

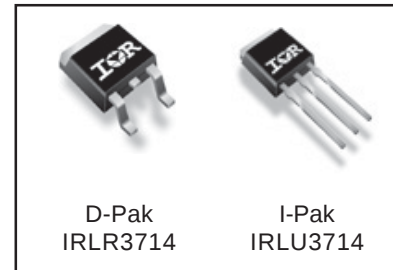
### Applications

- High Frequency Isolated DC-DC Converters with Synchronous Rectification for Telecom and Industrial Use
- High Frequency Buck Converters for Computer Processor Power
- Lead-Free

### Benefits

- Ultra-Low Gate Impedance
- Very Low  $R_{DS(on)}$  at 4.5V  $V_{GS}$
- Fully Characterized Avalanche Voltage and Current

| $V_{DSS}$ | $R_{DS(on)}$ max | $I_D$ |
|-----------|------------------|-------|
| 20V       | 20m $\Omega$     | 36A   |



### Absolute Maximum Ratings

| Symbol                           | Parameter                                | Max.        | Units               |
|----------------------------------|------------------------------------------|-------------|---------------------|
| $V_{DS}$                         | Drain-Source Voltage                     | 20          | V                   |
| $V_{GS}$                         | Gate-to-Source Voltage                   | $\pm 20$    | V                   |
| $I_D$ @ $T_C = 25^\circ\text{C}$ | Continuous Drain Current, $V_{GS}$ @ 10V | 36 ⑤        | A                   |
| $I_D$ @ $T_C = 70^\circ\text{C}$ | Continuous Drain Current, $V_{GS}$ @ 10V | 31          |                     |
| $I_{DM}$                         | Pulsed Drain Current①                    | 140         |                     |
| $P_D$ @ $T_C = 25^\circ\text{C}$ | Maximum Power Dissipation③               | 47          | W                   |
| $P_D$ @ $T_C = 70^\circ\text{C}$ | Maximum Power Dissipation③               | 33          | W                   |
|                                  | Linear Derating Factor                   | 0.31        | W/ $^\circ\text{C}$ |
| $T_J, T_{STG}$                   | Junction and Storage Temperature Range   | -55 to +175 | $^\circ\text{C}$    |

### Thermal Resistance

|                 | Parameter                        | Typ. | Max. | Units                     |
|-----------------|----------------------------------|------|------|---------------------------|
| $R_{\theta JC}$ | Junction-to-Case                 | —    | 3.2  | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient              | —    | 50   |                           |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB mount)④ | —    | 110  |                           |

Notes ① through ⑤ are on page 10

# IRLR/U3714PbF

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## Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

|                                 | Parameter                            | Min. | Typ.  | Max. | Units               | Conditions                                           |
|---------------------------------|--------------------------------------|------|-------|------|---------------------|------------------------------------------------------|
| $V_{(BR)DSS}$                   | Drain-to-Source Breakdown Voltage    | 20   | —     | —    | V                   | $V_{GS} = 0V, I_D = 250\mu A$                        |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.022 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}, I_D = 1mA$           |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | 15    | 20   | $m\Omega$           | $V_{GS} = 10V, I_D = 18A$ ③                          |
|                                 |                                      | —    | 21    | 28   |                     | $V_{GS} = 4.5V, I_D = 14A$ ③                         |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | 1.0  | —     | 3.0  | V                   | $V_{DS} = V_{GS}, I_D = 250\mu A$                    |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —     | 20   | $\mu A$             | $V_{DS} = 16V, V_{GS} = 0V$                          |
|                                 |                                      | —    | —     | 100  |                     | $V_{DS} = 16V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —     | 200  | nA                  | $V_{GS} = 16V$                                       |
|                                 | Gate-to-Source Reverse Leakage       | —    | —     | -200 |                     | $V_{GS} = -16V$                                      |

