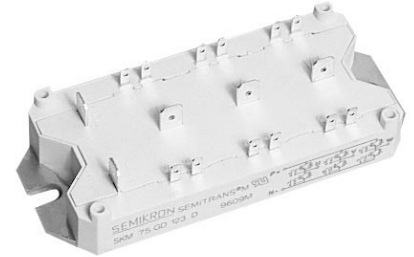


Absolute Maximum Ratings		Values	Units
Symbol	Conditions <sup>1)</sup>		
V <sub>CES</sub>		1200	V
V <sub>CGR</sub>	R <sub>GE</sub> = 20 kΩ	1200	V
I <sub>C</sub>	T <sub>case</sub> = 25/80 °C	40 / 30	A
I <sub>CM</sub>	T <sub>case</sub> = 25/80 °C; t <sub>p</sub> = 1 ms	70 / 50	A
V <sub>GES</sub>		± 20	V
P <sub>tot</sub>	per IGBT, T <sub>case</sub> = 25 °C	220	W
T <sub>j</sub> , (T <sub>stg</sub> )		- 40 ... +150 (125)	°C
V <sub>isol</sub>	AC, 1 min.	2 500	V
humidity	DIN 40 040	Class F	
climate	DIN IEC 68 T.1	40/125/56	
Inverse Diode			
I <sub>F</sub> = - I <sub>C</sub>	T <sub>case</sub> = 25/80 °C	45 / 30	A
I <sub>FM</sub> = - I <sub>CM</sub>	T <sub>case</sub> = 25/80 °C; t <sub>p</sub> = 1 ms	70 / 50	A
I <sub>FSM</sub>	t <sub>p</sub> = 10 ms; sin.; T <sub>j</sub> = 150 °C	350	A
I <sub>t</sub> <sup>2</sup>	t <sub>p</sub> = 10 ms; T <sub>j</sub> = 150 °C	600	A <sup>2</sup> s

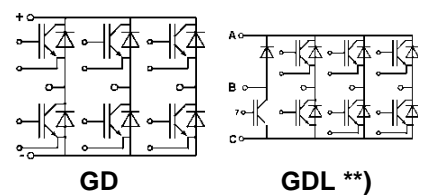
Characteristics		min.	typ.	max.	Units
Symbol	Conditions <sup>1)</sup>				
V <sub>(BR)CES</sub>	V <sub>GE</sub> = 0, I <sub>C</sub> = 0,8 mA	≥ V <sub>CES</sub>	-	-	V
V <sub>GE(th)</sub>	V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 1 mA	4,5	5,5	6,5	V
I <sub>CES</sub>	V <sub>GE</sub> = 0 } T <sub>j</sub> = 25 °C	-	0,1	1	mA
	V <sub>CE</sub> = V <sub>CES</sub> } T <sub>j</sub> = 125 °C	-	3	-	mA
I <sub>GES</sub>	V <sub>GE</sub> = 20 V, V <sub>CE</sub> = 0	-	-	200	nA
V <sub>CEsat</sub>	I <sub>C</sub> = 25 A } V <sub>GE</sub> = 15 V;	-	2,5(3,1)	3(3,7)	V
V <sub>CEsat</sub>	I <sub>C</sub> = 40 A } T <sub>j</sub> = 25 (125) °C	-	3,1(3,9)	-	V
g <sub>fs</sub>	V <sub>CE</sub> = 20 V, I <sub>C</sub> = 25 A		20	-	S
C <sub>CHC</sub>	per IGBT	-	-	300	pF
C <sub>ies</sub>	V <sub>GE</sub> = 0	-	1600	2100	pF
C <sub>oes</sub>	V <sub>CE</sub> = 25 V	-	250	300	pF
C <sub>res</sub>	f = 1 MHz	-	110	150	pF
L <sub>CE</sub>		-	-	60	nH
t <sub>d(on)</sub>	V <sub>CC</sub> = 600 V	-	70	-	ns
t <sub>r</sub>	V <sub>GE</sub> = + 15 V / - 15 V <sup>3)</sup>	-	55	-	ns
t <sub>d(off)</sub>	I <sub>C</sub> = 25 A, ind. load	-	400	-	ns
t <sub>f</sub>	R <sub>Gon</sub> = R <sub>Goff</sub> = 40 Ω	-	40	-	ns
E <sub>on</sub> <sup>5)</sup>	T <sub>j</sub> = 125 °C	-	3,8	-	mWs
E <sub>off</sub> <sup>5)</sup>		-	2,3	-	mWs
Inverse Diode <sup>8)</sup>					
V <sub>F</sub> = V <sub>EC</sub>	I <sub>F</sub> = 25 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> = 40 A } T <sub>j</sub> = 25 (125) °C	-	2,3(2,1)	-	V
V <sub>TO</sub>	T <sub>j</sub> = 125 °C	-	1,1	1,2	V
r <sub>T</sub>	T <sub>j</sub> = 125 °C	-	25	44	mΩ
I <sub>RRM</sub>	I <sub>F</sub> = 25 A; T <sub>j</sub> = 25 (125) °C <sup>2)</sup>	-	19(25)	-	A
Q <sub>rr</sub>	I <sub>F</sub> = 25 A; T <sub>j</sub> = 25 (125) °C <sup>2)</sup>	-	1,5(4,5)	-	μC
Thermal Characteristics					
R <sub>thjc</sub>	per IGBT	-	-	0,56	°C/W
R <sub>thjc</sub>	per diode	-	-	1,0	°C/W
R <sub>thch</sub>	per module	-	-	0,05	°C/W

