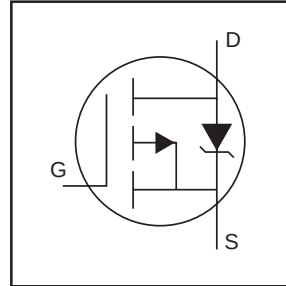


- Ultra Low On-Resistance
- Surface Mount (IRFR5305)
- Straight Lead (IRFU5305)
- Advanced Process Technology
- Fast Switching
- Fully Avalanche Rated
- Lead-Free



$$V_{DS} = -55V$$

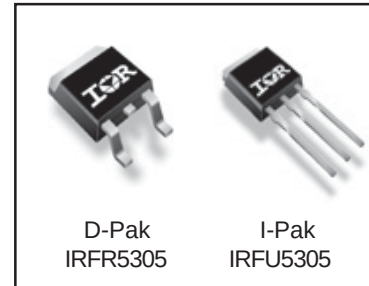
$$R_{DS(on)} = 0.065\Omega$$

$$I_D = -31A$$

## Description

Fifth Generation HEXFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET® Power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The D-Pak is designed for surface mounting using vapor phase, infrared, or wave soldering techniques. The straight lead version (IRFU series) is for through-hole mounting applications. Power dissipation levels up to 1.5 watts are possible in typical surface mount applications.



D-Pak  
IRFR5305

I-Pak  
IRFU5305

## Absolute Maximum Ratings

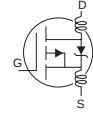
|                             | Parameter                                 | Max.                   | Units |
|-----------------------------|-------------------------------------------|------------------------|-------|
| $I_D$ @ $T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS}$ @ -10V | -31                    | A     |
| $I_D$ @ $T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS}$ @ -10V | -22                    |       |
| $I_{DM}$                    | Pulsed Drain Current ①⑥                   | -110                   |       |
| $P_D$ @ $T_C = 25^\circ C$  | Power Dissipation                         | 110                    | W     |
|                             | Linear Derating Factor                    | 0.71                   | W/°C  |
| $V_{GS}$                    | Gate-to-Source Voltage                    | $\pm 20$               | V     |
| $E_{AS}$                    | Single Pulse Avalanche Energy②⑥           | 280                    | mJ    |
| $I_{AR}$                    | Avalanche Current①⑥                       | -16                    | A     |
| $E_{AR}$                    | Repetitive Avalanche Energy①              | 11                     | mJ    |
| $dv/dt$                     | Peak Diode Recovery $dv/dt$ ③⑥            | -5.0                   | V/ns  |
| $T_J$                       | 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         | 10 lbf•in (1.1N•m)     |       |

## Thermal Resistance

|                 | Parameter                        | Typ. | Max. | Units |
|-----------------|----------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case                 | —    | 1.4  | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB mount)* | —    | 50   |       |
| $R_{\theta JA}$ | Junction-to-Ambient**            | —    | 110  |       |

## 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    | -55  | —      | —     | V                  | $V_{GS} = 0V$ , $I_D = -250\mu A$                                             |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | -0.034 | —     | $V/^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = -1mA$                                |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | —      | 0.065 | $\Omega$           | $V_{GS} = -10V$ , $I_D = -16A$ ④                                              |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | -2.0 | —      | -4.0  | V                  | $V_{DS} = V_{GS}$ , $I_D = -250\mu A$                                         |
| $g_{fs}$                        | Forward Transconductance             | 8.0  | —      | —     | S                  | $V_{DS} = -25V$ , $I_D = -16A$ ⑥                                              |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —      | -25   | $\mu A$            | $V_{DS} = -55V$ , $V_{GS} = 0V$                                               |
|                                 |                                      | —    | —      | -250  |                    | $V_{DS} = -44V$ , $V_{GS} = 0V$ , $T_J = 150^\circ\text{C}$                   |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —      | 100   | nA                 | $V_{GS} = 20V$                                                                |
|                                 | Gate-to-Source Reverse Leakage       | —    | —      | -100  |                    | $V_{GS} = -20V$                                                               |
| $Q_g$                           | Total Gate Charge                    | —    | —      | 63    | nC                 | $I_D = -16A$                                                                  |
| $Q_{gs}$                        | Gate-to-Source Charge                | —    | —      | 13    |                    | $V_{DS} = -44V$                                                               |
| $Q_{gd}$                        | Gate-to-Drain ("Miller") Charge      | —    | —      | 29    |                    | $V_{GS} = -10V$ , See Fig. 6 and 13 ④⑥                                        |
| $t_{d(on)}$                     | Turn-On Delay Time                   | —    | 14     | —     | ns                 | $V_{DD} = -28V$                                                               |
| $t_r$                           | Rise Time                            | —    | 66     | —     |                    | $I_D = -16A$                                                                  |
| $t_{d(off)}$                    | Turn-Off Delay Time                  | —    | 39     | —     |                    | $R_G = 6.8\Omega$                                                             |
| $t_f$                           | Fall Time                            | —    | 63     | —     |                    | $R_D = 1.6\Omega$ , See Fig. 10 ④⑥                                            |
| $L_D$                           | Internal Drain Inductance            | —    | 4.5    | —     | nH                 | Between lead,<br>6mm (0.25in.)<br>from package<br>and center of die contact ⑤ |
| $L_S$                           | Internal Source Inductance           | —    | 7.5    | —     |                    |                                                                               |
| $C_{iss}$                       | Input Capacitance                    | —    | 1200   | —     | pF                 | $V_{GS} = 0V$                                                                 |
| $C_{oss}$                       | Output Capacitance                   | —    | 520    | —     |                    | $V_{DS} = -25V$                                                               |
| $C_{rss}$                       | Reverse Transfer Capacitance         | —    | 250    | —     |                    | $f = 1.0MHz$ , See Fig. 5 ⑥                                                   |



