

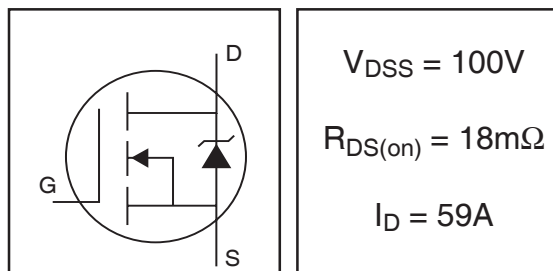
## Features

- Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Repetitive Avalanche Allowed up to  $T_{jmax}$
- Lead-Free, RoHS Compliant
- Automotive Qualified \*

## 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.

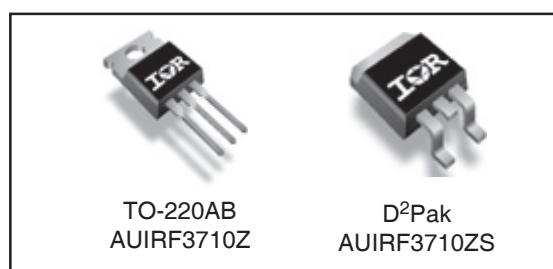
## HEXFET® Power MOSFET



$$V_{DS} = 100V$$

$$R_{DS(on)} = 18m\Omega$$

$$I_D = 59A$$



TO-220AB  
AUIRF3710Z

D²Pak  
AUIRF3710ZS

## 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 |
|-----------------------------|----------------------------------------------------|------------------------|-------|
| $I_D$ @ $T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS}$ @ 10V           | 59                     | A     |
| $I_D$ @ $T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS}$ @ 10V           | 42                     |       |
| $I_{DM}$                    | Pulsed Drain Current ①                             | 240                    |       |
| $P_D$ @ $T_C = 25^\circ C$  | Maximum Power Dissipation                          | 160                    | W     |
|                             | Linear Derating Factor                             | 1.1                    | W/°C  |
| $V_{GS}$                    | Gate-to-Source Voltage                             | $\pm 20$               | V     |
| $E_{AS}$                    | Single Pulse Avalanche Energy (Thermally limited)② | 170                    | mJ    |
| $E_{AS}$ (tested)           | Single Pulse Avalanche Energy Tested Value ③       | 200                    |       |
| $I_{AR}$                    | Avalanche Current ①                                | See Fig.12a,12b,15,16  | A     |
| $E_{AR}$                    | Repetitive Avalanche Energy                        |                        | mJ    |
| $T_J$                       | Operating Junction and                             | -55 to + 175           | °C    |
| $T_{STG}$                   | Storage Temperature Range                          |                        |       |
|                             | Soldering Temperature, for 10 seconds              | 300 (1.6mm from case ) |       |
|                             | Mounting torque, 6-32 or M3 screw ④                | 10 lbf•in (1.1N•m)     |       |

## Thermal Resistance

|                 | Parameter                                     | Typ. | Max. | Units |
|-----------------|-----------------------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case ③                            | —    | 0.92 | °C/W  |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface           | 0.50 | —    |       |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mount, steady state) | —    | 40   |       |

HEXFET® is a registered trademark of International Rectifier.

\*Qualification standards can be found at <http://www.irf.com/>

[www.irf.com](http://www.irf.com)

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

|                              | Parameter                            | Min. | Typ. | Max. | Units | Conditions                                            |
|------------------------------|--------------------------------------|------|------|------|-------|-------------------------------------------------------|
| $V_{(BR)DSS}$                | Drain-to-Source Breakdown Voltage    | 100  | —    | —    | V     | $V_{GS} = 0V, I_D = 250\mu A$                         |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.10 | —    | V/°C  | Reference to $25^\circ\text{C}, I_D = 1mA$            |
| $R_{DS(on)}$                 | Static Drain-to-Source On-Resistance | —    | 14   | 18   | mΩ    | $V_{GS} = 10V, I_D = 35A$ ④                           |
| $V_{GS(th)}$                 | Gate Threshold Voltage               | 2.0  | —    | 4.0  | V     | $V_{DS} = V_{GS}, I_D = 250\mu A$                     |
| $g_{fs}$                     | Forward Transconductance             | 35   | —    | —    | S     | $V_{DS} = 50V, I_D = 35A$                             |
| $I_{DSS}$                    | Drain-to-Source Leakage Current      | —    | —    | 20   | μA    | $V_{DS} = 100V, V_{GS} = 0V$                          |
|                              |                                      | —    | —    | 250  |       | $V_{DS} = 100V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                    | Gate-to-Source Forward Leakage       | —    | —    | 200  | nA    | $V_{GS} = 20V$                                        |
|                              | Gate-to-Source Reverse Leakage       | —    | —    | -200 |       | $V_{GS} = -20V$                                       |

