# SKM600GM12M7



**SEMITRANS® 3**

## IGBT M7 Modules

**SKM600GM12M7**

### Features*

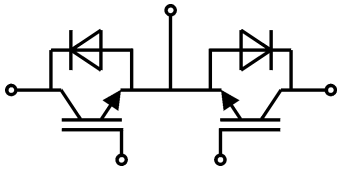
- $V_{CE(sat)}$ with positive temperature coefficient
- High overload capability
- Low loss high density IGBT´s
- Fast & soft switching inverse CAL diodes
- Large clearance (10 mm) and creepage distances (20 mm)
- Insulated copper baseplate using DBC Technology (Direct Bonded Copper)
- UL recognized, file no. E63532

### Typical Applications

- Matrix Inverter
- Bidirectional switch

### Remarks

- Max. case temperature limited to $T_C$ = $T_S$ = 125 °C
- Product reliability results are valid for $T_j$ = 150 °C (recommended $T_{j,op}$ = -40...+150 °C)
- For storage and case temperature with TIM see document: "Technical Explanations Thermal Interface Materials"



**GM**

| Absolute Maximum Ratings | | | | |
|---|---|---|---|---|
| **Symbol** | **Conditions** | | **Values** | **Unit** |
| **IGBT** | | | | |
| $V_{CES}$ | $T_j$ = 25 °C | | 1200 | V |
| $I_C$ | $T_j$ = 175 °C | $T_c$ = 25 °C | 893 | A |
| | | $T_c$ = 80 °C | 676 | A |
| $I_{Cnom}$ | | | 600 | A |
| $I_{CRM}$ | | | 1200 | A |
| $V_{GES}$ | | | -20 ... 20 | V |
| $t_{psc}$ | $V_{CC}$ = 800 V<br>$V_{GE} \leq$ 15 V<br>$V_{CES} \leq$ 1200 V | $T_j$ = 150 °C | 8 | µs |
| $T_j$ | | | -40 ... 175 | °C |
| **Inverse diode** | | | | |
| $V_{RRM}$ | $T_j$ = 25 °C | | 1200 | V |
| $I_F$ | $T_j$ = 175 °C | $T_c$ = 25 °C | 688 | A |
| | | $T_c$ = 80 °C | 513 | A |
| $I_{FRM}$ | | | 1200 | A |
| $I_{FSM}$ | $t_p$ = 10 ms, sin 180°, $T_j$ = 25 °C | | 3240 | A |
| $T_j$ | | | -40 ... 175 | °C |
| **Module** | | | | |
| $I_{t(RMS)}$ | $T_{Terminal} \leq$ 90°C, $T_C$ = 90°C | | 650 | A |
| $T_{stg}$ | module without TIM | | -40 ... 125 | °C |
| $V_{isol}$ | AC sinus 50 Hz, t = 1 min | | 4000 | V |

| Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| **IGBT** | | | | | | |
| $V_{CE(sat)}$ | $I_C$ = 600 A<br>$V_{GE}$ = 15 V<br>chiplevel | $T_j$ = 25 °C | | 1.55 | 1.88 | V |
| | | $T_j$ = 150 °C | | 1.80 | | V |
| $V_{CE0}$ | chiplevel | $T_j$ = 25 °C | | 0.85 | 1.02 | V |
| | | $T_j$ = 150 °C | | 0.75 | | V |
| $r_{CE}$ | $V_{GE}$ = 15 V<br>chiplevel | $T_j$ = 25 °C | | 1.17 | 1.43 | mΩ |
| | | $T_j$ = 150 °C | | 1.75 | | mΩ |
| $V_{GE(th)}$ | $V_{CE}$ = 10 V, $I_C$ = 60 mA | | 5.4 | 6 | 6.6 | V |
| $I_{CES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V, $T_j$ = 25 °C | | | | 1 | mA |
| $C_{ies}$ | $V_{CE}$ = 10 V<br>$V_{GE}$ = 0 V | f = 1 MHz | | 120.0 | | nF |
| $C_{oes}$ | | f = 1 MHz | | 3.60 | | nF |
| $C_{res}$ | | f = 1 MHz | | 1.28 | | nF |
| $Q_G$ | $V_{GE}$ = -8V ... + 15V | | | 5360 | | nC |
| $R_{Gint}$ | $T_j$ = 25 °C | | | 0.8 | | Ω |
| $t_{d(on)}$ | $V_{CC}$ = 600 V<br>$I_C$ = 600 A<br>$V_{GE}$ = +15/-15 V<br>$R_{G\ on}$ = 1.2 Ω<br>$R_{G\ off}$ = 1 Ω<br>$di/dt_{on}$ = 8000 A/µs<br>$di/dt_{off}$ = 5240 A/µs<br>dv/dt = 5960 V/µs | $T_j$ = 150 °C | | 260 | | ns |
| $t_r$ | | $T_j$ = 150 °C | | 85 | | ns |
| $E_{on}$ | | $T_j$ = 150 °C | | 57 | | mJ |
| $t_{d(off)}$ | | $T_j$ = 150 °C | | 436 | | ns |
| $t_f$ | | $T_j$ = 150 °C | | 95 | | ns |
| $E_{off}$ | | $T_j$ = 150 °C | | 68 | | mJ |
| $R_{th(j-c)}$ | per IGBT | | | | 0.06 | K/W |
| $R_{th(c-s)}$ | per IGBT, P12 (reference) | | | 0.037 | | K/W |
| $R_{th(c-s)}$ | per IGBT, HP-PCM | | | 0.020 | | K/W |

# SKM600GM12M7



**SEMITRANS® 3**

## IGBT M7 Modules

**SKM600GM12M7**

### Features*

- $V_{CE(sat)}$ with positive temperature coefficient
- High overload capability
- Low loss high density IGBT´s
- Fast & soft switching inverse CAL diodes
- Large clearance (10 mm) and creepage distances (20 mm)
- Insulated copper baseplate using DBC Technology (Direct Bonded Copper)
- UL recognized, file no. E63532

### Typical Applications

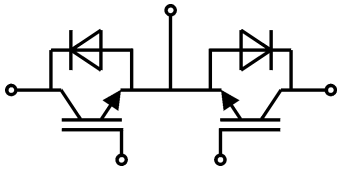
- Matrix Inverter
- Bidirectional switch

### Remarks

- Max. case temperature limited to $T_C$ = $T_S$ = 125 °C
- Product reliability results are valid for $T_j$ = 150 °C (recommended $T_{j,op}$ = -40...+150 °C)
- For storage and case temperature with TIM see document: "Technical Explanations Thermal Interface Materials"

