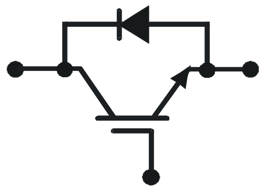
V_{CE} = 3300 V
I_C = 1200 A



HiPak

IGBT Module
5SNA 1200E330100

Doc. No. 5SYA1556-06 10-2020

- **Low-loss, rugged SPT chip-set**
- **Smooth switching SPT chip-set for good EMC**
- **Industry standard package**
- **High power density**
- **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		3300	V
DC collector current	I_C	T_c = 80 °C		1200	A
Peak collector current	I_{CM}	t_p = 1 ms, T_c = 80 °C		2400	A
Gate-emitter voltage	V_{GES}		-20	20	V
Total power dissipation	P_{tot}	T_c = 25 °C, per switch (IGBT)		11750	W
DC forward current	I_F			1200	A
Peak forward current	I_{FRM}			2400	A
Surge current	I_{FSM}	V_R = 0 V, T_{vj} = 125 °C, t_p = 10 ms, half-sinewave		12000	A
IGBT short circuit SOA	t_{psc}	V_{CC} = 2500 V, $V_{CEM\,CHIP} \leq$ 3300 V $V_{GE} \leq$ 15 V, $T_{vj} \leq$ 125 °C		10	µs
Isolation voltage	V_{isol}	1 min, f = 50 Hz		6000	V
Junction temperature	T_{vj}			150	°C
Junction operating temperature	$T_{vj(op)}$		-50	125	°C
Case temperature	T_c		-50	125	°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. 5SYA2039

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 = 1200 A, V_{GE} = 15 V	T_{vj} = 25 °C	2.7	3.1	3.4	V
			T_{vj} = 125 °C	3.5	3.8	4.3	V
Collector cut-off current	I_{CES}	V_{CE} = 3300 V, V_{GE} = 0 V	T_{vj} = 25 °C			12	mA
			T_{vj} = 125 °C			120	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	$V_{GE(TO)}$	I_C = 240 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.5		7.5	V
Gate charge	Q_{ge}	I_C = 1200 A, V_{CE} = 1800 V, V_{GE} = -15 V .. 15 V			12.1		µC
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz, T_{vj} = 25 °C			187		nF
Output capacitance	C_{oes}				11.57		
Reverse transfer capacitance	C_{res}				2.22		
Turn-on delay time	$t_{d(on)}$	V_{CC} = 1800 V, I_C = 1200 A, R_G = 1.5 Ω, V_{GE} = ±15 V, $L_σ$ = 100 nH, inductive load	T_{vj} = 25 °C		400		ns
			T_{vj} = 125 °C		400		
Rise time	t_r		T_{vj} = 25 °C		175		ns
			T_{vj} = 125 °C		200		
Turn-off delay time	$t_{d(off)}$	V_{CC} = 1800 V, I_C = 1200 A, R_G = 1.5 Ω, V_{GE} = ±15 V, $L_σ$ = 100 nH, inductive load	T_{vj} = 25 °C		940		ns
			T_{vj} = 125 °C		1070		
Fall time	t_f		T_{vj} = 25 °C		350		ns
			T_{vj} = 125 °C		440		
Turn-on switching energy	E_{on}	V_{CC} = 1800 V, I_C = 1200 A, V_{GE} = ±15 V, R_G = 1.5 Ω, $L_σ$ = 100 nH, inductive load	T_{vj} = 25 °C		1340		mJ
			T_{vj} = 125 °C		1890		
Turn-off switching energy	E_{off}	V_{CC} = 1800 V, I_C = 1200 A, V_{GE} = ±15 V, R_G = 1.5 Ω, $L_σ$ = 100 nH, inductive load	T_{vj} = 25 °C		1420		mJ
			T_{vj} = 125 °C		1950		
Short circuit current	I_{SC}	t_{psc} ≤ 10 µs, V_{GE} = 15 V, T_{vj} = 125 °C, V_{CC} = 2500 V, $V_{CEM\ CHIP}$ ≤ 3300 V			5000		A
Module stray inductance	$L_{σ\ CE}$				10		nH
Resistance, terminal-chip	$R_{CC'+EE'}$		T_C = 25 °C		0.06		mΩ
			T_C = 125 °C		0.085		

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 = 1200 A	T_{vj} = 25 °C	2.0	2.3	2.6	V
			T_{vj} = 125 °C	2.0	2.35	2.6	
Reverse recovery current	I_{rr}	V_{CC} = 1800 V, I_F = 1200 A, V_{GE} = ±15 V, R_G = 1.5 Ω, $L_σ$ = 100 nH, inductive load	T_{vj} = 25 °C		1100		A
			T_{vj} = 125 °C		1350		
Recovered charge	Q_{rr}		T_{vj} = 25 °C		715		µC
			T_{vj} = 125 °C		1280		
Reverse recovery time	t_{rr}		T_{vj} = 25 °C		520		ns
			T_{vj} = 125 °C		1450		
Reverse recovery energy	E_{rec}		T_{vj} = 25 °C		840		mJ
			T_{vj} = 125 °C		1530		

