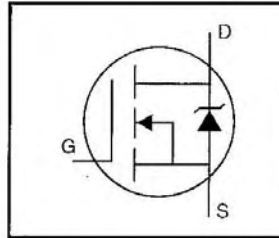


HEXFET® Power MOSFET

**IRFRC20PbF**  
**IRFUC20PbF**

- Dynamic dv/dt Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFRC20)
- Straight Lead (IRFUC20)
- Available in Tape & Reel
- Fast Switching
- Ease of Paralleling
- Lead-Free

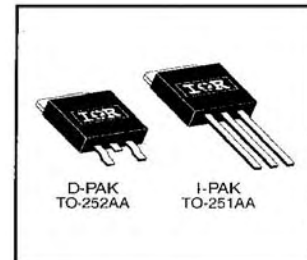


|                          |
|--------------------------|
| $V_{DSS} = 600V$         |
| $R_{DS(on)} = 4.4\Omega$ |
| $I_D = 2.0A$             |

**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, $V_{GS} @ 10 V$ | 2.0                   | A     |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ 10 V$ | 1.3                   |       |
| $I_{DM}$                  | Pulsed Drain Current ①                    | 8.0                   |       |
| $P_D @ T_C = 25^\circ C$  | Power Dissipation                         | 42                    | W     |
| $P_D @ T_A = 25^\circ C$  | Power Dissipation (PCB Mount)**           | 2.5                   |       |
|                           | Linear Derating Factor                    | 0.33                  | W/°C  |
|                           | Linear Derating Factor (PCB Mount)**      | 0.020                 |       |
| $V_{GS}$                  | Gate-to-Source Voltage                    | $\pm 20$              | V     |
| $E_{AS}$                  | Single Pulse Avalanche Energy ②           | 450                   | mJ    |
| $I_{AR}$                  | Avalanche Current ①                       | 2.0                   | A     |
| $E_{AR}$                  | Repetitive Avalanche Energy ①             | 4.2                   | mJ    |
| dv/dt                     | Peak Diode Recovery dv/dt ③               | 3.0                   | 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                  | —    | —    | 3.0  | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB mount)** | —    | —    | 50   |       |
| $R_{\theta JA}$ | Junction-to-Ambient               | —    | —    | 110  |       |

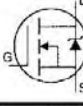
\*\* When mounted on 1" square PCB (FR-4 or G-10 Material).

