

Data sheet 5SYA 1488-01 Jan 22

5SNG 0600R120500

LoPak phase leg IGBT module

- $V_{CE} = 1200\text{ V}$
- $I_C = 2 \times 600\text{ A}$
- Press-fit pins for reliable auxiliary contacts
- Ultra low-loss rugged Trench IGBT chipset
- NTC thermistor for temperature sensing
- Cu baseplate for low thermal resistance
- Industry standard package



Maximum rated values ¹⁾

Parameter	Symbol	Conditions	Min.	Max.	Unit
Collector-emitter voltage	V_{CES}	$V_{GE} = 0\text{ V}$, $T_{vj} \geq 25\text{ °C}$		1200	V
DC collector current	I_C	$T_C = 105\text{ °C}$, $T_{vj} = 175\text{ °C}$		600	A
Peak collector current	I_{CM}	$t_p = 1\text{ ms}$		1200	A
Gate-emitter voltage	V_{GES}		-20	20	V
DC forward current	I_F			600	A
Peak forward current	I_{FRM}	$t_p = 1\text{ ms}$		1200	A
Surge current	I_{FSM}	$T_{vj\text{ start}} = 175\text{ °C}$, $t_p = 10\text{ ms}$, half-sinewave		2000	A
IGBT short circuit SOA	t_{psc}	$V_{GE} \leq 15\text{ V}$, $V_{CC} = 900\text{ V}$ $V_{CE,max} \leq 1200\text{ V}$	$T_{vj\text{ start}} \leq 150\text{ °C}$	8	μs
			$T_{vj\text{ start}} \leq 175\text{ °C}$	6	
Isolation voltage	V_{isol}	1 min, $f = 50\text{ Hz}$		4000	V
Max 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	125 ²⁾ / 150	$^{\circ}\text{C}$
Storage temperature	T_{stg}		-40	125	$^{\circ}\text{C}$
Mounting torques ³⁾	M_s	Base-heat sink, M5 screws	3	6	Nm
	M_{t1}	Main terminals, M6 screws	3	6	

