

# 5SNG 1000X170300

## LinPak phase leg IGBT module

$$V_{CE} = 1700 \text{ V}$$

$$I_C = 2 \times 1000 \text{ A}$$

Ultra low inductance phase-leg module  
 Compact design with very high current density  
 Paralleling without derating  
 AISiC base-plate for high power cycling capability  
 AlN substrate for low thermal resistance  
 Low-loss, fast and rugged SPT++ chip-set



### Maximum rated values <sup>1)</sup>

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	$V_{CES}$	$V_{GE} = 0 \text{ V}$ , $T_{vj} \geq 25 \text{ °C}$		1700	V
DC collector current	$I_C$	$T_C = 100 \text{ °C}$ , $T_{vj} = 175 \text{ °C}$		1000	A
Peak collector current	$I_{CM}$	$t_p = 1 \text{ ms}$		2000	A
Gate-emitter voltage	$V_{GES}$		-20	20	V
Total power dissipation	$P_{tot}$	$T_C = 25 \text{ °C}$ , $T_{vj} = 175 \text{ °C}$		5500	W
DC forward current	$I_F$			1000	A
Peak forward current	$I_{FRM}$	$t_p = 1 \text{ ms}$		2000	A
Surge current	$I_{FSM}$	$V_R = 0 \text{ V}$ , $T_{vj} = 175 \text{ °C}$ , $t_p = 10 \text{ ms}$ , half-sinewave		5400	A
IGBT short circuit SOA	$t_{psc}$	$V_{CC} = 1300 \text{ V}$ , $V_{CEM \text{ CHIP}} \leq 1700 \text{ V}$ $V_{GE} \leq 15 \text{ V}$ , $T_{vj \text{ start}} \leq 150 \text{ °C}$		10	$\mu\text{s}$
Isolation voltage	$V_{ISOL}$	1 min, $f = 50 \text{ Hz}$		4000	V
Junction temperature	$T_{vj}$		-40	175	$^{\circ}\text{C}$
Junction operating temperature	$T_{vj(op)}$		-40	175	$^{\circ}\text{C}$
Case temperature	$T_C$		-40	150	$^{\circ}\text{C}$
Storage temperature	$T_{stg}$		-40	125	$^{\circ}\text{C}$
Mounting torques <sup>2)</sup>	$M_s$	Base-heatsink, M6 screws	4	6	Nm
	$M_{t1}$	Main terminals, M8 screws	8	10	
	$M_{t2}$	Auxiliary terminals, M3 screws	0.9	1.1	

<sup>1)</sup> Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747

<sup>2)</sup> For detailed mounting instructions refer to ABB Document No. 5SYA 2039

### IGBT characteristic values <sup>3)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
Collector (-emitter) breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}$ , $I_C = 10\text{ mA}$ , $T_{vj} = 25\text{ °C}$	1700			V
Collector-emitter <sup>4)</sup> saturation voltage	$V_{CE\text{ sat}}$	$I_C = 1000\text{ A}$ , $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	2.25	2.5	V
			$T_{vj} = 125\text{ °C}$	2.55	2.8	V
			$T_{vj} = 175\text{ °C}$	2.75		V
Collector cut-off current	$I_{CES}$	$V_{CE} = 1700\text{ V}$ , $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	0.003		mA
			$T_{vj} = 125\text{ °C}$	2.55		mA
			$T_{vj} = 175\text{ °C}$	55		mA
Gate leakage current	$I_{GES}$	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$ , $T_{vj} = 125\text{ °C}$	-500		500	nA
Gate-emitter threshold voltage	$V_{GE(TO)}$	$I_C = 40\text{ mA}$ , $V_{CE} = V_{GE}$ , $T_{vj} = 25\text{ °C}$		5.9		V
Gate charge	$Q_{ge}$	$I_C = 1000\text{ A}$ , $V_{CE} = 900\text{ V}$ , $V_{GE} = -15\text{ V} \dots 15\text{ V}$		6.4		$\mu\text{C}$
Input capacitance	$C_{ies}$	$V_{CE} = 25\text{ V}$ , $V_{GE} = 0\text{ V}$ , $f = 1\text{ MHz}$ , $T_{vj} = 25\text{ °C}$		62		nF
Output capacitance	$C_{oes}$			5.3		nF
Reverse transfer capacitance	$C_{res}$			3.8		nF
Internal gate resistance	$R_{Gint}$	per switch		0.75		$\Omega$
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 900\text{ V}$ , $I_C = 1000\text{ A}$ , $R_G = 0.39\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ , $V_{GE} = \pm 15\text{ V}$ , $L_\sigma = 20\text{ nH}$ , inductive load	$T_{vj} = 25\text{ °C}$	270		ns
			$T_{vj} = 125\text{ °C}$	290		ns
			$T_{vj} = 175\text{ °C}$	300		ns
Rise time	$t_r$	$V_{CC} = 900\text{ V}$ , $I_C = 1000\text{ A}$ , $R_G = 0.39\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ , $V_{GE} = \pm 15\text{ V}$ , $L_\sigma = 20\text{ nH}$ , inductive load	$T_{vj} = 25\text{ °C}$	80		ns
			$T_{vj} = 125\text{ °C}$	90		ns
			$T_{vj} = 175\text{ °C}$	100		ns
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 900\text{ V}$ , $I_C = 1000\text{ A}$ , $R_G = 0.56\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ , $V_{GE} = \pm 15\text{ V}$ , $L_\sigma = 20\text{ nH}$ , inductive load	$T_{vj} = 25\text{ °C}$	570		ns
			$T_{vj} = 125\text{ °C}$	680		ns
			$T_{vj} = 175\text{ °C}$	730		ns
Fall time	$t_f$	$V_{CC} = 900\text{ V}$ , $I_C = 1000\text{ A}$ , $R_G = 0.56\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ , $V_{GE} = \pm 15\text{ V}$ , $L_\sigma = 20\text{ nH}$ , inductive load	$T_{vj} = 25\text{ °C}$	90		ns
			$T_{vj} = 125\text{ °C}$	120		ns
			$T_{vj} = 175\text{ °C}$	140		ns
Turn-on switching energy	$E_{on}$	$V_{CC} = 900\text{ V}$ , $I_C = 1000\text{ A}$ , $R_G = 0.39\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ , $V_{GE} = \pm 15\text{ V}$ , $L_\sigma = 20\text{ nH}$ , inductive load	$T_{vj} = 25\text{ °C}$	250		mJ
			$T_{vj} = 125\text{ °C}$	410		mJ
			$T_{vj} = 175\text{ °C}$	500		mJ
Turn-off switching energy	$E_{off}$	$V_{CC} = 900\text{ V}$ , $I_C = 1000\text{ A}$ , $R_G = 0.56\text{ }\Omega$ , $C_{GE} = 0\text{ nF}$ , $V_{GE} = \pm 15\text{ V}$ , $L_\sigma = 20\text{ nH}$ , inductive load	$T_{vj} = 25\text{ °C}$	190		mJ
			$T_{vj} = 125\text{ °C}$	280		mJ
			$T_{vj} = 175\text{ °C}$	350		mJ
Short circuit current	$I_{sc}$	$V_{CC} = 1300\text{ V}$ , $V_{GE} = 15\text{ V}$	$T_{vj\text{ start}} = 150\text{ °C}$	3000		A

