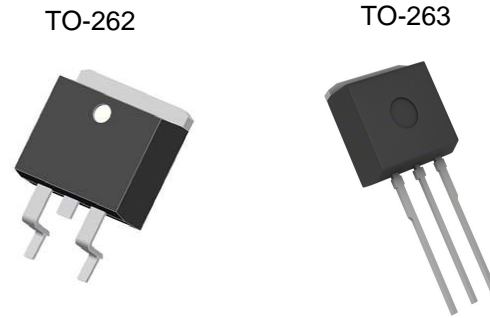
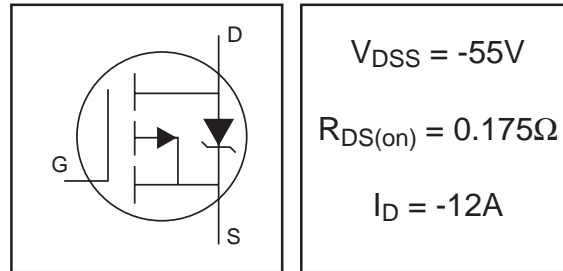


- Advanced Process Technology
- Surface Mount (IRF9Z24NS)
- Low-profile through-hole (IRF9Z24NL)
- 175°C Operating Temperature
- P-Channel
- Fast Switching
- Fully Avalanche Rated



Description

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 (IRF9Z24NL) 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	-12	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$ ⑤	-8.5	
I_{DM}	Pulsed Drain Current ①⑤	-48	
$P_D @ T_A = 25^\circ C$	Power Dissipation	3.8	W
$P_D @ T_C = 25^\circ C$	Power Dissipation	45	W
	Linear Derating Factor	0.30	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy②⑤	96	mJ
I_{AR}	Avalanche Current①	-7.2	A
E_{AR}	Repetitive Avalanche Energy①	4.5	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	—	3.3	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB Mounted,steady-state)**	—	40	

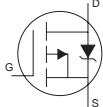


IRF9Z24NS/L

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	—	-0.05	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = -1\text{mA}$ ⑤
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.175	Ω	$V_{GS} = -10V, I_D = -7.2A$ 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	2.5	—	—	S	$V_{DS} = -25V, I_D = -7.2A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	-25	μA	$V_{DS} = -55V, V_{GS} = 0V$
		—	—	-250		$V_{DS} = -44V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
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	—	—	19	nC	$I_D = -7.2A$
Q_{gs}	Gate-to-Source Charge	—	—	5.1		$V_{DS} = -44V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	10		$V_{GS} = -10V$, See Fig. 6 and 13 ④⑤
$t_{d(on)}$	Turn-On Delay Time	—	13	—	ns	$V_{DD} = -28V$
t_r	Rise Time	—	55	—		$I_D = -7.2A$
$t_{d(off)}$	Turn-Off Delay Time	—	23	—		$R_G = 24\Omega$
t_f	Fall Time	—	37	—		$R_D = 3.7\Omega$, See Fig. 10 ④⑤
L_S	Internal Source Inductance		7.5		nH	Between lead, and center of die contact
C_{iss}	Input Capacitance	—	350	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	170	—		$V_{DS} = -25V$
C_{rss}	Reverse Transfer Capacitance	—	92	—		$f = 1.0\text{MHz}$, See Fig. 5⑤

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	-12	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) •	—	—	-48		
V_{SD}	Diode Forward Voltage	—	—	-1.6	V	$T_J = 25^\circ\text{C}, I_S = -7.2A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	47	71	ns	$T_J = 25^\circ\text{C}, I_F = -7.2A$
Q_{rr}	Reverse Recovery Charge	—	84	130	nC	$di/dt = -100A/\mu s$ 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 Starting $T_J = 25^\circ\text{C}, L = 3.7\text{mH}$
 $R_G = 25\Omega, I_{AS} = -7.2A$. (See Figure 12)
- ③ $I_{SD} \leq -7.2A, di/dt \leq -280A/\mu s, V_{DD} \leq V_{(BR)DSS}, T_J \leq 175^\circ\text{C}$
- ④ Pulse width $\leq 300\mu s$; duty cycle $\leq 2\%$.
- ⑤ Uses IRF9Z24N data and test conditions

