

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
 Recognized under UL1557, File E196689



Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	V_{CES}	$V_{GE} = 0 \text{ V}$, $T_{vj} \geq 25 \text{ °C}$		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	μs
Isolation voltage	V_{isol}	1 min, $f = 50 \text{ Hz}$		4000	V
Junction temperature	T_{vj}			175	°C
Junction operating temperature	$T_{vj(op)}$		-50	150	°C
Case temperature	T_C		-50	150	°C
Storage temperature	T_{stg}		-50	125	°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	$V_{(BR)CES}$	$V_{GE} = 0 \text{ V}$, $I_C = 10 \text{ mA}$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$	1700			V
Collector-emitter ⁴⁾ saturation voltage	$V_{CE \text{ sat}}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$	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}	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		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		μC
Internal gate resistance	R_{Gint}			0.8		Ω
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		600		ns
		$T_{vj} = 125 \text{ }^{\circ}\text{C}$		660		ns
		$T_{vj} = 150 \text{ }^{\circ}\text{C}$		680		ns
Rise time	t_r	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		330		ns
		$T_{vj} = 125 \text{ }^{\circ}\text{C}$		350		ns
		$T_{vj} = 150 \text{ }^{\circ}\text{C}$		360		ns
Turn-off delay time	$t_{d(off)}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		940		ns
		$T_{vj} = 125 \text{ }^{\circ}\text{C}$		1050		ns
		$T_{vj} = 150 \text{ }^{\circ}\text{C}$		1080		ns
Fall time	t_f	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		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}	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		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}	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		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

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 = 2400 A	T _{Vj} = 25 °C	1.85	2.2	V
			T _{Vj} = 125 °C	1.95	2.3	V
			T _{Vj} = 150 °C	1.9		V
Peak reverse recovery current	I _{RM}	V _{CC} = 900 V, I _F = 2400 A, V _{GE} = ±15 V, R _G = 0.9 Ω, C _{GE} = 0 nF, L _σ = 75 nH, inductive load	T _{Vj} = 25 °C	1190		A
			T _{Vj} = 125 °C	1390		A
			T _{Vj} = 150 °C	1470		A
Recovered charge	Q _{rr}		T _{Vj} = 25 °C	610		μC
			T _{Vj} = 125 °C	1000		μC
			T _{Vj} = 150 °C	1180		μC
Reverse recovery time	t _{rr}		T _{Vj} = 25 °C	1050		ns
			T _{Vj} = 125 °C	1430		ns
			T _{Vj} = 150 °C	1540		ns
Reverse recovery energy	E _{rec}		T _{Vj} = 25 °C	360		mJ
			T _{Vj} = 125 °C	610		mJ
			T _{Vj} = 150 °C	720		mJ

⁵⁾ Characteristic values according to IEC 60747 – 15

⁶⁾ Forward voltage is given at chip level

Package properties ⁷⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$				0.011	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.018	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
Comparative tracking index	CTI		600			
Module stray inductance	$L_{\sigma CE}$			12		nH
Resistance, terminal-chip	$R_{CC'+EE'}$	$T_C = 25\text{ °C}$		0.082		m Ω
		$T_C = 125\text{ °C}$		0.113		
		$T_C = 150\text{ °C}$		0.120		

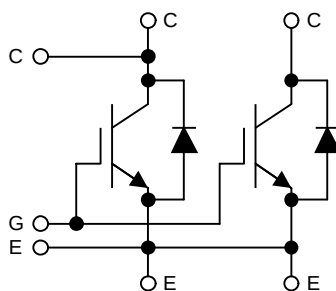
²⁾ For detailed mounting instructions refer to Document No. 5SYA 2039

