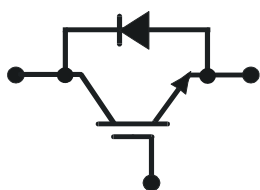


$V_{CE} = 6500 \text{ V}$
 $I_C = 400 \text{ A}$

ABB HiPak



IGBT Module 5SNA 0400J650100

Doc. No. 5SYA 1592-04 05-2016

- 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
- Improved high reliability package
- Recognized under UL1557, File E196689



Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	V_{CES}	$V_{GE} = 0 \text{ V}$, $T_{vj} \geq 25 \text{ °C}$		6500	V
DC collector current	I_C	$T_c = 85 \text{ °C}$		400	A
Peak collector current	I_{CM}	$t_p = 1 \text{ ms}$, $T_c = 85 \text{ °C}$		800	A
Gate-emitter voltage	V_{GES}		-20	20	V
Total power dissipation	P_{tot}	$T_c = 25 \text{ °C}$, per switch (IGBT)		7350	W
DC forward current	I_F			400	A
Peak forward current	I_{FRM}			800	A
Surge current	I_{FSM}	$V_R = 0 \text{ V}$, $T_{vj} = 125 \text{ °C}$, $t_p = 10 \text{ ms}$, half-sinewave		4000	A
IGBT short circuit SOA	t_{psc}	$V_{CC} = 4400 \text{ V}$, $V_{CEMCHIP} \leq 6500 \text{ V}$ $V_{GE} \leq 15 \text{ V}$, $T_{vj} \leq 125 \text{ °C}$		10	μs
Isolation voltage	V_{isol}	1 min, $f = 50 \text{ Hz}$		10200	V
Junction temperature	T_{vj}			125	°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 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	$V_{(BR)CES}$	$V_{GE} = 0 \text{ V}$, $I_C = 10 \text{ mA}$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$	6500			V
Collector-emitter ⁴⁾ saturation voltage	$V_{CE \text{ sat}}$	$I_C = 400 \text{ A}$, $V_{GE} = 15 \text{ V}$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$		4.2	4.8	V
		$T_{vj} = 125 \text{ }^{\circ}\text{C}$		5.4	5.9	V
Collector cut-off current	I_{CES}	$V_{CE} = 6500 \text{ V}$, $V_{GE} = 0 \text{ V}$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$			8	mA
		$T_{vj} = 125 \text{ }^{\circ}\text{C}$		35	80	mA
Gate leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$, $T_{vj} = 125 \text{ }^{\circ}\text{C}$	-500		500	nA
Gate-emitter threshold voltage	$V_{GE(TO)}$	$I_C = 160 \text{ mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$	6	7.4	8	V
Gate charge	Q_{ge}	$I_C = 400 \text{ A}$, $V_{CE} = 3600 \text{ V}$, $V_{GE} = -15 \text{ V} \dots 15 \text{ V}$		5.3		μC
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 1 \text{ MHz}$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$		95.3		nF
Output capacitance	C_{oes}			4.41		
Reverse transfer capacitance	C_{res}			0.85		
Internal gate resistance	R_{Gint}			0.81		Ω
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 3600 \text{ V}$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$		700		ns
		$I_C = 400 \text{ A}$, $T_{vj} = 125 \text{ }^{\circ}\text{C}$		630		
Rise time	t_r	$R_G = 5.6 \text{ } \Omega$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$		250		ns
		$V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 125 \text{ }^{\circ}\text{C}$		220		
Turn-off delay time	$t_{d(off)}$	$L_{\sigma} = 280 \text{ nH}$, inductive load, $T_{vj} = 25 \text{ }^{\circ}\text{C}$		1410		ns
		$T_{vj} = 125 \text{ }^{\circ}\text{C}$		1700		
Fall time	t_f	$V_{CC} = 3600 \text{ V}$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$		650		ns
		$I_C = 400 \text{ A}$, $T_{vj} = 125 \text{ }^{\circ}\text{C}$		980		
Turn-on switching energy	E_{on}	$R_G = 5.6 \text{ } \Omega$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$		2250		mJ
		$V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 125 \text{ }^{\circ}\text{C}$		2800		
Turn-off switching energy	E_{off}	$L_{\sigma} = 280 \text{ nH}$, inductive load, $T_{vj} = 25 \text{ }^{\circ}\text{C}$		1340		mJ
		$T_{vj} = 125 \text{ }^{\circ}\text{C}$		2120		
Short circuit current	I_{SC}	$t_{psc} \leq 10 \text{ } \mu\text{s}$, $V_{GE} = 15 \text{ V}$, $T_{vj} = 125 \text{ }^{\circ}\text{C}$, $V_{CC} = 4400 \text{ V}$, $V_{CEM \text{ CHIP}} \leq 6500 \text{ V}$		1800		A
Module stray inductance	$L_{\sigma \text{ CE}}$			20		nH
Resistance, terminal-chip	$R_{CC'+EE'}$	$T_C = 25 \text{ }^{\circ}\text{C}$		0.1		m Ω
		$T_C = 125 \text{ }^{\circ}\text{C}$		0.15		