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

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

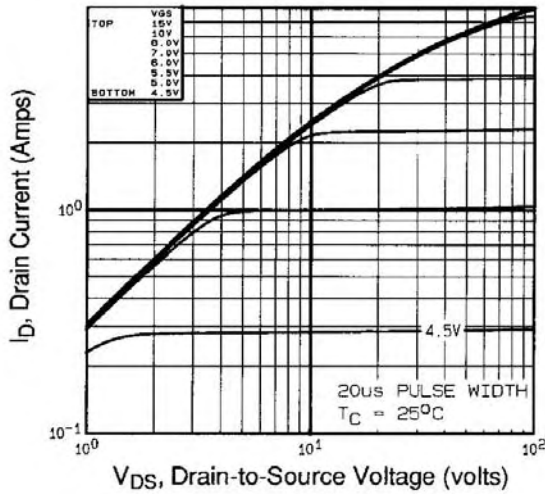
|                                        | Parameter                            | Min. | Typ. | Max. | Units | Test Conditions                                                                      |
|----------------------------------------|--------------------------------------|------|------|------|-------|--------------------------------------------------------------------------------------|
| V <sub>(BR)DSS</sub>                   | Drain-to-Source Breakdown Voltage    | 600  | —    | —    | V     | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                           |
| ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub> | Breakdown Voltage Temp. Coefficient  | —    | 0.88 | —    | V/°C  | Reference to 25°C, I <sub>D</sub> =1mA                                               |
| R <sub>DS(on)</sub>                    | Static Drain-to-Source On-Resistance | —    | —    | 4.4  | Ω     | V <sub>GS</sub> =10V, I <sub>D</sub> =1.2A ④                                         |
| 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             | 1.4  | —    | —    | S     | V <sub>DS</sub> =50V, I <sub>D</sub> =1.2A ④                                         |
| I <sub>DSS</sub>                       | Drain-to-Source Leakage Current      | —    | —    | 100  | μA    | V <sub>DS</sub> =600V, V <sub>GS</sub> =0V                                           |
|                                        |                                      | —    | —    | 500  |       | V <sub>DS</sub> =480V, 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 |       | V <sub>GS</sub> =-20V                                                                |
| Q <sub>g</sub>                         | Total Gate Charge                    | —    | —    | 18   | nC    | I <sub>D</sub> =2.0A                                                                 |
| Q <sub>gs</sub>                        | Gate-to-Source Charge                | —    | —    | 3.0  |       | V <sub>DS</sub> =360V                                                                |
| Q <sub>gd</sub>                        | Gate-to-Drain ("Miller") Charge      | —    | —    | 8.9  |       | V <sub>GS</sub> =10V See Fig. 6 and 13 ④                                             |
| t <sub>d(on)</sub>                     | Turn-On Delay Time                   | —    | 10   | —    | ns    | V <sub>DD</sub> =300V                                                                |
| t <sub>r</sub>                         | Rise Time                            | —    | 23   | —    |       | I <sub>D</sub> =2.0A                                                                 |
| t <sub>d(off)</sub>                    | Turn-Off Delay Time                  | —    | 30   | —    |       | R <sub>G</sub> =18Ω                                                                  |
| t <sub>f</sub>                         | Fall Time                            | —    | 25   | —    |       | R <sub>D</sub> =135Ω 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                    | —    | 350  | —    | pF    | V <sub>GS</sub> =0V                                                                  |
| C <sub>oss</sub>                       | Output Capacitance                   | —    | 48   | —    |       | V <sub>DS</sub> =25V                                                                 |
| C <sub>rss</sub>                       | Reverse Transfer Capacitance         | —    | 8.6  | —    |       | f=1.0MHz See Figure 5                                                                |

### Source-Drain Ratings and Characteristics

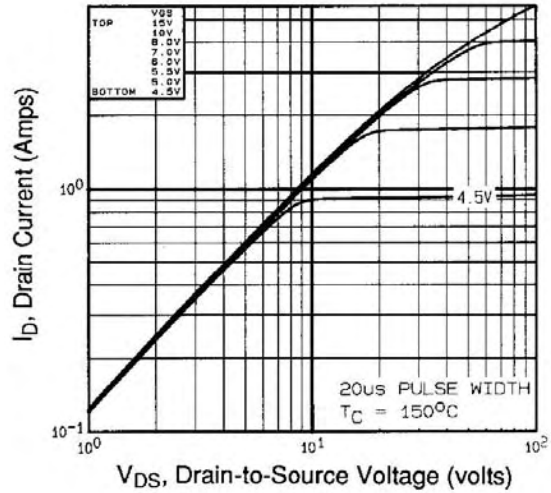
|                 | Parameter                              | Min.                                                                                           | Typ. | Max. | Units | Test Conditions                                                                                                                                      |
|-----------------|----------------------------------------|------------------------------------------------------------------------------------------------|------|------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| I <sub>S</sub>  | Continuous Source Current (Body Diode) | —                                                                                              | —    | 2.0  | A     | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I <sub>SM</sub> | Pulsed Source Current (Body Diode) ①   | —                                                                                              | —    | 8.0  |       |                                                                                                                                                      |
| V <sub>SD</sub> | Diode Forward Voltage                  | —                                                                                              | —    | 1.6  | V     | T <sub>J</sub> =25°C, I <sub>S</sub> =2.0A, V <sub>GS</sub> =0V ④                                                                                    |
| t <sub>rr</sub> | Reverse Recovery Time                  | —                                                                                              | 290  | 580  | ns    | T <sub>J</sub> =25°C, I <sub>F</sub> =2.0A                                                                                                           |
| Q <sub>rr</sub> | Reverse Recovery Charge                | —                                                                                              | 0.67 | 1.3  | 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:

