

IRF4905SPbF IRF4905LPbF

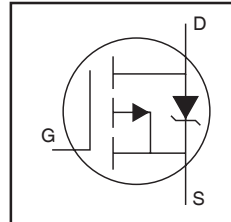
Features

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

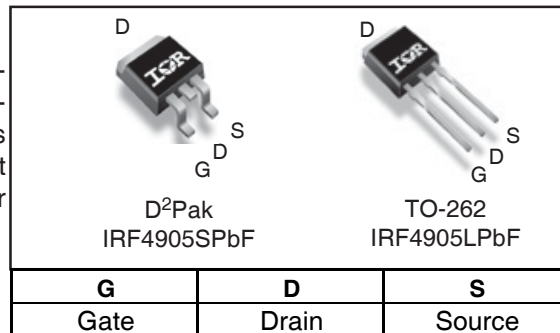
Description

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.

HEXFET® Power MOSFET



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



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	± 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		
	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°C , $I_D = -1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	20	m Ω	$V_{GS} = -10V$, $I_D = -42A$ ③
$V_{GS(th)}$	Gate Threshold Voltage	-2.0	—	-4.0	V	$V_{DS} = V_{GS}$, $I_D = -250\mu A$
g_{fs}	Forward Transconductance	19	—	—	S	$V_{DS} = -25V$, $I_D = -42A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	-25	μA	$V_{DS} = -55V$, $V_{GS} = 0V$
		—	—	-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	—		$f = 1.0MHz$
C_{oss}	Output Capacitance	—	4620	—		$V_{GS} = 0V$, $V_{DS} = -1.0V$, $f = 1.0MHz$
C_{oss}	Output Capacitance	—	940	—		$V_{GS} = 0V$, $V_{DS} = -44V$, $f = 1.0MHz$
$C_{oss\text{ eff.}}$	Effective Output Capacitance	—	1530	—		$V_{GS} = 0V$, $V_{DS} = 0V$ 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)				

