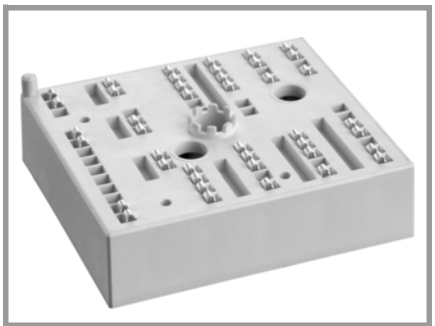

MiniSKiiP® 2

3-Level TNPC IGBT-Module

SKiiP 29TMLI12F4V1

Features

- Fast Trench 4 IGBTs
- Trench IGBTs
- Robust and soft diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognised: File no. E63532

Remarks*

- Case temperature limited to T_C=125°C max.; T_C = T_S (for baseplateless modules)
- Product reliability results valid for T_j≤150°C (recommended T_{jop}=-40...+150°C)
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- IGBT 2: inner IGBTs T2&T3
- Diode 1: outer diodes D1&D4
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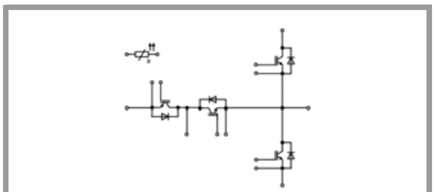
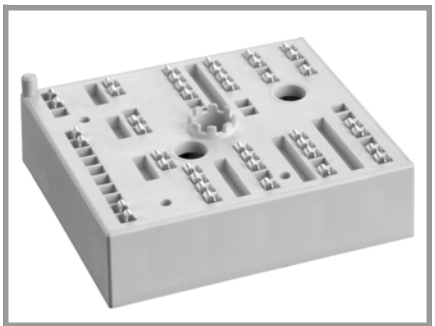


TMLI

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	144	A
	T_j = 175 °C	T_s = 70 °C	115	A
I_C	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	172	A
	T_j = 175 °C	T_s = 70 °C	138	A
I_{Cnom}			150	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		450	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	131	A
	T_j = 175 °C	T_s = 70 °C	104	A
I_C	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	150	A
	T_j = 175 °C	T_s = 70 °C	120	A
I_{Cnom}			150	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		450	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	148	A
	T_j = 175 °C	T_s = 70 °C	117	A
I_F	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	170	A
	T_j = 175 °C	T_s = 70 °C	136	A
I_{Fnom}			150	A
I_{FRM}	I_{FRM} = 3 x I_{Fnom}		450	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		774	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	129	A
	T_j = 175 °C	T_s = 70 °C	99	A
I_F	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	155	A
	T_j = 175 °C	T_s = 70 °C	121	A
I_{Fnom}			150	A
I_{FRM}	I_{FRM} = 2 x I_{Fnom}		300	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		1200	A
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$			100	A
T_{stg}			-40 ... 125	°C
V_{isol}	AC sinus 50 Hz, t = 1 min		2500	V



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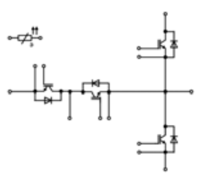
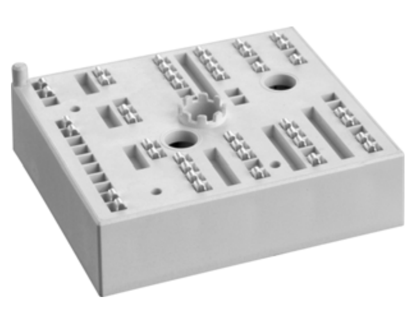


TMLI

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
$V_{CE(sat)}$	I_C = 150 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		6.3	7.6	mΩ
		T_j = 150 °C		11	12	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 5.2 mA		5.2	5.8	6.4	V
I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V, T_j = 25 °C				0.3	mA
C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V	f = 1 MHz		8.80		nF
C_{oes}		f = 1 MHz		0.58		nF
C_{res}		f = 1 MHz		0.47		nF
Q_G	V_{GE} = - 8 V...+ 15 V			850		nC
R_{Gint}	T_j = 25 °C			5.0		Ω
$t_{d(on)}$	V_{CE} = 300 V, I_C = 150 A, V_{GE} = +15/-15 V, $R_{G\,on}$ = 1.6 Ω, $R_{G\,off}$ = 1.6 Ω, di/dt_{on} = 2550 A/µs, di/dt_{off} = 1850 A/µs	T_j = 150 °C		155		ns
t_r		T_j = 150 °C		54		ns
E_{on}		T_j = 150 °C		5.2		mJ
$t_{d(off)}$		T_j = 150 °C		323		ns
t_f		T_j = 150 °C		66		ns
E_{off}		T_j = 150 °C		6.1		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.35		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.26		K/W
IGBT2						
$V_{CE(sat)}$	I_C = 150 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.45	1.77	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		3.7	5.1	mΩ
		T_j = 150 °C		5.9	8.0	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 2.4 mA		5.1	5.8	6.4	V
I_{CES}	V_{GE} = 0 V, V_{CE} = 650 V, T_j = 25 °C				0.3	mA
C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V	f = 1 MHz		9.24		nF
C_{oes}		f = 1 MHz		0.60		nF
C_{res}		f = 1 MHz		0.27		nF
Q_G	V_{GE} = - 8 V...+ 15 V			1360		nC
R_{Gint}	T_j = 25 °C			2.0		Ω
$t_{d(on)}$	V_{CE} = 300 V, I_C = 150 A, V_{GE} = +15/-15 V, $R_{G\,on}$ = 1.6 Ω, $R_{G\,off}$ = 1.6 Ω, di/dt_{on} = 3900 A/µs, di/dt_{off} = 1650 A/µs	T_j = 150 °C		118		ns
t_r		T_j = 150 °C		40		ns
E_{on}		T_j = 150 °C		1.6		mJ
$t_{d(off)}$		T_j = 150 °C		276		ns
t_f		T_j = 150 °C		79		ns
E_{off}		T_j = 150 °C		6.1		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.57		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.46		K/W



