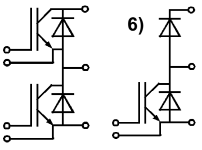
SEMITRANS® M
Low Loss IGBT Modules

SKM 195 GB 124 DN
SKM 195 GAL 124 DN

SEMITRANS 2N (low inductance)



Features

- N channel, homogeneous Silicon structure NPT-IGBT (Non punch through)
- Low saturation voltage
- Low inductance case
- Low tail current with low temperature dependence
- High short circuit capability, self limiting to 6 * I_{cnom}
- Fast & soft inverse CAL diodes 8)
- Without hard mould
- Large clearance (10 mm) and creepage distances (20 mm)

Typical Applications

- Switching (not for linear use)
- Switched mode power supplies
- DC servo and robot drives
- Inverters
- DC choppers
- AC motor speed control
- UPS Uninterruptable power supplies
- General power switching applications
- Electronic (also portable) welders

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	260 / 180	A
I_{CM}	T_{case} = 25/80 °C; t_p = 1 ms	520 / 360	A
V_{GES}		± 20	V
P_{tot}	per IGBT, T_{case} = 25 °C	1040	W
T_j, (T_{stg})		–40 ... +150 (125)	°C
V_{isol}	AC, 1 min.	2500	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	200 / 160	A
$I_{FM} = -I_{CM}$	T_{case} = 25/80 °C; t_p = 1 ms	520 / 360	A
I_{FSM}	t_p = 10 ms; sin.; T_j = 150 °C	1450	A
I^2t	t_p = 10 ms; T_j = 150 °C	10 500	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 = 6 mA	4,5	5,5	6,5	V
I_{CES}	V_{GE} = 0 } T_j = 25 °C	–	0,2	0,4	mA
	V_{CE} = V_{CES} } T_j = 125 °C	–	12	–	mA
I_{GES}	V_{GE} = 20 V, V_{CE} = 0	–	–	0,3	µA
V_{CEsat}	I_C = 150 A { V_{GE} = 15 V; }	–	2,1(2,4)	2,45(2,85)	V
V_{CEsat}	I_C = 200 A { T_j = 25 (125) °C }	–	2,5(3,0)	–	V
g_{fs}	V_{CE} = 20 V, I_C = 150 A	62	–	–	S
C_{CHC}	per IGBT	–	–	350	pF
C_{ies}	} V_{GE} = 0	–	11	15	nF
C_{oes}	} V_{CE} = 25 V	–	1,6	2	nF
C_{res}	} f = 1 MHz	–	0,8	1	nF
L_{CE}		–	–	25	nH
$t_{d(on)}$	} V_{CC} = 600 V	–	70	–	ns
t_r	} V_{GE} = +15 V / -15 V 3)	–	55	–	ns
$t_{d(off)}$	} I_C = 150 A, ind. load	–	490	–	ns
t_f	} R_{Gon} = R_{Goff} = 7Ω	–	65	–	ns
E_{on}	} T_j = 125 °C	–	26	–	mWs
E_{off}		–	23	–	mWs
Inverse Diode and FWD of type „GAL“ 6 8)					
$V_F = V_{EC}$	I_F = 150 A { V_{GE} = 0 V; }	–	2,0(1,8)	2,5	V
$V_F = V_{EC}$	I_F = 200 A { T_j = 25 (125) °C }	–	2,25(2,05)	–	V
V_{TO}	T_j = 125 °C 2)	–	1,1	1,2	V
r_t	T_j = 125 °C 2)	–	–	7	mΩ
I_{RRM}	I_F = 150 A; T_j = 125 °C 2)	–	87	–	A
Q_{rr}	I_F = 150 A; T_j = 125 °C 2)	–	19	–	µC
Thermal characteristics					
R_{thjc}	per IGBT	–	–	0,12	°C/W
R_{thjc}	per diode	–	–	0,23	°C/W
R_{thch}	per module	–	–	0,05	°C/W

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
6) The free-wheeling diodes of the GAL type have the data of the inverse diodes.
8) CAL = Controlled Axial Lifetime Technology

