

## SKM400GB17E4



## IGBT4 Modules

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## Features\*

- IGBT4 = 4th generation medium fast trench IGBT (Infineon)
- CAL4 = Soft switching 4th generation CAL-Diode
- Insulated copper baseplate using DBC Technology (Direct Copper Bonding)
- With integrated Gate resistor
- For switching frequencies up to 8kHz
- UL recognized, file no. E63532

## Typical Applications

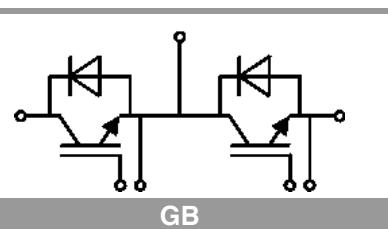
- AC inverter drives
- UPS
- Electronic welders
- Public transport
- Wind power

## 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  $T_j = 150^\circ\text{C}$

Absolute Maximum Ratings		Values	Unit
Symbol	Conditions		
<b>IGBT</b>			
$V_{CES}$	$T_j = 25^\circ\text{C}$	1700	V
$I_c$	$T_j = 175^\circ\text{C}$	614	A
	$T_c = 25^\circ\text{C}$	474	A
$I_{Cnom}$	$T_c = 80^\circ\text{C}$	400	A
$I_{CRM}$	$I_{CRM} = 3 \times I_{Cnom}$	1200	A
$V_{GES}$		-20 ... 20	V
$t_{psc}$	$V_{CC} = 1000\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 1700\text{ V}$	10	$\mu\text{s}$
$T_j$		-40 ... 175	$^\circ\text{C}$
<b>Inverse diode</b>			
$V_{RRM}$	$T_j = 25^\circ\text{C}$	1700	V
$I_F$	$T_j = 175^\circ\text{C}$	443	A
	$T_c = 25^\circ\text{C}$	327	A
$I_{Fnom}$	$T_c = 80^\circ\text{C}$	400	A
$I_{FRM}$	$I_{FRM} = 2 \times I_{Fnom}$	800	A
$I_{FSM}$	$t_p = 10\text{ ms, sin }180^\circ, T_j = 25^\circ\text{C}$	2340	A
$T_j$		-40 ... 175	$^\circ\text{C}$
<b>Module</b>			
$I_{t(RMS)}$		500	A
$T_{stg}$	module without TIM	-40 ... 125	$^\circ\text{C}$
$V_{isol}$	AC sinus 50 Hz, $t = 1\text{ min}$	4000	V

Symbol	Conditions	min.	typ.	max.	Unit
<b>IGBT</b>					
$V_{CE(sat)}$	$I_c = 400\text{ A}$ $V_{GE} = 15\text{ V}$ chiplevel	1.92	2.20	2.60	V
	$T_j = 25^\circ\text{C}$				
	$T_j = 150^\circ\text{C}$	2.30	2.60		
$V_{CE0}$	chiplevel	0.80	0.90	0.90	V
	$T_j = 25^\circ\text{C}$				
	$T_j = 150^\circ\text{C}$	0.70	0.80		
$r_{CE}$	$V_{GE} = 15\text{ V}$ chiplevel	2.8	3.3	3.3	$\text{m}\Omega$
	$T_j = 25^\circ\text{C}$				
	$T_j = 150^\circ\text{C}$	4.0	4.5		
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_c = 16\text{ mA}$	5.2	5.8	6.4	V
$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 1700\text{ V}, T_j = 25^\circ\text{C}$			5	$\text{mA}$
$C_{ies}$	$V_{CE} = 25\text{ V}$ $f = 1\text{ MHz}$	36.0			$\text{nF}$
$C_{oes}$	$V_{GE} = 0\text{ V}$ $f = 1\text{ MHz}$	1.36			$\text{nF}$
$C_{res}$	$f = 1\text{ MHz}$	1.16			$\text{nF}$
$Q_G$	$V_{GE} = -8\text{ V} \dots +15\text{ V}$	3200			$\text{nC}$
$R_{Gint}$	$T_j = 25^\circ\text{C}$	1.9			$\Omega$
$t_{d(on)}$	$V_{CC} = 1200\text{ V}$	280			$\text{ns}$
$t_r$	$I_c = 400\text{ A}$ $V_{GE} = +15/-15\text{ V}$	45			$\text{ns}$
$E_{on}$	$R_{G\text{ on}} = 2\Omega$	157			$\text{mJ}$
$t_{d(off)}$	$R_{G\text{ off}} = 1\Omega$	760			$\text{ns}$
$t_f$	$di/dt_{on} = 10000\text{ A}/\mu\text{s}$ $di/dt_{off} = 2300\text{ A}/\mu\text{s}$ $dv/dt = 5600\text{ V}/\mu\text{s}$	140			$\text{ns}$
$E_{off}$	$T_j = 150^\circ\text{C}$	180			$\text{mJ}$
$R_{th(j-c)}$	per IGBT		0.066		$\text{K/W}$
$R_{th(c-s)}$	per IGBT ( $\lambda_{grease} = 0.81\text{ W}/(\text{m}^*\text{K})$ )		0.028		$\text{K/W}$
$R_{th(c-s)}$	per IGBT, pre-applied phase change material		0.017		$\text{K/W}$