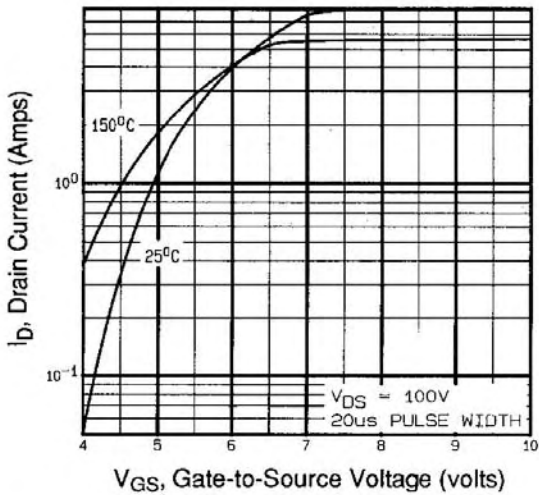
- ① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)
- ② V<sub>DD</sub>=50V, starting T<sub>J</sub>=25°C, L=206mH R<sub>G</sub>=25Ω, I<sub>AS</sub>=2.0A (See Figure 12)
- ③ I<sub>SD</sub>≤2.0A, di/dt≤40A/μs, V<sub>DD</sub>≤V<sub>(BR)DSS</sub>, T<sub>J</sub>≤150°C
- ④ Pulse width ≤ 300 μs; duty cycle ≤2%.



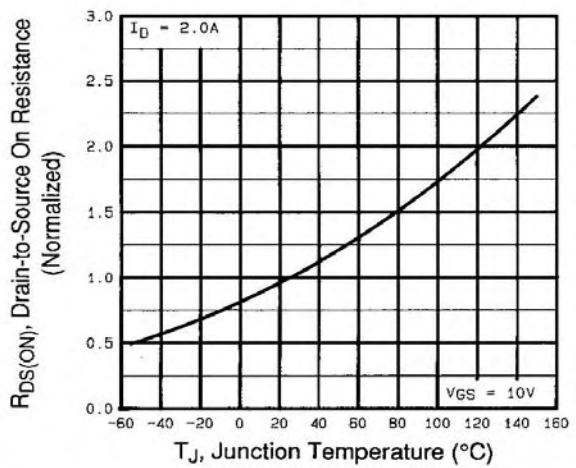
**Fig 1.** Typical Output Characteristics,  
 $T_C=25^\circ\text{C}$



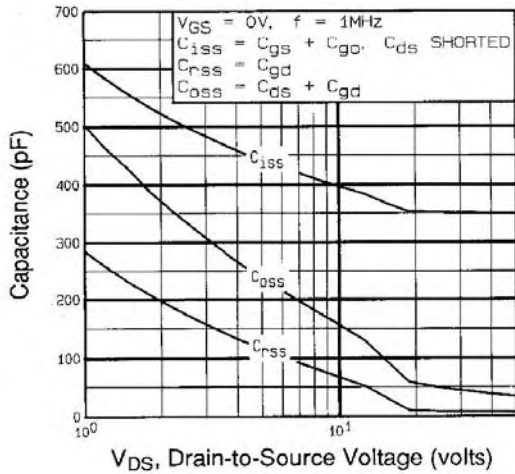
**Fig 2.** Typical Output Characteristics,  
 $T_C=150^\circ\text{C}$



