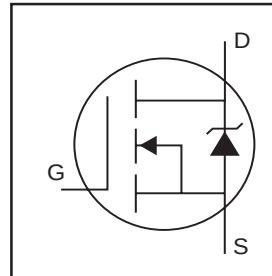


# IRF640S/L

HEXFET® Power MOSFET

- Surface Mount (IRF640S)
- Low-profile through-hole (IRF640L)
- Available in Tape & Reel (IRF640S)
- Dynamic dv/dt Rating
- 150°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated

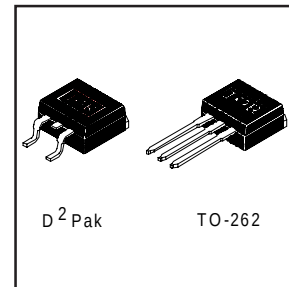


|                           |
|---------------------------|
| $V_{DS} = 200V$           |
| $R_{DS(on)} = 0.18\Omega$ |
| $I_D = 18A$               |

## Description

Third Generation HEXFETs from International Rectifier provide the designer with the best combinations of fast switching , ruggedized device design, low on-resistance and cost-effectiveness.

The D<sup>2</sup>Pak 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 D<sup>2</sup>Pak 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 (IRF640L) is available for low-profile applications.



## Absolute Maximum Ratings

|                           | Parameter                                  | Max.                   | Units |
|---------------------------|--------------------------------------------|------------------------|-------|
| $I_D @ T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS} @ 10V$ ⑤ | 18                     | A     |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ ⑤ | 11                     |       |
| $I_{DM}$                  | Pulsed Drain Current ①⑤                    | 72                     |       |
| $P_D @ T_A = 25^\circ C$  | Power Dissipation                          | 3.1                    | W     |
| $P_D @ T_C = 25^\circ C$  | Power Dissipation                          | 130                    | W     |
|                           | Linear Derating Factor                     | 1.0                    | W/°C  |
| $V_{GS}$                  | Gate-to-Source Voltage                     | $\pm 20$               | V     |
| $E_{AS}$                  | Single Pulse Avalanche Energy②⑤            | 580                    | mJ    |
| $I_{AR}$                  | Avalanche Current①                         | 18                     | A     |
| $E_{AR}$                  | Repetitive Avalanche Energy①               | 13                     | mJ    |
| dv/dt                     | Peak Diode Recovery dv/dt ③⑤               | 5.0                    | V/ns  |
| $T_J$                     | Operating Junction and                     | -55 to + 175           | °C    |
| $T_{STG}$                 | Storage Temperature Range                  |                        |       |
|                           | Soldering Temperature, for 10 seconds      | 300 (1.6mm from case ) |       |

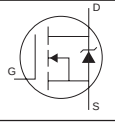
## Thermal Resistance

|                 | Parameter                                          | Typ. | Max. | Units |
|-----------------|----------------------------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case                                   | —    | 1.0  | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient ( PCB Mounted, steady-state)** | —    | 40   |       |

## 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    | 200  | —    | —    | V                   | $V_{GS} = 0V, I_D = 250\mu A$                         |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.29 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 1mA$ ⑤       |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | —    | 0.18 | $\Omega$            | $V_{GS} = 10V, I_D = 11A$ 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             | 6.7  | —    | —    | S                   | $V_{DS} = 50V, I_D = 11A$ ⑤                           |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —    | 25   | $\mu A$             | $V_{DS} = 200V, V_{GS} = 0V$                          |
|                                 |                                      | —    | —    | 250  |                     | $V_{DS} = 160V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA                  | $V_{GS} = 20V$                                        |
|                                 | Gate-to-Source Reverse Leakage       | —    | —    | -100 |                     | $V_{GS} = -20V$                                       |
| $Q_g$                           | Total Gate Charge                    | —    | —    | 70   | nC                  | $I_D = 18A$                                           |
| $Q_{gs}$                        | Gate-to-Source Charge                | —    | —    | 13   |                     | $V_{DS} = 160V$                                       |
| $Q_{gd}$                        | Gate-to-Drain ("Miller") Charge      | —    | —    | 39   |                     | $V_{GS} = 10V$ , See Fig. 6 and 13 ④⑤                 |
| $t_{d(on)}$                     | Turn-On Delay Time                   | —    | 14   | —    | ns                  | $V_{DD} = 100V$                                       |
| $t_r$                           | Rise Time                            | —    | 51   | —    |                     | $I_D = 18A$                                           |
| $t_{d(off)}$                    | Turn-Off Delay Time                  | —    | 45   | —    |                     | $R_G = 9.1\Omega$                                     |
| $t_f$                           | Fall Time                            | —    | 36   | —    |                     | $R_D = 5.4\Omega$ , See Fig. 10 ④⑤                    |
| $L_S$                           | Internal Source Inductance           | —    | 7.5  | —    | nH                  | Between lead, and center of die contact               |
| $C_{iss}$                       | Input Capacitance                    | —    | 1300 | —    | pF                  | $V_{GS} = 0V$                                         |
| $C_{oss}$                       | Output Capacitance                   | —    | 430  | —    |                     | $V_{DS} = 25V$                                        |
| $C_{rss}$                       | Reverse Transfer Capacitance         | —    | 130  | —    |                     | $f = 1.0MHz$ , See Fig. 5⑤                            |

