SEMIKRON

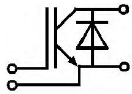
SEMITRANS® M IGBT Modules

SKM 400 GA 123 D

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	400 / 300	A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	800 / 600	A
V_{GES}		± 20	V
P_{tot}	per IGBT, T_{case} = 25 °C	2500	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			
I_F= – I_C	T_{case} = 25/80 °C	390 / 260	A
I_{FM}= – I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	800 / 600	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	2900	A
I^2t	t_p = 10 ms; T_j = 150 °C	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 = 12 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0, T_j = 25 °C	–	0,4	6	mA
	V_{CE} = V_{CES}, T_j = 125 °C	–	24		mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	1	µA
V_{CEsat}	I_C = 300 A, V_{GE} = 15 V;	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 400 A, T_j = 25 (125) °C	–	2,8(3,6)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 300 A	124	–	–	S
C_{CHC}		–	1300	1500	pF
C_{ies}	V_{GE} = 0	–	22	30	nF
C_{oes}	V_{CE} = 25 V	–	3,3	4	nF
C_{res}	f = 1 MHz	–	1,2	1,6	nF
L_{CE}		–	–	20	nH
$t_{d(on)}$	V_{CC} = 600 V	–	200	400	ns
t_r	V_{GE} = +15 V/-15V [3]	–	115	220	ns
$t_{d(off)}$	I_C = 300 A, ind. load	–	720	900	ns
t_f	R_{Gon} = R_{Goff} = 3,3 Ω	–	80	100	ns
E_{on} [5]	T_j = 125 °C	–	38	–	mWs
E_{off} [5]		–	40	–	mWs
Inverse Diode [8]					
V_F = V_{EC}	I_F = 300 A, V_{GE} = 0 V;	–	2,0(1,8)	2,5	V
V_F = V_{EC}	I_F = 400 A, T_j = 25 (125) °C	–	2,25(2,05)	–	V
V_{TO}	T_j = 125 °C [2]	–	–	1,2	V
r_T	T_j = 125 °C [2]	–	2,5	3,5	mΩ
I_{RRM}	I_F = 300 A; T_j = 25 (125) °C [2]	–	85(140)	–	A
Q_{rr}	I_F = 300 A; T_j = 25 (125) °C [2]	–	13(40)	–	µC
V_F = V_{EC}	I_F = 300 A, V_{GE} = 0 V;	–			V
V_F = V_{EC}	I_F = 400 A, T_j = 25 (125) °C	–		–	V
V_{TO}	T_j = 125 °C	–	–		V
r_T	T_j = 125 °C	–	–		mΩ
I_{RRM}	I_F = 300 A; T_j = 25 (125) °C [2]	–		–	A
Q_{rr}	I_F = 300 A; T_j = 25 (125) °C [2]	–		–	µC
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,05	°C/W
R_{thjc}	per diode D	–	–	0,125	°C/W
R_{thch}	per module	–	–	0,038	°C/W

SEMITRANS 4



GA

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 6-105

- 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 = 2000 A/µs, V_{GE} = 0 V

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

5) See fig. 2 + 3; R_{Goff} = 3,3 Ω

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

8) CAL = Controlled Axial Lifetime Technology.

Cases and mech. data → B6-106 SEMITRANS 4

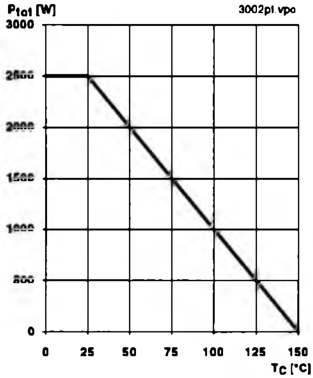
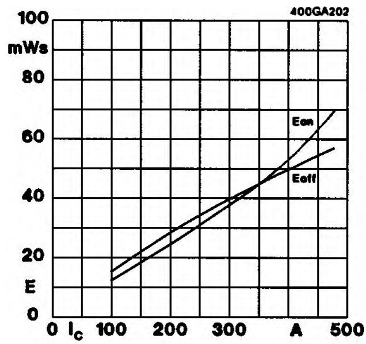
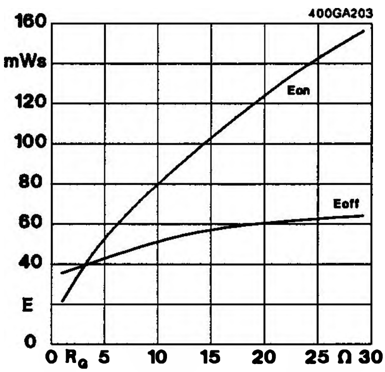