5) Characteristic values according to IEC 60747 – 2
6) Forward voltage is given at chip level

Thermal properties [7)]

Parameter	Symbol	Conditions	min	typ	max	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$				0.0085	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.017	K/W
Thermal resistance case to heatsink [2)]	$R_{th(c-s)}$	per module, λ grease = 1W/m × K		0.006		K/W

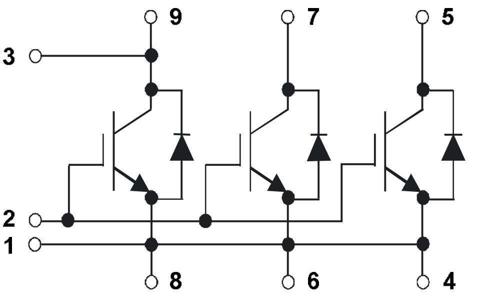
2) For detailed mounting instructions refer to Document No. 5SYA2039

Mechanical properties [7)]

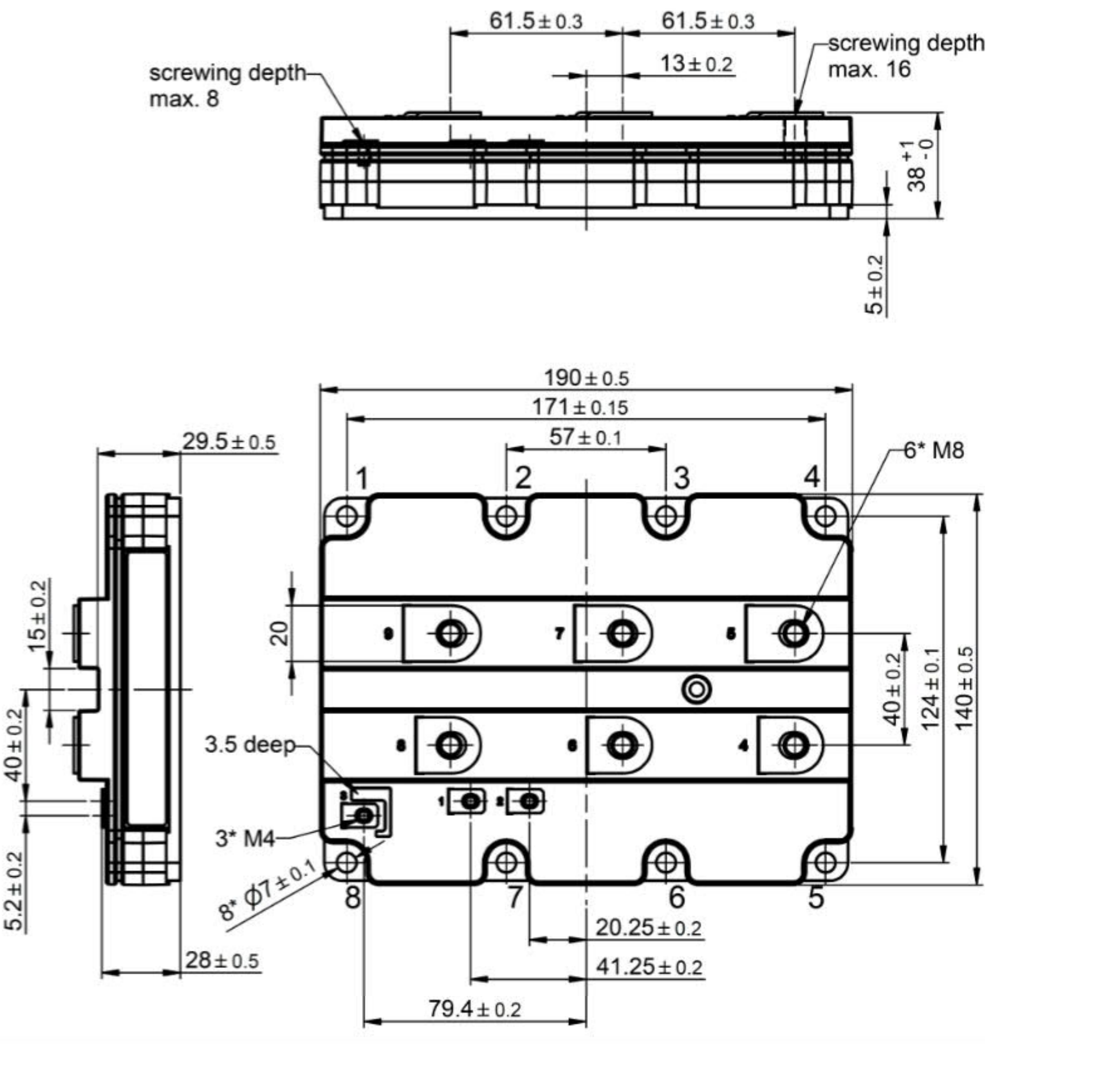
Parameter	Symbol	Conditions		min	typ	max	Unit
Dimensions	L × W × H	Typical , see outline drawing		190 × 140 × 38			mm
Comparative tracking index	CTI			600			
Clearance distance in air	d_a	according to IEC 60664-1 and EN 50124-1	Term. to base:	23			mm
			Term. to term:	19			
Surface creepage distance	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) Thermal and mechanical properties according to IEC 60747 – 15

Electrical configuration



Outline drawing [2)]



[2)] For detailed mounting instructions refer to Document No. 5SYA2039

This product has been designed and qualified for Industrial Level.

