

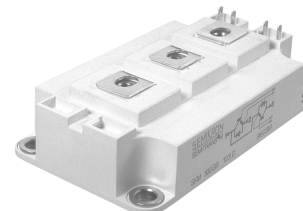
Absolute Maximum Ratings		Values	Units
Symbol	Conditions ¹⁾		
V_{CES}		1200	V
V_{CGR}	$R_{GE} = 20 \text{ k}\Omega$	1200	V
I_C	$T_{case} = 25/80 \text{ }^\circ\text{C}$	300 / 210	A
I_{CM}	$T_{case} = 25/80 \text{ }^\circ\text{C}; t_p = 1 \text{ ms}$	600 / 420	A
V_{GES}		± 20	V
P_{tot}	per IGBT, $T_{case} = 25 \text{ }^\circ\text{C}$	1660	W
$T_j, (T_{stg})$		-40 ... +150 (125)	$^\circ\text{C}$
V_{isol}	AC, 1 min.	2500	V
humidity	IEC 60721-3-3		
climate	DIN IEC 68 T.1	40/125/56	
Inverse Diode			
$I_F = -I_C$	$T_{case} = 25/80 \text{ }^\circ\text{C}$	260 / 180	A
$I_{FM} = -I_{CM}$	$T_{case} = 25/80 \text{ }^\circ\text{C}; t_p = 1 \text{ ms}$	600 / 420	A
I_{FSM}	$t_p = 10 \text{ ms; sin.}; T_j = 150 \text{ }^\circ\text{C}$	2200	A
I^2t	$t_p = 10 \text{ ms; } T_j = 150 \text{ }^\circ\text{C}$	24200	A^2s

Characteristics		min.	typ.	max.	Units
Symbol	Conditions ¹⁾				
$V_{(BR)CES}$	$V_{GE} = 0, I_C = 4 \text{ mA}$	$\geq V_{CES}$			V
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 8 \text{ mA}$	4,5	5,5	6,5	V
I_{CES}	$V_{GE} = 0 \quad \left. \begin{array}{l} T_j = 25 \text{ }^\circ\text{C} \\ V_{CE} = V_{CES} \quad T_j = 125 \text{ }^\circ\text{C} \end{array} \right\}$		3	4,5	mA
I_{GES}	$V_{GE} = 20 \text{ V}, V_{CE} = 0$			0,4	μA
V_{CESat}	$I_C = 200 \text{ A} \quad \left. \begin{array}{l} V_{GE} = 15 \text{ V}; \\ T_j = 25 \text{ }^\circ\text{C} \end{array} \right\}$		3,3	3,85	V
V_{CESat}	$I_C = 300 \text{ A} \quad \left. \begin{array}{l} V_{GE} = 15 \text{ V}; \\ T_j = 25 \text{ }^\circ\text{C} \end{array} \right\}$		3,8		V
g_{fs}	$V_{CE} = 20 \text{ V}, I_C = 200 \text{ A}$	108	150		S
C_{CHC}	per IGBT			700	pF
C_{ies}	$V_{GE} = 0$		18	24	nF
C_{oes}	$V_{CE} = 25 \text{ V}$		2,5	3,2	nF
C_{res}	$f = 1 \text{ MHz}$		1,0	1,3	nF
L_{CE}				20	nH
$t_{d(on)}$	$V_{CC} = 600 \text{ V}$		130		ns
t_r	$V_{GE} = -15 \text{ V} / +15 \text{ V}^{(3)}$		40		ns
$t_{d(off)}$	$I_C = 200 \text{ A, ind. load}$		460		ns
t_f	$R_{Gon} = R_{Goff} = 3 \text{ } \Omega$		30		ns
$E_{on}^{(5)}$	$T_j = 125 \text{ }^\circ\text{C}$		16		mWs
$E_{off}^{(5)}$			11		mWs
Inverse Diode ⁸⁾					
$V_F = V_{EC}$	$I_F = 200 \text{ A} \quad \left\{ \begin{array}{l} V_{GE} = 0 \text{ V}; \\ T_j = 25 (125) \text{ }^\circ\text{C} \end{array} \right\}$		2,0(1,8)	2,5	V
$V_F = V_{EC}$	$I_F = 300 \text{ A} \quad \left\{ \begin{array}{l} V_{GE} = 0 \text{ V}; \\ T_j = 25 (125) \text{ }^\circ\text{C} \end{array} \right\}$		2,25(2,1)		V
V_{TO}	$T_j = 125 \text{ }^\circ\text{C}$		1,1	1,2	V
r_t	$T_j = 125 \text{ }^\circ\text{C}$		3	5,5	$\text{m}\Omega$
I_{RRM}	$I_F = 200 \text{ A}; T_j = 25 (125) \text{ }^\circ\text{C}^{(2)}$		70(105)		A
Q_{rr}	$I_F = 200 \text{ A}; T_j = 25 (125) \text{ }^\circ\text{C}^{(2)}$		10(26)		μC
Thermal characteristics					
R_{thjc}	per IGBT			0,075	$^\circ\text{C/W}$
R_{thjc}	per diode			0,18	$^\circ\text{C/W}$
R_{thch}	per module			0,038	$^\circ\text{C/W}$

