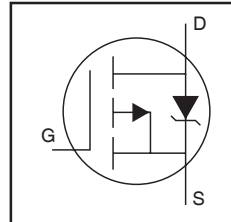


**IRF4905SPbF**  
**IRF4905LPbF**

**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

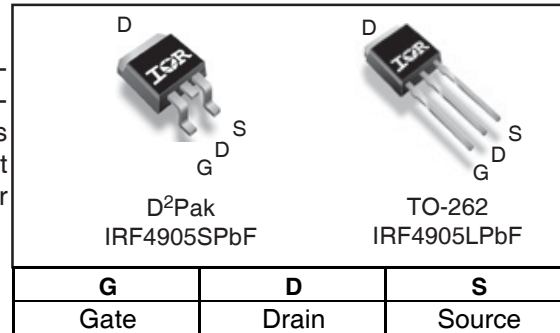
HEXFET® Power MOSFET



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

**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 ③	790	
$I_{AR}$	Avalanche Current ④	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 ⑧	—	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/°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, 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 (Body Diode)	—	—	-42	A	MOSFET symbol showing the integral reverse p-n junction diode.
$I_{SM}$	Pulsed Source Current (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 $L_S+L_D$ )				

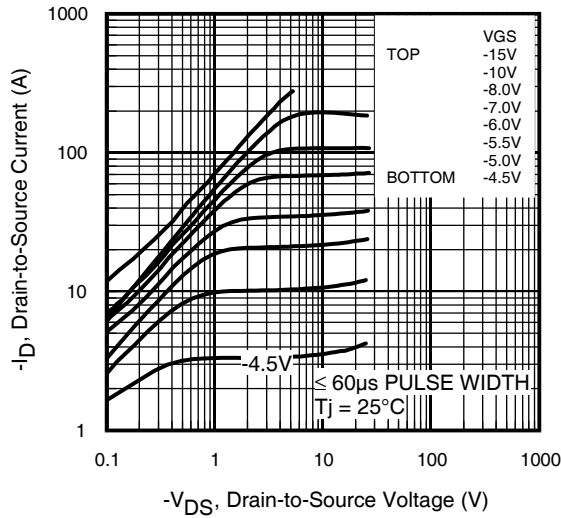


Fig 1. Typical Output Characteristics

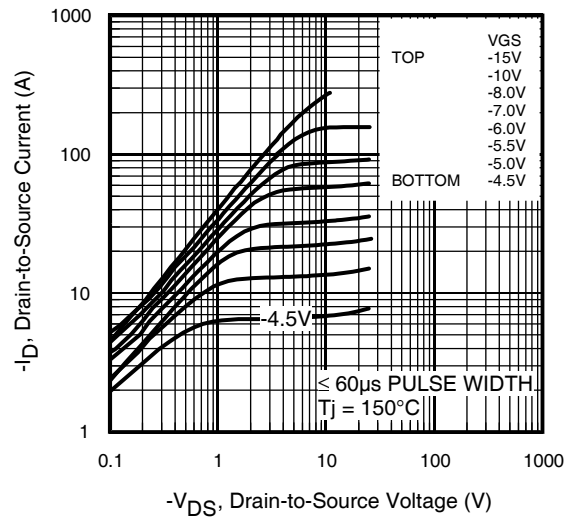


Fig 2. Typical Output Characteristics

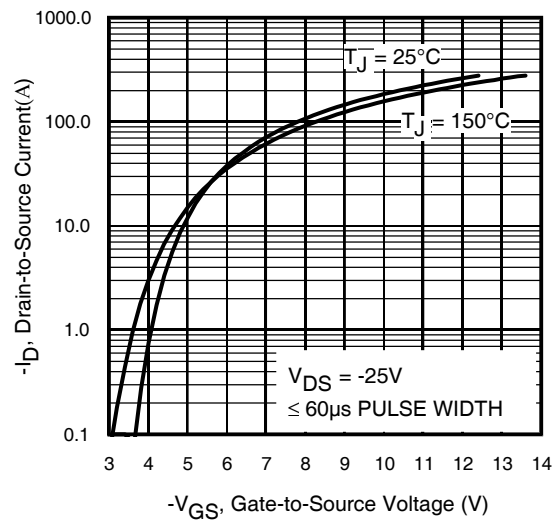


Fig 3. Typical Transfer Characteristics

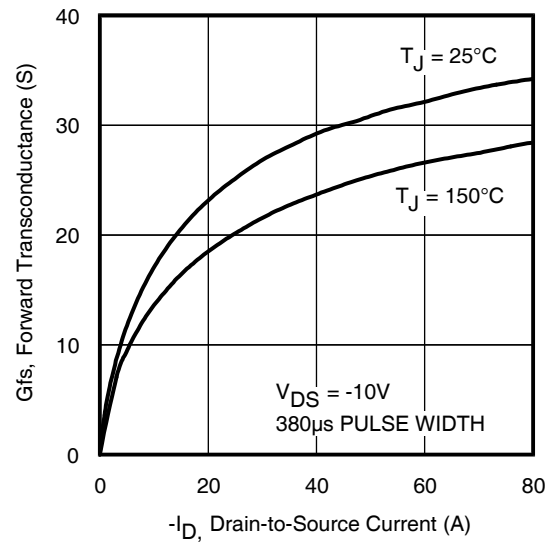
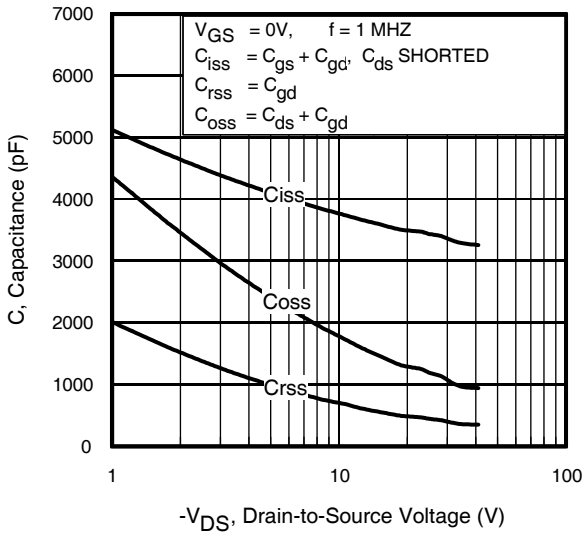
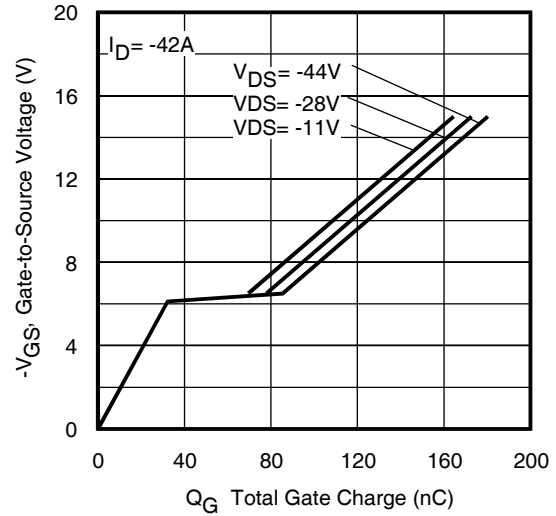


