

SKM400GB12F4



SEMITRANS® 3

High Speed IGBT4 Modules

SKM400GB12F4

Features*

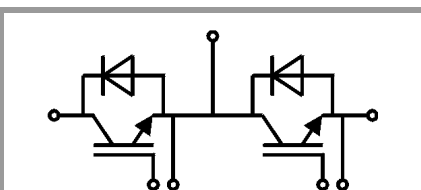
- High speed trench and field-stop IGBT
- CAL4 ultra-fast = soft switching 4. generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- For higher switching frequencies above 15kHz
- UL recognized, file no. E63532

Typical Applications

- UPS
- Electronic welders
- Inductive heating
- Switched mode power supplies

Remarks

- Case temperature limited to $T_c = 125^\circ\text{C}$ max.
- Recommended $T_{op} = -40 \dots +150^\circ\text{C}$
- Product reliability results valid for $T_j = 150^\circ\text{C}$



GB

Absolute Maximum Ratings			
Symbol	Conditions	Values	Unit
IGBT			
V_{CES}	$T_j = 25^\circ\text{C}$	1200	V
I_C	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	548
		$T_c = 80^\circ\text{C}$	418
I_{Cnom}		400	A
I_{CRM}	$I_{CRM} = 2 \times I_{Cnom}$	800	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 1200\text{ V}$ $R_{G\ on/off} \geq 3\ \Omega$	$T_j = 150^\circ\text{C}$	10
T_j		-40 ... 175	$^\circ\text{C}$
Inverse diode			
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	402
		$T_c = 80^\circ\text{C}$	295
I_{Fnom}		400	A
I_{FRM}	$I_{FRM} = 2 \times I_{Fnom}$	800	A
I_{FSM}	$t_p = 10\text{ ms}$, $\sin 180^\circ$, $T_j = 25^\circ\text{C}$	1980	A
T_j		-40 ... 175	$^\circ\text{C}$
Module			
$I_{t(RMS)}$		500	A
T_{stg}	module without TIM	-40 ... 125	$^\circ\text{C}$
V_{isol}	AC sinus 50 Hz, $t = 1\text{ min}$	4000	V

Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
IGBT					
$V_{CE(sat)}$	$I_C = 400\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	2.06	2.44	V
		$T_j = 150^\circ\text{C}$	2.59	2.97	V
V_{CE0}	chipelevel	$T_j = 25^\circ\text{C}$	1.10	1.28	V
		$T_j = 150^\circ\text{C}$	0.95	1.13	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	2.4	2.9	$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	4.1	4.6	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 15.2\text{ mA}$	5.1	5.8	6.4	V
I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_j = 25^\circ\text{C}$			5	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	24.6		nF
C_{oes}		$f = 1\text{ MHz}$	1.62		nF
C_{res}		$f = 1\text{ MHz}$	1.38		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		2268		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		1.6		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 400\text{ A}$	$T_j = 150^\circ\text{C}$	110		ns
t_r	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$	55		ns
E_{on}	$R_{G\ on} = 2\ \Omega$	$T_j = 150^\circ\text{C}$	28		mJ
$t_{d(off)}$	$R_{G\ off} = 1\ \Omega$	$T_j = 150^\circ\text{C}$	415		ns
t_f	$di/dt_{on} = 7960\text{ A}/\mu\text{s}$ $di/dt_{off} = 4430\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$	75		ns
E_{off}	$dv/dt = 4530\text{ V}/\mu\text{s}$	$T_j = 150^\circ\text{C}$	32		mJ
$R_{th(j-c)}$	per IGBT			0.072	K/W
$R_{th(c-s)}$	per IGBT ($\lambda_{grease} = 0.81\text{ W}/(\text{m}^2\text{K})$)		0.041		K/W



