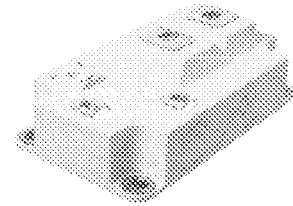
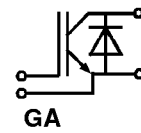


SEMITRANS® M Low Loss IGBT Modules

SKM 500 GA 124 D



SEMITRANS 4



Features

- MOS input (voltage controlled)
- N channel, homogeneous Silicon structure (NPT-Non punch through-IGBT)
- 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 without hard mould
- Large clearance (12 mm) and creepage distances (20 mm)

Typical Applications

- Switching (not for linear use)
- Inverter drives
- UPS

¹⁾ $T_{case} = 25 \text{ °C}$, unless otherwise specified

²⁾ $I_F = -I_C$, $V_R = 600 \text{ V}$, $-di_F/dt = 2000 \text{ A}/\mu\text{s}$, $V_{GE} = 0 \text{ V}$

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

⁸⁾ CAL = Controlled Axial Lifetime Technology.

Cases and mech. data

→ B 6 – 218

Absolute Maximum Ratings		Values	Units
Symbol	Conditions ¹⁾		
V_{CES}		1200	V
V_{CGR}	$R_{GE} = 20 \text{ k}\Omega$	1200	V
I_C	$T_{case} = 25/80 \text{ °C}$	700 / 500	A
I_{CM}	$T_{case} = 25/80 \text{ °C}; t_p = 1 \text{ ms}$	1400 / 1000	A
V_{GES}		± 20	V
P_{tot}	per IGBT, $T_{case} = 25 \text{ °C}$	3000	W
T_j , (T_{stg})		-40 ... +150 (125)	°C
V_{isol}	AC, 1 min.	2500	V
humidity	DIN 40040	Class F	
climate	DIN IEC 68 T.1	40/125/56	
Inverse Diode			
$I_F = -I_C$	$T_{case} = 25/80 \text{ °C}$	500 / 350	A
$I_{FM} = -I_{CM}$	$T_{case} = 25/80 \text{ °C}; t_p = 1 \text{ ms}$	1400 / 1000	A
I_{FSM}	$t_p = 10 \text{ ms}; \text{sin.}; T_j = 150 \text{ °C}$	3600	A
I^2t	$t_p = 10 \text{ ms}; T_j = 150 \text{ °C}$	64 800	A ² s

Characteristics		min.	typ.	max.	Units
