SEMITRANS® 3

Fast IGBT4 Modules

SKM600GAL12T4

Features*

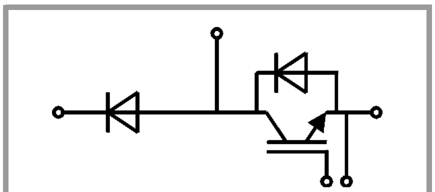
- IGBT4 = 4th generation fast trench IGBT (Infineon)
- CAL4 = Soft switching 4th generation CAL-diode
- Insulated copper baseplate using DBC technology (Direct Bonded Copper)
- Increased power cycling capability
- With integrated gate resistor
- For higher switching frequencies up to 20kHz
- UL recognized, 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°C max.
- Recommended T_{op} = -40 ... +150°C
- Product reliability results valid for T_j = 150°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	860	A
		T_c = 80 °C	702	A
I_{Cnom}			600	A
I_{CRM}			1800	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 800 V V_{GE} ≤ 15 V V_{CES} ≤ 1200 V	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	623	A
		T_c = 80 °C	466	A
I_{Fnom}			500	A
I_{FRM}			1200	A
I_{FSM}	t_p = 10 ms, sin 180°, T_j = 25 °C		2736	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	707	A
		T_c = 80 °C	529	A
I_{Fnom}			600	A
I_{FRM}			1200	A
I_{FSM}	t_p = 10 ms, sin 180°, T_j = 25 °C		3240	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 = 600 A V_{GE} = 15 V chiplevel	T_j = 25 °C		1.80	2.05	V
		T_j = 150 °C		2.20	2.42	V
V_{CE0}	chiplevel	T_j = 25 °C		0.80	0.90	V
		T_j = 150 °C		0.70	0.80	V
r_{CE}	V_{GE} = 15 V chiplevel	T_j = 25 °C		1.67	1.92	mΩ
		T_j = 150 °C		2.5	2.7	mΩ
$V_{GE(th)}$	V_{GE}=V_{CE}, I_C = 24 mA		5	5.8	6.5	V
I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V, T_j = 25 °C				5	mA
C_{ies}	V_{CE} = 25 V V_{GE} = 0 V	f = 1 MHz		37.2		nF
C_{oes}		f = 1 MHz		2.32		nF
C_{res}		f = 1 MHz		2.04		nF
Q_G	V_{GE} = - 8 V...+ 15 V			3400		nC
R_{Gint}	T_j = 25 °C			1.3		Ω

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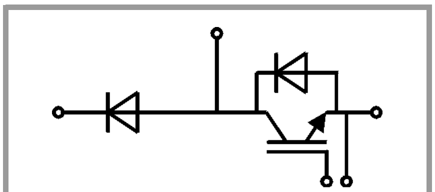

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Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
IGBT						
$t_{d(on)}$	V_{CC} = 600 V	T_j = 150 °C		178		ns
t_r	I_C = 600 A	T_j = 150 °C		68		ns
E_{on}	V_{GE} = +15/-15 V	T_j = 150 °C		33		mJ
$t_{d(off)}$	$R_{G\,on}$ = 1.6 Ω; $R_{G\,off}$ = 1 Ω	T_j = 150 °C		523		ns
t_f	di/dt_{on} = 8900 A/µs	T_j = 150 °C		116		ns
E_{off}	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; V_{GE} = 0 V	T_j = 25 °C		2.28	2.63	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; V_{GE} = -15 V	T_j = 150 °C		99		µC
E_{rr}	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; V_{GE} = 0 V	T_j = 25 °C		2.14	2.46	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; V_{GE} = ±15 V	T_j = 150 °C		90		µC
E_{rr}	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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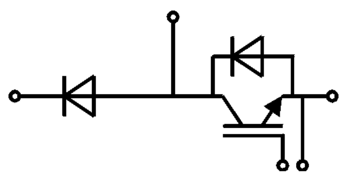
Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
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			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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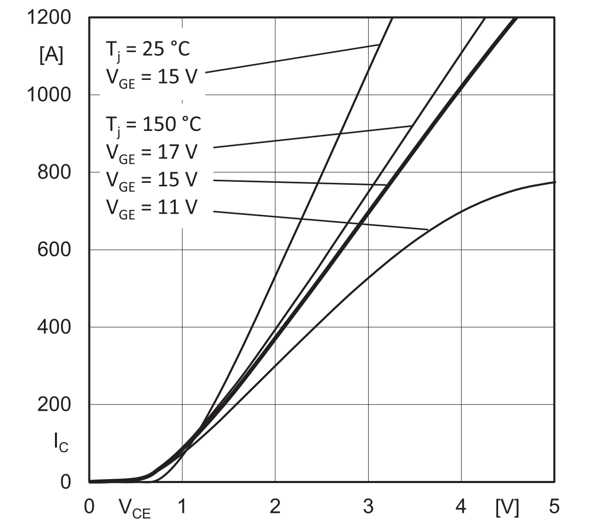


