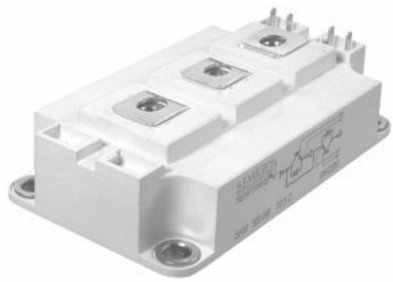
| Absolute Maximum Ratings Symbol | Conditions [1] | Values | | Units |
|---|---|---|---|---|
| $V_{CES}$ | | 1200 | | V |
| $V_{CGR}$ | $R_{GE}$ = 20 kΩ | 1200 | | V |
| $I_C$ | $T_{case}$ = 25/80 °C | 300 / 220 | | A |
| $I_{CM}$ | $T_{case}$ = 25/80 °C; $t_p$ = 1 ms | 600 / 440 | | A |
| $V_{GES}$ | | ± 20 | | V |
| $P_{tot}$ | per IGBT, $T_{case}$ = 25 °C | 1660 | | W |
| $T_j$, ($T_{stg}$) | | – 40 . . .+150 (125) | | °C |
| $V_{isol}$ | AC, 1 min. | 2 500 | | V |
| humidity | DIN 40 040 | Class F | | |
| climate | DIN IEC 68 T.1 | 40/125/56 | | |
| Inverse Diode | | | FWD [6] | |
| $I_F$= – $I_C$ | $T_{case}$ = 25/80 °C | 260 / 180 | 350 / 230 | A |
| $I_{FM}$= – $I_{CM}$ | $T_{case}$ = 25/80 °C; $t_p$ = 1 ms | 600 / 440 | 600 / 440 | A |
| $I_{FSM}$ | $t_p$ = 10 ms; sin.; $T_j$ = 150 °C | 2200 | 2900 | A |
| $I^2t$ | $t_p$ = 10 ms; $T_j$ = 150 °C | 24200 | 42000 | $A^2s$ |

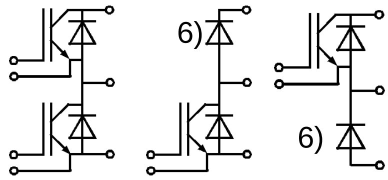
| Characteristics Symbol | Conditions [1] | min. | typ. | max. | Units |
|---|---|---|---|---|---|
| $V_{(BR)CES}$ | $V_{GE}$ = 0, $I_C$ = 4 mA | ≥ $V_{CES}$ | – | – | V |
| $V_{GE(th)}$ | $V_{GE}$ = $V_{CE}$, $I_C$ = 8 mA | 4,5 | 5,5 | 6,5 | V |
| $I_{CES}$ | $V_{GE}$ = 0 } $T_j$ = 25 °C | – | 3 | 4,5 | mA |
| | $V_{CE}$ = $V_{CES}$ } $T_j$ = 125 °C | – | 15 | – | mA |
| $I_{GES}$ | $V_{GE}$ = 20 V, $V_{CE}$ = 0 | – | – | 0,4 | µA |
| $V_{CEsat}$ | $I_C$ = 200 A { $V_{GE}$ = 15 V; | – | 2,5(3,1) | 3(3,7) | V |
| $V_{CEsat}$ | $I_C$ = 300 A { $T_j$ = 25 (125) °C | – | 3(3,8) | – | V |
| $g_{fs}$ | $V_{CE}$ = 20 V, $I_C$ = 200 A | 108 | 150 | – | S |
| $C_{CHC}$ | per IGBT | – | | 700 | pF |
| $C_{ies}$ | $V_{GE}$ = 0 | – | 18 | 24 | nF |
| $C_{oes}$ | $V_{CE}$ = 25 V | – | 2,5 | 3,2 | nF |
| $C_{res}$ | f = 1 MHz | – | 1,0 | 1,3 | nF |
| $L_{CE}$ | | – | – | 20 | nH |
| $t_{d(on)}$ | $V_{CC}$ = 600 V | – | 250 | 400 | ns |
| $t_r$ | $V_{GE}$ = + 15 V / - 15 V [3] | – | 90 | 160 | ns |
| $t_{d(off)}$ | $I_C$ = 200 A, ind. load | – | 550 | 700 | ns |
| $t_f$ | $R_{Gon}$ = $R_{Goff}$ = 4,7 Ω | – | 70 | 100 | ns |
| $E_{on}$ [5] | $T_j$ = 125 °C | – | 28 | – | mWs |
| $E_{off}$ [5] | | – | 26 | – | mWs |
| Inverse Diode [8] | | | | | |
| $V_F$ = $V_{EC}$ | $I_F$ = 200 A { $V_{GE}$ = 0 V; | – | 2,0(1,8) | 2,5 | V |
| $V_F$ = $V_{EC}$ | $I_F$ = 300 A { $T_j$ = 25 (125) °C | – | 2,25(2,1) | – | V |
| $V_{TO}$ | $T_j$ = 125 °C [2] | – | 1,1 | 1,2 | V |
| $r_T$ | $T_j$ = 125 °C [2] | – | 3 | 5,5 | mΩ |
| $I_{RRM}$ | $I_F$ = 200 A; $T_j$ = 25 (125) °C [2] | – | 70(105) | – | A |
| $Q_{rr}$ | $I_F$ = 200 A; $T_j$ = 25 (125) °C [2] | – | 10(26) | – | µC |
| FWD of type "GAL" and "GAR" [8) 6)] | | | | | |
| $V_F$ = $V_{EC}$ | $I_F$ = 200 A { $V_{GE}$ = 0 V; | – | 1,9(1,7) | 2,4 | V |
| $V_F$ = $V_{EC}$ | $I_F$ = 300 A { $T_j$ = 25 (125) °C | – | 2,1(1,8) | – | V |
| $V_{TO}$ | $T_j$ = 125 °C | – | – | 1,2 | V |
| $r_T$ | $T_j$ = 125 °C | – | 3 | 3,5 | mΩ |
| $I_{RRM}$ | $I_F$ = 200 A; $T_j$ = 25 (125) °C [2] | – | 80(140) | – | ns |
| $Q_{rr}$ | $I_F$ = 200 A; $T_j$ = 25 (125) °C [2] | – | 10(34) | – | µC |
| Thermal Characteristics | | | | | |
| $R_{thjc}$ | per IGBT | – | – | 0,075 | °C/W |
| $R_{thjc}$ | per diode / FWD [6] | – | – | 0,18/0,15 | °C/W |
| $R_{thch}$ | per module | – | – | 0,038 | °C/W |