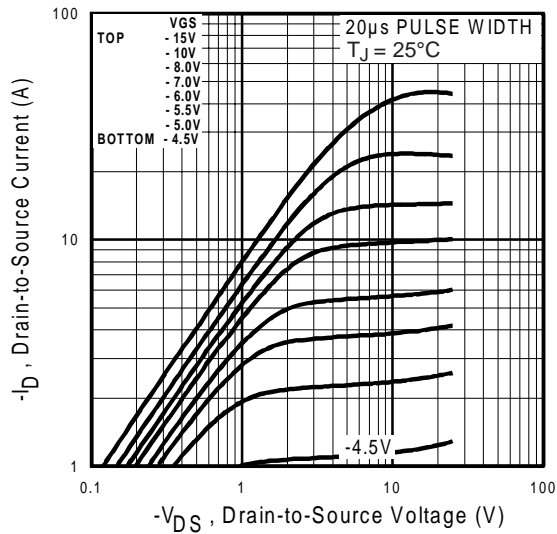


Fig 1. Typical Output Characteristics

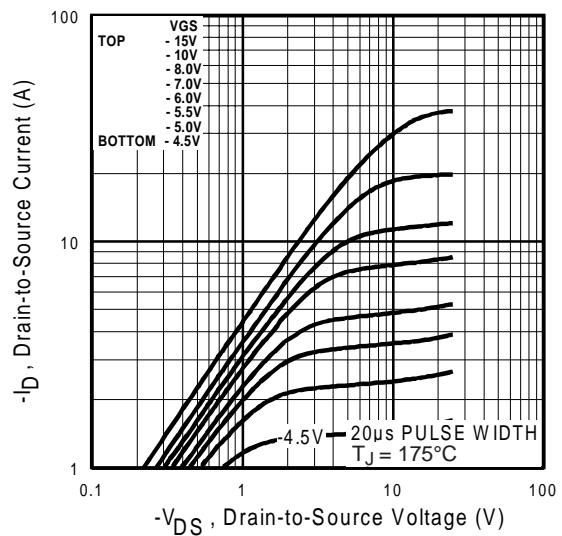


Fig 2. Typical Output Characteristics

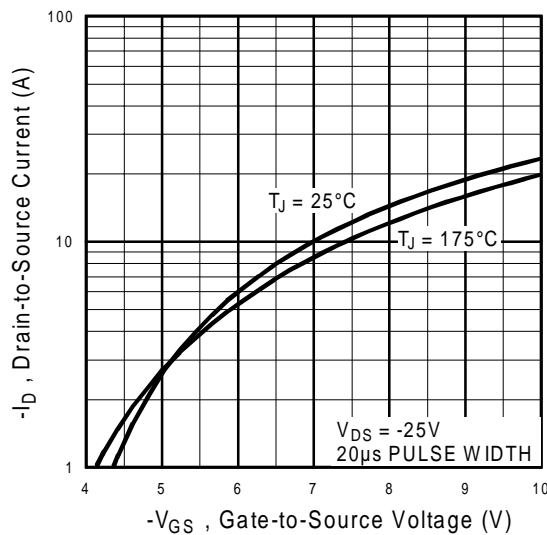


Fig 3. Typical Transfer Characteristics

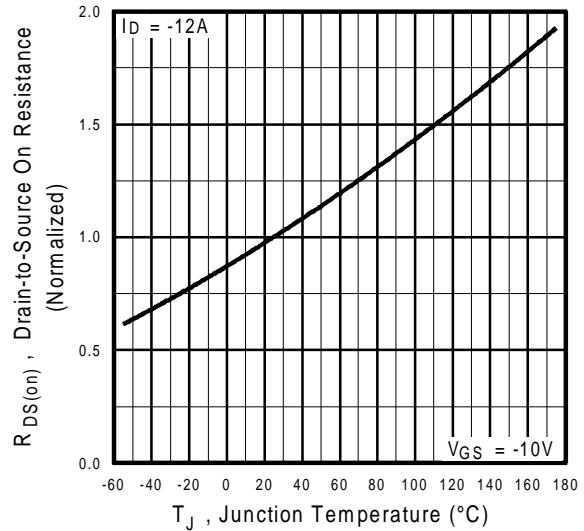


Fig 4. Normalized On-Resistance Vs. Temperature

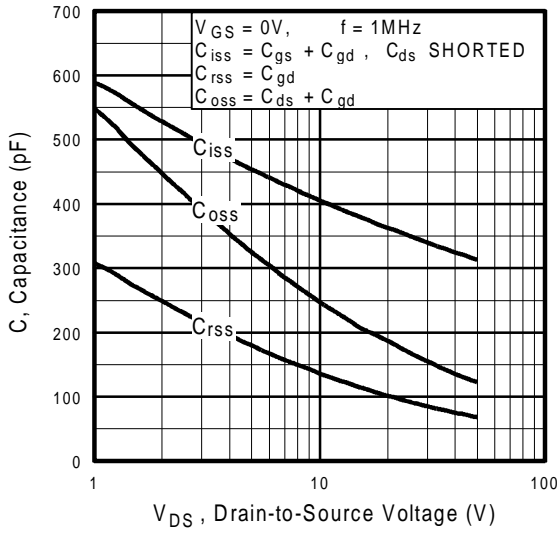