## SEMITRANS® M IGBT Modules

**SKM 40 GD 123 D**  
**SKM 40 GD 123 D L\*)**  
**SKM 40 GDL 123 D \*\*)**



### Sixpack



### 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 (9 mm) and creepage distances (13 mm).

### Typical Applications

- Switched mode power supplies
- Three phase inverters for AC motor speed control
- Pulse frequencies also above 15 kHz

- 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 = 500 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> = 40 Ω
- 8) CAL = Controlled Axial Lifetime Technology.

**\*) Main terminals = 2 mm dia. outline → B 6 - 68**

**\*\*) Sevenpack, picture → B 6 - 99  
 Cases and mech. data → B 6 - 74  
 Sixpack and Sevenpack**

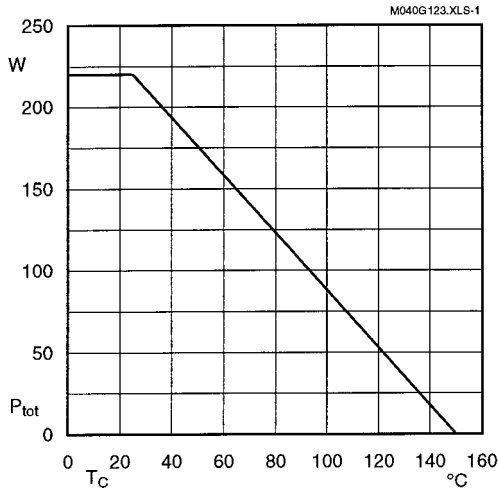


Fig. 1 Rated power dissipation  $P_{tot} = f(T_C)$

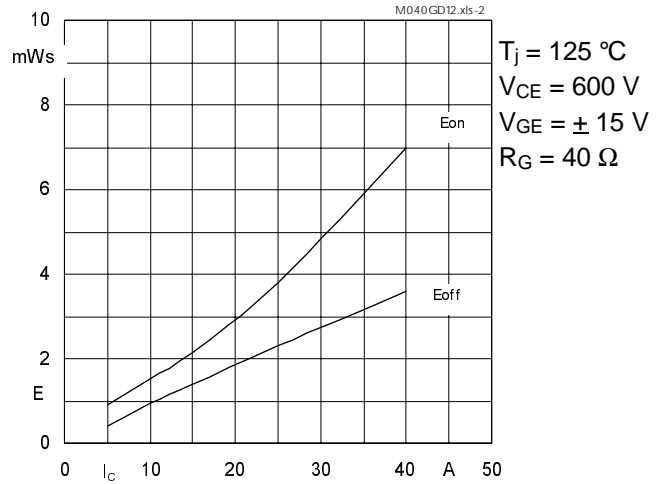


Fig. 2 Turn-on /-off energy  $= f(I_C)$

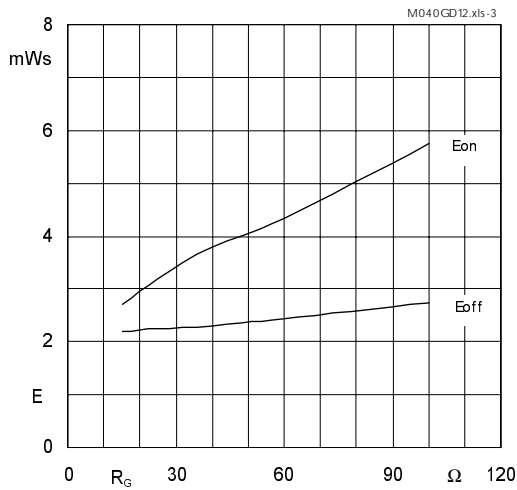


Fig. 3 Turn-on /-off energy  $= f(R_G)$

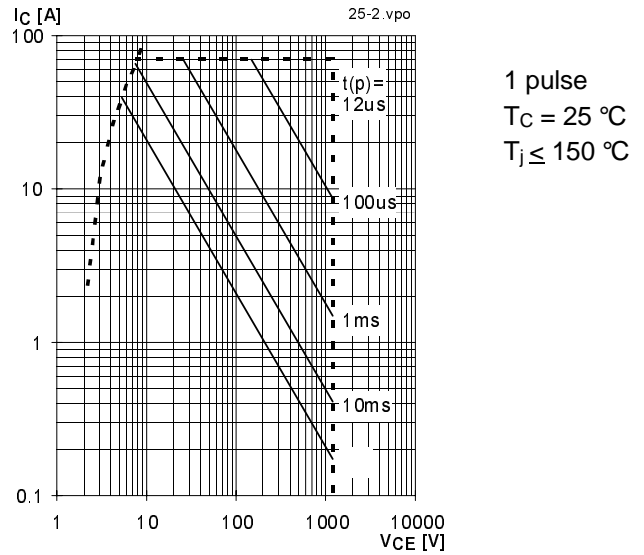


Fig. 4 Maximum safe operating area (SOA)  $I_C = f(V_{CE})$

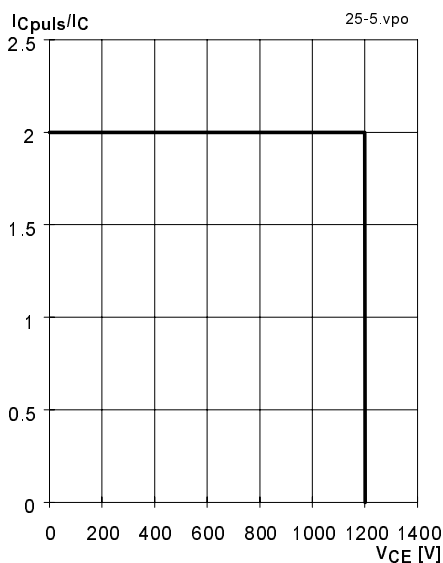


Fig. 5 Turn-off safe operating area (RBSOA)

