



SEMITRANS® 3

## IGBT4 Modules

### SKM450GB12E4

#### Features

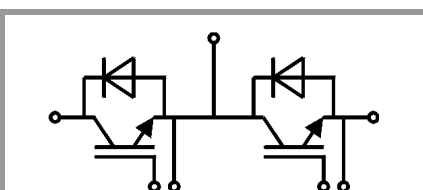
- IGBT4 = 4th generation medium fast trench IGBT (Infineon)
- CAL4 = Soft switching 4th generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- With integrated gate resistor
- For higher switching frequencies up to 12kHz
- UL recognized, file no. E63532

#### Typical Applications\*

- AC inverter drives
- UPS

#### Remarks

- Case temperature limited to  $T_c = 125^\circ\text{C}$  max.
- Recommended  $T_{op} = -40 \dots +150^\circ\text{C}$
- Product reliability results valid for  $T_j = 150^\circ\text{C}$



GB

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT				
V <sub>CES</sub>	T <sub>j</sub> = 25 °C		1200	V
I <sub>C</sub>	T <sub>j</sub> = 175 °C	T <sub>c</sub> = 25 °C	700	A
		T <sub>c</sub> = 80 °C	538	A
I <sub>Cnom</sub>			450	A
I <sub>CRM</sub>	I <sub>CRM</sub> = 3xI <sub>Cnom</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>	T <sub>j</sub> = 175 °C	T <sub>c</sub> = 25 °C	461	A
		T <sub>c</sub> = 80 °C	345	A
I <sub>Fnom</sub>			400	A
I <sub>FRM</sub>	I <sub>FRM</sub> = 3xI <sub>Fnom</sub>		1200	A
I <sub>FSM</sub>	t <sub>p</sub> = 10 ms, sin 180°, T <sub>j</sub> = 25 °C		1980	A
T <sub>j</sub>			-40 ... 175	°C
Module				
I <sub>t(RMS)</sub>			500	A
T <sub>stg</sub>	module without TIM		-40 ... 125	°C
V <sub>isol</sub>	AC sinus 50 Hz, t = 1 min		4000	V

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT						
V <sub>CE(sat)</sub>	I <sub>C</sub> = 450 A	T <sub>j</sub> = 25 °C		1.84	2.07	V
	V <sub>GE</sub> = 15 V chipevel	T <sub>j</sub> = 150 °C		2.23	2.42	V
V <sub>CE0</sub>	chipevel	T <sub>j</sub> = 25 °C		0.80	0.90	V
		T <sub>j</sub> = 150 °C		0.70	0.80	V
r <sub>CE</sub>	V <sub>GE</sub> = 15 V	T <sub>j</sub> = 25 °C		2.3	2.6	mΩ
	chipevel	T <sub>j</sub> = 150 °C		3.4	3.6	mΩ
V <sub>GE(th)</sub>	V <sub>GE</sub> =V <sub>CE</sub> , I <sub>C</sub> = 16.4 mA		5	5.8	6.5	V
I <sub>CES</sub>	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V, T <sub>j</sub> = 25 °C				5	mA
C <sub>ies</sub>	V <sub>CE</sub> = 25 V V <sub>GE</sub> = 0 V	f = 1 MHz		27.2		nF
C <sub>oes</sub>		f = 1 MHz		1.76		nF
C <sub>res</sub>		f = 1 MHz		1.50		nF
Q <sub>G</sub>	V <sub>GE</sub> = - 8 V...+ 15 V			2500		nC
R <sub>Gint</sub>	T <sub>j</sub> = 25 °C			1.9		Ω
t <sub>d(on)</sub>	V <sub>CC</sub> = 600 V	T <sub>j</sub> = 150 °C		246		ns
t <sub>r</sub>	I <sub>C</sub> = 450 A	T <sub>j</sub> = 150 °C		59		ns
E <sub>on</sub>	V <sub>GE</sub> = +15/-15 V	T <sub>j</sub> = 150 °C		32		mJ
t <sub>d(off)</sub>	R <sub>G on</sub> = 1 Ω	T <sub>j</sub> = 150 °C		529		ns
t <sub>f</sub>	R <sub>G off</sub> = 1 Ω	T <sub>j</sub> = 150 °C		102		ns
E <sub>off</sub>	di/dt <sub>on</sub> = 8100 A/μs di/dt <sub>off</sub> = 3400 A/μs	T <sub>j</sub> = 150 °C		60		mJ
R <sub>th(j-c)</sub>	per IGBT				0.062	K/W
R <sub>th(c-s)</sub>	per IGBT (λ <sub>grease</sub> =0.81 W/(m*K))			0.028		K/W
R <sub>th(c-s)</sub>	per IGBT , pre-applied phase change material			0.017		K/W