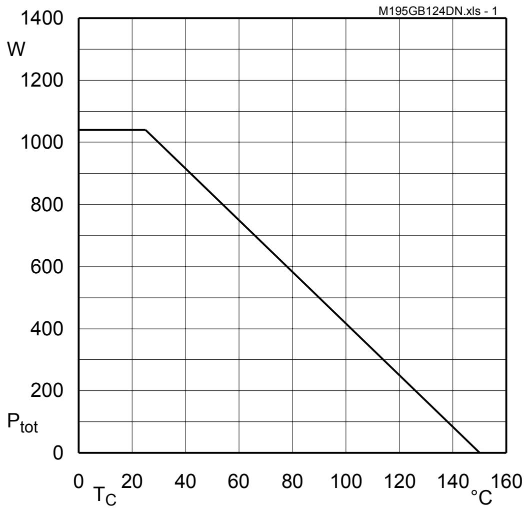
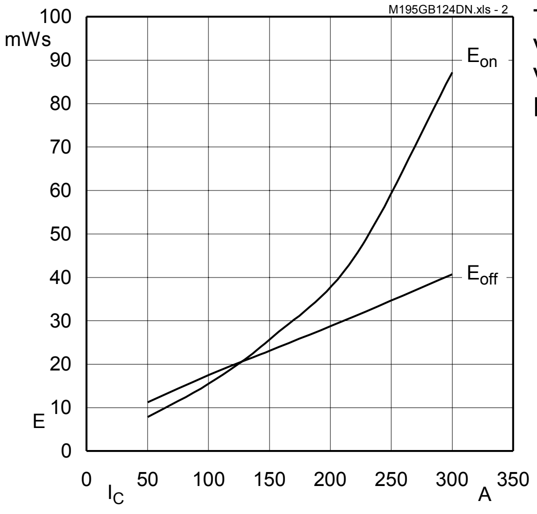
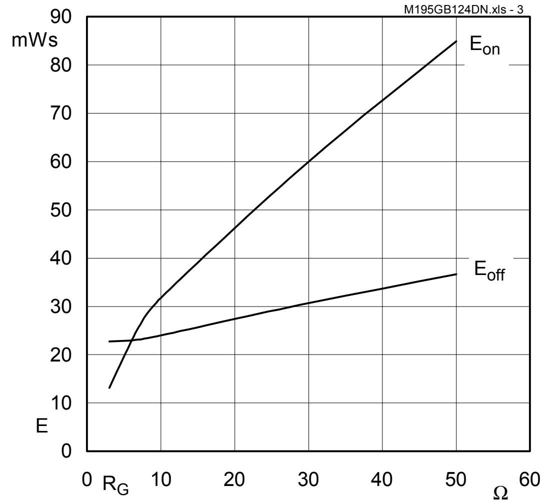


Fig. 1 Rated power dissipation P_{tot} = f (T_C)



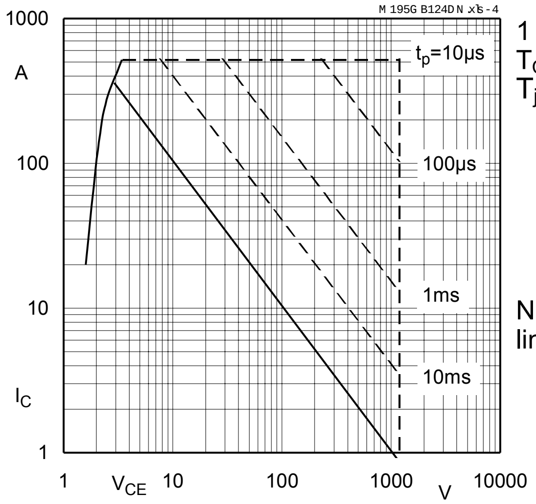
T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_G = 7 Ω

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

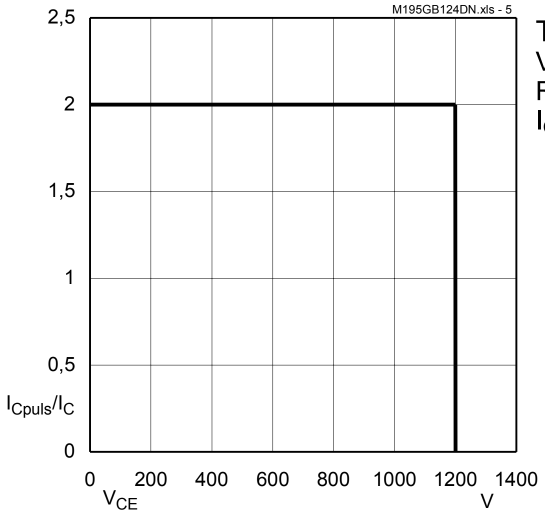
Fig. 3 Turn-on /-off energy = f (R_G)



