

SEMITOP®E2

3-Level NPC

SK100MLI07S5TD1E2

Features*

- Optimized design for superior thermal performance
- Low inductive design
- Press-Fit contact technology
- Split IGBT gates for optimized driving
- 650V Trench5 IGBT (S5)
- Rapid switching diode technology
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

Typical Applications

- UPS
- Energy Storage Systems
- Solar

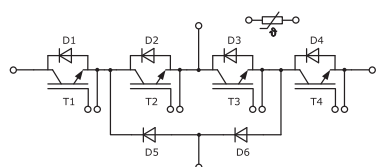
Remarks*

- Recommended $T_{j,op} = -40 \dots +150 \text{ °C}$
- IGBTs characteristics are valid for paralleled chips (split gates connected)
- 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

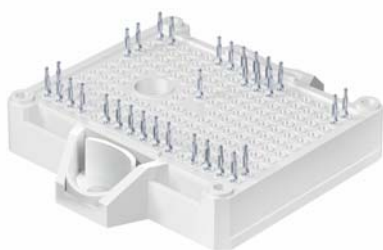
Footnotes

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	96	A
		T _s = 70 °C	76	A
I _C	λ _{paste} =2.5 W/(mK) T _J = 175 °C	T _s = 25 °C	113	A
		T _s = 70 °C	90	A
I _{Cnom}			100	A
I _{CRM}			200	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 360 V, V _{GE} ≤ 15 V, T _J = 150 °C, V _{CES} ≤ 650 V		not capable	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	96	A
		T _s = 70 °C	76	A
I _C	λ _{paste} =2.5 W/(mK) T _J = 175 °C	T _s = 25 °C	113	A
		T _s = 70 °C	90	A
I _{Cnom}			100	A
I _{CRM}			200	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 360 V, V _{GE} ≤ 15 V, T _J = 150 °C, V _{CES} ≤ 650 V		not capable	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	107	A
		T _s = 70 °C	82	A
I _F	λ _{paste} =2.5 W/(mK) T _J = 175 °C	T _s = 25 °C	127	A
		T _s = 70 °C	98	A
I _{FRM}			200	A
I _{FSM}	10 ms, sin 180°, T _J = 25 °C		630	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	107	A
		T _s = 70 °C	82	A
I _F	λ _{paste} =2.5 W/(mK) T _J = 175 °C	T _s = 25 °C	127	A
		T _s = 70 °C	98	A
I _{FRM}			200	A
I _{FSM}	10 ms, sin 180°, T _J = 25 °C		630	A
T _J			-40 ... 175	°C



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Absolute Maximum Ratings

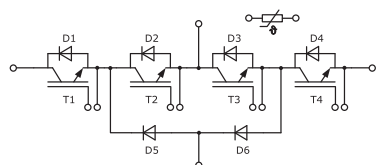
Symbol	Conditions	Values	Unit
Diode5			
V_{RRM}	$T_j = 25 \text{ °C}$	650	V
I_F	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 25 \text{ °C}$	A
	$T_j = 175 \text{ °C}$	$T_s = 70 \text{ °C}$	A
I_F	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 25 \text{ °C}$	A
	$T_j = 175 \text{ °C}$	$T_s = 70 \text{ °C}$	A
I_{FRM}		200	A
I_{FSM}	10 ms, sin 180°, $T_j = 25 \text{ °C}$	540	A
T_j		-40 ... 175	°C

Module

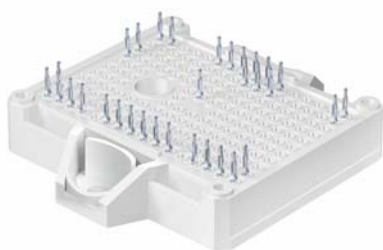
$I_{t(RMS)}$	$\Delta T_{terminal}$ at PCB joint = 30 K, per pin	30	A
T_{stg}	module without TIM	-40 ... 125	°C
V_{isol}	AC, sinusoidal, t = 1 min	2500	V

Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
IGBT1					
$V_{CE(sat)}$	$I_C = 100 \text{ A}$ $V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ °C}$	1.35	1.75	V
		$T_j = 150 \text{ °C}$	1.56	2.06	V
V_{CE0}	chipelevel	$T_j = 25 \text{ °C}$	0.92	1.02	V
		$T_j = 150 \text{ °C}$	0.82	0.97	V
r_{CE}	$V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ °C}$	4.3	7.3	mΩ
		$T_j = 150 \text{ °C}$	7.4	11	mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 1 \text{ mA}$	3.2	4	4.8	V
I_{CES}	$V_{GE} = 0 \text{ V}, V_{CE} = 650 \text{ V}, T_j = 25 \text{ °C}$			0.45	mA
C_{ies}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	6.2		nF
C_{oes}		$f = 1 \text{ MHz}$	0.176		nF
C_{res}		$f = 1 \text{ MHz}$	0.024		nF
Q_G	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		480		nC
R_{Gint}	$T_j = 25 \text{ °C}$		0		Ω
$t_{d(on)}$	$V_{CE} = 300 \text{ V}$ $I_C = 100 \text{ A}$	$T_j = 150 \text{ °C}$	27		ns
t_r	$V_{GE} = +15/-15 \text{ V}$ $R_{G on} = 1.5 \text{ Ω}$	$T_j = 150 \text{ °C}$	22		ns
E_{on}	$R_{G off} = 1.5 \text{ Ω}$	$T_j = 150 \text{ °C}$	0.36		mJ
$t_{d(off)}$	$di/dt_{on} = 4170 \text{ A/μs}$	$T_j = 150 \text{ °C}$	107		ns
	$di/dt_{off} = 2930 \text{ A/μs}$	$T_j = 150 \text{ °C}$	29		ns
t_f	$dv/dt = 7710 \text{ V/μs}$	$T_j = 150 \text{ °C}$			ns
E_{off}			1.63		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W/(mK)}$		0.74		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W/(mK)}$		0.57		K/W