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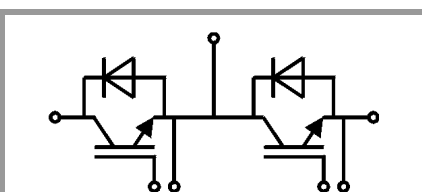
#### Typical Applications\*

- AC inverter drives
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#### Remarks

- Case temperature limited to  $T_c = 125^\circ\text{C}$  max.
- Recommended  $T_{op} = -40 \dots +150^\circ\text{C}$
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse diode						
V <sub>F</sub> = V <sub>EC</sub>	I <sub>F</sub> = 450 A	T <sub>j</sub> = 25 °C		2.31	2.65	V
	V <sub>GE</sub> = 0 V chipelevel	T <sub>j</sub> = 150 °C		2.31	2.64	V
V <sub>F0</sub>	chipelevel	T <sub>j</sub> = 25 °C		1.30	1.50	V
		T <sub>j</sub> = 150 °C		0.90	1.10	V
r <sub>F</sub>	chipelevel	T <sub>j</sub> = 25 °C		2.3	2.6	mΩ
		T <sub>j</sub> = 150 °C		3.1	3.4	mΩ
I <sub>RRM</sub>	I <sub>F</sub> = 450 A	T <sub>j</sub> = 150 °C		452		A
Q <sub>rr</sub>	di/dt <sub>off</sub> = 8300 A/μs	T <sub>j</sub> = 150 °C		62		μC
E <sub>rr</sub>	V <sub>GE</sub> = ±15 V V <sub>CC</sub> = 600 V	T <sub>j</sub> = 150 °C		28		mJ
R <sub>th(j-c)</sub>	per diode				0.13	K/W
R <sub>th(c-s)</sub>	per diode (λ <sub>grease</sub> =0.81 W/(m*K))			0.038		K/W
R <sub>th(c-s)</sub>	per diode, pre-applied phase change material			0.032		K/W
Module						
L <sub>CE</sub>				15		nH
R <sub>CC'+EE'</sub>	measured per switch	T <sub>C</sub> = 25 °C		0.55		mΩ
		T <sub>C</sub> = 125 °C		0.85		mΩ
R <sub>th(c-s)1</sub>	calculated without thermal coupling			0.008		K/W
R <sub>th(c-s)2</sub>	including thermal coupling, Ts underneath module (λ <sub>grease</sub> =0.81 W/(m*K))			0.013		K/W
R <sub>th(c-s)2</sub>	including thermal coupling, Ts underneath module, pre-applied phase change material			0.009		K/W
M <sub>s</sub>	to heat sink M6		3		5	Nm
M <sub>t</sub>		to terminals M6	2.5		5	Nm
w					325	g



