

Normally – OFF Silicon Carbide Super Junction Transistor

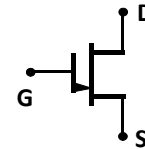
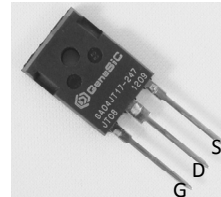
V_{DS}	=	1700 V
$V_{DS(ON)}$	=	2.0 V
I_D	=	4 A
$R_{DS(ON)}$	=	500 mΩ

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	$T_{C,MAX} = 95 ^\circ C$	4	A
Gate Peak Current	I_{GM}		5	A
Reverse Gate – Source Voltage	V_{SG}		60	V
Reverse Drain – Source Voltage	V_{SD}		50	V
Power Dissipation	P_{tot}	$T_C = 25 ^\circ C$	91	W
Storage Temperature	T_{stg}		-55 to 175	$^\circ C$

Electrical Characteristics at $T_j = 175 ^\circ C$, unless otherwise specified

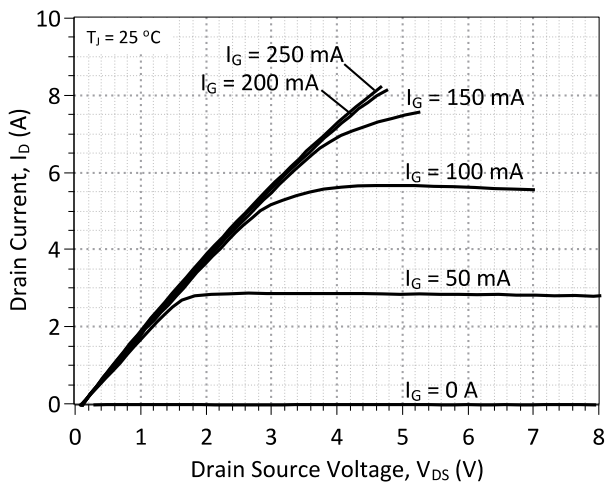
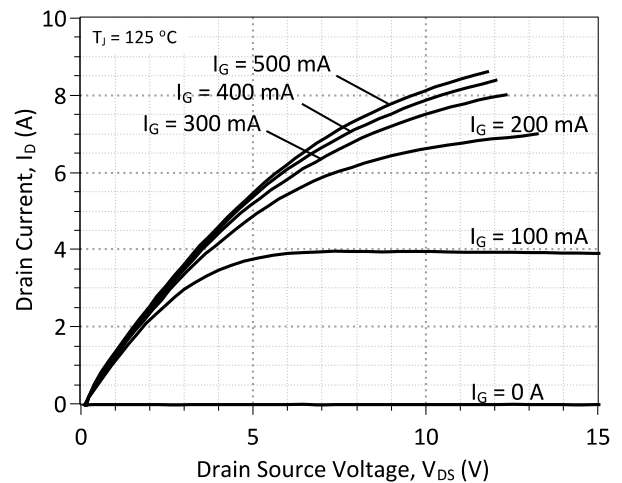
Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
On Characteristics						
Drain – Source On Voltage	$V_{DS(ON)}$	$I_D = 4 A, I_G = 250 mA, T_j = 25 ^\circ C$	2.0			V
		$I_D = 4 A, I_G = 500 mA, T_j = 125 ^\circ C$	3.3			
		$I_D = 4 A, I_G = 500 mA, T_j = 175 ^\circ C$	4.5			
Drain – Source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

Electrical Characteristics at $T_j = 175\text{ }^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit	
			min.	typ.	max.		
Switching Characteristics							
Turn On Delay Time	$t_{d(on)}$	$V_{DD} = 1100\text{ V}$, $I_D = 4\text{ A}$, $R_{G(on)} = R_{G(off)} = 44\ \Omega$, $V_{GS} = -8/15\text{ V}$, $L = 1.1\text{ mH}$, FWD = GB05SLT12, $T_j = 25\text{ }^\circ\text{C}$		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}		Refer to Figure 11 for gate current waveform		323		μJ
Turn-Off Energy Per Pulse	E_{off}				60		μJ
Total Switching Energy	E_{ts}				383		μJ
Turn On Delay Time	$t_{d(on)}$				30		ns
Rise Time	t_r				14		ns
Turn Off Delay Time	$t_{d(off)}$		$V_{DD} = 1100\text{ V}$, $I_D = 4\text{ A}$, $R_{G(on)} = R_{G(off)} = 44\ \Omega$, $V_{GS} = -8/15\text{ V}$, $L = 1.1\text{ mH}$, FWD = GB05SLT12, $T_j = 175\text{ }^\circ\text{C}$		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	$^\circ\text{C/W}$
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Figure 1: Typical Output Characteristics at $25\text{ }^\circ\text{C}$