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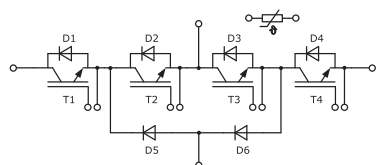
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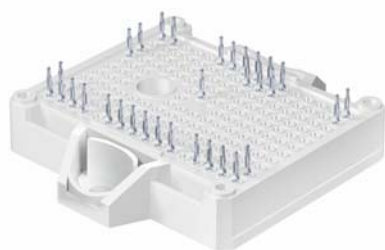
Footnotes

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT2						
V _{CE(sat)}	I _C = 100 A	T _j = 25 °C		1.35	1.75	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		1.56	2.06	V
V _{CE0}	chiplevel	T _j = 25 °C		0.92	1.02	V
		T _j = 150 °C		0.82	0.97	V
r _{CE}	V _{GE} = 15 V chiplevel	T _j = 25 °C		4.3	7.3	mΩ
		T _j = 150 °C		7.4	11	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 1 mA		3.2	4	4.8	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 650 V, T _j = 25 °C				0.45	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		6.2		nF
C _{oes}		f = 1 MHz		0.176		nF
C _{res}		f = 1 MHz		0.024		nF
Q _G	V _{GE} = -15V ... +15V			480		nC
R _{Gint}	T _j = 25 °C			0		Ω
t _{d(on)}	V _{CC} = 300 V	T _j = 150 °C		24		ns
	I _C = 100 A					
t _r	V _{GE} = +15/-15 V	T _j = 150 °C		17		ns
E _{on}	R _{G on} = 1 Ω	T _j = 150 °C		0.36		mJ
t _{d(off)}	R _{G off} = 1 Ω	T _j = 150 °C		103		ns
t _f	di/dt _{on} = 4330 A/μs	T _j = 150 °C		30		ns
E _{off}	di/dt _{off} = 2520 A/μs dv/dt = 7220 V/μs	T _j = 150 °C		1.77		mJ
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/(mK)			0.74		K/W
R _{th(j-s)}	per IGBT, λ _{paste} =2.5 W/(mK)			0.57		K/W
Diode1						
V _F = V _{EC}	I _F = 100 A	T _j = 25 °C		1.55	1.82	V
	chiplevel	T _j = 150 °C		1.45	1.75	V
V _{F0}	chiplevel	T _j = 25 °C		1.10	1.32	V
		T _j = 150 °C		0.95	1.14	V
r _F	chiplevel	T _j = 25 °C		4.5	5.0	mΩ
		T _j = 150 °C		5.0	6.1	mΩ
I _{RRM}	I _F = 100 A	T _j = 150 °C		107		A
Q _{rr}	di/dt _{off} = 4690 A/μs V _R = 300 V	T _j = 150 °C		6.75		μC
E _{rr}	V _{GE} = +15/-15 V	T _j = 150 °C		1.77		mJ
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			0.79		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			0.62		K/W
Diode2						
V _F = V _{EC}	I _F = 100 A	T _j = 25 °C		1.55	1.82	V
	chiplevel	T _j = 150 °C		1.45	1.75	V
V _{F0}	chiplevel	T _j = 25 °C		1.10	1.32	V
		T _j = 150 °C		0.95	1.14	V
r _F	chiplevel	T _j = 25 °C		4.5	5.0	mΩ
		T _j = 150 °C		5.0	6.1	mΩ
I _{RRM}		T _j = 150 °C		-		A
Q _{rr}		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)			0.79		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			0.62		K/W



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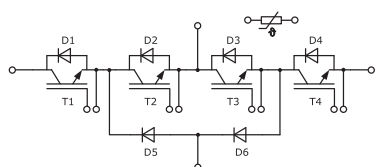
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- Diode5: clamping Diodes D5 & D6

