

5SNA 1500E250300

HiPak IGBT Module

$V_{CE} = 2500 \text{ V}$
 $I_C = 1500 \text{ A}$

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



Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	V_{CES}	$V_{GE} = 0 \text{ V}$, $T_{vj} \geq 25 \text{ °C}$		2500	V
DC collector current	I_C	$T_C = 100 \text{ °C}$, $T_{vj} = 150 \text{ °C}$		1500	A
Peak collector current	I_{CM}	$t_p = 1 \text{ ms}$		3000	A
Gate-emitter voltage	V_{GES}		-20	20	V
Total power dissipation	P_{tot}	$T_C = 25 \text{ °C}$, $T_{vj} = 150 \text{ °C}$		13800	W
DC forward current	I_F			1500	A
Peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$		3000	A
Surge current	I_{FSM}	$V_R = 0 \text{ V}$, $T_{vj} = 150 \text{ °C}$, $t_p = 10 \text{ ms}$, half-sinewave		10000	A
IGBT short circuit SOA	t_{psc}	$V_{CC} = 1800 \text{ V}$, $V_{CEM \text{ CHIP}} \leq 2500 \text{ V}$ $V_{GE} \leq 15 \text{ V}$, $T_{vj} \leq 150 \text{ °C}$		10	μs
Isolation voltage	V_{isol}	1 min, $f = 50 \text{ Hz}$		5000	V
Junction temperature	T_{vj}			150	$^{\circ}\text{C}$
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 ABB Document No. 5SYA 2039

