

SK 150 TMLI 12F4 Tp



SEMITOP® 4 Press-Fit

3-Level TNPC Inverter

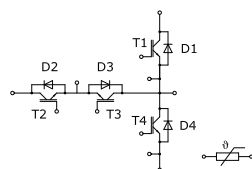
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Features

- One screw mounting module
- Solder free mounting with Press-Fit terminals
- Fully compatible with other SEMITOP® Press-Fit types
- Improved thermal performances by aluminium oxide substrate
- 1200V Fast Trench4 IGBT and 650V Trench3 IGBT technology
- CAL4F technology FWD
- Integrated NTC temperature sensor
- UL recognized, file no. E 63 532

Remarks*

- Recommended $T_{jop} = -40 \dots +150^\circ\text{C}$
- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes D2 & D3



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Absolute Maximum Ratings

Symbol	Conditions	Values	Unit
IGBT1			
V_{CES}	$T_j = 25^\circ\text{C}$	1200	V
I_C	$T_j = 175^\circ\text{C}$	$T_s = 25^\circ\text{C}$	180
		$T_s = 70^\circ\text{C}$	145
I_{Cnom}		150	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$	450	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}, V_{GE} \leq 15\text{ V}, T_j = 150^\circ\text{C}, V_{CES} \leq 1200\text{ V}$	10	μs
T_j		-40 ... 175	$^\circ\text{C}$
IGBT2			
V_{CES}	$T_j = 25^\circ\text{C}$	650	V
I_C	$T_j = 175^\circ\text{C}$	$T_s = 25^\circ\text{C}$	105
		$T_s = 70^\circ\text{C}$	83
I_{Cnom}		100	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$	300	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 360\text{ V}, V_{GE} \leq 15\text{ V}, T_j = 150^\circ\text{C}, V_{CES} \leq 650\text{ V}$	6	μs
T_j		-40 ... 175	$^\circ\text{C}$
Diode1			
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V
I_F	$T_j = 175^\circ\text{C}$	$T_s = 25^\circ\text{C}$	100
		$T_s = 70^\circ\text{C}$	79
I_{Fnom}		100	A
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$	200	A
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$	550	A
T_j		-40 ... 175	$^\circ\text{C}$
Diode2			
V_{RRM}	$T_j = 25^\circ\text{C}$	650	V
I_F	$T_j = 175^\circ\text{C}$	$T_s = 25^\circ\text{C}$	132
		$T_s = 70^\circ\text{C}$	103
I_{Fnom}		100	A
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$	200	A
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$	990	A
T_j		-40 ... 175	$^\circ\text{C}$
Module			
$I_{t(RMS)}$	$T_{terminal} = 100^\circ\text{C}, T_s = 60^\circ\text{C}, \text{ per pin}$	40	A
T_{stg}		-40 ... 125	$^\circ\text{C}$
V_{isol}	AC, sinusoidal, $t = 1\text{ min}$	2500	V

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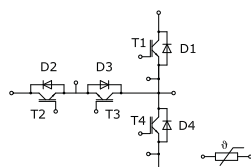
Typical Applications

- Three-level inverter

Remarks*

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- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes D2 & D3