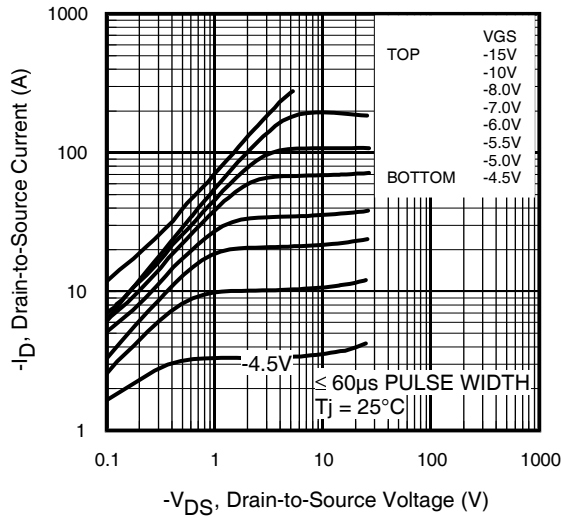


Fig 1. Typical Output Characteristics

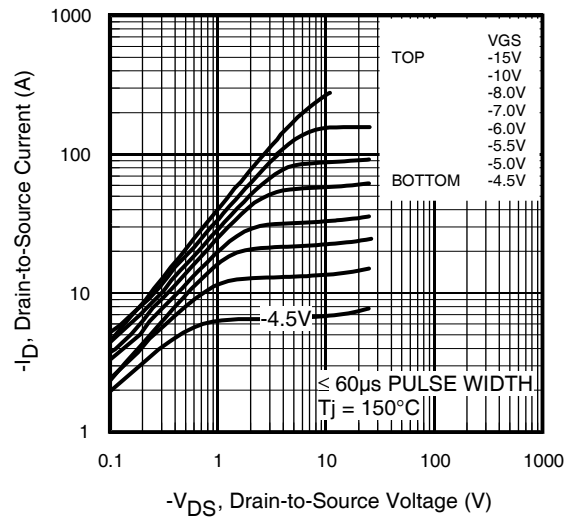


Fig 2. Typical Output Characteristics

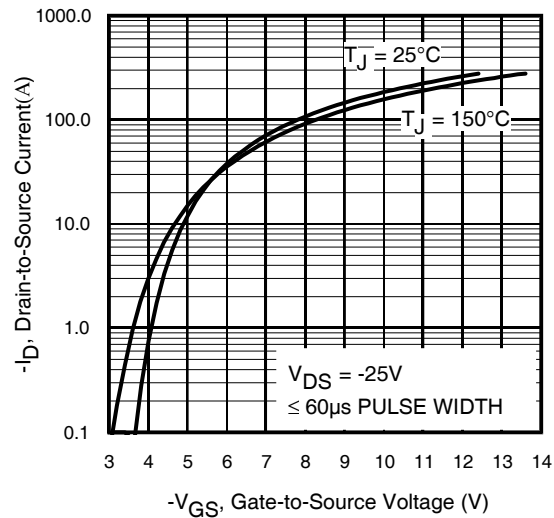


