

Absolute Maximum Ratings		Values		Units
Symbol	Conditions <sup>1)</sup>			
V <sub>CES</sub>		1200		V
V <sub>CGR</sub>	R <sub>GE</sub> = 20 kΩ	1200		V
I <sub>C</sub>	T <sub>case</sub> = 25/80 °C	150 / 110		A
I <sub>CM</sub>	T <sub>case</sub> = 25/80 °C; t <sub>p</sub> = 1 ms	300 / 220		A
V <sub>GES</sub>		± 20		V
P <sub>tot</sub>	per IGBT, T <sub>case</sub> = 25 °C	830		W
T <sub>j</sub> , (T <sub>stg</sub> )		- 40 ... +150 (125)		°C
V <sub>isol</sub>	AC, 1 min.	2 500 <sup>7)</sup>		V
humidity	DIN 40 040	Class F		
climate	DIN IEC 68 T.1	40/125/56		
Inverse Diode		FWD <sup>6)</sup>		
I <sub>F</sub> = - I <sub>C</sub>	T <sub>case</sub> = 25/80 °C	150 / 100	200 / 135	A
I <sub>FM</sub> = - I <sub>CM</sub>	T <sub>case</sub> = 25/80 °C; t <sub>p</sub> = 1 ms	300 / 220	300 / 220	A
I <sub>FSM</sub>	t <sub>p</sub> = 10 ms; sin.; T <sub>j</sub> = 150 °C	1100	1450	A
I <sub>t</sub> <sup>2</sup>	t <sub>p</sub> = 10 ms; T <sub>j</sub> = 150 °C	6000	10500	A <sup>2</sup> s

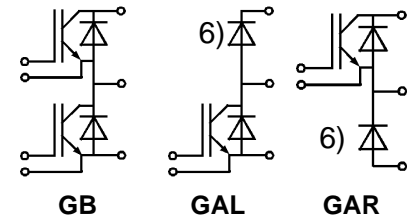
Characteristics		min.	typ.	max.	Units		
Symbol	Conditions <sup>1)</sup>						
V <sub>(BR)CES</sub>	V <sub>GE</sub> = 0, I <sub>C</sub> = 4 mA	≥ V <sub>CES</sub>	-	-	V		
V <sub>GE(th)</sub>	V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 4 mA	4,5	5,5	6,5	V		
I <sub>CES</sub>	V <sub>GE</sub> = 0 } T <sub>j</sub> = 25 °C	-	0,2	2	mA		
		V <sub>CE</sub> = V <sub>CES</sub> } T <sub>j</sub> = 125 °C	-	9		mA	
I <sub>GES</sub>	V <sub>GE</sub> = 20 V, V <sub>CE</sub> = 0	-	-	1	μA		
V <sub>CEsat</sub>	I <sub>C</sub> = 100 A } V <sub>GE</sub> = 15 V;	-	2,5(3,1)	3(3,7)	V		
V <sub>CEsat</sub>	I <sub>C</sub> = 150 A } T <sub>j</sub> = 25 (125) °C	-	3(3,8)	-	V		
g <sub>fs</sub>	V <sub>CE</sub> = 20 V, I <sub>C</sub> = 100 A	54	-	-	S		
C <sub>CHC</sub>	per IGBT	-	-	700	pF		
C <sub>ies</sub>	} V <sub>GE</sub> = 0	-	6,5	8,5	nF		
C <sub>oes</sub>		} V <sub>CE</sub> = 25 V	-	1000	1500	pF	
C <sub>res</sub>			f = 1 MHz	-	500	600	pF
L <sub>CE</sub>		-	-	20	nH		
t <sub>d(on)</sub>	} V <sub>CC</sub> = 600 V	-	160	320	ns		
t <sub>r</sub>		} V <sub>GE</sub> = + 15 V; - 15 V <sup>3)</sup>	-	80	160	ns	
t <sub>d(off)</sub>			} I <sub>C</sub> = 100 A, ind. load	-	400	520	ns
t <sub>f</sub>		} R <sub>Gon</sub> = R <sub>Goff</sub> = 6,8 Ω		-	70	100	ns
E <sub>on</sub> <sup>5)</sup>				} T <sub>j</sub> = 125 °C	-	13	-
E <sub>off</sub> <sup>5)</sup>		-	11		-	mWs	
Inverse Diode <sup>8)</sup>							
V <sub>F</sub> = V <sub>EC</sub>	I <sub>F</sub> = 100 A } V <sub>GE</sub> = 0 V;	-	2,0(1,8)	2,5	V		
V <sub>F</sub> = V <sub>EC</sub>		I <sub>F</sub> = 150 A } T <sub>j</sub> = 25 (125) °C	-	2,25(2,1)	-	V	
V <sub>TO</sub>	T <sub>j</sub> = 125 °C	-	-	1,2	V		
r <sub>T</sub>	T <sub>j</sub> = 125 °C	-	8	11	mΩ		
I <sub>R</sub> RM	I <sub>F</sub> = 100 A; T <sub>j</sub> = 25 (125) °C <sup>2)</sup>	-	35(50)	-	A		
Q <sub>rr</sub>	I <sub>F</sub> = 100 A; T <sub>j</sub> = 25 (125) °C <sup>2)</sup>	-	5(14)	-	μC		
FWD of types "GAL", "GAR" <sup>8)</sup>							
V <sub>F</sub> = V <sub>EC</sub>	I <sub>F</sub> = 100 A } V <sub>GE</sub> = 0 V;	-	1,85(1,6)	2,2	V		
V <sub>F</sub> = V <sub>EC</sub>		I <sub>F</sub> = 150 A } T <sub>j</sub> = 25 (125) °C	-	2,0(1,8)	-	V	
V <sub>TO</sub>	T <sub>j</sub> = 125 °C	-	-	1,2	V		
r <sub>T</sub>	T <sub>j</sub> = 125 °C	-	5	7	mΩ		
I <sub>R</sub> RM	I <sub>F</sub> = 100 A; T <sub>j</sub> = 25 (125) °C <sup>2)</sup>	-	40(65)	-	A		
Q <sub>rr</sub>	I <sub>F</sub> = 100 A; T <sub>j</sub> = 25 (125) °C <sup>2)</sup>	-	5(15)	-	μC		
Thermal Characteristics							
R <sub>thjc</sub>	per IGBT	-	-	0,15	°C/W		
R <sub>thjc</sub>	per diode / FWD "GAL; GAR"	-	-	0,30/0,25	°C/W		
R <sub>thch</sub>	per module	-	-	0,038	°C/W		

