# THE DATASHEET OF

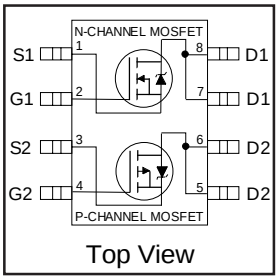
# IRF7309QTRPBF

International
IOR Rectifier

# IRF7309QPbF

HEXFET® Power MOSFET

- Advanced Process Technology
- Ultra Low On-Resistance
- Dual N and P Channel MOSFET
- Surface Mount
- Available in Tape & Reel
- 150°C Operating Temperature
- Lead-Free



Top View

| | N-Ch | P-Ch |
|---|---|---|
| $V_{DSS}$ | 30V | -30V |
| $R_{DS(on)}$ | 0.050Ω | 0.10Ω |


SO-8

## Description

These HEXFET® Power MOSFET's in a Dual SO-8 package utilize the lastest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of these HEXFET Power MOSFET's are a 150°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These benefits combine to make this design an extremely efficient and reliable device for use in a wide variety of applications.
The efficient SO-8 package provides enhanced thermal characteristics and dual MOSFET die capability making it ideal in a variety of power applications. This dual, surface mount SO-8 can dramatically reduce board space and is also available in Tape & Reel.

## Absolute Maximum Ratings

| Parameter | | Max. | | Units |
|---|---|---|---|---|
| | | N-Channel | P-Channel | |
| $I_D$ @ $T_A$ = 25°C | 10 Sec. Pulse Drain Current, $V_{GS}$ @ 10V | 4.7 | -3.5 | A |
| $I_D$ @ $T_A$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V | 4.0 | -3.0 | A |
| $I_D$ @ $T_A$ = 70°C | Continuous Drain Current, $V_{GS}$ @ 10V | 3.2 | -2.4 | A |
| $I_{DM}$ | Pulsed Drain Current ① | 16 | -12 | A |
| $P_D$ @$T_A$ = 25°C | Power Dissipation (PCB Mount)** | 1.4 | | W |
| | Linear Derating Factor (PCB Mount)** | 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 |
| $T_J$, $T_{STG}$ | Junction and Storage Temperature Range | -55 to + 150 | | °C |

## Thermal Resistance

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

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

## 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 | — | — | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| | | P-Ch | -1.0 | — | — | | $V_{DS}$ = $V_{GS}$, $I_D$ = -250µA |
| $g_{fs}$ | Forward Transconductance | N-Ch | 5.2 | — | — | S | $V_{DS}$ = 15V, $I_D$ = 2.4A ③ |
| | | P-Ch | 2.5 | — | — | | $V_{DS}$ = -24V, $I_D$ = -1.8A ③ |
| $I_{DSS}$ | 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 |
| $Q_g$ | Total Gate Charge | N-Ch | — | — | 25 | nC | N-Channel<br>$I_D$ = 2.6A, $V_{DS}$ = 16V, $V_{GS}$ = 4.5V ③<br>P-Channel<br>$I_D$ = -2.2A, $V_{DS}$ = -16V, $V_{GS}$ = -4.5V |
| | | P-Ch | — | — | 25 | | |
| $Q_{gs}$ | Gate-to-Source Charge | N-Ch | — | — | 2.9 | | |
| | | P-Ch | — | — | 2.9 | | |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | N-Ch | — | — | 7.9 | | |
| | | P-Ch | — | — | 9.0 | | |
| $t_{d(on)}$ | Turn-On Delay Time | N-Ch | — | 6.8 | — | ns | N-Channel<br>$V_{DD}$ = 10V, $I_D$ = 2.6A, $R_G$ = 6.0Ω,<br>$R_D$ = 3.8Ω ③<br>P-Channel<br>$V_{DD}$ = -10V, $I_D$ = -2.2A, $R_G$ = 6.0Ω,<br>$R_D$ = 4.5Ω |
| | | P-Ch | — | 11 | — | | |
| $t_r$ | Rise Time | N-Ch | — | 21 | — | | |
| | | P-Ch | — | 17 | — | | |
| $t_{d(off)}$ | Turn-Off Delay Time | N-Ch | — | 22 | — | | |
| | | P-Ch | — | 25 | — | | |
| $t_f$ | Fall Time | N-Ch | — | 7.7 | — | | |
| | | P-Ch | — | 18 | — | | |
| $L_D$ | Internal Drain Inductace | N-P | — | 4.0 | — | nH | Between lead tip<br>and center of die contact |
| $L_S$ | Internal Source Inductance | N-P | — | 6.0 | — | | |
| $C_{iss}$ | Input Capacitance | N-Ch | — | 520 | — | pF | N-Channel<br>$V_{GS}$ = 0V, $V_{DS}$ = 15V, $f$ = 1.0MHz ③<br>P-Channel<br>$V_{GS}$ = 0V, $V_{DS}$ = -15V, $f$ = 1.0MHz |
| | | P-Ch | — | 440 | — | | |
| $C_{oss}$ | Output Capacitance | N-Ch | — | 180 | — | | |
| | | P-Ch | — | 200 | — | | |
| $C_{rss}$ | Reverse Transfer Capacitance | N-Ch | — | 72 | — | | |
| | | P-Ch | — | 93 | — | | |

