

HEXFET® Power MOSFET

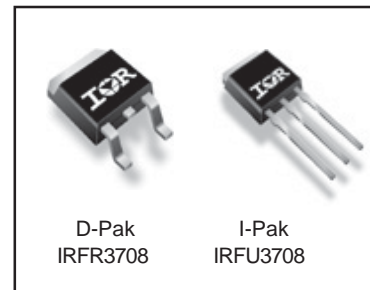
Applications

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

| | | |
|------------------------|-------------------------------|------------------------|
| V_{DSS} | R_{DS(on)} max | I_D |
| 30V | 12.5mΩ | 61A^④ |

Benefits

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



Absolute Maximum Ratings

| Symbol | Parameter | Max. | Units |
|--|---|-----------------|-------|
| V _{DS} | Drain-Source Voltage | 30 | V |
| V _{GS} | Gate-to-Source Voltage | ± 12 | V |
| I _D @ T _A = 25°C | Continuous Drain Current, V _{GS} @ 10V | 61 ^④ | A |
| I _D @ T _A = 70°C | Continuous Drain Current, V _{GS} @ 10V | 51 ^④ | |
| I _{DM} | Pulsed Drain Current ^① | 244 | |
| P _D @ T _A = 25°C | Maximum Power Dissipation ^③ | 87 | W |
| P _D @ T _A = 70°C | Maximum Power Dissipation ^③ | 61 | W |
| | Linear Derating Factor | 0.58 | W/°C |
| T _J , T _{STG} | Junction and Storage Temperature Range | -55 to + 175 | °C |

Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|------------------|----------------------------------|------|------|-------|
| R _{θJC} | Junction-to-Case | — | 1.73 | °C/W |
| R _{θJA} | Junction-to-Ambient (PCB mount)* | — | 50 | |
| R _{θJA} | 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

Notes ① through ④ are on page 9

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IRFR/U3708PbF

International
IR Rectifier

Static @ T_J = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|--|--------------------------------------|------|-------|------|-------|---|
| V _{(BR)DSS} | Drain-to-Source Breakdown Voltage | 30 | — | — | V | V _{GS} = 0V, I _D = 250μA |
| ΔV _{(BR)DSS} /ΔT _J | Breakdown Voltage Temp. Coefficient | — | 0.028 | — | V/°C | Reference to 25°C, I _D = 1mA |
| R _{DS(on)} | Static Drain-to-Source On-Resistance | — | 8.5 | 12.5 | mΩ | V _{GS} = 10V, I _D = 15A ③ |
| | | — | 10.0 | 14.0 | | V _{GS} = 4.5V, I _D = 12A ③ |
| | | — | 15.0 | 30.0 | | V _{GS} = 2.8V, I _D = 7.5A ③ |
| V _{GS(th)} | Gate Threshold Voltage | 0.6 | — | 2.0 | V | V _{DS} = V _{GS} , I _D = 250μA |
| I _{DSS} | Drain-to-Source Leakage Current | — | — | 20 | μA | V _{DS} = 24V, V _{GS} = 0V |
| | | — | — | 100 | | V _{DS} = 24V, V _{GS} = 0V, T _J = 125°C |
| I _{GSS} | Gate-to-Source Forward Leakage | — | — | 200 | nA | V _{GS} = 12V |
| | Gate-to-Source Reverse Leakage | — | — | -200 | | V _{GS} = -12V |

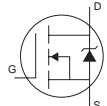
Dynamic @ T_J = 25°C (unless otherwise specified)

| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---------------------|---------------------------------|------|------|------|-------|---|
| g _{fs} | Forward Transconductance | 49 | — | — | S | V _{DS} = 15V, I _D = 50A |
| Q _g | Total Gate Charge | — | 24 | — | nC | I _D = 24.8A |
| Q _{gs} | Gate-to-Source Charge | — | 6.7 | — | | V _{DS} = 15V |
| Q _{gd} | Gate-to-Drain ("Miller") Charge | — | 5.8 | — | | V _{GS} = 4.5V ③ |
| Q _{oss} | Output Gate Charge | — | 14 | 21 | | V _{GS} = 0V, I _D = 24.8A, V _{DS} = 15V |
| t _{d(on)} | Turn-On Delay Time | — | 7.2 | — | ns | V _{DD} = 15V |
| t _r | Rise Time | — | 50 | — | | I _D = 24.8A |
| t _{d(off)} | Turn-Off Delay Time | — | 17.6 | — | | R _G = 0.6Ω |
| t _f | Fall Time | — | 3.7 | — | | V _{GS} = 4.5V ③ |
| C _{iss} | Input Capacitance | — | 2417 | — | pF | V _{GS} = 0V |
| C _{oss} | Output Capacitance | — | 707 | — | | V _{DS} = 15V |
| C _{rss} | Reverse Transfer Capacitance | — | 52 | — | | f = 1.0MHz |

Avalanche Characteristics

| Symbol | Parameter | Typ. | Max. | Units |
|-----------------|--------------------------------|------|------|-------|
| E _{AS} | Single Pulse Avalanche Energy② | — | 213 | mJ |
| I _{AR} | Avalanche Current① | — | 62 | A |

Diode Characteristics

| Symbol | Parameter | Min. | Typ. | Max. | Units | Conditions |
|-----------------|--|------|------|------|-------|--|
| I _S | Continuous Source Current (Body Diode) | — | — | 61④ | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I _{SM} | Pulsed Source Current (Body Diode) ① | — | — | 244 | | |
| V _{SD} | Diode Forward Voltage | — | 0.88 | 1.3 | V | T _J = 25°C, I _S = 31A, V _{GS} = 0V ③ |
| | | — | 0.80 | — | | T _J = 125°C, I _S = 31A, V _{GS} = 0V ③ |
| t _{rr} | Reverse Recovery Time | — | 41 | 62 | ns | T _J = 25°C, I _F = 31A, V _R = 20V |
| Q _{rr} | Reverse Recovery Charge | — | 64 | 96 | nC | di/dt = 100A/μs ③ |
| t _{rr} | Reverse Recovery Time | — | 43 | 65 | ns | T _J = 125°C, I _F = 31A, V _R = 20V |
| Q _{rr} | Reverse Recovery Charge | — | 70 | 105 | nC | di/dt = 100A/μs ③ |

