Normally – OFF Silicon Carbide Junction Transistor

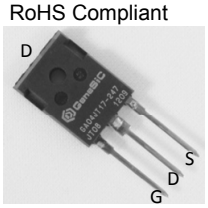
V_{DS}	=	1700 V
$V_{DS(ON)}$	=	2.0 V
I_D	=	4 A
$R_{DS(ON)}$	=	500 mΩ

Features

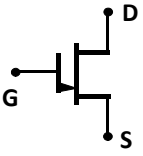
- 175 °C maximum operating temperature
- Temperature independent switching performance
- Gate oxide free SiC switch
- Suitable for connecting an anti-parallel diode
- Positive temperature coefficient for easy paralleling
- Low gate charge
- Low intrinsic capacitance

Package

- RoHS Compliant



TO-247AB



Advantages

- Low switching losses
- Higher efficiency
- High temperature operation
- High short circuit withstand capability

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 unless otherwise specified

Parameter	Symbol	Conditions	Values	Unit
Drain – Source Voltage	V_{DS}	V_{GS} = 0 V	1700	V
Continuous Drain Current	I_D	$T_{C,MAX}$ = 95 °C	4	A
Gate Peak Current	I_{GM}		5	A
Turn-Off Safe Operating Area	RBSOA	T_{VJ} = 175 °C, I_G = 1 A, Clamped Inductive Load	$I_{D,max}$ = 4 @ $V_{DS} \leq V_{DSmax}$	A
Short Circuit Safe Operating Area	SCSOA	T_{VJ} = 175 °C, I_G = 1 A, V_{DS} = 1200 V, Non Repetitive	20	µs
Reverse Gate – Source Voltage	V_{SG}		30	V
Reverse Drain – Source Voltage	V_{SD}		50	V
Power Dissipation	P_{tot}	T_C = 25 °C	91	W
Storage Temperature	T_{stg}		-55 to 175	°C

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

Parameter	Symbol	Conditions	Values min.	Values typ.	Values max.	Unit
On Characteristics						
Drain – Source On Voltage	$V_{DS(ON)}$	I_D = 4 A, I_G = 250 mA, T_j = 25 °C		2.0		V
		I_D = 4 A, I_G = 500 mA, T_j = 125 °C		3.3		
		I_D = 4 A, I_G = 500 mA, T_j = 175 °C		4.5		
Drain – Source On Resistance	$R_{DS(ON)}$	I_D = 4 A, I_G = 250 mA, T_j = 25 °C		500		mΩ
		I_D = 4 A, I_G = 500 mA, T_j = 125 °C		800		
		I_D = 4 A, I_G = 500 mA, T_j = 175 °C		1100		
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		3.2		
DC Current Gain	β	V_{DS} = 5 V, I_D = 4 A, T_j = 25 °C		60		
		V_{DS} = 5 V, I_D = 4 A, T_j = 175 °C		35		
Off Characteristics						
Drain Leakage Current	I_{DSS}	V_R = 1700 V, V_{GS} = 0 V, T_j = 25 °C		0.5		µA
		V_R = 1700 V, V_{GS} = 0 V, T_j = 125 °C		1.0		
		V_R = 1700 V, V_{GS} = 0 V, T_j = 175 °C		2.0		
Gate Leakage Current	I_{SG}	V_{SG} = 20 V, T_j = 25 °C		20		nA