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
V _{CE(sat)}	I _C = 150 A	T _j = 25 °C		2.05	2.42	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.59	2.96	V
V _{CE0}	chiplevel	T _j = 25 °C		1.10	1.28	V
		T _j = 150 °C		0.95	1.13	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		6.3	7.6	mΩ
	chiplevel	T _j = 150 °C		11	12	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 5.1 mA		5.2	5.8	6.4	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				2	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		8.31		nF
C _{oes}		f = 1 MHz		0.615		nF
C _{res}		f = 1 MHz		0.48		nF
Q _G	V _{GE} = -15V ... +15V			1030		nC
R _{Gint}	T _j = 25 °C			1.3		Ω
t _{d(on)}	V _{CE} = 300 V	T _j = 150 °C		58		ns
t _r	I _C = 150 A	T _j = 150 °C		29		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		3.13		mJ
t _{d(off)}	R _{G on} = 0.6 Ω	T _j = 150 °C		239		ns
t _f	R _{G off} = 0.6 Ω	T _j = 150 °C		65.5		ns
E _{off}	di/dt _{on} = 4700 A/μs di/dt _{off} = 2100 A/μs	T _j = 150 °C		5.29		mJ
R _{th(j-s)}	per IGBT			0.24		K/W
IGBT2						
V _{CE(sat)}	I _C = 100 A	T _j = 25 °C		1.45	1.85	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		1.70	2.10	V
V _{CE0}	chiplevel	T _j = 25 °C		0.90	1.00	V
		T _j = 150 °C		0.82	0.90	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		5.5	8.5	mΩ
	chiplevel	T _j = 150 °C		8.8	12	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 1.6 mA		5	5.8	6.5	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 650 V, T _j = 25 °C				0.4	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		6.16		nF
C _{oes}		f = 1 MHz		0.384		nF
C _{res}		f = 1 MHz		0.183		nF
Q _G	V _{GE} = -15V...+15V			980		nC
R _{Gint}	T _j = 25 °C			2.0		Ω
t _{d(on)}	V _{CE} = 300 V	T _j = 150 °C		69		ns
t _r	I _C = 100 A	T _j = 150 °C		30		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		2		mJ
t _{d(off)}	R _{G on} = 3 Ω	T _j = 150 °C		138		ns
t _f	R _{G off} = 0.6 Ω	T _j = 150 °C		65		ns
E _{off}	di/dt _{on} = 4010 A/μs di/dt _{off} = 1407 A/μs	T _j = 150 °C		3.4		mJ
R _{th(j-s)}	per IGBT			0.65		K/W



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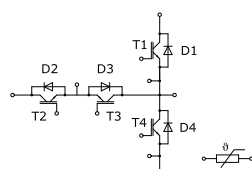
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- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes D2 & D3

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
V _F = V _{EC}	I _F = 100 A	T _j = 25 °C		2.20	2.52	V
	chiplevel	T _j = 150 °C		2.15	2.47	V
V _{F0}	chiplevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
r _F	chiplevel	T _j = 25 °C		9.0	10	mΩ
		T _j = 150 °C		13	14	mΩ
I _{RRM}	I _F = 100 A	T _j = 150 °C		127		A
Q _{rr}	di/dt _{off} = 3730 A/μs	T _j = 150 °C		19		μC
E _{rr}	V _R = 300 V V _{GE} = +15/-15 V	T _j = 150 °C		4.8		mJ
R _{th(j-s)}	per Diode			0.65		K/W
Diode2						
V _F = V _{EC}	I _F = 100 A	T _j = 25 °C		1.37	1.73	V
	chiplevel	T _j = 150 °C		1.35	1.72	V
V _{F0}	chiplevel	T _j = 25 °C		1.04	1.24	V
		T _j = 150 °C		0.85	0.99	V
r _F	chiplevel	T _j = 25 °C		3.3	4.9	mΩ
		T _j = 150 °C		5.0	7.3	mΩ
I _{RRM}	I _F = 150 A	T _j = 150 °C		172		A
Q _{rr}	di/dt _{off} = 4700 A/μs	T _j = 150 °C		16		μC
E _{rr}	V _R = 300 V V _{GE} = +15/-15 V	T _j = 150 °C		3.51		mJ
R _{th(j-s)}	per Diode			0.61		K/W
Module						
L _{sCE1}				-		nH
L _{CE}				-		nH
R _{CC'+EE'}		T _s = 25 °C		-		mΩ
		T _s = 125 °C		-		mΩ
M _s	to heatsink		2.5		2.75	Nm
M _t				-		Nm
				-		Nm
w				60		g
Temperature Sensor						
R ₁₀₀	T _c =100°C (R ₂₅ =5 kΩ)			493 ± 5%		Ω
B _{100/125}	R _(T) =R ₁₀₀ exp[B _{100/125} (1/T-1/T ₁₀₀)]; T[K];			3550 ±2%		K



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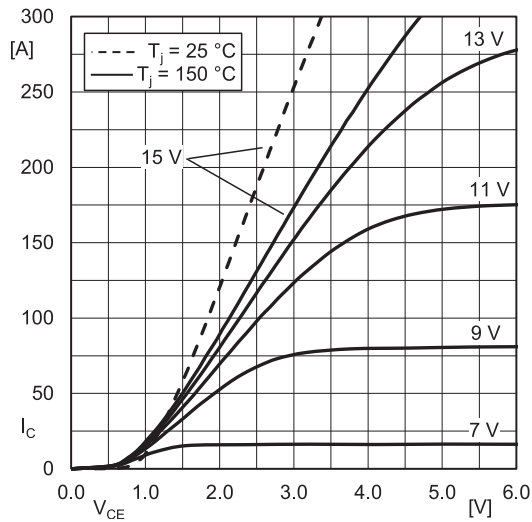