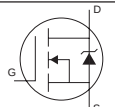
## Dynamic @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

| Symbol       | Parameter                       | Min. | Typ. | Max. | Units | Conditions                  |
|--------------|---------------------------------|------|------|------|-------|-----------------------------|
| $g_{fs}$     | Forward Transconductance        | 17   | —    | —    | S     | $V_{DS} = 10V, I_D = 14A$   |
| $Q_g$        | Total Gate Charge               | —    | 6.5  | 9.7  | nC    | $I_D = 14A$                 |
| $Q_{gs}$     | Gate-to-Source Charge           | —    | 1.8  | —    |       | $V_{DS} = 10V$              |
| $Q_{gd}$     | Gate-to-Drain ("Miller") Charge | —    | 2.9  | —    |       | $V_{GS} = 4.5V$             |
| $Q_{oss}$    | Output Gate Charge              | —    | 7.1  | —    |       | $V_{GS} = 0V, V_{DS} = 10V$ |
| $t_{d(on)}$  | Turn-On Delay Time              | —    | 8.7  | —    | ns    | $V_{DD} = 10V$              |
| $t_r$        | Rise Time                       | —    | 78   | —    |       | $I_D = 14A$                 |
| $t_{d(off)}$ | Turn-Off Delay Time             | —    | 10   | —    |       | $R_G = 1.8\Omega$           |
| $t_f$        | Fall Time                       | —    | 4.5  | —    |       | $V_{GS} = 4.5V$ ③           |
| $C_{iss}$    | Input Capacitance               | —    | 670  | —    | pF    | $V_{GS} = 0V$               |
| $C_{oss}$    | Output Capacitance              | —    | 470  | —    |       | $V_{DS} = 10V$              |
| $C_{rss}$    | Reverse Transfer Capacitance    | —    | 68   | —    |       | $f = 1.0MHz$                |

## Avalanche Characteristics

| Symbol   | Parameter                      | Typ. | Max. | Units |
|----------|--------------------------------|------|------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy② | —    | 72   | mJ    |
| $I_{AR}$ | Avalanche Current①             | —    | 14   | A     |

## Diode Characteristics

| Symbol   | Parameter                              | Min. | Typ. | Max. | Units | Conditions                                                                                                                                           |
|----------|----------------------------------------|------|------|------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —    | 36⑤  | —    | A     | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —    | 140  | —    |       |                                                                                                                                                      |
| $V_{SD}$ | Diode Forward Voltage                  | —    | —    | 1.3  | V     | $T_J = 25^\circ\text{C}, I_S = 18A, V_{GS} = 0V$ ③                                                                                                   |
|          |                                        | —    | 0.88 | —    |       | $T_J = 125^\circ\text{C}, I_S = 18A, V_{GS} = 0V$ ③                                                                                                  |
| $t_{rr}$ | Reverse Recovery Time                  | —    | 35   | 53   | ns    | $T_J = 25^\circ\text{C}, I_F = 18A, V_R = 10V$                                                                                                       |
| $Q_{rr}$ | Reverse Recovery Charge                | —    | 34   | 51   | nC    | $di/dt = 100A/\mu s$ ③                                                                                                                               |
| $t_{rr}$ | Reverse Recovery Time                  | —    | 35   | 53   | ns    | $T_J = 125^\circ\text{C}, I_F = 18A, V_R = 10V$                                                                                                      |
| $Q_{rr}$ | Reverse Recovery Charge                | —    | 35   | 53   | nC    | $di/dt = 100A/\mu s$ ③                                                                                                                               |