Symbol	Conditions ¹⁾				
$V_{(BR)CES}$	$V_{GE} = 0$, $I_C = 6 \text{ mA}$	$\geq V_{CES}$	–	–	V
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 16 \text{ mA}$	4,5	5,5	6,5	V
I_{CES}	$V_{GE} = 0$ } $T_j = 25 \text{ °C}$	–	–	10	mA
	$V_{CE} = V_{CES}$ } $T_j = 125 \text{ °C}$	–	15	–	mA
I_{GES}	$V_{GE} = 20 \text{ V}$, $V_{CE} = 0$	–	–	1	μA
V_{CEsat}	$I_C = 400 \text{ A}$ } $V_{GE} = 15 \text{ V};$	–	2,1(2,4)	2,45(2,85)	V
V_{CEsat}	$I_C = 500 \text{ A}$ } $T_j = 25 (125) \text{ °C}$ }	–	2,5(2,8)	–	V
g_{fs}	$V_{CE} = 20 \text{ V}$, $I_C = 400 \text{ A}$	216	150	–	S
C_{CHC}		–	–	1500	pF
C_{ies}	} $V_{GE} = 0$ } $V_{CE} = 25 \text{ V}$ } $f = 1 \text{ MHz}$	–	26	40	nF
C_{oes}		–	4	5,2	nF
C_{res}		–	2	2,6	nF
L_{CE}		–	–	20	nH
$t_{d(on)}$	} $V_{CC} = 600 \text{ V}$ } $V_{GE} = -15 \text{ V} / +15 \text{ V}^{3)}$ } $I_C = 400 \text{ A}$, ind. load } $R_{Gon} = R_{Goff} = 3 \text{ }\Omega$ } $T_j = 125 \text{ °C}$	–	100	600	ns
t_r		–	75	340	ns
$t_{d(off)}$		–	660	1100	ns
t_f		–	82	125	ns
E_{on}		–	39	–	mWs
E_{off}		–	57	–	mWs
Inverse Diode⁸⁾					
$V_F = V_{EC}$	$I_F = 400 \text{ A}$ } $V_{GE} = 0 \text{ V};$	–	2,0(1,8)	2,5	V
$V_F = V_{EC}$	$I_F = 500 \text{ A}$ } $T_j = 25 (125) \text{ °C}$ }	–	2,25(2,1)	–	V
V_{TO}	$T_j = 125 \text{ °C}$	–	–	1,2	V
r_t	$T_j = 125 \text{ °C}$	–	–	3	m Ω
I_{RRM}	$I_F = 400 \text{ A}; T_j = 25 (125) \text{ °C}^{2)}$	–	180	–	A
Q_{rr}	$I_F = 400 \text{ A}; T_j = 25 (125) \text{ °C}^{2)}$	–	52	–	μC
Thermal characteristics					
R_{thjc}	per IGBT	–	–	0,041	°C/W
R_{thjc}	per diode D	–	–	0,09	°C/W
R_{thch}	per module	–	–	0,038	°C/W

