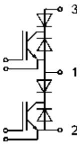
SEMITRANS® M
IGBT Modules

SKM 200 GBD 123 D 1S

SEMITRANS 3



GBD

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	200 / 180		A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	400 / 360		A
V_{GES}		± 20		V
P_{tot}	per IGBT, T_{case} = 25 °C	1380		W
T_j, (T_{stg})		– 40 . . .+150 (125)		°C
V_{isol}	AC, 1 min.	2 500 [7]		V
humidity	DIN 40 040	Class F		
climate	DIN IEC 68 T.1	40/125/56		
Diodes		Inverse D. [9]	Series [6]	
$I_F = – I_C$	T_{case} = 25/80 °C	25 / 15	260 / 180	A
$I_{FM} = – I_{CM}$	T_{case} = 25/80 °C; t_p = 1 ms	50 / 30	600 / 400	A

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 = 6 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0 T_j = 25 °C	–	0,2	3	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 = 150 A V_{GE} = 15 V;	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 200 A T_j = 25 (125) °C	–	2,8(3,6)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 150 A	95	–	–	S
C_{CHC}	per IGBT	–	–	700	pF
C_{ies}	V_{GE} = 0	–	10	13	nF
C_{oes}	V_{CE} = 25 V	–	1,5	2	nF
C_{res}	f = 1 MHz	–	0,8	1,2	nF
L_{CE}		–	–	40	nH
$t_{d(on)}$	V_{CC} = 600 V	–	220	400	ns
t_r	V_{GE} = -15 V / +15 V [3]	–	100	200	ns
$t_{d(off)}$	I_C = 150 A, ind. load	–	600	800	ns
t_f	R_{Gon} = R_{Goff} = 5,6 Ω	–	70	100	ns
E_{on} [5]	T_j = 125 °C	–	24	–	mWs
E_{off} [5]		–	17	–	mWs
Inverse Diode [8] D1, D2 [9]					
$V_F = V_{EC}$	I_F = 15 A V_{GE} = 0 V;	–	2,0(1,8)	2,5	V
$V_F = V_{EC}$	I_F = 25 A T_j = 25 (125) °C	–	2,3(2,1)	–	V
V_{TO}	T_j = 125 °C	–	–	1,2	V
r_T	T_j = 125 °C	–	45	70	mΩ
I_{RRM}	I_F = 150 A; T_j = 25 (125) °C [2]	–	12(16)	–	A
Q_{rr}	I_F = 150 A; T_j = 25 (125) °C [2]	–	1(2,7)	–	µC
Series Diodes D3, D4 [8] [6]					
$V_F = V_{EC}$	I_F = 200 A V_{GE} = 0 V;	–	2,0(1,8)	2,5	V
$V_F = V_{EC}$	I_F = 300 A T_j = 25 (125) °C	–	2,25(2,1)	–	V
V_{TO}	T_j = 125 °C	–	–	1,2	V
r_T	T_j = 125 °C	–	3	5,5	mΩ
I_{RRM}	I_F = 200 A; T_j = 25 (125) °C [2]	–	70(105)	–	A
Q_{rr}	I_F = 200 A; T_j = 25 (125) °C [2]	–	10(26)	–	µC
Thermal Characteristics					
R_{thjc}	per IGBT	–	–	0,09	°C/W
R_{thjc}	per inverse/series diode	–	–	1,5/0,18	°C/W
R_{thch}	per module	–	–	0,038	°C/W

Features

- MOS input (voltage controlled)
- N channel, Homogeneous Si
- 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
- Large clearance (13 mm) and creepage distances (20 mm).

Typical Applications:

- Switching (not for linear use)
- Resonant inverters

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

[2] I_F = – I_C, V_R = 600 V, – di_F/dt = 1500 A/µs, V_{GE} = 0 V

[3] Use V_{GEoff} = -5 ... -15 V

[5] See fig. 2 + 3; R_{Goff} = 5,6 Ω

[6] Series diodes have the data of the inverse diodes of SKM 300 GB 123 D

[8] CAL = Controlled Axial Lifetime Technology.

