SEMIKRON

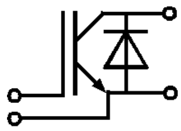
Absolute Maximum Ratings Symbol	Conditions [1]	Values	Units
V_{CES}		1200	V
V_{CGR}	R_{GE} = 20 kΩ	1200	V
I_C	T_{case} = 25/80 °C	400 / 360	A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	800 / 720	A
V_{GES}		± 20	V
P_{tot}	per IGBT, T_{case} = 25 °C	2750	W
T_j, (T_{stg})		– 40 . . .+150 (125)	°C
V_{isol}	AC, 1 min.	2 500 [7]	V
humidity	DIN 40 040	Class F	
climate	DIN IEC 68 T.1	40/125/56	
Inverse Diode			
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 / 720	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, V_{CE} = V_{CES}; T_j = 25 °C	–	0,4	6	mA
	V_{GE} = 0, 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; T_j = 25 (125) °C	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 400 A; V_{GE} = 15 V; 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, V_{CE} = 25 V, f = 1 MHz	–	22	30	nF
C_{oes}	V_{GE} = 0, V_{CE} = 25 V, f = 1 MHz	–	3,3	4	nF
C_{res}	V_{GE} = 0, V_{CE} = 25 V, f = 1 MHz	–	1,2	1,6	nF
L_{CE}		–	–	20	nH
$t_{d(on)}$	V_{CC} = 600 V; V_{GE} = +15 V/-15V [3]; I_C = 300 A, ind. load; R_{Gon} = R_{Goff} = 3,3 Ω; T_j = 125 °C	–	200	400	ns
t_r		–	115	220	ns
$t_{d(off)}$		–	720	900	ns
t_f		–	80	100	ns
E_{on} [5]		–	38	–	mWs
E_{off} [5]		–	40	–	mWs
Inverse Diode [8]					
V_F = V_{EC}	I_F = 300 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,0(1,8)	2,5	V
V_F = V_{EC}	I_F = 400 A; V_{GE} = 0 V; 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
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,045	°C/W
R_{thjc}	per diode D	–	–	0,125	°C/W
R_{thch}	per module	–	–	0,038	°C/W

SEMITRANS® M IGBT Modules

SKM 400 GA 123 D

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: → B6-187

- 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 → B6-188 SEMITRANS 4

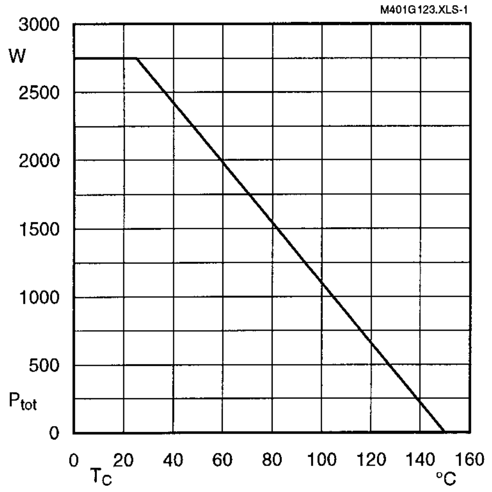
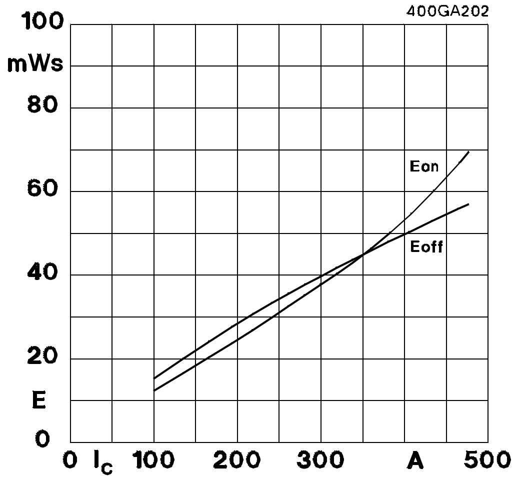
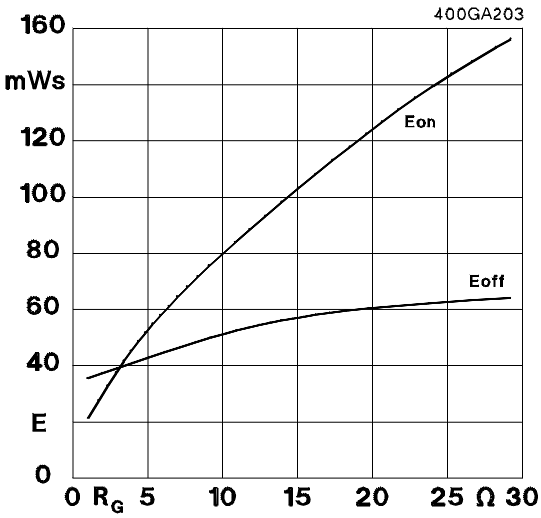


