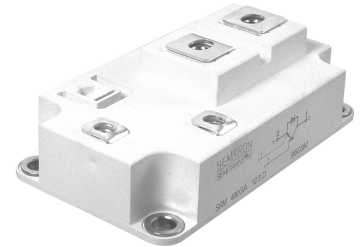


Absolute Maximum Ratings		Values	Units
Symbol	Conditions <sup>1)</sup>		
$V_{CES}$		1700	V
$V_{CGR}$	$R_{GE} = 20 \text{ k}\Omega$	1700	V
$I_C; I_{CN}$	$T_{case} = 25/80 \text{ }^\circ\text{C}$	600 / 440 <sup>5)</sup>	A
$I_{CM}$	$T_{case} = 25/80 \text{ }^\circ\text{C}; t_p = 1 \text{ ms}$	1200 / 880	A
$V_{GES}$		$\pm 20$	V
$P_{tot}$	per IGBT, $T_{case} = 25 \text{ }^\circ\text{C}$	3100	W
$T_j, (T_{stg})$		-40 ... +150 (125)	$^\circ\text{C}$
$V_{isol}$	AC, 1 min. <sup>4)</sup>	3400	V
humidity	IEC 60721-3-3	class 3K7/IE32	
climate	IEC 68 T.1	40/125/56	
Inverse Diode <sup>8)</sup>			
$I_F = -I_C$	$T_{case} = 25/80 \text{ }^\circ\text{C}$	600 / 440	A
$I_{FM} = -I_{CM}$	$T_{case} = 25/80 \text{ }^\circ\text{C}; t_p = 1 \text{ ms}$	1200 / 880	A
$I_{FSM}$	$t_p = 10 \text{ ms; sin.}; T_j = 150 \text{ }^\circ\text{C}$	4400	A
$I^2t$	$t_p = 10 \text{ ms}; T_j = 150 \text{ }^\circ\text{C}$	96800	$\text{A}^2\text{s}$

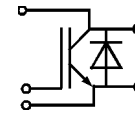
Characteristics		min.	typ.	max.	Units
Symbol	Conditions <sup>1)</sup>				
$V_{(BR)CES}$	$V_{GE} = 0, I_C = 8 \text{ mA}$	$\geq V_{CES}$	-	-	V
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 18 \text{ mA}$	4,5	5,5	6,5	V
$I_{CES}$	$V_{GE} = 0 \left. \begin{array}{l} T_j = 25 \text{ }^\circ\text{C} \\ T_j = 125 \text{ }^\circ\text{C} \end{array} \right\}$	-	0,1	1	mA
	$V_{CE} = V_{CES}$	-	16	-	mA
$I_{GES}$	$V_{GE} = 20 \text{ V}, V_{CE} = 0$	-	-	0,3	$\mu\text{A}$
$V_{CESat}$	$I_C = 400 \text{ A} \left. \begin{array}{l} V_{GE} = 15 \text{ V}; \\ T_j = 25 (125) \text{ }^\circ\text{C} \end{array} \right\}$	-	2,8(3,2)	3,3(3,6)	V
	$I_C = 500 \text{ A}$	-	3,1(3,7)	-	V
$g_{fs}$	$V_{CE} = 20 \text{ V}, I_C = 400 \text{ A}$	-	220	-	S
$C_{CHC}$	per IGBT	-	-	1,4	nF
$C_{ies}$	$V_{GE} = 0$	-	27	-	nF
$C_{oes}$	$V_{CE} = 25 \text{ V}$	-	3,8	-	nF
$C_{res}$	$f = 1 \text{ MHz}$	-	1,3	-	nF
$L_{CE}$		-	-	20	nH
$t_{d(on)}$	$V_{CC} = 1200 \text{ V}$	-	350	-	ns
$t_r$	$V_{GE} = -15 \text{ V} / +15 \text{ V}^3)$	-	100	-	ns
$t_{d(off)}$	$I_C = 400 \text{ A, ind. load}$	-	1100	-	ns
$t_f$	$R_{Gon} = R_{Goff} = 3 \text{ }^\circ\Omega$	-	100	-	ns
$E_{on}$	$T_j = 125 \text{ }^\circ\text{C} (V_{CC} = 900 \text{ V}/1200 \text{ V})$	-	170/300	-	mWs
$E_{off}$	$L_S = 60 \text{ nH} (V_{CC} = 900 \text{ V}/1200 \text{ V})$	-	135/210	-	mWs
Inverse Diode <sup>8)</sup>					
$V_F = V_{EC}$	$I_F = 400 \text{ A} \left. \begin{array}{l} V_{GE} = 0 \text{ V}; \\ T_j = 25 (125) \text{ }^\circ\text{C} \end{array} \right\}$	-	2,15(1,8)	2,4(2,2)	V
$V_F = V_{EC}$	$I_F = 500 \text{ A}$	-	2,3(2,0)	-	V
$V_{TO}$	$T_j = 125 \text{ }^\circ\text{C}$	-	1,3	1,5	V
$r_t$	$T_j = 125 \text{ }^\circ\text{C}$	-	1,6	2,1	$\text{m}\Omega$
$I_{RRM}$	$I_F = 400 \text{ A}; T_j = 25 (125) \text{ }^\circ\text{C}^2)$	-	270(550)	-	A
$Q_{rr}$	$I_F = 400 \text{ A}; T_j = 25 (125) \text{ }^\circ\text{C}^2)$	-	70(117)	-	$\mu\text{C}$
Thermal characteristics					
$R_{thjc}$	per IGBT	-	-	0,040	$^\circ\text{C}/\text{W}$
$R_{thjc}$	per diode D	-	-	0,070	$^\circ\text{C}/\text{W}$
$R_{thch}$	per module	-	-	0,038	$^\circ\text{C}/\text{W}$