## Source-Drain Ratings and Characteristics

|          | Parameter                                 | Min. | Typ. | Max. | Units | Conditions                                                              |
|----------|-------------------------------------------|------|------|------|-------|-------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current<br>(Body Diode) | —    | —    | -31  | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode) ①   | —    | —    | -110 |       |                                                                         |
| $V_{SD}$ | Diode Forward Voltage                     | —    | —    | -1.3 | V     | $T_J = 25^\circ\text{C}$ , $I_S = -16A$ , $V_{GS} = 0V$ ④               |
| $t_{rr}$ | Reverse Recovery Time                     | —    | 71   | 110  | ns    | $T_J = 25^\circ\text{C}$ , $I_F = -16A$                                 |
| $Q_{rr}$ | Reverse Recovery Charge                   | —    | 170  | 250  | nC    | $di/dt = -100A/\mu s$ ④⑥                                                |

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See Fig. 11)
- ②  $V_{DD} = -25V$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 2.1mH$ ,  $R_G = 25\Omega$ ,  $I_{AS} = -16A$ . (See Figure 12)
- ③  $I_{SD} \leq -16A$ ,  $di/dt \leq -280A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 175^\circ\text{C}$

④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .

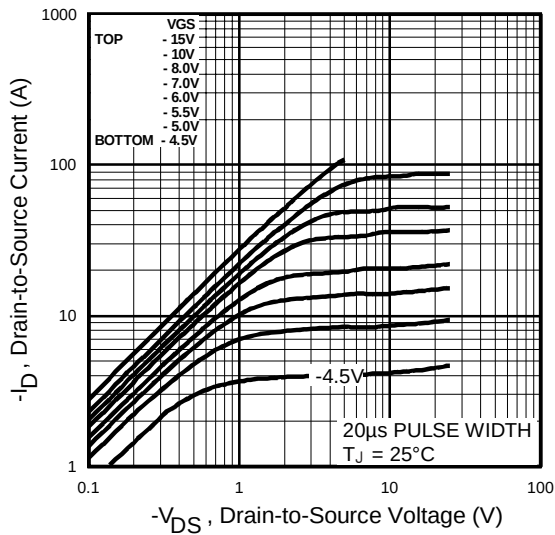
⑤ This is applied for I-PAK,  $L_S$  of D-PAK is measured between lead and center of die contact.

⑥ Uses IRF5305 data and test conditions.

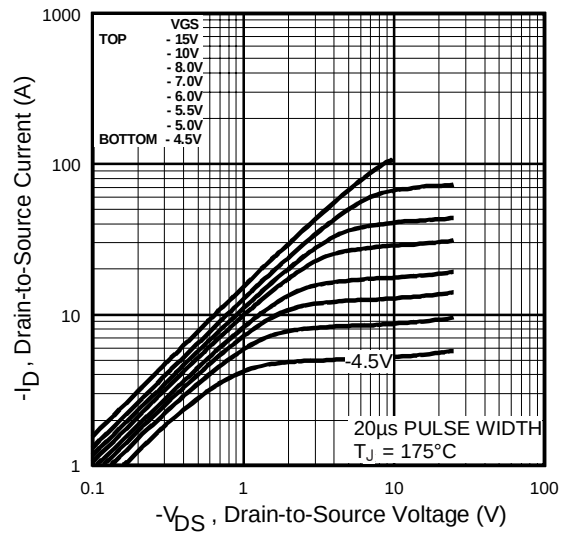
\* When mounted on 1" square PCB (FR-4 or G-10 Material).

For recommended footprint and soldering techniques refer to application note #AN-994.

