SKiM® 93

Hybrid SiC Trench IGBT Modules

SKiM459GD12F4V3

Features

- IGBT 4 Fast
- SiC Schottky free-wheeling diodes, 3 diodes per switch
- Solderless sinter technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Low inductance case
- Insulated by Al_2O_3 DCB (Direct Copper Bonded) ceramic substrate
- Pressure contact technology for thermal contacts
- Spring contact system to attach driver PCB to the control terminals
- High short circuit capability
- Integrated temperature sensor
- UL recognized: File no. E63532

Typical Applications*

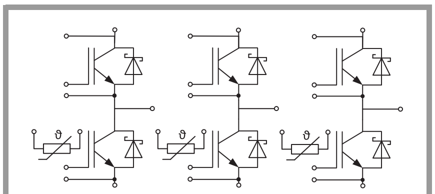
- UPS (inv., rect.)
- Energy storage
- Active front-end

Remarks

- Case temperature limited to T_s = 125°C max; $T_c = T_s$ (for baseplateless modules)

Footnotes

I_{FSM} value is valid for SiC Schottky diode in combination with IGBT, please see Technical Explanations SKiM63/93 for further details



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Absolute Maximum Ratings

Symbol	Conditions		Values	Unit
Inverter - IGBT				
V_{CES}	T_j = 25 °C		1200	V
I_C	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	476	A
	T_j = 175 °C	T_s = 70 °C	383	A
I_C	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	533	A
	T_j = 175 °C	T_s = 70 °C	430	A
I_{Cnom}			450	A
I_{CRM}	I_{CRM} = 3 x I_{Cnom}		1350	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
Inverse - Diode				
I_F	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	214	A
	T_j = 175 °C	T_s = 70 °C	173	A
I_F	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	217	A
	T_j = 175 °C	T_s = 70 °C	175	A
I_{Fnom}			125	A
I_{FRM}			250	A
I_{FSM}	t_p = 10 ms, sin 180°, T_j = 150 °C		529 [1)]	A
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$	$T_{terminal}$ = 80 °C,		700	A
T_{stg}			-40 ... 125	°C
V_{isol}	AC sinus 50 Hz, t = 1 min		2500	V

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
Inverter - IGBT						
$V_{CE(sat)}$	I_C = 450 A	T_j = 25 °C		2.05	2.42	V
	V_{GE} = 15 V chiplevel	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	T_j = 25 °C		2.1	2.5	mΩ
	chiplevel	T_j = 150 °C		3.6	4.1	mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE}$, I_C = 15.6 mA		5.2	5.8	6.4	V
I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V, T_j = 25 °C			0.15	3	mA
C_{ies}	V_{CE} = 25 V V_{GE} = 0 V	f = 1 MHz		26.4		nF
C_{oes}		f = 1 MHz		1.74		nF
C_{res}		f = 1 MHz		1.41		nF
Q_G	V_{GE} = - 8 V...+ 15 V			2550		nC
R_{Gint}	T_j = 25 °C			1.7		Ω
$t_{d(on)}$	V_{CC} = 600 V	T_j = 150 °C		231		ns
t_r	I_C = 120 A	T_j = 150 °C		27		ns
E_{on}	$R_{G\,on}$ = 1 Ω $R_{G\,off}$ = 1 Ω	T_j = 150 °C		2		mJ
$t_{d(off)}$	di/dt_{on} = 4800 A/µs	T_j = 150 °C		595		ns
t_f	di/dt_{off} = 1730 A/µs	T_j = 150 °C		75		ns
E_{off}	du/dt = 2550 V/µs V_{GE} = +15/-15 V L_s = 24 nH	T_j = 150 °C		11		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.099		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.082		K/W

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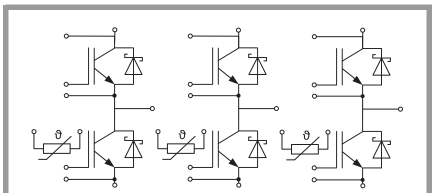