## Source-Drain Ratings and Characteristics

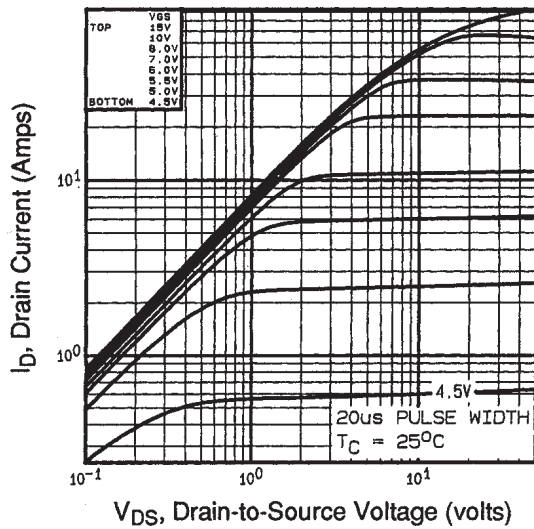
|          | Parameter                              | Min.                                                                        | Typ. | Max. | Units   | Conditions                                                                                                                                           |
|----------|----------------------------------------|-----------------------------------------------------------------------------|------|------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —                                                                           | —    | 18   | A       | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①⑤  | —                                                                           | —    | 72   |         |                                                                                                                                                      |
| $V_{SD}$ | Diode Forward Voltage                  | —                                                                           | —    | 2.0  | V       | $T_J = 25^\circ\text{C}, I_S = 18A, V_{GS} = 0V$ ④                                                                                                   |
| $t_{rr}$ | Reverse Recovery Time                  | —                                                                           | 300  | 610  | ns      | $T_J = 25^\circ\text{C}, I_F = 18A$                                                                                                                  |
| $Q_{rr}$ | Reverse Recovery Charge                | —                                                                           | 3.4  | 7.1  | $\mu C$ | $di/dt = 100A/\mu s$ ④⑤                                                                                                                              |
| $t_{on}$ | Forward Turn-On Time                   | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$ ) |      |      |         |                                                                                                                                                      |

### Notes:

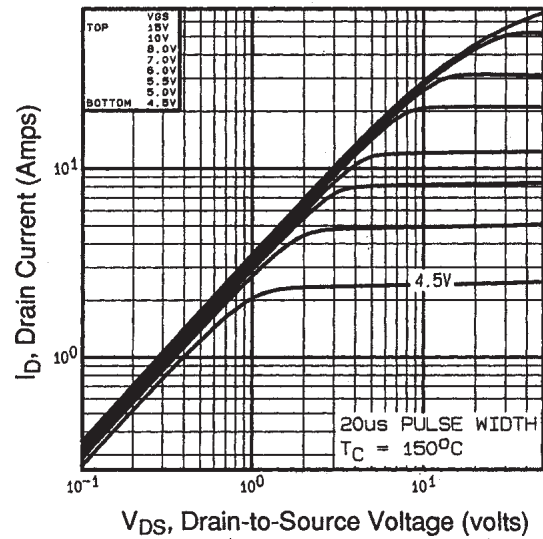
- ① Repetitive rating; pulse width limited by max. junction temperature. ( See fig. 11 )
- ②  $V_{DD} = 50V$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 2.7mH$   
 $R_G = 25\Omega$ ,  $I_{AS} = 18A$ . (See Figure 12)
- ③  $I_{SD} \leq 18A$ ,  $di/dt \leq 150A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  
 $T_J \leq 150^\circ\text{C}$
- ④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .
- ⑤ Uses IRF640 data and test conditions