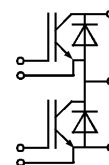
SEMITRANS® M Superfast IGBT Modules

SKM 300 GB 125 D

Preliminary Data



SEMITRANS 3



GB

Features

- N channel, homogeneous Silicon structure (NPT-Non punch-through IGBT)
- Low inductance case
- **Short tail** current with low temperature dependence
- High short circuit capability, self limiting
- Fast & soft inverse CAL diodes ⁸⁾
- Isolated copper baseplate using DCB Direct Copper Bonding Technology
- Large clearance (12 mm) and creepage distances (20 mm)

Typical Applications

- Switching (not for linear use)
- Switched mode power supplies at $f_{sw} > 20 \text{ kHz}$
- Resonant inverters up to 100 kHz
- Silent AC motor speed control (elevators)
- Inductive heating
- Silent UPS Uninterruptable power supplies at $f_{sw} > 20 \text{ kHz}$
- Electronic (also portable) welders at $f_{sw} > 20 \text{ kHz}$

¹⁾ $T_{case} = 25 \text{ }^\circ\text{C}$, unless otherwise specified

²⁾ $I_F = -I_C$, $V_R = 600 \text{ V}$,
– $di_F/dt = 2000 \text{ A}/\mu\text{s}$, $V_{GE} = 0 \text{ V}$

