

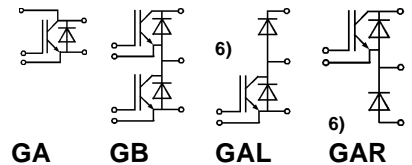
Absolute Maximum Ratings		Values	Units
Symbol	Conditions ¹⁾		
V _{CES}		600	V
V _{CGR}	R _{GE} = 20 kΩ	600	V
I _C	T _{case} = 25/60 °C	475 / 400	A
I _{CM}	T _{case} = 25/60 °C; t _p = 1 ms	950 / 800	A
V _{GES}		± 20	V
P _{tot}	per IGBT, T _{case} = 25 °C	1400	W
T _j , (T _{stg})		-40 ... +150 (125)	°C
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	400 / 270	A
I _{FM} = -I _{CM}	T _{case} = 25/80 °C; t _p = 1 ms	950 / 800	A
I _{FSM}	t _p = 10 ms; sin.; T _j = 150 °C	2800	A
I ² t	t _p = 10 ms; T _j = 150 °C	39 000	A ² s

SEMITRANS® M PT-IGBT Modules

SKM 400 GA 062 D ^{*)}
SKM 400 GB 062 D
SKM 400 GAL 062 D ⁶⁾
SKM 400 GAR 062 D ⁶⁾



SEMITRANS 3



Features

- N channel, epitaxial Silicon structure (PT- Punch-through IGBT)
- High short circuit capability, self limiting, if term. G is clamped to E
- Latch-up free, if clamped as above
- Fast & soft inverse CAL diodes ⁸⁾
- Isolated copper baseplate using DCB Direct Copper Bonding Technology without hard mould
- Large clearance (13 mm) and creepage distances (20 mm)

Typical Applications → B6 – 61

- Switching (not for linear use)
- Switched mode power supplies
- AC inverter drives
- UPS uninterruptable power supplies

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

²⁾ I_F = -I_C, V_R = 300 V, -di_F/dt = 2000 A/μs, V_{GE} = 0 V

³⁾ Use V_{GEoff} = -5... -15 V

⁶⁾ The free-wheeling diode of the GAL and GAR types have the data of the inverse diodes of SKM 400 GB 062 D

⁸⁾ CAL = Controlled Axial Lifetime Technology

Cases and mech. data → B6 – 62
^{*)}SEMITRANS4 → B6 – 168

Characteristics		min.	typ.	max.	Units
Symbol	Conditions ¹⁾				
V _{(BR)CES}	V _{GE} = 0, I _C = 4 mA	≥ V _{CES}	–	–	V
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 9 mA	4,5	5,5	6,5	V
I _{CES}	V _{GE} = 0 } T _j = 25 °C V _{CE} = V _{CES} } T _j = 125 °C	–	5	12	mA
I _{GES}	V _{GE} = 20 V, V _{CE} = 0	–	–	1	μA
V _{CESat}	I _C = 400 A } V _{GE} = 15 V; T _j = 25 (125) °C }	–	2,3(2,2)	2,55(2,65)	V
g _{fs}	V _{CE} = 20 V, I _C = 400 A	80	–	–	S
C _{CHC}	per IGBT	–	–	700	pF
C _{ies}	V _{GE} = 0	–	22	–	nF
C _{oes}	V _{CE} = 25 V	–	2,5	–	nF
C _{res}	f = 1 MHz	–	1,5	–	nF
L _{CCE}		–	–	20	nH
t _{d(on)}	V _{CC} = 300 V	–	180	–	ns
t _r	V _{GE} = -15 V / +15 V ³⁾	–	120	–	ns
t _{d(off)}	I _C = 400 A, ind. load	–	600	–	ns
t _f	R _{Gon} = R _{Goff} = 5 Ω	–	180	–	ns
E _{on}	T _j = 125 °C	–	22	–	mWs
E _{off}		–	40	–	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 }	–	1,5(1,4)	1,65(1,6)	V
V _F = V _{EC}	I _F = 400 A } V _{GE} = 0 V; T _j = 25 (125) °C }	–	1,6(1,6)	1,8(1,8)	V
V _{TO}	T _j = 125 °C	–	–	0,9	V
r _t	T _j = 125 °C	–	–	3	mΩ
I _{RRM}	I _F = 400 A; T _j = 125 °C ²⁾	–	140	–	A
Q _{rr}	I _F = 400 A; T _j = 125 °C ²⁾	–	19	–	μC
Thermal characteristics					
R _{thjc}	per IGBT	–	–	0,09	°C/W
R _{thjc}	per diode	–	–	0,15	°C/W
R _{thch}	per module	–	–	0,038	°C/W

