



SKiM® 93

Trench IGBT Modules

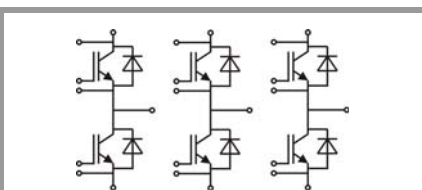
SKiM459GD12E4

Features

- IGBT 4 Trench Gate Technology
- Solderless sinter technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Low inductance case
- Isolated by Al_2O_3 DCB (Direct Copper Bonded) ceramic substrate
- Pressure contact technology for thermal contacts and electrical contacts
- High short circuit capability, self limiting to $6 \times I_C$
- Integrated temperature sensor

Typical Applications*

- Automotive inverter
- High reliability AC inverter wind
- High reliability AC inverter drives



GD

Absolute Maximum Ratings				
Symbol	Conditions	Values	Unit	
IGBT				
V_{CES}		1200	V	
I_C	$T_j = 175\text{ °C}$	$T_s = 25\text{ °C}$	554	A
		$T_s = 70\text{ °C}$	450	A
I_{Cnom}		450	A	
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$	1350	A	
V_{GES}		-20 ... 20	V	
t_{psc}	$V_{CC} = 800\text{ V}$	$T_j = 150\text{ °C}$	10	μs
	$V_{GE} \leq 15\text{ V}$			
	$V_{CES} \leq 1200\text{ V}$			
T_j		-40 ... 175	$^{\circ}\text{C}$	
Inverse diode				
I_F	$T_j = 175\text{ °C}$	$T_s = 25\text{ °C}$	438	A
		$T_s = 70\text{ °C}$	347	A
I_{Fnom}		450	A	
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$	1350	A	
I_{FSM}	$t_p = 10\text{ ms, sin } 180^{\circ}, T_j = 25\text{ °C}$	2430	A	
T_j		-40 ... 175	$^{\circ}\text{C}$	
Module				
$I_{t(RMS)}$	$T_{terminal} = 80\text{ °C}$	700	A	
T_{stg}		-40 ... 125	$^{\circ}\text{C}$	
V_{isol}	AC sinus 50 Hz, $t = 1\text{ min}$	2500	V	

Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
IGBT					
$V_{CE(sat)}$	$I_C = 450\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25\text{ °C}$	1.85	2.10	V
		$T_j = 150\text{ °C}$	2.25	2.45	V
V_{CE0}		$T_j = 25\text{ °C}$	0.8	0.9	V
		$T_j = 150\text{ °C}$	0.7	0.8	V
r_{CE}	$V_{GE} = 15\text{ V}$	$T_j = 25\text{ °C}$	2.3	2.7	$\text{m}\Omega$
		$T_j = 150\text{ °C}$	3.4	3.7	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 18\text{ mA}$	5	5.8	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}$ $V_{CE} = 1200\text{ V}$	$T_j = 25\text{ °C}$	0.1	0.3	mA
		$T_j = 150\text{ °C}$			mA
C_{ies}	$V_{CE} = 25\text{ V}$	$f = 1\text{ MHz}$	26.40		nF
C_{oes}	$V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	1.74		nF
C_{res}		$f = 1\text{ MHz}$	1.41		nF
Q_G	$V_{GE} = -8\text{ V...} + 15\text{ V}$		2550		nC
R_{Gint}	$T_j = 25\text{ °C}$		1.7		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150\text{ °C}$	276		ns
t_r	$I_C = 450\text{ A}$	$T_j = 150\text{ °C}$	55		ns
E_{on}	$R_{G\ on} = 1.3\ \Omega$	$T_j = 150\text{ °C}$	22		mJ
$t_{d(off)}$	$R_{G\ off} = 1.3\ \Omega$	$T_j = 150\text{ °C}$	538		ns
t_f	$di/dt_{on} = 8340\text{ A}/\mu\text{s}$ $di/dt_{off} = 3660\text{ A}/\mu\text{s}$	$T_j = 150\text{ °C}$	114		ns
		$T_j = 150\text{ °C}$	57		mJ
E_{off}			57		mJ
$R_{th(j-s)}$	per IGBT			0.092	K/W



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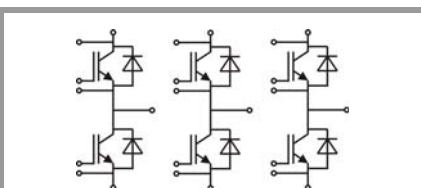
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GD

