# SKM400GAL12V



**SEMITRANS® 3**

**SKM400GAL12V**

### Features

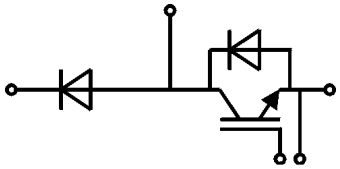
- V-IGBT = 6. Generation Trench V-IGBT (Fuji)
- CAL4 = Soft switching 4. Generation CAL-diode
- Isolated copper baseplate using DBC technology (Direct Copper Bonding)
- UL recognized, file no. E63532
- Increased power cycling capability
- With integrated gate resistor
- Low switching losses at high di/dt

### Typical Applications*

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

### Remarks

- Case temperature limited to $T_c$ = 125°C max, recomm. $T_{op}$ = -40 ... +150°C, product rel. results valid for $T_j$ = 150°



**GAL**

**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 | 612 | A |
| | | $T_c$ = 80 °C | 467 | A |
| $I_{Cnom}$ | | | 400 | A |
| $I_{CRM}$ | $I_{CRM}$ = 3x$I_{Cnom}$ | | 1200 | A |
| $V_{GES}$ | | | -20 ... 20 | V |
| $t_{psc}$ | $V_{CC}$ = 720 V<br>$V_{GE}$ ≤ 20 V<br>$V_{CES}$ ≤ 1200 V | $T_j$ = 125 °C | 10 | µs |
| $T_j$ | | | -40 ... 175 | °C |
| **Inverse diode** | | | | |
| $I_F$ | $T_j$ = 175 °C | $T_c$ = 25 °C | 440 | A |
| | | $T_c$ = 80 °C | 329 | A |
| $I_{Fnom}$ | | | 400 | A |
| $I_{FRM}$ | $I_{FRM}$ = 3x$I_{Fnom}$ | | 1200 | A |
| $I_{FSM}$ | $t_p$ = 10 ms, sin 180°, $T_j$ = 25 °C | | 1980 | A |
| $T_j$ | | | -40 ... 175 | °C |
| **Freewheeling diode** | | | | |
| $I_F$ | $T_j$ = 175 °C | $T_c$ = 25 °C | 440 | A |
| | | $T_c$ = 80 °C | 329 | A |
| $I_{Fnom}$ | | | 400 | A |
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| $T_j$ | | | -40 ... 175 | °C |
| **Module** | | | | |
| $I_{t(RMS)}$ | $T_{terminal}$ = 80 °C | | 500 | A |
| $T_{stg}$ | | | -40 ... 125 | °C |
| $V_{isol}$ | AC sinus 50Hz, t = 1 min | | 4000 | V |

**Characteristics**

| Symbol | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| **IGBT** | | | | | | |
| $V_{CE(sat)}$ | $I_C$ = 400 A<br>$V_{GE}$ = 15 V<br>chiplevel | $T_j$ = 25 °C | | 1.75 | 2.20 | V |
| | | $T_j$ = 150 °C | | 2.20 | 2.50 | V |
| $V_{CE0}$ | | $T_j$ = 25 °C | | 0.94 | 1.04 | V |
| | | $T_j$ = 150 °C | | 0.88 | 0.98 | V |
| $r_{CE}$ | $V_{GE}$ = 15 V | $T_j$ = 25 °C | | 2.02 | 2.9 | mΩ |
| | | $T_j$ = 150 °C | | 3.30 | 3.80 | mΩ |
| $V_{GE(th)}$ | $V_{GE}$=$V_{CE}$, $I_C$ = 16 mA | | 5.5 | 6 | 6.5 | V |
| $I_{CES}$ | $V_{GE}$ = 0 V | $T_j$ = 25 °C | | 0.1 | 0.3 | mA |
| | $V_{CE}$ = 1200 V | $T_j$ = 150 °C | | | | mA |
| $C_{ies}$ | $V_{CE}$ = 25 V<br>$V_{GE}$ = 0 V | f = 1 MHz | | 24.04 | | nF |
| $C_{oes}$ | | f = 1 MHz | | 2.36 | | nF |
| $C_{res}$ | | f = 1 MHz | | 2.356 | | nF |
| $Q_G$ | $V_{GE}$ = - 8 V...+ 15 V | | | 4420 | | nC |
| $R_{Gint}$ | | | | 1.9 | | Ω |



