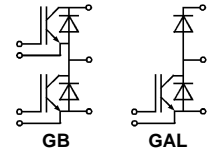


SEMITRANS® M IGBT Modules

SKM 50 GB 123 D SKM 50 GAL 123 D



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 $6 \cdot I_{cnom}$
- Latch-up free
- Fast & soft inverse CAL diodes⁸⁾
- 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) $T_{case} = 25 \text{ °C}$, unless otherwise specified

2) $I_F = -I_C$, $V_R = 600 \text{ V}$, $-di/dt = 800 \text{ A}/\mu\text{s}$, $V_{GE} = 0 \text{ V}$

3) Use $V_{GEOff} = -5 \dots -15 \text{ V}$

5) See fig. 2 + 3; $R_{Goff} = 27 \text{ } \Omega$

8) CAL = Controlled Axial Lifetime Technology.

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

Absolute Maximum Ratings		Values ... 123 D	Units
Symbol	Conditions ¹⁾		
V_{CES}		1200	V
V_{CGR}	$R_{GE} = 20 \text{ k}\Omega$	1200	V
I_C	$T_{case} = 25/80 \text{ °C}$	50 / 40	A
I_{CM}	$T_{case} = 25/80 \text{ °C}$; $t_p = 1 \text{ ms}$	100 / 80	A
V_{GES}		± 20	V
P_{tot}		310	W
T_j , (T_{stg})	per IGBT, $T_{case} = 25 \text{ °C}$	$-40 \dots +150$ (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			
$I_F = -I_C$	$T_{case} = 25/80 \text{ °C}$	50 / 40	A
$I_{FM} = -I_{CM}$	$T_{case} = 25/80 \text{ °C}$; $t_p = 1 \text{ ms}$	100 / 80	A
I_{FSM}	$t_p = 10 \text{ ms}$; \sin ; $T_j = 150 \text{ °C}$	550	
I^2t	$t_p = 10 \text{ ms}$; $T_j = 150 \text{ °C}$	1500	A ² s

Characteristics		min.	typ.	max.	Units
Symbol	Conditions ¹⁾				
$V_{(BR)CES}$	$V_{GE} = 0$, $I_C = 1 \text{ mA}$	$\geq V_{CES}$	–	–	V
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 2 \text{ mA}$	4,5	5,5	6,5	V
I_{CES}	$V_{GE} = 0$ } $T_j = 25 \text{ °C}$	–	0,3	1	mA
	$V_{CE} = V_{CES}$ } $T_j = 125 \text{ °C}$	–	3	–	mA
I_{GES}	$V_{GE} = 20 \text{ V}$, $V_{CE} = 0$	–	–	200	nA
V_{CESat}	$I_C = 40 \text{ A}$ } $V_{GE} = 15 \text{ V}$; } $I_C = 50 \text{ A}$ } $T_j = 25$ (125) °C }	–	2,5(3,1)	3(3,7)	V
V_{CESat}	$I_C = 50 \text{ A}$ } $T_j = 25$ (125) °C }	–	2,7(3,5)	–	V
g_{fs}	$V_{CE} = 20 \text{ V}$, $I_C = 40 \text{ A}$	–	30	–	S
C_{CHC}	per IGBT	–	–	350	pF
C_{ies}	$V_{GE} = 0$	–	3300	4000	pF
C_{oes}	$V_{CE} = 25 \text{ V}$	–	500	600	pF
C_{res}	$f = 1 \text{ MHz}$	–	220	300	pF
L_{CE}		–	–	30	nH
$t_{d(on)}$	} $V_{CC} = 600 \text{ V}$ } $V_{GE} = +15 \text{ V} / -15 \text{ V}^{3)}$ } $I_C = 40 \text{ A}$, ind. load } $R_{Gon} = R_{Goff} = 22 \text{ } \Omega$ } $T_j = 125 \text{ °C}$	–	70	–	ns
t_r		–	60	–	ns
$t_{d(off)}$		–	400	–	ns
t_f		–	45	–	ns
$E_{on}^{5)}$		–	7	–	mWs
$E_{off}^{5)}$		–	4,5	–	mWs
Diodes ⁸⁾					
$V_F = V_{EC}$	$I_F = 40 \text{ A}$ } $V_{GE} = 0 \text{ V}$; } $I_F = 50 \text{ A}$ } $T_j = 25$ (125) °C }	–	1,85(1,6)	2,2	V
$V_F = V_{EC}$		–	2,0(1,8)	–	V
V_{TO}	$T_j = 125 \text{ °C}$	–	–	1,2	V
r_T	$T_j = 125 \text{ °C}$	–	–	22	m Ω
I_{RRM}	$I_F = 40 \text{ A}$; $T_j = 25$ (125) °C ²⁾	–	23(35)	–	A
Q_{rr}	$I_F = 40 \text{ A}$; $T_j = 25$ (125) °C ²⁾	–	2,3(7)	–	μC
$V_F = V_{EC}$	$I_F = 50 \text{ A}$ } $V_{GE} = 0 \text{ V}$; } $I_F = 75 \text{ A}$ } $T_j = 25$ (125) °C }	–	–	–	V
$V_F = V_{EC}$		–	–	–	V
V_{TO}	$T_j = 125 \text{ °C}$	–	–	–	V
r_T	$T_j = 125 \text{ °C}$	–	–	–	m Ω
I_{RRM}	$I_F = 50 \text{ A}$; $T_j = 25$ (125) °C ²⁾	–	–	–	A
Q_{rr}	$I_F = 50 \text{ A}$; $T_j = 25$ (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