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

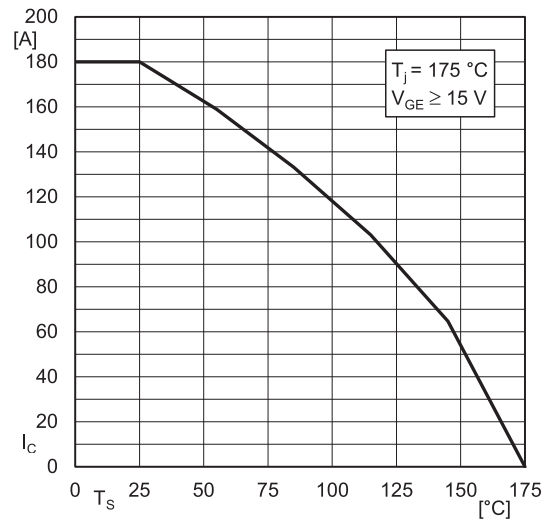


Fig. 2: IGBT1 rated current vs. Temperature $I_C=f(T_s)$

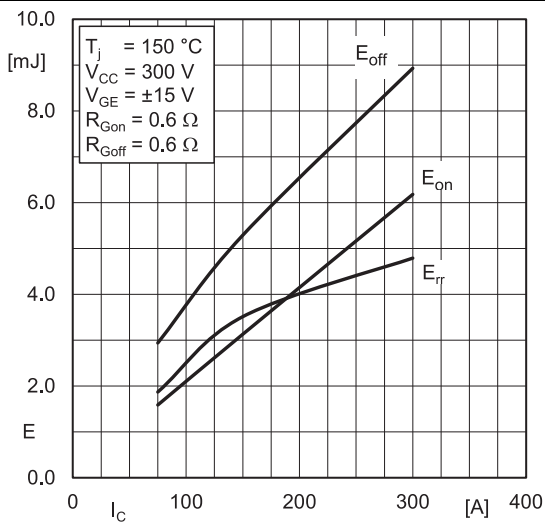


Fig. 3: Typ. IGBT1 & Diode2 turn-on /-off energy = $f(I_C)$

