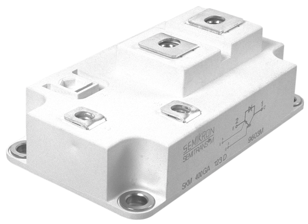
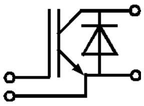
SEMITRANS® M Low Loss IGBT Modules

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)

Absolute Maximum Ratings

Symbol	Conditions [1]	Values	Units
V_{CES}		1200	V
V_{CGR}	R_{GE} = 20 kΩ	1200	V
I_C	T_{case} = 25/80 °C	700 / 600 [4]	A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	1400 / 1200	A
V_{GES}		± 20	V
P_{tot}	per IGBT, T_{case} = 25 °C	4000	W
T_j, (T_{stg})		–40 ... +150 (125)	°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 °C	700 / 500	A
$I_{FM} = -I_{CM}$	T_{case} = 25/80 °C; t_p = 1 ms	1400 / 1200	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	5000	A
I^2t	t_p = 10 ms; T_j = 150 °C	125000	A^2s

Characteristics

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

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[1] T_{case} = 25 °C, unless otherwise specified

[2] I_F = – I_C, V_R = 600 V, –di_F/dt = 4000 A/µs, V_{GE} = 0 V

[3] Use V_{GEoff} = – 5 ... – 15 V

[4] Limited by terminals to I_{DC} = 500 A for $T_{terminal}$ = 100 °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.

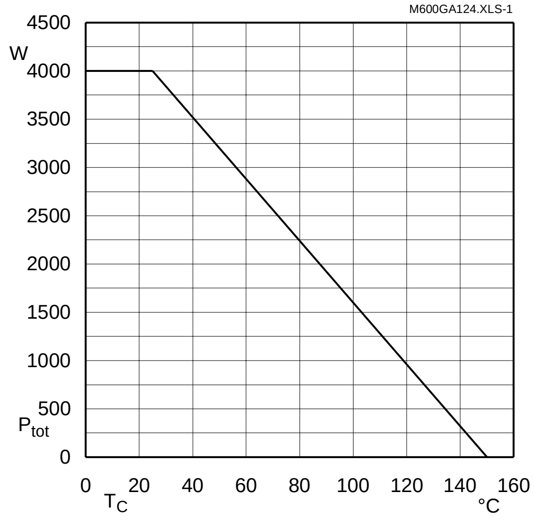
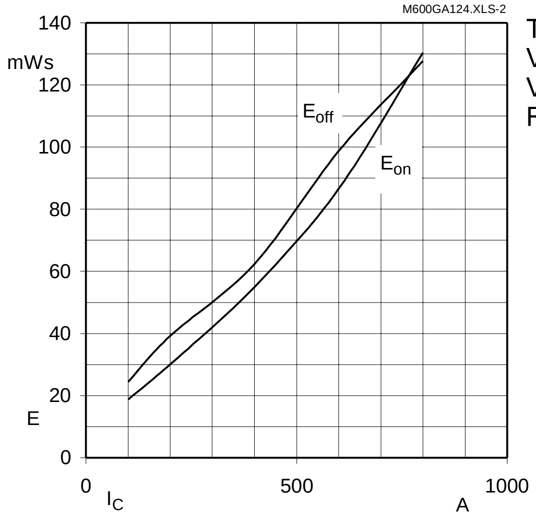
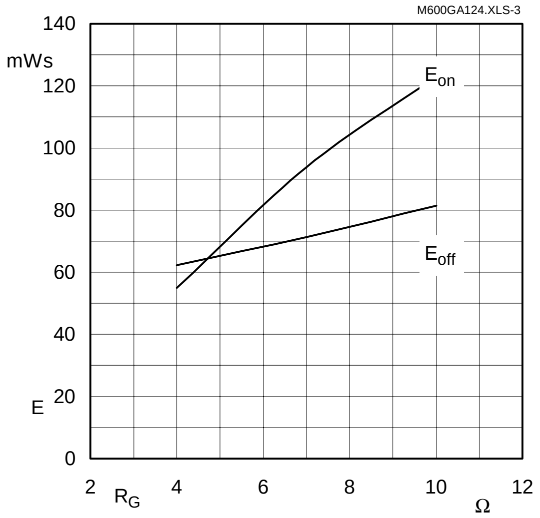


