



SEMITRANS® 3

IGBT4 Modules

SKM450GB12E4

Features

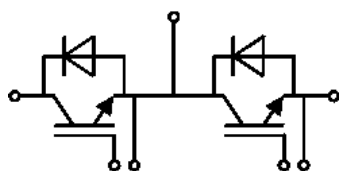
- IGBT4 = 4th generation medium fast trench IGBT (Infineon)
- CAL4 = Soft switching 4th generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- With integrated gate resistor
- For higher switching frequencies up to 12kHz
- UL recognized, file no. E63532

Typical Applications*

- AC inverter drives
- UPS

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 $T_j = 150^\circ\text{C}$



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Absolute Maximum Ratings

Symbol	Conditions	Values	Unit
IGBT			
V_{CES}	$T_j = 25^\circ\text{C}$	1200	V
I_C	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	700
		$T_c = 80^\circ\text{C}$	538
I_{Cnom}		450	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$	1350	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 1200\text{ V}$	$T_j = 150^\circ\text{C}$	10
T_j		-40 ... 175	$^\circ\text{C}$
Inverse diode			
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	461
		$T_c = 80^\circ\text{C}$	345
I_{Fnom}		400	A
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$	1200	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					
$V_{CE(sat)}$	$I_C = 450\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.84	2.07	V
		$T_j = 150^\circ\text{C}$	2.23	2.42	V
V_{CE0}	chipelevel	$T_j = 25^\circ\text{C}$	0.80	0.90	V
		$T_j = 150^\circ\text{C}$	0.70	0.80	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	2.3	2.6	m Ω
		$T_j = 150^\circ\text{C}$	3.4	3.6	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 16.4\text{ mA}$	5	5.8	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_j = 25^\circ\text{C}$			5	mA
C_{ies}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	27.2		nF
C_{oes}		$f = 1\text{ MHz}$	1.76		nF
C_{res}		$f = 1\text{ MHz}$	1.50		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		2500		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		1.9		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$	246		ns
t_r	$I_C = 450\text{ A}$	$T_j = 150^\circ\text{C}$	59		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$	32		mJ
$t_{d(off)}$	$R_{G on} = 1\text{ }\Omega$	$T_j = 150^\circ\text{C}$	529		ns
t_f	$R_{G off} = 1\text{ }\Omega$	$T_j = 150^\circ\text{C}$	102		ns
E_{off}	$di/dt_{on} = 8100\text{ A}/\mu\text{s}$ $di/dt_{off} = 3400\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$			
		$T_j = 150^\circ\text{C}$	60		mJ
$R_{th(j-c)}$	per IGBT			0.062	K/W
$R_{th(c-s)}$	per IGBT ($\lambda_{grease} = 0.81\text{ W}/(\text{m}^2\text{K})$)		0.028		K/W
$R_{th(c-s)}$	per IGBT, pre-applied phase change material		0.017		K/W



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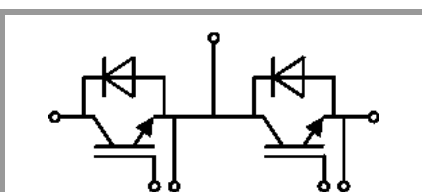
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse diode						
V _F = V _{EC}	I _F = 450 A	T _j = 25 °C		2.31	2.65	V
	V _{GE} = 0 V chipelevel	T _j = 150 °C		2.31	2.64	V
V _{F0}	chipelevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
r _F	chipelevel	T _j = 25 °C		2.3	2.6	mΩ
		T _j = 150 °C		3.1	3.4	mΩ
I _{RRM}	I _F = 450 A	T _j = 150 °C		452		A
Q _{rr}	di/dt _{off} = 8300 A/μs	T _j = 150 °C		62		μC
E _{rr}	V _{GE} = ±15 V V _{CC} = 600 V	T _j = 150 °C		28		mJ
R _{th(j-c)}	per diode				0.13	K/W
R _{th(c-s)}	per diode (λ _{grease} =0.81 W/(m*K))			0.038		K/W
R _{th(c-s)}	per diode, pre-applied phase change material			0.032		K/W
Module						
L _{CE}				15		nH
R _{CC'+EE'}	measured per switch	T _C = 25 °C		0.55		mΩ
		T _C = 125 °C		0.85		mΩ
R _{th(c-s)1}	calculated without thermal coupling			0.008		K/W
R _{th(c-s)2}	including thermal coupling, Ts underneath module (λ _{grease} =0.81 W/(m*K))			0.013		K/W
R _{th(c-s)2}	including thermal coupling, Ts underneath module, pre-applied phase change material			0.009		K/W
M _s	to heat sink M6		3		5	Nm
M _t		to terminals M6	2.5		5	Nm
						Nm
w					325	g



