International
IOR Rectifier

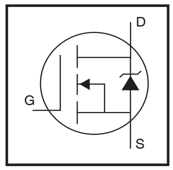
AUTOMOTIVE GRADE

# AUIRFR4292
# AUIRFU4292

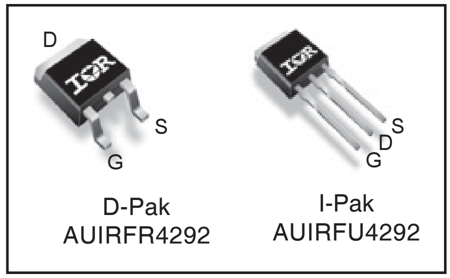
## Features

- Advanced Process Technology
- Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax
- Lead-Free, RoHS Compliant
- Automotive Qualified *

HEXFET® Power MOSFET




| | | |
|---|---|---|
| $V_{(BR)DSS}$ | | 250V |
| $R_{DS(on)}$ | typ. | 275mΩ |
| | max. | 345mΩ |
| $I_D$ | | 9.3A |




| G | D | S |
|---|---|---|
| Gate | Drain | Source |

## Description

Specifically designed for Automotive applications, this HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating . These features combine to make this design an extremely efficient and reliable device for use in Automotive applications and a wide variety of other applications.

| Base part number | Package Type | Standard Pack | | Orderable Part Number | Note |
|---|---|---|---|---|---|
| | | Form | Quantity | | |
| AUIRFR4292 | DPak | Tube | 75 | AUIRFR4292 | |
| | | Tape and Reel | 2000 | AUIRFR4292TR | |
| | | Tape and Reel Left | 3000 | AUIRFR4292TRL | |
| | | ~~Tape and Reel Right~~ | ~~3000~~ | ~~AUIRFR4292TRR~~ | EOL notice # 530 |
| AUIRFU4292 | IPak | Tube | 75 | AUIRFU4292 | |

## Absolute Maximum Ratings

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the specifications is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature ($T_A$) is 25°C, unless otherwise specified.

| | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V | 9.3 | |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V | 6.6 | A |
| $I_{DM}$ | Pulsed Drain Current ① | 40 | |
| $P_D$ @$T_C$ = 25°C | Power Dissipation | 100 | W |
| | Linear Derating Factor | 0.67 | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 20 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy (Thermally Limited) ② | 130 | mJ |
| $E_{AS}$ (tested ) | Single Pulse Avalanche Energy Tested Value ⑥ | 97 | |
| $I_{AR}$ | Avalanche Current ① | See Fig.12a, 12b, 15, 16 | A |
| $E_{AR}$ | Repetitive Avalanche Energy ⑤ | | mJ |
| $T_J$ | Operating Junction and | -55 to + 175 | |
| $T_{STG}$ | Storage Temperature Range | | °C |
| | Soldering Temperature, for 10 seconds (1.6mm from case ) | 300 | |

## Thermal Resistance

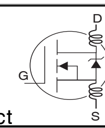
| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case ⑧ | —— | 1.5 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mount) ⑦ | —— | 50 | |
| $R_{\theta JA}$ | Junction-to-Ambient | —— | 110 | |

HEXFET® is a registered trademark of International Rectifier.
*Qualification standards can be found at http://www.irf.com/

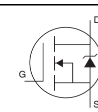
### Static Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 250 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.31 | — | V/°C | Reference to 25°C, $I_D$ = 1.0mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | 275 | 345 | mΩ | $V_{GS}$ = 10V, $I_D$ = 5.6A ③ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 3.0 | — | 5.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 50µA |
| gfs | Forward Transconductance | 6.2 | — | — | V | $V_{DS}$ = 50V, $I_D$ = 5.6A |
| $I_{DSS}$ | Drain-to-Source Leakage Current | — | — | 20 | µA | $V_{DS}$ = 250V, $V_{GS}$ = 0V |
| | | — | — | 250 | | $V_{DS}$ = 250V, $V_{GS}$ = 0V, $T_J$ = 125°C |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS}$ = 20V |
| | Gate-to-Source Reverse Leakage | — | — | -100 | | $V_{GS}$ = -20V |

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge | — | 13 | 20 | nC | $I_D$ = 5.6A |
| $Q_{gs}$ | Gate-to-Source Charge | — | 4.7 | — | | $V_{DS}$ = 125V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | — | 4.8 | — | | $V_{GS}$ = 10V ③ |
| $t_{d(on)}$ | Turn-On Delay Time | — | 11 | — | ns | $V_{DD}$ = 250V |
| $t_r$ | Rise Time | — | 15 | — | | $I_D$ = 5.6A |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 16 | — | | $R_G$ = 15Ω |
| $t_f$ | Fall Time | — | 8.4 | — | | $V_{GS}$ = 10V ③ |
| $L_D$ | Internal Drain Inductance | — | 4.5 | — | nH | Between lead, 6mm (0.25in.)   |
| $L_S$ | Internal Source Inductance | — | 7.5 | — | | from package and center of die contact |
| $C_{iss}$ | Input Capacitance | — | 705 | — | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | — | 71 | — | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 20 | — | | $f$ = 1.0MHz |
| $C_{oss}$ | Output Capacitance | — | 600 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 1.0V, $f$ = 1.0MHz |
| $C_{oss}$ | Output Capacitance | — | 26 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 200V, $f$ = 1.0MHz |
| $C_{oss}$ eff. | Effective Output Capacitance | — | 65 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 200V ④ |

### Diode Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 9.3 | A | MOSFET symbol showing the   |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | — | — | 40 | | integral reverse p-n junction diode. |
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.3 | V | $T_J$ = 25°C, $I_S$ = 5.6A, $V_{GS}$ = 0V ③ |
| $t_{rr}$ | Reverse Recovery Time | — | 110 | 165 | ns | $T_J$ = 25°C, $I_F$ = 5.6A, $V_{DD}$ = 125V |
| $Q_{rr}$ | Reverse Recovery Charge | — | 390 | 585 | nC | di/dt = 100A/µs ③ |
| $t_{on}$ | Forward Turn-On Time | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD) | | | | |

**Notes:**

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).

