



SKiM® 93

## 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

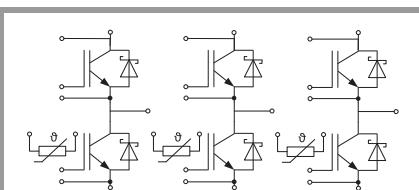
- UPS (inv., rect.)
- Energy storage
- Active front-end

#### 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



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Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
Inverter - IGBT				
V <sub>CES</sub>	T <sub>j</sub> = 25 °C		1200	V
I <sub>C</sub>	λ <sub>paste</sub> =0.8 W/(mK)	T <sub>s</sub> = 25 °C	589	A
	T <sub>j</sub> = 175 °C	T <sub>s</sub> = 70 °C	476	A
I <sub>C</sub>	λ <sub>paste</sub> =2.5 W/(mK)	T <sub>s</sub> = 25 °C	687	A
	T <sub>j</sub> = 175 °C	T <sub>s</sub> = 70 °C	558	A
I <sub>Cnom</sub>			450	A
I <sub>CRM</sub>			1350	A
V <sub>GES</sub>			-20 ... 20	V
t <sub>psc</sub>	V <sub>CC</sub> = 800 V V <sub>GE</sub> ≤ 15 V V <sub>CES</sub> ≤ 1200 V	T <sub>j</sub> = 150 °C	10	μs
T <sub>j</sub>			-40 ... 175	°C
Inverse - Diode				
V <sub>RRM</sub>	T <sub>j</sub> = 25 °C		1200	V
I <sub>F</sub>	λ <sub>paste</sub> =0.8 W/(mK)	T <sub>s</sub> = 25 °C	401	A
	T <sub>j</sub> = 175 °C	T <sub>s</sub> = 70 °C	323	A
I <sub>F</sub>	λ <sub>paste</sub> =2.5 W/(mK)	T <sub>s</sub> = 25 °C	455	A
	T <sub>j</sub> = 175 °C	T <sub>s</sub> = 70 °C	367	A
I <sub>FRM</sub>			500	A
I <sub>FSM</sub>	t <sub>p</sub> = 10 ms, sin 180°, T <sub>j</sub> = 150 °C		1048 <sup>1)</sup>	A
T <sub>j</sub>			-40 ... 175	°C
Module				
I <sub>t(RMS)</sub>	T <sub>terminal</sub> = 80 °C,		700	A
T <sub>stg</sub>			-40 ... 125	°C
V <sub>isol</sub>	AC sinus 50 Hz, t = 1 min		2500	V

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverter - IGBT						
V <sub>CE(sat)</sub>	I <sub>C</sub> = 450 A	T <sub>j</sub> = 25 °C		2.05	2.42	V
	V <sub>GE</sub> = 15 V chiplevel	T <sub>j</sub> = 150 °C		2.59	2.96	V
V <sub>CE0</sub>	chiplevel	T <sub>j</sub> = 25 °C		1.10	1.28	V
		T <sub>j</sub> = 150 °C		0.95	1.13	V
r <sub>CE</sub>	V <sub>GE</sub> = 15 V	T <sub>j</sub> = 25 °C		2.1	2.5	mΩ
	chiplevel	T <sub>j</sub> = 150 °C		3.6	4.1	mΩ
V <sub>GE(th)</sub>	V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 15.6 mA		5.2	5.8	6.4	V
I <sub>CES</sub>	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V, T <sub>j</sub> = 25 °C				6	mA
C <sub>ies</sub>	V <sub>CE</sub> = 25 V V <sub>GE</sub> = 0 V	f = 1 MHz		26.4		nF
C <sub>oes</sub>		f = 1 MHz		1.74		nF
C <sub>res</sub>		f = 1 MHz		1.41		nF
Q <sub>G</sub>	V <sub>GE</sub> = - 8 V...+ 15 V			2550		nC
R <sub>Gint</sub>	T <sub>j</sub> = 25 °C			1.7		Ω
t <sub>d(on)</sub>	V <sub>CC</sub> = 600 V	T <sub>j</sub> = 150 °C		258		ns
t <sub>r</sub>	I <sub>C</sub> = 250 A	T <sub>j</sub> = 150 °C		30		ns
E <sub>on</sub>	R <sub>G on</sub> = 1.2 Ω	T <sub>j</sub> = 150 °C		5		mJ
t <sub>d(off)</sub>	R <sub>G off</sub> = 1.2 Ω	T <sub>j</sub> = 150 °C		517		ns
t <sub>f</sub>	di/dt <sub>on</sub> = 8060 A/μs	T <sub>j</sub> = 150 °C		73		ns
E <sub>off</sub>	di/dt <sub>off</sub> = 3520 A/μs dv/dt = 3430 V/μs V <sub>GE</sub> = +15/-15 V L <sub>s</sub> = 30 nH	T <sub>j</sub> = 150 °C		20		mJ
R <sub>th(j-s)</sub>	per IGBT, λ <sub>paste</sub> =0.8 W/(mK)			0.069		K/W
R <sub>th(j-s)</sub>	per IGBT, λ <sub>paste</sub> =2.5 W/(mK)			0.053		K/W

