V_{CE} = 6500 V
I_C = 400 A

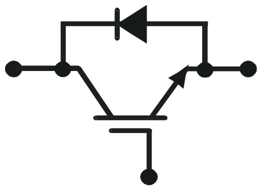


ABB HiPak™

IGBT Module

5SNA 0400J650100

Doc. No. 5SYA 1592-01 Jun 07

- **Low-loss, rugged SPT chip-set**
- **Smooth switching SPT chip-set for good EMC**
- **High insulation package**
- **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} ≥ 25 °C		6500	V
DC collector current	I_C	T_c = 85 °C		400	A
Peak collector current	I_{CM}	t_p = 1 ms, T_c = 85 °C		800	A
Gate-emitter voltage	V_{GES}		-20	20	V
Total power dissipation	P_{tot}	T_c = 25 °C, per switch (IGBT)		7350	W
DC forward current	I_F			400	A
Peak forward current	I_{FRM}			800	A
Surge current	I_{FSM}	V_R = 0 V, T_{vj} = 125 °C, t_p = 10 ms, half-sinewave		4000	A
IGBT short circuit SOA	t_{psc}	V_{CC} = 4400 V, $V_{CEM\,CHIP}$ ≤ 6500 V V_{GE} ≤ 15 V, T_{vj} ≤ 125 °C		10	µs
Isolation voltage	V_{isol}	1 min, f = 50 Hz		10200	V
Junction temperature	T_{vj}			125	°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

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		6500			V
Collector-emitter [4)] saturation voltage	$V_{CE\ sat}$	I_C = 400 A, V_{GE} = 15 V	T_{vj} = 25 °C		4.2	4.8	V
			T_{vj} = 125 °C		5.4	5.9	V
Collector cut-off current	I_{CES}	V_{CE} = 6500 V, V_{GE} = 0 V	T_{vj} = 25 °C			8	mA
			T_{vj} = 125 °C		35	80	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 = 160 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		6	7.4	8	V
Gate charge	Q_{ge}	I_C = 400 A, V_{CE} = 3600 V, V_{GE} = -15 V .. 15 V			5.3		µC
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz, T_{vj} = 25 °C			95.3		nF
Output capacitance	C_{oes}				4.41		
Reverse transfer capacitance	C_{res}				0.85		
Turn-on delay time	$t_{d(on)}$	V_{CC} = 3600 V, I_C = 400 A, R_G = 5.6 Ω, V_{GE} = ±15 V, L_σ = 280 nH, inductive load	T_{vj} = 25 °C		700		ns
			T_{vj} = 125 °C		630		
Rise time	t_r		T_{vj} = 25 °C		250		ns
			T_{vj} = 125 °C		220		
Turn-off delay time	$t_{d(off)}$	V_{CC} = 3600 V, I_C = 400 A, R_G = 5.6 Ω, V_{GE} = ±15 V, L_σ = 280 nH, inductive load	T_{vj} = 25 °C		1410		ns
			T_{vj} = 125 °C		1700		
Fall time	t_f		T_{vj} = 25 °C		650		ns
			T_{vj} = 125 °C		980		
Turn-on switching energy	E_{on}	V_{CC} = 3600 V, I_C = 400 A, V_{GE} = ±15 V, R_G = 5.6 Ω, L_σ = 280 nH, inductive load	T_{vj} = 25 °C		2250		mJ
			T_{vj} = 125 °C		2800		
Turn-off switching energy	E_{off}	V_{CC} = 3600 V, I_C = 400 A, V_{GE} = ±15 V, R_G = 5.6 Ω, L_σ = 280 nH, inductive load	T_{vj} = 25 °C		1340		mJ
			T_{vj} = 125 °C		2120		
Short circuit current	I_{SC}	t_{psc} ≤ 10 µs, V_{GE} = 15 V, T_{vj} = 125 °C, V_{CC} = 4400 V, $V_{CEM\ CHIP}$ ≤ 6500 V			1800		A
Module stray inductance	$L_{\sigma\ CE}$				20		nH
Resistance, terminal-chip	$R_{CC'+EE'}$		T_C = 25 °C		0.1		mΩ
			T_C = 125 °C		0.15		

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 = 400 A	T_{vj} = 25 °C		3.2	3.8	V
			T_{vj} = 125 °C		3.4	4.0	
Reverse recovery current	I_{rr}	V_{CC} = 3600 V, I_F = 400 A, V_{GE} = ±15 V, R_G = 5.6 Ω L_σ = 280 nH inductive load	T_{vj} = 25 °C		510		A
			T_{vj} = 125 °C		680		
Recovered charge	Q_{rr}		T_{vj} = 25 °C		450		µC
			T_{vj} = 125 °C		770		
Reverse recovery time	t_{rr}		T_{vj} = 25 °C		1840		ns
			T_{vj} = 125 °C		2120		
Reverse recovery energy	E_{rec}		T_{vj} = 25 °C		670		mJ
			T_{vj} = 125 °C		1380		