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

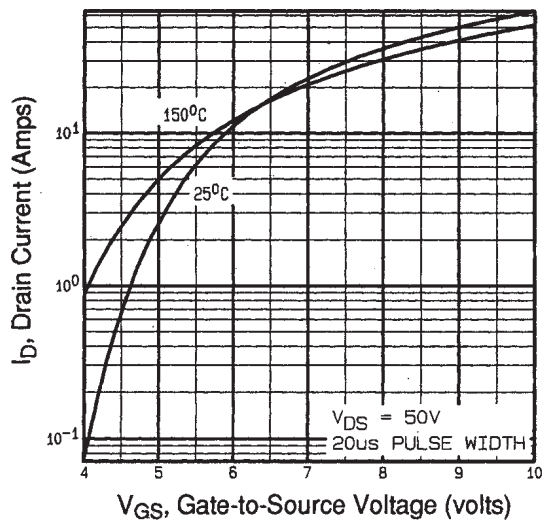
For recommended footprint and soldering techniques refer to application note #AN-994.



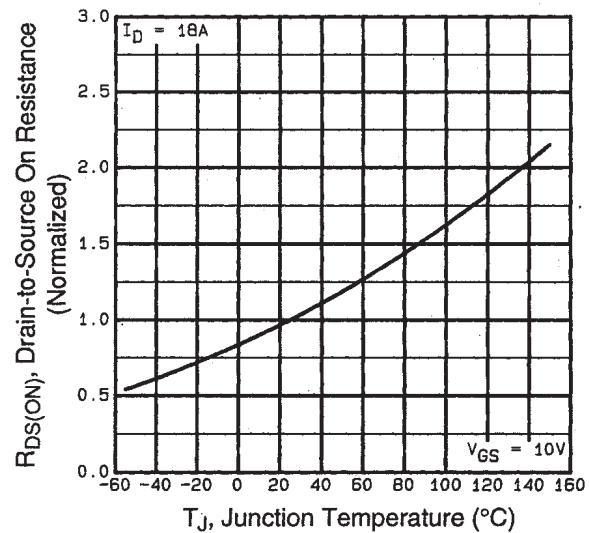
**Fig 1.** Typical Output Characteristics,  
 $T_J = 25^\circ\text{C}$



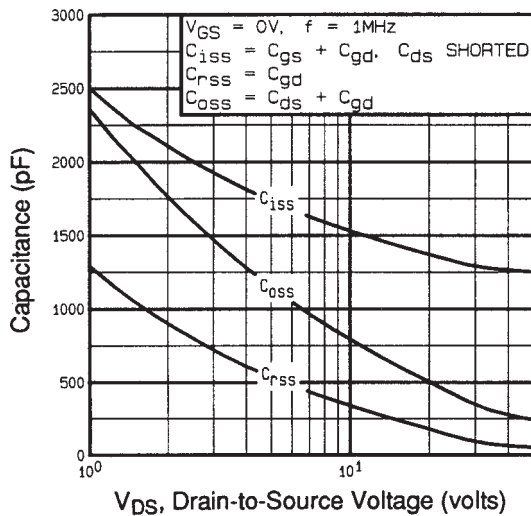
**Fig 2.** Typical Output Characteristics,  
 $T_J = 175^\circ\text{C}$



