



SKiM® 93

Trench IGBT Modules

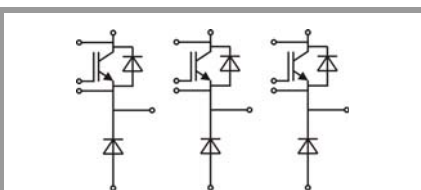
SKiM609GAR12E4

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



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Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT				
V_{CES}			1200	V
I_C	$T_j = 175\text{ °C}$	$T_s = 25\text{ °C}$	748	A
		$T_s = 70\text{ °C}$	608	A
I_{Cnom}			600	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$		1800	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	°C
Inverse diode				
I_F	$T_j = 175\text{ °C}$	$T_s = 25\text{ °C}$	139	A
		$T_s = 70\text{ °C}$	110	A
I_{Fnom}			600	A
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$		1800	A
I_{FSM}	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25\text{ °C}$		900	A
T_j			-40 ... 175	°C
Freewheeling diode				
I_F	$T_j = 175\text{ °C}$	$T_s = 25\text{ °C}$	1397	A
		$T_s = 70\text{ °C}$	1107	A
I_{Fnom}			1350	A
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$		4050	A
I_{FSM}	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25\text{ °C}$		6480	A
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$	$T_{terminal} = 80\text{ °C}$		700	A
T_{stg}			-40 ... 125	°C
V_{isol}	AC sinus 50 Hz, $t = 1\text{ min}$		2500	V

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT						
$V_{CE(sat)}$	$I_C = 600\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25\text{ °C}$	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}	$V_{GE} = 15\text{ V}$	$T_j = 25\text{ °C}$	1.8	2.0		mΩ
		$T_j = 150\text{ °C}$	2.6	2.8		mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 24\text{ mA}$		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}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	35.20			nF
C_{oes}		$f = 1\text{ MHz}$	2.32			nF
C_{res}		$f = 1\text{ MHz}$	1.88			nF
Q_G	$V_{GE} = -8\text{ V...} + 15\text{ V}$		3400			nC
R_{Gint}	$T_j = 25\text{ °C}$		1.3			Ω



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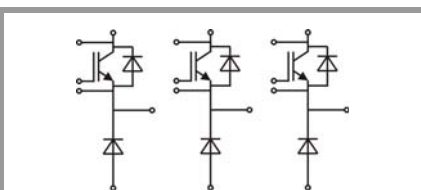
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Typical Applications*