1 pulse
T_C = 25 °C
T_j ≤ 150 °C

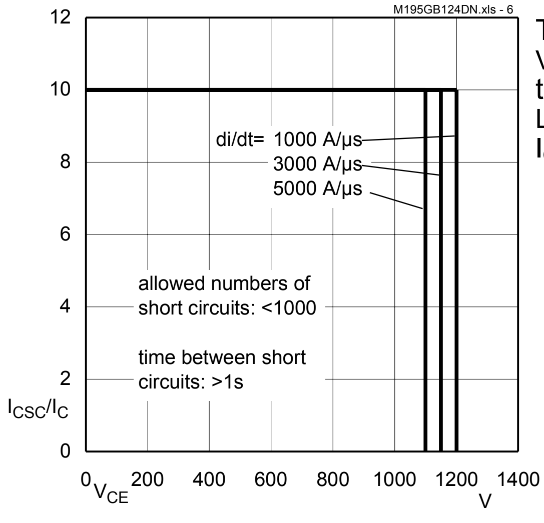
Not for linear use

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



T_j ≤ 150 °C
V_{GE} = 15 V
R_{Goff} = 7 Ω
I_C = 150 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_C = 150 A

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

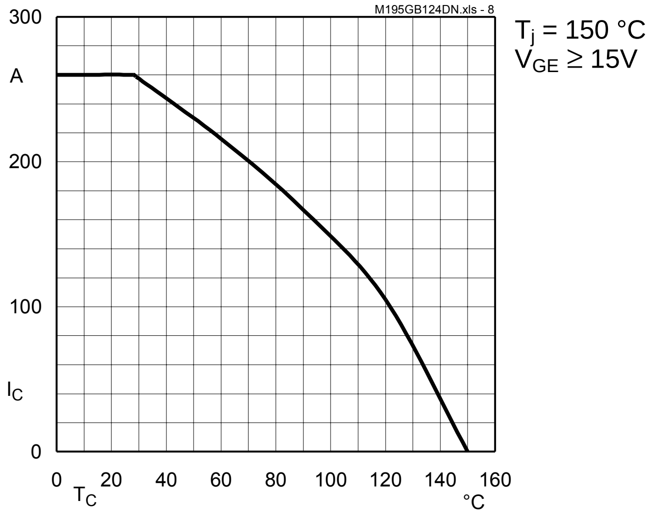


Fig. 8 Rated current vs. temperature $I_C = f (T_C)$

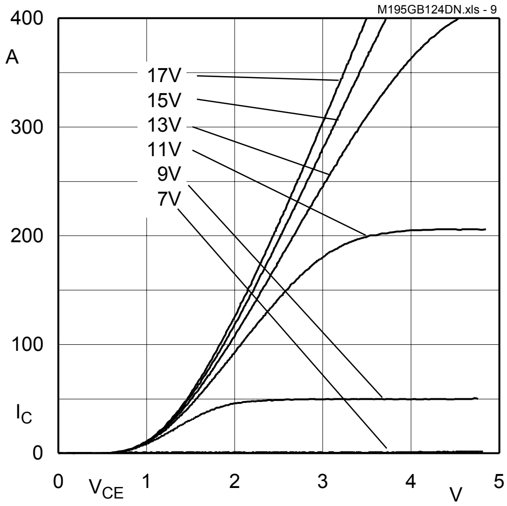


Fig. 9 Typ. output characteristic, t_p = 80 µs; 25 °C

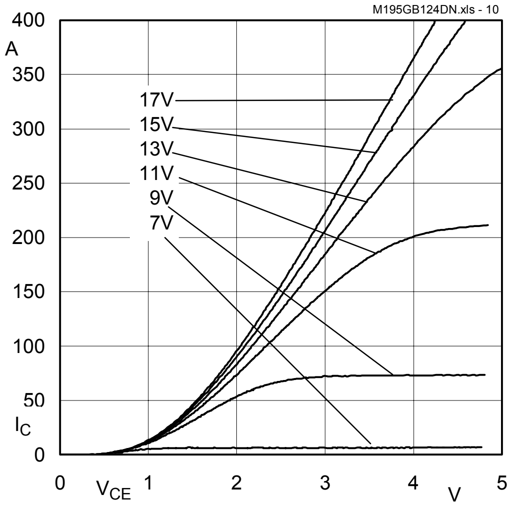