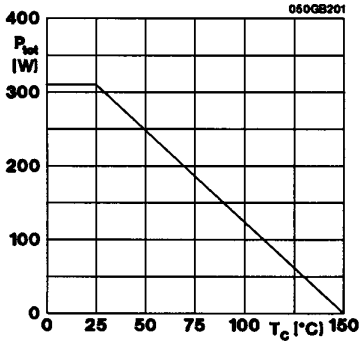


Fig. 1 Rated power dissipation $P_{tot} = f(T_c)$

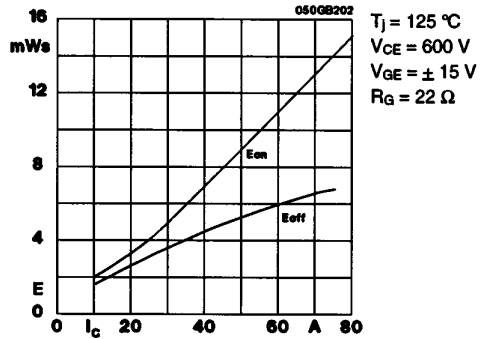


Fig. 2 Turn-on /-off energy = $f(I_c)$

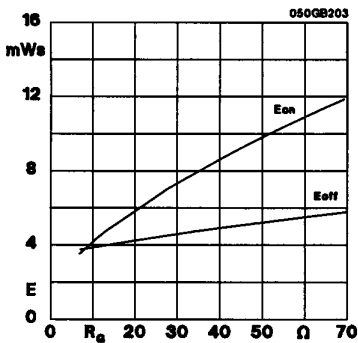


Fig. 3 Turn-on /-off energy = $f(R_g)$

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

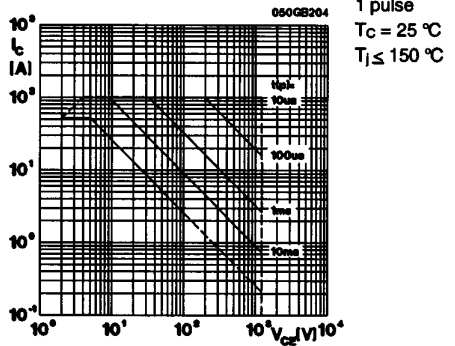


Fig. 4 Maximum safe operating area (SOA) $I_c = f(V_{CE})$

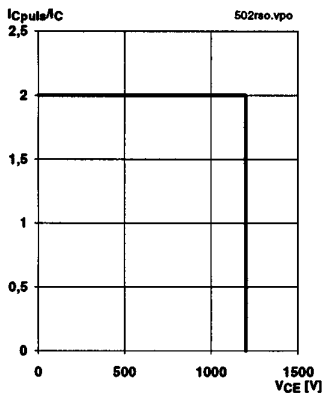


Fig. 5 Turn-off safe operating area (RBSOA)

