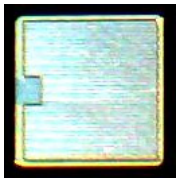
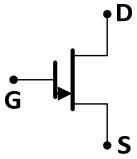
Normally – OFF Silicon Carbide Junction Transistor

V_{DS}	=	600 V
$R_{DS(ON)}$	=	65 mΩ
I_D (Tc = 25°C)	=	45 A
$h_{FE(Tc = 25°C)}$	=	110

Features

- 250°C maximum operating temperature
- Gate Oxide Free SiC switch
- Exceptional Safe Operating Area
- Excellent Gain Linearity
- Temperature Independent Switching Performance
- Low Output Capacitance
- Positive Temperature Co-efficient of $R_{DS,ON}$
- Suitable for connecting an anti-parallel diode





Advantages

- Compatible with Si MOSFET/IGBT gate-drivers
- > 20 µs Short-Withstand Capability
- Lowest-in-class Conduction Losses
- High Circuit Efficiency
- Minimal Input Signal Distortion
- High Amplifier Bandwidth

Applications

- Down Hole Oil Drilling, Geothermal Instrumentation
- Hybrid Electric Vehicles (HEV)
- Solar Inverters
- Switched-Mode Power Supply (SMPS)
- Power Factor Correction (PFC)
- Induction Heating
- Uninterruptible Power Supply (UPS)
- Motor Drives

Electrical Specifications

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Values	Unit
Drain – Source Voltage	V_{DS}	V_{GS} = 0 V	600	V
Continuous Drain Current	I_D	T_{VJ} < 250 °C	20	A
Gate Peak Current	I_{GM}		10	A
Turn-Off Safe Operating Area	RBSOA	T_{VJ} = 250 °C, I_G = 1 A, Clamped Inductive Load	$I_{D,max}$ = 20 @ $V_{DS} \leq V_{DSmax}$	A
Short Circuit Safe Operating Area	SCSOA	T_{VJ} = 250 °C, I_G = 1 A, V_{DS} = 400 V, Non Repetitive	20	µs
Reverse Gate – Source Voltage	V_{GS}		30	V
Reverse Drain – Source Voltage	V_{DS}		40	V
Operating and Storage Temperature	T_j, T_{stg}		-55 to 250	°C

Electrical Characteristics

Parameter	Symbol	Conditions	Values min.	Values typ.	Values max.	Unit
On Characteristics						
Drain – Source On Resistance	$R_{DS(ON)}$	I_D = 20 A, I_G = 400 mA, T_j = 25 °C I_D = 20 A, I_G = 500 mA, T_j = 125 °C I_D = 20 A, I_G = 1000 mA, T_j = 175 °C I_D = 20 A, I_G = 1000 mA, T_j = 250 °C		65 90 110 165		mΩ
Gate Forward Voltage	$V_{GS(FWD)}$	I_G = 1000 mA, T_j = 25 °C I_G = 1000 mA, T_j = 250 °C		3.0 2.7		V
DC Current Gain	h_{FE}	V_{DS} = 5 V, I_D = 20 A, T_j = 25 °C V_{DS} = 5 V, I_D = 20 A, T_j = 125 °C V_{DS} = 5 V, I_D = 20 A, T_j = 175 °C V_{DS} = 5 V, I_D = 20 A, T_j = 250 °C		110 78 73 69		
Off Characteristics						
Drain Leakage Current	I_{DSS}	V_R = 600 V, V_{GS} = 0 V, T_j = 25 °C V_R = 600 V, V_{GS} = 0 V, T_j = 250 °C		10 100		µA
Gate – Source Leakage Current	I_{GSS}	V_{GS} = -20 V, T_j = 25 °C		20		nA
Capacitance Characteristics						
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_D = 100 V, f = 1 MHz		2500		pF
Reverse Transfer/Output Capacitance	C_{rss}/C_{oss}	V_D = 100 V, f = 1 MHz		160		pF