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Characteristics			min.	typ.	max.	Unit
Symbol	Conditions					
Inverse diode						
$V_F = V_{EC}$	$I_F = 400\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		2.55	2.93	V
		$T_j = 150^\circ\text{C}$		2.44	2.80	V
V_{F0}	chipelevel	$T_j = 25^\circ\text{C}$		1.51	1.75	V
		$T_j = 150^\circ\text{C}$		1.16	1.40	V
r_F	chipelevel	$T_j = 25^\circ\text{C}$		2.6	2.9	m Ω
		$T_j = 150^\circ\text{C}$		3.2	3.5	m Ω
I_{RRM}	$I_F = 400\text{ A}$	$T_j = 150^\circ\text{C}$		424		A
Q_{rr}	$di/dt_{off} = 7183\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		51		μC
E_{rr}	$V_{GE} = -15\text{ V}$ $V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		18.5		mJ
$R_{th(j-c)}$	per diode				0.14	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)			0.047		K/W
Module						
L_{CE}				15		nH
R_{CC+EE}	measured per switch	$T_c = 25^\circ\text{C}$		0.55		m Ω
		$T_c = 125^\circ\text{C}$		0.85		m Ω
$R_{th(c-s)1}$	calculated without thermal coupling			0.0109		K/W
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)			0.017		K/W
M_s	to heat sink M6		3		5	Nm
M_t			2.5		5	Nm
	to terminals M6					
					-	Nm
w					325	g



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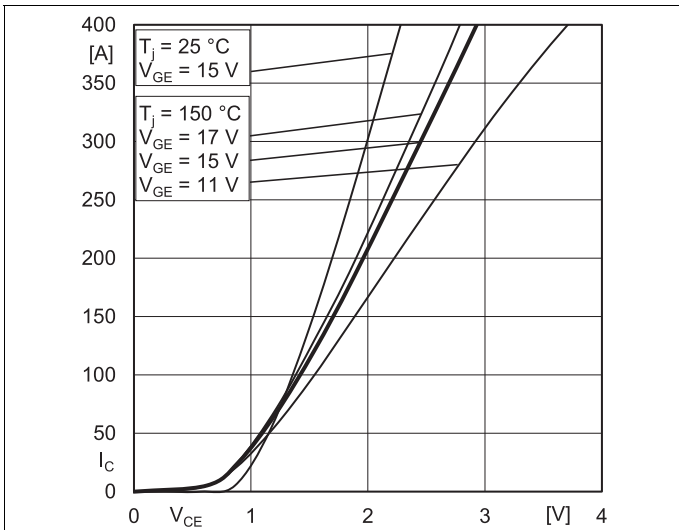


