SEMITOP® 4 Press-Fit

3-Level NPC Inverter

SK 150 MLI 07F3 TD1p

Features

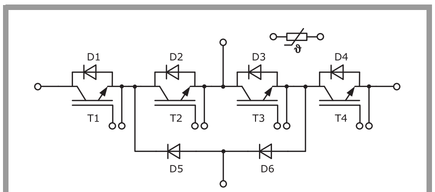
- One screw mounting module
- Solder free mounting with Press-Fit terminals
- Fully compatible with other SEMITOP® Press-Fit types
- Improved thermal performances by aluminium oxide substrate
- 650V Trench IGBT technology
- CAL4F technology FWD
- Rapid switching clamping diode technology
- Integrated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

Remarks*

- Recommended T_{jop}= -40 ... +150°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.



MLI-T

Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
IGBT1				
V_{CES}	T_j = 25 °C		650	V
I_C	T_j = 175 °C	T_s = 25 °C	151	A
		T_s = 70 °C	120	A
I_{Cnom}			150	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		450	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 400 V, V_{GE} ≤ 15 V, T_j = 150 °C, V_{CES} ≤ 650 V		5	µs
T_j			-40 ... 175	°C
IGBT2				
V_{CES}	T_j = 25 °C		650	V
I_C	T_j = 175 °C	T_s = 25 °C	178	A
		T_s = 70 °C	143	A
I_{Cnom}			150	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		450	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 360 V, V_{GE} ≤ 15 V, T_j = 150 °C, V_{CES} ≤ 650 V		6	µs
T_j			-40 ... 175	°C
Diode1				
V_{RRM}	T_j = 25 °C		650	V
I_F	T_j = 175 °C	T_s = 25 °C	137	A
		T_s = 70 °C	107	A
I_{Fnom}			100	A
I_{FRM}	I_{FRM} = 2 x I_{Fnom}		200	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		990	A
T_j			-40 ... 175	°C
Diode2				
V_{RRM}	T_j = 25 °C		650	V
I_F	T_j = 175 °C	T_s = 25 °C	137	A
		T_s = 70 °C	107	A
I_{Fnom}			100	A
I_{FRM}	I_{FRM} = 2 x I_{Fnom}		200	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		990	A
T_j			-40 ... 175	°C
Diode5				
V_{RRM}	T_j = 25 °C		650	V
I_F	T_j = 175 °C	T_s = 25 °C	134	A
		T_s = 70 °C	105	A
I_{Fnom}			150	A
I_{FRM}	I_{FRM} = 2 x I_{Fnom}		300	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		810	A
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$	$T_{terminal}$ = 100 °C, T_S = 60°C, per pin		40	A
T_{stg}			-40 ... 125	°C
V_{isol}	AC, sinusoidal, t = 1 min		2500	V

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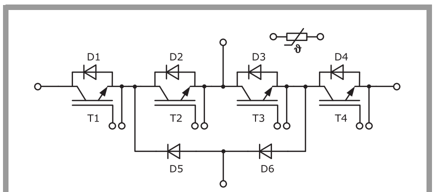
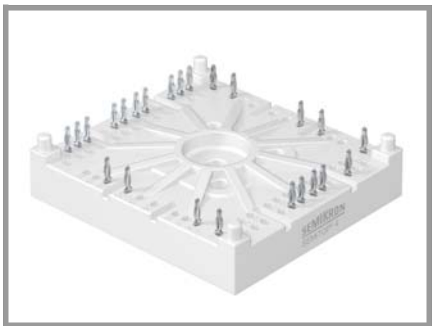


