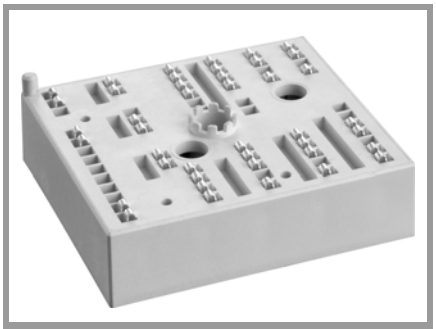
SKiiP 28TMLI12F4V1



MiniSKiiP® 2

3-Level TNPC Inverter (*)

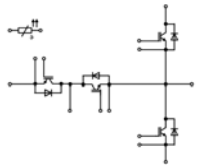
SKiiP 28TMLI12F4V1

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°C max.; $T_C = T_S$ (for baseplateless modules)
- Product reliability results valid for T_j≤150°C (recommended T_{jop}=-40...+150°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

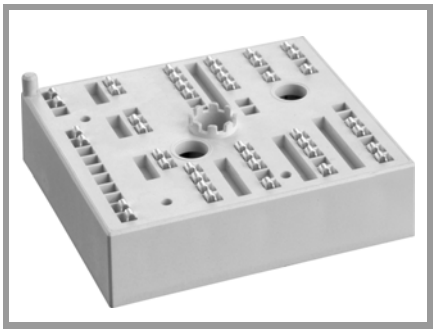


TMLI

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



MiniSKiiP® 2

3-Level TNPC Inverter (*)

SKiiP 28TMLI12F4V1

Features

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Remarks

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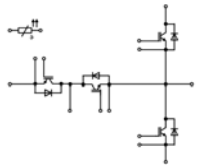


TMLI

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

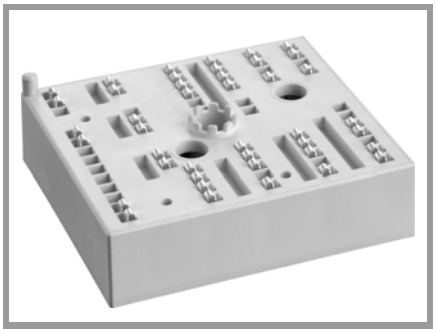
Symbol	Conditions	Values	Unit
Module			
$I_{t(RMS)}$	$T_{terminal}$ = 80 °C, 20 A per spring	80	A
T_{stg}		-40 ... 125	°C
V_{isol}	AC sinus 50 Hz, t = 1 min	2500	V

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT 1						
$V_{CE(sat)}$	I_C = 80 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		2.05	2.40	V
		T_j = 150 °C		2.50	2.85	V
V_{CE0}	chiplevel	T_j = 25 °C		0.8	0.9	V
		T_j = 150 °C		0.7	0.8	V
r_{CE}	V_{GE} = 15 V, chiplevel	T_j = 25 °C		16	19	mΩ
		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, V_{CE} = 1200 V	T_j = 25 °C		0.1	0.3	mA
						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, I_C = 80 A, $R_{G\ on}$ = 1.6 Ω, $R_{G\ off}$ = 1.6 Ω, di/dt$_{on}$ = 1330 A/µs, di/dt$_{off}$ = 1220 A/µs, $V_{GE\ neg}$ = -15 V, $V_{GE\ pos}$ = 15 V	T_j = 150 °C		168		ns
t_r		T_j = 150 °C		54		ns
E_{on}		T_j = 150 °C		3.4		mJ
$t_{d(off)}$		T_j = 150 °C		285		ns
t_f		T_j = 150 °C		58		ns
E_{off}		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



MiniSKiiP® 2

3-Level TNPC Inverter (*)

SKiiP 28TMLI12F4V1

Features

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- Trench IGBTs
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- Highly reliable spring contacts for electrical connections
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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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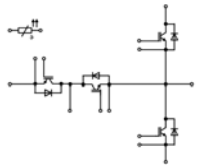