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

|                        |                                 |   |      |     |    |                                                                             |
|------------------------|---------------------------------|---|------|-----|----|-----------------------------------------------------------------------------|
| $Q_g$                  | Total Gate Charge               | — | 82   | 120 | nC | $I_D = 35A$                                                                 |
| $Q_{gs}$               | Gate-to-Source Charge           | — | 19   | 28  |    | $V_{DS} = 80V$                                                              |
| $Q_{gd}$               | Gate-to-Drain ("Miller") Charge | — | 27   | 40  |    | $V_{GS} = 10V$ ④                                                            |
| $t_{d(on)}$            | Turn-On Delay Time              | — | 17   | —   | ns | $V_{DD} = 50V$                                                              |
| $t_r$                  | Rise Time                       | — | 77   | —   |    | $I_D = 35A$                                                                 |
| $t_{d(off)}$           | Turn-Off Delay Time             | — | 41   | —   |    | $R_G = 6.8\Omega$                                                           |
| $t_f$                  | Fall Time                       | — | 56   | —   | nH | $V_{GS} = 10V$ ④                                                            |
| $L_D$                  | Internal Drain Inductance       | — | 4.5  | —   |    | Between lead,<br>6mm (0.25in.)<br>from package<br>and center of die contact |
| $L_S$                  | Internal Source Inductance      | — | 7.5  | —   |    |                                                                             |
| $C_{iss}$              | Input Capacitance               | — | 2900 | —   | pF | $V_{GS} = 0V$                                                               |
| $C_{oss}$              | Output Capacitance              | — | 290  | —   |    | $V_{DS} = 25V$                                                              |
| $C_{rss}$              | Reverse Transfer Capacitance    | — | 150  | —   |    | $f = 1.0MHz$ , See Fig. 5                                                   |
| $C_{oss}$              | Output Capacitance              | — | 1130 | —   |    | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$                                    |
| $C_{oss}$              | Output Capacitance              | — | 170  | —   |    | $V_{GS} = 0V, V_{DS} = 80V, f = 1.0MHz$                                     |
| $C_{oss \text{ eff.}}$ | Effective Output Capacitance    | — | 280  | —   |    | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 80V$                                  |

## Diode Characteristics

|          | Parameter                                 | Min.                                                                      | Typ. | Max. | Units | Conditions                                                              |
|----------|-------------------------------------------|---------------------------------------------------------------------------|------|------|-------|-------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current<br>(Body Diode) | —                                                                         | —    | 59   | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode) ①   | —                                                                         | —    | 240  |       |                                                                         |
| $V_{SD}$ | Diode Forward Voltage                     | —                                                                         | —    | 1.3  | V     | $T_J = 25^\circ\text{C}, I_S = 35A, V_{GS} = 0V$ ④                      |
| $t_{rr}$ | Reverse Recovery Time                     | —                                                                         | 50   | 75   | ns    | $T_J = 25^\circ\text{C}, I_F = 35A, V_{DD} = 25V$                       |
| $Q_{rr}$ | Reverse Recovery Charge                   | —                                                                         | 100  | 160  | nC    | $di/dt = 100A/\mu s$ ④                                                  |
| $t_{on}$ | Forward Turn-On Time                      | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S+L_D$ ) |      |      |       |                                                                         |

### Notes:

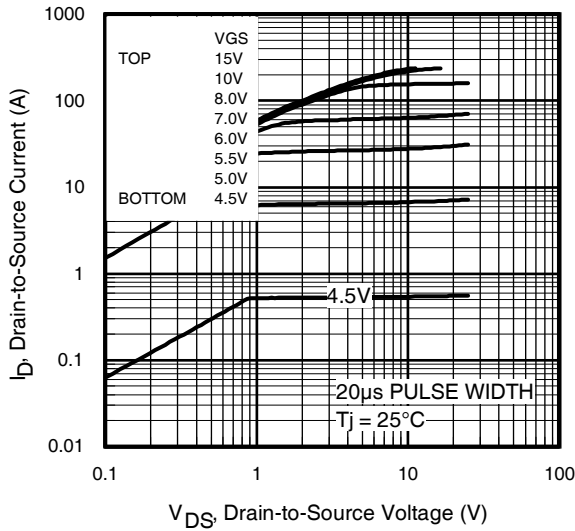
- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Limited by  $T_{Jmax}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.27mH$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 35A$ ,  $V_{GS} = 10V$ . Part not recommended for use above this value.
- ③  $I_{SD} \leq 35A$ ,  $di/dt \leq 380A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 175^\circ\text{C}$ .
- ④ Pulse width  $\leq 1.0ms$ ; duty cycle  $\leq 2\%$ .
- ⑤  $C_{oss \text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .
- ⑥ This value determined from sample failure population, starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.27mH$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 35A$ ,  $V_{GS} = 10V$ .
- ⑦ This is applied to D<sup>2</sup>Pak, 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  $90^\circ\text{C}$ .
- ⑨ This is only applied to TO-220AB package.

## Qualification Information<sup>†</sup>

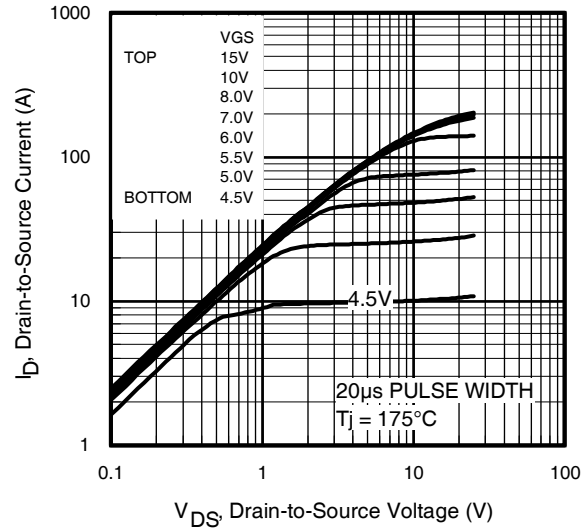
|                                   |                      |                                                                                                                                                                         |      |
|-----------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>Qualification Level</b>        |                      | Automotive<br>(per AEC-Q101) <sup>††</sup>                                                                                                                              |      |
|                                   |                      | Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level. |      |
| <b>Moisture Sensitivity Level</b> |                      | TO-220AB                                                                                                                                                                | N/A  |
|                                   |                      | D <sup>2</sup> PAK                                                                                                                                                      | MSL1 |
| <b>ESD</b>                        | Machine Model        | Class M4<br>AEC-Q101-002                                                                                                                                                |      |
|                                   | Human Body Model     | Class H1C<br>AEC-Q101-001                                                                                                                                               |      |
|                                   | Charged Device Model | Class C3<br>AEC-Q101-005                                                                                                                                                |      |
| <b>RoHS Compliant</b>             |                      | Yes                                                                                                                                                                     |      |