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150\text{ °C}$		150		ns
t_r	$I_C = 600\text{ A}$	$T_j = 150\text{ °C}$		121		ns
E_{on}	$V_{GE} = 15\text{ V}$	$T_j = 150\text{ °C}$		136		mJ
$t_{d(off)}$	$R_{G\ on} = 4.1\ \Omega$	$T_j = 150\text{ °C}$		808		ns
t_f	$R_{G\ off} = 4.1\ \Omega$	$T_j = 150\text{ °C}$		100		ns
E_{off}	$di/dt_{on} = 5000\text{ A}/\mu\text{s}$	$T_j = 150\text{ °C}$		83		mJ
	$di/dt_{off} = 4400\text{ A}/\mu\text{s}$	$T_j = 150\text{ °C}$				
$R_{th(j-s)}$	per IGBT				0.068	K/W
Inverse diode						
$V_F = V_{EC}$	$I_F = 150\text{ A}$	$T_j = 25\text{ °C}$		2.1	2.5	V
	$V_{GE} = 0\text{ V}$	$T_j = 150\text{ °C}$		2.1	2.4	V
	chip					
V_{F0}		$T_j = 25\text{ °C}$	1.1	1.3	1.5	V
		$T_j = 150\text{ °C}$	0.7	0.9	1.1	V
r_F		$T_j = 25\text{ °C}$	4.3	5.6	6.4	m Ω
		$T_j = 150\text{ °C}$	6.7	7.8	8.5	m Ω
I_{RRM}	$I_F = 150\text{ A}$	$T_j = 150\text{ °C}$		153		A
Q_{rr}	$di/dt_{off} = 3300\text{ A}/\mu\text{s}$	$T_j = 150\text{ °C}$		15		μC
E_{rr}	$V_{GE} = -15\text{ V}$	$T_j = 150\text{ °C}$		9		mJ
	$V_{CC} = 600\text{ V}$					
$R_{th(j-s)}$	per diode				0.501	K/W
Freewheeling diode						
$V_F = V_{EC}$	$I_F = 600\text{ A}$	$T_j = 25\text{ °C}$		1.7	1.9	V
	$V_{GE} = 0\text{ V}$	$T_j = 150\text{ °C}$		1.4	1.7	V
	chip					
V_{F0}		$T_j = 25\text{ °C}$	1.1	1.3	1.5	V
		$T_j = 150\text{ °C}$	0.7	0.9	1.1	V
r_F		$T_j = 25\text{ °C}$	0.5	0.6	0.7	m Ω
		$T_j = 150\text{ °C}$	0.7	0.9	0.9	m Ω
I_{RRM}	$I_F = 600\text{ A}$	$T_j = 150\text{ °C}$		510		A
Q_{rr}	$di/dt_{off} = 5300\text{ A}/\mu\text{s}$	$T_j = 150\text{ °C}$		123		μC
E_{rr}	$V_{GE} = -15\text{ V}$	$T_j = 150\text{ °C}$		39		mJ
	$V_{CC} = 600\text{ V}$					
$R_{th(j-s)}$	per diode				0.048	K/W
Module						
L_{CE}				10	15	nH
R_{CC+EE}	terminal-chip	$T_s = 25\text{ °C}$		0.3		m Ω
		$T_s = 125\text{ °C}$		0.5		m Ω
w				1042		g
Temperatur Sensor						
R_{100}	$T_{Sensor} = 100\text{ °C}$ ($R_{25} = 5\text{ k}\Omega$)			339		Ω
$B_{100/125}$	$R_{(T)} = R_{100} \exp[B_{100/125}(1/T - 1/373)]$; $T[K]$;			4096		K



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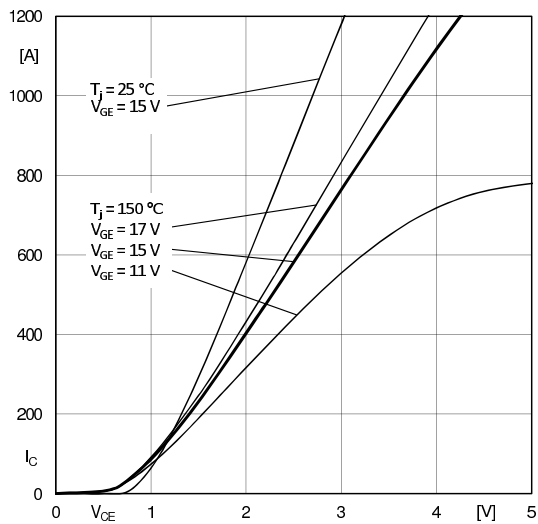


