

# SKM450GB12T4



## SEMITRANS® 3

### Fast IGBT4 Modules

#### SKM450GB12T4

#### Features

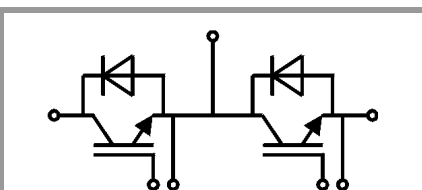
- IGBT4 = 4. generation fast trench IGBT (Infineon)
- CAL4 = Soft switching 4. generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- With integrated gate resistor
- For higher switching frequencies up to 20kHz
- UL recognized, 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             |
| <b>IGBT</b>              |  |                           |             |                  |
| $V_{CES}$                | $T_j = 25^\circ\text{C}$                                     |                           | 1200        | V                |
| $I_C$                    | $T_j = 175^\circ\text{C}$                                    | $T_c = 25^\circ\text{C}$  | 699         | A                |
|                          |  | $T_c = 80^\circ\text{C}$  | 538         | A                |
| $I_{Cnom}$               |  |                           | 450         | A                |
| $I_{CRM}$                | $I_{CRM} = 3 \times I_{Cnom}$                                |                           | 1350        | A                |
| $V_{GES}$                |  |                           | -20 ... 20  | V                |
| $t_{psc}$                | $V_{CC} = 800\text{ V}$                                      | $T_j = 150^\circ\text{C}$ | 10          | $\mu\text{s}$    |
|                          | $V_{GE} \leq 15\text{ V}$                                    |                           |             |                  |
|                          | $V_{CES} \leq 1200\text{ V}$                                 |                           |             |                  |
| $T_j$                    |  |                           | -40 ... 175 | $^\circ\text{C}$ |
| <b>Inverse diode</b>     |  |                           |             |                  |
| $I_F$                    | $T_j = 175^\circ\text{C}$                                    | $T_c = 25^\circ\text{C}$  | 461         | A                |
|                          |  | $T_c = 80^\circ\text{C}$  | 345         | A                |
| $I_{Fnom}$               |  |                           | 400         | A                |
| $I_{FRM}$                | $I_{FRM} = 3 \times I_{Fnom}$                                |                           | 1200        | A                |
| $I_{FSM}$                | $t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$ |                           | 1980        | A                |
| $T_j$                    |  |                           | -40 ... 175 | $^\circ\text{C}$ |
| <b>Module</b>            |  |                           |             |                  |
| $I_{t(RMS)}$             |  |                           | 500         | A                |
| $T_{stg}$                |  |                           | -40 ... 125 | $^\circ\text{C}$ |
| $V_{isol}$               | AC sinus 50 Hz, $t = 1\text{ min}$                           |                           | 4000        | V                |

