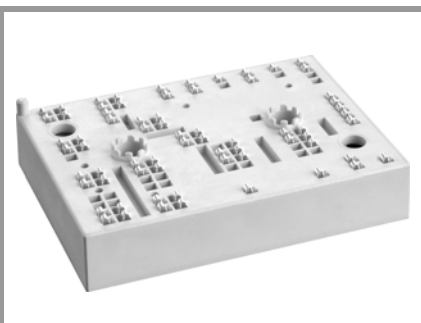


SKiIP 39TMLI12T4V2



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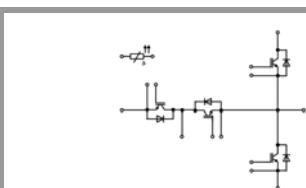
Target Data

Features

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

Remarks*

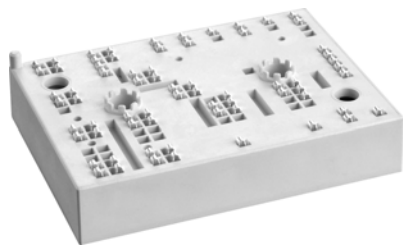
- Case temperature limited to $T_C = 125^\circ\text{C}$ max.; $T_C = T_S$ (valid for baseplateless modules)
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$ (recommended $T_{op} = -40 \dots +150^\circ\text{C}$)
- IGBT 1: outer IGBTs T1&T4
- IGBT 2: inner IGBTs T2&T3
- Diode 1: outer diodes D1&D4
- Diode 2: inner diodes D2&D3
- $I_{t(RMS)} = 160\text{A}$ max. for power terminals



TMLI

Absolute Maximum Ratings				
Symbol	Conditions	Values	Unit	
IGBT1				
V_{CES}	$T_j = 25^\circ\text{C}$	1200	V	
I_C	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	235	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	191	A
I_C	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	290	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	236	A
I_{Cnom}		200	A	
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$	600	A	
V_{GES}		-20 ... 20	V	
t_{psc}	$V_{CC} = 800\text{ V}, V_{GE} \leq 15\text{ V}, T_j = 150^\circ\text{C}, V_{CES} \leq 1200\text{ V}$	6	μs	
T_j		-40 ... 175	$^\circ\text{C}$	
IGBT2				
V_{CES}	$T_j = 25^\circ\text{C}$	650	V	
I_C	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	207	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	165	A
I_C	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	240	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	192	A
I_{Cnom}		200	A	
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$	600	A	
V_{GES}		-20 ... 20	V	
t_{psc}	$V_{CC} = 360\text{ V}, V_{GE} \leq 15\text{ V}, T_j = 150^\circ\text{C}, V_{CES} \leq 650\text{ V}$	6	μs	
T_j		-40 ... 175	$^\circ\text{C}$	
Diode1				
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V	
I_F	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	194	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	154	A
I_F	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	224	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	179	A
I_{Fnom}		200	A	
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$	600	A	
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$	990	A	
T_j		-40 ... 175	$^\circ\text{C}$	
Diode2				
V_{RRM}	$T_j = 25^\circ\text{C}$	650	V	
I_F	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	223	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	174	A
I_F	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	255	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	200	A
I_{Fnom}		200	A	
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$	400	A	
I_{FSM}	10 ms, sin 180°, $T_j = 25^\circ\text{C}$	1476	A	
T_j		-40 ... 175	$^\circ\text{C}$	
Module				
$I_{t(RMS)}$		160	A	
T_{stg}		-40 ... 125	$^\circ\text{C}$	
V_{isol}	AC sinus 50 Hz, t = 1 min	2500	V	

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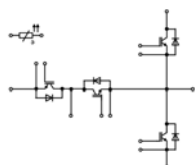
Target Data

Features

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

Remarks*

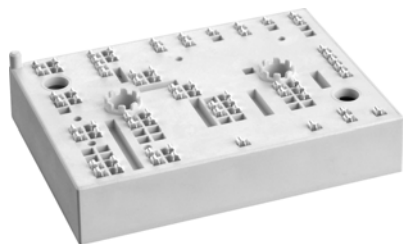
- Case temperature limited to $T_C = 125^\circ\text{C}$ max.; $T_C = T_S$ (valid for baseplateless modules)
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$ (recommended $T_{op} = -40 \dots +150^\circ\text{C}$)
- IGBT 1: outer IGBTs T1&T4
- IGBT 2: inner IGBTs T2&T3
- Diode 1: outer diodes D1&D4
- Diode 2: inner diodes D2&D3
- $I_{t(RMS)} = 160\text{A}$ max. for power terminals



