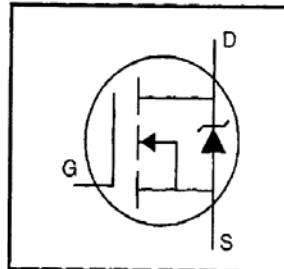


# IRFD024PbF

- Dynamic dv/dt Rating
- For Automatic Insertion
- End Stackable
- 175°C Operating Temperature
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Lead-Free

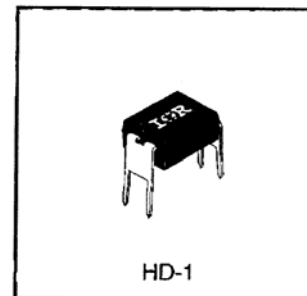


$V_{DSS} = 60V$
$R_{DS(on)} = 0.10\Omega$
$I_D = 2.5A$

## Description

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

The 4-pin DIP package is a low cost machine-insertable case style which can be stacked in multiple combinations on standard 0.1 inch pin centers. The dual drain serves as a thermal link to the mounting surface for power dissipation levels up to 1 watt.



## Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_A = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	2.5	A
$I_D @ T_A = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	1.8	
$I_{DM}$	Pulsed Drain Current ①	20	
$P_D @ T_A = 25^\circ C$	Power Dissipation	1.3	W
	Linear Derating Factor	0.0083	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy ②	91	mJ
dv/dt	Peak Diode Recovery dv/dt ③	4.5	V/ns
$T_J$	Operating Junction and	-55 to +175	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10sec		

## Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient	—	120	°C/W

# IRFD024PbF

International  
IR Rectifier

## Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
V <sub>(BR)DSS</sub>	Drain-to-Source Breakdown Voltage	60	—	—	V	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA
ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	0.061	—	V/°C	Reference to 25°C, I <sub>D</sub> =1mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	—	0.10	Ω	V <sub>GS</sub> =10V, I <sub>D</sub> =1.5A ④
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	—	4.0	V	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA
g <sub>fs</sub>	Forward Transconductance	0.90	—	—	S	V <sub>DS</sub> =25V, I <sub>D</sub> =1.5A ④
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	25	μA	V <sub>DS</sub> =60V, V <sub>GS</sub> =0V
		—	—	250		V <sub>DS</sub> =48V, V <sub>GS</sub> =0V, T <sub>J</sub> =150°C
I <sub>GSS</sub>	Gate-to-Source Forward Leakage	—	—	100	nA	V <sub>GS</sub> =20V
	Gate-to-Source Reverse Leakage	—	—	-100		V <sub>GS</sub> =-20V
Q <sub>G</sub>	Total Gate Charge	—	—	25	nC	I <sub>D</sub> =17A
Q <sub>Gs</sub>	Gate-to-Source Charge	—	—	5.8		V <sub>DS</sub> =48V
Q <sub>Gd</sub>	Gate-to-Drain ("Miller") Charge	—	—	11		V <sub>GS</sub> =10V See Fig. 6 and 13 ④
t <sub>d(on)</sub>	Turn-On Delay Time	—	13	—	ns	V <sub>DD</sub> =30V I <sub>D</sub> =17A R <sub>G</sub> =18Ω R <sub>D</sub> =1.7Ω See Figure 10 ④
t <sub>r</sub>	Rise Time	—	58	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	25	—		
t <sub>f</sub>	Fall Time	—	42	—		
L <sub>D</sub>	Internal Drain Inductance	—	4.0	—	nH	Between lead, 6 mm (0.25in.) from package and center of die contact
L <sub>S</sub>	Internal Source Inductance	—	6.0	—		
C <sub>iss</sub>	Input Capacitance	—	640	—	pF	V <sub>GS</sub> =0V V <sub>DS</sub> =25V f=1.0MHz See Figure 5
C <sub>oss</sub>	Output Capacitance	—	360	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	79	—		

## Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	2.5	A	MOSFET symbol showing the integral reverse p-n junction diode.
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	20		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.5	V	T <sub>J</sub> =25°C, I <sub>S</sub> =2.5A, V <sub>GS</sub> =0V ④
t <sub>rr</sub>	Reverse Recovery Time	—	88	180	ns	T <sub>J</sub> =25°C, I <sub>F</sub> =17A
Q <sub>rr</sub>	Reverse Recovery Charge	—	0.29	0.64	μC	di/dt=100A/μs ④
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> +L <sub>D</sub> )				