| Characteristics |   |                           |      |      |       |                  |
|-----------------|---|---------------------------|------|------|-------|------------------|
| Symbol          | Conditions  |                           | min. | typ. | max.  | Unit             |
| <b>IGBT</b>     |   |                           |      |      |       |                  |
| $V_{CE(sat)}$   | $I_C = 450\text{ A}$<br>$V_{GE} = 15\text{ V}$<br>chipelevel                          | $T_j = 25^\circ\text{C}$  | 1.84 | 2.07 |       | V                |
|                 |   | $T_j = 150^\circ\text{C}$ | 2.23 | 2.42 |       | V                |
| $V_{CE0}$       | chipelevel  | $T_j = 25^\circ\text{C}$  | 0.80 | 0.90 |       | V                |
|                 |   | $T_j = 150^\circ\text{C}$ | 0.70 | 0.80 |       | V                |
| $r_{CE}$        | $V_{GE} = 15\text{ V}$<br>chipelevel  | $T_j = 25^\circ\text{C}$  | 2.3  | 2.6  |       | $\text{m}\Omega$ |
|                 |   | $T_j = 150^\circ\text{C}$ | 3.4  | 3.6  |       | $\text{m}\Omega$ |
| $V_{GE(th)}$    | $V_{GE} = V_{CE}, I_C = 16.4\text{ mA}$   |                           | 5.3  | 5.8  | 6.3   | V                |
| $I_{CES}$       | $V_{GE} = 0\text{ V}$<br>$V_{CE} = 1200\text{ V}$                                     | $T_j = 25^\circ\text{C}$  |      |      | 5     | $\text{mA}$      |
|                 |   | $T_j = 150^\circ\text{C}$ |      |      | -     | $\text{mA}$      |
| $C_{ies}$       | $V_{CE} = 25\text{ V}$<br>$V_{GE} = 0\text{ V}$                                       | $f = 1\text{ MHz}$        |      | 27.2 |       | $\text{nF}$      |
| $C_{oes}$       |   | $f = 1\text{ MHz}$        |      | 1.76 |       | $\text{nF}$      |
| $C_{res}$       |   | $f = 1\text{ MHz}$        |      | 1.50 |       | $\text{nF}$      |
| $Q_G$           | $V_{GE} = -8\text{ V} \dots +15\text{ V}$   |                           |      | 2500 |       | $\text{nC}$      |
| $R_{Gint}$      | $T_j = 25^\circ\text{C}$  |                           |      | 1.9  |       | $\Omega$         |
| $t_{d(on)}$     | $V_{CC} = 600\text{ V}$   | $T_j = 150^\circ\text{C}$ |      | 224  |       | $\text{ns}$      |
| $t_r$           | $I_C = 450\text{ A}$<br>$V_{GE} = +15/-15\text{ V}$                                   | $T_j = 150^\circ\text{C}$ |      | 59   |       | $\text{ns}$      |
|                 |   | $T_j = 150^\circ\text{C}$ |      | 32   |       | $\text{mJ}$      |
| $E_{on}$        | $R_{Gon} = 1\ \Omega$   | $T_j = 150^\circ\text{C}$ |      | 32   |       | $\text{mJ}$      |
| $t_{d(off)}$    | $R_{Goff} = 1\ \Omega$  | $T_j = 150^\circ\text{C}$ |      | 460  |       | $\text{ns}$      |
| $t_f$           | $di/dt_{on} = 8300\text{ A}/\mu\text{s}$<br>$di/dt_{off} = 3800\text{ A}/\mu\text{s}$ | $T_j = 150^\circ\text{C}$ |      | 91   |       | $\text{ns}$      |
|                 |   | $T_j = 150^\circ\text{C}$ |      | 49   |       | $\text{mJ}$      |
| $E_{off}$       | $du/dt = 3700\text{ V}/\mu\text{s}$   | $T_j = 150^\circ\text{C}$ |      | 49   |       | $\text{mJ}$      |
| $R_{th(j-c)}$   | per IGBT  |                           |      |      | 0.062 | $\text{K/W}$     |

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- Product reliability results valid for  $T_j = 150^\circ\text{C}$

| Characteristics      |   |                           |      |      |       |               |
|----------------------|---|---------------------------|------|------|-------|---------------|
| Symbol               | Conditions  |                           | min. | typ. | max.  | Unit          |
| <b>Inverse diode</b> |   |                           |      |      |       |               |
| $V_F = V_{EC}$       | $I_F = 450\text{ A}$<br>$V_{GE} = 0\text{ V}$<br>chipelevel | $T_j = 25^\circ\text{C}$  |      | 2.31 | 2.65  | V             |
|                      |   | $T_j = 150^\circ\text{C}$ |      | 2.31 | 2.64  | V             |
| $V_{F0}$             | chipelevel  | $T_j = 25^\circ\text{C}$  |      | 1.30 | 1.50  | V             |
|                      |   | $T_j = 150^\circ\text{C}$ |      | 0.90 | 1.10  | V             |
| $r_F$                | chipelevel  | $T_j = 25^\circ\text{C}$  |      | 2.3  | 2.6   | m $\Omega$    |
|                      |   | $T_j = 150^\circ\text{C}$ |      | 3.1  | 3.4   | m $\Omega$    |
| $I_{RRM}$            | $I_F = 450\text{ A}$  | $T_j = 150^\circ\text{C}$ |      | 440  |       | A             |
| $Q_{rr}$             | $di/dt_{off} = 8000\text{ A}/\mu\text{s}$                   | $T_j = 150^\circ\text{C}$ |      | 65   |       | $\mu\text{C}$ |
| $E_{rr}$             | $V_{GE} = 15\text{ V}$<br>$V_{CC} = 600\text{ V}$           | $T_j = 150^\circ\text{C}$ |      | 28   |       | mJ            |
| $R_{th(j-c)}$        | per diode   |                           |      |      | 0.13  | K/W           |
| <b>Module</b>        |   |                           |      |      |       |               |
| $L_{CE}$             |   |                           |      | 15   |       | nH            |
| $R_{CC'+EE'}$        | measured per switch   | $T_c = 25^\circ\text{C}$  |      | 0.55 |       | m $\Omega$    |
|                      |   | $T_c = 125^\circ\text{C}$ |      | 0.85 |       | m $\Omega$    |
| $R_{th(c-s)}$        | per module  |                           |      | 0.02 | 0.038 | K/W           |
| $M_s$                | to heat sink M6   |                           |      | 3    | 5     | Nm            |
| $M_t$                |   | to terminals M6           |      | 2.5  | 5     | Nm            |
|                      |   |                           |      |      |       | Nm            |
| $w$                  |   |                           |      |      | 325   | g             |