## SEMITRANS® M IGBT Modules

**SKM 150 GB 123 D**  
**SKM 150 GAL 123 D <sup>6)</sup>**  
**SKM 150 GAR 123 D <sup>6)</sup>**



### 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<sub>cnom</sub>
- Latch-up free
- Fast & soft inverse CAL diodes<sup>8)</sup>
- Isolated copper baseplate using DCB Direct Copper Bonding Technology
- Large clearance (12 mm) and creepage distances (20 mm).

#### Typical Applications: → B 6-141

- Switching (not for linear use)

1) T<sub>case</sub> = 25 °C, unless otherwise specified

2) I<sub>F</sub> = - I<sub>C</sub>, V<sub>R</sub> = 600 V,

- di<sub>F</sub>/dt = 1000 A/μs, V<sub>GE</sub> = 0 V

3) Use V<sub>GEoff</sub> = -5 ... -15 V

5) See fig. 2 + 3; R<sub>Goff</sub> = 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<sub>isol</sub> = 4000 V<sub>rms</sub> on request

8) CAL = Controlled Axial Lifetime Technology.

**Cases and mech. data → B6-142 SEMITRANS 3**

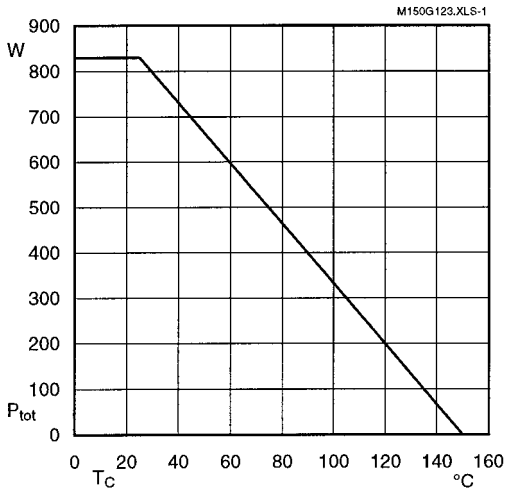


Fig. 1 Rated power dissipation  $P_{tot} = f(T_C)$

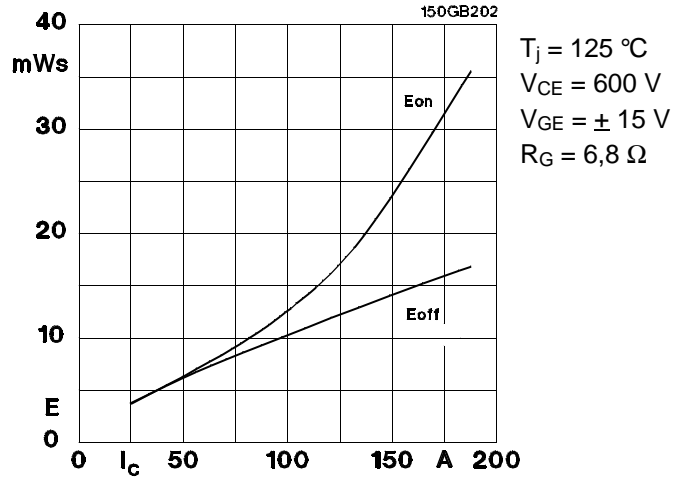


Fig. 2 Turn-on /-off energy  $= f(I_C)$

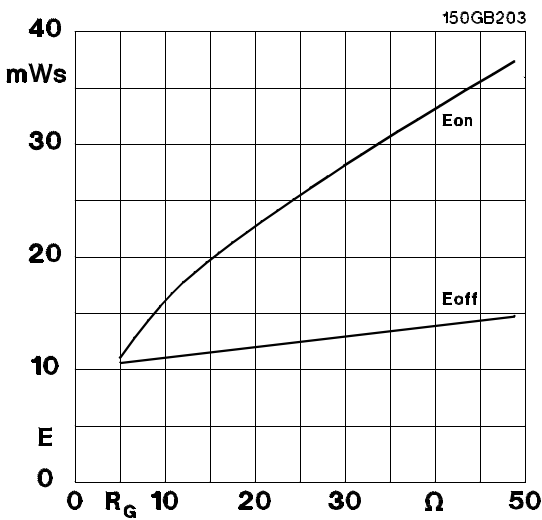


Fig. 3 Turn-on /-off energy  $= f(R_G)$

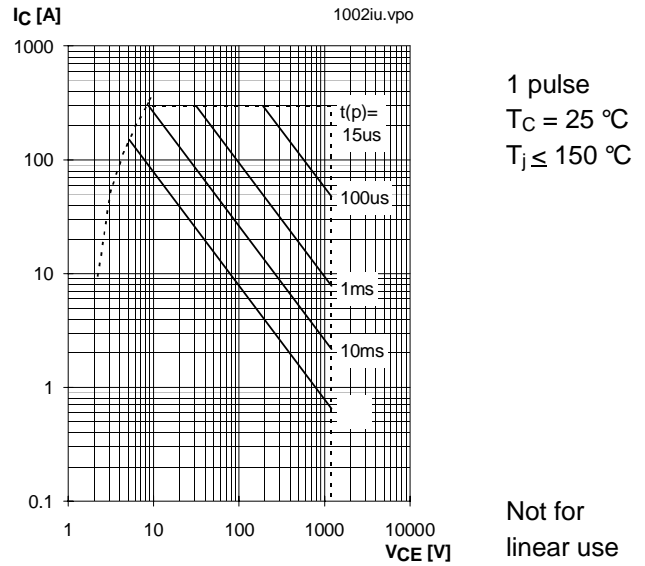


Fig. 4 Maximum safe operating area (SOA)  $I_C = f(V_{CE})$

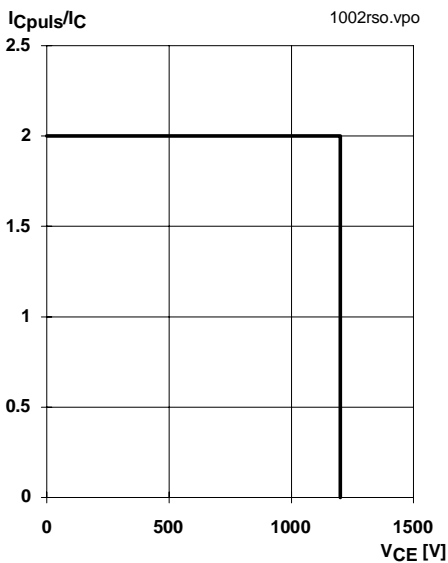


Fig. 5 Turn-off safe operating area (RBSOA)