**GB**

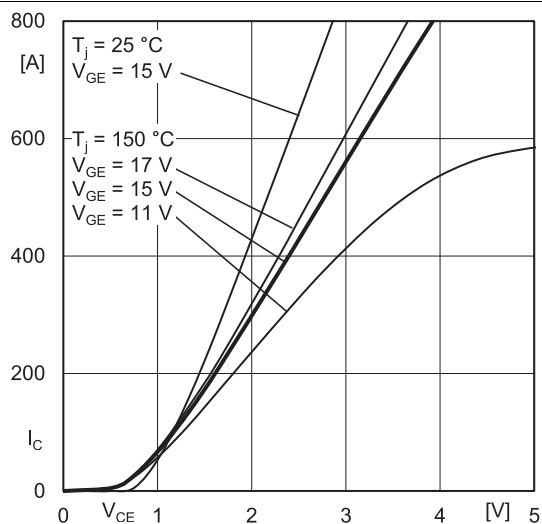


Fig. 1: Typ. output characteristic, inclusive  $R_{CC'+EE'}$

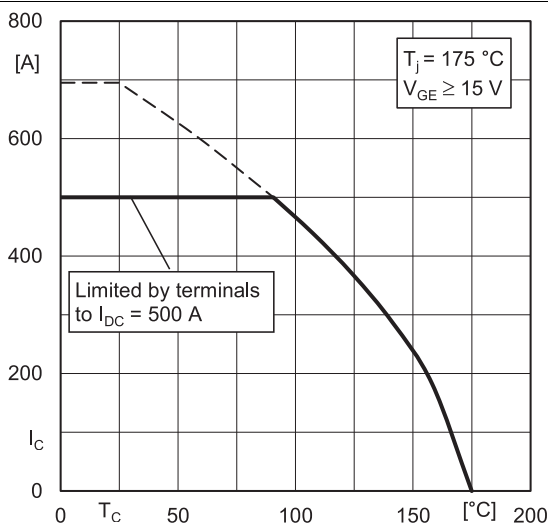


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

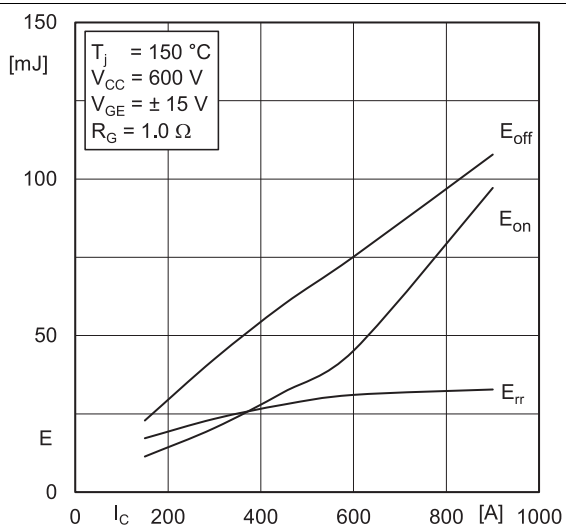


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

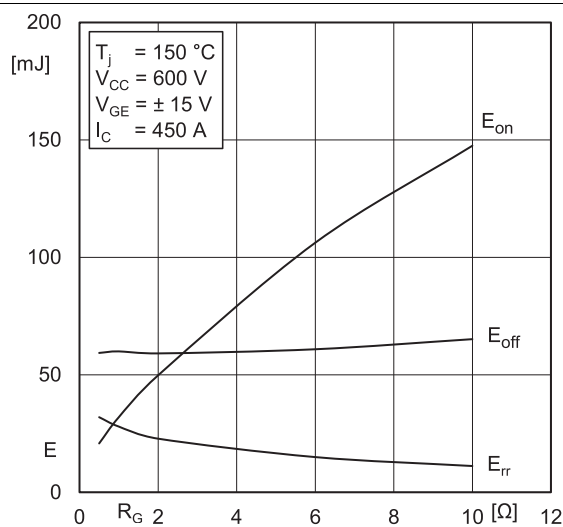