Fig. 1 Rated power dissipation P_{tot} = f (T_C)



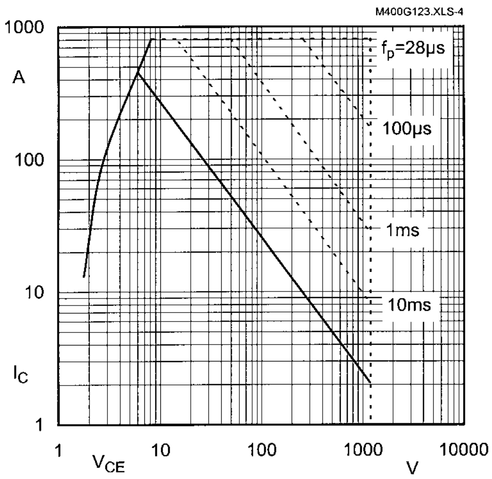
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 3,3 Ω

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

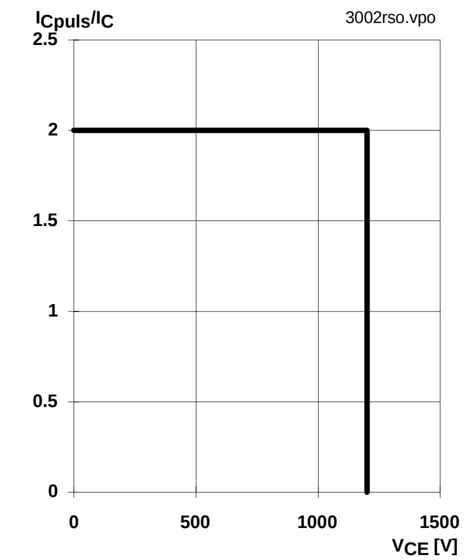
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
T_j ≤ 150 °C

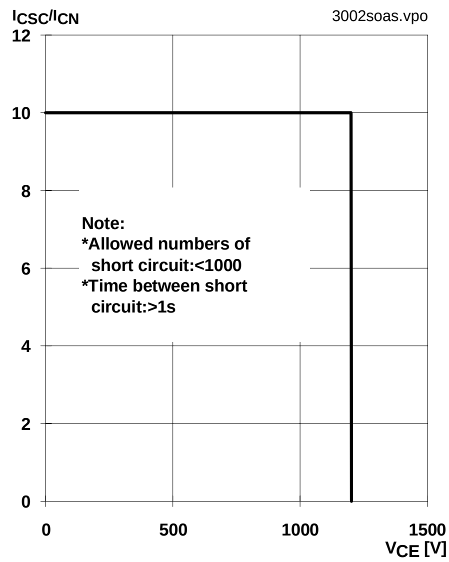
Not for linear use

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



T_j ≤ 150 °C
V_{GE} = 15 V
R_{Goff} = 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})