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

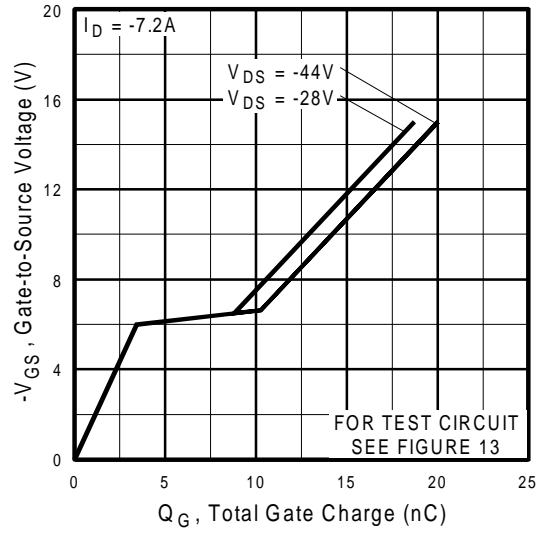


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

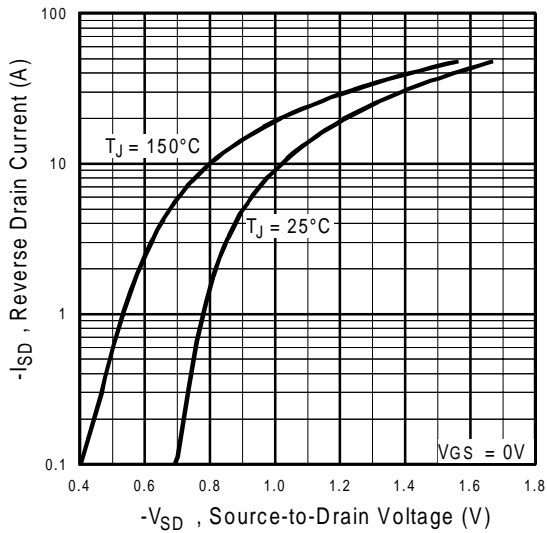


Fig 7. Typical Source-Drain Diode Forward Voltage

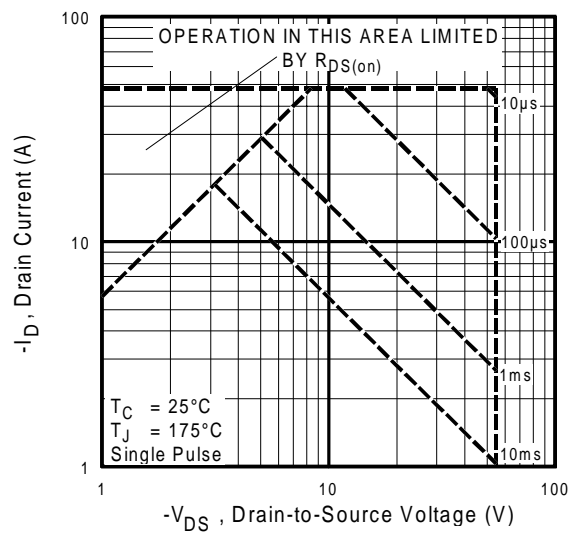


Fig 8. Maximum Safe Operating Area

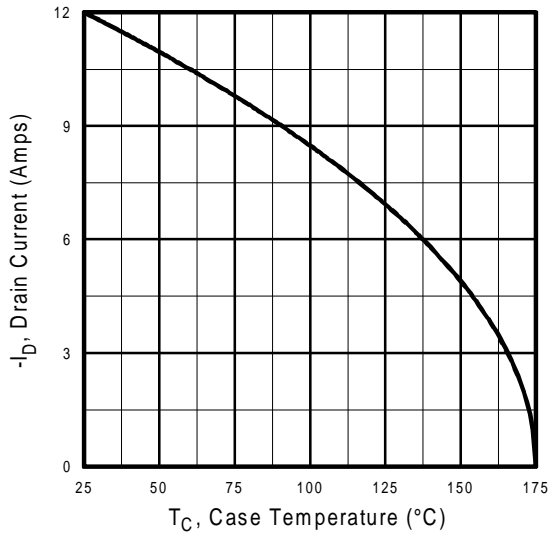


