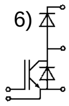
Absolute Maximum Ratings Symbol	Conditions [1]	Values ... 123 D		Units
V_{CES}		1200		V
V_{CGR}	R_{GE} = 20 kΩ	1200		V
I_C	T_{case} = 25/80 °C	200 / 150		A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	400 / 300		A
V_{GES}		± 20		V
P_{tot}	per IGBT, T_{case} = 25 °C	1250		W
T_j, (T_{stg})		– 40 . . .+150 (125)		°C
V_{isol}	AC, 1 min.	2 500		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	25 / 15	130 / 90	A
I_{FM}= – I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	50 / 30	400 / 300	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	200	1100	A
I^2t	t_p = 10 ms; T_j = 150 °C	200	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 = 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}		–	–	30	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) 7)]					
V_F = V_{EC}	I_F = 15 A } V_{GE} = 0 V;	–	2,0(1,8)	2,5	V
V_F = V_{EC}	I_F = 25 A } T_j = 25 (125) °C	–	2,3(2,1)	–	V
V_{TO}	T_j = 125 °C	–	–	1,2	V
r_T	T_j = 125 °C	–	45	70	mΩ
I_{RRM}	I_F = 15 A; T_j = 25 (125) °C [2]	–	12(16)	–	A
Q_{rr}	I_F = 15 A; T_j = 25 (125) °C [2]	–	1(2,7)	–	µC
FWD of types "GAL" [6]					
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
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,1	°C/W
R_{thjc}	per diode / FWD "GAL"	–	–	1,5/0,36	°C/W
R_{thch}	per module	–	–	0,05	°C/W

SEMITRANS® M
IGBT Modules

SKM 195 GAL 123 D [6)]

SEMITRANS 2



GAL

Features
- MOS input (voltage controlled)
- N channel, Homogeneous Si
- 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:
- Switching (not for linear use)
- Brake chopper, Step-up-chopper

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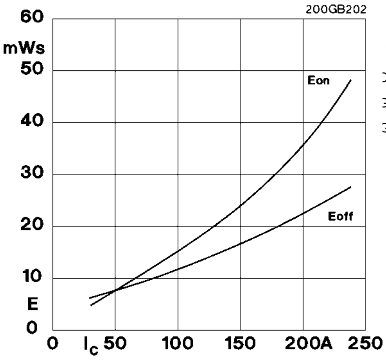
1) T_{case} = 25 °C, unless otherwise specified
2) I_F = – I_C, V_R = 600 V, – di_F/dt = 1000 A/µs, V_{GE} = 0 V
3) Use V_{GEoff} = -5 ... -15 V
5) See fig. 2 + 3; R_{Goff} = 5,6 Ω
6) The free-wheeling diodes of the GAL type have the data of the inverse diodes of SKM 145 GB 123 D
7) for protection only
8) CAL = Controlled Axial Lifetime Technology.

Cases and mech. data →

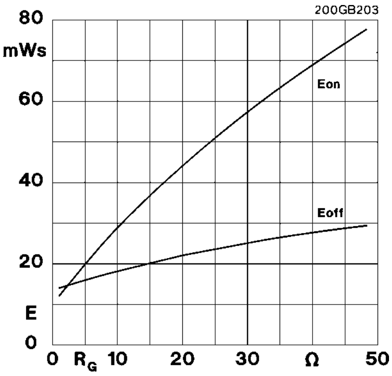
c:\marketin\datenbl\igbt\195gal.chp

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



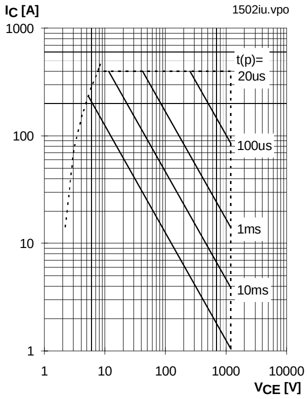
= 125 °C
CE = 600 V
GE = ± 15 V
G = 5,6 Ω

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

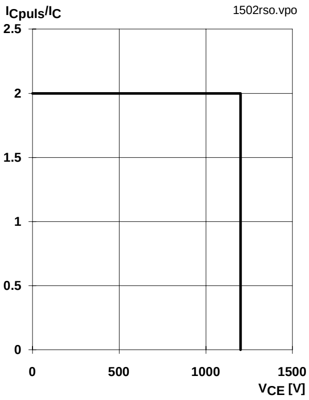
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
$T_j \leq$ 150 °C