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

²⁾ For UL1557 compliance T_{Cmax} must be limited to 125 $^{\circ}\text{C}$

³⁾ For detailed mounting instructions refer to application note 5SYA 2142

IGBT characteristic values ⁴⁾

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}$, $I_C = 5\text{ mA}$	$T_{vj} = 25\text{ °C}$	1200		V
Collector-emitter ⁵⁾ saturation voltage	V_{CEsat}	$I_C = 600\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	1.53		V
			$T_{vj} = 125\text{ °C}$	1.71		V
			$T_{vj} = 175\text{ °C}$	1.83		V
Collector cut-off current	I_{CES}	$V_{CE} = 1200\text{ V}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		0.1	mA
			$T_{vj} = 125\text{ °C}$	0.35		mA
			$T_{vj} = 175\text{ °C}$	12		mA
Gate leakage current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$	$T_{vj} = 125\text{ °C}$	-150	150	nA
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 24\text{ mA}$, $V_{CE} = V_{GE}$	$T_{vj} = 25\text{ °C}$	5.5		V
Gate charge	Q_G	$I_C = 600\text{ A}$, $V_{CE} = 600\text{ V}$, $V_{GE} = -15\text{ V} \dots 15\text{ V}$		4.1		μC
Input capacitance	C_{ies}	per switch	$T_{vj} = 25\text{ °C}$	76		nF
Internal gate resistance	$R_{g,int}$	per switch		2		Ω
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 600\text{ V}$, $I_C = 600\text{ A}$, $R_G = 0.51\ \Omega$, $C_{GE} = 0\text{ nF}$, $V_{GE} = \pm 15\text{ V}$, $L_\sigma = 30\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	435		ns
			$T_{vj} = 125\text{ °C}$	488		ns
			$T_{vj} = 175\text{ °C}$	510		ns
Rise time	t_r	$V_{CC} = 600\text{ V}$, $I_C = 600\text{ A}$, $R_G = 0.51\ \Omega$, $C_{GE} = 0\text{ nF}$, $V_{GE} = \pm 15\text{ V}$, $L_\sigma = 30\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	156		ns
			$T_{vj} = 125\text{ °C}$	202		ns
			$T_{vj} = 175\text{ °C}$	225		ns
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 600\text{ V}$, $I_C = 600\text{ A}$, $R_G = 0.51\ \Omega$, $C_{GE} = 0\text{ nF}$, $V_{GE} = \pm 15\text{ V}$, $L_\sigma = 30\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	385		ns
			$T_{vj} = 125\text{ °C}$	417		ns
			$T_{vj} = 175\text{ °C}$	427		ns
Fall time	t_f	$V_{CC} = 600\text{ V}$, $I_C = 600\text{ A}$, $R_G = 0.51\ \Omega$, $C_{GE} = 0\text{ nF}$, $V_{GE} = \pm 15\text{ V}$, $L_\sigma = 30\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	112		ns
			$T_{vj} = 125\text{ °C}$	148		ns
			$T_{vj} = 175\text{ °C}$	176		ns
Turn-on switching energy	E_{on}	$V_{CC} = 600\text{ V}$, $I_C = 600\text{ A}$, $R_G = 0.51\ \Omega$, $C_{GE} = 0\text{ nF}$, $V_{GE} = \pm 15\text{ V}$, $L_\sigma = 30\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	95		mJ
			$T_{vj} = 125\text{ °C}$	140		mJ
			$T_{vj} = 175\text{ °C}$	171		mJ
Turn-off switching energy	E_{off}	$V_{CC} = 600\text{ V}$, $I_C = 600\text{ A}$, $R_G = 0.51\ \Omega$, $C_{GE} = 0\text{ nF}$, $V_{GE} = \pm 15\text{ V}$, $L_\sigma = 30\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	67		mJ
			$T_{vj} = 125\text{ °C}$	99		mJ
			$T_{vj} = 175\text{ °C}$	115		mJ
Short circuit current	I_{SC}	$V_{CC} = 900\text{ V}$, $V_{GE} = 15\text{ V}$, $V_{CEM,CHIP} \leq 1200\text{ V}$	$T_{vj} = 175\text{ °C}$	2500		A

⁴⁾ Characteristic values according to IEC 60747 – 9

⁵⁾ Collector-emitter saturation voltage is given at chip level

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Diode characteristic values ⁶⁾

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward voltage ⁷⁾	V _F	I _F = 600 A	T _{vj} = 25 °C	1.67		V
			T _{vj} = 125 °C	1.71		V
			T _{vj} = 175 °C	1.65		V
Peak reverse recovery current	I _{rm}		T _{vj} = 25 °C	368		A
			T _{vj} = 125 °C	377		A
			T _{vj} = 175 °C	400		A
Recovered charge	Q _{rr}	V _{CC} = 600 V, I _F = 600 A, V _{GE} = ±15 V, R _G = 0.51 Ω, C _{GE} = 0 nF, L _σ = 30 nH, di/dt = 2.9 kA / μs, inductive load	T _{vj} = 25 °C	77		μC
			T _{vj} = 125 °C	105		μC
			T _{vj} = 175 °C	141		μC
Reverse recovery time	t _{rr}		T _{vj} = 25 °C	294		ns
			T _{vj} = 125 °C	498		ns
			T _{vj} = 175 °C	696		ns
Reverse recovery energy	E _{rec}		T _{vj} = 25 °C	18		mJ
			T _{vj} = 125 °C	26		mJ
			T _{vj} = 175 °C	34		mJ

⁶⁾ Characteristic values according to IEC 60747 – 2

⁷⁾ Forward voltage is given at chip level

NTC Thermistor

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Rated resistance	R ₂₅	T _c = 25 °C		5		kΩ
R100	R ₁₀₀	T _c = 100 °C	468		517	Ω
B-value	B _{25/85}	R ₂₅ = R ₂₅ exp [B _{25/85} (1/T ₂ – 1/(298.15K))]		3375		K
B-value	B _{25/100}	R ₂₅ = R ₂₅ exp [B _{25/100} (1/T ₂ – 1/(298.15K))]		3433		K

