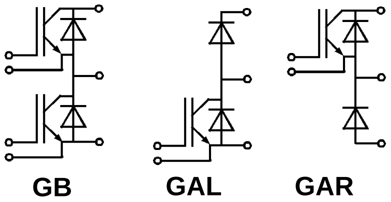
SEMITRANS® M Superfast NPT-IGBT Modules

SKM 300 GB 063 D
SKM 300 GAR 063 D
SKM 300 GAL 063 D

Absolute Maximum Ratings **Symbol**	**Conditions** [1]	**Values**		**Units**
V_{CES}		600		V
V_{CGR}	R_{GE} = 20 kΩ	600		V
I_C	T_{case} = 25/70 °C	400 / 300		A
I_{CM}	T_{case} = 25/70 °C; t_p = 1 ms	450 / 450		A
V_{GES}		± 20		V
P_{tot}	per IGBT, T_{case} = 25 °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			FWD	
$I_F = –I_C$	T_{case} = 25/80 °C	250 / 170	400 / 270	A
$I_{FM} = –I_{CM}$	T_{case} = 25/80 °C; t_p = 1 ms	450 / 450	450 / 450	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	1 600	2800	A
I^2t	t_p = 10 ms; T_j = 150 °C	12 800	39 000	A^2s

Characteristics **Symbol**	**Conditions** [1]	**min.**	**typ.**	**max.**	**Units**
$V_{(BR)CES}$	V_{GE} = 0, I_C = 8 mA	≥ V_{CES}	–	–	V
$V_{GE(th)}$	$V_{GE} = V_{CE}$, I_C = 6 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	–	12	–	mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	1	µA
V_{CEsat}	I_C = 200 A V_{GE} = 15 V;	–	1,8(2,0)	–	V
V_{CEsat}	I_C = 300 A T_j = 25 (125) °C	–	2,1(2,4)	2,5(2,8)	V
g_{fs}	V_{CE} = 20 V, I_C = 300 A	100	–	–	S
C_{CHC}	per IGBT	–	–	700	pF
C_{ies}	V_{GE} = 0		17	–	nF
C_{oes}	V_{CE} = 25 V	–	2000	–	pF
C_{res}	f = 1 MHz	–	1200	–	pF
L_{CE}		–	–	20	nH
$t_{d(on)}$	V_{CC} = 300 V	–	160	–	ns
t_r	V_{GE} = –15 V / +15 V [3]	–	80	–	ns
$t_{d(off)}$	I_C = 300 A, ind. load	–	550	–	ns
t_f	$R_{Gon} = R_{Goff}$ = 6 Ω	–	50	–	ns
E_{on}	T_j = 125 °C	–	14	–	mWs
E_{off}		–	13	–	mWs
Inverse Diode [8]					
$V_F = V_{EC}$	I_F = 200 A V_{GE} = 0 V;	–	1,45(1,35)	1,7	V
	I_F = 300 A T_j = 25 (125) °C	–	1,65(1,65)	2,0	V
V_{TO}	T_j = 125 °C	–	–	0,9	V
r_t	T_j = 125 °C	–	3	4	mΩ
I_{RRM}	I_F = 300 A; T_j = 125 °C [2]	–	120	–	A
Q_{rr}	I_F = 300 A; T_j = 125 °C [2]	–	18	–	µC
FWD of type “GAL”, “GAR”					
$V_F = V_{EC}$	I_F = 200 A V_{GE} = 0 V;	–	1,35(1,30)	1,6	V
$V_F = V_{EC}$	I_F = 300 A T_j = 25 (125) °C	–	1,45(1,40)	1,8	V
V_{TO}	T_j = 125 °C	–	–	0,9	V
r_t	T_j = 125 °C	–	–	3	mΩ
I_{RRM}	I_F = 300 A; T_j = 125 °C [2]	–	130	–	A
Q_{rr}	I_F = 300 A; T_j = 125 °C [2]	–	23	–	µC
Thermal characteristics					
R_{thjc}	per IGBT	–	–	0,09	°C/W
R_{thjc}	per diode / FWD “GAL, GAR”	–	–	0,25/0,15	°C/W
R_{thch}	per module	–	–	0,038	°C/W