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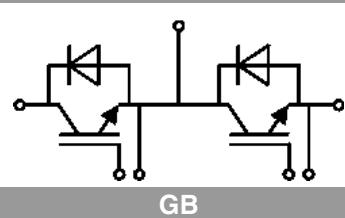
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Characteristics		Symbol	Conditions	min.	typ.	max.	Unit						
Inverse diode													
<b>V<sub>F</sub> = V<sub>EC</sub></b>													
$I_F = 400 \text{ A}$	$T_j = 25^\circ\text{C}$			2.00	2.40		V						
	$V_{GE} = 0 \text{ V}$ chiplevel			2.16	2.57		V						
$V_{FO}$	chiplevel		$T_j = 25^\circ\text{C}$	1.32	1.56		V						
			$T_j = 150^\circ\text{C}$	1.08	1.22		V						
$r_F$	chiplevel		$T_j = 25^\circ\text{C}$	1.71	2.1		$\text{m}\Omega$						
			$T_j = 150^\circ\text{C}$	2.7	3.4		$\text{m}\Omega$						
$I_{RRM}$	$I_F = 400 \text{ A}$		$T_j = 150^\circ\text{C}$	615			A						
$Q_{rr}$	$\text{di/dt}_{\text{off}} = 10100 \text{ A/}\mu\text{s}$		$T_j = 150^\circ\text{C}$	150			$\mu\text{C}$						
$E_{rr}$	$V_{GE} = -15 \text{ V}$ $V_{CC} = 1200 \text{ V}$		$T_j = 150^\circ\text{C}$	130			$\text{mJ}$						
$R_{th(j-c)}$	per diode				0.13		K/W						
$R_{th(c-s)}$	per diode ( $\lambda_{\text{grease}}=0.81 \text{ W/(m}^\circ\text{K)}$ )				0.038		K/W						
$R_{th(c-s)}$	per diode, pre-applied phase change material				0.032		K/W						
<b>Module</b>													
$L_{CE}$				15			nH						
$R_{CC+EE'}$	measured per switch		$T_C = 25^\circ\text{C}$	0.55			$\text{m}\Omega$						
			$T_C = 125^\circ\text{C}$	0.85			$\text{m}\Omega$						
$R_{th(c-s)1}$	calculated without thermal coupling ( $\lambda_{\text{grease}}=0.81 \text{ W/(m}^\circ\text{K)}$ )				0.0081		K/W						
$R_{th(c-s)2}$	including thermal coupling, $T_s$ underneath module ( $\lambda_{\text{grease}}=0.81 \text{ W/(m}^\circ\text{K)}$ )				0.013		K/W						
$R_{th(c-s)2}$	including thermal coupling, $T_s$ underneath module, pre-applied phase change material				0.009		K/W						
$M_s$	to heat sink M6			3	5		Nm						
$M_t$	to terminals M6			2.5	5		Nm						
							Nm						
$w$						325	g						



