

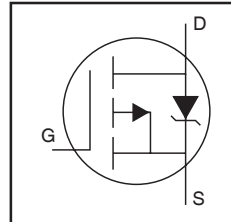


**IRF4905SPbF**  
**IRF4905LPbF**

**Features**

- Advanced Process Technology
- Ultra Low On-Resistance
- 150°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax
- Some Parameters Are Different from IRF4905S
- Lead-Free

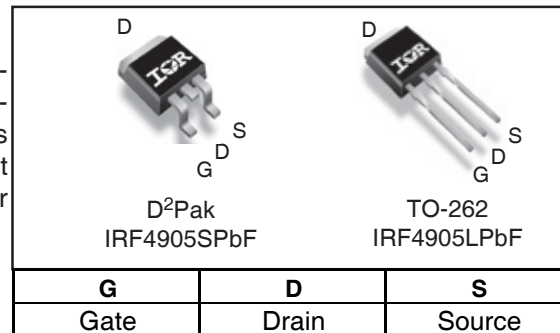
HEXFET® Power MOSFET



|                          |
|--------------------------|
| $V_{DSS} = -55V$         |
| $R_{DS(on)} = 20m\Omega$ |
| $I_D = -42A$             |

**Description**

Features of this design are a 150°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 a wide variety of other applications.



**Absolute Maximum Ratings**

|                              | Parameter  | Max.                     | Units |
|------------------------------|--|--------------------------|-------|
| $I_D @ T_C = 25^\circ C$     | Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited) | -70                      | A     |
| $I_D @ T_C = 100^\circ C$    | Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited) | -44                      |       |
| $I_D @ T_C = 25^\circ C$     | Continuous Drain Current, $V_{GS} @ 10V$ (Package Limited) | -42                      |       |
| $I_{DM}$                     | Pulsed Drain Current ①                                     | -280                     |       |
| $P_D @ T_C = 25^\circ C$     | Power Dissipation  | 170                      | W     |
|                              | Linear Derating Factor                                     | 1.3                      | W/°C  |
| $V_{GS}$                     | Gate-to-Source Voltage                                     | $\pm 20$                 | V     |
| $E_{AS}$ (Thermally limited) | Single Pulse Avalanche Energy ②                            | 140                      | mJ    |
| $E_{AS}$ (Tested )           | Single Pulse Avalanche Energy Tested Value ⑥               | 790                      |       |
| $I_{AR}$                     | Avalanche Current ①  | See Fig.12a, 12b, 15, 16 | A     |
| $E_{AR}$                     | Repetitive Avalanche Energy ⑤                              |                          | mJ    |
| $T_J$                        | Operating Junction and                                     | -55 to + 150             | °C    |
| $T_{STG}$                    | Storage Temperature Range                                  |                          |       |
|                              | Soldering Temperature, for 10 seconds                      | 300 (1.6mm from case )   |       |
|                              | Mounting Torque, 6-32 or M3 screw ⑦                        | 10 lbf•in (1.1N•m)       |       |

**Thermal Resistance**

|                 | Parameter   | Typ. | Max. | Units |
|-----------------|---|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case ③                                | —    | 0.75 |       |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mount, steady state) ⑦ ⑧ | —    | 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    | -55  | —      | —    | V                   | $V_{GS} = 0V, I_D = -250\mu A$                        |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | -0.054 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = -1\text{mA}$ |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | —      | 20   | m $\Omega$          | $V_{GS} = -10V, I_D = -42A$ ③                         |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | -2.0 | —      | -4.0 | V                   | $V_{DS} = V_{GS}, I_D = -250\mu A$                    |
| gfs                             | Forward Transconductance             | 19   | —      | —    | S                   | $V_{DS} = -25V, I_D = -42A$                           |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —      | -25  | $\mu A$             | $V_{DS} = -55V, V_{GS} = 0V$                          |
|                                 |                                      | —    | —      | -200 |                     | $V_{DS} = -44V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —      | 100  | nA                  | $V_{GS} = -20V$                                       |
|                                 | Gate-to-Source Reverse Leakage       | —    | —      | -100 |                     | $V_{GS} = 20V$  |
| $Q_g$                           | Total Gate Charge                    | —    | 120    | 180  | nC                  | $I_D = -42A$  |
| $Q_{gs}$                        | Gate-to-Source Charge                | —    | 32     | —    |                     | $V_{DS} = -44V$                                       |
| $Q_{gd}$                        | Gate-to-Drain ("Miller") Charge      | —    | 53     | —    |                     | $V_{GS} = -10V$ ③                                     |
| $t_{d(on)}$                     | Turn-On Delay Time                   | —    | 20     | —    | ns                  | $V_{DD} = -28V$                                       |
| $t_r$                           | Rise Time                            | —    | 99     | —    |                     | $I_D = -42A$  |
| $t_{d(off)}$                    | Turn-Off Delay Time                  | —    | 51     | —    |                     | $R_G = 2.6\ \Omega$                                   |
| $t_f$                           | Fall Time                            | —    | 64     | —    |                     | $V_{GS} = -10V$ ③                                     |
| $L_S$                           | Internal Source Inductance           | —    | 7.5    | —    | nH                  | Between lead,<br>and center of die contact            |
| $C_{iss}$                       | Input Capacitance                    | —    | 3500   | —    | pF                  | $V_{GS} = 0V$   |
| $C_{oss}$                       | Output Capacitance                   | —    | 1250   | —    |                     | $V_{DS} = -25V$                                       |
| $C_{rss}$                       | Reverse Transfer Capacitance         | —    | 450    | —    |                     | $f = 1.0\text{MHz}$                                   |
| $C_{oss}$                       | Output Capacitance                   | —    | 4620   | —    |                     | $V_{GS} = 0V, V_{DS} = -1.0V, f = 1.0\text{MHz}$      |
| $C_{oss}$                       | Output Capacitance                   | —    | 940    | —    |                     | $V_{GS} = 0V, V_{DS} = -44V, f = 1.0\text{MHz}$       |
| $C_{oss\ eff.}$                 | Effective Output Capacitance         | —    | 1530   | —    |                     | $V_{GS} = 0V, V_{DS} = 0V\ \text{to}\ -44V$ ④         |

