

International IR Rectifier

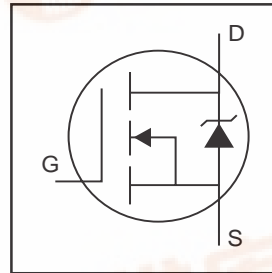
PD-93853C

IRF1404S

IRF1404L

HEXFET® Power MOSFET

- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated



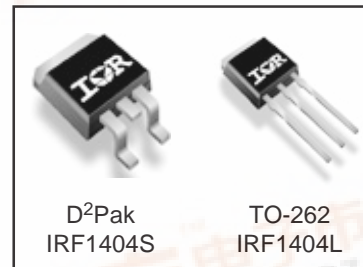
$V_{DSS} = 40V$
 $R_{DS(on)} = 0.004\Omega$
 $I_D = 162A\text{⑥}$

Description

Seventh Generation HEXFET® Power MOSFETs from International Rectifier utilize advanced processing techniques to achieve extremely 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 a wide variety of applications.

The D²Pak is a surface mount power package capable of accommodating die sizes up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface mount package. The D²Pak is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0W in a typical surface mount application.

The through-hole version (IRF1404L) is available for low-profile applications.



D²Pak
IRF1404S

TO-262
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Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---------------------------|--|------------------------|-------|
| $I_D @ T_C = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V\text{⑦}$ | 162⑥ | A |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V\text{⑦}$ | 115⑥ | |
| I_{DM} | Pulsed Drain Current ①⑦ | 650 | |
| $P_D @ T_A = 25^\circ C$ | Power Dissipation | 3.8 | W |
| $P_D @ T_C = 25^\circ C$ | Power Dissipation | 200 | W |
| | Linear Derating Factor | 1.3 | W/°C |
| V_{GS} | Gate-to-Source Voltage | ± 20 | V |
| E_{AS} | Single Pulse Avalanche Energy② | 519 | mJ |
| I_{AR} | Avalanche Current① | 95 | A |
| E_{AR} | Repetitive Avalanche Energy① | 20 | mJ |
| dv/dt | Peak Diode Recovery dv/dt ③⑦ | 5.0 | V/ns |
| T_J | Operating Junction and | -55 to +175 | °C |
| T_{STG} | Storage Temperature Range | -55 to +175 | |
| | Soldering Temperature, for 10 seconds | 300 (1.6mm from case) | |

Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|-----------------|--|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case | — | 0.75 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB mounted, steady-state)* | — | 40 | |



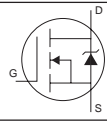
IRF1404S/L

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---------------------------------|--------------------------------------|------|--------|-------|---------------------|--|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 40 | — | — | V | $V_{GS} = 0V, I_D = 250\mu A$ |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.036 | — | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}, I_D = 1mA$ |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | 0.0035 | 0.004 | Ω | $V_{GS} = 10V, I_D = 95A$ ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | — | 4.0 | V | $V_{DS} = 10V, I_D = 250\mu A$ |
| g_{fs} | Forward Transconductance | 106 | — | — | S | $V_{DS} = 25V, I_D = 60A$ ⑦ |
| I_{DSS} | Drain-to-Source Leakage Current | — | — | 20 | μA | $V_{DS} = 40V, V_{GS} = 0V$ |
| | | — | — | 250 | | $V_{DS} = 32V, V_{GS} = 0V, T_J = 150^\circ\text{C}$ |
| I_{GSS} | Gate-to-Source Forward Leakage | — | — | 200 | nA | $V_{GS} = 20V$ |
| | Gate-to-Source Reverse Leakage | — | — | -200 | | $V_{GS} = -20V$ |
| Q_g | Total Gate Charge | — | 160 | 200 | nC | $I_D = 95A$ |
| Q_{gs} | Gate-to-Source Charge | — | 35 | — | | $V_{DS} = 32V$ |
| Q_{gd} | Gate-to-Drain ("Miller") Charge | — | 42 | 60 | | $V_{GS} = 10V$ ④ ⑦ |
| $t_{d(on)}$ | Turn-On Delay Time | — | 17 | — | ns | $V_{DD} = 20V$ |
| t_r | Rise Time | — | 140 | — | | $I_D = 95A$ |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 72 | — | | $R_G = 2.5\Omega$ |
| t_f | Fall Time | — | 26 | — | | $R_D = 0.21\Omega$ ④ ⑦ |
| L_S | Internal Source Inductance | — | 7.5 | — | nH | Between lead, and center of die contact |
| C_{iss} | Input Capacitance | — | 7360 | — | pF | $V_{GS} = 0V$ |
| C_{oss} | Output Capacitance | — | 1680 | — | | $V_{DS} = 25V$ |
| C_{riss} | Reverse Transfer Capacitance | — | 240 | — | | $f = 1.0MHz$, See Fig. 5 ⑦ |
| C_{oss} | Output Capacitance | — | 6630 | — | | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$ |
| C_{oss} | Output Capacitance | — | 1490 | — | | $V_{GS} = 0V, V_{DS} = 32V, f = 1.0MHz$ |
| $C_{oss\ eff.}$ | Effective Output Capacitance ⑤ ⑦ | — | 1540 | — | | $V_{GS} = 0V, V_{DS} = 0V$ to $32V$ |