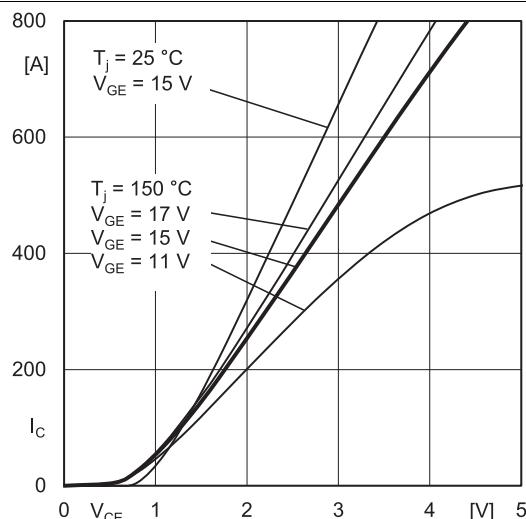
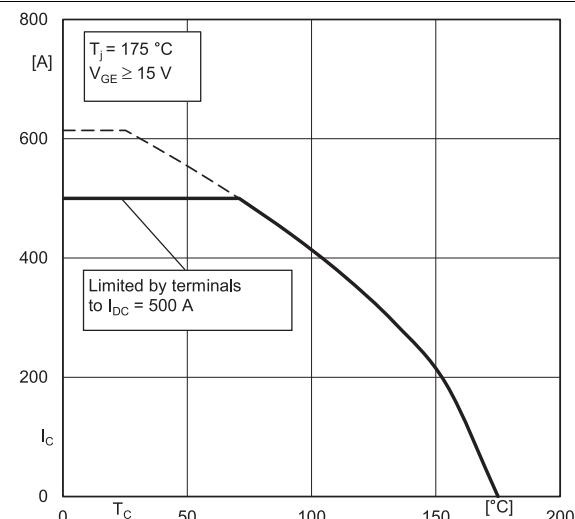
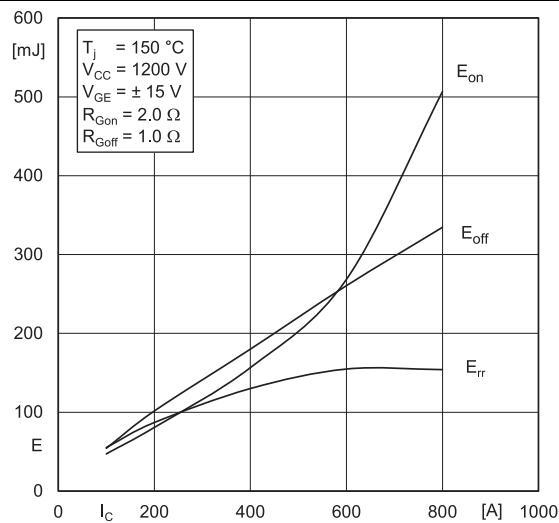
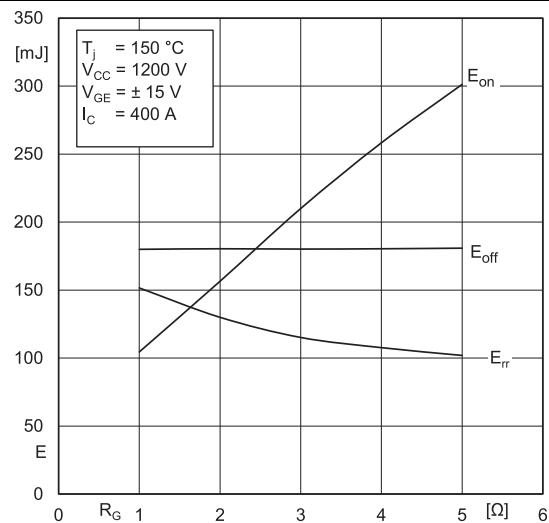
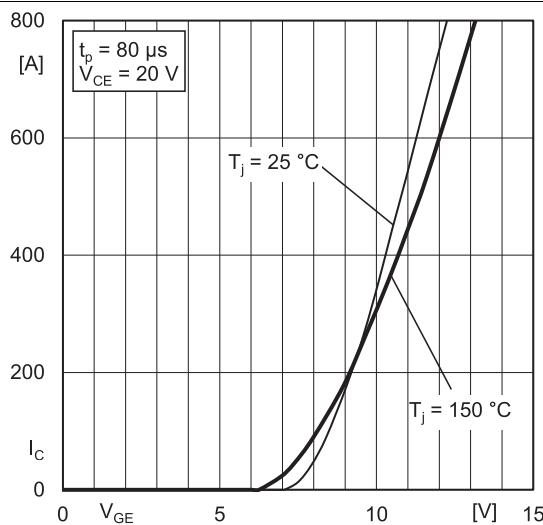
Fig. 1: Typ. output characteristic, inclusive  $R_{CC} + EE$ Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$ Fig. 3: Typ. turn-on /-off energy = f ( $I_C$ )Fig. 4: Typ. turn-on /-off energy = f ( $R_G$ )

