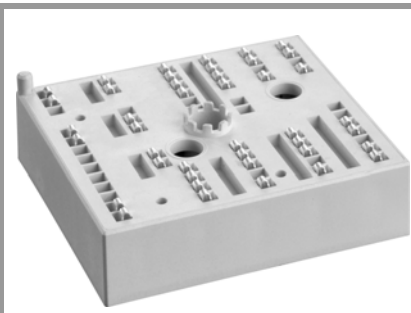


SKiP 28TMLI12F4V1



MiniSKiP® 2

3-Level TNPC Inverter (*)

SKiP 28TMLI12F4V1

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

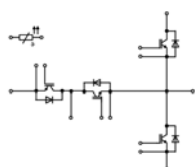
Remarks

- Case temperature limited to $T_C=125^{\circ}\text{C}$ max.; $T_C = T_S$ (for baseplateless modules)
- Product reliability results valid for $T_j \leq 150^{\circ}\text{C}$ (recommended $T_{jop} = -40 \dots +150^{\circ}\text{C}$)
- IGBT 1: outer IGBTs T1&T4
- IGBT 2: inner IGBTs T2&T3
- Diode 1: outer diodes D1&D4
- Diode 2: inner diodes D2&D3

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT 1				
V _{CES}	T _j = 25 °C		1200	V
I _C	T _j = 150 °C	T _s = 25 °C	84	A
		T _s = 70 °C	65	A
I _C	T _j = 175 °C	T _s = 25 °C	93	A
		T _s = 70 °C	76	A
I _{Cnom}			80	A
I _{CRM}	I _{CRM} = 3 x I _{Cnom}		240	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V V _{GE} ≤ 15 V V _{CES} ≤ 1200 V	T _j = 150 °C	10	μs
T _j			-40 ... 175	°C

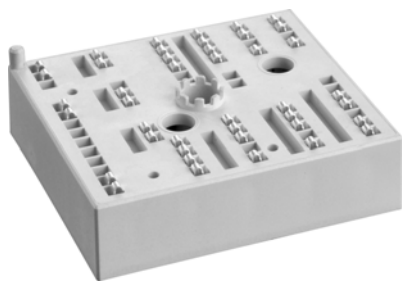
Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT 2				
V _{CES}	T _j = 25 °C		650	V
I _C	T _j = 150 °C	T _s = 25 °C	68	A
		T _s = 70 °C	51	A
I _C	T _j = 175 °C	T _s = 25 °C	77	A
		T _s = 70 °C	61	A
I _{Cnom}			75	A
I _{CRM}	I _{CRM} = 3 x I _{Cnom}		225	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 360 V V _{GE} ≤ 15 V V _{CES} ≤ 650 V	T _j = 150 °C	6	µs
T _j			-40 ... 175	°C

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Diode 1				
V _{RRM}	T _j = 25 °C		1200	V
I _F	T _j = 150 °C	T _s = 25 °C	68	A
		T _s = 70 °C	51	A
I _F	T _j = 175 °C	T _s = 25 °C	76	A
		T _s = 70 °C	61	A
I _{Fnom}			75	A
I _{FRM}	I _{FRM} = 3 x I _{Fnom}		225	A
I _{FSM}	10 ms, sin 180°, T _j = 150 °C		430	A
T _j			-40 ... 175	°C



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3-Level TNPC Inverter (*)

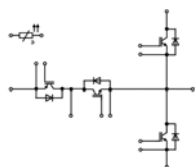
SKiP 28TMLI12F4V1

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- Diode 1: outer diodes D1&D4
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TMLI

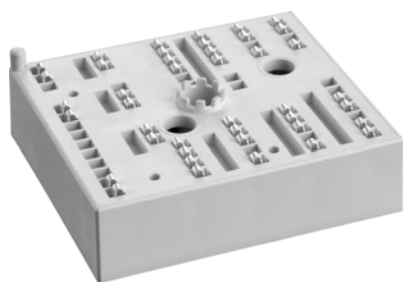
Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Diode 2				
V _{RRM}	T _j = 25 °C		650	V
I _F	T _j = 175 °C	T _s = 25 °C	65	A
		T _s = 70 °C	51	A
I _{Fnom}			50	A
I _{FRM}	I _{FRM} = 2 x I _{Fnom}		100	A
I _{FSM}	10 ms sin 180°	T _j = 25 °C	550	A
		T _j = 150 °C	460	A
T _j			-40 ... 175	°C

Absolute Maximum Ratings			
Symbol	Conditions	Values	Unit
Module			
I _{t(RMS)}	T _{terminal} = 80 °C, 20 A per spring	80	A
T _{stg}		-40 ... 125	°C
V _{isol}	AC sinus 50 Hz, t = 1 min	2500	V