## SEMITRANS® M IGBT Modules

## SKM 300 GB 123 D
## SKM 300 GAL 123 D [6]
## SKM 300 GAR 123 D [6]



**SEMITRANS 3**




GB GAL GAR

**Features**

- MOS input (voltage controlled)
- N channel, Homogeneous Si
- Low inductance case
- Very low tail current with low temperature dependence
- High short circuit capability, self limiting to 6 * $I_{cnom}$
- Latch-up free
- Fast & soft inverse CAL diodes[8]
- Isolated copper baseplate using DCB Direct Copper Bonding Technology
- Large clearance (12 mm) and creepage distances (20 mm).

**Typical Applications:** → B6-153

- Switching, not for linear use
- AC-inverter drives
- UPS

1) $T_{case}$ = 25 °C, unless otherwise specified
2) $I_F$ = – $I_C$, $V_R$ = 600 V, – $di_F/dt$ = 2000 A/µs, $V_{GE}$ = 0 V
3) Use $V_{GEoff}$ = -5 ... -15 V
5) see fig. 2 + 3; $R_{Goff}$ = 4,7 Ω
6) The free-wheeling diodes of the GAL and GAR types have the data of the inverse diodes of SKM 400 GA 123 D
8) CAL = Controlled Axial Lifetime Technology.

