



SEMITRANS® 3

Fast IGBT4 Modules

SKM600GAR12T4

Features*

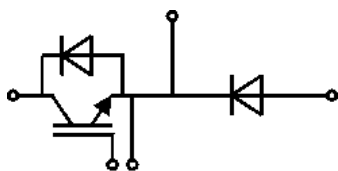
- IGBT4 = 4th generation fast trench IGBT (Infineon)
- CAL4 = Soft switching 4th generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- With integrated gate resistor
- For higher switching frequencies up to 20kHz
- UL recognized, 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
		$T_c = 80^\circ\text{C}$	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	$^\circ\text{C}$
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
		$T_c = 80^\circ\text{C}$	529
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	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



Fast IGBT4 Modules

SKM600GAR12T4

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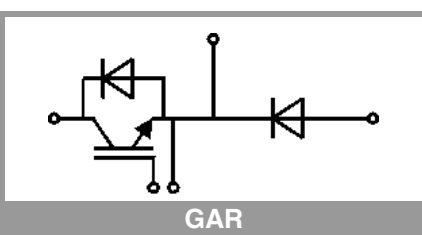
Typical Applications

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Remarks

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT						
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		178		ns
t _r	I _C = 600 A	T _j = 150 °C		68		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		33		mJ
t _{d(off)}	R _{G on} = 1.6 Ω	T _j = 150 °C		523		ns
t _f	R _{G off} = 1 Ω	T _j = 150 °C		116		ns
E _{off}	di/dt _{on} = 8900 A/μs di/dt _{off} = 4300 A/μs dv/dt = 3550 V/μs L _s = 24 nH	T _j = 150 °C		70		mJ
R _{th(j-c)}	per IGBT				0.049	K/W
R _{th(c-s)}	per IGBT (λ _{grease} =0.81 W/(m*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 A	T _j = 25 °C		2.28	2.63	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.28	2.61	V
V _{F0}	chiplevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
r _F	chiplevel	T _j = 25 °C		1.64	1.88	mΩ
		T _j = 150 °C		2.3	2.5	mΩ
I _{RRM}	I _F = 600 A	T _j = 150 °C		566		A
Q _{rr}	di/dt _{off} = 8700 A/μs	T _j = 150 °C		99		μC
E _{rr}	V _{GE} = -15 V V _{CC} = 600 V	T _j = 150 °C		40		mJ
R _{th(j-c)}	per diode				0.095	K/W
R _{th(c-s)}	per diode (λ _{grease} =0.81 W/(m*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 A	T _j = 25 °C		2.14	2.46	V
	V _{GE} = 0 V chiplevel	T _j = 150 °C		2.07	2.38	V
V _{F0}	chiplevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
r _F	chiplevel	T _j = 25 °C		1.40	1.60	mΩ
		T _j = 150 °C		1.95	2.1	mΩ
I _{RRM}	I _F = 600 A	T _j = 150 °C		600		A
Q _{rr}	di/dt _{off} = 9000 A/μs	T _j = 150 °C		90		μC
E _{rr}	V _{GE} = ±15 V V _{CC} = 600 V	T _j = 150 °C		39		mJ
R _{th(j-c)}	per diode				0.086	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			0.024		K/W



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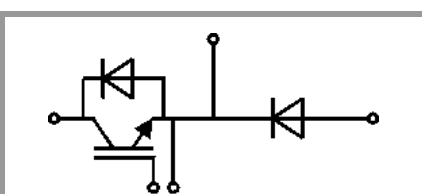
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Module						
L _{CE}			15			nH
R _{CC'+EE'}	measured per	T _C = 25 °C	0.55			mΩ
	switch	T _C = 125 °C	0.85			mΩ
R _{th(c-s)1}	calculated without thermal coupling		0.0172			K/W
R _{th(c-s)2}	including thermal coupling, Ts underneath module (λ _{grease} =0.81 W/(m*K))		0.020			K/W
R _{th(c-s)2}	including thermal coupling, Ts 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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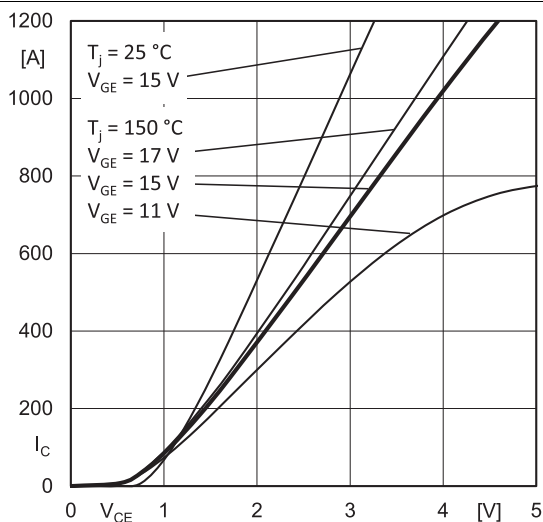