## Source-Drain Ratings and 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<br>$T_J$ = 25°C, $I_F$ = 2.6A, di/dt = 100A/µs<br>P-Channel ③<br>$T_J$ = 25°C, $I_F$ = -2.2A, di/dt = 100A/µs |
| | | P-Ch | — | 53 | 80 | | |
| $Q_{rr}$ | Reverse Recovery Charge | N-Ch | — | 56 | 84 | nC | |
| | | P-Ch | — | 66 | 99 | | |
| $t_{on}$ | Forward Turn-On Time | N-P | Intrinsic turn-on time is neglegible (turn-on is dominated by $L_S$+$L_D$) | | | | |

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%.

**N-Channel**

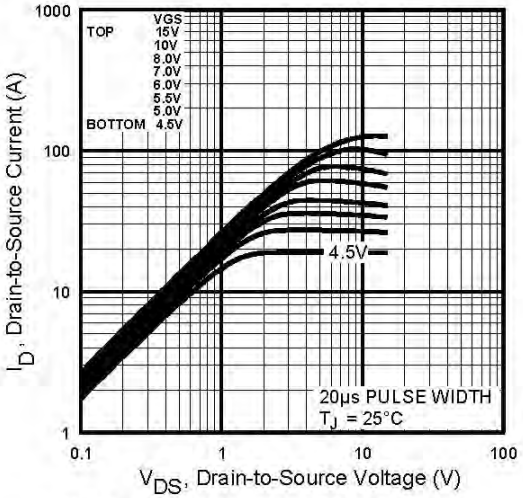



**Fig 1.** Typical Output Characteristics, $T_J$ = 25ºC

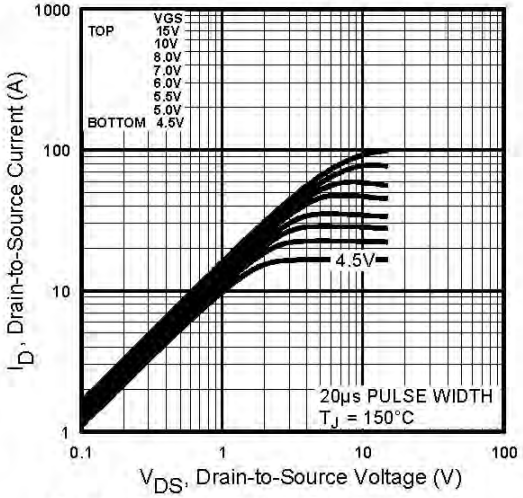



**Fig 2.** Typical Output Characteristics, $T_J$ = 150ºC

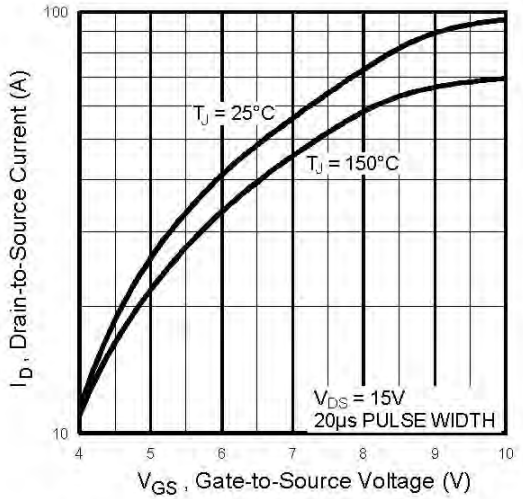



**Fig 3.** Typical Transfer Characteristics

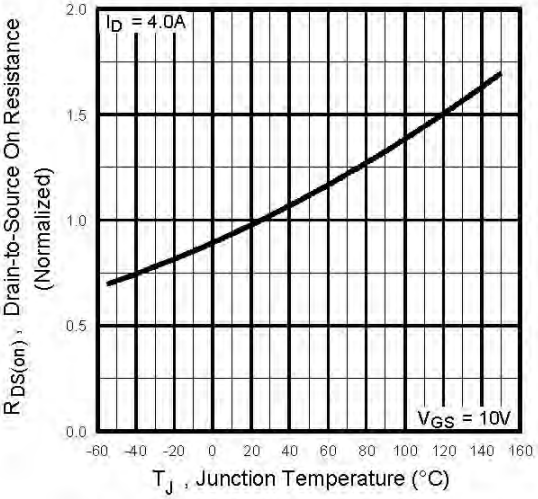



**Fig 4.** Normalized On-Resistance Vs. Temperature

**N-Channel**

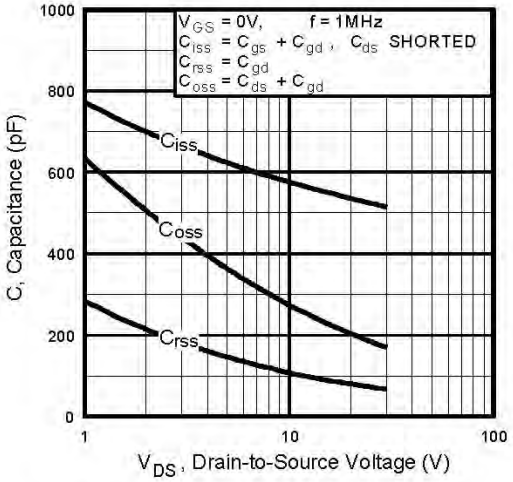



**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

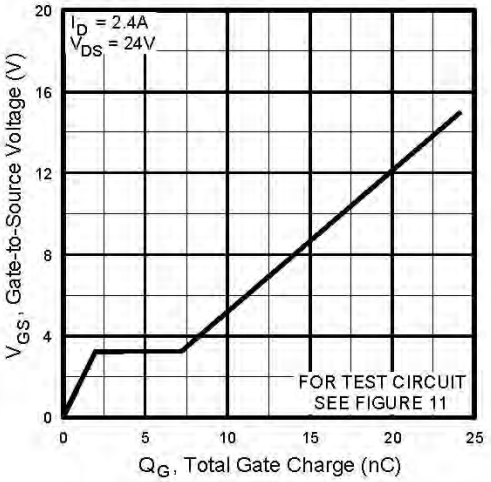



