



SEMITRANS® 3

IGBT4 Modules

SKM600GM12E4

Features*

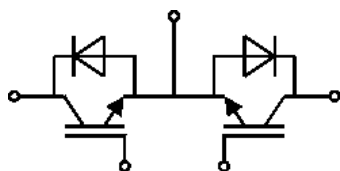
- IGBT4 = 4th generation medium fast trench IGBT (Infineon)
- CAL4 = Soft switching 4th generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- With integrated gate resistor
- For higher switching frequencies up to 12kHz
- UL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

Typical Applications

- Matrix Inverter
- Bidirectional switch

Remarks

- Case temperature limited to $T_c = 125^\circ\text{C}$ max, recomm.
 $T_{op} = -40 \dots +150^\circ\text{C}$, product rel. 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	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	860
		$T_c = 80^\circ\text{C}$	702
I_{Cnom}		600	A
I_{CRM}		1800	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	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	623
		$T_c = 80^\circ\text{C}$	466
I_{Fnom}		500	A
I_{FRM}		1200	A
I_{FSM}	$t_p = 10\text{ ms}$, $\sin 180^\circ$, $T_j = 25^\circ\text{C}$	2736	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					
$V_{CE(sat)}$	$I_C = 600\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.80	2.05	V
		$T_j = 150^\circ\text{C}$	2.20	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	$T_j = 25^\circ\text{C}$	1.67	1.92	m Ω
		$T_j = 150^\circ\text{C}$	2.5	2.7	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 24\text{ mA}$	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}	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	37.2		nF
C_{oes}		$f = 1\text{ MHz}$	2.32		nF
C_{res}		$f = 1\text{ MHz}$	2.04		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		3400		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		1.3		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$	156		ns
t_r	$I_C = 600\text{ A}$	$T_j = 150^\circ\text{C}$	68		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$	30		mJ
$t_{d(off)}$	$R_{G on} = 1.8\text{ }\Omega$	$T_j = 150^\circ\text{C}$	522		ns
t_f	$R_{G off} = 1\text{ }\Omega$	$T_j = 150^\circ\text{C}$	138		ns
E_{off}	$di/dt_{on} = 9100\text{ A}/\mu\text{s}$ $di/dt_{off} = 4000\text{ A}/\mu\text{s}$ $dv/dt = 3500\text{ V}/\mu\text{s}$ $L_s = 25\text{ nH}$	$T_j = 150^\circ\text{C}$	77		mJ
$R_{th(j-c)}$	per IGBT			0.049	K/W
$R_{th(c-s)}$	per IGBT ($\lambda_{grease} = 0.81\text{ W}/(\text{m}^2\text{K})$)		0.032		K/W
$R_{th(c-s)}$	per IGBT, pre-applied phase change material		0.016		K/W



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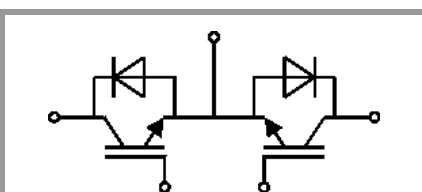
Typical Applications

