

**AUTOMOTIVE MOSFET IRF3007PbF**

**Typical Applications**

- 42 Volts Automotive Electrical Systems
- Lead-Free

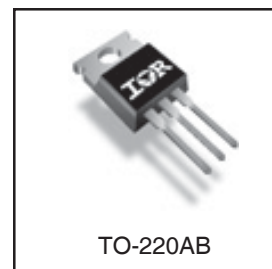
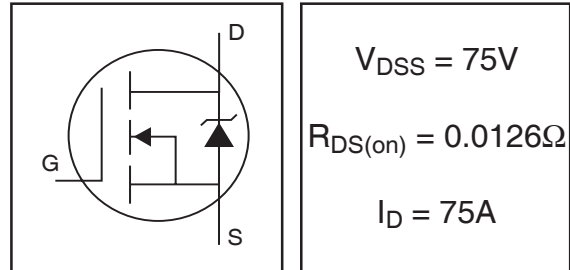
**Features**

- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to  $T_{jmax}$
- Automotive [Q101] Qualified

**Description**

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

**HEXFET® Power MOSFET**



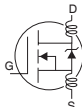
**Absolute Maximum Ratings**

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Silicon limited)	80	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (See Fig.9)	56	
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$ (Package limited)	75	
$I_{DM}$	Pulsed Drain Current ①	320	
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation	200	W
	Linear Derating Factor	1.3	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy②	280	mJ
$E_{AS}$ (6 sigma)	Single Pulse Avalanche Energy Tested Value②	946	
$I_{AR}$	Avalanche Current①	See Fig.12a, 12b, 15, 16	A
$E_{AR}$	Repetitive Avalanche Energy③		mJ
$T_J$	Operating Junction and	-55 to + 175	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case )	
	Mounting Torque, 6-32 or M3 screw	1.1 (10)	N•m (lb•in)

**Thermal Resistance**

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.74	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	62	

## Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

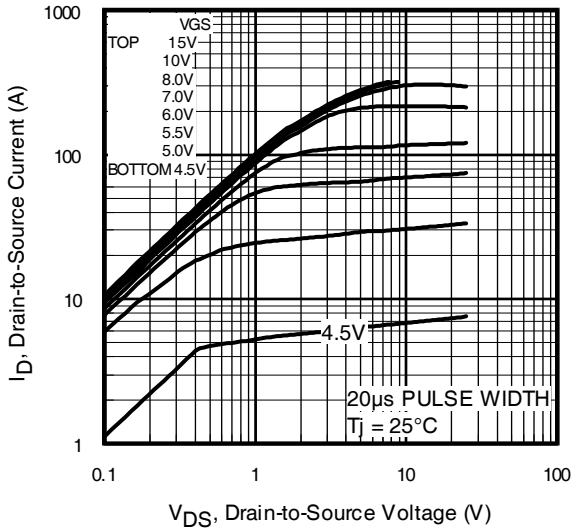
	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)DSS</sub>	Drain-to-Source Breakdown Voltage	75	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	0.084	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	10.5	12.6	mΩ	V <sub>GS</sub> = 10V, I <sub>D</sub> = 48A ④
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	—	4.0	V	V <sub>DS</sub> = 10V, I <sub>D</sub> = 250μA
g <sub>fs</sub>	Forward Transconductance	180	—	—	S	V <sub>DS</sub> = 25V, I <sub>D</sub> = 48A
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	20	μA	V <sub>DS</sub> = 75V, V <sub>GS</sub> = 0V
		—	—	250		V <sub>DS</sub> = 60V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 150°C
I <sub>GSS</sub>	Gate-to-Source Forward Leakage	—	—	200	nA	V <sub>GS</sub> = 20V
	Gate-to-Source Reverse Leakage	—	—	-200		V <sub>GS</sub> = -20V
Q <sub>g</sub>	Total Gate Charge	—	89	130	nC	I <sub>D</sub> = 48A
Q <sub>gs</sub>	Gate-to-Source Charge	—	21	32		V <sub>DS</sub> = 60V
Q <sub>gd</sub>	Gate-to-Drain ("Miller") Charge	—	30	45		V <sub>GS</sub> = 10V
t <sub>d(on)</sub>	Turn-On Delay Time	—	12	—	ns	V <sub>DD</sub> = 38V
t <sub>r</sub>	Rise Time	—	80	—		I <sub>D</sub> = 48A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	55	—		R <sub>G</sub> = 4.6Ω
t <sub>f</sub>	Fall Time	—	49	—		V <sub>GS</sub> = 10V ④
L <sub>D</sub>	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.) from package and center of die contact
L <sub>S</sub>	Internal Source Inductance	—	7.5	—		
C <sub>iss</sub>	Input Capacitance	—	3270	—	pF	V <sub>GS</sub> = 0V
C <sub>oss</sub>	Output Capacitance	—	520	—		V <sub>DS</sub> = 25V
C <sub>rss</sub>	Reverse Transfer Capacitance	—	78	—		f = 1.0MHz, See Fig. 5
C <sub>oss</sub>	Output Capacitance	—	3500	—		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 1.0V, f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	340	—		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 60V, f = 1.0MHz
C <sub>oss eff.</sub>	Effective Output Capacitance ⑤	—	640	—		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 60V