TMLI

Characteristics

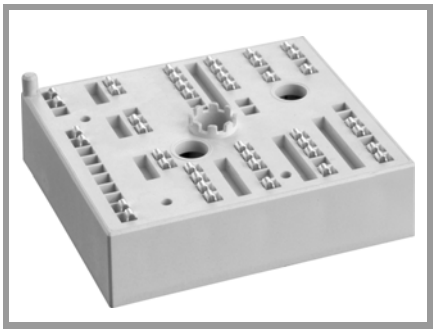
Symbol	Conditions		min.	typ.	max.	Unit
IGBT 2						
$V_{CE(sat)}$	I_C = 75 A V_{GE} = 15 V chiplevel	T_j = 25 °C		1.45	1.77	V
		T_j = 150 °C		1.70	2.10	V
V_{CE0}	chiplevel	T_j = 25 °C		0.9	1	V
		T_j = 150 °C		0.82	0.9	V
r_{CE}	V_{GE} = 15 V chiplevel	T_j = 25 °C		7.3	10	mΩ
		T_j = 150 °C		12	16	mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE}$ V, I_C = 1.5 mA		5.1	5.8	6.4	V
I_{CES}	V_{GE} = 0 V V_{CE} = 650 V	T_j = 25 °C		0.1	0.3	mA
		T_j = 150 °C				mA
C_{ies}	V_{CE} = 25 V V_{GE} = 0 V	f = 1 MHz		4.62		nF
C_{oes}		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 I_C = 75 A $R_{G\ on}$ = 1.6 Ω $R_{G\ off}$ = 1.6 Ω di/dt_{on} = 2600 A/µs di/dt_{off} = 1000 A/µs $V_{GE\ neg}$ = -15 V $V_{GE\ pos}$ = 15 V	T_j = 150 °C		84		ns
t_r		T_j = 150 °C		33		ns
E_{on}		T_j = 150 °C		1.6		mJ
$t_{d(off)}$		T_j = 150 °C		212		ns
t_f		T_j = 150 °C		65		ns
E_{off}		T_j = 150 °C		1.9		mJ
$R_{th(j-s)}$	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 V_{GE} = 0 V chiplevel	T_j = 25 °C		2.2	2.5	V
		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 di/dt_{off} = 2360 A/µs V_{GE} = -15 V V_R = 300 V	T_j = 150 °C		115		A
Q_{rr}		T_j = 150 °C		8.9		µC
E_{rr}		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 V_{GE} = 0 V chiplevel	T_j = 25 °C		1.4	1.7	V
		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 di/dt_{off} = 1250 A/µs V_{GE} = -15 V V_R = 300 V	T_j = 125 °C		48.7		A
Q_{rr}		T_j = 125 °C		5		µC
E_{rr}		T_j = 125 °C		0.7		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/K*m			1.25		K/W



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SKiiP 28TMLI12F4V1

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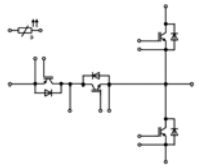


