International
IOR Rectifier

**AUTOMOTIVE GRADE**

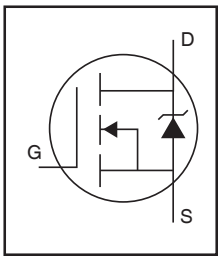
PD - 96412

# AUIRLS3114Z

HEXFET® Power MOSFET

## Features

- Advanced Process Technology
- Ultra Low On-Resistance
- Enhanced dV/dT and dI/dT capability
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax
- Lead-Free, RoHS Compliant
- Automotive Qualified *




| | |
|---|---|
| $V_{DSS}$ | 40V |
| $R_{DS(on)}$ typ. | 3.8mΩ |
| max. | 4.9mΩ |
| $I_D$ (Silicon Limited) | 122A① |
| $I_D$ (Wirebond Limited) | 56A |


D²Pak
AUIRLS3114Z

| 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.

## 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 (Silicon Limited) | 122① | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10V (Silicon Limited) | 86 ① | |
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V (Wirebond Limited) | 56 | |
| $I_{DM}$ | Pulsed Drain Current ② | 488 | |
| $P_D$ @$T_C$ = 25°C | Maximum Power Dissipation | 143 | W |
| | Linear Derating Factor | 0.95 | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 20 | V |
| $E_{AS\ (Thermally\ Limited)}$ | Single Pulse Avalanche Energy ③ | 168 | mJ |
| $E_{AS\ (Tested)}$ | Single Pulse Avalanche Energy | 518 | |
| $I_{AR}$ | Avalanche Current ② | See Fig. 12a, 12b, 15, 16 | A |
| $E_{AR}$ | Repetitive Avalanche Energy ② | | mJ |
| dv/dt | Peak Diode Recovery ④ | 2.3 | V/ns |
| $T_J$ | Operating Junction and | -55 to + 175 | °C |
| $T_{STG}$ | Storage Temperature Range | | |
| | Soldering Temperature, for 10 seconds (1.6mm from case) | 300 | |

## Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case ⑧ | — | 1.05 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mount) ⑦ | — | 40 | |

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 | 40 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.03 | — | V/°C | Reference to 25°C, $I_D$ = 1mA② |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | 3.8 | 4.9 | mΩ | $V_{GS}$ = 10V, $I_D$ = 56A ⑤ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 1 | 1.7 | 2.5 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 100µA |
| $\Delta V_{GS(th)}$ | Gate Threshold Voltage Coefficient | — | -6.6 | — | mV/°C | |
| gfs | Forward Transconductance | 103 | — | — | S | $V_{DS}$ = 10V, $I_D$ = 56A |
| $R_G$ | Internal Gate Resistance | — | 0.8 | — | Ω | |
| $I_{DSS}$ | Drain-to-Source Leakage Current | — | — | 20 | µA | $V_{DS}$ = 40V, $V_{GS}$ = 0V |
| | | — | — | 250 | | $V_{DS}$ = 40V, $V_{GS}$ = 0V, $T_J$ = 125°C |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS}$ = 16V |
| | Gate-to-Source Reverse Leakage | — | — | -100 | | $V_{GS}$ = -16V |

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge | — | 35 | 53 | nC | $I_D$ = 56A |
| $Q_{gs}$ | Gate-to-Source Charge | — | 11 | — | | $V_{DS}$ =20V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | — | 16 | | | $V_{GS}$ = 4.5V ⑤ |
| $t_{d(on)}$ | Turn-On Delay Time | — | 28 | — | ns | $V_{DD}$ = 20V |
| $t_r$ | Rise Time | — | 271 | — | | $I_D$ = 56A |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 43 | — | | $R_G$ = 3.7Ω |
| $t_f$ | Fall Time | — | 60 | — | | $V_{GS}$ = 4.5V ⑤ |
| $C_{iss}$ | Input Capacitance | — | 3617 | — | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | — | 633 | — | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 345 | — | | $f$ = 1.0 MHz, See Fig. 5 |
| $C_{oss}$ | Output Capacitance | — | 2378 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 1.0V, $f$ = 1.0MHz |
| $C_{oss}$ | Output Capacitance | — | 570 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 32V, $f$ = 1.0MHz |
| $C_{oss}$ eff. | Effective Output Capacitance | — | 875 | — | | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 32V ⑥ |

**Diode Characteristics**

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 122① | A | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ② | — | — | 488 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.3 | V | $T_J$ = 25°C, $I_S$ = 56A, $V_{GS}$ = 0V ⑤ |
| $t_{rr}$ | Reverse Recovery Time | — | 33 | 50 | ns | $T_J$ = 25°C, $I_F$ = 56A, $V_{DD}$ = 20V, di/dt = 100A/µs ⑤ |
| $Q_{rr}$ | Reverse Recovery Charge | — | 32 | 48 | nC | |
| $t_{on}$ | Forward Turn-On Time | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD) | | | | |

**Notes:**

① Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 56A. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements. (Refer to AN-1140)

② Repetitive rating; pulse width limited by max. junction temperature.

