



SKiM[®] 93

Trench IGBT Modules

SKiM459GD12E4

Features

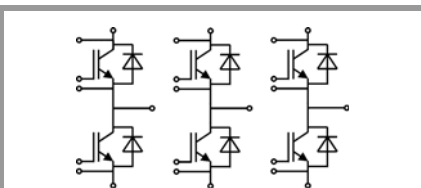
- IGBT 4 Trench Gate Technology
- Solderless sinter technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Low inductance case
- Insulated by Al_2O_3 DCB (Direct Copper Bonded) ceramic substrate
- Pressure contact technology for thermal contacts
- Spring contact system to attach driver PCB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

Typical Applications*

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

Remarks

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



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Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Inverter - IGBT				
V_{CES}	$T_j = 25^\circ C$		1200	V
I_C	$\lambda_{paste}=0.8 W/(mK)$	$T_s = 25^\circ C$	556	A
		$T_j = 175^\circ C$	452	A
I_C	$\lambda_{paste}=2.5 W/(mK)$	$T_s = 25^\circ C$	716	A
		$T_j = 175^\circ C$	585	A
I_{Cnom}			450	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$		1350	A
V_{GES}			-20 ... 20	V
t_{psc}	$V_{CC} = 800 V$	$T_j = 150^\circ C$	10	μs
	$V_{GE} \leq 15 V$			
	$V_{CES} \leq 1200 V$			
T_j			-40 ... 175	$^\circ C$
Inverse - Diode				
I_F	$\lambda_{paste}=0.8 W/(mK)$	$T_s = 25^\circ C$	438	A
		$T_j = 175^\circ C$	347	A
I_F	$\lambda_{paste}=2.5 W/(mK)$	$T_s = 25^\circ C$	530	A
		$T_j = 175^\circ C$	422	A
I_{Fnom}			450	A
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$		1350	A
I_{FSM}	10 ms, sin 180°, $T_j = 150^\circ C$		2430	A
T_j			-40 ... 175	$^\circ C$
Module				
$I_t(RMS)$	$T_{terminal} = 80^\circ C,$		700	A
T_{stg}			-40 ... 125	$^\circ C$
V_{isol}	AC sinus 50 Hz, t = 1 min		2500	V

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverter - IGBT						
$V_{CE(sat)}$	$I_C = 450 A$ $V_{GE} = 15 V$ chipelevel	$T_j = 25^\circ C$	1.85	2.10		V
		$T_j = 150^\circ C$	2.25	2.45		V
V_{CE0}	chipelevel	$T_j = 25^\circ C$	0.80	0.90		V
		$T_j = 150^\circ C$	0.70	0.80		V
r_{CE}	$V_{GE} = 15 V$ chipelevel	$T_j = 25^\circ C$	2.3	2.7		m Ω
		$T_j = 150^\circ C$	3.4	3.7		m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 18 mA$		5	5.8	6.5	V
I_{CES}	$V_{GE} = 0 V, V_{CE} = 1200 V, T_j = 25^\circ C$		0.1	0.3		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	$V_{GE} = -8 V \dots +15 V$			2550		nC
R_{Gint}	$T_j = 25^\circ C$			1.7		Ω
$t_{d(on)}$	$V_{CC} = 600 V$	$T_j = 150^\circ C$		276		ns
t_r	$I_C = 450 A$ $R_{G on} = 1.3 \Omega$	$T_j = 150^\circ C$		55		ns
		$T_j = 150^\circ C$		22		mJ
E_{on}	$R_{G off} = 1.3 \Omega$	$T_j = 150^\circ C$		22		mJ
$t_{d(off)}$	$di/dt_{on} = 8340 A/\mu s$	$T_j = 150^\circ C$		538		ns
t_f	$di/dt_{off} = 3660 A/\mu s$	$T_j = 150^\circ C$		114		ns
E_{off}	$V_{GE} = +15/-15 V$	$T_j = 150^\circ C$		57		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 W/(mK)$			0.092		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 W/(mK)$			0.059		K/W