Fig 9. Maximum Drain Current Vs. Case Temperature

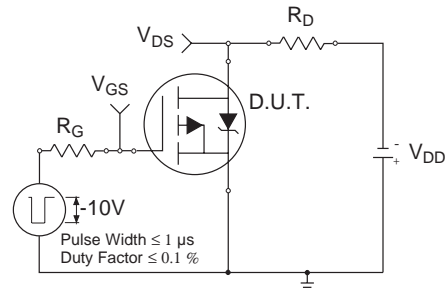


Fig 10a. Switching Time Test Circuit

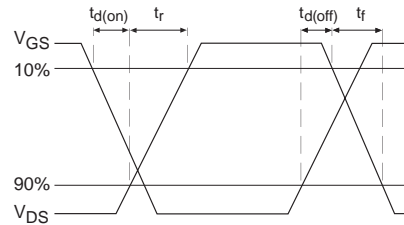


Fig 10b. Switching Time Waveforms

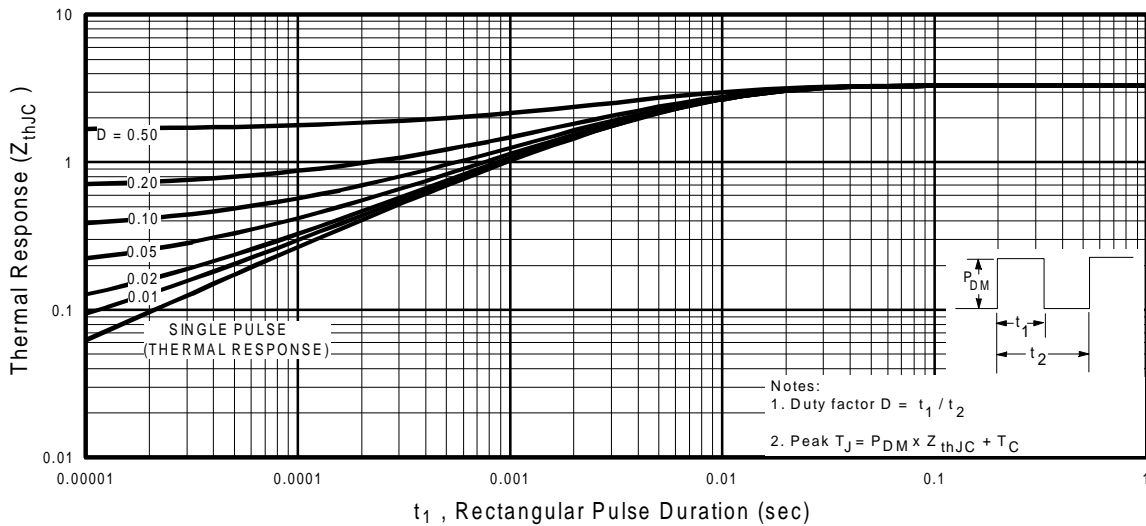


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

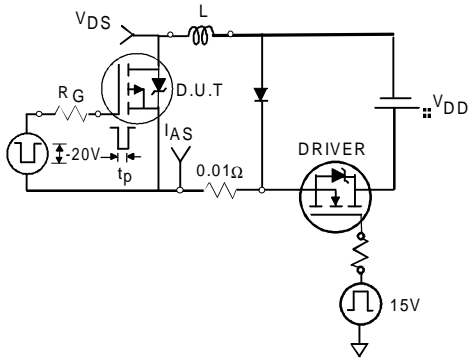


Fig 12a. Unclamped Inductive Test Circuit

