

# SKiM459GD12E4V2



SKiM® 93

## Trench IGBT Modules

### SKiM459GD12E4V2

#### Features

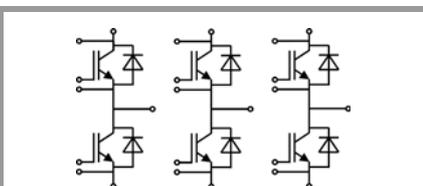
- IGBT 4 Trench Gate Technology
- Solderless sinter technology
- $V_{CE(sat)}$  with positive temperature coefficient
- Low inductance case
- Insulated by  $Al_2O_3$  DBC (Direct Bonded Copper) ceramic substrate
- Pressure contact technology for thermal contacts
- Spring contact system to attach driver PCB to the control terminals
- High short circuit capability, self limiting to  $6 \times I_C$
- Integrated temperature sensor
- Improved power cycle capability of diodes due to AlCu-bond wires

#### Typical Applications\*

- Automotive inverter
- High reliability AC inverter wind
- High reliability AC inverter drives

#### Remarks

- Case temperature limited to  $T_s = 125^\circ C$  max;  $T_c = T_s$  (for baseplateless modules)
- Recommended  $T_{op} = -40 \dots +150^\circ C$



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#### Absolute Maximum Ratings

Symbol	Conditions	Values	Unit
<b>Inverter - IGBT</b>			
$V_{CES}$	$T_j = 25^\circ C$	1200	V
$I_C$	$\lambda_{paste}=0.8 W/(mK)$	$T_s = 25^\circ C$	556
	$T_j = 175^\circ C$	$T_s = 70^\circ C$	452
$I_C$	$\lambda_{paste}=2.5 W/(mK)$	$T_s = 25^\circ C$	716
	$T_j = 175^\circ C$	$T_s = 70^\circ C$	585
$I_{Cnom}$		450	A
$I_{CRM}$	$I_{CRM} = 3 \times I_{Cnom}$	1350	A
$V_{GES}$		-20 ... 20	V
$t_{psc}$	$V_{CC} = 800 V$	$T_j = 150^\circ C$	10
	$V_{GE} \leq 15 V$		
	$V_{CES} \leq 1200 V$		
$T_j$		-40 ... 175	$^\circ C$
<b>Inverse - Diode</b>			
$I_F$	$\lambda_{paste}=0.8 W/(mK)$	$T_s = 25^\circ C$	438
	$T_j = 175^\circ C$	$T_s = 70^\circ C$	347
$I_F$	$\lambda_{paste}=2.5 W/(mK)$	$T_s = 25^\circ C$	530
	$T_j = 175^\circ C$	$T_s = 70^\circ C$	422
$I_{Fnom}$		450	A
$I_{FRM}$	$I_{FRM} = 3 \times I_{Fnom}$	1350	A
$I_{FSM}$	$t_p = 10 ms, \sin 180^\circ, T_j = 150^\circ C$	2430	A
$T_j$		-40 ... 175	$^\circ C$
<b>Module</b>			
$I_t(RMS)$	$T_{terminal} = 80^\circ C,$	700	A
$T_{stg}$		-40 ... 125	$^\circ C$
$V_{isol}$	AC sinus 50 Hz, $t = 1 min$	2500	V

