

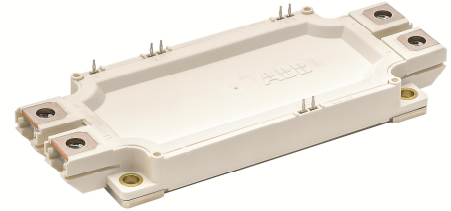
5SNG 0450R170300

LoPak1 phase leg IGBT Module

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

$$I_C = 2 \times 450 \text{ A}$$

Press-fit pins for reliable auxiliary contacts
 Ultra low-loss, rugged SPT++ chip-set
 NTC thermistor for temperature sensing
 Cu base-plate for low thermal resistance
 Industry standard package



Maximum rated values ¹⁾

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	V_{CES}	$V_{GE} = 0 \text{ V}$, $T_{vj} \geq 25 \text{ }^\circ\text{C}$		1700	V
DC collector current	I_C	$T_C = 115 \text{ }^\circ\text{C}$, $T_{vj} = 175 \text{ }^\circ\text{C}$		450	A
Peak collector current	I_{CM}	$t_p = 1 \text{ ms}$		900	A
Gate-emitter voltage	V_{GES}		-20	20	V
DC forward current	I_F			450	A
Peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$		900	A
Surge current	I_{FSM}	$V_R = 0 \text{ V}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $t_p = 10 \text{ ms}$, half-sinewave		2500	A
IGBT short circuit SOA	t_{psc}	$V_{CC} = 1300 \text{ V}$, $V_{CEM \text{ CHIP}} \leq 1700 \text{ V}$ $V_{GE} \leq 15 \text{ V}$, $T_{vj} \leq 150 \text{ }^\circ\text{C}$		10	μs
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	125 ²⁾ / 150	$^\circ\text{C}$
Storage temperature	T_{stg}		-40	125	$^\circ\text{C}$
Mounting torques ³⁾	M_s	Base-heatsink, 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 ABB Document No. 5SYA 2113

IGBT characteristic values ⁴⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
Collector (-emitter) breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}$, $I_C = 10\text{ mA}$, $T_{vj} = 25\text{ °C}$	1700			V
Collector-emitter ⁵⁾ saturation voltage	$V_{CE\text{ sat}}$	$I_C = 450\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	2.25	2.6	V
			$T_{vj} = 125\text{ °C}$		2.55	V
			$T_{vj} = 175\text{ °C}$		2.75	V
Collector cut-off current	I_{CES}	$V_{CE} = 1700\text{ V}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		0.1	mA
			$T_{vj} = 125\text{ °C}$		1.2	mA
			$T_{vj} = 175\text{ °C}$		20	mA
Gate leakage current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$, $T_{vj} = 175\text{ °C}$	-500		500	nA
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 12\text{ mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25\text{ °C}$	4.5		6.5	V
Gate charge	Q_G	$I_C = 450\text{ A}$, $V_{CE} = 900\text{ V}$, $V_{GE} = -15\text{ V} \dots 15\text{ V}$		3.2		μC
Input capacitance	C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$, $T_{vj} = 25\text{ °C}$		28.8		nF
Internal gate resistance	R_{Gint}	per switch		1		W
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 900\text{ V}$, $I_C = 450\text{ A}$, $R_G = 0.47\text{ W}$, $V_{GE} = \pm 15\text{ V}$, $L_S = 40\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	245		ns
			$T_{vj} = 125\text{ °C}$	260		ns
			$T_{vj} = 175\text{ °C}$	270		ns
Rise time	t_r	$V_{CC} = 900\text{ V}$, $I_C = 450\text{ A}$, $R_G = 0.47\text{ W}$, $V_{GE} = \pm 15\text{ V}$, $L_S = 40\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	70		ns
			$T_{vj} = 125\text{ °C}$	90		ns
			$T_{vj} = 175\text{ °C}$	95		ns
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 900\text{ V}$, $I_C = 450\text{ A}$, $R_G = 0.47\text{ W}$, $V_{GE} = \pm 15\text{ V}$, $L_S = 40\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	440		ns
			$T_{vj} = 125\text{ °C}$	540		ns
			$T_{vj} = 175\text{ °C}$	600		ns
Fall time	t_f	$V_{CC} = 900\text{ V}$, $I_C = 450\text{ A}$, $R_G = 0.47\text{ W}$, $V_{GE} = \pm 15\text{ V}$, $L_S = 40\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	110		ns
			$T_{vj} = 125\text{ °C}$	160		ns
			$T_{vj} = 175\text{ °C}$	165		ns
Turn-on switching energy	E_{on}	$V_{CC} = 900\text{ V}$, $I_C = 450\text{ A}$, $R_G = 0.47\text{ W}$, $V_{GE} = \pm 15\text{ V}$, $L_S = 40\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	95		mJ
			$T_{vj} = 125\text{ °C}$	145		mJ
			$T_{vj} = 175\text{ °C}$	185		mJ
Turn-off switching energy	E_{off}	$V_{CC} = 900\text{ V}$, $I_C = 450\text{ A}$, $R_G = 0.47\text{ W}$, $V_{GE} = \pm 15\text{ V}$, $L_S = 40\text{ nH}$, inductive load	$T_{vj} = 25\text{ °C}$	90		mJ
			$T_{vj} = 125\text{ °C}$	135		mJ
			$T_{vj} = 175\text{ °C}$	165		mJ
Short circuit current	I_{SC}	$t_{psc} \leq 10\text{ }\mu\text{s}$, $V_{GE} = 15\text{ V}$, $V_{CC} = 1300\text{ V}$, $V_{CEM\text{ CHIP}} \leq 1700\text{ V}$	$T_{vj} = 150\text{ °C}$	1500		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	$I_F = 450 \text{ A}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	1.6	2.2	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1.75	V
			$T_{vj} = 175 \text{ }^\circ\text{C}$		1.7	V
Peak reverse recovery current	I_{RM}		$T_{vj} = 25 \text{ }^\circ\text{C}$	480		A
			$T_{vj} = 125 \text{ }^\circ\text{C}$		490	A
			$T_{vj} = 175 \text{ }^\circ\text{C}$		530	A
Recovered charge	Q_r	$V_{CC} = 900 \text{ V}$, $I_F = 450 \text{ A}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0.47 \text{ } \Omega$, $di/dt = 5.3 \text{ kA}/\mu\text{s}$ $L_s = 40 \text{ nH}$, inductive load	$T_{vj} = 25 \text{ }^\circ\text{C}$	120		μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$		190	μC
			$T_{vj} = 175 \text{ }^\circ\text{C}$		260	μC
Reverse recovery time	t_{rr}		$T_{vj} = 25 \text{ }^\circ\text{C}$	490		ns
			$T_{vj} = 125 \text{ }^\circ\text{C}$		790	ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$		930	ns
Reverse recovery energy	E_{rec}		$T_{vj} = 25 \text{ }^\circ\text{C}$	75		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		115	mJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$		155	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}	$T_C = 25 \text{ }^\circ\text{C}$		5		k Ω
R100	R_{100}	$T_C = 100 \text{ }^\circ\text{C}$	468		517	Ω
B-value	$B_{25/50}$	$R_{25} = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15K))]$		3375		K
B-value	$B_{25/100}$	$R_{25} = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298.15K))]$		3433		K