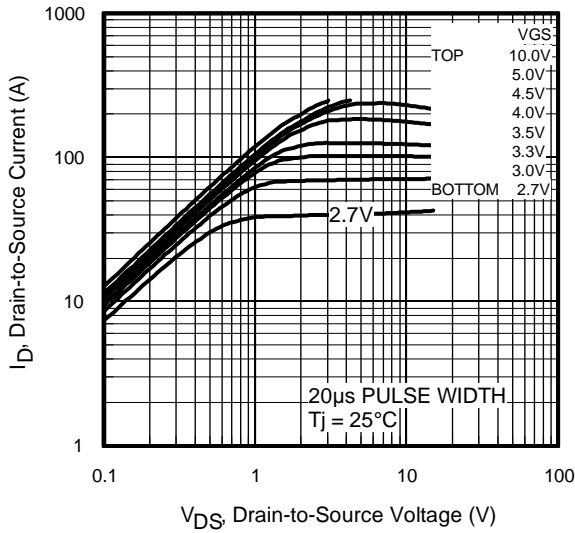


Fig 1. Typical Output Characteristics

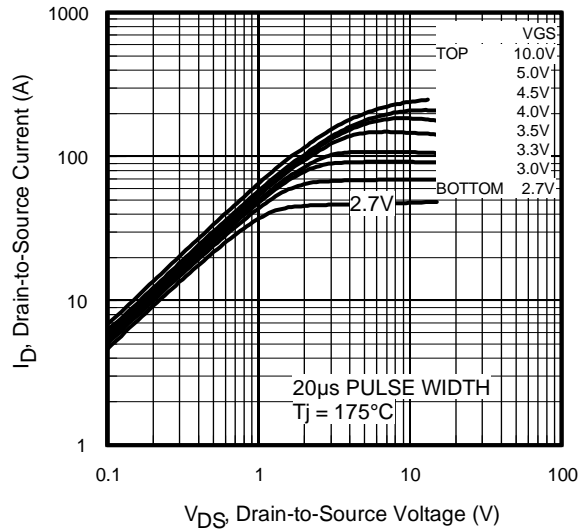


Fig 2. Typical Output Characteristics

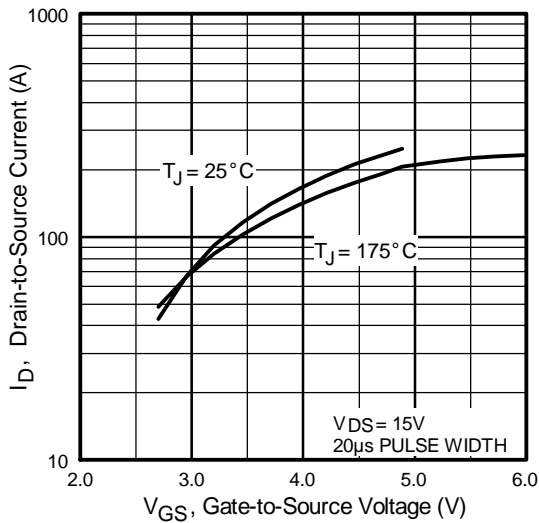


Fig 3. Typical Transfer Characteristics

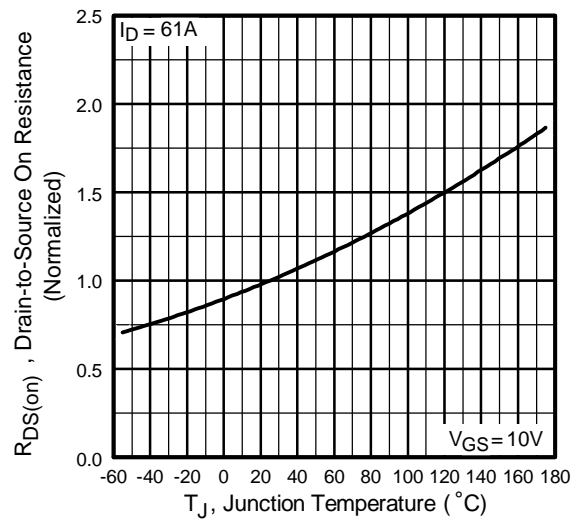


Fig 4. Normalized On-Resistance Vs. Temperature

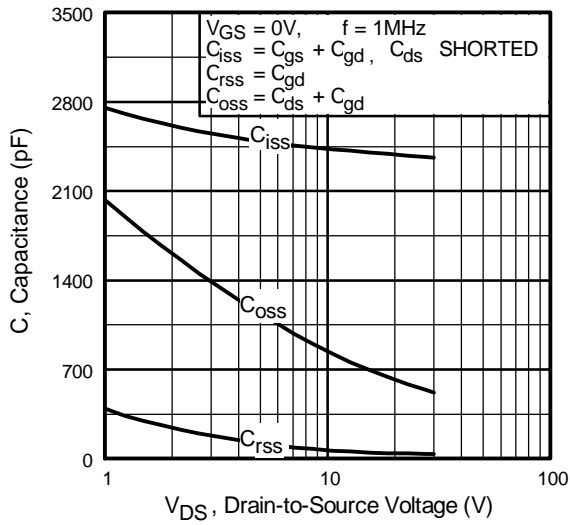


