



SEMITRANS®3

Fast IGBT4 Modules

SKM400GB12T4

Features

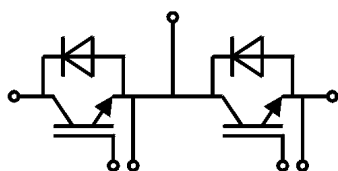
- IGBT4 = 4. Generation (Trench)IGBT
- VCEsat with positive temperature coefficient
- High short circuit capability, self limiting to $6 \times I_{CNOM}$
- Soft switching 4. Generation CAL diode (CAL4)

Typical Applications

- AC inverter drives
- UPS
- Electronic welders at fsw up to 20 kHz

Remarks

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



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Absolute Maximum Ratings

Symbol	Conditions	Values	Unit
IGBT			
V_{CES}		1200	V
I_C	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$ $T_c = 80^\circ\text{C}$	A
		475	A
I_{Cnom}		400	A
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$	1200	A
V_{GES}		-20 ... 20	V
t_{psc}	$V_{CC} = 800\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 1200\text{ V}$	$T_j = 150^\circ\text{C}$	μs
T_j		-40 ... 175	$^\circ\text{C}$
Inverse diode			
I_F	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$ $T_c = 80^\circ\text{C}$	A
		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° , $T_j = 25^\circ\text{C}$	1980	A
T_j		-40 ... 175	$^\circ\text{C}$
Module			
$I_{t(RMS)}$		500	A
T_{stg}		-40 ... 125	$^\circ\text{C}$
V_{isol}	AC sinus 50Hz, $t = 1\text{ min}$	4000	V

Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
IGBT					
$V_{CE(sat)}$	$I_C = 400\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	1.8 2.2	2.05 2.4	V
V_{CE0}		$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	0.8 0.7	0.9 0.8	V
r_{CE}	$V_{GE} = 15\text{ V}$	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	2.5 3.8	2.9 4.0	m Ω
$V_{GE(th)}$	$V_{GE} = V_{CE}$, $I_C = 15.2\text{ mA}$	5	5.8	6.5	V
I_{CES}	$V_{GE} = 0\text{ V}$ $V_{CE} = 1200\text{ V}$	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	0.1	0.3	mA
C_{ies}	$V_{CE} = 25\text{ V}$	$f = 1\text{ MHz}$	24.6		nF
C_{oes}	$V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	1.62		nF
C_{res}		$f = 1\text{ MHz}$	1.38		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		2260		nC
R_{Gint}	$T_j = 25^\circ\text{C}$		1.9		Ω
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$	220		ns
t_r	$I_C = 400\text{ A}$	$T_j = 150^\circ\text{C}$	47		ns
E_{on}	$V_{GE} = \pm 15\text{ V}$ $R_{G on} = 1\text{ }\Omega$	$T_j = 150^\circ\text{C}$	33		mJ
$t_{d(off)}$	$R_{G off} = 1\text{ }\Omega$	$T_j = 150^\circ\text{C}$	505		ns
t_f	$di/dt_{on} = 9700\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$	78		ns
E_{off}	$di/dt_{off} = 4300\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$	42		mJ
$R_{th(j-c)}$	per IGBT			0.072	K/W



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- Soft switching 4. Generation CAL diode (CAL4)