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

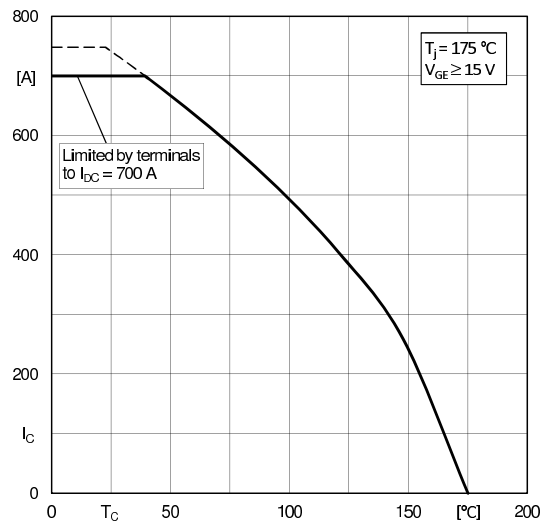


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

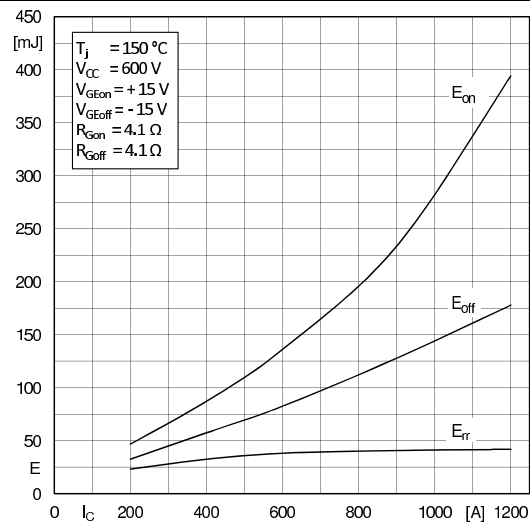


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

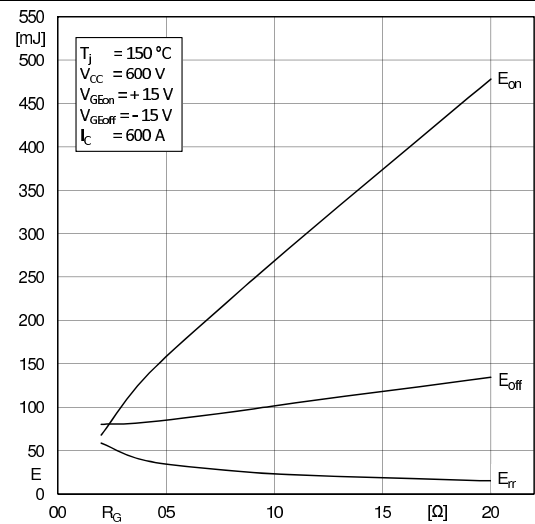


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

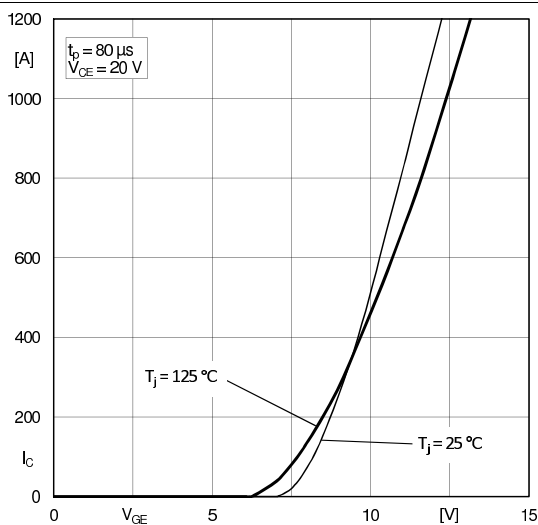


