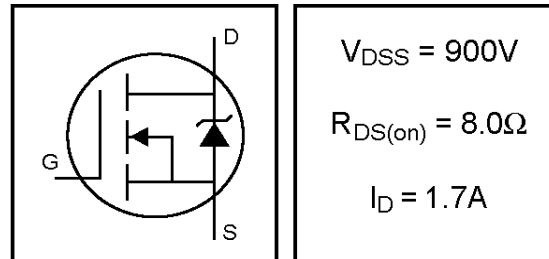


# IRFBF20S/LPbF

## HEXFET® Power MOSFET

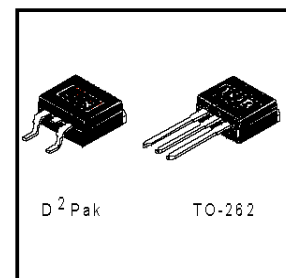
- Surface Mount (IRFBF20S)
- Low-profile through-hole (IRFBF20L)
- Available in Tape & Reel (IRFBF20S)
- Dynamic dv/dt Rating
- 150°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Lead-Free



### Description

Third generation HEXFETs from International Rectifier provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The D<sup>2</sup>Pak is a surface mount power package capable of accommodating die sizes up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface mount package. The D<sup>2</sup>Pak is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0W in a typical surface mount application. The through-hole version (IRFBF20L) is available for low-profile applications.



### Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}^{\text{③}}$	1.7	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}^{\text{③}}$	1.1	
$I_{DM}$	Pulsed Drain Current ①⑤	6.8	
$P_D @ T_A = 25^\circ\text{C}$	Power Dissipation	3.1	W
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation	54	W
	Linear Derating Factor	0.43	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy ②⑤	180	mJ
$I_{AR}$	Avalanche Current ①	1.7	A
$E_{AR}$	Repetitive Avalanche Energy ①	5.4	mJ
dv/dt	Peak Diode Recovery dv/dt ③⑤	1.5	V/ns
$T_J$	Operating Junction and	-55 to + 150	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case )	

### Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	---	2.3	°C/W
$R_{\theta JA}$	Junction-to-Ambient ( PCB Mounted, steady-state)**	---	40	

## 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	900	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
ΔV <sub>(BR)DSS/ΔT<sub>J</sub></sub>	Breakdown Voltage Temp. Coefficient	—	1.1	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1mA <sup>⑤</sup>
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	—	8.0	Ω	V <sub>GS</sub> = 10V, I <sub>D</sub> = 1.0A <sup>④</sup>
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	—	4.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
g <sub>fs</sub>	Forward Transconductance	0.60	—	—	S	V <sub>DS</sub> = 50V, I <sub>D</sub> = 1.0A <sup>⑤</sup>
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	100	μA	V <sub>DS</sub> = 900V, V <sub>GS</sub> = 0V V <sub>DS</sub> = 720V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GSS</sub>	Gate-to-Source Forward Leakage	—	—	100	nA	V <sub>GS</sub> = 20V
	Gate-to-Source Reverse Leakage	—	—	-100	nA	V <sub>GS</sub> = -20V
Q <sub>g</sub>	Total Gate Charge	—	—	38	nC	I <sub>D</sub> = 1.7A
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	4.7	nC	V <sub>DS</sub> = 360V
Q <sub>gd</sub>	Gate-to-Drain ("Miller") Charge	—	—	21	nC	V <sub>GS</sub> = 10V, See Fig. 6 and 13 <sup>④⑤</sup>
t <sub>d(on)</sub>	Turn-On Delay Time	—	8.0	—	ns	V <sub>DD</sub> = 450V
t <sub>r</sub>	Rise Time	—	21	—		I <sub>D</sub> = 1.7A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	56	—		R <sub>G</sub> = 18Ω
t <sub>f</sub>	Fall Time	—	32	—		R <sub>D</sub> = 280Ω, See Fig. 10 <sup>④⑤</sup>
L <sub>S</sub>	Internal Source Inductance	—	7.5	—	nH	Between lead, and center of die contact
C <sub>iss</sub>	Input Capacitance	—	490	—	pF	V <sub>GS</sub> = 0V
C <sub>oss</sub>	Output Capacitance	—	55	—		V <sub>DS</sub> = 25V
C <sub>rss</sub>	Reverse Transfer Capacitance	—	18	—		f = 1.0MHz, See Fig. 5 <sup>⑤</sup>