Source-Drain Ratings and Characteristics

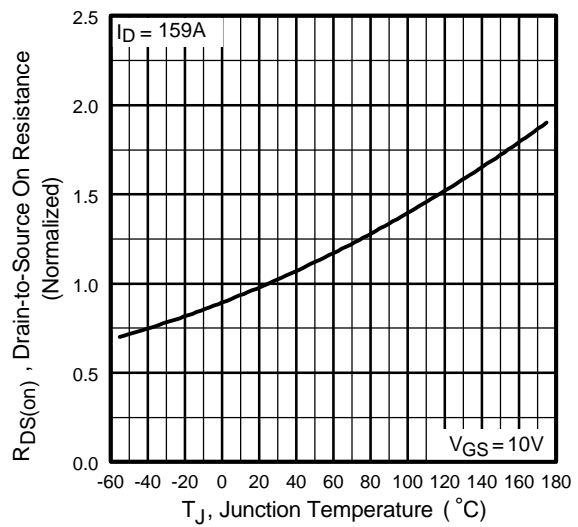
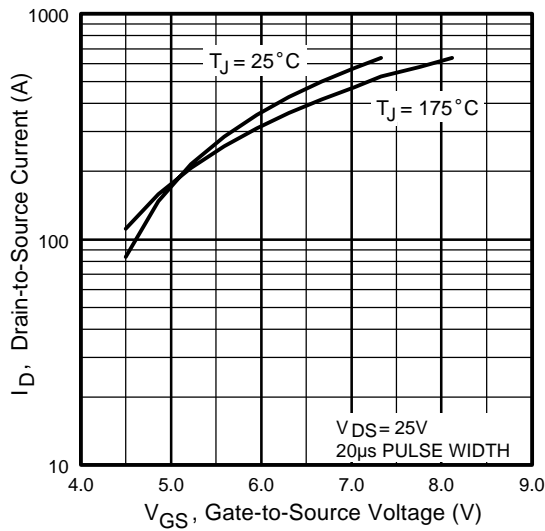
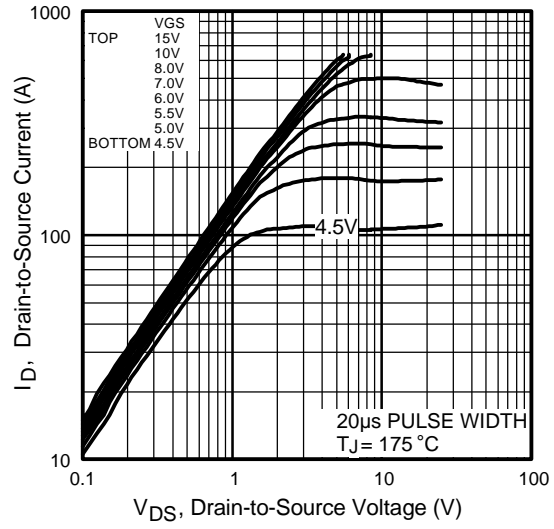
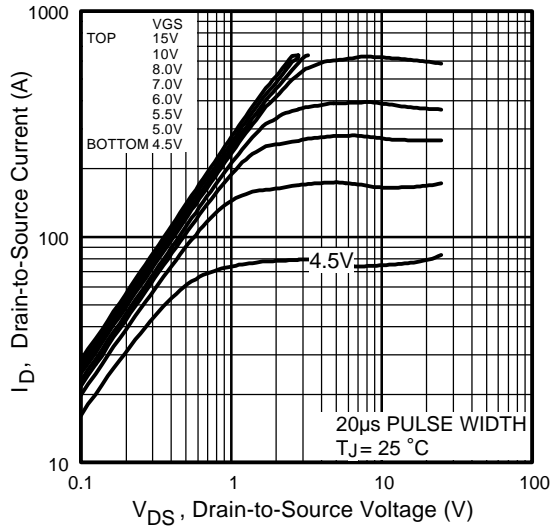
| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|----------|--|---|------|------|-------|--|
| I_S | Continuous Source Current (Body Diode) | — | — | 162 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I_{SM} | Pulsed Source Current (Body Diode) ① | — | — | 650 | | |
| V_{SD} | Diode Forward Voltage | — | — | 1.3 | V | $T_J = 25^\circ\text{C}, I_S = 95A, V_{GS} = 0V$ ④ |
| t_{rr} | Reverse Recovery Time | — | 71 | 110 | ns | $T_J = 25^\circ\text{C}, I_F = 95A$ |
| Q_{rr} | Reverse Recovery Charge | — | 180 | 270 | nC | $di/dt = 100A/\mu s$ ④ ⑦ |
| 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 Starting $T_J = 25^\circ\text{C}$, $L = 0.12mH$, $R_G = 25\Omega$, $I_{AS} = 95A$. (See Figure 12)
- ③ $I_{SD} \leq 95A$, $di/dt \leq 150A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175^\circ\text{C}$
- ④ Pulse width $\leq 300\mu s$; duty cycle $\leq 2\%$.
- ⑤ $C_{oss\ eff.}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}
- ⑥ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 75A
- ⑦ Use IRF1404 data and test conditions.