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse diode						
$V_F = V_{EC}$	$I_F = 450 \text{ A}$ $V_{GE} = 0 \text{ V}$ chip	$T_j = 25 \text{ }^\circ\text{C}$		2.1	2.5	V
		$T_j = 150 \text{ }^\circ\text{C}$		2.1	2.4	V
V_{F0}		$T_j = 25 \text{ }^\circ\text{C}$	1.1	1.3	1.5	V
		$T_j = 150 \text{ }^\circ\text{C}$	0.7	0.9	1.1	V
r_F		$T_j = 25 \text{ }^\circ\text{C}$	1.4	1.9	2.1	m Ω
		$T_j = 150 \text{ }^\circ\text{C}$	2.2	2.6	2.8	m Ω
I_{RRM}	$I_F = 450 \text{ A}$ $di/dt_{off} = 8880 \text{ A}/\mu\text{s}$ $V_{GE} = -15 \text{ V}$ $V_{CC} = 600 \text{ V}$	$T_j = 150 \text{ }^\circ\text{C}$		570		A
Q_{rr}		$T_j = 150 \text{ }^\circ\text{C}$		80		μC
E_{rr}		$T_j = 150 \text{ }^\circ\text{C}$			40	
$R_{th(j-s)}$	per diode				0.155	K/W
Module						
L_{CE}				10	15	nH
$R_{CC'+EE'}$	terminal-chip	$T_s = 25 \text{ }^\circ\text{C}$		0.3		m Ω
		$T_s = 125 \text{ }^\circ\text{C}$		0.5		m Ω
w				1042		g
Temperature sensor						
R_{100}	$T_{Sensor} = 100 \text{ }^\circ\text{C}$ ($R_{25} = 5 \text{ k}\Omega$)			339		Ω
$B_{100/125}$	$R_{(T)} = R_{100} \exp[B_{100/125}(1/T - 1/373)]$; $T[\text{K}]$;			4096		K

