

SEMTRANS® 3

## Ultra Fast IGBT Modules

SKM 400GB125D

SKM 400GAL125D

SKM 400GAR125D

## Features

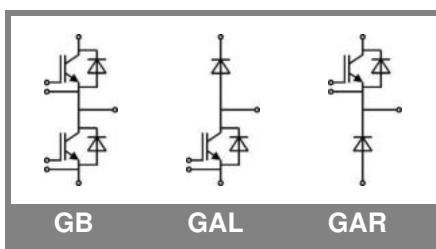
- Low inductance case
- Short tail current with low temperature dependence
- High short circuit capability, self limiting to  $6 \times I_{Cnom}$
- Fast & soft inverse CAL diodes
- Isolated copper baseplate using DBC Direct Copper Bonding Technology
- Large clearance (13 mm) and creepage distances (20 mm)

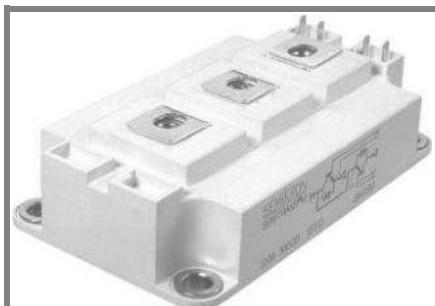
## Typical Applications\*

- Switched mode power supplies at  $f_{sw} > 20\text{kHz}$
- Resonant inverters up to 100 kHz
- Inductive heating
- Electronic welders at  $f_{sw} > 20\text{ kHz}$

| Absolute Maximum Ratings  |  | $T_c = 25\text{ }^\circ\text{C}$ , unless otherwise specified |  |                  |
|---------------------------|--|---|--|------------------|
| Symbol                    | Conditions   | Values  |  | Units            |
| <b>IGBT</b>               |  |   |  |                  |
| $V_{CES}$                 | $T_j = 25\text{ }^\circ\text{C}$   | 1200  |  | V                |
| $I_C$                     | $T_j = 150\text{ }^\circ\text{C}$<br>$T_{case} = 25\text{ }^\circ\text{C}$<br>$T_{case} = 80\text{ }^\circ\text{C}$  | 400<br>300  |  | A<br>A           |
| $I_{CRM}$                 | $I_{CRM} = 2 \times I_{Cnom}$  | 600   |  | A                |
| $V_{GES}$                 |  | $\pm 20$  |  | V                |
| $t_{psc}$                 | $V_{CC} = 600\text{ V}$ ; $V_{GE} \leq 20\text{ V}$ ; $T_j = 125\text{ }^\circ\text{C}$<br>$V_{CES} < 1200\text{ V}$ | 10  |  | $\mu\text{s}$    |
| <b>Inverse Diode</b>      |  |   |  |                  |
| $I_F$                     | $T_j = 150\text{ }^\circ\text{C}$<br>$T_{case} = 25\text{ }^\circ\text{C}$<br>$T_{case} = 80\text{ }^\circ\text{C}$  | 390<br>260  |  | A<br>A           |
| $I_{FRM}$                 | $I_{FRM} = 2 \times I_{Fnom}$  | 600   |  | A                |
| $I_{FSM}$                 | $t_p = 10\text{ ms}$ ; sin.<br>$T_j = 150\text{ }^\circ\text{C}$   | 2880  |  | A                |
| <b>Freewheeling Diode</b> |  |   |  |                  |
| $I_F$                     | $T_j = 150\text{ }^\circ\text{C}$<br>$T_{case} = 25\text{ }^\circ\text{C}$<br>$T_{case} = 80\text{ }^\circ\text{C}$  | 390<br>260  |  | A<br>A           |
| $I_{FRM}$                 | $I_{FRM} = 2 \times I_{Fnom}$  | 600   |  | A                |
| $I_{FSM}$                 | $t_p = 10\text{ ms}$ ; sin.<br>$T_j = 150\text{ }^\circ\text{C}$   | 2880  |  | A                |
| <b>Module</b>             |  |   |  |                  |
| $I_{t(RMS)}$              |  | 500   |  | A                |
| $T_{vj}$                  |  | - 40...+ 150  |  | $^\circ\text{C}$ |
| $T_{stg}$                 |  | - 40...+ 125  |  | $^\circ\text{C}$ |
| $V_{isol}$                | AC, 1 min.   | 4000  |  | V                |