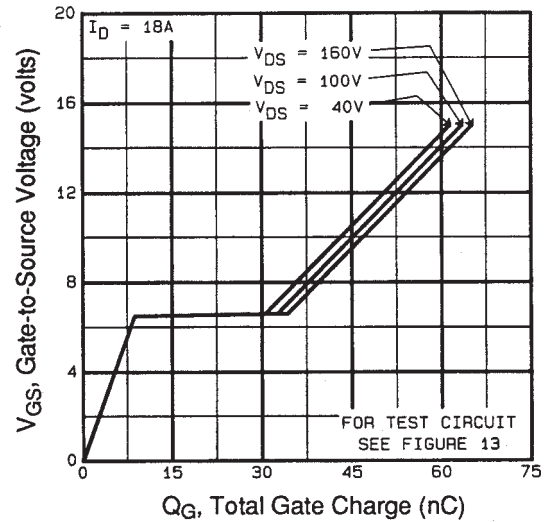
**Fig 3.** Typical Transfer Characteristics



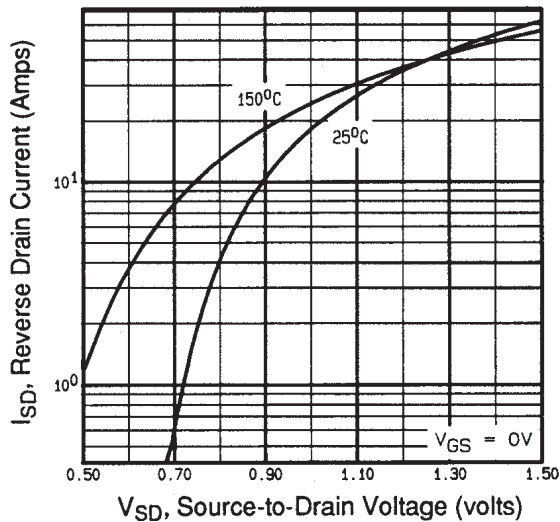
**Fig 4.** Normalized On-Resistance  
Vs. Temperature



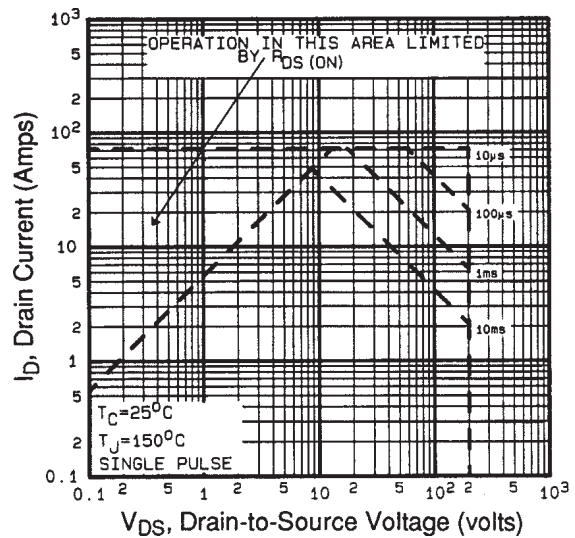
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



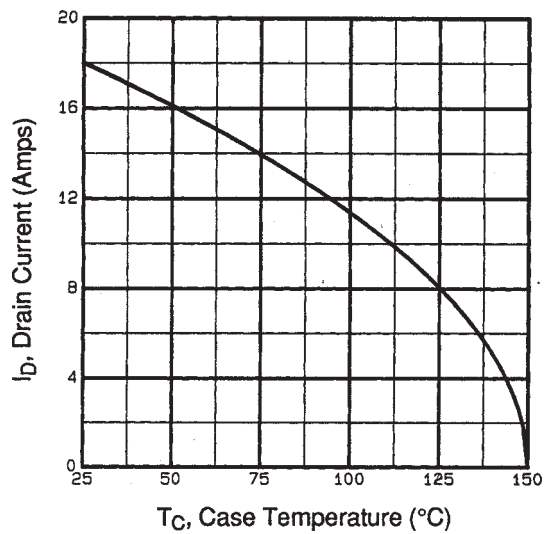
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



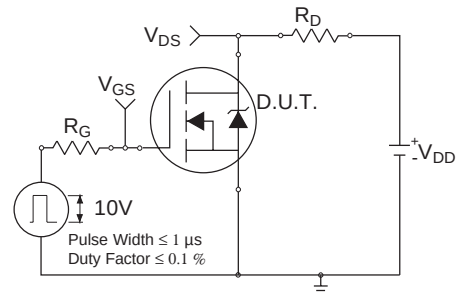
**Fig 7.** Typical Source-Drain Diode Forward Voltage