[9] → B6-156 for protection only

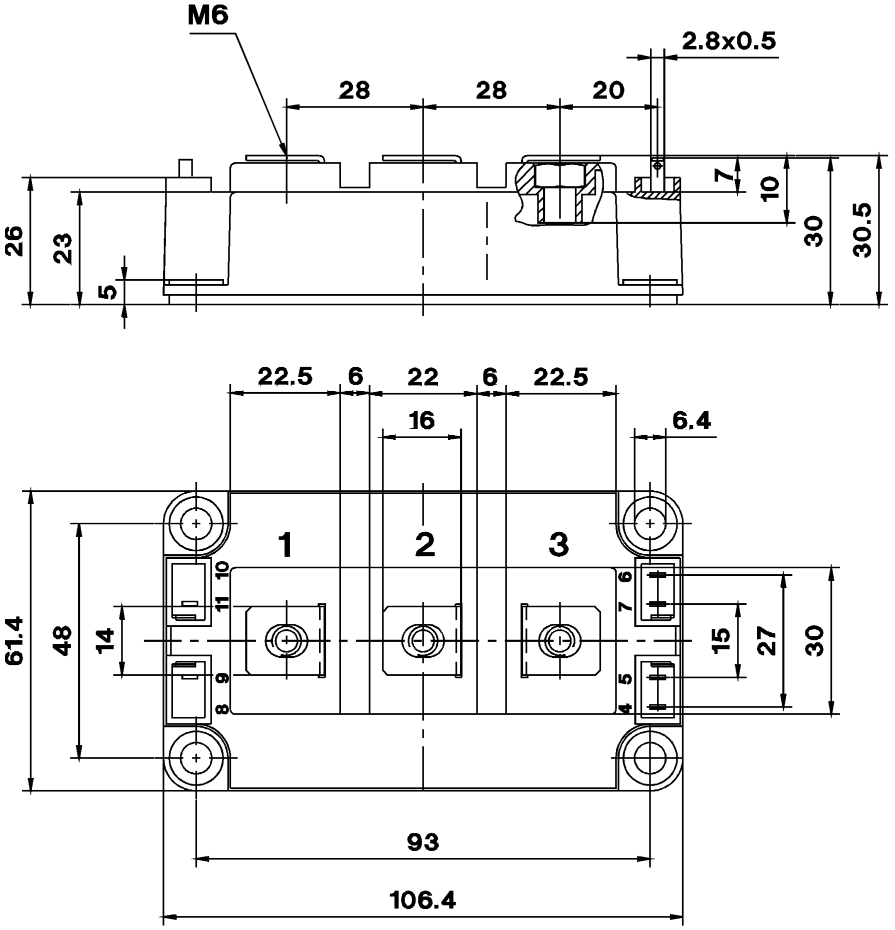
Cases and mech. data → B6-156
Diagrams → B6-150...153 (IGBT) and B6-172 and B6-173 (D3, D4)

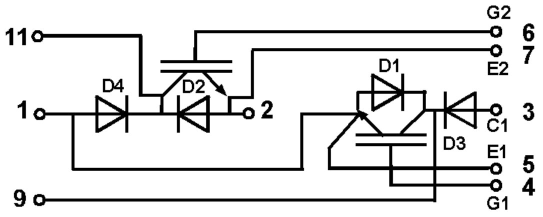
SEMITRANS 3

Case D 56a

UL Recognized

File no. E 63 532





Dimensions in mm

Case outline and circuit diagrams

[9] The inverse diodes D1 and D2 have the function of protective devices only. Data see type SKM 22GD123D (Fig. 17, 18, 22-24)

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)	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 and 20 pieces are used if suitable.

Accessories → B 6 - 4
SEMIBOX → C - 1.

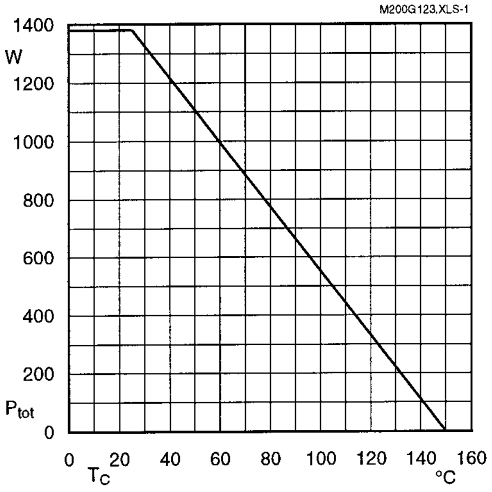
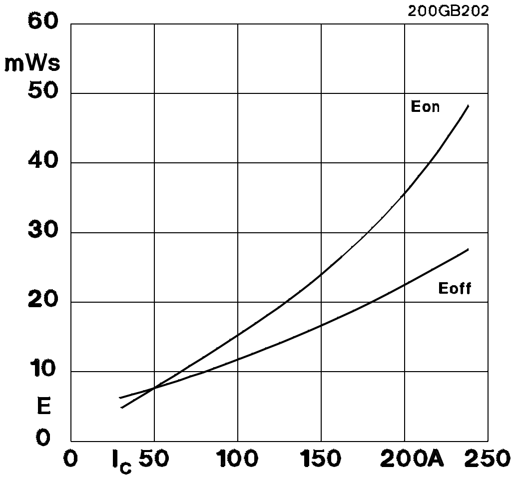
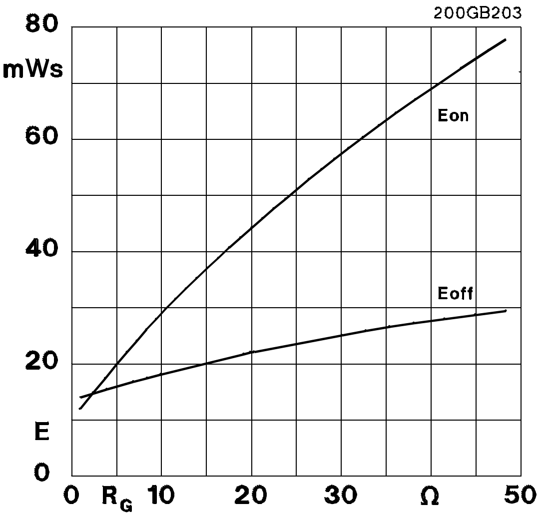