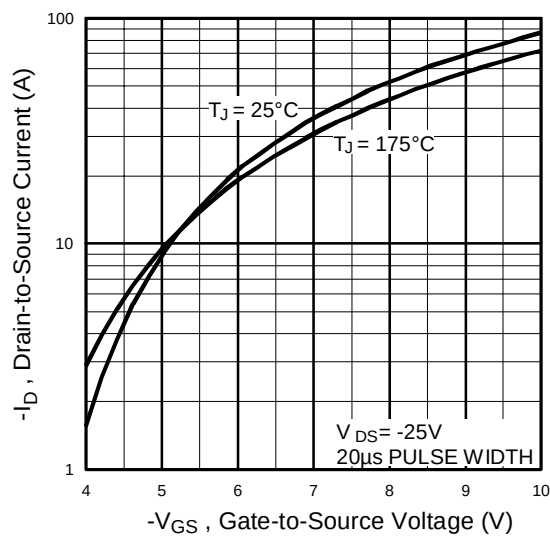
\*\* Uses typical socket mount.



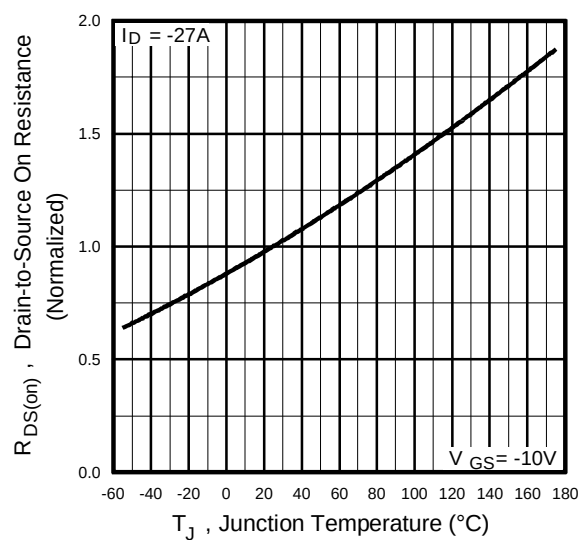
**Fig 1.** Typical Output Characteristics



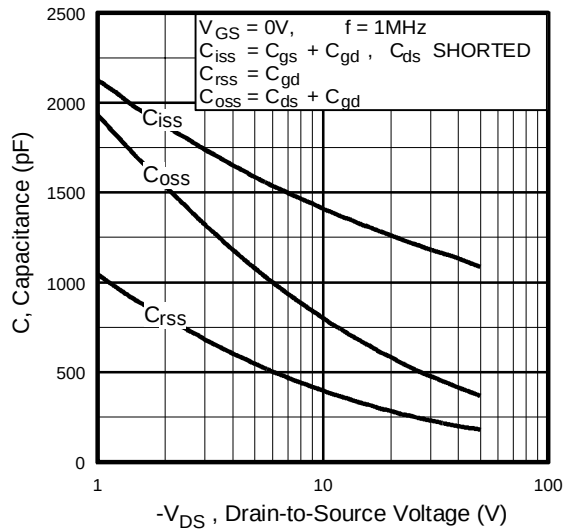
**Fig 2.** Typical Output Characteristics



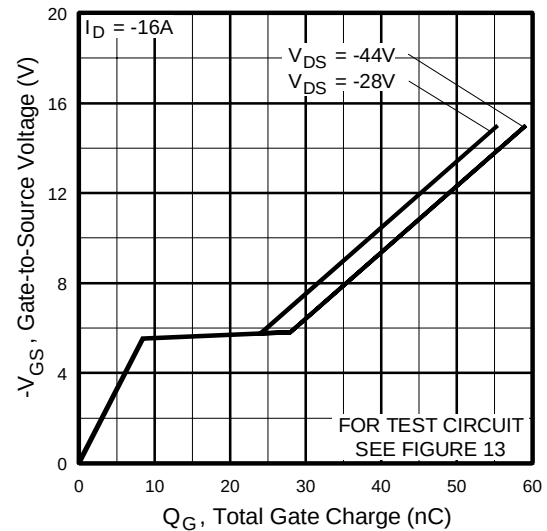
**Fig 3.** Typical Transfer Characteristics



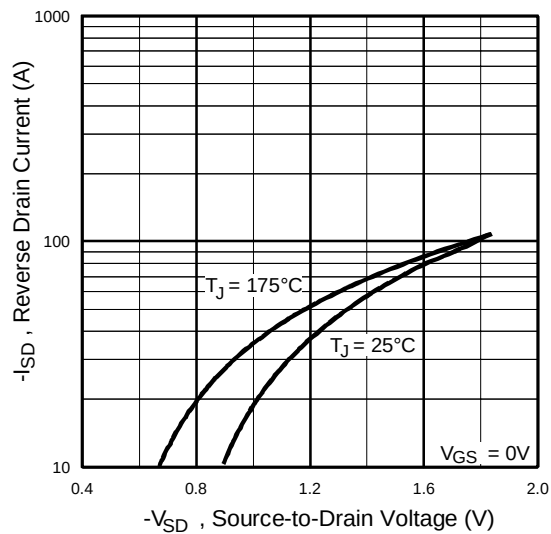
**Fig 4.** Normalized On-Resistance Vs. Temperature