TMLI

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
$V_{CE(sat)}$	$I_C = 200\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$		1.80	2.05	V
		$T_j = 150^\circ\text{C}$		2.20	2.40	V
V_{CE0}	chipllevel	$T_j = 25^\circ\text{C}$		0.80	0.90	V
		$T_j = 150^\circ\text{C}$		0.70	0.80	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$		5.0	5.8	m Ω
		$T_j = 150^\circ\text{C}$		7.5	8.0	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 12\text{ mA}$		5	5.8	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_j = 25^\circ\text{C}$				0.3	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		12.30		nF
C_{oes}		$f = 1\text{ MHz}$		0.81		nF
C_{res}		$f = 1\text{ MHz}$		0.69		nF
Q_G	$-8\text{ V} \dots +15\text{ V}$			1130		nC
R_{Gint}	$T_j = 25^\circ\text{C}$			3.8		Ω
$t_{d(on)}$	$V_{CE} = 300\text{ V}$	$T_j = 150^\circ\text{C}$		186		ns
t_r	$I_C = 200\text{ A}$	$T_j = 150^\circ\text{C}$		80		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		7.5		mJ
$t_{d(off)}$	$R_{G on} = 1.5\ \Omega$	$T_j = 150^\circ\text{C}$		377		ns
t_f	$R_{G off} = 1.5\ \Omega$	$T_j = 150^\circ\text{C}$		109		ns
E_{off}	$di/dt_{on} = 2300\text{ A}/\mu\text{s}$ $di/dt_{off} = 1630\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		12.8		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$			0.23		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$			0.16		K/W
IGBT2						
$V_{CE(sat)}$	$I_C = 200\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$		1.45	1.85	V
		$T_j = 150^\circ\text{C}$		1.70	2.10	V
V_{CE0}	chipllevel	$T_j = 25^\circ\text{C}$		0.90	1.00	V
		$T_j = 150^\circ\text{C}$		0.82	0.90	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$		2.8	4.3	m Ω
		$T_j = 150^\circ\text{C}$		4.4	6.0	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 3.2\text{ mA}$		5	5.8	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}, T_j = 25^\circ\text{C}$				0.3	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		12.32		nF
C_{oes}		$f = 1\text{ MHz}$		0.77		nF
C_{res}		$f = 1\text{ MHz}$		0.37		nF
Q_G	$-8\text{ V} \dots +15\text{ V}$			1600		nC
R_{Gint}	$T_j = 25^\circ\text{C}$			1.0		Ω
$t_{d(on)}$	$V_{CE} = 300\text{ V}$	$T_j = 150^\circ\text{C}$		93		ns
t_r	$I_C = 200\text{ A}$	$T_j = 150^\circ\text{C}$		62		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		2		mJ
$t_{d(off)}$	$R_{G on} = 2\ \Omega$	$T_j = 150^\circ\text{C}$		295		ns
t_f	$R_{G off} = 2\ \Omega$	$T_j = 150^\circ\text{C}$		86		ns
E_{off}	$di/dt_{on} = 3300\text{ A}/\mu\text{s}$ $di/dt_{off} = 2200\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		9.3		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$			0.33		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$			0.26		K/W

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Target Data

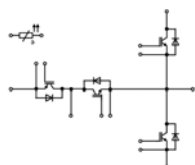
Features

- Robust and soft freewheeling 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.; $T_C = T_S$ (valid for baseplateless modules)
- Product reliability results valid for $T_j \leq 150^\circ\text{C}$ (recommended $T_{op} = -40 \dots +150^\circ\text{C}$)
- IGBT 1: outer IGBTs T1&T4
- IGBT 2: inner IGBTs T2&T3
- Diode 1: outer diodes D1&D4
- Diode 2: inner diodes D2&D3
- $I_{t(RMS)} = 160\text{A}$ max. for power terminals

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
$V_F = V_{EC}$	$I_F = 200\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		2.20	2.52	V
		$T_j = 150^\circ\text{C}$		2.15	2.47	V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$		1.30	1.50	V
		$T_j = 150^\circ\text{C}$		0.90	1.10	V
r_F	chipelevel	$T_j = 25^\circ\text{C}$		4.5	5.1	m Ω
		$T_j = 150^\circ\text{C}$		6.3	6.9	m Ω
I_{RRM}	$I_F = 200\text{ A}$	$T_j = 150^\circ\text{C}$		219		A
Q_{rr}	$di/dt_{off} = 3700\text{ A}/\mu\text{s}$ $V_R = 300\text{ V}$	$T_j = 150^\circ\text{C}$		31		μC
E_{rr}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		9.7		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$			0.34		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$			0.27		K/W
Diode2						
$V_F = V_{EC}$	$I_F = 200\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		1.40	1.76	V
		$T_j = 150^\circ\text{C}$		1.38	1.77	V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$		1.04	1.24	V
		$T_j = 150^\circ\text{C}$		0.85	0.99	V
r_F	chipelevel	$T_j = 25^\circ\text{C}$		1.78	2.6	m Ω
		$T_j = 150^\circ\text{C}$		2.7	3.9	m Ω
I_{RRM}	$I_F = 200\text{ A}$	$T_j = 150^\circ\text{C}$		154		A
Q_{rr}	$di/dt_{off} = 2200\text{ A}/\mu\text{s}$ $V_R = 300\text{ V}$	$T_j = 150^\circ\text{C}$		22.7		μC
E_{rr}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		5.5		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 0.8\text{ W}/(\text{mK})$			0.38		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste} = 2.5\text{ W}/(\text{mK})$			0.31		K/W
Module						
L_{sCE1}						nH
L_{CE}				t.b.d.		nH
R_{CC+EE}			$T_s = 25^\circ\text{C}$			m Ω
						m Ω
M_s	to heat sink		2		2.5	Nm
M_t	to heat sink					Nm
						Nm
w				82		g
Temperature Sensor						
R_{100}	$T_r = 100^\circ\text{C}$ ($R_{25} = 1000\Omega$)			$1670 \pm 3\%$		Ω
$B_{100/125}$	$R(T) = R_{100} \exp[B_{100/125}(1/T - 1/T_{100})]$; T[K]			$3550 \pm 2\%$		K