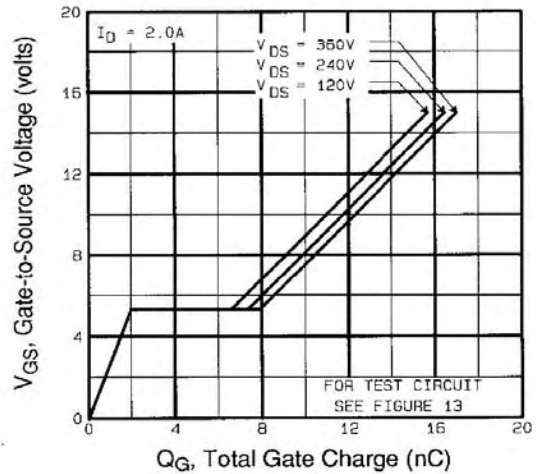
**Fig 3.** Typical Transfer Characteristics



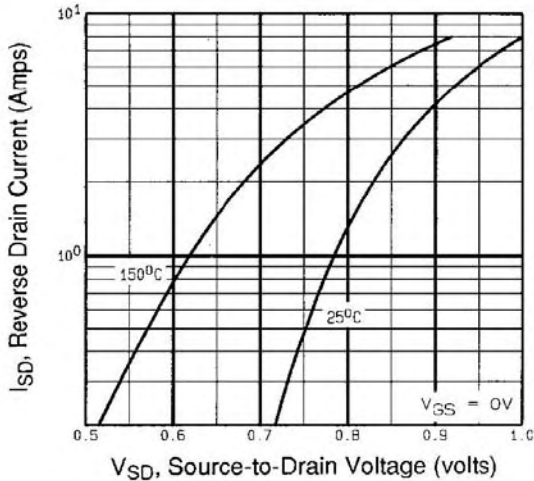
**Fig 4.** Normalized On-Resistance  
 Vs. Temperature



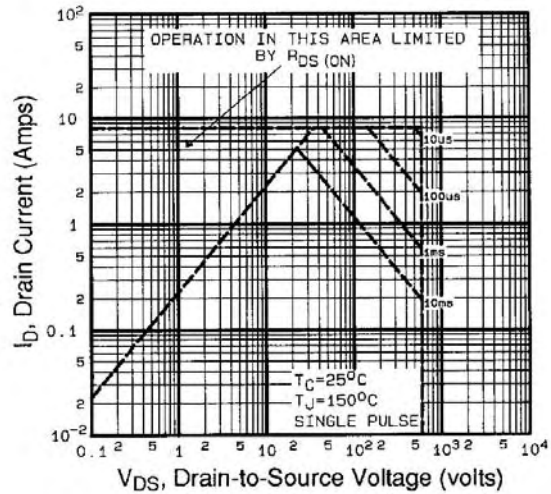
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



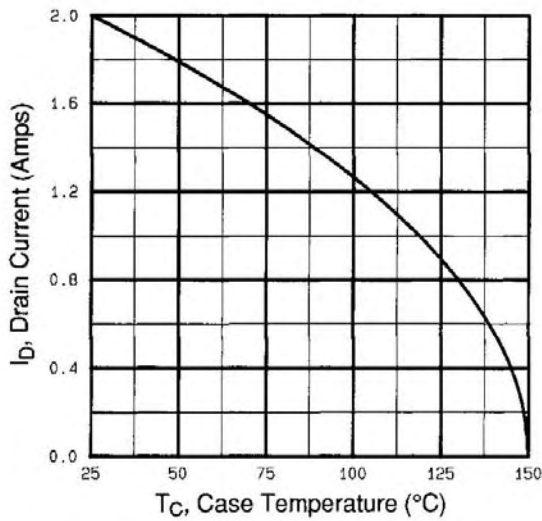
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



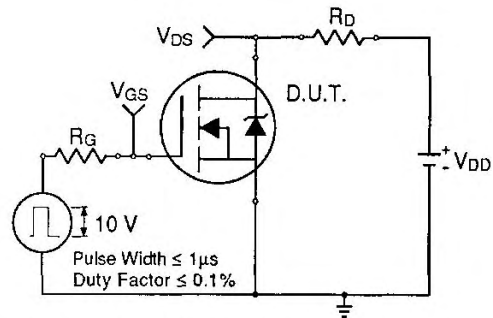
**Fig 7.** Typical Source-Drain Diode Forward Voltage



