Data Sheet, Doc. No. 5SYA 1430-02 11-2017

5SNA 2000K451300
StakPak IGBT Module

V_{CE} = 4500 V
I_C = 2000 A

Low-loss, rugged SPT+ chip-set
Smooth switching SPT+ chip-set for good EMC
High tolerance to uneven mounting pressure
Explosion resistant package

Maximum rated values [1]

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	V_{CES}	V_{GE} = 0 V, $T_{vj} \geq 25$ °C		4500	V
DC collector current	I_C	T_C = 85 °C, T_{vj} = 125 °C		2000	A
Peak collector current	I_{CM}	t_p = 1 ms		4000	A
Gate-emitter voltage	V_{GES}		-20	20	V
Total power dissipation	P_{tot}	T_C = 25 °C, T_{vj} = 125 °C		20800	W
DC forward current	I_F			2000	A
Peak forward current	I_{FRM}	t_p = 1 ms		4000	A
Surge current	I_{FSM}	V_R = 0 V, T_{vj} = 125 °C, t_p = 10 ms, half-sinewave		14000	A
IGBT short circuit SOA	t_{psc}	V_{CC} = 3400 V, $V_{CEM\,CHIP} \leq 4500$ V $V_{GE} \leq 15$ V, $T_{vj} \leq 125$ °C		10	µs
Junction temperature	T_{vj}		-50	150	°C
Junction operating temperature	$T_{vj(op)}$		-50	125	°C
Case temperature	T_C		-50	125	°C
Storage temperature	T_{stg}		-50	70	°C
Mounting force [2][3]	F_M		60	90	kN

[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. 5SYA 2037-02

[3] All electrical characteristics are valid only when the module is clamped

IGBT characteristic values [4]

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		4500			V
Collector-emitter [5] saturation voltage	$V_{CE\ sat}$	I_C = 2000 A, V_{GE} = 15 V	T_{vj} = 25 °C	2.55	2.85	3.15	V
			T_{vj} = 125 °C	3.35	3.65	3.95	V
Collector cut-off current	I_{CES}	V_{CE} = 4500 V, V_{GE} = 0 V	T_{vj} = 25 °C			1	mA
			T_{vj} = 125 °C		50	100	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	$V_{GE(th)}$	I_C = 320 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.3		7.3	V
Gate charge	Q_G	I_C = 2000 A, V_{CE} = 2800 V, V_{GE} = -15 V ..15 V			9.6		μC
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz, T_{vj} = 25 °C			186		nF
Output capacitance	C_{oes}				13.4		nF
Reverse transfer capacitance	C_{res}				3.7		nF
Internal gate resistor	R_{Gint}				0.16		Ω
Turn-on delay time	$t_{d(on)}$	V_{CC} = 2800 V, I_C = 2000 A, R_G = 1.8 Ω, C_{GE} = 330 nF, V_{GE} = ±15 V, L_σ = 200 nH, inductive load	T_{vj} = 25 °C		820		ns
			T_{vj} = 125 °C		690		ns
Rise time	t_r		T_{vj} = 25 °C		530		ns
			T_{vj} = 125 °C		540		ns
Turn-off delay time	$t_{d(off)}$	V_{CC} = 2800 V, I_C = 2000 A, R_G = 8.2 Ω, C_{GE} = 330 nF, V_{GE} = ±15 V, L_σ = 200 nH, inductive load	T_{vj} = 25 °C		3990		ns
			T_{vj} = 125 °C		4410		ns
Fall time	t_f		T_{vj} = 25 °C		710		ns
			T_{vj} = 125 °C		800		ns
Turn-on switching energy	E_{on}	V_{CC} = 2800 V, I_C = 2000 A, R_G = 1.8 Ω, C_{GE} = 330 nF, V_{GE} = ±15 V, L_σ = 200 nH, inductive load	T_{vj} = 25 °C		8110		mJ
			T_{vj} = 125 °C		9960		mJ
Turn-off switching energy	E_{off}	V_{CC} = 2800 V, I_C = 2000 A, R_G = 8.2 Ω, C_{GE} = 330 nF, V_{GE} = ±15 V, L_σ = 200 nH, inductive load	Tvj = 25 °C		7670		mJ
			Tvj = 125 °C		9790		mJ
Short circuit current	I_{SC}	t_{psc} ≤ 10 μs, V_{GE} = 15 V, V_{CC} = 3400 V, $V_{CEM\ CHIP}$ ≤ 4500 V	Tvj = 125 °C		7800		A

[4] Characteristic values according to IEC 60747 – 9

[5] Collector-emitter saturation voltage is given at chip level

Diode characteristic values [6]