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	$R_{th(j-c)IGBT}$				0.016	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.032	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 [7)] 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} ≤ 10pC (acc. to IEC 61287)	5100			V
Comparative tracking index	CTI			≥ 600		

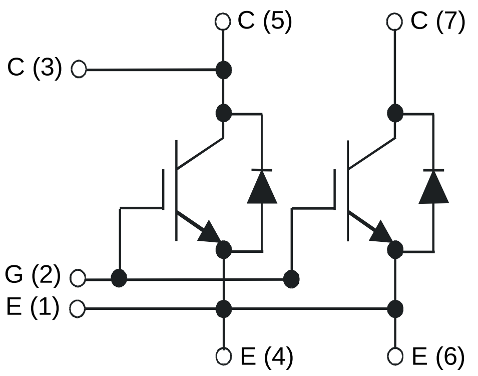
2) For detailed mounting instructions refer to ABB Document No. 5SYA2039

Mechanical properties [7)]

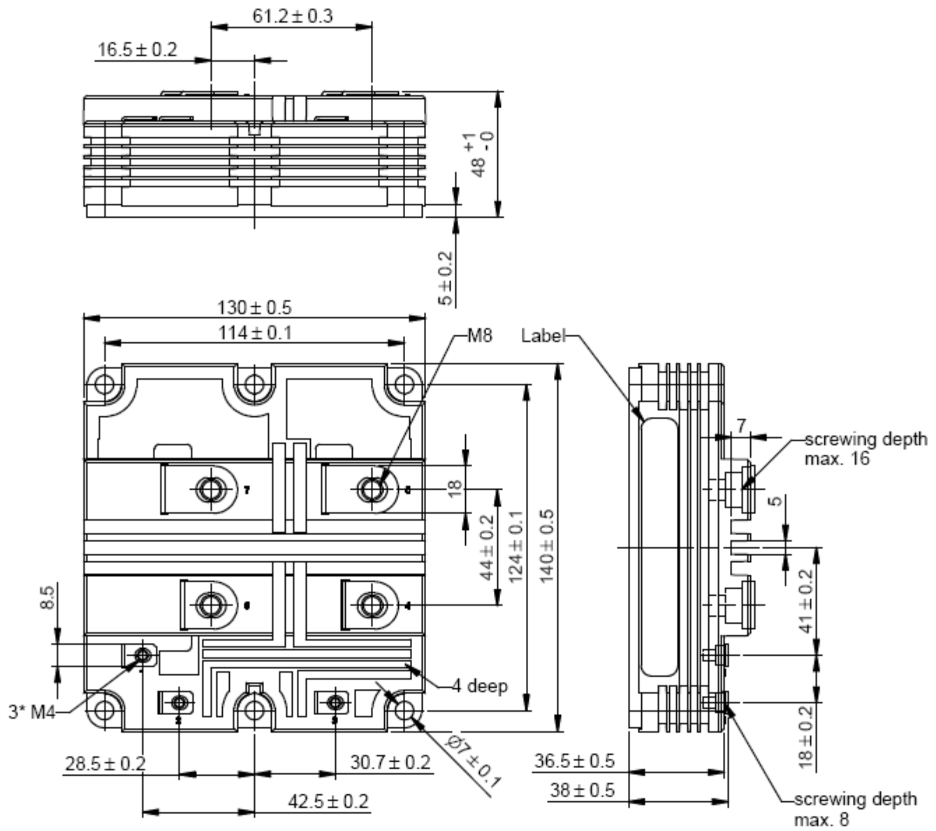
Parameter	Symbol	Conditions		min	typ	max	Unit
Dimensions	L x W x H	Typical , see outline drawing			130 x 140 x 48		mm
Clearance distance in air	d_a	according to IEC 60664-1 and EN 50124-1	Term. to base:	40			mm
			Term. to term:	26			
Surface creepage distance	d_s	according to IEC 60664-1 and EN 50124-1	Term. to base:	64			mm
			Term. to term:	56			
Mass	m				1150		g

7) Package 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.