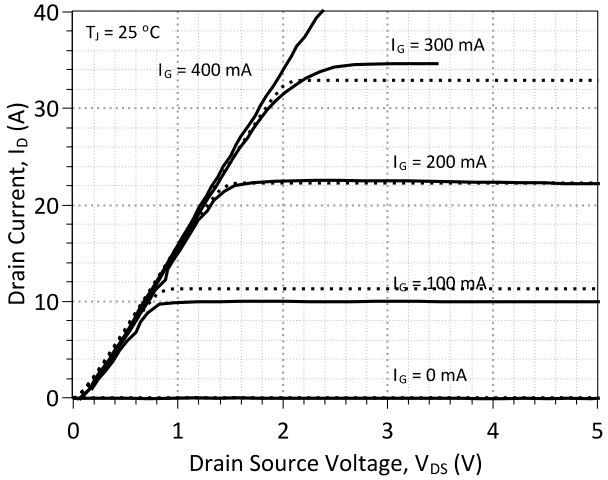


Figure 1: Typical Output Characteristics at 25 °C

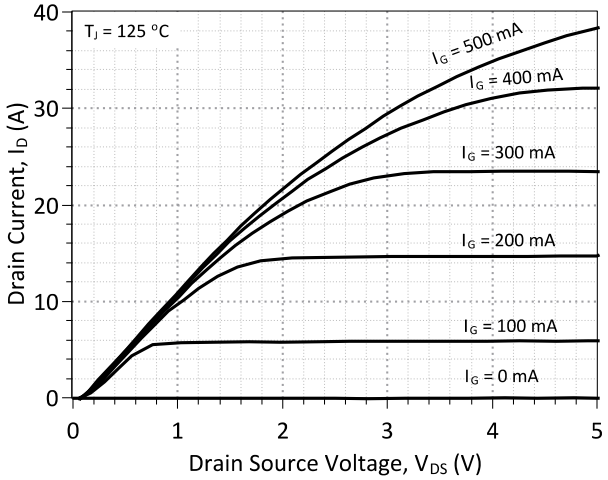


Figure 2: Typical Output Characteristics at 125 °C

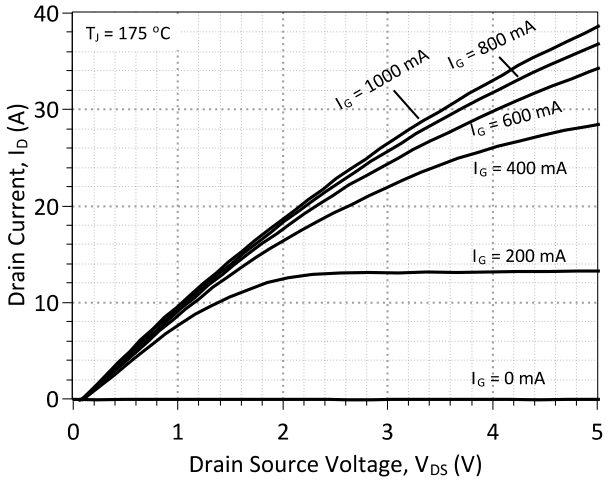


Figure 3: Typical Output Characteristics at 175 °C

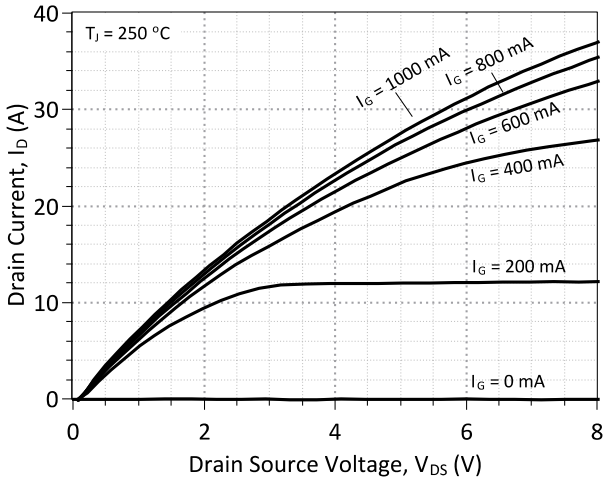


Figure 4: Typical Output Characteristics at 250 °C

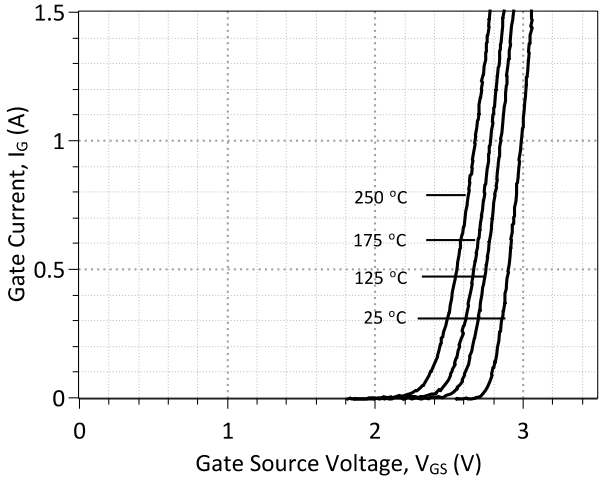


Figure 5: Typical Gate Source I-V Characteristics vs. Temperature

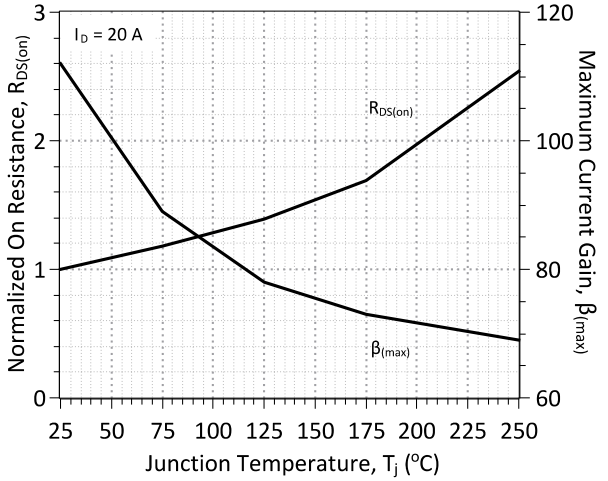


