

MiniSKiiP® 3

3-Level NPC IGBT-Module

SKiiP 39MLI07E3V1

Features*

- 650V Trench IGBTs
- Robust and soft diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognised: File no. E63532
- NTC T-Sensor

Typical Applications

- Uninterruptible power supplies (UPS)
- Solar inverters

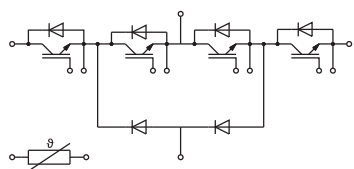
Remarks*

- Case temperature limited to $T_C=125^\circ\text{C}$ max.; $T_C=T_S$ (valid for baseplate-less modules)
- Product reliability results are valid for $T_{jop}=150^\circ\text{C}$
- 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

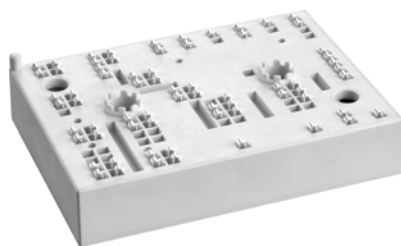
Footnotes

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

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT1				
V _{CES}	T _j = 25 °C		650	V
I _C	λ _{paste} =0.8 W/(mK) T _j = 175 °C	T _s = 25 °C	159	A
		T _s = 70 °C	126	A
I _C	λ _{paste} =2.5 W/(mK) T _j = 175 °C	T _s = 25 °C	208	A
		T _s = 70 °C	165	A
I _{Cnom}			200	A
I _{CRM}			600	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
IGBT2				
V _{CES}	T _j = 25 °C		650	V
I _C	λ _{paste} =0.8 W/(mK) T _j = 175 °C	T _s = 25 °C	159	A
		T _s = 70 °C	126	A
I _C	λ _{paste} =2.5 W/(mK) T _j = 175 °C	T _s = 25 °C	208	A
		T _s = 70 °C	165	A
I _{Cnom}			200	A
I _{CRM}			600	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	λ _{paste} =0.8 W/(mK) T _j = 175 °C	T _s = 25 °C	163	A
		T _s = 70 °C	125	A
I _F	λ _{paste} =2.5 W/(mK) T _j = 175 °C	T _s = 25 °C	200	A
		T _s = 70 °C	155	A
I _{FRM}			400	A
I _{FSM}	10 ms, sin 180°, T _j = 25 °C		1470	A
T _j			-40 ... 175	°C
Diode2				
V _{RRM}	T _j = 25 °C		650	V
I _F	λ _{paste} =0.8 W/(mK) T _j = 175 °C	T _s = 25 °C	163	A
		T _s = 70 °C	125	A
I _F	λ _{paste} =2.5 W/(mK) T _j = 175 °C	T _s = 25 °C	200	A
		T _s = 70 °C	155	A
I _{FRM}			400	A
I _{FSM}	10 ms, sin 180°, T _j = 25 °C		1470	A
T _i			-40 ... 175	°C



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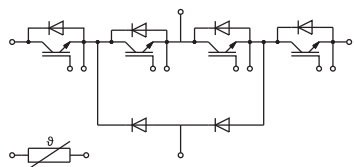
Symbol	Conditions	Values	Unit
Diode5			
V_{RRM}	$T_j = 25^{\circ}\text{C}$	650	V
I_F	$\lambda_{paste}=0.8\text{ W/(mK)}$ $T_j = 175^{\circ}\text{C}$	163	A
	$T_s = 25^{\circ}\text{C}$ $T_s = 70^{\circ}\text{C}$	125	A
I_F	$\lambda_{paste}=2.5\text{ W/(mK)}$ $T_j = 175^{\circ}\text{C}$	200	A
	$T_s = 25^{\circ}\text{C}$ $T_s = 70^{\circ}\text{C}$	155	A
I_{FRM}		400	A
I_{FSM}	10 ms, sin 180°, $T_j = 25^{\circ}\text{C}$	1470	A
T_j		-40 ... 175	$^{\circ}\text{C}$

