



**THE DATASHEET OF  
IRF2903ZPBF**

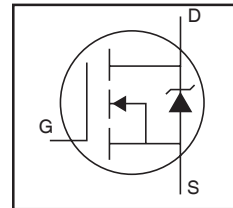


**IRF2903ZPbF**

**HEXFET® Power MOSFET**

**Features**

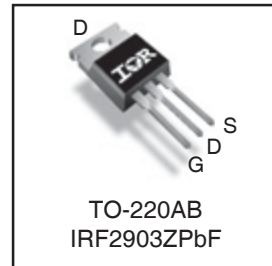
- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to  $T_{jmax}$
- Lead-Free



$V_{DSS} = 30V$
$R_{DS(on)} = 2.4m\Omega$
$I_D = 75A$

**Description**

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 a wide variety of applications.



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

**Absolute Maximum Ratings**

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited)	260	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited)	180	
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Package Limited)	75	
$I_{DM}$	Pulsed Drain Current ①	1020	
$P_D @ T_C = 25^\circ C$	Power Dissipation	290	W
	Linear Derating Factor	2.0	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$ (Thermally limited)	Single Pulse Avalanche Energy ②	290	mJ
$E_{AS}$ (Tested )	Single Pulse Avalanche Energy Tested Value ③	820	
$I_{AR}$	Avalanche Current ④	See Fig.12a, 12b, 15, 16	A
$E_{AR}$	Repetitive Avalanche Energy ⑤		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 ⑦	10 lbf•in (1.1N•m)	

**Thermal Resistance**

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑧	—	0.51	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface ⑨	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient ⑩	—	62	

# IRF2903ZPbF

International  
IR Rectifier

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	30	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.021	—	V/°C	Reference to $25^\circ\text{C}$ , $I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	1.9	2.4	m $\Omega$	$V_{GS} = 10V, I_D = 75A$ ③
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 150\mu A$
gfs	Forward Transconductance	120	—	—	S	$V_{DS} = 10V, I_D = 75A$
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	20	$\mu A$	$V_{DS} = 30V, V_{GS} = 0V$ $V_{DS} = 30V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-200	nA	$V_{GS} = -20V$
$Q_g$	Total Gate Charge	—	160	240	nC	$I_D = 75A$
$Q_{gs}$	Gate-to-Source Charge	—	51	—	nC	$V_{DS} = 24V$
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	58	—	nC	$V_{GS} = 10V$ ③
$t_{d(on)}$	Turn-On Delay Time	—	24	—	ns	$V_{DD} = 15V$
$t_r$	Rise Time	—	100	—		$I_D = 75A$
$t_{d(off)}$	Turn-Off Delay Time	—	48	—		$R_G = 3.2\ \Omega$
$t_f$	Fall Time	—	37	—		$V_{GS} = 10V$ ③
$L_D$	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.) from package and center of die contact
$L_S$	Internal Source Inductance	—	7.5	—		
$C_{iss}$	Input Capacitance	—	6320	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	1980	—		$V_{DS} = 25V$
$C_{rss}$	Reverse Transfer Capacitance	—	1100	—		$f = 1.0MHz$
$C_{oss}$	Output Capacitance	—	5930	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$
$C_{oss}$	Output Capacitance	—	2010	—		$V_{GS} = 0V, V_{DS} = 24V, f = 1.0MHz$
$C_{oss\ eff.}$	Effective Output Capacitance	—	3050	—		$V_{GS} = 0V, V_{DS} = 0V\ to\ 24V$ ④

## Source-Drain Ratings and 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.
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	1020		
$V_{SD}$	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 75A, V_{GS} = 0V$ ③
$t_{rr}$	Reverse Recovery Time	—	34	51	ns	$T_J = 25^\circ\text{C}, I_F = 75A, V_{DD} = 15V$
$Q_{rr}$	Reverse Recovery Charge	—	29	44	nC	$di/dt = 100A/\mu s$ ③
$t_{on}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S+L_D$ )				

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Limited by  $T_{Jmax}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.10mH$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 75A$ ,  $V_{GS} = 10V$ . Part not recommended for use above this value.
- ③ Pulse width  $\leq 1.0ms$ ; duty cycle  $\leq 2\%$ .
- ④  $C_{oss\ eff.}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .
- ⑤ Limited by  $T_{Jmax}$ , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑥ This value determined from sample failure population. 100% tested to this value in production.
- ⑦ This is only applied to TO-220AB package.
- ⑧  $R_{\theta}$  is measured at  $T_J$  approximately  $90^\circ\text{C}$