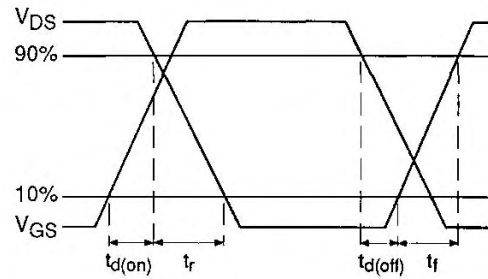
**Fig 8.** Maximum Safe Operating Area



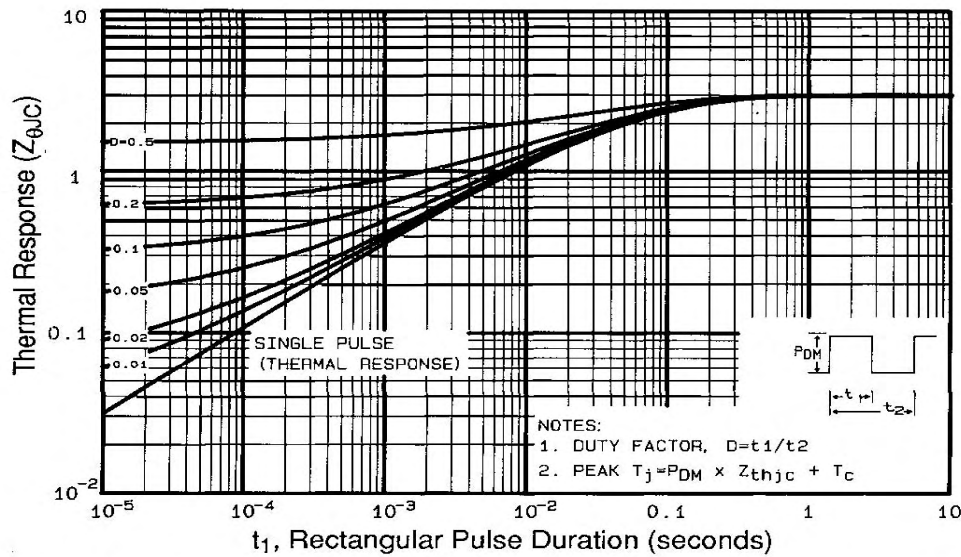
**Fig 9.** Maximum Drain Current Vs. Case Temperature



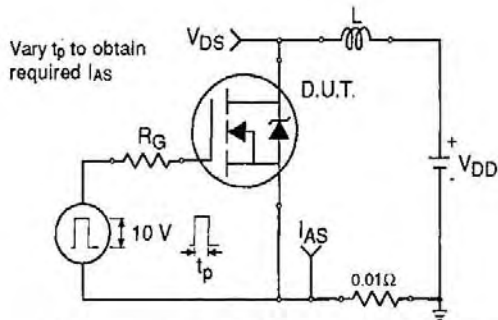
**Fig 10a.** Switching Time Test Circuit



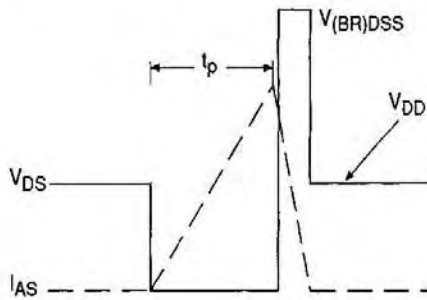
**Fig 10b.** Switching Time Waveforms



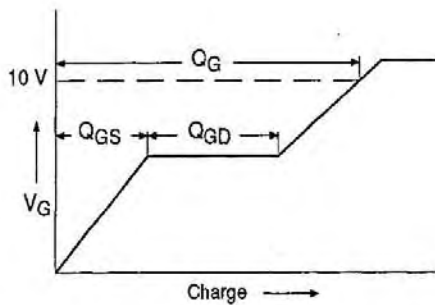
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



