

# IRF3007SPbF

# IRF3007LPbF

HEXFET® Power MOSFET

## Typical Applications

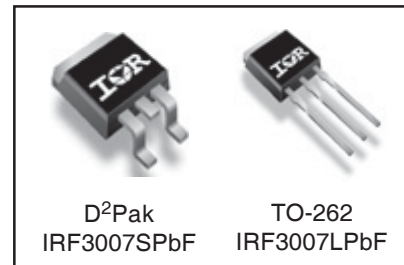
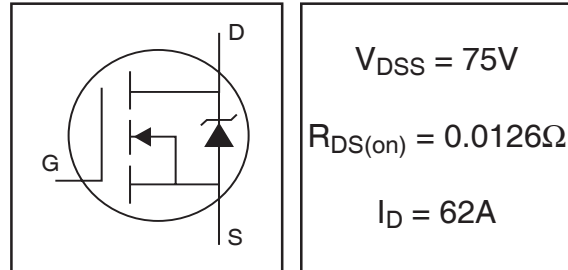
- Industrial Motor Drive

## Features

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

## Description

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 a wide variety of applications.



## Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	62	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	44	
$I_{DM}$	Pulsed Drain Current ①	320	
$P_D @ T_C = 25^\circ C$	Power Dissipation	120	W
	Linear Derating Factor	0.8	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy ②	290	mJ
$E_{AS} (6 \text{ sigma})$	Single Pulse Avalanche Energy Tested Value ③	946	
$I_{AR}$	Avalanche Current ④	See Fig.12a, 12b, 15, 16	A
$E_{AR}$	Repetitive Avalanche Energy ⑤		mJ
$T_J$	Operating Junction and Storage Temperature Range	-55 to + 175	°C
$T_{STG}$			

## Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	1.25	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB Mounted, steady state)**	—	62	

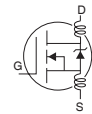
\*\* This is applied to D<sup>2</sup>Pak, when mounted on 1" square PCB ( FR-4 or G-10 Material ).  
 For recommended footprint and soldering techniques refer to application note #AN-994.

# IRF3007S/LPbF

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	75	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.084	—	V/°C	Reference to $25^\circ\text{C}, I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	10.5	12.6	mΩ	$V_{GS} = 10V, I_D = 48A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = 10V, I_D = 250\mu A$
$g_{fs}$	Forward Transconductance	180	—	—	S	$V_{DS} = 25V, I_D = 48A$
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 75V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 60V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-200		$V_{GS} = -20V$
$Q_g$	Total Gate Charge	—	89	130	nC	$I_D = 48A$
$Q_{gs}$	Gate-to-Source Charge	—	21	32		$V_{DS} = 60V$
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	30	45		$V_{GS} = 10V$
$t_{d(on)}$	Turn-On Delay Time	—	12	—	ns	$V_{DD} = 38V$
$t_r$	Rise Time	—	80	—		$I_D = 48A$
$t_{d(off)}$	Turn-Off Delay Time	—	55	—		$R_G = 4.6\Omega$
$t_f$	Fall Time	—	49	—		$V_{GS} = 10V$ ④
$L_D$	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	—	3270	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	520	—		$V_{DS} = 25V$
$C_{rss}$	Reverse Transfer Capacitance	—	78	—		$f = 1.0MHz$ , See Fig. 5
$C_{oss}$	Output Capacitance	—	3500	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$
$C_{oss}$	Output Capacitance	—	340	—		$V_{GS} = 0V, V_{DS} = 60V, f = 1.0MHz$
$C_{oss\ eff.}$	Effective Output Capacitance ⑤	—	640	—		$V_{GS} = 0V, V_{DS} = 0V\ to\ 60V$

