



SEMITRANS® 3

## Fast IGBT4 Modules

### SKM600GB12T4

#### Features\*

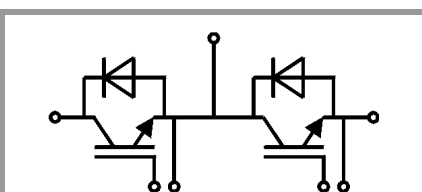
- IGBT4 = 4th generation fast trench IGBT (Infineon)
- CAL4 = Soft switching 4th generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- With integrated gate resistor
- For higher switching frequencies up to 20kHz
- UL recognized, file no. E63532

#### Typical Applications

- AC inverter drives
- UPS
- Electronic welders at fsw up to 20 kHz

#### 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  | 860         | A    |
|                          |  | T <sub>c</sub> = 80 °C  | 702         | A    |
| I <sub>Cnom</sub>        |  |                         | 600         | A    |
| I <sub>CRM</sub>         |  |                         | 1800        | A    |
| V <sub>GES</sub>         |  |                         | -20 ... 20  | V    |
| t <sub>psc</sub>         | V <sub>CC</sub> = 800 V<br>V <sub>GE</sub> ≤ 15 V<br>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  | 623         | A    |
|                          |  | T <sub>c</sub> = 80 °C  | 466         | A    |
| I <sub>Fnom</sub>        |  |                         | 500         | A    |
| I <sub>FRM</sub>         |  |                         | 1200        | A    |
| I <sub>FSM</sub>         | t <sub>p</sub> = 10 ms, sin 180°, T <sub>j</sub> = 25 °C                       |                         | 2736        | 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> = 600 A  | T <sub>j</sub> = 25 °C  |      | 1.80  | 2.05  | V    |
|                      | V <sub>GE</sub> = 15 V<br>chiplevel                                     | T <sub>j</sub> = 150 °C |      | 2.20  | 2.42  | V    |
| V <sub>CE0</sub>     | chiplevel   | 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  |      | 1.67  | 1.92  | mΩ   |
|                      | chiplevel   | T <sub>j</sub> = 150 °C |      | 2.5   | 2.7   | mΩ   |
| V <sub>GE(th)</sub>  | V <sub>GE</sub> =V <sub>CE</sub> , I <sub>C</sub> = 24 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<br>V <sub>GE</sub> = 0 V                         | f = 1 MHz               |      | 37.2  |       | nF   |
| C <sub>oes</sub>     |   | f = 1 MHz               |      | 2.32  |       | nF   |
| C <sub>res</sub>     |   | f = 1 MHz               |      | 2.04  |       | nF   |
| Q <sub>G</sub>       | V <sub>GE</sub> = - 8 V...+ 15 V  |                         |      | 3400  |       | nC   |
| R <sub>Gint</sub>    | T <sub>j</sub> = 25 °C  |                         |      | 1.3   |       | Ω    |
| t <sub>d(on)</sub>   | V <sub>CC</sub> = 600 V   | T <sub>j</sub> = 150 °C |      | 178   |       | ns   |
| t <sub>r</sub>       | I <sub>C</sub> = 600 A  | T <sub>j</sub> = 150 °C |      | 68    |       | ns   |
| E <sub>on</sub>      | V <sub>GE</sub> = +15/-15 V<br>R <sub>G on</sub> = 1.6 Ω                | T <sub>j</sub> = 150 °C |      | 33    |       | mJ   |
| t <sub>d(off)</sub>  | R <sub>G off</sub> = 1 Ω  | T <sub>j</sub> = 150 °C |      | 523   |       | ns   |
| t <sub>f</sub>       | di/dt <sub>on</sub> = 8900 A/μs<br>di/dt <sub>off</sub> = 4300 A/μs     | T <sub>j</sub> = 150 °C |      | 116   |       | ns   |
| E <sub>off</sub>     | dv/dt = 3550 V/μs<br>L <sub>s</sub> = 24 nH                             | T <sub>j</sub> = 150 °C |      | 70    |       | mJ   |
| R <sub>th(j-c)</sub> | per IGBT  |                         |      |       | 0.049 | K/W  |
| R <sub>th(c-s)</sub> | per IGBT (λ <sub>grease</sub> =0.81 W/(m*K))                            |                         |      | 0.032 |       | K/W  |
| R <sub>th(c-s)</sub> | per IGBT, pre-applied phase change material                             |                         |      | 0.016 |       | K/W  |