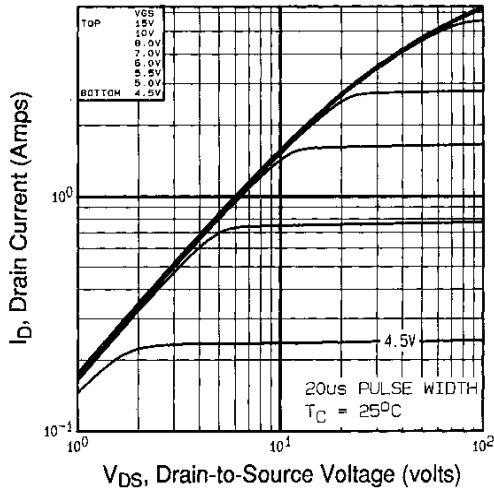
## Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	1.7	A	MOSFET symbol showing the integral reverse p-n junction diode.
I <sub>SM</sub>	Pulsed Source Current (Body Diode) <sup>①</sup>	—	—	6.8		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.5	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 1.7A, V <sub>GS</sub> = 0V <sup>④</sup>
t <sub>rr</sub>	Reverse Recovery Time	—	350	530	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = 1.7A
Q <sub>rr</sub>	Reverse Recovery Charge	—	0.85	1.3	μC	di/dt = 100A/μs <sup>④⑤</sup>
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> )				

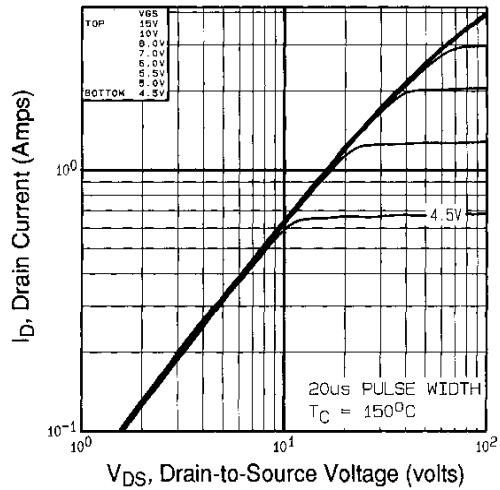
### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. ( See fig. 11 )
- ② V<sub>DD</sub> = 50V, starting T<sub>J</sub> = 25°C, L = 117mH  
R<sub>G</sub> = 25Ω, I<sub>AS</sub> = 1.7A. (See Figure 11)
- ③ I<sub>SD</sub> ≤ 1.7A, di/dt ≤ 70A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>,  
T<sub>J</sub> ≤ 150°C
- ④ Pulse width ≤ 300μs; duty cycle ≤ 2%.
- ⑤ Uses IRFBF20 data and test conditions

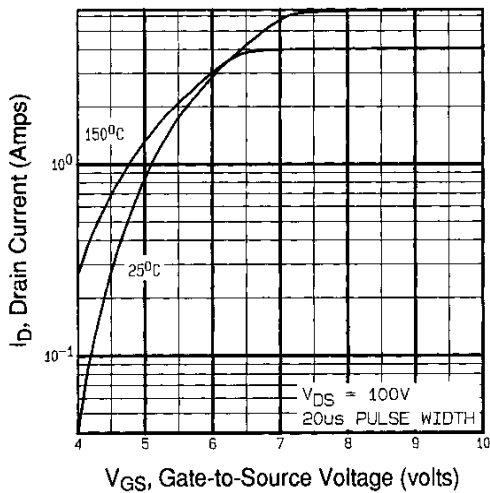
\*\* When mounted on 1" square PCB (FR-4 or G-10 Material ).  
For recommended footprint and soldering techniques refer to application note #AN-994.



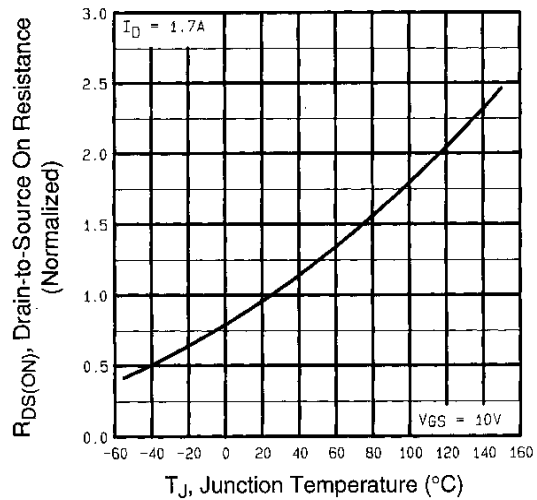
**Fig 1.** Typical Output Characteristics,