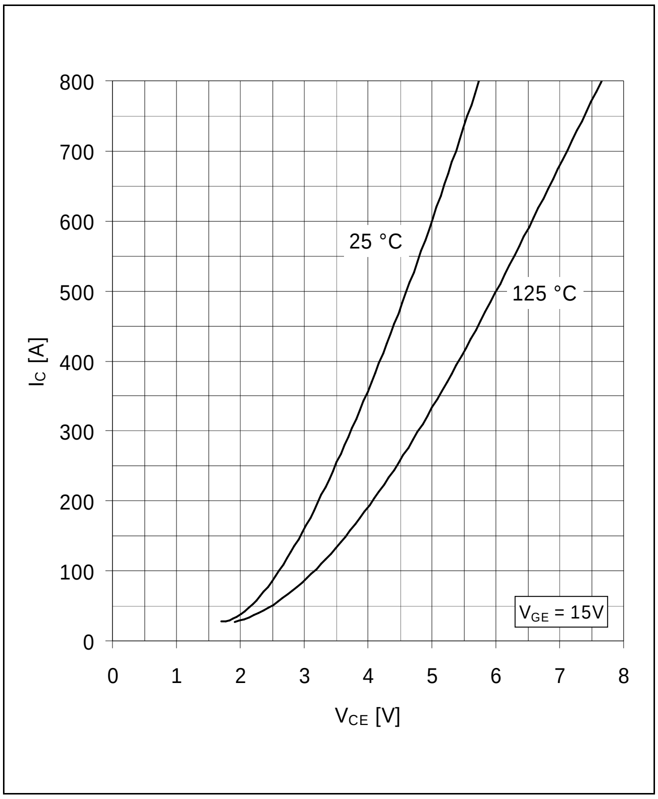


Fig. 1 Typical on-state characteristics, chip level

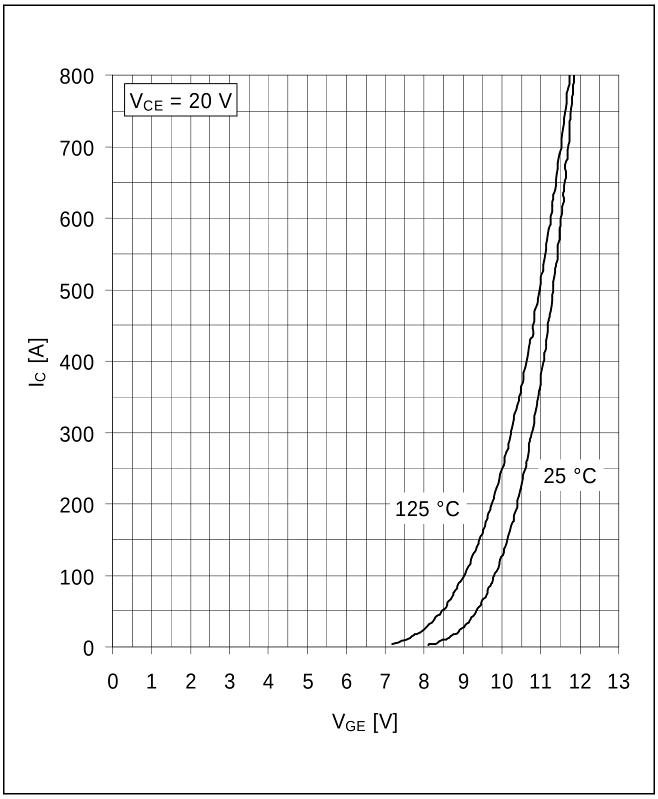


Fig. 2 Typical transfer characteristics, chip level

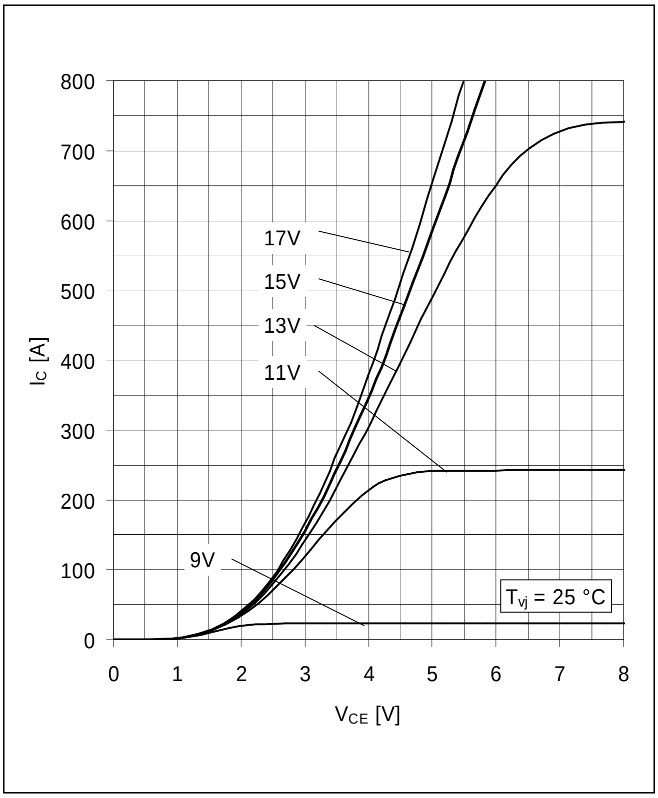


Fig. 3 Typical output characteristics, chip level

