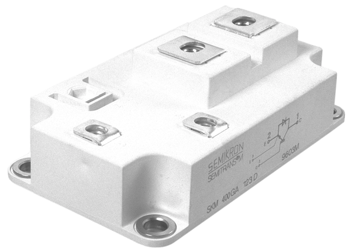
SEMIKRON

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

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

SEMITRANS® M
Low Loss IGBT Modules

SKM 500 GA 174 D



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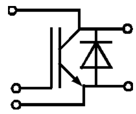


GA

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 [8]
- 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)

[1] T_{case} = 25 °C, unless otherwise specified
[2] I_F = – I_C, V_R = 1200 V, –di_F/dt = 5000 A/µs, V_{GE} = 0 V
[3] Use V_{GEoff} = – 5 ... – 15 V
[4] Option V_{isol} = 4000V/1 min add suffix „H4“ - on request
[5] Limited by terminals to $I_{C(DC)}$ = 500 A at $T_c = T_{terminal}$ ≤ 100 °C
[8] CAL = Controlled Axial Lifetime Technology

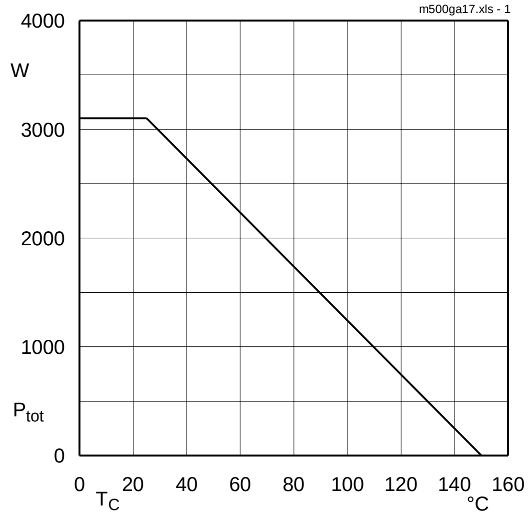


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$

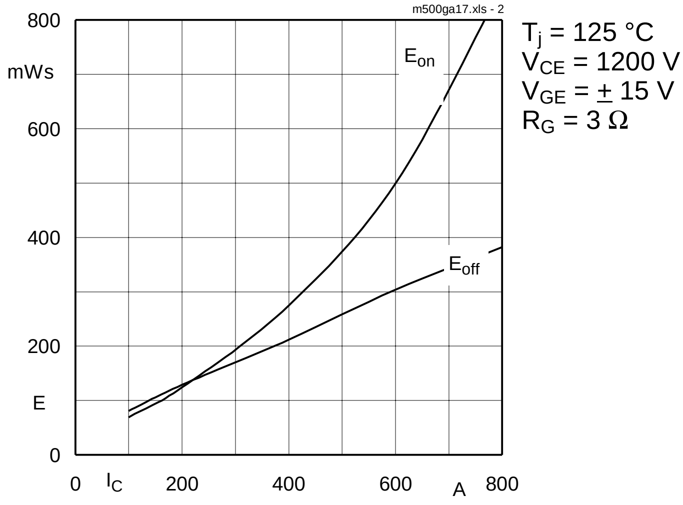


Fig. 2 Turn-on /-off energy = f (I_C)

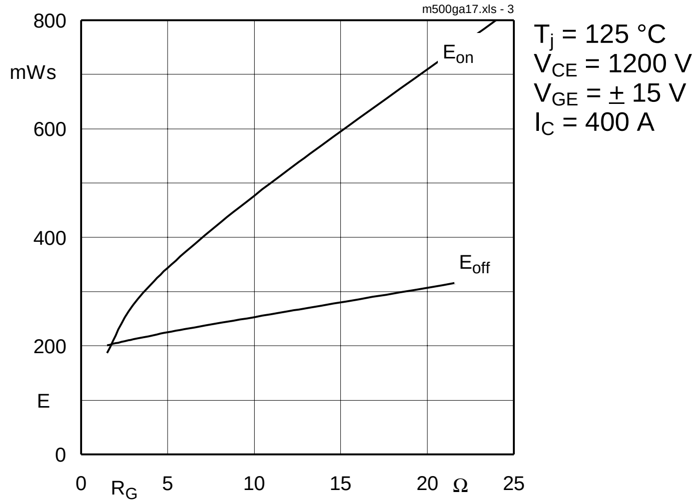


Fig. 3 Turn-on /-off energy = f (R_G)