TMLI

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

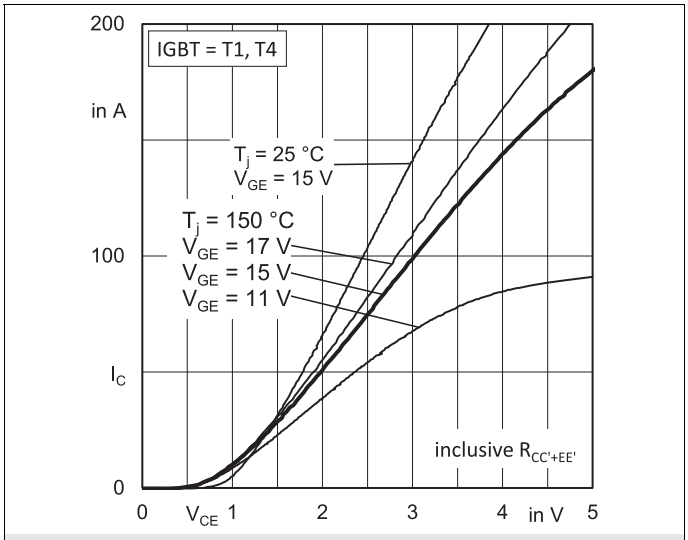


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+ EE'}$

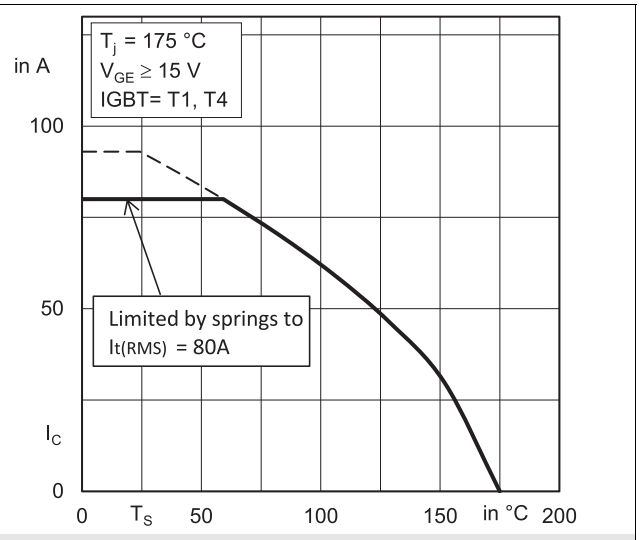


Fig. 2: Rated current vs. temperature $I_C = f(T_S)$

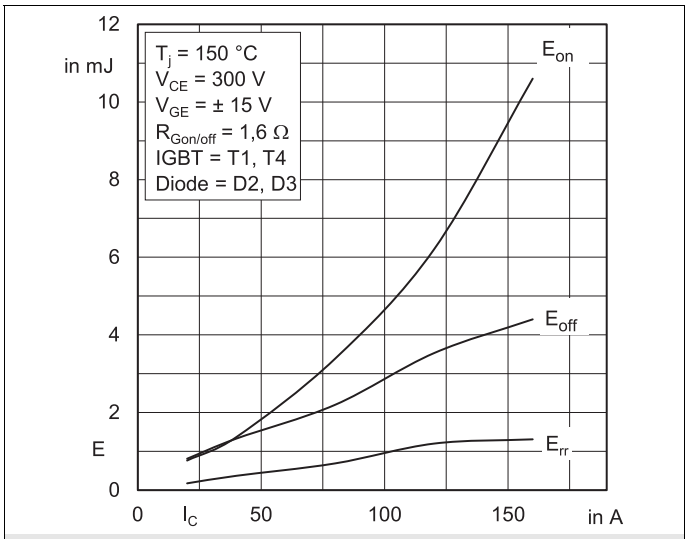


Fig. 3: Typ. turn-on /-off energy = f (I_C)

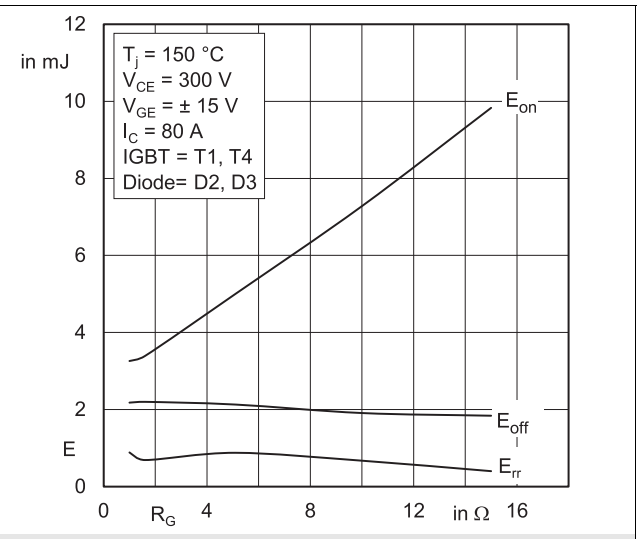


Fig. 4: Typ. turn-on /-off energy = f (R_G)