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

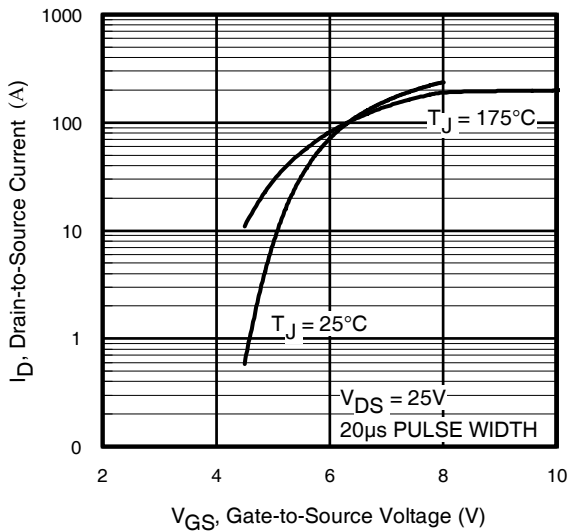
<sup>††</sup> Exceptions to AEC-Q101 requirements are noted in the qualification report.



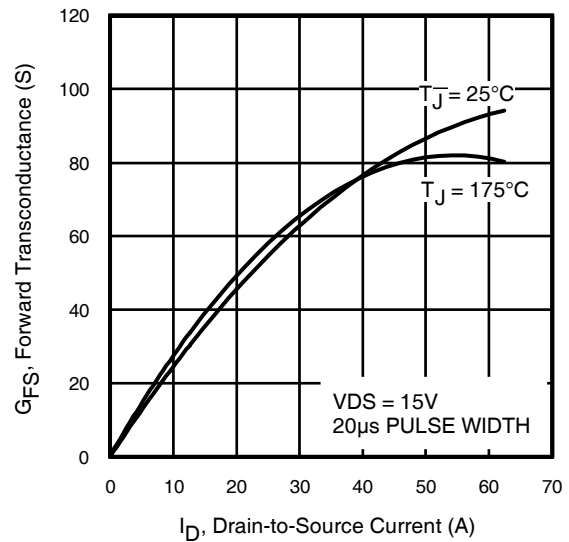
**Fig 1.** Typical Output Characteristics



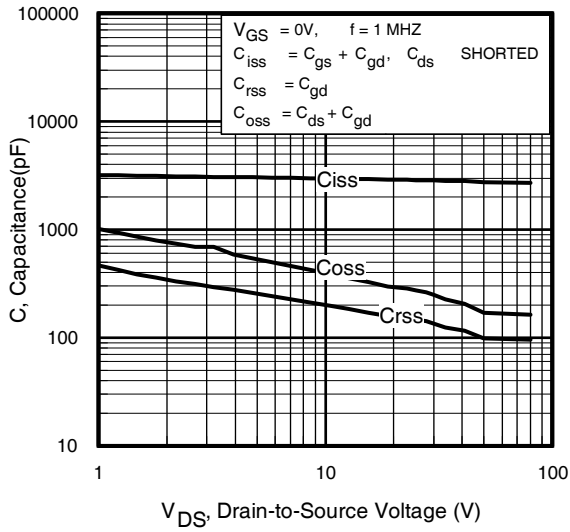
**Fig 2.** Typical Output Characteristics



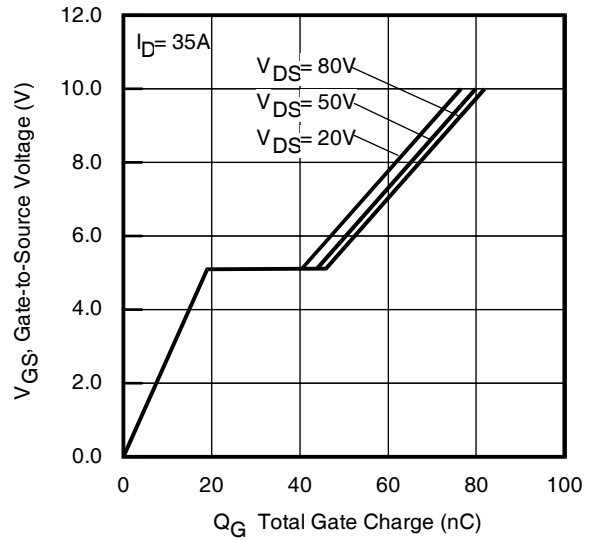
**Fig 3.** Typical Transfer Characteristics



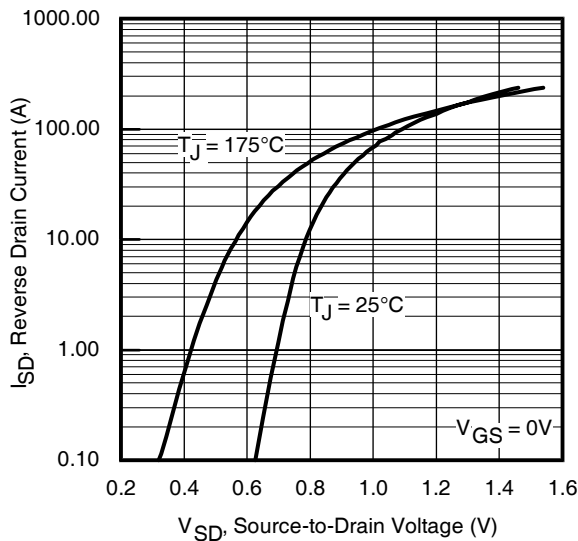
**Fig 4.** Typical Forward Transconductance vs. Drain Current



