



SEMITRANS® 3

SKM400GAR12V

Features

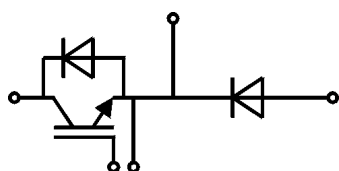
- V-IGBT = 6. Generation Trench V-IGBT (Fuji)
- CAL4 = Soft switching 4. Generation CAL-diode
- Isolated copper baseplate using DBC technology (Direct Copper Bonding)
- UL recognized, file no. E63532
- Increased power cycling capability
- With integrated gate resistor
- Low switching losses at high di/dt

Typical Applications*

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

Remarks

- Case temperature limited to $T_c = 125^\circ\text{C}$ max, recomm. $T_{op} = -40 \dots +150^\circ\text{C}$, product rel. results valid for $T_j = 150^\circ$



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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	612	A
		T _c = 80 °C	467	A
I _{Cnom}			400	A
I _{CRM}	I _{CRM} = 3xI _{Cnom}		1200	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 720 V V _{GE} ≤ 15 V V _{CES} ≤ 1200 V	T _j = 125 °C	10	μs
T _j			-40 ... 175	°C

Inverse diode

I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	440	A
		$T_c = 80^\circ\text{C}$	329	A
I_{Fnom}			400	A
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$		1200	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

I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	440	A
		$T_c = 80^\circ\text{C}$	329	A
I_{Fnom}			400	A
I_{FRM}	$I_{FRM} = 3 \times I_{Fnom}$		1200	A
I_{FSM}	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$		1980	A
T_j			-40 ... 175	$^\circ\text{C}$

Module

$I_{t(RMS)}$	$T_{terminal} = 80^\circ\text{C}$	500	A
T_{stg}		-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	$T_j = 25^\circ\text{C}$	1.75	2.20	V
		$T_j = 150^\circ\text{C}$	2.20	2.50	V
V_{CE0}	chipelevel	$T_j = 25^\circ\text{C}$	0.94	1.04	V
		$T_j = 150^\circ\text{C}$	0.88	0.98	V
r_{CE}	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	2.02	2.90	$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	3.30	3.80	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 16\text{ mA}$	5.5	6	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}$ $V_{CE} = 1200\text{ V}$	$T_j = 25^\circ\text{C}$	0.1	0.3	mA
		$T_j = 150^\circ\text{C}$			mA
C_{ies}	$V_{CE} = 25\text{ V}$	$f = 1\text{ MHz}$	24.0		nF
C_{oes}	$V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	2.36		nF
C_{res}		$f = 1\text{ MHz}$	2.36		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		4400		nC
R_{Gint}			1.88		Ω



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Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $T_j = 150^\circ\text{C}$		350		ns
t_r	$I_C = 400\text{ A}$ $T_j = 150^\circ\text{C}$		60		ns
E_{on}	$V_{GE} = \pm 15\text{ V}$ $R_{G\ on} = 3\ \Omega$ $T_j = 150^\circ\text{C}$		39		mJ
$t_{d(off)}$	$R_{G\ off} = 3\ \Omega$ $T_j = 150^\circ\text{C}$		700		ns
t_f	$di/dt_{on} = 9800\text{ A}/\mu\text{s}$ $T_j = 150^\circ\text{C}$		65		ns
E_{off}	$di/dt_{off} = 5000\text{ A}/\mu\text{s}$ $du/dt_{off} = 7600\text{ V}/\mu\text{s}$ $T_j = 150^\circ\text{C}$		42		mJ
$R_{th(j-c)}$	per IGBT			0.072	K/W

Inverse diode

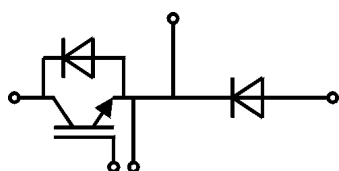
$V_F = V_{EC}$	$I_F = 400\text{ A}$ $V_{GE} = 0\text{ V}$ chiplevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	2.20 2.15	2.52 2.47	V
V_{F0}	chiplevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	1.3 0.9	1.5 1.1	V
r_F	chiplevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	2.0 2.6	2.3 3.1	2.5 3.4
I_{RRM}	$I_F = 400\text{ A}$ $T_j = 150^\circ\text{C}$		450		A
Q_{rr}	$di/dt_{off} = 9500\text{ A}/\mu\text{s}$ $V_{GE} = 15\text{ V}$ $T_j = 150^\circ\text{C}$		58		μC
E_{rr}	$V_{CC} = 600\text{ V}$ $T_j = 150^\circ\text{C}$		26		mJ
$R_{th(j-c)}$	per diode			0.14	K/W