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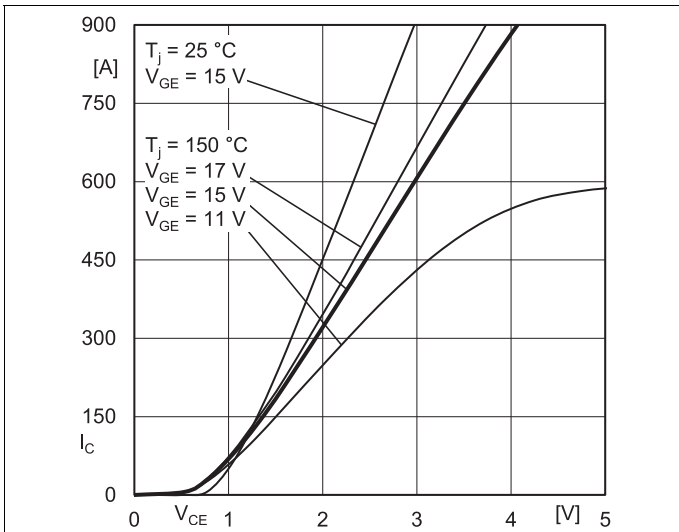


Fig. 1: Typ. output characteristic, inclusive  $R_{CC+EE'}$

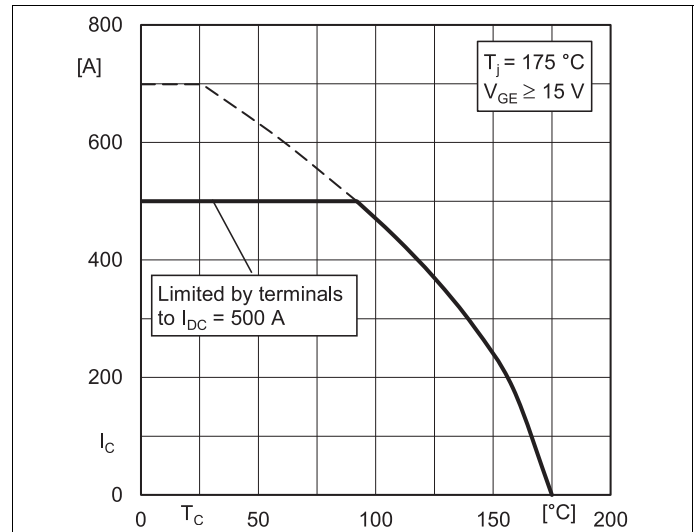


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

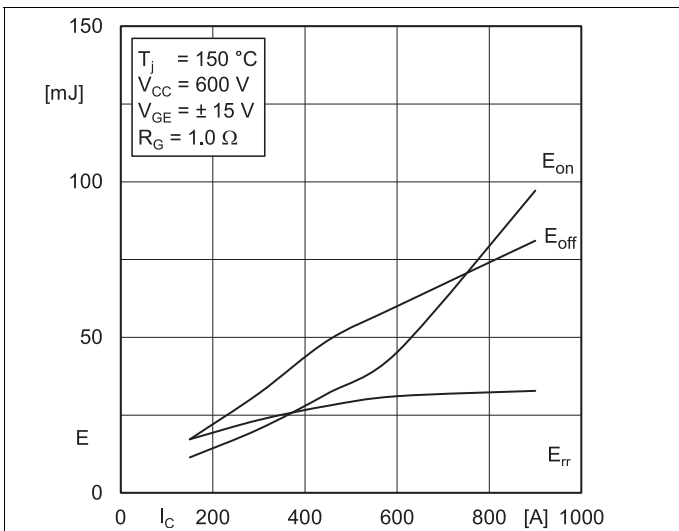