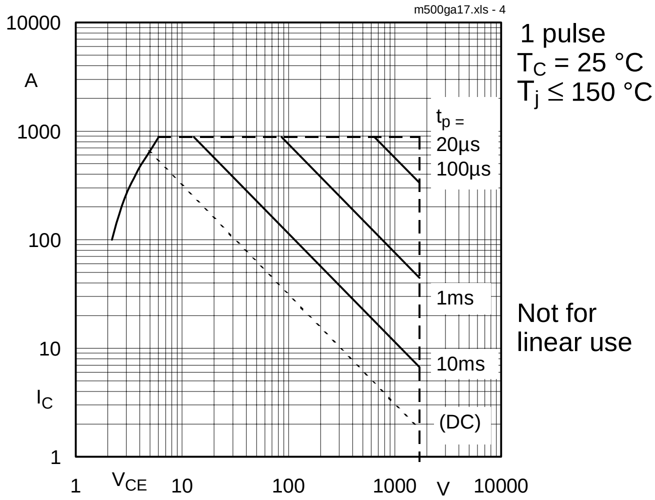


Fig. 4 Maximum safe operating area (SOA) $I_C = f(V_{CE})$

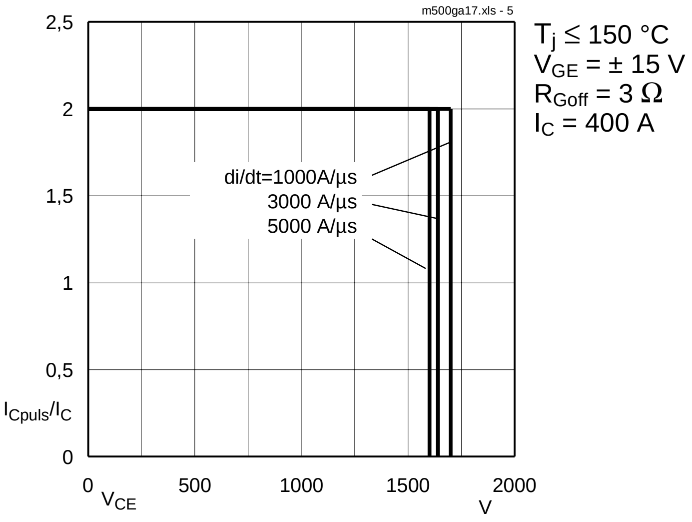


Fig. 5 Turn-off safe operating area (RBSOA)