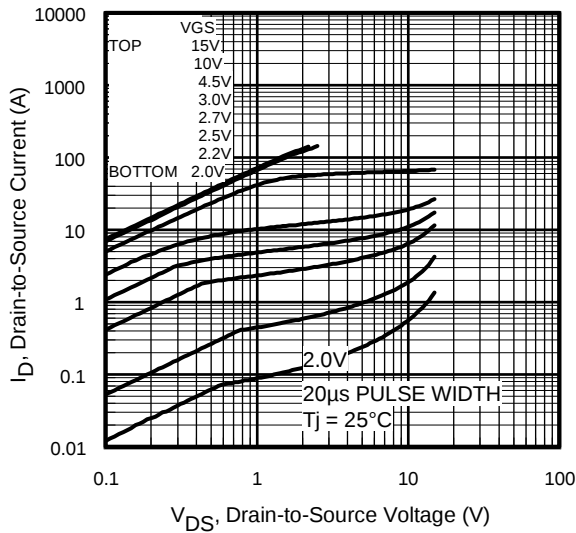


Fig 1. Typical Output Characteristics

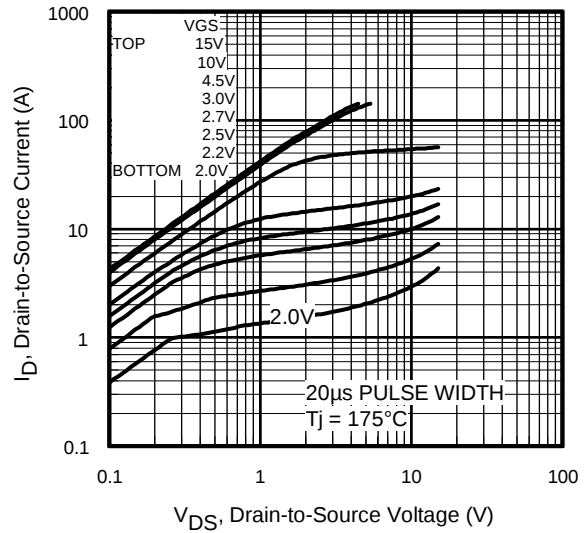


Fig 2. Typical Output Characteristics

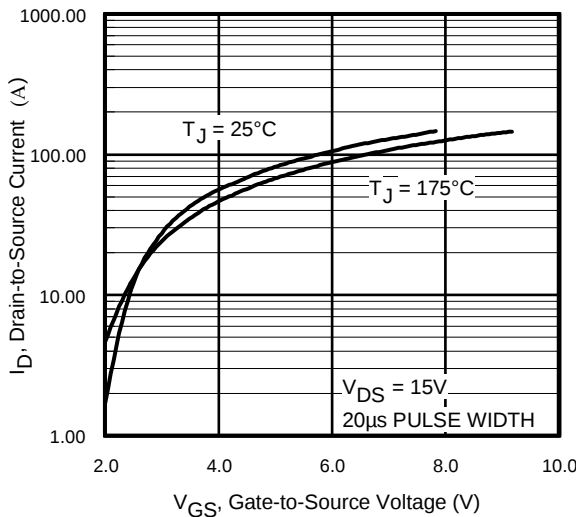


Fig 3. Typical Transfer Characteristics

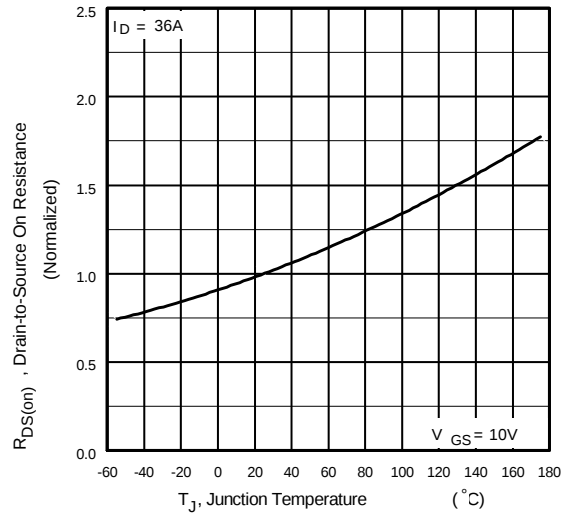
