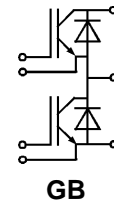


SEMITRANS® M Low Loss IGBT Modules

SKM 200 GB 124 D



SEMITRANS 3



Features

- MOS input (voltage controlled)
- N channel, homogeneous Silicon structure NPT-IGBT (Non punch through)
- Low saturation voltage
- Low inductance case
- 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 → page 5

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

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

²⁾ $I_F = -I_C$, $V_R = 600 \text{ V}$, $-di_F/dt = 1500 \text{ A}/\mu\text{s}$, $V_{GE} = 0 \text{ V}$

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

⁸⁾ CAL = Controlled Axial Lifetime Technology

Cases and mech. data → page 6 SEMITRANS 3

Absolute Maximum Ratings		Values	Units
Symbol	Conditions ¹⁾		
V_{CES}		1200	V
V_{CGR}	$R_{GE} = 20 \text{ k}\Omega$	1200	V
I_C	$T_{case} = 25/85 \text{ °C}$	290 / 200	A
I_{CM}	$T_{case} = 25/85 \text{ °C}$; $t_p = 1 \text{ ms}$	580 / 400	A
V_{GES}		± 20	V
P_{tot}	per IGBT, $T_{case} = 25 \text{ °C}$	1350	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			
$I_F = -I_C$	$T_{case} = 25/80 \text{ °C}$	195 / 130	A
$I_{FM} = -I_{CM}$	$T_{case} = 25/80 \text{ °C}$; $t_p = 1 \text{ ms}$	580 / 400	A
I_{FSM}	$t_p = 10 \text{ ms}$; sin.; $T_j = 150 \text{ °C}$	1450	A
I^2t	$t_p = 10 \text{ ms}$; $T_j = 150 \text{ °C}$	10 500	A ² s

Characteristics		min.	typ.	max.	Units
Symbol	Conditions ¹⁾				
$V_{(BR)CES}$	$V_{GE} = 0$, $I_C = 4 \text{ mA}$	$\geq V_{CES}$	-	-	V
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 6 \text{ mA}$	4,5	5,5	6,5	V
I_{CES}	$V_{GE} = 0$ } $T_j = 25 \text{ °C}$ $V_{CE} = V_{CES}$ } $T_j = 125 \text{ °C}$	-	0,4	14	mA
		-	12	-	mA
I_{GES}	$V_{GE} = 20 \text{ V}$, $V_{CE} = 0$	-	-	0,32	μA
V_{CESat}	$I_C = 150 \text{ A}$ } $V_{GE} = 15 \text{ V}$; $I_C = 200 \text{ A}$ } $T_j = 25 (125) \text{ °C}$ }	-	2,1(2,4)	2,45(2,85)	V
V_{CESat}		-	2,5(3,0)	-	V
g_{fs}	$V_{CE} = 20 \text{ V}$, $I_C = 150 \text{ A}$	62	-	-	S
C_{CHC}	per IGBT	-	-	700	pF
C_{ies}	$V_{GE} = 0$ $V_{CE} = 25 \text{ V}$ $f = 1 \text{ MHz}$	-	11	15	nF
C_{oes}		-	1,6	2	nF
C_{res}		-	0,8	1	nF
L_{CE}		-	-	20	nH
$t_{d(on)}$	$V_{CC} = 600 \text{ V}$ $V_{GE} = -15 \text{ V} / +15 \text{ V}^{3)}$ $I_C = 150 \text{ A}$, ind. load $R_{Gon} = R_{Goff} = 7 \Omega$ $T_j = 125 \text{ °C}$	-	75	-	ns
t_r		-	50	-	ns
$t_{d(off)}$		-	520	-	ns
t_f		-	50	-	ns
E_{on}		-	21	-	mWs
E_{off}		-	19	-	mWs
Inverse Diode ⁸⁾					
$V_F = V_{EC}$	$I_F = 150 \text{ A}$ } $V_{GE} = 0 \text{ V}$; $I_F = 200 \text{ A}$ } $T_j = 25 (125) \text{ °C}$ }	-	2,0(1,8)	2,5	V
$V_F = V_{EC}$		-	2,25(2,05)	-	V
V_{TO}	$T_j = 125 \text{ °C}^{2)}$	-	1,1	1,2	V
r_t	$T_j = 125 \text{ °C}^{2)}$	-	-	7	m Ω
I_{RRM}	$I_F = 150 \text{ A}$; $T_j = 125 \text{ °C}^{2)}$	-	78	-	A
Q_{rr}	$I_F = 150 \text{ A}$; $T_j = 125 \text{ °C}^{2)}$	-	19,5	-	μC
Thermal characteristics					
R_{thjc}	per IGBT	-	-	0,09	°C/W
R_{thjc}	per diode	-	-	0,25	°C/W
R_{thch}	per module	-	-	0,038	°C/W