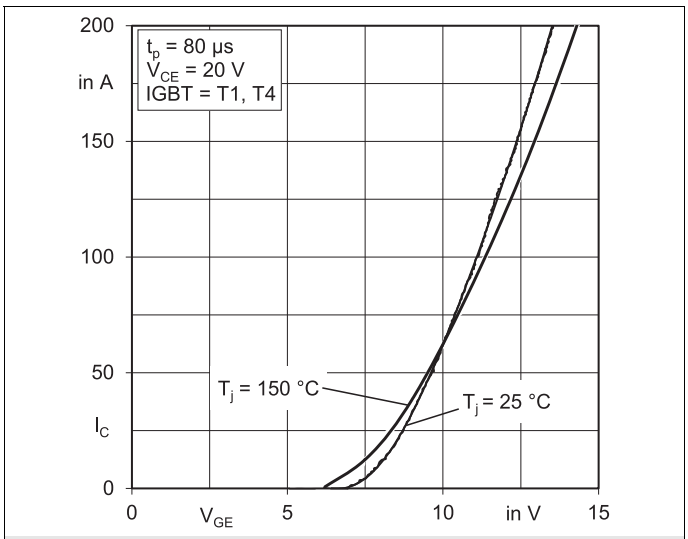


Fig. 5: Typ. transfer characteristic

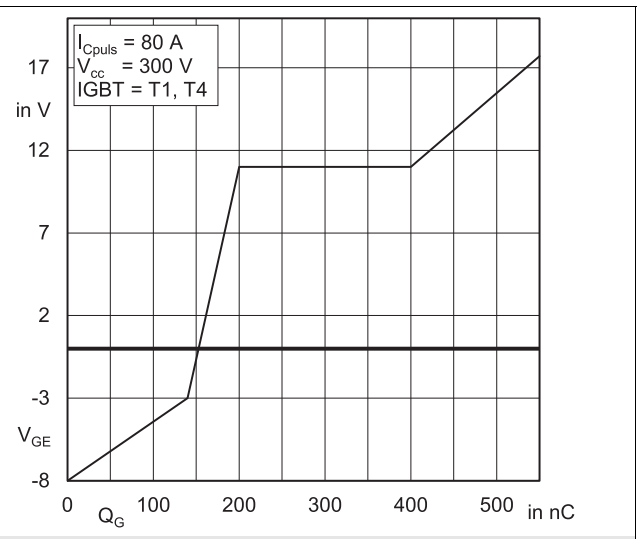


Fig. 6: Typ. gate charge characteristic

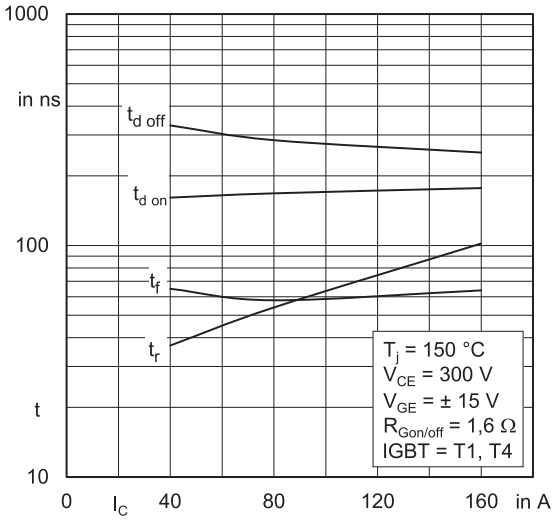


Fig. 7: Typ. switching times vs. I_C

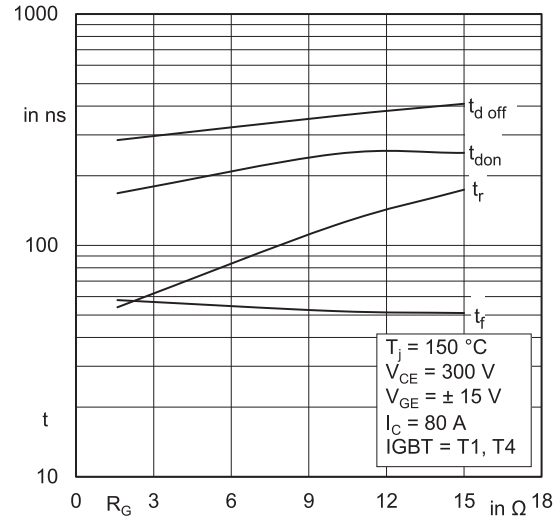


Fig. 8: Typ. switching times vs. gate resistor R_G

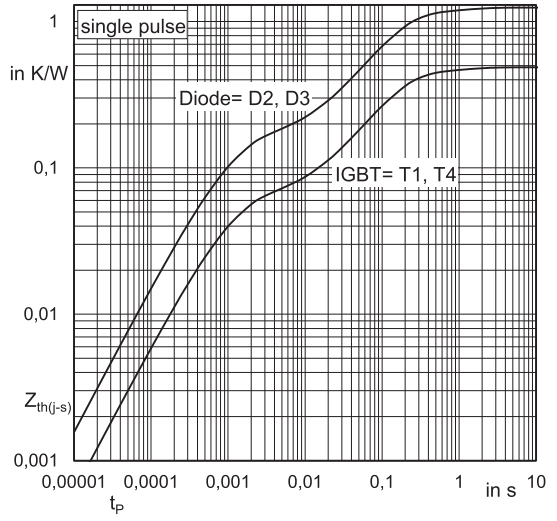


Fig. 9: Transient thermal impedance of IGBT and Diode

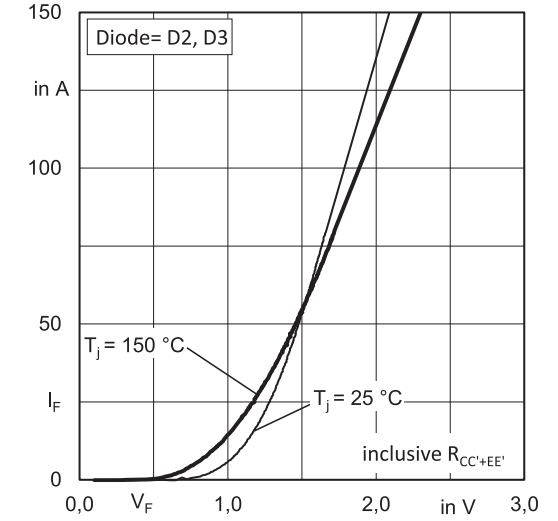


