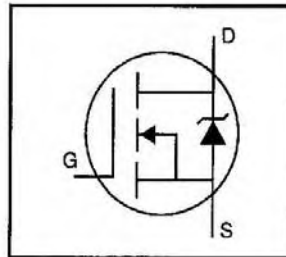


# IRLR014PbF IRLU014PbF

## HEXFET® Power MOSFET

- Dynamic dv/dt Rating
- Surface Mount (IRLR014)
- Straight Lead (IRLU014)
- Available in Tape & Reel
- Logic-Level Gate Drive
- RDS(on) Specified at VGS=4V & 5V
- Fast Switching
- Lead-Free

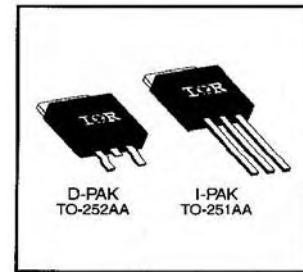


|                           |
|---------------------------|
| $V_{DSS} = 60V$           |
| $R_{DS(on)} = 0.20\Omega$ |
| $I_D = 7.7A$              |

### 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-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.



### Absolute Maximum Ratings

|                           | Parameter                                  | Max.                  | Units |
|---------------------------|--|-----------------------|-------|
| $I_D @ T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS} @ 5.0 V$ | 7.7                   | A     |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ 5.0 V$ | 4.9                   |       |
| $I_{DM}$                  | Pulsed Drain Current ①                     | 31                    |       |
| $P_D @ T_C = 25^\circ C$  | Power Dissipation                          | 25                    | W     |
| $P_D @ T_A = 25^\circ C$  | Power Dissipation (PCB Mount)**            | 2.5                   |       |
|                           | Linear Derating Factor                     | 0.20                  | W/°C  |
|                           | Linear Derating Factor (PCB Mount)**       | 0.020                 |       |
| $V_{GS}$                  | Gate-to-Source Voltage                     | $\pm 10$              | V     |
| $E_{AS}$                  | Single Pulse Avalanche Energy ②            | 47                    | mJ    |
| dv/dt                     | Peak Diode Recovery dv/dt ③                | 4.5                   | V/ns  |
| $T_J, T_{STG}$            | Junction and Storage Temperature Range     | -55 to +150           | °C    |
|                           | Soldering Temperature, for 10 seconds      | 260 (1.6mm from case) |       |

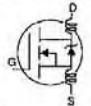
### Thermal Resistance

|                 | Parameter                         | Min. | Typ. | Max. | Units |
|-----------------|-----------------------------------|------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case                  | —    | —    | 5.0  | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB mount)** | —    | —    | 50   |       |
| $R_{\theta JA}$ | Junction-to-Ambient               | —    | —    | 110  |       |

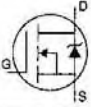
\*\* When mounted on 1" square PCB (FR-4 or G-10 Material).