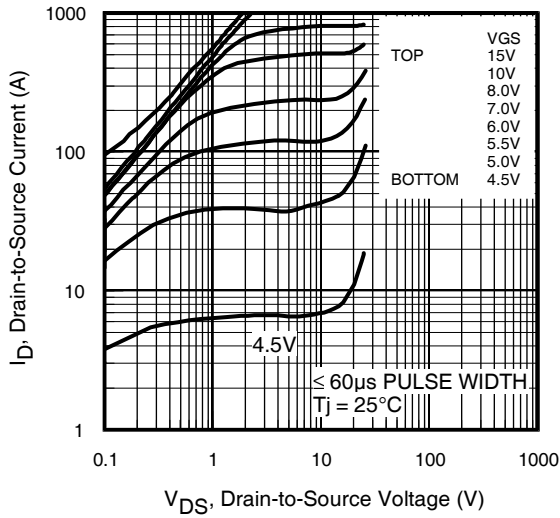


Fig 1. Typical Output Characteristics

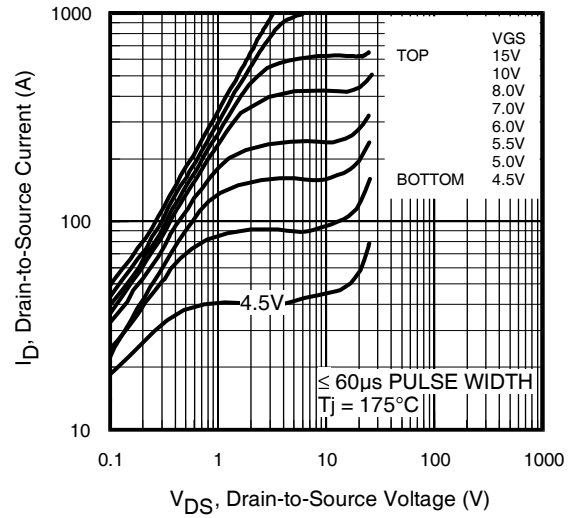


Fig 2. Typical Output Characteristics

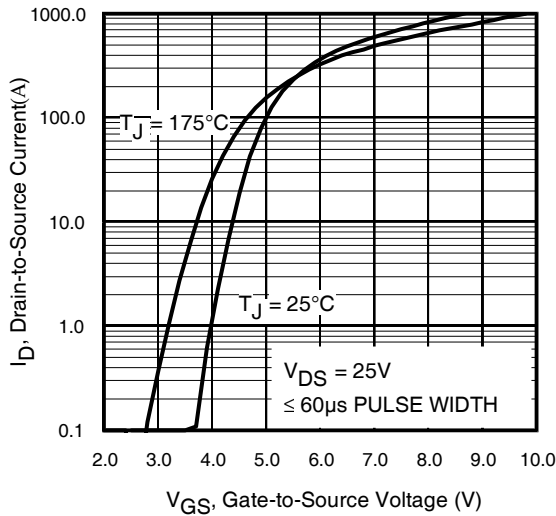


Fig 3. Typical Transfer Characteristics

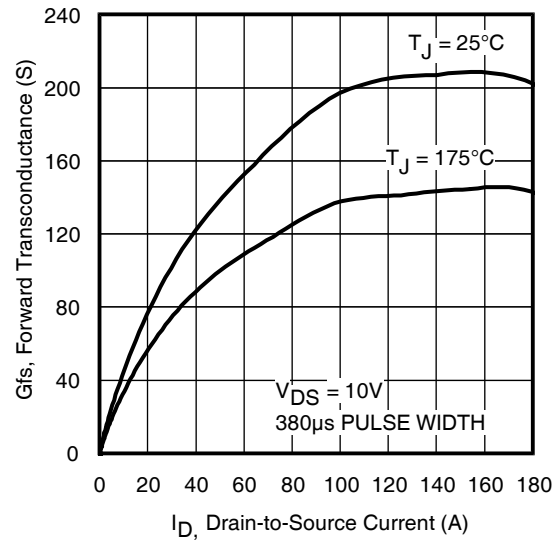
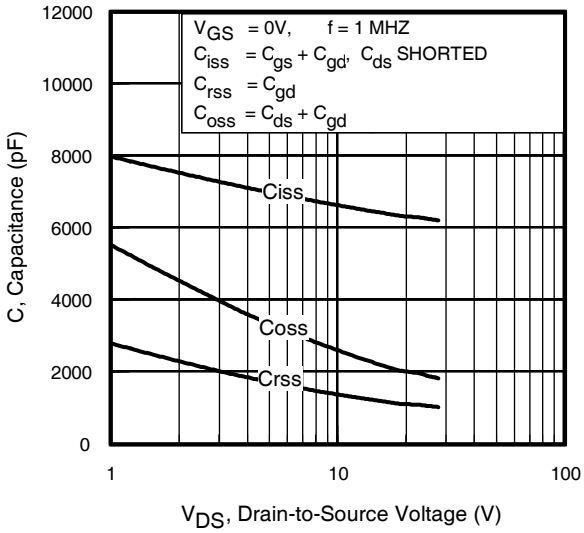