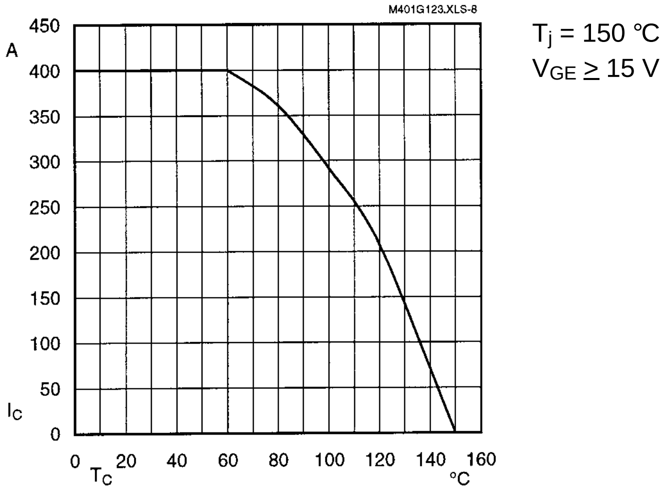


Fig. 8 Rated current vs. temperature $I_C = f\,(T_C)$

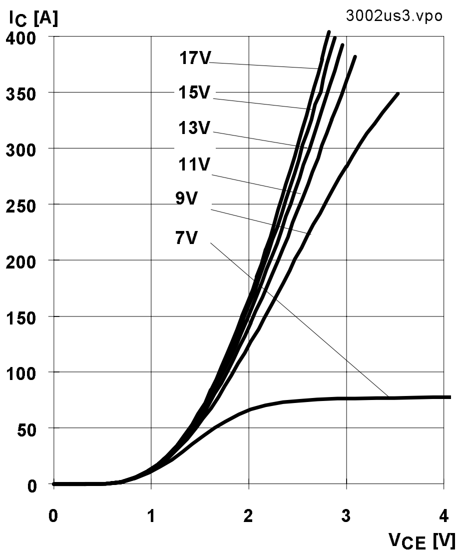


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

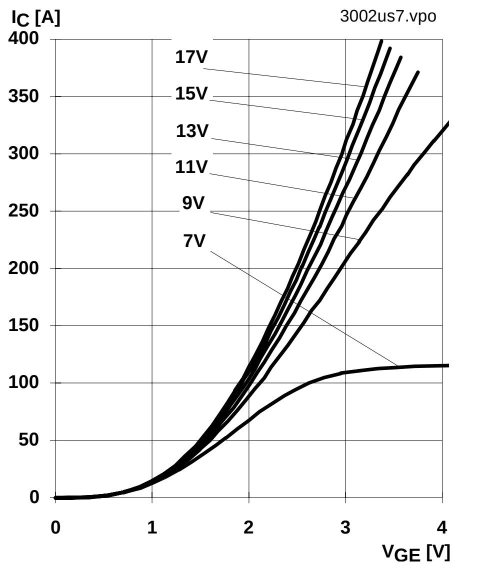


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

typ.: $r_{CE(Tj)} = 0{,}0033 + 0{,}000013\,(T_j - 25)$ [Ω]

max.: $r_{CE(Tj)} = 0{,}0050 + 0{,}000017\,(T_j - 25)$ [Ω]

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

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

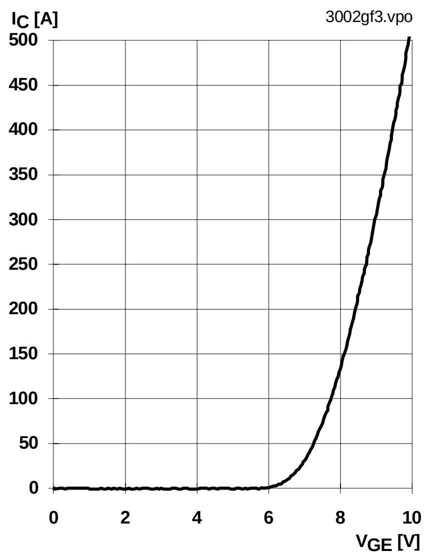
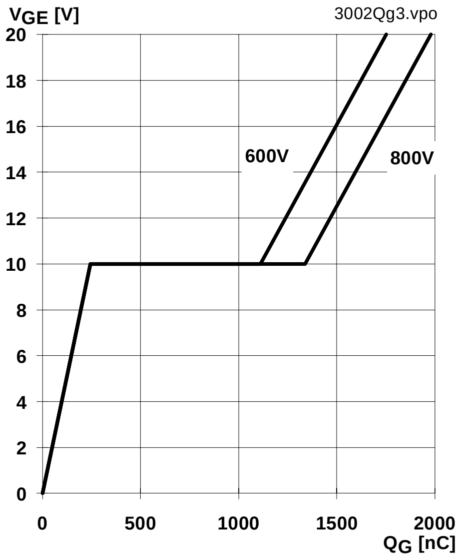
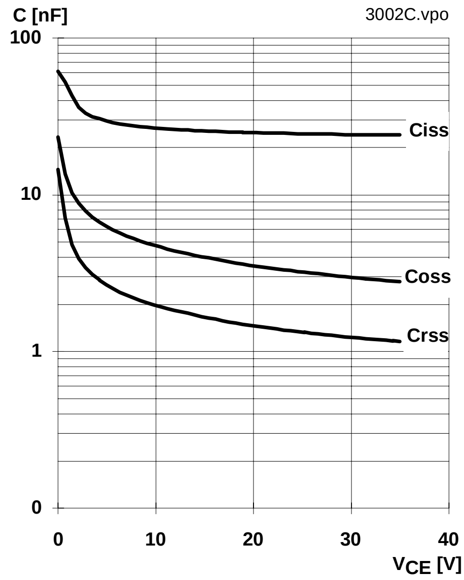