Fig. 1 Rated power dissipation P_{tot} = f (T_C)



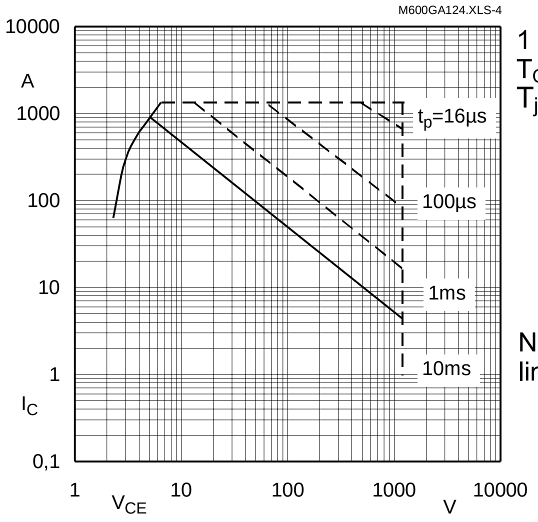
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 4 Ω

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 400 A

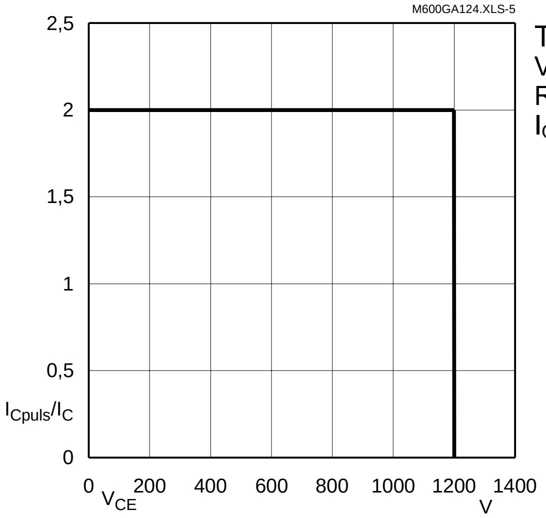
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
T_j ≤ 150 °C