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### Typical Applications*

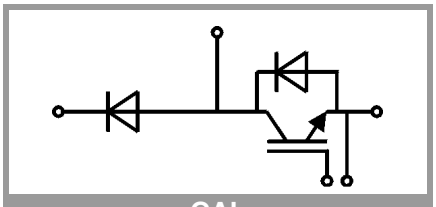
- Electronic welders
- DC/DC – converter
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### Remarks

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**Characteristics**

| Symbol | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | $V_{CC}$ = 600 V<br>$I_C$ = 400 A<br>$V_{GE}$ = ±15 V<br>$R_{G\ on}$ = 3 Ω<br>$R_{G\ off}$ = 3 Ω<br>$di/dt_{on}$ = 9800 A/µs<br>$di/dt_{off}$ = 5000 A/µs<br>$du/dt_{off}$ = 7600 V/µs | $T_j$ = 150 °C | | 350 | | ns |
| $t_r$ | | $T_j$ = 150 °C | | 60 | | ns |
| $E_{on}$ | | $T_j$ = 150 °C | | 39 | | mJ |
| $t_{d(off)}$ | | $T_j$ = 150 °C | | 700 | | ns |
| $t_f$ | | $T_j$ = 150 °C | | 65 | | ns |
| $E_{off}$ | | $T_j$ = 150 °C | | 42 | | mJ |
| $R_{th(j-c)}$ | per IGBT | | | | 0.072 | K/W |
| **Inverse diode** | | | | | | |
| $V_F = V_{EC}$ | $I_F$ = 400 A<br>$V_{GE}$ = 0 V<br>chip | $T_j$ = 25 °C | | 2.20 | 2.52 | V |
| | | $T_j$ = 150 °C | | 2.15 | 2.47 | V |
| $V_{F0}$ | | $T_j$ = 25 °C | | 1.3 | 1.5 | V |
| | | $T_j$ = 150 °C | | 0.9 | 1.1 | V |
| $r_F$ | | $T_j$ = 25 °C | | 2.3 | 2.5 | mΩ |
| | | $T_j$ = 150 °C | | 3.1 | 3.4 | mΩ |
| $I_{RRM}$ | $I_F$ = 400 A<br>$di/dt_{off}$ = 9500 A/µs<br>$V_{GE}$ = ±15 V<br>$V_{CC}$ = 600 V | $T_j$ = 150 °C | | 450 | | A |
| $Q_{rr}$ | | $T_j$ = 150 °C | | 58 | | µC |
| $E_{rr}$ | | $T_j$ = 150 °C | | 26 | | mJ |
| $R_{th(j-c)}$ | per diode | | | | 0.14 | K/W |
| **Freewheeling diode** | | | | | | |
| $V_F = V_{EC}$ | $I_F$ = 400 A<br>$V_{GE}$ = 0 V<br>chip | $T_j$ = 25 °C | | 2.20 | 2.52 | V |
| | | $T_j$ = 150 °C | | 2.15 | 2.47 | V |
| $V_{F0}$ | | $T_j$ = 25 °C | | 1.3 | 1.5 | V |
| | | $T_j$ = 150 °C | | 0.9 | 1.1 | V |
| $r_F$ | | $T_j$ = 25 °C | | 2.3 | 2.5 | mΩ |
| | | $T_j$ = 150 °C | | 3.1 | 3.4 | mΩ |
| $I_{RRM}$ | $I_F$ = 400 A<br>$di/dt_{off}$ = 8800 A/µs<br>$V_{GE}$ = ±15 V<br>$V_{CC}$ = 600 V | $T_j$ = 150 °C | | 450 | | A |
| $Q_{rr}$ | | $T_j$ = 150 °C | | 68 | | µC |
| $E_{rr}$ | | $T_j$ = 150 °C | | 30.5 | | mJ |
| $R_{th(j-c)}$ | per Diode | | | | 0.14 | K/W |
| **Module** | | | | | | |
| $L_{CE}$ | | | | 15 | 20 | nH |
| $R_{CC'+EE'}$ | terminal-chip | $T_C$ = 25 °C | | 0.25 | | mΩ |
| | | $T_C$ = 125 °C | | 0.5 | | mΩ |
| $R_{th(c-s)}$ | 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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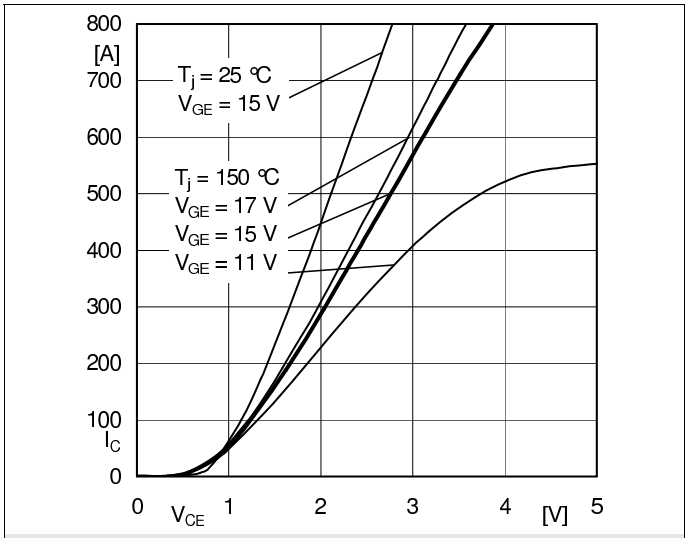



Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

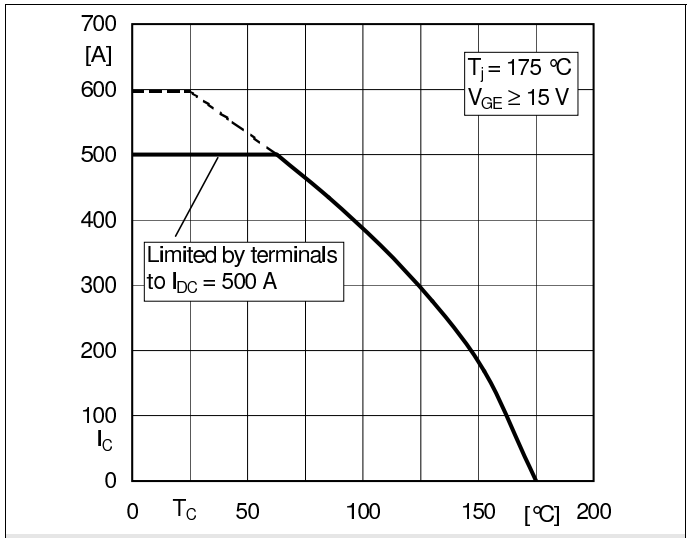



Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

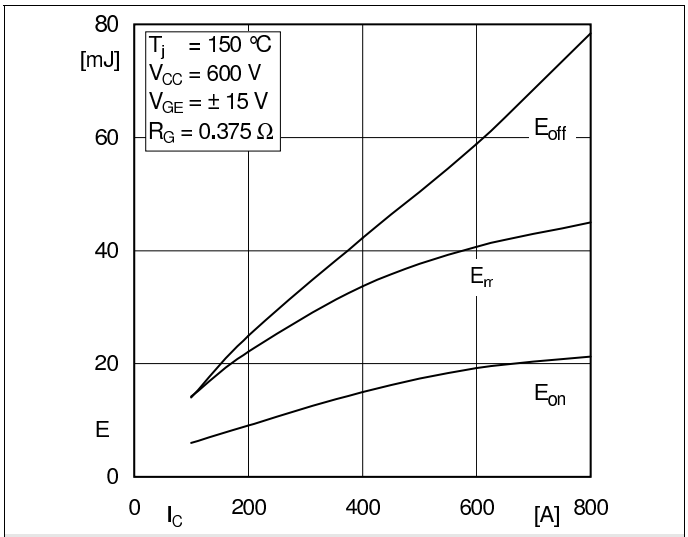



Fig. 3: Typ. turn-on /-off energy = f ($I_C$)

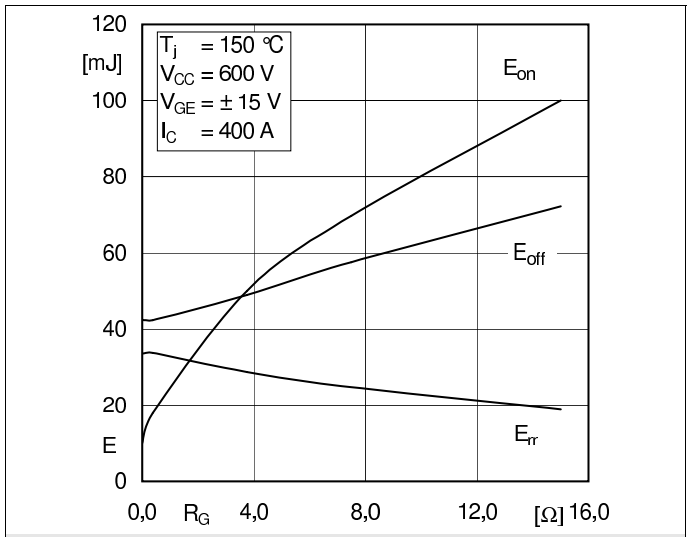



Fig. 4: Typ. turn-on /-off energy = f ($R_G$)