³⁾ Use $V_{GEoff} = -5 \text{ ... } -15 \text{ V}$

⁵⁾ See fig. 2 + 3; $R_{Goff} = 3 \text{ } \Omega$

⁸⁾ CAL = Controlled Axial Lifetime Technology

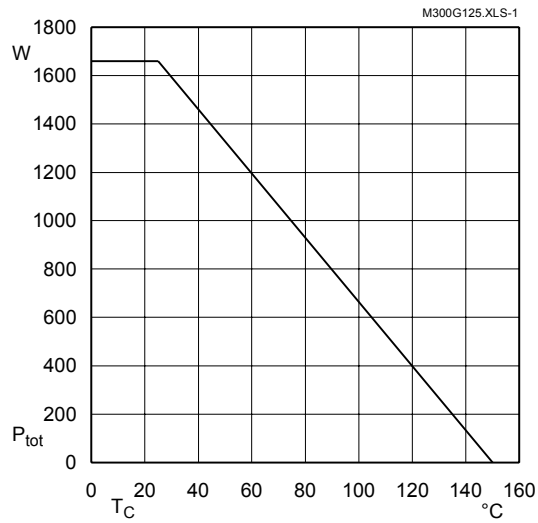


Fig. 1 Rated power dissipation $P_{tot} = f(T_C)$

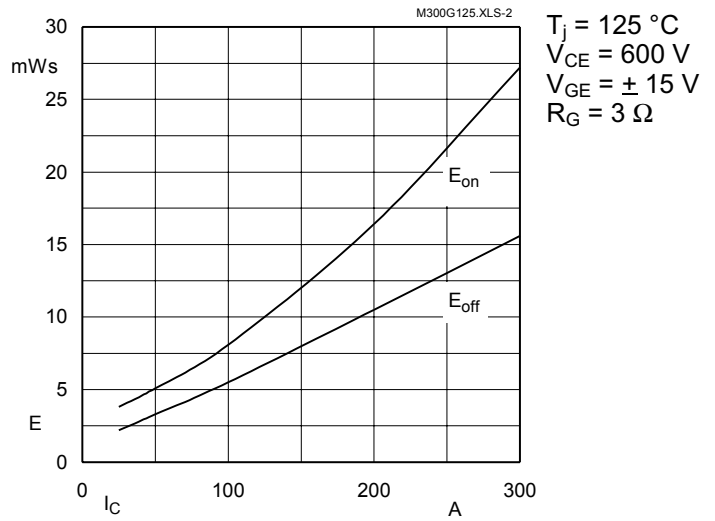


Fig. 2 Turn-on /-off energy = $f(I_C)$

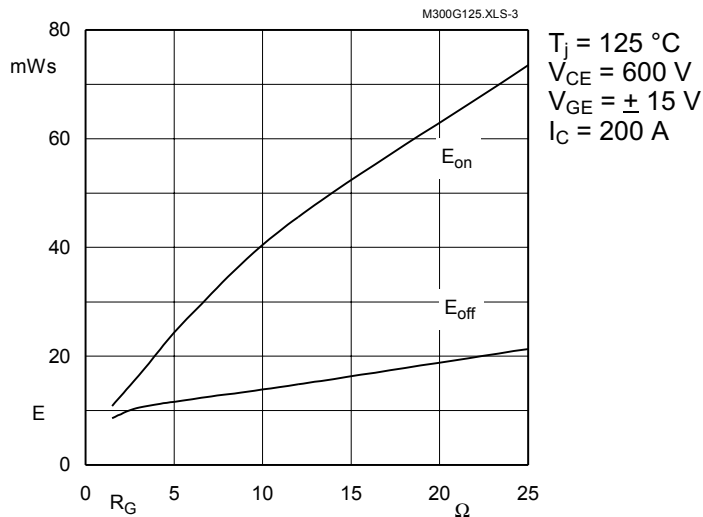


Fig. 3 Turn-on /-off energy = $f(R_G)$

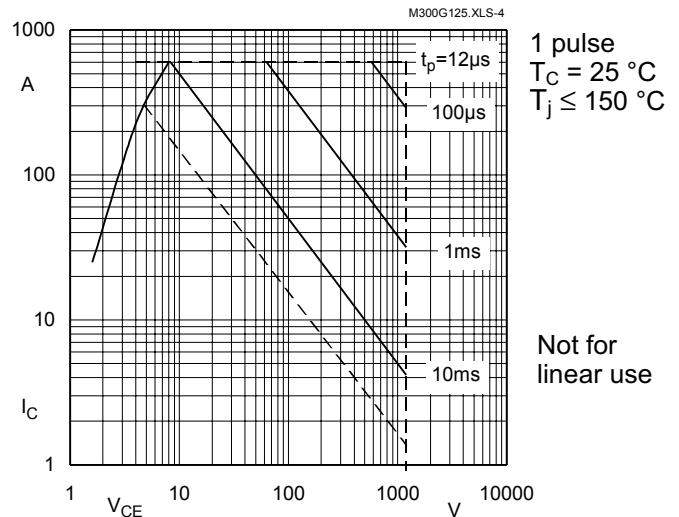


Fig. 4 Maximum safe operating area (SOA) $I_C = f(V_{CE})$

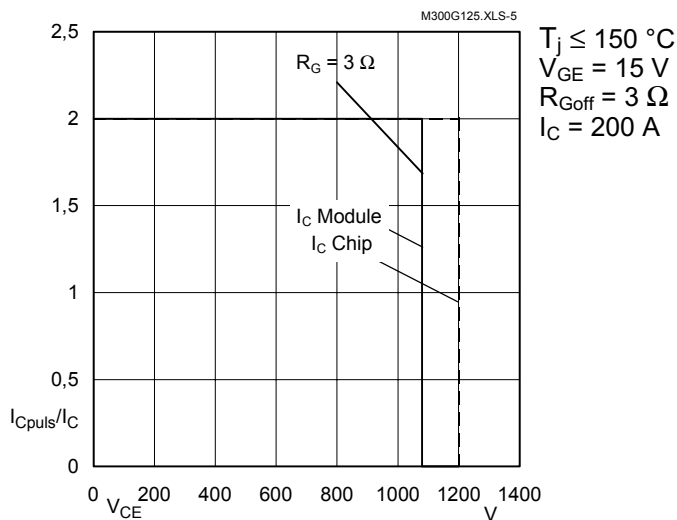


Fig. 5 Turn-off safe operating area (RBSOA)