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+EE'}$

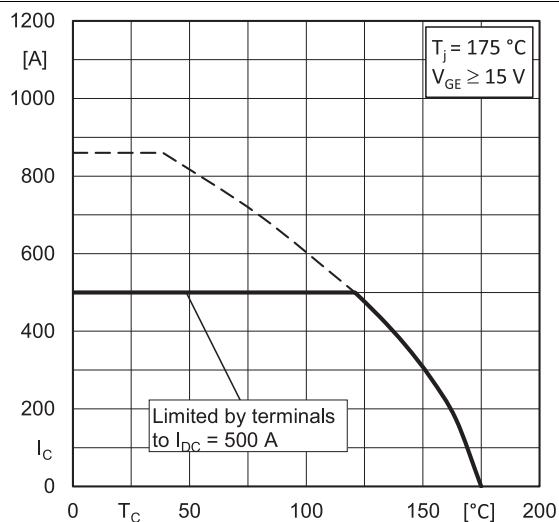


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

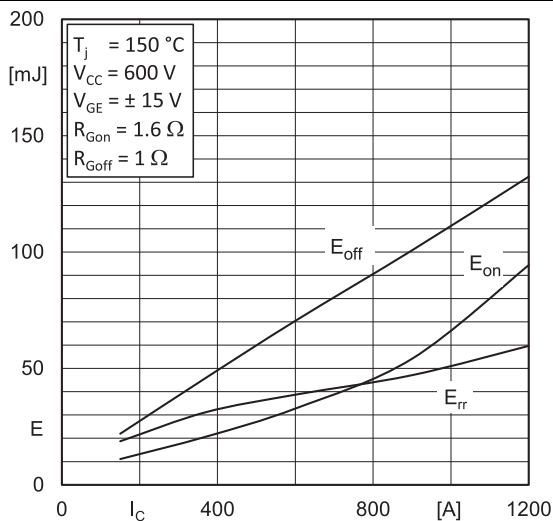


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

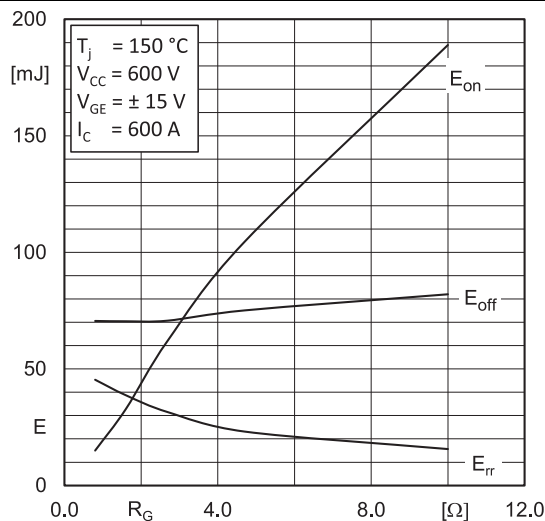


