SEMIKRON

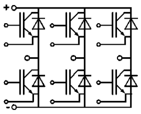
| Absolute Maximum Ratings Symbol | Conditions [1] | Values | Units |
|---|---|---|---|
| $V_{CES}$ | | 1200 | V |
| $V_{CGR}$ | $R_{GE}$ = 20 kΩ | 1200 | V |
| $I_C$ | $T_{case}$ = 25/80 °C | 40 / 25 | A |
| $I_{CM}$ | $T_{case}$ = 25/80 °C; $t_p$ = 1 ms | 70 / 50 | A |
| $V_{GES}$ | | ± 20 | V |
| $P_{tot}$ | per IGBT, $T_{case}$ = 25 °C | 200 | 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 | 55/150/56 | |
| Inverse Diode | | | |
| $I_F$= – $I_C$ | $T_{case}$ = 25/80 °C | 45 / 30 | A |
| $I_{FM}$= – $I_{CM}$ | $T_{case}$ = 25/80 °C; $t_p$ = 1 ms | 70 / 50 | A |
| $I_{FSM}$ | $t_p$ = 10 ms; sin.; $T_j$ = 150 °C | 350 | A |
| $I^2t$ | $t_p$ = 10 ms; $T_j$ = 150 °C | 600 | $A^2s$ |

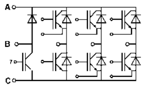
| Characteristics Symbol | Conditions [1] | min. | typ. | max. | Units |
|---|---|---|---|---|---|
| $V_{(BR)CES}$ | $V_{GE}$ = 0, $I_C$ = 0,8 mA | ≥ $V_{CES}$ | – | – | V |
| $V_{GE(th)}$ | $V_{GE}$ = $V_{CE}$, $I_C$ = 1 mA | 4,5 | 5,5 | 6,5 | V |
| $I_{CES}$ | $V_{GE}$ = 0, $V_{CE}$ = $V_{CES}$; $T_j$ = 25 °C | – | 0,1 | 1 | mA |
| | $V_{GE}$ = 0, $V_{CE}$ = $V_{CES}$; $T_j$ = 125 °C | – | 3 | – | mA |
| $I_{GES}$ | $V_{GE}$ = 20 V, $V_{CE}$ = 0 | – | – | 200 | nA |
| $V_{CEsat}$ | $I_C$ = 25 A; $V_{GE}$ = 15 V; $T_j$ = 25 (125) °C | – | 2,5(3,1) | 3(3,7) | V |
| $V_{CEsat}$ | $I_C$ = 40 A; $V_{GE}$ = 15 V; $T_j$ = 25 (125) °C | – | 3,1(3,9) | – | V |
| $g_{fs}$ | $V_{CE}$ = 20 V, $I_C$ = 25 A | | 20 | – | S |
| $C_{CHC}$ | per IGBT | – | – | 300 | pF |
| $C_{ies}$ | $V_{GE}$ = 0; $V_{CE}$ = 25 V; f = 1 MHz | – | 1600 | 2100 | pF |
| $C_{oes}$ | $V_{GE}$ = 0; $V_{CE}$ = 25 V; f = 1 MHz | – | 250 | 300 | pF |
| $C_{res}$ | $V_{GE}$ = 0; $V_{CE}$ = 25 V; f = 1 MHz | – | 110 | 150 | pF |
| $L_{CE}$ | | – | – | 60 | nH |
| $t_{d(on)}$ | $V_{CC}$ = 600 V; $V_{GE}$ = + 15 V / - 15 V [3]; $I_C$ = 25 A, ind. load; $R_{Gon}$ = $R_{Goff}$ = 40 Ω; $T_j$ = 125 °C | – | 70 | – | ns |
| $t_r$ | | – | 55 | – | ns |
| $t_{d(off)}$ | | – | 400 | – | ns |
| $t_f$ | | – | 40 | – | ns |
| $E_{on}$ [5] | | – | 3,8 | – | mWs |
| $E_{off}$ [5] | | – | 2,3 | – | mWs |
| Inverse Diode [8] | | | | | |
| $V_F$ = $V_{EC}$ | $I_F$ = 25 A; $V_{GE}$ = 0 V; $T_j$ = 25 (125) °C | – | 2,0(1,8) | 2,5 | V |
| $V_F$ = $V_{EC}$ | $I_F$ = 40 A; $V_{GE}$ = 0 V; $T_j$ = 25 (125) °C | – | 2,3(2,1) | – | V |
| $V_{TO}$ | $T_j$ = 125 °C | – | 1,1 | 1,2 | V |
| $r_T$ | $T_j$ = 125 °C | – | 25 | 44 | mΩ |
| $I_{RRM}$ | $I_F$ = 25 A; $T_j$ = 25 (125) °C [2] | – | 19(25) | – | A |
| $Q_{rr}$ | $I_F$ = 25 A; $T_j$ = 25 (125) °C [2] | – | 1,5(4,5) | – | µC |
| Thermal Characteristics | | | | | |
| $R_{thjc}$ | per IGBT | – | – | 0,6 | °C/W |
| $R_{thjc}$ | per diode | – | – | 1,0 | °C/W |
| $R_{thch}$ | per module | – | – | 0,05 | °C/W |