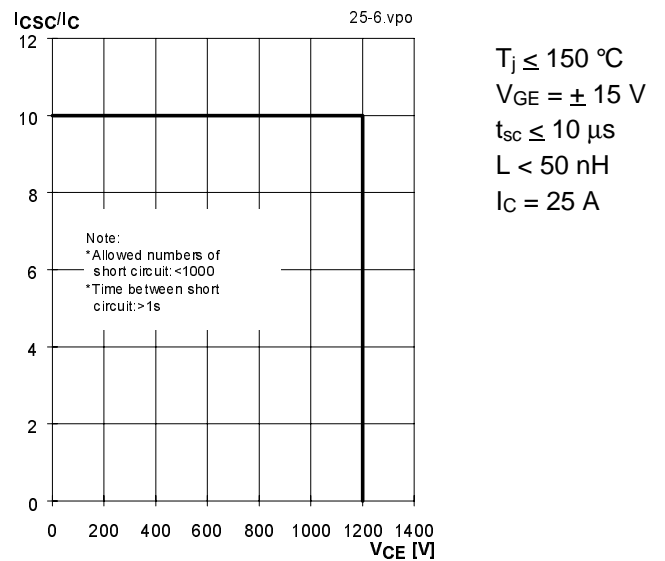


Fig. 6 Safe operating area at short circuit  $I_C = f(V_{CE})$

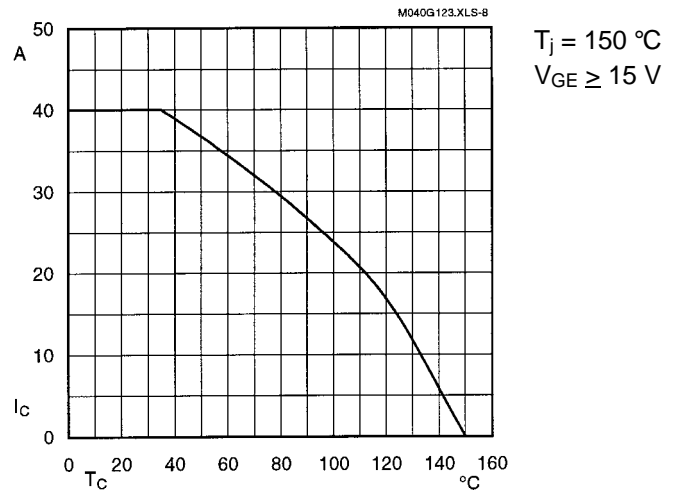


Fig. 8 Rated current vs. temperature  $I_c = f(T_c)$

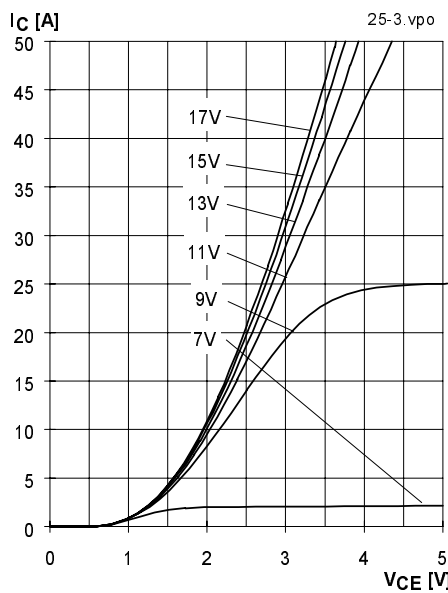


Fig. 9 Typ. output characteristic,  $t_p = 80 \mu s$ ;  $25 \text{ }^\circ\text{C}$

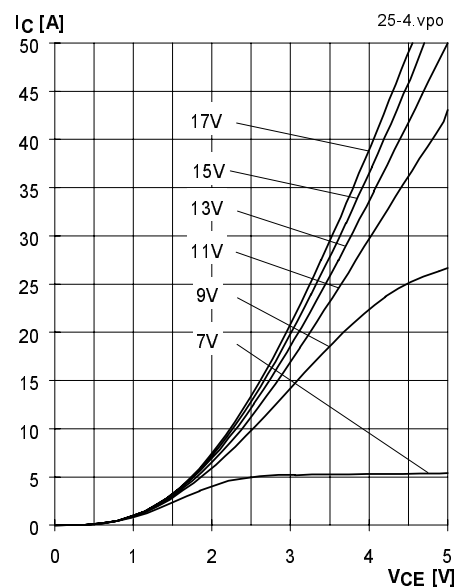


Fig. 10 Typ. output characteristic,  $t_p = 80 \mu s$ ;  $125 \text{ }^\circ\text{C}$

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

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

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

$$\text{typ.: } r_{\text{CE(Tj)}} = 0,040 + 0,00016 (T_j - 25) \text{ } [\Omega]$$

$$\text{max.: } r_{\text{CE(Tj)}} = 0,060 + 0,00020 (T_j - 25) \text{ } [\Omega]$$