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

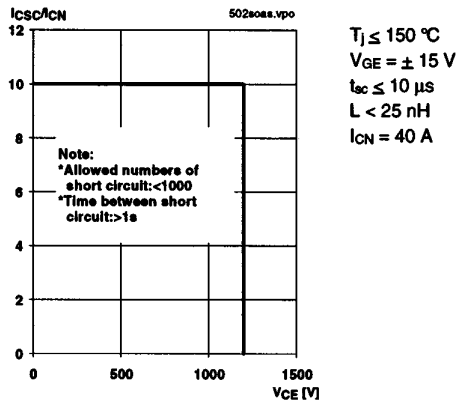


Fig. 6 Safe operating area at short circuit $I_c = f(V_{CE})$

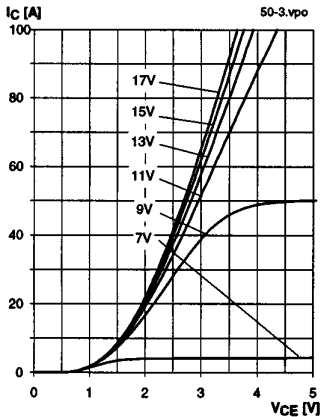


Fig. 9 Typ. output characteristic, $t_p = 80 \mu s$; $25 \text{ }^\circ\text{C}$

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

$$V_{\text{CEsat}(t)} = V_{\text{CE}(T_0)(T_j)} + r_{\text{CE}(T_j)} \cdot I_{\text{C}(t)}$$

$$V_{\text{CE}(T_0)(T_j)} \leq 1,5 + 0,002 (T_j - 25) [\text{V}]$$

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

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

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

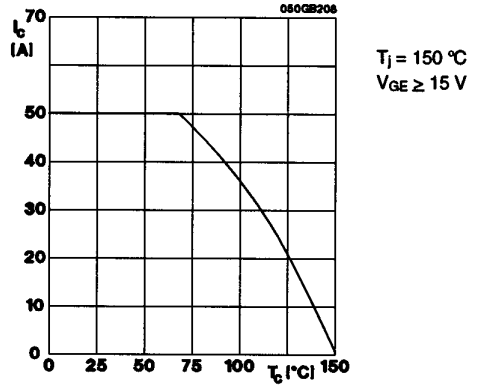


Fig. 8 Rated current vs. temperature $I_{\text{C}} = f(T_{\text{C}})$

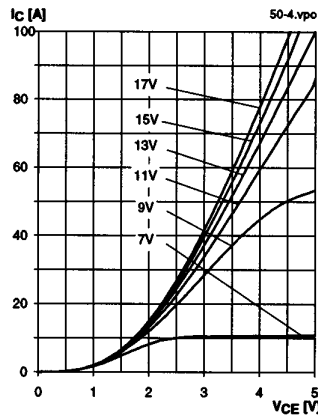


Fig. 10 Typ. output characteristic, $t_p = 80 \mu s$; $125 \text{ }^\circ\text{C}$

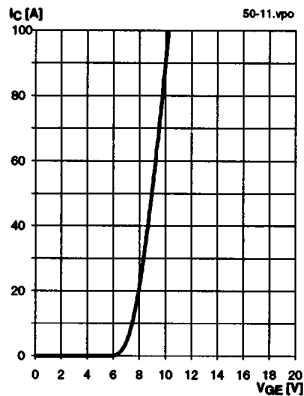


Fig. 12 Typ. transfer characteristic, $t_p = 80 \mu s$; $V_{\text{CE}} = 20 \text{ V}$