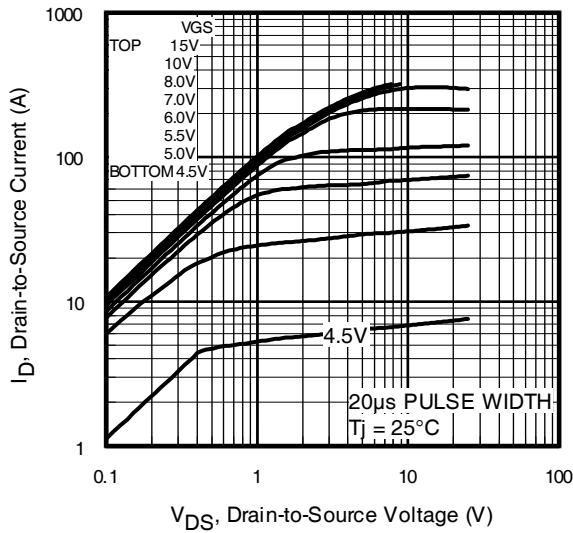


## Source-Drain Ratings and Characteristics

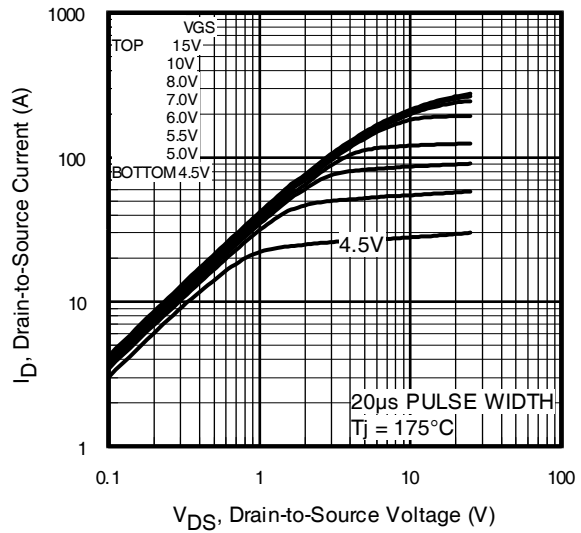
	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	80	A	MOSFET symbol showing the integral reverse p-n junction diode.
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	320		
$V_{SD}$	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 48A, V_{GS} = 0V$ ④
$t_{rr}$	Reverse Recovery Time	—	85	130	ns	$T_J = 25^\circ\text{C}, I_F = 48A, V_{DD} = 38V$
$Q_{rr}$	Reverse Recovery Charge	—	280	420	nC	$di/dt = 100A/\mu s$ ④
$t_{on}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$ )				

### Notes:

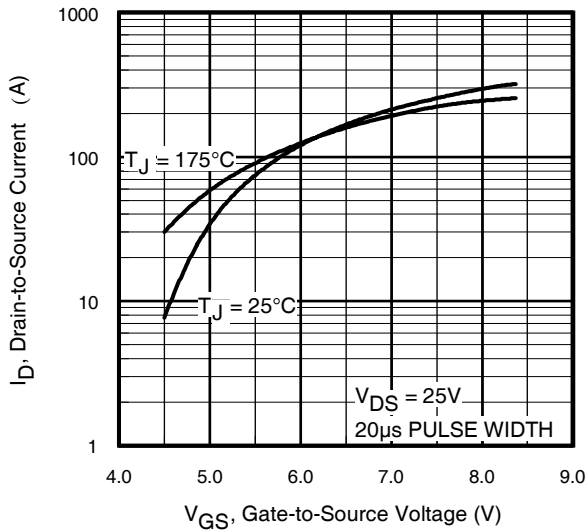
- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.24mH$   
 $R_G = 25\Omega, I_{AS} = 48A, V_{GS} = 10V$  (See Figure 12).
- ③  $I_{SD} \leq 48A, di/dt \leq 330A/\mu s, V_{DD} \leq V_{(BR)DSS}, T_J \leq 175^\circ\text{C}$
- ④ Pulse width  $\leq 400\mu s$ ; duty cycle  $\leq 2\%$ .
- ⑤  $C_{oss\ eff.}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .
- ⑥ Limited by  $T_{Jmax}$ , 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.



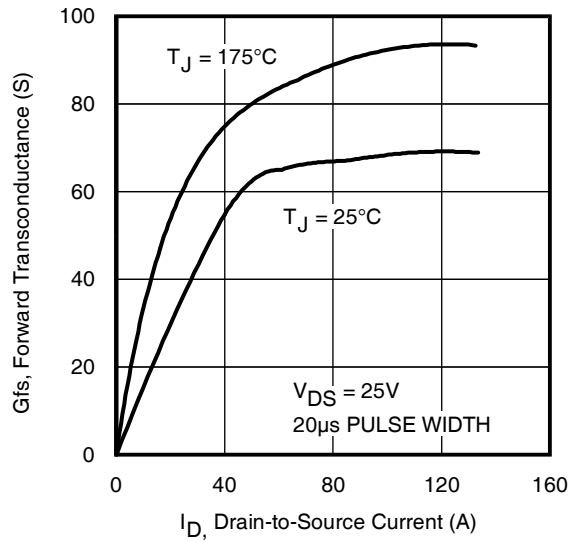
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics