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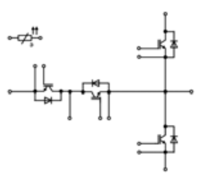


TMLI

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Diode1						
$V_F = V_{EC}$	I_F = 150 A V_{GE} = 0 V chiplevel	T_j = 25 °C		2.17	2.49	V
		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		5.8	6.6	mΩ
		T_j = 150 °C		8.1	8.8	mΩ
I_{RRM}	I_F = 150 A di/dt_{off} = 3760 A/µs V_R = 300 V V_{GE} = +15/-15 V	T_j = 150 °C		191.3		A
Q_{rr}		T_j = 150 °C		26		µC
E_{rr}		T_j = 150 °C		6.5		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.45		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.36		K/W
Diode2						
$V_F = V_{EC}$	I_F = 150 A V_{GE} = 0 V chiplevel	T_j = 25 °C		1.40	1.76	V
		T_j = 150 °C		1.39	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		2.4	3.5	mΩ
		T_j = 150 °C		3.6	5.2	mΩ
I_{RRM}	I_F = 150 A di/dt_{off} = 2640 A/µs V_R = 300 V V_{GE} = +15/-15 V	T_j = 150 °C		131.4		A
Q_{rr}		T_j = 150 °C		13.5		µC
E_{rr}		T_j = 150 °C		2.4		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.73		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.56		K/W
Module						
L_{sCE1}				-		nH
L_{CE}				t.b.d.		nH
$R_{CC'+EE'}$		T_s = 25 °C				mΩ
				t.b.d.		mΩ
M_s	to heat sink		2		2.5	Nm
M_t		to heat sink				Nm
						Nm
w				55		g
Temperature Sensor						
R_{100}	T_r=100°C (R_{25}=1000Ω)			1670 ± 3%		Ω
$B_{100/125}$	$R(T)=R_{100}exp[B_{100/125}(1/T-1/T_{100})]$; T[K]			3550 ± 2%		K