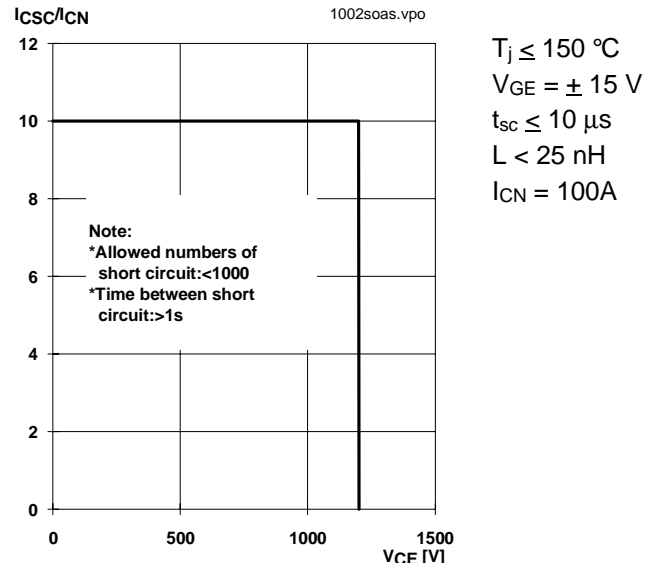
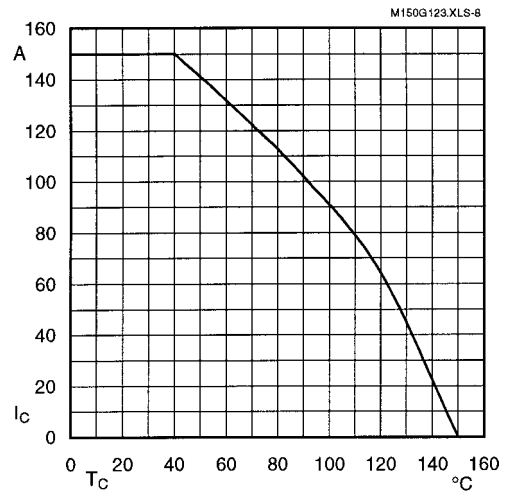


Fig. 6 Safe operating area at short circuit  $I_C = f(V_{CE})$



$T_j = 150\text{ }^{\circ}C$   
 $V_{GE} \geq 15\text{ V}$

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

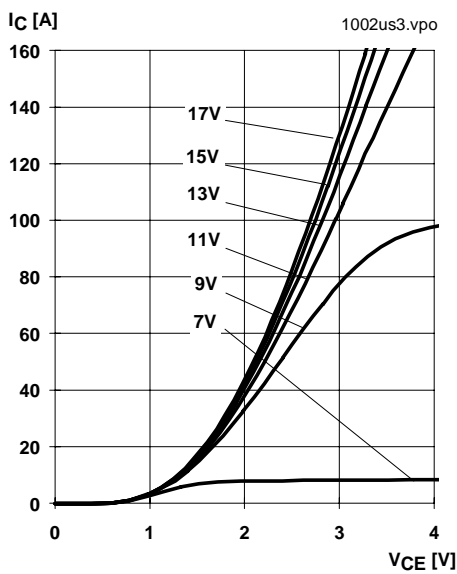


Fig. 9 Typ. output characteristic,  $t_p = 80\text{ }\mu s$ ;  $25\text{ }^{\circ}C$

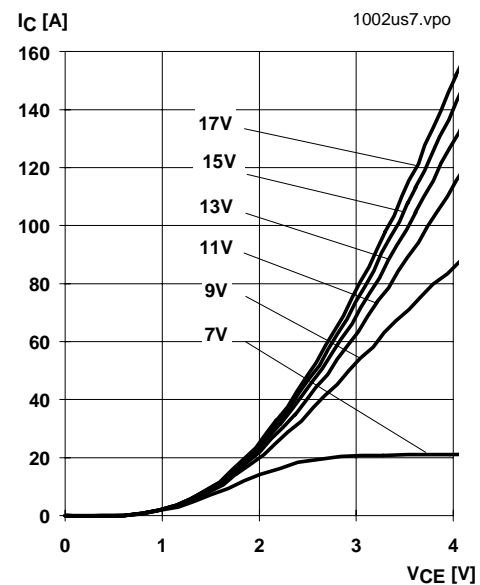


Fig. 10 Typ. output characteristic,  $t_p = 80\text{ }\mu s$ ;  $125\text{ }^{\circ}C$

