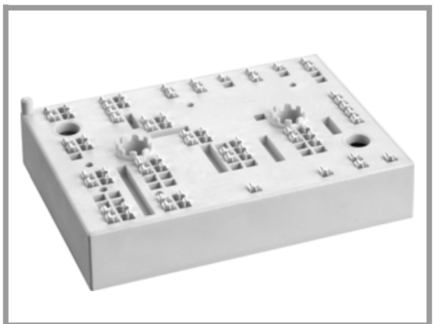


MiniSKiiP® 3

3-Level 3 Phase TNPC IGBT-Module

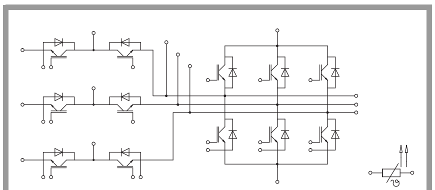
SKiiP 35TMLI12F4V2

Features

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

Remarks*

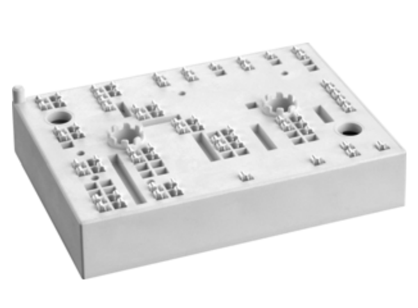
- Max. case temperature limited to T_C= 125°C
- Product reliability results valid for T_j≤150°C (recommended $T_{j,op}$=-40...+150°C)
- IGBT 1: outer IGBTs T1-T6
- IGBT 2: inner IGBTs T7-T12
- Diode 1: outer diodes D1-D6
- Diode 2: inner diodes D7-D12



3~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_j = 175 °C	T_s = 25 °C	49	A
		T_s = 70 °C	40	A
I_C	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 25 °C	56	A
		T_s = 70 °C	46	A
I_{Cnom}			40	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		120	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 800 V, V_{GE} ≤ 15 V, T_j = 150 °C, V_{CES} ≤ 1200 V		10	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	42	A
		T_s = 70 °C	34	A
I_C	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 25 °C	46	A
		T_s = 70 °C	37	A
I_{Cnom}			30	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		90	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	46	A
		T_s = 70 °C	37	A
I_F	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 25 °C	51	A
		T_s = 70 °C	41	A
I_{Fnom}			35	A
I_{FRM}	I_{FRM} = 3 x I_{Fnom}		105	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		170	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	69	A
		T_s = 70 °C	54	A
I_F	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 25 °C	78	A
		T_s = 70 °C	61	A
I_{Fnom}			50	A
I_{FRM}	I_{FRM} = 2 x I_{Fnom}		100	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		550	A
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$			40	A
T_{stg}			-40 ... 125	°C
V_{isol}	AC sinus 50 Hz, t = 1 min		2500	V



MiniSKiiP® 3

3-Level 3 Phase TNPC IGBT-Module

SKiiP 35TMLI12F4V2

Features

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Remarks*

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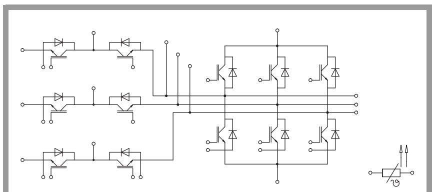

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Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
$V_{CE(sat)}$	I_C = 40 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		2.05	2.40	V
		T_j = 150 °C		2.59	2.85	V
V_{CE0}	chiplevel	T_j = 25 °C		0.80	0.90	V
		T_j = 150 °C		0.70	0.80	V
r_{CE}	V_{GE} = 15 V, chiplevel	T_j = 25 °C		31	38	mΩ
		T_j = 150 °C		47	51	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 1.5 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		2.30		nF
C_{oes}		f = 1 MHz		0.19		nF
C_{res}		f = 1 MHz		0.14		nF
Q_G	V_{GE} = - 8 V...+ 15 V			227		nC
R_{Gint}	T_j = 25 °C			0		Ω
$t_{d(on)}$	V_{CE} = 300 V, I_C = 40 A, V_{GE} = +15/-15 V, $R_{G\,on}$ = 8.2 Ω, $R_{G\,off}$ = 8.2 Ω, di/dt_{on} = 1140 A/µs, di/dt_{off} = 500 A/µs	T_j = 150 °C		18		ns
t_r		T_j = 150 °C		29		ns
E_{on}		T_j = 150 °C		1.2		mJ
$t_{d(off)}$		T_j = 150 °C		240		ns
t_f		T_j = 150 °C		66		ns
E_{off}		T_j = 150 °C		1.7		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.88		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.71		K/W
IGBT2						
$V_{CE(sat)}$	I_C = 30 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.45	1.87	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		18	29	mΩ
		T_j = 150 °C		29	40	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 0.43 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		1.63		nF
C_{oes}		f = 1 MHz		0.11		nF
C_{res}		f = 1 MHz		0.05		nF
Q_G	V_{GE} = - 8 V...+ 15 V			240		nC
R_{Gint}	T_j = 25 °C			0		Ω
$t_{d(on)}$	V_{CE} = 300 V, I_C = 30 A, V_{GE} = +15/-15 V, $R_{G\,on}$ = 10 Ω, $R_{G\,off}$ = 10 Ω, di/dt_{on} = 1050 A/µs, di/dt_{off} = 350 A/µs	T_j = 150 °C		9.2		ns
t_r		T_j = 150 °C		32		ns
E_{on}		T_j = 150 °C		0.8		mJ
$t_{d(off)}$		T_j = 150 °C		174		ns
t_f		T_j = 150 °C		72		ns
E_{off}		T_j = 150 °C		1		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			1.35		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			1.15		K/W

