

SKM600GAL12T4



SEMITRANS® 3

Fast IGBT4 Modules

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Features*

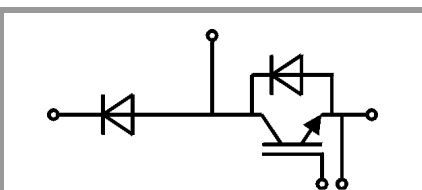
- IGBT4 = 4th generation fast trench IGBT (Infineon)
- CAL4 = Soft switching 4th generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- With integrated gate resistor
- For higher switching frequencies up to 20kHz
- UL recognized, file no. E63532

Typical Applications

- Electronic welders at fsw up to 20 kHz
- 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 $T_j = 150^\circ\text{C}$



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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	A
		$T_c = 80^\circ\text{C}$	702	A
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	μs
T_j		-40 ... 175	$^\circ\text{C}$	
Inverse diode				
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V	
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	623	A
		$T_c = 80^\circ\text{C}$	466	A
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	$^\circ\text{C}$	
Freewheeling diode				
V_{RRM}	$T_j = 25^\circ\text{C}$	1200	V	
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	707	A
		$T_c = 80^\circ\text{C}$	529	A
I_{Fnom}		600	A	
I_{FRM}		1200	A	
I_{FSM}	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$	3240	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	$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	2.5	2.7	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 24\text{ mA}$	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



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- Increased power cycling capability
- With integrated gate resistor
- For higher switching frequencies up to 20kHz
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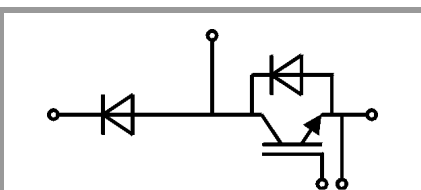
Typical Applications

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

Remarks

- Case temperature limited to $T_c = 125^\circ\text{C}$ max.
- Recommended $T_{op} = -40 \dots +150^\circ\text{C}$
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT						
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		178		ns
t_r	$I_C = 600\text{ A}$	$T_j = 150^\circ\text{C}$		68		ns
E_{on}	$V_{GE} = +15/-15\text{ V}$	$T_j = 150^\circ\text{C}$		33		mJ
	$R_{G\ on} = 1.6\ \Omega$	$T_j = 150^\circ\text{C}$		523		ns
$t_{d(off)}$	$R_{G\ off} = 1\ \Omega$	$T_j = 150^\circ\text{C}$		116		ns
t_f	$di/dt_{on} = 8900\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		70		mJ
	$di/dt_{off} = 4300\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$				
E_{off}	$dv/dt = 3550\text{ V}/\mu\text{s}$	$T_j = 150^\circ\text{C}$				
	$L_s = 24\text{ nH}$					
$R_{th(j-c)}$	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
Inverse diode						
$V_F = V_{EC}$	$I_F = 600\text{ A}$	$T_j = 25^\circ\text{C}$		2.28	2.63	V
	$V_{GE} = 0\text{ V}$	$T_j = 150^\circ\text{C}$		2.28	2.61	V
	chiplevel					
V_{F0}		$T_j = 25^\circ\text{C}$		1.30	1.50	V
	chiplevel	$T_j = 150^\circ\text{C}$		0.90	1.10	V
r_F		$T_j = 25^\circ\text{C}$		1.64	1.88	m Ω
	chiplevel	$T_j = 150^\circ\text{C}$		2.3	2.5	m Ω
I_{RRM}	$I_F = 600\text{ A}$	$T_j = 150^\circ\text{C}$		566		A
Q_{rr}	$di/dt_{off} = 8700\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		99		μC
E_{rr}	$V_{GE} = -15\text{ V}$	$T_j = 150^\circ\text{C}$		40		mJ
	$V_{CC} = 600\text{ V}$					
$R_{th(j-c)}$	per diode				0.095	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)			0.039		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material			0.028		K/W
Freewheeling diode						
$V_F = V_{EC}$	$I_F = 600\text{ A}$	$T_j = 25^\circ\text{C}$		2.14	2.46	V
	$V_{GE} = 0\text{ V}$	$T_j = 150^\circ\text{C}$		2.07	2.38	V
	chiplevel					
V_{F0}		$T_j = 25^\circ\text{C}$		1.30	1.50	V
	chiplevel	$T_j = 150^\circ\text{C}$		0.90	1.10	V
r_F		$T_j = 25^\circ\text{C}$		1.40	1.60	m Ω
	chiplevel	$T_j = 150^\circ\text{C}$		1.95	2.1	m Ω
I_{RRM}	$I_F = 600\text{ A}$	$T_j = 150^\circ\text{C}$		600		A
Q_{rr}	$di/dt_{off} = 9000\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		90		μC
E_{rr}	$V_{GE} = \pm 15\text{ V}$	$T_j = 150^\circ\text{C}$		39		mJ
	$V_{CC} = 600\text{ V}$					
$R_{th(j-c)}$	per diode				0.086	K/W
$R_{th(c-s)}$	per diode ($\lambda_{grease}=0.81\text{ W}/(\text{m}^2\text{K})$)			0.038		K/W
$R_{th(c-s)}$	per diode, pre-applied phase change material			0.024		K/W