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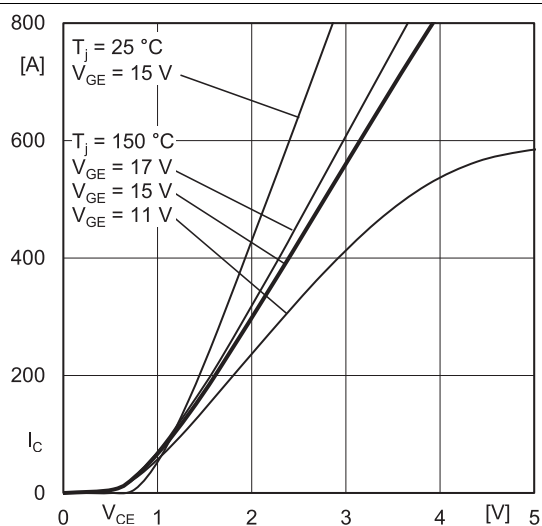


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

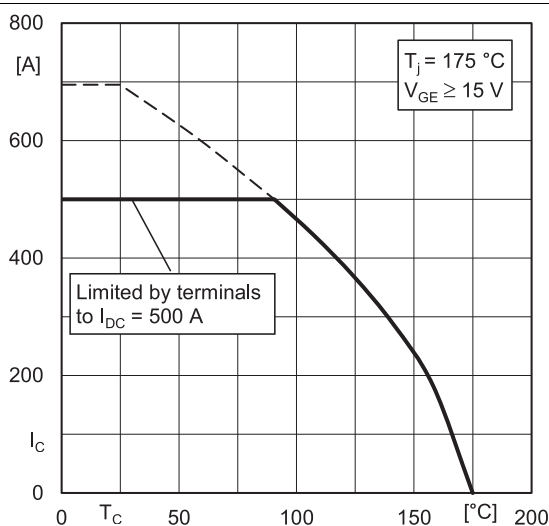


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

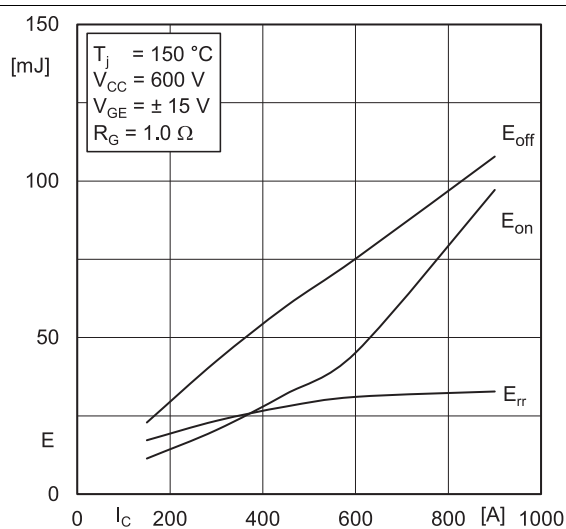


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