SEMITRANS 3



Features

- N channel, homogeneous Silicon structure (NPT- Non punch-through IGBT)
- Low tail current with low temperature dependence
- High short circuit capability, self limiting if term. G is clamped to E
- Pos. temp.-coeff. of V_{CEsat}
- 50 % less turn off losses [9]
- 30 % less short circuit current [9]
- Very low C_{ies}, C_{oes}, C_{res} [9]
- Latch-up free
- 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

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

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[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

[8] CAL = Controlled Axial Lifetime Technology

[9] Compared to PT-IGBT

Cases and mech. data → B 6 – 56

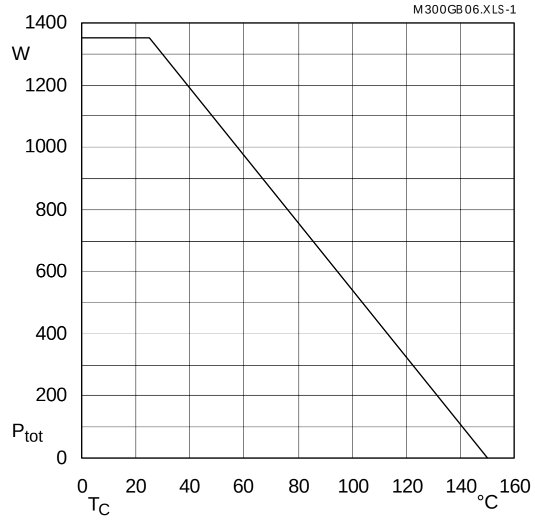
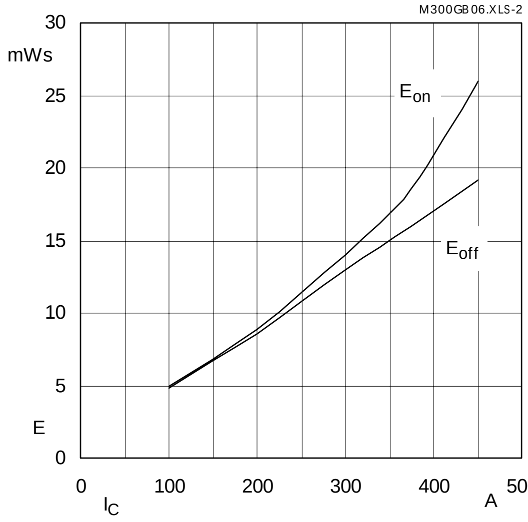
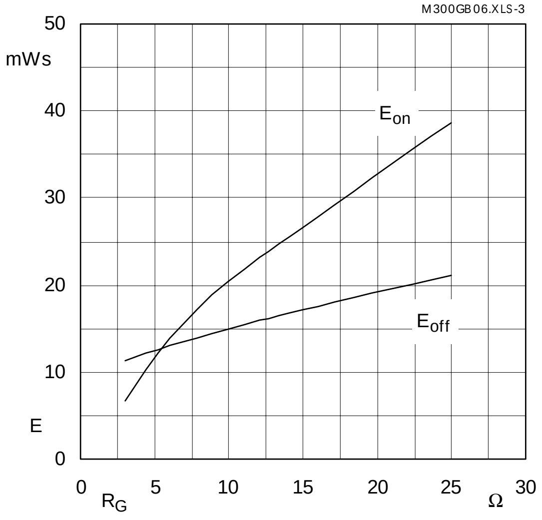


