



SKiM® 93

## Trench IGBT Modules

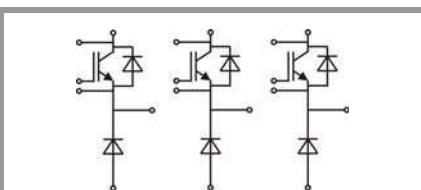
### SKiM609GAR12E4

#### 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	
<b>IGBT</b>				
$V_{CES}$		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	
$t_{psc}$	$V_{CC} = 800\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 1200\text{ V}$	$T_j = 150\text{ °C}$	10	$\mu\text{s}$
$T_j$		-40 ... 175	$^{\circ}\text{C}$	
<b>Inverse diode</b>				
$I_F$	$T_j = 175\text{ °C}$	$T_s = 25\text{ °C}$	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	$^{\circ}\text{C}$	
<b>Freewheeling diode</b>				
$I_F$	$T_j = 175\text{ °C}$	$T_s = 25\text{ °C}$	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	$^{\circ}\text{C}$	
<b>Module</b>				
$I_{t(RMS)}$	$T_{terminal} = 80\text{ °C}$	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
<b>IGBT</b>					
$V_{CE(sat)}$	$I_C = 600\text{ A}$ $V_{GE} = 15\text{ V}$ 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	$\text{m}\Omega$
		$T_j = 150\text{ °C}$	2.6	2.8	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 24\text{ mA}$	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	$\text{mA}$
		$T_j = 150\text{ °C}$			$\text{mA}$
$C_{ies}$	$V_{CE} = 25\text{ V}$		35.20		nF
$C_{oes}$	$V_{GE} = 0\text{ V}$		2.32		nF
$C_{res}$			1.88		nF
$Q_G$	$V_{GE} = -8\text{ V...} + 15\text{ V}$		3400		nC
$R_{Gint}$	$T_j = 25\text{ °C}$		1.3		$\Omega$



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### SKiM609GAR12E4

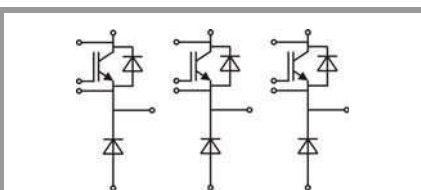
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#### Typical Applications\*

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- High reliability AC inverter drives

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



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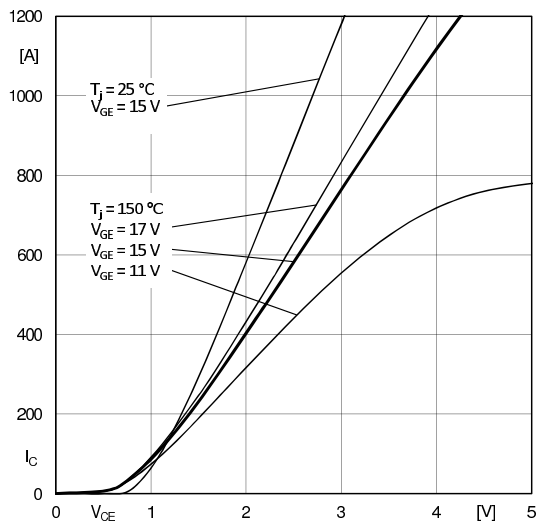