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

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

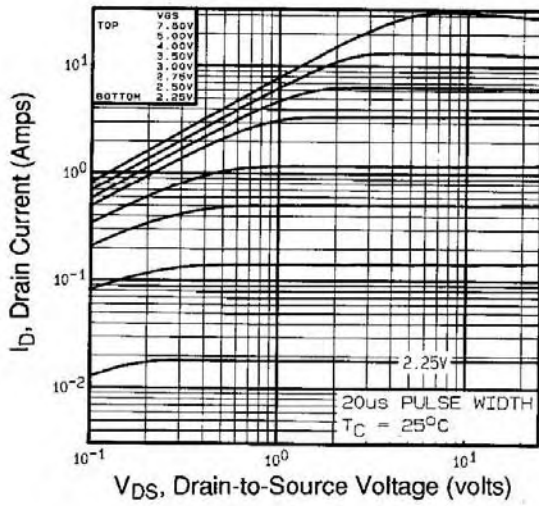
|                                      | Parameter                            | Min. | Typ.  | Max. | Units | Test Conditions   |
|--------------------------------------|--------------------------------------|------|-------|------|-------|---|
| V <sub>(BR)DSS</sub>                 | Drain-to-Source Breakdown Voltage    | 60   | —     | —    | V     | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA  |
| ΔV <sub>(BR)DSS/ΔT<sub>J</sub></sub> | Breakdown Voltage Temp. Coefficient  | —    | 0.073 | —    | V/°C  | Reference to 25°C, I <sub>D</sub> =1mA  |
| R <sub>DS(on)</sub>                  | Static Drain-to-Source On-Resistance | —    | —     | 0.20 | Ω     | V <sub>GS</sub> =5.0V, I <sub>D</sub> =4.6A ④   |
|                                      |                                      | —    | —     | 0.28 |       | V <sub>GS</sub> =4.0V, I <sub>D</sub> =3.9A ④   |
| V <sub>GS(th)</sub>                  | Gate Threshold Voltage               | 1.0  | —     | 2.0  | V     | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                              |
| g <sub>fs</sub>                      | Forward Transconductance             | 3.4  | —     | —    | S     | V <sub>DS</sub> =25V, I <sub>D</sub> =4.6A ④  |
| I <sub>DSS</sub>                     | Drain-to-Source Leakage Current      | —    | —     | 25   | μA    | V <sub>DS</sub> =60V, V <sub>GS</sub> =0V   |
|                                      |                                      | —    | —     | 250  |       | V <sub>DS</sub> =48V, 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> =10V  |
|                                      | Gate-to-Source Reverse Leakage       | —    | —     | -100 |       | V <sub>GS</sub> =-10V   |
| Q <sub>g</sub>                       | Total Gate Charge                    | —    | —     | 8.4  | nC    | I <sub>D</sub> =10A   |
| Q <sub>gs</sub>                      | Gate-to-Source Charge                | —    | —     | 3.5  |       | V <sub>DS</sub> =48V  |
| Q <sub>gd</sub>                      | Gate-to-Drain ("Miller") Charge      | —    | —     | 6.0  |       | V <sub>GS</sub> =5.0V See Fig. 6 and 13 ④   |
| t <sub>d(on)</sub>                   | Turn-On Delay Time                   | —    | 9.3   | —    | ns    | V <sub>DD</sub> =30V  |
| t <sub>r</sub>                       | Rise Time                            | —    | 110   | —    |       | I <sub>D</sub> =10A   |
| t <sub>d(off)</sub>                  | Turn-Off Delay Time                  | —    | 17    | —    |       | R <sub>G</sub> =12Ω   |
| t <sub>f</sub>                       | Fall Time                            | —    | 26    | —    |       | R <sub>D</sub> =2.8Ω See Figure 10 ④  |
| L <sub>D</sub>                       | Internal Drain Inductance            | —    | 4.5   | —    | nH    | Between lead, 6 mm (0.25in.) from package and center of die contact                   |
| L <sub>S</sub>                       | Internal Source Inductance           | —    | 7.5   | —    |       |  |
| C <sub>iss</sub>                     | Input Capacitance                    | —    | 400   | —    | pF    | V <sub>GS</sub> =0V   |
| C <sub>oss</sub>                     | Output Capacitance                   | —    | 170   | —    |       | V <sub>DS</sub> =25V  |
| C <sub>rss</sub>                     | Reverse Transfer Capacitance         | —    | 42    | —    |       | f=1.0MHz See Figure 5   |

## Source-Drain Ratings and Characteristics

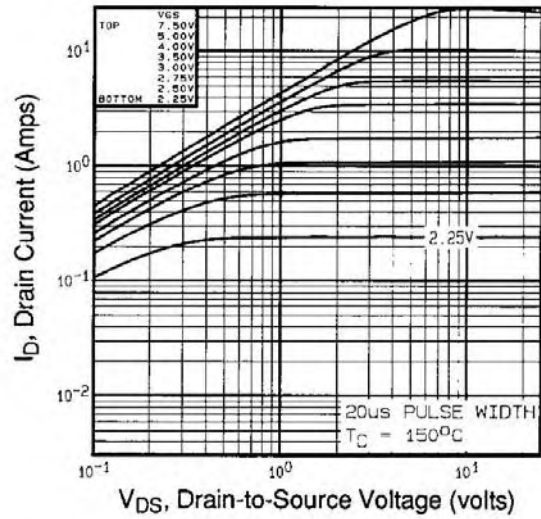
|                 | Parameter                              | Min.   | Typ. | Max. | Units | Test Conditions  |
|-----------------|--|--|------|------|-------|--|
| I <sub>S</sub>  | Continuous Source Current (Body Diode) | —  | —    | 7.7  | A     | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I <sub>SM</sub> | Pulsed Source Current (Body Diode) ①   | —  | —    | 31   |       |  |
| V <sub>SD</sub> | Diode Forward Voltage                  | —  | —    | 1.6  | V     | T <sub>J</sub> =25°C, I <sub>S</sub> =7.7A, V <sub>GS</sub> =0V ④  |
| t <sub>rr</sub> | Reverse Recovery Time                  | —  | 65   | 130  | ns    | T <sub>J</sub> =25°C, I <sub>F</sub> =10A  |
| Q <sub>rr</sub> | Reverse Recovery Charge                | —  | 0.33 | 0.65 | μC    | di/dt=100A/μs ④  |
| 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:

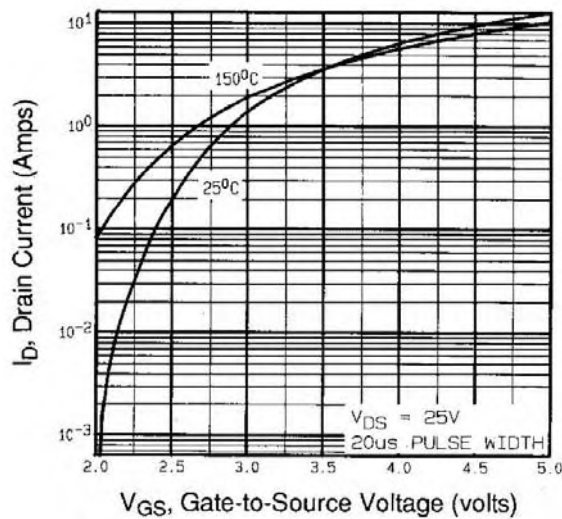
- ① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)
- ② V<sub>DD</sub>=25V, starting T<sub>J</sub>=25°C, L=924μH R<sub>G</sub>=25Ω, I<sub>AS</sub>=7.7A (See Figure 12)
- ③ I<sub>SD</sub>≤10A, di/dt≤90A/μs, V<sub>DD</sub>≤V<sub>(BR)DSS</sub>, T<sub>J</sub>≤150°C
- ④ Pulse width ≤ 300 μs; duty cycle ≤2%.



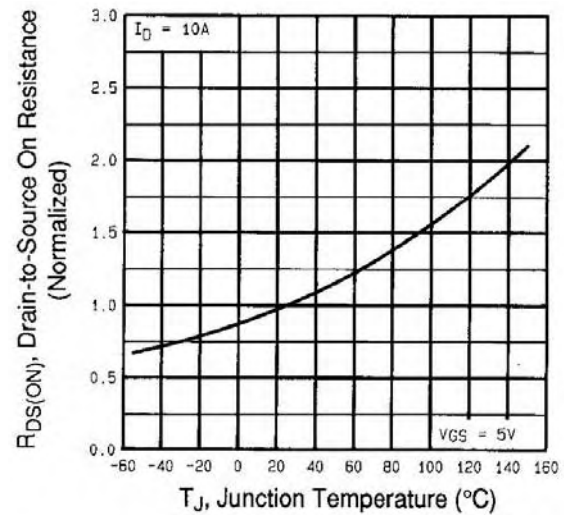
**Fig 1.** Typical Output Characteristics,  
 $T_C=25^\circ\text{C}$



