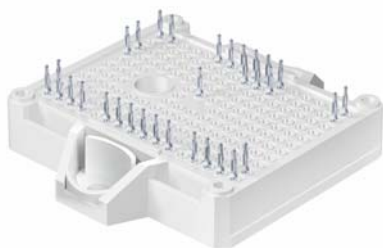


SK200TMLI12F4TE2



SEMITOP®E2

3-Level TNPC

SK200TMLI12F4TE2

Features*

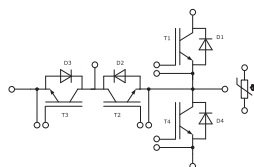
- Optimized design for superior thermal performances
- Low inductive design
- Press-Fit contact technology
- 1200V Trench IGBT4 Fast (F4)
- 650V Trench IGBT3 (E3)
- Robust and soft switching CAL4F diode technology
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

Typical Applications

- UPS
- Solar

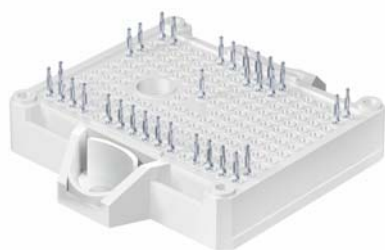
Remarks*

- Recommended $T_{jop} = -40 \dots +150^{\circ}\text{C}$
- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes D2 & D3



TMLI-T

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 _s = 25 °C	169	A
	T _j = 175 °C	T _s = 70 °C	135	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	248	A
	T _j = 175 °C	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 _s = 25 °C	102	A
	T _j = 175 °C	T _s = 70 °C	81	A
I _C	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	123	A
	T _j = 175 °C	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 _s = 25 °C	69	A
	T _j = 175 °C	T _s = 70 °C	55	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	101	A
	T _j = 175 °C	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 _s = 25 °C	98	A
	T _j = 175 °C	T _s = 70 °C	76	A
I _F	λ _{paste} =2.5 W/(mK)	T _s = 25 °C	132	A
	T _j = 175 °C	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



SEMITOP®E2

3-Level TNPC

SK200TMLI12F4TE2

Features*

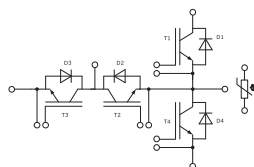
- Optimized design for superior thermal performances
- Low inductive design
- Press-Fit contact technology
- 1200V Trench IGBT4 Fast (F4)
- 650V Trench IGBT3 (E3)
- Robust and soft switching CAL4F diode technology
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

Typical Applications

- UPS
- Solar

Remarks*

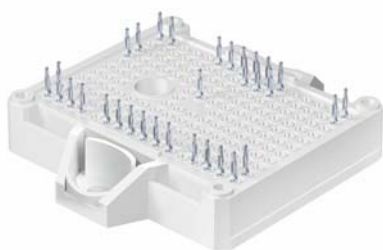
- Recommended $T_{jop} = -40 \dots +150^{\circ}\text{C}$
- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes D2 & D3



TMLI-T

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
V _{CE(sat)}	I _C = 200 A	T _j = 25 °C		2.05	2.42	V
	V _{GE} = 15 V chipllevel	T _j = 150 °C		2.59	2.96	V
V _{CE0}	chipllevel	T _j = 25 °C		1.10	1.28	V
		T _j = 150 °C		0.95	1.13	V
r _{CE}	V _{GE} = 15 V chipllevel	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	T _j = 150 °C		164		ns
t _r	I _C = 100 A	T _j = 150 °C		30		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		4.44		mJ
t _{d(off)}	R _{G on} = 1.1 Ω	T _j = 150 °C		404		ns
t _f	R _{G off} = 1.1 Ω	T _j = 150 °C		58		ns
E _{off}	di/dt _{on} = 4708 A/μs	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	T _j = 25 °C		1.45	1.85	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		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	T _j = 150 °C		78		ns
t _r	I _C = 100 A	T _j = 150 °C		31		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		4.3		mJ
t _{d(off)}	R _{G on} = 3.3 Ω	T _j = 150 °C		262		ns
t _f	R _{G off} = 3.3 Ω	T _j = 150 °C		52		ns
E _{off}	di/dt _{on} = 3800 A/μs	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

