International
IOR Rectifier

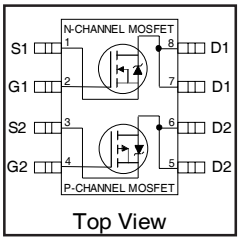
**AUTOMOTIVE GRADE**

# AUIRF7309Q

HEXFET® Power MOSFET

## Features

- Advanced Planar Technology
- Low On-Resistance
- Logic Level Gate Drive
- Dual N and P Channel MOSFET
- Dynamic dV/dT Rating
- 150°C Operating Temperature
- Fast Switching
- Lead-Free, RoHS Compliant
- Automotive Qualified*



Top View

| | N-CH | P-CH |
|---|---|---|
| $V_{(BR)DSS}$ | 30V | -30V |
| $R_{DS(on)}$ max. | 0.05Ω | 0.10Ω |
| $I_D$ | 4.7A | -3.5A |


SO-8
AUIRF7309Q

## Description

Specifically designed for Automotive applications, this cellular design of HEXFET® Power MOSFETs utilizes the latest processing techniques to achieve low on-resistance per silicon area. This benefit combined with the fast switching speed and ruggedized device design that HEXFET power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in Automotive and a wide variety of other applications.

| Base Part Number | Package Type | Standard Pack | | Orderable Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| AUIRF7309Q | SO-8 | Tube | 95 | AUIRF7309Q |
| | | Tape and Reel | 4000 | AUIRF7309QTR |

## 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 |
|---|---|---|---|---|
| | | N-Channel | P-Channel | |
| $I_D$ @ $T_A$ = 25°C | 10 Sec. Pulsed Drain Current, $V_{GS}$ @ 10V | 4.7 | -3.5 | A |
| $I_D$ @ $T_A$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V | 4 | -3.0 | |
| $I_D$ @ $T_A$ = 70°C | Continuous Drain Current, $V_{GS}$ @ 10V | 3.2 | -2.4 | |
| $I_{DM}$ | Pulsed Drain Current ① | 16 | -12 | |
| $P_D$ @$T_A$ = 25°C | Power Dissipation ④ | 1.4 | | W |
| | Linear Derating Factor ④ | 0.011 | | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 20 | | V |
| dv/dt | Peak Diode Recovery dv/dt ② | 6.9 | -6.0 | V/ns |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -55 to + 150 | | °C |

## Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mount, steady state) ④ | —— | 90 | °C/W |

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*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 | N-Ch | 30 | ––– | ––– | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| | | P-Ch | -30 | ––– | ––– | | $V_{GS}$ = 0V, $I_D$ =-250µA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | N-Ch | ––– | 0.032 | ––– | V/°C | Reference to 25°C, $I_D$ = 1mA |
| | | P-Ch | ––– | -0.037 | ––– | | Reference to 25°C, $I_D$ = -1mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | N-Ch | ––– | ––– | 0.050 | Ω | $V_{GS}$ = 10V, $I_D$ = 2.4A ③ |
| | | | ––– | ––– | 0.080 | | $V_{GS}$ = 4.5V, $I_D$ = 2.0A ③ |
| | | P-Ch | ––– | ––– | 0.10 | | $V_{GS}$ = -10V, $I_D$ = 1.8A ③ |
| | | | ––– | ––– | 0.16 | | $V_{GS}$ = -4.5V, $I_D$ = 1.5A ③ |
| $V_{GS(th)}$ | Gate Threshold Voltage | N-Ch | 1.0 | ––– | 3.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| | | P-Ch | -1.0 | ––– | -3.0 | | $V_{DS}$ = $V_{GS}$, $I_D$ = -250µA |
| gfs | Forward Transconductance | N-Ch | 5.2 | ––– | ––– | S | $V_{DS}$ = 15V, $I_D$ = 2.4A |
| | | P-Ch | 2.5 | ––– | ––– | | $V_{DS}$ = -24V, $I_D$ = -1.8A |
| $I_{DSS}$ | Drain-to-Source Leakage Current | N-Ch | ––– | ––– | 1.0 | µA | $V_{DS}$ = 24V, $V_{GS}$ = 0V |
| | | P-Ch | ––– | ––– | -1.0 | | $V_{DS}$ = -24V, $V_{GS}$ = 0V |
| | | N-Ch | ––– | ––– | 25 | | $V_{DS}$ = 24V, $V_{GS}$ = 0V, $T_J$ = 125°C |
| | | P-Ch | ––– | ––– | -25 | | $V_{DS}$ = -24V, $V_{GS}$ = 0V, $T_J$ = 125°C |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | N-P | ––– | ––– | -100 | nA | $V_{GS}$ = 20V |
| | Gate-to-Source Reverse Leakage | N-P | ––– | ––– | 100 | | $V_{GS}$ = -20V |