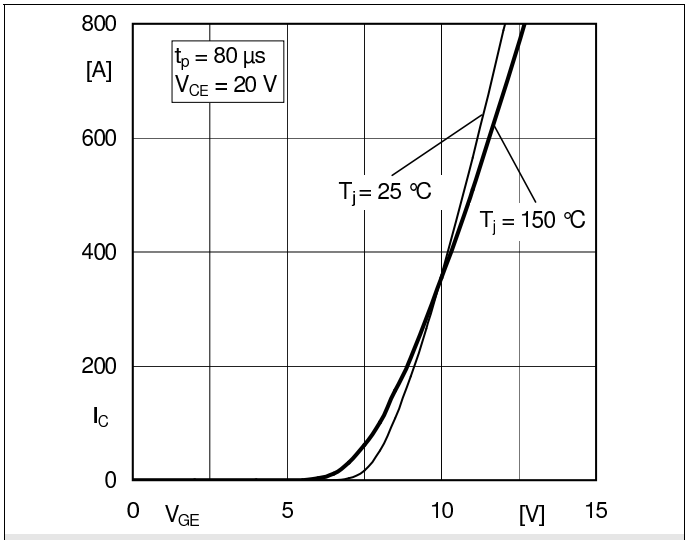



Fig. 5: Typ. transfer characteristic

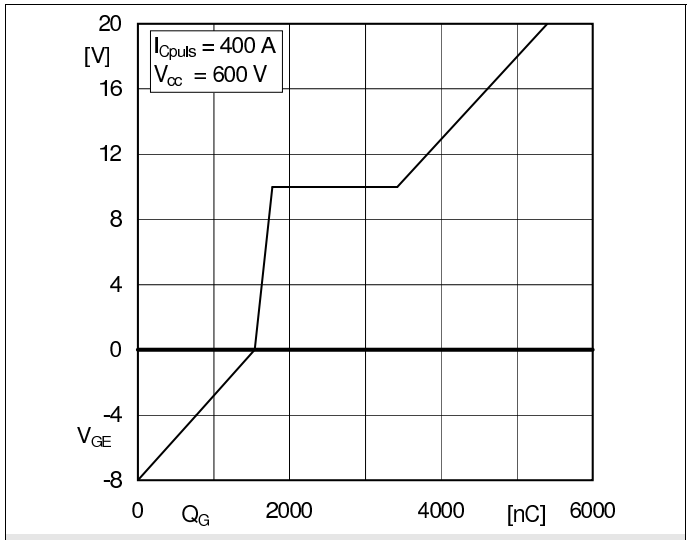



Fig. 6: Typ. gate charge characteristic

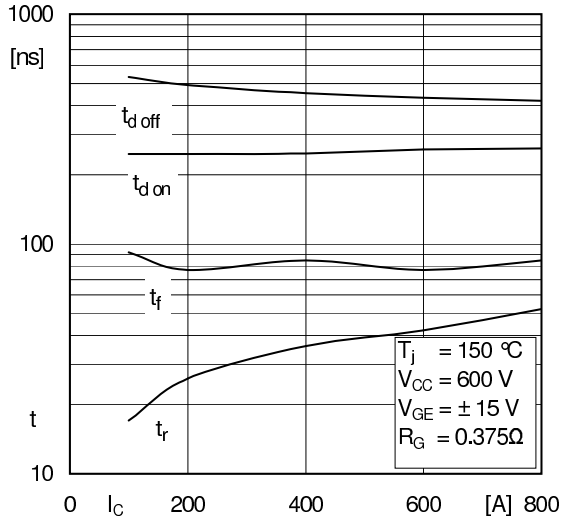