**Characteristics**

| Symbol | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| **Inverse diode** | | | | | | |
| $V_F = V_{EC}$ | $I_F$ = 600 A<br>$V_{GE}$ = 0 V<br>chiplevel | $T_j$ = 25 °C | | 2.14 | 2.46 | V |
| | | $T_j$ = 150 °C | | 2.07 | | V |
| $V_{F0}$ | chiplevel | $T_j$ = 25 °C | | 1.30 | 1.50 | V |
| | | $T_j$ = 150 °C | | 0.90 | | V |
| $r_F$ | chiplevel | $T_j$ = 25 °C | | 1.40 | 1.60 | mΩ |
| | | $T_j$ = 150 °C | | 1.95 | | mΩ |
| $I_{RRM}$ | $I_F$ = 600 A<br>$di/dt_{off}$ = 8000 A/µs<br>$V_{GE}$ = -15 V<br>$V_{CC}$ = 600 V | $T_j$ = 150 °C | | 555 | | A |
| $Q_{rr}$ | | $T_j$ = 150 °C | | 92 | | µC |
| $E_{rr}$ | | $T_j$ = 150 °C | | 43 | | mJ |
| $R_{th(j-c)}$ | per diode | | | | 0.09 | K/W |
| $R_{th(c-s)}$ | per diode, P12 (reference) | | | 0.039 | | K/W |
| $R_{th(c-s)}$ | per diode, HP-PCM | | | 0.022 | | K/W |
| **Module** | | | | | | |
| $L_{CE}$ | | | | 15 | | nH |
| $R_{CC'+EE'}$ | measured per switch | $T_C$ = 25 °C | | 0.43 | | mΩ |
| | | $T_C$ = 125 °C | | 0.6 | | mΩ |
| $R_{th(c-s)1}$ | calculated without thermal coupling, P12 (reference) | | | 0.0095 | | K/W |
| $R_{th(c-s)2}$ | including thermal coupling, $T_s$ underneath module, P12 (reference) | | | 0.0155 | | K/W |
| $R_{th(c-s)2}$ | including thermal coupling, $T_s$ underneath module, HP-PCM | | | 0.0086 | | K/W |
| $M_s$ | to heat sink M6 | | 3 | | 5 | Nm |
| $M_t$ | | to terminals M6 | 2.5 | | 5 | Nm |
| | | | | - | | Nm |
| w | | | | | 325 | g |



**GM**

 © by Semikron Danfoss

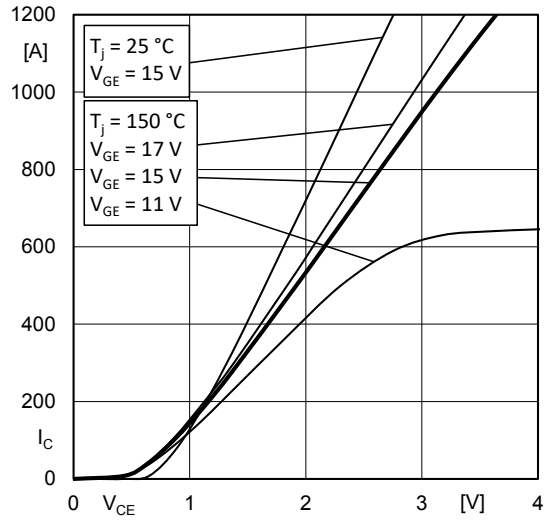



Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

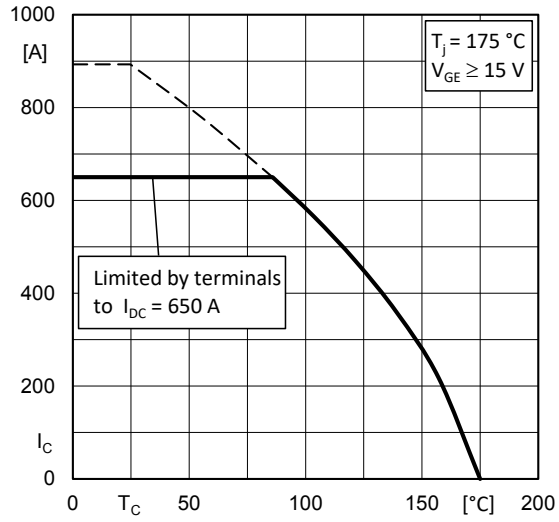



Fig. 2: Rated current vs. temperature $I_c = f(T_c)$

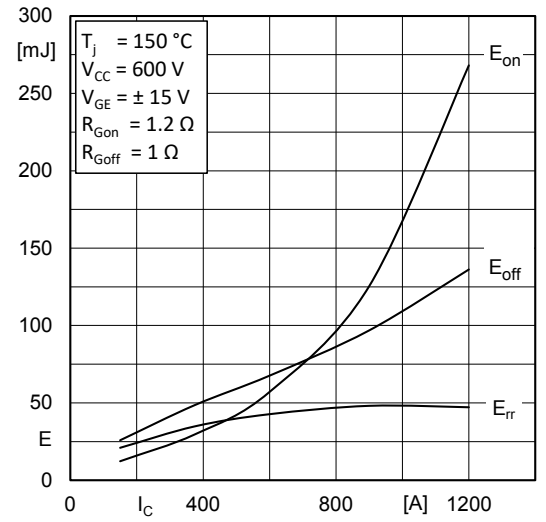



Fig. 3: Typ. turn-on /-off energy = f ($I_C$)