③ Limited by $T_{Jmax}$, starting $T_J$ = 25°C, L = 0.107mH, $R_G$ = 50Ω, $I_{AS}$ = 56A, $V_{GS}$ =10V. Part not recommended for use above this value.

④ $I_{SD}$ ≤ 56A, di/dt ≤ 263A/µs, $V_{DD}$ ≤ $V_{(BR)DSS}$, $T_J$ ≤ 175°C.

⑤ Pulse width ≤ 1.0ms; duty cycle ≤ 2%.

⑥ $C_{oss}$ eff. is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

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

## Qualification Information†

| | | | |
|---|---|---|---|
| **Qualification Level** | | Automotive (per AEC-Q101) †† | |
| | | Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level. | |
| **Moisture Sensitivity Level** | | 3L-D2 PAK | MSL1 |
| **ESD** | Machine Model | Class M4(+/- 600V )††† (per AEC-Q101-002) | |
| | Human Body Model | Class H1C(+/- 2000V )††† (per AEC-Q101-001) | |
| | Charged Device Model | Class C5(+/- 2000V )††† (per AEC-Q101-005) | |
| **RoHS Compliant** | | Yes | |

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

†† Exceptions (if any) to AEC-Q101 requirements are noted in the qualification report.

††† Highest passing voltage

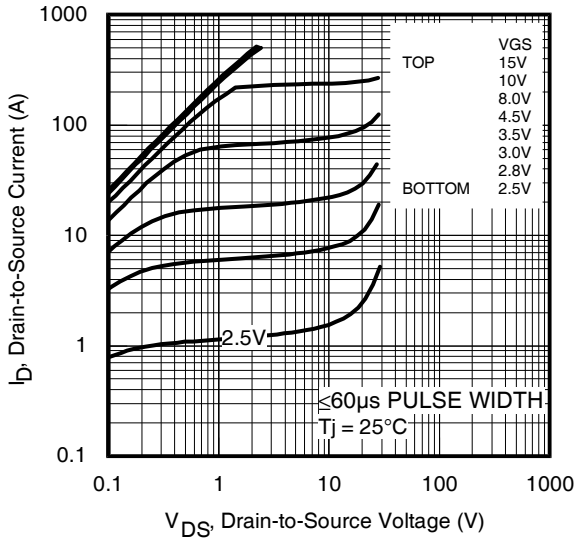



**Fig 1.** Typical Output Characteristics

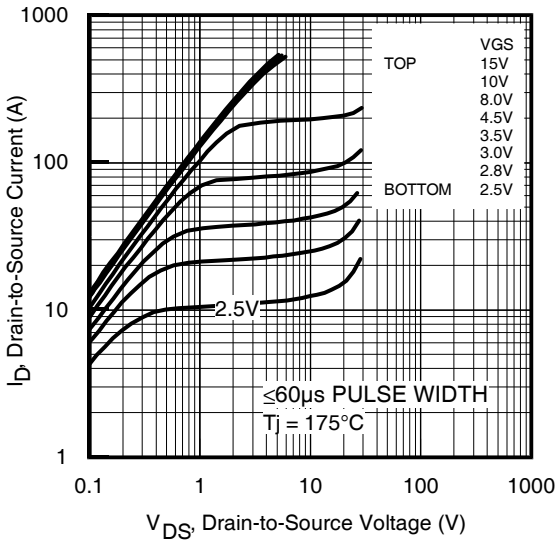



