

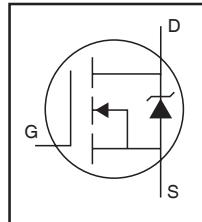
AUTOMOTIVE GRADE

**AUIRF2907Z**

HEXFET® Power MOSFET

**Features**

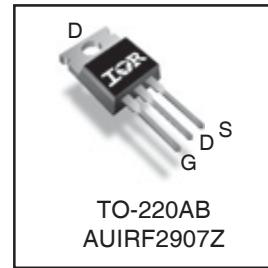
- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to  $T_{jmax}$
- Lead-Free, RoHS Compliant
- Automotive Qualified \*



<b><math>V_{(BR)DSS}</math></b>	<b>75V</b>
<b><math>R_{DS(on)}</math> max.</b>	<b>4.5mΩ</b>
<b><math>I_D</math> (Silicon Limited)</b>	<b>170A</b>
<b><math>I_D</math> (Package Limited)</b>	<b>75A</b>

**Description**

Specifically designed for Automotive applications, this HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These features combine to make this design an extremely efficient and reliable device for use in Automotive applications and a wide variety of other applications.



<b>G</b>	<b>D</b>	<b>S</b>
Gate	Drain	Source

**Absolute Maximum Ratings**

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the specifications is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature ( $T_A$ ) is 25°C, unless otherwise specified.

	Parameter	Max.	Units
$I_D$ @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	170	A
$I_D$ @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon Limited)	120	
$I_D$ @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Package Limited)	75	
$I_{DM}$	Pulsed Drain Current ①	680	
$P_D$ @ $T_C = 25^\circ\text{C}$	Maximum Power Dissipation	300	W
	Linear Derating Factor	2.0	W/°C
$V_{GS}$	Gate-to-Source Voltage	± 20	V
$E_{AS}$	Single Pulse Avalanche Energy (Thermally Limited) ②	270	mJ
$E_{AS}$ (tested)	Single Pulse Avalanche Energy Tested Value ③	690	
$I_{AR}$	Avalanche Current ①	See Fig.12a,12b,15,16	A
$E_{AR}$	Repetitive Avalanche Energy ④		mJ
$T_J$	Operating Junction and	-55 to + 175	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 seconds (1.6mm from case )	300	
	Mounting torque, 6-32 or M3 screw	10 lbf·in (1.1N·m)	

**Thermal Resistance**

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑤	—	0.50⑥	
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	°C/W
$R_{\theta JA}$	Junction-to-Ambient	—	62	

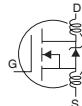
HEXFET® is a registered trademark of International Rectifier.

\*Qualification standards can be found at <http://www.irf.com/>

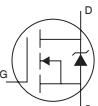
Static Electrical Characteristics @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(\text{BR})\text{DSS}}$	Drain-to-Source Breakdown Voltage	75	—	—	V	$V_{\text{GS}} = 0\text{V}$ , $I_D = 250\mu\text{A}$
$\Delta V_{\text{DSS}}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.069	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$
$R_{\text{DS}(\text{on})}$	Static Drain-to-Source On-Resistance	—	3.5	4.5	$\text{m}\Omega$	$V_{\text{GS}} = 10\text{V}$ , $I_D = 75\text{A}$ ④
$V_{\text{GS}(\text{th})}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{\text{DS}} = V_{\text{GS}}$ , $I_D = 250\mu\text{A}$
$g_{\text{fs}}$	Forward Transconductance	180	—	—	S	$V_{\text{DS}} = 25\text{V}$ , $I_D = 75\text{A}$
$I_{\text{DSS}}$	Drain-to-Source Leakage Current	—	—	20	$\mu\text{A}$	$V_{\text{DS}} = 75\text{V}$ , $V_{\text{GS}} = 0\text{V}$
		—	—	250	$\mu\text{A}$	$V_{\text{DS}} = 75\text{V}$ , $V_{\text{GS}} = 0\text{V}$ , $T_J = 125^\circ\text{C}$
$I_{\text{GSS}}$	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{\text{GS}} = 20\text{V}$
		—	—	-200	nA	$V_{\text{GS}} = -20\text{V}$