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT 1						
V _{CE(sat)}	I _C = 80 A	T _j = 25 °C		2.05	2.40	V
	V _{GE} = 15 V chipelevel	T _j = 150 °C		2.50	2.85	V
V _{CE0}	chipelevel	T _j = 25 °C		0.8	0.9	V
		T _j = 150 °C		0.7	0.8	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		16	19	mΩ
	chipelevel	T _j = 150 °C		23	26	mΩ
V _{GE(th)}	V _{GE} = V _{CE} V, I _C = 1 mA		5.2	5.8	6.4	V
I _{CES}	V _{GE} = 0 V	T _j = 25 °C		0.1	0.3	mA
	V _{CE} = 1200 V					mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		4.60		nF
C _{oes}		f = 1 MHz		0.37		nF
C _{res}		f = 1 MHz		0.27		nF
Q _G	- 8 V...+ 15 V			370		nC
R _{Gint}	T _j = 25 °C			4		Ω
t _{d(on)}	V _{CE} = 300 V	T _j = 150 °C		168		ns
t _r	I _C = 80 A	T _j = 150 °C		54		ns
E _{on}	R _{G on} = 1.6 Ω R _{G off} = 1.6 Ω	T _j = 150 °C		3.4		mJ
t _{d(off)}	di/dt _{on} = 1330 A/μs	T _j = 150 °C		285		ns
t _f	di/dt _{off} = 1220 A/μs	T _j = 150 °C		58		ns
E _{off}	V _{GE neg} = -15 V V _{GE pos} = 15 V	T _j = 150 °C		2.2		mJ
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/K*m			0.49		K/W

Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
Module					
M _s	to heat sink	2		2.5	Nm
w	weight		55		g

SKiiP 28TMLI12F4V1



MiniSKiiP® 2

3-Level TNPC Inverter (*)

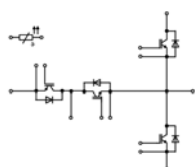
SKiiP 28TMLI12F4V1

Features

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- 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 $T_C=125^\circ\text{C}$ max.; $T_C = T_S$ (for baseplateless modules)
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- IGBT 1: outer IGBTs T1&T4
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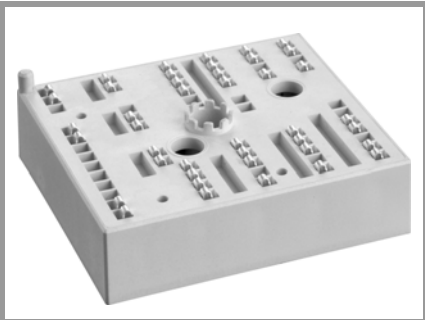
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT 2						
V _{CE(sat)}	I _C = 75 A	T _j = 25 °C		1.45	1.77	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		1.70	2.10	V
V _{CE0}	chiplevel	T _j = 25 °C		0.9	1	V
		T _j = 150 °C		0.82	0.9	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		7.3	10	mΩ
	chiplevel	T _j = 150 °C		12	16	mΩ
V _{GE(th)}	V _{GE} = V _{CE} V, I _C = 1.5 mA		5.1	5.8	6.4	V
I _{CES}	V _{GE} = 0 V	T _j = 25 °C		0.1	0.3	mA
	V _{CE} = 650 V	T _j = 150 °C				mA
C _{ies}	V _{CE} = 25 V	f = 1 MHz		4.62		nF
C _{oes}	V _{GE} = 0 V	f = 1 MHz		0.30		nF
C _{res}		f = 1 MHz		0.14		nF
Q _G	- 8 V...+ 15 V			680		nC
R _{Gint}	T _j = 25 °C			4		Ω
t _{d(on)}	V _{CE} = 300 V	T _j = 150 °C		84		ns
t _r	I _C = 75 A	T _j = 150 °C		33		ns
E _{on}	R _{G on} = 1.6 Ω	T _j = 150 °C		1.6		mJ
t _{d(off)}	R _{G off} = 1.6 Ω	T _j = 150 °C		212		ns
t _f	di/dt _{on} = 2600 A/μs	T _j = 150 °C		65		ns
E _{off}	di/dt _{off} = 1000 A/μs	T _j = 150 °C				
	V _{GE neg} = -15 V	T _j = 150 °C		1.9		mJ
	V _{GE pos} = 15 V					
R _{th(j-s)}	per IGBT, λ _{paste} =0.8 W/K*m			0.89		K/W

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode 1						
V _F = V _{EC}	I _F = 75 A	T _j = 25 °C		2.2	2.5	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.1	2.4	V
V _{F0}	chiplevel	T _j = 25 °C		1.3	1.5	V
		T _j = 150 °C		0.9	1.1	V
r _F	chiplevel	T _j = 25 °C		12	13	mΩ
		T _j = 150 °C		16	18	mΩ
I _{RRM}	I _F = 75 A	T _j = 150 °C		115		A
Q _{rr}	di/dt _{off} = 2360 A/μs	T _j = 150 °C		8.9		μC
E _{rr}	V _{GE} = -15 V V _R = 300 V	T _j = 150 °C		1.7		mJ
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/K*m			0.86		K/W