| Characteristics                     |   | $T_c = 25\text{ }^\circ\text{C}$ , unless otherwise specified |                |                  |
|-------------------------------------|---|---|----------------|------------------|
| Symbol                              | Conditions  | min.  | typ.           | max.             |
| <b>IGBT</b>                         |   |   |                |                  |
| $V_{GE(th)}$                        | $V_{GE} = V_{CE}$ , $I_C = 12\text{ mA}$  | 4,5   | 5,5            | 6,5              |
| $I_{CES}$                           | $V_{GE} = 0\text{ V}$ , $V_{CE} = V_{CES}$<br>$T_j = 25\text{ }^\circ\text{C}$  | 0,15  | 0,45           | mA               |
| $V_{CEO}$                           | $T_j = 25\text{ }^\circ\text{C}$<br>$T_j = 125\text{ }^\circ\text{C}$   | 1,4<br>1,7  |                | V                |
| $r_{CE}$                            | $V_{GE} = 15\text{ V}$<br>$T_j = 25\text{ }^\circ\text{C}$<br>$T_j = 125\text{ }^\circ\text{C}$   | 6,3<br>7,6  |                | $\text{m}\Omega$ |
| $V_{CE(sat)}$                       | $I_{Cnom} = 300\text{ A}$ , $V_{GE} = 15\text{ V}$<br>$T_j = 25\text{ }^\circ\text{C}_{\text{chiplev.}}$<br>$T_j = 125\text{ }^\circ\text{C}_{\text{chiplev.}}$ | 3,3<br>4  | 3,85<br>4,55   | V                |
| $C_{ies}$<br>$C_{oes}$<br>$C_{res}$ | $V_{CE} = 25$ , $V_{GE} = 0\text{ V}$<br>$f = 1\text{ MHz}$   | 22<br>3,3<br>1,2  | 30<br>4<br>1,6 | nF               |
| $Q_G$                               | $V_{GE} = 0\text{V} - +20\text{V}$  | 2650  |                | nC               |
| $R_{Gint}$                          | $T_j = 25\text{ }^\circ\text{C}$  | 1,25  |                | $\Omega$         |
| $t_{d(on)}$<br>$t_r$<br>$E_{on}$    | $R_{Gon} = 2\text{ }\Omega$<br>$V_{CC} = 600\text{V}$<br>$I_C = 300\text{A}$  | 70<br>50<br>17  |                | ns<br>ns<br>mJ   |
| $t_{d(off)}$<br>$t_f$<br>$E_{off}$  | $R_{Goff} = 2\text{ }\Omega$<br>$T_j = 125\text{ }^\circ\text{C}$<br>$V_{GE} = \pm 15\text{ V}$   | 500<br>32<br>18   |                | ns<br>ns<br>mJ   |
| $R_{th(j-c)}$                       | per IGBT  | 0,05  |                | K/W              |





