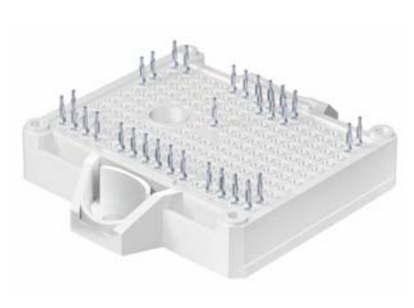
SK200TMLI12F4TE2



SEMITOP®E2

3-Level TNPC

SK200TMLI12F4TE2

Features*

- Optimized design for superior thermal performances
- Low inductive design
- Press-Fit contact technology
- 1200V Trench IGBT4 Fast (F4)
- 650V Trench IGBT3 (E3)
- Robust and soft switching CAL4F diode technology
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

Typical Applications

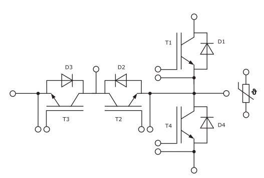
- UPS
- Solar

Remarks*

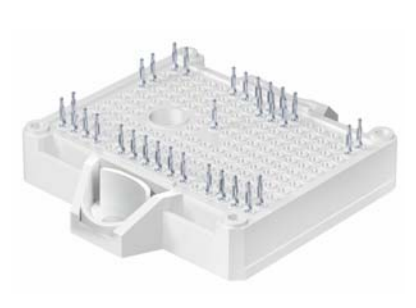
- Recommended T_{jop}= -40 ... +150°C
- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes D2 & D3

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_j = 175 °C	T_s = 25 °C	169	A
		T_s = 70 °C	135	A
I_C	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 25 °C	248	A
		T_s = 70 °C	200	A
I_{Cnom}			200	A
I_{CRM}			600	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 800 V, V_{GE} ≤ 15 V, T_j = 150 °C, V_{CES} ≤ 1200 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	102	A
		T_s = 70 °C	81	A
I_C	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 25 °C	123	A
		T_s = 70 °C	99	A
I_{Cnom}			100	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		6	µs
T_j			-40 ... 175	°C
Diode1				
V_{RRM}	T_j = 25 °C		1200	V
I_F	λ_{paste}=0.8 W/(mK) T_j = 175 °C	T_s = 25 °C	69	A
		T_s = 70 °C	55	A
I_F	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 25 °C	101	A
		T_s = 70 °C	81	A
I_{FRM}			150	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		430	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	98	A
		T_s = 70 °C	76	A
I_F	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 25 °C	132	A
		T_s = 70 °C	104	A
I_{FRM}			200	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		820	A
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$			30	A
T_{stg}			-40 ... 125	°C
V_{isol}	AC, sinusoidal, t = 1 min		2500	V



TMLI-T



SEMITOP®E2

3-Level TNPC

SK200TMLI12F4TE2

Features*

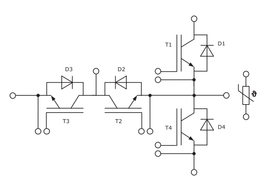
- Optimized design for superior thermal performances
- Low inductive design
- Press-Fit contact technology
- 1200V Trench IGBT4 Fast (F4)
- 650V Trench IGBT3 (E3)
- Robust and soft switching CAL4F diode technology
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

Typical Applications

- UPS
- Solar

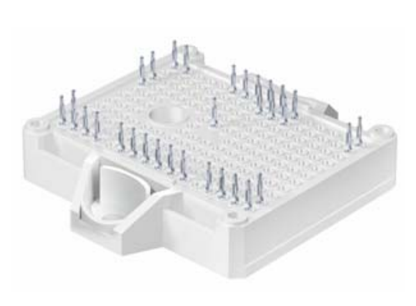
Remarks*

- Recommended T_{jop}= -40 ... +150°C
- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes D2 & D3



