

SKM150GAR12F4G



SEMITRANS® 3

High Speed IGBT4 Modules

SKM150GAR12F4G

Features*

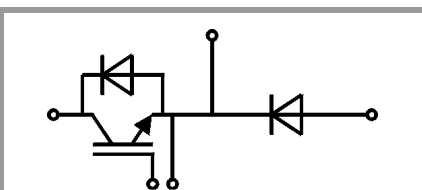
- High speed trench and field-stop IGBT
- CAL4 ultra-fast = soft switching 4. generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- For higher switching frequencies above 15kHz
- UL recognized, file no. E63532

Typical Applications

- Electronic welders
- DC/DC – converter
- Brake chopper
- Switched reluctance motor

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



GAR

| Absolute Maximum Ratings | | | | | |
|---------------------------|--|---------------------------|-------------|------------------|---------------|
| Symbol | Conditions | | Values | Unit | |
| IGBT | | | | | |
| V_{CES} | $T_j = 25^\circ\text{C}$ | | 1200 | V | |
| I_C | $T_j = 175^\circ\text{C}$ | $T_c = 25^\circ\text{C}$ | 221 | A | |
| | | $T_c = 80^\circ\text{C}$ | 169 | A | |
| I_{Cnom} | | | 150 | A | |
| I_{CRM} | $I_{CRM} = 2 \times I_{Cnom}$ | | 300 | A | |
| V_{GES} | | | -20 ... 20 | V | |
| t_{psc} | $V_{CC} = 800\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 1200\text{ V}$ $R_{G\ on/off} \geq 2.7\ \Omega$ | $T_j = 150^\circ\text{C}$ | 10 | | μs |
| | | | | | |
| T_j | | | -40 ... 175 | $^\circ\text{C}$ | |
| Inverse diode | | | | | |
| V_{RRM} | $T_j = 25^\circ\text{C}$ | | 1200 | V | |
| I_F | $T_j = 175^\circ\text{C}$ | $T_c = 25^\circ\text{C}$ | 197 | A | |
| | | $T_c = 80^\circ\text{C}$ | 146 | A | |
| I_{Fnom} | | | 150 | A | |
| I_{FRM} | $I_{FRM} = 2 \times I_{Fnom}$ | | 300 | A | |
| I_{FSM} | $t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$ | | 774 | A | |
| T_j | | | -40 ... 175 | $^\circ\text{C}$ | |
| Freewheeling diode | | | | | |
| V_{RRM} | $T_j = 25^\circ\text{C}$ | | 1200 | V | |
| I_F | $T_j = 175^\circ\text{C}$ | $T_c = 25^\circ\text{C}$ | 197 | A | |
| | | $T_c = 80^\circ\text{C}$ | 146 | A | |
| I_{Fnom} | | | 150 | A | |
| I_{FRM} | $I_{FRM} = 2 \times I_{Fnom}$ | | 300 | A | |
| I_{FSM} | $t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$ | | 774 | A | |
| T_j | | | -40 ... 175 | $^\circ\text{C}$ | |
| Module | | | | | |
| $I_{t(RMS)}$ | | | 500 | A | |
| T_{stg} | module without TIM | | -40 ... 125 | $^\circ\text{C}$ | |
| V_{isol} | AC sinus 50 Hz, $t = 1\text{ min}$ | | 4000 | V | |