IGBT characteristic values ³⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Collector (-emitter) breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0 \text{ V}$, $I_C = 10 \text{ mA}$, $T_{vj} = 25 \text{ }^\circ\text{C}$	2500			V
Collector-emitter ⁴⁾ saturation voltage	$V_{CE \text{ sat}}$	$I_C = 1500 \text{ A}$, $V_{GE} = 15 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	2.0		V
			$T_{vj} = 125 \text{ }^\circ\text{C}$	2.5		V
			$T_{vj} = 150 \text{ }^\circ\text{C}$	2.6		V
Collector cut-off current	I_{CES}	$V_{CE} = 2500 \text{ V}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		1	mA
			$T_{vj} = 125 \text{ }^\circ\text{C}$	8	16	mA
			$T_{vj} = 150 \text{ }^\circ\text{C}$	42		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	$V_{GE(TO)}$	$I_C = 240 \text{ mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25 \text{ }^\circ\text{C}$	4.9		6.9	V
Gate charge	Q_{ge}	$I_C = 1500 \text{ A}$, $V_{CE} = 1250 \text{ V}$, $V_{GE} = -15 \text{ V} \dots 15 \text{ V}$		12.1		μC
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 1 \text{ MHz}$, $T_{vj} = 25 \text{ }^\circ\text{C}$		184		nF
Output capacitance	C_{oes}			12.5		nF
Reverse transfer capacitance	C_{res}			4.7		nF
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 1250 \text{ V}$, $I_C = 1500 \text{ A}$, $R_G = 2.2 \text{ } \Omega$, $C_{GE} = 0 \text{ nF}$, $V_{GE} = \pm 15 \text{ V}$, $L_\sigma = 100 \text{ nH}$, inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$	560		ns
			$T_{vj} = 125 \text{ }^\circ\text{C}$	550		ns
			$T_{vj} = 150 \text{ }^\circ\text{C}$	540		ns
Rise time	t_r	$V_{CC} = 1250 \text{ V}$, $I_C = 1500 \text{ A}$, $R_G = 2.2 \text{ } \Omega$, $C_{GE} = 0 \text{ nF}$, $V_{GE} = \pm 15 \text{ V}$, $L_\sigma = 100 \text{ nH}$, inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$	330		ns
			$T_{vj} = 125 \text{ }^\circ\text{C}$	340		ns
			$T_{vj} = 150 \text{ }^\circ\text{C}$	350		ns
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 1250 \text{ V}$, $I_C = 1500 \text{ A}$, $R_G = 1.5 \text{ } \Omega$, $C_{GE} = 0 \text{ nF}$, $V_{GE} = \pm 15 \text{ V}$, $L_\sigma = 100 \text{ nH}$, inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$	1290		ns
			$T_{vj} = 125 \text{ }^\circ\text{C}$	1430		ns
			$T_{vj} = 150 \text{ }^\circ\text{C}$	1440		ns
Fall time	t_f	$V_{CC} = 1250 \text{ V}$, $I_C = 1500 \text{ A}$, $R_G = 1.5 \text{ } \Omega$, $C_{GE} = 0 \text{ nF}$, $V_{GE} = \pm 15 \text{ V}$, $L_\sigma = 100 \text{ nH}$, inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$	450		ns
			$T_{vj} = 125 \text{ }^\circ\text{C}$	490		ns
			$T_{vj} = 150 \text{ }^\circ\text{C}$	500		ns
Turn-on switching energy	E_{on}	$V_{CC} = 1250 \text{ V}$, $I_C = 1500 \text{ A}$, $R_G = 2.2 \text{ } \Omega$, $C_{GE} = 0 \text{ nF}$, $V_{GE} = \pm 15 \text{ V}$, $L_\sigma = 100 \text{ nH}$, inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$	1070		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	1440		mJ
			$T_{vj} = 150 \text{ }^\circ\text{C}$	1530		mJ
Turn-off switching energy	E_{off}	$V_{CC} = 1250 \text{ V}$, $I_C = 1500 \text{ A}$, $R_G = 1.5 \text{ } \Omega$, $C_{GE} = 0 \text{ nF}$, $V_{GE} = \pm 15 \text{ V}$, $L_\sigma = 100 \text{ nH}$, inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$	1790		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	2200		mJ
			$T_{vj} = 150 \text{ }^\circ\text{C}$	2250		mJ
Short circuit current	I_{SC}	$t_{psc} \leq 10 \text{ } \mu\text{s}$, $V_{GE} = 15 \text{ V}$, $V_{CC} = 1800 \text{ V}$, $V_{CEM \text{ CHIP}} \leq 2500 \text{ V}$	$T_{vj} = 150 \text{ }^\circ\text{C}$	6000		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	$I_F = 1500 \text{ A}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	1.95		V
			$T_{vj} = 125 \text{ }^\circ\text{C}$	1.95		V
			$T_{vj} = 150 \text{ }^\circ\text{C}$	1.9		V
Reverse recovery current	I_{rr}		$T_{vj} = 25 \text{ }^\circ\text{C}$	1050		A
			$T_{vj} = 125 \text{ }^\circ\text{C}$	1330		A
			$T_{vj} = 150 \text{ }^\circ\text{C}$	1420		A
Recovered charge	Q_{rr}	$V_{CC} = 1250 \text{ V},$ $I_F = 1500 \text{ A},$ $V_{GE} = \pm 15 \text{ V},$ $R_G = 2.2 \text{ } \Omega, C_{GE} = 0 \text{ nF},$ $di/dt = 4.7 \text{ kA}/\mu\text{s}$ $L_\sigma = 100 \text{ nH}, \text{ inductive load}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	640		μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$	1160		μC
			$T_{vj} = 150 \text{ }^\circ\text{C}$	1390		μC
Reverse recovery time	t_{rr}		$T_{vj} = 25 \text{ }^\circ\text{C}$	590		ns
			$T_{vj} = 125 \text{ }^\circ\text{C}$	1320		ns
			$T_{vj} = 150 \text{ }^\circ\text{C}$	1400		ns
Reverse recovery energy	E_{rec}		$T_{vj} = 25 \text{ }^\circ\text{C}$	560		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	1050		mJ
			$T_{vj} = 150 \text{ }^\circ\text{C}$	1250		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	$R_{th(j-c)IGBT}$				0.009	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.017	K/W
IGBT thermal resistance ²⁾ case to heatsink	$R_{th(c-s)IGBT}$	IGBT per switch, λ grease = 1W/m x K		0.009		K/W
Diode thermal resistance ²⁾ case to heatsink	$R_{th(c-s)DIODE}$	Diode per switch, λ grease = 1W/m x K		0.018		K/W
Comparative tracking index	CTI			> 600		
Module stray inductance	$L_{\sigma CE}$			8		nH
Resistance, terminal-chip	$R_{CC' \rightarrow EE'}$		$T_C = 25 \text{ }^\circ\text{C}$	0.055		m Ω
			$T_C = 125 \text{ }^\circ\text{C}$	0.075		
			$T_C = 150 \text{ }^\circ\text{C}$	0.080		

²⁾ For detailed mounting instructions refer to ABB 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:	23		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