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



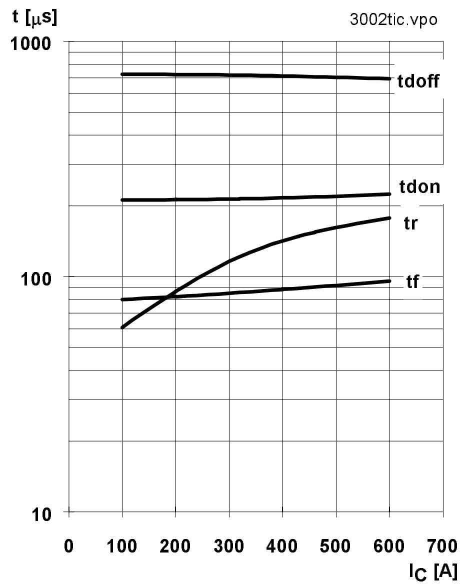
I_{Cpuls} = 300 A

Fig. 13 Typ. gate charge characteristic



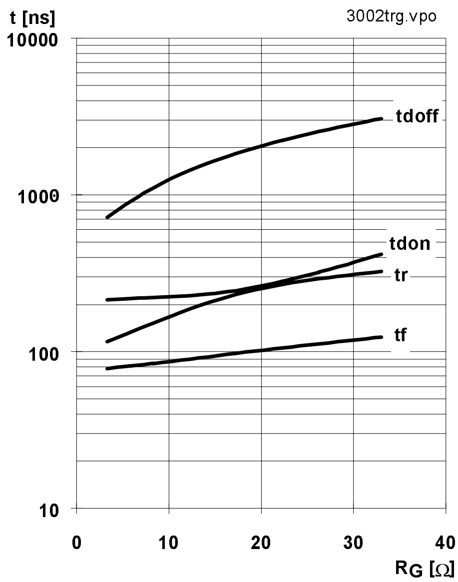
V_{GE} = 0 V
f = 1 MHZ

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{Gon} = 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