## SEMITRANS® M Low Loss IGBT Modules

### SKM 500 GA 174 D



### SEMITRANS 4



GA

### Features

- N channel, homogeneous Silicon structure (NPT- Non punch-through IGBT)
- Low inductance case
- High short circuit capability, self limiting
- Fast & soft inverse CAL diodes <sup>8)</sup>
- Without hard mould
- Large clearance (13 mm) and creepage distances (20 mm)

### Typical Applications

- AC inverter drives on mains 575 - 750  $V_{AC}$
- DC bus voltage 750 - 1200  $V_{DC}$
- Public transport (auxiliary syst.)
- Switching (not for linear use)

<sup>1)</sup>  $T_{case} = 25 \text{ }^\circ\text{C}$ , unless otherwise specified

<sup>2)</sup>  $I_F = -I_C, V_R = 1200 \text{ V}, -di_F/dt = 5000 \text{ A}/\mu\text{s}, V_{GE} = 0 \text{ V}$

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

<sup>4)</sup> Option  $V_{isol} = 4000\text{V}/1 \text{ min}$  add suffix „H4“ - on request

<sup>5)</sup> Limited by terminals to  $I_{C(DC)} = 500 \text{ A}$  at  $T_c = T_{terminal} \leq 100 \text{ }^\circ\text{C}$

