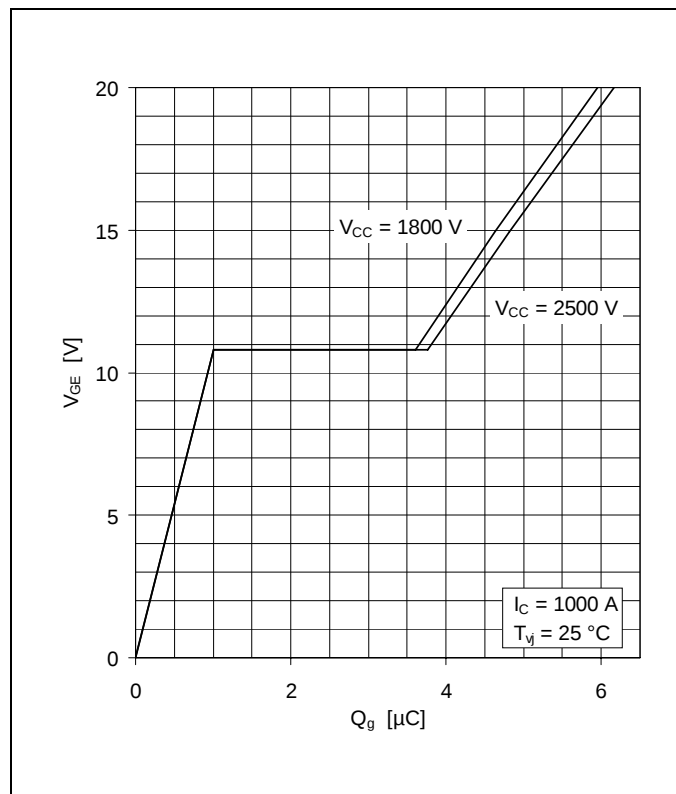


Fig. 10 Typical gate charge characteristics

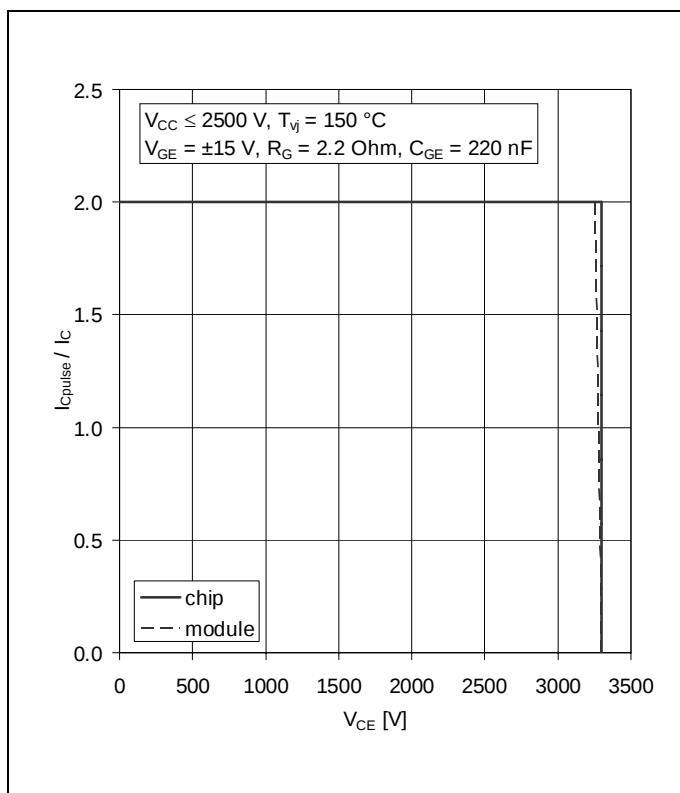


Fig. 11 Turn-off safe operating area (RBSOA)