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

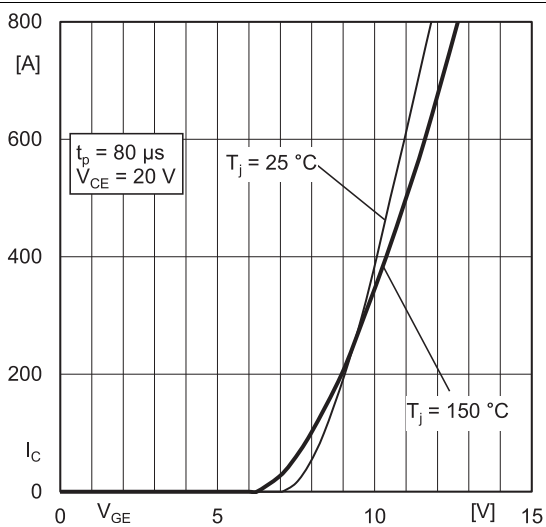


Fig. 5: Typ. transfer characteristic

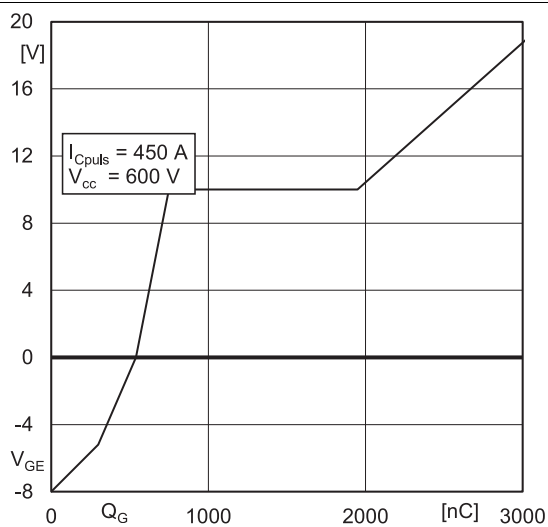


Fig. 6: Typ. gate charge characteristic

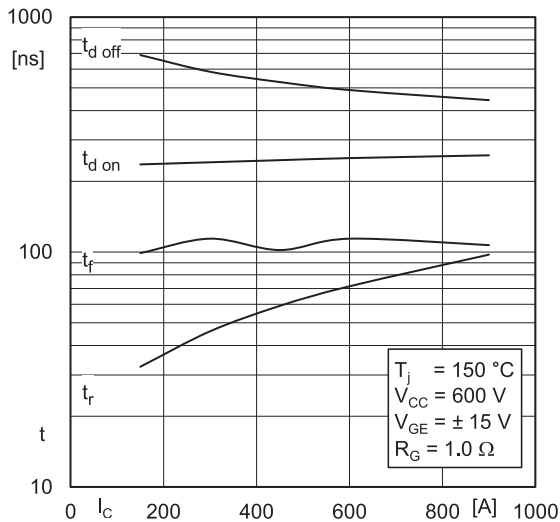


Fig. 7: Typ. switching times vs.  $I_C$

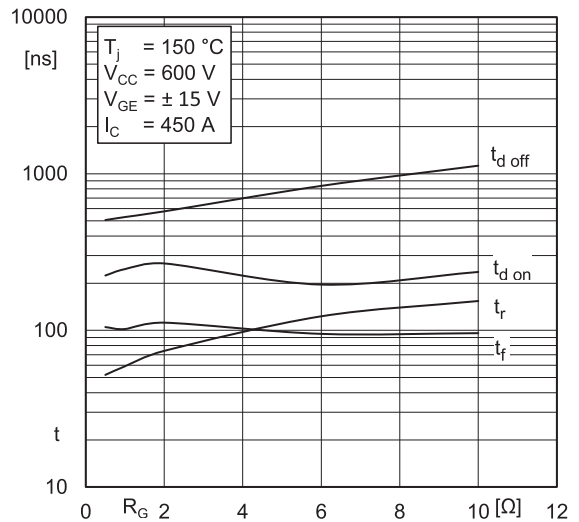