* When mounted on 1" square PCB (FR-4 or G-10 Material).

For recommended footprint and soldering techniques refer to application note #AN-994.



IRF1404S/L

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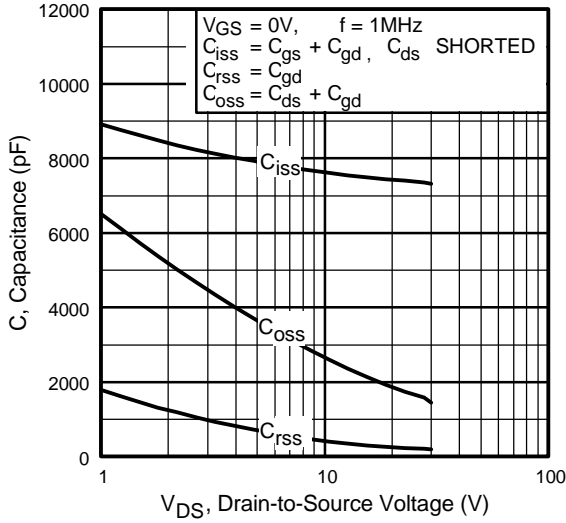


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

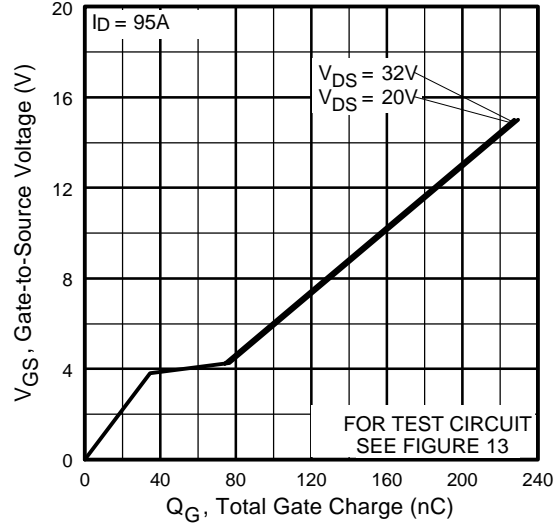


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

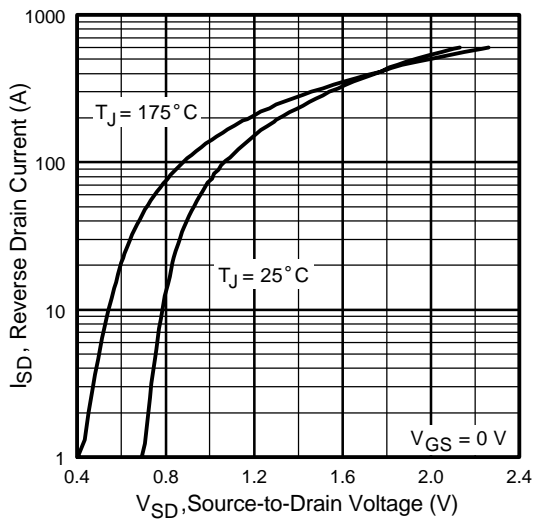


Fig 7. Typical Source-Drain Diode Forward Voltage

