

SEMITOP®E2

3-Level NPC

SK150MLI07S5TD1E2

Features*

- Optimized design for superior thermal performance
- Low inductive design
- Press-Fit contact technology
- Split IGBT gates for optimized driving
- 650V Trench5 IGBT (S5/L5)
- Rapid switching diode technology
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

Typical Applications

- UPS
- Solar

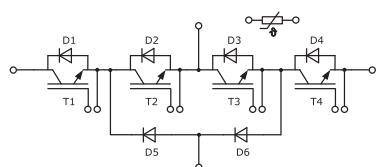
Remarks*

- Recommended $T_{j,op} = -40 \dots +150 \text{ }^{\circ}\text{C}$
- 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

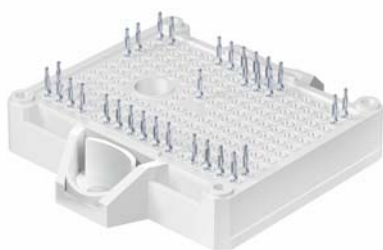
Footnotes

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 _s = 25 °C	127	A
	T _j = 175 °C	T _s = 70 °C	99	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	157	A
	T _j = 175 °C	T _s = 70 °C	124	A
I _{Cnom}			150	A
I _{CRM}			300	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 _s = 25 °C	189	A
	T _j = 175 °C	T _s = 70 °C	147	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	240	A
	T _j = 175 °C	T _s = 70 °C	189	A
I _{Cnom}			150	A
I _{CRM}			300	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 _s = 25 °C	107	A
	T _j = 175 °C	T _s = 70 °C	82	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	127	A
	T _j = 175 °C	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 _s = 25 °C	107	A
	T _j = 175 °C	T _s = 70 °C	82	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	127	A
	T _j = 175 °C	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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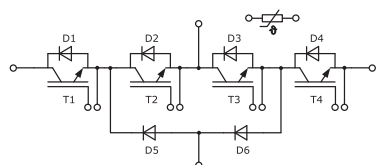
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Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
Diode5				
V _{RRM}	T _j = 25 °C		650	V
I _F	λ _{paste} =0.8 W/(mK)	T _s = 25 °C	126	A
	T _j = 175 °C	T _s = 70 °C	99	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	153	A
	T _j = 175 °C	T _s = 70 °C	120	A
I _{FRM}			300	A
I _{FSM}	10 ms, sin 180°, T _j = 25 °C		810	A
T _j			-40 ... 175	°C
Module				
I _{t(RMS)}	ΔT _{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

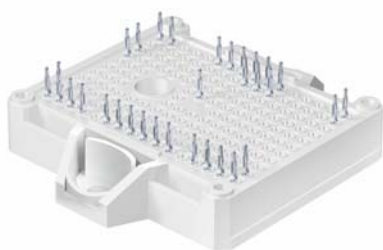
Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
IGBT1					
$V_{CE(sat)}$	$I_C = 150 \text{ A}$ $V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ °C}$	1.42	1.75	V
		$T_j = 150 \text{ °C}$	1.61	2.06	V
V_{CE0}	chipelevel	$T_j = 25 \text{ °C}$	0.95	1.05	V
		$T_j = 150 \text{ °C}$	0.85	1.00	V
r_{CE}	$V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ °C}$	3.1	4.7	mΩ
		$T_j = 150 \text{ °C}$	5.1	7.1	mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 1.5 \text{ mA}$	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}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	9		nF
C_{oes}		$f = 1 \text{ MHz}$	0.26		nF
C_{res}		$f = 1 \text{ MHz}$	0.034		nF
Q_G	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		720		nC
R_{Gint}	$T_j = 25 \text{ °C}$		0		Ω
$t_{d(on)}$	$V_{CE} = 300 \text{ V}$ $I_C = 150 \text{ A}$	$T_j = 150 \text{ °C}$	27		ns
t_r	$V_{GE} = +15/-15 \text{ V}$ $R_{G on} = 1 \text{ Ω}$	$T_j = 150 \text{ °C}$	22		ns
E_{on}	$R_{G off} = 1 \text{ Ω}$	$T_j = 150 \text{ °C}$	0.54		mJ
$t_{d(off)}$	$di/dt_{on} = 6250 \text{ A/μs}$ $di/dt_{off} = 4400 \text{ A/μs}$	$T_j = 150 \text{ °C}$	107		ns
t_f	$dv/dt = 7710 \text{ V/μs}$	$T_j = 150 \text{ °C}$	29		ns
E_{off}		$T_j = 150 \text{ °C}$	2.45		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 0.8 \text{ W/(mK)}$		0.61		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 2.5 \text{ W/(mK)}$		0.44		K/W



