



Hybrid SiC Trench IGBT Modules

SKiM459GD12F4V4

Features*

- IGBT 4 Fast
- SiC Schottky free-wheeling diodes, 6 diodes per switch
- 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
- Integrated temperature sensor
- UL recognized: File no. E63532

Typical Applications

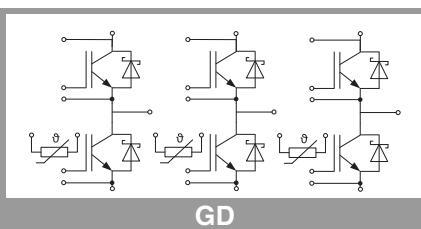
- UPS (inv., rect.)
- Energy storage
- Active front-end

Remarks

- Case temperature limited to $T_s = 125^\circ C$ max; $T_c = T_s$ (for baseplateless modules)

Footnotes

I_{FSM} value is valid for SiC Schottky diode in combination with IGBT, please see Technical Explanations SKiM63/93 for further details



Absolute Maximum Ratings		Values	Unit
Symbol	Conditions		
Inverter - IGBT			
V_{CES}	$T_j = 25^\circ C$	1200	V
I_c	$\lambda_{paste}=0.8 W/(mK)$ $T_j = 175^\circ C$	589	A
I_c	$\lambda_{paste}=2.5 W/(mK)$ $T_j = 175^\circ C$	476	A
I_c	$\lambda_{paste}=2.5 W/(mK)$ $T_s = 25^\circ C$	687	A
I_c	$\lambda_{paste}=2.5 W/(mK)$ $T_s = 70^\circ C$	558	A
I_{Cnom}		450	A
I_{CRM}		1350	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800 V$ $V_{GE} \leq 15 V$ $V_{CES} \leq 1200 V$	10	μs
T_j		-40 ... 175	$^\circ C$
Inverse - Diode			
V_{RRM}	$T_j = 25^\circ C$	1200	V
I_F	$\lambda_{paste}=0.8 W/(mK)$ $T_j = 175^\circ C$	401	A
I_F	$\lambda_{paste}=2.5 W/(mK)$ $T_j = 175^\circ C$	323	A
I_F	$\lambda_{paste}=2.5 W/(mK)$ $T_s = 25^\circ C$	455	A
I_F	$\lambda_{paste}=2.5 W/(mK)$ $T_s = 70^\circ C$	367	A
I_{FRM}		500	A
I_{FSM}	$t_p = 10 ms, \sin 180^\circ, T_j = 150^\circ C$	1048 ¹⁾	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		min.	typ.	max.	Unit
Symbol	Conditions				
Inverter - IGBT					
$V_{CE(sat)}$	$I_c = 450 A$ $V_{GE} = 15 V$ chiplevel	$T_j = 25^\circ C$	2.05	2.42	V
		$T_j = 150^\circ C$	2.59	2.96	V
V_{CEO}	chiplevel	$T_j = 25^\circ C$	1.10	1.28	V
		$T_j = 150^\circ C$	0.95	1.13	V
r_{CE}	$V_{GE} = 15 V$ chiplevel	$T_j = 25^\circ C$	2.1	2.5	$m\Omega$
		$T_j = 150^\circ C$	3.6	4.1	$m\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_c = 15.6 mA$		5.2	5.8	6.4
I_{CES}	$V_{GE} = 0 V, V_{CE} = 1200 V, T_j = 25^\circ C$			6	mA
C_{ies}	$V_{CE} = 25 V$	$f = 1 MHz$	26.4		nF
C_{oes}	$V_{GE} = 0 V$	$f = 1 MHz$	1.74		nF
C_{res}		$f = 1 MHz$	1.41		nF
Q_G	$V_{GE} = -8 V ... +15 V$		2550		nC
R_{Gint}	$T_j = 25^\circ C$		1.7		Ω
$t_{d(on)}$	$V_{CC} = 600 V$	$T_j = 150^\circ C$	258		ns
t_r	$I_c = 250 A$	$T_j = 150^\circ C$	30		ns
E_{on}	$R_{G\,on} = 1.2 \Omega$	$T_j = 150^\circ C$	5		mJ
$t_{d(off)}$	$R_{G\,off} = 1.2 \Omega$ di/dt _{on} = 8060 A/ μs	$T_j = 150^\circ C$	517		ns
t_f	di/dt _{off} = 3520 A/ μs dv/dt = 3430 V/ μs	$T_j = 150^\circ C$	73		ns
E_{off}	$V_{GE} = +15/-15 V$ $L_s = 30 nH$	$T_j = 150^\circ C$	20		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 W/(mK)$		0.069		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 W/(mK)$		0.053		K/W