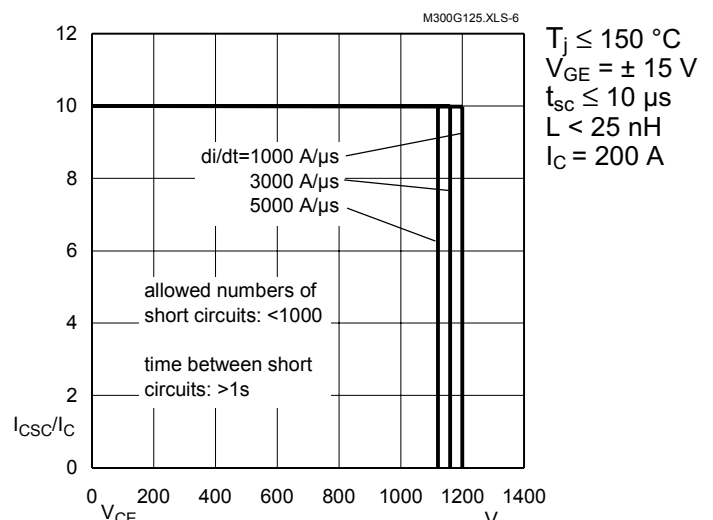


Fig. 6 Safe operating area at short circuit $I_C = f(V_{CE})$

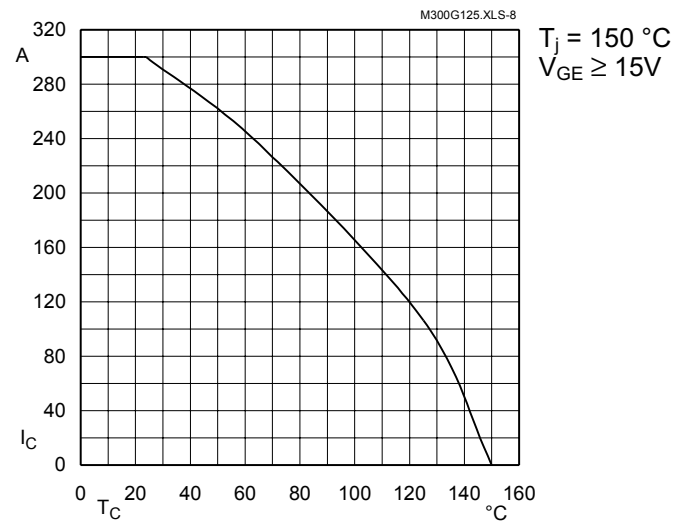


Fig. 8 Rated current vs. temperature $I_C = f(T_C)$

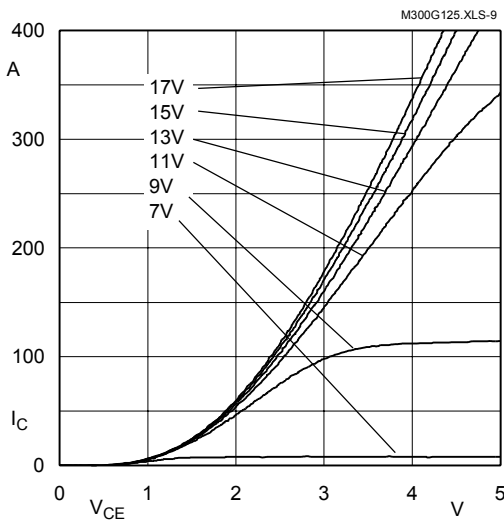


Fig. 9 Typ. output characteristic, $t_p = 80$ μs; 25 °C

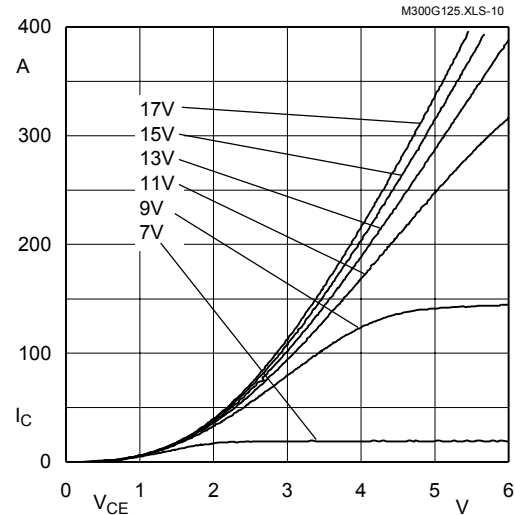


Fig. 10 Typ. output characteristic, $t_p = 80$ μs; 125 °C

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

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