Module

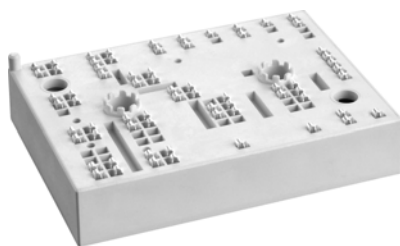
$I_{t(RMS)}$	$T_{terminal} = 80^{\circ}\text{C}$, 20A per spring	200	A
T_{stg}	module without TIM	-40 ... 125	$^{\circ}\text{C}$
V_{isol}	AC sinus 50 Hz, $t = 1\text{ min}$	2500	V

Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
IGBT1					
$V_{CE(sat)}$	$I_C = 200\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel				
	$T_j = 25^{\circ}\text{C}$		1.45	1.90	V
	$T_j = 150^{\circ}\text{C}$		1.70	2.10	V
V_{CE0}	chipelevel				
	$T_j = 25^{\circ}\text{C}$		0.90	1.00	V
	$T_j = 150^{\circ}\text{C}$		0.82	0.90	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipelevel				
	$T_j = 25^{\circ}\text{C}$		2.8	4.5	m Ω
	$T_j = 150^{\circ}\text{C}$		4.4	6.0	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 3.2\text{ mA}$	5.1	5.8	6.4	V
I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 650\text{ V}$, $T_j = 25^{\circ}\text{C}$			2.0	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$		12.34		nF
C_{oes}	$V_{GE} = 0\text{ V}$		0.77		nF
C_{res}			0.37		nF
Q_G	$V_{GE} = -8\text{ V}...+15\text{ V}$		1600		nC
R_{Gint}	$T_j = 25^{\circ}\text{C}$		2.0		Ω
$t_{d(on)}$	$V_{CE} = 300\text{ V}$ $I_C = 200\text{ A}$		165		ns
t_r	$V_{GE} = +15/-15\text{ V}$		69		ns
E_{on}	$R_{G on} = 2\text{ }\Omega$		3.6		mJ
$t_{d(off)}$	$R_{G off} = 2\text{ }\Omega$		341		ns
t_f	$di/dt_{on} = 3150\text{ A}/\mu\text{s}$ $di/dt_{off} = 2000\text{ A}/\mu\text{s}$		83		ns
E_{off}			8.9		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8\text{ W/(mK)}$		0.5		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5\text{ W/(mK)}$		0.33		K/W



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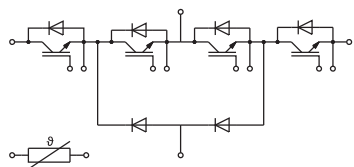
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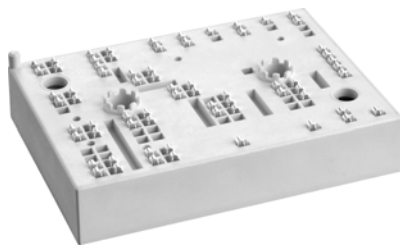
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT2						
V _{CE(sat)}	I _C = 200 A	T _j = 25 °C		1.45	1.90	V
	V _{GE} = 15 V chipllevel	T _j = 150 °C		1.70	2.10	V
V _{CE0}	chipllevel	T _j = 25 °C		0.90	1.00	V
		T _j = 150 °C		0.82	0.90	V
r _{CE}	V _{GE} = 15 V chipllevel	T _j = 25 °C		2.8	4.5	mΩ
		T _j = 150 °C		4.4	6.0	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 3.2 mA		5.1	5.8	6.4	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 650 V, T _j = 25 °C				2.0	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		12.34		nF
C _{oes}		f = 1 MHz		0.77		nF
C _{res}		f = 1 MHz		0.37		nF
Q _G	V _{GE} = - 8 V...+ 15 V			1600		nC
R _{Gint}	T _j = 25 °C			2.0		Ω
t _{d(on)}	V _{CC} = 300 V	T _j = 150 °C		152		ns
	I _C = 200 A					
t _r	V _{GE} = +15/-15 V	T _j = 150 °C		70		ns
E _{on}	R _{G on} = 2 Ω	T _j = 150 °C		1.8		mJ
t _{d(off)}	R _{G off} = 2 Ω	T _j = 150 °C		324		ns
t _f	di/dt _{on} = 3120 A/μs	T _j = 150 °C		89		ns
	di/dt _{off} = 2000 A/μs					
E _{off}		T _j = 150 °C		9.5		mJ
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/(mK)			0.5		K/W
R _{th(j-s)}	per IGBT, λ _{paste} =2.5 W/(mK)			0.33		K/W
Diode1						
V _F = V _{EC}	I _F = 200 A	T _j = 25 °C		1.39	1.75	V
	V _{GE} = 0 V chipllevel	T _j = 150 °C		1.38	1.76	V
V _{F0}	chipllevel	T _j = 25 °C		1.04	1.24	V
		T _j = 150 °C		0.85	0.99	V
r _F	chipllevel	T _j = 25 °C		1.76	2.6	mΩ
		T _j = 150 °C		2.6	3.9	mΩ
I _{RRM}	I _F = 200 A	T _j = 150 °C		157		A
Q _{rr}	di/dt _{off} = 2700 A/μs	T _j = 150 °C		31		μC
	V _R = 300 V					
E _{rr}	V _{GE} = +15/-15 V	T _j = 150 °C		8.3		mJ
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			0.6		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			0.45		K/W
Diode2						
V _F = V _{EC}	I _F = 200 A	T _j = 25 °C		1.39	1.75	V
	V _{GE} = 0 V chipllevel	T _j = 150 °C		1.38	1.76	V
V _{F0}	chipllevel	T _j = 25 °C		1.04	1.24	V
		T _j = 150 °C		0.85	0.99	V
r _F	chipllevel	T _j = 25 °C		1.76	2.6	mΩ
		T _j = 150 °C		2.6	3.9	mΩ
I _{RRM}	I _F = 200 A	T _j = 150 °C		171		A
Q _{rr}	di/dt _{off} = 3100 A/μs	T _j = 150 °C		31		μC
	V _R = 300 V					
E _{rr} ¹⁾	V _{GE} = +15/-15 V	T _j = 150 °C		8.3		mJ
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			0.6		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			0.45		K/W