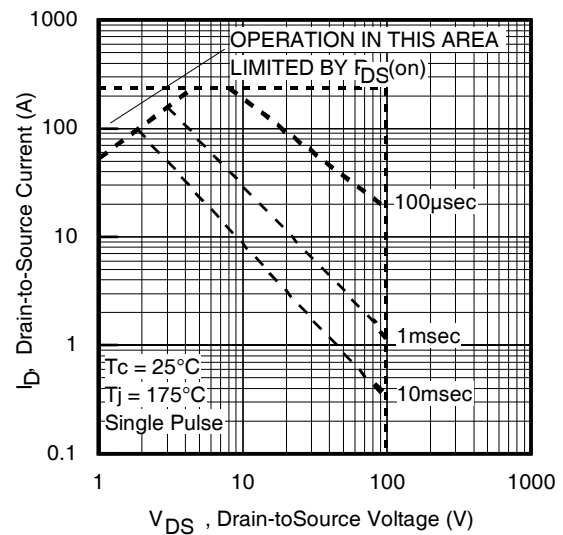
**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage



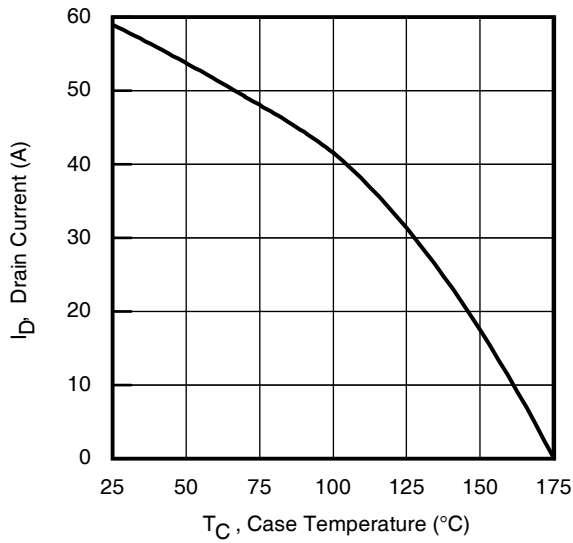
**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage



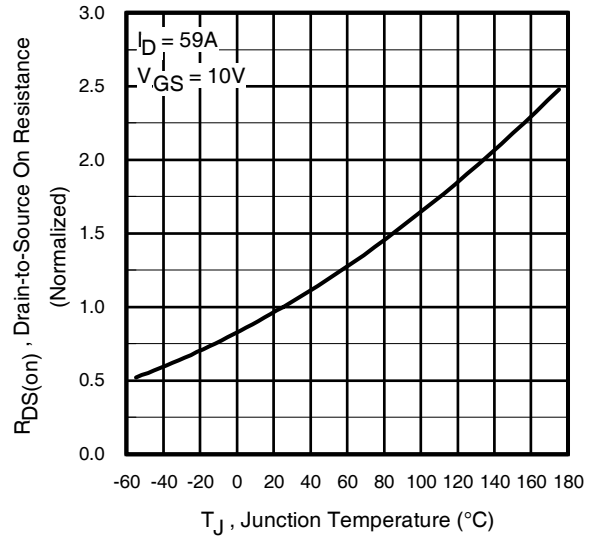
**Fig 7.** Typical Source-Drain Diode Forward Voltage



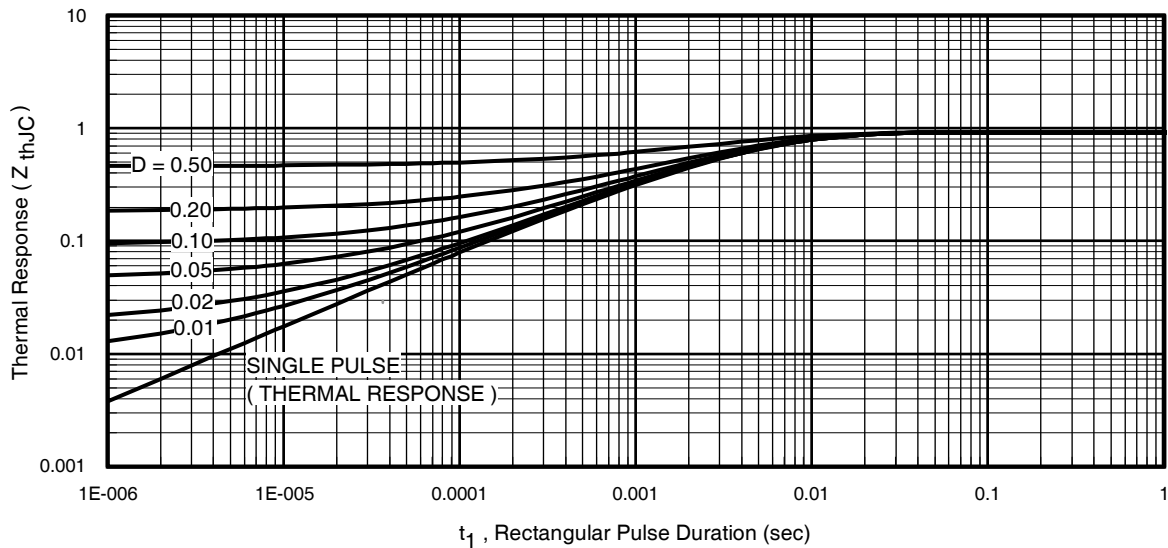
**Fig 8.** Maximum Safe Operating Area



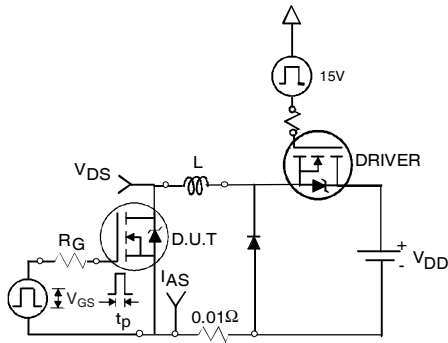
**Fig 9.** Maximum Drain Current vs. Case Temperature