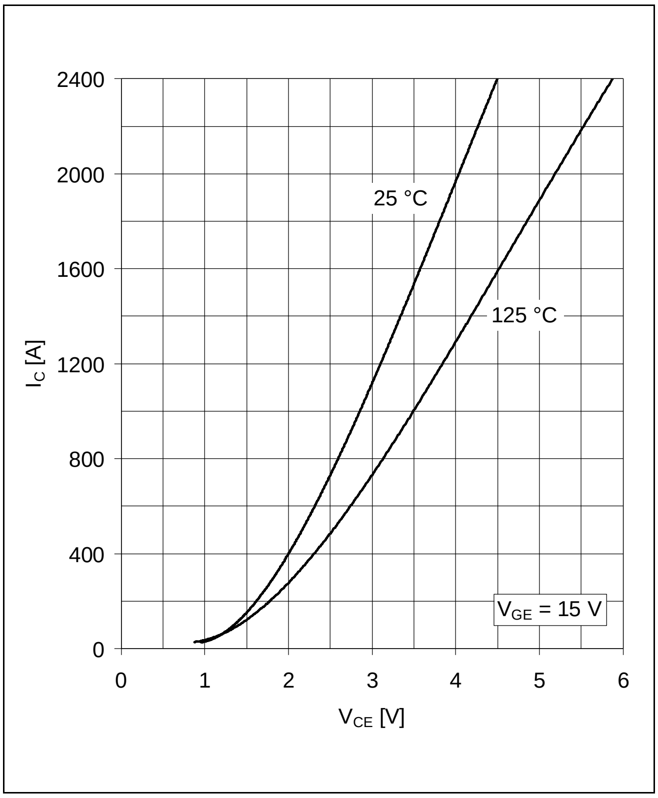


Fig. 1 Typical on-state characteristics, chip level

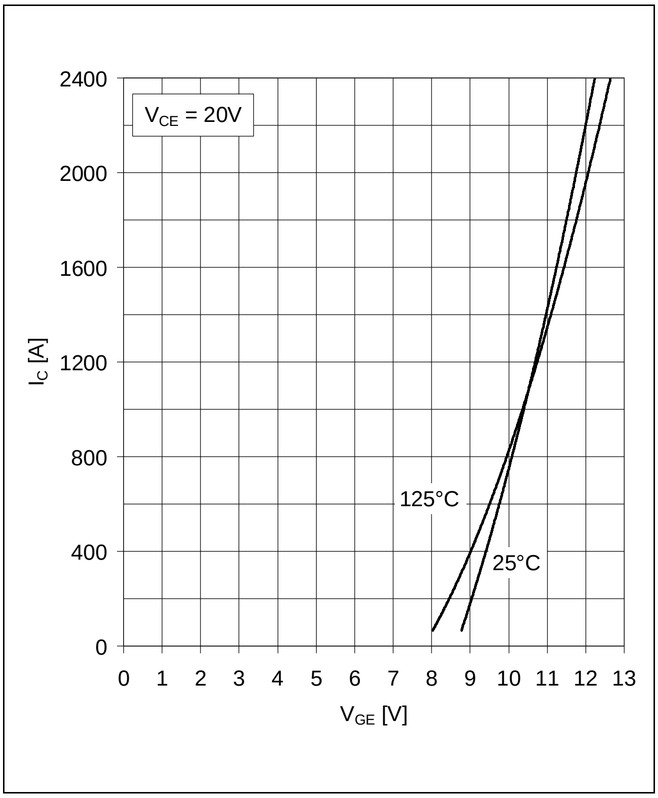


Fig. 2 Typical transfer characteristics, chip level

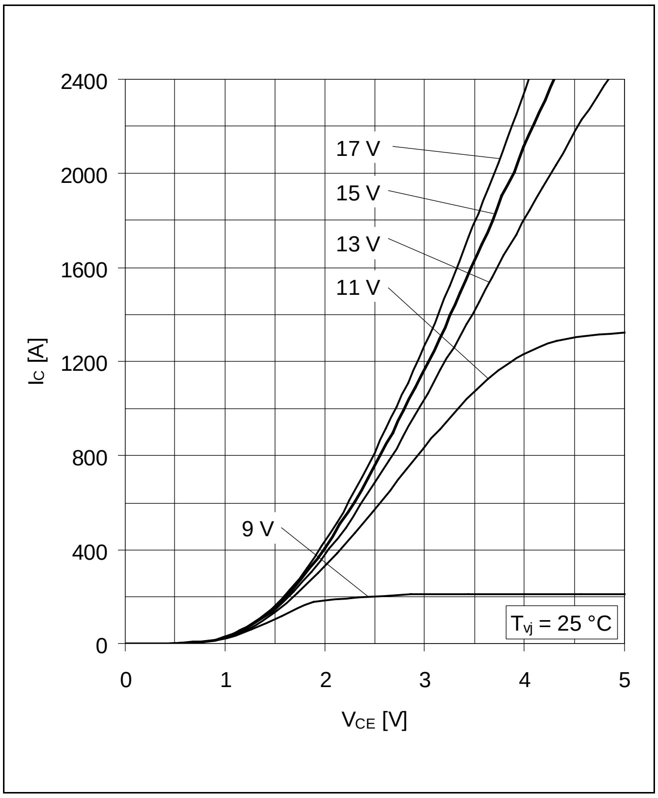


Fig. 3 Typical output characteristics, chip level