# SKiM459GD12F4V4



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- Energy storage
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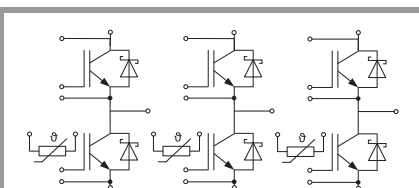
#### Remarks

- Case temperature limited to  $T_s = 125^\circ\text{C}$  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

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse - Diode						
V <sub>F</sub> = V <sub>EC</sub>	I <sub>F</sub> = 250 A	T <sub>j</sub> = 25 °C		1.33	1.51	V
	chiplevel	T <sub>j</sub> = 150 °C		1.63	1.90	V
V <sub>F0</sub>	chiplevel	T <sub>j</sub> = 25 °C		0.95	1.05	V
		T <sub>j</sub> = 150 °C		0.80	0.90	V
r <sub>F</sub>	chiplevel	T <sub>j</sub> = 25 °C		1.50	1.83	mΩ
		T <sub>j</sub> = 150 °C		3.3	4.0	mΩ
C <sub>j</sub>	V <sub>R</sub> = 800 V, f = 1 MHz, T <sub>j</sub> = 25 °C			1.260		nF
Q <sub>c</sub>	V <sub>R</sub> = 800 V, di/dt <sub>off</sub> = 500 A/μs, T <sub>j</sub> = 25 °C			1		μC
R <sub>th(j-s)</sub>	per Diode, λ <sub>paste</sub> =0.8 W/(mK)			0.142		K/W
R <sub>th(j-s)</sub>	per Diode, λ <sub>paste</sub> =2.5 W/(mK)			0.115		K/W
Module						
L <sub>CE</sub>				10	15	nH
R <sub>CC'+EE'</sub>	measured per	T <sub>s</sub> = 25 °C		0.3		mΩ
	switch	T <sub>s</sub> = 125 °C		0.5		mΩ
w				1042		g
Temperature Sensor						
R <sub>100</sub>	T <sub>r</sub> =100°C (R <sub>25</sub> =1000Ω)			1670 ± 1%		Ω
R <sub>(T)</sub>	R(T)=1kΩ[1+A(T-25°C)+B(T-25°C) <sup>2</sup> ], A = 7.64*10 <sup>-3</sup> °C <sup>-1</sup> , B = 1.73*10 <sup>-5</sup> °C <sup>-2</sup>					