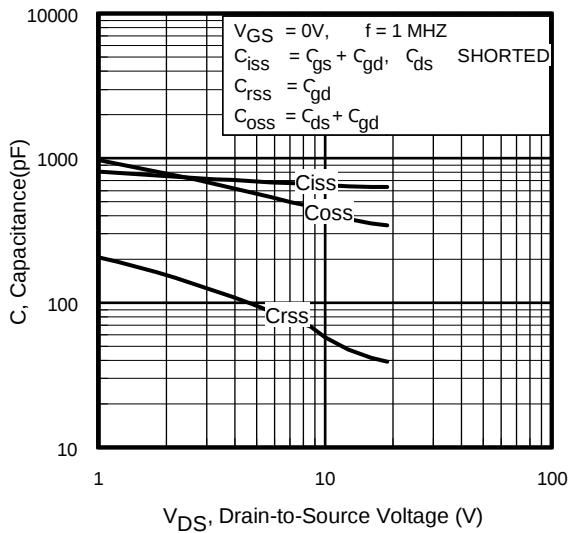
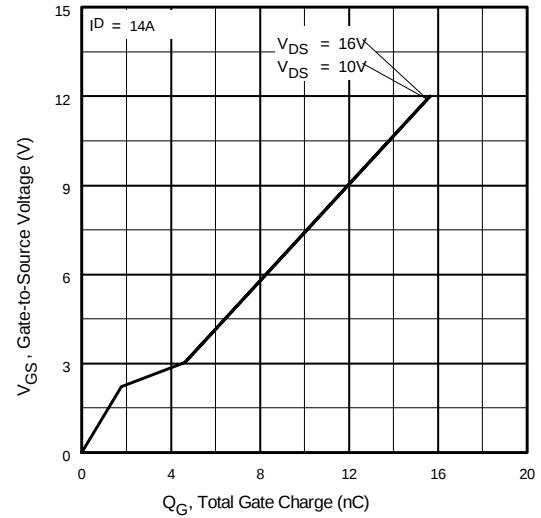


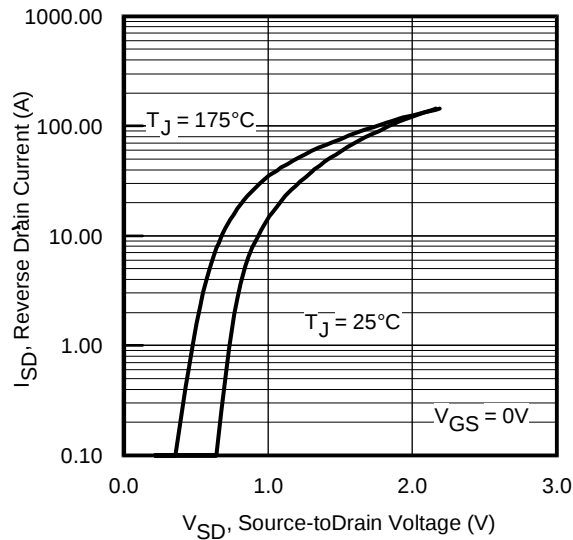
Fig 4. Normalized On-Resistance Vs. Temperature



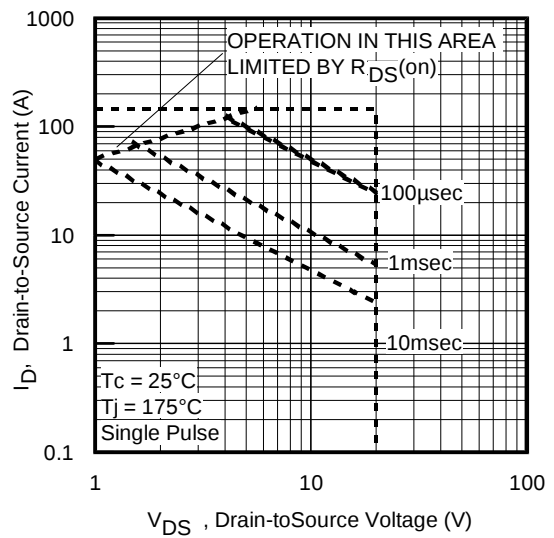
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