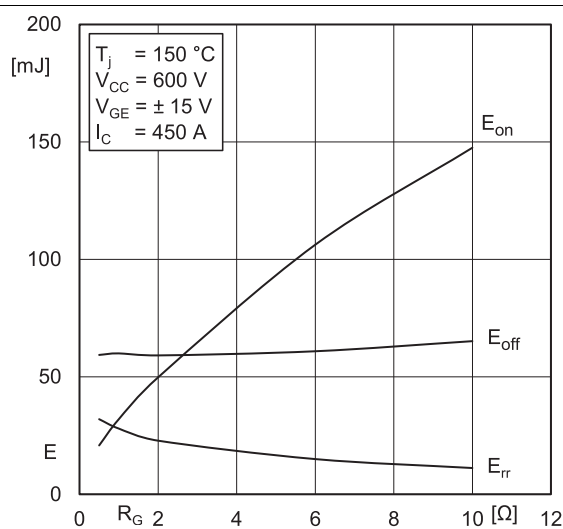


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

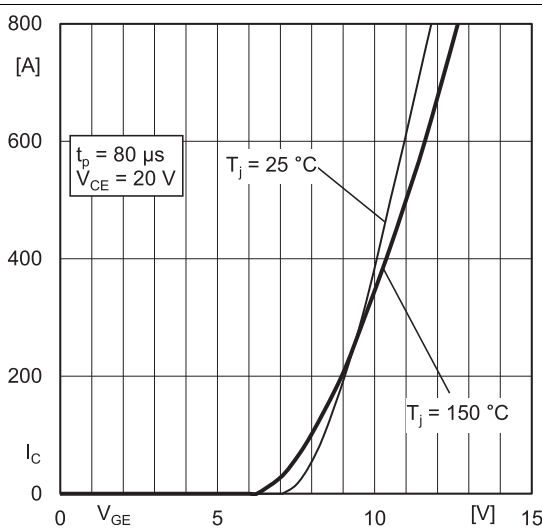


Fig. 5: Typ. transfer characteristic

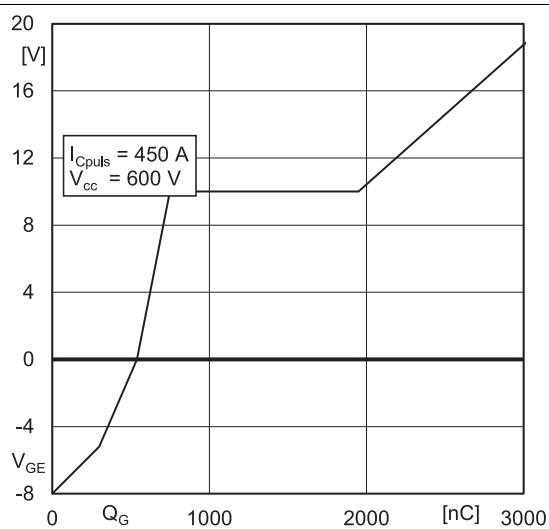


Fig. 6: Typ. gate charge characteristic

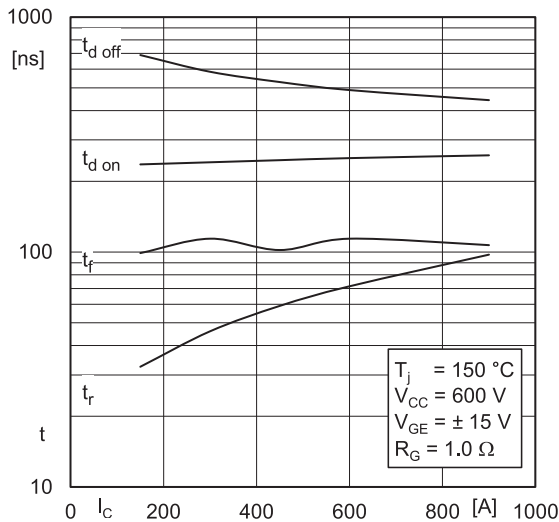


Fig. 7: Typ. switching times vs. I_C