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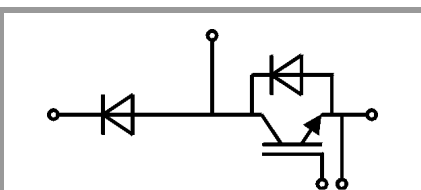
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Characteristics							
Symbol	Conditions		min.	typ.	max.	Unit	
Module							
L_{CE}				15		nH	
$R_{CC'+EE'}$	measured per switch	$T_c = 25^\circ\text{C}$		0.55		m Ω	
		$T_c = 125^\circ\text{C}$		0.85		m Ω	
$R_{th(c-s)1}$	calculated without thermal coupling			0.0172		K/W	
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module ($\lambda_{grease}=0.81 \text{ W}/(\text{m}^*\text{K})$)			0.020		K/W	
$R_{th(c-s)2}$	including thermal coupling, T_s underneath module, pre-applied phase change material			0.011		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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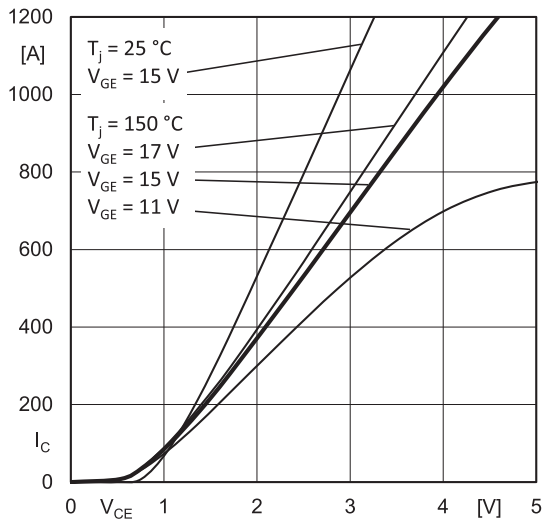