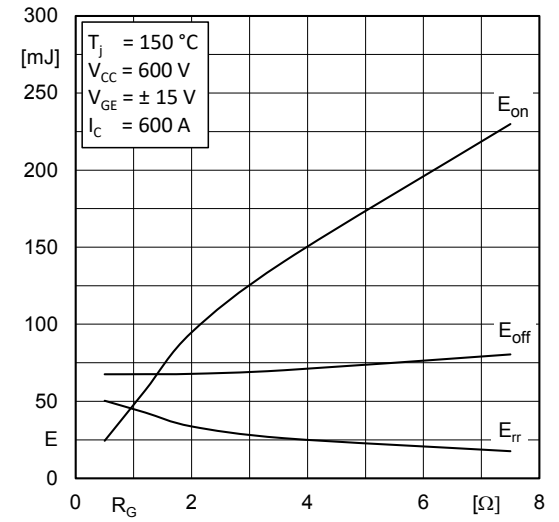



Fig. 4: Typ. turn-on /-off energy = f ($R_G$)

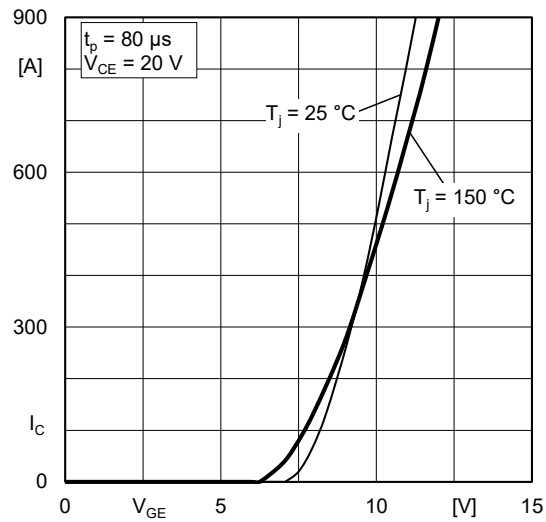



Fig. 5: Typ. transfer characteristic

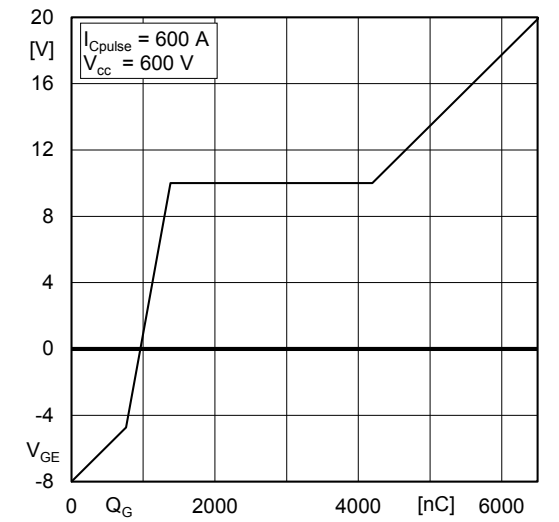



Fig. 6: Typ. gate charge characteristic

