Absolute Maximum Ratings

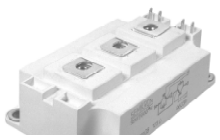
Symbol	Conditions [1]	Values	Units
V_{CES}		1200	V
V_{CGR}	R_{GE} = 20 kΩ	1200	V
I_C	T_{case} = 25/80 °C	570 / 400	A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	1140 / 800	A
V_{GES}		± 20	V
P_{tot}	per IGBT, T_{case} = 25 °C	2500	W
T_j, (T_{stg})		–40 ... +150 (125)	°C
V_{isol}	AC, 1 min.	2500	V
humidity	DIN 40040	Class F	
climate	DIN IEC 68 T.1	40/125/56	
Inverse Diode; Free-wheeling Diode FWD			
$I_F = -I_C$	T_{case} = 25/80 °C	390 / 260	A
$I_{FM} = -I_{CM}$	T_{case} = 25/80 °C; t_p = 1 ms	1140 / 800	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	2900	A
I^2t	t_p = 10 ms; T_j = 150 °C	42 000	A^2s

Characteristics

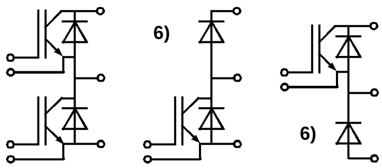
Symbol	Conditions [1]	min.	typ.	max.	Units
$V_{(BR)CES}$	V_{GE} = 0, I_C = 4 mA	≥ V_{CES}	–	–	V
$V_{GE(th)}$	$V_{GE} = V_{CE}$, I_C = 12 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0, $V_{CE} = V_{CES}$; T_j = 25 °C	–	8	14	mA
	V_{GE} = 0, $V_{CE} = V_{CES}$; T_j = 125 °C	–	24	–	mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	0,35	µA
V_{CEsat}	I_C = 300 A; V_{GE} = 15 V; T_j = 25 (125) °C	–	2,1(2,4)	2,45(2,85)	V
V_{CEsat}	I_C = 400 A; V_{GE} = 15 V; T_j = 25 (125) °C	–	2,5(3,0)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 300 A	110	–	–	S
C_{CHC}	per IGBT	–	–	700	pF
C_{ies}	V_{GE} = 0; V_{CE} = 25 V; f = 1 MHz	–	22	30	nF
C_{oes}		–	3,3	4	nF
C_{res}		–	1,2	1,6	nF
L_{CE}		–	–	20	nH
$t_{d(on)}$	V_{CC} = 600 V; V_{GE} = –15 V / +15 V[3]; I_C = 300 A, ind. load; $R_{Gon} = R_{Goff}$ = 5 Ω; T_j = 125 °C	–	85	–	ns
t_r		–	65	–	ns
$t_{d(off)}$		–	680	–	ns
t_f		–	56	–	ns
E_{on}		–	36	–	mWs
E_{off}		–	42	–	mWs
Inverse Diode and FWD of types "GAL", GAR" [8]					
$V_F = V_{EC}$	I_F = 300 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,0(1,8)	2,5	V
$V_F = V_{EC}$	I_F = 400 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,25(2,05)	–	V
V_{TO}	T_j = 125 °C [2]	–	1,1	1,2	V
r_t	T_j = 125 °C [2]	–	–	3,5	mΩ
I_{RRM}	I_F = 300 A; T_j = 125 °C[2]	–	136	–	A
Q_{rr}	I_F = 300 A; T_j = 125 °C[2]	–	36	–	µC
Thermal characteristics					
R_{thjc}	per IGBT	–	–	0,05	°C/W
R_{thjc}	per diode	–	–	0,125	°C/W
R_{thch}	per module	–	–	0,038	°C/W

SEMITRANS® M
Low Loss IGBT Modules

SKM 400 GB 124 D
SKM 400 GAL 124D [6]
SKM 400 GAR 124D [6]



SEMITRANS 3



GB **GAL** **GAR**

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 * I_{cnom}
- Latch-up free
- 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 → B 6 – 205

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

[1] T_{case} = 25 °C, unless otherwise specified
[2] $I_F = -I_C$, V_R = 600 V, $-di_F/dt$ = 2000 A/µs, V_{GE} = 0 V
[3] Use V_{GEoff} = –5... –15 V
[6] The free-wheeling diodes of the GAL and GAR types have the data of the inverse diodes of SKM 400 GB 124 D
[8] CAL = Controlled Axial Lifetime Technology.