- Matrix Inverter
- Bidirectional switch

Remarks

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse diode						
$V_F = V_{EC}$	$I_F = 600\text{ A}$	$T_j = 25\text{ }^{\circ}\text{C}$		2.28	2.63	V
	$V_{GE} = 0\text{ V}$ chipelevel	$T_j = 150\text{ }^{\circ}\text{C}$		2.28	2.61	V
V_{F0}	chipelevel	$T_j = 25\text{ }^{\circ}\text{C}$		1.30	1.50	V
		$T_j = 150\text{ }^{\circ}\text{C}$		0.90	1.10	V
r_F	chipelevel	$T_j = 25\text{ }^{\circ}\text{C}$		1.64	1.88	mΩ
		$T_j = 150\text{ }^{\circ}\text{C}$		2.3	2.5	mΩ
I_{RRM}	$I_F = 600\text{ A}$	$T_j = 150\text{ }^{\circ}\text{C}$		559		A
Q_{rr}	$di/dt_{off} = 8500\text{ A}/\mu\text{s}$	$T_j = 150\text{ }^{\circ}\text{C}$		98		μC
E_{rr}	$V_{GE} = -15\text{ V}$ $V_{CC} = 600\text{ V}$	$T_j = 150\text{ }^{\circ}\text{C}$		39		mJ
$R_{th(j-c)}$	per diode				0.095	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			0.039		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material			0.028		K/W
Module						
L_{CE}				15		nH
$R_{CC'+EE'}$	measured per switch	$T_C = 25\text{ }^{\circ}\text{C}$		0.55		mΩ
		$T_C = 125\text{ }^{\circ}\text{C}$		0.85		mΩ
$R_{th(c-s)1}$	calculated without thermal coupling			0.00879		K/W
$R_{th(c-s)2}$	including thermal coupling, Ts underneath module ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			0.014		K/W
$R_{th(c-s)2}$	including thermal coupling, Ts underneath module, pre-applied phase change material			0.008		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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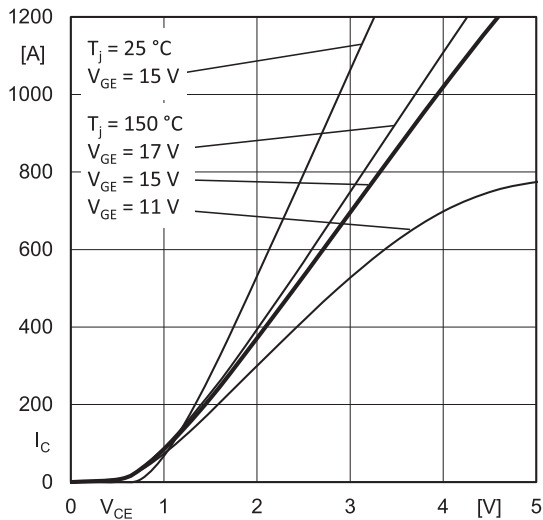