<sup>8)</sup> CAL = Controlled Axial Lifetime Technology

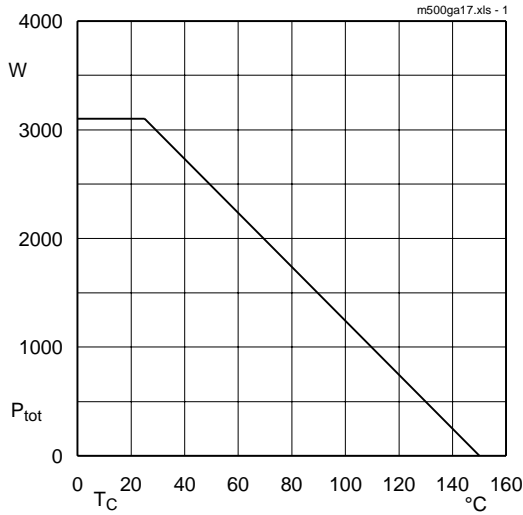


Fig. 1 Rated power dissipation  $P_{tot} = f(T_C)$

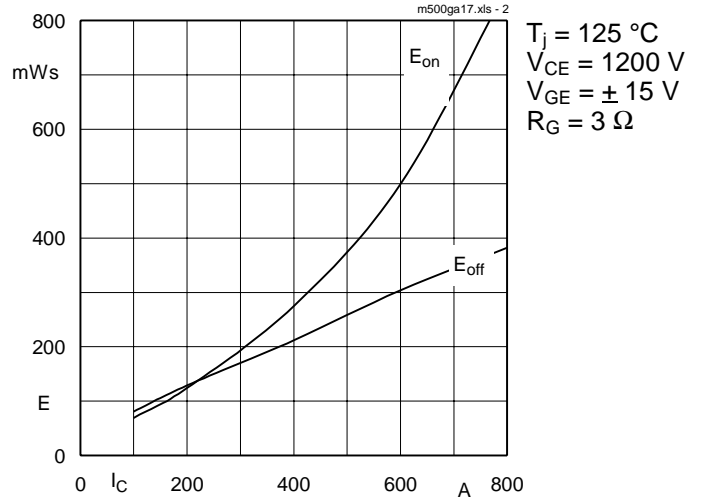


Fig. 2 Turn-on /-off energy  $= f(I_C)$

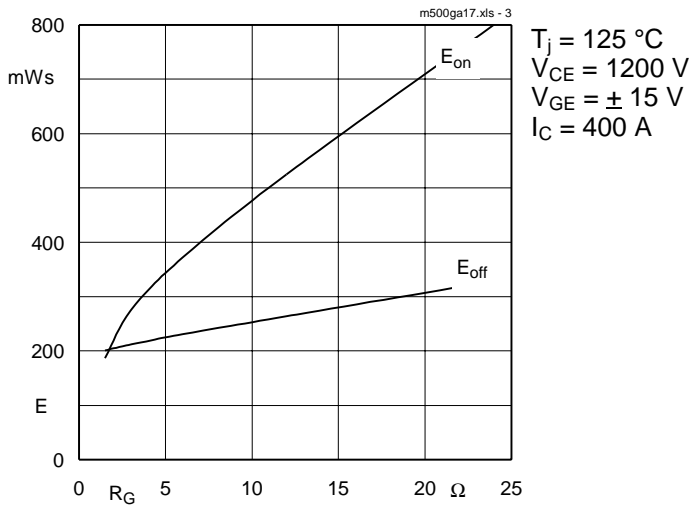


Fig. 3 Turn-on /-off energy  $= f(R_G)$

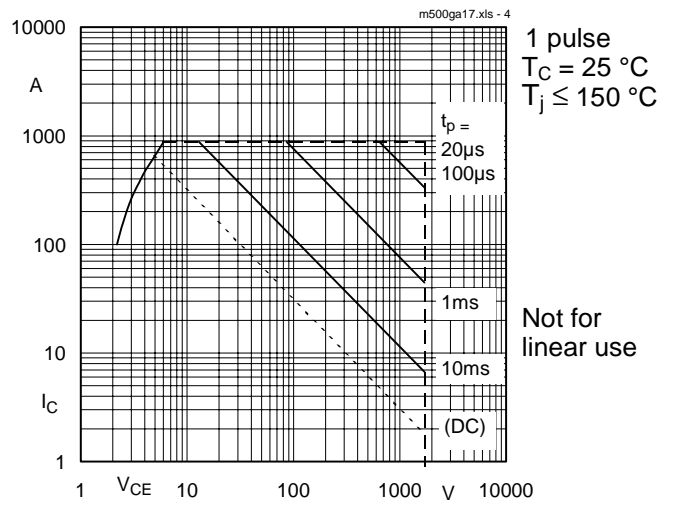


Fig. 4 Maximum safe operating area (SOA)  $I_C = f(V_{CE})$

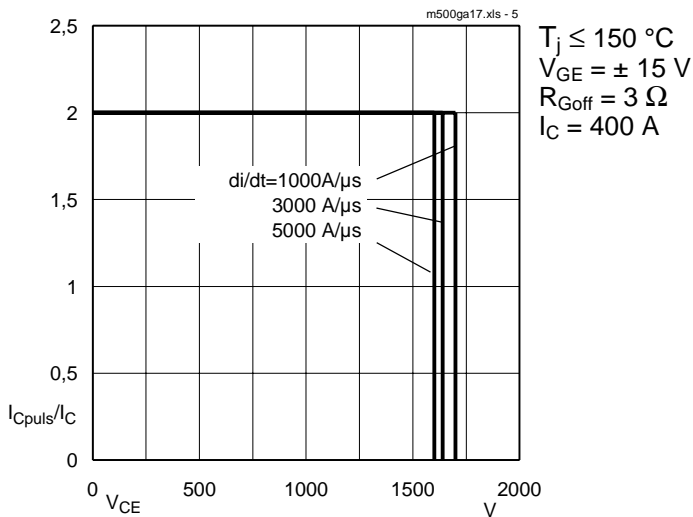


Fig. 5 Turn-off safe operating area (RBSOA)

