

SKM400GAL12V



SEMITRANS® 3

SKM400GAL12V

Features

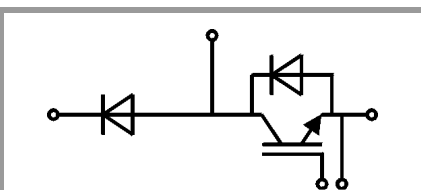
- V-IGBT = 6. Generation Trench V-IGBT (Fuji)
- CAL4 = Soft switching 4. Generation CAL-diode
- Isolated copper baseplate using DBC technology (Direct Copper Bonding)
- UL recognized, file no. E63532
- Increased power cycling capability
- With integrated gate resistor
- Low switching losses at high di/dt

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}	$T_j = 25^\circ\text{C}$	1200	V	
I_C	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	612	A
		$T_c = 80^\circ\text{C}$	467	A
I_{Cnom}		400	A	
I_{CRM}	$I_{CRM} = 3 \times I_{Cnom}$	1200	A	
V_{GES}		-20 ... 20	V	
t_{psc}	$V_{CC} = 720\text{ V}$	10	μs	
	$V_{GE} \leq 20\text{ V}$			
	$V_{CES} \leq 1200\text{ V}$			
T_j		-40 ... 175	$^\circ\text{C}$	
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 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	$T_j = 25^\circ\text{C}$	1.75	2.20	V
		$T_j = 150^\circ\text{C}$	2.20	2.50	V
V_{CE0}		$T_j = 25^\circ\text{C}$	0.94	1.04	V
		$T_j = 150^\circ\text{C}$	0.88	0.98	V
r_{CE}	$V_{GE} = 15\text{ V}$	$T_j = 25^\circ\text{C}$	2.02	2.9	$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	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}	$V_{CE} = 25\text{ V}$		24.04		nF
C_{oes}	$V_{GE} = 0\text{ V}$		2.36		nF
C_{res}			2.356		nF
Q_G	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		4420		nC
R_{Gint}			1.9		Ω

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Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 400\text{ A}$ $T_j = 150^\circ\text{C}$		350		ns
t_r	$V_{GE} = \pm 15\text{ V}$ $R_{G\ on} = 3\ \Omega$ $T_j = 150^\circ\text{C}$		60		ns
E_{on}	$R_{G\ off} = 3\ \Omega$ $T_j = 150^\circ\text{C}$		39		mJ
$t_{d(off)}$	$T_j = 150^\circ\text{C}$		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

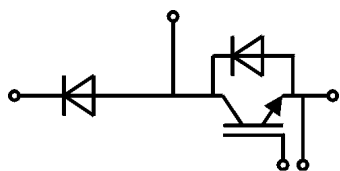
$V_F = V_{EC}$	$I_F = 400\text{ A}$ $V_{GE} = 0\text{ V}$ chip	$T_j = 25^\circ\text{C}$	2.20	2.52	V
		$T_j = 150^\circ\text{C}$	2.15	2.47	V
V_{F0}		$T_j = 25^\circ\text{C}$	1.3	1.5	V
		$T_j = 150^\circ\text{C}$	0.9	1.1	V
r_F		$T_j = 25^\circ\text{C}$	2.3	2.5	m Ω
		$T_j = 150^\circ\text{C}$	3.1	3.4	m Ω
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

Freewheeling diode

$V_F = V_{EC}$	$I_F = 400\text{ A}$ $V_{GE} = 0\text{ V}$ chip	$T_j = 25^\circ\text{C}$	2.20	2.52	V
		$T_j = 150^\circ\text{C}$	2.15	2.47	V
V_{F0}		$T_j = 25^\circ\text{C}$	1.3	1.5	V
		$T_j = 150^\circ\text{C}$	0.9	1.1	V
r_F		$T_j = 25^\circ\text{C}$	2.3	2.5	m Ω
		$T_j = 150^\circ\text{C}$	3.1	3.4	m Ω
I_{RRM}	$I_F = 400\text{ A}$ $T_j = 150^\circ\text{C}$		450		A
Q_{rr}	$di/dt_{off} = 8800\text{ A}/\mu\text{s}$ $V_{GE} = \pm 15\text{ V}$ $T_j = 150^\circ\text{C}$		68		μC
E_{rr}	$V_{CC} = 600\text{ V}$ $T_j = 150^\circ\text{C}$		30.5		mJ
$R_{th(j-c)}$	per Diode			0.14	K/W

