



SEMITRANS® 3

High Speed IGBT4 Modules

SKM400GAR12F4

Features*

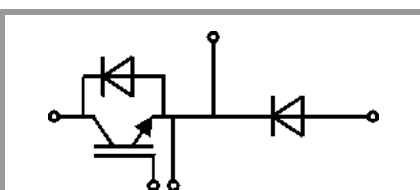
- High speed trench and field-stop IGBT
- CAL4 ultra-fast = soft switching 4. generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- For higher switching frequencies above 15kHz
- UL recognized, file no. E63532

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



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Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
IGBT				
V _{CES}	T _j = 25 °C		1200	V
I _C	T _j = 175 °C	T _c = 25 °C	548	A
		T _c = 80 °C	418	A
I _{Cnom}			400	A
I _{CRM}	I _{CRM} = 2 x I _{Cnom}		800	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V V _{GE} ≤ 15 V V _{CES} ≤ 1200 V R _{G on/off} ≥ 3 Ω	T _j = 150 °C	10	μs
T _j			-40 ... 175	°C
Inverse diode				
V _{RRM}	T _j = 25 °C		1200	V
I _F	T _j = 175 °C	T _c = 25 °C	402	A
		T _c = 80 °C	295	A
I _{Fnom}			400	A
I _{FRM}	I _{FRM} = 2xI _{Fnom}		800	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 25 °C		1980	A
T _j			-40 ... 175	°C
Freewheeling diode				
V _{RRM}	T _j = 25 °C		1200	V
I _F	T _j = 175 °C	T _c = 25 °C	402	A
		T _c = 80 °C	295	A
I _{Fnom}			400	A
I _{FRM}	I _{FRM} = 2xI _{Fnom}		800	A
I _{FSM}	t _p = 10 ms, sin 180°, T _j = 25 °C		1980	A
T _j			-40 ... 175	°C
Module				
I _{t(RMS)}			500	A
T _{stg}	module without TIM		-40 ... 125	°C
V _{isol}	AC sinus 50 Hz, t = 1 min		4000	V

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT						
V _{CE(sat)}	I _C = 400 A	T _j = 25 °C		2.06	2.44	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.59	2.97	V
V _{CE0}	chiplevel	T _j = 25 °C		1.10	1.28	V
		T _j = 150 °C		0.95	1.13	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		2.4	2.9	mΩ
	chiplevel	T _j = 150 °C		4.1	4.6	mΩ
V _{GE(th)}	V _{GE} =V _{CE} , I _C = 15.2 mA		5.1	5.8	6.4	V
I _{CES}	V _{GE} = 0 V	T _j = 25 °C		5		mA
	V _{CE} = 1200 V	T _j = 150 °C		-		mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		24.6		nF
C _{oes}		f = 1 MHz		1.62		nF
C _{res}		f = 1 MHz		1.38		nF
Q _G	V _{GE} = - 8 V...+ 15 V			2268		nC
R _{Gint}	T _j = 25 °C			1.6		Ω



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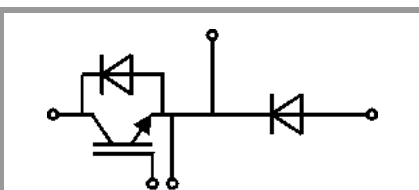
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- Product reliability results valid for $T_j = 150^\circ\text{C}$