Footnotes

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode5						
V _F = V _{EC}	I _F = 100 A	T _j = 25 °C		1.35	1.92	V
	chipelevel	T _j = 150 °C		1.30	1.89	V
V _{F0}	chipelevel	T _j = 25 °C		0.90	1.10	V
		T _j = 150 °C		0.71	0.94	V
r _F	chipelevel	T _j = 25 °C		4.5	8.2	mΩ
		T _j = 150 °C		5.8	9.5	mΩ
I _{RRM}	I _F = 100 A	T _j = 150 °C		115		A
Q _{rr}	di/dt _{off} = 4210 A/μs V _R = 300 V	T _j = 150 °C		6.45		μC
E _{rr}	V _{GE} = +15/-15 V	T _j = 150 °C		1.79		mJ
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			0.83		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			0.65		K/W
Module						
L _{sCE1}				10		nH
L _{sCE2}				12		nH
R _{CC'+EE'}		T _s = 25 °C		-		mΩ
		T _s = 150 °C		-		mΩ
M _s	to heatsink		1.6		2.3	Nm
M _t				-		Nm
				-		Nm
w				35		g
Temperature Sensor						
R ₂₅	T _r =25°C			22 ±1%		kΩ
B _{25/100}	R(T)=R ₂₅ exp[B _{25/100} (1/T-1/T ₂₅)]; T[K]			4000 ±1%		K



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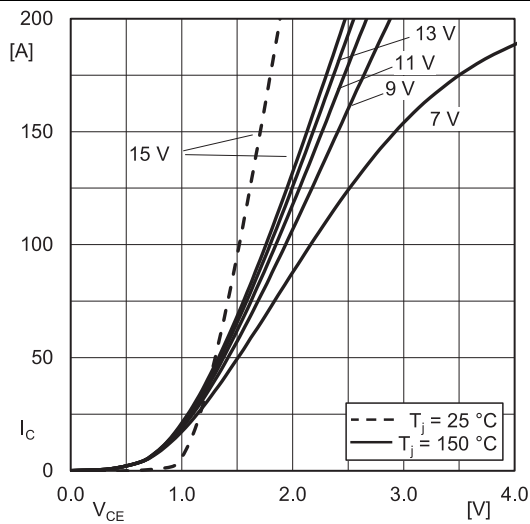


