

# IRL3502SPbF

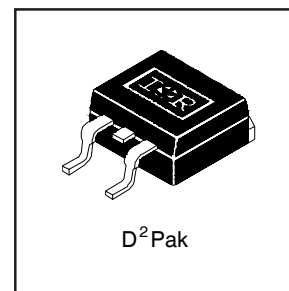
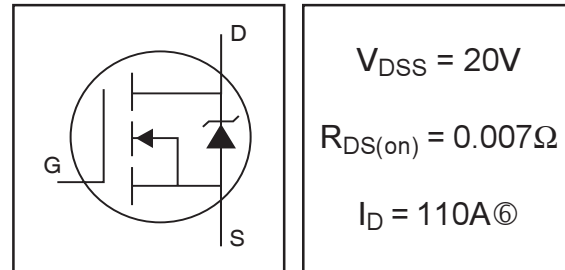
HEXFET® Power MOSFET

- Advanced Process Technology
- Surface Mount
- Optimized for 4.5V-7.0V Gate Drive
- Ideal for CPU Core DC-DC Converters
- Fast Switching
- Lead-Free

## Description

These HEXFET Power MOSFETs were designed specifically to meet the demands of CPU core DC-DC converters in the PC environment. Advanced processing techniques combined with an optimized gate oxide design results in a die sized specifically to offer maximum efficiency at minimum cost.

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.



## Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 4.5\text{V}$ Ⓞ	110Ⓞ	A
$I_D @ T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 4.5\text{V}$ Ⓞ	67	
$I_{DM}$	Pulsed Drain Current ① ⑤	420	
$P_D @ T_C = 25^\circ\text{C}$	Power Dissipation	140	W
	Linear Derating Factor	1.1	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 10$	V
$V_{GSM}$	Gate-to-Source Voltage (Start Up Transient, $t_p = 100\mu\text{s}$ )	14	V
$E_{AS}$	Single Pulse Avalanche Energy② ⑤	390	mJ
$I_{AR}$	Avalanche Current①	64	A
$E_{AR}$	Repetitive Avalanche Energy①	14	mJ
dv/dt	Peak Diode Recovery dv/dt ③ ⑤	5.0	V/ns
$T_J$	Operating Junction and Storage Temperature Range	-55 to + 150	°C
$T_{STG}$			
	Soldering Temperature, for 10 seconds	300 (1.6mm from case )	

## Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	---	0.89	°C/W
$R_{\theta JA}$	Junction-to-Ambient ( PCB Mounted, steady-state)**	---	40	

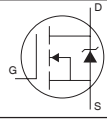
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## Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)DSS</sub>	Drain-to-Source Breakdown Voltage	20	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	0.019	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1.0mA <sup>⑤</sup>
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	—	0.008	Ω	V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 64A <sup>④</sup>
		—	—	0.007		V <sub>GS</sub> = 7.0V, I <sub>D</sub> = 64A <sup>④</sup>
V <sub>GS(th)</sub>	Gate Threshold Voltage	0.70	—	—	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
g <sub>fs</sub>	Forward Transconductance	77	—	—	S	V <sub>DS</sub> = 10V, I <sub>D</sub> = 64A <sup>⑤</sup>
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	25	μA	V <sub>DS</sub> = 20V, V <sub>GS</sub> = 0V
		—	—	250		V <sub>DS</sub> = 10V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 150°C
I <sub>GSS</sub>	Gate-to-Source Forward Leakage	—	—	100	nA	V <sub>GS</sub> = 10V
	Gate-to-Source Reverse Leakage	—	—	-100		V <sub>GS</sub> = -10V
Q <sub>g</sub>	Total Gate Charge	—	—	110	nC	I <sub>D</sub> = 64A
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	27		V <sub>DS</sub> = 16V
Q <sub>gd</sub>	Gate-to-Drain ("Miller") Charge	—	—	39		V <sub>GS</sub> = 4.5V, See Fig. 6 <sup>④⑤</sup>
t <sub>d(on)</sub>	Turn-On Delay Time	—	10	—	ns	V <sub>DD</sub> = 10V
t <sub>r</sub>	Rise Time	—	140	—		I <sub>D</sub> = 64A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	96	—		R <sub>G</sub> = 3.8Ω, V <sub>GS</sub> = 4.5V
t <sub>f</sub>	Fall Time	—	130	—		R <sub>D</sub> = 0.15Ω, <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	—	4700	—	pF	V <sub>GS</sub> = 0V
C <sub>oss</sub>	Output Capacitance	—	1900	—		V <sub>DS</sub> = 15V
C <sub>rss</sub>	Reverse Transfer Capacitance	—	640	—		f = 1.0MHz, See Fig. 5 <sup>⑤</sup>