Mechanical properties ⁷⁾

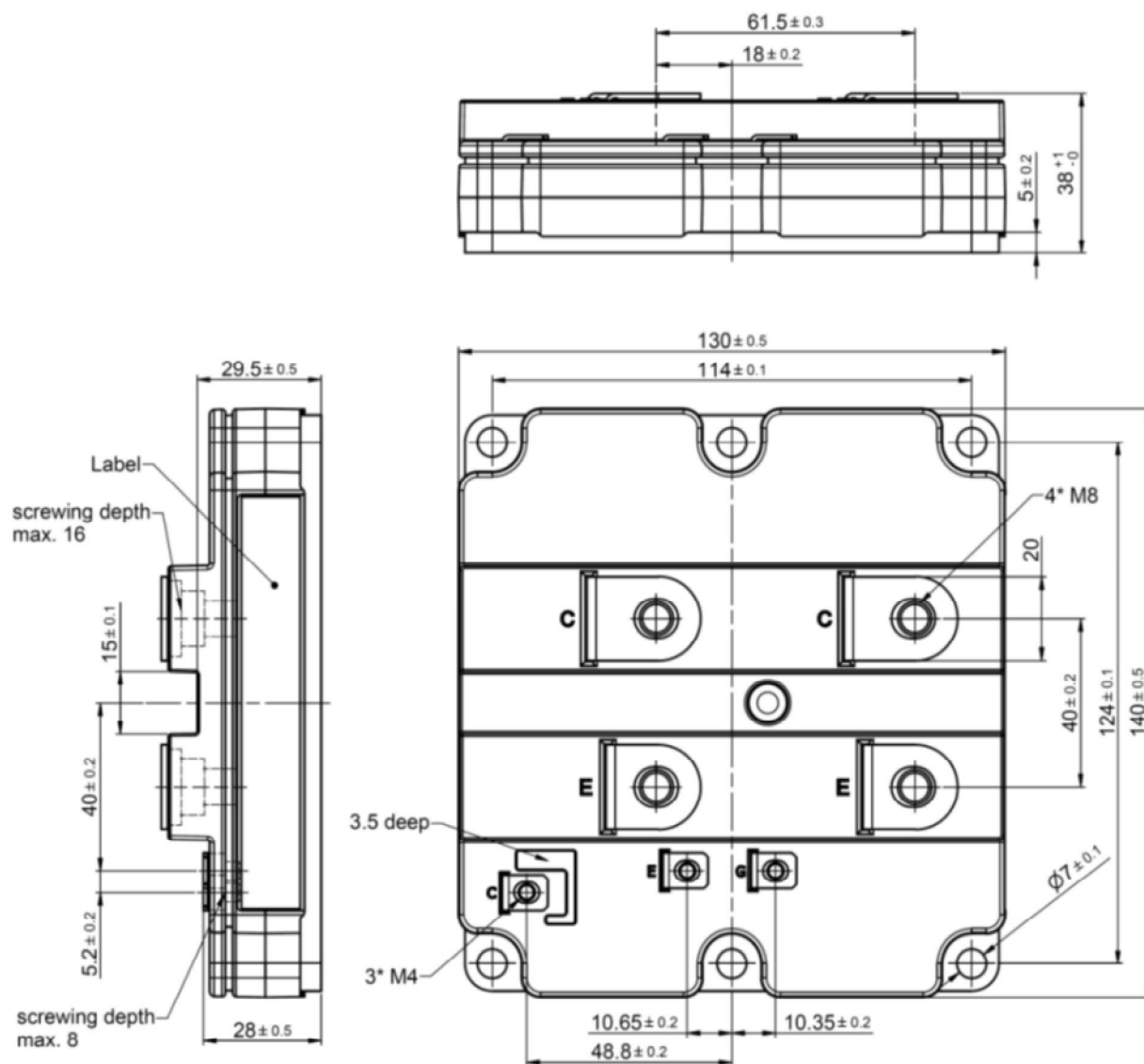
Parameter	Symbol	Conditions	min	typ	max	Unit
Dimensions	L x W x H	Typical	130 x 140 x 38			mm
Clearance distance in air	d_a	according to IEC 60664-1 and EN 50124-1	Term. to base:	19		mm
			Term. to term:	19		
Surface creepage distance	d_s	according to IEC 60664-1 and EN 50124-1	Term. to base:	28.2		mm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