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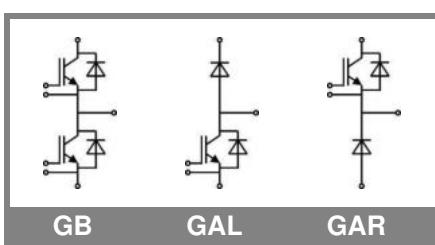
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- Switched mode power supplies at  $f_{sw} > 20\text{kHz}$
- Resonant inverters up to 100 kHz
- Inductive heating
- Electronic welders at  $f_{sw} > 20\text{ kHz}$

| Symbol                            | Conditions  | min. | typ.  | max.  | Units                    |
|-----------------------------------|---|------|-------|-------|--------------------------|
| <b>Inverse Diode</b>              |   |      |       |       |                          |
| $V_F = V_{EC}$                    | $I_{Fnom} = 300\text{ A}; V_{GE} = 0\text{ V}$<br>$T_j = 25\text{ }^\circ\text{C}_{\text{chiplev.}}$<br>$T_j = 125\text{ }^\circ\text{C}_{\text{chiplev.}}$ | 2    | 2,5   |       | V                        |
| $V_{FO}$                          | $T_j = 25\text{ }^\circ\text{C}$<br>$T_j = 125\text{ }^\circ\text{C}$   | 1,1  | 1,2   |       | V                        |
| $r_F$                             | $T_j = 25\text{ }^\circ\text{C}$<br>$T_j = 125\text{ }^\circ\text{C}$   | 3    | 4,3   |       | $\text{m}\Omega$         |
| $I_{RRM}$<br>$Q_{rr}$<br>$E_{rr}$ | $I_F = 300\text{ A}$<br>$\text{di/dt} = 8300\text{ A}/\mu\text{s}$<br>$V_{GE} = 0\text{ V}; V_{CC} = 600\text{ V}$  | 350  | 45    | 16    | A<br>$\mu\text{C}$<br>mJ |
| $R_{th(j-c)D}$                    | per diode   |      |       | 0,125 | K/W                      |
| <b>Freewheeling Diode</b>         |   |      |       |       |                          |
| $V_F = V_{EC}$                    | $I_{Fnom} = 300\text{ A}; V_{GE} = 0\text{ V}$<br>$T_j = 25\text{ }^\circ\text{C}_{\text{chiplev.}}$<br>$T_j = 125\text{ }^\circ\text{C}_{\text{chiplev.}}$ | 2    | 2,5   |       | V                        |
| $V_{FO}$                          | $T_j = 25\text{ }^\circ\text{C}$<br>$T_j = 125\text{ }^\circ\text{C}$   | 1,1  | 1,2   |       | V                        |
| $r_F$                             | $T_j = 25\text{ }^\circ\text{C}$<br>$T_j = 125\text{ }^\circ\text{C}$   | 3    | 4,3   |       | V                        |
| $I_{RRM}$<br>$Q_{rr}$<br>$E_{rr}$ | $I_F = 300\text{ A}$<br>$\text{di/dt} = 8300\text{ A}/\mu\text{s}$<br>$V_{GE} = 0\text{ V}; V_{CC} = 600\text{ V}$  | 350  | 45    | 16    | A<br>$\mu\text{C}$<br>mJ |
| $R_{th(j-c)FD}$                   | per diode   |      |       | 0,125 | K/W                      |
| <b>Module</b>                     |   |      |       |       |                          |
| $L_{CE}$                          |   | 15   | 20    |       | nH                       |
| $R_{CC'EE'}$                      | res., terminal-chip<br>$T_{case} = 25\text{ }^\circ\text{C}$<br>$T_{case} = 125\text{ }^\circ\text{C}$  | 0,35 |       |       | $\text{m}\Omega$         |
| $R_{th(c-s)}$                     | per module  |      | 0,038 |       | K/W                      |
| $M_s$                             | to heat sink M6   | 3    | 5     |       | Nm                       |
| $M_t$                             | to terminals M6   | 2,5  | 5     |       | Nm                       |
| $w$                               |   |      |       | 325   | g                        |

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 personal.