Fig. 5: Typ. transfer characteristic

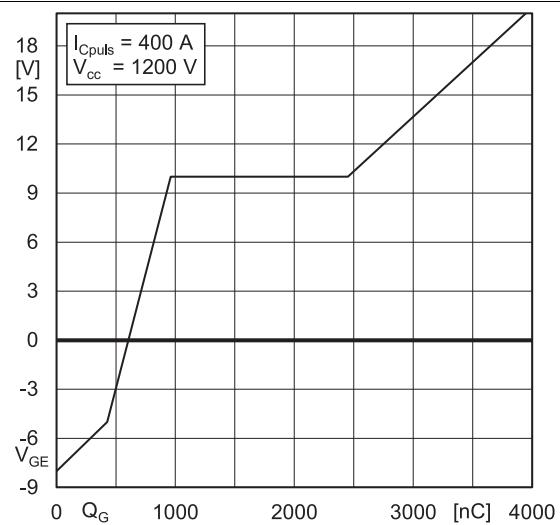


Fig. 6: Typ. gate charge characteristic

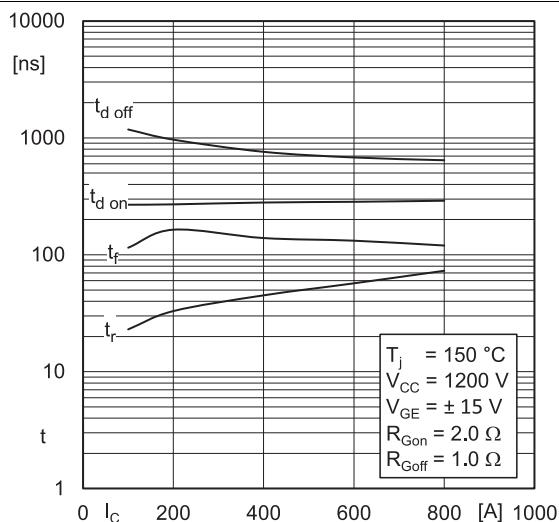


Fig. 7: Typ. switching times vs.  $I_C$

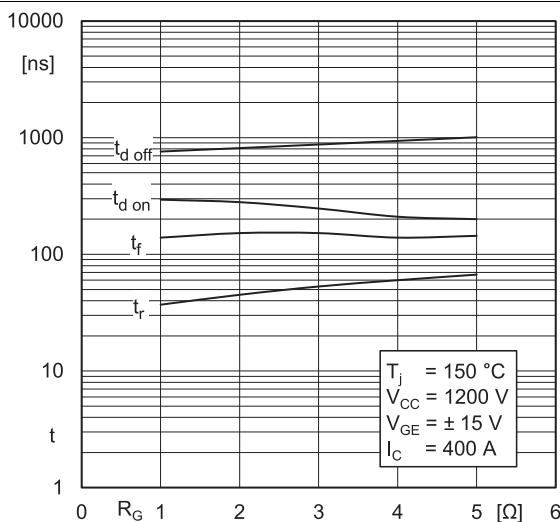


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