Dynamic Electrical Characteristics @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge	—	180	270	nC	$I_D = 75\text{A}$
$Q_{\text{gs}}$	Gate-to-Source Charge	—	46	—		$V_{\text{DS}} = 60\text{V}$
$Q_{\text{gd}}$	Gate-to-Drain ("Miller") Charge	—	65	—		$V_{\text{GS}} = 10\text{V}$ ④
$t_{\text{d}(\text{on})}$	Turn-On Delay Time	—	19	—		$V_{\text{DD}} = 38\text{V}$
$t_r$	Rise Time	—	140	—		$I_D = 75\text{A}$
$t_{\text{d}(\text{off})}$	Turn-Off Delay Time	—	97	—		$R_G = 2.5\Omega$
$t_f$	Fall Time	—	100	—	nH	$V_{\text{GS}} = 10\text{V}$ ④
$L_D$	Internal Drain Inductance	—	5.0	—		Between lead, 6mm (0.25in.) from package and center of die contact
$L_S$	Internal Source Inductance	—	13	—		
$C_{\text{iss}}$	Input Capacitance	—	7500	—		$V_{\text{GS}} = 0\text{V}$
$C_{\text{oss}}$	Output Capacitance	—	970	—		$V_{\text{DS}} = 25\text{V}$
$C_{\text{rss}}$	Reverse Transfer Capacitance	—	510	—		$f = 1.0\text{MHz}$ , See Fig. 5
$C_{\text{oss}}$	Output Capacitance	—	3640	—	pF	$V_{\text{GS}} = 0\text{V}$ , $V_{\text{DS}} = 1.0\text{V}$ , $f = 1.0\text{MHz}$
$C_{\text{oss}}$	Output Capacitance	—	650	—		$V_{\text{GS}} = 0\text{V}$ , $V_{\text{DS}} = 60\text{V}$ , $f = 1.0\text{MHz}$
$C_{\text{oss eff.}}$	Effective Output Capacitance	—	1020	—		$V_{\text{GS}} = 0\text{V}$ , $V_{\text{DS}} = 0\text{V}$ to $60\text{V}$

## Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	75	A	MOSFET symbol showing the integral reverse p-n junction diode.
	Pulsed Source Current (Body Diode) ①	—	—	680		
$V_{\text{SD}}$	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}$ , $I_S = 75\text{A}$ , $V_{\text{GS}} = 0\text{V}$ ④
$t_{\text{rr}}$	Reverse Recovery Time	—	41	61	ns	$T_J = 25^\circ\text{C}$ , $I_F = 75\text{A}$ , $V_{\text{DD}} = 38\text{V}$
$Q_{\text{rr}}$	Reverse Recovery Charge	—	59	89	nC	$\text{di/dt} = 100\text{A}/\mu\text{s}$ ④
$t_{\text{on}}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $LS+LD$ )				