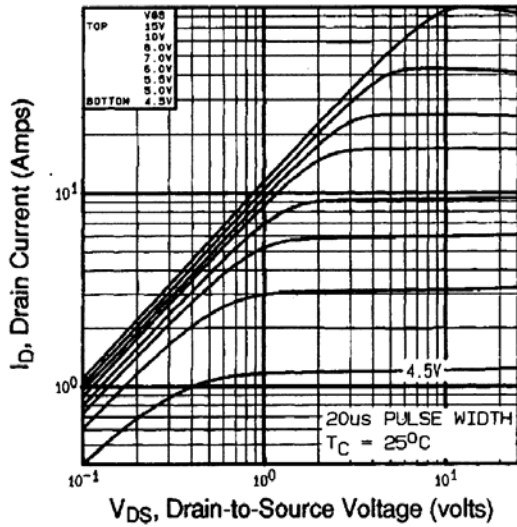
### Notes:

① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)

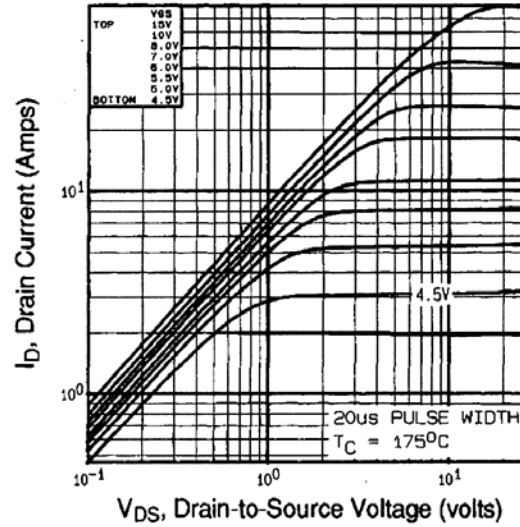
② V<sub>DD</sub>=25V, starting T<sub>J</sub>=25°C, L=16mH  
R<sub>G</sub>=25Ω, I<sub>AS</sub>=2.5A (See Figure 12)

③ I<sub>SD</sub>≤17A, di/dt≤140A/μs, V<sub>DD</sub>≤V<sub>(BR)DSS</sub>,  
T<sub>J</sub>≤175°C

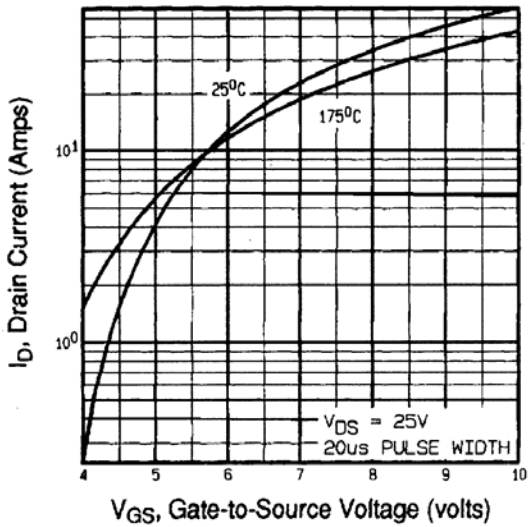
④ Pulse width ≤ 300 μs; duty cycle ≤2%.



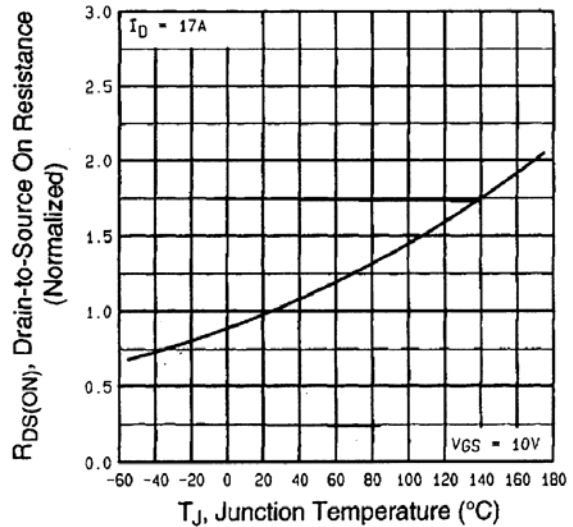
**Fig 1.** Typical Output Characteristics,  
 $T_C=25^\circ\text{C}$