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Package properties

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$	per switch			0.0645	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$	per switch			0.1425	K/W
IGBT thermal resistance case to heatsink ⁸⁾	$R_{th(c-s)IGBT}$	IGBT per switch, $\lambda_{Grease} = 1 \text{ W/m} \times \text{K}$		0.029		K/W
Diode thermal resistance case to heatsink ⁸⁾	$R_{th(c-s)DIODE}$	Diode per switch, $\lambda_{Grease} = 1 \text{ W/m} \times \text{K}$		0.036		K/W
Comparative tracking index	CTI		200			
Module stray inductance	$L_{\sigma CE}$	per switch		20		nH
Resistance, terminal-chip	R_{CC-EE}	per switch	$T_C = 25 \text{ }^\circ\text{C}$	0.95		mΩ
			$T_C = 125 \text{ }^\circ\text{C}$	1.35		
			$T_C = 175 \text{ }^\circ\text{C}$	1.55		

⁸⁾ Depends on heatsink design

Mechanical properties ⁹⁾

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Dimensions	L x W x H	Typical		152 x 62 x 17		mm
Clearance distance in air	d_a	According to IEC 60664-1 and EN 50124-1	Term. to base:	12.5		mm
			Term. to base:	10		
Surface creepage distance	d_s	According to IEC 60664-1 and EN 50124-1	Term. to base:	14.5		mm
			Term. to base:	13		
Mass	m			350		g

⁹⁾ Package and mechanical properties according to IEC 60747 – 15

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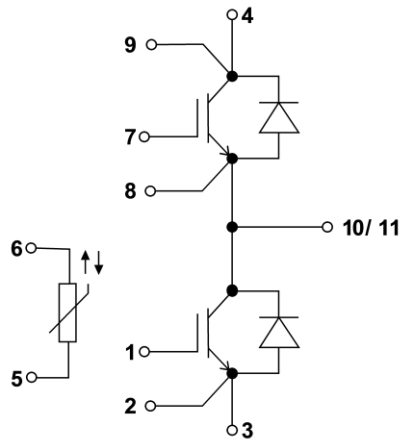
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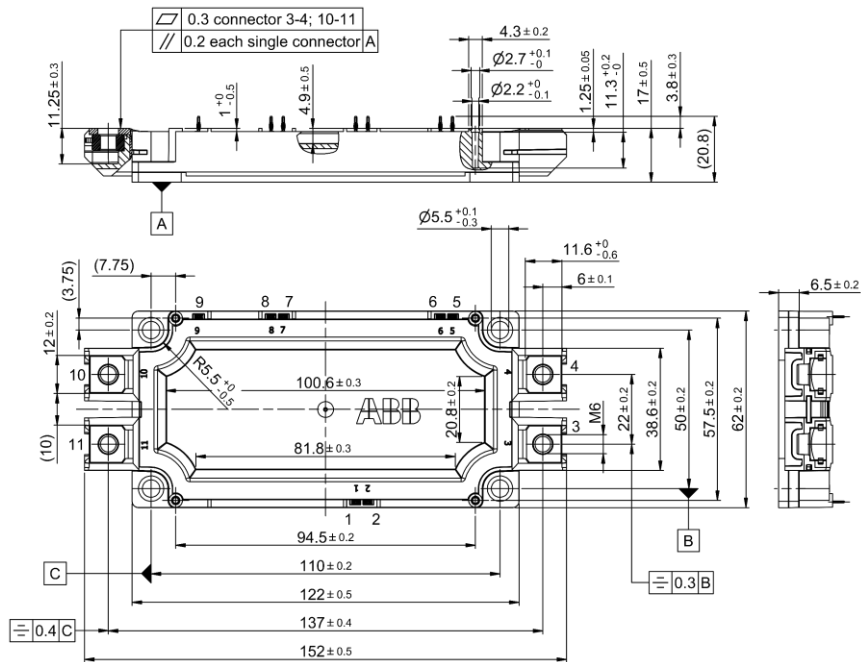
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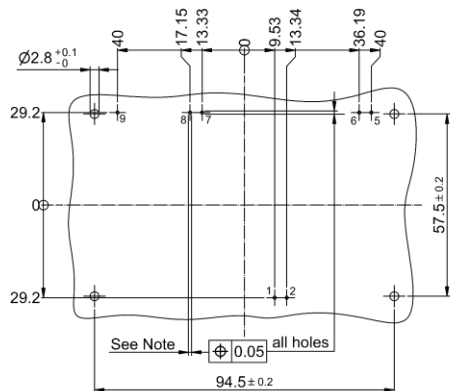
Electrical configuration