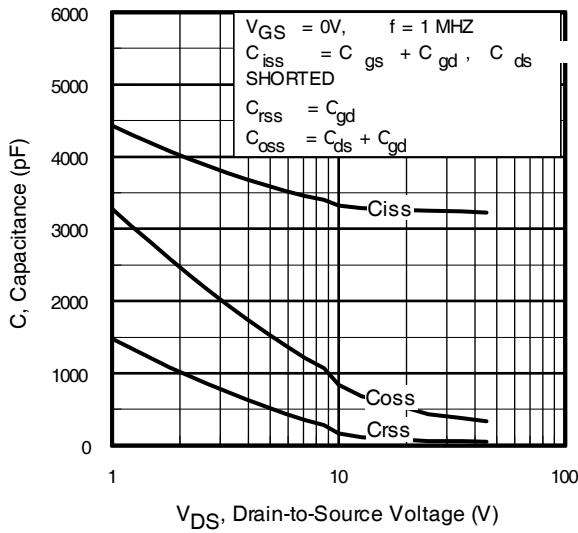


**Fig 3.** Typical Transfer Characteristics

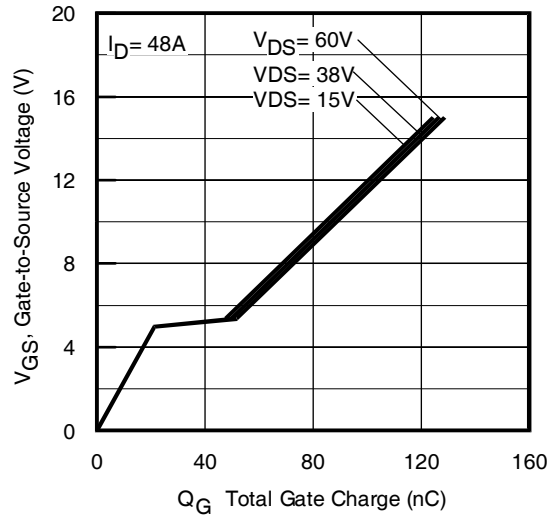


**Fig 4.** Typical Forward Transconductance Vs. Drain Current

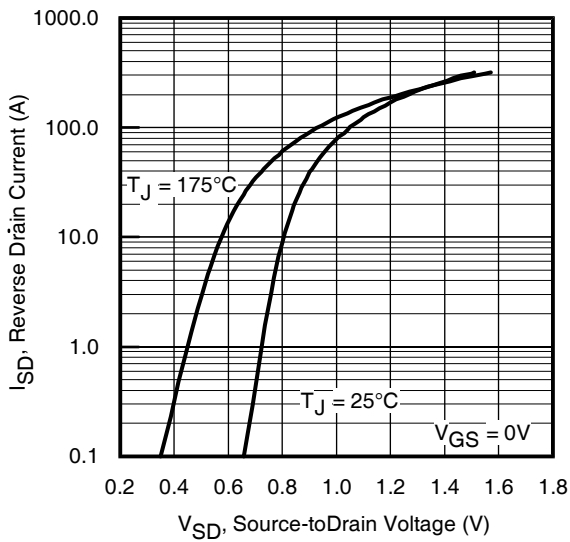
# IRF3007S/LPbF



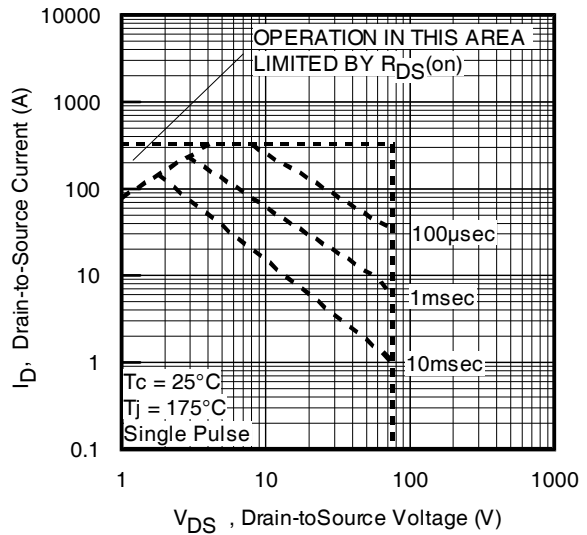
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