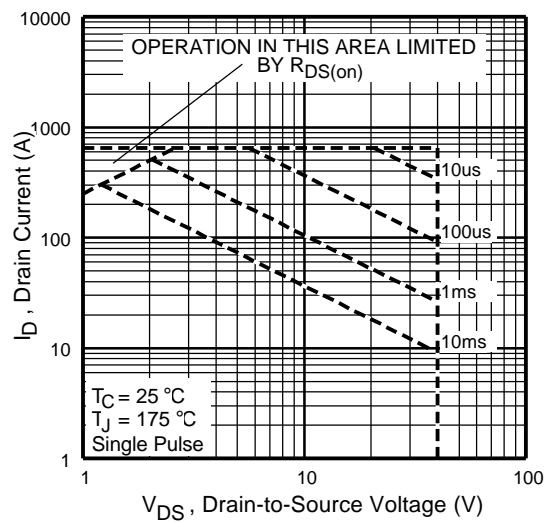


Fig 8. Maximum Safe Operating Area

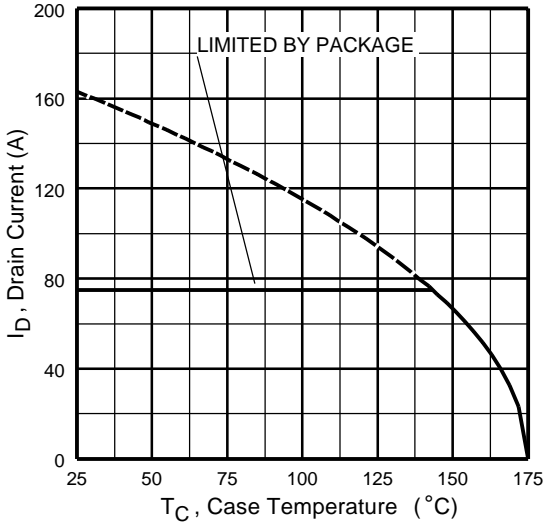


Fig 9. Maximum Drain Current Vs. Case Temperature

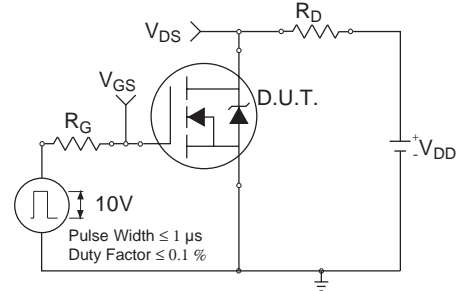


Fig 10a. Switching Time Test Circuit

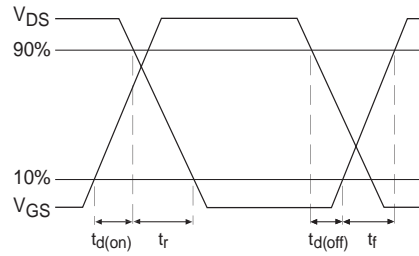


Fig 10b. Switching Time Waveforms

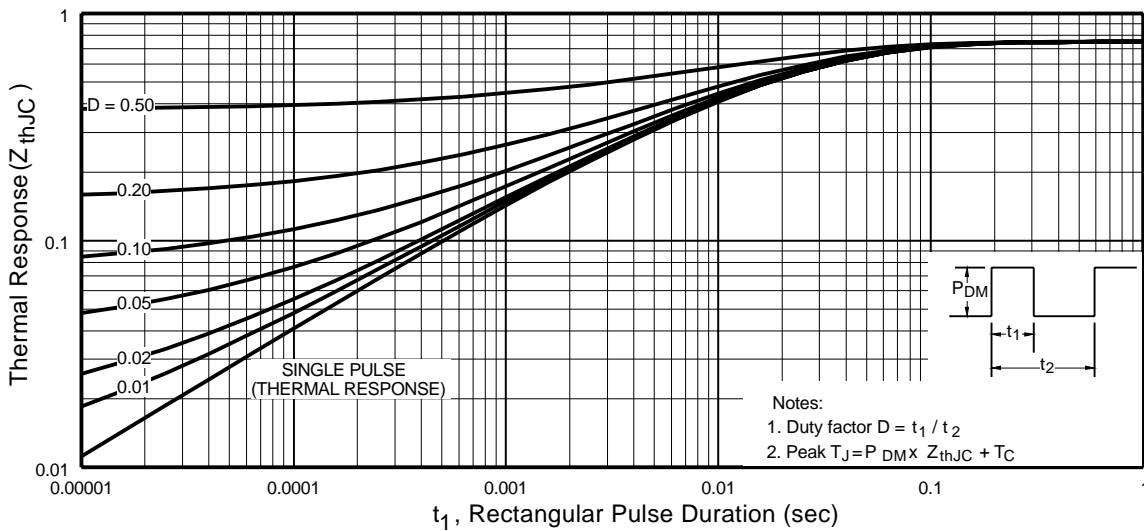


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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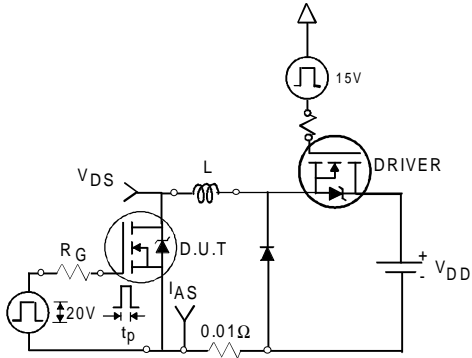