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



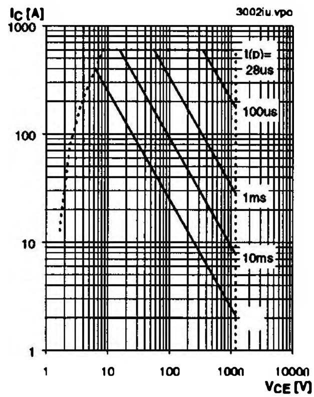
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 3,3 Ω

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 300 A

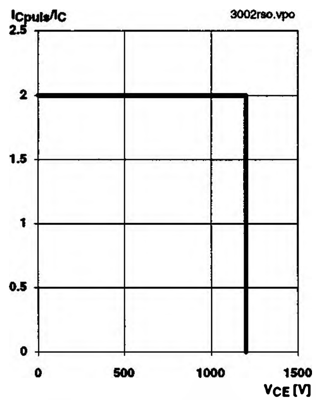
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
T_j ≤ 150 °C

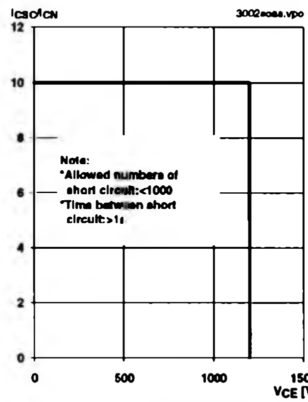
Not for
linear use

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



T_j ≤ 150 °C
V_{GE} = 15 V
$R_{g(off)}$ = 3,3 Ω
I_C = 300 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} = 300 A

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

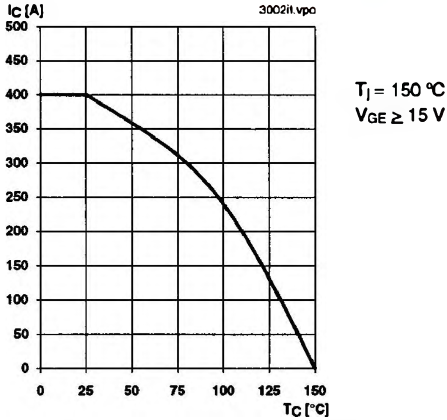


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

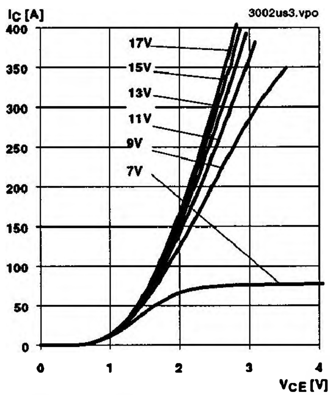


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

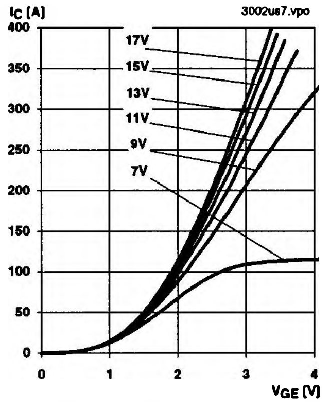


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

$r_{CE(Tj)} = 0{,}0033 + 0{,}000014\ (T_j - 25)$ [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

