GeneSiC SEMICONDUCTOR GA20SICP12-263

Silicon Carbide Junction Transistor/Schottky Diode Co-pack

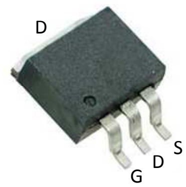
V_{DS}	=	1200 V
$V_{DS(ON)}$	=	1.4 V
I_D	=	20 A
$R_{DS(ON)}$	=	70 mΩ

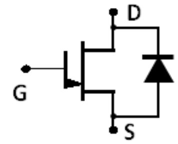
Features

- 175 °C maximum operating temperature
- Temperature independent switching performance
- Gate oxide free SiC switch
- Integrated SiC Schottky Rectifier
- Positive temperature coefficient for easy paralleling
- Low intrinsic device capacitance
- Low gate charge

Package

- RoHS Compliant





TO-263

Advantages

- Low switching losses
- High circuit efficiency
- High temperature operation
- High short circuit withstand capability
- Reduced cooling requirements
- Reduced system size

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

Maximum Ratings at T_j = 175 °C, unless otherwise specified

Parameter	Symbol	Conditions	Values	Unit
SiC Junction Transistor				
Drain – Source Voltage	V_{DS}	V_{GS} = 0 V	1200	V
Continuous Drain Current	I_D	$T_{C,MAX}$ = 95 °C	20	A
Gate Peak Current	I_{GM}		10	A
Turn-Off Safe Operating Area	RBSOA	T_{VJ} = 175 °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} = 175 °C, I_G = 1 A, V_{DS} = 800 V, Non Repetitive	20	µs
Reverse Gate – Source Voltage	V_{SG}		30	V
Reverse Drain – Source Voltage	V_{SD}		25	V
Power Dissipation	P_{tot}	T_C = 95 °C	157	W
Storage Temperature	T_{stg}		-55 to 175	°C
Free-wheeling Silicon Carbide diode				
DC-Forward Current	I_F	$T_C \leq$ 150 °C	20	A
Non Repetitive Peak Forward Current	I_{FM}	T_C = 25 °C, t_P = 10 µs	280	A
Surge Non Repetitive Forward Current	$I_{F,SM}$	t_P = 10 ms, half sine, T_C = 25 °C	65	A

Thermal Characteristics

Thermal resistance, junction - case	R_{thJC}	SiC Junction Transistor	0.51	°C/W
Thermal resistance, junction - case	R_{thJC}	SiC Diode	0.82	°C/W

