SEMIKRON

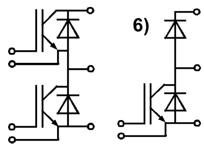
Absolute Maximum Ratings Symbol	Conditions [1]	Values	Units
V_{CES}		1700	V
V_{CGR}	R_{GE} = 20 kΩ	1700	V
I_C	T_{case} = 25/80 °C	160 / 110	A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	320 / 220	A
V_{GES}		± 20	V
P_{tot}	per IGBT, T_{case} = 25 °C	780	W
T_j, (T_{stg})		–40 ... + 150 (125)	°C
V_{isol}	AC, 1 min.	3 400	V
humidity	IEC 60721-3-3	class 3K7/IE32	
climate	IEC 68 T.1	40/125/56	
Inverse Diode and FWD of type „GAL“[6)8)]			
$I_F = -I_C$	T_{case} = 25/80 °C	145 / 100	A
$I_{FM} = -I_{CM}$	T_{case} = 25/80 °C; t_p = 1 ms	320 / 220	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	720	A
I^2t	t_p = 10 ms; T_j = 150 °C	2600	A^2s

Characteristics Symbol	Conditions [1]	min.	typ.	max.	Units
$V_{(BR)CES}$	V_{GE} = 0, I_C = 5 mA	≥ V_{CES}	–	–	V
$V_{GE(th)}$	$V_{GE} = V_{CE}$, I_C = 5 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0; T_j = 25 °C	–	0,1	0,3	mA
	$V_{CE} = V_{CES}$; T_j = 125 °C	–	4	–	mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	0,2	µA
V_{CEsat}	I_C = 100 A; V_{GE} = 15 V;	–	2,6(3,2)	3,3(3,6)	V
V_{CEsat}	I_C = 150 A; T_j = 25 (125) °C	–	3,2(3,8)	3,8(4,2)	V
g_{fs}	V_{CE} = 20 V, I_C = 100 A	36	–	–	S
C_{CHC}	per IGBT	–	–	350	pF
C_{ies}	V_{GE} = 0	–	7	8,5	nF
C_{oes}	V_{CE} = 25 V	–	1100	1500	pF
C_{res}	f = 1 MHz	–	400	600	pF
L_{CE}		–	–	25	nH
$t_{d(on)}$	V_{CC} = 1200 V	–	90	–	ns
t_r	V_{GE} = –15 V / +15 V[3)]	–	80	–	ns
$t_{d(off)}$	I_C = 100 A, ind. load	–	900	–	ns
t_f	$R_{Gon} = R_{Goff}$ = 15 Ω	–	80	–	ns
E_{on} [5)]	T_j = 125 °C (V_{CC} = 900 V/1200 V)	–	50/70	–	mWs
E_{off} [5)]	L_s = 60 nH (V_{CC} = 900 V/1200 V)	–	30/45	–	mWs
Inverse Diode and FWD of type „GAL“[6)8)]					
$V_F = V_{EC}$	I_F = 100 A; V_{GE} = 0 V;	–	2,2(1,9)	2,7(2,4)	V
$V_F = V_{EC}$	I_F = 150 A; 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	–	7	9	mΩ
I_{RRM}	I_F = 100 A; T_j = 125 °C[2)]	–	90	–	A
Q_{rr}	I_F = 100 A; T_j = 125 °C[2)]	–	27	–	µC
Thermal characteristics					
R_{thjc}	per IGBT	–	–	0,16	°C/W
R_{thjc}	per diode	–	–	0,30	°C/W
R_{thch}	per module	–	–	0,05	°C/W

SEMITRANS® M
Low Loss IGBT Modules

SKM 145 GB 174 DN
SKM 145 GAL 174 DN

SEMITRANS 2N (low inductance)



GB **GAL**

Features

- N channel, homogeneous Silicon structure (NPT- Non punch-through IGBT)
- Low inductance case
- High short circuit capability, self limiting
- Fast & soft inverse CAL diodes [8)]
- Without hard mould
- Large clearance (10 mm) and creepage distances (20 mm)