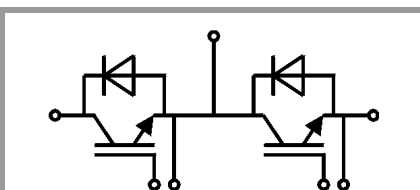
Typical Applications

- AC inverter drives
- UPS
- Electronic welders at fsw up to 20 kHz

Remarks

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

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Inverse diode						
$V_F = V_{EC}$	$I_F = 400\text{ A}$ $V_{GE} = 0\text{ V}$ chip	$T_j = 25\text{ }^{\circ}\text{C}$		2.2	2.52	V
		$T_j = 150\text{ }^{\circ}\text{C}$		2.15	2.47	V
V_{F0}		$T_j = 25\text{ }^{\circ}\text{C}$		1.3	1.5	V
		$T_j = 150\text{ }^{\circ}\text{C}$		0.9	1.1	V
r_F		$T_j = 25\text{ }^{\circ}\text{C}$		2.3	2.5	mΩ
		$T_j = 150\text{ }^{\circ}\text{C}$		3.1	3.4	mΩ
I_{RRM}	$I_F = 400\text{ A}$ $di/dt_{off} = 8800\text{ A}/\mu\text{s}$	$T_j = 150\text{ }^{\circ}\text{C}$		450		A
Q_{rr}		$T_j = 150\text{ }^{\circ}\text{C}$		68		μC
E_{rr}		$T_j = 150\text{ }^{\circ}\text{C}$		30.5		mJ
$R_{th(j-c)}$	per diode				0.14	K/W
Module						
L_{CE}				15	20	nH
$R_{CC'+EE'}$	terminal-chip	$T_C = 25\text{ }^{\circ}\text{C}$		0.25		mΩ
		$T_C = 125\text{ }^{\circ}\text{C}$		0.5		mΩ
$R_{th(c-s)}$	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
						Nm
w					325	g



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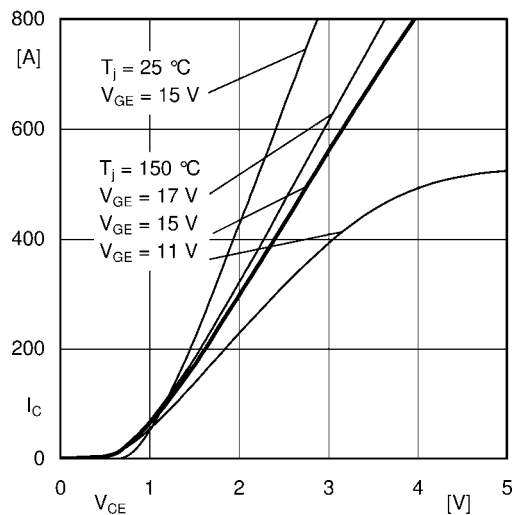


