MiniSKiiP® 3

3-Level NPC IGBT-Module

SKiiP 39MLI12T4V1

Features

- Trench 4 IGBTs
- Robust and soft freewheeling diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognised: File no. E63532
- NTC T-Sensor

Remarks*

- Max. case temperature limited to T_C= 125°C
- Product reliability results valid for T_j≤150°C (recommended $T_{j,op}$=-40...+150°C)
- IGBT1: outer IGBTs T1 & T4
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- Diode1: outer diodes D1 & D4
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Footnotes

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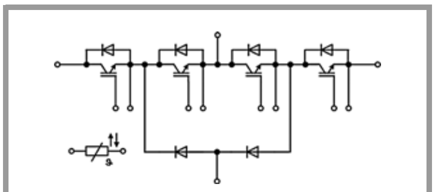
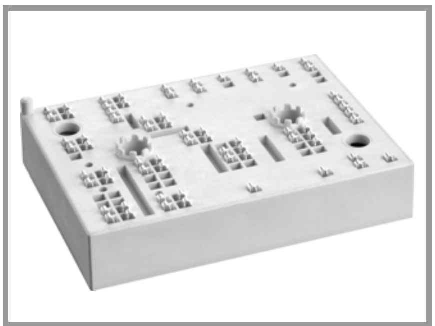


MLI

Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
IGBT1				
V_{CES}	T_j = 25 °C		1200	V
I_C	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	159	A
	T_j = 175 °C	T_s = 70 °C	128	A
I_C	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	196	A
	T_j = 175 °C	T_s = 70 °C	160	A
I_{Cnom}			150	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		450	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	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	164	A
	T_j = 175 °C	T_s = 70 °C	133	A
I_C	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	201	A
	T_j = 175 °C	T_s = 70 °C	163	A
I_{Cnom}			150	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		450	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	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	120	A
	T_j = 175 °C	T_s = 70 °C	94	A
I_F	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	145	A
	T_j = 175 °C	T_s = 70 °C	115	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		900	A
T_j			-40 ... 175	°C
Diode2				
V_{RRM}	T_j = 25 °C		1200	V
I_F	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	131	A
	T_j = 175 °C	T_s = 70 °C	103	A
I_F	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	158	A
	T_j = 175 °C	T_s = 70 °C	126	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		900	A
T_j			-40 ... 175	°C



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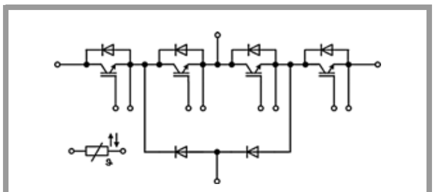


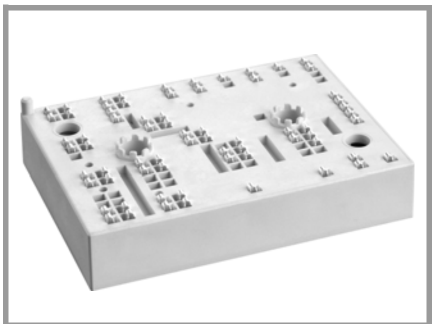
MLI

Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
Diode5				
V_{RRM}	T_j = 25 °C		1200	V
I_F	λ_{paste}=0.8 W/(mK) T_j = 175 °C	T_s = 25 °C	119	A
		T_s = 70 °C	93	A
I_F	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 25 °C	145	A
		T_s = 70 °C	115	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		900	A
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$			160	A
T_{stg}			-40 ... 125	°C
V_{isol}	AC sinus 50 Hz, t = 1 min		2500	V