## SEMITRANS® M IGBT Modules

## SKM 40 GD 123 D
## SKM 40 GD 123 D L*)
## SKM 40 GDL 123 D **)

**Sixpack**





**GD** **GDL **)**

**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 (9 mm) and creepage distances (13 mm).

**Typical Applications**

- Switched mode power supplies
- Three phase inverters for AC motor speed control
- Pulse frequencies also above 15 kHz

1) $T_{case}$ = 25 °C, unless otherwise specified
2) $I_F$ = – $I_C$, $V_R$ = 600 V, – $di_F/dt$ = 500 A/µs, $V_{GE}$ = 0 V
3) Use $V_{GEoff}$ = -5 ... -15 V
5) See fig. 2 + 3; $R_{Goff}$ = 40 Ω
8) CAL = Controlled Axial Lifetime Technology.

***) Main terminals = 2 mm dia. outline → B 6 – 10**

****) Sevenpack, picture → B6 - 29**
**Cases and mech. data → B6 - 16**
**Sixpack and Sevenpack**

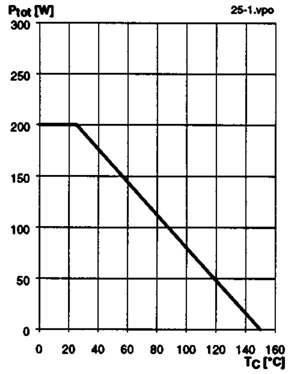



Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$

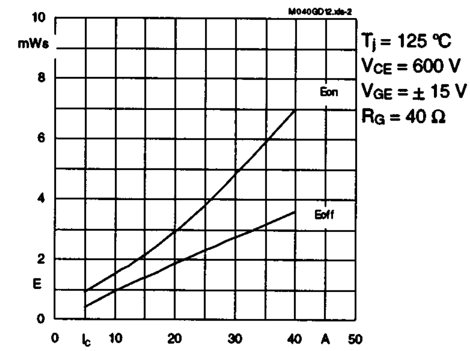



Fig. 2 Turn-on /-off energy = f ($I_C$)

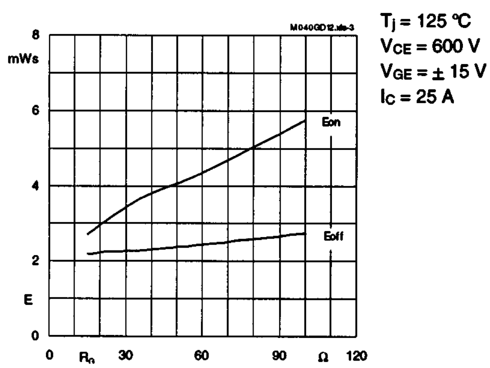



Fig. 3 Turn-on /-off energy = f ($R_G$)

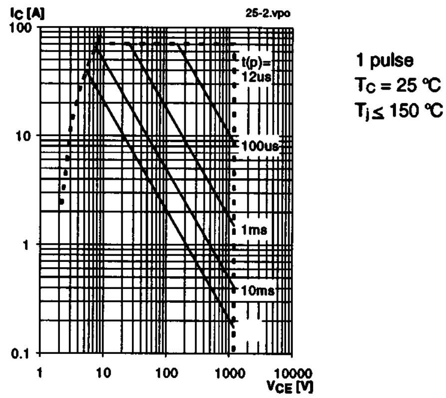



Fig. 4 Maximum safe operating area (SOA) $I_C = f(V_{CE})$

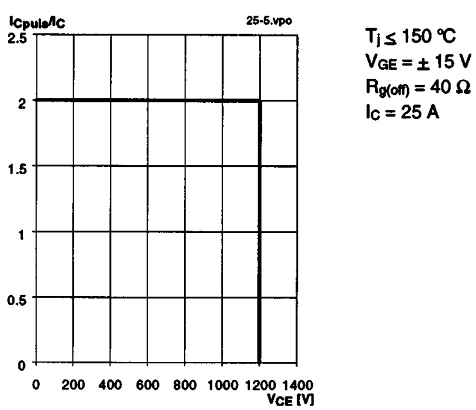



Fig. 5 Turn-off safe operating area (RBSOA)