Hybrid SiC Trench IGBT Modules

SKiM459GD12F4V4

Features*

- IGBT 4 Fast
- SiC Schottky free-wheeling diodes, 6 diodes per switch
- 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
- Integrated temperature sensor
- UL recognized: File no. E63532

Typical Applications

- UPS (inv., rect.)
- Energy storage
- Active front-end

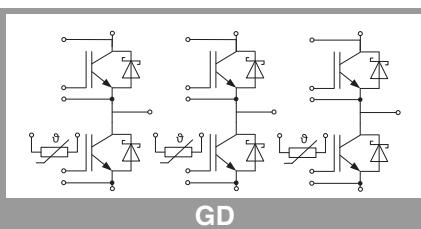
Remarks

- Case temperature limited to $T_s = 125^\circ C$ max; $T_c = T_s$ (for baseplateless modules)

Footnotes

I_{F5M} value is valid for SiC Schottky diode in combination with IGBT, please see Technical Explanations SKiM63/93 for further details

Characteristics		Symbol	Conditions	min.	typ.	max.	Unit						
Inverse - Diode													
SKiM® 93													
$V_F = V_{EC}$	$I_F = 250 \text{ A}$	V_F0	$T_j = 25^\circ C$	1.33	1.51	1.63	V						
	chiplevel		$T_j = 150^\circ C$	1.63	1.90	1.90	V						
V_F0	chiplevel	r_F	$T_j = 25^\circ C$	0.95	1.05	1.05	V						
			$T_j = 150^\circ C$	0.80	0.90	0.90	V						
r_F	chiplevel	C_j	$T_j = 25^\circ C$	1.50	1.83	1.83	$m\Omega$						
			$T_j = 150^\circ C$	3.3	4.0	4.0	$m\Omega$						
C_j	$V_R = 800 \text{ V}, f = 1 \text{ MHz}, T_j = 25^\circ C$	Q_c		1.260			nF						
			$V_R = 800 \text{ V}, di/dt_{off} = 500 \text{ A}/\mu\text{s}, T_j = 25^\circ C$	1			μC						
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$	$R_{th(j-s)}$		0.142			K/W						
				0.115			K/W						
Module													
L_{CE}				10	15	10	nH						
$R_{CC' + EE'}$	measured per switch	w	$T_s = 25^\circ C$	0.3		0.5	$m\Omega$						
			$T_s = 125^\circ C$	1042		1042	g						
Temperature Sensor													
R_{100}	$T_r=100^\circ C (R_{25}=1000\Omega)$			1670 \pm 1%			Ω						
$R_{(T)}$	$R(T)=1k\Omega[1+A(T-25^\circ C)+B(T-25^\circ C)^2], A = 7.64*10^{-3}\text{ }^\circ\text{C}^{-1}, B = 1.73*10^{-5}\text{ }^\circ\text{C}^{-2}$												