Typical Applications

- AC inverter drives on mains
- 575 - 750 V AC
- 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
3) Use V_{GEoff} = –5... –15 V
5) See fig. 2 + 3; R_{Goff} = 15 Ω
6) The free-wheeling diode of the GAL type has the data of the inverse diode.
8) CAL = Controlled Axial Lifetime Technology

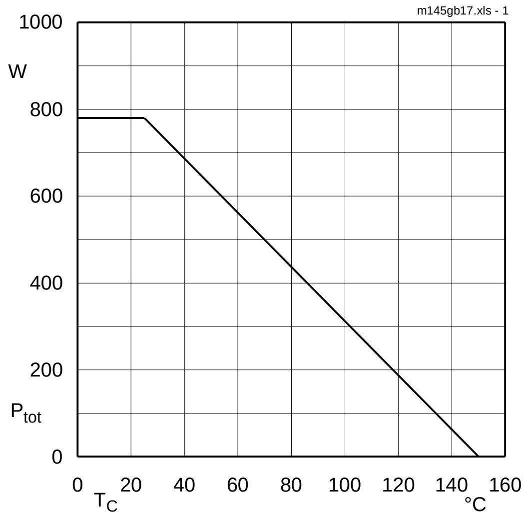


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$

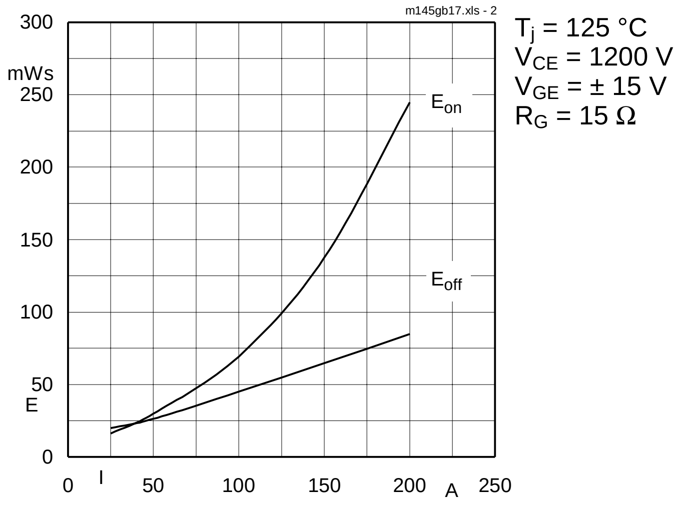


Fig. 2 Turn-on /-off energy = f (I_C)

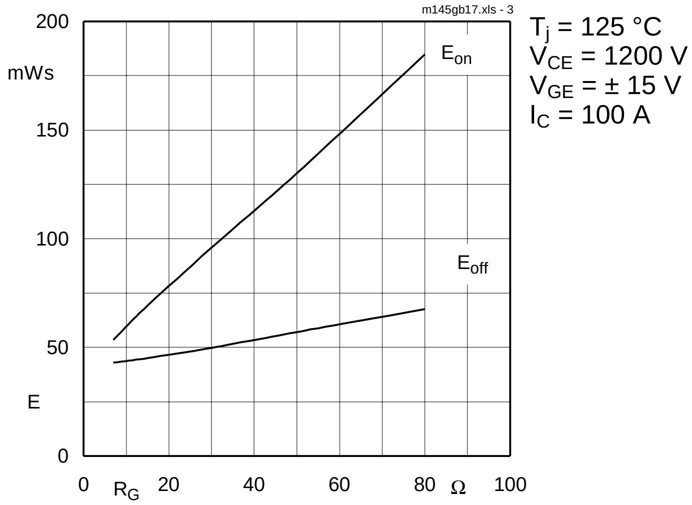


Fig. 3 Turn-on /-off energy = f (R_G)

