V_{CE} = 1700 V
I_C = 2400 A

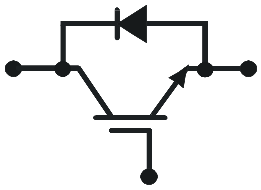


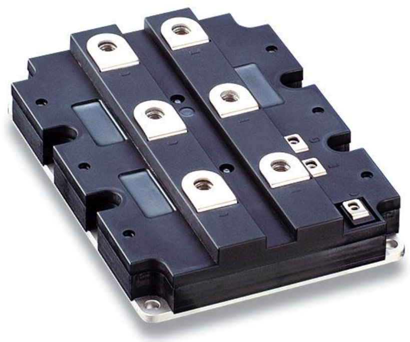
ABB HiPak™

IGBT Module

5SNA 2400E170100

Doc. No. 5SYA1555-03 Oct 06

- **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, $T_{vj} \geq 25$ °C		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)		14300	W
DC forward current	I_F			2400	A
Peak forward current	I_{FRM}			4800	A
Surge current	I_{FSM}	V_R = 0 V, T_{vj} = 125 °C, t_p = 10 ms, half-sinewave		20000	A
IGBT short circuit SOA	t_{psc}	V_{CC} = 1200 V, $V_{CEM\,CHIP} \leq 1700$ V $V_{GE} \leq 15$ V, $T_{vj} \leq 125$ °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
Case temperature	T_c		-40	125	°C
Storage temperature	T_{stg}		-40	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 ABB Document No. 5SYA2039

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

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		1700			V
Collector-emitter [4)] saturation voltage	$V_{CE\ sat}$	I_C = 2400 A, V_{GE} = 15 V	T_{vj} = 25 °C	2.0	2.3	2.6	V
			T_{vj} = 125 °C	2.3	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		320		ns
			T_{vj} = 125 °C		320		
Rise time	t_r		T_{vj} = 25 °C		270		ns
			T_{vj} = 125 °C		275		
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		1000		ns
			T_{vj} = 125 °C		1090		
Fall time	t_f		T_{vj} = 25 °C		250		ns
			T_{vj} = 125 °C		265		
Turn-on switching energy	E_{on}	V_{CC} = 900 V, I_C = 2400 A, V_{GE} = ±15 V, R_G = 0.56 Ω, $L_σ$ = 60 nH, inductive load	T_{vj} = 25 °C		495		mJ
			T_{vj} = 125 °C		700		
Turn-off switching energy	E_{off}	V_{CC} = 900 V, I_C = 2400 A, V_{GE} = ±15 V, R_G = 0.56 Ω, $L_σ$ = 60 nH, inductive load	T_{vj} = 25 °C		850		mJ
			T_{vj} = 125 °C		1000		
Short circuit current	I_{SC}	t_{psc} ≤ 10 µs, V_{GE} = 15 V, T_{vj} = 125 °C, V_{CC} = 1200 V, $V_{CEM\ CHIP}$ ≤ 1700 V			11100		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 = 2400 A	T_{vj} = 25 °C		1.65	2.0	V
			T_{vj} = 125 °C		1.7	2.0	
Reverse recovery current	I_{rr}	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		1520		A
			T_{vj} = 125 °C		1880		
Recovered charge	Q_{rr}		T_{vj} = 25 °C		590		µC
			T_{vj} = 125 °C		1025		
Reverse recovery time	t_{rr}		T_{vj} = 25 °C		580		ns
			T_{vj} = 125 °C		870		
Reverse recovery energy	E_{rec}		T_{vj} = 25 °C		420		mJ
			T_{vj} = 125 °C		720		

[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	$R_{th(j-c)IGBT}$				0.007	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.012	K/W
IGBT thermal resistance case to heatsink [2]	$R_{th(c-s)IGBT}$	IGBT per switch, λ grease = 1W/m x K		0.009		K/W
Diode thermal resistance case to heatsink [7]	$R_{th(c-s)DIODE}$	Diode per switch, λ grease = 1W/m x K		0.018		K/W

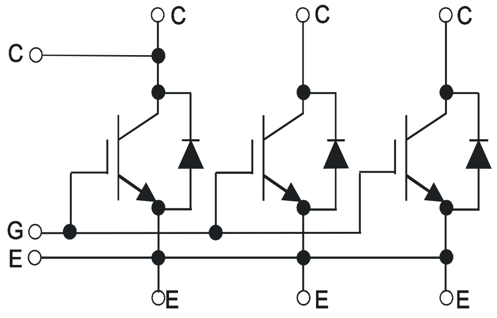
[2] For detailed mounting instructions refer to ABB Document No. 5SYA2039

Mechanical properties [7]