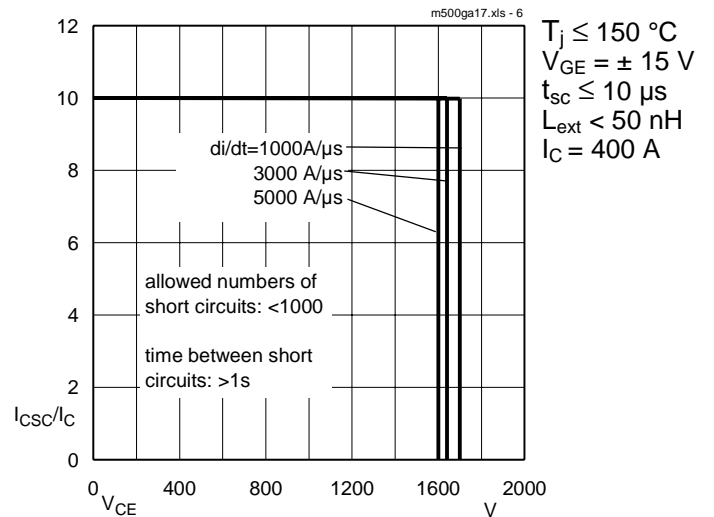


Fig. 6 Safe operating area at short circuit  $I_C = f(V_{CE})$

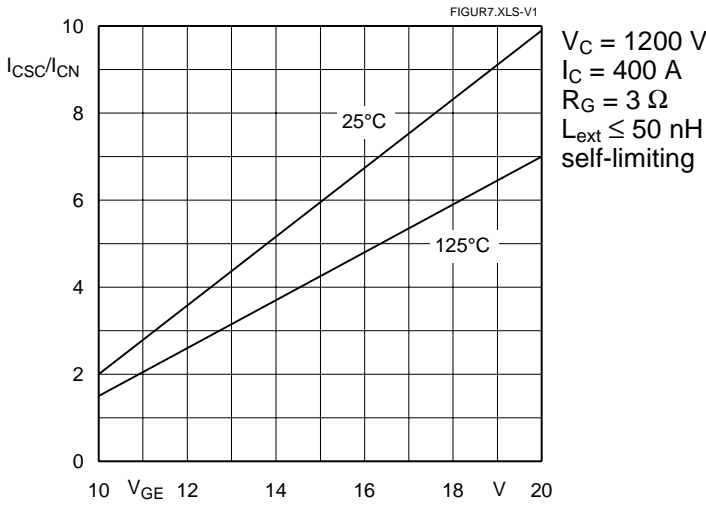


Fig. 7 Short circuit current vs. turn-on gate voltage

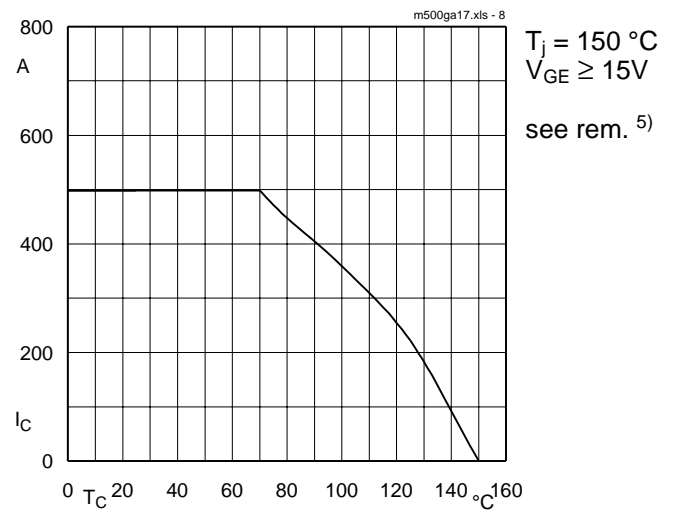


Fig. 8 Rated current vs. temperature  $I_C = f(T_C)$

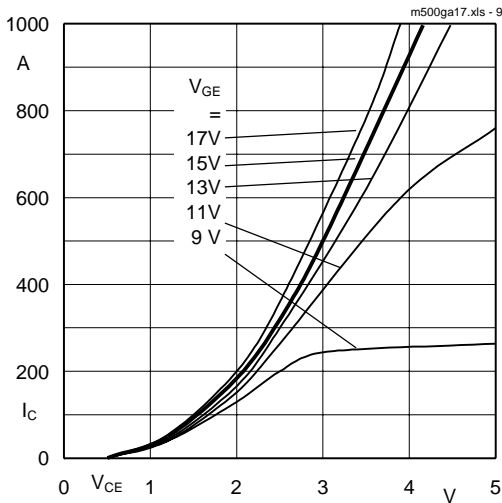


Fig. 9 Typ. output characteristic,  $t_p = 80 \mu s$ ; 25 °C

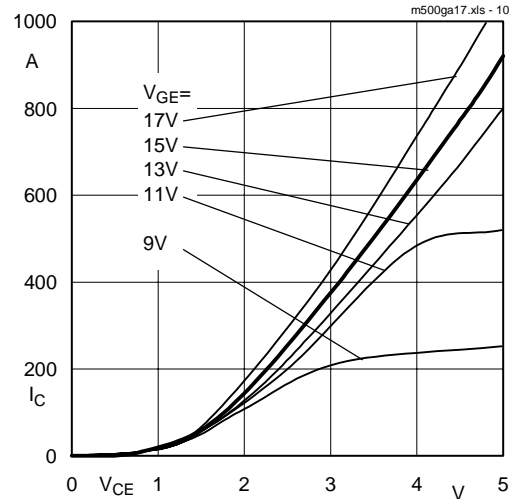


Fig. 10 Typ. output characteristic,  $t_p = 80 \mu s$ ; 125 °C

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