<sup>3)</sup> Characteristic values according to IEC 60747 - 9

<sup>4)</sup> Collector-emitter saturation voltage is given at chip level

## Diode characteristic values <sup>5)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
Forward voltage <sup>6)</sup>	V <sub>F</sub>	I <sub>F</sub> = 1000 A	T <sub>vj</sub> = 25 °C	1.6	1.9	V
			T <sub>vj</sub> = 125 °C	1.75	2.05	V
			T <sub>vj</sub> = 175 °C	1.7		V
Peak reverse recovery current	I <sub>RM</sub>		T <sub>vj</sub> = 25 °C	1130		A
			T <sub>vj</sub> = 125 °C	1160		A
			T <sub>vj</sub> = 175 °C	1230		A
Recovered charge	Q <sub>rr</sub>	V <sub>CC</sub> = 900 V, I <sub>F</sub> = 1000 A, V <sub>GE</sub> = ±15 V, R <sub>G</sub> = 0.39 Ω, C <sub>GE</sub> = 0 nF, L <sub>σ</sub> = 20 nH, inductive load	T <sub>vj</sub> = 25 °C	290		μC
			T <sub>vj</sub> = 125 °C	460		μC
			T <sub>vj</sub> = 175 °C	630		μC
Reverse recovery time	t <sub>rr</sub>		T <sub>vj</sub> = 25 °C	520		ns
			T <sub>vj</sub> = 125 °C	830		ns
			T <sub>vj</sub> = 175 °C	1040		ns
Reverse recovery energy	E <sub>rec</sub>		T <sub>vj</sub> = 25 °C	170		mJ
			T <sub>vj</sub> = 125 °C	260		mJ
			T <sub>vj</sub> = 175 °C	370		mJ

<sup>5)</sup> Characteristic values according to IEC 60747 - 2

<sup>6)</sup> Forward voltage is given at chip level

## NTC Thermistor

Parameter	Symbol	Conditions	min	typ	max	Unit
Rated resistor	R <sub>25</sub>			4.7		kΩ
B-value	B <sub>25/85</sub>	R <sub>2</sub> = R <sub>25</sub> exp [B <sub>25/85</sub> (1/T <sub>2</sub> - 1/(298.15K))]		3371		K
	B <sub>25/100</sub>	R <sub>2</sub> = R <sub>25</sub> exp [B <sub>25/100</sub> (1/T <sub>2</sub> - 1/(298.15K))]		3435		K

## Package properties <sup>7)</sup>

Parameter	Symbol	Conditions	min	typ	max	Unit
IGBT thermal resistance junction to case	R <sub>th(j-c)IGBT</sub>				27	K/kW
Diode thermal resistance junction to case	R <sub>th(j-c)DIODE</sub>				45	K/kW
IGBT thermal resistance <sup>2)</sup> case to heatsink	R <sub>th(c-s)IGBT</sub>	IGBT per switch, λ grease = 1W/m x K		27		K/kW
Diode thermal resistance <sup>2)</sup> case to heatsink	R <sub>th(c-s)DIODE</sub>	Diode per switch, λ grease = 1W/m x K		33		K/kW
Comparative tracking index	CTI		600			
Module stray inductance	L <sub>σ CE</sub>	total C1-E2		10		nH
Resistance, terminal-chip	R <sub>C1E1</sub> IGBT / Diode	T <sub>C</sub> = 25 °C		0.25 / 0.34		mΩ
		T <sub>C</sub> = 125 °C		0.35 / 0.47		
		T <sub>C</sub> = 175 °C		0.40 / 0.54		
	R <sub>C2E2</sub> IGBT / Diode	T <sub>C</sub> = 25 °C		0.35 / 0.45		
		T <sub>C</sub> = 125 °C		0.49 / 0.62		
		T <sub>C</sub> = 175 °C		0.56 / 0.71		

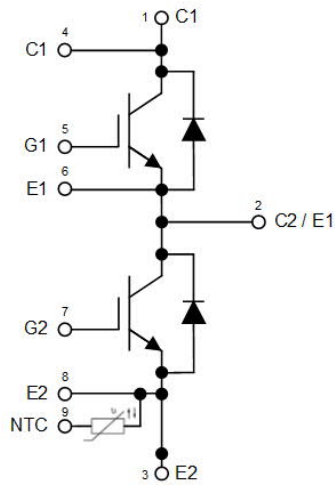
<sup>2)</sup> For detailed mounting instructions refer to ABB Document No. 5SYA 2039