Cases and mech. data
→ B 6 – 206

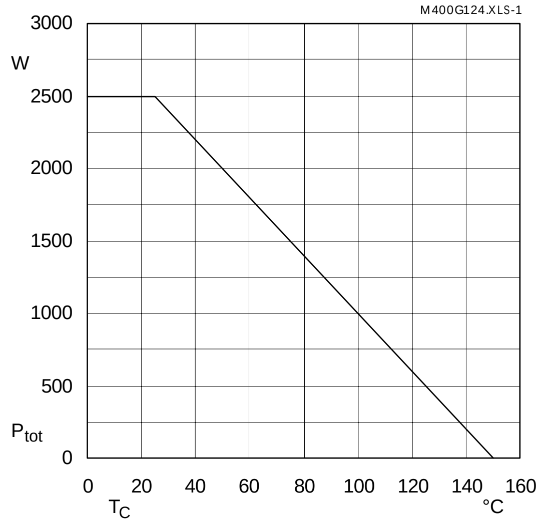


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$

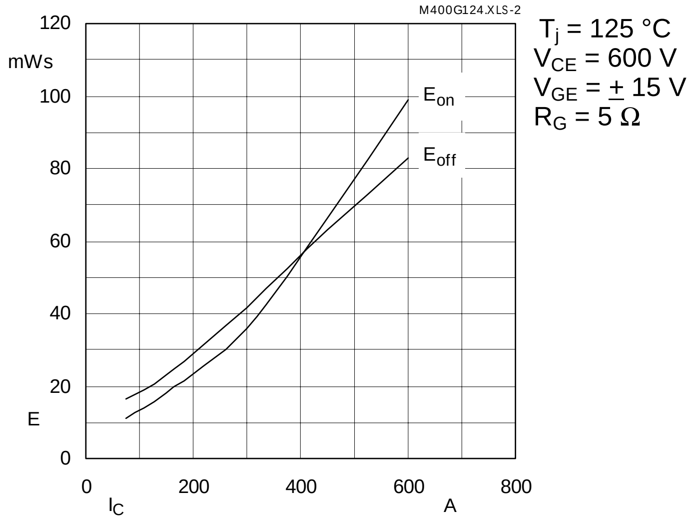


Fig. 2 Turn-on /-off energy = f (I_C)

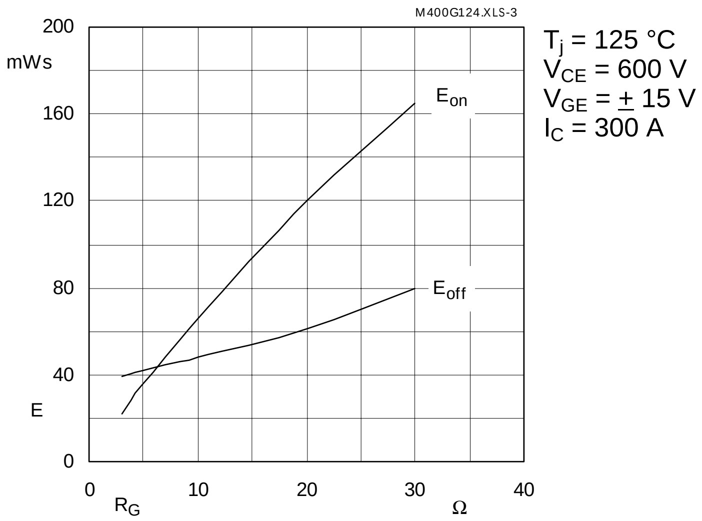


Fig. 3 Turn-on /-off energy = f (R_G)