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Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Inverse - Diode						
$V_F = V_{EC}$	I_F = 125 A	T_j = 25 °C		1.33	1.51	V
	chiplevel	T_j = 150 °C		1.63	1.90	V
V_{F0}	chiplevel	T_j = 25 °C		0.95	1.05	V
		T_j = 150 °C		0.80	0.90	V
r_F	chiplevel	T_j = 25 °C		3.0	3.7	mΩ
		T_j = 150 °C		6.7	8.0	mΩ
C_j	V_R = 800 V, f = 1 MHz, T_j = 25 °C			0.630		nF
Q_c	V_R = 800 V, di/dt_{off} = 500 A/µs, T_j = 25 °C			0.50		µC
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.253		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.247		K/W
Module						
L_{CE}				10	15	nH
$R_{CC'+EE'}$	measured per switch	T_s = 25 °C		0.3		mΩ
		T_s = 125 °C		0.5		mΩ
w				1042		g
Temperature Sensor						
R_{100}	T_r=100°C (R_{25}=1000Ω)			1670 ± 1%		Ω
R(T)	R(T)=1kΩ[1+A(T-25°C)+B(T-25°C)²], A = 7.64*10⁻³°C⁻², B = 1.73*10⁻⁵°C⁻²					

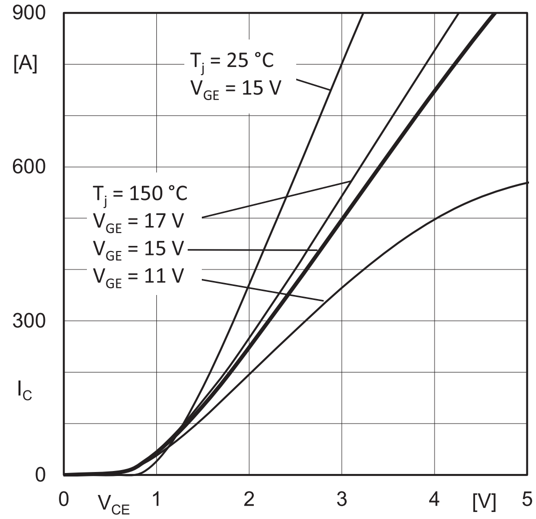


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+ EE'}$

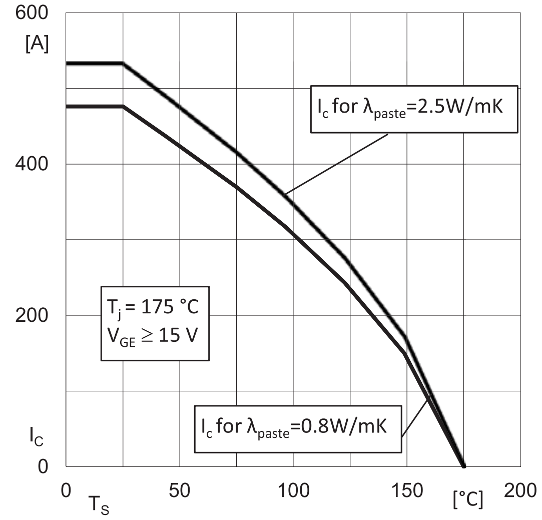


Fig. 2: Typ. rated current vs. temperature $I_C = f(T_S)$

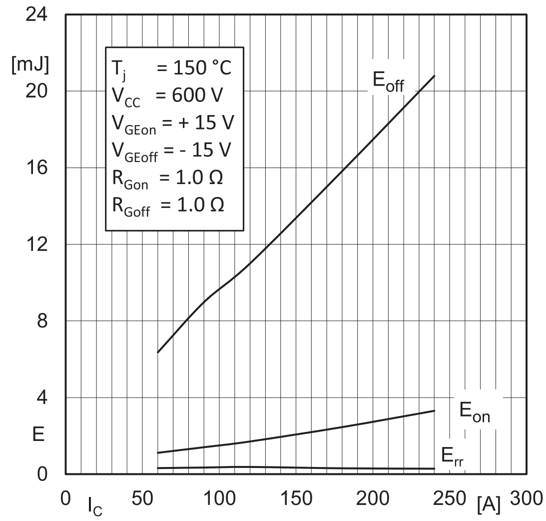


Fig. 3: Typ. turn-on /-off energy = f (I_C)