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

| | Parameter | | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge | N-Ch | ––– | ––– | 25 | nC | N-Channel |
| | | P-Ch | ––– | ––– | 25 | | $I_D$ = 2.6A, $V_{DS}$ = 16V, $V_{GS}$ = 4.5V ③ |
| $Q_{gs}$ | Gate-to-Source Charge | N-Ch | ––– | ––– | 2.9 | | |
| | | P-Ch | ––– | ––– | 2.9 | | P-Channel |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | N-Ch | ––– | ––– | 7.9 | | $I_D$ =-2.2A, $V_{DS}$ =-16V, $V_{GS}$ =-4.5V |
| | | N-Ch | ––– | ––– | 9.0 | | |
| $t_{d(on)}$ | Turn-On Delay Time | P-Ch | ––– | 6.8 | ––– | ns | N-Channel |
| | | N-Ch | ––– | 11 | ––– | | $V_{DD}$= 10V, $I_D$ = 2.6A $R_G$ = 6.0Ω |
| $t_r$ | Rise Time | P-Ch | ––– | 21 | ––– | | $R_D$ = 3.8Ω |
| | | N-Ch | ––– | 17 | ––– | | |
| $t_{d(off)}$ | Turn-Off Delay Time | N-Ch | ––– | 22 | ––– | | P-Channel |
| | | P-Ch | ––– | 25 | ––– | | $V_{DD}$=-10V, $I_D$ =-2.2A $R_G$ = 6.0Ω |
| $t_f$ | Fall Time | N-Ch | ––– | 7.7 | ––– | | $R_D$ = 4.5Ω |
| | | P-Ch | ––– | 18 | ––– | | |
| $L_D$ | Internal Drain Inductance | N-P | ––– | 4.0 | ––– | nH | Between lead, |
| $L_S$ | Internal Source Inductance | N-P | ––– | 6.0 | ––– | | 6mm (0.25in.) from package and center of die contact |
| $C_{iss}$ | Input Capacitance | N-Ch | ––– | 520 | ––– | pF | N-Channel |
| | | P-Ch | ––– | 440 | ––– | | $V_{GS}$ = 0V, $V_{DS}$ = 15V, $f$ = 1.0MHz ③ |
| $C_{oss}$ | Output Capacitance | N-Ch | ––– | 180 | ––– | | |
| | | P-Ch | ––– | 200 | ––– | | P-Channel |
| $C_{rss}$ | Reverse Transfer Capacitance | N-Ch | ––– | 72 | ––– | | $V_{GS}$ = 0V, $V_{DS}$ = -15V, $f$ = 1.0MHz |
| | | P-Ch | ––– | 93 | ––– | | |

**Diode Characteristics**

| | Parameter | | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | N-Ch | ––– | ––– | 1.8 | A | |
| | | P-Ch | ––– | ––– | -1.8 | | |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | N-Ch | ––– | ––– | 16 | | |
| | | P-Ch | ––– | ––– | -12 | | |
| $V_{SD}$ | Diode Forward Voltage | N-Ch | ––– | ––– | 1.0 | V | $T_J$ = 25°C, $I_S$ = 1.8A, $V_{GS}$ = 0V ③ |
| | | P-Ch | ––– | ––– | -1.0 | | $T_J$ = 25°C, $I_S$ = -1.8A, $V_{GS}$ = 0V ③ |
| $t_{rr}$ | Reverse Recovery Time | N-Ch | ––– | 47 | 71 | ns | N-Channel |
| | | P-Ch | ––– | 53 | 80 | | $T_J$ = 25°C,$I_F$ =2.6A, di/dt = 100A/µs |
| $Q_{rr}$ | Reverse Recovery Charge | N-Ch | ––– | 56 | 84 | nC | P-Channel ③ |
| | | P-Ch | ––– | 66 | 99 | | $T_J$ = 25°C,$I_F$ =-2.2A, di/dt = 100A/µs |
| $t_{on}$ | Forward Turn-On Time | N-P | 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. 23 )

② N-Channel $I_{SD}$ ≤ 2.4A, di/dt ≤ 73A/µs, $V_{DD}$ ≤ $V_{(BR)DSS}$, $T_J$ ≤ 150°C.
P-Channel $I_{SD}$ ≤ -1.8A, di/dt ≤ 90A/µs, $V_{DD}$ ≤ $V_{(BR)DSS}$, $T_J$ ≤ 150°C.

③ Pulse width ≤ 300µs; duty cycle ≤ 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.