**Fig 2.** Typical Output Characteristics,

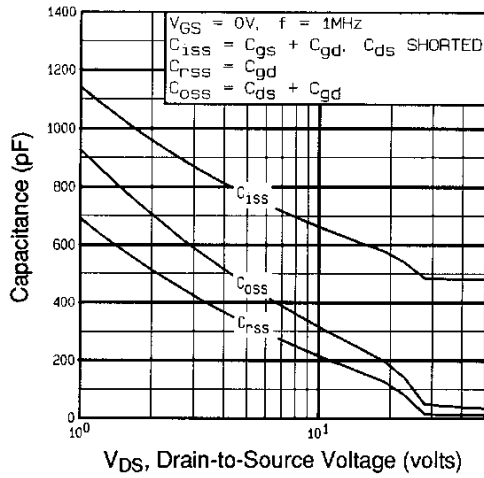


**Fig 3.** Typical Transfer Characteristics

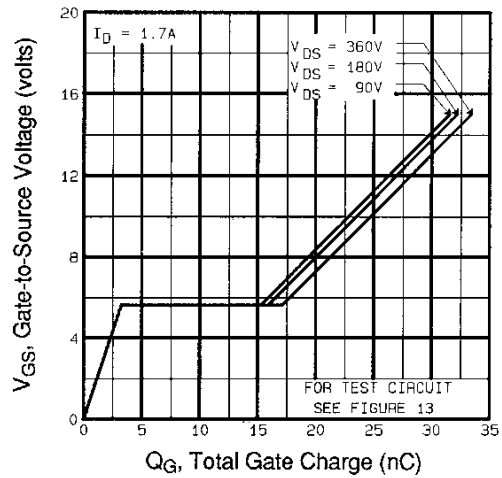


**Fig 4.** Normalized On-Resistance Vs. Temperature

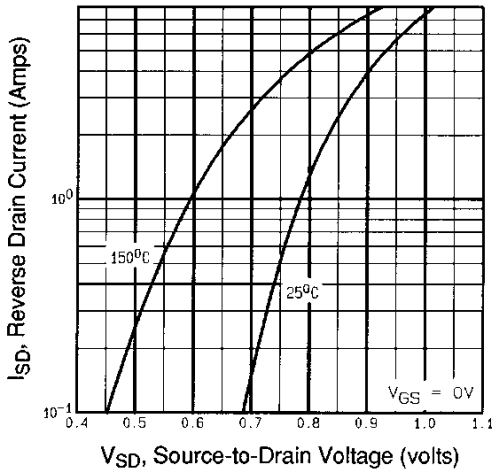
# IRFBF20S/LPbF



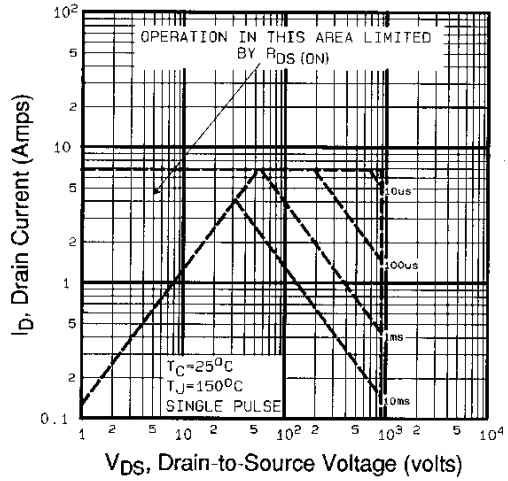
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



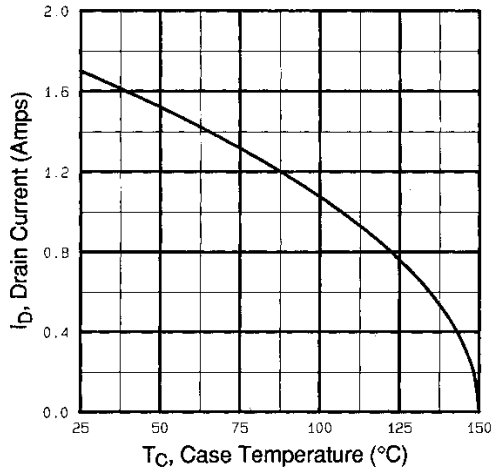
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