MLI-T

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
IGBT1						
$V_{CE(sat)}$	I_C = 150 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.85	2.22	V
		T_j = 150 °C		2.18	2.55	V
V_{CE0}	chiplevel	T_j = 25 °C		1.10	1.20	V
		T_j = 150 °C		1.00	1.10	V
r_{CE}	V_{GE} = 15 V, chiplevel	T_j = 25 °C		5.0	6.8	mΩ
		T_j = 150 °C		7.9	9.7	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 2.4 mA		4.2	5.1	5.6	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		9.24		nF
C_{oes}		f = 1 MHz		480		nF
C_{res}		f = 1 MHz		0.274		nF
Q_G	V_{GE} = -15V ... +15 V			1500		nC
R_{Gint}	T_j = 25 °C			2.4		Ω
$t_{d(on)}$	V_{CE} = 300 V, I_C = 150 A, V_{GE} = +15/-15 V, $R_{G\,on}$ = 1.8 Ω, $R_{G\,off}$ = 1.8 Ω, di/dt_{on} = 1650 A/µs, di/dt_{off} = 5083 A/µs	T_j = 150 °C		194		ns
t_r		T_j = 150 °C		80		ns
E_{on}		T_j = 150 °C		9.07		mJ
$t_{d(off)}$		T_j = 150 °C		374		ns
t_f		T_j = 150 °C		27		ns
E_{off}		T_j = 150 °C		1.3		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.38		K/W
IGBT2						
$V_{CE(sat)}$	I_C = 150 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.45	1.77	V
		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, chiplevel	T_j = 25 °C		3.7	5.1	mΩ
		T_j = 150 °C		5.9	8.0	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 2.4 mA		5.1	5.8	6.4	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		9.24		nF
C_{oes}		f = 1 MHz		0.6		nF
C_{res}		f = 1 MHz		0.274		nF
Q_G	V_{GE} = -15V ... +15 V			1360		nC
R_{Gint}	T_j = 25 °C			2.0		Ω
$t_{d(on)}$	V_{CE} = 300 V, I_C = 150 A, V_{GE} = +15/-15 V, $R_{G\,on}$ = 3 Ω, $R_{G\,off}$ = 3 Ω, di/dt_{on} = 3460 A/µs, di/dt_{off} = 2011 A/µs	T_j = 150 °C		69		ns
t_r		T_j = 150 °C		47		ns
E_{on}		T_j = 150 °C		3.47		mJ
$t_{d(off)}$		T_j = 150 °C		288		ns
t_f		T_j = 150 °C		43		ns
E_{off}		T_j = 150 °C		3.98		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.35		K/W



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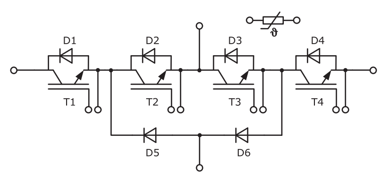

MLI-T

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Diode1						
$V_F = V_{EC}$	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		135		A
Q_{rr}	di/dt_{off} = 3460 A/µs V_R = 300 V	T_j = 150 °C		13.8		µC
E_{rr}	V_{GE} = +15/-15 V	T_j = 150 °C		1.76		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.58		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 = 100 A	T_j = 150 °C		-		A
Q_{rr}	V_R = 300 V	T_j = 150 °C		-		µC
E_{rr} [1]	V_{GE} = +15/-15 V	T_j = 150 °C		-		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.58		K/W
Diode5						
$V_F = V_{EC}$	I_F = 150 A	T_j = 25 °C		1.35	1.92	V
	chiplevel	T_j = 150 °C		1.30	1.89	V
V_{F0}	chiplevel	T_j = 25 °C		0.90	1.10	V
		T_j = 150 °C		0.71	0.94	V
r_F	chiplevel	T_j = 25 °C		3.0	5.5	mΩ
		T_j = 150 °C		3.9	6.3	mΩ
I_{RRM}	I_F = 150 A	T_j = 150 °C		55		A
Q_{rr}	di/dt_{off} = 1650 A/µs V_R = 300 V	T_j = 150 °C		9.7		µC
E_{rr}	V_{GE} = +15/-15 V	T_j = 150 °C		1.39		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.63		K/W

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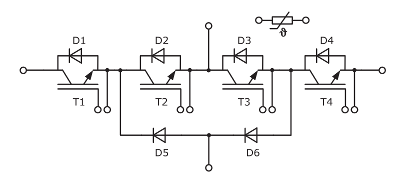


MLI-T

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Module						
L_{sCE1}				-		nH
L_{sCE2}				-		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

