



SKiM® 93

Trench IGBT Modules

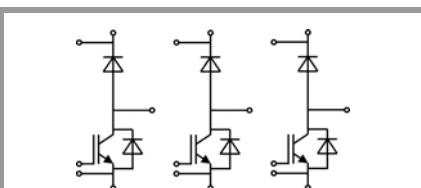
SKiM609GAL12E4 V2

Features*

- IGBT 4 Trench Gate Technology
- Solderless sinter technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Low inductance case
- Insulated by Al_2O_3 DBC (Direct Bonded Copper) ceramic substrate
- Pressure contact technology for thermal contacts
- Spring contact system to attach driver PCB to the control terminals
- High short circuit capability, self limiting to $6 \times I_C$
- Integrated temperature sensor

Remarks*

- Case temperature limited to $T_s = 125^\circ C$ max; $T_c = T_s$ (for baseplateless modules)
- Recommended $T_{op} = -40 \dots +150^\circ C$



GAL

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT				
V _{CES}	T _J = 25 °C		1200	V
I _C	λ _{paste} =0.8 W/(mK) T _J = 175 °C	T _s = 25 °C	748	A
		T _s = 70 °C	608	A
I _C	λ _{paste} =2.5 W/(mK) T _J = 175 °C	T _s = 25 °C	845	A
		T _s = 70 °C	688	A
I _{Cnom}			600	A
I _{CRM}			1800	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V, V _{GE} ≤ 15 V, T _J = 150 °C, V _{CES} ≤ 1200 V		10	μs
T _J			-40 ... 175	°C
Inverse diode				
V _{RRM}	T _J = 25 °C		1200	V
I _F	λ _{paste} =0.8 W/(mK) T _J = 175 °C	T _s = 25 °C	139	A
		T _s = 70 °C	110	A
I _F	λ _{paste} =2.5 W/(mK) T _J = 175 °C	T _s = 25 °C	172	A
		T _s = 70 °C	137	A
I _{FRM}			300	A
I _{FSM}	10 ms, sin 180°, T _J = 25 °C		900	A
T _J			-40 ... 175	°C
Freewheeling diode				
V _{RRM}	T _J = 25 °C		1200	V
I _F	λ _{paste} =0.8 W/(mK) T _J = 175 °C	T _s = 25 °C	1328	A
		T _s = 70 °C	1052	A
I _F	λ _{paste} =2.5 W/(mK) T _J = 175 °C	T _s = 25 °C	1418	A
		T _s = 70 °C	1126	A
I _{FRM}			1200	A
I _{FSM}	10 ms, sin 180°, T _J = 25 °C		6480	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
IGBT						
V _{CE(sat)}	I _C = 600 A	T _j = 25 °C		1.85	2.10	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.25	2.45	V
V _{CE0}	chiplevel	T _j = 25 °C		0.80	0.90	V
		T _j = 150 °C		0.70	0.80	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		1.75	2.0	mΩ
	chiplevel	T _j = 150 °C		2.6	2.8	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 24 mA		5	5.8	6.5	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C			0.1	5	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		35.2		nF
C _{oes}		f = 1 MHz		2.32		nF
C _{res}		f = 1 MHz		1.88		nF
Q _G	V _{GE} = - 8 V...+ 15 V			3400		nC