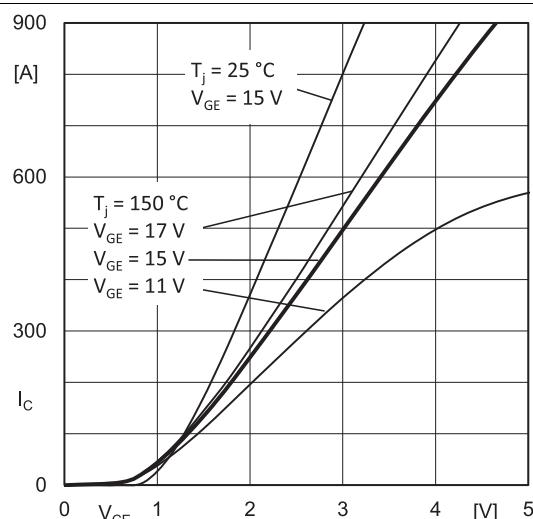


Fig. 1: Typ. output characteristic, inclusive $R_{CC} + EE'$

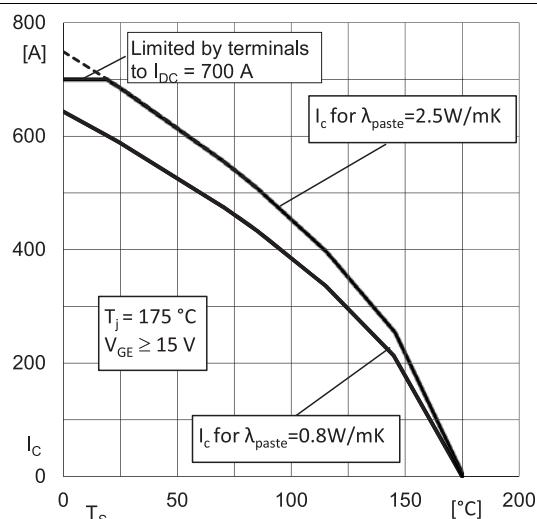


Fig. 2: Typ. rated current vs. temperature $I_c = f(T_s)$

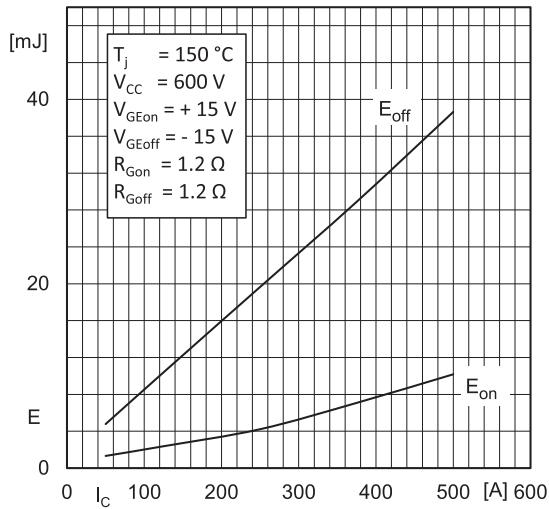


Fig. 3: Typ. turn-on /-off energy = $f(I_c)$

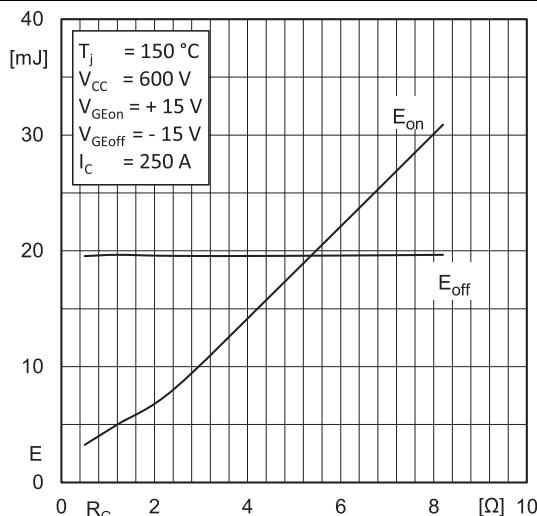