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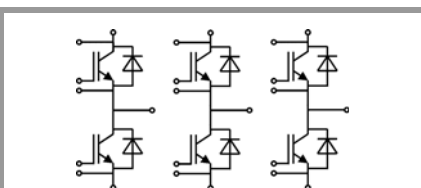
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse - Diode						
$V_F = V_{EC}$	$I_F = 450 \text{ A}$	$T_j = 25^\circ C$		2.14	2.46	V
		chipelevel	$T_j = 150^\circ C$	2.07	2.38	V
V_{F0}	chipelevel	$T_j = 25^\circ C$		1.30	1.50	V
		$T_j = 150^\circ C$		0.90	1.10	V
r_F	chipelevel	$T_j = 25^\circ C$		1.87	2.1	m Ω
		$T_j = 150^\circ C$		2.6	2.8	m Ω
I_{RRM}	$I_F = 450 \text{ A}$	$T_j = 150^\circ C$		570		A
Q_{rr}	$di/dt_{off} = 8880 \text{ A}/\mu\text{s}$	$T_j = 150^\circ C$		80		μC
E_{rr}	$V_{GE} = +15/-15 \text{ V}$	$T_j = 150^\circ C$		40		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			0.155		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			0.115		K/W
Module						
L_{CE}				10	15	nH
R_{CC+EE}	measured per switch	$T_s = 25^\circ C$		0.3		m Ω
		$T_s = 125^\circ C$		0.5		m Ω
W				1042		g
Temperature Sensor						
R_{100}	$T_{Sensor} = 100^\circ C$ ($R_{25} = 5 \text{ k}\Omega$)			339		Ω
$B_{100/125}$	$R(T) = R_{100} \exp[B_{100/125}(1/T - 1/373)]$; $T[K]$;			4096		K