**Fig 2.** Typical Output Characteristics

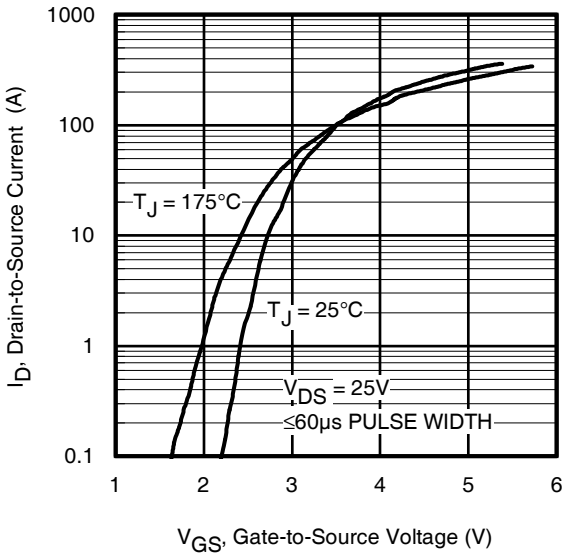



**Fig 3.** Typical Transfer Characteristics

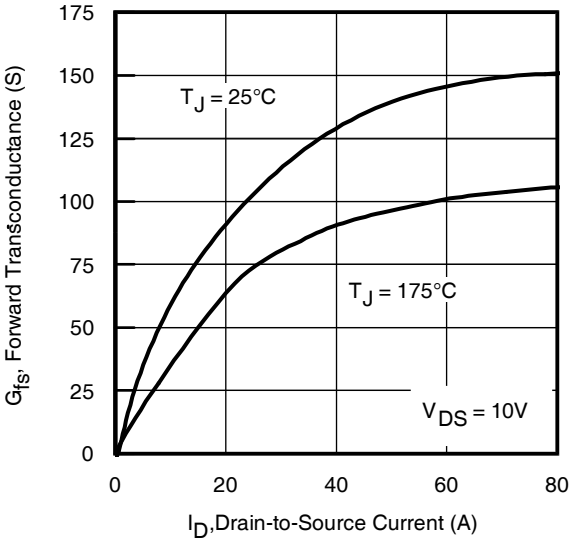



**Fig 4.** Typical Forward Transconductance vs. Drain Current

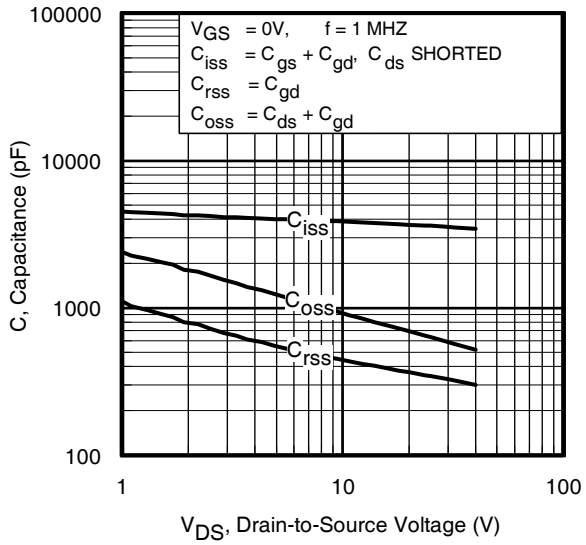



**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage

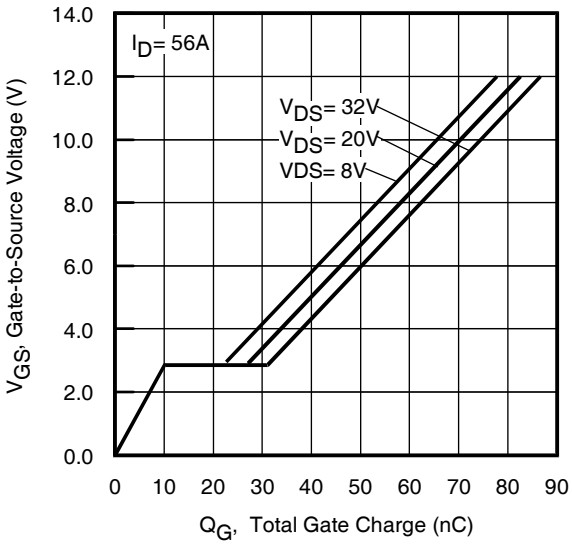



**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage

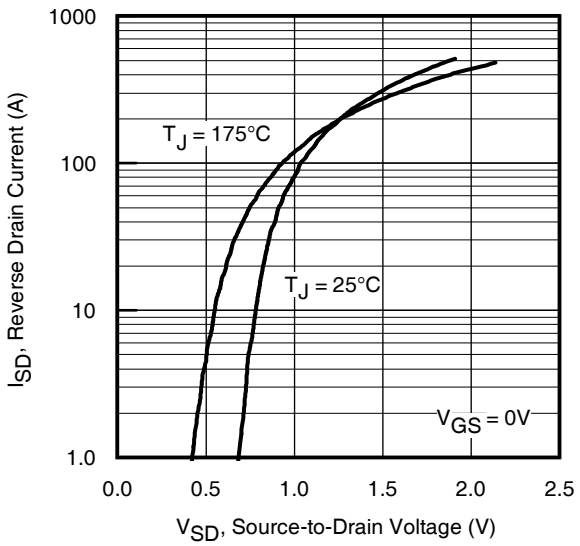



**Fig 7.** Typical Source-Drain Diode Forward Voltage

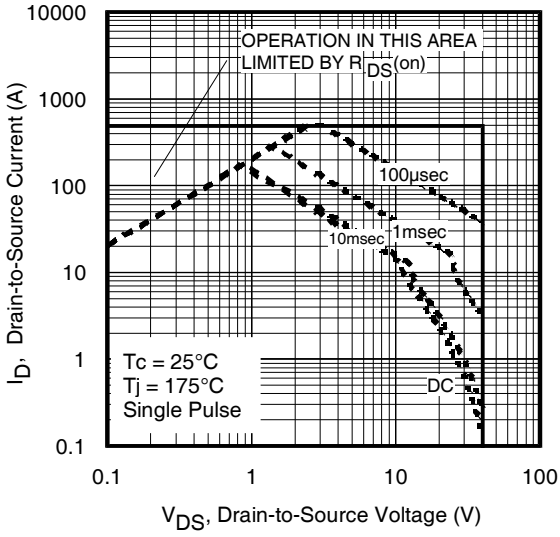