**Fig 2.** Typical Output Characteristics,  
 $T_C=150^\circ\text{C}$

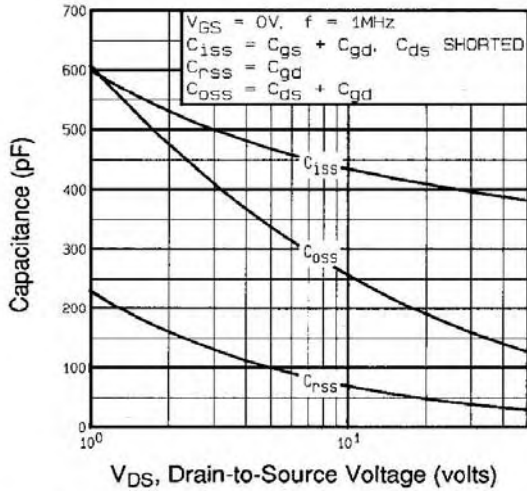


**Fig 3.** Typical Transfer Characteristics

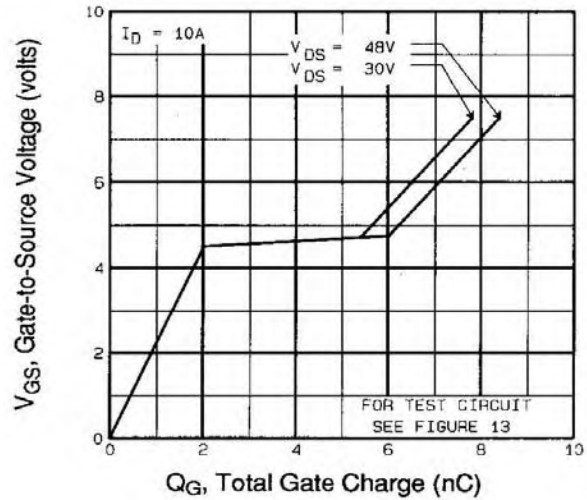


**Fig 4.** Normalized On-Resistance  
Vs. Temperature

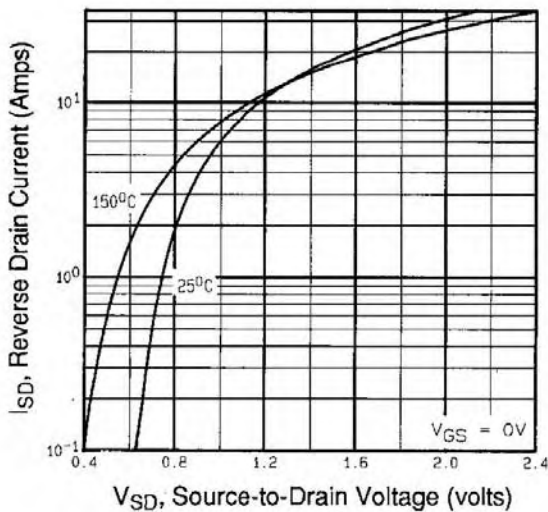




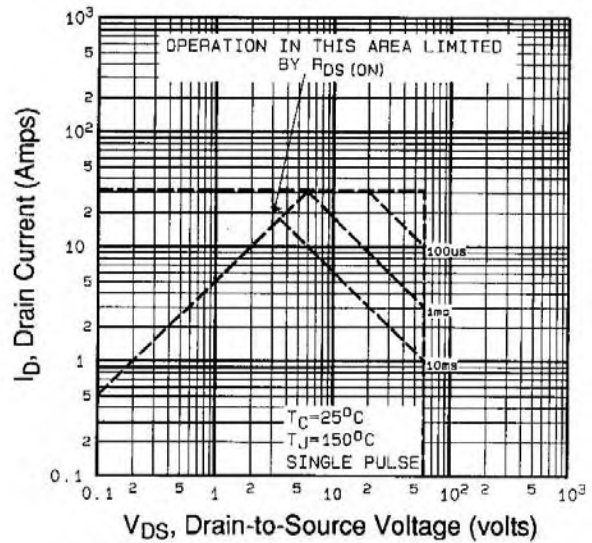
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



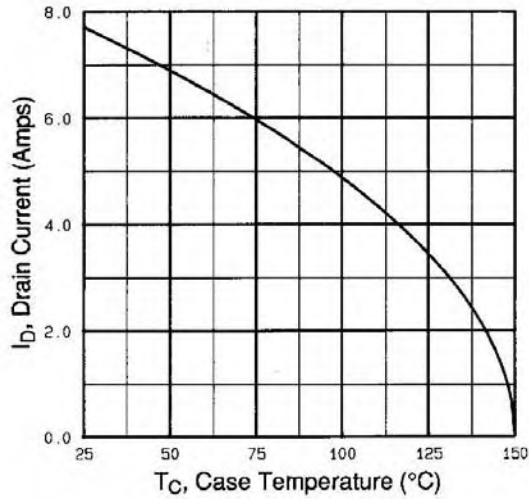
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