$$V_{CE(TO)(T_j)} \leq 1,4 + 0,003 (T_j - 25) [V]$$

$$\text{typ.: } r_{CE(T_j)} = 0,0091 + 0,000022 (T_j - 25) [\Omega]$$

$$\text{max.: } r_{CE(T_j)} = 0,0107 + 0,000018 (T_j - 25) [\Omega]$$

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

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

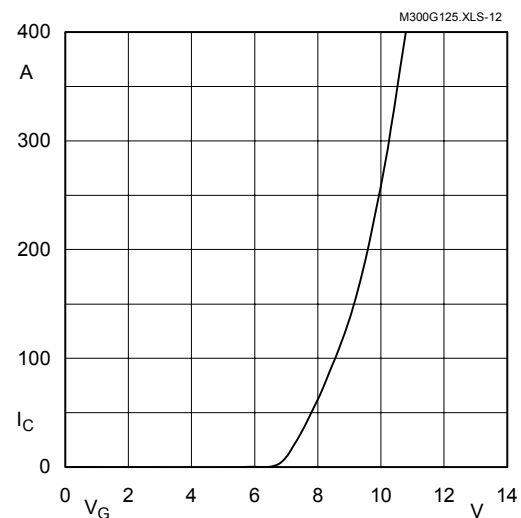


Fig. 12 Typ. transfer characteristic, $t_p = 80$ μs; $V_{CE} = 20$ V

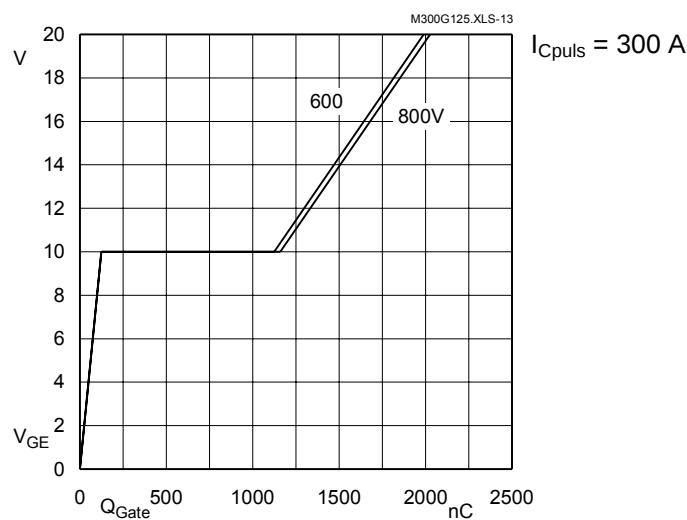


Fig. 13 Typ. gate charge characteristic

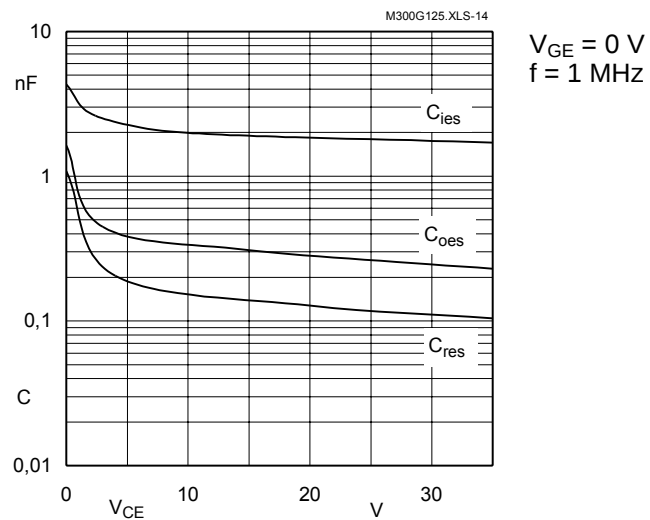