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

$$V_{CEsat(t)} = V_{CE(TO)(T_j)} + r_{CE(T_j)} \cdot I_C(t)$$

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

$$\text{typ.: } r_{CE(T_j)} = 0,010 + 0,00004 (T_j - 25) \text{ [\Omega]}$$

$$\text{max.: } r_{CE(T_j)} = 0,015 + 0,00005 (T_j - 25) \text{ [\Omega]}$$

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

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

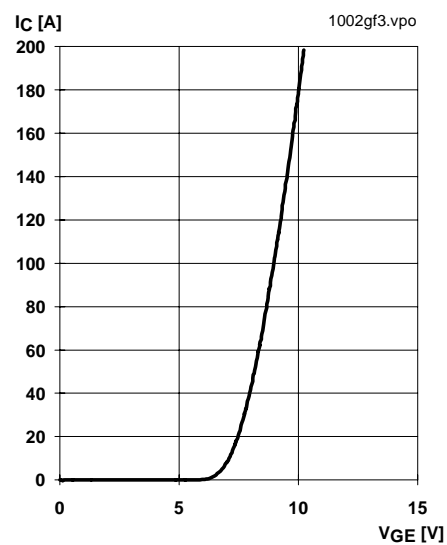


Fig. 12 Typ. transfer characteristic,  $t_p = 80\text{ }\mu s$ ;  $V_{CE} = 20\text{ V}$

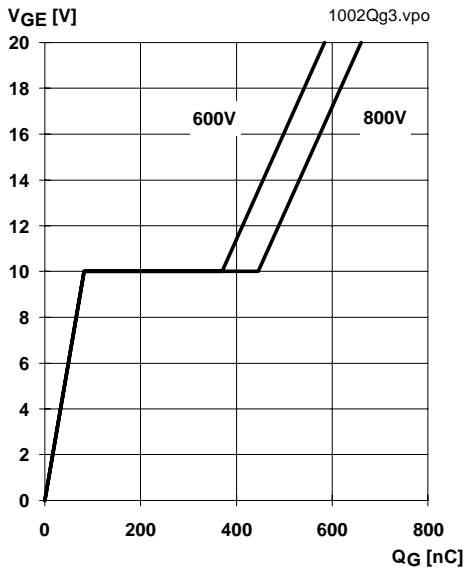
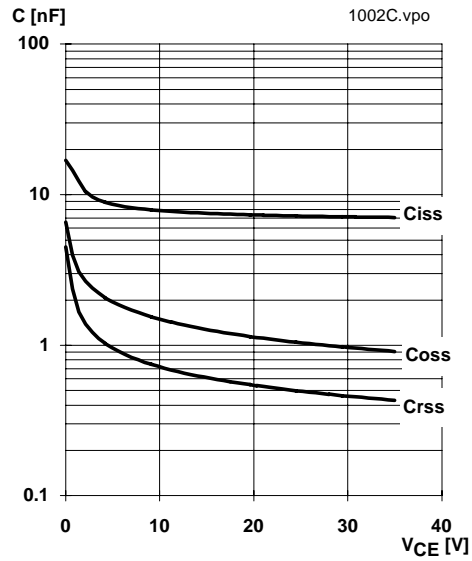


