

SKM400GAL12F4



SEMITRANS® 3

High Speed IGBT4 Modules

SKM400GAL12F4

Features*

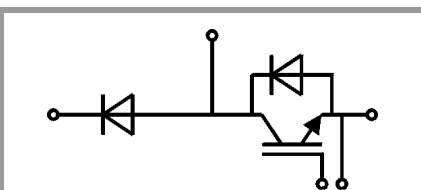
- High speed trench and field-stop IGBT
- CAL4 ultra-fast = soft switching 4. generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- For higher switching frequencies above 15kHz
- UL recognized, file no. E63532

Typical Applications

- Electronic welders
- DC/DC – converter
- Brake chopper
- Switched reluctance motor

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



GAL

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	A
		$T_c = 80^\circ\text{C}$	418	A
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	μs
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	A
		$T_c = 80^\circ\text{C}$	295	A
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	$^\circ\text{C}$	
Freewheeling 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	A
		$T_c = 80^\circ\text{C}$	295	A
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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
		$T_j = 150^\circ\text{C}$		-	mA
C_{ies}	$V_{CE} = 25\text{ V}$		24.6		nF
C_{oes}	$V_{GE} = 0\text{ V}$		1.62		nF
C_{res}			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

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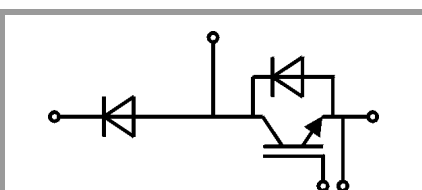
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		110		ns
t_r	$I_C = 400\text{ A}$	$T_j = 150^\circ\text{C}$		55		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		28		mJ
	$R_{G\ on} = 2\ \Omega$					
$t_{d(off)}$	$R_{G\ off} = 1\ \Omega$	$T_j = 150^\circ\text{C}$		415		ns
t_f	$di/dt_{on} = 7960\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		75		ns
	$di/dt_{off} = 4430\text{ A}/\mu\text{s}$					
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 ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			0.041		K/W
Inverse diode						
$V_F = V_{EC}$	$I_F = 400\text{ A}$	$T_j = 25^\circ\text{C}$		2.55	2.93	V
	$V_{GE} = 0\text{ V}$	$T_j = 150^\circ\text{C}$		2.44	2.80	V
	chipllevel					
V_{F0}	chipllevel	$T_j = 25^\circ\text{C}$		1.51	1.75	V
		$T_j = 150^\circ\text{C}$		1.16	1.40	V
r_F	chipllevel	$T_j = 25^\circ\text{C}$		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}	$V_{GE} = -15\text{ V}$	$T_j = 150^\circ\text{C}$		18.5		mJ
	$V_{CC} = 600\text{ V}$					
$R_{th(j-c)}$	per diode				0.14	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			0.047		K/W
Freewheeling diode						
$V_F = V_{EC}$	$I_F = 400\text{ A}$	$T_j = 25^\circ\text{C}$		2.55	2.93	V
	$V_{GE} = 0\text{ V}$	$T_j = 150^\circ\text{C}$		2.44	2.80	V
	chipllevel					
V_{F0}	chipllevel	$T_j = 25^\circ\text{C}$		1.51	1.75	V
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E_{rr}	$V_{GE} = -15\text{ V}$	$T_j = 150^\circ\text{C}$		18.5		mJ
	$V_{CC} = 600\text{ V}$					
$R_{th(j-c)}$	per diode				0.14	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			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 ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			0.0219		K/W
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module ($\lambda_{grease}=0.81\text{ W}/(\text{m}^*\text{K})$)			0.024		K/W
M_s	to heat sink M6		3		5	Nm
M_t	to terminals M6		2.5		5	Nm
						Nm
w					325	g