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode 2						
V _F = V _{EC}	I _F = 50 A	T _j = 25 °C		1.4	1.7	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		1.4	1.7	V
V _{F0}	chiplevel	T _j = 25 °C		1	1.2	V
		T _j = 150 °C		0.9	1	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	T _j = 125 °C		48.7		A
Q _{rr}	di/dt _{off} = 1250 A/μs	T _j = 125 °C		5		μC
E _{rr}	V _{GE} = -15 V	T _j = 125 °C		0.7		mJ
	V _R = 300 V					
R _{th(j-s)}	per Diode, λ _{paste} =0.8 W/K*m			1.25		K/W

SKiiP 28TMLI12F4V1



MiniSKiiP® 2

Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
Temperature Sensor					
R ₁₀₀	T _r = 100 °C, tolerance = 3 %		1670 ± 3%		Ω
B _{100/125}	$R(T)=1000\Omega[1+A(T-25^{\circ}\text{C})+B(T-25^{\circ}\text{C})^2]$, A = 7.635*10 ⁻³ °C ⁻¹ , B = 1.731*10 ⁻⁵ °C ⁻²		3550 ± 2%		K

3-Level TNPC Inverter (*)

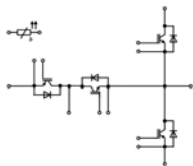
SKiiP 28TMLI12F4V1

Features

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- IGBT 2: inner IGBTs T2&T3
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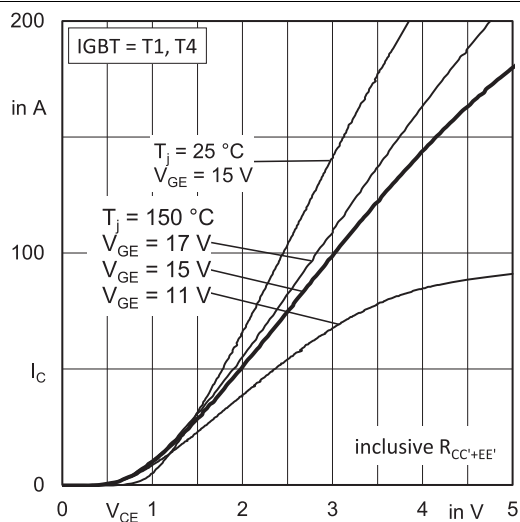