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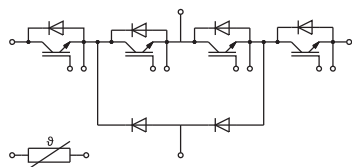
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode5						
V _F = V _{EC}	I _F = 200 A	T _j = 25 °C		1.39	1.75	V
	chipelevel	T _j = 150 °C		1.38	1.76	V
V _{F0}	chipelevel	T _j = 25 °C		1.04	1.24	V
		T _j = 150 °C		0.85	0.99	V
r _F	chipelevel	T _j = 25 °C		1.76	2.6	mΩ
		T _j = 150 °C		2.6	3.9	mΩ
I _{RRM}	I _F = 200 A			t.b.d.		A
Q _{rr}	V _R = 300 V			16		μC
E _{rr}	V _{GE} = +15/-15 V			4		mJ
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			0.6		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			0.45		K/W
Module						
L _{sCE1}				-		nH
L _{sCE2}				-		nH
R _{CC'+EE'}		T _s = 25 °C		-		mΩ
		T _s = 125 °C		-		mΩ
M _s	to heat sink		2		2.5	Nm
M _t				-		Nm
				-		Nm
W				82		g
Temperature Sensor						
R ₁₀₀	T _c =100°C (R ₂₅ =5 kΩ) ¹⁾			493		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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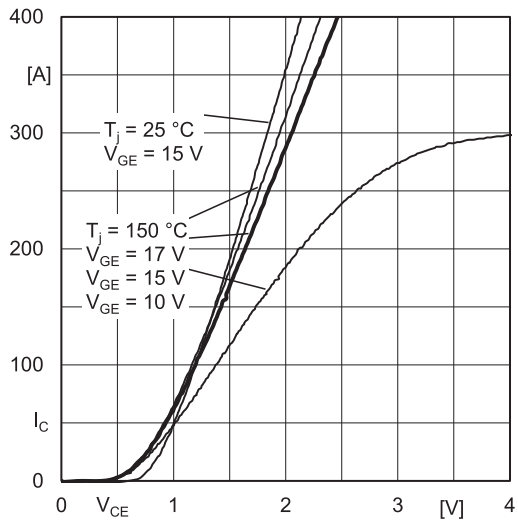