## Source-Drain Ratings and Characteristics

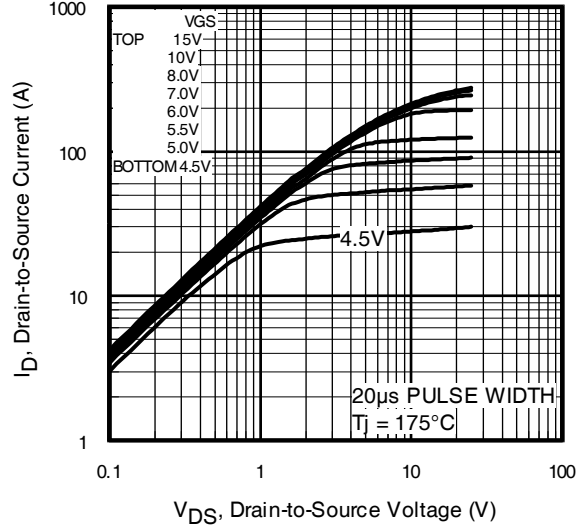
	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	80⑥	A	MOSFET symbol showing the integral reverse p-n junction diode.
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	320		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.3	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 48A, V <sub>GS</sub> = 0V ④
t <sub>rr</sub>	Reverse Recovery Time	—	85	130	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = 48A, V <sub>DD</sub> = 38V
Q <sub>rr</sub>	Reverse Recovery Charge	—	280	420	nC	di/dt = 100A/μs ④
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> +L <sub>D</sub> )				

### Notes:

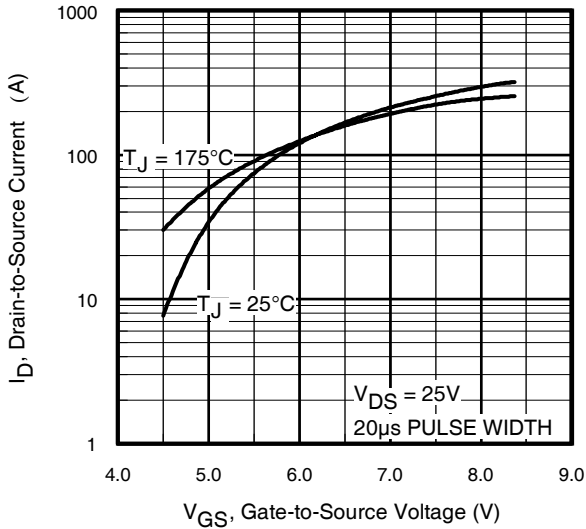
- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Starting T<sub>J</sub> = 25°C, L = 0.24mH  
R<sub>G</sub> = 25Ω, I<sub>AS</sub> = 48A, V<sub>GS</sub> = 10V (See Figure 12).
- ③ I<sub>SD</sub> ≤ 48A, di/dt ≤ 330A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>,  
T<sub>J</sub> ≤ 175°C
- ④ Pulse width ≤ 400μs; duty cycle ≤ 2%.
- ⑤ C<sub>oss eff.</sub> is a fixed capacitance that gives the same charging time as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 to 80% V<sub>DSS</sub>.
- ⑥ Limited by T<sub>Jmax</sub>, see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑦ This value determined from sample failure population. 100% tested to this value in production.