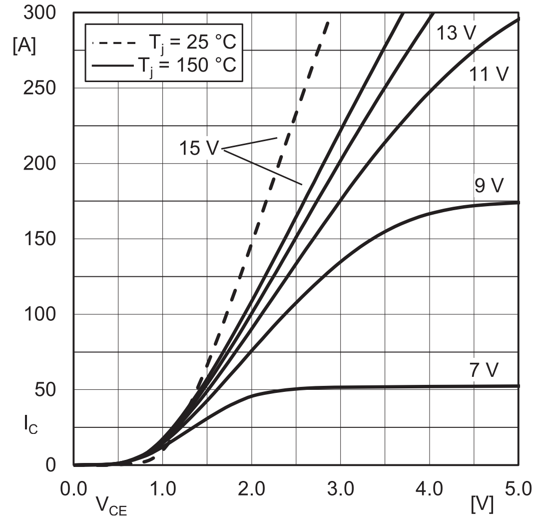


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+ EE'}$

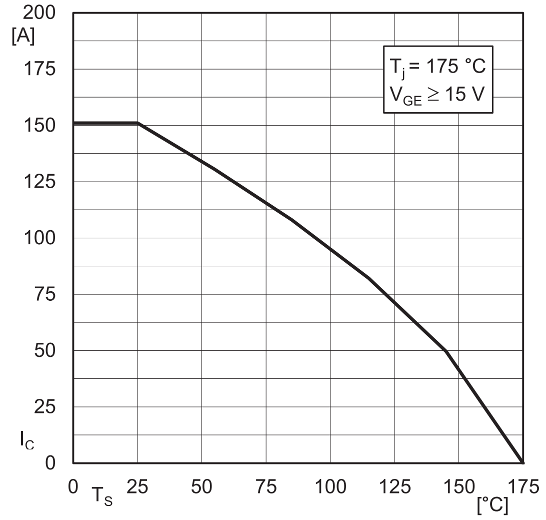


Fig. 2: IGBT1 rated current vs. Temperature $I_c=f(T_s)$

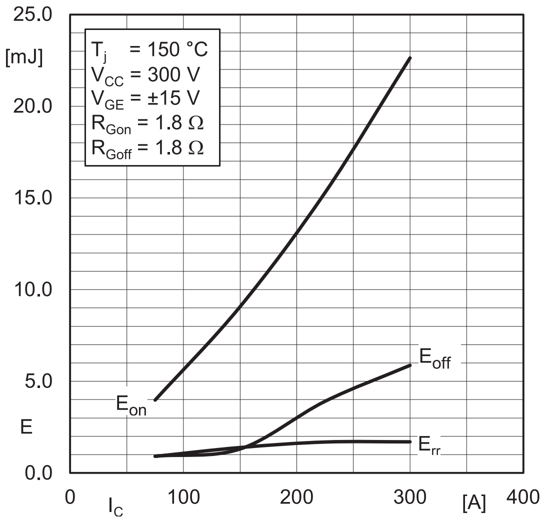


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = f (I_C)

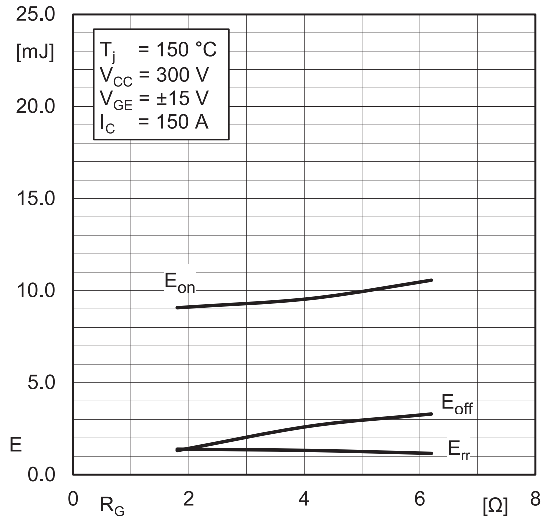


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = f(R_G)

