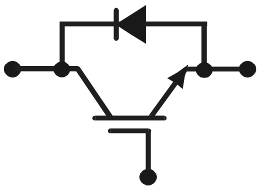
V_{CE} = 1700 V
I_C = 2400 A

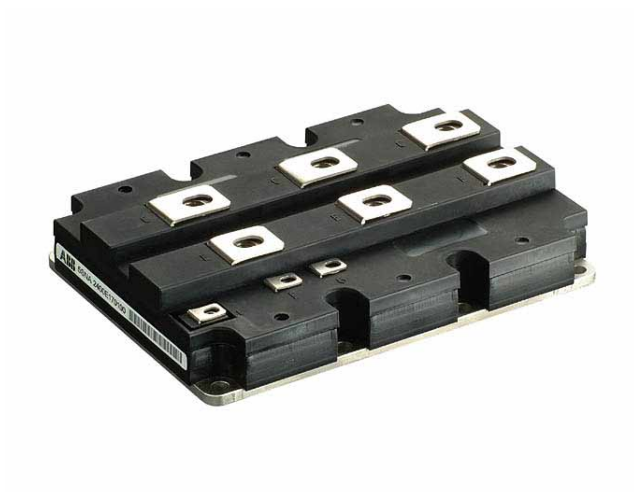
ABB HiPak™



IGBT Module
5SNA 2400E170100
PRELIMINARY

Doc. No. 5SYA 1555-01 Oct 03

- **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**



Maximum rated values [1)]

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	V_{CES}	V_{GE} = 0 V		1700	V
DC collector current	I_C	T_c = 80 °C		2400	A
Peak collector current	I_{CM}	t_p = 1 ms, T_c = 80 °C		4800	A
Gate-emitter voltage	V_{GES}		-20	20	V
Total power dissipation	P_{tot}	T_c = 25 °C, per switch (IGBT)		16700	W
DC forward current	I_F			2400	A
Peak forward current	I_{FM}			4800	A
Surge current	I_{FSM}	V_R = 0 V, T_{vj} = 125 °C, t_p = 10 ms, half-sinewave		22000	A
IGBT short circuit SOA	t_{psc}	V_{CC} = 1000 V, $V_{CEM\,CHIP} \le$ 1700 V $V_{GE} \le$ 15 V, $T_{vj} \le$ 125 °C		10	µs
Isolation voltage	V_{isol}	1 min, f = 50 Hz		4000	V
Junction temperature	T_{vj}			150	°C
Junction operating temperature	$T_{vj(op)}$		-40	125	°C
Storage temperature	T_{stg}		-40	125	°C
Mounting torques	M_1	Base-heatsink, M6 screws	4	6	Nm
	M_2	Main terminals, M8 screws	8	10	

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

ABB Switzerland Ltd, Semiconductors reserves the right to change specifications without notice.

IGBT characteristic values

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		1700			V
Collector-emitter [2)] saturation voltage	$V_{CE\ sat}$	I_C = 2400 A, V_{GE} = 15 V	T_{vj} = 25 °C		2.3	2.6	V
			T_{vj} = 125 °C		2.6	2.9	V
Collector cut-off current	I_{CES}	V_{CE} = 1700 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		4.5		6.5	V
Gate charge	Q_{ge}	I_C = 2400 A, V_{CE} = 900 V, V_{GE} = -15 V .. 15 V			22		µC
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz, T_{vj} = 25 °C			228		nF
Output capacitance	C_{oes}				22.1		
Reverse transfer capacitance	C_{res}				9.6		
Turn-on delay time	$t_{d(on)}$	V_{CC} = 900 V, I_C = 2400 A, R_G = 0.56 Ω, V_{GE} = ±15 V, $L_σ$ = 60 nH, inductive load	T_{vj} = 25 °C		300		ns
			T_{vj} = 125 °C		340		
Rise time	t_r		T_{vj} = 25 °C		250		ns
			T_{vj} = 125 °C		260		
Turn-off delay time	$t_{d(off)}$	V_{CC} = 900 V, I_C = 2400 A, R_G = 0.56 Ω, V_{GE} = ±15 V, $L_σ$ = 60 nH, inductive load	T_{vj} = 25 °C		960		ns
			T_{vj} = 125 °C		1050		
Fall time	t_f		T_{vj} = 25 °C		250		ns
			T_{vj} = 125 °C		270		
Turn-on switching energy	E_{on}	V_{CC} = 900 V, I_C = 2400 A, V_{GE} = ±15, R_G = 0.56 Ω, $L_σ$ = 60 nH, inductive load	T_{vj} = 25 °C		420		mJ
			T_{vj} = 125 °C		600		
Turn-off switching energy	E_{off}	V_{CC} = 900 V, I_C = 2400 A, V_{GE} = ±15, R_G = 0.56 Ω, $L_σ$ = 60 nH, inductive load	T_{vj} = 25 °C		810		mJ
			T_{vj} = 125 °C		980		
Short circuit current	I_{SC}	t_{psc} ≤ 10 µs, V_{GE} = 15 V, T_{vj} = 125 °C, V_{CC} = 1000 V, $V_{CEM\ CHIP}$ ≤ 1700 V			11300		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		