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



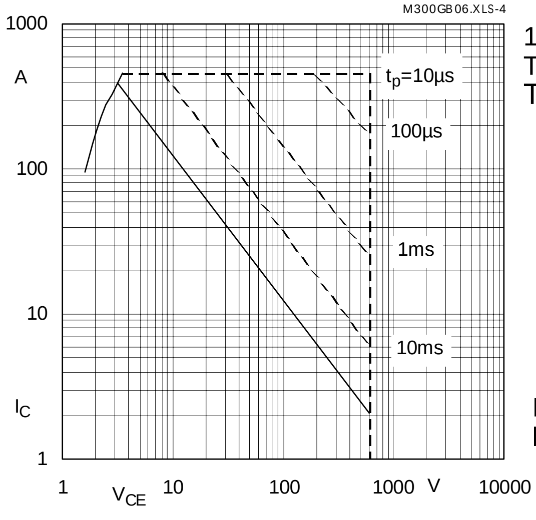
T_j = 125 °C
V_{CE} = 300 V
V_{GE} = ± 15 V
R_G = 6 Ω

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



T_j = 125 °C
V_{CE} = 300 V
V_{GE} = ± 15 V
I_C = 300 A

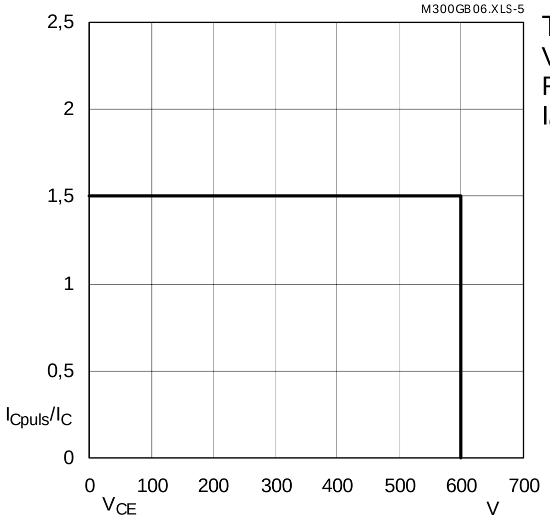
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
T_j ≤ 150 °C