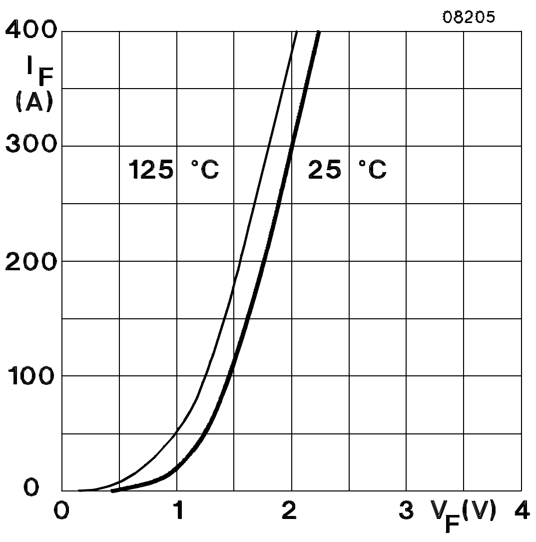


Fig. 17 Typ. CAL diode forward characteristic

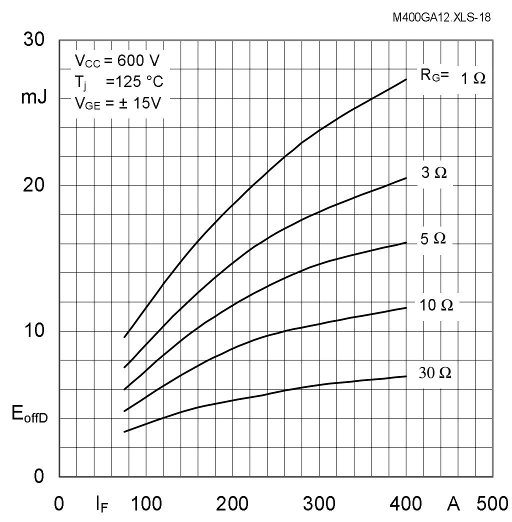


Fig. 18 Diode turn-off energy dissipation per pulse

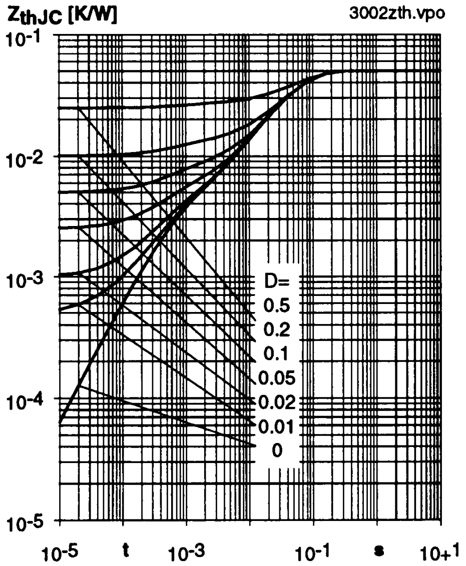


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

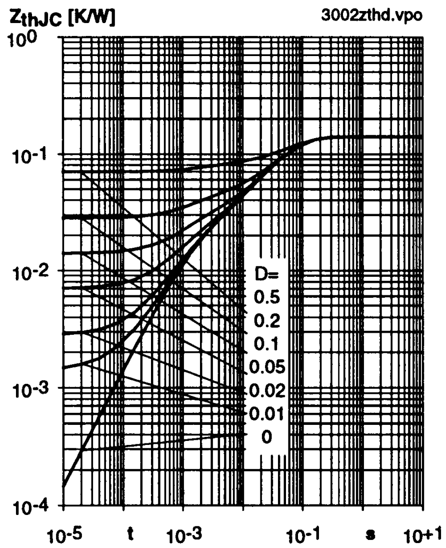


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

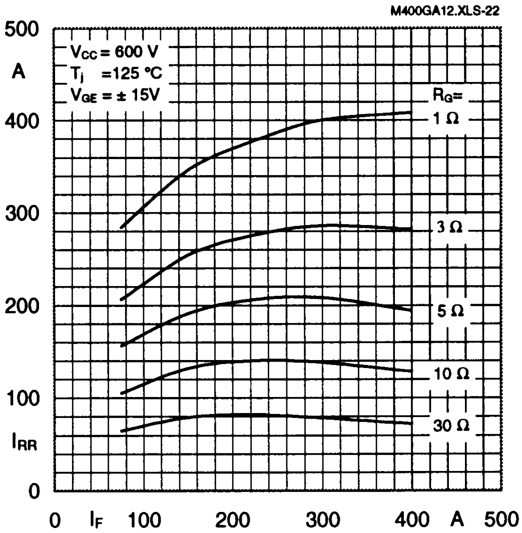


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

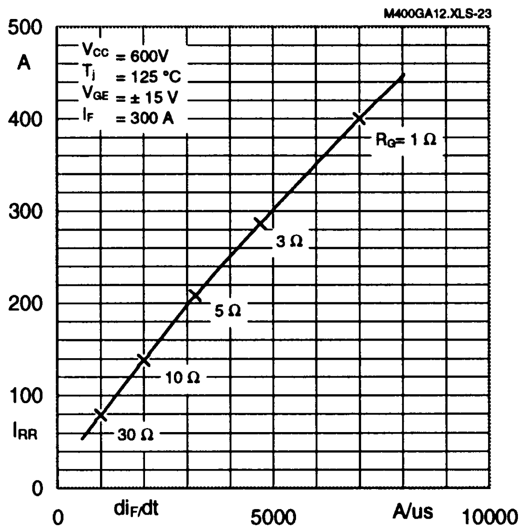