Fig. 1: Typ. output characteristic, inclusive $R_{CC'+ EE'}$

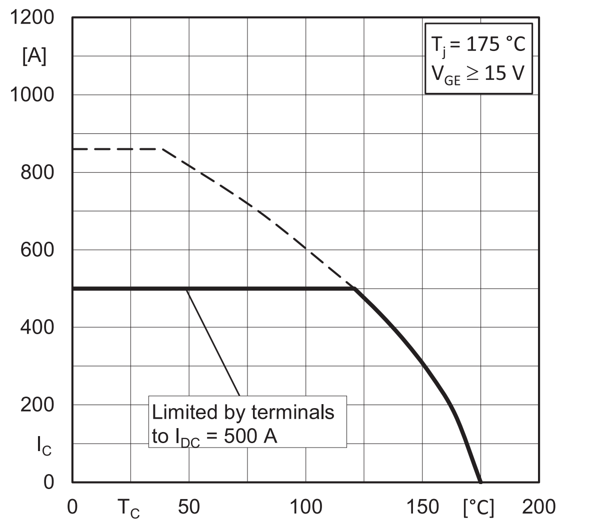


Fig. 2: Rated current vs. temperature $I_C = f (T_C)$

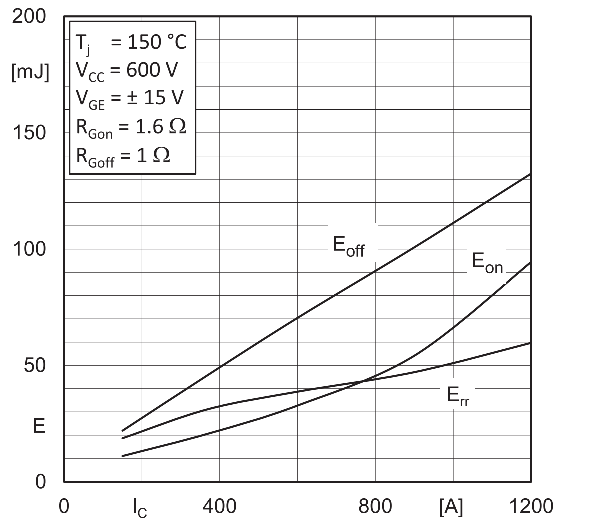


Fig. 3: Typ. turn-on /-off energy = f (I_C)

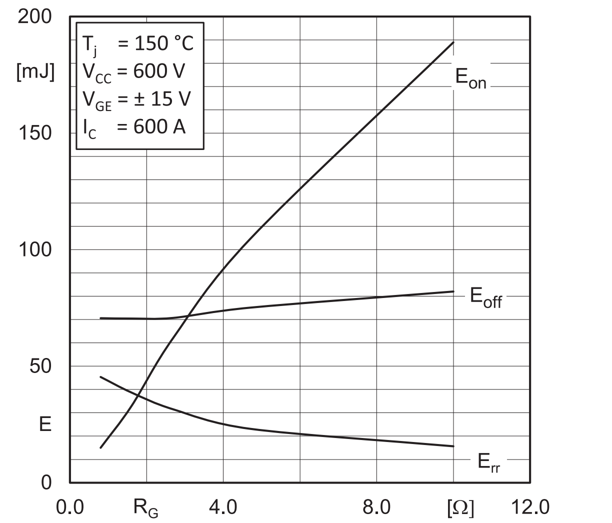


Fig. 4: Typ. turn-on /-off energy = f (R_G)