Module

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



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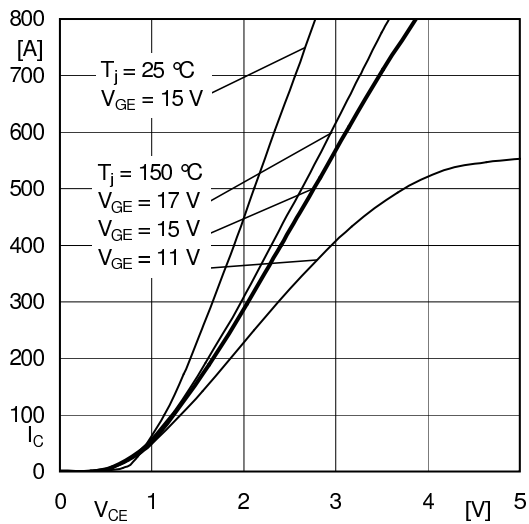


Fig. 1: Typ. output characteristic, inclusive R_{CC+EE}

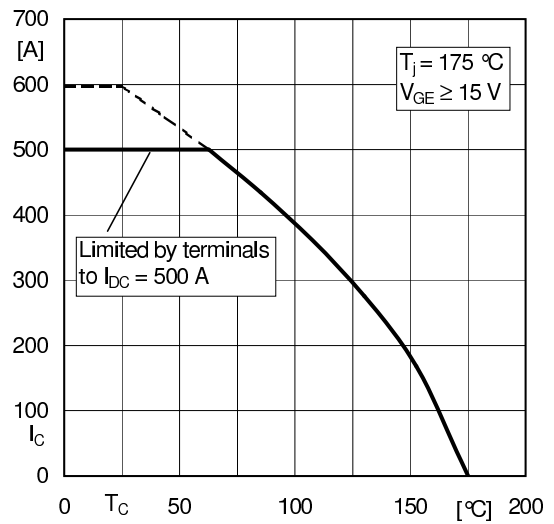


Fig. 2: Rated current vs. temperature $I_C = f(T_C)$

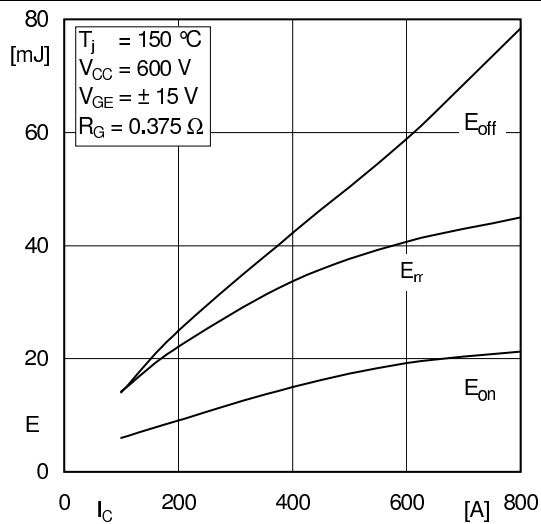


Fig. 3: Typ. turn-on /-off energy = $f(I_C)$