## Mechanical properties <sup>7)</sup>

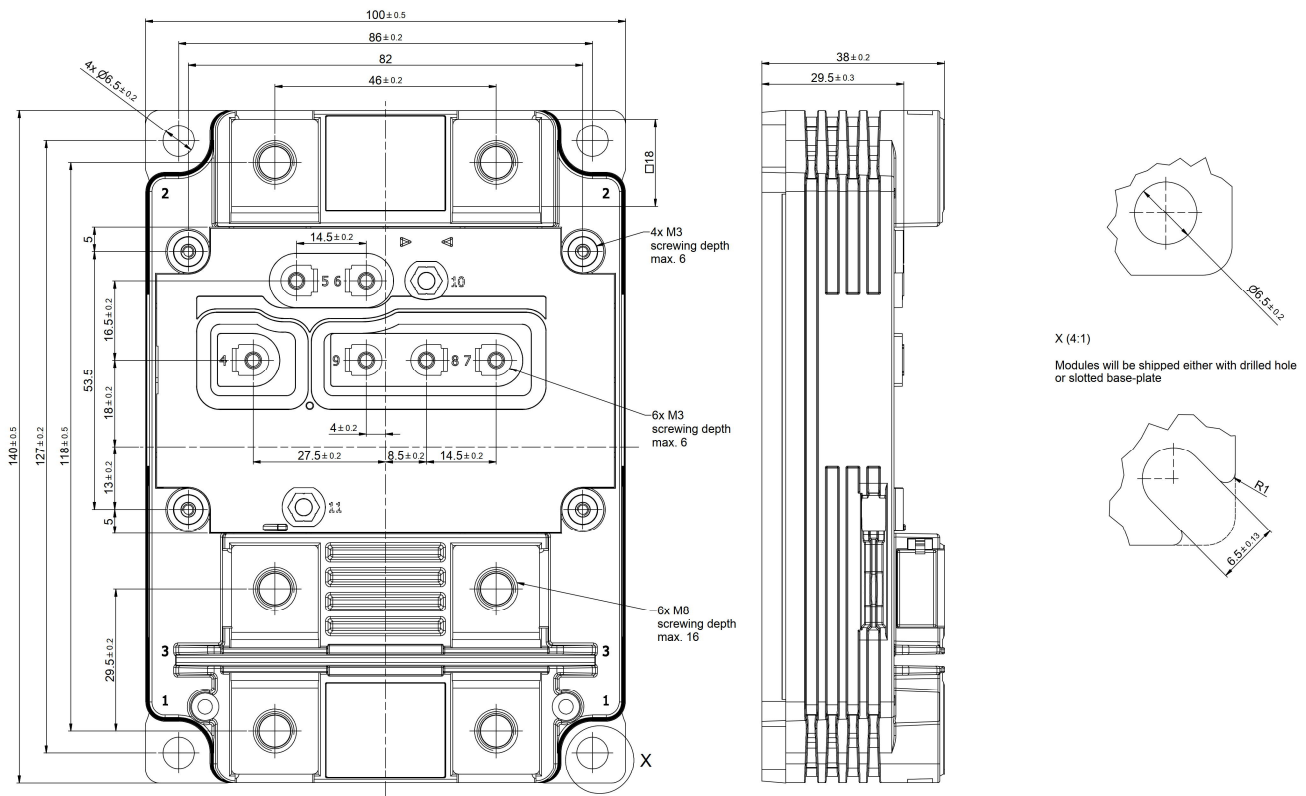
Parameter	Symbol	Conditions	min	typ	max	Unit
Dimensions	L x W x H	Typical		140 x 100 x 38		mm
Clearance distance in air	d <sub>a</sub>	according to IEC 60664-1 and EN 50124-1	Term. to base:	20		mm
			Term. to term:	8		
Surface creepage distance	d <sub>s</sub>	according to IEC 60664-1 and EN 50124-1	Term. to base:	30		mm
			Term. to term:	30		
Mass	m			820		g

<sup>7)</sup> Package and mechanical properties according to IEC 60747 - 15

## Electrical configuration



## Outline drawing



Note: all dimensions are shown in millimeters

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.