Package properties ⁸⁾

Parameter	Symbol	Conditions	min	typ	max	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$	per switch			0.048	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.087	K/W
IGBT thermal resistance ³⁾ case to heatsink	$R_{th(c-s)IGBT}$	IGBT per switch, I grease = 1W/m x K		0.029		K/W
Diode thermal resistance ³⁾ case to heatsink	$R_{th(c-s)DIODE}$	Diode per switch, I grease = 1W/m x K		0.048		K/W
Comparative tracking index	CTI		200			
Module stray inductance	$L_{\sigma CE}$	per switch		25		nH
Resistance, terminal-chip	$R_{CC'+EE'}$	per switch	$T_C = 25 \text{ }^\circ\text{C}$	0.95		m Ω
			$T_C = 125 \text{ }^\circ\text{C}$	1.35		
			$T_C = 175 \text{ }^\circ\text{C}$	1.55		

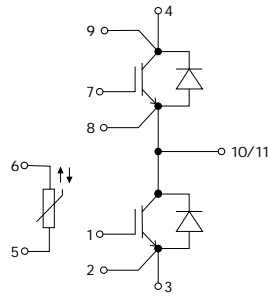
³⁾ For detailed mounting instructions refer to ABB Document No. 5SYA 2113

Mechanical properties ⁸⁾

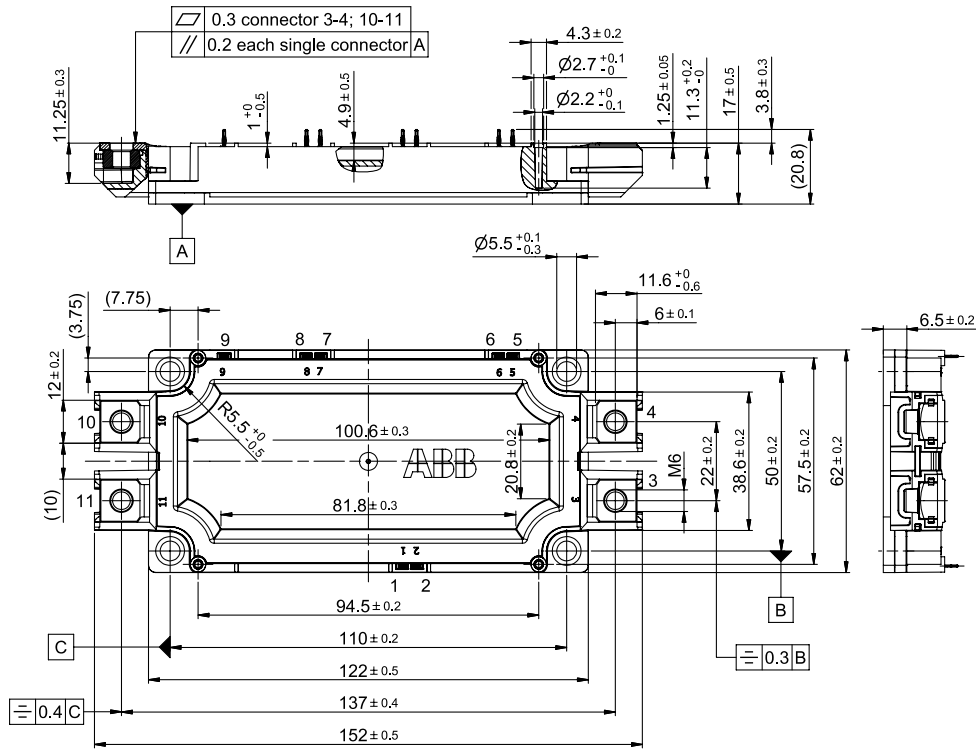
Parameter	Symbol	Conditions	min	typ	max	Unit
Dimensions	L x W x H	Typical		152 x 62 x 17		mm
Clearance distance in air	d_a	according to IEC 60664-1 and EN 50124-1	Term. to base:	12.5		mm
			Term. to term:	10		
Surface creepage distance	d_s	according to IEC 60664-1 and EN 50124-1	Term. to base:	14.5	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