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

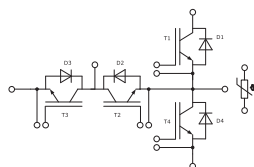
Typical Applications

- UPS
- Solar

Remarks*

- Recommended $T_{jop} = -40 \dots +150^{\circ}\text{C}$
- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer diodes D1 & D4
- Diode2: inner diodes D2 & D3

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	T _j = 150 °C		12.3		μC
E _{rr}	V _R = 400 V 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	T _j = 150 °C		12.2		μC
E _{rr}	V _R = 400 V 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



TMLI-T

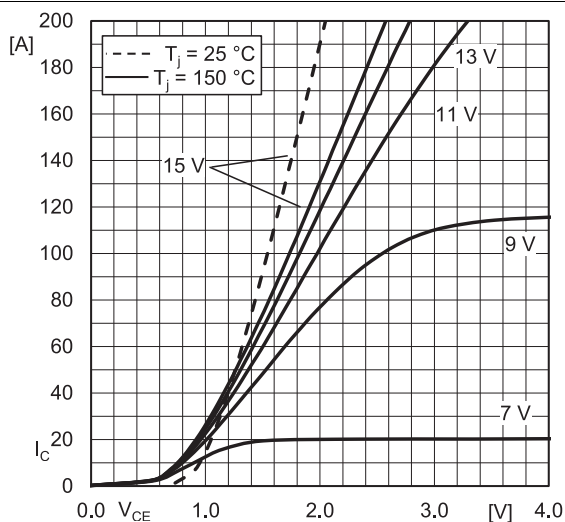


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

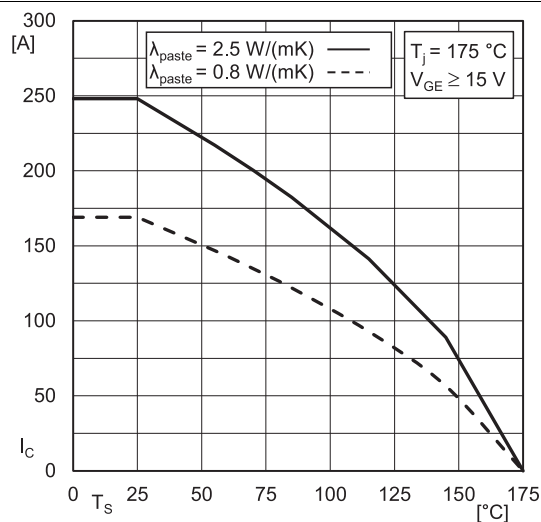


Fig. 2: IGBT1 rated current vs. Temperature $I_C=f(T_s)$

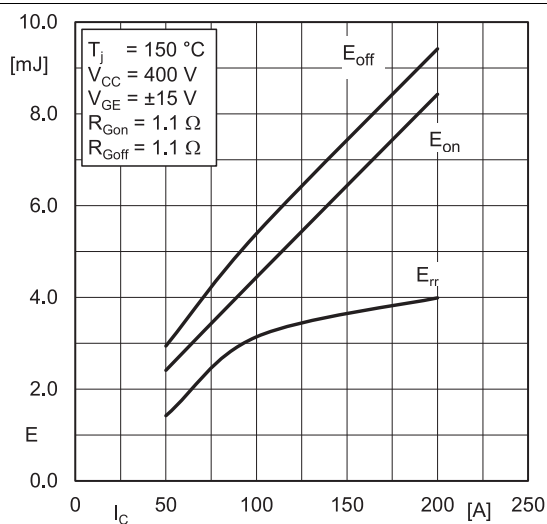


Fig. 3: Typ. IGBT1 & Diode2 turn-on /-off energy = $f(I_C)$

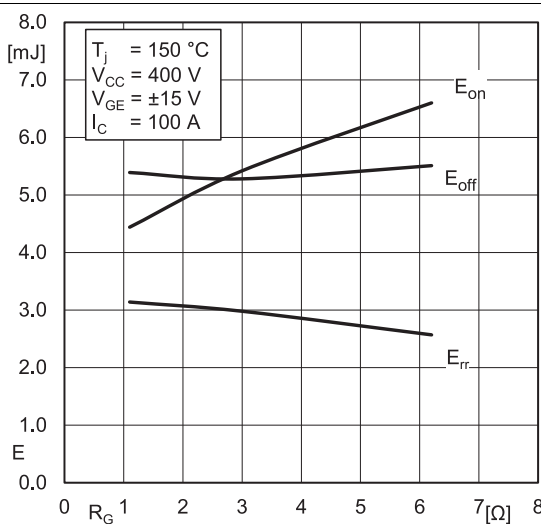


