

# SKM50GAL12T4



SEMITRANS® 2

## Fast IGBT4 Modules

### SKM50GAL12T4

#### Features

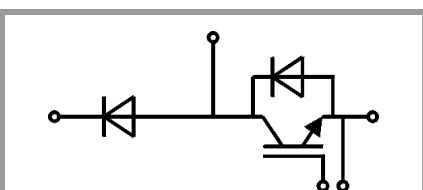
- $V_{CE(sat)}$  with positive temperature coefficient
- High short circuit capability, self limiting to 6 x  $I_{Cnom}$
- Fast & soft inverse CAL diodes
- Large clearance (10 mm) and creepage distances (20 mm)
- Isolated copper baseplate using DBC Technology (Direct Copper Bonding)
- UL recognized, file no. E63532

#### Typical Applications\*

- DC/DC – converter
- Brake chopper
- Switched reluctance motor
- DC – 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
<b>IGBT</b>				
$V_{CES}$	$T_j = 25^\circ\text{C}$		1200	V
$I_C$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	81	A
		$T_c = 80^\circ\text{C}$	62	A
$I_{Cnom}$			50	A
$I_{CRM}$	$I_{CRM} = 3 \times I_{Cnom}$		150	A
$V_{GES}$			-20 ... 20	V
$t_{psc}$	$V_{CC} = 800\text{ V}$	$T_j = 150^\circ\text{C}$	10	$\mu\text{s}$
	$V_{GE} \leq 15\text{ V}$			
	$V_{CES} \leq 1200\text{ V}$			
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Inverse diode</b>				
$I_F$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	65	A
		$T_c = 80^\circ\text{C}$	49	A
$I_{Fnom}$			50	A
$I_{FRM}$	$I_{FRM} = 3 \times I_{Fnom}$		150	A
$I_{FSM}$	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$		270	A
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Freewheeling diode</b>				
$I_F$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	65	A
		$T_c = 80^\circ\text{C}$	49	A
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$I_{FRM}$	$I_{FRM} = 3 \times I_{Fnom}$		150	A
$I_{FSM}$	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$		270	A
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Module</b>				
$I_{t(RMS)}$	$T_{terminal} = T_{terminal} < 80^\circ\text{C}$		200	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
<b>IGBT</b>						
$V_{CE(sat)}$	$I_C = 50\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.85	2.1		V
		$T_j = 150^\circ\text{C}$	2.2	2.4		V
$V_{CE0}$		$T_j = 25^\circ\text{C}$	0.8	0.9		V
		$T_j = 150^\circ\text{C}$	0.7	0.8		V
$r_{CE}$	$V_{GE} = 15\text{ V}$	$T_j = 25^\circ\text{C}$	21.0	24.0		$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	30.0	32.0		$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 1.7\text{ mA}$		5	5.8	6.5	V
$I_{CES}$	$V_{GE} = 0\text{ V}$ $V_{CE} = 1200\text{ V}$	$T_j = 25^\circ\text{C}$	0.1	0.3		$\text{mA}$
		$T_j = 150^\circ\text{C}$				$\text{mA}$
$C_{ies}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	2.77			$\text{nF}$
$C_{oes}$		$f = 1\text{ MHz}$	0.20			$\text{nF}$
$C_{res}$		$f = 1\text{ MHz}$	0.16			$\text{nF}$
$Q_G$	$V_{GE} = -8\text{ V} \dots +15\text{ V}$		280			$\text{nC}$
$R_{Gint}$	$T_j = 25^\circ\text{C}$		4.0			$\Omega$



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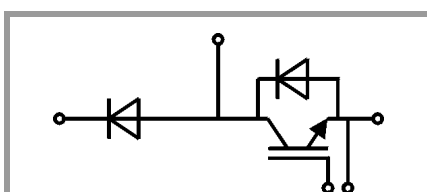
#### Typical Applications\*

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- Switched reluctance motor
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#### Remarks