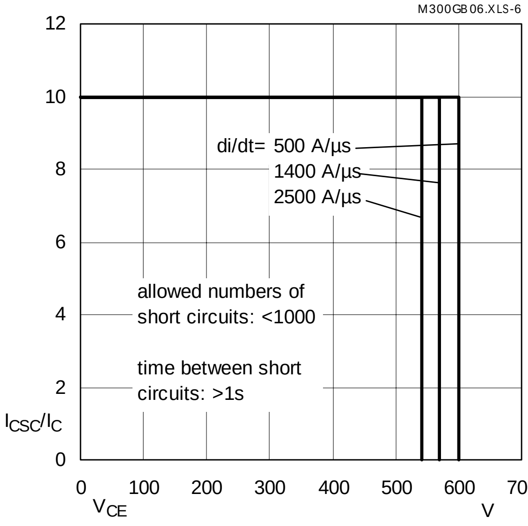
Not for
linear use

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



T_j ≤ 150 °C
V_{GE} = ± 15 V
R_{Goff} = 6 Ω
I_C = 300 A

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



allowed numbers of
short circuits: <1000

time between short
circuits: >1s

T_j ≤ 150 °C
V_{GE} = ± 15 V
t_{sc} ≤ 10 µs
L < 50 nH
I_C = 300 A

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

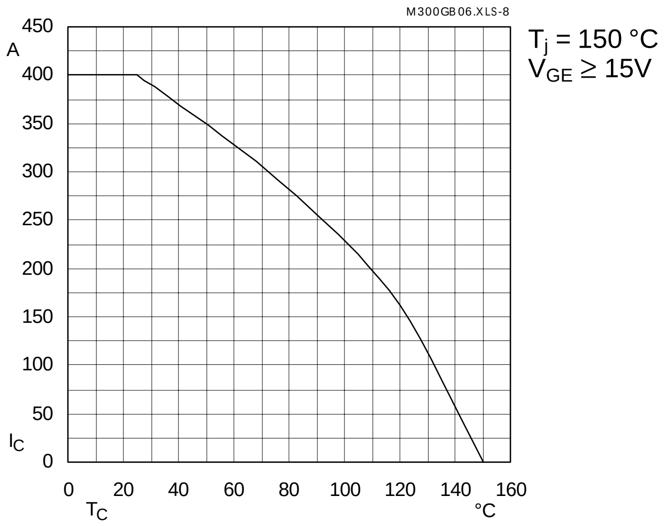


Fig. 8 Rated current vs. temperature $I_C = f\ (T_C)$

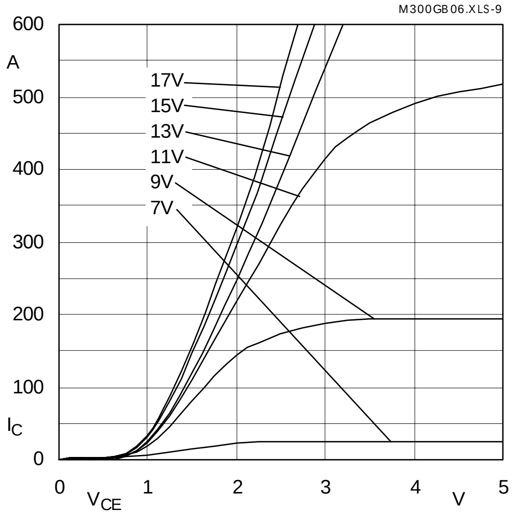