Mechanical drawing



PCB drill hole pattern for press-fit



Note:
 $\phi 1.15^{+0.09}_{-0.06}$ Diameter of finished plated through-hole
 $\phi 1.15$ Diameter of drilled hole

Note: all dimensions are shown in millimeters

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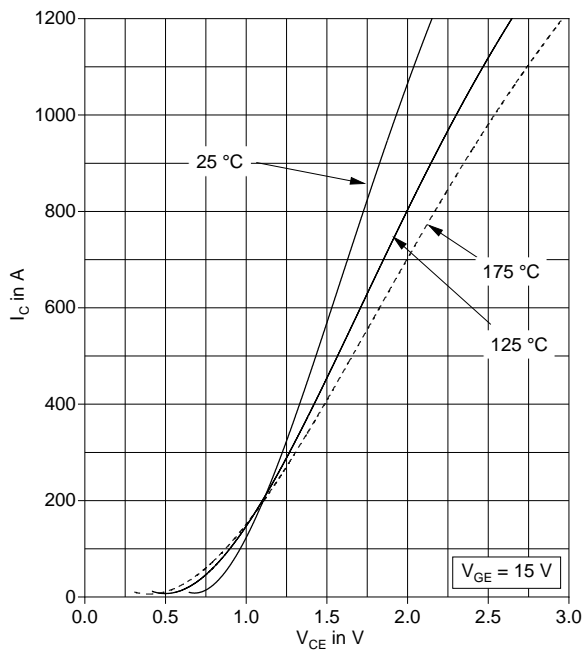