⁸⁾ Package and mechanical properties according to IEC 60747 - 15

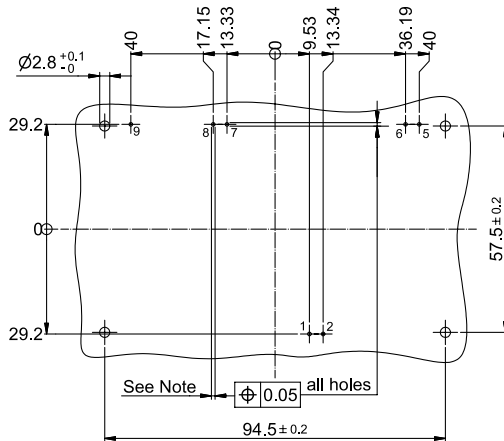
Electrical configuration



Outline drawing ³⁾



PCB drill hole pattern for press-fit



Note:

Ø1^{+0.09}_{-0.06} Diameter of finished plated through-hole

Ø1.15 Diameter of drilled hole

Note: all dimensions are shown in millimeters

³⁾ For detailed mounting instructions refer to ABB Document No. 5SYA 2113

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.

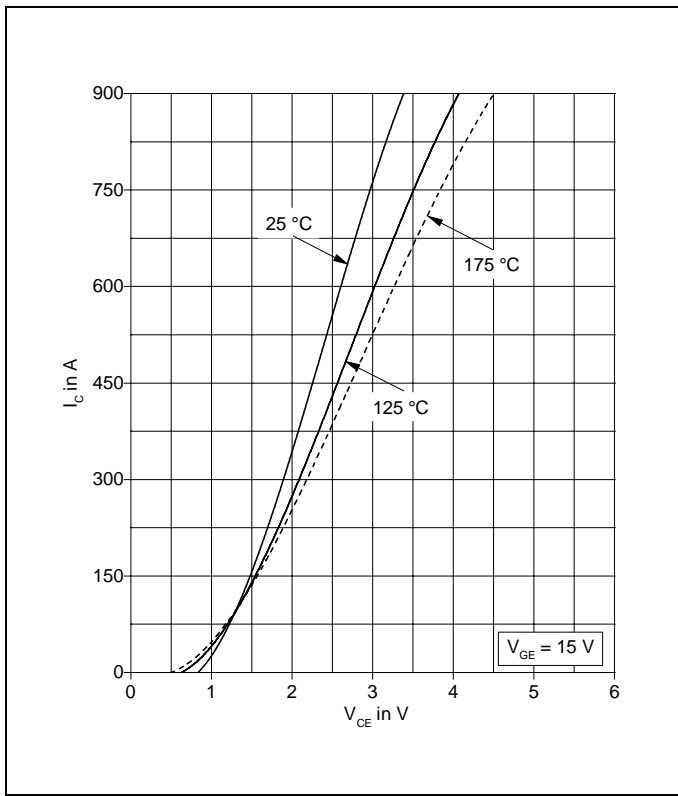


Fig. 1 Typical on-state characteristics, chip level

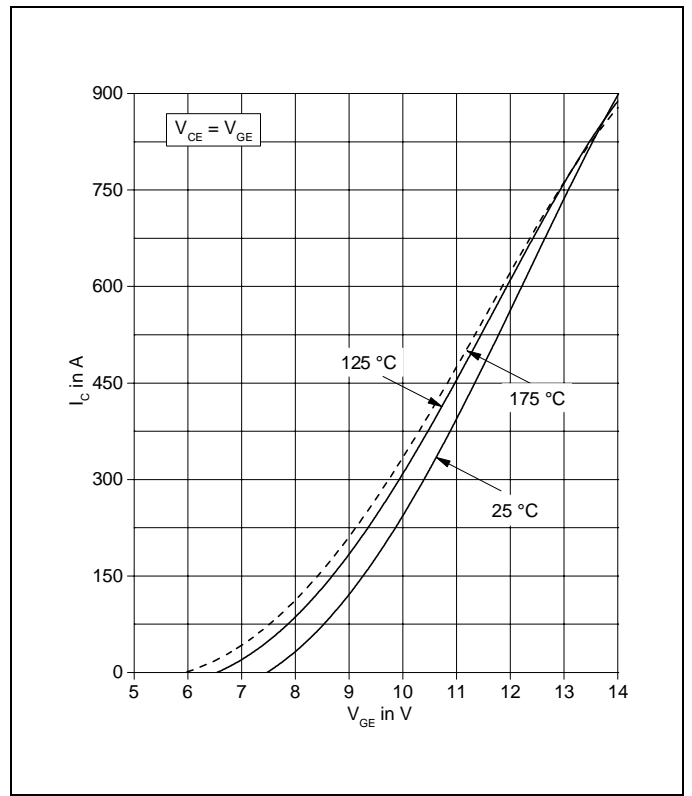


Fig. 2 Typical transfer characteristics, chip level

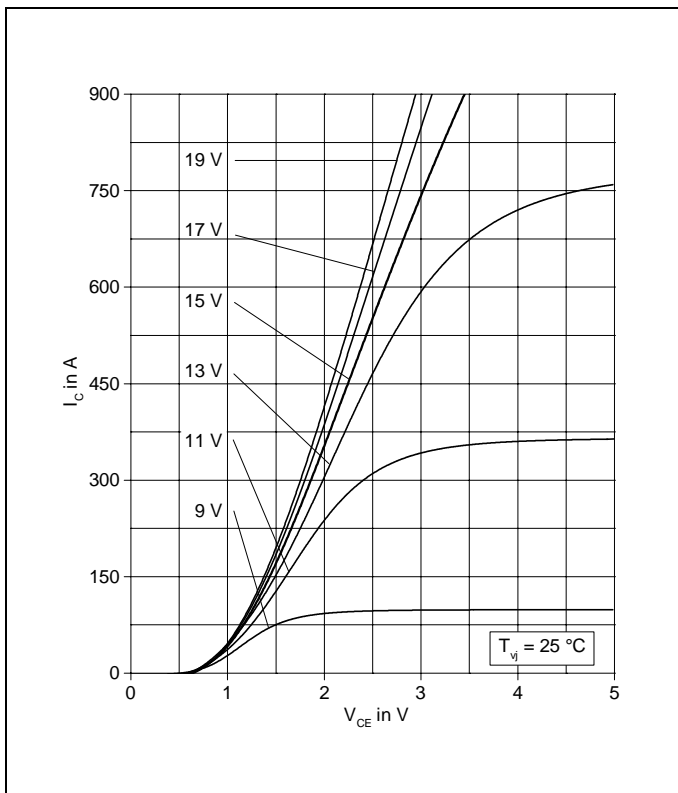


