5SNE 1000E330300
HiPak Chopper IGBT Module

V_{CE} = 3300 V
I_C = 1000 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 V, T_{vj} ≥ 25 °C		3300	V
DC collector current	I_C	T_C = 100 °C, T_{vj} = 150 °C		1000	A
Peak collector current	I_{CM}	t_p = 1 ms		2000	A
Gate-emitter voltage	V_{GES}		-20	20	V
Total power dissipation	P_{tot}	T_C = 25 °C, T_{vj} = 150 °C, per switch		9800	W
DC forward current	I_F			1000	A
Peak forward current	I_{FRM}	t_p = 1 ms		2000	A
Surge current	I_{FSM}	V_R = 0 V, T_{vj} = 150 °C, t_p = 10 ms, half-sinewave		9000	A
IGBT short circuit SOA	t_{psc}	V_{CC} = 2500 V, $V_{CEM\ CHIP}$ ≤ 3300 V V_{GE} ≤ 15 V, T_{vj} ≤ 150 °C		10	µs
Isolation voltage	V_{isol}	1 min, f = 50 Hz		6000	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 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	$t_{d(off)}$	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		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 Hz, $Q_{PD} \leq$ 10 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 °C		0.083		mΩ
			T_C = 125 °C		0.113		
			T_C = 150 °C		0.120		

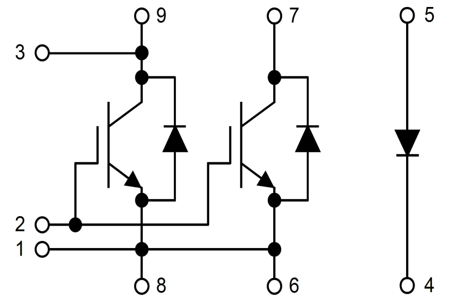
2) For detailed mounting instructions refer to Document No. 5SYA 2039

Mechanical properties [7)]

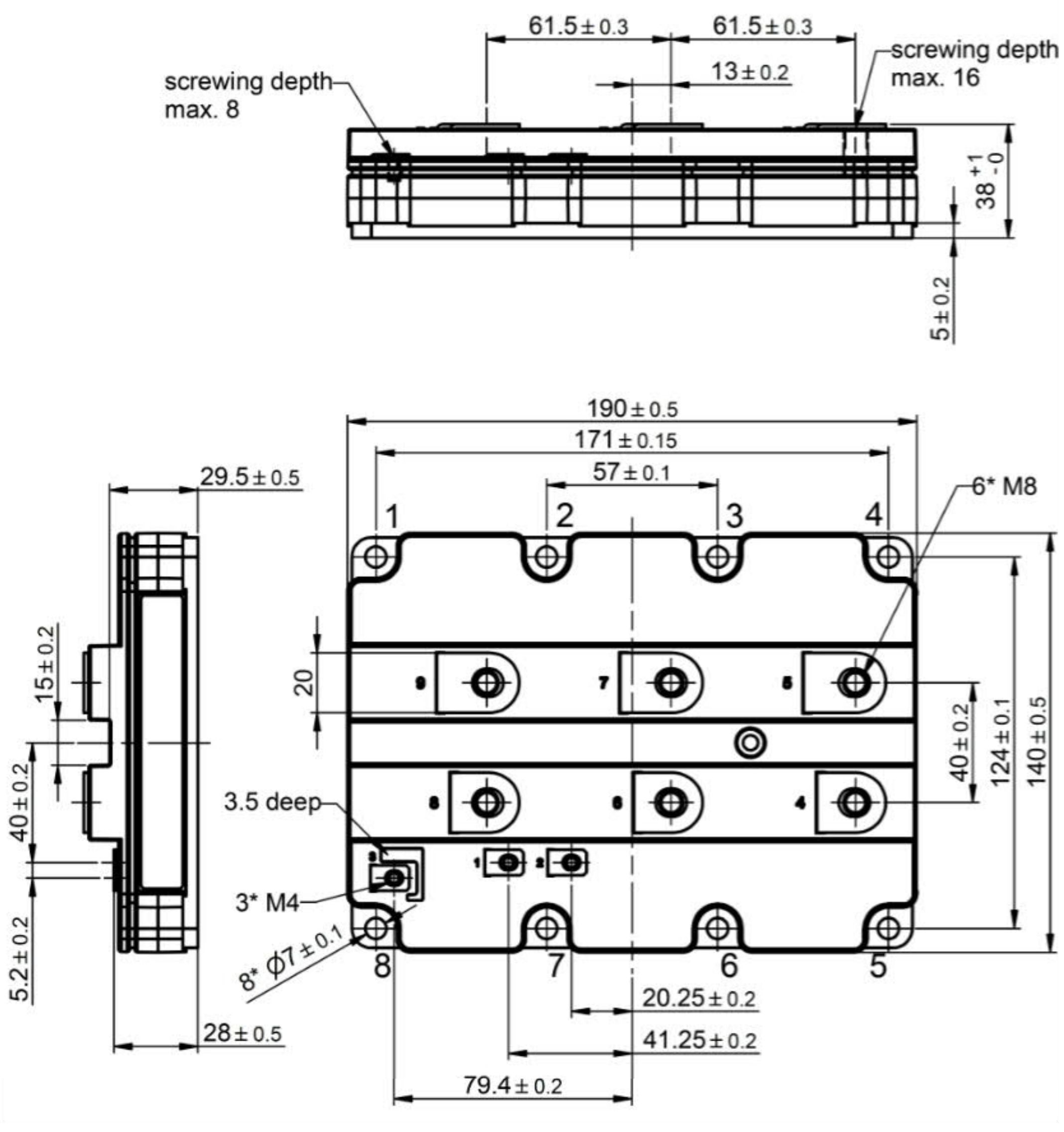
Parameter	Symbol	Conditions		min	typ	max	Unit
Dimensions	L x W x H	Typical			190 x 140 x 38		mm
Clearance distance in air	d_a	according to IEC 60664-1 and EN 50124-1	Term. to base:	19			mm
			Term. to term:	19			
Surface creepage distance	d_s	according to IEC 60664-1 and EN 50124-1	Term. to base:	28.2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

