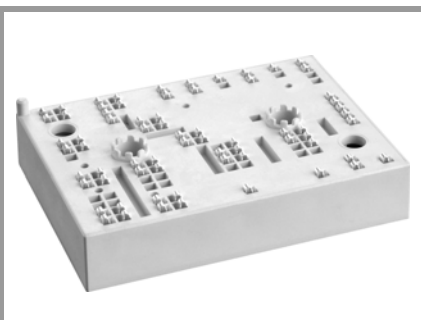


SKiIP 39MLI12T4V1



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

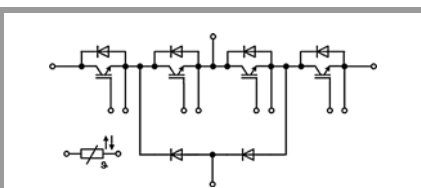
Remarks*

- Max. case temperature limited to $T_C = 125^\circ\text{C}$
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$ (recommended $T_{j,op} = -40 \dots +150^\circ\text{C}$)
- 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

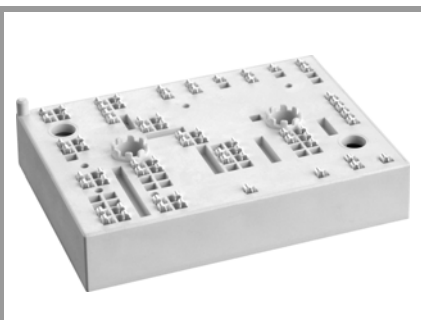
¹⁾ Please find further technical information on the SEMIKRON website.

Absolute Maximum Ratings				
Symbol	Conditions	Values	Unit	
IGBT1				
V_{CES}	$T_j = 25^\circ\text{C}$	1200	V	
I_C	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	159	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	128	A
I_C	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	196	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	160	A
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}	$T_j = 25^\circ\text{C}$	1200	V	
I_C	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	164	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	133	A
I_C	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	201	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	163	A
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	$^\circ\text{C}$	
Diode1				
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V	
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	120	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	94	A
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	145	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	115	A
I_{Fnom}		150	A	
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$	300	A	
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$	900	A	
T_j		-40 ... 175	$^\circ\text{C}$	
Diode2				
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V	
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	131	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	103	A
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	158	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	126	A
I_{Fnom}		150	A	
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$	300	A	
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$	900	A	
T_j		-40 ... 175	$^\circ\text{C}$	



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- Highly reliable spring contacts for electrical connections
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- NTC T-Sensor

Remarks*

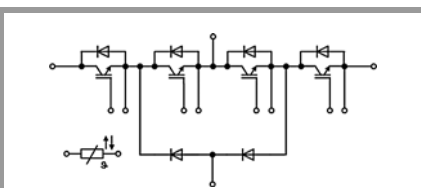
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Footnotes

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

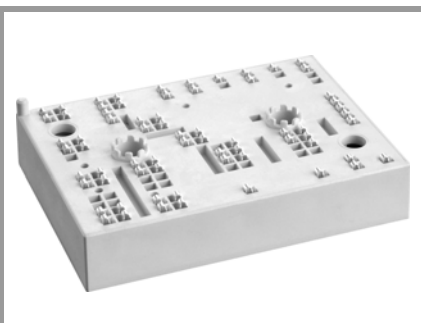
Absolute Maximum Ratings				
Symbol	Conditions	Values	Unit	
Diode5				
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V	
I_F	$\lambda_{paste} = 0.8 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	119	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	93	A
I_F	$\lambda_{paste} = 2.5 \text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	145	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	115	A
I_{Fnom}		150	A	
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$	300	A	
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$	900	A	
T_j		-40 ... 175	$^\circ\text{C}$	
Module				
$I_{t(RMS)}$		160	A	
T_{stg}		-40 ... 125	$^\circ\text{C}$	
V_{isol}	AC sinus 50 Hz, $t = 1 \text{ min}$	2500	V	

Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
IGBT1					
$V_{CE(sat)}$	$I_C = 150 \text{ A}$ $V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.85	2.10	V
		$T_j = 150^\circ\text{C}$	2.25	2.45	V
V_{CE0}	chipelevel	$T_j = 25^\circ\text{C}$	0.80	0.90	V
		$T_j = 150^\circ\text{C}$	0.70	0.80	V
r_{CE}	$V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	7.0	8.0	$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	10	11	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 6 \text{ mA}$	5	5.8	6.5	V
I_{CES}	$V_{GE} = 0 \text{ V}, V_{CE} = 1200 \text{ V}, T_j = 25^\circ\text{C}$			0.3	mA
C_{ies}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	8.80		nF
C_{oes}		$f = 1 \text{ MHz}$	0.58		nF
C_{res}		$f = 1 \text{ MHz}$	0.47		nF
Q_G	$V_{GE} = -8 \text{ V} \dots +15 \text{ V}$		850		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		5.0		Ω
$t_{d(on)}$	$V_{CE} = 600 \text{ V}$ $I_C = 150 \text{ A}$	$T_j = 150^\circ\text{C}$	129		ns
t_r	$V_{GE} = +15/-15 \text{ V}$	$T_j = 150^\circ\text{C}$	37		ns
E_{on}	$R_{G on} = 1 \Omega$	$T_j = 150^\circ\text{C}$	17		mJ
$t_{d(off)}$	$R_{G off} = 1 \Omega$	$T_j = 150^\circ\text{C}$	355		ns
t_f	$di/dt_{on} = 4000 \text{ A}/\mu\text{s}$ $di/dt_{off} = 1700 \text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$	77		ns
E_{off}	$du/dt = 3800 \text{ V}/\mu\text{s}$ $L_s = 25 \text{ nH}$	$T_j = 150^\circ\text{C}$	15		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 0.8 \text{ W/(mK)}$		0.36		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 2.5 \text{ W/(mK)}$		0.25		K/W



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3-Level NPC IGBT-Module

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Features

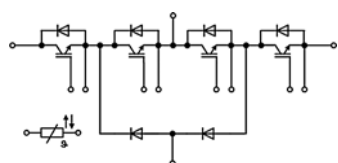
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Remarks*

- Max. case temperature limited to $T_C = 125^\circ\text{C}$
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$ (recommended $T_{j,op} = -40 \dots +150^\circ\text{C}$)
- IGBT1: outer IGBTs T1 & T4
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Footnotes

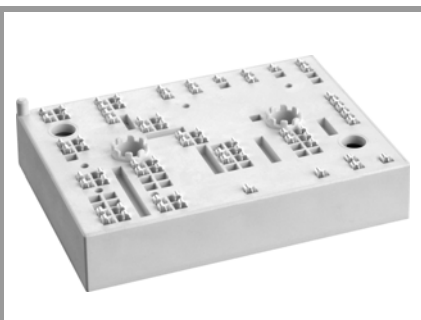
¹⁾ Please find further technical information on the SEMIKRON website.



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

SKiIP 39MLI12T4V1



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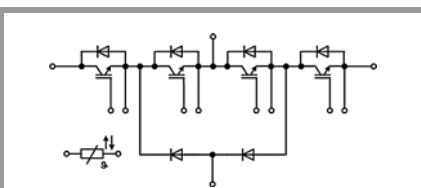
Remarks*

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- IGBT1: outer IGBTs T1 & T4
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Footnotes

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

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode5						
$V_F = V_{EC}$	$I_F = 150\text{ A}$ $V_{GE} = 0\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$		2.14	2.46	V
		$T_j = 150^\circ\text{C}$		2.07	2.38	V
V_{F0}	chipllevel	$T_j = 25^\circ\text{C}$		1.30	1.50	V
		$T_j = 150^\circ\text{C}$		0.90	1.10	V
r_F	chipllevel	$T_j = 25^\circ\text{C}$		5.6	6.4	m Ω
		$T_j = 150^\circ\text{C}$		7.8	8.5	m Ω
I_{RRM}	$I_F = 150\text{ A}$	$T_j = 150^\circ\text{C}$		177		A
Q_{rr}	$di/dt_{off} = 3900\text{ A}/\mu\text{s}$ $V_R = 600\text{ V}$	$T_j = 150^\circ\text{C}$		32		μC
E_{rr}	$V_{GE} = +15/-15\text{ V}$ $L_s = 25\text{ nH}$	$T_j = 150^\circ\text{C}$		12.6		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$			0.64		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$			0.47		K/W
Module						
L_{sCE1}				-		nH
L_{sCE2}				-		nH
R_{CC+EE}			$T_s = 25^\circ\text{C}$		-	m Ω
					-	m Ω
M_s	to heat sink			2	2.5	Nm
M_t	to heat sink					Nm
						Nm
w				82		g
Temperature Sensor						
R_{100}	$T_c=100^\circ\text{C}$ ($R_{25}=5\text{ k}\Omega$)			$493 \pm 5\%$		Ω
$B_{100/125}$	$R(T)=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$; $T[\text{K}]$;			$3550 \pm 2\%$		K