Electrical Characteristics at T_j = 175 °C, unless otherwise specified

Parameter	Symbol	Conditions	Values min.	Values typ.	Values max.	Unit
SJT On-State Characteristics						
Drain – Source On Voltage	$V_{DS(ON)}$	I_D = 20 A, I_G = 400 mA, T_j = 25 °C I_D = 20 A, I_G = 800 mA, T_j = 125 °C I_D = 20 A, I_G = 1600 mA, T_j = 175 °C		1.4 1.6 2.2		V
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 = 800 mA, T_j = 125 °C I_D = 20 A, I_G = 1600 mA, T_j = 175 °C		70 80 110		mΩ
Gate Forward Voltage	$V_{GS(FWD)}$	I_G = 500 mA, T_j = 25 °C I_G = 500 mA, T_j = 175 °C		3.3 3.1		V
DC Current Gain	β	V_{DS} = 5 V, I_D = 20 A, T_j = 25 °C V_{DS} = 5 V, I_D = 20 A, T_j = 175 °C		TBD TBD		
SJT Off-State Characteristics						
Drain Leakage Current	I_{DSS}	V_R = 1200 V, V_{GS} = 0 V, T_j = 25 °C V_R = 1200 V, V_{GS} = 0 V, T_j = 125 °C V_R = 1200 V, V_{GS} = 0 V, T_j = 175 °C		1.1 1.6 2.1		µA
Gate Leakage Current	I_{SG}	V_{SG} = 20 V, T_j = 25 °C		20		nA
SJT Capacitance Characteristics						
Gate-Source Capacitance	C_{gs}	V_{GS} = 0 V, f = 1 MHz		tbd		pF
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_D = 1 V, f = 1 MHz		tbd		pF
Reverse Transfer/Output Capacitance	C_{rss}/C_{oss}	V_D = 1 V, f = 1 MHz		tbd		pF
SJT Switching Characteristics						
Turn On Delay Time	$t_{d(on)}$	V_{DD} = 800 V, I_D = 20 A, $R_{G(on)}$ = $R_{G(off)}$ = tbd Ω, FWD = GB20SLT12, T_j = 25 ºC Refer to Figure 15 for gate current waveform		tbd		ns
Rise Time	t_r			tbd		ns
Turn Off Delay Time	$t_{d(off)}$			tbd		ns
Fall Time	t_f			tbd		ns
Turn-On Energy Per Pulse	E_{on}			tbd		µJ
Turn-Off Energy Per Pulse	E_{off}			tbd		µJ
Total Switching Energy	E_{ts}			tbd		µJ
Turn On Delay Time	$t_{d(on)}$	V_{DD} = 800 V, I_D = 20 A, $R_{G(on)}$ = $R_{G(off)}$ = tbd Ω, FWD = GB20SLT12, T_j = 175 ºC Refer to Figure 15 for gate current waveform		tbd		
Rise Time	t_r			tbd		ns
Turn Off Delay Time	$t_{d(off)}$			tbd		ns
Fall Time	t_f			tbd		ns
Turn-On Energy Per Pulse	E_{on}			tbd		µJ
Turn-Off Energy Per Pulse	E_{off}			tbd		µJ
Total Switching Energy	E_{ts}			tbd		µJ
Free-wheeling Silicon Carbide Schottky Diode						
Forward Voltage	V_F	I_F = 20 A, V_{GE} = 0 V, T_j = 25 ºC (175 ºC)		2.4		V
Diode Knee Voltage	$V_{D(knee)}$	T_j = 25 ºC, I_F = 1 mA		0.8		V
Peak Reverse Recovery Current	I_{rrm}	I_F = 20 A, V_{GE} = 0 V, V_R = 800 V, -dI_F/dt = 625 A/µs, T_j = 175 ºC		tbd		A
Reverse Recovery Time	t_{rr}			tbd		ns
Rise Time	t_r	V_{DD}= 800 V, I_D = 20 A, R_{gon} = R_{goff} = tbd Ω, , T_j= 25 ºC		tbd		ns
Fall Time	t_f			tbd		ns
Turn-On Energy Loss Per Pulse	E_{on}			tbd		µJ
Turn-Off Energy Loss Per Pulse	E_{off}			tbd		µJ
Reverse Recovery Charge	Q_{rr}			tbd		nC
Rise Time	t_r	V_{DD}= 800 V, I_D = 20 A, R_{gon} = R_{goff} = tbd Ω, T_j= 175 ºC		tbd		ns
Fall Time	t_f			tbd		ns
Turn-On Energy Loss Per Pulse	E_{on}			tbd		µJ
Turn-Off Energy Loss Per Pulse	E_{off}			tbd		µJ
Reverse Recovery Charge	Q_{rr}			tbd		nC

Figures

TBD

Figure 1: Typical Output Characteristics at 25 °C

TBD

Figure 2: Typical Output Characteristics at 125 °C

TBD

Figure 3: Typical Output Characteristics at 175 °C

TBD

Figure 4: Typical Gate Source I-V Characteristics vs. Temperature

TBD

Figure 5: Normalized On-Resistance and Current Gain vs. Temperature

TBD

Figure 6: Typical Blocking Characteristics

TBD

Figure 7: Capacitance Characteristics

TBD

Figure 8: Capacitance Characteristics

TBD

Figure 9: Typical Hard-switched Turn On Waveforms

TBD

Figure 10: Typical Hard-switched Turn Off Waveforms

TBD

Figure 11: Typical Turn On Energy Losses and Switching Times vs. Temperature

TBD

Figure 12: Typical Turn Off Energy Losses and Switching Times vs. Temperature

TBD

Figure 13: Typical Turn On Energy Losses vs. Drain Current

TBD

Figure 14: Typical Turn Off Energy Losses vs. Drain Current

TBD

Figure 15: Typical Gate Current Waveform

TBD

Figure 16: Typical Hard Switched Device Power Loss vs. Switching Frequency [1]

TBD

Figure 17: Power Derating Curve

TBD

Figure 18: Forward Bias Safe Operating Area

[1] – Representative values based on device switching energy loss. Actual losses will depend on gate drive conditions, device load, and circuit topology.