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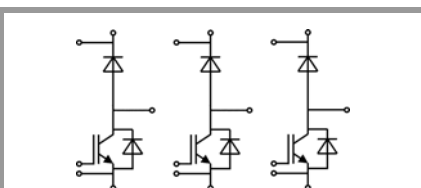
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Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
IGBT					
R_{Gint}	$T_j = 25^\circ C$		1.3		Ω
$t_{d(on)}$	$V_{CC} = 600 V$ $I_C = 600 A$ $T_j = 150^\circ C$		150		ns
t_r	$V_{GE} = +15/-15 V$ $T_j = 150^\circ C$		121		ns
E_{on}	$R_{G on} = 4.1 \Omega$ $T_j = 150^\circ C$		136		mJ
$t_{d(off)}$	$R_{G off} = 4.1 \Omega$ $T_j = 150^\circ C$		808		ns
t_f	$di/dt_{on} = 5000 A/\mu s$ $di/dt_{off} = 4400 A/\mu s$ $T_j = 150^\circ C$		100		ns
E_{off}	$T_j = 150^\circ C$		83		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 W/(mK)$		0.068		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 W/(mK)$		0.055		K/W
Inverse diode					
$V_F = V_{EC}$	$I_F = 150 A$ $T_j = 25^\circ C$		2.14	2.46	V
	chipelevel $T_j = 150^\circ C$		2.07	2.38	V
V_{F0}	$T_j = 25^\circ C$		1.30	1.50	V
	chipelevel $T_j = 150^\circ C$		0.90	1.10	V
r_F	$T_j = 25^\circ C$		5.6	6.4	m Ω
	chipelevel $T_j = 150^\circ C$		7.8	8.5	m Ω
I_{RRM}	$I_F = 150 A$ $T_j = 150^\circ C$		153		A
Q_{rr}	$di/dt_{off} = 3300 A/\mu s$ $V_R = 600 V$ $T_j = 150^\circ C$		15		μC
E_{rr}	$V_{GE} = +15/-15 V$ $T_j = 150^\circ C$		9		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 W/(mK)$		0.501		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 W/(mK)$		0.361		K/W
Freewheeling diode					
$V_F = V_{EC}$	$I_F = 600 A$ $T_j = 25^\circ C$		1.67	1.93	V
	chipelevel $T_j = 150^\circ C$		1.42	1.67	V
V_{F0}	$T_j = 25^\circ C$		1.30	1.50	V
	chipelevel $T_j = 150^\circ C$		0.90	1.10	V
r_F	$T_j = 25^\circ C$		0.62	0.71	m Ω
	chipelevel $T_j = 150^\circ C$		0.87	0.95	m Ω
I_{RRM}	$I_F = 600 A$ $T_j = 150^\circ C$		510		A
Q_{rr}	$di/dt_{off} = 5300 A/\mu s$ $V_R = 600 V$ $T_j = 150^\circ C$		123		μC
$E_{rr}^{1)}$	$V_{GE} = +/-15 V$ $T_j = 150^\circ C$		39		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 W/(mK)$		0.051		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 W/(mK)$		0.046		K/W

Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
Temperature Sensor					
R_{100}	$T_r=100^\circ C$ ($R_{25}=1000\Omega$)		1670 $\pm$ 1%		Ω
$R(T)$	$R(T)=1k\Omega[1+A(T-25^\circ C)+B(T-25^\circ C)^2]$, $A = 7.64 \cdot 10^{-3} ^\circ C^{-1}$, $B = 1.73 \cdot 10^{-5} ^\circ C^{-2}$				