Fig. 10: CAL diode forward characteristic

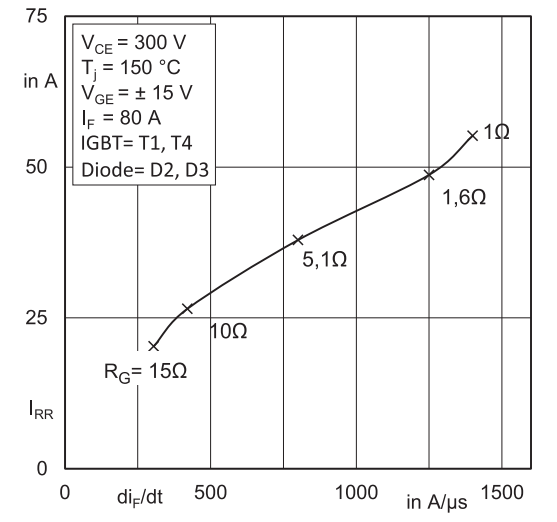


Fig. 11: Typ. CAL diode peak reverse recovery current

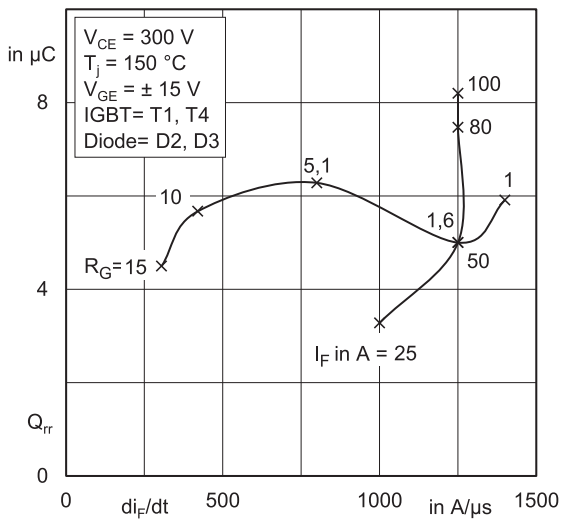


Fig. 12: Typ. CAL diode recovery charge

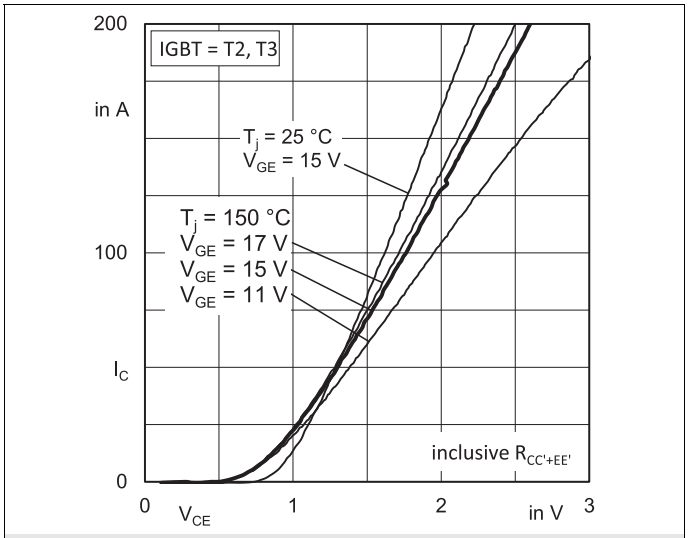


Fig. 13: Typ. output characteristic, inclusive $R_{CC'+ EE'}$

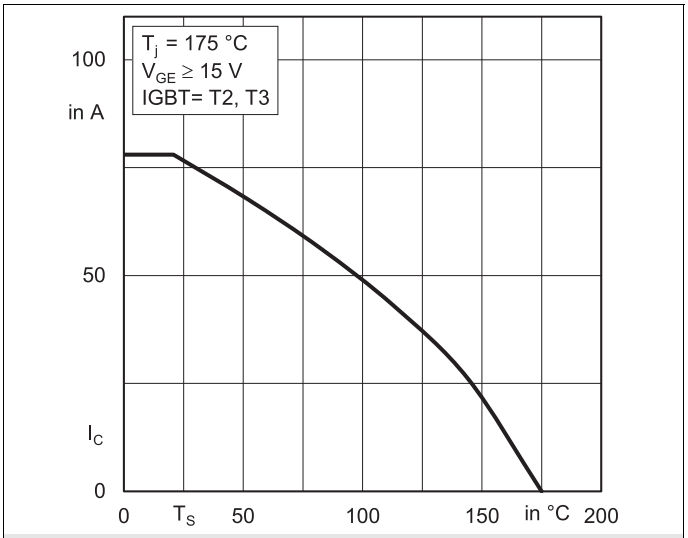


Fig. 14: Rated current vs. temperature $I_C = f(T_S)$

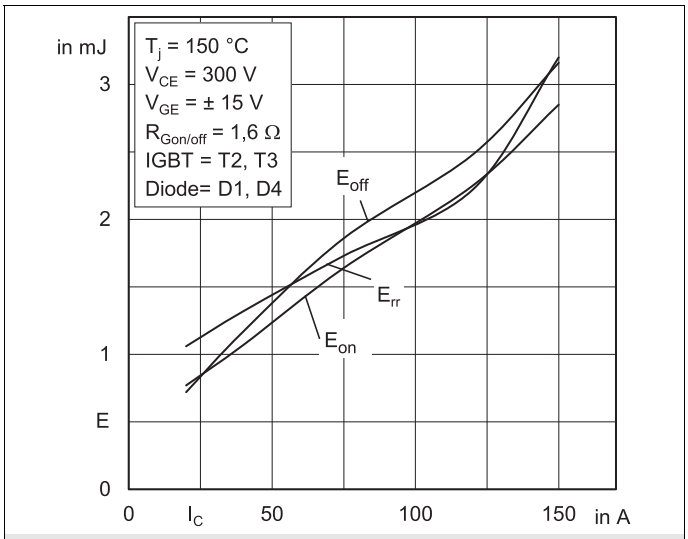


Fig. 15: Typ. turn-on /-off energy = f (I_C)