**Cases and mech. data → B6-174 SEMITRANS 3**

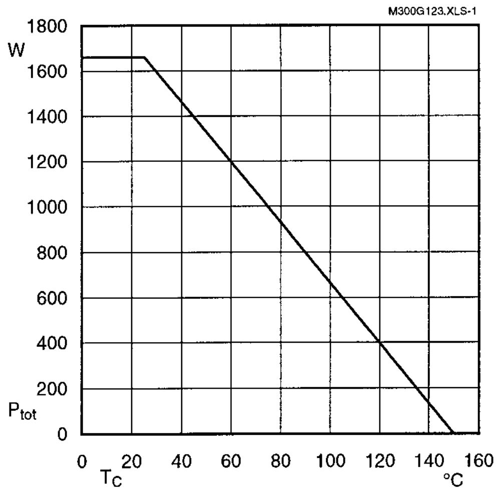
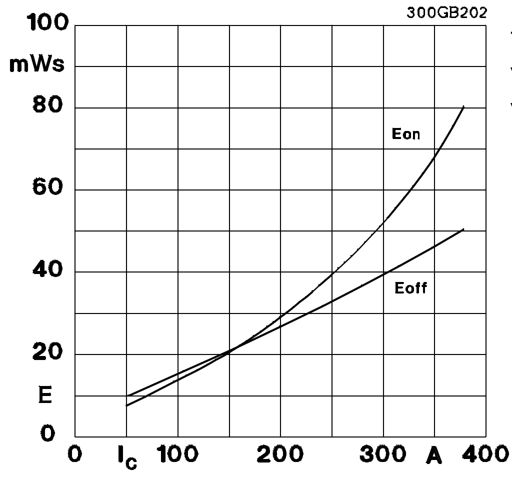
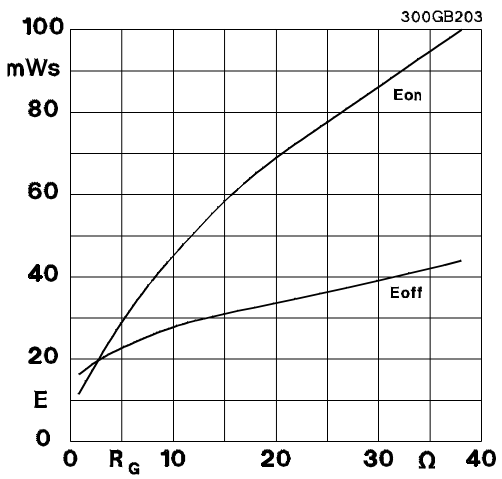



Fig. 1 Rated power dissipation $P_{tot}$ = f ($T_C$)



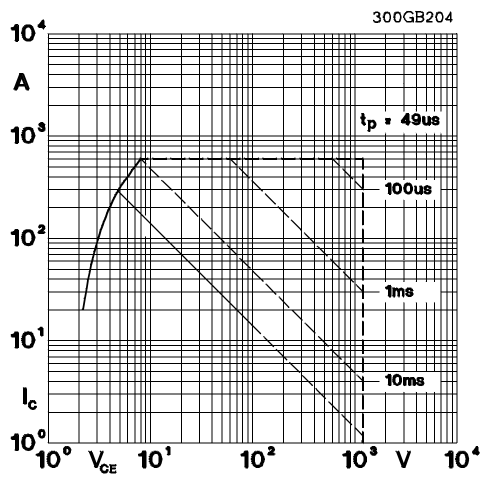

$T_j$ = 125 °C
$V_{CE}$ = 600 V
$V_{GE}$ = ± 15 V
$R_G$ = 4,7 Ω

Fig. 2 Turn-on /-off energy = f ($I_C$)




$T_j$ = 125 °C
$V_{CE}$ = 600 V
$V_{GE}$ = ± 15 V
$I_C$ = 200 A

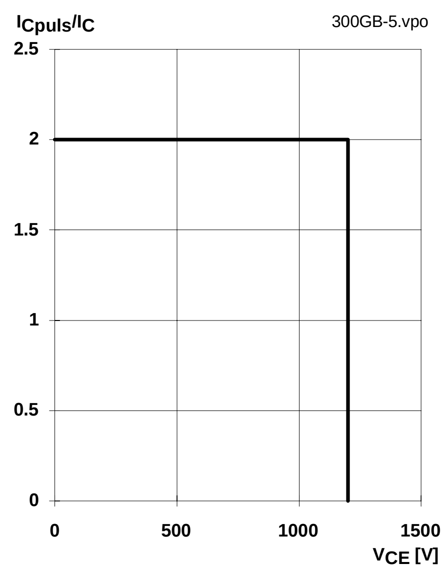
Fig. 3 Turn-on /-off energy = f ($R_G$)




1 pulse
$T_C$ = 25 °C
$T_j$ ≤ 150 °C

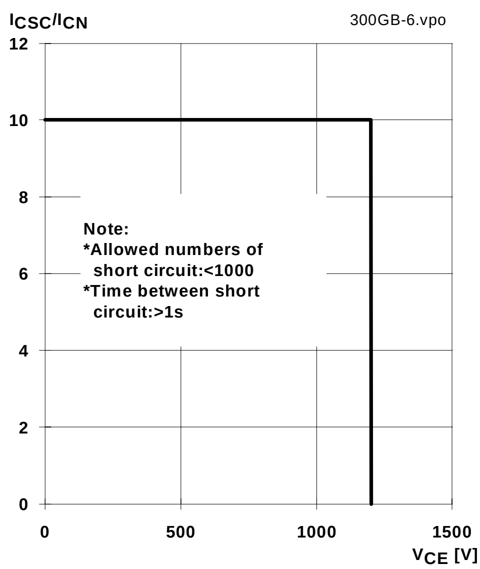
Not for linear use

Fig. 4 Maximum safe operating area (SOA) $I_C$ = f ($V_{CE}$)