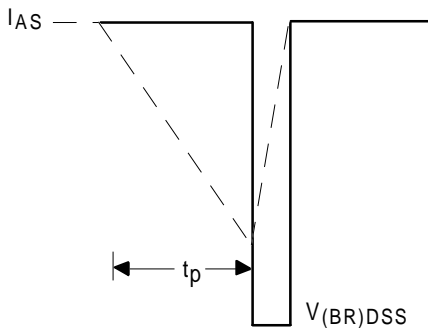


Fig 12b. Unclamped Inductive Waveforms

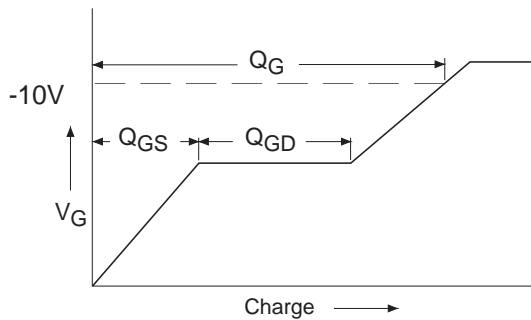


Fig 13a. Basic Gate Charge Waveform

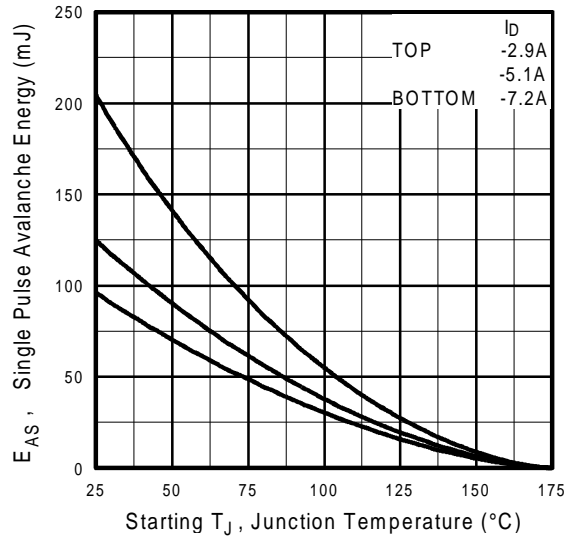


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

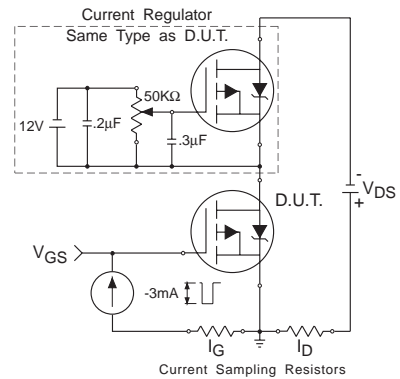
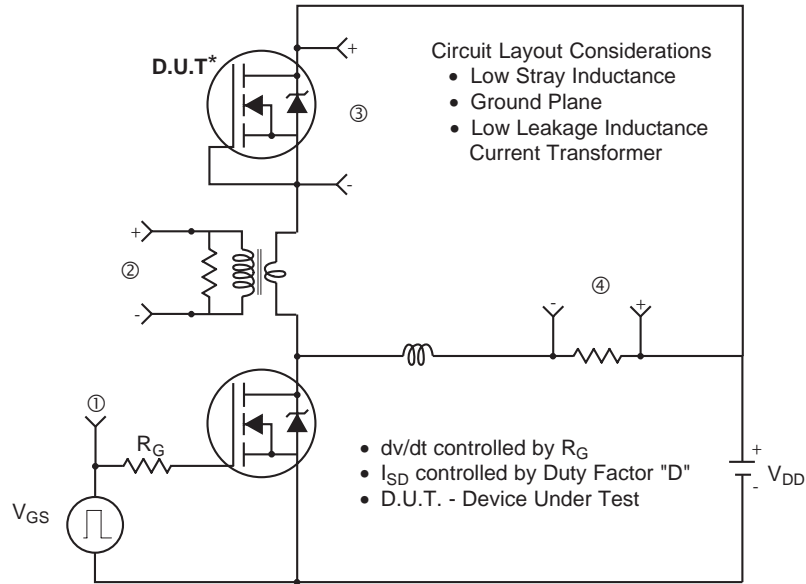
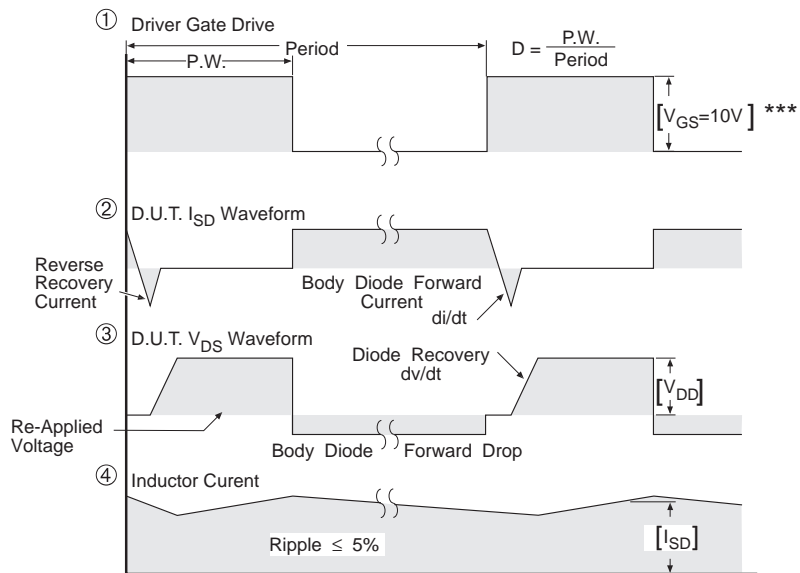


Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



* Reverse Polarity of D.U.T for P-Channel



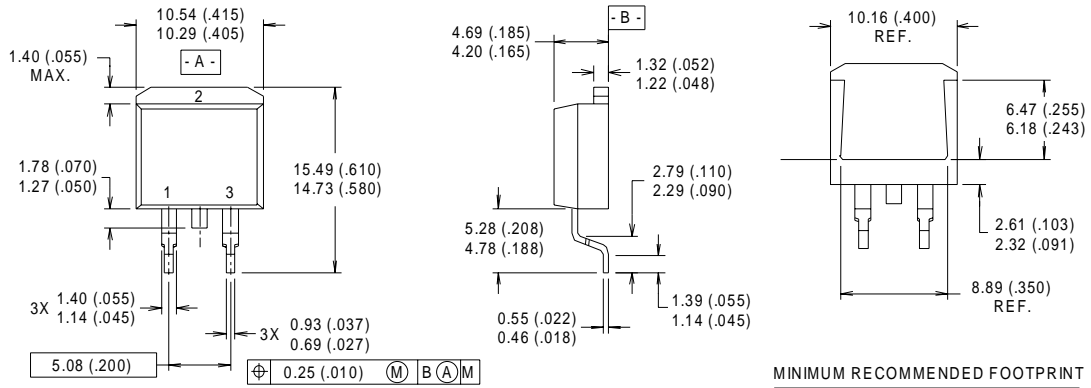
*** $V_{GS} = 5.0V$ for Logic Level and 3V Drive Devices

Fig 14. For P-Channel HEXFETS



IRF9Z24NS/L

D²Pak Package Outline



NOTES:

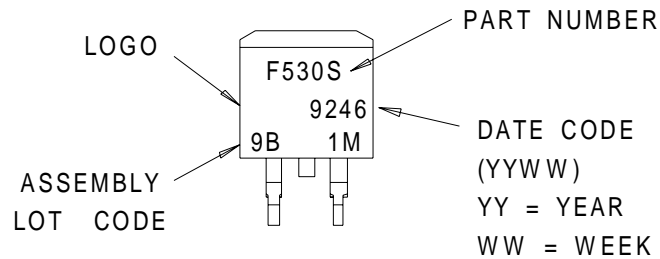
- 1 DIMENSIONS AFTER SOLDER DIP.
- 2 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 3 CONTROLLING DIMENSION : INCH.
- 4 HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