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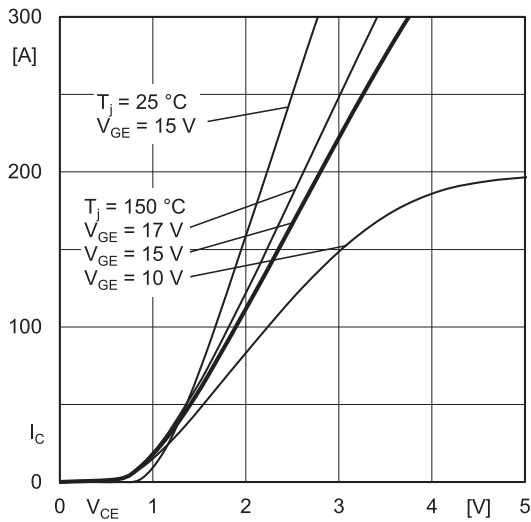


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

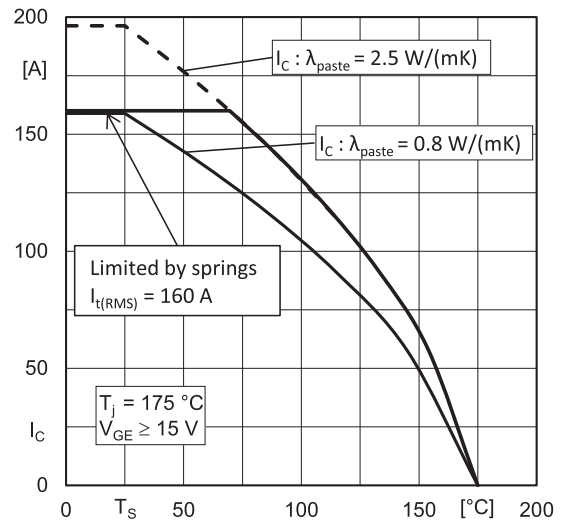


Fig. 2: IGBT1 rated current vs. Temperature $I_c=f(T_s)$

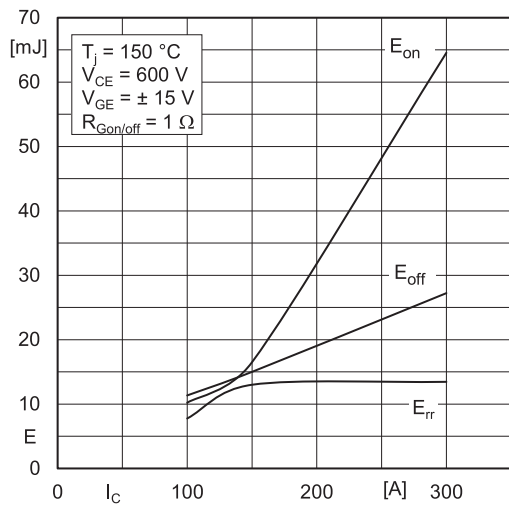


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(I_c)$

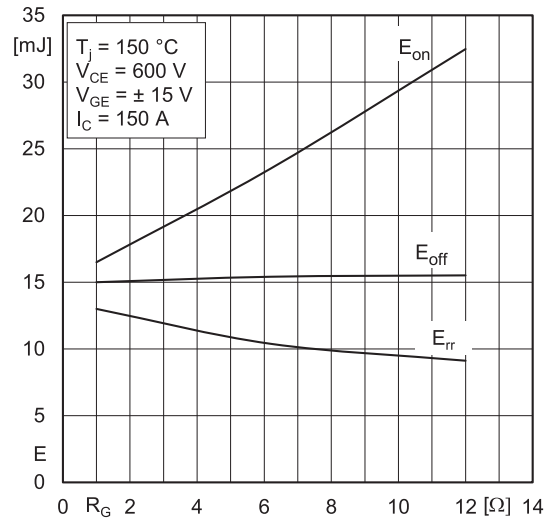


