



3-Level NPC Inverter

SK 70 MLI 12T4 Tp

Features*

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

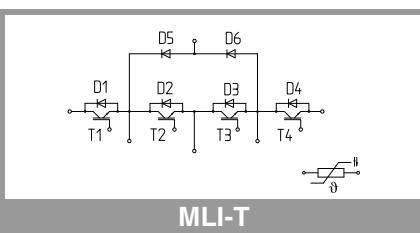
Remarks*

- 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
- Diode5: clamping diodes D5 & D6

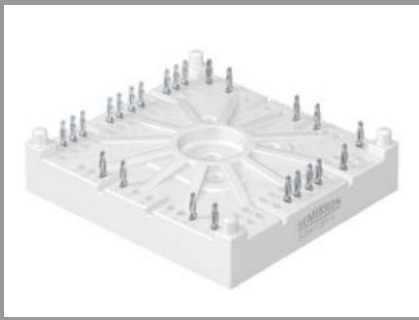
Footnotes

¹⁾ Please find further technical information on the SEMIKRON website.

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT1				
V _{CES}	T _j = 25 °C		1200	V
I _C	T _j = 175 °C	T _s = 25 °C	98	A
		T _s = 70 °C	80	A
I _{Cnom}			70	A
I _{CRM}			210	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V, V _{GE} ≤ 15 V, T _j = 150 °C, V _{CES} ≤ 1200 V		10	μs
T _j			-40 ... 175	°C
IGBT2				
V _{CES}	T _j = 25 °C		1200	V
I _C	T _j = 175 °C	T _s = 25 °C	98	A
		T _s = 70 °C	80	A
I _{Cnom}			70	A
I _{CRM}			210	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V, V _{GE} ≤ 15 V, T _j = 150 °C, V _{CES} ≤ 1200 V		10	μs
T _j			-40 ... 175	°C
Diode1				
V _{RRM}	T _j = 25 °C		1200	V
I _F	T _j = 175 °C	T _s = 25 °C	78	A
		T _s = 70 °C	63	A
I _{FRM}			140	A
I _{FSM}	10 ms, sin 180°, T _j = 25 °C		306	A
T _j			-40 ... 175	°C
Diode2				
V _{RRM}	T _j = 25 °C		1200	V
I _F	T _j = 175 °C	T _s = 25 °C	78	A
		T _s = 70 °C	63	A
I _{FRM}			140	A
I _{FSM}	10 ms, sin 180°, T _j = 25 °C		306	A
T _j			-40 ... 175	°C
Diode5				
V _{RRM}	T _j = 25 °C		1200	V
I _F	T _j = 175 °C	T _s = 25 °C	78	A
		T _s = 70 °C	63	A
I _{FRM}			140	A
I _{FSM}	10 ms, sin 180°, T _j = 25 °C		306	A
T _j			-40 ... 175	°C
Module				
I _{t(RMS)}	ΔT _{terminal} at PCB joint = 30 K, per pin		35	A
T _{stg}			-40 ... 125	°C
V _{isol}	AC, sinusoidal, t = 1 min		2500	V



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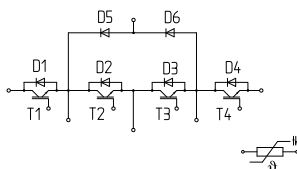
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- Diode5: clamping diodes D5 & D6