## Source-Drain Ratings and Characteristics

|          | Parameter                                 | Min.  | Typ. | Max. | Units | Conditions  |
|----------|---|---|------|------|-------|---|
| $I_S$    | Continuous Source Current<br>(Body Diode) | —   | —    | -42  | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode) ①   | —   | —    | -280 |       |   |
| $V_{SD}$ | Diode Forward Voltage                     | —   | —    | -1.3 | V     | $T_J = 25^\circ\text{C}, I_S = -42A, V_{GS} = 0V$ ③                     |
| $t_{rr}$ | Reverse Recovery Time                     | —   | 61   | 92   | ns    | $T_J = 25^\circ\text{C}, I_F = -42A, V_{DD} = -28V$                     |
| $Q_{rr}$ | Reverse Recovery Charge                   | —   | 150  | 220  | nC    | $di/dt = -100A/\mu s$ ③   |
| $t_{on}$ | Forward Turn-On Time                      | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S+L_D$ ) |      |      |       |   |

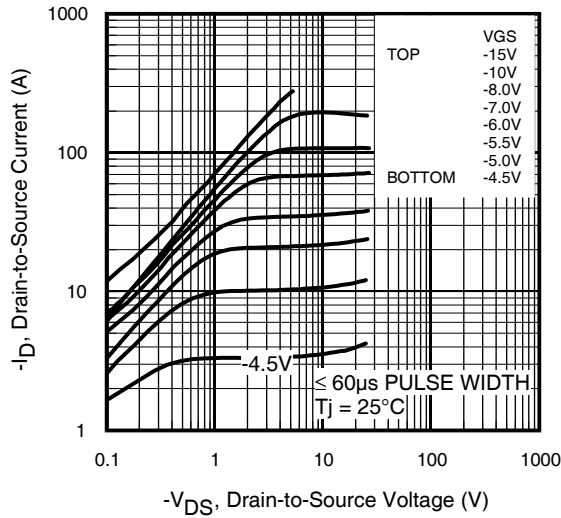


Fig 1. Typical Output Characteristics

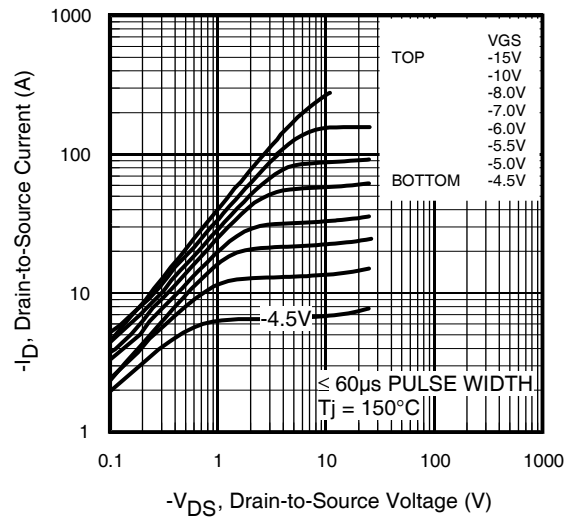


Fig 2. Typical Output Characteristics

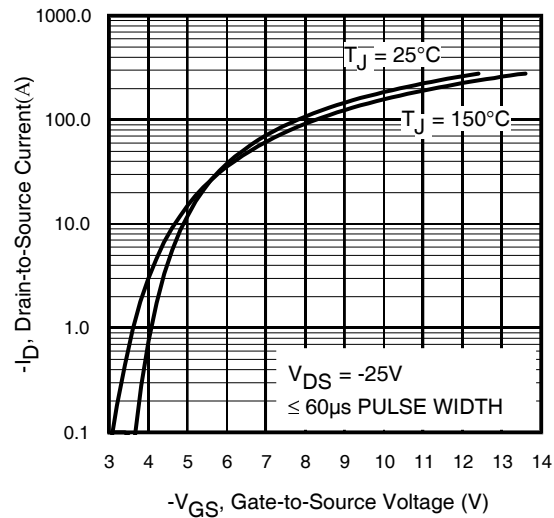


Fig 3. Typical Transfer Characteristics

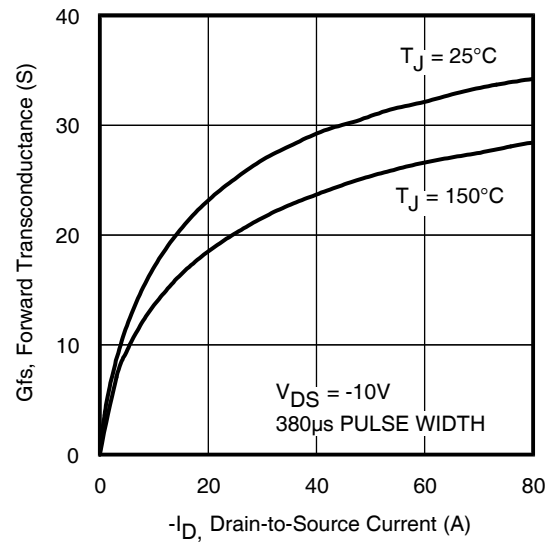
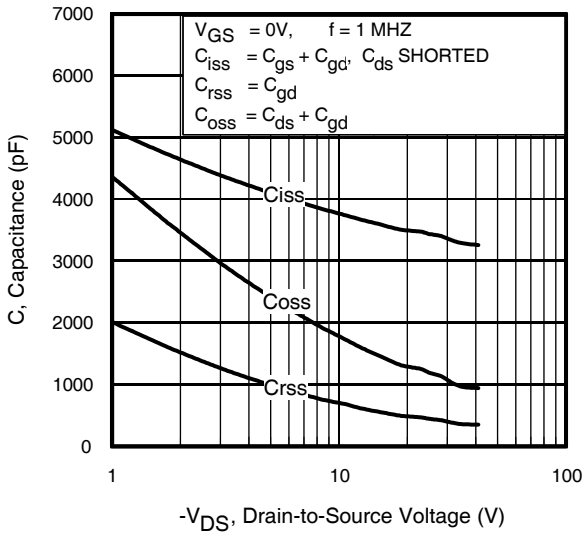
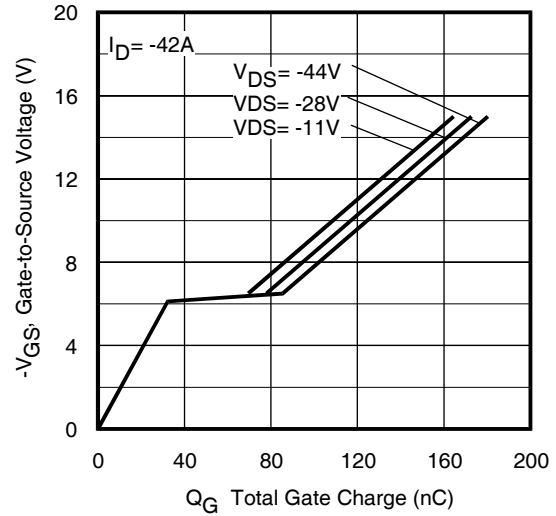


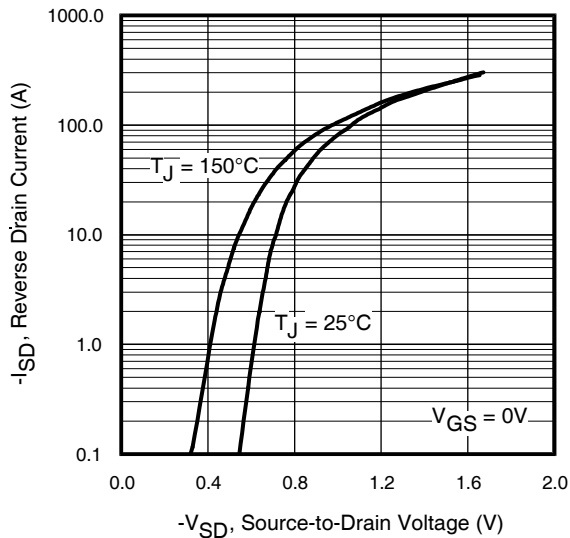
Fig 4. Typical Forward Transconductance Vs. Drain Current



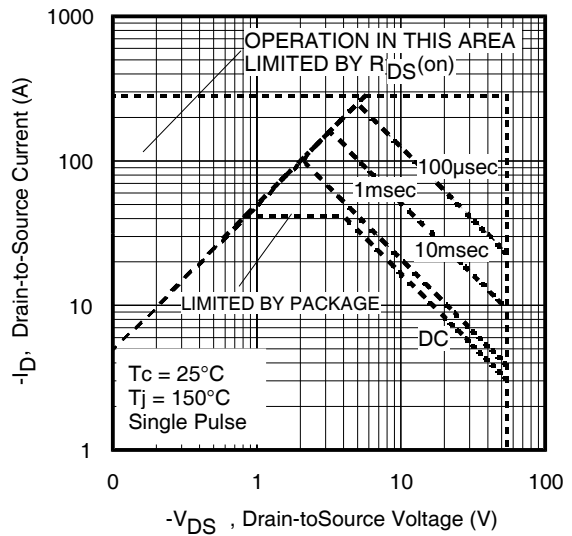
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