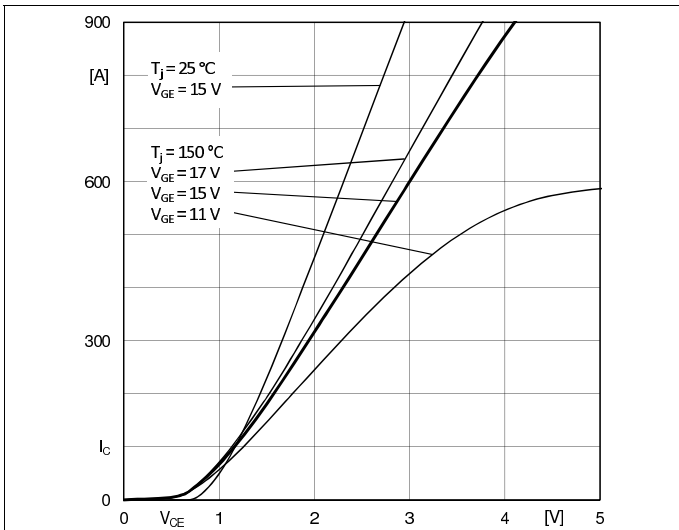


Fig. 1: Typ. output characteristic, inclusive R_{CC+EE}

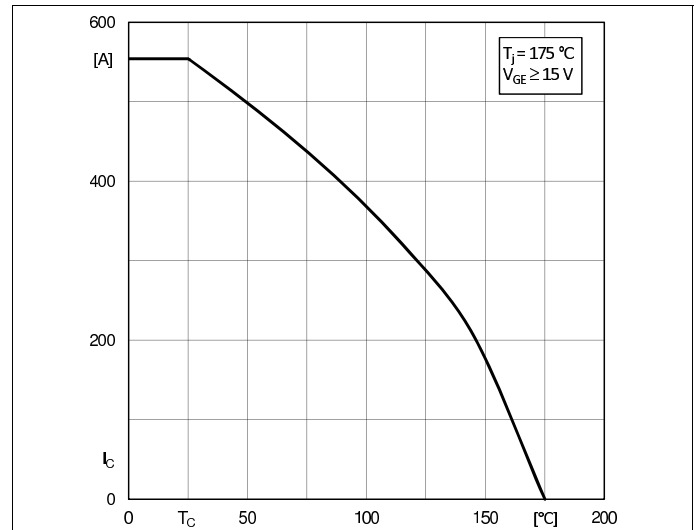


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

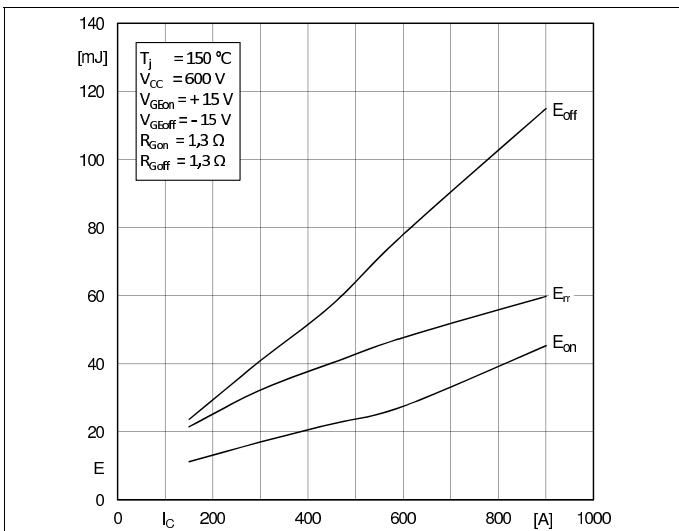


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

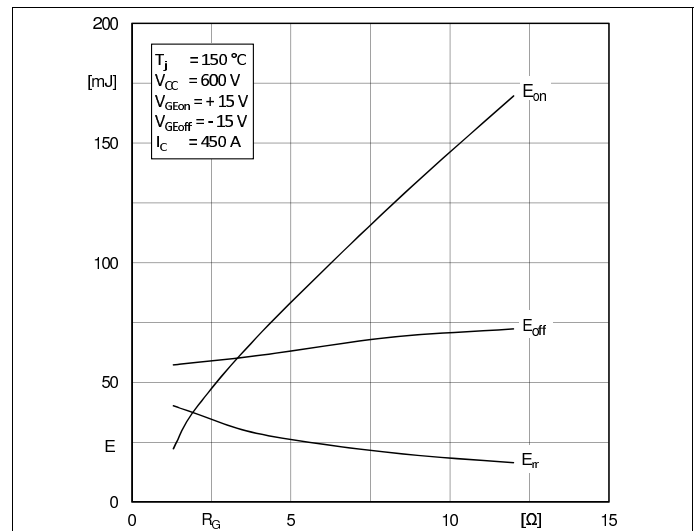


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