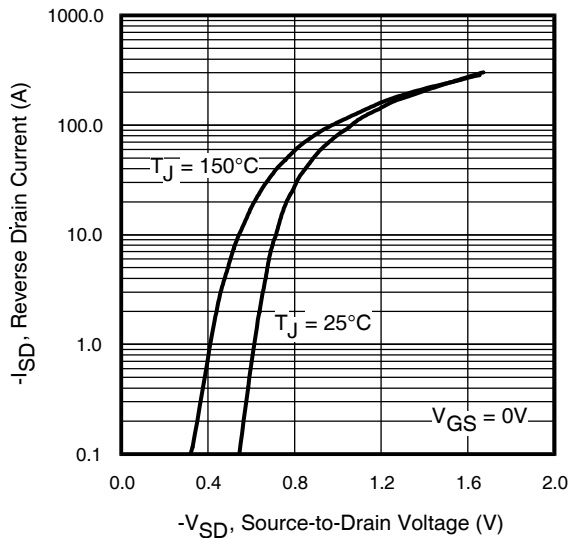
Fig 4. Typical Forward Transconductance Vs. Drain Current



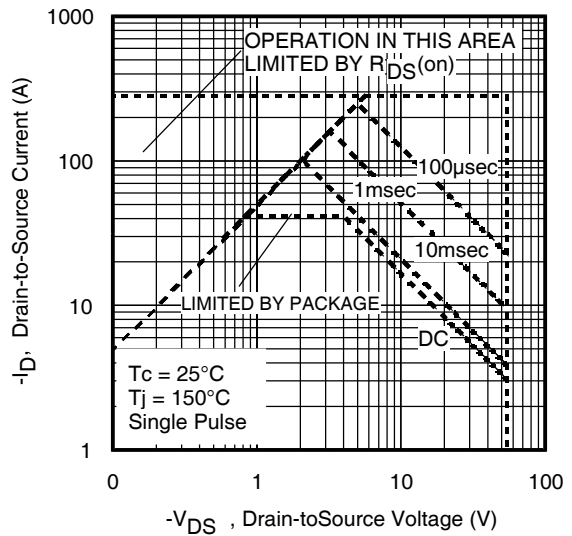
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