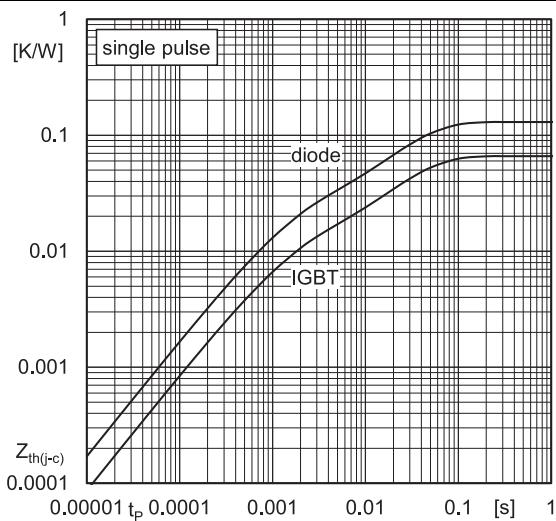


Fig. 9: Transient thermal impedance

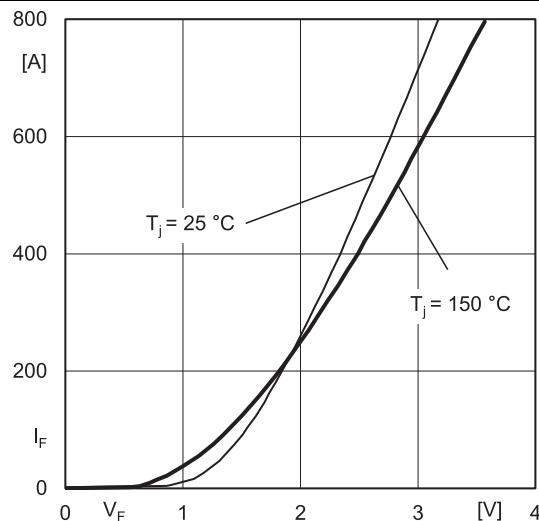


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC' + EE'}$

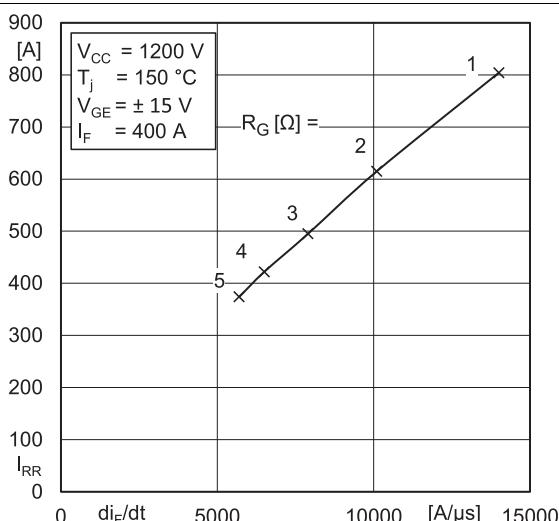


Fig. 11: Typ. CAL diode peak reverse recovery current

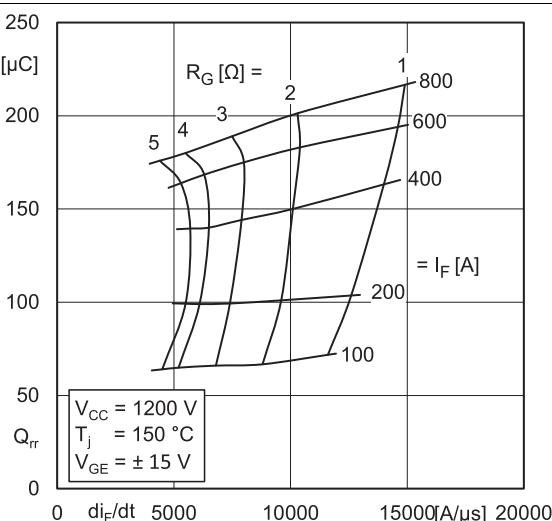