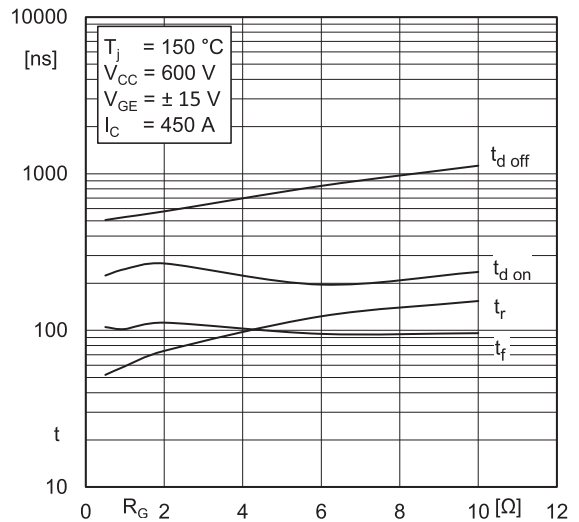


Fig. 8: Typ. switching times vs. gate resistor R_G

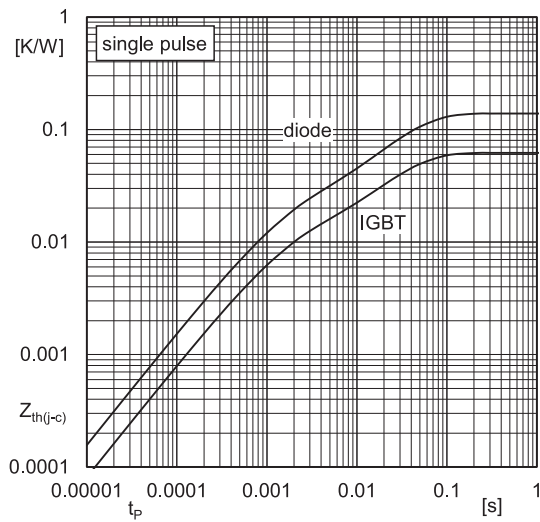


Fig. 9: Transient thermal impedance

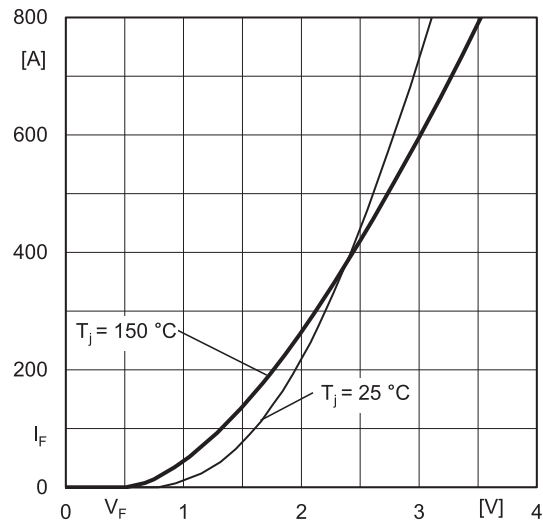


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

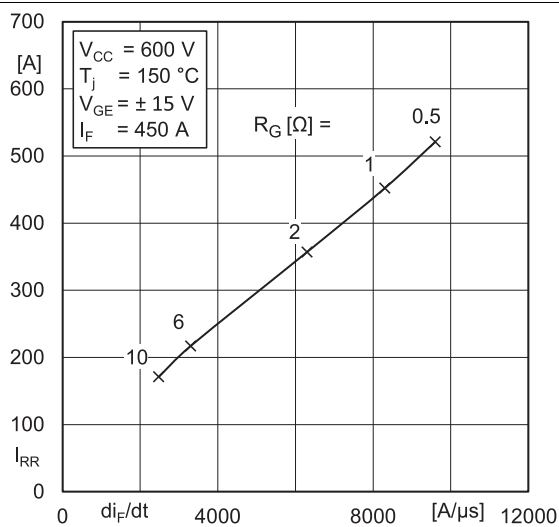