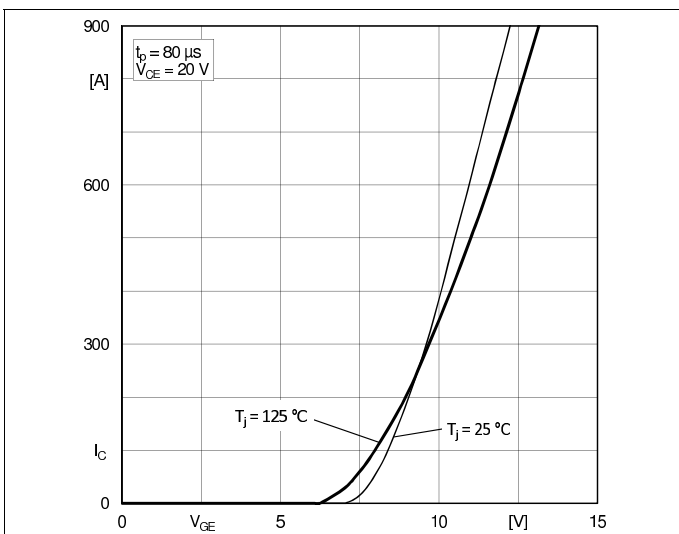


Fig. 5: Typ. transfer characteristic

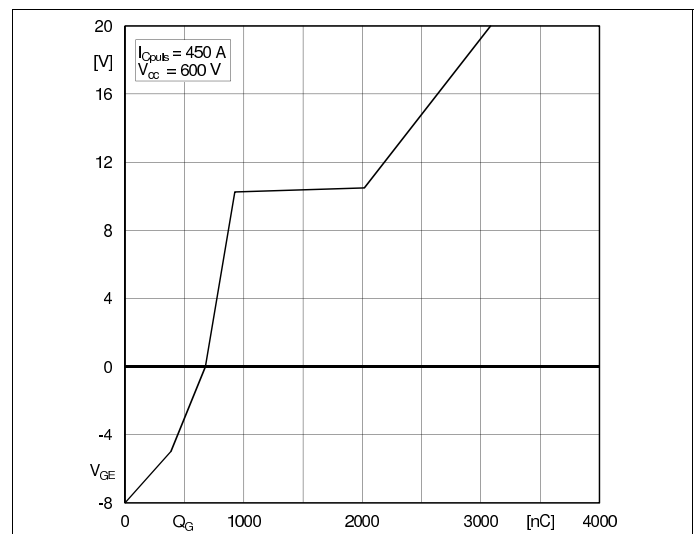


Fig. 6: Typ. gate charge characteristic

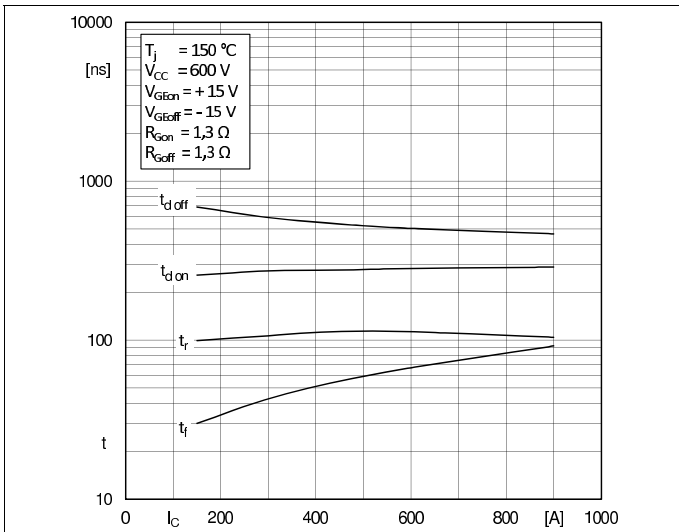


Fig. 7: Typ. switching times vs. I_C

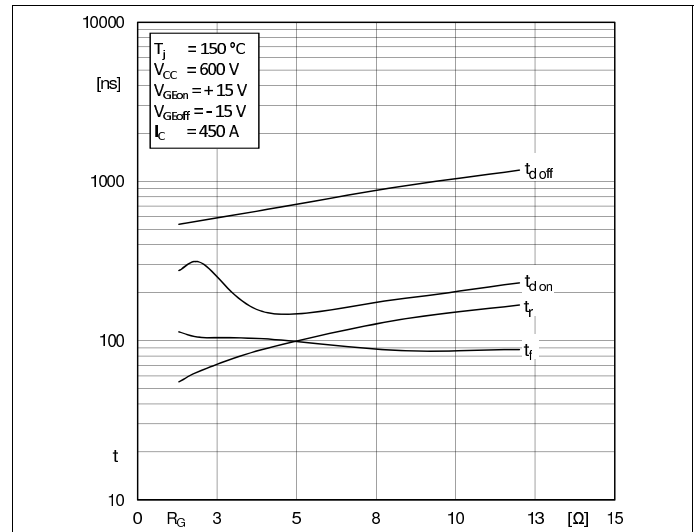


Fig. 8: Typ. switching times vs. gate resistor R_G

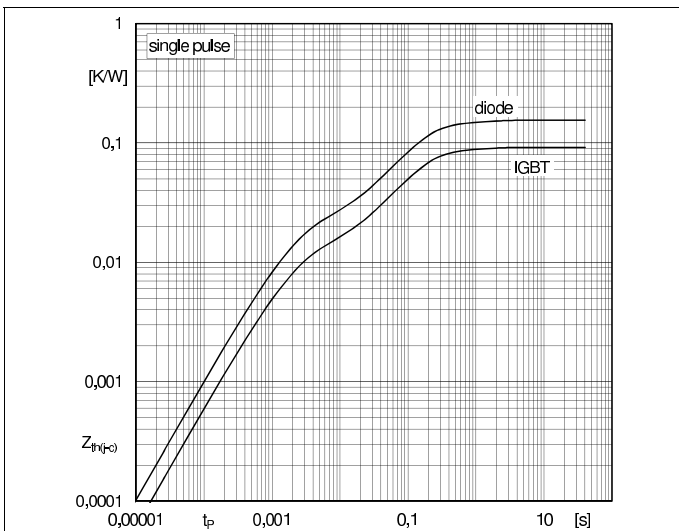


Fig. 9: Typ. transient thermal impedance