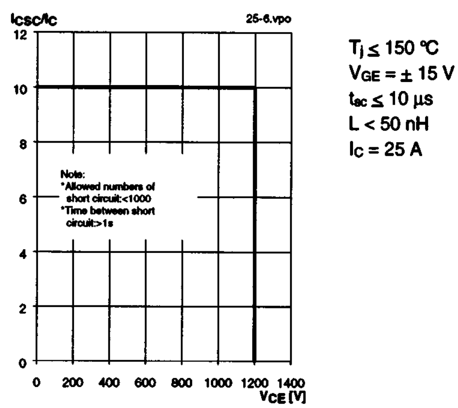



Fig. 6 Safe operating area at short circuit $I_C = f(V_{CE})$

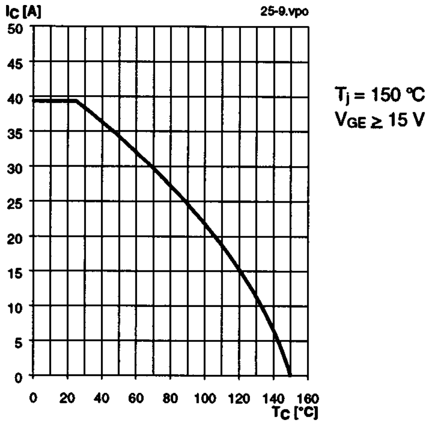



Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

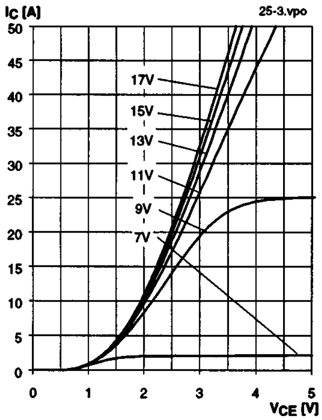



Fig. 9 Typ. output characteristic, $t_p$ = 80 µs; 25 °C

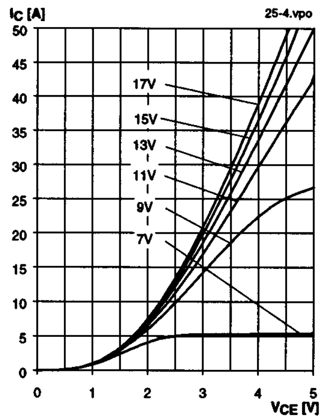



Fig. 10 Typ. output characteristic, $t_p$ = 80 µs; 125 °C

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

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

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

$r_{CE(Tj)} = 0{,}040 + 0{,}00016\,(T_j - 25)$ [Ω]

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

Fig. 11 Typ. saturation characteristic (IGBT)
Calculation elements and equations

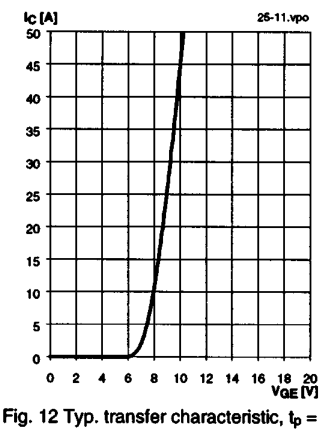
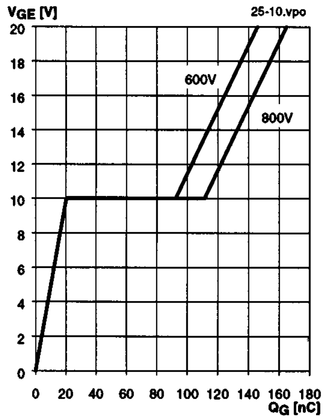
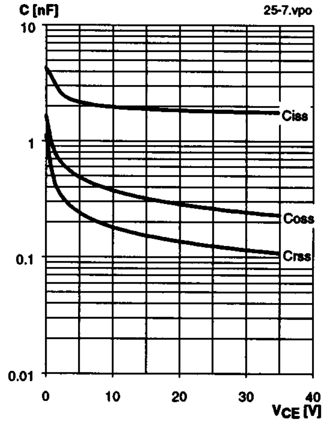