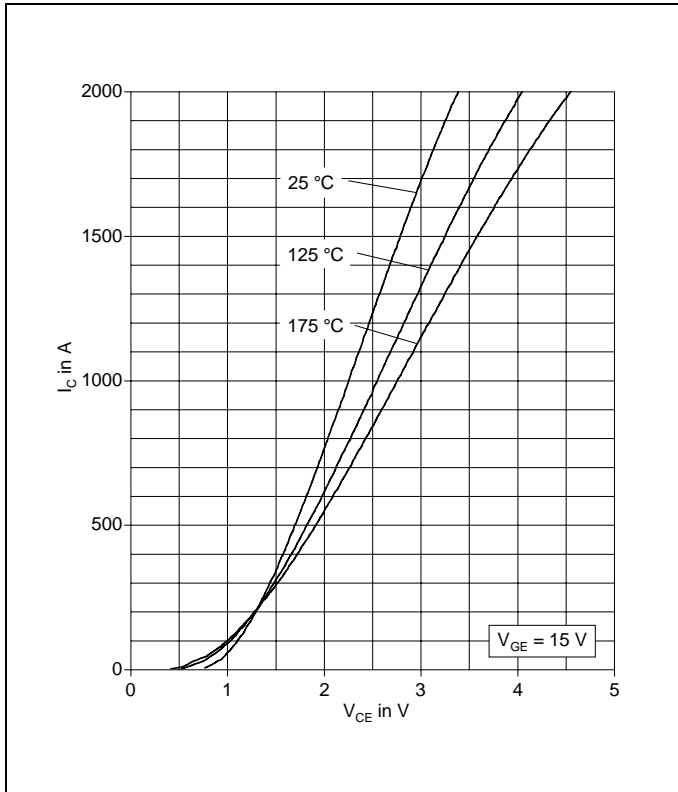


Fig. 1 Typical on-state characteristics, chip level

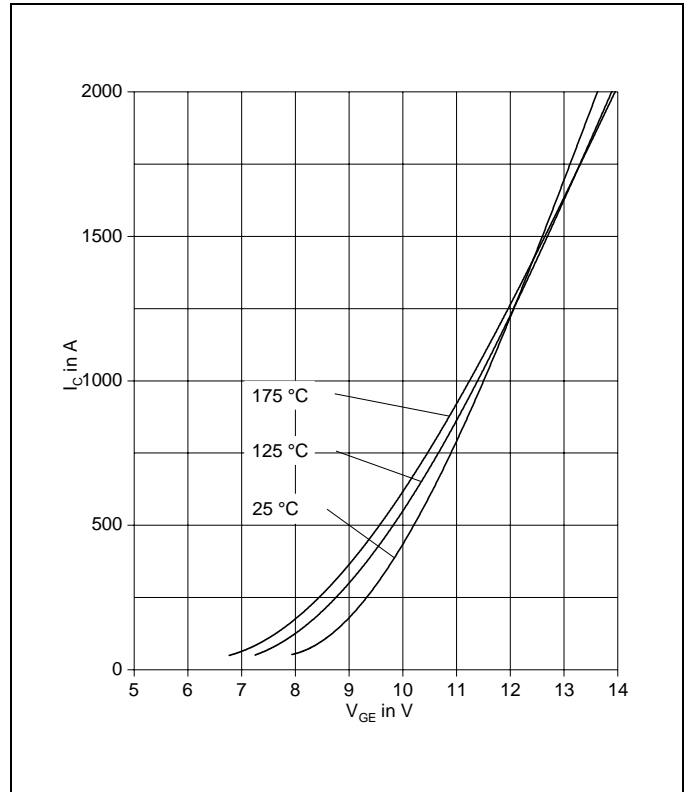


Fig. 2 Typical transfer characteristics, chip level

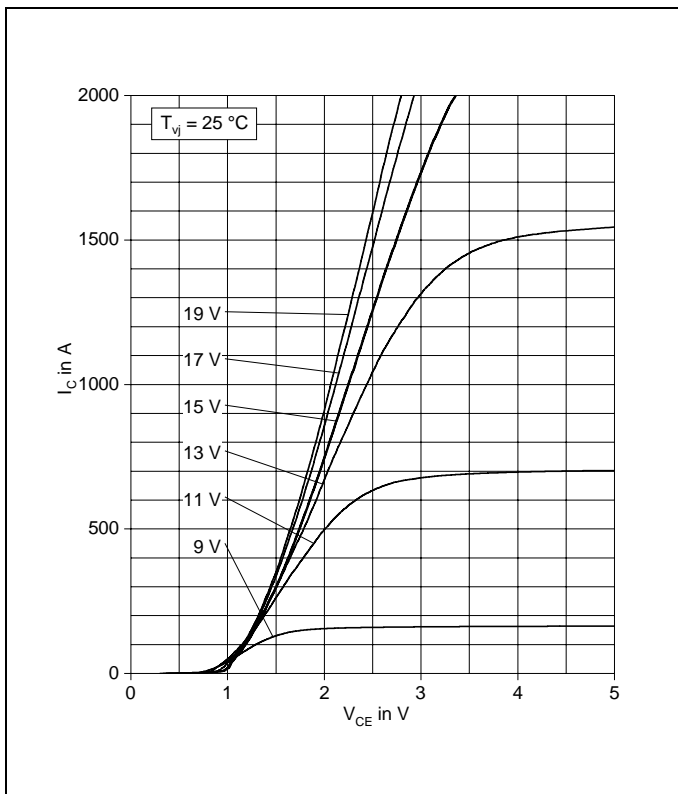


Fig. 3 Typical output characteristics, chip level

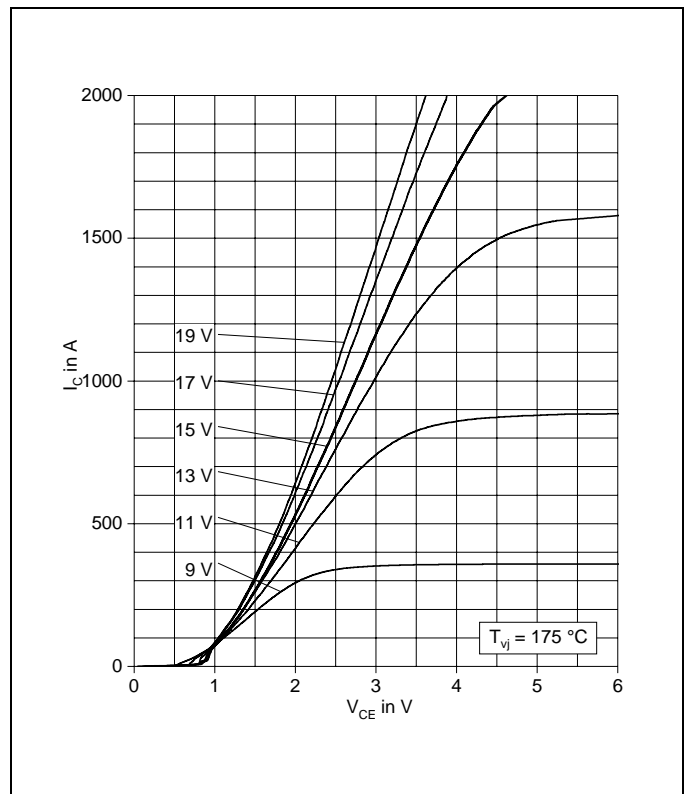


Fig. 4 Typical output characteristics, chip level