Fig. 4: Typ. IGBT1 & Diode2 turn-on /-off energy = $f(R_G)$

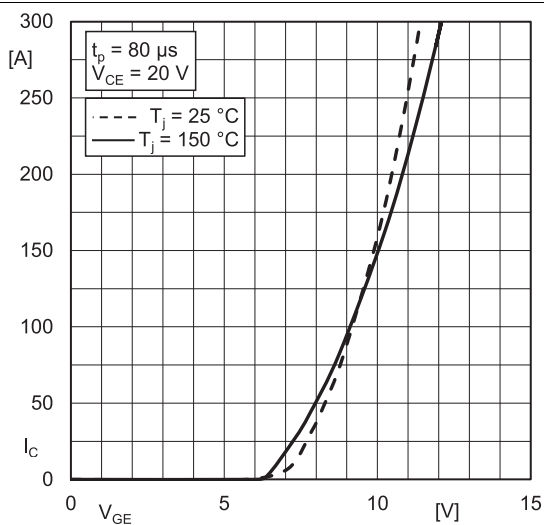


Fig. 5: Typ. IGBT1 transfer characteristic

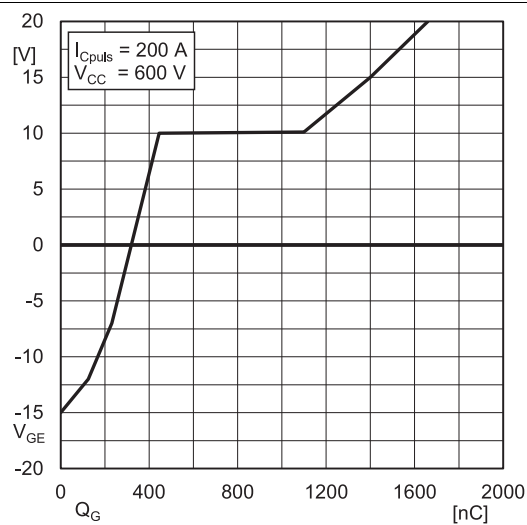
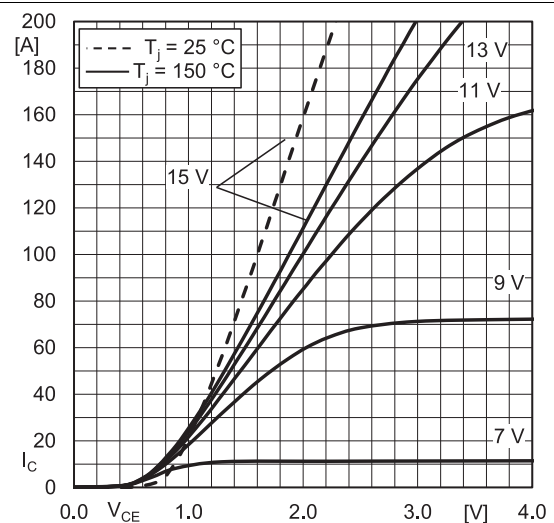
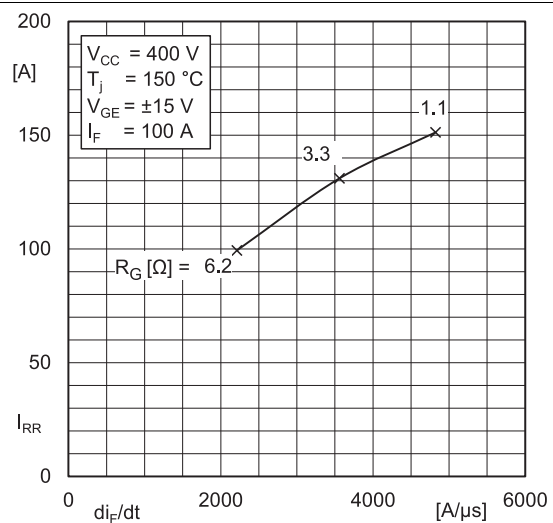
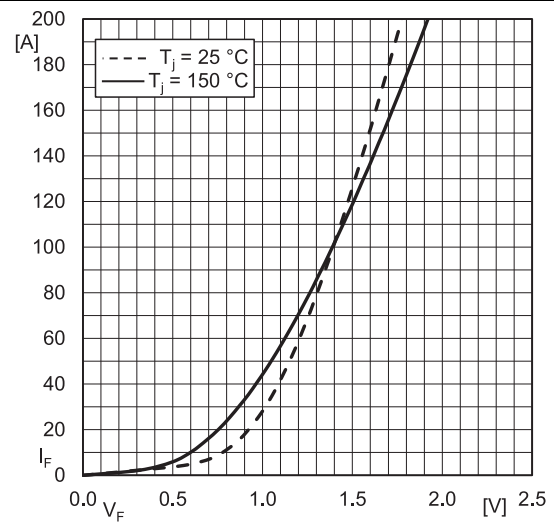
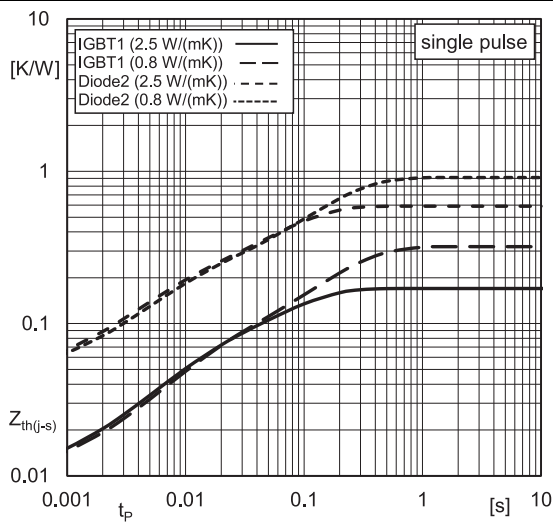
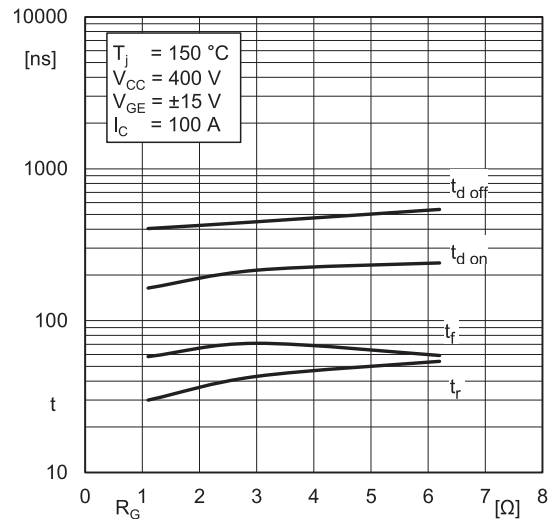
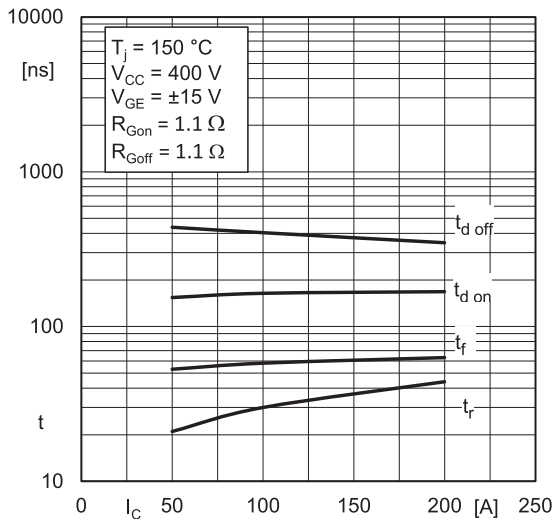