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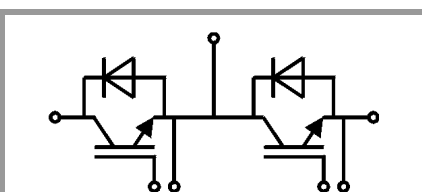
#### Typical Applications

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- UPS
- Electronic welders at fsw up to 20 kHz

#### 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> = 600 A   | T <sub>j</sub> = 25 °C  |      | 2.28    | 2.63  | V    |
|                                  | V <sub>GE</sub> = 0 V<br>chipelevel  | T <sub>j</sub> = 150 °C |      | 2.28    | 2.61  | 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  |      | 1.64    | 1.88  | mΩ   |
|                                  |  | T <sub>j</sub> = 150 °C |      | 2.3     | 2.5   | mΩ   |
| I <sub>RRM</sub>                 | I <sub>F</sub> = 600 A   | T <sub>j</sub> = 150 °C |      | 566     |       | A    |
| Q <sub>rr</sub>                  | di/dt <sub>off</sub> = 8700 A/μs   | T <sub>j</sub> = 150 °C |      | 99      |       | μC   |
| E <sub>rr</sub>                  | V <sub>GE</sub> = -15 V<br>V <sub>CC</sub> = 600 V   | T <sub>j</sub> = 150 °C |      | 40      |       | mJ   |
| R <sub>th(j-c)</sub>             | per diode  |                         |      |         | 0.095 | K/W  |
| R <sub>th(c-s)</sub>             | per diode (λ <sub>grease</sub> =0.81 W/(m*K))  |                         |      | 0.039   |       | K/W  |
| R <sub>th(c-s)</sub>             | per diode, pre-applied phase change material   |                         |      | 0.028   |       | 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  |                         |      | 0.00879 |       | K/W  |
| R <sub>th(c-s)2</sub>            | including thermal coupling,<br>Ts underneath module<br>(λ <sub>grease</sub> =0.81 W/(m*K)) |                         |      | 0.014   |       | K/W  |
| R <sub>th(c-s)2</sub>            | including thermal coupling,<br>Ts underneath module, pre-applied<br>phase change material  |                         |      | 0.008   |       | K/W  |
| M <sub>s</sub>                   | to heat sink M6  |                         | 3    |         | 5     | Nm   |
| M <sub>t</sub>                   |  | to terminals M6         | 2.5  |         | 5     | Nm   |
|                                  |  |                         |      |         |       | Nm   |
| w                                |  |                         |      |         | 325   | g    |