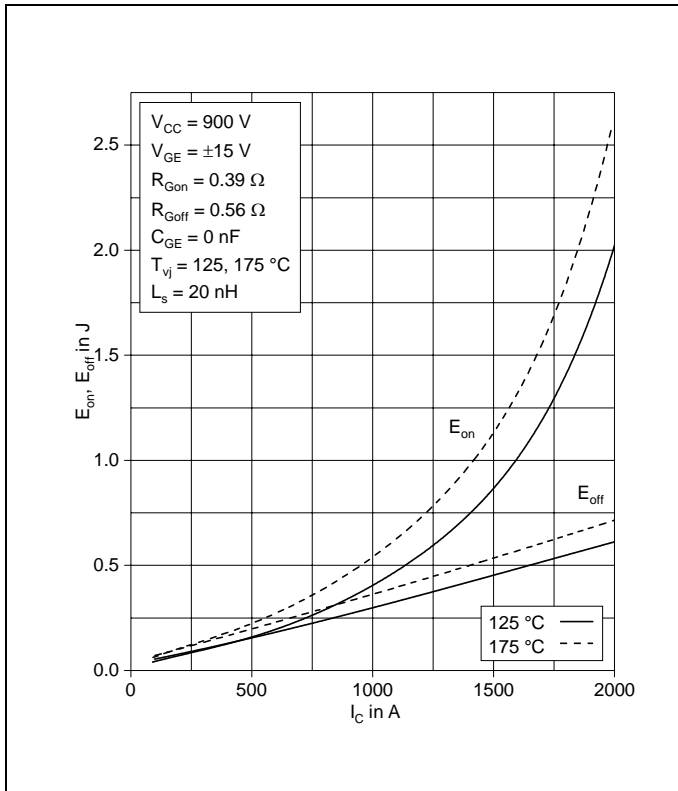


Fig. 5 Typical switching energies per pulse vs. collector current

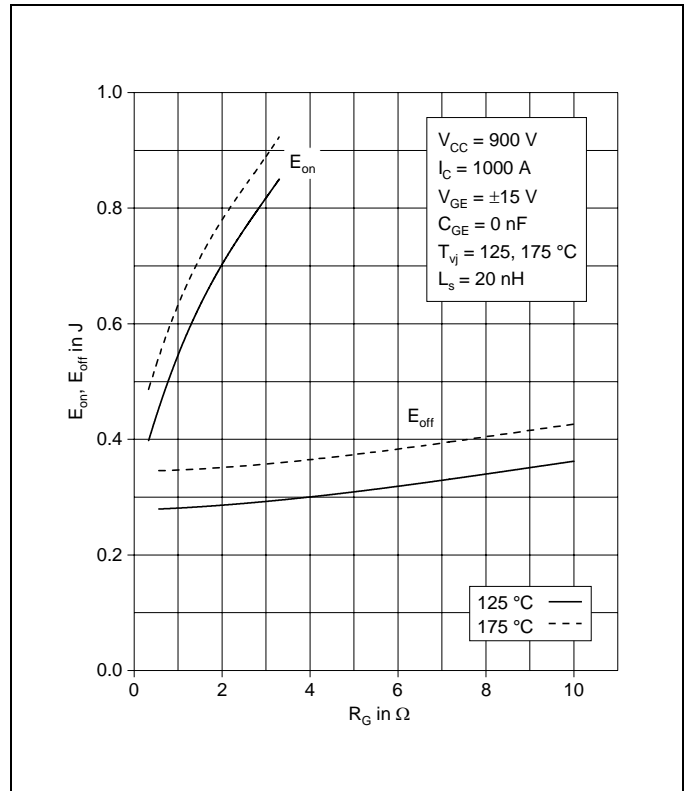


Fig. 6 Typical switching energies per pulse vs. gate resistor

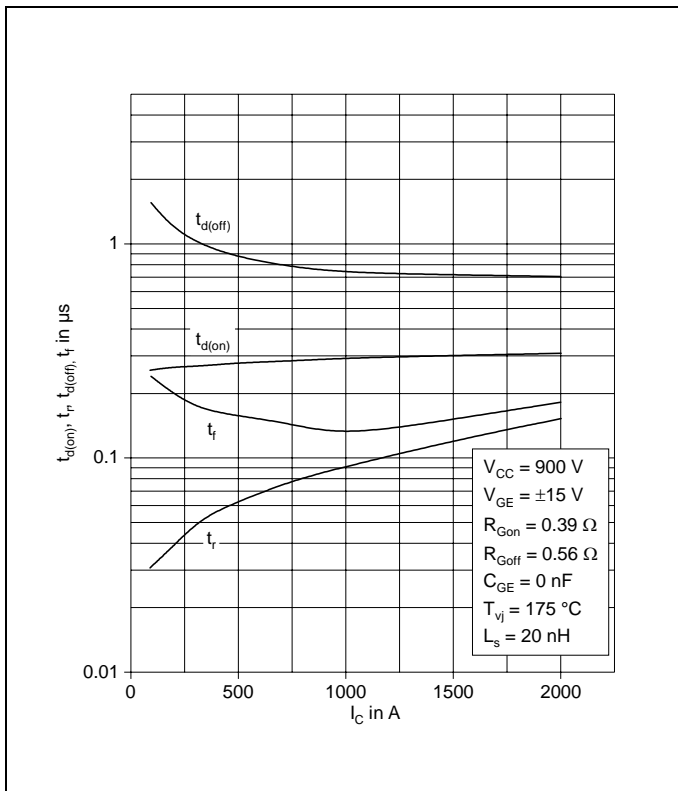


Fig. 7 Typical switching times vs. collector current