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

Parameter	Symbol	Conditions	Values min.	Values typ.	Values max.	Unit
Capacitance Characteristics						
Gate-Source Capacitance	C_{gs}	V_{GS} = 0 V, f = 1 MHz		340		pF
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_D = 1 V, f = 1 MHz		460		pF
Reverse Transfer/Output Capacitance	C_{rss}/C_{oss}	V_D = 1 V, f = 1 MHz		120		pF
Switching Characteristics						
Turn On Delay Time	$t_{d(on)}$	T_j = 25 ºC "Option 2" Gate Driven V_{DD} = 1100 V, I_D = 4 A, $R_{G(on)} = R_{G(off)}$ = 22 Ω, V_{GS} = -8/15 V, L = 1.1 mH, FWD = GB05SLT12, Refer to Figure 15 for gate current waveform		35		ns
Rise Time	t_r			28		ns
Turn Off Delay Time	$t_{d(off)}$			60		ns
Fall Time	t_f			50		ns
Turn-On Energy Per Pulse	E_{on}			323		µJ
Turn-Off Energy Per Pulse	E_{off}			60		µJ
Total Switching Energy	E_{ts}			383		µJ
Turn On Delay Time	$t_{d(on)}$	T_j = 175 ºC "Option 2" Gate Driven V_{DD} = 1100 V, I_D = 4 A, $R_{G(on)} = R_{G(off)}$ = 22 Ω, V_{GS} = -8/15 V, L = 1.1 mH, FWD = GB05SLT12, Refer to Figure 15 for gate current waveform		30		ns
Rise Time	t_r			14		ns
Turn Off Delay Time	$t_{d(off)}$			73		ns
Fall Time	t_f			58		ns
Turn-On Energy Per Pulse	E_{on}			172		µJ
Turn-Off Energy Per Pulse	E_{off}			73		µJ
Total Switching Energy	E_{ts}			245		µJ
Thermal Characteristics						
Thermal resistance, junction - case	R_{thJC}			1.64		°C/W