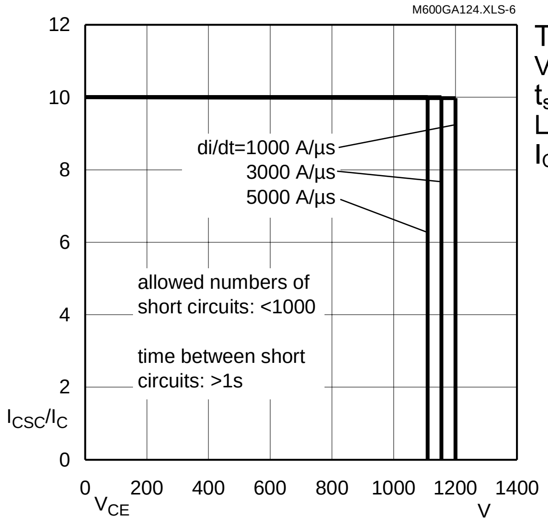
Not for linear use

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



T_j ≤ 150 °C
V_{GE} = ± 15 V
R_{Goff} = 4 Ω
I_C = 600 A

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



T_j ≤ 150 °C
V_{GE} = ± 15 V
t_{sc} ≤ 10 µs
L < 20 nH
I_C = 600 A

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

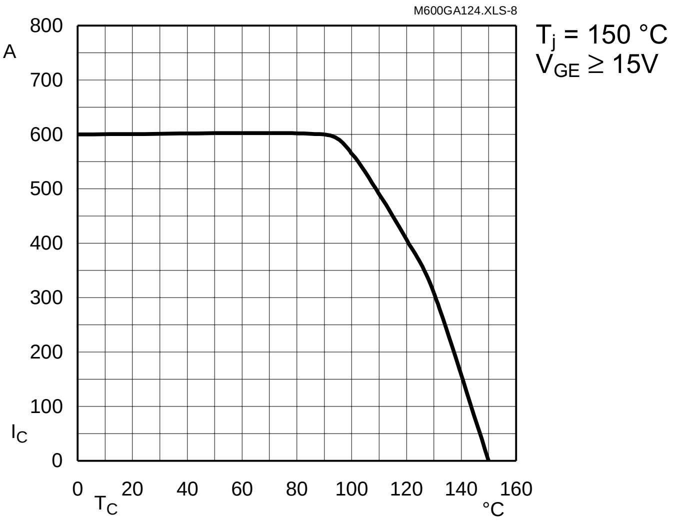


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

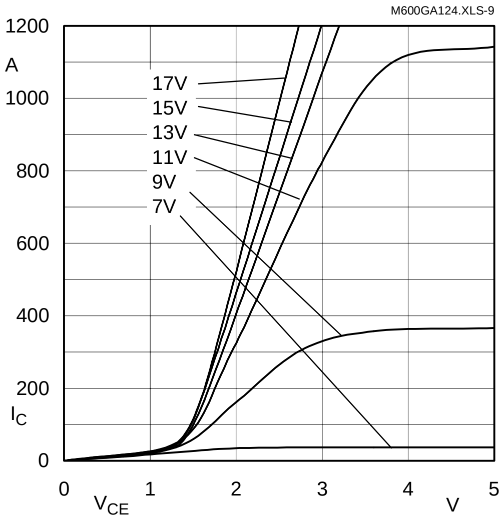


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

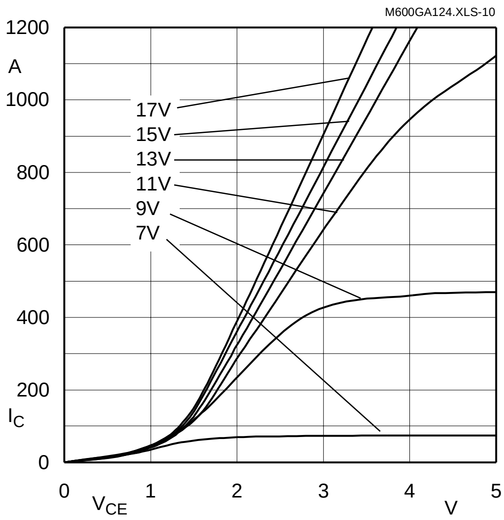


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

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

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

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

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

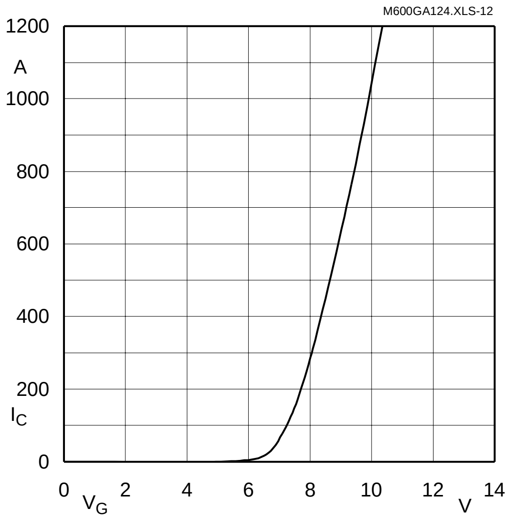
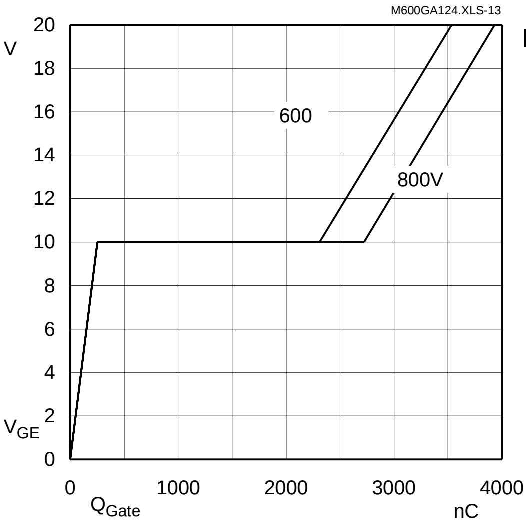
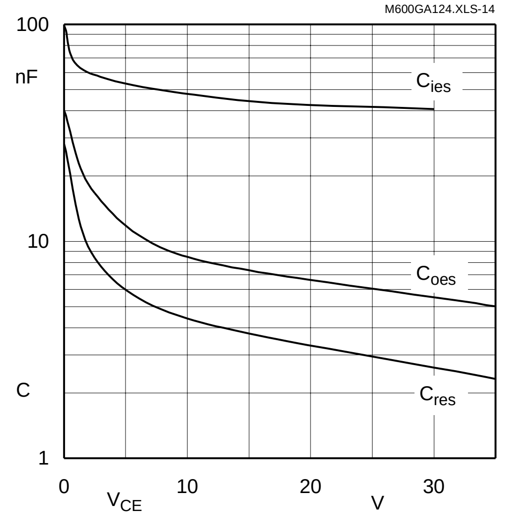