## Notes:

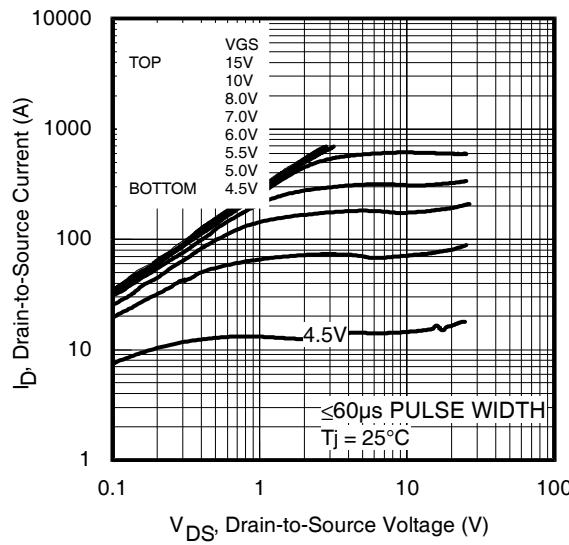
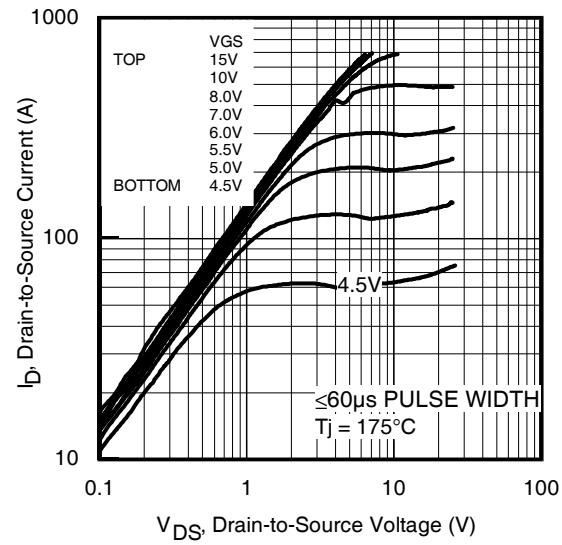
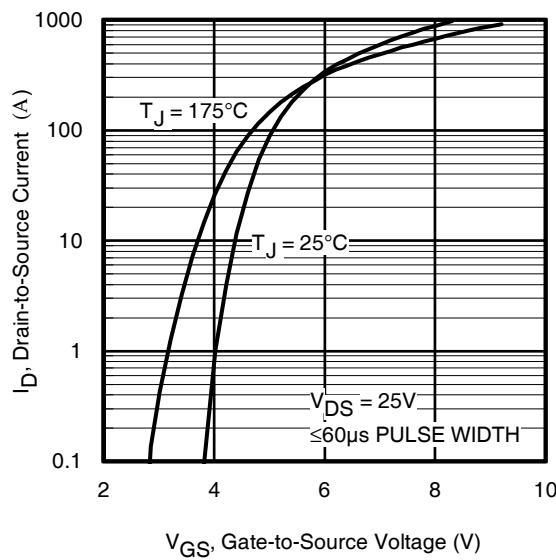
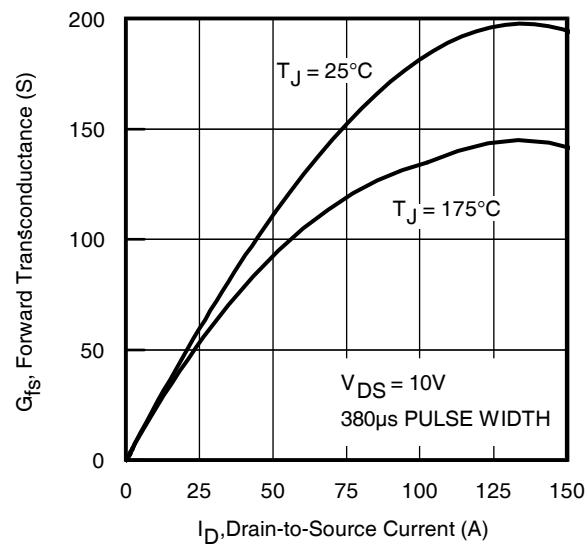
- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ⑥ Limited by  $T_{\text{Jmax}}$ , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ② Limited by  $T_{\text{Jmax}}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L=0.095\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{\text{AS}} = 75\text{A}$ ,  $V_{\text{GS}} = 10\text{V}$ . Part not recommended for use above this value.
- ⑦ This value determined from sample failure population, starting  $T_J = 25^\circ\text{C}$ ,  $L=0.095\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{\text{AS}} = 75\text{A}$ ,  $V_{\text{GS}} = 10\text{V}$ .
- ③  $I_{\text{SD}} \leq 75\text{A}$ ,  $\text{di/dt} \leq 340\text{A}/\mu\text{s}$ ,  $V_{\text{DD}} \leq V_{(\text{BR})\text{DSS}}$ ,  $T_J \leq 175^\circ\text{C}$ .
- ⑧  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .
- ④ Pulse width  $\leq 1.0\text{ms}$ ; duty cycle  $\leq 2\%$ .
- ⑨ TO-220 device will have an  $R_{\text{th}}$  of  $0.45^\circ\text{C}/\text{W}$ .
- ⑤  $C_{\text{oss eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{\text{oss}}$  while  $V_{\text{DS}}$  is rising from 0 to 80%  $V_{\text{DSS}}$ .

**Qualification Information<sup>†</sup>**

<b>Qualification Level</b>		Automotive (per AEC-Q101) <sup>††</sup>	
Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.			
<b>Moisture Sensitivity Level</b>		TO-220AB	N/A
<b>ESD</b>	Machine Model	Class M4 (425V) AEC-Q101-002	
	Human Body Model	Class H2 (4000V) AEC-Q101-001	
	Charged Device Model	Class C4 (1000V) AEC-Q101-005	
<b>RoHS Compliant</b>		Yes	

<sup>†</sup> Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/>

<sup>††</sup> Exceptions to AEC-Q101 requirements are noted in the qualification report.

**Fig 1.** Typical Output Characteristics**Fig 2.** Typical Output Characteristics**Fig 3.** Typical Transfer Characteristics**Fig 4.** Typical Forward Transconductance vs. Drain Current

