Absolute Maximum Ratings Symbol	Conditions [1]	Values ... 123 D	Units
V_{CES}		1200	V
V_{CGR}	R_{GE} = 20 kΩ	1200	V
I_C	T_{case} = 25/80 °C	50 / 40	A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	100 / 80	A
V_{GES}		± 20	V
P_{tot}	per IGBT, T_{case} = 25 °C	310	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	
Diodes			
I_F= – I_C	T_{case} = 25/80 °C	50 / 40	A
I_{FM}= – I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	100 / 80	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	550	
I^2t	t_p = 10 ms; T_j = 150 °C	1500	A^2s

Characteristics Symbol	Conditions [1]	min.	typ.	max.	Units
$V_{(BR)CES}$	V_{GE} = 0, I_C = 1 mA	≥ V_{CES}	–	–	V
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 2 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0, T_j = 25 °C	–	0,3	1	mA
	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 = 40 A; V_{GE} = 15 V; T_j = 25 (125) °C	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 50 A; V_{GE} = 15 V; T_j = 25 (125) °C	–	2,7(3,5)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 40 A		30	–	S
C_{CHC}	per IGBT	–	–	350	pF
C_{ies}	V_{GE} = 0	–	3300	4000	pF
C_{oes}	V_{CE} = 25 V	–	500	600	pF
C_{res}	f = 1 MHz	–	220	300	pF
L_{CE}		–	–	30	nH
$t_{d(on)}$	V_{CC} = 600 V	–	70	–	ns
t_r	V_{GE} = + 15 V / - 15 V [3]	–	60	–	ns
$t_{d(off)}$	I_C = 40 A, ind. load	–	400	–	ns
t_f	R_{Gon} = R_{Goff} = 22 Ω	–	45	–	ns
E_{on} [5]	T_j = 125 °C	–	7	–	mWs
E_{off} [5]		–	4,5	–	mWs
Diodes [8]					
V_F = V_{EC}	I_F = 40 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	1,85(1,6)	2,2	V
V_F = V_{EC}	I_F = 50 A; 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	–	–	22	mΩ
I_{RRM}	I_F = 40 A; Tj = 25 (125) °C [2]	–	23(35)	–	A
Q_{rr}	I_F = 40 A; T_j = 25 (125) °C [2]	–	2,3(7)	–	µC
V_F = V_{EC}	I_F = 50 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	–	–	V
V_F = V_{EC}	I_F = 75 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 = 50 A; T_j = 25 (125) °C [2]	–	–	–	A
Q_{rr}	I_F = 50 A; T_j = 25 (125) °C [2]	–	–	–	µC
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,4	°C/W
R_{thjc}	per diode	–	–	0,7	°C/W
R_{thch}	per module	–	–	0,05	°C/W

SEMITRANS® M IGBT Modules

SKM 50 GB 123 D
SKM 50 GAL 123 D



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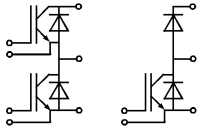


GB GAL

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

Typical Applications: → **B 6 - 21**

- Three phase inverter drives
- 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 = 800 A/µs, V_{GE} = 0 V
3) Use V_{GEoff} = -5 ... -15 V
5) See fig. 2 + 3; R_{Goff} = 27 Ω
8) CAL = Controlled Axial Lifetime Technology.

Case and mech. data → **B 6 - 22**
SEMITRANS 2

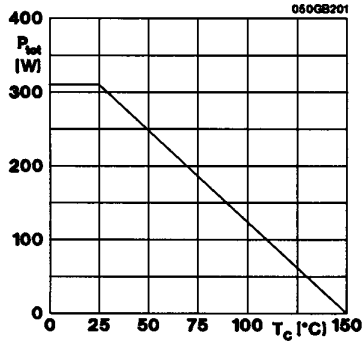
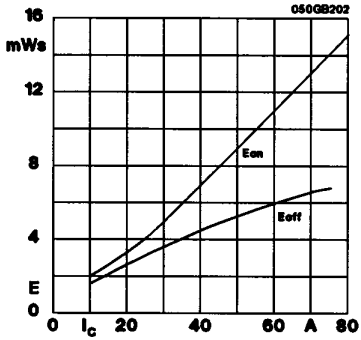
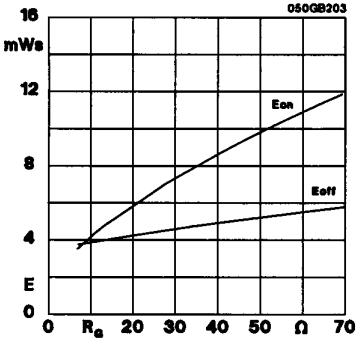


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



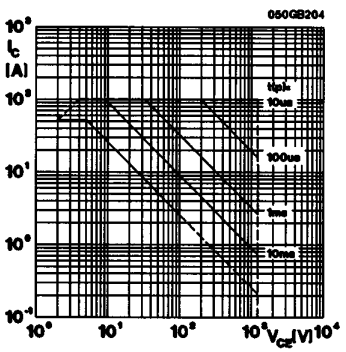
$T_j = 125\ °C$
$V_{CE} = 600\ V$
$V_{GE} = \pm 15\ V$
$R_G = 22\ \Omega$

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



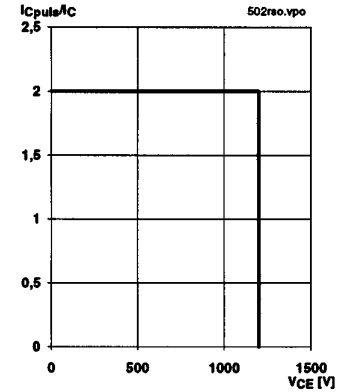
$T_j = 125\ °C$
$V_{CE} = 600\ V$
$V_{GE} = \pm 15\ V$
$I_C = 40\ A$

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



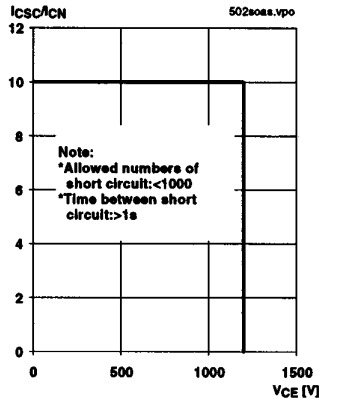
1 pulse
$T_C = 25\ °C$
$T_j \leq 150\ °C$

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



$T_j \leq 150\ °C$
$V_{GE} = \pm 15\ V$
$R_{g(off)} = 22\ \Omega$
$I_C = 40\ A$

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



$T_j \leq 150\ °C$
$V_{GE} = \pm 15\ V$
$t_{sc} \leq 10\ \mu s$
$L < 25\ nH$
$I_{CN} = 40\ A$

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

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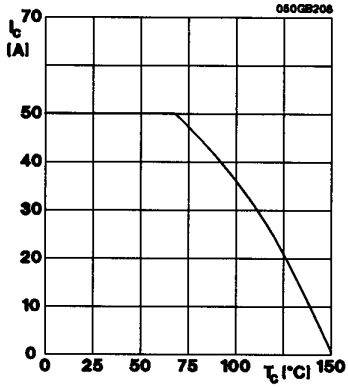


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

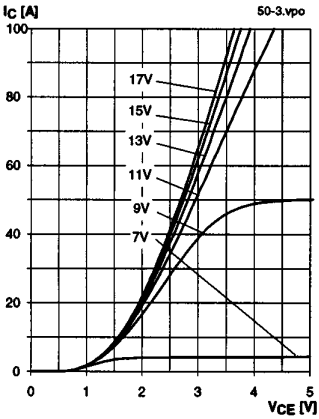


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

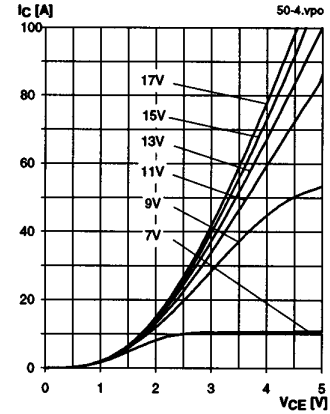


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

$r_{CE(Tj)} = 0{,}025 + 0{,}00010\ (T_j - 25)$ [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

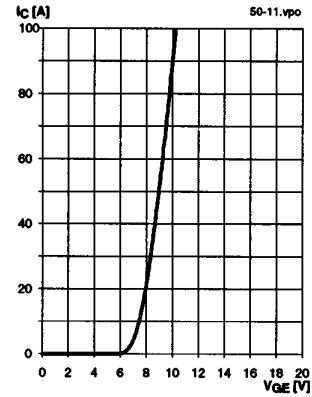


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V

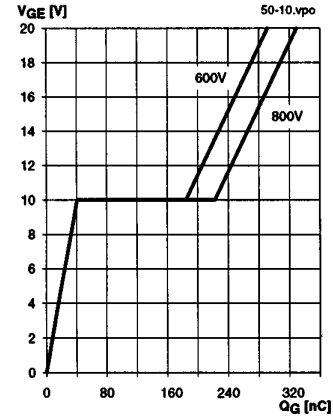
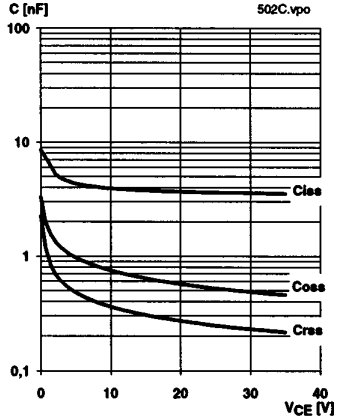


Fig. 13 Typ. gate charge characteristic

I_{Cpuls} = 50 A



V_{GE} = 0 V
f = 1 MHZ

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

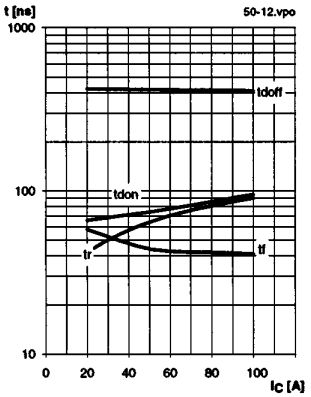


Fig. 15 Typ. switching times vs. I_C

T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{gon} = 22 Ω
R_{goff} = 22 Ω
induct. load

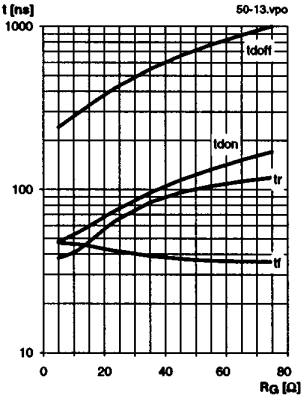


Fig. 16 Typ. switching times vs. gate resistor R_G

T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 40 A
induct. load

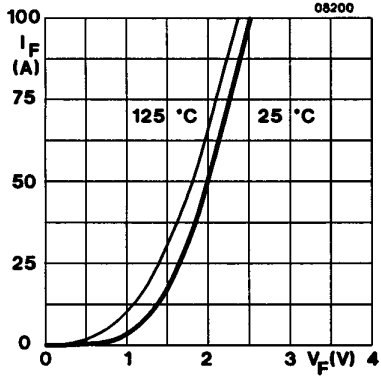


Fig. 17 Typ. CAL diode forward characteristic

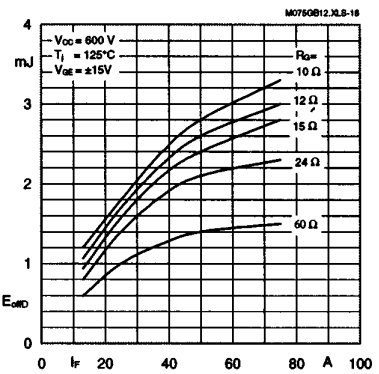


Fig. 18 Diode turn-off energy dissipation per pulse

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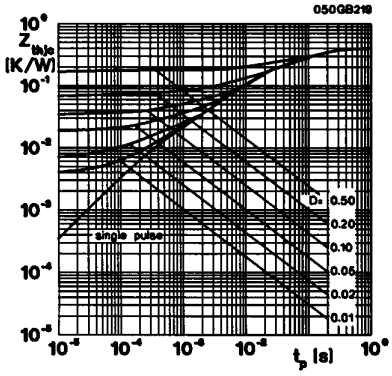


Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

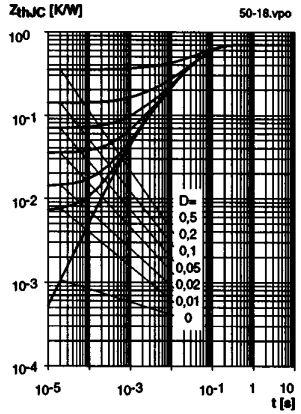


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

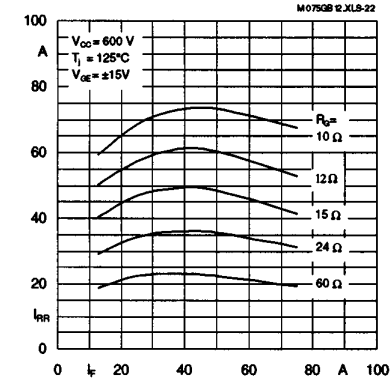


Fig. 22 Typ. CAL diode peak reverse recovery current
$I_{RR} = f(I_F, R_G)$

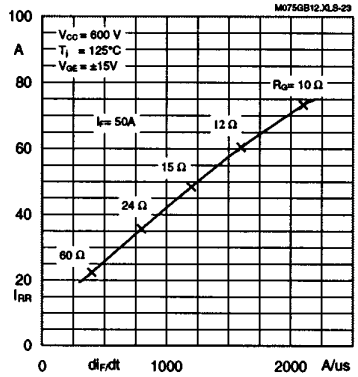


Fig. 23 Typ CAL diode peak reverse recovery current
$I_{RR} = f(di/dt)$

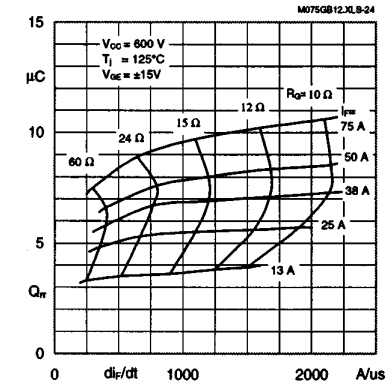


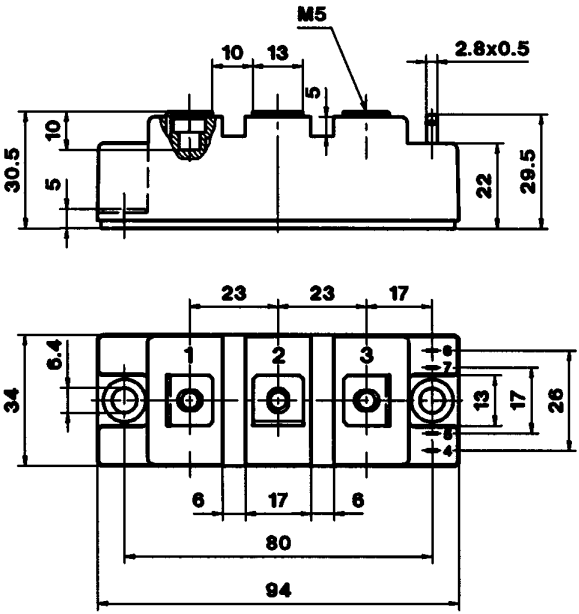
Fig. 24 Typ. CAL diode recovery charge

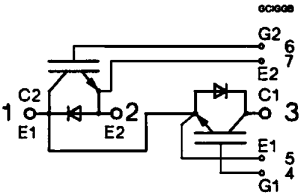
Typical Applications include

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
Pulse frequencies also above 15 kHz

SEMITRANS 2
Case D 61
UL Recognized
File no. E 63 532
SKM 50 GB 123 D

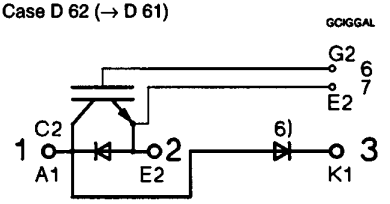
CASED61





Dimensions in mm

SKM 50 GAL 123 D
Case D 62 (→ D 61)



Case outline and circuit diagrams

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	(M5)	2,5	–	5	Nm
	for terminals US Units		22	–	44	lb.in.
a			–	–	5x9,81	m/s^2
w			–	–	250	g

This is an electrostatic discharge sensitive device (ESDS). Please observe the international standard IEC 747-1, Chapter IX.