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

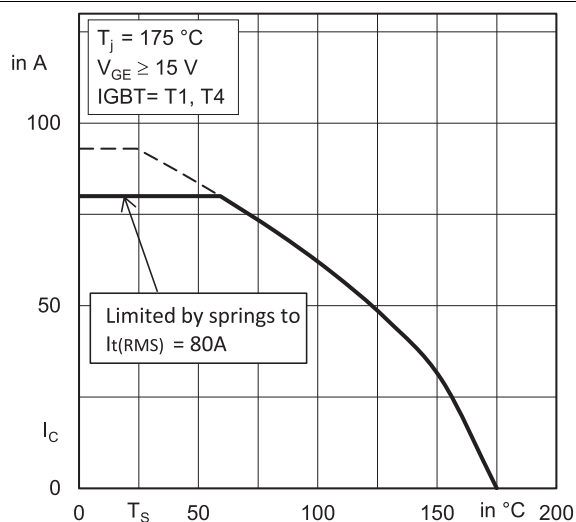


Fig. 2: Rated current vs. temperature $I_C = f(T_s)$

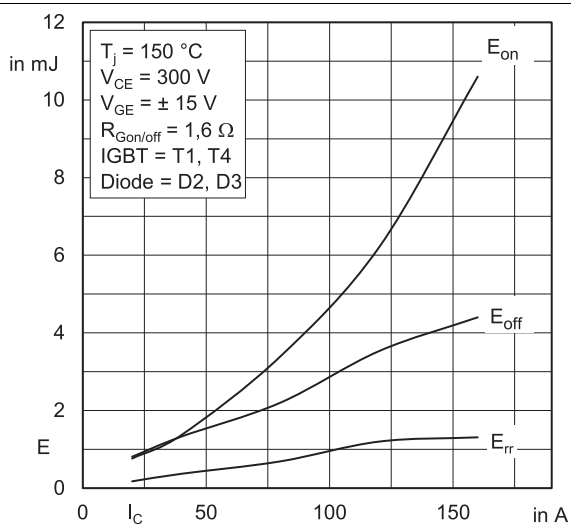


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

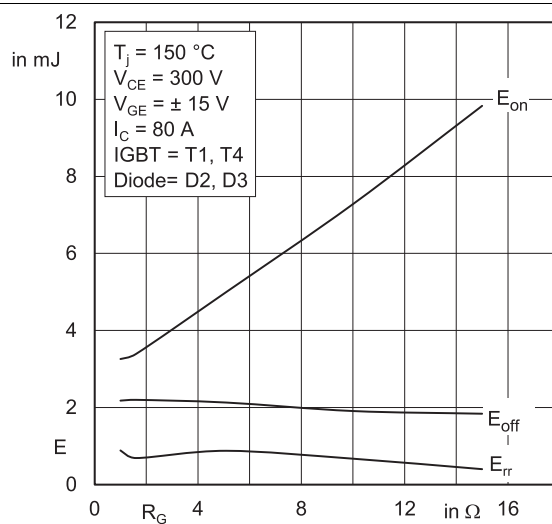


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

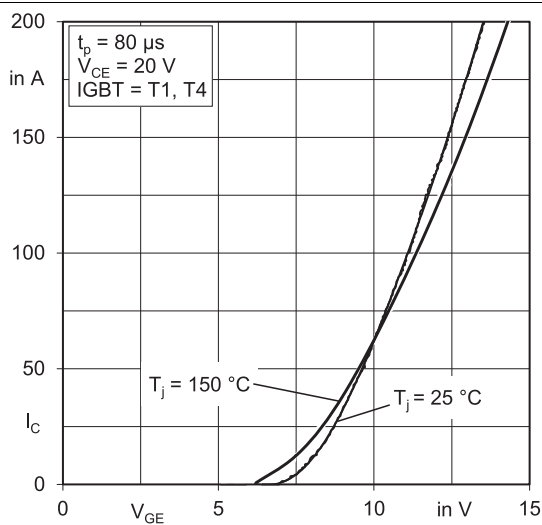


Fig. 5: Typ. transfer characteristic

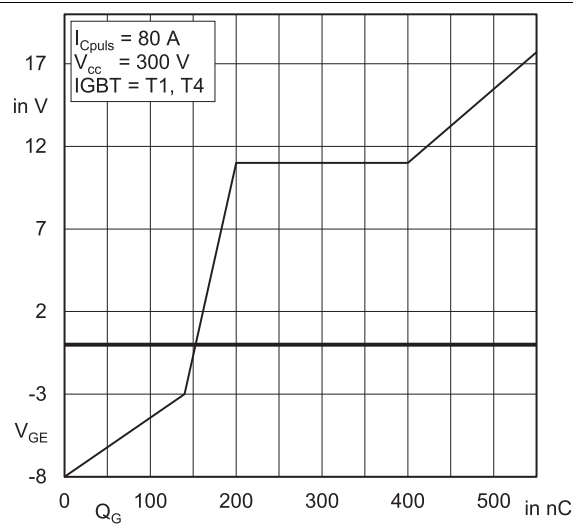