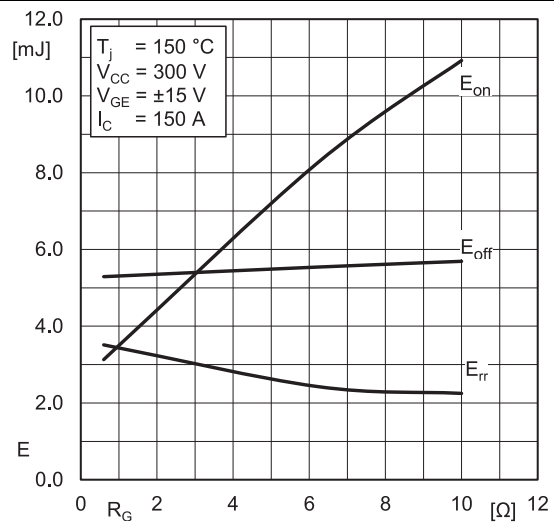


Fig. 4: Typ. IGBT1 & Diode2 turn-on /-off energy = $f(R_G)$

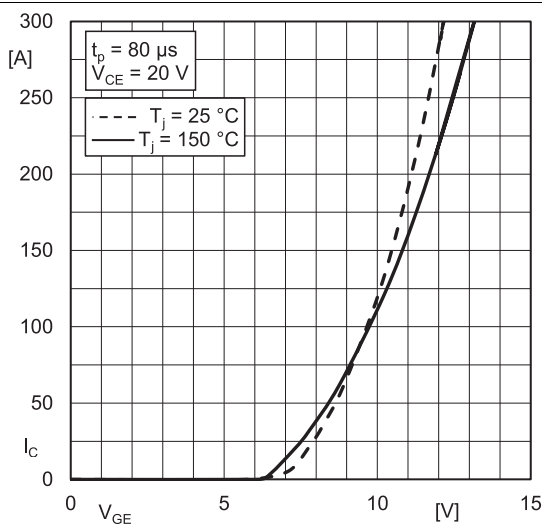


Fig. 5: Typ. IGBT1 transfer characteristic

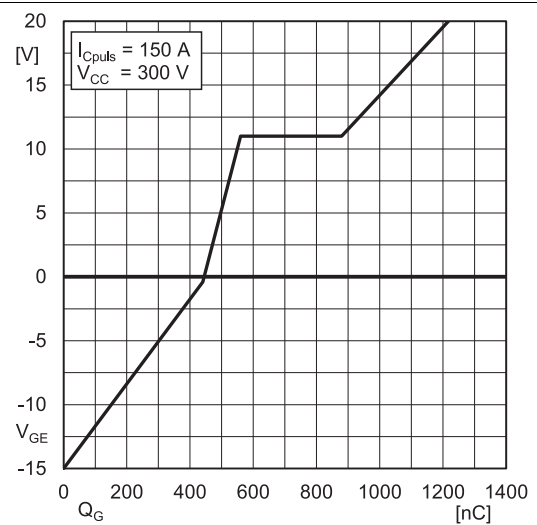