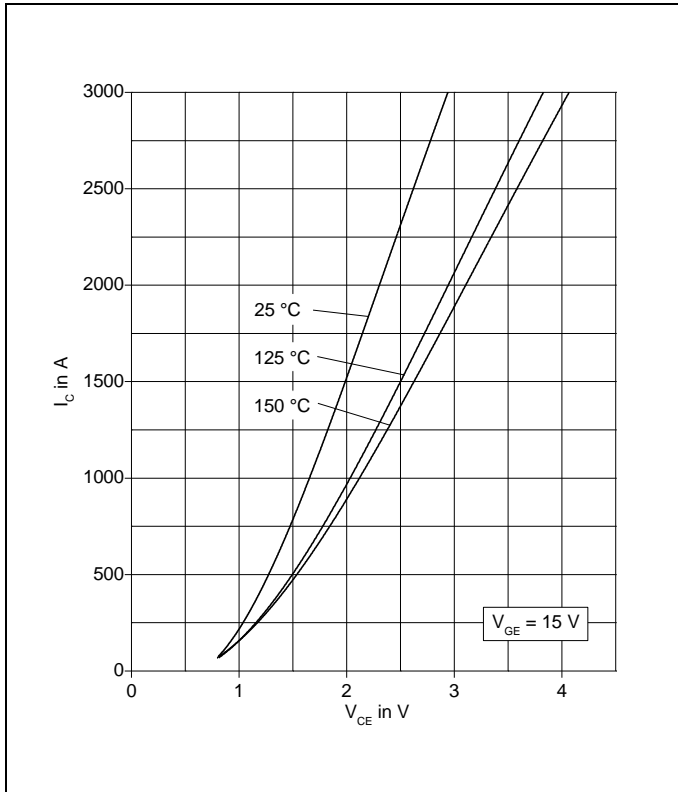


Fig. 1 Typical on-state characteristics, chip level

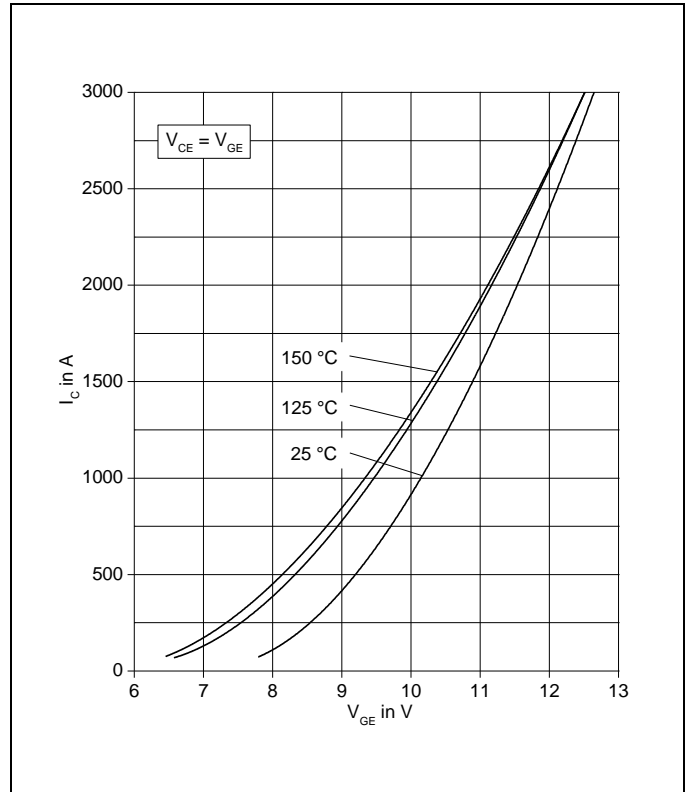


Fig. 2 Typical transfer characteristics, chip level

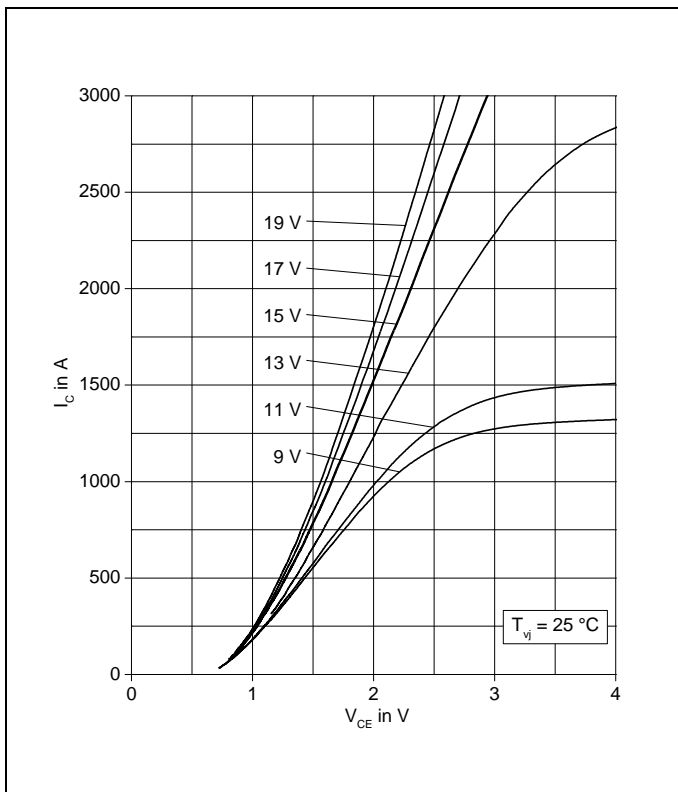


Fig. 3 Typical output characteristics, chip level