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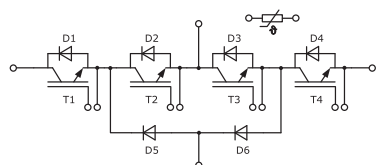
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Symbol	Conditions		min.	typ.	max.	Unit	
IGBT2							
V _{CE(sat)}	I _C = 150 A	T _j = 25 °C		1.10	1.45	V	
	V _{GE} = 15 V chiplevel	T _j = 150 °C		1.12	1.38	V	
V _{CE0}	chiplevel	T _j = 25 °C		0.78	0.98	V	
		T _j = 150 °C		0.65	0.85	V	
r _{CE}	V _{GE} = 15 V chiplevel	T _j = 25 °C		2.1	3.1	mΩ	
		T _j = 150 °C		3.1	3.5	mΩ	
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 2 mA		4.2	5	5.8	V	
I _{CES}	V _{GE} = 0 V, V _{CE} = 650 V, T _j = 25 °C				0.6	mA	
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		24.2		nF	
C _{oes}		f = 1 MHz		0.3		nF	
C _{res}		f = 1 MHz		0.084		nF	
Q _G	V _{GE} = -15V ... +15V			2000		nC	
R _{Gint}	T _j = 25 °C			0		Ω	
t _{d(on)}	V _{CC} = 300 V	T _j = 150 °C		23		ns	
t _r	I _C = 150 A	T _j = 150 °C		25		ns	
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		0.08		mJ	
t _{d(off)}	R _{G on} = 1 Ω	T _j = 150 °C		222		ns	
t _f	R _{G off} = 1 Ω	T _j = 150 °C		110		ns	
E _{off}	di/dt _{on} = 6020 A/μs di/dt _{off} = 1210 A/μs dv/dt = 2870 V/μs	T _j = 150 °C		9.59		mJ	
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/(mK)			0.53		K/W	
R _{th(j-s)}	per IGBT, λ _{paste} =2.5 W/(mK)			0.37		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 = 150 A	T _j = 150 °C		111		A	
Q _{rr}	di/dt _{off} = 6000 A/μs V _R = 300 V	T _j = 150 °C		9.6		μC	
E _{rr}	V _{GE} = +15/-15 V	T _j = 150 °C		1.55		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}				-		A	
Q _{rr}					-		μC
E _{rr} ¹⁾		V _{GE} = +15/-15 V			-		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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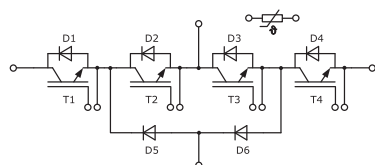
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode5						
V _F = V _{EC}	I _F = 150 A	T _j = 25 °C		1.35	1.92	V
	chiplevel	T _j = 150 °C		1.30	1.89	V
V _{F0}	chiplevel	T _j = 25 °C		0.90	1.10	V
		T _j = 150 °C		0.71	0.94	V
r _F	chiplevel	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		172		A
Q _{rr}	di/dt _{off} = 6320 A/μs V _R = 300 V	T _j = 150 °C		9.68		μC
E _{rr}	V _{GE} = +15/-15 V	T _j = 150 °C		2.68		mJ
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/(mK)			0.69		K/W
R _{th(j-s)}	per Diode, λ _{paste} =2.5 W/(mK)			0.52		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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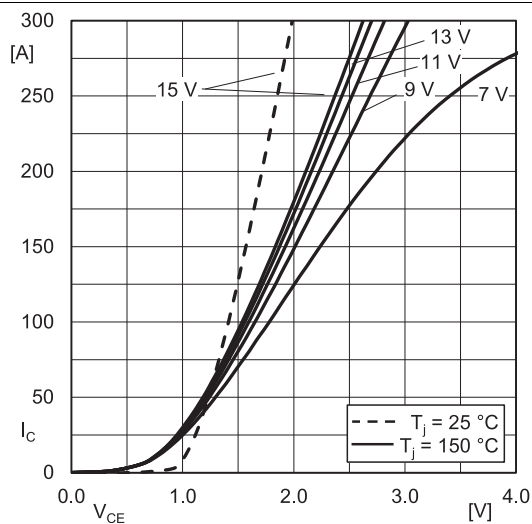