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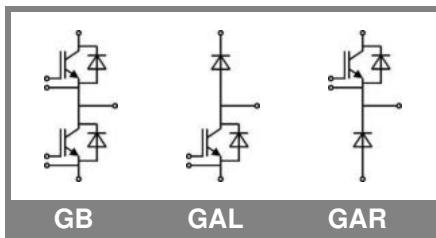
| $Z_{th}$<br>Symbol | Conditions | Values | Units |
|--------------------|------------|--------|-------|
| $Z_{th(j-c)I}$     |            |        |       |
| $R_i$              | i = 1      | 36     | mk/W  |
| $R_i$              | i = 2      | 10,5   | mk/W  |
| $R_i$              | i = 3      | 3      | mk/W  |
| $R_i$              | i = 4      | 0,5    | mk/W  |
| $\tau_i$           | i = 1      | 0,0744 | s     |
| $\tau_i$           | i = 2      | 0,0078 | s     |
| $\tau_i$           | i = 3      | 0,0016 | s     |
| $\tau_i$           | i = 4      | 0,0002 | s     |
| $Z_{th(j-c)D}$     |            |        |       |
| $R_i$              | i = 1      | 75     | mk/W  |
| $R_i$              | i = 2      | 38     | mk/W  |
| $R_i$              | i = 3      | 10,6   | mk/W  |
| $R_i$              | i = 4      | 1,4    | mk/W  |
| $\tau_i$           | i = 1      | 0,0386 | s     |
| $\tau_i$           | i = 2      | 0,0201 | s     |
| $\tau_i$           | i = 3      | 0,001  | s     |
| $\tau_i$           | i = 4      | 0,003  | s     |

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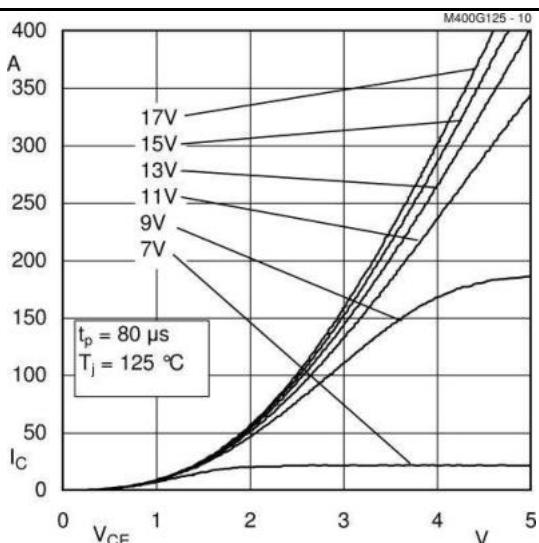