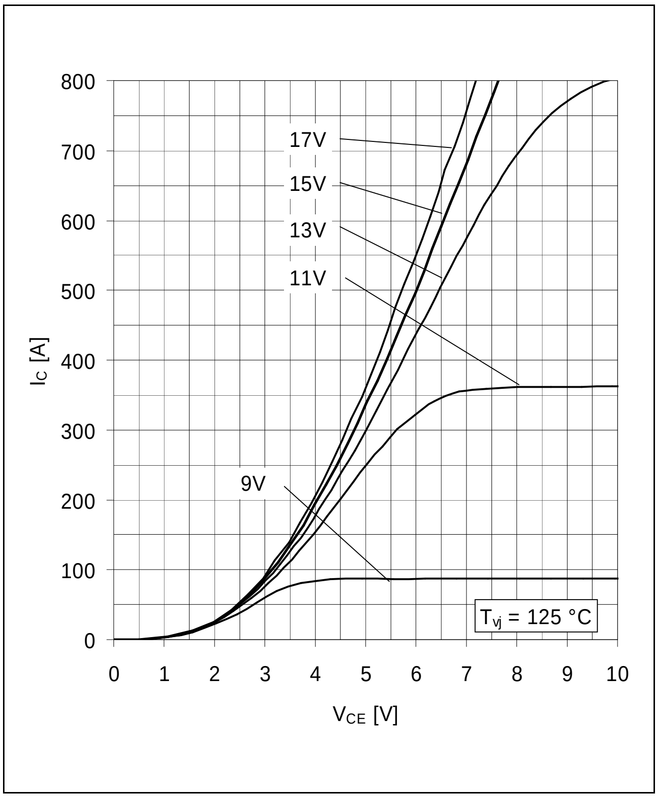


Fig. 4 Typical output characteristics, chip level

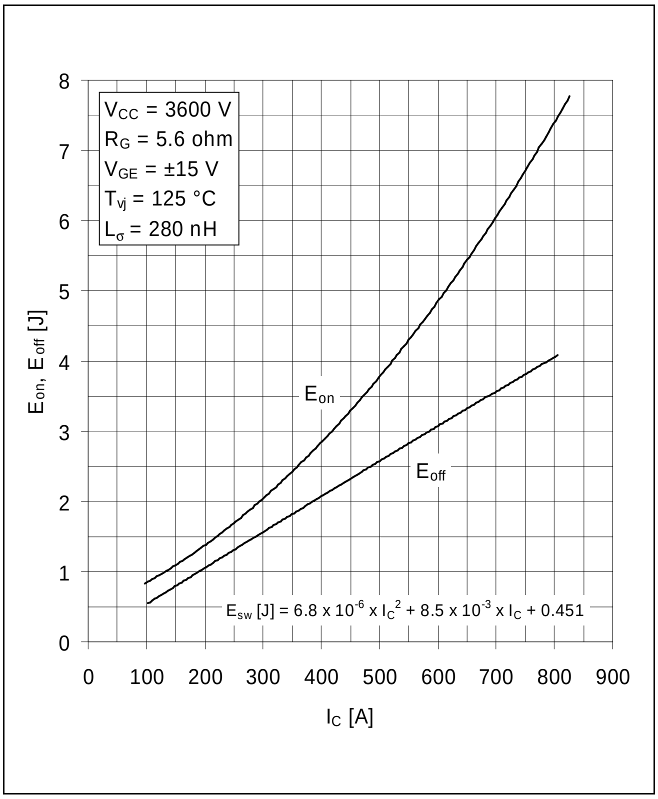


Fig. 5 Typical switching energies per pulse vs collector current

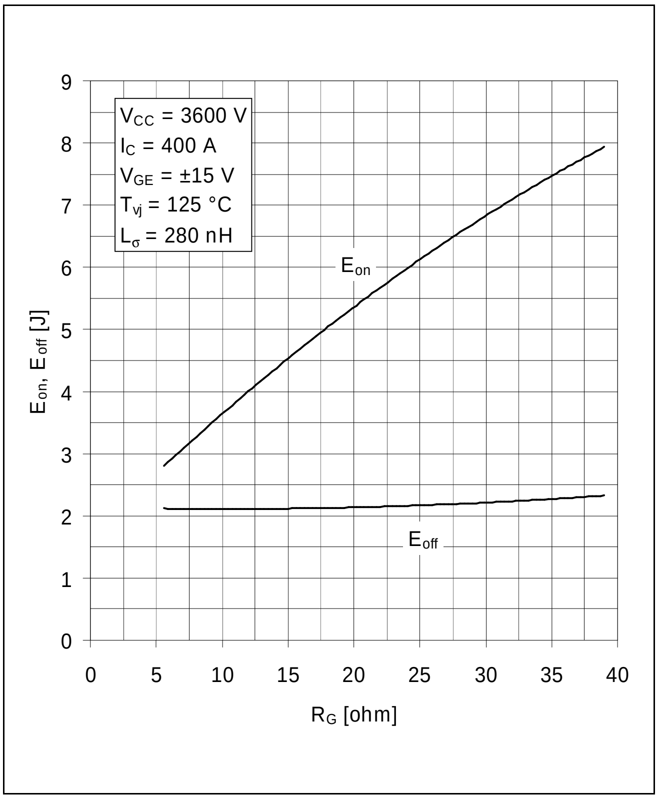