Eight devices are supplied in one SEMIBOX A without mounting hardware, which can be ordered separately under Ident No. 33321100 (for 10 SEMITRANS 2)
Larger packaging units of 20 or 42 pieces are used if suitable
Accessories → page B 6 - 4.
SEMIBOX → page C - 1.

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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	78 / 50		A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	156 / 100		A
V_{GES}		± 20		V
P_{tot}	per IGBT, T_{case} = 25 °C	400		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	
I_F= – I_C	T_{case} = 25/80 °C	75 / 50	95/65	A
I_{FM}= – I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	152 / 100	152/100	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	550	720	A
I^2t	t_p = 10 ms; T_j = 150 °C	150	2600	A^2s

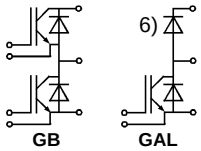
Characteristics Symbol	Conditions [1]	min.	typ.	max.	Units
$V_{(BR)CES}$	V_{GE} = 0, I_C = 4 mA	≥ V_{CES}	–	–	V
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 2 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0, T_j = 25 °C	–	0,8	1	mA
	V_{CE} = V_{CES}, T_j = 125 °C	–	3,5		mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	200	nA
V_{CEsat}	I_C = 50 A, V_{GE} = 15 V;	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 75 A, T_j = 25 (125) °C	–	3(3,8)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 50 A	23	40	–	S
C_{CHC}	per IGBT	–	–	350	pF
C_{ies}	V_{GE} = 0	–	3,3	4,3	nF
C_{oes}	V_{CE} = 25 V	–	500	600	pF
C_{res}	f = 1 MHz	–	220	300	pF
L_{CE}		–	–	30	nH
$t_{d(on)}$	V_{CC} = 600 V	–	44	100	ns
t_r	V_{GE} = + 15 V, - 15 V [3]	–	56	100	ns
$t_{d(off)}$	I_C = 50 A, ind. load	–	380	500	ns
t_f	R_{Gon} = R_{Goff} = 22 Ω	–	70	100	ns
E_{on} [5]	T_j = 125 °C	–	8	–	mWs
E_{off} [5]		–	5	–	mWs
Inverse Diode [8]					
V_F = V_{EC}	I_F = 50 A, V_{GE} = 0 V;	–	2,0(1,8)	2,5	V
V_F = V_{EC}	I_F = 75 A, T_j = 25 (125) °C	–	2,25 (2,1)	–	V
V_{TO}	T_j = 125 °C	–	–	1,2	V
r_T	T_j = 125 °C	–	18	22	mΩ
I_{RRM}	I_F = 50 A; T_j = 25 (125) °C [2]	–	23(35)	–	A
Q_{rr}	I_F = 50 A; T_j = 25 (125) °C [2]	–	2,3(7)	–	µC
FWD of types "GAL" [8]					
V_F = V_{EC}	I_F = 50 A, V_{GE} = 0 V;	–	1,85(1,6)	2,2	V
V_F = V_{EC}	I_F = 75 A, 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	–	12	15	mΩ
I_{RRM}	I_F = 50 A; T_j = 25 (125) °C [2]	–	27(40)	–	A
Q_{rr}	I_F = 50 A; T_j = 25 (125) °C [2]	–	2,5(8)	–	µC
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,30	°C/W
R_{thjc}	per diode / FWD "GAL"	–	–	0,60/0,50	°C/W
R_{thch}	per module	–	–	0,05	°C/W

SEMITRANS® M
IGBT Modules

SKM 75 GB 123 D
SKM 75 GAL 123 D [6]



SEMITRANS 2



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

Typical Applications: → B 6 - 27

- 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 = 800 A/µs, V_{GE} = 0 V
3) Use V_{GEoff} = -5 ... -15 V
5) See fig. 2 + 3; R_{Goff} = 22 Ω
6) The free-wheeling diodes of the GAL types have the data of the inverse diodes of SKM 100 GB 123 D
7) V_{isol} = 4000 V_{rms} on request
8) CAL = Controlled Axial Lifetime Technology.

Cases and mech. data → B6 - 28
SEMITRANS 2

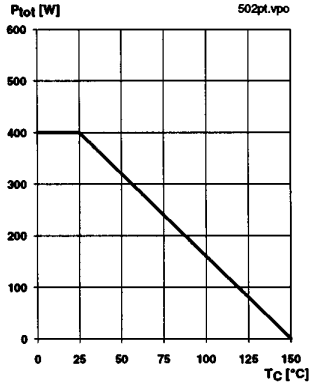
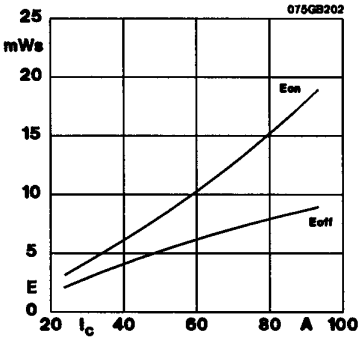
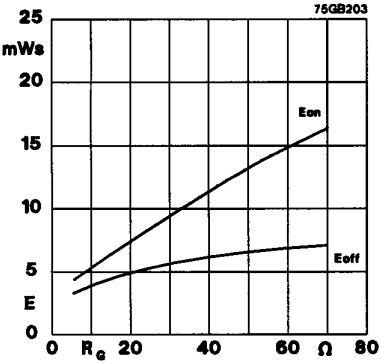


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



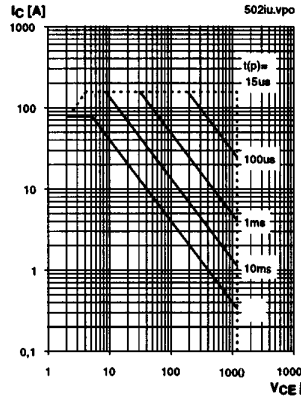
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 22 Ω

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 50 A

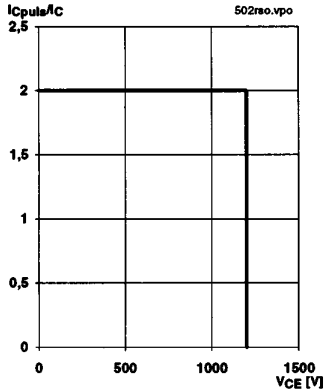
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
$T_j \leq$ 150 °C

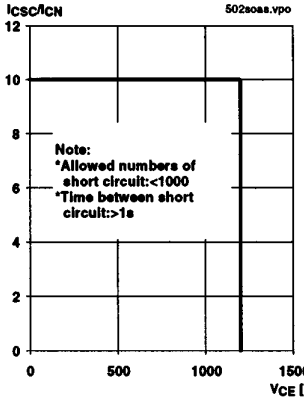
Not for linear use

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



$T_j \leq$ 150 °C
V_{GE} = 15 V
$R_{g(off)}$ = 22 Ω
I_C = 50 A

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



$T_j \leq$ 150 °C
V_{GE} = ± 15 V
$t_{sc} \leq$ 10 µs
L < 25 nH
I_{CN} = 50 A

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

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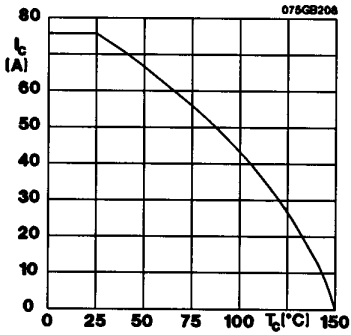


T_j = 150 °C
$V_{GE} \geq$ 15 V

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

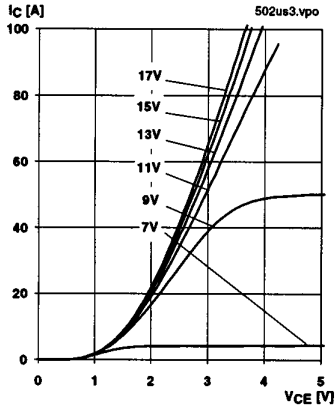


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

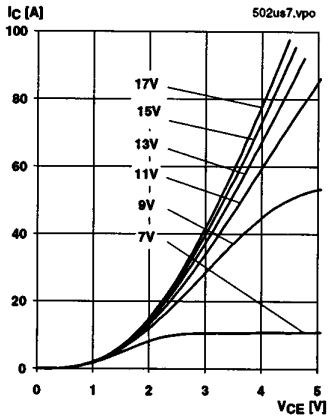


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

$r_{CE(Tj)} = 0{,}020 + 0{,}00008\ (T_j - 25)$ [Ω]

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

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

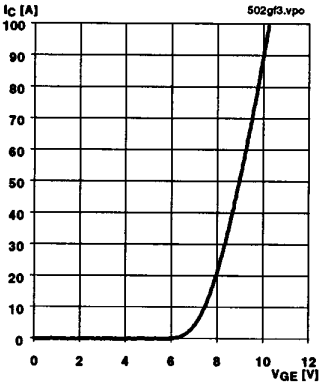


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V

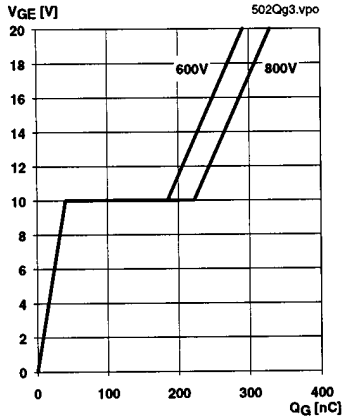
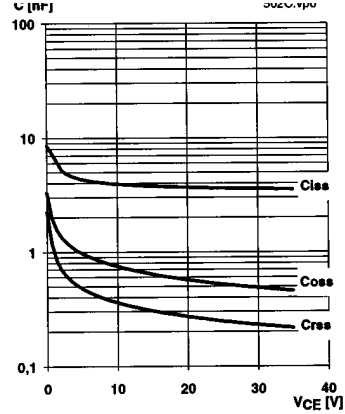


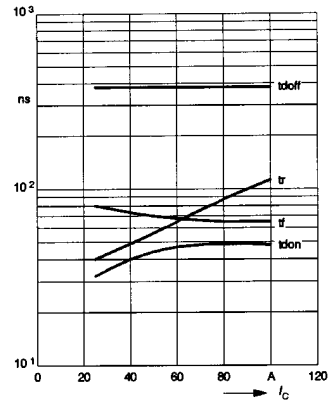
Fig. 13 Typ. gate charge characteristic

I_{Cpuls} = 50 A



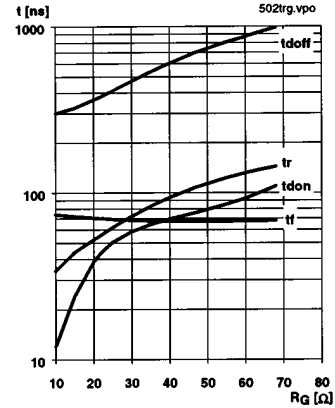
V_{GE} = 0 V
f = 1 MHZ

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{gon} = 22 Ω
R_{goff} = 22 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 = 50 A
induct. load

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

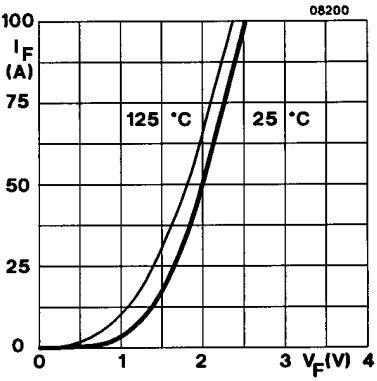


Fig. 17 Typ. CAL diode forward characteristic

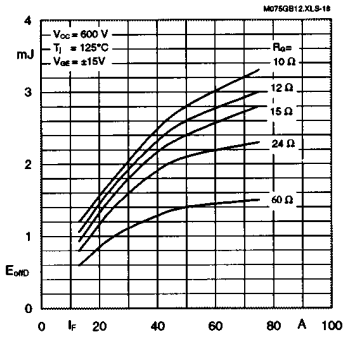


Fig. 18 Diode turn-off energy dissipation per pulse

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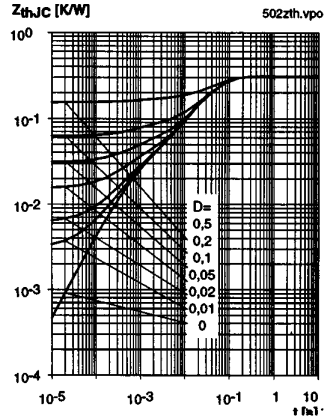


Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

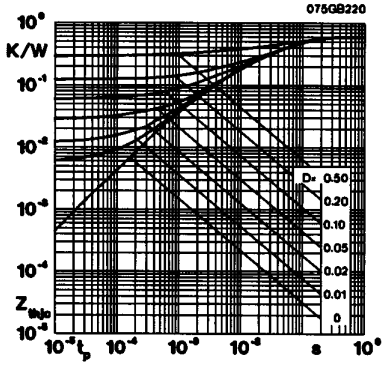


Fig. 20 Transient thermal impedance of inverse CAL diodes
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

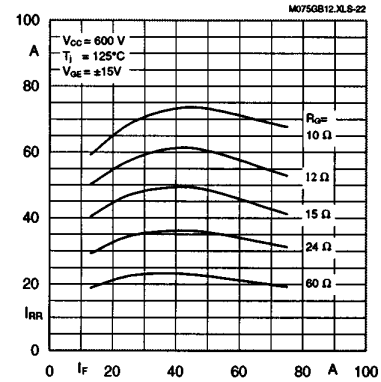


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

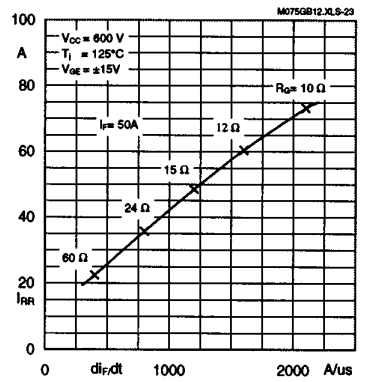


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di/dt)$

Typical Applications include

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

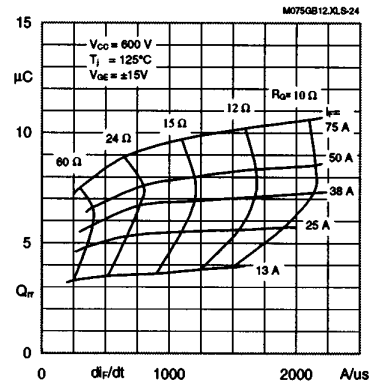
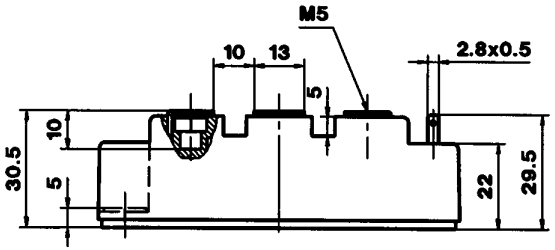


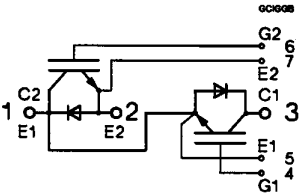
Fig. 24 Typ. CAL diode recovered charge $Q_{rr} = f(di/dt)$

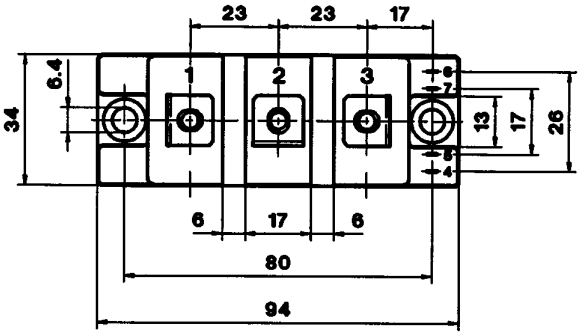
SEMITRANS 2
Case D 61
UL Recognized
File no. E 63 532

SKM 75 GB 123 D
SKM 75 GB 173 D

CASED61

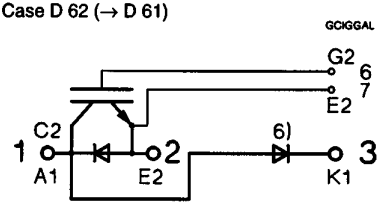






Dimensions in mm

SKM 75 GAL 123 D
Case D 62 (→ D 61)



Case outline and circuit diagrams

Mechanical Data						
Symbol	Conditions		Values			Units
			min.	typ.	max.	
M_1	to heatsink, SI Units	(M6)	3	–	5	Nm
	to heatsink, US Units		27	–	44	lb.in.
M_2	for terminals, SI Units	(M5)	2,5	–	5	Nm
	for terminals US Units		22	–	44	lb.in.
a			–	–	5x9,81	m/s^2
w			–	–	250	g

This is an electrostatic discharge sensitive device (ESDS). Please observe the international standard IEC 747-1, Chapter IX.