Figure 2: Typical Output Characteristics at $125\text{ }^\circ\text{C}$

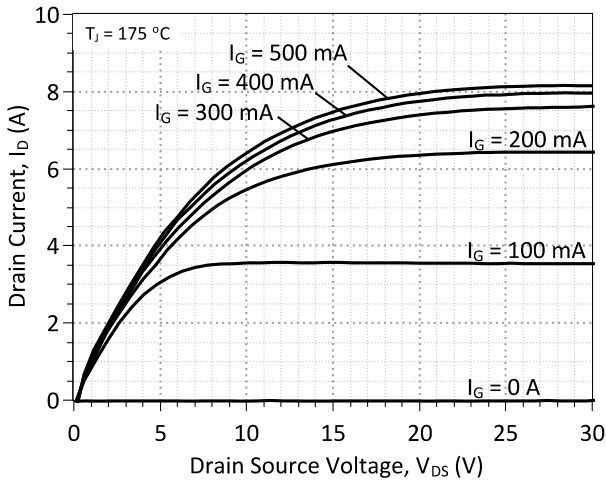


Figure 3: Typical Output Characteristics at 175 °C

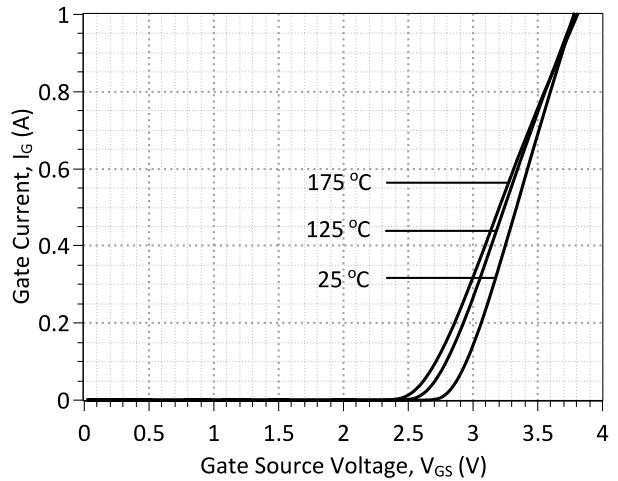


Figure 4: Typical Gate Source I-V Characteristics vs. Temperature

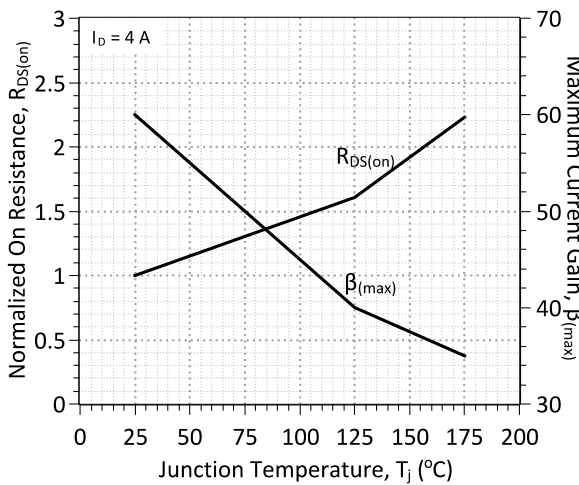


Figure 5: Normalized On-Resistance and Current Gain vs. Temperature

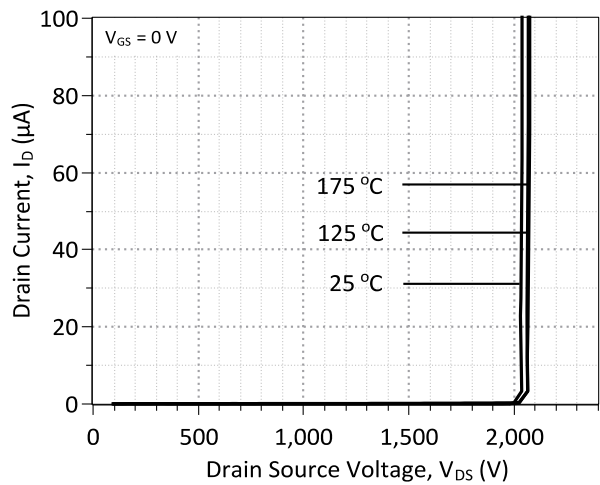


Figure 6: Typical Blocking Characteristics

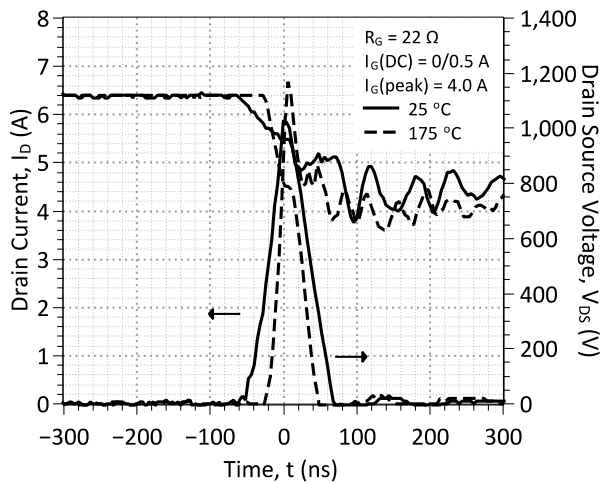


Figure 7: Typical Hard-switched Turn On Waveforms

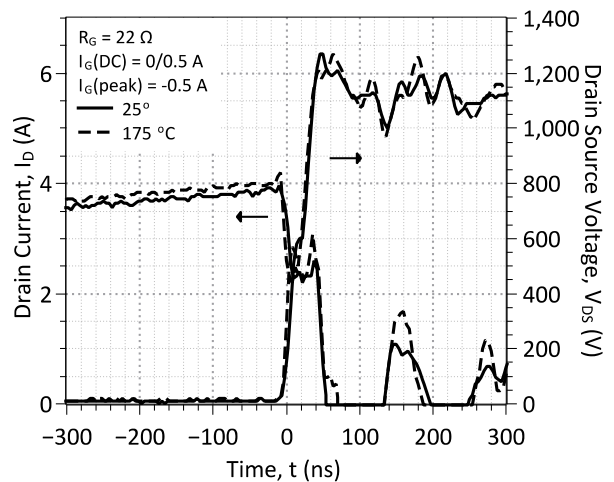


Figure 8: Typical Hard-switched Turn Off Waveforms

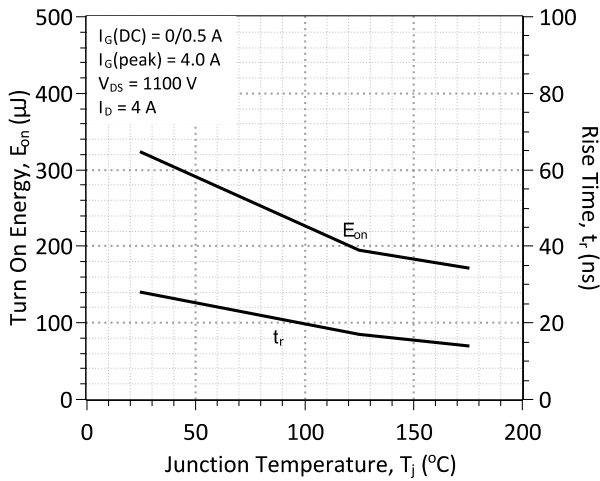