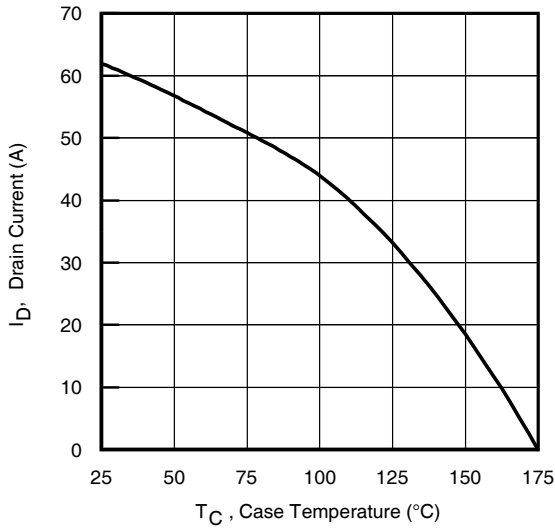
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



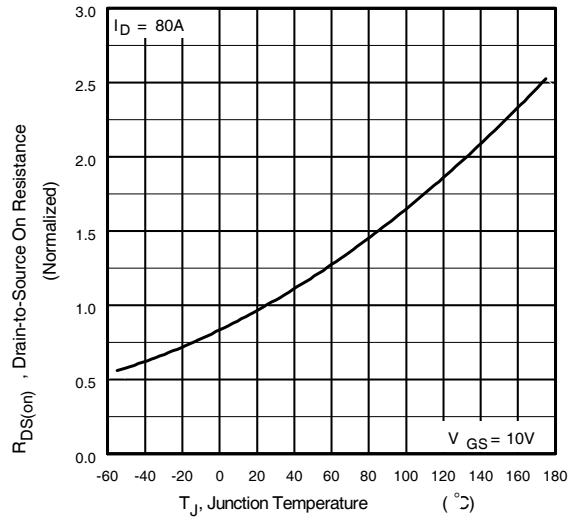
**Fig 7.** Typical Source-Drain Diode Forward Voltage



