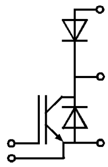
SEMIKRON

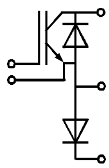
SEMITRANS® M IGBT Modules

SKM 200 GAX 173 D [6)]
SKM 200 GAY 173 D [6)]

SEMITRANS 3



GAX



GAY

Absolute Maximum Ratings

Symbol	Conditions [1)]	Values		Units
V_{CES}		1700		V
V_{CGR}	R_{GE} = 20 kΩ	1700		V
I_C	T_{case} = 25/80 °C	220 / 150		A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	440 / 300		A
V_{GES}		± 20		V
P_{tot}	per IGBT, T_{case} = 25 °C	1250		W
T_j, (T_{stg})		–40 ... +150 (125)		°C
V_{isol}	AC, 1 min.	4000		V
humidity	DIN 40 040	Class F		
climate	DIN IEC 68 T.1	40/125/56		
Diodes [8)]		Inverse	Series [6)]	
$I_F = -I_C$	T_{case} = 25/80 °C	150 / 100	230 / 150	A
$I_{FM} = -I_{CM}$	T_{case} = 25/80 °C; t_p = 1 ms	400 / 300	440 / 300	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	1450	2200	A
I^2t	t_p = 10 ms; T_j = 150 °C	10500	24000	A^2s

Characteristics

Symbol	Conditions [1)]	min.	typ.	max.	Units
$V_{(BR)CES}$	V_{GE} = 0, I_C = 3 mA	≥ V_{CES}	–	–	V
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 10 mA	4,8	5,5	6,2	V
I_{CES}	V_{GE} = 0, V_{CE} = V_{CES}; T_j = 25 °C	–	–	1,5	mA
	T_j = 125 °C	–	–	4,5	mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0 V	–	–	400	nA
V_{CEsat}	I_C = 150 A; V_{GE} = 15 V; T_j = 25 (125) °C	–	3,4(4,5)	3,9(5)	V
V_{CEsat}	I_C = 200 A; V_{GE} = 15 V; T_j = 25 (125) °C	–	3,8(5,5)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 150 A	54	–	–	S
C_{CHC}	per IGBT	–	–	200	pF
C_{ies}	V_{GE} = 0; V_{CE} = 25 V; f = 1 MHz	–	20	–	nF
C_{oes}		–	2	–	nF
C_{res}		–	0,55	–	nF
L_{CE}		–	–	20	nH
$t_{d(on)}$	V_{CC} = 1200 V; V_{GE} = + 15 V / – 15 V; I_C = 150 A, ind. load; R_{Gon} = R_{Goff} = 4 Ω; T_j = 125 °C	–	580	–	ns
t_r		–	100	–	ns
$t_{d(off)}$		–	750	–	ns
t_f		–	40	–	ns
E_{on}		–	95	–	mWs
E_{off}		–	45	–	mWs
Inverse Diode [8)]					
$V_F = V_{EC}$	I_F = 150 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,2(1,9)	2,7(2,3)	V
$V_F = V_{EC}$	I_F = 200 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,4(2,2)	–	V
V_{TO}	T_j = 125 °C	–	1,3	1,5	V
r_T	T_j = 125 °C	–	4,5	6,2	mΩ
I_{RR}	I_F = 150 A; T_j = 25 (125) °C [2)]	–	60(85)	–	A
Q_{rr}	I_F = 150 A; T_j = 25 (125) °C [2)]	–	15(38)	–	µC
Series Diode [8) 6)]					
$V_F = V_{EC}$	I_F = 200 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,2(1,9)	2,7(2,3)	V
$V_F = V_{EC}$	I_F = 300 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,4(2,2)	–	V
V_{TO}	T_j = 125 °C	–	1,3	1,5	V
r_T	T_j = 125 °C	–	4	4,5	mΩ
I_{RR}	I_F = 200 A; T_j = 25 (125) °C [2)]	–	100(150)	–	A
Q_{rr}	I_F = 200 A; T_j = 25 (125) °C [2)]	–	24(58)	–	µC
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,1	°C/W
R_{thjc}	per inverse/series diode	–	–	0,32/0,20	°C/W
R_{thch}	per module	–	–	0,038	°C/W

Features

- N channel, Homogeneous Silicon structure (NPT-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
- Large clearance (13 mm) and creepage distances (20 mm).

Typical Applications

- Bidirectional switches as “reverse blocking” IGBT
- Regenerative braking
- Quasi resonant inverters
- DC bus voltage 750 - 1200 V_{DC}
- Public transport (auxiliary syst.)
- Switching (not for linear use)

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

2) $I_F = -I_C$, V_R = 1200 V, $-di_F/dt$ = 1000 A/µs, V_{GE} = 0 V

6) The series diodes have the data of the inverse diodes of SKM 300 GA 173 D

8) CAL = Controlled Axial Lifetime Technology.