Fig. 12 Typ. transfer characteristic, $t_p$ = 80 µs; $V_{CE}$ = 20 V




$I_{Cpuls}$ = 25 A

Fig. 13 Typ. gate charge characteristic

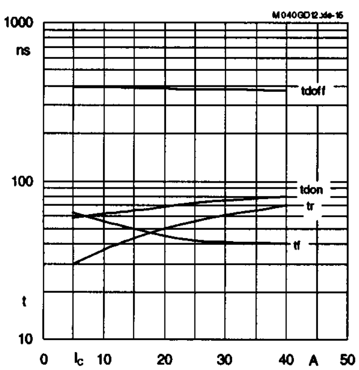



$V_{GE}$ = 0 V
f = 1 MHZ

$C_{ies}$

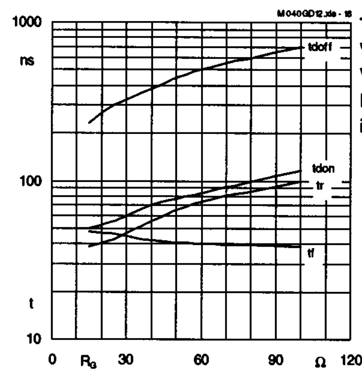
$C_{oes}$
$C_{res}$

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




$T_j$ = 125 °C
$V_{CE}$ = 600 V
$V_{GE}$ = ± 15 V
$R_{gon}$ = 40 Ω
$R_{goff}$ = 40 Ω
induct. load

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




$T_j$ = 125 °C
$V_{CE}$ = 600 V
$V_{GE}$ = ± 15 V
$I_C$ = 25 A
induct. load

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

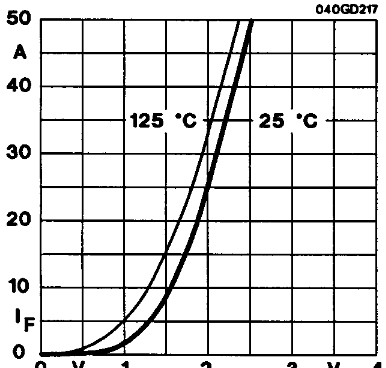



Fig. 17 Typ. CAL diode forward characteristic

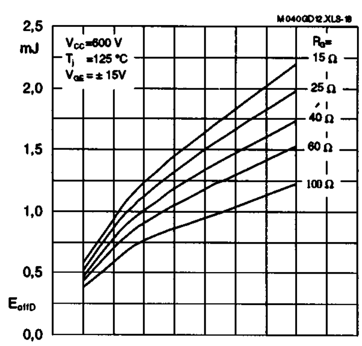



Fig. 18 Diode turn-off energy dissipation per pulse

 0796 

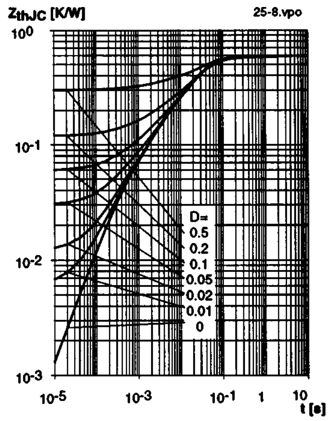



Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f\ (t_p)$; $D = t_p / t_c = t_p \cdot f$

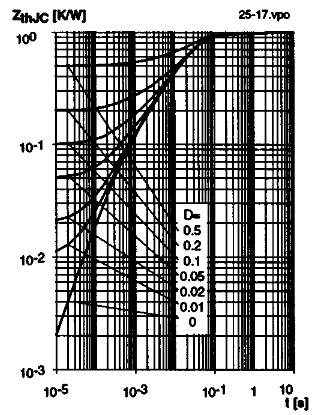



Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f\ (t_p)$; $D = t_p / t_c = t_p \cdot f$