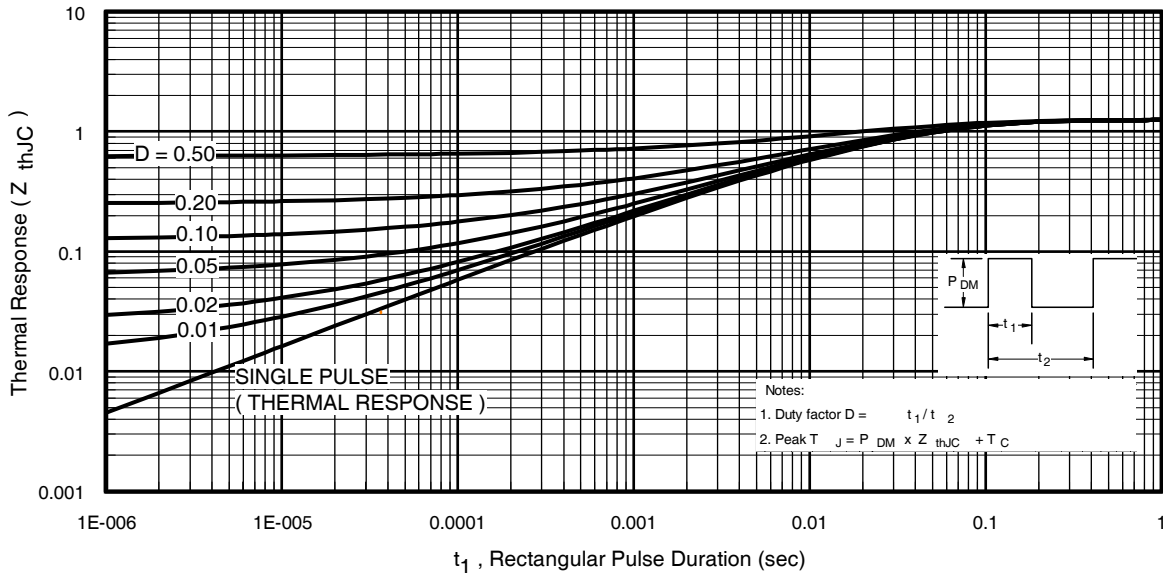
**Fig 8.** Maximum Safe Operating Area



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



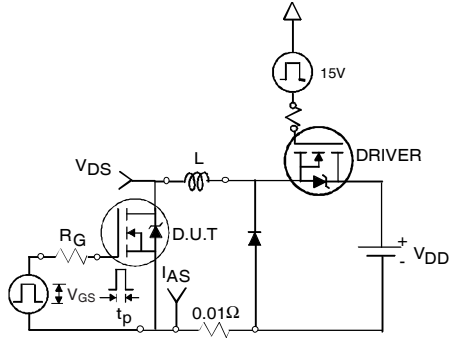
**Fig 10.** Normalized On-Resistance Vs. Temperature



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

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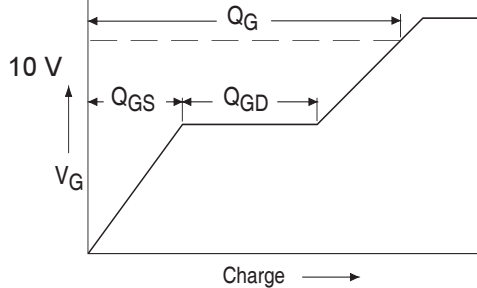
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**Fig 12a.** Unclamped Inductive Test Circuit



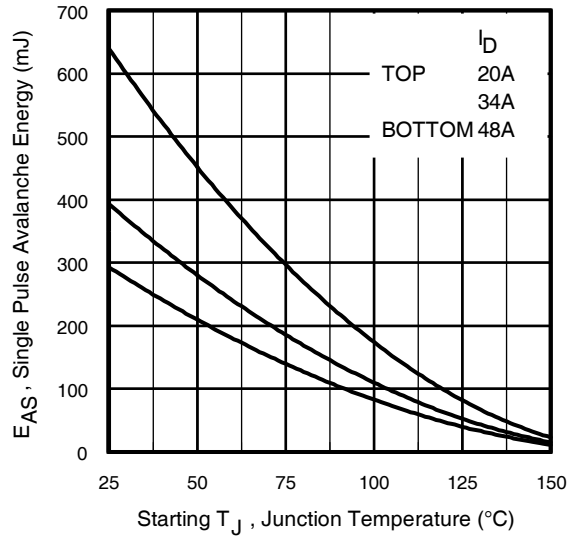
**Fig 12b.** Unclamped Inductive Waveforms