³⁾ Characteristic values according to IEC 60747 – 9⁴⁾ 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	$I_F = 400 \text{ A}$	$T_{vj} = 25 \text{ °C}$	3.2	3.8	V
			$T_{vj} = 125 \text{ °C}$	3.4	4.0	
Reverse recovery current	I_{rr}	$V_{CC} = 3600 \text{ V},$ $I_F = 400 \text{ A},$ $V_{GE} = \pm 15 \text{ V},$ $R_G = 5.6 \text{ } \Omega$ $L_\sigma = 280 \text{ nH}$ inductive load	$T_{vj} = 25 \text{ °C}$	510		A
			$T_{vj} = 125 \text{ °C}$	680		
Recovered charge	Q_{rr}		$T_{vj} = 25 \text{ °C}$	450		μC
			$T_{vj} = 125 \text{ °C}$	770		
Reverse recovery time	t_{rr}		$T_{vj} = 25 \text{ °C}$	1840		ns
			$T_{vj} = 125 \text{ °C}$	2120		
Reverse recovery energy	E_{rec}		$T_{vj} = 25 \text{ °C}$	670		mJ
			$T_{vj} = 125 \text{ °C}$	1380		

⁵⁾ Characteristic values according to IEC 60747 – 2⁶⁾ Forward voltage is given at chip level**Package properties** ⁷⁾

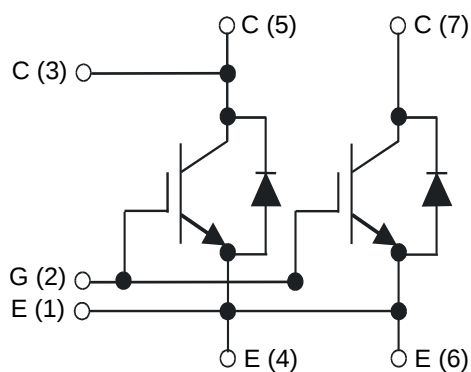
Parameter	Symbol	Conditions	min	typ	max	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$				0.016	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.032	K/W
IGBT thermal resistance ²⁾ case to heatsink	$R_{th(c-s)IGBT}$	IGBT per switch, λ grease = $1\text{W/m} \times \text{K}$		0.012		K/W
Diode thermal resistance ⁷⁾ case to heatsink	$R_{th(c-s)DIODE}$	Diode per switch, λ grease = $1\text{W/m} \times \text{K}$		0.024		K/W
Partial discharge extinction voltage	V_e	$f = 50 \text{ Hz}, Q_{PD} \leq 10\text{pC}$ (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⁾

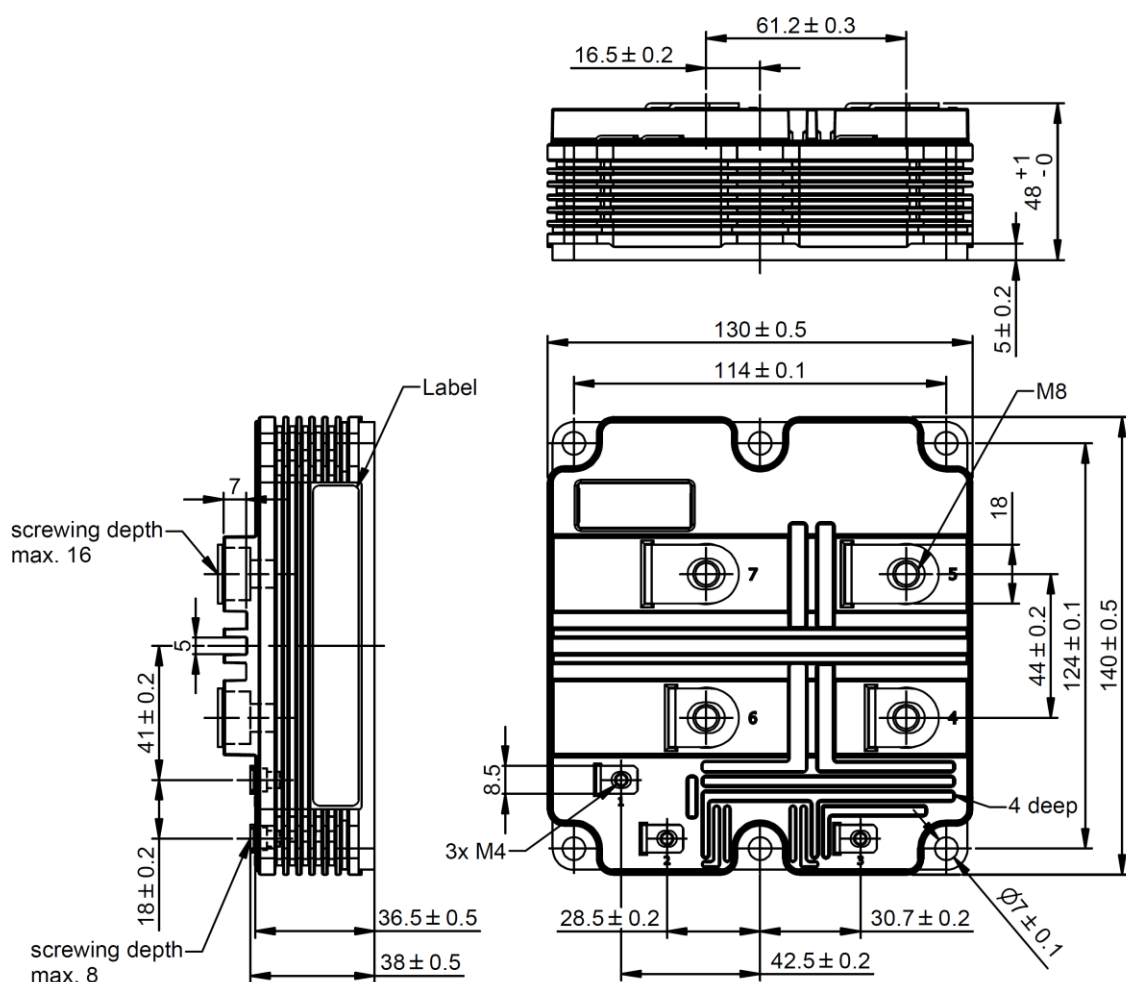
Parameter	Symbol	Conditions	min	typ	max	Unit
Dimensions	$L \times W \times H$	Typical , see outline drawing	130 × 140 × 48			mm
Clearance distance in air	d_a	according to IEC 60664-1 and EN 50124-1	Term. to base: 40			mm
			Term. to term: 26			
Surface creepage distance	d_s	according to IEC 60664-1 and EN 50124-1	Term. to base: 64			mm
			Term. to term: 56			
Mass	m			1010		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.