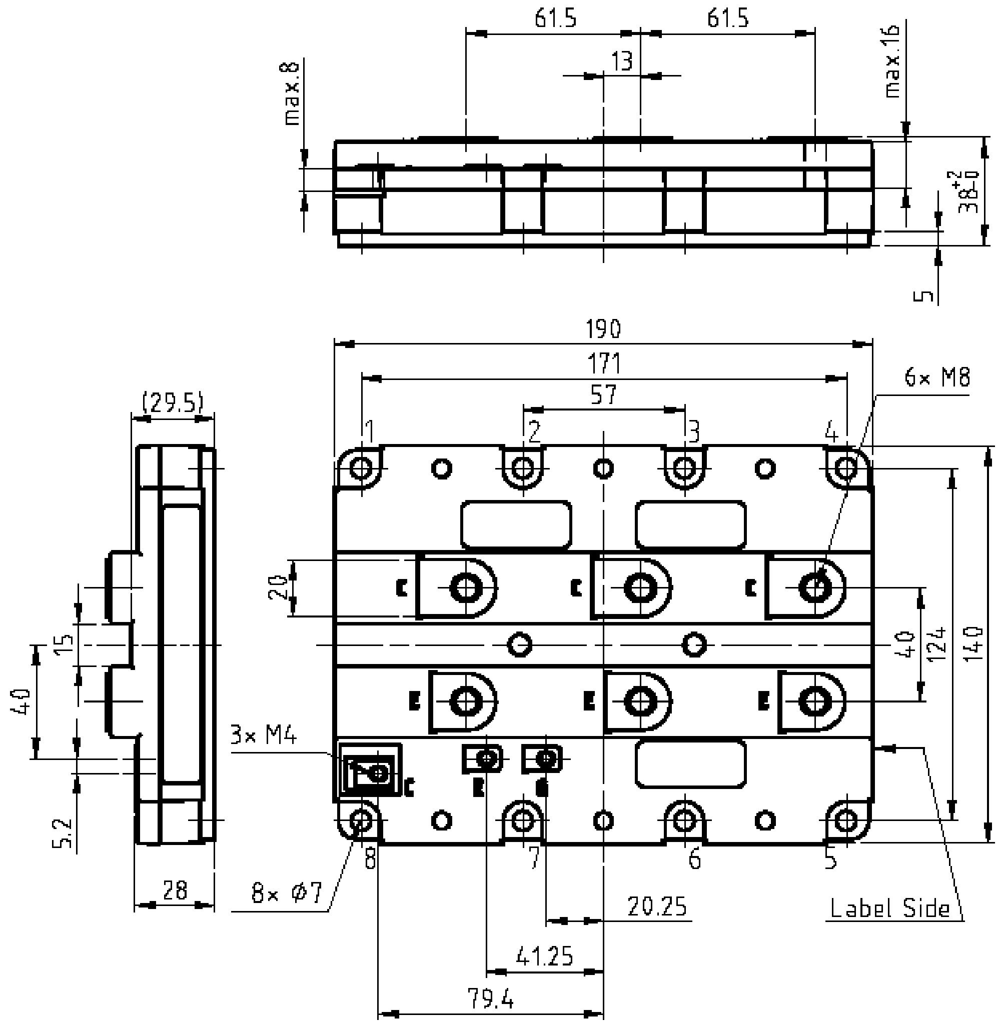
Parameter	Symbol	Conditions		min	typ	max	Unit
Dimensions	L x W x H	Typical , see outline drawing		190 x 140 x 38			mm
Clearance distance in air	d_a	according to IEC 60664-1 and EN 50124-1	Term. to base:	23			mm
			Term. to term:	19			
Surface creepage distance	d_s	according to IEC 60664-1 and EN 50124-1	Term. to base:	33			mm
			Term. to term:	32			
Mass	m				1500		g

[7] Thermal and mechanical properties according to IEC 60747 – 15

Electrical configuration



Outline drawing [2)]



Note: all dimensions are shown in mm

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

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

This product has been designed and qualified for Industrial Level.

