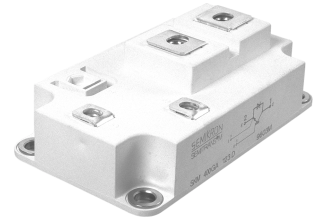


Absolute Maximum Ratings		Values	Units
Symbol	Conditions ¹⁾		
V_{CES}		1200	V
V_{CGR}	$R_{GE} = 20 \text{ k}\Omega$	1200	V
I_C	$T_{case} = 25/80 \text{ }^\circ\text{C}$	700 / 600 ⁴⁾	A
I_{CM}	$T_{case} = 25/80 \text{ }^\circ\text{C}; t_p = 1 \text{ ms}$	1400 / 1200	A
V_{GES}		± 20	V
P_{tot}	per IGBT, $T_{case} = 25 \text{ }^\circ\text{C}$	4000	W
$T_j, (T_{stg})$		-40 ... +150 (125)	$^\circ\text{C}$
V_{isol}	AC, 1 min.	2500	V
humidity	IEC 60721-3-3	3K7/IE32	
climate	IEC 60068-1	40/125/56	
Inverse Diode			
$I_F = -I_C$	$T_{case} = 25/80 \text{ }^\circ\text{C}$	700 / 500	A
$I_{FM} = -I_{CM}$	$T_{case} = 25/80 \text{ }^\circ\text{C}; t_p = 1 \text{ ms}$	1400 / 1200	A
I_{FSM}	$t_p = 10 \text{ ms}; \sin.; T_j = 150 \text{ }^\circ\text{C}$	5000	A
I^2t	$t_p = 10 \text{ ms}; T_j = 150 \text{ }^\circ\text{C}$	125000	A^2s

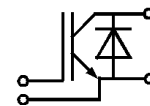
Characteristics		min.	typ.	max.	Units
Symbol	Conditions ¹⁾				
$V_{(BR)CES}$	$V_{GE} = 0, I_C = 6 \text{ mA}$	$\geq V_{CES}$	-	-	V
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 24 \text{ mA}$	4,5	5,5	6,5	V
I_{CES}	$V_{GE} = 0 \left. \begin{array}{l} T_j = 25 \text{ }^\circ\text{C} \\ T_j = 125 \text{ }^\circ\text{C} \end{array} \right\}$	-	-	2	mA
	$V_{CE} = V_{CES}$	-	15	-	mA
I_{GES}	$V_{GE} = 20 \text{ V}, V_{CE} = 0$	-	-	1	μA
V_{CESat}	$I_C = 400 \text{ A} \left. \begin{array}{l} V_{GE} = 15 \text{ V}; \\ T_j = 25 (125) \text{ }^\circ\text{C} \end{array} \right\}$ ⁴⁾	-	2,0(2,2)	2,15(2,35)	V
V_{CESat}	$I_C = 600 \text{ A} \left. \begin{array}{l} V_{GE} = 15 \text{ V}; \\ T_j = 25 (125) \text{ }^\circ\text{C} \end{array} \right\}$ ⁴⁾	-	2,4(2,6)	2,45	V
g_{fs}	$V_{CE} = 20 \text{ V}, I_C = 400 \text{ A}$	220	-	-	S
C_{CHC}		-	-	1500	pF
C_{ies}	$\left. \begin{array}{l} V_{GE} = 0 \\ V_{CE} = 25 \text{ V} \\ f = 1 \text{ MHz} \end{array} \right\}$	-	44	60	nF
C_{oes}		-	6,6	8	nF
C_{res}		-	2,4	3,2	nF
L_{CE}		-	-	20	nH
$t_{d(on)}$	$\left. \begin{array}{l} V_{CC} = 600 \text{ V} \\ V_{GE} = -15 \text{ V} / +15 \text{ V}^{3)} \\ I_C = 400 \text{ A, ind. load} \\ R_{Gon} = R_{Goff} = 4 \text{ }^\circ\Omega \\ T_j = 125 \text{ }^\circ\text{C} \end{array} \right\}$	-	100	-	ns
t_r		-	100	-	ns
$t_{d(off)}$		-	1020	-	ns
t_f		-	90	-	ns
E_{on}		-	55	-	mWs
E_{off}		-	63	-	mWs
Inverse Diode ⁸⁾					
$V_F = V_{EC}$	$\left. \begin{array}{l} I_F = 400 \text{ A} \\ I_F = 600 \text{ A} \end{array} \right\} \left. \begin{array}{l} V_{GE} = 0 \text{ V}; \\ T_j = 25 (125) \text{ }^\circ\text{C} \end{array} \right\}$	-	2,0(1,7)	2,2(2,0)	V
$V_F = V_{EC}$		-	2,3(2,1)	2,5	V
V_{TO}	$T_j = 125 \text{ }^\circ\text{C}$	-	-	1,2	V
r_t	$T_j = 125 \text{ }^\circ\text{C}$	-	1,5	2	$\text{m}\Omega$
I_{RRM}	$I_F = 400 \text{ A}; T_j = 125 \text{ }^\circ\text{C}^{2)}$	-	400	-	A
Q_{rr}	$I_F = 400 \text{ A}; T_j = 125 \text{ }^\circ\text{C}^{2)}$	-	58	-	μC
E_{rec}	$I_F = 400 \text{ A}; T_j = 125 \text{ }^\circ\text{C}^{2)}$	-	22	-	mWs
Thermal characteristics					
R_{thjc}	per IGBT ⁵⁾	-	-	0,030	$^\circ\text{C}/\text{W}$
R_{thjc}	per diode D	-	-	0,07	$^\circ\text{C}/\text{W}$
R_{thch}	per module ⁵⁾	-	-	0,030	$^\circ\text{C}/\text{W}$