MiniSKiiP® 3

3-Level 3 Phase TNPC IGBT-Module

SKiiP 35TMLI12F4V2

Features

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Remarks*

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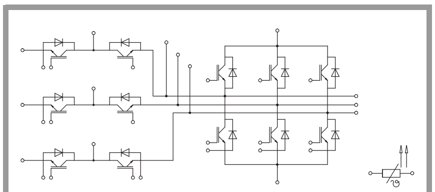
- Product reliability results valid for T_j≤150°C (recommended $T_{j,op}$=-40...+150°C)
- IGBT 1: outer IGBTs T1-T6
- IGBT 2: inner IGBTs T7-T12
- Diode 1: outer diodes D1-D6
- Diode 2: inner diodes D7-D12

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Diode1						
$V_F = V_{EC}$	I_F = 35 A V_{GE} = 0 V chiplevel	T_j = 25 °C		2.30	2.62	V
		T_j = 150 °C		2.29	2.62	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		29	32	mΩ
		T_j = 150 °C		40	43	mΩ
I_{RRM}	I_F = 35 A di/dt_{off} = 1050 A/µs V_R = 300 V V_{GE} = +15/-15 V	T_j = 150 °C		40		A
Q_{rr}		T_j = 150 °C		4.5		µC
E_{rr}		T_j = 150 °C		1		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			1.13		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.95		K/W
Diode2						
$V_F = V_{EC}$	I_F = 50 A V_{GE} = 0 V chiplevel	T_j = 25 °C		1.37	1.73	V
		T_j = 150 °C		1.35	1.72	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		6.7	9.8	mΩ
		T_j = 150 °C		10	15	mΩ
I_{RRM}	I_F = 50 A di/dt_{off} = 1140 A/µs V_R = 300 V V_{GE} = +15/-15 V	T_j = 150 °C		46.7		A
Q_{rr}		T_j = 150 °C		4.2		µC
E_{rr}		T_j = 150 °C		0.8		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			1.14		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.95		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				82		g
Temperature Sensor						
R_{100}	T_r=100°C (R_{25}=1000Ω)			1670 ± 3%		Ω
R(T)	R(T)=1000Ω[1+A(T-25°C)+B(T-25°C)^2], A = 7.635*10^{-3} °C^{-1}, B = 1.731*10^{-5} °C^{-2}					



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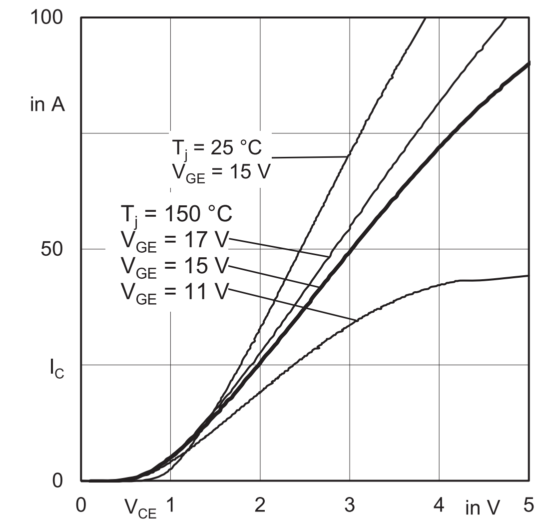