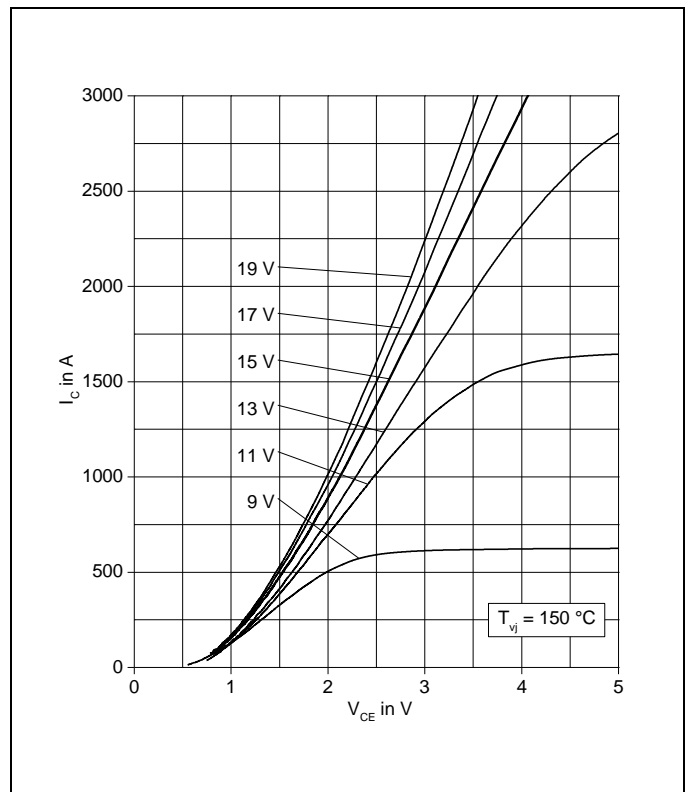


Fig. 4 Typical output characteristics, chip level

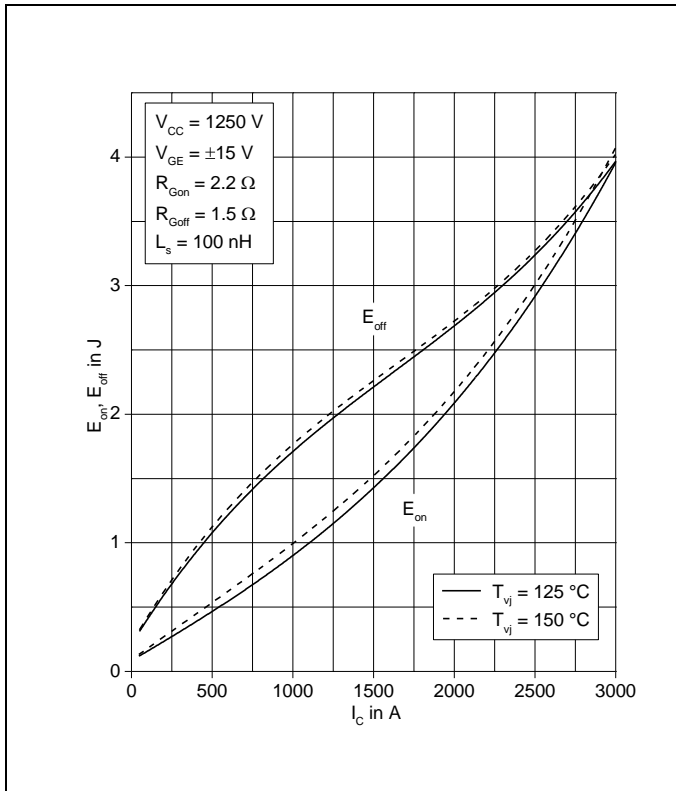


Fig. 5 Typical switching energies per pulse vs. collector current

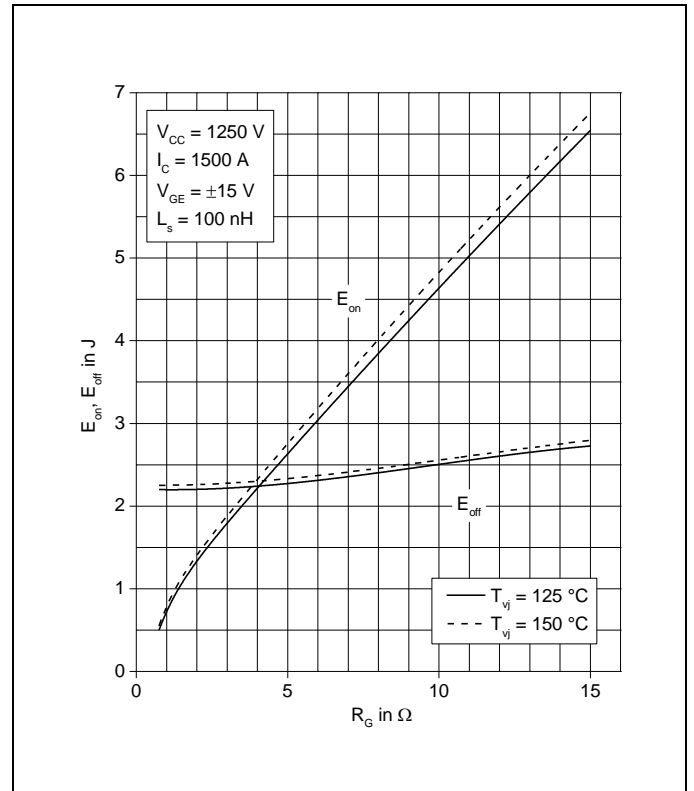