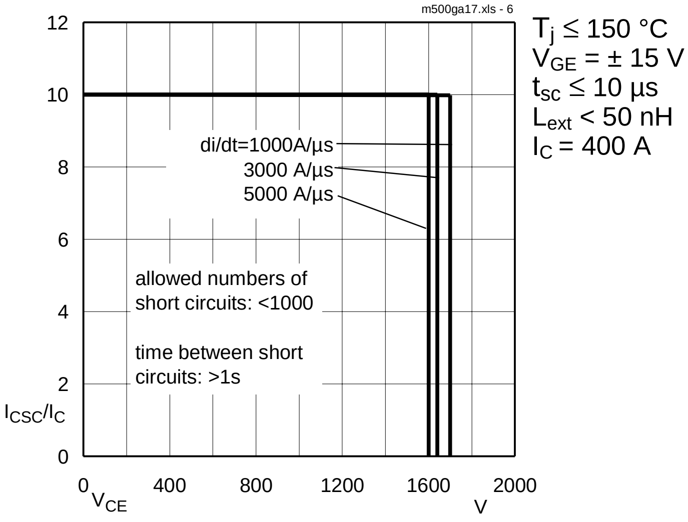


Fig. 6 Safe operating area at short circuit $I_C = f(V_{CE})$

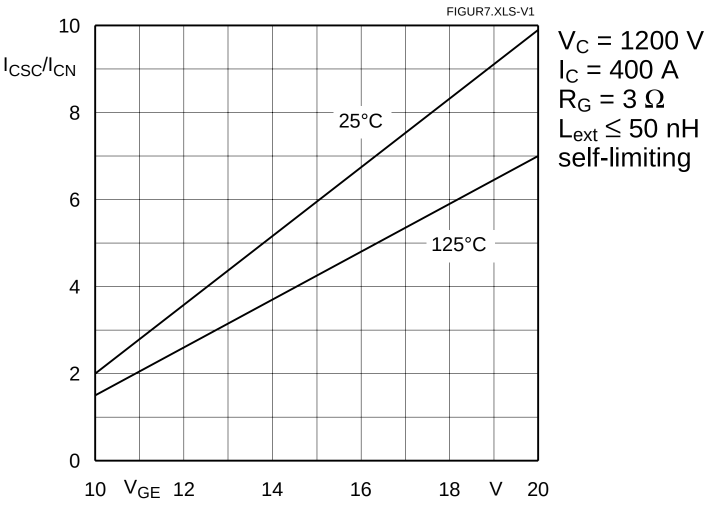


Fig. 7 Short circuit current vs. turn-on gate voltage

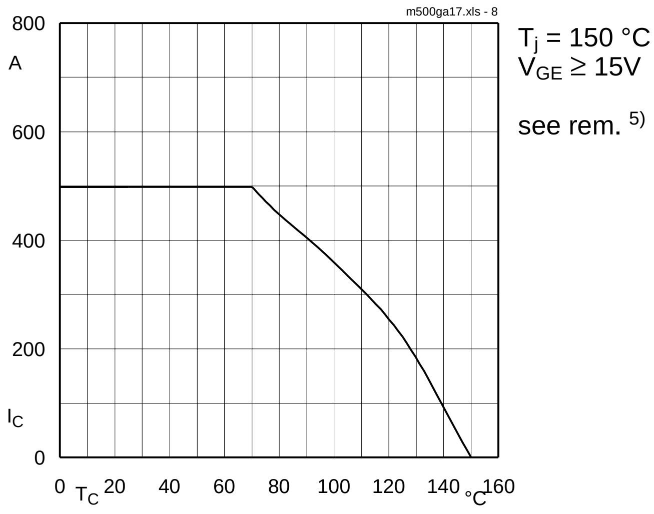


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

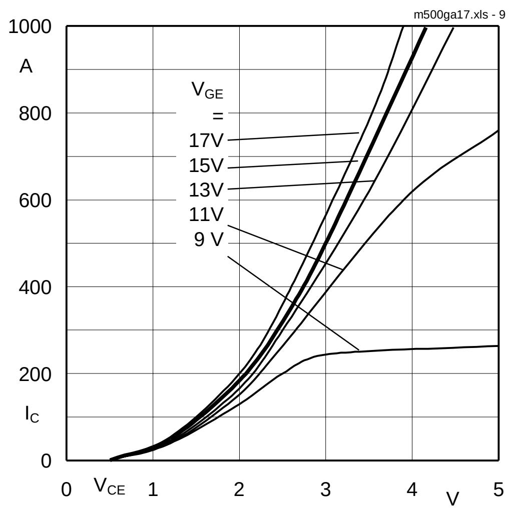


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