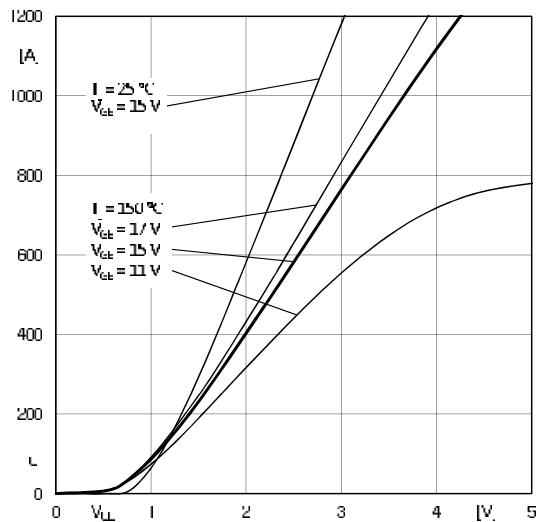


Fig. 1: Typ. output characteristic, inclusive $R_{CC'} + E_{E'}$

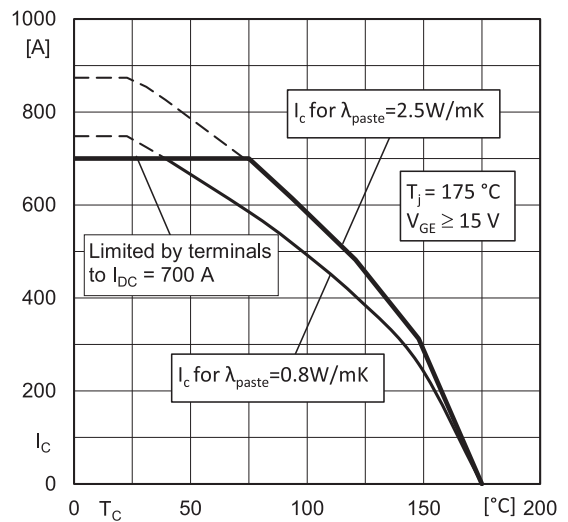


Fig. 2: Typ. rated current vs. temperature $I_C = f(T_S)$

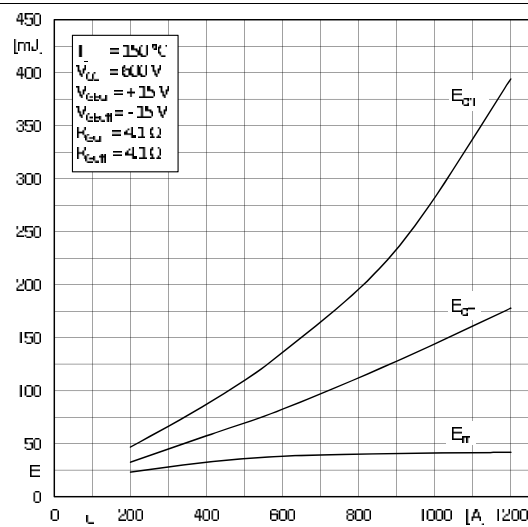


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

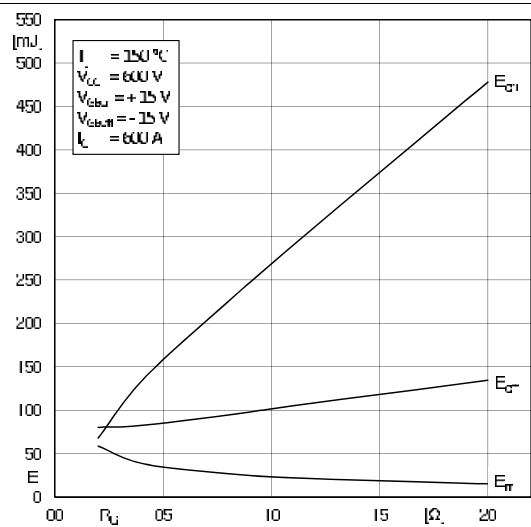