Fig. 1 Typical on-state characteristics, chip level

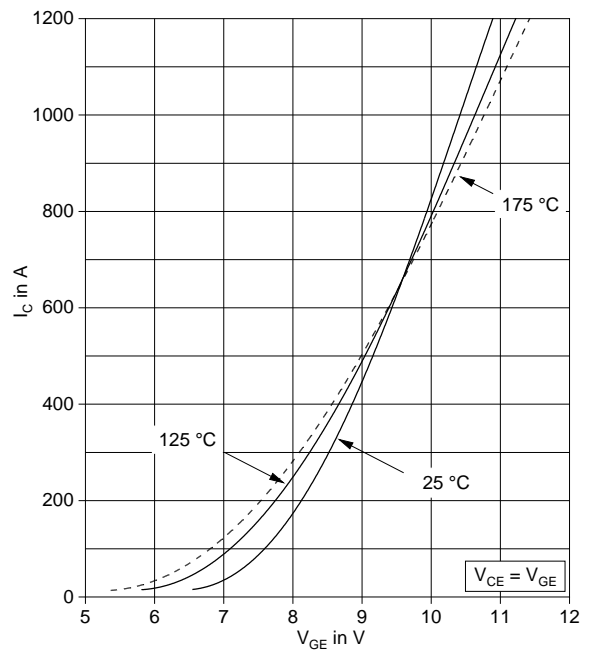


Fig. 2 Typical transfer characteristics, chip level

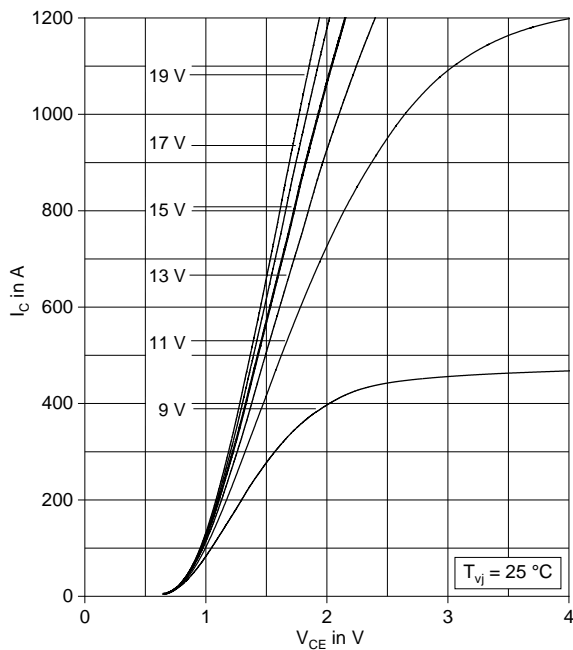


Fig. 3 Typical output characteristics, chip level

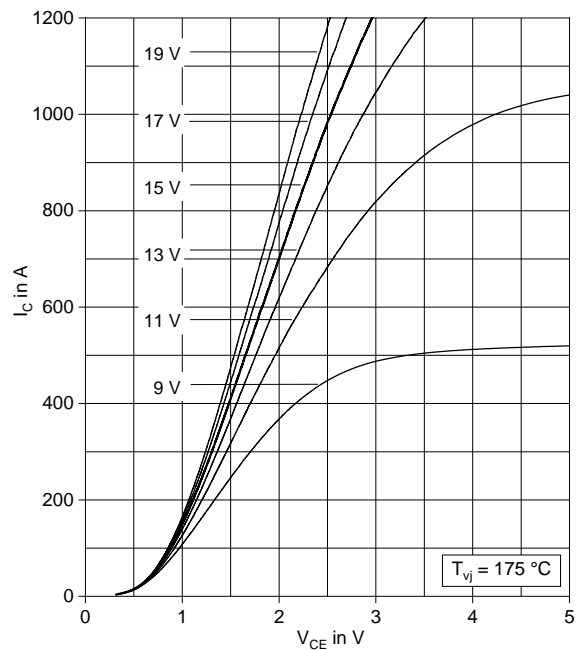


Fig. 4 Typical output characteristics, chip level

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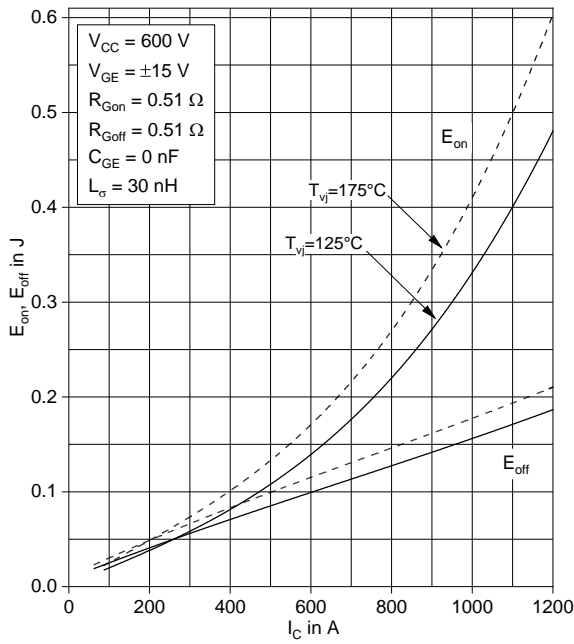