Parameter	Symbol	Conditions		min	typ	max	Unit
Forward voltage [7]	V_F	I_F = 2000 A	T_{vj} = 25 °C		2.6	2.9	V
			T_{vj} = 125 °C		3.0	3.4	V
Peak reverse recovery current	I_{RM}	V_{CC} = 2800 V, I_F = 2000 A, V_{GE} = ±15 V, R_G = 1.8 Ω, C_{GE} = 330 nF, di/dt = 3.8 kA/µs L_σ = 200 nH, inductive load	T_{vj} = 25 °C		1670		A
			T_{vj} = 125 °C		1950		A
Recovered charge	Q_r		T_{vj} = 25 °C		1770		µC
			T_{vj} = 125 °C		2710		µC
Reverse recovery time	t_{rr}		T_{vj} = 25 °C		2030		ns
			T_{vj} = 125 °C		2340		ns
Reverse recovery energy	E_{rec}		T_{vj} = 25 °C		2930		mJ
			T_{vj} = 125 °C		4690		mJ

[6] Characteristic values according to IEC 60747 – 2

[7] Forward voltage is given at chip level

Package properties

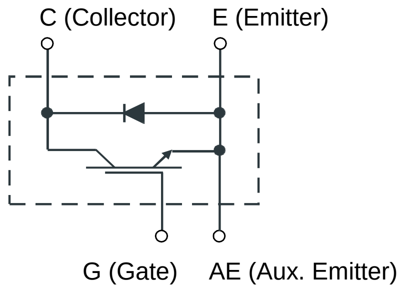
Parameter	Symbol	Conditions	min	typ	max	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$				0.0048	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.0091	K/W
IGBT thermal resistance [2] case to heatsink	$R_{th(c-h)IGBT}$	Heatsink flatness : Complete module area < 100 µm Each submodule area < 20 µm Roughness : < 1.6 µm		0.0011		K/W
Diode thermal resistance [2] case to heatsink	$R_{th(c-h)DIODE}$			0.0023		K/W
Comparative tracking index	CTI		600			

[2] for detailed mounting instructions refer to ABB Document No. 5SYA 2037-02

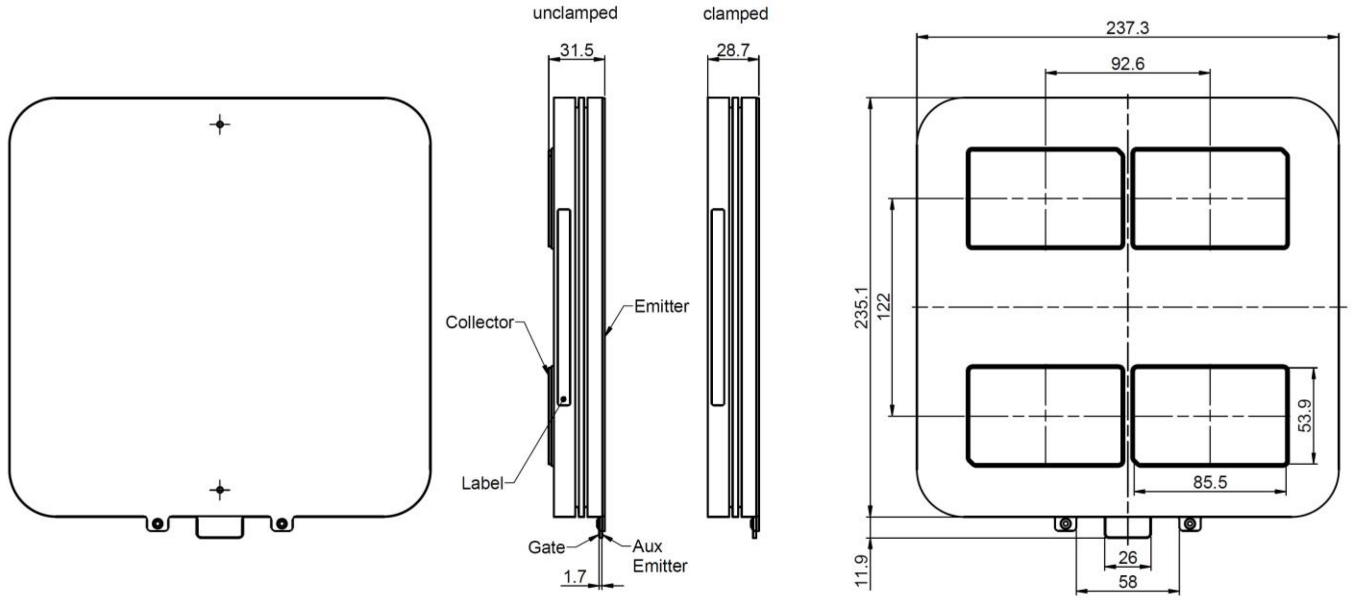
Mechanical properties

Parameter	Symbol	Conditions		min	typ	max	Unit
Dimensions	L x W x H	Typical	device clamped		246.95 x 237.3 x 28.75		mm
			device unclamped		246.95 x 237.3 x 31.5		
Clearance distance in air	d_a	according to IEC 60664-1 and EN 50124-1		23			mm
Surface creepage distance	d_s	according to IEC 60664-1 and EN 50124-1		40			mm
Mass	m				3745		g

Electrical configuration



Outline drawing [2)]



Note: all dimensions are shown in millimeters

2) For detailed mounting instructions refer to ABB Document No. 5SYA 2039

This is an electrostatic sensitive device; please observe the international standard IEC 60747-1, chap. VIII.
This product has been designed and qualified for Industrial Level.