Fig. 14 Typ. capacitances vs. V_{CE}

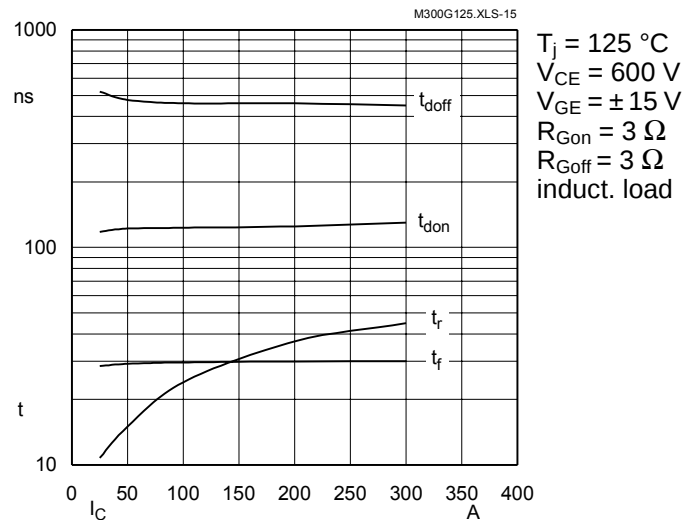


Fig. 15 Typ. switching times vs. I_C

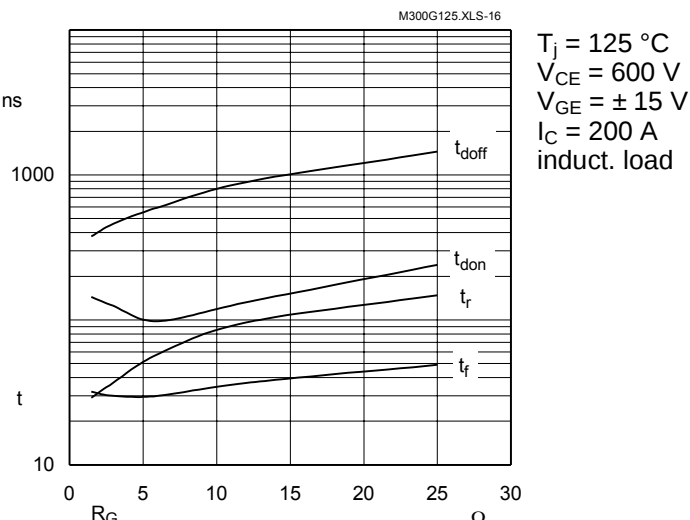


Fig. 16 Typ. switching times vs. gate resistor R_G

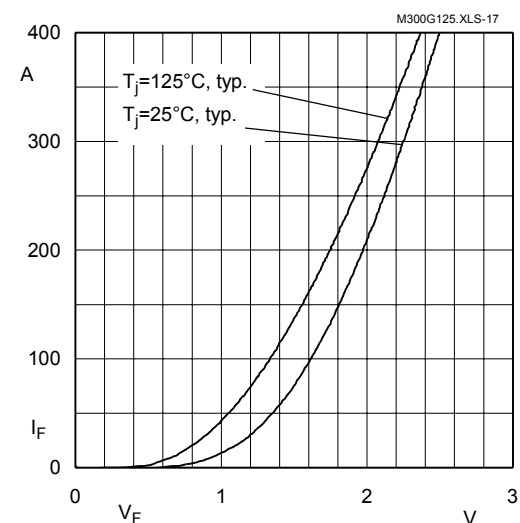


Fig. 17 Typ. CAL diode forward characteristic

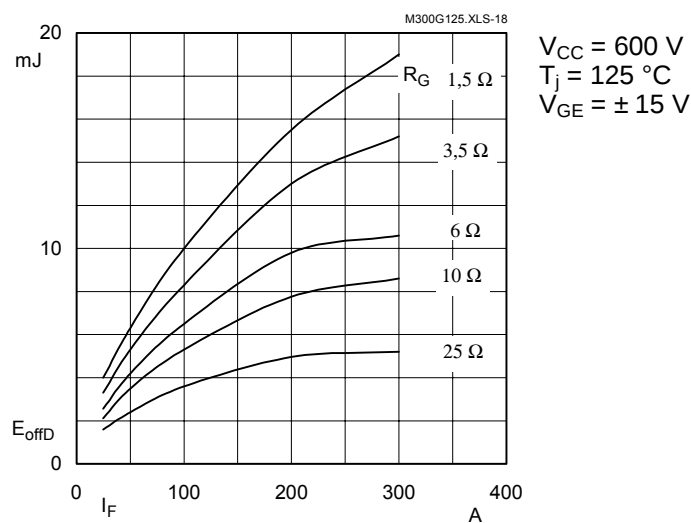


Fig. 18 Diode turn-off energy dissipation per pulse

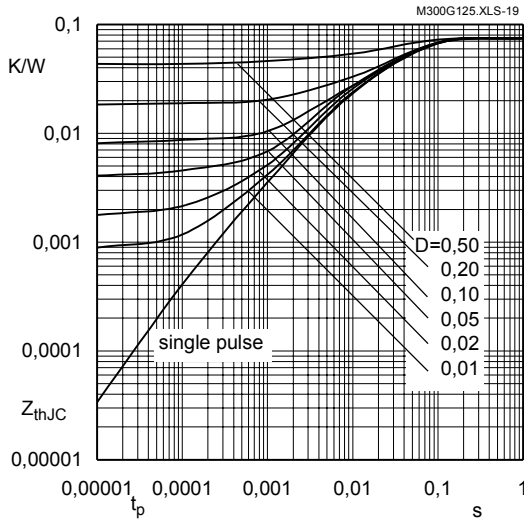


Fig. 19 Transient thermal impedance of IGBT
 $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