Eight devices are supplied in one SEMIBOX A without mounting hardware, which can be ordered separately under Ident No. 33321100 (for 10 SEMITRANS 2)
Accessories → page B 6 - 4.
SEMIBOX → page C - 1.
Larger packing units of 20 or 42 pieces are used if suitable.

6) Freewheeling diode → page B 6 - 23, remark 6.

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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	100 / 75		A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	200 / 150		A
V_{GES}		± 20		V
P_{tot}	per IGBT, T_{case} = 25 °C	625		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	95 / 65	130 / 90	A
I_{FM}= – I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	200 / 150	200 / 150	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	720	1100	A
I^2t	t_p = 10 ms; T_j = 150 °C	2600	6000	A^2s

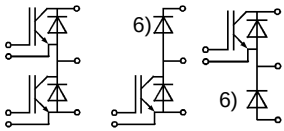
Characteristics Symbol	Conditions [1]	min.	typ.	max.	Units
$V_{(BR)CES}$	V_{GE} = 0, I_C = 4 mA	≥ V_{CES}	–	–	V
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 2 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0, T_j = 25 °C	–	0,1	1,5	mA
	V_{CE} = V_{CES}, T_j = 125 °C	–	6		mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	300	nA
V_{CEsat}	I_C = 75 A, V_{GE} = 15 V;	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 100 A, T_j = 25 (125) °C	–	2,8(3,6)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 75 A	31		–	S
C_{CHC}	per IGBT	–	–	350	pF
C_{ies}	V_{GE} = 0	–	5	6,6	nF
C_{oes}	V_{CE} = 25 V	–	720	900	pF
C_{res}	f = 1 MHz	–	380	500	pF
L_{CE}		–	–	30	nH
$t_{d(on)}$	V_{CC} = 600 V	–	30	60	ns
t_r	V_{GE} = +15 V, - 15 V [3]	–	70	140	ns
$t_{d(off)}$	I_C = 75 A, ind. load	–	450	600	ns
t_f	R_{Gon} = R_{Goff} = 15 Ω	–	70	90	ns
E_{on} [5]	T_j = 125 °C	–	10	–	mWs
E_{off} [5]		–	8	–	mWs
Inverse Diode [8]					
V_F = V_{EC}	I_F = 75 A, V_{GE} = 0 V;	–	2,0(1,8)	2,5	V
V_F = V_{EC}	I_F = 100 A, 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	–	12	15	mΩ
I_{RRM}	I_F = 75 A; T_j = 25 (125) °C [2]	–	27(40)	–	A
Q_{rr}	I_F = 75 A; T_j = 25 (125) °C [2]	–	3(10)	–	µC
FWD of types “GAL”, “GAR” [8]					
V_F = V_{EC}	I_F = 75 A, V_{GE} = 0 V;	–	1,85(1,6)	2,2	V
V_F = V_{EC}	I_F = 100 A, 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	–	9	11	mΩ
I_{RRM}	I_F = 75 A; T_j = 25 (125) °C [2]	–	30(45)	–	A
Q_{rr}	I_F = 75 A; T_j = 25 (125) °C [2]	–	3,5(11)	–	µC
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,2	°C/W
R_{thjc}	per diode / FWD “GAL; GAR”	–	–	0,50/0,36	°C/W
R_{thch}	per module	–	–	0,05	°C/W

SEMITRANS® M
IGBT Modules

SKM 100 GB 123 D
SKM 100 GAL 123 D [6]
SKM 100 GAR 123 D [6]



SEMITRANS 2



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

Typical Applications: → B 6 - 45

- 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 = 800 A/µs, V_{GE} = 0 V
3) Use V_{GEoff} = -5 ... -15 V
5) See fig. 2 + 3; R_{Goff} = 15 Ω
6) The free-wheeling diodes of the GAL and GAR types have the data of the inverse diodes of SKM 150 GB 123 D
7) V_{isol} = 4000 V_{rms} on request
8) CAL = Controlled Axial Lifetime Technology.

Cases and mech. data → **B6 - 46**

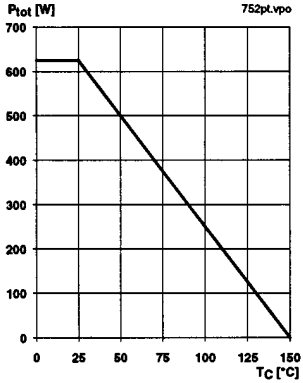
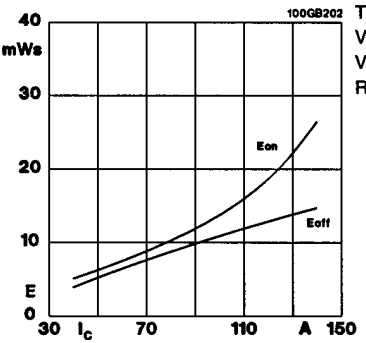
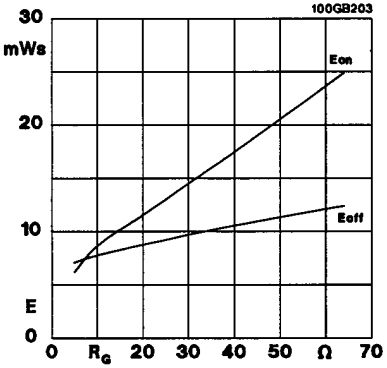


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



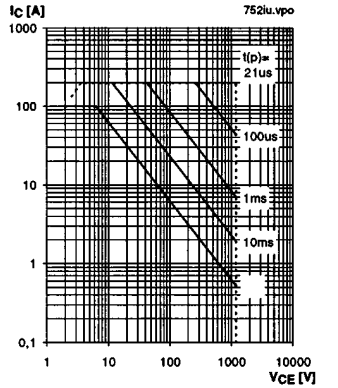
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 15 Ω

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 75 A

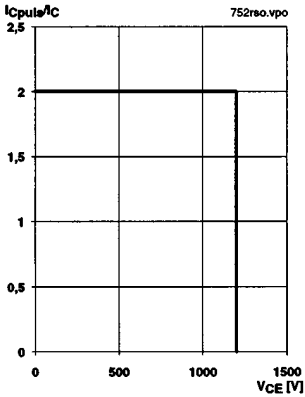
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
$T_j \leq$ 150 °C

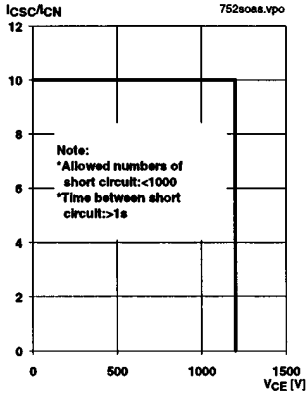
Not for linear use

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



$T_j \leq$ 150 °C
V_{GE} = 15 V
$R_{g(off)}$ = 15 Ω
I_C = 75 A

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



$T_j \leq$ 150 °C
V_{GE} = ± 15 V
$t_{sc} \leq$ 10 µs
L < 25 nH
I_{CN} = 75 A

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

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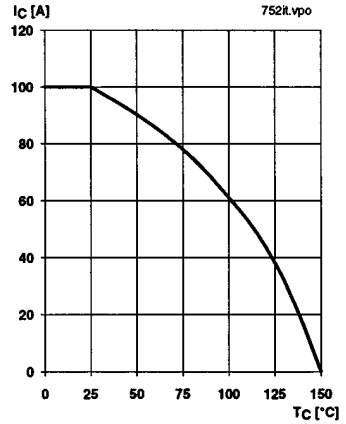


T_j = 150 °C
$V_{GE} \geq$ 15 V

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

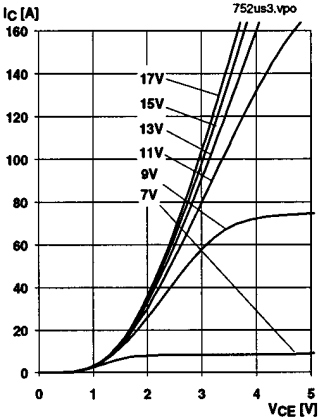


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

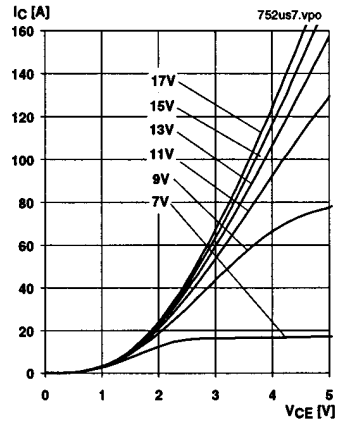


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

$r_{CE(Tj)} = 0{,}013 + 0{,}00006\ (T_j - 25)$ [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

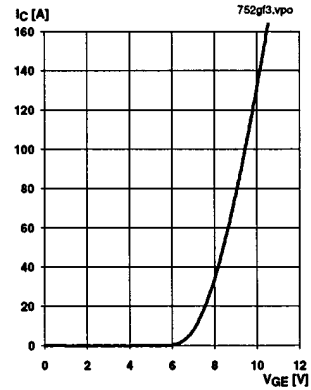


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V

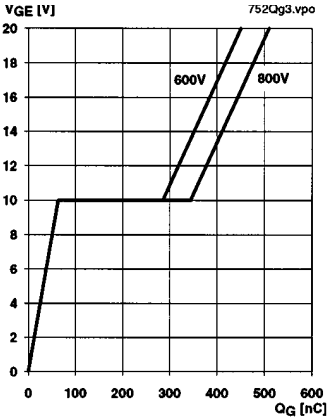
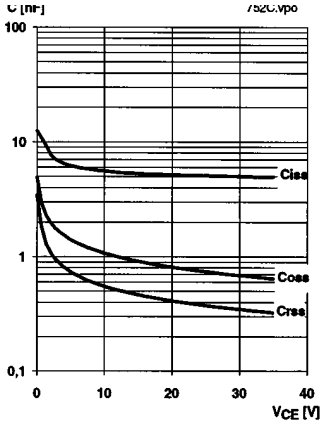


Fig. 13 Typ. gate charge characteristic

I_{Cpuls} = 75 A



V_{GE} = 0 V
f = 1 MHZ

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

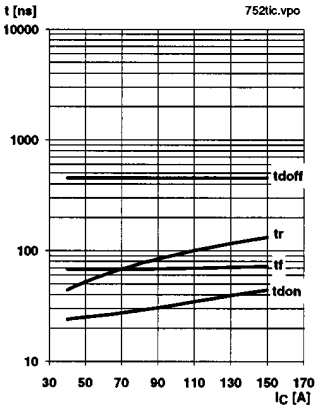


Fig. 15 Typ. switching times vs. I_C

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

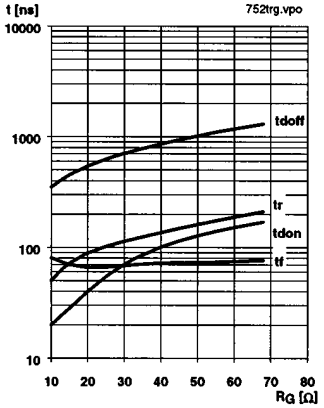


Fig. 16 Typ. switching times vs. gate resistor R_G

T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 75 A
induct. load

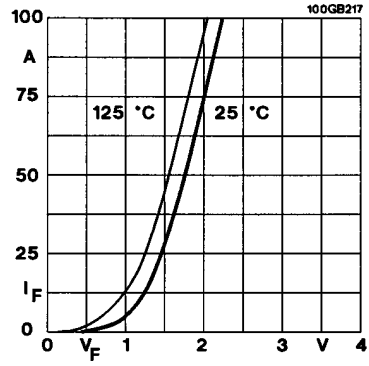


Fig. 17 Typ. CAL diode forward characteristic

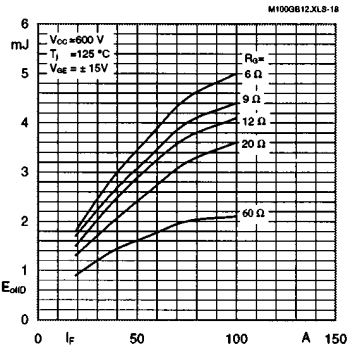


Fig. 18 Diode turn-off energy dissipation per pulse

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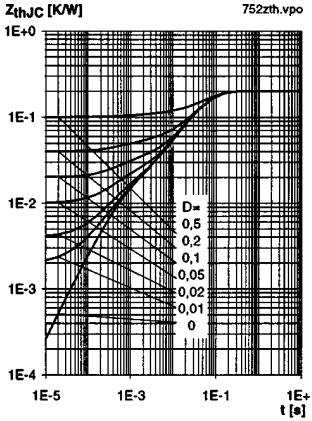


Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

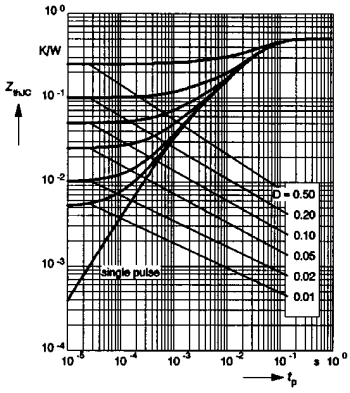


Fig. 20 Transient thermal impedance of inverse CAL diodes
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

