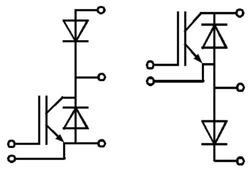
Absolute Maximum Ratings		Values		
Symbol	Conditions [1]			Units
V_{CES}		1200		V
V_{CGR}	R_{GE} = 20 kΩ	1200		V
I_C	T_{case} = 25/80 °C	145 / 110		A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	290 / 220		A
V_{GES}		± 20		V
P_{tot}	per IGBT, T_{case} = 25 °C	830		W
T_j, (T_{stg})		–40 ... +150 (125)		°C
V_{isol}	AC, 1 min.	2500		V
humidity	DIN 40 040	Class F		
climate	DIN IEC 68 T.1	40/125/56		
Diode		Inverse	Series [6]	
$I_F = -I_C$	T_{case} = 25/80 °C	130 / 90	145 / 115	A
$I_{FM} = -I_{CM}$	T_{case} = 25/80 °C; t_p = 1 ms	300 / 220	290 / 220	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	1100	1450	A
I^2t	t_p = 10 ms; T_j = 150 °C	6000	10500	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 = 4 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0, $V_{CE} = V_{CES}$; T_j = 25 °C	–	0,2	2	mA
	V_{GE} = 0, $V_{CE} = V_{CES}$; T_j = 125 °C	–	9	–	mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	1	µA
V_{CEsat}	I_C = 100 A; V_{GE} = 15 V; T_j = 25 (125) °C	–	2,5(3,1)	3(3,7)	V
V_{CEsat}	I_C = 150 A; V_{GE} = 15 V; T_j = 25 (125) °C	–	3(3,8)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 100 A	54	–	–	S
C_{CHC}	per IGBT	–	–	350	pF
C_{ies}	V_{GE} = 0; V_{CE} = 25 V; f = 1 MHz	–	6,5	8,5	nF
C_{oes}	V_{GE} = 0; V_{CE} = 25 V; f = 1 MHz	–	1000	1500	pF
C_{res}	V_{GE} = 0; V_{CE} = 25 V; f = 1 MHz	–	500	600	pF
L_{CE}		–	–	30	nH
$t_{d(on)}$	V_{CC} = 600 V; V_{GE} = +15 V / –15 V [3]; I_C = 100 A, ind. load; $R_{Gon} = R_{Goff}$ = 6,8 Ω; T_j = 125 °C	–	160	320	ns
t_r		–	80	160	ns
$t_{d(off)}$		–	400	520	ns
t_f		–	70	100	ns
E_{on} [5]		–	16	–	mWs
E_{off} [5]		–	12	–	mWs
Inverse Diode [8]					
$V_F = V_{EC}$	I_F = 100 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,0(1,8)	2,5	V
$V_F = V_{EC}$	I_F = 150 A; V_{GE} = 0 V; 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	–	8	11	mΩ
I_{RRM}	I_F = 100 A; T_j = 25 (125) °C [2]	–	35(50)	–	A
Q_{rr}	I_F = 100 A; T_j = 25 (125) °C [2]	–	5(14)	–	µC
Series Diode [6] [8]					
$V_F = V_{EC}$	I_F = 100 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	1,9(1,7)	2,4	V
$V_F = V_{EC}$	I_F = 150 A; V_{GE} = 0 V; T_j = 25 (125) °C	–	2,1(1,8)	–	V
V_{TO}	T_j = 125 °C	–	–	1,2	V
r_T	T_j = 125 °C	–	–	7	mΩ
I_{RRM}	I_F = 100 A; T_j = 25 (125) °C [2]		40(65)	–	A
Q_{rr}	I_F = 100 A; T_j = 25 (125) °C [2]	–	5(15)	–	µC
Thermal characteristics					
R_{thjc}	per IGBT	–	–	0,15	°C/W
R_{thjc}	per inverse/series diode [6]	–	–	0,36/0,30	°C/W
R_{thch}	per module	–	–	0,05	°C/W

SEMITRANS® M IGBT Modules

SKM 145 GAX 123 D [6]
SKM 145 GAY 123 D [6]

SEMITRANS 2



GAX GAY

Features

- N channel, Homogeneous Silicon structure (NPT-IGBT)
- 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 (10 mm) and creepage distances (20 mm).