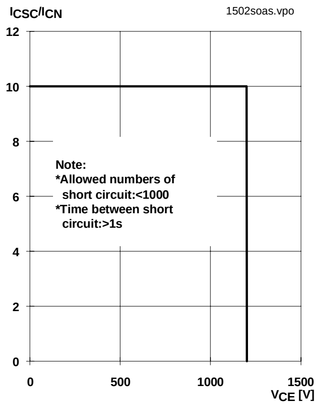
Not for
linear use

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 $I_C = f(V_{CE})$

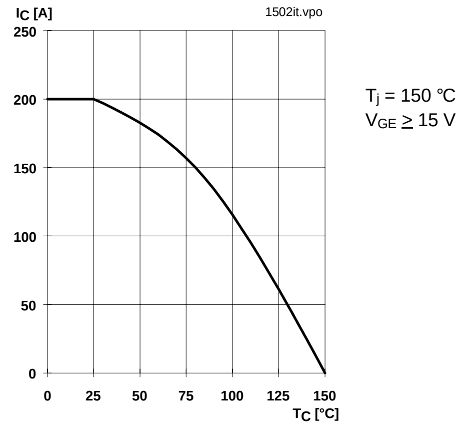


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

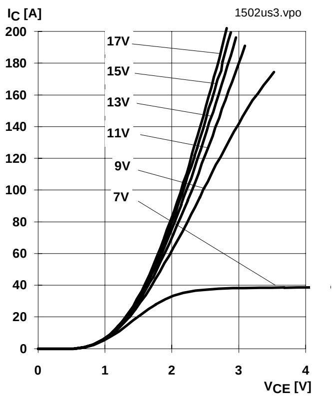


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

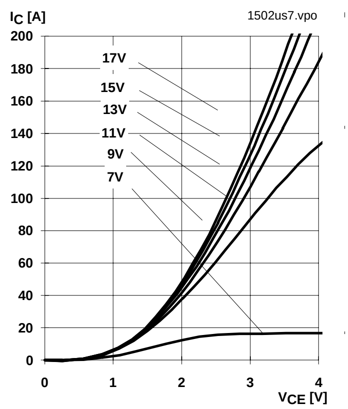


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

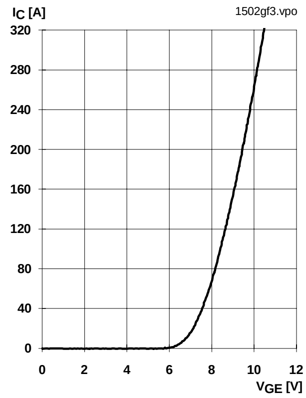
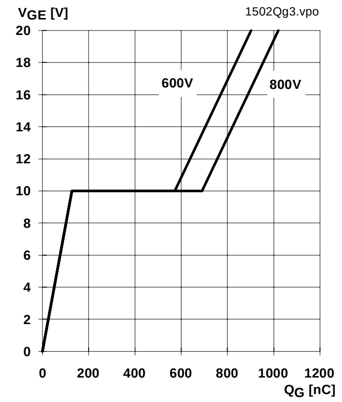
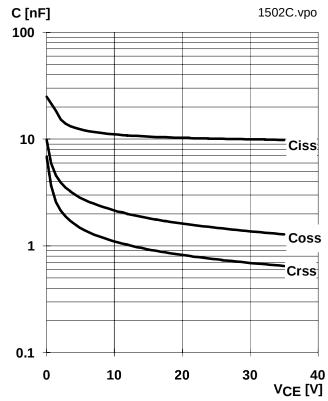