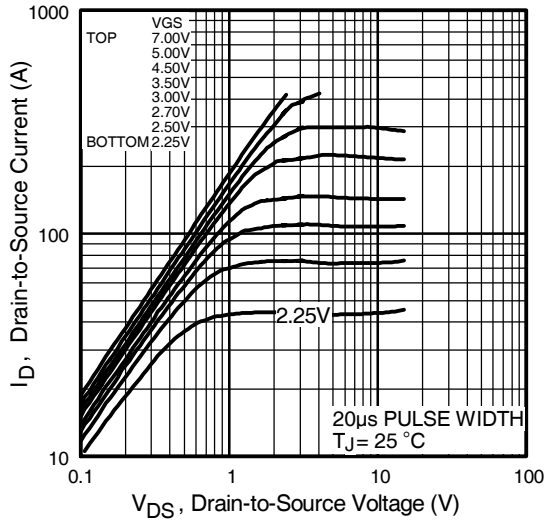
## Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	110 <sup>⑥</sup>	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I <sub>SM</sub>	Pulsed Source Current (Body Diode) <sup>①⑤</sup>	—	—	420		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.3	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 64A, V <sub>GS</sub> = 0V <sup>④</sup>
t <sub>rr</sub>	Reverse Recovery Time	—	87	130	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = 64A
Q <sub>rr</sub>	Reverse Recovery Charge	—	200	310	nC	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> )				

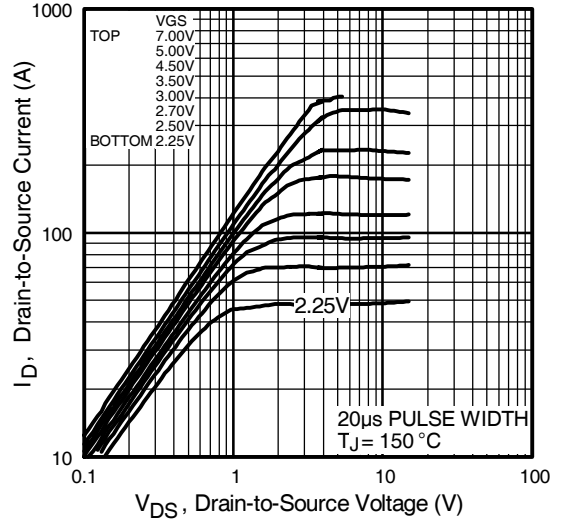
### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting T<sub>J</sub> = 25°C, L = 190μH  
R<sub>G</sub> = 25Ω, I<sub>AS</sub> = 64A.
- ③ I<sub>SD</sub> ≤ 64A, di/dt ≤ 86A/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 IRL3502 data and test conditions
- ⑥ Calculated continuous current based on maximum allowable junction temperature; for recommended current-handling of the package refer to Design Tip # 93-4