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



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



**Fig 8.** Maximum Safe Operating Area

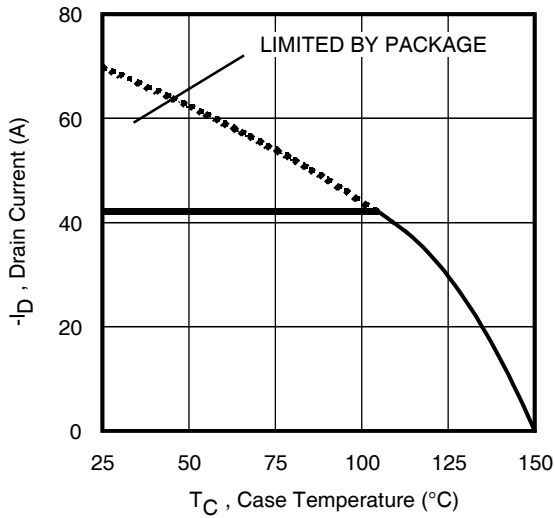


Fig 9. Maximum Drain Current Vs. Case Temperature

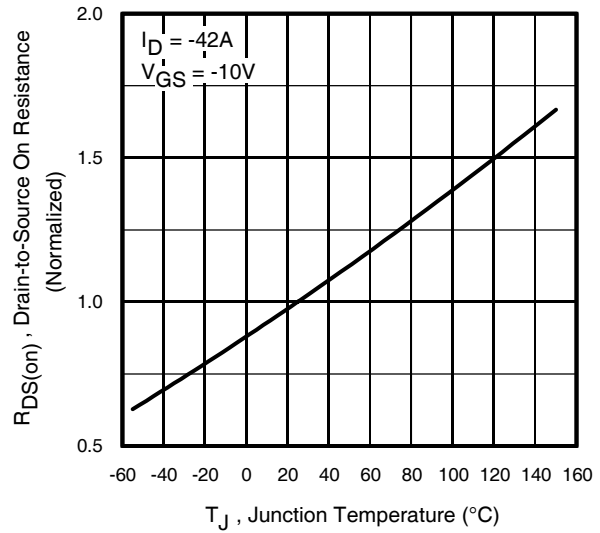


Fig 10. Normalized On-Resistance Vs. Temperature

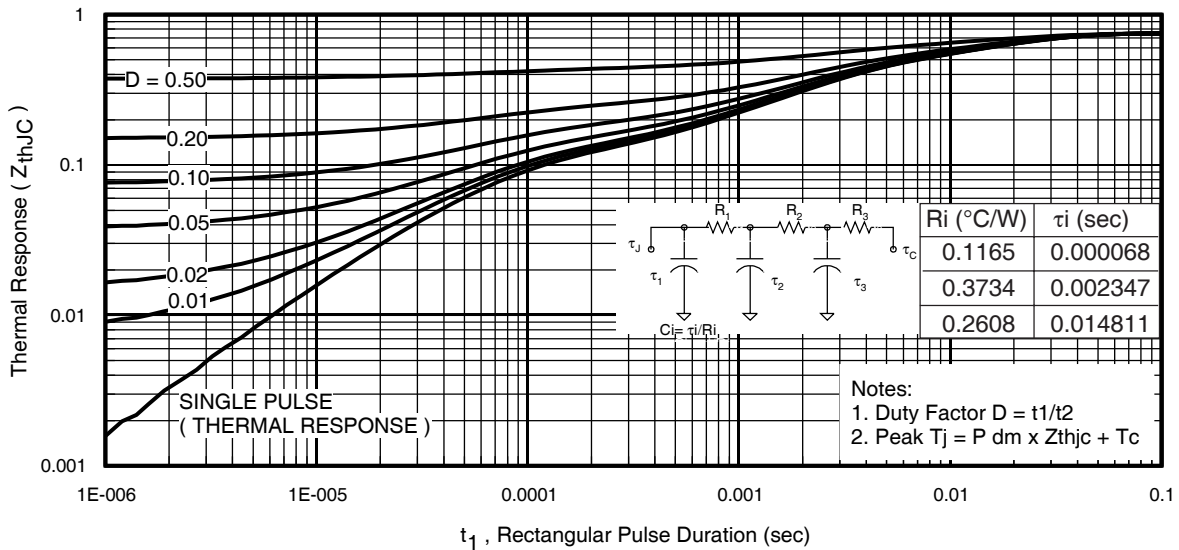
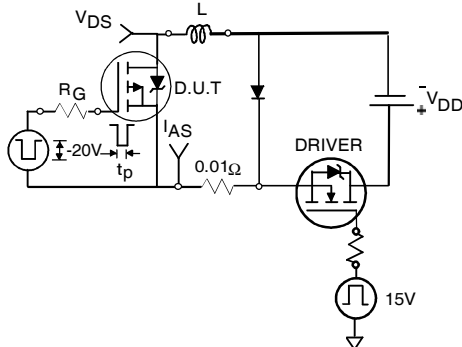
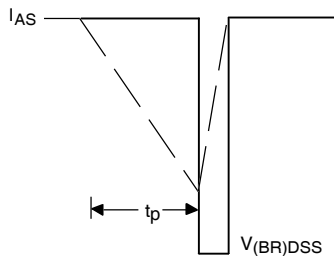