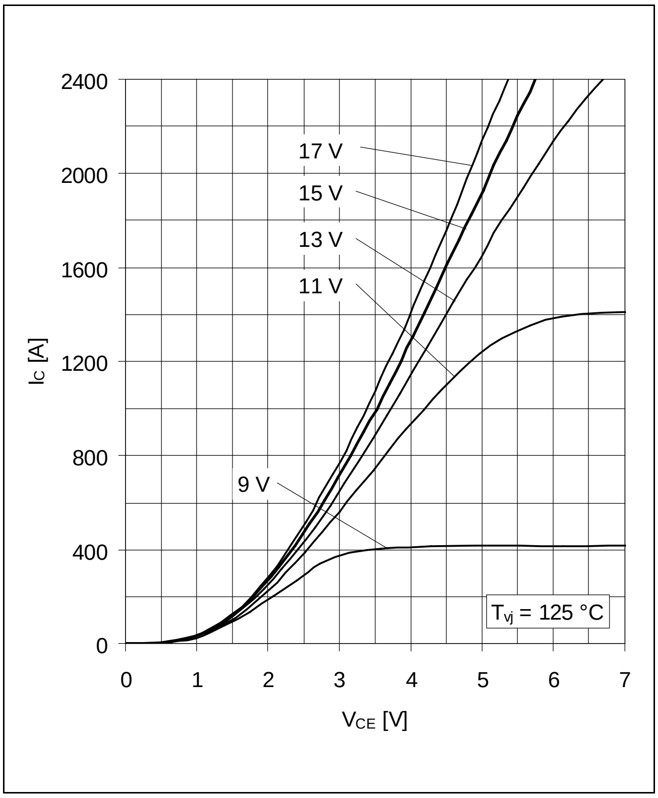


Fig. 4 Typical output characteristics, chip level

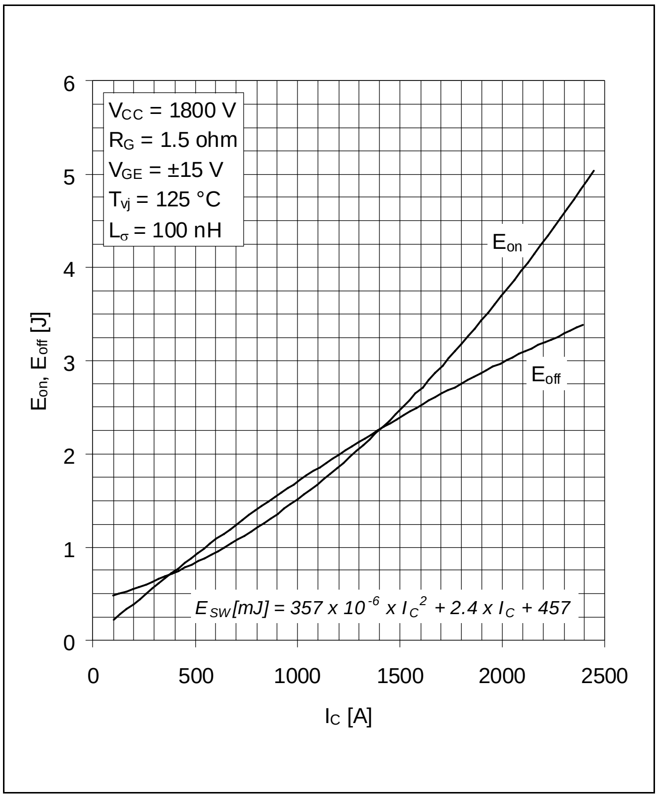


Fig. 5 Typical switching energies per pulse vs collector current

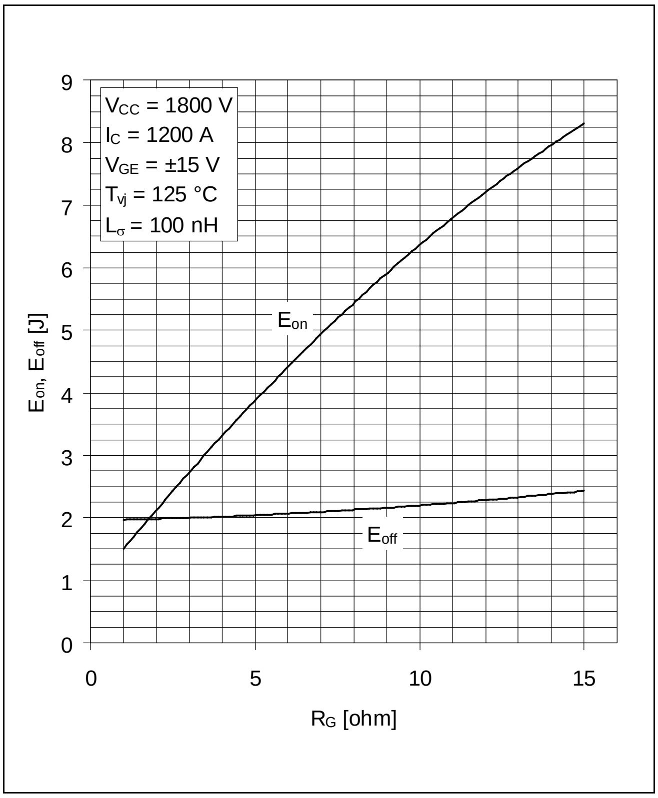