Fig. 1: Typ. output characteristic, inclusive $R_{CC'} + E_{E'}$

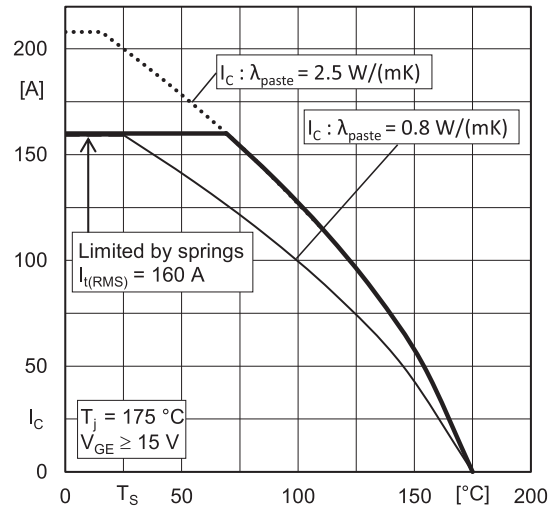


Fig. 2: Rated current vs. temperature $I_C = f(T_s)$

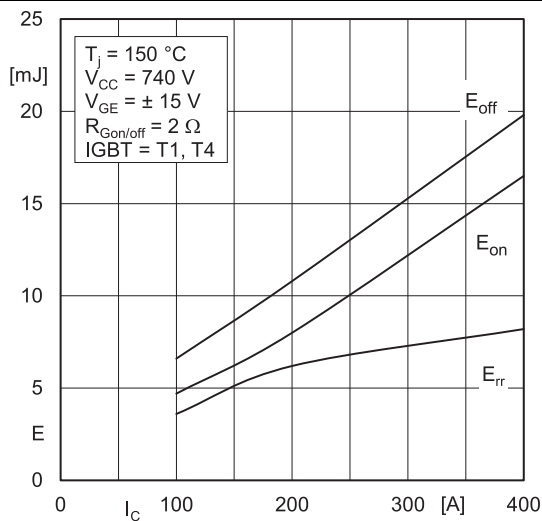


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(I_C)$

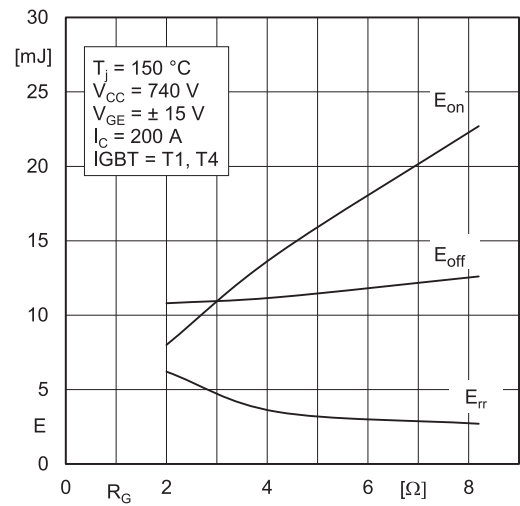


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(R_G)$