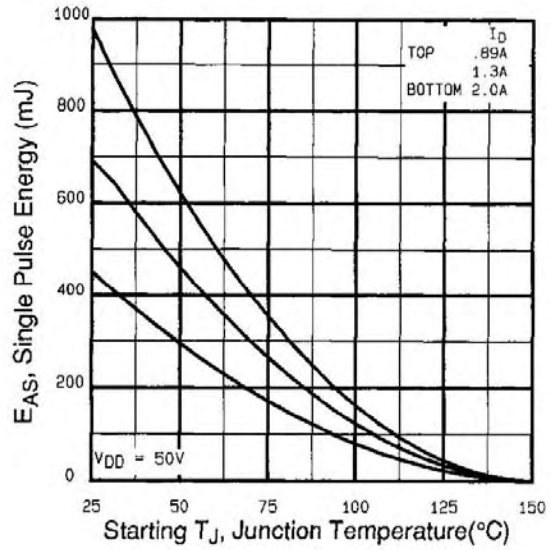
**Fig 12a.** Unclamped Inductive Test Circuit



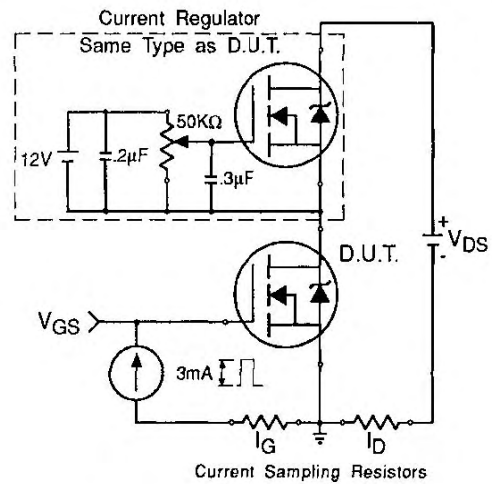
**Fig 12b.** Unclamped Inductive Waveforms