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

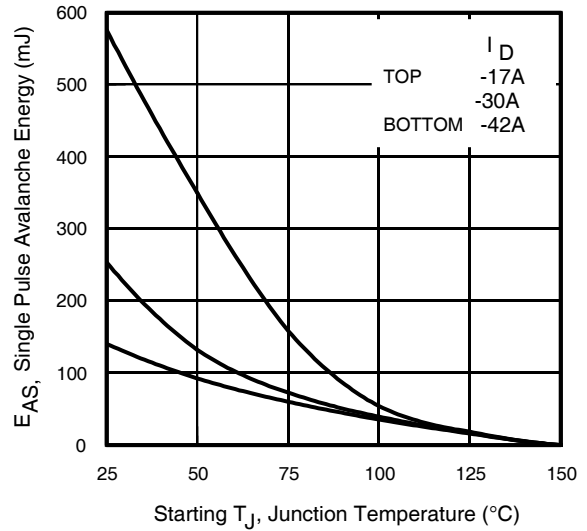
# IRF4905S/L



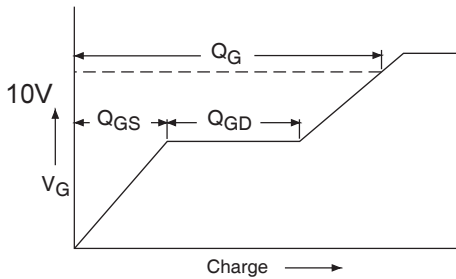
**Fig 12a.** Unclamped Inductive Test Circuit



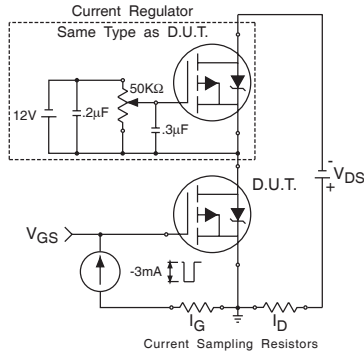
**Fig 12b.** Unclamped Inductive Waveforms



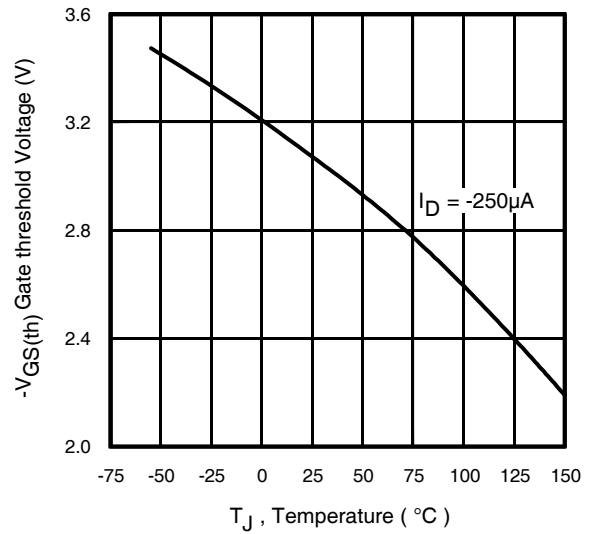
**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