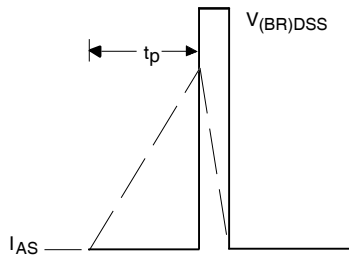
**Fig 10.** Normalized On-Resistance vs. Temperature



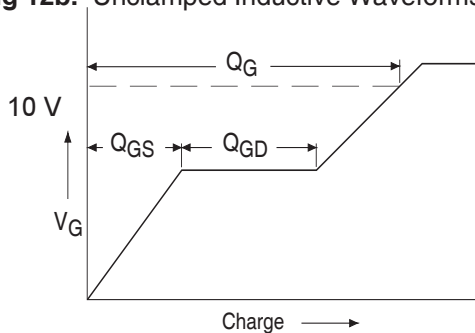
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



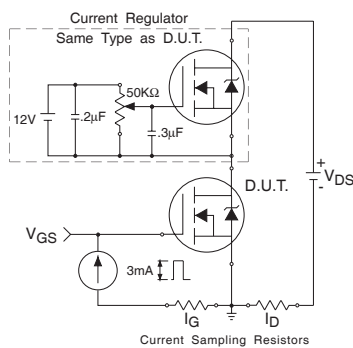
**Fig 12a.** Unclamped Inductive Test Circuit



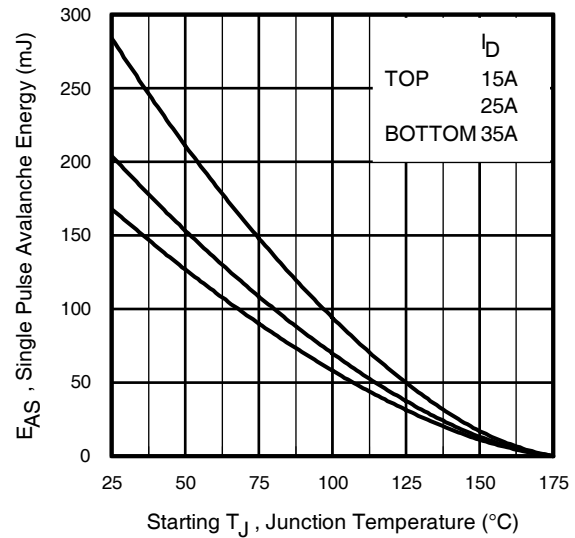
**Fig 12b.** Unclamped Inductive Waveforms