Fig. 6 Typical switching energies per pulse vs gate resistor

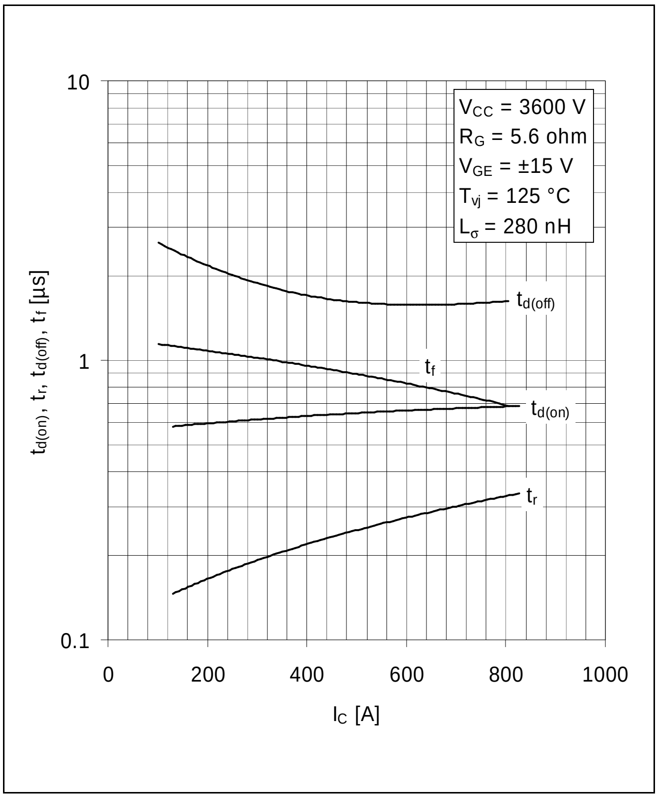


Fig. 7 Typical switching times vs collector current

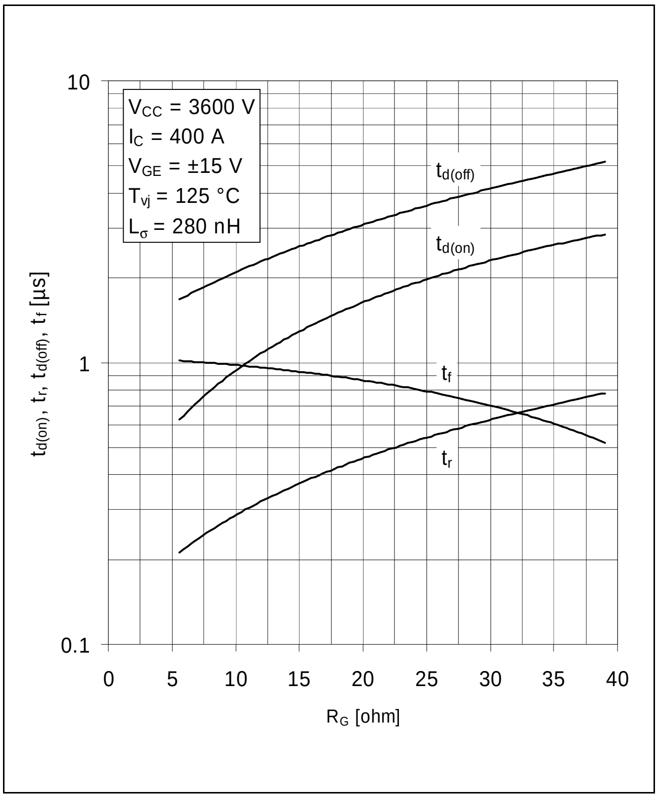


Fig. 8 Typical switching times vs gate resistor