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

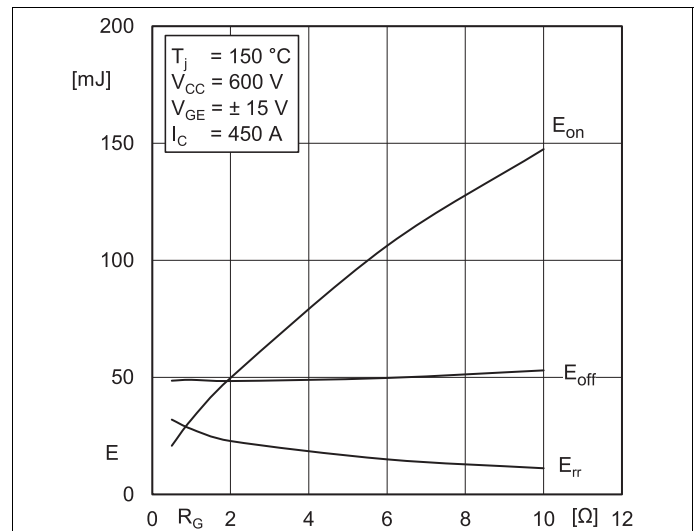


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

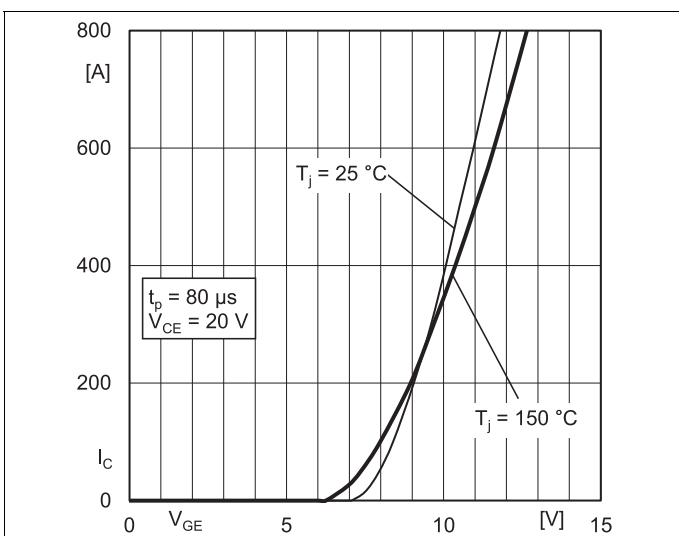


Fig. 5: Typ. transfer characteristic

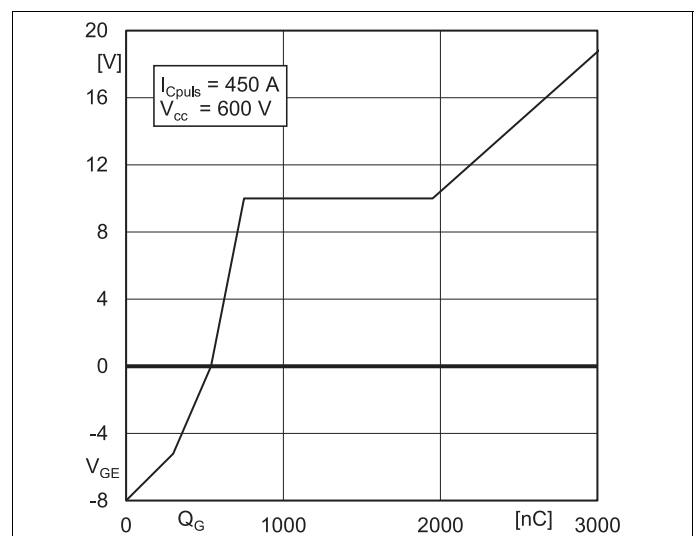