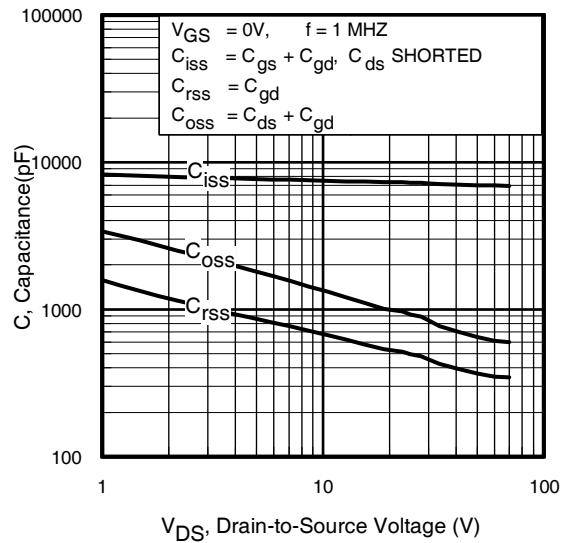


Fig 5. Typical Capacitance vs.  
Drain-to-Source Voltage

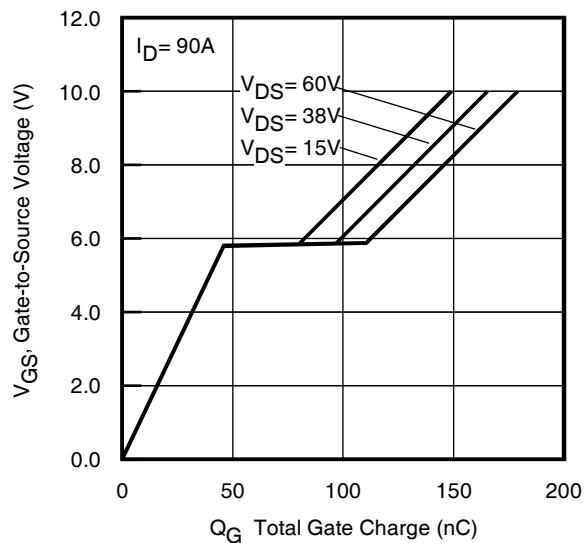


Fig 6. Typical Gate Charge vs.  
Gate-to-Source Voltage

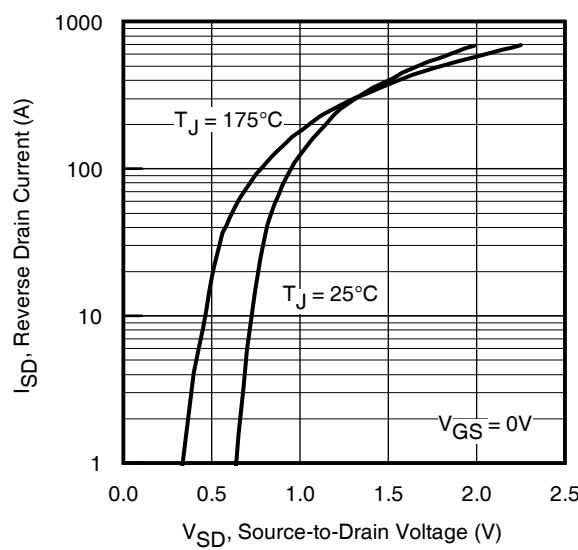


Fig 7. Typical Source-Drain Diode  
Forward Voltage

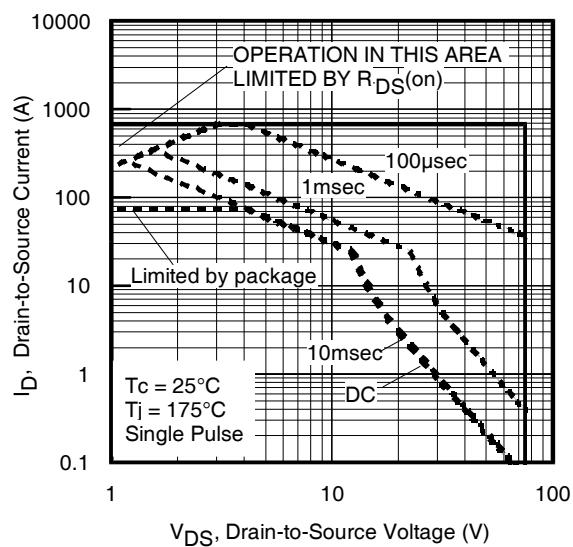
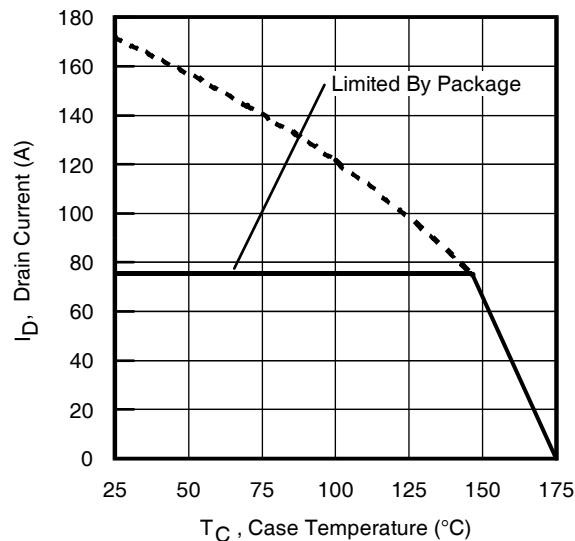
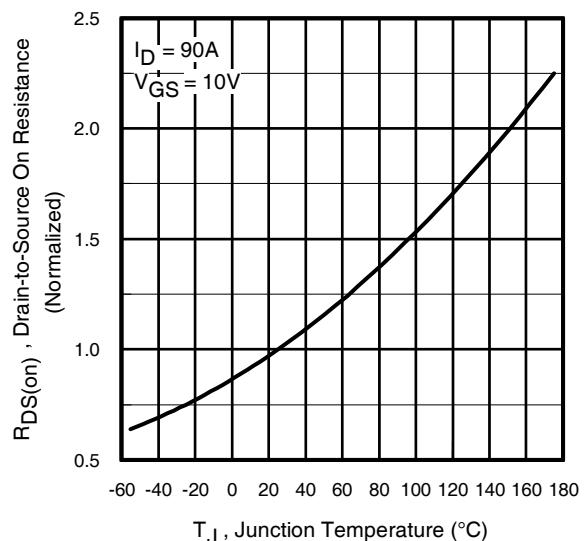