Fig. 6: Typ. IGBT1 gate charge characteristic



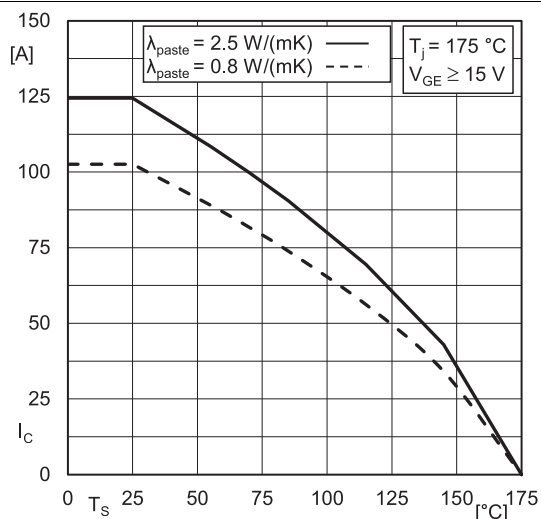


Fig. 14: IGBT2 Rated current vs. Temperature $I_C = f(T_s)$

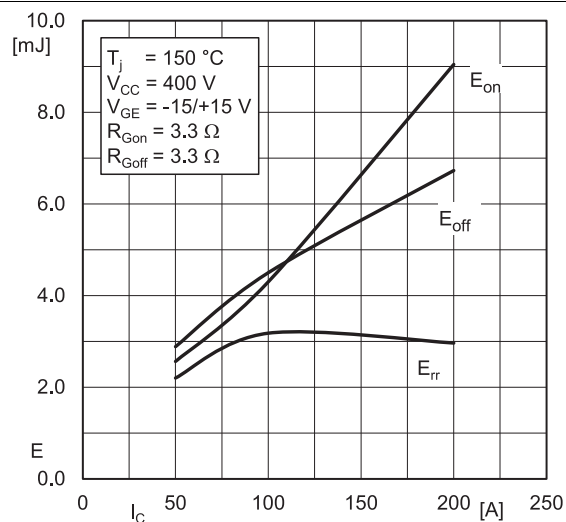


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(I_C)$

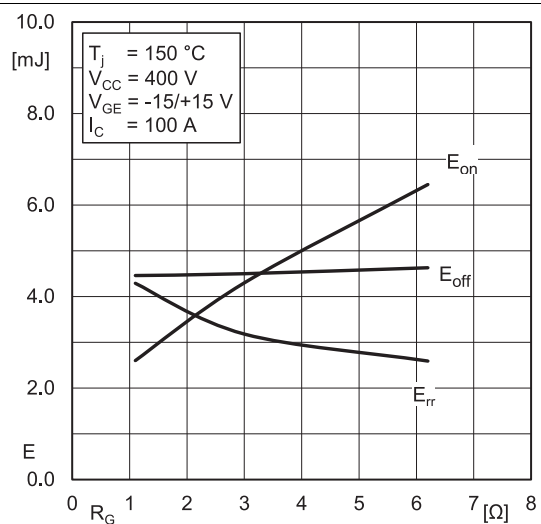


Fig. 16: Typ. IGBT2 & Diode1 turn-on /-off energy = $f(R_G)$