Fig. 6: Typ. gate charge characteristic

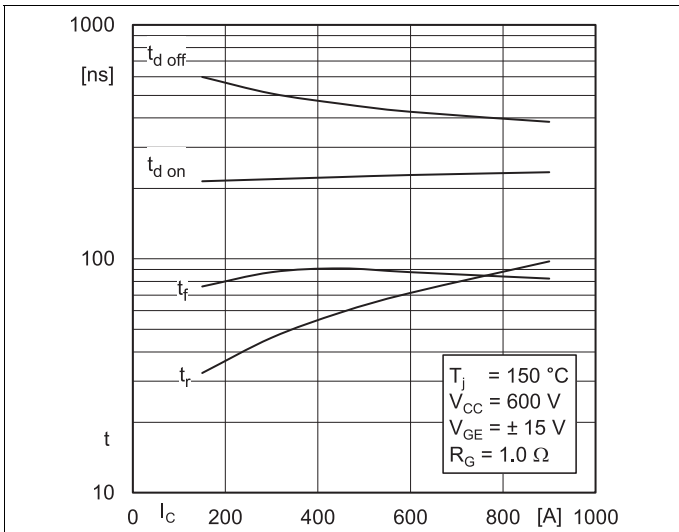


Fig. 7: Typ. switching times vs.  $I_C$

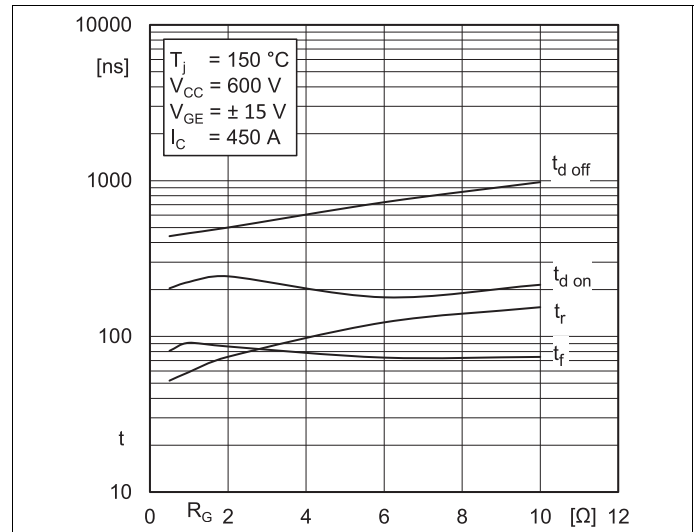


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

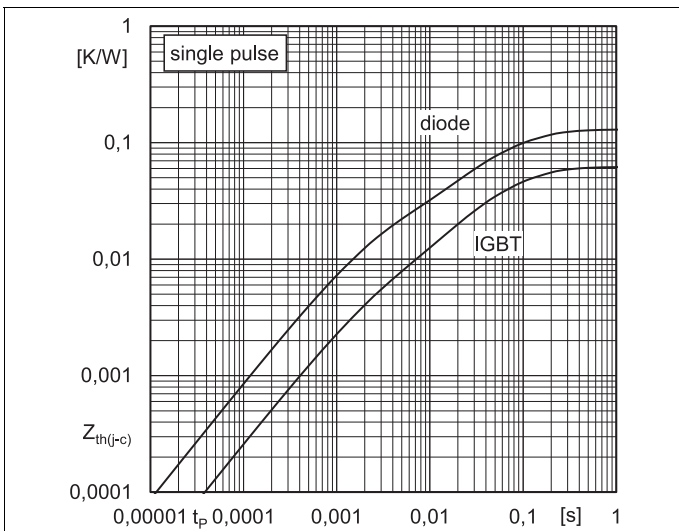