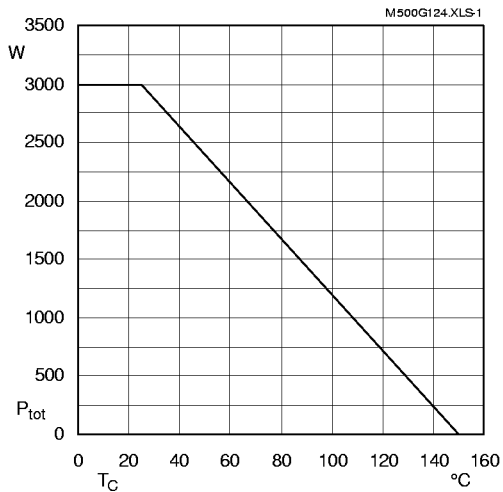


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$

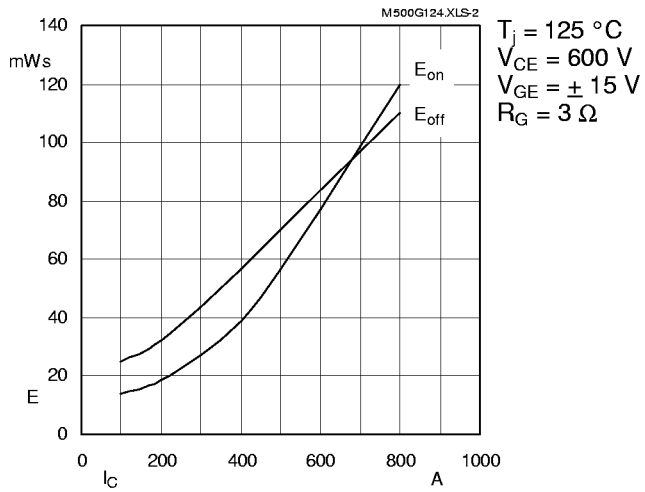


Fig. 2 Turn-on /-off energy $E = f(I_C)$

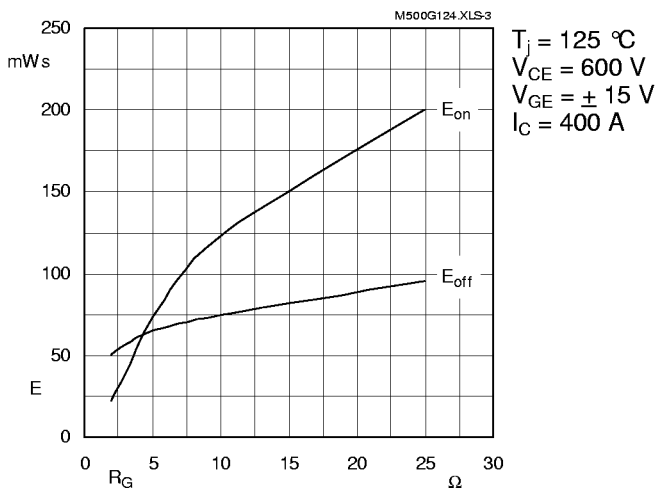


Fig. 3 Turn-on /-off energy $E = f(R_G)$

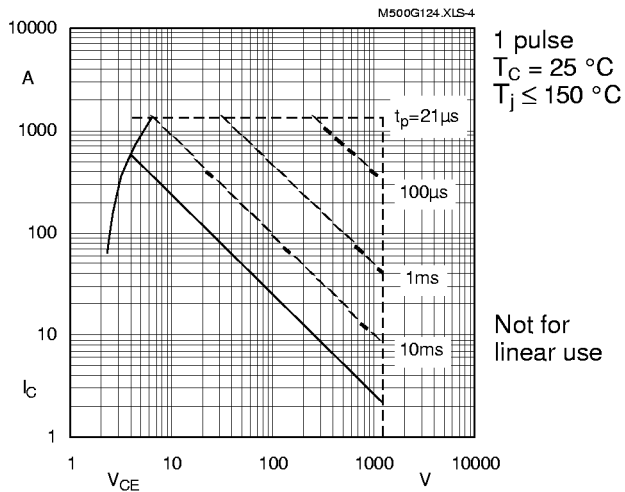


Fig. 4 Maximum safe operating area (SOA) $I_C = f(V_{CE})$

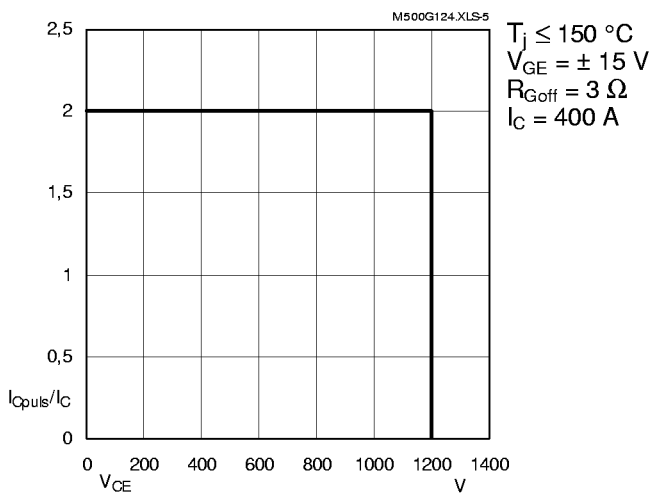


Fig. 5 Turn-off safe operating area (RBSOA)