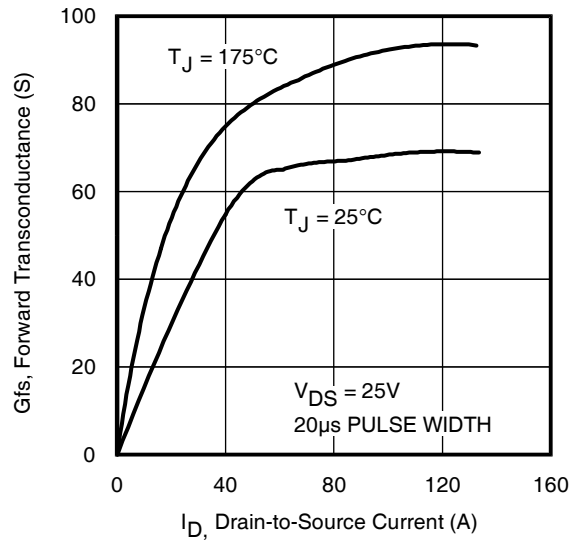
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics

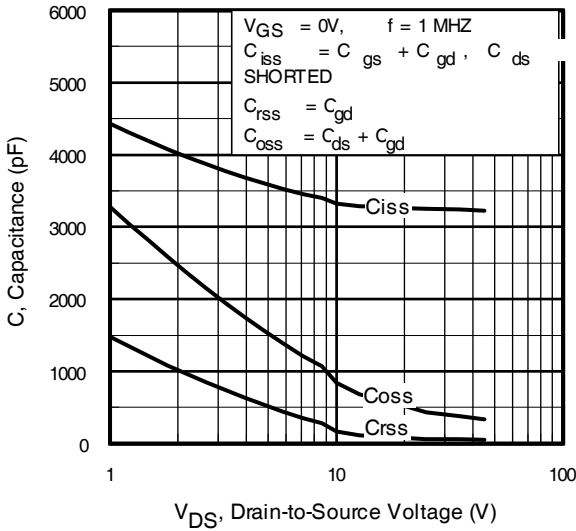


**Fig 3.** Typical Transfer Characteristics

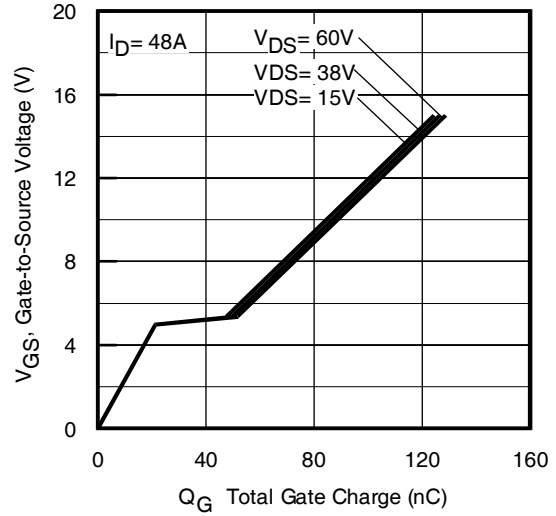


**Fig 4.** Typical Forward Transconductance Vs. Drain Current

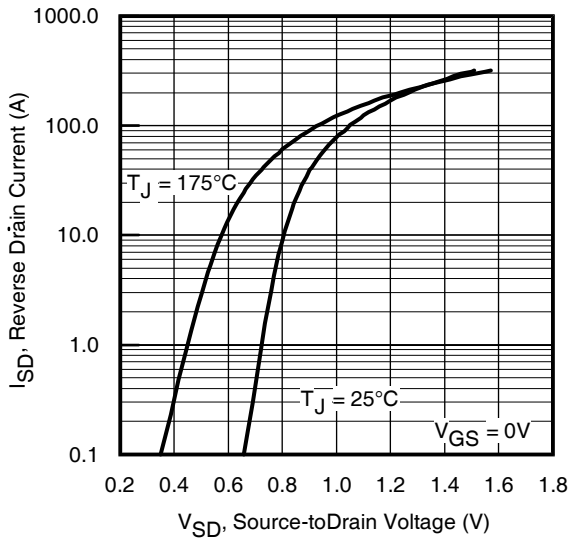