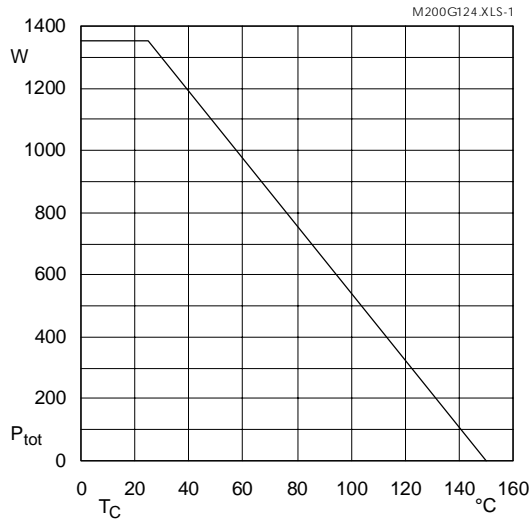


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$

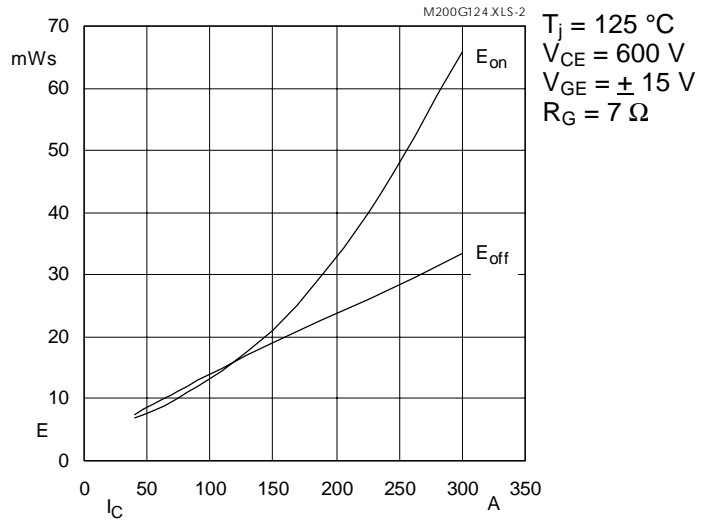


Fig. 2 Turn-on /-off energy $= f(I_C)$

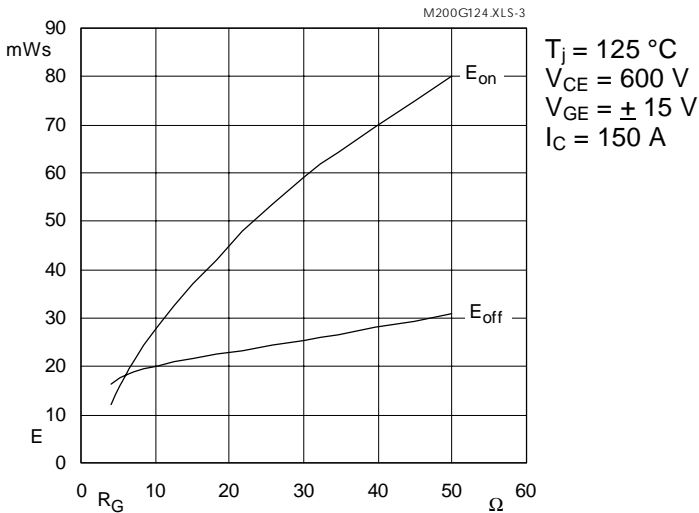