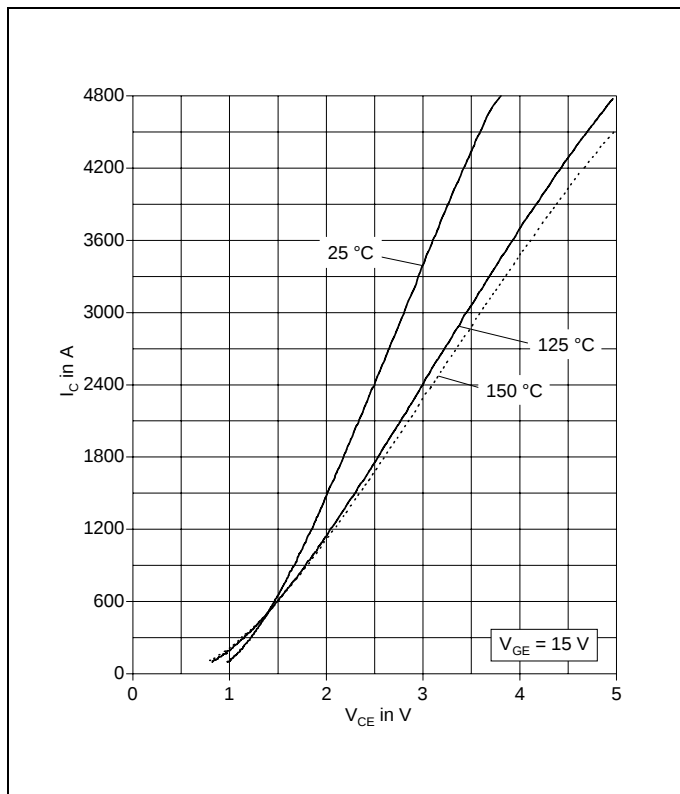


Fig. 1 Typical on-state characteristics, chip level

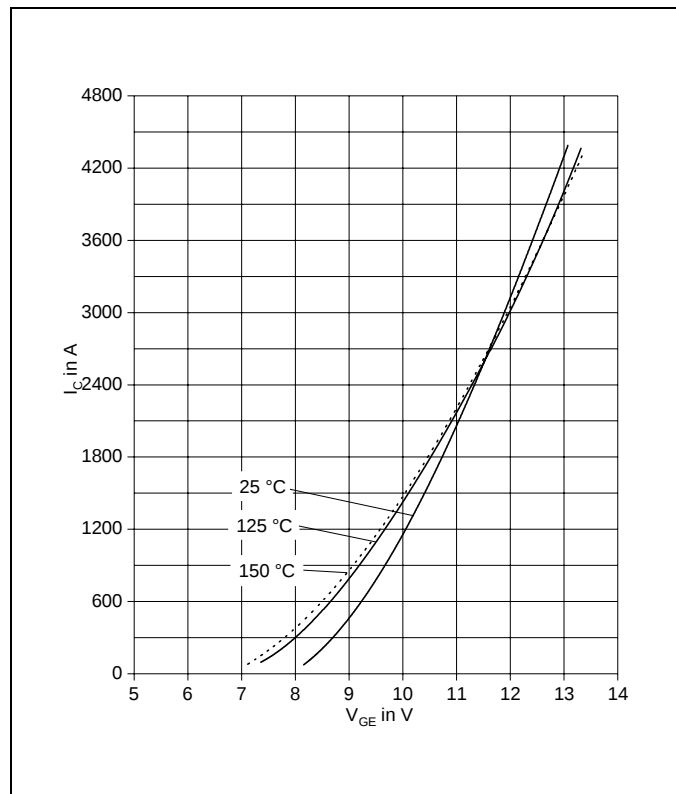


Fig. 2 Typical transfer characteristics, chip level

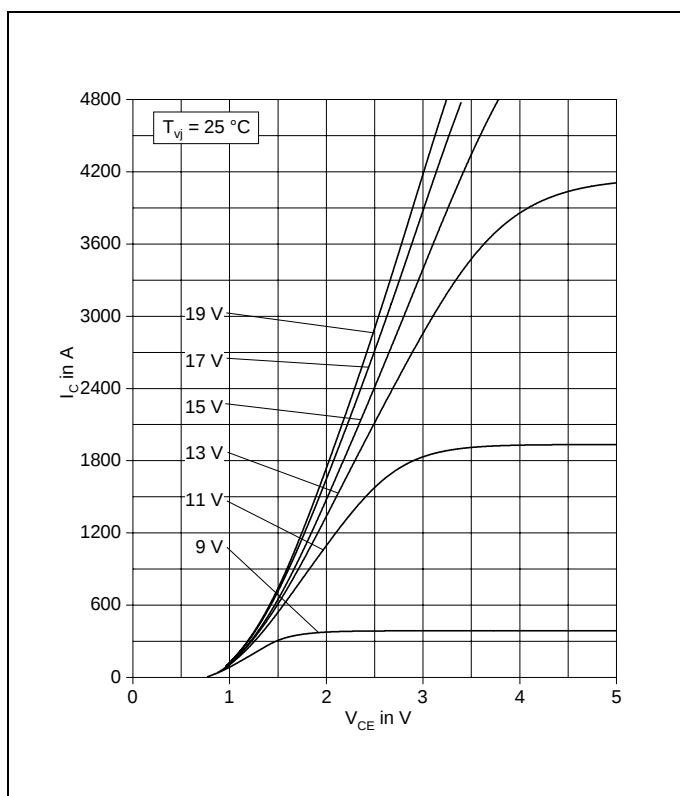