Fig. 1: Typ. output characteristic, inclusive $R_{CC'} + E_{E'}$

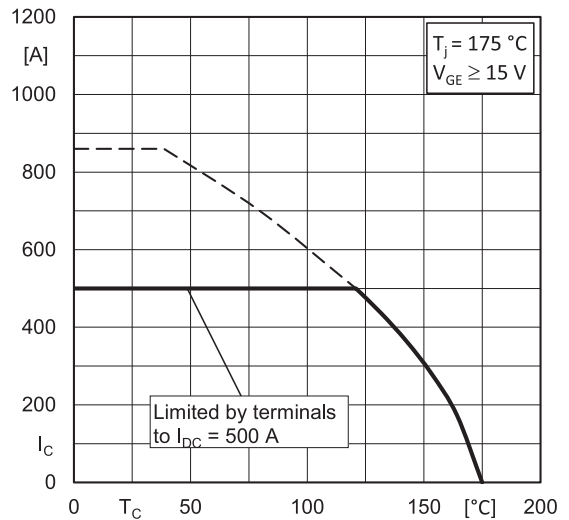


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

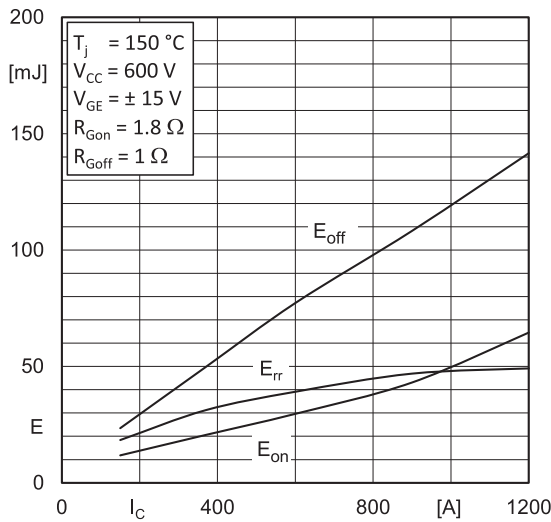


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

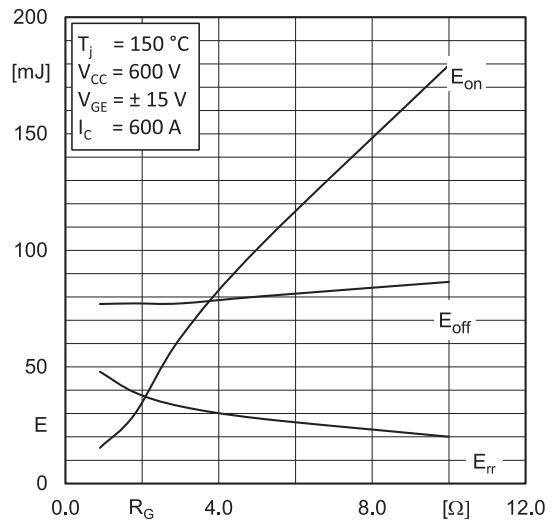


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

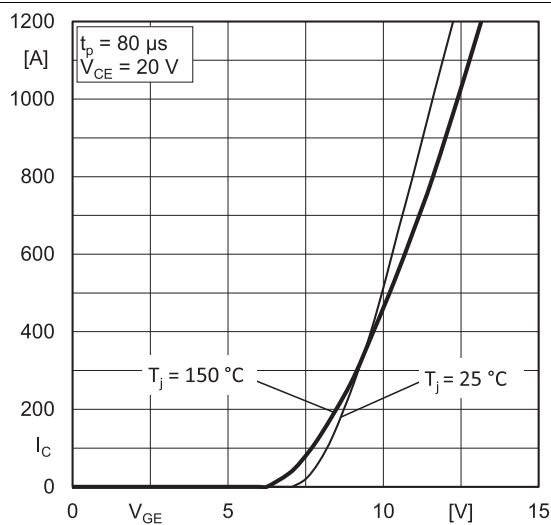