Fig 3. Typical Transfer Characteristics

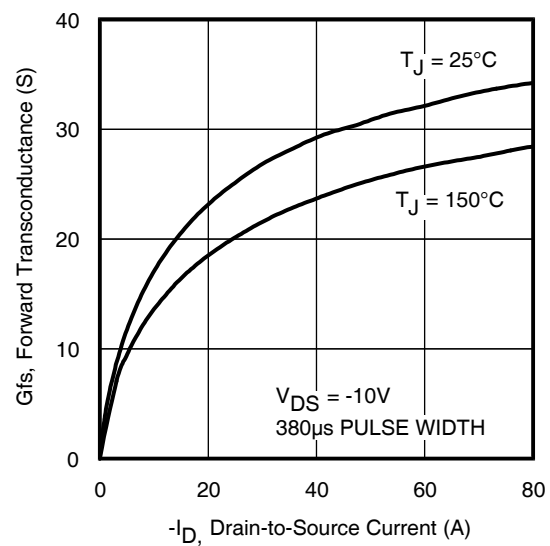
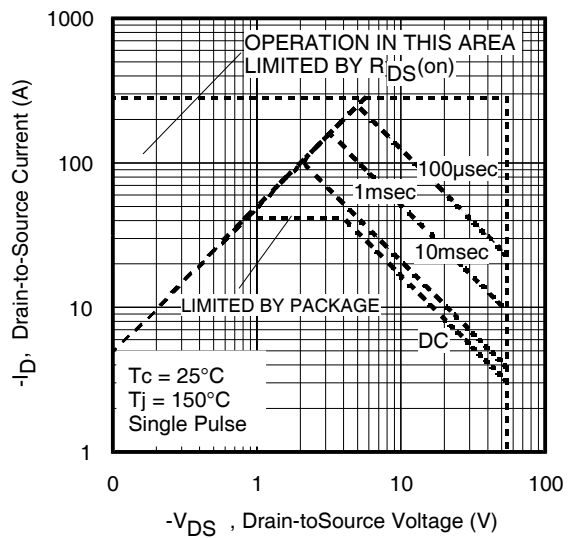
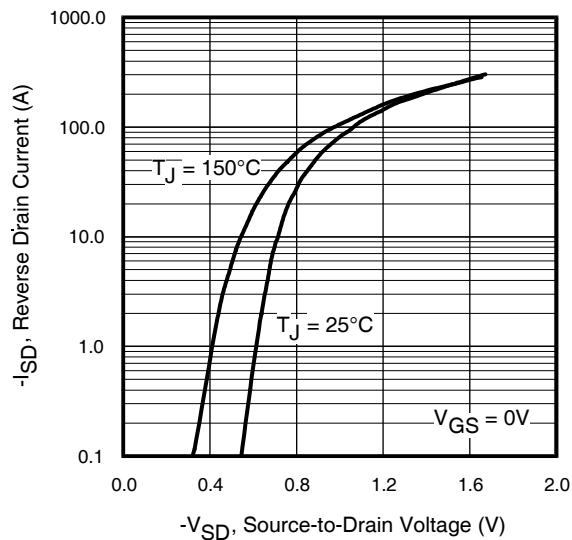
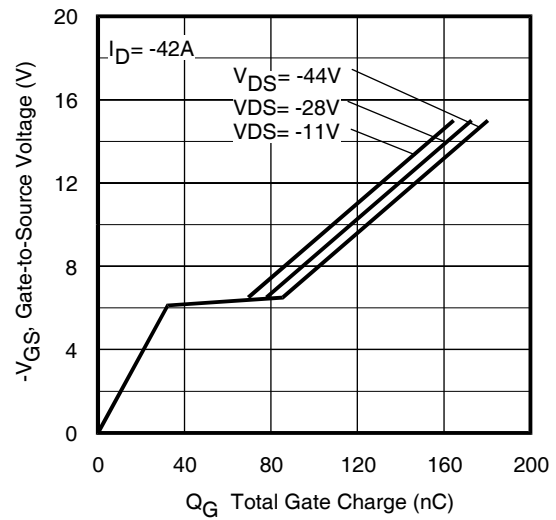
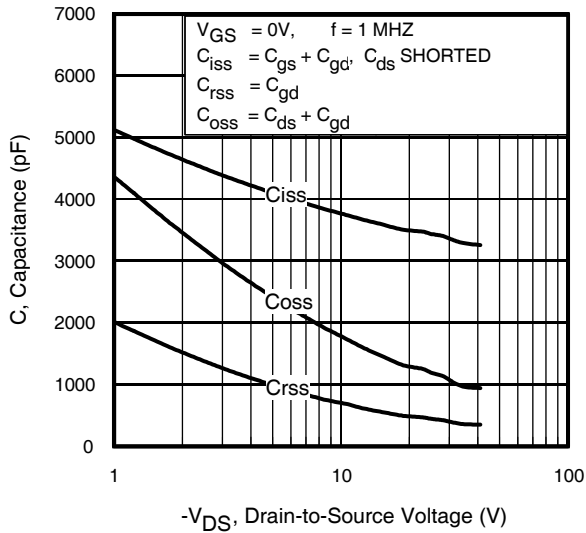