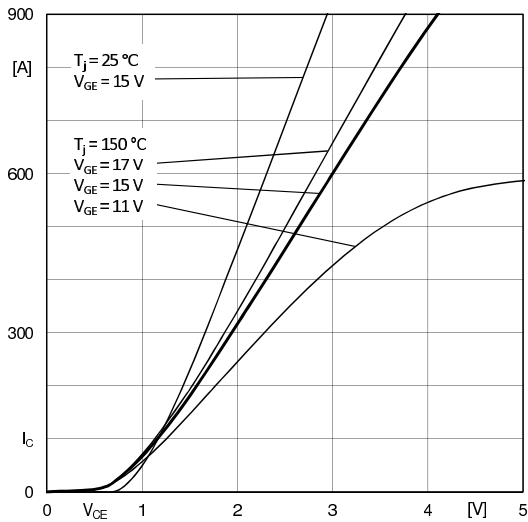


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

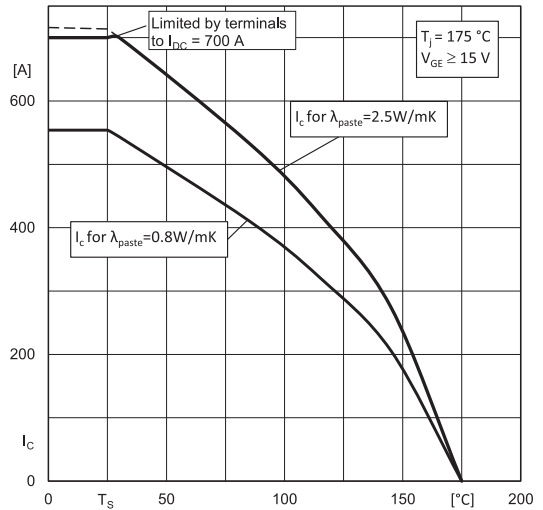


Fig. 2: Typ. rated current vs. temperature $I_C = f(T_S)$

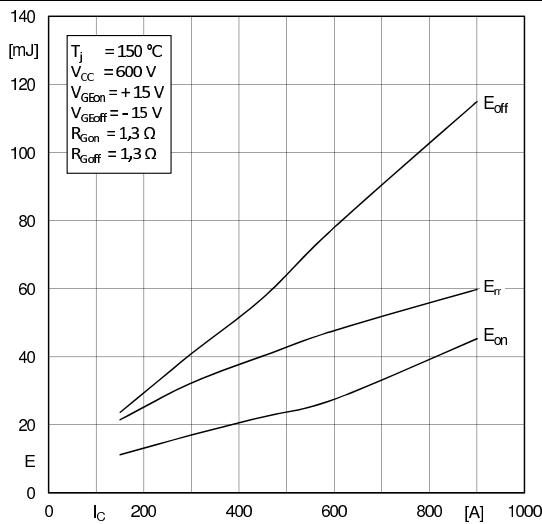


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

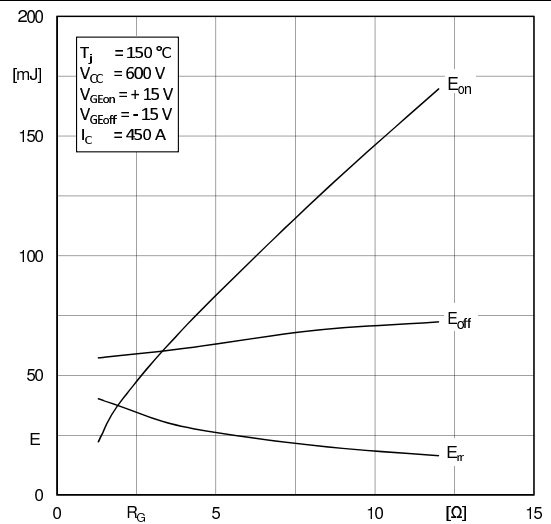


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