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

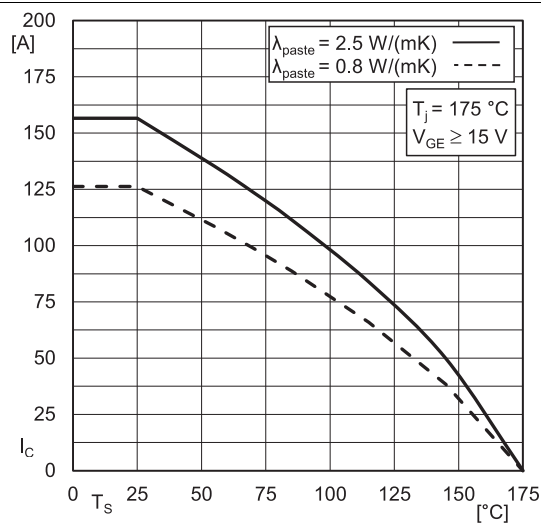


Fig. 2: IGBT1 rated current vs. Temperature $I_C=f(T_s)$

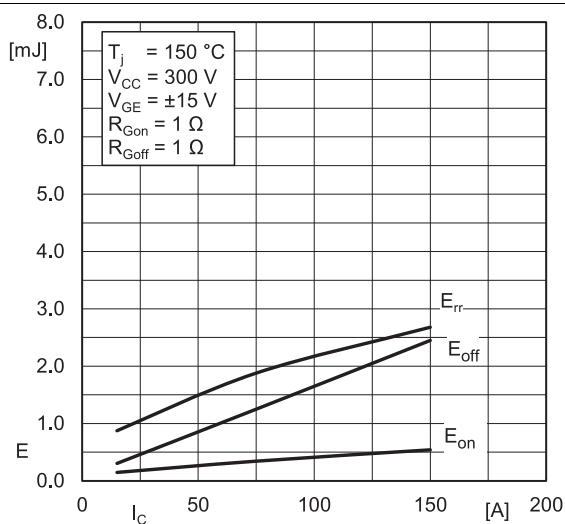


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(I_C)$

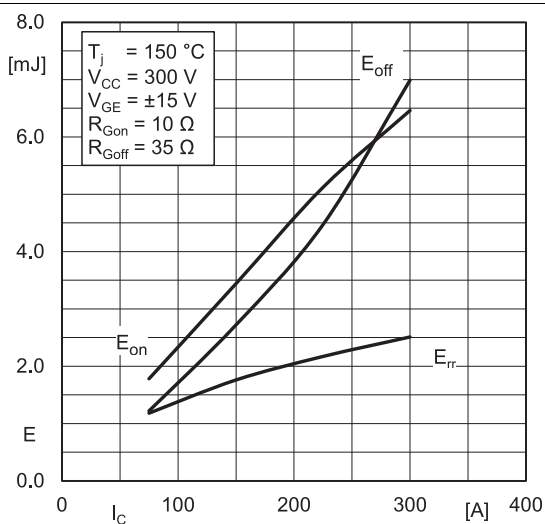


Fig. 3a: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(I_C)$