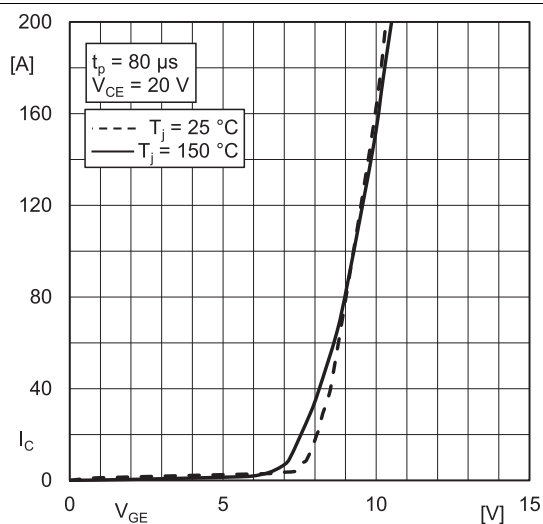


Fig. 17: Typ. IGBT2 transfer characteristic

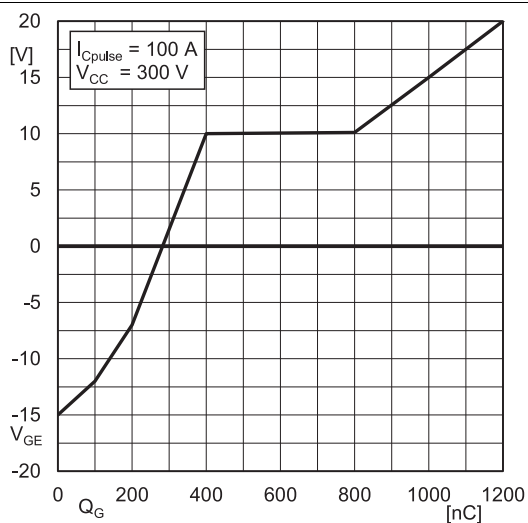


Fig. 18: Typ. IGBT2 gate charge characteristic

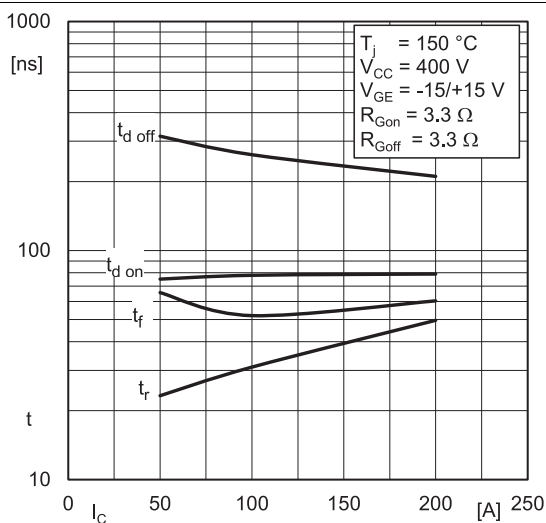
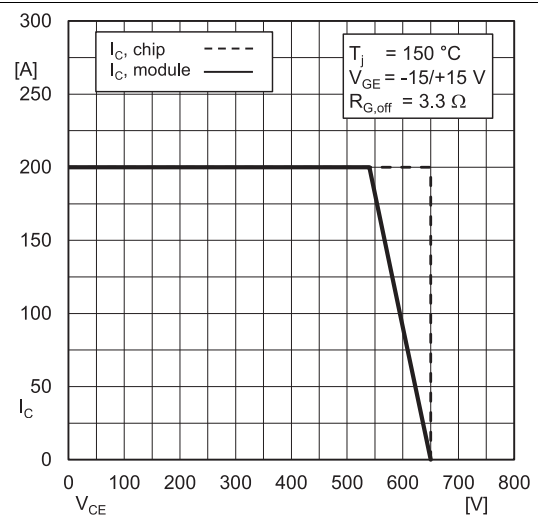
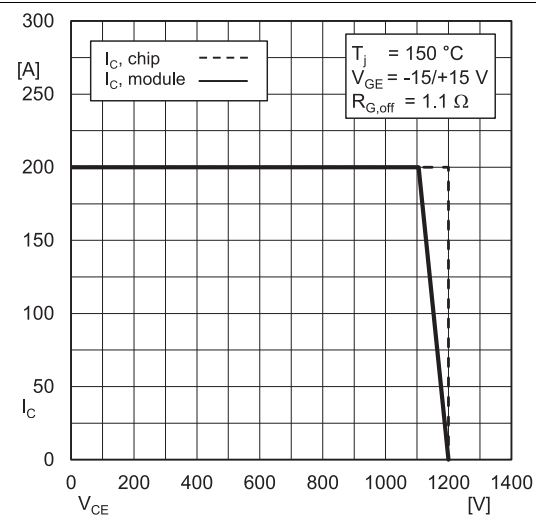