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	2.10	V
		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 chiplevel	T_j = 25 °C		7.0	8.0	mΩ
		T_j = 150 °C		10	11	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 6 mA		5	5.8	6.5	V
I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V, T_j = 25 °C				0.3	mA
C_{ies}	V_{CE} = 25 V V_{GE} = 0 V	f = 1 MHz		8.80		nF
C_{oes}		f = 1 MHz		0.58		nF
C_{res}		f = 1 MHz		0.47		nF
Q_G	V_{GE} = - 8 V...+ 15 V			850		nC
R_{Gint}	T_j = 25 °C			5.0		Ω
$t_{d(on)}$	V_{CE} = 600 V I_C = 150 A V_{GE} = +15/-15 V $R_{G\,on}$ = 1 Ω $R_{G\,off}$ = 1 Ω di/dt_{on} = 4000 A/µs di/dt_{off} = 1700 A/µs du/dt = 3800 V/µs L_s = 25 nH	T_j = 150 °C		129		ns
t_r		T_j = 150 °C		37		ns
E_{on}		T_j = 150 °C		17		mJ
$t_{d(off)}$		T_j = 150 °C		355		ns
t_f		T_j = 150 °C		77		ns
E_{off}		T_j = 150 °C		15		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.36		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.25		K/W



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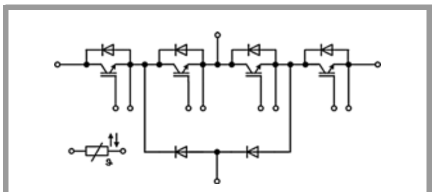

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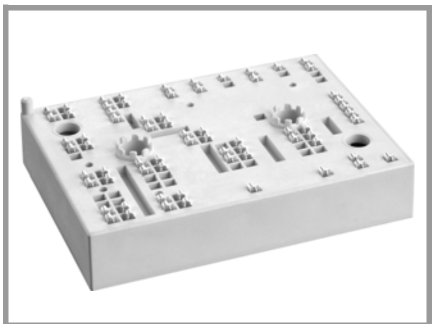
Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
IGBT2						
$V_{CE(sat)}$	I_C = 150 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.85	2.10	V
		T_j = 150 °C		2.25	2.45	V
V_{CE0}	chiplevel	T_j = 25 °C		0.80	0.90	V
		T_j = 150 °C		0.70	0.80	V
r_{CE}	V_{GE} = 15 V, chiplevel	T_j = 25 °C		7.0	8.0	mΩ
		T_j = 150 °C		10	11	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 6 mA		5	5.8	6.5	V
I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V, T_j = 25 °C				0.3	mA
C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V	f = 1 MHz		8.80		nF
C_{oes}		f = 1 MHz		0.58		nF
C_{res}		f = 1 MHz		0.47		nF
Q_G	V_{GE} = - 8 V...+ 15 V			850		nC
R_{Gint}	T_j = 25 °C			5.0		Ω
$t_{d(on)}$	V_{CC} = 600 V, I_C = 150 A, V_{GE} = +15/-15 V, $R_{G\,on}$ = 1 Ω, $R_{G\,off}$ = 1 Ω, di/dt_{on} = 3200 A/µs, di/dt_{off} = 1400 A/µs, du/dt = 4400 V/µs, L_s = 25 nH	T_j = 150 °C		128		ns
t_r		T_j = 150 °C		44		ns
E_{on}		T_j = 150 °C		16.5		mJ
$t_{d(off)}$		T_j = 150 °C		360		ns
t_f		T_j = 150 °C		67		ns
E_{off}		T_j = 150 °C		15		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.34		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.24		K/W
Diode1						
$V_F = V_{EC}$	I_F = 150 A, V_{GE} = 0 V, chiplevel	T_j = 25 °C		2.14	2.46	V
		T_j = 150 °C		2.07	2.38	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		5.6	6.4	mΩ
		T_j = 150 °C		7.8	8.5	mΩ
I_{RRM}	I_F = 150 A, di/dt_{off} = 3200 A/µs, V_R = 600 V, V_{GE} = +15/-15 V, L_s = 25 nH	T_j = 150 °C		143		A
Q_{rr}		T_j = 150 °C		34		µC
E_{rr}		T_j = 150 °C		13		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.63		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.47		K/W
Diode2						
$V_F = V_{EC}$	I_F = 150 A, V_{GE} = 0 V, chiplevel	T_j = 25 °C		2.14	2.46	V
		T_j = 150 °C		2.07	2.38	V
V_{F0}	chiplevel	T_j = 25 °C		1.30	1.50	V
		T_j = 150 °C		0.90	1.10	V
r_F	level = chiplevel	T_j = 25 °C		5.6	6.4	mΩ
		T_j = 150 °C		7.8	8.5	mΩ
I_{RRM}	I_F = 150 A, V_R = 600 V, V_{GE} = +15/-15 V	T_j = 150 °C		-		A
Q_{rr}		T_j = 150 °C		-		µC
E_{rr} 1)		T_j = 150 °C		-		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.55		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.41		K/W