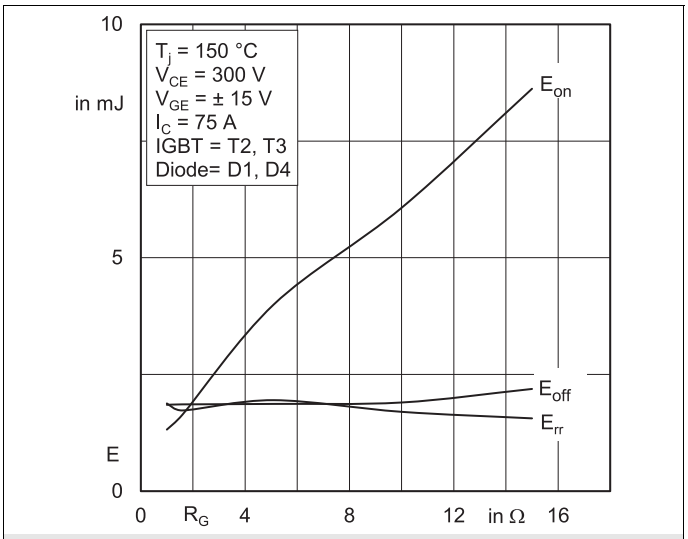


Fig. 16: Typ. turn-on /-off energy = f (R_G)