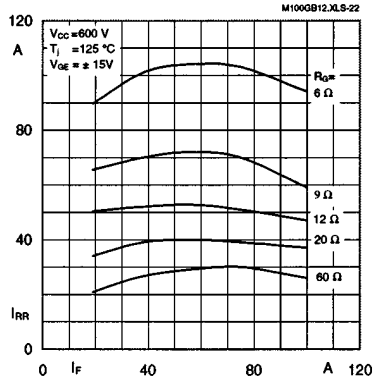


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

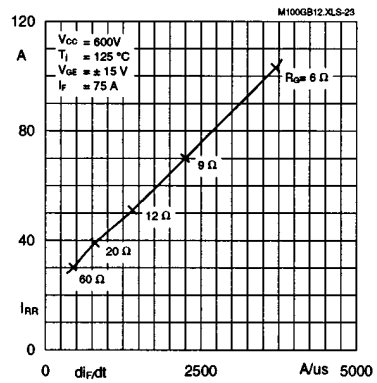


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di_F/dt)$

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
Electronic (also portable) welders
Pulse frequencies also above 15 kHz

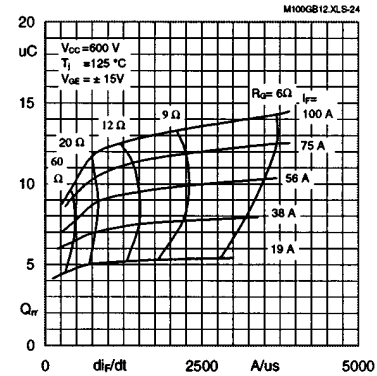
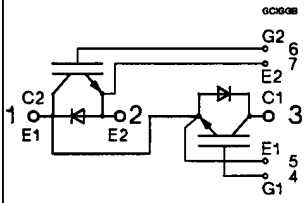
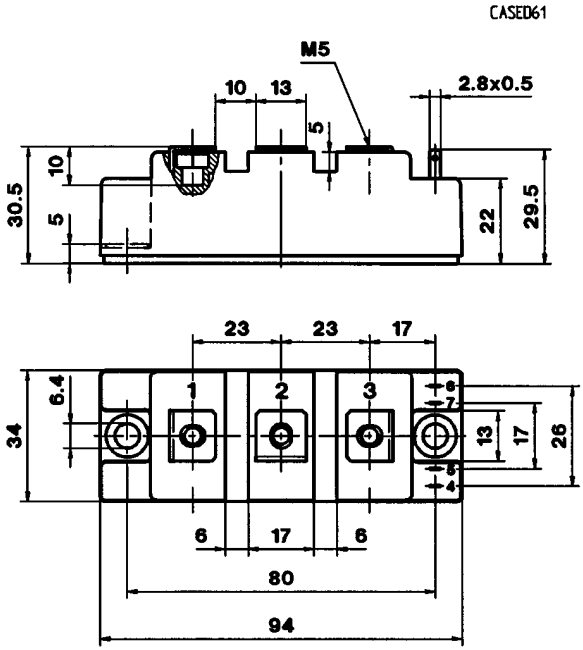


Fig. 24 Typ. CAL diode recovered charge $Q_{rr} = f(di/dt)$

SEMITRANS 2
Case D 61
UL Recognized
File no. E 63 532

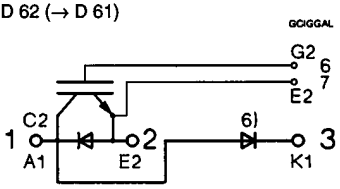
SKM 100 GB 123 D
SKM 100 GB 173 D



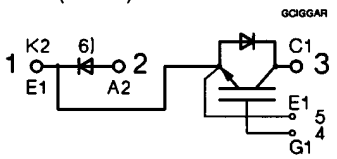


Dimensions in mm

SKM 100 GAL 123 D
Case D 62 (→ D 61)



SKM 100 GAR 123 D
Case D 63 (→ D 61)



Case outline and circuit diagrams

Mechanical Data						
Symbol	Conditions		Values			Units
			min.	typ.	max.	
M_1	to heatsink, SI Units	(M6)	3	–	5	Nm
	to heatsink, US Units		27	–	44	lb.in.
M_2	for terminals, SI Units	(M5)	2,5	–	5	Nm
	for terminals US Units		22	–	44	lb.in.
a			–	–	5x9,81	m/s^2
w			–	–	250	g

This is an electrostatic discharge sensitive device (ESDS). Please observe the international standard IEC 747-1, Chapter IX.

Eight devices are supplied in one SEMIBOX A without mounting hardware, which can be ordered separately under Ident No. 33321100 (for 10 SEMITRANS 2). Larger packing units of 20 and 42 pieces are used if suitable
Accessories → page B 6 - 4.
SEMIBOX → page C - 1.

6) Freewheeling diode → page B 6 - 41, remark 6.

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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 / 100		A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	300 / 200		A
V_{GES}		± 20		V
P_{tot}	per IGBT, T_{case} = 25 °C	800		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	150 / 100	200 / 135	A
I_{FM}= – I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	300 / 200	300 / 200	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

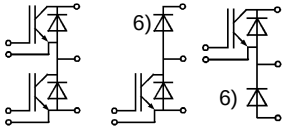
Characteristics Symbol	Conditions [1]	min.	typ.	max.	Units
$V_{(BR)CES}$	V_{GE} = 0, I_C = 4 mA	≥ V_{CES}	–	–	V
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 4 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0, T_j = 25 °C	–	0,2	2	mA
	V_{CE} = V_{CES}, T_j = 125 °C	–	9		mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	1	µA
V_{CEsat}	I_C = 100 A, V_{GE} = 15 V;	–	2,5(3,1	3(3,7)	V
V_{CEsat}	I_C = 150 A, T_j = 25 (125) °C	–	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	–	6,5	8,5	nF
C_{oes}	V_{CE} = 25 V	–	1000	1500	pF
C_{res}	f = 1 MHz	–	500	600	pF
L_{CE}		–	–	20	nH
$t_{d(on)}$	V_{CC} = 600 V	–	160	320	ns
t_r	V_{GE} = + 15 V; - 15 V [3]	–	80	160	ns
$t_{d(off)}$	I_C = 100 A, ind. load	–	400	520	ns
t_f	R_{Gon} = R_{Goff} = 6,8 Ω	–	70	100	ns
E_{on} [5]	T_j = 125 °C	–	13	–	mWs
E_{off} [5]		–	11	–	mWs
Inverse Diode [8]					
V_F = V_{EC}	I_F = 100 A; V_{GE} = 0 V;	–	2,0(1,8)	2,5	V
V_F = V_{EC}	I_F = 150 A; T_j = 25 (125) °C	–	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;	–	1,85(1,6)	2,2	V
V_F = V_{EC}	I_F = 150 A; 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	–	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	–	–	0,16	°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 - 63

- 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 - 64
SEMITRANS 3

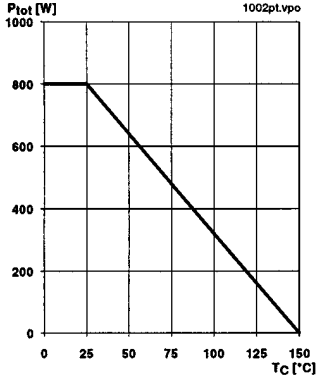
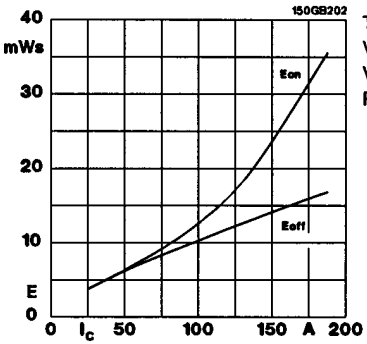
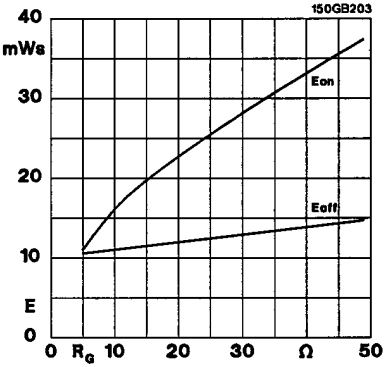


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



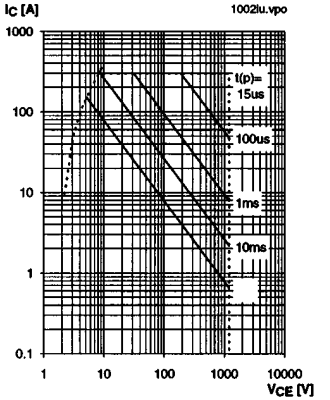
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 6,8 Ω

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

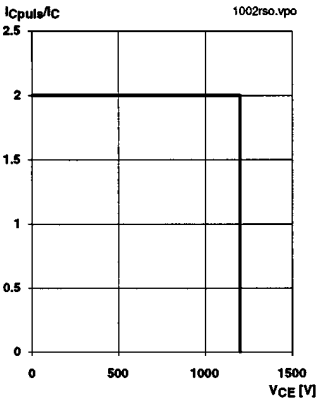
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
$T_j \leq$ 150 °C

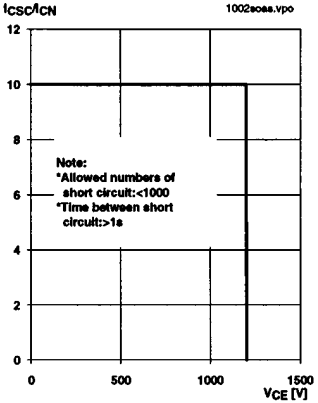
Not for linear use

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



$T_j \leq$ 150 °C
V_{GE} = 15 V
$R_{g(off)}$ = 6,8 Ω
I_C = 100A

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



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

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

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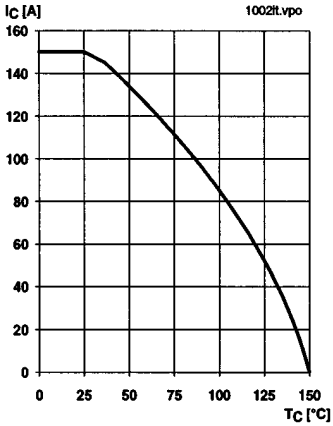


T_j = 150 °C
$V_{GE} \geq$ 15 V

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

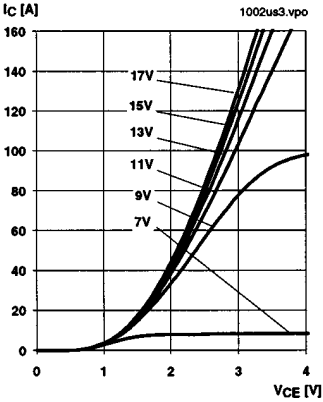


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

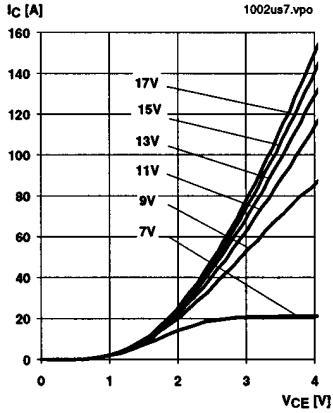


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

$r_{CE(Tj)} = 0{,}010 + 0{,}00004\ (T_j - 25)$ [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

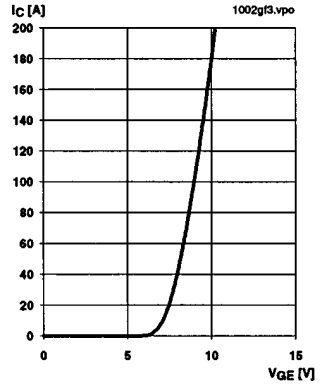
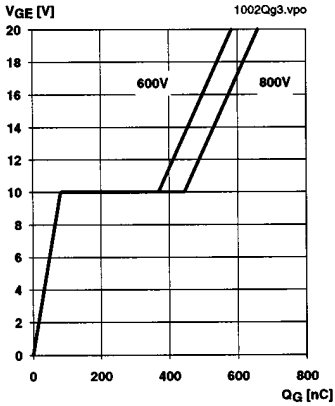
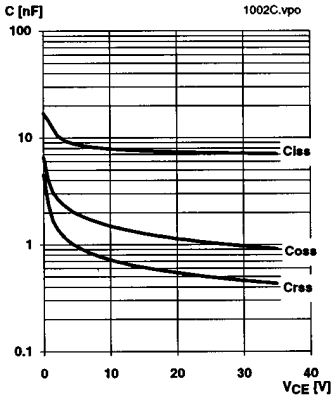


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



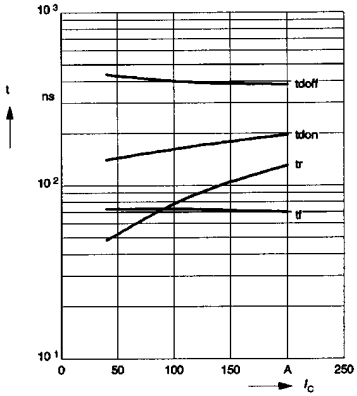
I_{Cpuls} = 100 A

Fig. 13 Typ. gate charge characteristic



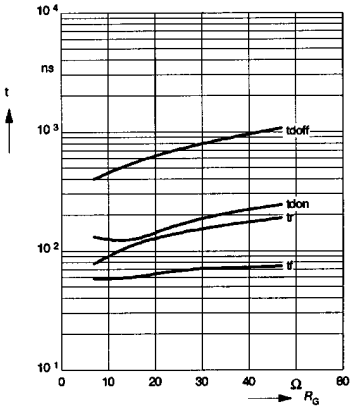
V_{GE} = 0 V
f = 1 MHZ

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

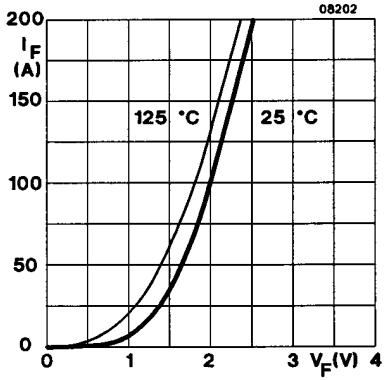


Fig. 17 Typ. CAL diode forward characteristic

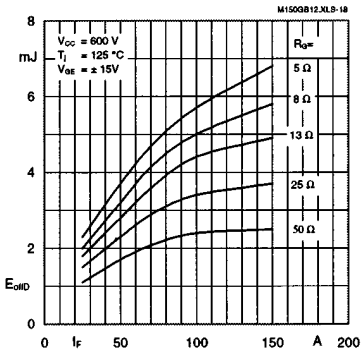


Fig. 18 Diode turn-off energy dissipation per pulse

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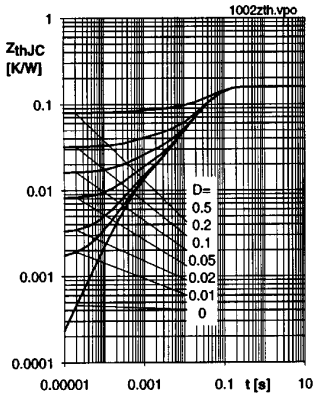


Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

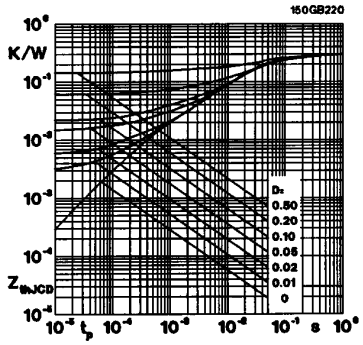


Fig. 20 Transient thermal impedance of inverse CAL diodes
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