#### Characteristics

Symbol	Conditions	min.	typ.	max.	Unit
<b>Inverter - IGBT</b>					
$V_{CE(sat)}$	$I_C = 450 A$ $V_{GE} = 15 V$ chiplevel	$T_j = 25^\circ C$	1.85	2.10	V
		$T_j = 150^\circ C$	2.25	2.45	V
$V_{CE0}$	chiplevel	$T_j = 25^\circ C$	0.80	0.90	V
		$T_j = 150^\circ C$	0.70	0.80	V
$r_{CE}$	$V_{GE} = 15 V$ chiplevel	$T_j = 25^\circ C$	2.3	2.7	m $\Omega$
		$T_j = 150^\circ C$	3.4	3.7	m $\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 18 mA$	5	5.8	6.5	V
$I_{CES}$	$V_{GE} = 0 V, V_{CE} = 1200 V, T_j = 25^\circ C$		0.1	0.3	mA
$C_{ies}$	$V_{CE} = 25 V$ $V_{GE} = 0 V$	$f = 1 MHz$	26.4		nF
$C_{oes}$		$f = 1 MHz$	1.74		nF
$C_{res}$		$f = 1 MHz$	1.41		nF
$Q_G$	$V_{GE} = -8 V \dots +15 V$		2550		nC
$R_{Gint}$	$T_j = 25^\circ C$		1.7		$\Omega$
$t_{d(on)}$	$V_{CC} = 600 V$	$T_j = 150^\circ C$	276		ns
$t_r$	$I_C = 450 A$ $R_{Gon} = 1.3 \Omega$ $R_{Goff} = 1.3 \Omega$	$T_j = 150^\circ C$	55		ns
		$T_j = 150^\circ C$	22		mJ
$E_{on}$		$T_j = 150^\circ C$	22		mJ
$t_{d(off)}$	$di/dt_{on} = 8340 A/\mu s$	$T_j = 150^\circ C$	538		ns
$t_f$	$di/dt_{off} = 3660 A/\mu s$	$T_j = 150^\circ C$	114		ns
$E_{off}$	$V_{GE} = +15/-15 V$	$T_j = 150^\circ C$	57		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 W/(mK)$		0.092		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 W/(mK)$		0.059		K/W



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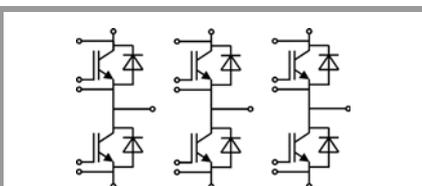
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Inverse - Diode</b>						
$V_F = V_{EC}$	$I_F = 450 \text{ A}$	$T_j = 25^\circ C$		2.14	2.46	V
		chipelevel	$T_j = 150^\circ C$	2.07	2.38	V
$V_{F0}$	chipelevel	$T_j = 25^\circ C$		1.30	1.50	V
		$T_j = 150^\circ C$		0.90	1.10	V
$r_F$	chipelevel	$T_j = 25^\circ C$		1.87	2.1	mΩ
		$T_j = 150^\circ C$		2.6	2.8	mΩ
$I_{RRM}$	$I_F = 450 \text{ A}$	$T_j = 150^\circ C$		570		A
$Q_{rr}$	$di/dt_{off} = 8880 \text{ A}/\mu s$	$T_j = 150^\circ C$		80		μC
$E_{rr}$	$V_{GE} = +15/-15 \text{ V}$ $V_{CC} = 600 \text{ V}$	$T_j = 150^\circ C$		40		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W}/(mK)$			0.155		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W}/(mK)$			0.115		K/W
<b>Module</b>						
$L_{CE}$				10	15	nH
$R_{CC+EE}$	measured per switch	$T_s = 25^\circ C$		0.3		mΩ
		$T_s = 125^\circ C$		0.5		mΩ
$w$				1042		g
<b>Temperature Sensor</b>						
$R_{100}$	$T_r=100^\circ C (R_{25}=1000\Omega)$			1670 ± 1%		Ω
$R(T)$	$R(T)=1k\Omega[1+A(T-25^\circ C)+B(T-25^\circ C)^2]$ , $A = 7.64 \cdot 10^{-3} \text{ } ^\circ C^{-1}$ , $B = 1.73 \cdot 10^{-5} \text{ } ^\circ C^{-2}$					