Fig. 9: Transient thermal impedance

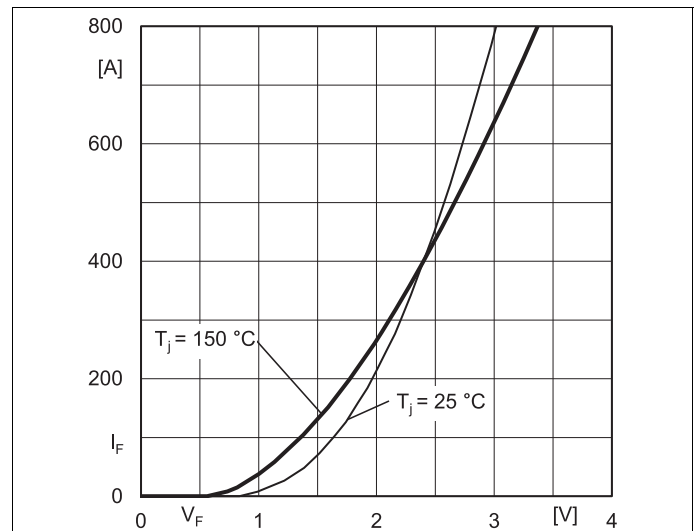


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC+EE}$

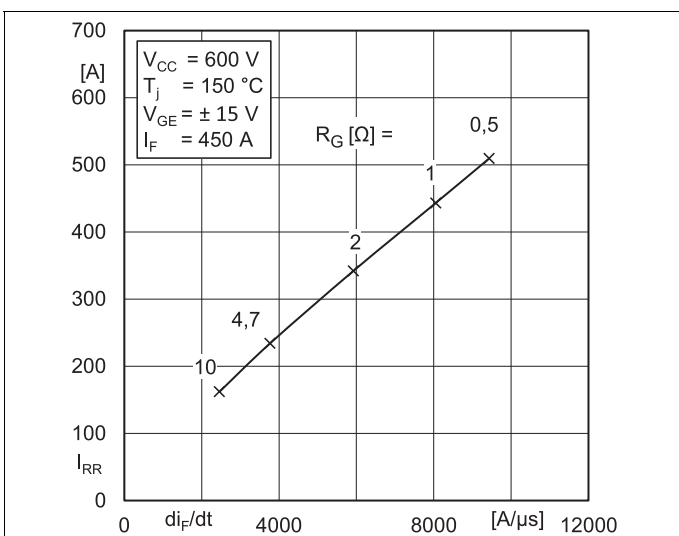


Fig. 11: CAL diode peak reverse recovery current

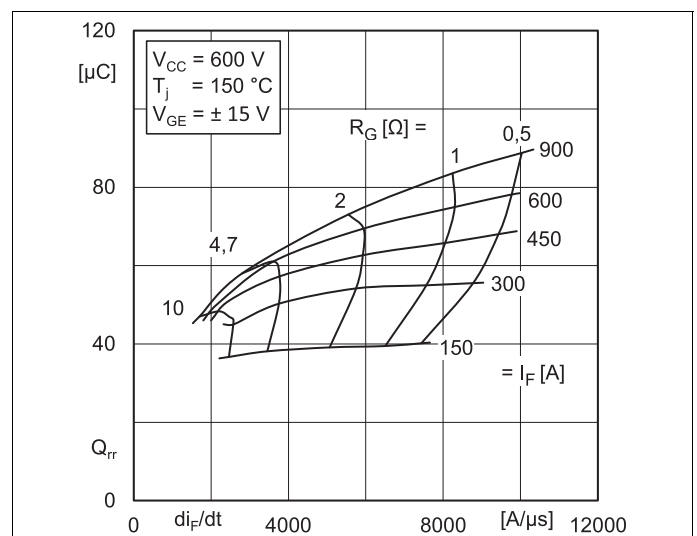