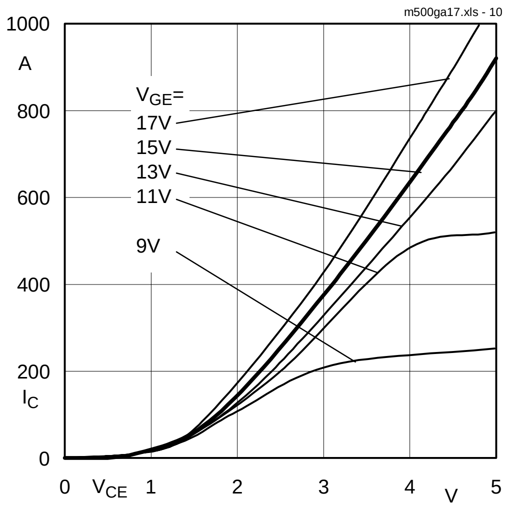


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

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

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

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

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

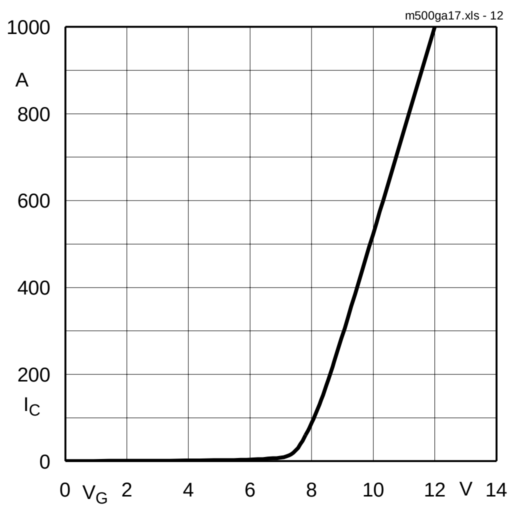
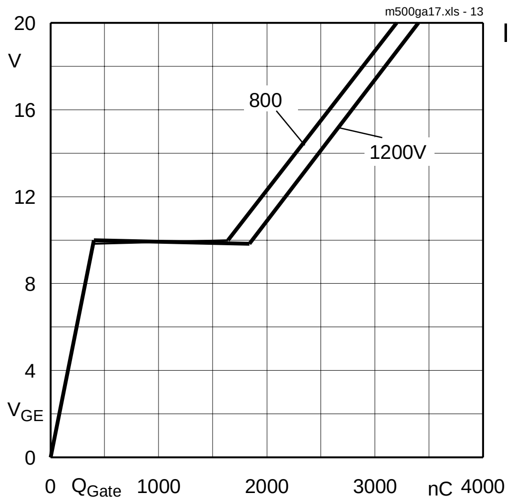
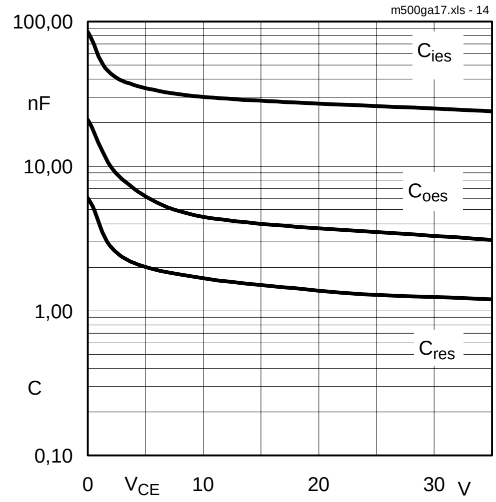