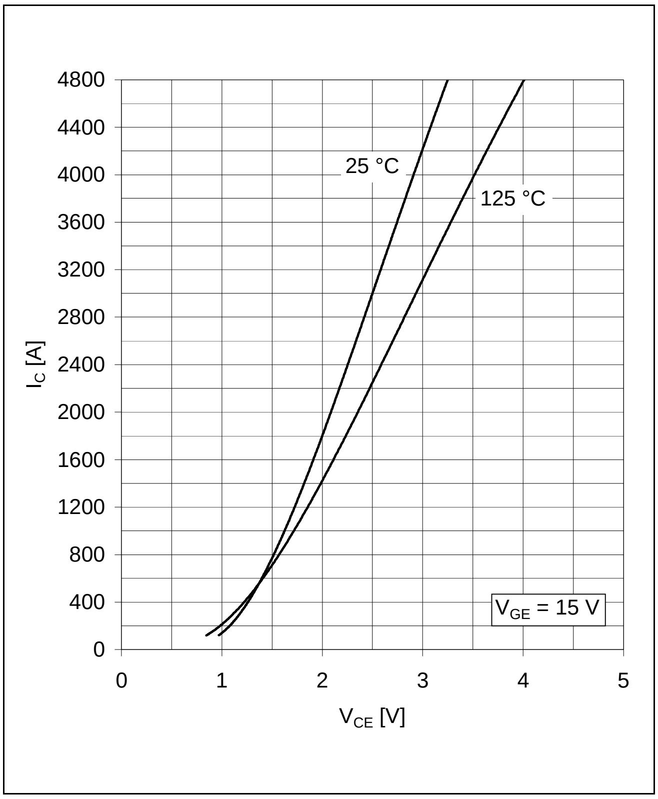


Fig. 1 Typical on-state characteristics, chip level

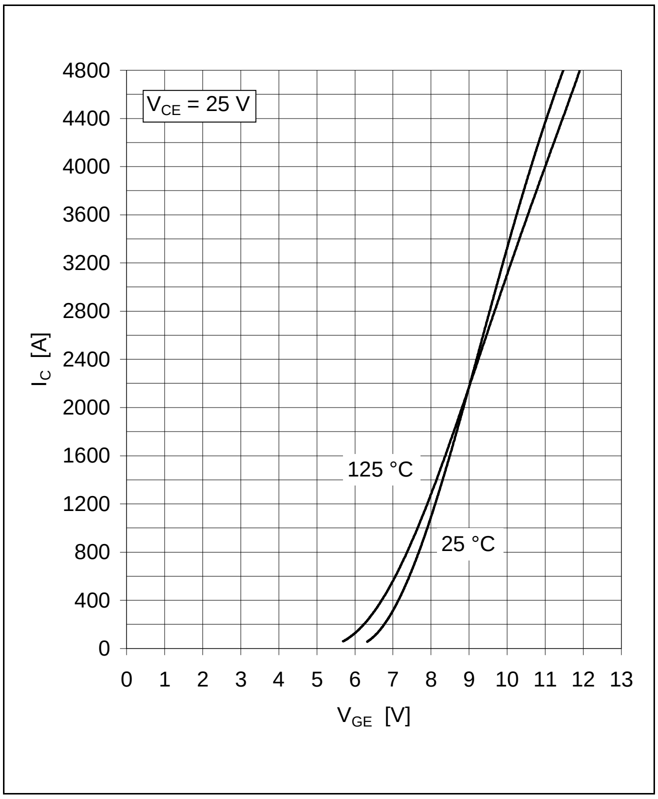


Fig. 2 Typical transfer characteristics, chip level

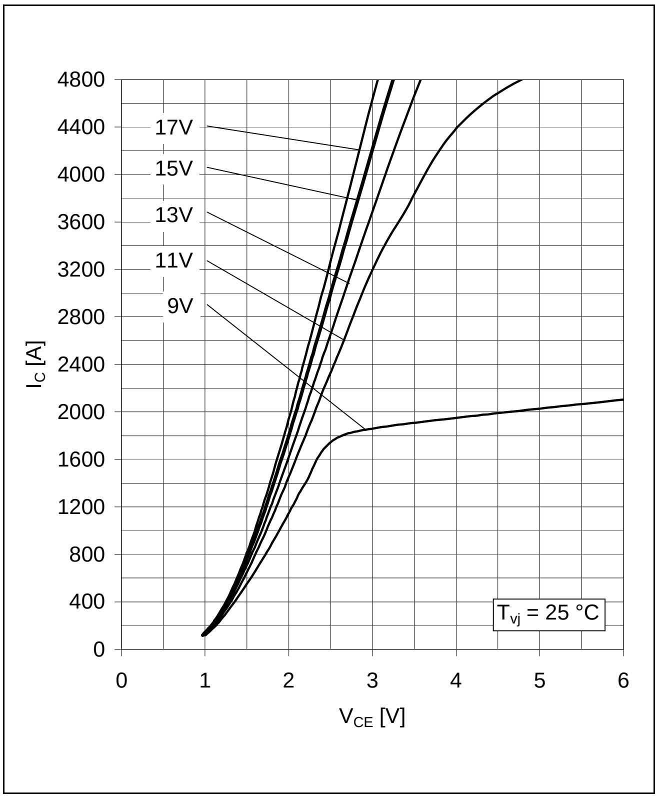


Fig. 3 Typical output characteristics, chip level