Fig. 10 Typ. output characteristic, t_p = 80 µs; 125 °C

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

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

$V_{CE(TO)(Tj)} \leq 1{,}29 + 0{,}0001\ (T_j - 25)$ [V]

typ.: $r_{CE(Tj)} = 0{,}0061 + 0{,}000022\ (T_j - 25)$ [Ω]

max.: $r_{CE(Tj)} = 0{,}0077 + 0{,}000022\ (T_j - 25)$ [Ω]

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

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

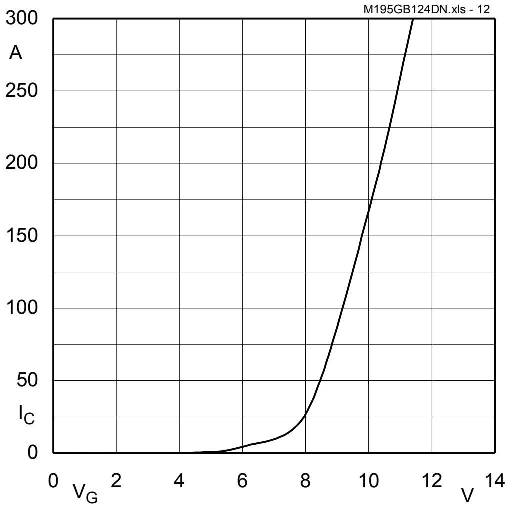
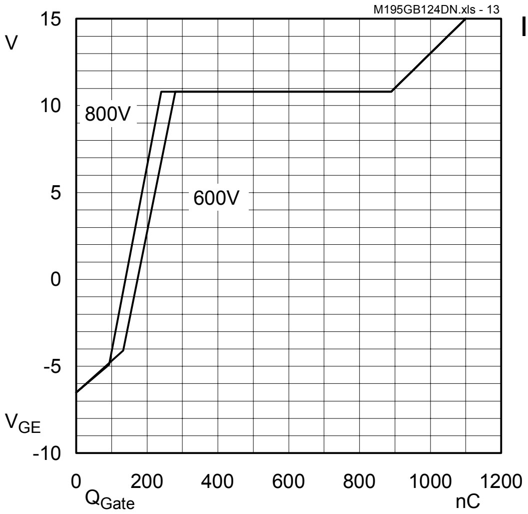
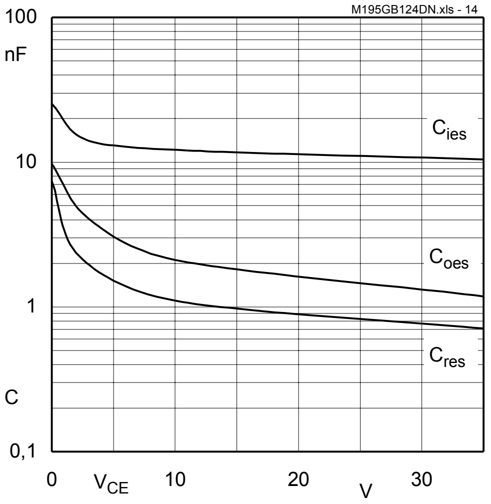