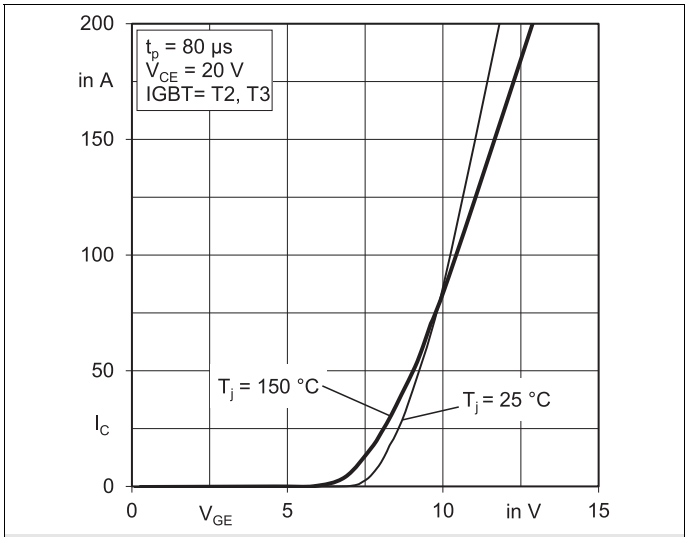


Fig. 17: Typ. transfer characteristic

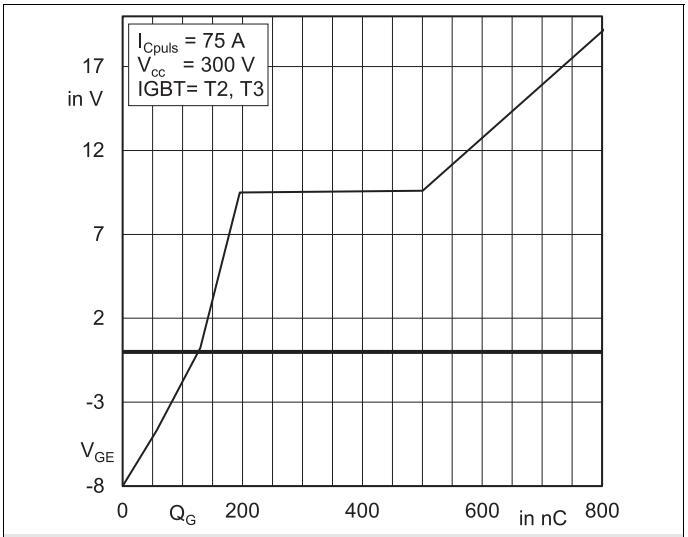


Fig. 18: Typ. gate charge characteristic

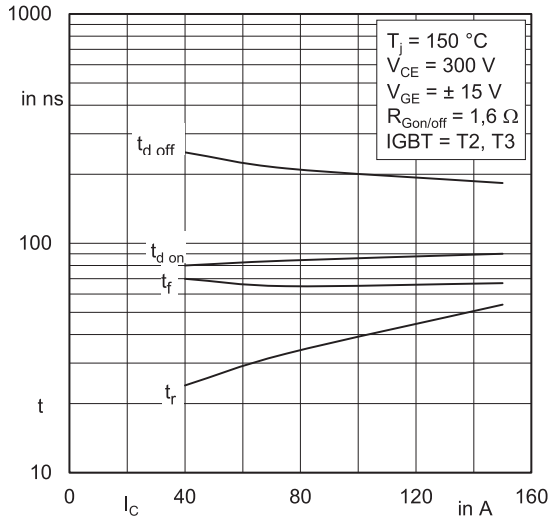


Fig. 19: Typ. switching times vs. I_C

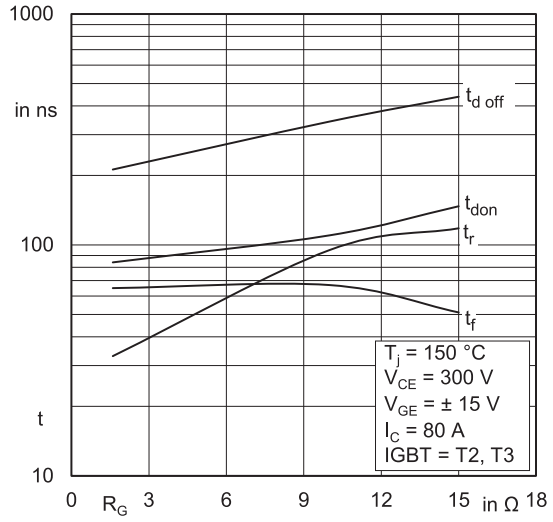


Fig. 20: Typ. switching times vs. gate resistor R_G

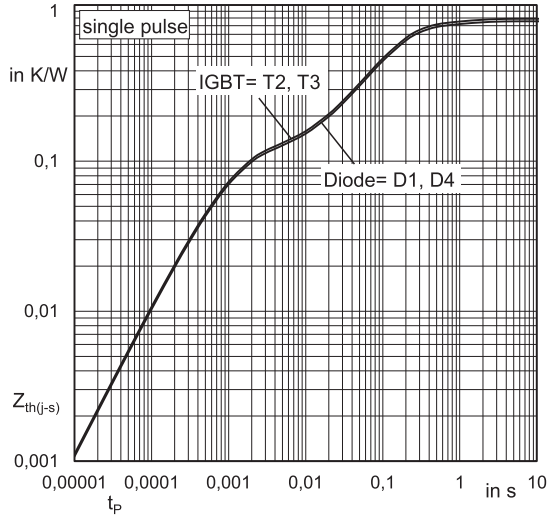


Fig. 21: Transient thermal impedance of IGBT and Diode