- Case temperature limited to  $T_c = 125^\circ\text{C}$  max, recomm.  
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
$t_{d(on)}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		98		ns
$t_r$	$I_C = 50\text{ A}$	$T_j = 150^\circ\text{C}$		29		ns
$E_{on}$	$V_{GE} = \pm 15\text{ V}$	$T_j = 150^\circ\text{C}$		5.5		mJ
$t_{d(off)}$	$R_{G\ on} = 8.2\ \Omega$	$T_j = 150^\circ\text{C}$		325		ns
$t_f$	$R_{G\ off} = 8.2\ \Omega$	$T_j = 150^\circ\text{C}$		75		ns
$E_{off}$	$di/dt_{on} = 1700\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		4.5		mJ
	$di/dt_{off} = 670\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$				
$R_{th(j-c)}$	per IGBT				0.53	K/W
Inverse diode						
$V_F = V_{EC}$	$I_F = 50\text{ A}$	$T_j = 25^\circ\text{C}$		2.22	2.54	V
	$V_{GE} = 0\text{ V}$	$T_j = 150^\circ\text{C}$		2.18	2.50	V
	chip					
$V_{F0}$		$T_j = 25^\circ\text{C}$		1.3	1.5	V
		$T_j = 150^\circ\text{C}$		0.9	1.1	V
$r_F$		$T_j = 25^\circ\text{C}$		18.4	20.8	m $\Omega$
		$T_j = 150^\circ\text{C}$		25.6	28.0	m $\Omega$
$I_{RRM}$	$I_F = 50\text{ A}$	$T_j = 150^\circ\text{C}$		35		A
$Q_{rr}$	$di/dt_{off} = 1380\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		8.7		$\mu\text{C}$
$E_{rr}$	$V_{GE} = \pm 15\text{ V}$	$T_j = 150^\circ\text{C}$		3.6		mJ
	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$				
$R_{th(j-c)}$	per diode				0.84	K/W
Freewheeling diode						
$V_F = V_{EC}$	$I_F = 50\text{ A}$	$T_j = 25^\circ\text{C}$		2.22	2.54	V
	$V_{GE} = 0\text{ V}$	$T_j = 150^\circ\text{C}$		2.18	2.50	V
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	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$				
$R_{th(j-c)}$	per Diode				0.84	K/W
Module						
$L_{CE}$					30	nH
$R_{CC'+EE'}$	terminal-chip	$T_c = 25^\circ\text{C}$		0.65		m $\Omega$
		$T_c = 125^\circ\text{C}$		1		m $\Omega$
$R_{th(c-s)}$	per module			0.04	0.05	K/W
$M_s$	to heat sink M6		3		5	Nm
$M_t$		to terminals M5	2.5		5	Nm
						Nm
$w$					160	g



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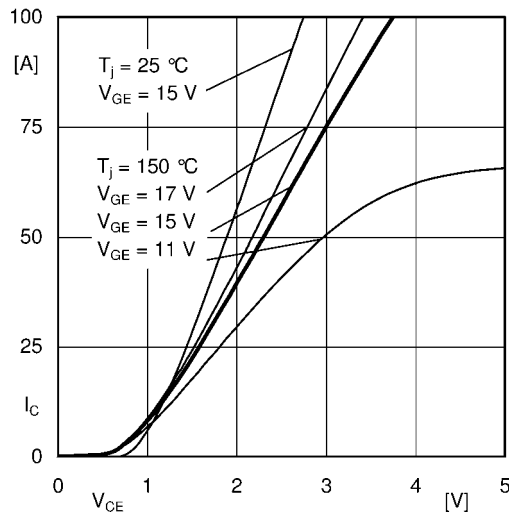