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

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

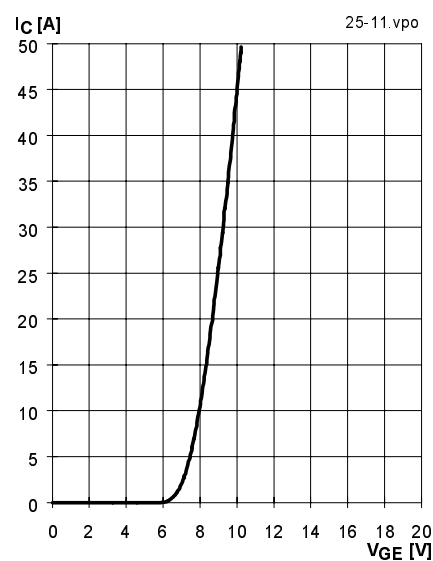


Fig. 12 Typ. transfer characteristic,  $t_p = 80 \mu s$ ;  $V_{\text{CE}} = 20 \text{ V}$

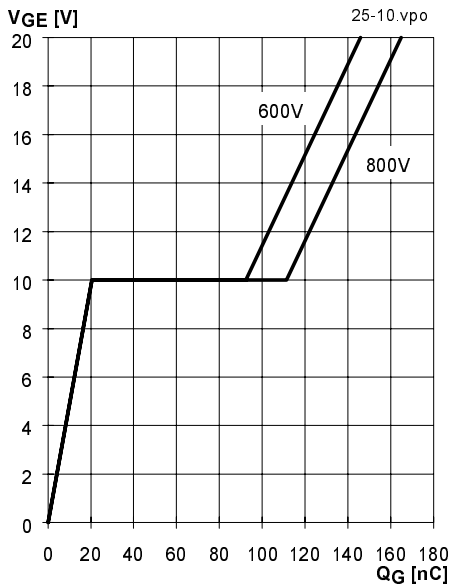


Fig. 13 Typ. gate charge characteristic

$I_{Cpuls} = 25 \text{ A}$

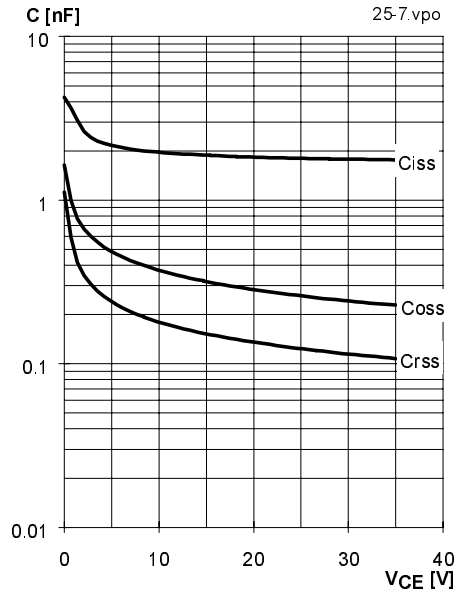


Fig. 14 Typ. capacitances vs.  $V_{CE}$

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

$C_{ies}$   
 $C_{oes}$   
 $C_{res}$

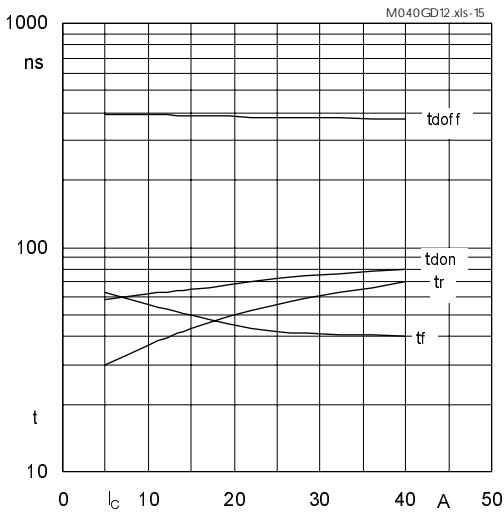


Fig. 15 Typ. switching times vs.  $I_C$

$T_j = 125 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{Gon} = 40 \text{ } \Omega$   
 $R_{Goff} = 40 \text{ } \Omega$   
induct. load