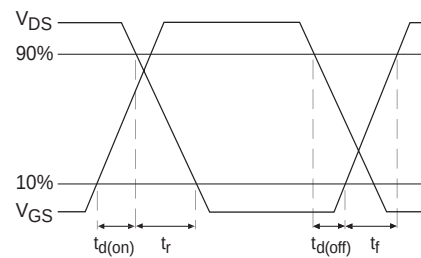
**Fig 8.** Maximum Safe Operating Area



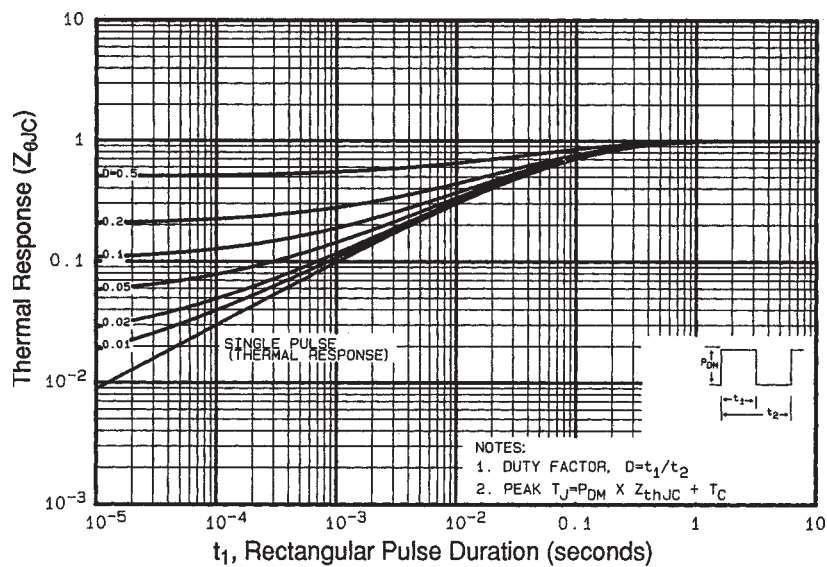
**Fig 9.** Maximum Drain Current Vs. Case Temperature



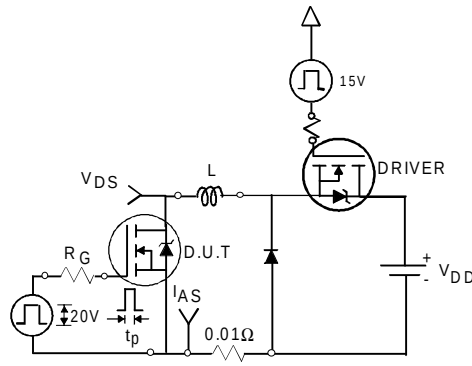
**Fig 10a.** Switching Time Test Circuit



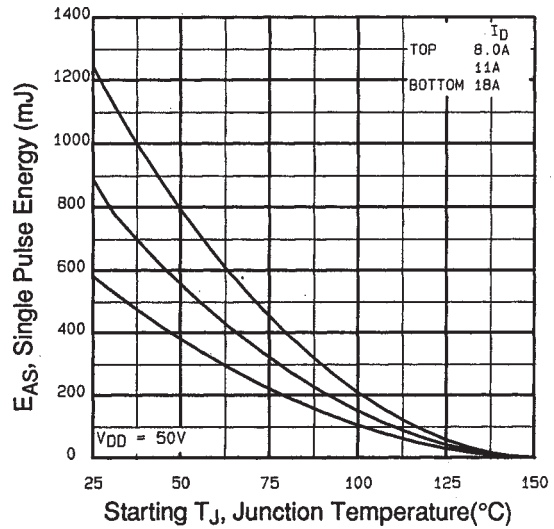
**Fig 10b.** Switching Time Waveforms



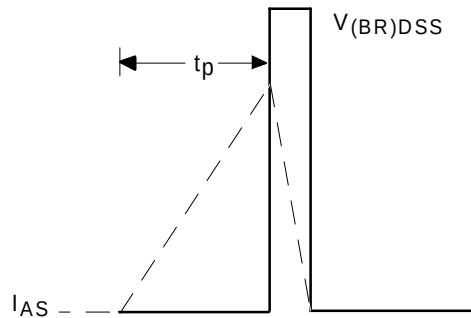
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