**Fig 8.** Maximum Safe Operating Area

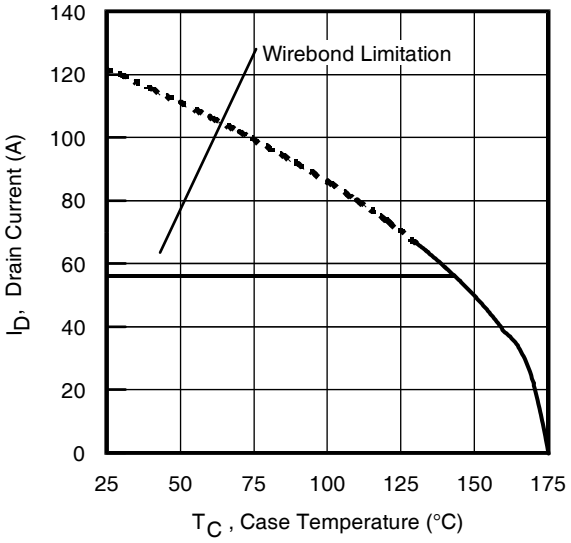



**Fig 9.** Maximum Drain Current vs. Case Temperature

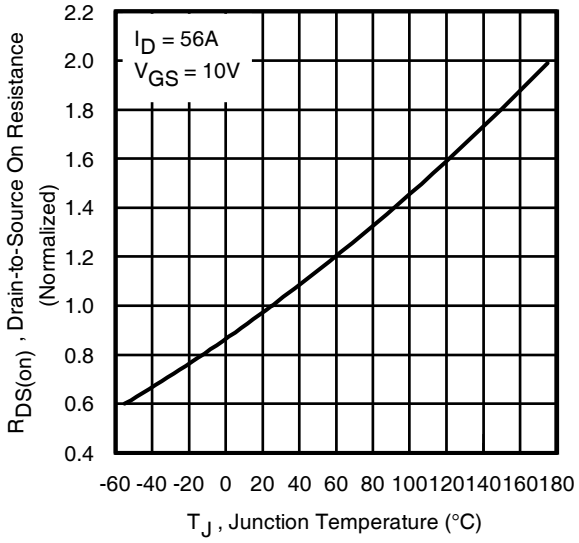



**Fig 10.** Normalized On-Resistance vs. Temperature

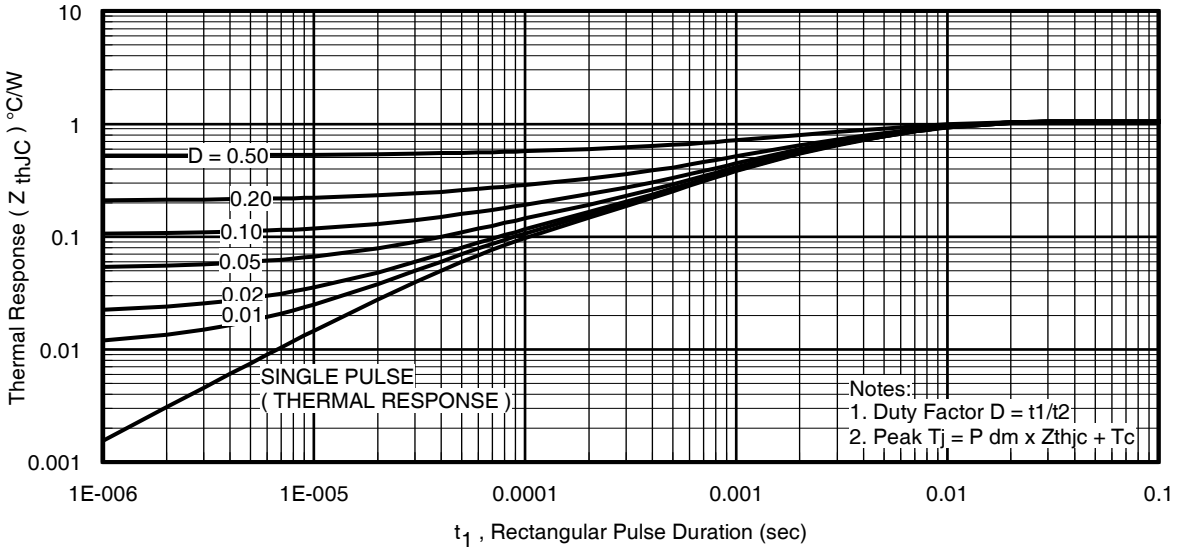



**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

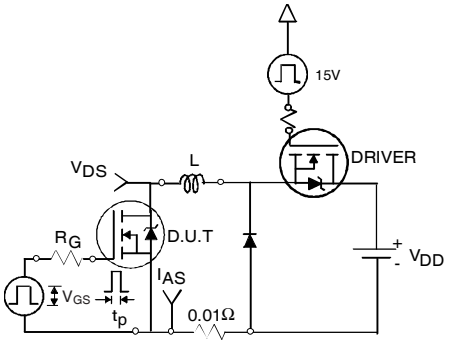



**Fig 12a.** Unclamped Inductive Test Circuit

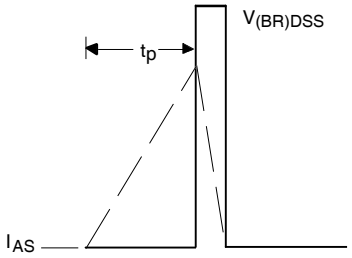



**Fig 12b.** Unclamped Inductive Waveforms

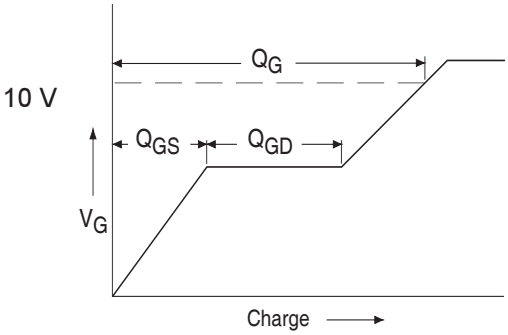