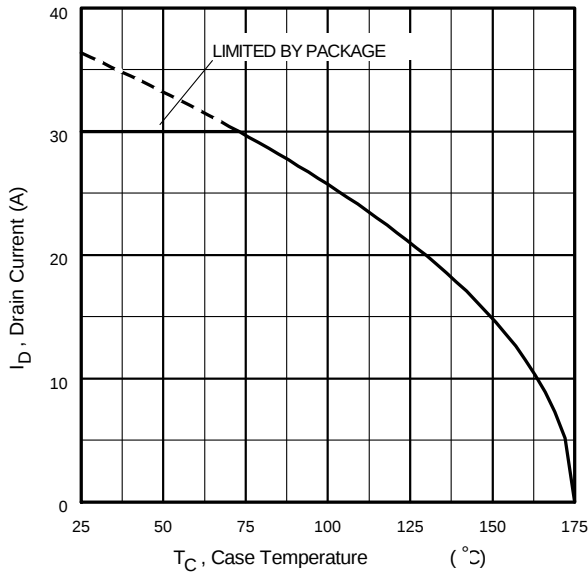
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



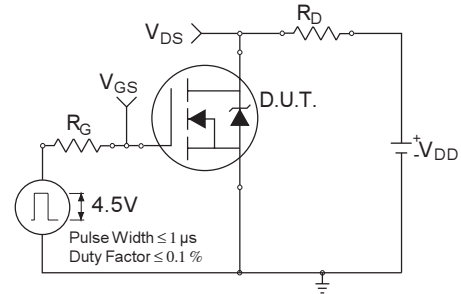
**Fig 7.** Typical Source-Drain Diode Forward Voltage



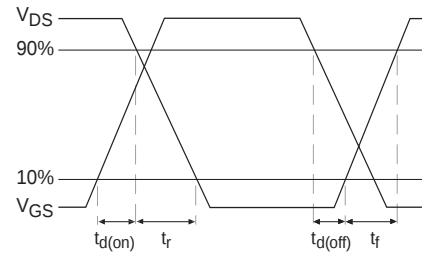
**Fig 8.** Maximum Safe Operating Area



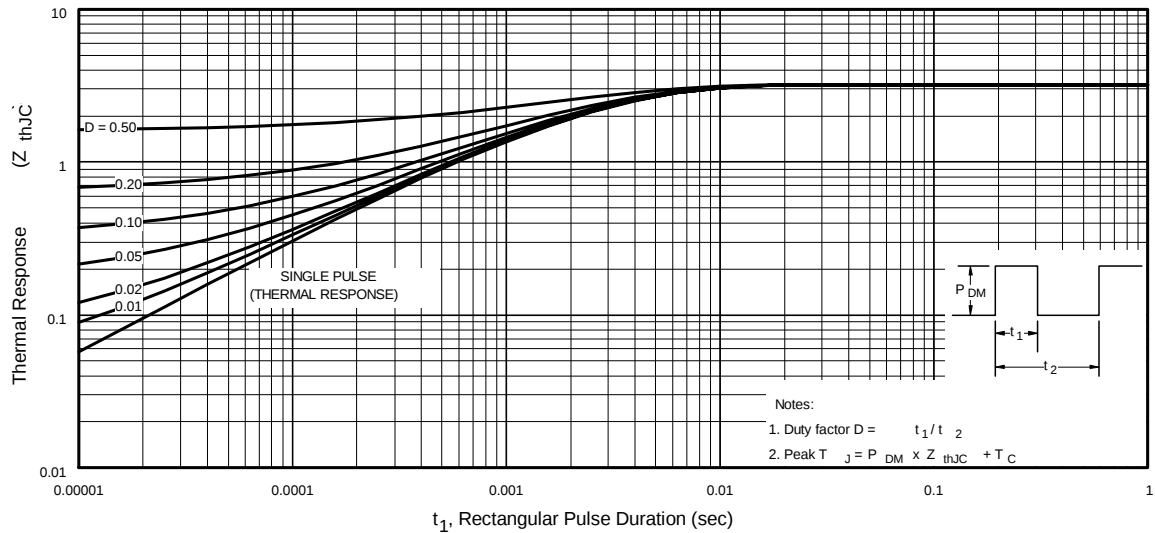
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