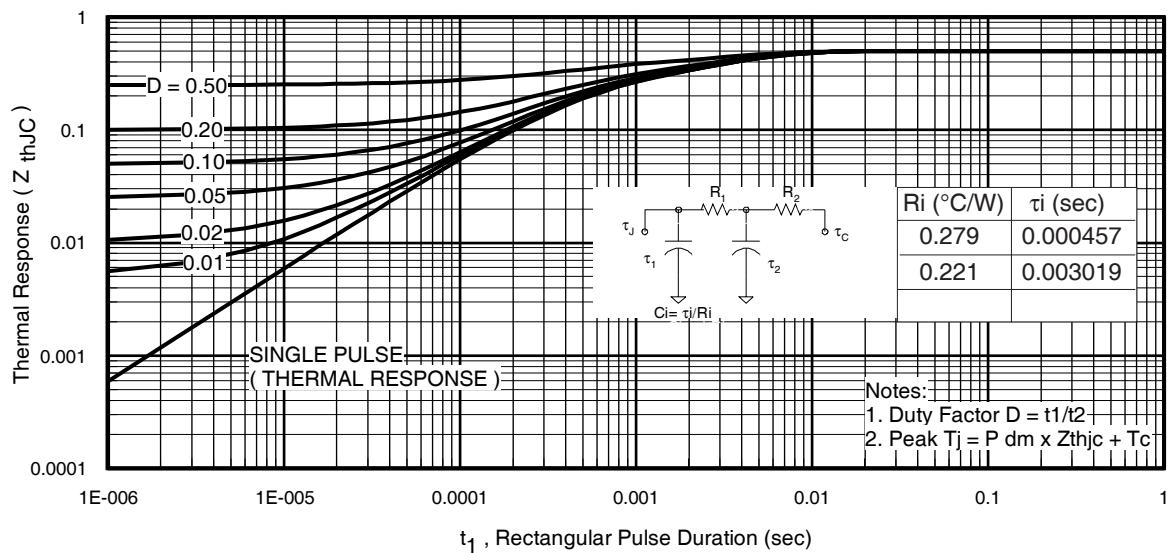
Fig 8. Maximum Safe Operating Area



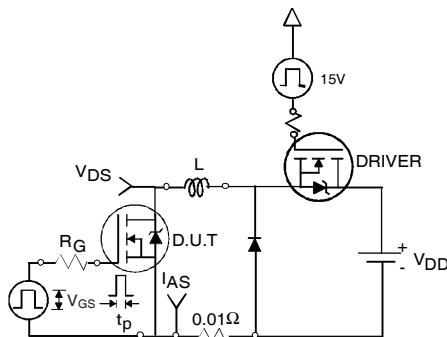
**Fig 9.** Maximum Drain Current vs.  
Case Temperature



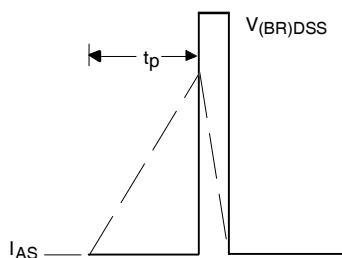
**Fig 10.** Normalized On-Resistance  
vs. Temperature



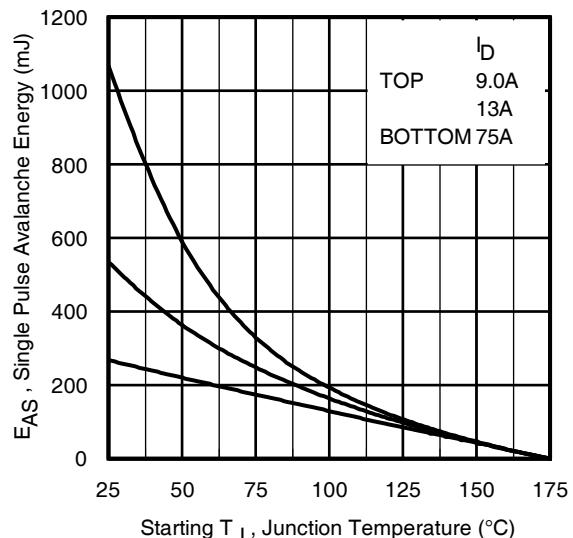
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