Figures

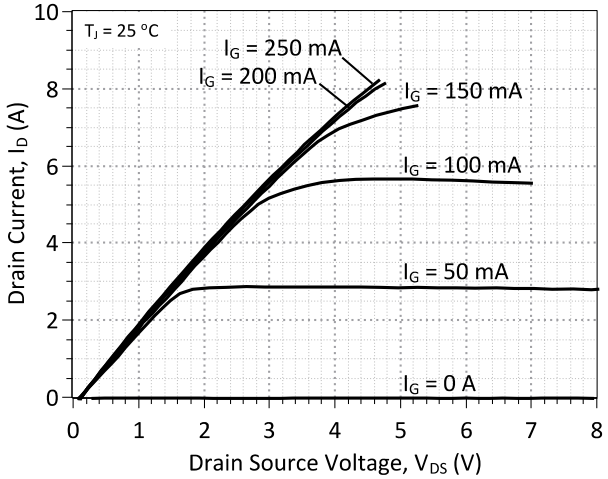


Figure 1: Typical Output Characteristics at 25 °C

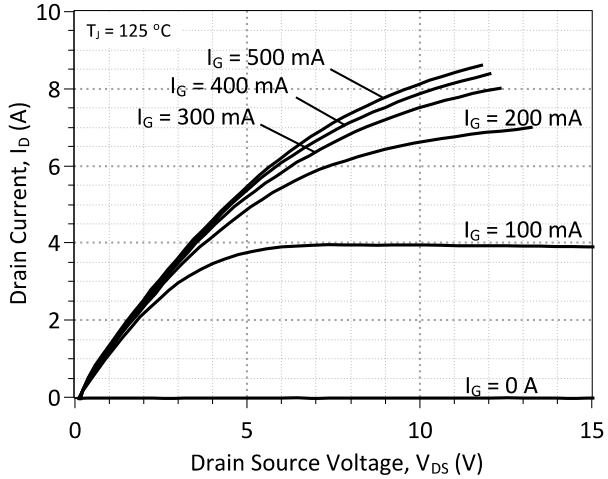


Figure 2: Typical Output Characteristics at 125 °C

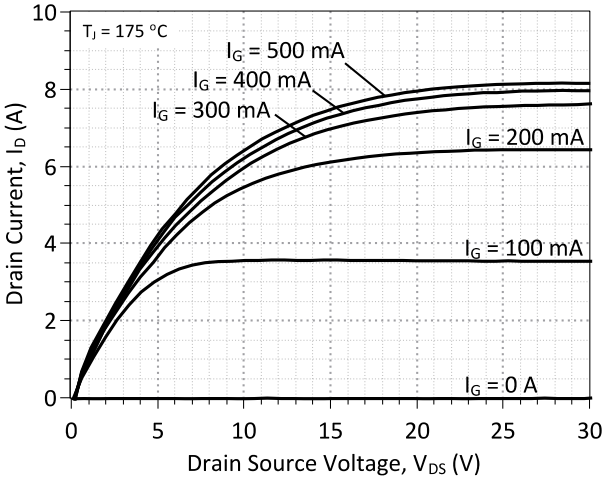


Figure 3: Typical Output Characteristics at 175 °C

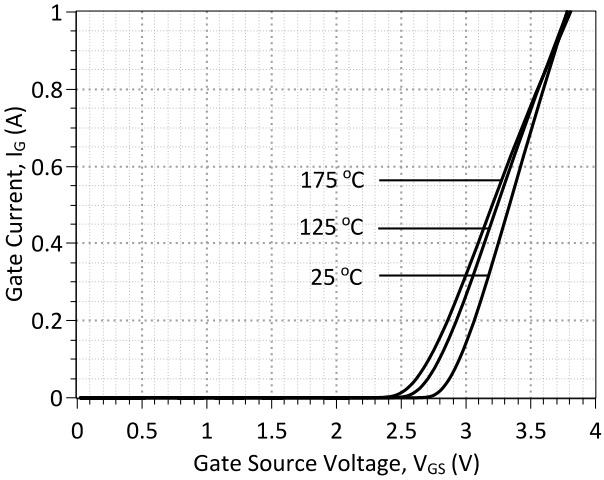


Figure 4: Typical Gate Source I-V Characteristics vs. Temperature

