

Silicon Carbide Junction Transistor/Schottky Diode Co-pack

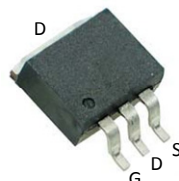
V_{DS}	=	1200 V
$V_{DS(ON)}$	=	1.4 V
I_D	=	20 A
$R_{DS(ON)}$	=	70 mΩ

Features

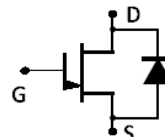
- 175 °C maximum operating temperature
- Temperature independent switching performance
- Gate oxide free SiC switch
- Integrated SiC Schottky Rectifier
- Positive temperature coefficient for easy paralleling
- Low intrinsic device capacitance
- Low gate charge

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 $T_J = 175\text{ °C}$, unless otherwise specified

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
SJT On-State Characteristics						
Drain – Source On Voltage	V _{DS(ON)}	I _D = 20 A, I _G = 400 mA, T _J = 25 °C		1.4		V
		I _D = 20 A, I _G = 800 mA, T _J = 125 °C		1.6		
		I _D = 20 A, I _G = 1600 mA, T _J = 175 °C		2.2		
Drain – Source On Resistance	R _{DS(ON)}	I _D = 20 A, I _G = 400 mA, T _J = 25 °C		70		mΩ
		I _D = 20 A, I _G = 800 mA, T _J = 125 °C		80		
		I _D = 20 A, I _G = 1600 mA, T _J = 175 °C		110		
Gate Forward Voltage	V _{GS(FWD)}	I _G = 500 mA, T _J = 25 °C		3.3		V
		I _G = 500 mA, T _J = 175 °C		3.1		
DC Current Gain	β	V _{DS} = 5 V, I _D = 20 A, T _J = 25 °C		TBD		
		V _{DS} = 5 V, I _D = 20 A, T _J = 175 °C		TBD		

SJT Off-State Characteristics

Drain Leakage Current	I_{DSS}	$V_R = 1200\text{ V}, V_{GS} = 0\text{ V}, T_j = 25^\circ\text{C}$ $V_R = 1200\text{ V}, V_{GS} = 0\text{ V}, T_j = 125^\circ\text{C}$ $V_R = 1200\text{ V}, V_{GS} = 0\text{ V}, T_j = 175^\circ\text{C}$		1.1 1.6 2.1		μA
Gate Leakage Current	I_{SG}	$V_{SG} = 20\text{ V}, T_j = 25^\circ\text{C}$		20		nA

SJT Capacitance Characteristics

Gate-Source Capacitance	C_{gs}	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		tbd		pF
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}, V_D = 1\text{ V}, f = 1\text{ MHz}$		tbd		pF
Reverse Transfer/Output Capacitance	C_{rss}/C_{oss}	$V_D = 1\text{ V}, f = 1\text{ MHz}$		tbd		pF

SJT Switching Characteristics

Turn On Delay Time	$t_{d(on)}$	$V_{DD} = 800\text{ V}, I_D = 20\text{ A},$ $R_{G(on)} = R_{G(off)} = \text{tbd } \Omega,$ $\text{FWD} = \text{GB20SLT12},$ $T_j = 25^\circ\text{C}$ 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}	$V_{DD} = 800\text{ V}, I_D = 20\text{ A},$ $R_{G(on)} = R_{G(off)} = \text{tbd } \Omega,$ $\text{FWD} = \text{GB20SLT12},$ $T_j = 175^\circ\text{C}$ Refer to Figure 15 for gate current waveform		tbd		μJ
Total Switching Energy	E_{ts}			tbd		μJ
Turn On Delay Time	$t_{d(on)}$			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	$I_F = 20\text{ A}, V_{GE} = 0\text{ V},$ $T_j = 25^\circ\text{C} (175^\circ\text{C})$		2.4		V
Diode Knee Voltage	$V_{D(knee)}$	$T_j = 25^\circ\text{C}, I_F = 1\text{ mA}$		0.8		V
Peak Reverse Recovery Current	I_{rrm}	$I_F = 20\text{ A}, V_{GE} = 0\text{ V}, V_R = 800\text{ V},$ $-di_F/dt = 625\text{ A}/\mu\text{s}, T_j = 175^\circ\text{C}$		tbd		A
Reverse Recovery Time	t_{rr}	$V_{DD} = 800\text{ V}, I_D = 20\text{ A},$ $R_{gon} = R_{goff} = \text{tbd } \Omega,$ $T_j = 25^\circ\text{C}$		tbd		ns
Rise Time	t_r			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}	$V_{DD} = 800\text{ V}, I_D = 20\text{ A},$ $R_{gon} = R_{goff} = \text{tbd } \Omega,$ $T_j = 175^\circ\text{C}$		tbd		nC
Rise Time	t_r			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 Frequency¹