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

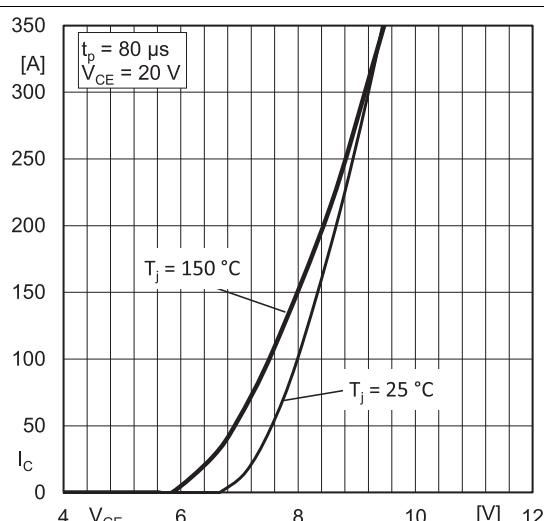


Fig. 5: Typ. transfer characteristic

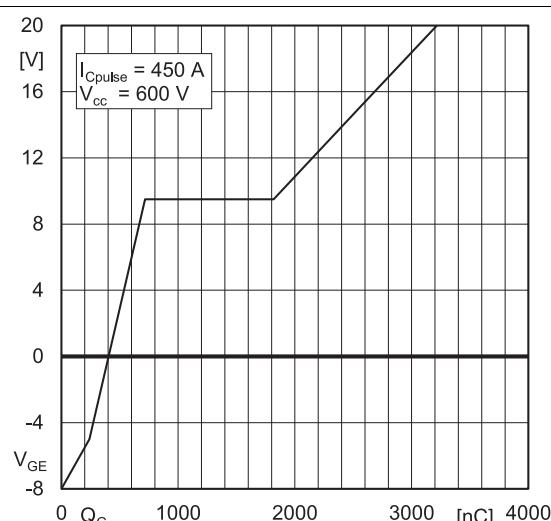


Fig. 6: Typ. gate charge characteristic

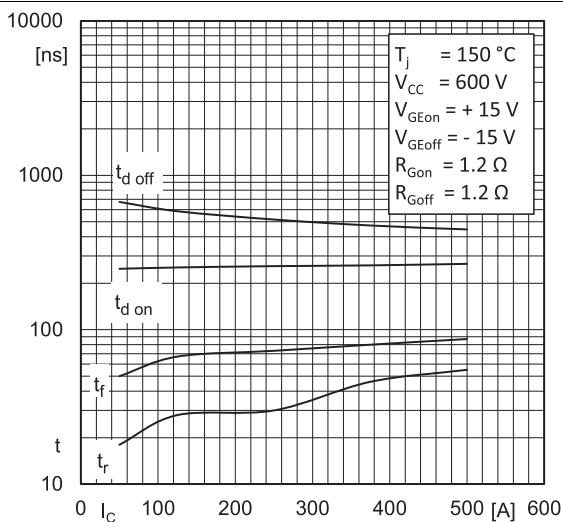


Fig. 7: Typ. switching times vs. I_C

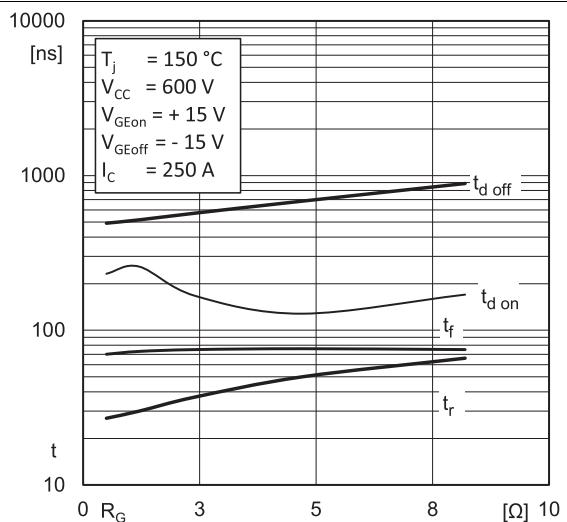