TMLI

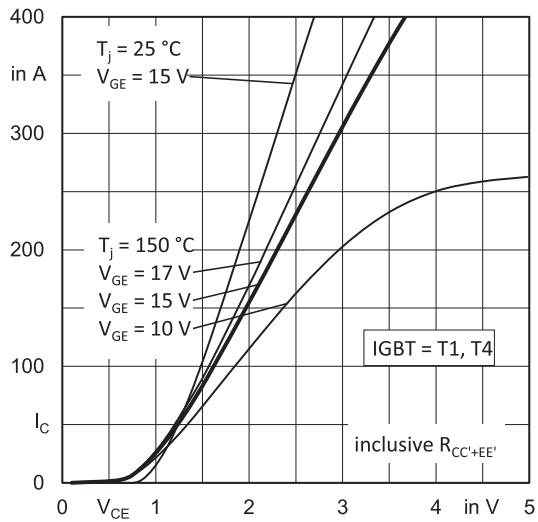


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

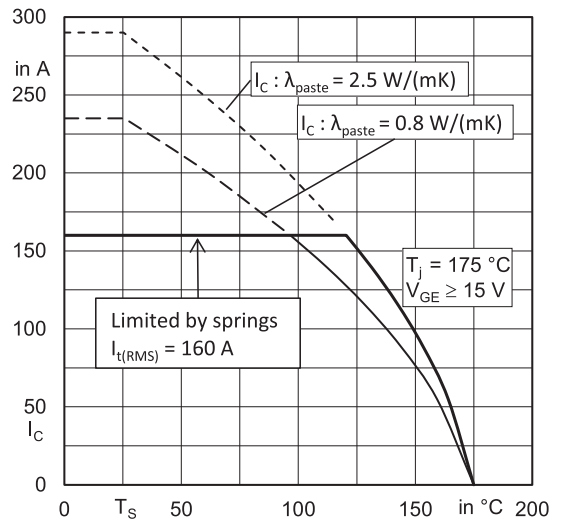


Fig. 2: Rated current vs. temperature $I_C = f(T_S)$

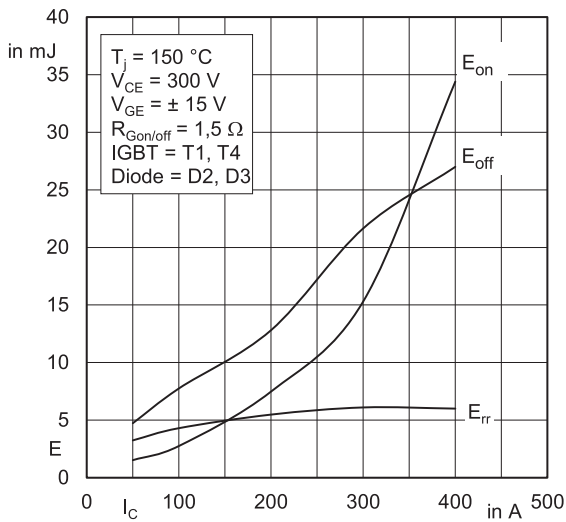


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

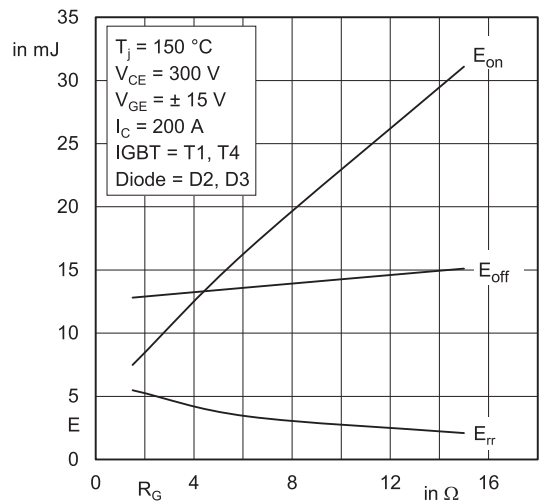


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

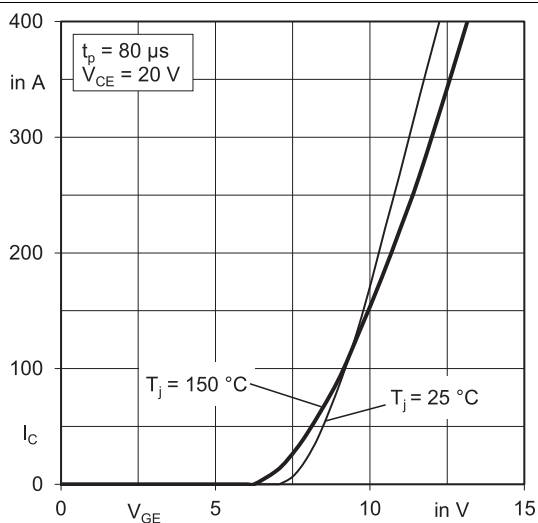


Fig. 5: Typ. transfer characteristic