Fig. 5: Typ. transfer characteristic

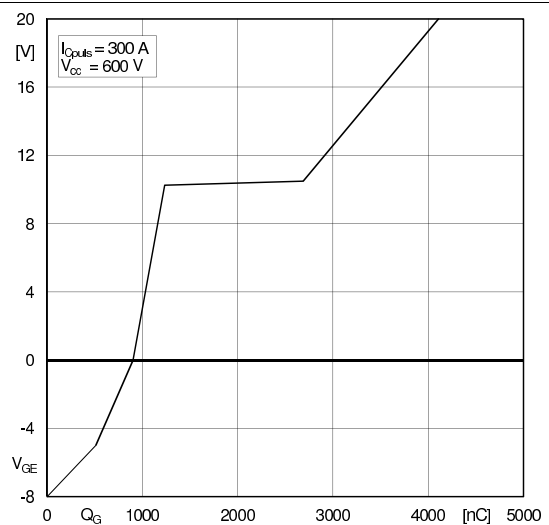


Fig. 6: Typ. gate charge characteristic

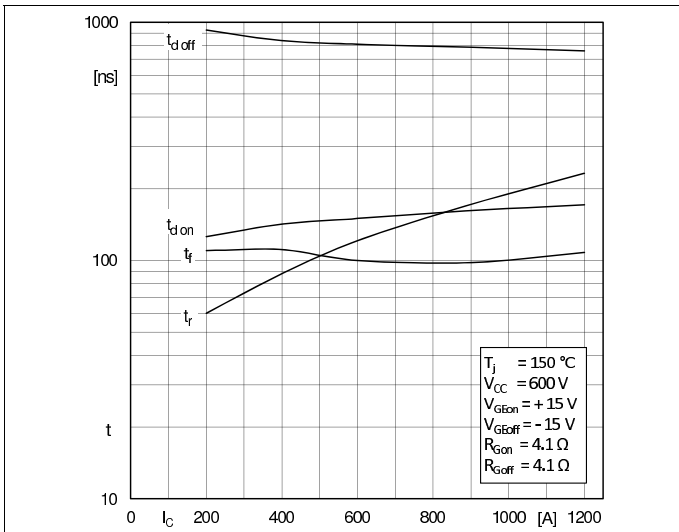


Fig. 7: Typ. switching times vs. I_C

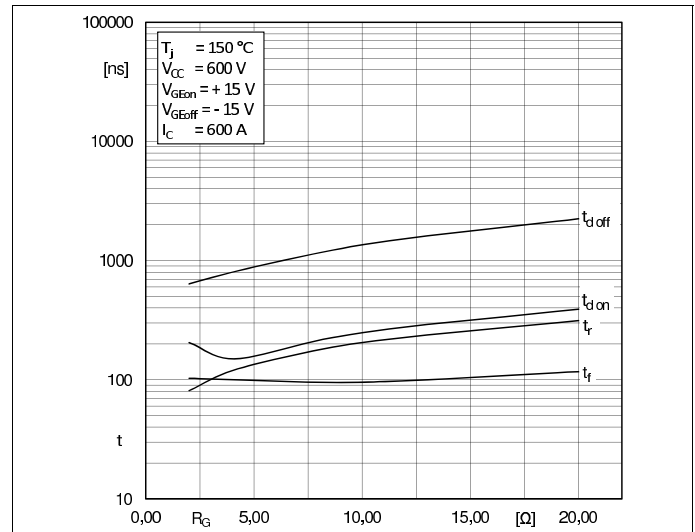


Fig. 8: Typ. switching times vs. gate resistor R_G

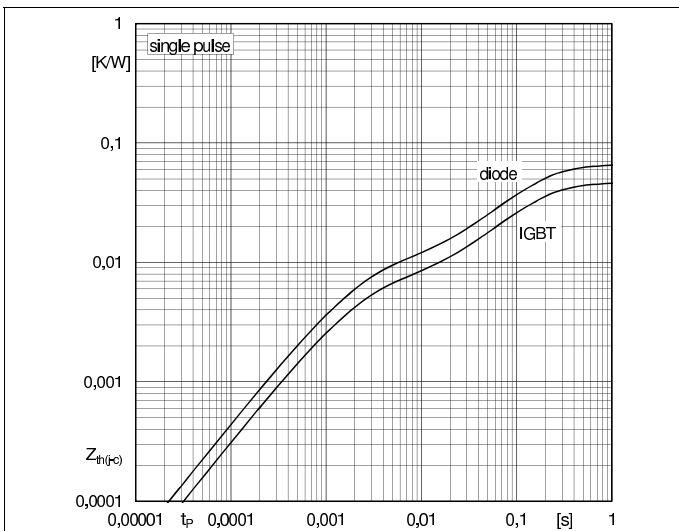