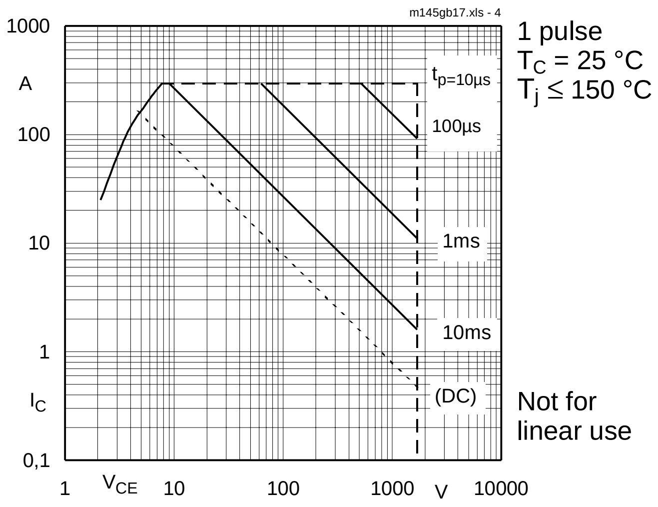


Fig. 4 Maximum safe operating area (SOA) $I_C = f(V_{CE})$

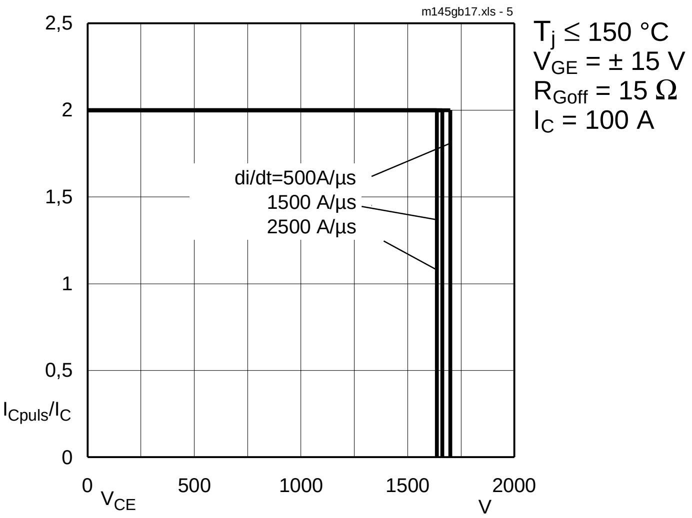


Fig. 5 Turn-off safe operating area (RBSOA)