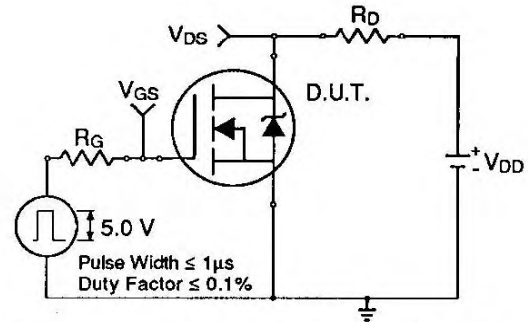
**Fig 7.** Typical Source-Drain Diode Forward Voltage



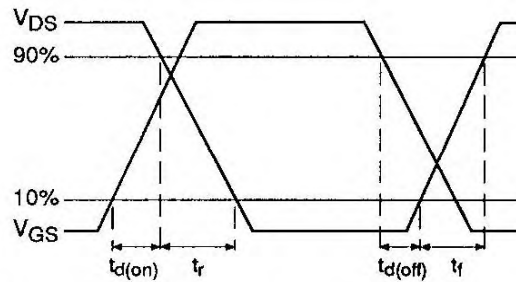
**Fig 8.** Maximum Safe Operating Area



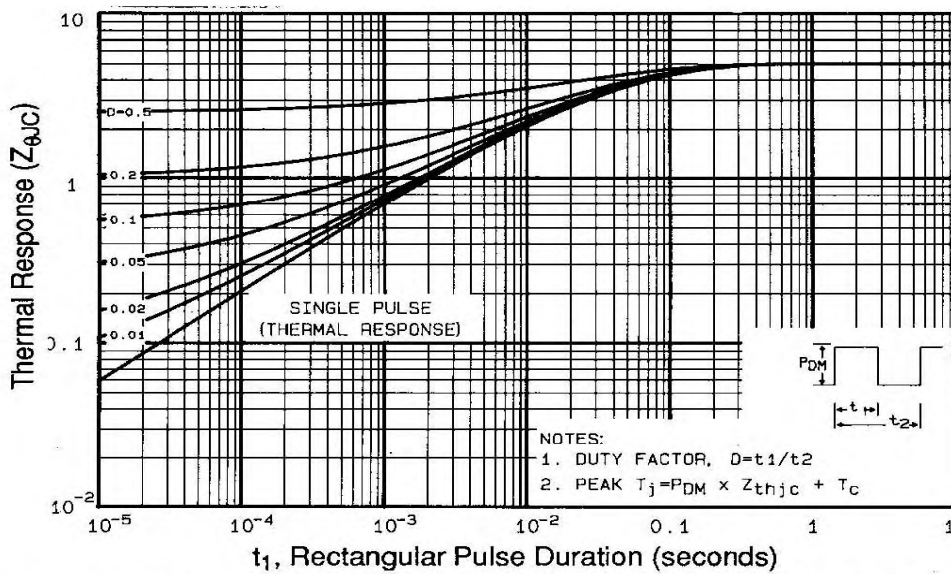
**Fig 9.** Maximum Drain Current Vs. Case Temperature



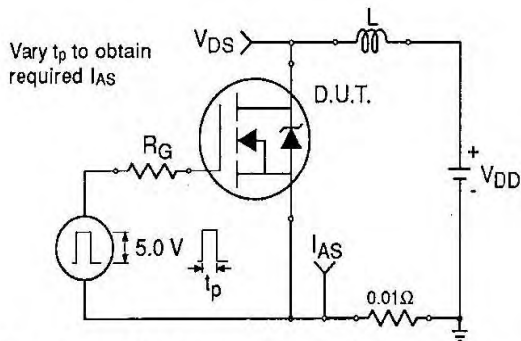
**Fig 10a.** Switching Time Test Circuit