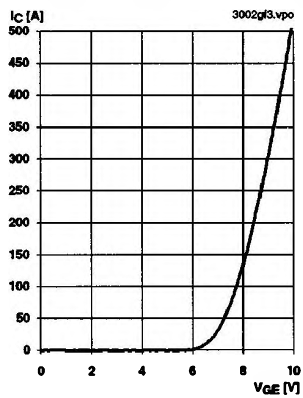
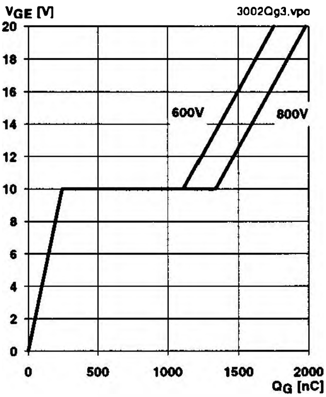
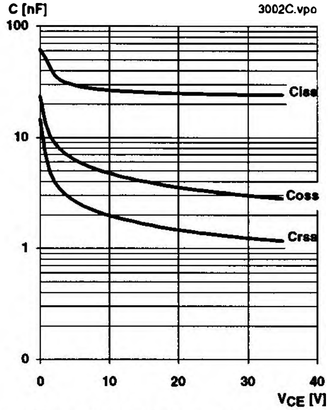


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



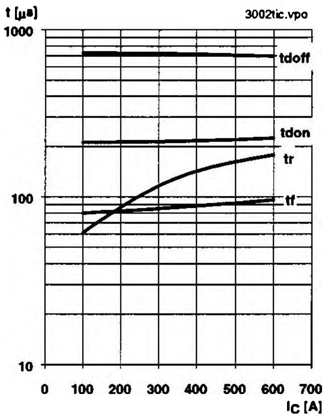
I_{Cpuls} = 300 A

Fig. 13 Typ. gate charge characteristic



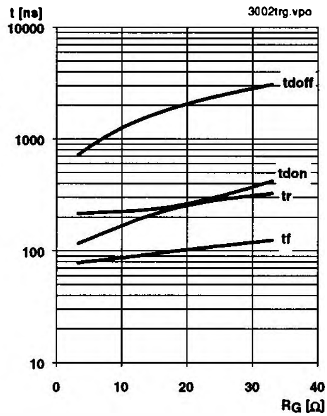
V_{GE} = 0 V
f = 1 MHZ

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{gon} = 3,3 Ω
R_{goff} = 3,3 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 = 300 A
induct. load