$T_j$ ≤ 150 °C
$V_{GE}$ = 15 V
$R_{Goff}$ = 4,7 Ω
$I_C$ = 200 A

Fig. 5 Turn-off safe operating area (RBSOA)




$T_j$ ≤ 150 °C
$V_{GE}$ = ± 15 V
$t_{sc}$ ≤ 10 µs
L < 25 nH
$I_{CN}$ = 200 A

Fig. 6 Safe operating area at short circuit $I_C$ = f ($V_{CE}$)

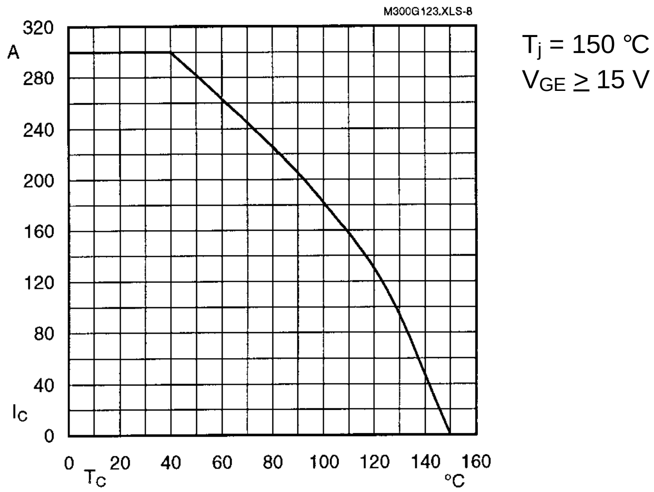



Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

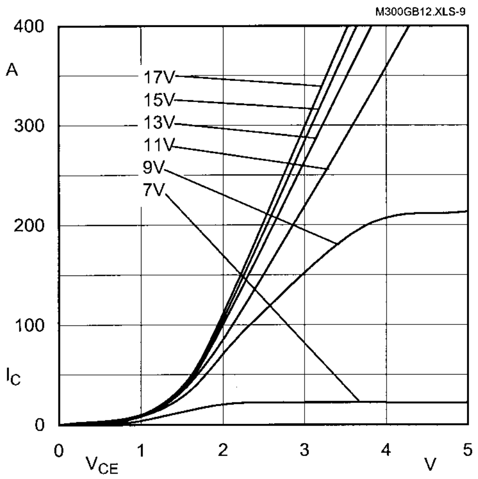



Fig. 9 Typ. output characteristic, $t_p$ = 80 µs; 25 °C

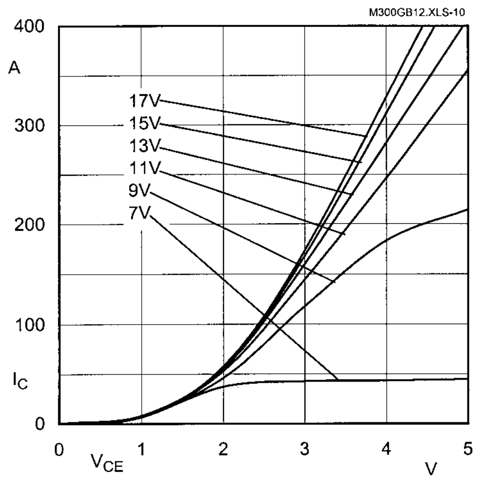



Fig. 10 Typ. output characteristic, $t_p$ = 80 µs; 125 °C

$P_{cond(t)} = V_{CEsat(t)} \cdot I_{C(t)}$

$V_{CEsat(t)} = V_{CE(TO)(Tj)} + r_{CE(Tj)} \cdot I_{C(t)}$

$V_{CE(TO)(Tj)} \leq 1{,}5 + 0{,}002\ (T_j - 25)$ [V]

typ.: $r_{CE(Tj)} = 0{,}005 + 0{,}00002\ (T_j - 25)$ [Ω]

max.: $r_{CE(Tj)} = 0{,}0075 + 0{,}000025\ (T_j - 25)$ [Ω]