② Limited by $T_{Jmax}$, starting $T_J$ = 25°C, L = 8.1mH, $R_G$ = 50Ω, $I_{AS}$ = 5.6A, $V_{GS}$ =10V. Part not recommended for use above this value.

③ Pulse width ≤ 1.0ms; duty cycle ≤ 2%.

④ $C_{oss}$ eff. is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$ .

⑤ Limited by $T_{Jmax}$ , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.

⑥ This value is determined from sample failure population, starting $T_J$ = 25°C, L = 8.1mH, $R_G$ = 50Ω, $I_{AS}$ = 5.6A, $V_{GS}$ =10V.

⑦ When mounted on 1" square PCB (FR-4 or G-10 Material ). For recommended footprint and soldering techniques refer to application note #AN-994.

⑧ $R_\theta$ is measured at $T_J$ approximately 90°C.

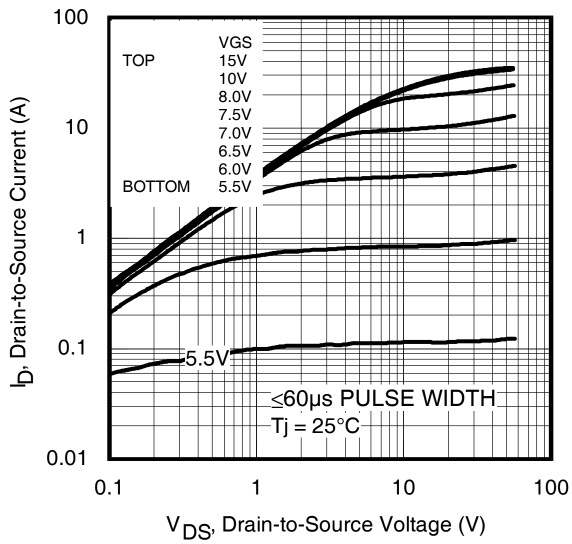



**Fig 1.** Typical Output Characteristics

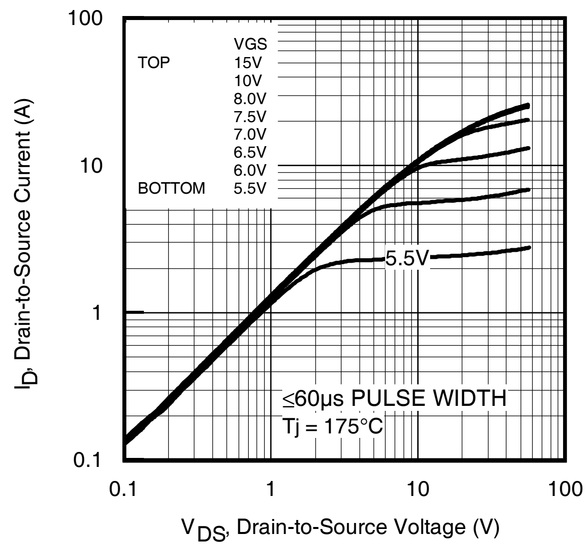



