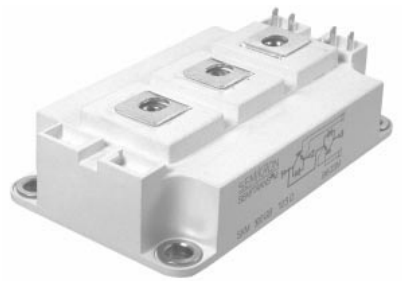
SEMIKRON

| 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 | 150 / 110 | | A |
| $I_{CM}$ | $T_{case}$ = 25/80 °C; $t_p$ = 1 ms | 300 / 220 | | A |
| $V_{GES}$ | | ± 20 | | V |
| $P_{tot}$ | per IGBT, $T_{case}$ = 25 °C | 830 | | W |
| $T_j$, ($T_{stg}$) | | – 40 . . .+150 (125) | | °C |
| $V_{isol}$ | AC, 1 min. | 2 500 [7] | | 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 | 150 / 100 | 200 / 135 | A |
| $I_{FM}$= – $I_{CM}$ | $T_{case}$ = 25/80 °C; $t_p$ = 1 ms | 300 / 220 | 300 / 220 | A |
| $I_{FSM}$ | $t_p$ = 10 ms; sin.; $T_j$ = 150 °C | 1100 | 1450 | A |
| $I^2t$ | $t_p$ = 10 ms; $T_j$ = 150 °C | 6000 | 10500 | $A^2s$ |

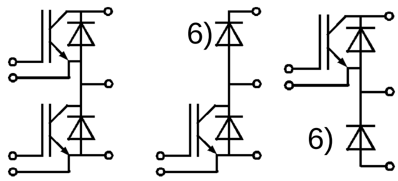
| Characteristics Symbol | Conditions [1] | min. | typ. | max. | Units |
|---|---|---|---|---|---|
| $V_{(BR)CES}$ | $V_{GE}$ = 0, $I_C$ = 4 mA | ≥ $V_{CES}$ | – | – | V |
| $V_{GE(th)}$ | $V_{GE}$ = $V_{CE}$, $I_C$ = 4 mA | 4,5 | 5,5 | 6,5 | V |
| $I_{CES}$ | $V_{GE}$ = 0, $V_{CE}$ = $V_{CES}$; $T_j$ = 25 °C | – | 0,2 | 2 | mA |
| | $T_j$ = 125 °C | – | 9 | | mA |
| $I_{GES}$ | $V_{GE}$ = 20 V, $V_{CE}$ = 0 | – | – | 1 | µA |
| $V_{CEsat}$ | $I_C$ = 100 A; $V_{GE}$ = 15 V; $T_j$ = 25 (125) °C | – | 2,5(3,1) | 3(3,7) | V |
| $V_{CEsat}$ | $I_C$ = 150 A | – | 3(3,8) | – | V |
| $g_{fs}$ | $V_{CE}$ = 20 V, $I_C$ = 100 A | 54 | – | – | S |
| $C_{CHC}$ | per IGBT | – | – | 700 | pF |
| $C_{ies}$ | $V_{GE}$ = 0; $V_{CE}$ = 25 V; f = 1 MHz | – | 6,5 | 8,5 | nF |
| $C_{oes}$ | | – | 1000 | 1500 | pF |
| $C_{res}$ | | – | 500 | 600 | pF |
| $L_{CE}$ | | – | – | 20 | nH |
| $t_{d(on)}$ | $V_{CC}$ = 600 V; $V_{GE}$ = + 15 V; - 15 V[3]; $I_C$ = 100 A, ind. load; $R_{Gon}$ = $R_{Goff}$ = 6,8 Ω; $T_j$ = 125 °C | – | 160 | 320 | ns |
| $t_r$ | | – | 80 | 160 | ns |
| $t_{d(off)}$ | | – | 400 | 520 | ns |
| $t_f$ | | – | 70 | 100 | ns |
| $E_{on}$ [5] | | – | 13 | – | mWs |
| $E_{off}$ [5] | | – | 11 | – | mWs |
| Inverse Diode [8] | | | | | |
| $V_F$ = $V_{EC}$ | $I_F$ = 100 A; $V_{GE}$ = 0 V; $T_j$ = 25 (125) °C | – | 2,0(1,8) | 2,5 | V |
| $V_F$ = $V_{EC}$ | $I_F$ = 150 A | – | 2,25(2,1) | – | V |
| $V_{TO}$ | $T_j$ = 125 °C | – | – | 1,2 | V |
| $r_T$ | $T_j$ = 125 °C | – | 8 | 11 | mΩ |
| $I_{RRM}$ | $I_F$ = 100 A; $T_j$ = 25 (125) °C[2] | – | 35(50) | – | A |
| $Q_{rr}$ | $I_F$ = 100 A; $T_j$ = 25 (125) °C[2] | – | 5(14) | – | µC |
| FWD of types “GAL”, “GAR” [8] | | | | | |
| $V_F$ = $V_{EC}$ | $I_F$ = 100 A; $V_{GE}$ = 0 V; $T_j$ = 25 (125) °C | – | 1,85(1,6) | 2,2 | V |
| $V_F$ = $V_{EC}$ | $I_F$ = 150 A | – | 2,0(1,8) | – | V |
| $V_{TO}$ | $T_j$ = 125 °C | – | – | 1,2 | V |
| $r_T$ | $T_j$ = 125 °C | – | 5 | 7 | mΩ |
| $I_{RRM}$ | $I_F$ = 100 A; $T_j$ = 25 (125) °C[2] | – | 40(65) | – | A |
| $Q_{rr}$ | $I_F$ = 100 A; $T_j$ = 25 (125) °C[2] | – | 5(15) | – | µC |
| Thermal Characteristics | | | | | |
| $R_{thjc}$ | per IGBT | – | – | 0,15 | °C/W |
| $R_{thjc}$ | per diode / FWD “GAL; GAR” | – | – | 0,30/0,25 | °C/W |
| $R_{thch}$ | per module | – | – | 0,038 | °C/W |