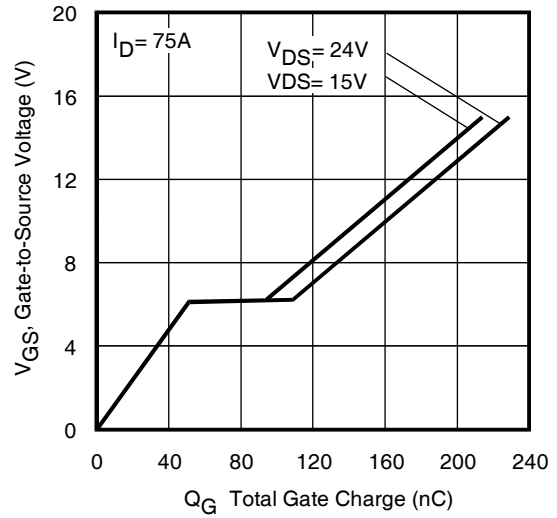


Fig 4. Typical Forward Transconductance Vs. Drain Current

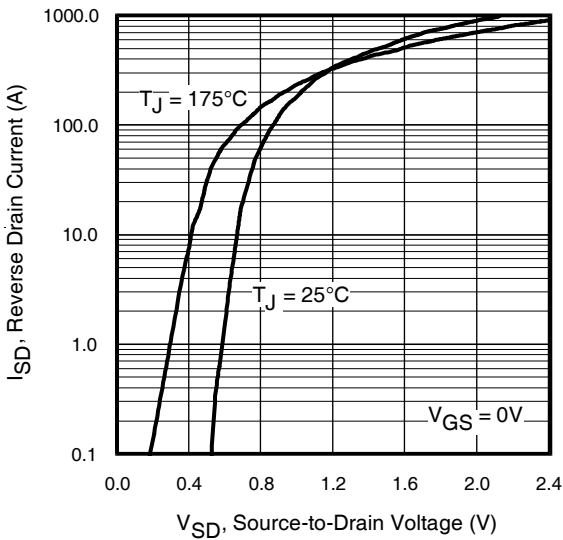
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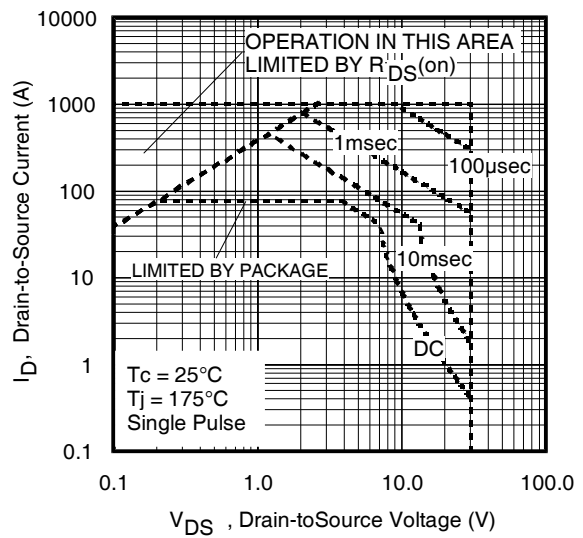
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