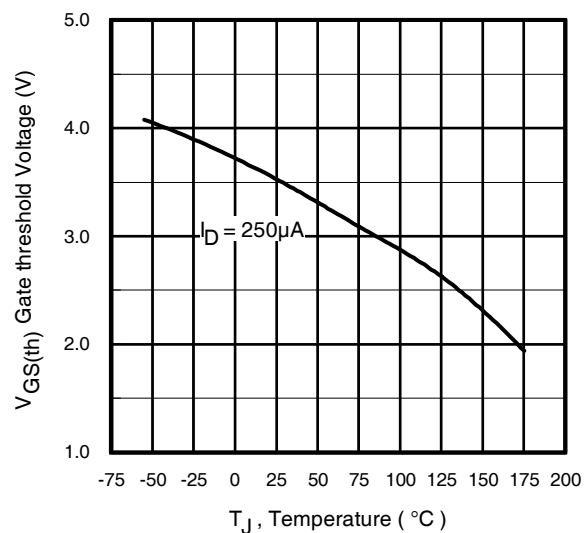
**Fig 13a.** Basic Gate Charge Waveform



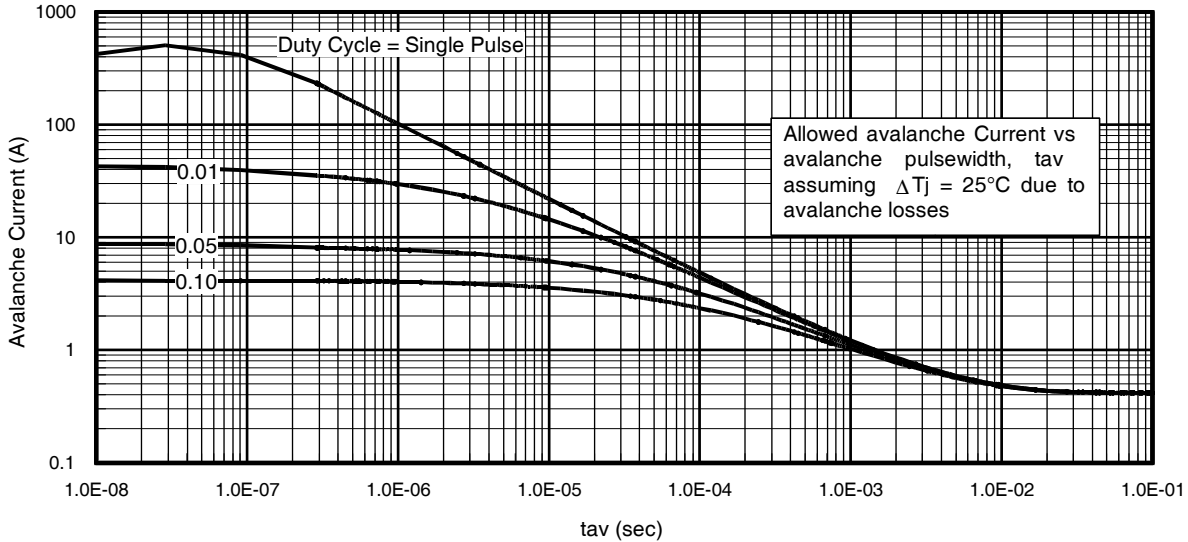
**Fig 13b.** Gate Charge Test Circuit



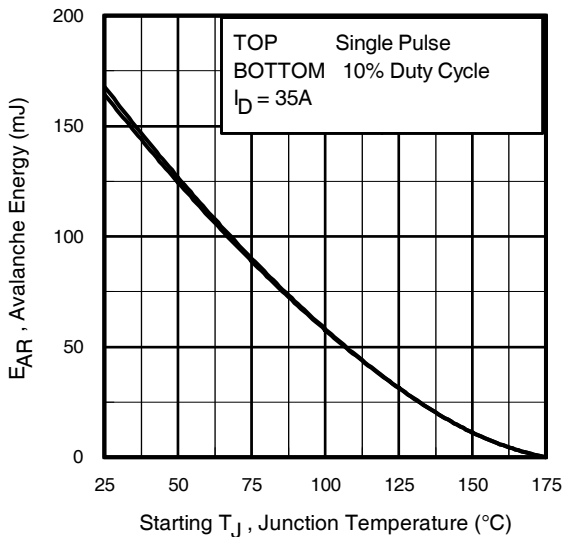
**Fig 12c.** Maximum Avalanche Energy vs. Drain Current



**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](http://www.irf.com))

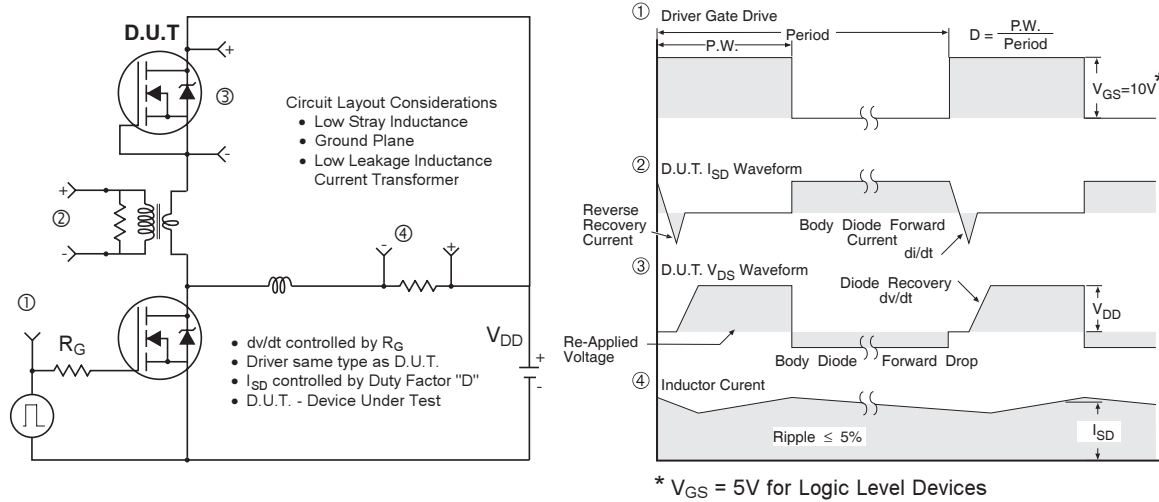
1. Avalanche failures assumption:  
Purely a thermal phenomenon and failure occurs at a temperature far in excess of  $T_{jmax}$ . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as  $T_{jmax}$  is not exceeded.
3. Equation below based on circuit and waveforms 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)

$$P_{D(ave)} = \frac{1}{2} (1.3 \cdot BV \cdot I_{av}) = \frac{\Delta T}{Z_{thJC}}$$

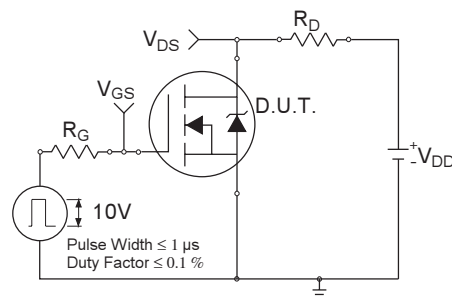
$$I_{av} = \frac{2 \Delta T}{1.3 \cdot BV \cdot Z_{thJC}}$$

$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$

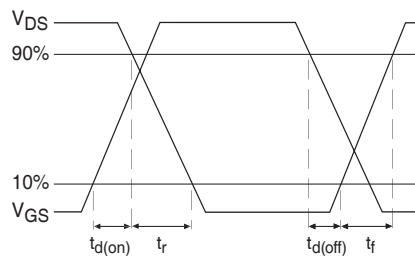




**Fig 17. Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs**



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



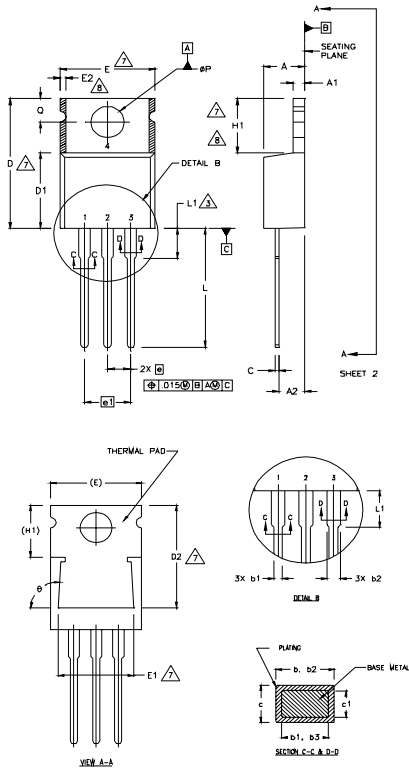
**Fig 18b. Switching Time Waveforms**

# AUIRF3710Z/S

International  
**IR** Rectifier

## TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
2. DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
3. LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4. 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.
5. DIMENSION b1 & c1 APPLY TO BASE METAL ONLY.
6. CONTROLLING DIMENSION : INCHES.
7. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
8. DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.