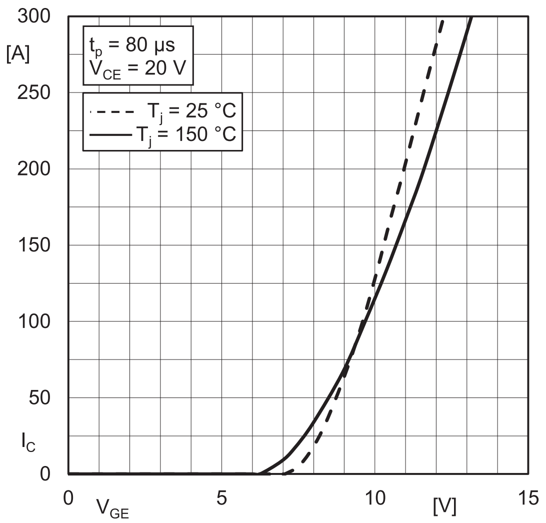


Fig. 5: Typ. IGBT1 transfer characteristic

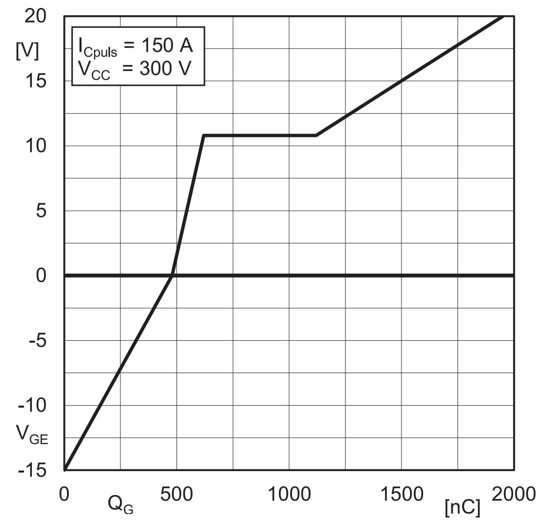


Fig. 6: Typ. IGBT1 gate charge characteristic

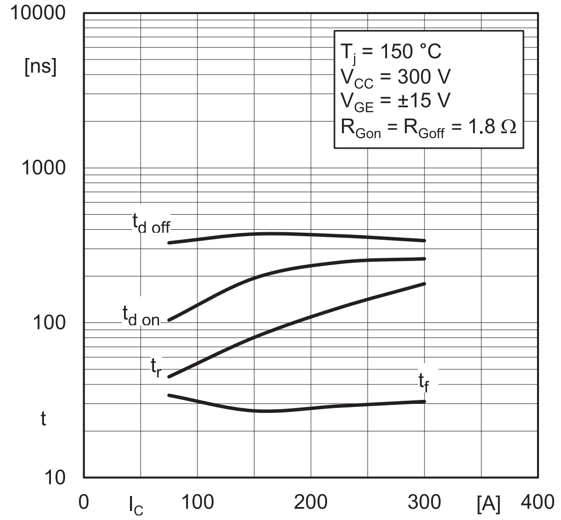


Fig. 7: Typ. IGBT1 switching times vs. I_C

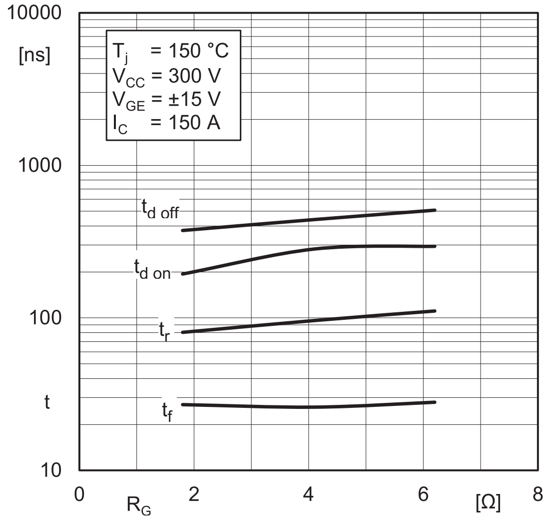


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

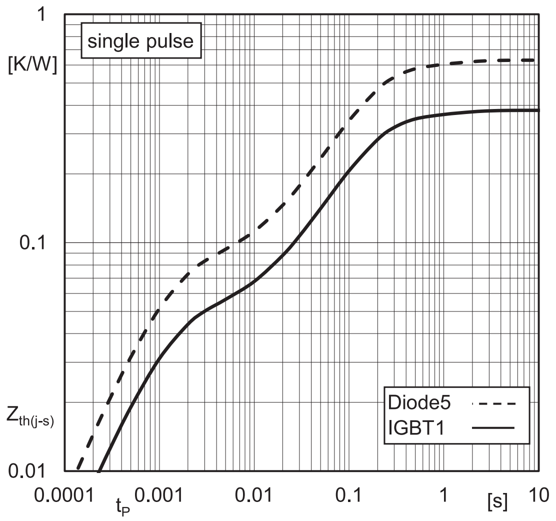