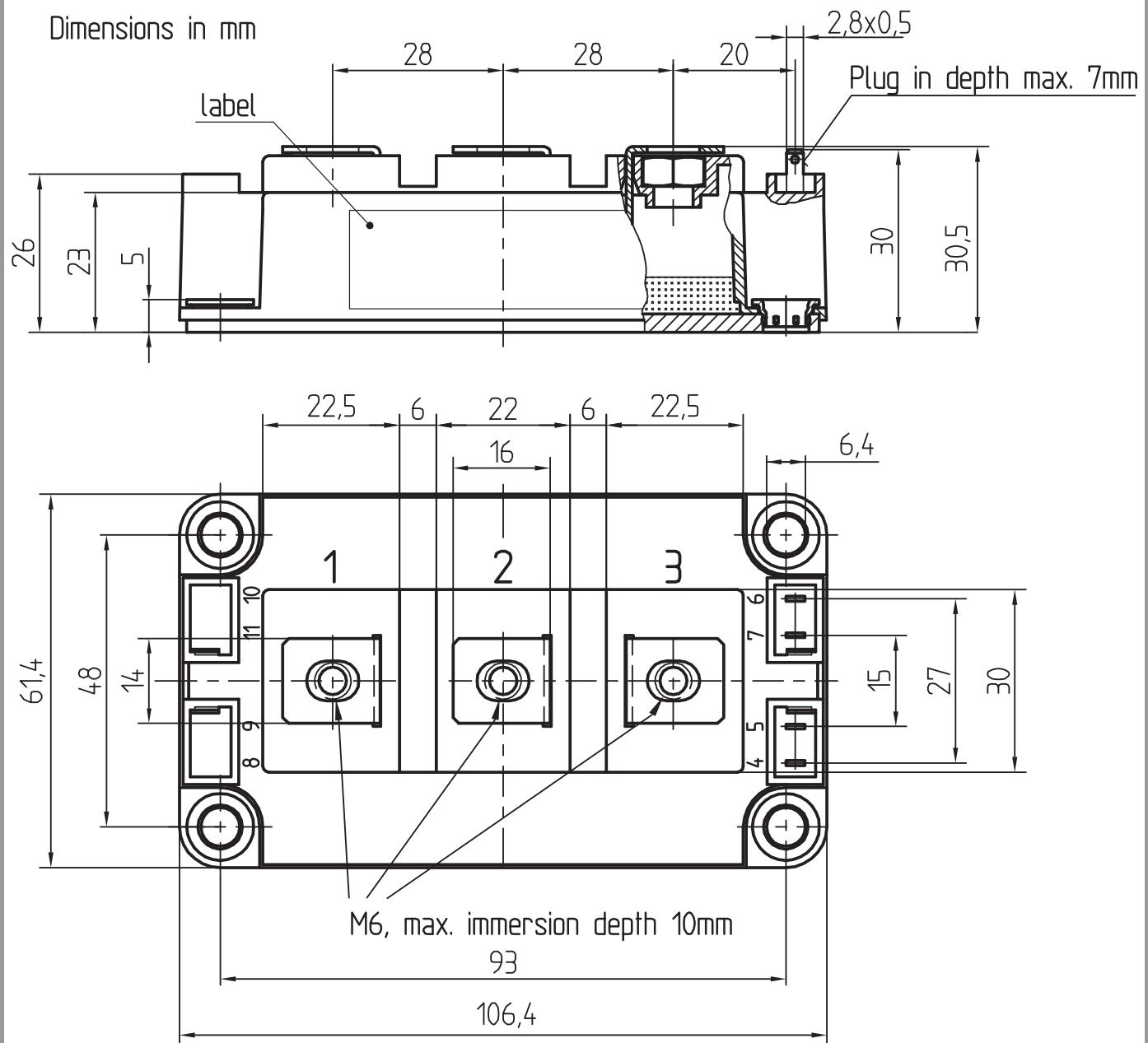


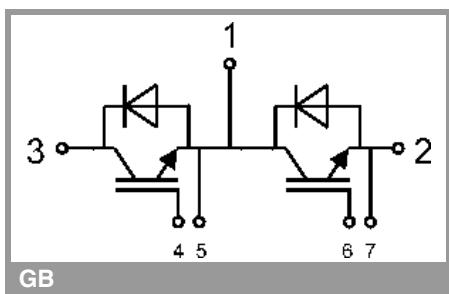
Fig. 12: Typ. CAL diode peak reverse recovery charge

Dimensions in mm



General tolerance  $\pm 0,5$  mm

SEMITRANS 3



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

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