Fig. 3 Typical output characteristics, chip level

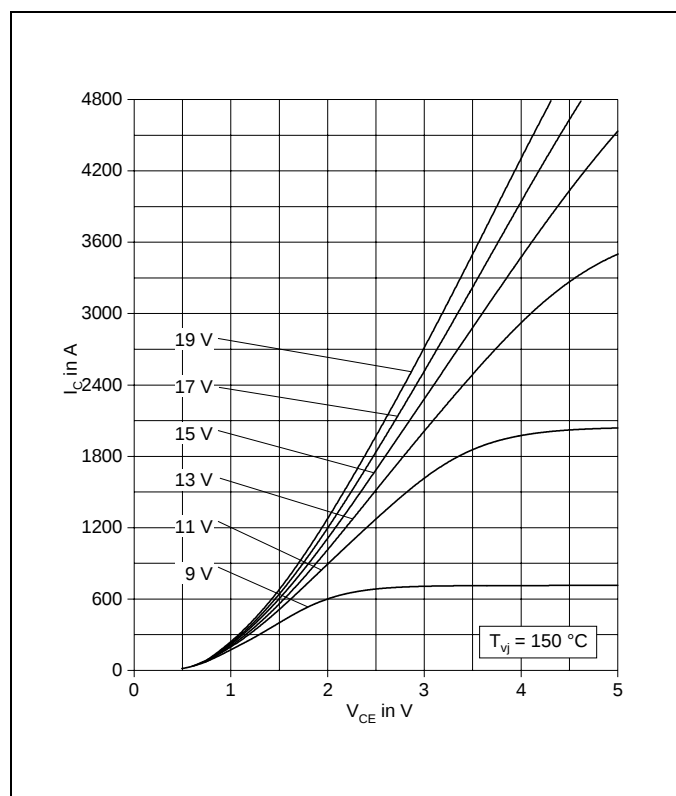


Fig. 4 Typical output characteristics, chip level

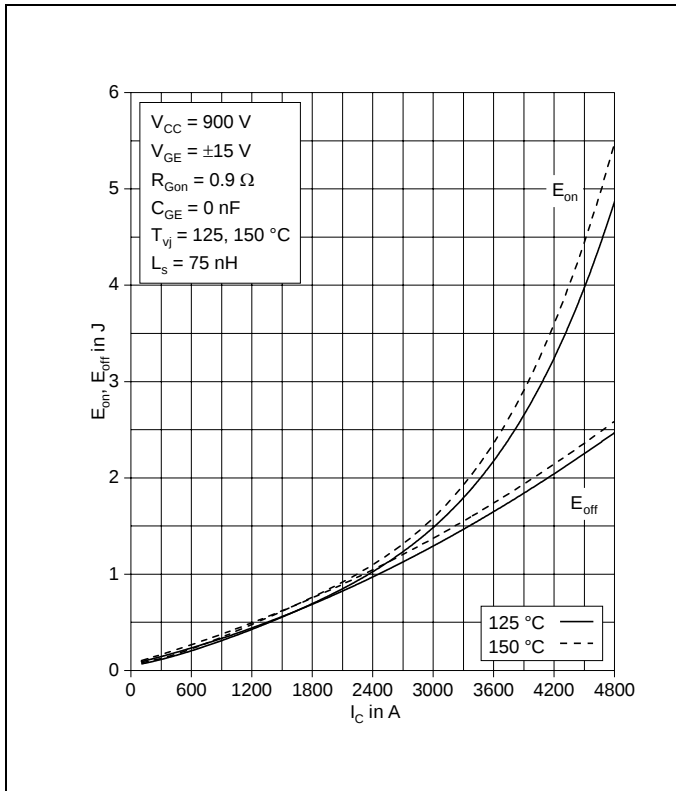


Fig. 5 Typical switching energies per pulse vs. collector current

