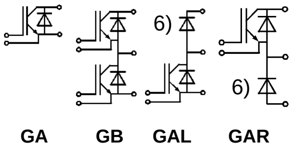
SEMIKRON

SEMITRANS® M
IGBT Modules

SKM 200 GA 123 D *)
SKM 200 GB 123 D
SKM 200 GB 123 D1 6)
SKM 200 GAL 123 D 6)
SKM 200 GAR 123 D 6)

SEMITRANS 3



Absolute Maximum Ratings

Symbol	Conditions 1)	Values ... 123 D	Values ... 123 D1	Units
V_{CES}		1200		V
V_{CGR}	R_{GE} = 20 kΩ	1200		V
I_C	T_{case} = 25/80 °C	200 / 150		A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	400 / 300		A
V_{GES}		± 20		V
P_{tot}	per IGBT, T_{case} = 25 °C	1250		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	55/150/56		
Inverse Diode			FWD 6)	
$I_F = -I_C$	T_{case} = 25/80 °C	200 / 130	260 / 180	A
$I_{FM} = -I_{CM}$	T_{case} = 25/80 °C; t_p = 1 ms	400 / 300	400 / 300	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	1450	1800	A
I^2t	t_p = 10 ms; T_j = 150 °C	10 500	24 200	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 = 6 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0, $V_{CE} = V_{CES}$; T_j = 25 °C	–	0,2	3	mA
	V_{GE} = 0, $V_{CE} = V_{CES}$; T_j = 125 °C	–	12	–	mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	1	µA
V_{CEsat}	I_C = 150 A; V_{GE} = 15 V; T_j = 25 (125) °C	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 200 A; V_{GE} = 15 V; T_j = 25 (125) °C	–	2,8(3,6)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 150 A	95	–	–	S
C_{CHC}	per IGBT	–		700	pF
C_{ies}	V_{GE} = 0; V_{CE} = 25 V; f = 1 MHz	–	10	13	nF
C_{oes}	V_{GE} = 0; V_{CE} = 25 V; f = 1 MHz	–	1,5	2	nF
C_{res}	V_{GE} = 0; V_{CE} = 25 V; f = 1 MHz	–	0,8	1,2	nF
L_{CE}		–	–	20	nH
$t_{d(on)}$	V_{CC} = 600 V; V_{GE} = -15 V / +15 V 3); I_C = 150 A, ind. load; $R_{Gon} = R_{Goff}$ = 5,6 Ω; T_j = 125 °C	–	220	400	ns
t_r		–	100	200	ns
$t_{d(off)}$		–	600	800	ns
t_f		–	70	100	ns
E_{on} 5)		–	24	–	mWs
E_{off} 5)		–	17	–	mWs
Inverse Diode 8)					
$V_F = V_{EC}$	I_F = 150 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,0(1,8)	2,5	V
$V_F = V_{EC}$	I_F = 200 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,25(2,05)	–	V
V_{TO}	T_j = 125 °C	–	–	1,2	V
r_T	T_j = 125 °C	–	5	7	mΩ
I_{RRM}	I_F = 150 A; T_j = 25 (125) °C 2)	–	55(80)	–	A
Q_{rr}	I_F = 150 A; T_j = 25 (125) °C 2)	–	8(20)	–	µC
FWD of types “GAL”, “GAR” "123D1" 8) 6)					
$V_F = V_{EC}$	I_F = 150 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	1,85(1,6)	2,2	V
$V_F = V_{EC}$	I_F = 200 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,0(1,8)	–	V
V_{TO}	T_j = 125 °C	–	–	1,2	V
r_T	T_j = 125 °C	–	3	5,5	mΩ
I_{RRM}	I_F = 150 A; T_j = 25 (125) °C 2)	–	60(90)	–	A
Q_{rr}	I_F = 150 A; T_j = 25 (125) °C 2)	–	8(23)	–	µC
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,1	°C/W
R_{thjc}	per diode / FWD “GAL; GAR”	–	–	0,25/0,18	°C/W
R_{thch}	per module	–	–	0,038	°C/W

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 (13 mm) and creepage distances (20 mm).

Typical Applications: → B 6 - 75

- Switching (not for linear use)

---

1) T_{case} = 25 °C, unless otherwise specified

2) $I_F = -I_C$, V_R = 600 V, $-di_F/dt$ = 1500 A/µs, V_{GE} = 0 V

3) Use V_{GEoff} = -5 ... -15 V

5) See fig. 2 + 3; R_{Goff} = 5,6 Ω

6) The free-wheeling diodes of the GAL and GAR types have the data of the inverse diodes of SKM 300 GA 123 D

7) V_{isol} = 4000 V_{rms} on request

8) CAL = Controlled Axial Lifetime Technology.