TMLI-T

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
IGBT1						
$V_{CE(sat)}$	I_C = 200 A V_{GE} = 15 V chiplevel	T_j = 25 °C		2.05	2.42	V
		T_j = 150 °C		2.59	2.96	V
V_{CE0}	chiplevel	T_j = 25 °C		1.10	1.28	V
		T_j = 150 °C		0.95	1.13	V
r_{CE}	V_{GE} = 15 V chiplevel	T_j = 25 °C		4.8	5.7	mΩ
		T_j = 150 °C		8.2	9.2	mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE}$, I_C = 7.6 mA		5.2	5.8	6.4	V
I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V, T_j = 25 °C				2.67	mA
C_{ies}	V_{CE} = 25 V V_{GE} = 0 V	f = 1 MHz		12.3		nF
C_{oes}		f = 1 MHz		0.81		nF
C_{res}		f = 1 MHz		0.69		nF
Q_G	V_{GE} = - 15 V...+ 15 V			1400		nC
R_{Gint}	T_j = 25 °C			3.8		Ω
$t_{d(on)}$	V_{CE} = 400 V I_C = 100 A V_{GE} = +15/-15 V $R_{G\,on}$ = 1.1 Ω $R_{G\,off}$ = 1.1 Ω di/dt_{on} = 4708 A/µs	T_j = 150 °C		164		ns
t_r		T_j = 150 °C		30		ns
E_{on}		T_j = 150 °C		4.44		mJ
$t_{d(off)}$		T_j = 150 °C		404		ns
t_f		T_j = 150 °C		58		ns
E_{off}		T_j = 150 °C		5.4		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.32		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.17		K/W
IGBT2						
$V_{CE(sat)}$	I_C = 100 A V_{GE} = 15 V chiplevel	T_j = 25 °C		1.45	1.85	V
		T_j = 150 °C		1.70	2.10	V
V_{CE0}	chiplevel	T_j = 25 °C		0.90	1.00	V
		T_j = 150 °C		0.82	0.90	V
r_{CE}	V_{GE} = 15 V chiplevel	T_j = 25 °C		5.5	8.5	mΩ
		T_j = 150 °C		8.8	12	mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE}$, I_C = 1.6 mA		5	5.8	6.5	V
I_{CES}	V_{GE} = 0 V, V_{CE} = 650 V, T_j = 25 °C				0.29	mA
C_{ies}	V_{CE} = 25 V V_{GE} = 0 V	f = 1 MHz		6.16		nF
C_{oes}		f = 1 MHz		0.384		nF
C_{res}		f = 1 MHz		0.183		nF
Q_G	V_{GE} = - 15 V...+ 15 V			1000		nC
R_{Gint}	T_j = 25 °C			2.0		Ω
$t_{d(on)}$	V_{CE} = 400 V I_C = 100 A V_{GE} = +15/-15 V $R_{G\,on}$ = 3.3 Ω $R_{G\,off}$ = 3.3 Ω di/dt_{on} = 3800 A/µs	T_j = 150 °C		78		ns
t_r		T_j = 150 °C		31		ns
E_{on}		T_j = 150 °C		4.3		mJ
$t_{d(off)}$		T_j = 150 °C		262		ns
t_f		T_j = 150 °C		52		ns
E_{off}		T_j = 150 °C		4.5		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.67		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.49		K/W



SEMITOP®E2

3-Level TNPC

SK200TMLI12F4TE2

Features*

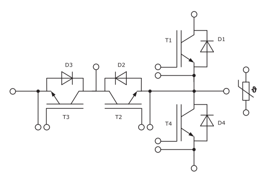
- Optimized design for superior thermal performances
- Low inductive design
- Press-Fit contact technology
- 1200V Trench IGBT4 Fast (F4)
- 650V Trench IGBT3 (E3)
- Robust and soft switching CAL4F diode technology
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

Typical Applications

- UPS
- Solar

Remarks*

- Recommended T_{jop}= -40 ... +150°C
- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes D2 & D3



TMLI-T

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Diode1						
$V_F = V_{EC}$	I_F = 75 A	T_j = 25 °C		2.17	2.49	V
	chiplevel	T_j = 150 °C		2.11	2.42	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		12	13	mΩ
		T_j = 150 °C		16	18	mΩ
I_{RRM}	I_F = 100 A	T_j = 150 °C		120		A
Q_{rr}	di/dt_{off} = 3800 A/µs V_R = 400 V	T_j = 150 °C		12.3		µC
E_{rr}	V_{GE} = +15/-15 V	T_j = 150 °C		3.2		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			1.01		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.55		K/W
Diode2						
$V_F = V_{EC}$	I_F = 100 A	T_j = 25 °C		1.40	1.76	V
	chiplevel	T_j = 150 °C		1.38	1.77	V
V_{F0}	chiplevel	T_j = 25 °C		1.04	1.24	V
		T_j = 150 °C		0.85	0.99	V
r_F	chiplevel	T_j = 25 °C		3.6	5.3	mΩ
		T_j = 150 °C		5.3	7.8	mΩ
I_{RRM}	I_F = 100 A	T_j = 150 °C		151		A
Q_{rr}	di/dt_{off} = 4823 A/µs V_R = 400 V	T_j = 150 °C		12.2		µC
E_{rr}	V_{GE} = +15/-15 V	T_j = 150 °C		3.14		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.91		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.59		K/W
Module						
L_{sCE1}				14		nH
L_{CE}				-		nH
$R_{CC'+EE'}$	per switch	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_{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