2) Collector emitter saturation voltage is given at chip level

Diode characteristic values

Parameter	Symbol	Conditions		min	typ	max	Unit
Continous forward voltage [3)]	V_F	I_F = 2400 A	T_{vj} = 25 °C		1.65	2.0	V
			T_{vj} = 125 °C		1.7	2.0	
Peak reverse recovery current	I_{RM}	V_{CC} = 900 V, I_F = 2400 A, V_{GE} = ±15 V, R_G = 0.56 Ω L_σ = 60 nH inductive load	T_{vj} = 25 °C		1460		A
			T_{vj} = 125 °C		1880		
Recovered charge	Q_{RR}		T_{vj} = 25 °C		575		µC
			T_{vj} = 125 °C		1025		
Reverse recovery time	t_{rr}		T_{vj} = 25 °C		580		ns
			T_{vj} = 125 °C		890		
Reverse recovery energy	E_{rec}		T_{vj} = 25 °C		410		mJ
			T_{vj} = 125 °C		720		

3) Forward voltage is given at chip level

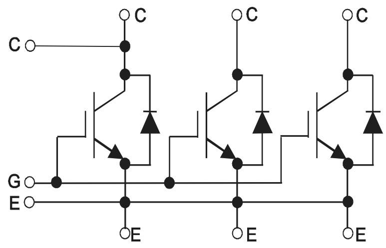
Thermal properties

Parameter	Symbol	Conditions	min	typ	max	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$				0.007	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.012	K/W
Thermal resistance case to heatsink	$R_{th(c-h)}$	per module, λ grease = 1W/m × K		0.006		K/W