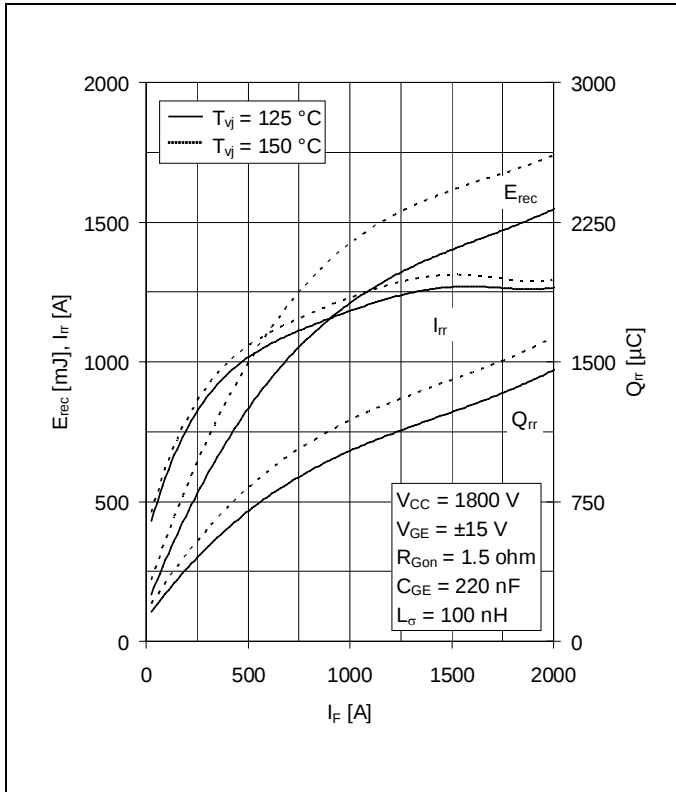


Fig. 12 Typical reverse recovery characteristics vs. forward current

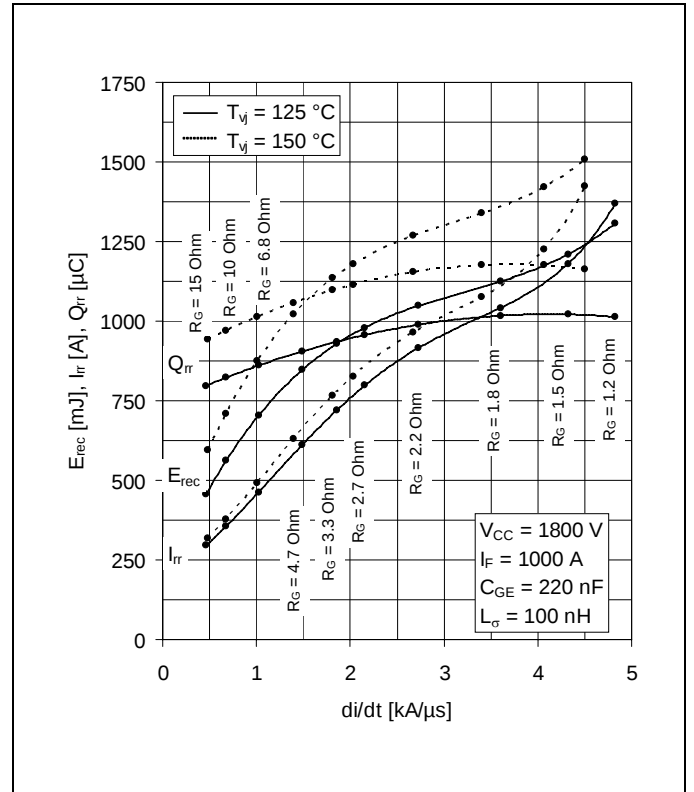


Fig. 13 Typical reverse recovery characteristics vs. di/dt

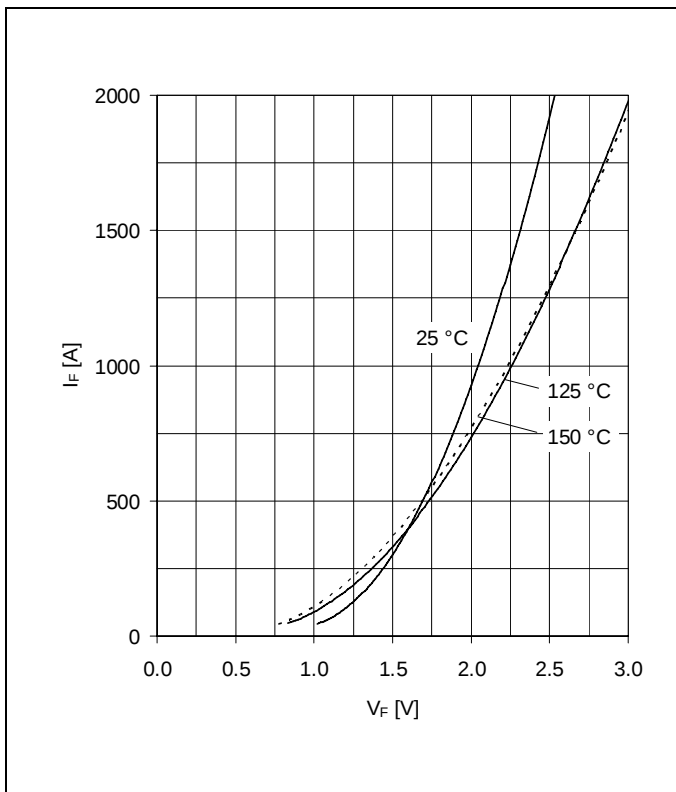


Fig. 14 Typical diode forward characteristics chip level

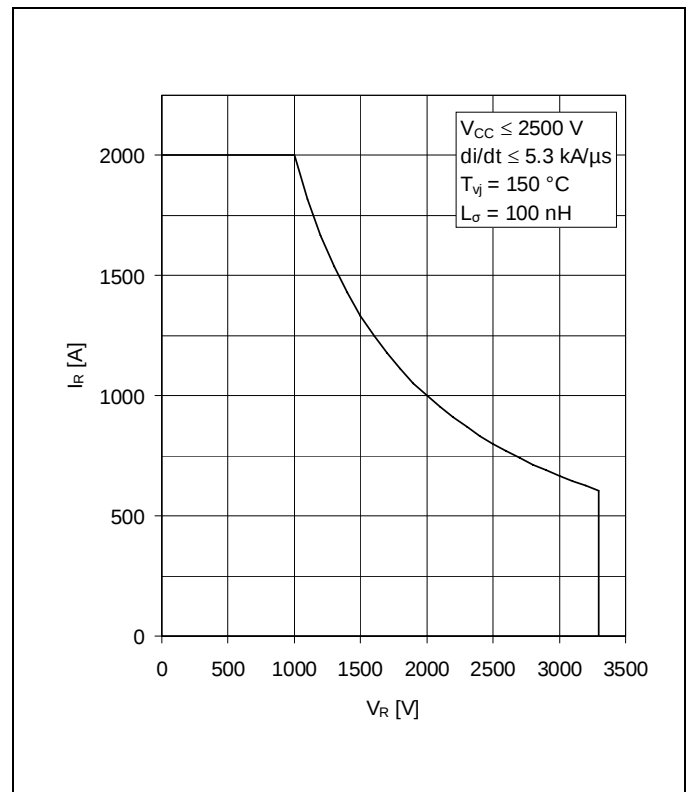


Fig. 15 Safe operating area diode (SOA)

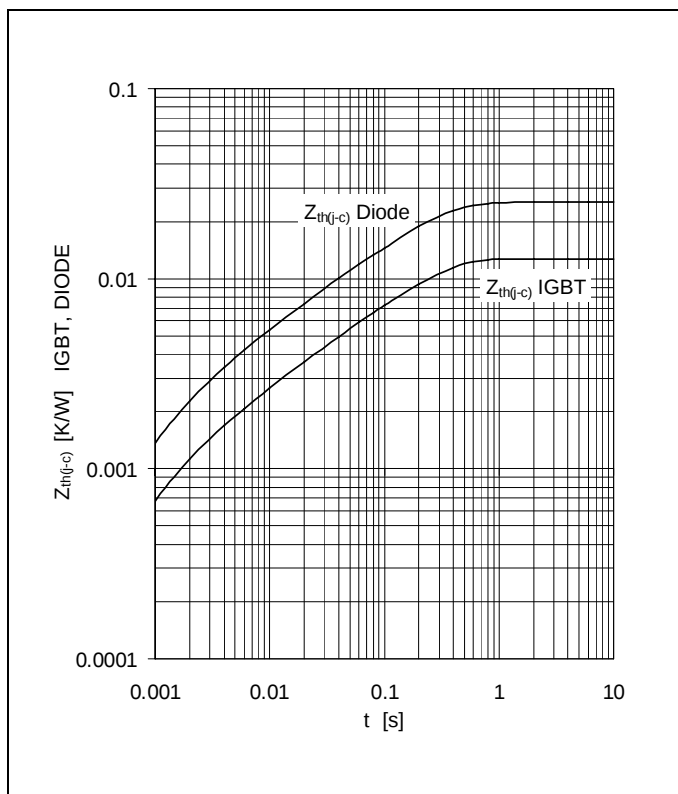


Fig. 16 Thermal impedance vs. time

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	5
IGBT	$R_i(K/kW)$	8.78	2.06	0.961	0.948	
	$\tau_i(ms)$	207.4	30.1	7.55	1.57	
DIODE	$R_i(K/kW)$	17.1	4.28	1.92	1.92	
	$\tau_i(ms)$	203.6	30.1	7.53	1.57	

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 2058 Surge currents for IGBT diodes
 5SYA 2093 Thermal design and temperature ratings of IGBT modules
 5SYA 2098 Paralleling of IGBT 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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