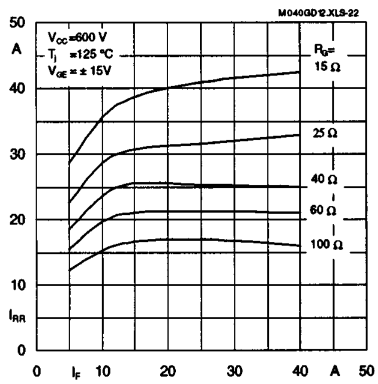



Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f\ (I_F; R_G)$

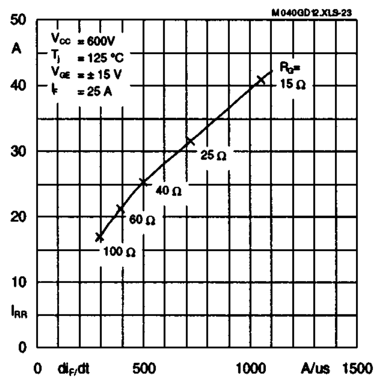



Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f\ (di/dt)$

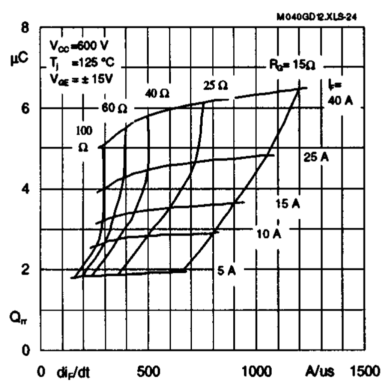
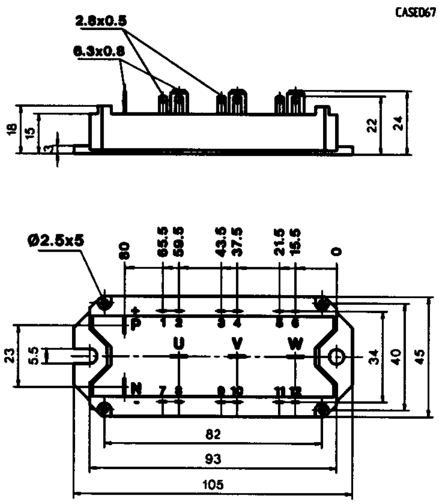
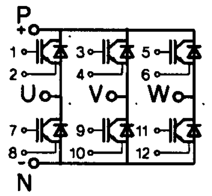



Fig. 24 Typ. CAL Diode recovered charge

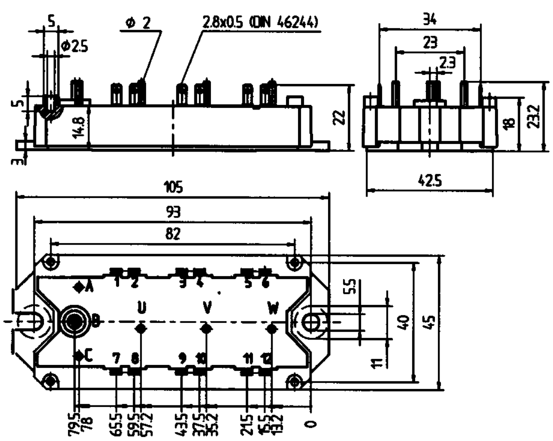
**SEMITRANS Sixpack**
Case D 67
UL Recognized
File no. E 63 532
**SKM 40 GD 123 D**

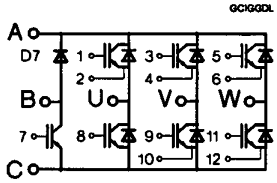



**SEMITRANS Sevenpack**
Case D 73
UL Recognized
File no. E 63 532
**SKM 40 GDL 123 D**

Remark: The pin height of 23,2 mm will be changed into 24,5 ± 0,2 mm during 1996




Dimensions in mm

Case outlines and circuit diagrams

| Mechanical Data | | | | | |
|---|---|---|---|---|---|
| **Symbol** | **Conditions** | **Values** min. | typ. | max. | **Units** |
| $M_1$ | to heatsink, SI Units (M5) | 4 | – | 5 | Nm |
| | to heatsink, US Units | 35 | – | 44 | lb.in. |
| a | | – | – | 5x9,81 | $m/s^2$ |
| w | | – | – | 190 | g |

**This is an electrostatic discharge sensitive device (ESD). Please observe the international standard IEC 747-1, Chapter IX.**
Two devices are supplied in one SEMIBOX A.
Larger packing units (10 and 20 pieces) are used if suitable.
SEMIBOX→ page C - 1.