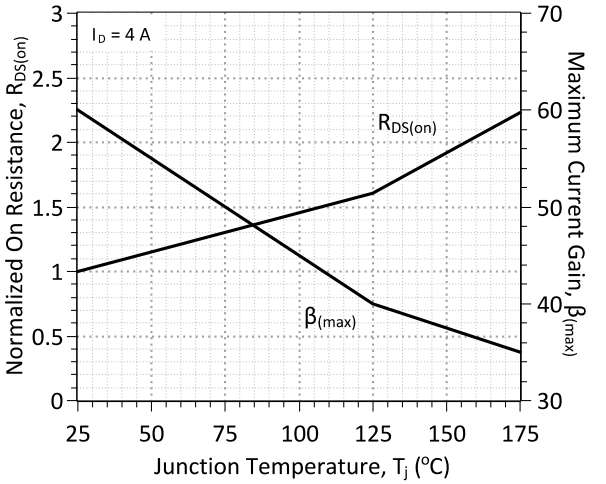


Figure 5: Normalized On-Resistance and Current Gain vs. Temperature

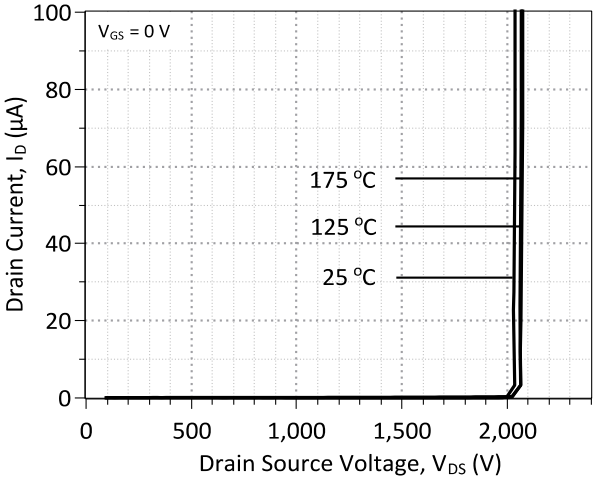


Figure 6: Typical Blocking Characteristics

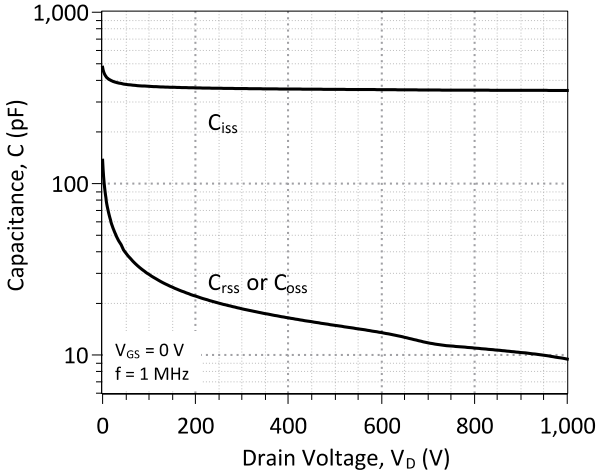


Figure 7: Capacitance Characteristics

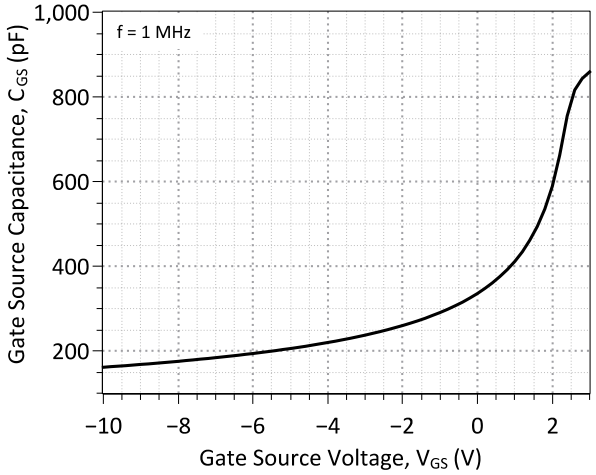


Figure 8: Capacitance Characteristics

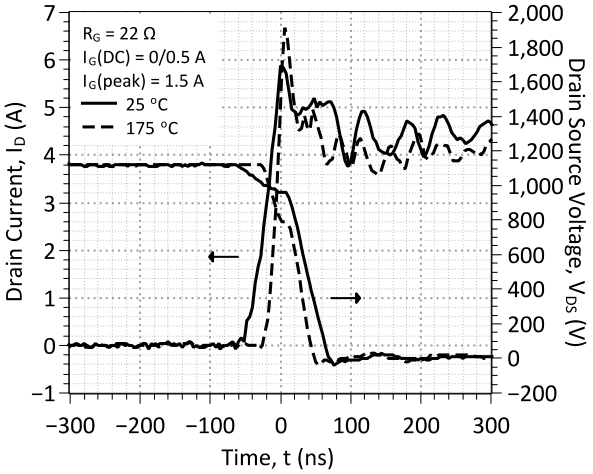