Fig. 3 Turn-on /-off energy $= f(R_G)$

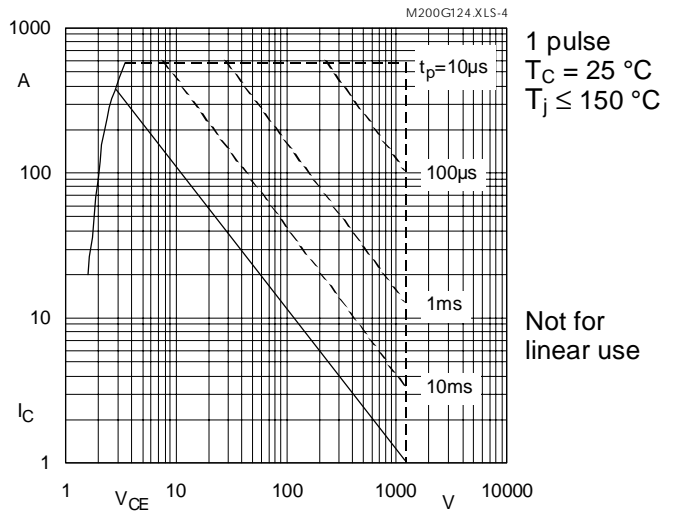


Fig. 4 Maximum safe operating area (SOA) $I_C = f(V_{CE})$

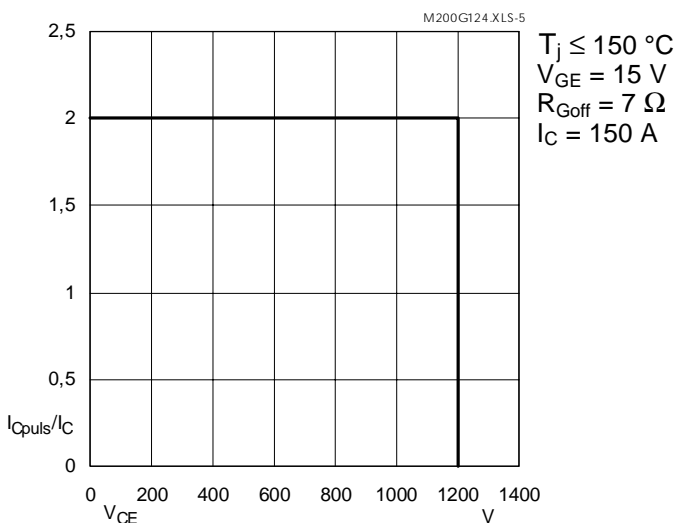


Fig. 5 Turn-off safe operating area (RBSOA)