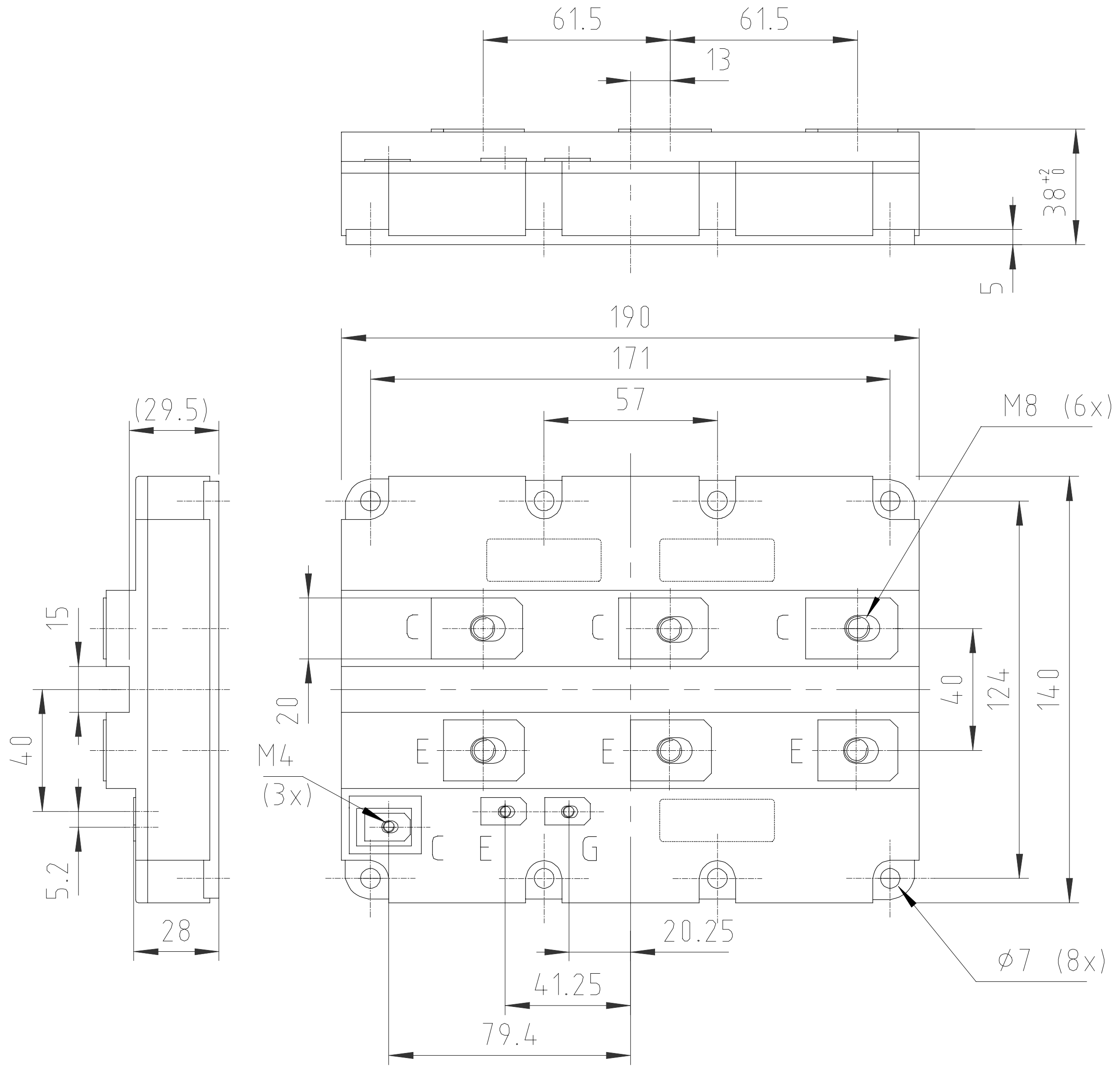
Mechanical properties

Parameter	Symbol	Conditions		min	typ	max	Unit
Dimensions	L × W × H	Typical , see outline drawing		190 × 140 × 38			mm
Clearance distance	D_C	according to IEC 60664-1 and EN 50124-1	Term. to base:	23			mm
			Term. to term:	19			
Surface creepage distance	D_{SC}	according to IEC 60664-1 and EN 50124-1	Term. to base:	33			mm
			Term. to term:	32			
Weight					1500		gr

Electrical configuration



Outline drawing



Note: all dimensions are shown in mm

This is an electrostatic sensitive device, please observe the international standard IEC 60747-1, chap. IX.