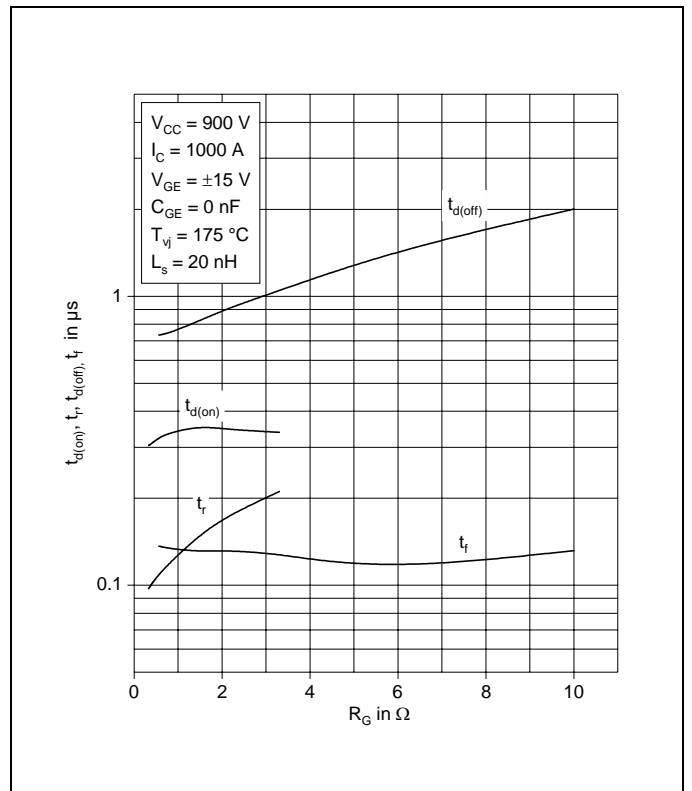


Fig. 8 Typical switching times vs. gate resistor

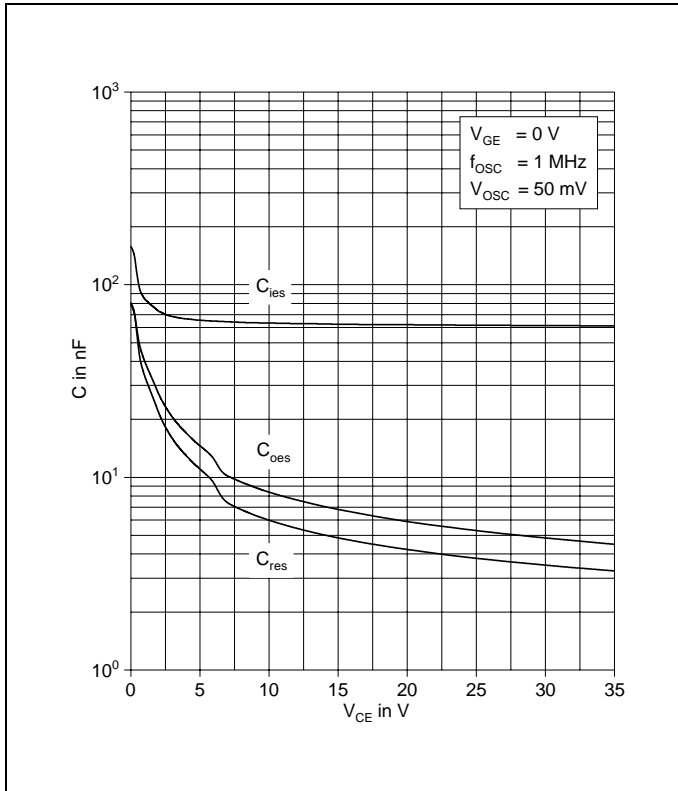


Fig. 9 Typical capacitances vs. collector-emitter voltage

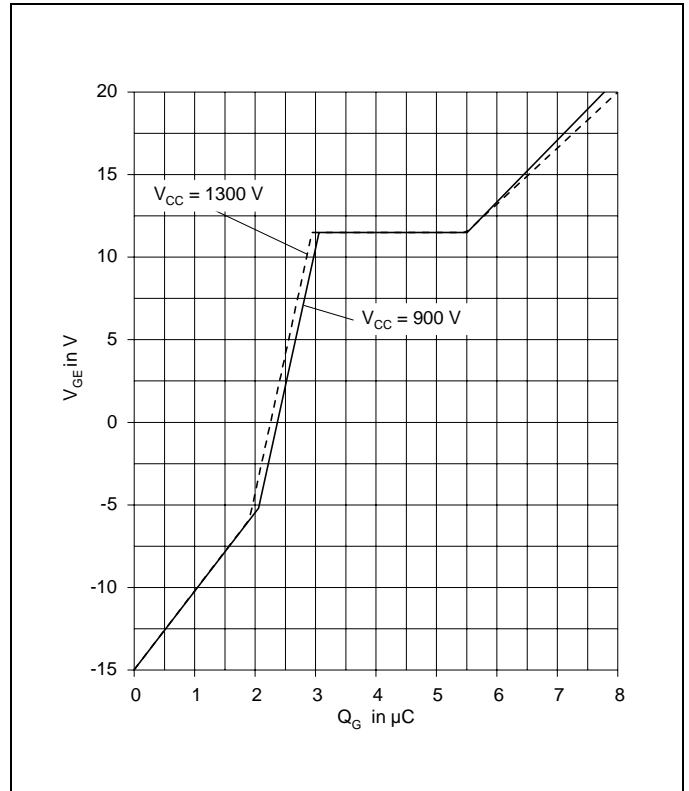


Fig. 10 Typical gate charge characteristics

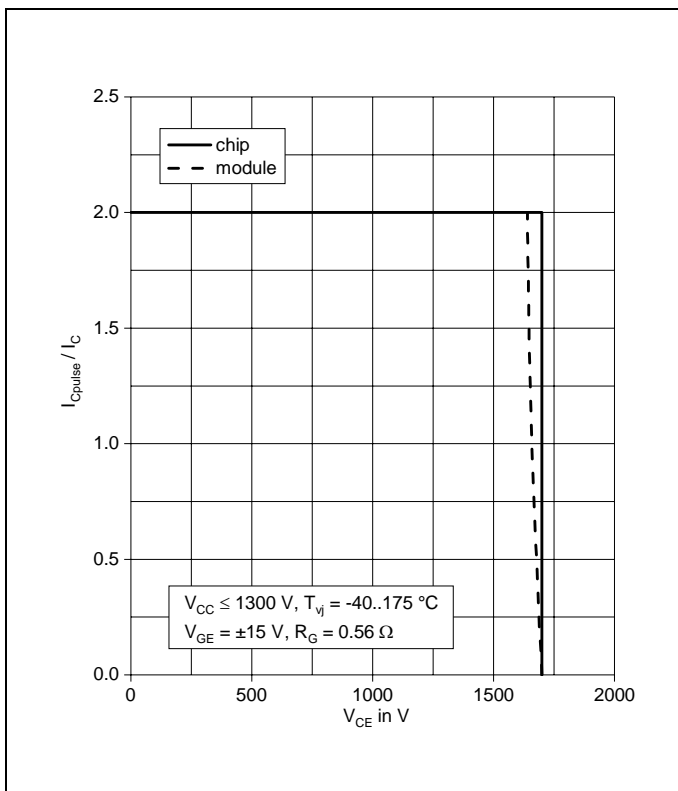


Fig. 11 Turn-off safe operating area (RBSOA)