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

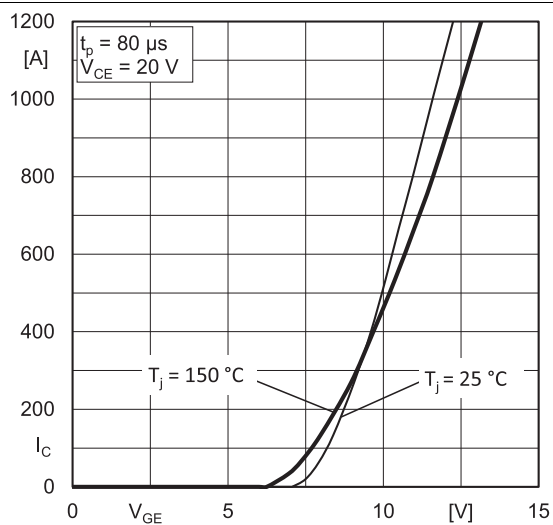


Fig. 5: Typ. transfer characteristic

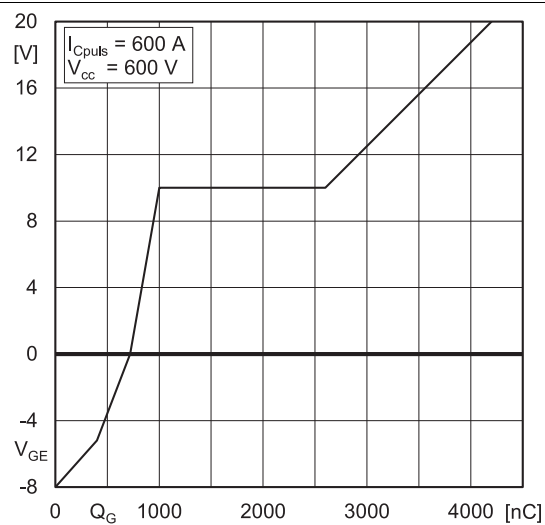


Fig. 6: Typ. gate charge characteristic

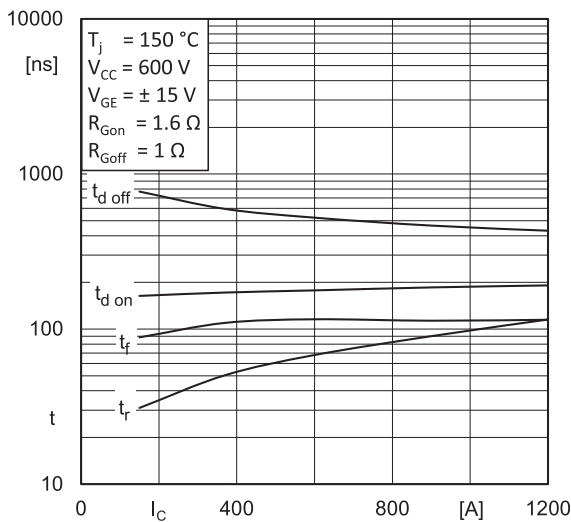


Fig. 7: Typ. switching times vs. I_C

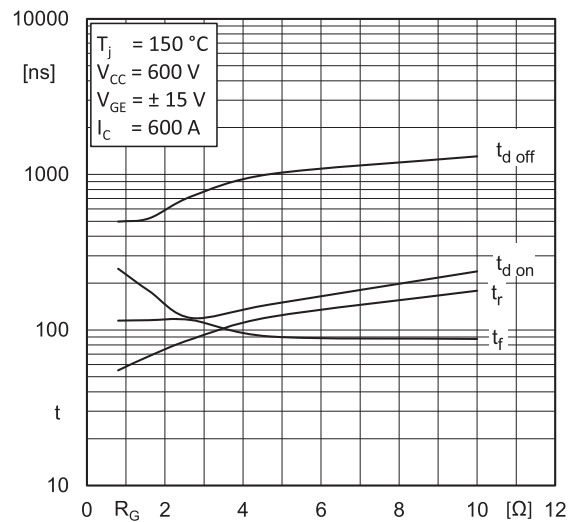