Footnotes

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
V _{CE(sat)}	I _C = 70 A	T _j = 25 °C		1.85	2.10	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.25	2.45	V
V _{CE0}	chiplevel	T _j = 25 °C		0.80	0.90	V
		T _j = 150 °C		0.70	0.80	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		15	17	mΩ
	chiplevel	T _j = 150 °C		22	24	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 2.4 mA		5	5.8	6.5	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				1	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		3.9		nF
C _{oes}		f = 1 MHz		0.31		nF
C _{res}		f = 1 MHz		0.23		nF
Q _G	V _{GE} = -15 V ... +15 V			516		nC
R _{Gint}	T _j = 25 °C			2.4		Ω
t _{d(on)}	V _{CE} = 600 V	T _j = 150 °C		14		ns
t _r	I _C = 70 A	T _j = 150 °C		34		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		5.5		mJ
t _{d(off)}	R _{G on} = 1.8 Ω	T _j = 150 °C		248		ns
t _f	R _{G off} = 1.8 Ω	T _j = 150 °C		67		ns
E _{off}	di/dt _{on} = 1750 A/μs di/dt _{off} = 1386 A/μs dv/dt = 3780 V/μs	T _j = 150 °C		6.5		mJ
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/(mK)			0.47		K/W
IGBT2						
V _{CE(sat)}	I _C = 70 A	T _j = 25 °C		1.85	2.10	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.25	2.45	V
V _{CE0}	chiplevel	T _j = 25 °C		0.80	0.90	V
		T _j = 150 °C		0.70	0.80	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		15	17	mΩ
	chiplevel	T _j = 150 °C		22	24	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 2.4 mA		5	5.8	6.5	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				1	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		3.9		nF
C _{oes}		f = 1 MHz		0.31		nF
C _{res}		f = 1 MHz		0.23		nF
Q _G	V _{GE} = -15 V ... +15 V			516		nC
R _{Gint}	T _j = 25 °C			2.4		Ω
t _{d(on)}	V _{CE} = 600 V	T _j = 150 °C		14		ns
t _r	I _C = 70 A	T _j = 150 °C		36		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		6		mJ
t _{d(off)}	R _{G on} = 1.8 Ω	T _j = 150 °C		248		ns
t _f	R _{G off} = 1.8 Ω	T _j = 150 °C		67		ns
E _{off}	di/dt _{on} = 1883 A/μs di/dt _{off} = 1386 A/μs dv/dt = 4508 V/μs	T _j = 150 °C		6.8		mJ
R _{th(j-s)}	per IGBT			0.47		K/W



MLI-T



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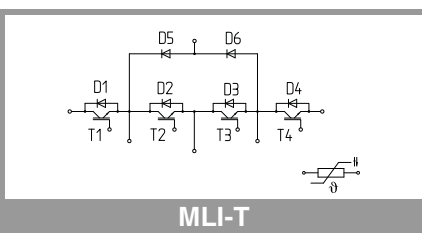
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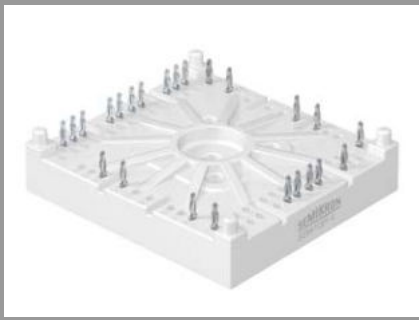
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
V _F = V _{EC}	I _F = 70 A	T _j = 25 °C		2.30	2.62	V
	chiplevel	T _j = 150 °C		2.29	2.62	V
V _{F0}	chiplevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
r _F	chiplevel	T _j = 25 °C		14	16	mΩ
		T _j = 150 °C		20	22	mΩ
I _{RRM}	I _F = 70 A	T _j = 150 °C		59		A
Q _{rr}	di/dt _{off} = 1883 A/μs	T _j = 150 °C		9.95		μC
E _{rr}	V _R = 600 V V _{GE} = -15 V	T _j = 150 °C		3.3		mJ
R _{th(j-s)}	per Diode			0.73		K/W
Diode2						
V _F = V _{EC}	I _F = 70 A	T _j = 25 °C		2.30	2.62	V
	chiplevel	T _j = 150 °C		2.29	2.62	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		14	16	mΩ
		T _j = 150 °C		20	22	mΩ
I _{RRM}	I _F = 70 A	T _j = 150 °C		-		A
Q _{rr}	V _R = 600 V	T _j = 150 °C		-		μC
E _{rr} 1)	V _{GE} = -15 V	T _j = 150 °C		-		mJ
R _{th(j-s)}	per Diode			0.73		K/W
Diode5						
V _F = V _{EC}	I _F = 70 A	T _j = 25 °C		2.30	2.62	V
	chiplevel	T _j = 150 °C		2.29	2.62	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		14	16	mΩ
		T _j = 150 °C		20	22	mΩ
I _{RRM}	I _F = 70 A	T _j = 150 °C		42		A
Q _{rr}	di/dt _{off} = 1750 A/μs	T _j = 150 °C		7.12		μC
E _{rr}	V _{GE} = -15 V	T _j = 150 °C		2.3		mJ
R _{th(j-s)}	per Diode			0.73		K/W