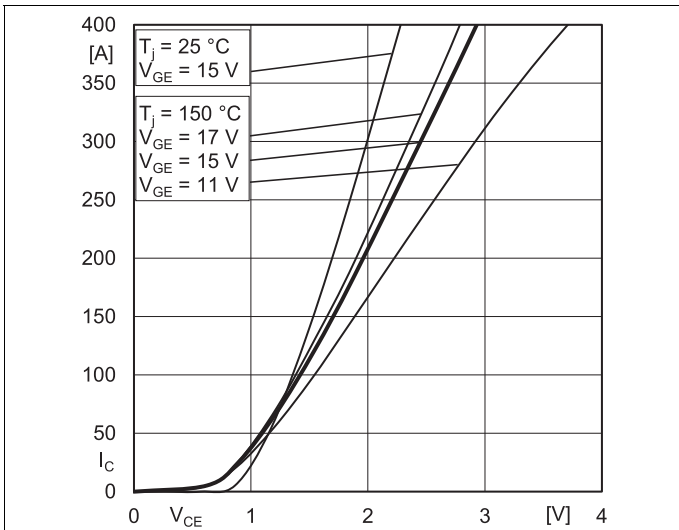


Fig. 1: Typ. output characteristic, inclusive R_{CC+EE}

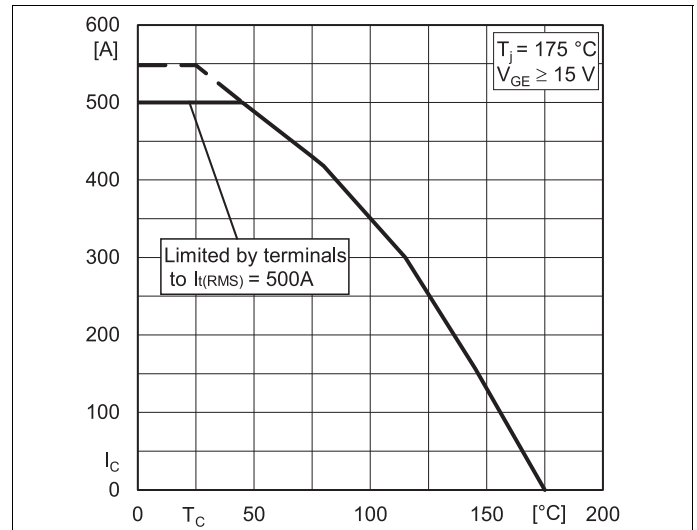


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

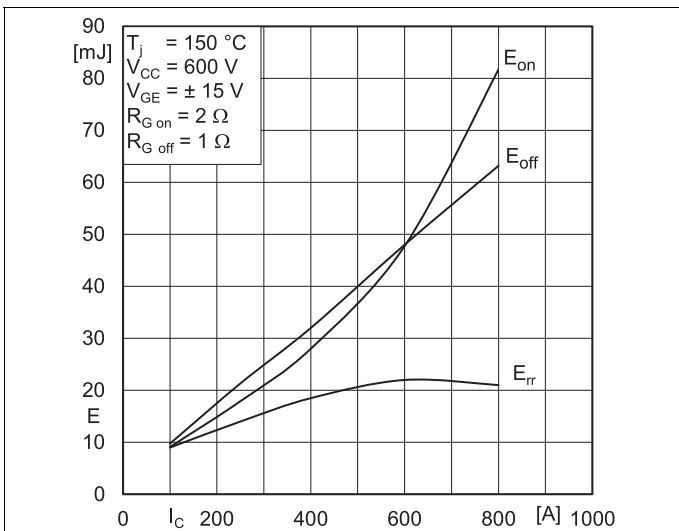


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

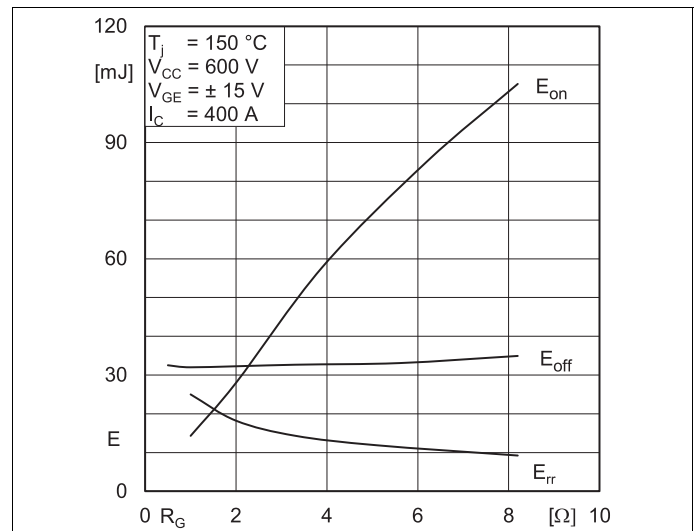