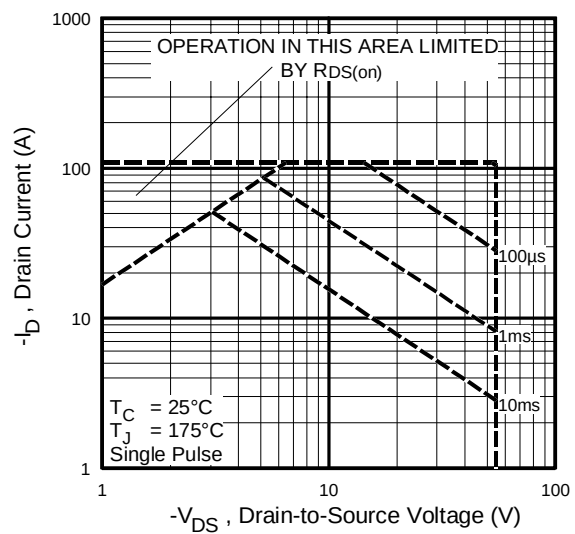
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



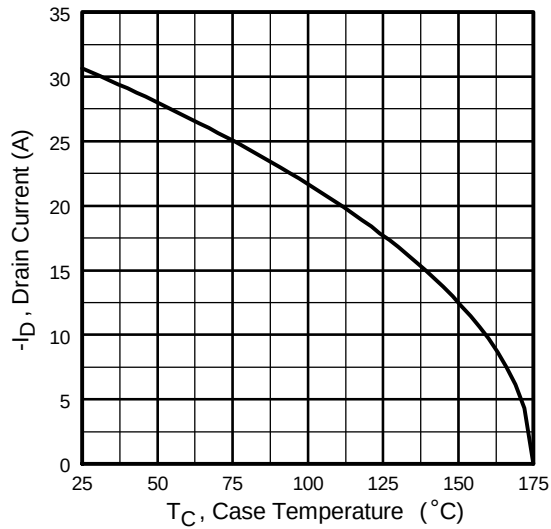
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



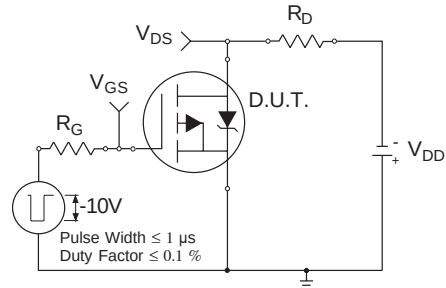
**Fig 7.** Typical Source-Drain Diode Forward Voltage



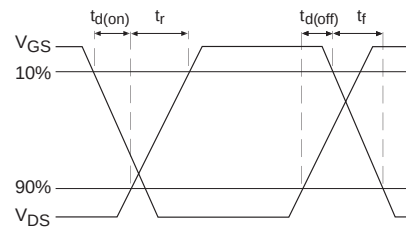
**Fig 8.** Maximum Safe Operating Area



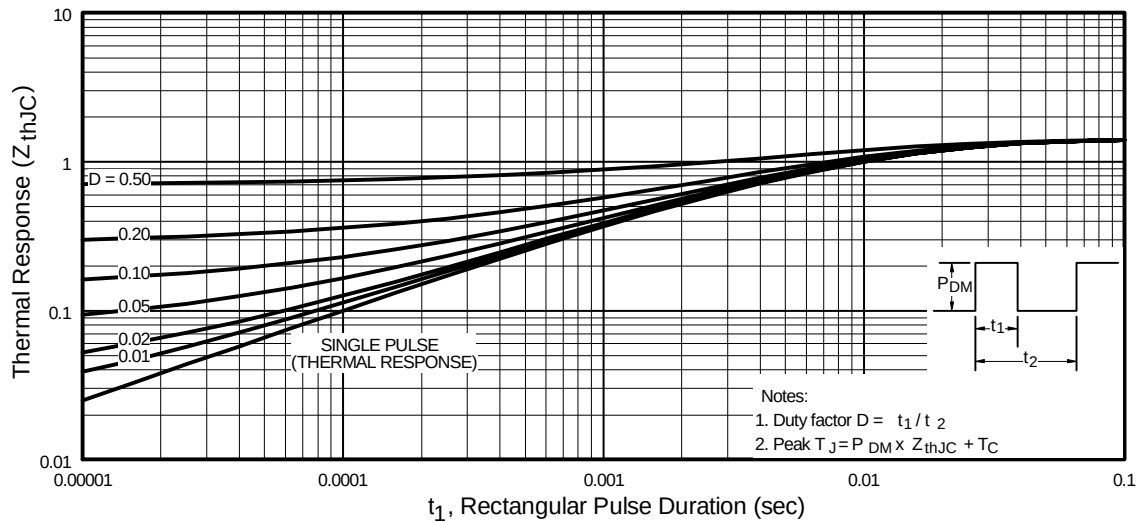
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