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

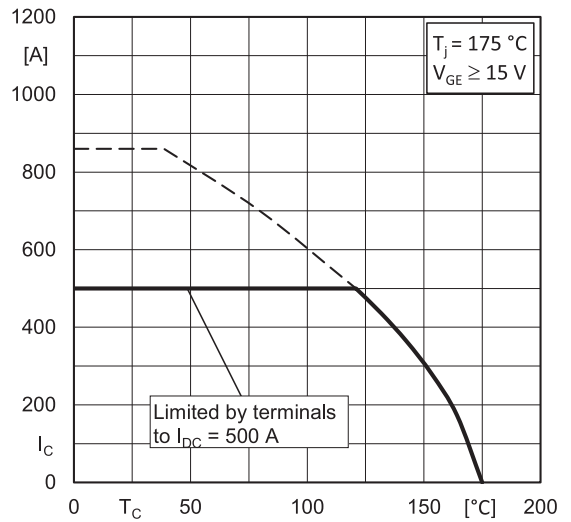


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

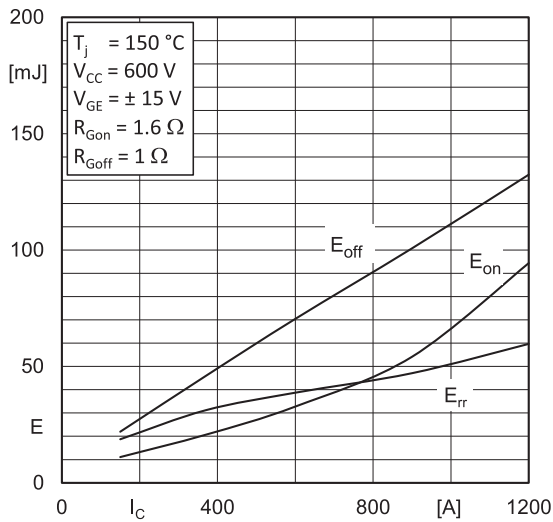


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

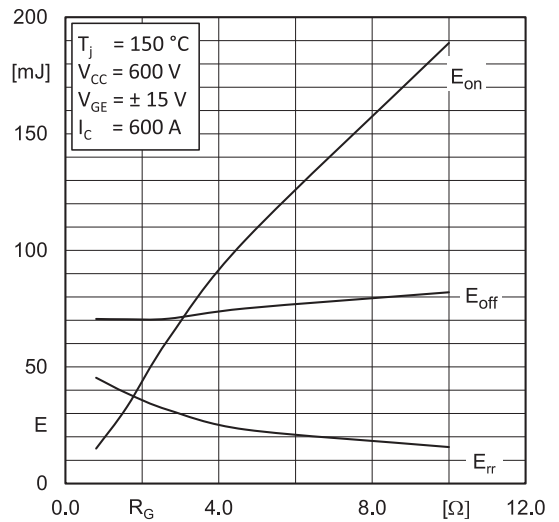


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

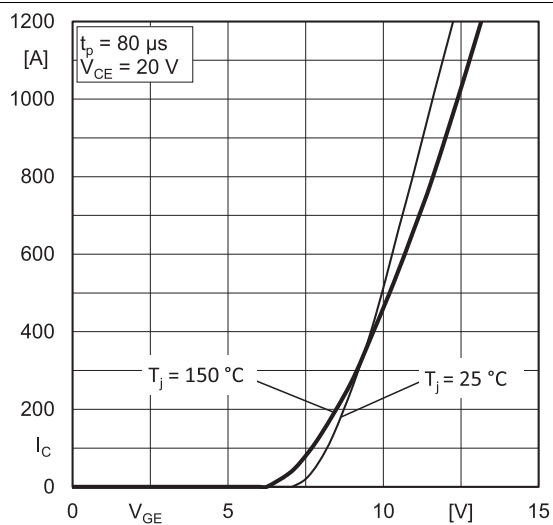


Fig. 5: Typ. transfer characteristic