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

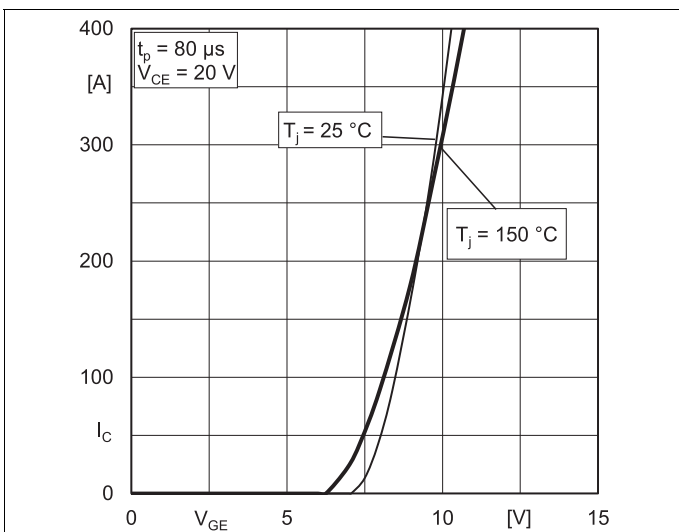


Fig. 5: Typ. transfer characteristic

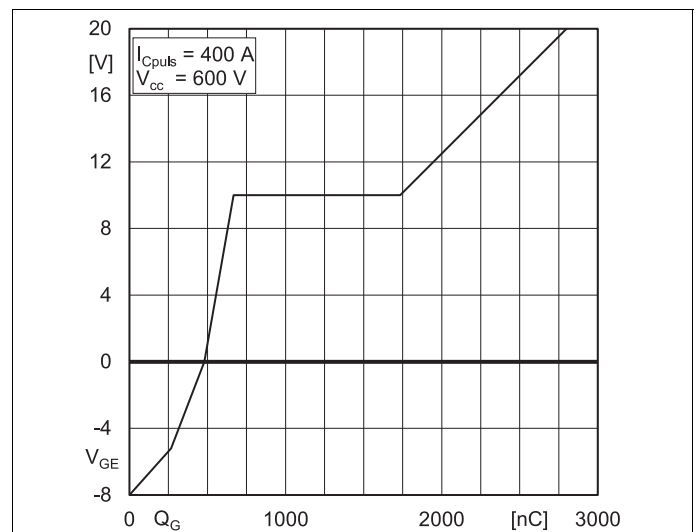


Fig. 6: Typ. gate charge characteristic

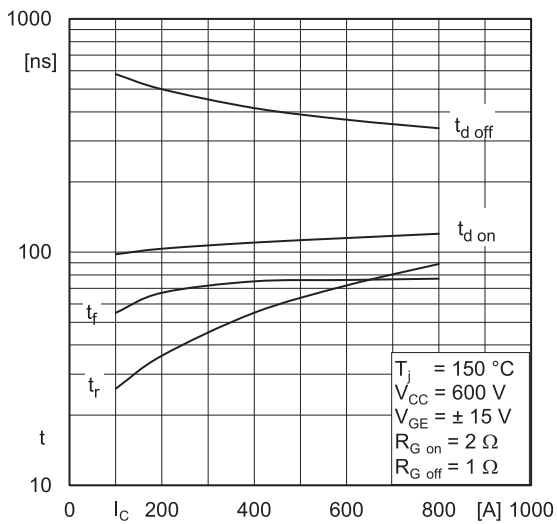


Fig. 7: Typ. switching times vs. I_C

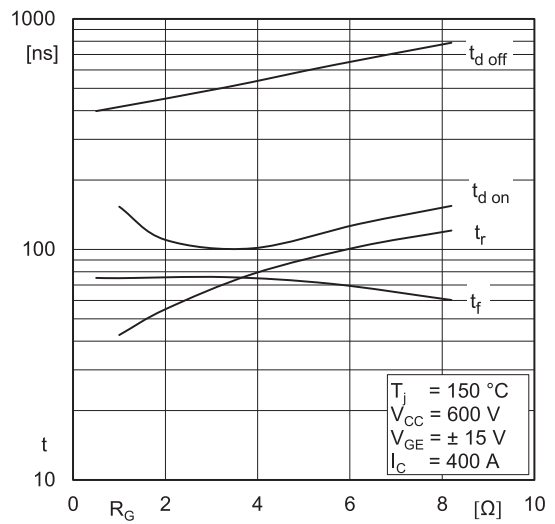