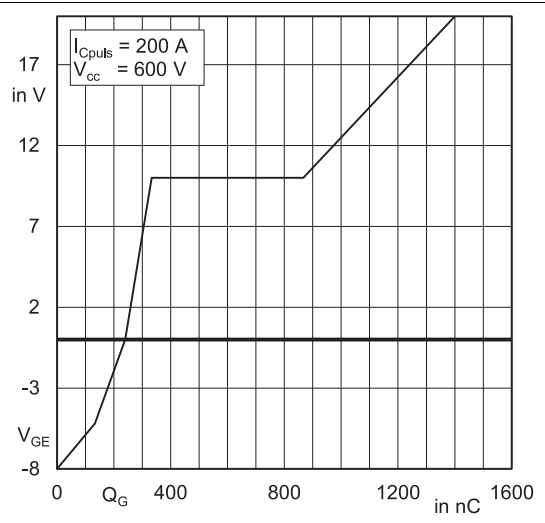


Fig. 6: Typ. gate charge characteristic

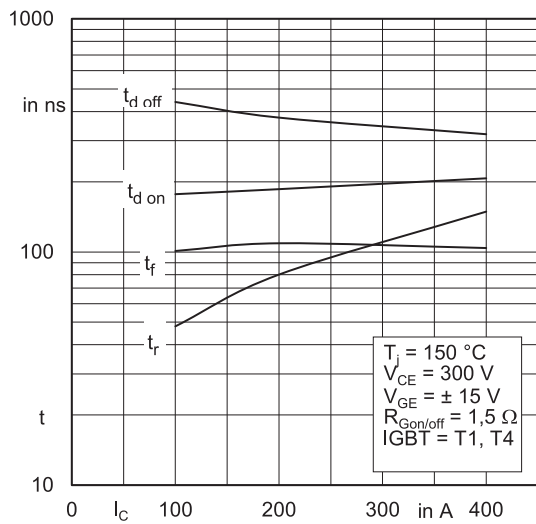


Fig. 7: Typ. switching times vs. I_C

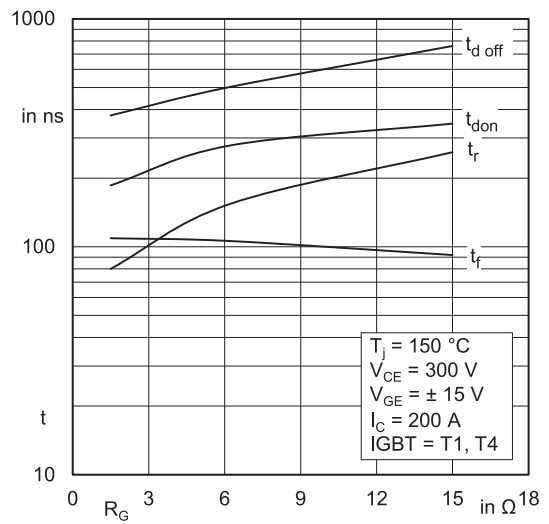


Fig. 8: Typ. switching times vs. gate resistor R_G

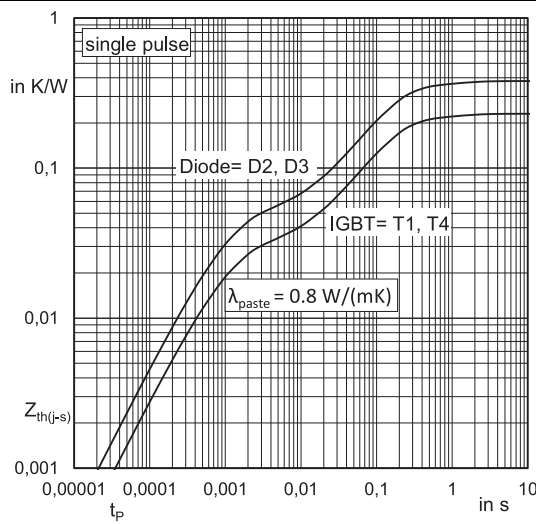


Fig. 9: Transient thermal impedance of IGBT and Diode

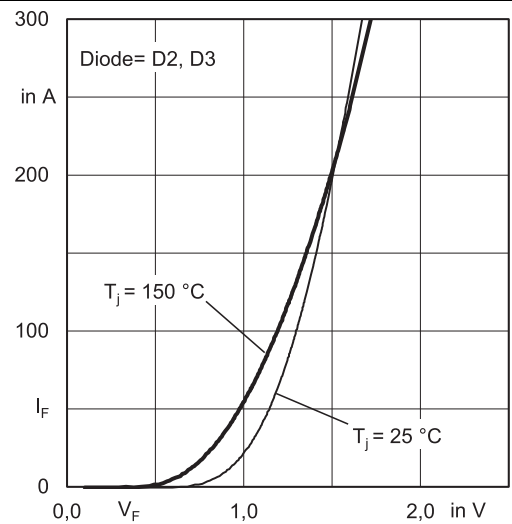


Fig. 10: CAL diode forward characteristic