Figure 9: Typical Hard-switched Turn On Waveforms

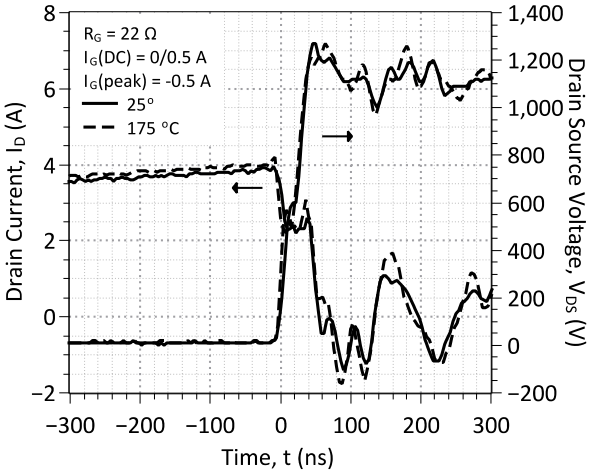


Figure 10: Typical Hard-switched Turn Off Waveforms

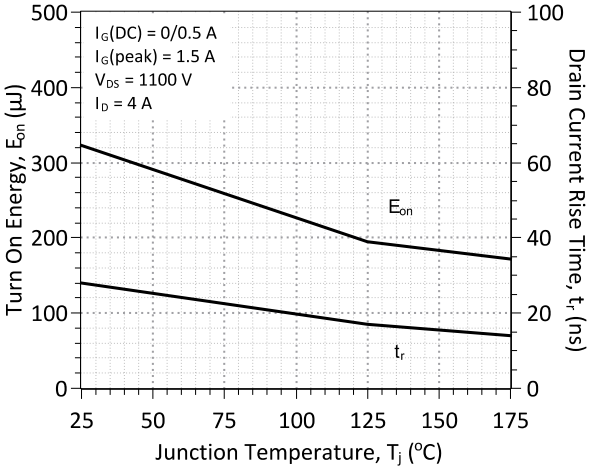


Figure 11: Typical Turn On Energy Losses and Switching Times vs. Temperature

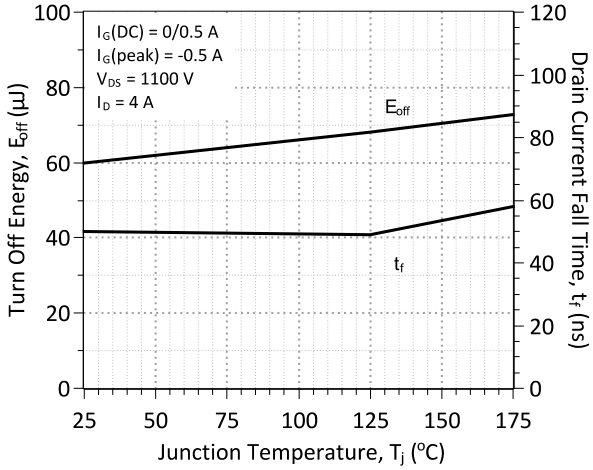


Figure 12: Typical Turn Off Energy Losses and Switching Times vs. Temperature