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+EE'}$

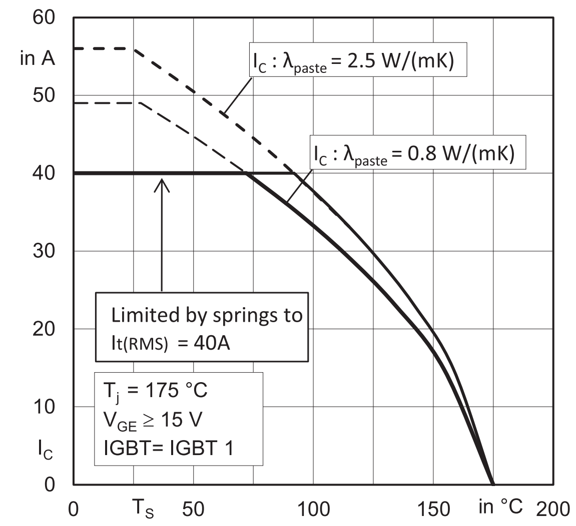


Fig. 2: IGBT1 rated current vs. Temperature $I_c=f(T_s)$

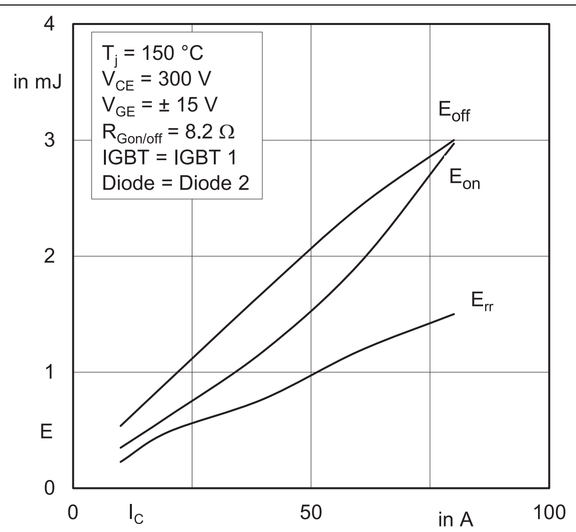


Fig. 3: Typ. IGBT1 & Diode2 turn-on /-off energy = f (I_C)

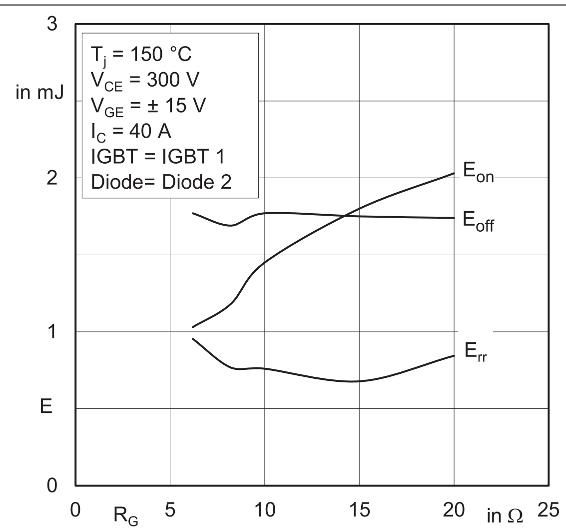


Fig. 4: Typ. IGBT1 & Diode2 turn-on /-off energy = f(R_G)