Fig. 3 Typical output characteristics, chip level

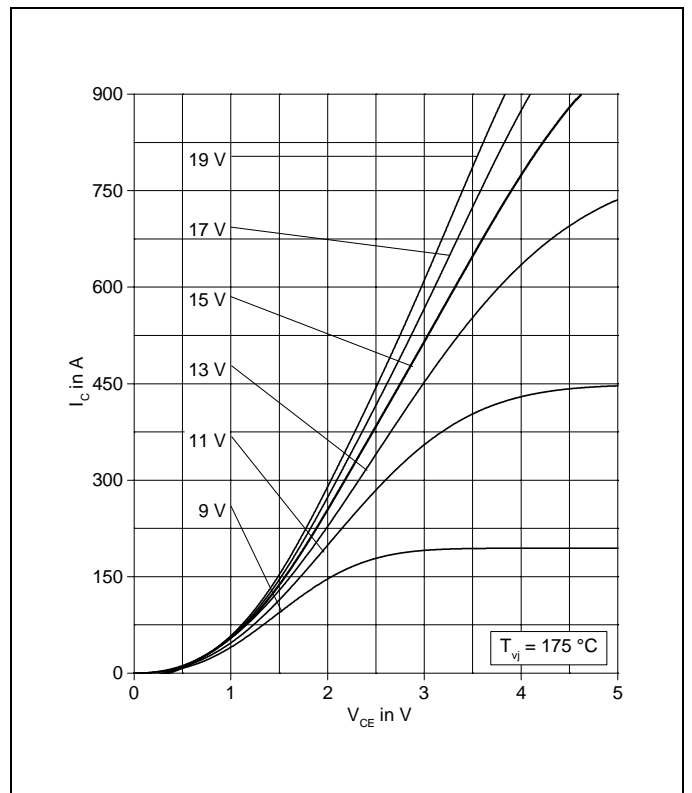


Fig. 4 Typical output characteristics, chip level

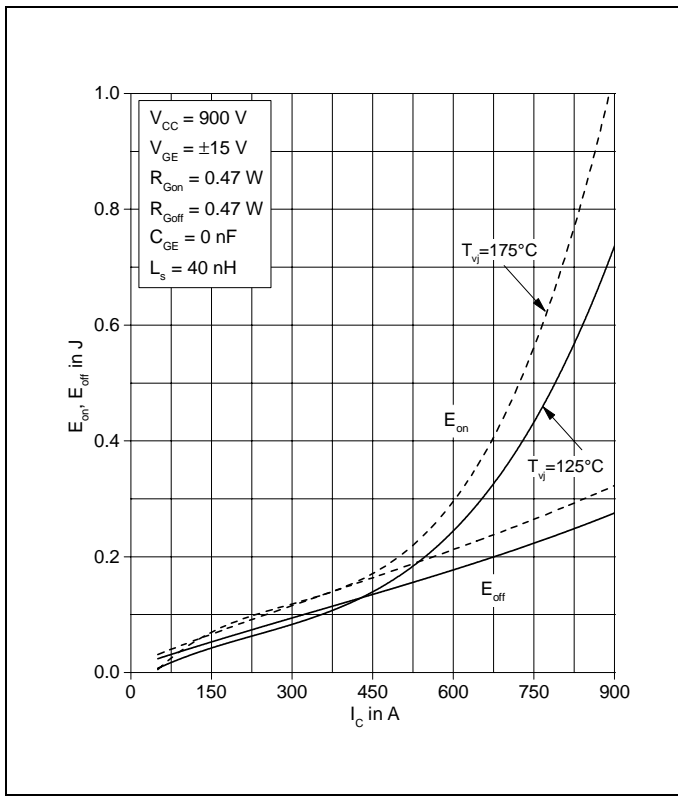


Fig. 5 Typical switching energies per pulse vs. collector current

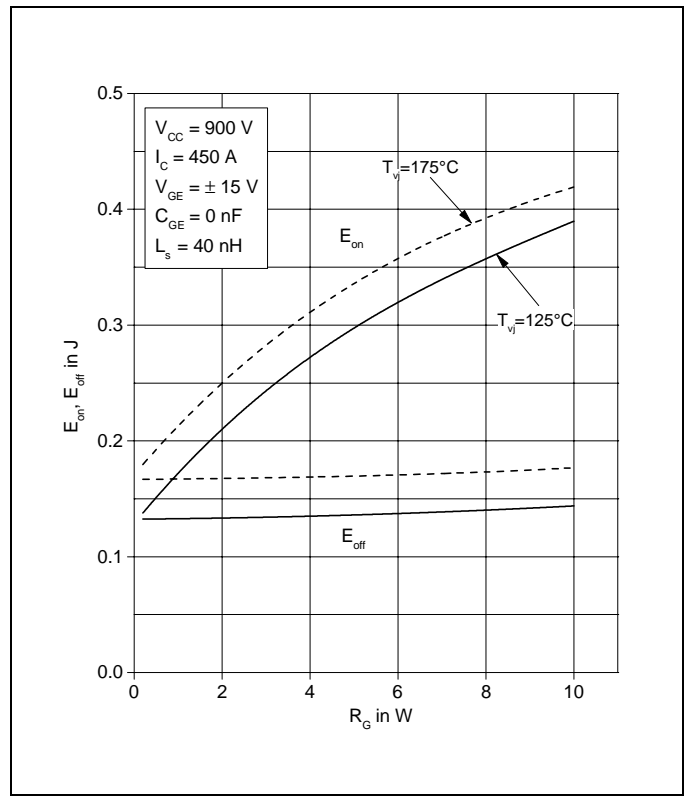


Fig. 6 Typical switching energies per pulse vs. gate resistor