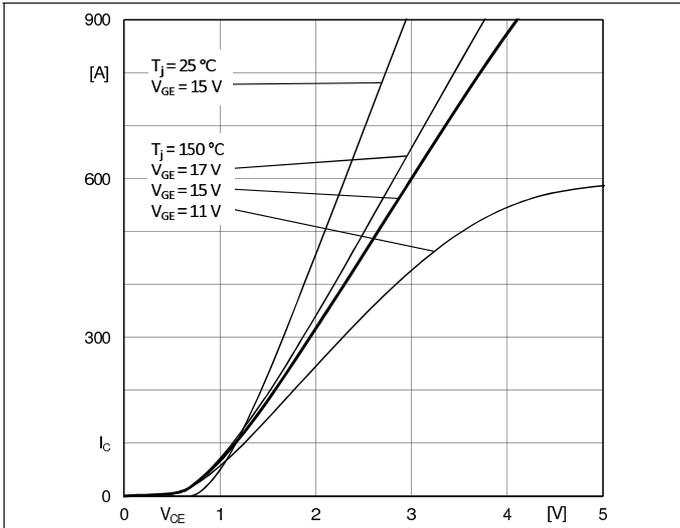


Fig. 1: Typ. output characteristic, inclusive  $R_{CC+EE}$

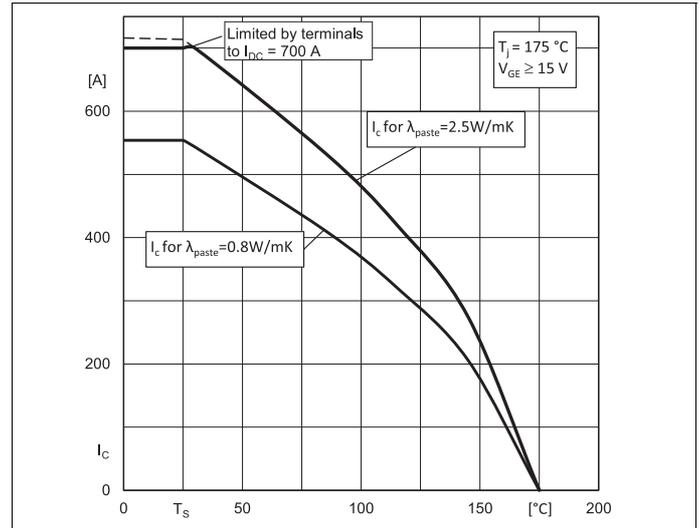


Fig. 2: Typ. rated current vs. temperature  $I_C = f(T_S)$

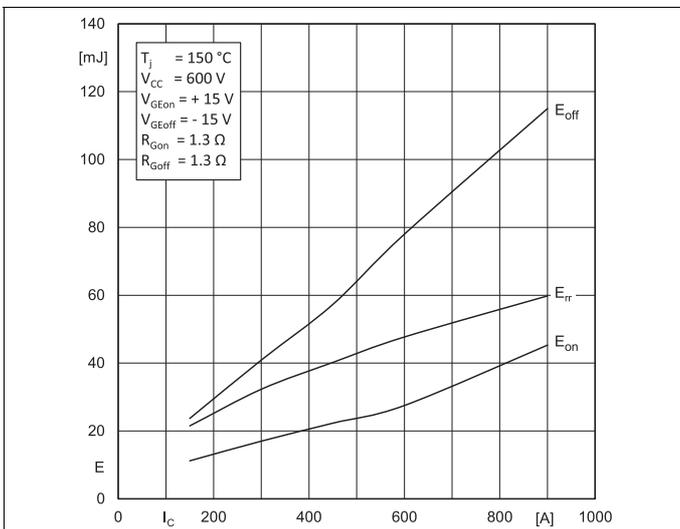


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

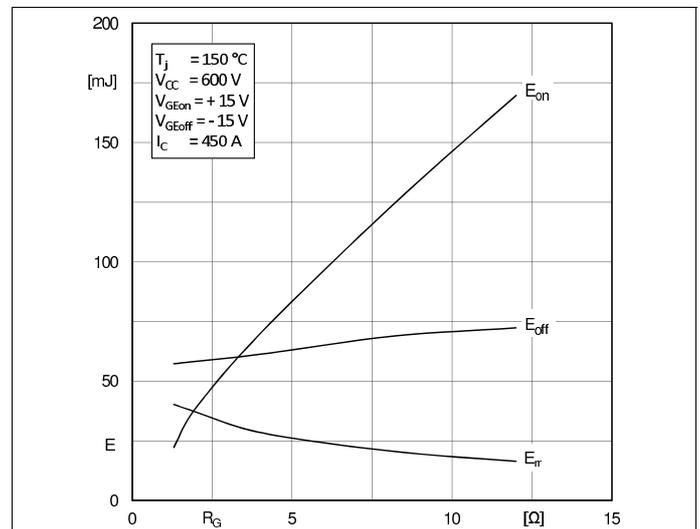


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

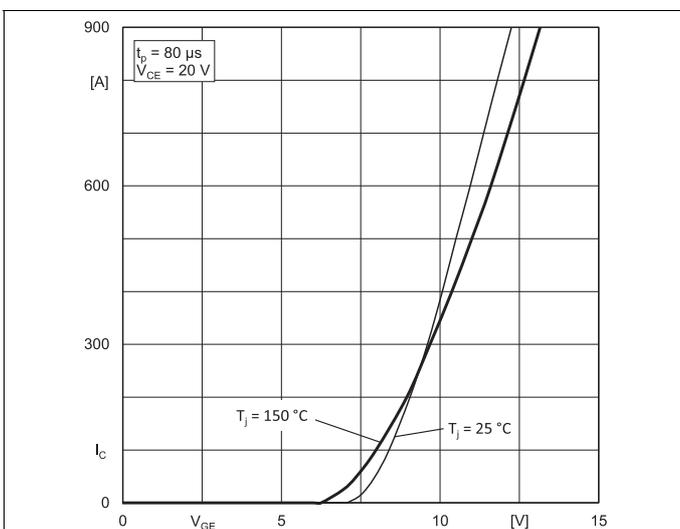