Fig. 1 Rated power dissipation P_{tot} = f (T_C)



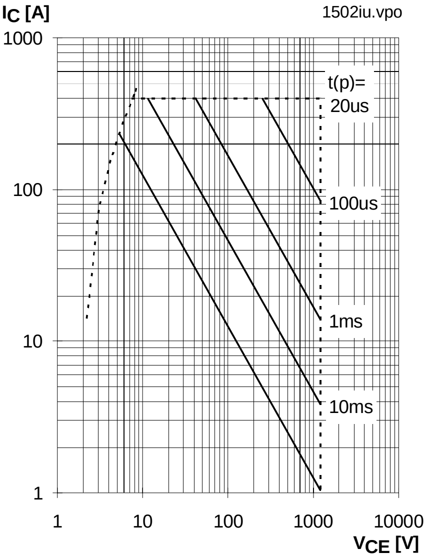
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 5,6 Ω

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 150 A

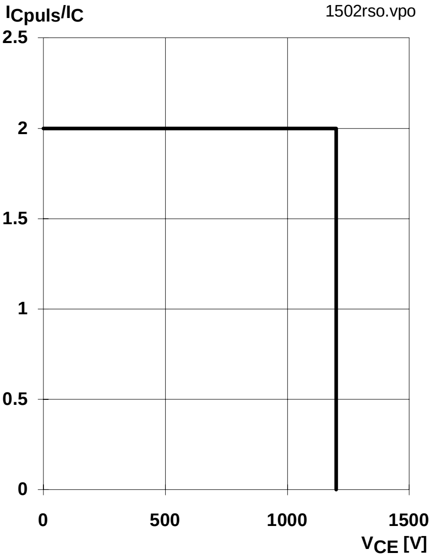
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
T_j ≤ 150 °C

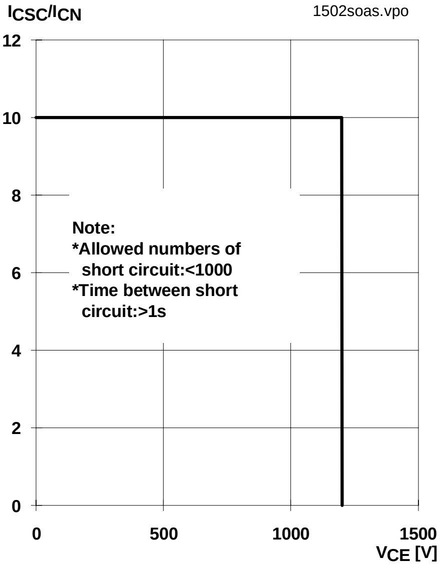
Not for
linear use

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



T_j ≤ 150 °C
V_{GE} = 15 V
R_{Goff} = 5,6 Ω
I_C = 150 A

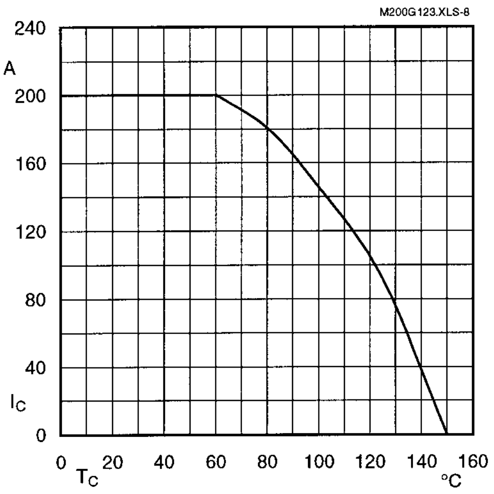
Fig. 5 Turn-off safe operating area (RBSOA)



Note:
***Allowed numbers of short circuit:<1000**
***Time between short circuit:>1s**