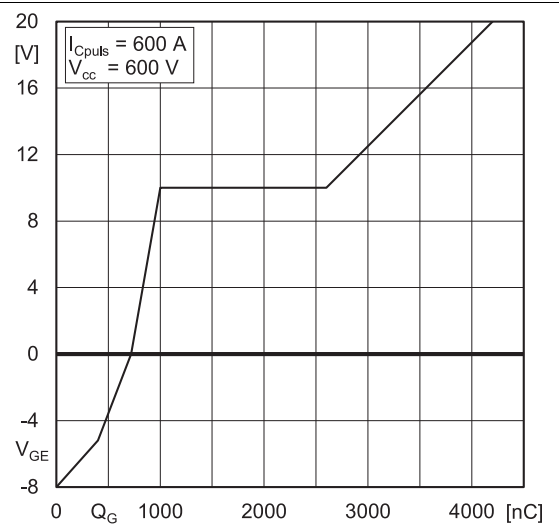


Fig. 6: Typ. gate charge characteristic

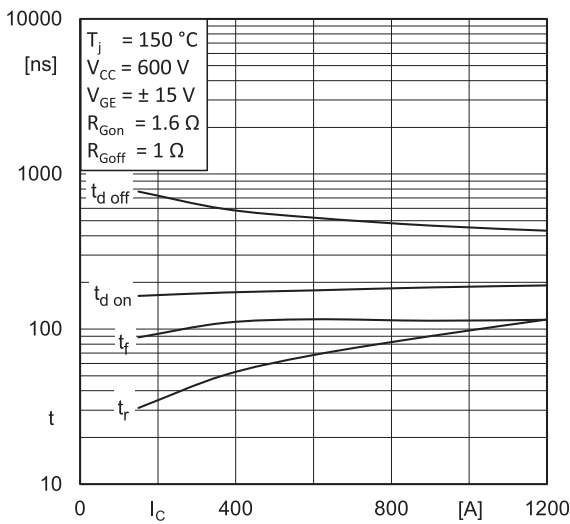


Fig. 7: Typ. switching times vs. I_C

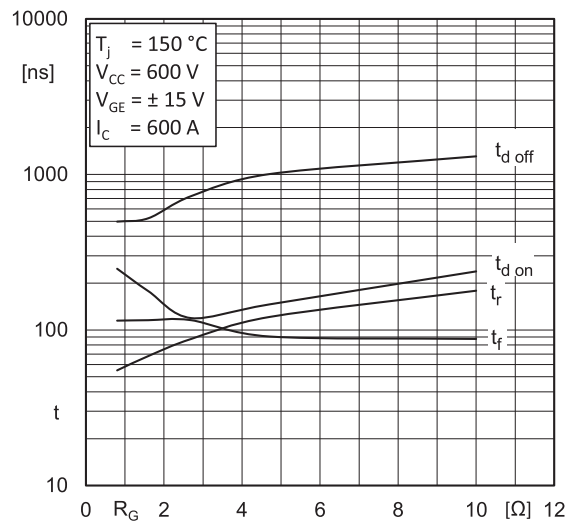


Fig. 8: Typ. switching times vs. gate resistor R_G

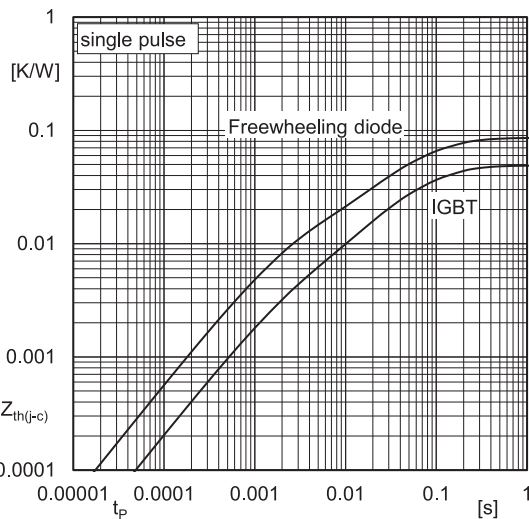


Fig. 9: Transient thermal impedance

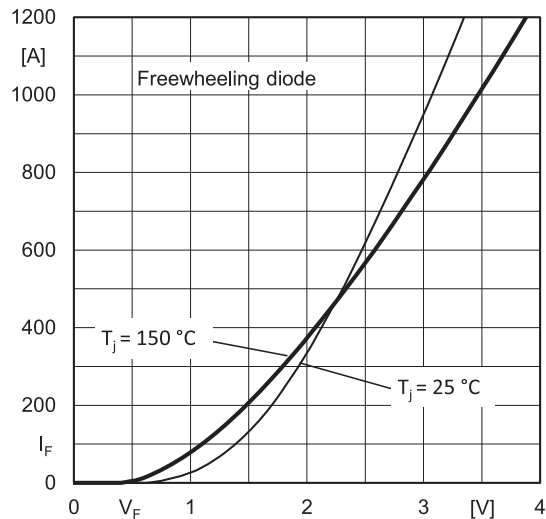