Fig. 5: Typ. transfer characteristic

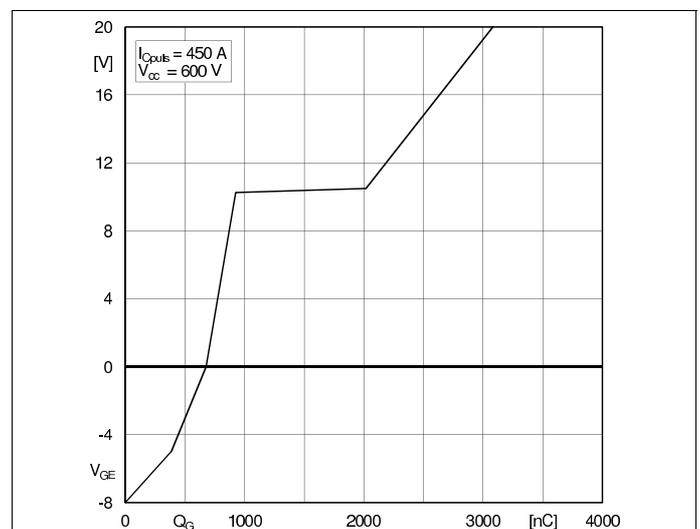


Fig. 6: Typ. gate charge characteristic

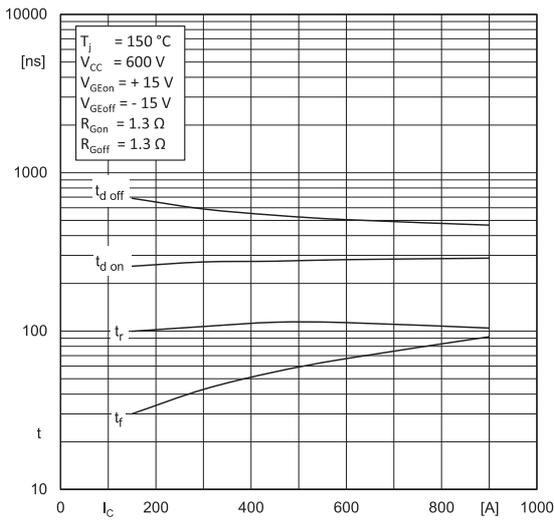


Fig. 7: Typ. switching times vs.  $I_c$

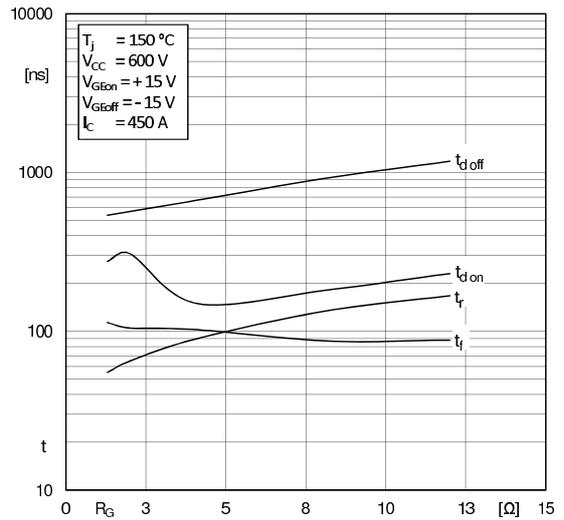


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

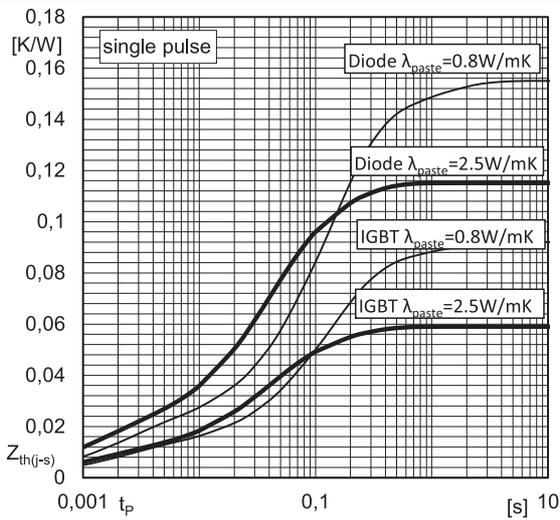


Fig. 9: Typ. transient thermal impedance