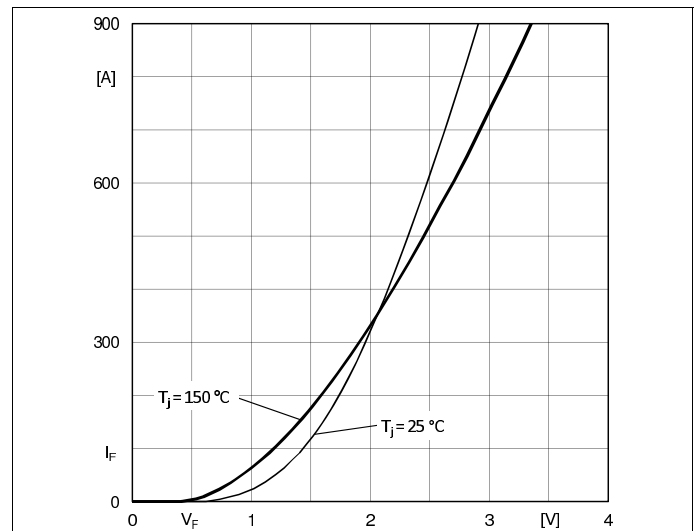


Fig. 10: Typ. CAL diode forward charact., incl. R_{CC+EE}

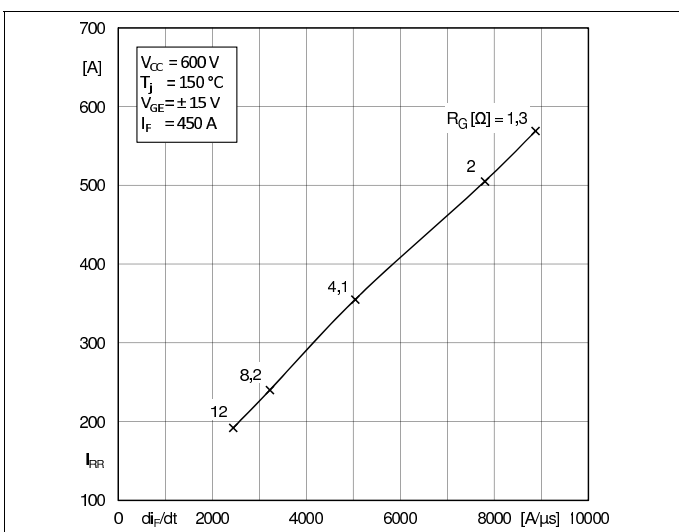


Fig. 11: Typ. CAL diode peak reverse recovery current

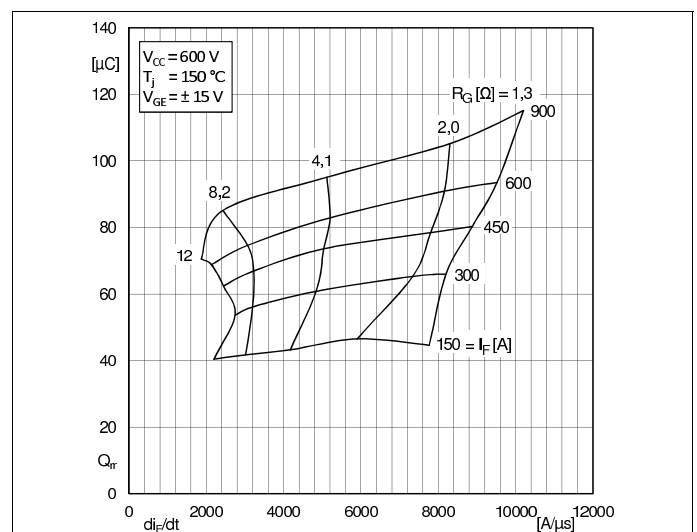
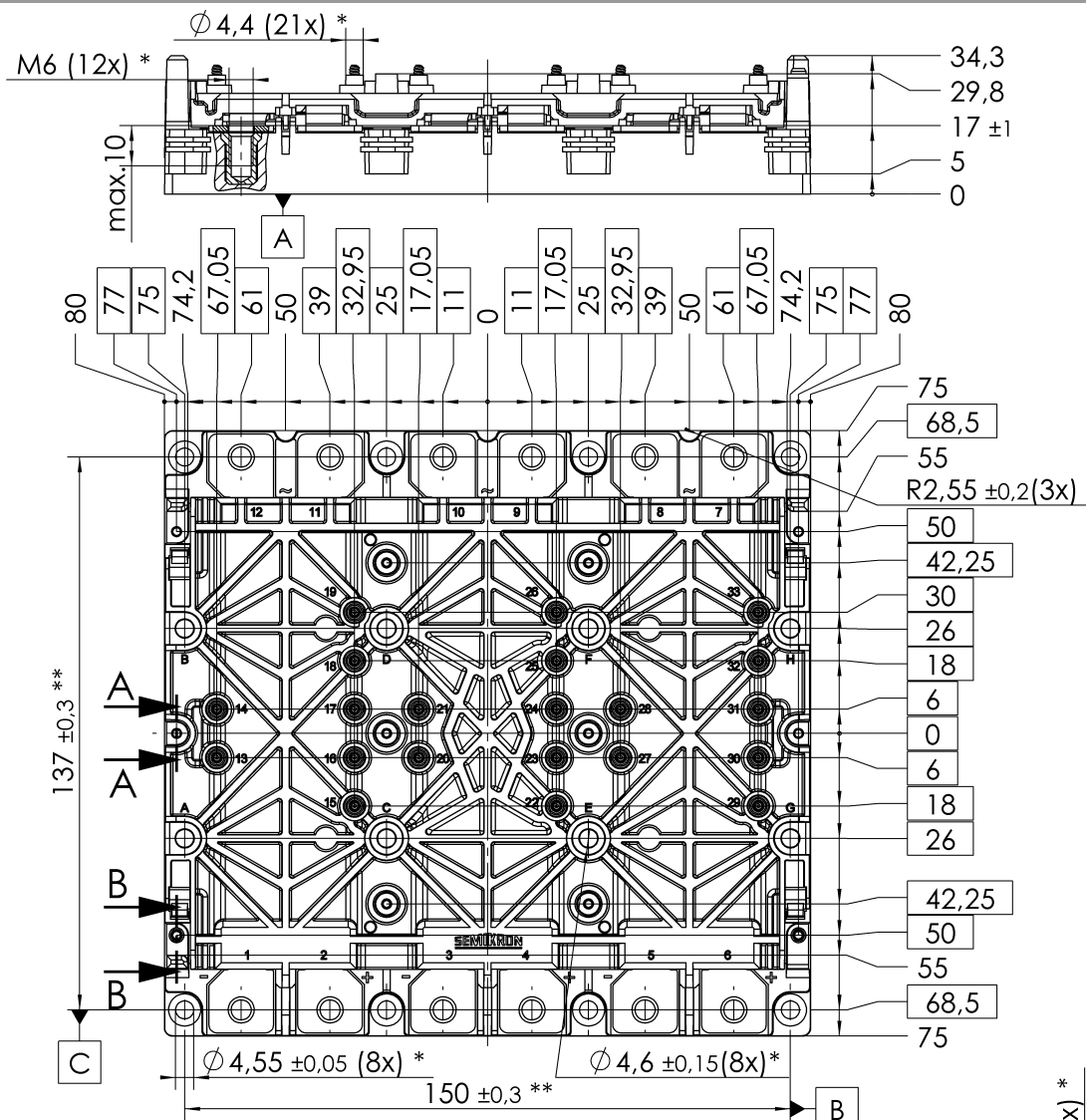
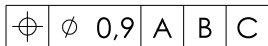


Fig. 12: Typ. CAL diode recovery charge

SKiM459GD12E4



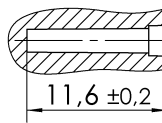
* all pos. dimensions valid when mounted



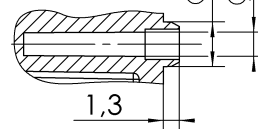
** valid for the outer 4 inserts

General Tolerances DIN ISO 2768-m
PCB spring landing pad = Ø 3,5 ± 0,2

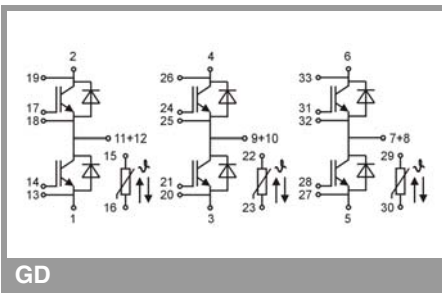
A-A (2 : 1)
(12x screw hole)



B-B (2 : 1)
(2x guide ring)



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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.