Fig. 7: Typ. switching times vs. $I_C$

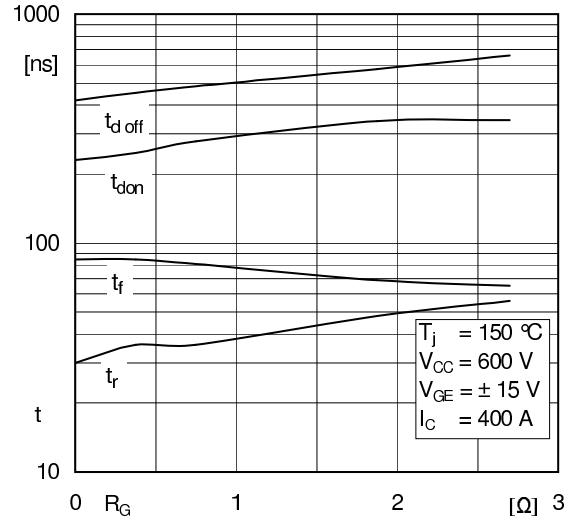



Fig. 8: Typ. switching times vs. gate resistor $R_G$

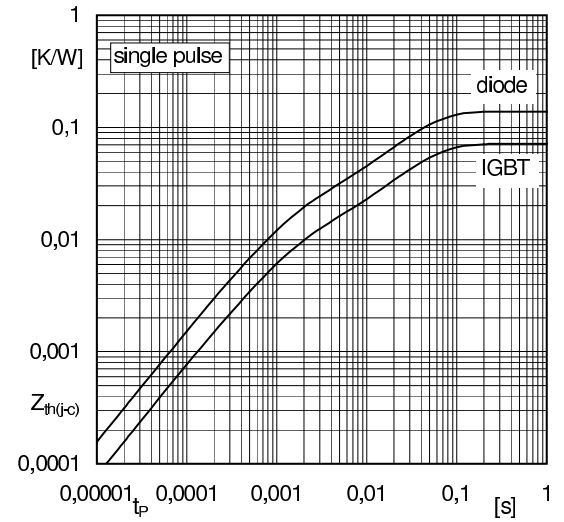



Fig. 9: Transient thermal impedance

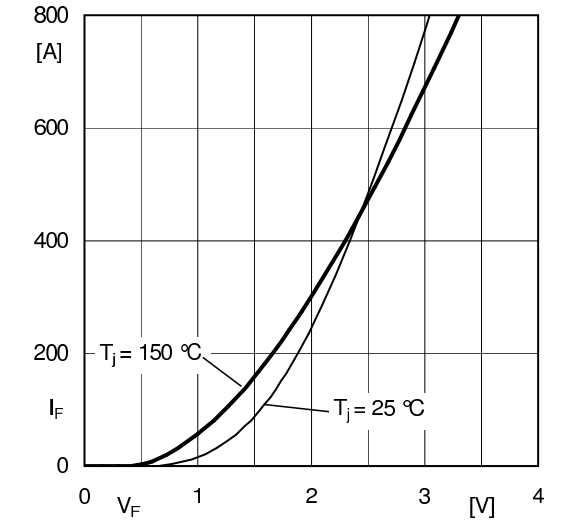



Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

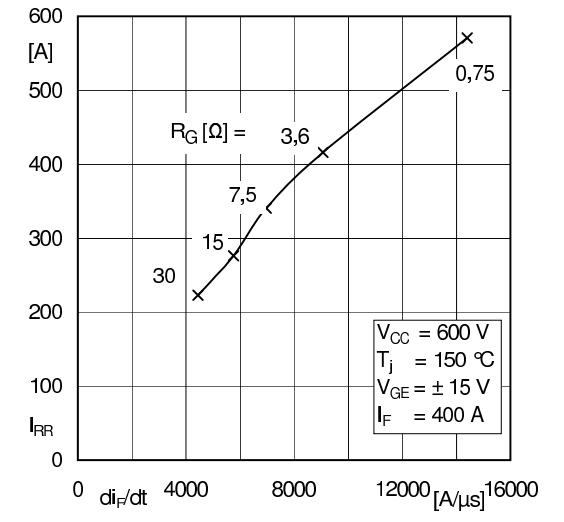



Fig. 11: CAL diode peak reverse recovery current

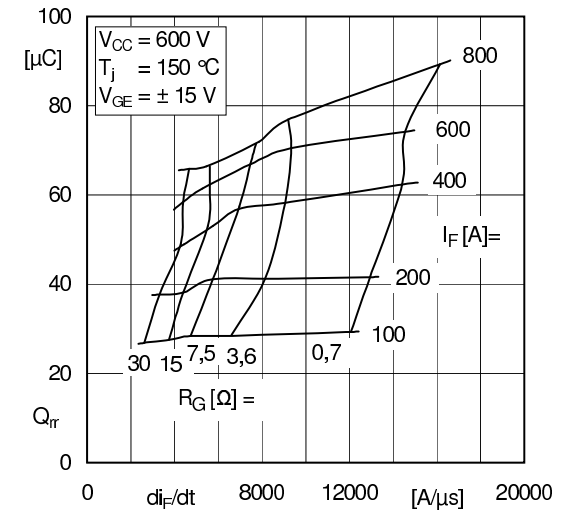
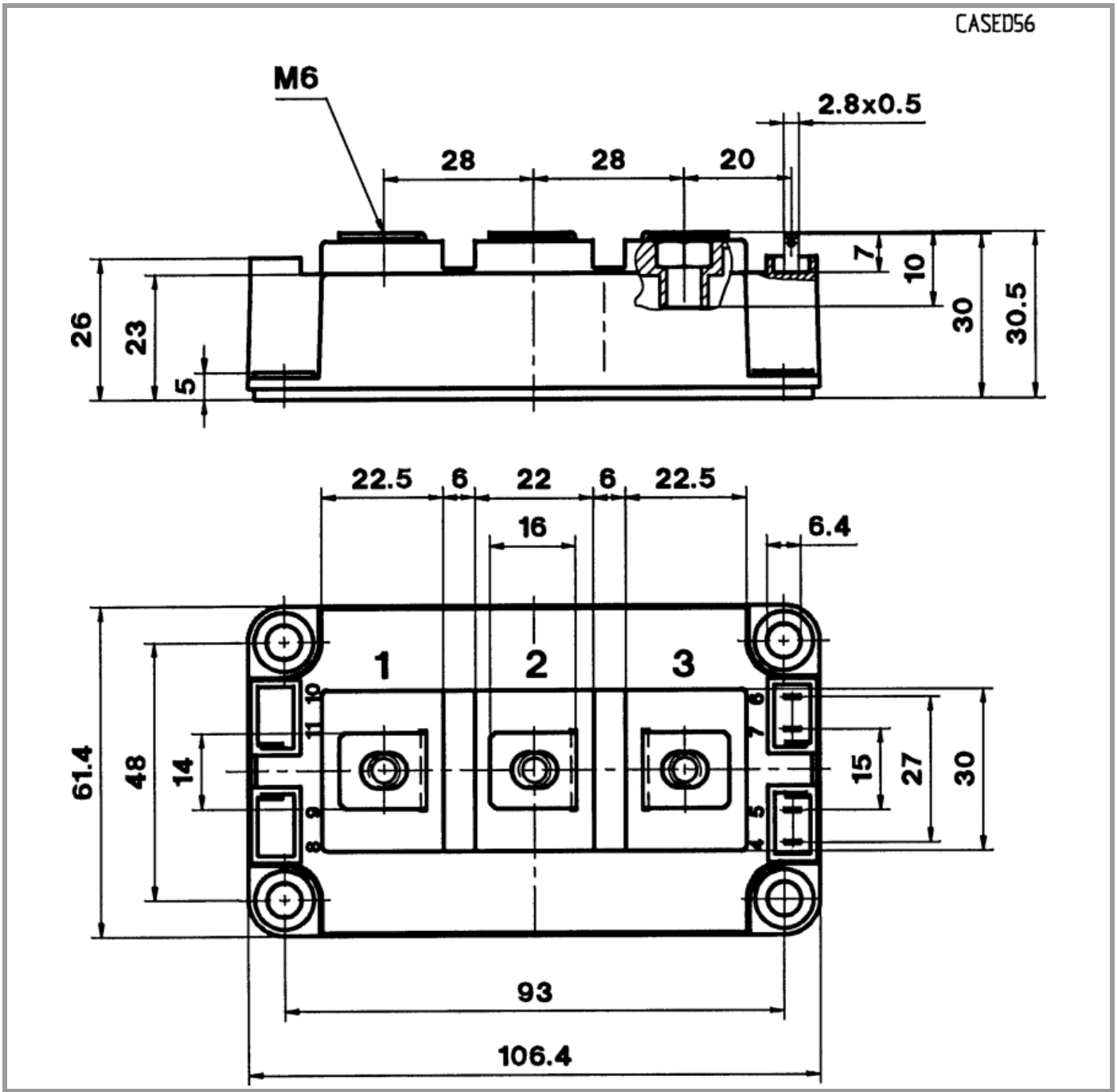
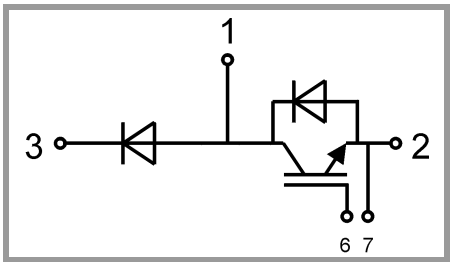



Fig. 12: Typ. CAL diode peak reverse recovery charge




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

* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.