Fig. 6 Typical switching energies per pulse vs. gate resistor

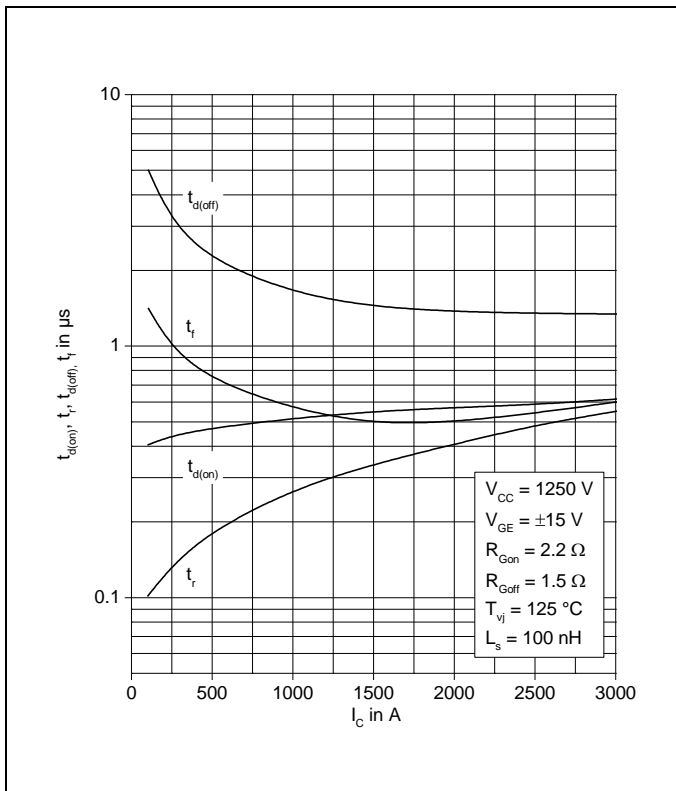


Fig. 7 Typical switching times vs. collector current

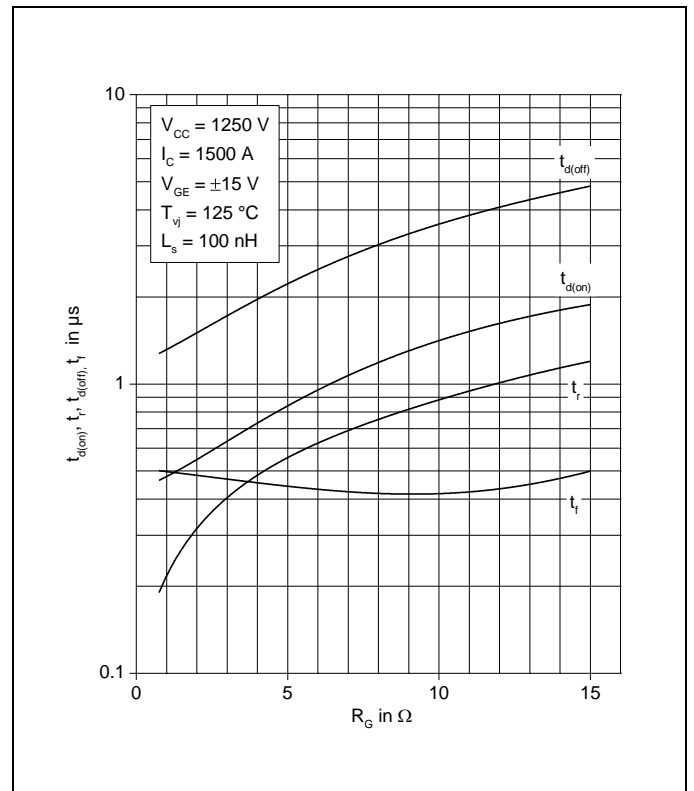


Fig. 8 Typical switching times vs. gate resistor