Figure 4: Normalized On-Resistance and Current Gain vs. Temperature

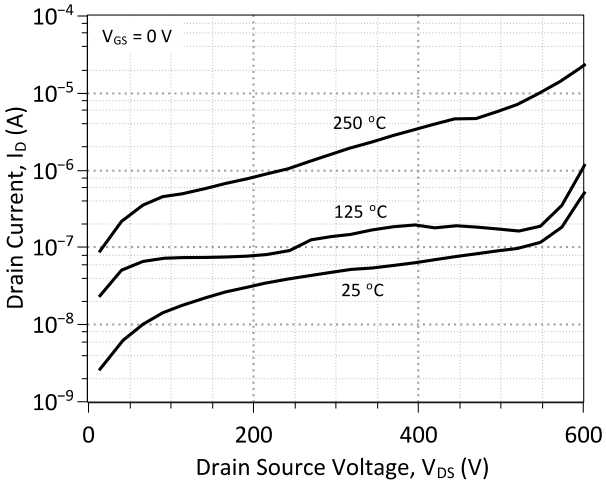


Figure 7: Typical Blocking Characteristics

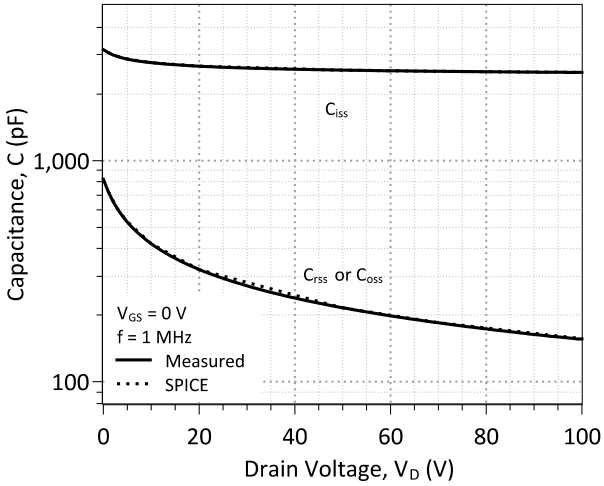


Figure 8: Capacitance Characteristics

Gate Drive Theory of Operation

The SJT transistor is a current controlled transistor which requires a positive gate current for turn-on as well as to remain in on-state. An ideal gate current waveform for ultra-fast switching of the SJT, while maintaining low gate drive losses, is shown in Figure 9.