Fig 4. Typical Forward Transconductance Vs. Drain Current

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International
IR Rectifier



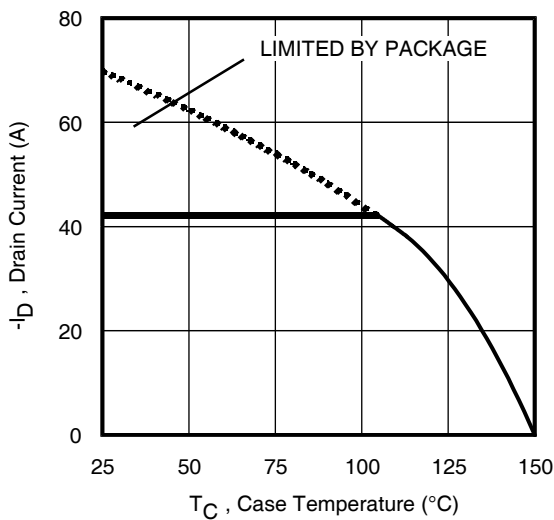


Fig 9. Maximum Drain Current Vs. Case Temperature

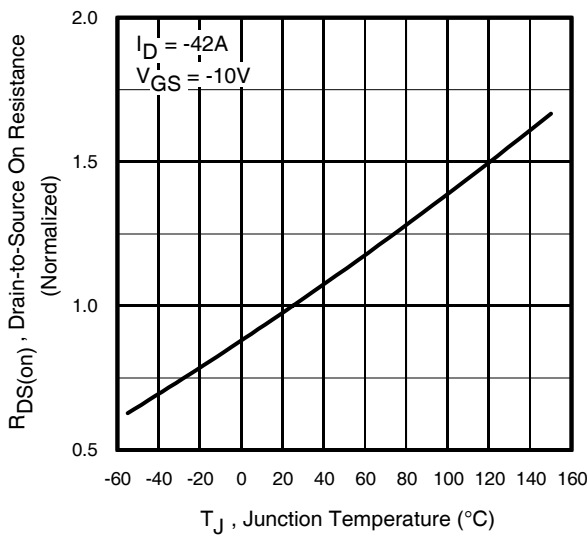


Fig 10. Normalized On-Resistance Vs. Temperature

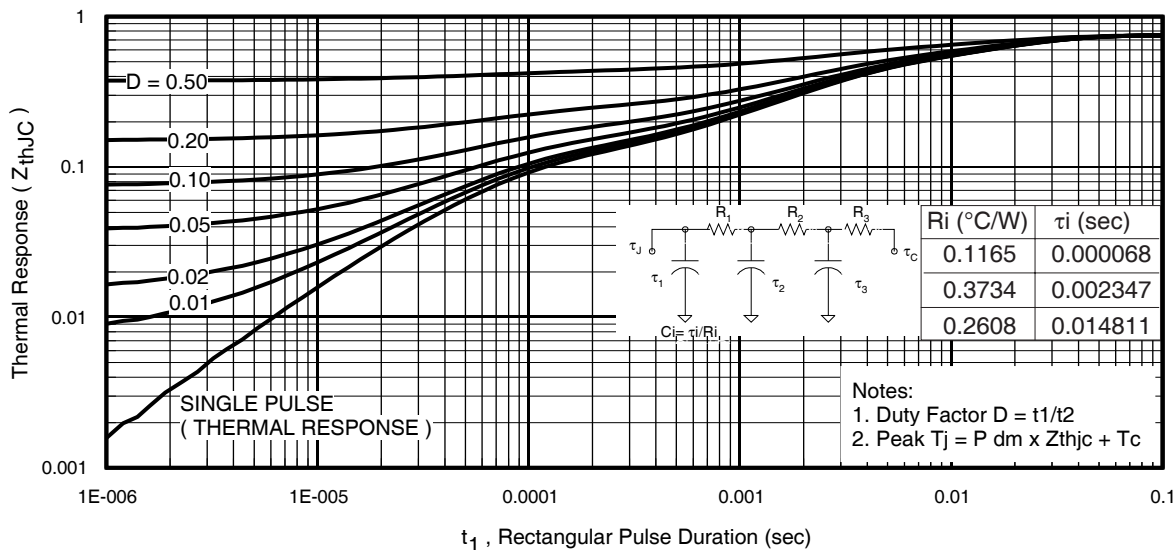


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRF4905S/L

International
IR Rectifier

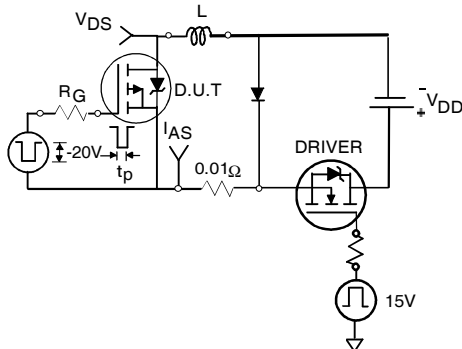


Fig 12a. Unclamped Inductive Test Circuit

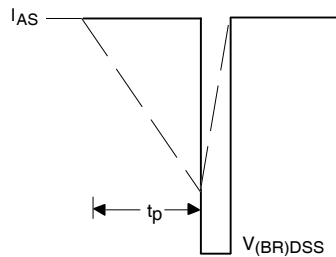


Fig 12b. Unclamped Inductive Waveforms

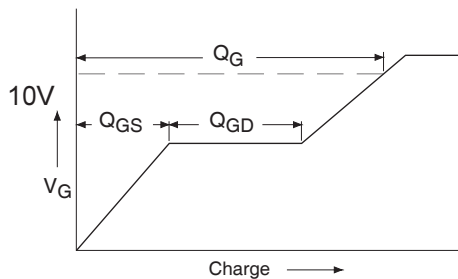