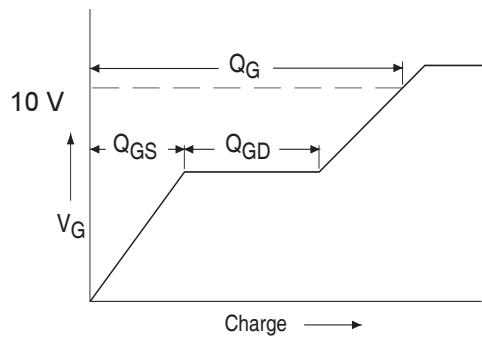
**Fig 12a.** Unclamped Inductive Test Circuit



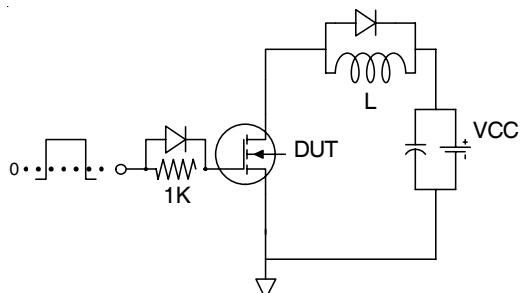
**Fig 12b.** Unclamped Inductive Waveforms



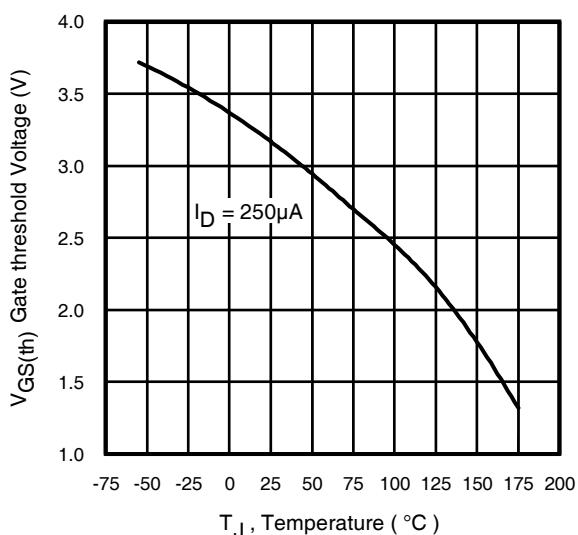
**Fig 12c.** Maximum Avalanche Energy vs. Drain Current