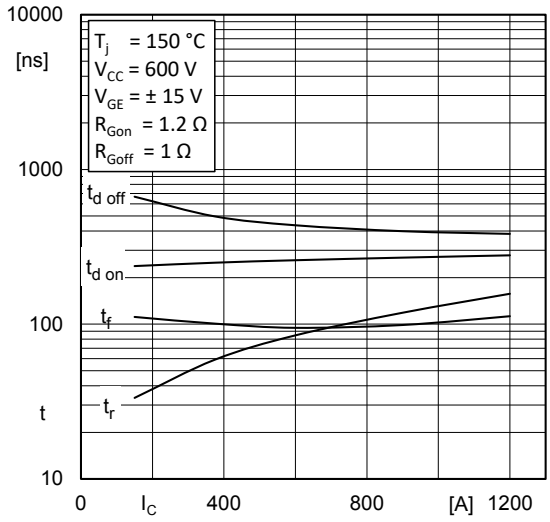



Fig. 7: Typ. switching times vs. $I_C$

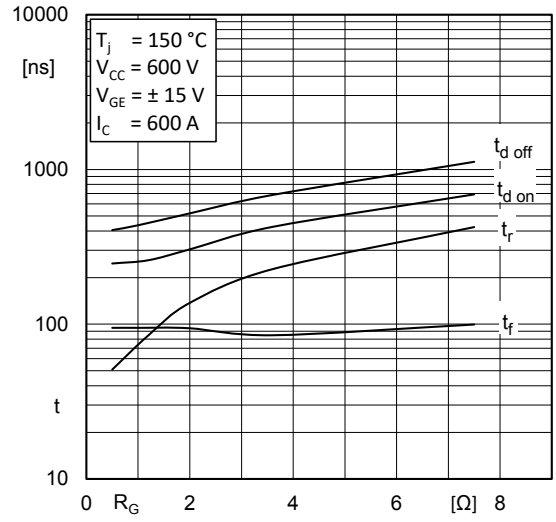



Fig. 8: Typ. switching times vs. gate resistor $R_G$

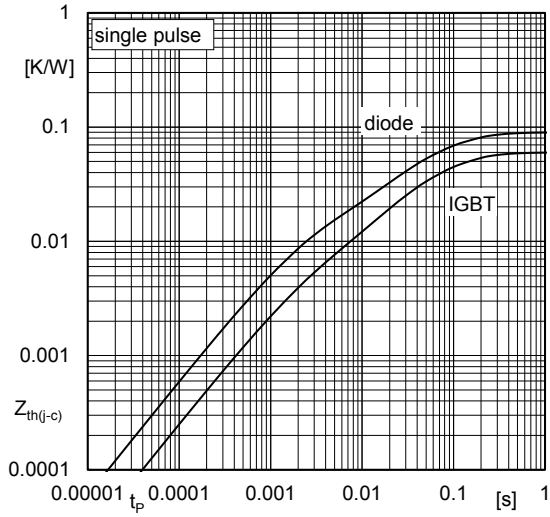



Fig. 9: Transient thermal impedance