Fig 13a. Basic Gate Charge Waveform

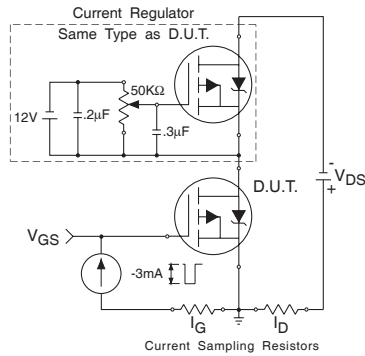


Fig 13b. Gate Charge Test Circuit

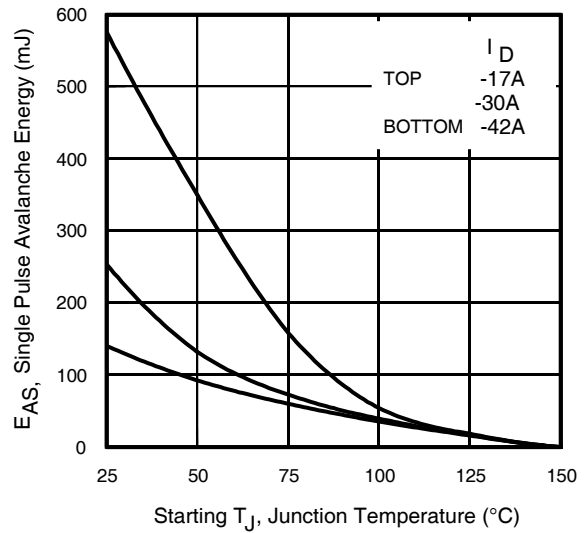


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

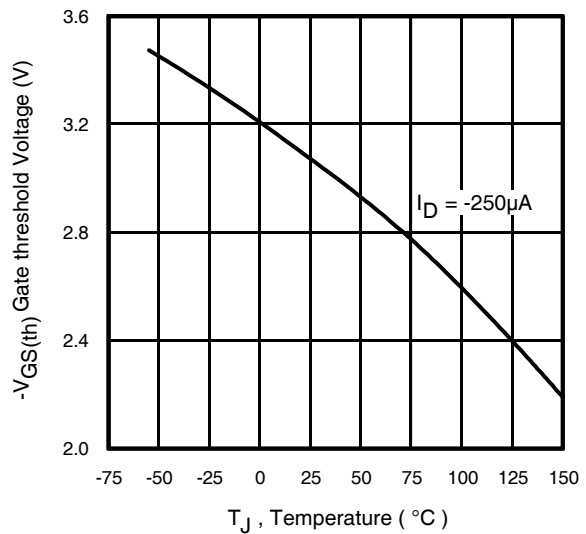


Fig 14. Threshold Voltage Vs. Temperature

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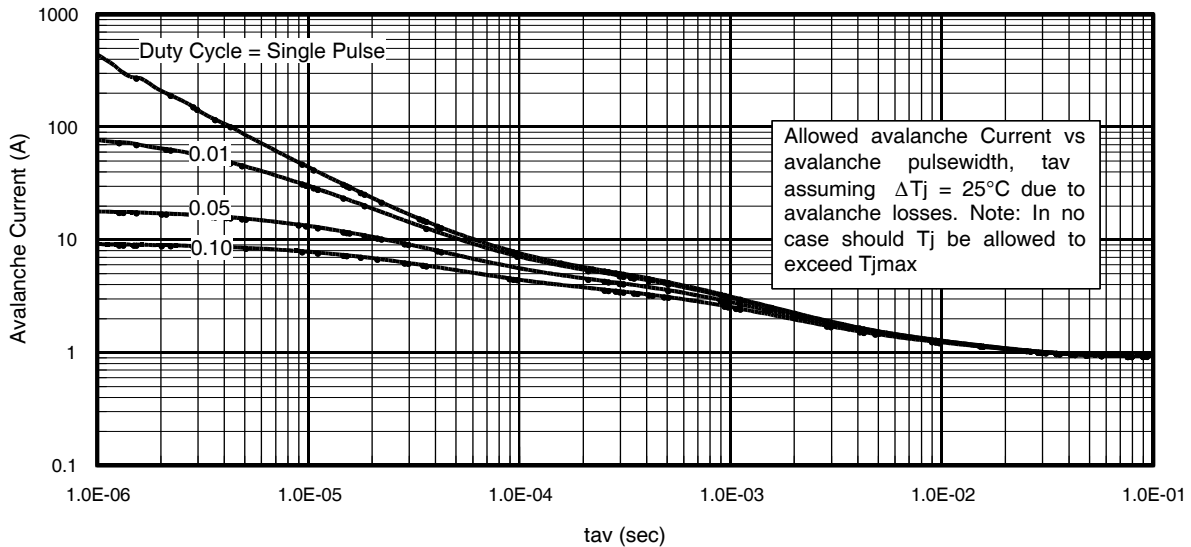


Fig 15. Typical Avalanche Current Vs. Pulsewidth

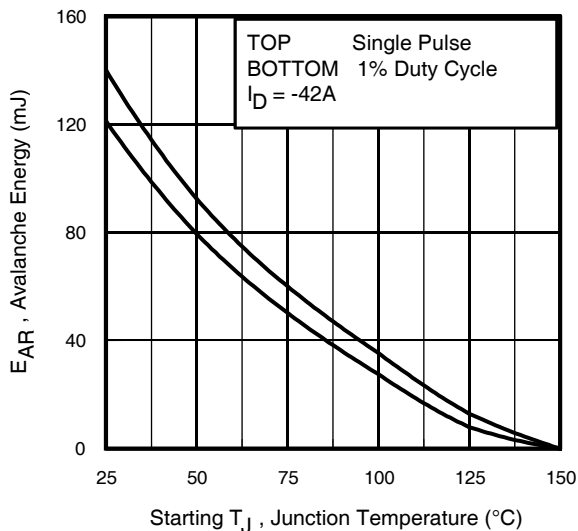


Fig 16. Maximum Avalanche Energy Vs. Temperature

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

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. ΔT = 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)