**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage

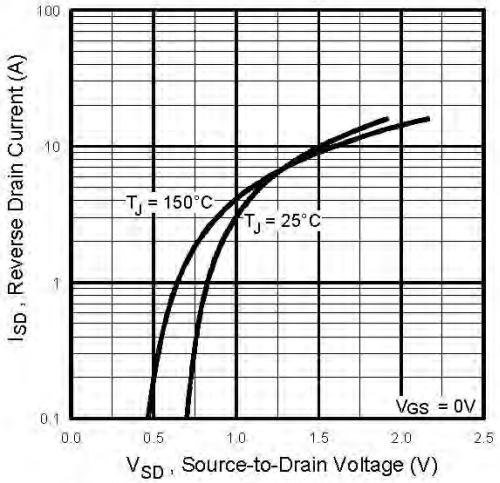



**Fig 7.** Typical Source-Drain Diode Forward Voltage

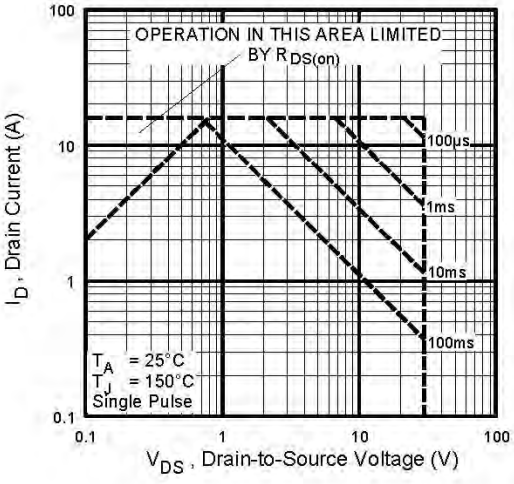



**Fig 8.** Maximum Safe Operating Area

## N-Channel

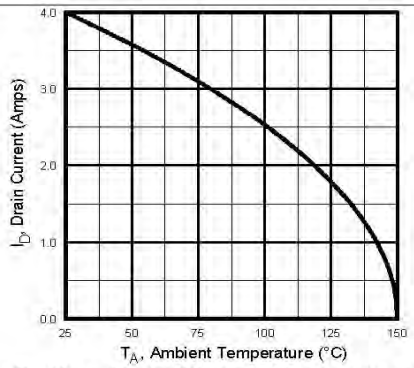



**Fig 9.** Max. Drain Current Vs. Ambient Temp.

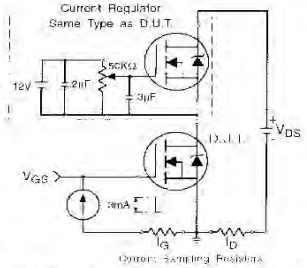



**Fig 11a.** Gate Charge Test Circuit

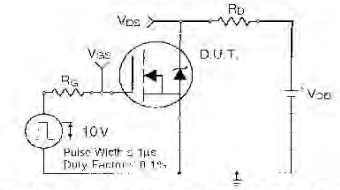