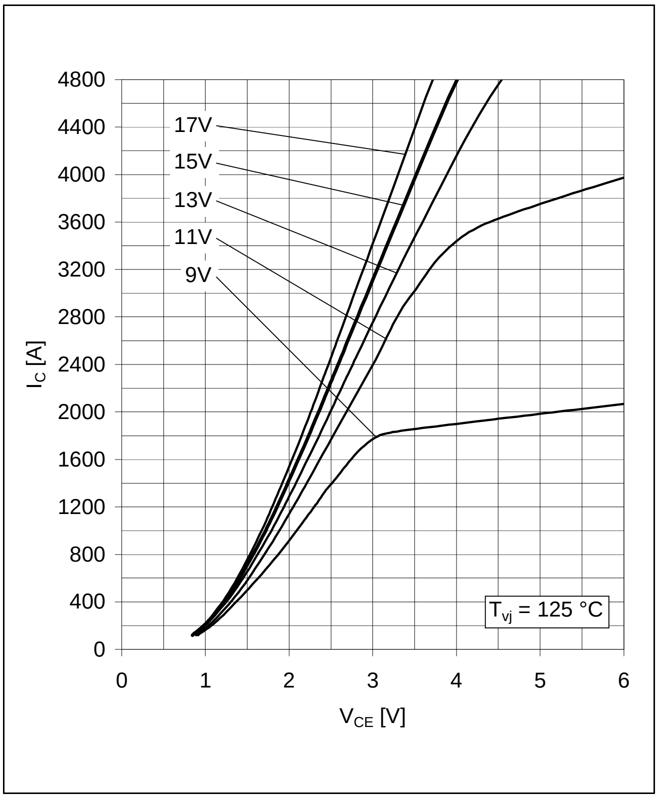


Fig. 4 Typical output characteristics, chip level

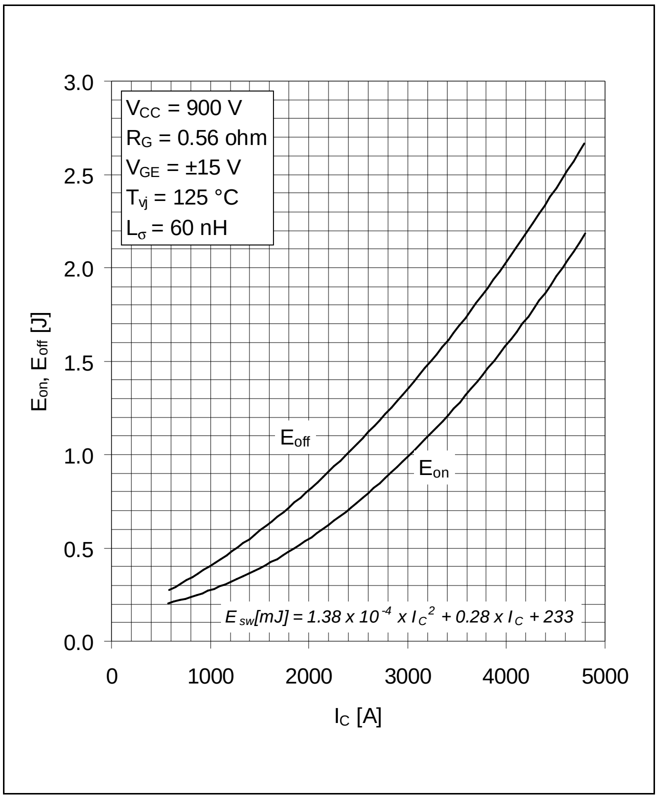


Fig. 5 Typical switching energies per pulse vs collector current

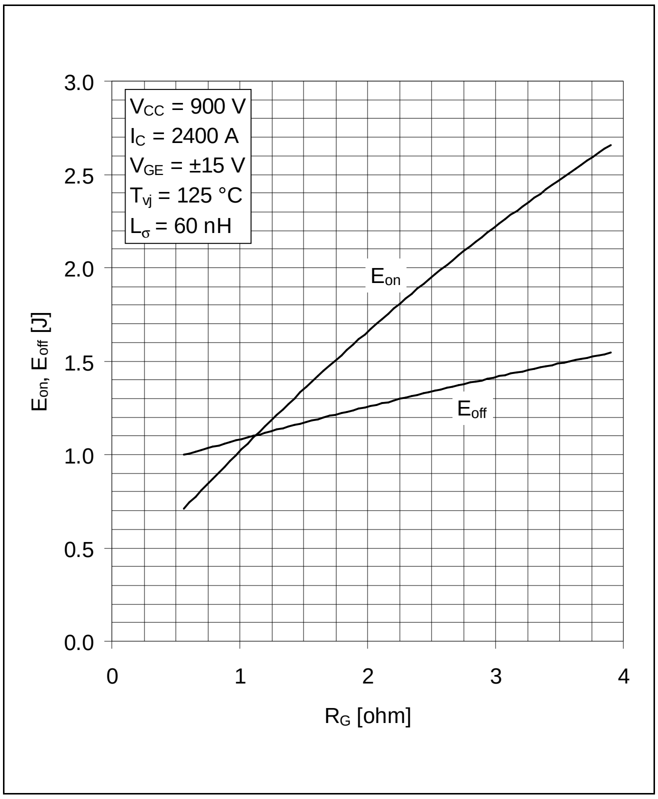