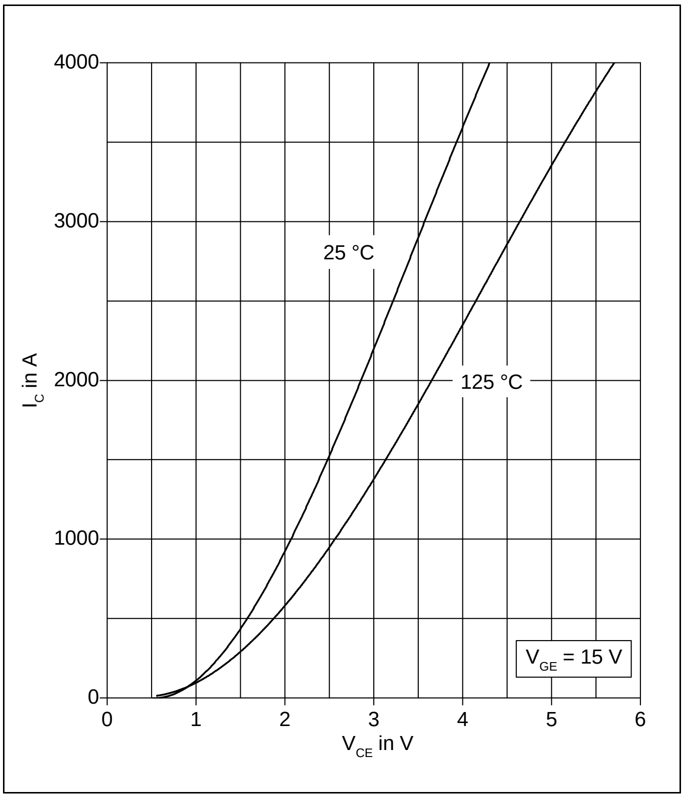


Fig. 1 Typical on-state characteristics, chip level

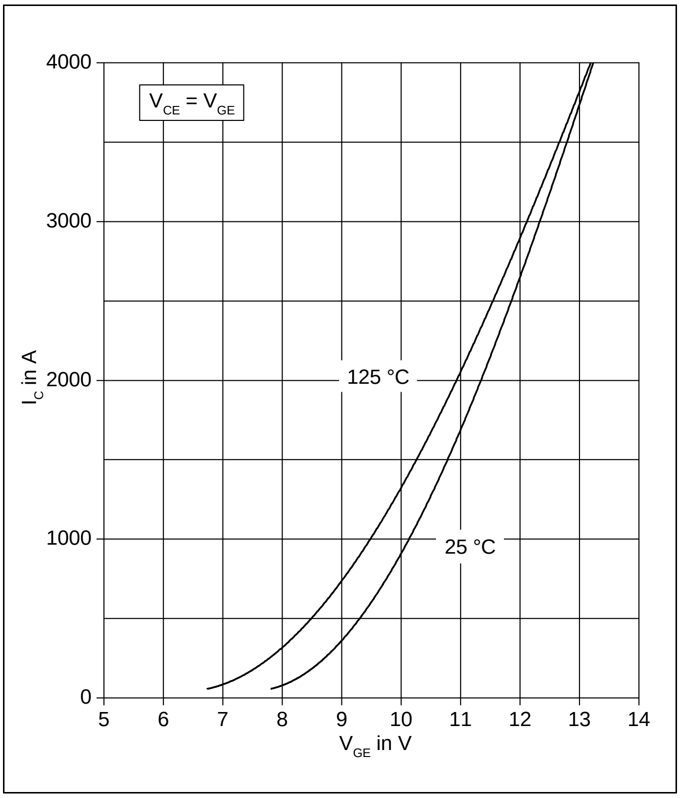


Fig. 2 Typical transfer characteristics, chip level

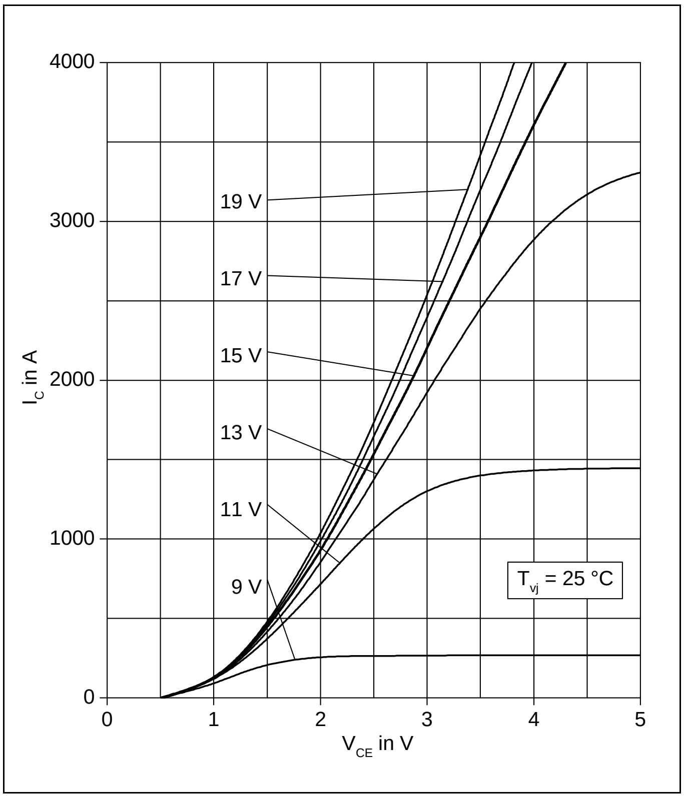


Fig. 3 Typical output characteristics, chip level