**Fig 10a.** Switching Time Test Circuit

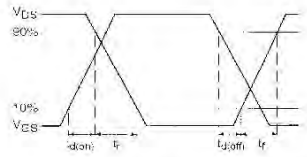



**Fig 10b.** Switching Time Waveforms

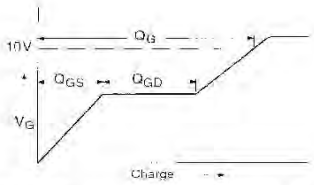



**Fig 11b.** Basic Gate Charge Waveform

## P-Channel

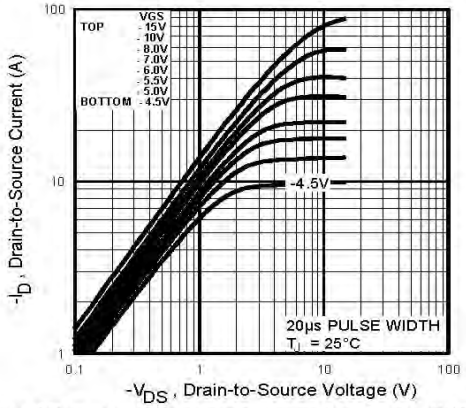



**Fig 12.** Typical Output Characteristics, $T_J$ = 25°C

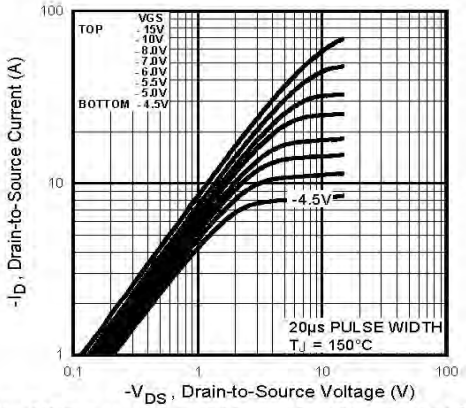



**Fig 13.** Typical Output Characteristics, $T_J$ = 150°C

**P-Channel**

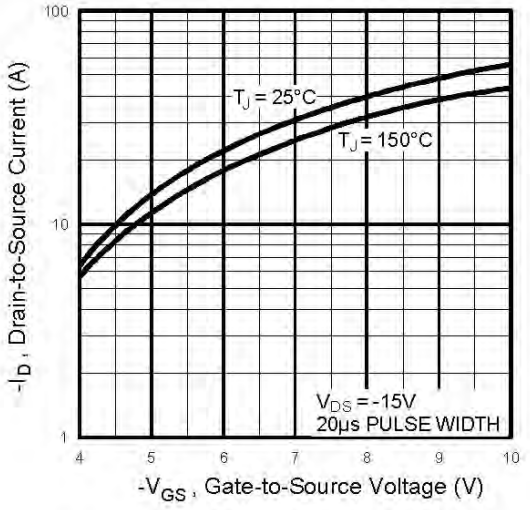



**Fig 14.** Typical Transfer Characteristics

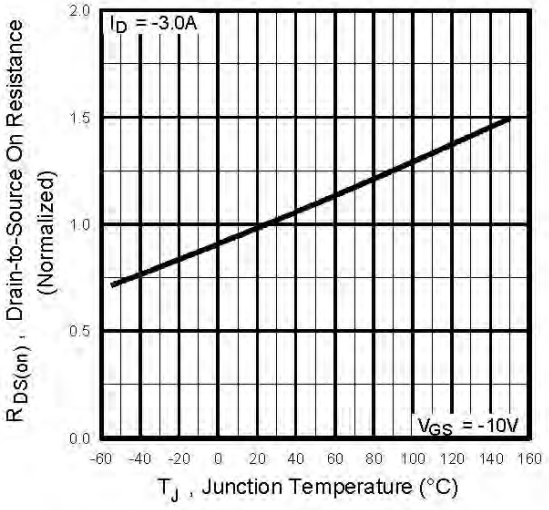