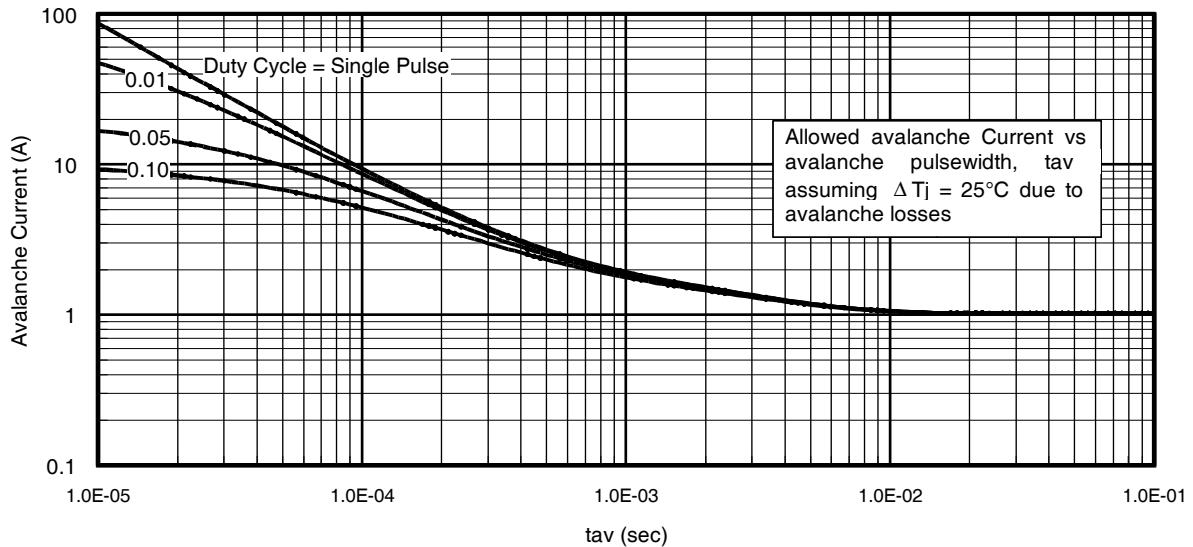
**Fig 13a.** Basic Gate Charge Waveform



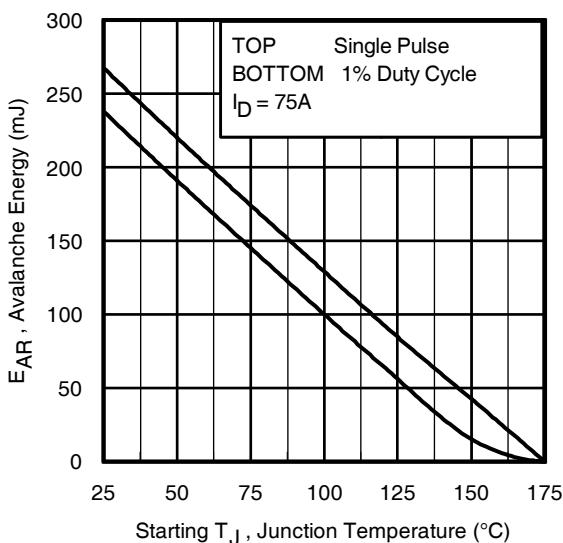
**Fig 13b.** Gate Charge Test Circuit  
www.irf.com



**Fig 14.** Threshold Voltage vs. Temperature



**Fig 15.** Typical Avalanche Current Vs.Pulsewidth



**Fig 16.** Maximum Avalanche Energy vs. Temperature

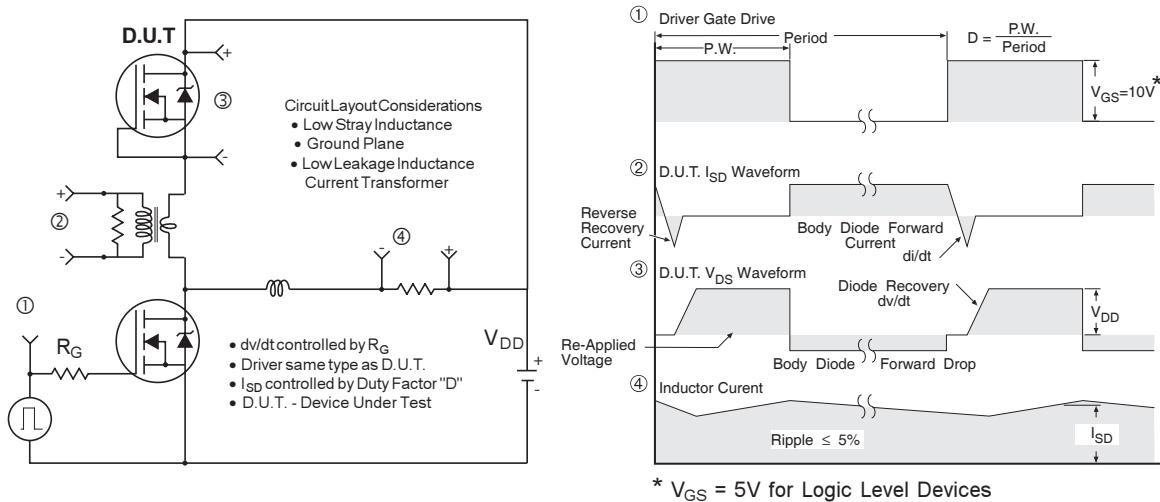
**Notes on Repetitive Avalanche Curves , Figures 15, 16:**  
**(For further info, see AN-1005 at [www.irf.com](http://www.irf.com))**

1. Avalanche failures assumption:  
Purely a thermal phenomenon and failure occurs at a temperature far in excess of  $T_{j\max}$ . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as  $T_{j\max}$  is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 12a, 12b.
4.  $P_D(\text{ave})$  = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6.  $I_{av}$  = Allowable avalanche current.
7.  $\Delta T$  = Allowable rise in junction temperature, not to exceed  $T_{j\max}$  (assumed as  $25^\circ\text{C}$  in Figure 15, 16).
- $t_{av}$  = Average time in avalanche.
- $D$  = Duty cycle in avalanche =  $t_{av} \cdot f$
- $Z_{thJC}(D, t_{av})$  = Transient thermal resistance, see figure 11)

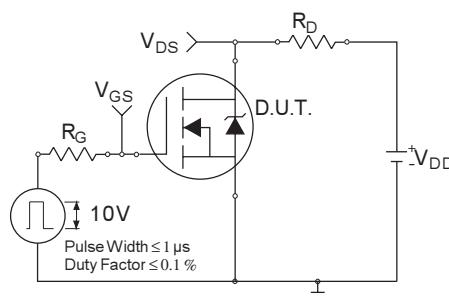
$$P_D(\text{ave}) = 1/2 ( 1.3 \cdot BV \cdot I_{av} ) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$