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



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



**Fig 8.** Maximum Safe Operating Area

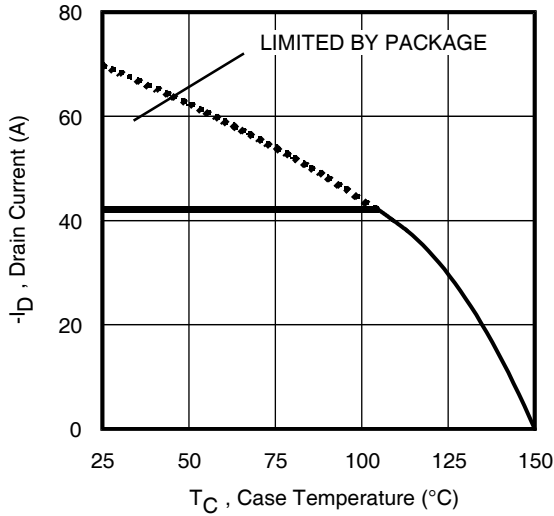


Fig 9. Maximum Drain Current Vs. Case Temperature

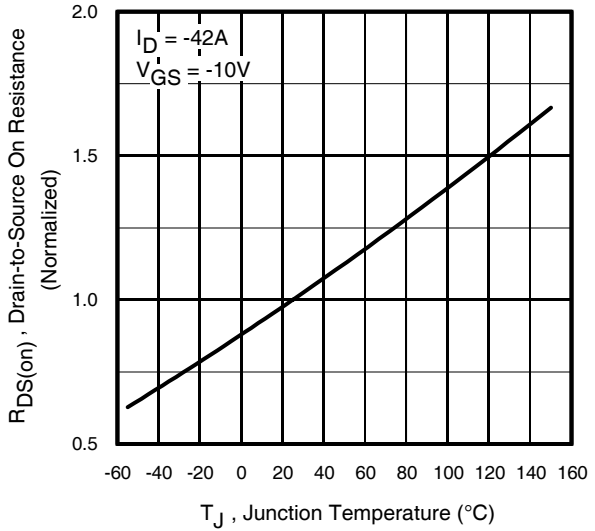


Fig 10. Normalized On-Resistance Vs. Temperature

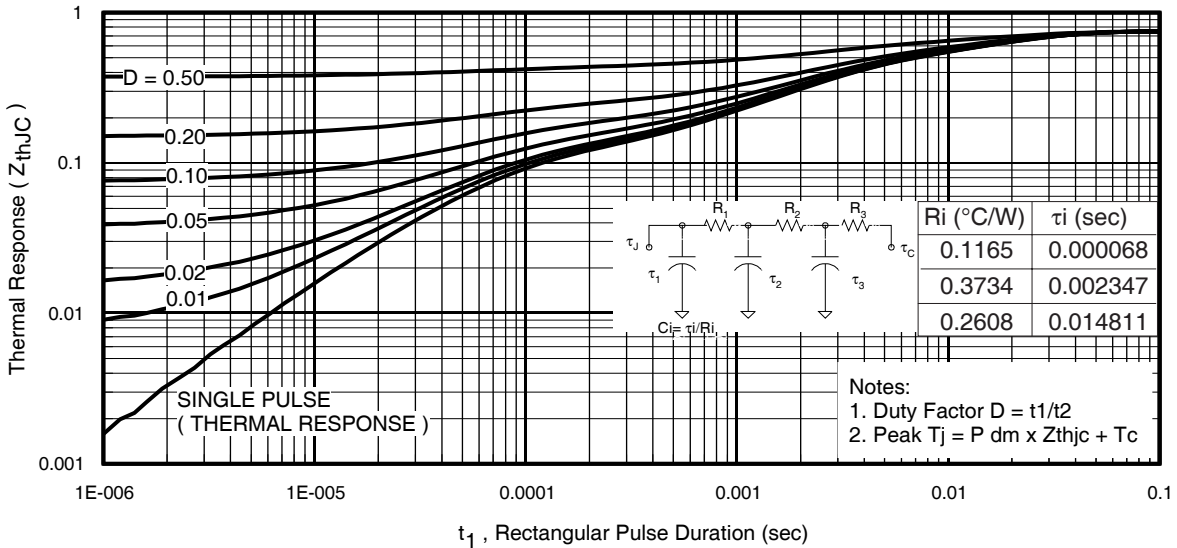
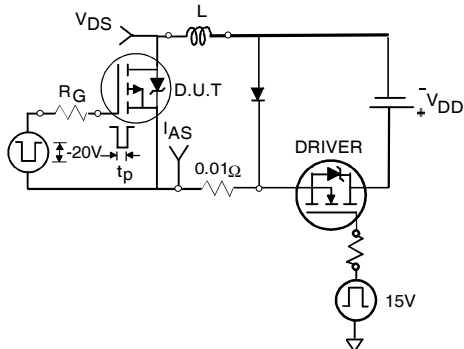