SEMITRANS® M Low Loss IGBT Modules

SKM 600 GA 124 D



SEMITRANS 4



GA

Features

- 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 $6 * I_{cnom}$
- Fast & soft inverse CAL diodes ⁸⁾
- 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)
- Wind generators (low loss)
- Inverter drives (low loss)
- UPS (low loss)

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

²⁾ $I_F = -I_C, V_R = 600 \text{ V}, -di_F/dt = 4000 \text{ A}/\mu\text{s}, V_{GE} = 0 \text{ V}$

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

⁴⁾ Limited by terminals to $I_{DC} = 500 \text{ A}$ for $T_{terminal} = 100 \text{ }^\circ\text{C}$

⁵⁾ T_C : ref. point on baseplate at hottest point (under chip)

⁷⁾ T_H : ref. point H on heatsink as close to the device as possible at hottest point

⁸⁾ CAL = Controlled Axial Lifetime Technology.

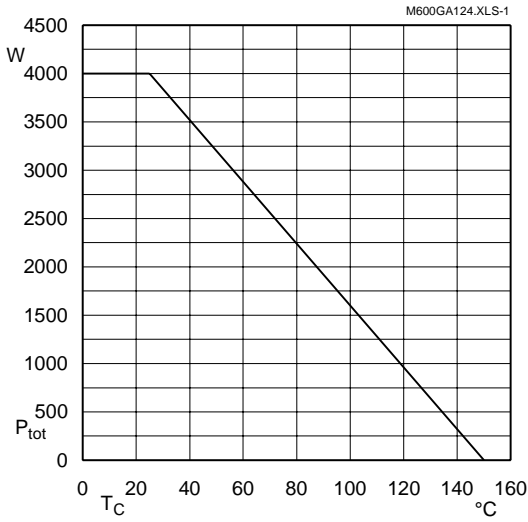


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$

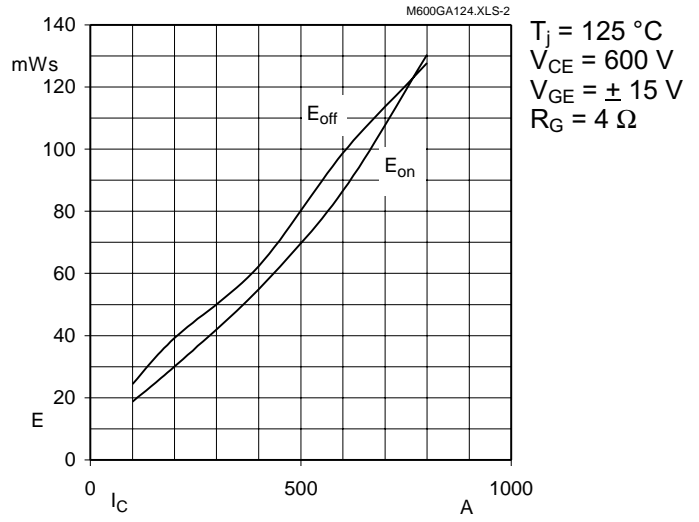


Fig. 2 Turn-on /-off energy $= f(I_C)$

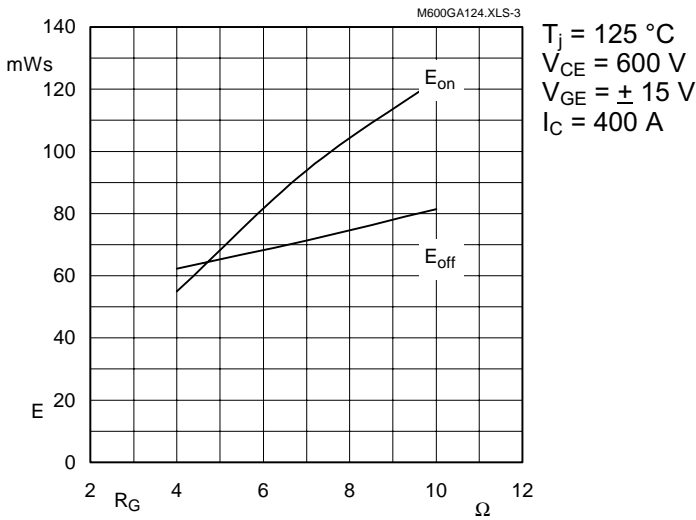


Fig. 3 Turn-on /-off energy $= f(R_G)$

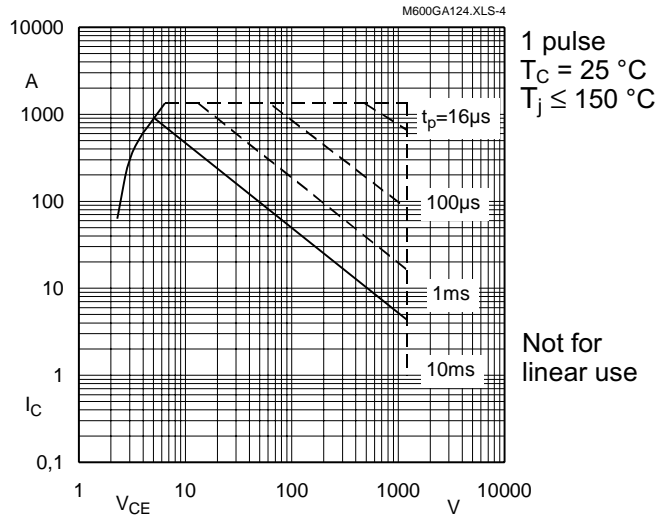


Fig. 4 Maximum safe operating area (SOA) $I_C = f(V_{CE})$

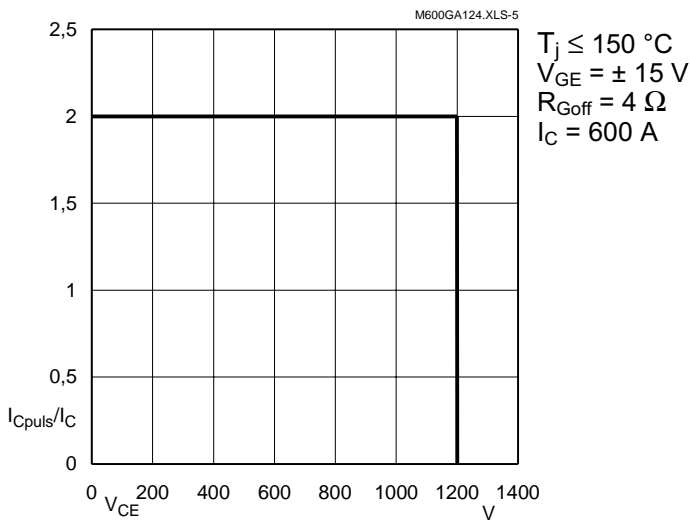


Fig. 5 Turn-off safe operating area (RBSOA)