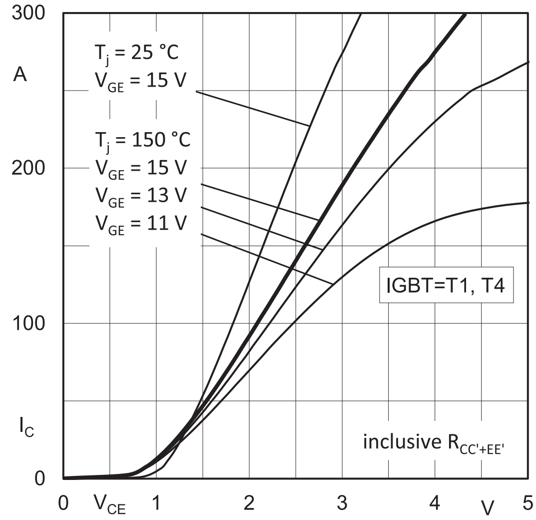


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

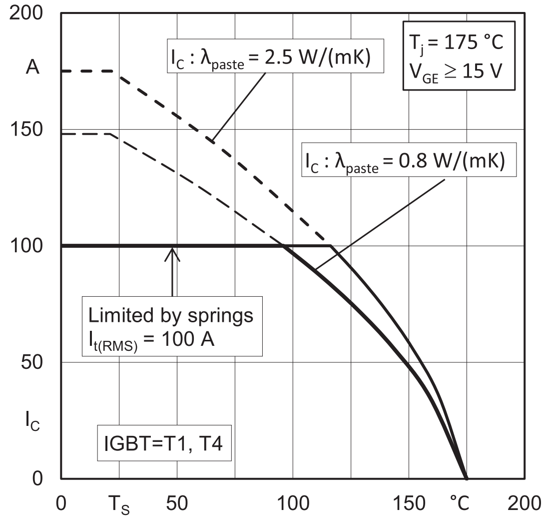


Fig. 2: IGBT1 rated current vs. Temperature $I_c=f(T_s)$

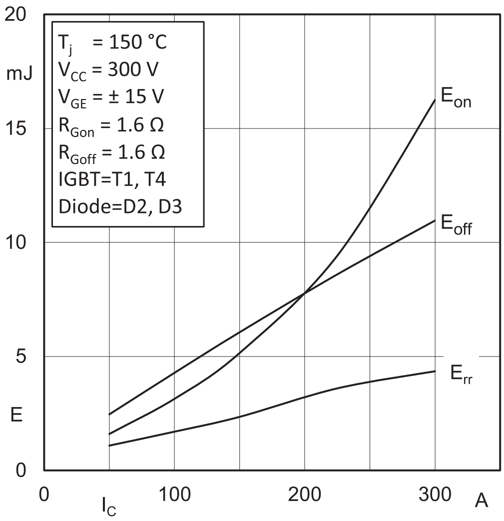


Fig. 3: Typ. IGBT1 & Diode2 turn-on /-off energy = f (I_C)

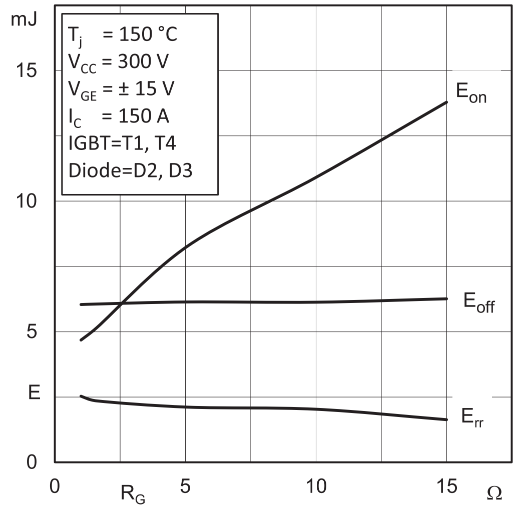


Fig. 4: Typ. IGBT1 & Diode2 turn-on /-off energy = f(R_G)