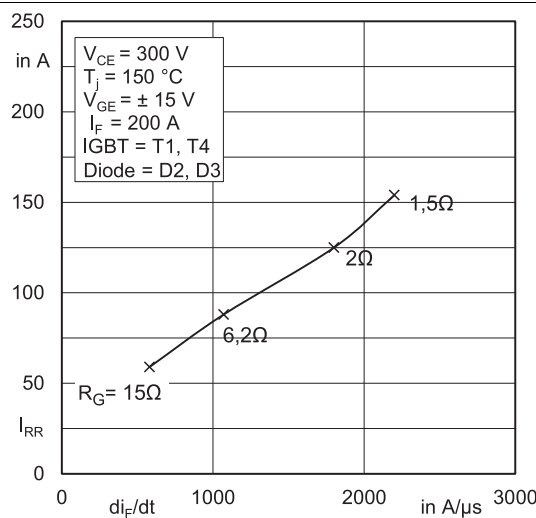


Fig. 11: Typ. CAL diode peak reverse recovery current

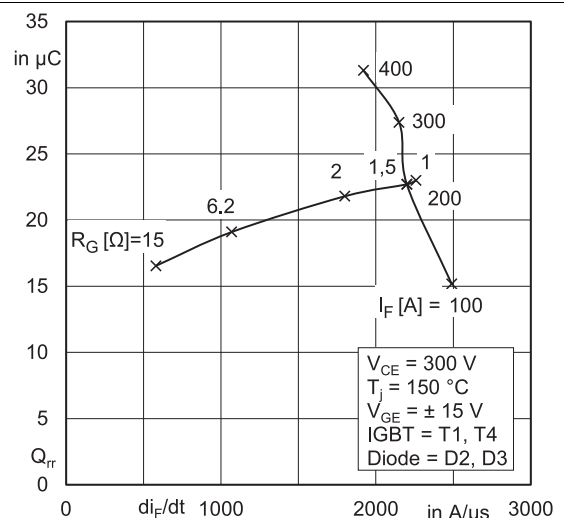


Fig. 12: Typ. CAL diode recovery charge

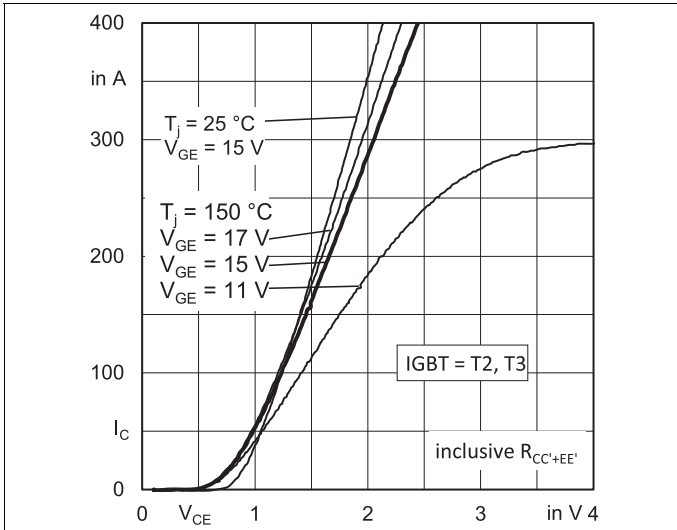


Fig. 13: Typ. output characteristic, inclusive R_{CC'+EE'}

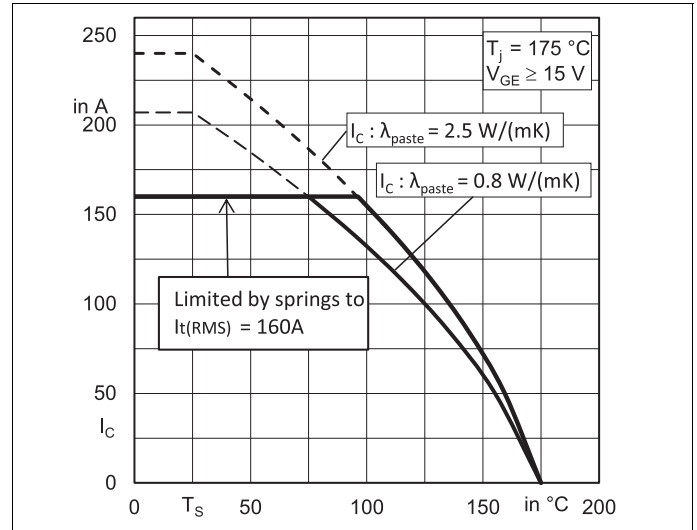


Fig. 14: Rated current vs. temperature I_C = f(T_s)

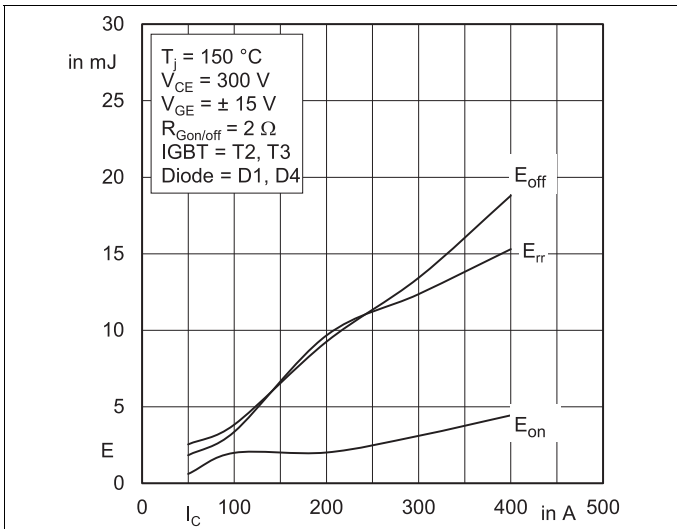


Fig. 15: Typ. turn-on /-off energy = f(I_C)