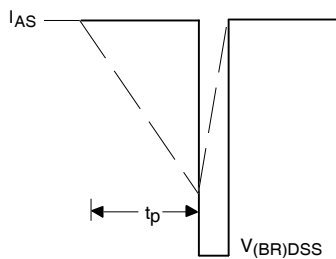
Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

# IRF4905S/L

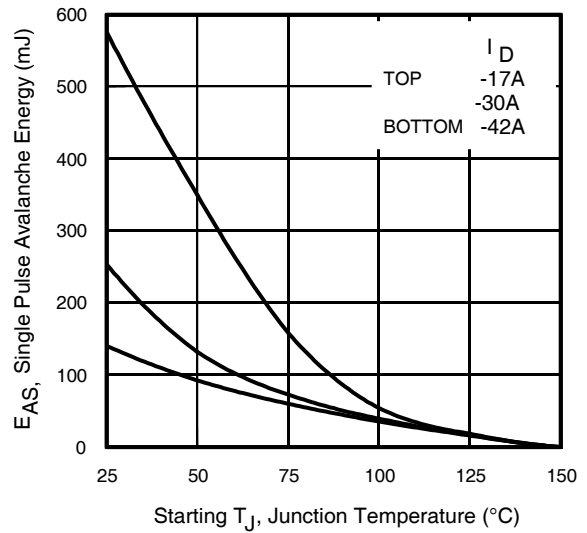
International  
**IR** Rectifier



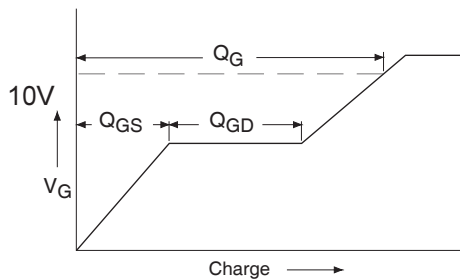
**Fig 12a.** Unclamped Inductive Test Circuit



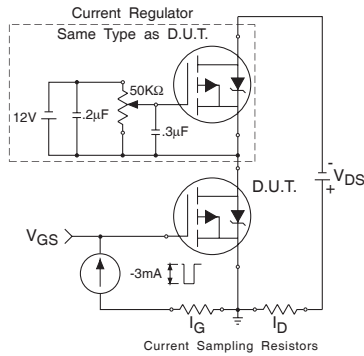
**Fig 12b.** Unclamped Inductive Waveforms



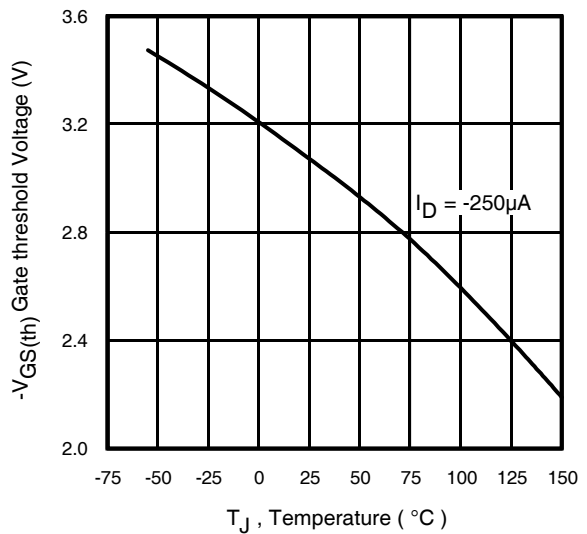
**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



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



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



**Fig 14.** Threshold Voltage Vs. Temperature

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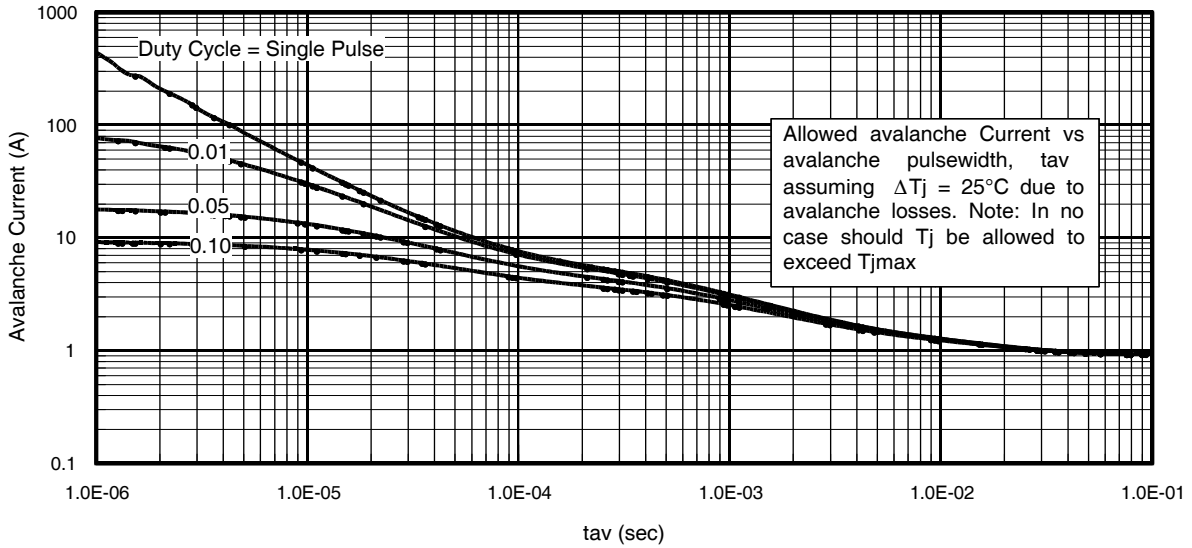