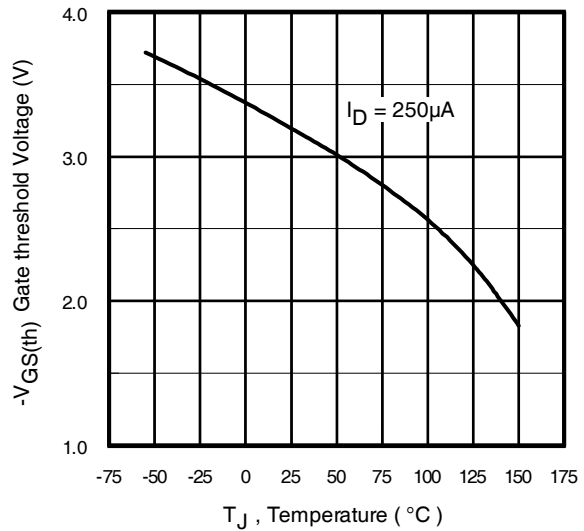
**Fig 13a.** Basic Gate Charge Waveform



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



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



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

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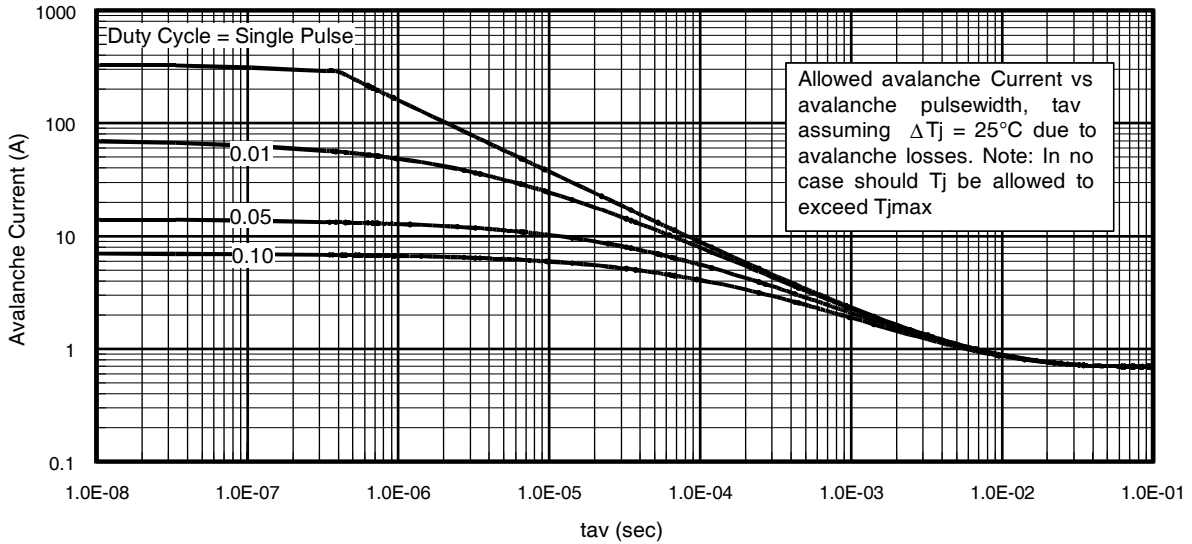


Fig 15. Typical Avalanche Current Vs.Pulsewidth

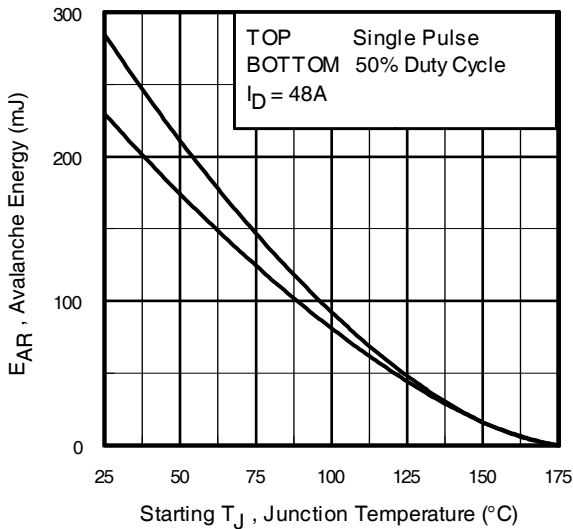


Fig 16. Maximum Avalanche Energy Vs. Temperature

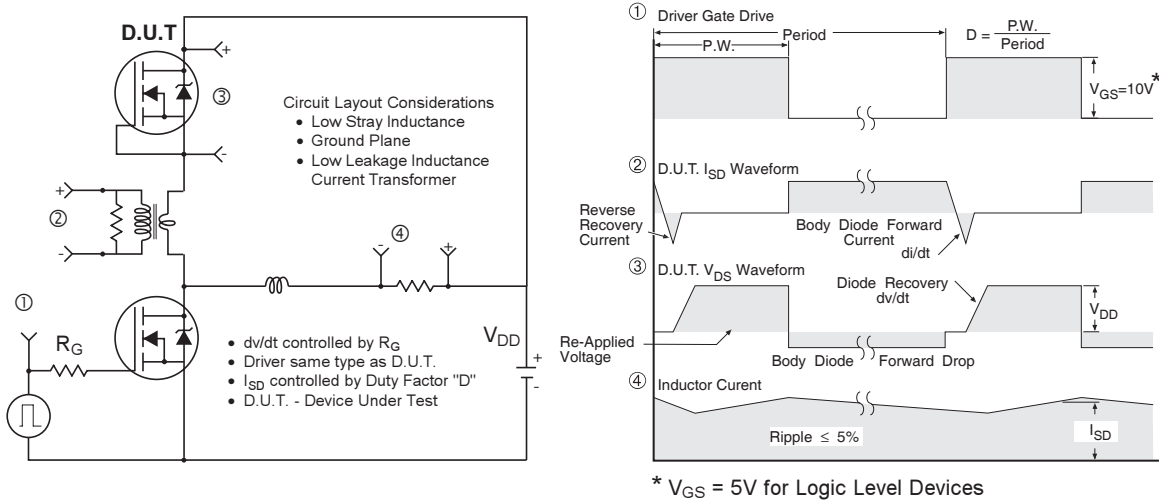
**Notes on Repetitive Avalanche Curves , Figures 15, 16:  
(For further info, see AN-1005 at www.irf.com)**