Fig. 12 Typ. transfer characteristic, t_p = 80 µs; V_{CE} = 20 V



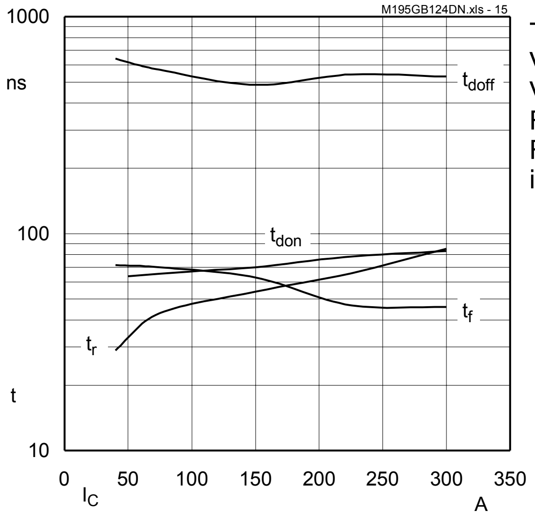
I_{Cpuls} = 150 A

Fig. 13 Typ. gate charge characteristic



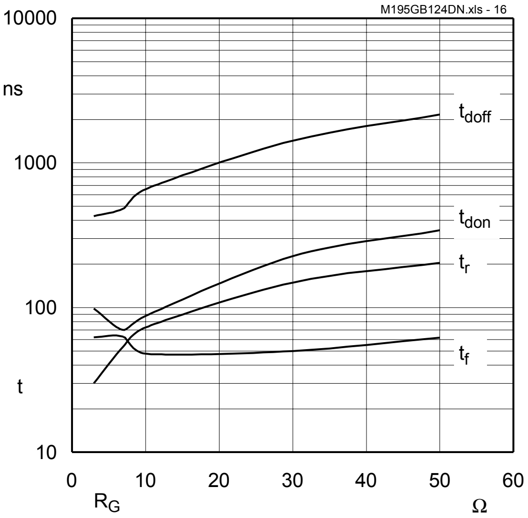
V_{GE} = 0 V
f = 1 MHz

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



T_j = 125 °C
V_{CE} = 600 V
V_{GE} = ± 15 V
R_{Gon} = 7 Ω
R_{Goff} = 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 = 150 A
induct. load

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

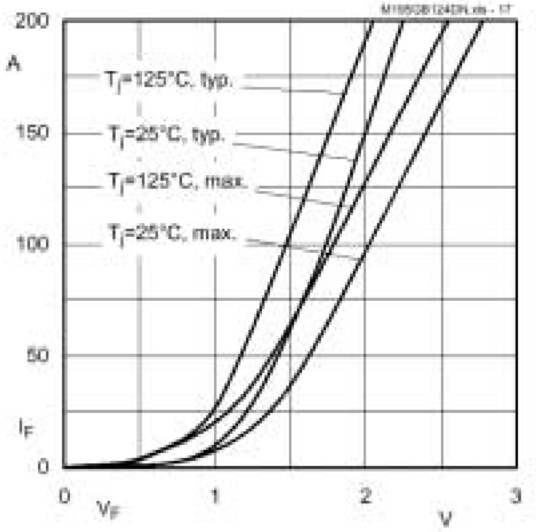
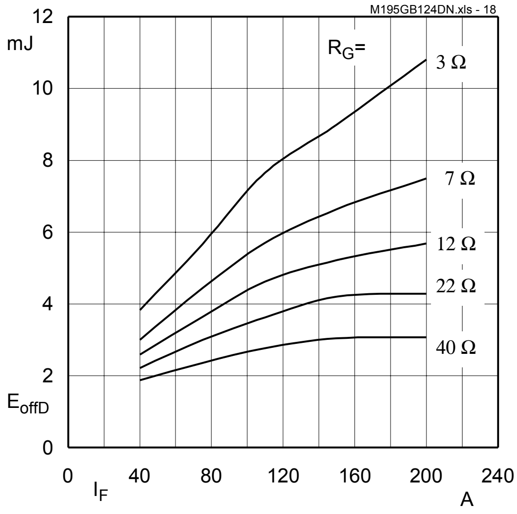