Fig 12a. Unclamped Inductive Test Circuit

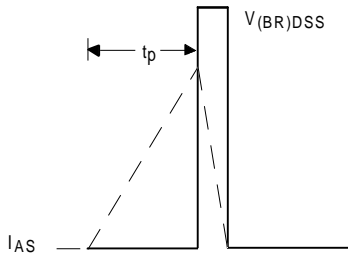


Fig 12b. Unclamped Inductive Waveforms

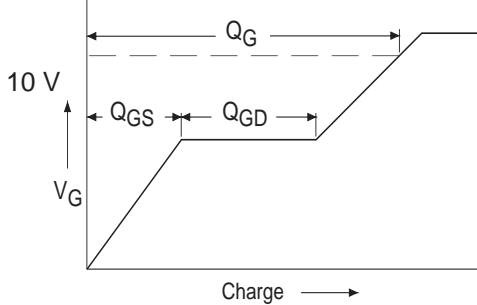


Fig 13a. Basic Gate Charge Waveform

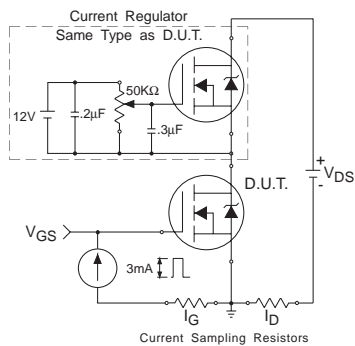