# IRF3007PbF



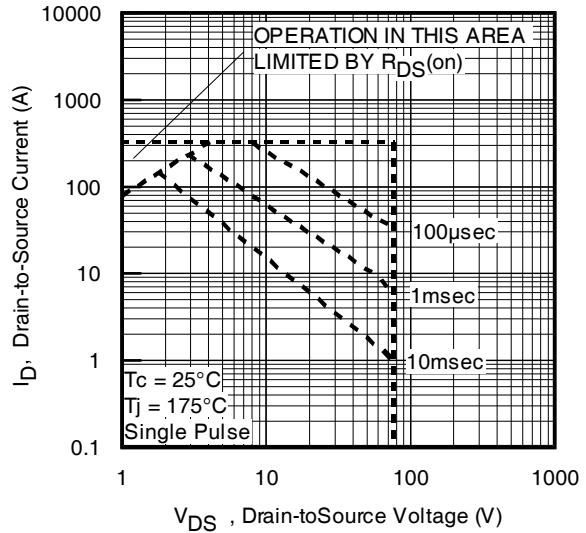
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



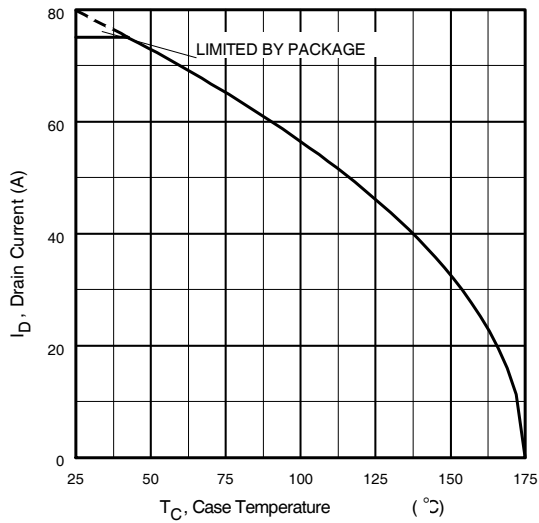
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



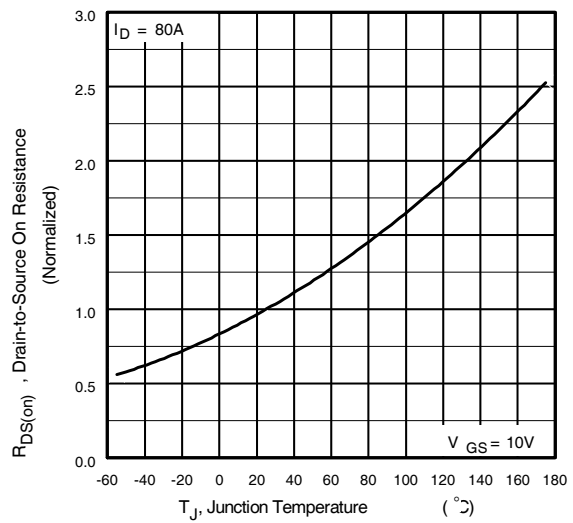
**Fig 7.** Typical Source-Drain Diode Forward Voltage