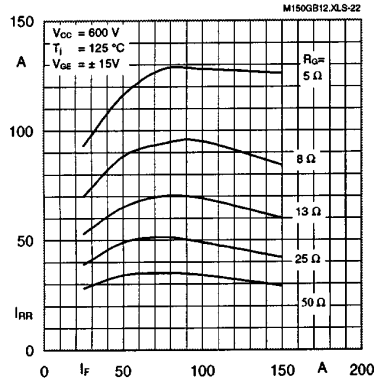


Fig. 22 Typ. CALdiode reverse recovery
current $I_{RR} = f(I_F; R_G)$

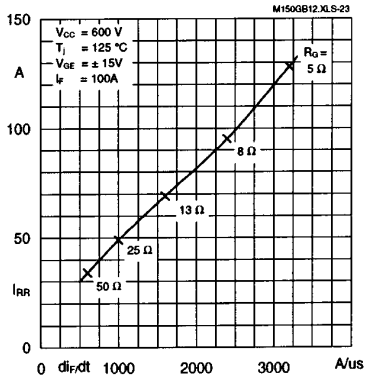


Fig. 23 Typ. CAL diode reverse recovery
current $I_{RR} = f(di_F/dt)$

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

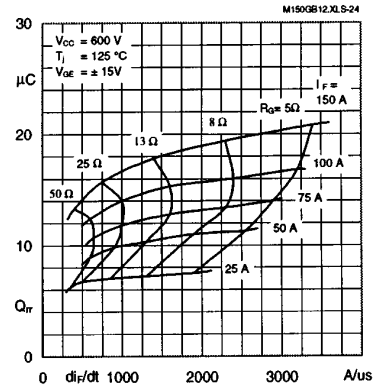
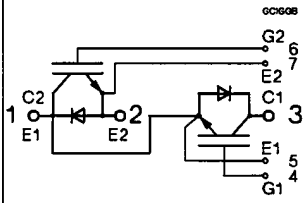
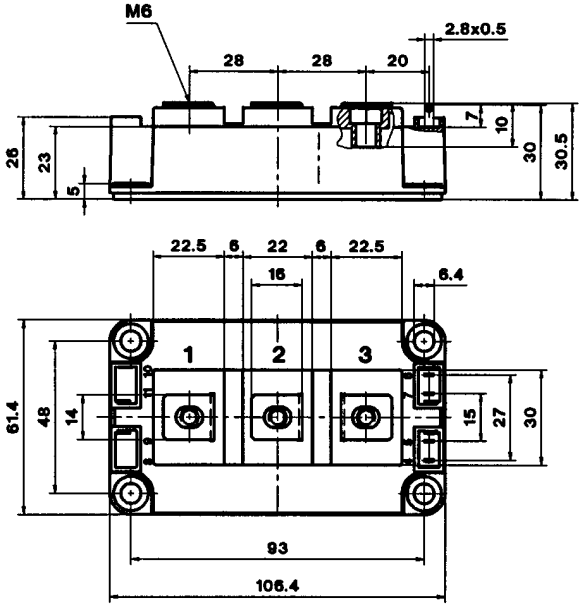


Fig. 24 Typ. CAL diode recovered charge $Q_{rr} = f(di/dt)$

SEMITRANS 3
Case D 56
UL Recognized
File no. E 63 532

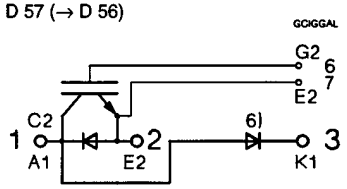
SKM 150 GB 123 D
SKM 150 GB 173 D



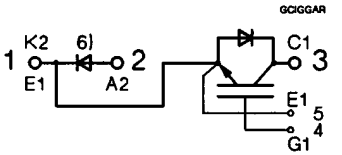


Dimensions in mm

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						
Symbol	Conditions		Values			Units
			min.	typ.	max.	
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 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 → page B 6 - 4.
SEMIBOX → page C - 1.

6) Freewheeling diode → page B 6 - 59, remark 6.

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Absolute Maximum Ratings		Values		
Symbol	Conditions [1]	... 123 D	... 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, T_j = 25 °C	–	0,2	3	mA
	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;	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 200 A, 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	–	10	13	nF
C_{oes}	V_{CE} = 25 V	–	1,5	2	nF
C_{res}	f = 1 MHz	–	0,8	1,2	nF
L_{CE}		–	–	20	nH
$t_{d(on)}$	V_{CC} = 600 V	–	220	400	ns
t_r	V_{GE} = -15 V / +15 V [3]	–	100	200	ns
$t_{d(off)}$	I_C = 150 A, ind. load	–	600	800	ns
t_f	R_{Gon} = R_{Goff} = 5,6 Ω	–	70	100	ns
E_{on} [5]	T_j = 125 °C	–	24	–	mWs
E_{off} [5]		–	17	–	mWs
Inverse Diode [8]					
V_F = V_{EC}	I_F = 150 A, V_{GE} = 0 V;	–	2,0(1,8)	2,5	V
V_F = V_{EC}	I_F = 200 A, 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;	–	1,85(1,6)	2,2	V
V_F = V_{EC}	I_F = 200 A, 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

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)



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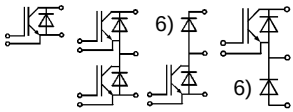


GA GB GAL GAR

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 (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**

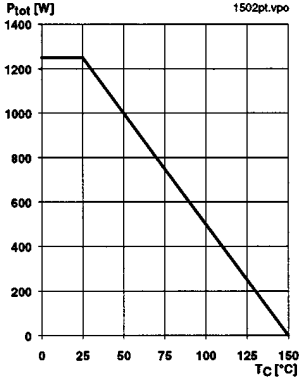
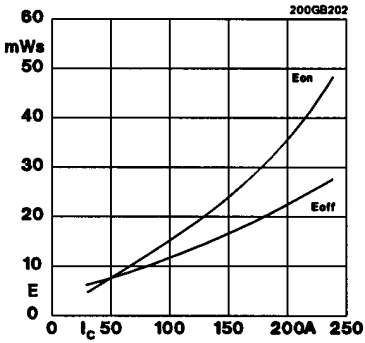
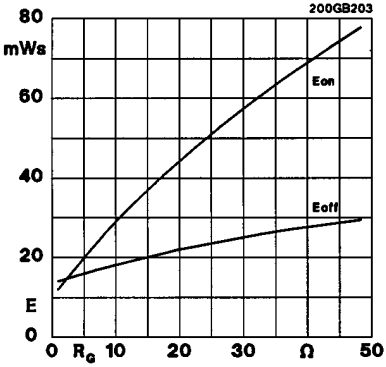


Fig. 1 Rated power dissipation P_{tot} = f (T_C)



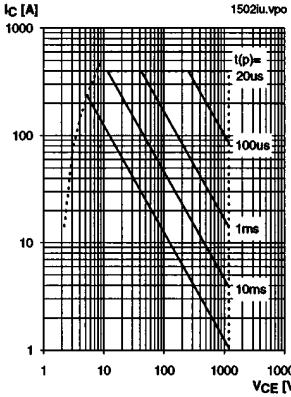
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 5,6 Ω

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

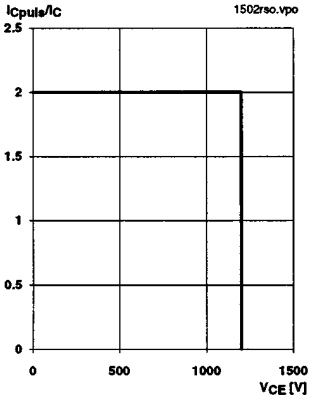
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
$T_j \leq$ 150 °C

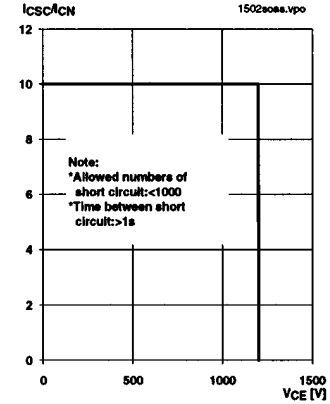
Not for linear use

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



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

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



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

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

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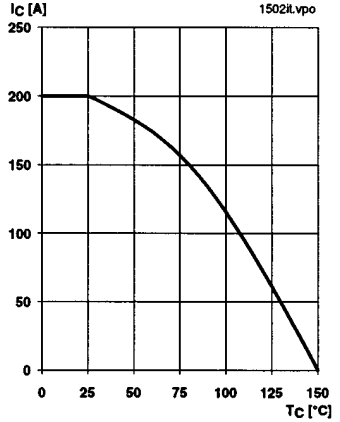


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

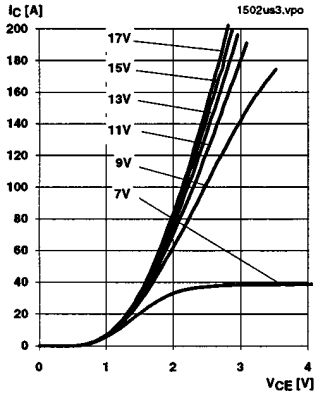


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

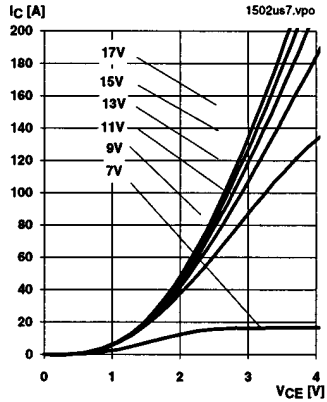


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

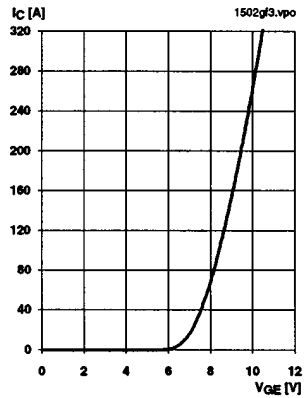
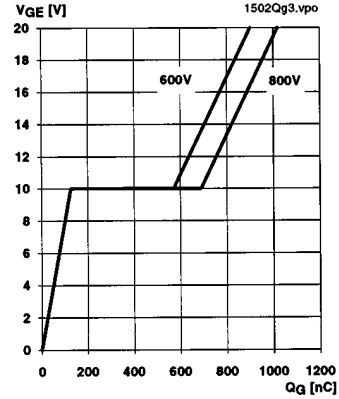
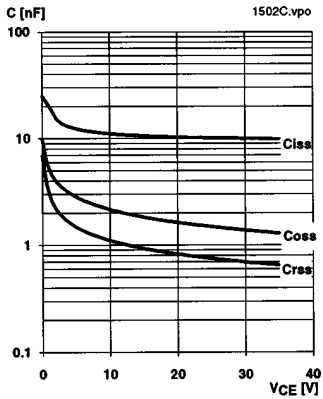


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



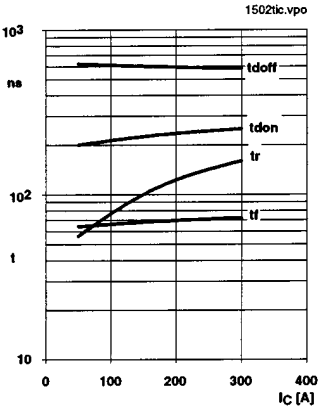
I_{Cpuls} = 150 A

Fig. 13 Typ. gate charge characteristic



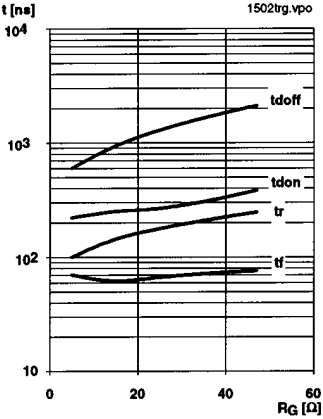
V_{GE} = 0 V
f = 1 MHZ

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

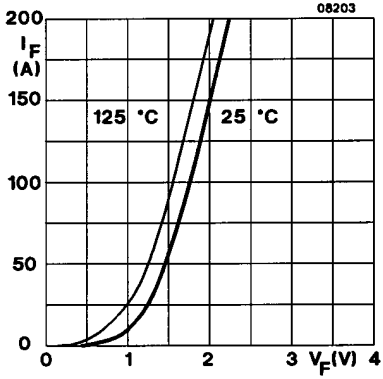


Fig. 17 Typ. CAL diode forward characteristic

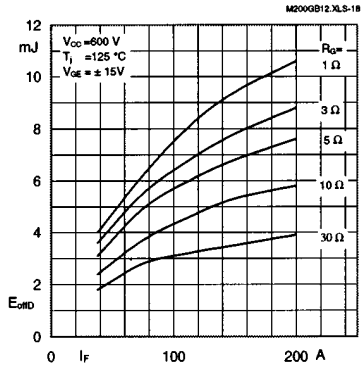


Fig. 18 Diode turn-off energy dissipation per pulse

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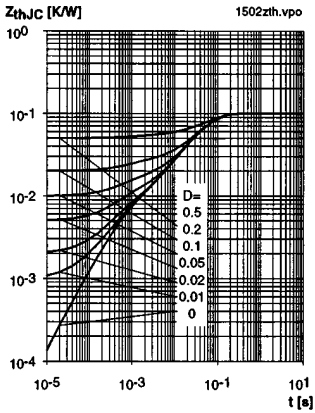

Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

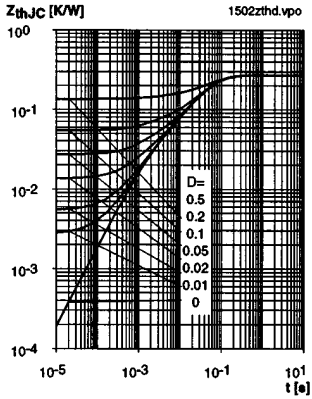

Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

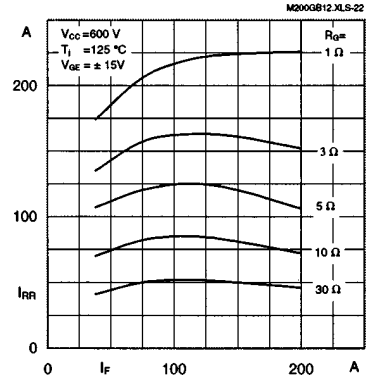

Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F, R_G)$

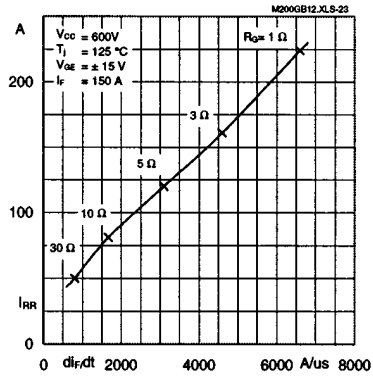

Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di_F/dt)$

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

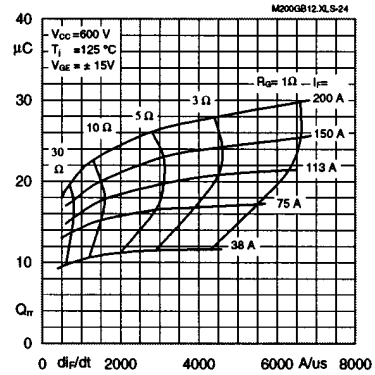

Fig. 24 Typ. CAL diode recovered charge $Q_{RR} = f(di/dt)$

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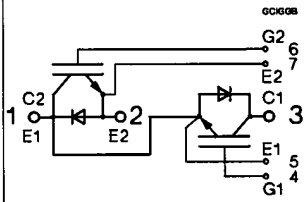
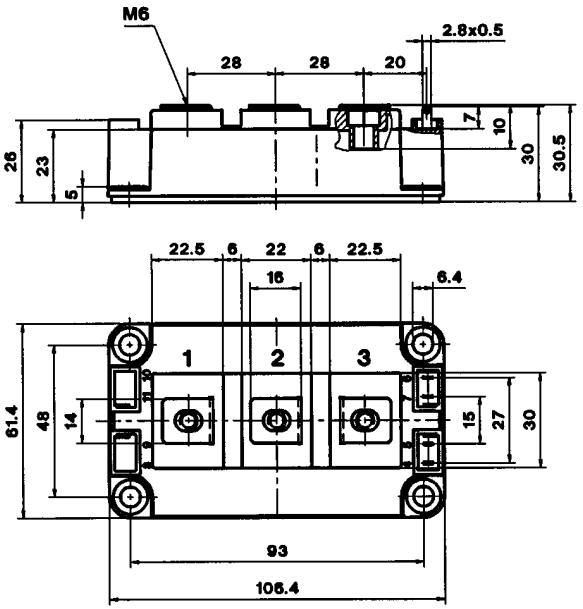
SKM 200 GB 123 D
SKM 200 GB 123 D1
SKM 200 GB 173 D
SKM 200 GB 173 D1

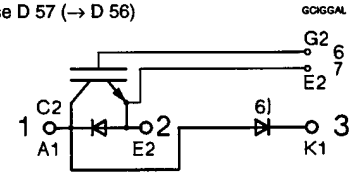




Dimensions in mm

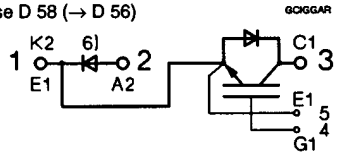
SKM 150 GAL 123 D **SKM 200 GAL 123 D** **SKM 200 GAL 173 D**

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			Units
			min.	typ.	max.	
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.