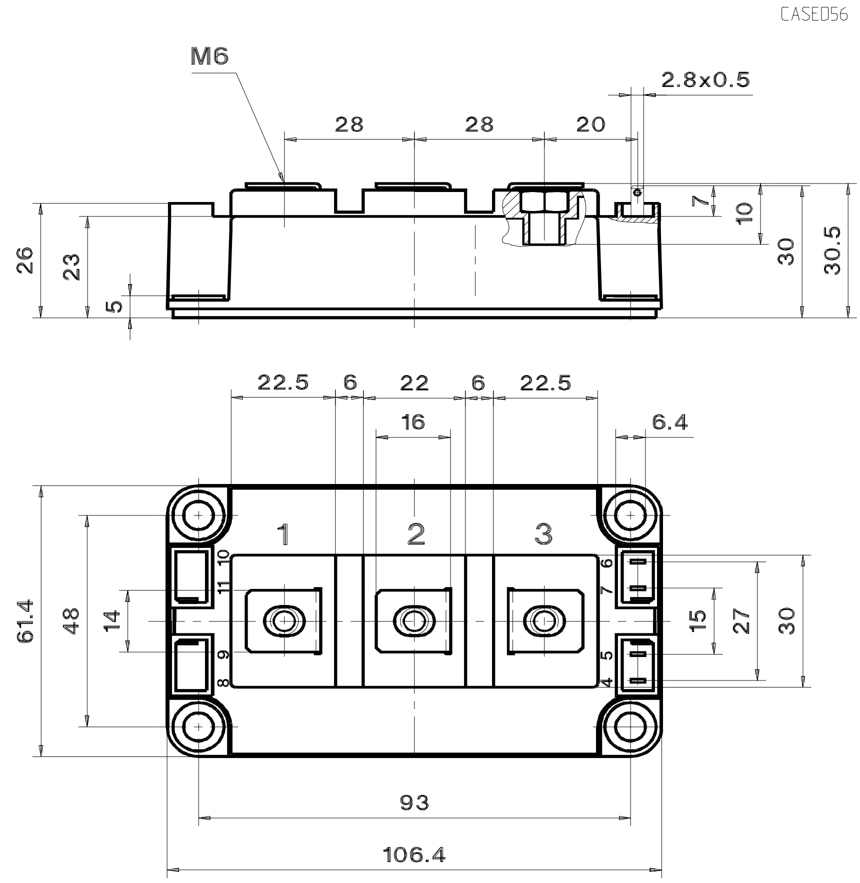
Cases and mech. data → B 6 – 260
Diagrams of IGBT → B 6 – 254...
of series diode → B 6 – 266
fig. 17, 18, 20 to 24

SEMITRANS 3

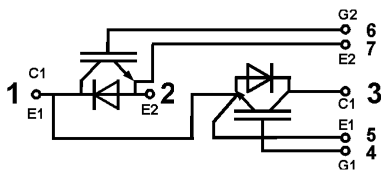
Case D 56

UL Recognized

File no. E 63 532



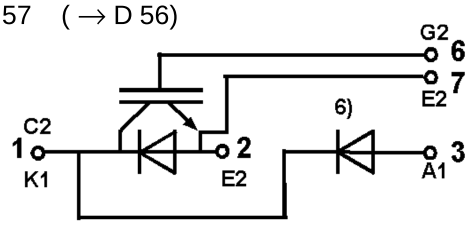
SKM 200 GB 173 D



Dimensions in mm

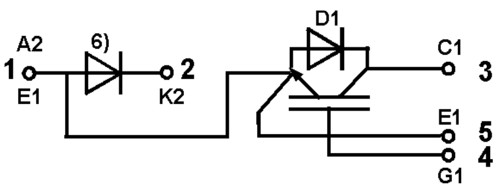
SKM 200 GAX 173 D

Case D 57 (→ D 56)



SKM 200 GAY 173 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	(M5)	2,5	–	5	Nm
	for terminals, US Units		22	–	44	lb.in.
a			–	–	5x9,81	m/s^2
w			–	–	325	g

6) Series diode → B 6 – 259, 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.

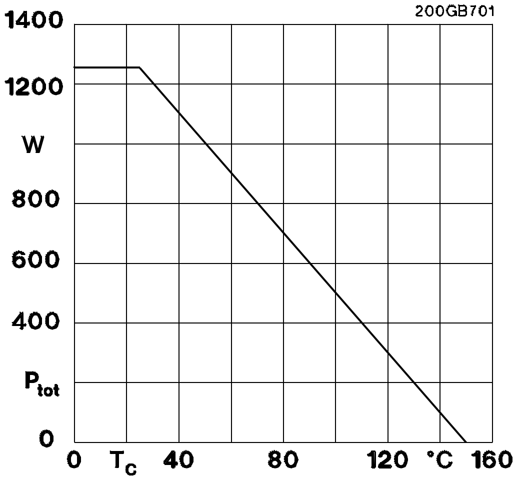
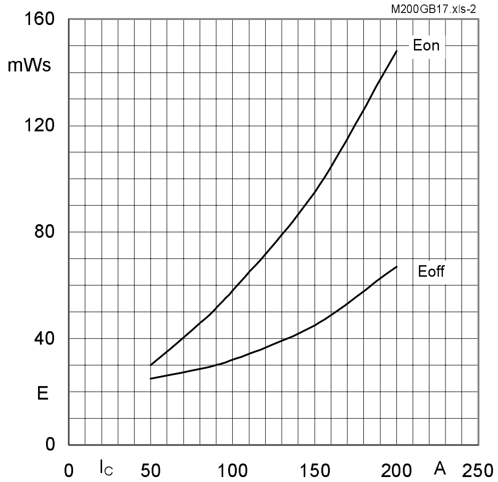
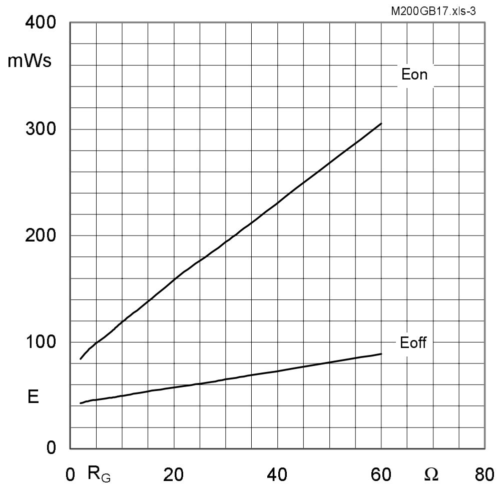