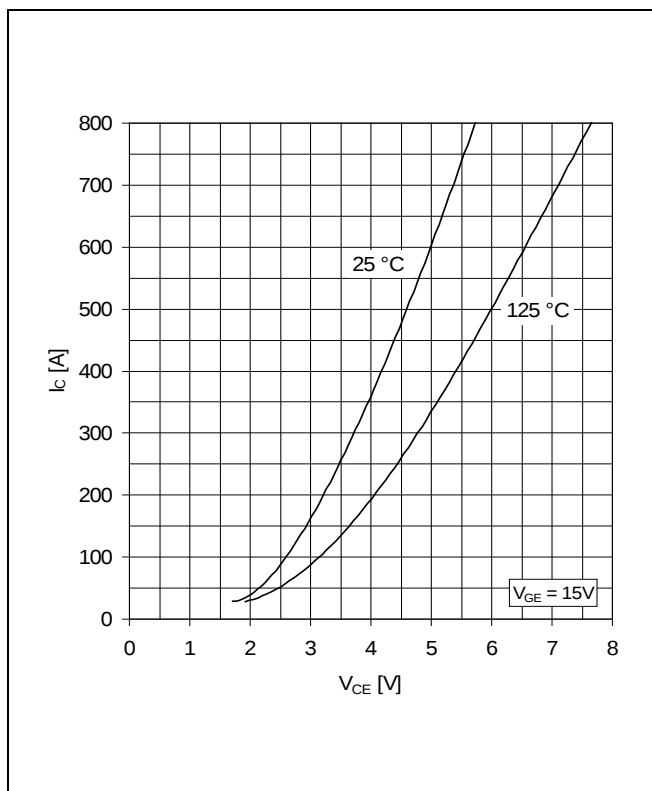


Fig. 1 Typical on-state characteristics, chip level

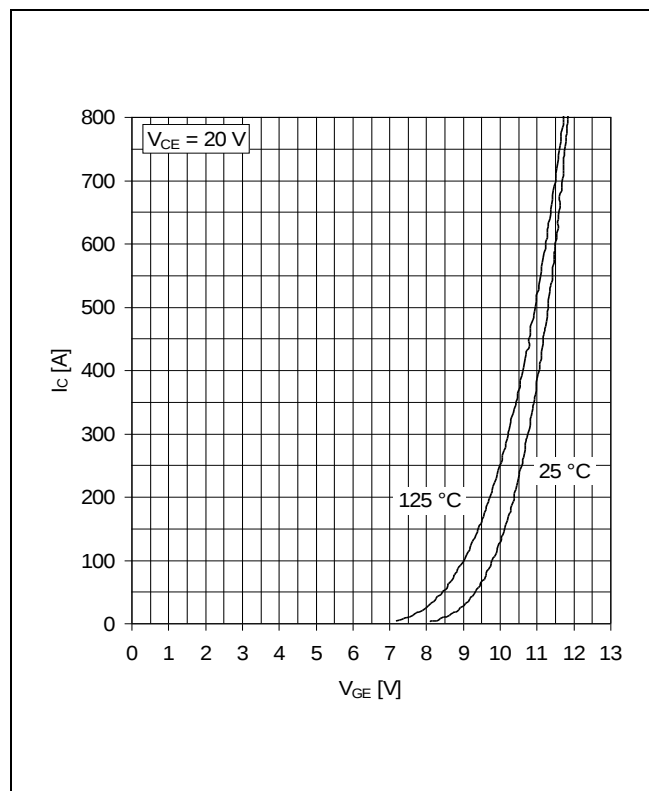


Fig. 2 Typical transfer characteristics, chip level

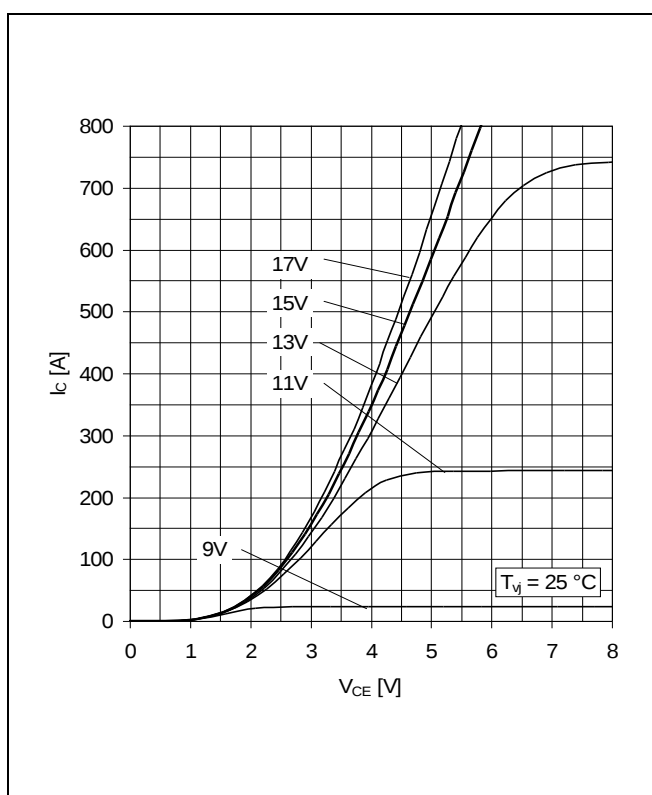


Fig. 3 Typical output characteristics, chip level