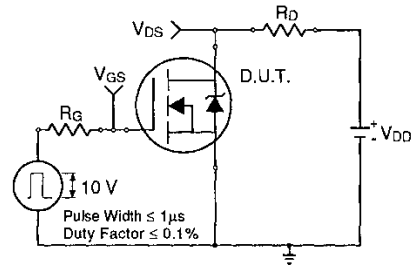
**Fig 7.** Typical Source-Drain Diode Forward Voltage



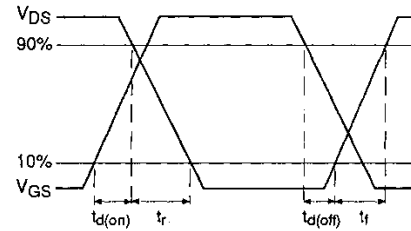
**Fig 8.** Maximum Safe Operating Area



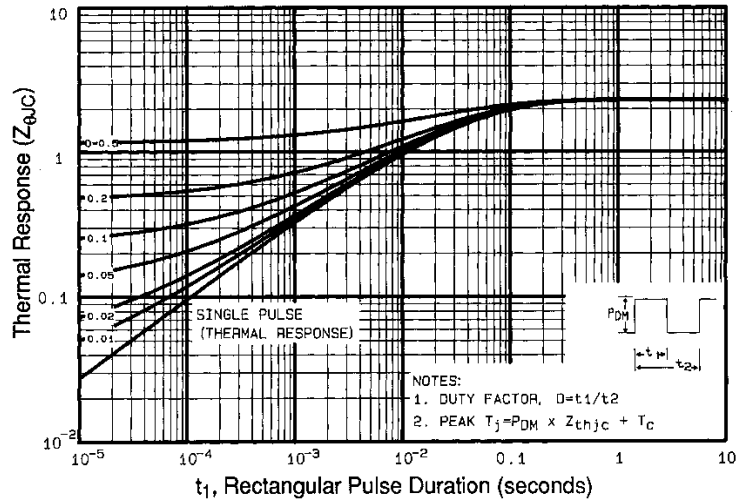
**Fig 9.** Maximum Drain Current Vs. Case Temperature



**Fig 10a.** Switching Time Test Circuit

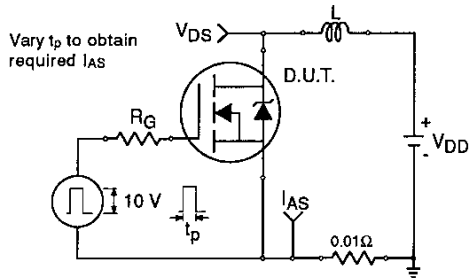


**Fig 10b.** Switching Time Waveforms

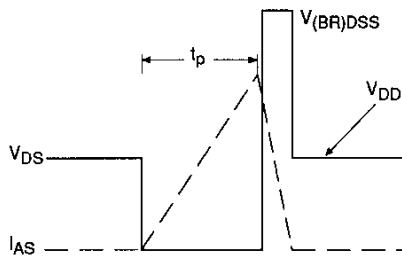


**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

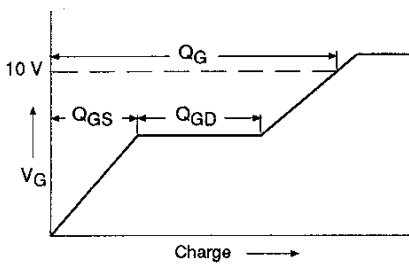
# IRFBF20S/LPbF



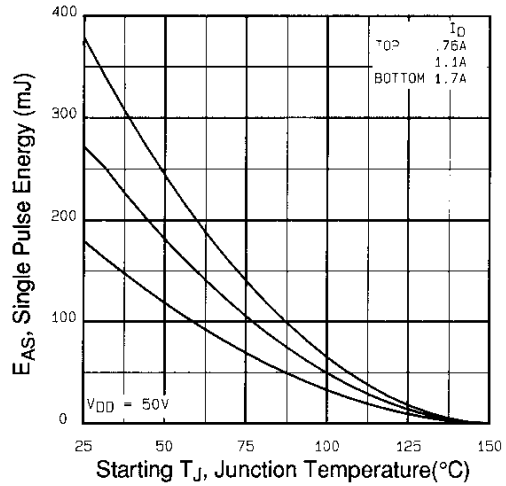
**Fig 12a.** Unclamped Inductive Test Circuit