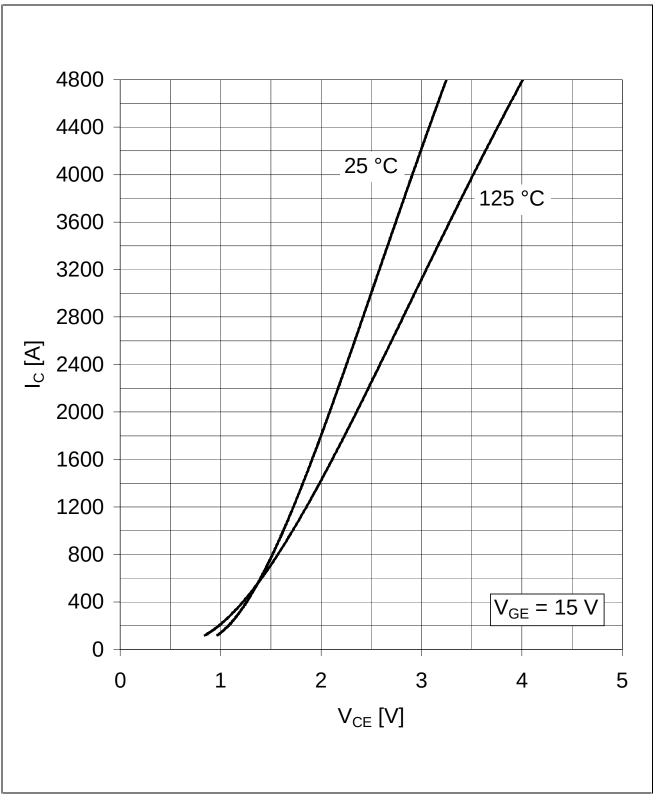


Fig. 1 Typical onstate characteristics, chip level

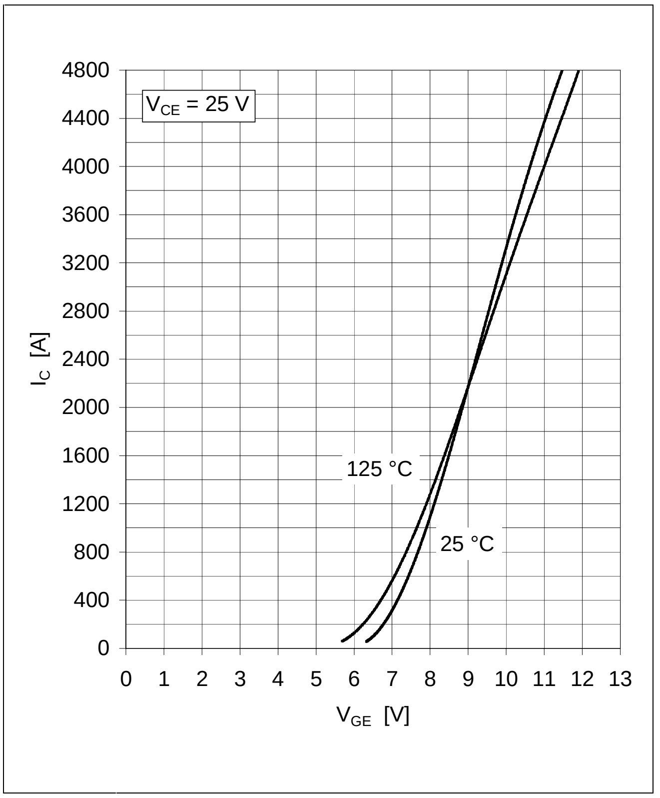


Fig. 2 Typical transfer characteristics, chip level

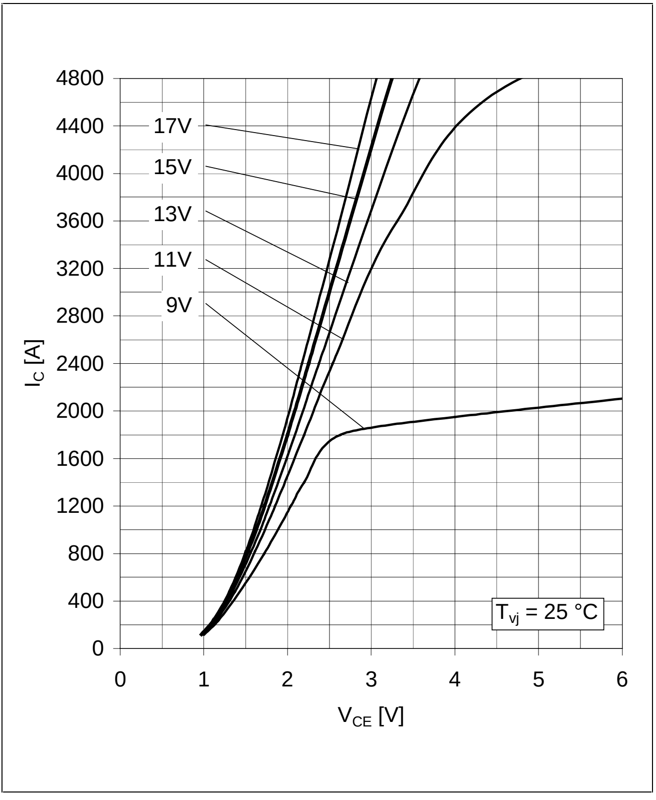


Fig. 3 Typical output characteristics, chip level