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



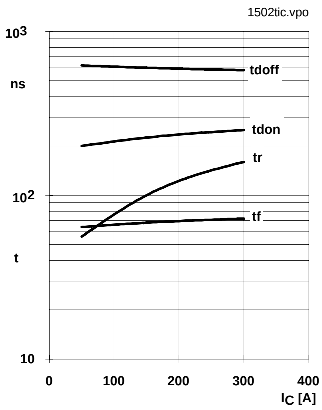
I_{Cpuls} = 150 A

Fig. 13 Typ. gate charge characteristic



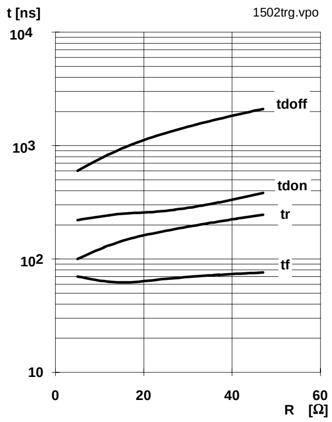
V_{GE} = 0 V
f = 1 MHZ

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

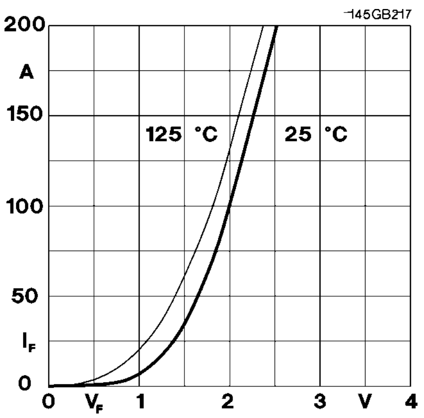


Fig. 17 Typ. CAL diode (FWD) forward characteristic

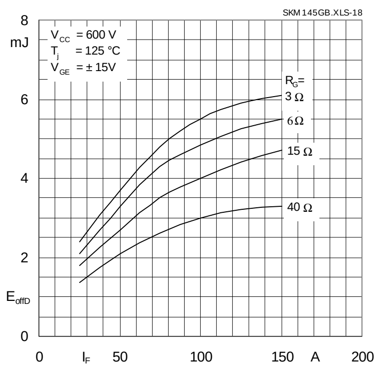


Fig. 18 FW-Diode turn-off energy dissipation per pulse

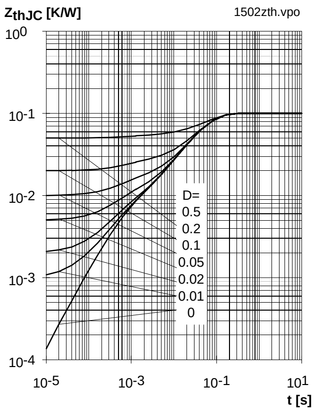


Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

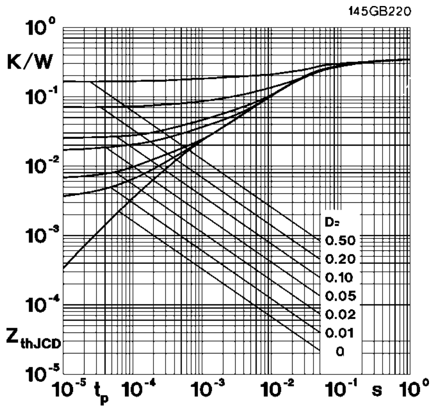


Fig. 20 Transient thermal impedance of FWD
(CAL diodes) $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

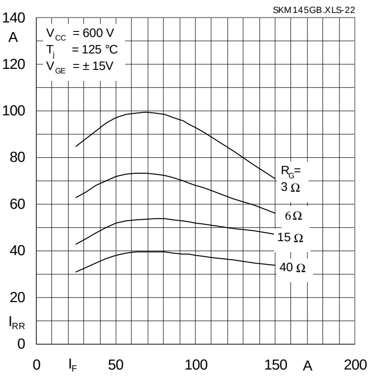


Fig. 22 Typ. FWD (CAL diode) peak reverse recovery current $I_{RR} = f(I_F, R_G)$

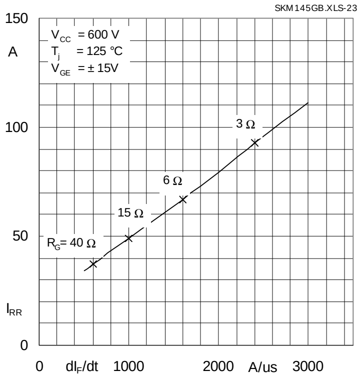


Fig. 23 Typ. FWD (CAL diode) peak reverse recovery current $I_{RR} = f(di_F/dt)$

Typical Applications include

DC choppers (versions GAR; GAL)
AC motor speed control
Brake choppers
Step-up choppers
Step-down choppers

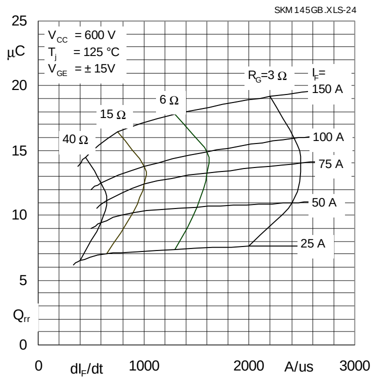


Fig. 24 Typ. FWD (CAL diode) recovered charge $Q_{RR} = f(di/dt)$

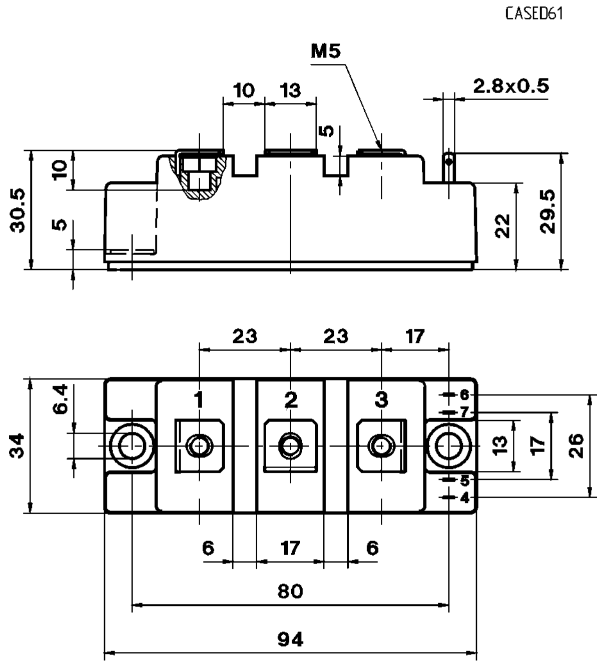
SEMITRANS 2

Case D 61

UL Recognition

File no. E 63 532

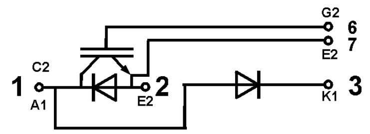
applied for



Dimensions in mm

SKM 195 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

[6)] Freewheeling diode → page B 6 - 49, remark 6.

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 → see SEMIKRON Book 97/98 page B 6 - 4.

SEMIBOX → page C - 1.