## N-Channel

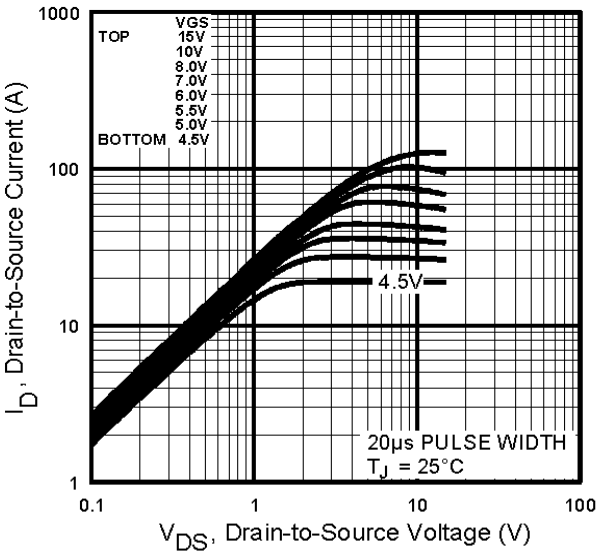



**Fig 1.** Typical Output Characteristics, $T_J$ = 25ºC

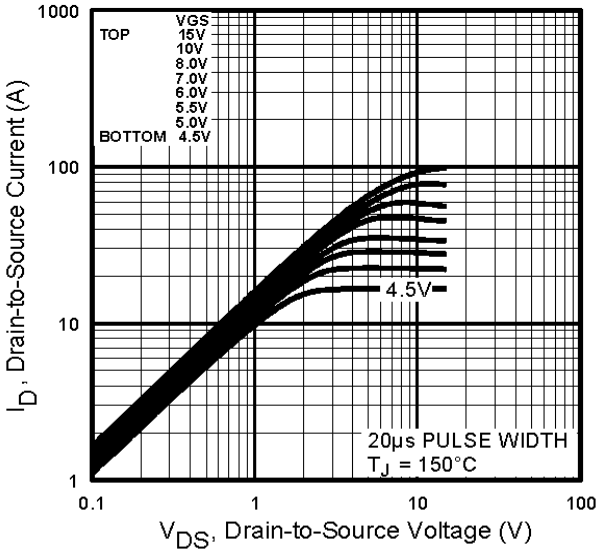



**Fig 2.** Typical Output Characteristics, $T_J$ = 150ºC

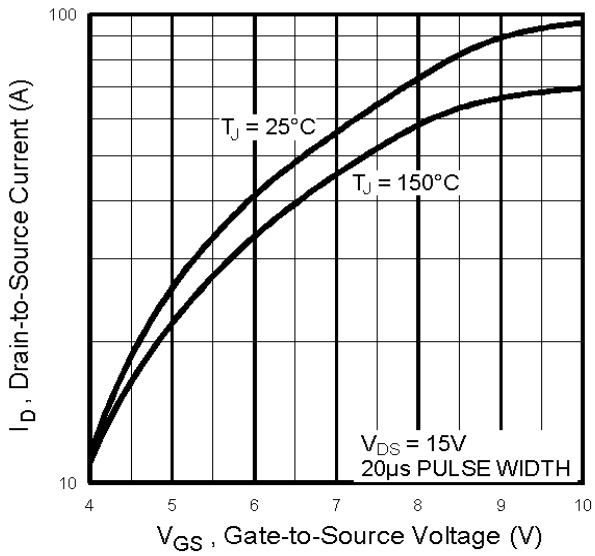



**Fig 3.** Typical Transfer Characteristics

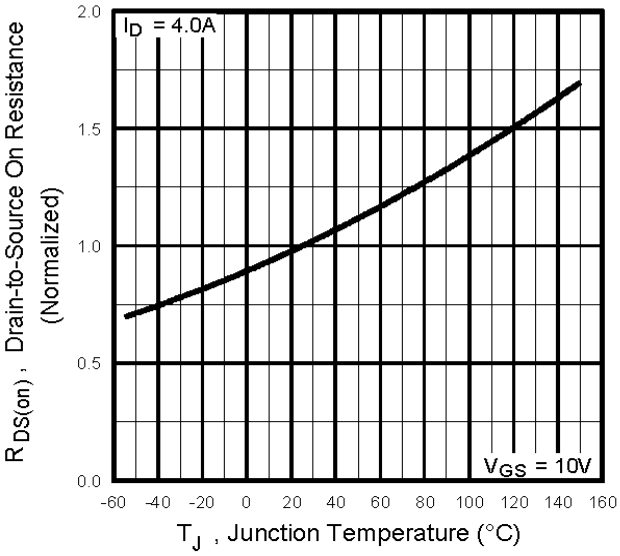



**Fig 4.** Normalized On-Resistance Vs. Temperature

N-Channel

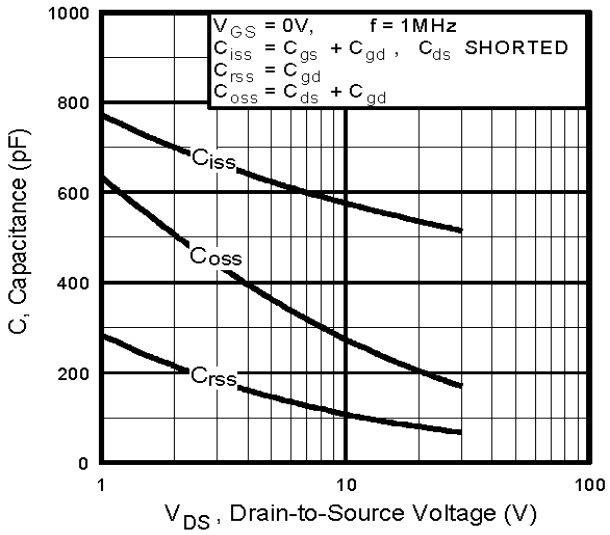



**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

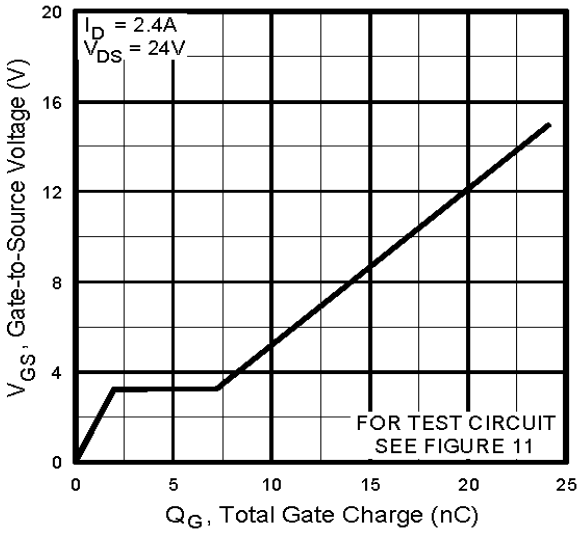



**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage

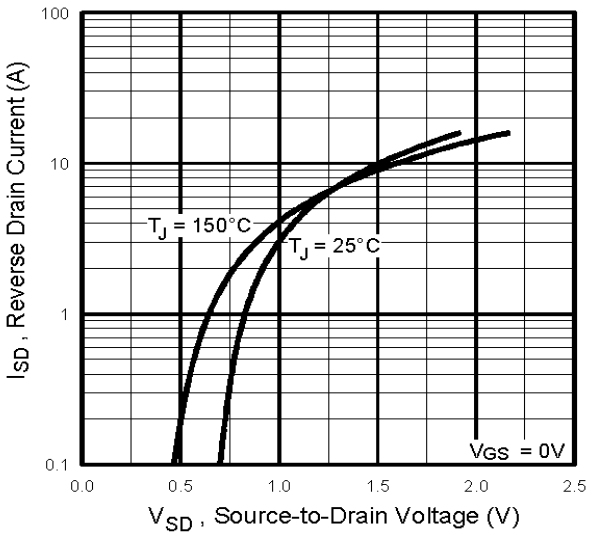