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

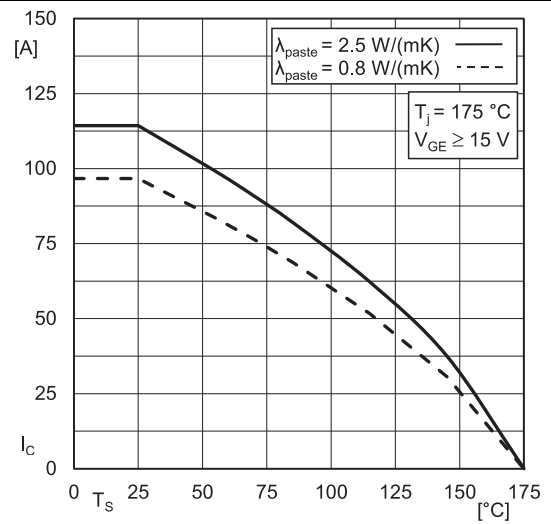


Fig. 2: IGBT1 rated current vs. Temperature $I_C=f(T_s)$

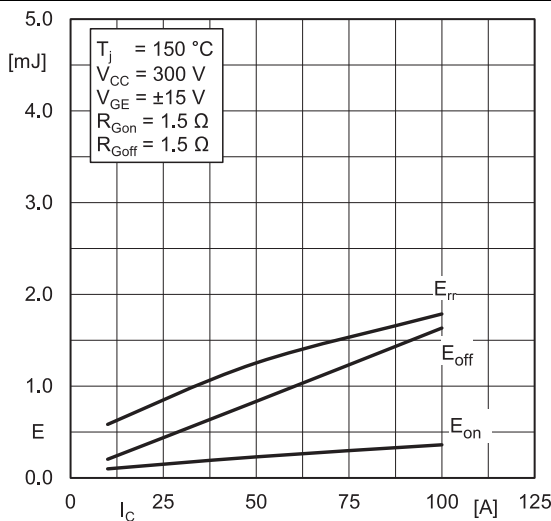


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(I_C)$

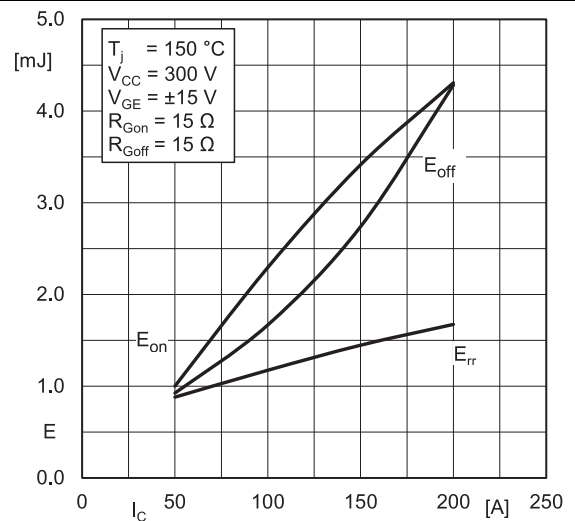


Fig. 3a: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(I_C)$

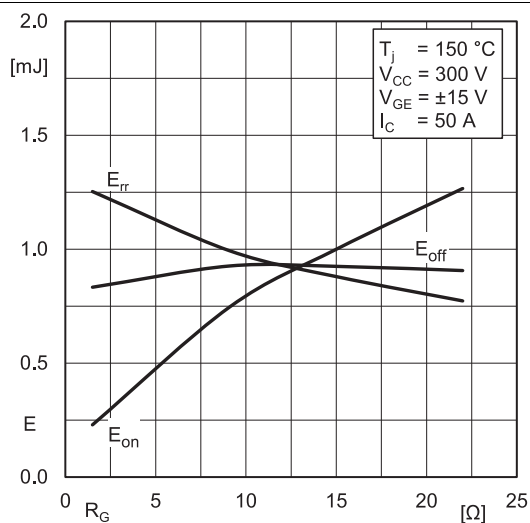


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(R_G)$

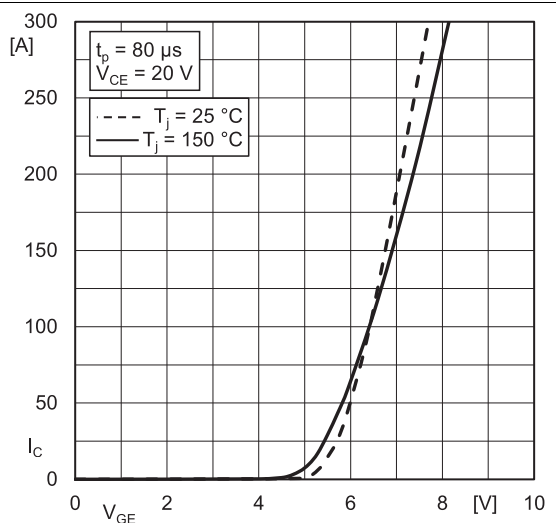


Fig. 5: Typ. IGBT1 transfer characteristic

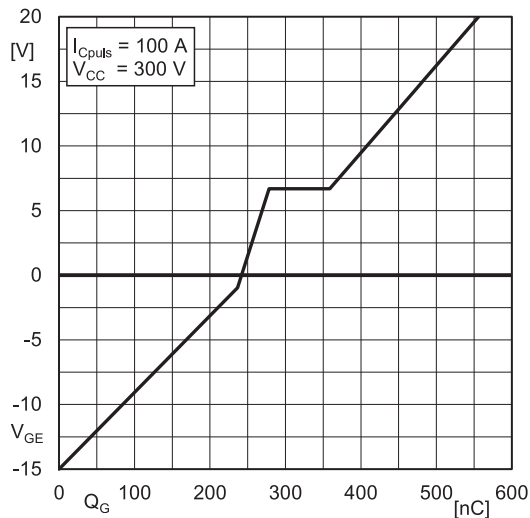