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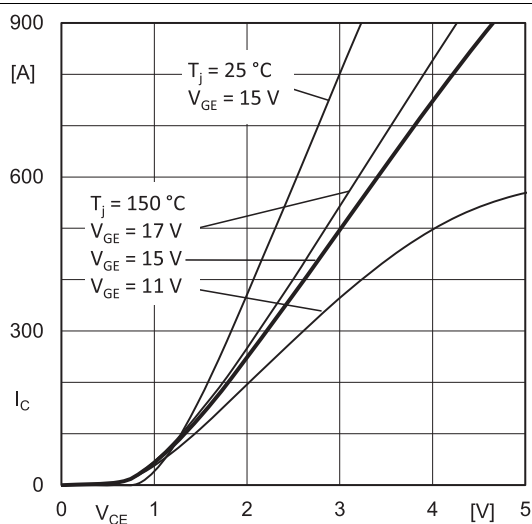
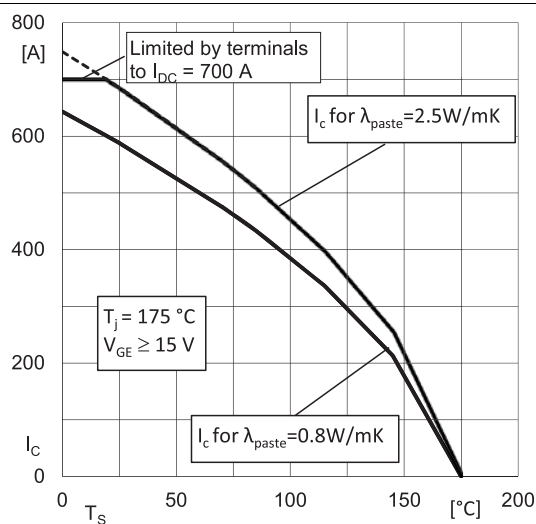
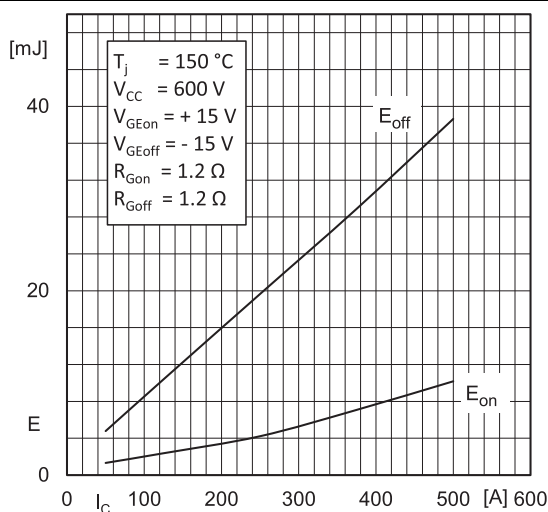
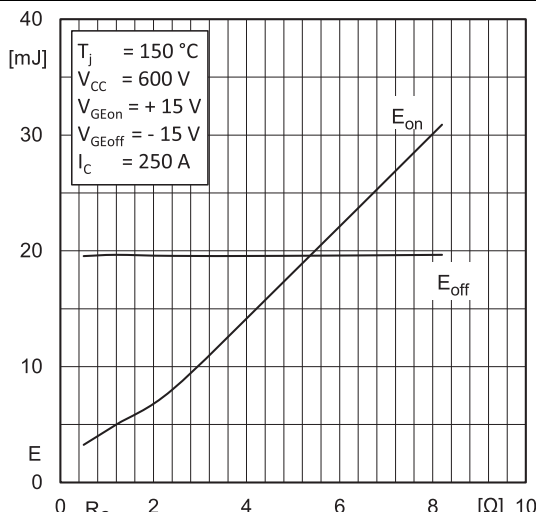
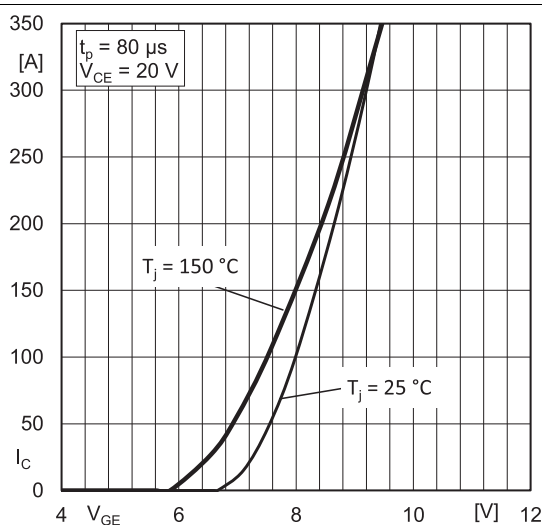