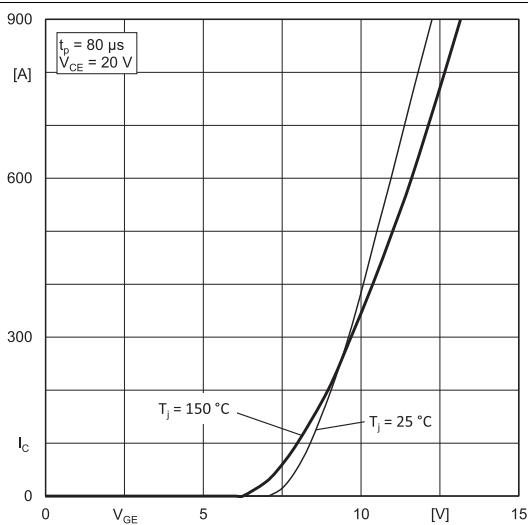


Fig. 5: Typ. transfer characteristic

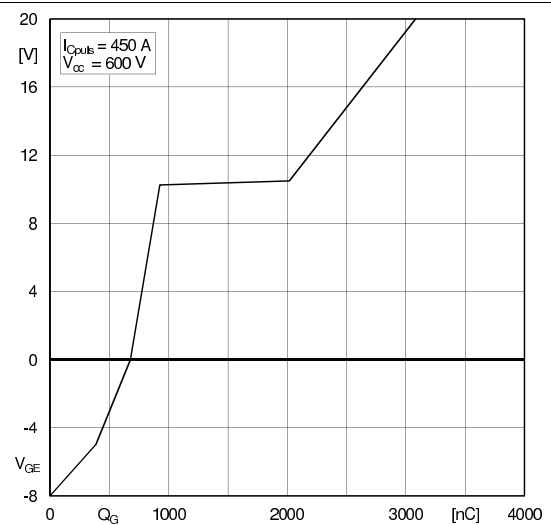


Fig. 6: Typ. gate charge characteristic

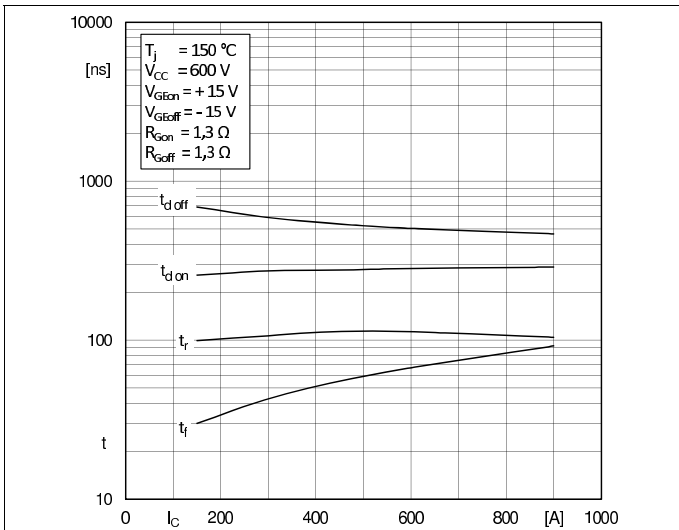


Fig. 7: Typ. switching times vs. I_C

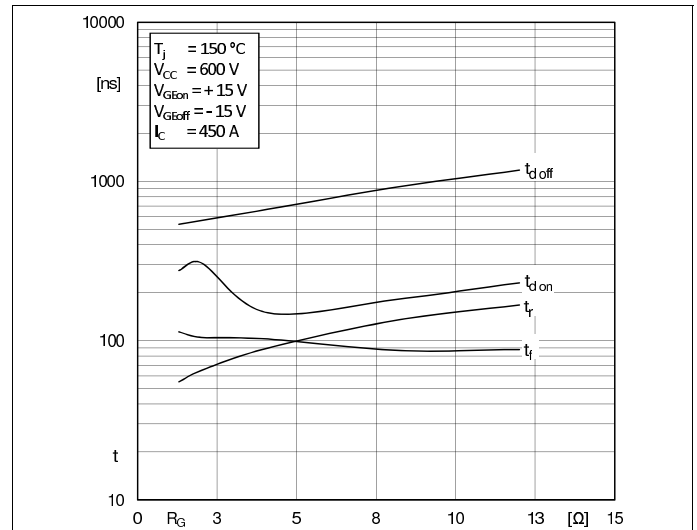


Fig. 8: Typ. switching times vs. gate resistor R_G

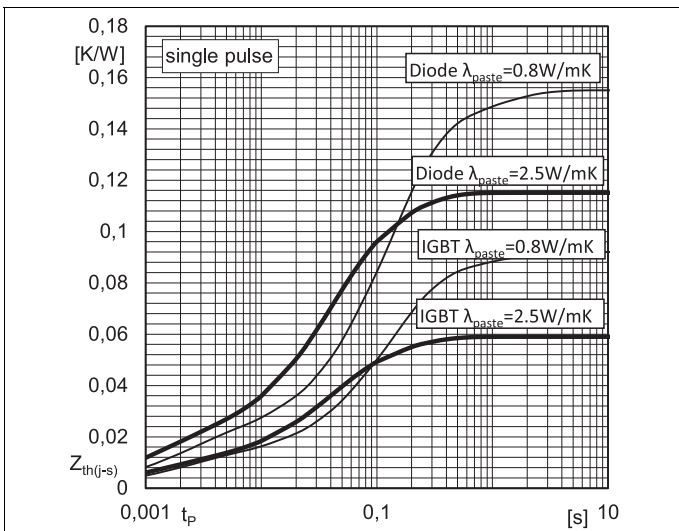


Fig. 9: Typ. transient thermal impedance