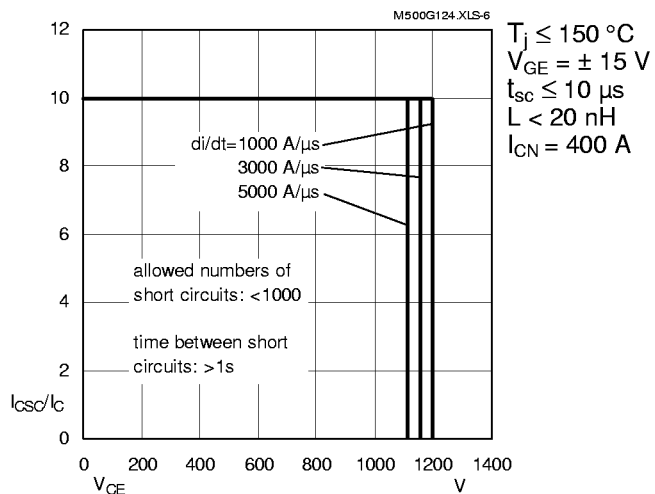


Fig. 6 Safe operating area at short circuit $I_C = f(V_{CE})$

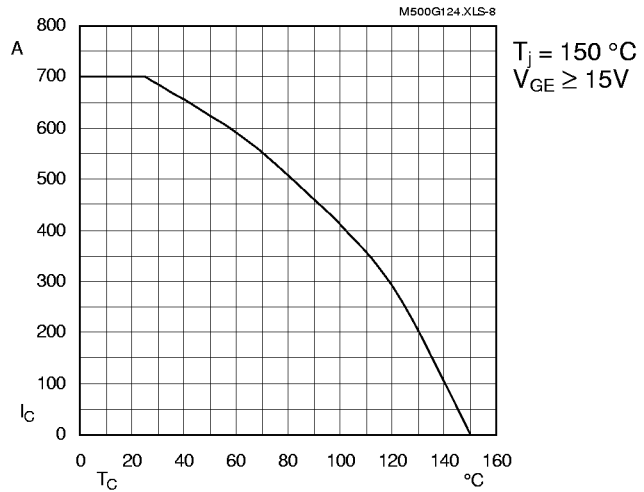


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

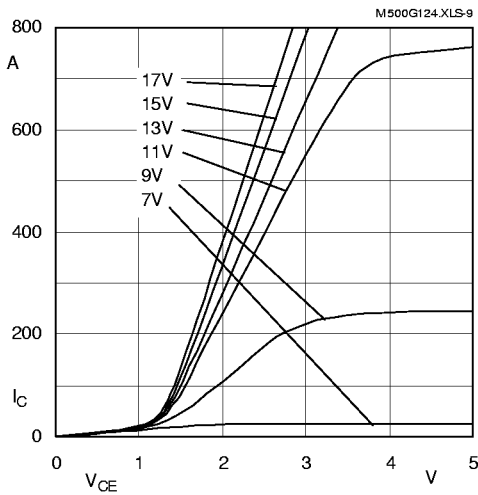


Fig. 9 Typ. output characteristic, $t_p = 80 \mu s$; $25 \text{ }^\circ\text{C}$

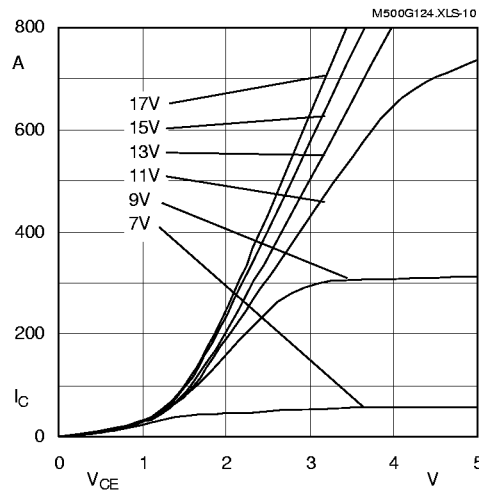


Fig. 10 Typ. output characteristic, $t_p = 80 \mu s$; $125 \text{ }^\circ\text{C}$

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

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

$$V_{\text{CE(TO)(T}_j)} \leq 1,3 + 0,005 (T_j - 25) \text{ [V]}$$

$$\text{typ.: } r_{\text{CE(T}_j)} = 0,0020 + 0,000006 (T_j - 25) \text{ [\Omega]}$$

$$\text{max.: } r_{\text{CE(T}_j)} = 0,0029 + 0,000009 (T_j - 25) \text{ [\Omega]}$$