## SEMITRANS® M IGBT Modules

## SKM 150 GB 123 D
## SKM 150 GAL 123 D [6]
## SKM 150 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:** → B 6-141

- Switching (not for linear use)

1) $T_{case}$ = 25 °C, unless otherwise specified
2) $I_F$ = – $I_C$, $V_R$ = 600 V, – $di_F/dt$ = 1000 A/µs, $V_{GE}$ = 0 V
3) Use $V_{GEoff}$ = -5 ... -15 V
5) See fig. 2 + 3; $R_{Goff}$ = 6,8 Ω
6) The free-wheeling diodes of the GAL and GAR types have the data of the inverse diodes of SKM 200 GB 123 D
7) $V_{isol}$ = 4000 $V_{rms}$ on request
8) CAL = Controlled Axial Lifetime Technology.

**Cases and mech. data** → **B6-142 SEMITRANS 3**

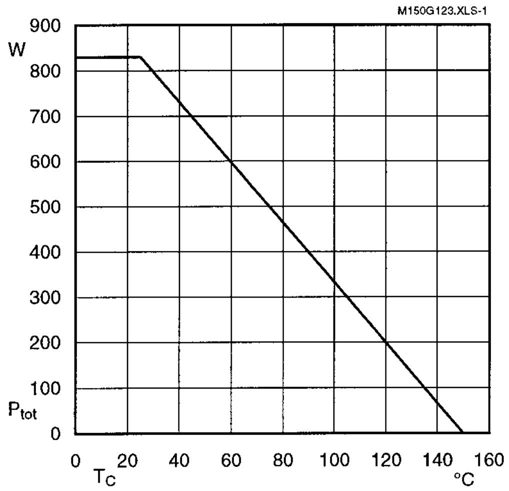
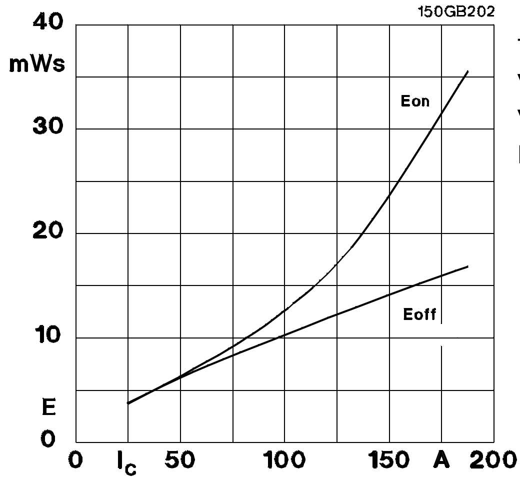
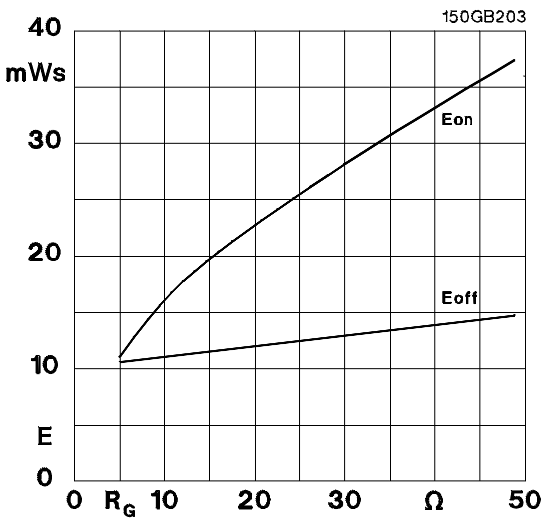