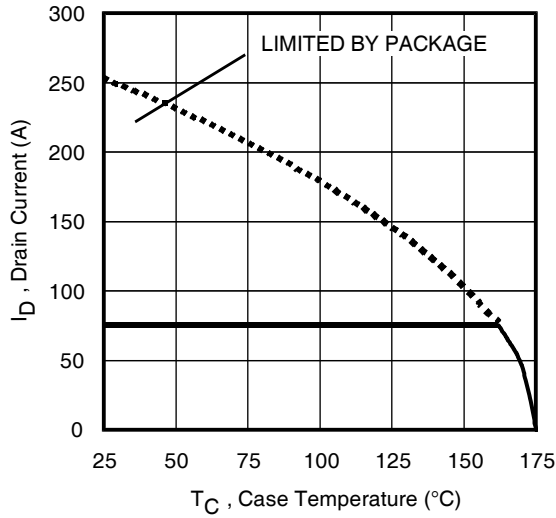
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



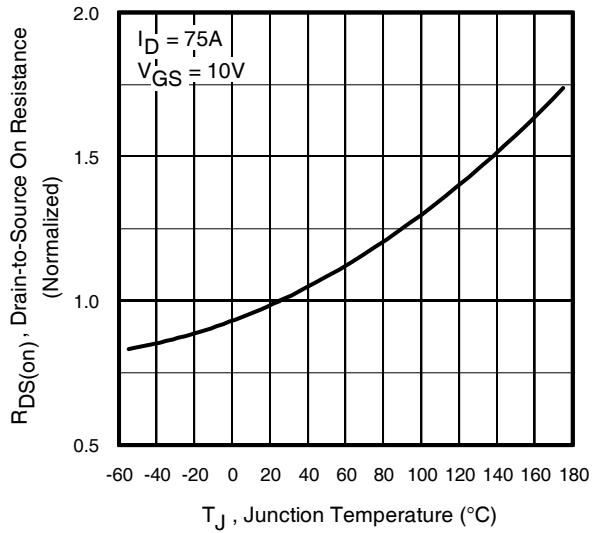
**Fig 7.** Typical Source-Drain Diode Forward Voltage