**Fig 7.** Typical Source-Drain Diode Forward Voltage

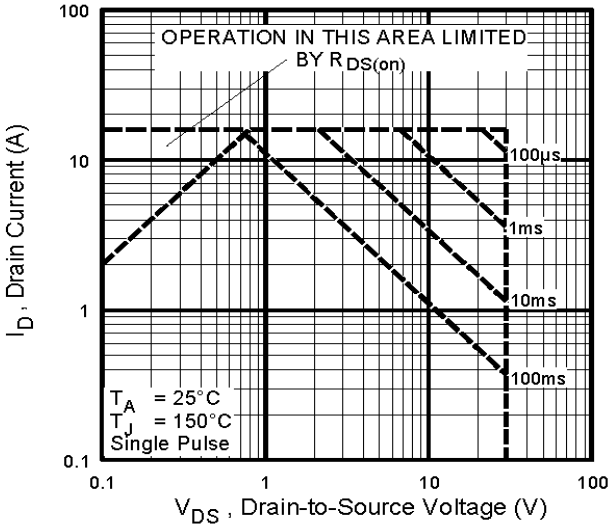



**Fig 8.** Maximum Safe Operating Area

## N-Channel

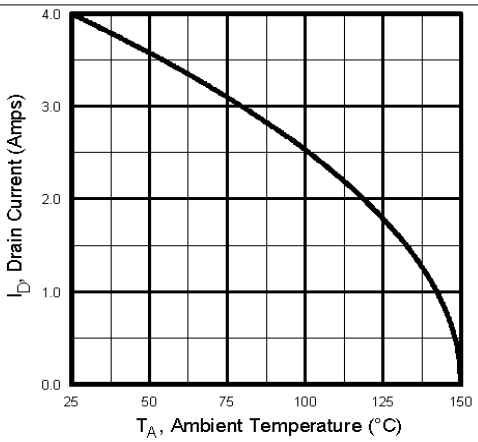



**Fig 9.** Max. Drain Current Vs. Ambient Temp.

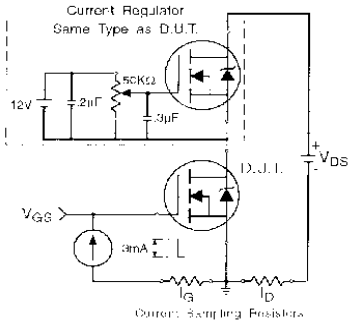



**Fig 11a.** Gate Charge Test Circuit

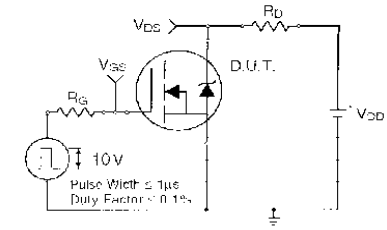



**Fig 10a.** Switching Time Test Circuit

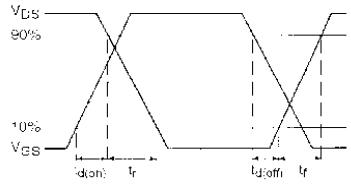



**Fig 10b.** Switching Time Waveforms

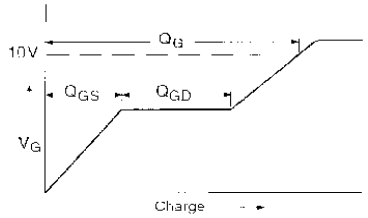



**Fig 11b.** Basic Gate Charge Waveform

## P-Channel

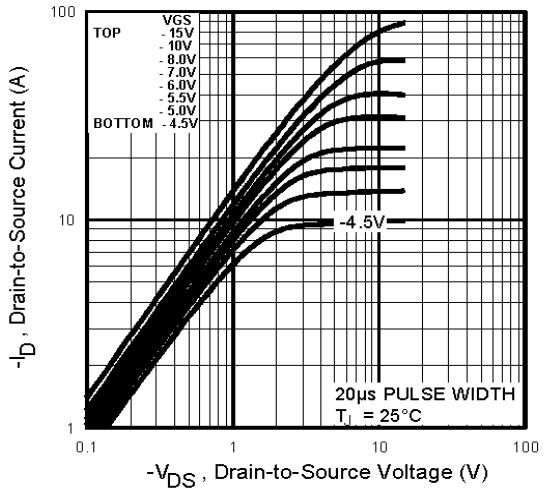



