GeneSiC SEMICONDUCTOR

GA100SICP12-227

Silicon Carbide Junction Transistor/Schottky Diode Co-pack

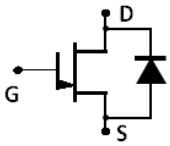
V_{DS}	=	1200 V
$V_{DS(ON)}$	=	1.4 V
I_D	=	100 A
$R_{DS(ON)}$	=	14 mΩ

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



SOT-227

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	100	A
Gate Peak Current	I_{GM}		10	A
Turn-Off Safe Operating Area	RBSOA	T_{VJ} = 175 °C, I_G = 2 A, Clamped Inductive Load	$I_{D,max}$ = 100 @ $V_{DS} \leq V_{DSmax}$	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	133	W
Storage Temperature	T_{stg}		-55 to 175	°C
Free-wheeling Silicon Carbide diode				
DC-Forward Current	I_F	$T_C \leq$ 150 °C	100	A
Non Repetitive Peak Forward Current	I_{FM}	T_C = 25 °C, t_P = 10 µs	3250	A
Surge Non Repetitive Forward Current	$I_{F,SM}$	t_P = 10 ms, half sine, T_C = 25 °C	700	A

Thermal Characteristics

Thermal resistance, junction - case	R_{thJC}	SiC Junction Transistor	0.60	°C/W
Thermal resistance, junction - case	R_{thJC}	SiC Diode	0.60	°C/W

Mechanical Properties

		Values			
		min.	typ.	max.	
Mounting Torque	M_d		1.5		Nm
Terminal Connection Torque		1.3		1.5	Nm
Weight			29		g
Case Color			Black		
Dimensions			38 x 25.4 x 12		mm

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 = 100 A, I_G = 1000 mA, T_j = 25 °C		1.4		V
		I_D = 100 A, I_G = 2000 mA, T_j = 125 °C		1.6		
		I_D = 100 A, I_G = 4000 mA, T_j = 175 °C		2.2		
Drain – Source On Resistance	$R_{DS(ON)}$	I_D = 100 A, I_G = 1000 mA, T_j = 25 °C		14		mΩ
		I_D = 100 A, I_G = 2000 mA, T_j = 125 °C		16		
		I_D = 100 A, I_G = 4000 mA, T_j = 175 °C		22		
Gate Forward Voltage	$V_{GS(FWD)}$	I_G = 1000 mA, T_j = 25 °C		3.3		V
		I_G = 1000 mA, T_j = 175 °C		3.1		
DC Current Gain	β	V_{DS} = 5 V, I_D = 100 A, T_j = 25 °C		TBD		
		V_{DS} = 5 V, I_D = 100 A, T_j = 175 °C		TBD		
SJT Off-State Characteristics						
Drain Leakage Current	I_{DSS}	V_R = 1200 V, V_{GS} = 0 V, T_j = 25 °C		100		μA
		V_R = 1200 V, V_{GS} = 0 V, T_j = 125 °C		150		
		V_R = 1200 V, V_{GS} = 0 V, T_j = 175 °C		200		
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 = 100 A, $R_{G(on)}$ = $R_{G(off)}$ = tbd Ω, FWD = GB100SLT12, 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 = 100 A, $R_{G(on)}$ = $R_{G(off)}$ = tbd Ω, FWD = GB100SLT12, 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 = 100 A, V_{GE} = 0 V, T_j = 25 ºC (175 ºC)		1.5		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 = 100 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 = 100 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 = 100 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

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 Gate Source I-V Characteristics vs. Temperature

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

Figure 6: Typical Blocking Characteristics

Figure 7: Capacitance Characteristics

Figure 8: Capacitance Characteristics

Figure 9: Typical Hard-switched Turn On Waveforms

Figure 10: Typical Hard-switched Turn Off Waveforms

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

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

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

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

Figure 15: Typical Gate Current Waveform

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

Figure 17: Power Derating Curve

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.

Figure 19: Turn-Off Safe Operating Area

Figure 20: Transient Thermal Impedance

Figure 21: Typical FWD Forward Characteristics

Gate Drive Technique (Option #1)

To drive the GA100SICP12-227 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 GA100SICP12-227 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.