Fig. 1: Typ. output characteristic, inclusive R_{CC+EE}

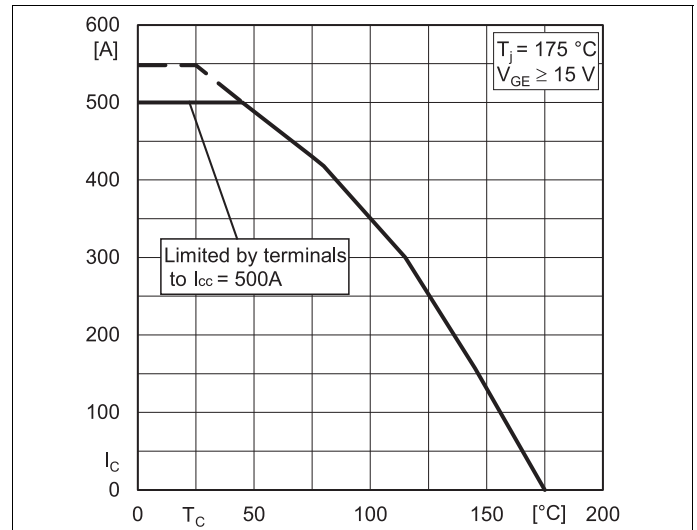


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

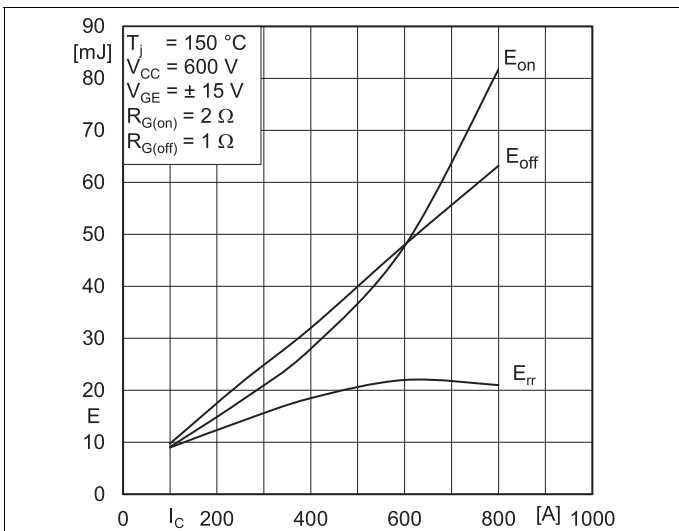


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

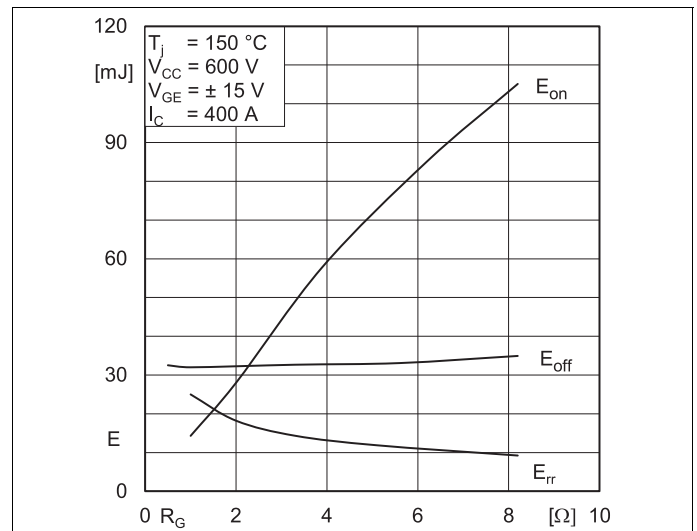


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