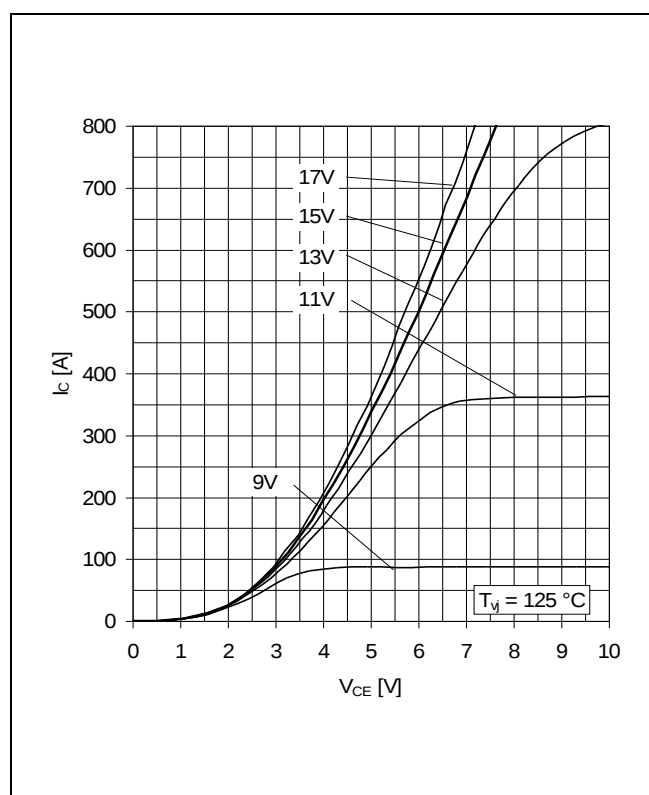


Fig. 4 Typical output characteristics, chip level

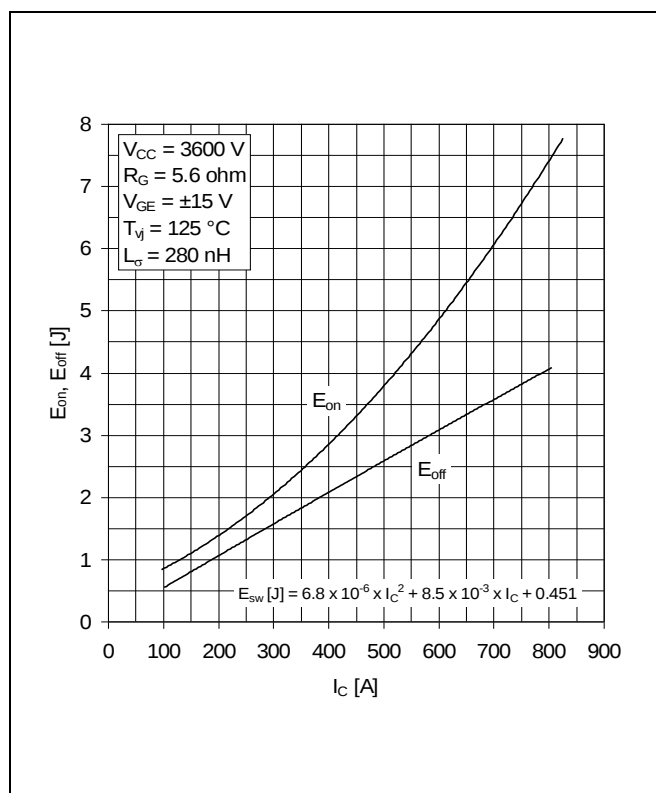


Fig. 5 Typical switching energies per pulse vs collector current

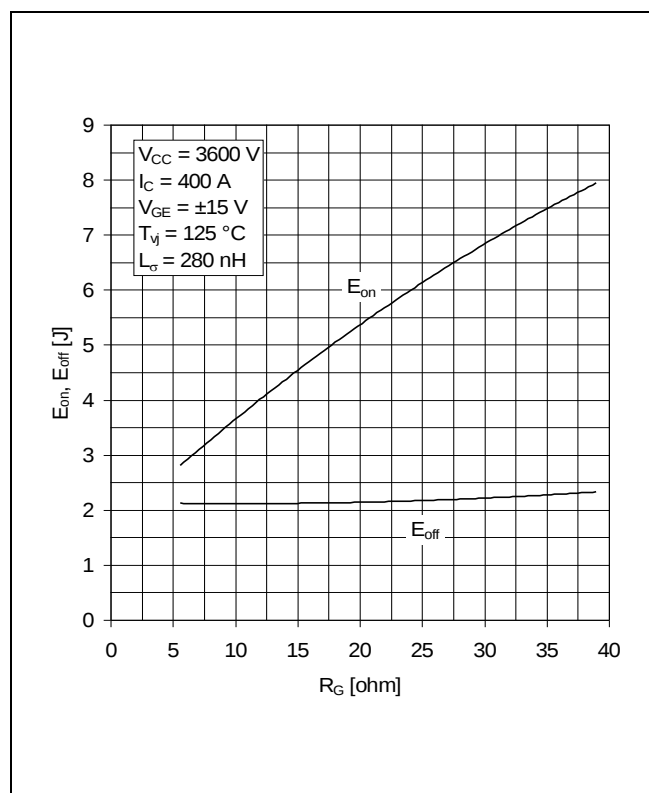