**Fig 2.** Typical Output Characteristics

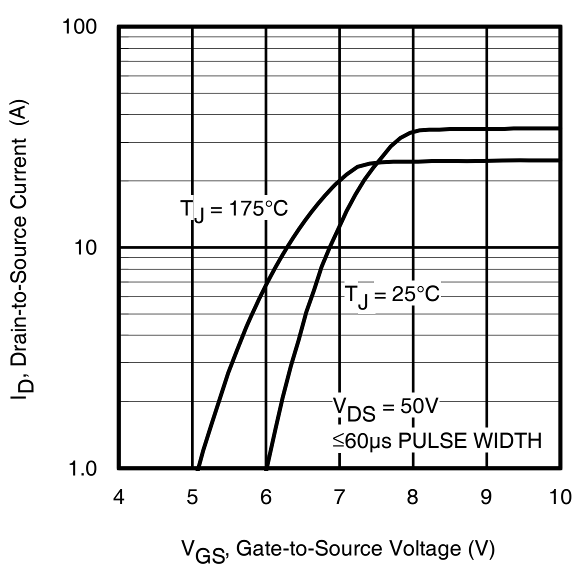



**Fig 3.** Typical Transfer Characteristics

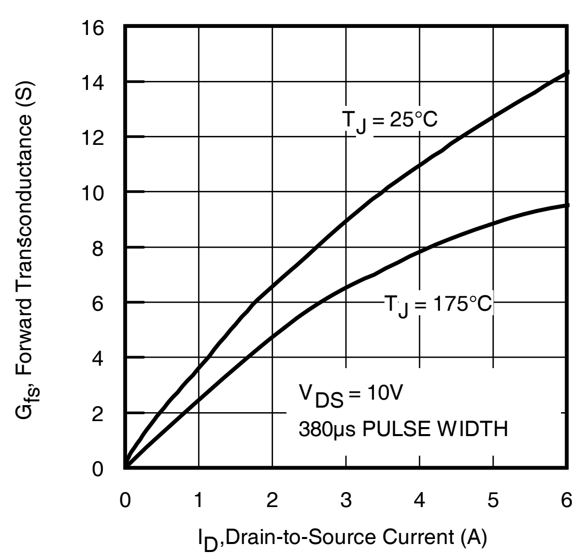



**Fig 4.** Typical Forward Transconductance vs. Drain Current

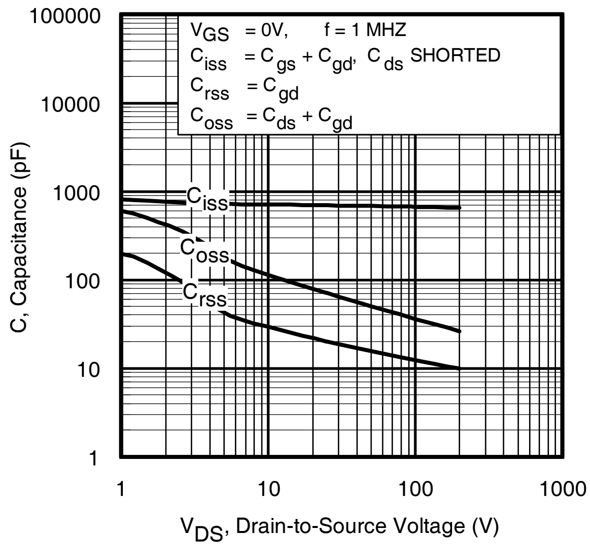



**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage

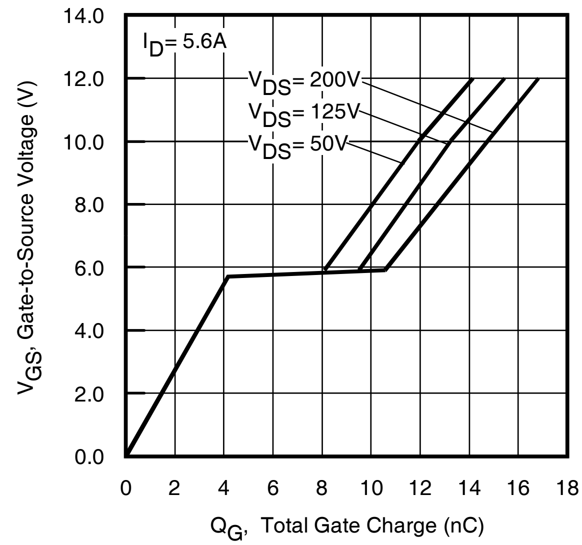



**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage

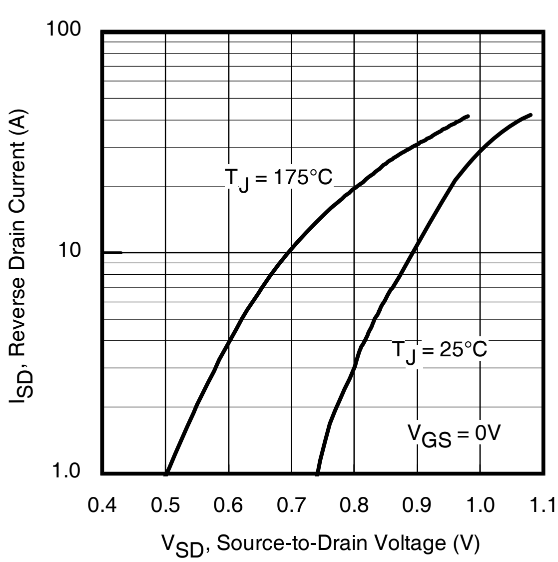



**Fig 7.** Typical Source-Drain Diode Forward Voltage

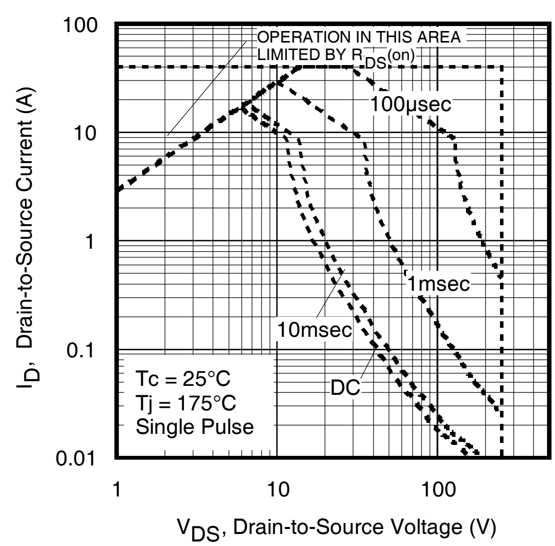



**Fig 8.** Maximum Safe Operating Area

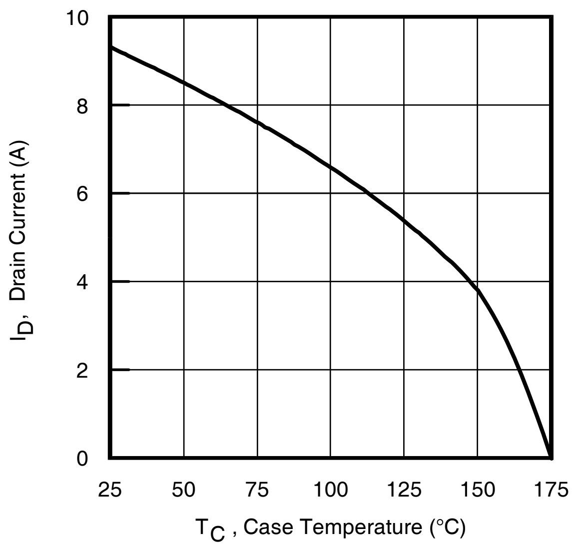



**Fig 9.** Maximum Drain Current vs. Case Temperature

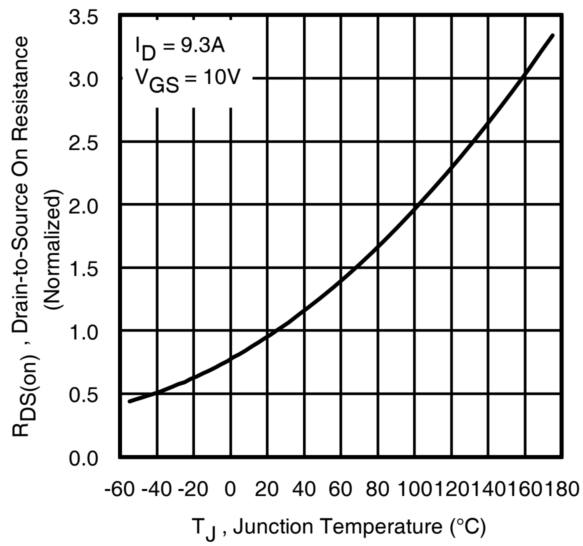