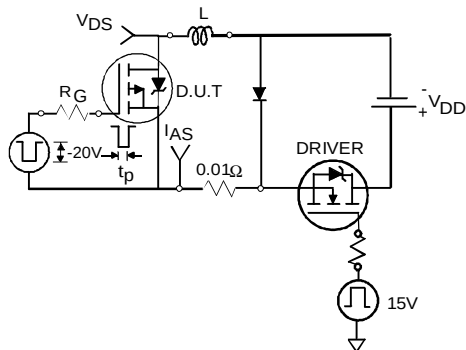
**Fig 10b.** Switching Time Waveforms



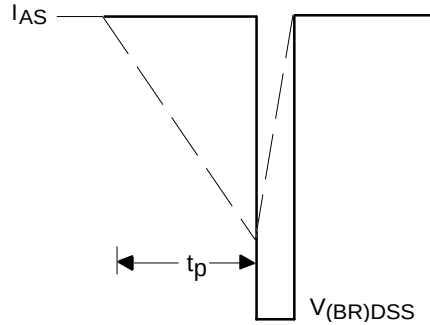
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

# IRFR/U5305PbF

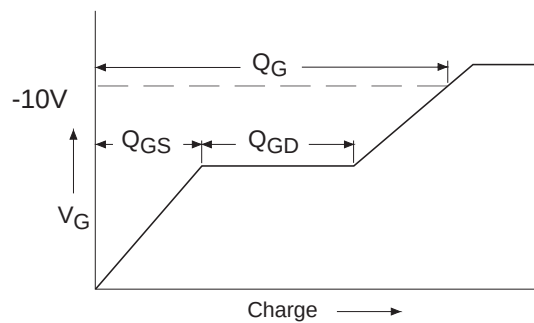
International  
IOR Rectifier



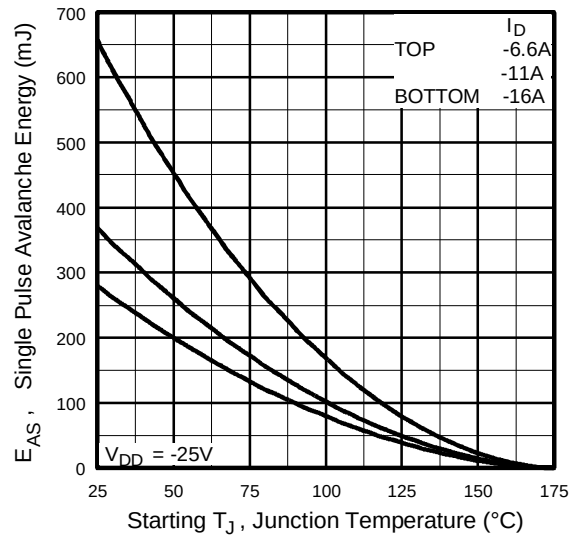
**Fig 12a.** Unclamped Inductive Test Circuit



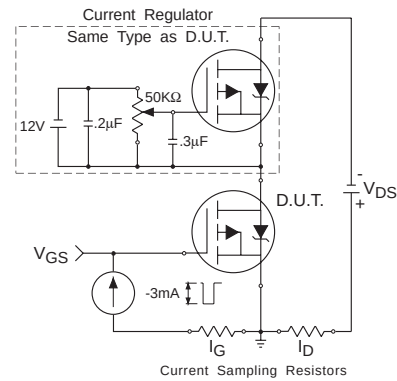
**Fig 12b.** Unclamped Inductive Waveforms