Fig. 8: Typ. switching times vs. gate resistor R_G

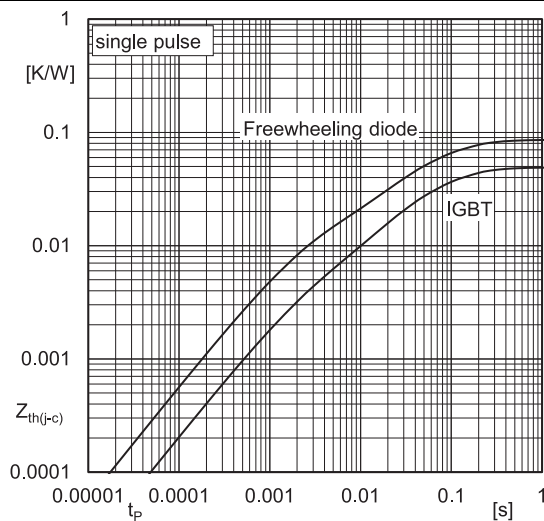


Fig. 9: Transient thermal impedance

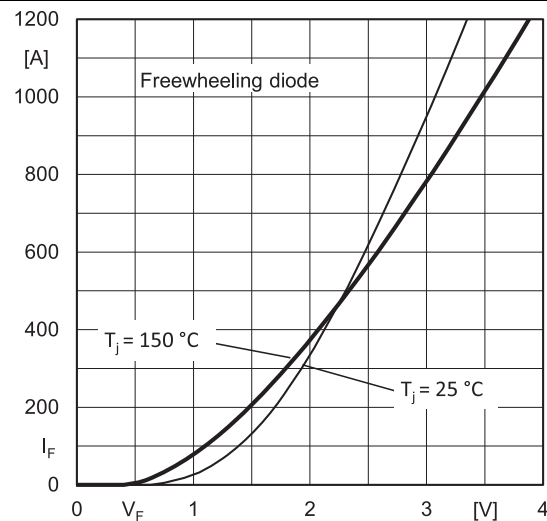


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

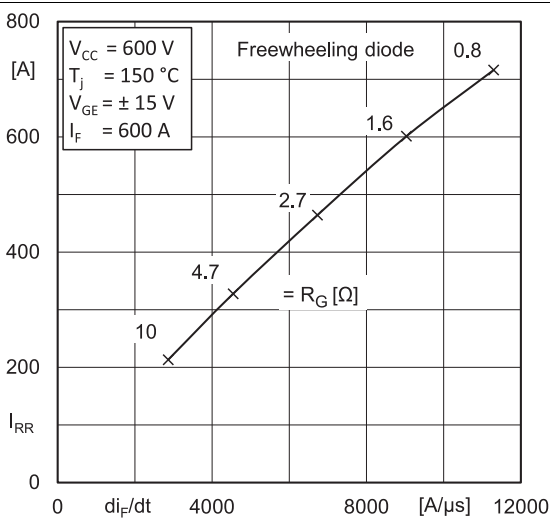


Fig. 11: Typ. CAL diode peak reverse recovery current