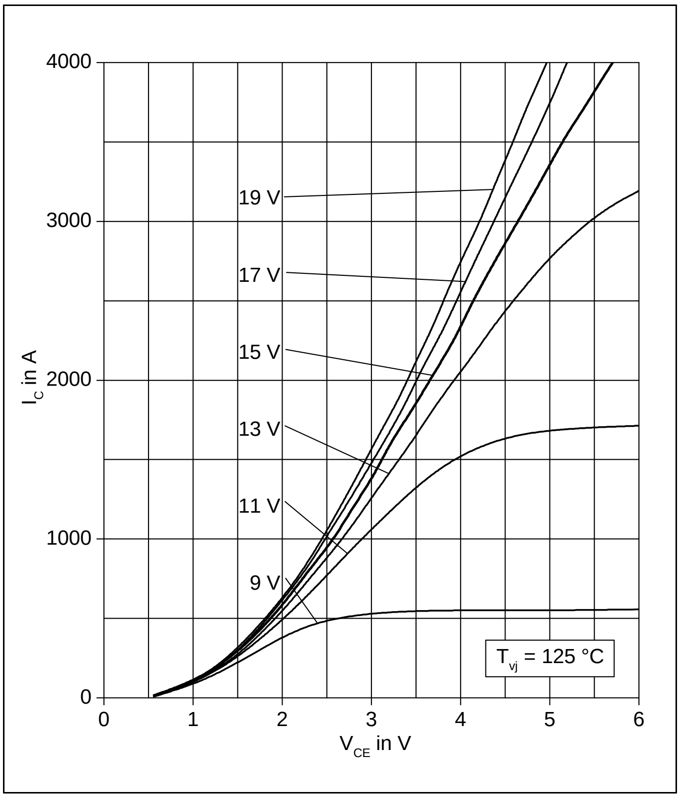


Fig. 4 Typical output characteristics, chip level

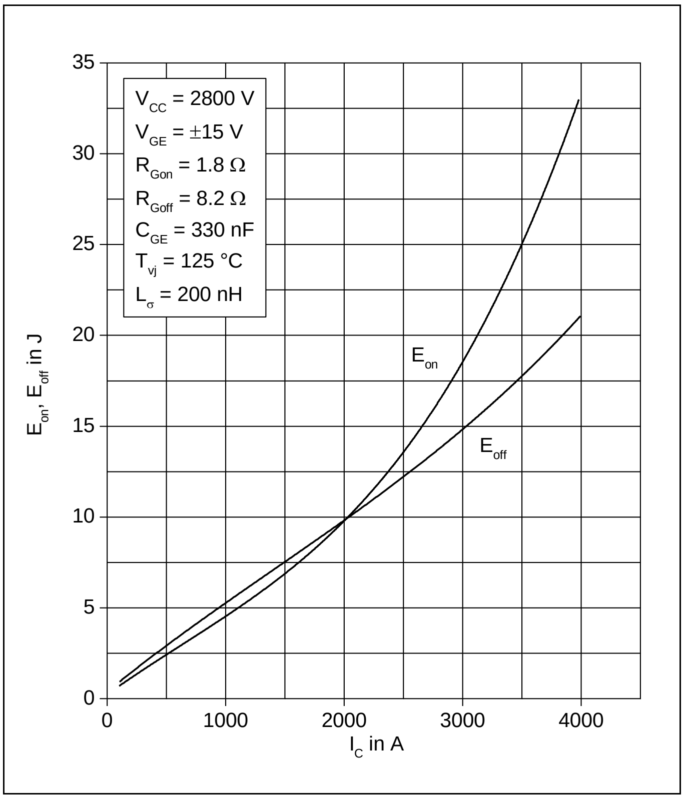


Fig. 5 Typical switching energies per pulse vs. collector current

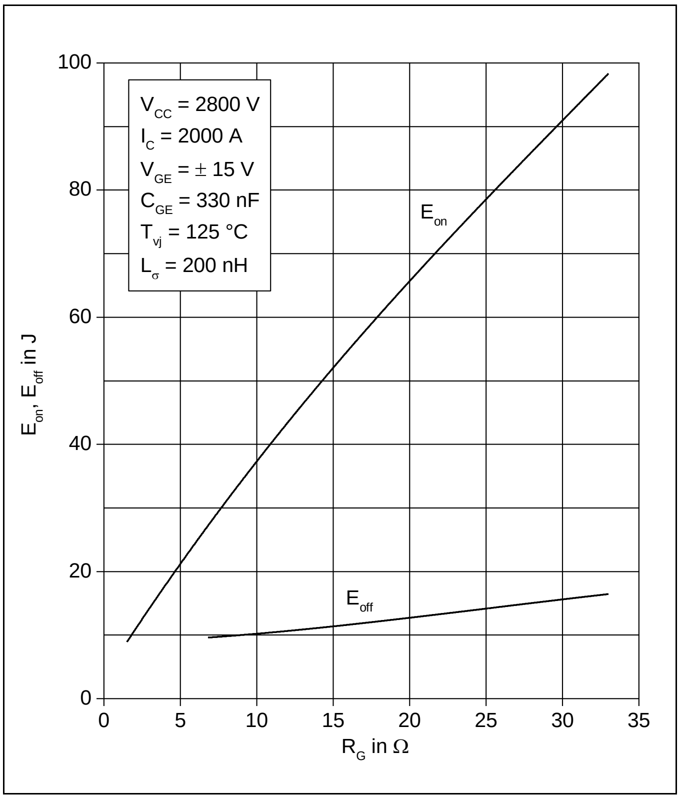