Fig. 8: Typ. switching times vs. gate resistor R_G

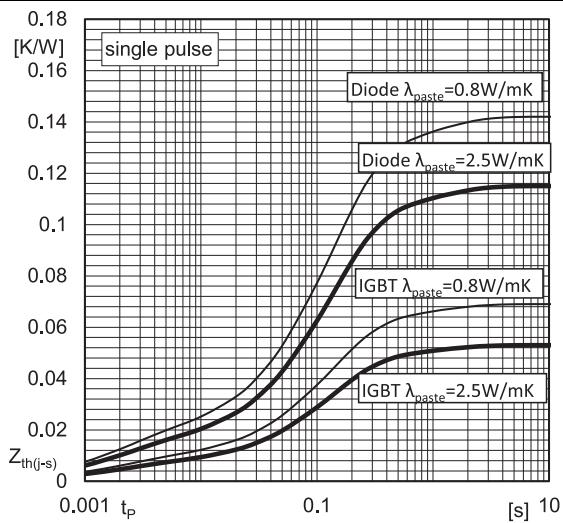


Fig. 9: Typ. transient thermal impedance

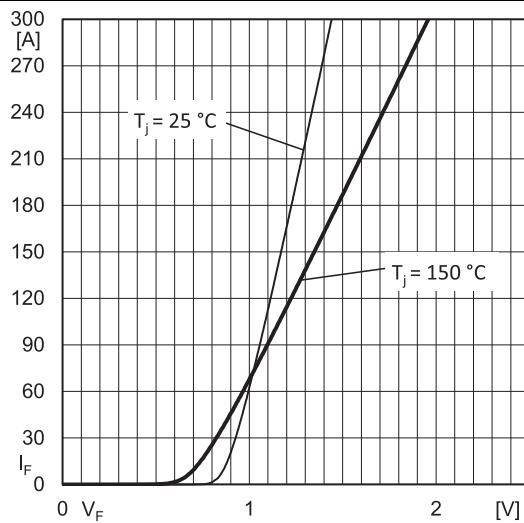


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC} + EE'$

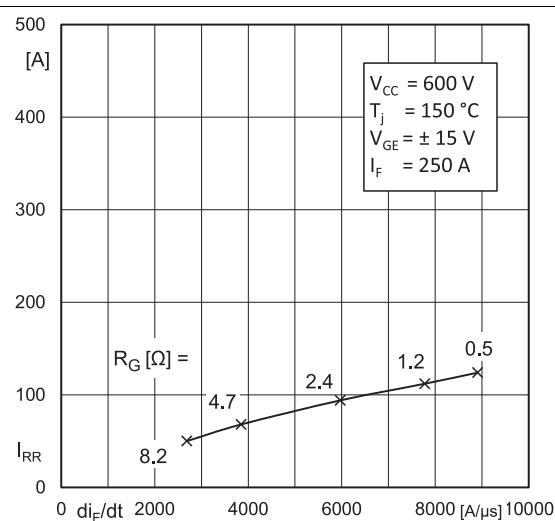
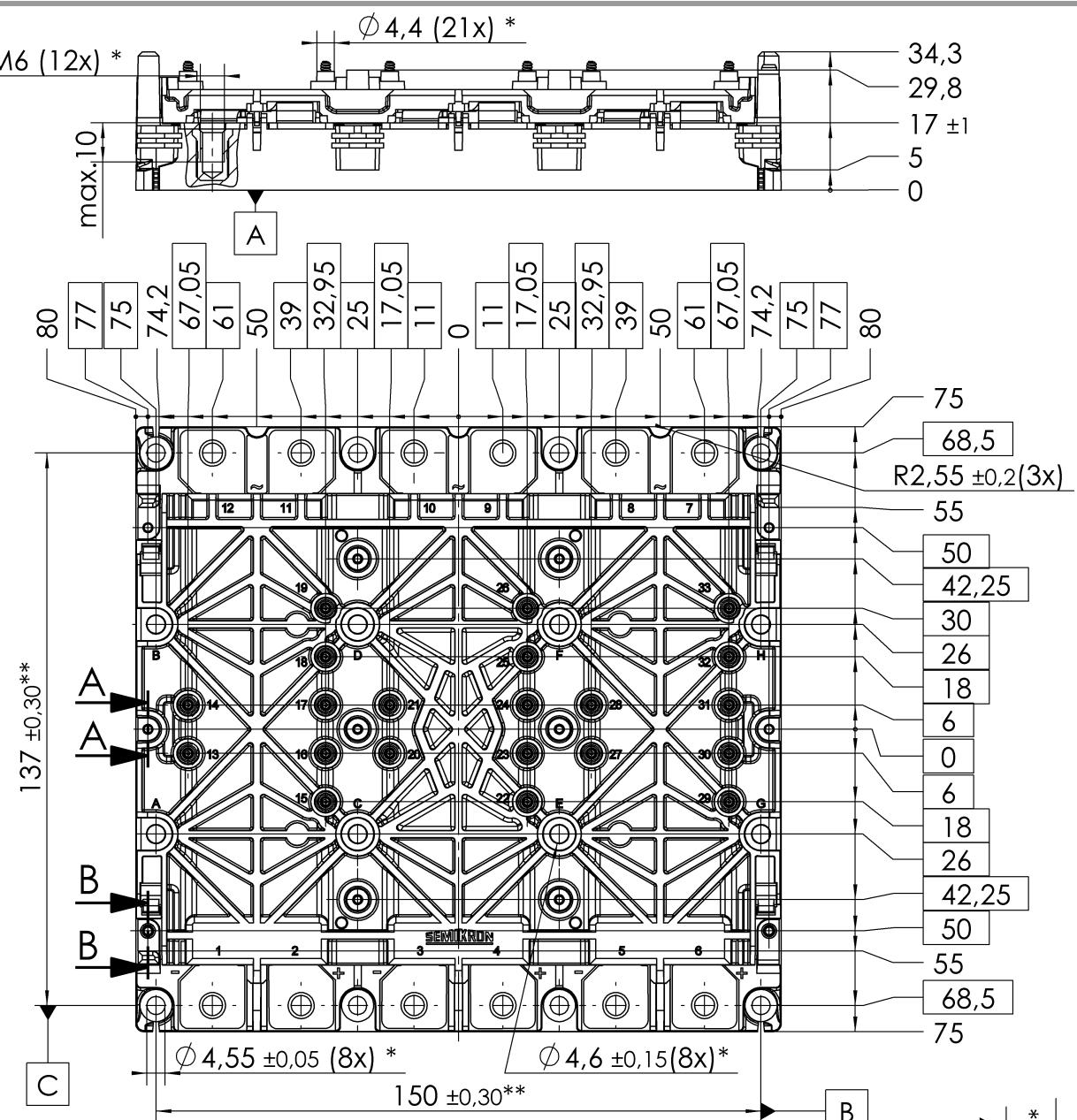