Figure 9: Typical Turn On Energy Losses and Switching Times vs. Temperature

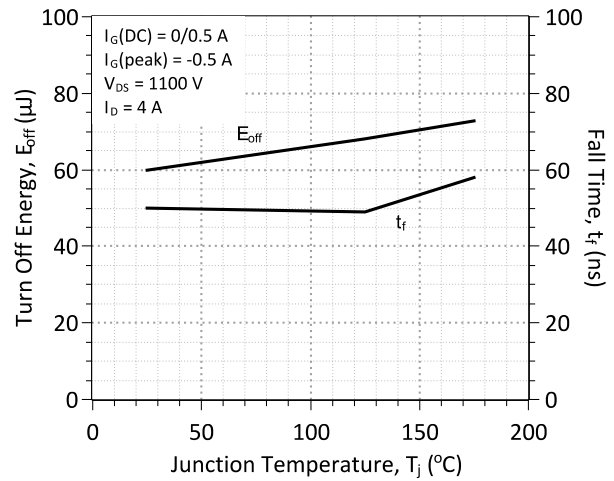


Figure 10: Typical Turn Off Energy Losses and Switching Times vs. Temperature

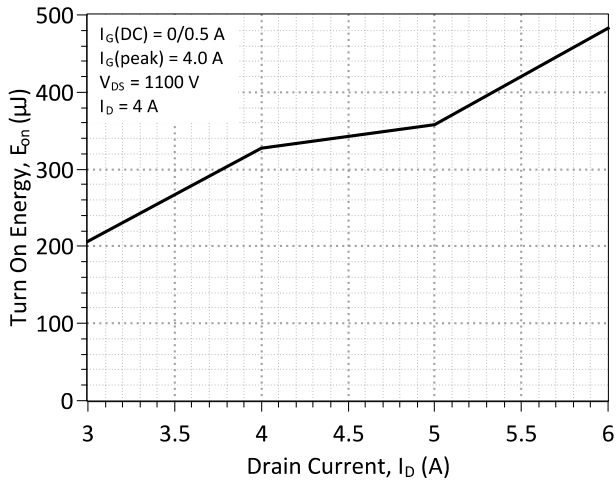


Figure 11: Typical Turn On Energy Losses vs. Drain Current

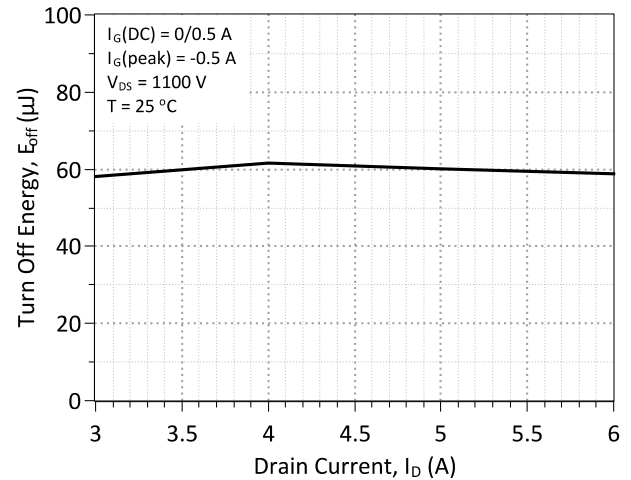


Figure 12: Typical Turn Off Energy Losses vs. Drain Current

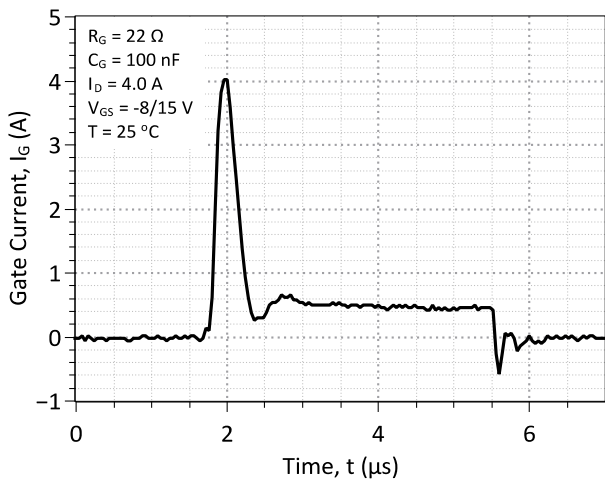


Figure 13: Typical Gate Current Waveform

Gate Drive Technique (Option #1)

To drive the GA04JT17-247 with the lowest gate drive losses, a custom-designed, dual voltage source gate drive configuration is recommended [for example, see Figure 5(a) in J. Rabkowski