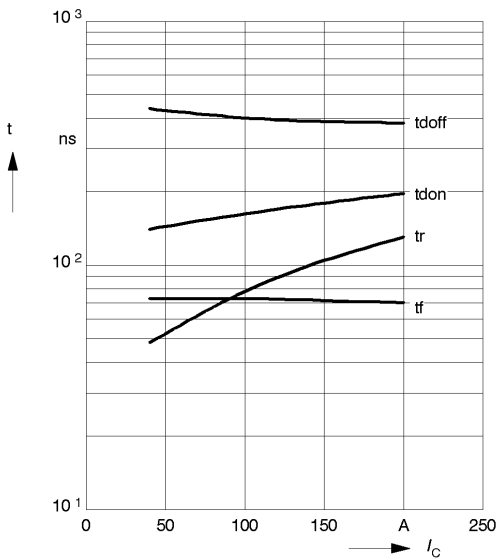
Fig. 13 Typ. gate charge characteristic

$I_{Cpuls} = 100 \text{ A}$



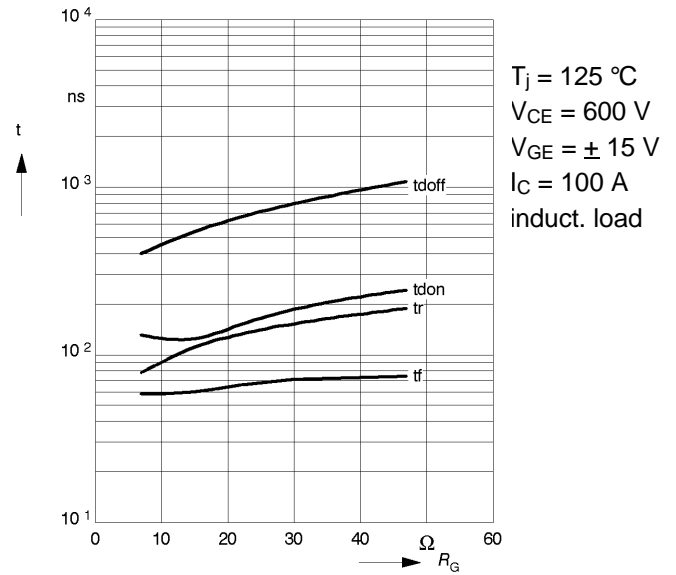
$V_{GE} = 0 \text{ V}$   
 $f = 1 \text{ MHz}$

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



$T_j = 125 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{Gon} = 6,8 \text{ } \Omega$   
 $R_{Goff} = 6,8 \text{ } \Omega$   
induct. load

Fig. 15 Typ. switching times vs.  $I_C$



$T_j = 125 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 100 \text{ A}$   
induct. load

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

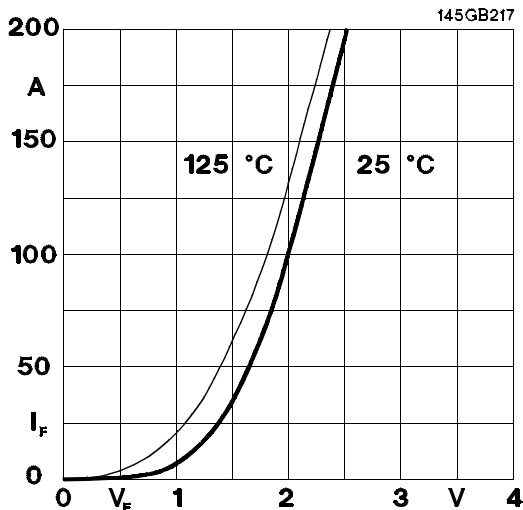


Fig. 17 Typ. CAL diode forward characteristic

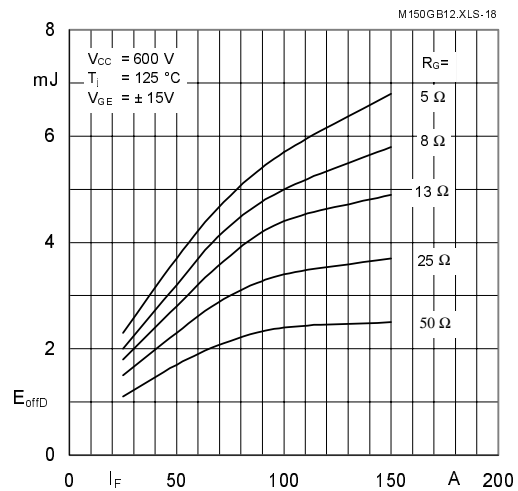


Fig. 18 Diode turn-off energy dissipation per pulse

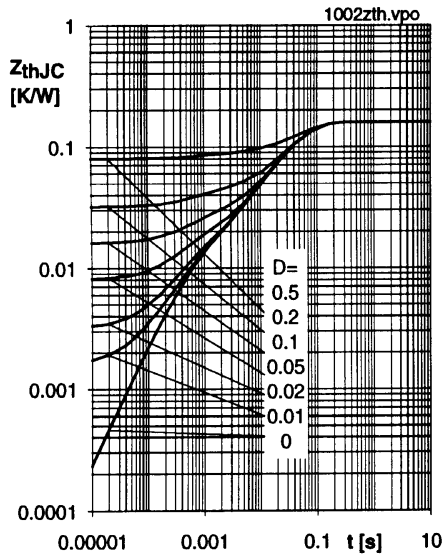


Fig. 19 Transient thermal impedance of IGBT  
 $Z_{thJC} = f(t_p)$ ;  $D = t_p / t_c = t_p \cdot f$