Fig. 6: Typ. IGBT1 gate charge characteristic

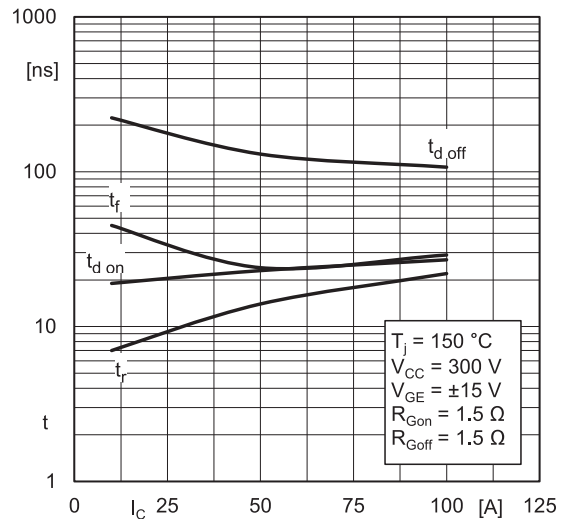


Fig. 7: Typ. IGBT1 switching times vs. I_C

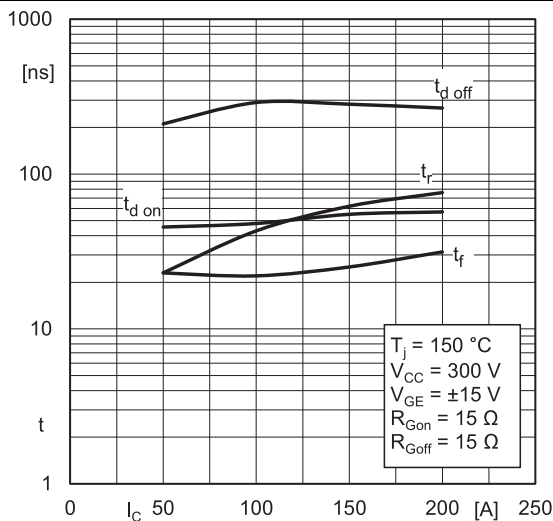


Fig. 7a: Typ. IGBT1 switching times vs. I_C

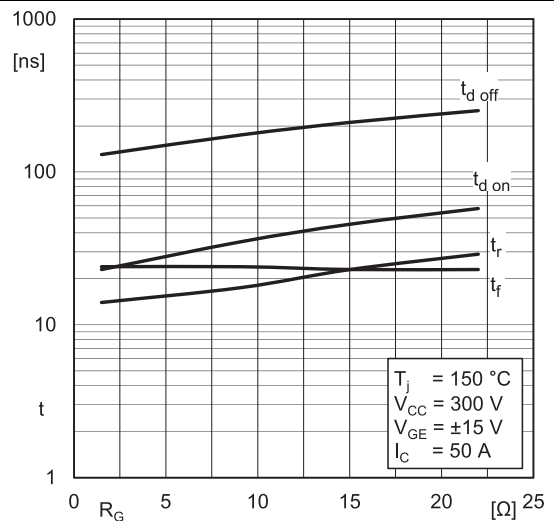


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

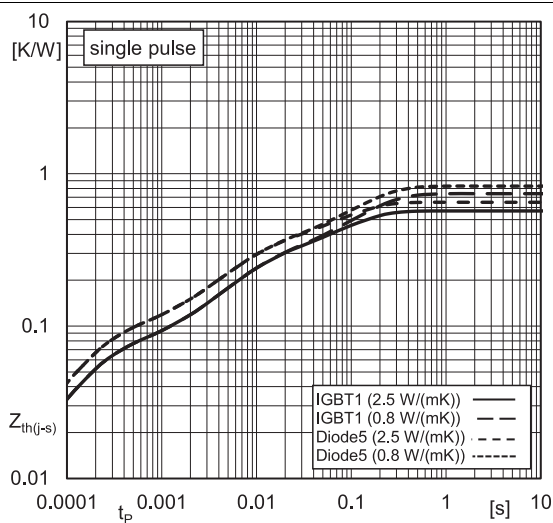


Fig. 9: Typ. transient thermal impedance

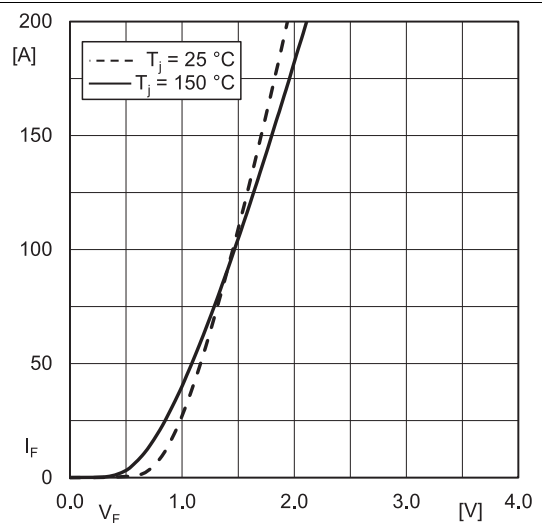


Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC'+EE'}$

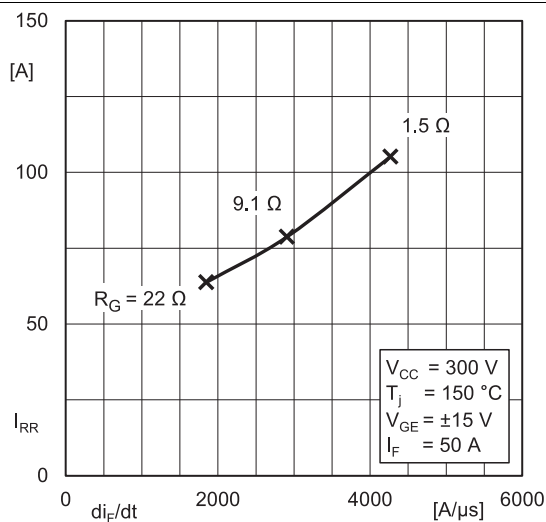


Fig. 11: Typ. Diode5 peak reverse recovery current

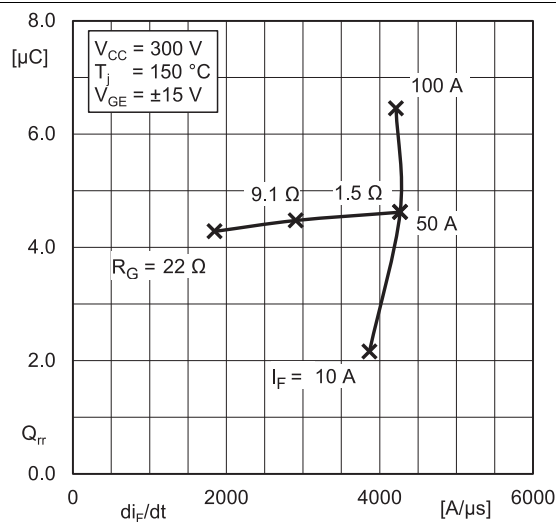