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)

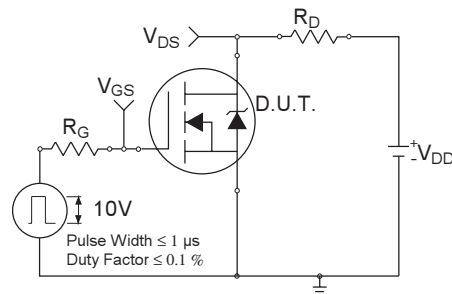
$$P_{D(ave)} = 1/2 ( 1.3 \cdot BV \cdot I_{av} ) = \Delta T / Z_{thJC}$$

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

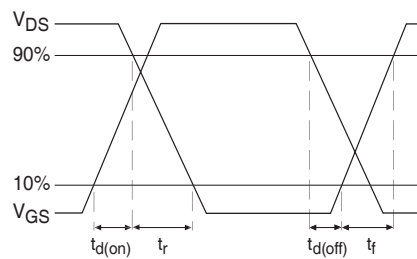
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



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



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

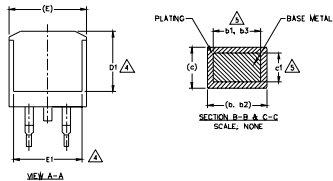
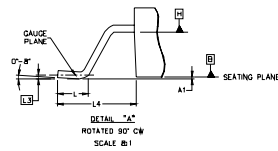
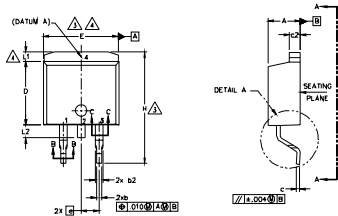


**Fig 18b. Switching Time Waveforms**



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**D<sup>2</sup>Pak (TO-263AB) Package Outline**  
 Dimensions are shown in millimeters (inches)

# IRF3007S/LPbF



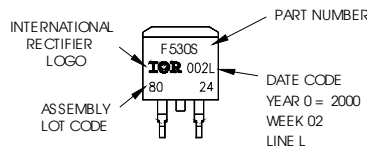
SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	5
b1	0.51	0.89	.020	.035	
b2	1.14	1.78	.045	.070	5
b3	1.14	1.73	.045	.068	
c	0.38	0.74	.015	.029	5
c1	0.38	0.58	.015	.023	
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	-	.270	-	4
E	9.65	10.67	.380	.420	3,4
E1	6.22	-	.245	-	4
e	2.54 BSC		.100 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	4
L1	-	1.65	-	.066	
L2	-	1.78	-	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	

- NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994  
 2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].  
 3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.  
 4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.  
 5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.  
 6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.  
 7. CONTROLLING DIMENSION: INCH.  
 8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.

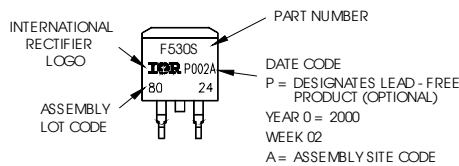
## D<sup>2</sup>Pak (TO-263AB) Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH  
 LOT CODE 8024  
 ASSEMBLED ON WW 02, 2000  
 IN THE ASSEMBLY LINE "L"

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



OR



### Notes:

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

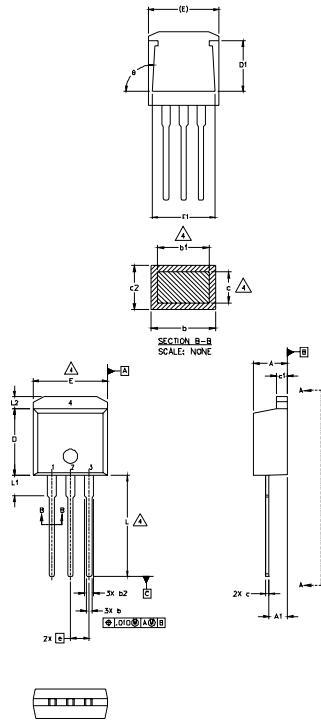
[www.irf.com](http://www.irf.com)