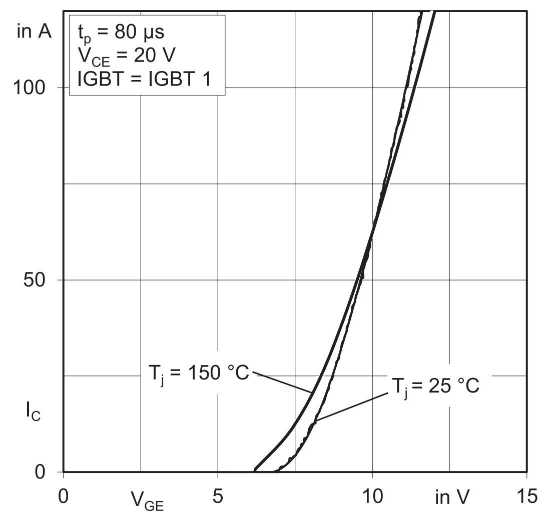


Fig. 5: Typ. IGBT1 transfer characteristic

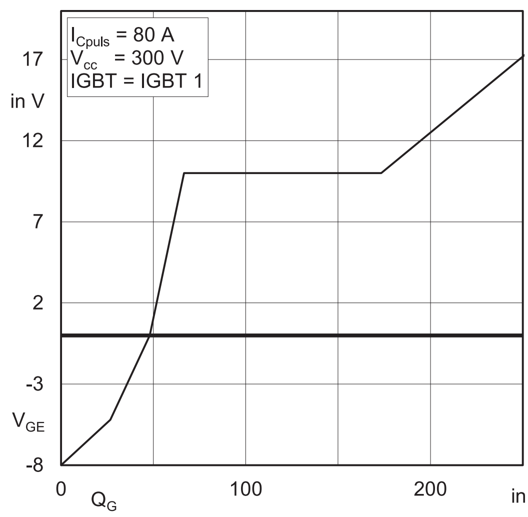


Fig. 6: Typ. IGBT1 gate charge characteristic

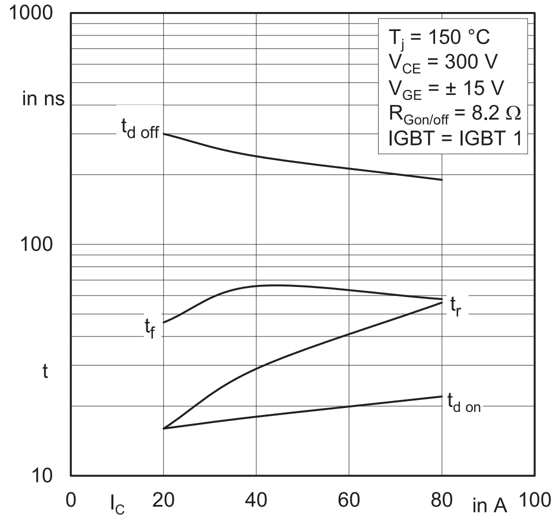


Fig. 7: Typ. IGBT1 switching times vs. I_C

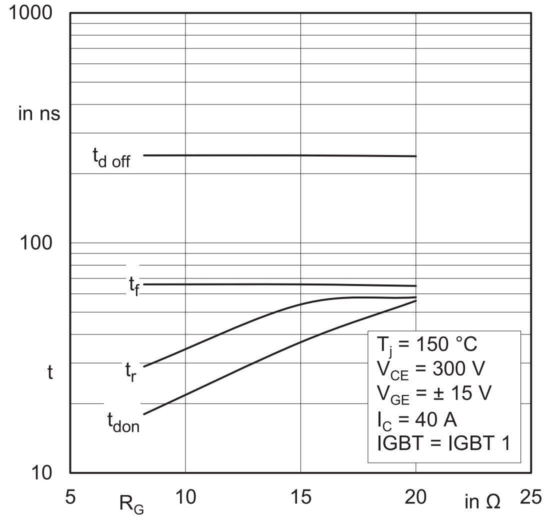


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

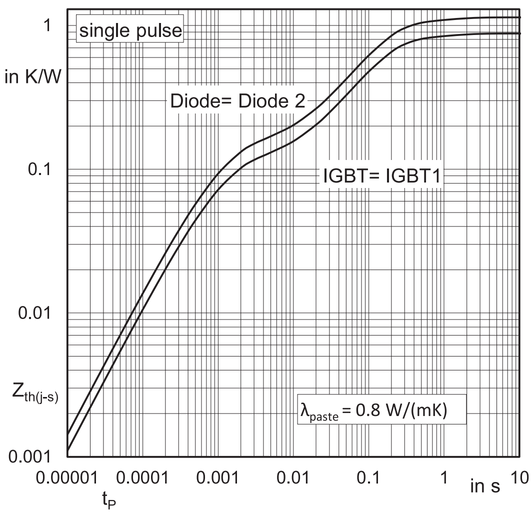


Fig. 9: Transient thermal impedance of IGBT1 & Diode2

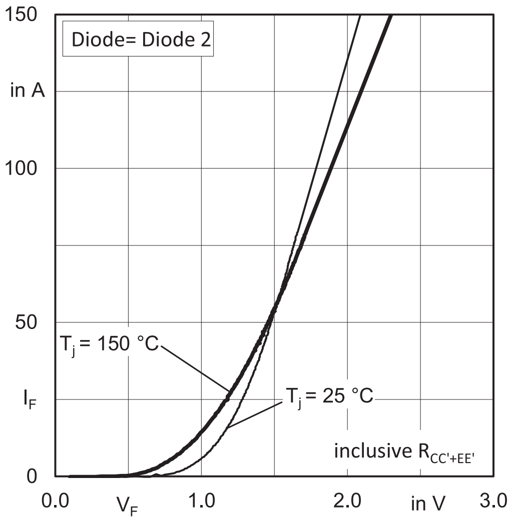


Fig. 10: Diode2 forward characteristic

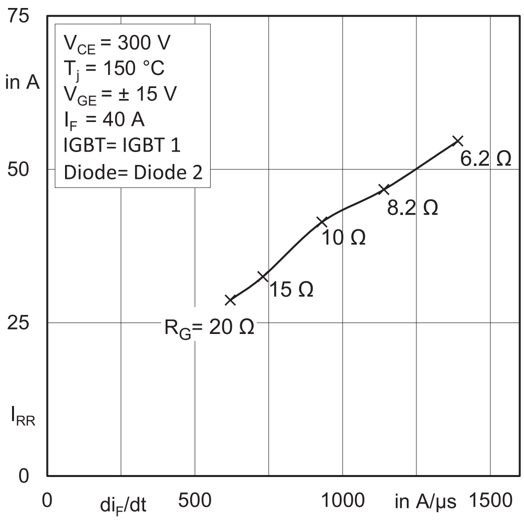