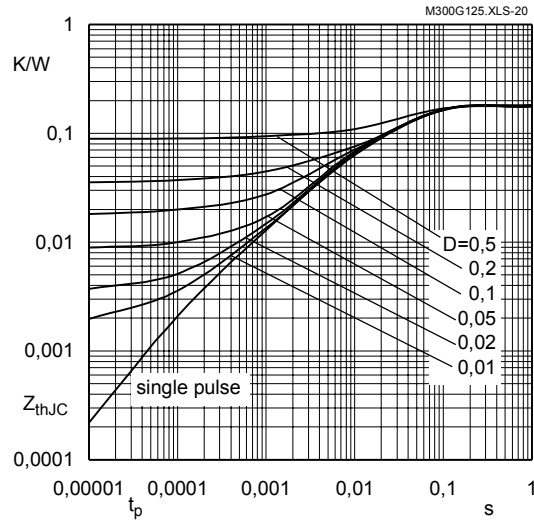


Fig. 20 Transient thermal impedance of inverse CAL diodes
 $Z_{thJC} = f(t_p)$; $D = t_p / t_c = t_p \cdot f$

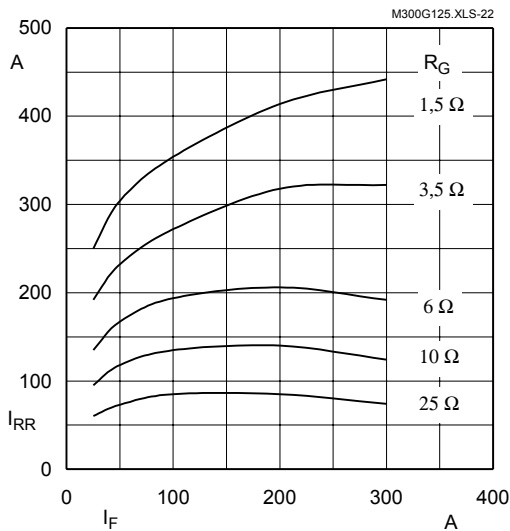


Fig. 22 Typ. CAL diode peak reverse recovery current $I_{RR} = f(I_F; R_G)$

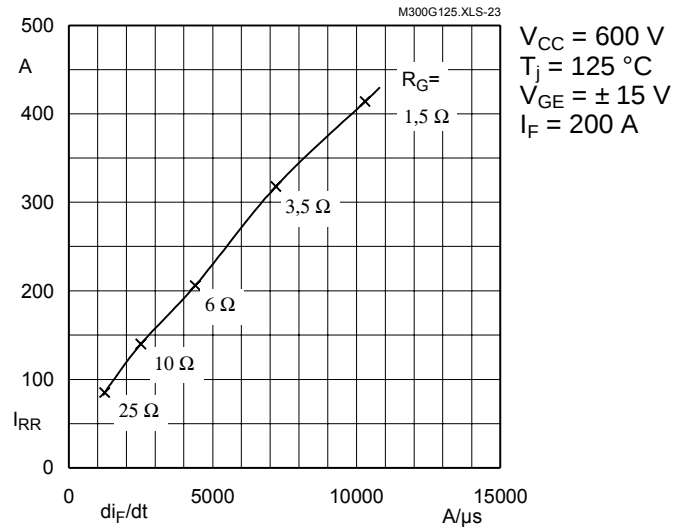


Fig. 23 Typ. CAL diode peak reverse recovery current $I_{RR} = f(di_F/dt; R_G)$