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

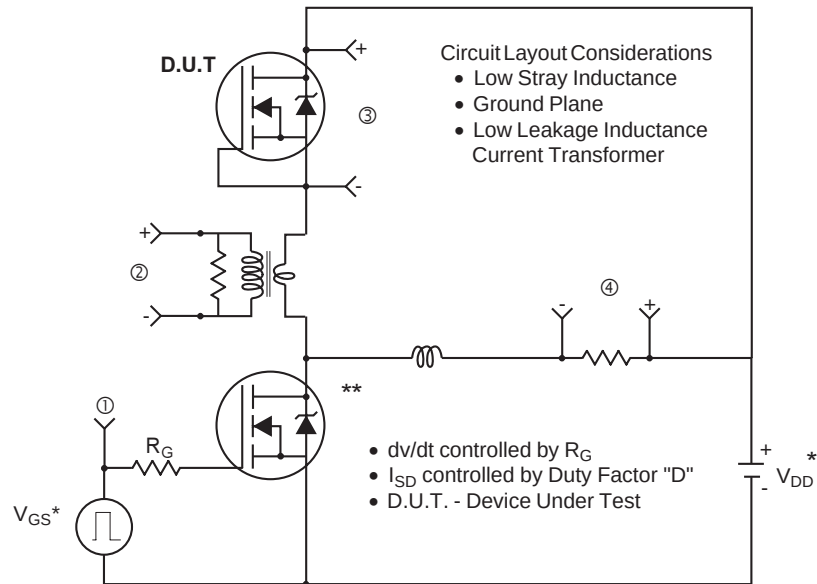


**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



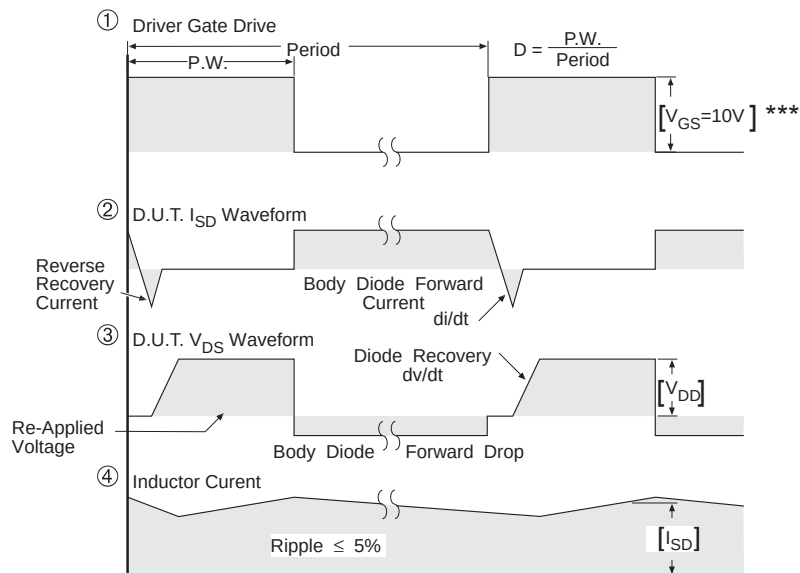
**Fig 13b.** Gate Charge Test Circuit

### Peak Diode Recovery dv/dt Test Circuit



\* Reverse Polarity for P-Channel

\*\* Use P-Channel Driver for P-Channel Measurements



\*\*\*  $V_{GS} = 5.0V$  for Logic Level and 3V Drive Devices

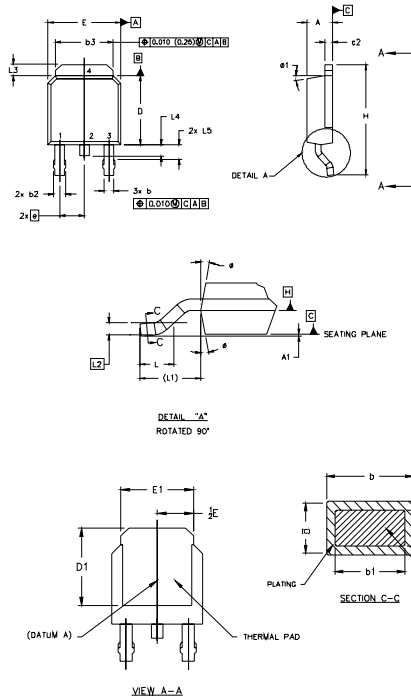
**Fig 14. For P-Channel HEXFETS**

# IRFR/U5305PbF

International  
**IR** Rectifier

## D-Pak (TO-252AA) Package Outline

Dimensions are shown in millimeters (inches)



- NOTES:
- 1.0 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
  - 2.0 DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]
  - 3.0 LEAD DIMENSION UNCONTROLLED IN L5
  - 4.0 DIMENSION D1 AND E1 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
  - 5.0 SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 [0.127] AND .010 [0.2540] FROM THE LEAD TIP.
  - 6.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
  - 7.0 OUTLINE CONFORMS TO JEDEC OUTLINE TO-252AA.