**Fig 15.** Normalized On-Resistance Vs. Temperature

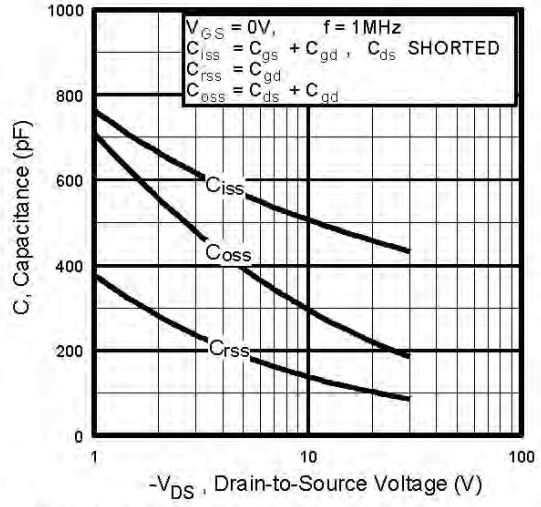



**Fig 16.** Typical Capacitance Vs. Drain-to-Source Voltage

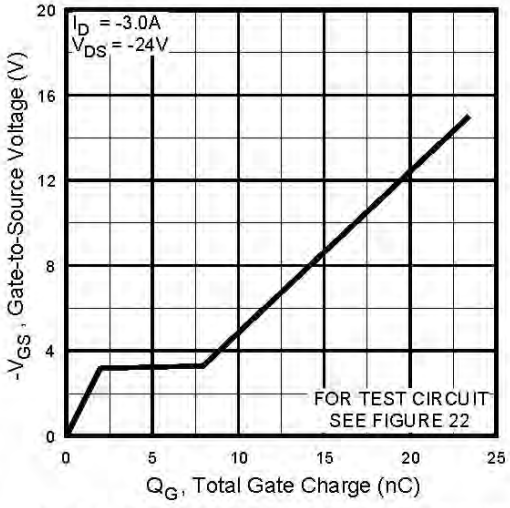



**Fig 17.** Typical Gate Charge Vs. Gate-to-Source Voltage

**P-Channel**

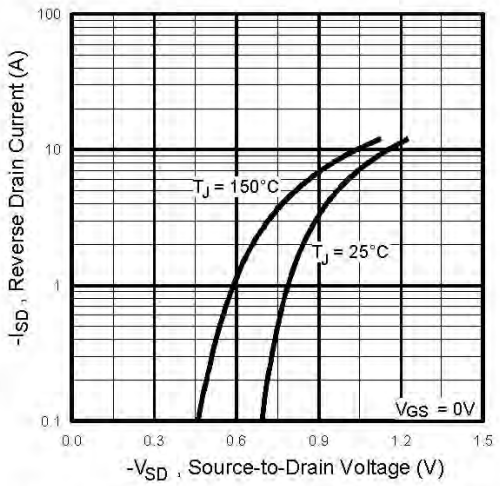



**Fig 18.** Typical Source-Drain Diode Forward Voltage

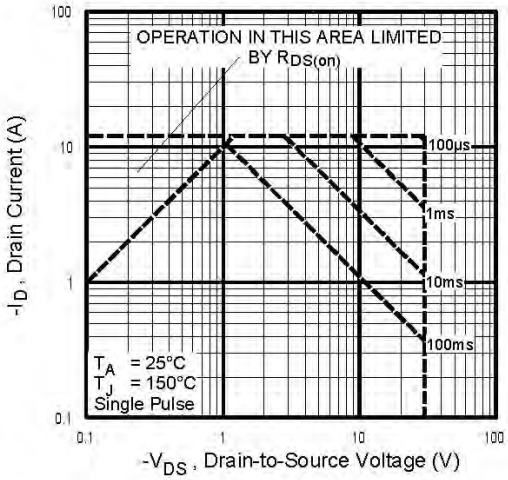



**Fig 19.** Maximum Safe Operating Area

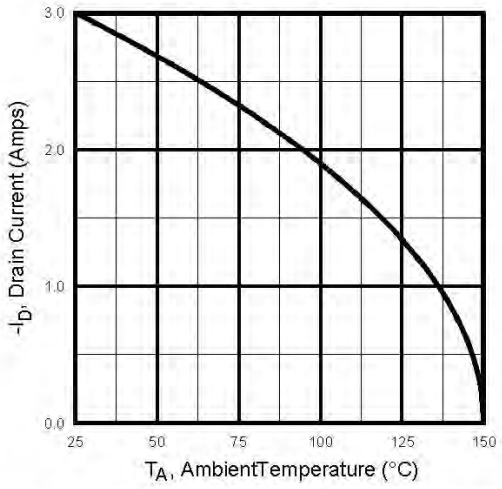