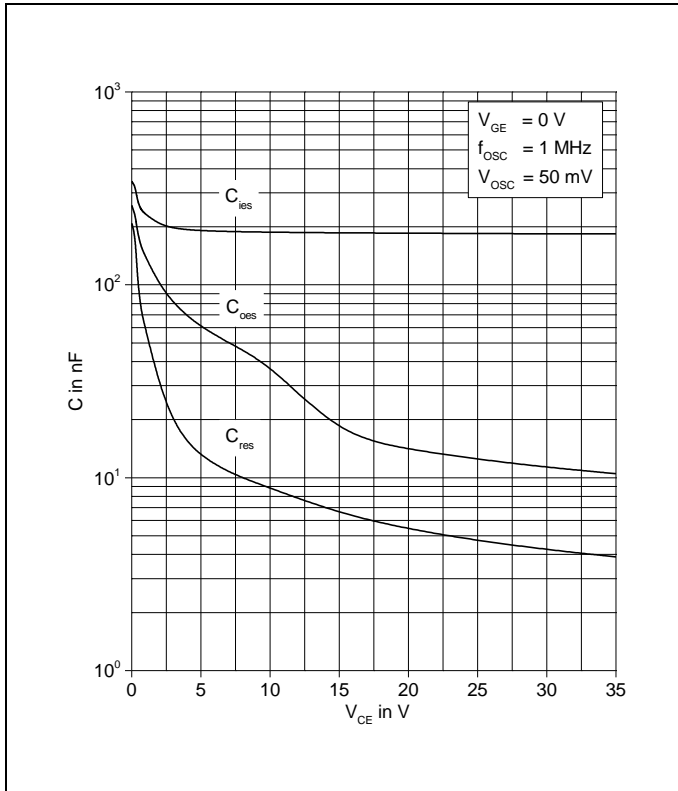


Fig. 9 Typical capacitances vs. collector-emitter voltage

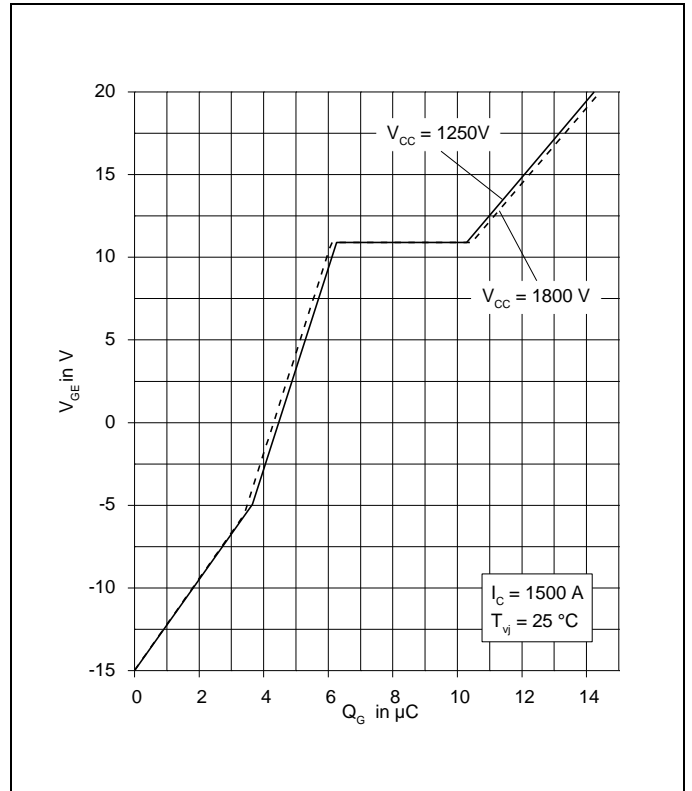


Fig. 10 Typical gate charge characteristics

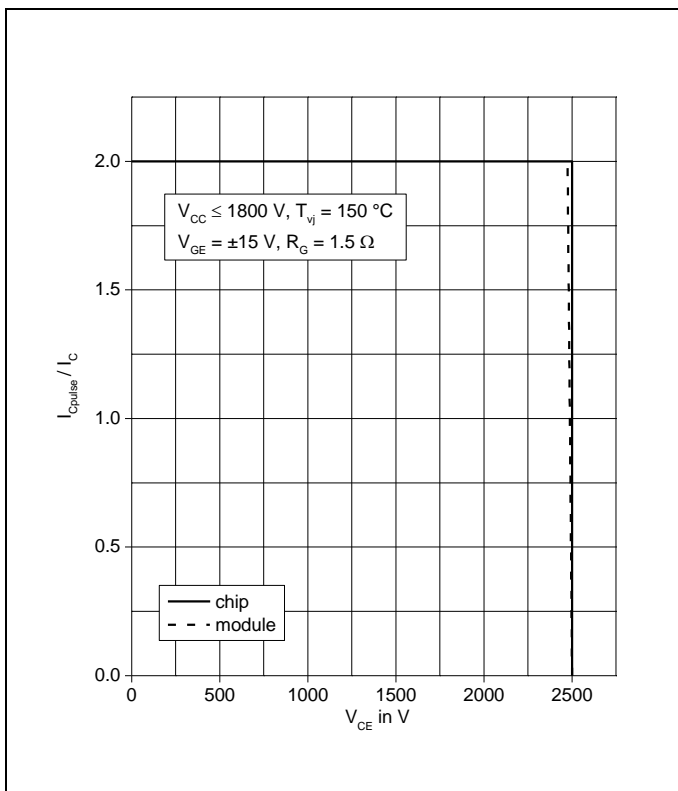


Fig. 11 Turn-off safe operating area (RBSOA)