Fig. 6 Typical switching energies per pulse vs gate resistor

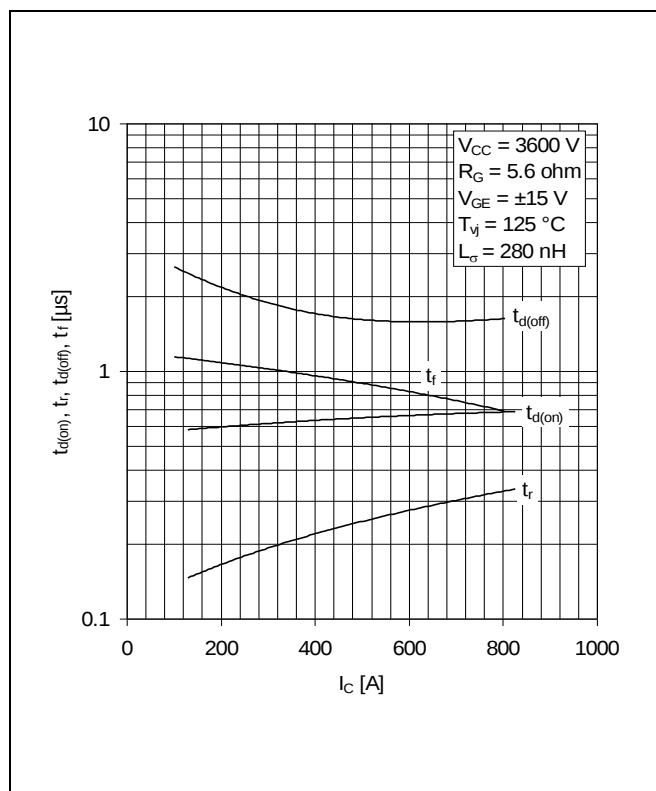


Fig. 7 Typical switching times vs collector current

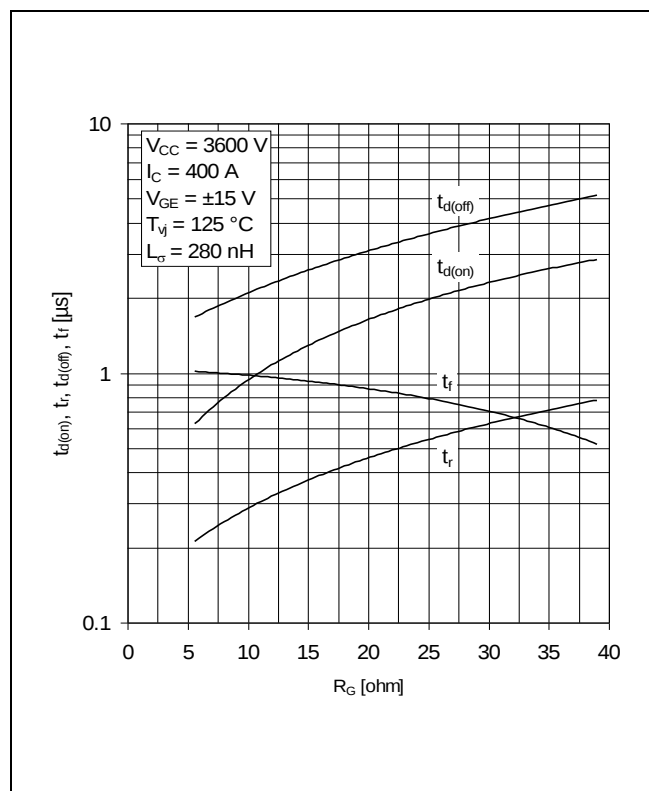


Fig. 8 Typical switching times vs gate resistor