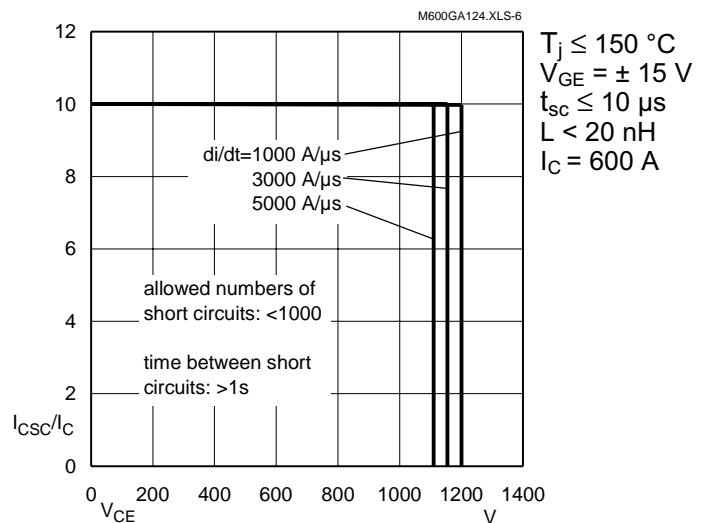


Fig. 6 Safe operating area at short circuit $I_C = f(V_{CE})$

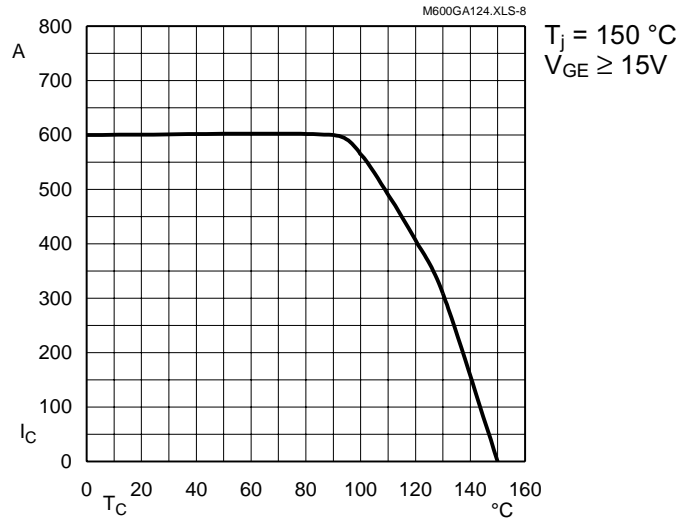


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

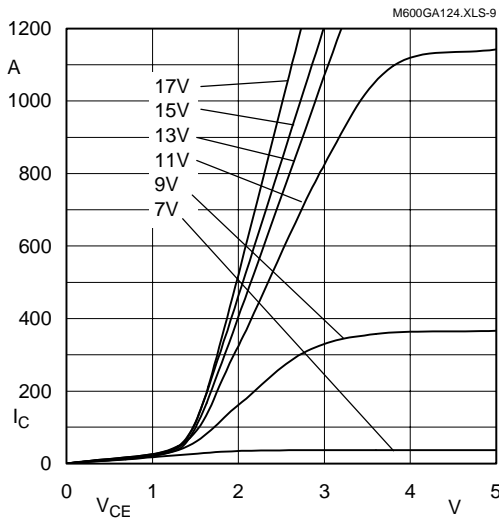


Fig. 9 Typ. output characteristic, $t_p = 80 \mu s$; $25 \text{ }^\circ\text{C}$

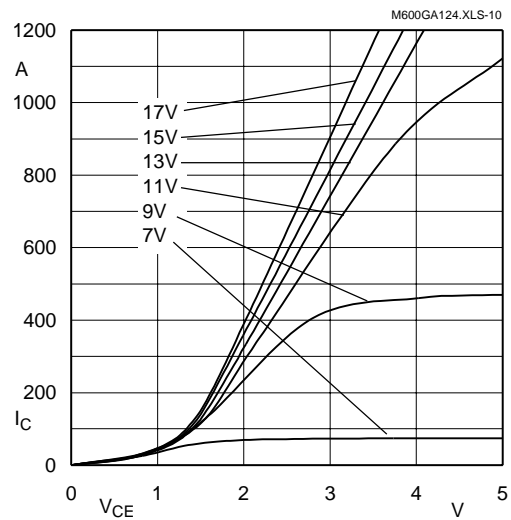


Fig. 10 Typ. output characteristic, $t_p = 80 \mu s$; $125 \text{ }^\circ\text{C}$

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

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

$$V_{\text{CE(TO)(Tj)}} \leq 1,15 - 0,0005 (T_j - 25) \text{ [V]}$$

$$\text{typ.: } r_{\text{CE(Tj)}} = 0,0021 + 0,000007 (T_j - 25) \text{ [}\Omega\text{]}$$

$$\text{max.: } r_{\text{CE(Tj)}} = 0,0023 + 0,000007 (T_j - 25) \text{ [}\Omega\text{]}$$

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

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

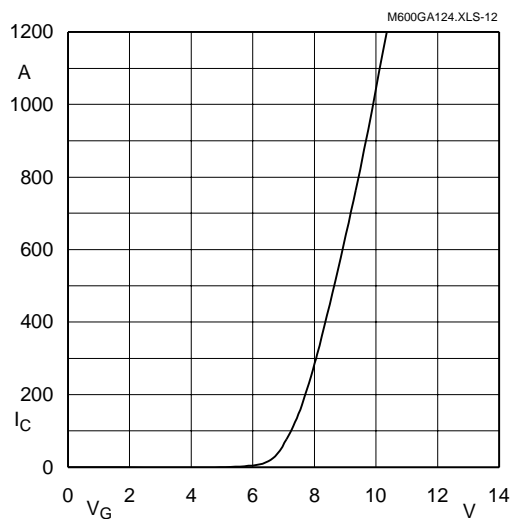


Fig. 12 Typ. transfer characteristic, $t_p = 80 \mu s$; $V_{\text{CE}} = 20 \text{ V}$