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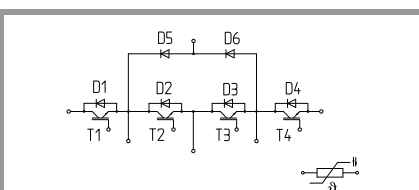
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Module						
L _{sCE1}				17		nH
L _{sCE2}				21		nH
R _{CC'+EE'}	per switch	T _s = 25 °C		1.5		mΩ
		T _s = 150 °C		2		mΩ
M _s	to heatsink		2.5		2.75	Nm
M _t				-		Nm
				-		Nm
w				60		g
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



MLI-T

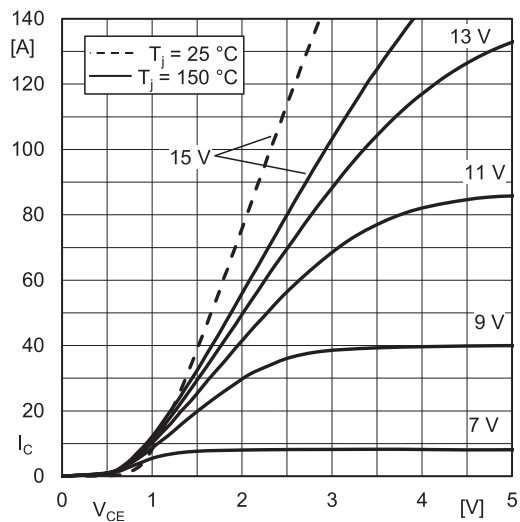


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