**Fig 12.** Typical Output Characteristics, $T_J$ = 25ºC

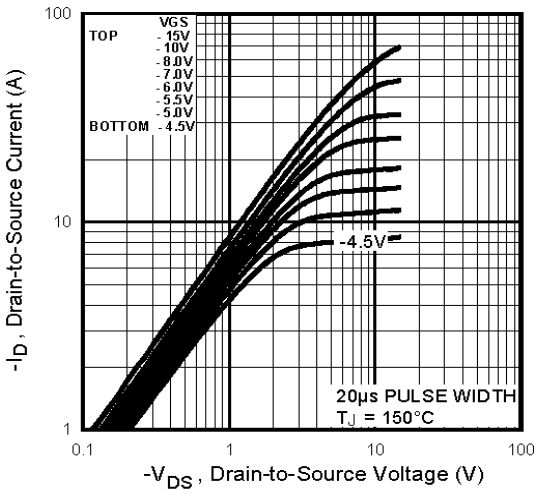



**Fig 13.** Typical Output Characteristics, $T_J$ = 150ºC

## P-Channel

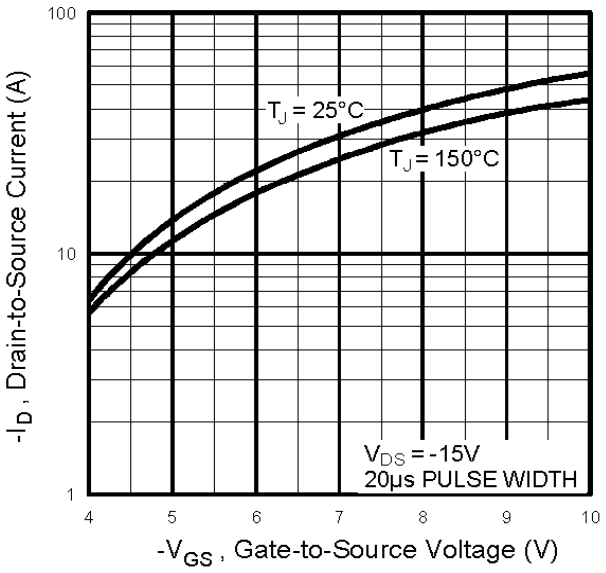



**Fig 14.** Typical Transfer Characteristics

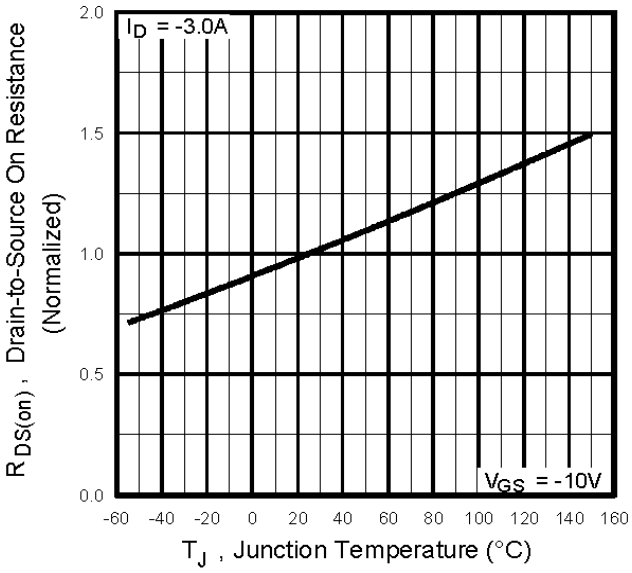



**Fig 15.** Normalized On-Resistance Vs. Temperature

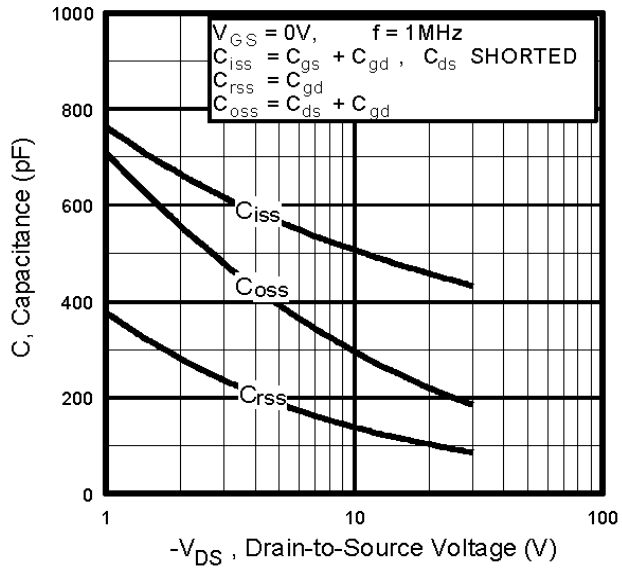



**Fig 16.** Typical Capacitance Vs. Drain-to-Source Voltage

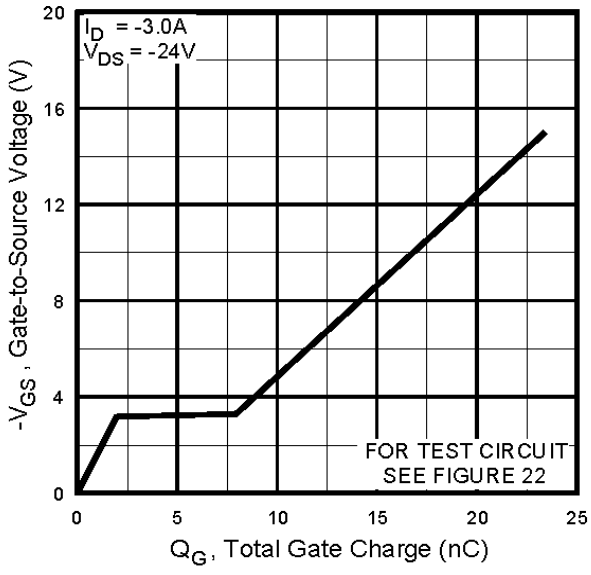



**Fig 17.** Typical Gate Charge Vs. Gate-to-Source Voltage

## P-Channel

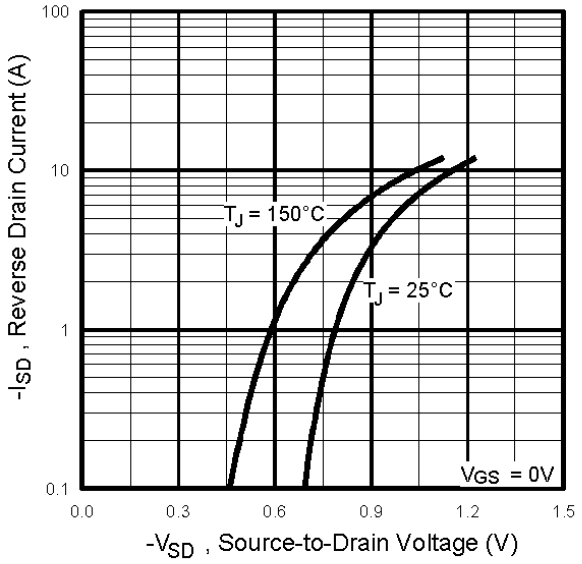