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

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

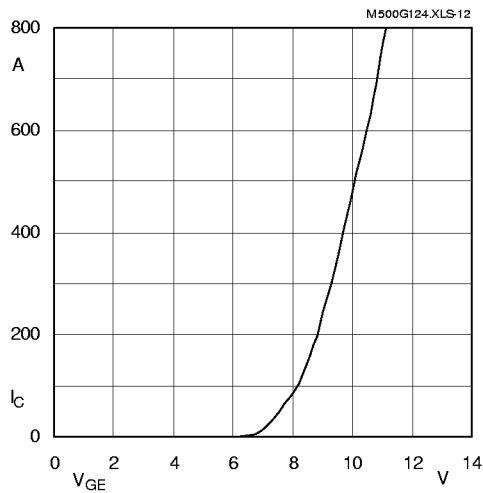


Fig. 12 Typ. transfer characteristic, $t_p = 80 \mu s$; $V_{\text{CE}} = 20 \text{ V}$

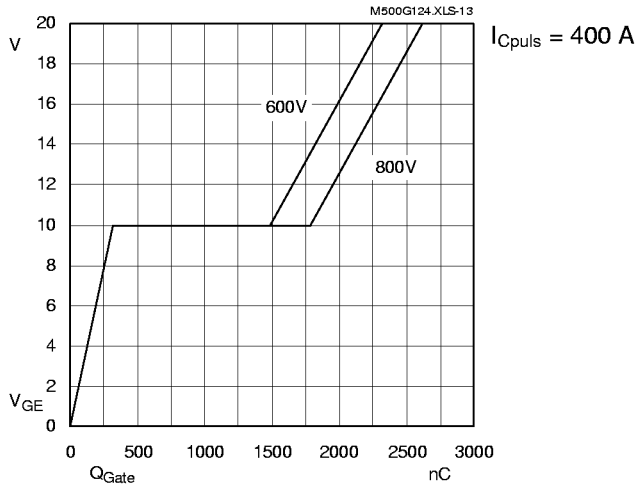


Fig. 13 Typ. gate charge characteristic

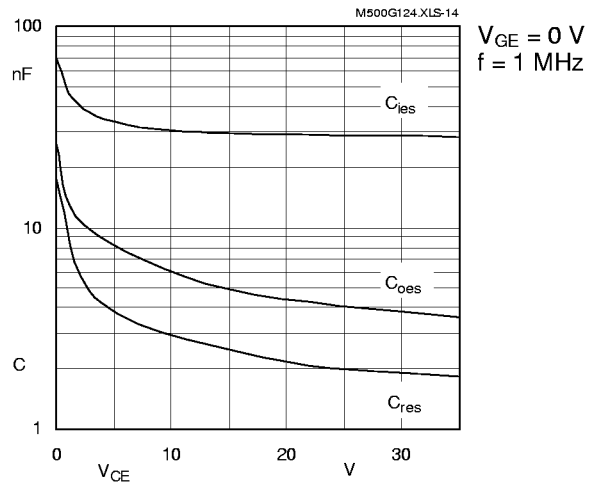


Fig. 14 Typ. capacitances vs. V_{CE}

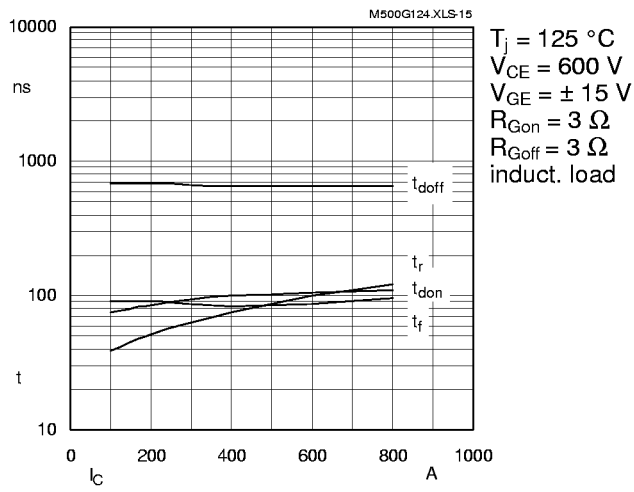