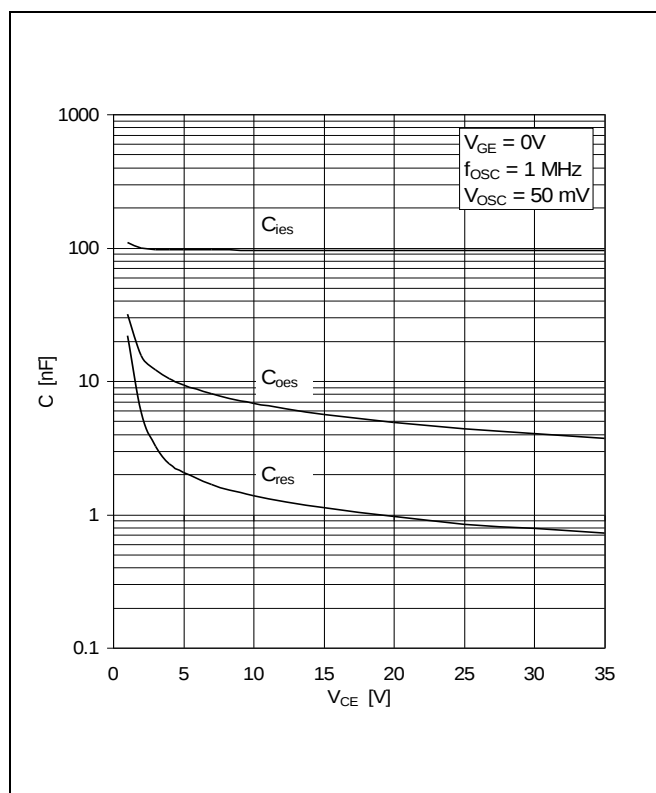


Fig. 9 Typical capacitances
vs collector-emitter voltage

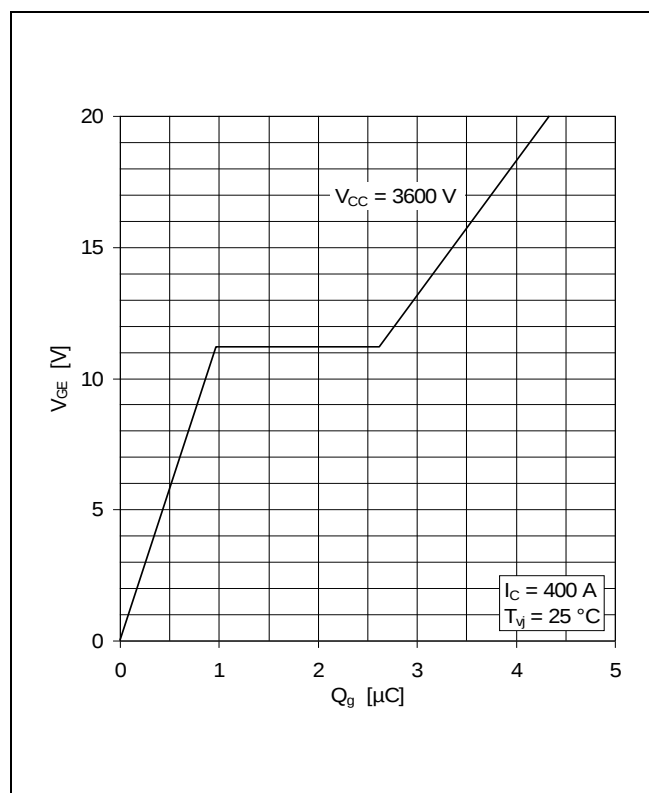


Fig. 10 Typical gate charge characteristics

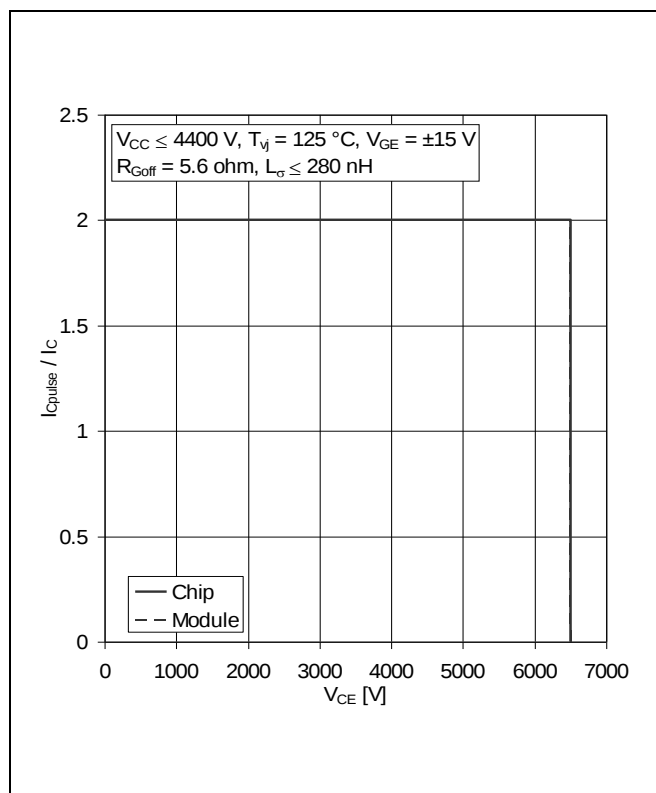


Fig. 11 Turn-off safe operating area (RBSOA)