Fig. 9: Transient thermal impedance of IGBT1 & Diode5

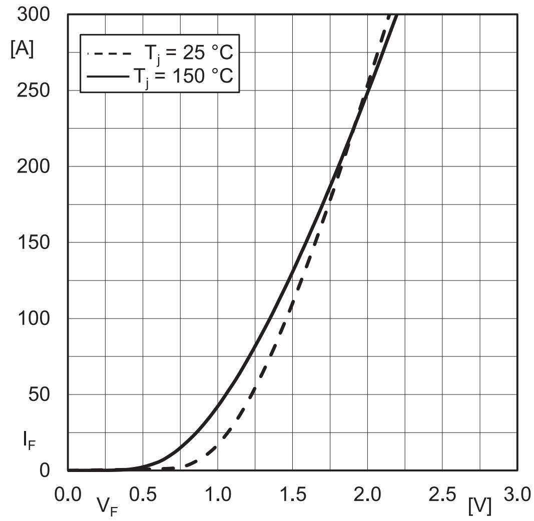


Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC'+EE'}$

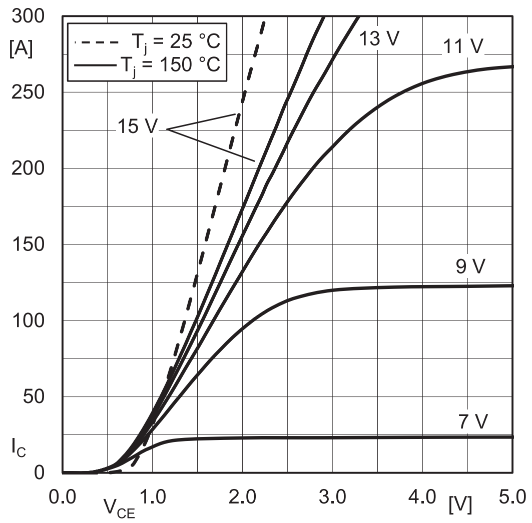


Fig. 13: Typ. IGBT2 output characteristic, incl. $R_{CC'+EE'}$

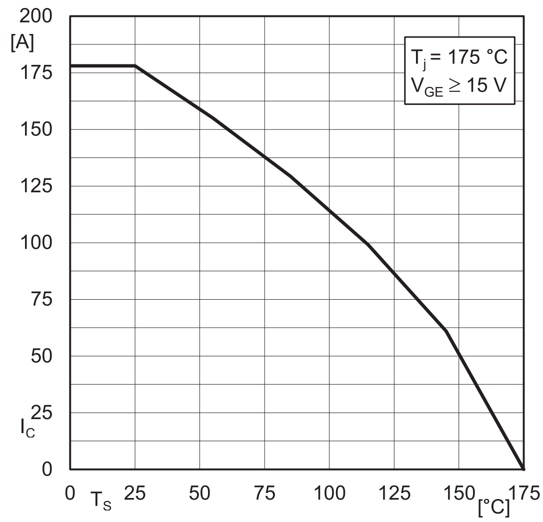


Fig. 14: IGBT2 Rated current vs. Temperature I_c= f (T_s)