LEAD ASSIGNMENTS

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

Part Marking Information

D²Pak

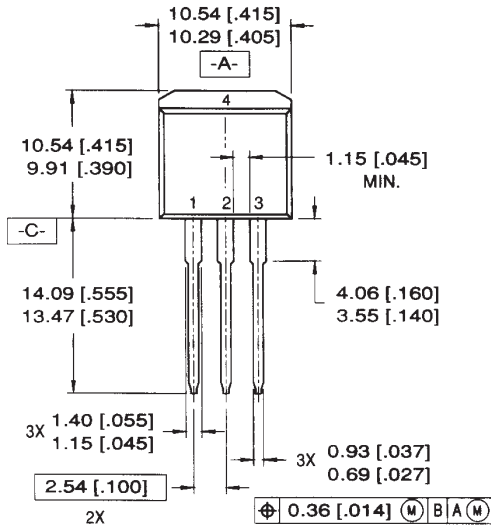




IRF9Z24NS/L

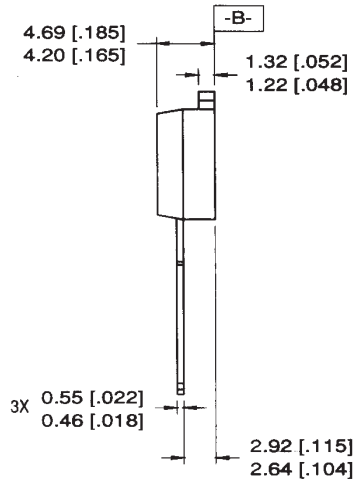
Package Outline

TO-262 Outline



LEAD ASSIGNMENTS

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



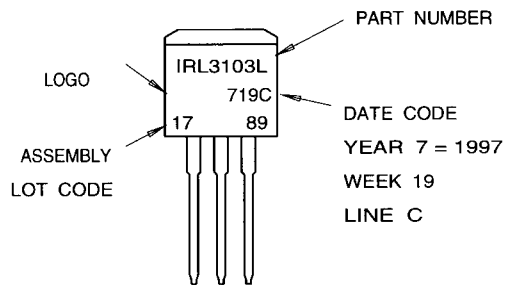
NOTES:

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

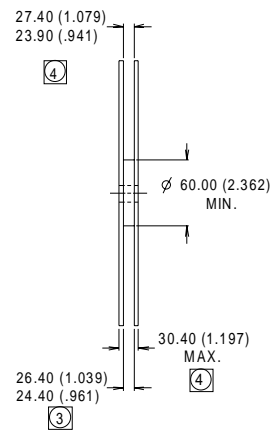
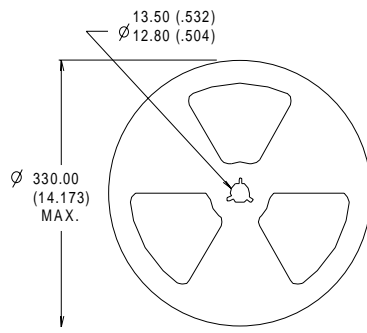
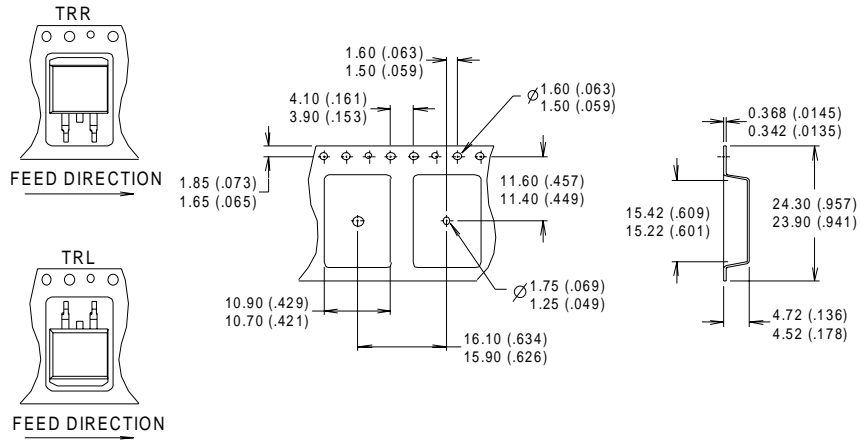
EXAMPLE: THIS IS AN IRL3103L
 LOT CODE 1789
 ASSEMBLED ON WW 19, 1997
 IN THE ASSEMBLY LINE "C"





IRF9Z24NS/L

Tape & Reel Information D²Pak



- NOTES :
1. CONFORMS TO EIA-418.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSION MEASURED @ HUB.
 4. INCLUDES FLANGE DISTORTION @ OUTER EDGE.