Fig. 15 Typ. switching times vs. I_C

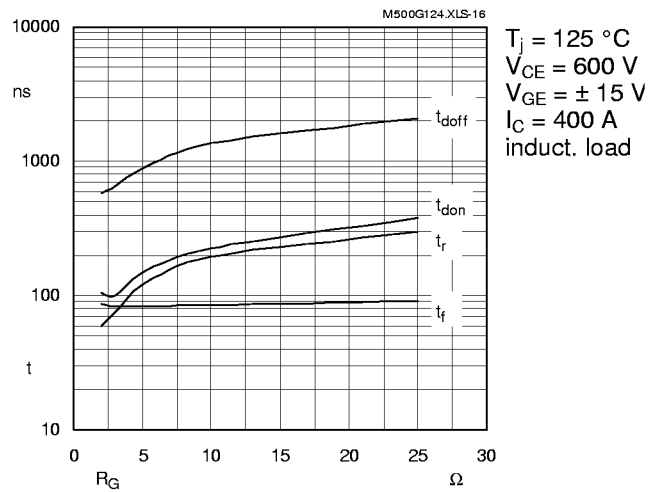


Fig. 16 Typ. switching times vs. gate resistor R_G

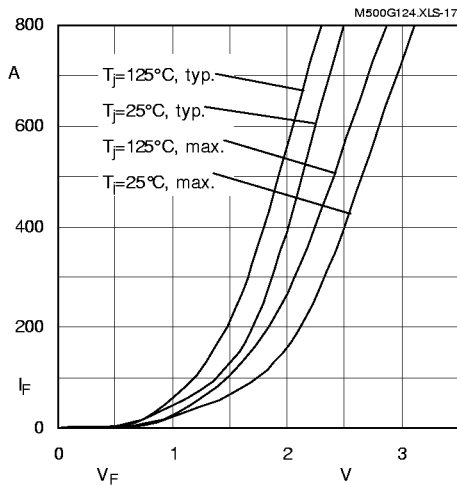


Fig. 17 Typ. CAL diode forward characteristic

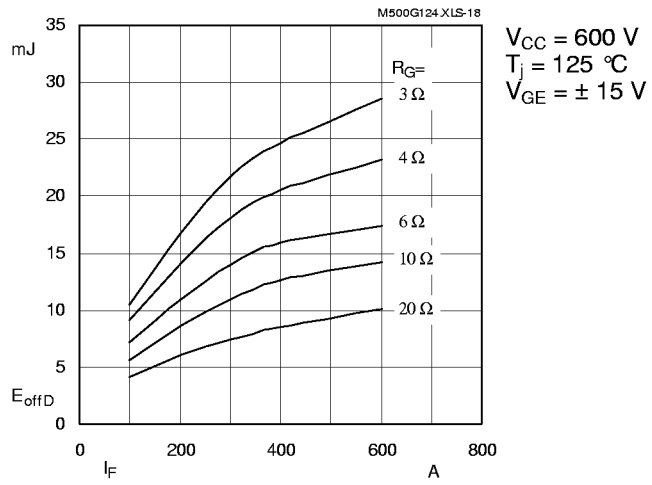


Fig. 18 Diode turn-off energy dissipation per pulse

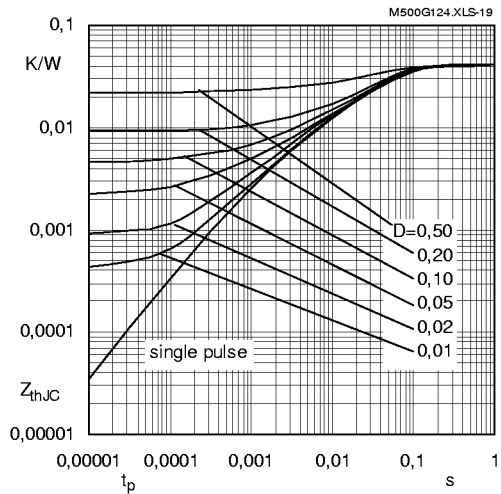


Fig. 19 Transient thermal impedance of IGBT
 $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