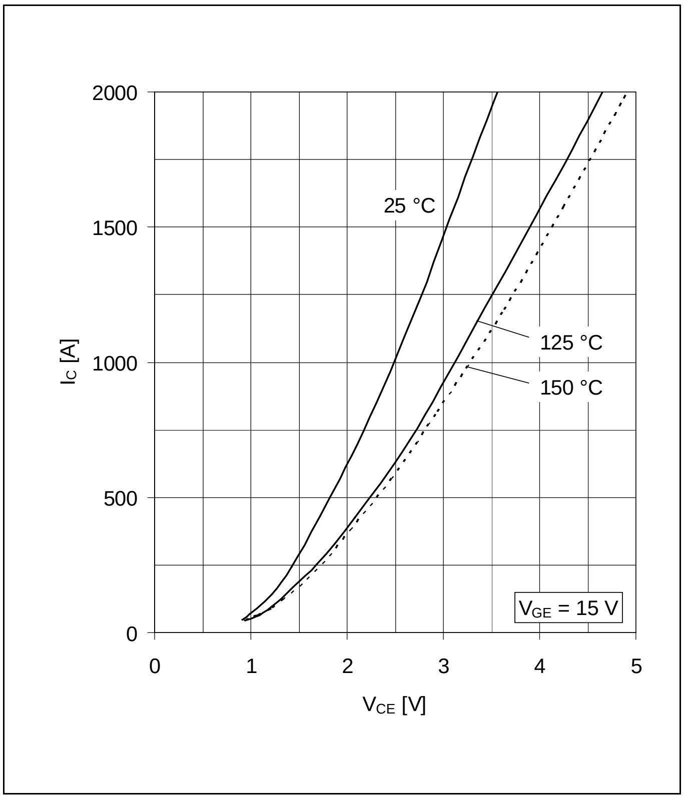


Fig. 1 Typical on-state characteristics, chip level

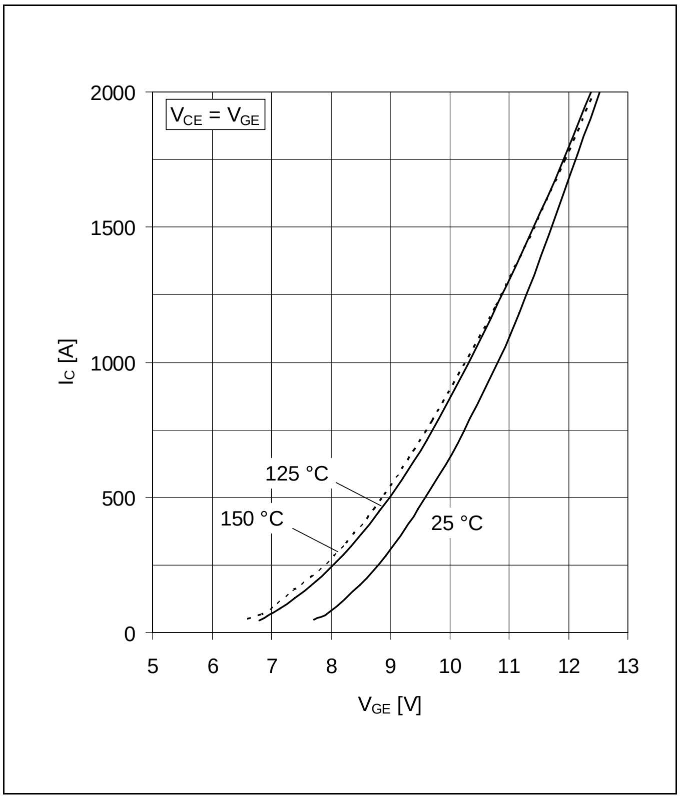


Fig. 2 Typical transfer characteristics, chip level