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



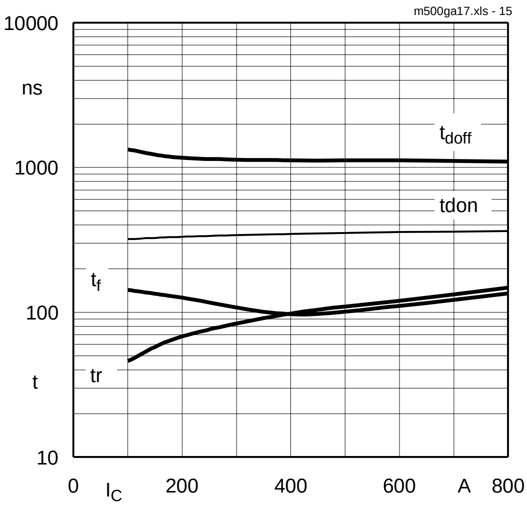
I_{Cpuls} = 400 A

Fig. 13 Typ. gate charge characteristic



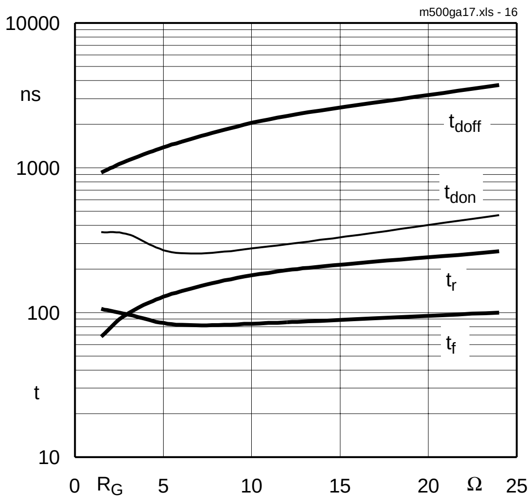
V_{GE} = 0 V
f = 1 MHz

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



T_j = 125 °C
V_{CE} = 1200 V
V_{GE} = ± 15 V
R_G = 3 Ω
ind. load

Fig. 15 Typ. switching times vs. I_C



T_j = 125 °C
V_{CE} = 1200 V
V_{GE} = ± 15 V
I_C = 400 A
ind. load

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

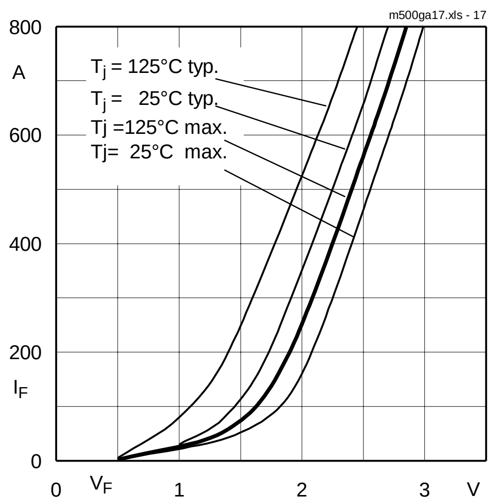
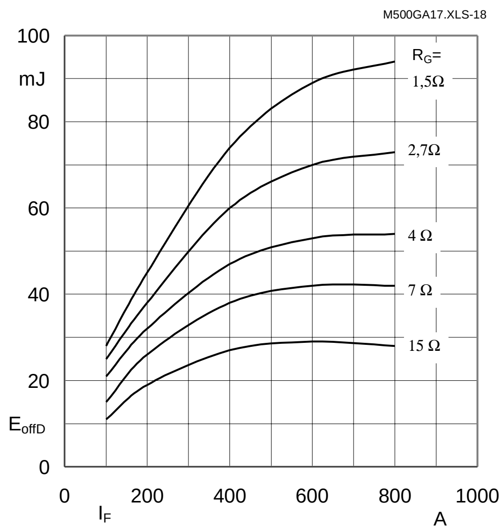