Typical Applications

- Switching (not for linear use)
- Bidirectional switches
- Regenerative Braking
- Quasi resonant inverters (CSI)

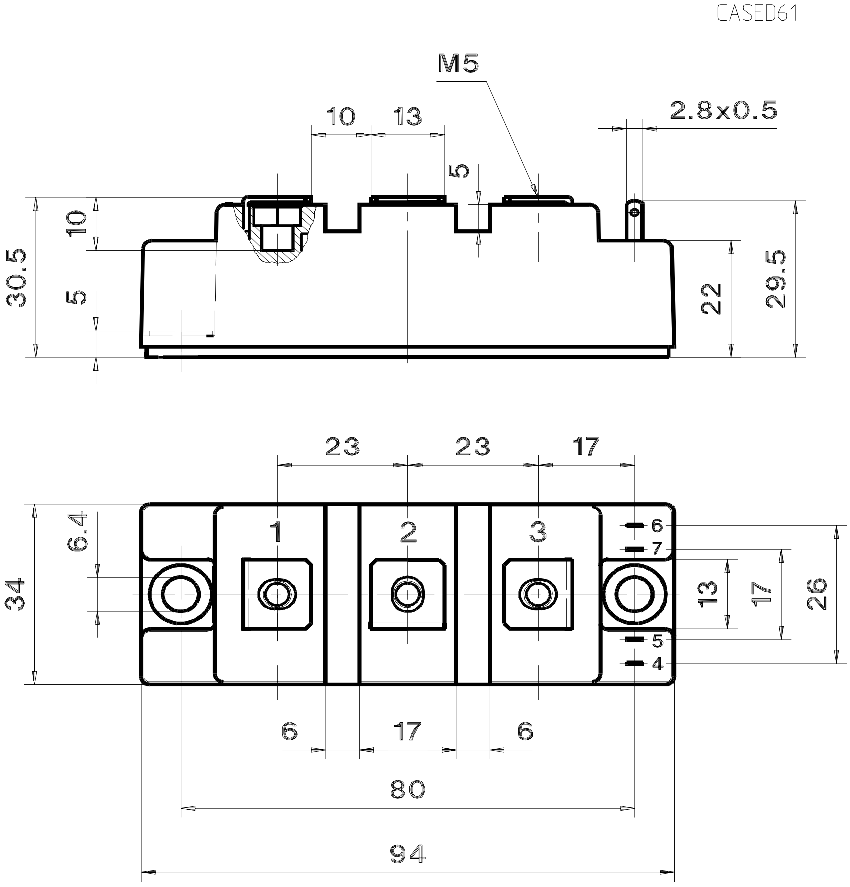
[1] T_{case} = 25 °C, unless otherwise specified
[2] $I_F = -I_C$, V_R = 600 V, $-di_F/dt$ = 1000 A/µs, V_{GE} = 0 V
[3] Use V_{GEoff} = –5 ... –15 V
[5] See fig. 2 + 3; R_{Goff} = 6,8 Ω
[6] The series diodes have the data of the inverse diodes of SKM 200 GB 123 D
[8] CAL = Controlled Axial Lifetime Technology.

Cases and mech. data → B 6 – 130
Diagrams of IGBT and inverse diode → B 6 – 124, of series diode on B 6 – 152 to 153

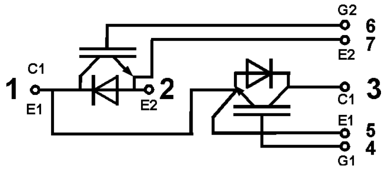
SKM 145 GAX(Y) 123 D

SEMITRANS 2

Case D 61
UL Recognized
File no. E 63 532



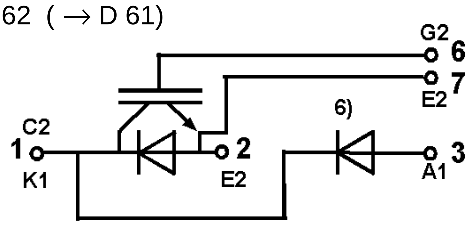
SKM 145 GB 123 D



Dimensions in mm

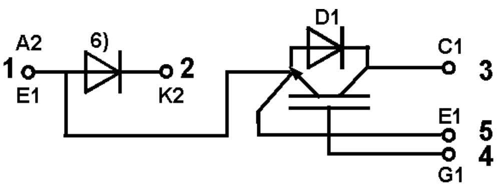
SKM 145 GAX 123 D

Case D 62 (→ D 61)



SKM 145 GAY 123 D

Case D 63 (→ D 61)



Case outline and circuit diagrams

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	(M5)	2,5	–	5	Nm
	for terminals, US Units		22	–	44	lb.in.
a			–	–	5x9,81	m/s^2
w			–	–	160	g

6) Series diode → B 6 – 129, 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.