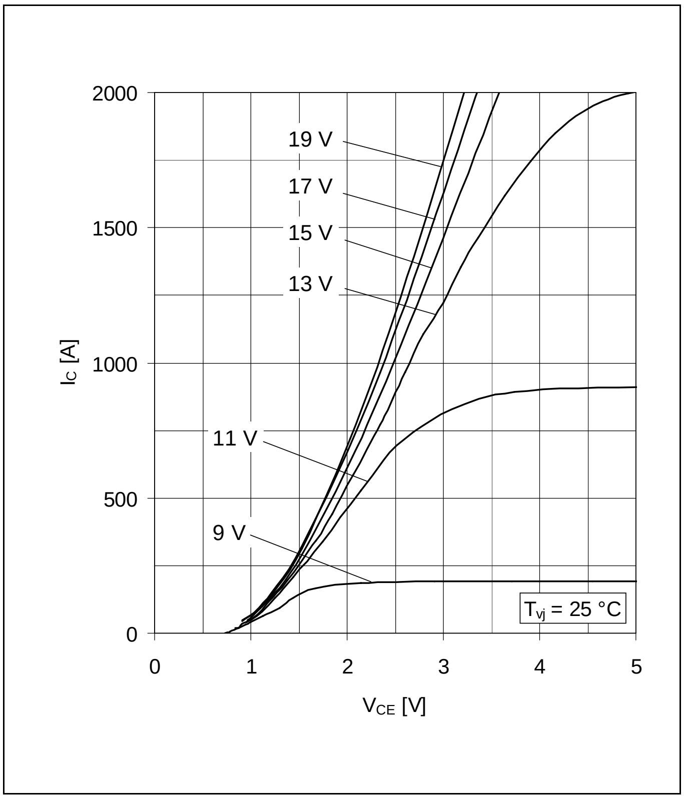


Fig. 3 Typical output characteristics, chip level

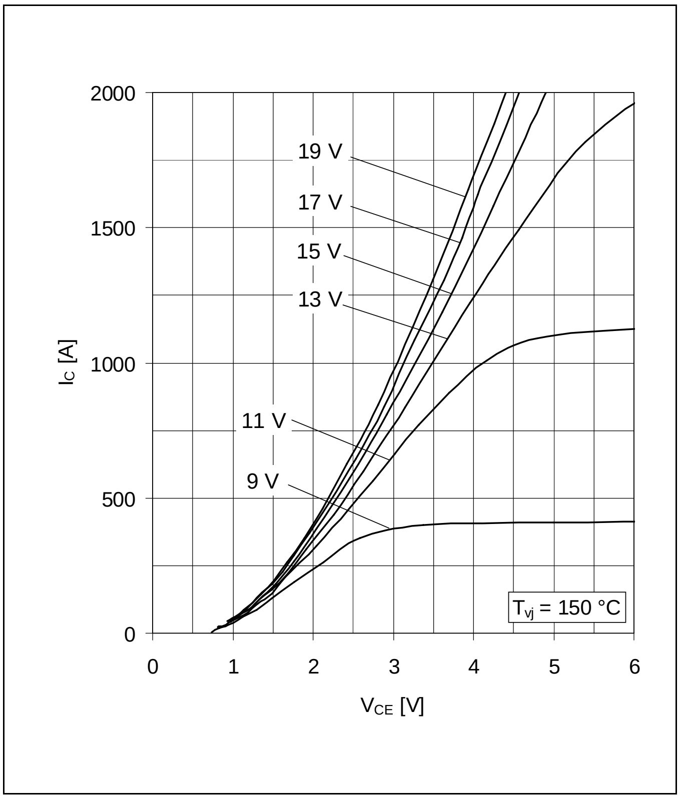


Fig. 4 Typical output characteristics, chip level

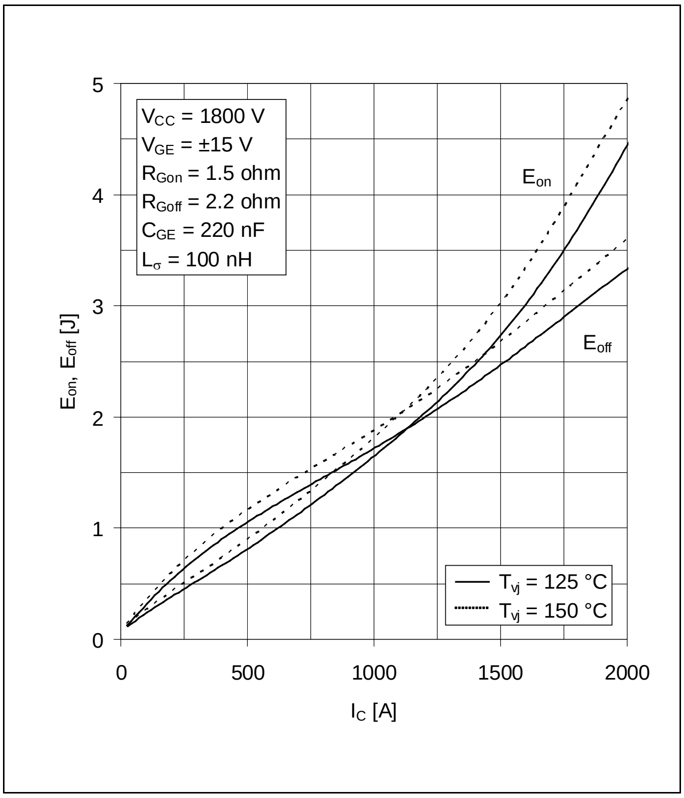