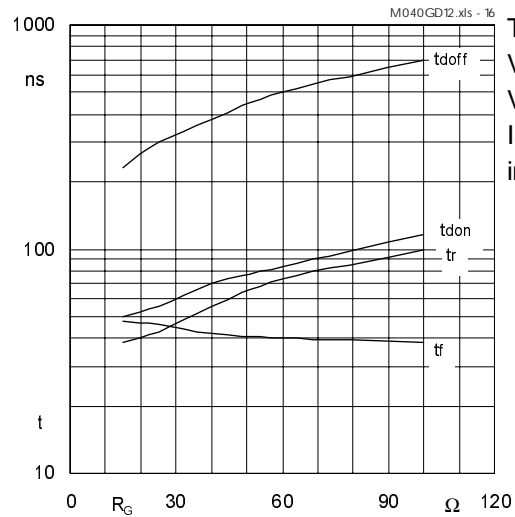


Fig. 16 Typ. switching times vs. gate resistor  $R_G$

$T_j = 125 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 25 \text{ A}$   
induct. load

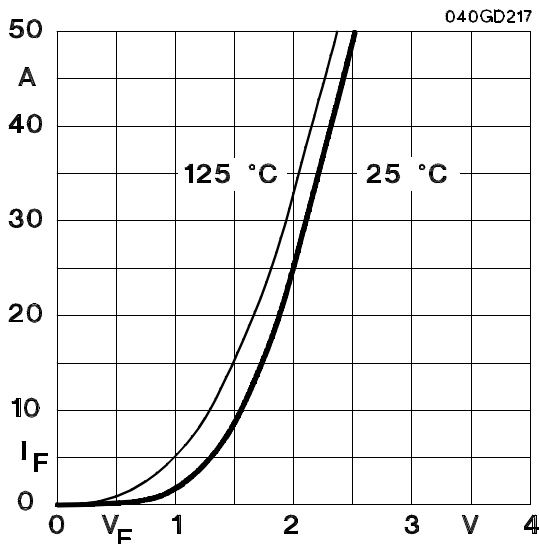


Fig. 17 Typ. CAL diode forward characteristic

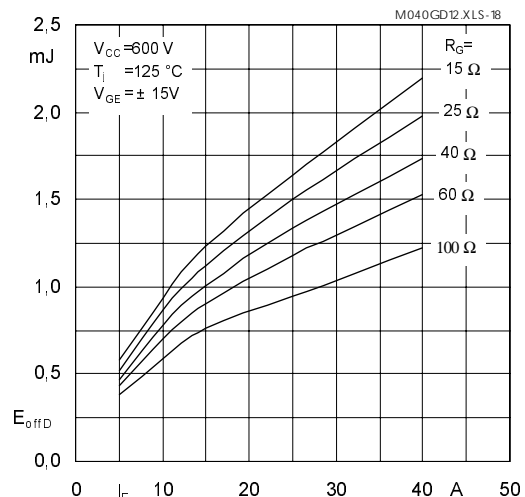


Fig. 18 Diode turn-off energy dissipation per pulse

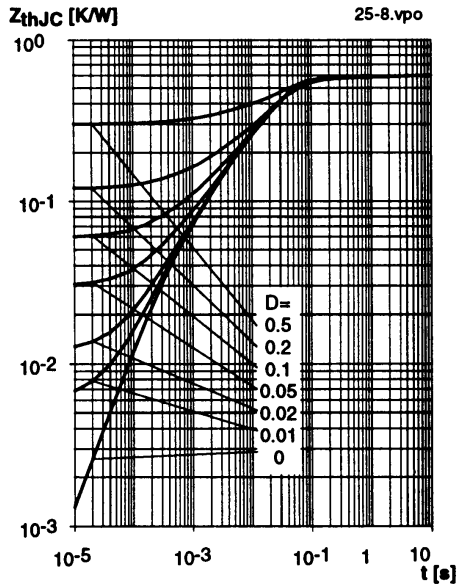


Fig. 19 Transient thermal impedance of IGBT  
 $Z_{thJC} = f(t_p)$ ;  $D = t_p / t_c = t_p \cdot f$