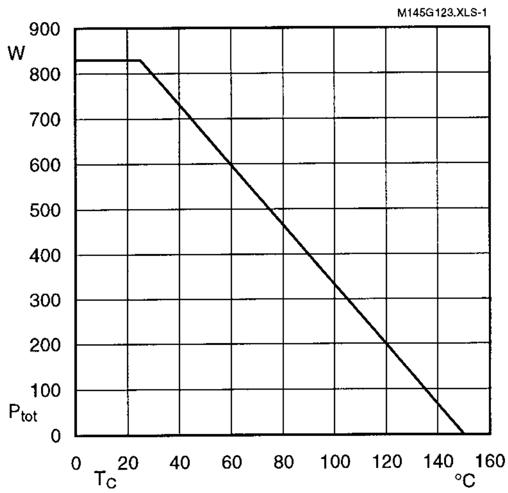
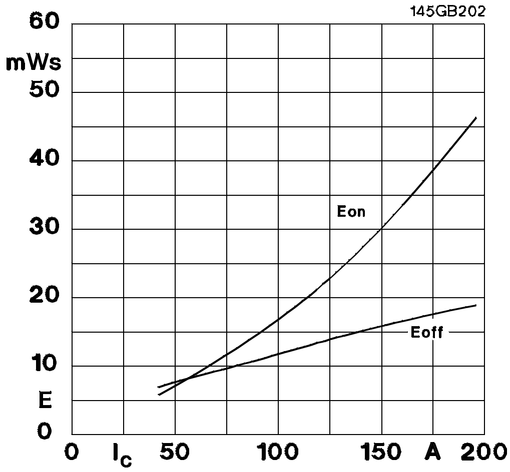
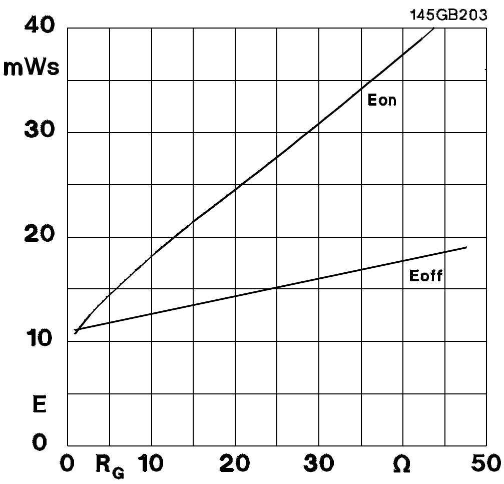


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$



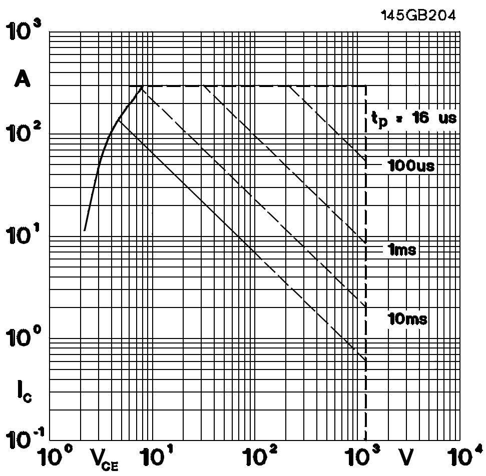
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 6,8 Ω

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
I_C = 100 A

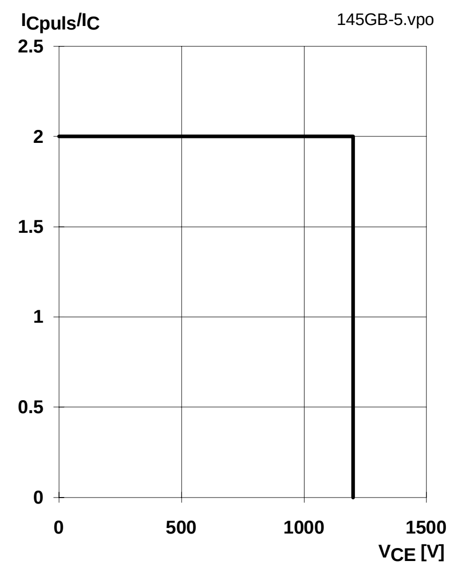
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
T_j ≤ 150 °C