Fig. 6: Typ. gate charge characteristic

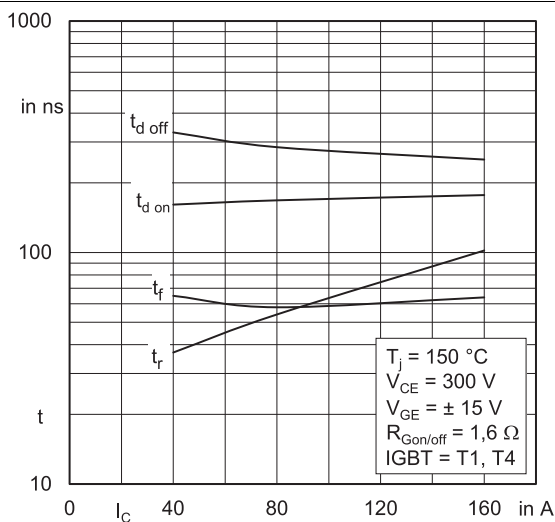


Fig. 7: Typ. switching times vs. I_C

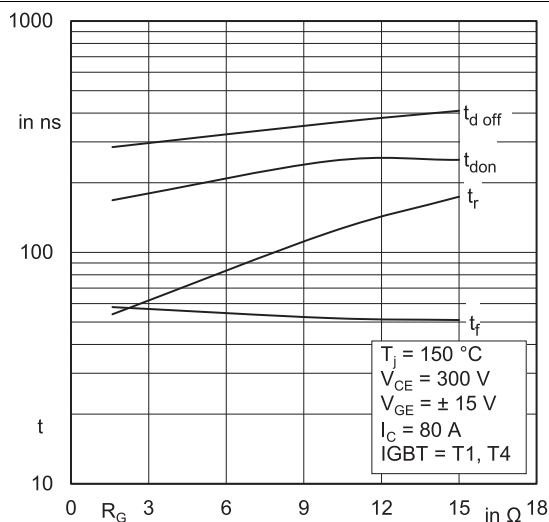


Fig. 8: Typ. switching times vs. gate resistor R_G

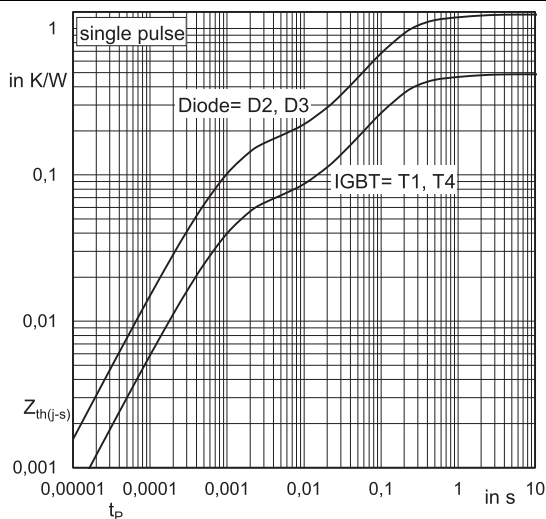


Fig. 9: Transient thermal impedance of IGBT and Diode

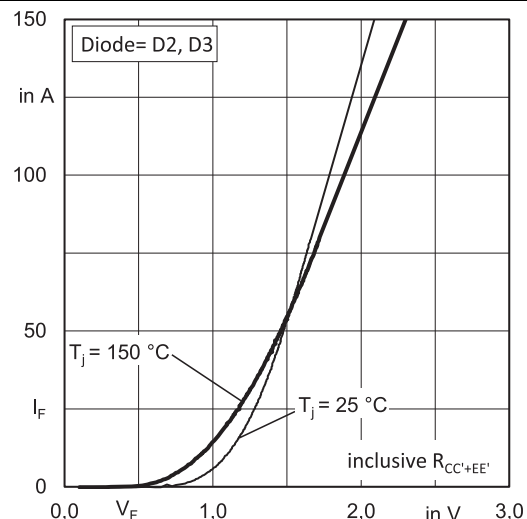


Fig. 10: CAL diode forward characteristic

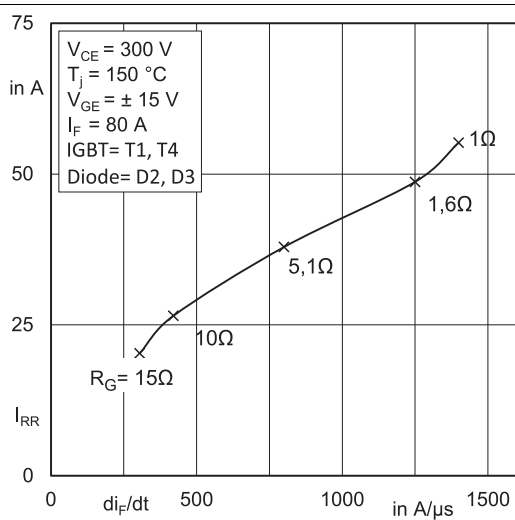


Fig. 11: Typ. CAL diode peak reverse recovery current