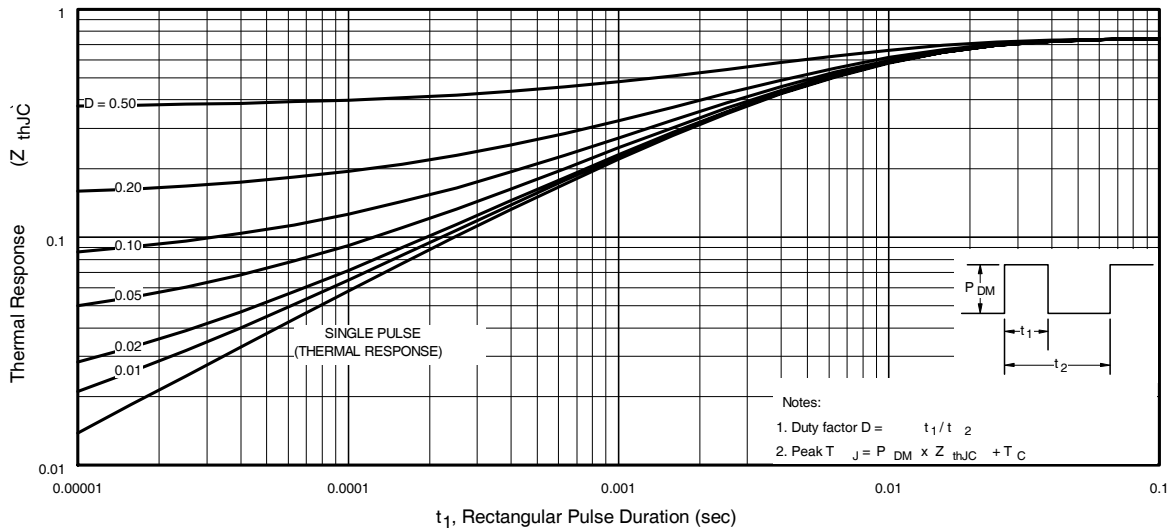
**Fig 8.** Maximum Safe Operating Area



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



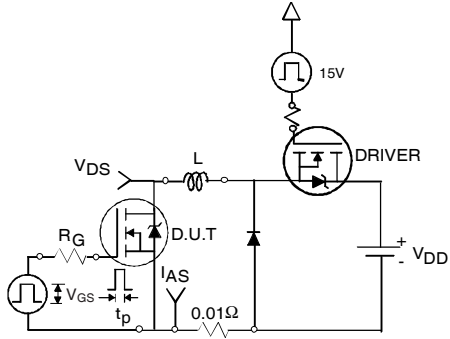
**Fig 10.** Normalized On-Resistance Vs. Temperature



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

# IRF3007PbF

International  
**IR** Rectifier



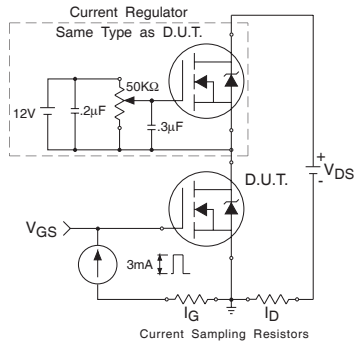
**Fig 12a.** Unclamped Inductive Test Circuit



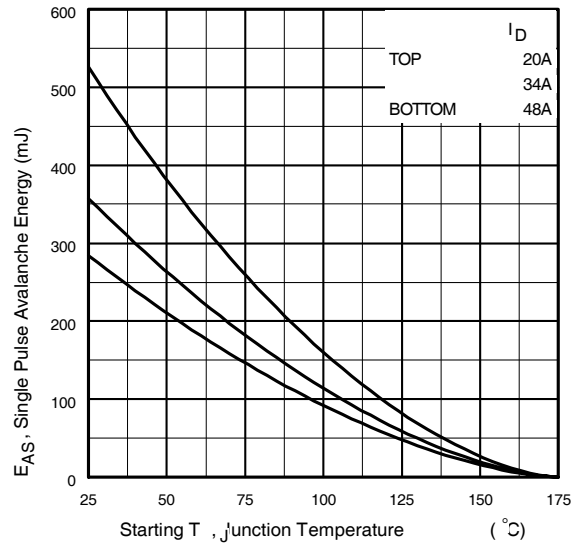
**Fig 12b.** Unclamped Inductive Waveforms