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



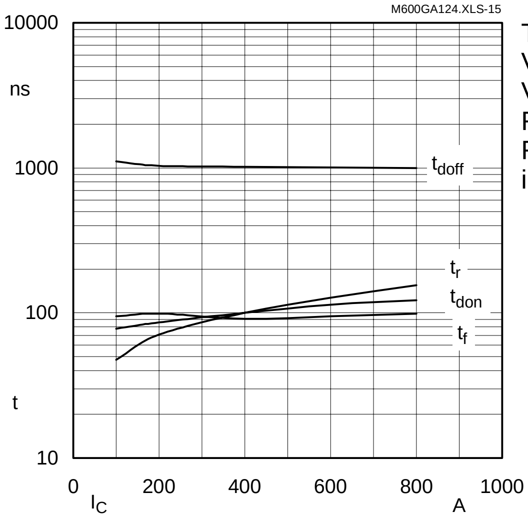
I_{Cpuls} = 400 A

Fig. 13 Typ. gate charge characteristic



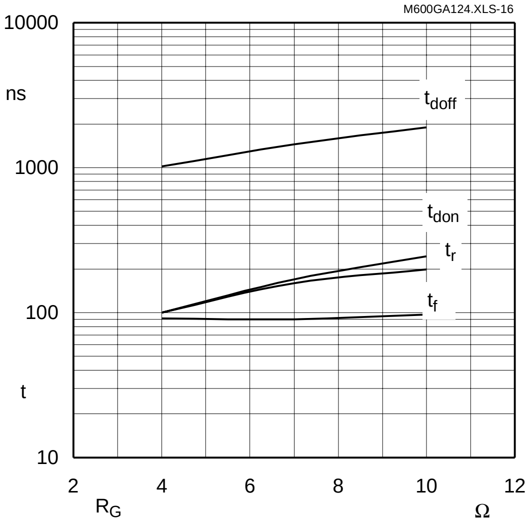
V_{GE} = 0 V
f = 1 MHz

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{Gon} = 4 Ω
R_{Goff} = 4 Ω
induct. load

Fig. 15 Typ. switching times vs. I_C



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 400 A
induct. load

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

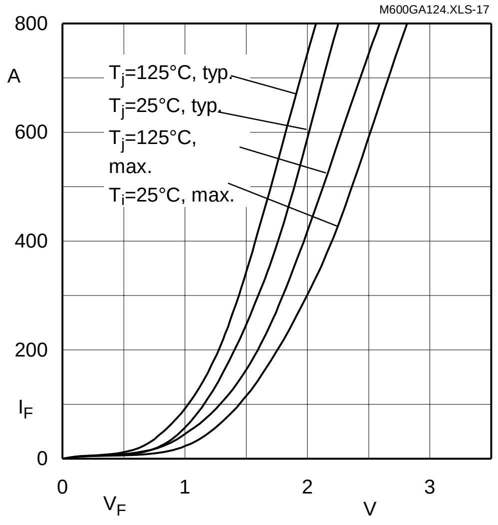
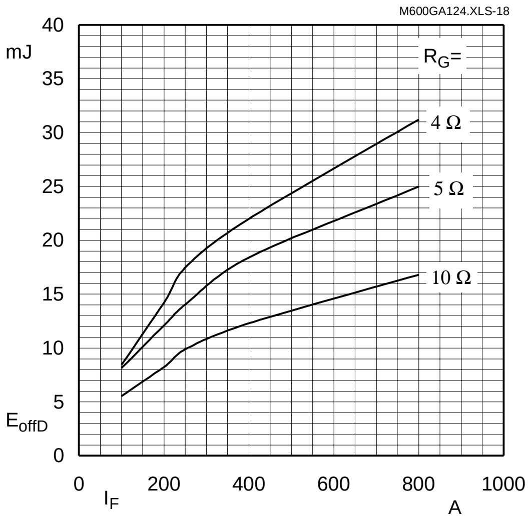