T_j ≤ 150 °C
V_{GE} = ± 15 V
t_{sc} ≤ 10 µs
L < 25 nH
I_{CN} = 150 A

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



T_j = 150 °C
$V_{GE} \geq 15$ V

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

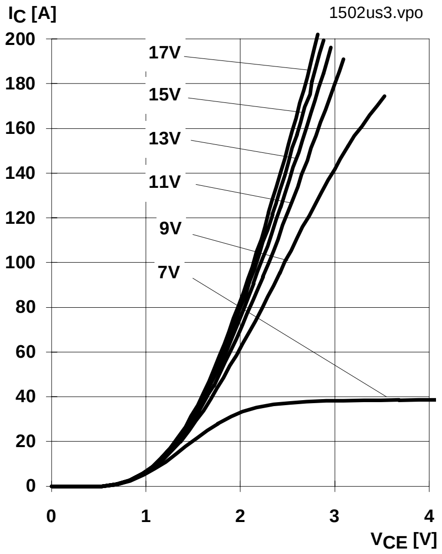


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

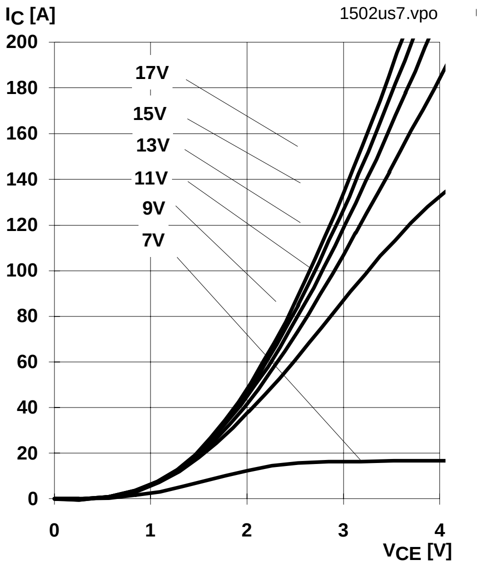


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

$V_{CE(TO)(Tj)} \leq 1{,}5 + 0{,}002\,(T_j - 25)$ [V]

typ.: $r_{CE(Tj)} = 0{,}0066 + 0{,}000027\,(T_j - 25)$ [Ω]

max.: $r_{CE(Tj)} = 0{,}0100 + 0{,}000033\,(T_j - 25)$ [Ω]

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

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

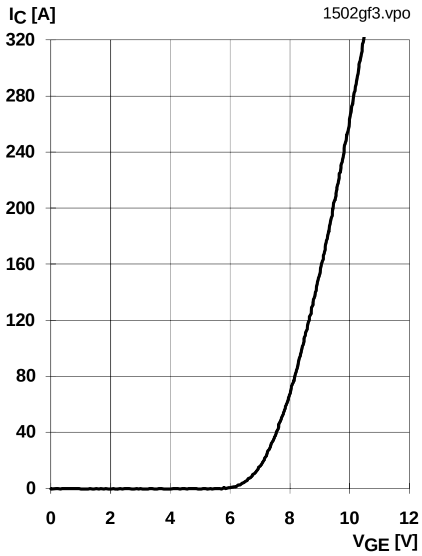
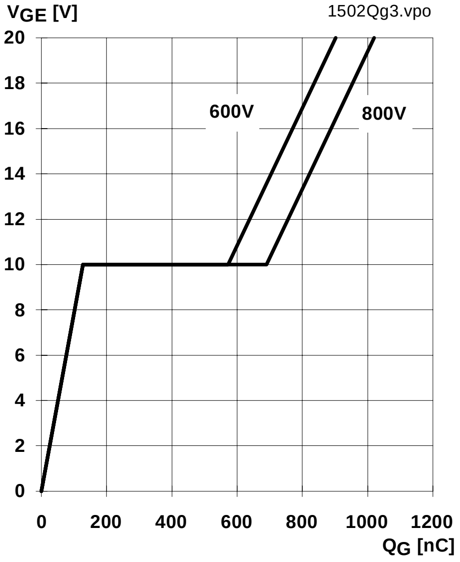
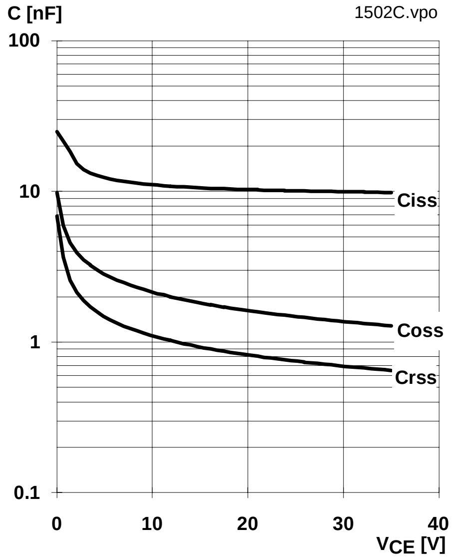