Fig. 12: Typ. Diode5 reverse recovery charge

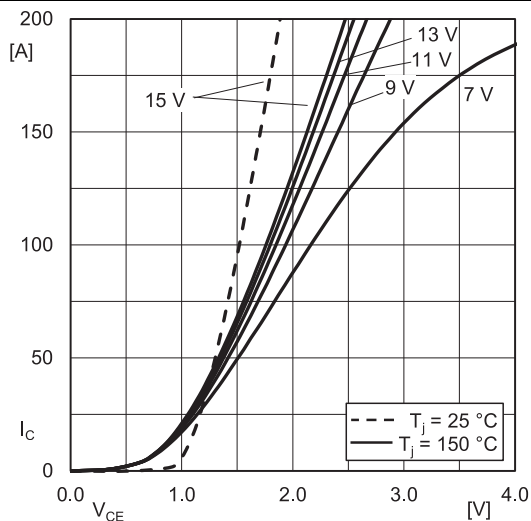


Fig. 13: Typ. IGBT2 output characteristic, incl. $R_{CC'}+EE'$

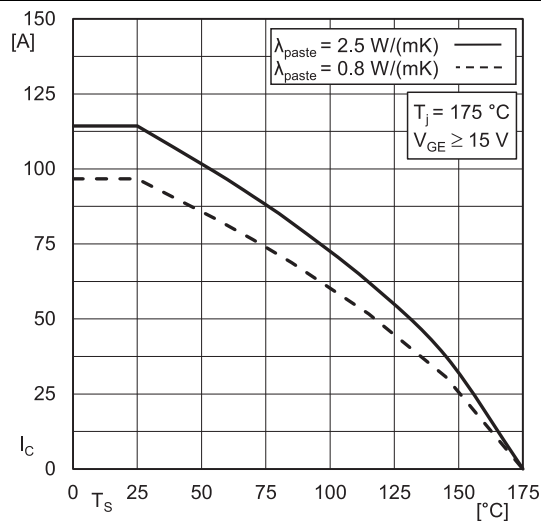


Fig. 14: IGBT2 Rated current vs. Temperature $I_C = f(T_s)$

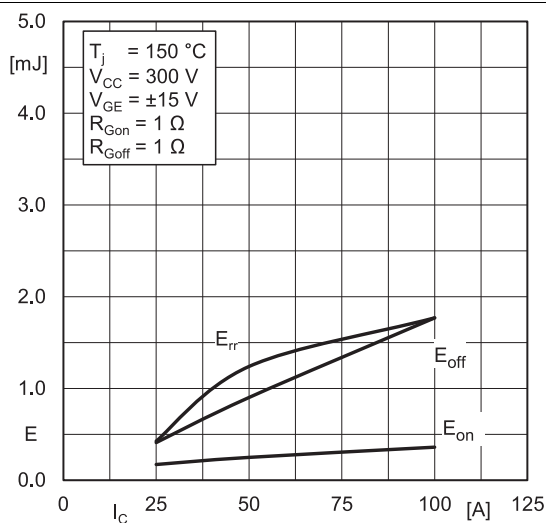


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(I_C)$

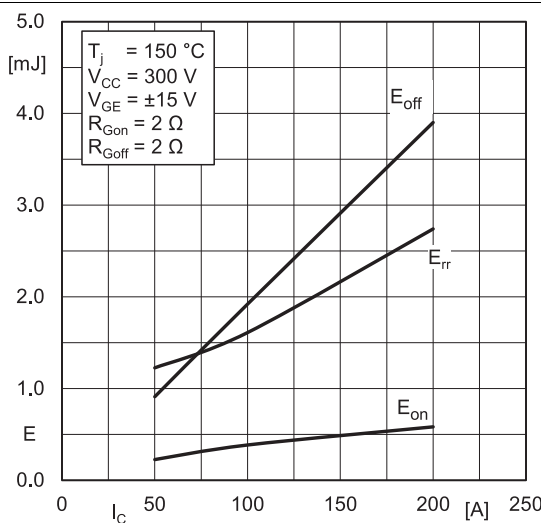


Fig. 15a: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(I_C)$

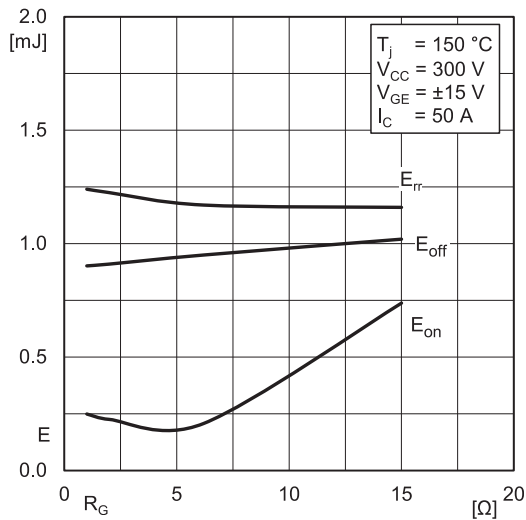


Fig. 16: Typ. IGBT2 & Diode1 turn-on / -off energy = $f(R_G)$

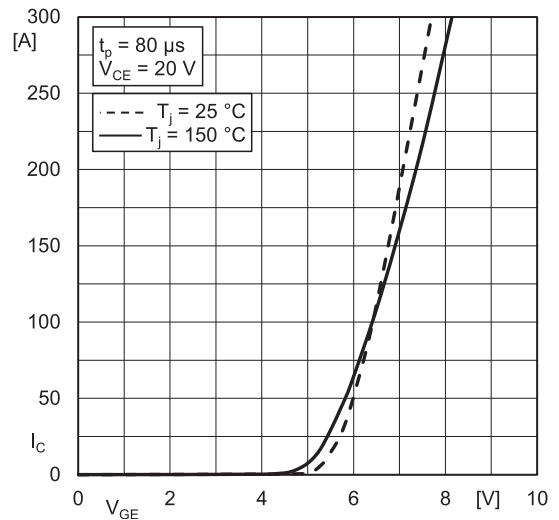