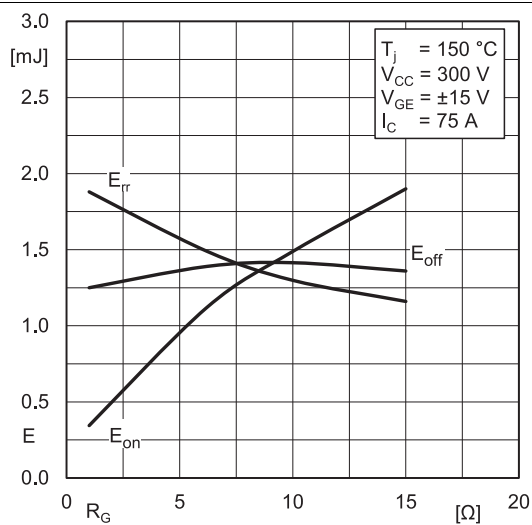


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = $f(R_G)$

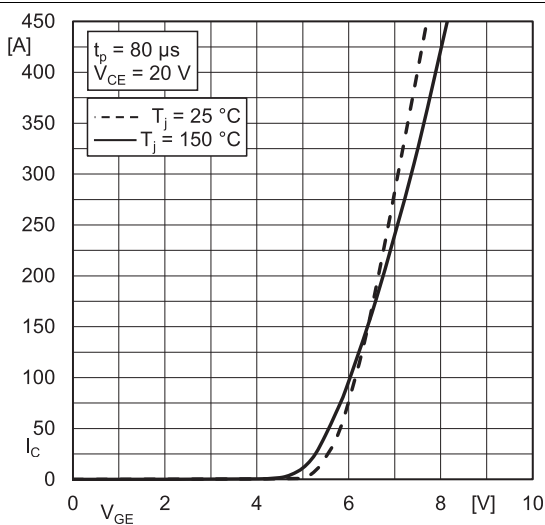


Fig. 5: Typ. IGBT1 transfer characteristic

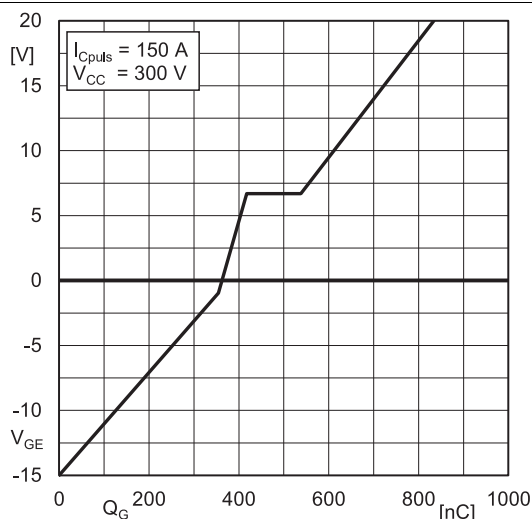


Fig. 6: Typ. IGBT1 gate charge characteristic

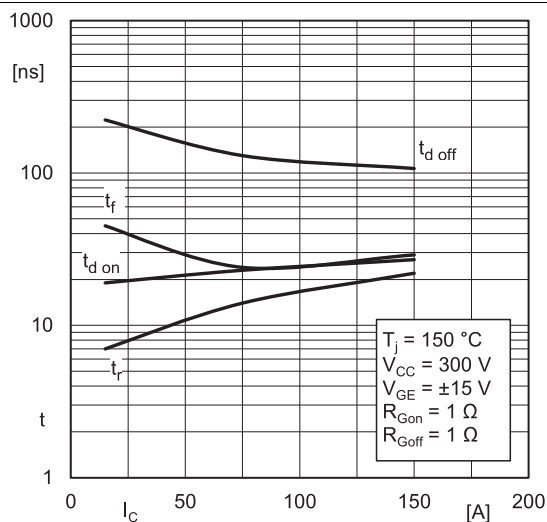


Fig. 7: Typ. IGBT1 switching times vs. I_C

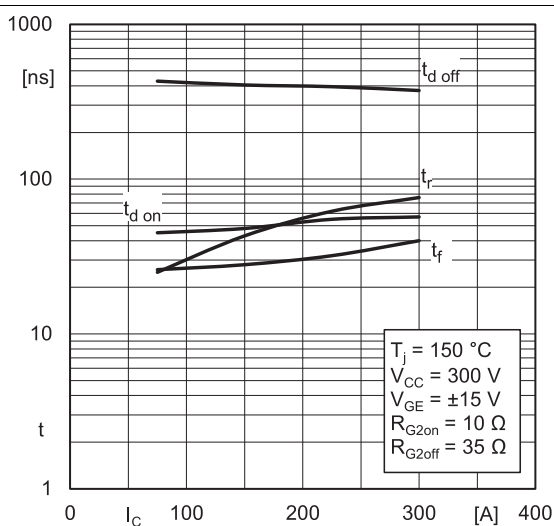