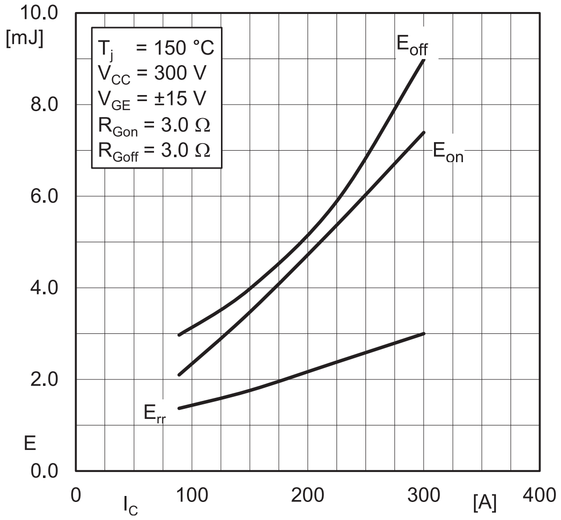


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = f (I_C)

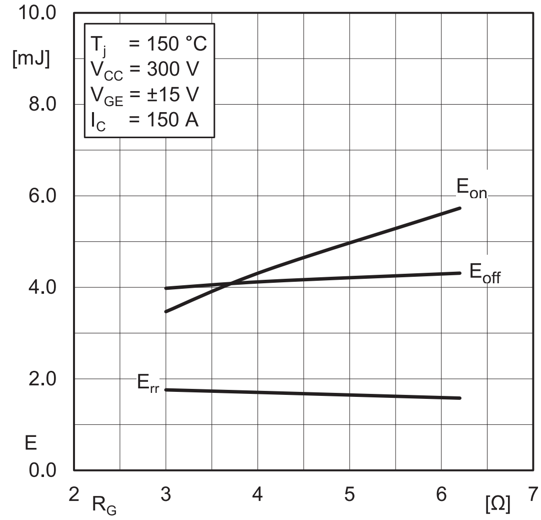


Fig. 16: Typ. IGBT2 & Diode1 turn-on / -off energy = f(R_G)