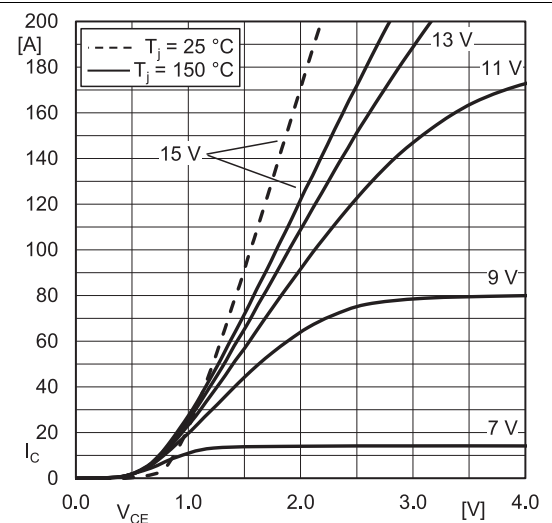
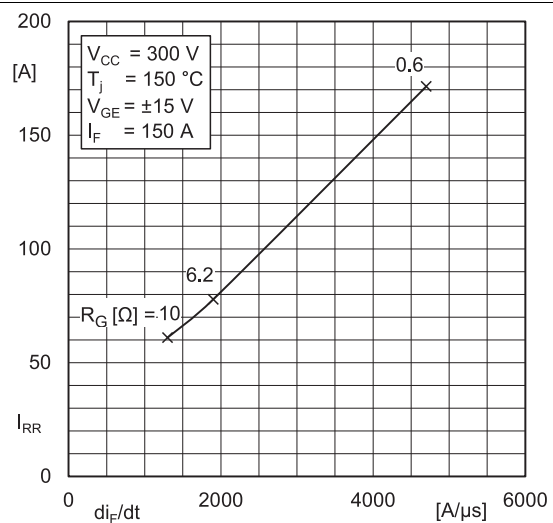
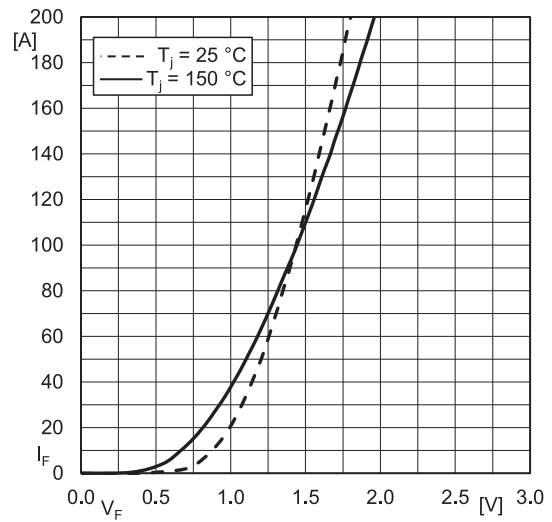
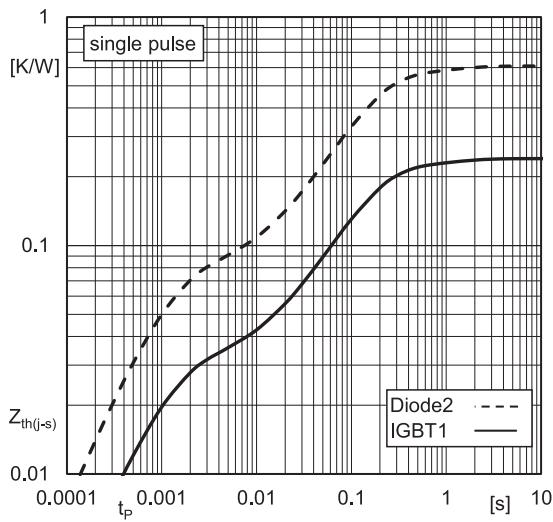
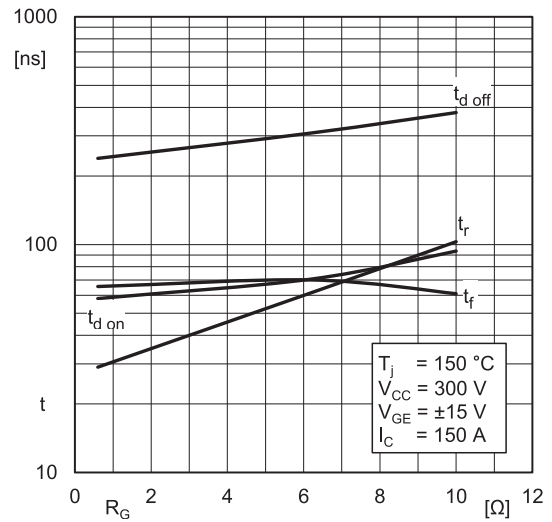
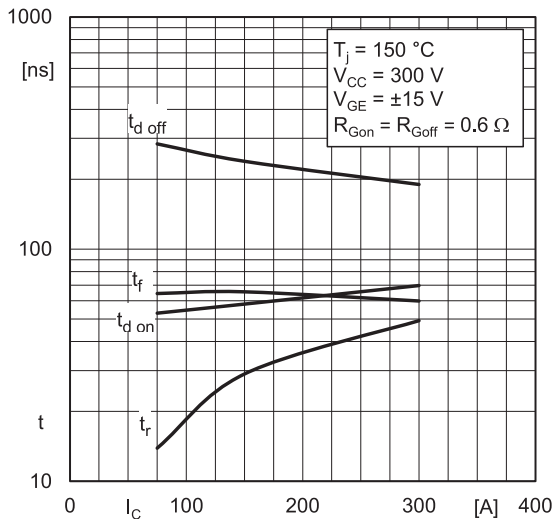