**GB**

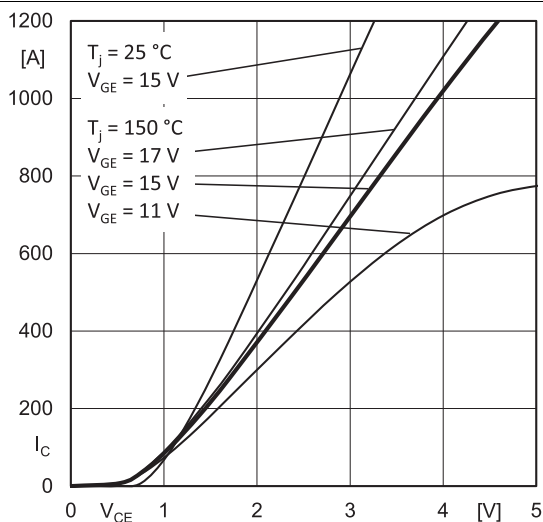


Fig. 1: Typ. output characteristic, inclusive  $R_{CC'} + E_{E'}$

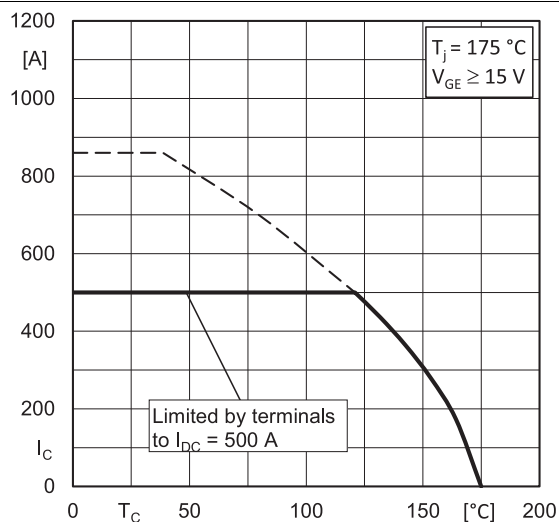


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

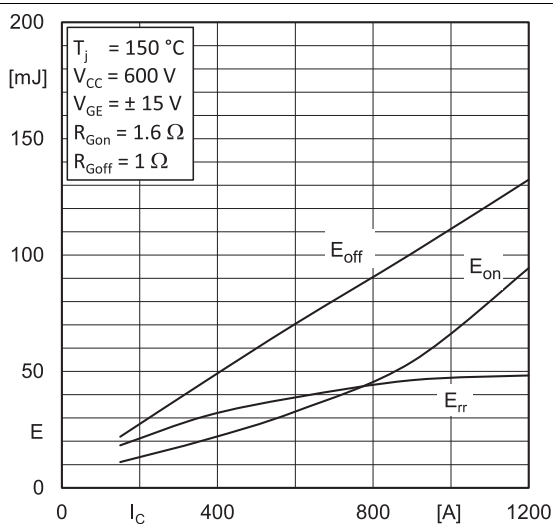


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