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(R_G)$

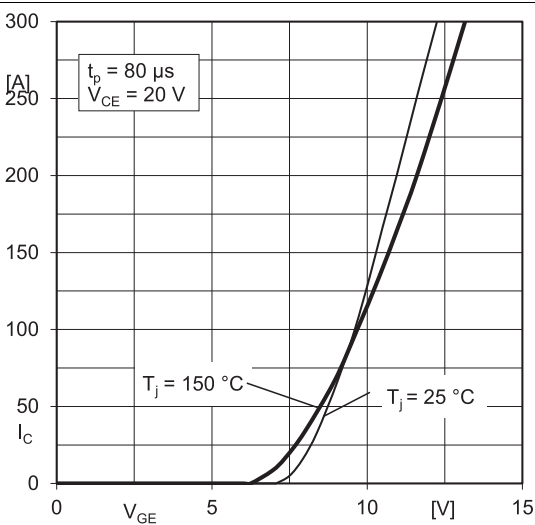


Fig. 5: Typ. IGBT1 transfer characteristic

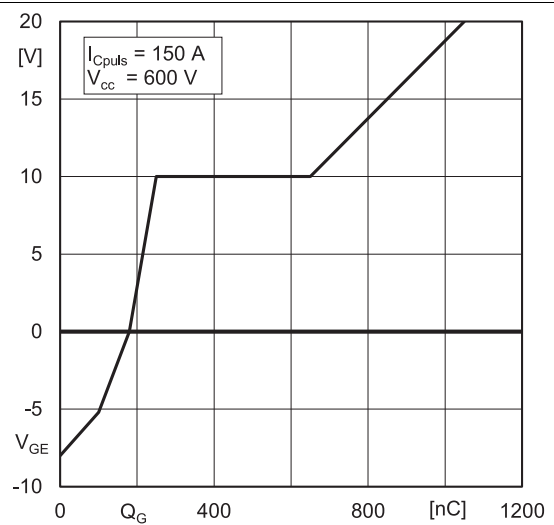


Fig. 6: Typ. IGBT1 gate charge characteristic

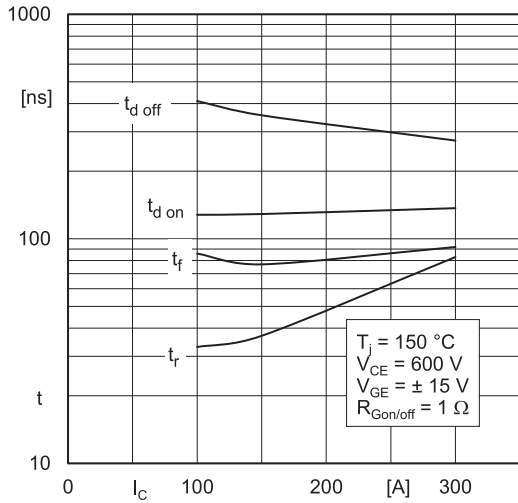


Fig. 7: Typ. IGBT1 switching times vs. I_C

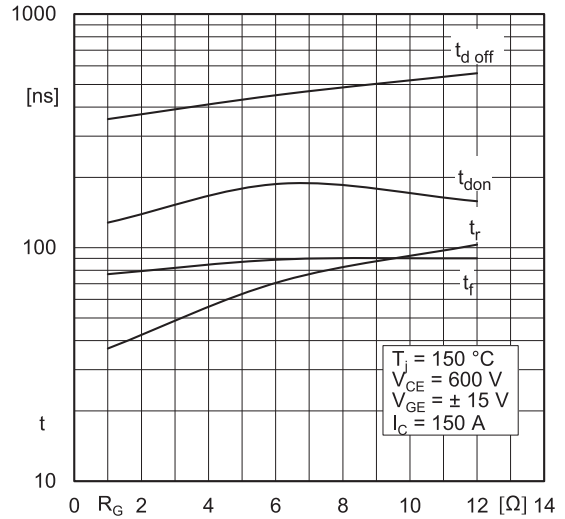


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