Fig. 1 Rated power dissipation $P_{tot} = f (T_C)$



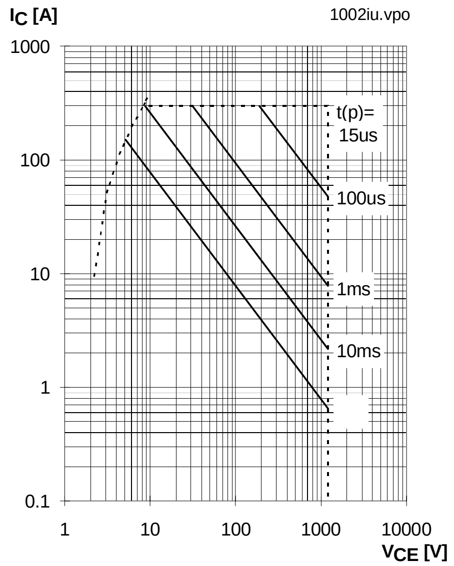

$T_j$ = 125 °C
$V_{CE}$ = 600 V
$V_{GE}$ = ± 15 V
$R_G$ = 6,8 Ω

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




$T_j$ = 125 °C
$V_{CE}$ = 600 V
$V_{GE}$ = ± 15 V
$I_C$ = 100 A

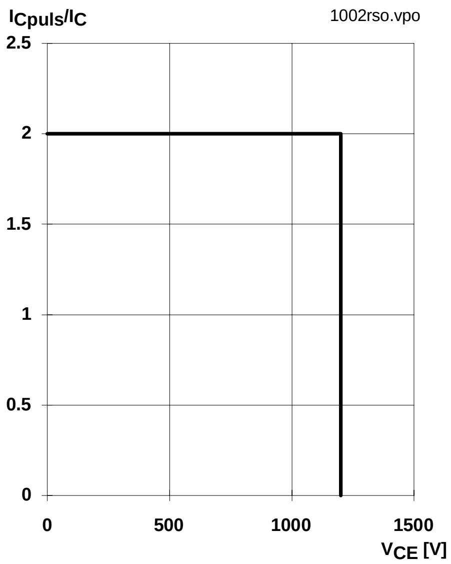
Fig. 3 Turn-on /-off energy = f ($R_G$)