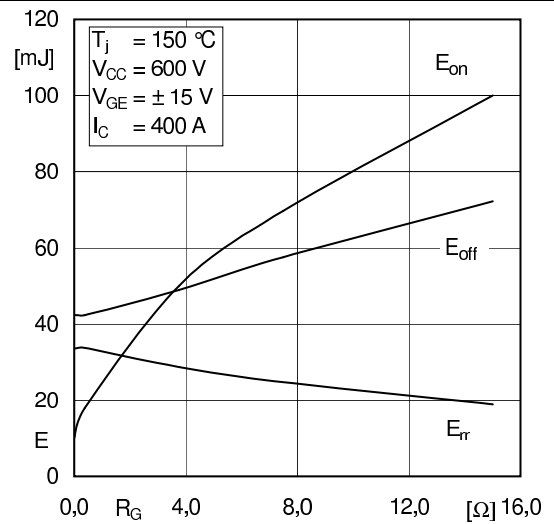


Fig. 4: Typ. turn-on /-off energy = $f(R_G)$

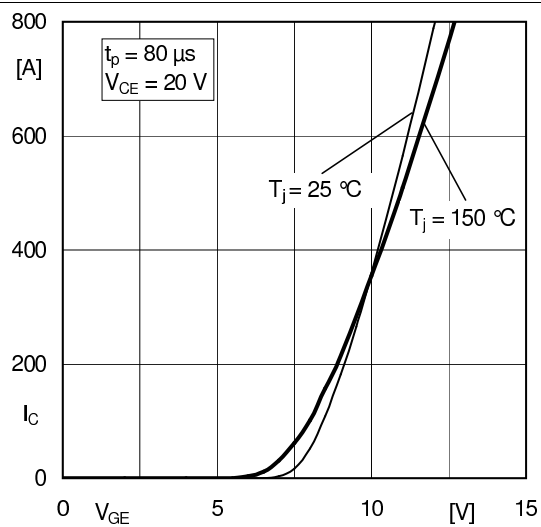


Fig. 5: Typ. transfer characteristic

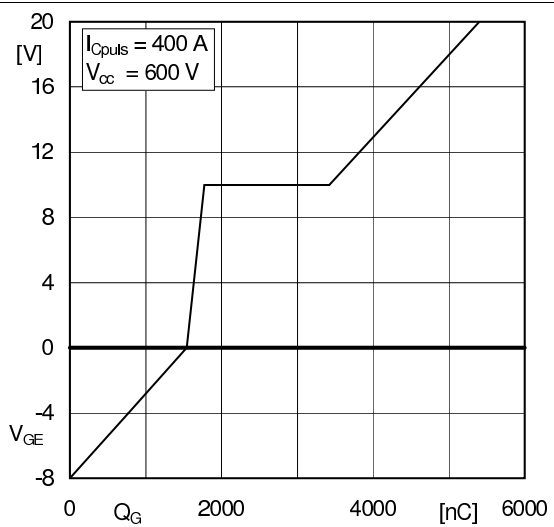


Fig. 6: Typ. gate charge characteristic

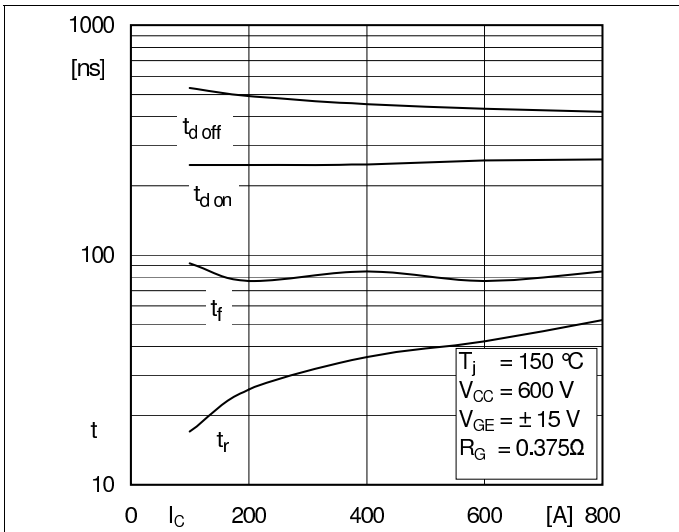


Fig. 7: Typ. switching times vs. I_C

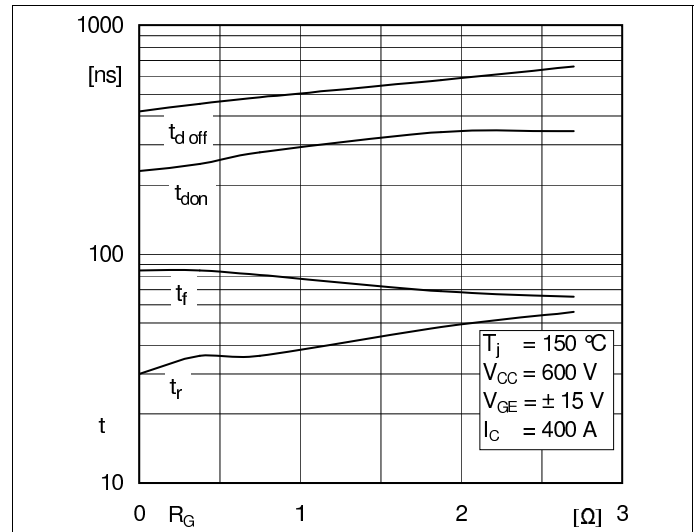