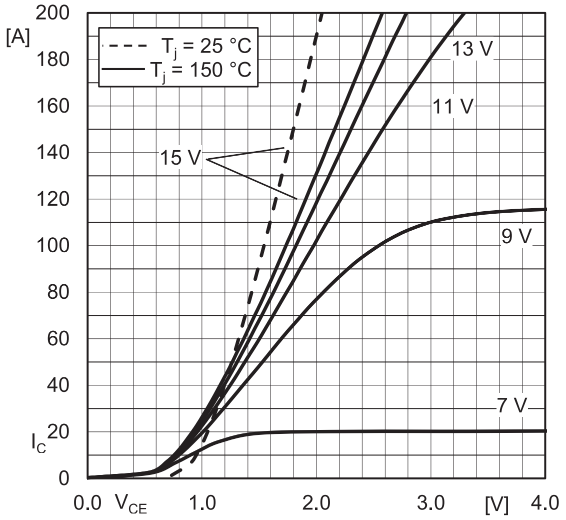


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

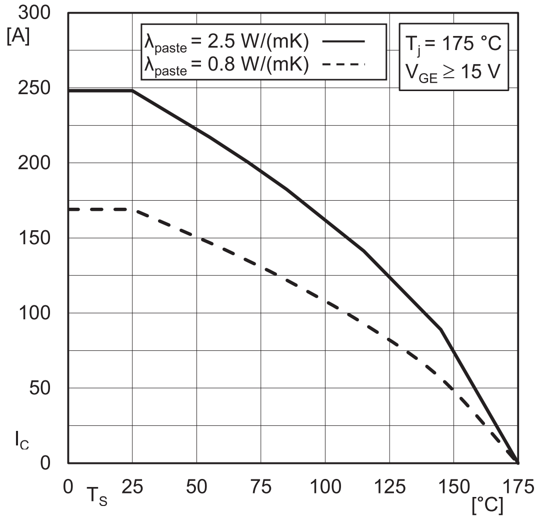


Fig. 2: IGBT1 rated current vs. Temperature I_c=f(T_s)

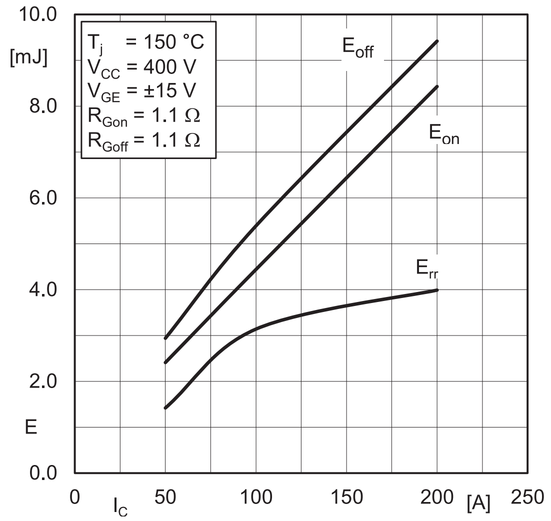


Fig. 3: Typ. IGBT1 & Diode2 turn-on /-off energy = f (I_C)

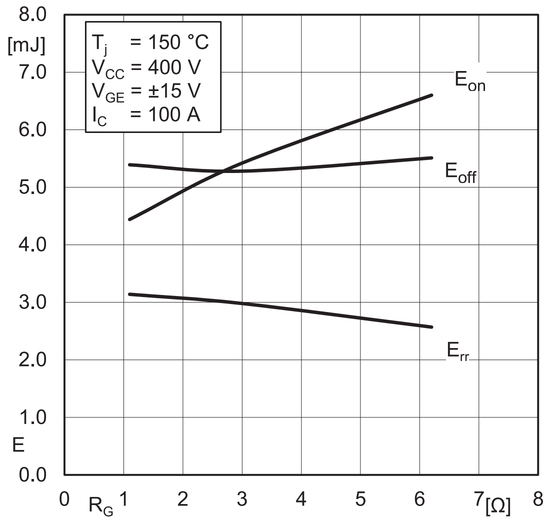


Fig. 4: Typ. IGBT1 & Diode2 turn-on /-off energy = f(R_G)