TBD

Figure 19: Turn-Off Safe Operating Area

TBD

Figure 20: Transient Thermal Impedance

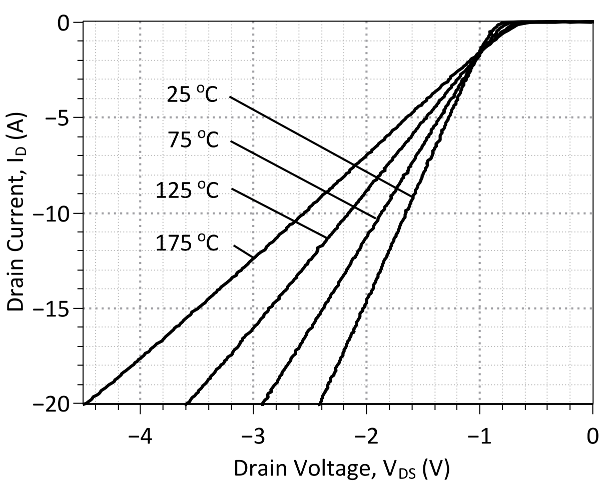


Figure 21: Typical FWD Forward Characteristics

Gate Drive Technique (Option #1)

To drive the GA20SICP12-263 with the lowest gate drive losses, please refer to the dual voltage source gate drive configuration described in Application Note AN-10B (http://www.genesicsemi.com/index.php/references/notes).

Gate Drive Technique (Option #2)

The GA20SICP12-263 can be effectively driven using the IXYS IXDN614 / IXDD614 non-inverting gate driver IC or a comparable product. A typical gate driver configuration along with component values using this driver is offered below. Additional information is available in GeneSiC Application Note AN-10A and from the manufacturer at www.ixys.com.

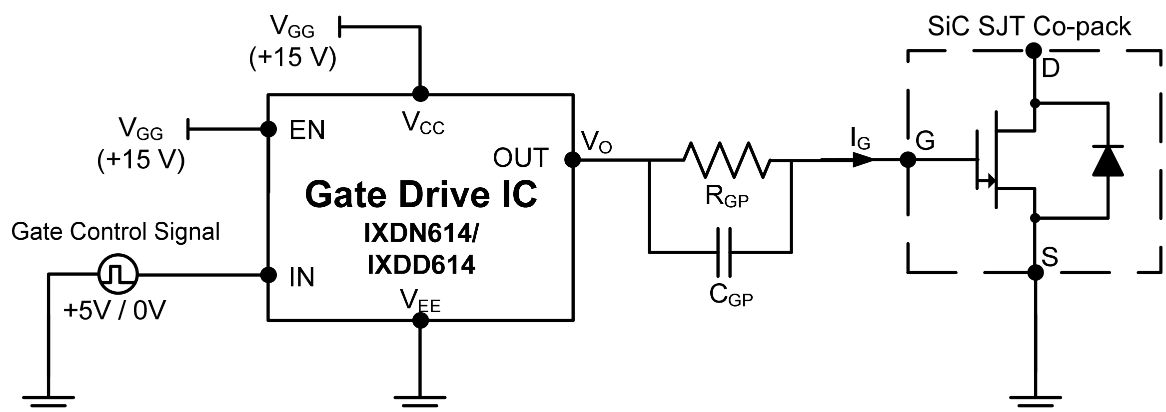
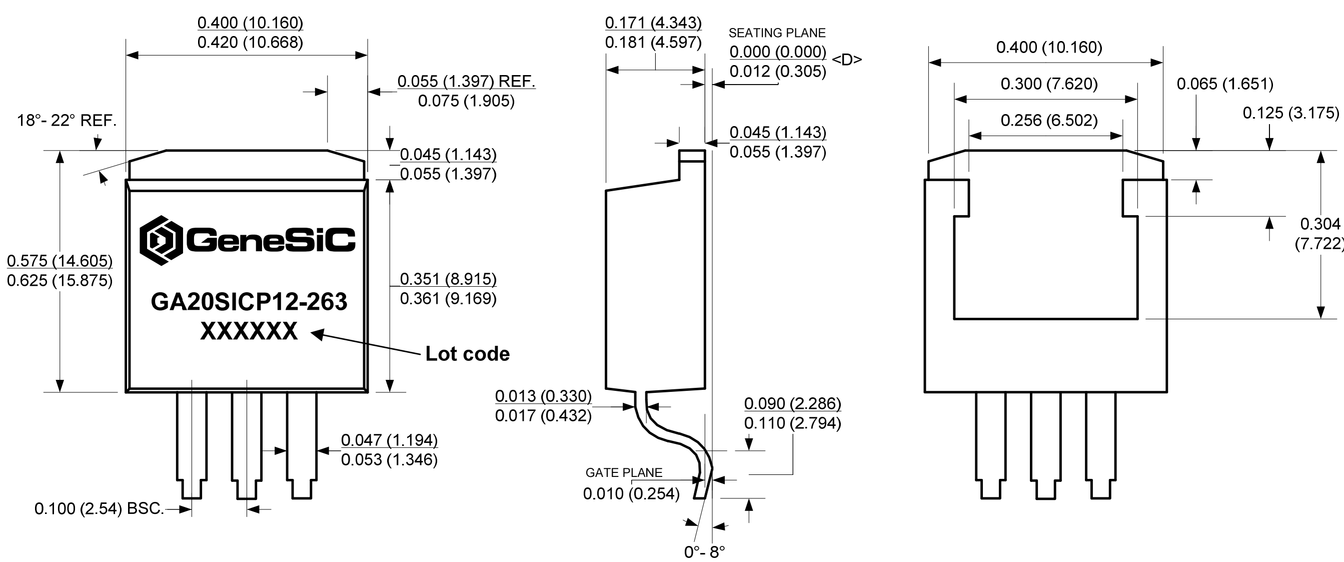