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



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



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

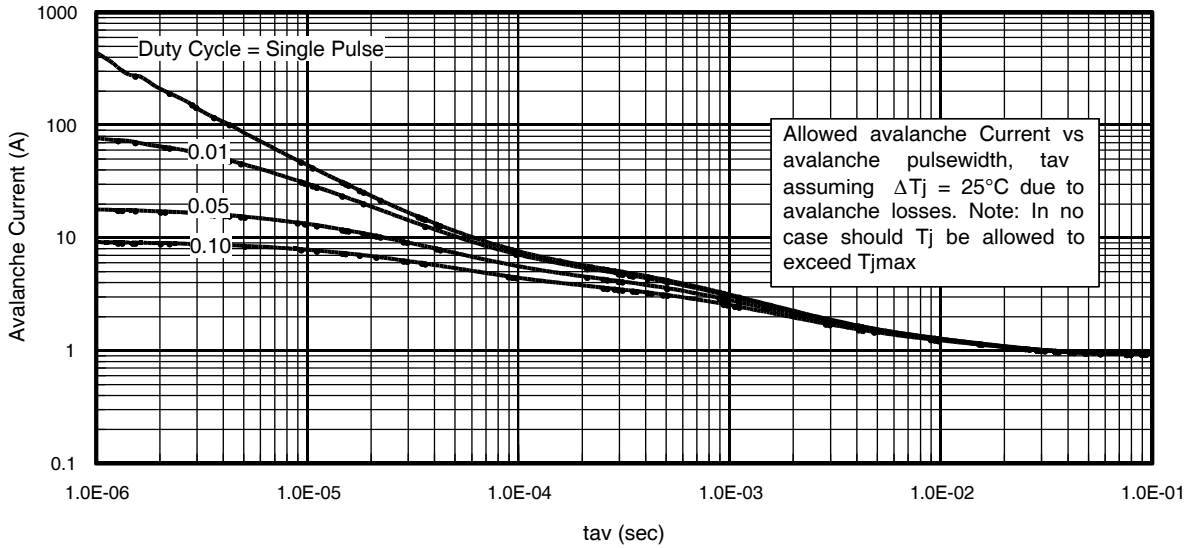


Fig 15. Typical Avalanche Current Vs.Pulsewidth

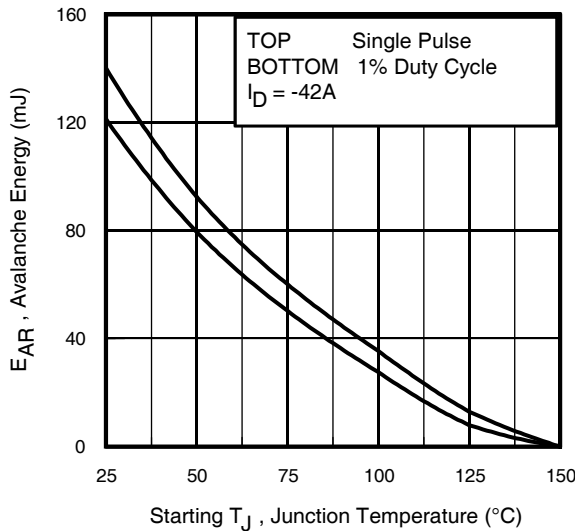


Fig 16. Maximum Avalanche Energy Vs. Temperature

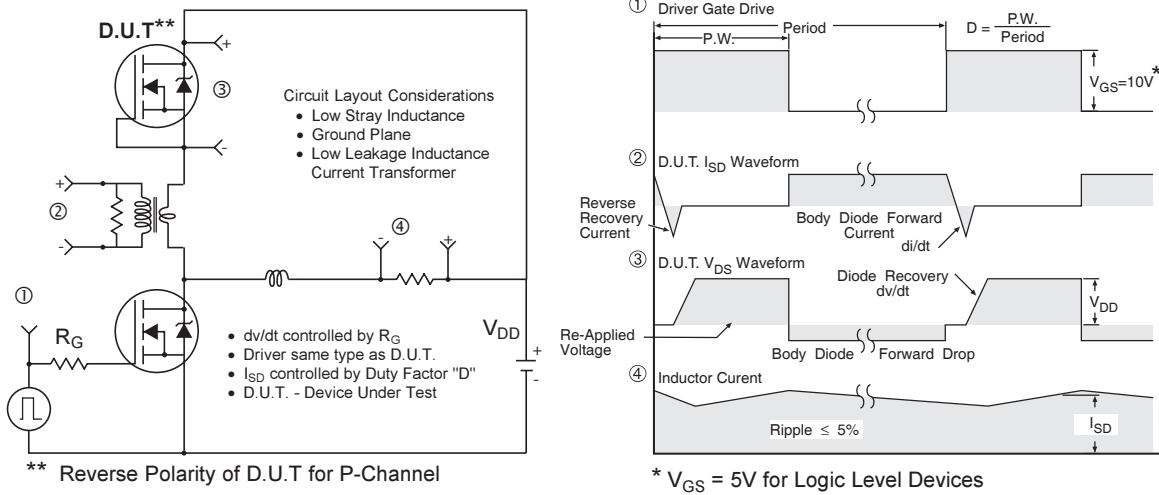
**Notes on Repetitive Avalanche Curves , Figures 15, 16:**  
**(For further info, see AN-1005 at www.irf.com)**

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)