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



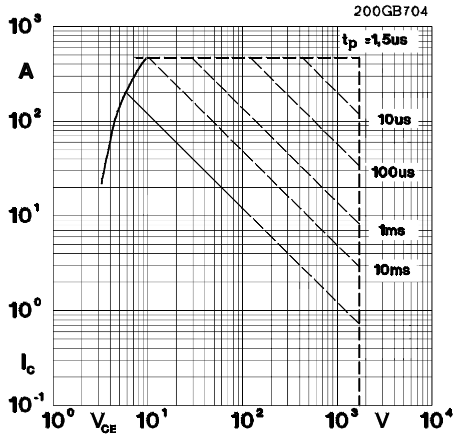
T_j = 125 °C
V_{CE} = 1200 V
V_{GE} = ± 15 V
R_G = 4 Ω

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



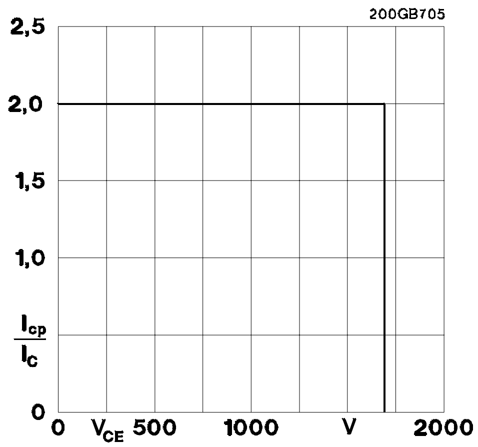
T_j = 125 °C
V_{CE} = 1200 V
V_{GE} = ± 15 V
I_C = 150 A

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



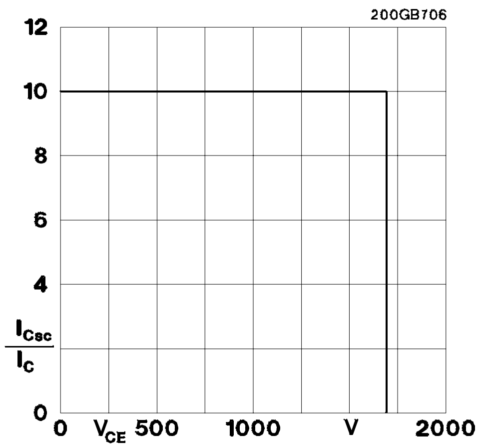
1 pulse
T_C = 25 °C
$T_j \leq$ 150 °C

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



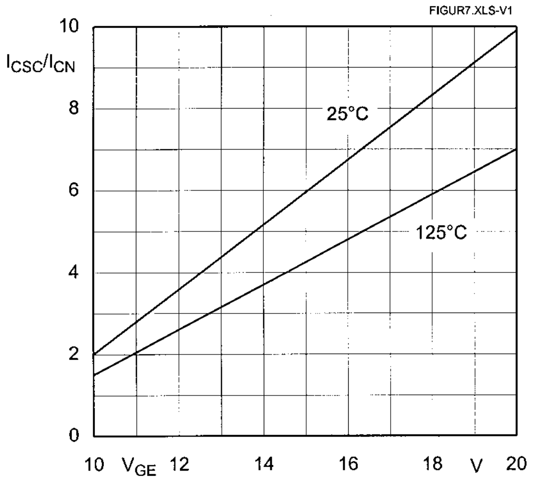
$T_j \leq$ 150 °C
V_{GE} = ± 15 V
R_{Goff} = 4 Ω
I_C = 150 A

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



$T_j \leq$ 150 °C
V_{GE} = ± 15 V
$t_{sc} \leq$ 10 µs
L_{ext} < 50 nH
I_C = 150 A