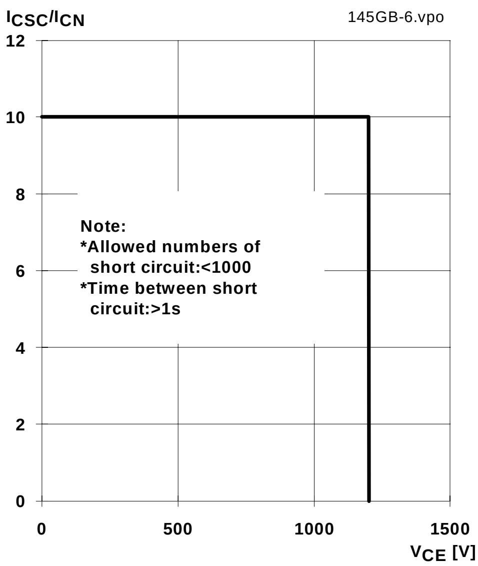
Not for linear use

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



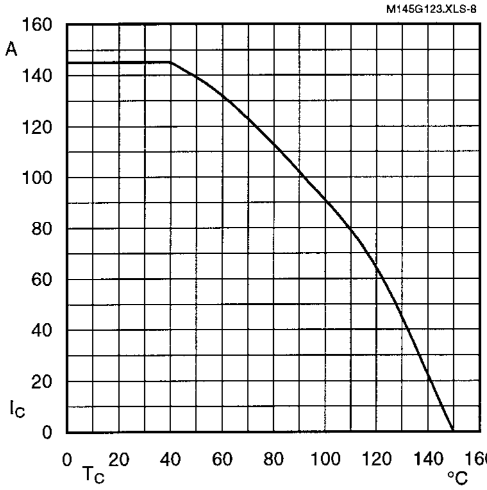
T_j ≤ 150 °C
V_{GE} = 15 V
R_{Goff} = 6,8 Ω
I_C = 100 A

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



T_j ≤ 150 °C
V_{GE} = ± 15 V
t_{sc} ≤ 10 µs
L < 25 nH
I_{CN} = 100 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 $I_C = f(T_C)$

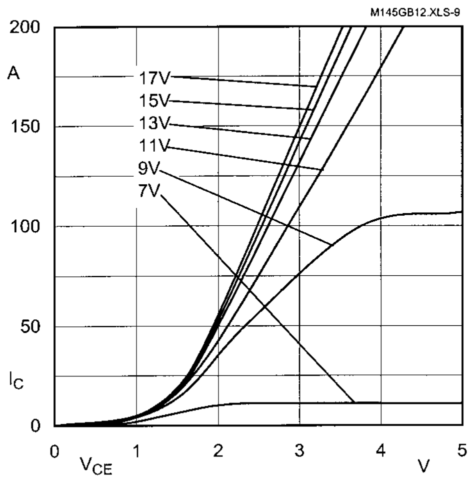


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

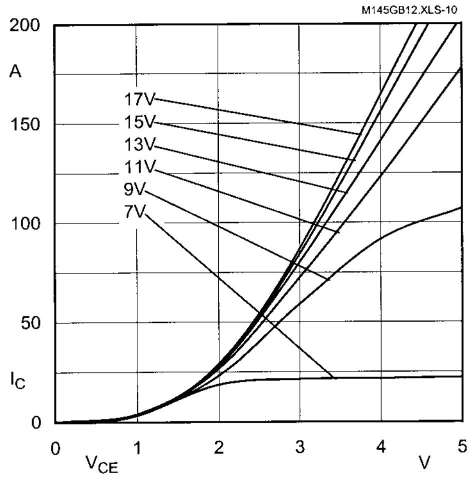


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

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

typ.: $r_{CE(Tj)} = 0{,}010 + 0{,}00004\ (T_j - 25)$ [Ω]

max.: $r_{CE(Tj)} = 0{,}015 + 0{,}00005\ (T_j - 25)$ [Ω]

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

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

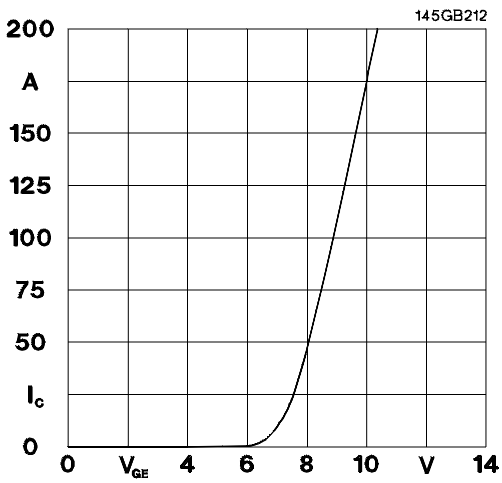
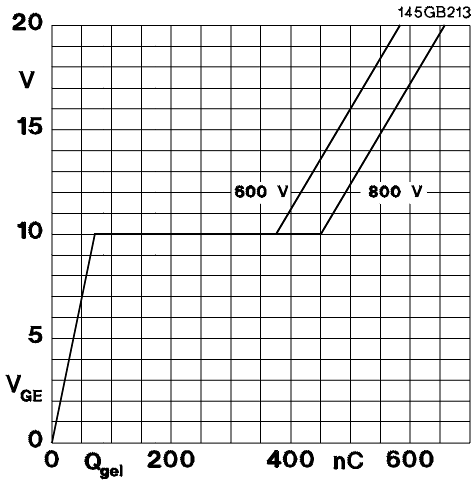
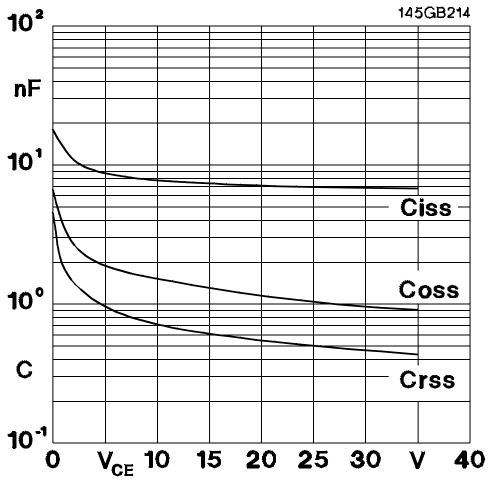