Fig. 1 Typ. output characteristic, inclusive  $R_{CC+EE}$

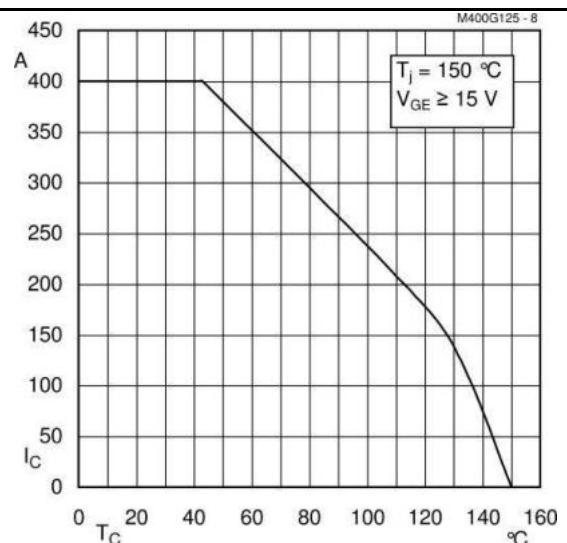


Fig. 2 Rated current vs. temperature  $I_C = f (T_C)$

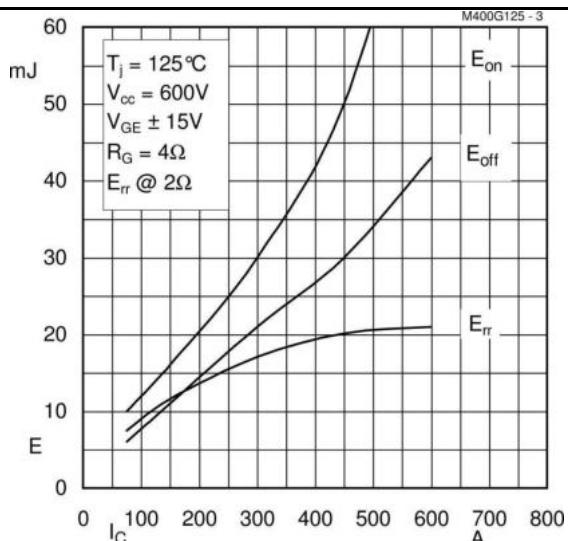


Fig. 3 Typ. turn-on /-off energy =  $f (I_C)$

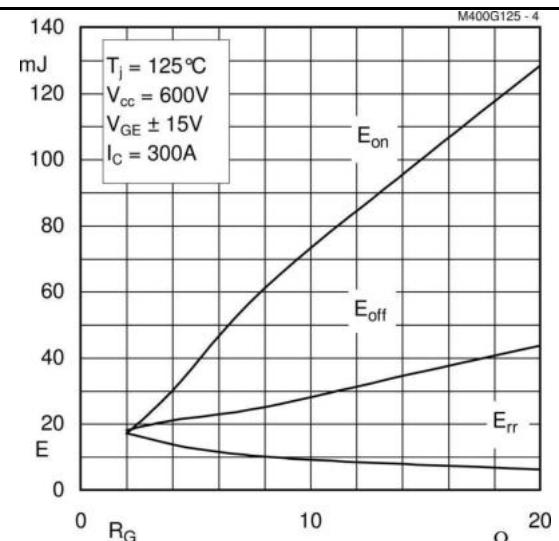