Fig. 17 Typ. CAL diode forward characteristic



V_{CC} = 1200 V
T_j = 125 °C
V_{GE} = ± 15 V

Fig. 18 Diode turn-off energy dissipation per pulse

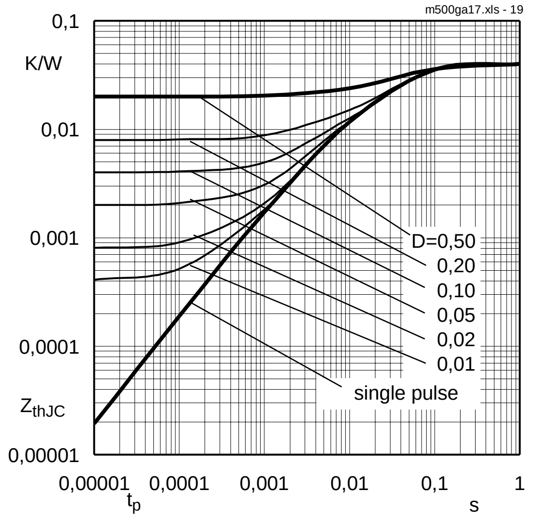


Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

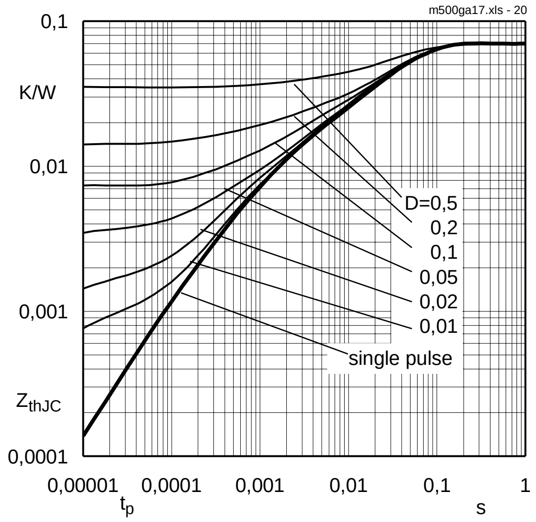
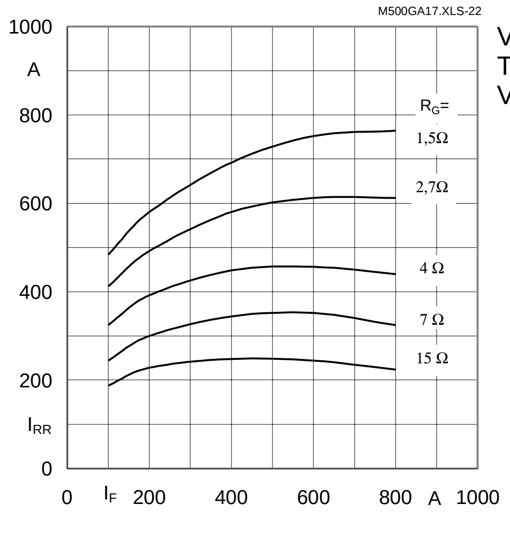
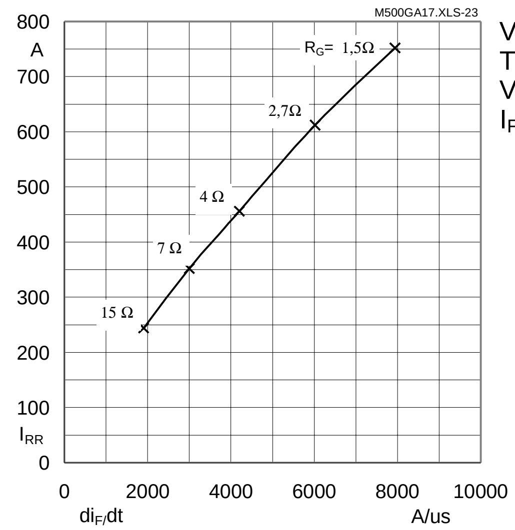


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$



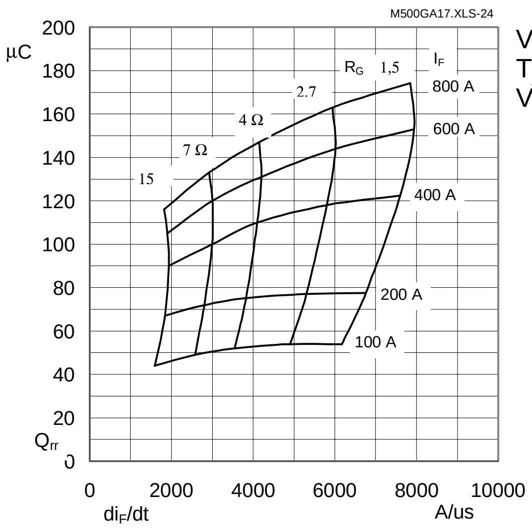
V_{CC} = 1200 V
T_j = 125 °C
V_{GE} = ± 15 V