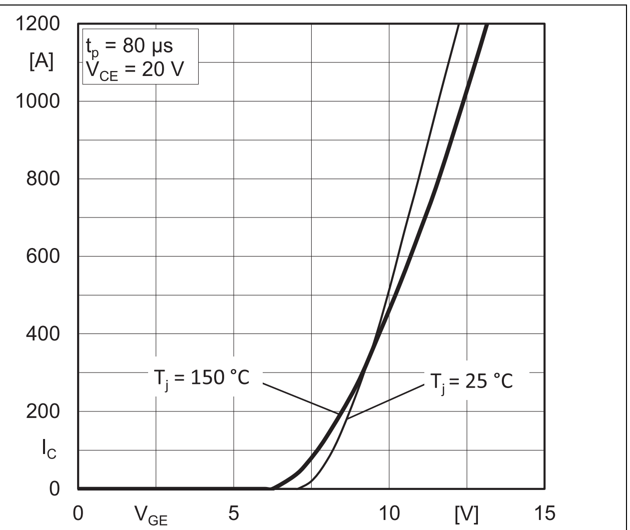


Fig. 5: Typ. transfer characteristic

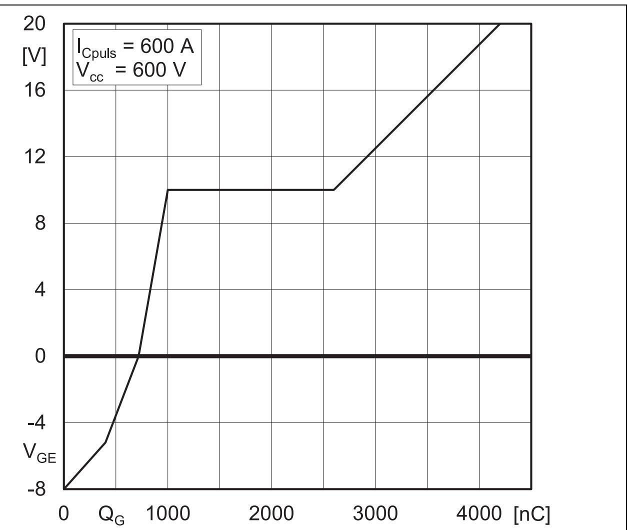


Fig. 6: Typ. gate charge characteristic

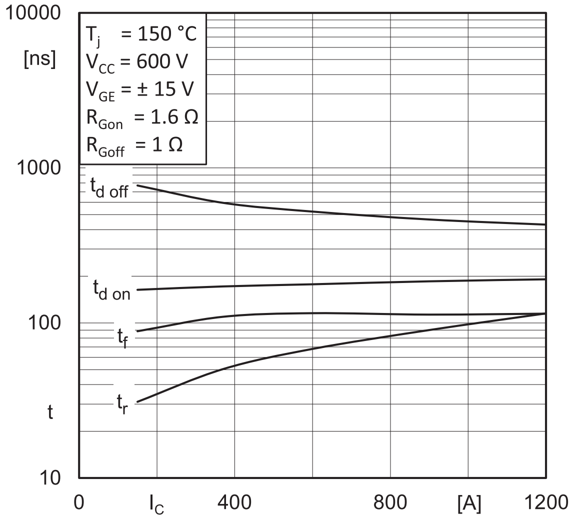


Fig. 7: Typ. switching times vs. I_C

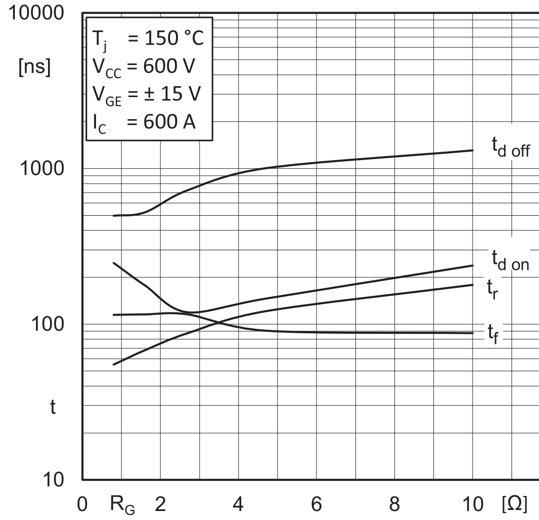


Fig. 8: Typ. switching times vs. gate resistor R_G