Fig. 5 Typical switching energies per pulse vs. collector current

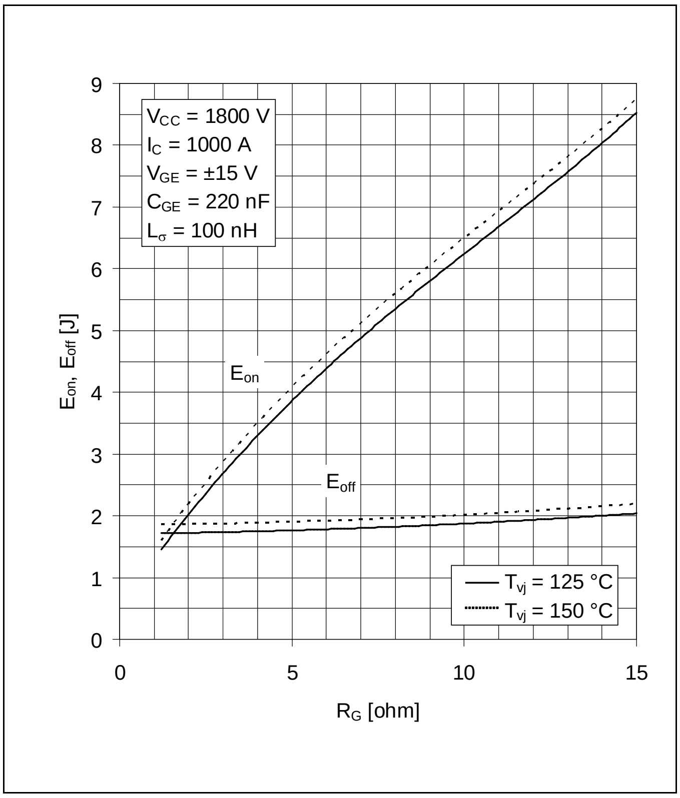


Fig. 6 Typical switching energies per pulse vs. gate resistor

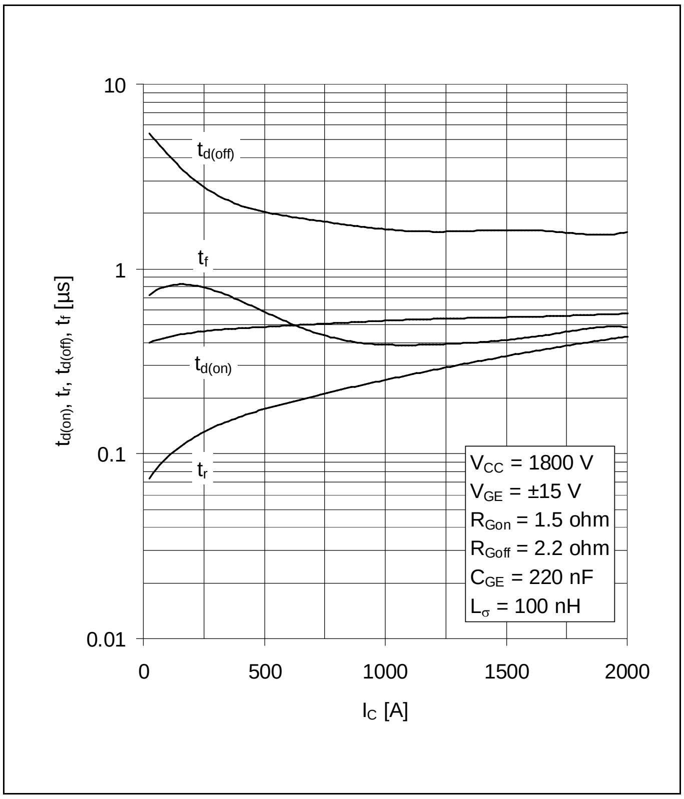