| Characteristics | | | | | | |
|-----------------|--|---------------------------|------|------|------|------------------|
| Symbol | Conditions | | min. | typ. | max. | Unit |
| IGBT | | | | | | |
| $V_{CE(sat)}$ | $I_C = 150\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel | $T_j = 25^\circ\text{C}$ | 2.05 | 2.42 | | V |
| | | $T_j = 150^\circ\text{C}$ | 2.60 | 2.93 | | V |
| V_{CE0} | chipelevel | $T_j = 25^\circ\text{C}$ | 1.10 | 1.28 | | V |
| | | $T_j = 150^\circ\text{C}$ | 0.95 | 1.13 | | V |
| r_{CE} | $V_{GE} = 15\text{ V}$ chipelevel | $T_j = 25^\circ\text{C}$ | 6.3 | 7.6 | | $\text{m}\Omega$ |
| | | $T_j = 150^\circ\text{C}$ | 11 | 12 | | $\text{m}\Omega$ |
| $V_{GE(th)}$ | $V_{GE} = V_{CE}, I_C = 5.2\text{ mA}$ | | 5.2 | 5.8 | 6.4 | V |
| I_{CES} | $V_{GE} = 0\text{ V}$ $V_{CE} = 1200\text{ V}$ | $T_j = 25^\circ\text{C}$ | | | 2.0 | mA |
| | | $T_j = 150^\circ\text{C}$ | | | - | mA |
| C_{ies} | $V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$ | $f = 1\text{ MHz}$ | | 8.8 | | nF |
| C_{oes} | | $f = 1\text{ MHz}$ | | 0.58 | | nF |
| C_{res} | | $f = 1\text{ MHz}$ | | 0.47 | | nF |
| Q_G | $V_{GE} = -8\text{ V} \dots +15\text{ V}$ | | | 850 | | nC |
| R_{Gint} | $T_j = 25^\circ\text{C}$ | | | 2.4 | | Ω |

SKM150GAR12F4G



SEMITRANS® 3

High Speed IGBT4 Modules

SKM150GAR12F4G

Features*

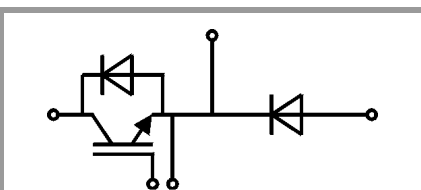
- High speed trench and field-stop IGBT
- CAL4 ultra-fast = soft switching 4. generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- For higher switching frequencies above 15kHz
- UL recognized, file no. E63532

Typical Applications

- Electronic welders
- DC/DC – converter
- Brake chopper
- Switched reluctance motor