valid for $V_{GE} = +\,15\,^{+2}_{-1}$ [V]; $I_C > 0{,}3\ I_{Cnom}$

Fig. 11 Saturation characteristic (IGBT)
Calculation elements and equations

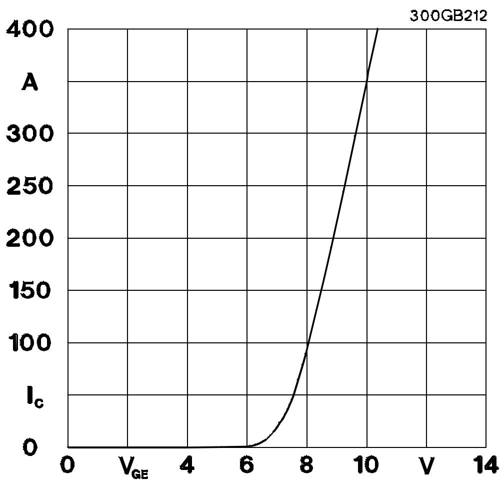
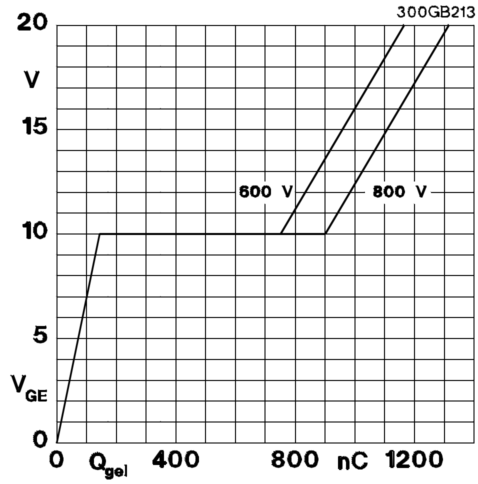


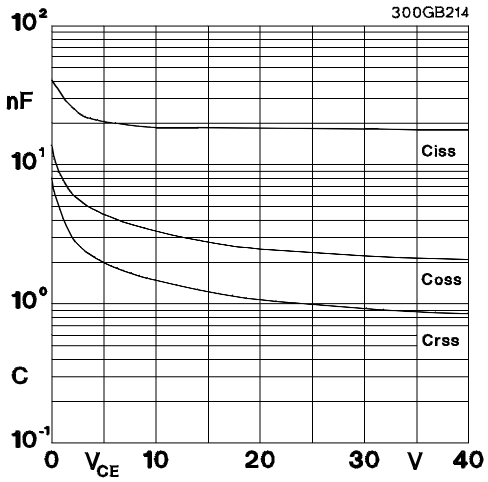

Fig. 12 Typ. transfer characteristic, $t_p$ = 80 µs; $V_{CE}$ = 20 V



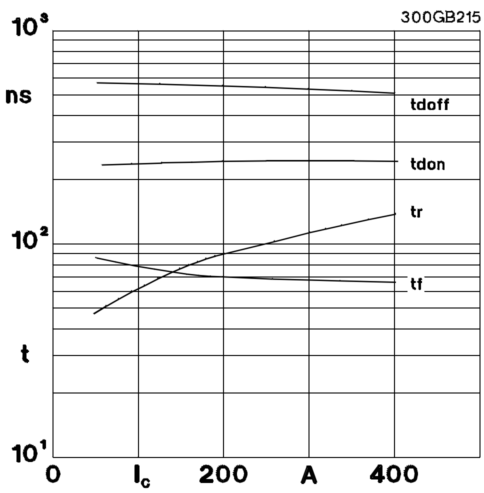

$I_{Cpuls}$ = 300 A

Fig. 13 Typ. gate charge characteristic



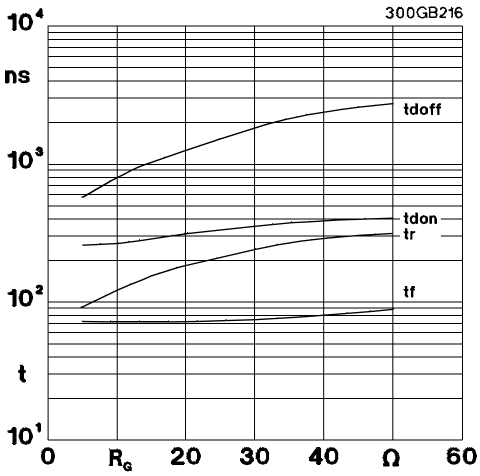

$V_{GE}$ = 0 V
f = 1 MHZ

Fig. 14 Typ. capacitances vs.$V_{CE}$




$T_j$ = 125 °C
$V_{CE}$ = 600 V
$V_{GE}$ = ± 15 V
$R_{Gon}$ = 4,7 Ω
$R_{Goff}$ = 4,7 Ω
induct. load