Fig. 8: Typ. switching times vs. gate resistor R_G

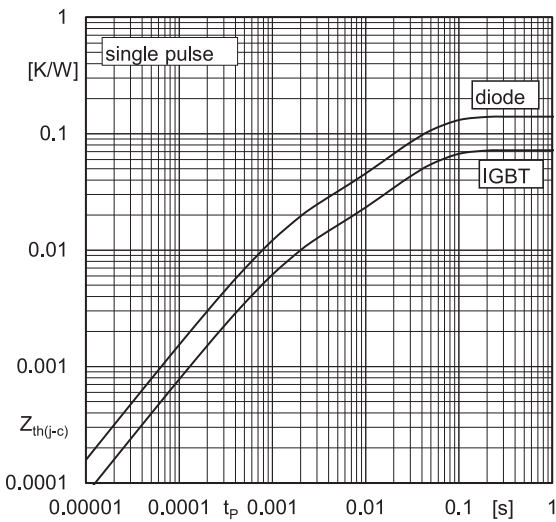


Fig. 9: Transient thermal impedance

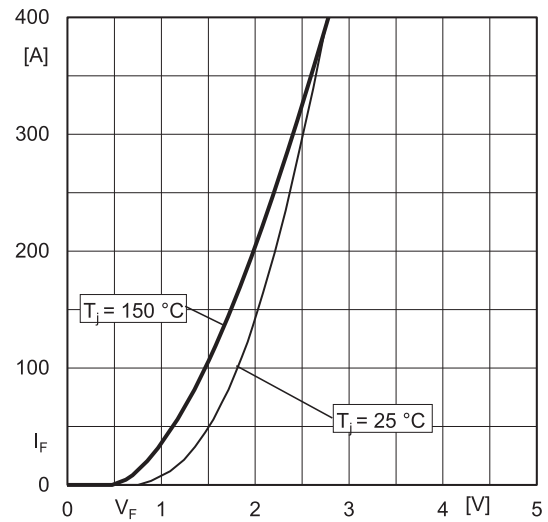


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC+EE'}$

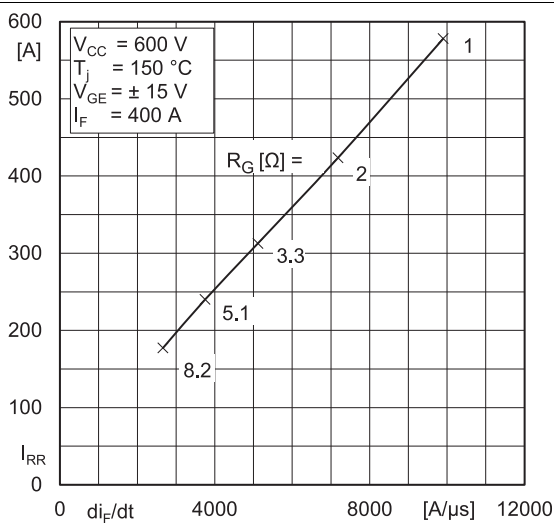


Fig. 11: Typ. CAL diode peak reverse recovery current