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di/dt)$

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

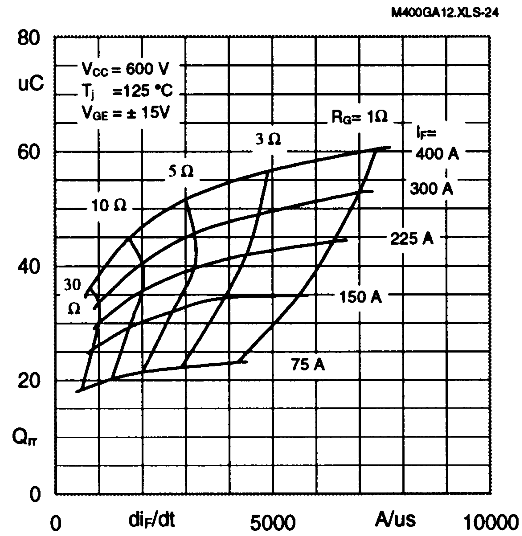


Fig. 24 Typ. CAL diode recovered charge

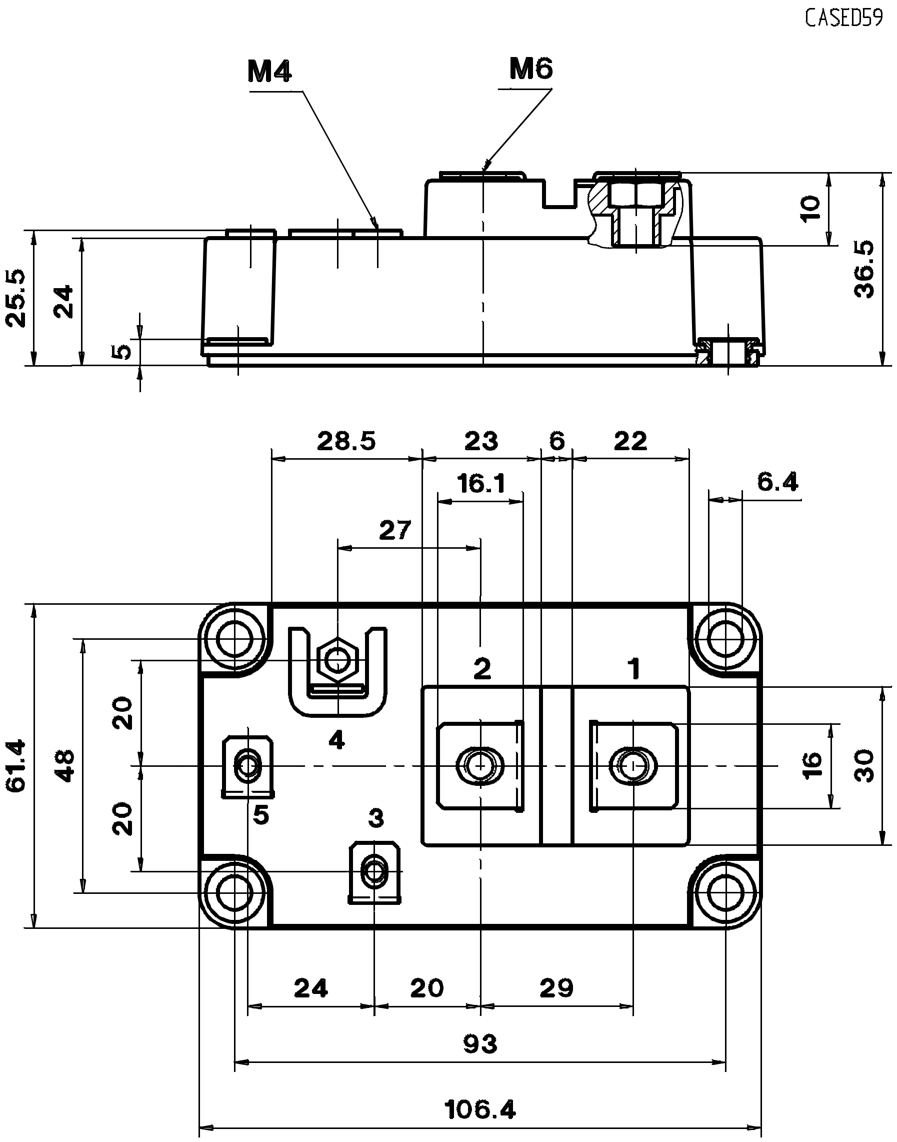
SEMITRANS 4

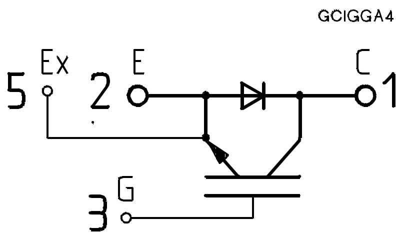
Case D 59

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 B 6 – 212)

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			–	–	330	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 → B 6 - 4.
SEMIBOX B → C - 2.