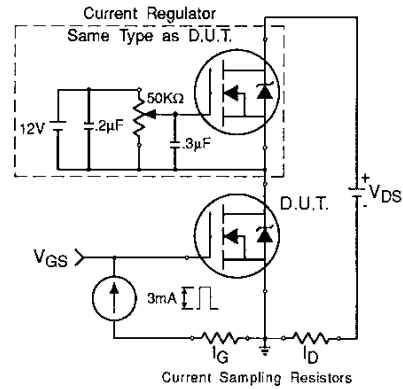
**Fig 12b.** Unclamped Inductive Waveforms



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

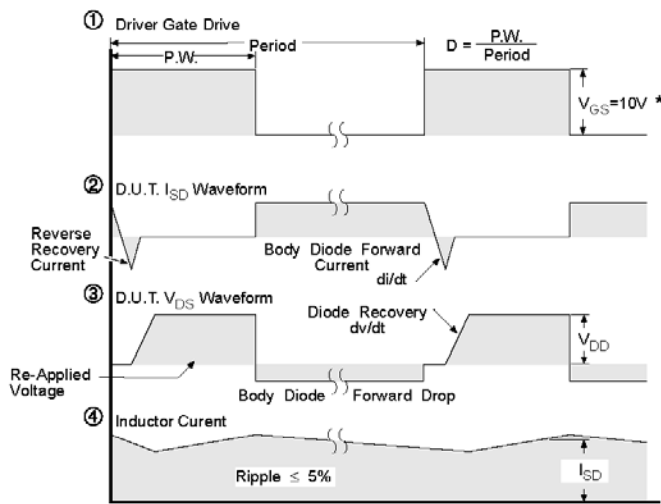
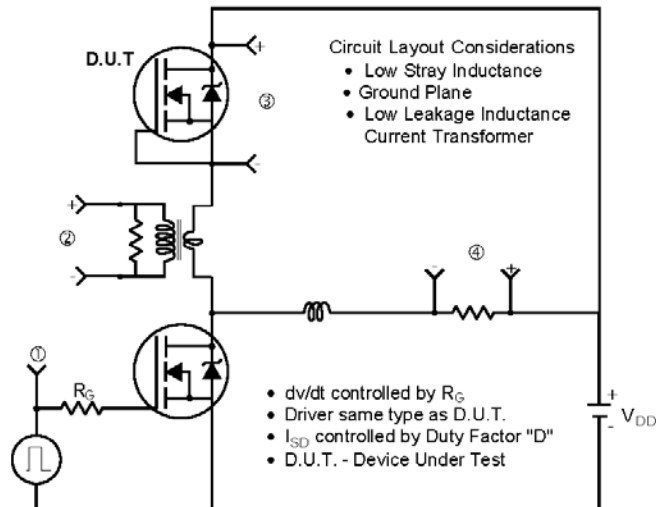


**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



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

## Peak Diode Recovery dv/dt Test Circuit



\*  $V_{GS} = 5V$  for Logic Level Devices

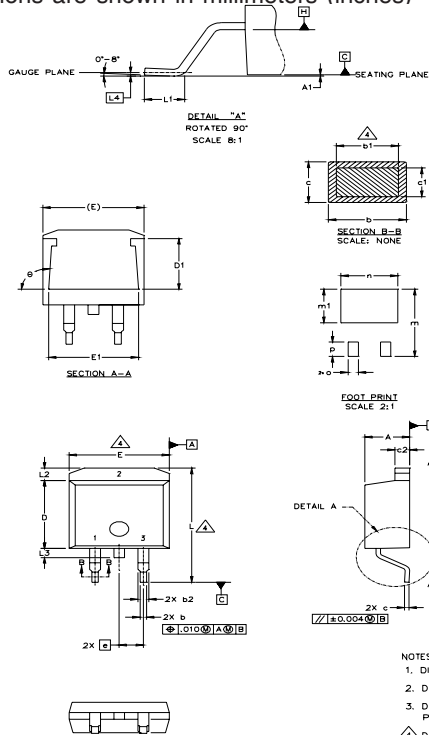
Fig 14. For N-Channel HEXFETS

# IRF530S/LPbF

International  
**IR** Rectifier

## D<sup>2</sup>Pak Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1		0.127		.005	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.40	.045	.055	4
c	0.43	0.63	.017	.025	
c1	0.38	0.74	.015	.029	3
c2	1.14	1.40	.045	.055	
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	14.61	15.88	.575	.625	
L1	1.78	2.79	.070	.110	
L2		1.65		.065	
L3	1.27	1.78	.050	.070	
L4	0.25 BSC		.010 BSC		
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
θ	90°	9.3°	90°	9.3°	

### LEAD ASSIGNMENTS

HEXFET	IGBTs, CoPACK	DIODES
1.- GATE	1.- GATE	1.- ANODE *
2.- DRAIN	2.- COLLECTOR	2.- CATHODE
3.- SOURCE	3.- EMITTER	3.- ANODE

\* PART DEPENDENT.