Fig. 7 Typical switching times vs. collector current

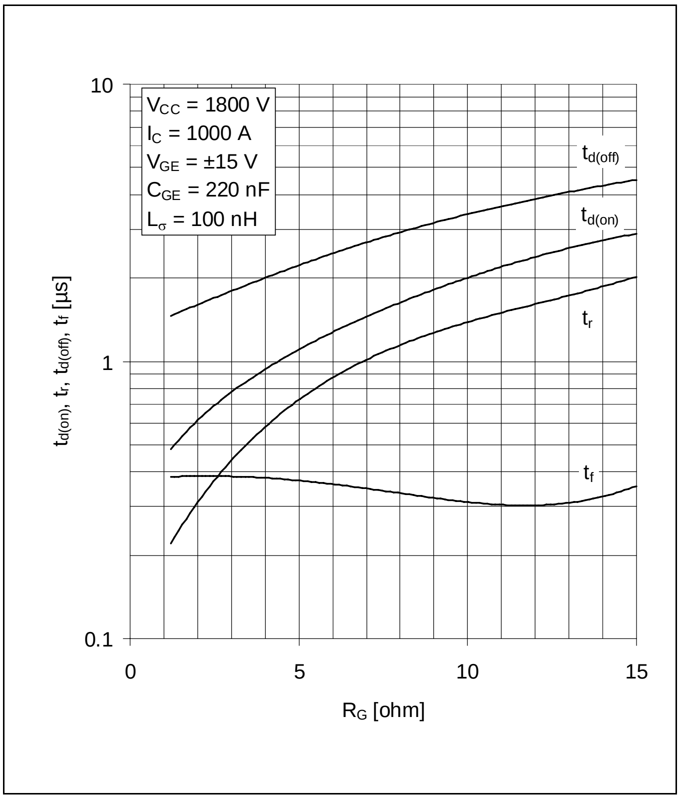


Fig. 8 Typical switching times vs. gate resistor

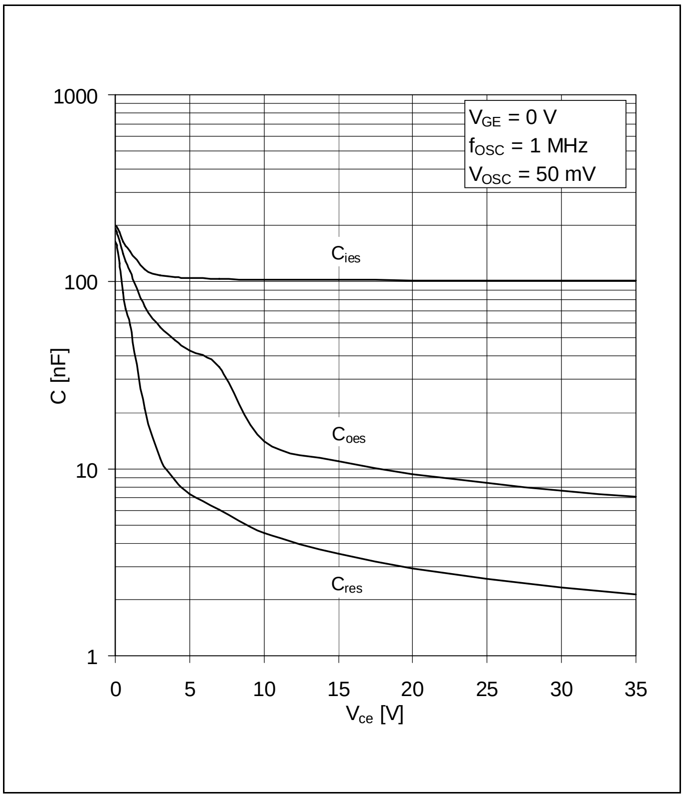