# IRF3007S/LPbF

## TO-262 Package Outline

Dimensions are shown in millimeters (inches)

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**IR** Rectifier



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	2.03	2.92	.080	.115	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	4
b2	1.14	1.40	.045	.055	
c	0.38	0.63	.015	.025	4
c1	1.14	1.40	.045	.055	
c2	0.43	.063	.017	.029	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	13.46	14.09	.530	.555	
L1	3.56	3.71	.140	.146	
L2		1.65		.065	

### LEAD ASSIGNMENTS

#### HEXFET

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN

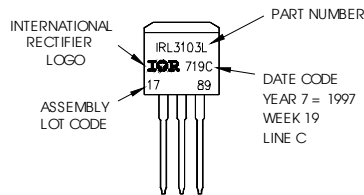
#### IGBT

- 1 - GATE
- 2 - COLLECTOR
- 3 - EMITTER

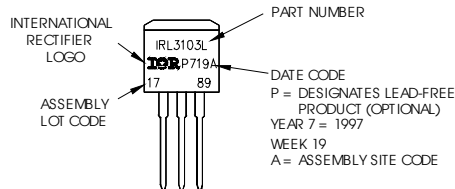
ES- DIMENSIONING AND TOLERANCING PER ASME Y14.6M-1994  
 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].  
 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.  
 DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.  
 5. CONTROLLING DIMENSION: INCH.

## TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 1997  
 IN THE ASSEMBLY LINE "C"  
 Note: "P" in assembly line position indicates "Lead-Free"



OR

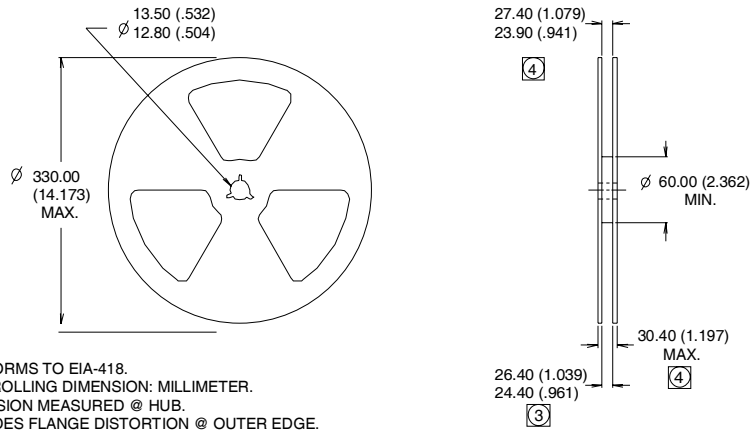
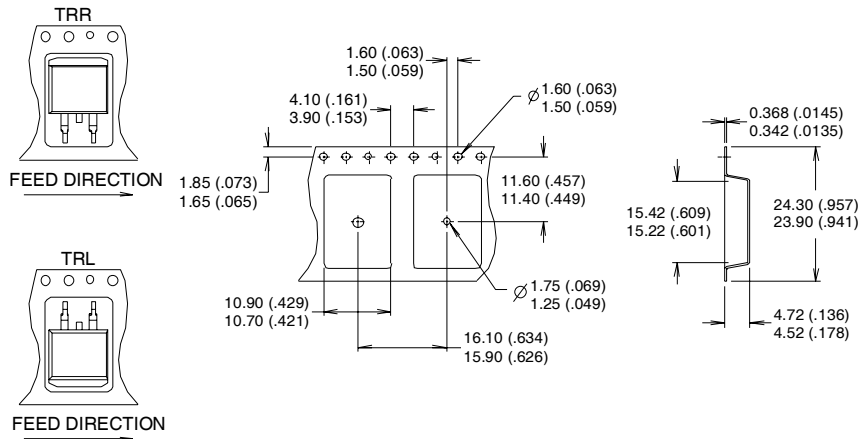


### Notes:

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

## D<sup>2</sup>Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



- NOTES :
1. COMFORMS TO EIA-418.
  2. CONTROLLING DIMENSION: MILLIMETER.
  - ③ DIMENSION MEASURED @ HUB.
  - ④ INCLUDES FLANGE DISTORTION @ OUTER EDGE.

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.