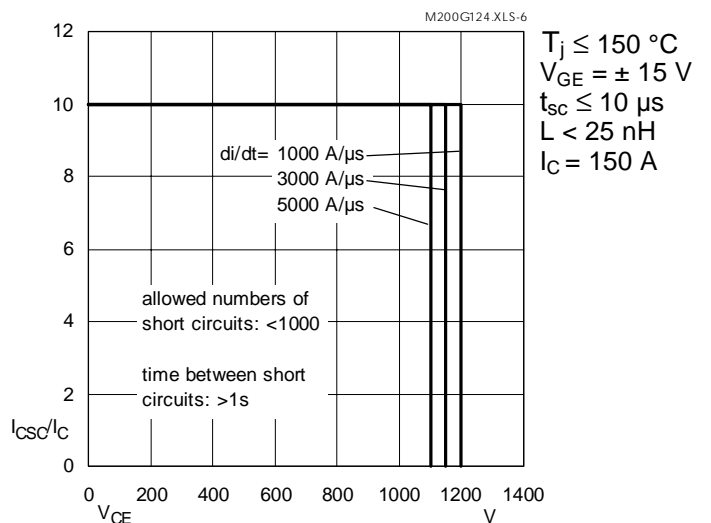


Fig. 6 Safe operating area at short circuit $I_C = f(V_{CE})$

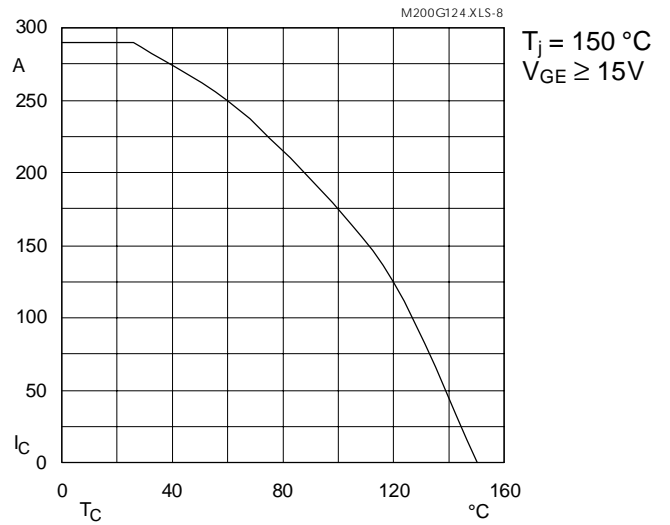


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

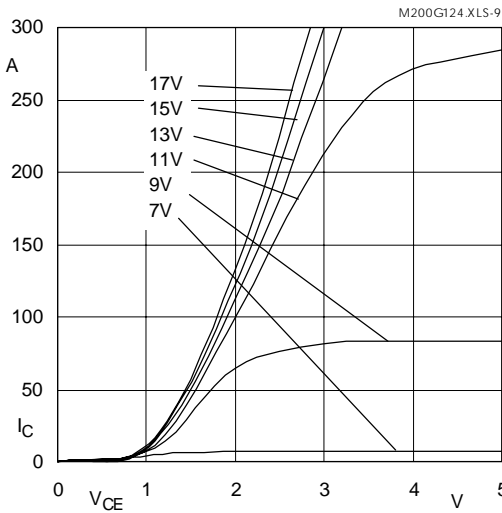


Fig. 9 Typ. output characteristic, $t_p = 80 \mu s$; $25 \text{ }^\circ\text{C}$

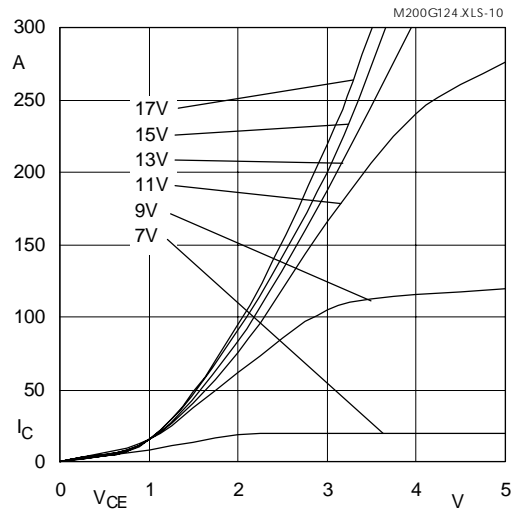


Fig. 10 Typ. output characteristic, $t_p = 80 \mu s$; $125 \text{ }^\circ\text{C}$

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

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

$$V_{\text{CE(TO)}(T_j)} \leq 1,3 + 0,0005 (T_j - 25) \text{ [V]}$$

$$\text{typ.: } r_{\text{CE}(T_j)} = 0,0053 + 0,000017 (T_j - 25) \text{ [}\Omega\text{]}$$

$$\text{max.: } r_{\text{CE}(T_j)} = 0,0077 + 0,000023 (T_j - 25) \text{ [}\Omega\text{]}$$

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

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

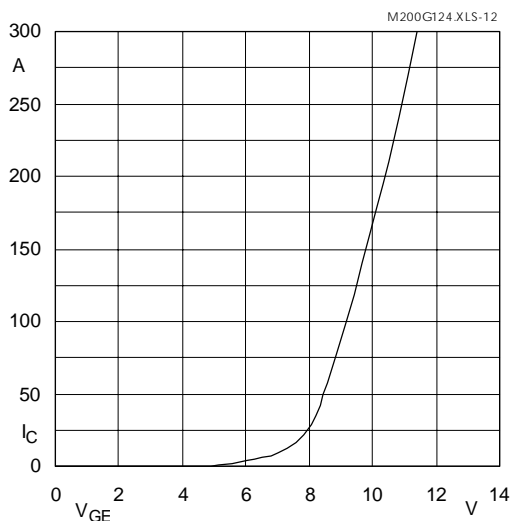


Fig. 12 Typ. transfer characteristic, $t_p = 80 \mu s$; $V_{\text{CE}} = 20 \text{ V}$