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



GAR

| Characteristics | | | | | | |
|--------------------|---|---------------------------|------|-------|-------|---------------|
| Symbol | Conditions | | min. | typ. | max. | Unit |
| $t_{d(on)}$ | $V_{CC} = 600\text{ V}$ | $T_j = 150^\circ\text{C}$ | | 62 | | ns |
| t_r | $I_C = 150\text{ A}$ | $T_j = 150^\circ\text{C}$ | | 27 | | ns |
| E_{on} | $V_{GE} = +15/-15\text{ V}$ | $T_j = 150^\circ\text{C}$ | | 7.8 | | mJ |
| | $R_{G\ on} = 2\ \Omega$ | | | | | |
| $t_{d(off)}$ | $R_{G\ off} = 1\ \Omega$ | $T_j = 150^\circ\text{C}$ | | 297 | | ns |
| t_f | $di/dt_{on} = 6785\text{ A}/\mu\text{s}$ | $T_j = 150^\circ\text{C}$ | | 62 | | ns |
| | $di/dt_{off} = 2000\text{ A}/\mu\text{s}$ | | | | | |
| E_{off} | $dv/dt = 4872\text{ V}/\mu\text{s}$ | $T_j = 150^\circ\text{C}$ | | 10.8 | | mJ |
| | $L_s = 25\text{ nH}$ | | | | | |
| $R_{th(j-c)}$ | per IGBT | | | | 0.17 | K/W |
| $R_{th(c-s)}$ | per IGBT ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$) | | | 0.072 | | K/W |
| Inverse diode | | | | | | |
| $V_F = V_{EC}$ | $I_F = 150\text{ A}$ | $T_j = 25^\circ\text{C}$ | | 2.43 | 2.80 | V |
| | $V_{GE} = 0\text{ V}$ | $T_j = 150^\circ\text{C}$ | | 2.30 | 2.65 | V |
| | chipllevel | | | | | |
| V_{F0} | chipllevel | $T_j = 25^\circ\text{C}$ | | 1.51 | 1.75 | V |
| | | $T_j = 150^\circ\text{C}$ | | 1.16 | 1.40 | V |
| r_F | chipllevel | $T_j = 25^\circ\text{C}$ | | 6.1 | 7.0 | m Ω |
| | | $T_j = 150^\circ\text{C}$ | | 7.6 | 8.3 | m Ω |
| I_{RRM} | $I_F = 150\text{ A}$ | $T_j = 150^\circ\text{C}$ | | 270 | | A |
| Q_{rr} | $di/dt_{off} = 6717\text{ A}/\mu\text{s}$ | $T_j = 150^\circ\text{C}$ | | 22.7 | | μC |
| E_{rr} | $V_{GE} = -15\text{ V}$ | $T_j = 150^\circ\text{C}$ | | 8.9 | | mJ |
| | $V_{CC} = 600\text{ V}$ | | | | | |
| $R_{th(j-c)}$ | per diode | | | | 0.264 | K/W |
| $R_{th(c-s)}$ | per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$) | | | 0.072 | | K/W |
| Freewheeling diode | | | | | | |
| $V_F = V_{EC}$ | $I_F = 150\text{ A}$ | $T_j = 25^\circ\text{C}$ | | 2.43 | 2.80 | V |
| | $V_{GE} = 0\text{ V}$ | $T_j = 150^\circ\text{C}$ | | 2.30 | 2.65 | V |
| | chipllevel | | | | | |
| V_{F0} | chipllevel | $T_j = 25^\circ\text{C}$ | | 1.51 | 1.75 | V |
| | | $T_j = 150^\circ\text{C}$ | | 1.16 | 1.40 | V |
| r_F | chipllevel | $T_j = 25^\circ\text{C}$ | | 6.1 | 7.0 | m Ω |
| | | $T_j = 150^\circ\text{C}$ | | 7.6 | 8.3 | m Ω |
| I_{RRM} | $I_F = 150\text{ A}$ | $T_j = 150^\circ\text{C}$ | | 270 | | A |
| Q_{rr} | $di/dt_{off} = 6717\text{ A}/\mu\text{s}$ | $T_j = 150^\circ\text{C}$ | | 22.7 | | μC |
| E_{rr} | $V_{GE} = -15\text{ V}$ | $T_j = 150^\circ\text{C}$ | | 8.9 | | mJ |
| | $V_{CC} = 600\text{ V}$ | | | | | |
| $R_{th(j-c)}$ | per diode | | | | 0.264 | K/W |
| $R_{th(c-s)}$ | per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$) | | | 0.072 | | K/W |
| Module | | | | | | |
| L_{CE} | | | | 15 | | nH |
| $R_{CC'+EE'}$ | measured per switch | $T_C = 25^\circ\text{C}$ | | 0.55 | | m Ω |
| | | $T_C = 125^\circ\text{C}$ | | 0.85 | | m Ω |
| $R_{th(c-s)1}$ | calculated without thermal coupling ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$) | | | 0.036 | | K/W |
| $R_{th(c-s)2}$ | including thermal coupling, T_s underneath module ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$) | | | 0.053 | | K/W |
| M_s | to heat sink M6 | | 3 | | 5 | Nm |
| M_t | to terminals M6 | | 2.5 | | 5 | Nm |
| | | | | | | Nm |
| w | | | | | 325 | g |