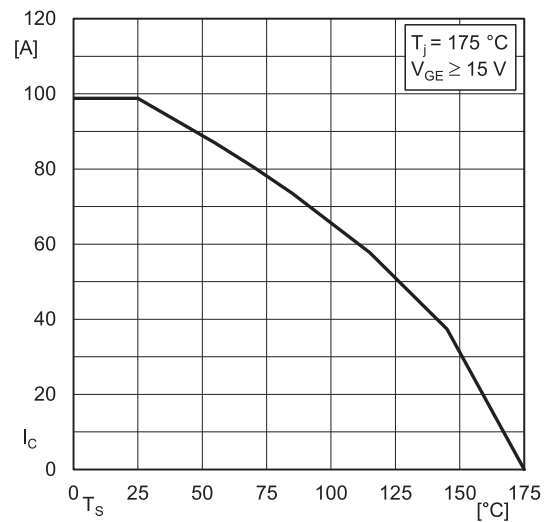


Fig. 2: IGBT1 rated current vs. Temperature $I_C=f(T_s)$

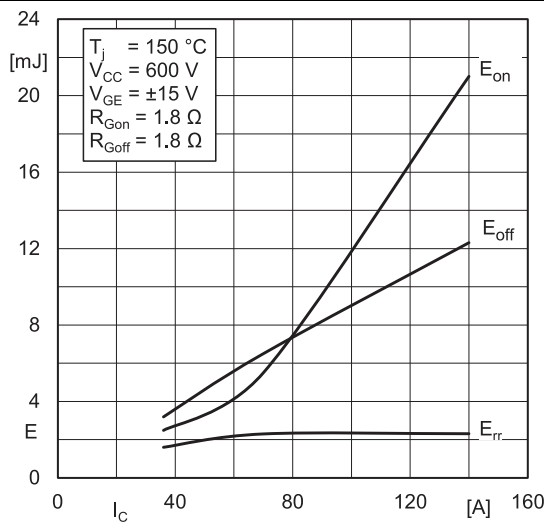


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(I_C)$

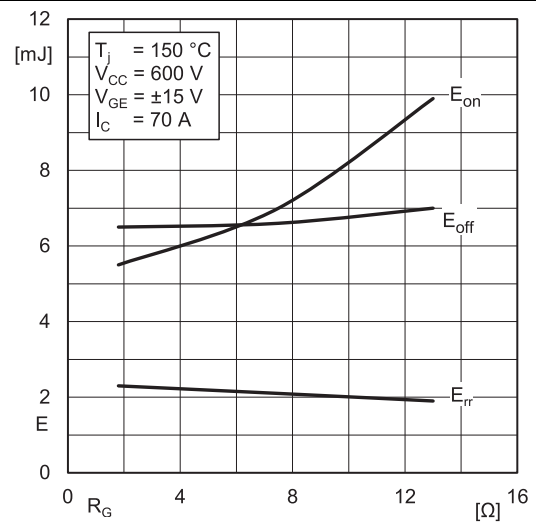


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(R_G)$

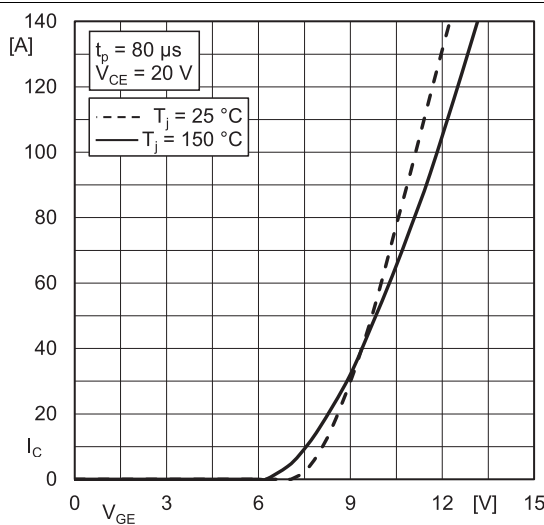


Fig. 5: Typ. IGBT1 transfer characteristic

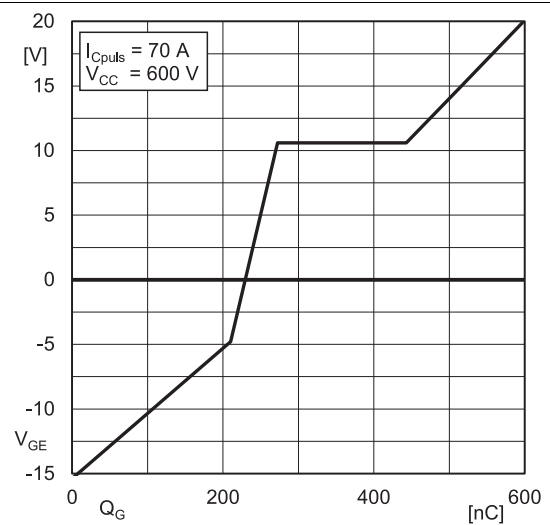


Fig. 6: Typ. IGBT1 gate charge characteristic