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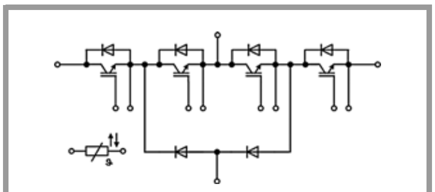


MLI

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Diode5						
$V_F = V_{EC}$	I_F = 150 A V_{GE} = 0 V chiplevel	T_j = 25 °C		2.14	2.46	V
		T_j = 150 °C		2.07	2.38	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		5.6	6.4	mΩ
		T_j = 150 °C		7.8	8.5	mΩ
I_{RRM}	I_F = 150 A di/dt$_{off}$ = 3900 A/µs V_R = 600 V V_{GE} = +15/-15 V L_s = 25 nH	T_j = 150 °C		177		A
Q_{rr}		T_j = 150 °C		32		µC
E_{rr}		T_j = 150 °C		12.6		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.64		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.47		K/W
Module						
L_{sCE1}				-		nH
L_{sCE2}				-		nH
$R_{CC'+EE'}$		T_s = 25 °C		-		mΩ
				-		mΩ
M_s	to heat sink		2		2.5	Nm
M_t		to heat sink				Nm
						Nm
w				82		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

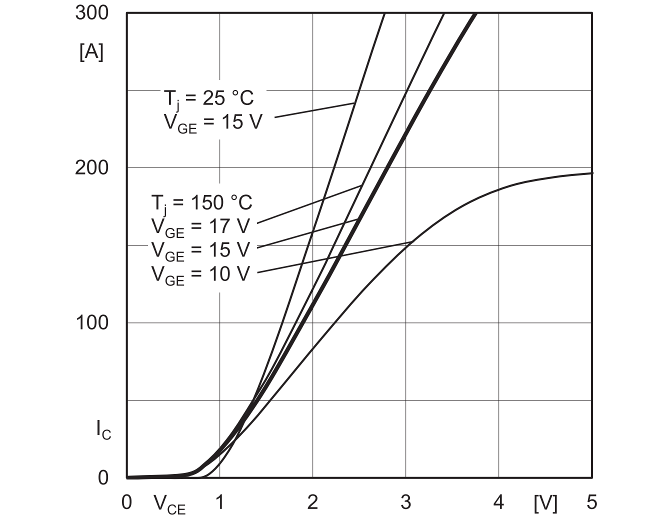


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

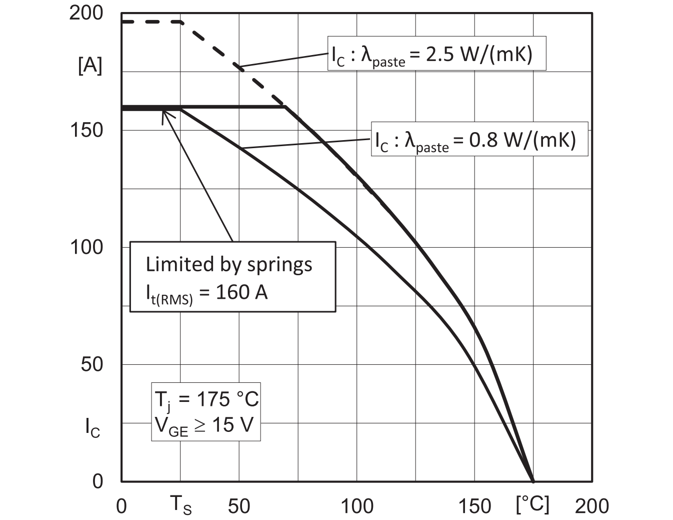


Fig. 2: IGBT1 rated current vs. Temperature I_c=f(T_s)