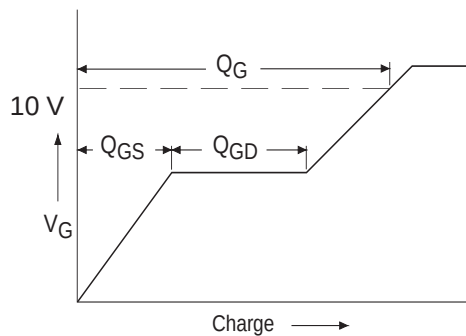
**Fig 12a.** Unclamped Inductive Test Circuit



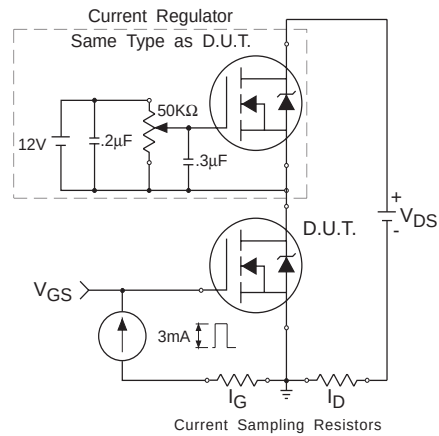
**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



**Fig 12b.** Unclamped Inductive Waveforms

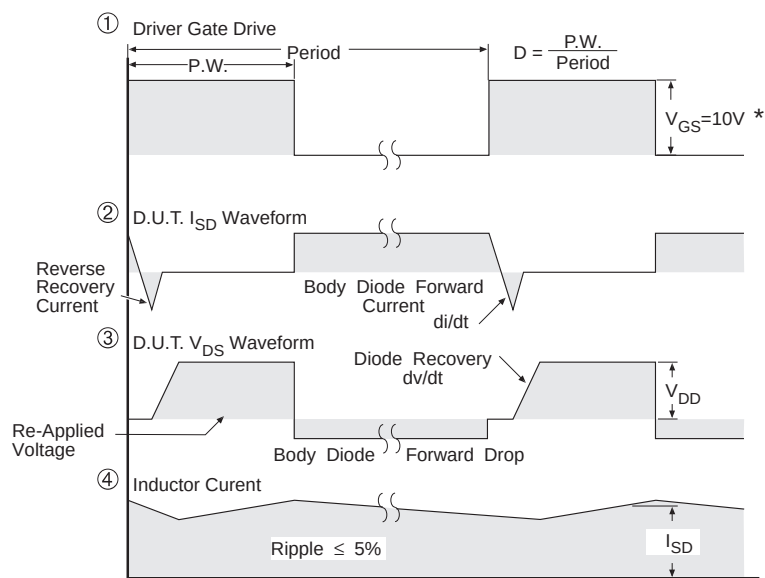
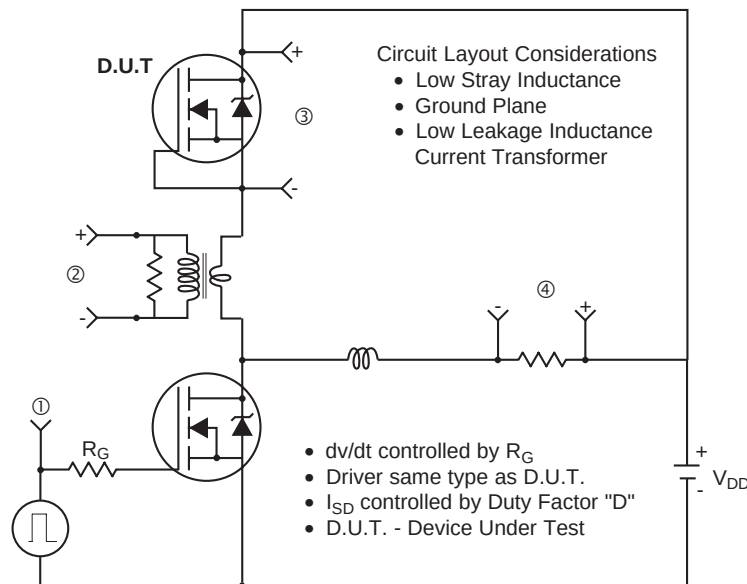