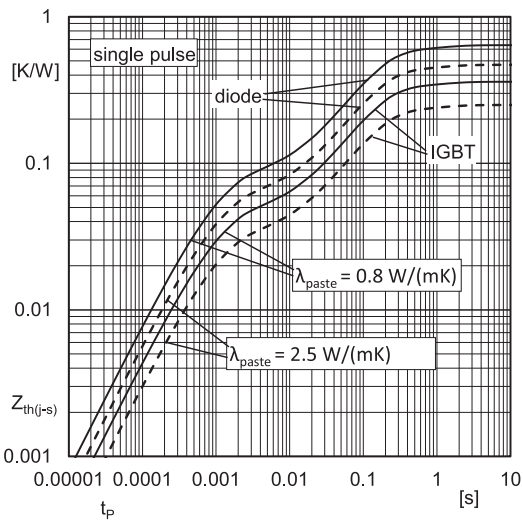


Fig. 9: Transient thermal impedance of IGBT1 & Diode5

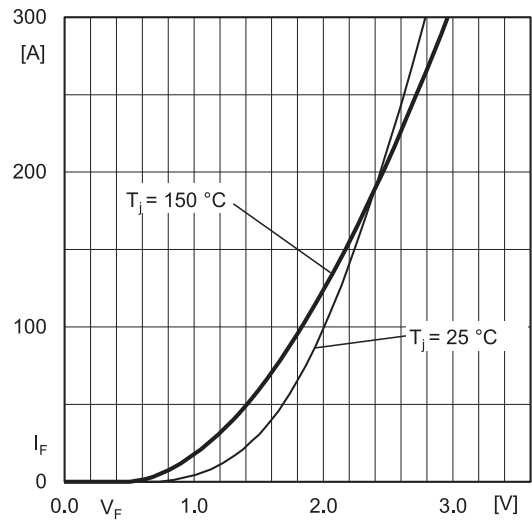


Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC+EE'}$

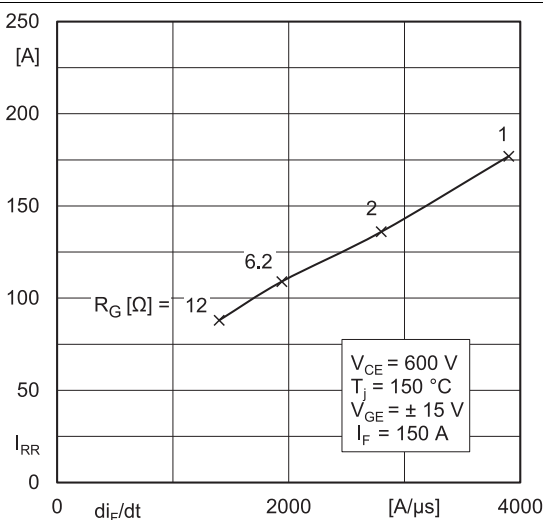


Fig. 11: Typ. Diode5 peak reverse recovery current

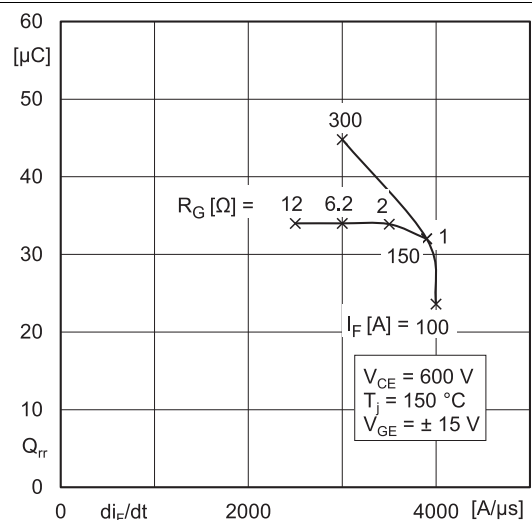
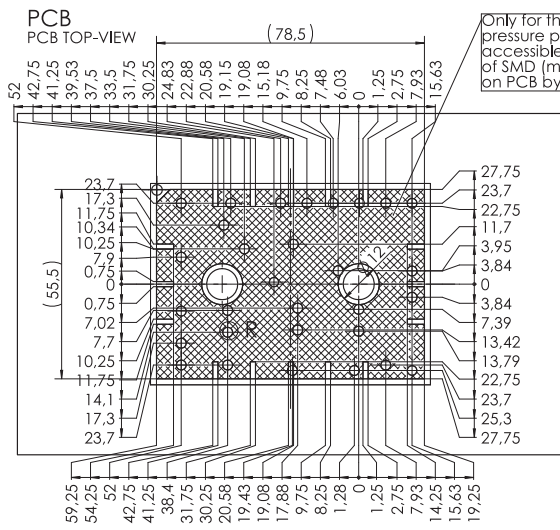
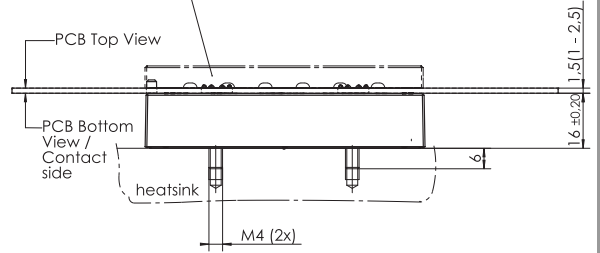