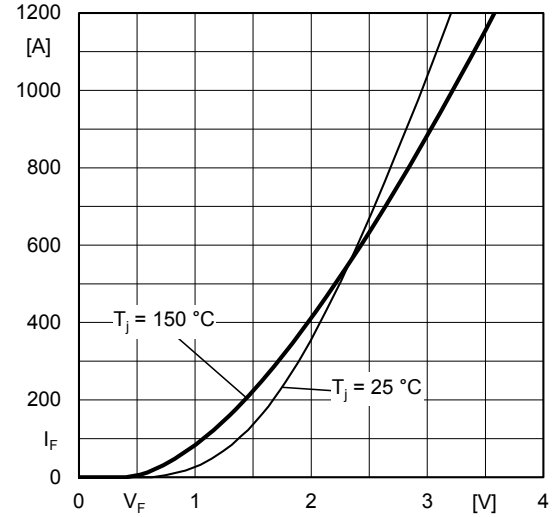



Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

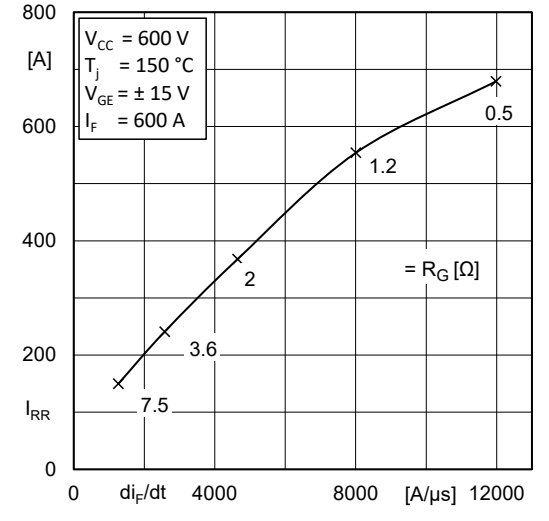



Fig. 11: Typ. CAL diode peak reverse recovery current

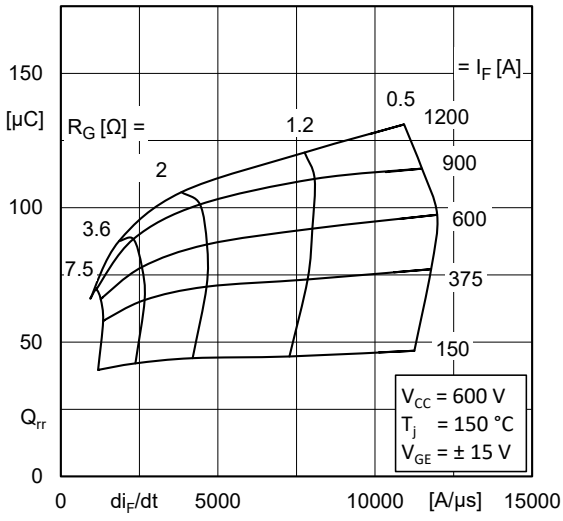
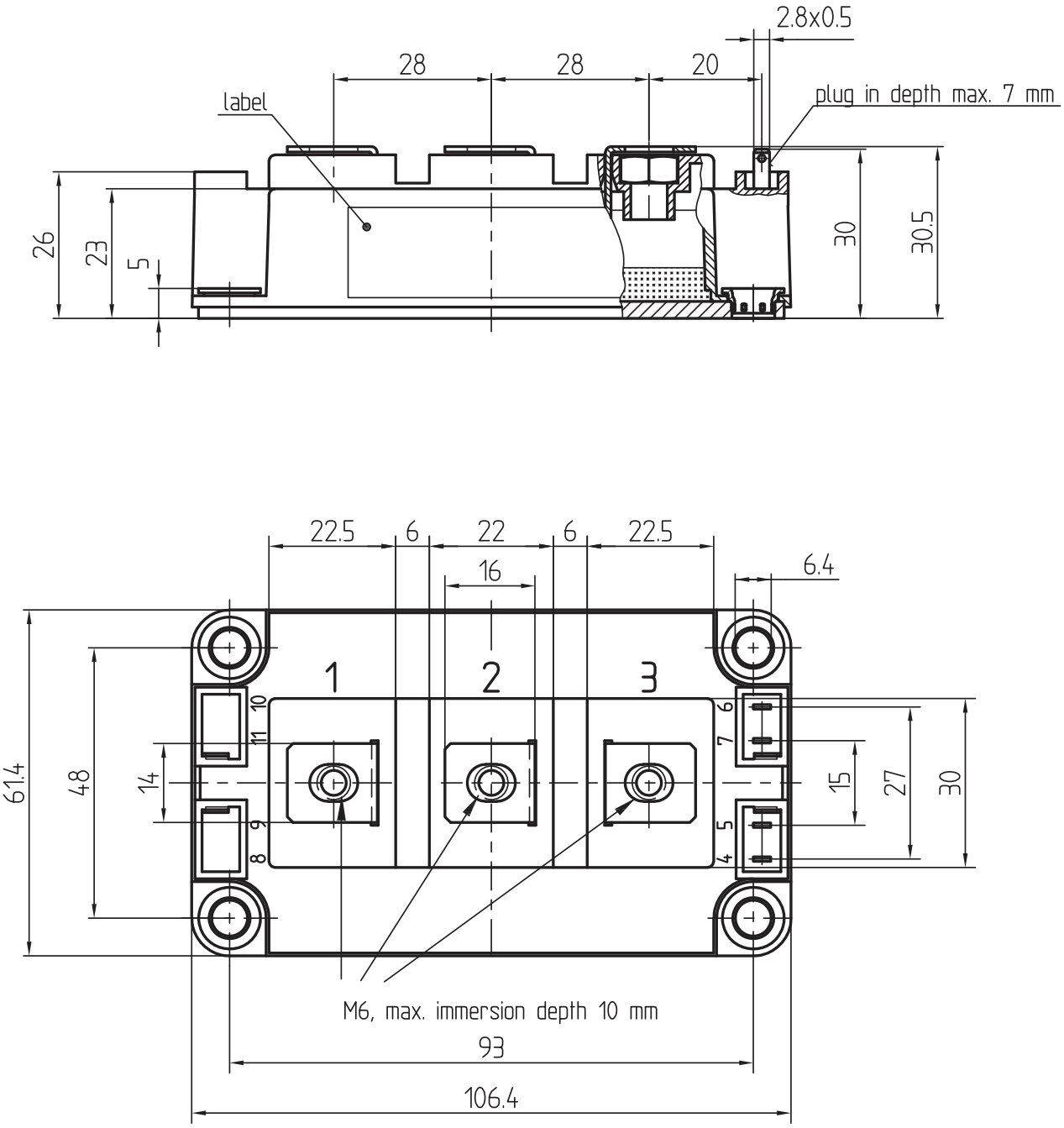