Fig. 1: Typ. output characteristic, inclusive  $R_{CC'+EE'}$

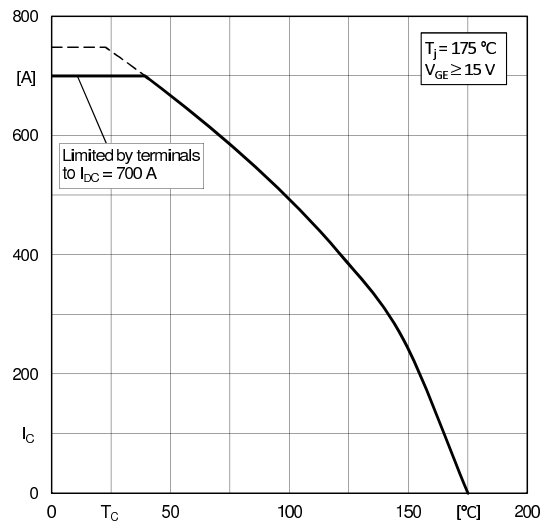


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

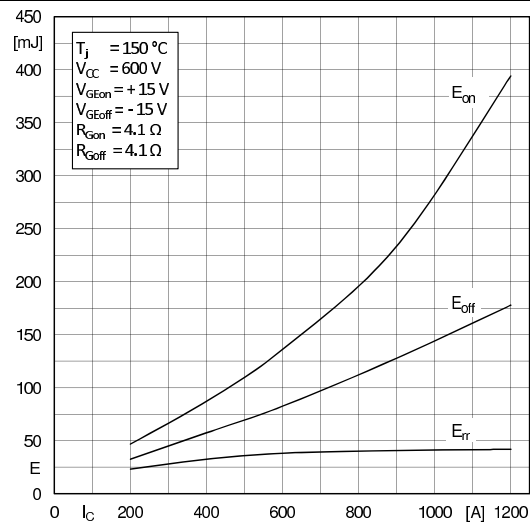


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

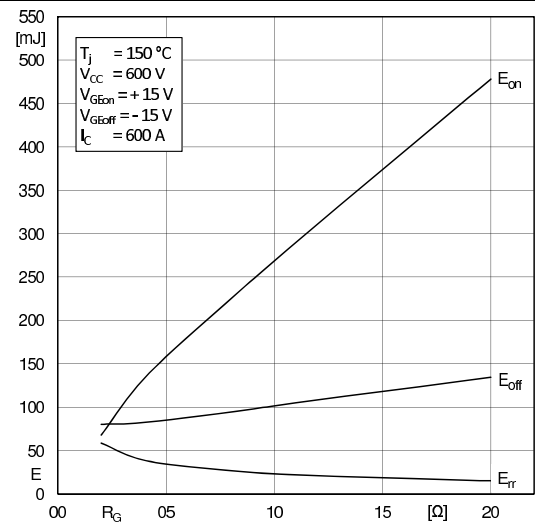


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