Fig. 6 Typical switching energies per pulse vs gate resistor

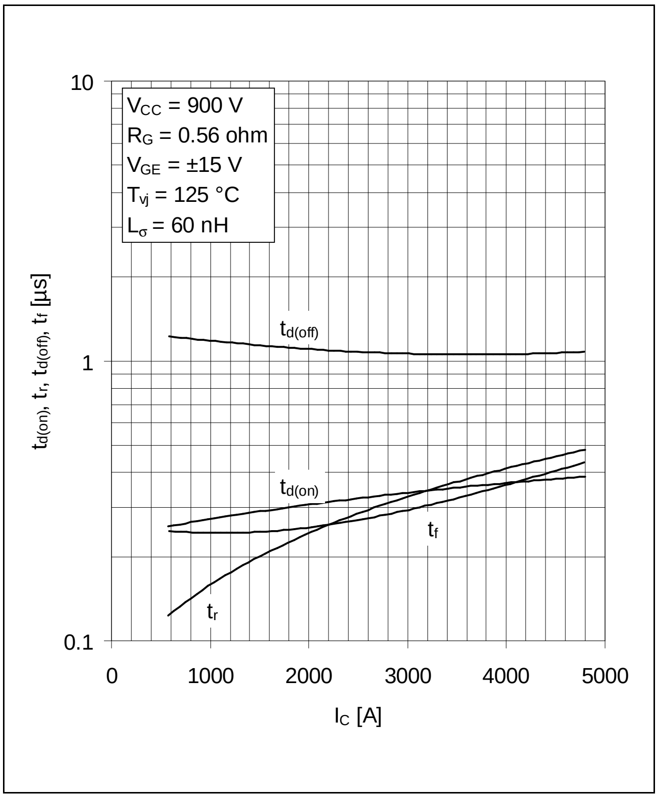


Fig. 7 Typical switching times vs collector current

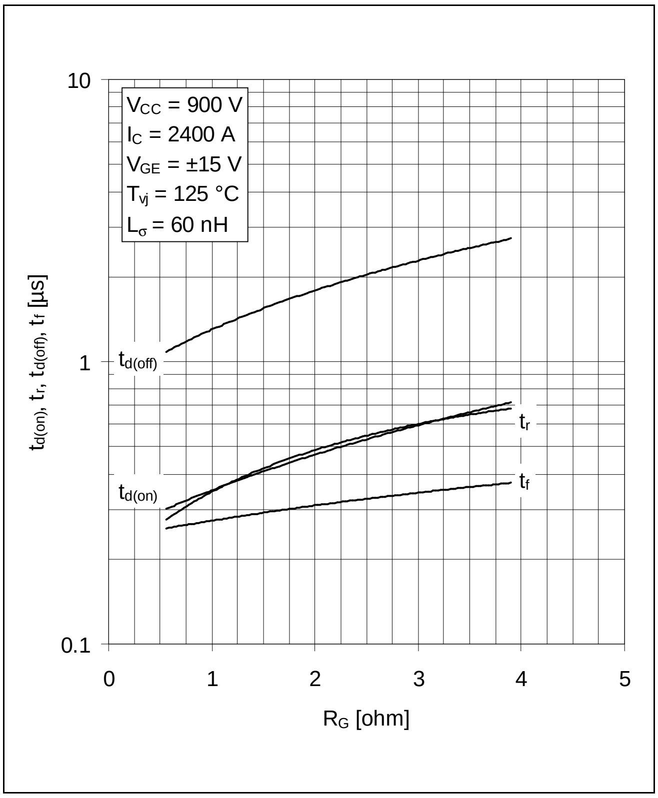


Fig. 8 Typical switching times vs gate resistor