Fig 13b. Gate Charge Test Circuit

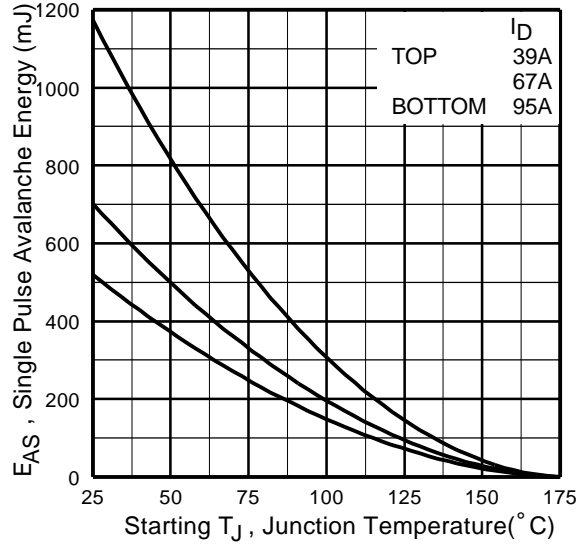


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

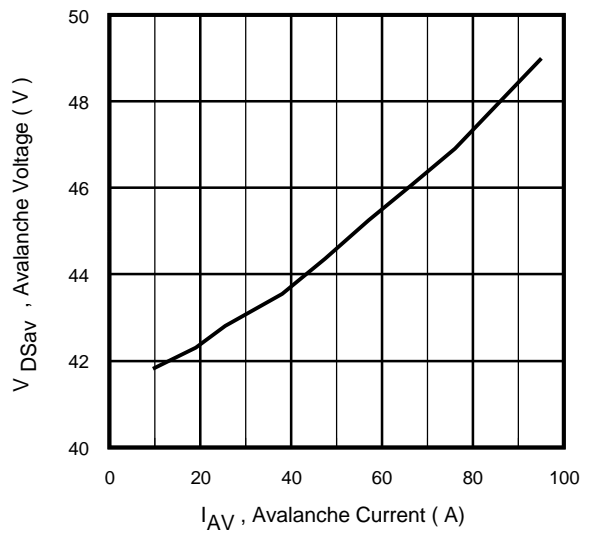
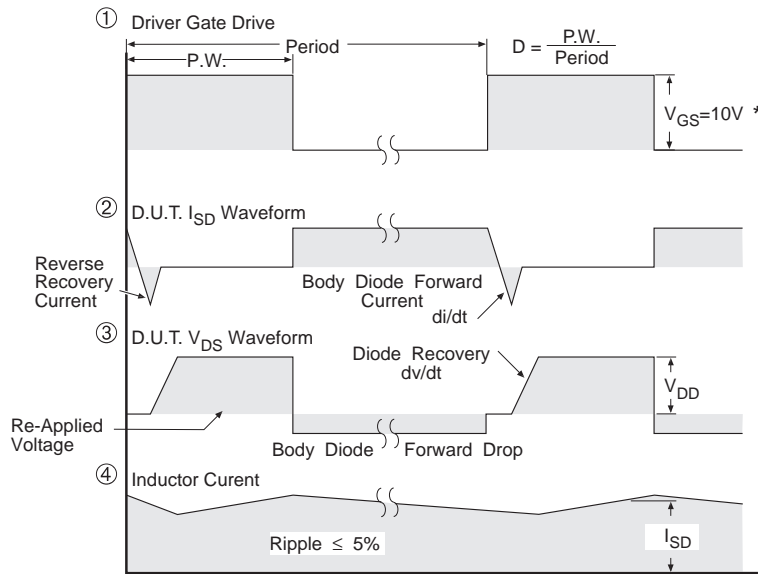
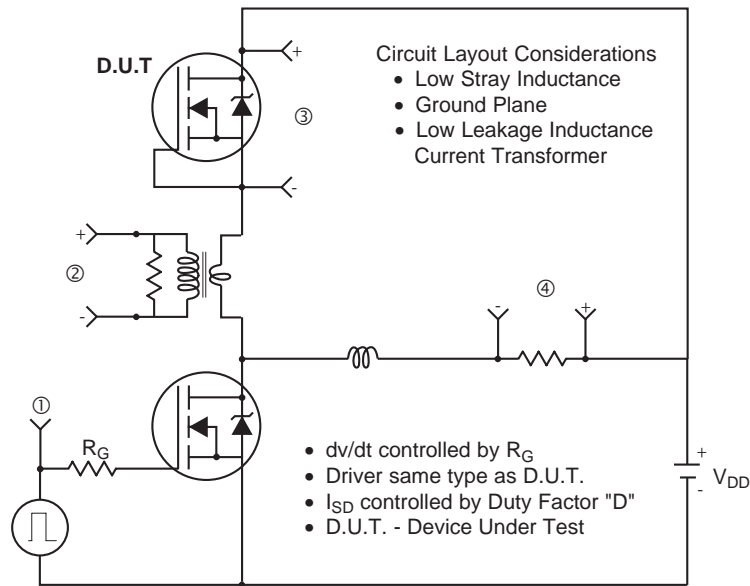