1 pulse
$T_C$ = 25 °C
$T_j$ ≤ 150 °C

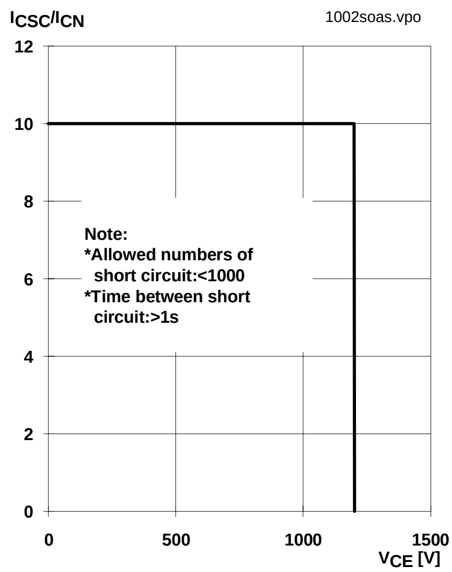
Not for
linear use

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




$T_j$ ≤ 150 °C
$V_{GE}$ = 15 V
$R_{Goff}$ = 6,8 Ω
$I_C$ = 100A

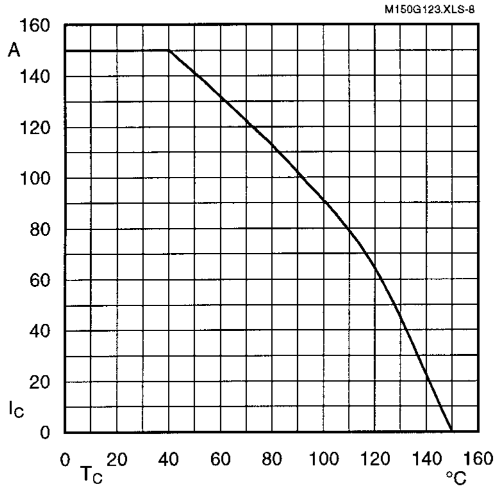
Fig. 5 Turn-off safe operating area (RBSOA)




$T_j$ ≤ 150 °C
$V_{GE}$ = ± 15 V
$t_{sc}$ ≤ 10 µs
L < 25 nH
$I_{CN}$ = 100A

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




$T_j$ = 150 °C
$V_{GE} \geq$ 15 V

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

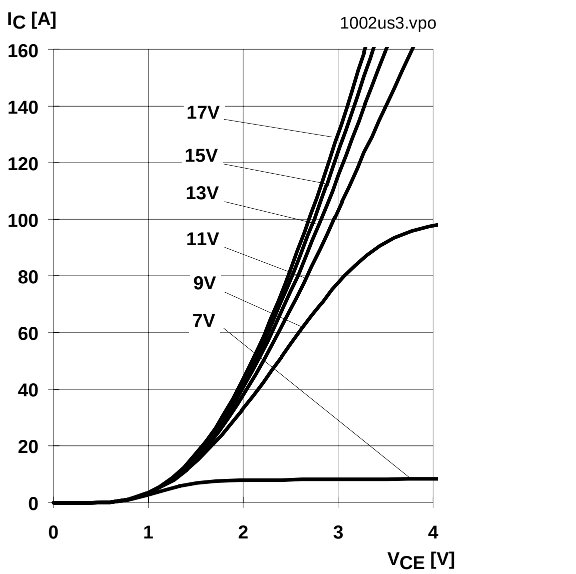



Fig. 9 Typ. output characteristic, $t_p$ = 80 µs; 25 °C

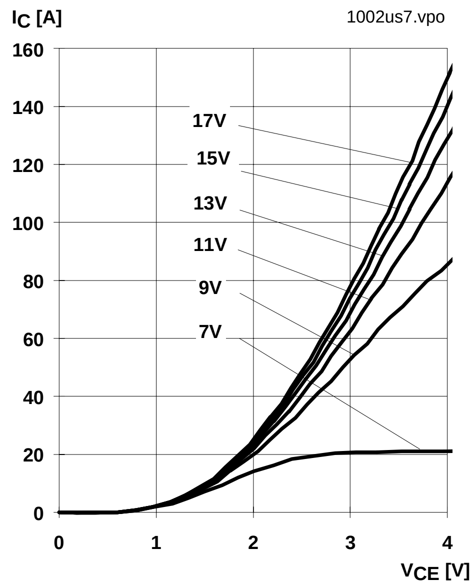



Fig. 10 Typ. output characteristic, $t_p$ = 80 µs; 125 °C

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

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

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

typ.: $r_{CE(Tj)} = 0{,}010 + 0{,}00004\ (T_j - 25)$ [Ω]

max.: $r_{CE(Tj)} = 0{,}015 + 0{,}00005\ (T_j - 25)$ [Ω]