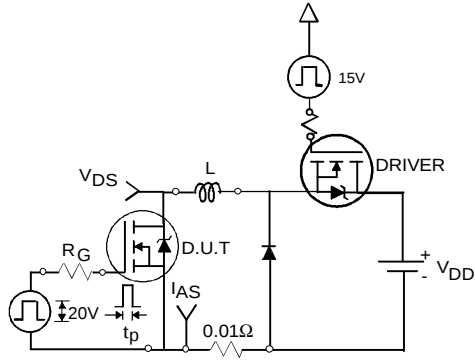
**Fig 10b.** Switching Time Waveforms



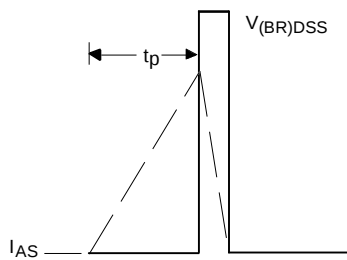
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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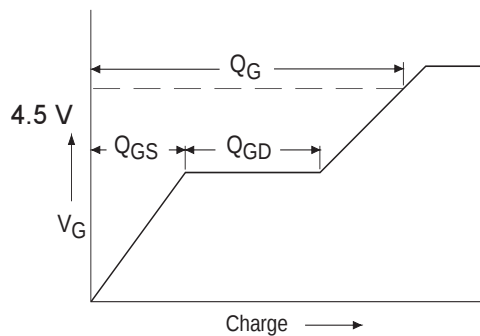
International  
**IR** Rectifier



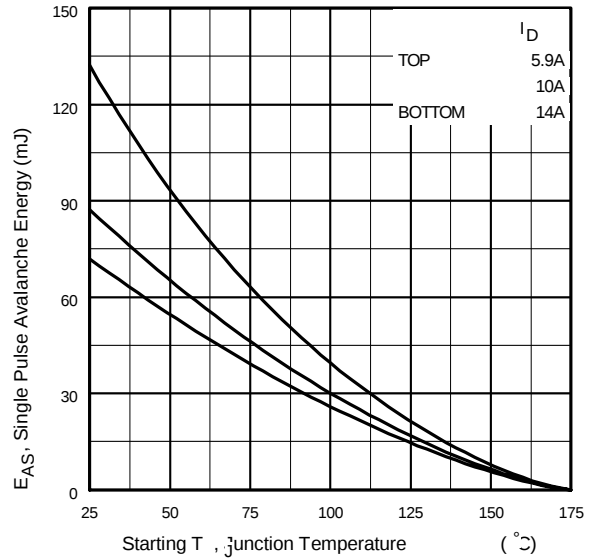
**Fig 12a.** Unclamped Inductive Test Circuit



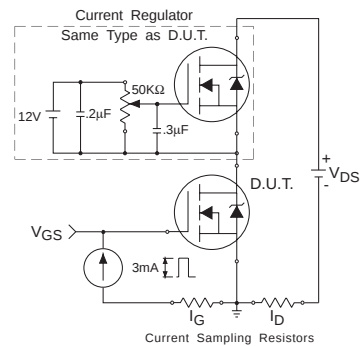
**Fig 12b.** Unclamped Inductive Waveforms