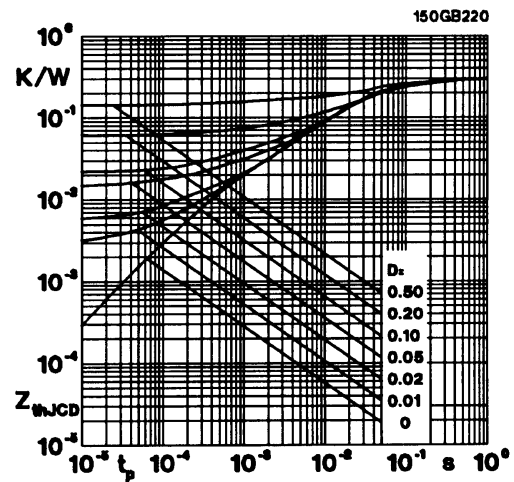


Fig. 20 Transient thermal impedance of inverse CAL diodes  
 $Z_{thJC} = f(t_p)$ ;  $D = t_p / t_c = t_p \cdot f$

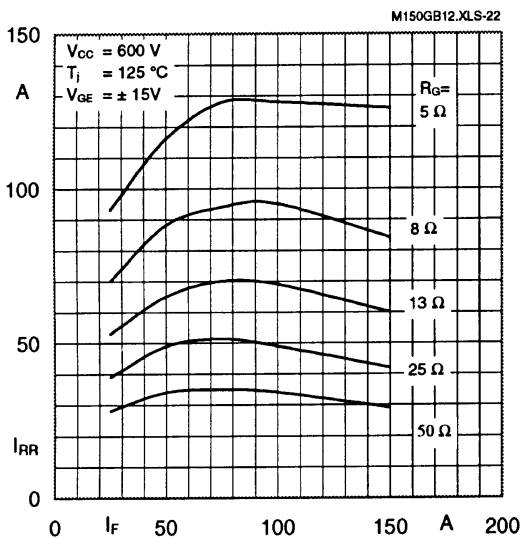


Fig. 22 Typ. CALdiode reverse recovery current  $I_{RR} = f(I_F; R_G)$

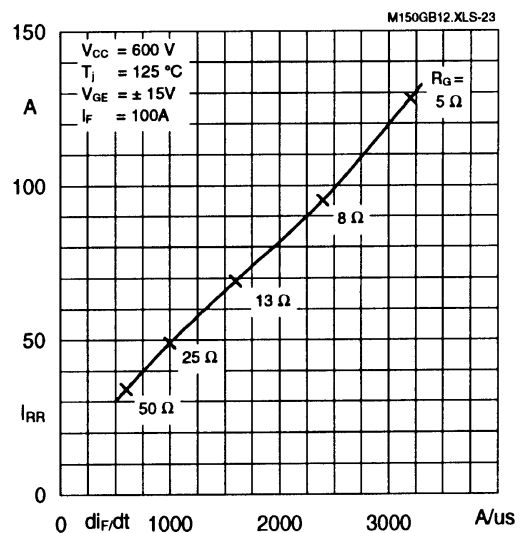


Fig. 23 Typ. CAL diode reverse recovery current  $I_{RR} = f(di_F/dt)$

## 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

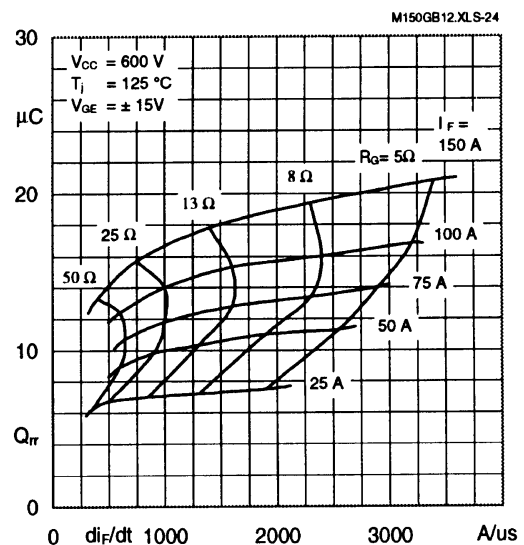


Fig. 24 Typ. CAL diode recovered charge  $Q_{rr} = f(di/dt)$

**SEMITRANS 3**

Case D 56

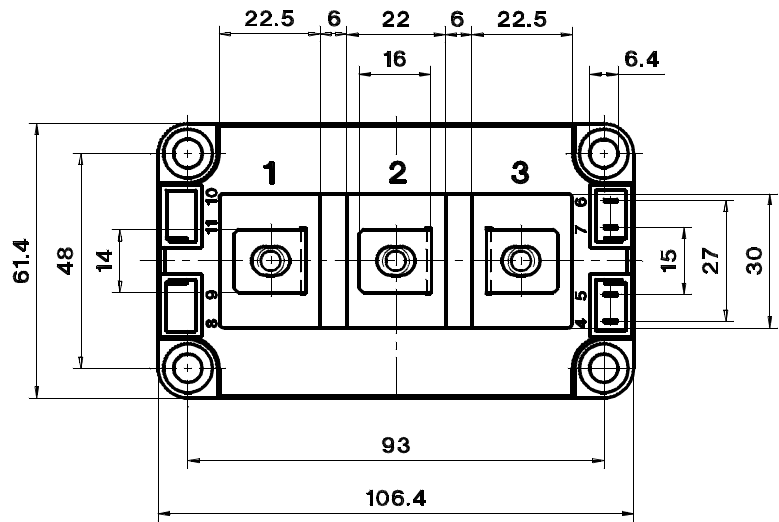
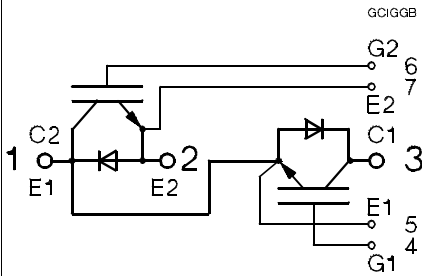
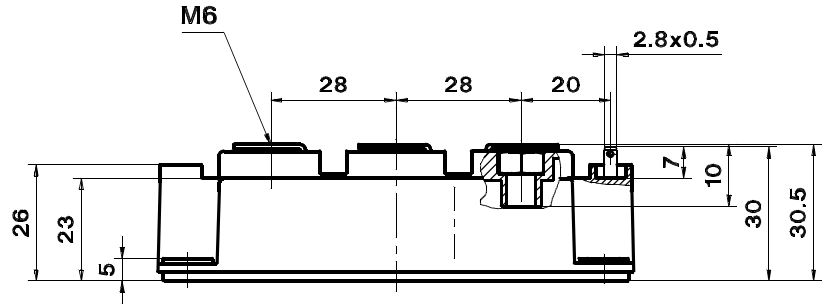
UL Recognized

File no. E 63 532