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

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

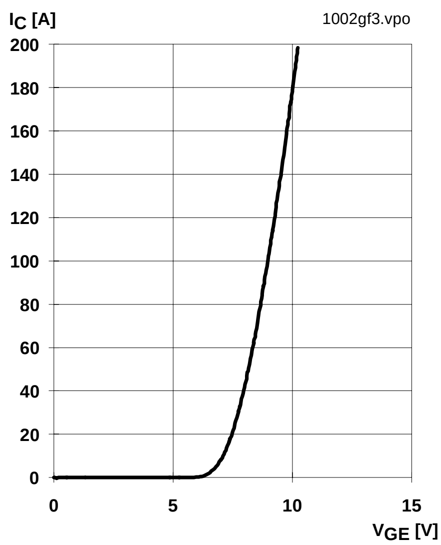
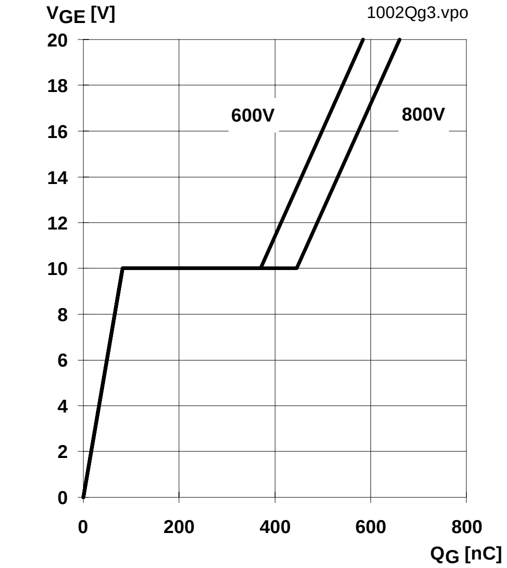
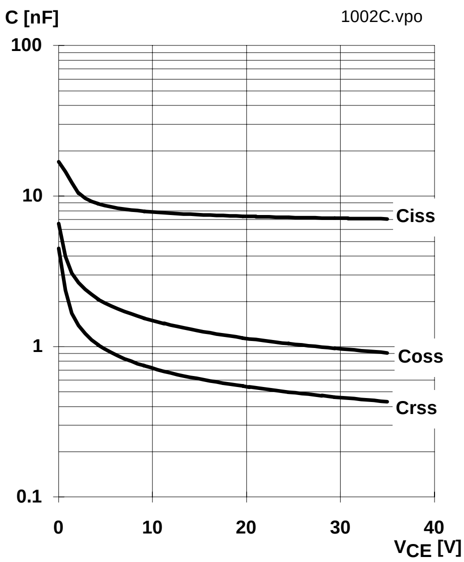