Fig. 6: Typ. IGBT1 gate charge characteristic



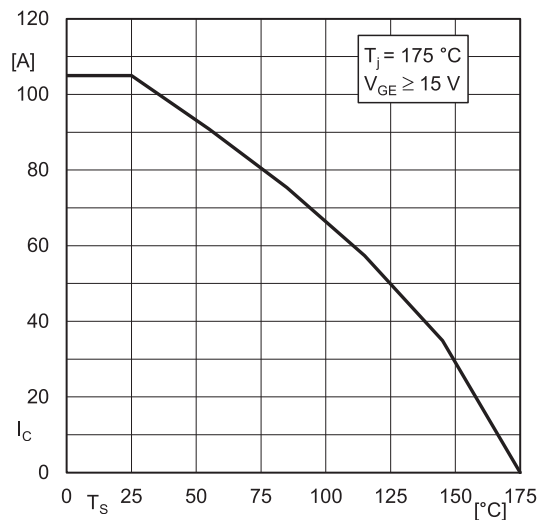


Fig. 14: IGBT2 Rated current vs. Temperature $I_c = f(T_s)$

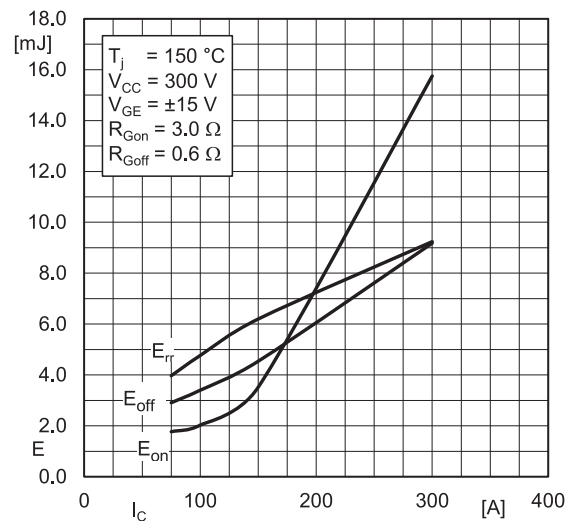


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(I_c)$

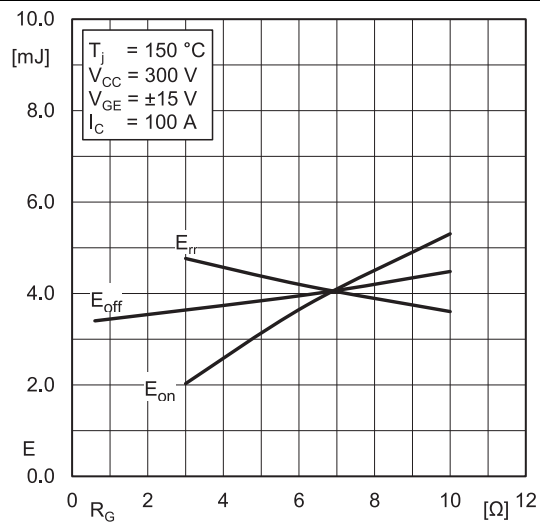


Fig. 16: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(R_G)$

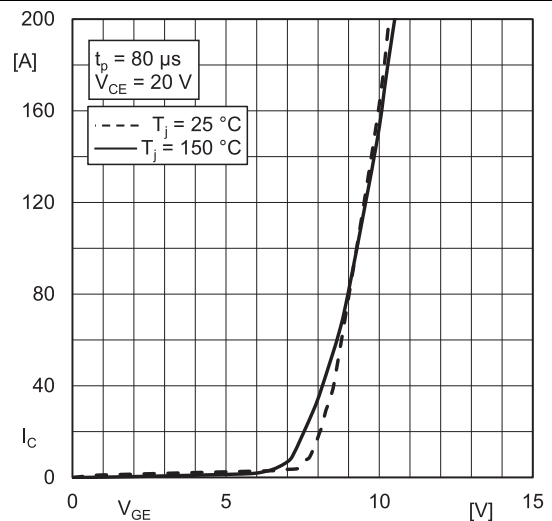


Fig. 17: Typ. IGBT2 transfer characteristic

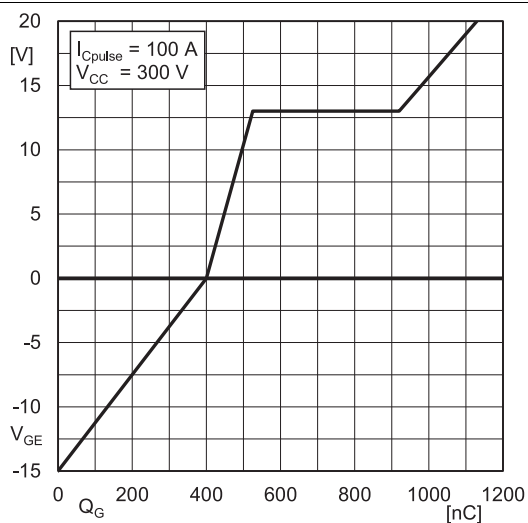


Fig. 18: Typ. IGBT2 gate charge characteristic