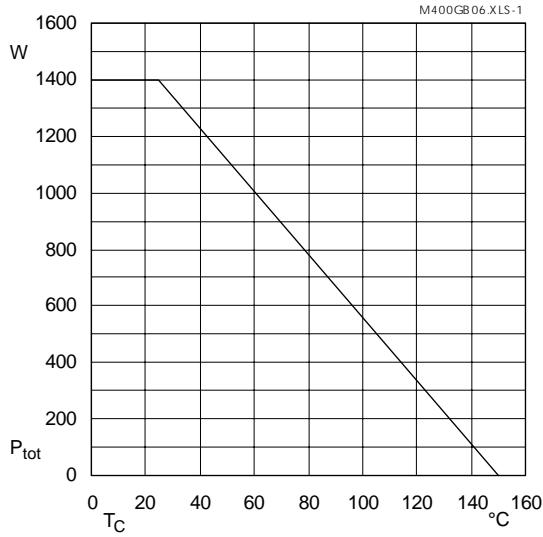


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$

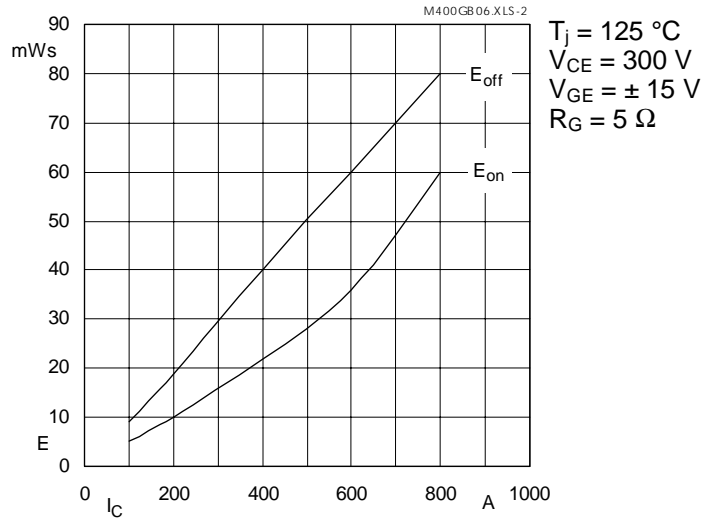


Fig. 2 Turn-on /-off energy $= f(I_C)$

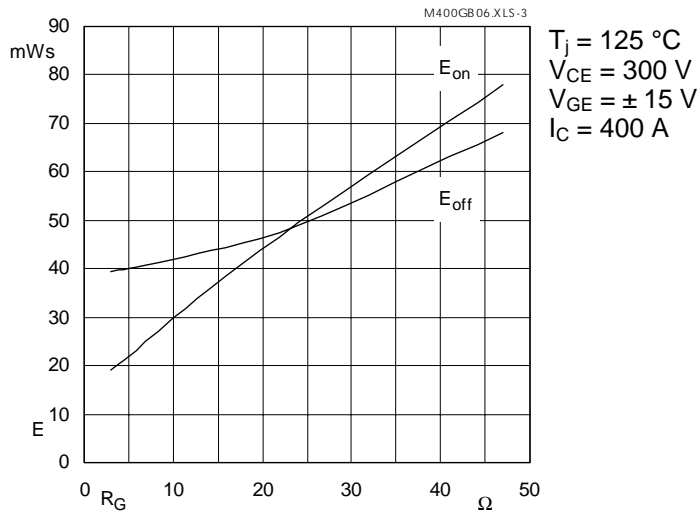