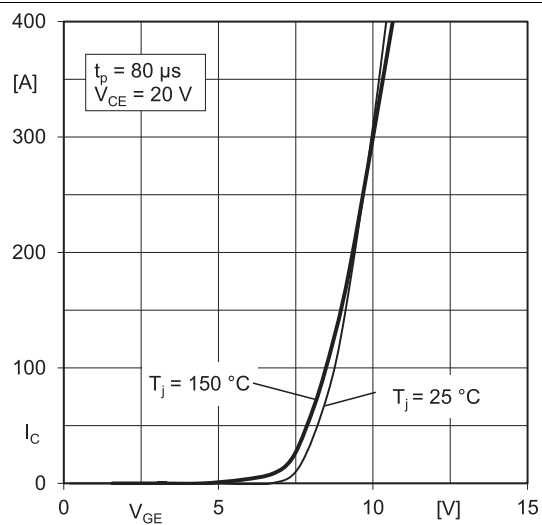


Fig. 5: Typ. IGBT1 transfer characteristic

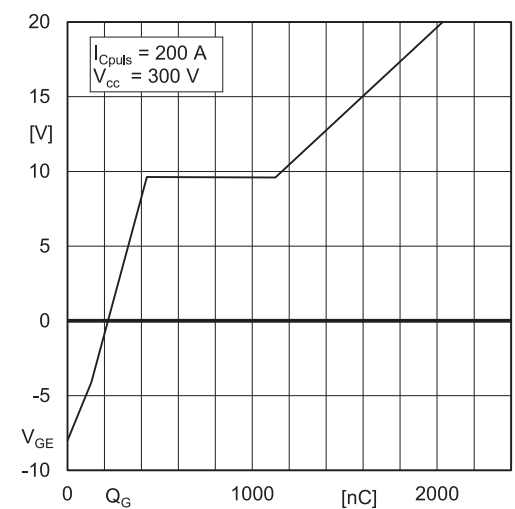


Fig. 6: Typ. IGBT1 gate charge characteristic

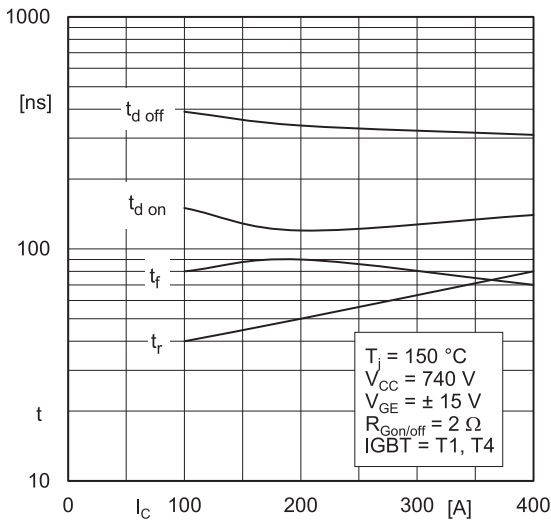


Fig. 7: Typ. IGBT1 switching times vs. I_C

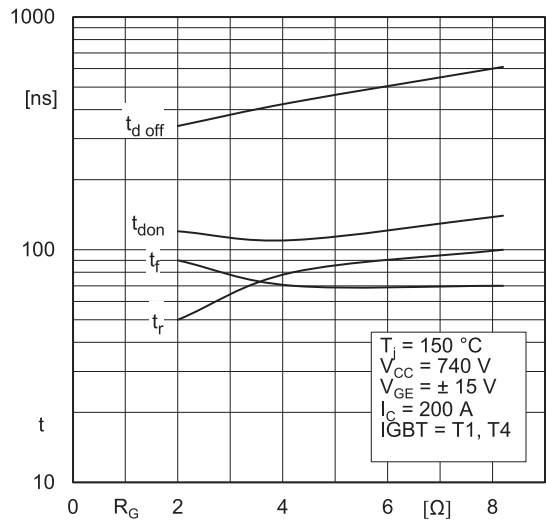


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