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

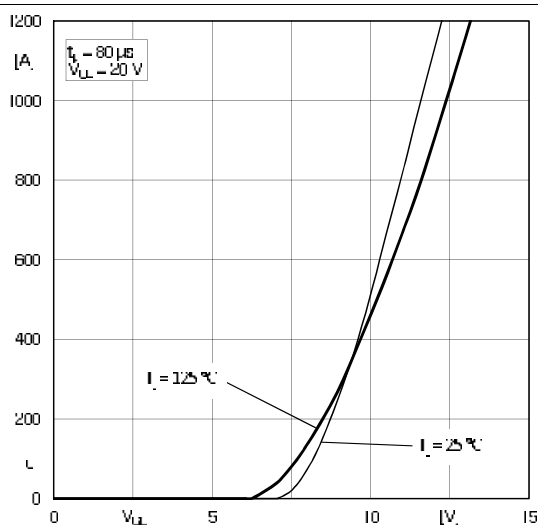


Fig. 5: Typ. transfer characteristic

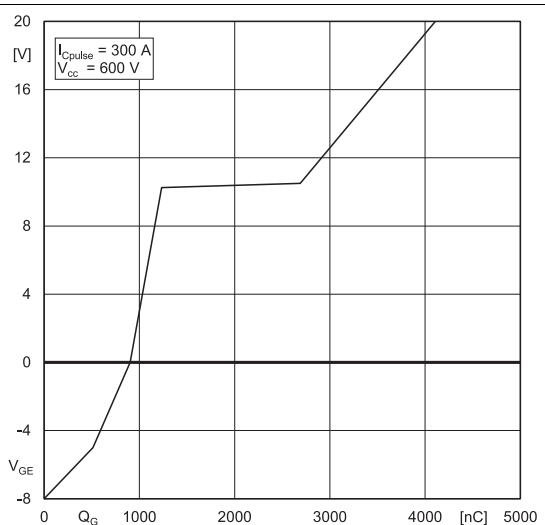


Fig. 6: Typ. gate charge characteristic

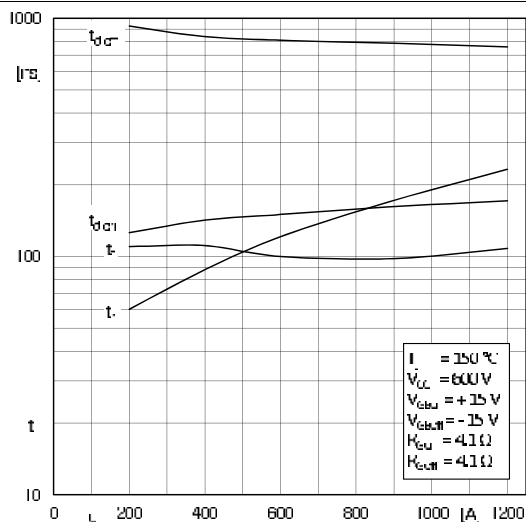


Fig. 7: Typ. switching times vs. I_C

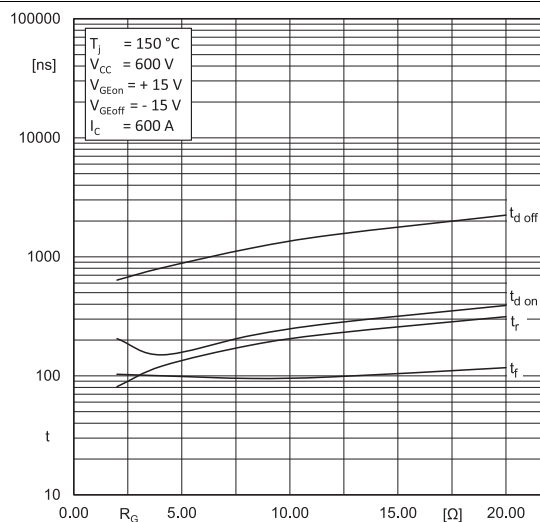