Cases and mech. data → B6 - 76

***) SEMITRANS 4 → B6 - 88**

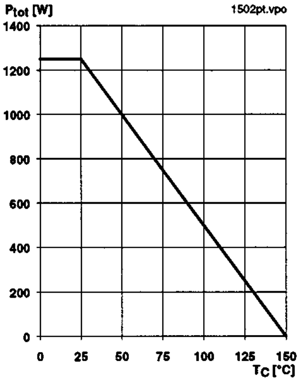
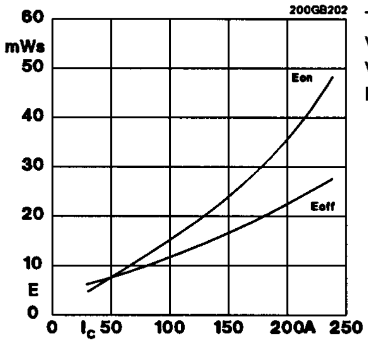
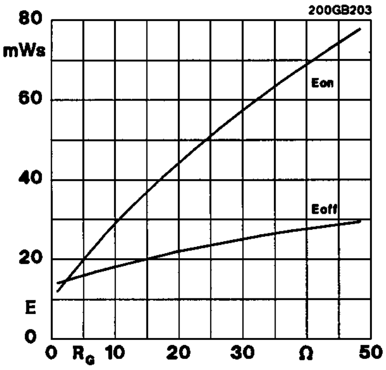


Fig. 1 Rated power dissipation P_{tot} = f (T_C)



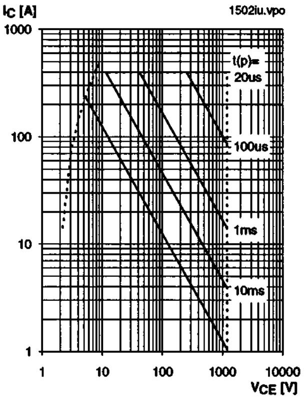
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 5,6 Ω

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 150 A

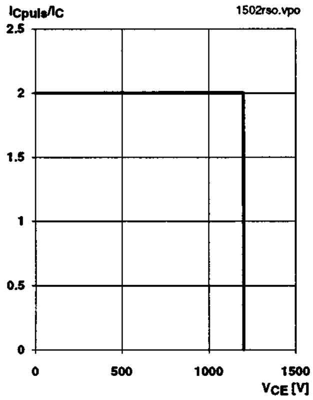
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
T_j ≤ 150 °C

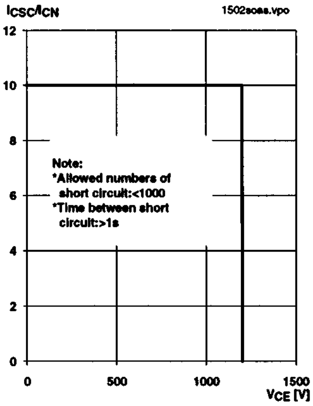
Not for
linear use

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



T_j ≤ 150 °C
V_{GE} = 15 V
$R_{g(off)}$ = 5,6 Ω
I_C = 150 A

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



Note:
*Allowed numbers of short circuit:<1000
*Time between short circuit:>1s

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

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

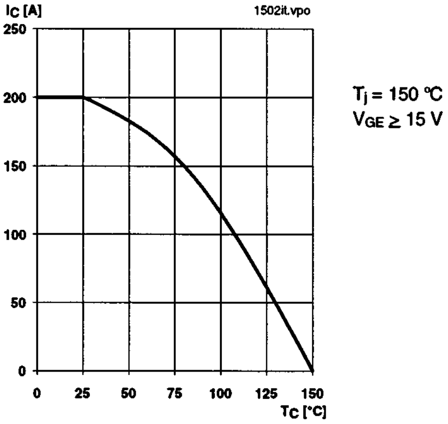


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

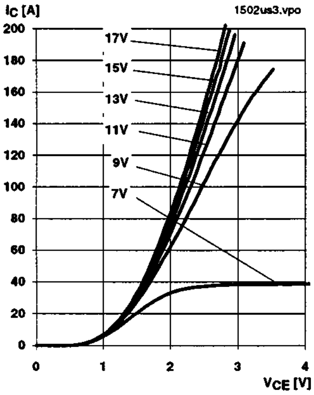


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

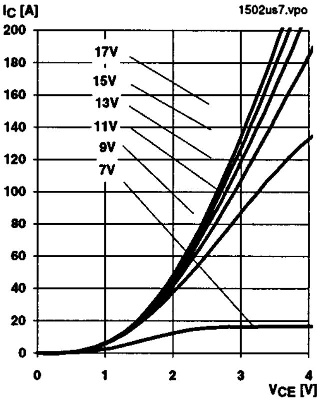


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

$r_{CE(Tj)} = 0{,}0066 + 0{,}000028\ (T_j - 25)$ [Ω]