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



V_{CC} = 1200 V
I_C = 150 A
R_G = 4 Ω
L_{ext} ≤ 50 nH
self-limiting
t_p = 10 µs

Fig. 7 Short circuit current vs. turn-on gate voltage

T_j = 150 °C
V_{GE} ≥ 15 V

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

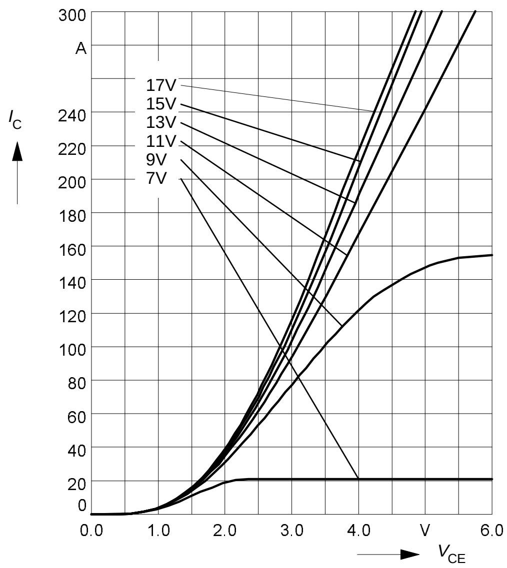


Fig. 9 Typ. output characteristic, t_p = 80 µs; T_j = 25 °C

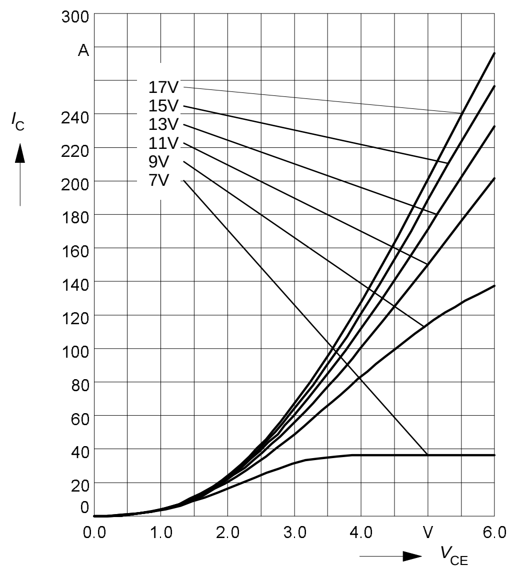


Fig. 10 Typ. output characteristic, t_p = 80 µs; T_j = 125 °C

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

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

$V_{CE(TO)(Tj)} \leq 1{,}9 + 0{,}003\ (T_j - 25)$ [V]

$r_{CE(Tj)} = 0{,}011 + 0{,}00004\ (T_j - 25)$ [Ω]