Fig. 3 Turn-on /-off energy $= f(R_G)$

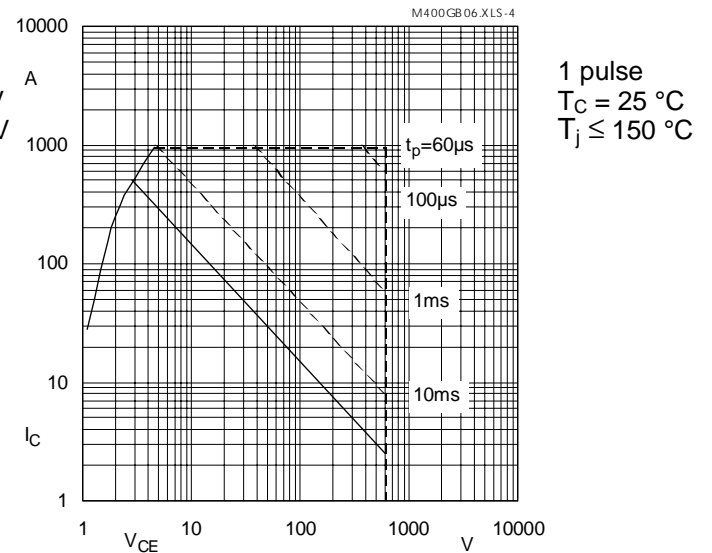


Fig. 4 Maximum safe operating area (SOA) $I_C = f(V_{CE})$

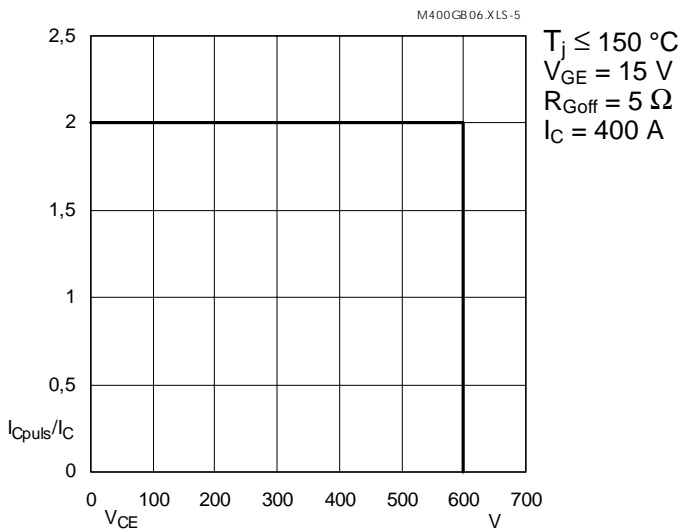


Fig. 5 Turn-off safe operating area (RBSOA)