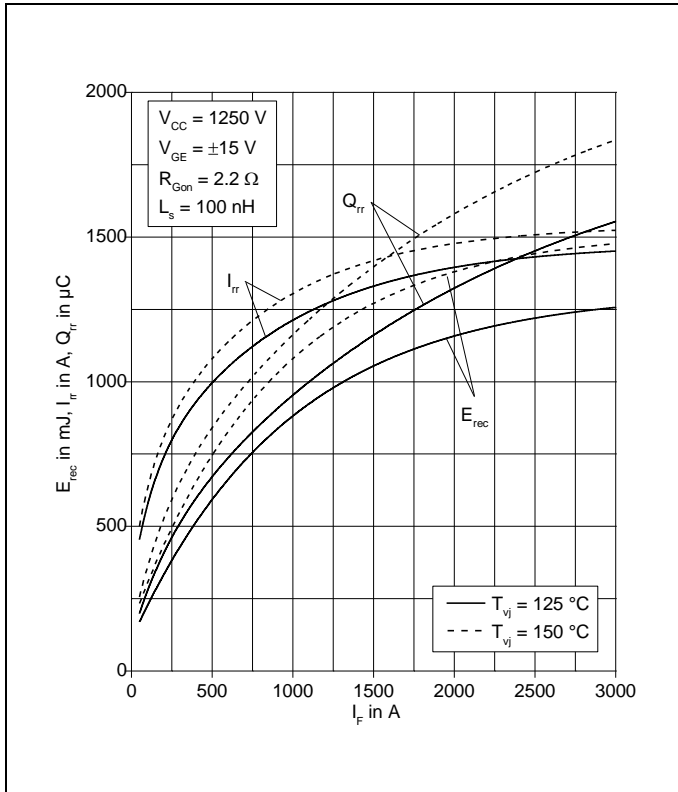


Fig. 12 Typical reverse recovery characteristics vs. forward current

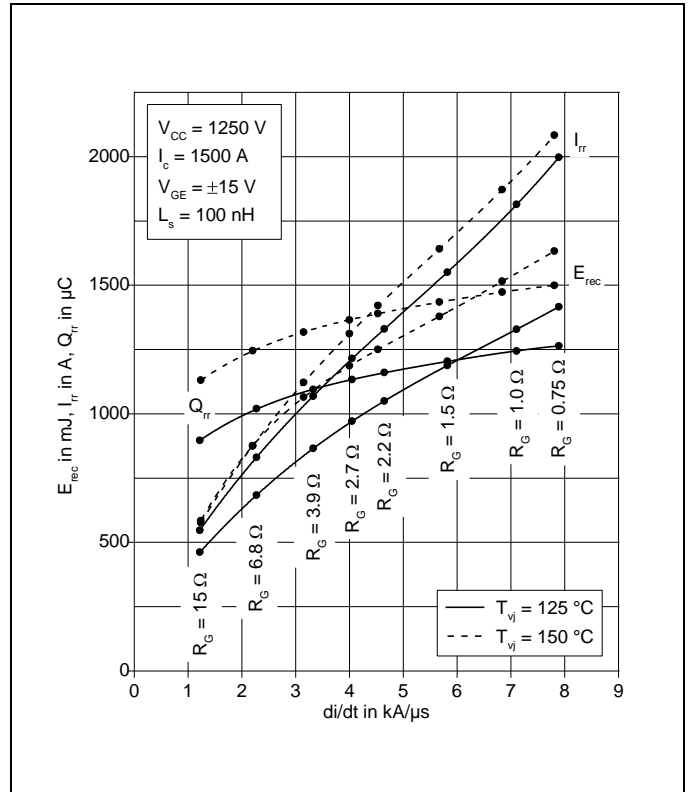


Fig. 13 Typical reverse recovery characteristics vs. di/dt

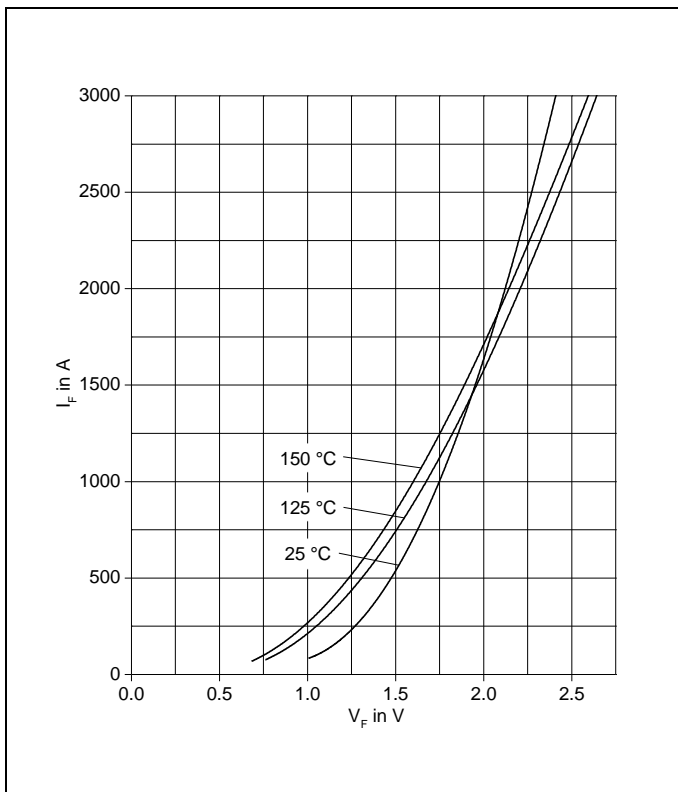


Fig. 14 Typical diode forward characteristics chip level

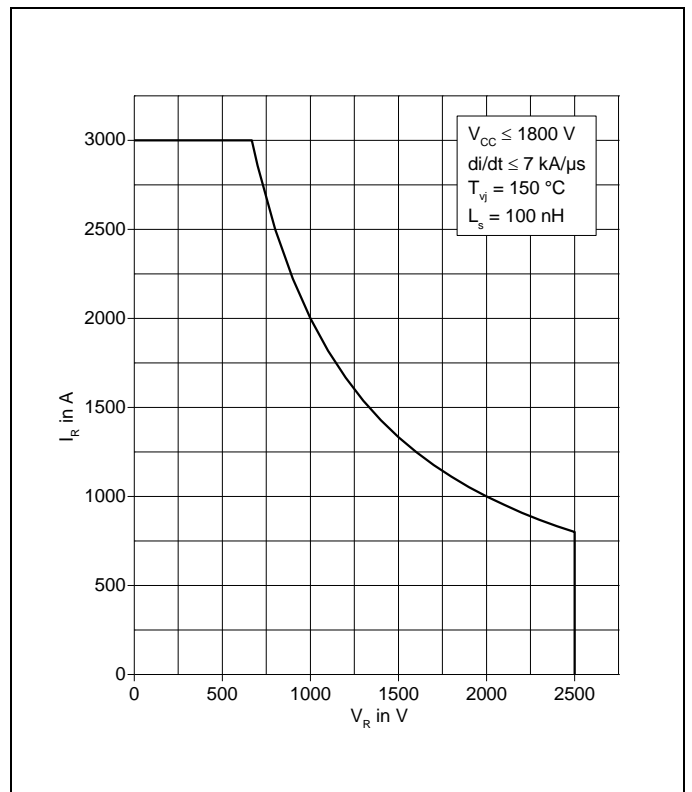


Fig. 15 Safe operating area diode (SOA)