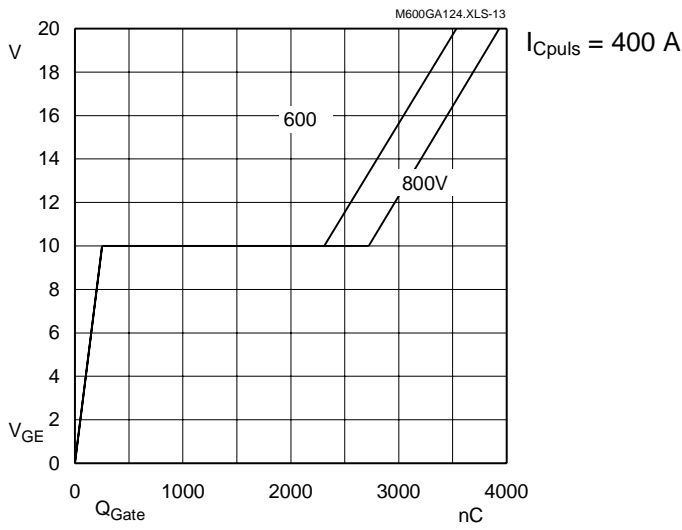


Fig. 13 Typ. gate charge characteristic

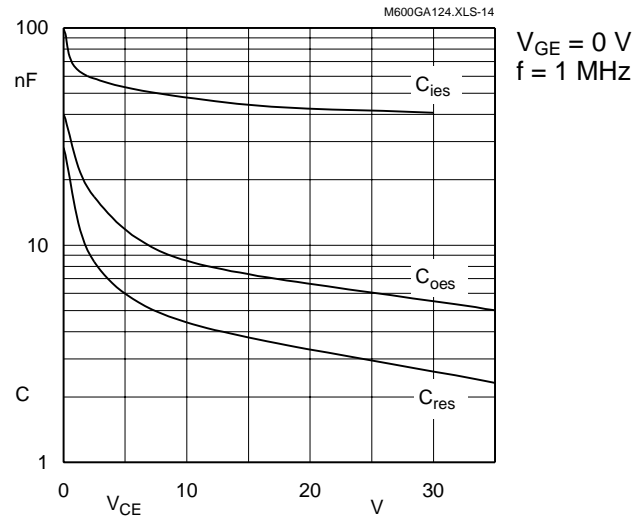


Fig. 14 Typ. capacitances vs. V_{CE}

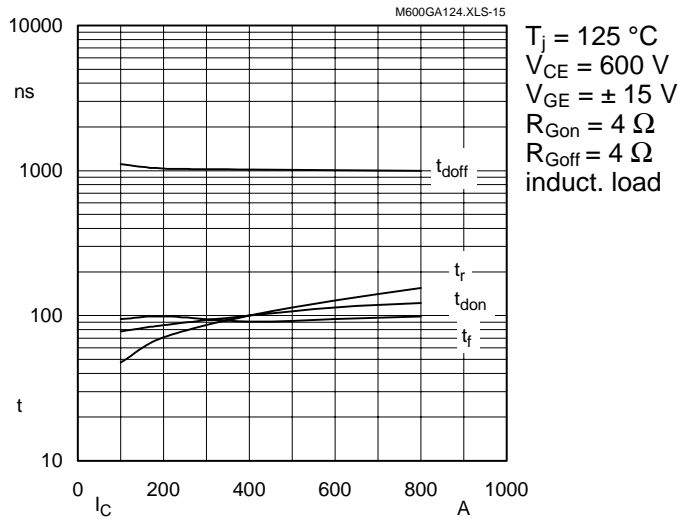


Fig. 15 Typ. switching times vs. I_C

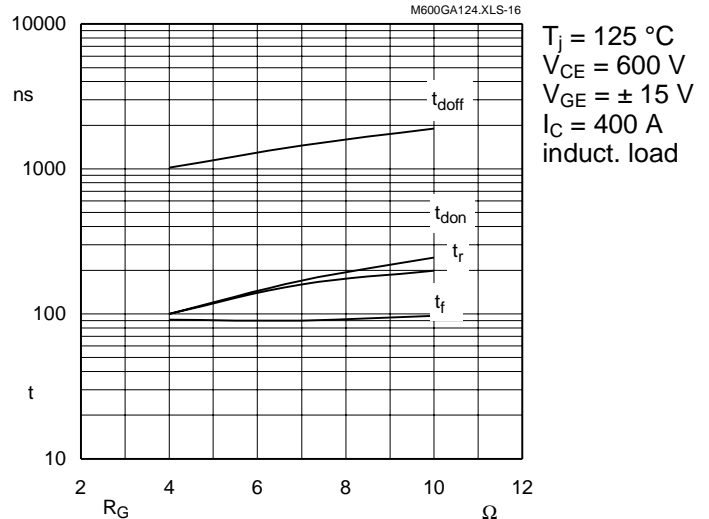


Fig. 16 Typ. switching times vs. gate resistor R_G

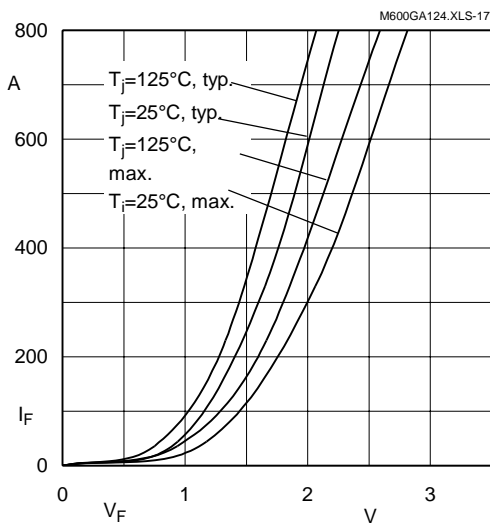


Fig. 17 Typ. CAL diode forward characteristic