**Fig 18.** Typical Source-Drain Diode Forward Voltage

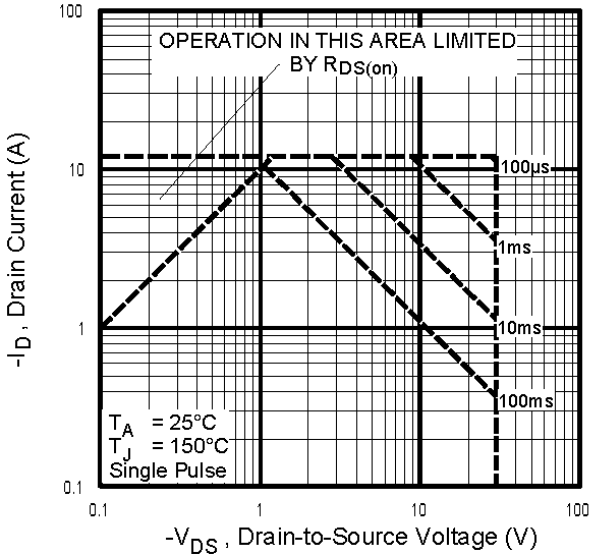



**Fig 19.** Maximum Safe Operating Area

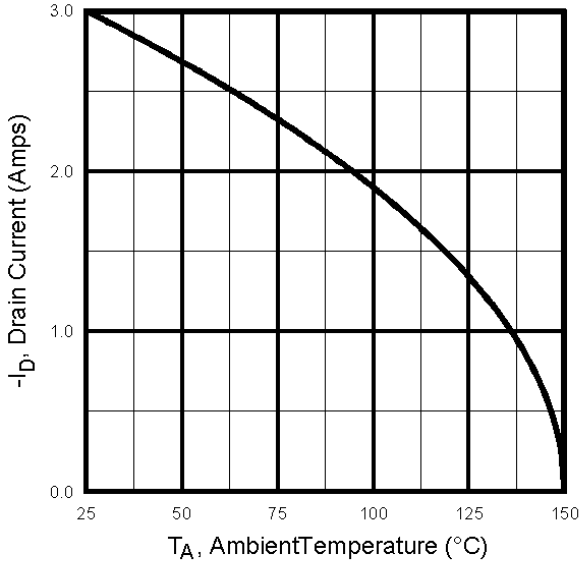



**Fig 20.** Max.Drain Current Vs. Ambient Temp.

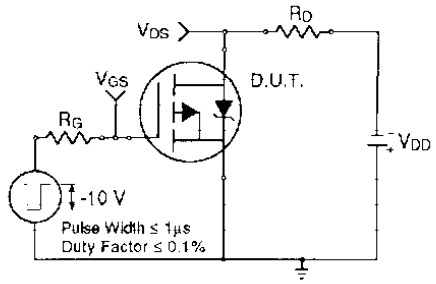



**Fig 21a.** Switching Time Test Circuit

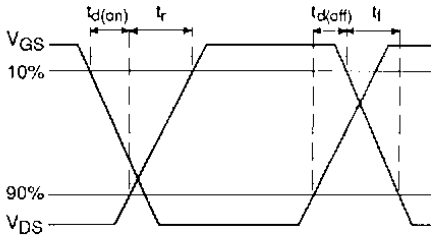



**Fig 21b.** Switching Time Waveforms

## P-Channel

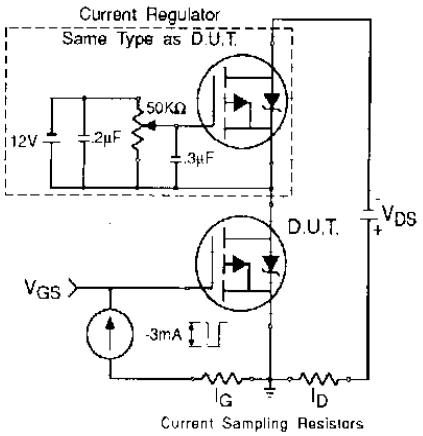



**Fig 22b.** Gate Charge Test Circuit

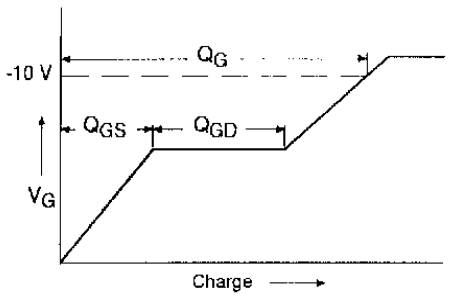