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

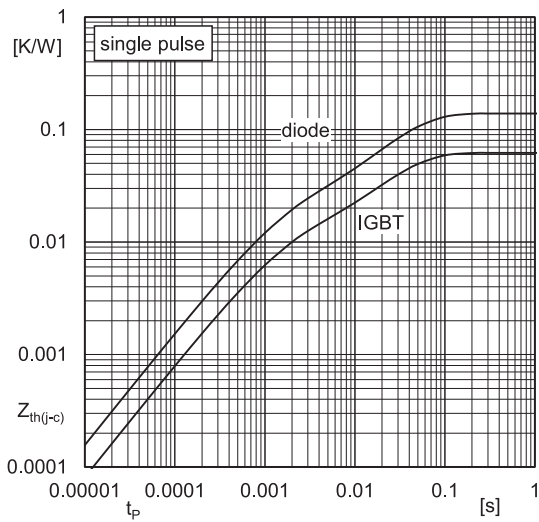


Fig. 9: Transient thermal impedance

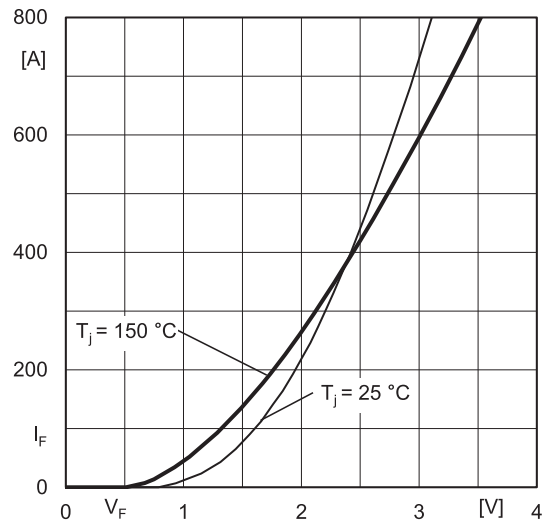


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC'+EE'}$

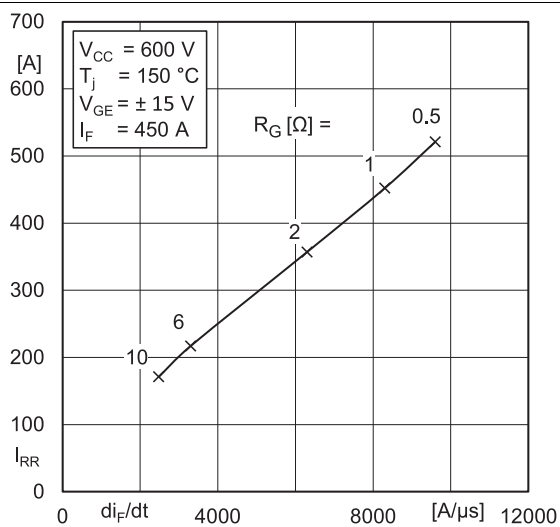


Fig. 11: CAL diode peak reverse recovery current

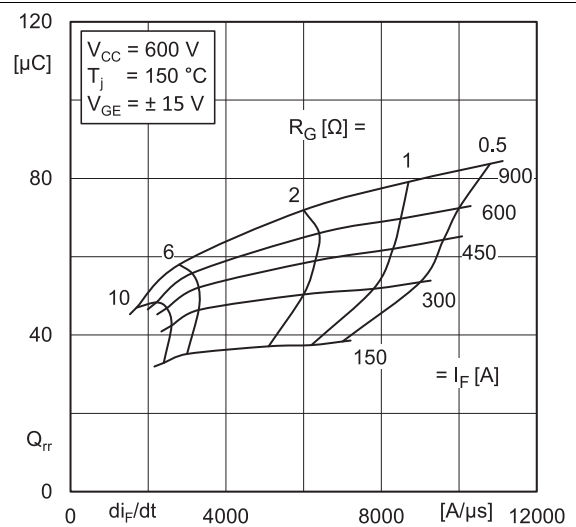