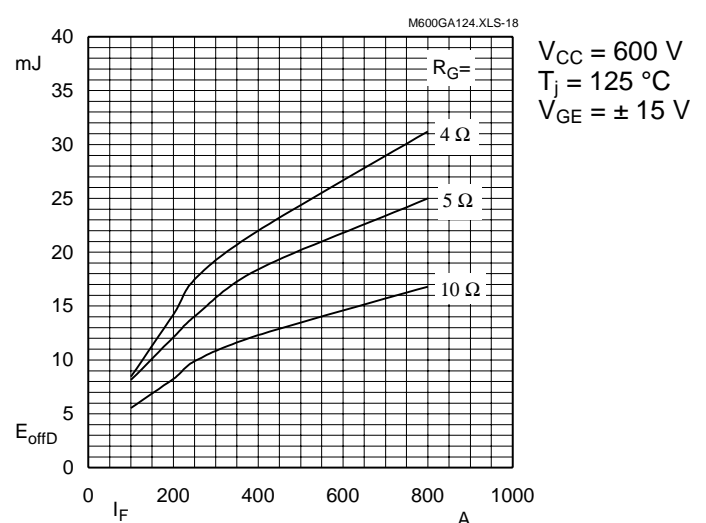


Fig. 18 Diode turn-off energy dissipation per pulse

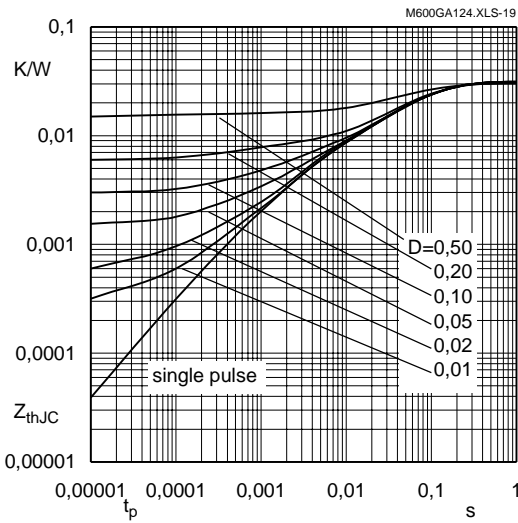


Fig. 19 Transient thermal impedance of IGBT
 $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

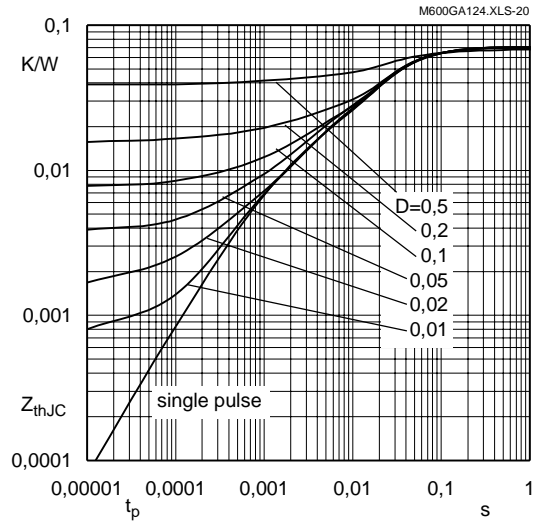


Fig. 20 Transient thermal impedance of inverse CAL diodes
 $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