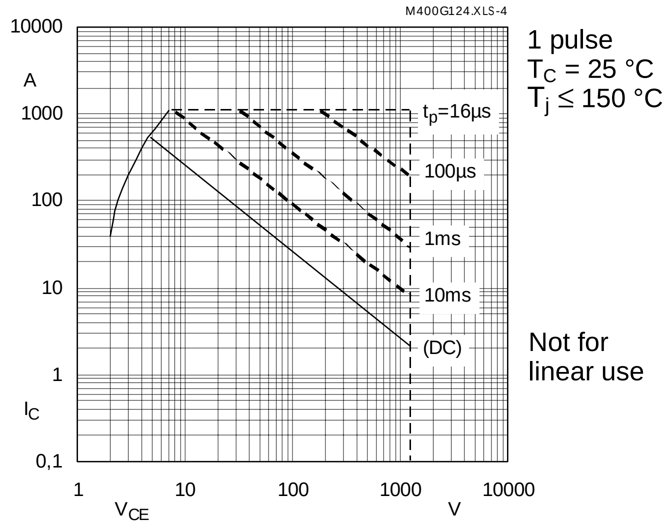


Fig. 4 Maximum safe operating area (SOA) $I_C = f(V_{CE})$

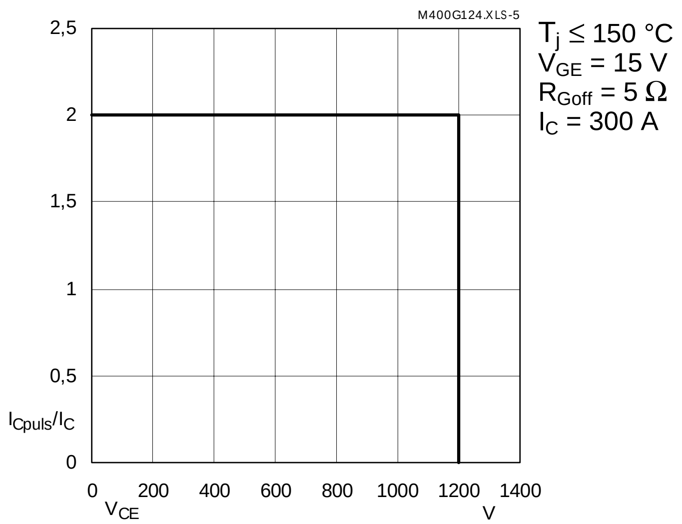


Fig. 5 Turn-off safe operating area (RBSOA)