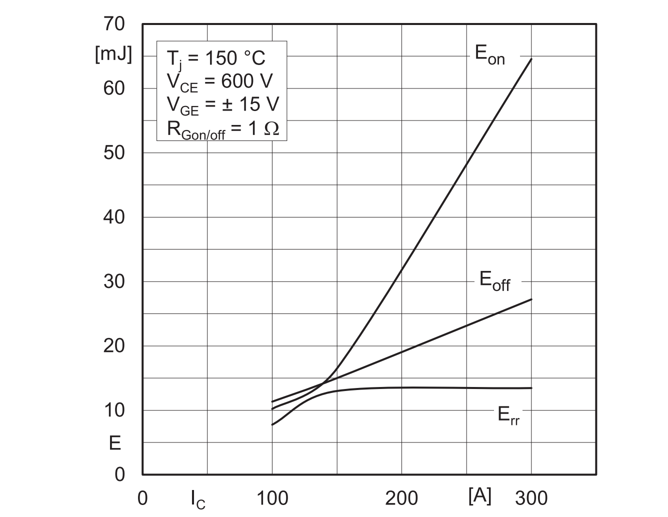


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = f (I_C)

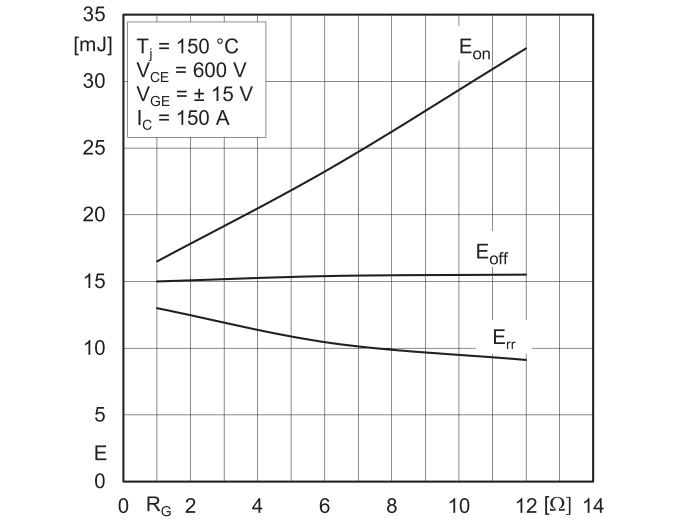


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = f(R_G)