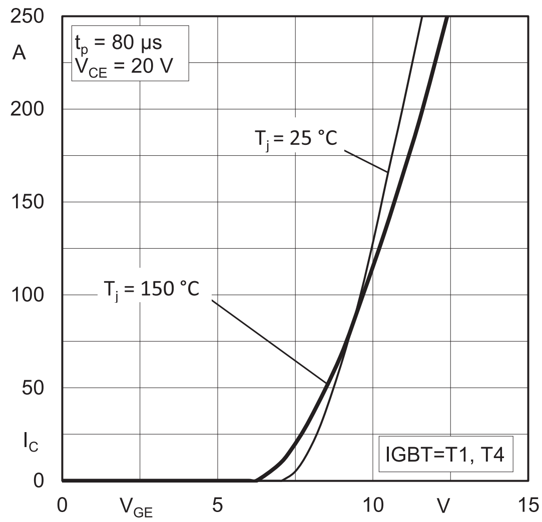


Fig. 5: Typ. IGBT1 transfer characteristic

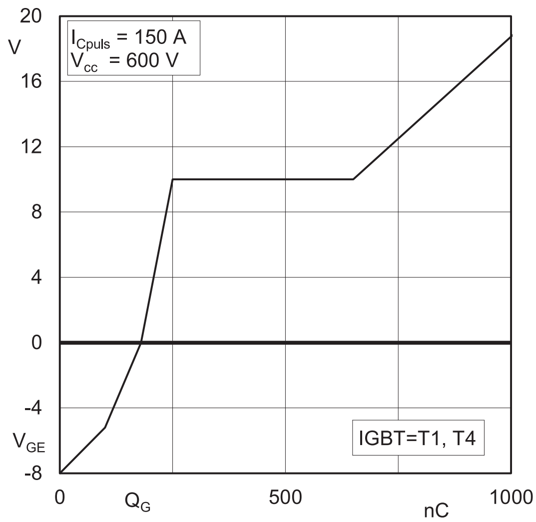


Fig. 6: Typ. IGBT1 gate charge characteristic

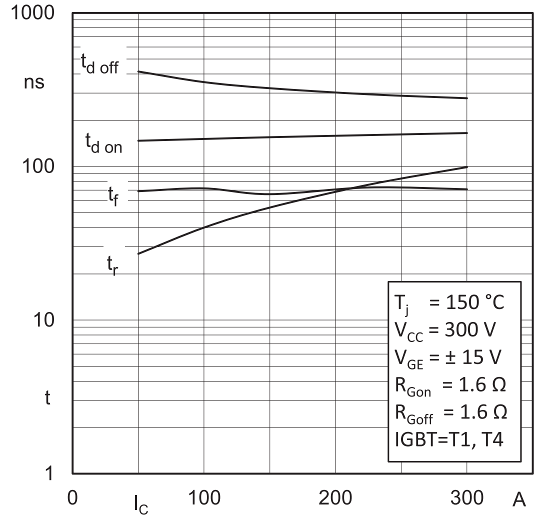


Fig. 7: Typ. IGBT1 switching times vs. I_C

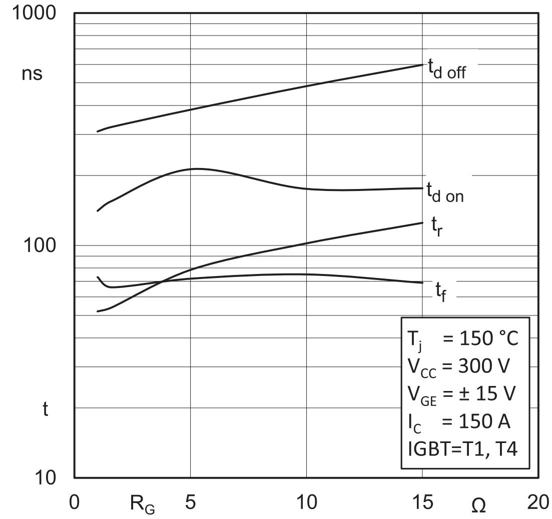


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

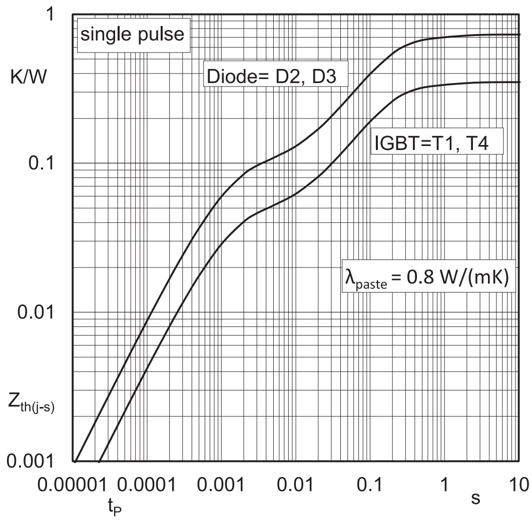


Fig. 9: Transient thermal impedance of IGBT1 & Diode2

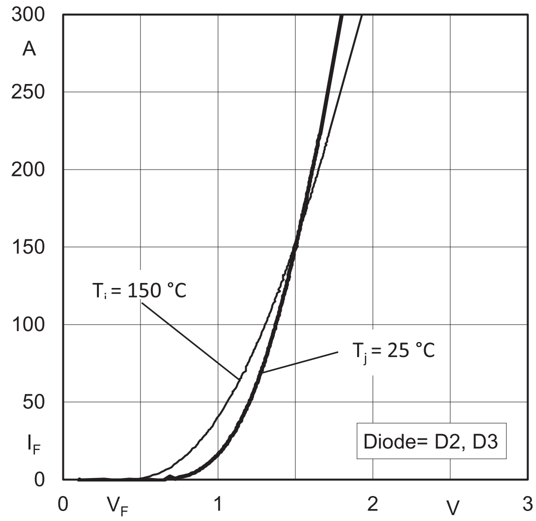


Fig. 10: Typ. Diode2 forward characteristic, incl. $R_{CC'+ EE'}$