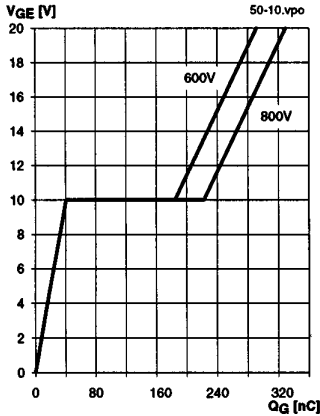


Fig. 13 Typ. gate charge characteristic

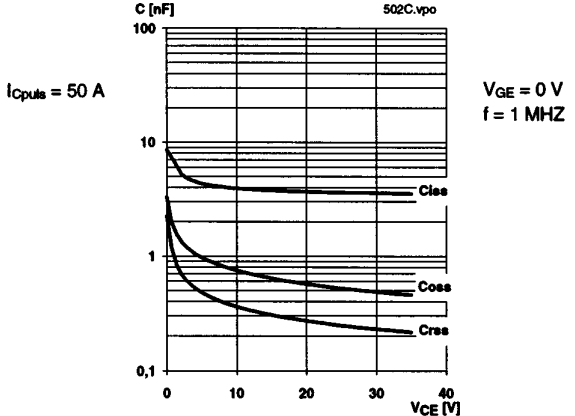


Fig. 14 Typ. capacitances vs. V_{CE}

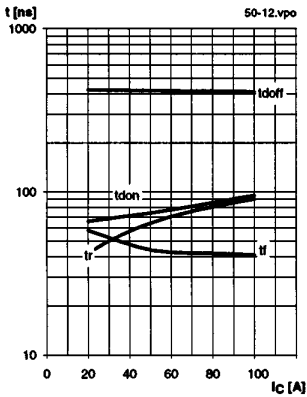


Fig. 15 Typ. switching times vs. I_c

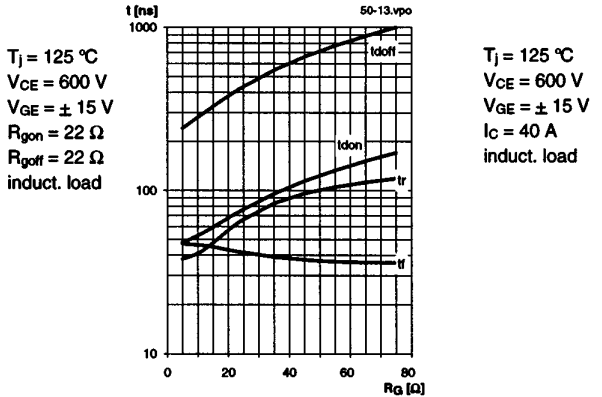


Fig. 16 Typ. switching times vs. gate resistor R_g

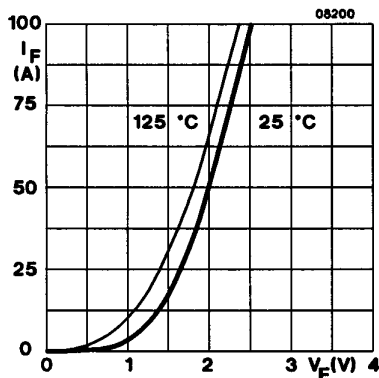


Fig. 17 Typ. CAL diode forward characteristic

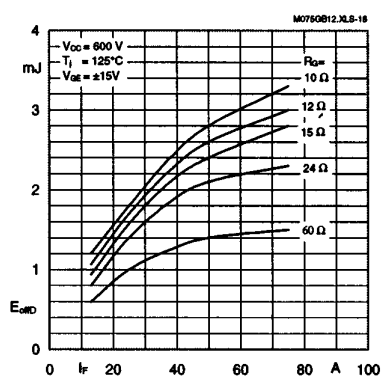


Fig. 18 Diode turn-off energy dissipation per pulse

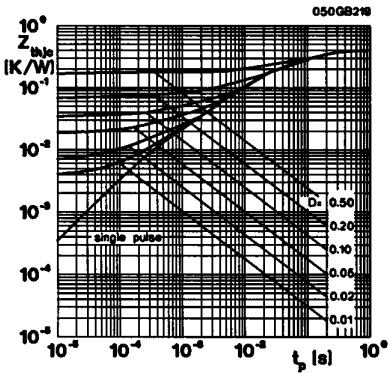


Fig. 19 Transient thermal impedance of IGBT
 $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