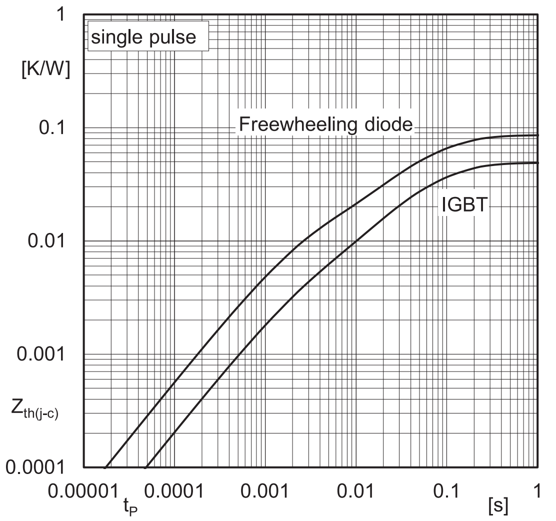


Fig. 9: Transient thermal impedance

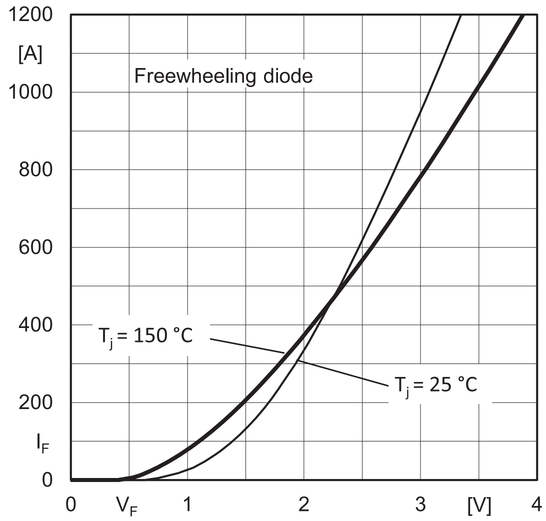


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

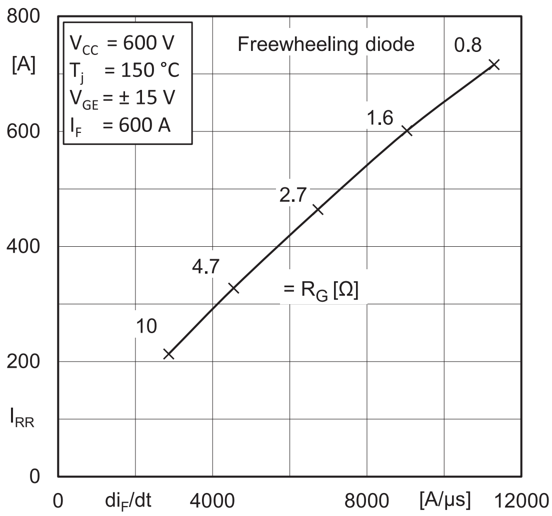


Fig. 11: Typ. CAL diode peak reverse recovery current

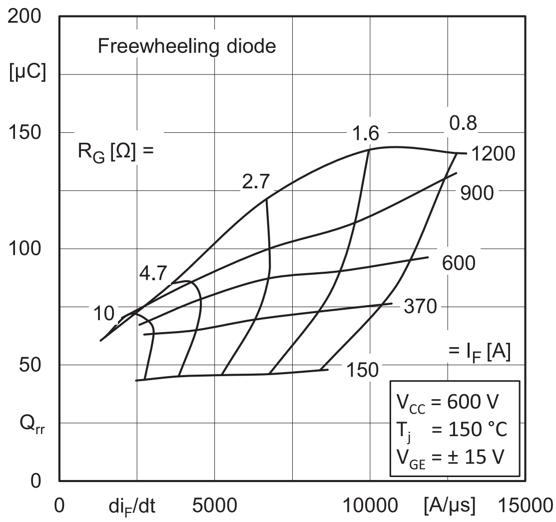