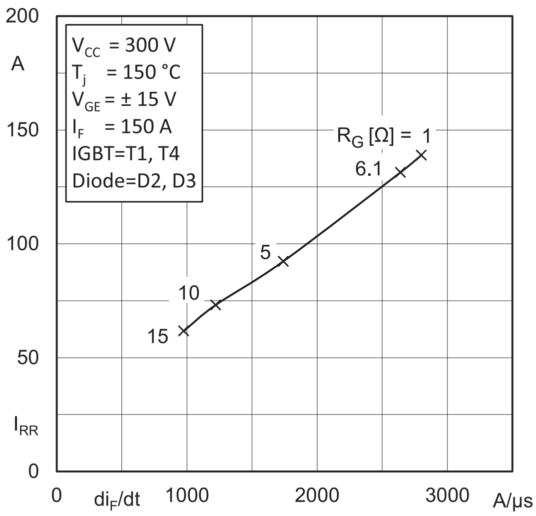


Fig. 11: Typ. Diode2 peak reverse recovery current

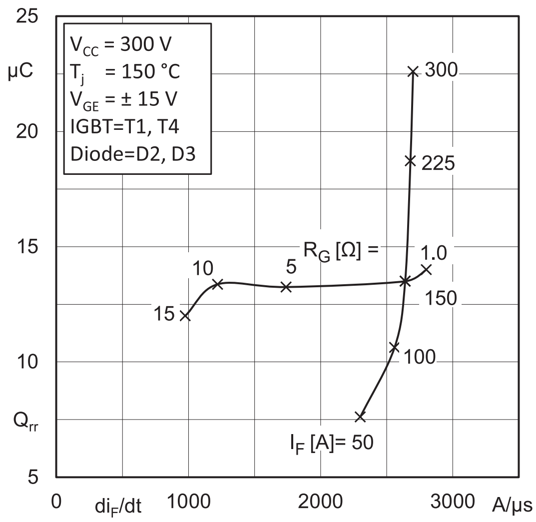


Fig. 12: Typ. Diode2 recovery charge

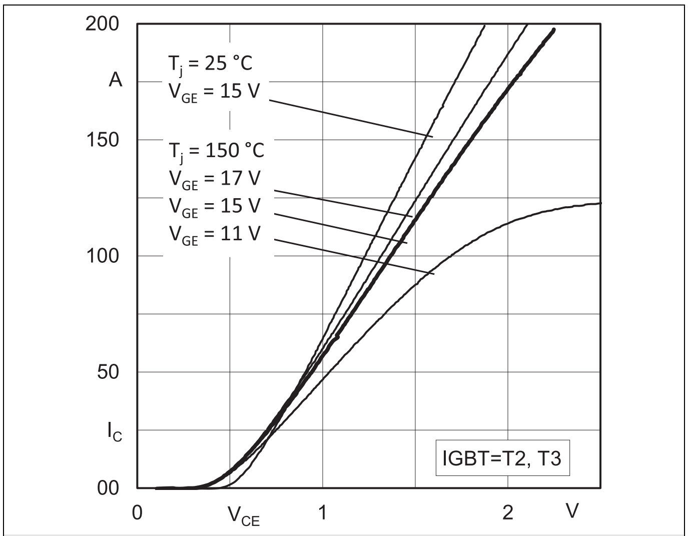


Fig. 13: Typ. IGBT2 output characteristic, incl. $R_{CC'+ EE'}$

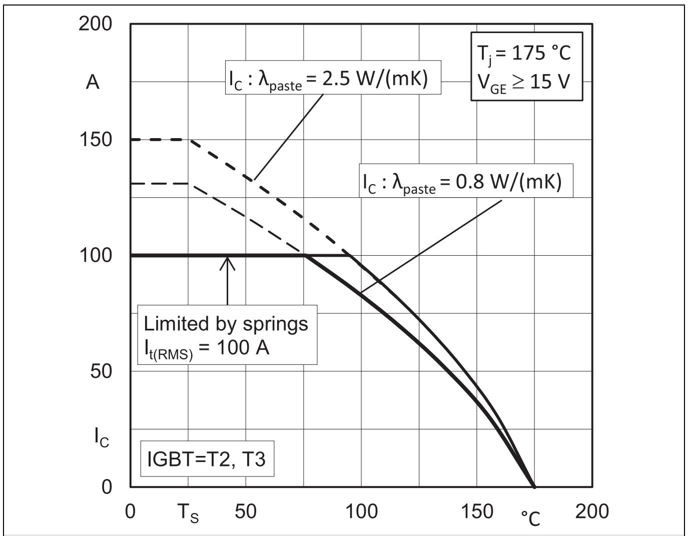


Fig. 14: IGBT2 Rated current vs. Temperature I_c= f (T_s)

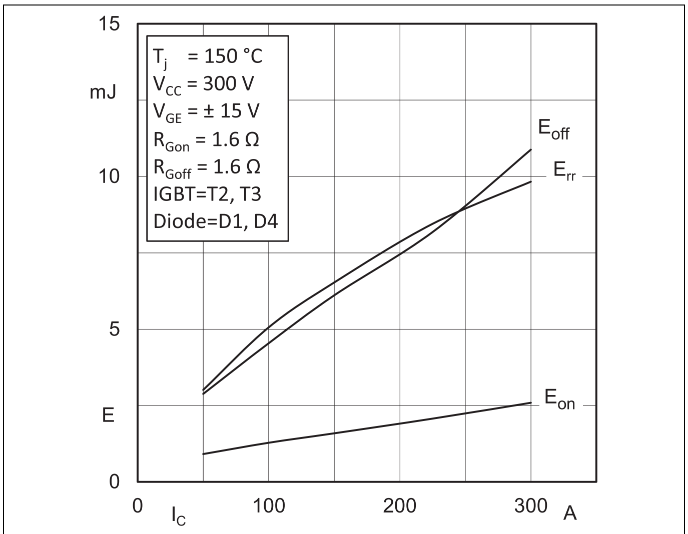


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = f (I_C)

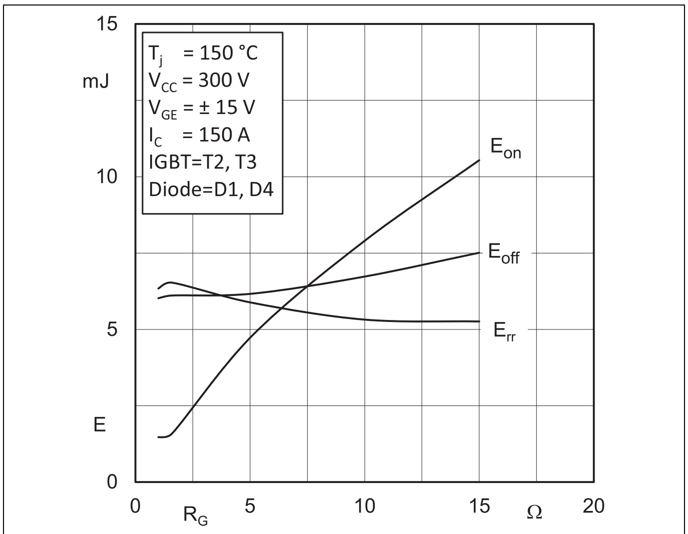


Fig. 16: Typ. IGBT2 & Diode1 turn-on / -off energy = f(R_G)