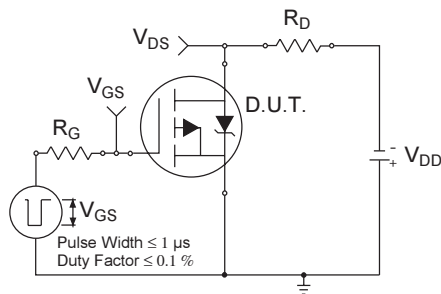
$$P_{D(ave)} = 1/2 ( 1.3 \cdot BV \cdot I_{av} ) = \Delta T / Z_{thJC}$$

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

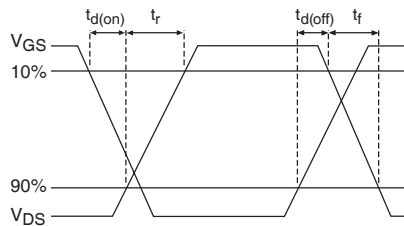
$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$



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



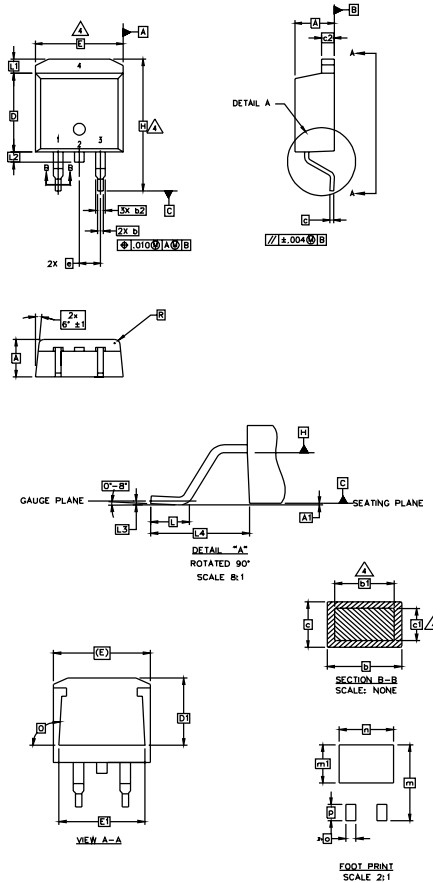
**Fig 18a. Switching Time Test Circuit**



**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	4
b1	0.51	0.89	.020	.035	
b2	1.14	1.78	.045	.070	3
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	3
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		
H	14.61	15.88	.575	.625	4
L	1.78	2.79	.070	.110	
L1		1.65		.065	4
L2	1.27	1.78	.050	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	4
m	17.78		.700		
m1	8.89		.350		4
n	11.43		.450		
o	2.08		.082		4
p	3.81		.150		
R	0.51	0.71	.020	.028	4
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**

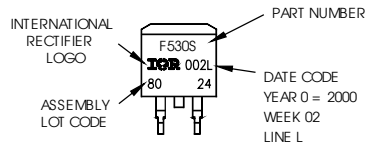
- 1.- ANODE \*
- 2, 4.- CATHODE
- 3.- ANODE

\* PART DEPENDENT.

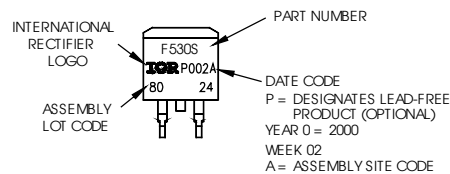
## D<sup>2</sup>Pak Part Marking Information

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"