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

Fig. 11 Typ. saturation characteristic (IGBT)
Calculation elements and equations

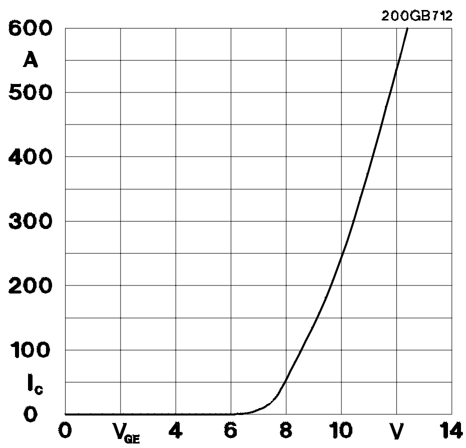


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V

I_{Cpuls} = 150 A

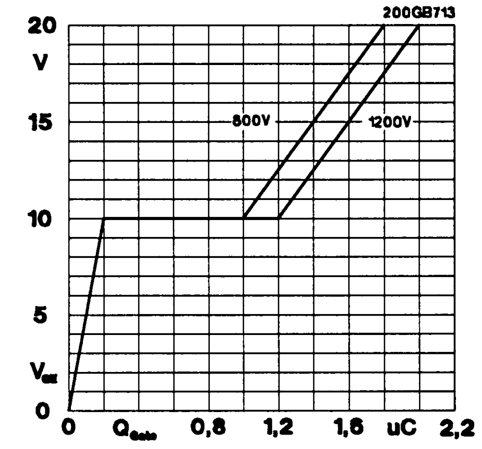


Fig. 13 Typ. gate charge characteristic

V_{GE} = 0 V
f = 1 MHZ

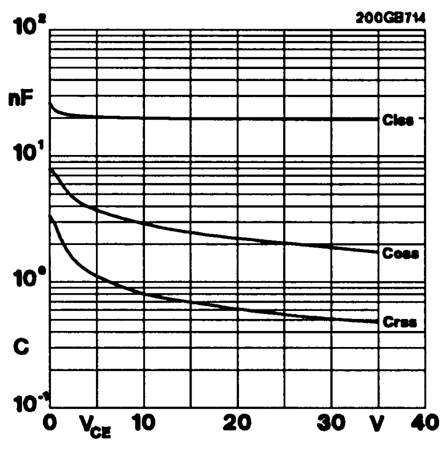


Fig. 14 Typ. capacitances vs.V_{CE}

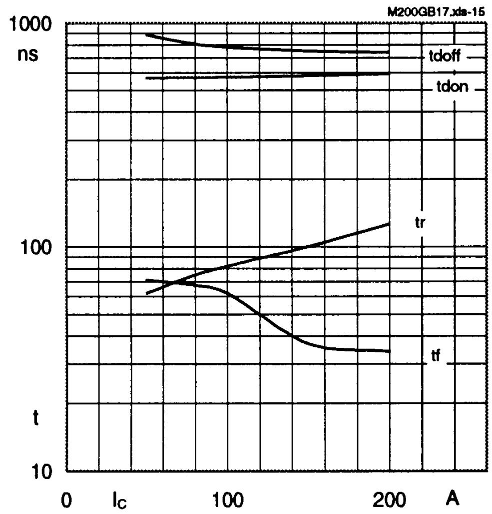


Fig. 15 Typ. switching times vs. I_C

T_j = 125 °C
V_{CC} = 1200 V
V_{GE} = ± 15 V
R_g = 4 Ω

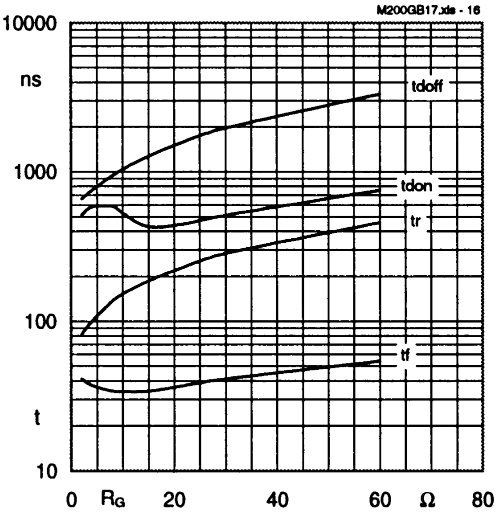


Fig. 16 Typ. switching times vs. R_G

