

SKM400GAL12V



SEMITRANS® 3

SKM400GAL12V

Features

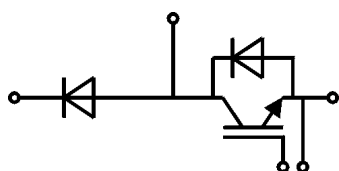
- V-IGBT = 6. Generation Trench V-IGBT (Fuji)
- CAL4 = Soft switching 4. Generation CAL-diode
- Isolated copper baseplate using DBC technology (Direct Copper Bonding)
- UL recognized, file no. E63532
- Increased power cycling capability
- With integrated gate resistor
- Low switching losses at high di/dt

Typical Applications*

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

Remarks

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



GAL

Absolute Maximum Ratings

| Symbol | Conditions | Values | Unit | |
|---------------------------|--|---------------------------|------------------|---------------|
| IGBT | | | | |
| V_{CES} | $T_j = 25^\circ\text{C}$ | 1200 | V | |
| I_C | $T_j = 175^\circ\text{C}$ | $T_c = 25^\circ\text{C}$ | 612 | A |
| | | $T_c = 80^\circ\text{C}$ | 467 | A |
| I_{Cnom} | | 400 | A | |
| I_{CRM} | $I_{CRM} = 3 \times I_{Cnom}$ | 1200 | A | |
| V_{GES} | | -20 ... 20 | V | |
| t_{psc} | $V_{CC} = 720\text{ V}$ | $T_j = 125^\circ\text{C}$ | 10 | μs |
| | $V_{GE} \leq 20\text{ V}$ | | | |
| | $V_{CES} \leq 1200\text{ V}$ | | | |
| T_j | | -40 ... 175 | $^\circ\text{C}$ | |
| Inverse diode | | | | |
| I_F | $T_j = 175^\circ\text{C}$ | $T_c = 25^\circ\text{C}$ | 440 | A |
| | | $T_c = 80^\circ\text{C}$ | 329 | 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 | $^\circ\text{C}$ | |
| Freewheeling diode | | | | |
| I_F | $T_j = 175^\circ\text{C}$ | $T_c = 25^\circ\text{C}$ | 440 | A |
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| T_j | | -40 ... 175 | $^\circ\text{C}$ | |
| Module | | | | |
| $I_{t(RMS)}$ | $T_{terminal} = 80^\circ\text{C}$ | 500 | A | |
| T_{stg} | | -40 ... 125 | $^\circ\text{C}$ | |
| V_{isol} | AC sinus 50Hz, $t = 1\text{ min}$ | 4000 | V | |

Characteristics

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

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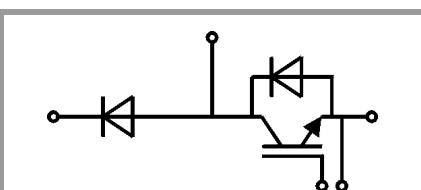
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| Characteristics | | | | | | |
|--------------------|--|---------------------------|------|------|-------|---------------|
| Symbol | Conditions | | min. | typ. | max. | Unit |
| $t_{d(on)}$ | $V_{CC} = 600\text{ V}$ | $T_j = 150^\circ\text{C}$ |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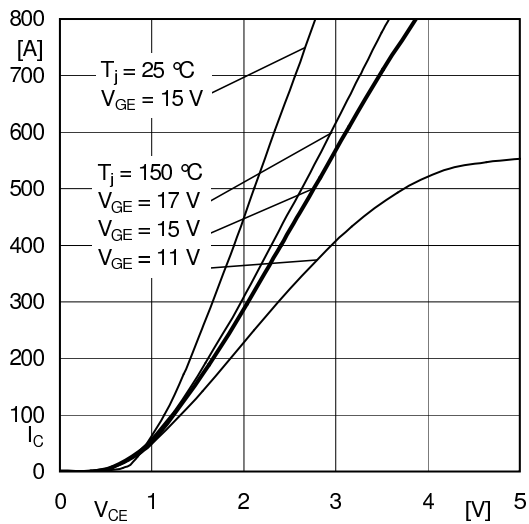