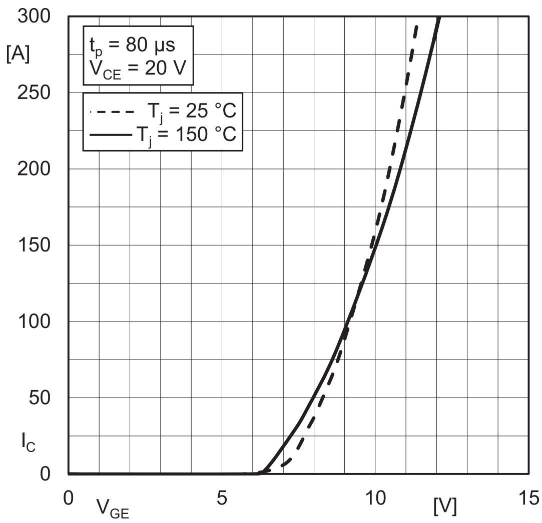


Fig. 5: Typ. IGBT1 transfer characteristic

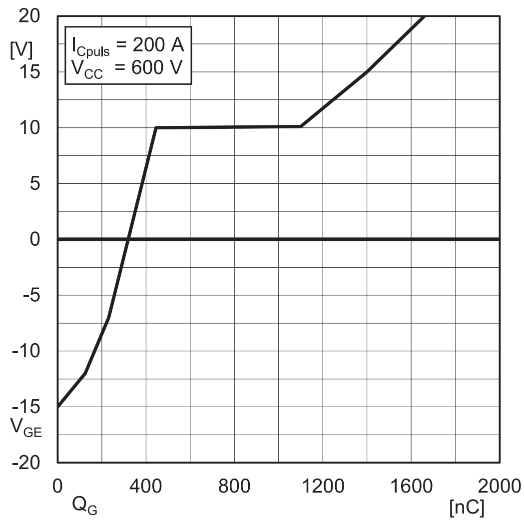


Fig. 6: Typ. IGBT1 gate charge characteristic

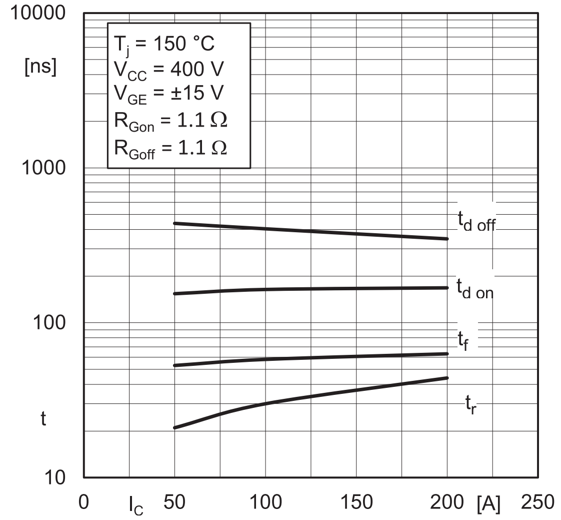


Fig. 7: Typ. IGBT1 switching times vs. I_C

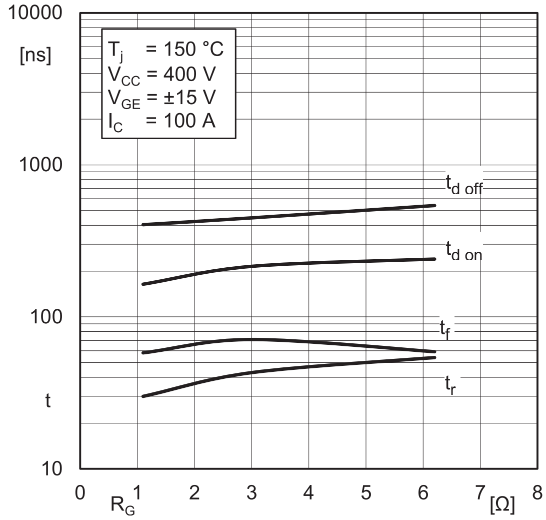


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

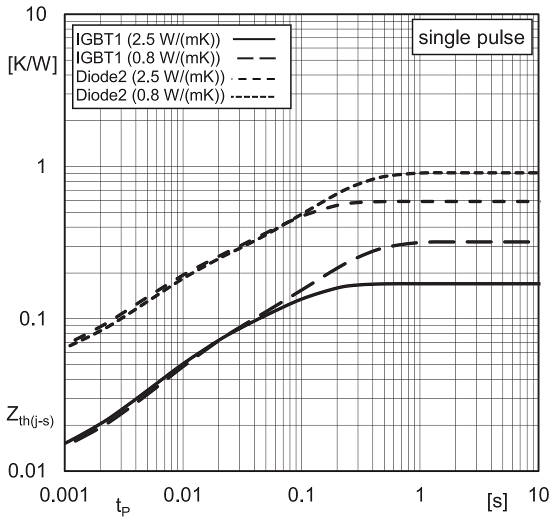


Fig. 9: Transient thermal impedance of IGBT1 & Diode2

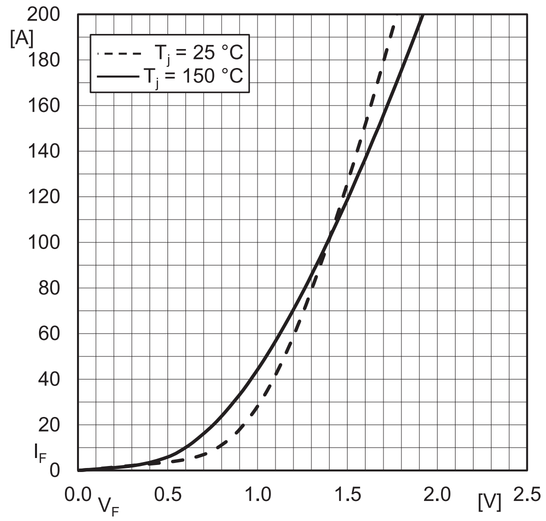