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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
t _{d(on)}	V _{CC} = 600 V	T _j = 150 °C		110		ns
t _r	I _C = 400 A	T _j = 150 °C		55		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		28		mJ
t _{d(off)}	R _{G on} = 2 Ω	T _j = 150 °C		415		ns
t _f	R _{G off} = 1 Ω	T _j = 150 °C		75		ns
E _{off}	di/dt _{on} = 7960 A/μs di/dt _{off} = 4430 A/μs dv/dt = 4530 V/μs	T _j = 150 °C		32		mJ
R _{th(j-c)}	per IGBT				0.072	K/W
R _{th(c-s)}	per IGBT (λ _{grease} =0.81 W/(m²K))			0.041		K/W
Inverse diode						
V _F = V _{EC}	I _F = 400 A	T _j = 25 °C		2.55	2.93	V
	V _{GE} = 0 V chipelevel	T _j = 150 °C		2.44	2.80	V
V _{F0}	chipelevel	T _j = 25 °C		1.51	1.75	V
		T _j = 150 °C		1.16	1.40	V
r _F	chipelevel	T _j = 25 °C		2.6	2.9	mΩ
		T _j = 150 °C		3.2	3.5	mΩ
I _{RRM}	I _F = 400 A	T _j = 150 °C		424		A
Q _{rr}	di/dt _{off} = 7183 A/μs	T _j = 150 °C		51		μC
E _{rr}	V _{GE} = -15 V V _{CC} = 600 V	T _j = 150 °C		18.5		mJ
R _{th(j-c)}	per diode				0.14	K/W
R _{th(c-s)}	per diode (λ _{grease} =0.81 W/(m²K))			0.047		K/W
Freewheeling diode						
V _F = V _{EC}	I _F = 400 A	T _j = 25 °C		2.55	2.93	V
	V _{GE} = 0 V chipelevel	T _j = 150 °C		2.44	2.80	V
V _{F0}	chipelevel	T _j = 25 °C		1.51	1.75	V
		T _j = 150 °C		1.16	1.40	V
r _F	chipelevel	T _j = 25 °C		2.6	2.9	mΩ
		T _j = 150 °C		3.2	3.5	mΩ
I _{RRM}	I _F = 400 A	T _j = 150 °C		424		A
Q _{rr}	di/dt _{off} = 7183 A/μs	T _j = 150 °C		51		μC
E _{rr}	V _{GE} = -15 V V _{CC} = 600 V	T _j = 150 °C		18.5		mJ
R _{th(j-c)}	per diode				0.14	K/W
R _{th(c-s)}	per diode (λ _{grease} =0.81 W/(m²K))			0.047		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 (λ _{grease} =0.81 W/(m²K))			0.0219		K/W
R _{th(c-s)2}	including thermal coupling, T _s underneath module (λ _{grease} =0.81 W/(m²K))			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