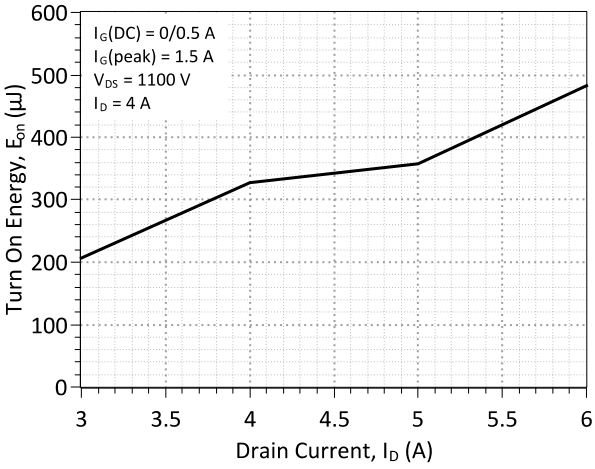


Figure 13: Typical Turn On Energy Losses vs. Drain Current

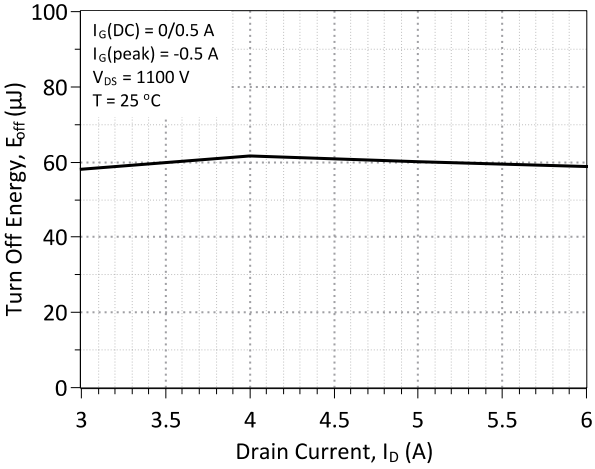


Figure 14: Typical Turn Off Energy Losses vs. Drain Current

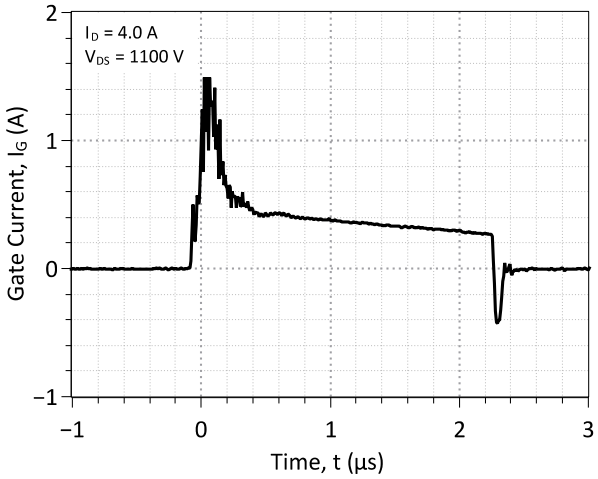


Figure 15: Typical Gate Current Waveform

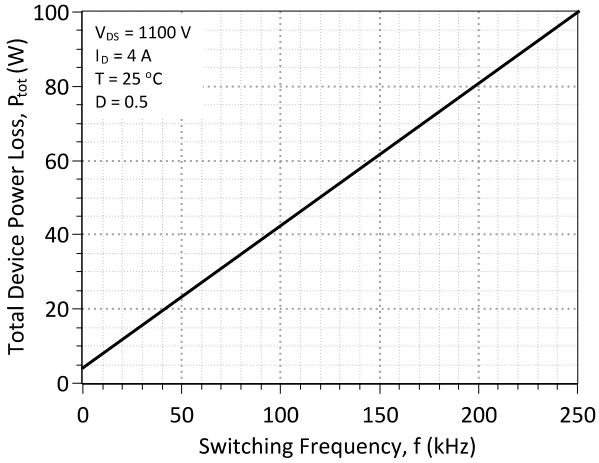


Figure 16: Typical Hard Switched Device Power Loss vs. Switching Frequency [1]