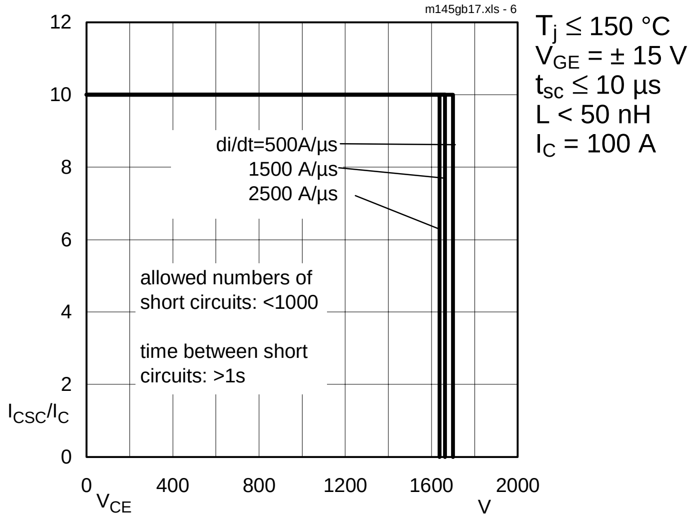


Fig. 6 Safe operating area at short circuit $I_C = f(V_{CE})$

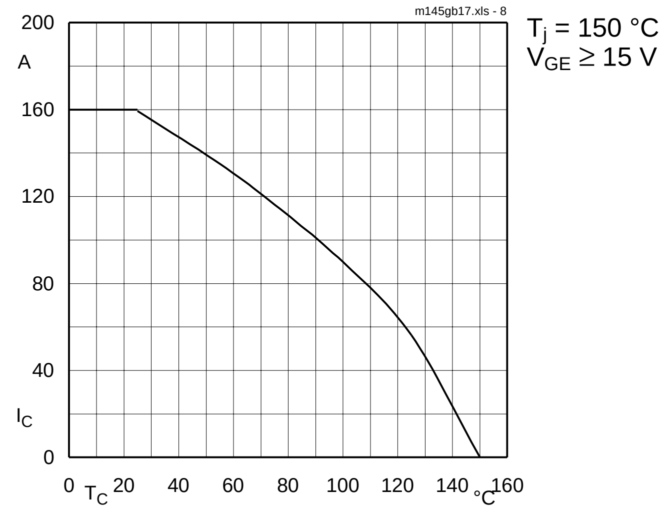


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

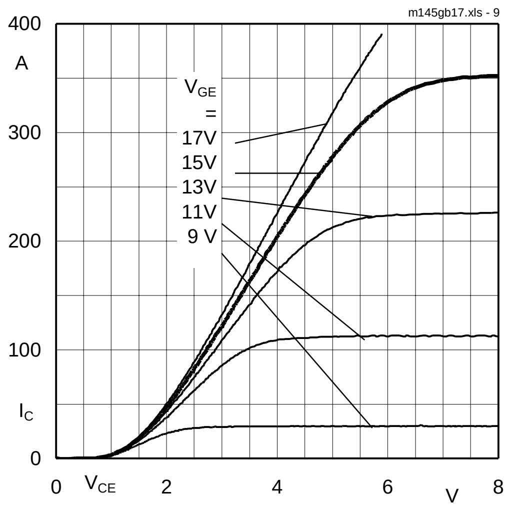


Fig. 9 Typ. output characteristic, t_p = 250 µs; T_j = 25 °C

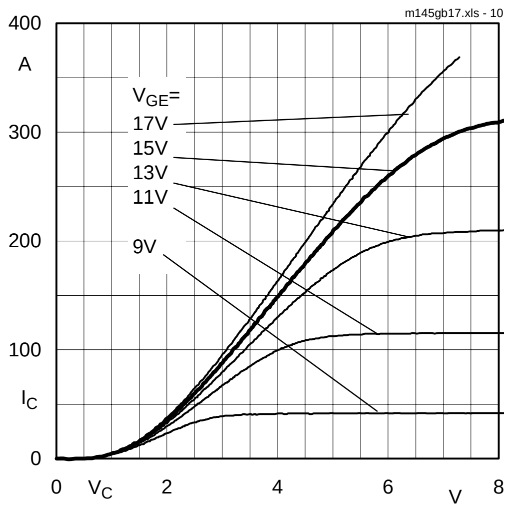


Fig. 10 Typ. output characteristic, t_p = 250 µs; T_j = 125 °C

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

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

$V_{CE(TO)(Tj)} \leq 1{,}5 + 0{,}001\ (T_j - 25)$ [V]

typ.: $r_{CE(Tj)} = 0{,}011 + 0{,}00005\ (T_j - 25)$ [Ω]

max.: $r_{CE(Tj)} = 0{,}0175 + 0{,}000025\ (T_j - 25)$ [Ω]