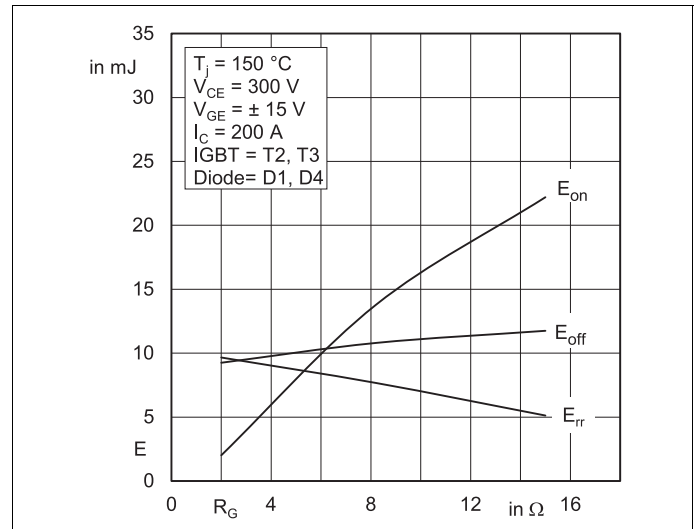


Fig. 16: Typ. turn-on /-off energy = f(R_G)

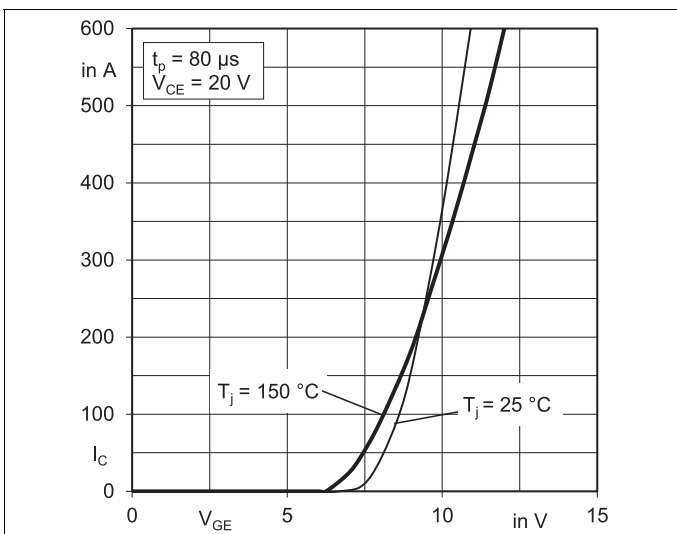


Fig. 17: Typ. transfer characteristic

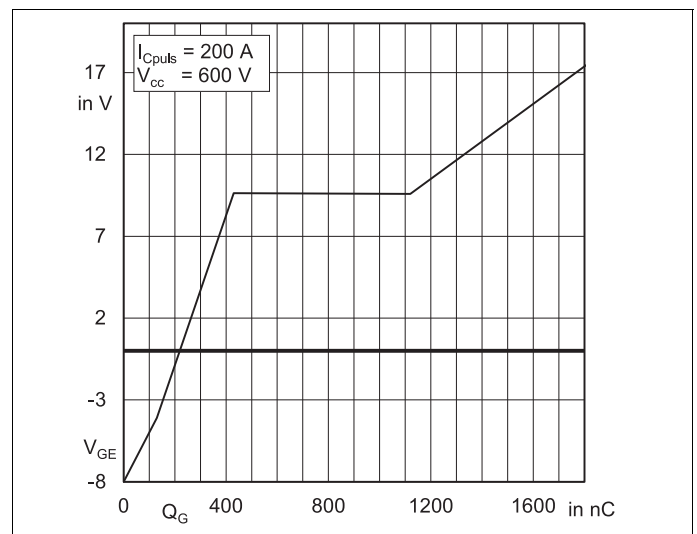


Fig. 18: Typ. gate charge characteristic

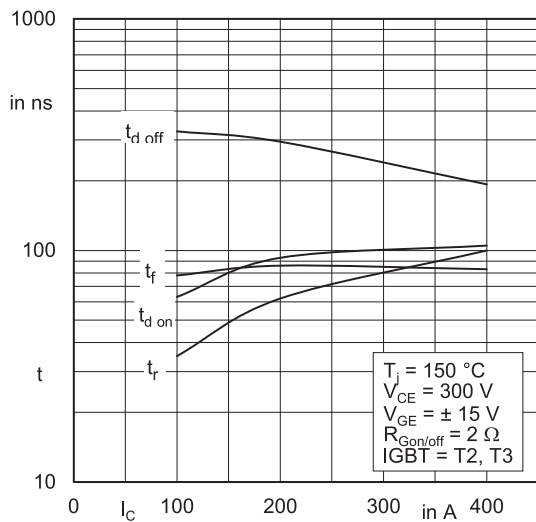


Fig. 19: Typ. switching times vs. I_C