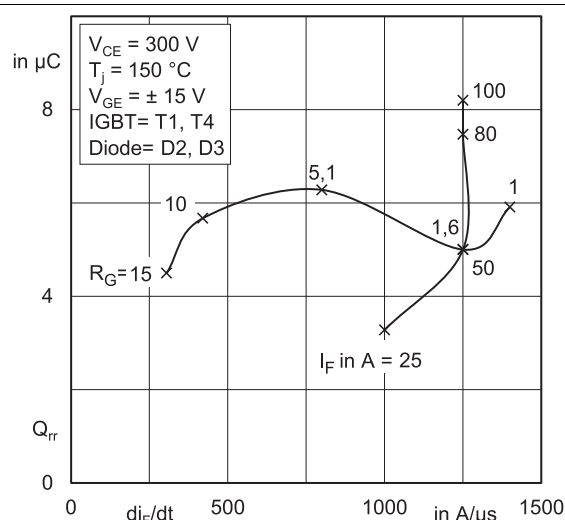


Fig. 12: Typ. CAL diode recovery charge

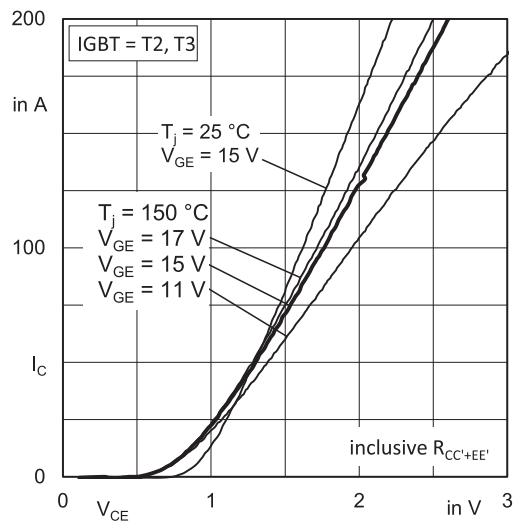


Fig. 13: Typ. output characteristic, inclusive $R_{CC'+EE'}$

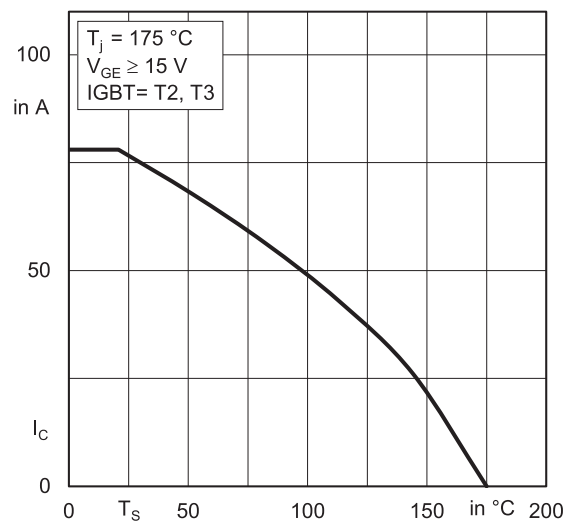


Fig. 14: Rated current vs. temperature $I_C = f(T_s)$

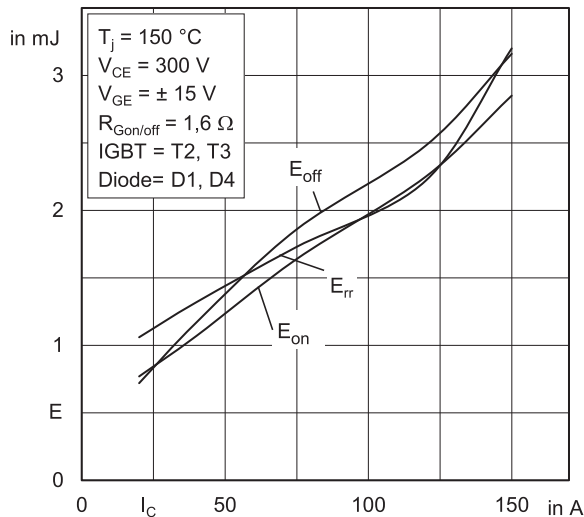


Fig. 15: Typ. turn-on /-off energy = $f(I_C)$

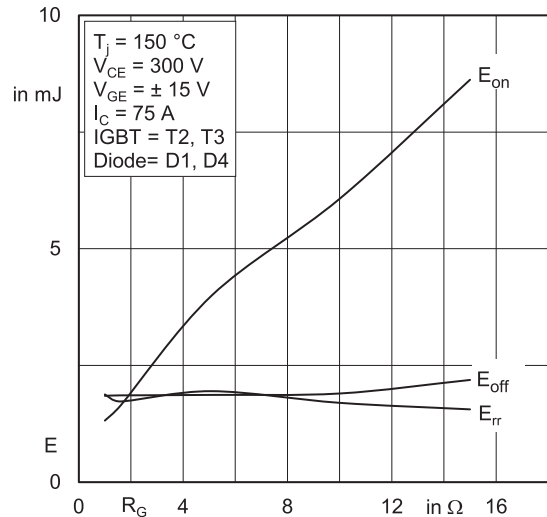


Fig. 16: Typ. turn-on /-off energy = $f(R_G)$

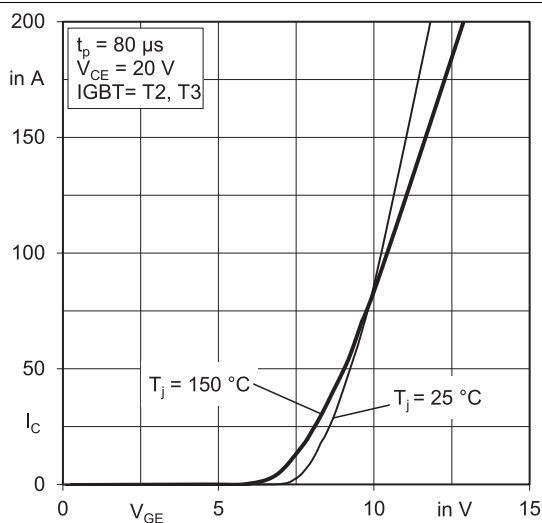