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

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

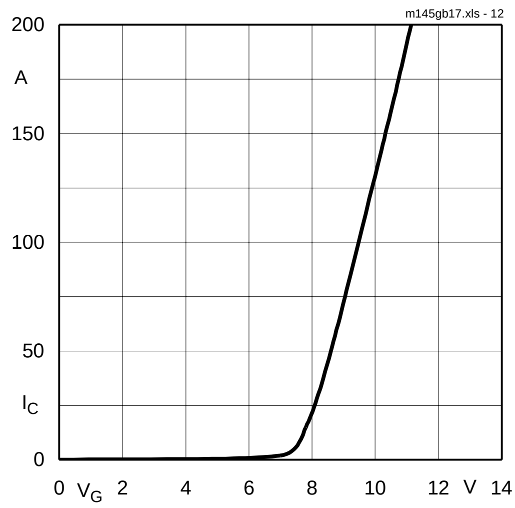


Fig. 12 Typ. transfer characteristic, t_p = 250 µs; V_{CE} = 20 V

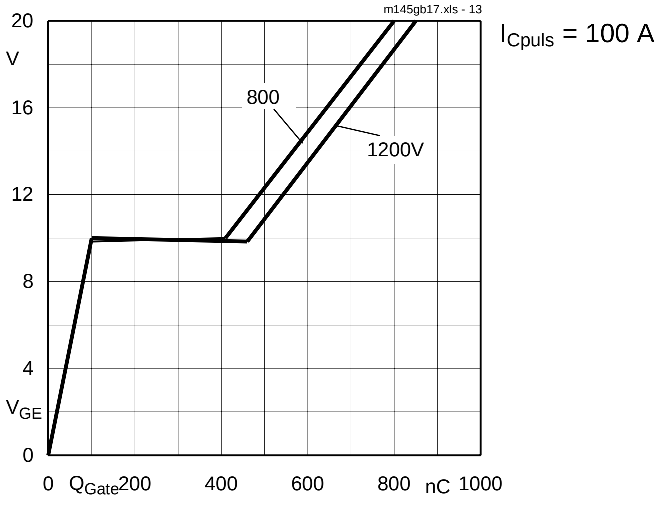


Fig. 13 Typ. gate charge characteristic

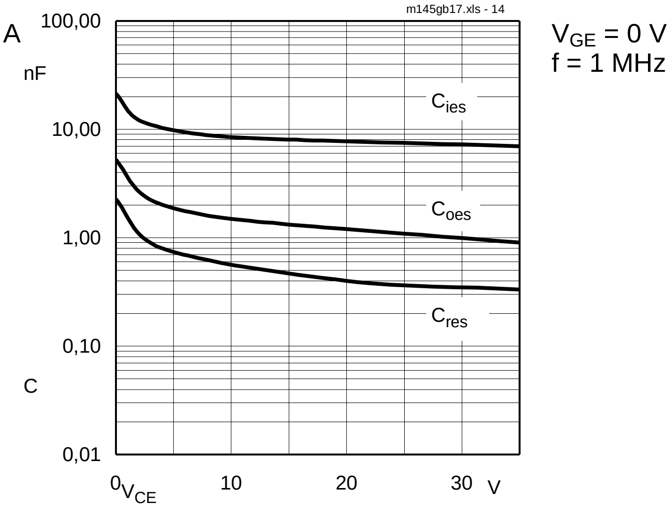


Fig. 14 Typ. capacitances vs. V_{CE}

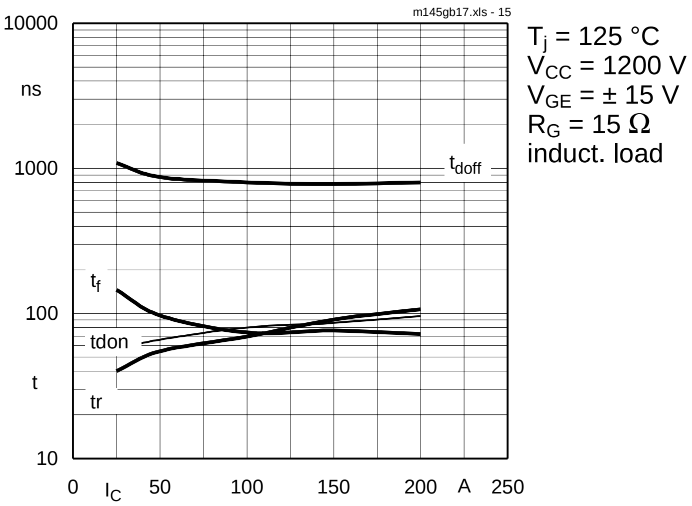