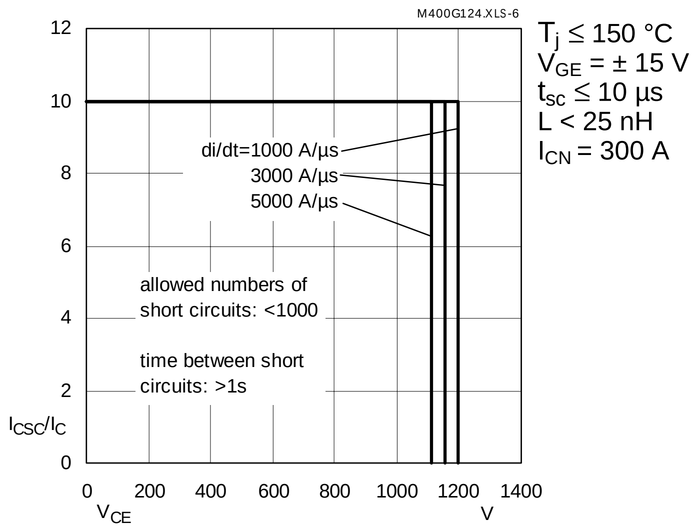


Fig. 6 Safe operating area at short circuit $I_C = f(V_{CE})$

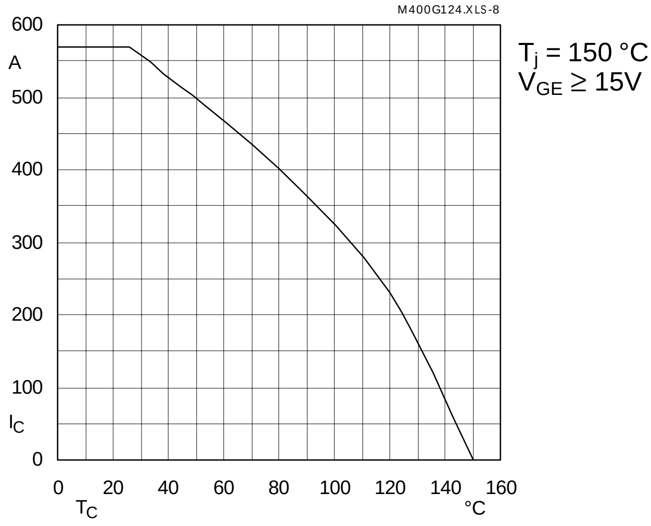


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

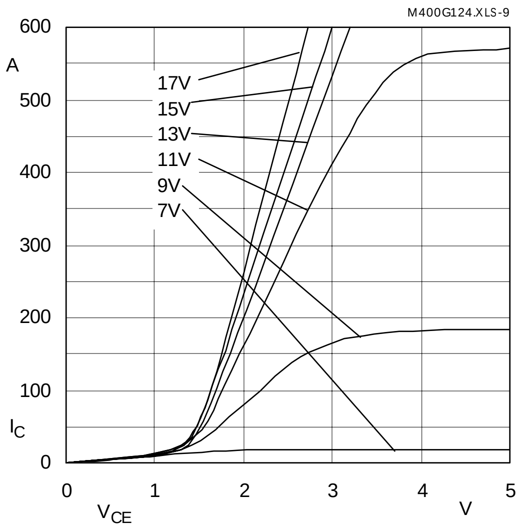


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

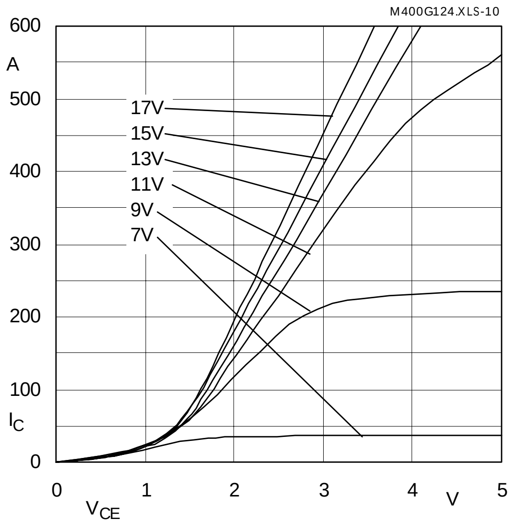


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

typ.: $r_{CE(Tj)} = 0{,}0027 + 0{,}000008\ (T_j - 25)$ [Ω]

max.: $r_{CE(Tj)} = 0{,}0038 + 0{,}000012\ (T_j - 25)$ [Ω]