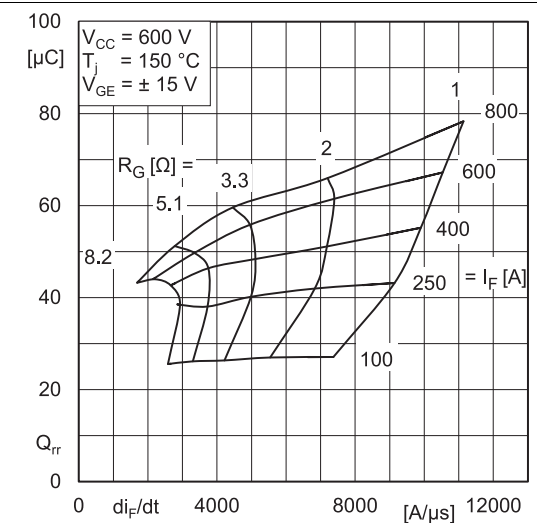
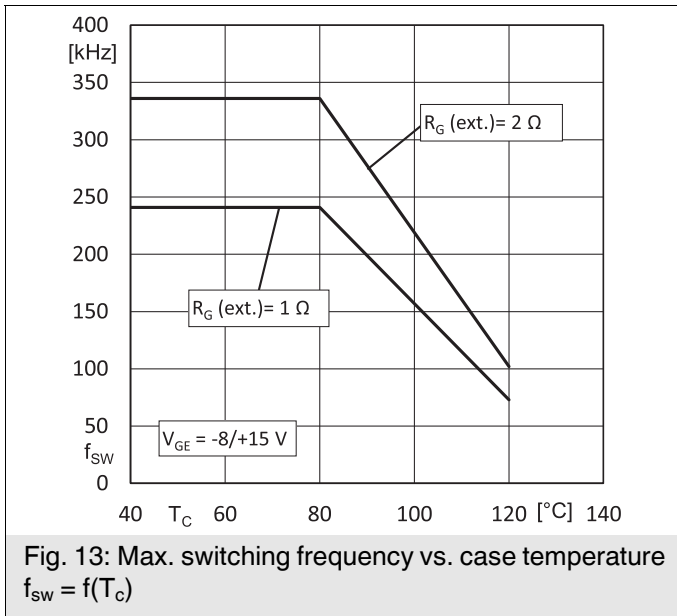
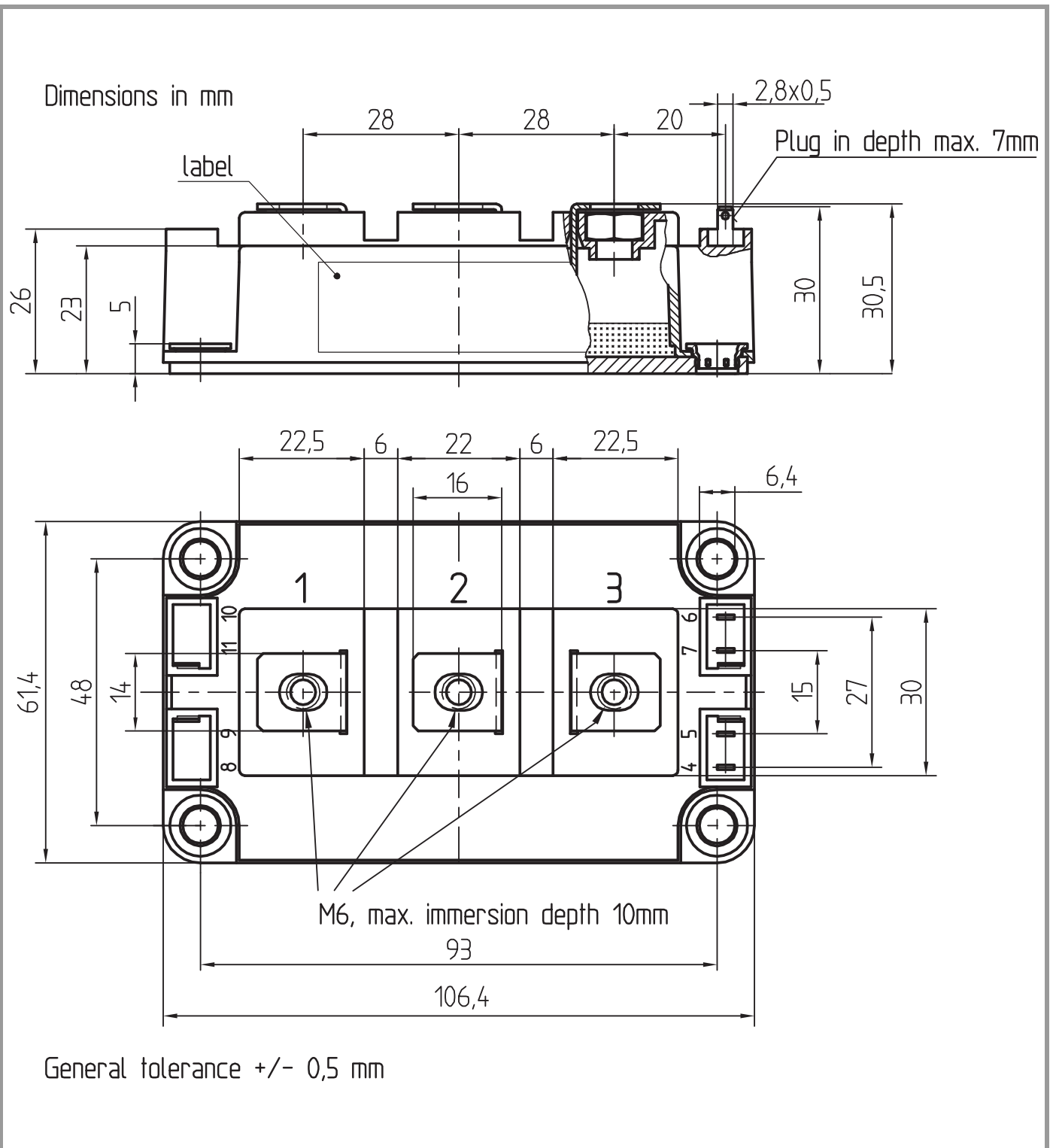


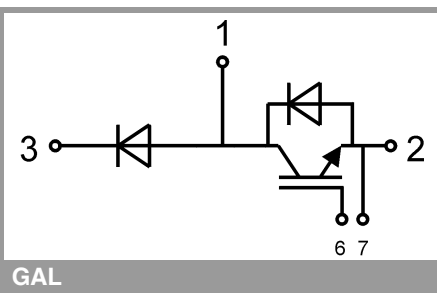
Fig. 12: Typ. CAL diode peak reverse recovery charge



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

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