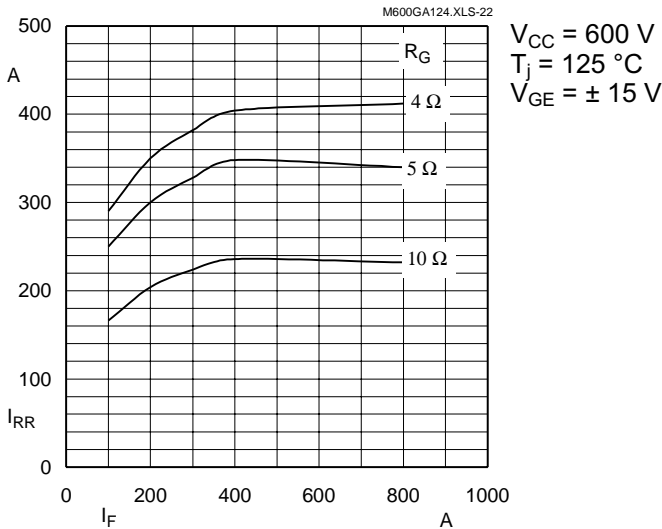


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

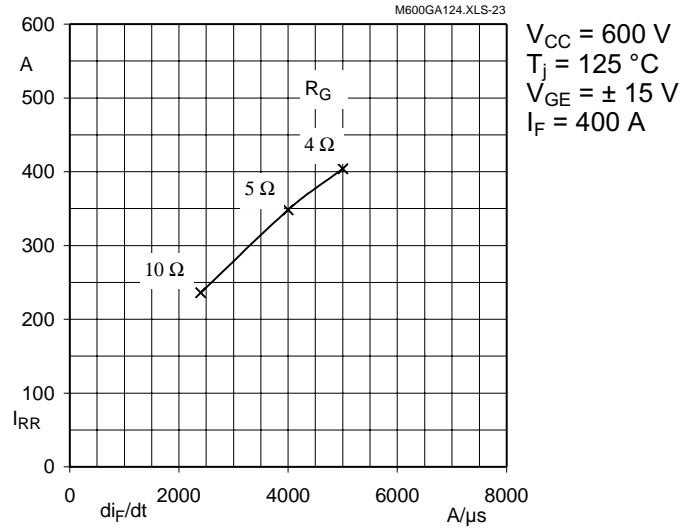


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di_F/dt; R_G)$

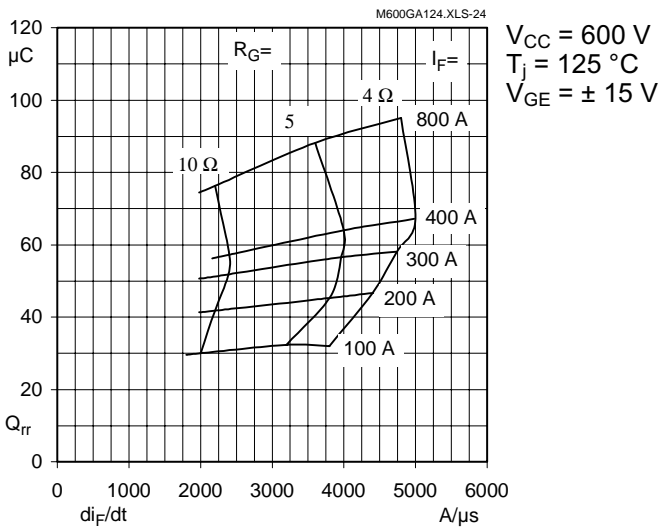
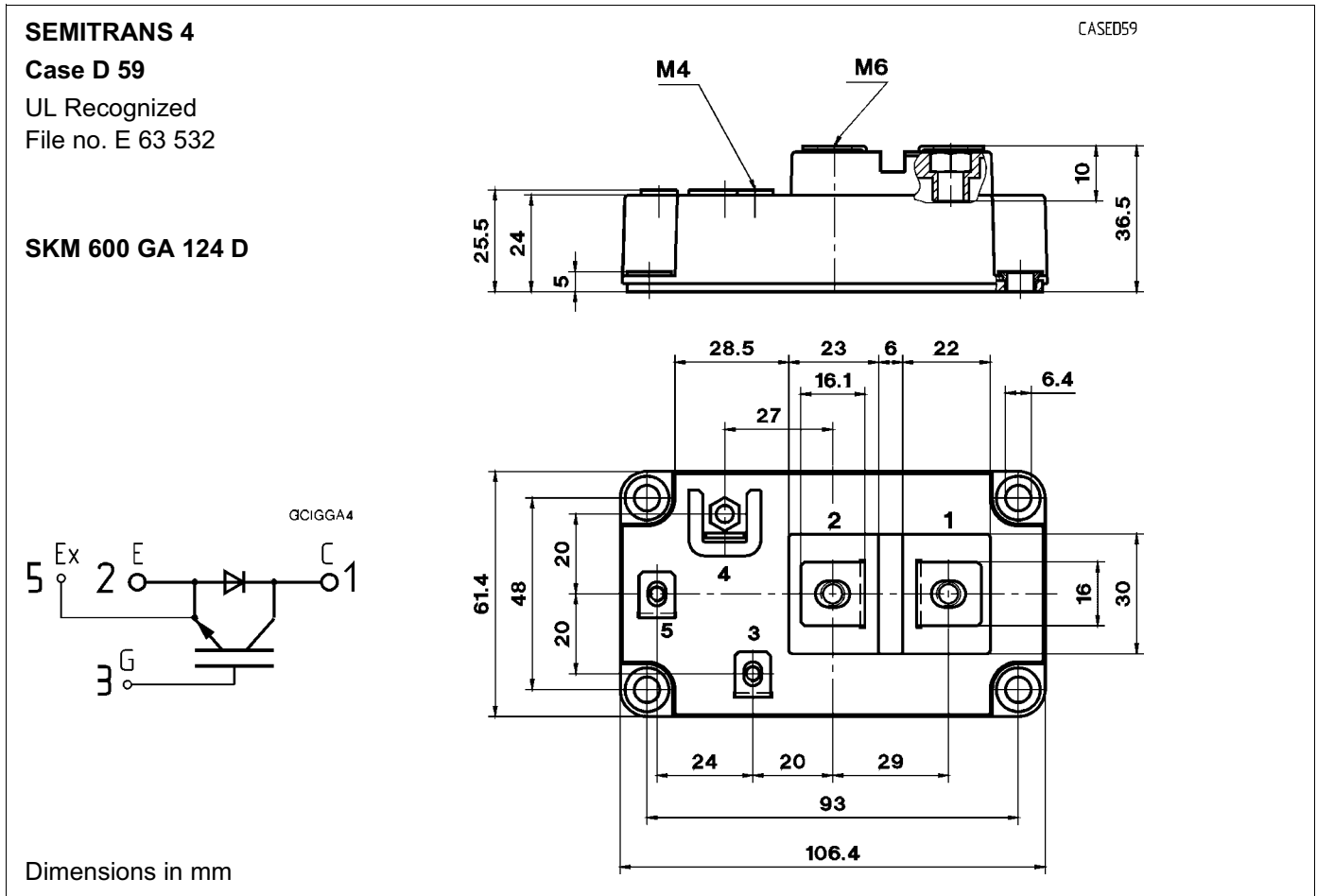
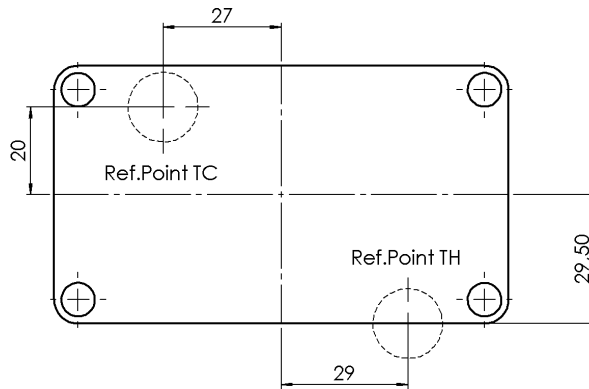


Fig. 24 Typ. CAL diode recovered charge
 $Q_{RR} = f(di_F/dt; I_F; R_G)$



Case outline and circuit diagram



Mechanical Data			Values			Units
Symbol	Conditions		min.	typ.	max.	
M ₁	to heatsink, SI Units to heatsink, US Units	(M6)	3 27	—	5 44	Nm lb.in.
M ₂	for terminals, SI Units for terminals, US Units	(M6/M4)	2,5/1,1 22/10	—	5/2 44/18	Nm 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)

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