Fig. 17: Typ. transfer characteristic

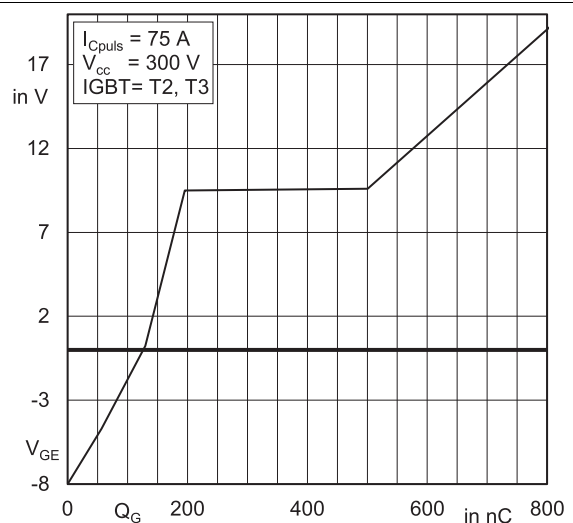


Fig. 18: Typ. gate charge characteristic

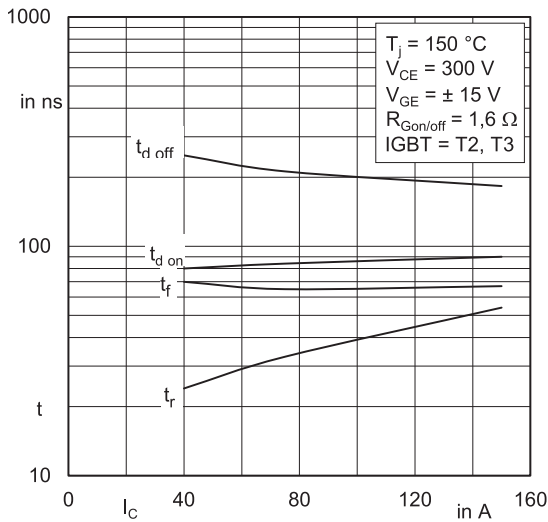


Fig. 19: Typ. switching times vs. I_C

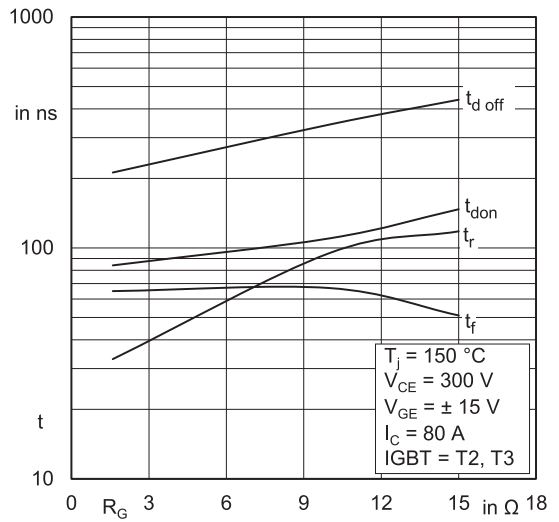


Fig. 20: Typ. switching times vs. gate resistor R_G

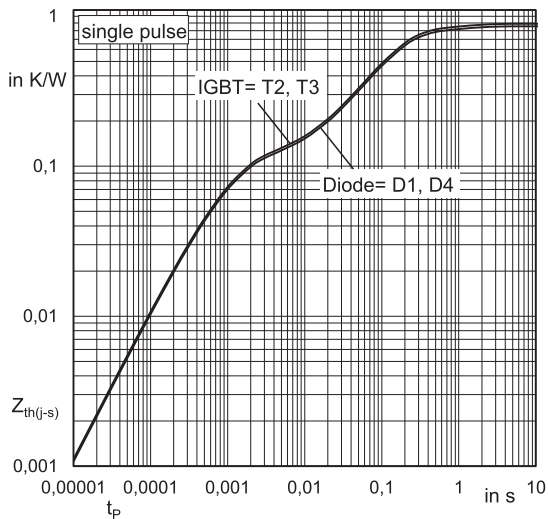


Fig. 21: Transient thermal impedance of IGBT and Diode

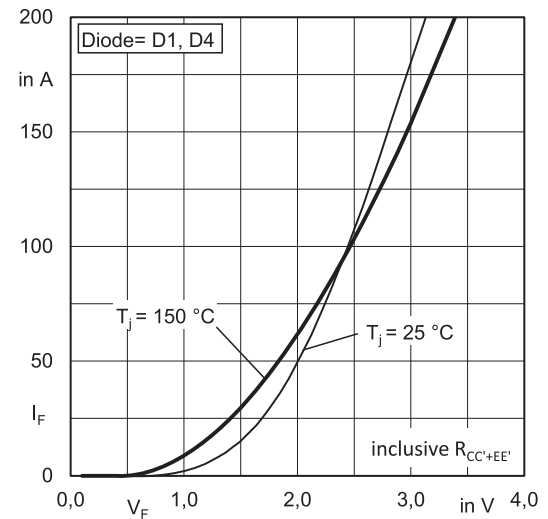


Fig. 22: CAL diode forward characteristic