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

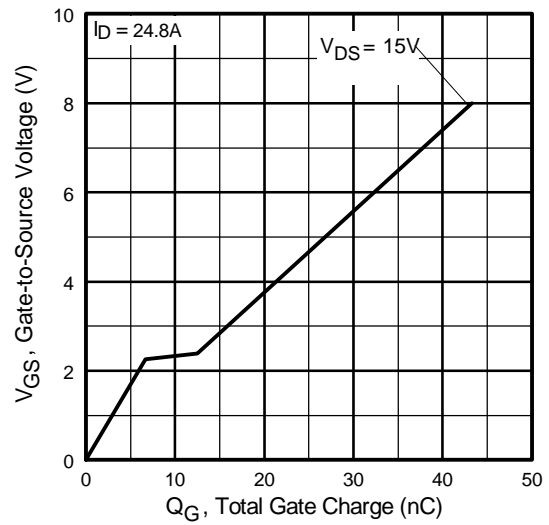


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

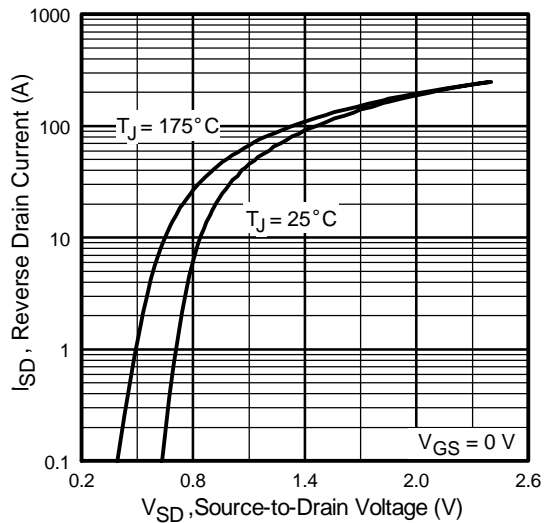


Fig 7. Typical Source-Drain Diode Forward Voltage

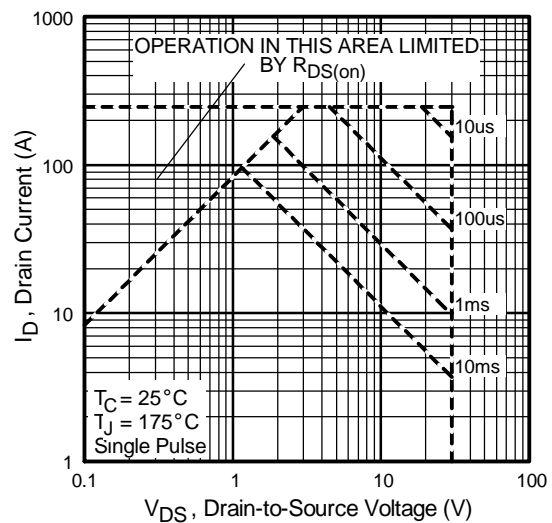


Fig 8. Maximum Safe Operating Area

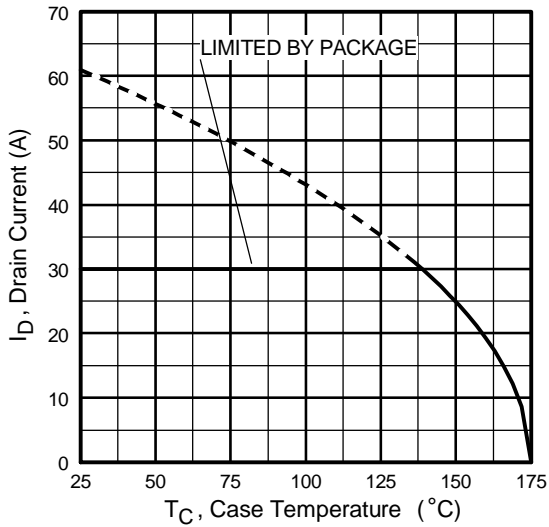