**Fig 10.** Normalized On-Resistance vs. Temperature

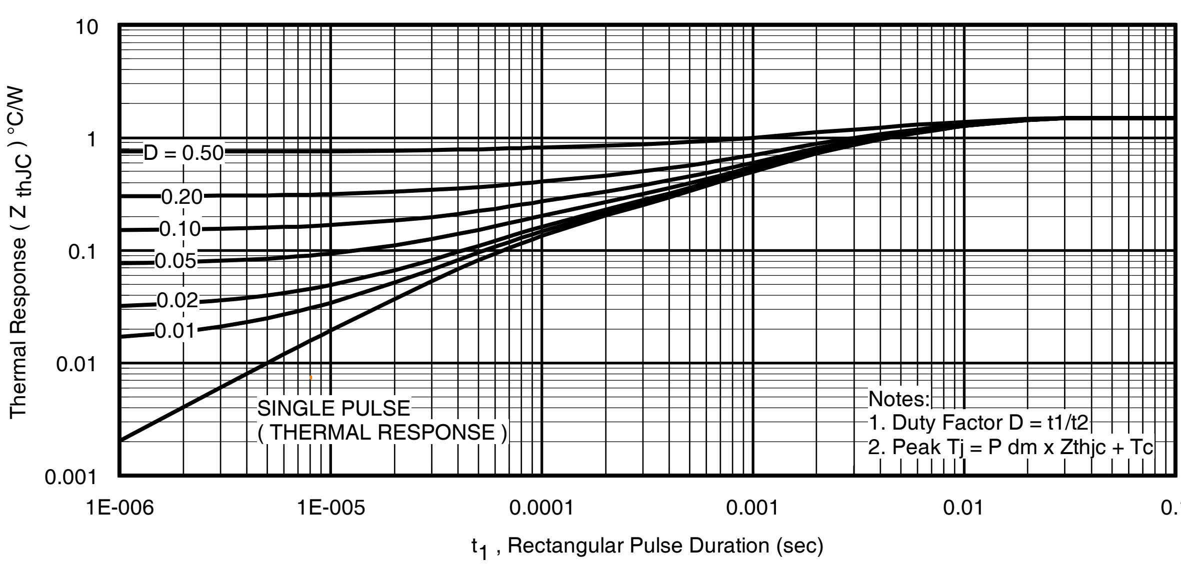



**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

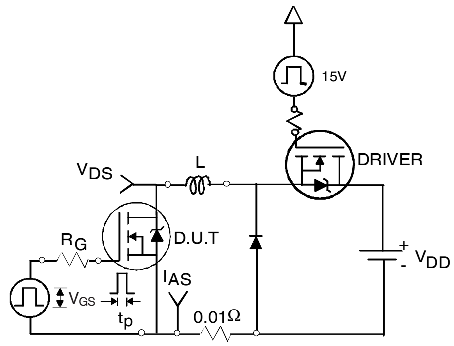



**Fig 12a.** Unclamped Inductive Test Circuit

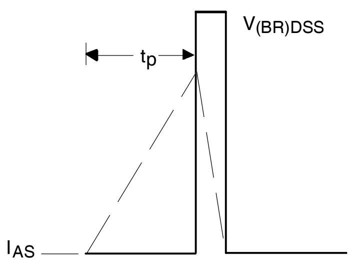



**Fig 12b.** Unclamped Inductive Waveforms

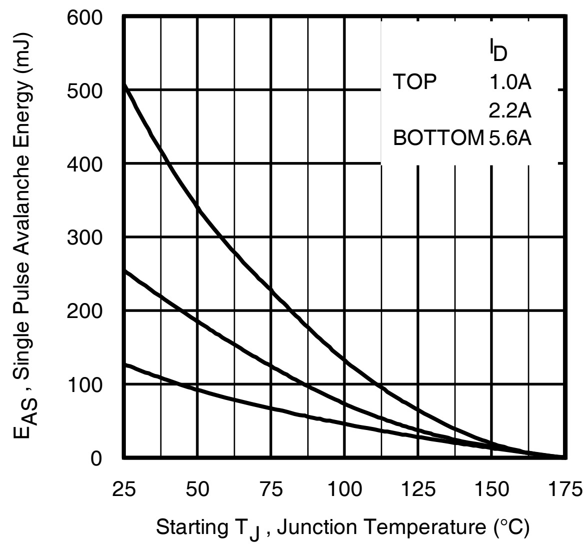



**Fig 12c.** Maximum Avalanche Energy
vs. Drain Current

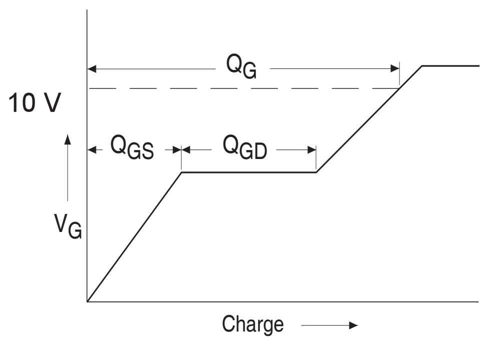



**Fig 13a.** Basic Gate Charge Waveform

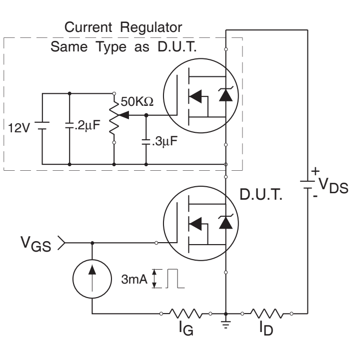



**Fig 13b.** Gate Charge Test Circuit

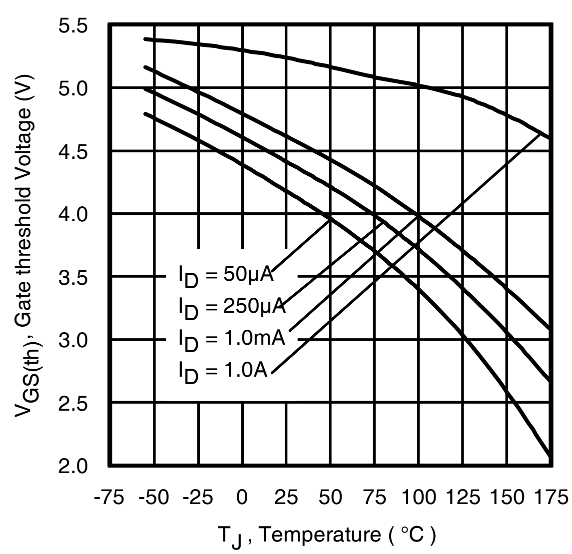



**Fig 14.** Threshold Voltage vs. Temperature

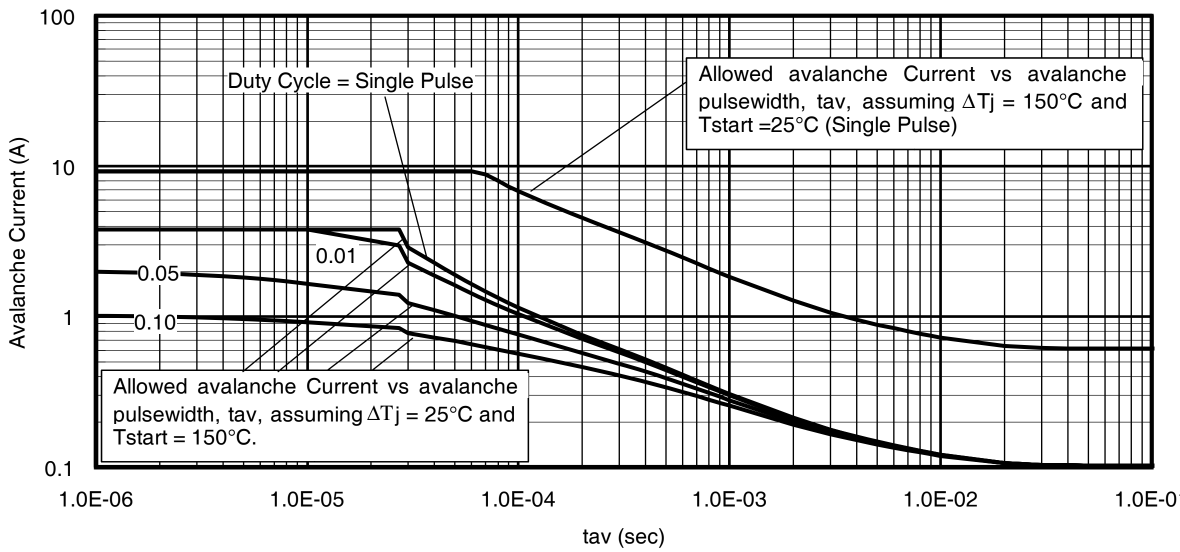