Fig. 5 Typical switching energies per pulse vs. collector current

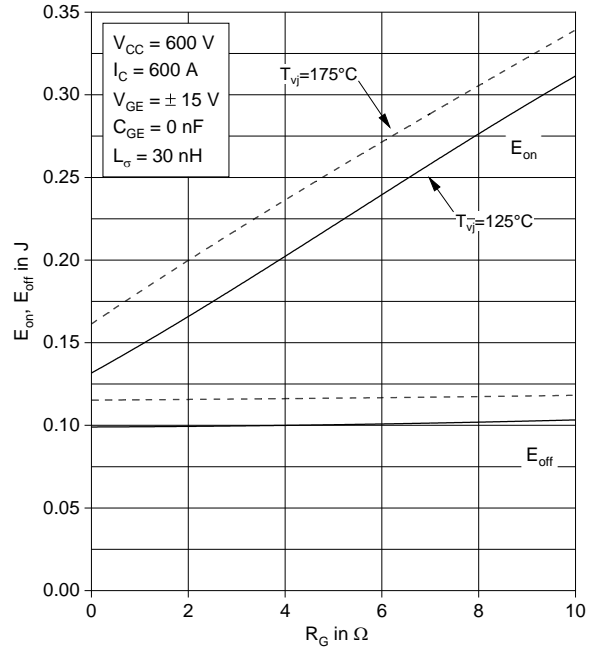


Fig. 6 Typical switching energies per pulse vs. gate resistor

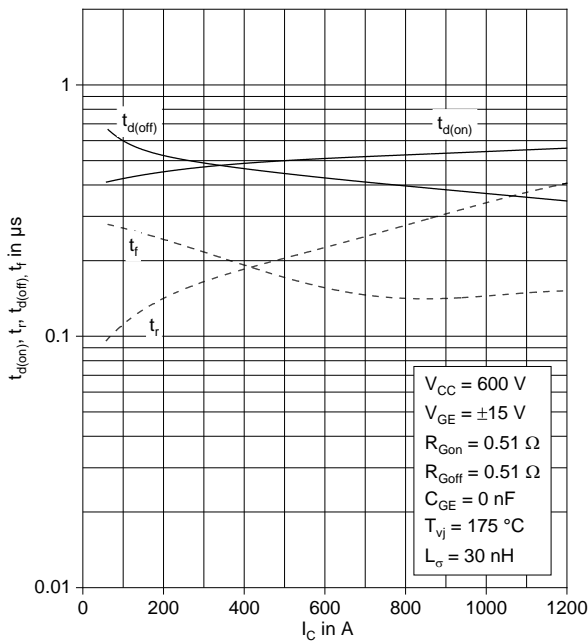


Fig. 7 Typical switching times vs. collector current

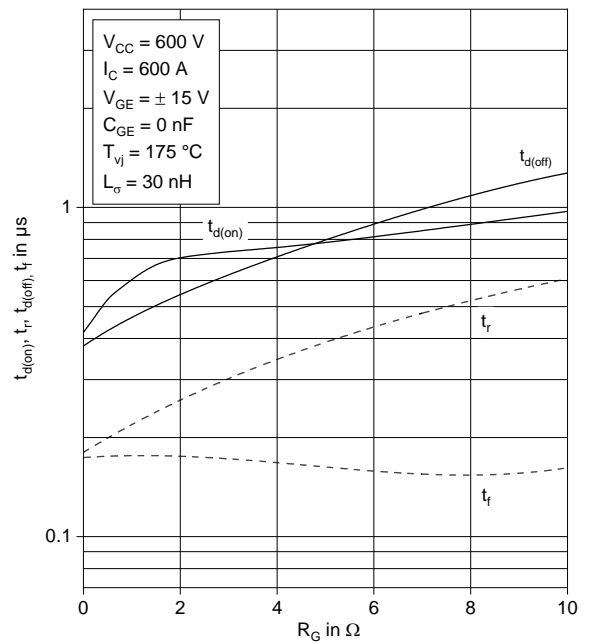


Fig. 8 Typical switching times vs. gate resistor

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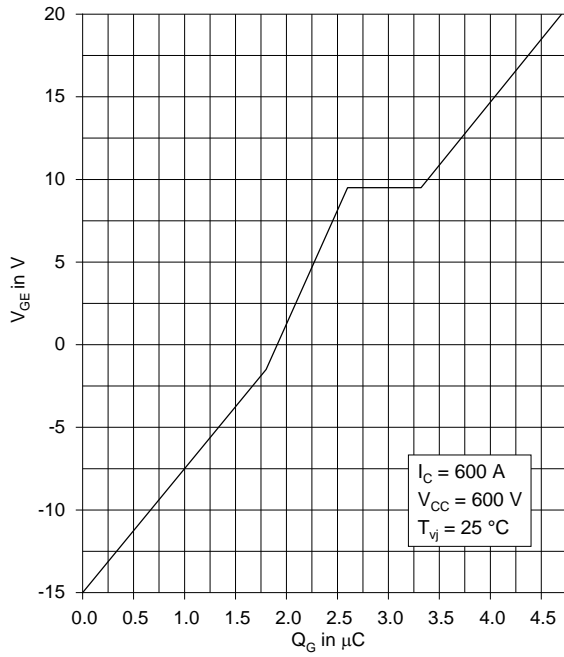