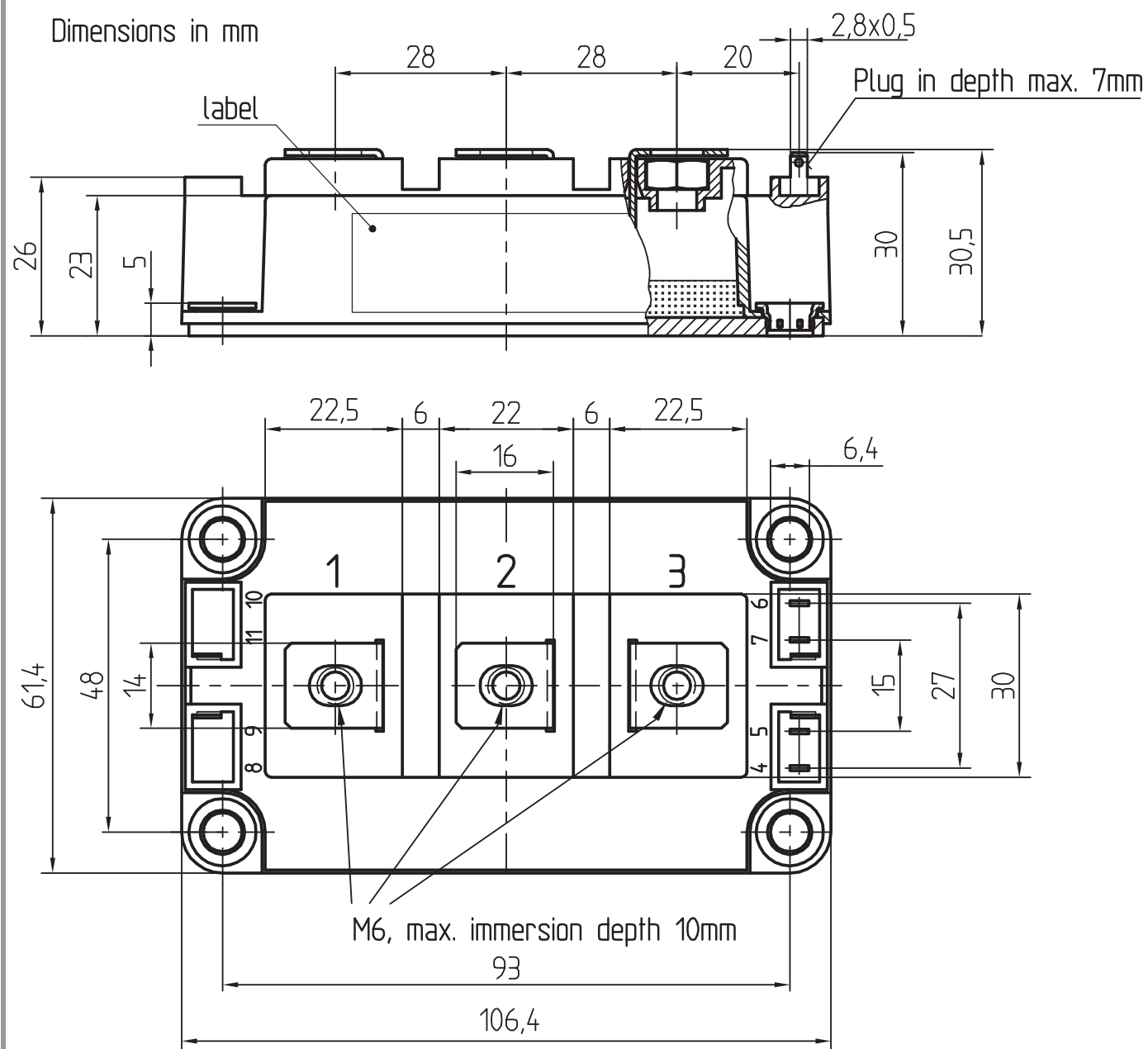
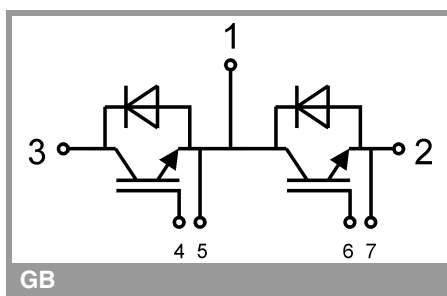


Fig. 12: Typ. CAL diode peak reverse recovery charge



General tolerance  $\pm 0.5$  mm

## SEMITRANS 3



This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

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

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