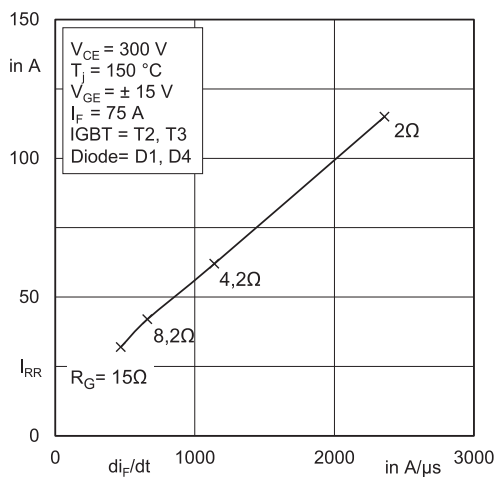


Fig. 23: Typ. CAL diode peak reverse recovery current

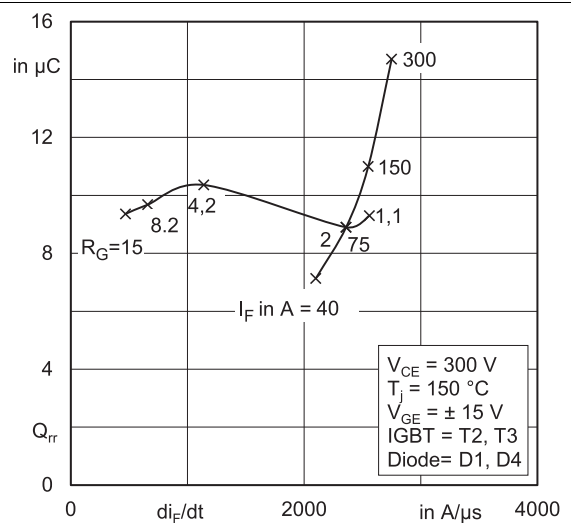
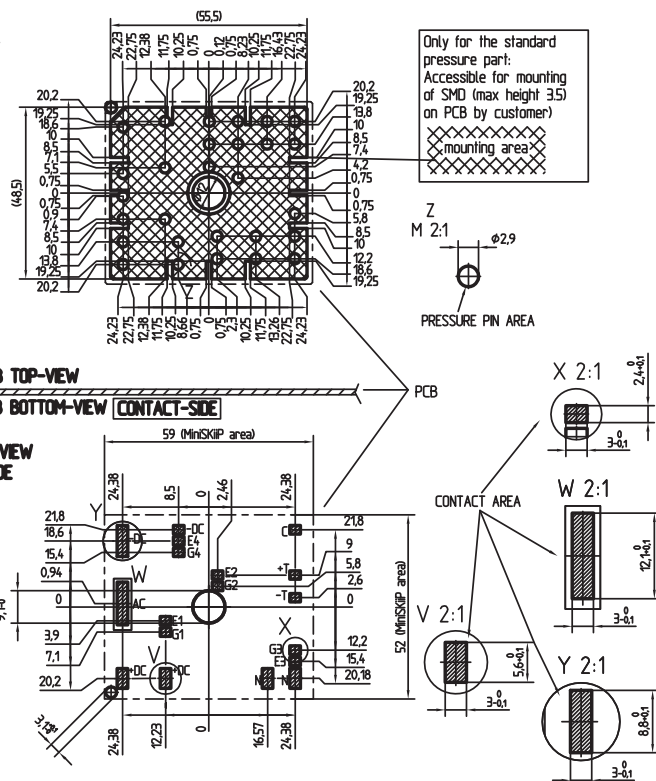
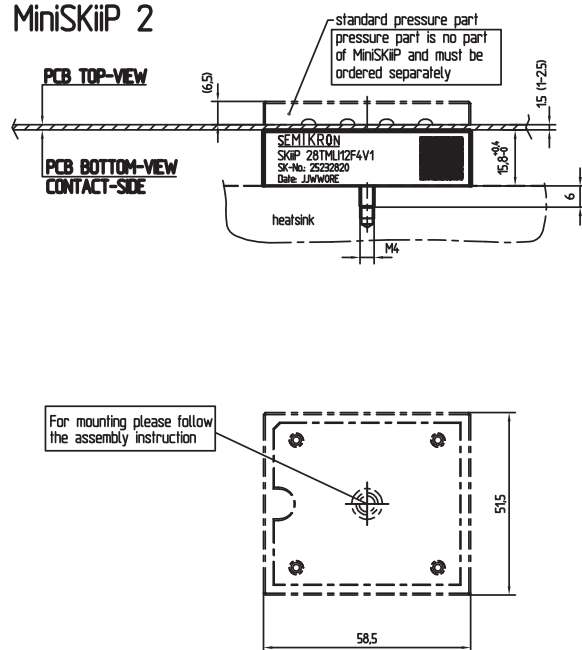


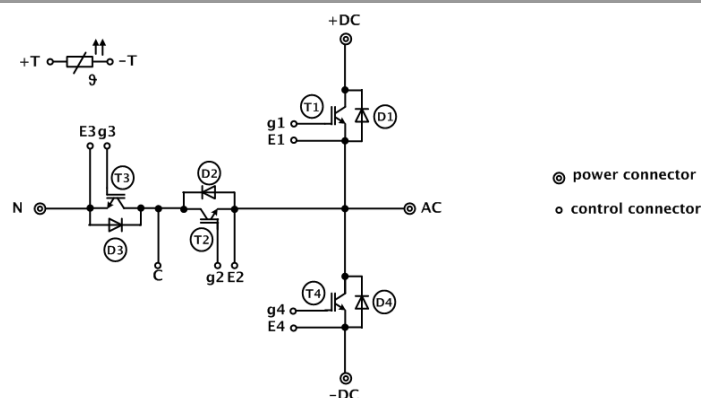
Fig. 24: Typ. CAL diode recovery charge

PCB
PCB TOP-VIEW

MiniSKiIP 2



pinout, dimensions



pinout

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

* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.