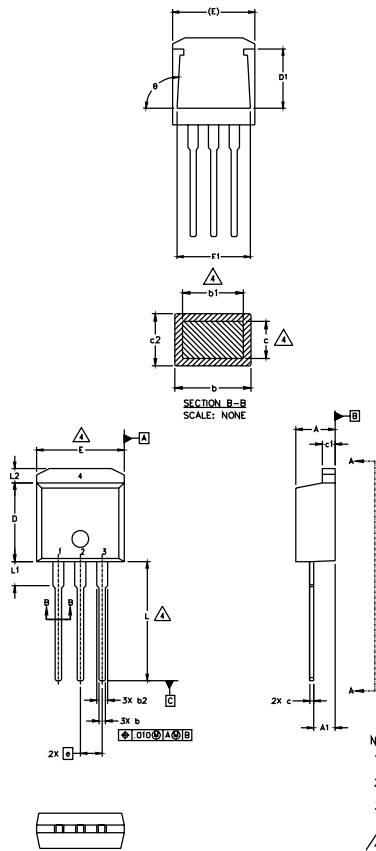
## OR



# IRF4905S/L



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



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	4
A1	2.03	2.92	.080	.115	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	
b2	1.14	1.40	.045	.055	4
c	0.38	0.63	.015	.025	
c1	1.14	1.40	.045	.055	3
c2	0.43	.063	.017	.029	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54	BSC	.100	BSC	
L	13.46	14.09	.530	.555	
L1	3.56	3.71	.140	.146	
L2		1.65		.065	

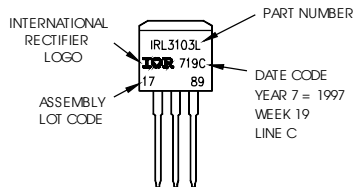
### LEAD ASSIGNMENTS

HEXFET	IGBT
1.- GATE	1- GATE
2.- DRAIN	2- COLLECTOR
3.- SOURCE	3- EMITTER
4.- DRAIN	4- COLLECTOR

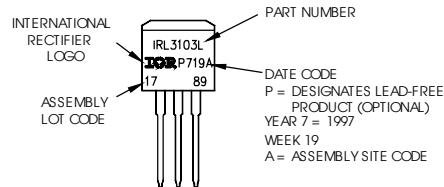
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
  2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
  3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
  4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
  5. CONTROLLING DIMENSION: INCH.

## TO-262 Part Marking Information

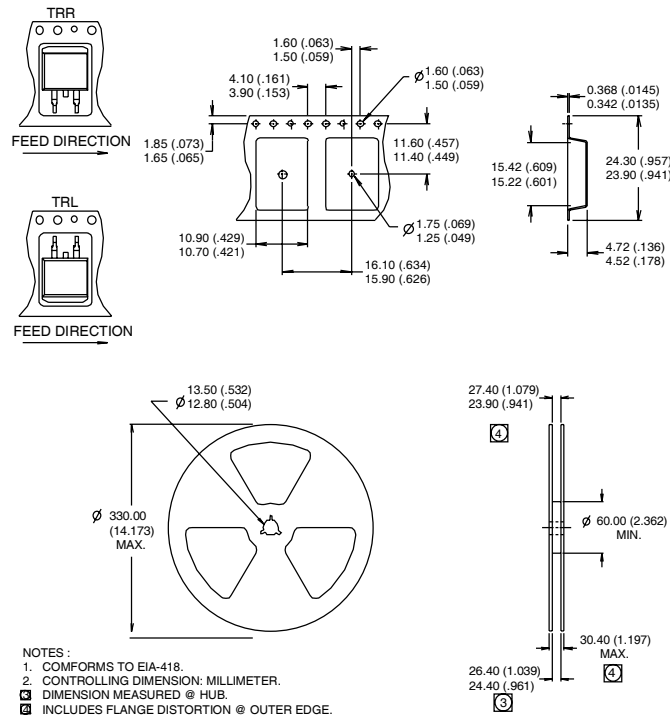
EXAMPLE: THIS IS AN IRL3103L  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 1997  
 IN THE ASSEMBLY LINE "C"  
 Note: "P" in assembly line position indicates "Lead-Free"



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  $T_J = 25^\circ C$ ,  $L = 0.16mH$ ,  $R_G = 25\Omega$ ,  $I_{AS} = -42A$ ,  $V_{GS} = -10V$ . Part not recommended for use above this value.
- ③ Pulse width  $\leq 1.0ms$ ; 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  $90^\circ C$ .

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/>

## **IMPORTANT NOTICE**

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffheitsgarantie").

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The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office ([www.infineon.com](http://www.infineon.com)).

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