Fig. 6 Typical switching energies per pulse vs gate resistor

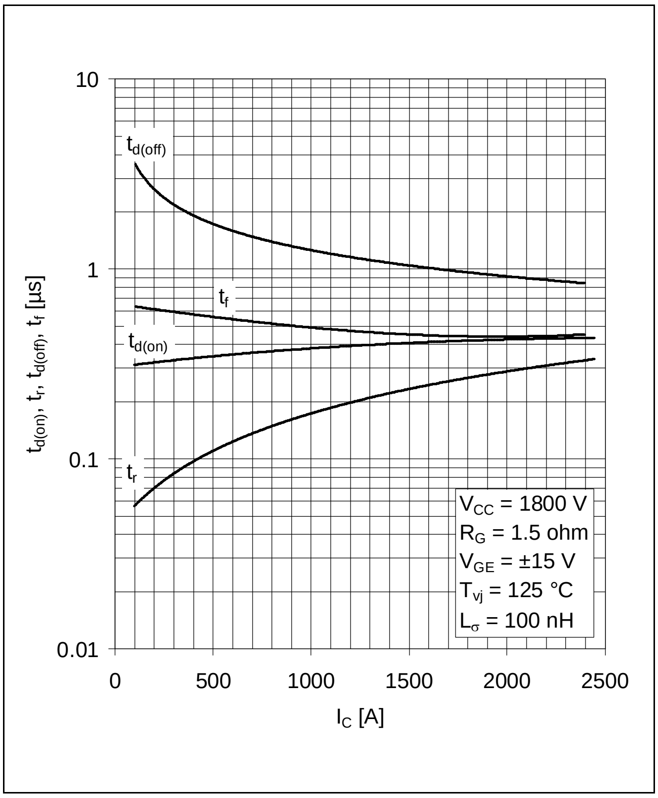


Fig. 7 Typical switching times vs collector current

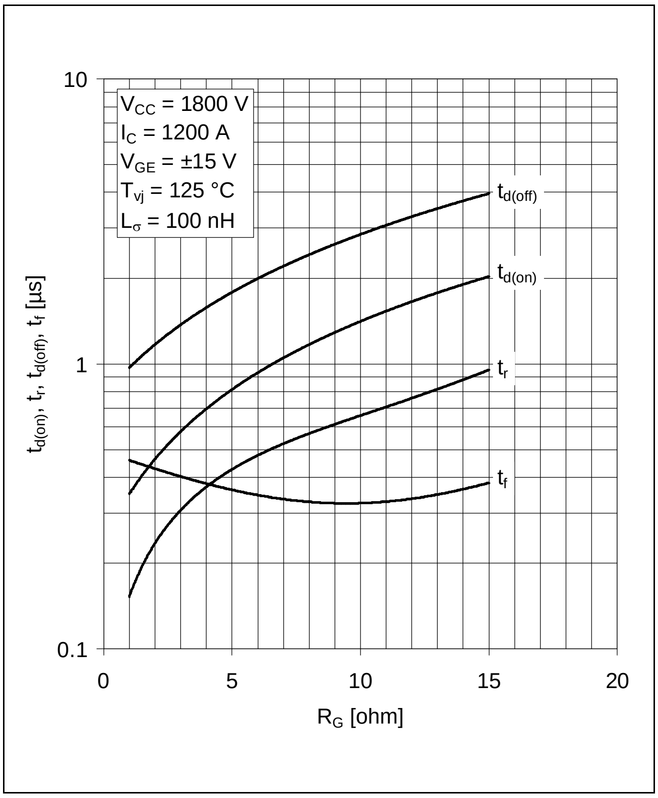


Fig. 8 Typical switching times vs gate resistor