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

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

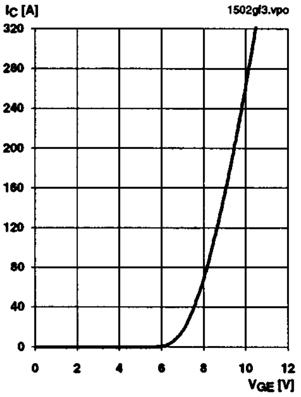
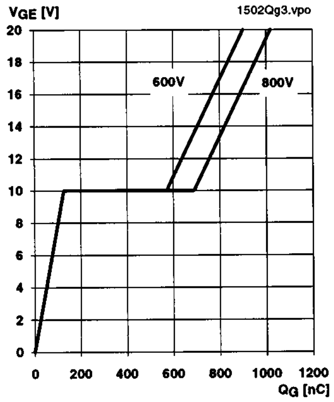
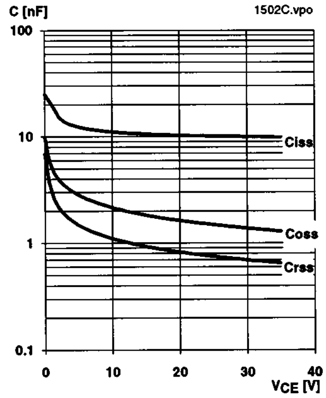


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



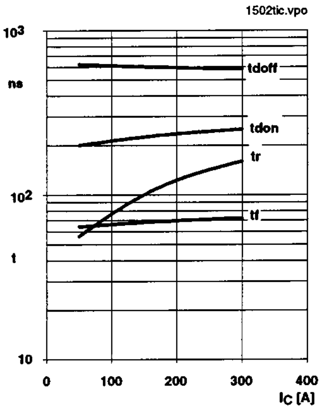
I_{Cpuls} = 150 A

Fig. 13 Typ. gate charge characteristic



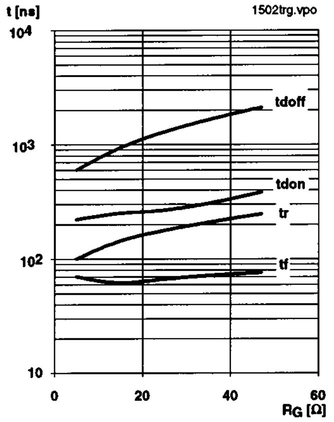
V_{GE} = 0 V
f = 1 MHZ

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{gon} = 5,6 Ω
R_{goff} = 5,6 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 = 150 A
induct. load