Fig. 7a: Typ. IGBT1 switching times vs. I_C

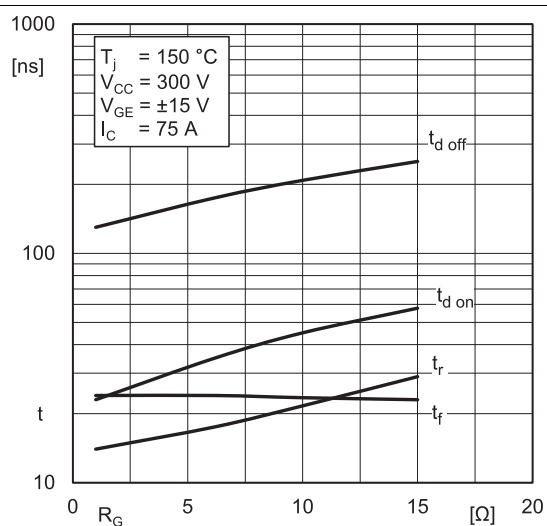


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

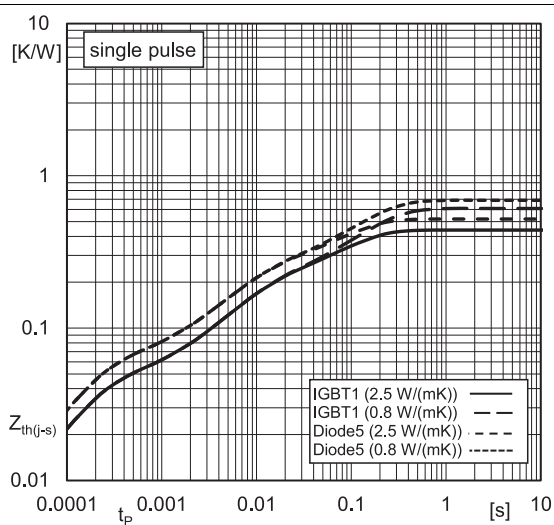


Fig. 9: Typ. transient thermal impedance

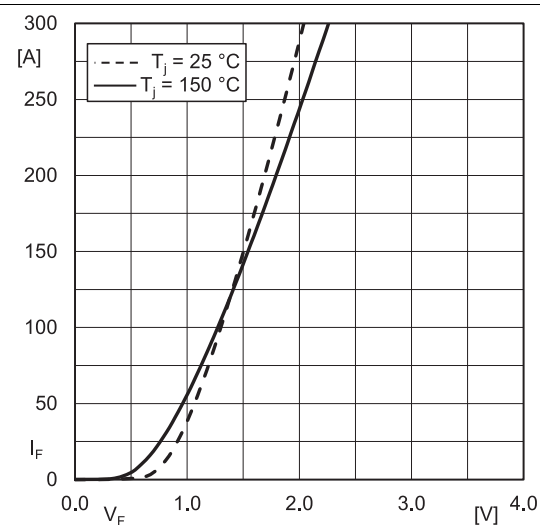
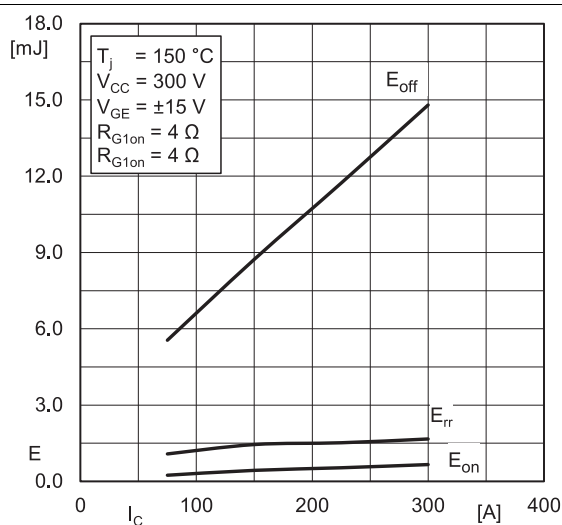
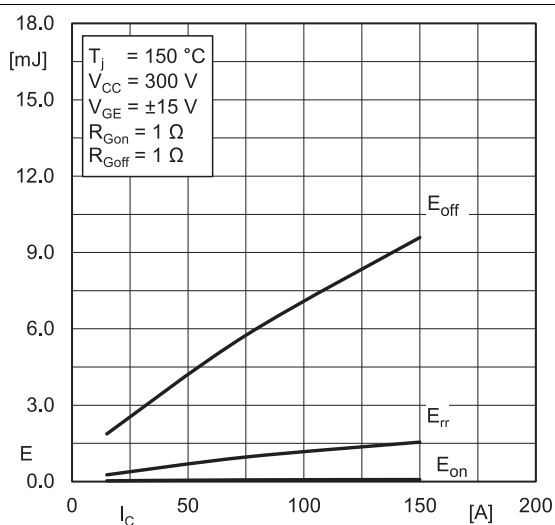
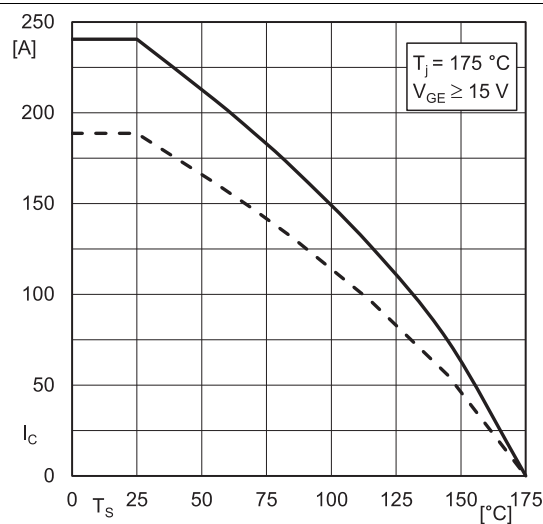