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

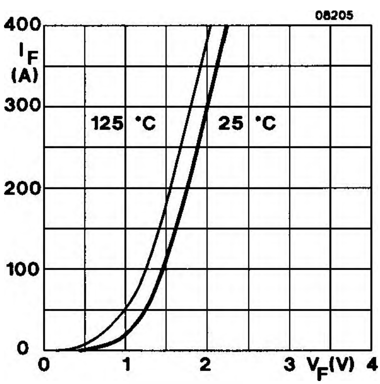


Fig. 17 Typ. CAL diode forward characteristic

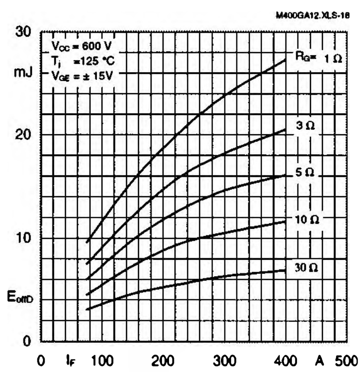


Fig. 18 Diode turn-off energy dissipation per pulse

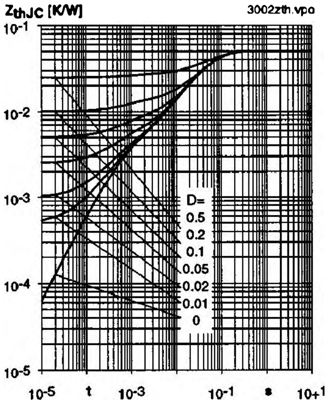


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

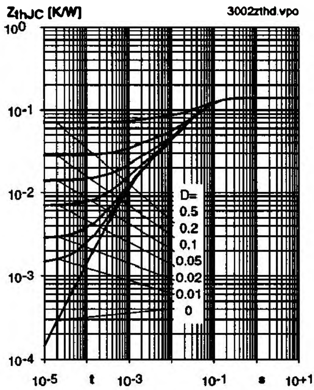


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

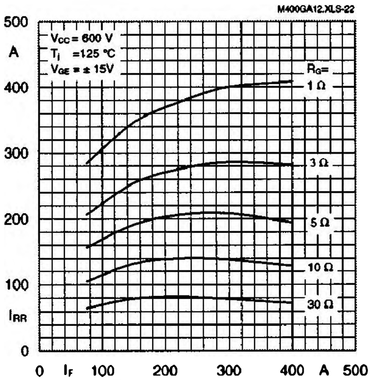


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

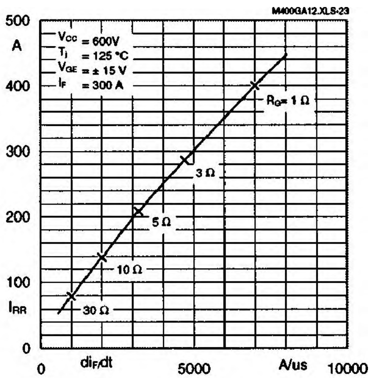


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di/dt)$

Typical Applications include

- Switched mode power supplies
- DC servo and robot drives
- Inverters
- DC choppers
- AC motor speed control
- Inductive heating
- UPS Uninterruptable power supplies
- General power switching applications
- Electronic (also portable) welders

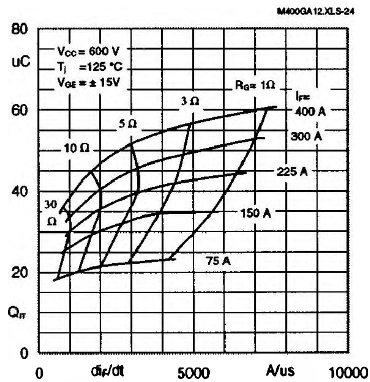


Fig. 24 Typ. CAL diode recovered charge

SEMITRANS 4

Case D 59

UL Recognized

File no. E 63 532

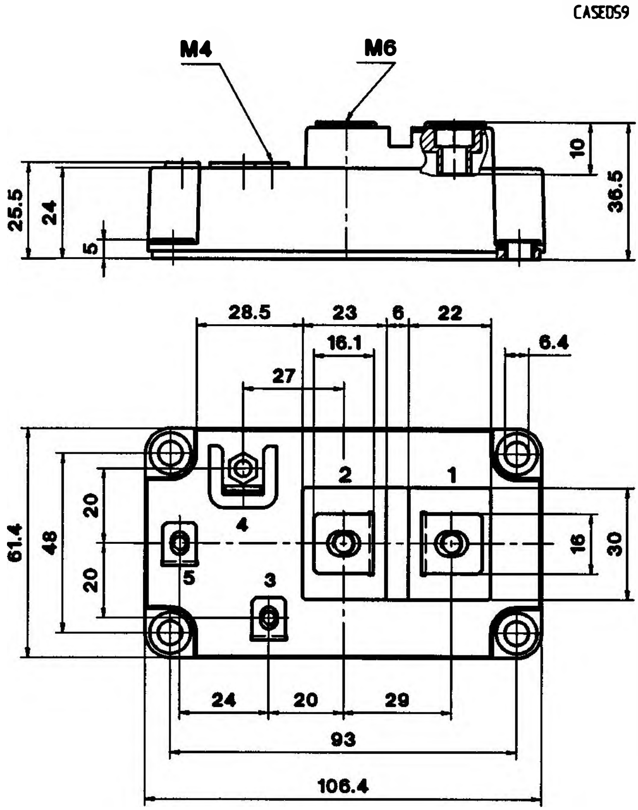
SKM 200 GA 123 D

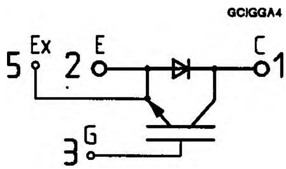
SKM 300 GA 123 D

SKM 300 GA 173 D

SKM 400 GA 123 D

SKM 400 GA 173 D





Dimensions in mm

Option on request:
Terminal 4 = collector sense V_{CE}, add suffix "S". (see page B 6 – 118)

Outline and circuit

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/M4)	2,5/1,1	–	5/2	Nm
	for terminals US Units	22/10	–	44/18	lb.in.
a		–	–	5x9,81	m/s^2
w		–	–	475	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 B without mounting hardware, which can be ordered separately under Ident No. 33321100 (for 10 SEMITRANS 4). Larger packing units of 12 and 20 pieces are used if suitable

Accessories → page B 6 - 4.
SEMIBOX B → page C - 2.