**Fig 13a.** Basic Gate Charge Waveform



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

### Peak Diode Recovery dv/dt Test Circuit



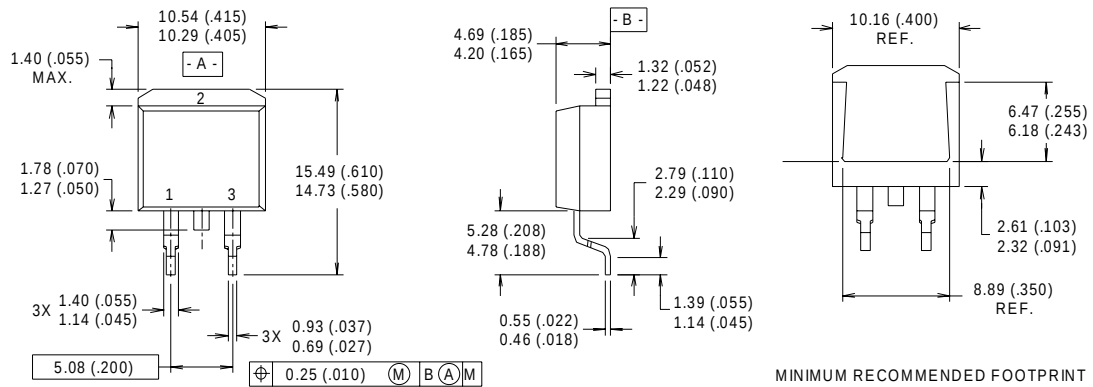
\*  $V_{GS} = 5V$  for Logic Level Devices

**Fig 14. For N-Channel HEXFETS**

# IRF640S/L

International  
**IR** Rectifier

## D<sup>2</sup>Pak Package Outline



### NOTES:

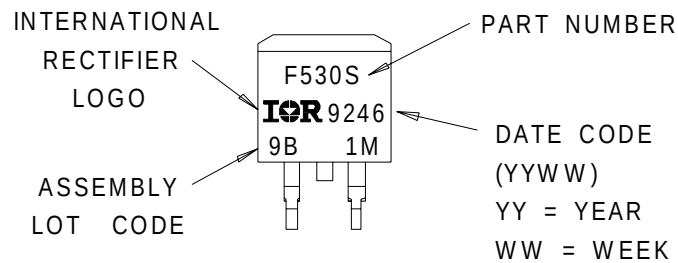
- 1 DIMENSIONS AFTER SOLDER DIP.
- 2 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 3 CONTROLLING DIMENSION : INCH.
- 4 HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