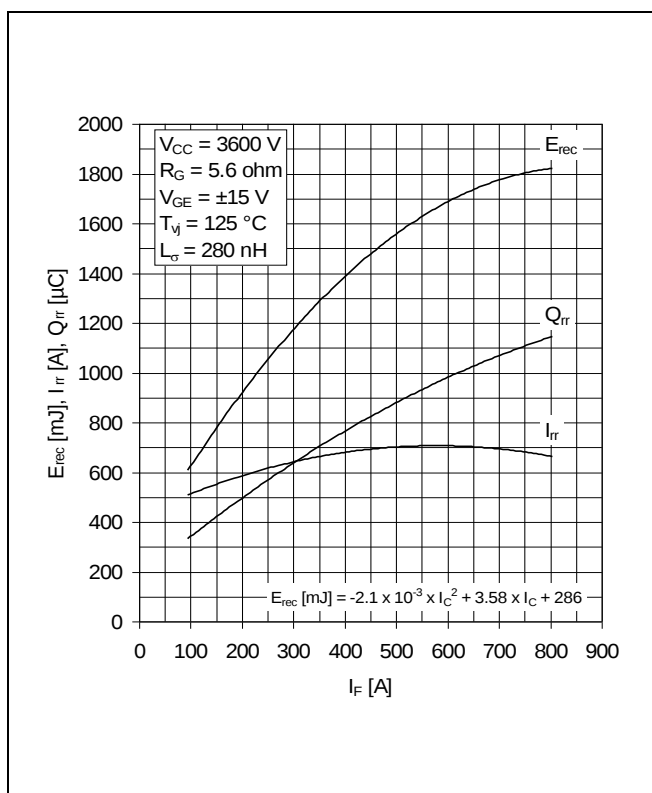


Fig. 12 Typical reverse recovery characteristics vs forward current

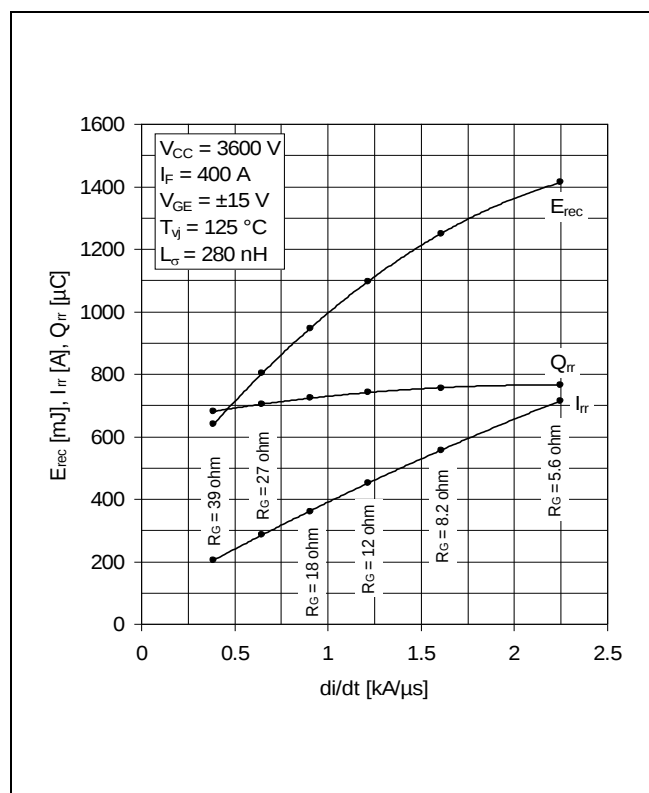


Fig. 13 Typical reverse recovery characteristics vs di/dt

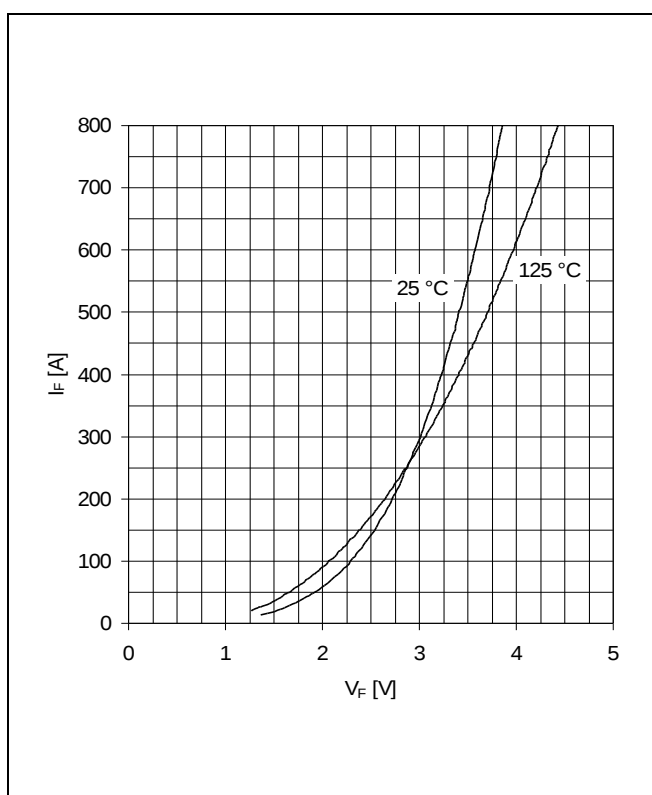


Fig. 14 Typical diode forward characteristics, chip level

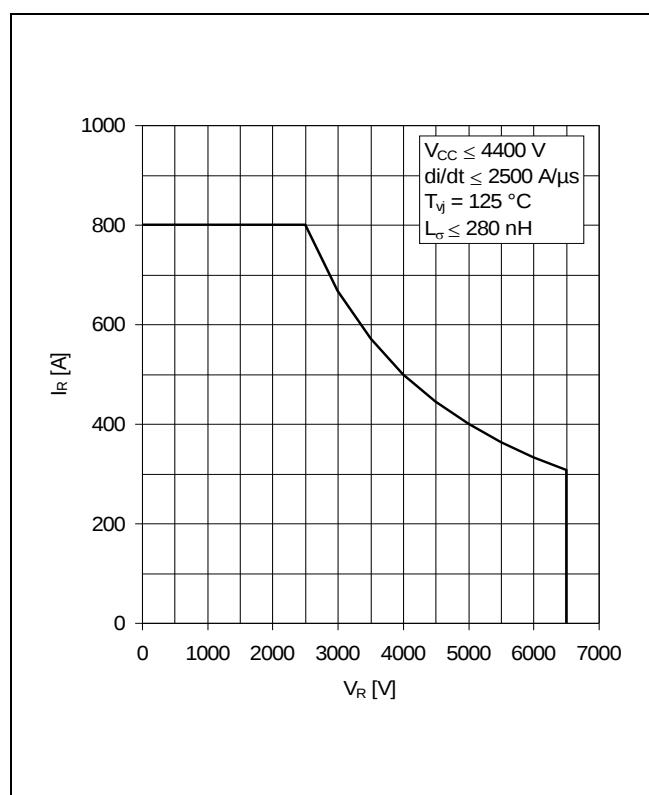


Fig. 15 Safe operating area diode (SOA)

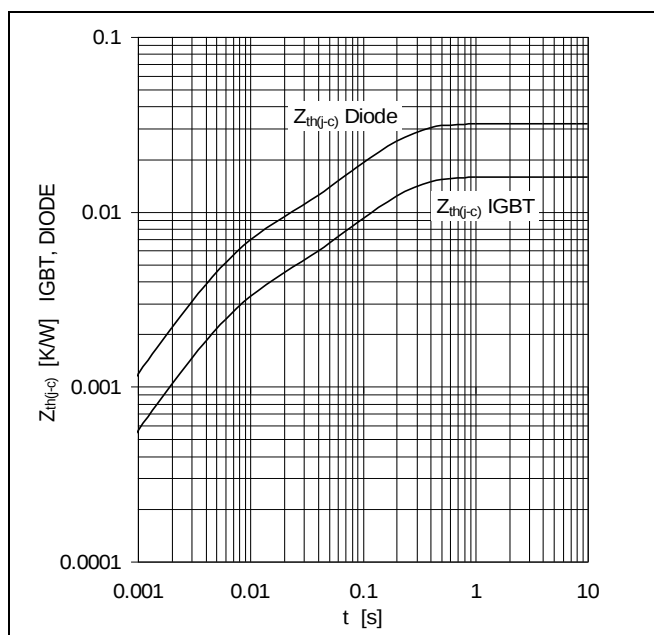


Fig. 16 Thermal impedance vs time

Analytical function for transient thermal impedance:

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

	i	1	2	3	4	5
IGBT	$R_i(K/KW)$	12.75	2.99			
	$\tau_i(ms)$	151	5.84			
DIODE	$R_i(K/KW)$	25.5	6.3			
	$\tau_i(ms)$	144	5.83			

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 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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ABB Switzerland Ltd
Semiconductors
 Fabrikstrasse 3
 CH-5600 Lenzburg, Switzerland

Telephone +41 (0)58 586 1419
 Fax +41 (0)58 586 1306
 Email abbsem@ch.abb.com
 Internet www.abb.com/semiconductors