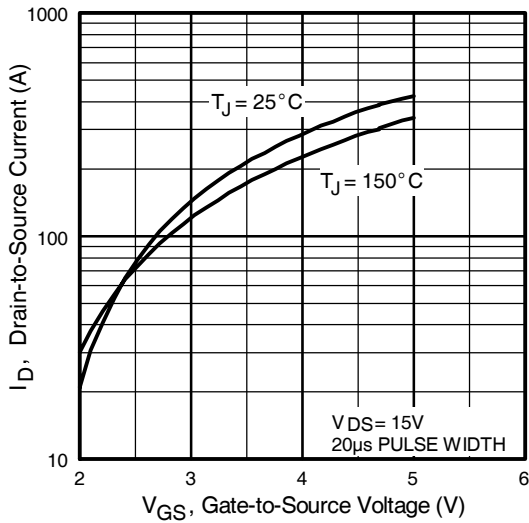
\*\* When mounted on FR-4 board using minimum recommended footprint.  
For recommended footprint and soldering techniques refer to application note #AN-994.



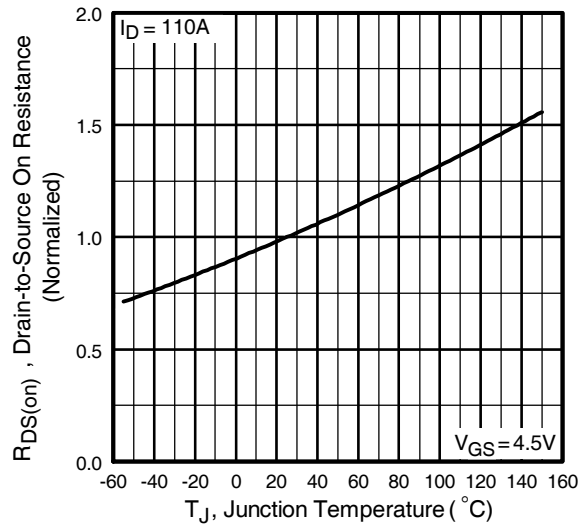
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics

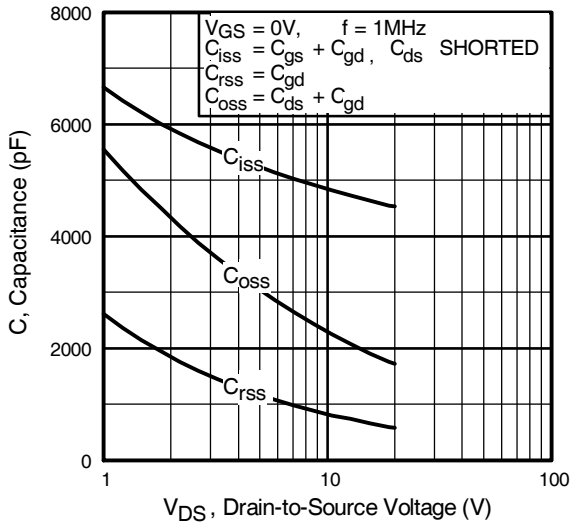


**Fig 3.** Typical Transfer Characteristics

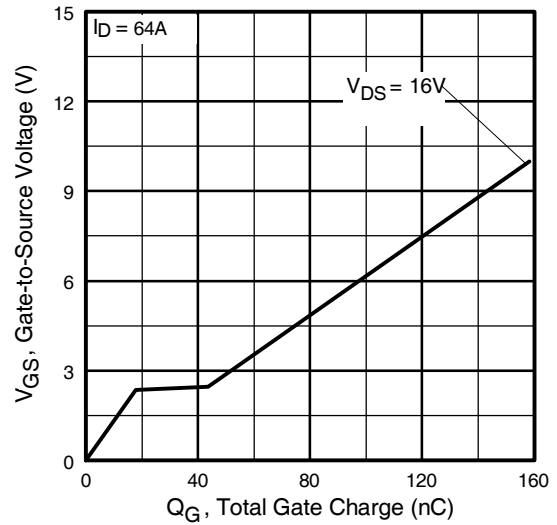


**Fig 4.** Normalized On-Resistance Vs. Temperature

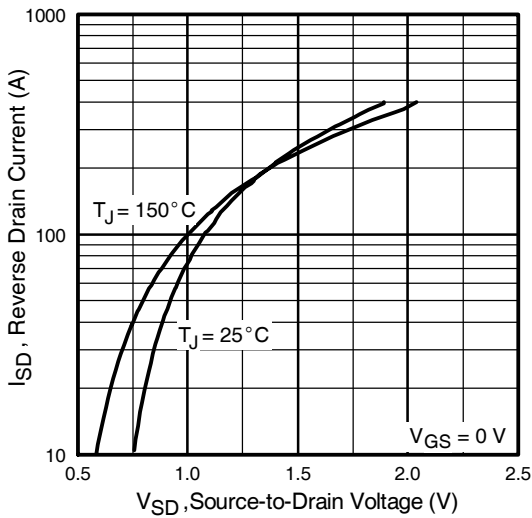
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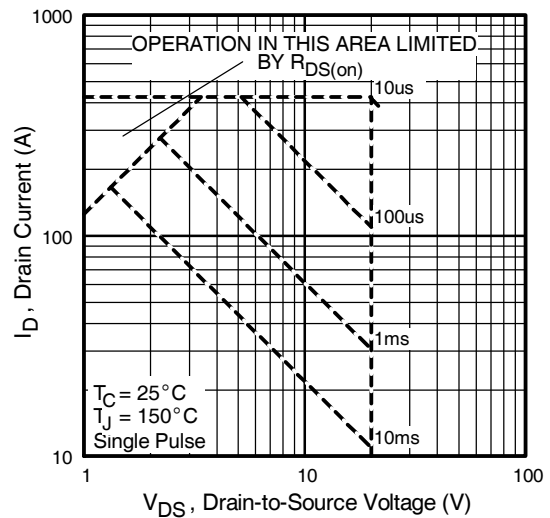
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



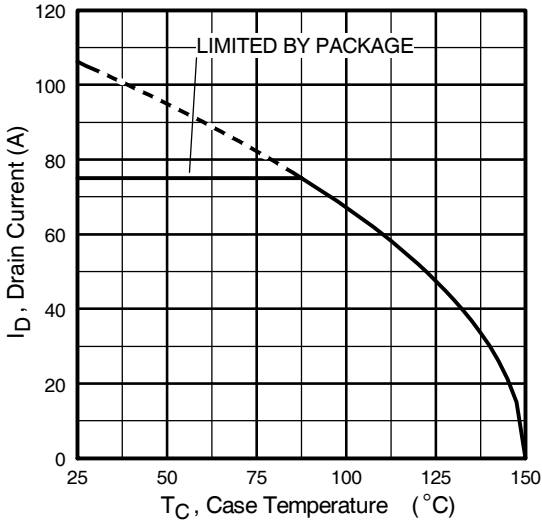
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



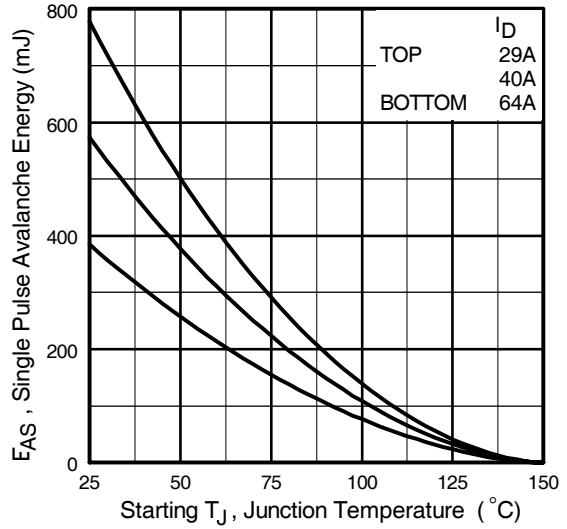
**Fig 7.** Typical Source-Drain Diode Forward Voltage