**Fig 13a.** Basic Gate Charge Waveform

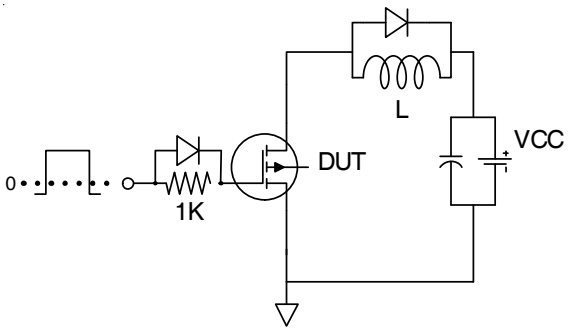



**Fig 13b.** Gate Charge Test Circuit

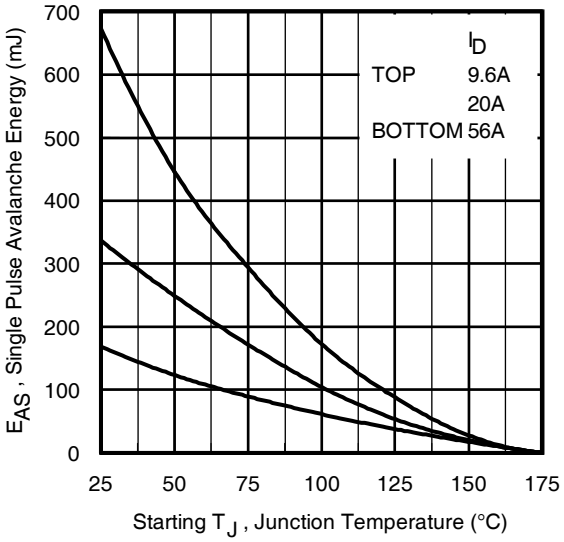



**Fig 12c.** Maximum Avalanche Energy vs. Drain Current

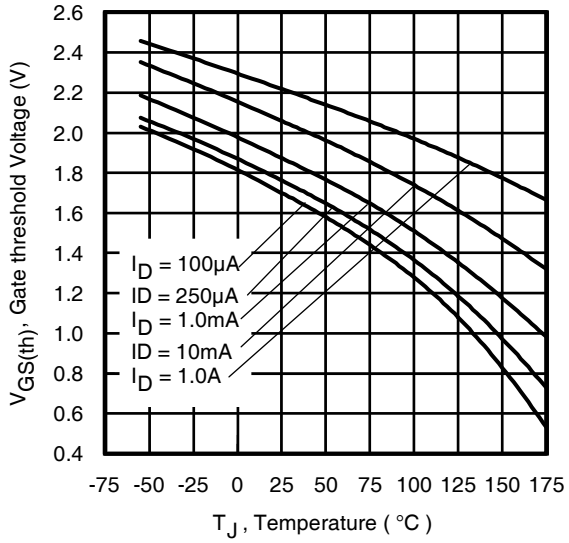



**Fig 14.** Threshold Voltage vs. Temperature

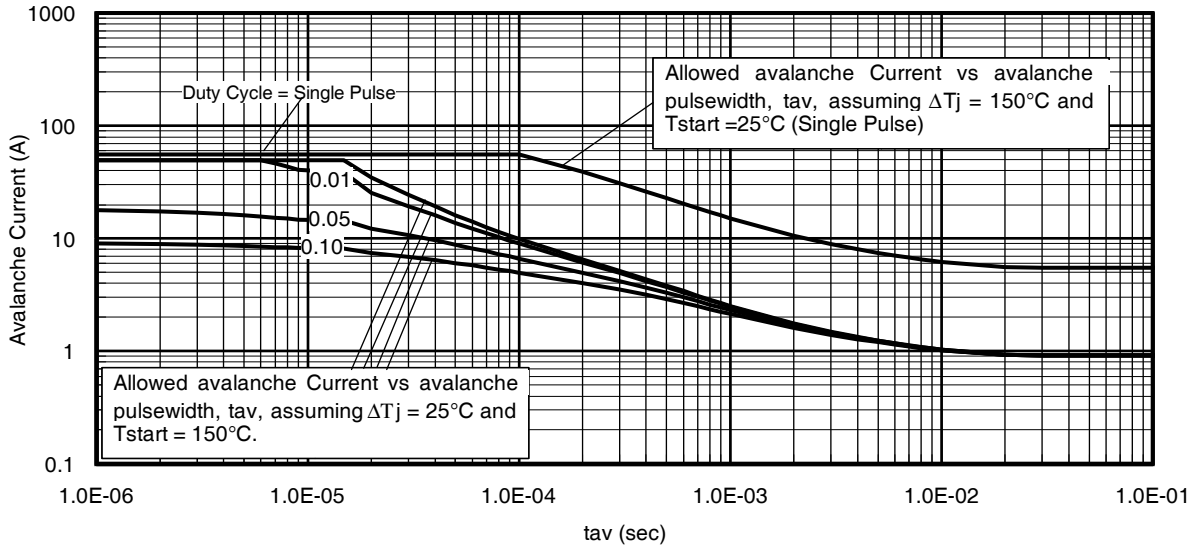



**Fig 15.** Typical Avalanche Current vs.Pulsewidth

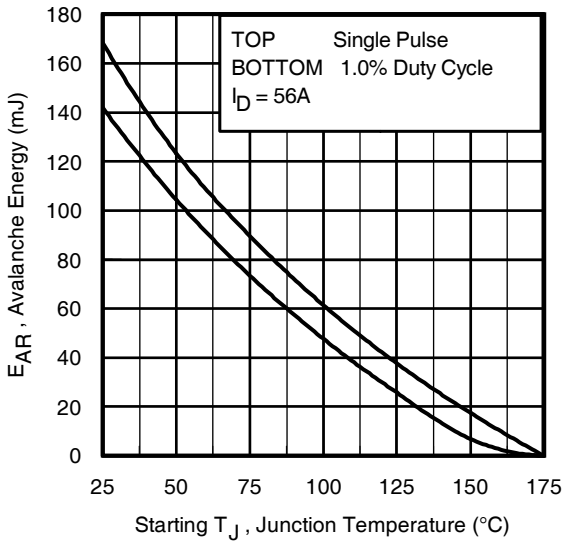



**Fig 16.** Maximum Avalanche Energy vs. Temperature

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

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)