Fig. 5: Typ. transfer characteristic

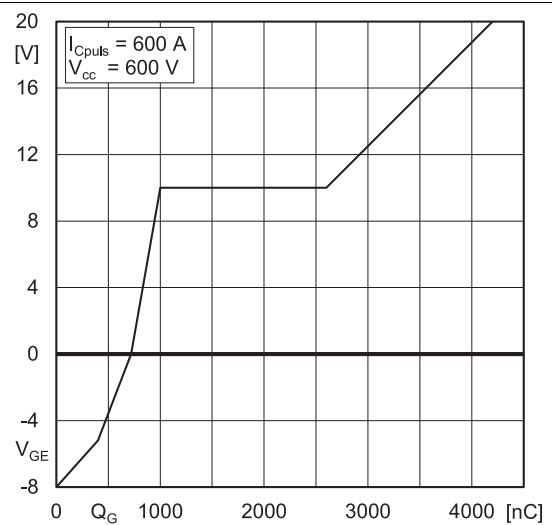


Fig. 6: Typ. gate charge characteristic

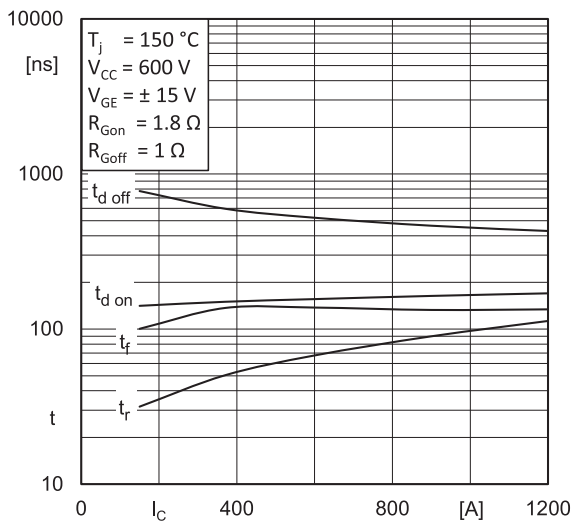


Fig. 7: Typ. switching times vs. I_C

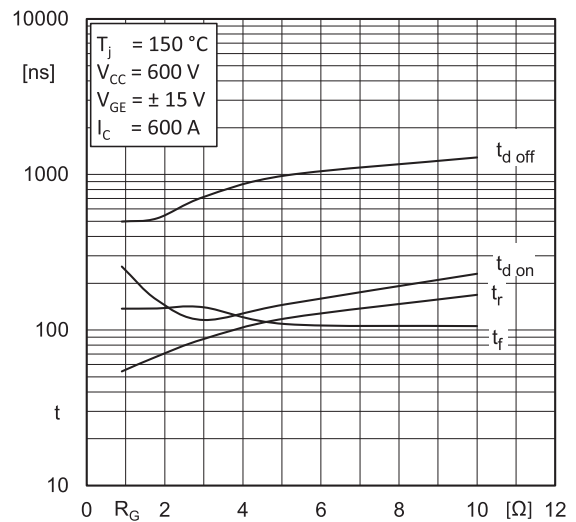


Fig. 8: Typ. switching times vs. gate resistor R_G

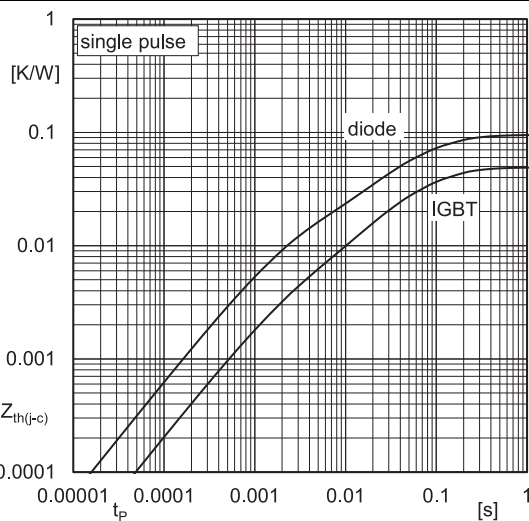


Fig. 9: Transient thermal impedance

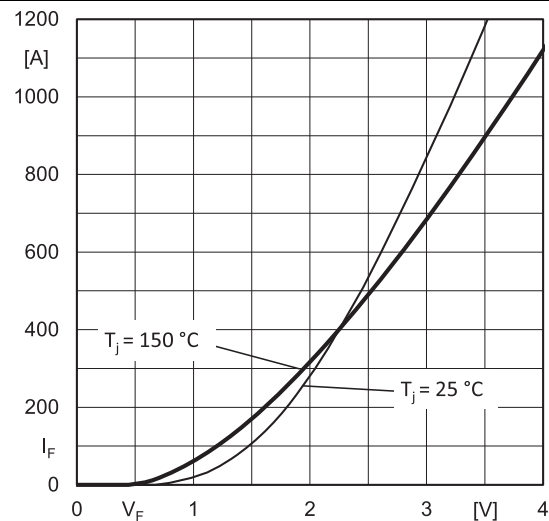