| SYMBOL | DIMENSIONS  |       |           |       | NOTES |
|--------|-------------|-------|-----------|-------|-------|
|        | MILLIMETERS |       | INCHES    |       |       |
|        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| A      | 2.18        | 2.39  | .086      | .094  |       |
| A1     |             | 0.13  |           | .005  |       |
| b      | 0.64        | 0.89  | .025      | .035  | 5     |
| b1     | 0.64        | 0.79  | .025      | 0.031 | 5     |
| b2     | 0.76        | 1.14  | .030      | .045  |       |
| b3     | 4.95        | 5.46  | .195      | .215  |       |
| c      | 0.46        | 0.61  | .018      | .024  | 5     |
| c1     | 0.41        | 0.56  | .016      | .022  | 5     |
| c2     | .046        | 0.89  | .018      | .035  | 5     |
| D      | 5.97        | 6.22  | .235      | .245  | 6     |
| D1     | 5.21        | —     | .205      | —     | 4     |
| E      | 6.35        | 6.73  | .250      | .265  | 6     |
| E1     | 4.32        | —     | .170      | —     | 4     |
| e      | 2.79        |       | .090 BSC  |       |       |
| H      | 9.40        | 10.41 | .370      | .410  |       |
| L      | 1.40        | 1.78  | .055      | .070  |       |
| L1     | 2.74 REF.   |       | .108 REF. |       |       |
| L2     | 0.051 BSC   |       | .020 BSC  |       |       |
| L3     | 0.89        | 1.27  | .035      | .050  |       |
| L4     |             | 1.02  |           | .040  |       |
| L5     | 1.14        | 1.52  | .045      | .060  | 3     |
| e      | 0"          | 10"   | 0"        | 10"   |       |
| e1     | 0"          | 15"   | 0"        | 15"   |       |

### LEAD ASSIGNMENTS

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

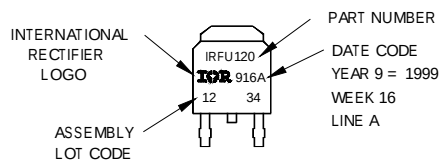
### GB1a, CoPACK

1. - GATE  
2. - COLLECTOR  
3. - EMITTER  
4. - COLLECTOR

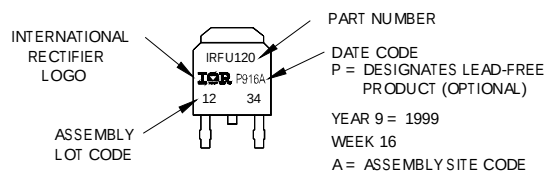
## D-Pak (TO-252AA) Part Marking Information

EXAMPLE: THIS IS AN IRFR120  
WITH ASSEMBLY  
LOT CODE 1234  
ASSEMBLED ON WW 16, 1999  
IN THE ASSEMBLY LINE "A"

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



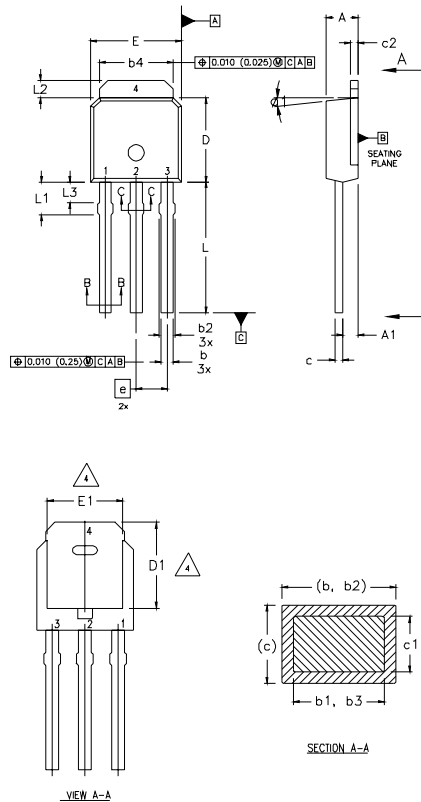
OR





## I-Pak (TO-251AA) Package Outline

Dimensions are shown in millimeters (inches)



### NOTES:

- 1 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
- 2 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 3 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- 4 THERMAL PAD CONTOUR OPTION WITHIN DIMENSION b4, L2, E1 & D1.
- 5 LEAD DIMENSION UNCONTROLLED IN L3.
- 6 DIMENSION b1, b3 APPLY TO BASE METAL ONLY.
- 7 OUTLINE CONFORMS TO JEDEC OUTLINE TO-251AA.
- 8 CONTROLLING DIMENSION : INCHES.