Fig. 6 Typical switching energies per pulse vs. gate resistor

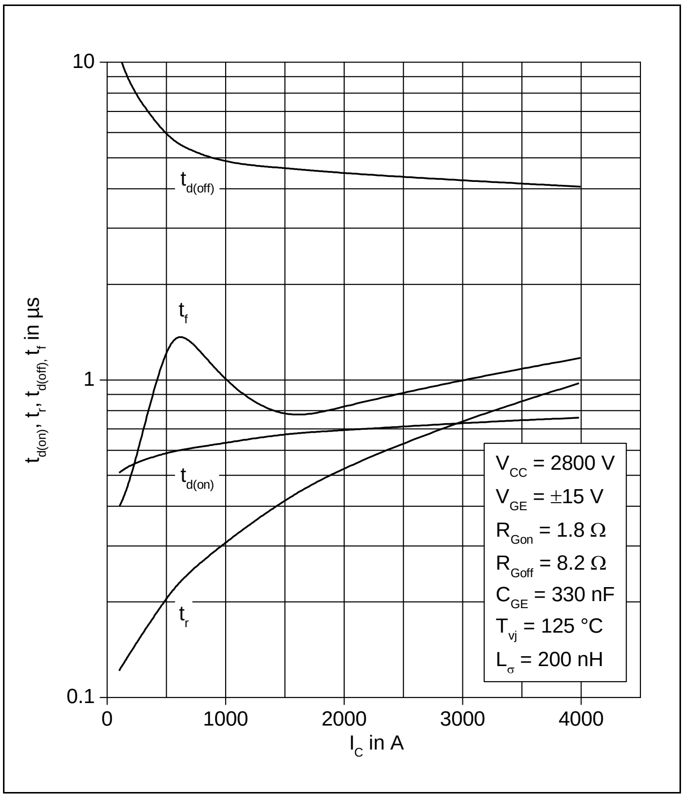


Fig. 7 Typical switching times vs. collector current

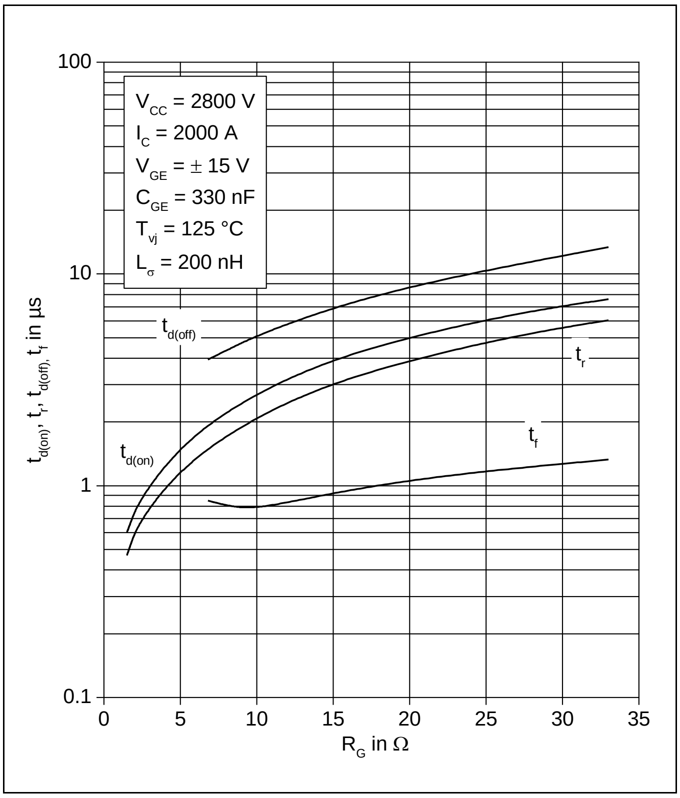


Fig. 8 Typical switching times vs. gate resistor