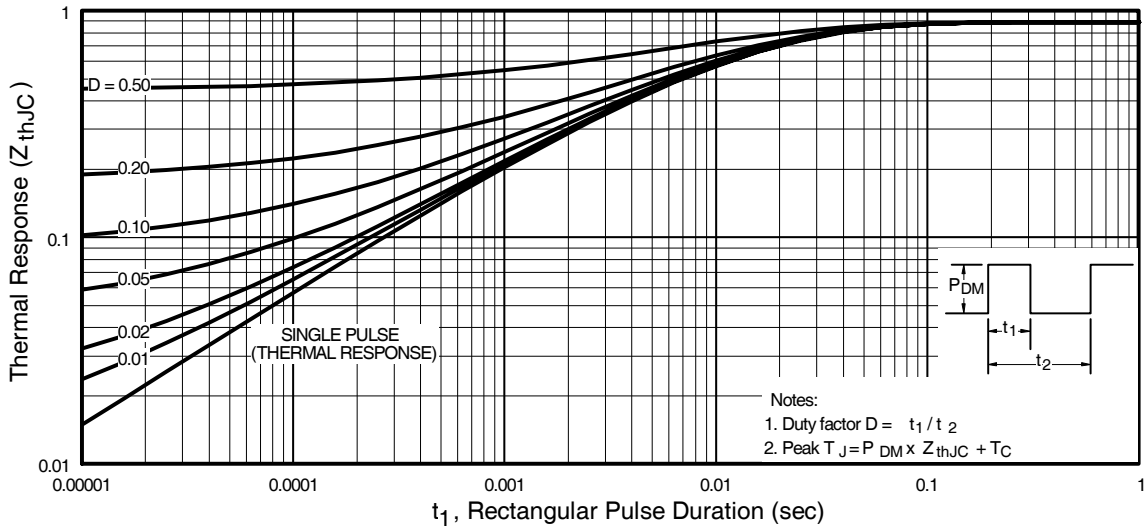
**Fig 8.** Maximum Safe Operating Area



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



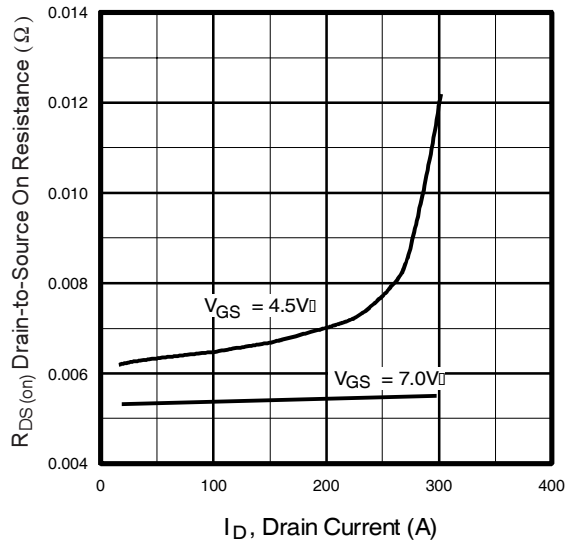
**Fig 10.** Maximum Avalanche Energy Vs. Drain Current