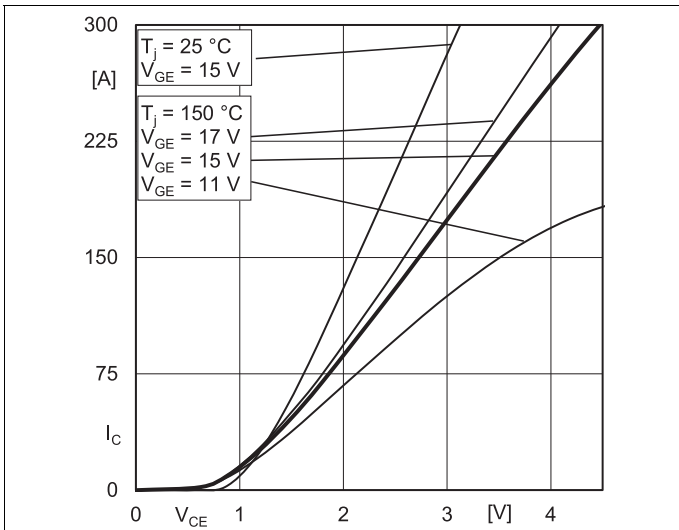


Fig. 1: Typ. output characteristic, inclusive R_{CC+EE}

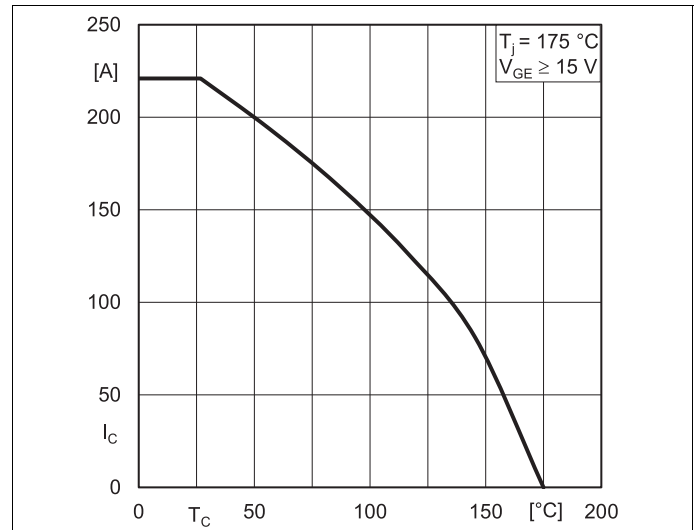


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

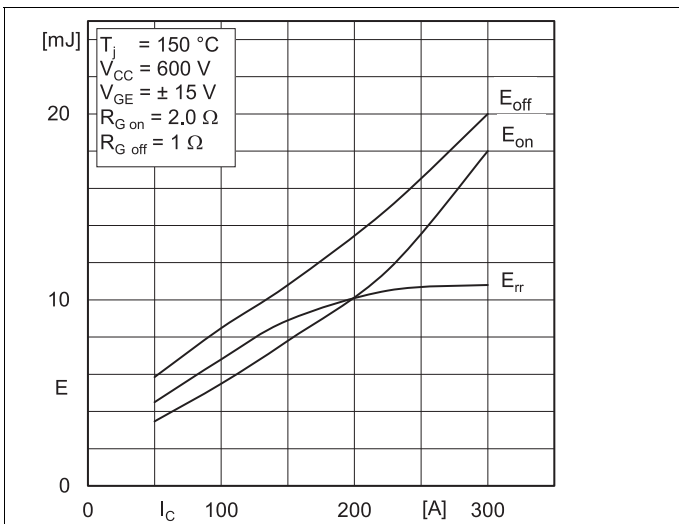


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