Fig. 15 Typ. switching times vs. $I_C$




$T_j$ = 125 °C
$V_{CE}$ = 600 V
$V_{GE}$ = ± 15 V
$I_C$ = 200 A
induct. load

Fig. 16 Typ. switching times vs. gate resistor $R_G$

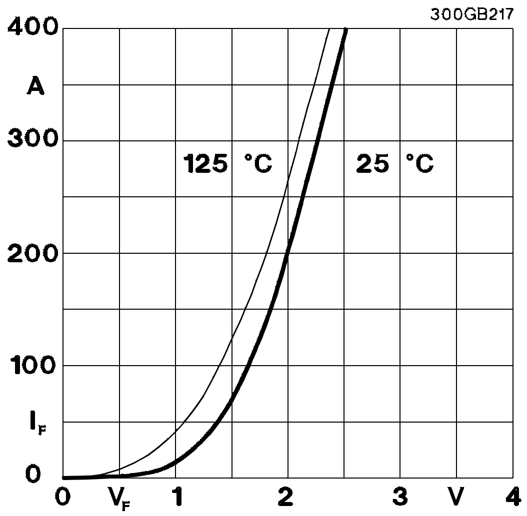



Fig. 17 Typ. CAL diode forward characteristic

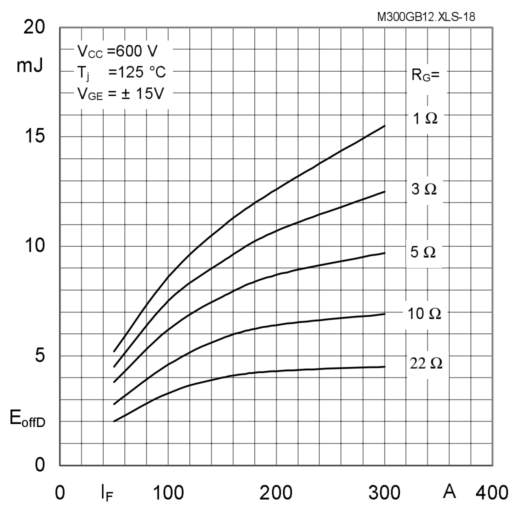



Fig. 18 Diode turn-off energy dissipation per pulse

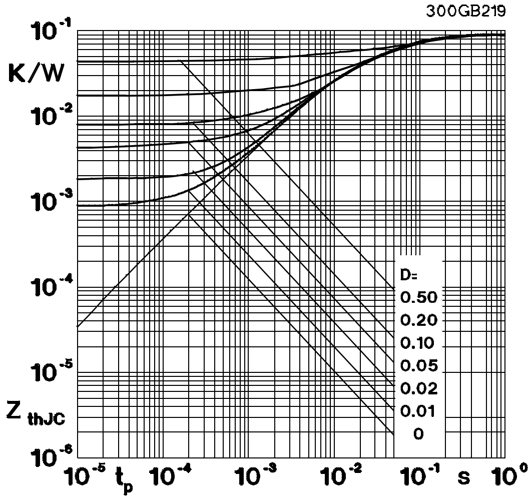



Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

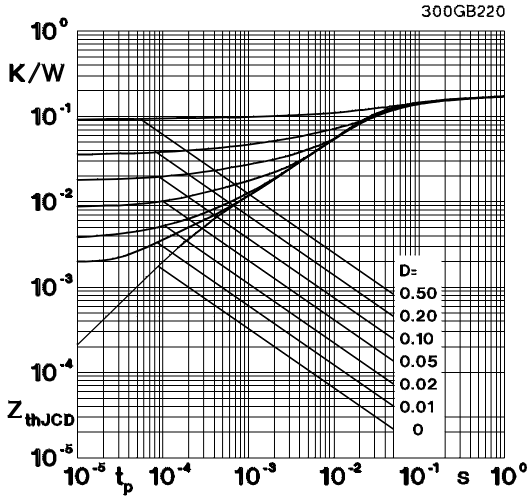



Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJCD} = f(t_p)$;