Fig. 1: Typ. output characteristic, inclusive $R_{CC'} + E_{E'}$

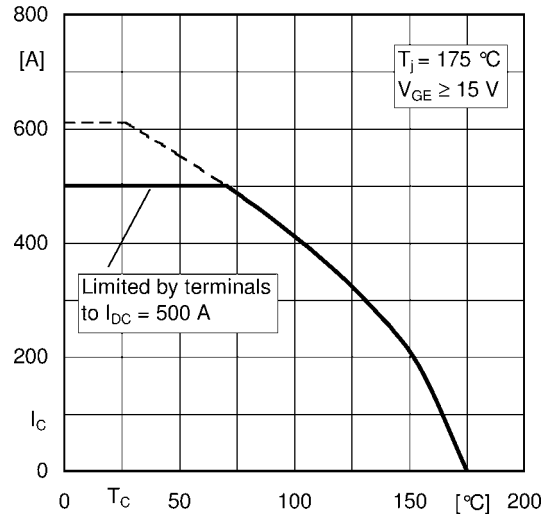


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

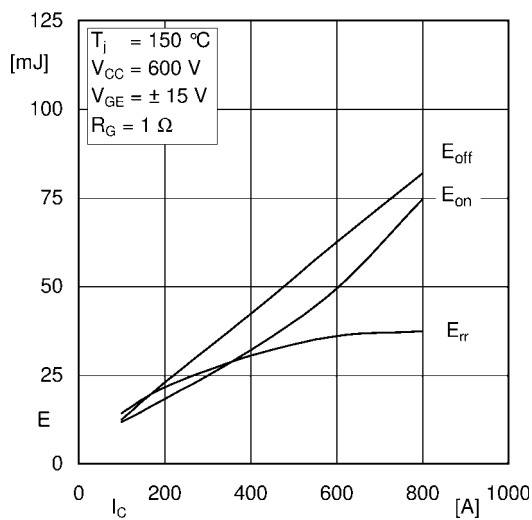


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

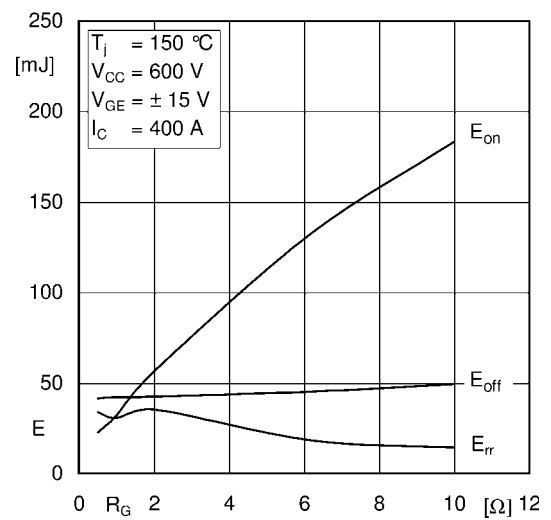


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

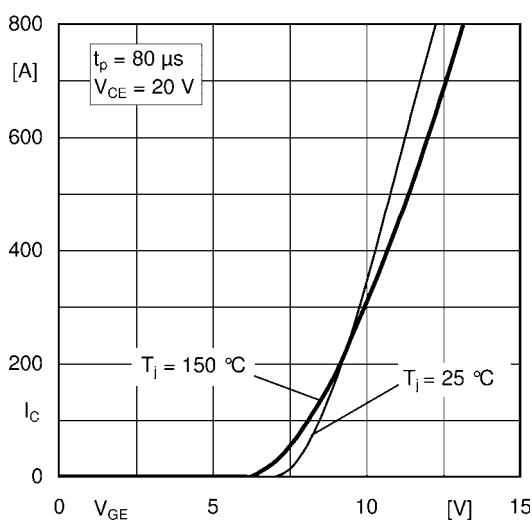