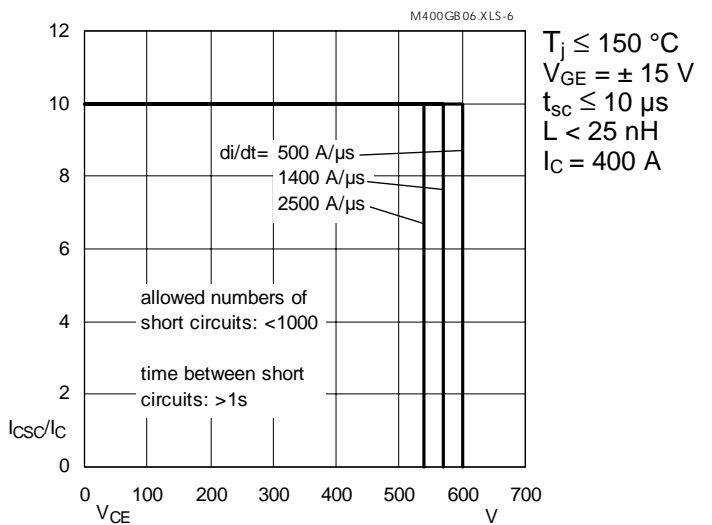


Fig. 6 Safe operating area at short circuit $I_C = f(V_{CE})$

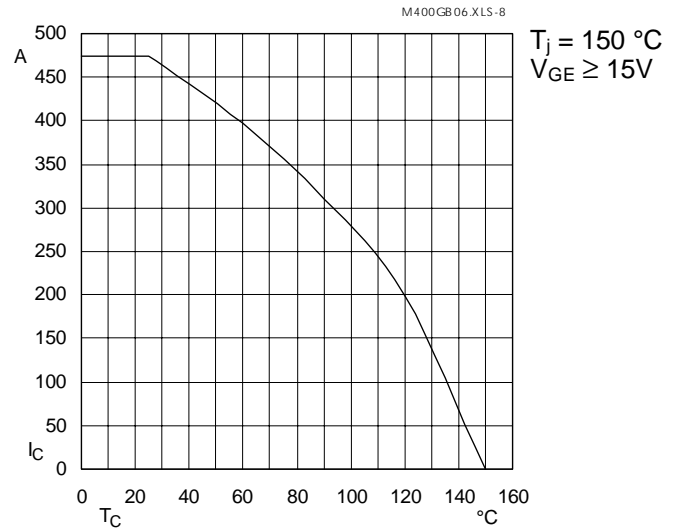


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

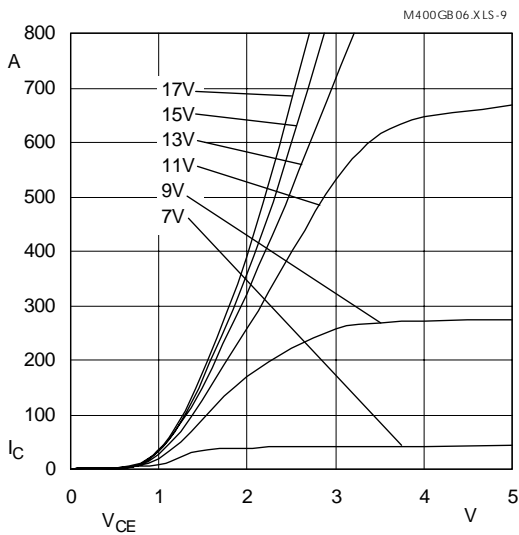


Fig. 9 Typ. output characteristic, $t_p = 250 \mu s$; $25 \text{ }^\circ\text{C}$

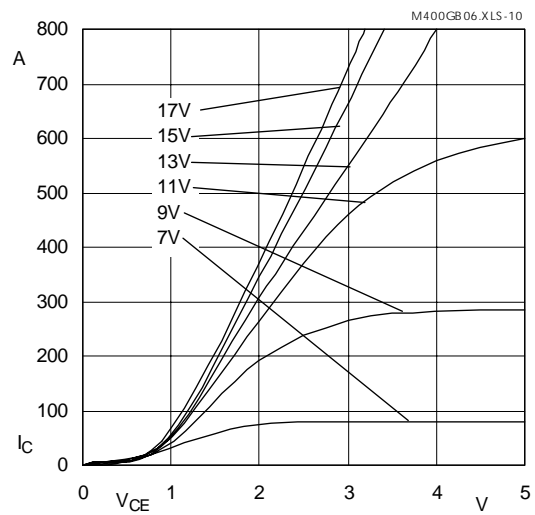


Fig. 10 Typ. output characteristic, $t_p = 250 \mu s$; $125 \text{ }^\circ\text{C}$

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

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

$$V_{\text{CE(TO)(Tj)}} \leq 1,3 - 0,003 (T_j - 25) \text{ [V]}$$

$$\text{typ.: } r_{\text{CE(Tj)}} = 0,0025 + 0,000005 (T_j - 25) \text{ [\Omega]}$$

$$\text{max.: } r_{\text{CE(Tj)}} = 0,0031 + 0,000010 (T_j - 25) \text{ [\Omega]}$$

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

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

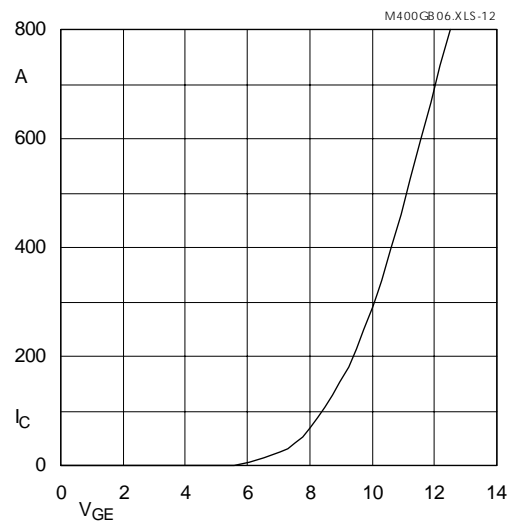


Fig. 12 Typ. transfer characteristic, $t_p = 250 \mu s$; $V_{\text{CE}} = 20 \text{ V}$