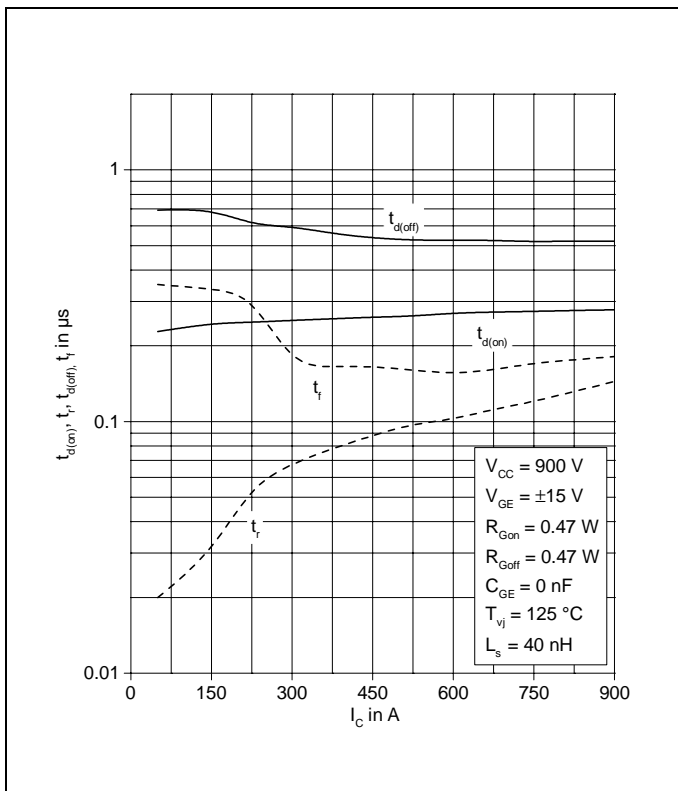


Fig. 7 Typical switching times vs. collector current

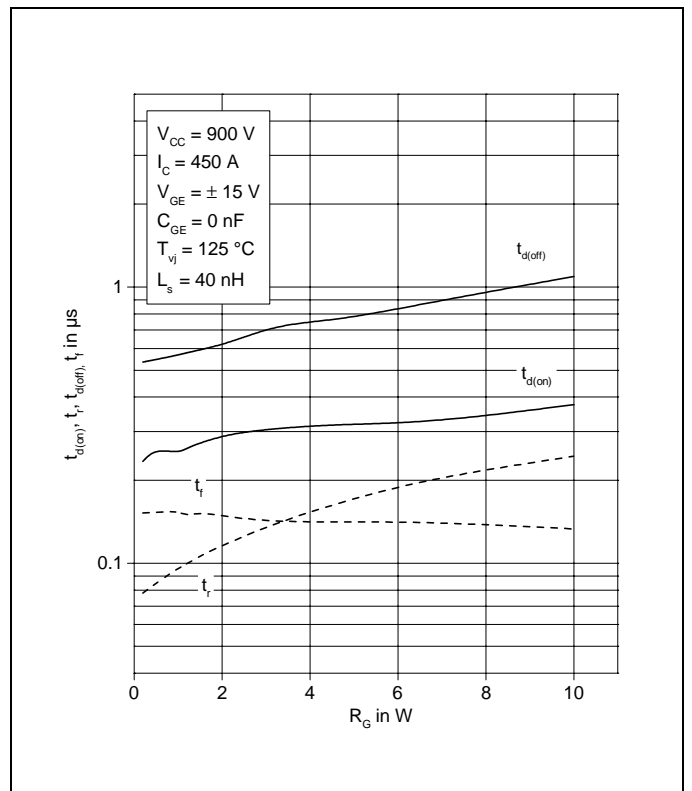


Fig. 8 Typical switching times vs. gate resistor

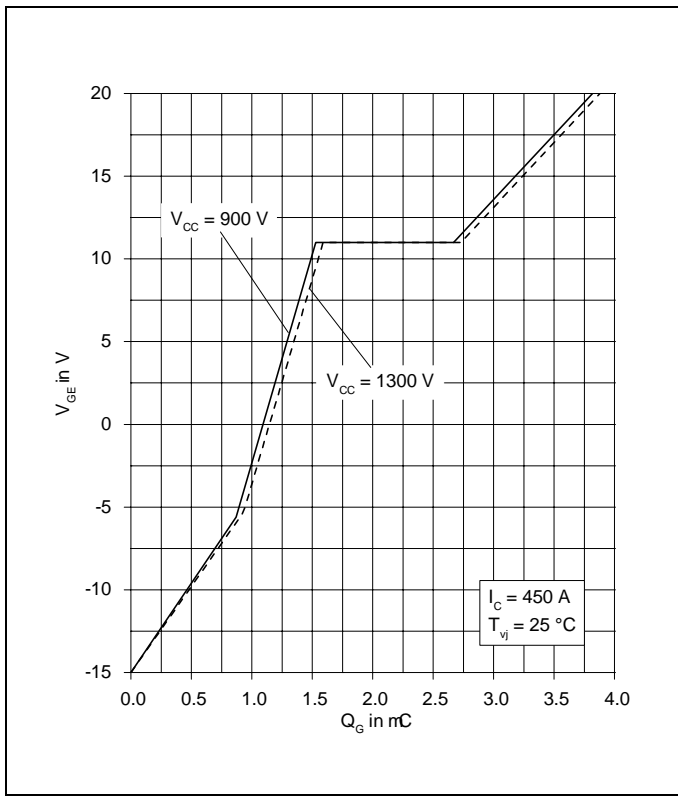


Fig. 9 Typical gate charge characteristics

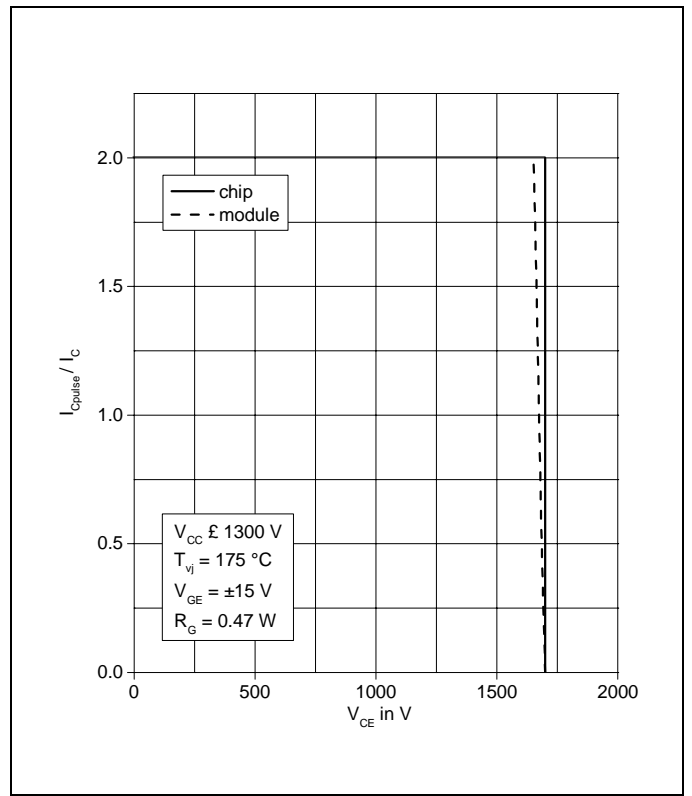


Fig. 10 Turn-off safe operating area (RBSOA)