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



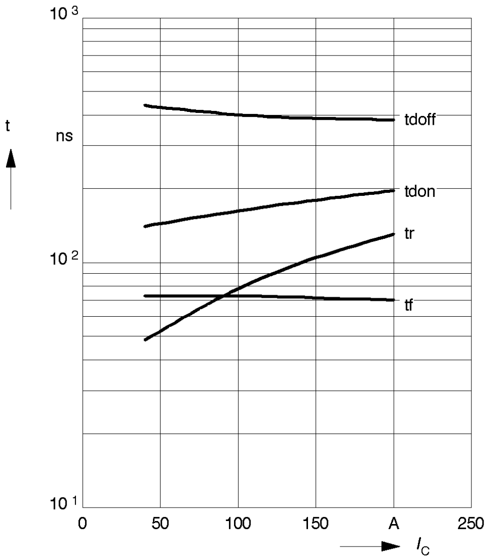
I_{Cpuls} = 100 A

Fig. 13 Typ. gate charge characteristic



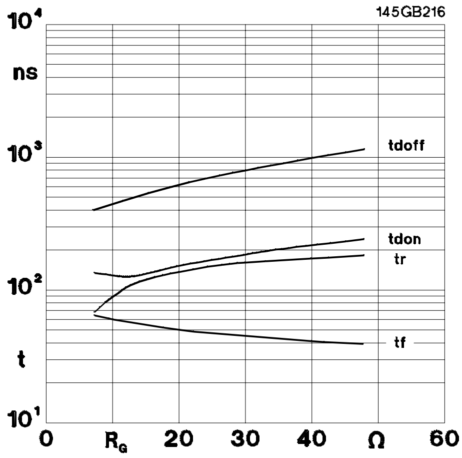
V_{GE} = 0 V
f = 1 MHZ

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{Gon} = 6,8 Ω
R_{Goff} = 6,8 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 = 100 A
induct. load