Freewheeling diode

$V_F = V_{EC}$	$I_F = 400\text{ A}$ $V_{GE} = 0\text{ V}$ chiplevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	2.20 2.15	2.52 2.47	V
V_{F0}	chiplevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	1.3 0.9	1.5 1.1	V
r_F	chiplevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	2.3 3.1	2.5 3.4	$m\Omega$
I_{RRM}	$I_F = 400\text{ A}$ $T_j = 150^\circ\text{C}$		450		A
Q_{rr}	$di/dt_{off} = 9500\text{ A}/\mu\text{s}$ $V_{GE} = \pm 15\text{ V}$ $T_j = 150^\circ\text{C}$		58		μC
E_{rr}	$V_{CC} = 600\text{ V}$ $T_j = 150^\circ\text{C}$		26		mJ
$R_{th(j-c)}$	per Diode			0.14	K/W

Module

L_{CE}			15	20	nH
$R_{CC'+EE'}$	terminal-chip	$T_c = 25^\circ\text{C}$ $T_c = 125^\circ\text{C}$	0.25 0.5		$m\Omega$
$R_{th(c-s)}$	per module		0.02	0.038	K/W
M_s	to heat sink M6		3	5	Nm
M_t		to terminals M6	2.5	5	Nm
w				325	g



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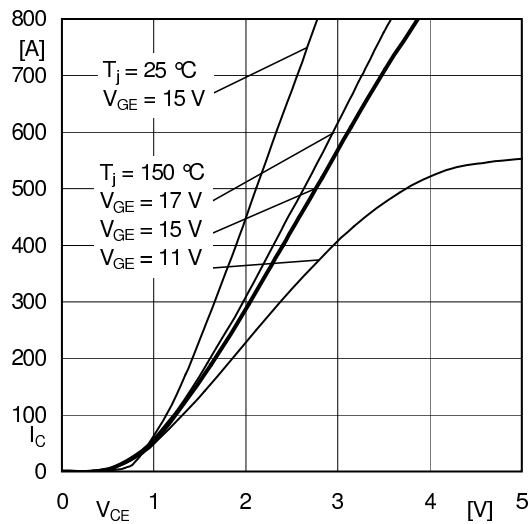