Fig. 12 Typ. transfer characteristic, $t_p$ = 80 µs; $V_{CE}$ = 20 V



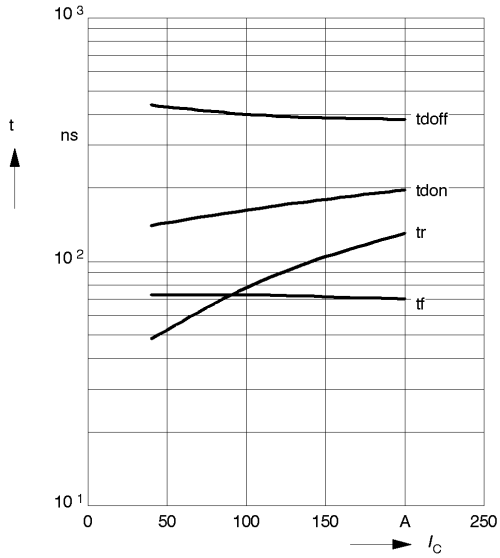

$I_{Cpuls}$ = 100 A

Fig. 13 Typ. gate charge characteristic



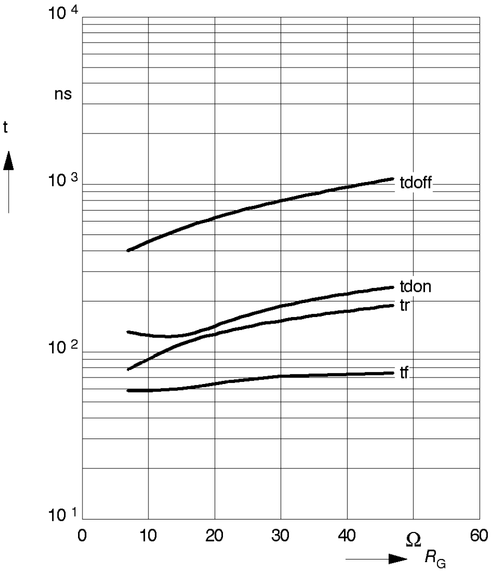

$V_{GE}$ = 0 V
f = 1 MHZ

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




$T_j$ = 125 °C
$V_{CE}$ = 600 V
$V_{GE}$ = ± 15 V
$R_{Gon}$ = 6,8 Ω
$R_{Goff}$ = 6,8 Ω
induct. load