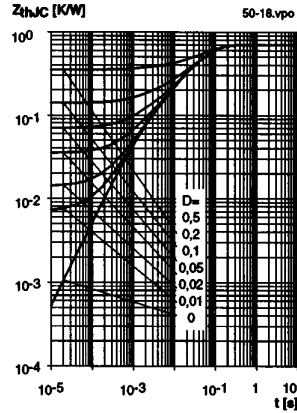


Fig. 20 Transient thermal impedance of inverse CAL diodes
 $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

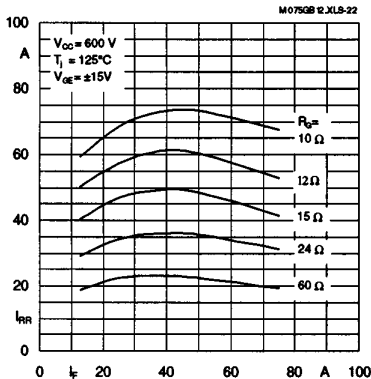


Fig. 22 Typ. CAL diode peak reverse recovery current
 $I_{RR} = f(I_F, R_G)$

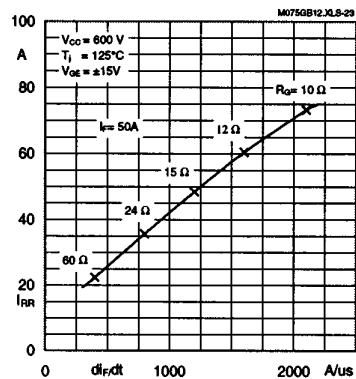


Fig. 23 Typ CAL diode peak reverse recovery current
 $I_{RR} = f(di/dt)$

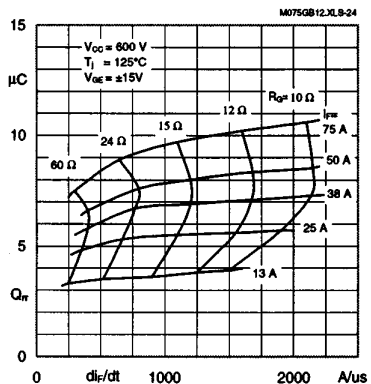


Fig. 24 Typ. CAL diode recovery charge

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

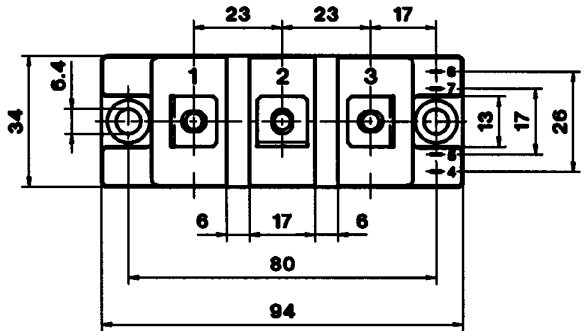
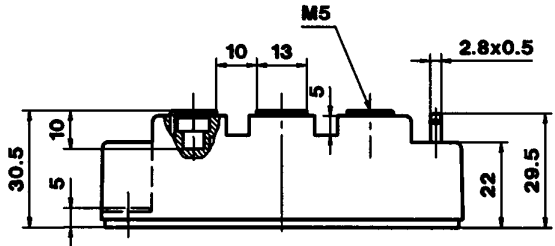
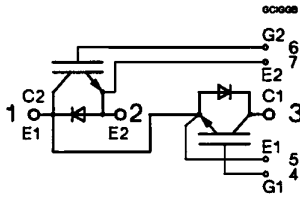
Case D 61

UL Recognized

File no. E 63 532

SKM 50 GB 123 D

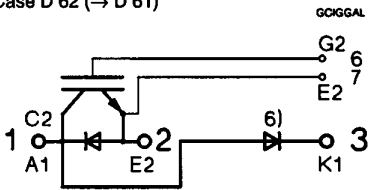
CASED61



Dimensions in mm

SKM 50 GAL 123 D

Case D 62 (→ D 61)



Case outline and circuit diagrams

Mechanical Data			Values			Units
Symbol	Conditions		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 packaging units of 20 or 42 pieces are used if suitable
Accessories → page B 6 - 4.
SEMIBOX → page C - 1.