### LEAD ASSIGNMENTS

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

## Part Marking Information

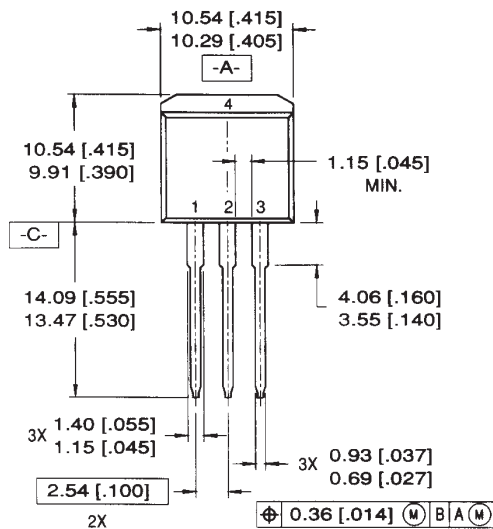
### D<sup>2</sup>Pak





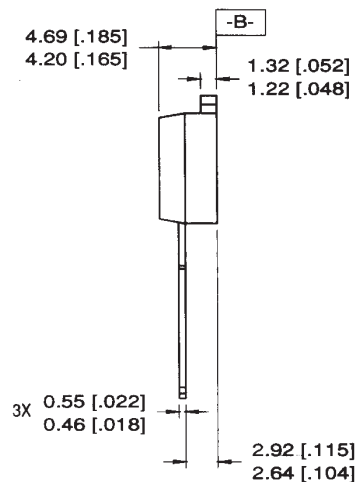
## Package Outline

## TO-262 Outline



## LEAD ASSIGNMENTS

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



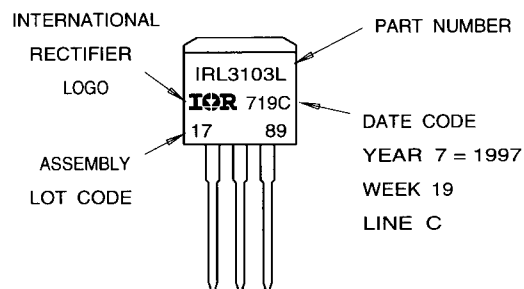
NOTES:

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.

### Part Marking Information

TO-262

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

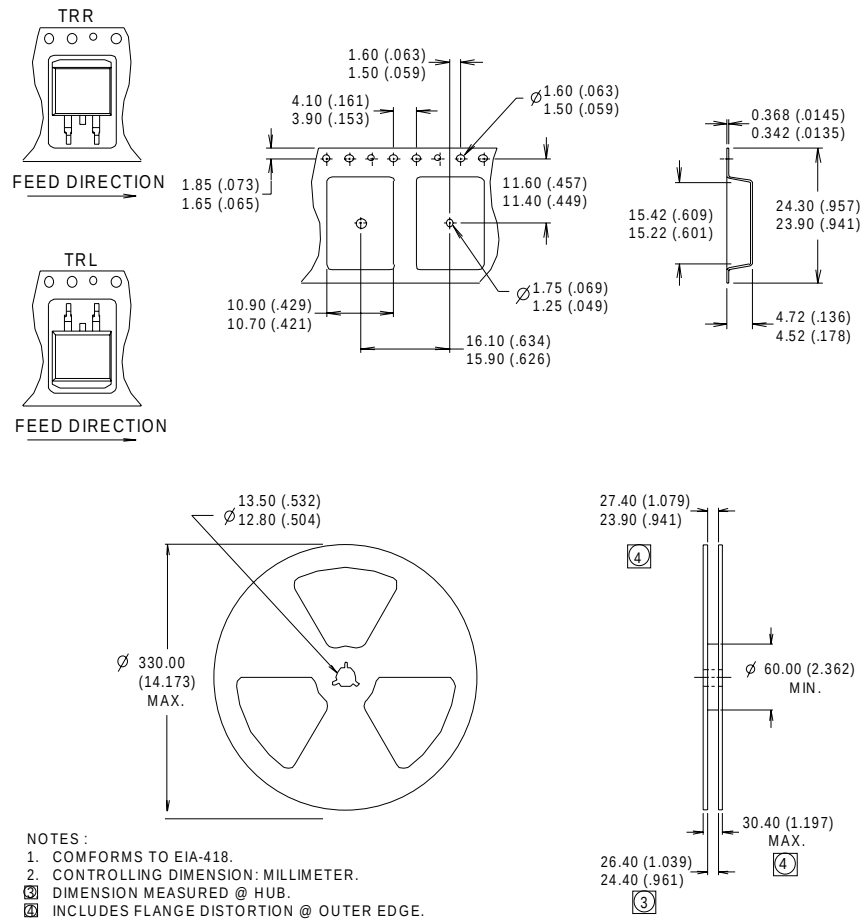


# IRF640S/L

International  
**IR** Rectifier

## Tape & Reel Information

**D<sup>2</sup>Pak**



International  
**IR** Rectifier

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**IR GREAT BRITAIN:** Hurst Green, Oxted, Surrey RH8 9BB, UK Tel: ++ 44 1883 732020

**IR CANADA:** 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200

**IR GERMANY:** Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590

**IR ITALY:** Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111

**IR FAR EAST:** K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo Japan 171 Tel: 81 3 3983 0086

**IR SOUTHEAST ASIA:** 1 Kim Seng Promenade, Great World City West Tower, 13-11, Singapore 237994 Tel: ++ 65 838 4630

**IR TAIWAN:** 16 Fl. Suite D. 207, Sec. 2, Tun Haw South Road, Taipei, 10673, Taiwan Tel: 886-2-2377-9936

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