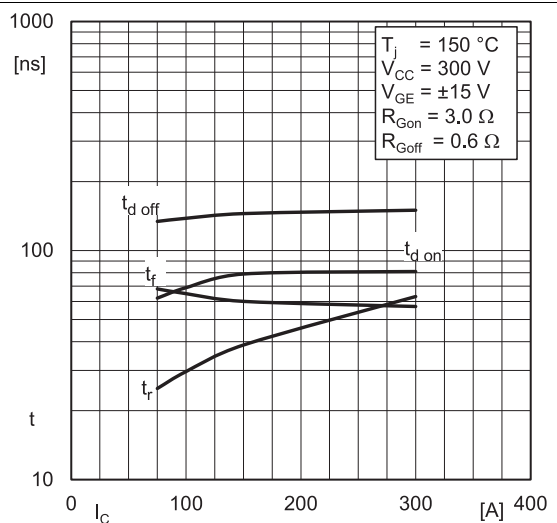


Fig. 19: Typ. IGBT2 switching times vs. I_c

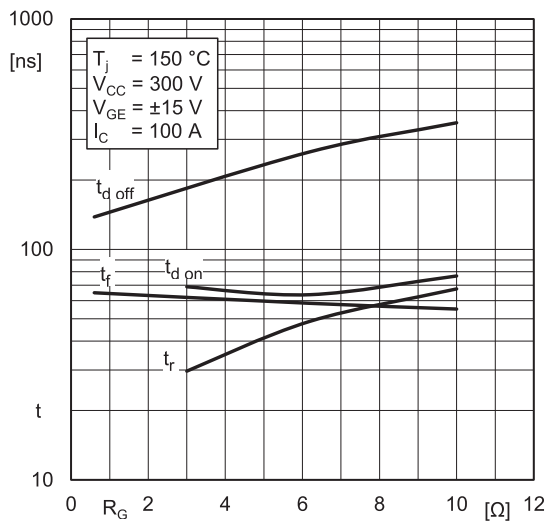


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

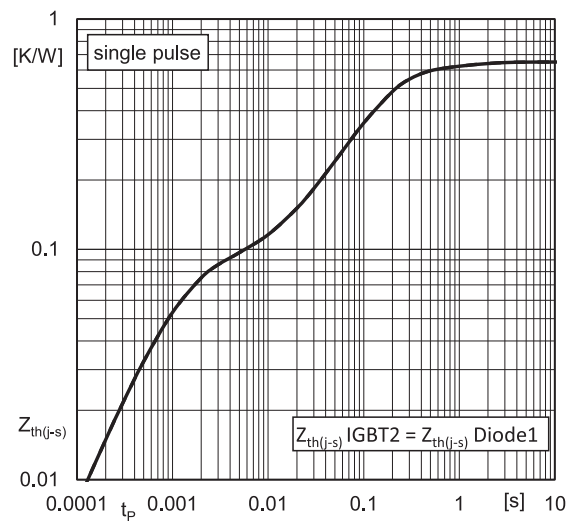


Fig. 21: Transient thermal impedance of IGBT2 & Diode1

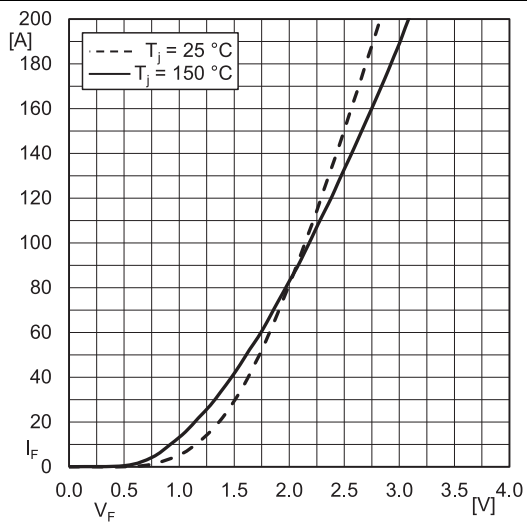


Fig. 22: Typ. Diode1 forward characteristic, incl. $R_{CC'+EE'}$

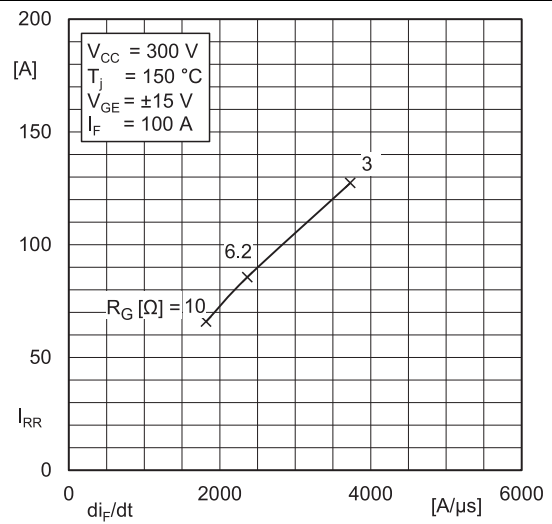
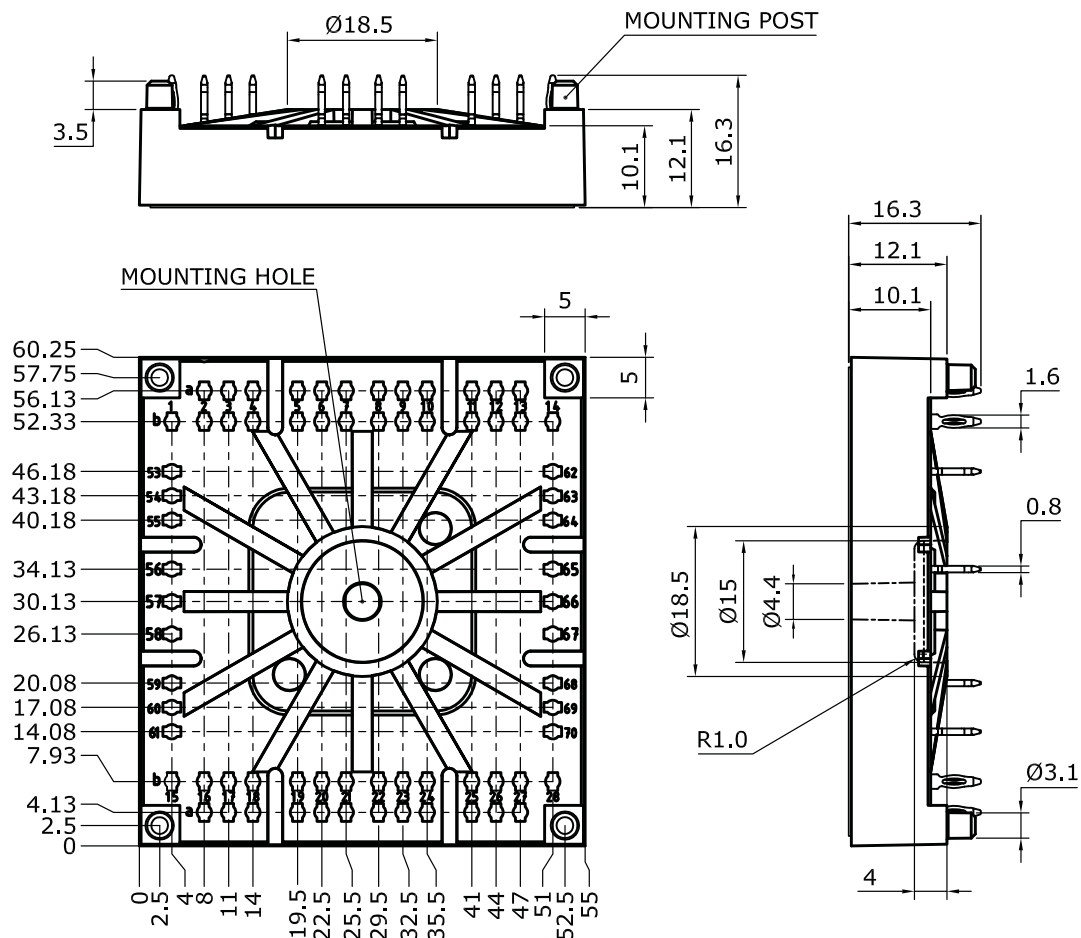


Fig. 23: Typ. Diode1 peak reverse recovery current

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Dimensions: mm

Tolerance system: ISO 2768-m



Suggested drilled hole diameter for terminal pins in the circuit board:

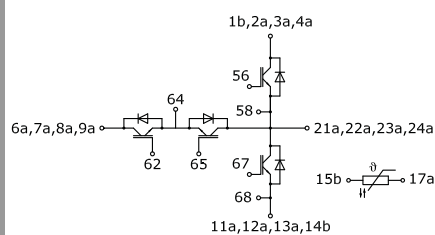
- minimum: 1.575 mm
- typical: 1.6 mm
- maximum: 1.625 mm

Suggested hole diameter for the mounting post in the circuit board:

- 3.6 mm

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SEMITOP 4 Press-Fit



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This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

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