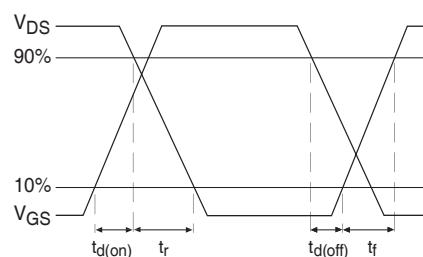
$$E_{AS(AR)} = P_D(\text{ave}) \cdot t_{av}$$



**Fig 17.** Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs



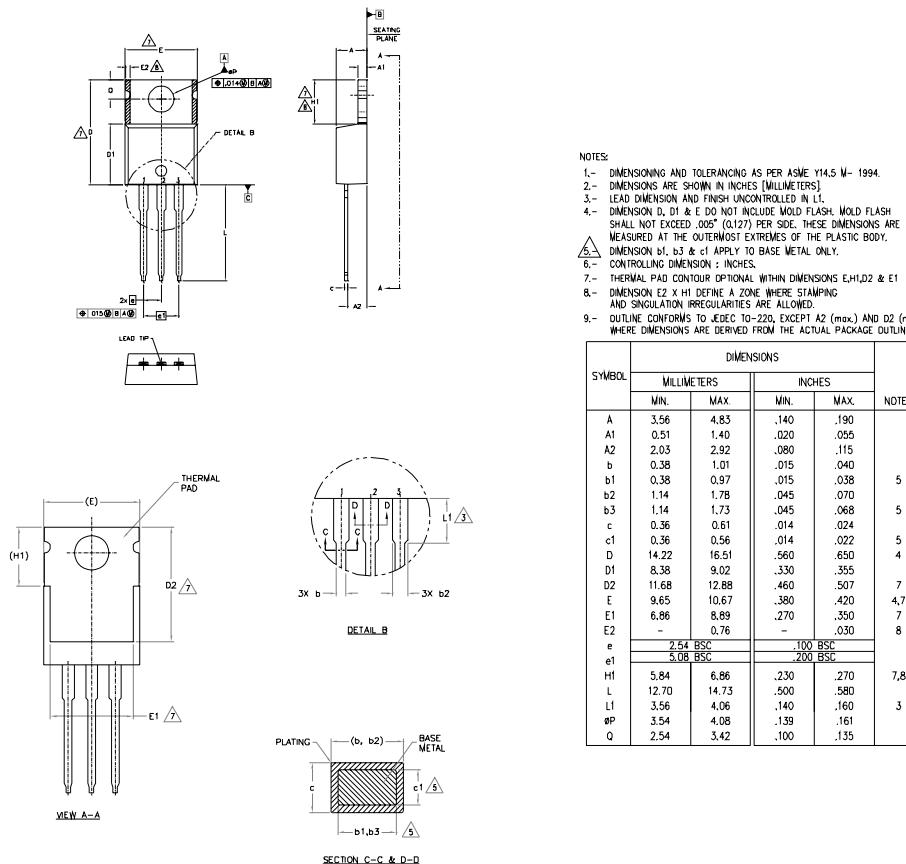
**Fig 18a.** Switching Time Test Circuit



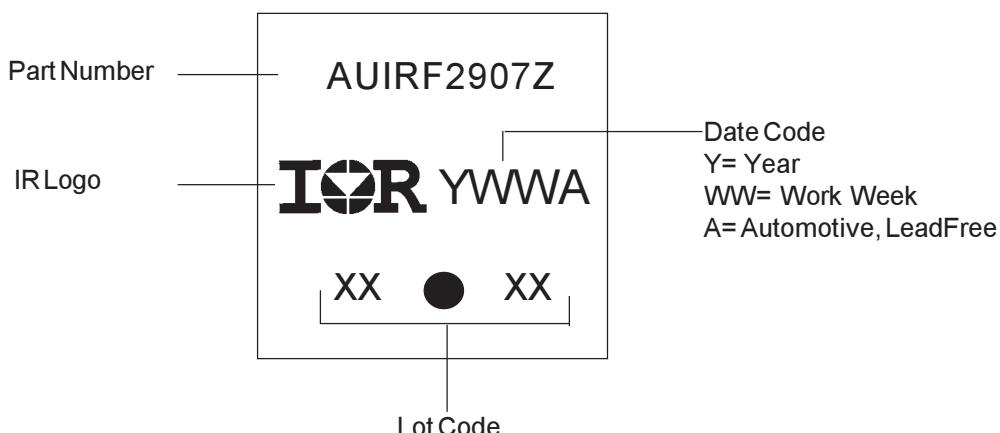
**Fig 18b.** Switching Time Waveforms

## TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



## TO-220AB Part Marking Information



TO-220AB packages are not recommended for Surface Mount Application.

Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

### Ordering Information

Base part	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRF2907Z	TO-220	Tube	50	AUIRF2907Z

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