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

TBD

Figure 19: Turn-Off Safe Operating Area

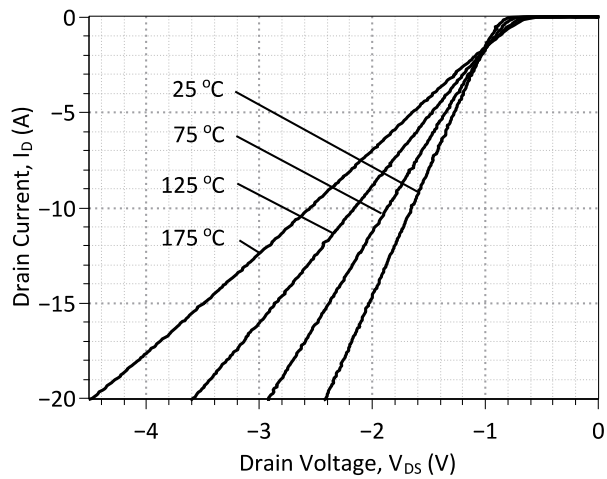


Figure 21: Typical FWD Forward Characteristics

Figure 20: Transient Thermal Impedance

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.

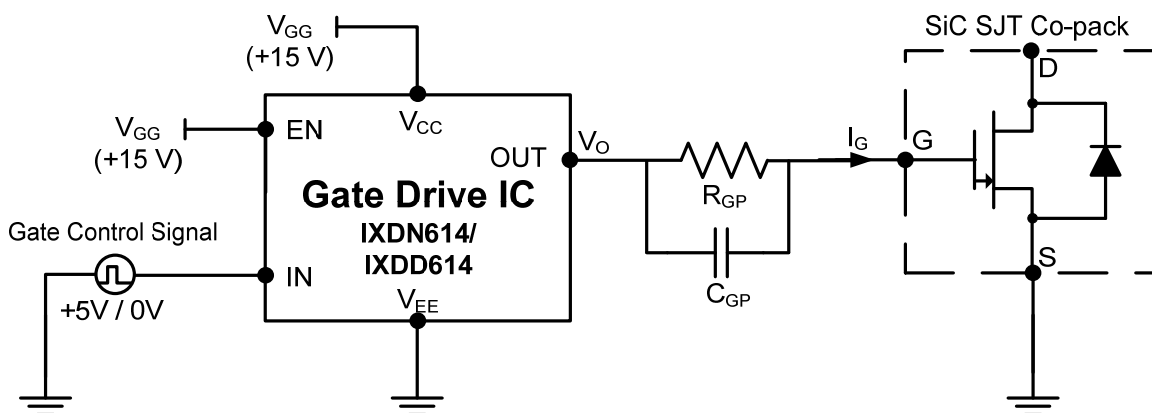
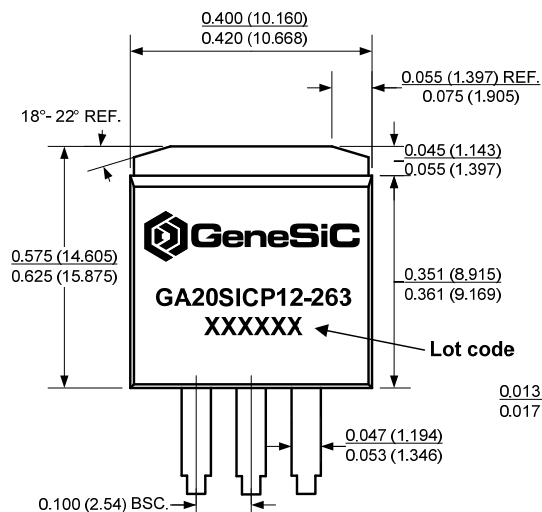
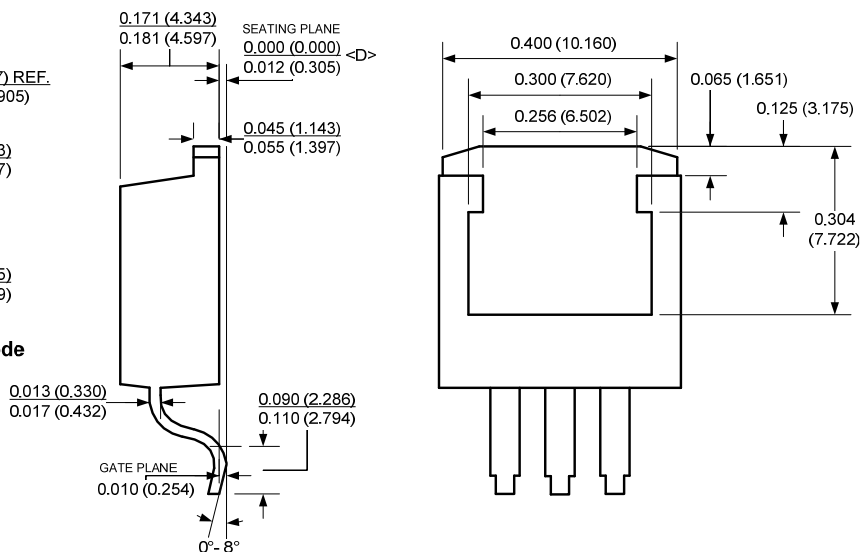


Figure 21: Recommended Gate Driver Configuration (Option #2)

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
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 ≈ 0.5 A	5	tbd		Ω
Gate Capacitance	C _{GP}	I _G ≈ 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	

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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
*
*      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.
*
*      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
```