Fig. 4 Typ. turn-on /-off energy =  $f (R_G)$

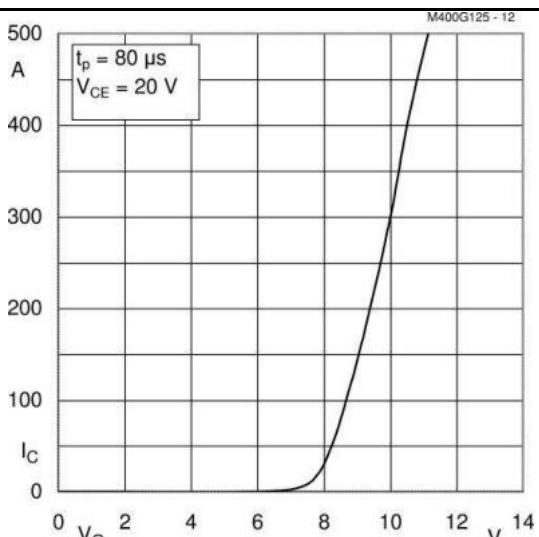


Fig. 5 Typ. transfer characteristic

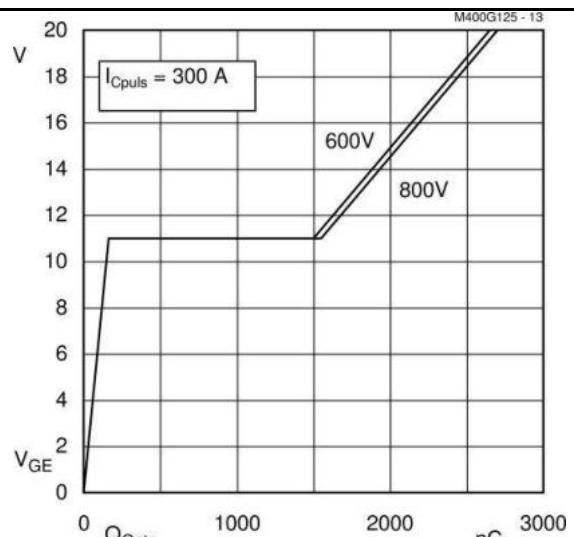


Fig. 6 Typ. gate charge characteristic

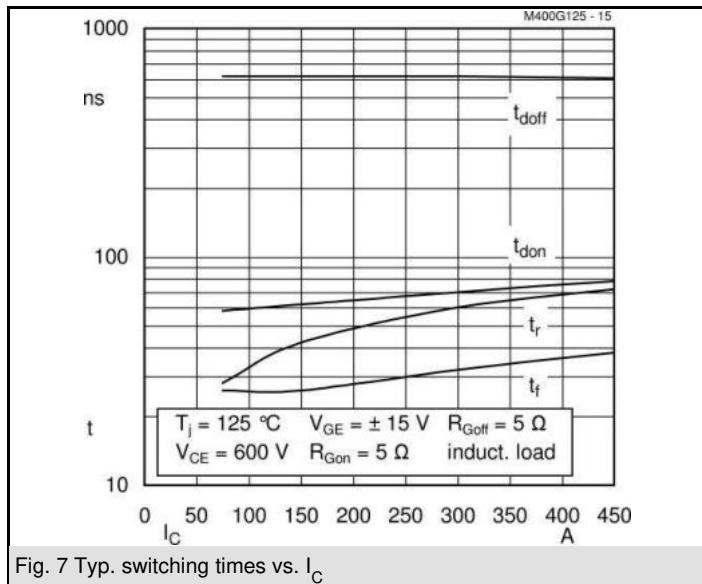


Fig. 7 Typ. switching times vs.  $I_C$