**Fig 20.** Max.Drain Current Vs. Ambient Temp.

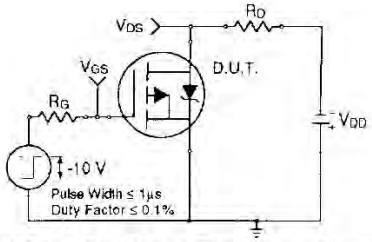



**Fig 21a.** Switching Time Test Circuit

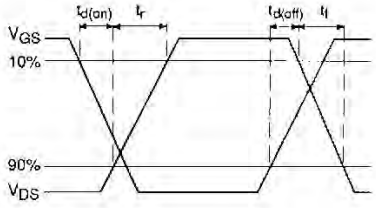



**Fig 21b.** Switching Time Waveforms

## P-Channel

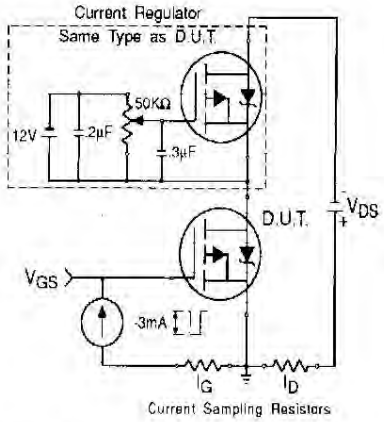



**Fig 22b.** Gate Charge Test Circuit

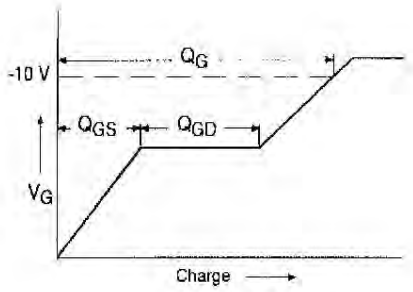



**Fig 22b.** Basic Gate Charge Waveform

## N- and P-Channel

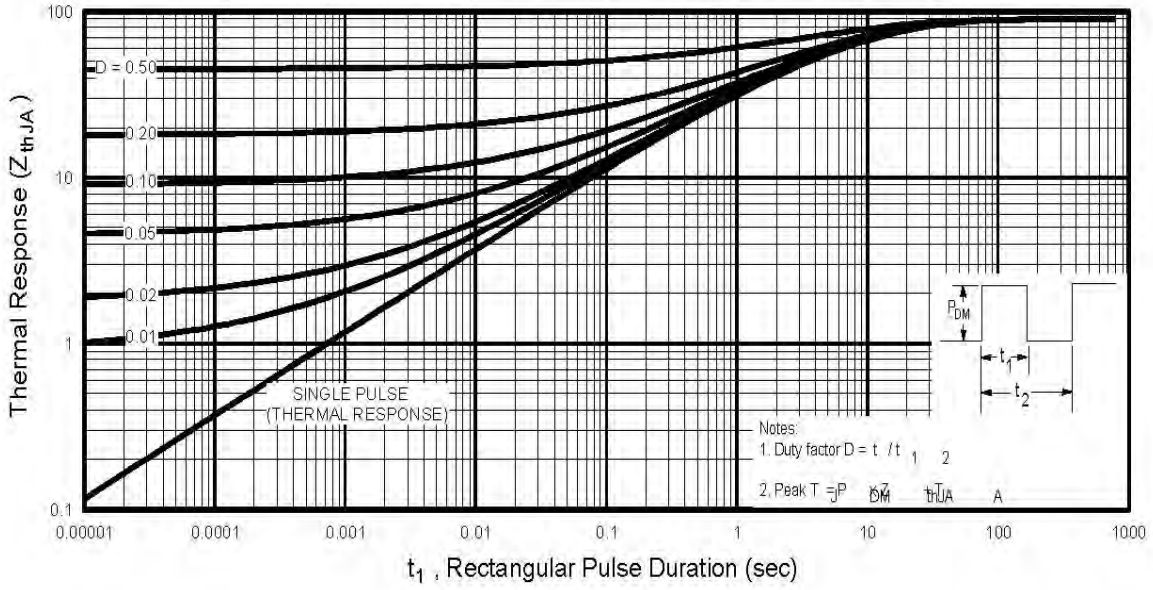
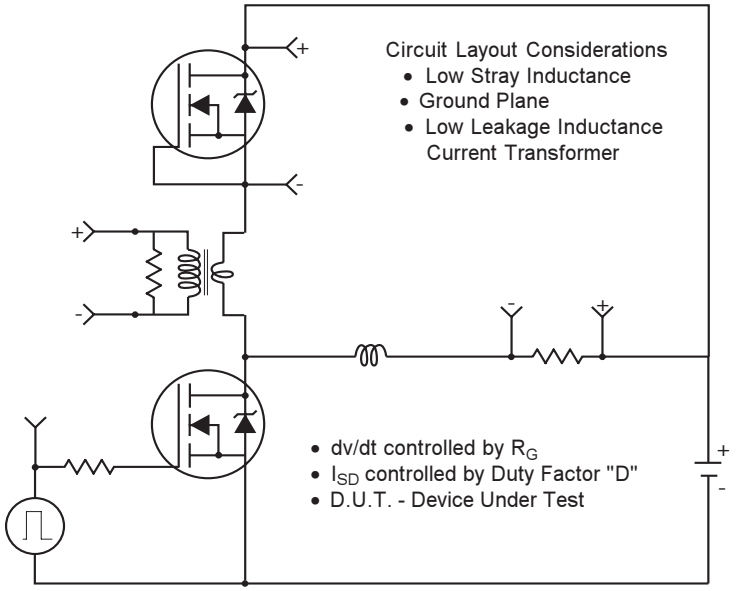
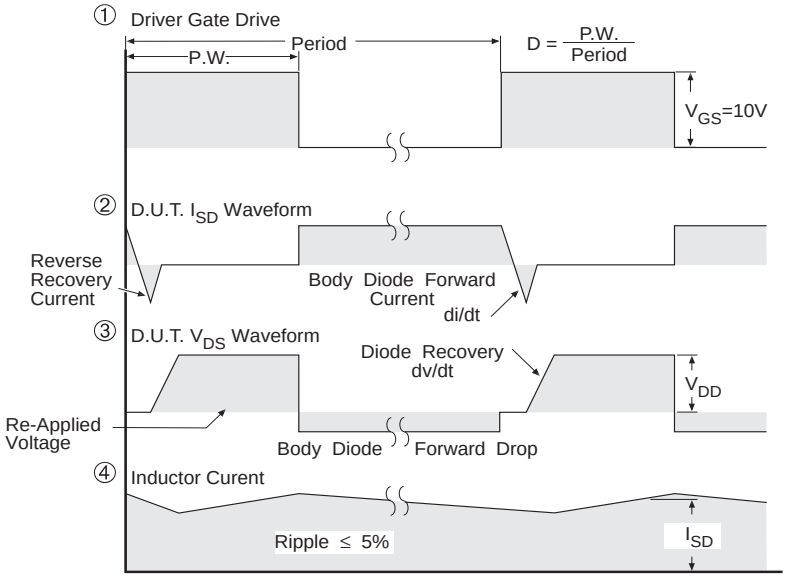