 Fig. 1: Typ. output characteristic, inclusive  $R_{CC} + E_{E'}$ 

 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

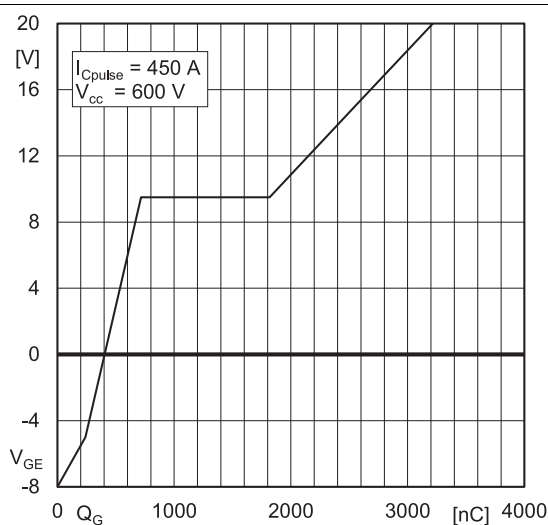
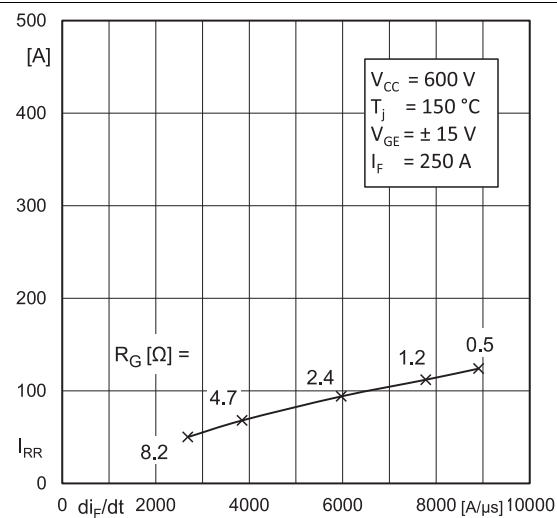
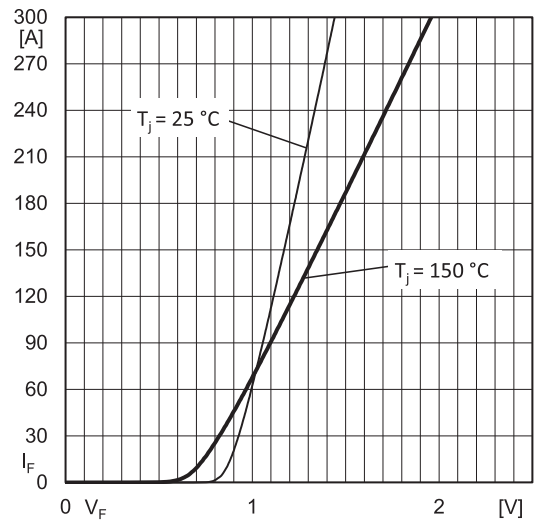
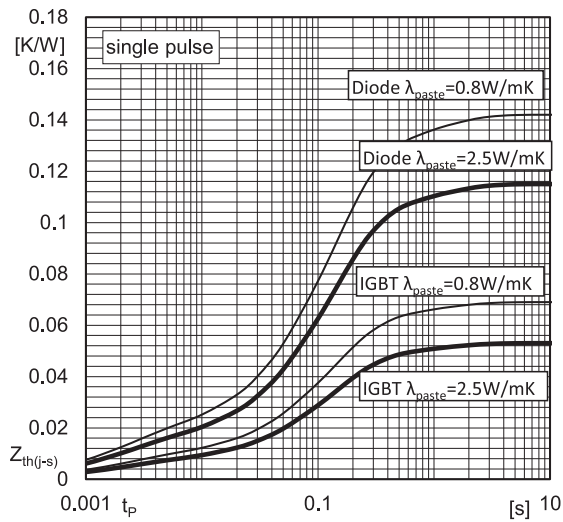