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

$$V_{CE(TO)(T_j)} \leq 1,6 + 0,001 (T_j - 25) [V]$$

$$\text{typ.: } r_{CE(T_j)} = 0,003 + 0,000008 (T_j - 25) [\Omega]$$

$$\text{max.: } r_{CE(T_j)} = 0,0041 + 0,000006 (T_j - 25) [\Omega]$$

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

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

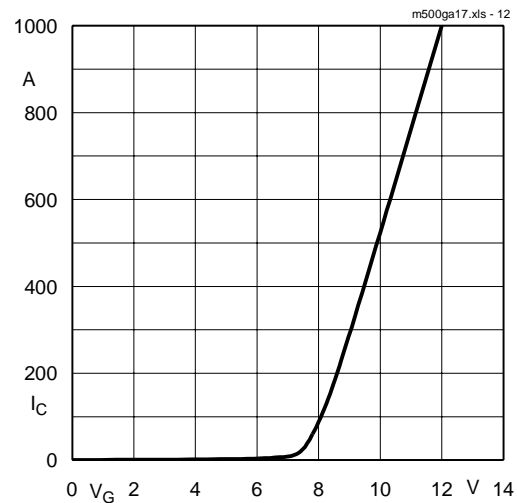


Fig. 12 Typ. transfer characteristic,  $t_p = 80 \mu s$ ;  $V_{CE} = 20 V$

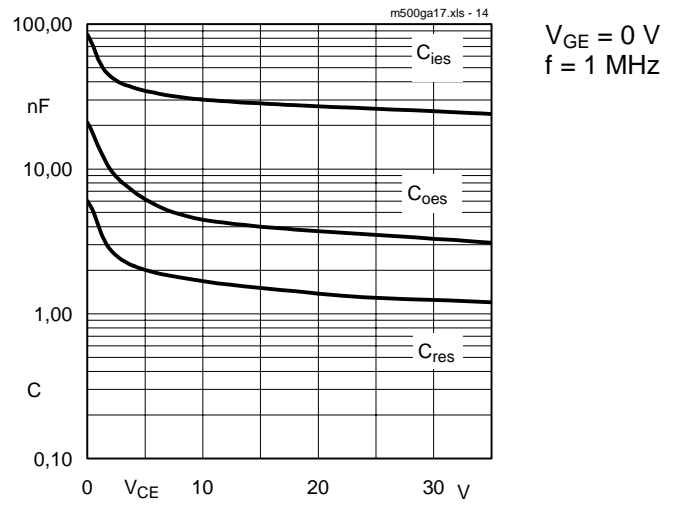
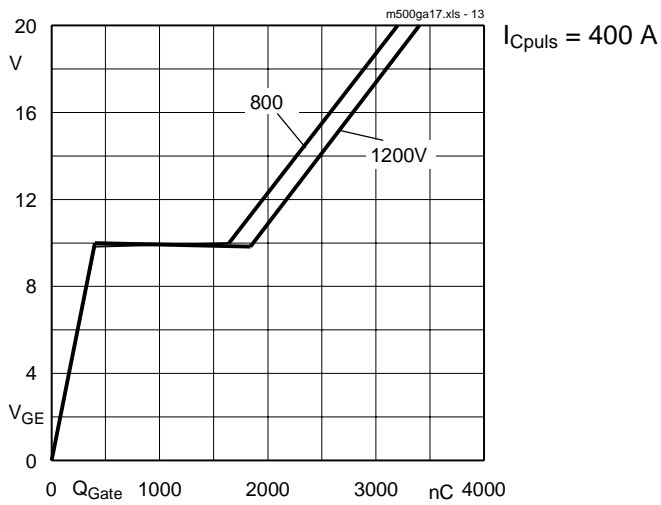