Fig. 9 Typ. output characteristic, t_p = 250 µs; T_j = 25 °C

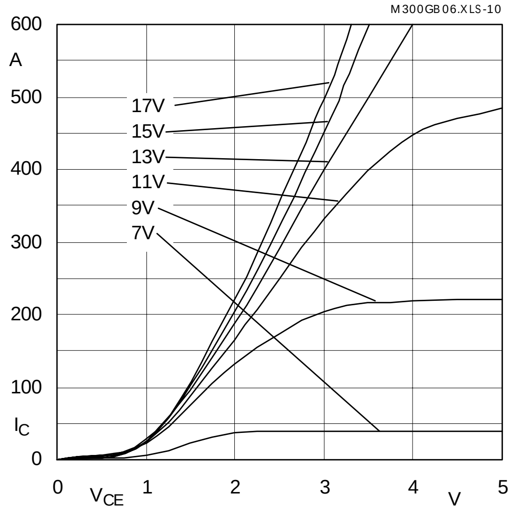


Fig. 10 Typ. output characteristic, t_p = 250 µs; T_j = 125 °C

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

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

$$V_{CE(TO)(Tj)} \leq 1{,}2 - 0{,}001\ (T_j - 25)\ [V]$$

typ.: $r_{CE(Tj)} = 0{,}003 + 0{,}000013\ (T_j - 25)\ [\Omega]$

max.: $r_{CE(Tj)} = 0{,}0043 + 0{,}000013\ (T_j - 25)\ [\Omega]$

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

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

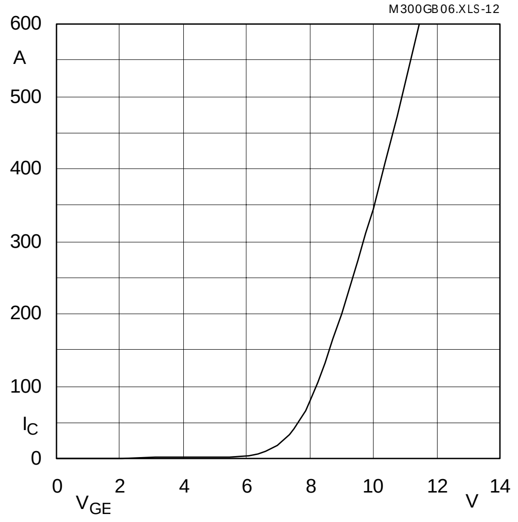