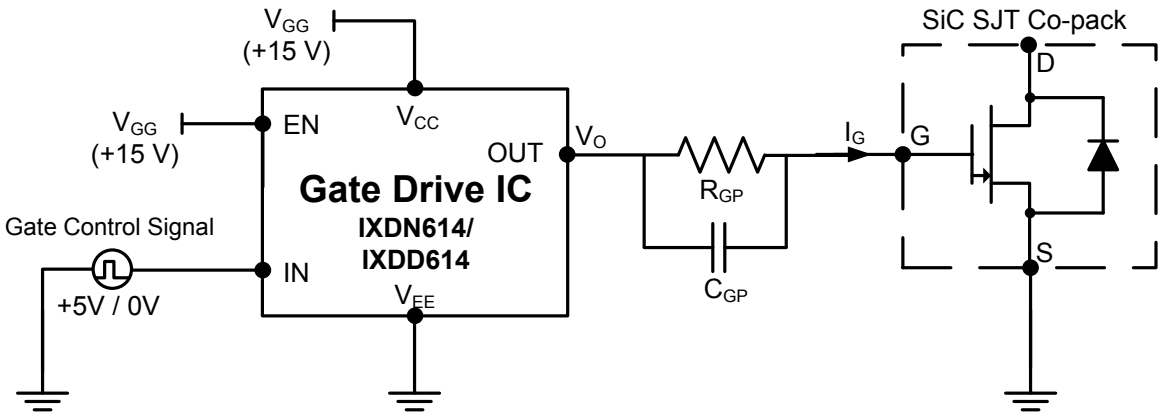
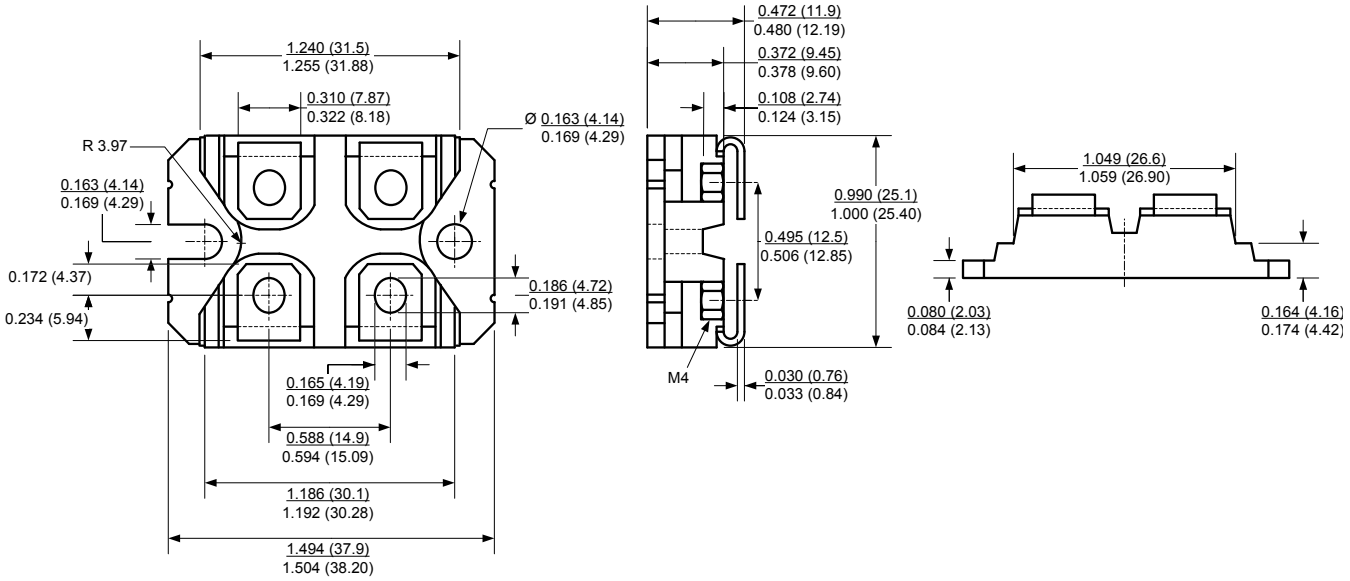


Figure 21: Recommended Gate Diver Configuration (Option #2)

Parameter	Symbol	Conditions	Values			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}	$I_G \approx 0.5$ A	5	tbd		Ω
Gate Capacitance	C_{GP}	$I_G \approx 0.5$ A		tbd		nF

Package Dimensions:

SOT-227 **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 GA100SICP12-227 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 GA100SICP12-227 SPICE Model
.SUBCKT GA100SIPC12 DRAIN GATE SOURCE
Q1 DRAIN GATE SOURCE GA100SIPC12_Q
D1 SOURCE DRAIN GA100SIPC12_D1
D2 SOURCE DRAIN GA100SIPC12_D2
Q2 DRAIN GATE SOURCE GA100SIPC12_Q
D3 SOURCE DRAIN GA100SIPC12_D1
D4 SOURCE DRAIN GA100SIPC12_D2
.model GA100SIPC12_Q NPN
+ IS       5.00E-47        ISE        1.26E-28        EG         3.2
+ BF       100             BR         0.55            IKF        3500
+ NF       1               NE         2               RB         0.26
+ RE       0.01            RC         0.011           CJC        1.75E-09
+ VJC      3               MJC        0.5             CJE        5.57E-09
+ VJE      3               MJE        0.5             XTI        3
+ XTB      -1.2            TRC1       7.00E-03        MFG   GeneSiC_Semi
.MODEL GA100SIPC12_D1 D
+ IS       1.99E-16        RS         0.015652965     N          1
+ IKF      1000            EG         1.2             XTI        3
+ TRS1     0.0042          TRS2       1.3E-05         CJO        3.86E-09
+ VJ       1.362328465     M          0.48198551      FC         0.5
+ TT       1.00E-10        IAVE       50
.MODEL GA100SIPC12_D2 D
+ IS       1.54E-19        RS         0.1             N          3.941
+ EG       3.23            TRS1       -0.004          IKF        19
+ XTI      0               FC         0.5             TT         0
.ENDS
* End of GA100SICP12-227 SPICE Model
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