Fig. 11: Typ. Diode2 peak reverse recovery current

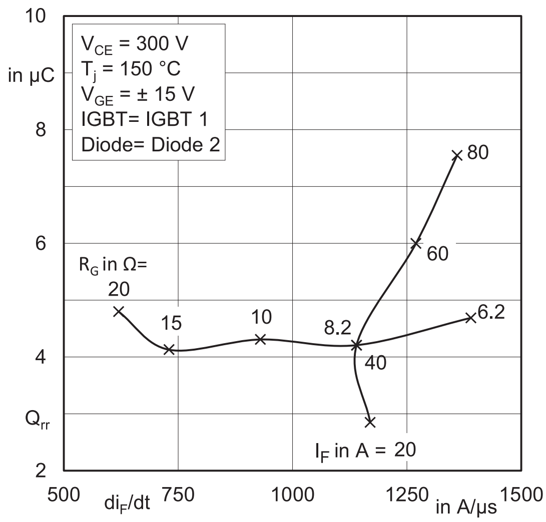


Fig. 12: Typ. Diode2 recovery charge

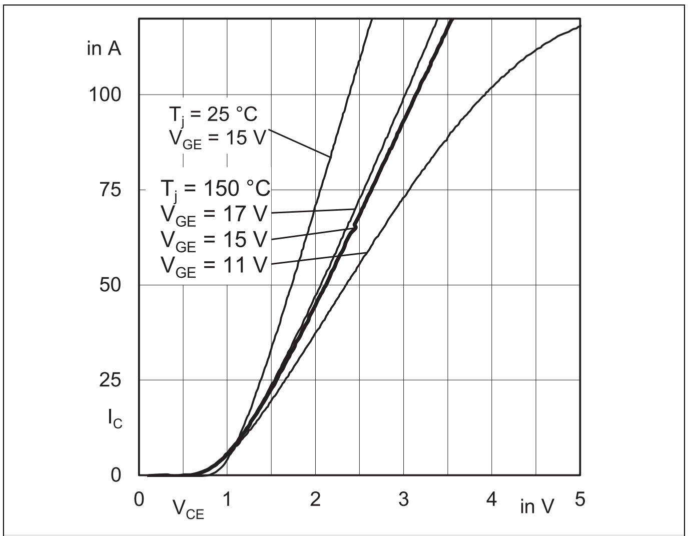


Fig. 13: Typ. IGBT2 output characteristic, incl. $R_{CC'+EE'}$

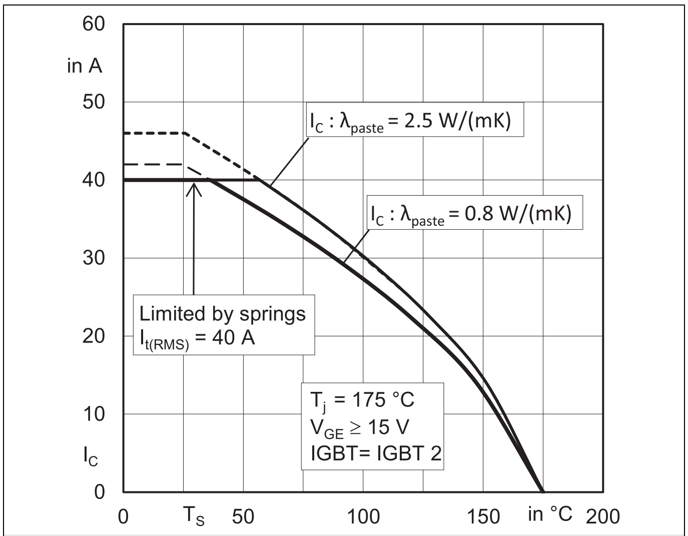


Fig. 14: IGBT2 Rated current vs. Temperature I_c= f (T_s)

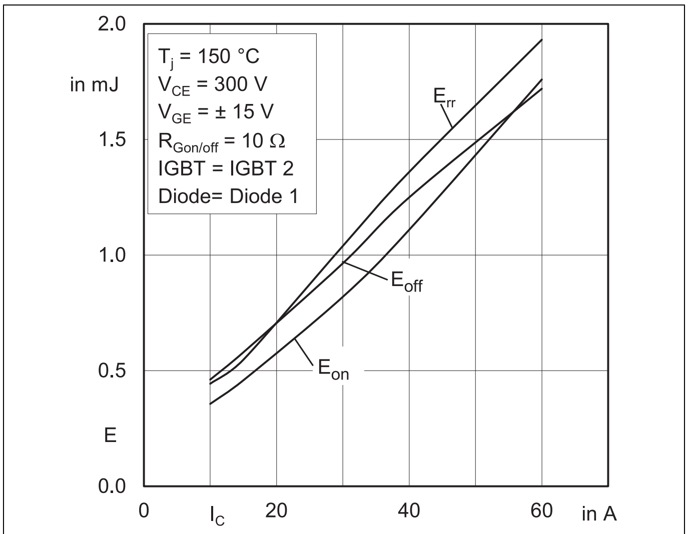


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = f (I_C)

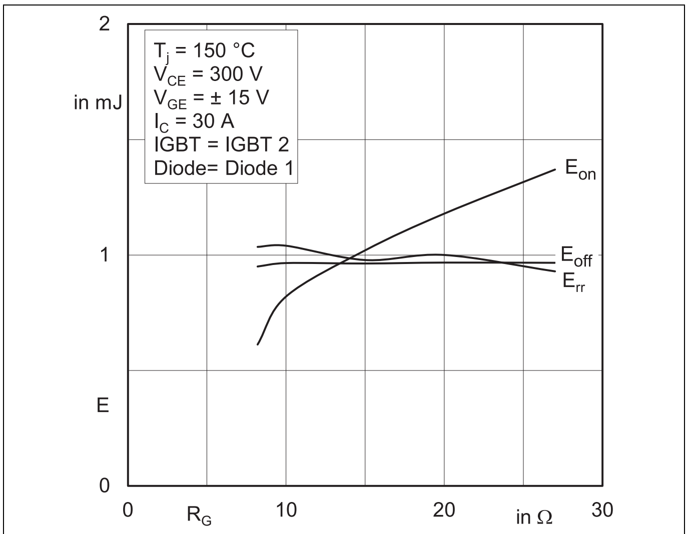


Fig. 16: Typ. IGBT2 & Diode1 turn-on / -off energy = f(R_G)