Fig. 10: Typ. CAL diode forward charact., incl. R_{CC+EE}

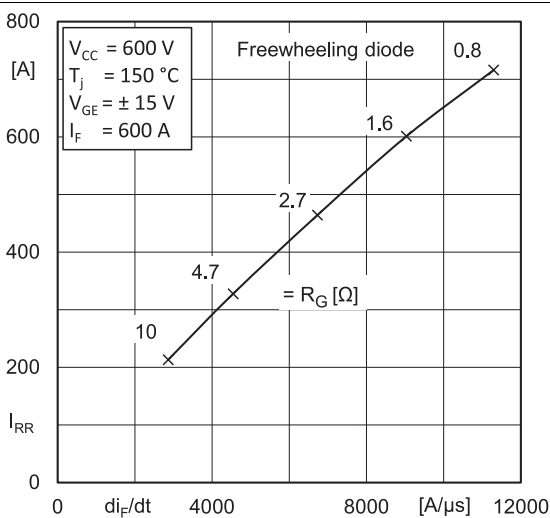


Fig. 11: Typ. CAL diode peak reverse recovery current

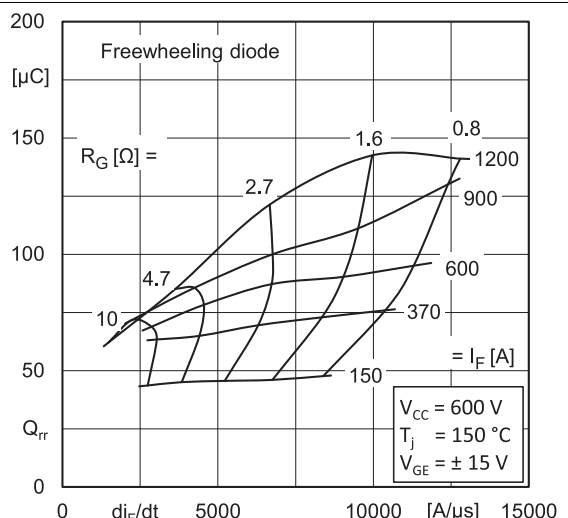
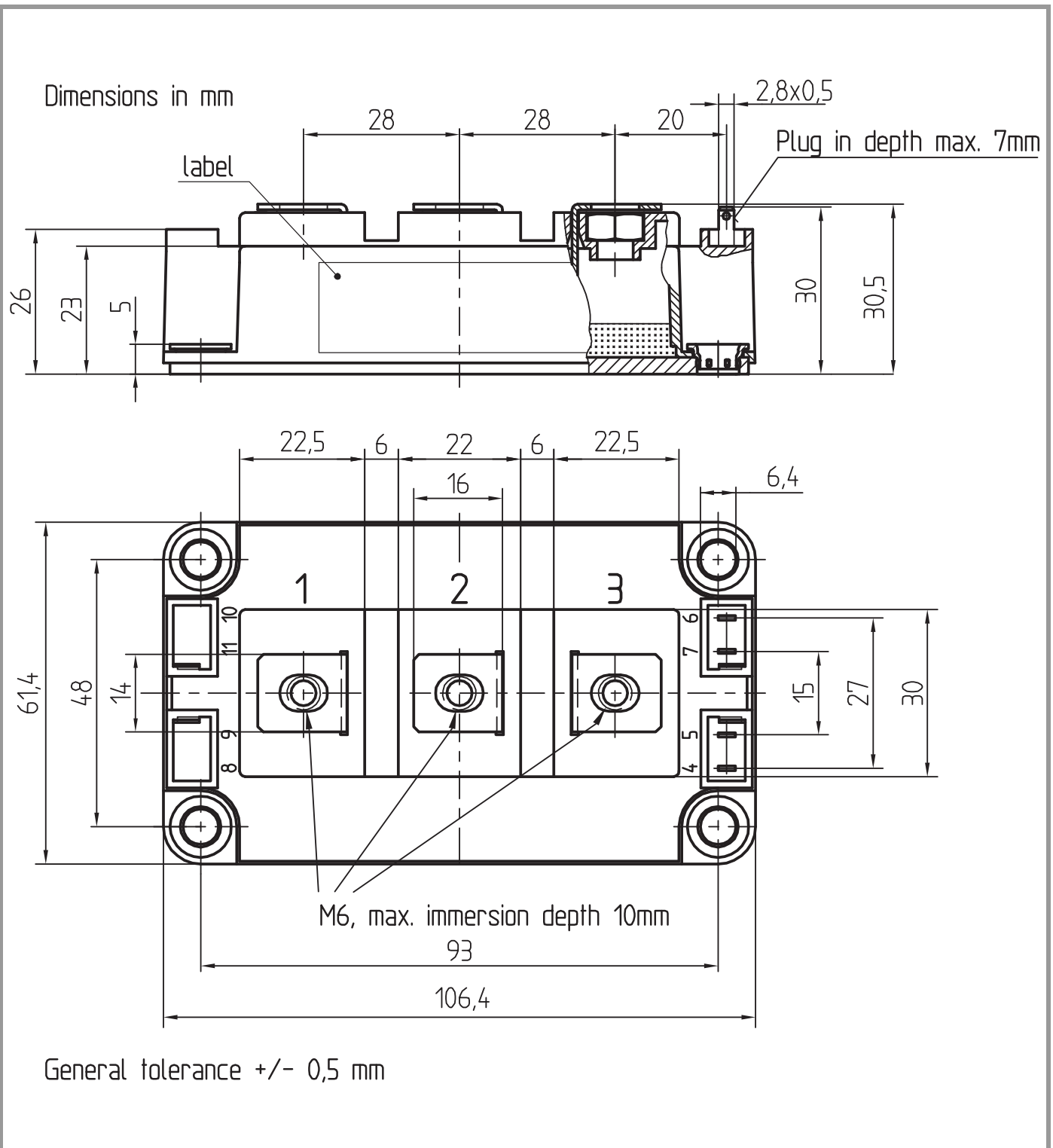
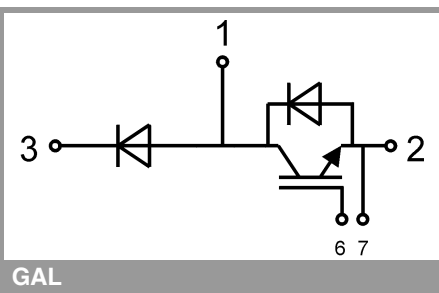


Fig. 12: Typ. CAL diode peak reverse recovery charge

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

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