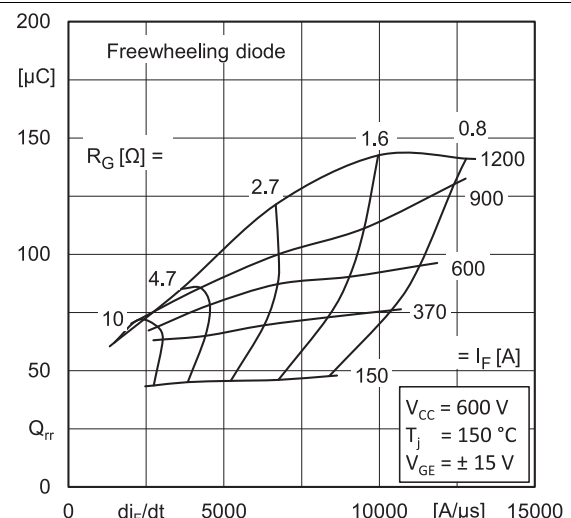
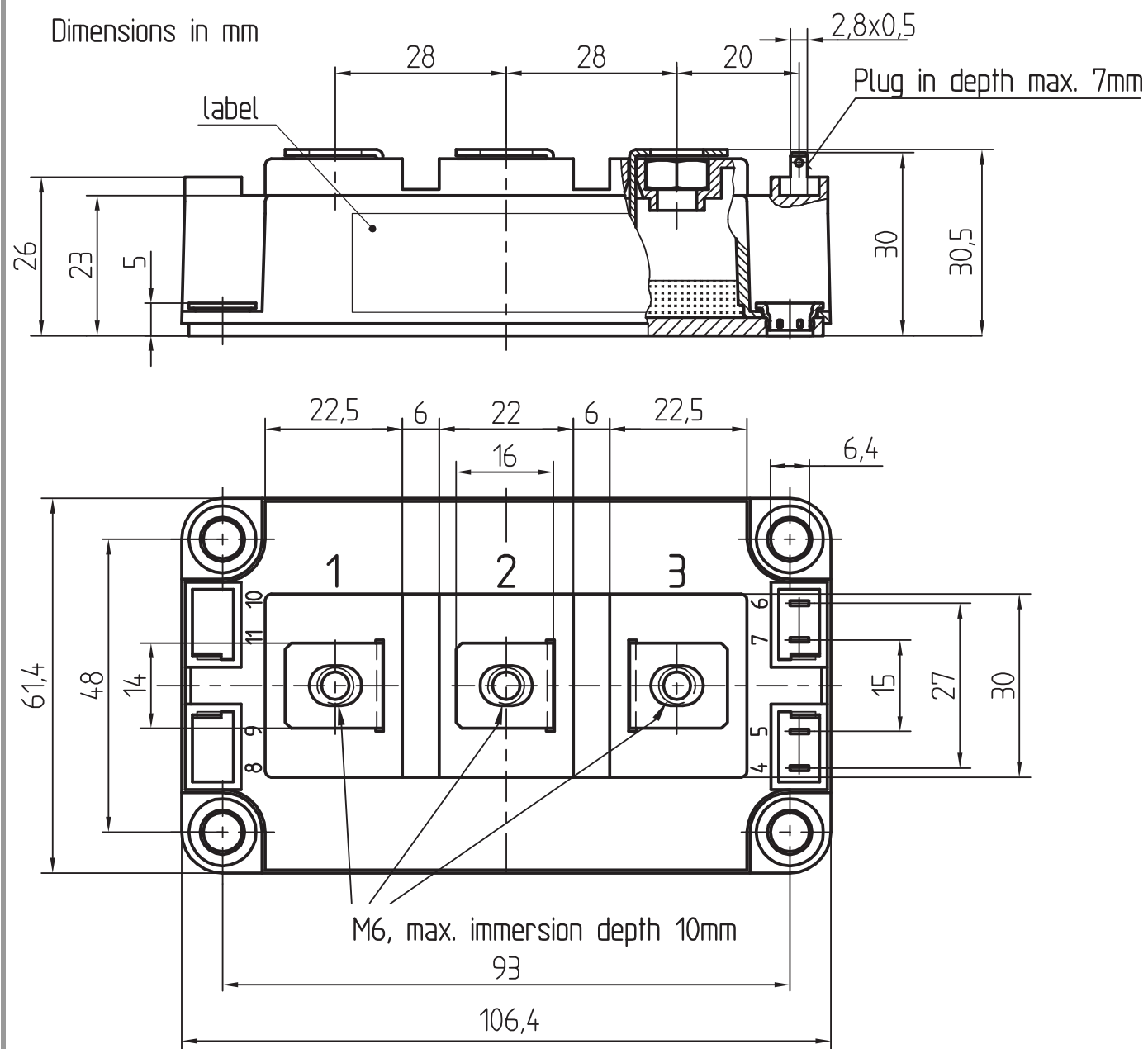
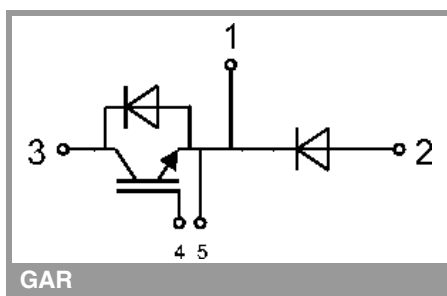


Fig. 12: Typ. CAL diode peak reverse recovery charge



General tolerance $\pm 0,5$ mm

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

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