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

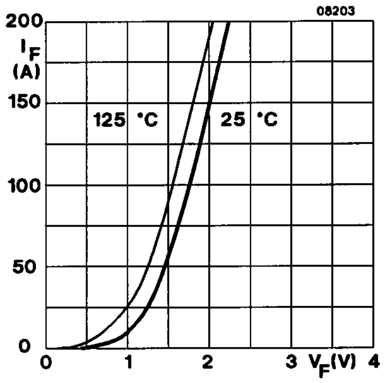


Fig. 17 Typ. CAL diode forward characteristic

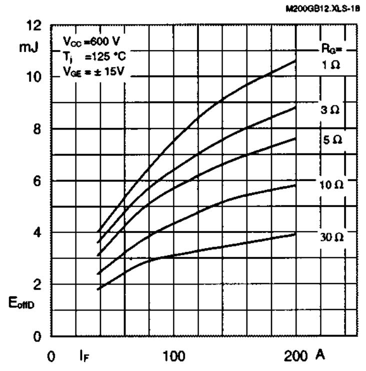


Fig. 18 Diode turn-off energy dissipation per pulse

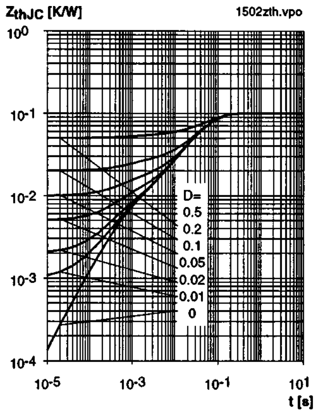


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

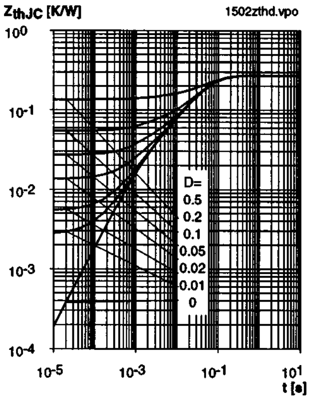


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

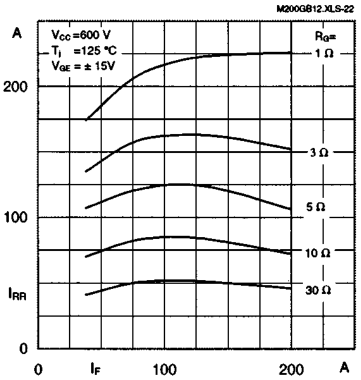


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F, R_G)$

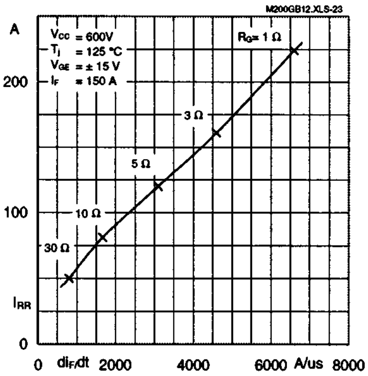


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di_F/dt)$

Typical Applications include

Switched mode power supplies

DC servo and robot drives

Inverters

DC choppers (versions GAR; GAL)

AC motor speed control

Inductive heating

UPS Uninterruptable power supplies

General power switching applications

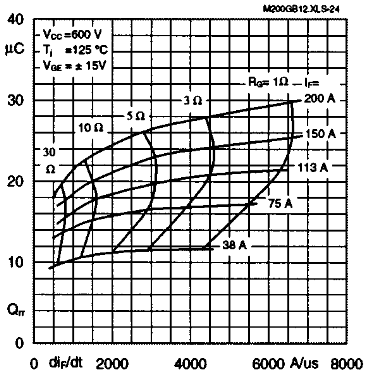


Fig. 24 Typ. CAL diode recovered charge Q_{RR}=f(di/dt)

SEMITRANS 3

Case D 56

UL Recognized

File no. E 63 532

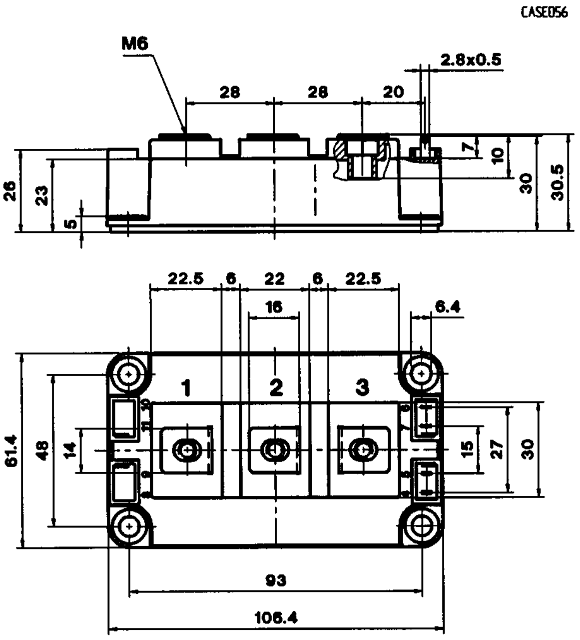
SKM 150 GB 123 D

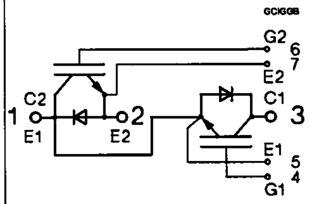
SKM 200 GB 123 D

SKM 200 GB 123 D1

SKM 200 GB 173 D

SKM 200 GB 173 D1

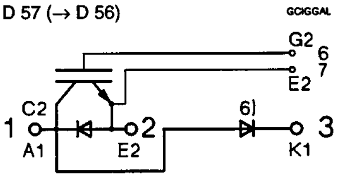




Dimensions in mm

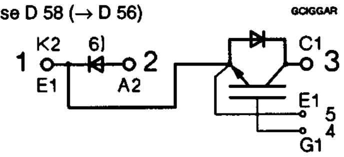
SKM 150 GAL 123 D **SKM 200 GAL 123 D**
SKM 200 GAL 173 D

Case D 57 (→ D 56)



SKM 150 GAR 123 D **SKM 200 GAR 123 D**

Case D 58 (→ D 56)



Case outline and circuit diagrams

For SKM 200 GA 123 D (SEMITRANS 4) → page B 6 - 88

Mechanical Data

Symbol	Conditions		Values 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			–	–	420	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 → page B 6 - 4.
SEMIBOX → page C - 1.

[6] Freewheeling diode → page B 6 - 71, remark 6.