Fig. 1: Typ. output characteristic, inclusive  $R_{CC'+EE'}$

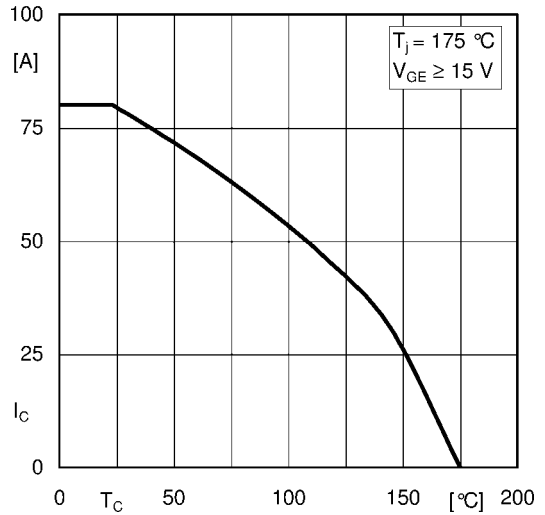


Fig. 2: Rated current vs. temperature  $I_c = f(T_c)$

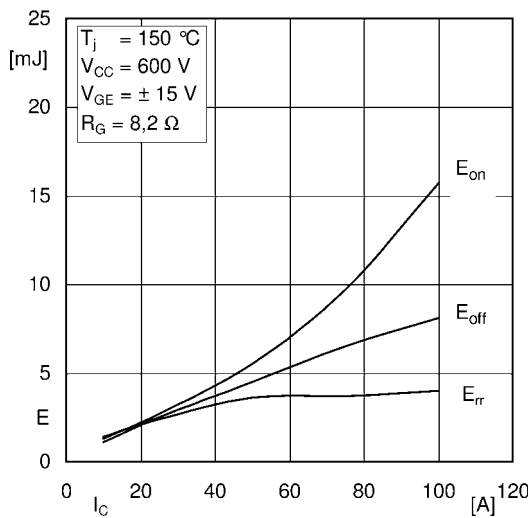


Fig. 3: Typ. turn-on /-off energy =  $f(I_c)$

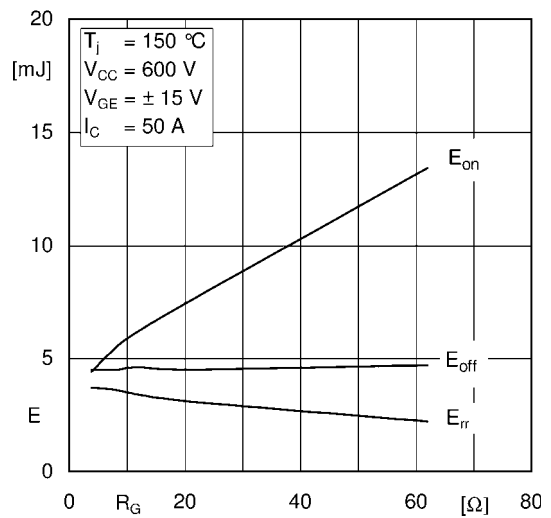


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

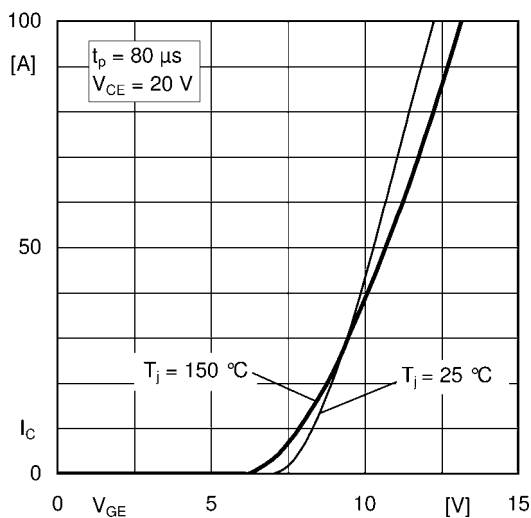


Fig. 5: Typ. transfer characteristic

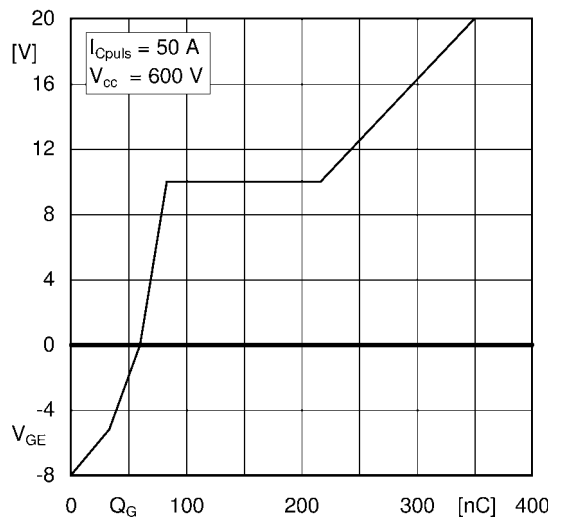


Fig. 6: Typ. gate charge characteristic

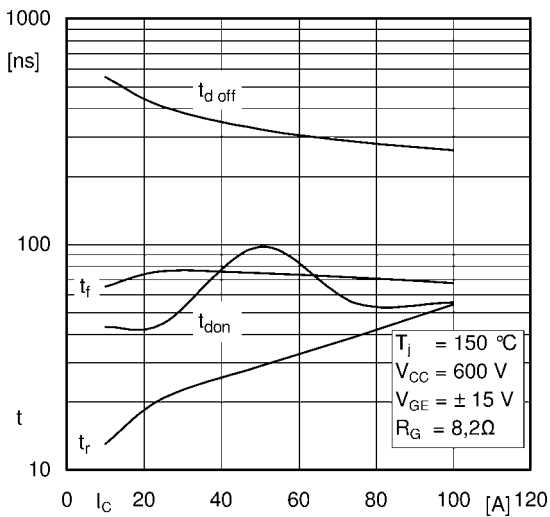