Fig 12d. Typical Drain-to-Source Voltage Vs. Avalanche Current

Peak Diode Recovery dv/dt Test Circuit



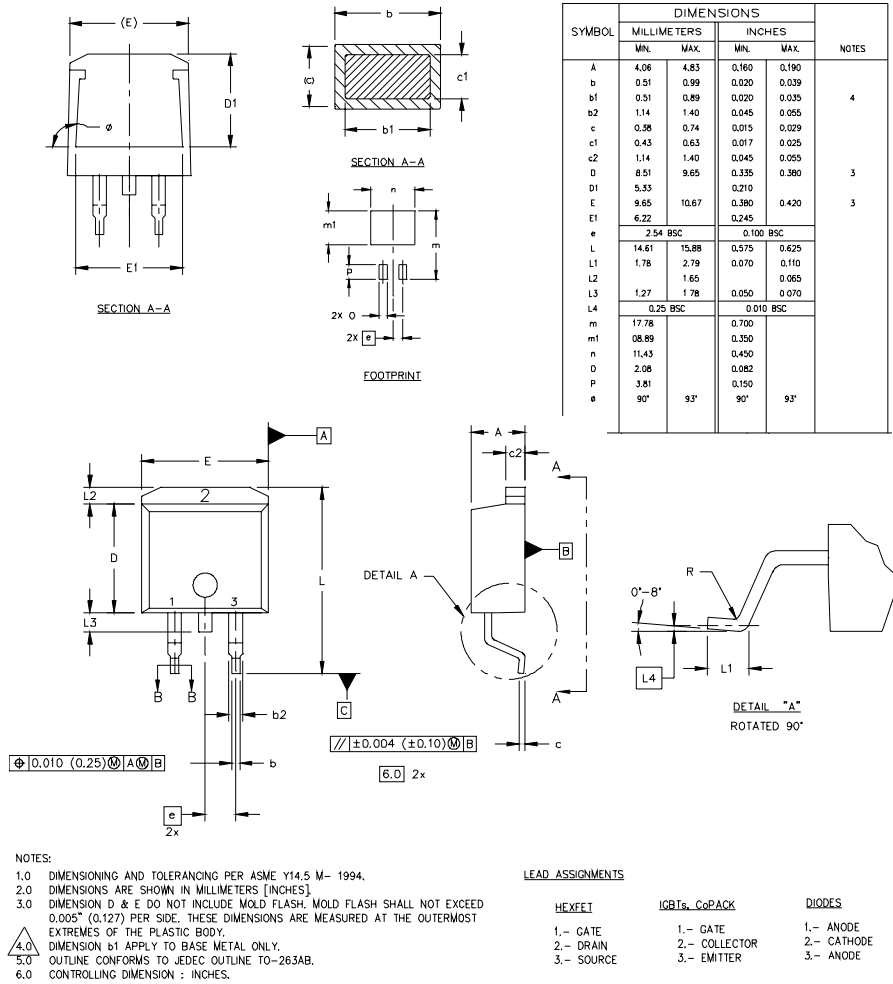
* $V_{GS} = 5V$ for Logic Level Devices

Fig 14. For N-channel HEXFET® Power MOSFETs

IRF1404S/L

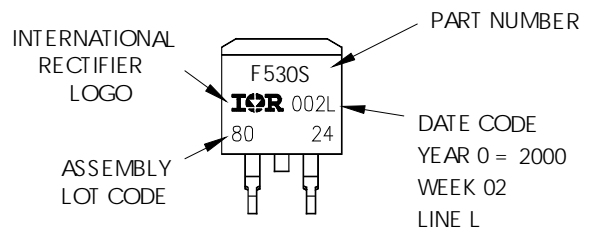


D²Pak Package Outline

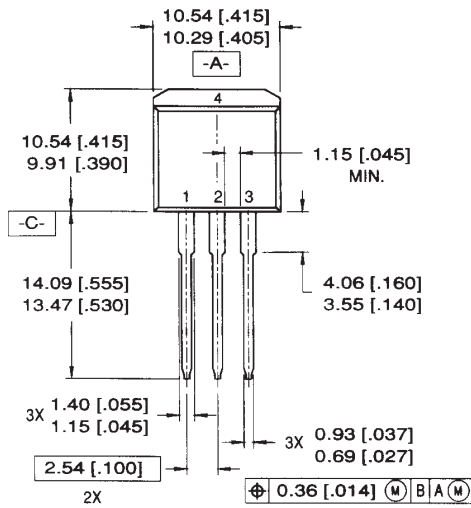


D²Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH
 LOT CODE 8024
 ASSEMBLED ON WW02, 2000
 IN THE ASSEMBLY LINE "L"