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

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

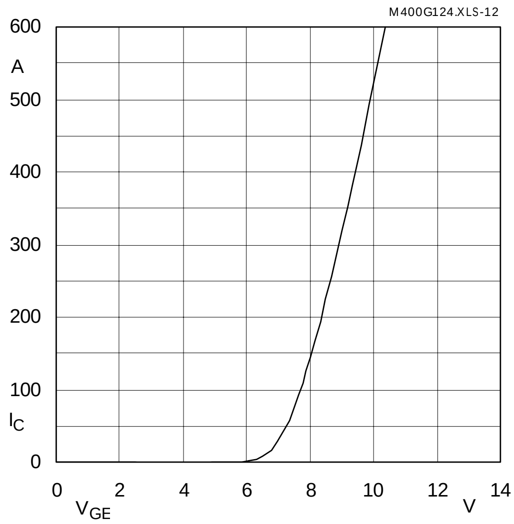


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V

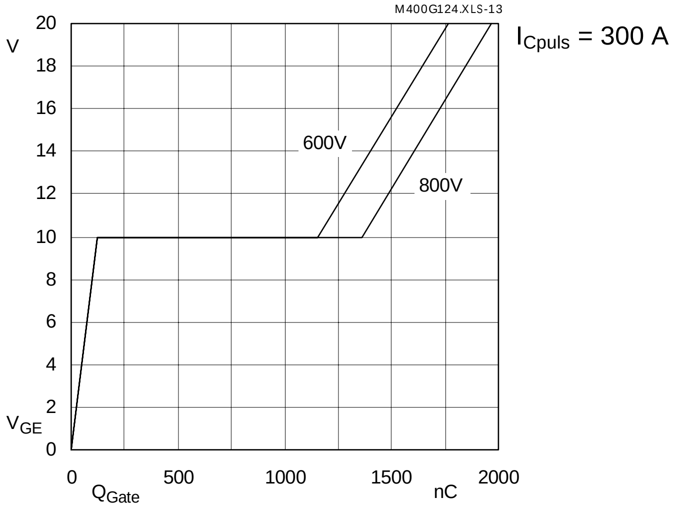


Fig. 13 Typ. gate charge characteristic

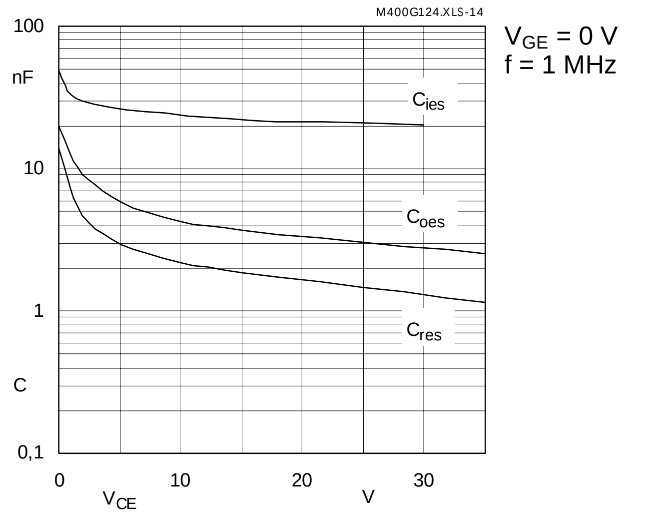


Fig. 14 Typ. capacitances vs.V_{CE}

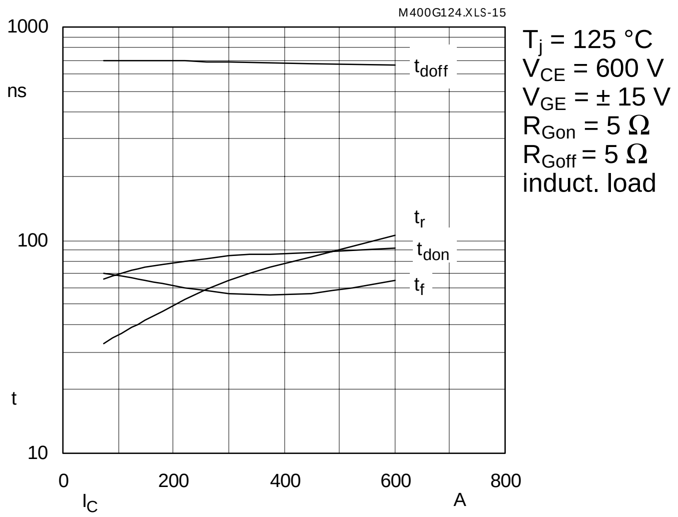


Fig. 15 Typ. switching times vs. I_C

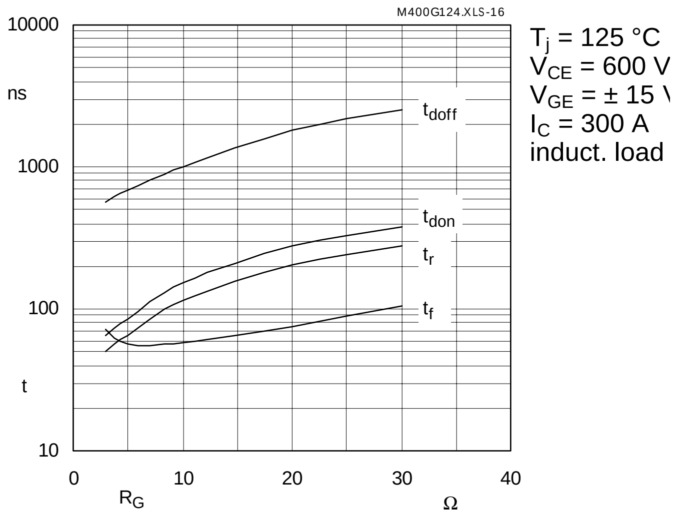