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



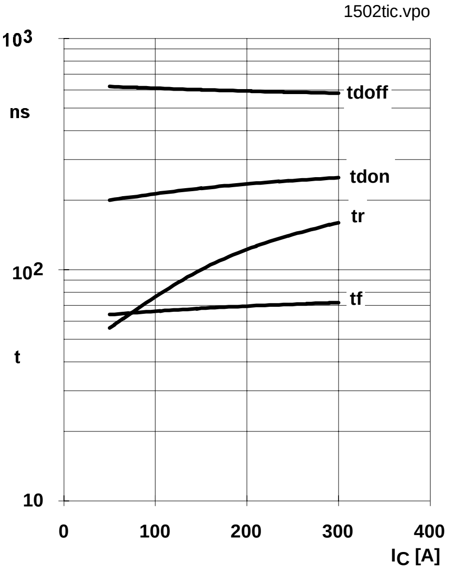
I_{Cpuls} = 150 A

Fig. 13 Typ. gate charge characteristic



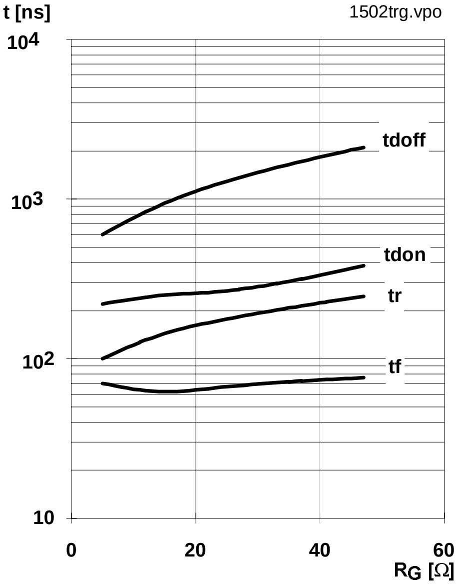
V_{GE} = 0 V
f = 1 MHZ

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{Gon} = 5,6 Ω
R_{Goff} = 5,6 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 = 150 A
induct. load