Fig. 9 Typical gate charge characteristics

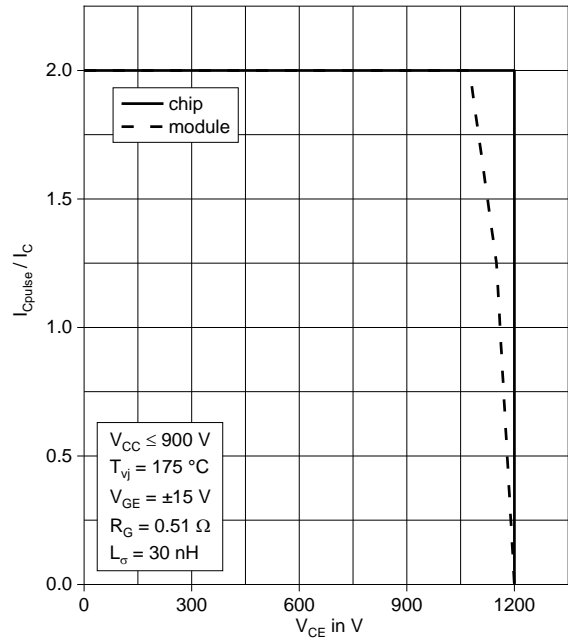


Fig. 10 Turn-off safe operating area (RBSOA)

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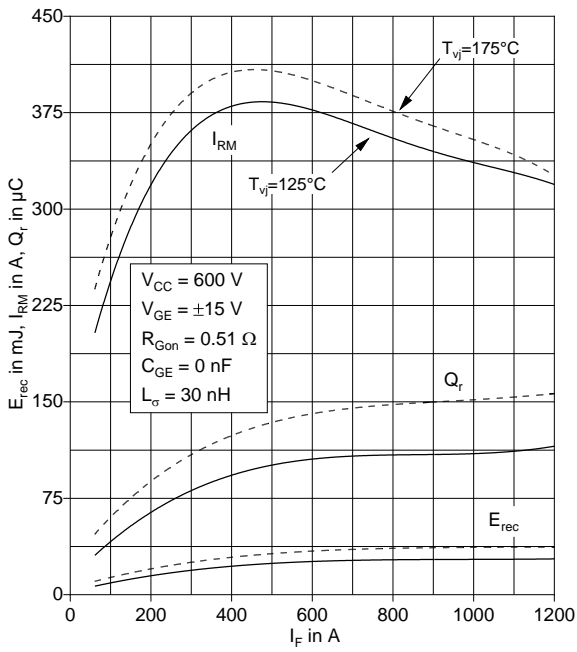