Fig. 10: Typ. Diode2 forward characteristic, incl. $R_{CC'+EE'}$

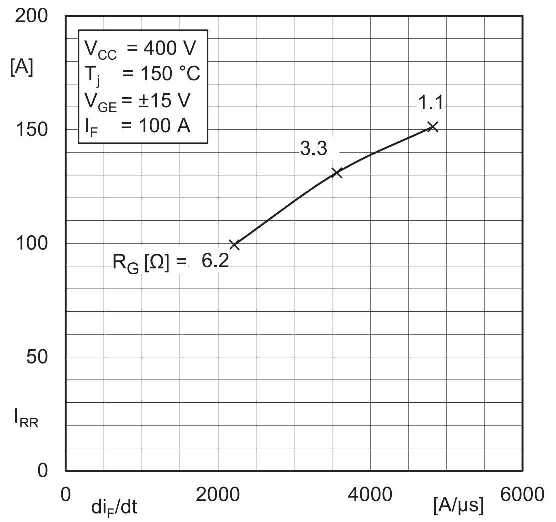


Fig. 11: Typ. Diode2 peak reverse recovery current

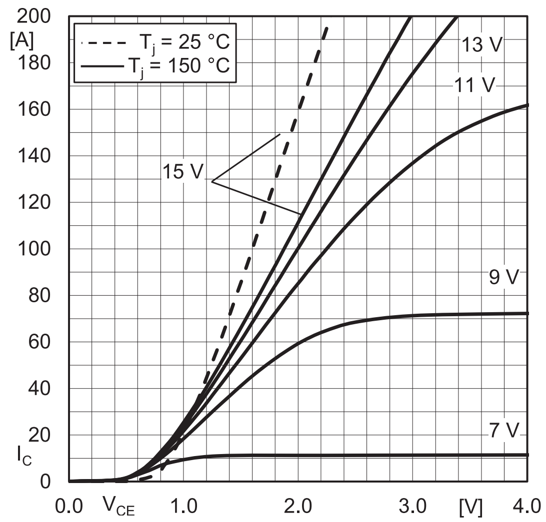


Fig. 13: Typ. IGBT2 output characteristic, incl. $R_{CC'+EE'}$

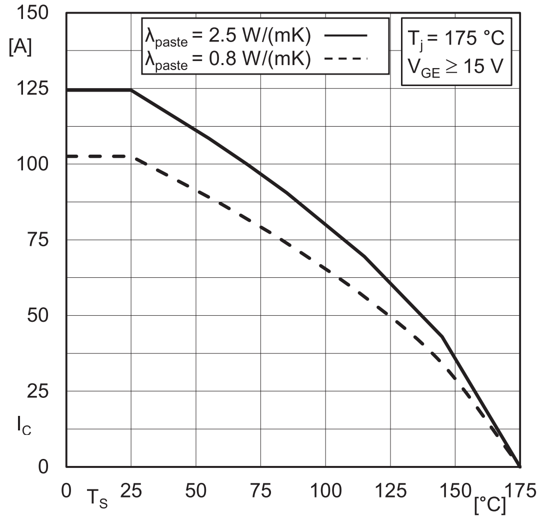


Fig. 14: IGBT2 Rated current vs. Temperature I_c= f (T_s)

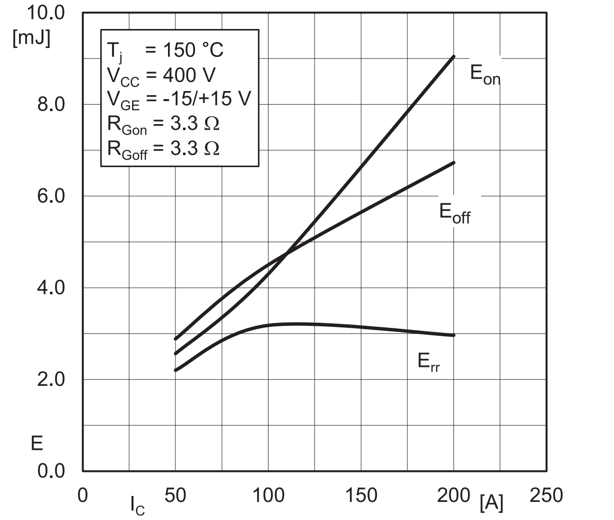


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = f (I_C)