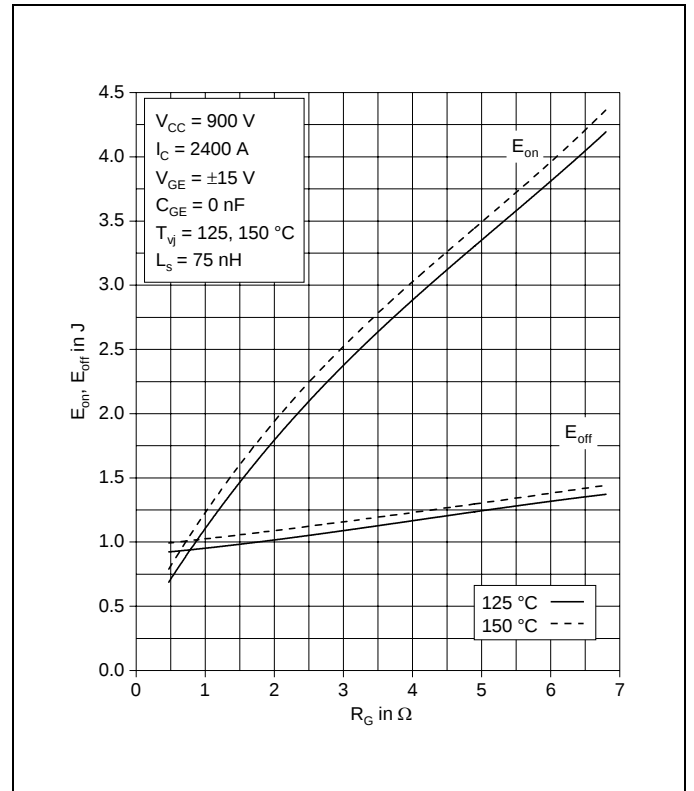


Fig. 6 Typical switching energies per pulse vs. gate resistor

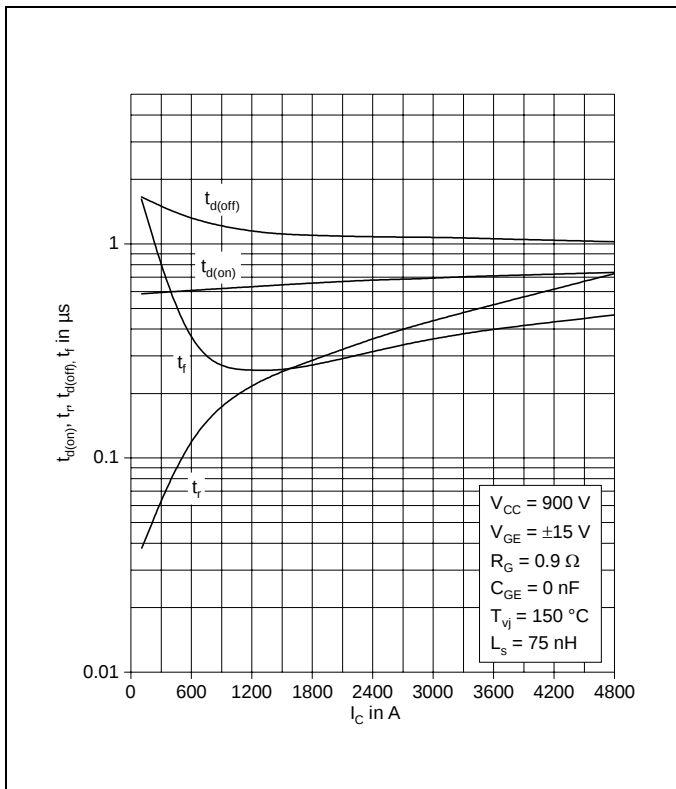


Fig. 7 Typical switching times vs. collector current

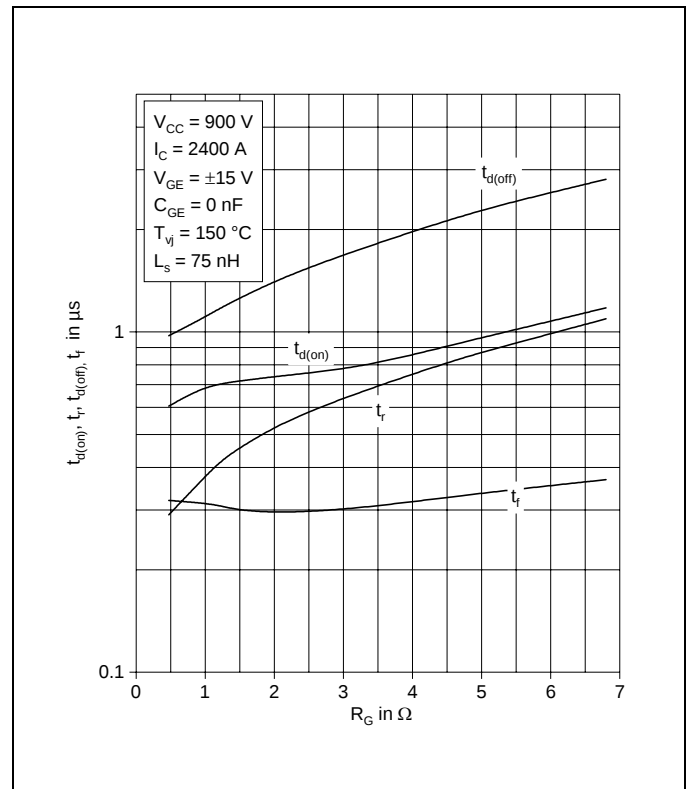