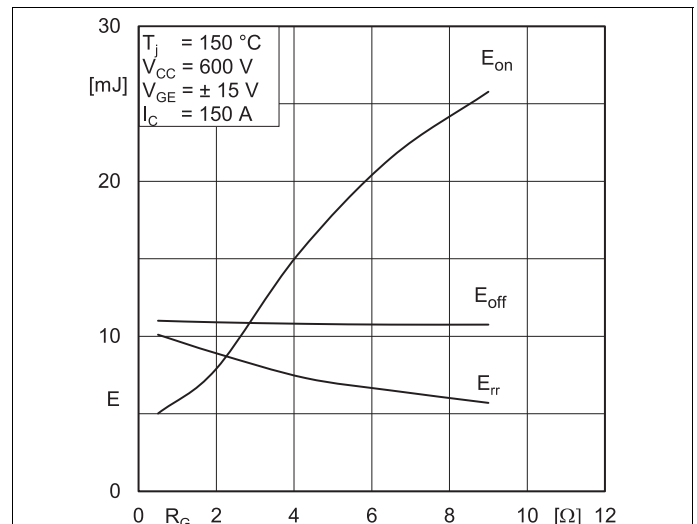


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

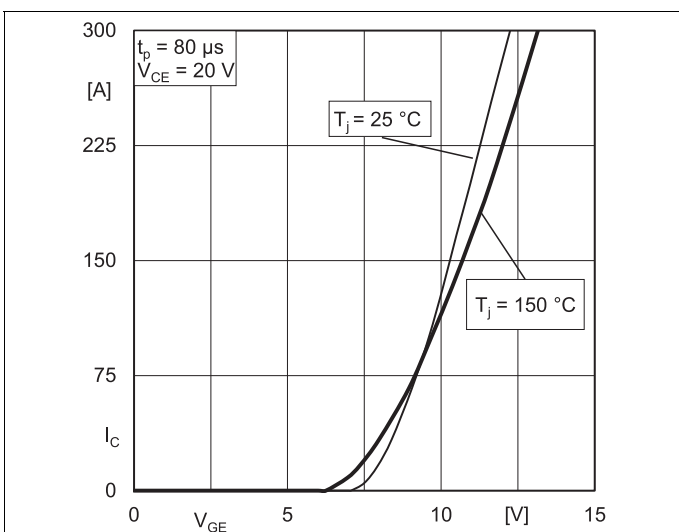


Fig. 5: Typ. transfer characteristic

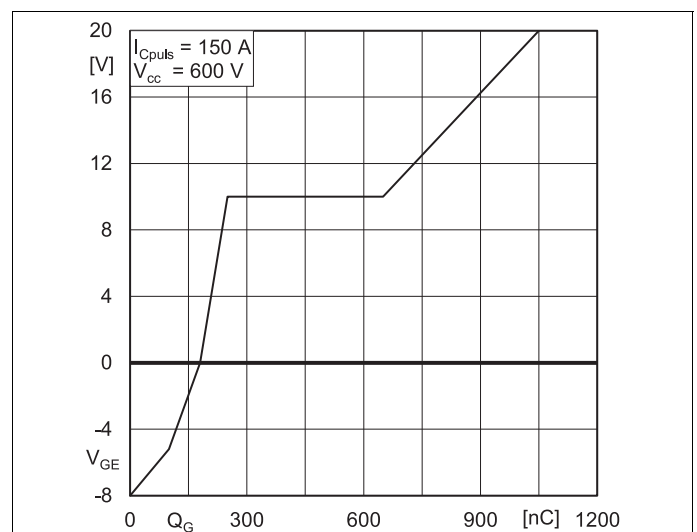


Fig. 6: Typ. gate charge characteristic

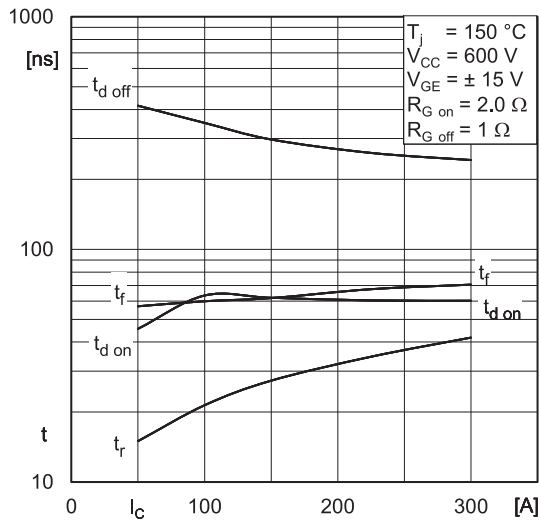