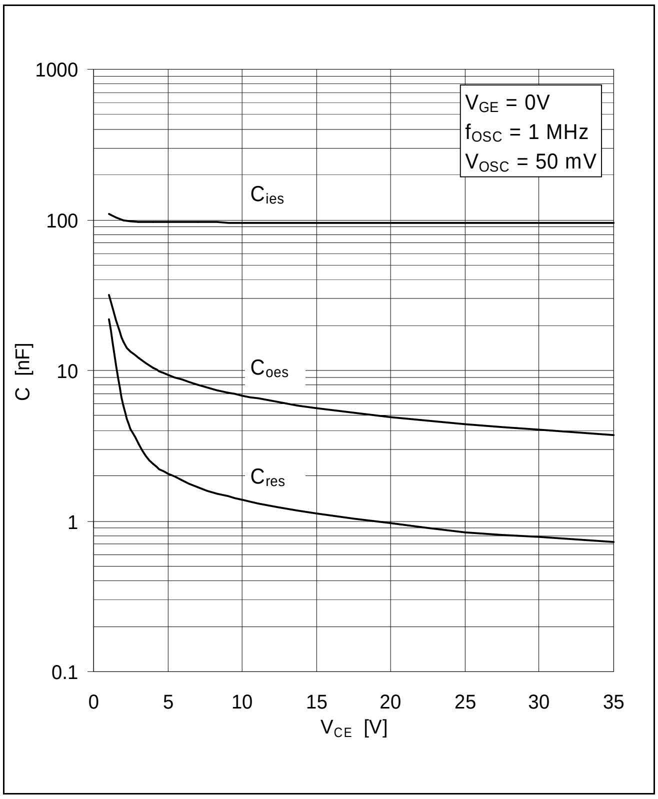


Fig. 9 Typical capacitances vs collector-emitter voltage

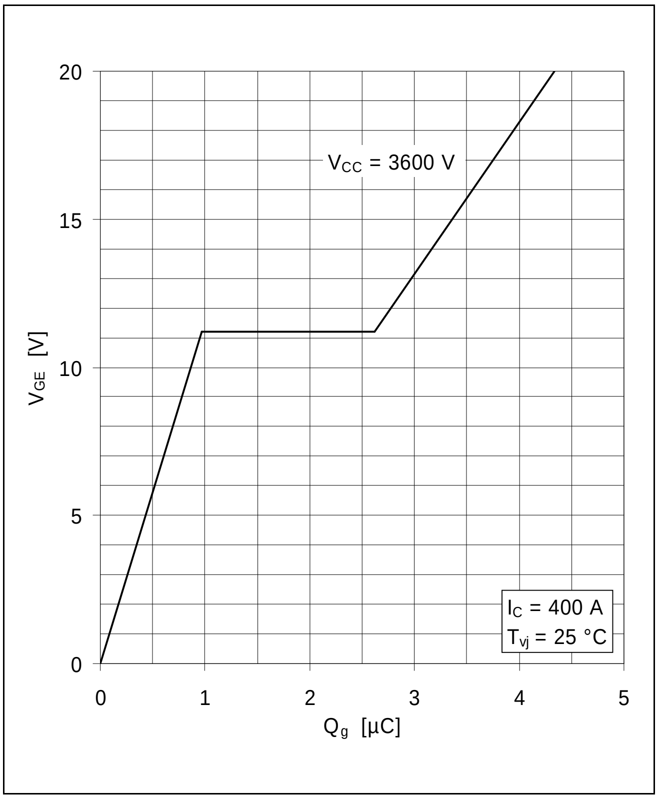


Fig. 10 Typical gate charge characteristics

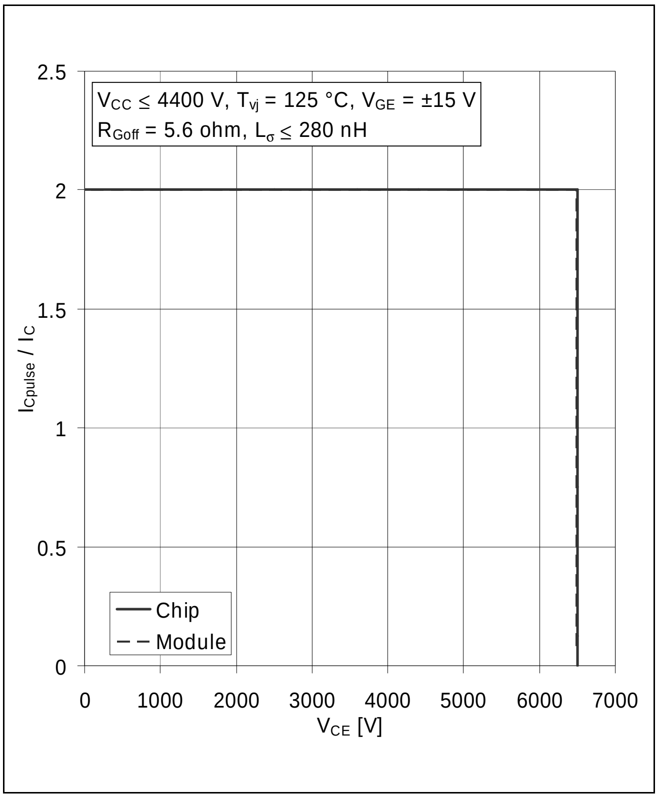


Fig. 11 Turn-off safe operating area (RBSOA)