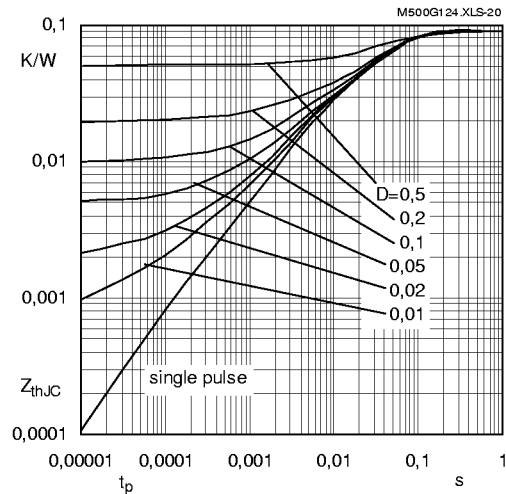


Fig. 20 Transient thermal impedance of inverse CAL diodes
 $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

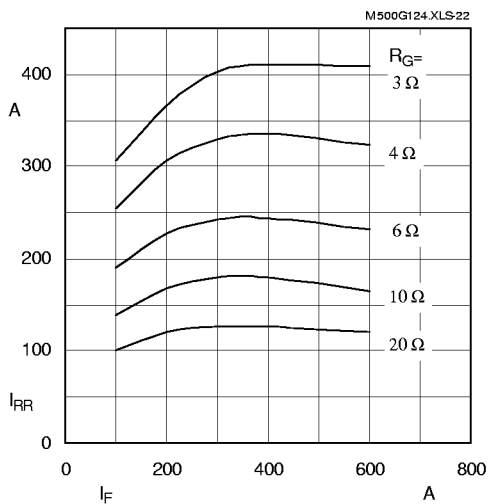


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

$V_{CC} = 600 \text{ V}$
 $T_j = 125 \text{ }^\circ\text{C}$
 $V_{GE} = \pm 15 \text{ V}$

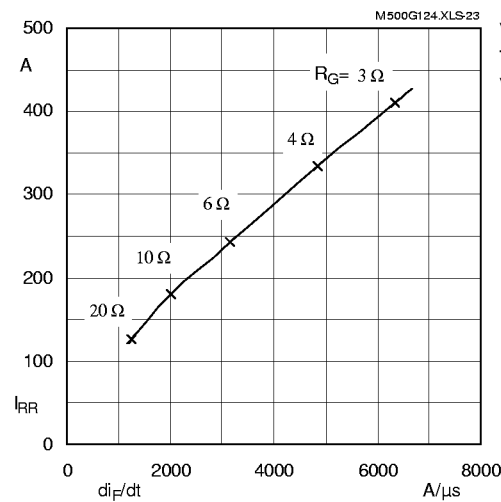


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di_F/dt; R_G)$

$V_{CC} = 600 \text{ V}$
 $T_j = 125 \text{ }^\circ\text{C}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_F = 400 \text{ A}$