T_j = 125 °C
V_{CC} = 1200 V
V_{GE} = ± 15 V
I_C = 150 Ω

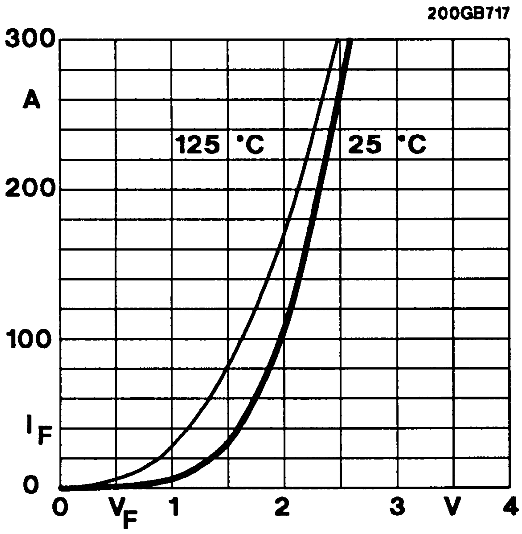


Fig. 17 Typ. CAL diode forward characteristic

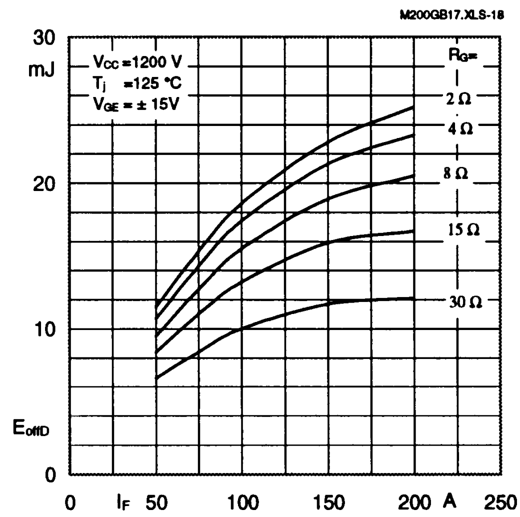


Fig. 18 Typ. Diode turn-off energy dissipation per pulse

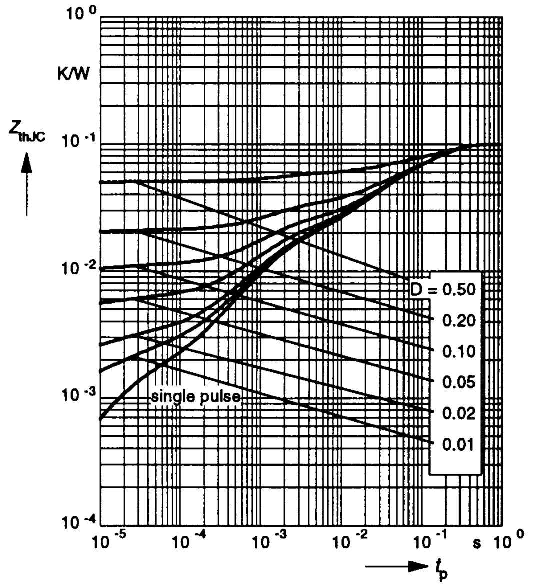


Fig. 19 Transient thermal impedance of IGBT: $Z_{thjc} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

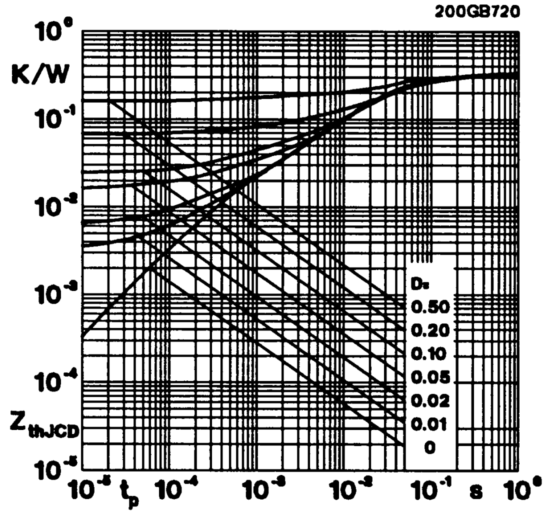


Fig. 20 Transient thermal impedance of inverse diode: $Z_{thjcD} = f(t_p)$

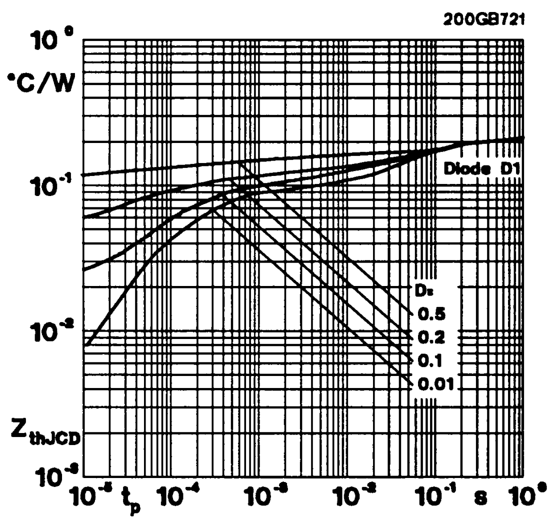


Fig. 21 Transient thermal impedance of FWD of SKM 200GAL173D: $Z_{thjcD} = f(t_p)$