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




$T_j$ = 125 °C
$V_{CE}$ = 600 V
$V_{GE}$ = ± 15 V
$I_C$ = 100 A
induct. load

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

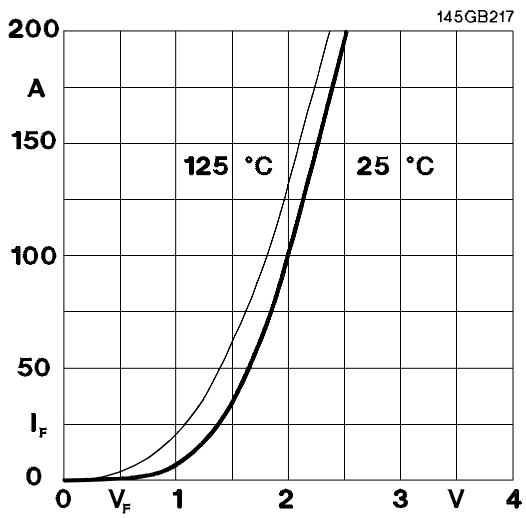



Fig. 17 Typ. CAL diode forward characteristic

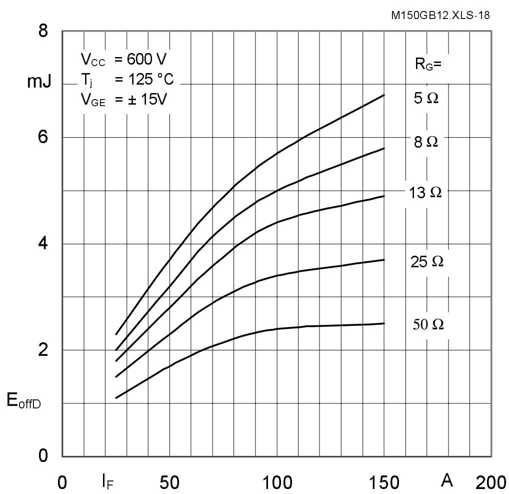



Fig. 18 Diode turn-off energy dissipation per pulse

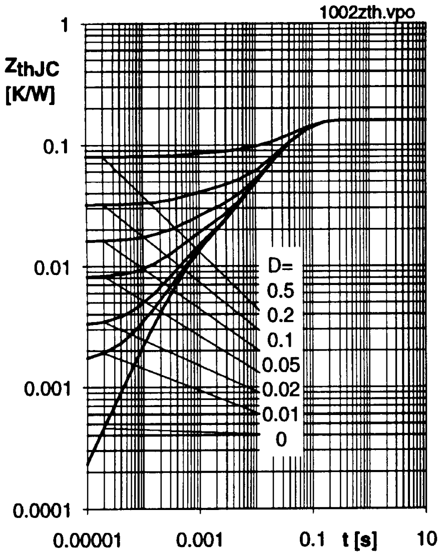



Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

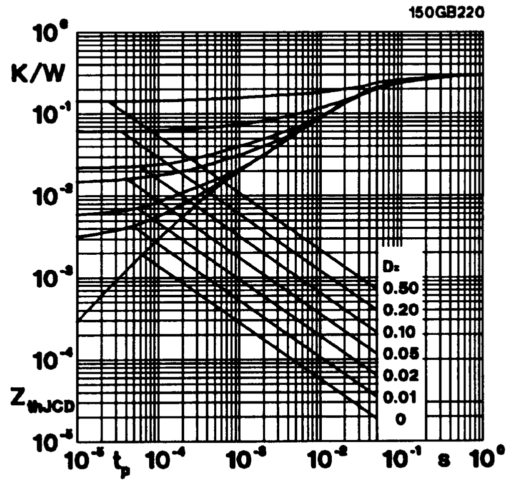



Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

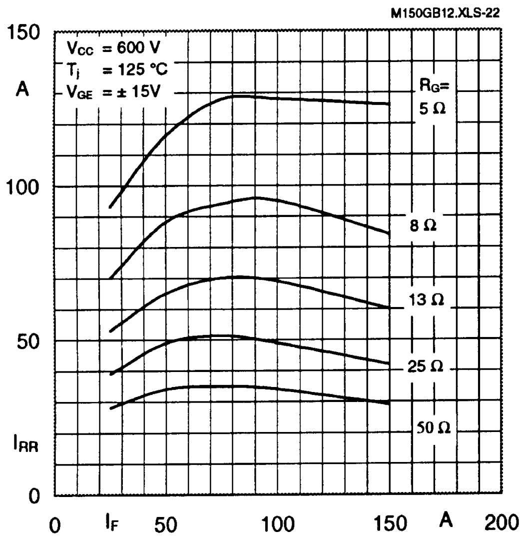



Fig. 22 Typ. CALdiode reverse recovery current $I_{RR} = f(I_F; R_G)$

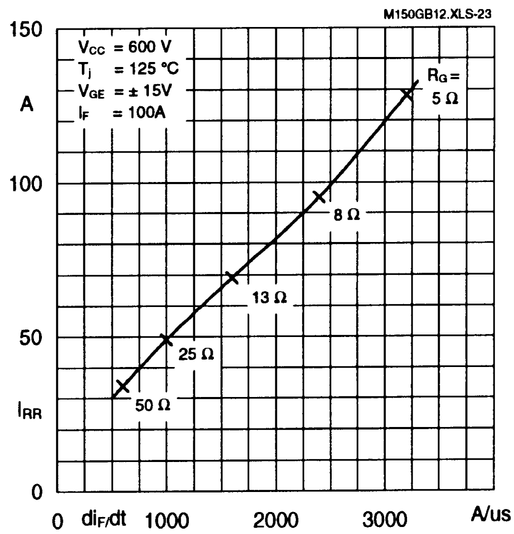



Fig. 23 Typ. CAL diode reverse recovery current $I_{RR} = f(di_F/dt)$

## Typical Applications include

Switched mode power supplies
DC servo and robot drives
Inverters
DC choppers (versions GAL and GAR)
AC motor speed control
Inductive heating
UPS Uninterruptable power supplies
General power switching applications
Electronic (also portable) welders
Pulse frequencies also above 15 kHz