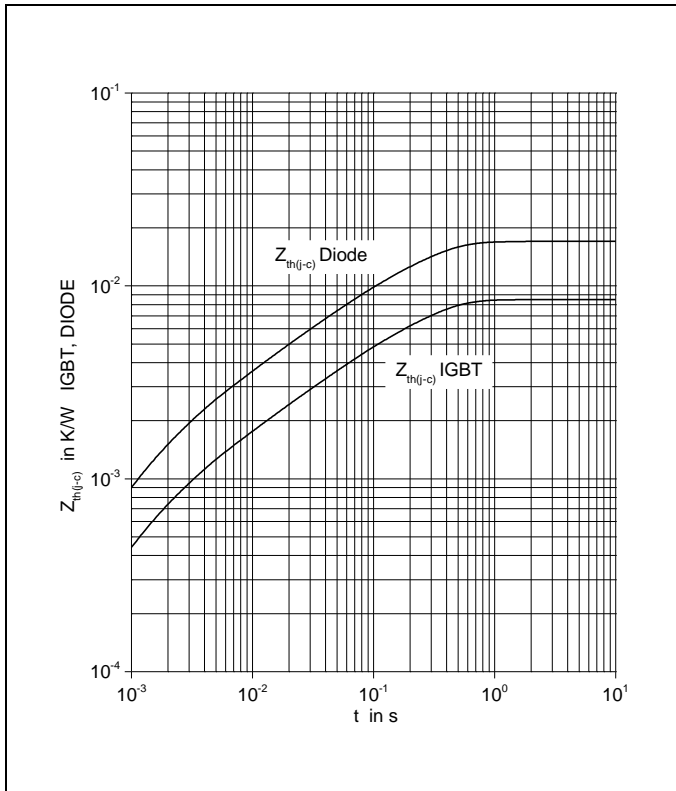


Fig. 16 Thermal impedance vs. time

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	Ri(K/kW)	6.287	1.685	0.685	0.337	
	τ_i (ms)	194.7	20.4	1.98	0.52	
DIODE	Ri(K/kW)	11.54	2.92	1.28	1.27	
	τ_i (ms)	203.4	29.3	6.96	1.5	

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 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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