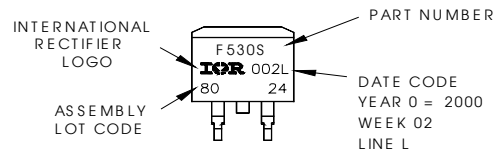
### NOTES:

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.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

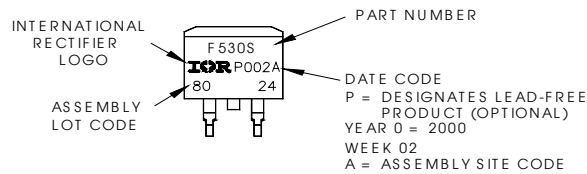
## D<sup>2</sup>Pak Part Marking Information (Lead-Free)

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"

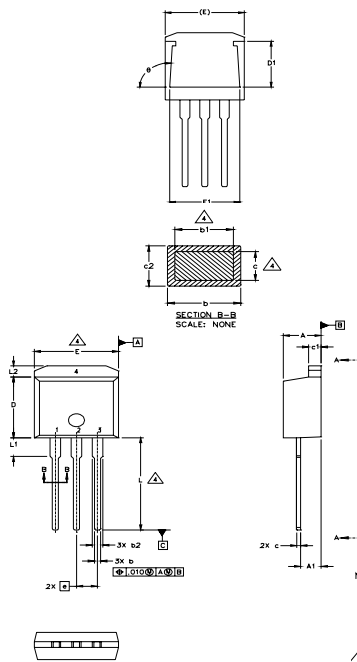


**OR**





## TO-262 Package Outline



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	4
b1	0.51	0.89	.020	.035	
b2	1.14	1.40	.045	.055	4
c	0.38	0.63	.015	.025	
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

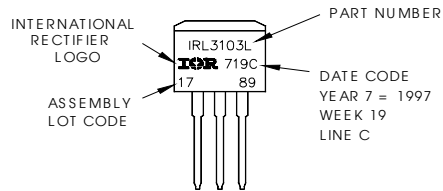
- 1 - GATE
- 2 - COLLECTOR
- 3 - EMITTER

#### NOTES:

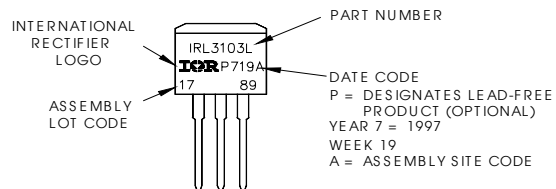
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY 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"



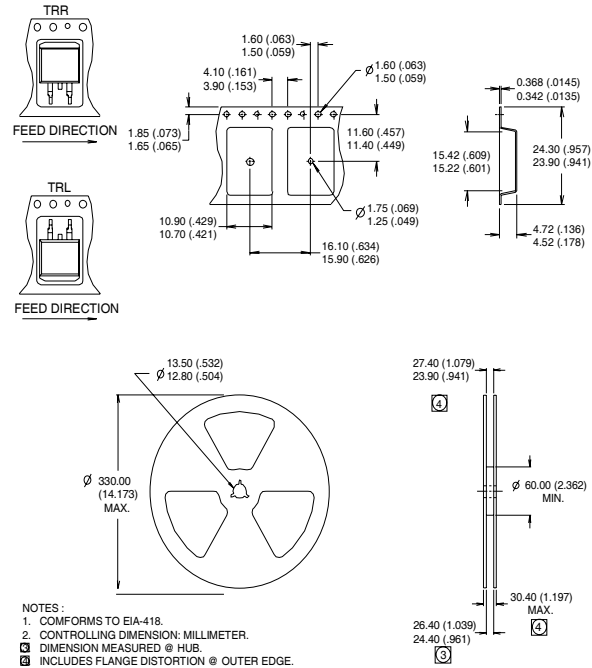
**OR**



# IRFBF20S/LPbF

International  
**IR** Rectifier

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



Data and specifications subject to change without notice.

International  
**IR** Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105

TAC Fax: (310) 252-7903

Visit us at [www.irf.com](http://www.irf.com) for sales contact information.07/04

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