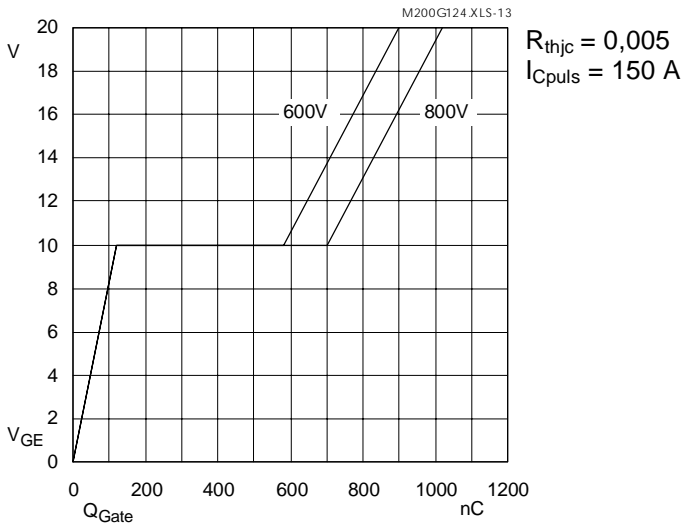


Fig. 13 Typ. gate charge characteristic

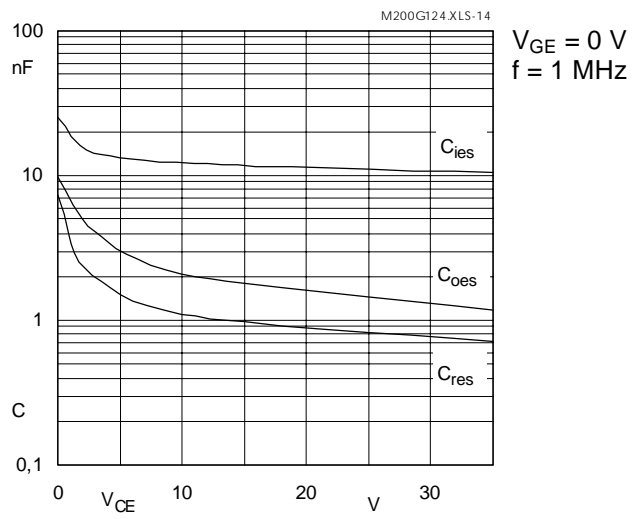


Fig. 14 Typ. capacitances vs. V_{CE}

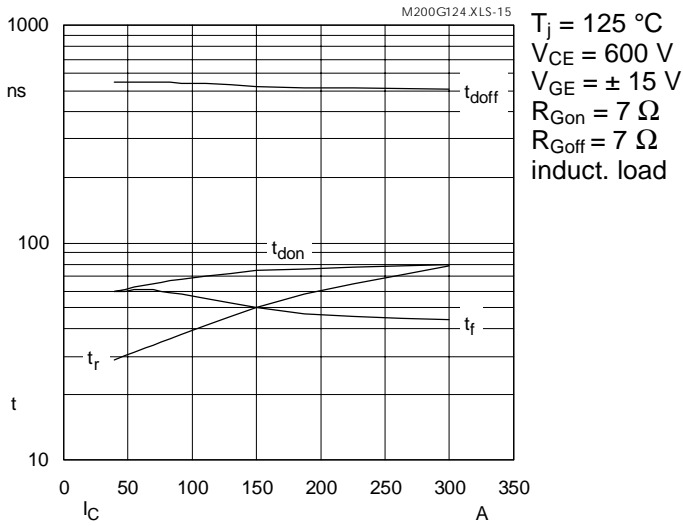


Fig. 15 Typ. switching times vs. I_C

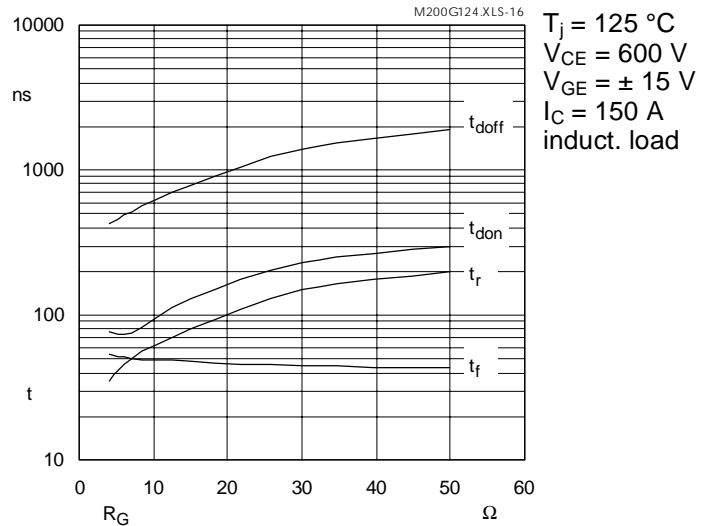


Fig. 16 Typ. switching times vs. gate resistor R_G

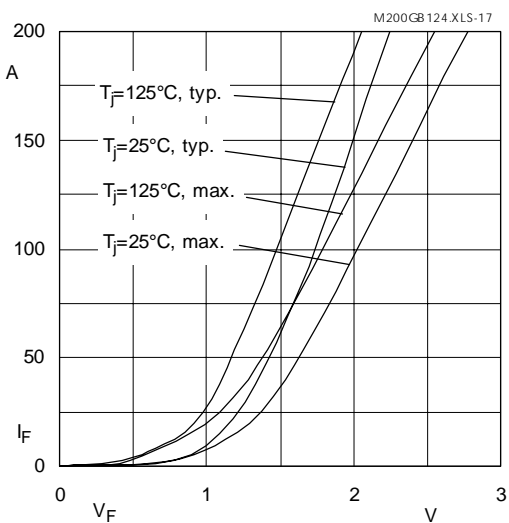


Fig. 17 Typ. CAL diode forward characteristic