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

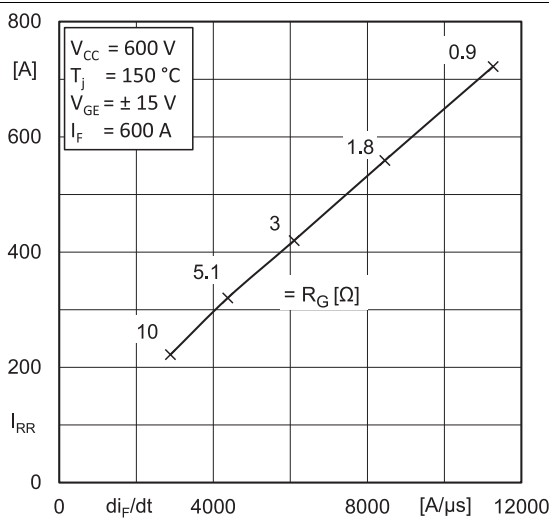


Fig. 11: Typ. CAL diode peak reverse recovery current

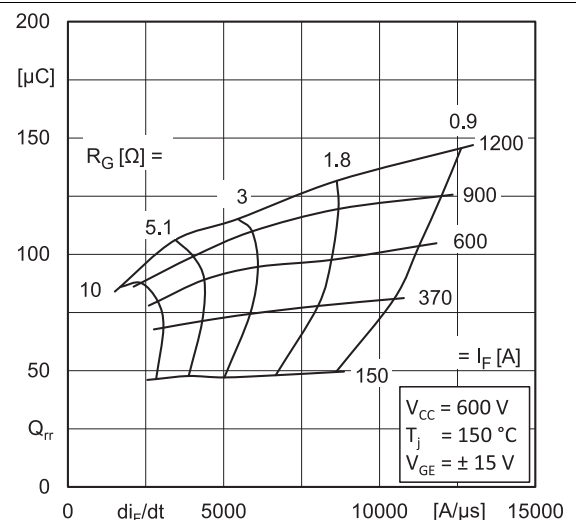
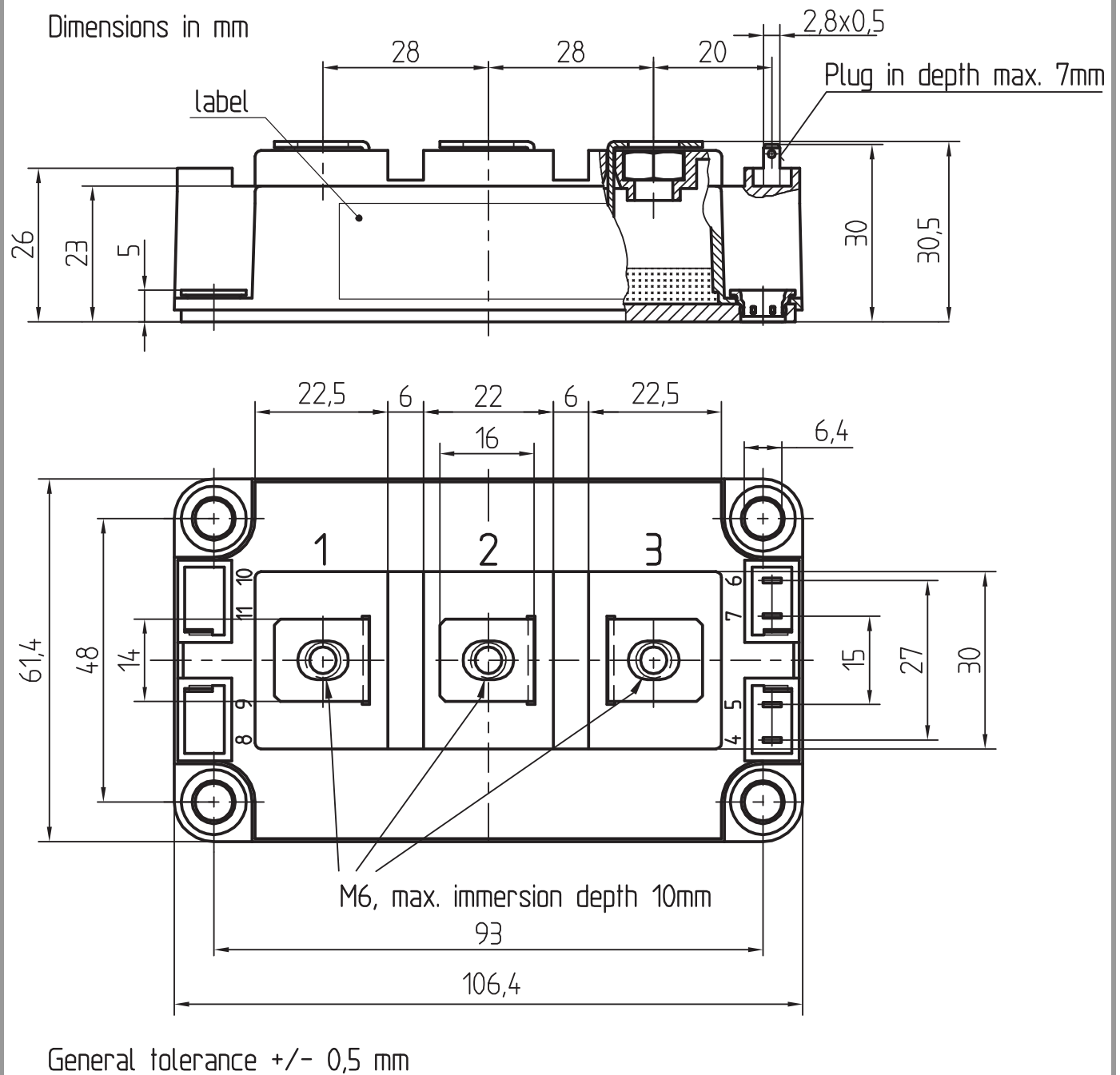
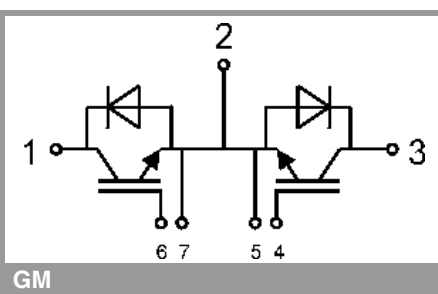


Fig. 12: Typ. CAL diode peak reverse recovery charge



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

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