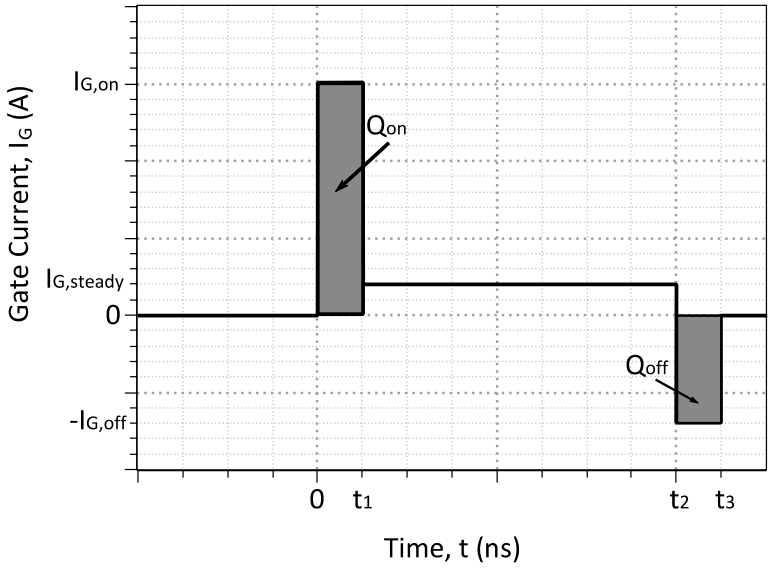


Figure 9: Idealized Gate Current Waveform

Gate Currents, $I_{G,pk}$/$-I_{G,pk}$ and Voltages during Turn-On and Turn-Off

An SJT is rapidly switched from its blocking state to on-state, when the necessary gate charge, Q_G, for turn-on is supplied by a burst of high gate current, $I_{G,on}$, until the gate-source capacitance, C_{GS}, and gate-drain capacitance, C_{GD}, are fully charged.

$$I_{G,on} * t_1 \geq Q_{gs} + Q_{gd}$$

The $I_{G,pon}$ pulse should ideally terminate, when the drain voltage falls to its on-state value, in order to avoid unnecessary drive losses during the steady on-state. In practice, the rise time of the $I_{G,on}$ pulse is affected by the parasitic inductances, L_{par} in the package and drive circuit. A voltage developed across the parasitic inductance in the source path, L_s, can de-bias the gate-source junction, when high drain currents begin to flow through the device. The applied gate voltage should be maintained high enough, above the $V_{GS,ON}$ level to counter these effects.

A high negative peak current, $-I_{G,off}$ is recommended at the start of the turn-off transition, in order to rapidly sweep out the injected carriers from the gate, and achieve rapid turn-off. While satisfactory turn off can be achieved with V_{GS} = 0 V, a negative gate voltage V_{GS} may be used in order to speed up the turn-off transition.

Steady On-State

After the device is turned on, I_G may be advantageously lowered to $I_{G,steady}$ for reducing unnecessary gate drive losses. The $I_{G,steady}$ is determined by noting the DC current gain, h_{FE}, of the device

The desired $I_{G,steady}$ is determined by the peak device junction temperature T_J during operation, drain current I_D, DC current gain h_{FE}, and a 50 % safety margin to ensure operating the device in the saturation region with low on-state voltage drop by the equation:

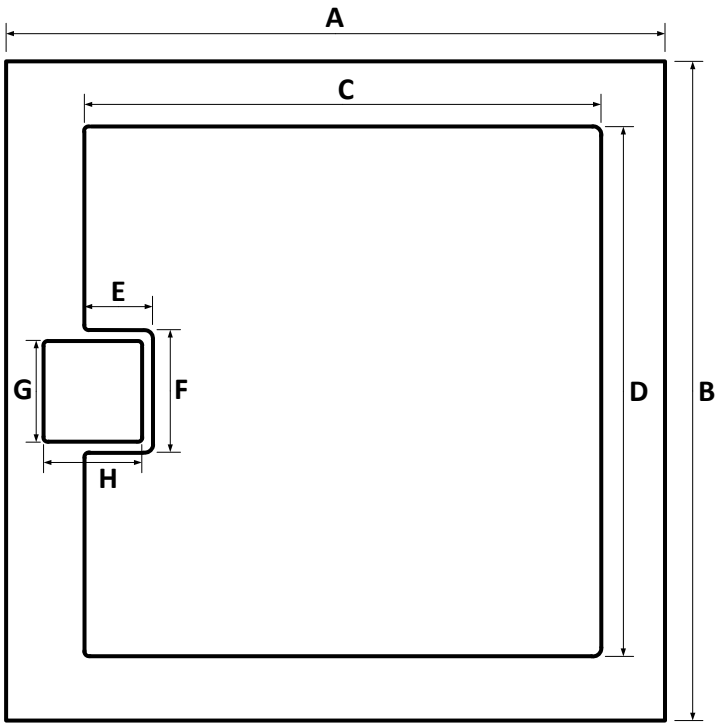
$$I_{G,steady} \approx \frac{I_D}{h_{FE}(T, I_D)} * 1.5$$

Mechanical Specifications

Mechanical Parameters

Raster Size	2.85 x 2.85	mm^2	112 x 112	mil^2
Area total / active	8.12/6.60	mm^2	12544/10237	mil^2
Thickness	360	µm	14	mil
Wafer Size	100	mm	3937	mil
Flat Position	0	deg	0	deg
Passivation frontside	Polyimide			
Pad Metal (Anode)	4000 nm Al			
Backside Metal (Cathode)	400 nm Ni + 200 nm Au -system			
Die Bond	Electrically conductive glue or solder			
Wire Bond	Al ≤ 10 mil (Source) Al ≤ 3 mil (Gate)			
Reject ink dot size	Φ ≥ 0.3 mm			
Recommended storage environment	Store in original container, in dry nitrogen, < 6 months at an ambient temperature of 23 °C			

Chip Dimensions:



		mm	mil
DIE	A	2.85	112
	B	2.85	112
SOURCE WIREBONDABLE	C	2.23	88
	D	2.29	90
	E	0.30	12
	F	0.53	21
GATE WIREBONDABLE	G	0.44	17
	H	0.43	17

Revision History			
Date	Revision	Comments	Supersedes
2014/08/26	3	Updated Electrical Characteristics	
2014/04/29	2	Updated Electrical Characteristics	
2014/02/27	1	Updated Electrical Characteristics	
2013/12/04	0	Initial release	

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SPICE Model Parameters

This is a secure document. Please copy this code from the SPICE model PDF file on our website (http://www.genesicsemi.com/images/hit_sic/baredie/sjt/GA20JT06-CAL_SPICE.pdf) into LTSPICE (version 4) software for simulation of the GA20JT06-CAL.

```
*     MODEL OF GeneSiC Semiconductor Inc.
*
*     $Revision:   1.1           $
*     $Date:   27-FEB-2014       $
*
*     GeneSiC Semiconductor Inc.
*     43670 Trade Center Place Ste. 155
*     Dulles, VA 20166
*
*     COPYRIGHT (C) 2013 GeneSiC Semiconductor Inc.
*     ALL RIGHTS RESERVED
*
* These models are provided "AS IS, WHERE IS, AND WITH NO WARRANTY
* OF ANY KIND EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED
* TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A
* PARTICULAR PURPOSE."
* Models accurate up to 2 times rated drain current.
*
.model GA20JT06 NPN
+ IS       5.00E-47
+ ISE      1.26E-28
+ EG       3.23
+ BF       114
+ BR       0.55
+ IKF      700
+ NF       1
+ NE       2
+ RB       0.26
+ RE       0.01
+ RC       0.045
+ CJC      8.2281E-10
+ VJC      3.311262797257
+ MJC      0.4811772789929
+ CJE      2.33957E-9
+ VJE      2.91486059646
+ MJE      0.4821112143335
+ XTI      3
+ XTB      -1.2
+ TRC1     6.20E-03
+ VCEO     600
+ ICRATING 20
+ MFG      GeneSiC_Semiconductor
*
* End of GA20JT06-CAL SPICE Model
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