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

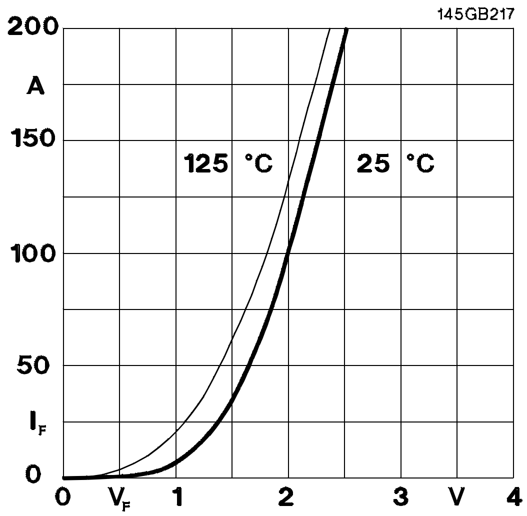


Fig. 17 Typ. CAL diode forward characteristic

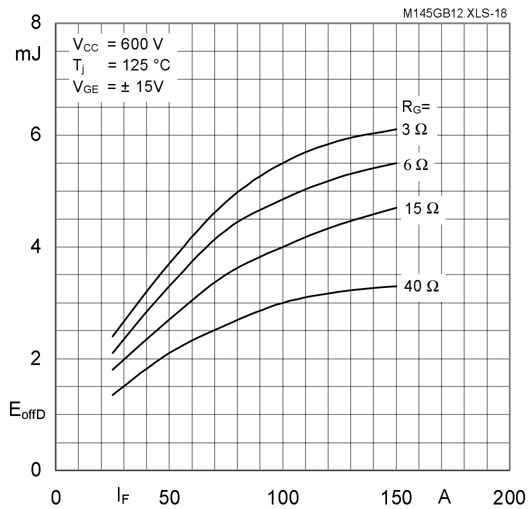


Fig. 18 Diode turn-off energy dissipation per pulse

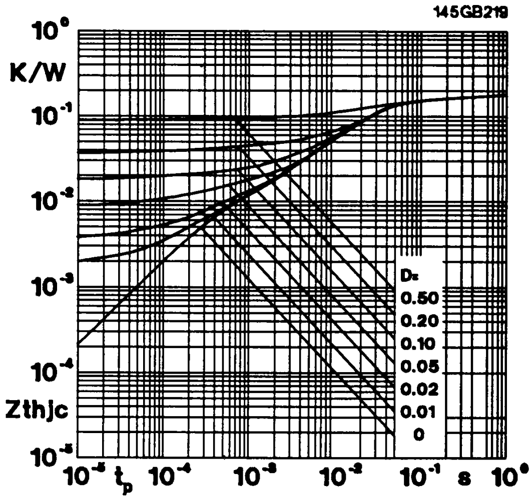


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

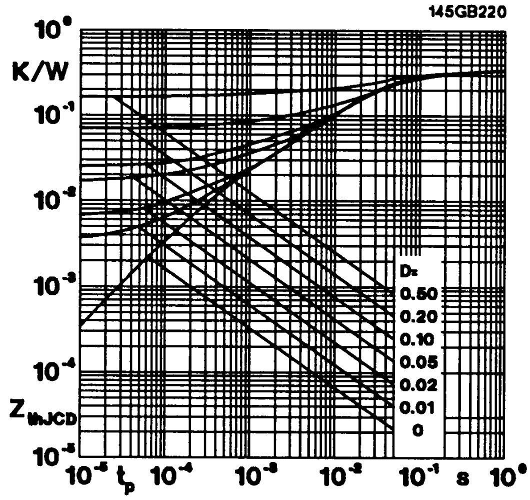


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

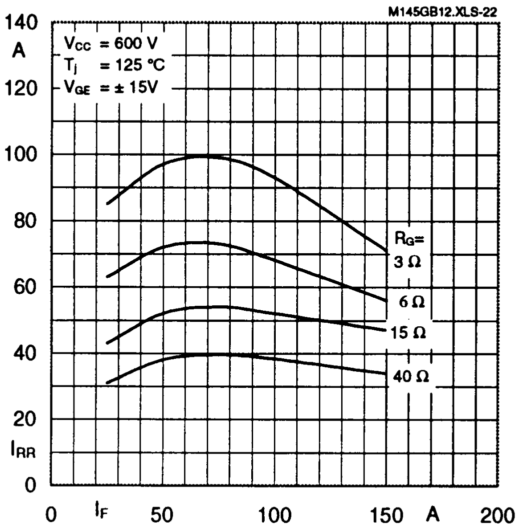


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

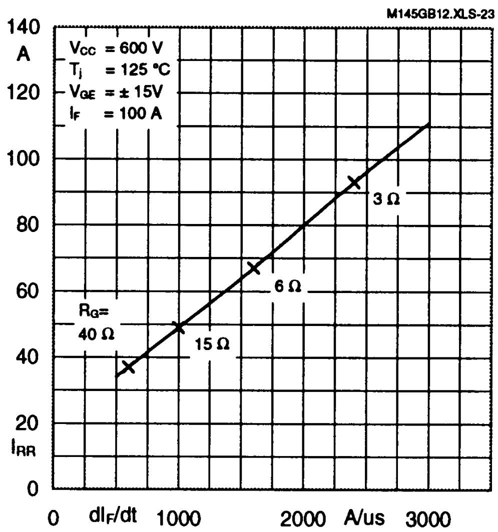


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di/dt)$

Typical Applications include

Switched mode power supplies

DC servo and robot drives

Inverters

DC choppers (versions GAL and GAR)

AC motor speed control

Inductive heating

UPS Uninterruptable power supplies

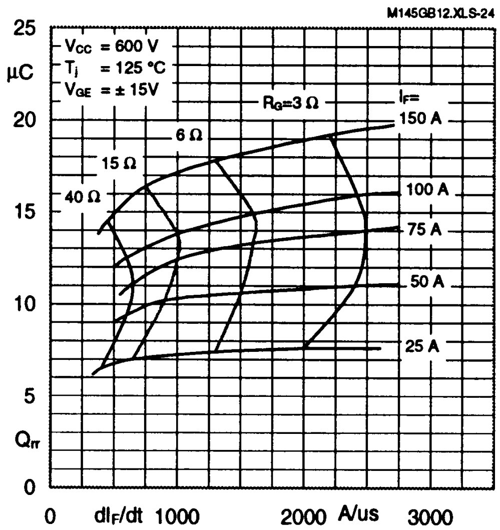
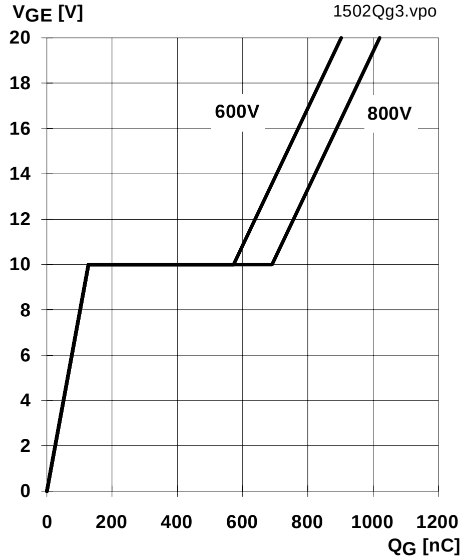
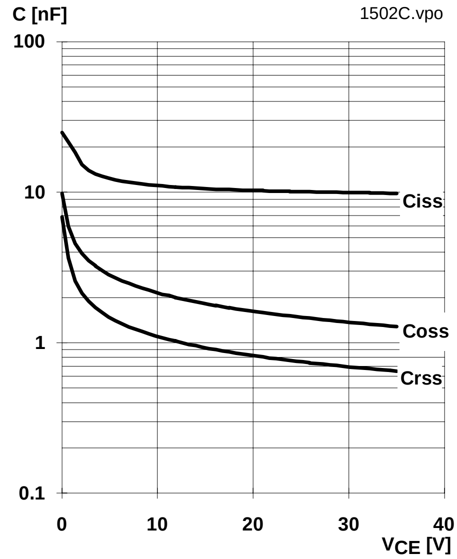