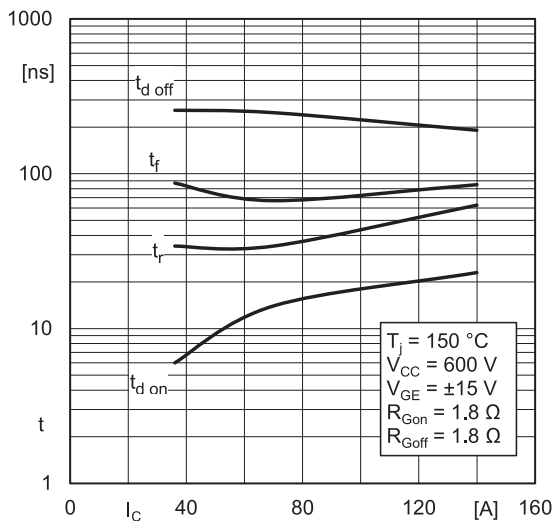


Fig. 7: Typ. IGBT1 switching times vs. I_C

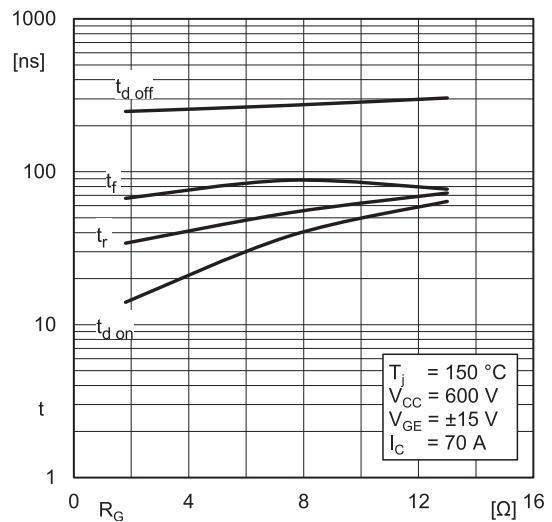


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

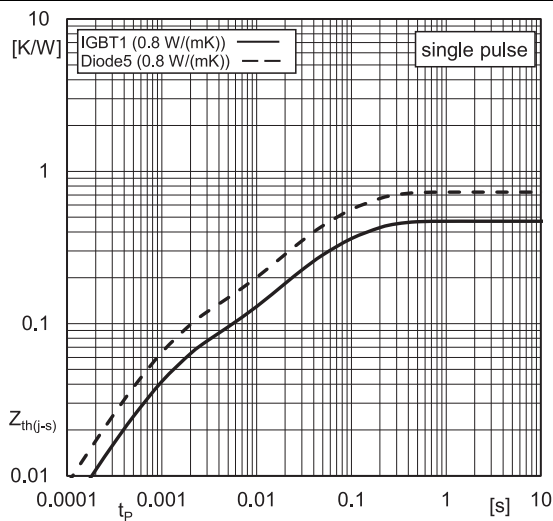


Fig. 9: Transient thermal impedance of IGBT1 & Diode5

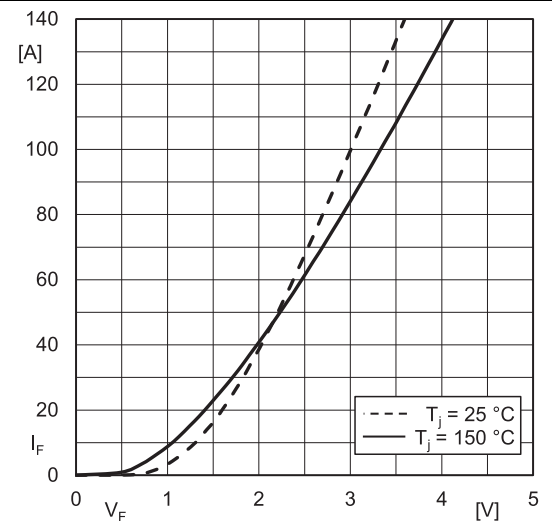


Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC'+EE'}$

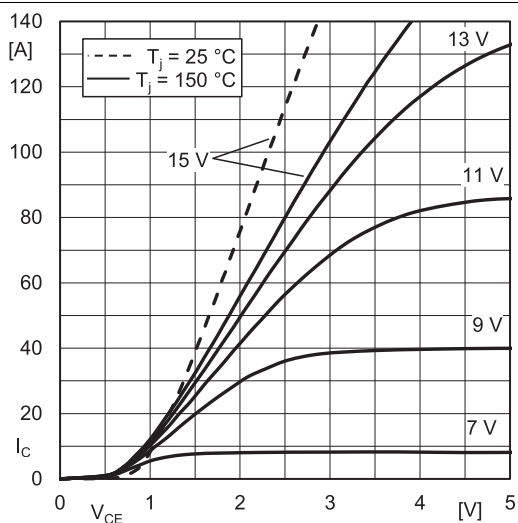


Fig. 13: Typ. IGBT2 output characteristic, incl. $R_{CC'+EE'}$