### LEAD ASSIGNMENTS

#### HEXCEL

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

#### IGBTs, CoPACK

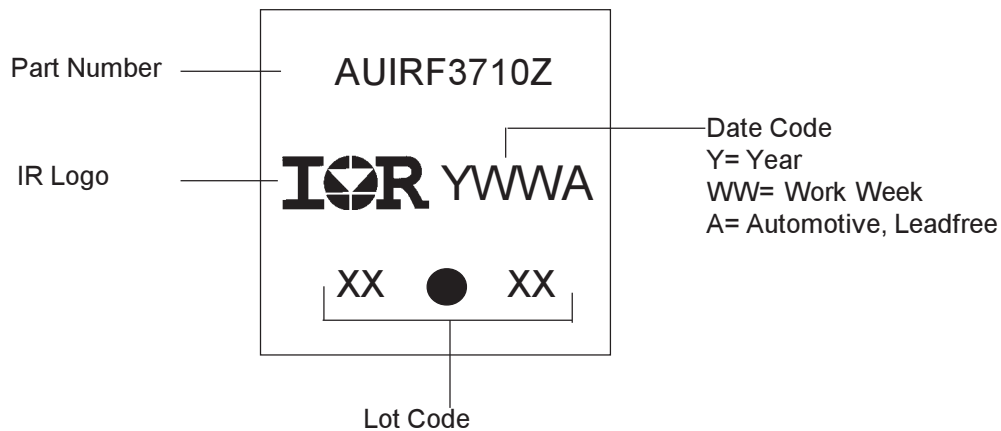
- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER

#### DIODES

- 1.- ANODE/OPEN
- 2.- CATHODE
- 3.- ANODE

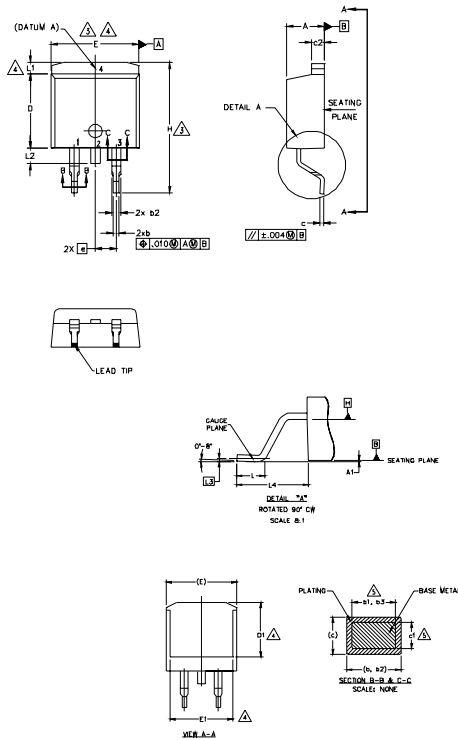
| SYMBOL | DIMENSIONS  |       |          |      | NOTES |
|--------|-------------|-------|----------|------|-------|
|        | MILLIMETERS |       | INCHES   |      |       |
|        | MIN.        | MAX.  | MIN.     | MAX. |       |
| A      | 3.56        | 4.82  | .140     | .190 | 5     |
| A1     | 0.51        | 1.40  | .020     | .055 |       |
| A2     | 2.04        | 2.92  | .080     | .115 |       |
| b      | 0.38        | 1.01  | .015     | .040 |       |
| b1     | 0.38        | 0.96  | .015     | .038 |       |
| b2     | 1.15        | 1.77  | .045     | .070 | 5     |
| b3     | 1.15        | 1.73  | .045     | .068 |       |
| c      | 0.36        | 0.61  | .014     | .024 |       |
| c1     | 0.36        | 0.56  | .014     | .022 |       |
| D      | 14.22       | 16.51 | .560     | .650 |       |
| D1     | 8.38        | 9.02  | .330     | .355 | 7     |
| D2     | 12.19       | 12.88 | .480     | .507 |       |
| E      | 9.66        | 10.66 | .380     | .420 |       |
| E1     | 8.38        | 8.89  | .330     | .350 | 7     |
| e      | 2.54 BSC    |       | .100 BSC |      | 7,8   |
| e1     | 5.08        |       | .200 BSC |      |       |
| H1     | 5.85        | 6.55  | .230     | .270 |       |
| L      | 12.70       | 14.73 | .500     | .580 | 3     |
| L1     | —           | 6.35  | —        | .250 |       |
| øP     | 3.54        | 4.08  | .139     | .161 |       |
| Q      | 2.54        | 3.42  | .100     | .135 |       |
| ø      | 90°-93°     |       | 90°-93°  |      |       |

## TO-220AB Part Marking Information



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

## D<sup>2</sup>Pak Package Outline (Dimensions are shown in millimeters (inches))



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.