Fig. 17 Typ. CAL diode forward characteristic



V_{CC} = 600 V
T_j = 125 °C
V_{GE} = ± 15 V

Fig. 18 Diode turn-off energy dissipation per pulse

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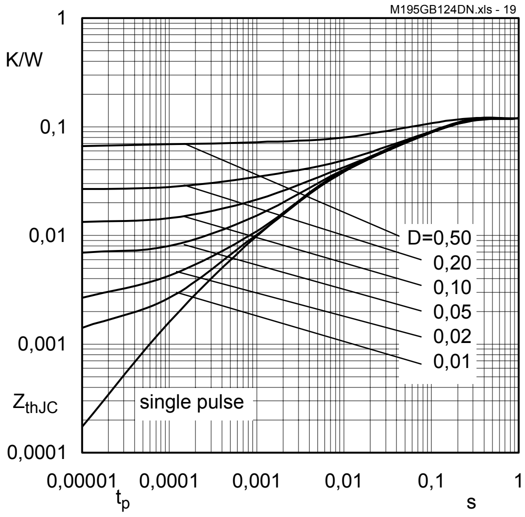


Fig. 19 Transient thermal impedance of IGBT $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

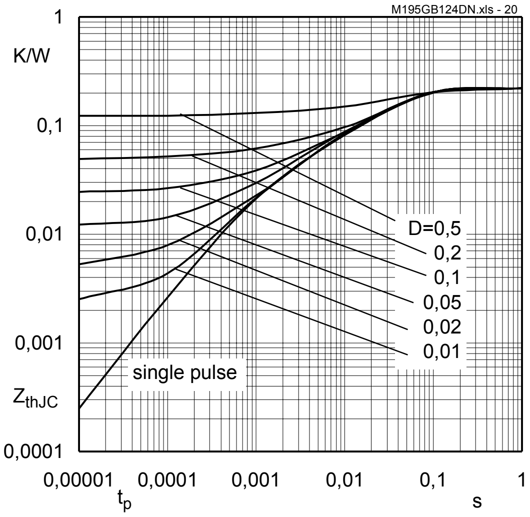


Fig. 20 Transient thermal impedance of inverse CAL diodes $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