Fig. 15 Typ. switching times vs. I_C

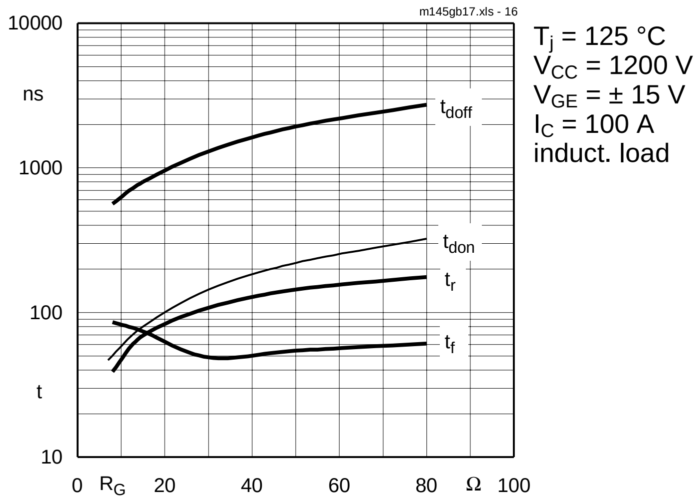


Fig. 16 Typ. switching times vs. gate resistor R_G

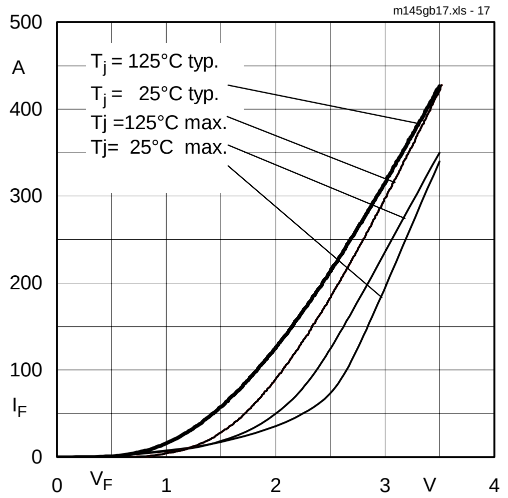


Fig. 17 Typ. CAL diode forward characteristic

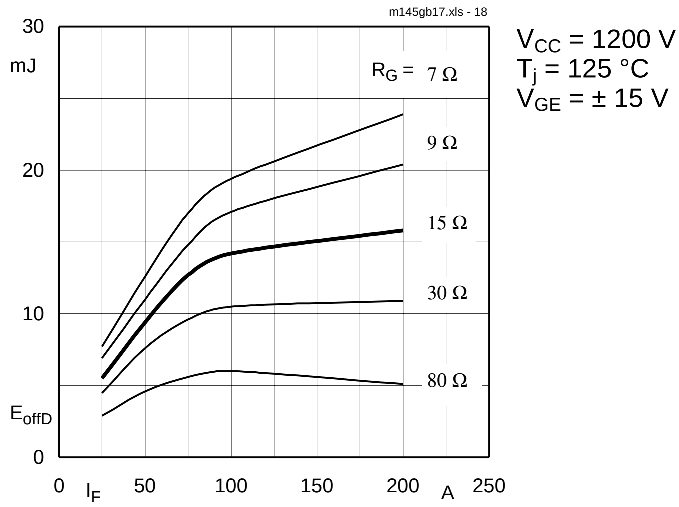


Fig. 18 Diode turn-off energy dissipation per pulse

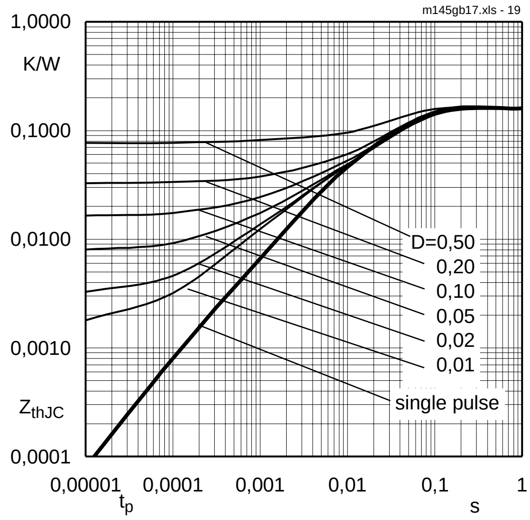


Fig. 19 Transient thermal impedance of IGBT
$Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