Fig. 1: Typ. output characteristic, inclusive $R_{CC'} + EE'$

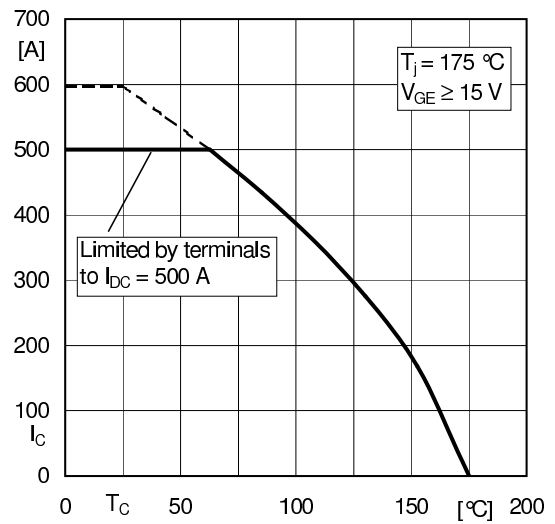


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

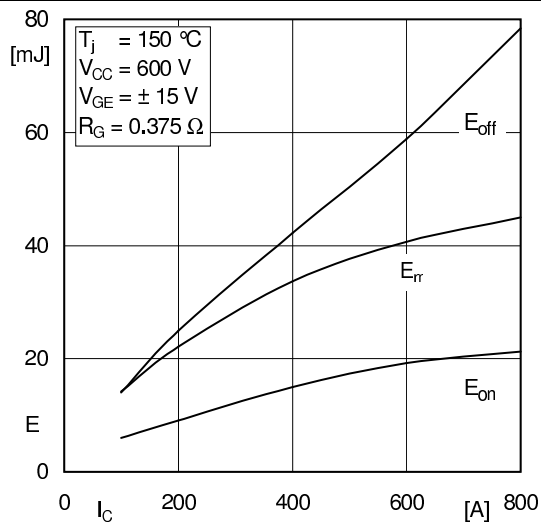


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

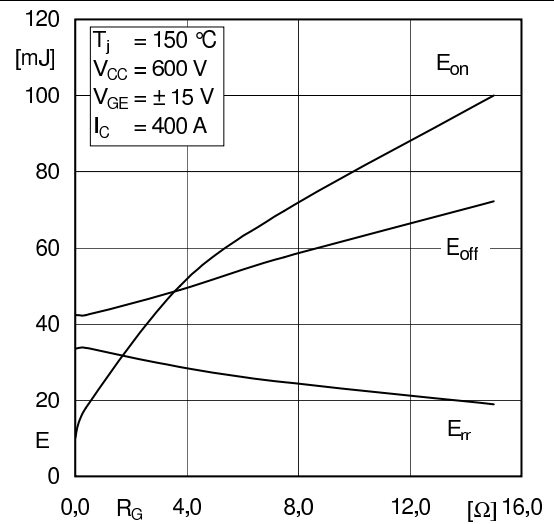


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

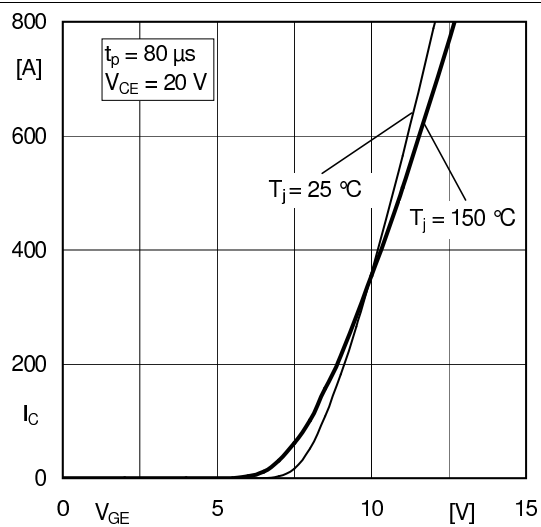


Fig. 5: Typ. transfer characteristic