Fig. 9 Typical capacitances vs. collector-emitter voltage

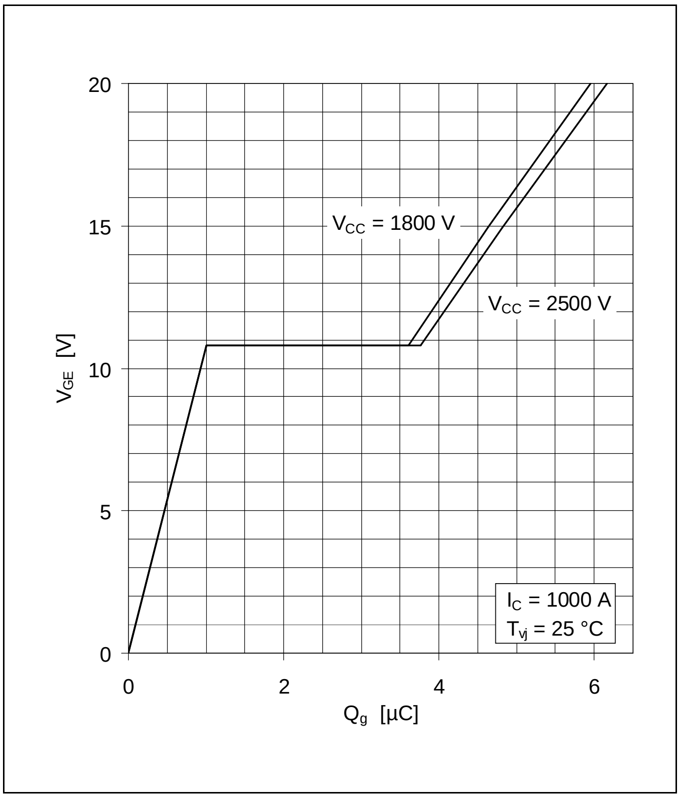


Fig. 10 Typical gate charge characteristics

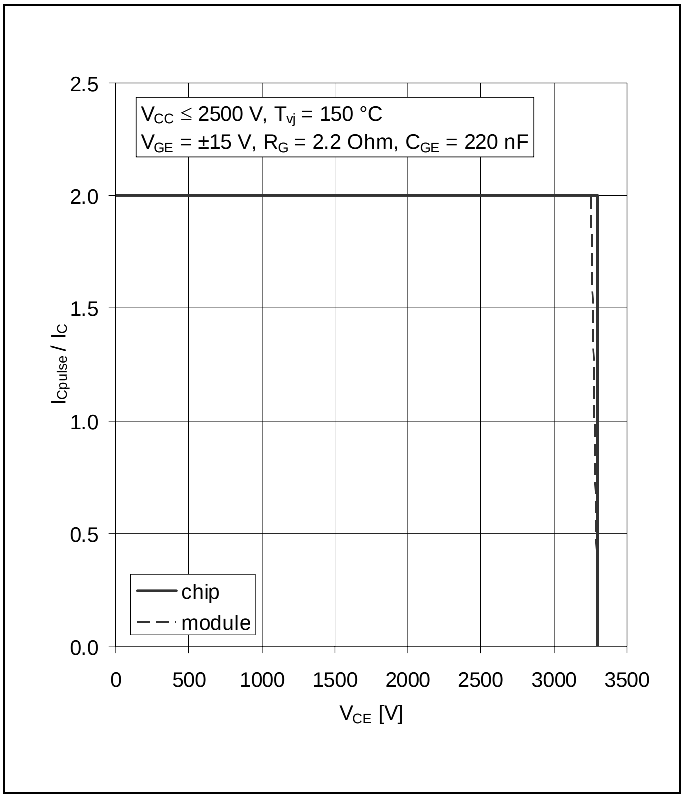


Fig. 11 Turn-off safe operating area (RBSOA)