Fig. 8: Typ. switching times vs. gate resistor R_G

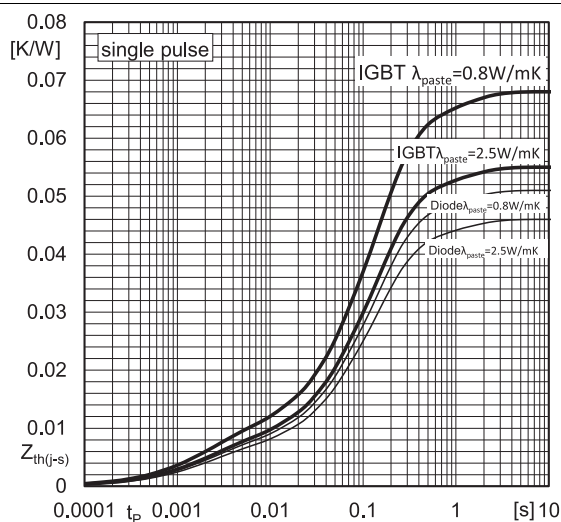


Fig. 9: Typ. transient thermal impedance

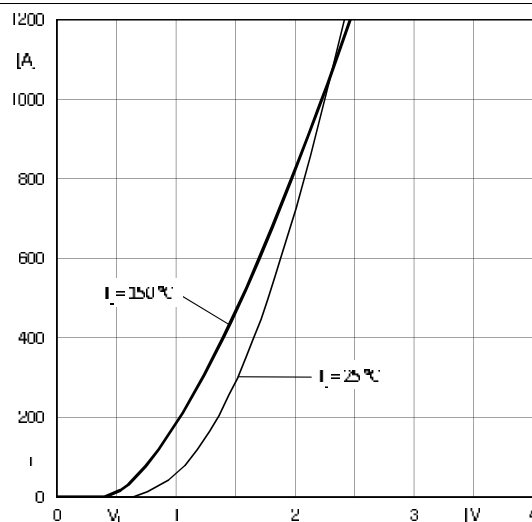


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

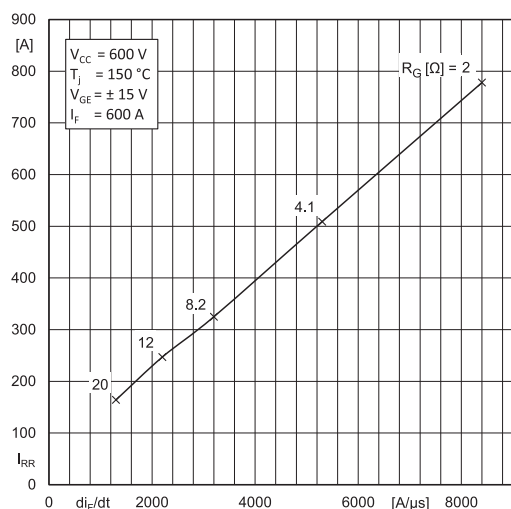


Fig. 11: Typ. CAL diode peak reverse recovery current