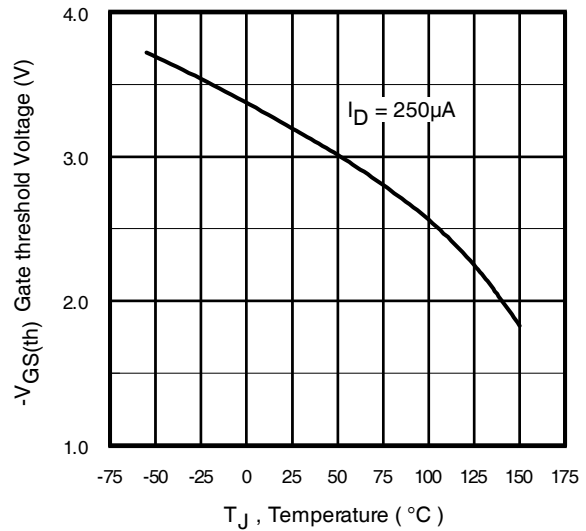
**Fig 13a.** Basic Gate Charge Waveform



**Fig 13b.** Gate Charge Test Circuit



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



**Fig 14.** Threshold Voltage Vs. Temperature

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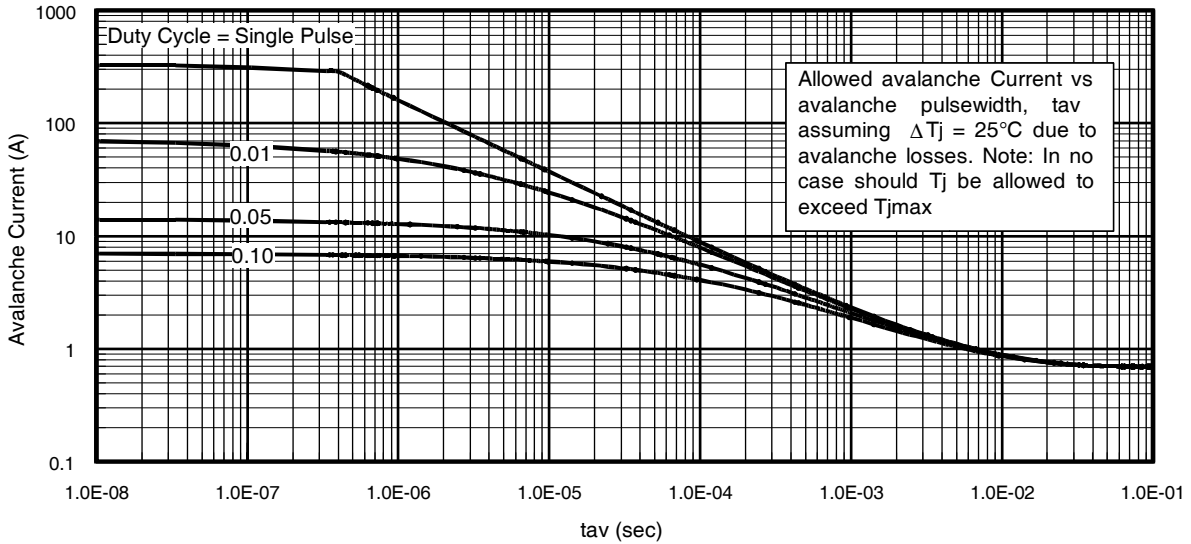


Fig 15. Typical Avalanche Current Vs.Pulsewidth

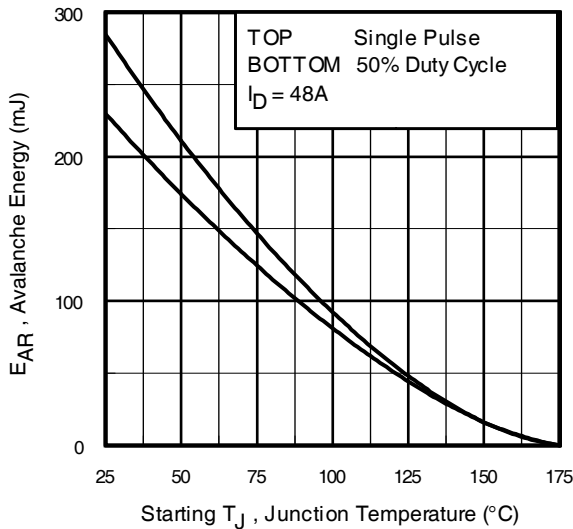


Fig 16. Maximum Avalanche Energy Vs. Temperature

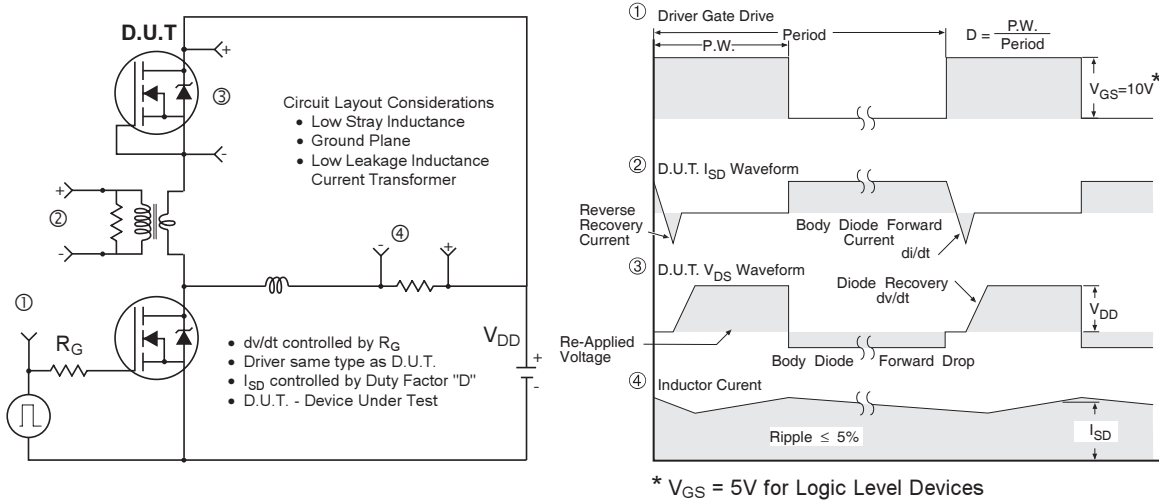
**Notes on Repetitive Avalanche Curves , Figures 15, 16:  
(For further info, see AN-1005 at www.irf.com)**