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

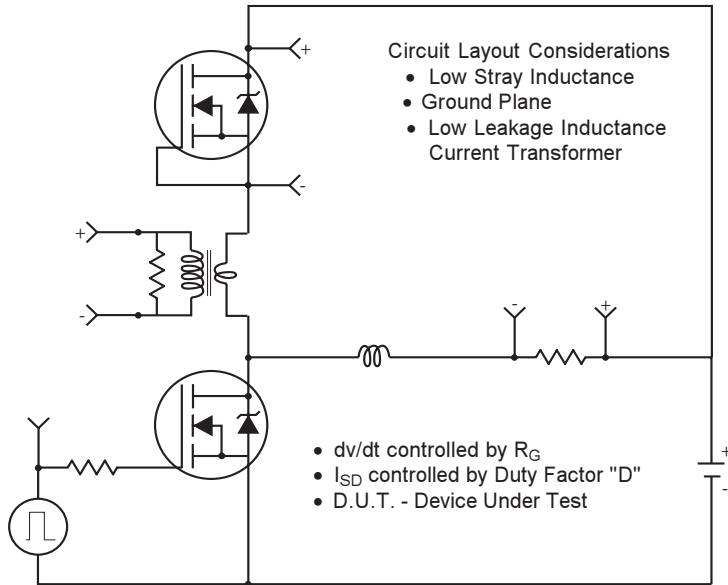


**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current

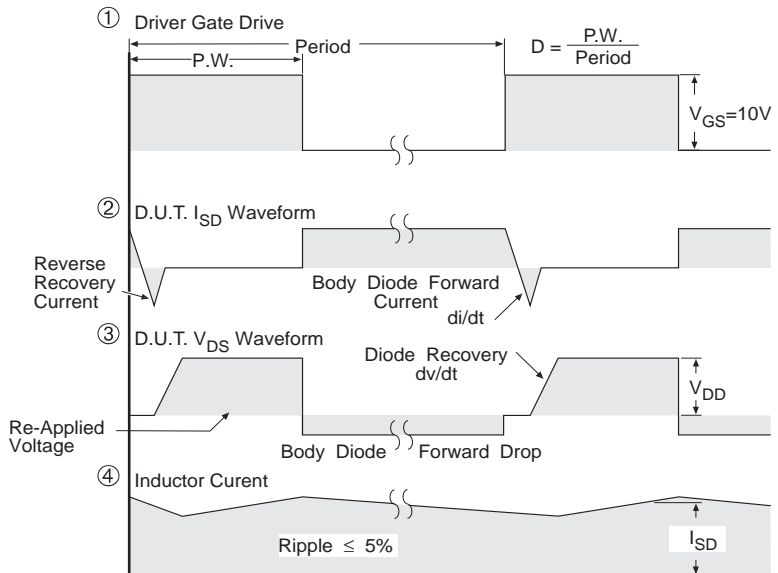


**Fig 13b.** Gate Charge Test Circuit

**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

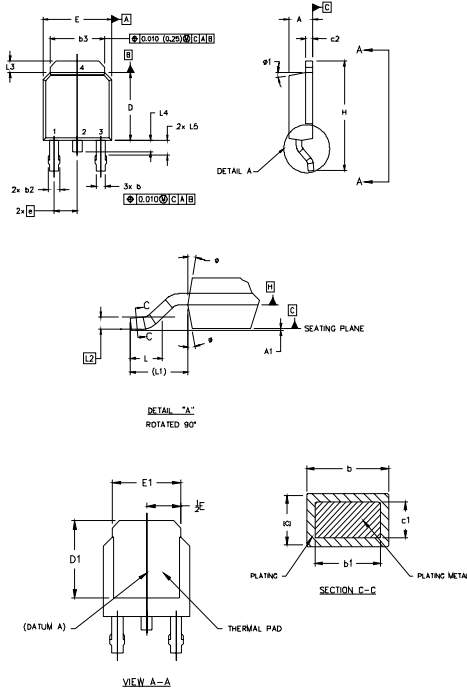
**Fig 14 For N Channel HEXFETS**

# IRFR/UC20PbF



## 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     |             | 0.15  |           | .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     | 0.46        | 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     | 0.851 BSC   |       | .020 BSC  |       |       |
| L3     | 0.89        | 1.27  | .035      | .050  |       |
| L4     |             | 1.02  |           | .040  |       |
| L5     | 1.14        | 1.52  | .045      | .060  | 5     |
| ø      | 0"          | 10"   | 0"        | 10"   |       |
| ø1     | 0"          | 15"   | 0"        | 15"   |       |

**LEAD ASSIGNMENTS**

**HEXFET**

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

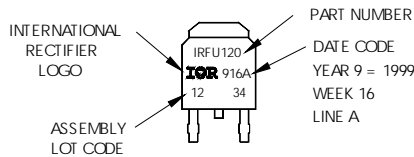
**IGBTs CoPACK**

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

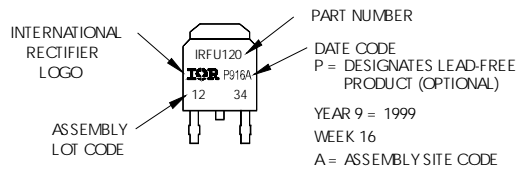
## D-Pak (TO-252AA) Part Marking Information

EXAMPLE: THIS IS AN IRFU120 WITH ASSEMBLY LOT CODE 1234 ASSEMBLED ON WW 16, 1999 IN THE ASSEMBLY LINE "A"