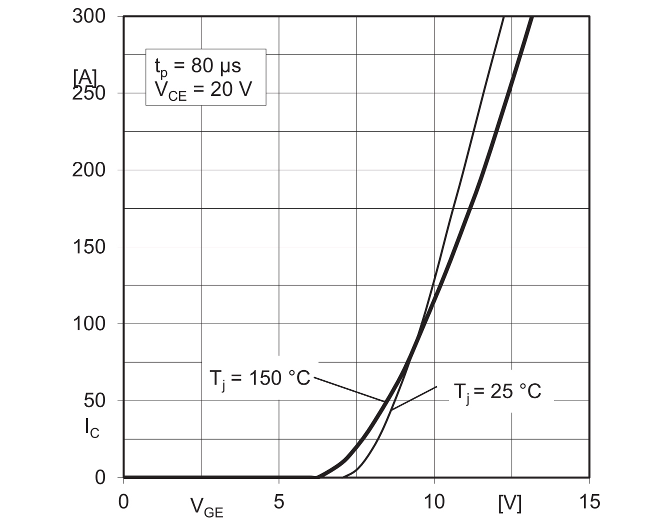


Fig. 5: Typ. IGBT1 transfer characteristic

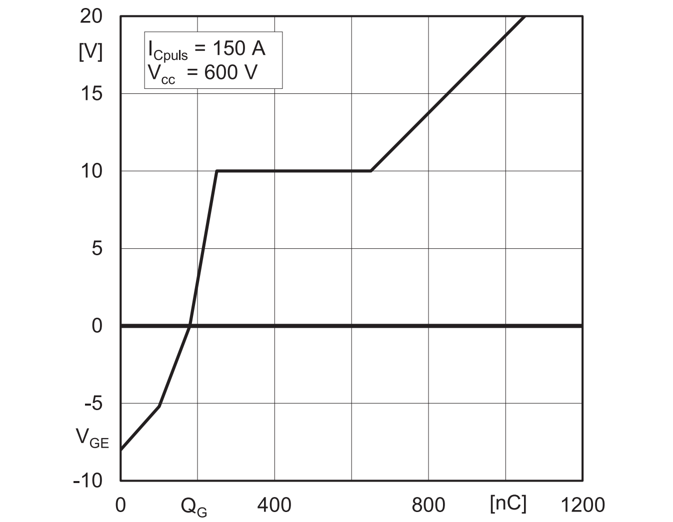


Fig. 6: Typ. IGBT1 gate charge characteristic

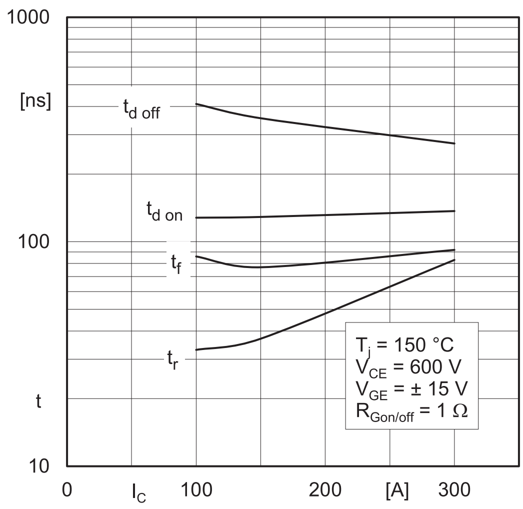


Fig. 7: Typ. IGBT1 switching times vs. I_C

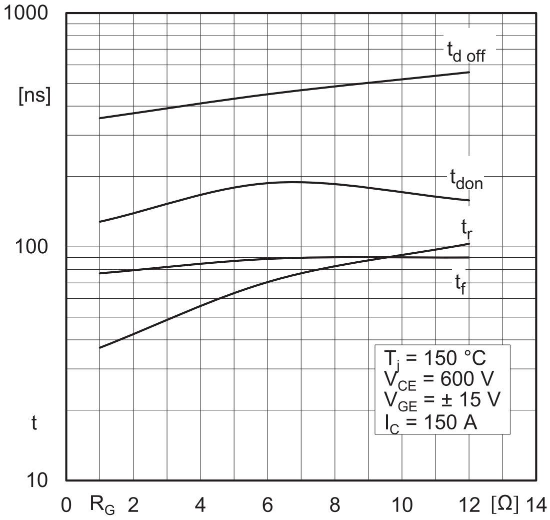