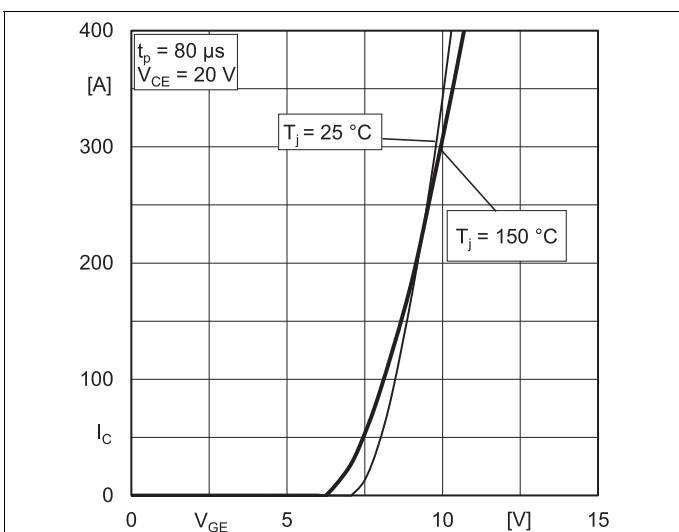


Fig. 5: Typ. transfer characteristic

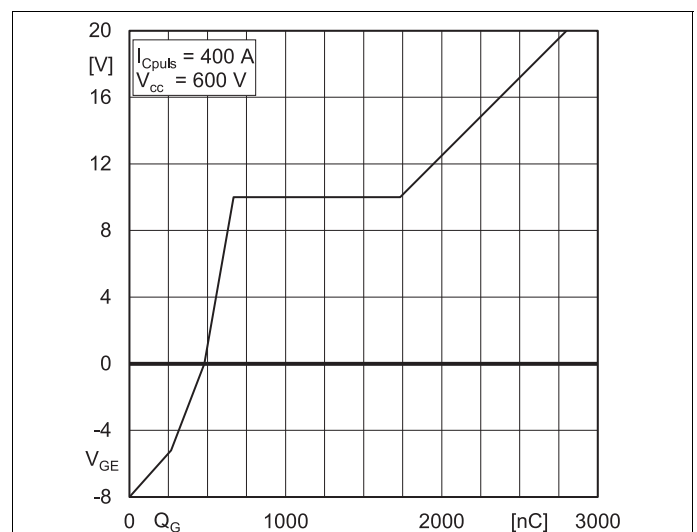


Fig. 6: Typ. gate charge characteristic

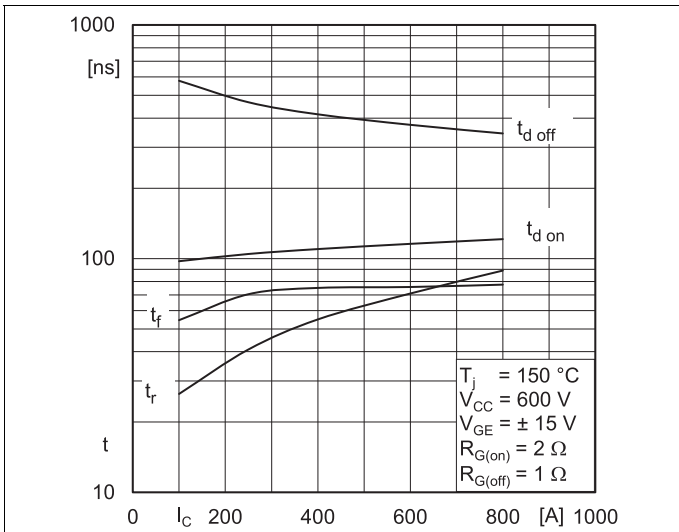


Fig. 7: Typ. switching times vs. I_C

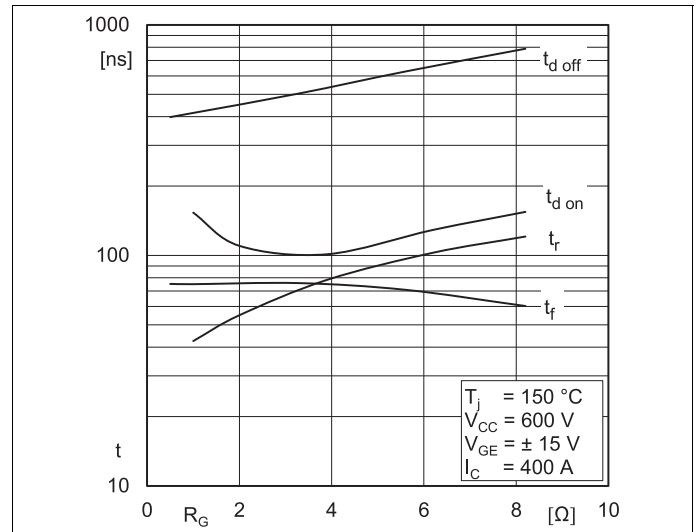


Fig. 8: Typ. switching times vs. gate resistor R_G

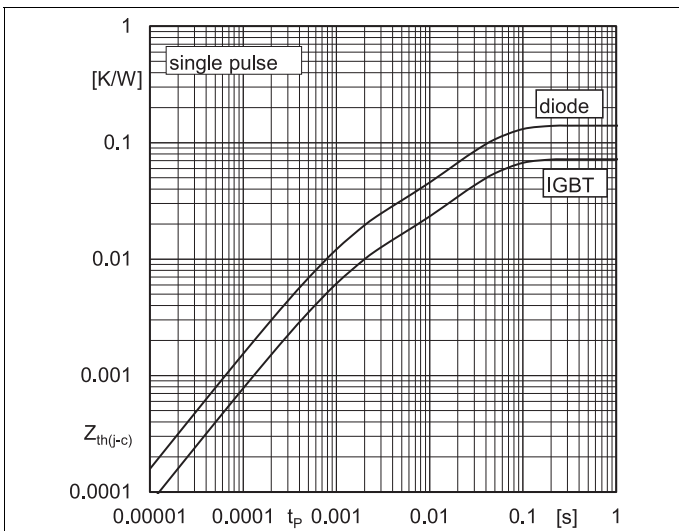