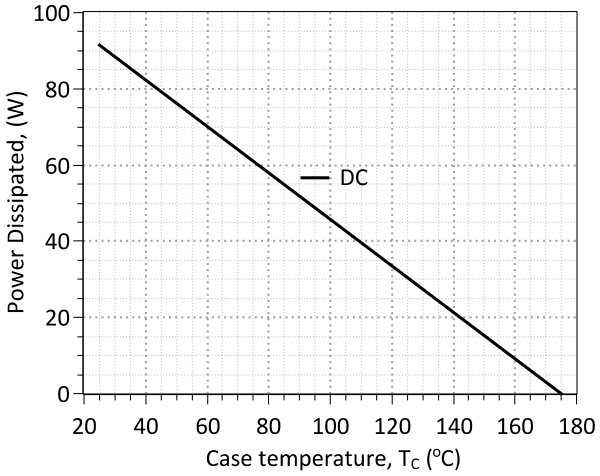


Figure 17: Power Derating Curve

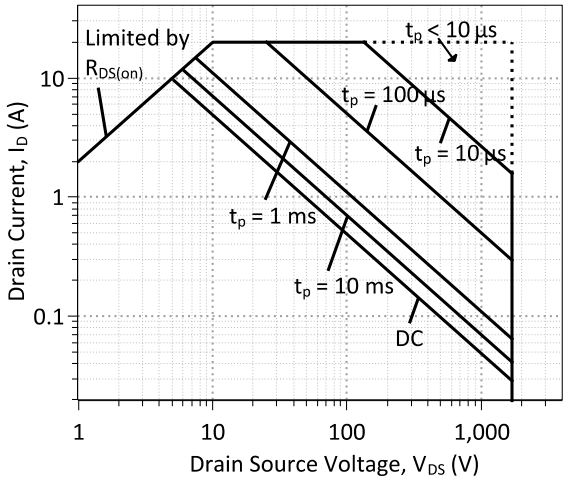


Figure 18: Forward Bias Safe Operating Area

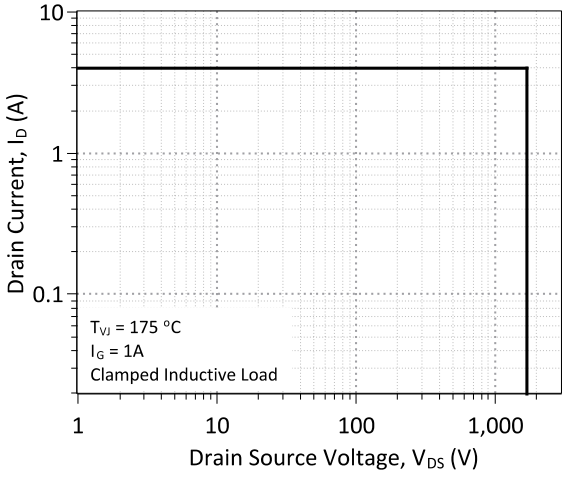


Figure 19: Turn-Off Safe Operating Area

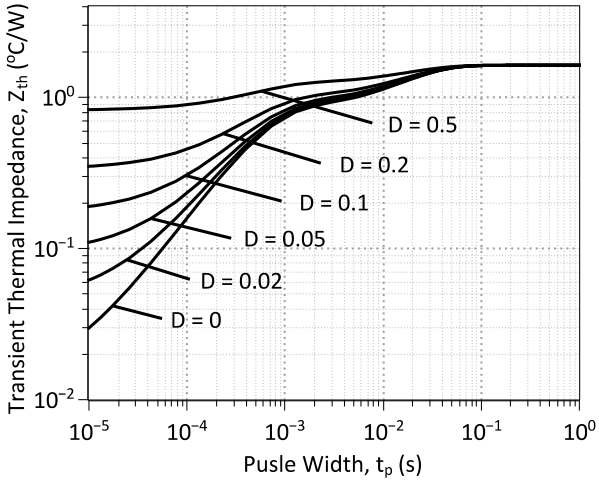


Figure 20: Transient Thermal Impedance

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

Gate Drive Technique (Option #1)

To drive the GA04JT17-247 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 GA04JT17-247 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.