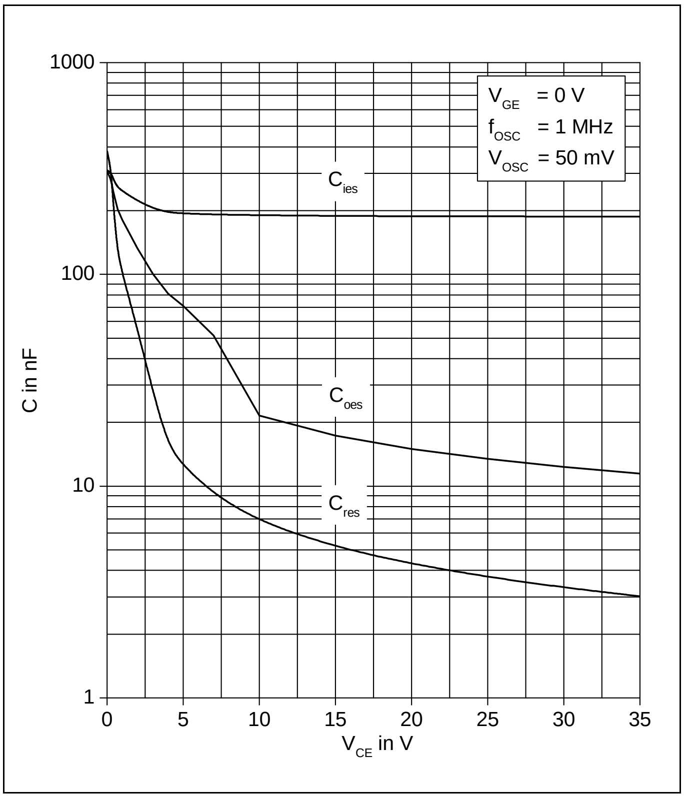


Fig. 9 Typical capacitances vs. collector-emitter voltage

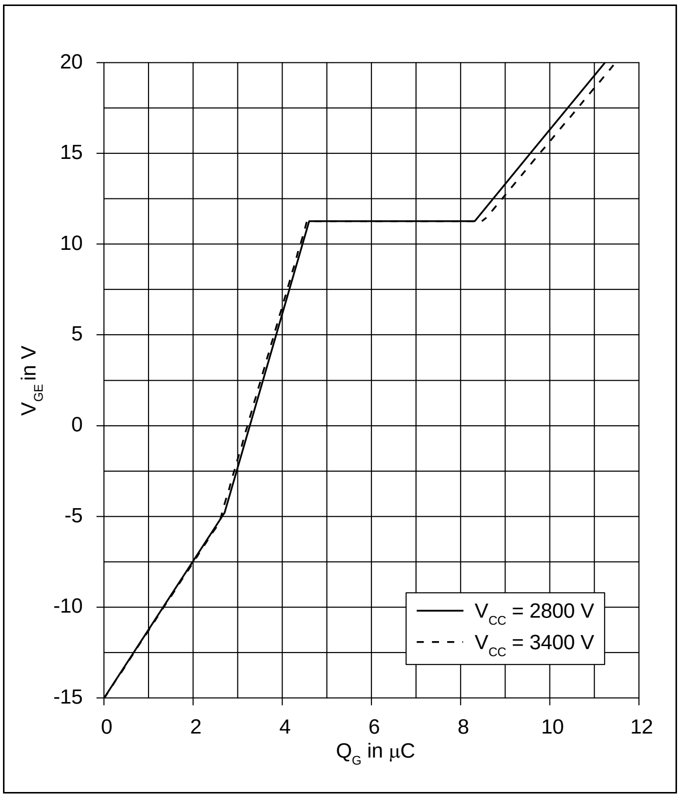


Fig. 10 Typical gate charge characteristics

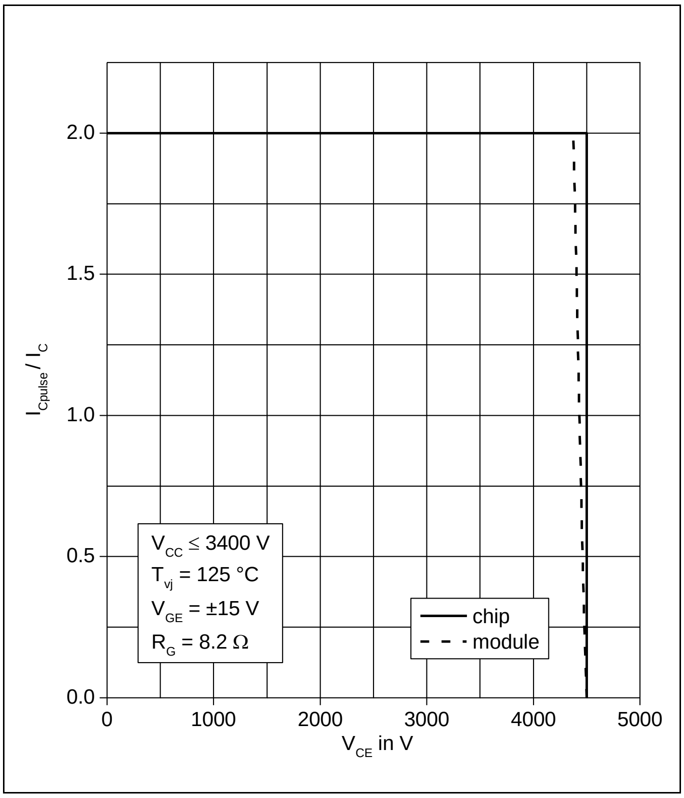


Fig. 11 Turn-off safe operating area (RBSOA)