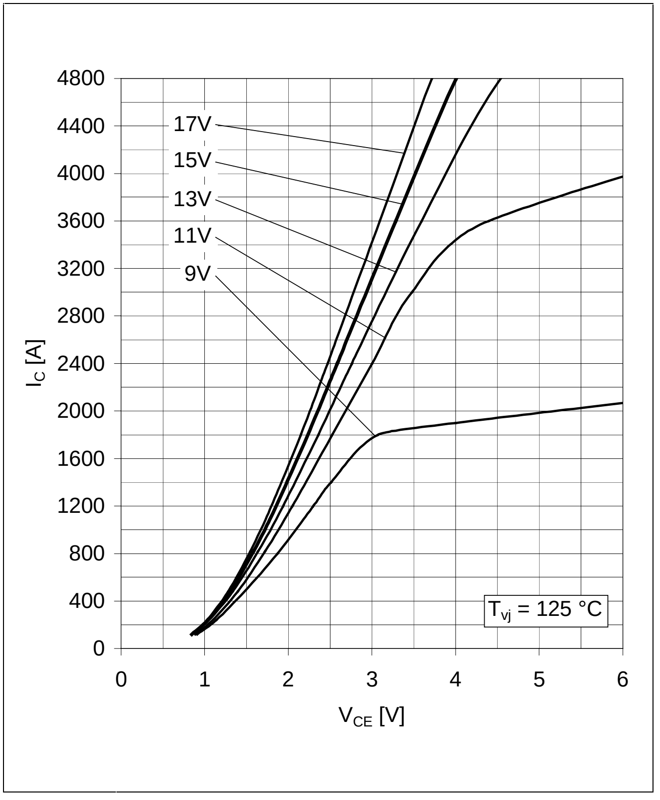


Fig. 4 Typical output characteristics, chip level

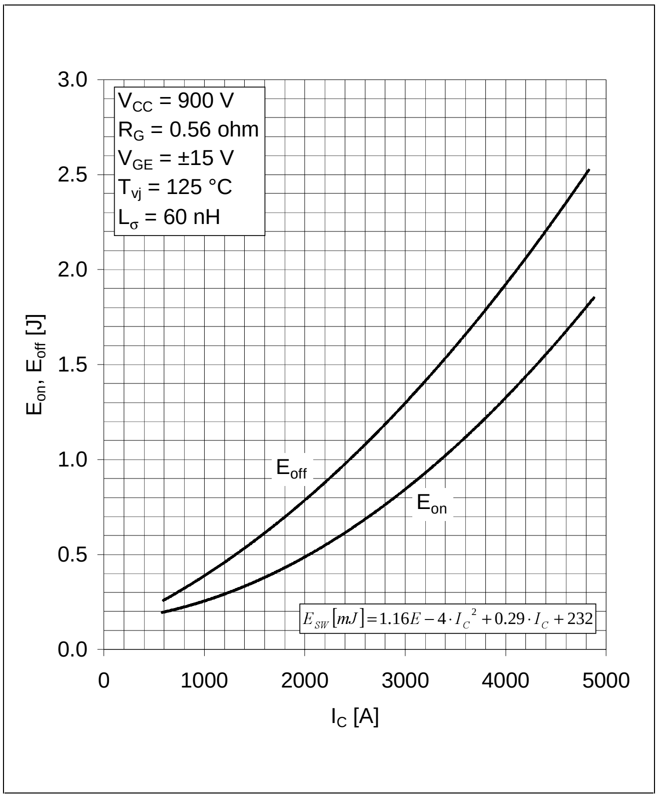


Fig. 5 Typical switching energies per pulse vs collector current

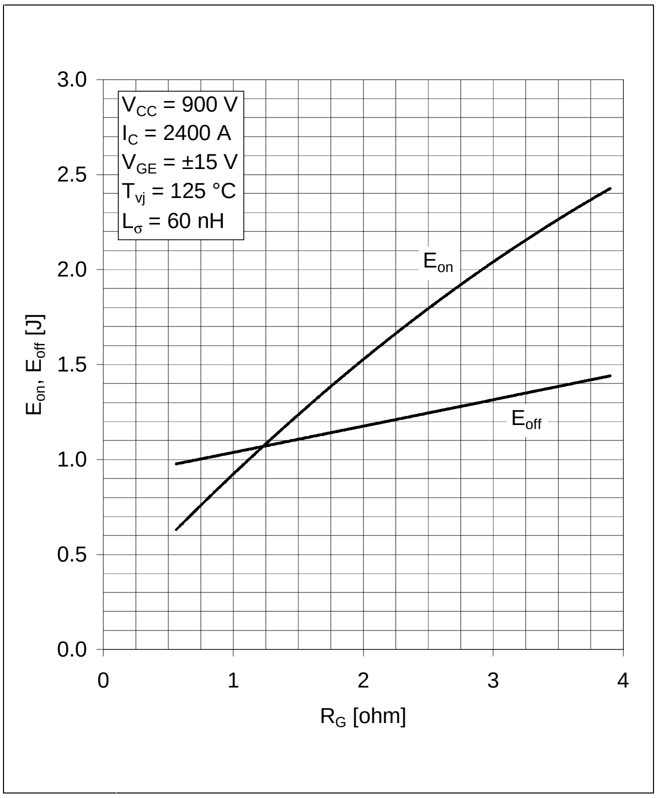