Fig. 8 Typical switching times vs. gate resistor

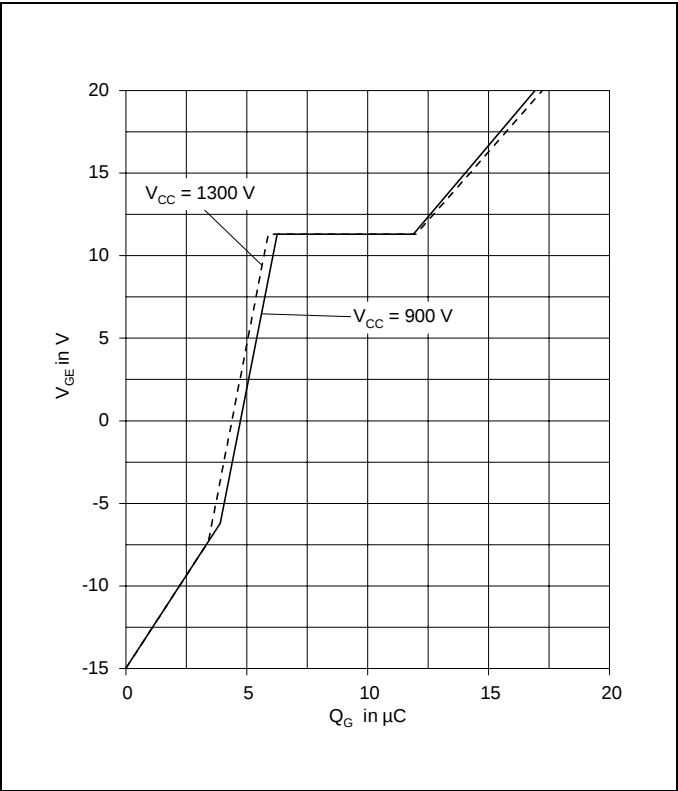


Fig. 9 Typical gate charge characteristics

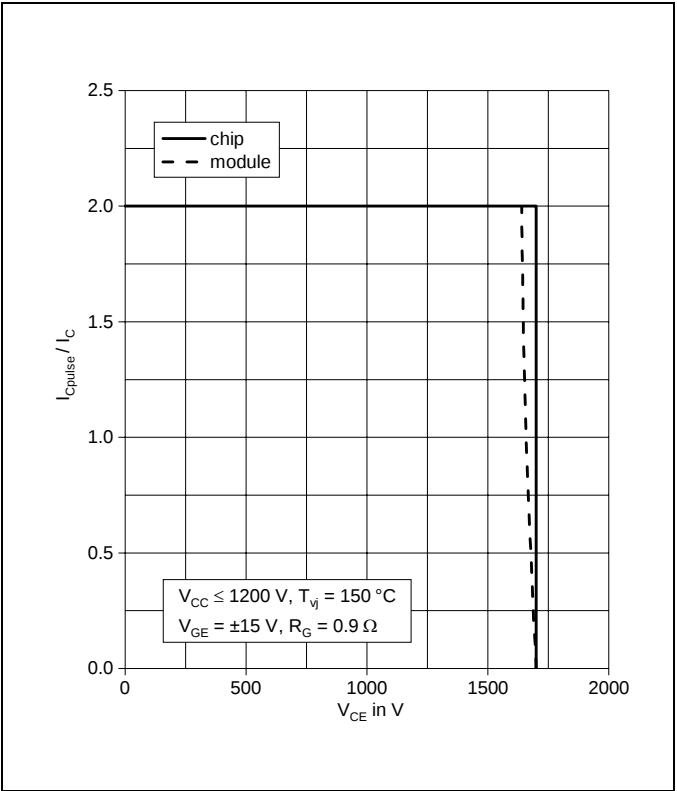


Fig. 10 Turn-off safe operating area (RBSOA)