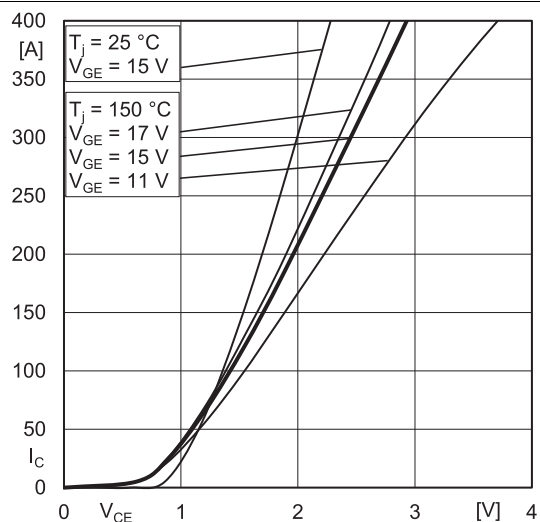


Fig. 1: Typ. output characteristic, inclusive $R_{CC} + EE'$

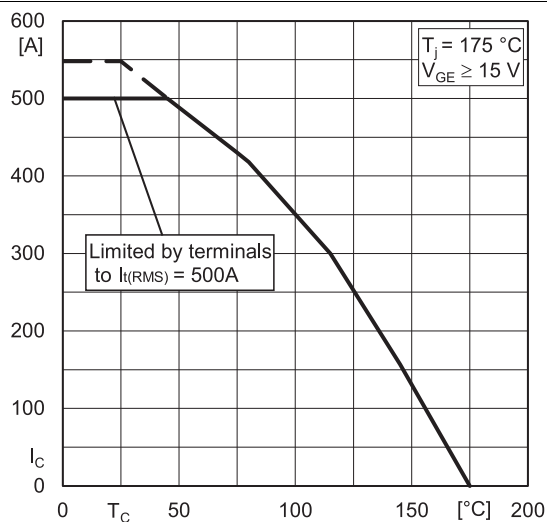


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

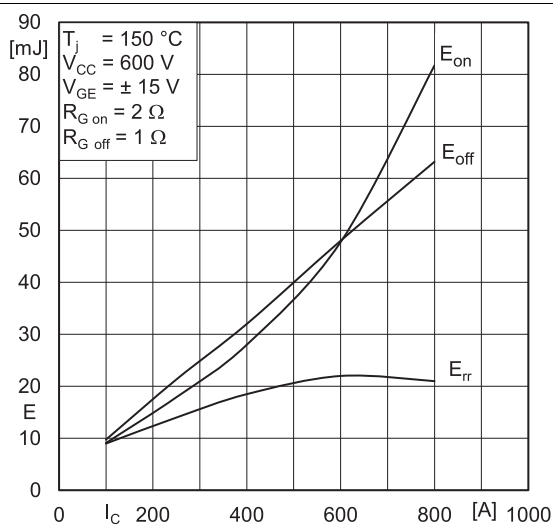


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

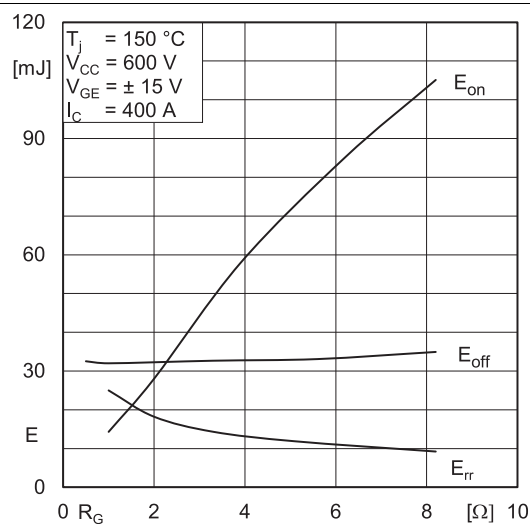