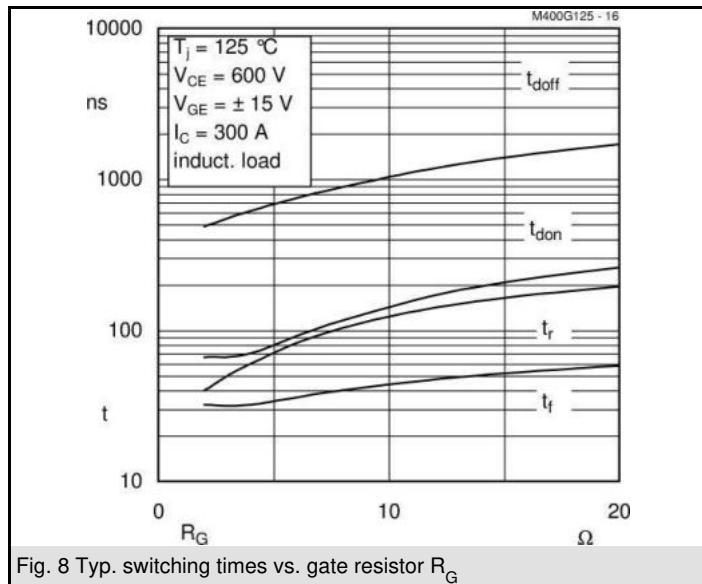


Fig. 8 Typ. switching times vs. gate resistor  $R_G$

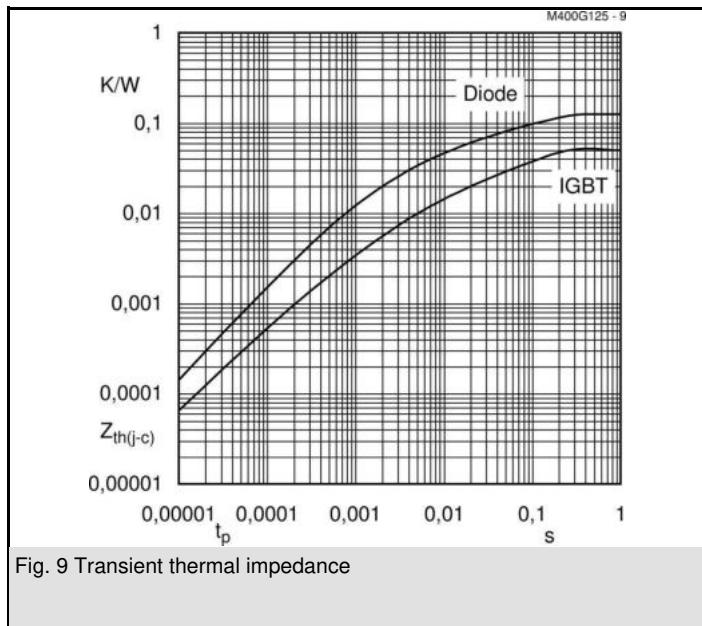


Fig. 9 Transient thermal impedance

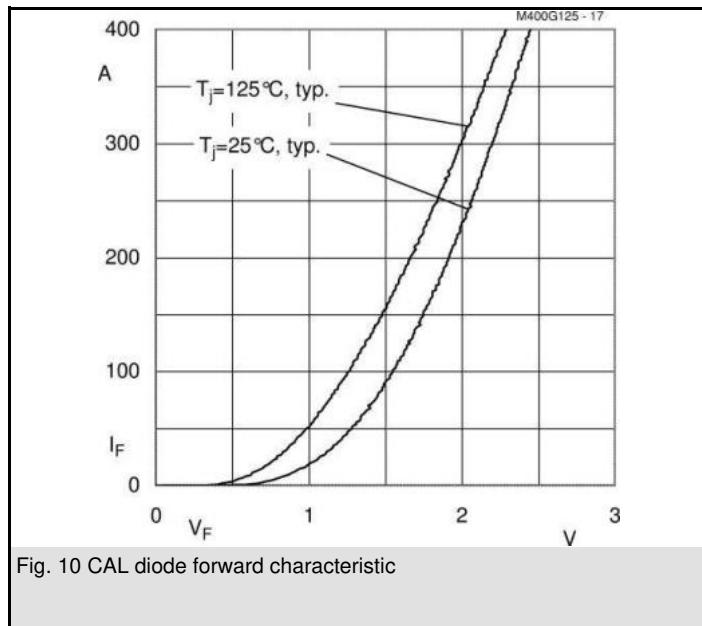


Fig. 10 CAL diode forward characteristic