Fig. 6 Typical switching energies per pulse vs gate resistor

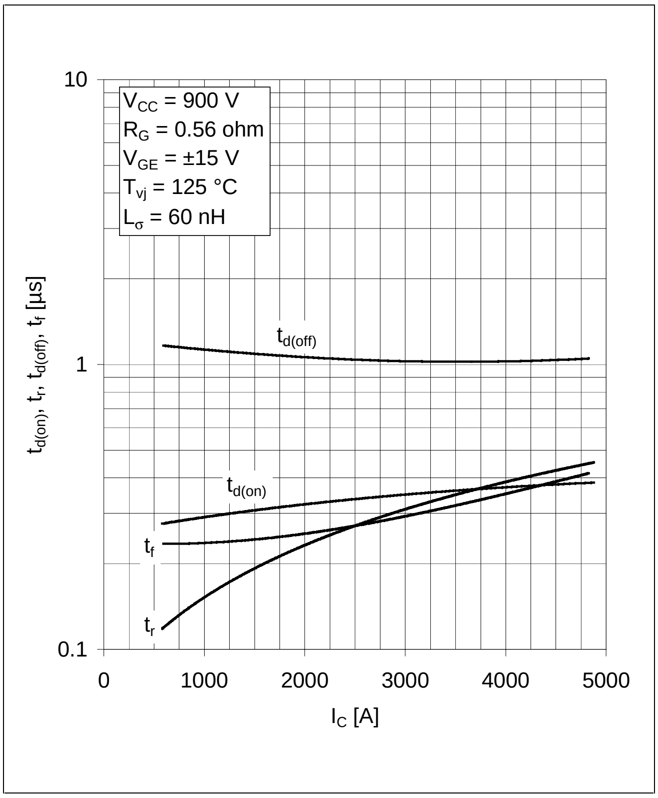


Fig. 7 Typical switching times vs collector current

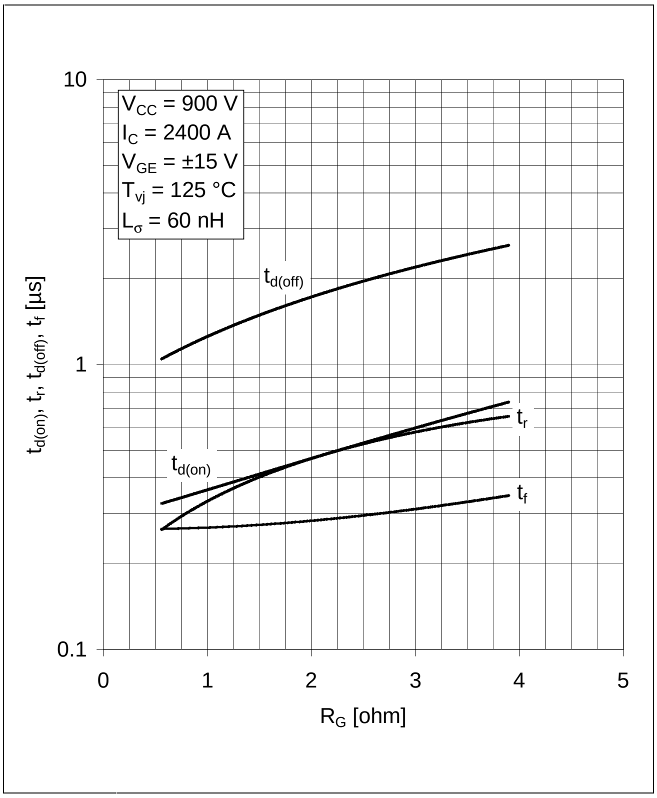


Fig. 8 Typical switching times vs gate resistor