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

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

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

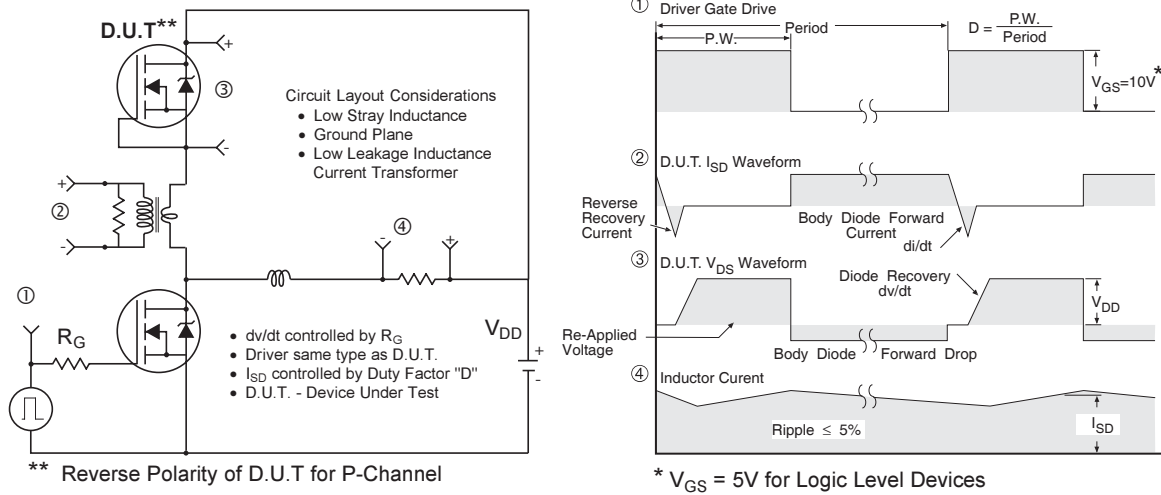


Fig 17. Peak Diode Recovery dv/dt Test Circuit for P-Channel HEXFET® Power MOSFETs

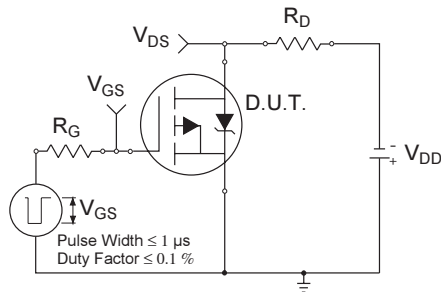


Fig 18a. Switching Time Test Circuit

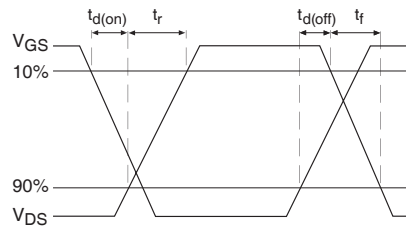
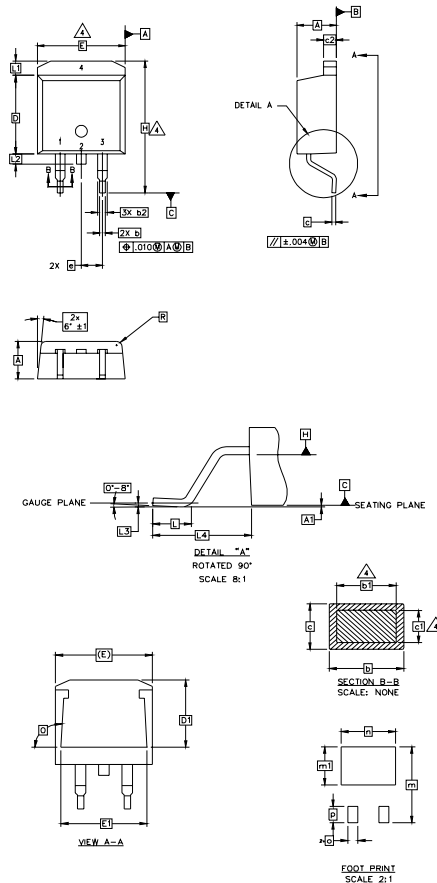


Fig 18b. Switching Time Waveforms

D²Pak 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 [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.