Fig. 13 Typ. gate charge characteristic

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

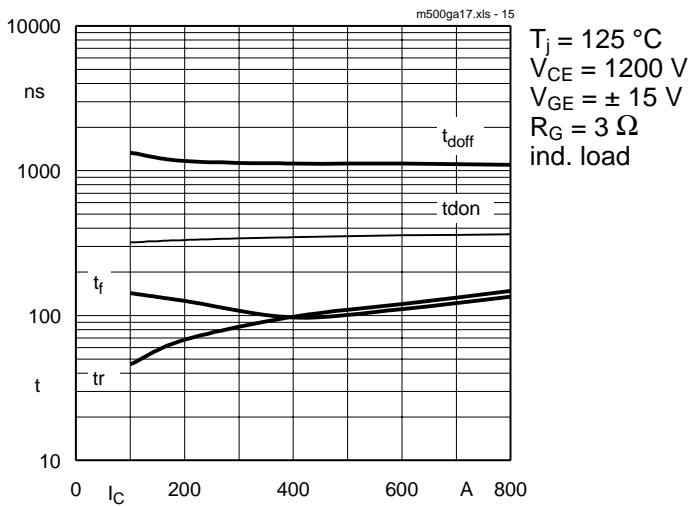


Fig. 15 Typ. switching times vs.  $I_C$

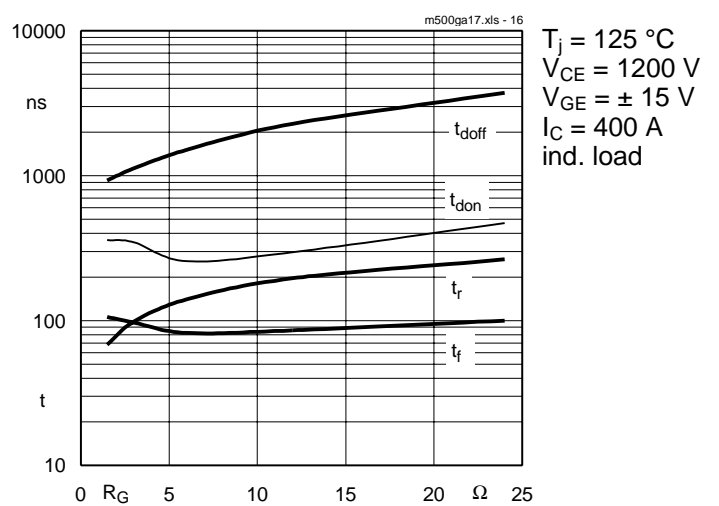


Fig. 16 Typ. switching times vs. gate resistor  $R_G$

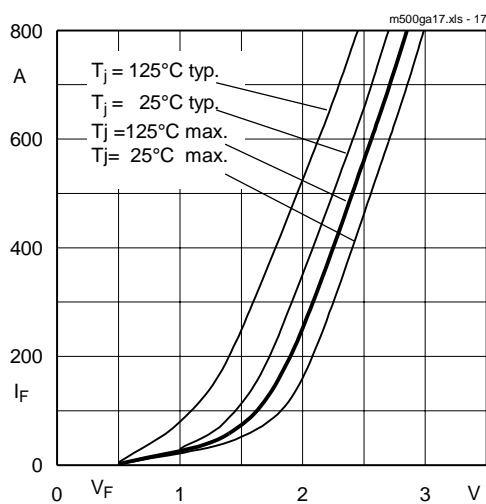


Fig. 17 Typ. CAL diode forward characteristic

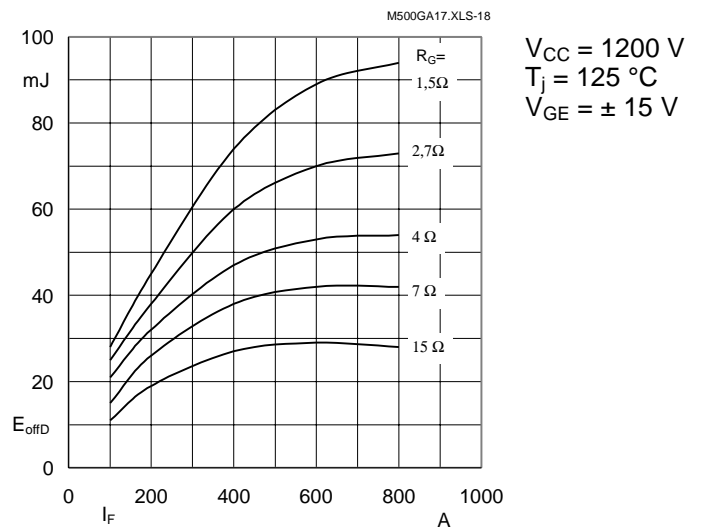


Fig. 18 Diode turn-off energy dissipation per pulse

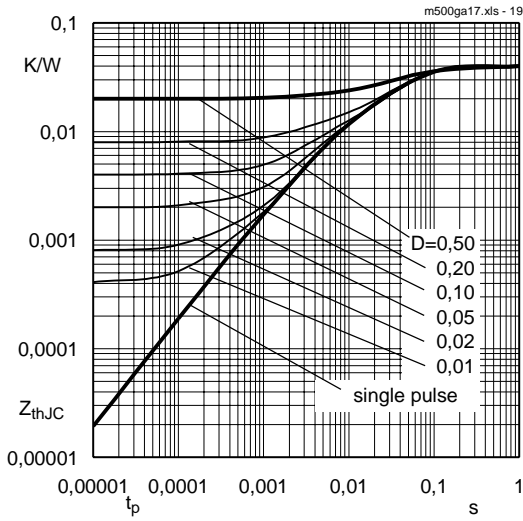


Fig. 19 Transient thermal impedance of IGBT  
 $Z_{thJC} = f(t_p)$ ;  $D = t_p / t_c = t_p \cdot f$