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

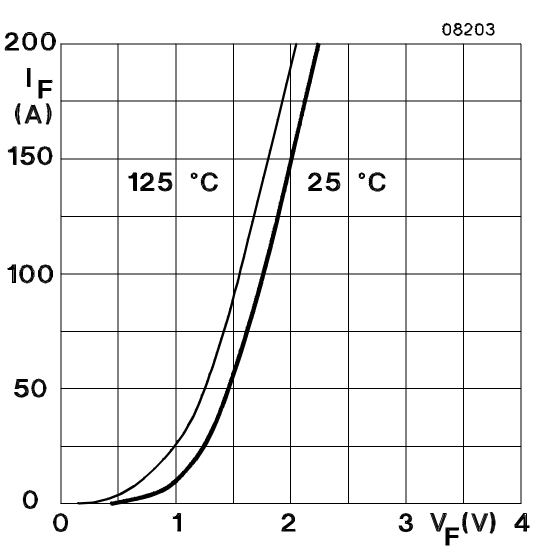


Fig. 17 Typ. CAL diode forward characteristic

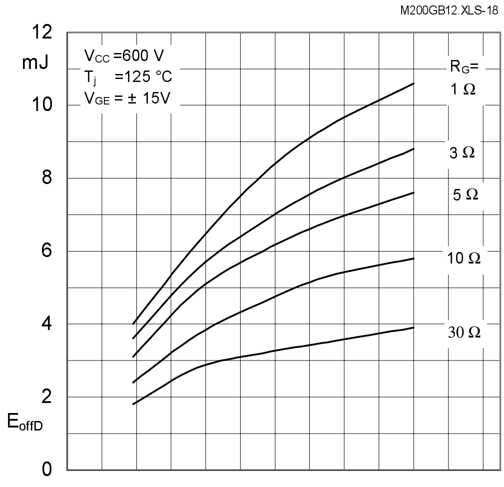


Fig. 18 Diode turn-off energy dissipation per pulse

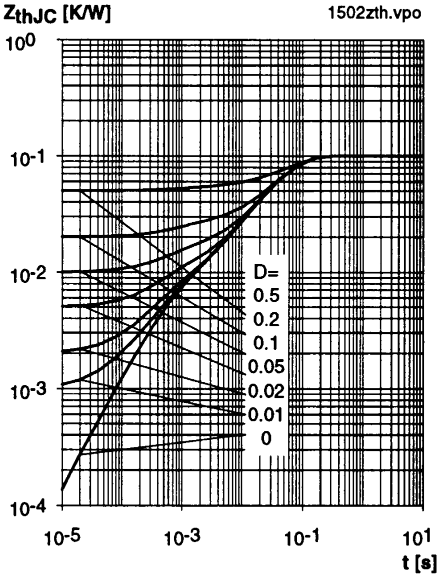


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

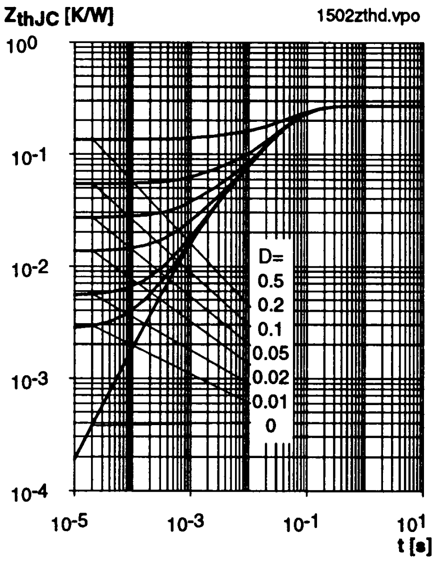


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

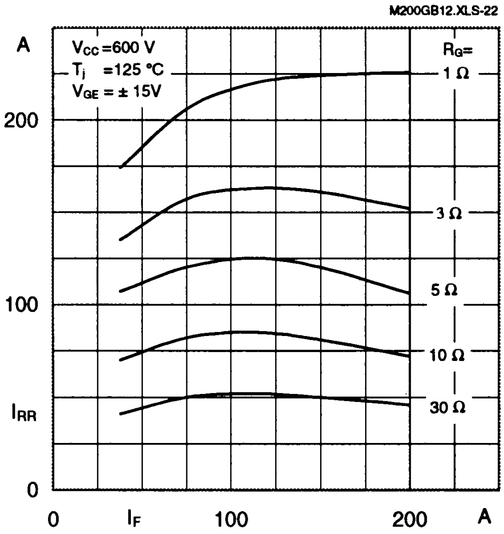


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F, R_G)$

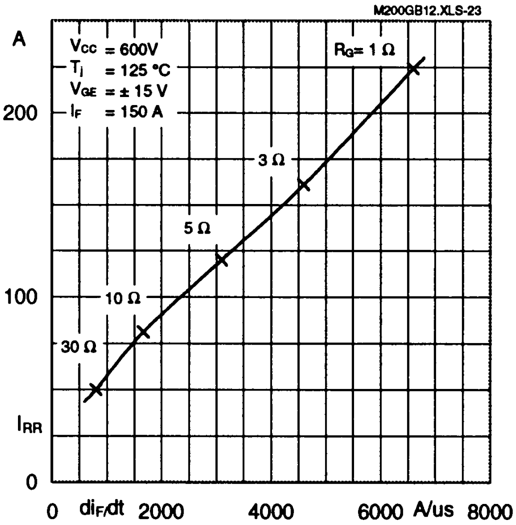


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di_F/dt)$

Typical Applications include

Switched mode power supplies
DC servo and robot drives
Inverters
DC choppers (versions GAR; GAL)
AC motor speed control
Inductive heating
UPS Uninterruptable power supplies
General power switching applications

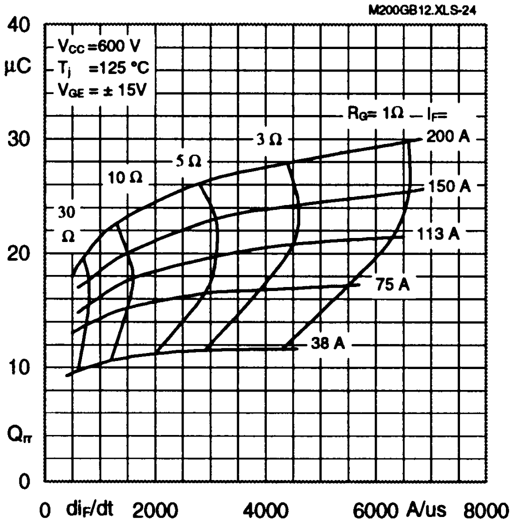
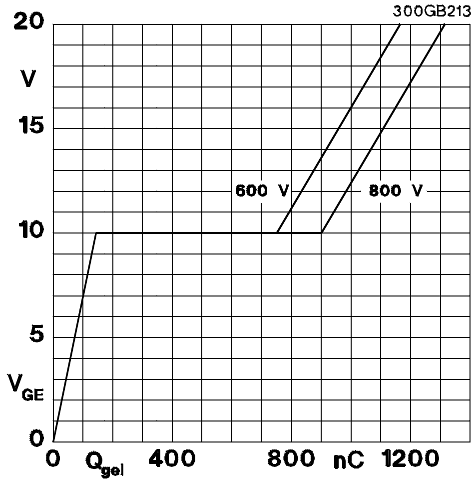
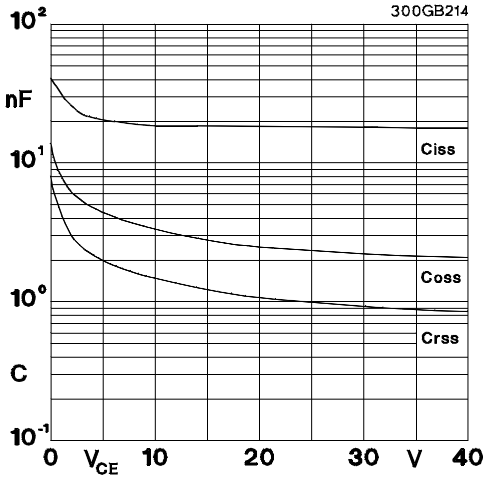