1. Avalanche failures assumption:  
Purely a thermal phenomenon and failure occurs at a temperature far in excess of  $T_{jmax}$ . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as  $T_{jmax}$  is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 12a, 12b.
4.  $P_{D(ave)}$  = 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  $T_{jmax}$  (assumed as 25°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)

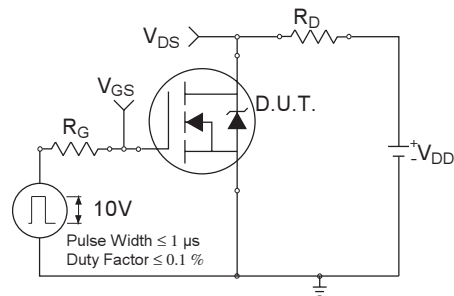
$$P_{D(ave)} = 1/2 ( 1.3 \cdot BV \cdot I_{av} ) = \Delta T / Z_{thJC}$$

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

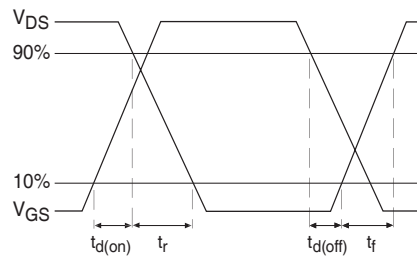
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



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



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

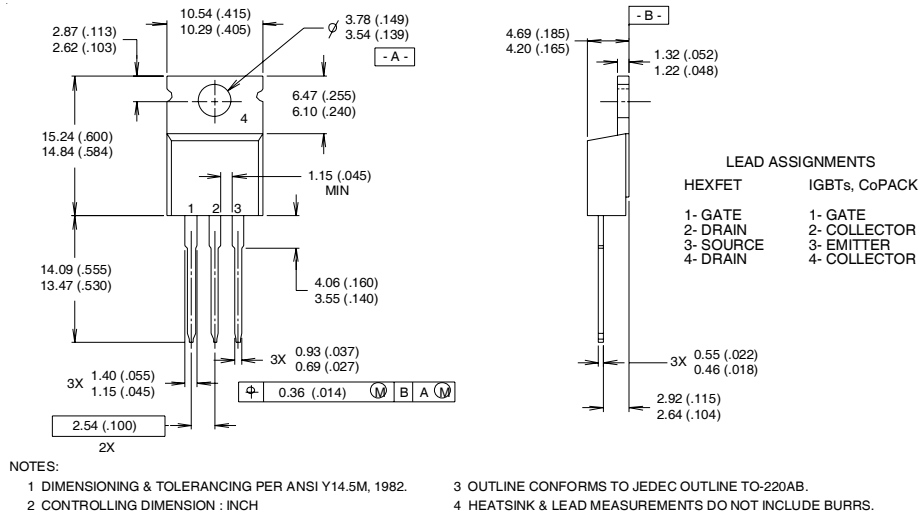


**Fig 18b. Switching Time Waveforms**



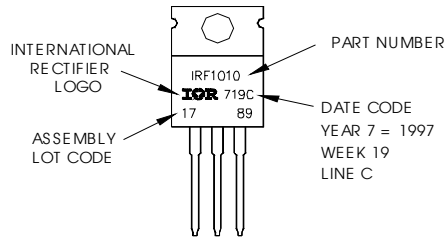
## TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



## TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 1997  
 IN THE ASSEMBLY LINE "C"  
**Note:** "P" in assembly line  
 position indicates "Lead-Free"



TO-220AB package is not recommended for Surface Mount Application

Data and specifications subject to change without notice.  
 This product has been designed and qualified for the Automotive [Q101] market.  
 Qualification Standards can be found on IR's Web site.

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