Fig. 9: Typ. transient thermal impedance

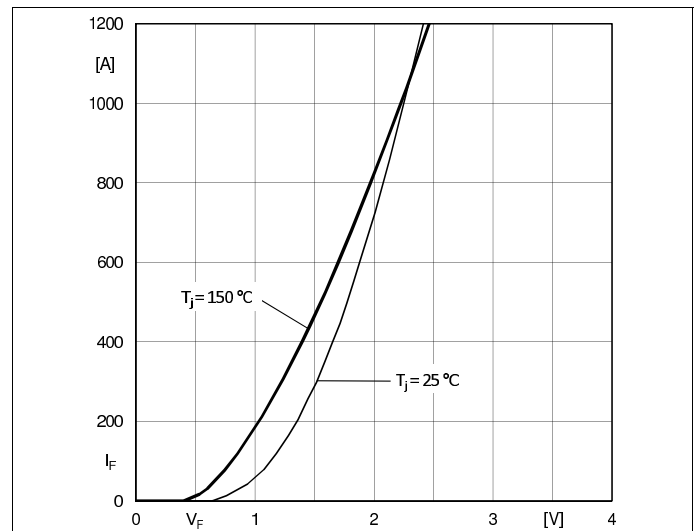


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

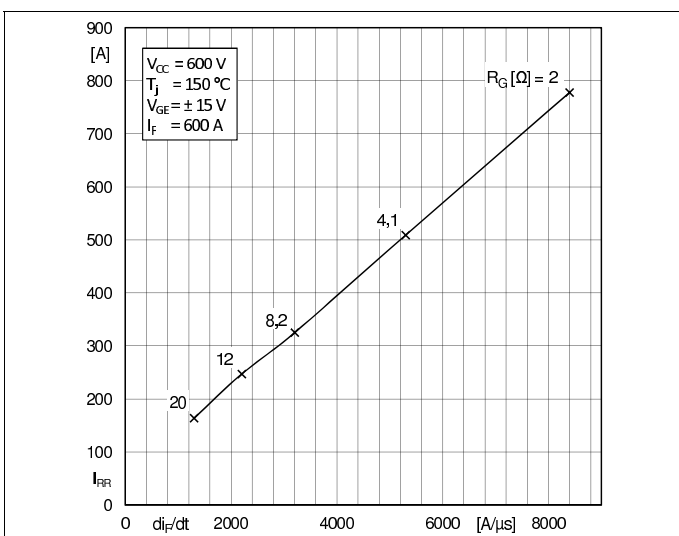


Fig. 11: Typ. CAL diode peak reverse recovery current

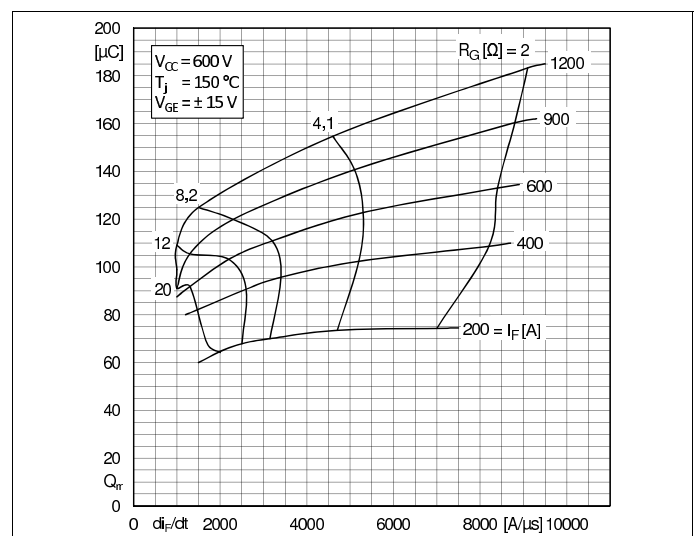
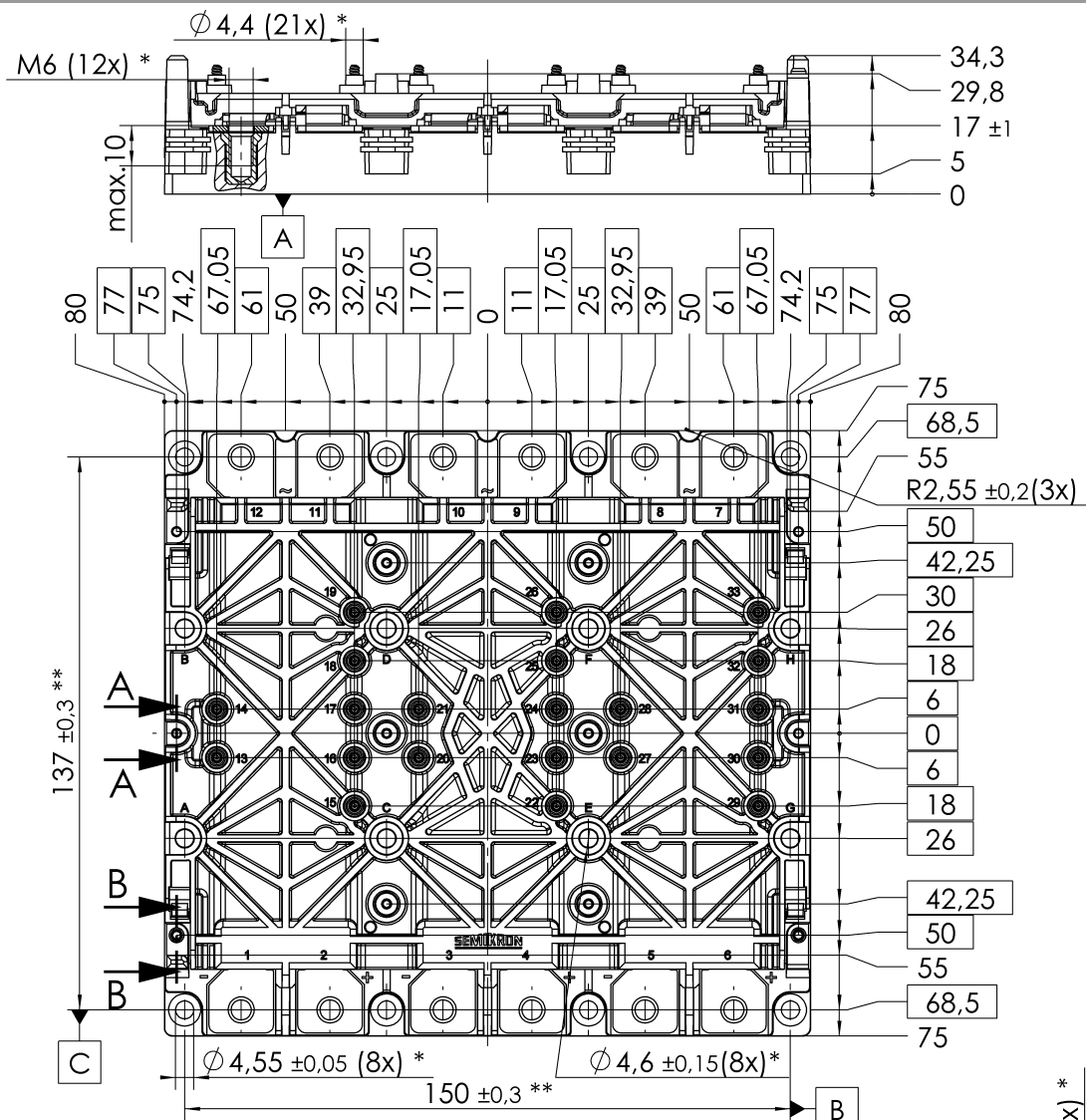


Fig. 12: Typ. CAL diode recovery charge

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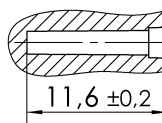
* all pos. dimensions valid when mounted

⊕ Ø 0,9 A B C

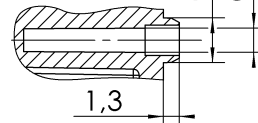
** valid for the outer 4 inserts

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

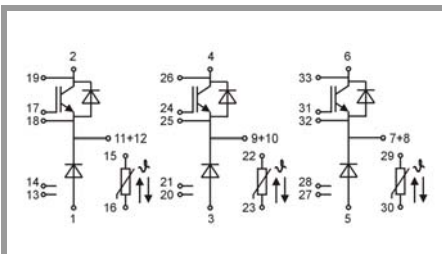
A-A (2 : 1)
(12x screw hole)



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.