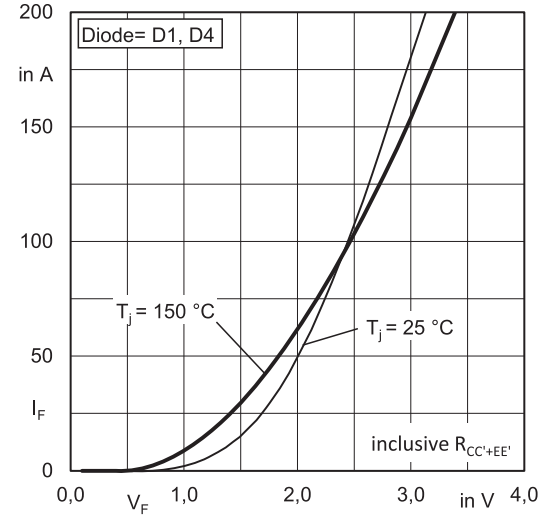


Fig. 22: CAL diode forward characteristic

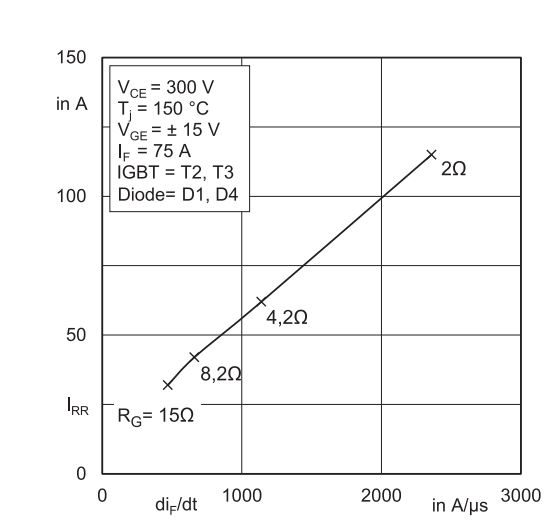


Fig. 23: Typ. CAL diode peak reverse recovery current

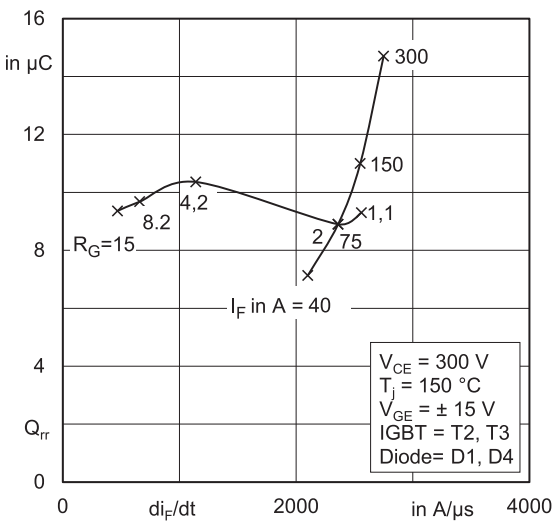
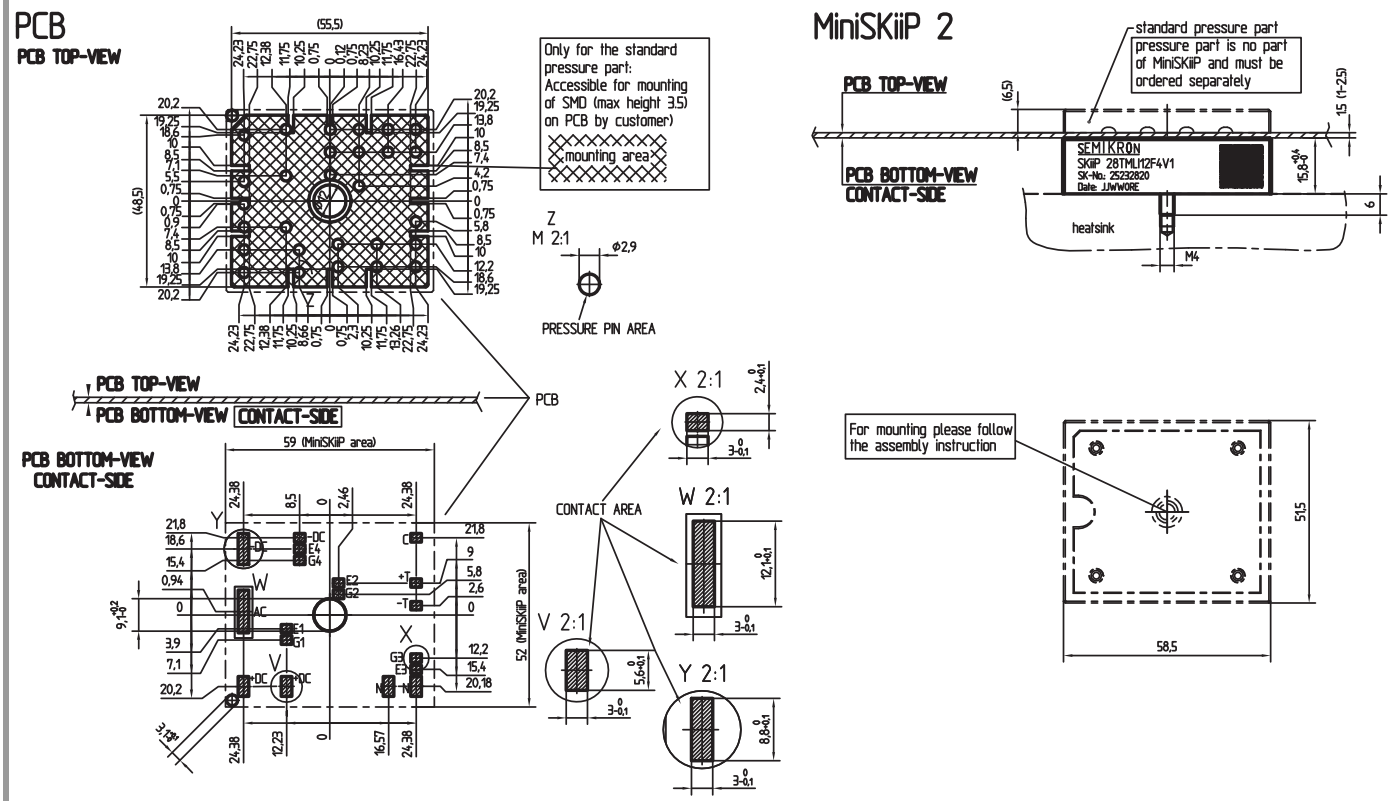
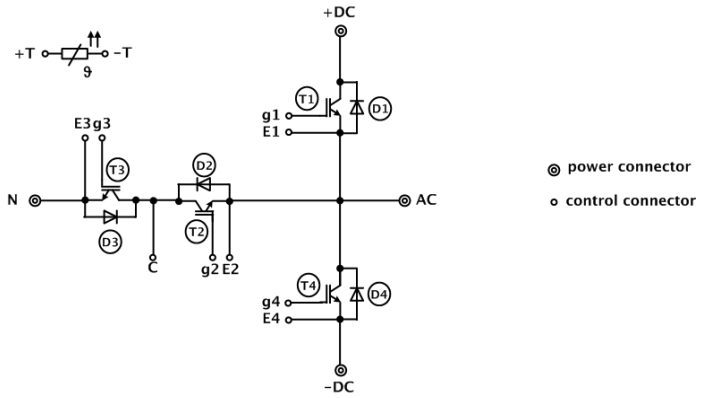


Fig. 24: Typ. CAL diode recovery charge



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.