Fig. 1: Typ. output characteristic, inclusive R_{CC+EE}

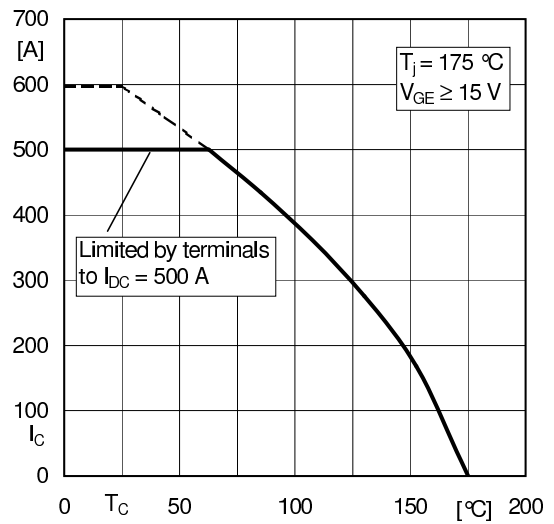


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

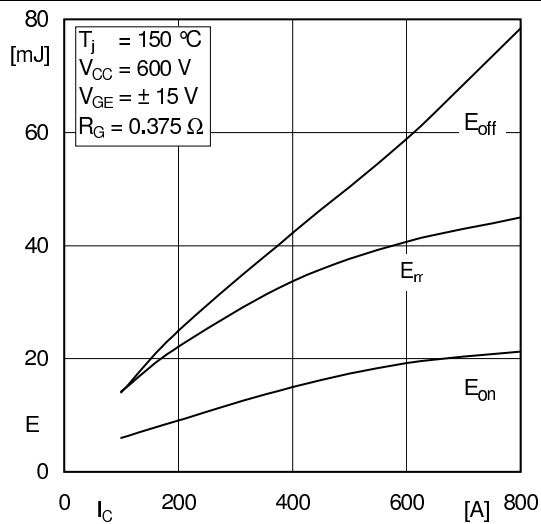


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

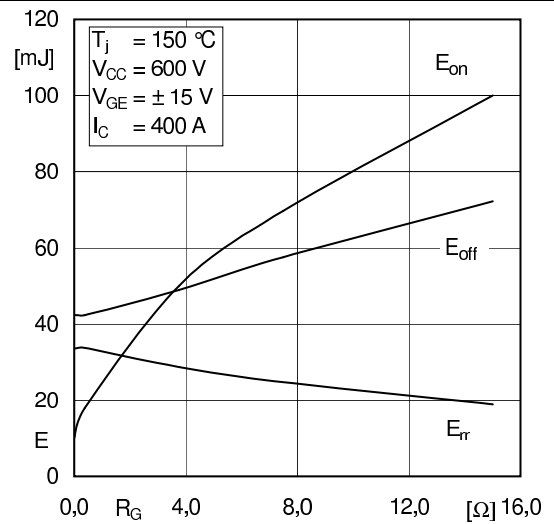


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