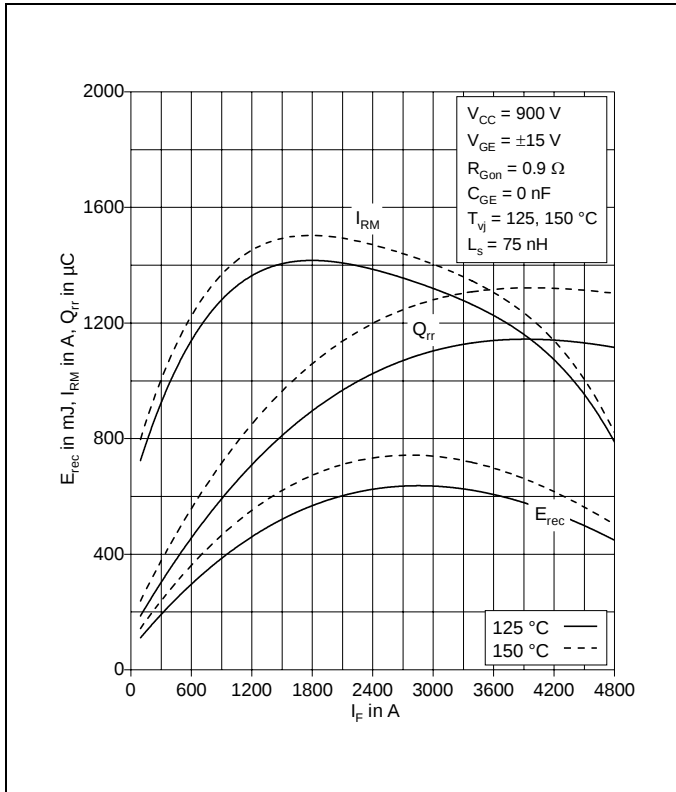


Fig. 11 Typical reverse recovery characteristics vs. forward current

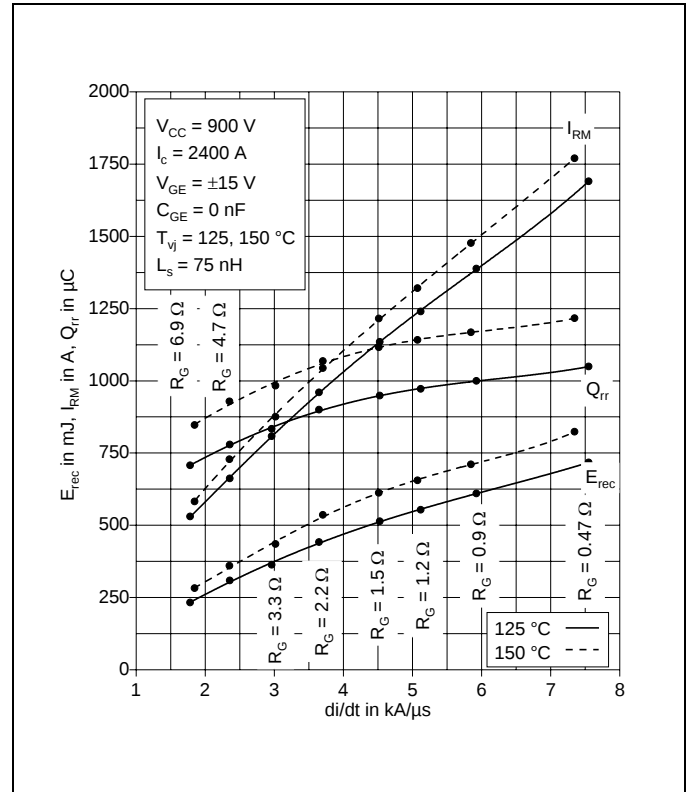


Fig. 12 Typical reverse recovery characteristics vs. di/dt

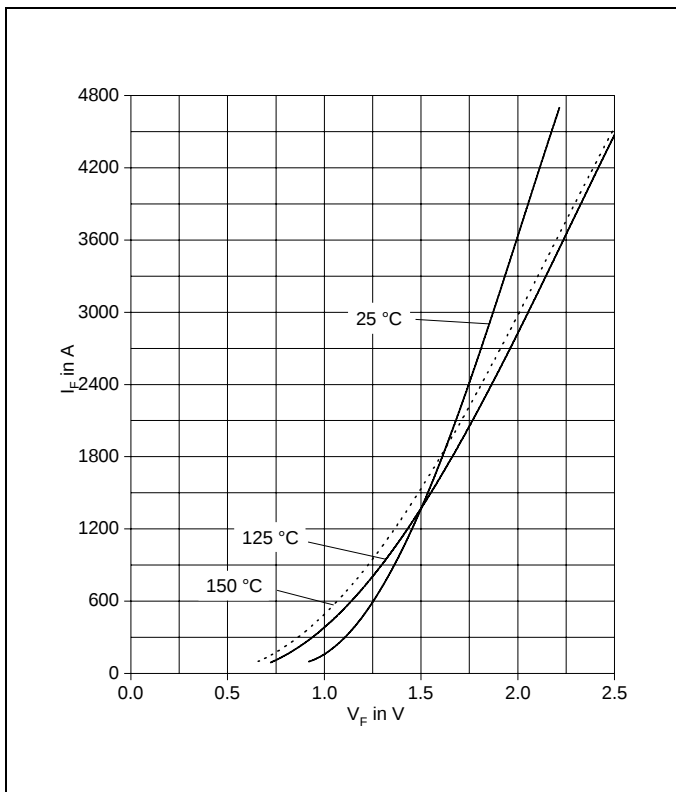


Fig. 13 Typical diode forward characteristics chip level

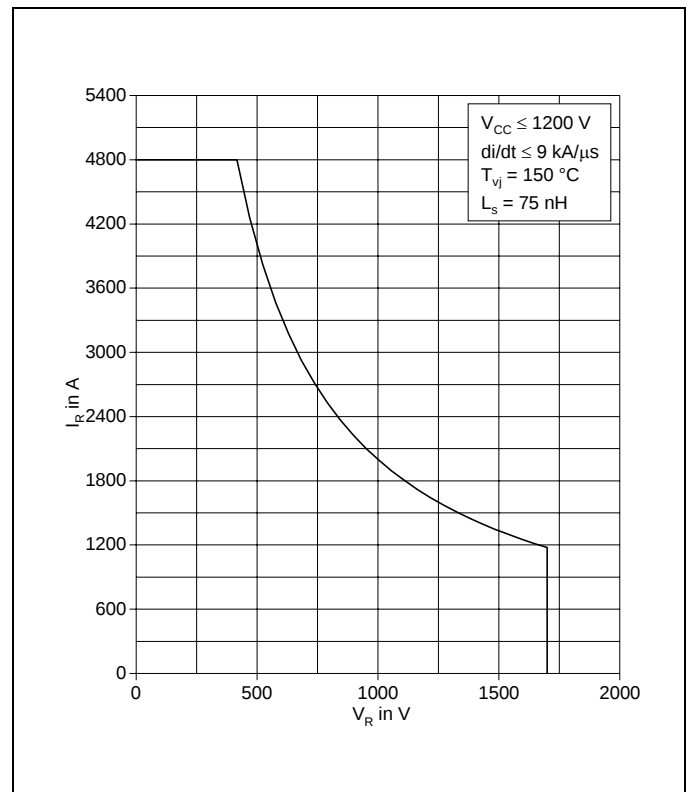