Fig. 7: Typ. switching times vs. I_C

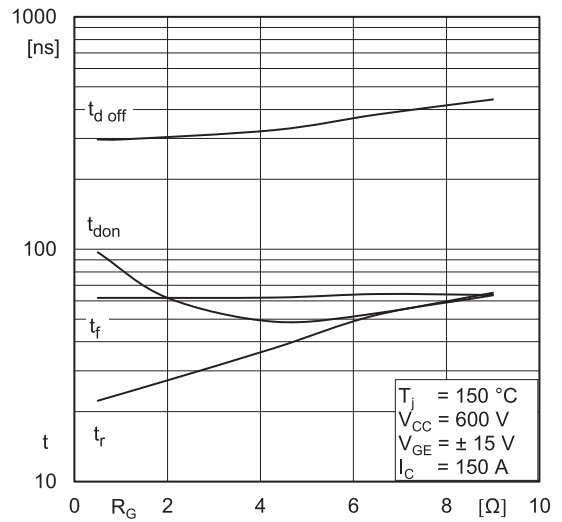


Fig. 8: Typ. switching times vs. gate resistor R_G

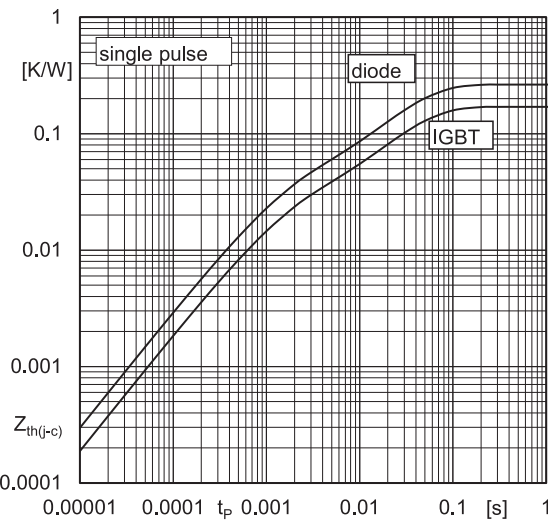


Fig. 9: Transient thermal impedance

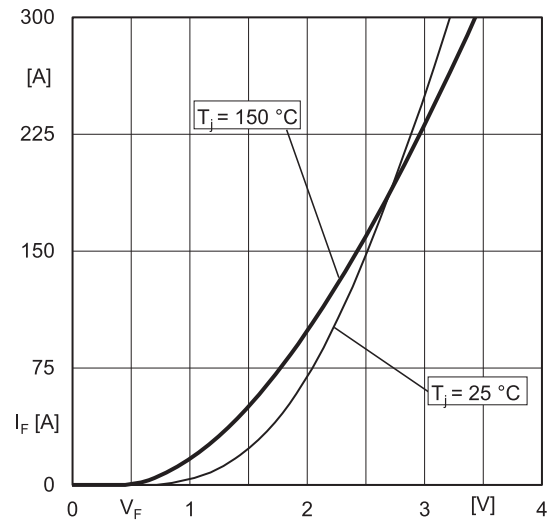


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC+EE'}$