Fig. 16 Typ. switching times vs. gate resistor R_G

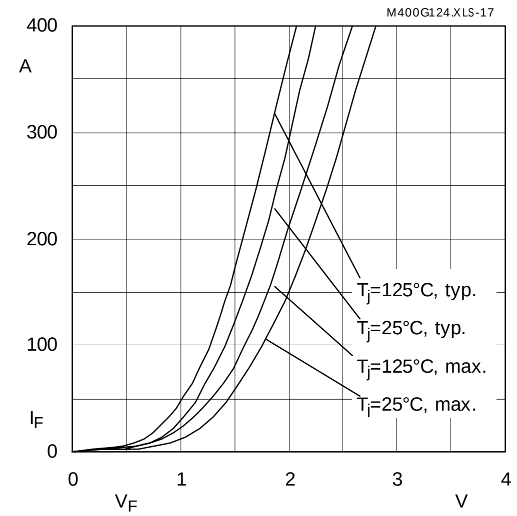


Fig. 17 Typ. CAL diode forward characteristic

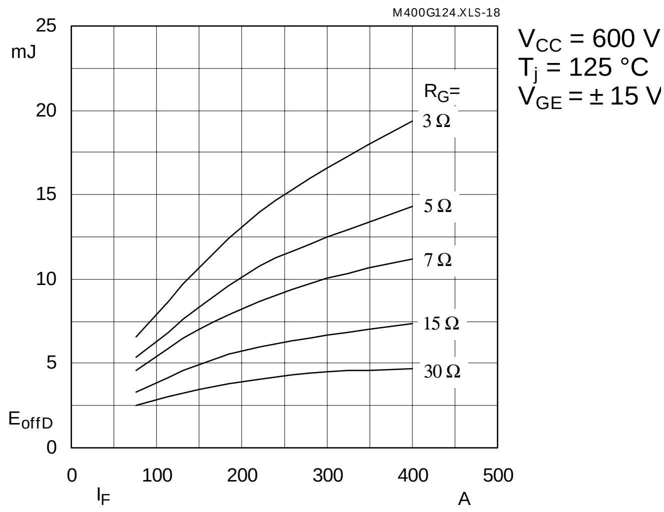


Fig. 18 Diode turn-off energy dissipation per pulse

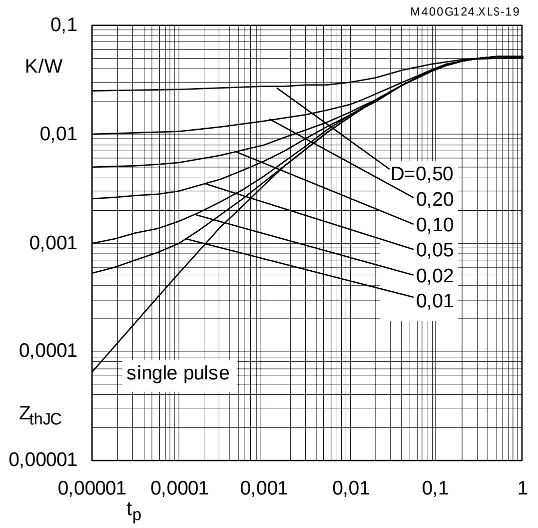


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

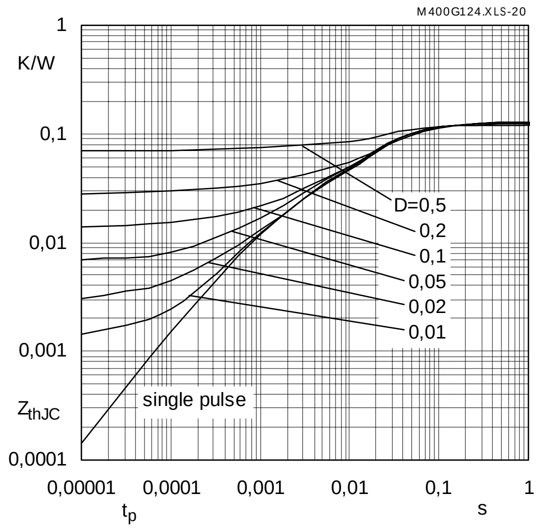


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

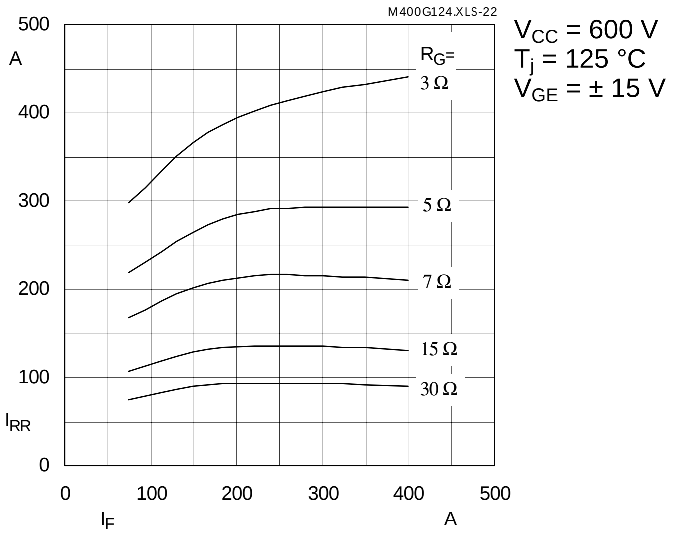