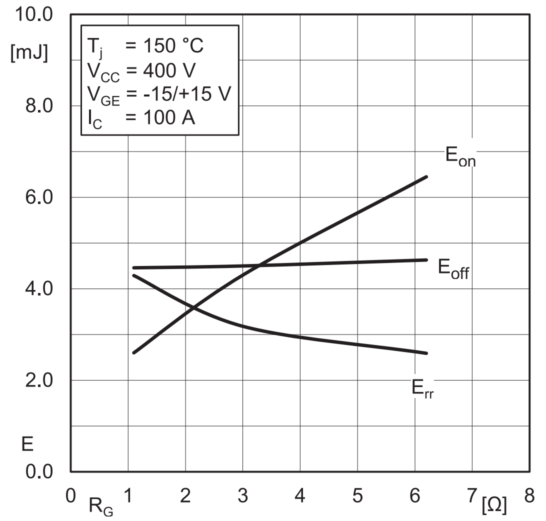


Fig. 16: Typ. IGBT2 & Diode1 turn-on / -off energy = f(R_G)

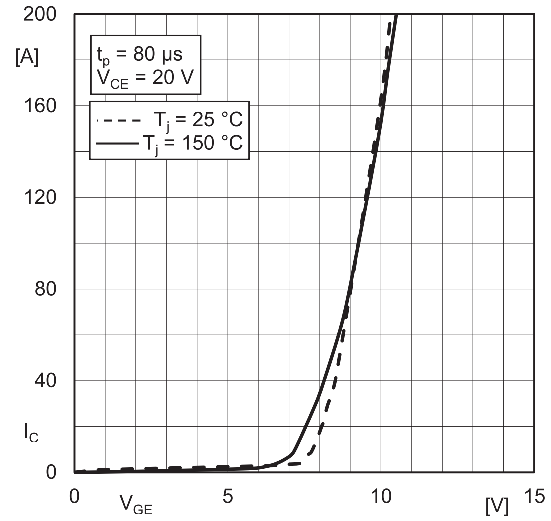


Fig. 17: Typ. IGBT2 transfer characteristic

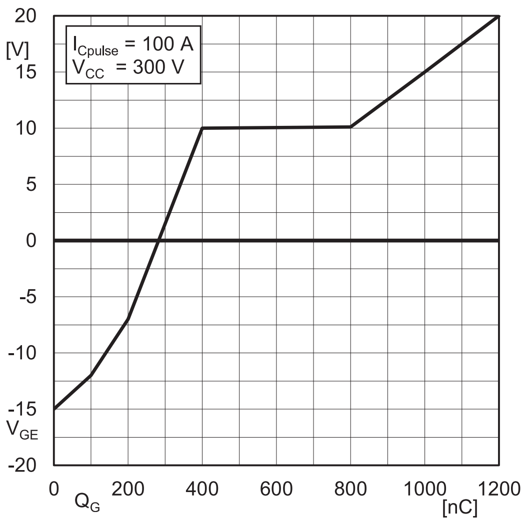


Fig. 18: Typ. IGBT2 gate charge characteristic

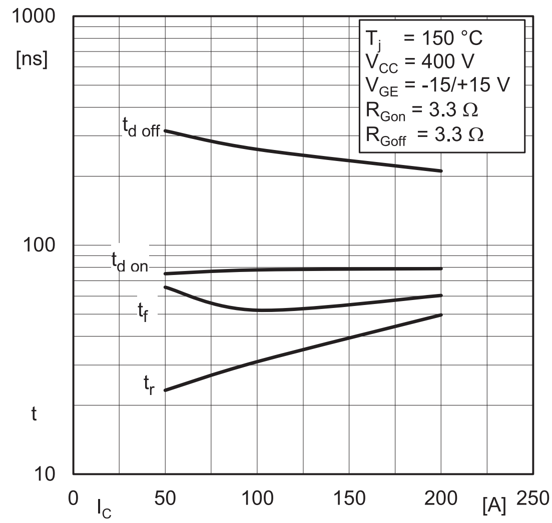


Fig. 19: Typ. IGBT2 switching times vs. I_C

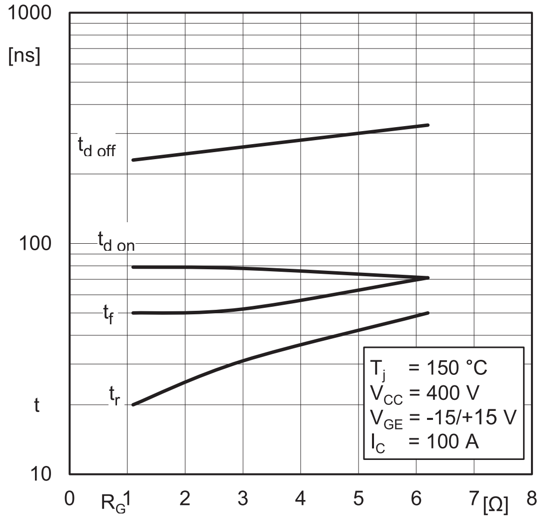


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