Fig 9. Maximum Drain Current Vs. Case Temperature

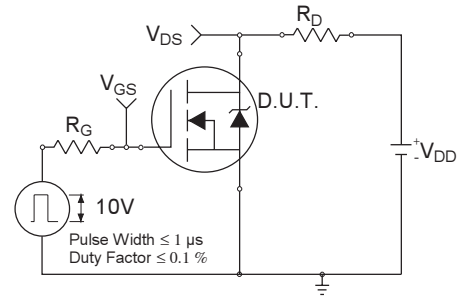


Fig 10a. Switching Time Test Circuit

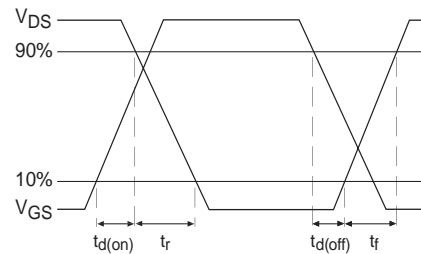


Fig 10b. Switching Time Waveforms

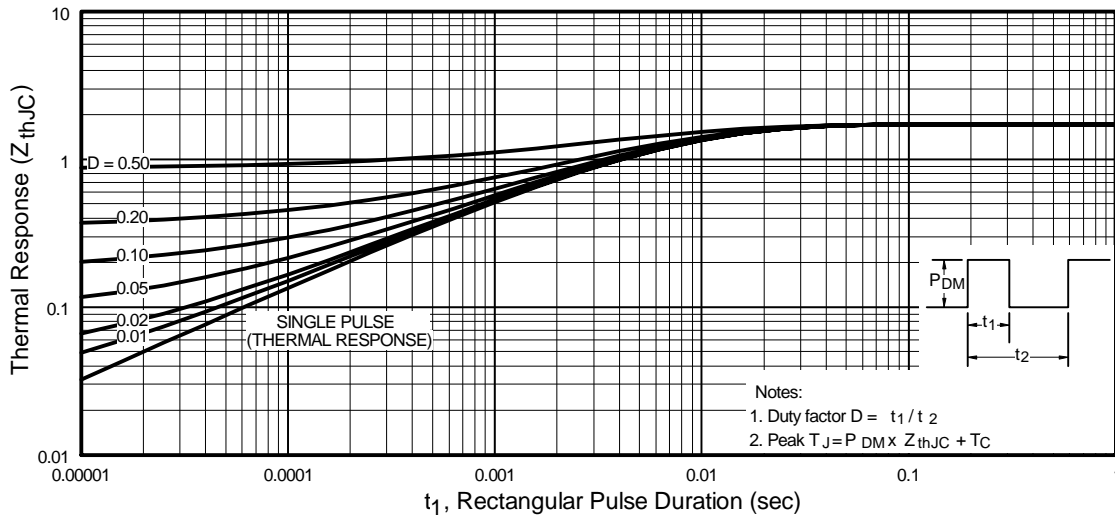


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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IR Rectifier