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

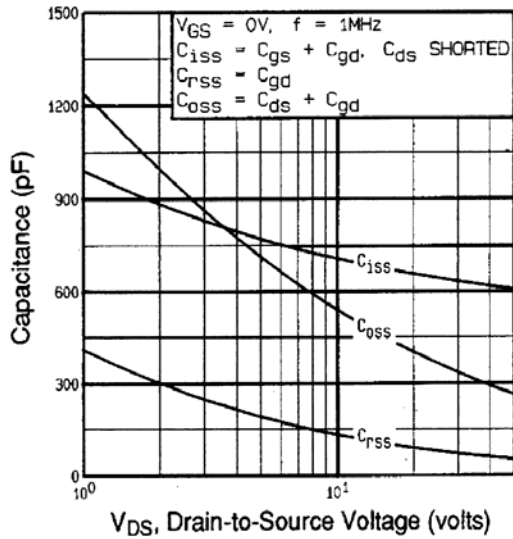


**Fig 3.** Typical Transfer Characteristics

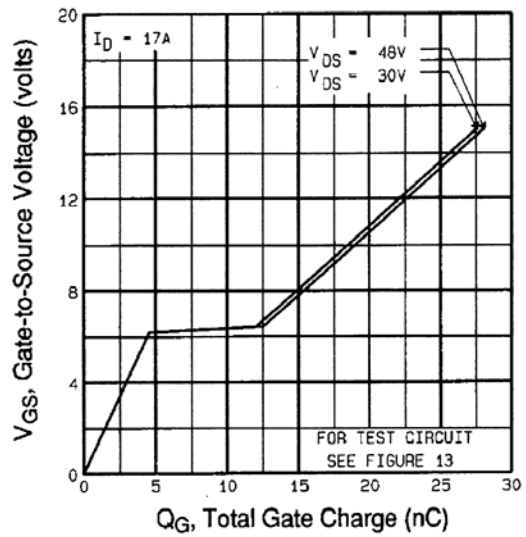


**Fig 4.** Normalized On-Resistance  
 Vs. Temperature

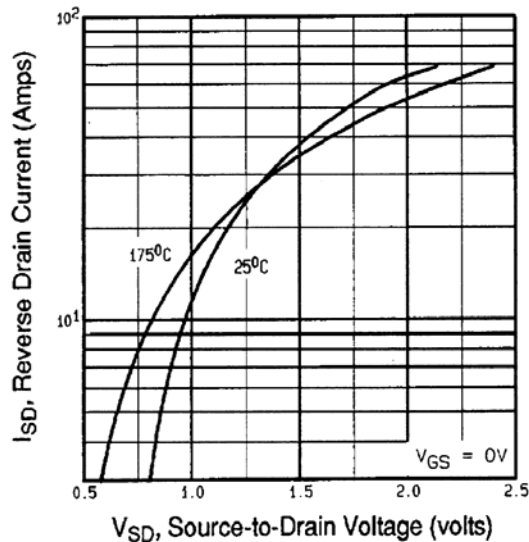
# IRFD024PbF



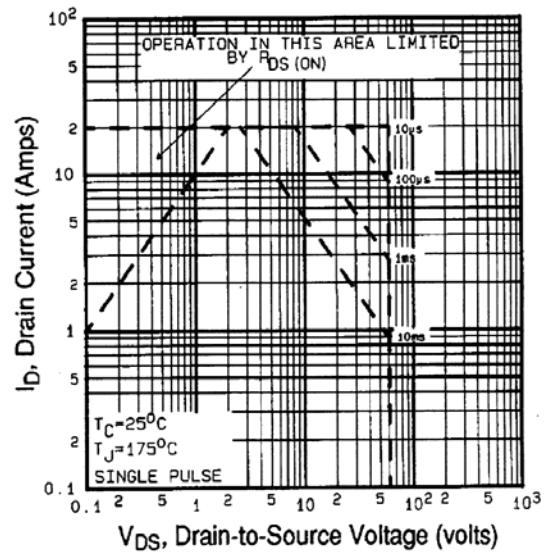
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



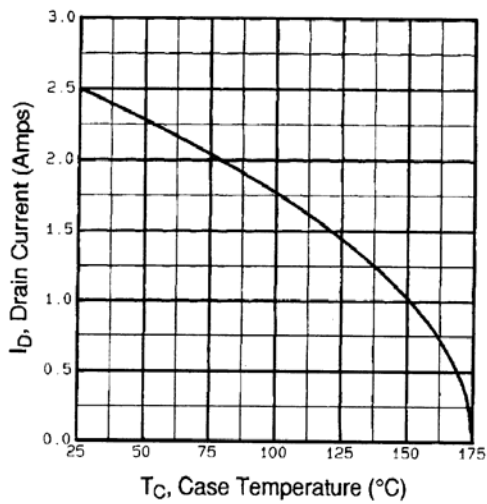
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



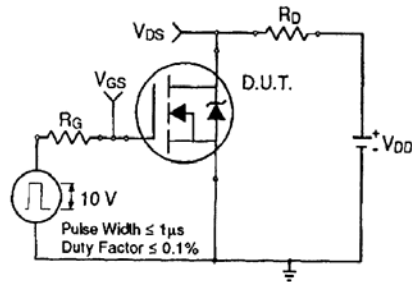
**Fig 7.** Typical Source-Drain Diode Forward Voltage