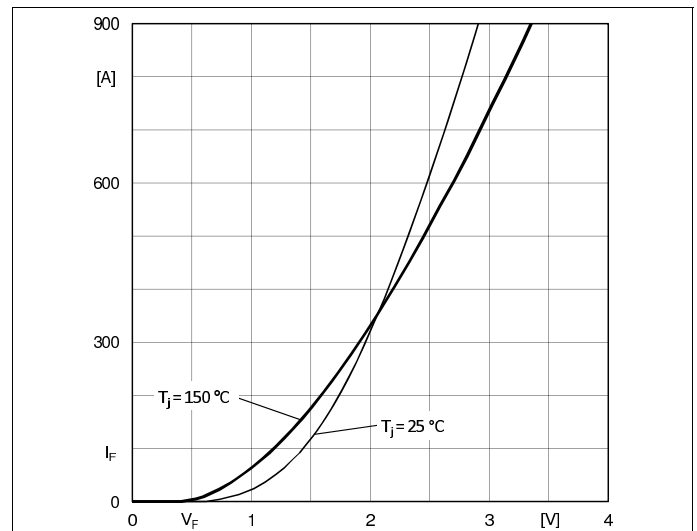


Fig. 10: Typ. CAL diode forward charact., incl. R_{CC+EE}

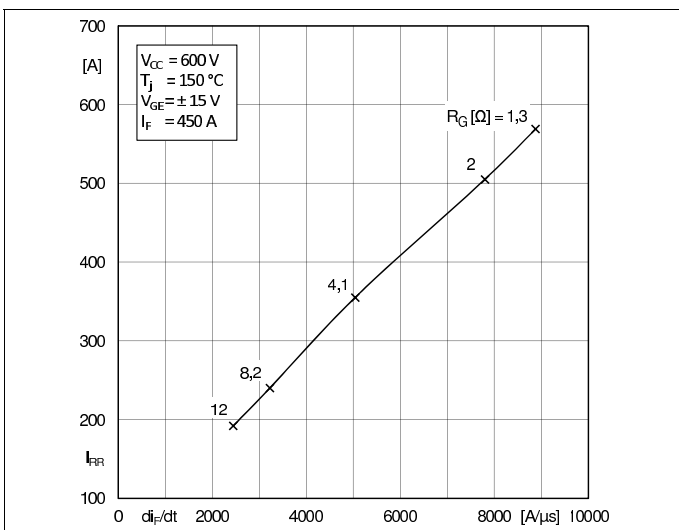


Fig. 11: Typ. CAL diode peak reverse recovery current

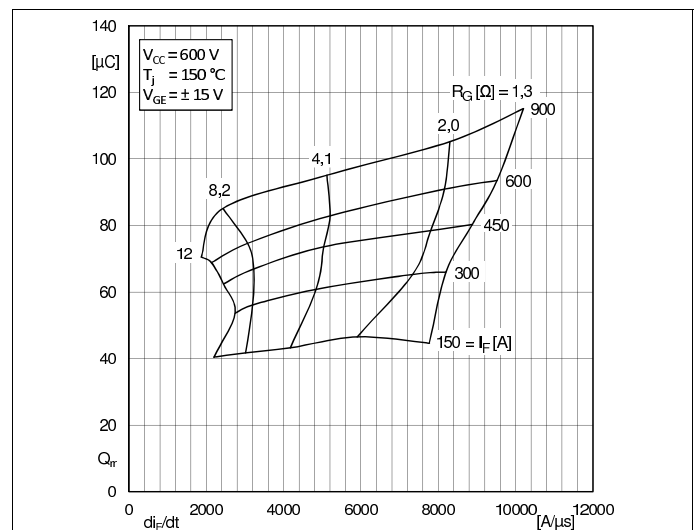
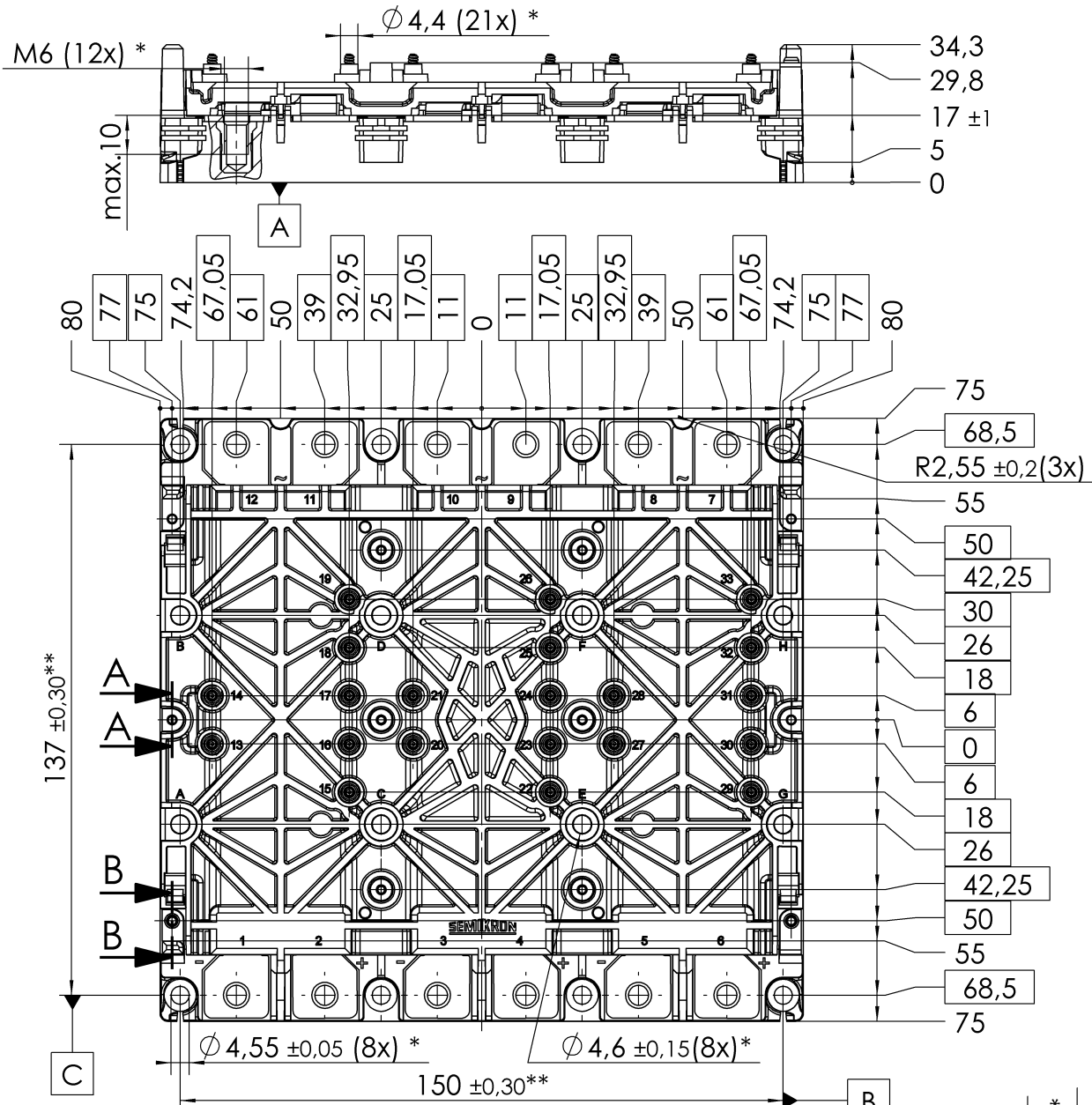
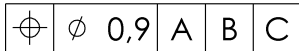


Fig. 12: Typ. CAL diode recovery charge

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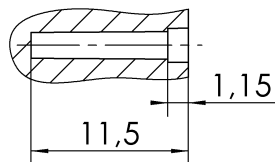
* all pos. dimensions valid when mounted



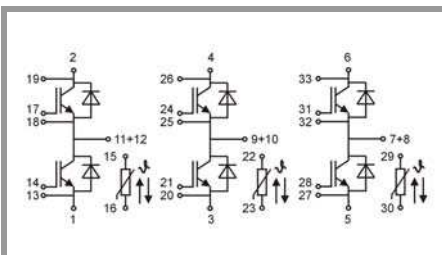
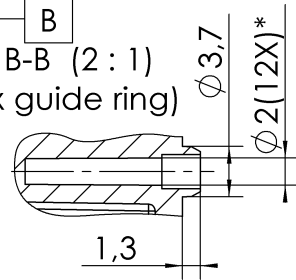
** valid for the outer 4 inserts

General Tolerances DIN ISO 2768-m
PCB spring landing pad = $\varnothing 3,5 \pm 0,2$

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.

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