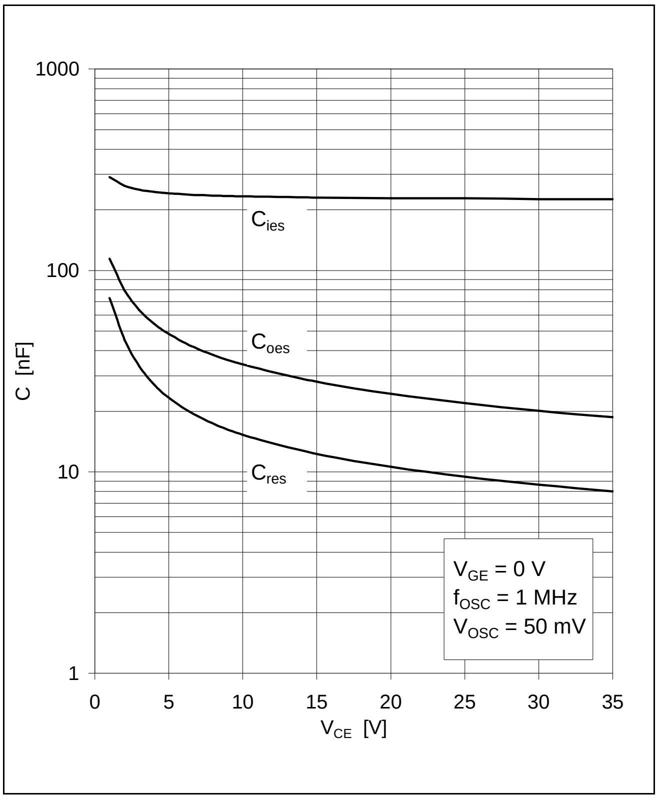


Fig. 9 Typical capacitances vs collector-emitter voltage

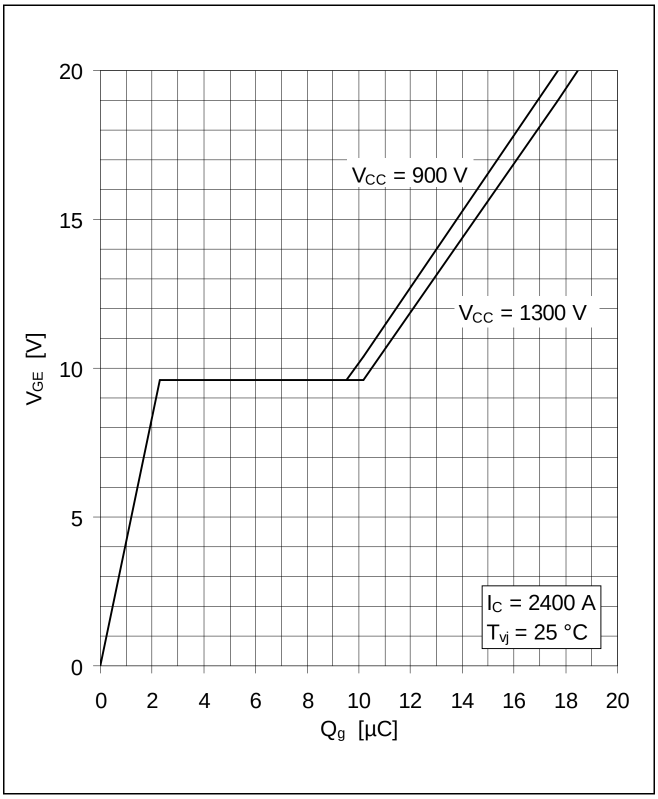


Fig. 10 Typical gate charge characteristics

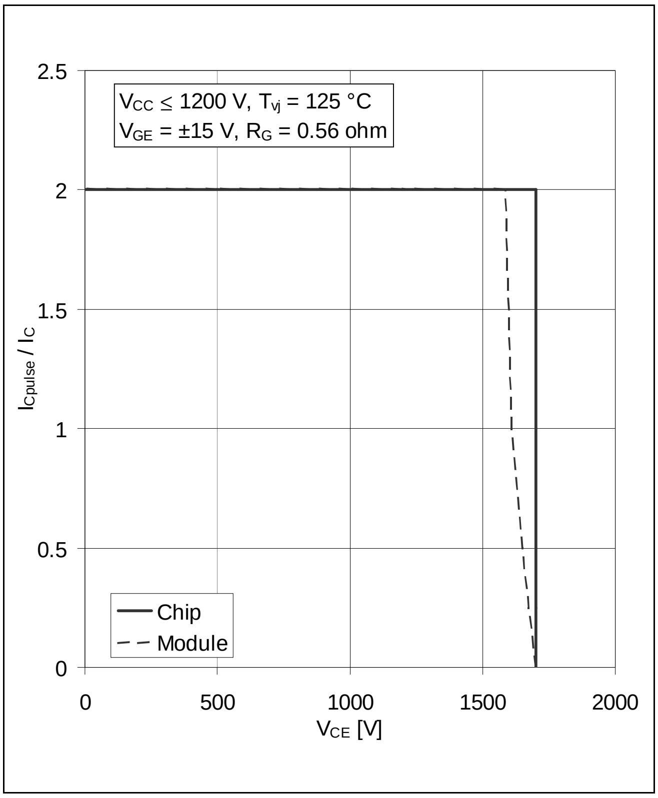


Fig. 11 Turn-off safe operating area (RBSOA)