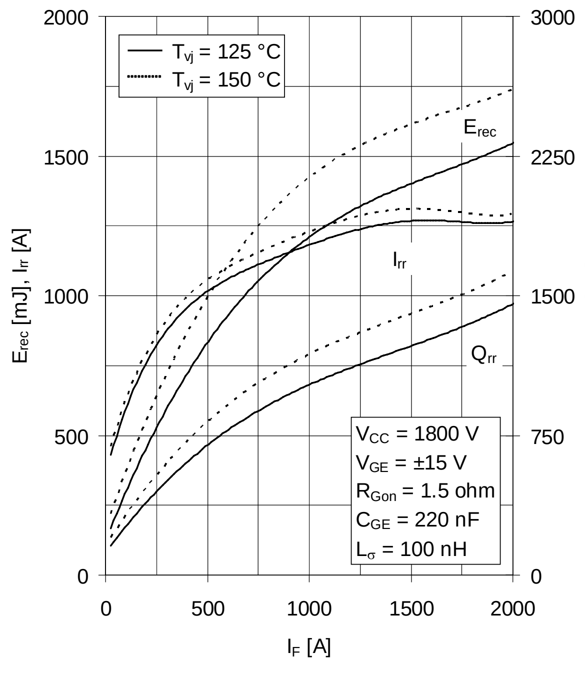


Fig. 12 Typical reverse recovery characteristics vs. forward current

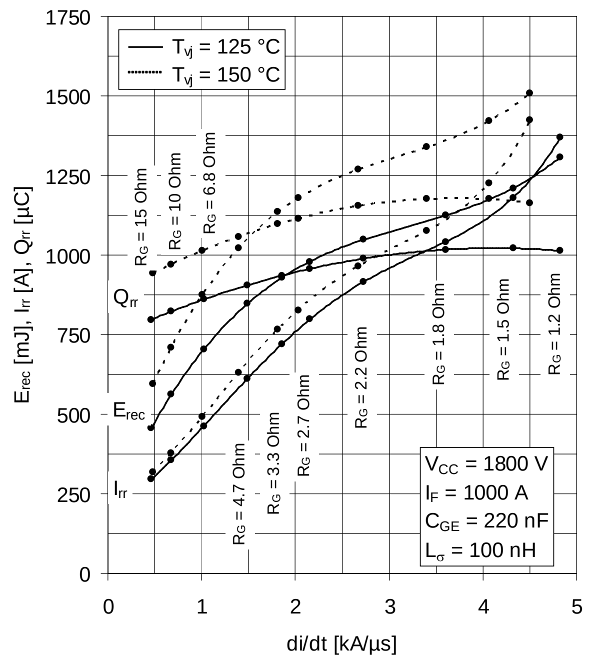


Fig. 13 Typical reverse recovery characteristics vs. di/dt

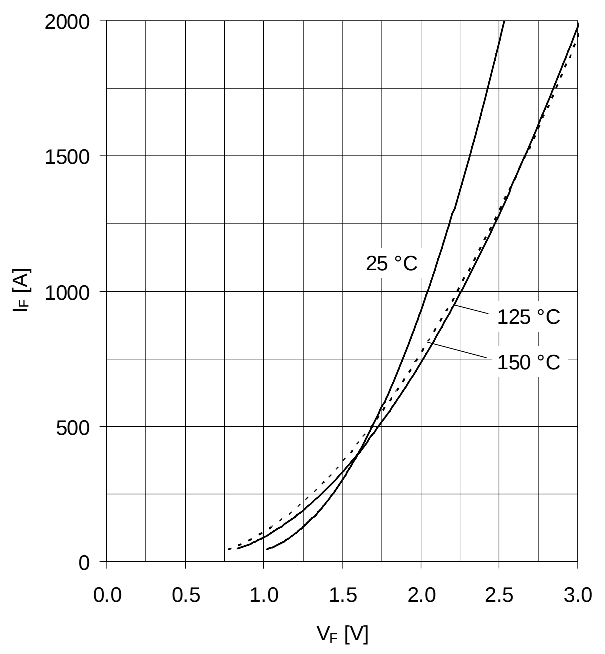


Fig. 14 Typicial diode forward characteristics chip level

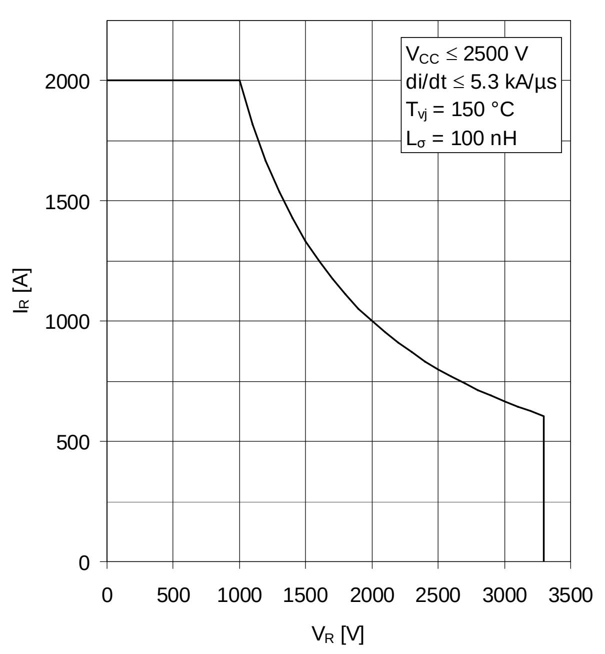


Fig. 15 Safe operating area diode (SOA)