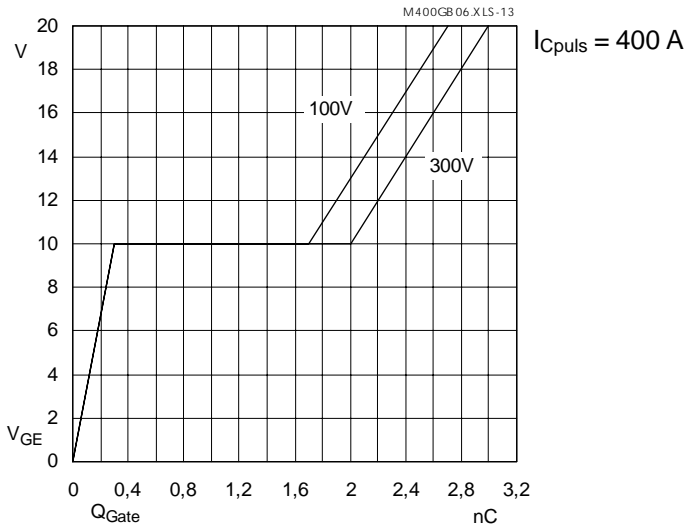


Fig. 13 Typ. gate charge characteristic

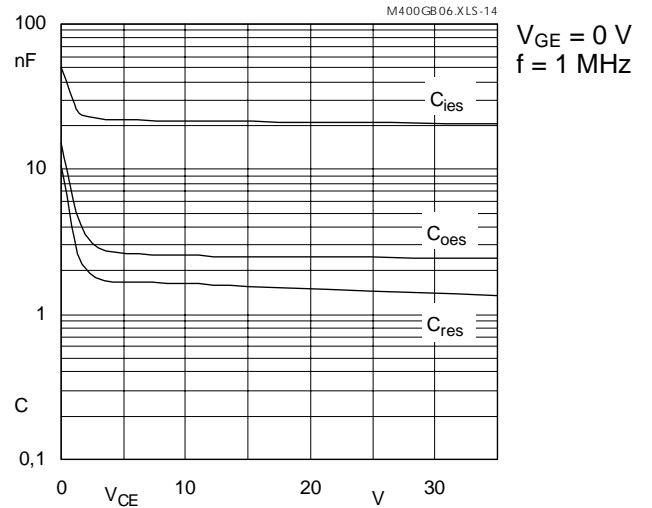


Fig. 14 Typ. capacitances vs. V_{CE}

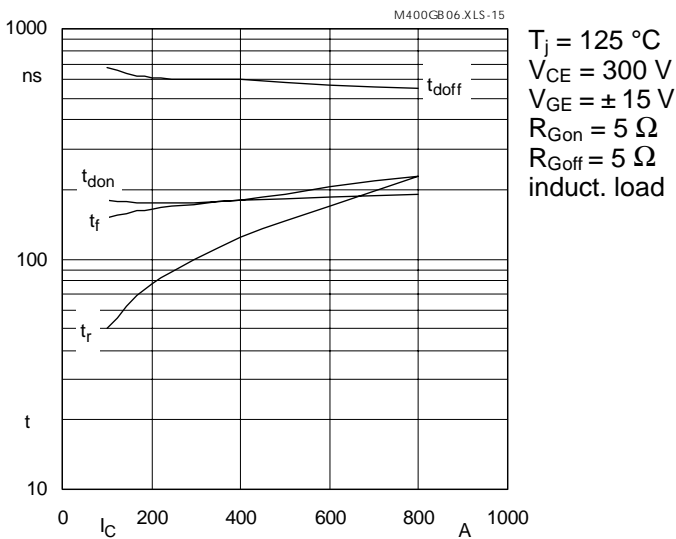


Fig. 15 Typ. switching times vs. I_C

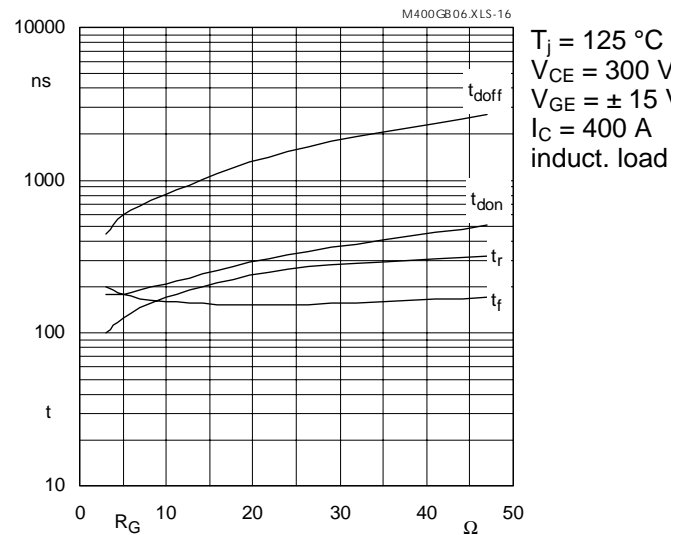


Fig. 16 Typ. switching times vs. gate resistor R_G