**Fig 15.** Typical Avalanche Current vs.Pulsewidth

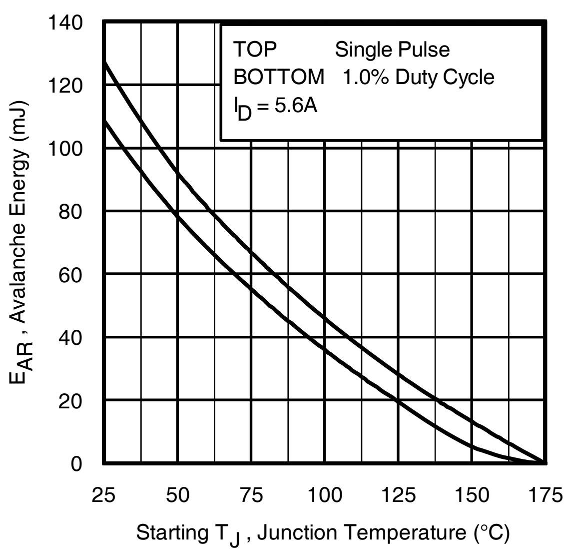
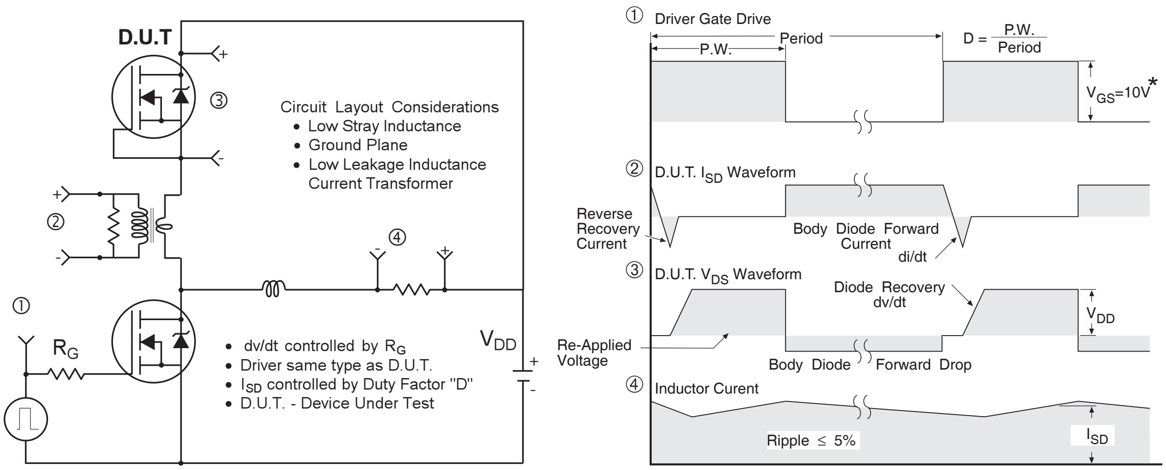



**Fig 16.** Maximum Avalanche Energy vs. Temperature

**Notes on Repetitive Avalanche Curves , Figures 15, 16:**
**(For further info, see AN-1005 at www.irf.com)**

1. Avalanche failures assumption:
   Purely a thermal phenomenon and failure occurs at a temperature far in excess of $T_{jmax}$. This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as $T_{jmax}$ is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 12a, 12b.
4. $P_{D\ (ave)}$ = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6. $I_{av}$ = Allowable avalanche current.
7. $\Delta T$ = Allowable rise in junction temperature, not to exceed $T_{jmax}$ (assumed as 25°C in Figure 15, 16).