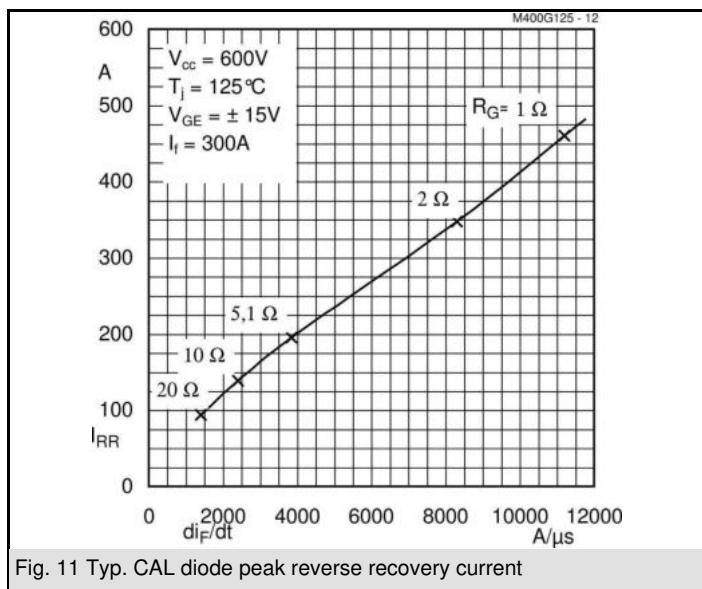


Fig. 11 Typ. CAL diode peak reverse recovery current

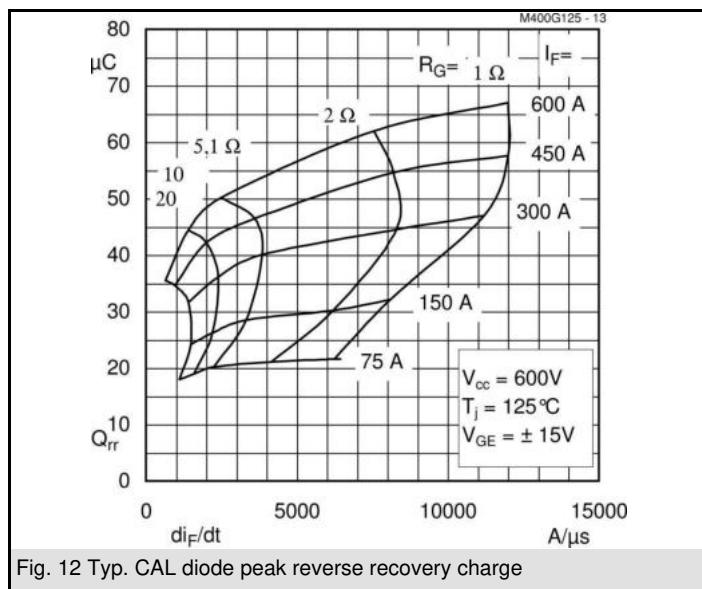


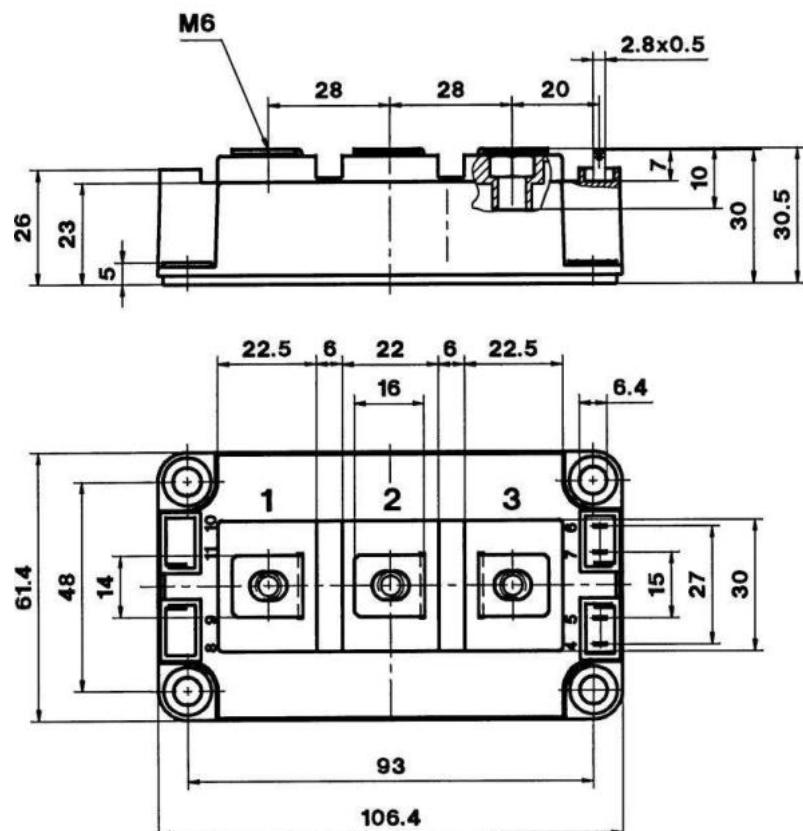
Fig. 12 Typ. CAL diode peak reverse recovery charge

# SKM 400GB125D

UL Recognized

File 63 532

CASED56



Case D 56