Fig. 17 Typ. CAL diode forward characteristic



V_{CC} = 600 V
T_j = 125 °C
V_{GE} = ± 15 V

Fig. 18 Diode turn-off energy dissipation per pulse

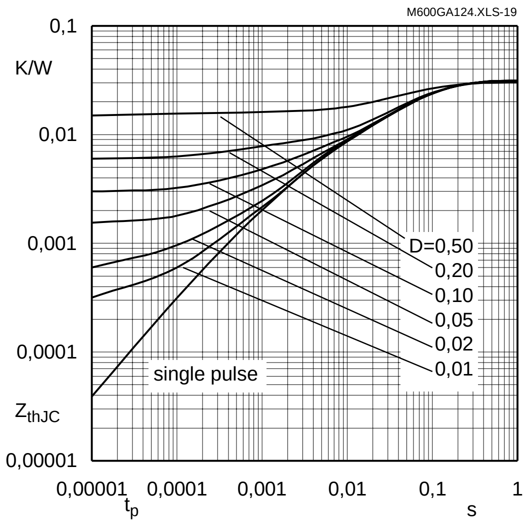


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

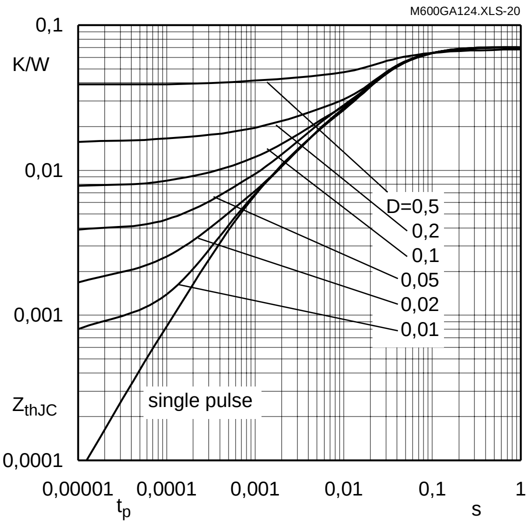
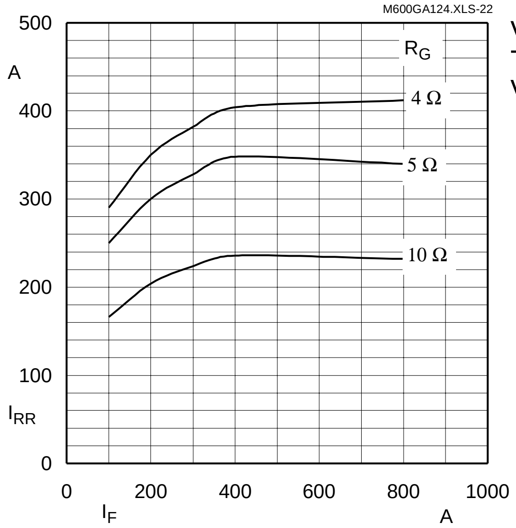
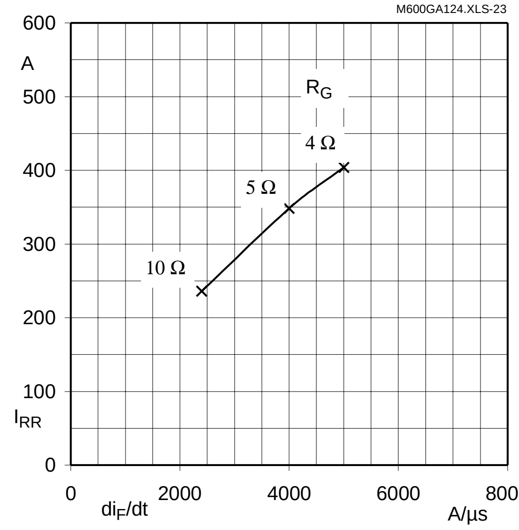