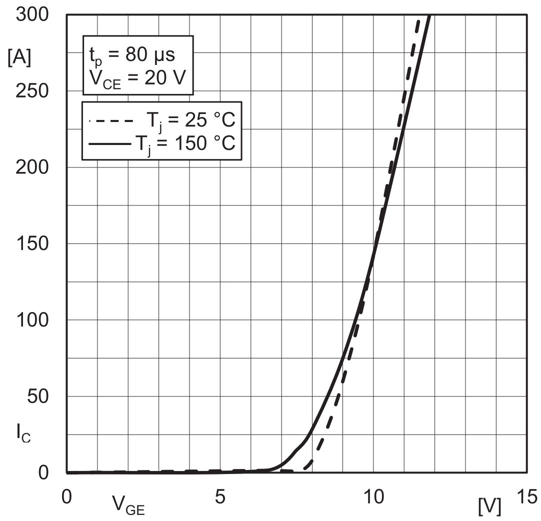


Fig. 17: Typ. IGBT2 transfer characteristic

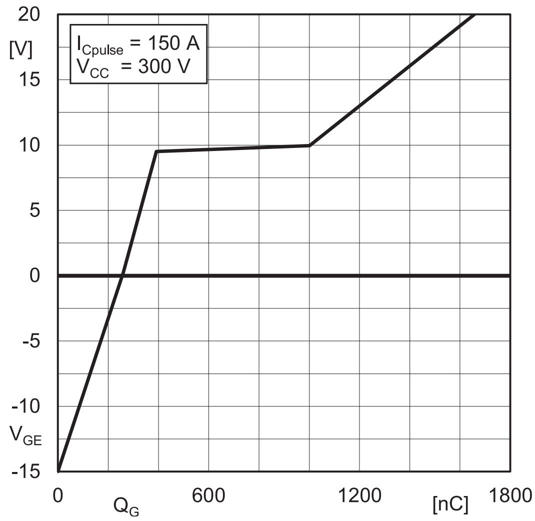


Fig. 18: Typ. IGBT2 gate charge characteristic

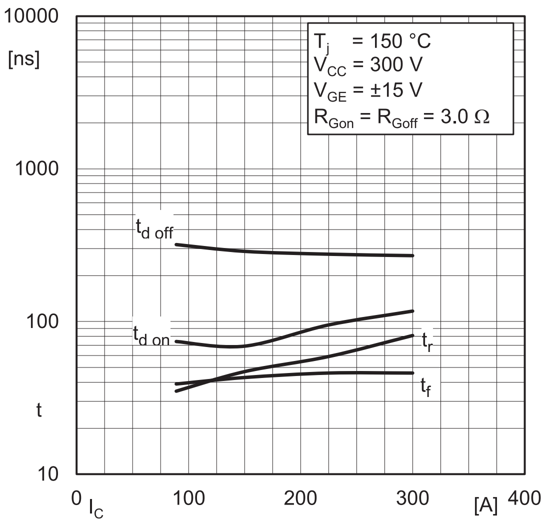


Fig. 19: Typ. IGBT2 switching times vs. I_C

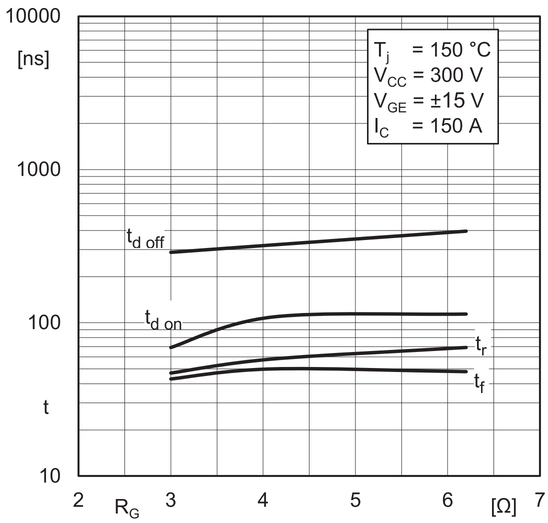


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

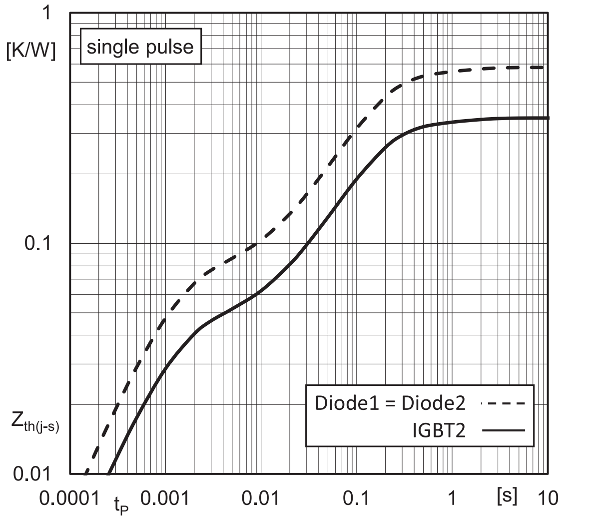


Fig. 21: Transient thermal impedance of IGBT2, Diode1 & Diode2

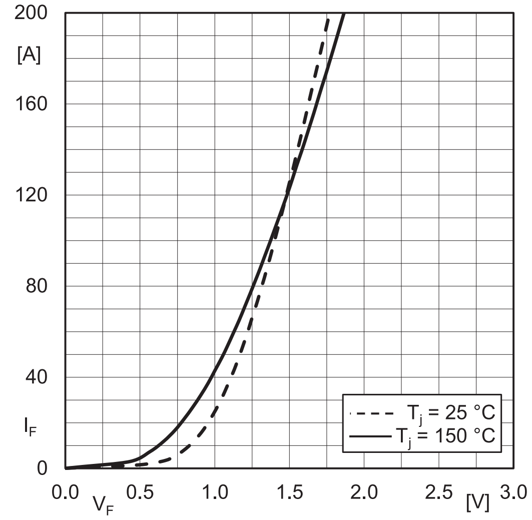