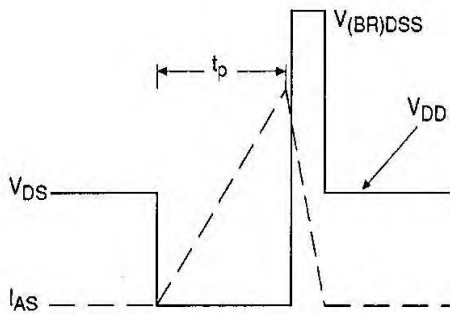
**Fig 10b.** Switching Time Waveforms



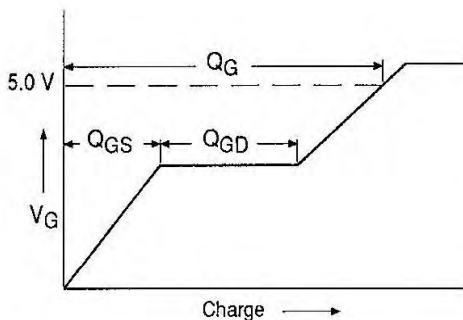
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case  
www.irf.com



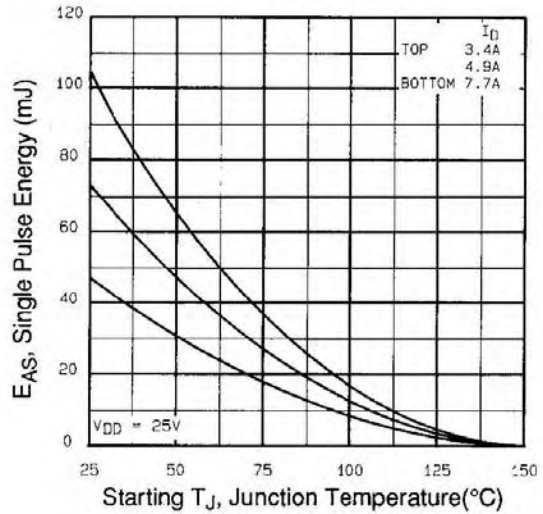
**Fig 12a.** Unclamped Inductive Test Circuit



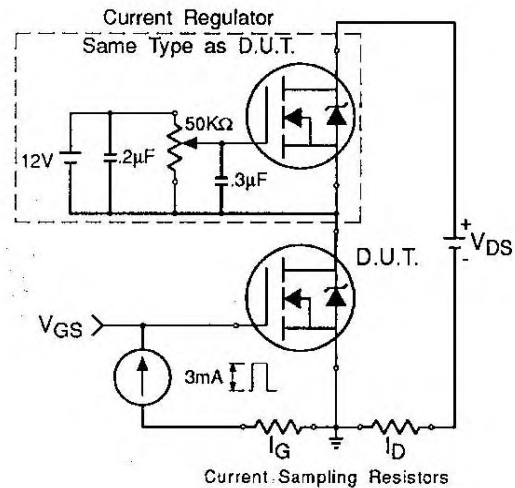
**Fig 12b.** Unclamped Inductive Waveforms