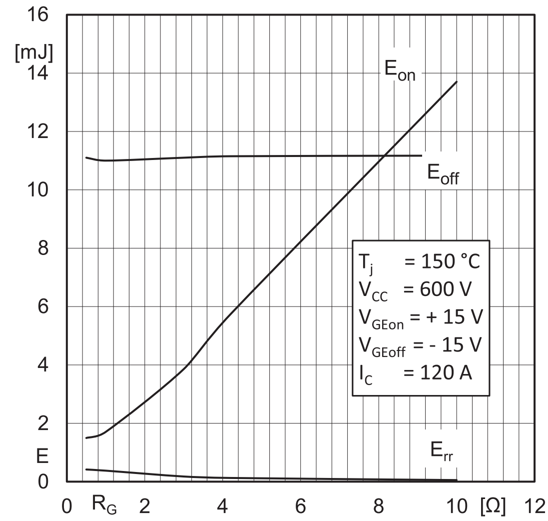


Fig. 4: Typ. turn-on /-off energy = f (R_G)

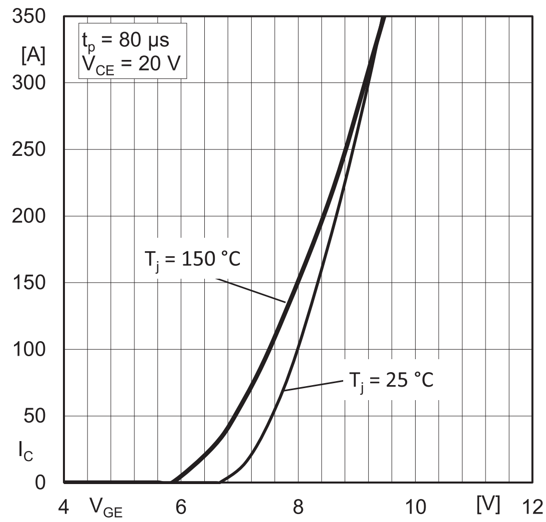


Fig. 5: Typ. transfer characteristic

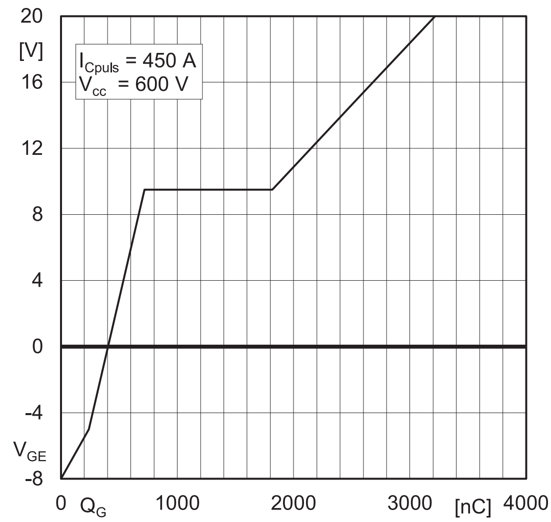


Fig. 6: Typ. gate charge characteristic

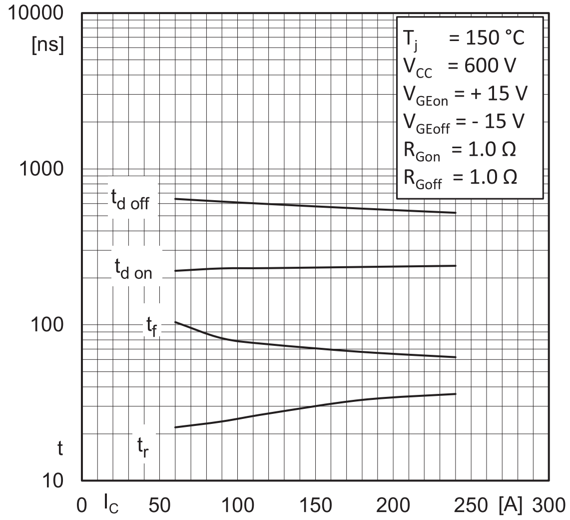


Fig. 7: Typ. switching times vs. I_C

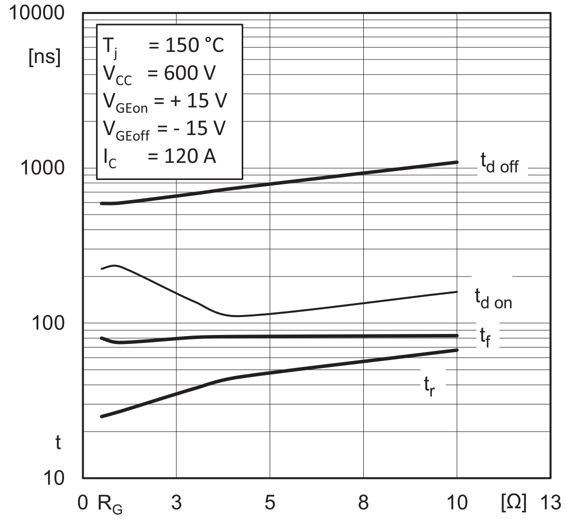


Fig. 8: Typ. switching times vs. gate resistor R_G

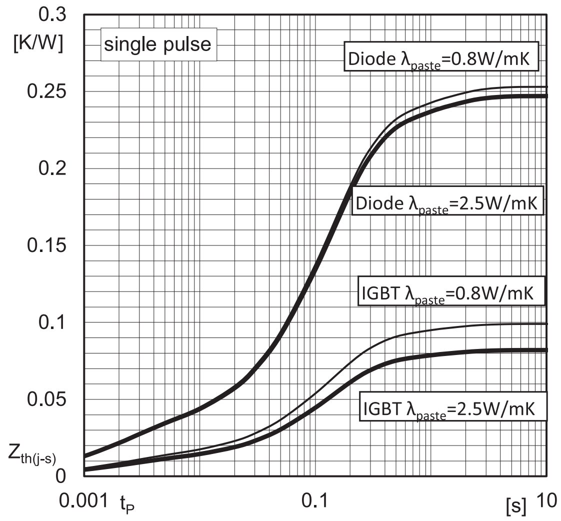


Fig. 9: Typ. transient thermal impedance