Fig. 7: Typ. switching times vs.  $I_C$

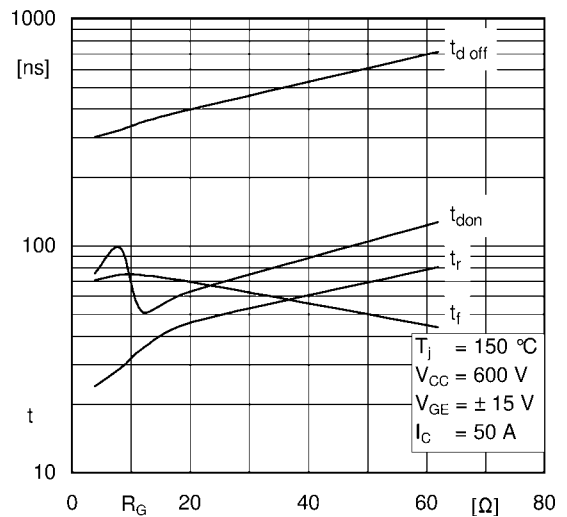


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

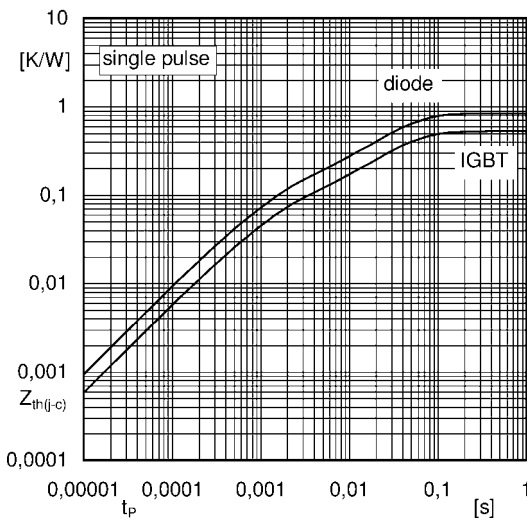


Fig. 9: Transient thermal impedance

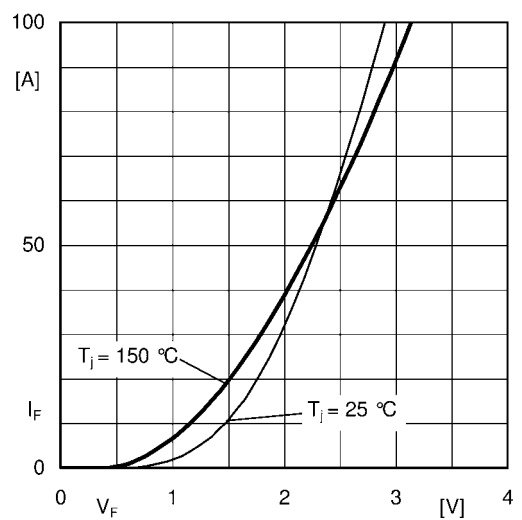


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC+EE'}$

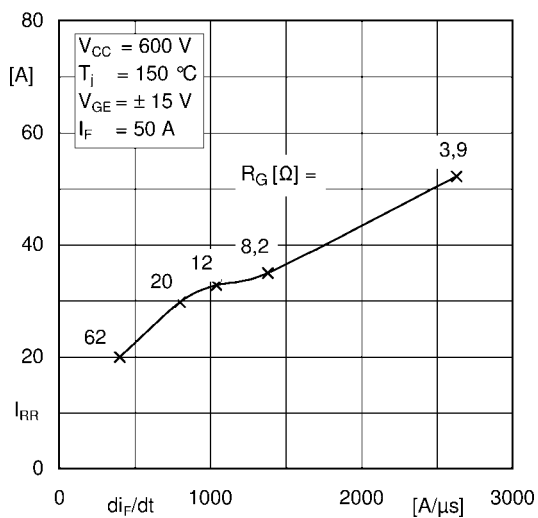


Fig. 11: CAL diode peak reverse recovery current

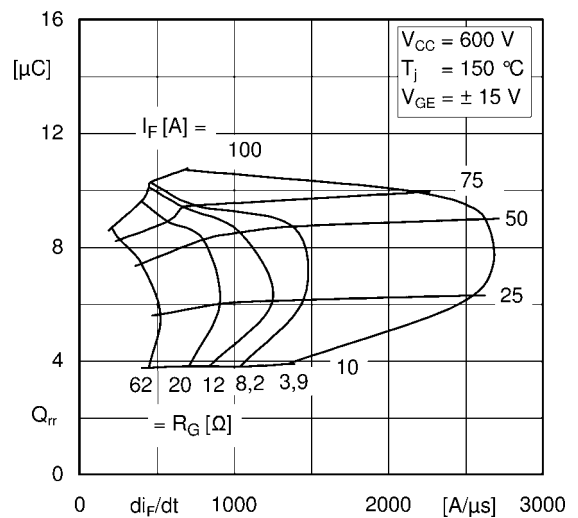


Fig. 12: Typ. CAL diode peak reverse recovery charge