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

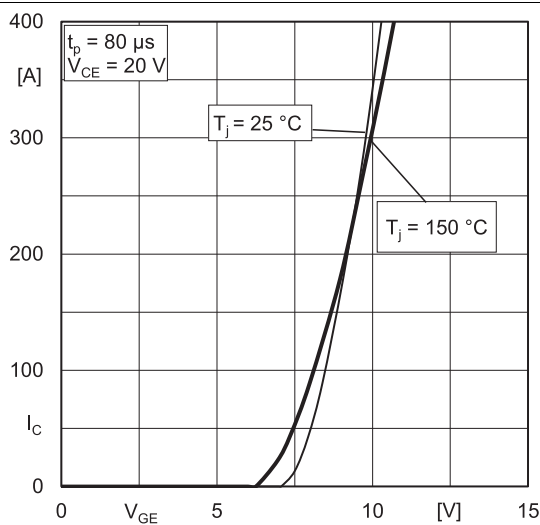


Fig. 5: Typ. transfer characteristic

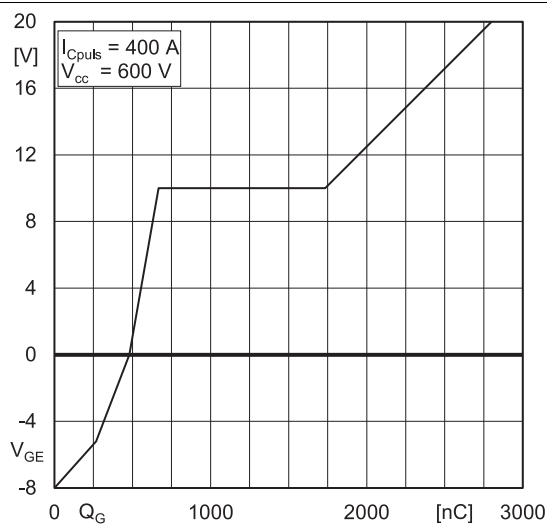


Fig. 6: Typ. gate charge characteristic

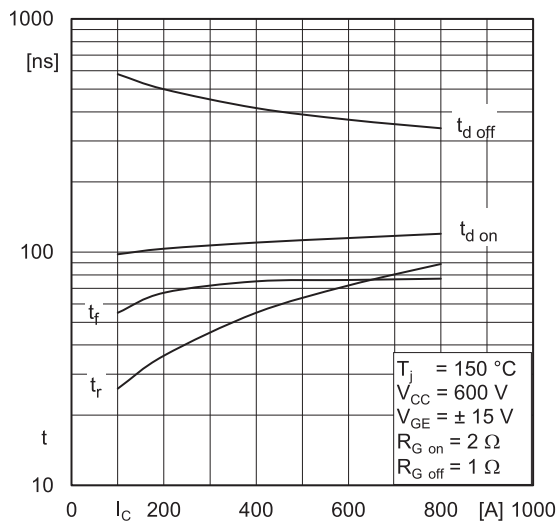


Fig. 7: Typ. switching times vs. I_C

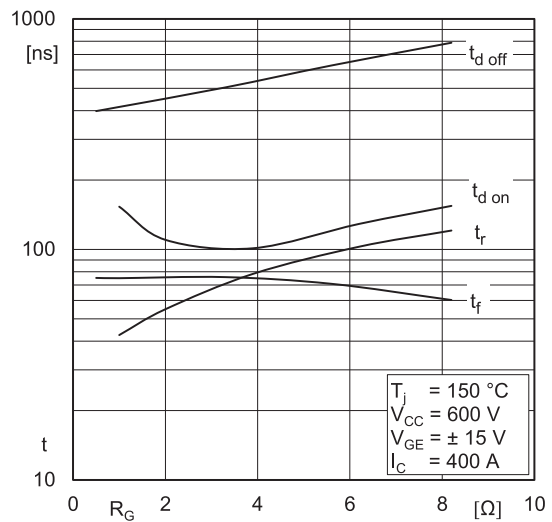