Fig. 14 Safe operating area diode (SOA)

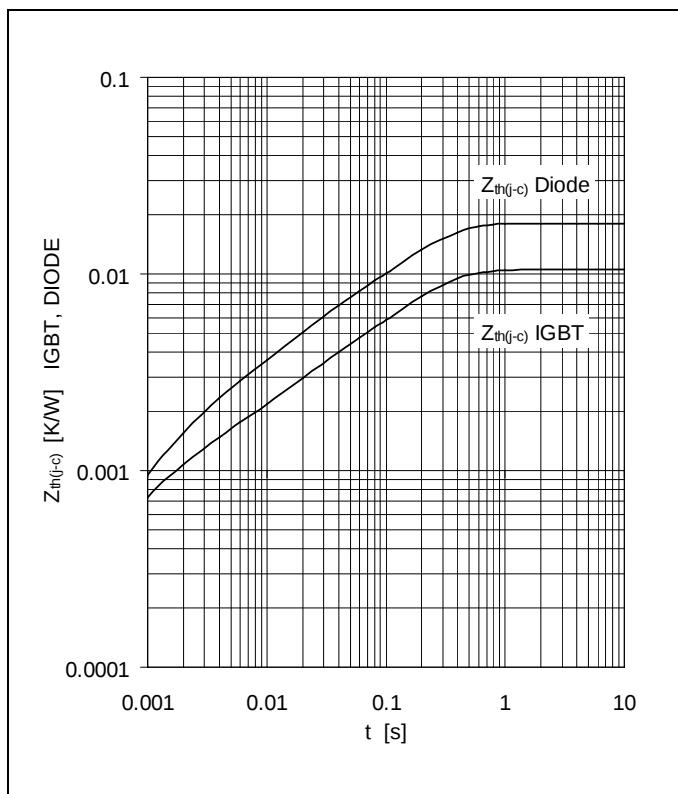


Fig. 15 Thermal impedance vs. time

Analytical function for transient thermal impedance:

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

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

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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