| SYMBOL | DIMENSIONS  |       |          |      | NOTES |
|--------|-------------|-------|----------|------|-------|
|        | MILLIMETERS |       | INCHES   |      |       |
|        | MIN.        | MAX.  | MIN.     | MAX. |       |
| A      | 4.06        | 4.83  | .160     | .190 |       |
| A1     | 0.00        | 0.254 | .000     | .010 |       |
| b      | 0.51        | 0.99  | .020     | .039 |       |
| b1     | 0.51        | 0.89  | .020     | .035 | 5     |
| b2     | 1.14        | 1.78  | .045     | .070 |       |
| b3     | 1.14        | 1.73  | .045     | .068 | 5     |
| c      | 0.38        | 0.74  | .015     | .029 |       |
| c1     | 0.38        | 0.58  | .015     | .023 | 5     |
| c2     | 1.14        | 1.65  | .045     | .065 |       |
| D      | 8.38        | 9.65  | .330     | .380 | 3     |
| D1     | 6.86        | -     | .270     | -    | 4     |
| E      | 9.65        | 10.67 | .380     | .420 | 3,4   |
| E1     | 6.22        | -     | .245     | -    | 4     |
| e      | 2.54 BSC    |       | .100 BSC |      |       |
| H      | 14.61       | 15.88 | .575     | .625 |       |
| L      | 1.78        | 2.79  | .070     | .110 |       |
| L1     | -           | 1.65  | -        | .066 | 4     |
| L2     | 1.27        | 1.78  | -        | .070 |       |
| L3     | 0.25 BSC    |       | .010 BSC |      |       |
| L4     | 4.78        | 5.28  | .188     | .208 |       |

### LEAD ASSIGNMENTS

#### HEXFET

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

#### IGBTs, CoPACK

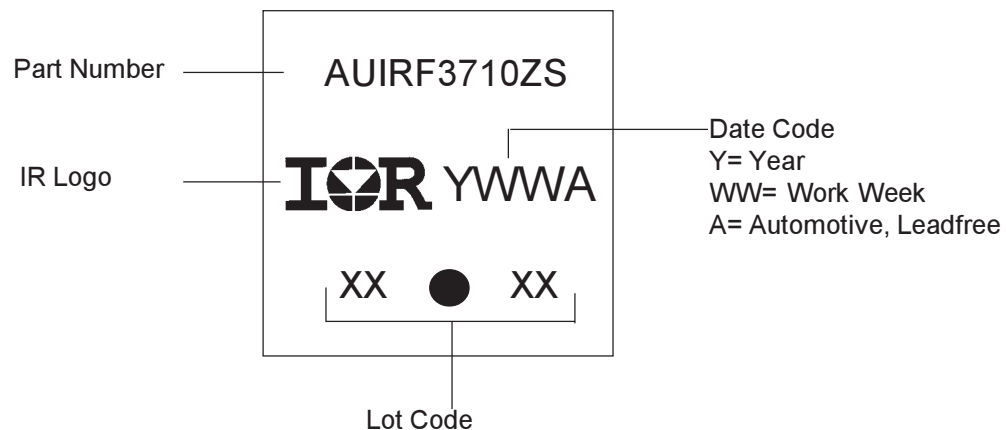
1. - GATE
2. 4. - COLLECTOR
3. - EMITTER

#### DIODES

1. - ANODE \*
2. 4. - CATHODE
3. - ANODE

\* PART DEPENDENT.

## D<sup>2</sup>Pak Part Marking Information

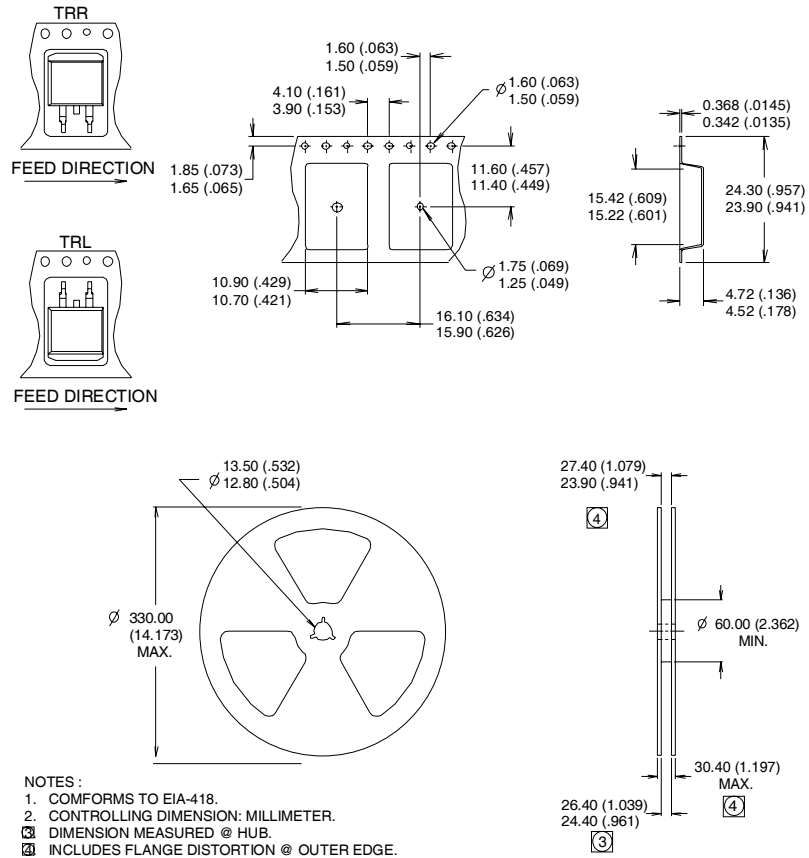


Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>  
www.irf.com

# AUIRF3710Z/S

International  
**IR** Rectifier

## D<sup>2</sup>Pak Tape & Reel Information



## Ordering Information

| Base part number | Package Type | Standard Pack       |          | Complete Part Number |
|------------------|--------------|---------------------|----------|----------------------|
|                  |              | Form                | Quantity |                      |
| AUIRF3710Z       | TO-220       | Tube                | 50       | AUIRF3710ZS          |
| AUIRF3710ZS      | D2Pak        | Tube                | 50       | AUIRF3710ZS          |
| AUIRF3710ZS      |              | Tape and Reel Left  | 800      | AUIRF3710ZSTRL       |
| AUIRF3710ZS      |              | Tape and Reel Right | 800      | AUIRF3710ZSTRR       |

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