Fig. 8: Typ. switching times vs. gate resistor R_G

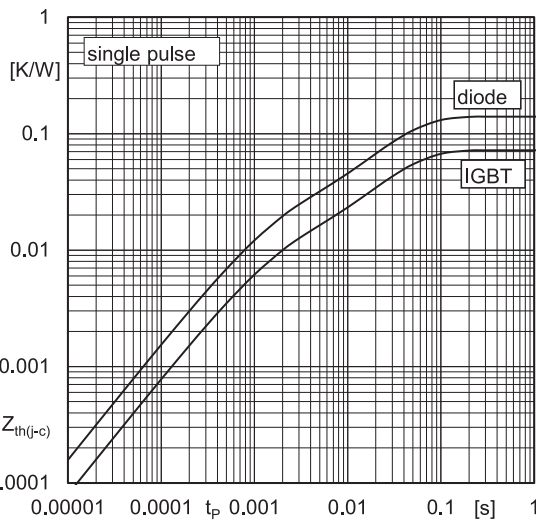


Fig. 9: Transient thermal impedance

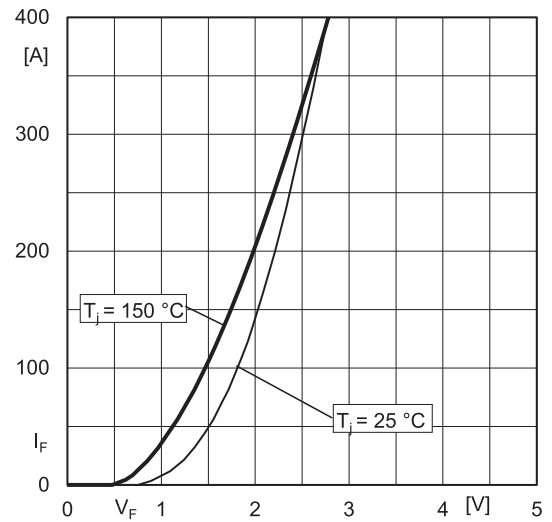


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

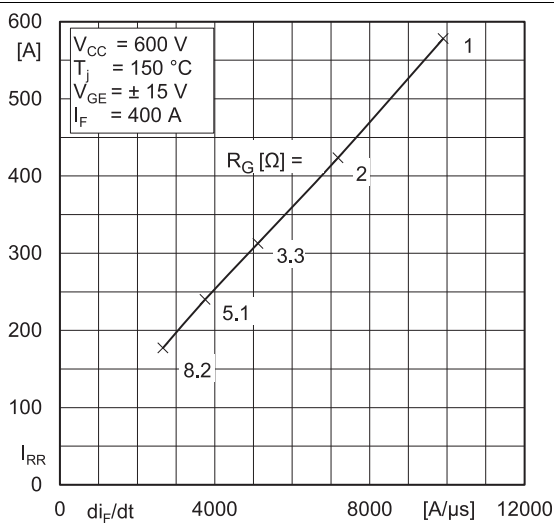


Fig. 11: Typ. CAL diode peak reverse recovery current