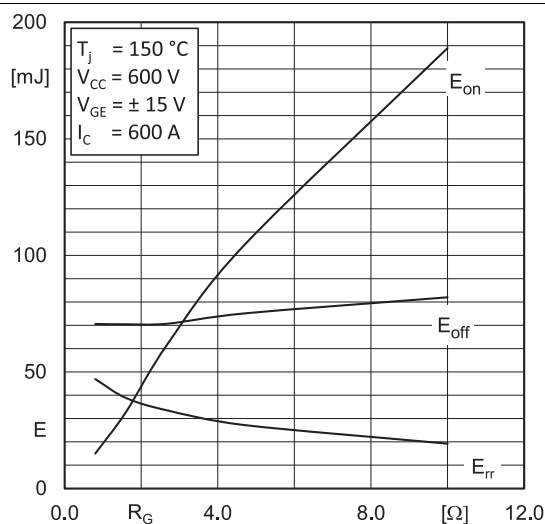


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

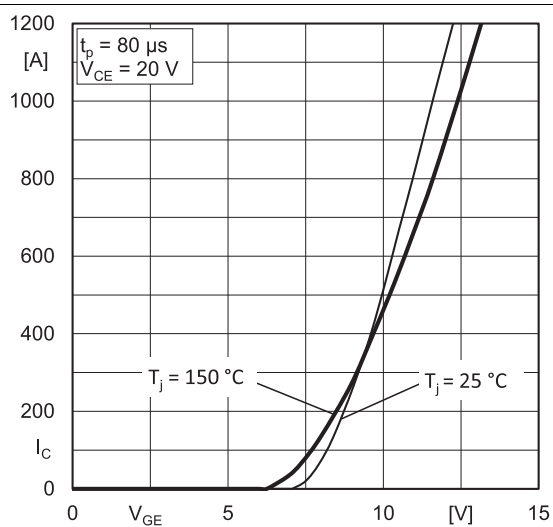


Fig. 5: Typ. transfer characteristic

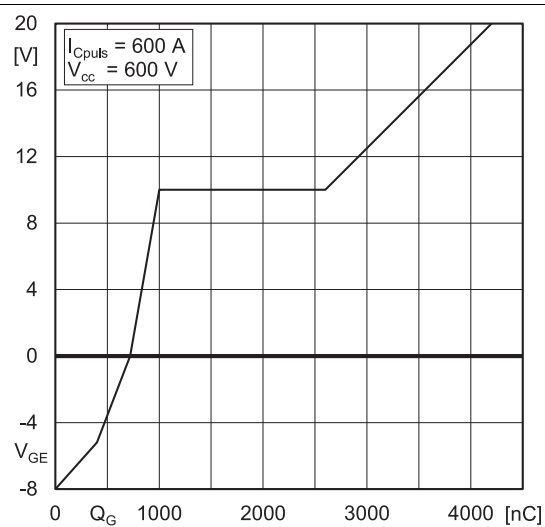


Fig. 6: Typ. gate charge characteristic

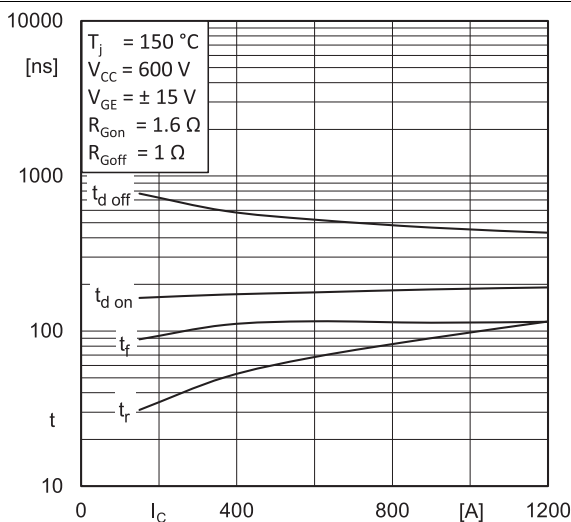


Fig. 7: Typ. switching times vs.  $I_C$