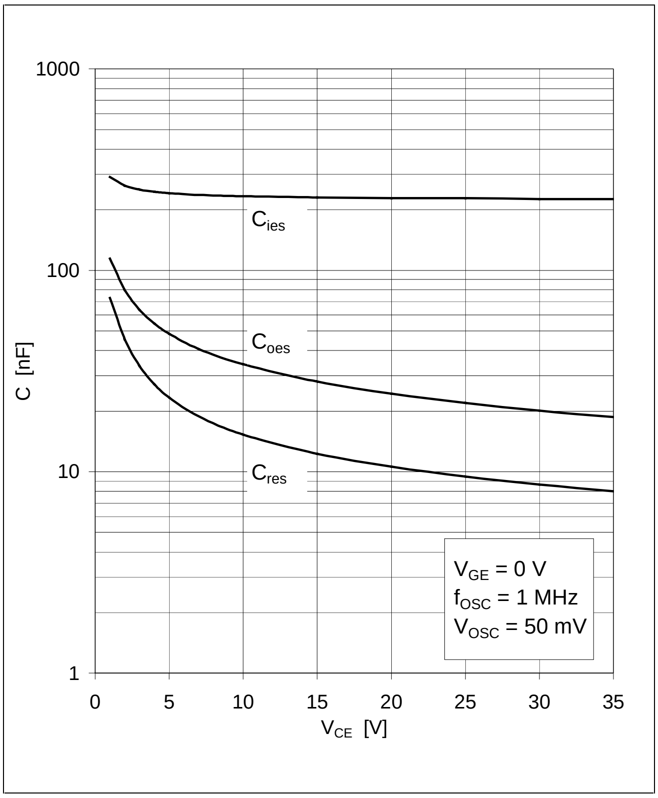


Fig. 9 Typical capacitances vs collector-emitter voltage

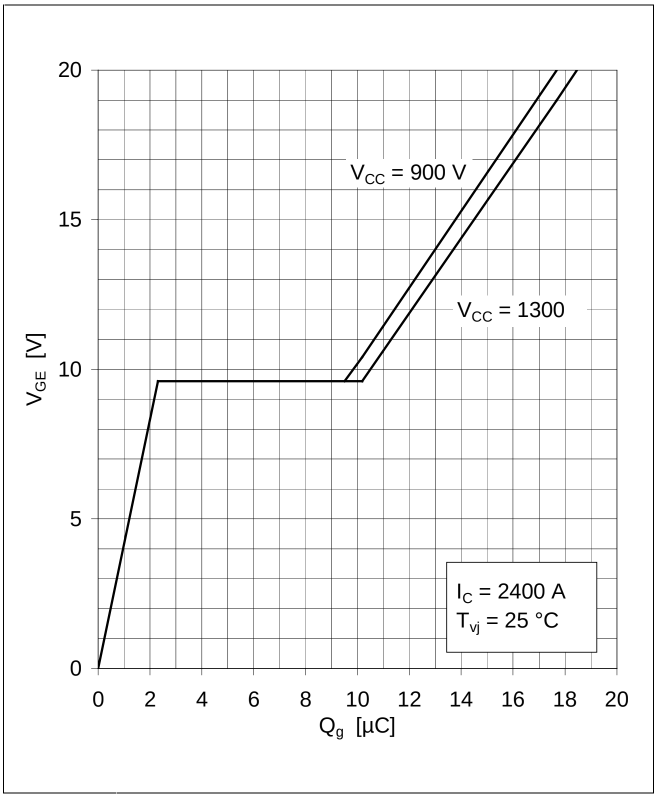


Fig. 10 Typical gate charge characteristics

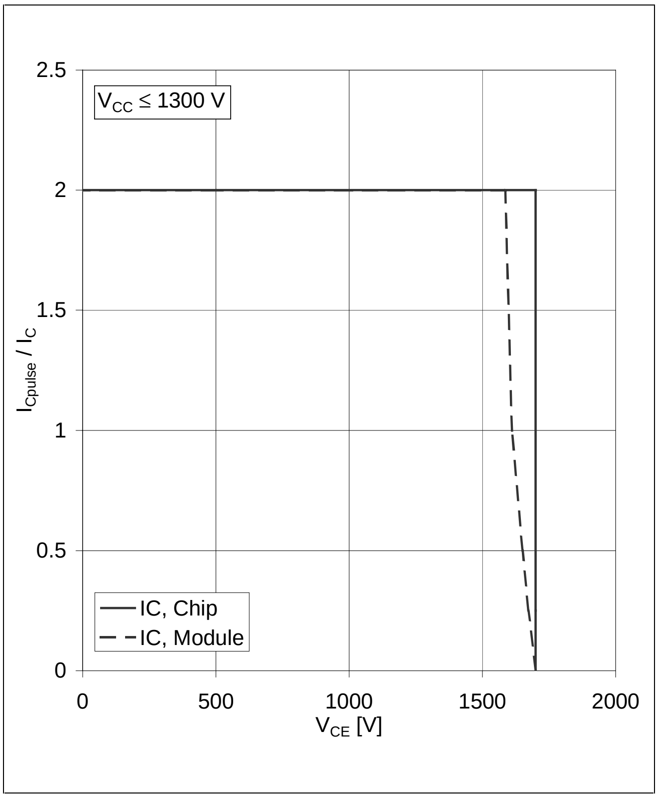


Fig. 11 Turn-off safe operating area (RBSOA)