Fig. 11: Typ. CAL diode peak reverse recovery current

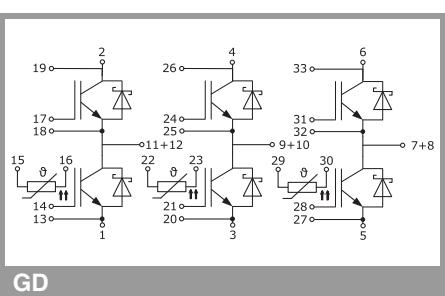


* all pos. dimensions
valid when mounted

∅ $0,9$ A B C

** valid for the outer 4 inserts

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



GD

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

***IMPORTANT INFORMATION AND WARNINGS**

The specifications of SEMIKRON products may not be considered as guarantee or assurance of product characteristics ("Beschaffenheitsgarantie"). The specifications of SEMIKRON products describe only the usual characteristics of products to be expected in typical applications, which may still vary depending on the specific application. Therefore, products must be tested for the respective application in advance. Application adjustments may be necessary. The user of SEMIKRON products is responsible for the safety of their applications embedding SEMIKRON products and must take adequate safety measures to prevent the applications from causing a physical injury, fire or other problem if any of SEMIKRON products become faulty. The user is responsible to make sure that the application design is compliant with all applicable laws, regulations, norms and standards. Except as otherwise explicitly approved by SEMIKRON in a written document signed by authorized representatives of SEMIKRON, SEMIKRON products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury. No representation or warranty is given and no liability is assumed with respect to the accuracy, completeness and/or use of any information herein, including without limitation, warranties of non-infringement of intellectual property rights of any third party. SEMIKRON does not assume any liability arising out of the applications or use of any product; neither does it convey any license under its patent rights, copyrights, trade secrets or other intellectual property rights, nor the rights of others. SEMIKRON makes no representation or warranty of non-infringement or alleged non-infringement of intellectual property rights of any third party which may arise from applications. Due to technical requirements our products may contain dangerous substances. For information on the types in question please contact the nearest SEMIKRON sales office. This document supersedes and replaces all information previously supplied and may be superseded by updates. SEMIKRON reserves the right to make changes.