### LEAD ASSIGNMENTS

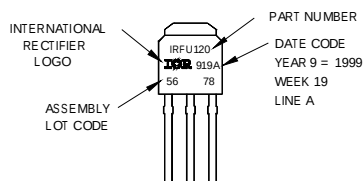
#### HEXFET

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

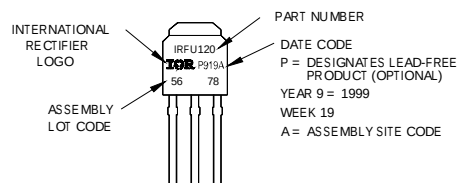
| SYMBOL | DIMENSIONS  |      |           |       | NOTES |
|--------|-------------|------|-----------|-------|-------|
|        | MILLIMETERS |      | INCHES    |       |       |
|        | MIN.        | MAX. | MIN.      | MAX.  |       |
| A      | 2.18        | 2.39 | 0.086     | .094  |       |
| A1     | 0.89        | 1.14 | 0.035     | 0.045 |       |
| b      | 0.64        | 0.89 | 0.025     | 0.035 |       |
| b1     | 0.64        | 0.79 | 0.025     | 0.031 | 4     |
| b2     | 0.76        | 1.14 | 0.030     | 0.045 |       |
| b3     | 0.76        | 1.04 | 0.030     | 0.041 |       |
| b4     | 5.00        | 5.46 | 0.195     | 0.215 | 4     |
| c      | 0.46        | 0.61 | 0.018     | 0.024 |       |
| c1     | 0.41        | 0.56 | 0.016     | 0.022 |       |
| c2     | .046        | 0.86 | 0.018     | 0.035 |       |
| D      | 5.97        | 6.22 | 0.235     | 0.245 | 3, 4  |
| D1     | 5.21        | -    | 0.205     | -     | 4     |
| E      | 6.35        | 6.73 | 0.250     | 0.265 | 3, 4  |
| E1     | 4.32        | -    | 0.170     | -     | 4     |
| e      | 2.29        |      | 0.090 BSC |       |       |
| L      | 8.89        | 9.60 | 0.350     | 0.380 |       |
| L1     | 1.91        | 2.29 | 0.075     | 0.090 |       |
| L2     | 0.89        | 1.27 | 0.035     | 0.050 | 4     |
| L3     | 1.14        | 1.52 | 0.045     | 0.060 | 5     |
| ø1     | 0"          | 15"  | 0"        | 15"   |       |

## I-Pak (TO-251AA) Part Marking Information

EXAMPLE: THIS IS AN IRFU120  
WITH ASSEMBLY  
LOT CODE 5678  
ASSEMBLED ON WW 19, 1999  
IN THE ASSEMBLY LINE "A"  
**Note:** "P" in assembly line  
position indicates "Lead-Free"



OR

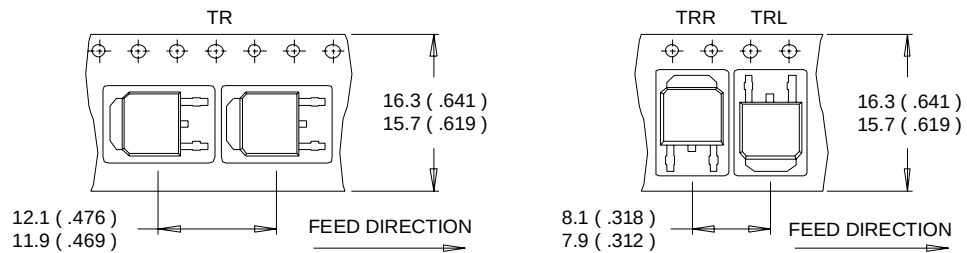


# IRFR/U5305PbF

International  
**IR** Rectifier

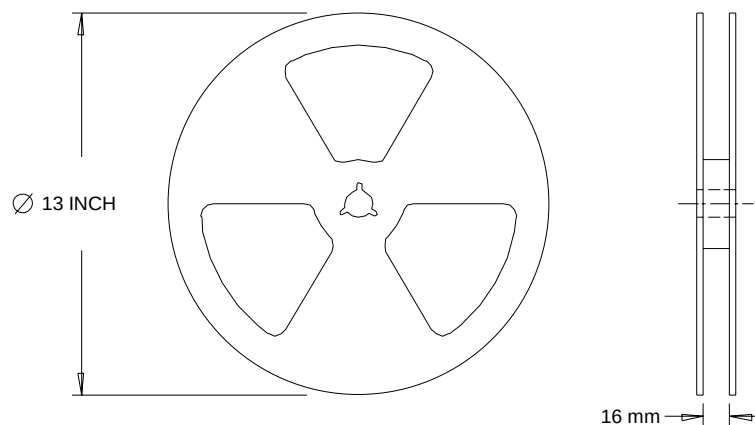
## D-Pak (TO-252AA) Tape & Reel Information

Dimensions are shown in millimeters (inches)



### NOTES :

1. CONTROLLING DIMENSION : MILLIMETER.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS ( INCHES ).
3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



### NOTES :

1. OUTLINE CONFORMS TO EIA-481.

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.12/04

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

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