Fig. 24 Typ. CAL diode recovered charge $Q_{rr} = f(di/dt)$



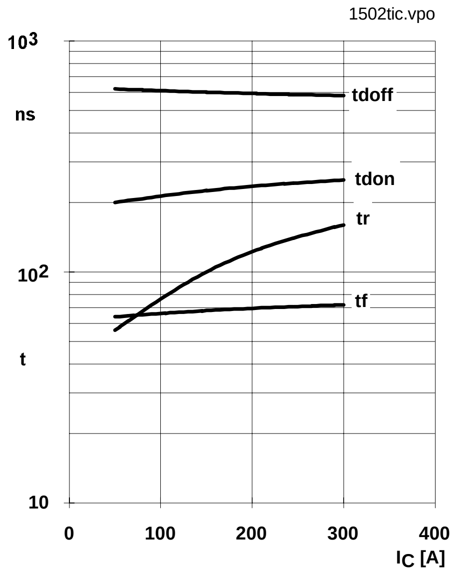
I_{Cpuls} = 150 A

Fig. 13 Typ. gate charge characteristic



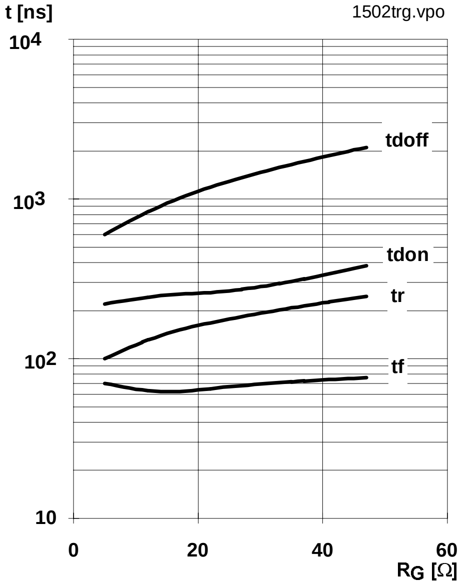
V_{GE} = 0 V
f = 1 MHZ

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

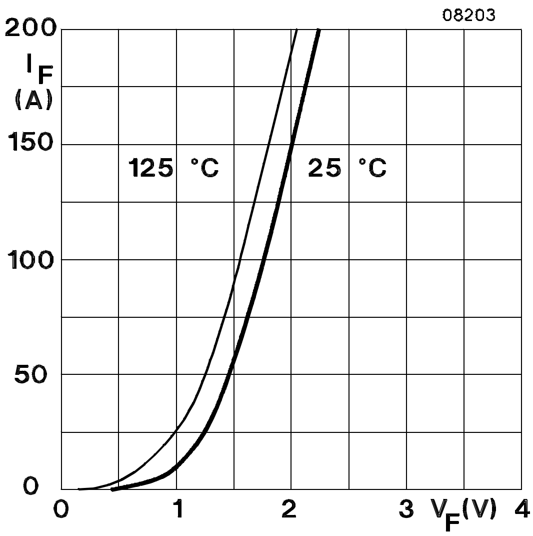


Fig. 17 Typ. CAL diode forward characteristic

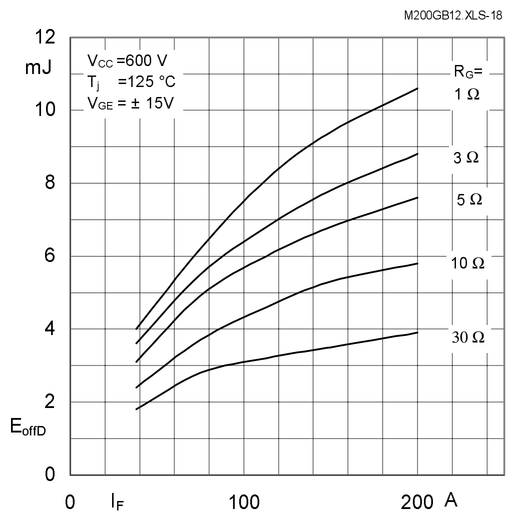


Fig. 18 Diode turn-off energy dissipation per pulse

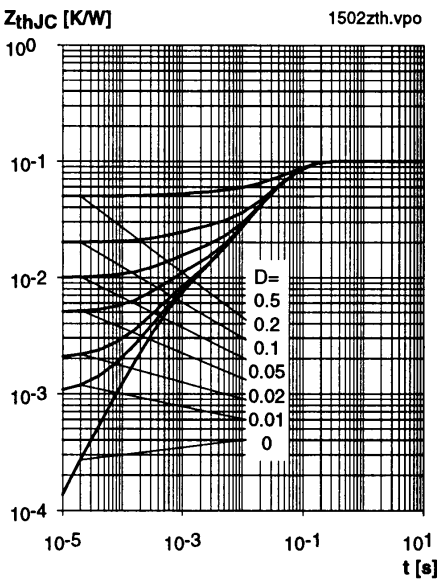