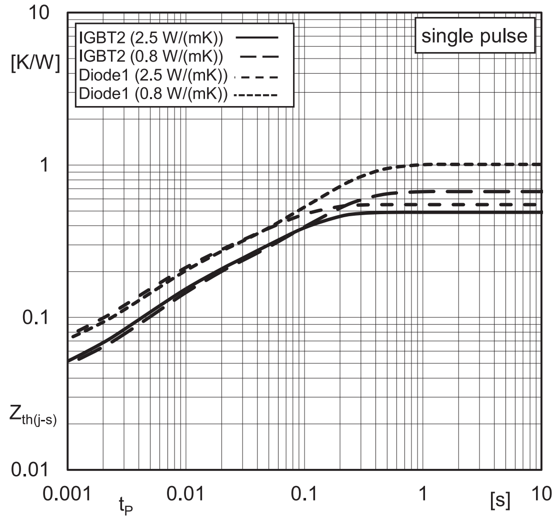


Fig. 21: Transient thermal impedance of IGBT2 & Diode1

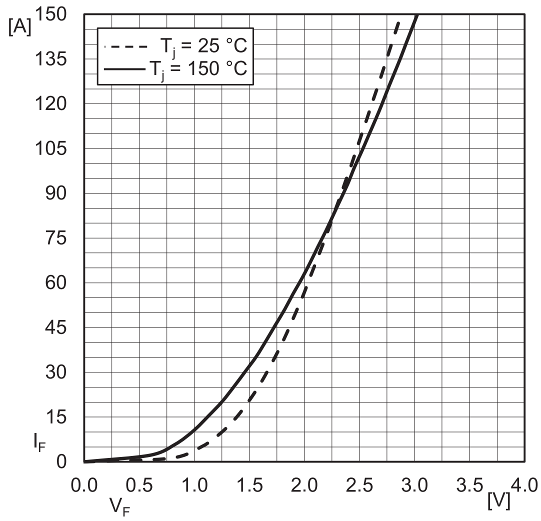


Fig. 22: Typ. Diode1 forward characteristic, incl. $R_{CC'+EE'}$

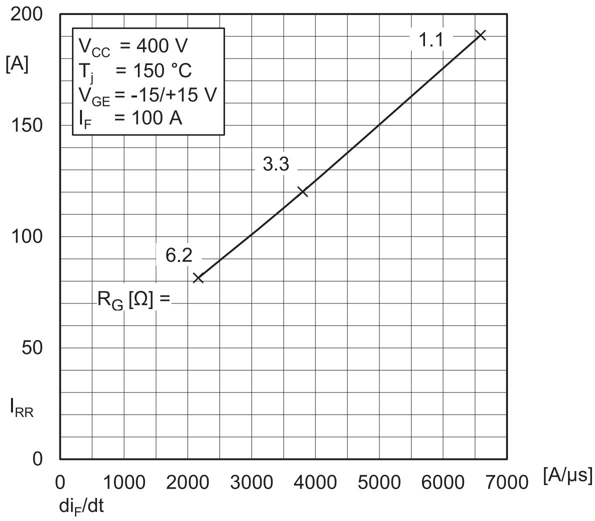


Fig. 23: Typ. Diode1 peak reverse recovery current

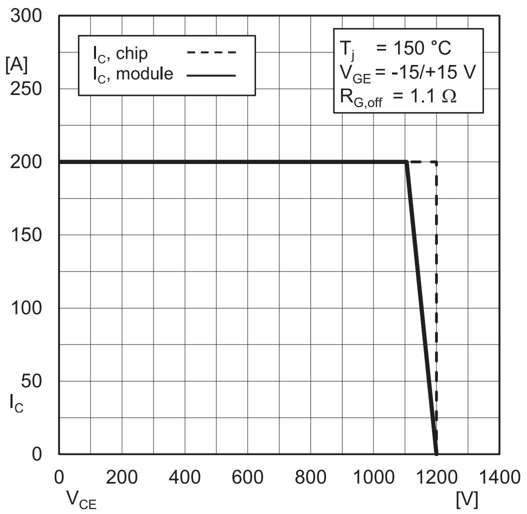


Fig. 25: RBSOA IGBT1

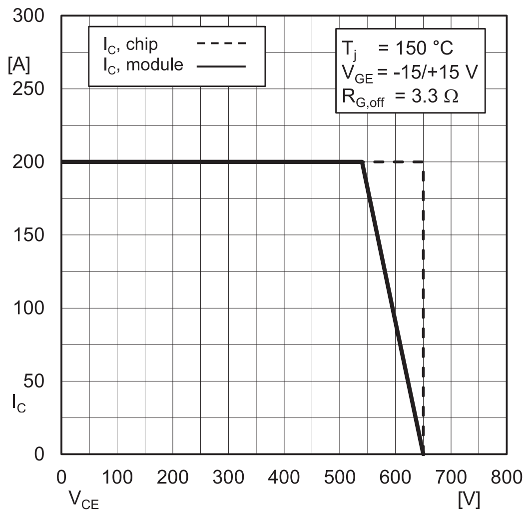
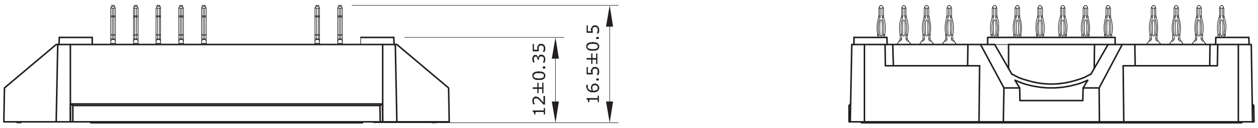
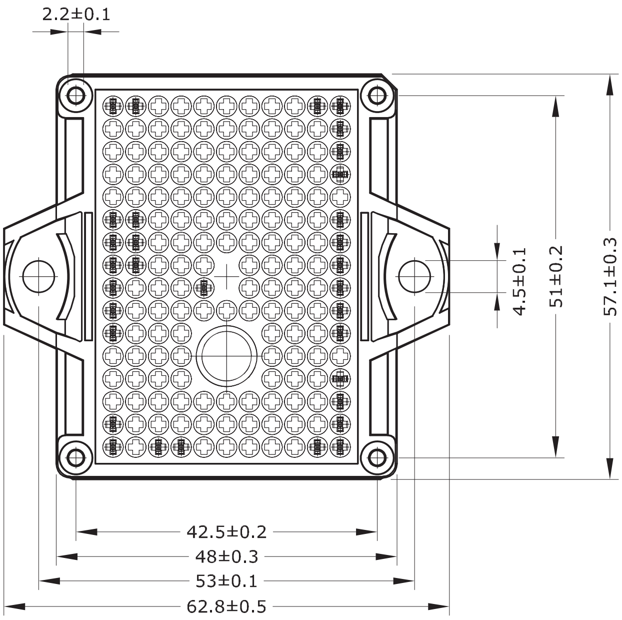