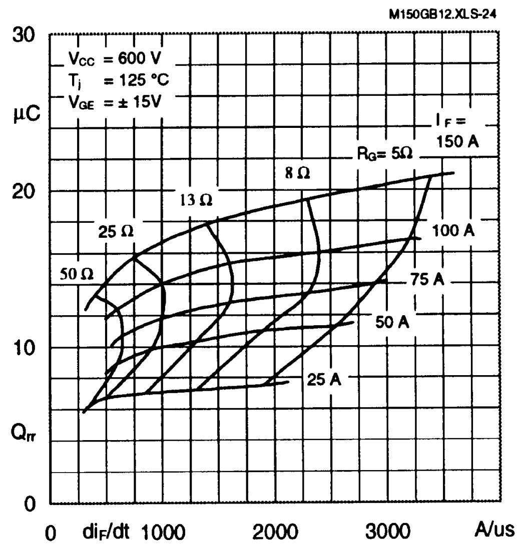



Fig. 24 Typ. CAL diode recovered charge $Q_{rr} = f(di/dt)$

**SEMITRANS 3**

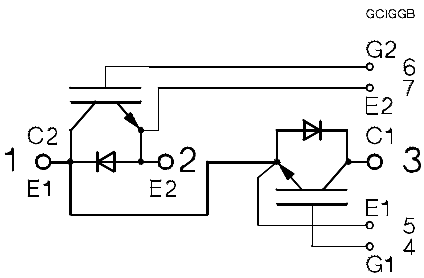
Case D 56

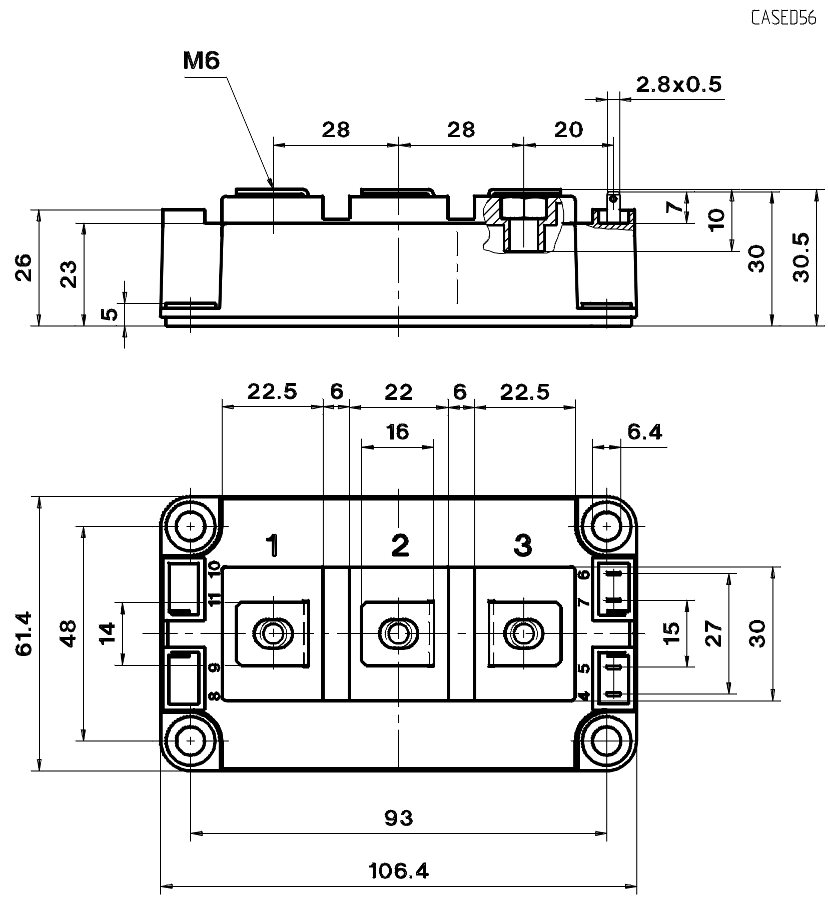
UL Recognized

File no. E 63 532

**SKM 150 GB 123 D**

**SKM 150 GB 173 D**

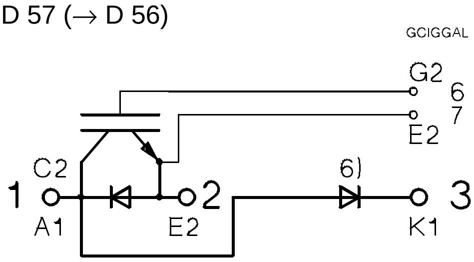



Dimensions in mm

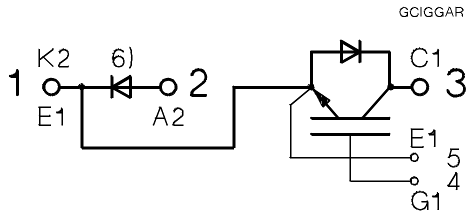
**SKM 150 GAL 123 D**

Case D 57 (→ D 56)




**SKM 150 GAR 123 D**

Case D 58 (→ D 56)




Case outline and circuit diagrams

| **Mechanical Data**<br>**Symbol** | **Conditions** | | **Values**<br>**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 |

[6] Freewheeling diode → B 6 - 137, remark 6.

**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 B 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.