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

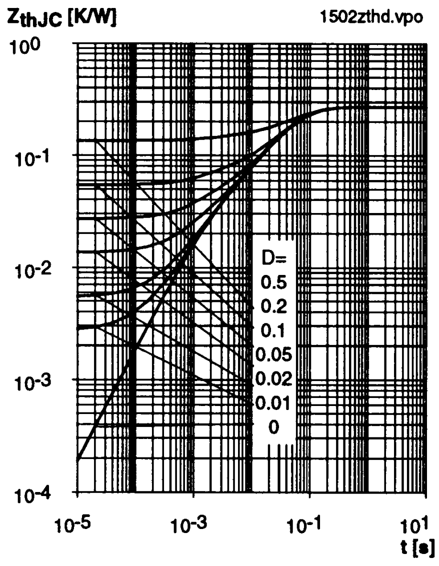


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

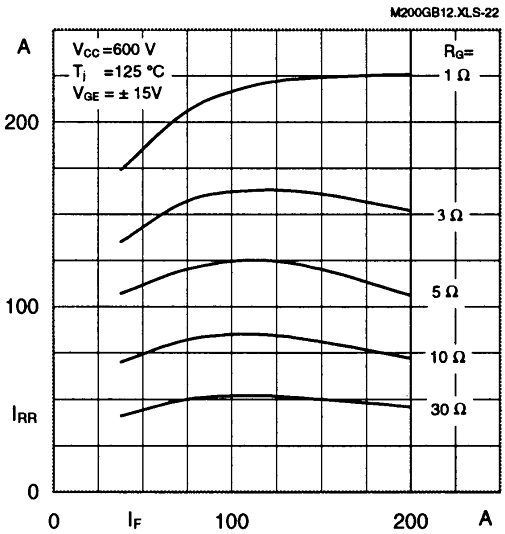


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F, R_G)$

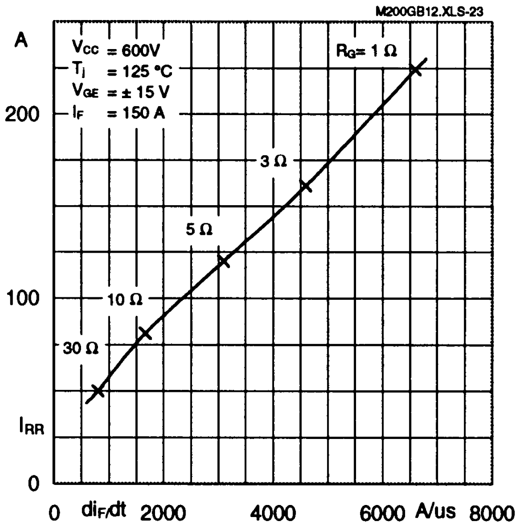


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di_F/dt)$

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

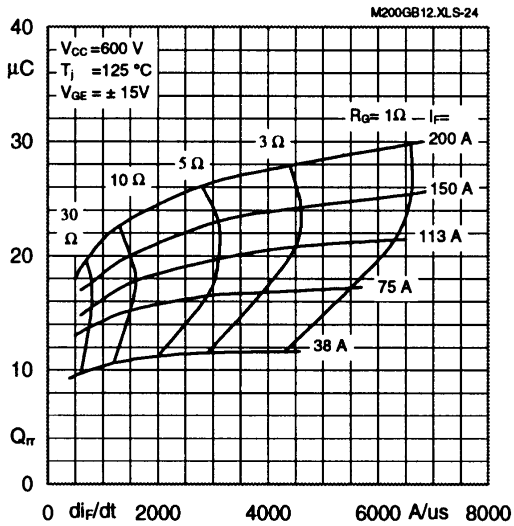


Fig. 24 Typ. CAL diode recovered charge $Q_{RR}=f(di/dt)$