Figure 21: Recommended Gate Diver Configuration (Option #2)

Parameter	Symbol	Conditions	Values min.	Values typ.	Values max.	Unit
Option #2 Gate Drive Conditions (IXDD614/IXDN614)						
Supply Voltage	V_{CC}		-0.3	15	40	V
Gate Control Input Signal, Low	IN		-5.0	0	0.8	V
Gate Control Input Signal, High	IN		3.0	5.0	V_{CC}+0.3	V
Enable, Low	EN	IXDD614 Only			1/3*V_{CC}	V
Enable, High	EN	IXDD614 Only	2/3*V_{CC}			V
Output Voltage, Low	V_{OUT}				0.025	V
Output Voltage, High	V_{OUT}		V_{CC}-0.025			V
Output Current, Peak	I_{OUT}	Package Limited		tbd	14	A
Output Current, Continuous	I_{OUT}			tbd	4.0	A
Passive Gate Components						
Gate Resistance	R_{GP}	$I_G \approx 0.5$ A	5	tbd		Ω
Gate Capacitance	C_{GP}	$I_G \approx 0.5$ A		tbd		nF

Package Dimensions:

TO-263 **PACKAGE OUTLINE**



NOTE
1. CONTROLLED DIMENSION IS INCH. DIMENSION IN BRACKET IS MILLIMETER.
2. DIMENSIONS DO NOT INCLUDE END FLASH, MOLD FLASH, MATERIAL PROTRUSIONS

Revision History			
Date	Revision	Comments	Supersedes
2013/09/12	0	Initial release	

Published by
GeneSiC Semiconductor, Inc.
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Dulles, VA 20166

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SPICE Model Parameters

Copy the following code into a SPICE software program for simulation of the GA20SICP12-263 device.

```
*     MODEL OF GeneSiC Semiconductor Inc.
*
*     $Revision:   1.0          $
*     $Date:   20-SEP-2013       $
*
*     GeneSiC Semiconductor Inc.
*     43670 Trade Center Place Ste. 155
*     Dulles, VA 20166
*     http://www.genesicsemi.com/index.php/sic-products/copack
*
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*
* 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.
*
* Start of GA20SICP12-263 SPICE Model
*
.SUBCKT GA20SIPC12 DRAIN GATE SOURCE
Q1 DRAIN GATE SOURCE GA20SIPC12_Q
D1 SOURCE DRAIN GA20SIPC12_D1
D2 SOURCE DRAIN GA20SIPC12_D2
.model GA20SIPC12_Q NPN
+ IS       5.00E-47         ISE        1.26E-28         EG         3.2
+ BF       100              BR         0.55             IKF        700
+ NF       1                NE         2                RB         0.26
+ RC       0.055            CJC        6.98E-10         VJC        3
+ MJC      0.5              CJE        2.22E-09         VJE        3
+ MJE      0.5              XTI        3                XTB        -1.2
+ TRC1     7.00E-03         MFG        GeneSiC_Semi
.MODEL GA20SIPC12_D1 D
+ IS       4.55E-15         RS         0.0736           N          1
+ IKF      1000             EG         1.2              XTI        -2
+ TRS1     0.005434         TRS2       2.71739E-05      CJO        6.40E-10
+ VJ       0.469            M          1.508            FC         0.5
+ TT       1.00E-10
.MODEL GA20SIPC12_D2 D
+ IS       1.54E-22         RS         0.19             TRS1       -0.004
+ N        3.941            EG         3.23             IKF        19
+ XTI      0                FC         0.5              TT    0
.ENDS
*
* End of GA20SICP12-263 SPICE Model
```