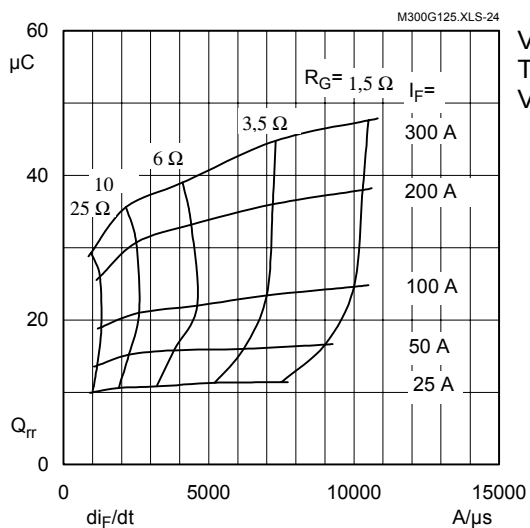
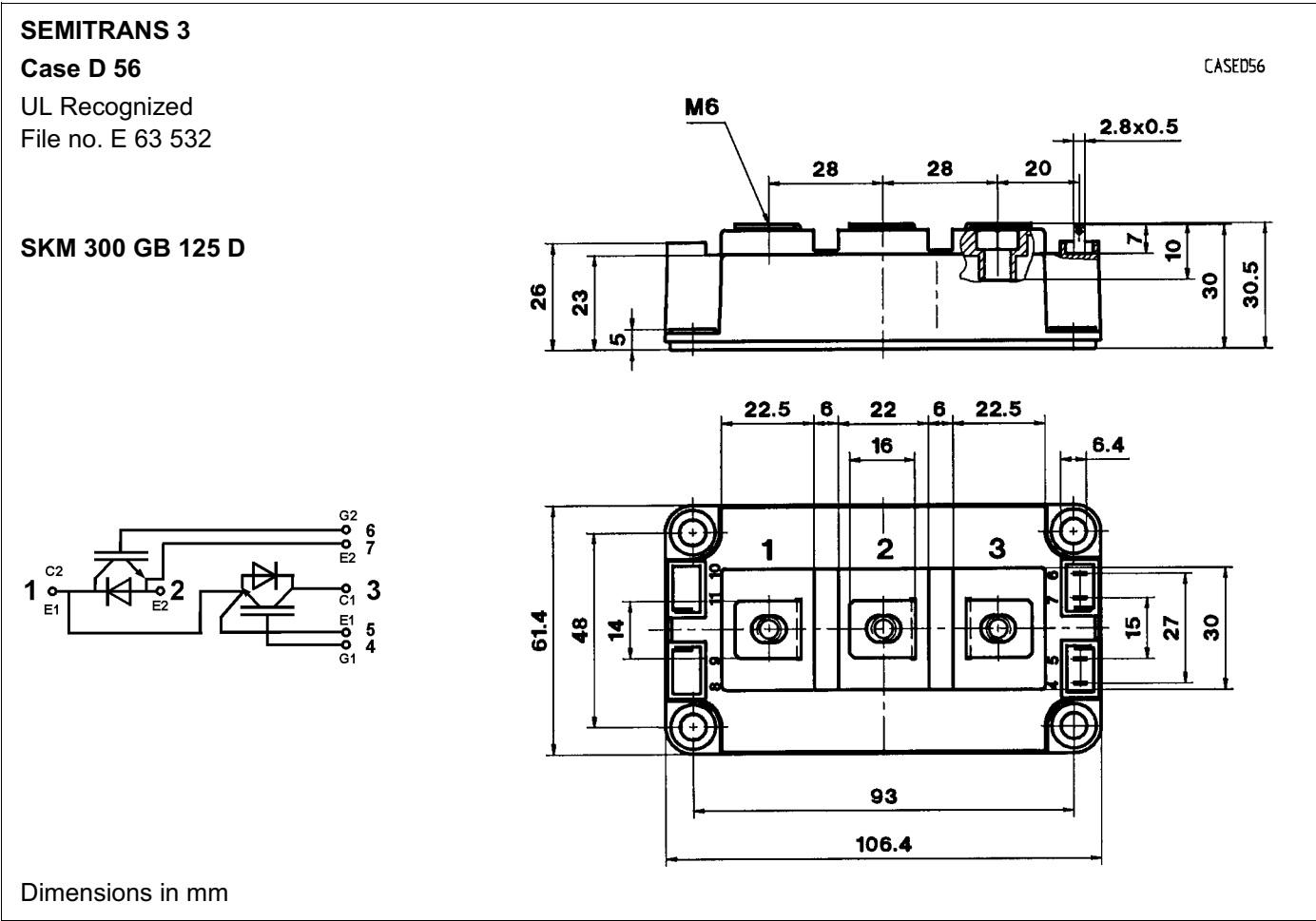


Fig. 24 Typ. CAL diode recovered charge
 $Q_{RR} = f(di_F/dt; I_F; R_G)$



Case outline and circuit diagram

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.

12 devices are supplied in one SEMIBOX D without mounting hardware, which can be ordered separately under Ident No. 33321100 (for 10 SEMITRANS 3).