Fig. 12: Typ. CAL diode peak reverse recovery charge

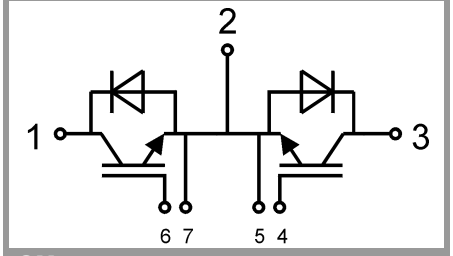
 © by Semikron Danfoss

Dimensions in mm




General tolerance +/- 0.5 mm

**SEMITRANS 3**




**GM**

**IMPORTANT INFORMATION AND WARNINGS**

This is an electrostatic discharge sensitive device (ESDS) according to international standard IEC 61340.

*The specifications of Semikron Danfoss products may not be considered as any guarantee or assurance of product characteristics ("Beschaffenheitsgarantie"). The specifications of Semikron Danfoss products describe only the usual characteristics of Semikron Danfoss products to be expected in typical applications, which may still vary depending on the specific application. Therefore, products must be tested for the respective application in advance. Resulting from this, application adjustments of any kind may be necessary. Any user of Semikron Danfoss products is responsible for the safety of their applications embedding Semikron Danfoss products and must take adequate safety measures to prevent the applications from causing any physical injury, fire or other problem, also if any Semikron Danfoss product becomes faulty. Any user is responsible for making sure that the application design and realization are compliant with all laws, regulations, norms and standards applicable to the scope of application. Unless otherwise explicitly approved by Semikron Danfoss in a written document signed by authorized representatives of Semikron Danfoss, Semikron Danfoss products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury. No representation or warranty is given and no liability is assumed with respect to the accuracy, completeness and/or use of any information herein, including without limitation, warranties of non-infringement of intellectual property rights of any third party. Semikron Danfoss does not convey any license under its or a third party's patent rights, copyrights, trade secrets or other intellectual property rights, neither does it make any representation or warranty of non-infringement of intellectual property rights of any third party which may arise from a user's applications.

 © by Semikron Danfoss