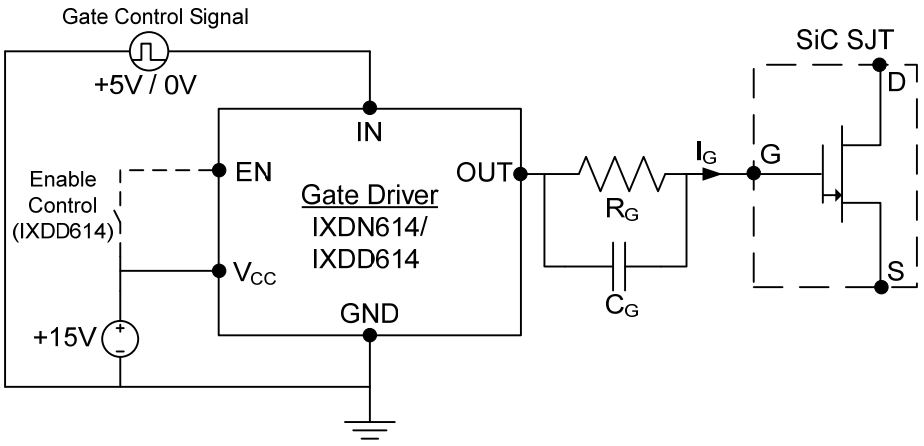
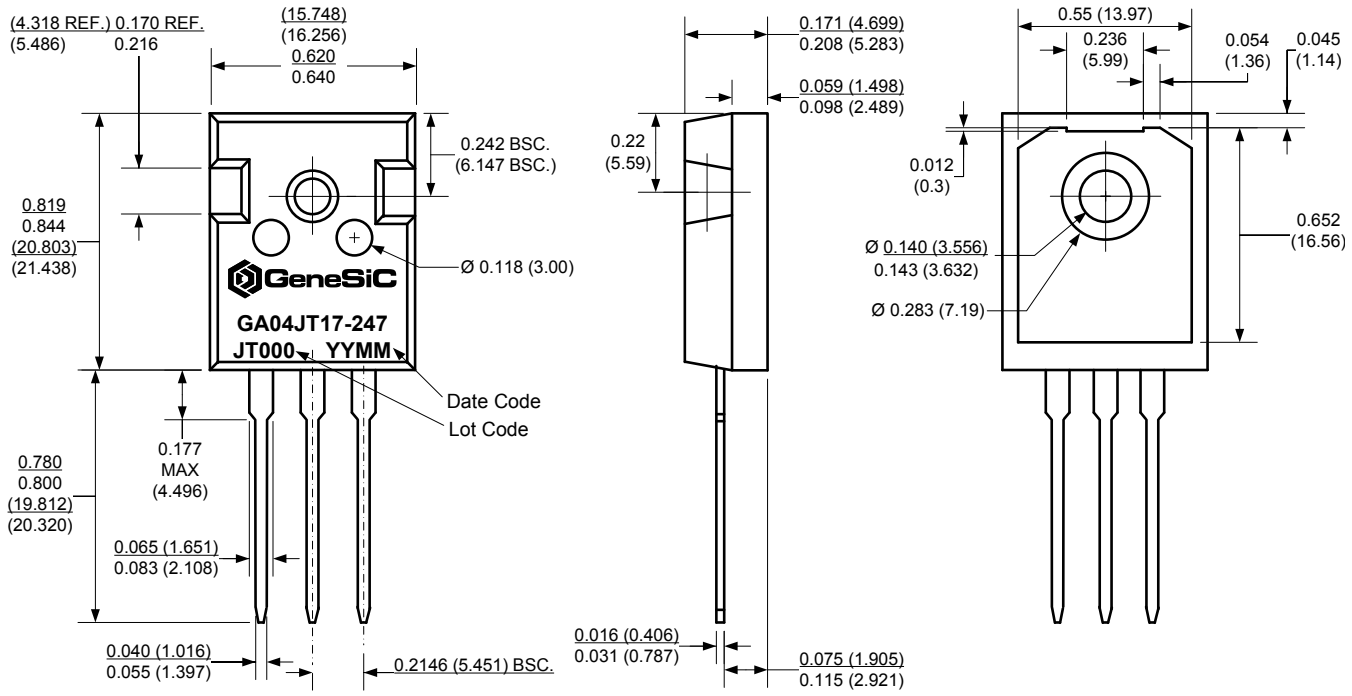


Figure 21: Recommended Gate Diver Configuration (Option #2)

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		4.5	14	A
Output Current, Continuous	I_{OUT}			0.5	4.0	A
Passive Gate Components						
Gate Resistance	R_G	$I_G \approx 0.5$ A	5	22		Ω
Gate Capacitance	C_G	$I_G \approx 0.5$ A		9		nF

Package Dimensions:

TO-247AB **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
2013/06/24	2	Updated Electrical Characteristics	
2013/02/21	1	Revised electrical characteristics	
2012/12/03	0	Initial release	

Published by
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43670 Trade Center Place Suite 155
Dulles, VA 20166

SPICE Model Parameters

Copy the following code into a SPICE software program for simulation of the GA04JT17 SJT device.

```
*     MODEL OF GeneSiC Semiconductor Inc.
*
*     $Revision:   1.0           $
*     $Date:   26-AUG-2013       $
*
*     GeneSiC Semiconductor Inc.
*     43670 Trade Center Place Ste. 155
*     Dulles, VA 20166
*     http://www.genesicsemi.com/index.php/sic-products/sjt
*
*     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 GA04JT17 NPN
+ IS       1.22E-47
+ ISE      3.91E-27
+ EG       3.2
+ BF       58
+ BR       0.55
+ IKF      200
+ NF       1
+ NE       2.022
+ RB       0.26
+ RE       0.131970371
+ RC       0.358
+ CJC      1.37E-10
+ VJC      3.173990516
+ MJC      0.436428533
+ CJE      3.36E-10
+ VJE      2.944816511
+ MJE      0.493905327
+ XTI      3
+ XTB      -1.16
+ TRC1     8.00E-3
+ VCEO     1700
+ ICRATING 4
+ MFG      GeneSiC_Semiconductor
*
* End of GA04JT17 SPICE Model
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