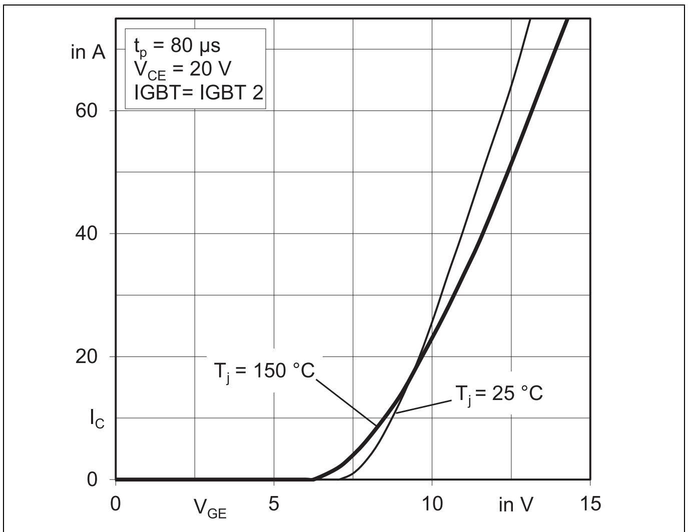


Fig. 17: Typ. IGBT2 transfer characteristic

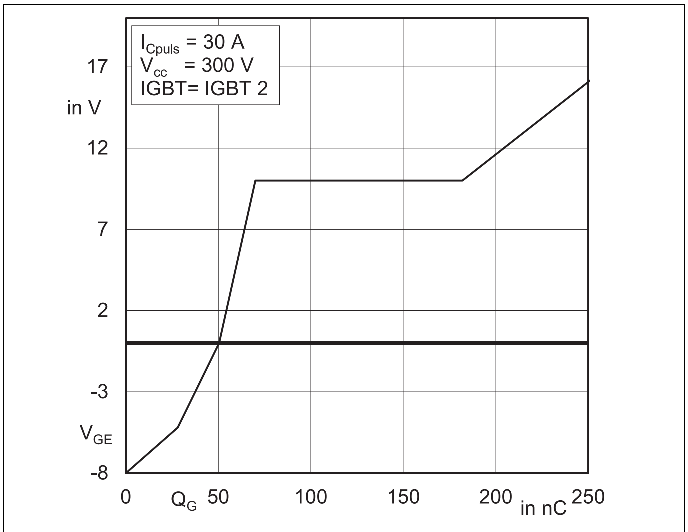


Fig. 18: Typ. IGBT2 gate charge characteristic

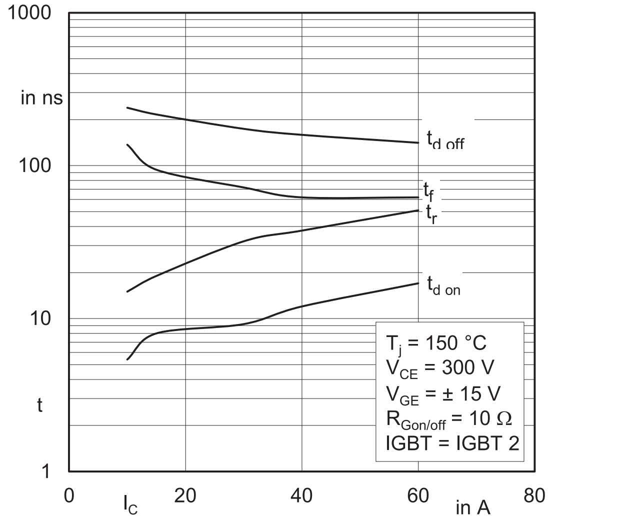


Fig. 19: Typ. IGBT2 switching times vs. I_C

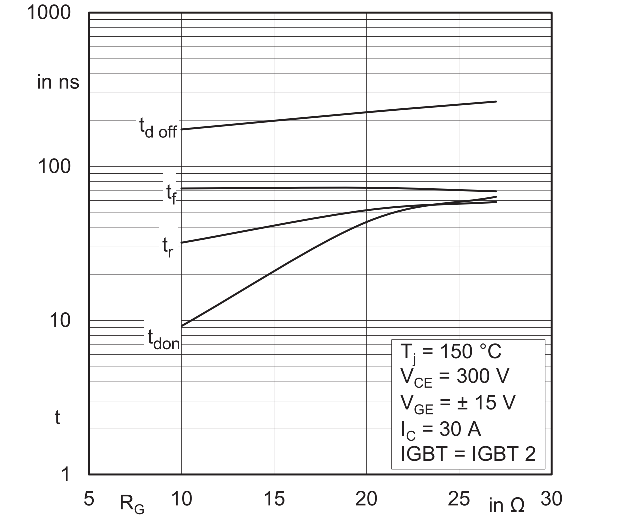