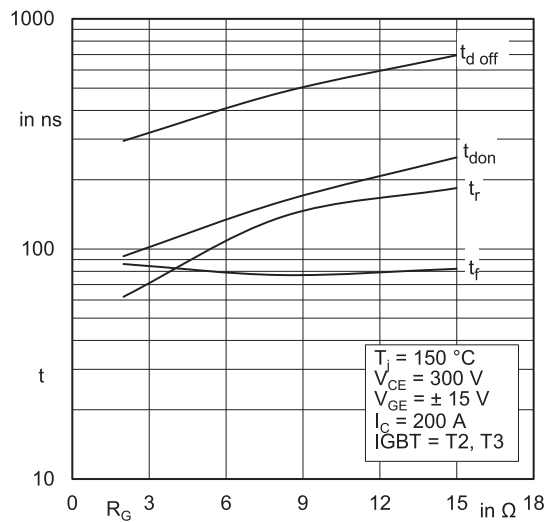


Fig. 20: Typ. switching times vs. gate resistor R_G

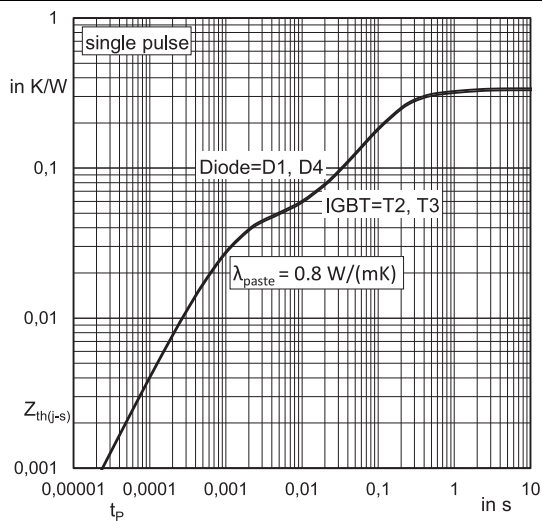


Fig. 21: Transient thermal impedance of IGBT and Diode

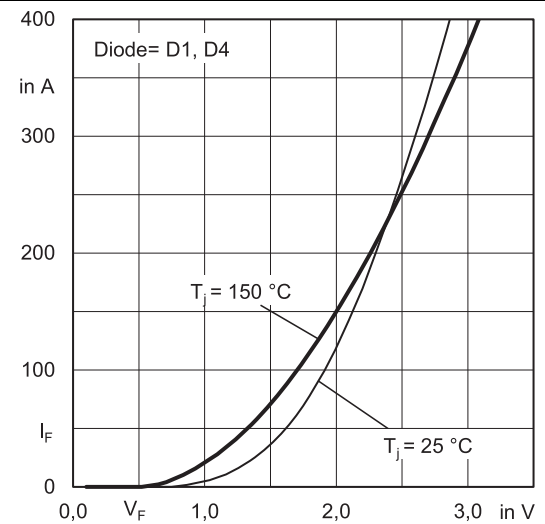


Fig. 22: CAL diode forward characteristic

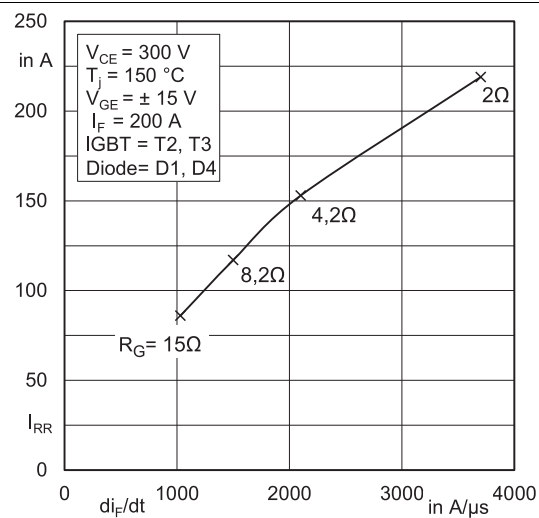


Fig. 23: Typ. CAL diode peak reverse recovery current