Fig. 9: Transient thermal impedance

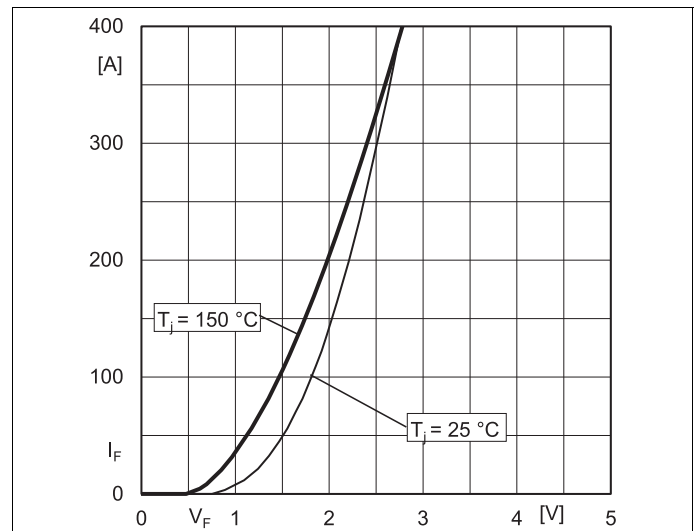


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC+EE'}$

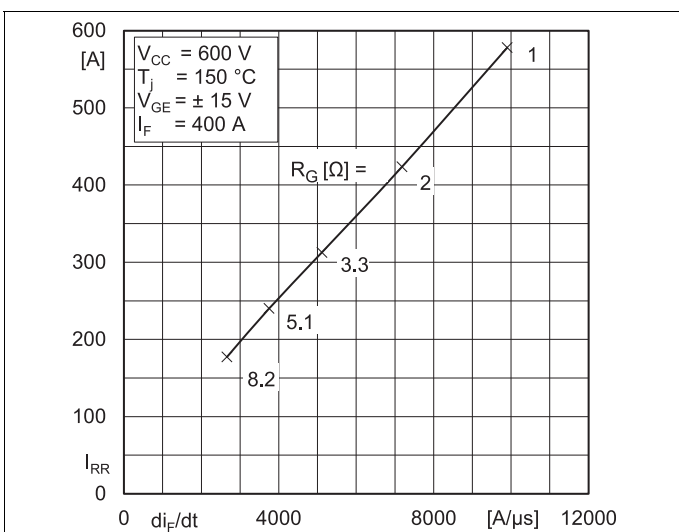


Fig. 11: Typ. CAL diode peak reverse recovery current

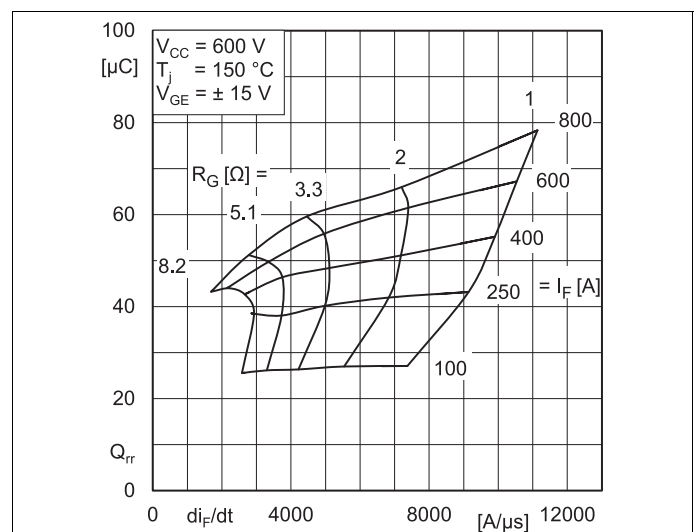


Fig. 12: Typ. CAL diode peak reverse recovery charge