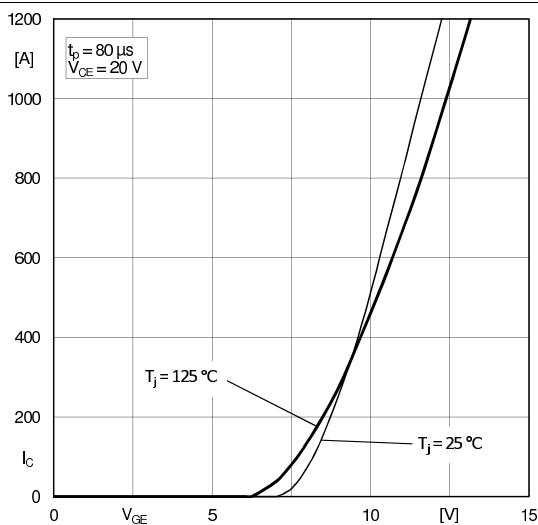


Fig. 5: Typ. transfer characteristic

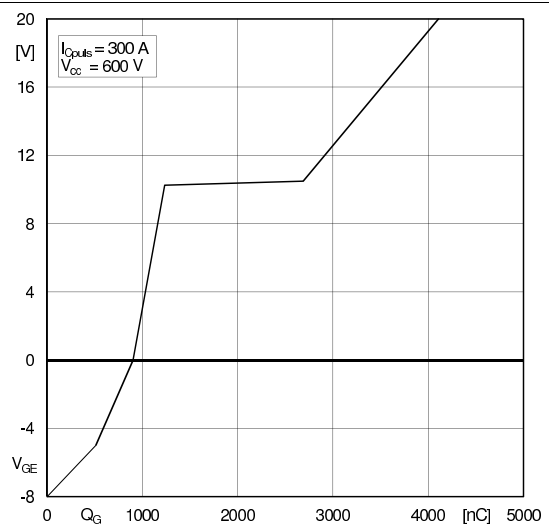


Fig. 6: Typ. gate charge characteristic

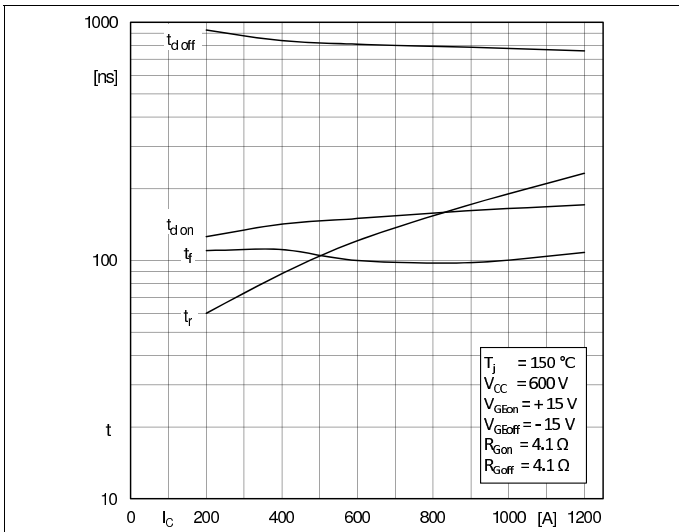


Fig. 7: Typ. switching times vs.  $I_C$

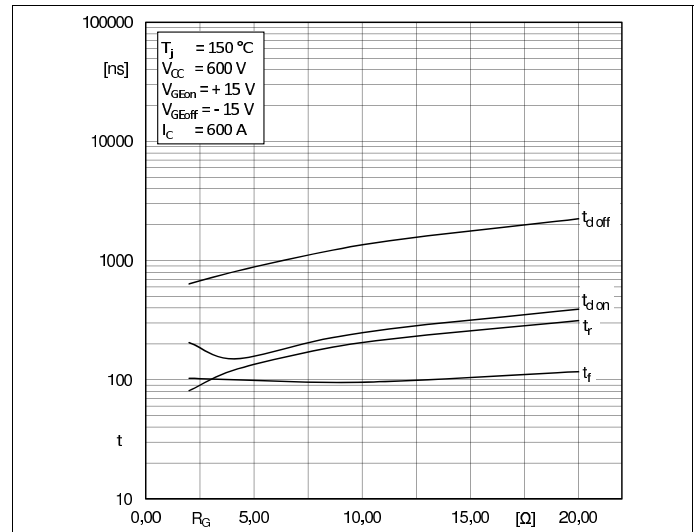


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

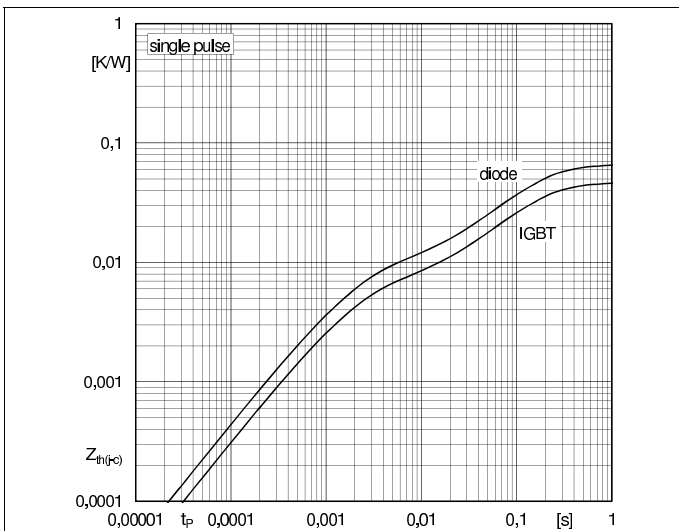