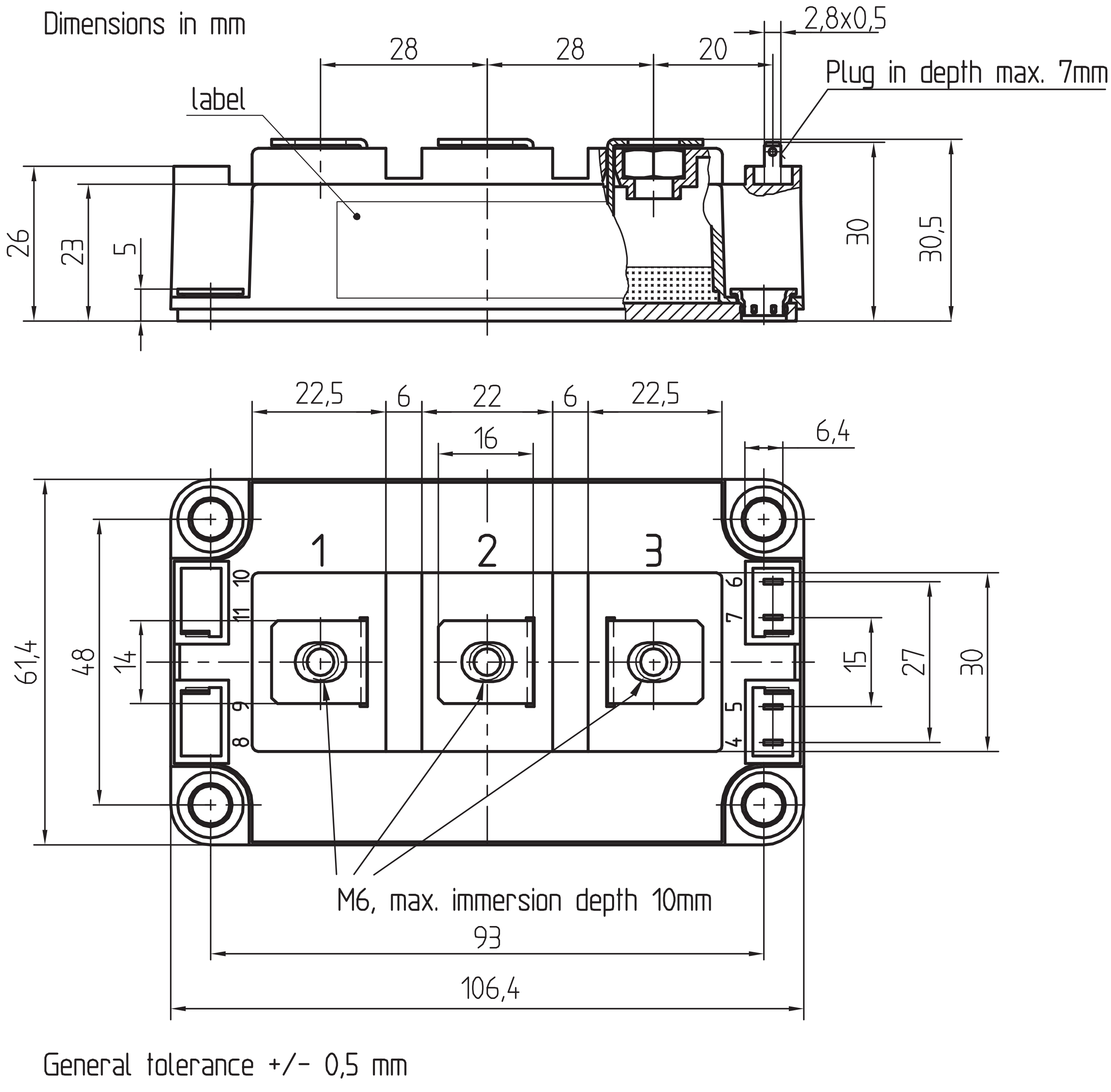


Fig. 12: Typ. CAL diode peak reverse recovery charge



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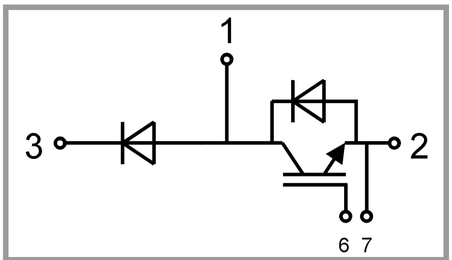

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This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

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