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

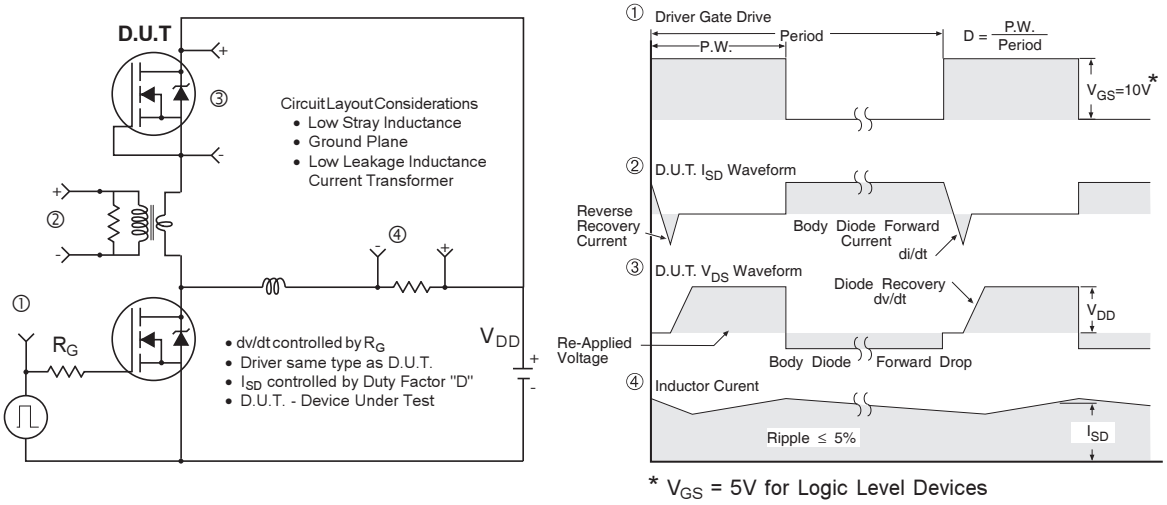



**Fig 17.** Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs

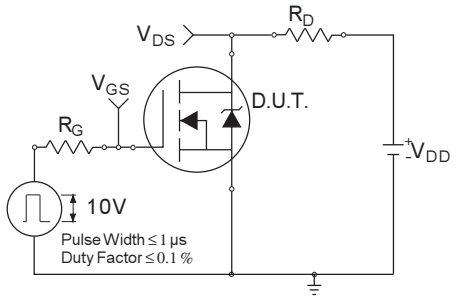



**Fig 18a.** Switching Time Test Circuit

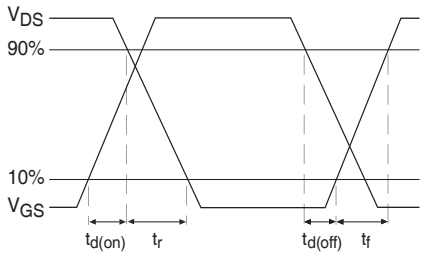
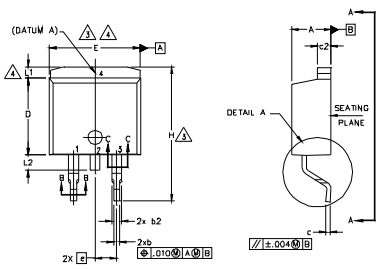
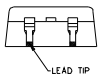
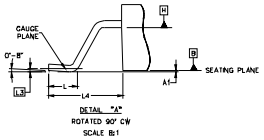


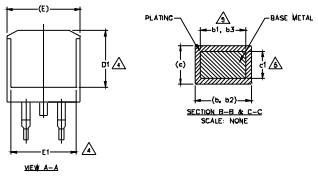

**Fig 18b.** Switching Time Waveforms

## D²Pak 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 [.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

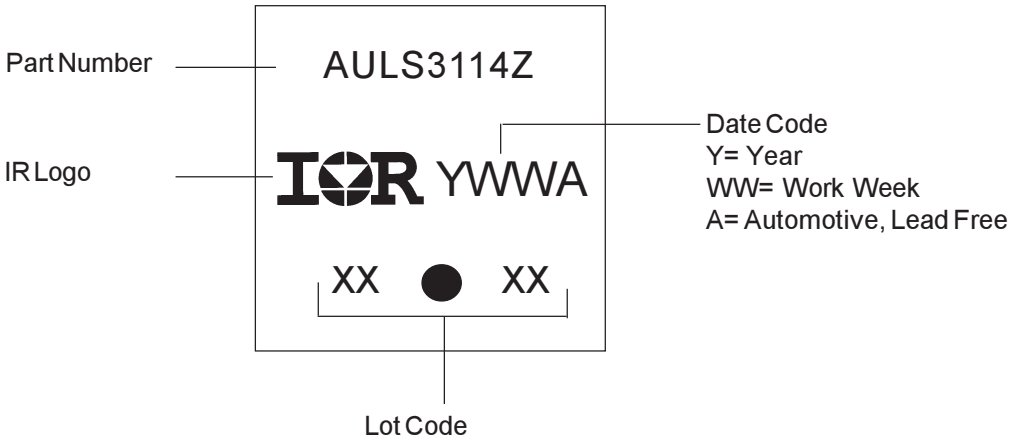
1.– GATE
2, 4.– COLLECTOR
3.– EMITTER

DIODES

1.– ANODE *
2, 4.– CATHODE
3.– ANODE

* PART DEPENDENT.