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		4
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1		1.65		.065	
L2	1.27	1.78	.050	.070	4
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	
m	17.78		.700		4
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		4
R	0.51	0.71	.020	.028	
g	90°	93°	90°	93°	

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

DIODES

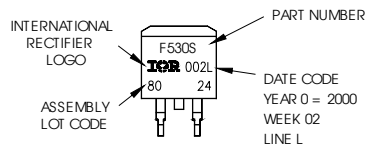
- 1.- ANODE *
- 2, 4.- CATHODE
- 3.- ANODE

* PART DEPENDENT.

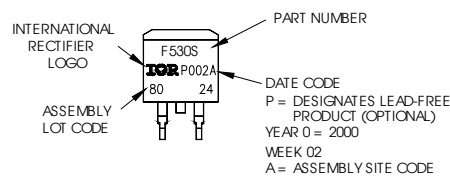
D²Pak Part Marking Information

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



International
IOR Rectifier

S Y M B O L	D I M E N S I O N S				N O T E S
	M I L L I M E T E R S		I N C H E S		
	M I N .	M A X .	M I N .	M A X .	
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	
c2	0.43	.063	.017	.029	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		3
E	9.65	10.67	.380	.420	
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	

<u>HEXFET</u>	<u>IGBT</u>
1.- GATE	1- GATE
2.- DRAIN	2- COLLECTOR
3.- SOURCE	3- EMITTER
4.- DRAIN	4- COLLECTOR

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.

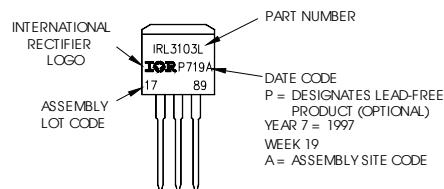
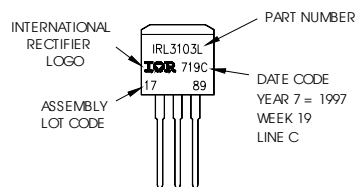
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.

5. CONTROLLING DIMENSION: INCH.

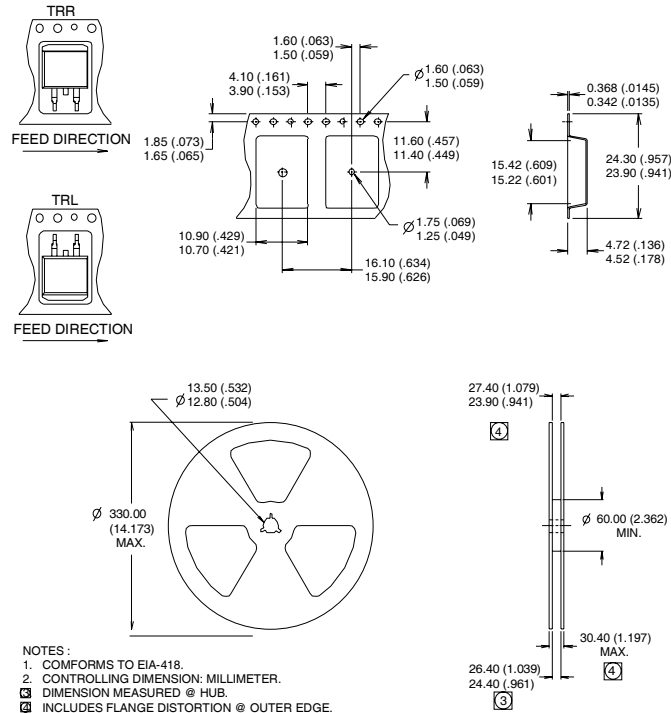
EXAMPLE: THIS IS AN IRL3103L
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

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

OR



D²Pak 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 D²Pak, 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_θ is measured at T_J approximately 90°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.

International
IR Rectifier

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

Visit us at www.irf.com for sales contact information. 08/05

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