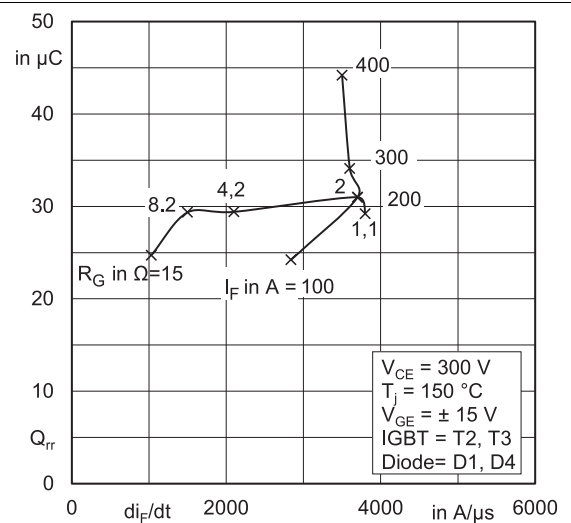
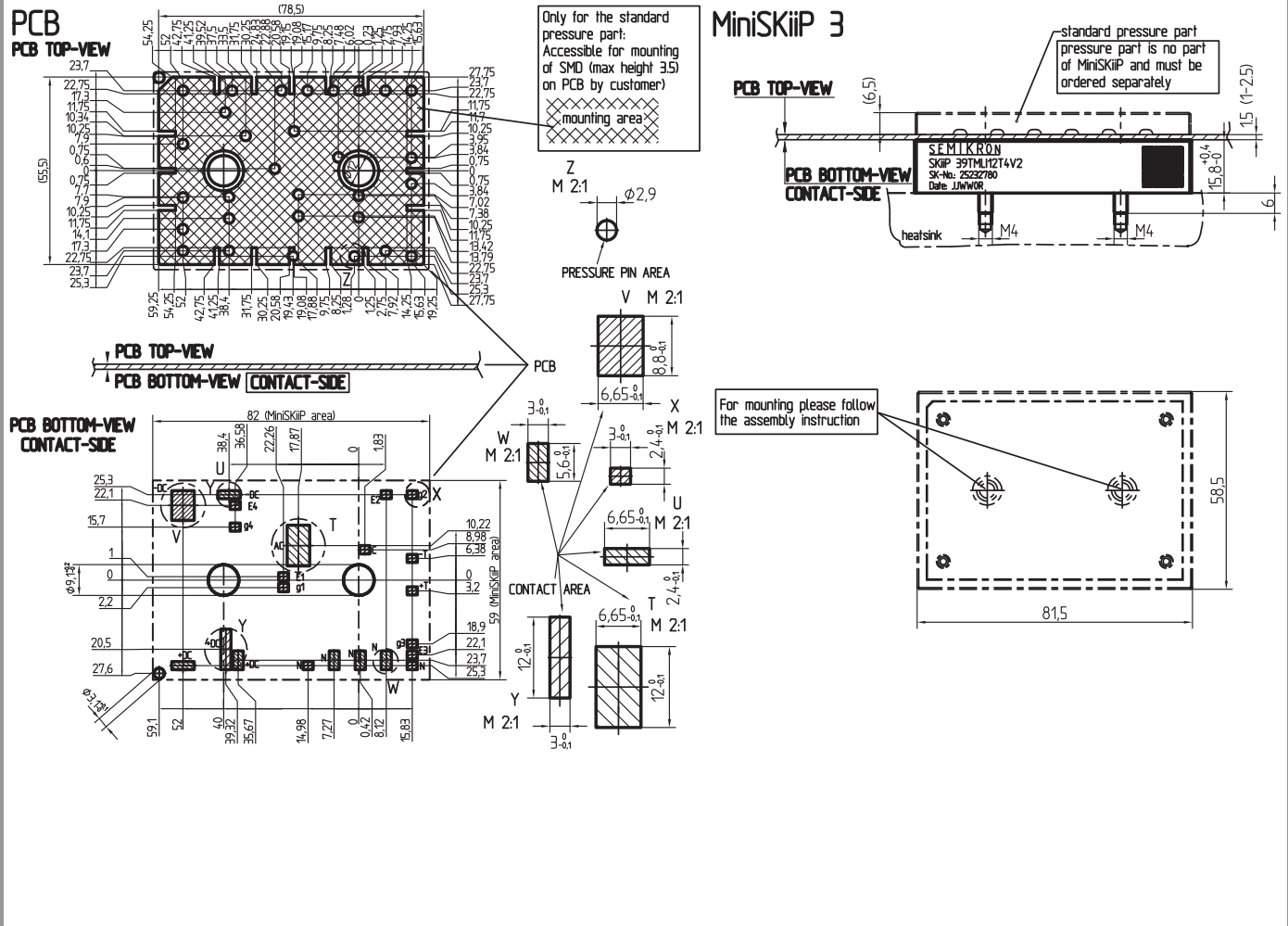
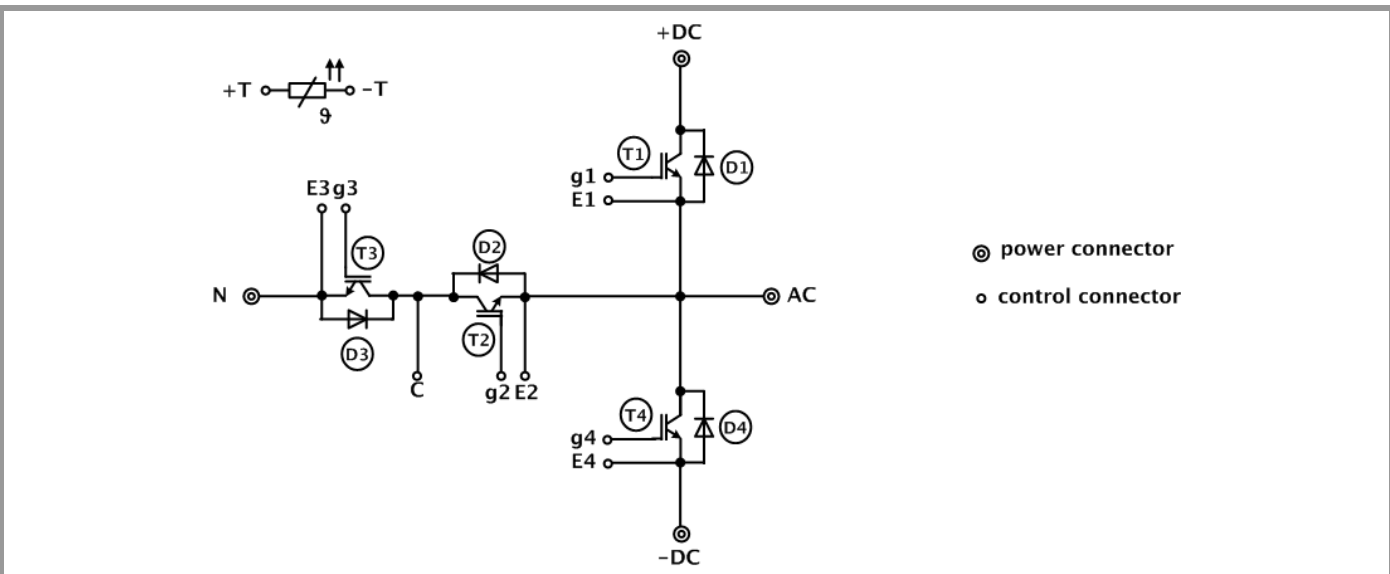


Fig. 24: Typ. CAL diode recovery charge



pinout, dimensions



pinout

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

***IMPORTANT INFORMATION AND WARNINGS**

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