**Fig 22b.** Basic Gate Charge Waveform

## N- and P-Channel

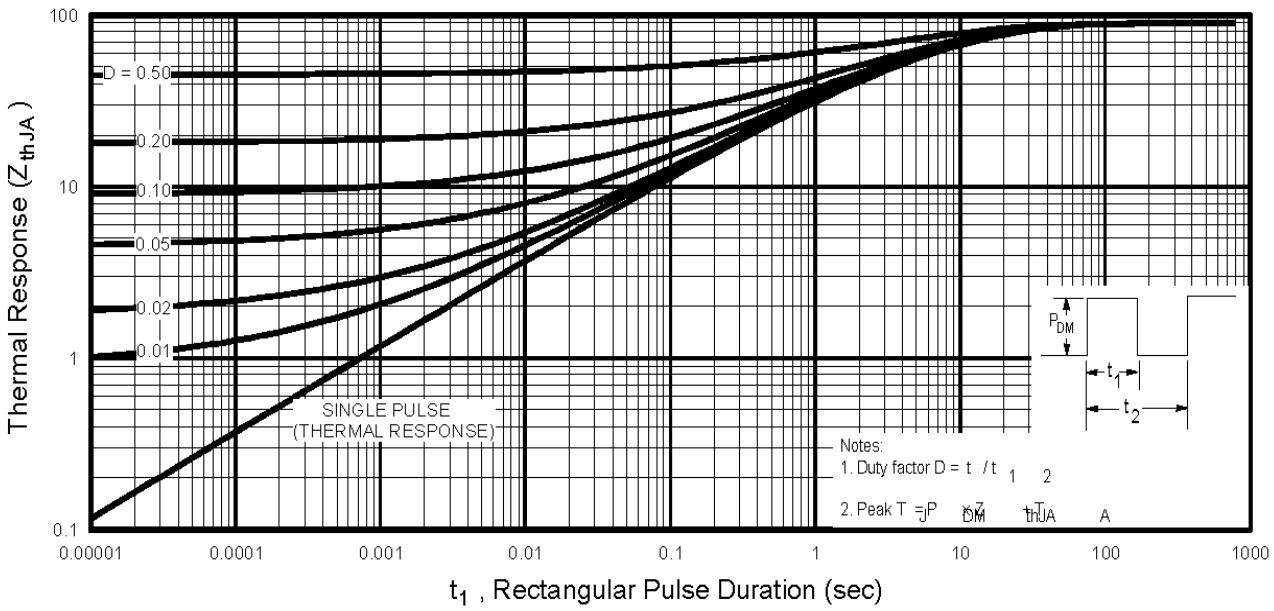
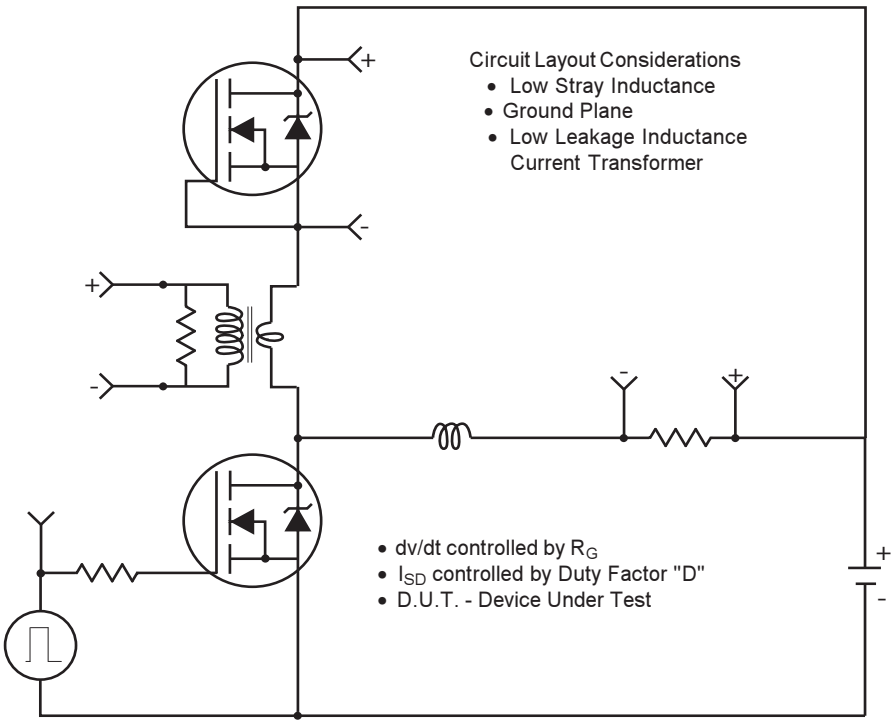
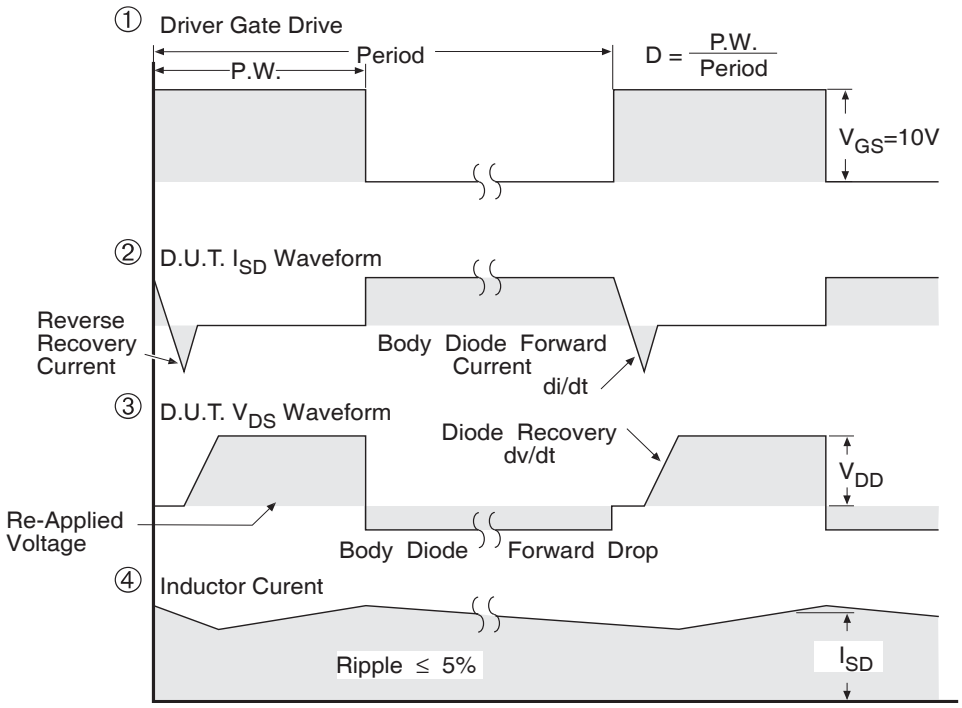



**Fig 23.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

## Peak Diode Recovery dv/dt Test Circuit




* Reverse Polarity for P-Channel
** Use P-Channel Driver for P-Channel Measurements

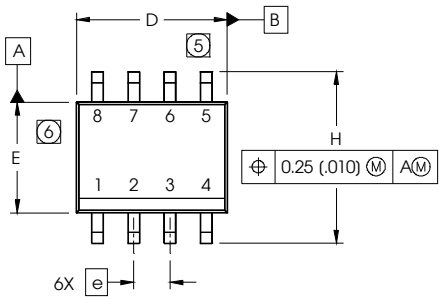



*** $V_{GS}$ = 5.0V for Logic Level and 3V Drive Devices

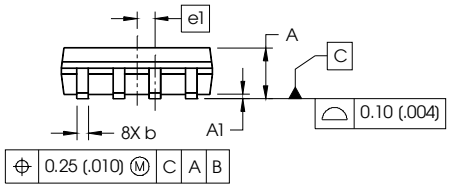
**Fig 24.** For N and P Channel HEXFETS

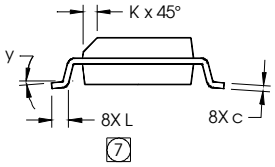
## SO-8 Package Outline

Dimensions are shown in millimeters (inches)