Fig. 5: Typ. transfer characteristic

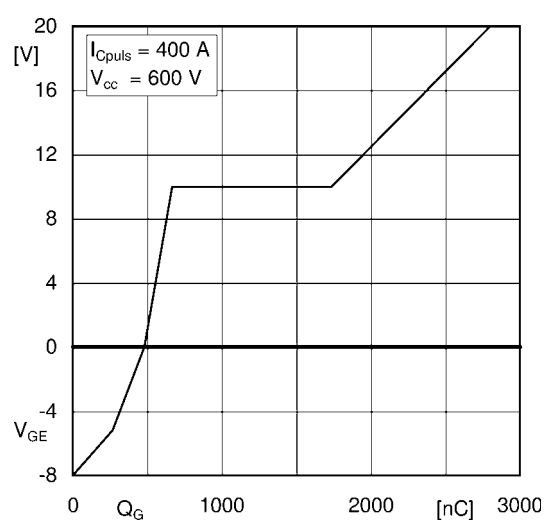


Fig. 6: Typ. gate charge characteristic

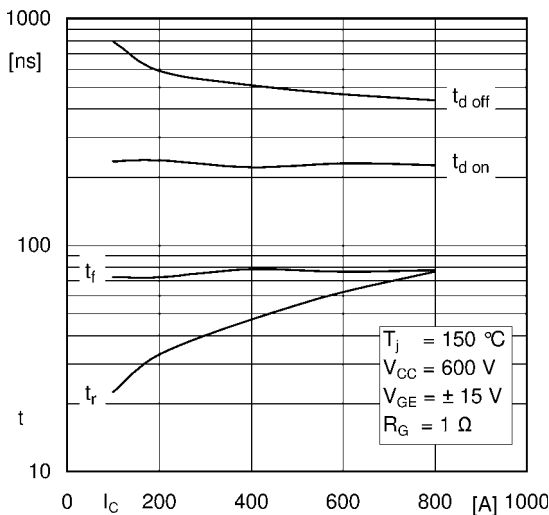


Fig. 7: Typ. switching times vs. I_C

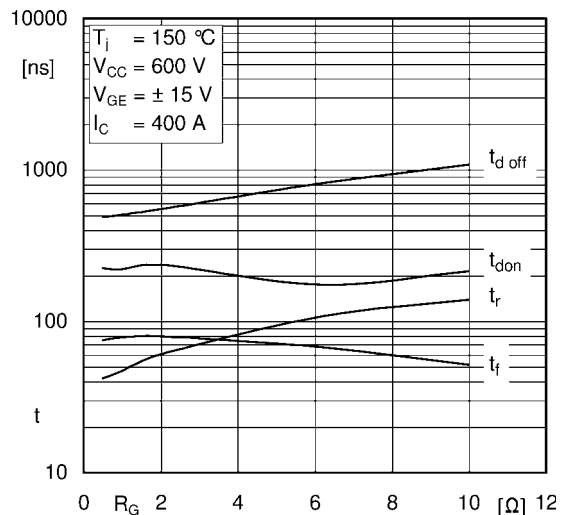


Fig. 8: Typ. switching times vs. gate resistor R_G

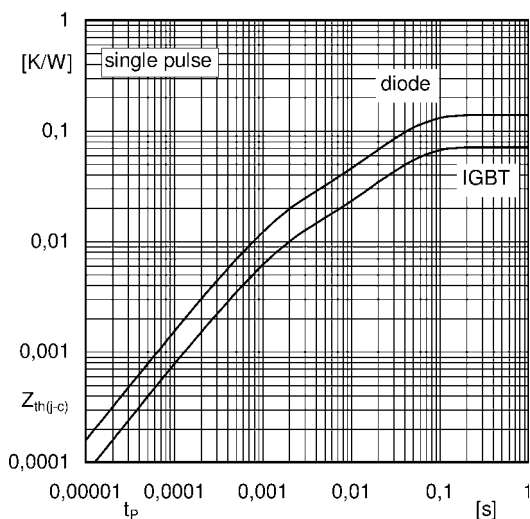


Fig. 9: Transient thermal impedance

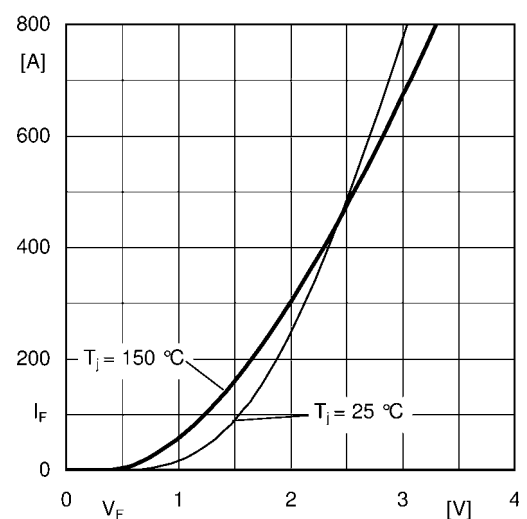