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

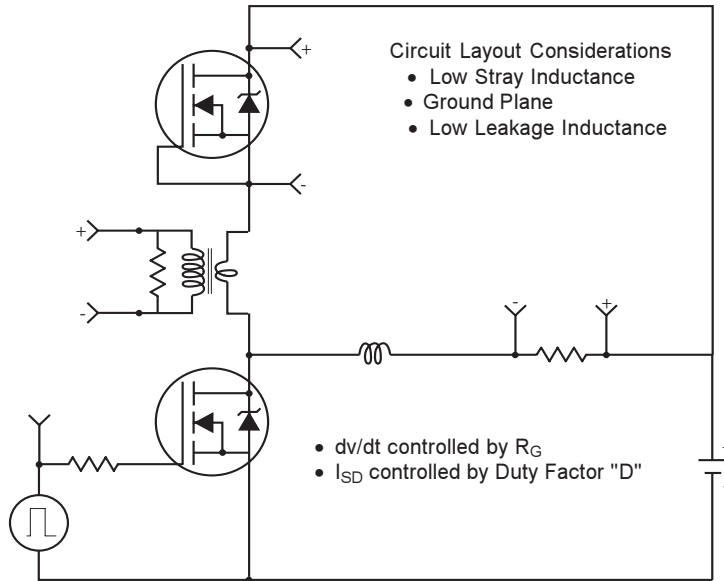


**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current

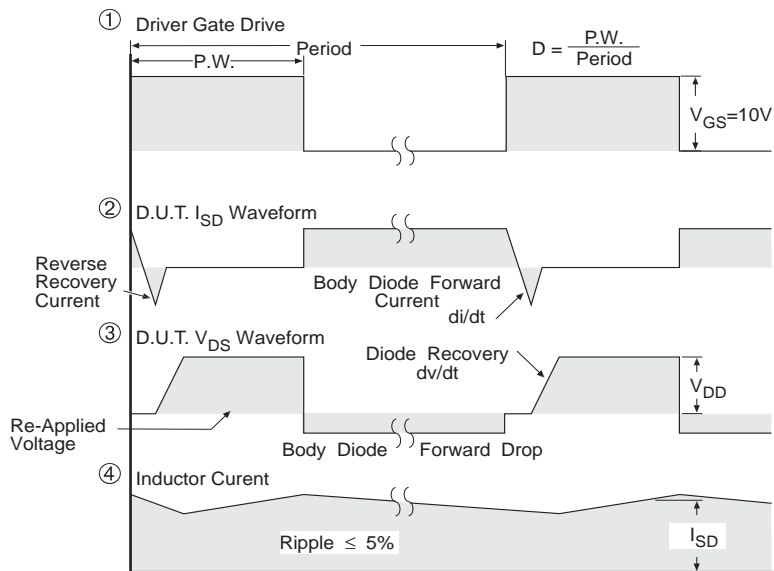


**Fig 13b.** Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



\* Reverse Polarity for P-Channel



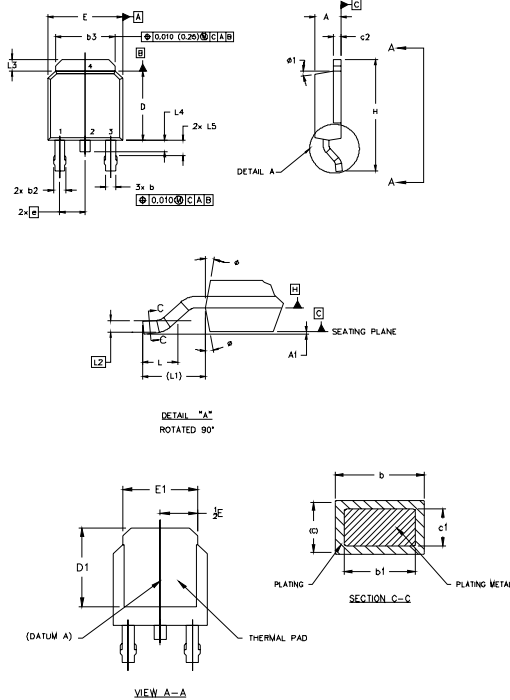
\*\*\*  $V_{GS} = 5.0V$  for Logic Level and 3V Drive Devices

Fig 14 For N Channel HEXFETS

# IRLR/U014PbF

## 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 [0.254] 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     |             | 0.15  |           | .006  |       |
| b      | 0.64        | 0.89  | .025      | .035  | 5     |
| b1     | 0.64        | 0.79  | .025      | 0.031 | 5     |
| b2     | 0.76        | 1.14  | .030      | .045  |       |
| b2     | 4.35        | 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      | 2.29        |       | .090 BSC  |       |       |
| H      | 9.40        | 10.41 | .370      | .410  |       |
| L      | 1.40        | 1.78  | .055      | .070  |       |
| L1     | 2.74 REF.   |       | .108 REF. |       |       |
| L2     | 0.061 BSC   |       | .020 BSC  |       |       |
| L3     | 0.89        | 1.27  | .035      | .050  |       |
| L4     |             | 1.02  |           | .040  |       |
| L5     | 1.14        | 1.52  | .045      | .060  | 3     |
| ø      | 0"          | 10"   | 0"        | 10"   |       |
| ø1     | 0"          | 15"   | 0"        | 15"   |       |

**LEAD ASSIGNMENTS**

**HEXFET**

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

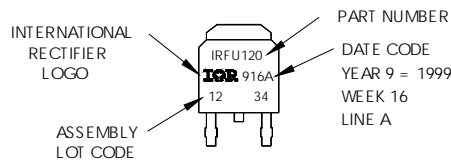
**IGBTs, CoPACK**

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

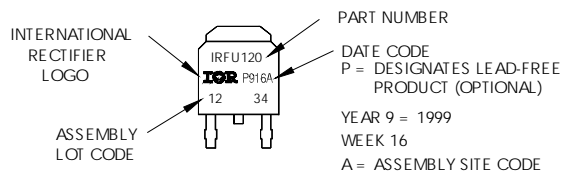
## D-Pak (TO-252AA) Part Marking Information