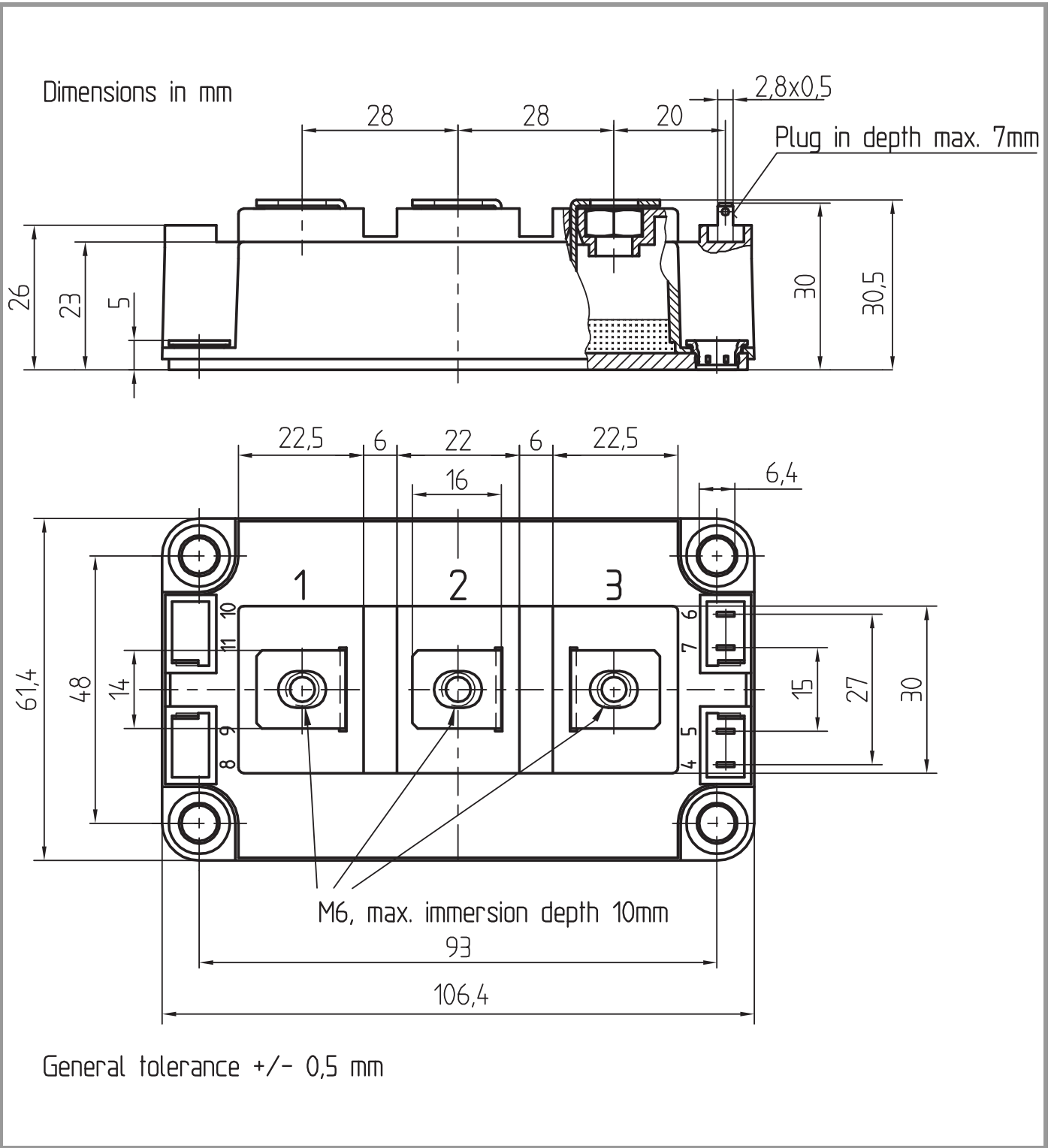
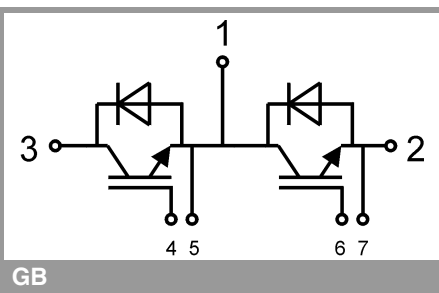


Fig. 12: Typ. CAL diode peak reverse recovery charge

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

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

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