Fig. 17: Typ. IGBT2 transfer characteristic

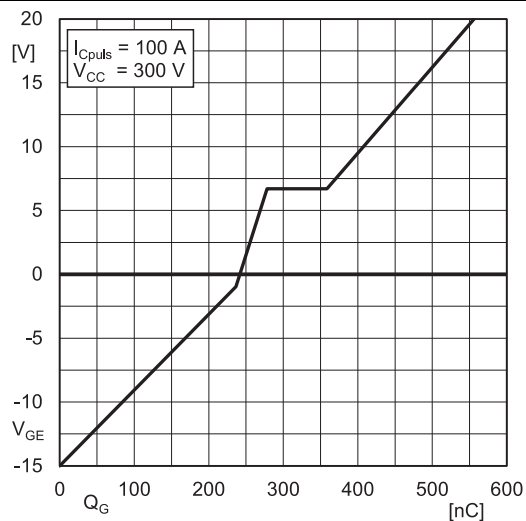


Fig. 18: Typ. IGBT2 gate charge characteristic

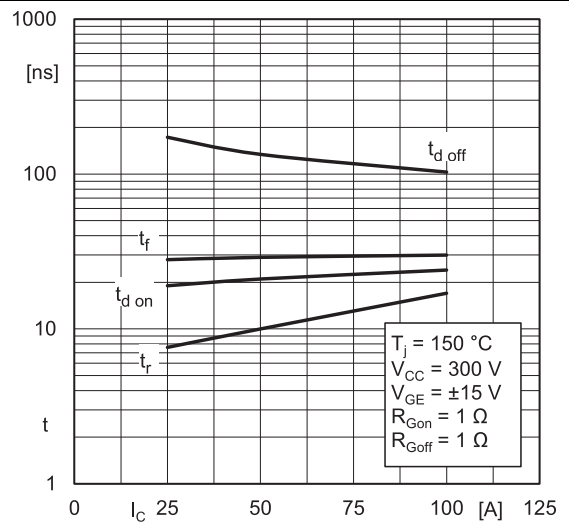


Fig. 19: Typ. IGBT2 switching times vs. I_C

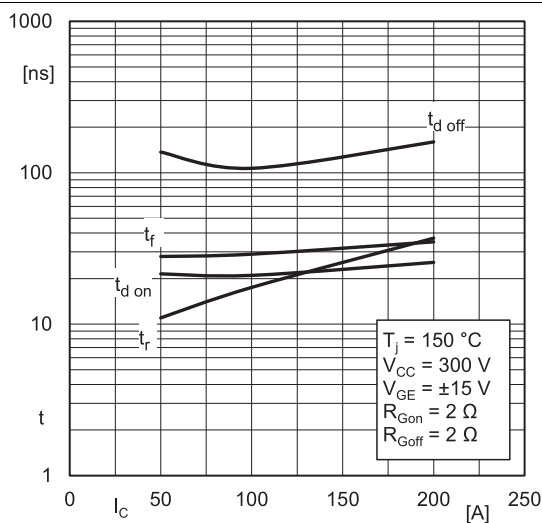


Fig. 19a: Typ. IGBT2 switching times vs. I_C

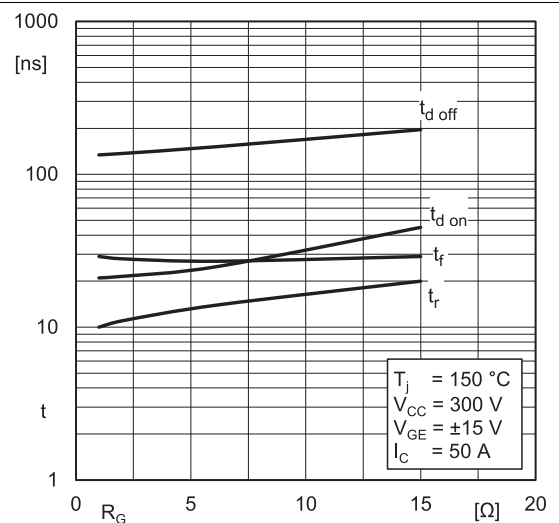


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

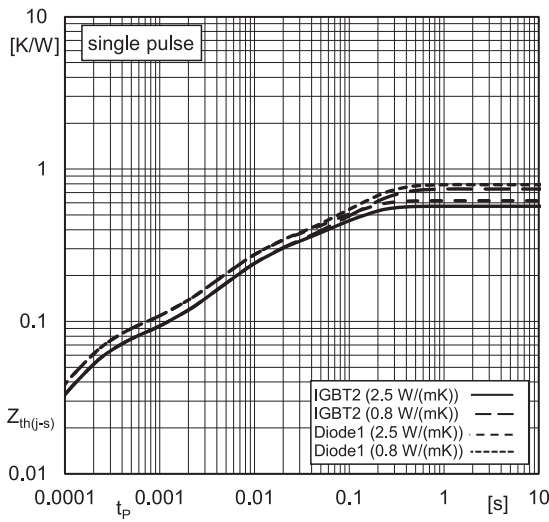


Fig. 21: Typ. transient thermal impedance

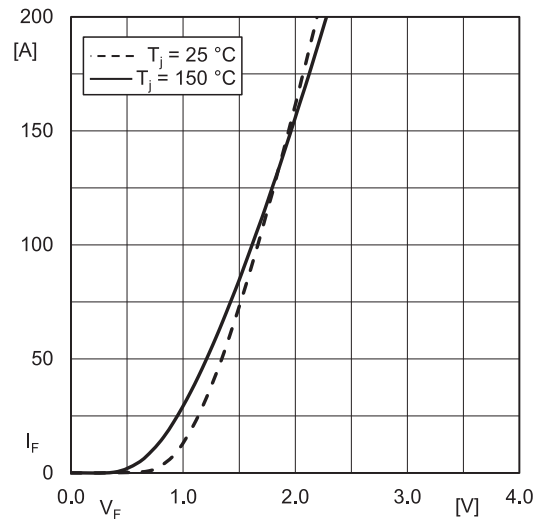


Fig. 22: Typ. Diode1 & Diode2 forward characteristic, incl. $R_{CC'+EE'}$