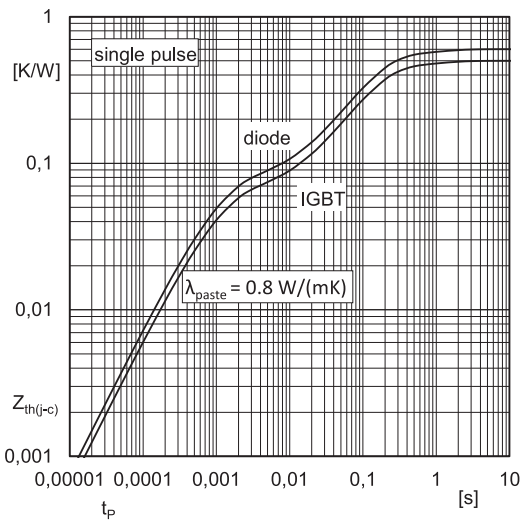


Fig. 9: Typ. transient thermal impedance of IGBT1 & Diode5

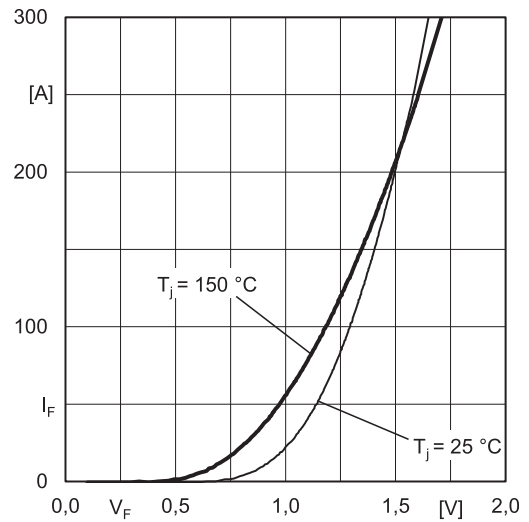


Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC'+EE'}$

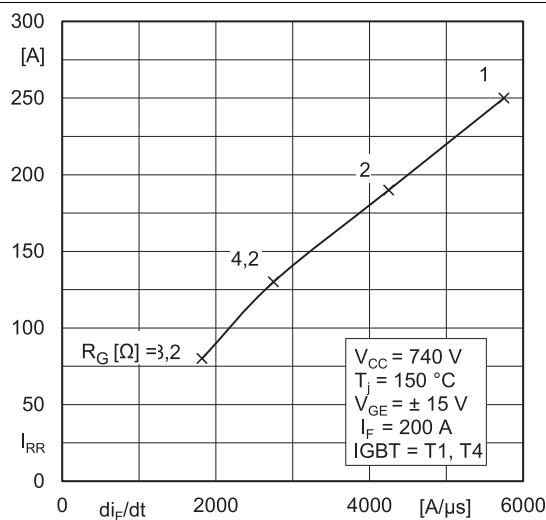


Fig. 11: Typ. Diode5 peak reverse recovery current

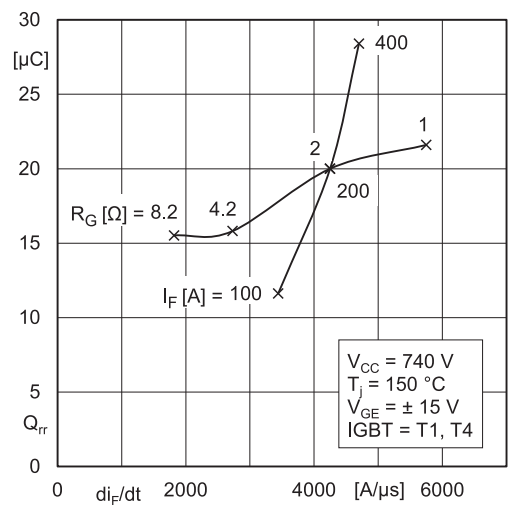
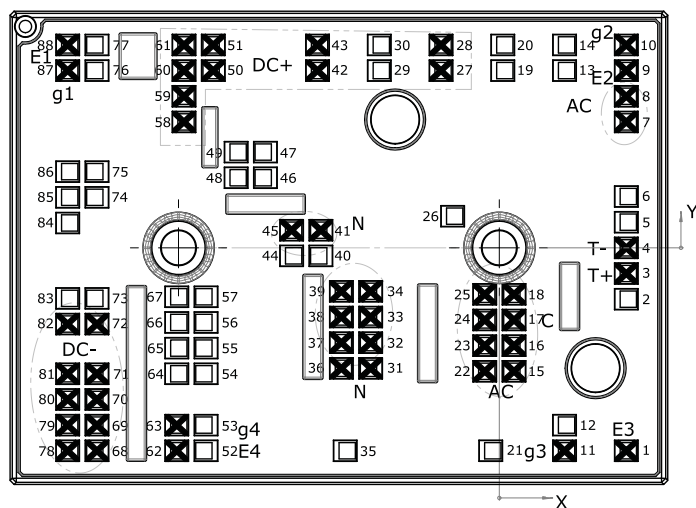