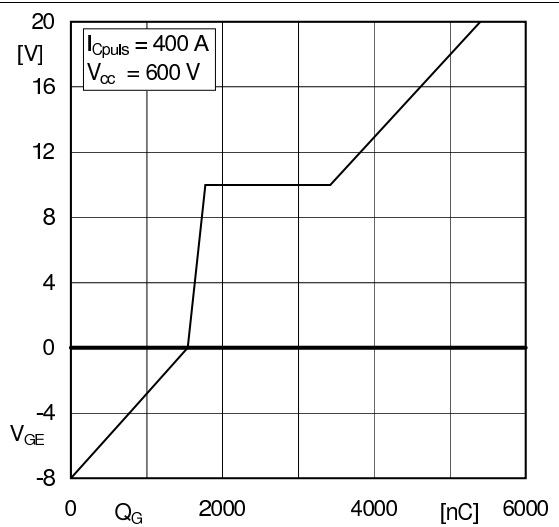


Fig. 6: Typ. gate charge characteristic

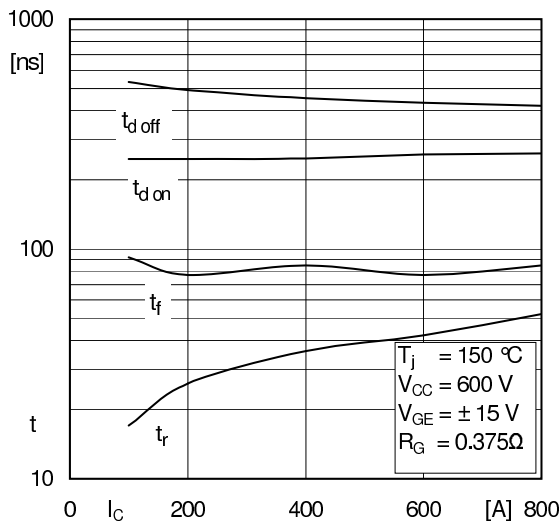


Fig. 7: Typ. switching times vs. I_C

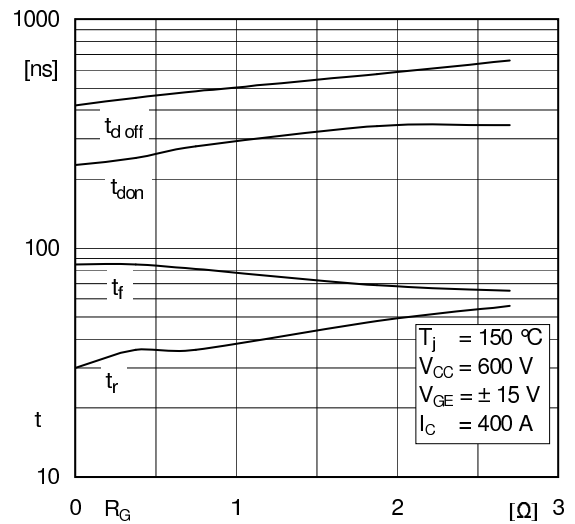


Fig. 8: Typ. switching times vs. gate resistor R_G

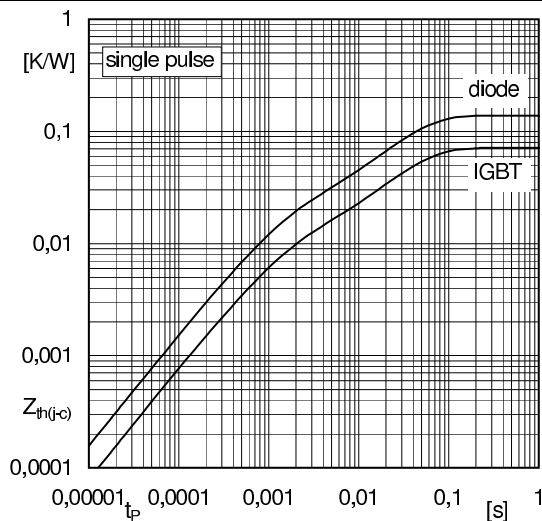


Fig. 9: Transient thermal impedance

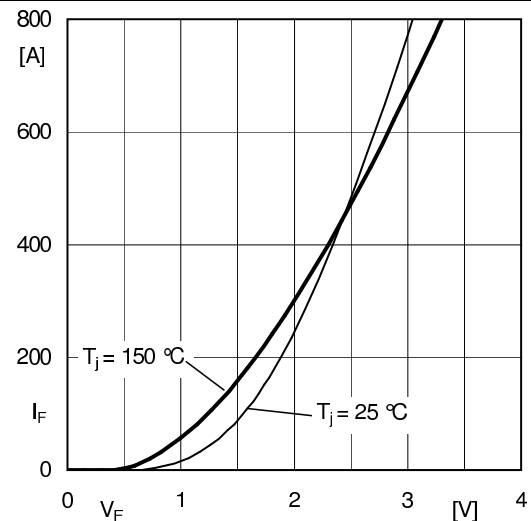