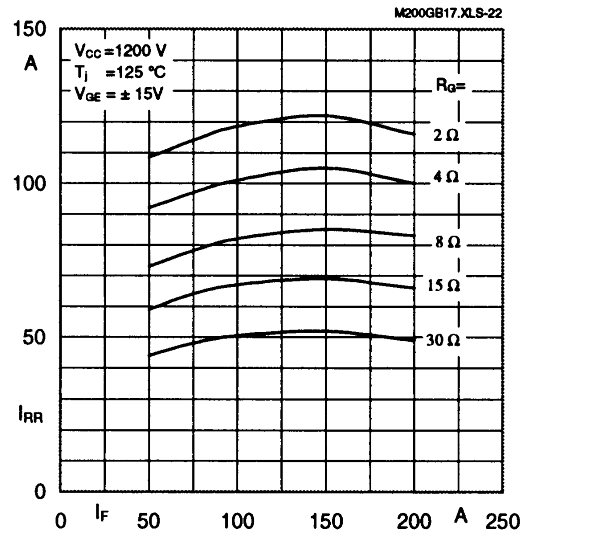


Fig. 22 Typ. CAL diode peak reverse recovery current of inverse diode $I_{RR} = f(I_F; R_G)$

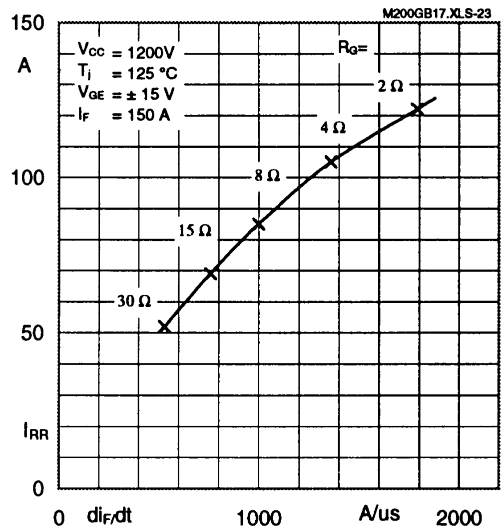


Fig. 23 Typ. CAL diode peak reverse recovery current of inverse diode: $I_{RR} = f(di_F/dt)$

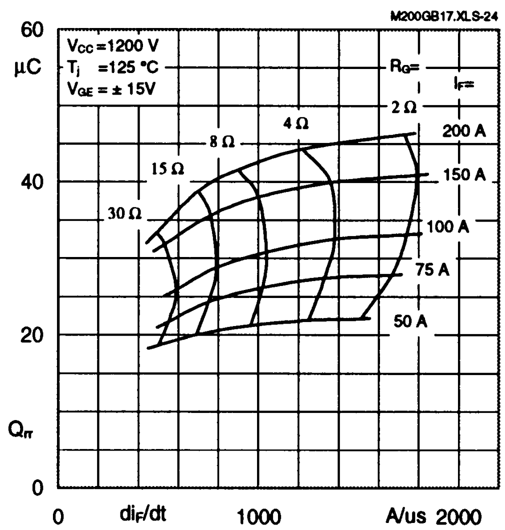


Fig. 24 Typ. CAL diode recovered charge Qrr of inverse diode

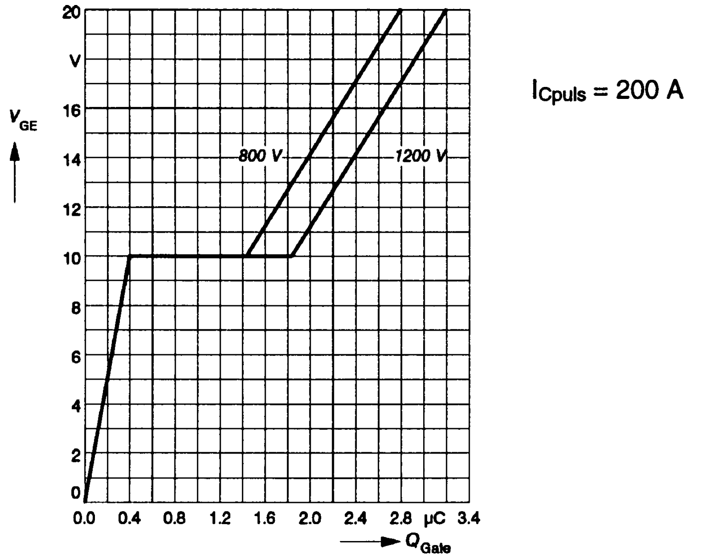
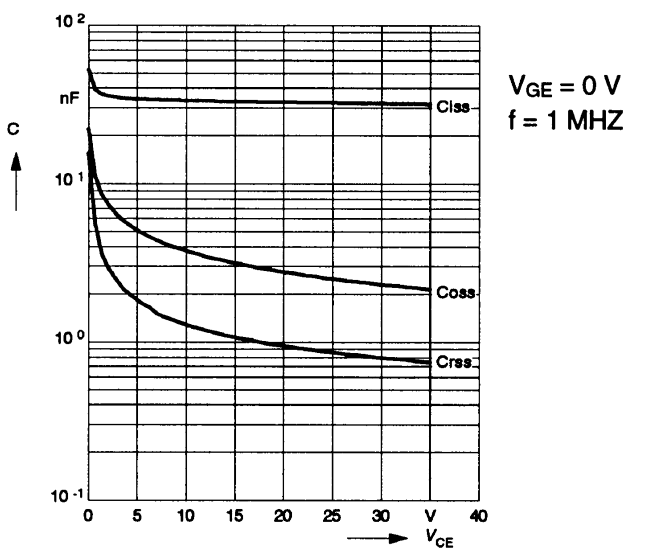