Fig. 24 Typ. CAL diode recovered charge $Q_{RR} = f(di/dt)$



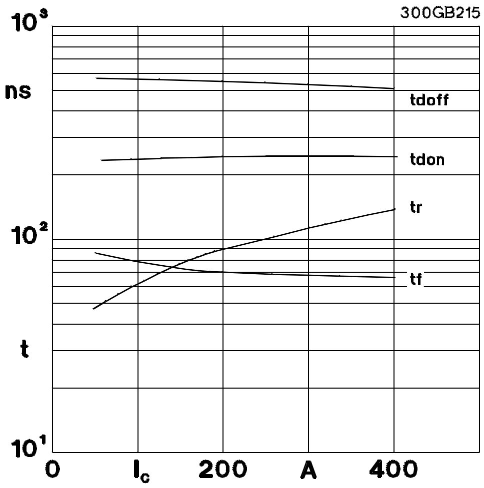
I_{Cpuls} = 300 A

Fig. 13 Typ. gate charge characteristic



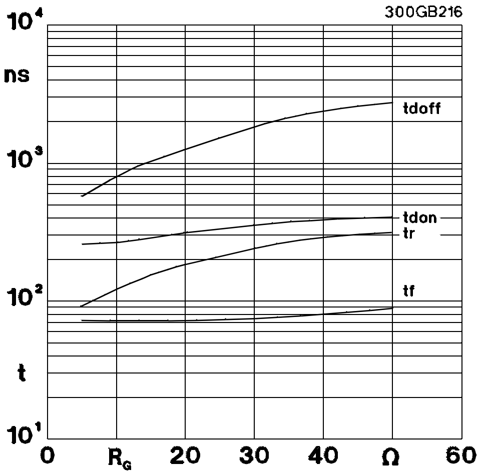
V_{GE} = 0 V
f = 1 MHZ

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{Gon} = 4,7 Ω
R_{Goff} = 4,7 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 = 200 A
induct. load