Fig. 11 Typical reverse recovery characteristics vs. forward current

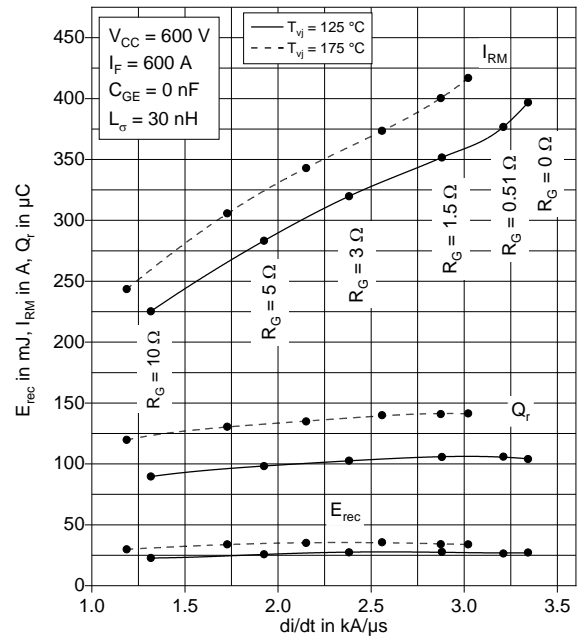


Fig. 12 Typical reverse recovery characteristics vs. di/dt

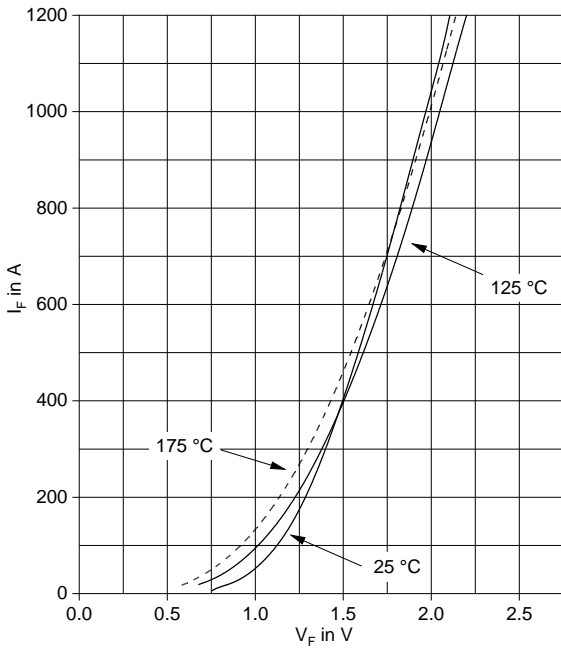


Fig. 13 Typical diode forward characteristics, chip level

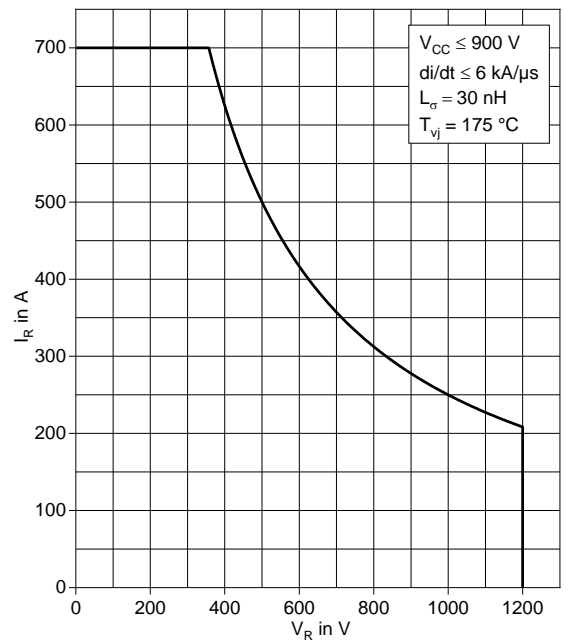


Fig. 14 Diode turn-off safe operating area (DSOA)

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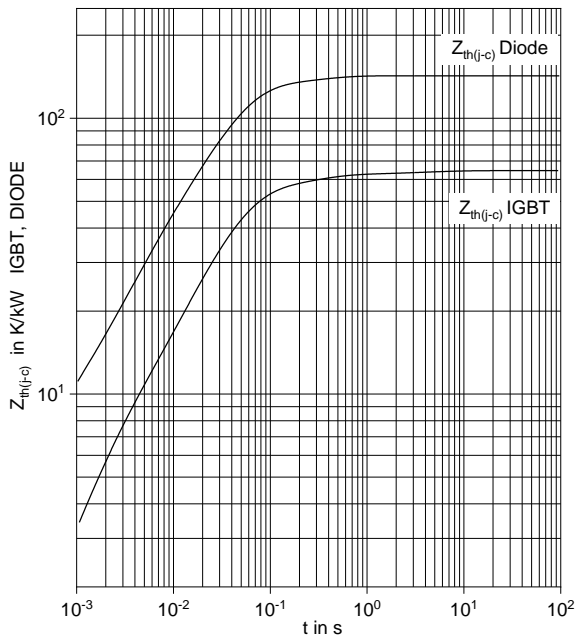


Fig. 16 Thermal impedance vs time

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)	4.58	9.97	47.7	2.3	
	τi(ms)	1.92	229.4	35.1	3922	
DIODE	Ri(K/kW)	5.29	14.9	108	14.3	
	τi(ms)	0.36	263.8	35.5	4.4	

Related documents:

- 5SYA 2042 Failure rates of IGBT modules due to cosmic rays
- 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 2142 LoPak modules use and installation

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