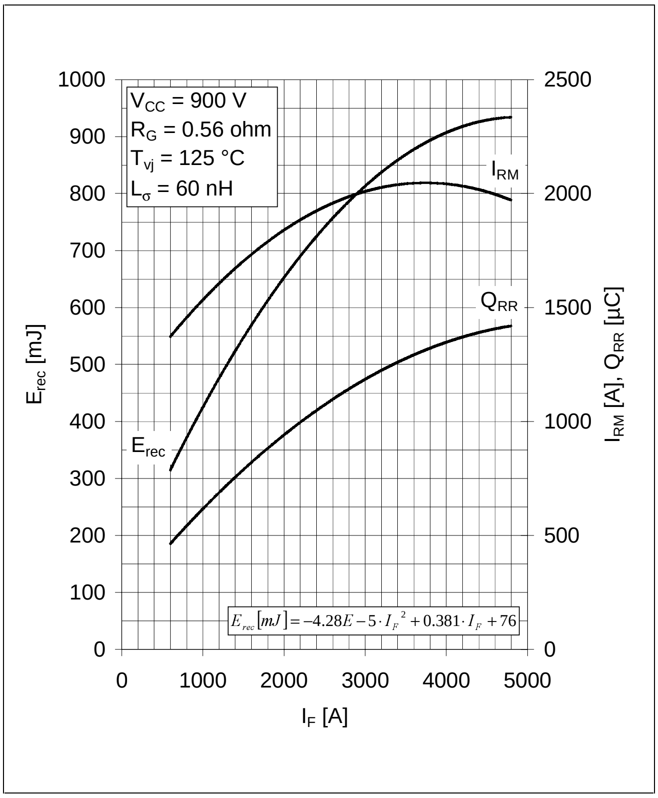


Fig. 12 Typical reverse recovery characteristics vs forward current

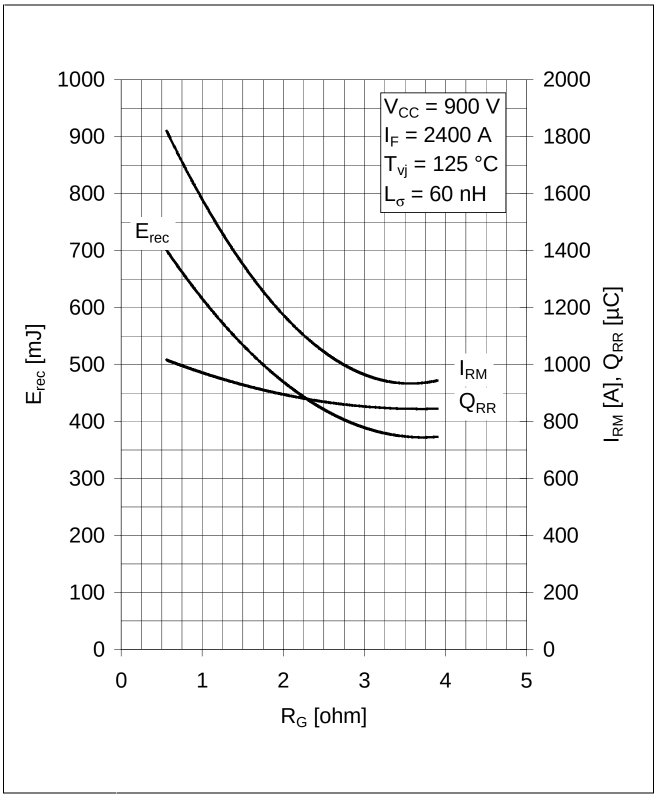


Fig. 13 Typical reverse recovery characteristics vs gate resistor

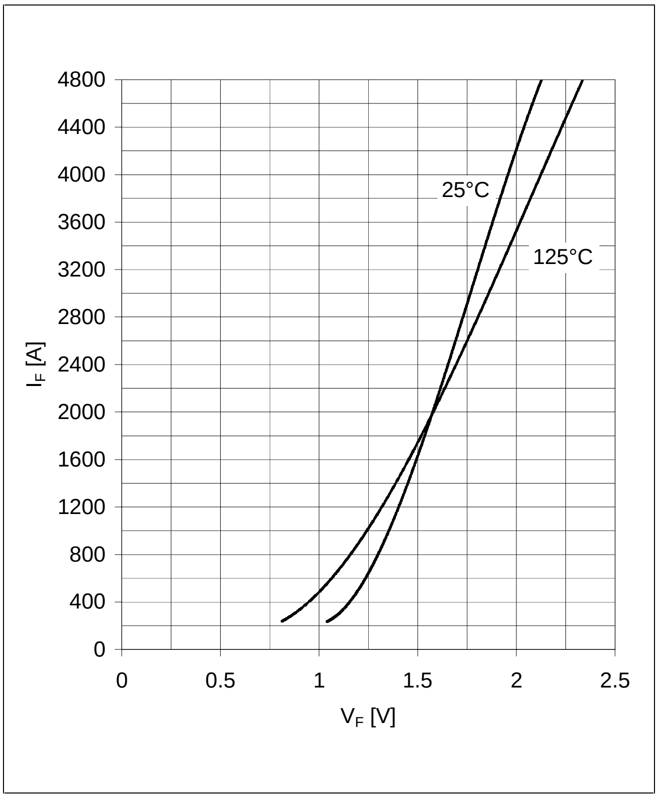


Fig. 14 Typical diode forward characteristics, chip level

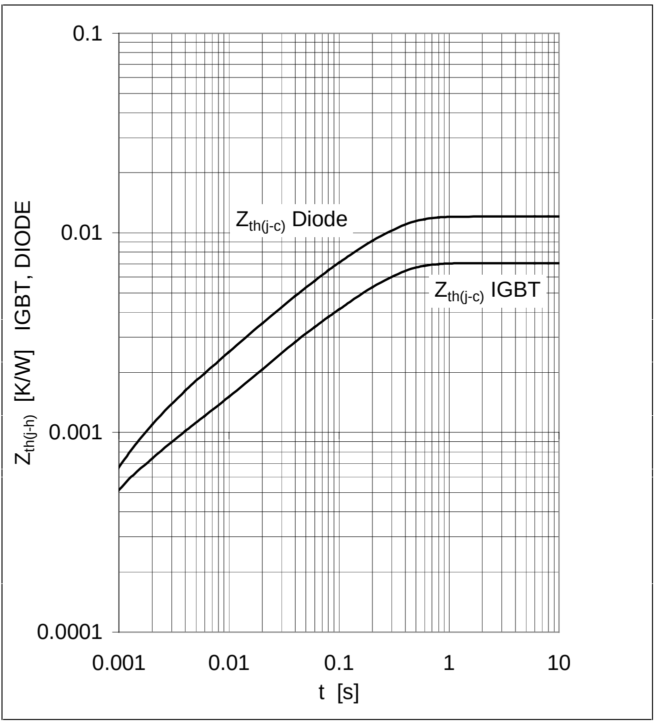


Fig. 15 Thermal impedance vs time

Analytical function for transient thermal impedance:

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

	i	1	2	3	4	5
IGBT	Ri(K/kW)	4.91	1.35	0.444	0.331	
	τ_i(ms)	189	22	2.4	0.54	
DIODE	Ri(K/kW)	8.17	2.16	0.862	0.885	
	τ_i(ms)	196	31	7.4	1.4	

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Doc. No. 5SYA 1555-01 Oct 03