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

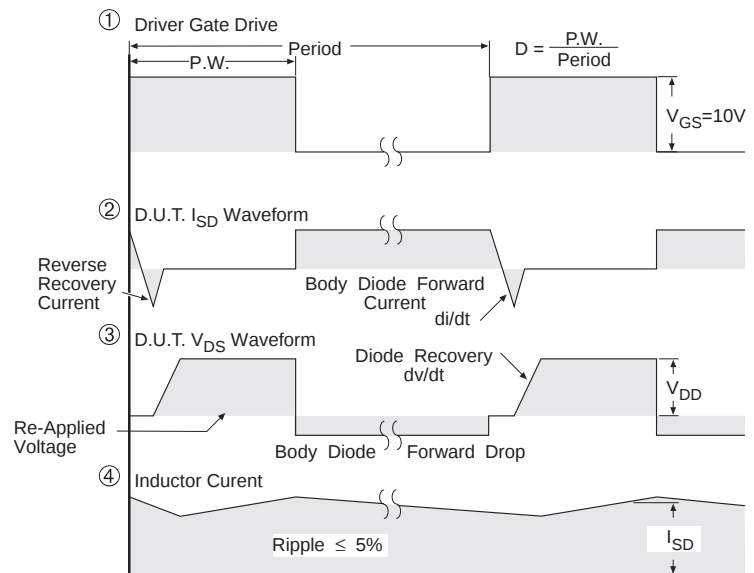
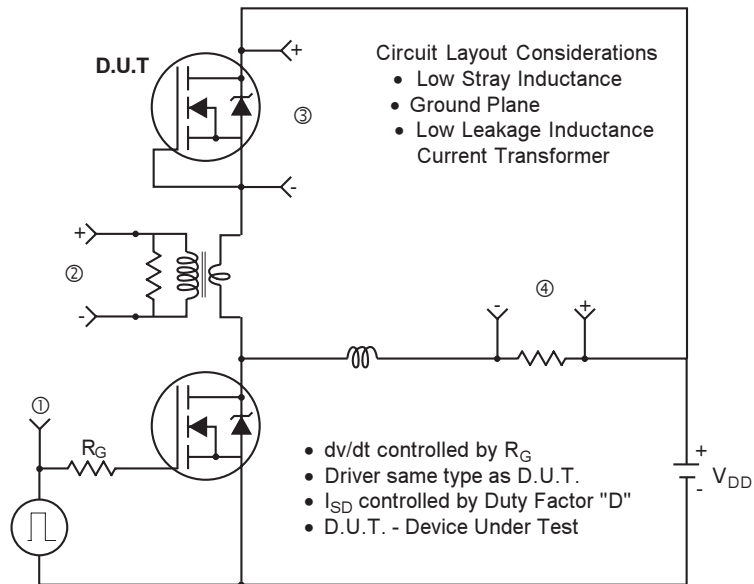


**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



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

### Peak Diode Recovery dv/dt Test Circuit



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

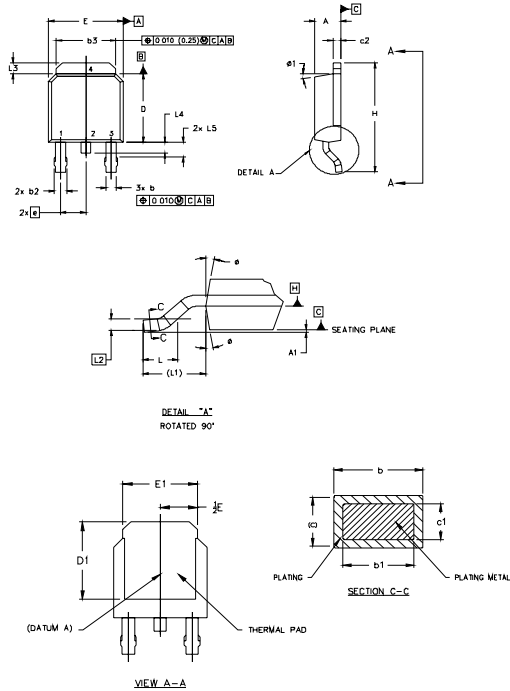
**Fig 14.** For N-Channel HEXFET® Power MOSFETs

# IRLR/U3714PbF

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 [0.254] FROM THE LEAD TIP.
  - 6.0 DIMENSION D & E DO NOT INCLUDE WELD FLASH. WELD 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        | 0.13  | .005      | .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     | 4.85        | 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     | 0.051 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

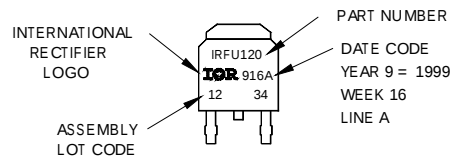
IGBTs, CoPACK

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

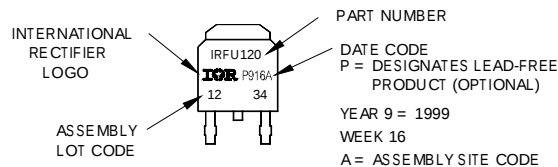
## D-Pak (TO-252AA) Part Marking Information