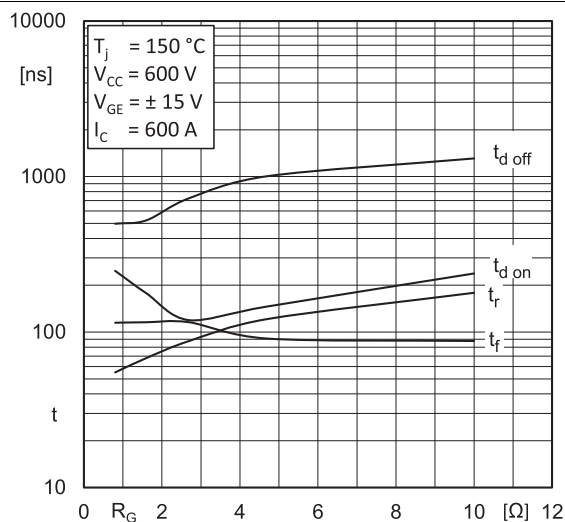


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

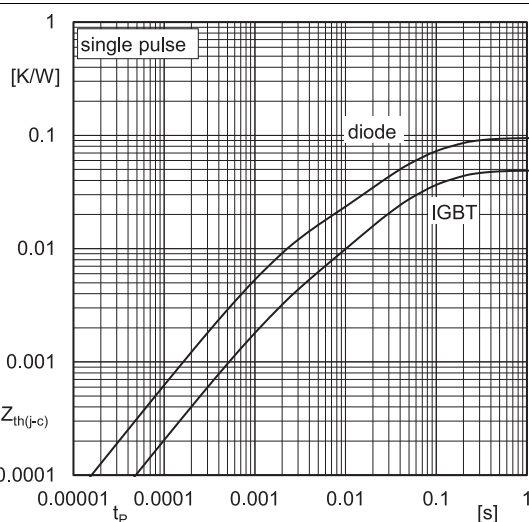


Fig. 9: Transient thermal impedance

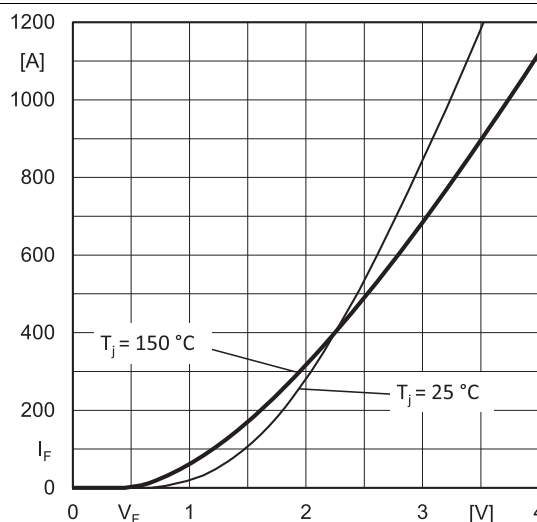


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC'+EE'}$

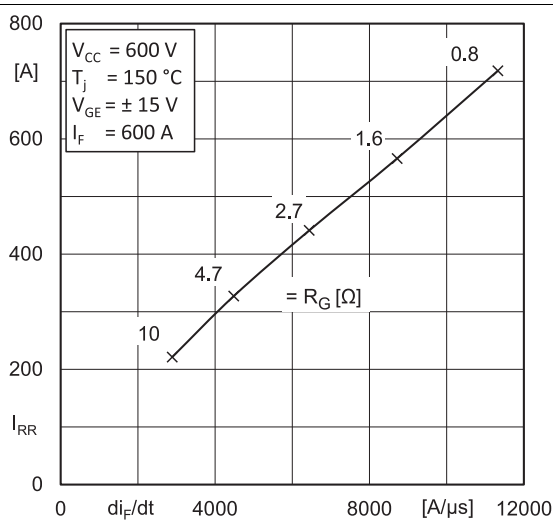