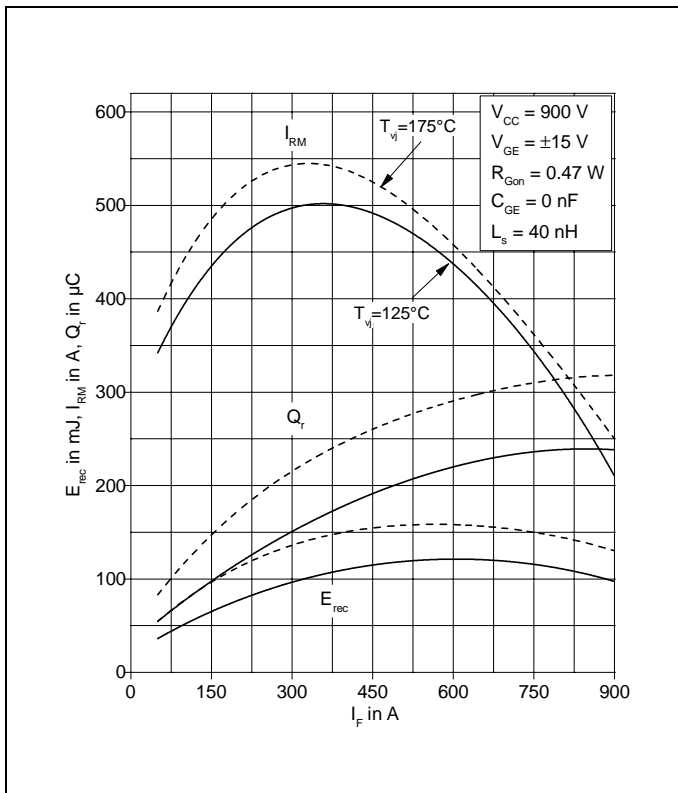


Fig. 11 Typical reverse recovery characteristics vs. forward current

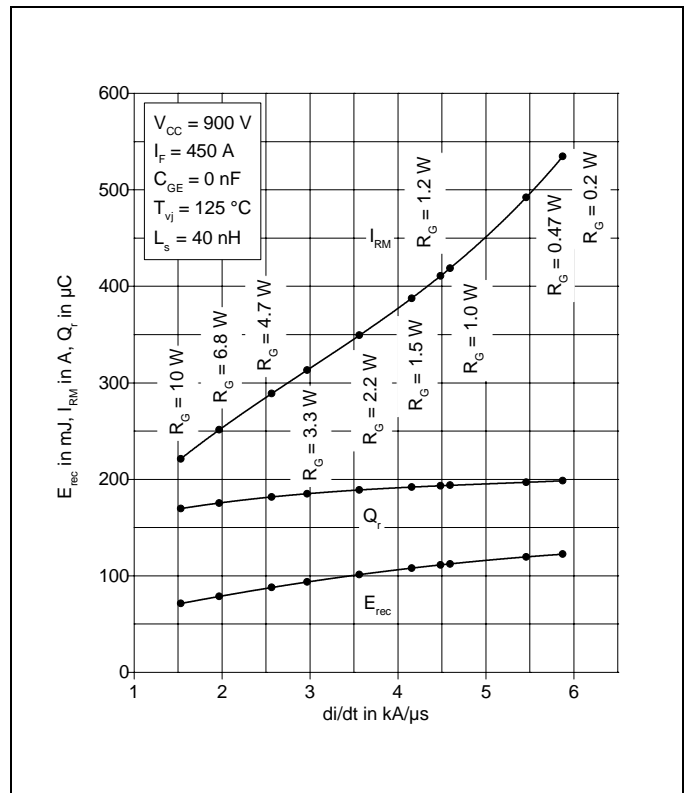


Fig. 12 Typical reverse recovery characteristics vs. di/dt

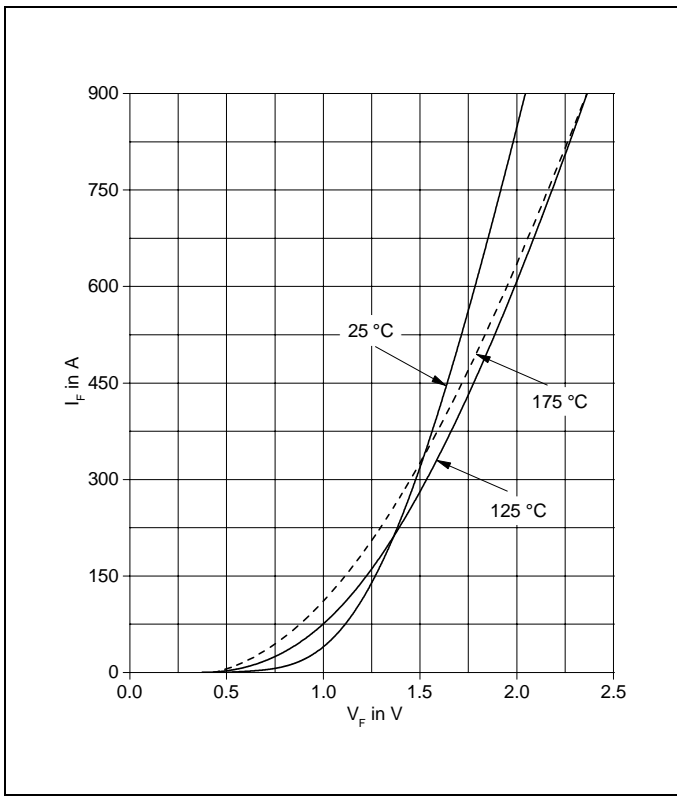


Fig. 13 Typical diode forward characteristics chip level

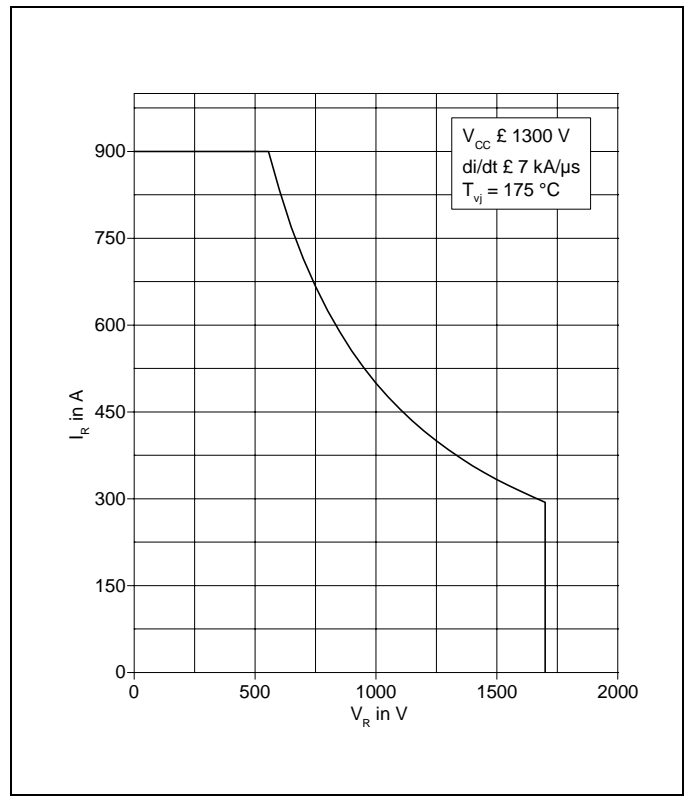


Fig. 14 Safe operating area diode (SOA)

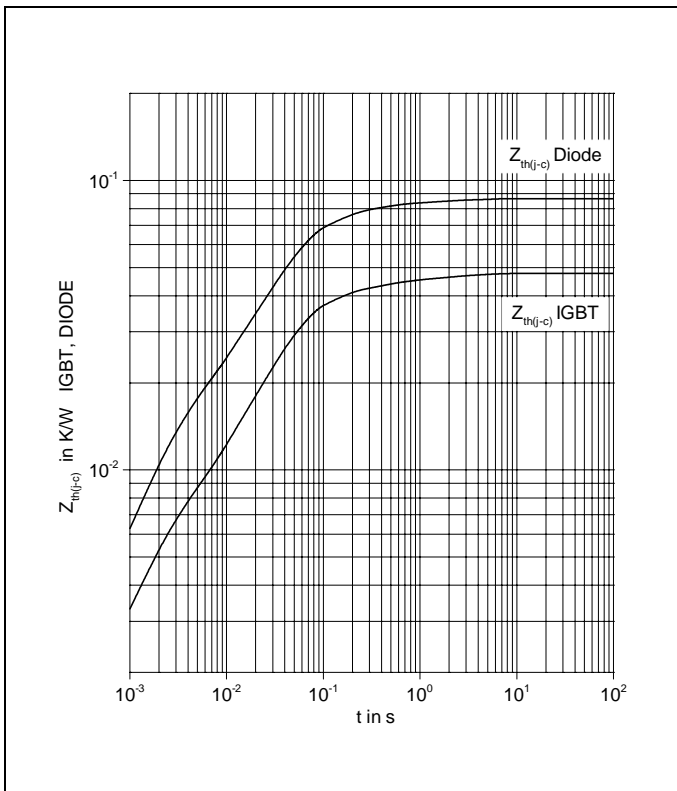


Fig. 15 Thermal impedance vs. time

Analytical function for transient thermal impedance:

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

	i	1	2	3	4	5
IGBT	R _i (K/kW)	4.97	33.5	6.07	3.29	
	t _i (ms)	1.43	42	318	2400	
DIODE	R _i (K/kW)	11.7	58.9	11.9	3.99	
	t _i (ms)	1.87	42.8	262	2290	

Related documents:

5SYA 2045 Thermal runaway during blocking
5SYA 2053 Applying IGBT
5SYA 2058 Surge currents for IGBT diodes
5SYA 2093 Thermal design and temperature ratings of IGBT modules
5SYA 2098 Paralleling of IGBT modules
5SYA 2113 Mounting instructions for LoPak1 modules

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