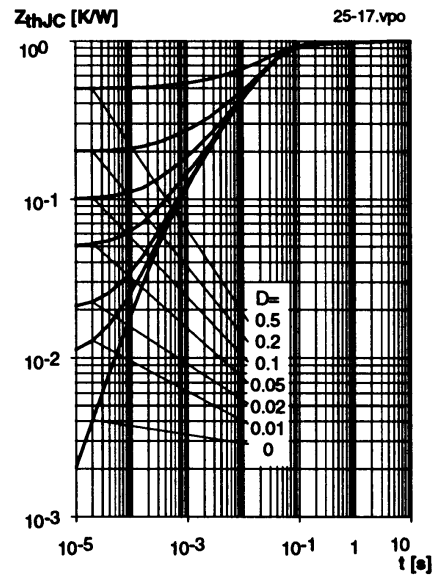


Fig. 20 Transient thermal impedance of inverse CAL diodes  
 $Z_{thJC} = f(t_p)$ ;  $D = t_p / t_c = t_p \cdot f$

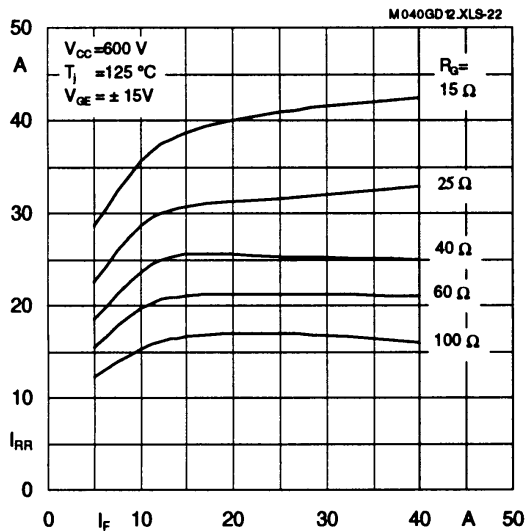


Fig. 22 Typ. CAL diode peak reverse recovery current  $I_{RR} = f(I_F; R_G)$

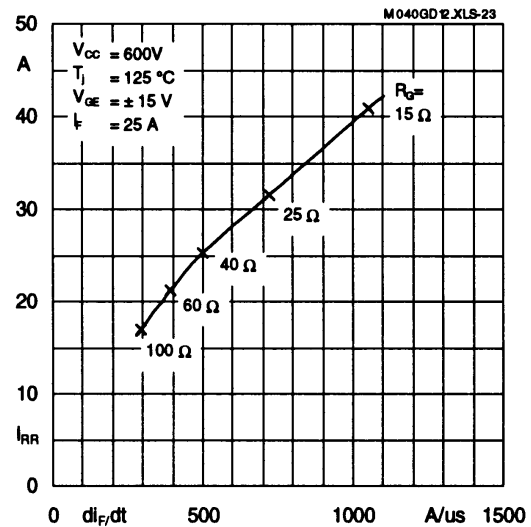


Fig. 23 Typ. CAL diode peak reverse recovery current  $I_{RR} = f(di/dt)$

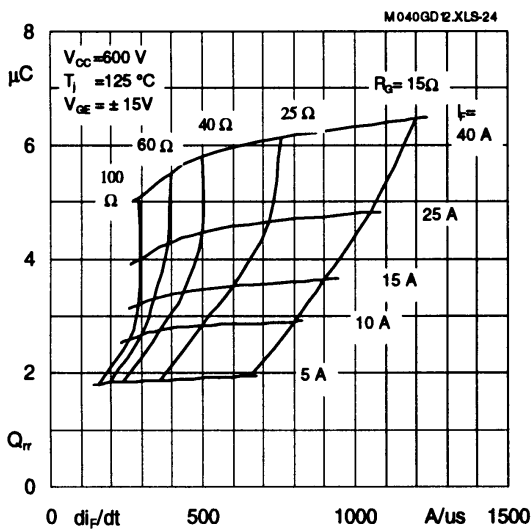
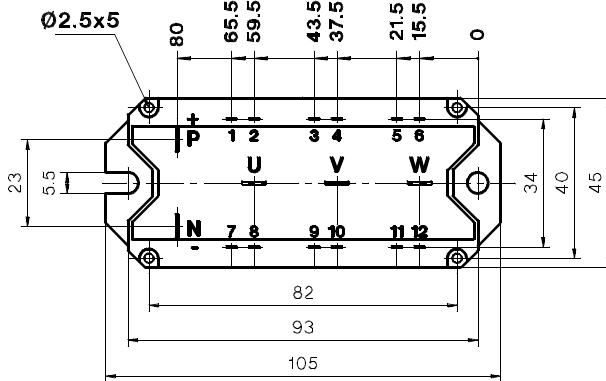
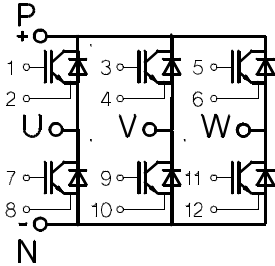
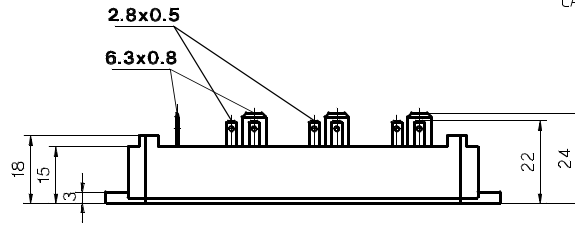