Fig. 8: Typ. switching times vs. gate resistor R_G

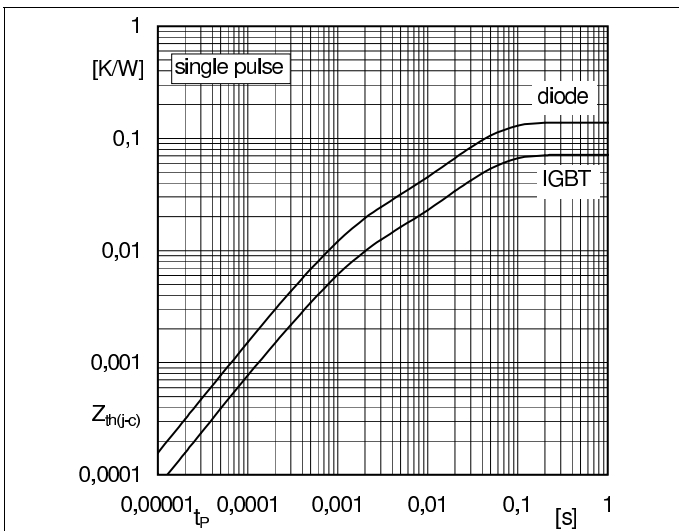


Fig. 9: Transient thermal impedance

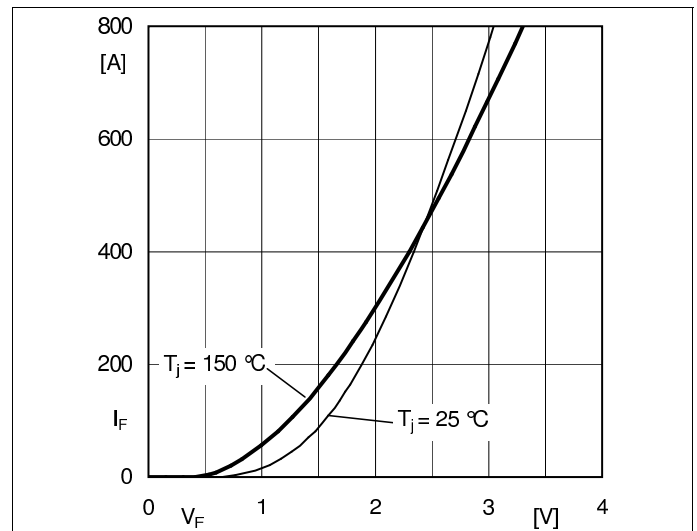


Fig. 10: Typ. CAL diode forward charact., incl. R_{CC+EE}

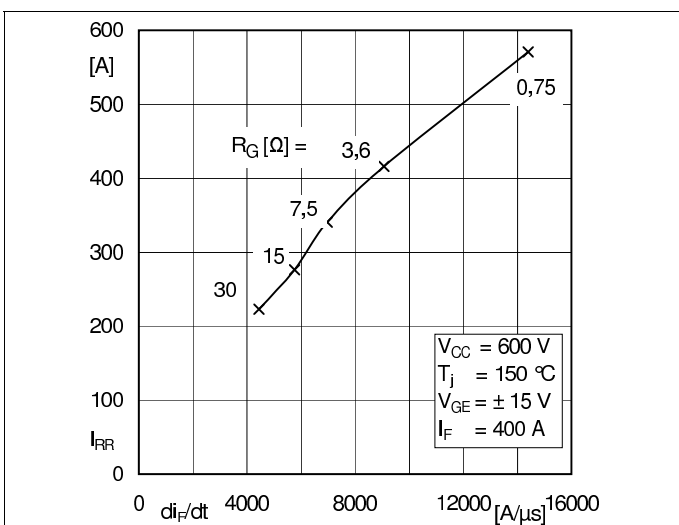


Fig. 11: CAL diode peak reverse recovery current

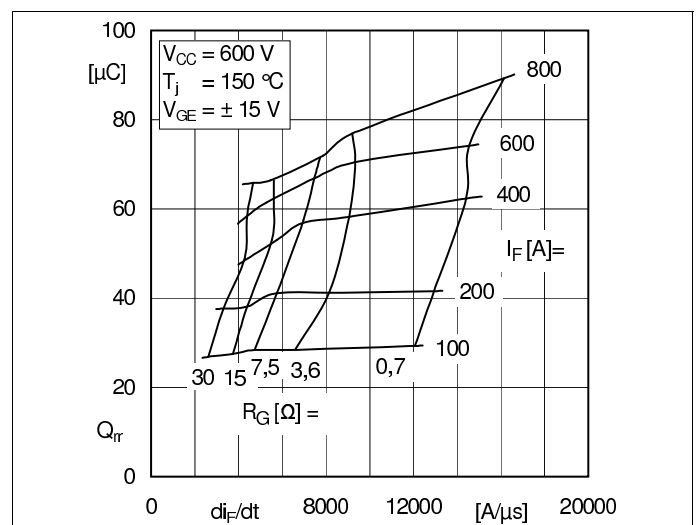


Fig. 12: Typ. CAL diode peak reverse recovery charge