   $t_{av}$ = Average time in avalanche.
   D = Duty cycle in avalanche = $t_{av} \cdot f$
   $Z_{thJC}(D, t_{av})$ = Transient thermal resistance, see figure 11)

$$P_{D\ (ave)} = 1/2\ (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$
$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$
$$E_{AS\ (AR)} = P_{D\ (ave)} \cdot t_{av}$$




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

**Fig 17.** Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

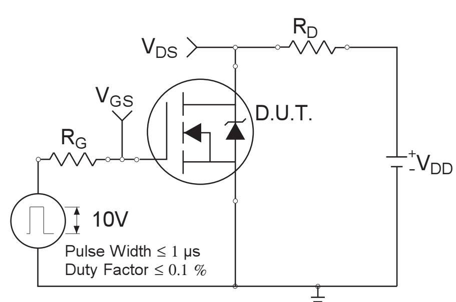



**Fig 18a.** Switching Time Test Circuit

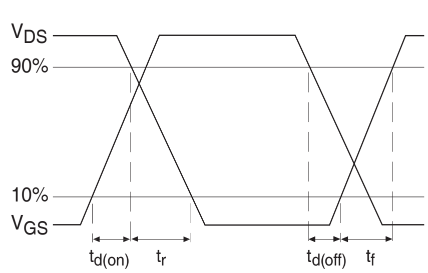
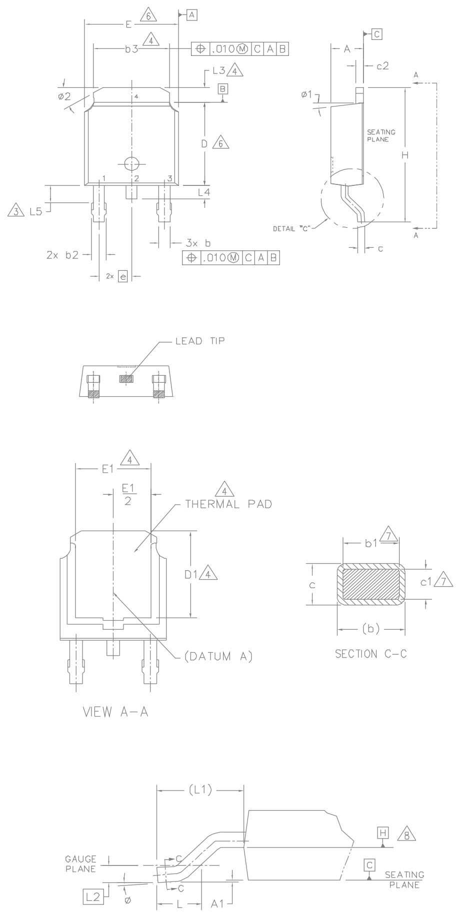



**Fig 18b.** Switching Time Waveforms

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

Dimensions are shown in millimeters (inches)




NOTES:

1.– DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994
2.– DIMENSION ARE SHOWN IN INCHES [MILLIMETERS].
3.– LEAD DIMENSION UNCONTROLLED IN L5.
4.– DIMENSION D1, E1, L3 & b3 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
5.– SECTION C–C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 AND 0.10 [0.13 AND 0.25] FROM THE LEAD TIP.
6.– DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .006 [0.15] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
7.– DIMENSION b1 & c1 APPLIED TO BASE METAL ONLY.
8.– DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
9.– 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 | |
| b1 | 0.64 | 0.79 | .025 | .031 | 7 |
| b2 | 0.76 | 1.14 | .030 | .045 | |
| b3 | 4.95 | 5.46 | .195 | .215 | 4 |
| c | 0.46 | 0.61 | .018 | .024 | |
| c1 | 0.41 | 0.56 | .016 | .022 | 7 |
| c2 | 0.46 | 0.89 | .018 | .035 | |
| 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 BSC | | .090 BSC | | |
| H | 9.40 | 10.41 | .370 | .410 | |
| L | 1.40 | 1.78 | .055 | .070 | |
| L1 | 2.74 BSC | | .108 REF. | | |
| L2 | 0.51 BSC | | .020 BSC | | |
| L3 | 0.89 | 1.27 | .035 | .050 | 4 |
| L4 | – | 1.02 | – | .040 | |
| L5 | 1.14 | 1.52 | .045 | .060 | 3 |
| ø | 0° | 10° | 0° | 10° | |
| ø1 | 0° | 15° | 0° | 15° | |
| ø2 | 25° | 35° | 25° | 35° | |

LEAD ASSIGNMENTS

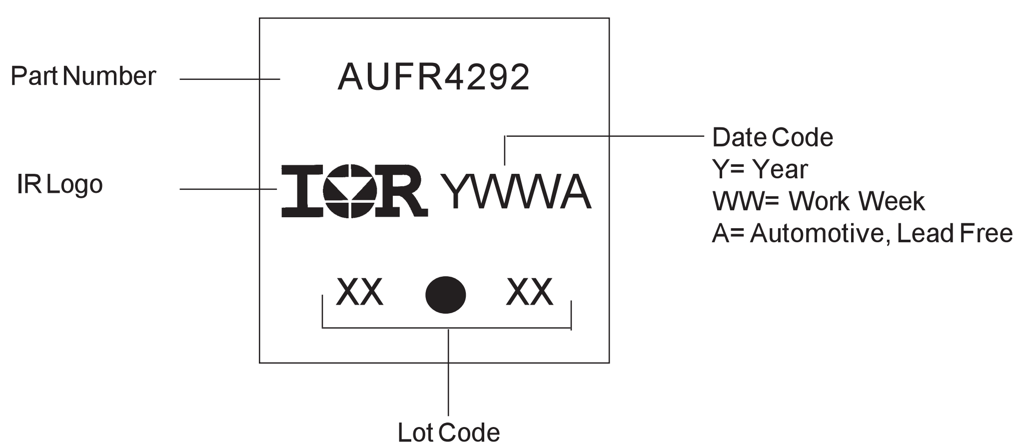
HEXFET

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

IGBT & CoPAK

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

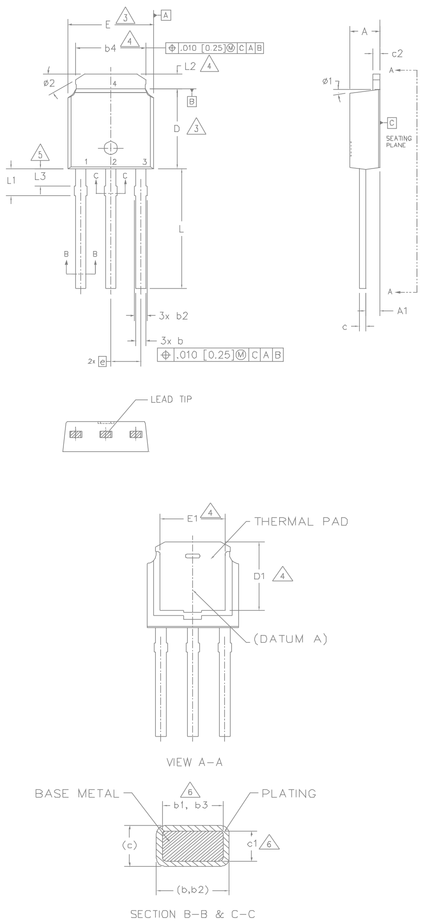
## D-Pak (TO-252AA) Part Marking Information




**Note: For the most current drawing please refer to IR website at: http://www.irf.com/package/**

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

Dimensions are shown in millimeters (inches)




NOTES:

1.– DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994

2.– DIMENSION ARE SHOWN IN INCHES [MILLIMETERS].

3.– DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005 [0.13] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST 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 & c1 APPLY TO BASE METAL ONLY.

7.– OUTLINE CONFORMS TO JEDEC OUTLINE TO-251AA (Date 06/02).

8.– CONTROLLING DIMENSION : INCHES.