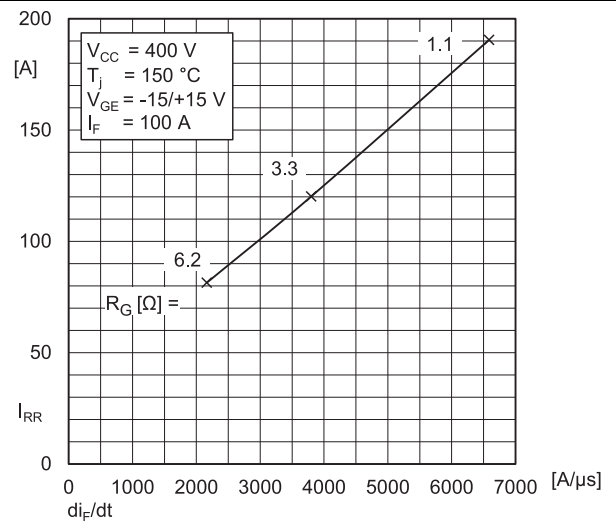
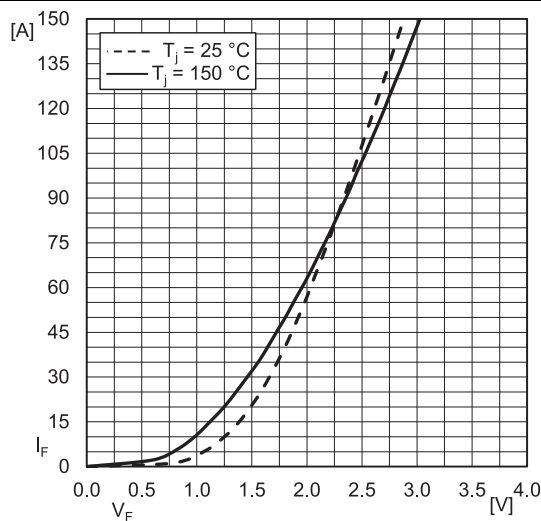
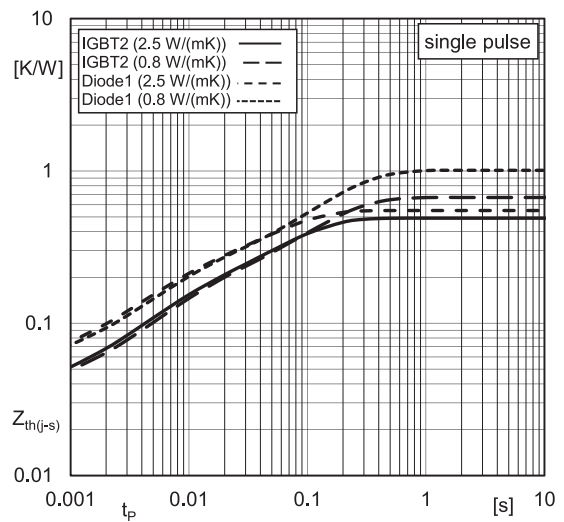
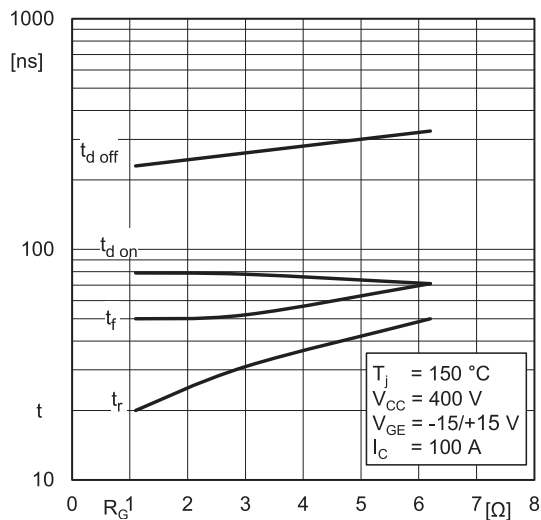
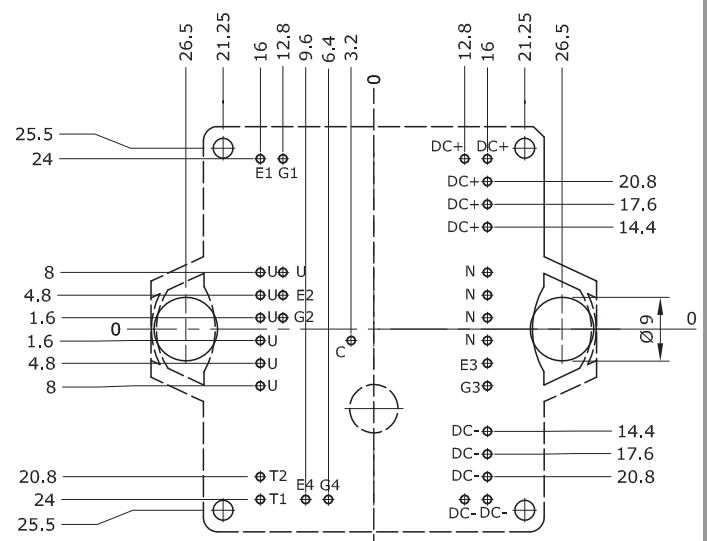
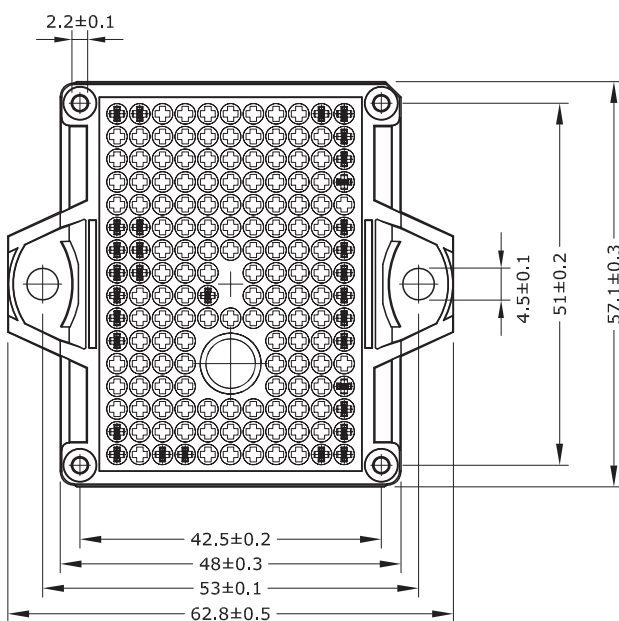
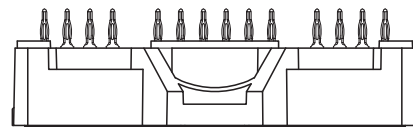
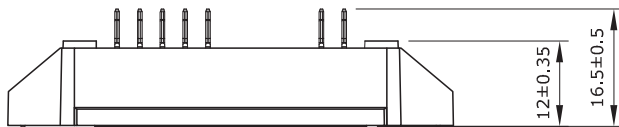