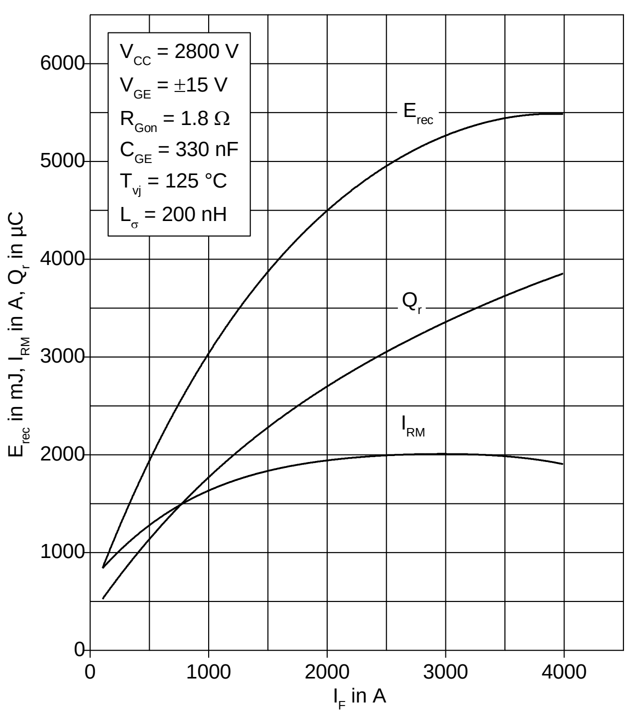


Fig. 12 Typical reverse recovery characteristics vs. forward current

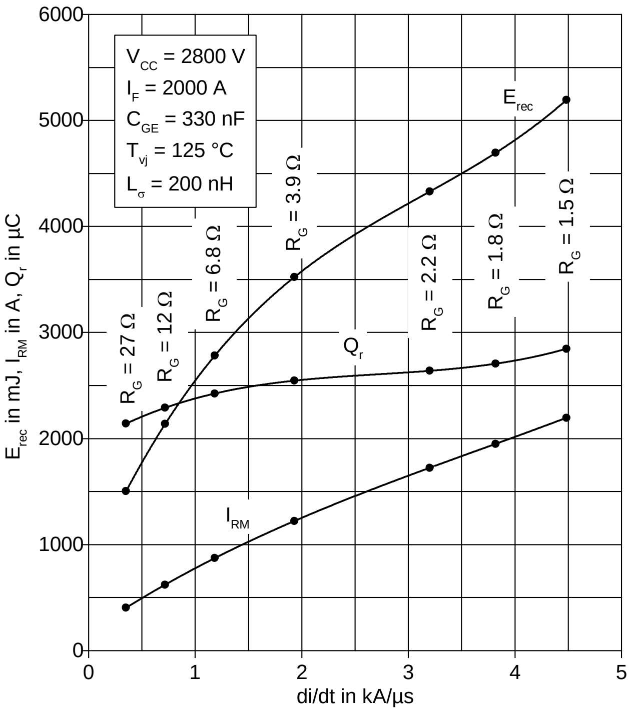


Fig. 13 Typical reverse recovery characteristics vs. di/dt

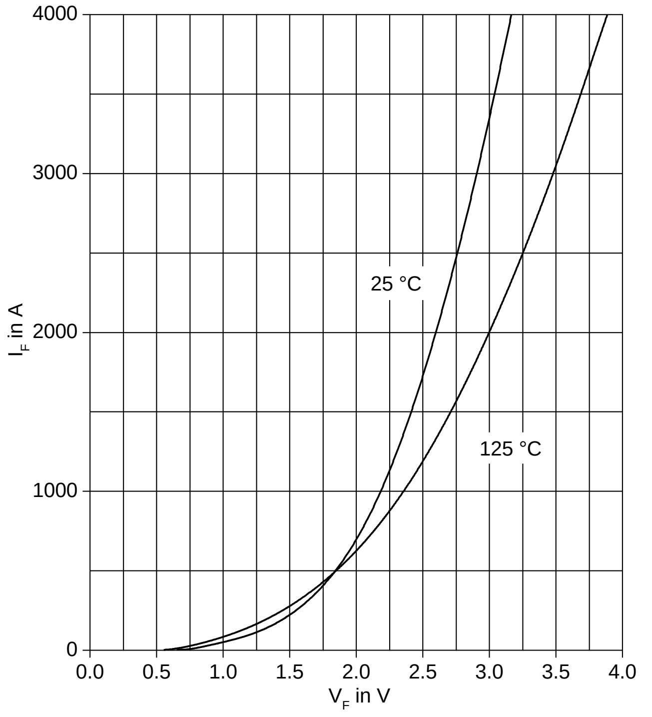


Fig. 14 Typical diode forward characteristics chip level

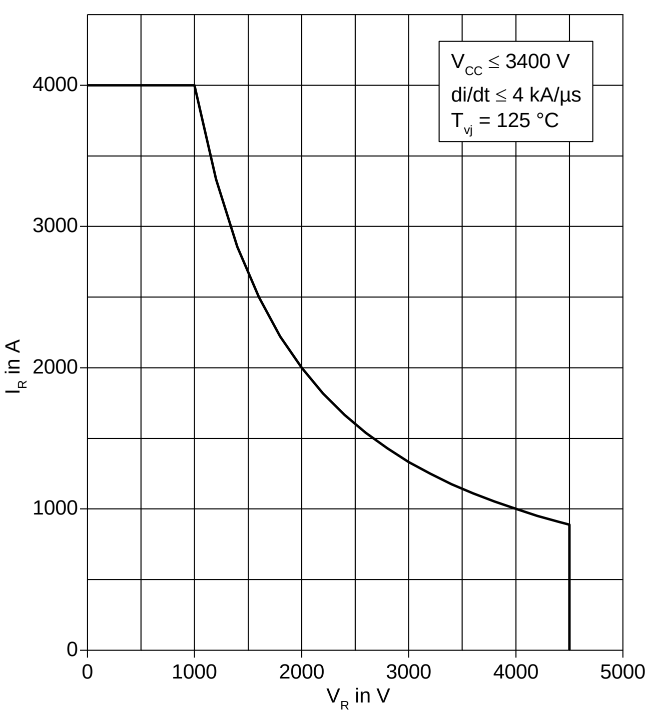


Fig. 15 Safe operating area diode (SOA)