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

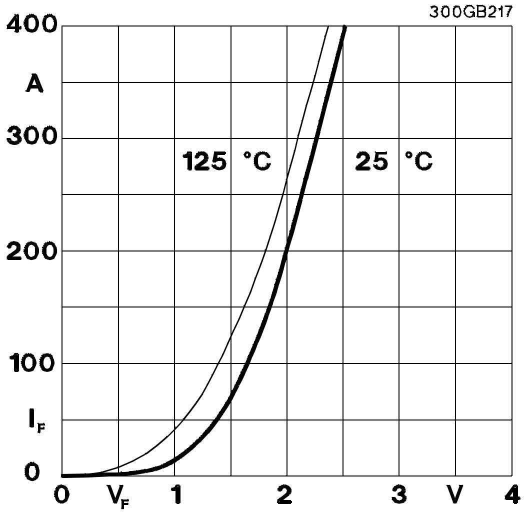


Fig. 17 Typ. CAL diode forward characteristic

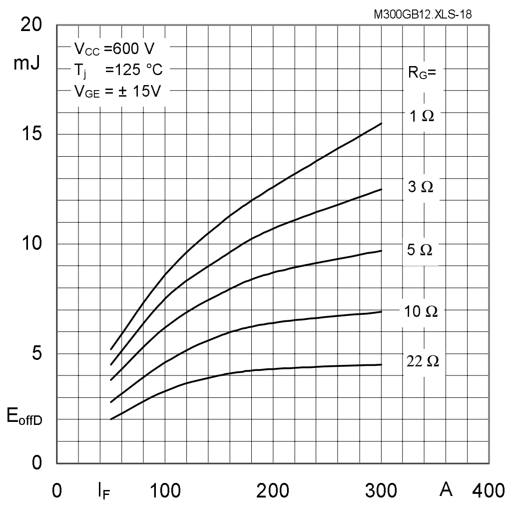


Fig. 18 Diode turn-off energy dissipation per pulse

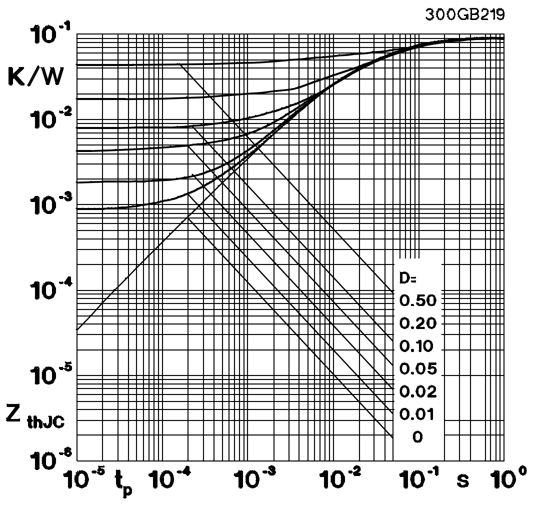


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

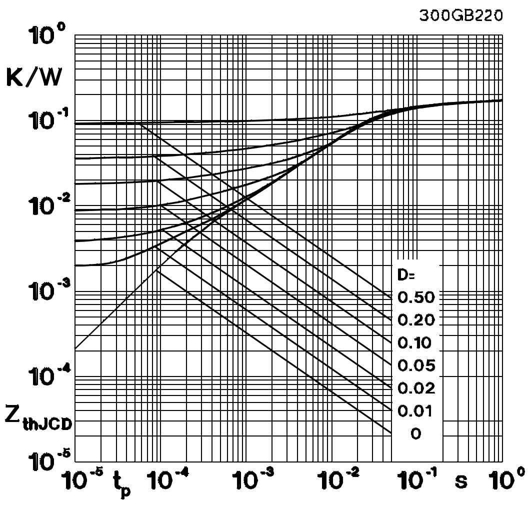


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJCD} = f(t_p)$;

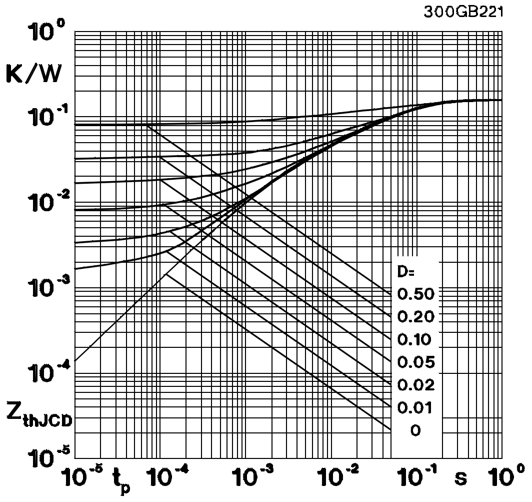


Fig. 21 Transient thermal impedance of the freewheeling diode $Z_{thjCD} \rightarrow$ B 6 – 169, rem. 6)

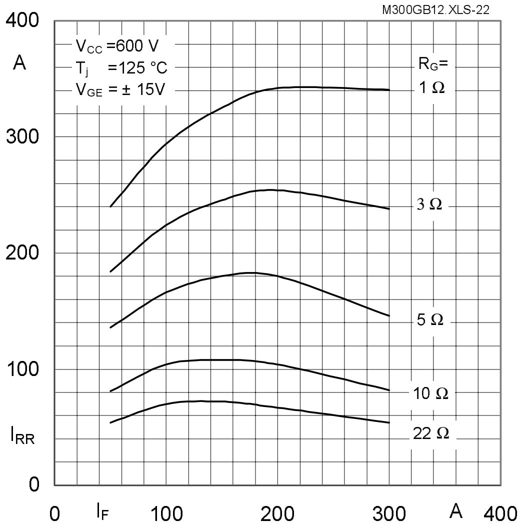


Fig. 22 Typ CAL diode reverse recovery current $I_{RR} = f(I_F; R_G)$

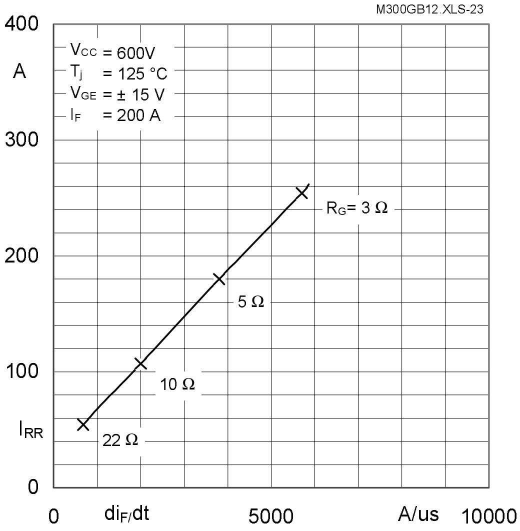


Fig. 23 Typ. CAL diode reverse recovery current $I_{RR} = f(di_F/dt; R_G)$

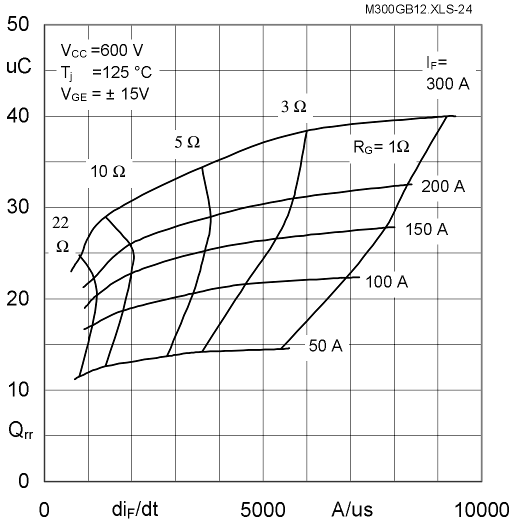


Fig. 24 Typ. CAL diode recovered charge $Q_{rr} = f(di_F/dt; I_F; R_G)$