Fig. 10: Typ. CAL diode forward charact., incl. $R_{CC'+EE'}$

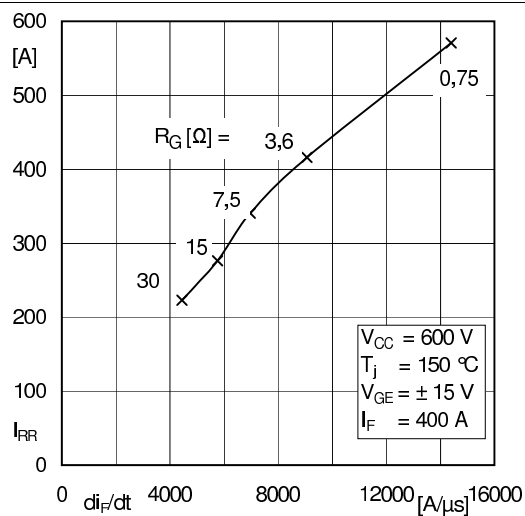


Fig. 11: CAL diode peak reverse recovery current

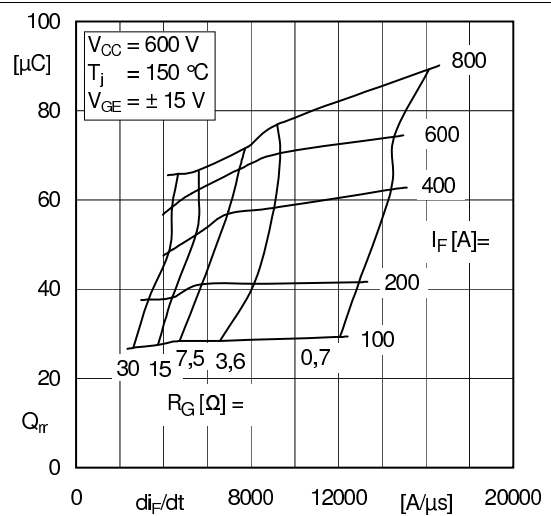
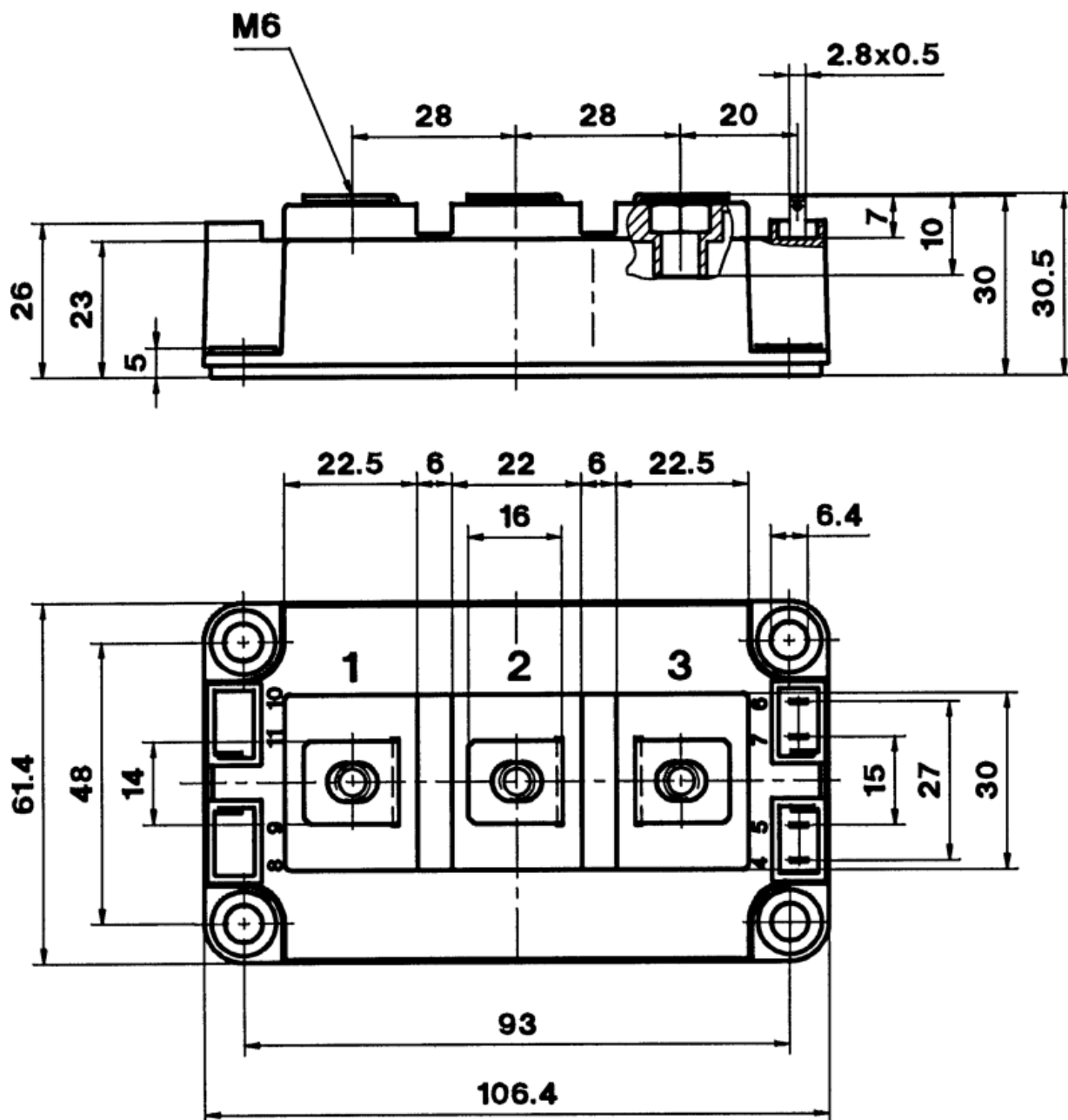
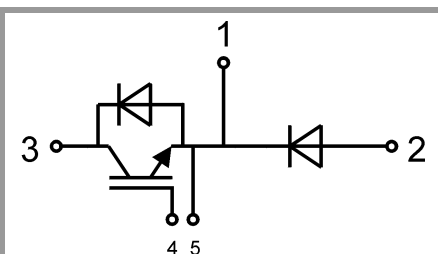


Fig. 12: Typ. CAL diode peak reverse recovery charge



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

* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.