Fig. 10: CAL diode forward characteristic

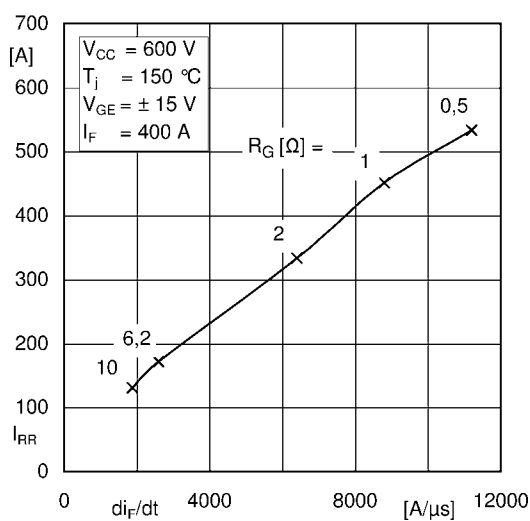


Fig. 11: CAL diode peak reverse recovery current

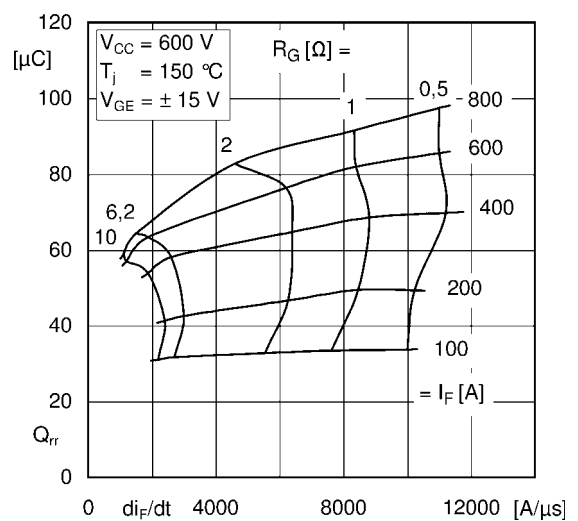
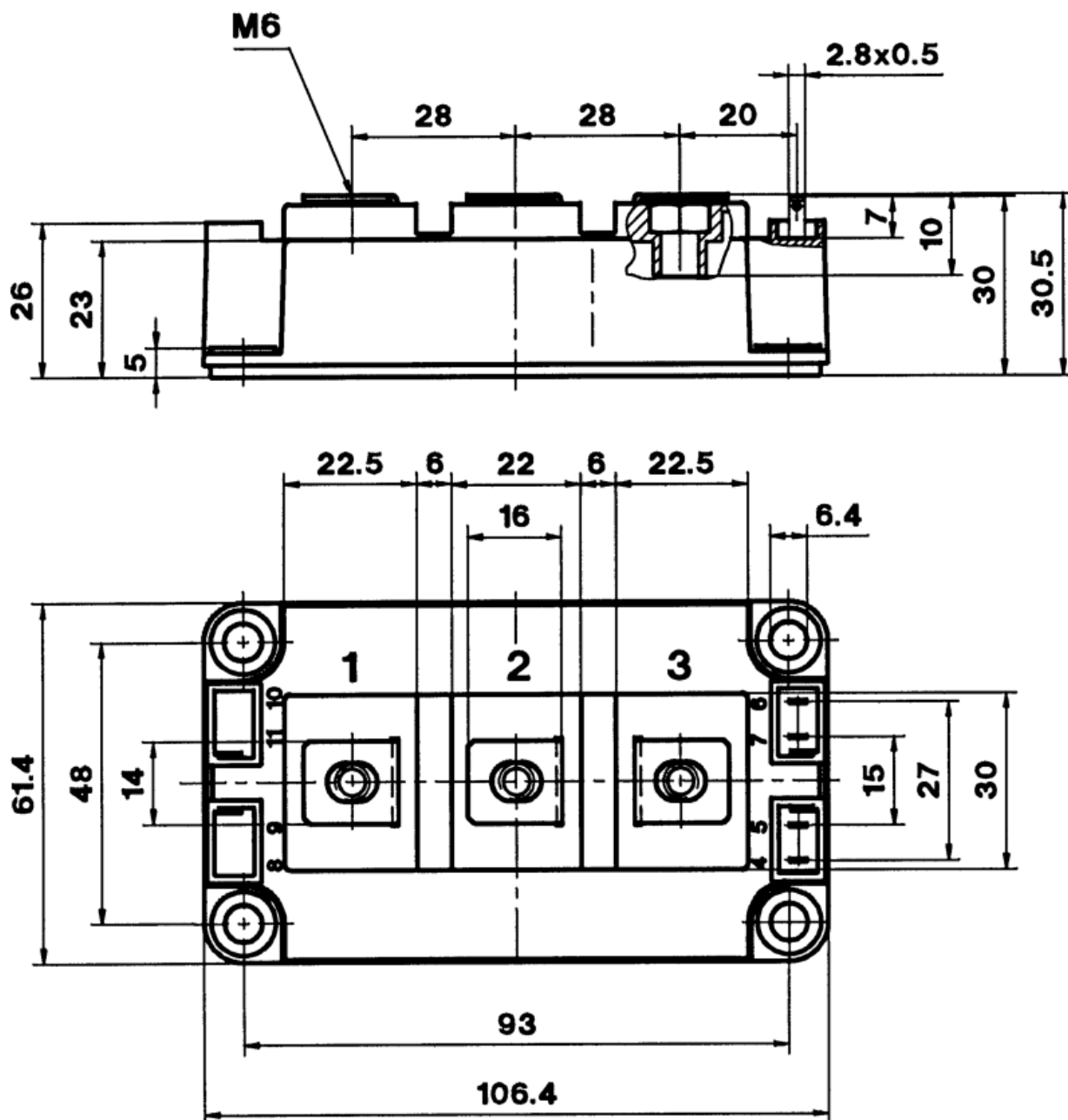
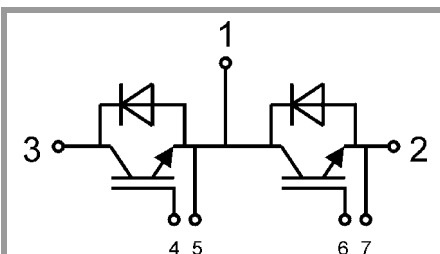


Fig. 12: Typ. CAL diode peak reverse recovery charge



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

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