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



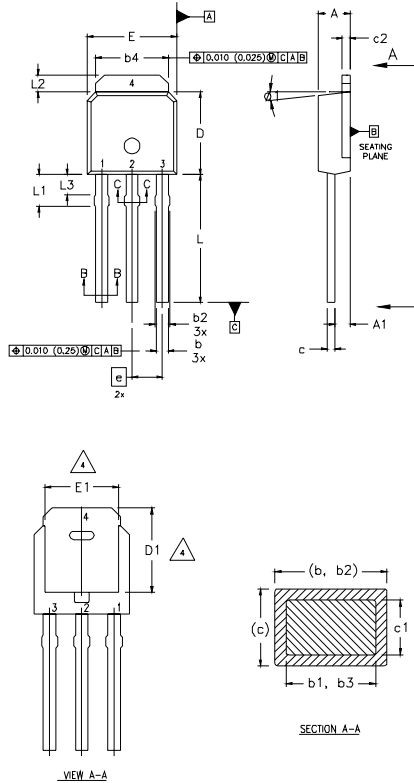
OR





## 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

#### HEXFECT

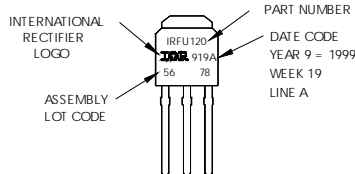
- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN

| 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'   |       |

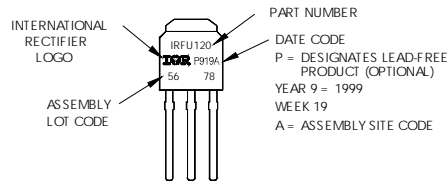
## I-Pak (TO-251AA) Part Marking Information

EXAMPLE: THIS IS AN IRFU120  
WITH ASSEMBLY  
LOT CODE 5678  
ASSEMBLED ON WW19, 1999  
IN THE ASSEMBLY LINE "A"

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



OR

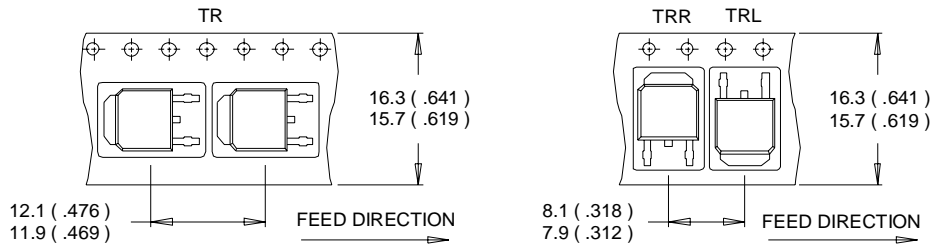


# IRFR/UC20PbF

International  
**IR** Rectifier

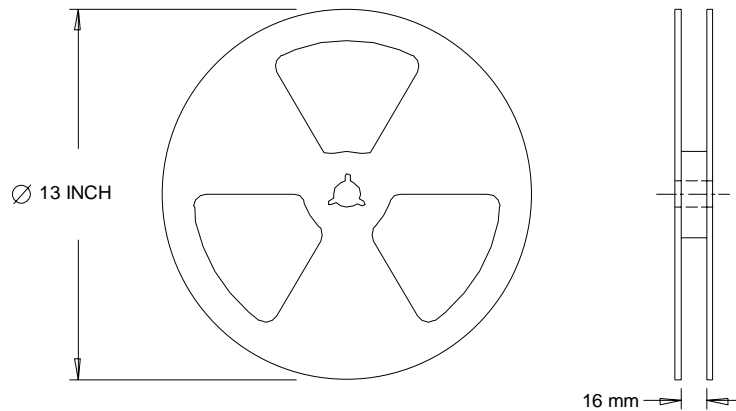
## D-Pak (TO-252AA) Tape & Reel Information

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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