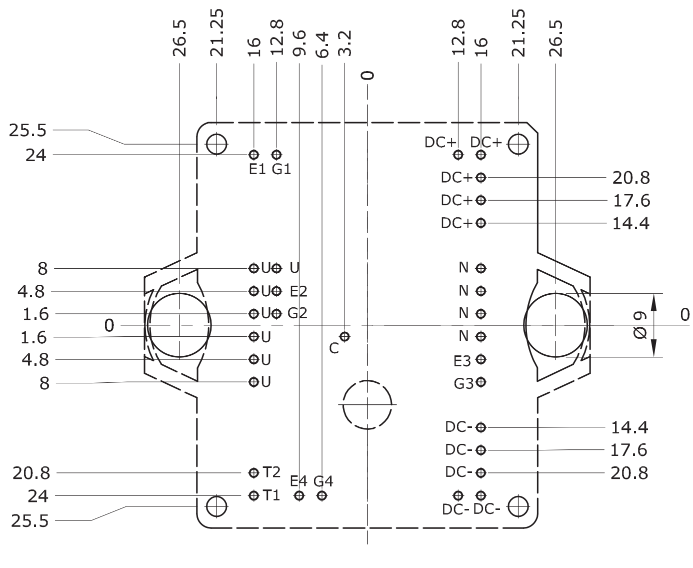


Fig. 26: RBSOA IGBT2

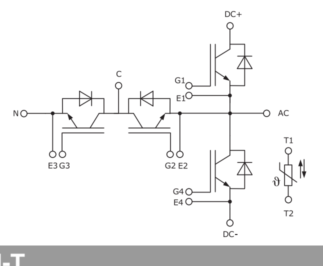






- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern ⌖ Ø0.1
- Diameters of drill Ø 1.15mm
- Copper thickness in hole 25 - 50 µm
- Hole specification for contacts:
  refer to SEMITOP E1/E2 Mounting Instruction

SEMITOP®E2



TMLI-T

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

***IMPORTANT INFORMATION AND WARNINGS**

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