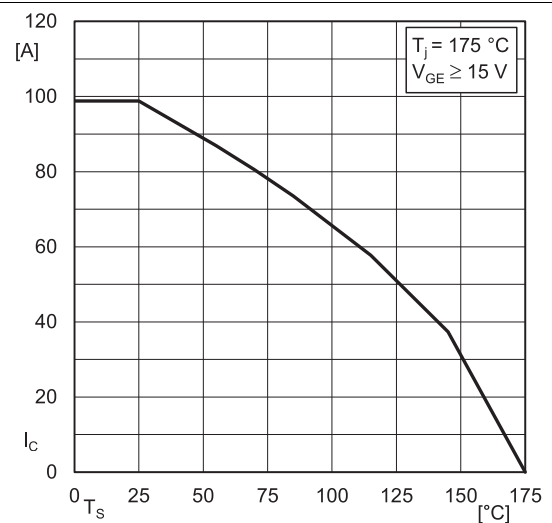


Fig. 14: IGBT2 Rated current vs. Temperature $I_C = f(T_s)$

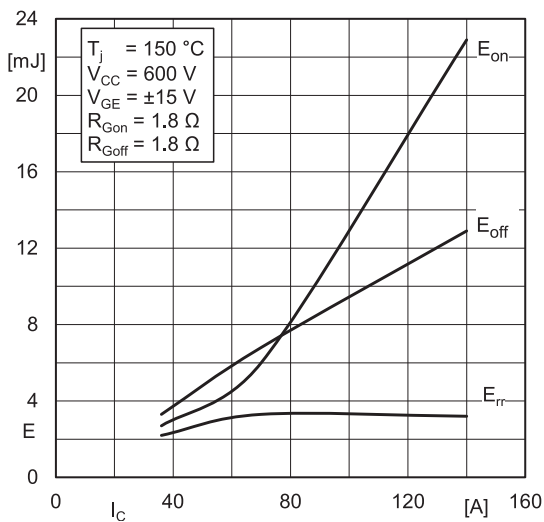


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(I_C)$

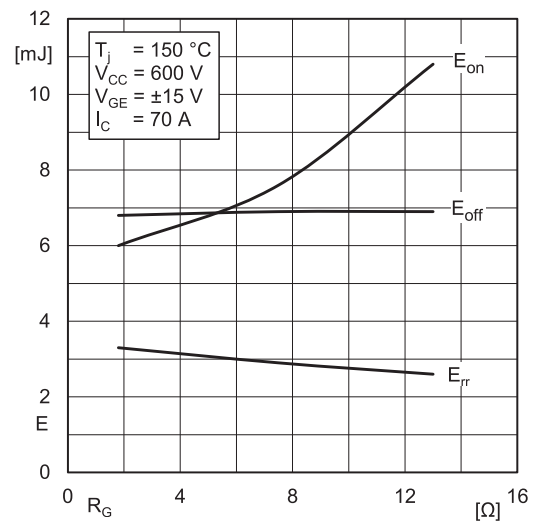


Fig. 16: Typ. IGBT2 & Diode1 turn-on / -off energy = $f(R_G)$

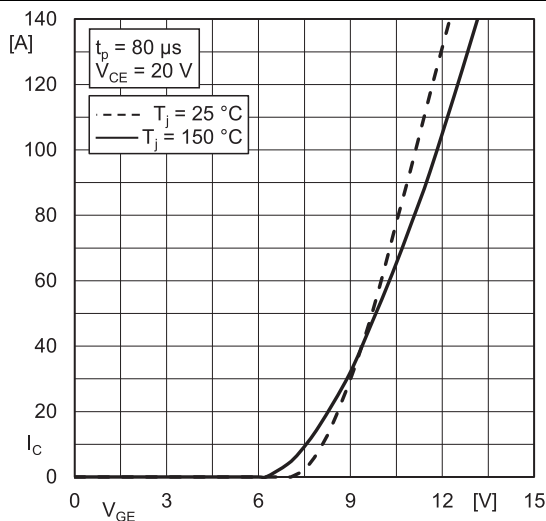


Fig. 17: Typ. IGBT2 transfer characteristic

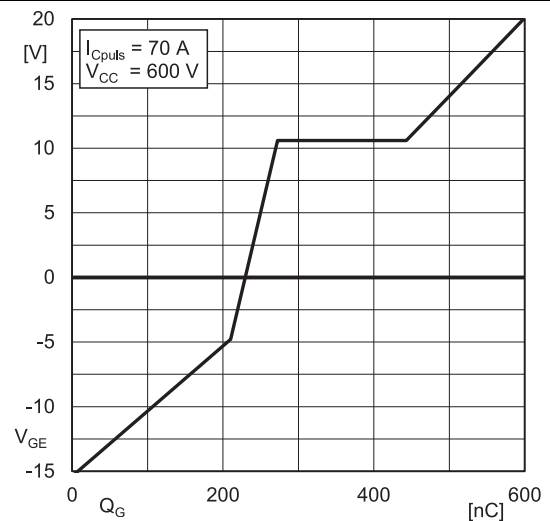


Fig. 18: Typ. IGBT2 gate charge characteristic