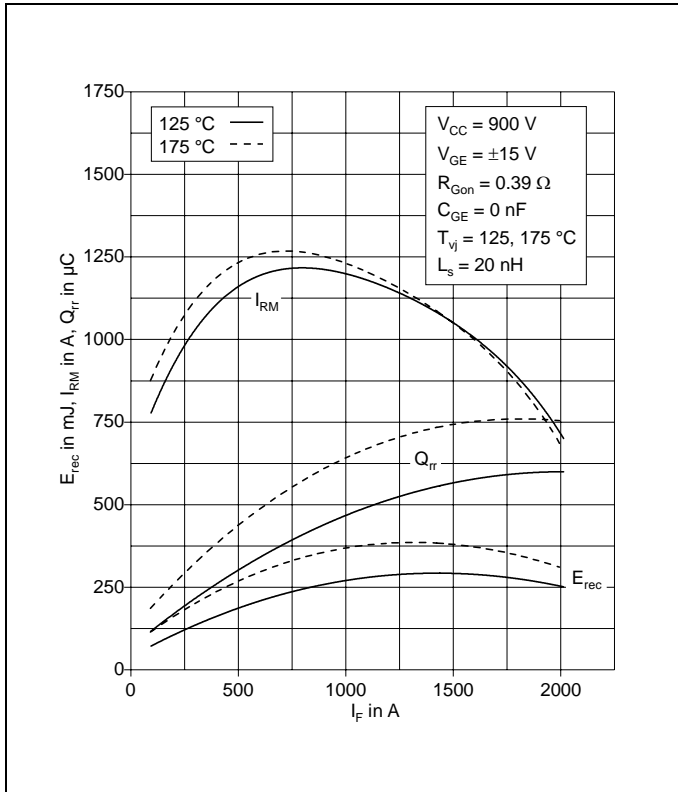


Fig. 12 Typical reverse recovery characteristics vs. forward current

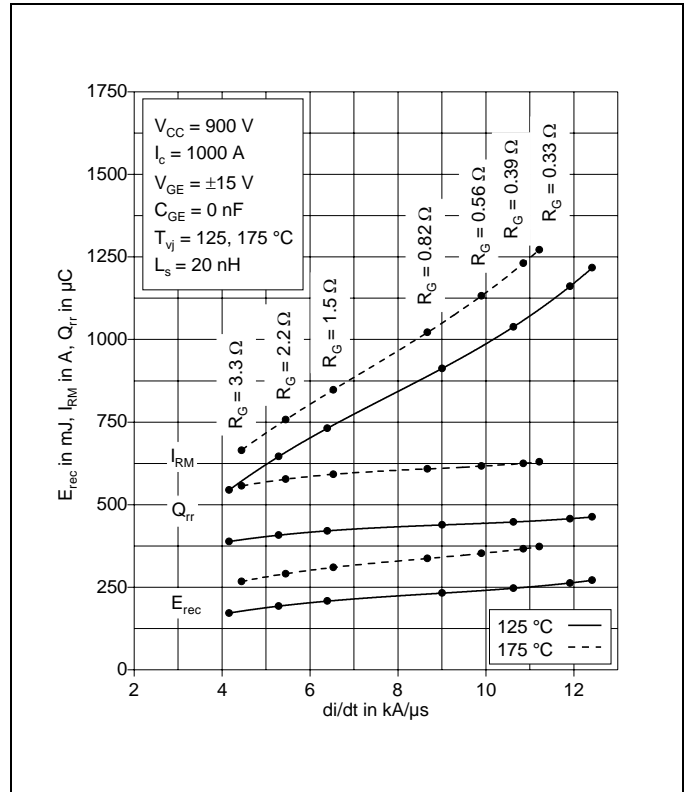


Fig. 13 Typical reverse recovery characteristics vs.  $di/dt$

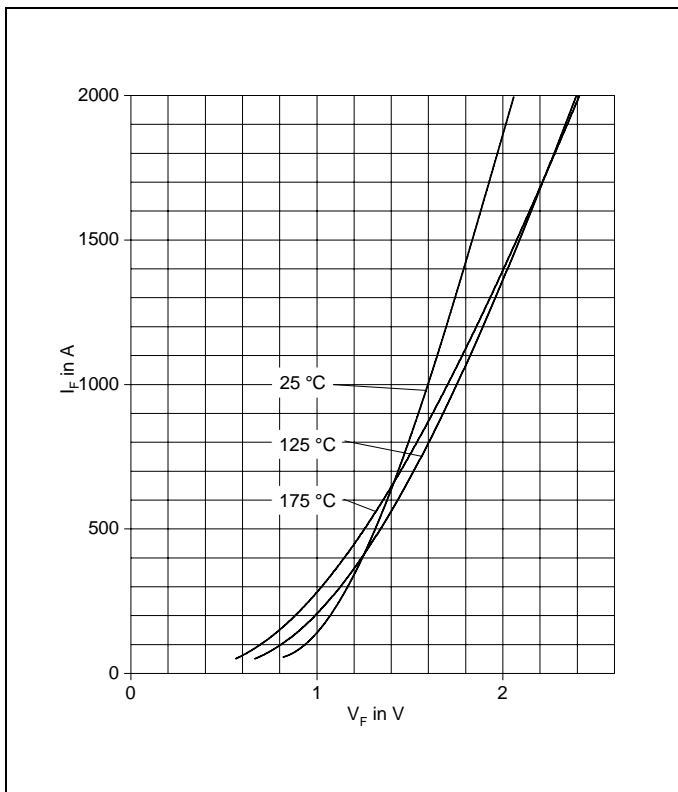


Fig. 14 Typical diode forward characteristics chip level

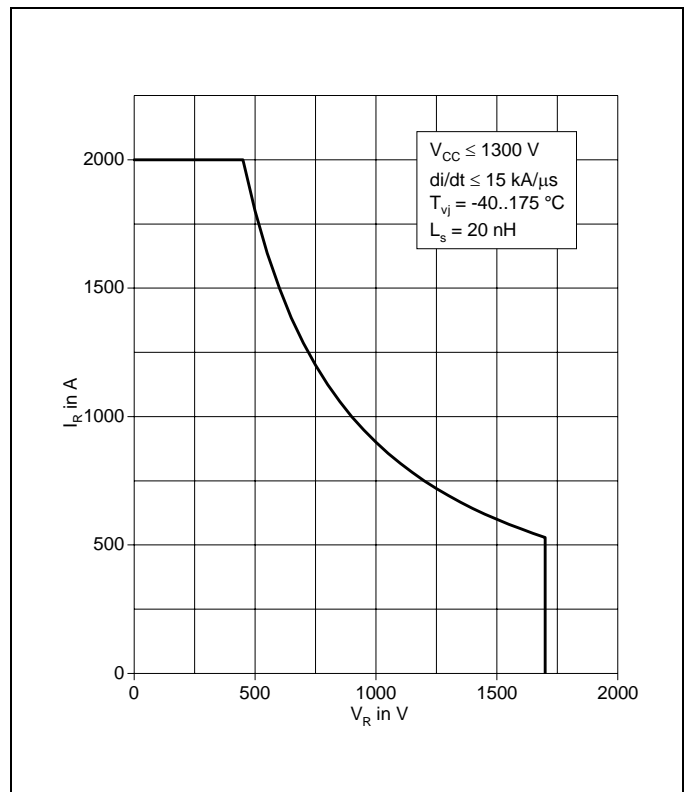


Fig. 15 Safe operating area diode (SOA)



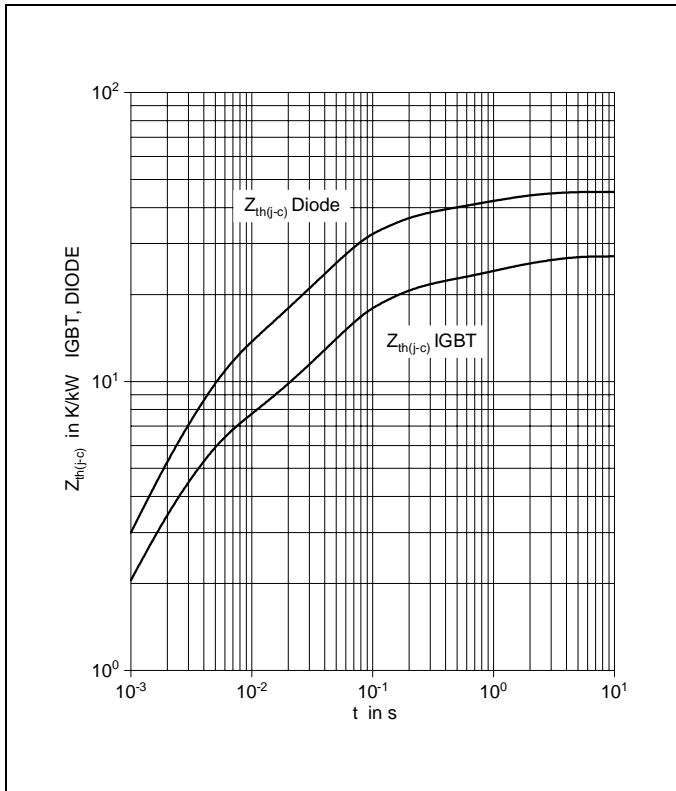


Fig. 16 Thermal impedance vs. time

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	Ri(K/kW)	15.0	6.48	5.58		
	$\tau_i$ (ms)	62.9	1280	2.55		
DIODE	Ri(K/kW)	26.3	10.0	8.96		
	$\tau_i$ (ms)	57.6	3.42	929		

#### Related documents:

- 5SYA 2042 Failure rates of IGBT modules due to cosmic rays
- 5SYA 2043 Load - cycle capability of HiPaks
- 5SYA 2045 Thermal runaway during blocking
- 5SYA 2053 Applying IGBT
- 5SYA 2057 IGBT diode safe operating area (SOA)
- 5SYA 2058 Surge currents for IGBT diodes
- 5SYA 2093 Thermal design of IGBT modules
- 5SYA 2098 Paralleling of IGBT modules
- 5SYA 2107 Mounting instructions for LinPak 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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