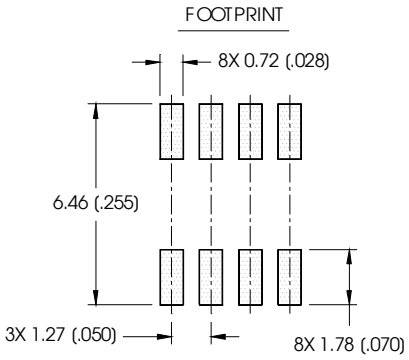

| DIM | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | .0532 | .0688 | 1.35 | 1.75 |
| A1 | .0040 | .0098 | 0.10 | 0.25 |
| b | .013 | .020 | 0.33 | 0.51 |
| c | .0075 | .0098 | 0.19 | 0.25 |
| D | .189 | .1968 | 4.80 | 5.00 |
| E | .1497 | .1574 | 3.80 | 4.00 |
| e | .050 BASIC | | 1.27 BASIC | |
| e1 | .025 BASIC | | 0.635 BASIC | |
| H | .2284 | .2440 | 5.80 | 6.20 |
| K | .0099 | .0196 | 0.25 | 0.50 |
| L | .016 | .050 | 0.40 | 1.27 |
| y | 0° | 8° | 0° | 8° |



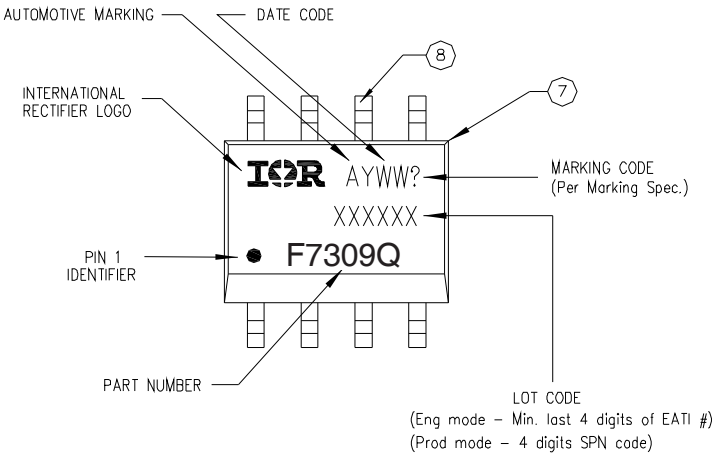




NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.
5. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.15 (.006).
6. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.25 (.010).
7. DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.



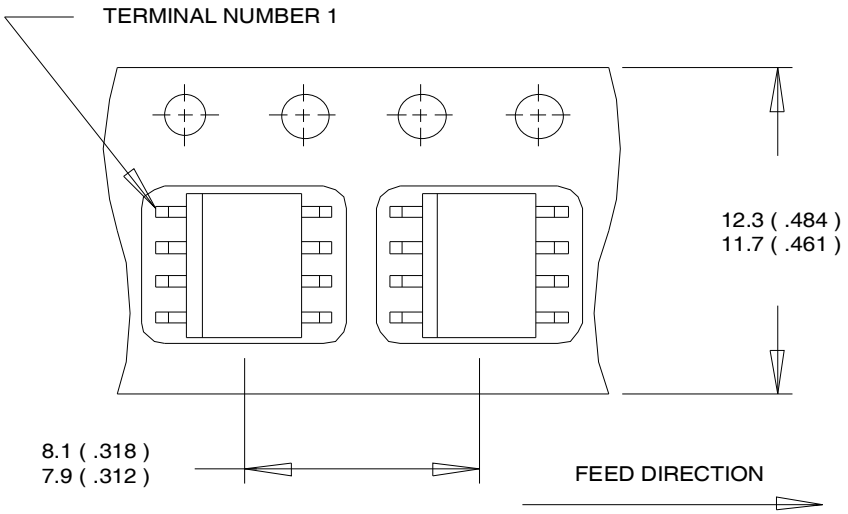

## SO-8 Part Marking



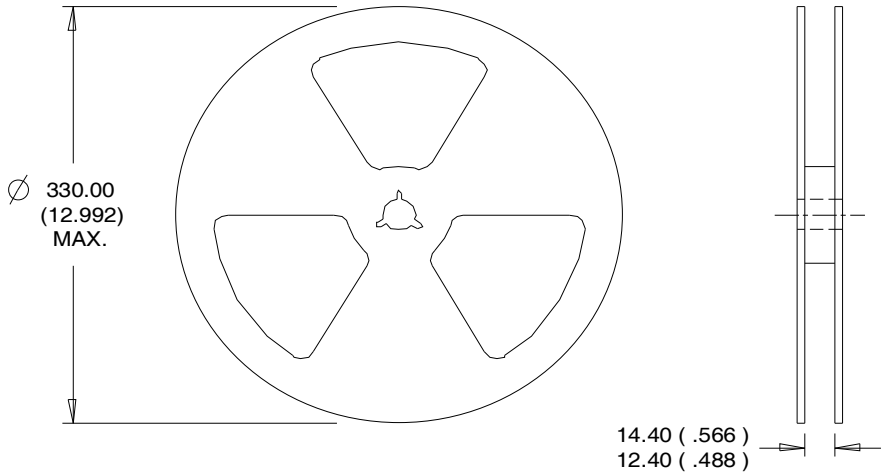

**Note: For the most current drawing please refer to IR website at http://www.irf.com/package/**

## SO-8 Tape and Reel

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. CONTROLLING DIMENSION : MILLIMETER.
2. OUTLINE CONFORMS TO EIA-481 & EIA-541.

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

## 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** | | SO-8 | MSL1 |
| **ESD** | Machine Model | N-CH: Class M2 (+/- 150V)††† P-CH: Class M2 (+/- 150V)††† AEC-Q101-002 | |
| | Human Body Model | N-CH: Class H1A (+/- 500V)††† P-CH: Class H0 (+/- 250V)††† AEC-Q101-001 | |
| | Charged Device Model | N-CH: Class C5 (+/- 2000V)††† P-CH: Class C5 (+/- 2000V)††† AEC-Q101-005 | |
| **RoHS Compliant** | | Yes | |

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

†† Exceptions to AEC-Q101 requirements are noted in the qualification report.

††† Highest passing voltage.

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For technical support, please contact IR’s Technical Assistance Center
http://www.irf.com/technical-info/

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Tel: (310) 252-7105

**Revision History**

| Date | Comments |
|---|---|
| 3/28/2014 | • Added "Logic Level Gate Drive" bullet in the features section on page 1<br>• Updated data sheet with new IR corporate template |