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

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

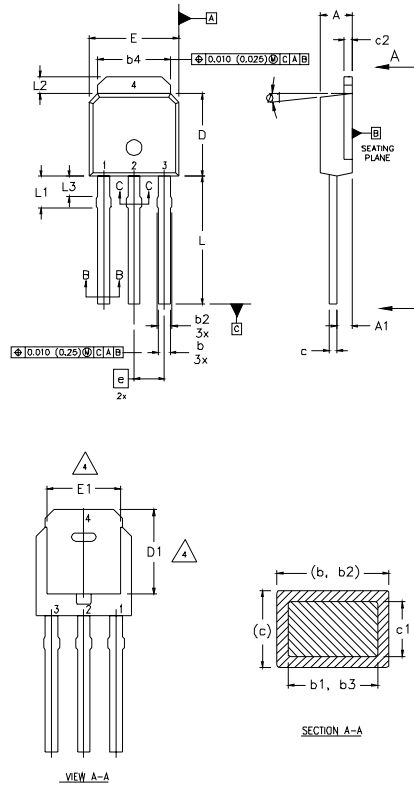


OR



## 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

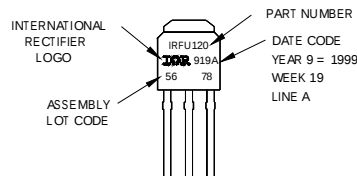
- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE
- 4.- DRAIN

| 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"   |       |

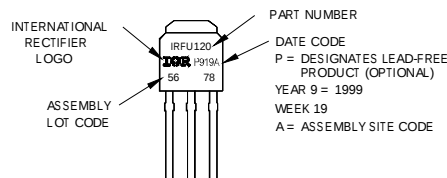
## I-Pak (TO-251AA) Part Marking Information

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**

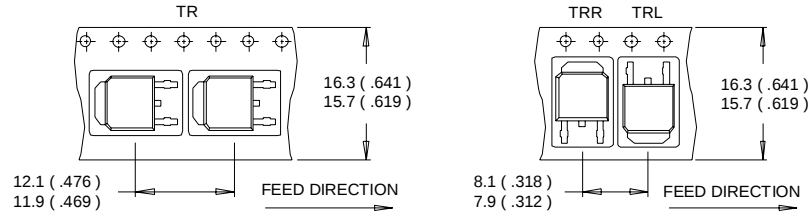


# IRLR/U3714PbF

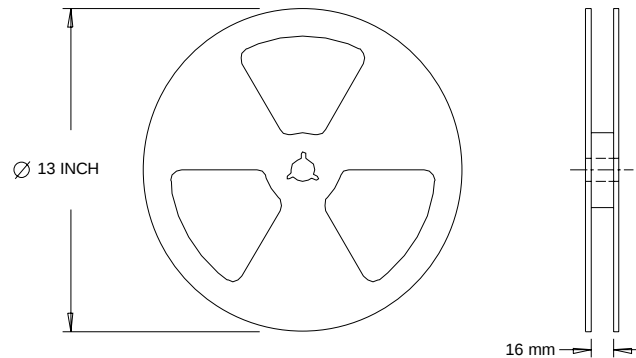
International  
**IR** Rectifier

## 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.

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.69\text{ mH}$   
 $R_G = 25\Omega$ ,  $I_{AS} = 14\text{A}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④ When mounted on 1" square PCB ( FR-4 or G-10 Material ). For recommended footprint and soldering techniques refer to application note #AN-994.
- ⑤ Calculated continuous current based on maximum allowable junction temperature; Package limitation current is 30A

Data and specifications subject to change without notice.  
These products have been designed and qualified for the Industrial market.  
Qualification Standards can be found on IR's Web site.

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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