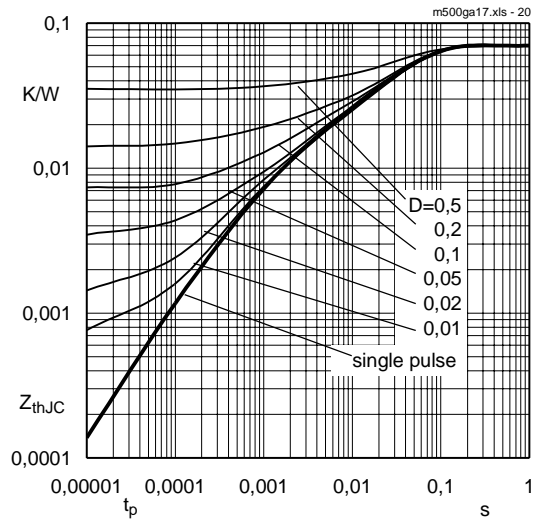


Fig. 20 Transient thermal impedance of inverse CAL diodes  
 $Z_{thJC} = f(t_p)$ ;  $D = t_p / t_c = t_p \cdot f$

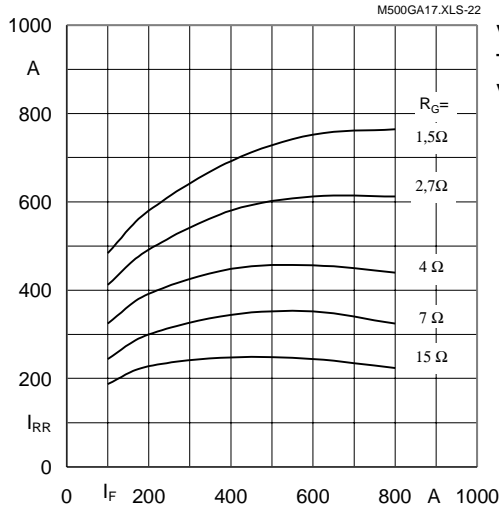


Fig. 22 Typ. CAL diode peak reverse recovery current  $I_{RR} = f(I_F; R_G)$

$V_{CC} = 1200\text{ V}$   
 $T_j = 125\text{ °C}$   
 $V_{GE} = \pm 15\text{ V}$

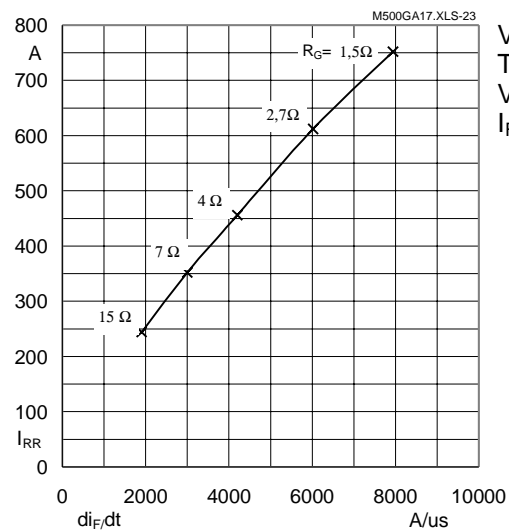


Fig. 23 Typ. CAL diode peak reverse recovery current  $I_{RR} = f(di/dt)$

$V_{CC} = 1200\text{ V}$   
 $T_j = 125\text{ °C}$   
 $V_{GE} = \pm 15\text{ V}$   
 $I_F = 400\text{ A}$

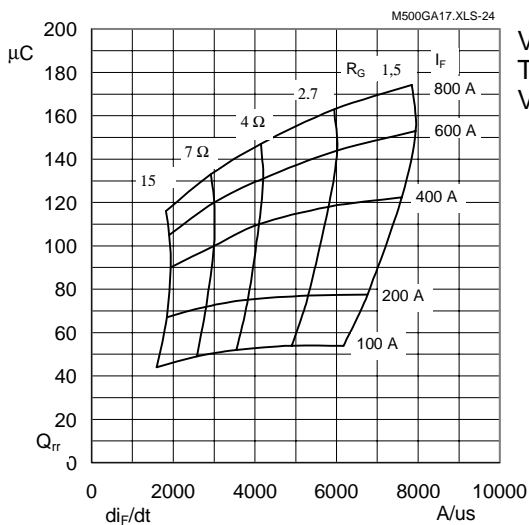


Fig. 24 Typ. CAL diode recovered charge

$V_{CC} = 1200\text{ V}$   
 $T_j = 125\text{ °C}$   
 $V_{GE} = \pm 15\text{ V}$