Fig 15. Typical Avalanche Current Vs.Pulsewidth

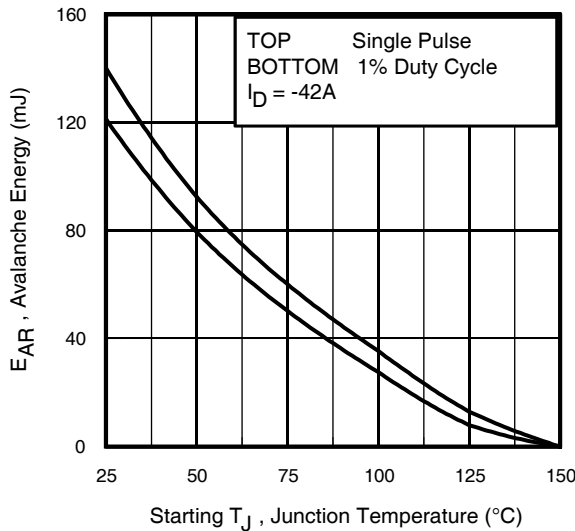


Fig 16. Maximum Avalanche Energy Vs. Temperature

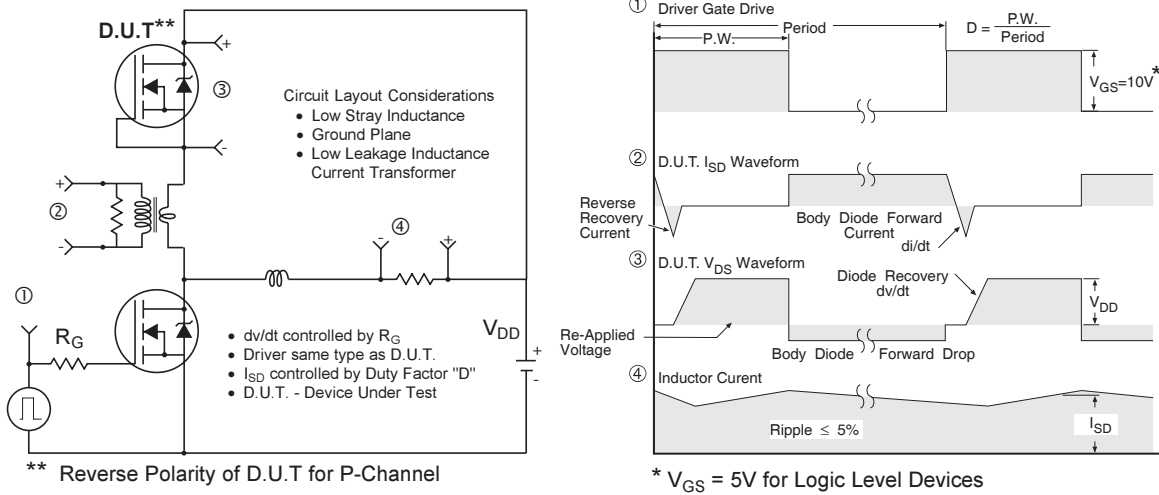
**Notes on Repetitive Avalanche Curves , Figures 15, 16:**  
(For further info, see AN-1005 at [www.irf.com](http://www.irf.com))

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)

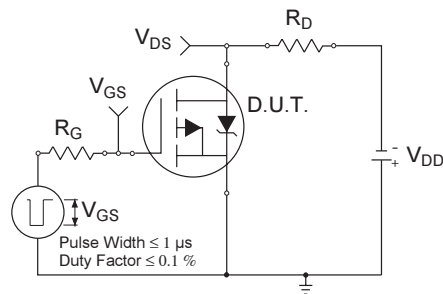
$$P_{D(ave)} = 1/2 ( 1.3 \cdot BV \cdot I_{av} ) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$

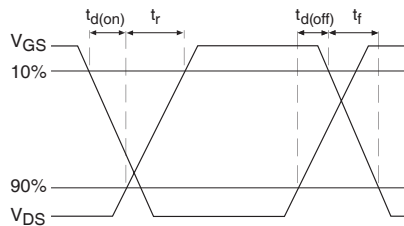
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