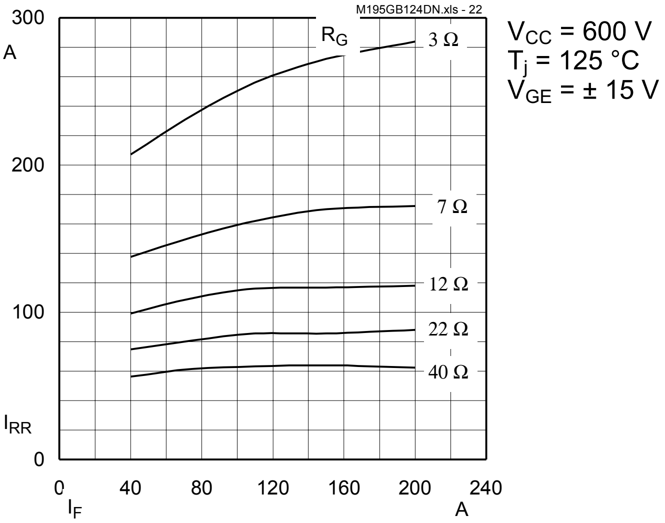


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

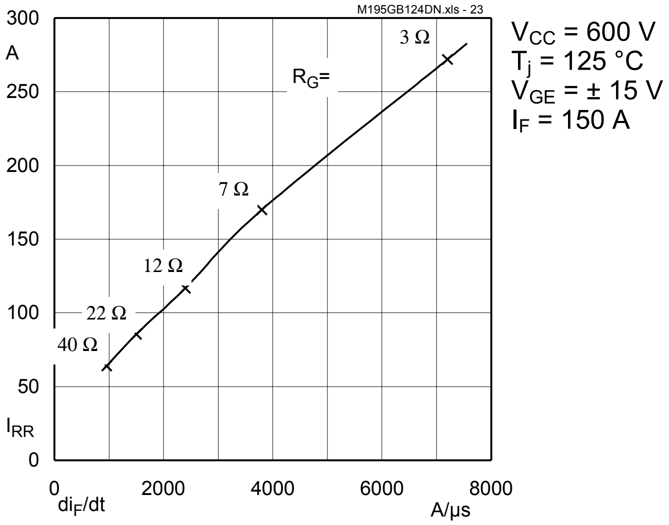


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di/dt)$

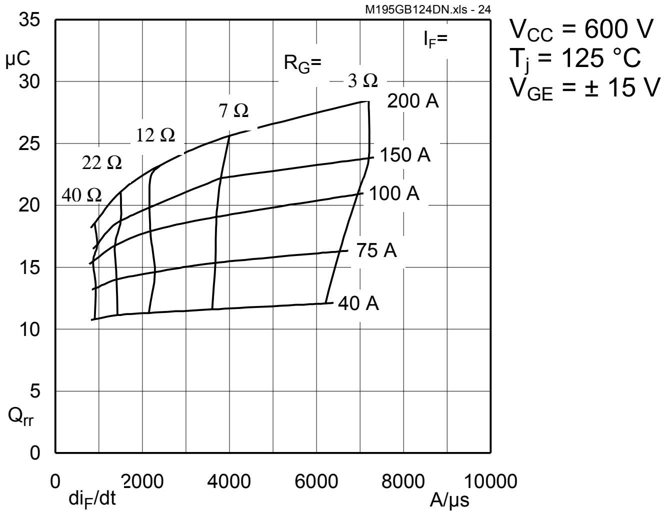


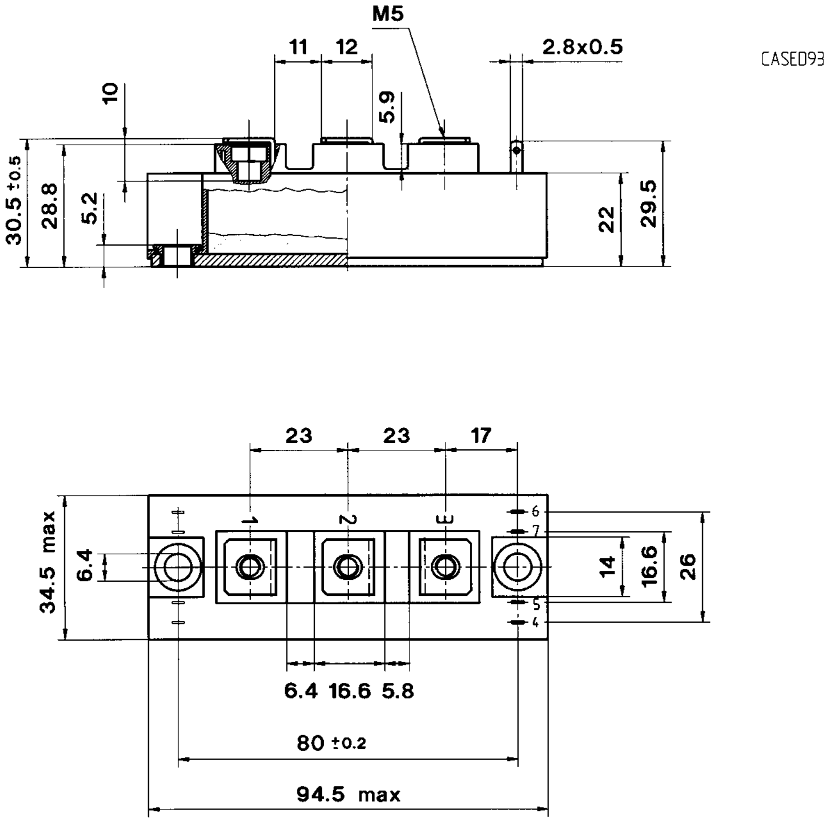
Fig. 24 Typ. CAL diode recovered charge

SEMITRANS 2N (low inductance)

Case D 93

UL Recognized

File no. E 63 532



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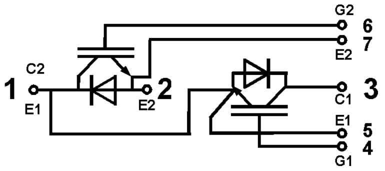
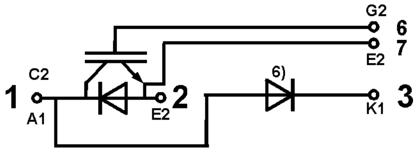


Dimensions in mm

SKM 195 GAL 124 DN

Case D 94 (→ D 93)



Case outline and circuit diagrams

Mechanical Data **Symbol**	**Conditions**		**Values** min.	 typ.	 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			–	–	160	g

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

Twenty devices are supplied in one SEMIBOX D 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

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