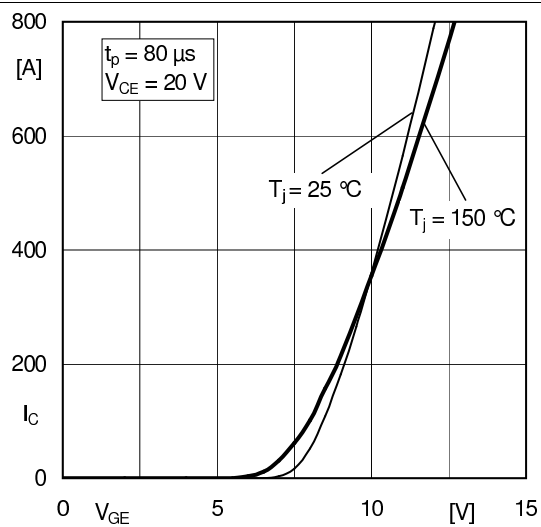


Fig. 5: Typ. transfer characteristic

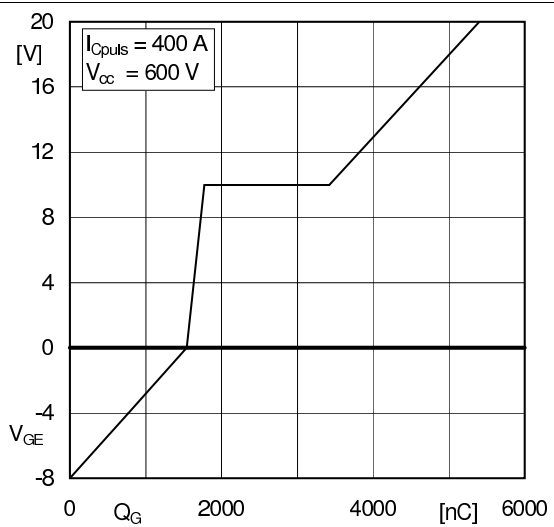


Fig. 6: Typ. gate charge characteristic

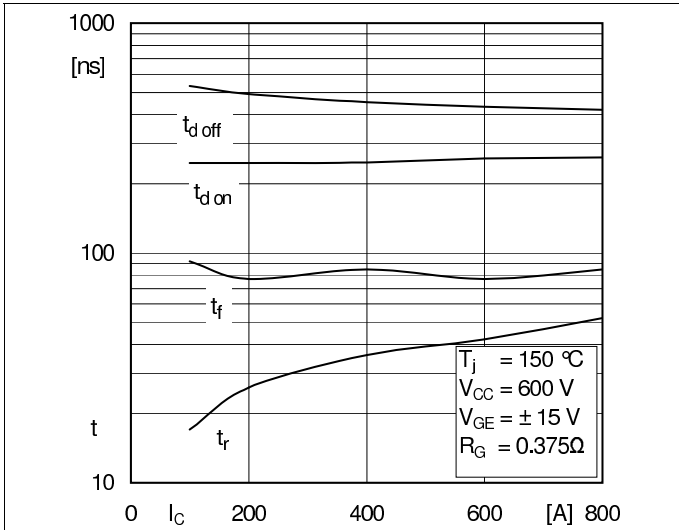


Fig. 7: Typ. switching times vs. I_C

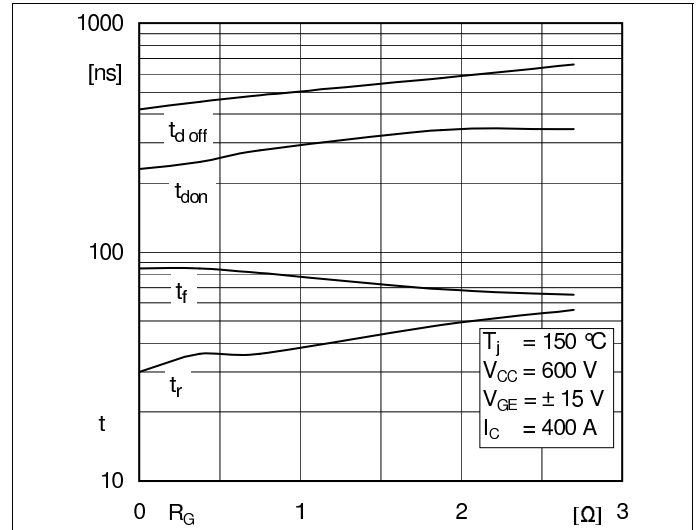


Fig. 8: Typ. switching times vs. gate resistor R_G