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

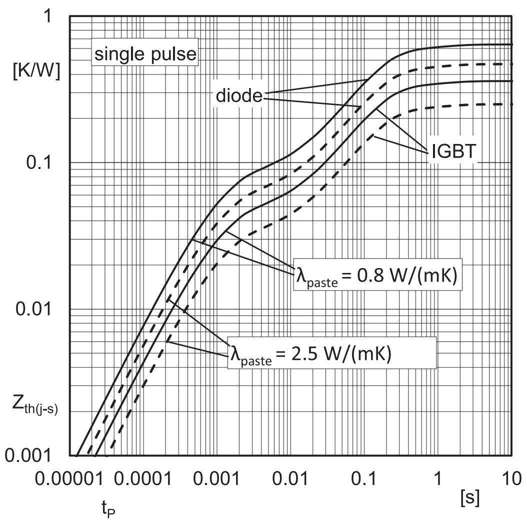


Fig. 9: Transient thermal impedance of IGBT1 & Diode5

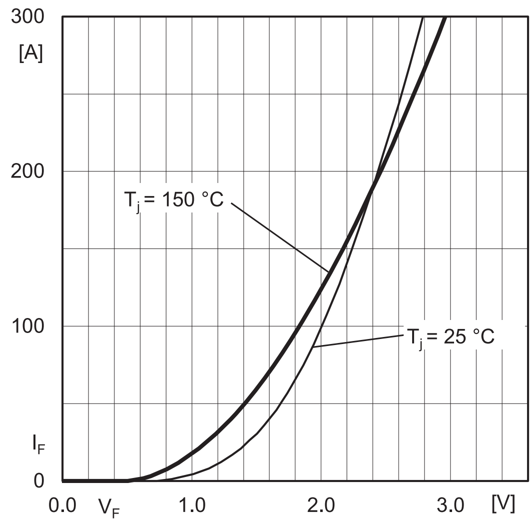


Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC'+EE'}$

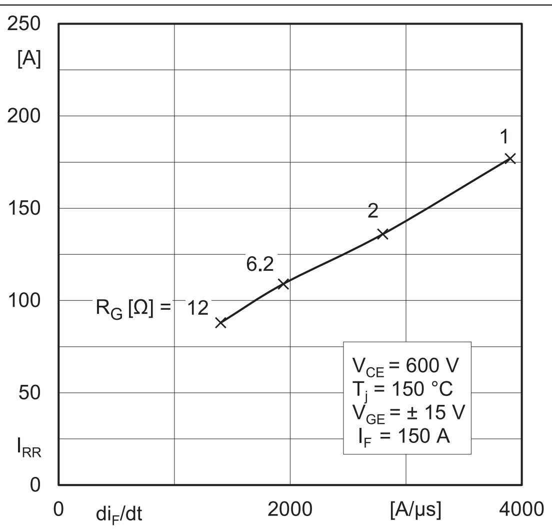


Fig. 11: Typ. Diode5 peak reverse recovery current