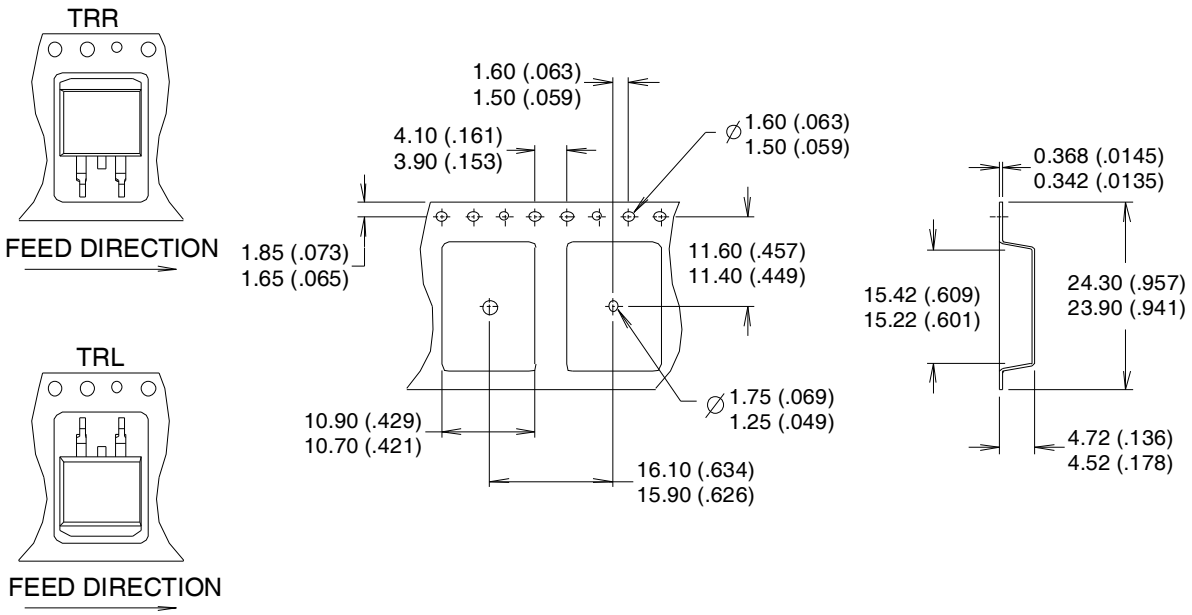
## D²Pak Part Marking Information

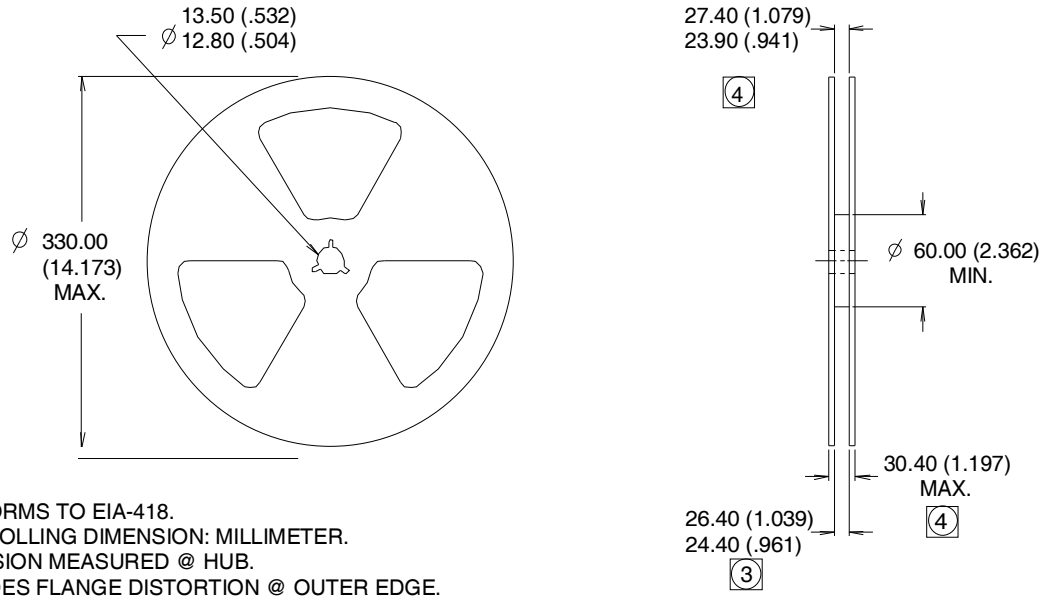



**Note: For the most current drawing please refer to IR website at http://www.irf.com/package/**

# D²Pak (TO-263AB) Tape & Reel Information

Dimensions are shown in millimeters (inches)




NOTES :

1. COMFORMS TO EIA-418.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION MEASURED @ HUB.
4. INCLUDES FLANGE DISTORTION @ OUTER EDGE.

## Ordering Information

| Base part | Package Type | Standard Pack | | Complete Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| AUIRLS3114Z | D2Pak | Tube | 50 | AUIRLS3114Z |
| | | Tape and Reel Left | 800 | AUIRLS3114ZTRL |
| | | Tape and Reel Right | 800 | AUIRLS3114ZTRR |

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