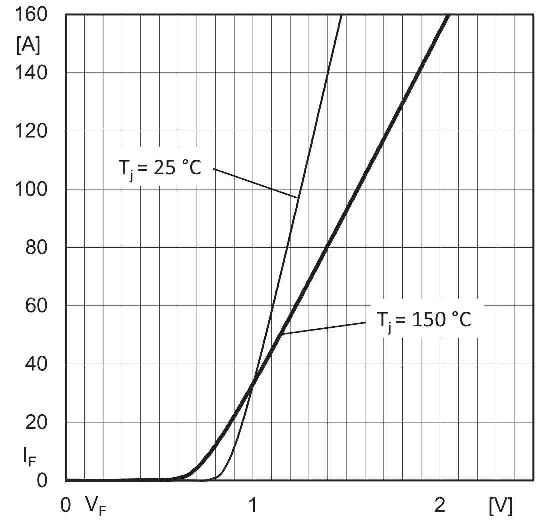


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

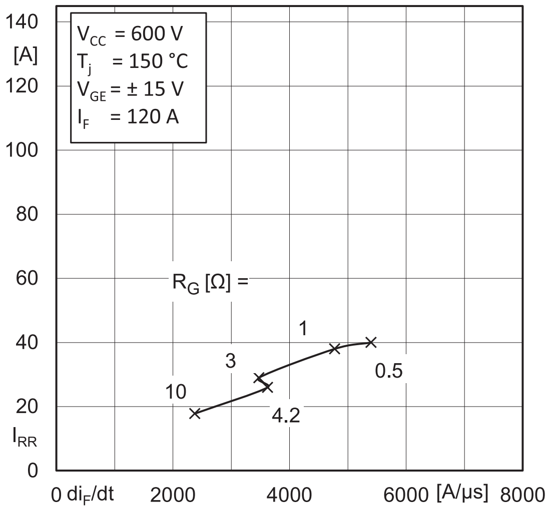
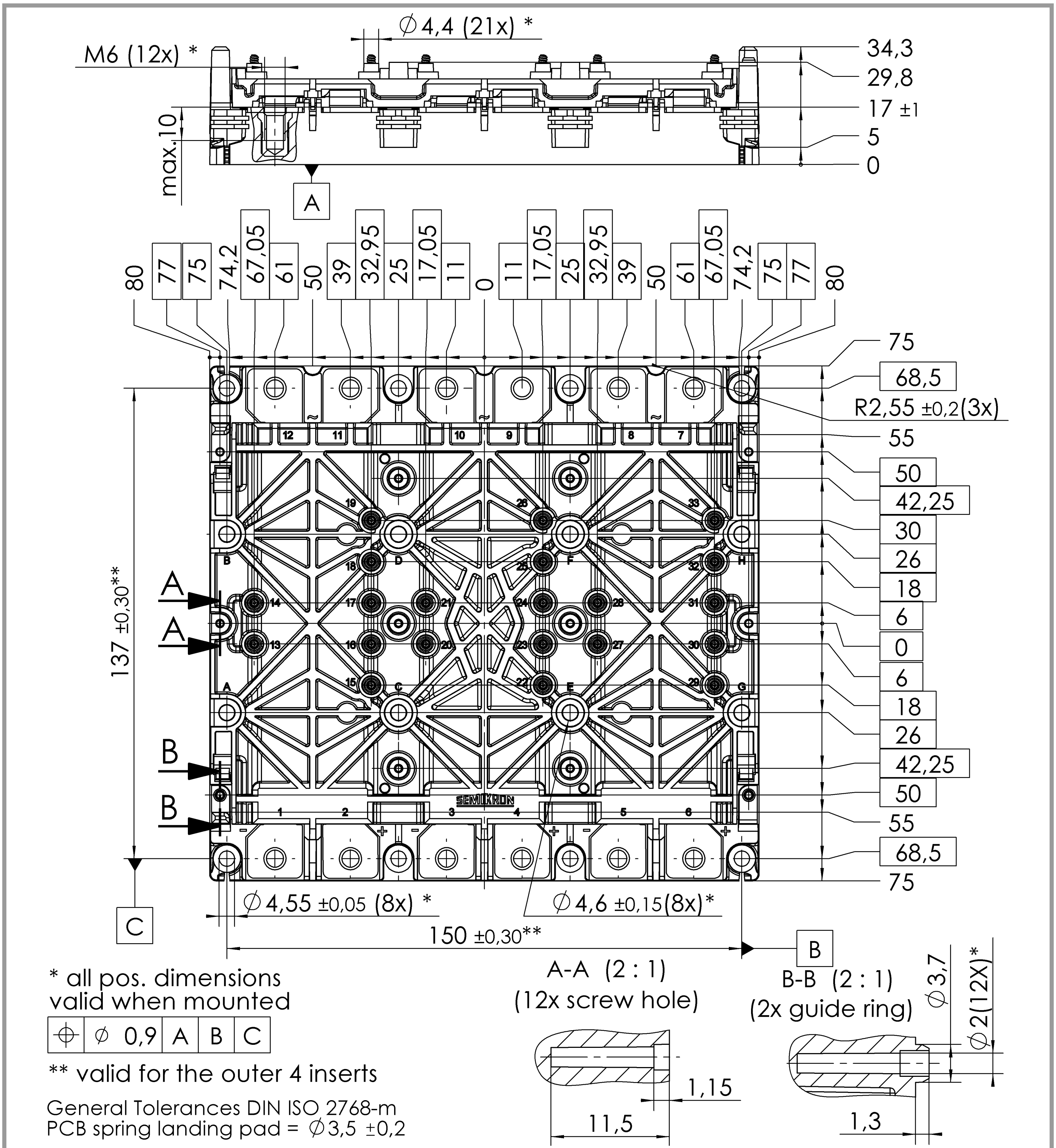
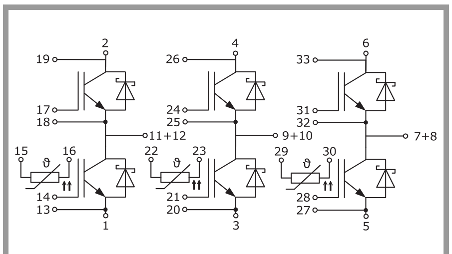


Fig. 11: Typ. CAL diode peak reverse recovery current



∅4,4 (21x) *
M6 (12x) *
34,3
29,8
17 ±1
5
0
max.10
A
80
77
75
74,2
67,05
61
50
39
32,95
25
17,05
11
0
75
68,5
R2,55 ±0,2(3x)
55
50
42,25
30
26
18
6
137 ±0,30**
A
B
C
SEMIKRON
∅4,55 ±0,05 (8x) *
∅4,6 ±0,15(8x)*
150 ±0,30**
B
A-A (2 : 1)
(12x screw hole)
B-B (2 : 1)
(2x guide ring)
∅3,7
∅2(12X)*
1,15
11,5
1,3
* all pos. dimensions
valid when mounted
∅ 0,9 A B C
** valid for the outer 4 inserts
General Tolerances DIN ISO 2768-m
PCB spring landing pad = ∅3,5 ±0,2



19
2
26
4
33
6
17
18
24
25
31
32
11+12
9+10
7+8
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29
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14
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28
27
1
3
5

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

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