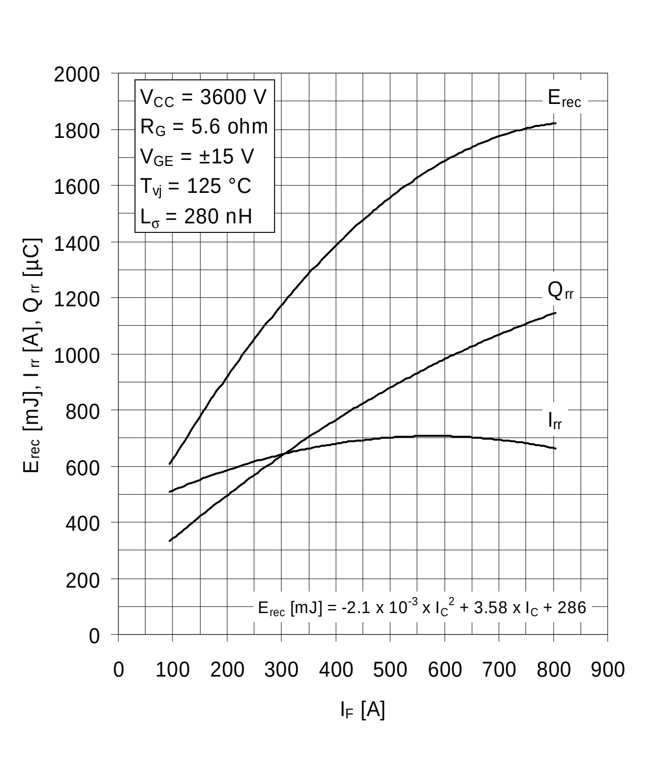


Fig. 12 Typical reverse recovery characteristics vs forward current

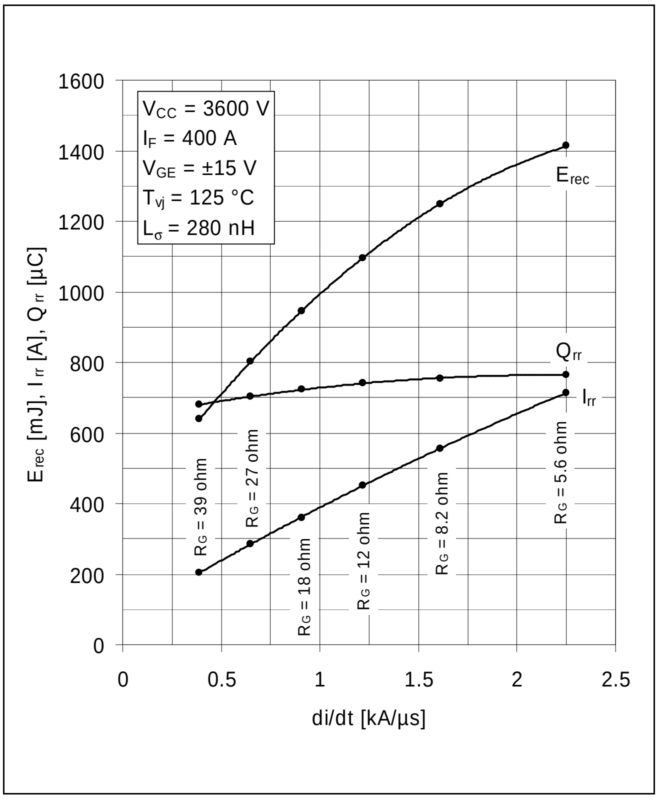


Fig. 13 Typical reverse recovery characteristics vs di/dt

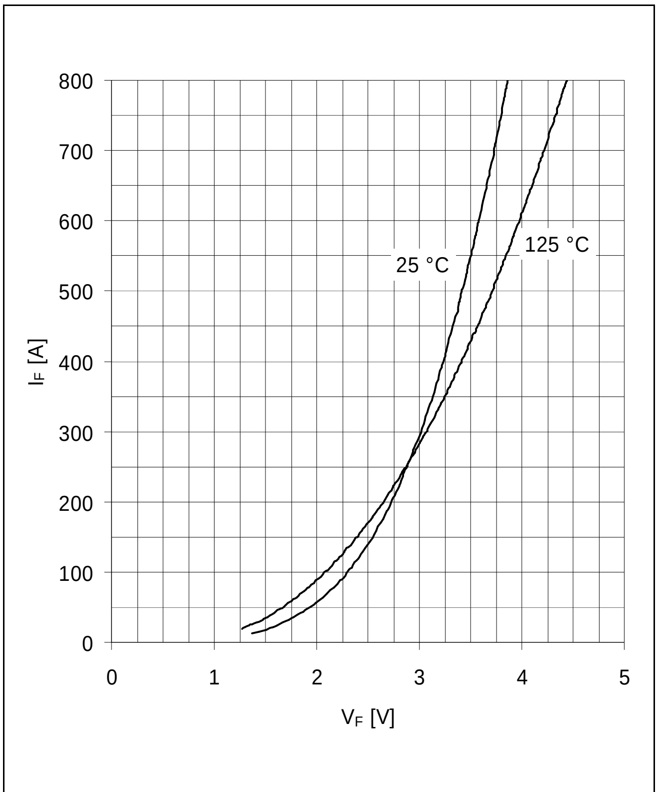


Fig. 14 Typical diode forward characteristics, chip level

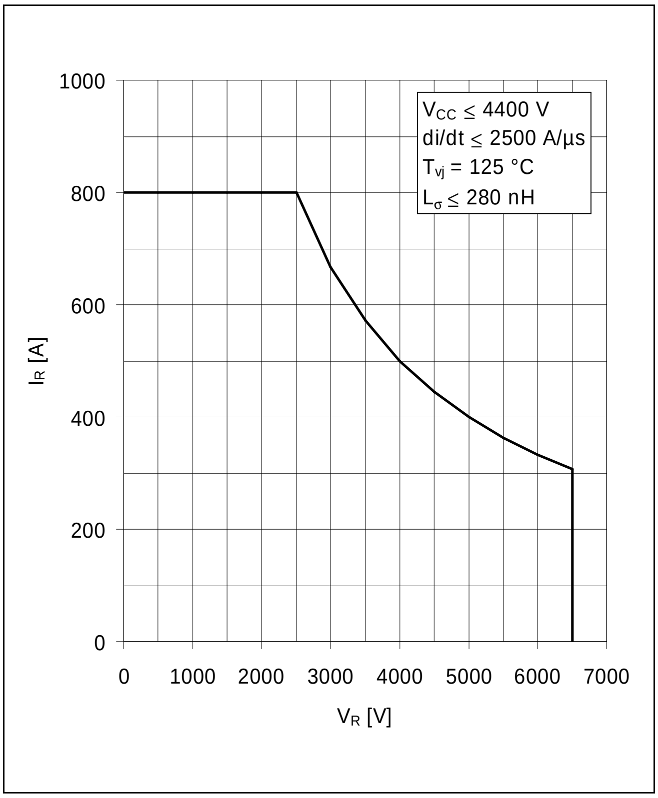


Fig. 15 Safe operating area diode (SOA)