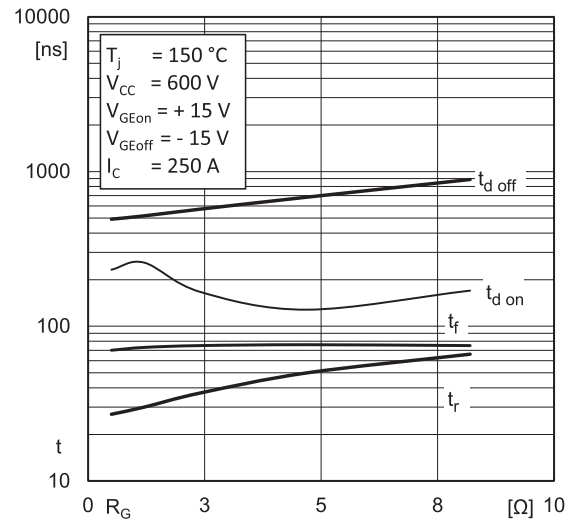
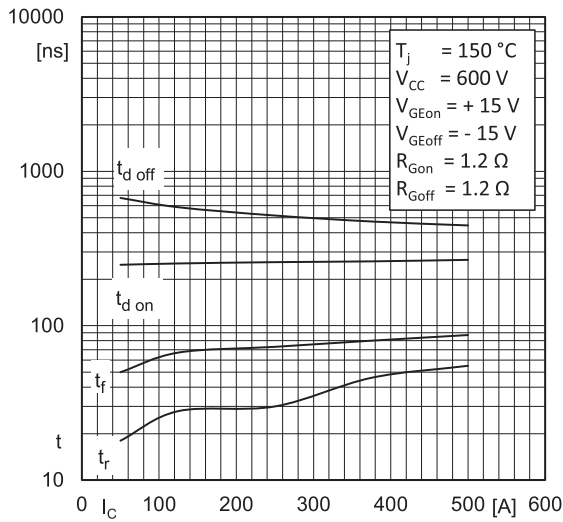
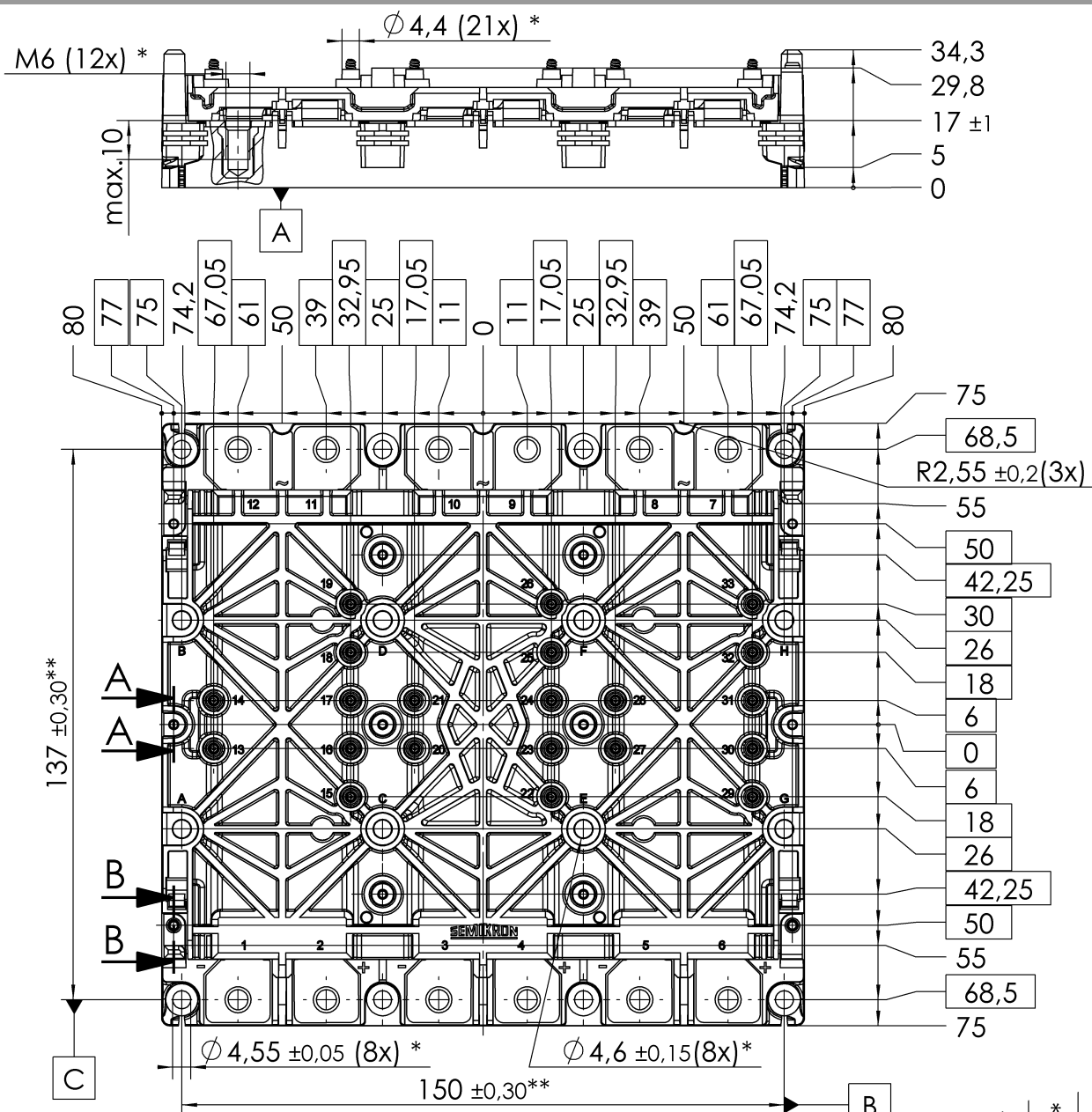


Fig. 6: Typ. gate charge characteristic





\* all pos. dimensions valid when mounted

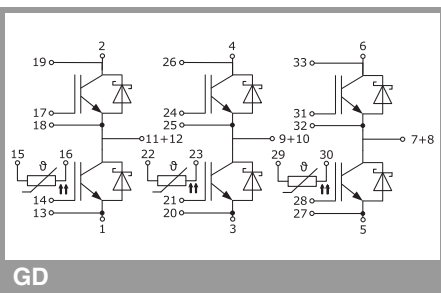
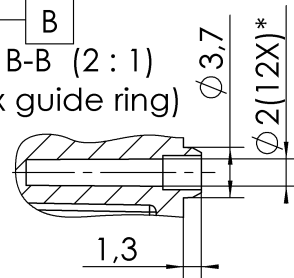
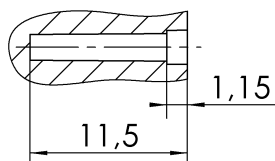
Ø	Ø 0,9	A	B	C
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\*\* valid for the outer 4 inserts

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) due to international standard IEC 61340.

## **\*IMPORTANT INFORMATION AND WARNINGS**

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