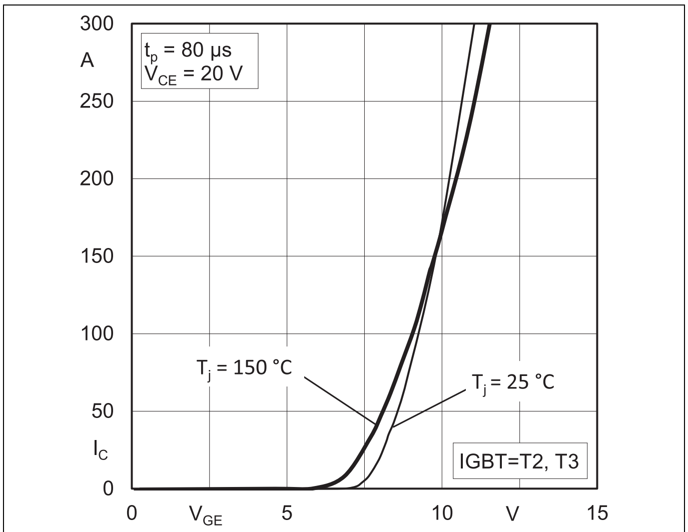


Fig. 17: Typ. IGBT2 transfer characteristic

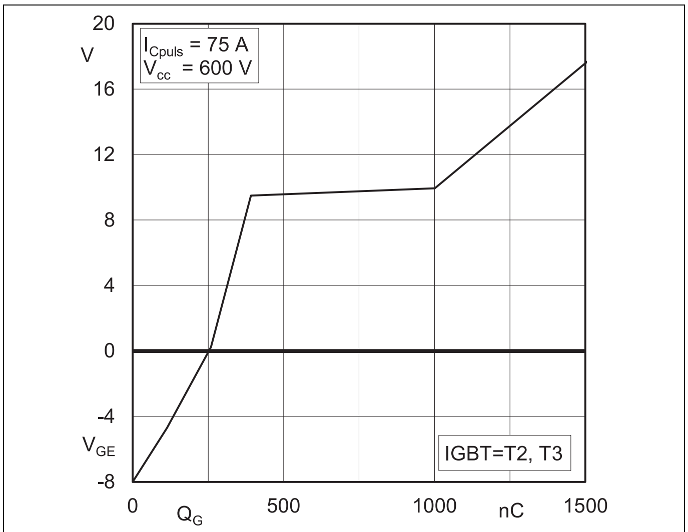


Fig. 18: Typ. IGBT2 gate charge characteristic

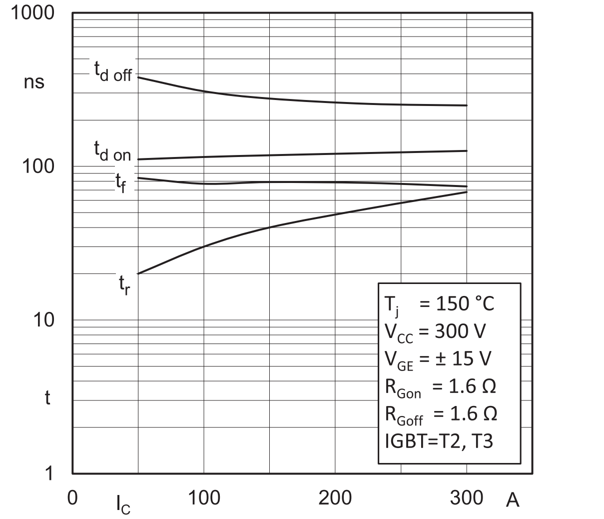


Fig. 19: Typ. IGBT2 switching times vs. I_C

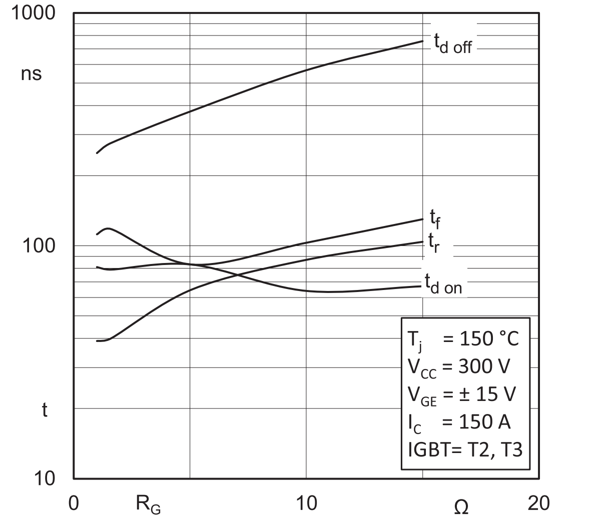


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