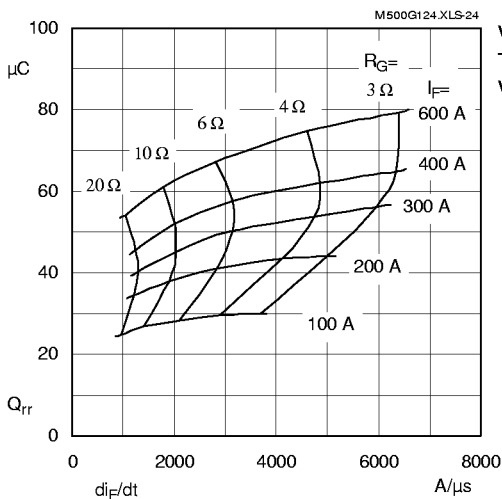
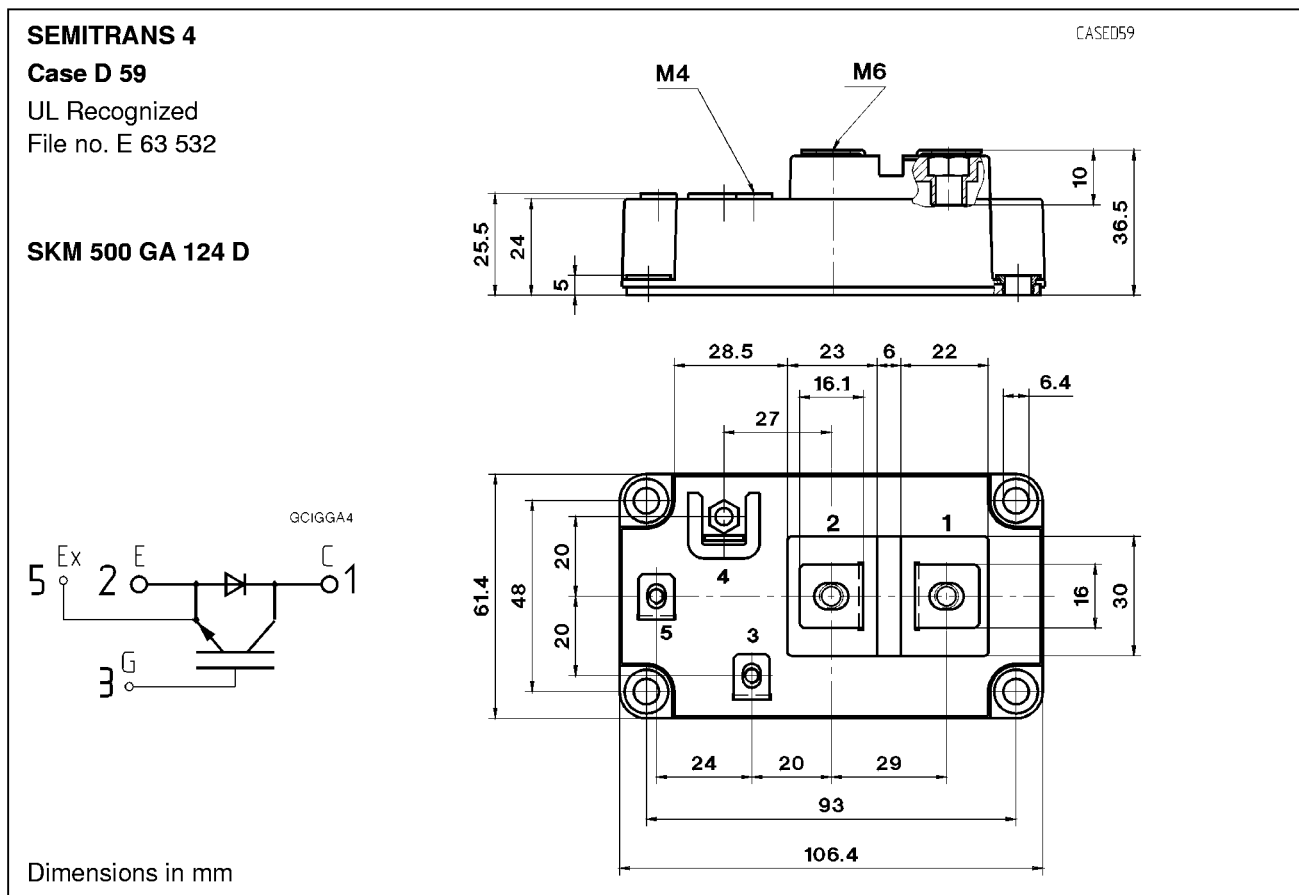


Fig. 24 Typ. CAL diode recovered charge
 $Q_{RR} = f(di_F/dt; I_F; R_G)$

$V_{CC} = 600 \text{ V}$
 $T_j = 125 \text{ }^\circ\text{C}$
 $V_{GE} = \pm 15 \text{ V}$



Case outline and circuit diagram

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	(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.

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

Larger packing units of 12 or 20 pieces are used if suitable
 Accessories → B 6 – 4
 SEMIBOX → C – 1.