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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	300 / 200	A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	600 / 400	A
V_{GES}		± 20	V
P_{tot}	per IGBT, T_{case} = 25 °C	1550	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	300 / 200	A
I_{FM}= – I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	600 / 400	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	2200	A
I^2t	t_p = 10 ms; T_j = 150 °C	24200	A^2s

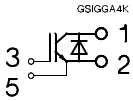
Characteristics Symbol	Conditions [1]	min.	typ.	max.	Units
$V_{(BR)CES}$	V_{GE} = 0, I_C = 3 mA	≥ V_{CES}	–	–	V
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 8 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0, T_j = 25 °C	–	0,4	4	mA
	V_{CE} = V_{CES}, T_j = 125 °C	–	18		mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	1	µA
V_{CEsat}	I_C = 200 A, V_{GE} = 15 V;	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 300 A, T_j = 25 (125) °C	–	3,0(3,8)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 200 A	110	–	–	S
C_{CHC}		–	1300	1500	pF
C_{ies}	V_{GE} = 0	–	15	19	nF
C_{oes}	V_{CE} = 25 V	–	2	2,6	nF
C_{res}	f = 1 MHz	–	1,0	1,3	nF
L_{CE}		–	–	20	nH
$t_{d(on)}$	V_{CC} = 600 V	–	250	400	ns
t_r	V_{GE} = +15 V, -15V [3]	–	90	160	ns
$t_{d(off)}$	I_C = 200 A, ind. load	–	550	700	ns
t_f	R_{Gon} = R_{Goff} = 4,7 Ω	–	70	100	ns
E_{on} [5]	T_j = 125 °C	–	26	–	mWs
E_{off} [5]		–	22	–	mWs
Inverse Diode [8]					
V_F = V_{EC}	I_F = 200 A, V_{GE} = 0 V;	–	2,0(1,8)	2,5	V
V_F = V_{EC}	I_F = 300 A, T_j = 25 (125) °C	–	2,25(2,1)	–	V
V_{TO}	T_j = 125 °C	–	–	1,2	V
r_T	T_j = 125 °C	–	3	5,5	mΩ
I_{RRM}	I_F = 200 A; T_j = 25 (125) °C [2]	–	80(120)	–	A
Q_{rr}	I_F = 200 A; T_j = 25 (125) °C [2]	–	11(29)	–	µC
V_F = V_{EC}	I_F = 200 A, V_{GE} = 0 V;	–			V
V_F = V_{EC}	I_F = 300 A, T_j = 25 (125) °C	–		–	V
V_{TO}	T_j = 125 °C	–	–		V
r_T	T_j = 125 °C	–	–		mΩ
t_{rr}	I_F = 200 A; T_j = 25 (125) °C [2]	–		–	µs
Q_{rr}	I_F = 200 A; T_j = 25 (125) °C [2]	–		–	µC
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,08	°C/W
R_{thjc}	per diode D	–	–	0,15	°C/W
R_{thch}	per module	–	–	0,038	°C/W

SEMITRANS® M IGBT Modules

SKM 300 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: → B 6 - 87

- 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} = 4,7 Ω
7) V_{isol} = 4000 V_{rms} on request
8) CAL = Controlled Axial Lifetime Technology.

Cases and mech. data → **B6 - 88**
SEMITRANS 4

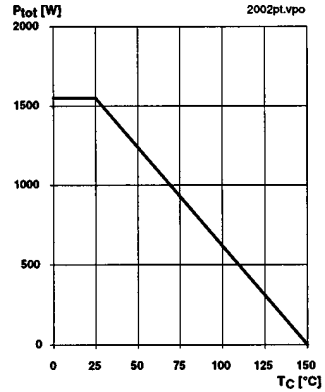
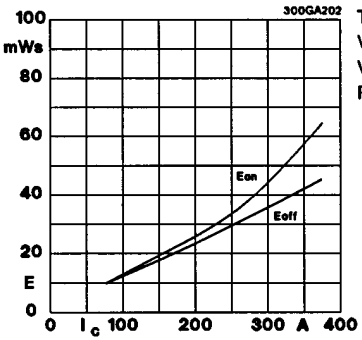
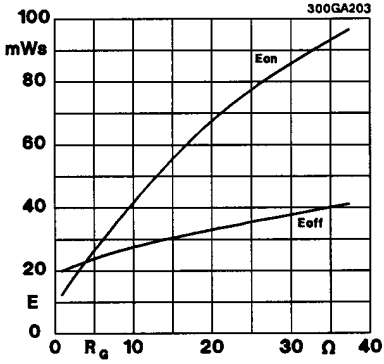


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



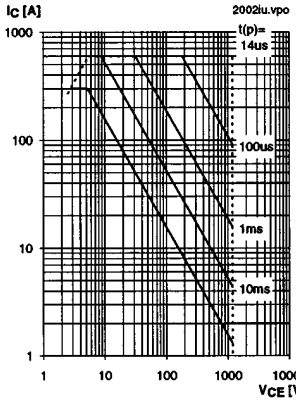
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 4,7 Ω

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 200 A

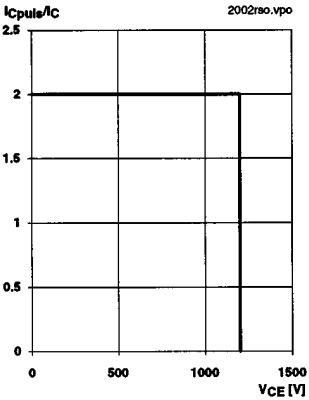
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
$T_j \leq$ 150 °C

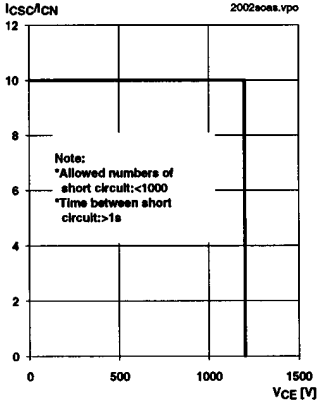
Not for linear use

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



$T_j \leq$ 150 °C
V_{GE} = 15 V
$R_{g(off)}$ = 4,7 Ω
I_C = 200 A

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



$T_j \leq$ 150 °C
V_{GE} = ± 15 V
$t_{sc} \leq$ 10 µs
L < 25 nH
I_{CN} = 200 A

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

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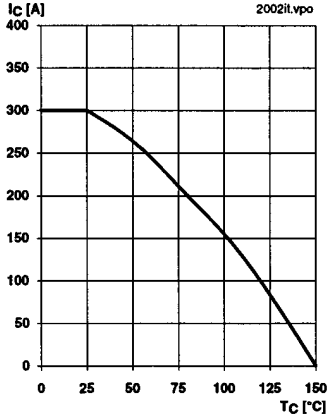


T_j = 150 °C
$V_{GE} \geq$ 15 V

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

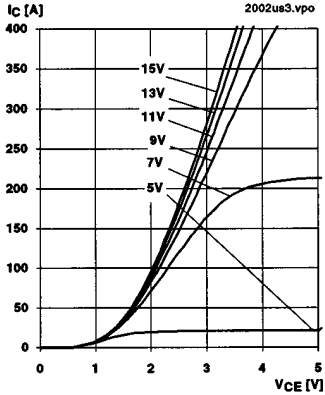


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

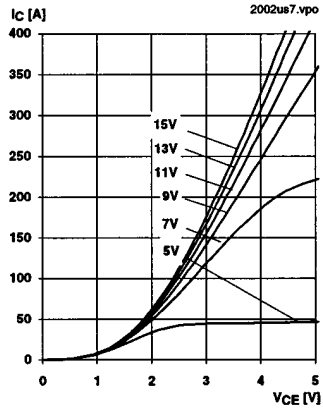


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

$r_{CE(Tj)} = 0{,}005 + 0{,}00002\ (T_j - 25)$ [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

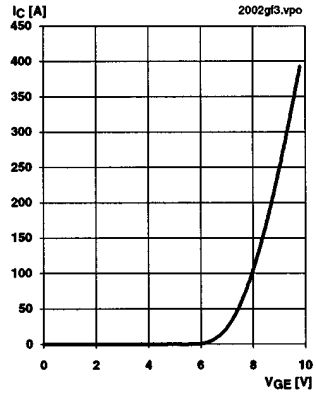
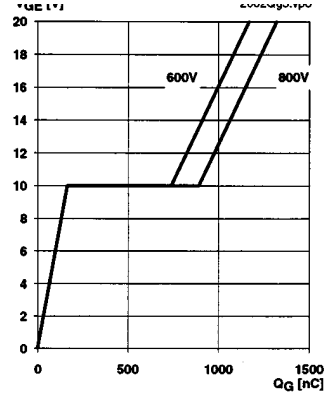
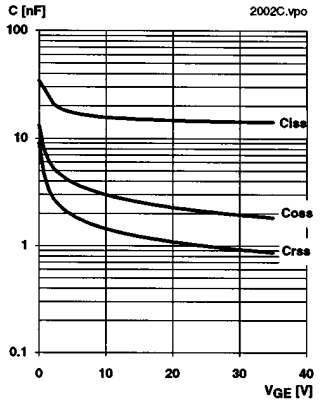


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



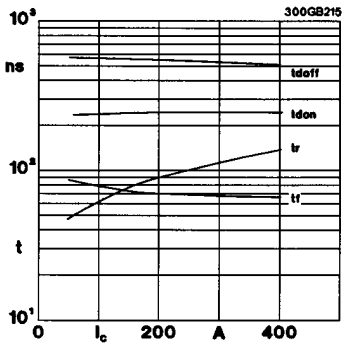
I_{Cpuls} = 200 A

Fig. 13 Typ. gate charge characteristic



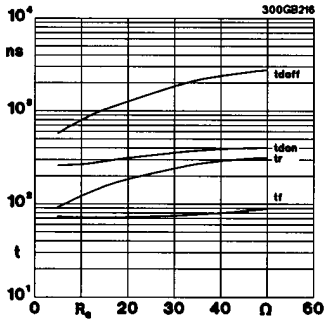
V_{GE} = 0 V
f = 1 MHZ

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{gon} = 4,7 Ω
R_{goff} = 4,7 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 = 200 A
induct. load

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

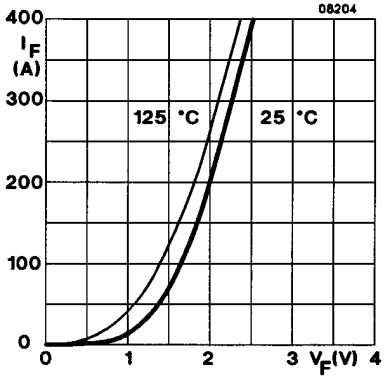


Fig. 17 Typ. CAL diode forward characteristic

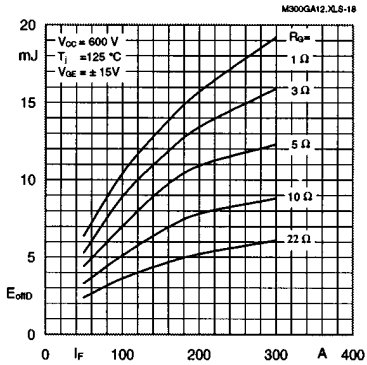


Fig. 18 Diode turn-off energy dissipation per pulse

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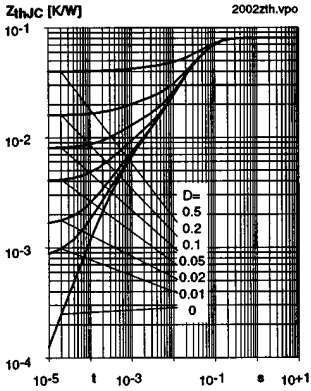


Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

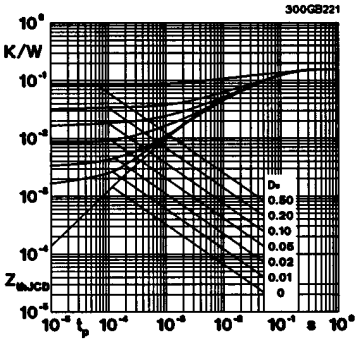


Fig. 20 Transient thermal impedance of inverse CAL diodes
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

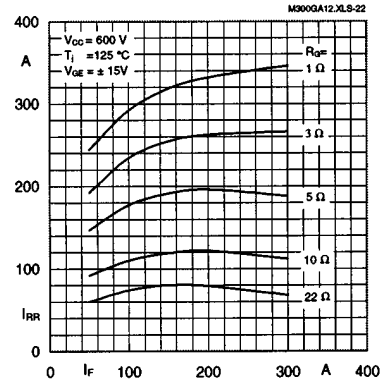


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_R; R_G)$

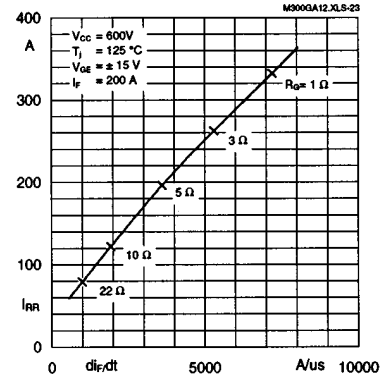


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di/dt)$

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
Pulse frequencies also above 15 kHz

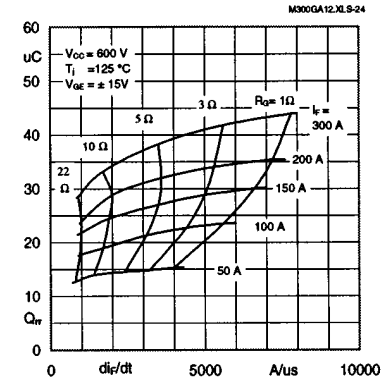
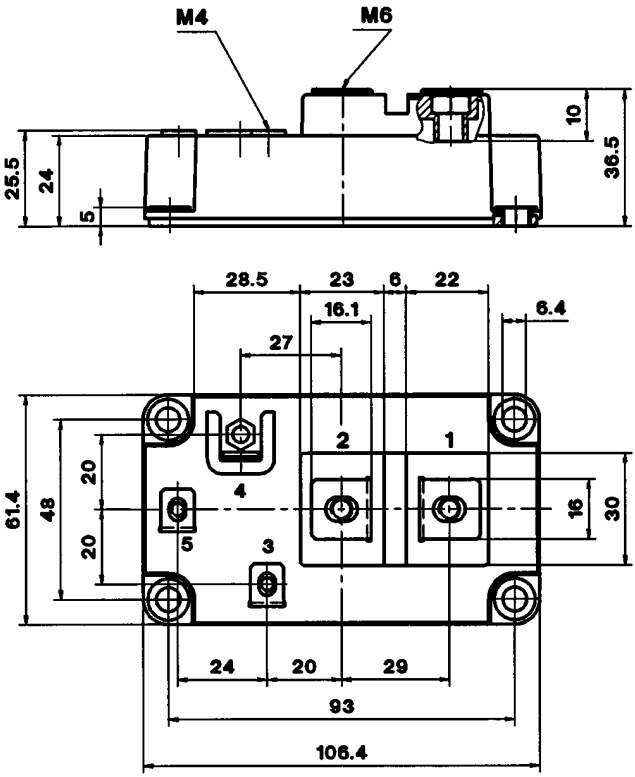


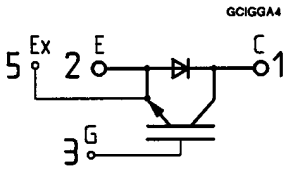
Fig. 24 Typ. CAL diode recovered charge

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

CASED59





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.