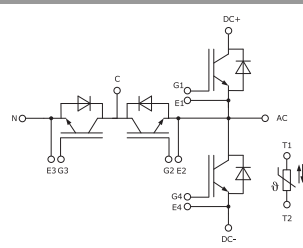
Fig. 19: Typ. IGBT2 switching times vs. I_C





- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern $\boxed{\oplus \mid \varnothing 0.1}$
- Diameters of drill $\varnothing 1.15\text{mm}$
- 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**

The specifications of SEMIKRON products may not be considered as guarantee or assurance of product characteristics ("Beschaffenheitsgarantie"). The specifications of SEMIKRON products describe only the usual characteristics of products to be expected in typical applications, which may still vary depending on the specific application. Therefore, products must be tested for the respective application in advance. Application adjustments may be necessary. The user of SEMIKRON products is responsible for the safety of their applications embedding SEMIKRON products and must take adequate safety measures to prevent the applications from causing a physical injury, fire or other problem if any of SEMIKRON products become faulty. The user is responsible to make sure that the application design is compliant with all applicable laws, regulations, norms and standards. Except as otherwise explicitly approved by SEMIKRON in a written document signed by authorized representatives of SEMIKRON, SEMIKRON products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury. No representation or warranty is given and no liability is assumed with respect to the accuracy, completeness and/or use of any information herein, including without limitation, warranties of non-infringement of intellectual property rights of any third party. SEMIKRON does not assume any liability arising out of the applications or use of any product; neither does it convey any license under its patent rights, copyrights, trade secrets or other intellectual property rights, nor the rights of others. SEMIKRON makes no representation or warranty of non-infringement or alleged non-infringement of intellectual property rights of any third party which may arise from applications. Due to technical requirements our products may contain dangerous substances. For information on the types in question please contact the nearest SEMIKRON sales office. This document supersedes and replaces all information previously supplied and may be superseded by updates. SEMIKRON reserves the right to make changes.