Fig. 12: Typ. Diode5 recovery charge

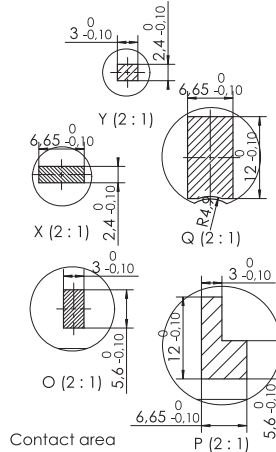
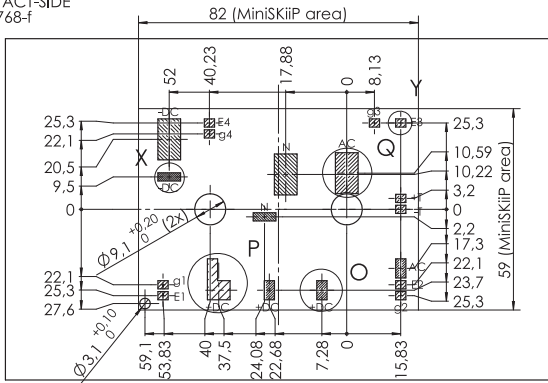
SKiiP 39MLI12T4V1



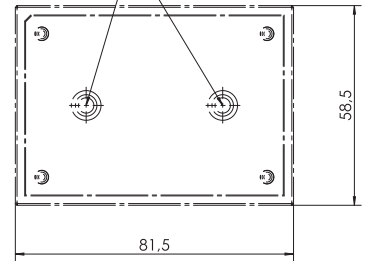
standard pressure part not part of MiniSKiiP, must be ordered separately



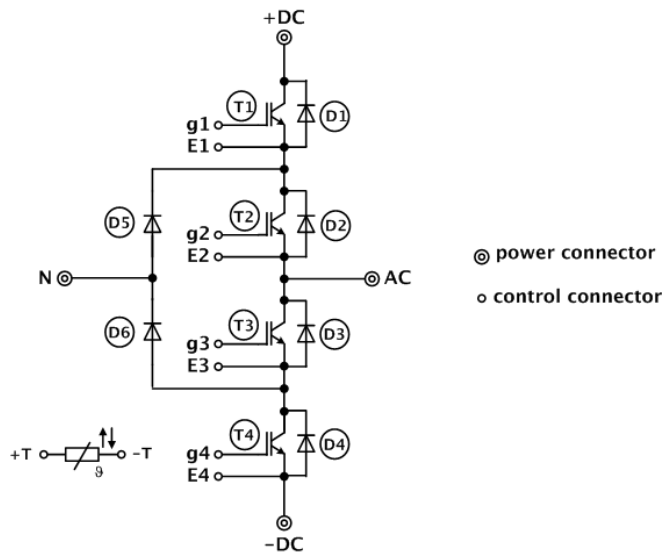
PCB BOTTOM VIEW CONTACT-SIDE ISO 2768-f



for mounting please follow the assembly instruction



pinout, dimensions



pinout

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

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