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



V_{CC} = 1200 V
T_j = 125 °C
V_{GE} = ± 15 V
I_F = 400 A

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



V_{CC} = 1200 V
T_j = 125 °C
V_{GE} = ± 15 V

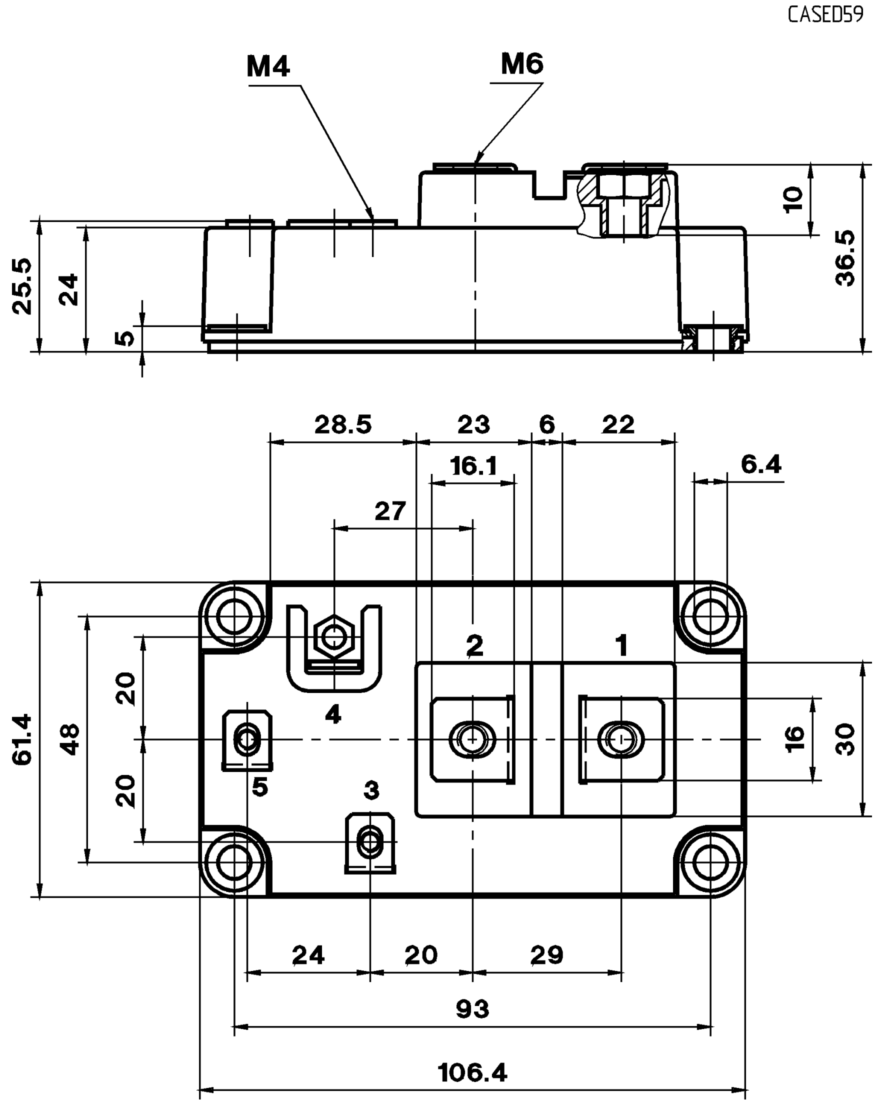
Fig. 24 Typ. CAL diode recovered charge

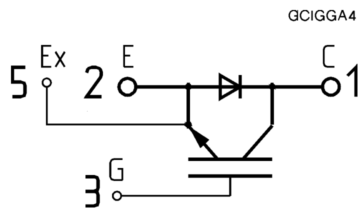
SEMITRANS 4

Case D 59

UL Recognition
File no. E 63 532

SKM 500 GA 174 D





Dimensions in mm

Case outline and circuit diagram

Mechanical Data						
Symbol	**Conditions**		**Values**			**Units**
			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	(M6/M4)	2,5/1,1	–	5/2	Nm
	for terminals, US Units		22/10	–	44/18	lb.in.
a			–	–	5x9,81	m/s^2
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)