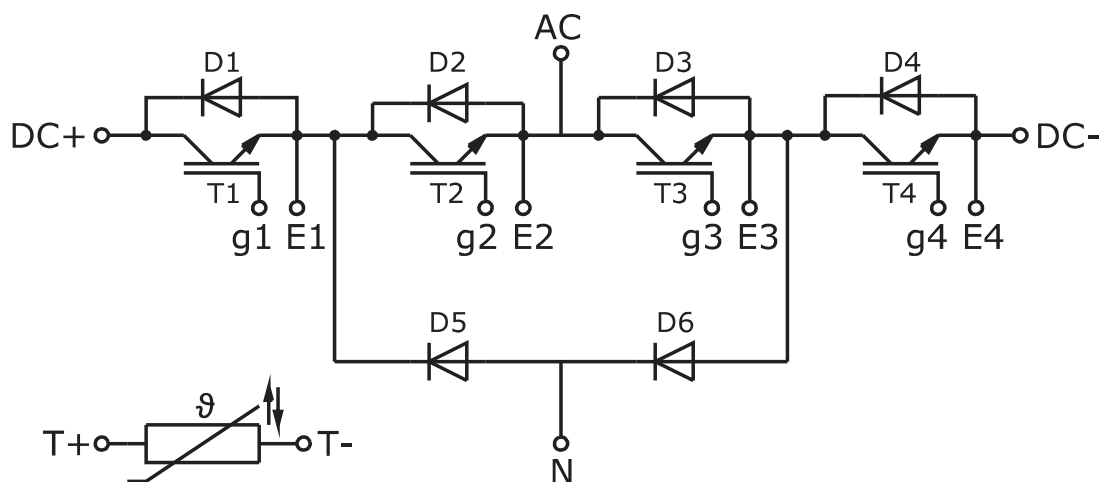
Fig. 12: Typ. Diode5 recovery charge

Pin out											
Pin	X	Y	Function	Pin	X	Y	Function	Pin	X	Y	Function
1	15,83	-25,30	E3	31	-16,05	-15,02	N	61	-39,33	25,30	DC+
2	15,83	-6,40		32	-16,05	-11,82	N	62	-40,23	-25,30	E4
3	15,83	-3,20	T+	33	-16,05	-8,62	N	63	-40,23	-22,10	g4
4	15,83	0	T-	34	-16,05	-5,42	N	64	-40,23	-15,70	
5	15,83	3,20		35	-19,23	-25,30		65	-40,23	-12,50	
6	15,83	6,40		36	-19,70	-15,02	N	66	-40,23	-9,30	
7	15,83	15,70	AC	37	-19,70	-11,82	N	67	-40,23	-6,10	
8	15,83	18,90	AC	38	-19,70	-8,62	N	68	-50,18	-25,30	DC-
9	15,83	22,10	E2	39	-19,70	-5,42	N	69	-50,18	-22,10	DC-
10	15,83	25,30	g2	40	-22,26	-1,00		70	-50,18	-18,90	DC-
11	8,13	-25,30	g3	41	-22,26	2,20	N	71	-50,18	-15,70	DC-
12	8,13	-22,10		42	-22,68	22,10	DC+	72	-50,18	-9,50	DC-
13	8,13	22,10		43	-22,68	25,30	DC+	73	-50,18	-6,30	
14	8,13	25,30		44	-25,91	-1,00		74	-50,18	6,30	
15	1,83	-15,39	AC	45	-25,91	2,20	N	75	-50,18	9,50	
16	1,83	-12,19	AC	46	-29,18	8,74		76	-50,18	22,10	
17	1,83	-8,99	AC	47	-29,18	11,94		77	-50,18	25,30	
18	1,83	-5,79	AC	48	-32,83	8,74		78	-53,83	-25,30	DC-
19	0,43	22,10		49	-32,83	11,94		79	-53,83	-22,10	DC-
20	0,43	25,30		50	-35,68	22,10	DC+	80	-53,83	-18,90	DC-
21	-1,08	-25,30		51	-35,68	25,30	DC+	81	-53,83	-15,70	DC-
22	-1,83	-15,39	AC	52	-36,58	-25,30		82	-53,83	-9,50	DC-
23	-1,83	-12,19	AC	53	-36,58	-22,10		83	-53,83	-6,30	
24	-1,83	-8,99	AC	54	-36,58	-15,70		84	-53,83	3,10	
25	-1,83	-5,79	AC	55	-36,58	-12,50		85	-53,83	6,30	
26	-5,83	3,95		56	-36,58	-9,30		86	-53,83	9,50	
27	-7,28	22,10	DC+	57	-36,58	-6,10		87	-53,83	22,10	g1
28	-7,28	25,30	DC+	58	-39,33	15,70	DC+	88	-53,83	25,30	E1
29	-14,98	22,10		59	-39,33	18,90	DC+				
30	-14,98	25,30		60	-39,33	22,10	DC+				

all values in mm



Pinout and Dimensions



Pinout

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

***IMPORTANT INFORMATION AND WARNINGS**

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