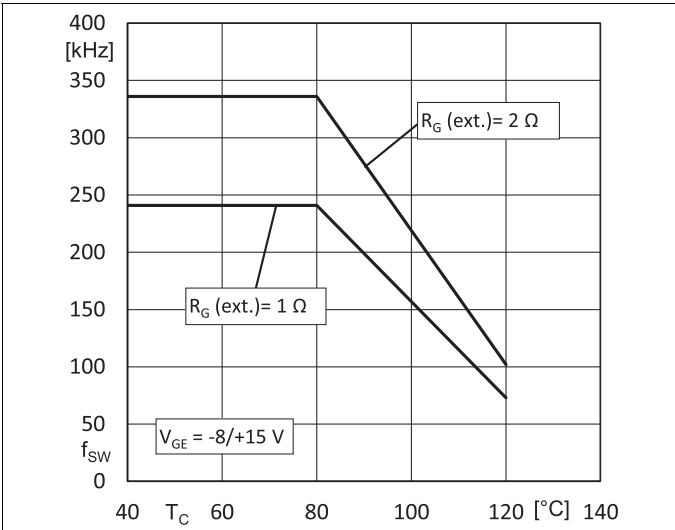
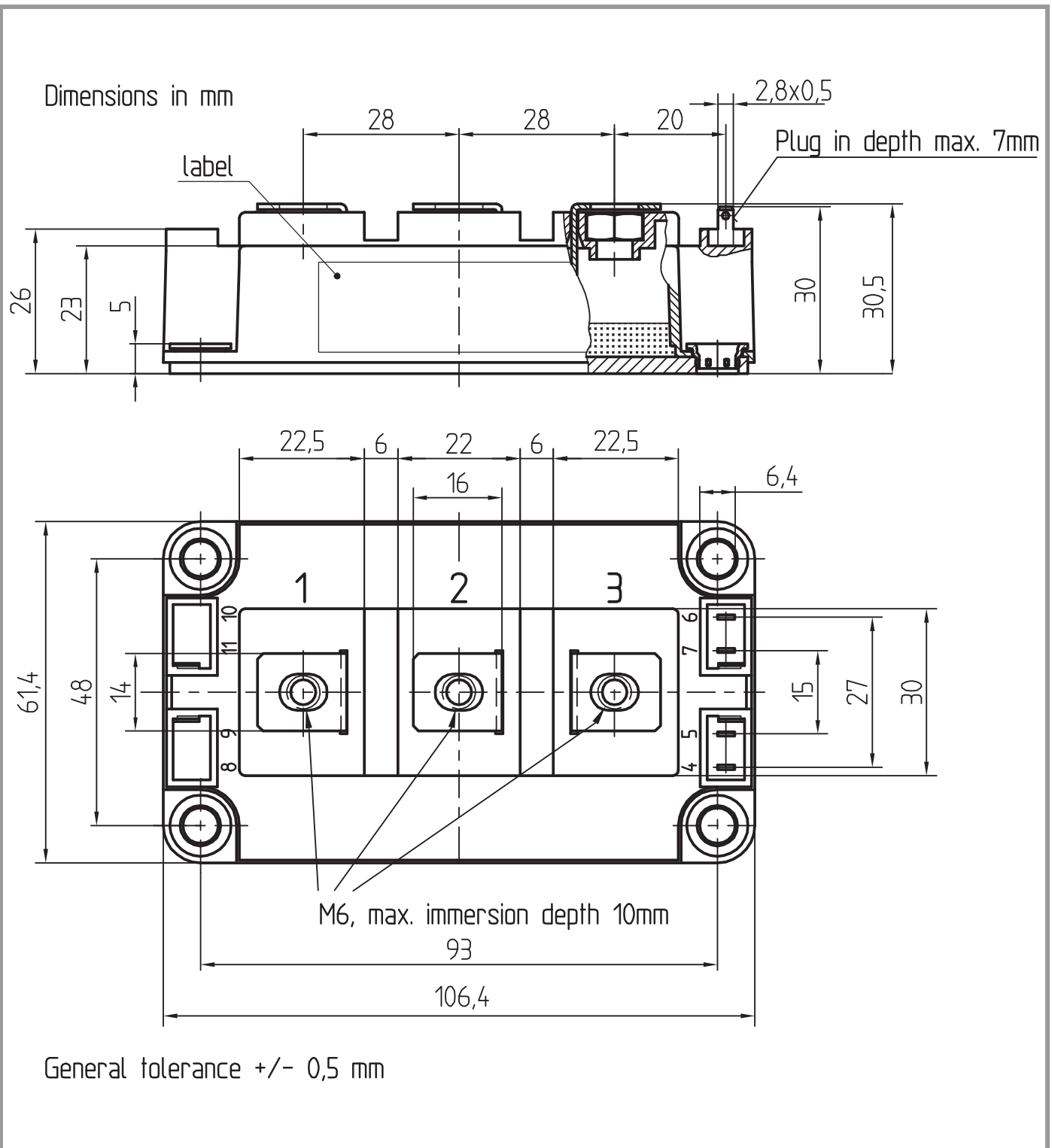
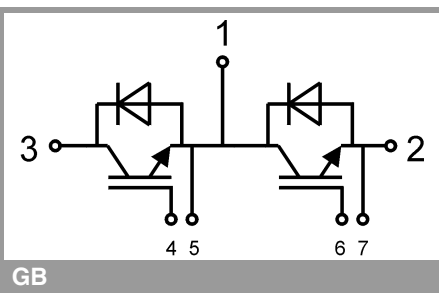


Fig. 13: Max. switching frequency vs. case temperature
 $f_{sw} = f(T_c)$

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SEMITRANS 3



This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

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