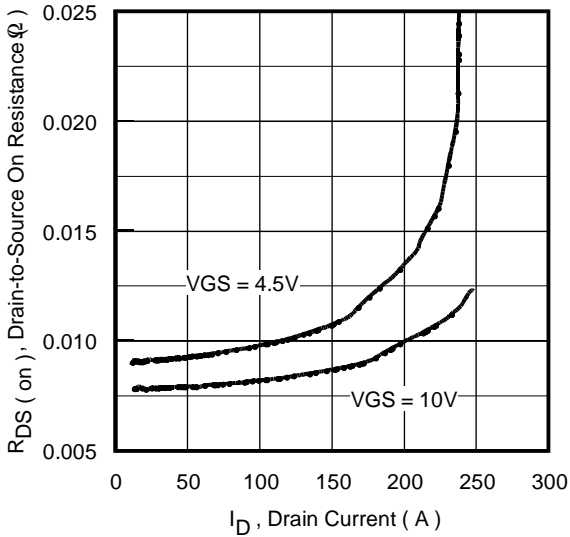


Fig 12. On-Resistance Vs. Drain Current

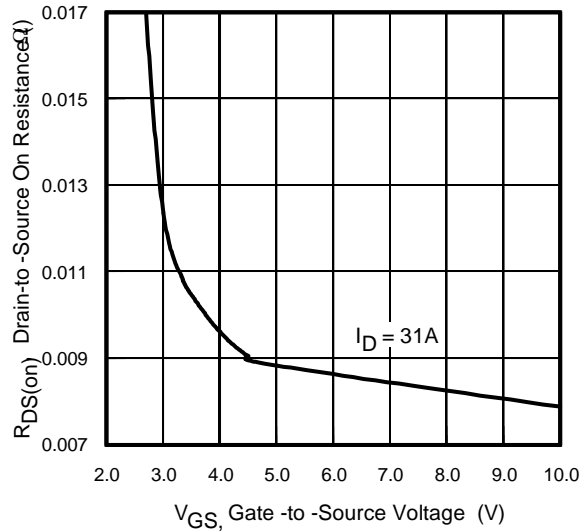


Fig 13. On-Resistance Vs. Gate Voltage

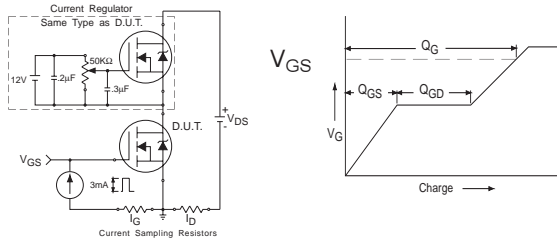


Fig 14a&b. Gate Charge Test Circuit and Waveform

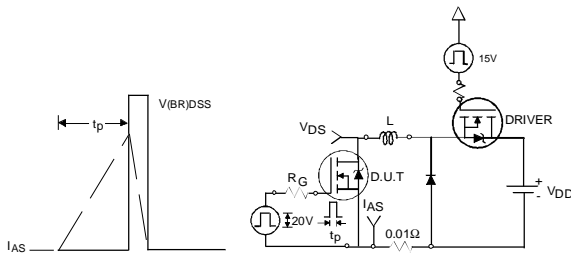


Fig 15a&b. Unclamped Inductive Test circuit and Waveforms

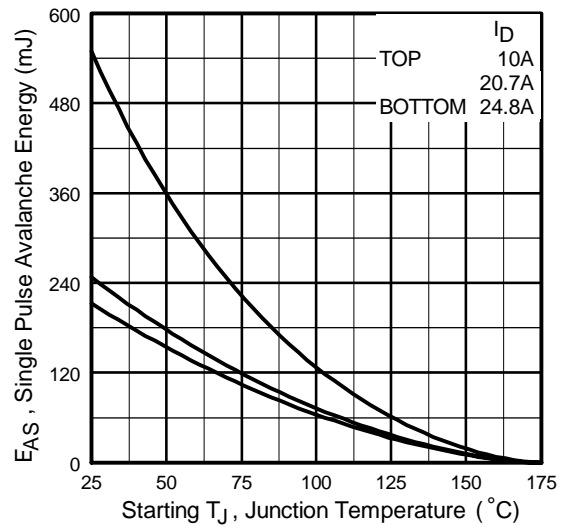
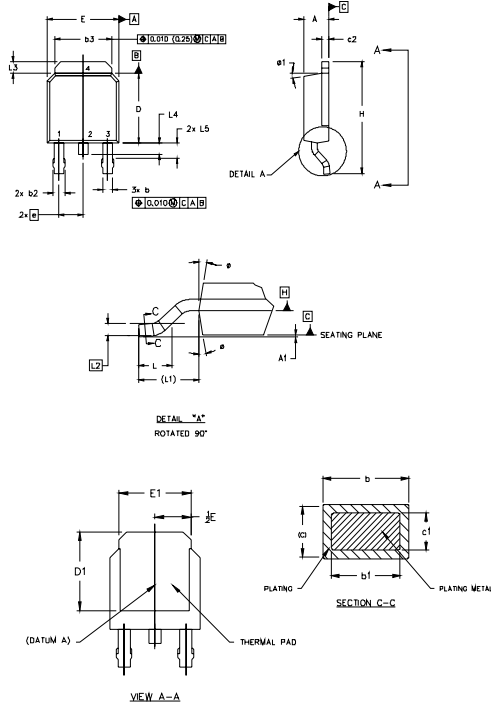


Fig 15c. Maximum Avalanche Energy Vs. Drain Current

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 | 2.59 | .086 | .094 | |
| A1 | | 0.13 | | .005 | |
| b | 0.64 | 0.89 | .025 | .035 | |
| b1 | 0.64 | 0.79 | .025 | .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 | 0.66 | .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 | .0051 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

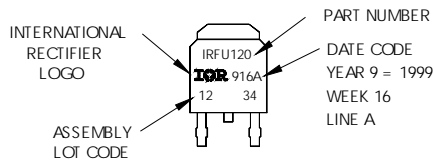
IGBTs, CoPACK

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

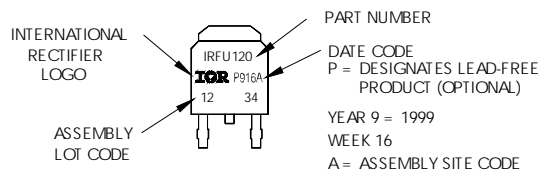
D-Pak (TO-252AA) Part Marking Information