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

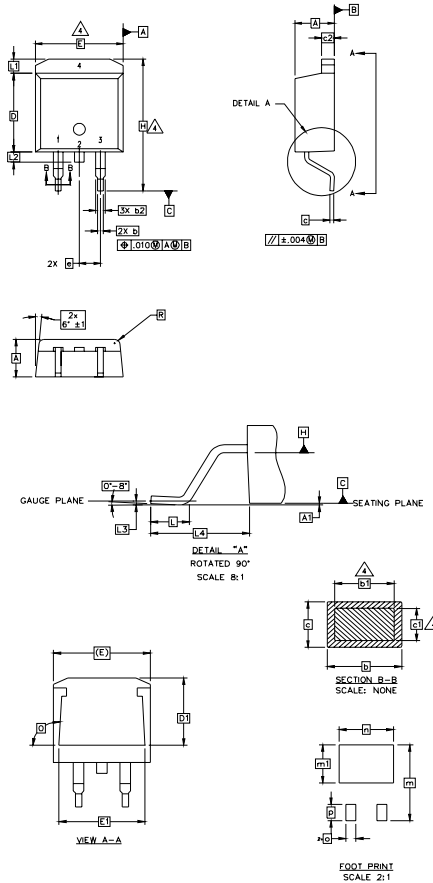


**Fig 18a. Switching Time Test Circuit**



**Fig 18b. Switching Time Waveforms**

## D<sup>2</sup>Pak 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.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

| SYMBOL | DIMENSIONS  |       |          |      | NOTES |
|--------|-------------|-------|----------|------|-------|
|        | MILLIMETERS |       | INCHES   |      |       |
|        | MIN.        | MAX.  | MIN.     | MAX. |       |
| A      | 4.06        | 4.83  | .160     | .190 | 4     |
| A1     | 0.00        | 0.254 | .000     | .010 |       |
| b      | 0.51        | 0.99  | .020     | .039 |       |
| b1     | 0.51        | 0.89  | .020     | .035 |       |
| b2     | 1.14        | 1.78  | .045     | .070 | 4     |
| c      | 0.38        | 0.74  | .015     | .029 |       |
| c1     | 0.38        | 0.58  | .015     | .023 | 4     |
| c2     | 1.14        | 1.65  | .045     | .065 |       |
| D      | 8.51        | 9.65  | .335     | .380 | 3     |
| D1     | 6.86        |       | .270     |      |       |
| E      | 9.65        | 10.67 | .380     | .420 | 3     |
| E1     | 6.22        |       | .245     |      |       |
| e      | 2.54 BSC    |       | .100 BSC |      | 3     |
| H      | 14.61       | 15.88 | .575     | .625 |       |
| L      | 1.78        | 2.79  | .070     | .110 | 3     |
| L1     |             | 1.65  | .065     |      |       |
| L2     | 1.27        | 1.78  | .050     | .070 | 3     |
| L3     | 0.25 BSC    |       | .010 BSC |      |       |
| L4     | 4.78        | 5.28  | .188     | .208 | 3     |
| m      | 17.78       |       | .700     |      |       |
| m1     | 8.89        |       | .350     |      | 3     |
| n      | 11.43       |       | .450     |      |       |
| o      | 2.08        |       | .082     |      | 3     |
| p      | 3.81        |       | .150     |      |       |
| R      | 0.51        | 0.71  | .020     | .028 | 3     |
| θ      | 90°         | 93°   | 90°      | 93°  |       |

**LEAD ASSIGNMENTS**

**HEXFET**

- 1.- GATE
- 2, 4.- DRAIN
- 3.- SOURCE

**IGBTs, CoPACK**

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

**DIODES**

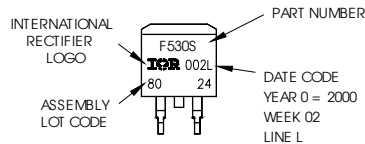
- 1.- ANODE \*
- 2, 4.- CATHODE
- 3.- ANODE

\* PART DEPENDENT.

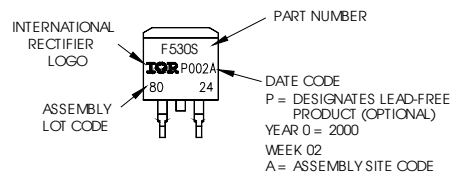
## D<sup>2</sup>Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH  
LOT CODE 8024  
ASSEMBLED ON WW 02, 2000  
IN THE ASSEMBLY LINE "L"

Note: "P" in assembly line  
position indicates "Lead-Free"