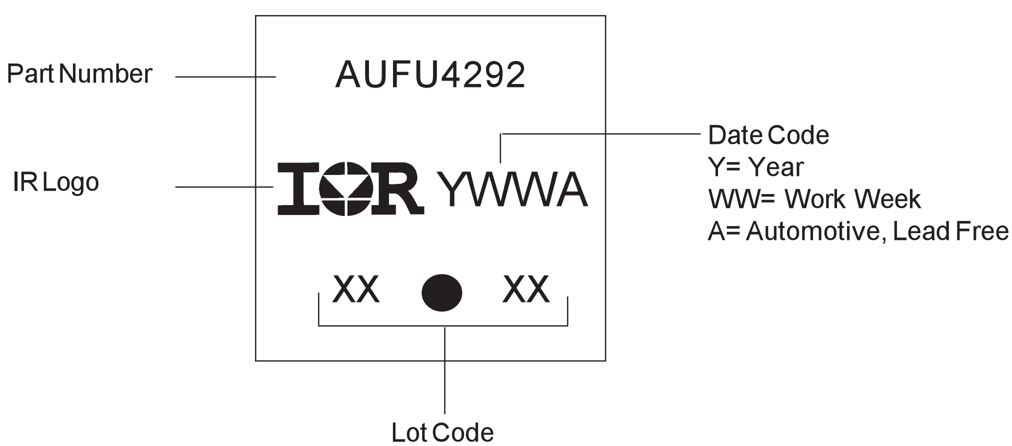
| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 2.18 | 2.39 | .086 | .094 | |
| A1 | 0.89 | 1.14 | .035 | .045 | |
| b | 0.64 | 0.89 | .025 | .035 | |
| b1 | 0.65 | 0.79 | .025 | .031 | 6 |
| b2 | 0.76 | 1.14 | .030 | .045 | |
| b3 | 0.76 | 1.04 | .030 | .041 | 6 |
| b4 | 4.95 | 5.46 | .195 | .215 | 4 |
| c | 0.46 | 0.61 | .018 | .024 | |
| c1 | 0.41 | 0.56 | .016 | .022 | 6 |
| c2 | 0.46 | 0.89 | .018 | .035 | |
| D | 5.97 | 6.22 | .235 | .245 | 3 |
| D1 | 5.21 | – | .205 | – | 4 |
| E | 6.35 | 6.73 | .250 | .265 | 3 |
| E1 | 4.32 | – | .170 | – | 4 |
| e | 2.29 BSC | | .090 BSC | | |
| L | 8.89 | 9.65 | .350 | .380 | |
| L1 | 1.91 | 2.29 | .045 | .090 | |
| L2 | 0.89 | 1.27 | .035 | .050 | 4 |
| L3 | 0.89 | 1.52 | .035 | .060 | 5 |
| ø1 | 0° | 15° | 0° | 15° | |
| ø2 | 25° | 35° | 25° | 35° | |

LEAD ASSIGNMENTS

HEXFET

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

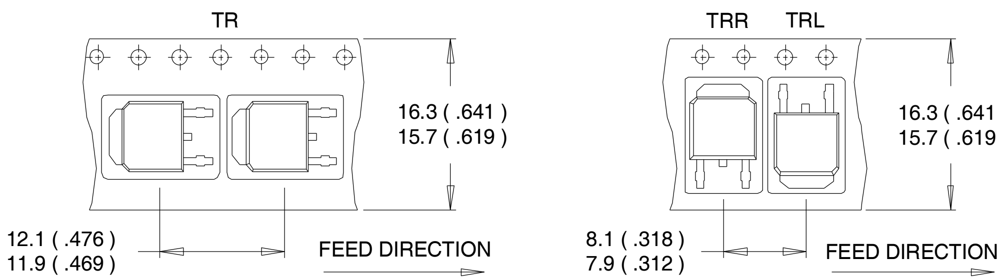
## I-Pak (TO-251AA) Part Marking Information



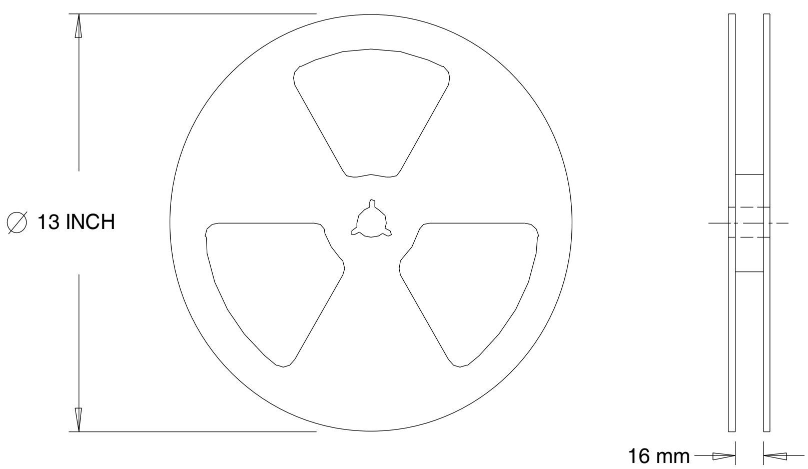

**Note: For the most current drawing please refer to IR website at: http://www.irf.com/package/**

## 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.

**Note: For the most current drawing please refer to IR website at: http://www.irf.com/package/**

**Qualification Information†**

<table>
<tr><td rowspan="2">Qualification Level</td><td colspan="3">Automotive<br>(per AEC-Q101)</td></tr>
<tr><td colspan="3">Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.</td></tr>
<tr><td rowspan="2">Moisture Sensitivity Level</td><td>D-PAK</td><td colspan="2" rowspan="2">MSL1</td></tr>
<tr><td>I-PAK</td></tr>
<tr><td rowspan="3">ESD</td><td>Machine Model</td><td colspan="2">Class M1B (+/- 100)††<br>AEC-Q101-002</td></tr>
<tr><td>Human Body Model</td><td colspan="2">Class H1A (+/- 500)††<br>AEC-Q101-001</td></tr>
<tr><td>Charged Device Model</td><td colspan="2">Class C5 (+/- 2000)††<br>AEC-Q101-005</td></tr>
<tr><td>RoHS Compliant</td><td colspan="3">Yes</td></tr>
</table>

† Qualification standards can be found at International Rectifier's web site: http//www.irf.com/

†† Highest passing voltage.

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Tel: (310) 252-7105

**Revision History**

| Date | Comments |
|---|---|
| 9/2/2014 | • Updated datasheet with IR corporate tempalte.<br>• Updated SOA curve Fig 8 from "50V" VDS to "250V" on page 4.<br>• Updated Package outline on page 9 & 10<br>• Updated ordering information to reflect the End-Of-life (EOL) of the option (EOL notice #530) |