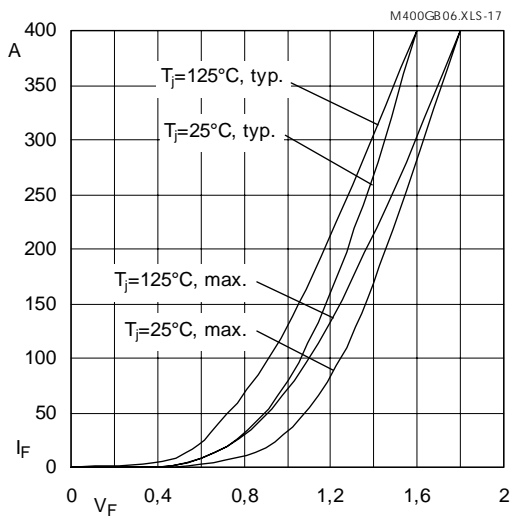


Fig. 17 Typ. CAL diode forward characteristic

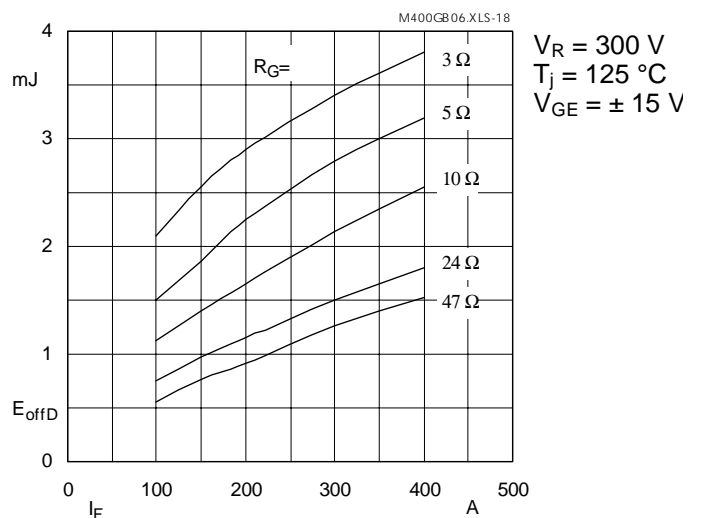


Fig. 18 Diode turn-off energy dissipation per pulse

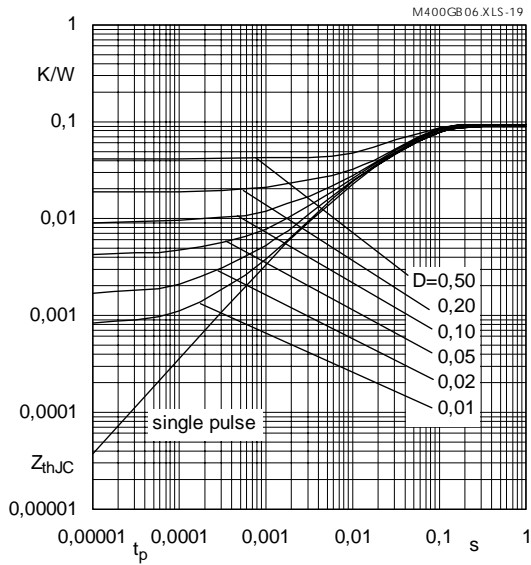


Fig. 19 Transient thermal impedance of IGBT
 $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