CASED56

**SKM 150 GB 123 D**

**SKM 150 GB 173 D**

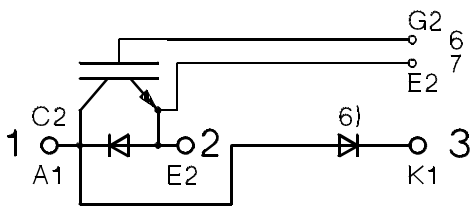


Dimensions in mm

**SKM 150 GAL 123 D**

Case D 57 (→ D 56)

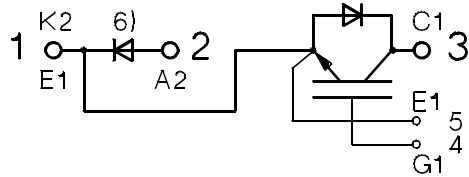
GCIGGAL



**SKM 150 GAR 123 D**

Case D 58 (→ D 56)

GCIGGAR



Case outline and circuit diagrams

**Mechanical Data**

Symbol	Conditions	Values			Units
		min.	typ.	max.	
M <sub>1</sub>	to heatsink, SI Units (M6)	3	—	5	Nm
	to heatsink, US Units	27	—	44	lb.in.
M <sub>2</sub>	for terminals, SI Units (M6)	2,5	—	5	Nm
	for terminals US Units	22	—	44	lb.in.
a		—	—	5x9,81	m/s <sup>2</sup>
w		—	—	325	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 → B 6 - 4.  
SEMIBOX → C - 1.

<sup>6)</sup> Freewheeling diode → B 6 - 137, remark 6.