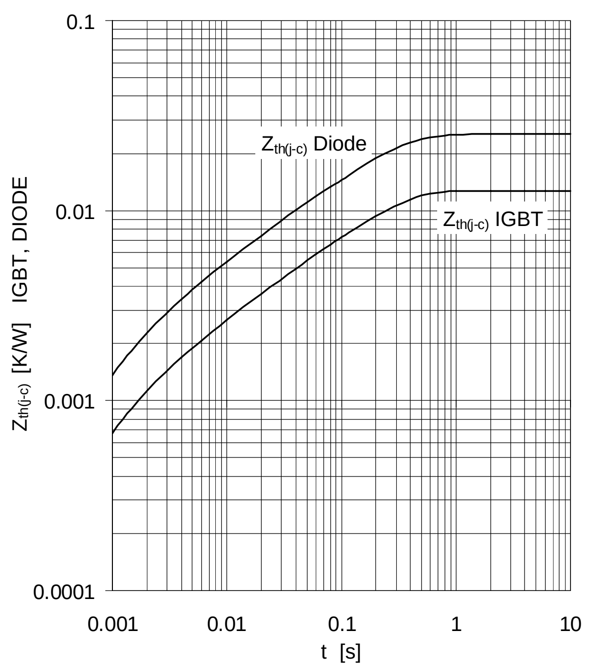


Fig. 16 Thermal impedance vs. time

Analytical function for transient thermal impedance:

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

	i	1	2	3	4	5
IGBT	R_i(K/kW)	8.78	2.06	0.961	0.948	
	τ_i(ms)	207.4	30.1	7.55	1.57	
DIODE	R_i(K/kW)	17.1	4.28	1.92	1.92	
	τ_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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