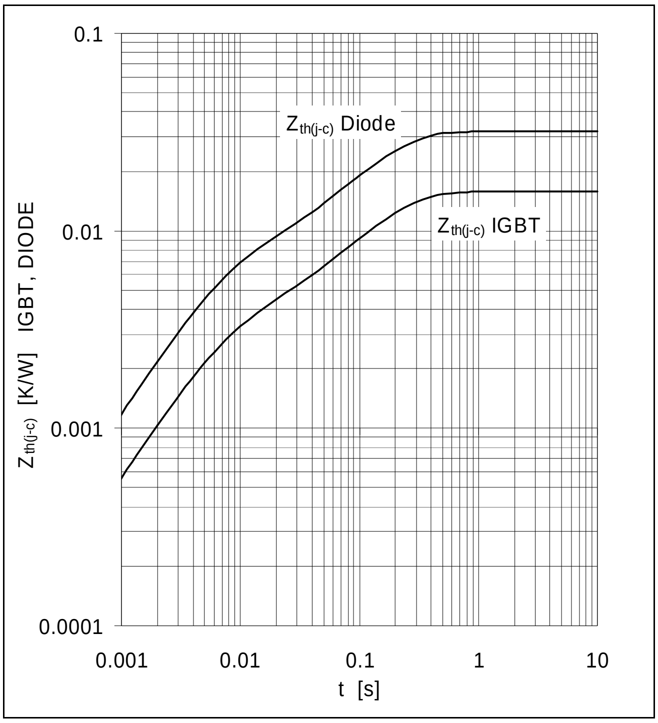


Fig. 16 Thermal impedance vs time

Analytical function for transient thermal impedance:

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

	i	1	2	3	4	5
IGBT	R_i(K/kW)	12.75	2.99			
	τ_i(ms)	151	5.84			
DIODE	R_i(K/kW)	25.5	6.3			
	τ_i(ms)	144	5.83			

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

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