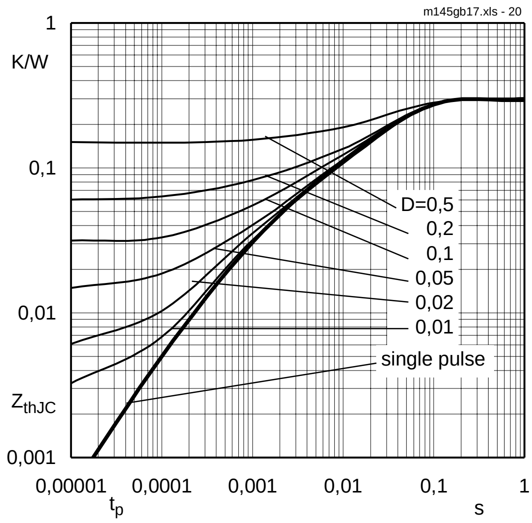


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

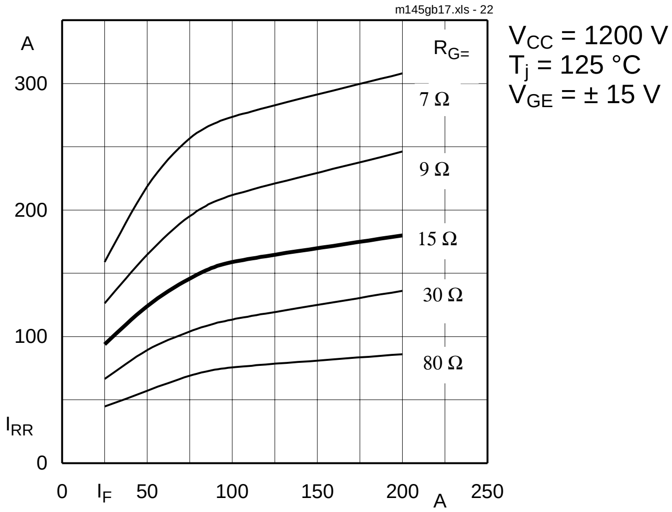


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

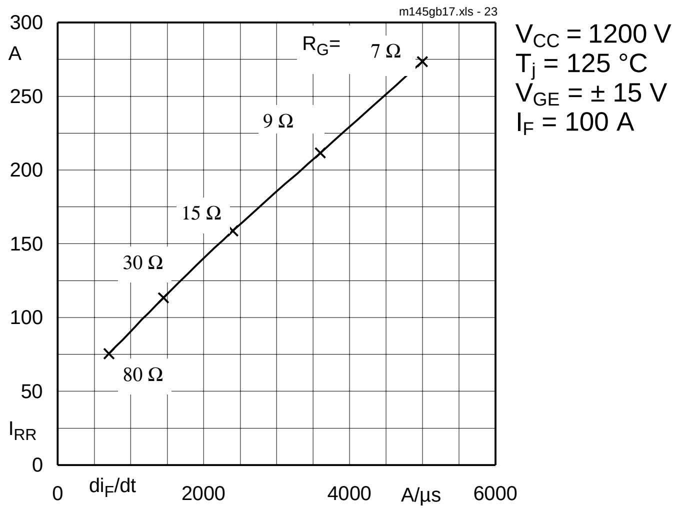


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di/dt)$

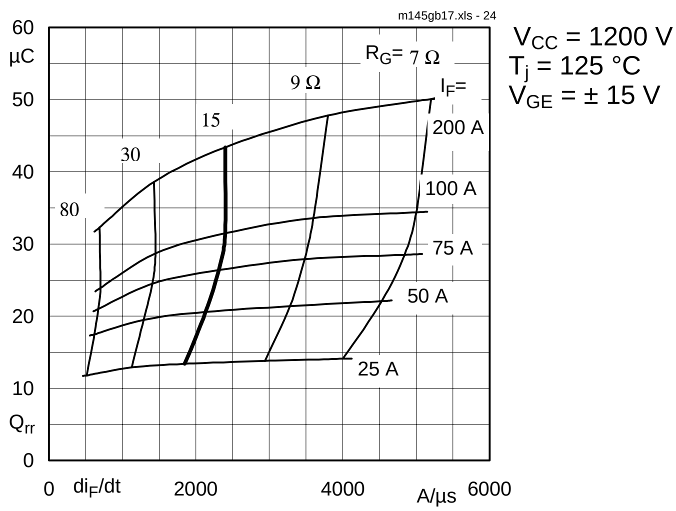
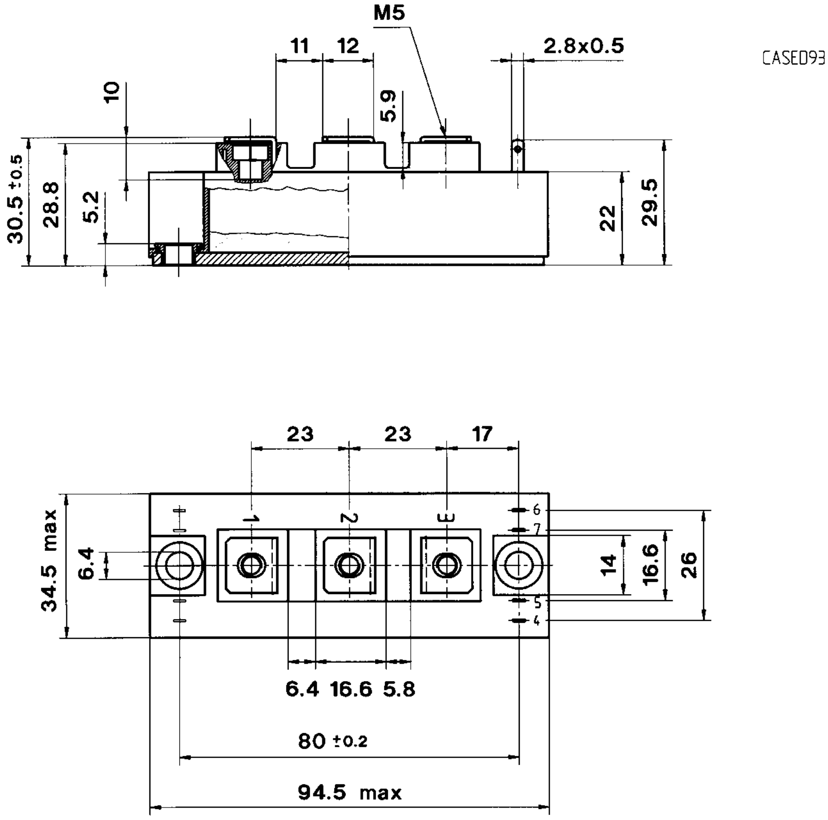


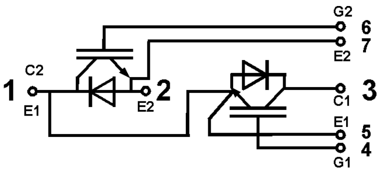
Fig. 24 Typ. CAL diode recovered charge

SEMITRANS 2N (low inductance)

Case D 93
UL Recognized
File no. E 63 532



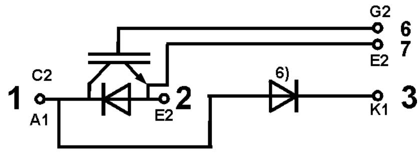
SKM 145 GB 174 DN



Dimensions in mm

SKM 145 GAL 174 DN

Case D 94 (→ D 93)



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

This is an electrostatic discharge sensitive device (ESDS). Please observe the international standard IEC 747-1, Chapter IX.

Eight devices are supplied in one SEMIBOX A without mounting hardware, which can be ordered separately under Ident No. 33321100 (for 10 SEMITRANS 2)

Larger packing units of 20 pieces are used if suitable