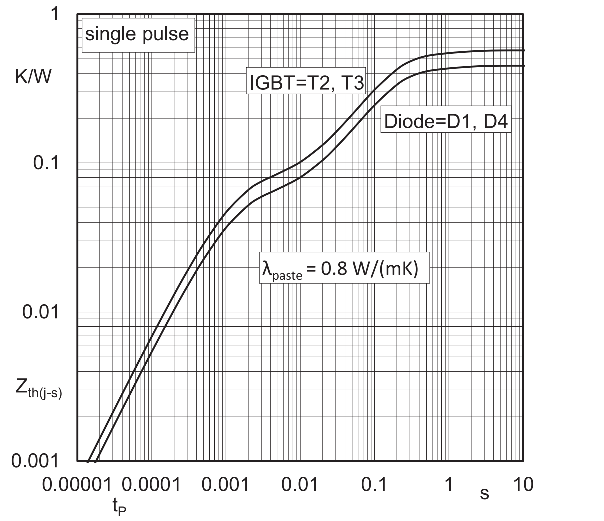


Fig. 21: Transient thermal impedance of IGBT2 & Diode1

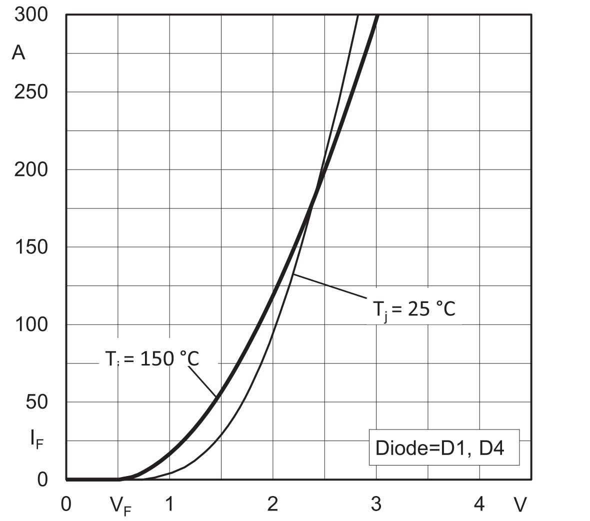


Fig. 22: Typ. Diode1 forward characteristic, incl. $R_{CC'+ EE'}$

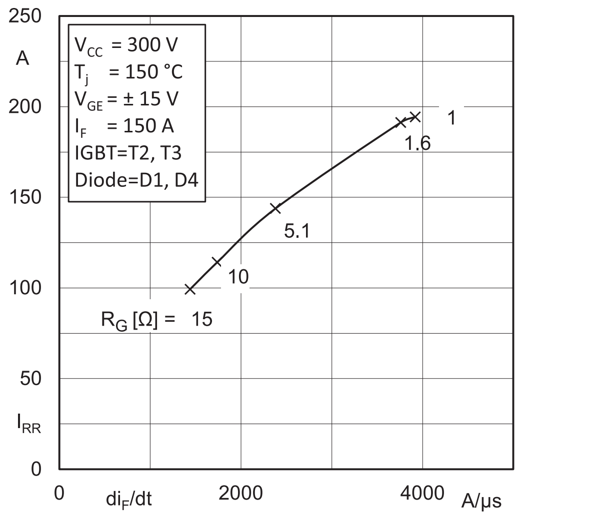


Fig. 23: Typ. Diode1 peak reverse recovery current