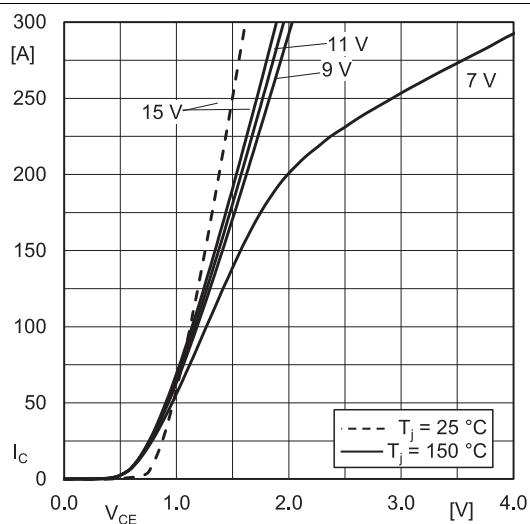
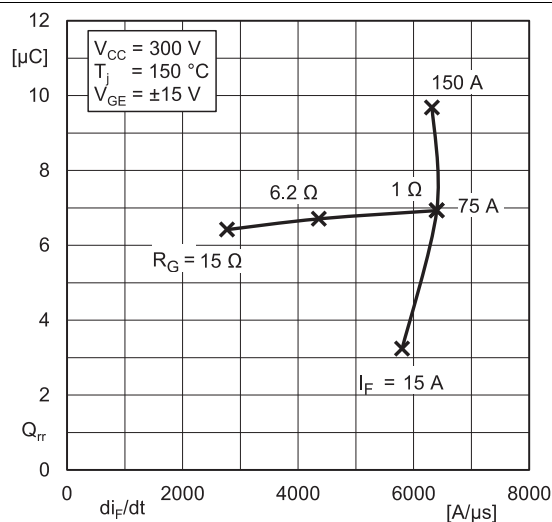
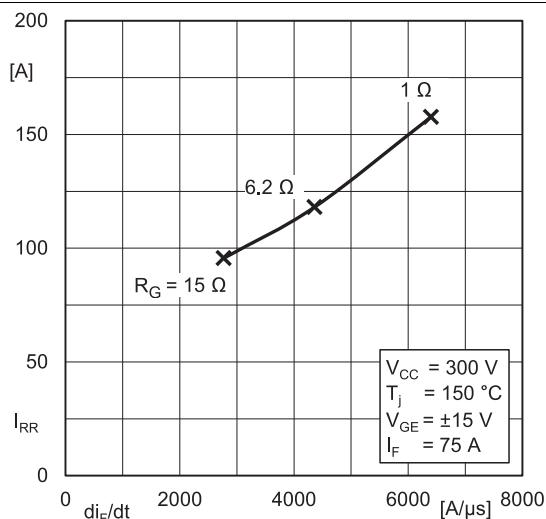
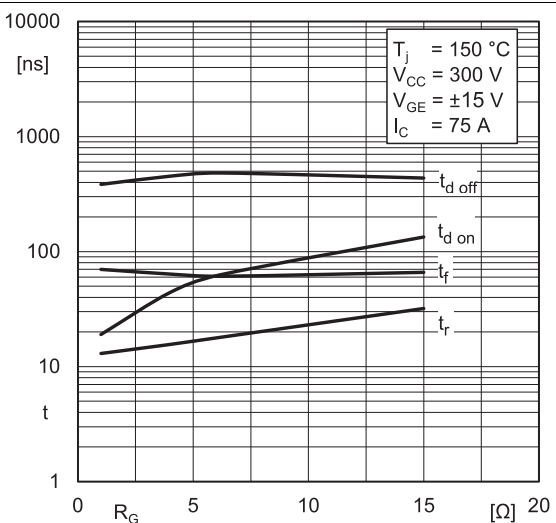
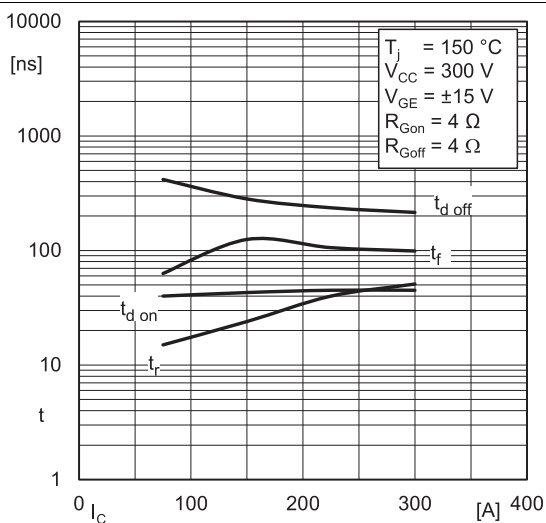
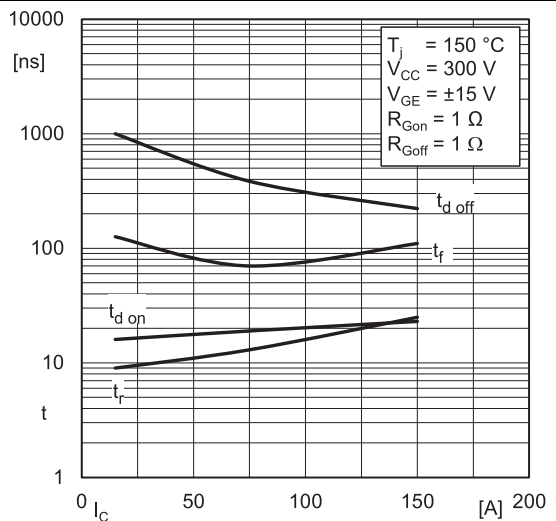
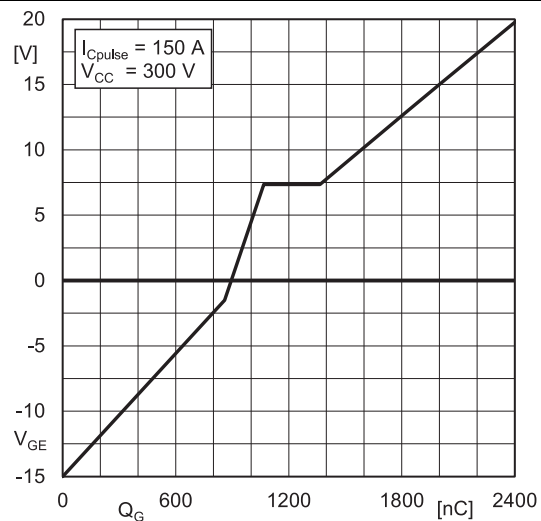
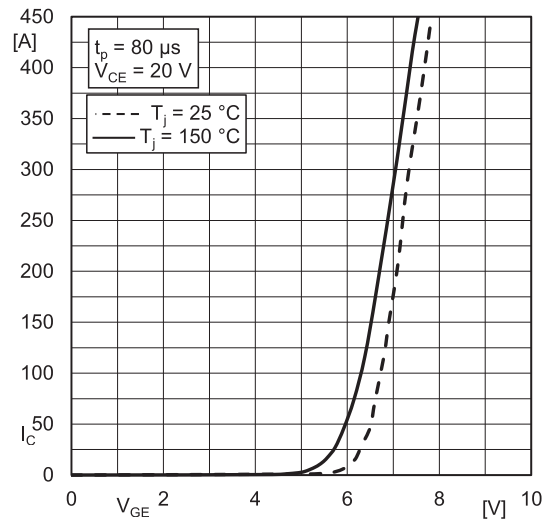
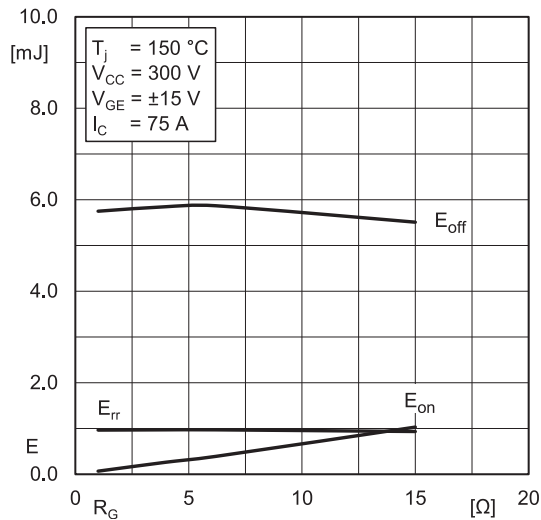


Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC'+EE'}$





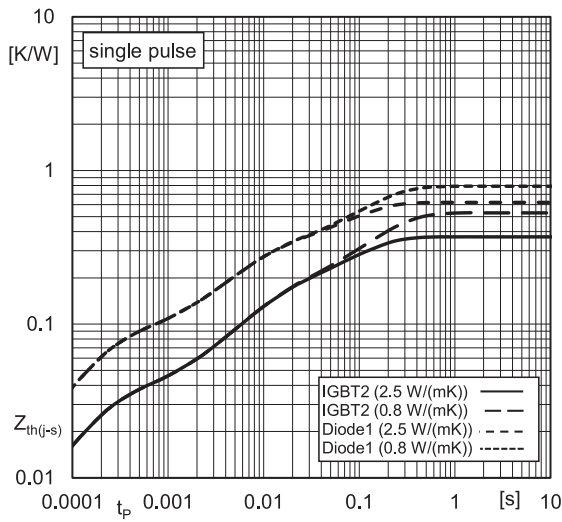


Fig. 21: Typ. transient thermal impedance

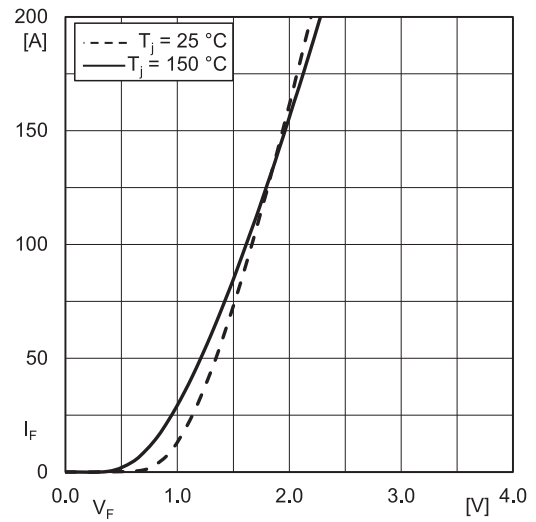


Fig. 22: Typ. Diode1 & Diode2 forward characteristic, incl. $R_{CC'+EE'}$

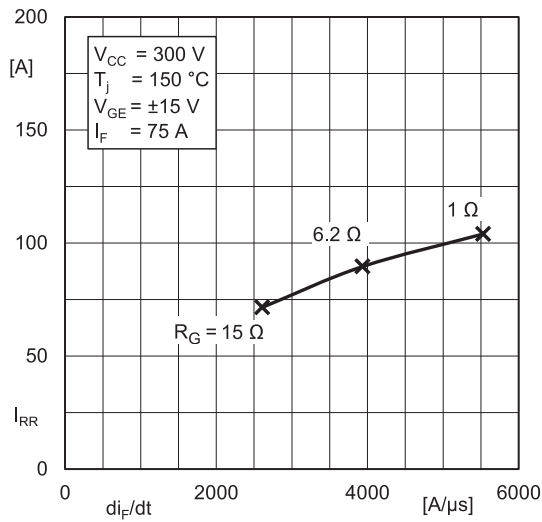


Fig. 23: Typ. Diode1 peak reverse recovery current

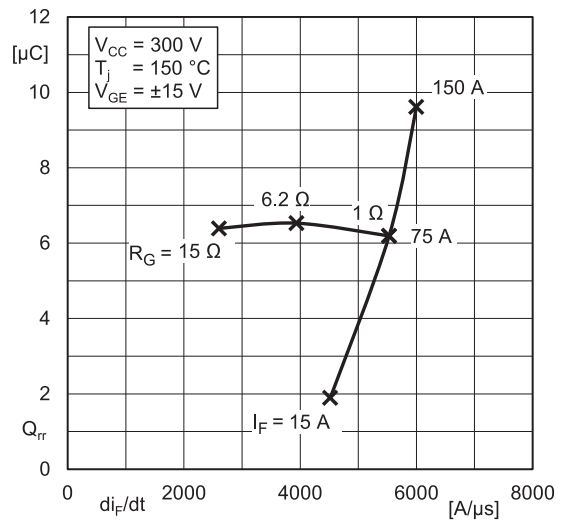
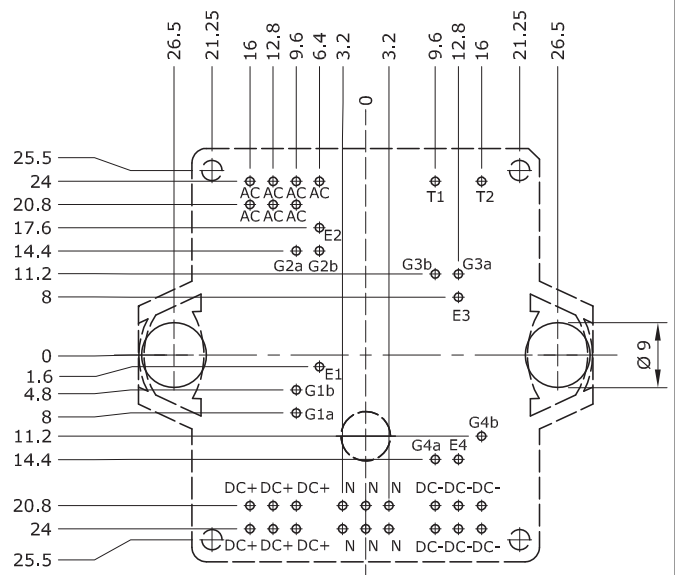
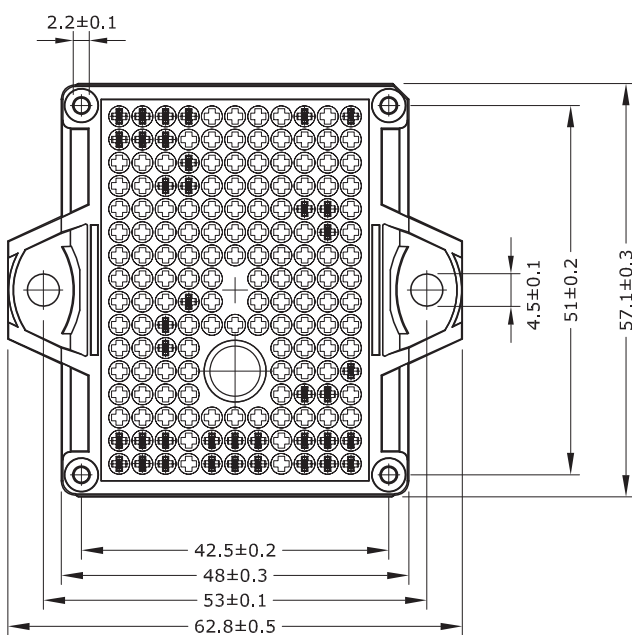
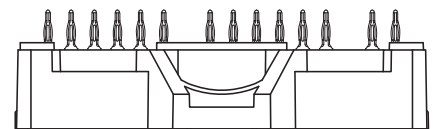
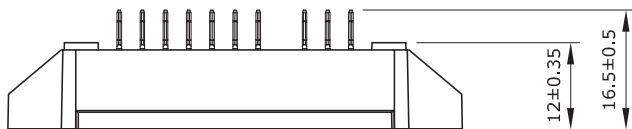
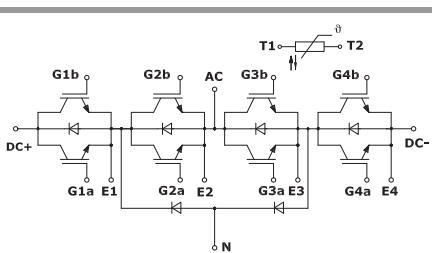


Fig. 24: Typ. Diode1 reverse recovery charge



- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern $\Phi \pm 0.1$
- Diameters of drill Φ 1.15mm
- Copper thickness in hole 25 - 50 μ m
- Hole specification for contacts:
refer to SEMITOP E1/E2 Mounting Instruction

SEMITOP®E2



MLI-T

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

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