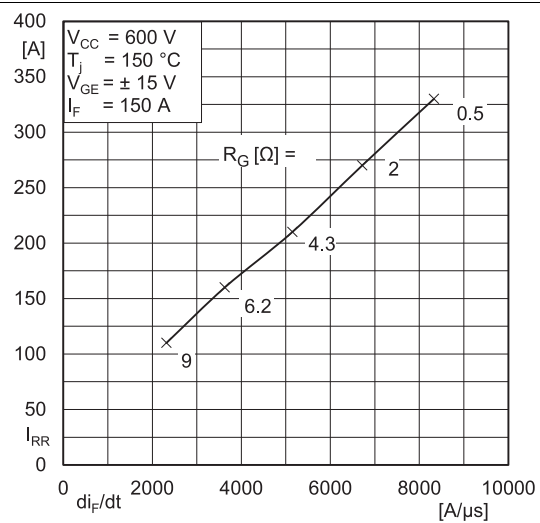


Fig. 11: Typ. CAL diode peak reverse recovery current

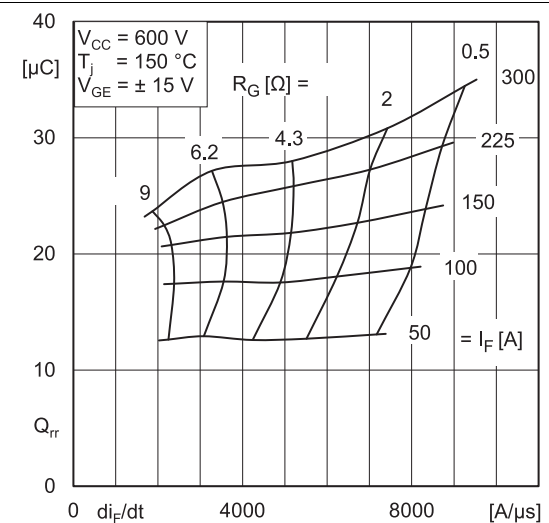


Fig. 12: Typ. CAL diode peak reverse recovery charge

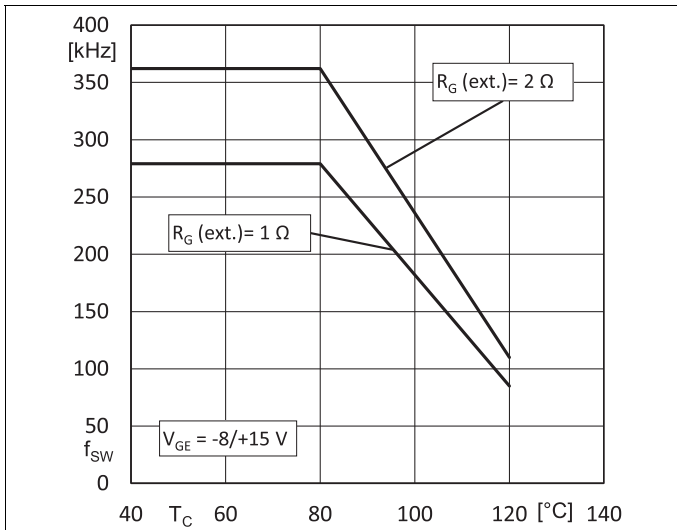
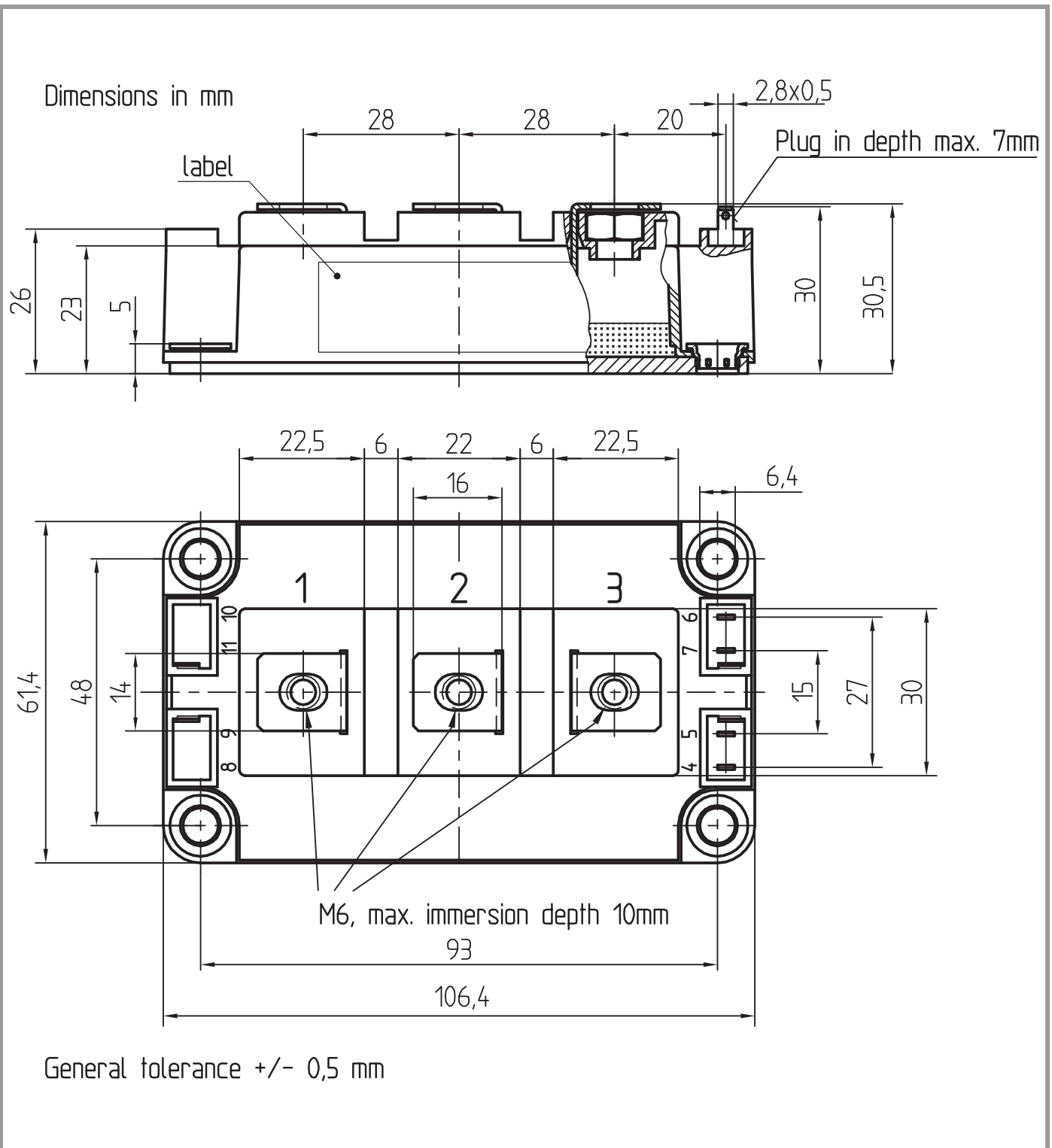
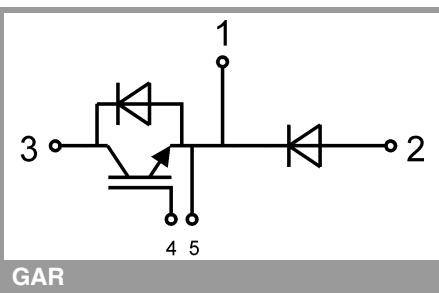