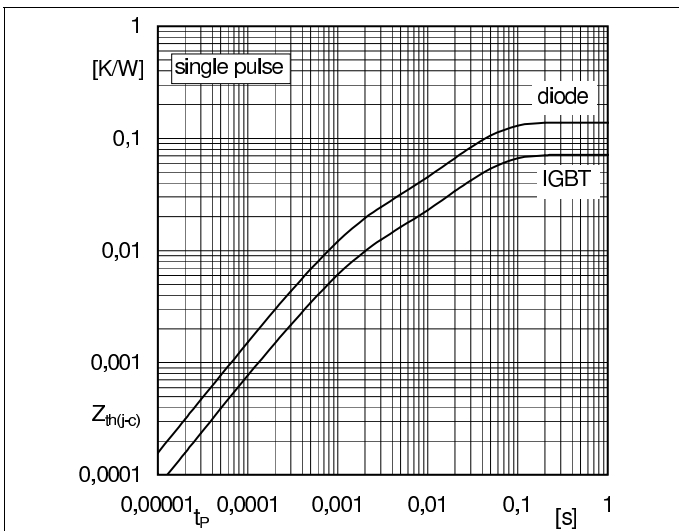


Fig. 9: Transient thermal impedance

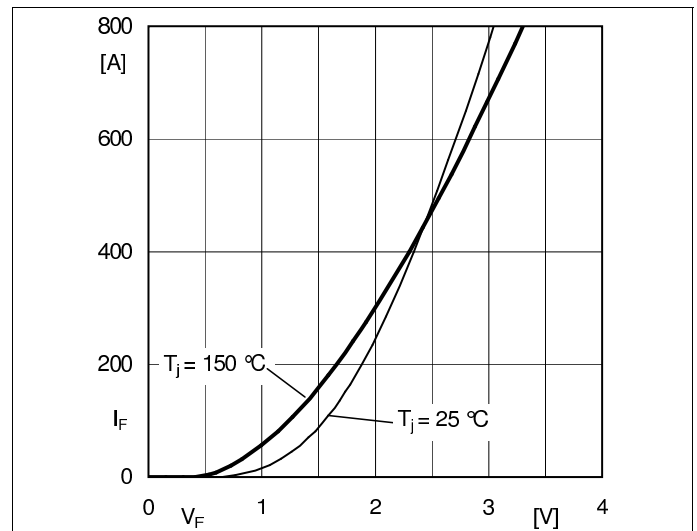


Fig. 10: Typ. CAL diode forward charact., incl. R_{CC+EE}

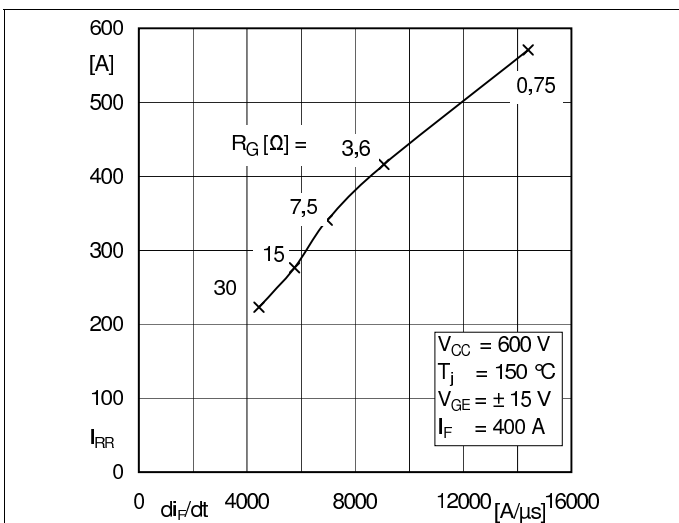


Fig. 11: CAL diode peak reverse recovery current

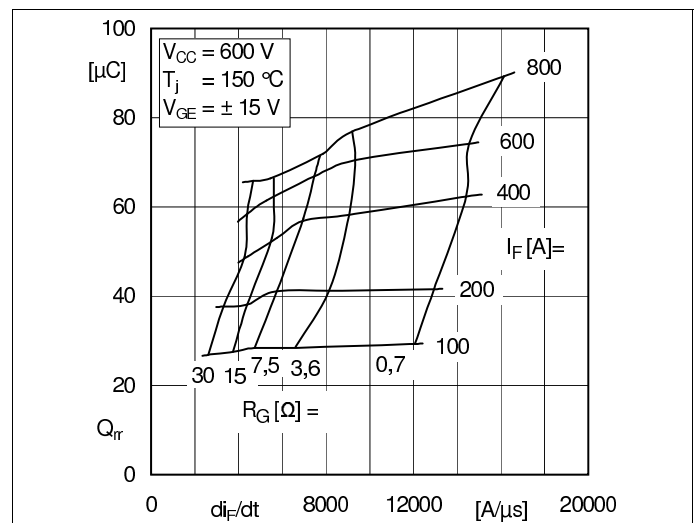


Fig. 12: Typ. CAL diode peak reverse recovery charge