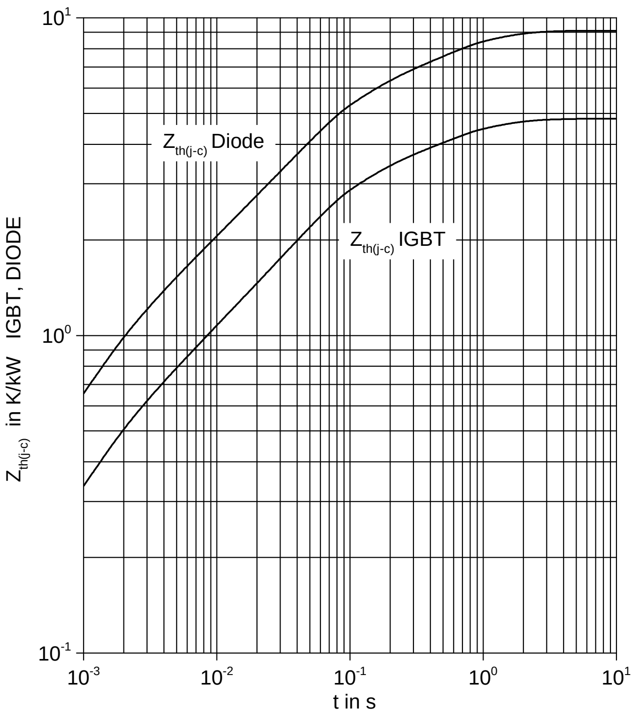


Fig. 16 Thermal impedance vs. time

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 in K/kW	1.801	2.234	0.403	0.369	
	τ_i in s	0.581	0.059	0.006	0.001	
DIODE	R_i in K/kW	3.614	3.958	0.803	0.727	
	τ_i in s	0.584	0.059	0.006	0.001	

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

Phone: +41 58 586 1419
Fax: +41 58 586 1306
E-Mail: abbsem@ch.abb.com
Internet: www.abb.com/semiconductors