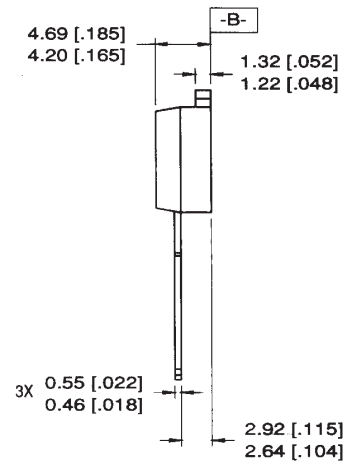


TO-262 Package Outline



LEAD ASSIGNMENTS

| | |
|-----------|------------|
| 1 = GATE | 3 = SOURCE |
| 2 = DRAIN | 4 = DRAIN |

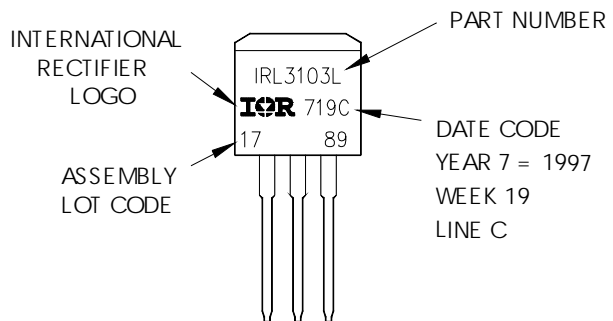


NOTES:

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
4. HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

TO-262 Part Marking Information

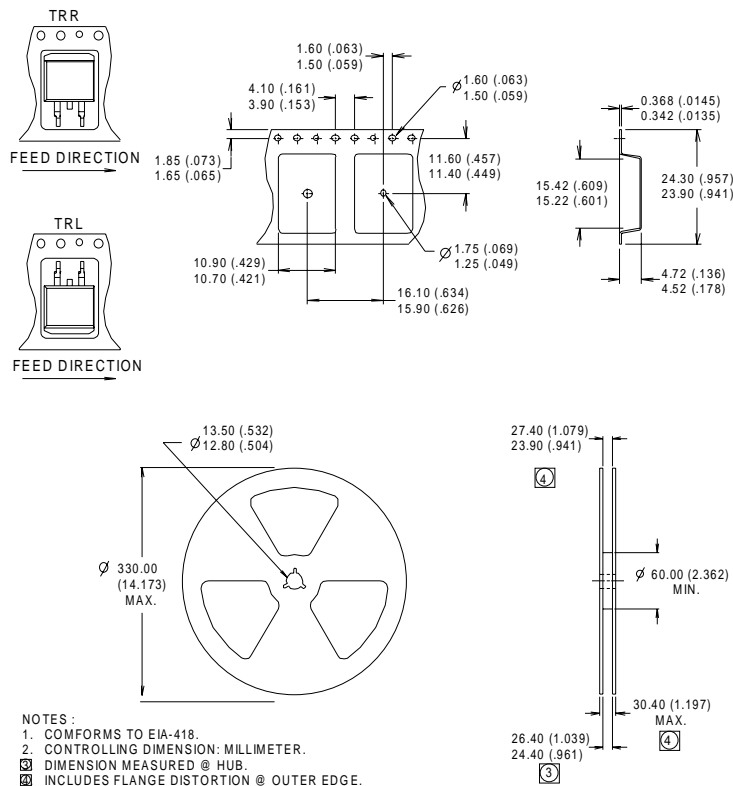
EXAMPLE: THIS IS AN IRL3103L
 LOT CODE 1789
 ASSEMBLED ON WW 19, 1997
 IN THE ASSEMBLY LINE "C"



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D²Pak Tape & Reel Information



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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IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903

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