Fig. 11: Typ. CAL diode peak reverse recovery current

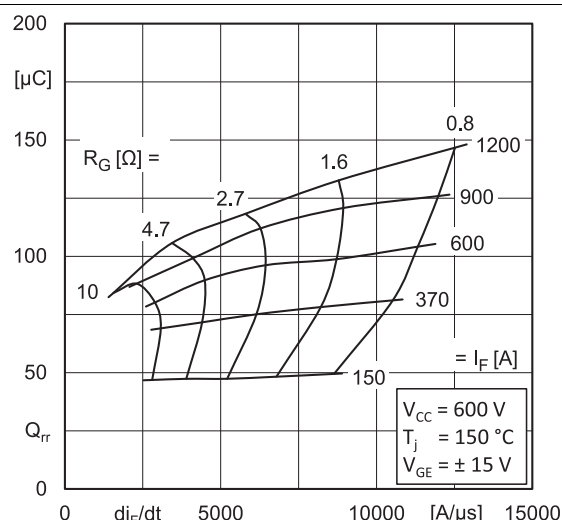
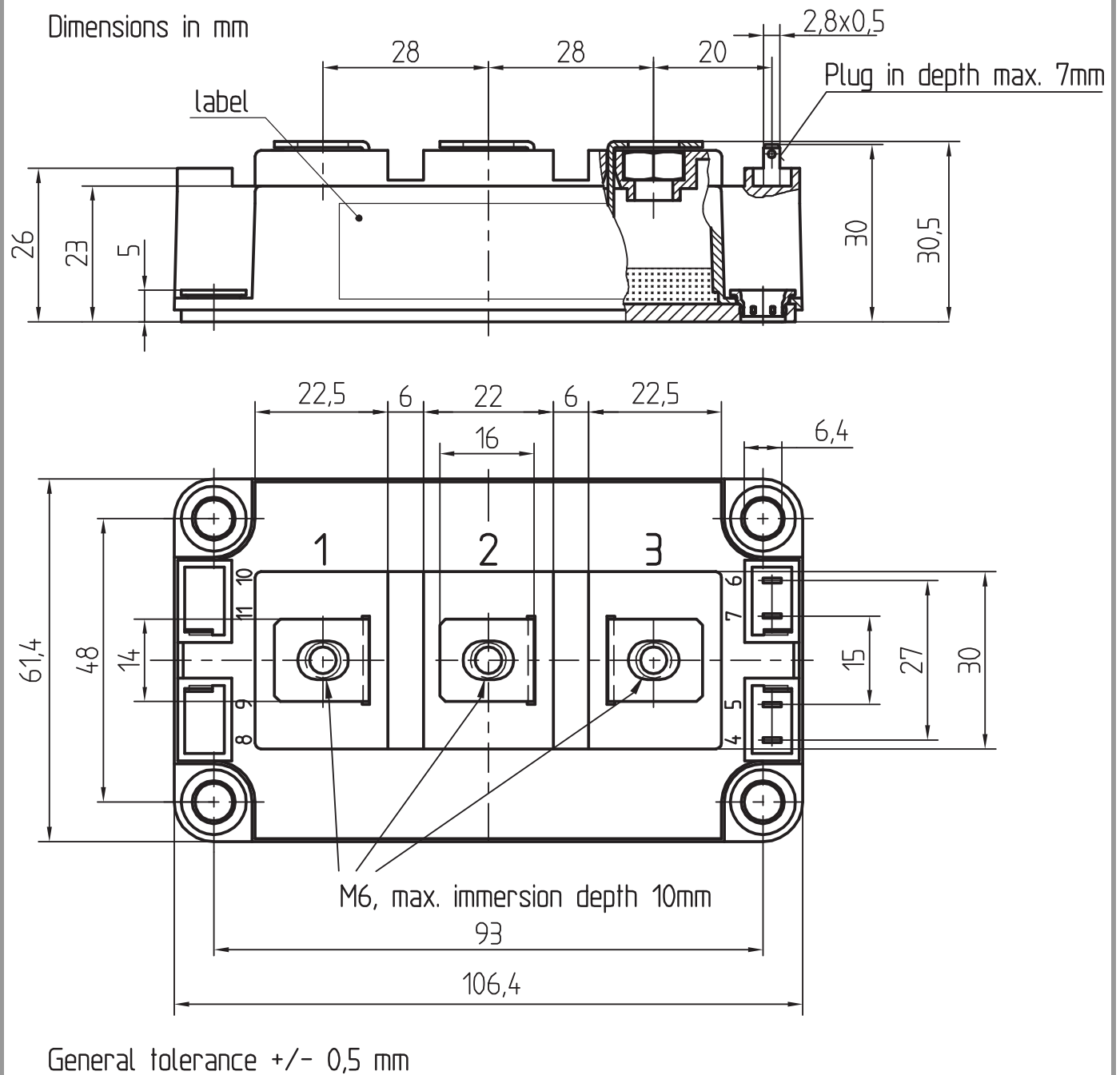
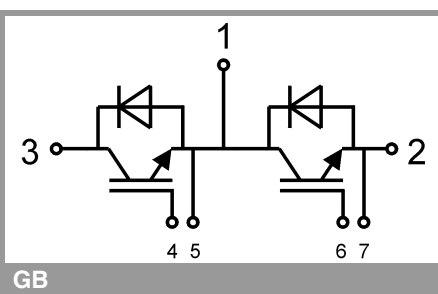


Fig. 12: Typ. CAL diode peak reverse recovery charge



## 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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