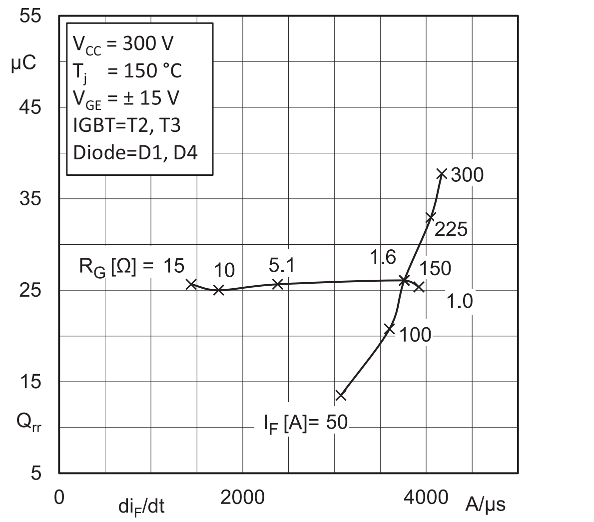
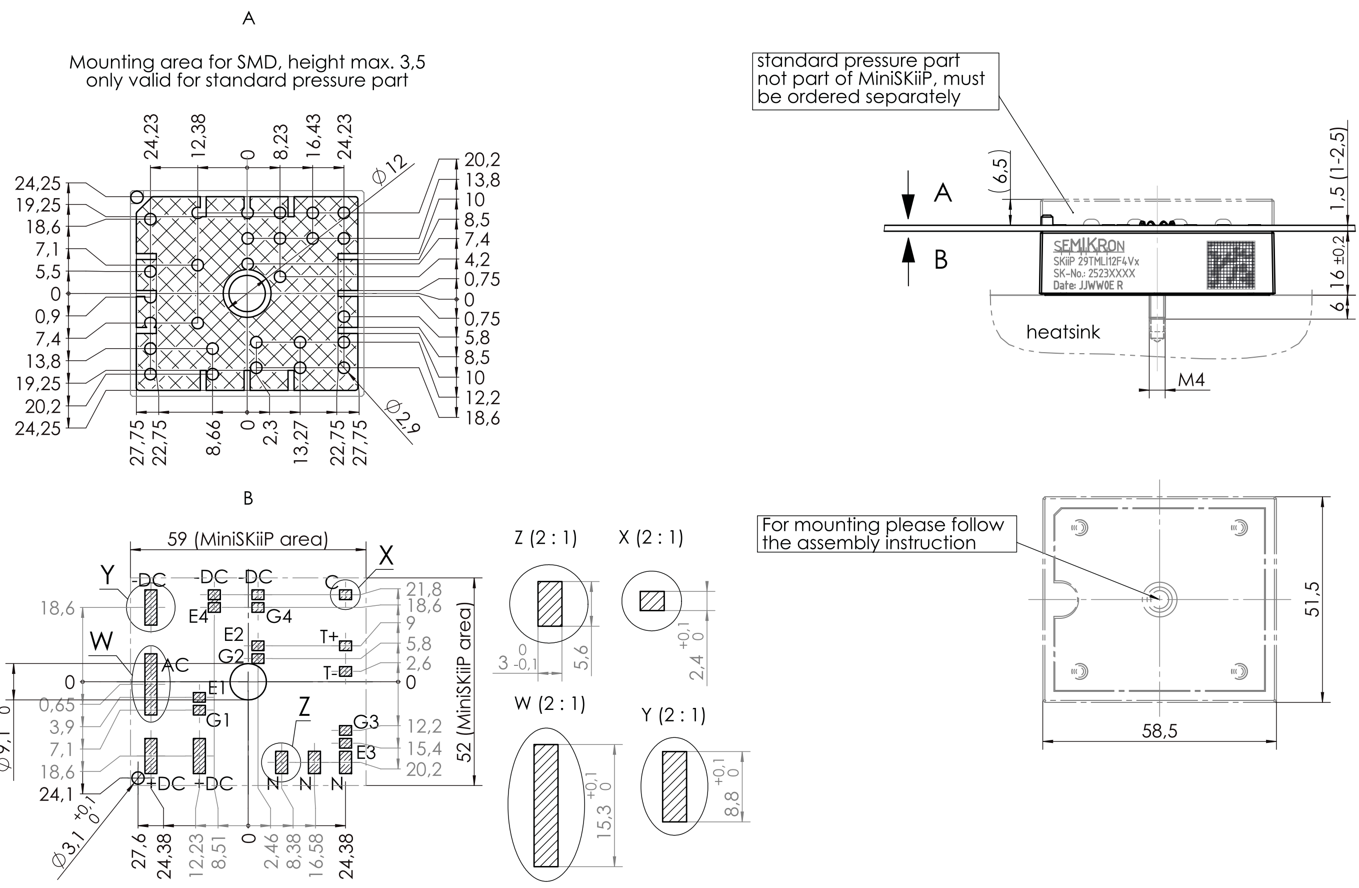
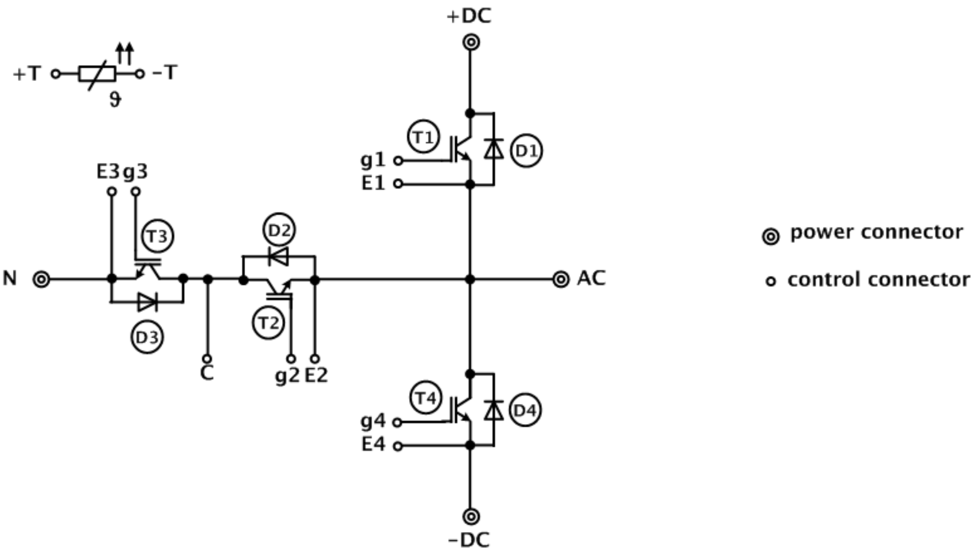


Fig. 24: Typ. Diode1 recovery charge



pinout, dimensions



pinout

This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

***IMPORTANT INFORMATION AND WARNINGS**

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