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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	290 / 200		A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	580 / 400		A
V_{GES}		± 20		V
P_{tot}	per IGBT, T_{case} = 25 °C	1400		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			FWD [6]	
I_F= – I_C	T_{case} = 25/80 °C	260 / 180	350 / 230	A
I_{FM}= – I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	600 / 400	580 / 400	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	2200	2900	A
I^2t	t_p = 10 ms; T_j = 150 °C	24200	42000	A^2s

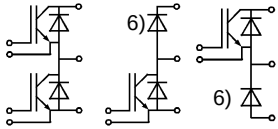
Characteristics Symbol	Conditions [1]	min.	typ.	max.	Units
$V_{(BR)CES}$	V_{GE} = 0, I_C = 4 mA	≥ V_{CES}	–	–	V
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 8 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0, T_j = 25 °C	–	3	4,5	mA
	V_{CE} = V_{CES}, T_j = 125 °C	–	15		mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	0,4	µA
V_{CEsat}	I_C = 200 A, V_{GE} = 15 V;	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 300 A, T_j = 25 (125) °C	–	3(3,8)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 200 A	108	150	–	S
C_{CHC}	per IGBT	–		700	pF
C_{ies}	V_{GE} = 0	–	18	24	nF
C_{oes}	V_{CE} = 25 V	–	2,5	3,2	nF
C_{res}	f = 1 MHz	–	1,0	1,3	nF
L_{CE}		–	–	20	nH
$t_{d(on)}$	V_{CC} = 600 V	–	250	400	ns
t_r	V_{GE} = + 15 V / - 15 V [3]	–	90	160	ns
$t_{d(off)}$	I_C = 200 A, ind. load	–	550	700	ns
t_f	R_{Gon} = R_{Goff} = 4,7 Ω	–	70	100	ns
E_{on} [5]	T_j = 125 °C	–	28	–	mWs
E_{off} [5]		–	26	–	mWs
Inverse Diode [8]					
V_F = V_{EC}	I_F = 200 A; V_{GE} = 0 V;	–	2,0(1,8)	2,5	V
V_F = V_{EC}	I_F = 300 A; T_j = 25 (125) °C	–	2,25(2,1)	–	V
V_{TO}	T_j = 125 °C [2]	–	1,1	1,2	V
r_T	T_j = 125 °C [2]	–	3	5,5	mΩ
I_{RRM}	I_F = 200 A; T_j = 25 (125) °C [2]	–	70(105)	–	A
Q_{rr}	I_F = 200 A; T_j = 25 (125) °C [2]	–	10(26)	–	µC
FWD of type "GAL" and "GAR" [8] [6]					
V_F = V_{EC}	I_F = 200 A; V_{GE} = 0 V;	–	1,9(1,7)	2,4	V
V_F = V_{EC}	I_F = 300 A; T_j = 25 (125) °C	–	2,1(1,8)	–	V
V_{TO}	T_j = 125 °C	–	–	1,2	V
r_T	T_j = 125 °C	–	3	3,5	mΩ
I_{RRM}	I_F = 200 A; T_j = 25 (125) °C [2]	–	80(140)	–	ns
Q_{rr}	I_F = 200 A; T_j = 25 (125) °C [2]	–	10(34)	–	µC
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,09	°C/W
R_{thjc}	per diode / FWD [6]	–	–	0,18/0,15	°C/W
R_{thch}	per module	–	–	0,038	°C/W

SEMITRANS® M
IGBT Modules

SKM 300 GB 123 D
SKM 300 GAL 123 D [6]
SKM 300 GAR 123 D [6]



SEMITRANS 3



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 - 79

- Switching, not for linear use
- AC-inverter drives
- UPS

[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} = 4,7 Ω
[6] The free-wheeling diodes of the GAL and GAR types have the data of the inverse diodes of SKM 400 GA 123 D
[8] CAL = Controlled Axial Lifetime Technology.

Cases and mech. data → **B6-100**
SEMITRANS 3

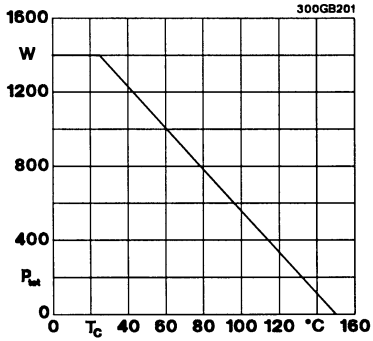
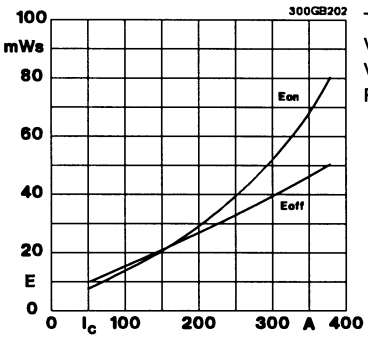
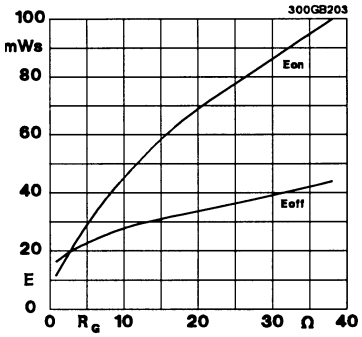


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



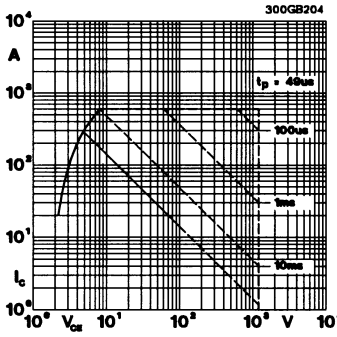
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 4,7 Ω

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 200 A

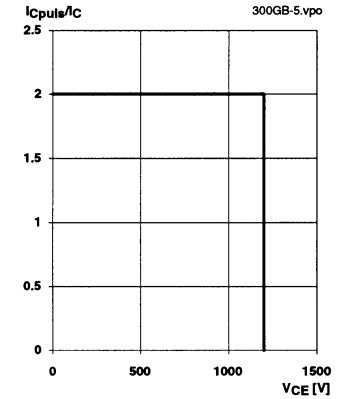
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
$T_j \leq$ 150 °C

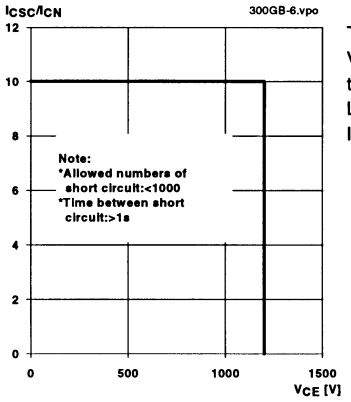
Not for linear use

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



$T_j \leq$ 150 °C
V_{GE} = 15 V
$R_{g(off)}$ = 4,7 Ω
I_C = 200 A

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



$T_j \leq$ 150 °C
V_{GE} = ± 15 V
$t_{sc} \leq$ 10 µs
L < 25 nH
I_{CN} = 200 A

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

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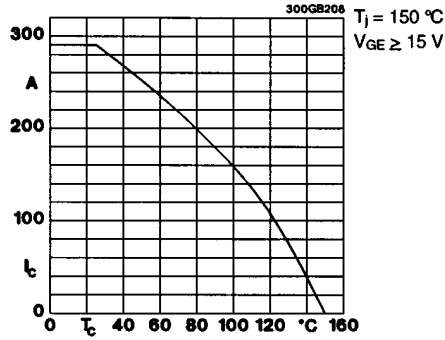


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

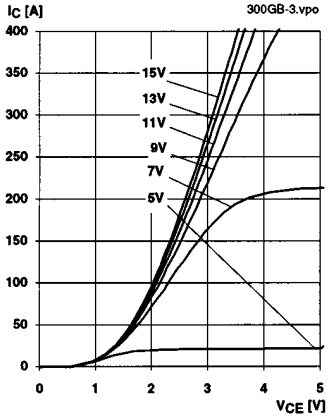


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

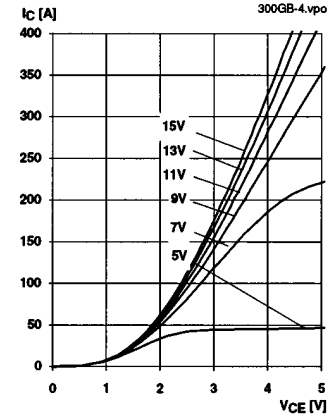


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

$r_{CE(Tj)} = 0{,}005 + 0{,}00002\ (T_j - 25)$ [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

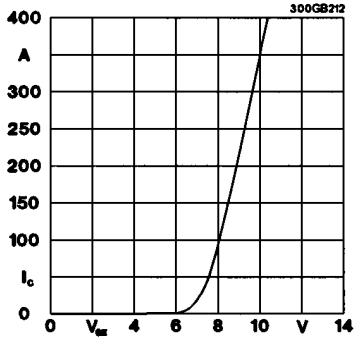
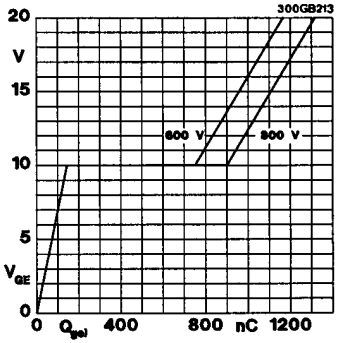
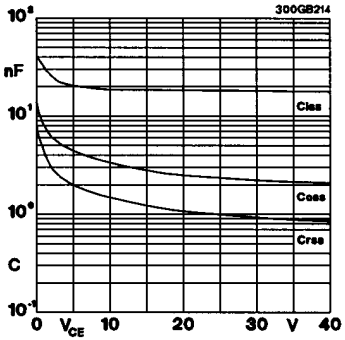


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



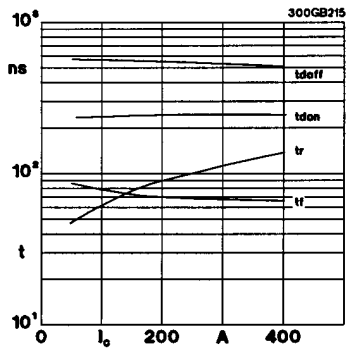
I_{Cpuls} = 300 A

Fig. 13 Typ. gate charge characteristic



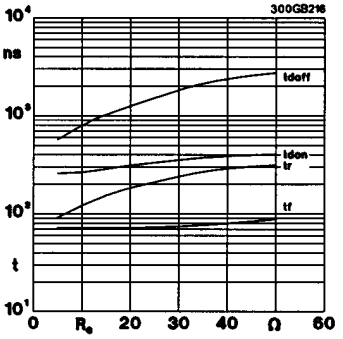
V_{GE} = 0 V
f = 1 MHZ

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{gon} = 4,7 Ω
R_{goff} = 4,7 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 = 200 A
induct. load

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

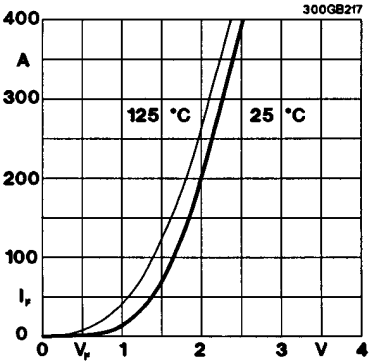


Fig. 17 Typ. CAL diode forward characteristic

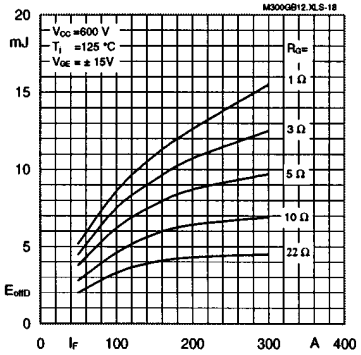


Fig. 18 Diode turn-off energy dissipation per pulse

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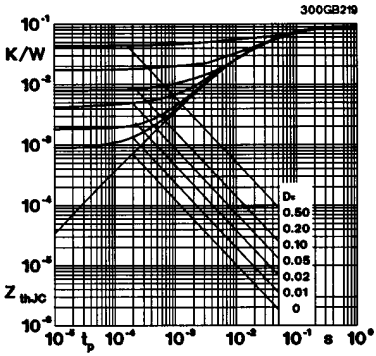


Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

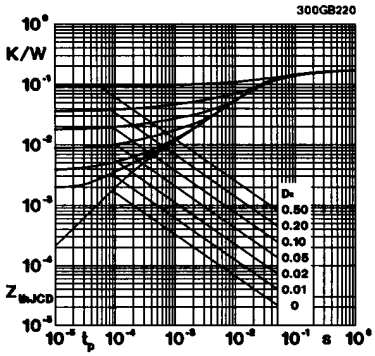


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJCD} = f(t_p)$;

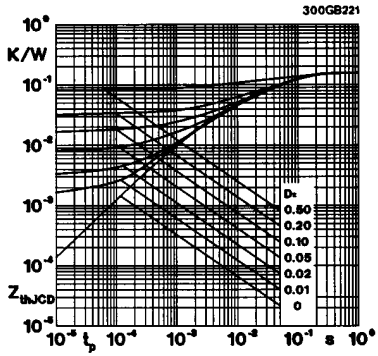


Fig. 21 Transient thermal impedance of the freewheeling diode Z_{thJCD} → B 6 – 95, rem. 6)