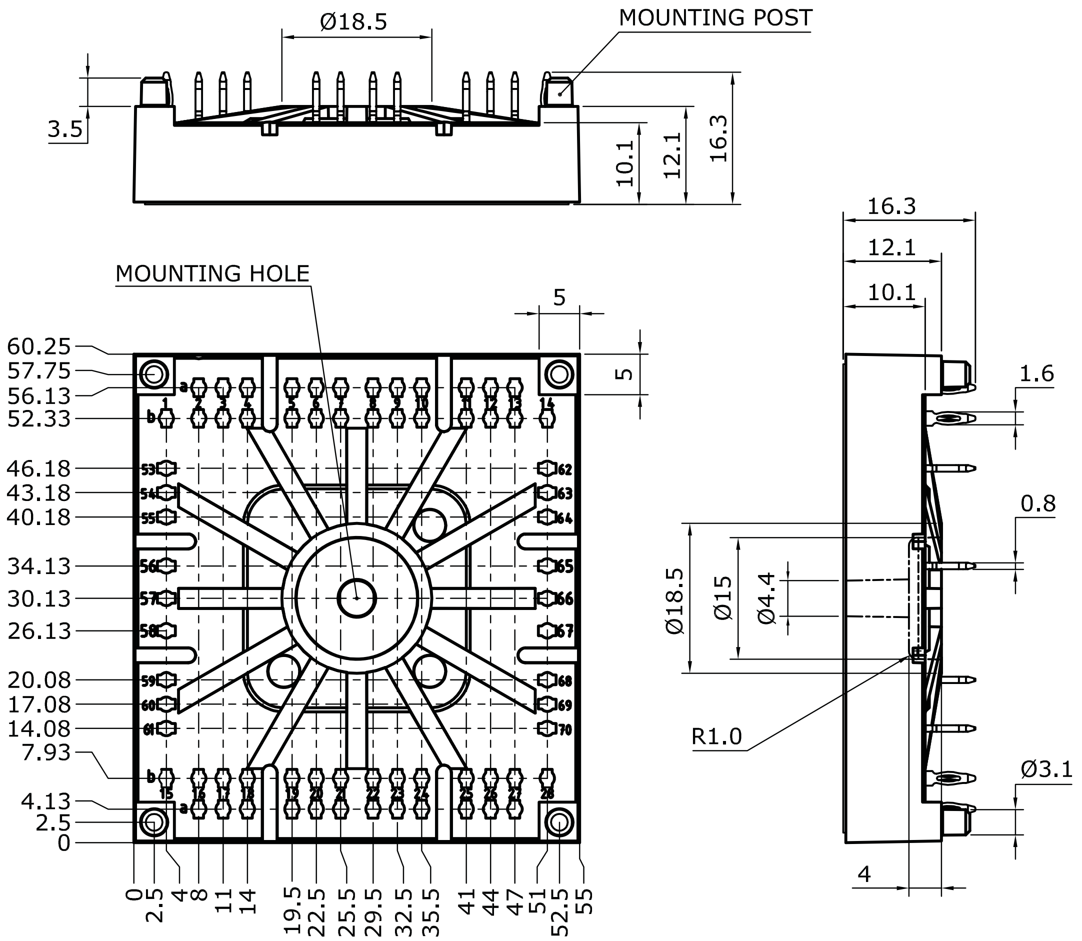


Fig. 22: Typ. Diode1 & Diode2 forward characteristic, incl. $R_{CC'+EE'}$

Dimensions: mm

Tolerance system: ISO 2768-m



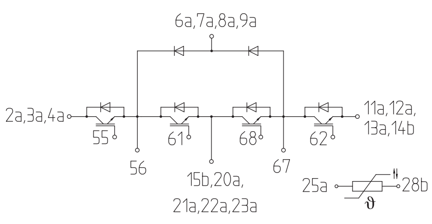
Suggested drilled hole diameter for terminal pins in the circuit board:

- 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

SEMITOP 4 Press-Fit



MLI-T

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

***IMPORTANT INFORMATION AND WARNINGS**

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