Fig. 13 Typ. gate charge characteristic



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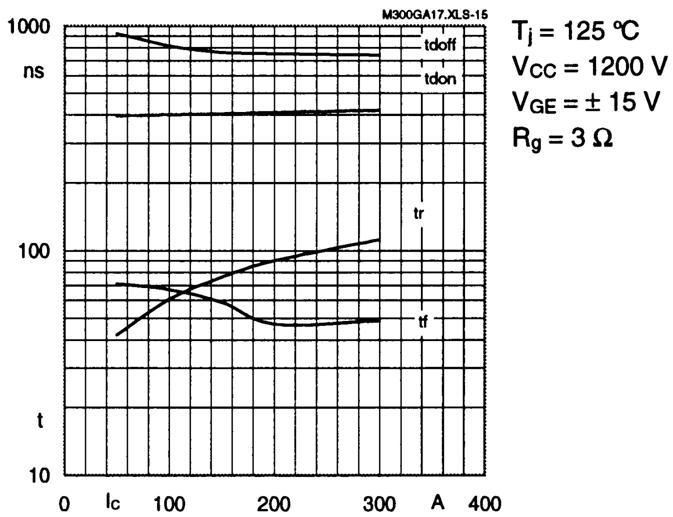

Fig. 15 Typ. switching times vs. I_C

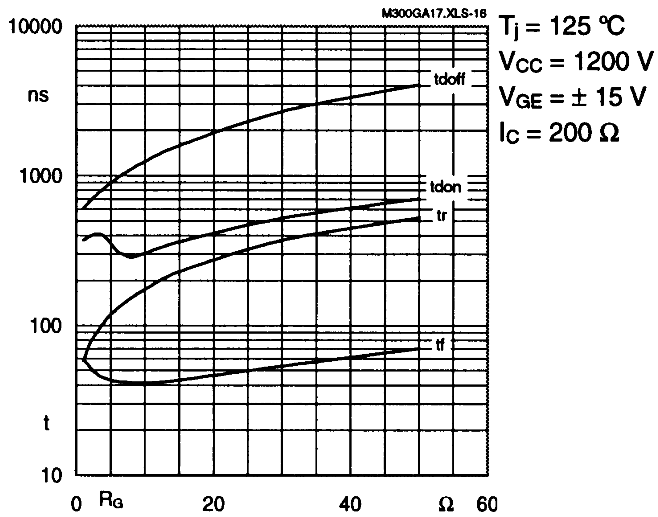

Fig. 16 Typ. switching times vs. R_G

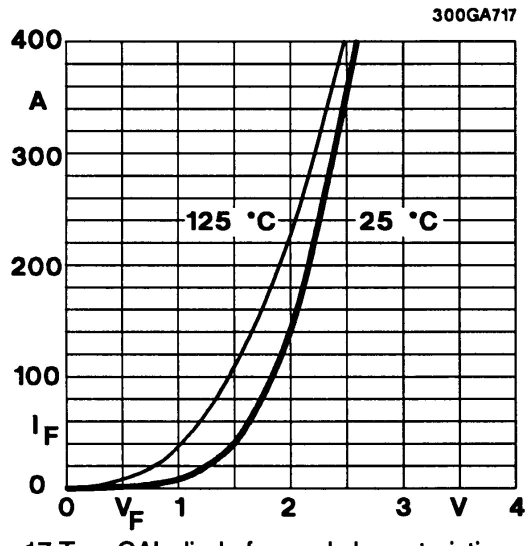

Fig. 17 Typ. CAL diode forward characteristic

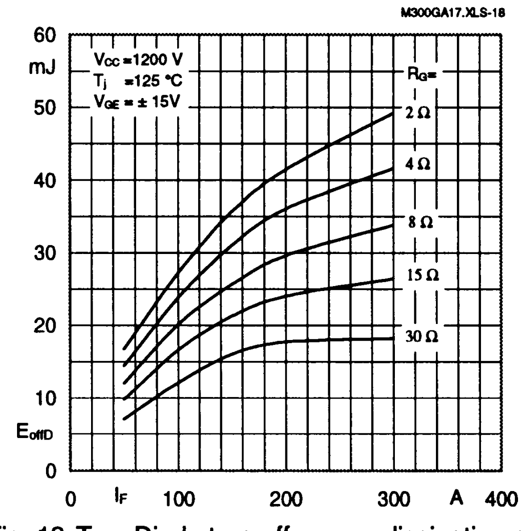

Fig. 18 Typ. Diode turn-off energy dissipation per pulse

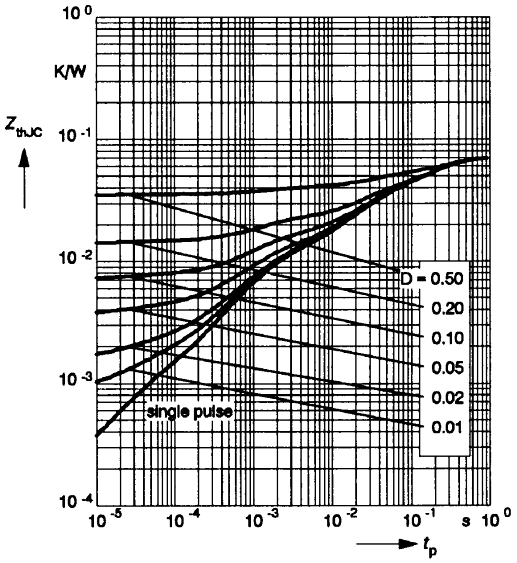

Fig. 19 Transient thermal impedance of IGBT: $Z_{thjc} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

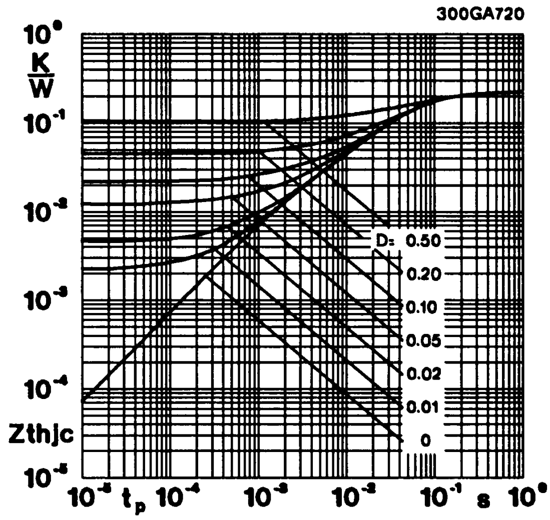

Fig. 20 Transient thermal impedance of inverse diode: $Z_{thjcD} = f(t_p)$

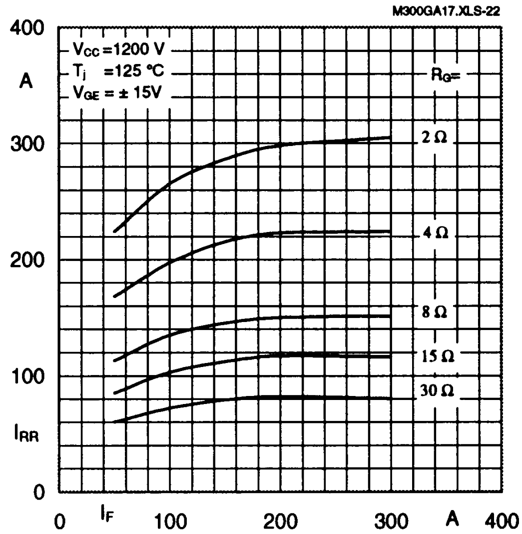

Fig. 22 Typ. CAL diode peak reverse recovery current of inverse diode $I_{RR} = f(I_F; R_G)$

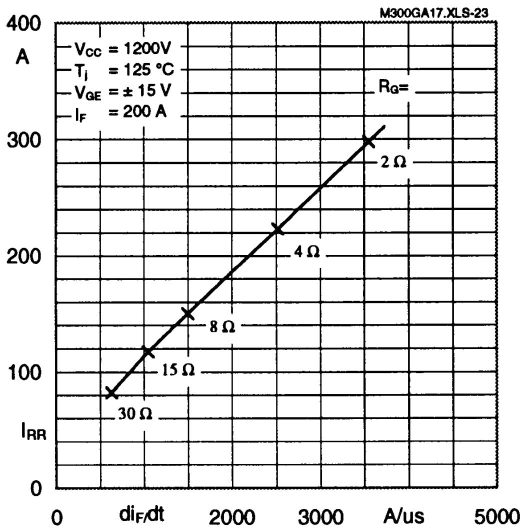

Fig. 23 Typ. CAL diode peak reverse recovery current of inverse diode: $I_{RR} = f(di_F/dt)$

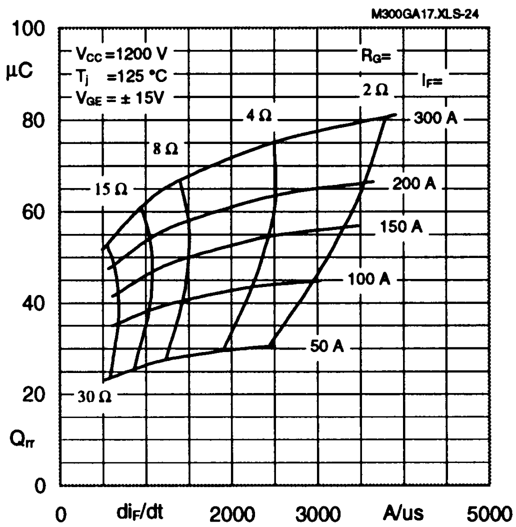

Fig. 24 Typ. CAL diode recovered charge Qrr of inverse diode