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

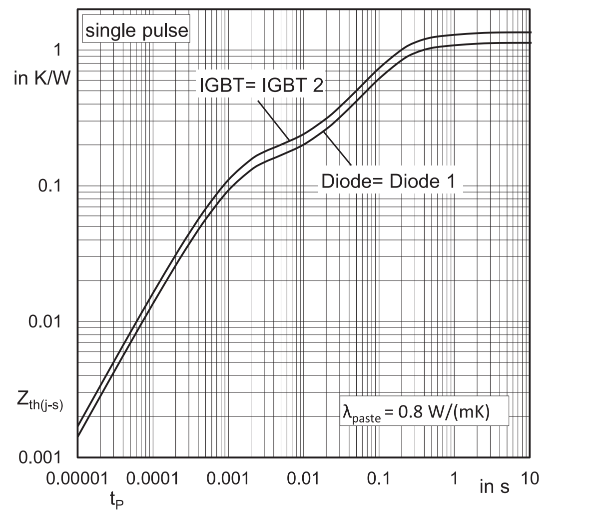


Fig. 21: Transient thermal impedance of IGBT2 & Diode1

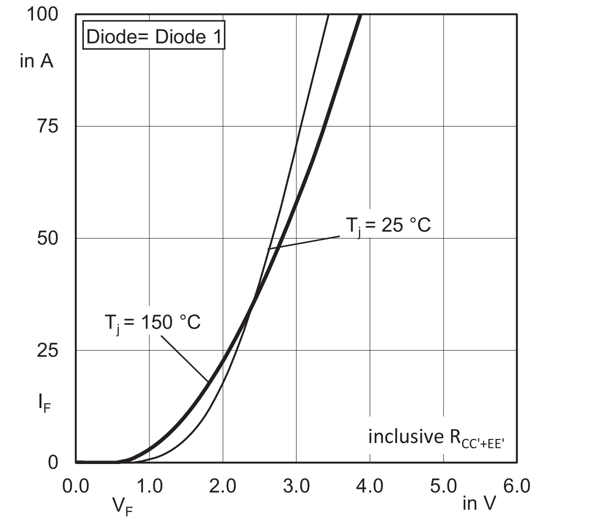


Fig. 22: Diode1 forward characteristic

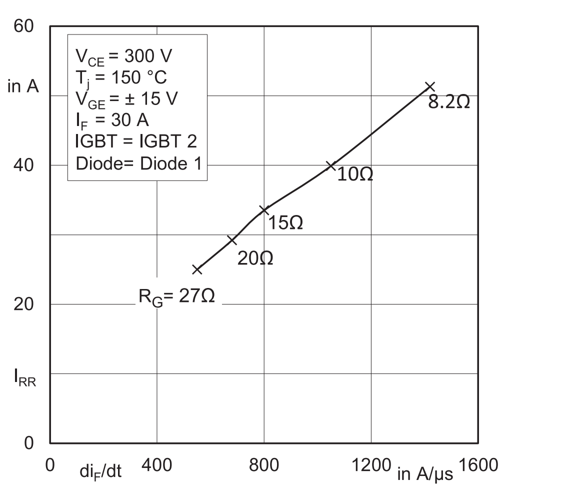


Fig. 23: Typ. Diode1 peak reverse recovery current