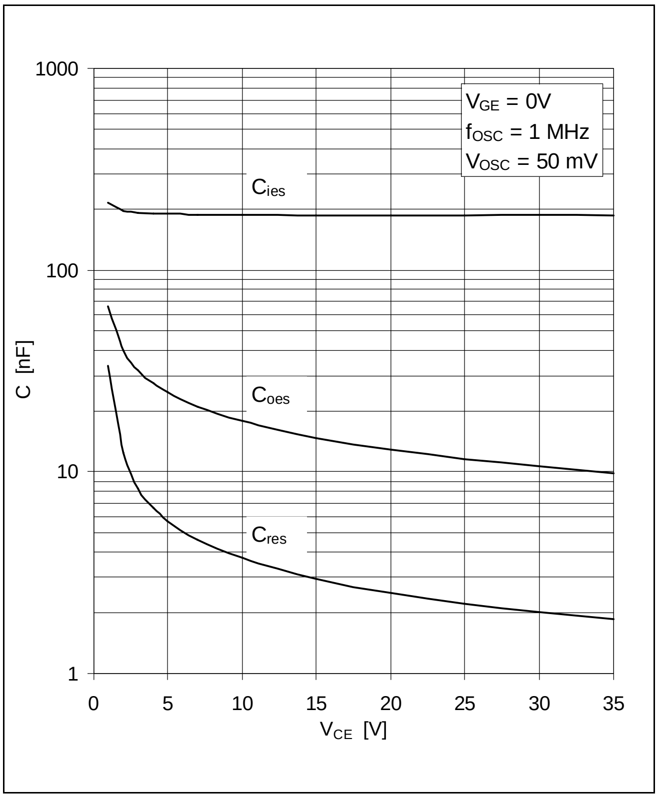


Fig. 9 Typical capacitances vs collector-emitter voltage

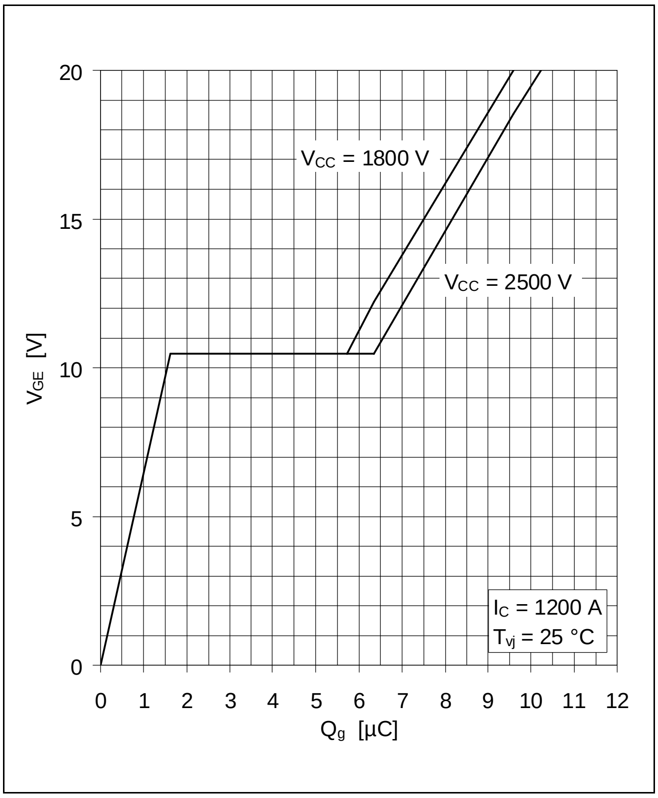


Fig. 10 Typical gate charge characteristics

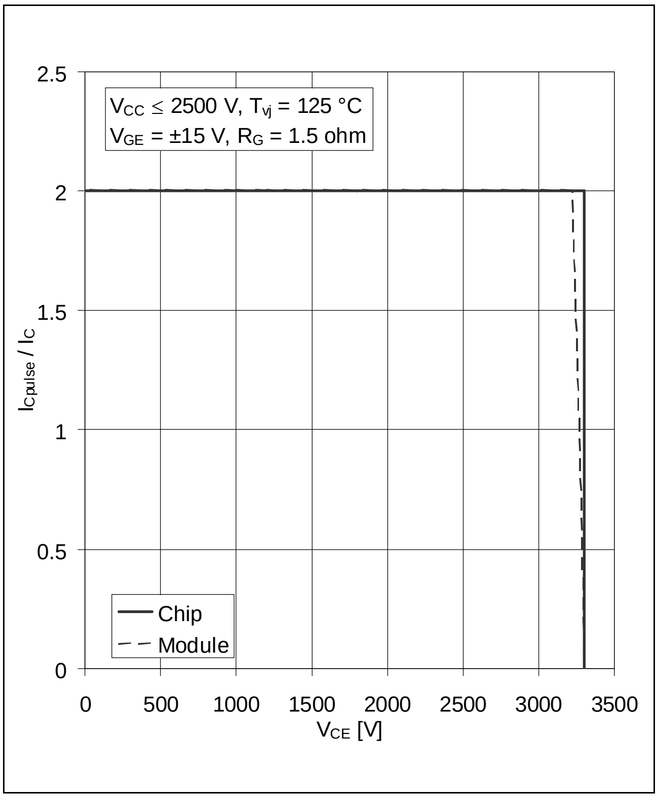


Fig. 11 Turn-off safe operating area (RBSOA)