**Fig 23.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

## Peak Diode Recovery dv/dt Test Circuit




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

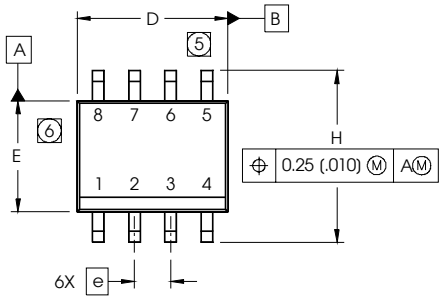



*** $V_{GS}$ = 5.0V for Logic Level and 3V Drive Devices

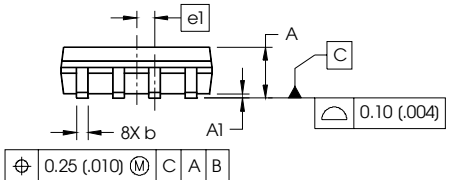
**Fig 24.** For N and P Channel HEXFETS

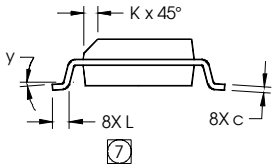
## SO-8 Package Outline

Dimensions are shown in millimeters (inches)



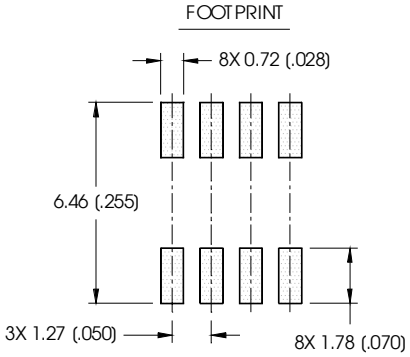

| DIM | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | .0532 | .0688 | 1.35 | 1.75 |
| A1 | .0040 | .0098 | 0.10 | 0.25 |
| b | .013 | .020 | 0.33 | 0.51 |
| c | .0075 | .0098 | 0.19 | 0.25 |
| D | .189 | .1968 | 4.80 | 5.00 |
| E | .1497 | .1574 | 3.80 | 4.00 |
| 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° |



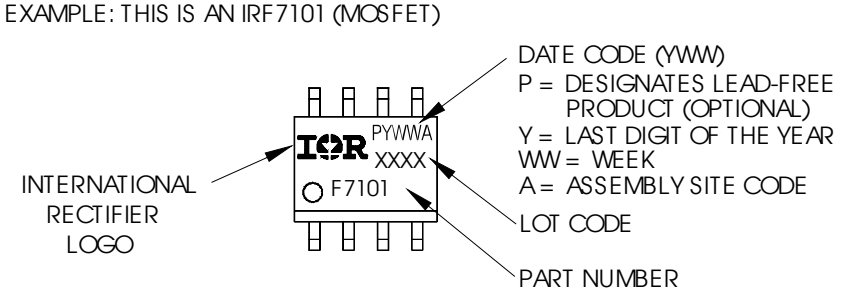




NOTES:

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



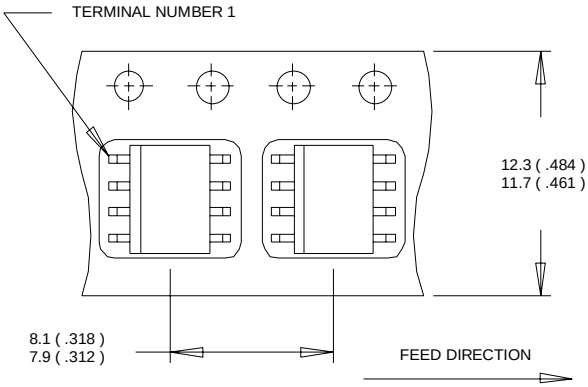

**Notes:**

**1. For an Automotive Qualified version of this part please see http://www.irf.com/product-info/auto/**

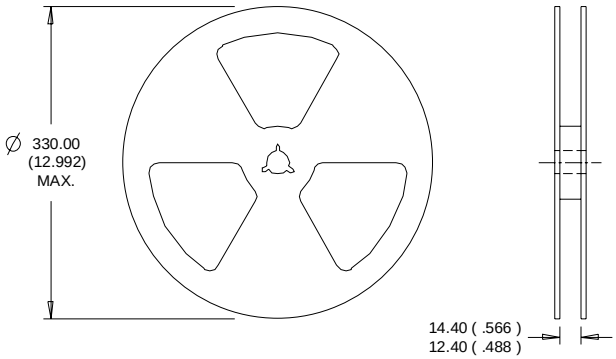
**2. For the most current drawing please refer to IR website at http://www.irf.com/package/**

## 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.

Data and specifications subject to change without notice.
This product has been designed and qualified for the Industrial market.
Qualification Standards can be found on IR's Web site.

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