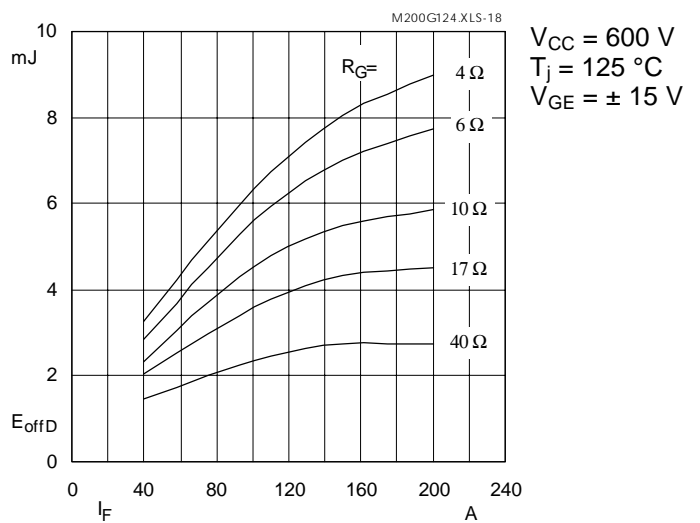


Fig. 18 Diode turn-off energy dissipation per pulse

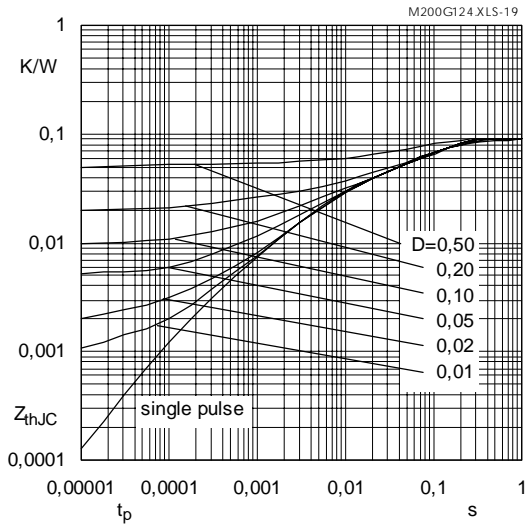


Fig. 19 Transient thermal impedance of IGBT
 $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

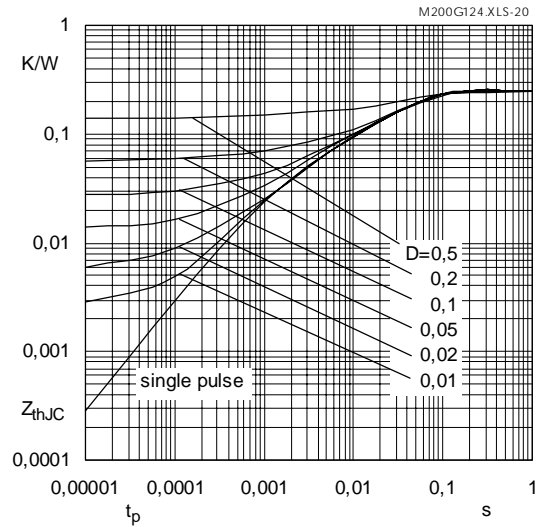


Fig. 20 Transient thermal impedance of inverse CAL diodes
 $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