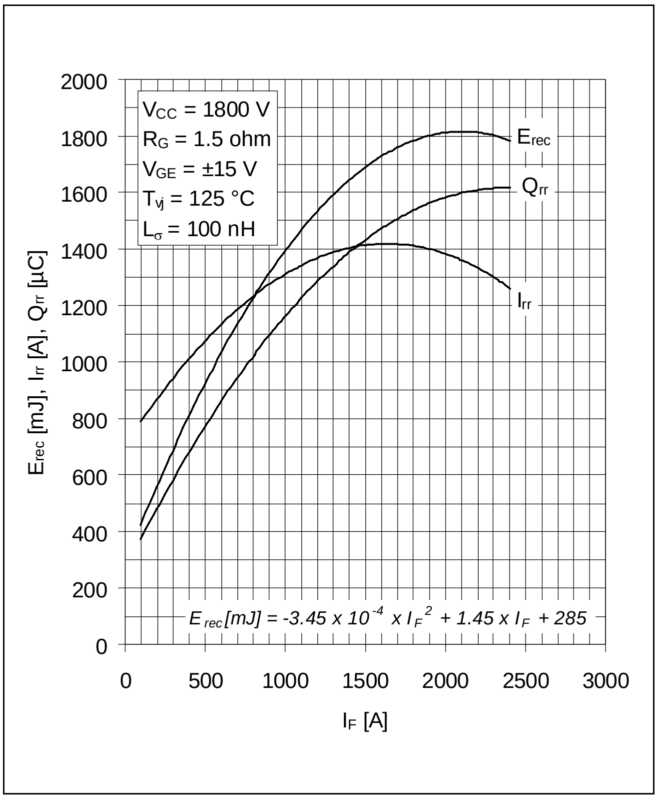


Fig. 12 Typical reverse recovery characteristics vs forward current

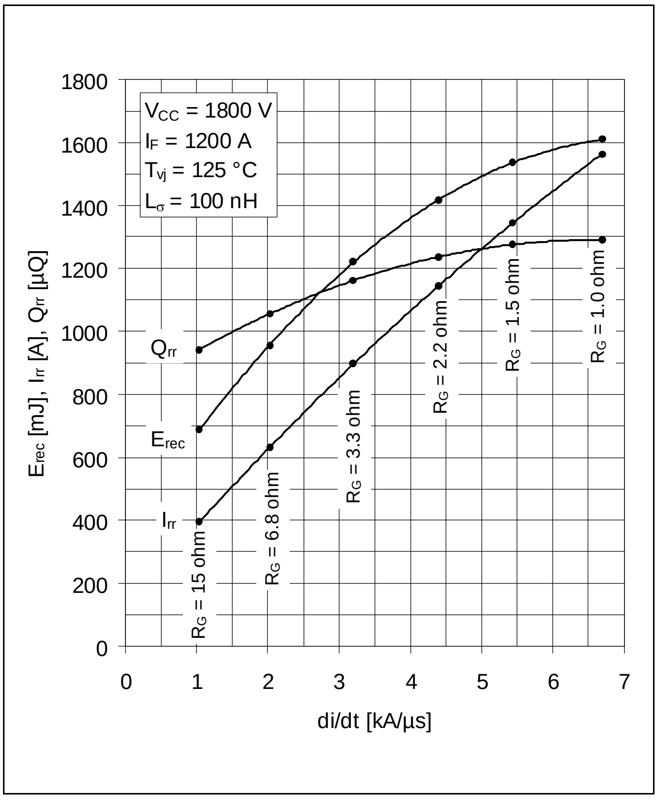


Fig. 13 Typical reverse recovery characteristics vs di/dt

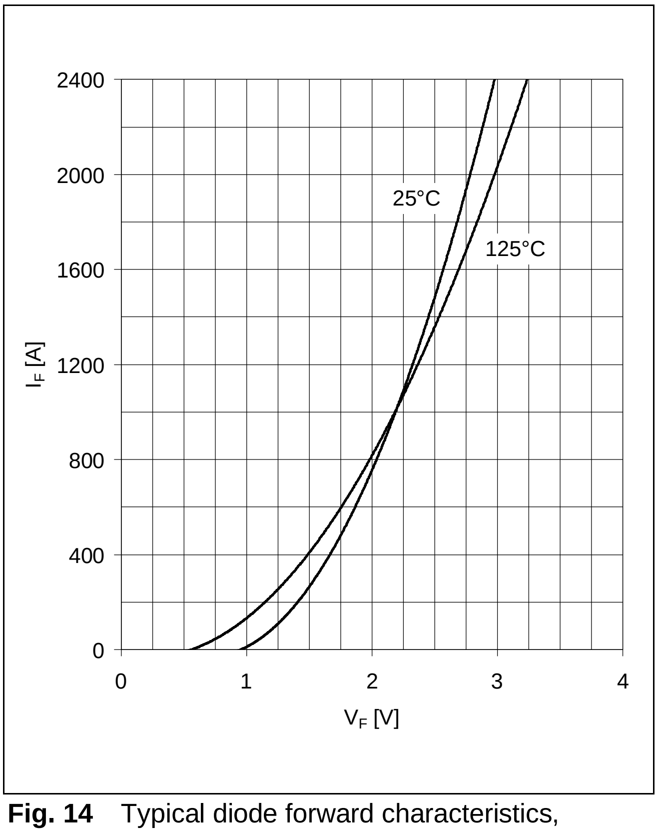


Fig. 14 Typical diode forward characteristics, chip level

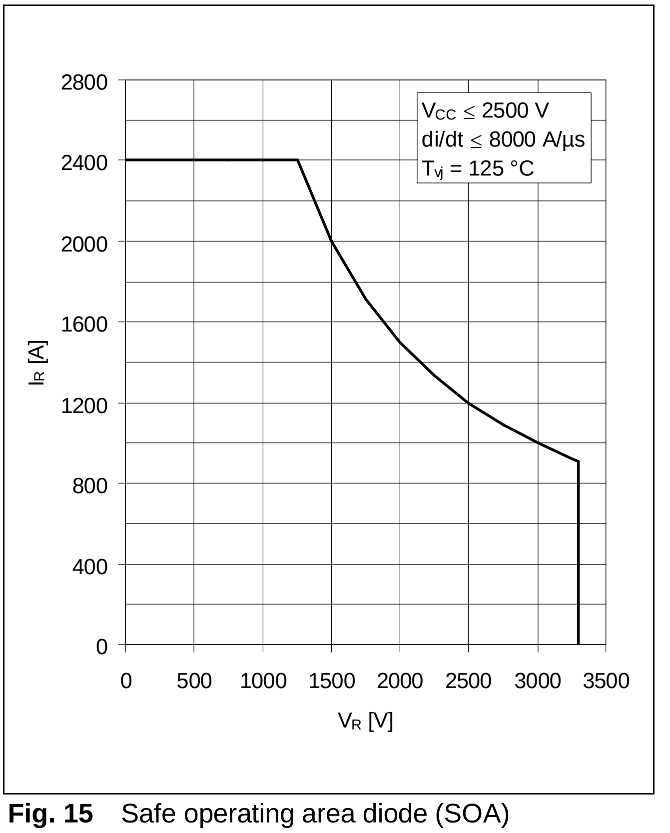


Fig. 15 Safe operating area diode (SOA)

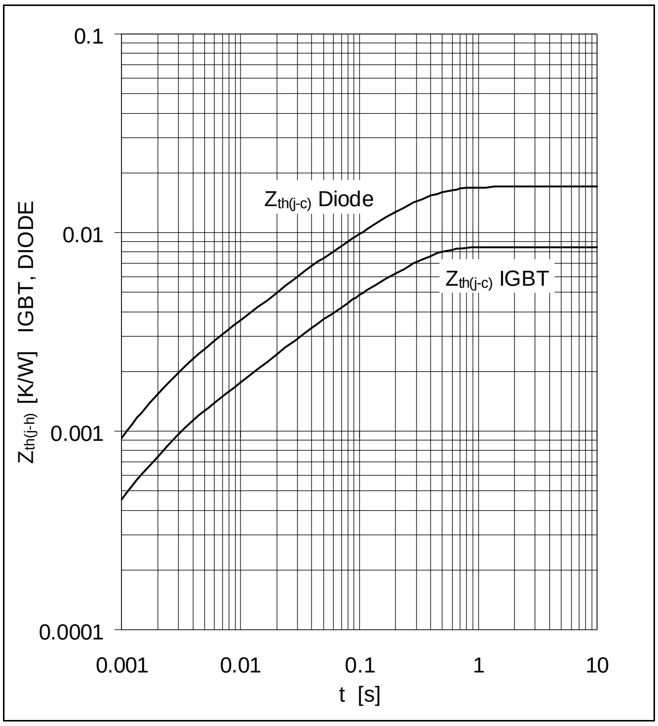


Fig. 16 Thermal impedance vs time

Analytical function for transient thermal impedance:

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

	i	1	2	3	4	5
IGBT	R_i(K/kW)	5.854	1.375	0.641	0.632	
	τ_i(ms)	207.4	30.1	7.55	1.57	
DIODE	R_i(K/kW)	11.54	2.887	1.229	1.295	
	τ_i(ms)	203.6	30.1	7.53	1.57	

Related documents:

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5SYA 2093 Thermal design of IGBT modules
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