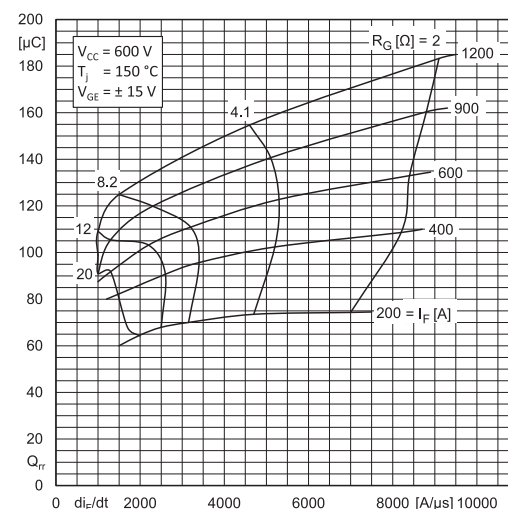
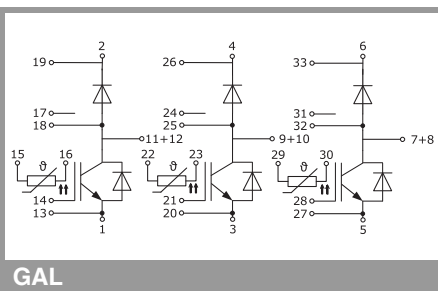
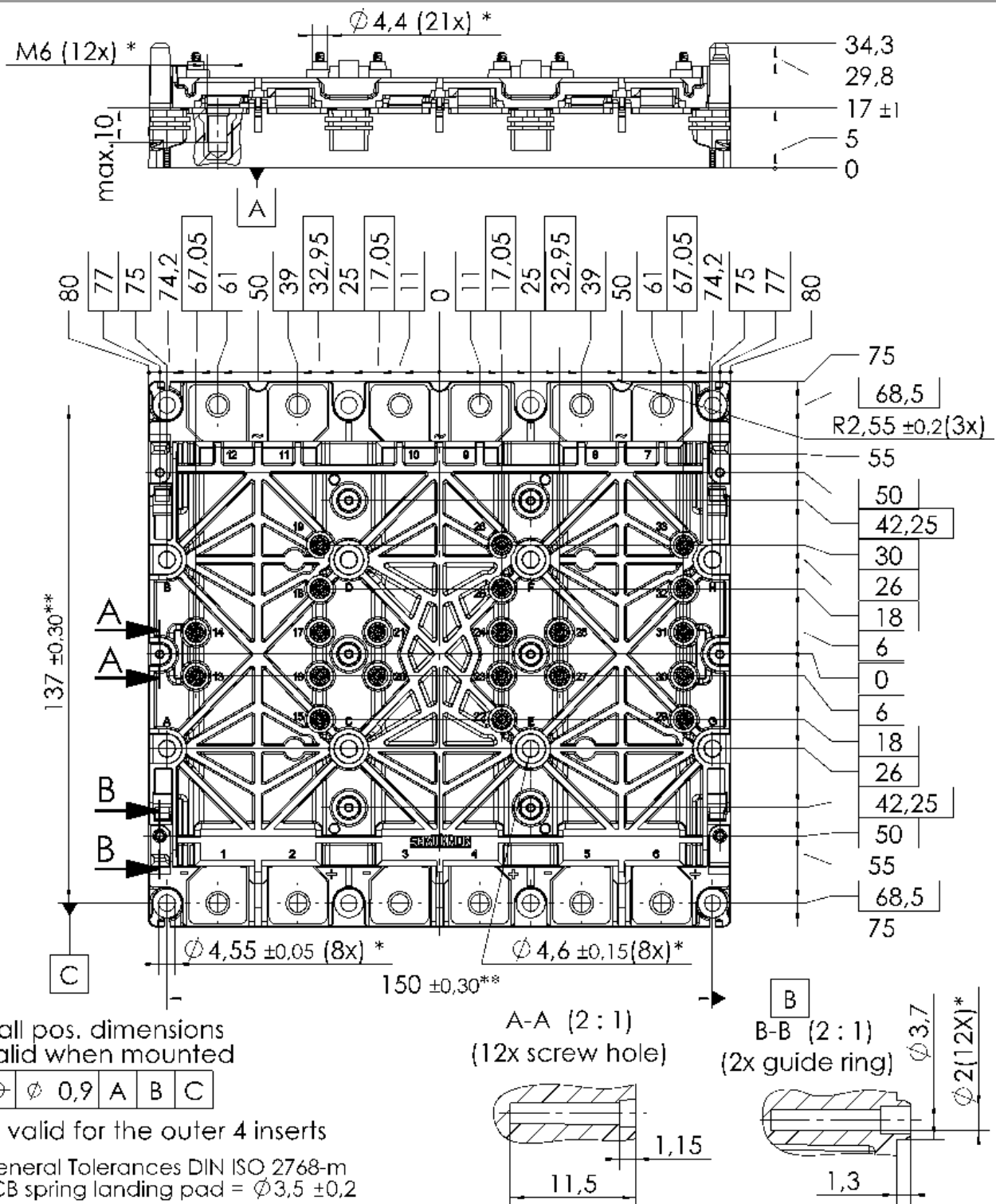


Fig. 12: Typ. CAL diode recovery charge



This is an electrostatic discharge sensitive device (ESDS) due to international standard IEC 61340.

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