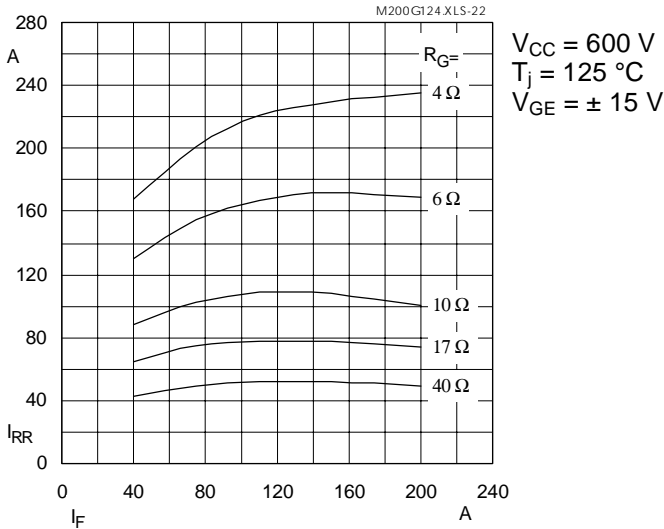


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

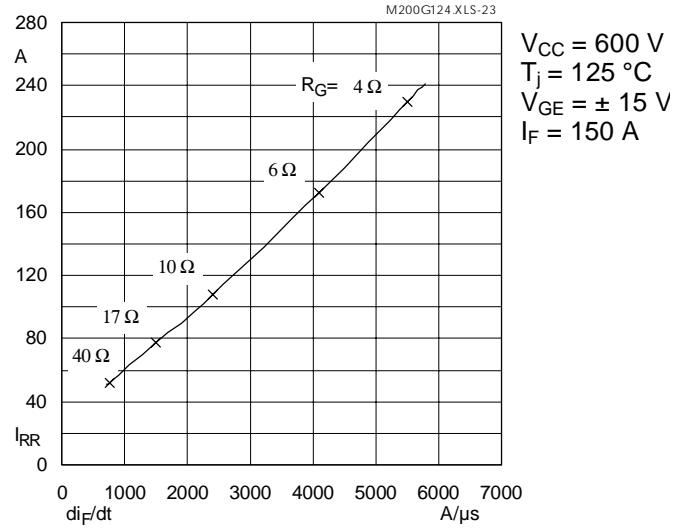


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di/dt)$

Typical Applications

include

- Switched mode power supplies
- DC servo and robot drives
- Inverters
- DC choppers
- AC motor speed control
- UPS Uninterruptable power supplies
- General power switching applications
- Electronic (also portable) welders