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"



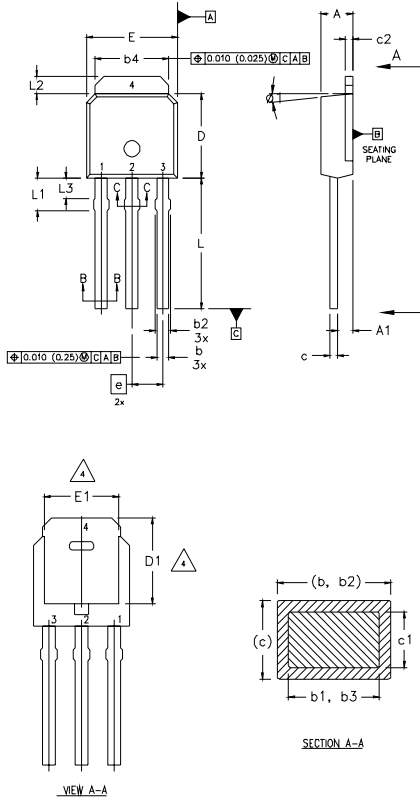
OR



IRFR/U3708PbF

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

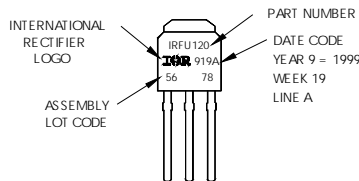
HEXFEEET

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

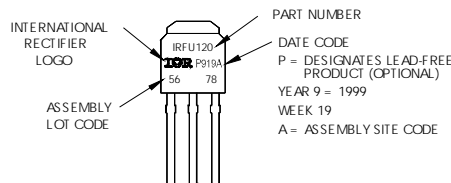
| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|--------|-------------|------|-----------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 2.18 | 2.39 | 0.086 | .094 | |
| A1 | 0.89 | 1.14 | 0.035 | 0.045 | |
| b | 0.64 | 0.89 | 0.025 | 0.035 | |
| b1 | 0.64 | 0.79 | 0.025 | 0.031 | 4 |
| b2 | 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 | 0.46 | 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 | Ø | 15' | Ø | 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"

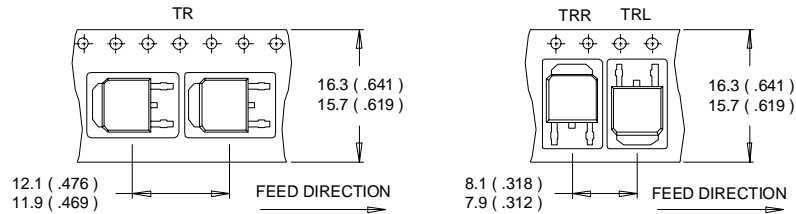


OR



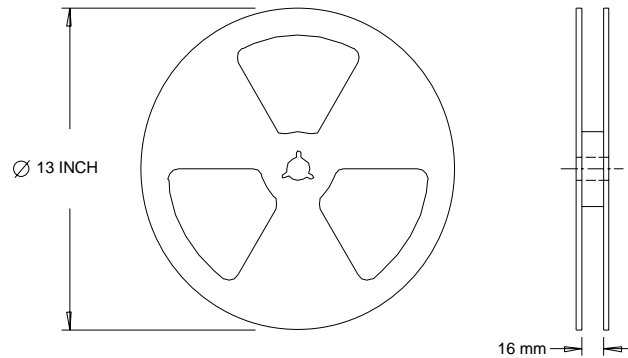
D-Pak (TO-252AA) Tape & Reel Information

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 $T_J = 25^\circ\text{C}$, $L = 0.7 \text{ mH}$
 $R_G = 25\Omega$, $I_{AS} = 24.8 \text{ A}$.
- ③ Pulse width $\leq 300\mu\text{s}$; duty cycle $\leq 2\%$.
- ④ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 30A.

Data and specifications subject to change without notice.

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

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