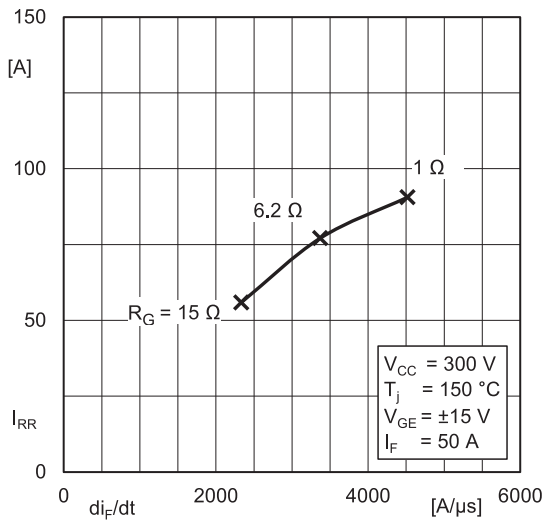


Fig. 23: Typ. Diode1 peak reverse recovery current

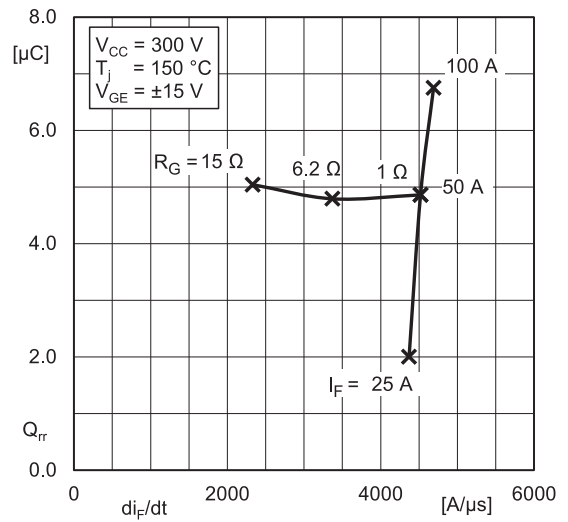
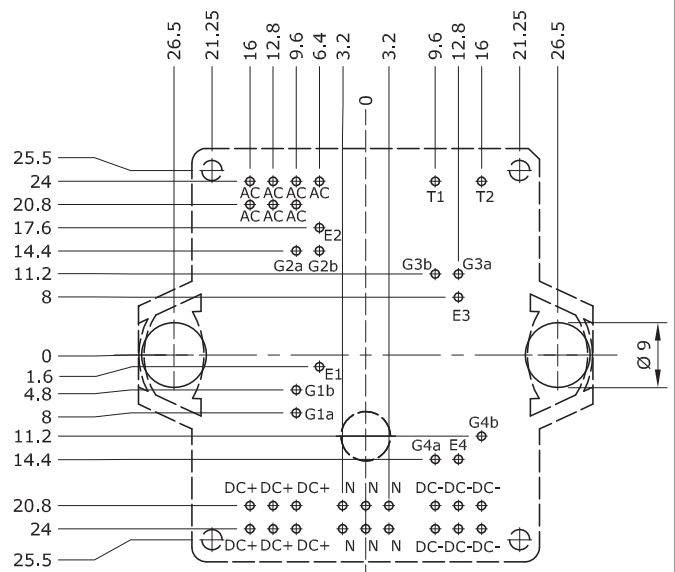
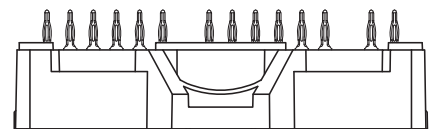
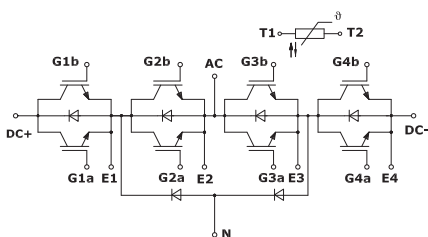


Fig. 24: Typ. Diode1 reverse recovery charge



- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern 
- Diameters of drill $\varnothing$ 1.15mm
- Copper thickness in hole 25 - 50 μ m
- Hole specification for contacts:
refer to SEMITOP E1/E2 Mounting Instruction



MLI-T

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

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