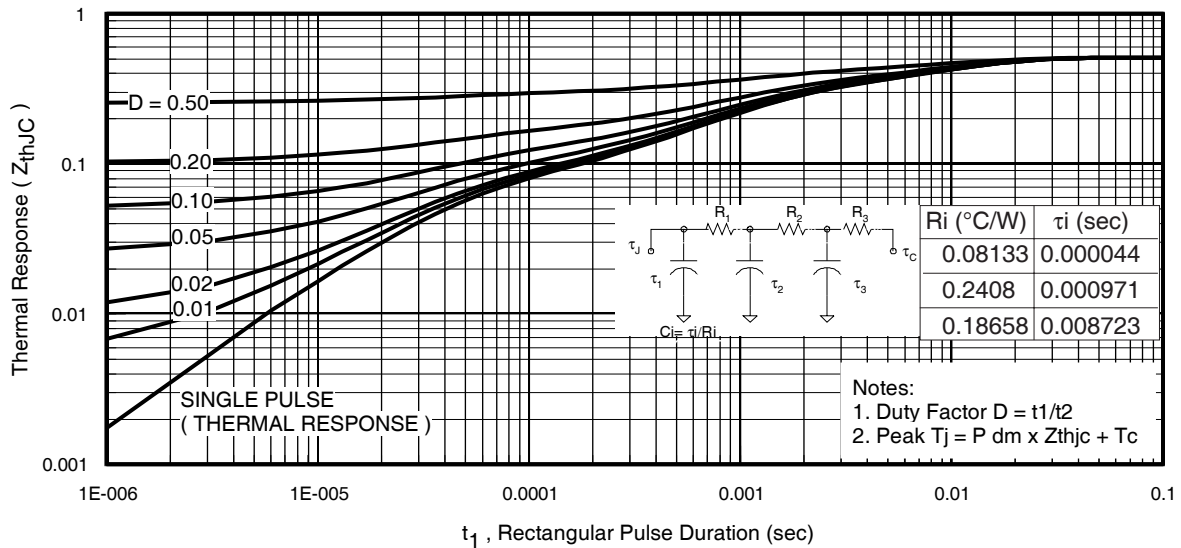
**Fig 8.** Maximum Safe Operating Area



**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

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



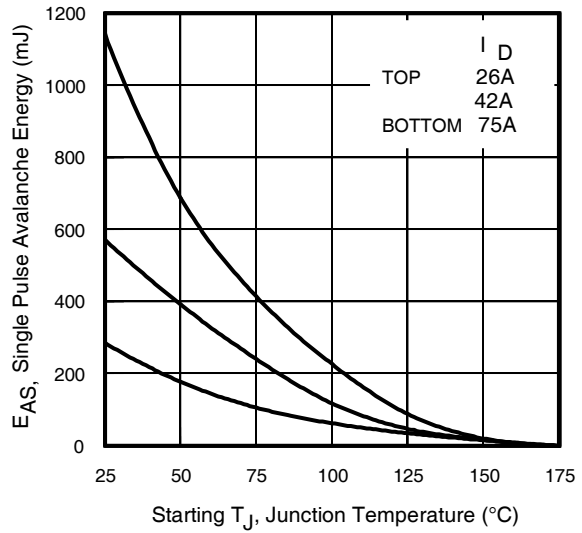
**Fig 12b.** Unclamped Inductive Waveforms