Fig. 13: Max. switching frequency vs. case temperature
 $f_{sw} = f(T_c)$

SKM150GAR12F4G



SEMITRANS 3



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

***IMPORTANT INFORMATION AND WARNINGS**

The specifications of SEMIKRON products may not be considered as guarantee or assurance of product characteristics ("Beschaffenheitsgarantie"). The specifications of SEMIKRON products describe only the usual characteristics of 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. Application adjustments may be necessary. The user of SEMIKRON products is responsible for the safety of their applications embedding SEMIKRON products and must take adequate safety measures to prevent the applications from causing a physical injury, fire or other problem if any of SEMIKRON products become faulty. The user is responsible to make sure that the application design is compliant with all applicable laws, regulations, norms and standards. Except as otherwise explicitly approved by SEMIKRON in a written document signed by authorized representatives of SEMIKRON, SEMIKRON 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 does not assume any liability arising out of the applications or use of any product; neither does it convey any license under its patent rights, copyrights, trade secrets or other intellectual property rights, nor the rights of others. SEMIKRON makes no representation or warranty of non-infringement or alleged non-infringement of intellectual property rights of any third party which may arise from applications. Due to technical requirements our products may contain dangerous substances. For information on the types in question please contact the nearest SEMIKRON sales office. This document supersedes and replaces all information previously supplied and may be superseded by updates. SEMIKRON reserves the right to make changes.