Fig. 9: Typ. transient thermal impedance

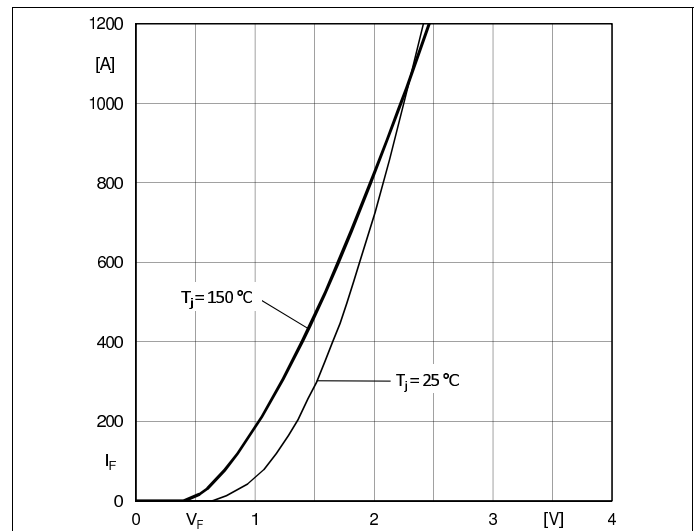


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC'+EE}$

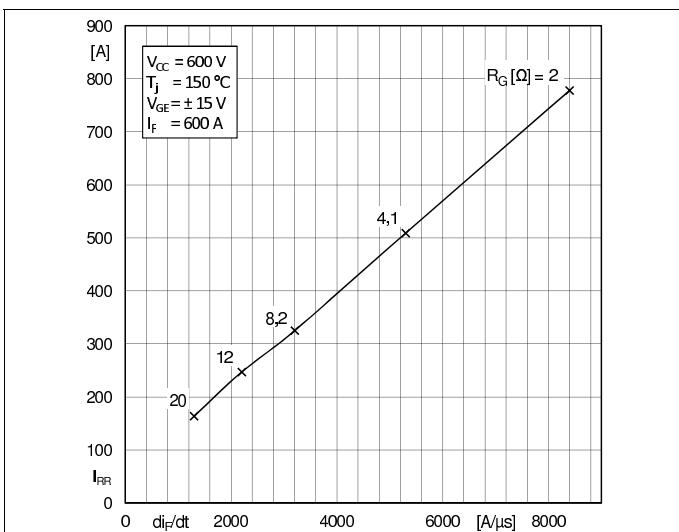


Fig. 11: Typ. CAL diode peak reverse recovery current

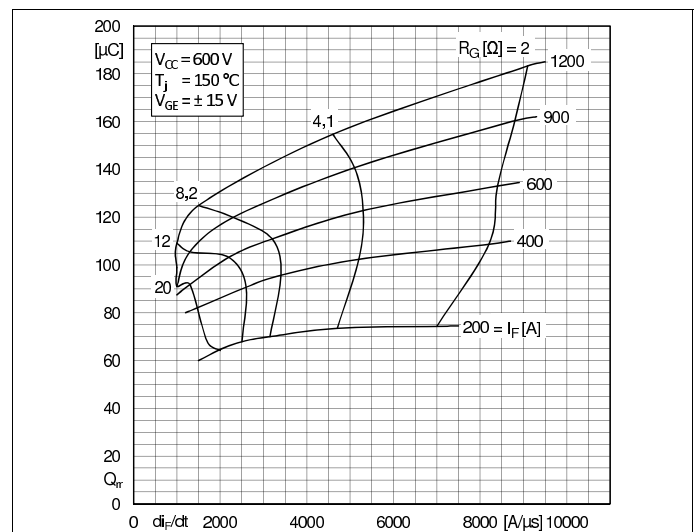
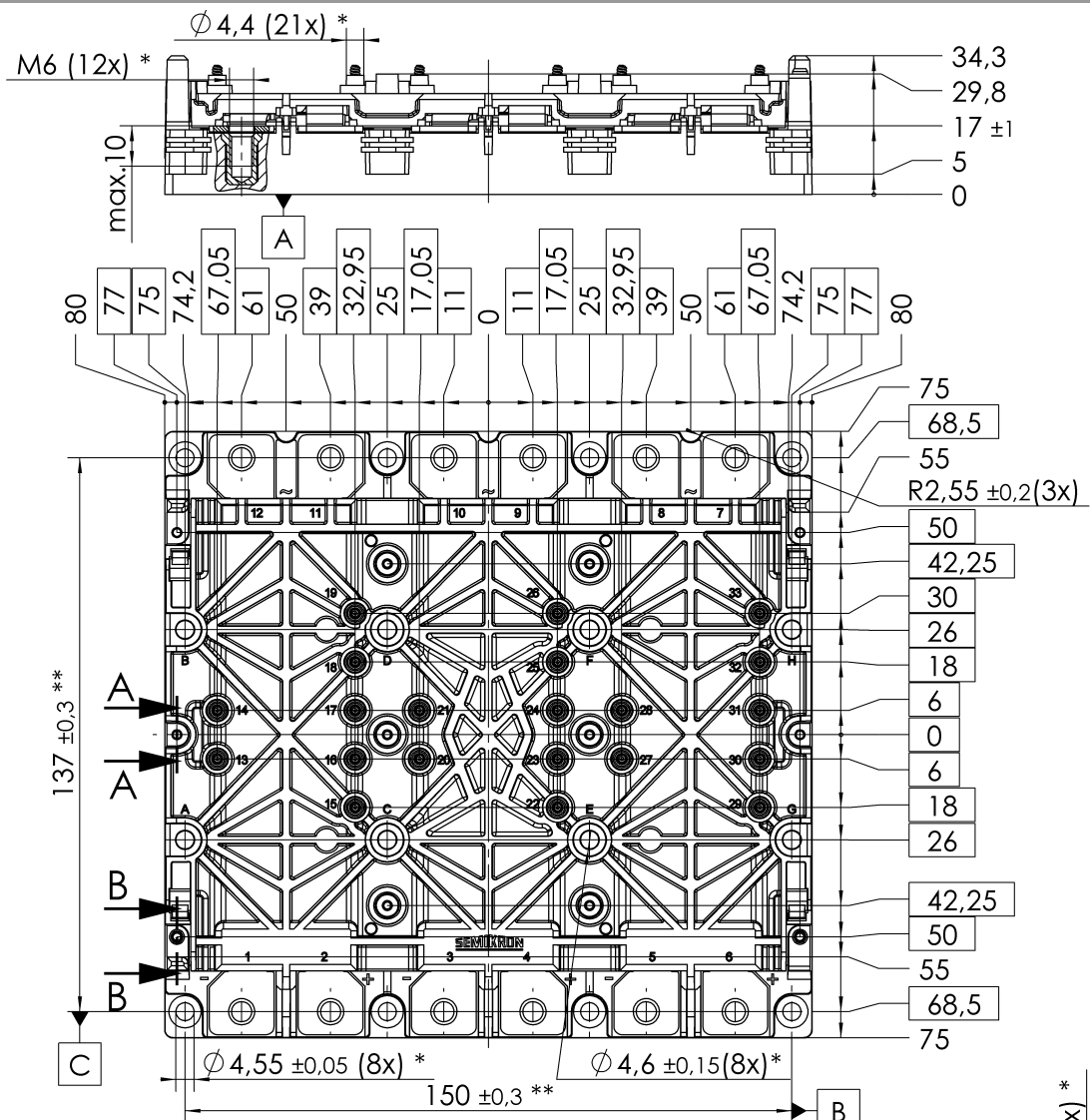


Fig. 12: Typ. CAL diode recovery charge

# SKiM609GAR12E4



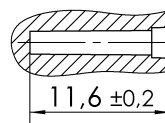
\* all pos. dimensions valid when mounted

⊕ Ø 0,9 A B C

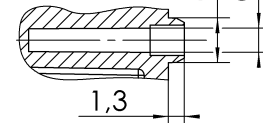
\*\* valid for the outer 4 inserts

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

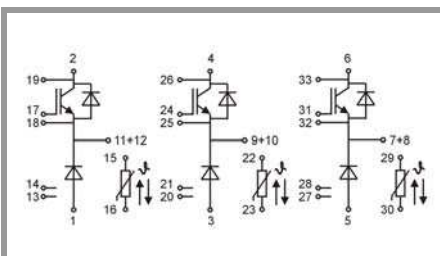
A-A (2:1)  
(12x screw hole)



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.