Fig. 24 Typ. CAL Diode recovered charge

**SEMITRANS Sixpack**

Case D 67  
 UL Recognized  
 File no. E 63 532  
**SKM 40 GD 123 D**

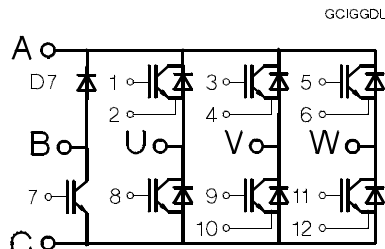
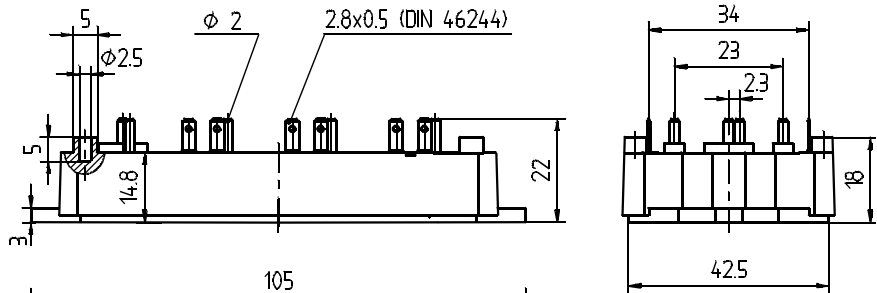
CASED67



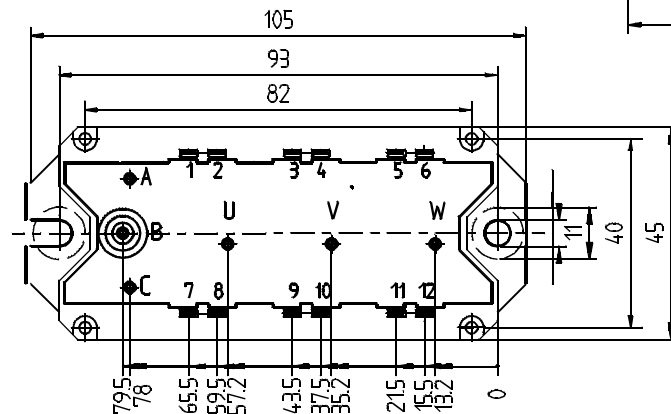
**SEMITRANS Sevenpack**

Case D 73  
 UL Recognized  
 File no. E 63 532  
**SKM 40 GDL 123 D**

CASED73



GCIGGDL



Dimensions in mm

Case outlines and circuit diagrams

Mechanical Data			Values			Units
Symbol	Conditions		min.	typ.	max.	
M <sub>1</sub>	to heatsink, SI Units	(M5)	4	—	5	Nm
	to heatsink, US Units		35	—	44	lb.in.
a			—	—	5x9,81	m/s <sup>2</sup>
w			—	—	175	g

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

Two devices are supplied in one SEMIBOX A. Larger packing units (10 and 20 pieces) are used if suitable. SEMIBOX → C - 1.