Fig. 11: CAL diode peak reverse recovery current

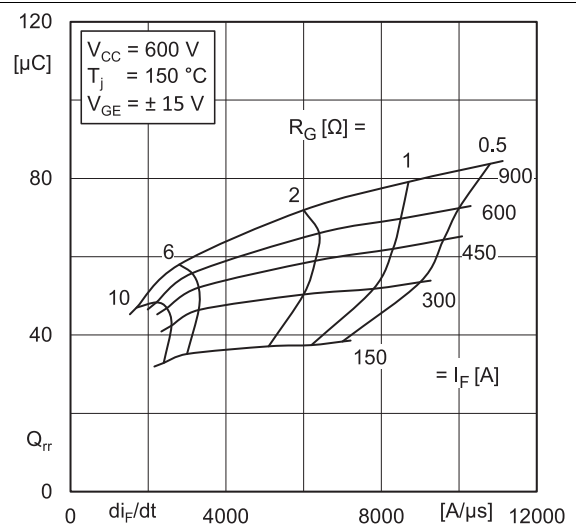
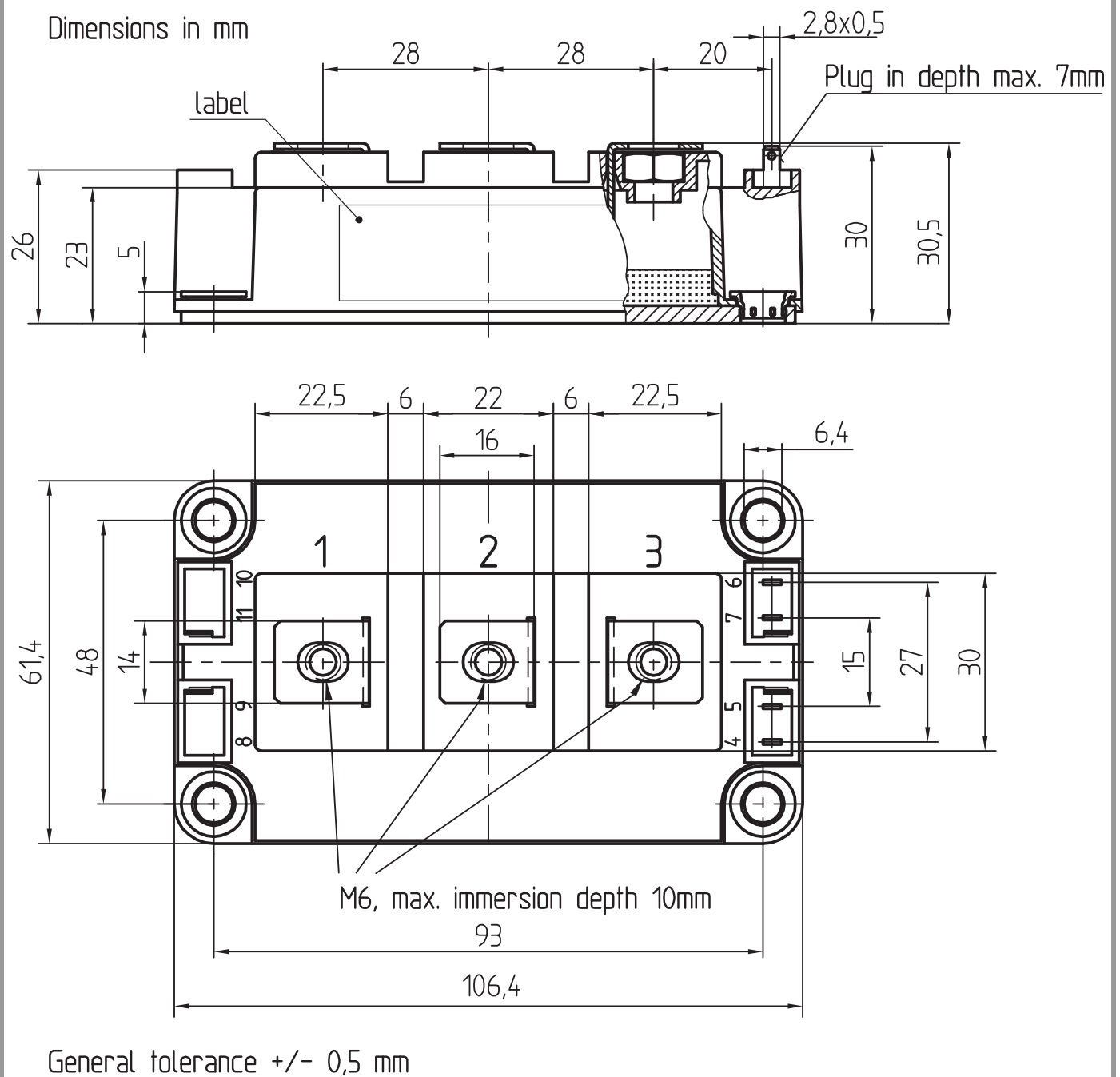
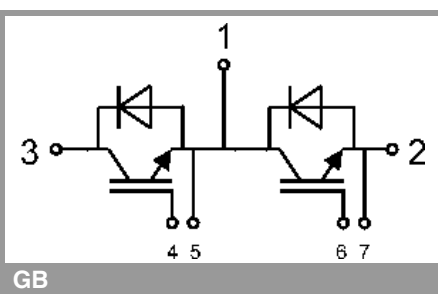


Fig. 12: Typ. CAL diode peak reverse recovery charge



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

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