Fig. 12 Typ. transfer characteristic, t_p = 250 µs; V_{CE} = 20 V

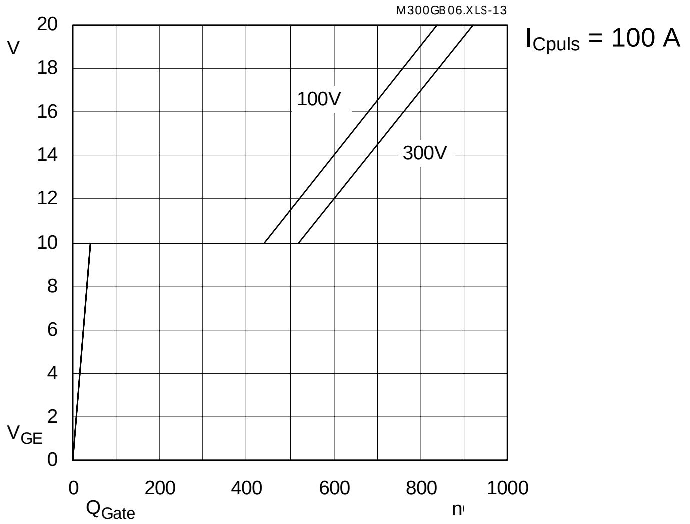


Fig. 13 Typ. gate charge characteristic

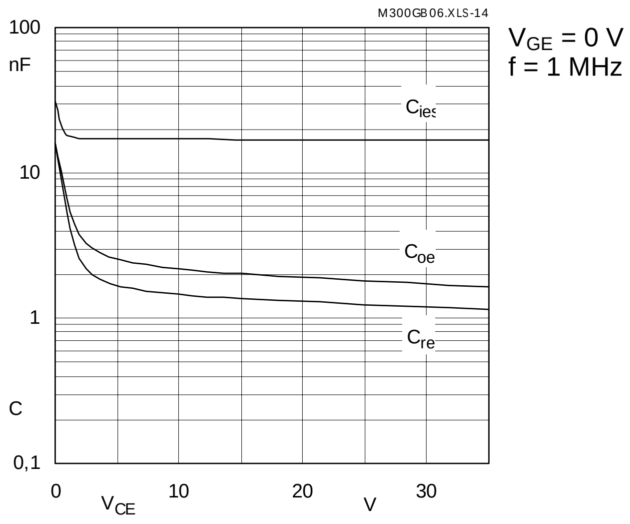


Fig. 14 Typ. capacitances vs.V_{CE}

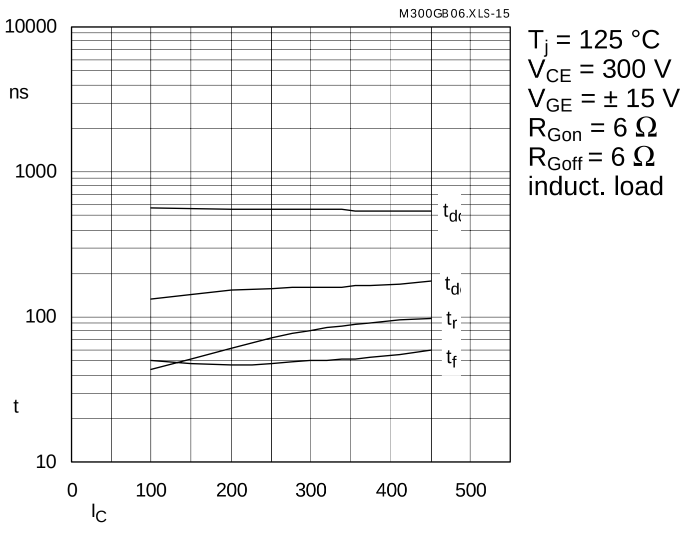


Fig. 15 Typ. switching times vs. I_C

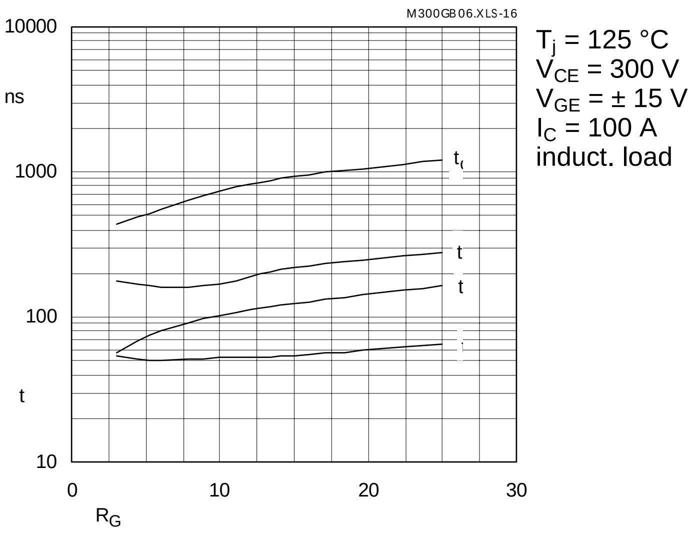


Fig. 16 Typ. switching times vs. gate resistor R_G

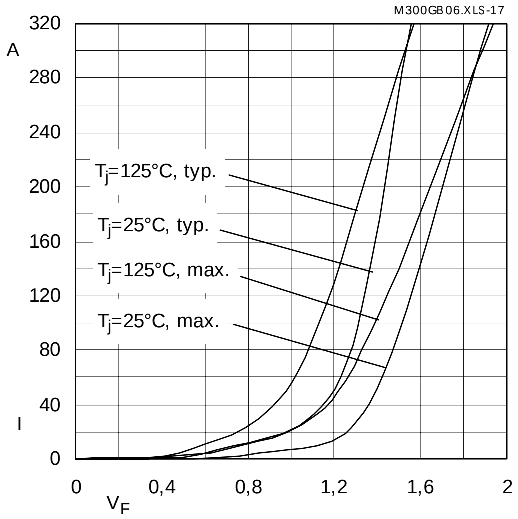


Fig. 17 Typ. CAL diode forward characteristic

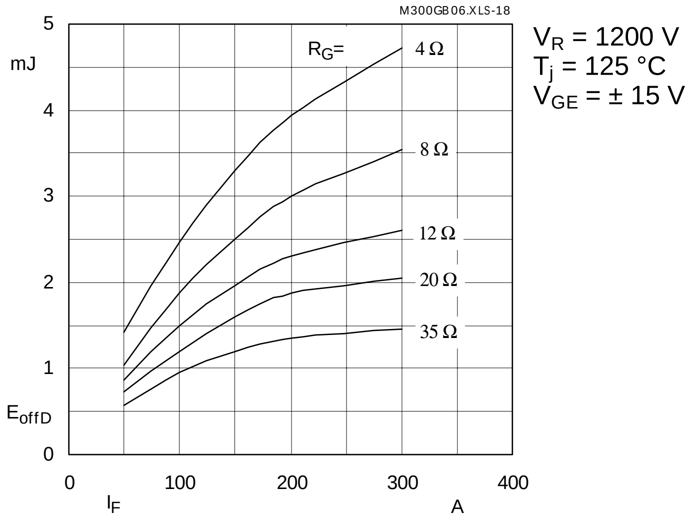
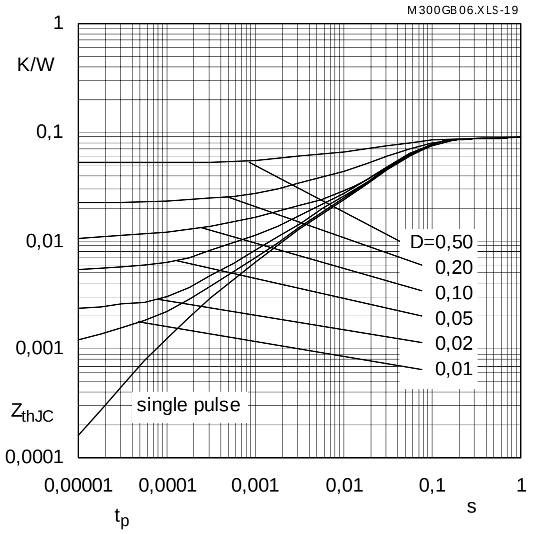