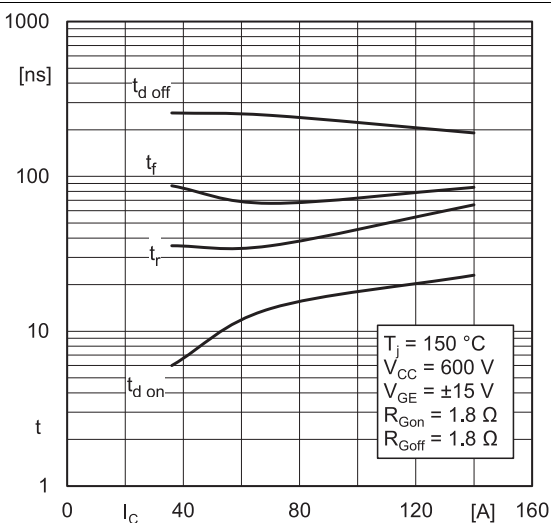


Fig. 19: Typ. IGBT2 switching times vs. I_C

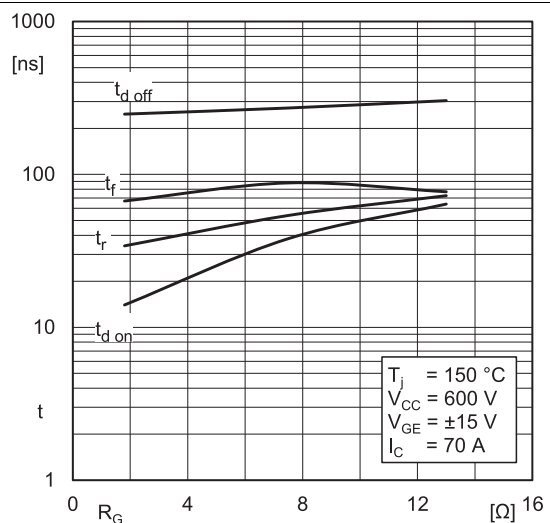


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

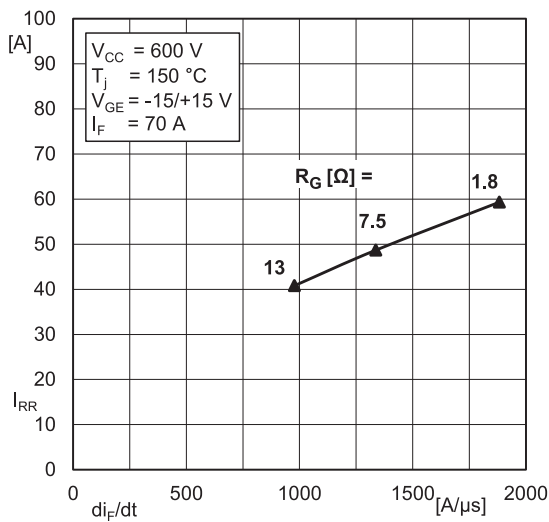


Fig. 21: Typ. CAL Diode 1 peak reverse recovery current

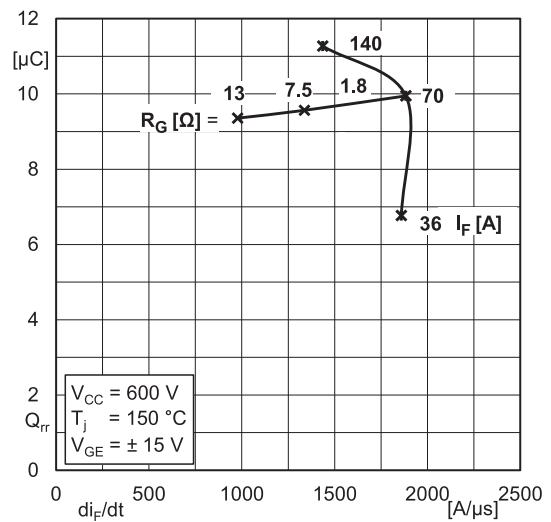


Fig. 22: Typ. CAL Diode 1 reverse recovery charge

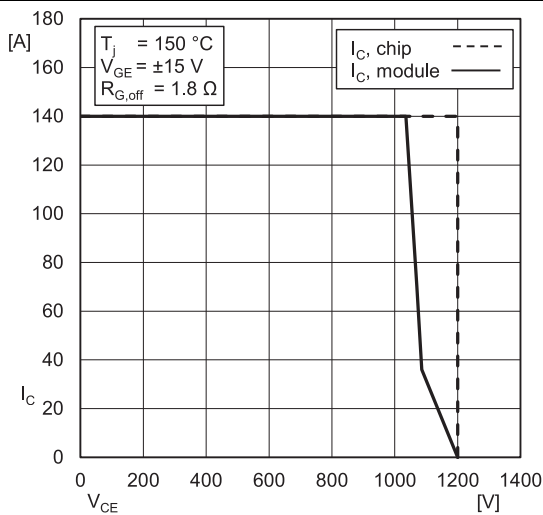
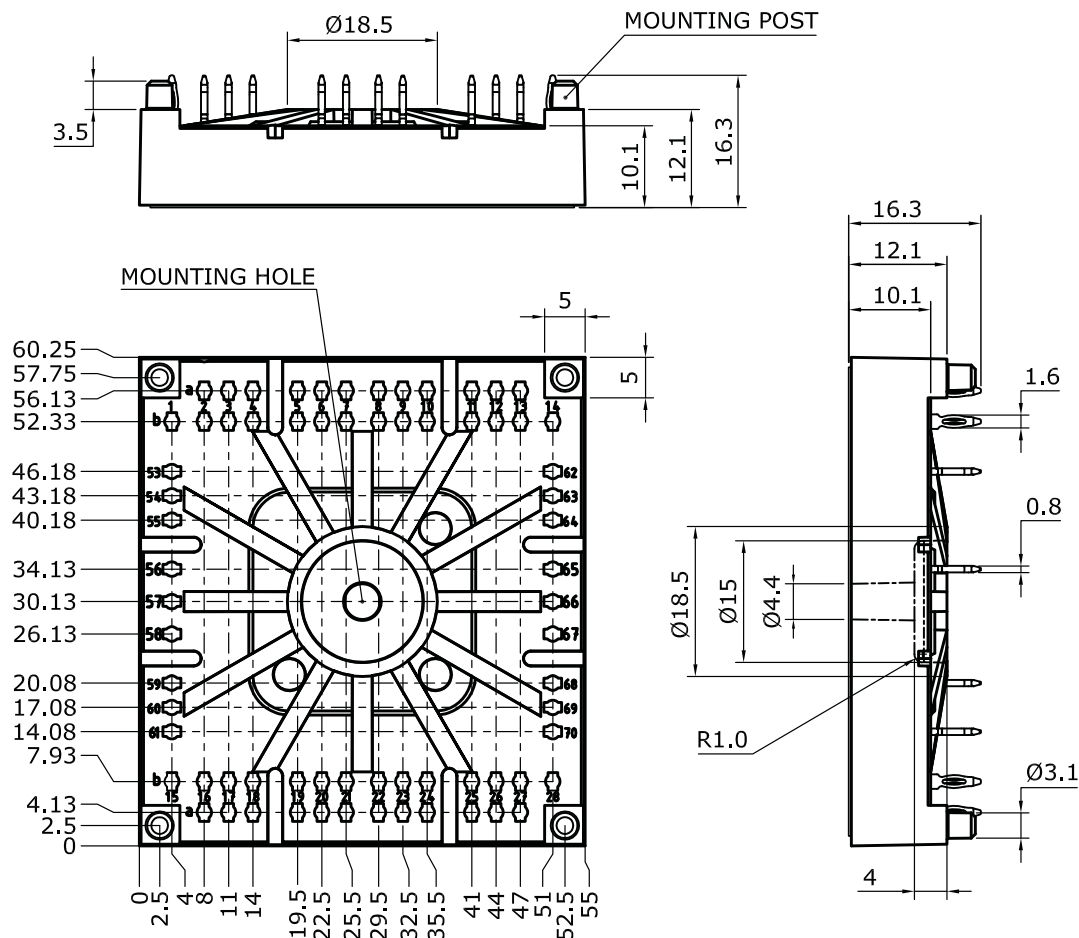


Fig. 24: IGBT Reverse Bias Safe Operating Area (RBSOA)

Tolerance system: ISO 2768-m



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

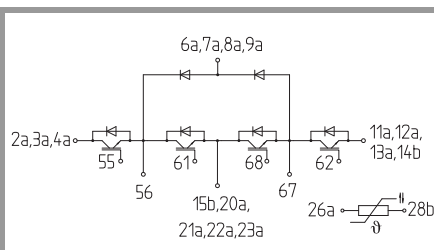
- minimum: 1.575 mm
- typical: 1.6 mm
- maximum: 1.625 mm

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

- 3.6 mm

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SEMITOP 4 Press-Fit



MLI-T

This is an electrostatic discharge sensitive device (ESDS) due to international standard IEC 61340.

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