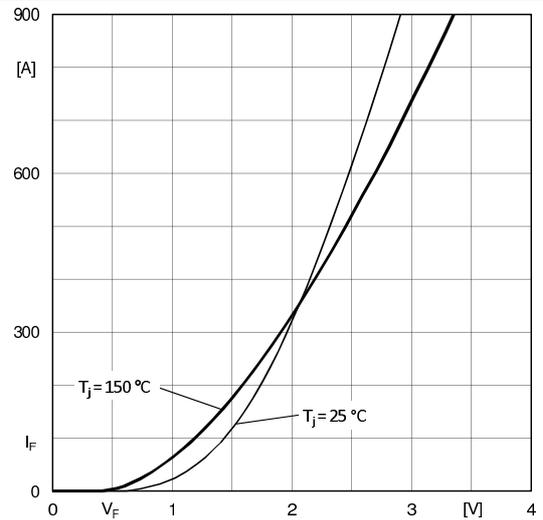


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC+EE}$

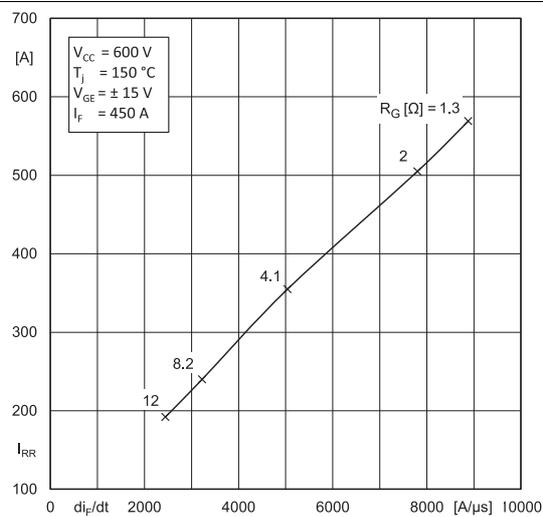


Fig. 11: Typ. CAL diode peak reverse recovery current

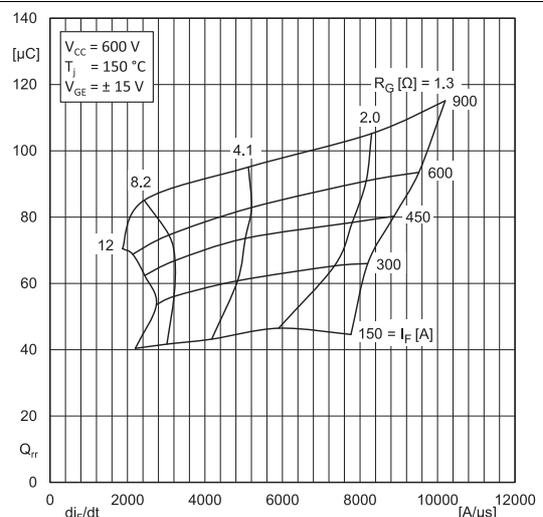


Fig. 12: Typ. CAL diode recovery charge



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

## **\*IMPORTANT INFORMATION AND WARNINGS**

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