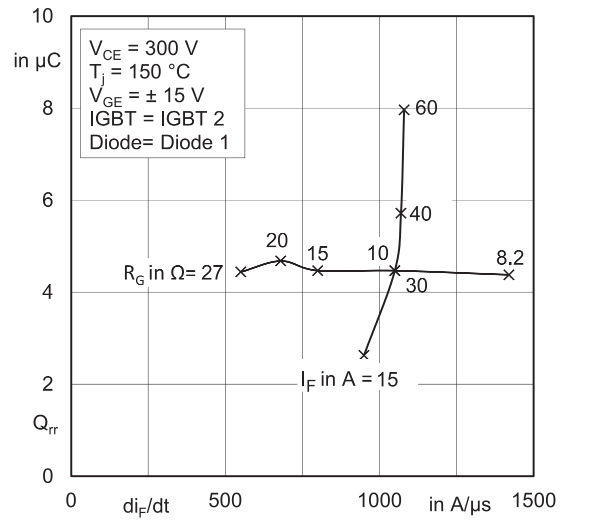
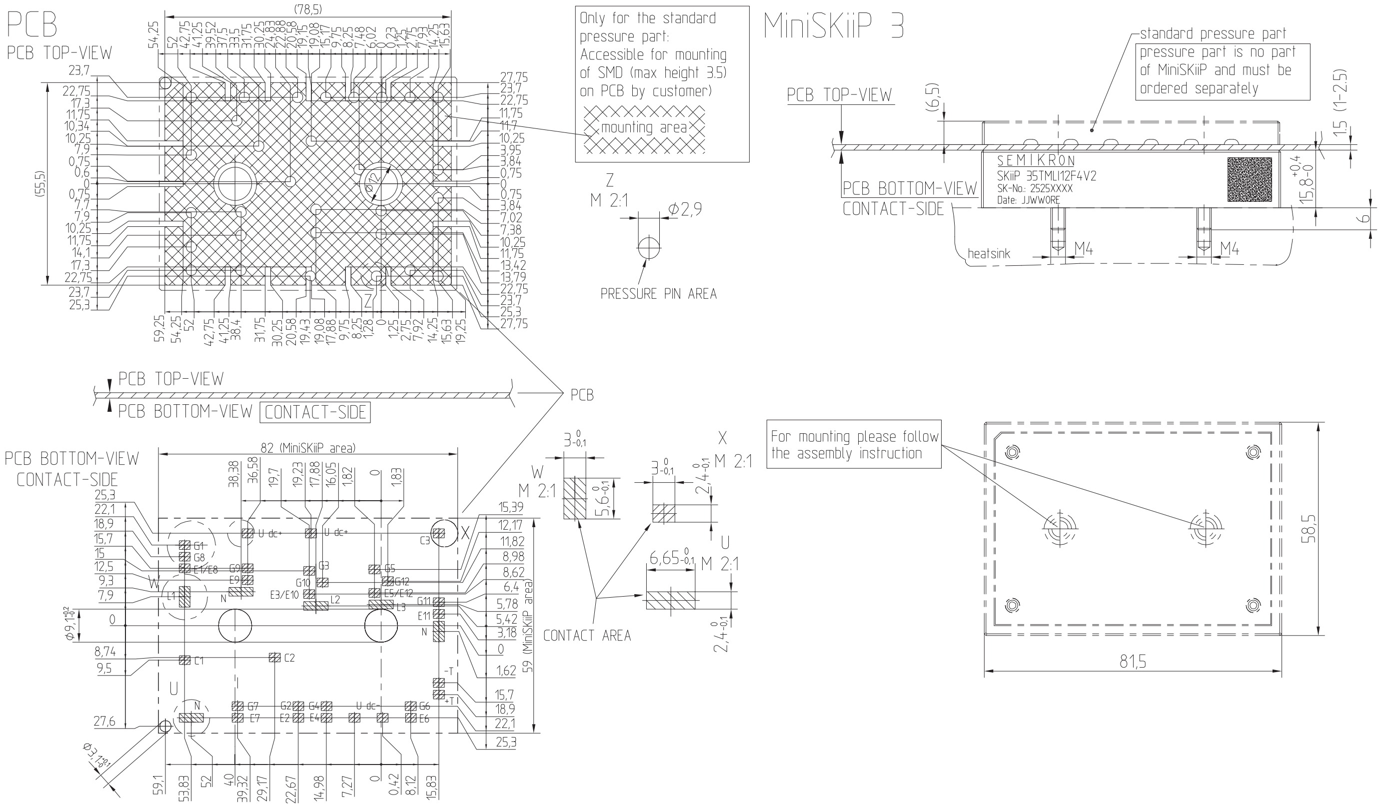
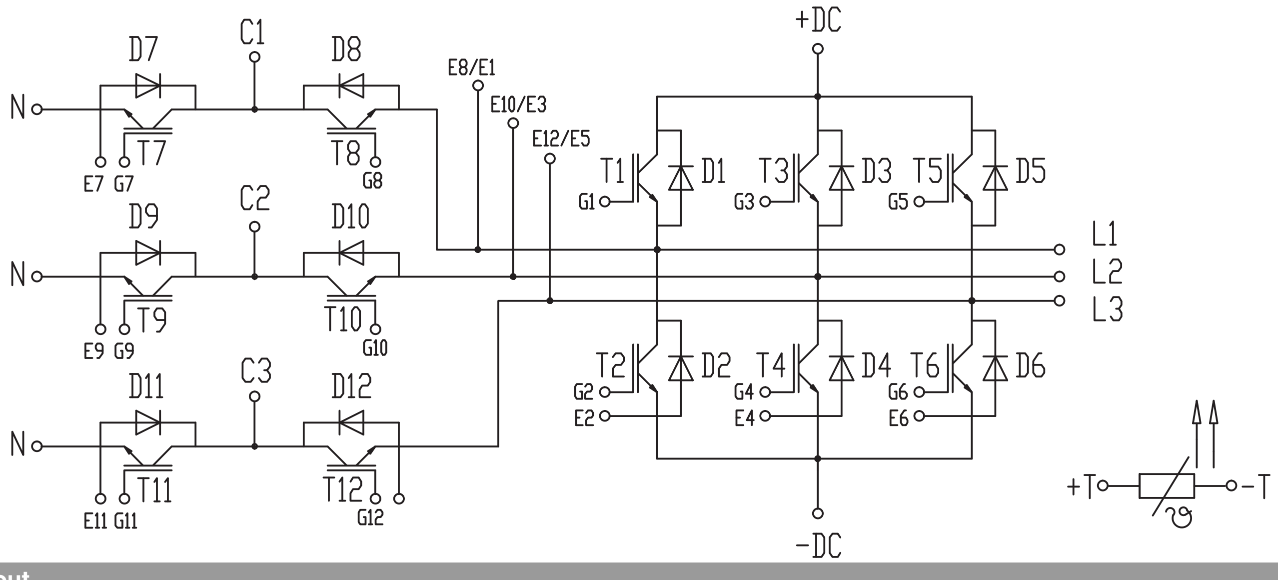


Fig. 24: Typ. Diode1 recovery charge



pinout, dimensions



pinout

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

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