et al. IEEE Trans. Power Electronics 27(5), 2633-2642 (2012)]. More details on using this optimized gate drive technique will be made available shortly. An effective simple alternative for ultra-fast switching of the GA04JT17-247 is available below.

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 from the manufacturer at www.ixys.com.

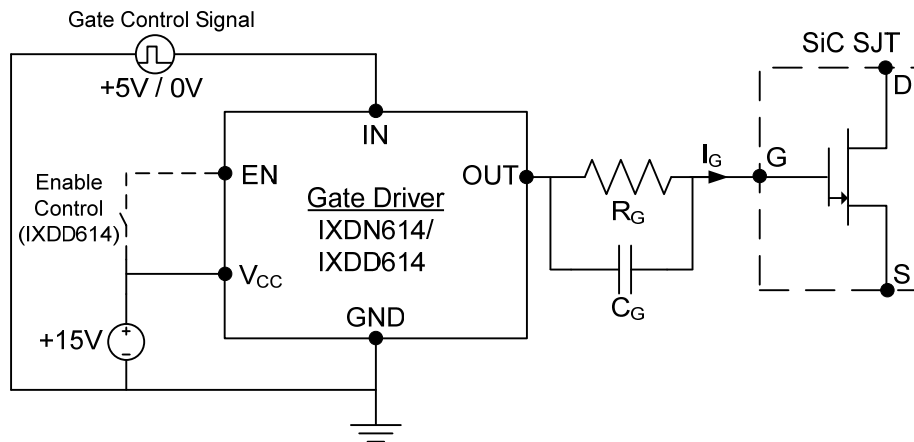


Figure 14: Recommended Gate Diver Configuration (Option #2)

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Gate Driver Pins (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			$1/3 \cdot V_{CC}$	V
Enable, High	EN	IXDD614 Only	$2/3 \cdot V_{CC}$			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		100		nF