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$



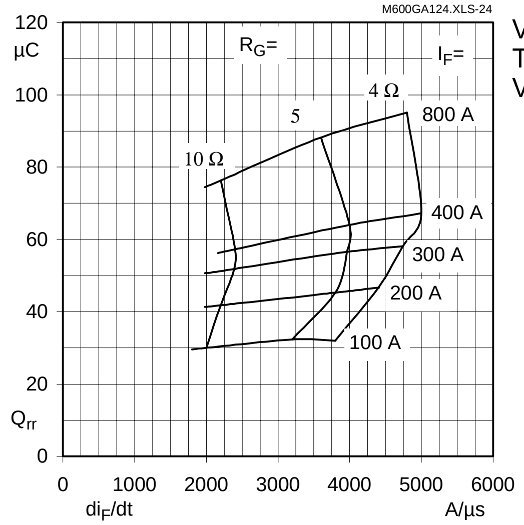
V_{CC} = 600 V
T_j = 125 °C
V_{GE} = ± 15 V

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



V_{CC} = 600 V
T_j = 125 °C
V_{GE} = ± 15 V
I_F = 400 A

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



V_{CC} = 600 V
T_j = 125 °C
V_{GE} = ± 15 V

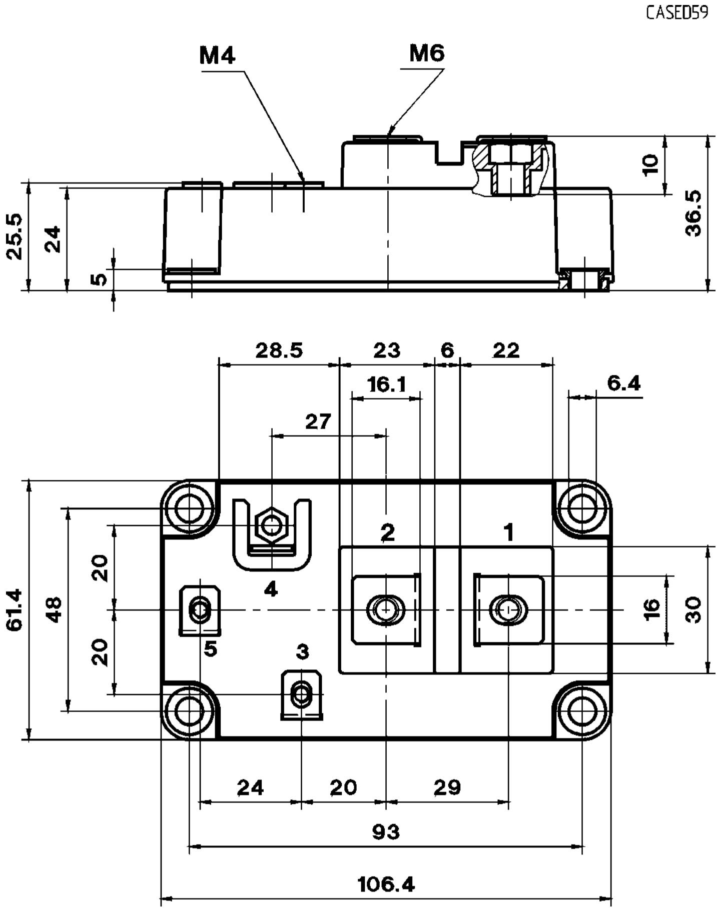
Fig. 24 Typ. CAL diode recovered charge $Q_{RR} = f(di_F/dt; I_F; R_G)$

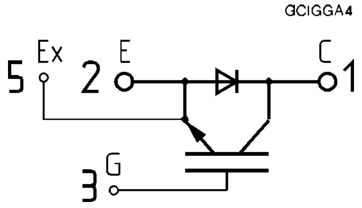
SEMITRANS 4

Case D 59

UL Recognized
File no. E 63 532

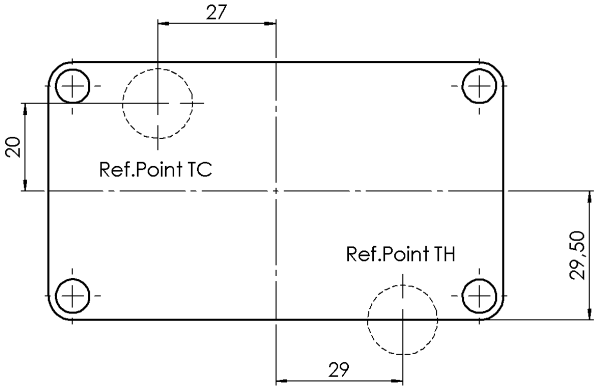
SKM 600 GA 124 D





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)