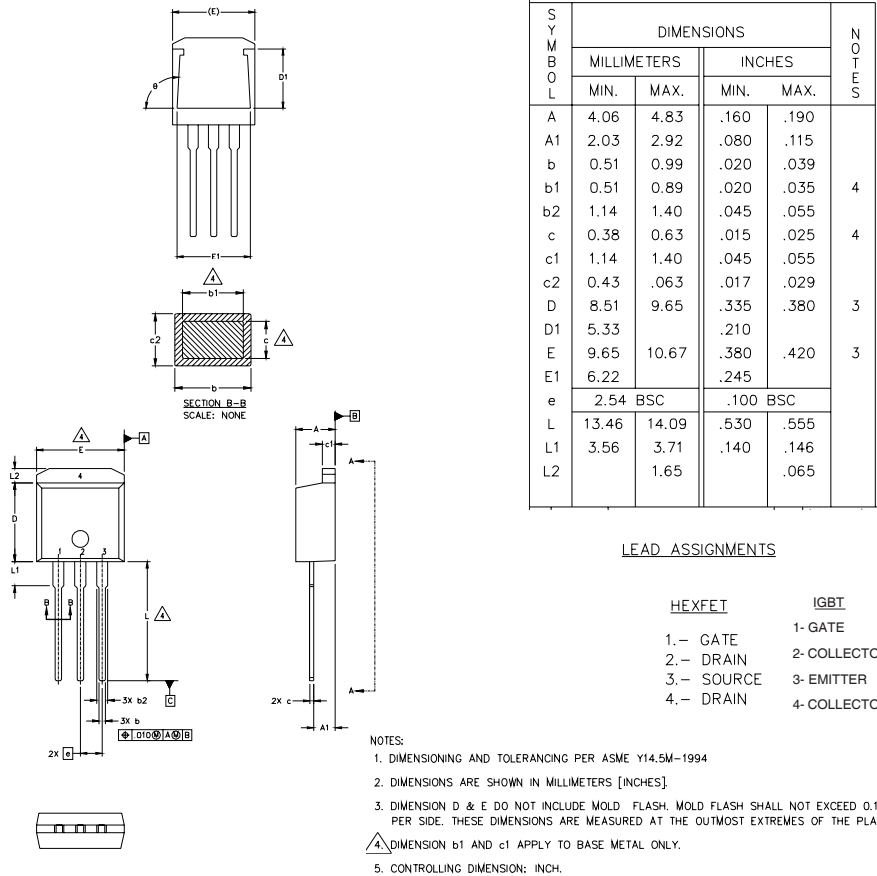
## OR



# IRF4905S/L

International  
**IR** Rectifier

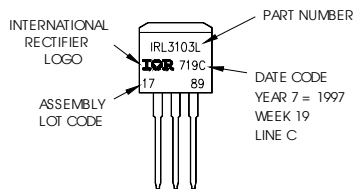
## TO-262 Package Outline (Dimensions are shown in millimeters (inches))



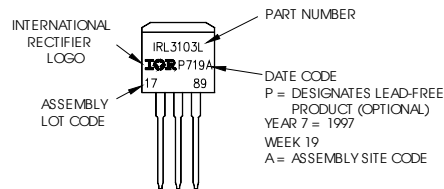
## TO-262 Part Marking Information

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

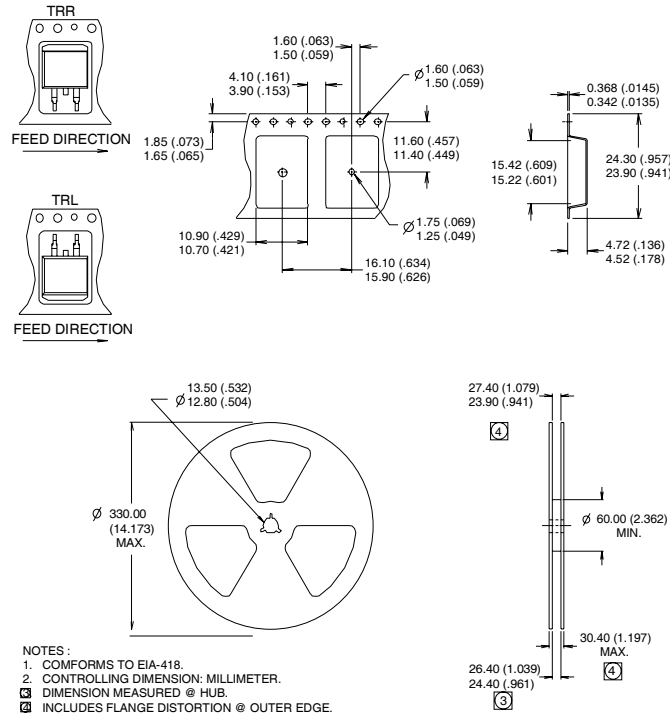
Note: "P" in assembly line position indicates "Lead-Free"



**OR**



D<sup>2</sup>Pak Tape & Reel Information



Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Limited by  $T_{Jmax}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.16\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = -42\text{A}$ ,  $V_{GS} = -10\text{V}$ . Part not recommended for use above this value.
- ③ Pulse width  $\leq 1.0\text{ms}$ ; duty cycle  $\leq 2\%$ .
- ④  $C_{OSS}$  eff. is a fixed capacitance that gives the same charging time as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .
- ⑤ Limited by  $T_{Jmax}$ ; see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑥ This value determined from sample failure population. 100% tested to this value in production.
- ⑦ This is applied to D<sup>2</sup>Pak, 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  $90^\circ\text{C}$

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.

Note: For the most current drawings please refer to the IR website at:  
<http://www.irf.com/package/>

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