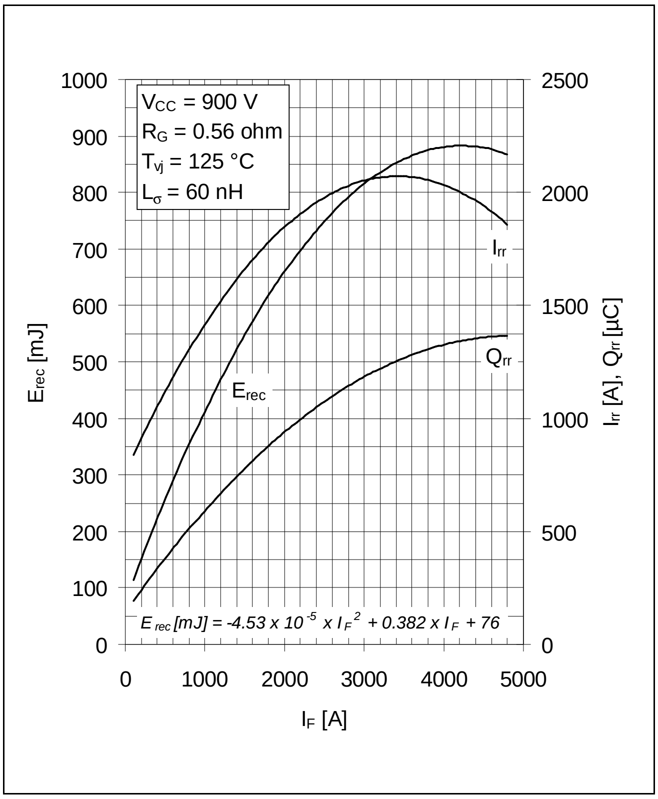


Fig. 12 Typical reverse recovery characteristics vs forward current

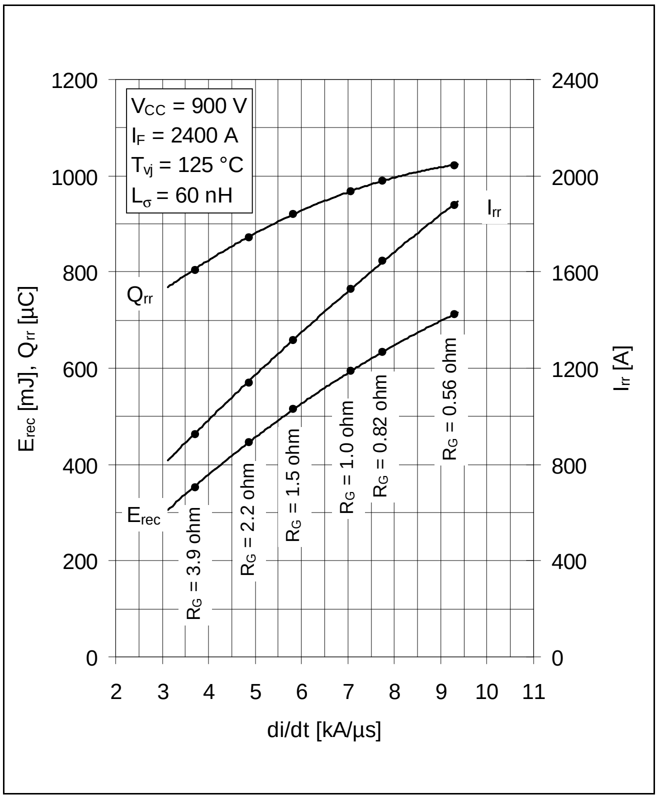


Fig. 13 Typical reverse recovery characteristics vs di/dt

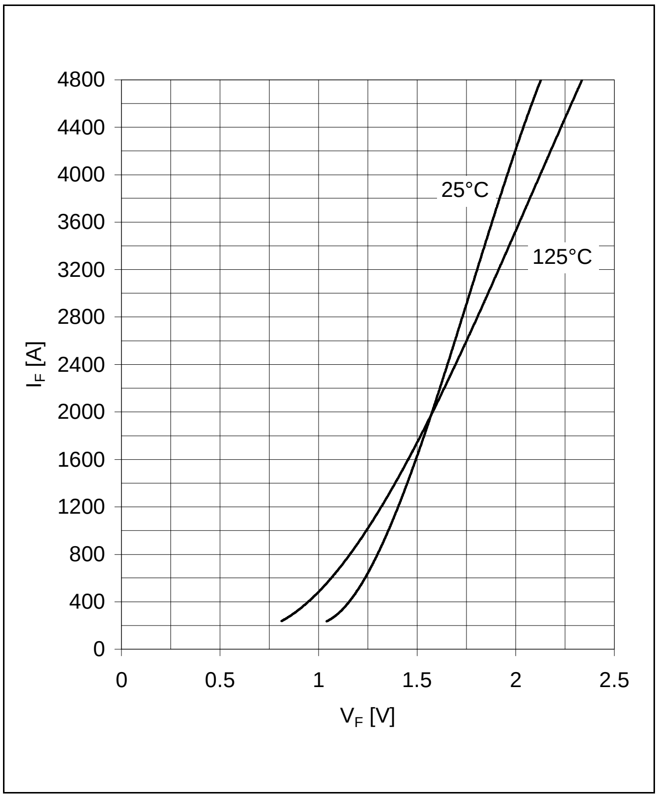


Fig. 14 Typical diode forward characteristics, chip level

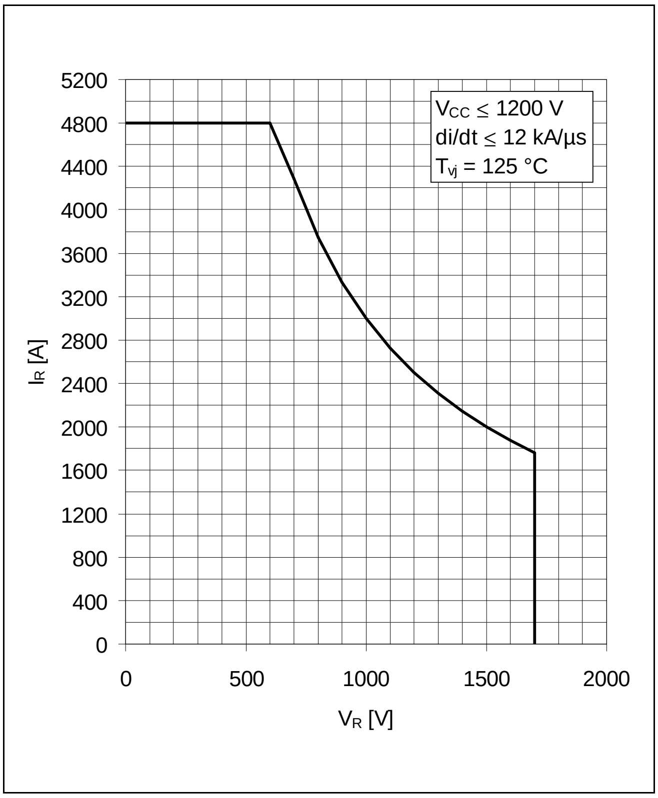


Fig. 15 Safe operating area diode (SOA)

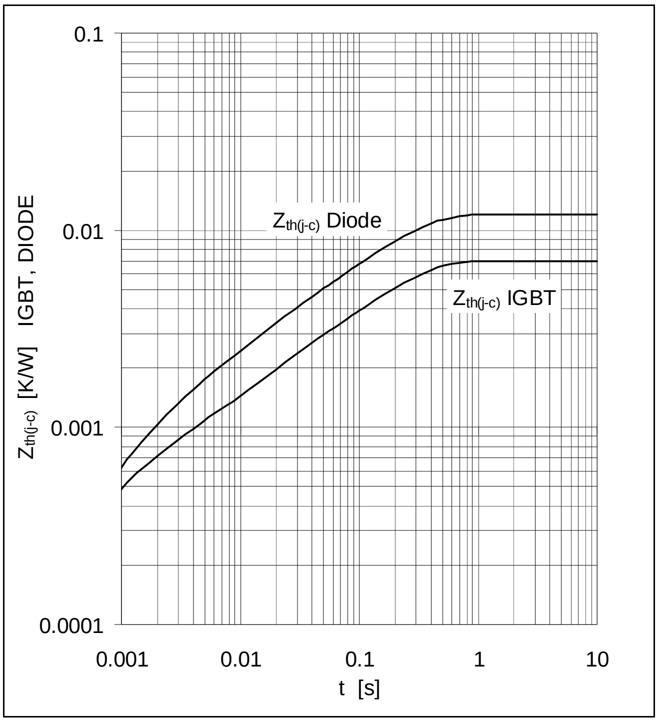


Fig. 16 Thermal impedance vs time

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	
IGBT	R_i(K/kW)	5.059	1.201	0.495	0.246	
	τ_i(ms)	202.9	20.3	2.01	0.52	
DIODE	R_i(K/kW)	8.432	1.928	0.866	0.839	
	τ_i(ms)	210	29.6	7.01	1.49	

For detailed information refer to:

- 5SYA 2042-02 Failure rates of HiPak modules due to cosmic rays
- 5SYA 2043-01 Load – cycle capability of HiPaks
- 5SZK 9120-00 Specification of environmental class for HiPak (available upon request)

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