Fig. 18 Diode turn-off energy dissipation per pulse



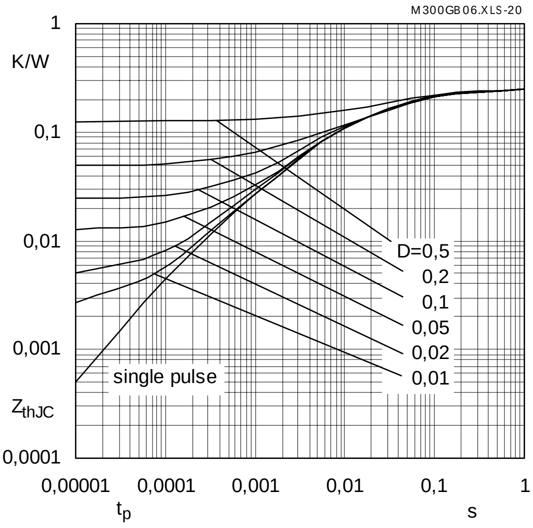
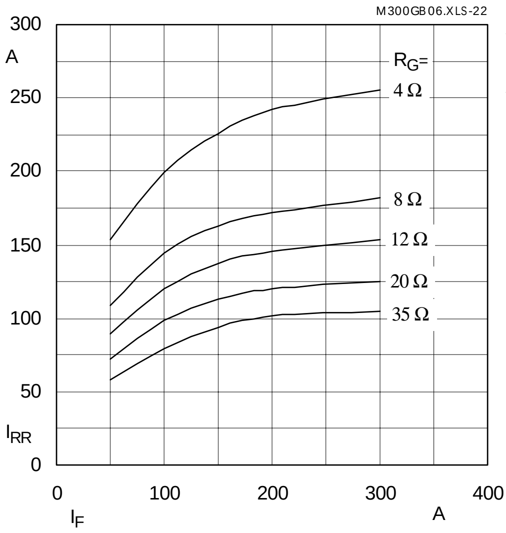
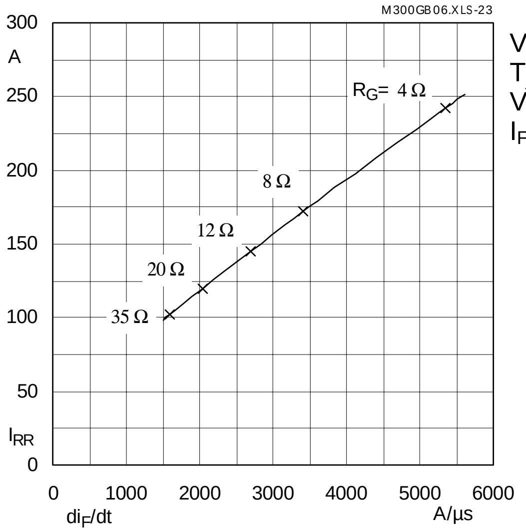


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

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



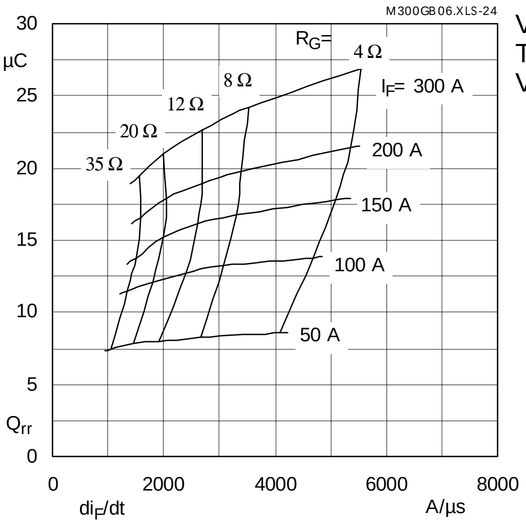
$V_R = 1200$ V
$T_j = 125$ °C
$V_{GE} = \pm 15$ V