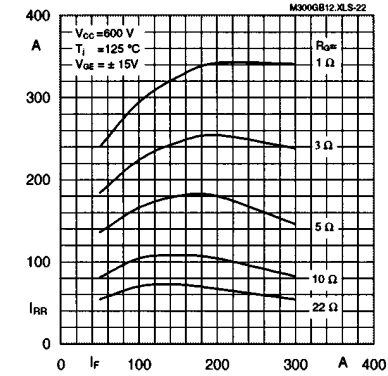


Fig. 22 Typ CAL diode reverse recovery current $I_{RR} = f(I_F; R_G)$

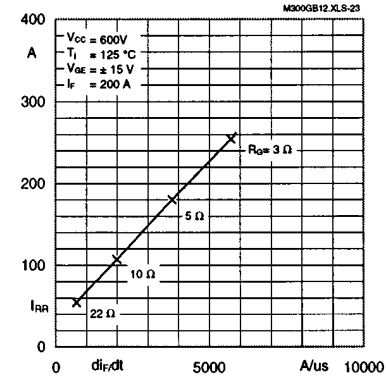


Fig. 23 Typ. CAL diode reverse recovery current $I_{RR} = f(di_F/dt; R_G)$

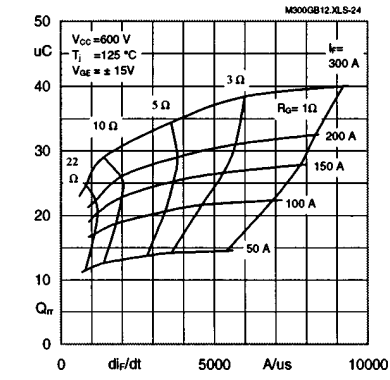
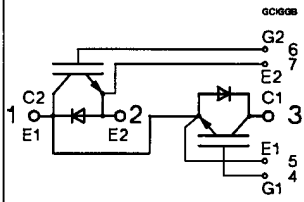
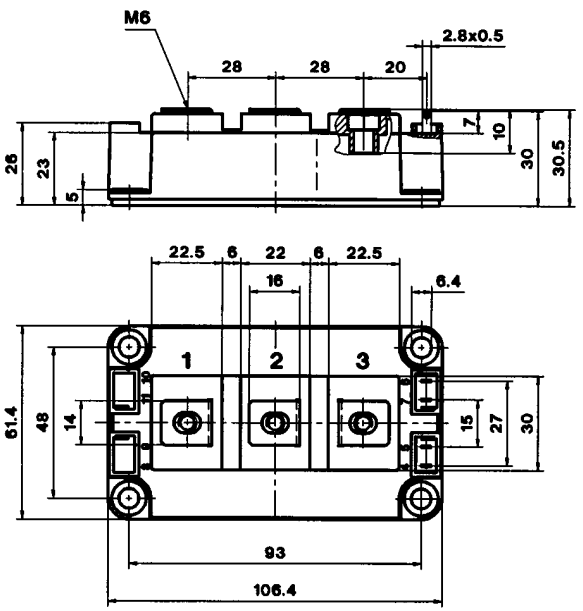


Fig. 24 Typ. CAL diode recovered charge $Q_{rr} = f(di_F/dt; I_F; R_G)$

SEMITRANS 3
Case D 56
UL Recognized
File no. E 63 532

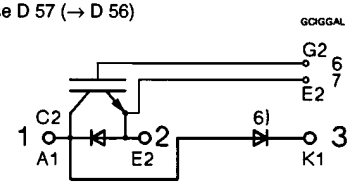
SKM 300 GB 123 D



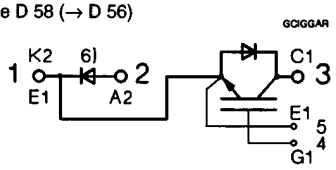


Dimensions in mm

SKM 300 GAL 123 D
Case D 57 (→ D 56)



SKM 300 GAR 123 D
Case D 58 (→ D 56)



Case outline and circuit diagrams

Mechanical Data						
Symbol	Conditions		Values			Units
			min.	typ.	max.	
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

[6] Freewheeling diode → page B 6 - 95, 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 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.

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SEMITRANS® M IGBT Modules

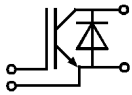
SKM 400 GA 123 D

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

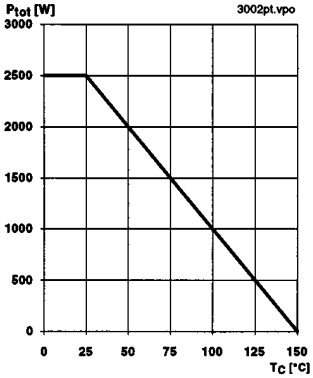
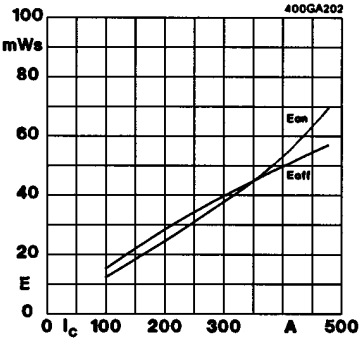
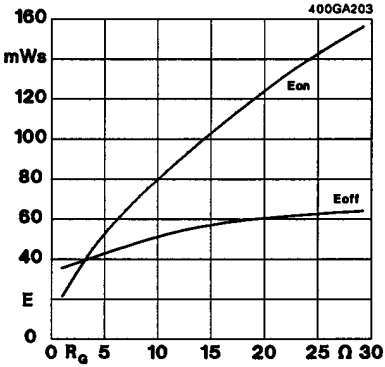


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



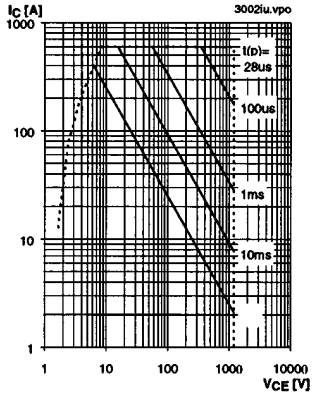
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 3,3 Ω

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

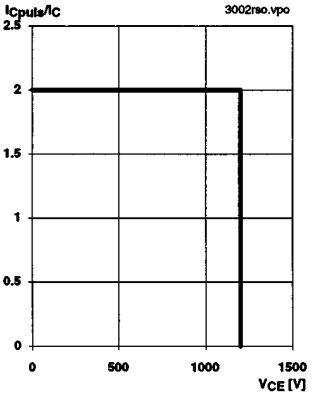
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
$T_j \leq$ 150 °C

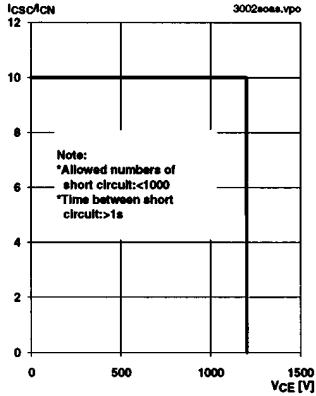
Not for linear use

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



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

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



$T_j \leq$ 150 °C
V_{GE} = ± 15 V
$t_{sc} \leq$ 10 µs
L < 25 nH
I_{CN} = 300 A

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

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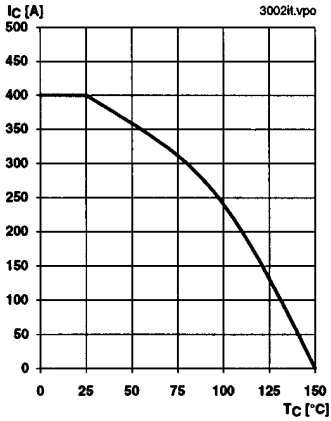


T_j = 150 °C
$V_{GE} \geq$ 15 V

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

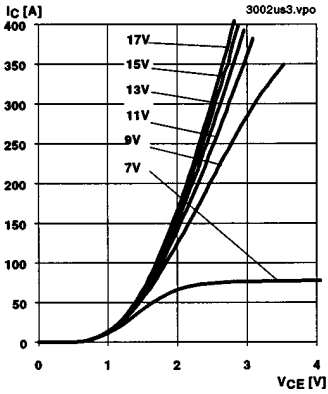


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

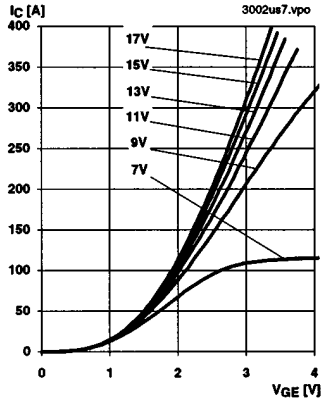


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

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

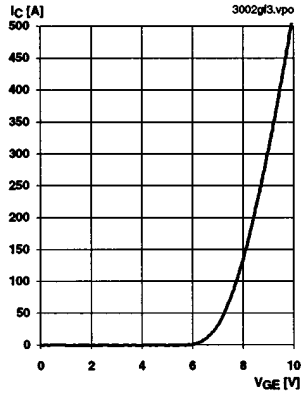


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V

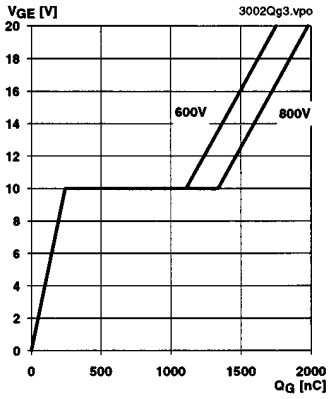
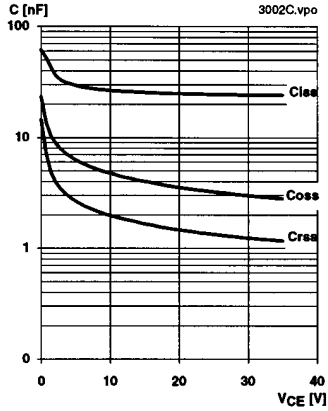


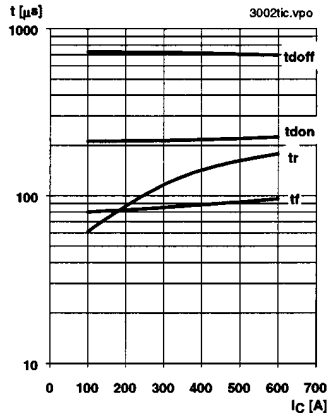
Fig. 13 Typ. gate charge characteristic

I_{Cpuls} = 300 A



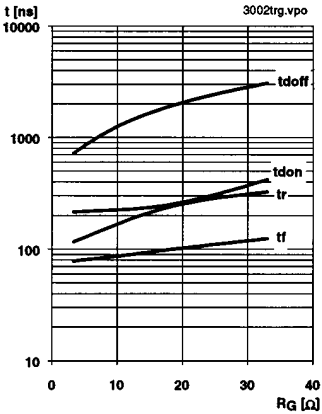
V_{GE} = 0 V
f = 1 MHZ

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

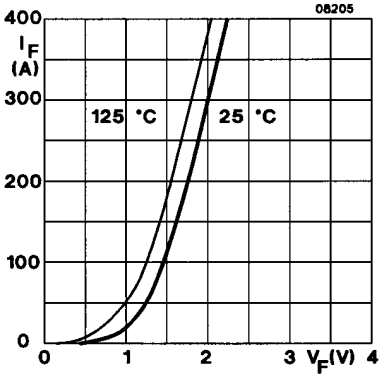


Fig. 17 Typ. CAL diode forward characteristic

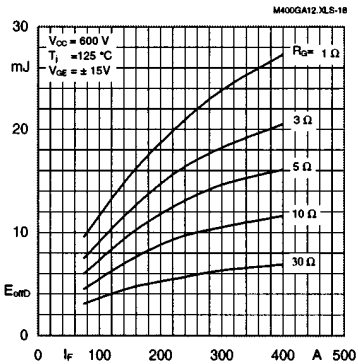


Fig. 18 Diode turn-off energy dissipation per pulse

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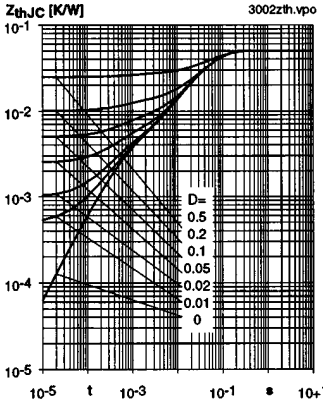


Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

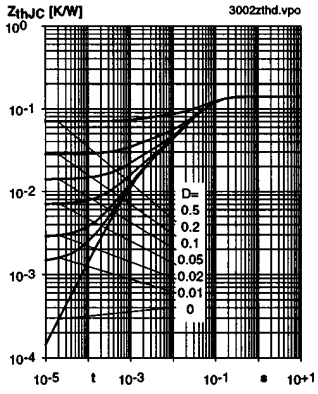


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

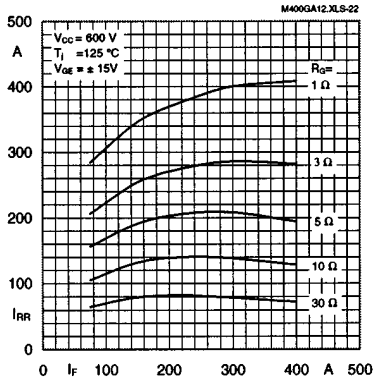


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

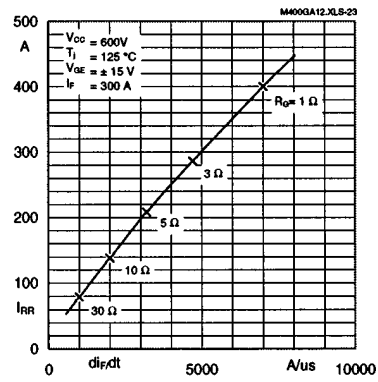


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di/dt)$

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

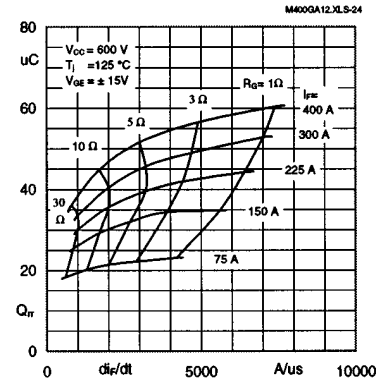
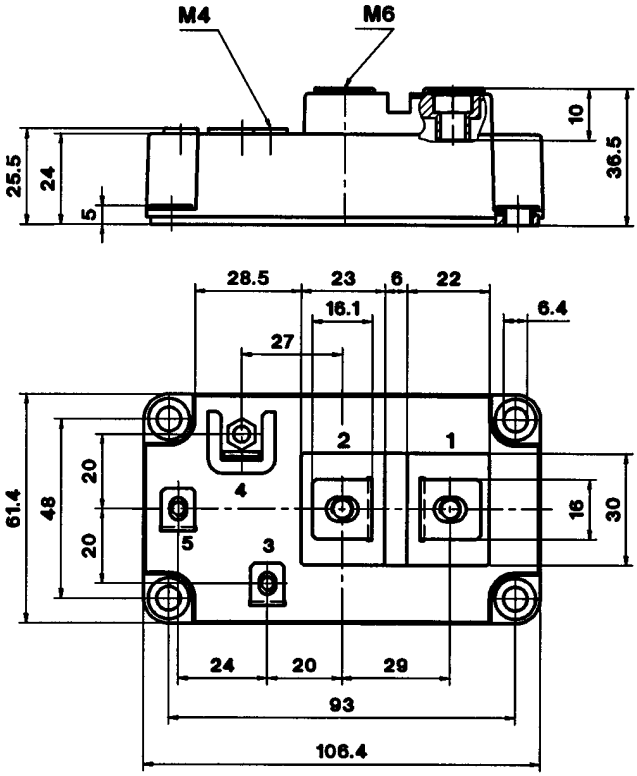


Fig. 24 Typ. CAL diode recovered charge

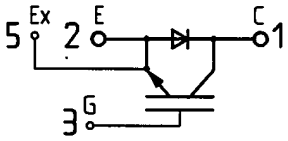
SEMITRANS 4
Case D 59
UL Recognized
File no. E 63 532

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

CASED59



GCIGGA4



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			Units
			min.	typ.	max.	
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.

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