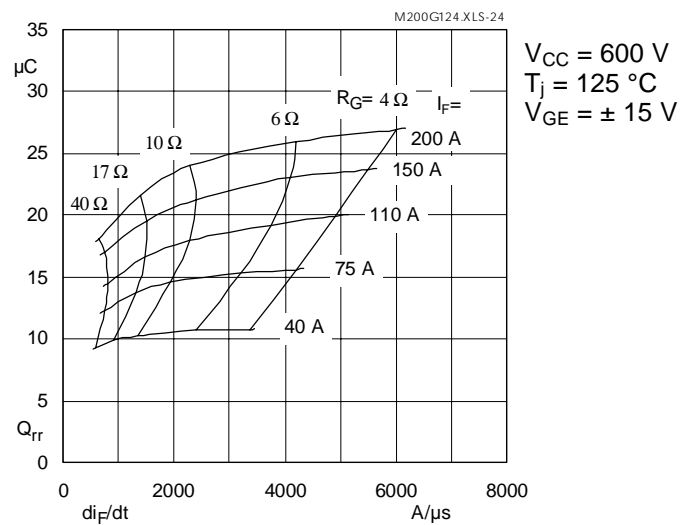
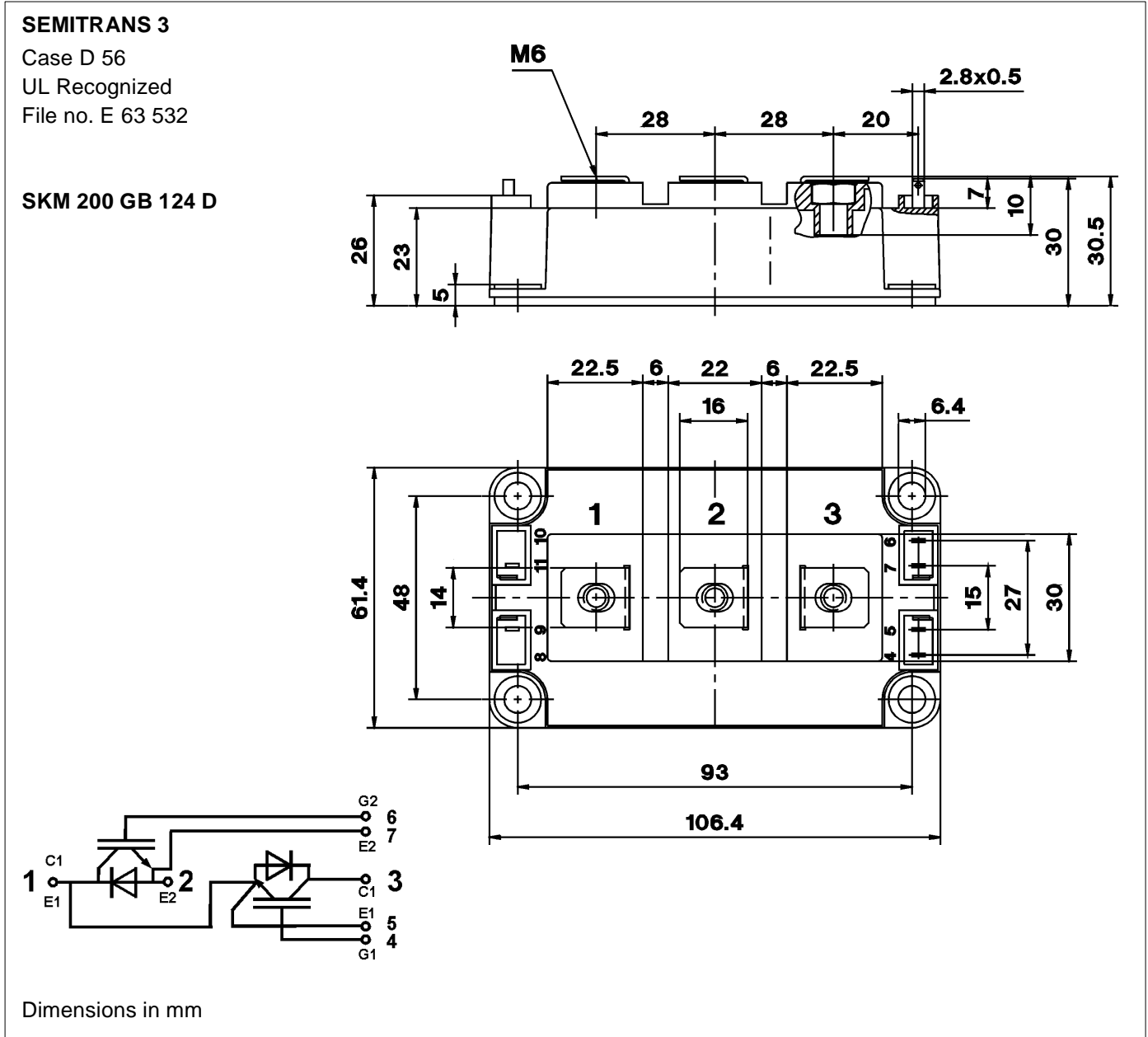


Fig. 24 Typ. CAL diode recovered charge



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 (M6)	27	–	44	lb.in.
M ₂	for terminals, SI Units (M6)	2,5	–	5	Nm
	for terminals, US Units (M6)	22	–	44	lb.in.
a		–	–	5x9,81	m/s ²
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 A 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 → page B 6 - 4.
 SEMIBOX → page C - 1.