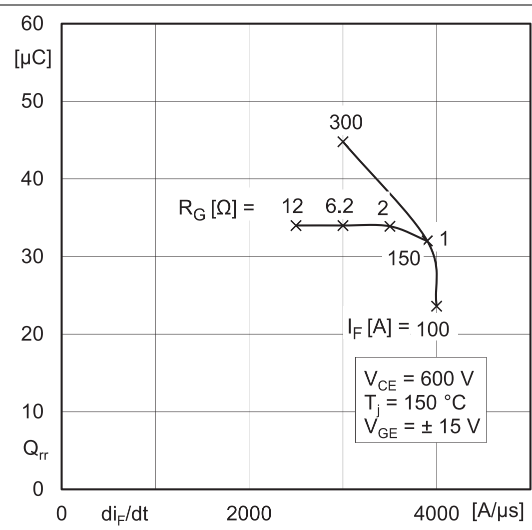
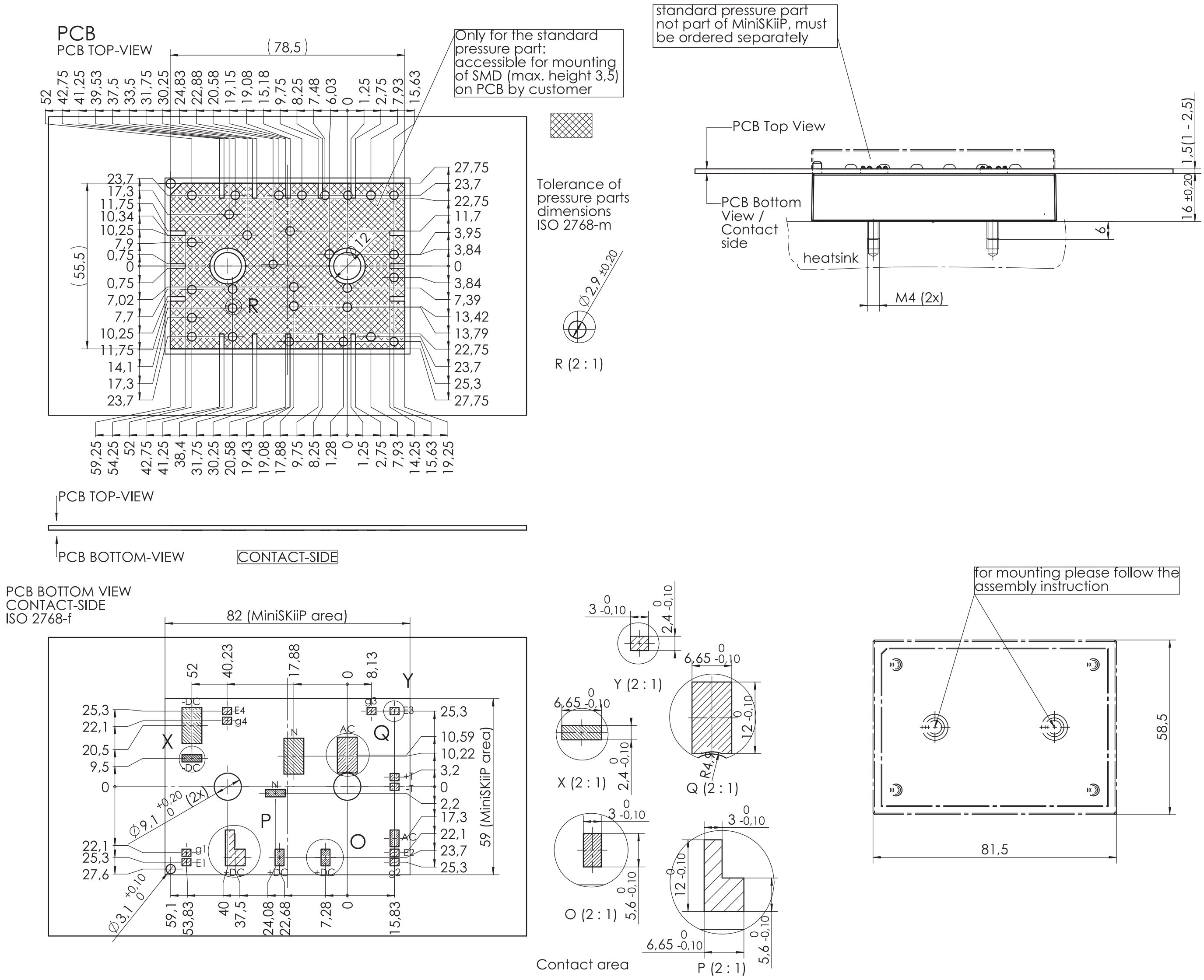
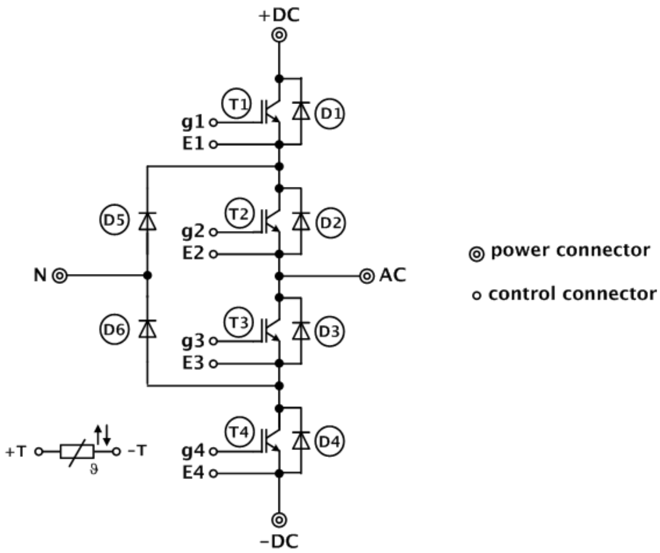


Fig. 12: Typ. Diode5 recovery charge



pinout, dimensions



pinout

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

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