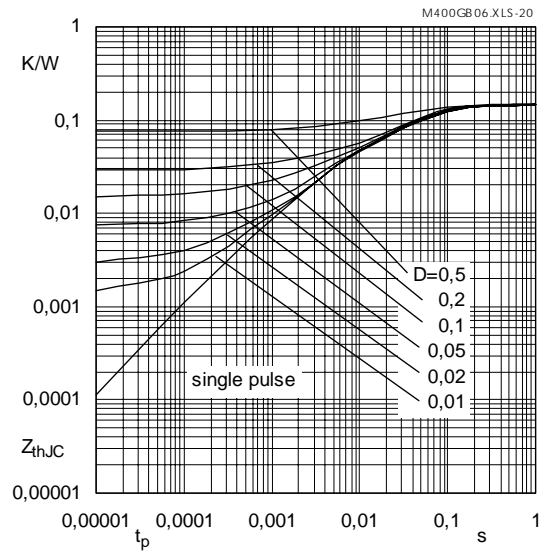


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

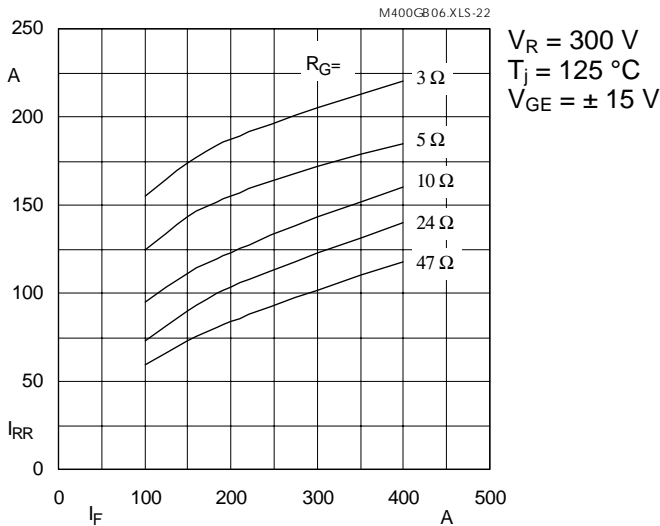


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

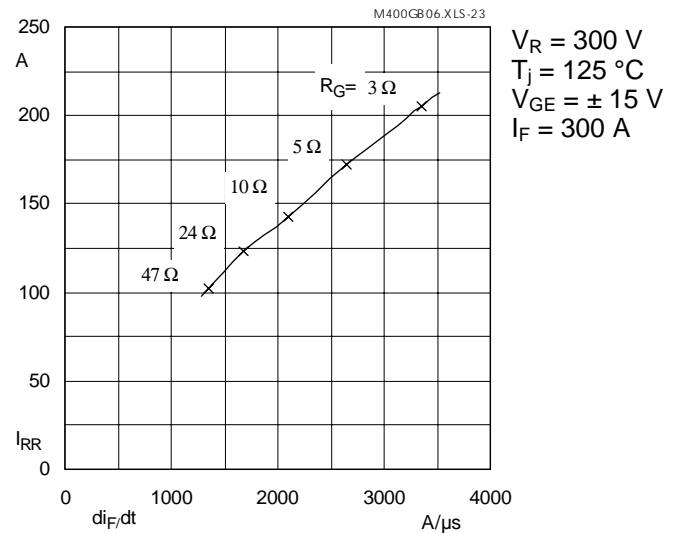


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di_F/dt)$

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

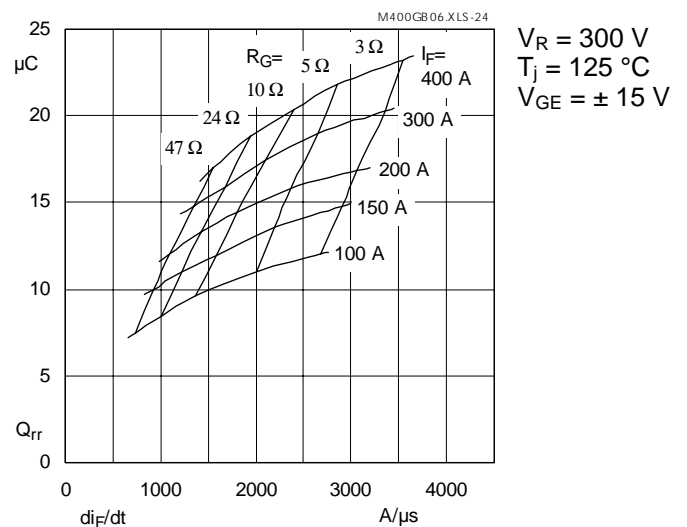


Fig. 24 Typ. CAL diode recovered charge

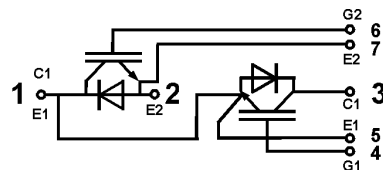
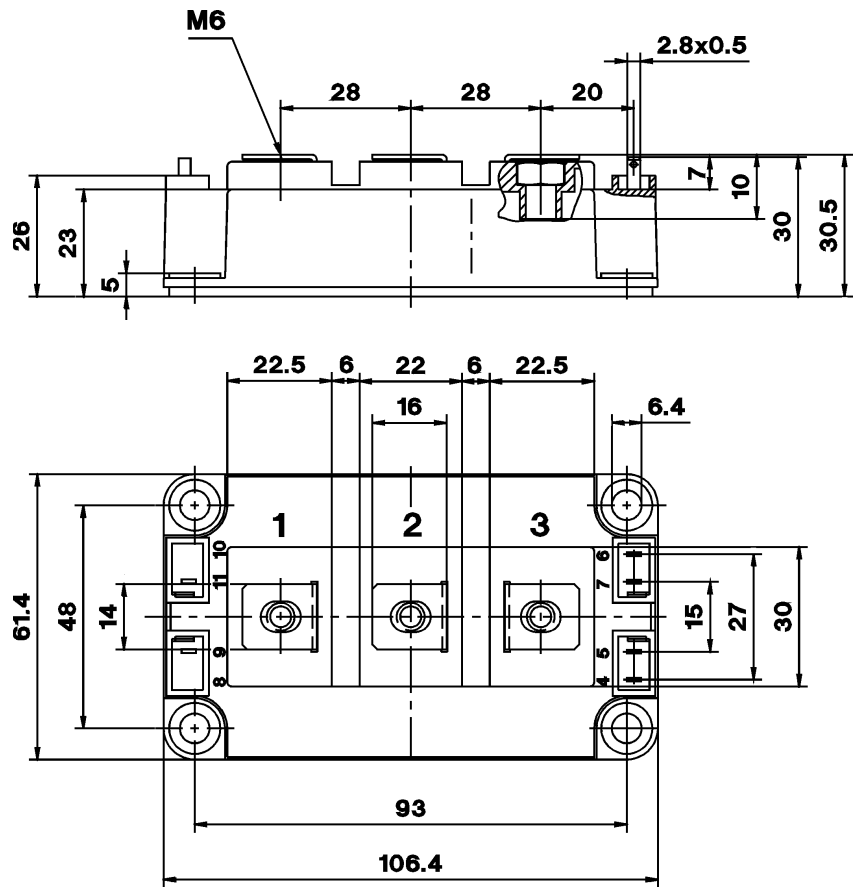
SEMITRANS 3

Case D 56

UL Recognized

File no. E 63 532

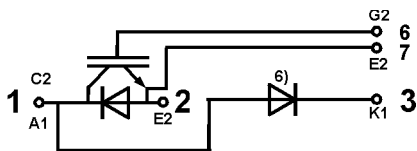
SKM 400 GB 062 D



Dimensions in mm

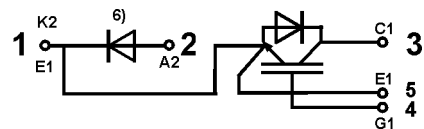
SKM 400 GAL 062 D

Case D 57 (→ D 56)



SKM 400 GAR 062 D

Case D 58 (→ D 56)



Case outline and circuit diagrams

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)	2,5	—	5	Nm
	for terminals, US Units	22	—	44	lb.in.
a		—	—	5x9,81	m/s ²
w		—	—	330	g

⁶⁾ Freewheeling diode → B 6 – 57, 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.