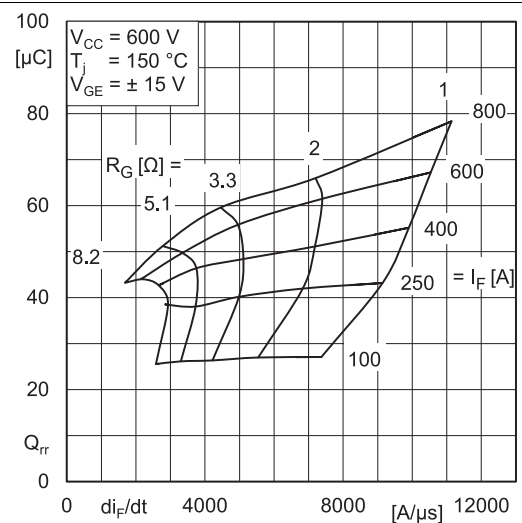
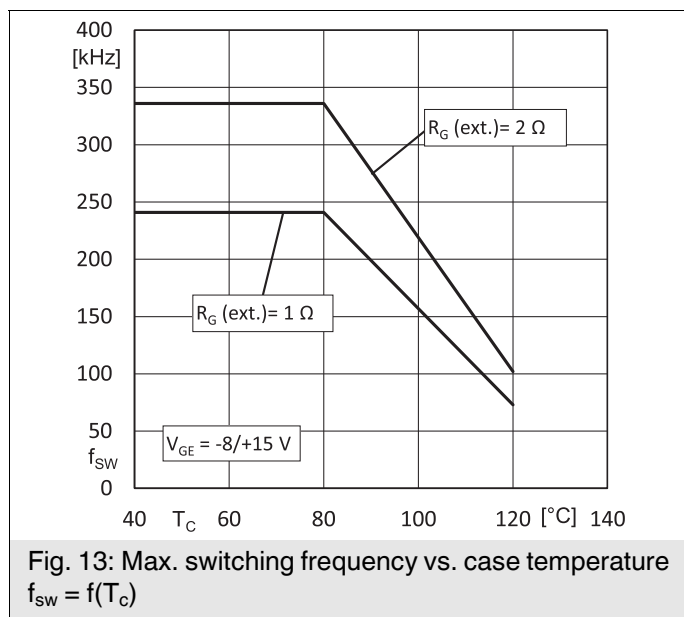
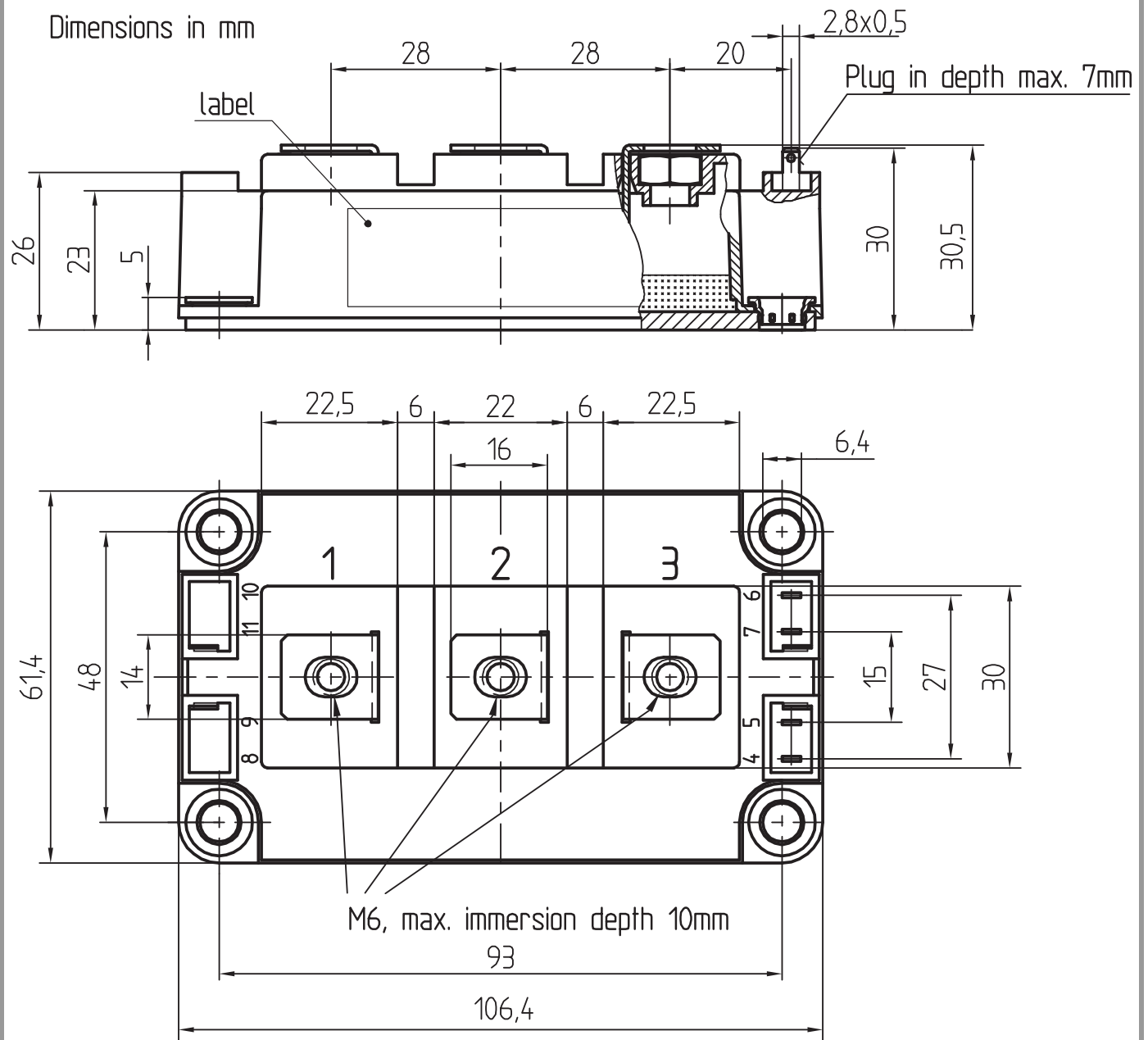


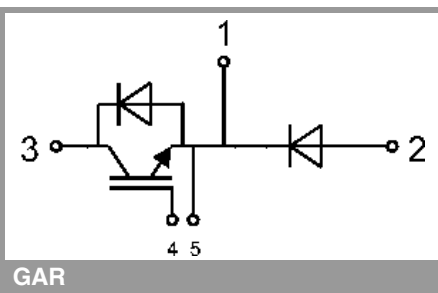
Fig. 12: Typ. CAL diode peak reverse recovery charge





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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