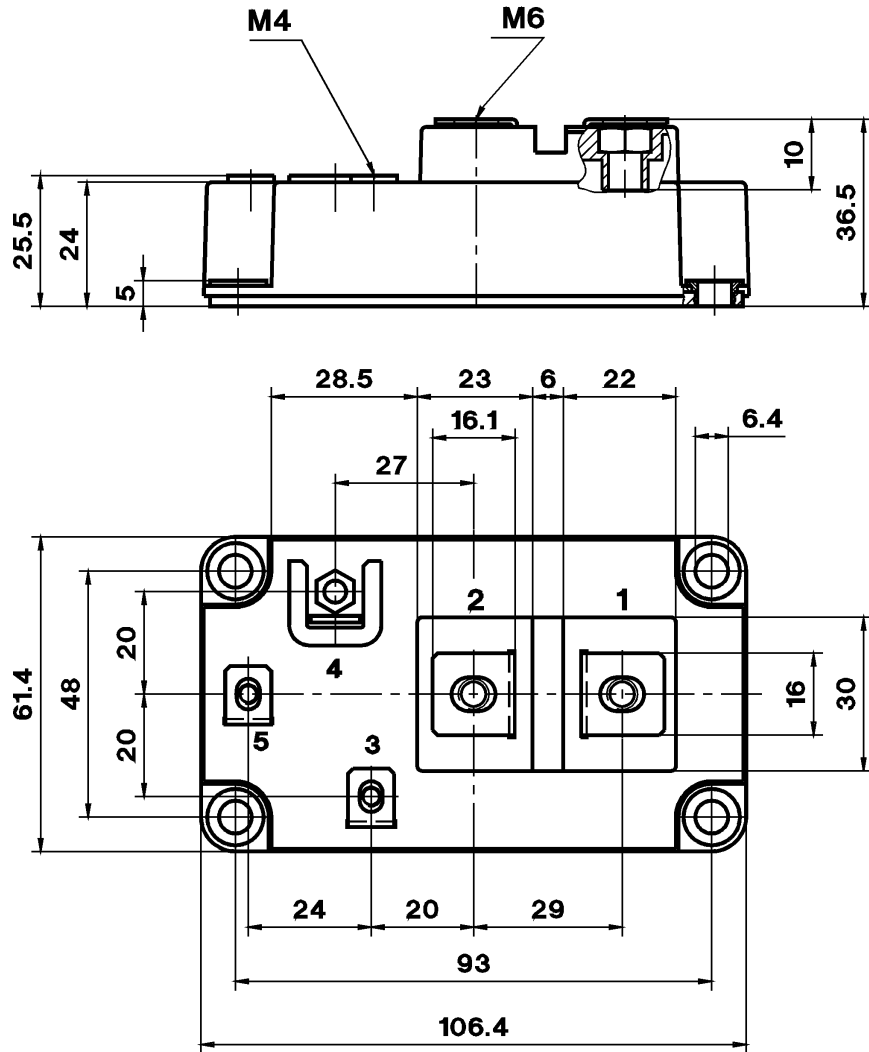
SEMITRANS 4

Case D 59

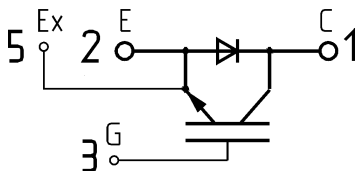
UL Recognition  
File no. E 63 532

CASED59

SKM 500 GA 174 D



GCIGGA4



Dimensions in mm

Case outline and circuit diagram

Mechanical Data		Values			Units
Symbol	Conditions	min.	typ.	max.	
M <sub>1</sub>	to heatsink, SI Units (M6)	3	—	5	Nm
M <sub>2</sub>	to heatsink, US Units	27	—	44	lb.in.
	for terminals, SI Units (M6/M4)	2,5/1,1	—	5/2	Nm
a	for terminals, US Units	22/10	—	44/18	lb.in.
		—	—	5x9,81	m/s <sup>2</sup>
w		—	—	330	g

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

Twelve devices are supplied in one SEMIBOX D without mounting hardware, which can be ordered separately under Ident No. 33321100 (for 10 SEMITRANS 4)

This technical information specifies semiconductor devices but promises no characteristics. No warranty or guarantee expressed or implied is made regarding delivery, performance or suitability.