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

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



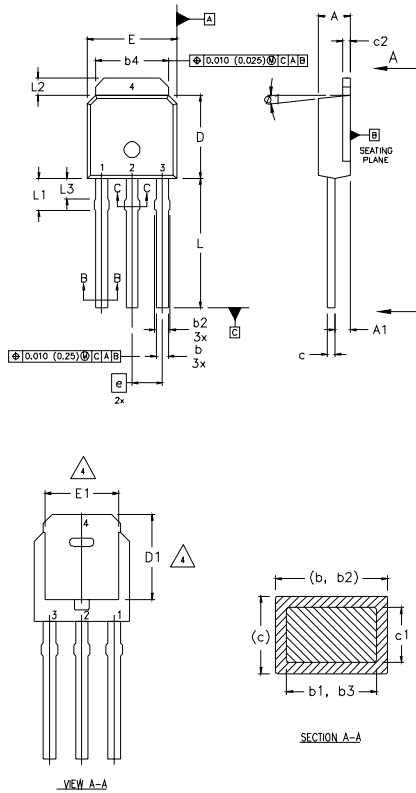
OR





## 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**

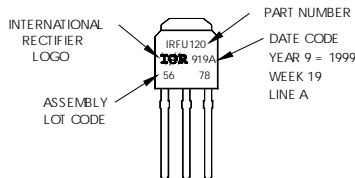
**HEXFET**

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

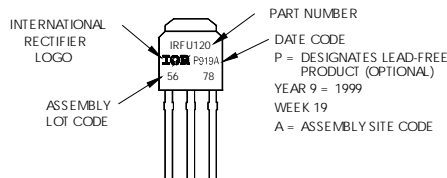
| SYMBOL | DIMENSIONS  |      |           |       | NOTES |
|--------|-------------|------|-----------|-------|-------|
|        | MILLIMETERS |      | INCHES    |       |       |
|        | MIN.        | MAX. | MIN.      | MAX.  |       |
| A      | 2.18        | 2.39 | 0.086     | .094  |       |
| 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     | 0.246 | 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     |
| a1     | Ø           | 15'  | Ø         | 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**

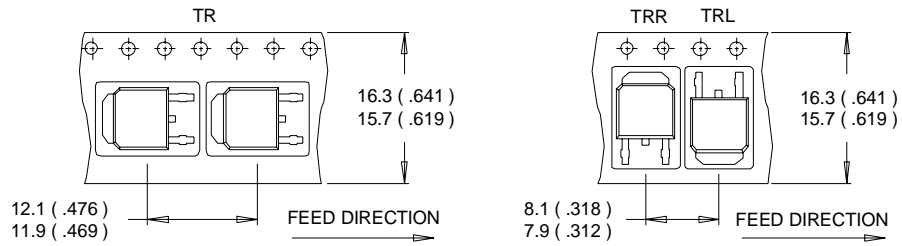


# IRLR/U014PbF

International  
**IR** Rectifier

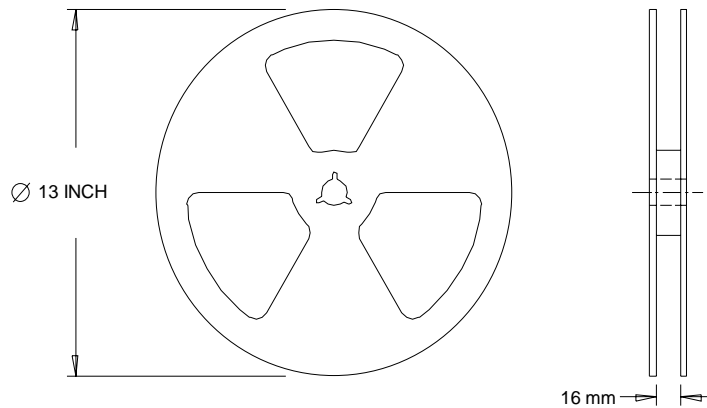
## D-Pak (TO-252AA) Tape & Reel Information

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

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