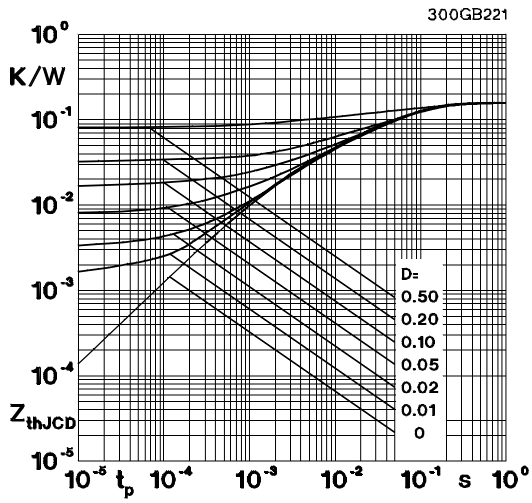



Fig. 21 Transient thermal impedance of the freewheeling diode $Z_{thjCD} \rightarrow$ B 6 – 169, rem. 6)

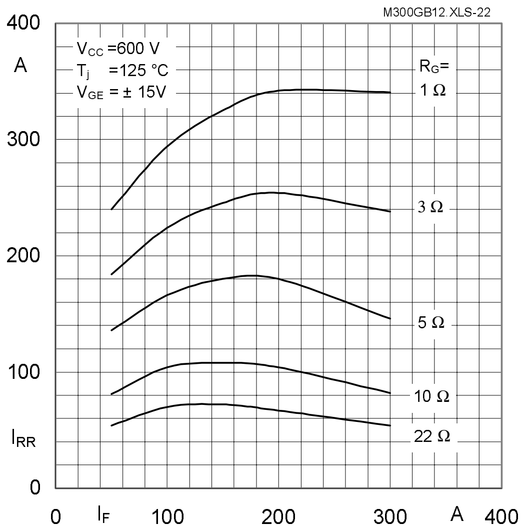



Fig. 22 Typ CAL diode reverse recovery current $I_{RR} = f(I_F; R_G)$

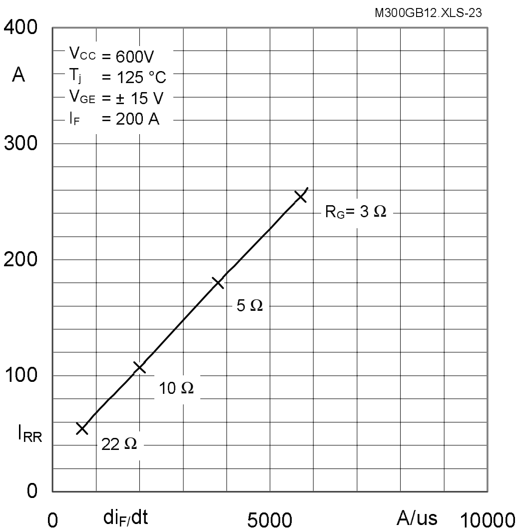



Fig. 23 Typ. CAL diode reverse recovery current $I_{RR} = f(di_F/dt; R_G)$

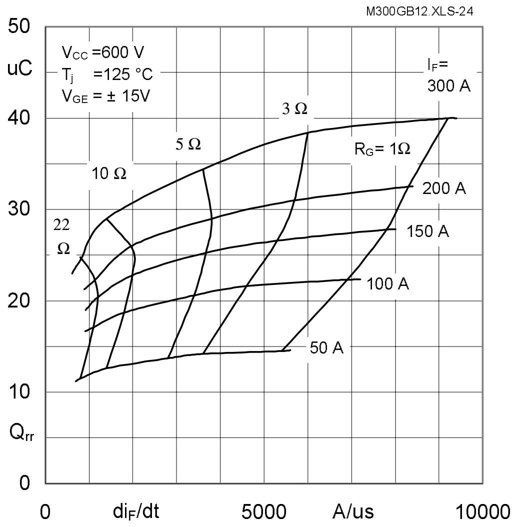


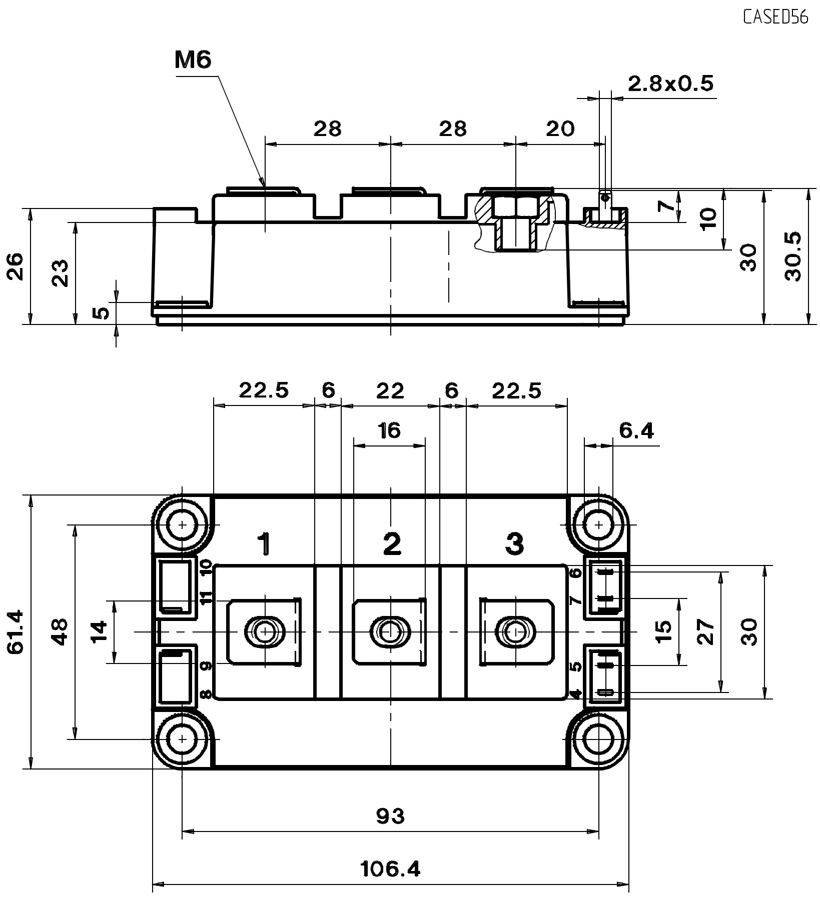

Fig. 24 Typ. CAL diode recovered charge $Q_{rr} = f(di_F/dt; I_F; R_G)$

**SEMITRANS 3**

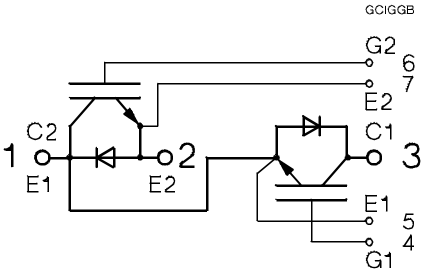
Case D 56

UL Recognized

File no. E 63 532



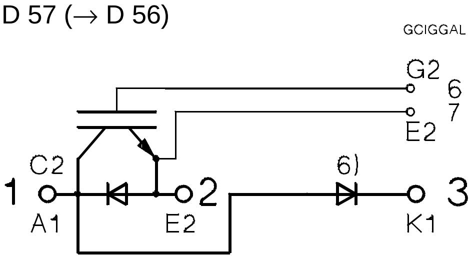

**SKM 300 GB 123 D**




Dimensions in mm

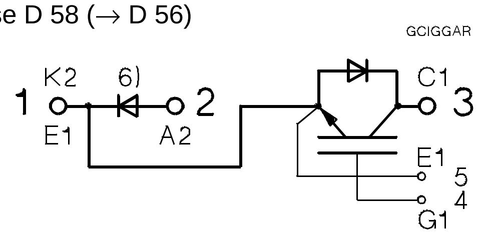
**SKM 300 GAL 123 D**

Case D 57 (→ D 56)




**SKM 300 GAR 123 D**

Case D 58 (→ D 56)




Case outline and circuit diagrams

## Mechanical Data

| Symbol | Conditions | | min. | typ. | max. | Units |
|---|---|---|---|---|---|---|
| $M_1$ | to heatsink, SI Units | (M6) | 3 | – | 5 | Nm |
| | to heatsink, US Units | | 27 | – | 44 | lb.in. |
| $M_2$ | for terminals, SI Units | (M6) | 2,5 | – | 5 | Nm |
| | for terminals US Units | | 22 | – | 44 | lb.in. |
| a | | | – | – | 5x9,81 | $m/s^2$ |
| w | | | – | – | 325 | g |

**This is an electrostatic discharge sensitive device (ESDS). Please observe the international standard IEC 747-1, Chapter IX.**

Three devices are supplied in one SEMIBOX A without mounting hardware, which can be ordered separately under Ident No. 33321100 (for 10 SEMITRANS 3). Larger packing units of 12 and 20 pieces are used if suitable

Accessories → B 6 - 4.
SEMIBOX → C - 1.

6) Freewheeling diode → B 6 - 169, remark 6.