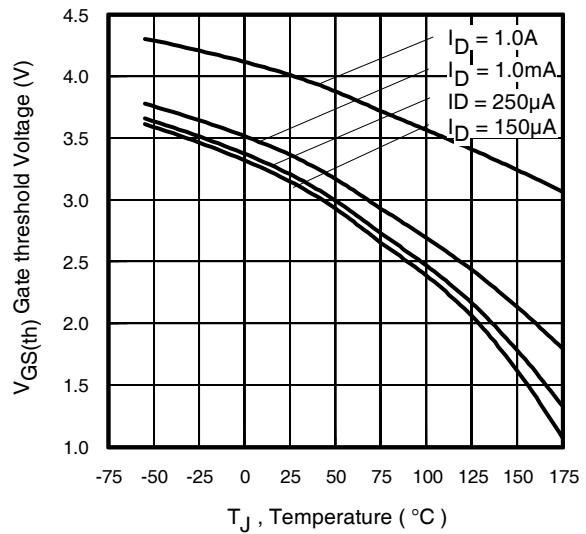
**Fig 13a.** Basic Gate Charge Waveform



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



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



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

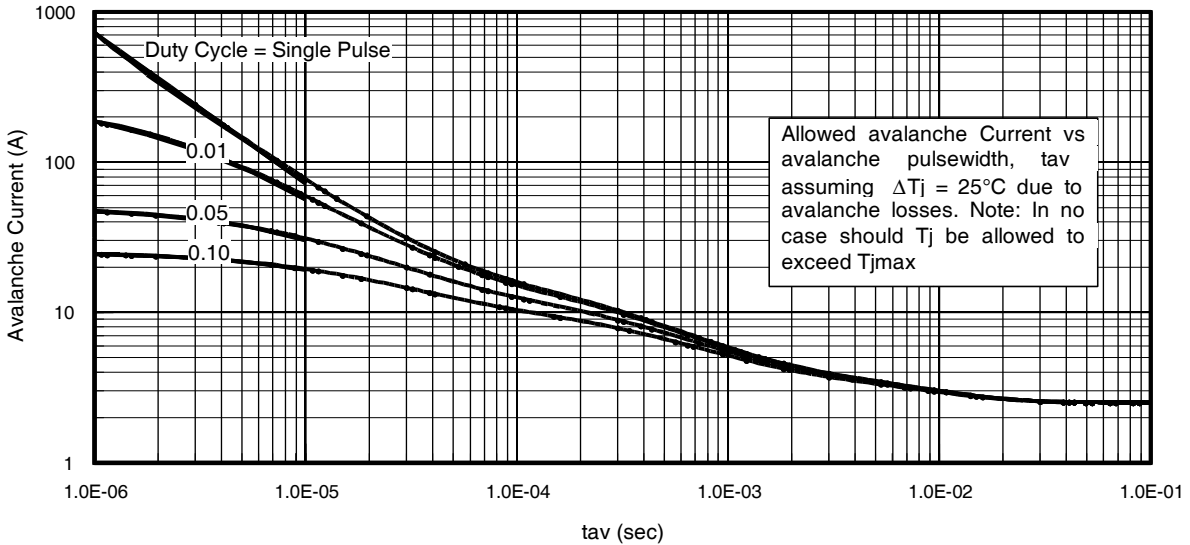


Fig 15. Typical Avalanche Current Vs.Pulsewidth

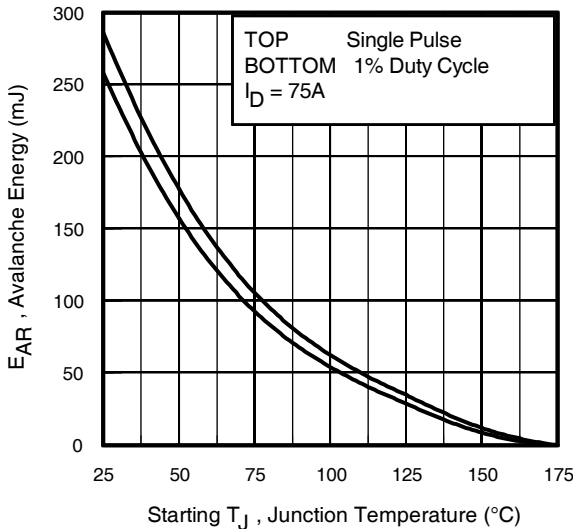


Fig 16. Maximum Avalanche Energy Vs. Temperature

**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  $T_{jmax}$ . 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**

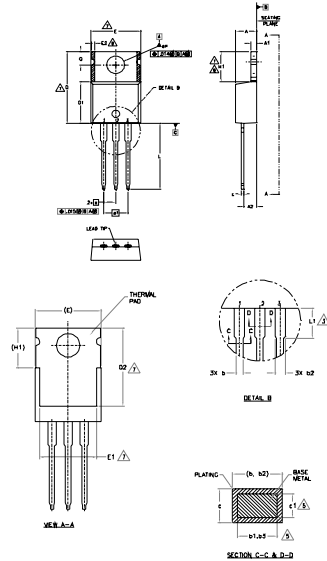


**Fig 18a. Switching Time Test Circuit**



**Fig 18b. Switching Time Waveforms**

## TO-220AB Package Outline (Dimensions are shown in millimeters (inches))



- NOTES
- 1- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M-1994.
  - 2- DIMENSIONS ARE SHOWN IN INCHES (MILLIMETERS).
  - 3- LEAD DIMENSIONS AND FLASH UNCONTROLLED IN L.S.
  - 4- DIMENSION D, D1 & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .002" (0.077) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMITY OF THE PLASTIC BODY. DIMENSION D1, D2 & E APPLY TO BASE METAL ONLY.
  - 5- CONTROLLING DIMENSION - INCHES.
  - 6- INTERNAL AND CONTOUR ORIGINAL DIMENSIONS EXCEPT E1 & E2.
  - 7- DIMENSION E2 ± .01 OFFLINE A ZONE WHERE STAMPING AND PRODUCTION VARIATIONS ARE ALLOWED.
  - 8- OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

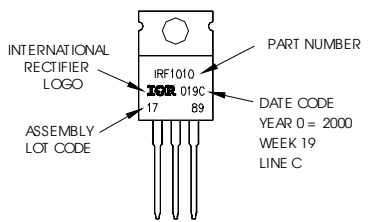
SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.55	4.83	.140	.190	
A1	0.51	1.40	.020	.056	
A2	2.03	2.92	.080	.115	
b	0.28	1.01	.015	.040	
b1	0.38	0.97	.015	.038	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	7
D2	11.88	12.28	.460	.507	7
E	9.65	10.67	.380	.420	4,7
E1	6.96	8.89	.270	.350	7
E2	0.76	-	.030	-	8
e	2.54	2.54	.100	.100	
e1	2.54	2.54	.100	.100	
ef	4.94	6.96	.240	.270	7,8
hf	12.70	14.73	.500	.580	
L	3.56	4.06	.140	.160	3
MP	3.24	4.06	.129	.161	
Q	2.54	3.42	.100	.135	

- LEAD FINISHES
- 1- GALT
  - 2- BURN
  - 3- TUMBLE
- MOLD CODES
- 1- DATE
  - 2- COLLECTOR
  - 3- SITE
- LOGOS
- 1- ANODE
  - 2- CATHODE
  - 3- GATE

## TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010  
LOT CODE 1789  
ASSEMBLED ON WW 19, 2000  
IN THE ASSEMBLY LINE "C"

Note: "P" in assembly line position indicates "Lead-Free"



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

- Notes:
1. For an Automotive Qualified version of this part please see <http://www.irf.com/product-info/auto/>
  2. For the most current drawing please refer to IR website at <http://www.irf.com/package/>

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

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