$V_R = 1200$ V
$T_j = 125$ °C
$V_{GE} = \pm 15$ V
$I_F = 200$ A

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 $I_{RR} = f(di/dt)$



$V_R = 1200$ V
$T_j = 125$ °C
$V_{GE} = \pm 15$ V

Fig. 24 Typ. CAL diode recovered charge

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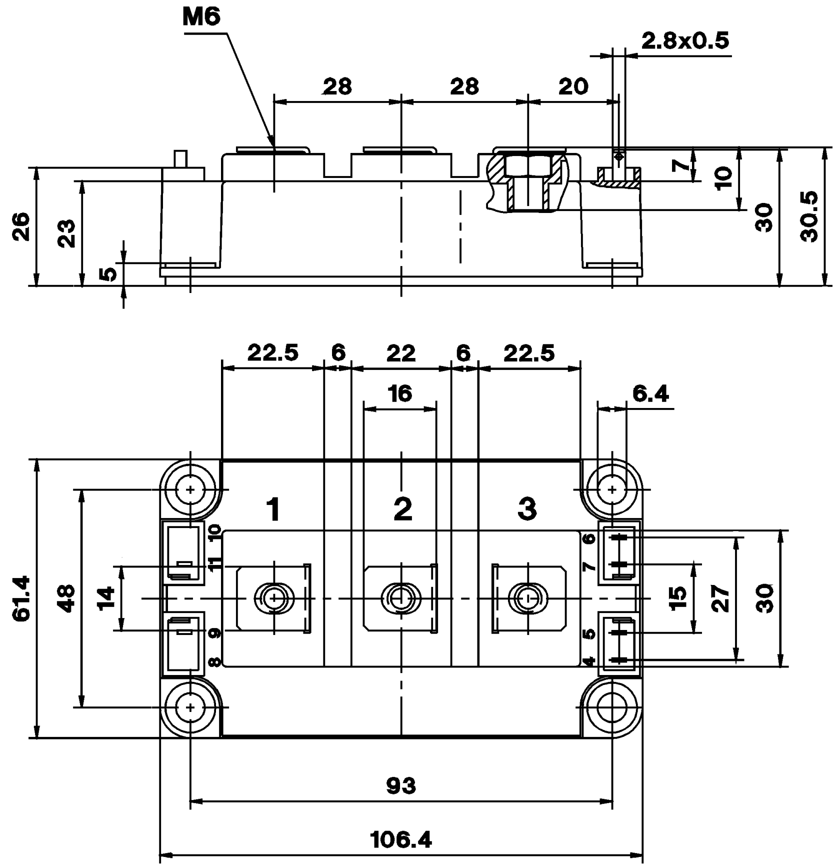
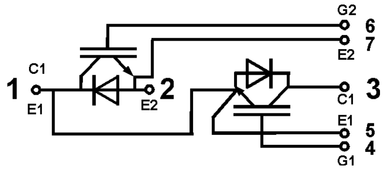
Case D 56

UL Recognized
File no. E 63 532

SKM 300 GB 063 D

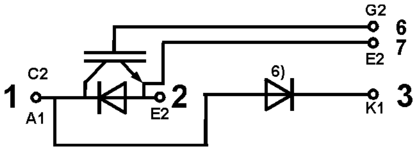




Dimensions in mm

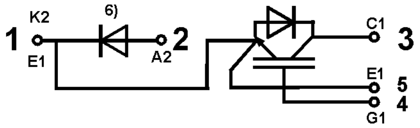
SKM 300 GAL 063 D

Case D 57 (→ D 56)



SKM 300 GAR 063 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

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 or 20 pieces are used if suitable
Accessories → B 6 – 4
SEMIBOX → C - 1.