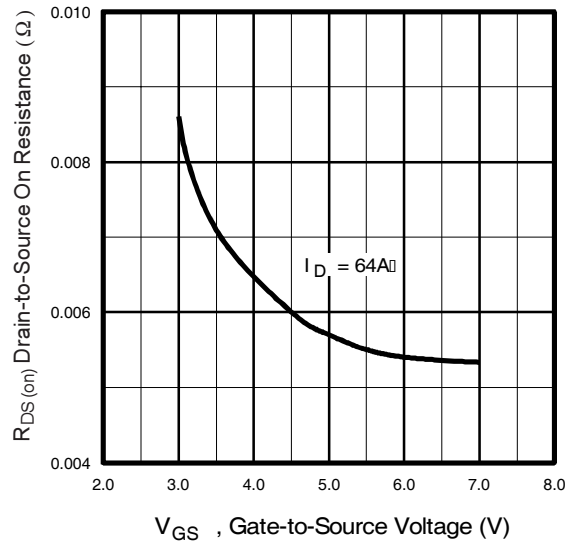
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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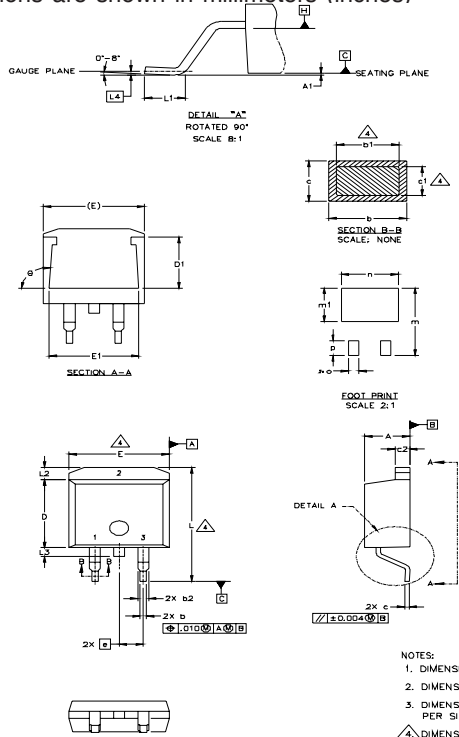
**Fig 12.** On-Resistance Vs. Drain Current



**Fig 13.** On-Resistance Vs. Gate Voltage

## 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	4
b2	1.14	1.40	.045	.055	
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	
D1	5.33		.210		3
E	9.65	10.67	.380	.420	
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

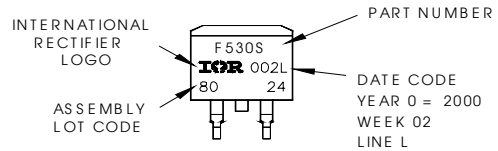
\* PART DEPENDENT.

- 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.

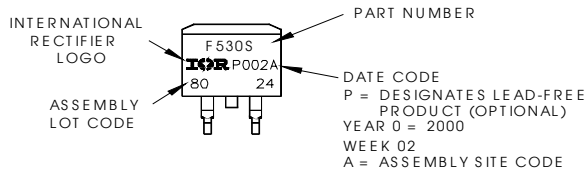
## D<sup>2</sup>Pak Part Marking Information (Lead-Free)

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**

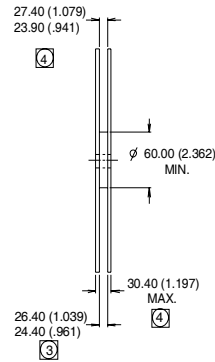
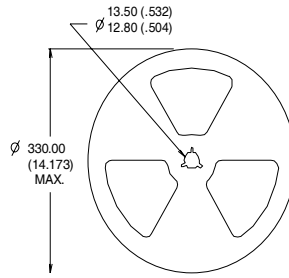
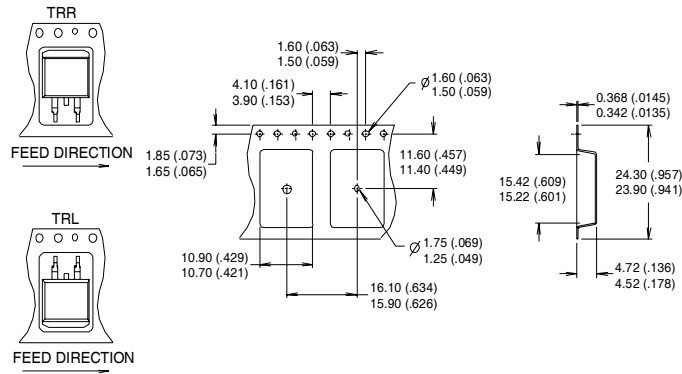


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## D<sup>2</sup>Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



- NOTES:
1. CONFORMS 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.

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