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

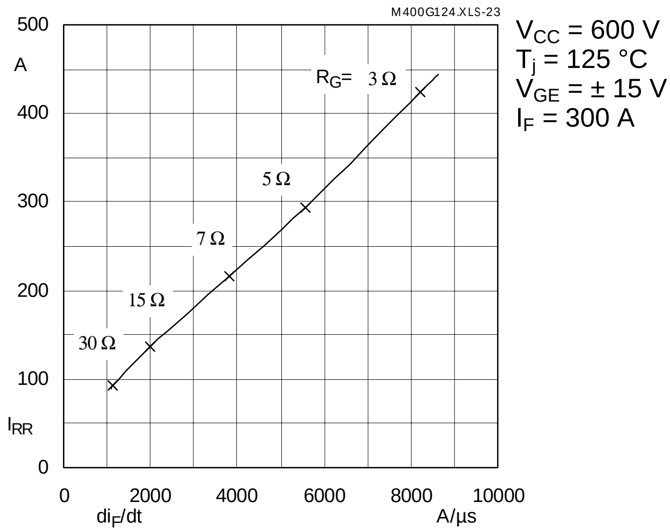


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di/dt)$

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

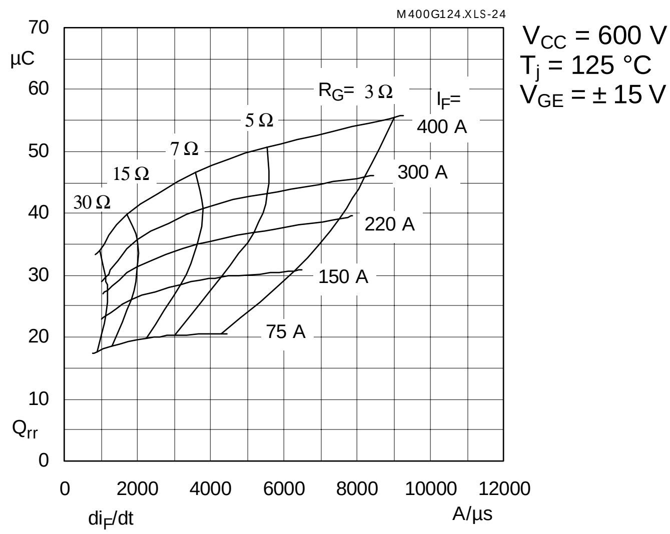
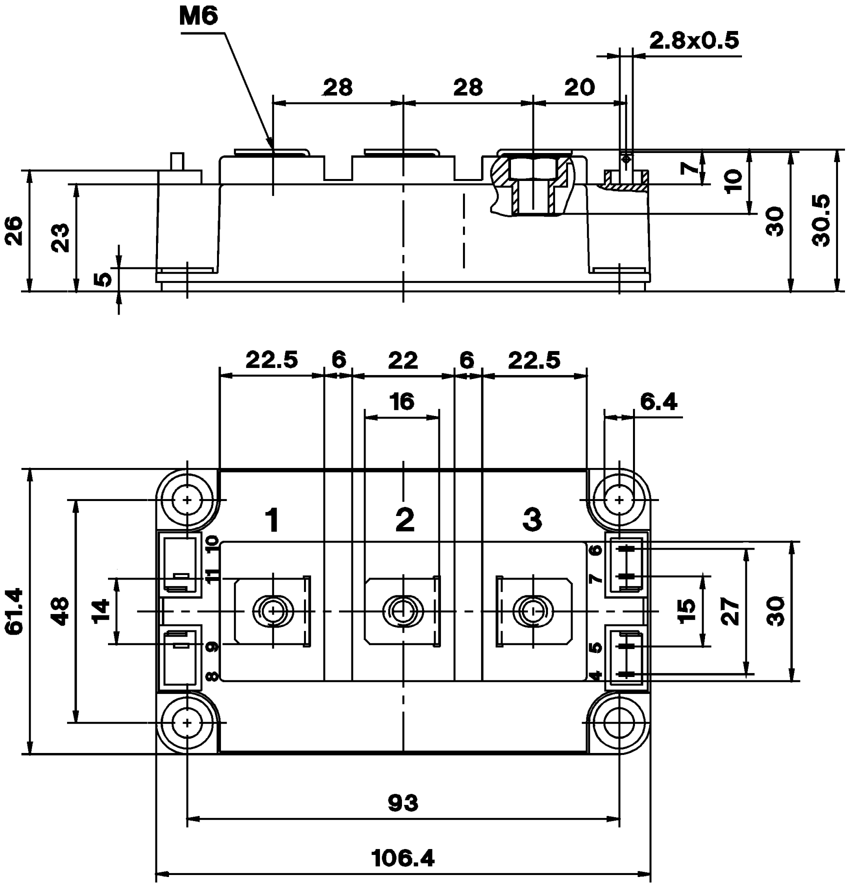


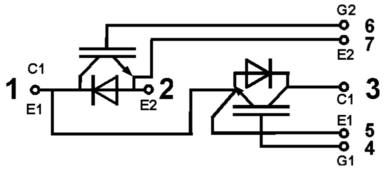
Fig. 24 Typ. CAL diode recovered charge

SEMITRANS 3

Case D 56
UL Recognized
File no. E 63 532



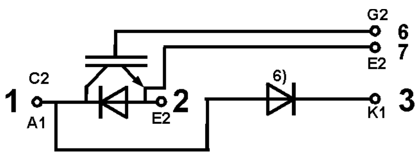
SKM 400 GB 124 D



Dimensions in mm

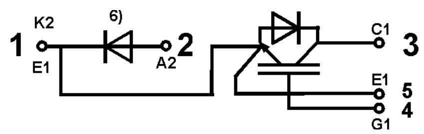
SKM 400 GAL 124 D

Case D 57 (→ D 56)



SKM 400 GAR 124 D

Case D 58 (→ D 56)



Case outline and circuit diagrams

Mechanical Data

Symbol	Conditions		Values min.	Values typ.	Values max.	Units
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)	2,5	–	5	Nm
	for terminals, US Units		22	–	44	lb.in.
a			–	–	5x9,81	m/s^2
w			-	-	325	g

[6] Freewheeling diode → B 6 – 201, remark 6.

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 → B 6 – 4.
SEMIBOX → C – 1.