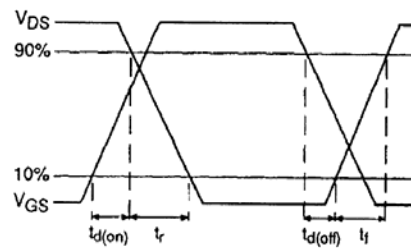
**Fig 8.** Maximum Safe Operating Area



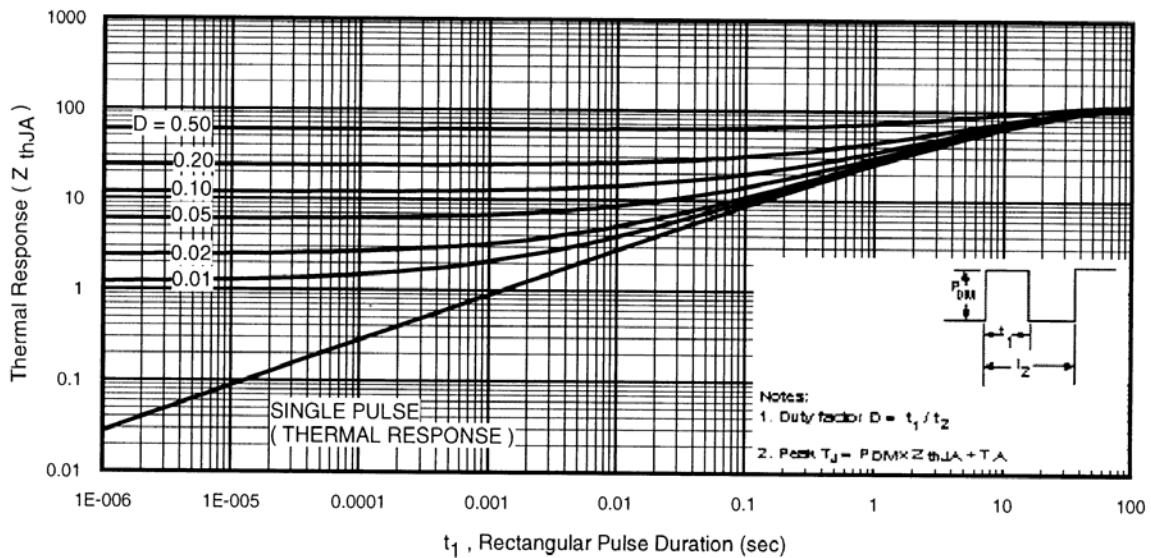
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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

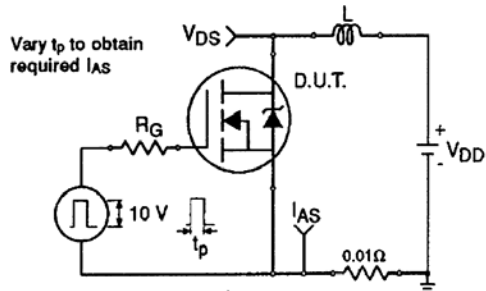


**Fig 10b.** Switching Time Waveforms

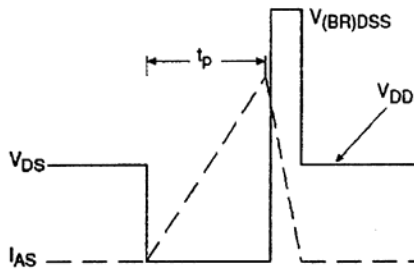


**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

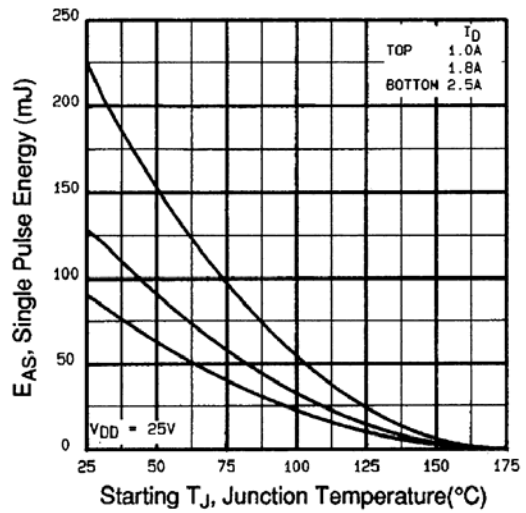
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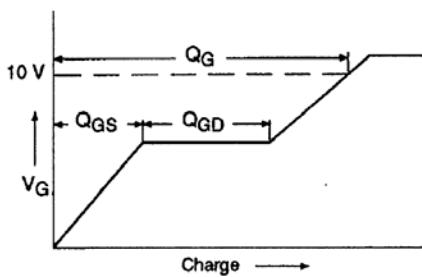
**Fig 12a. Unclamped Inductive Test Circuit**



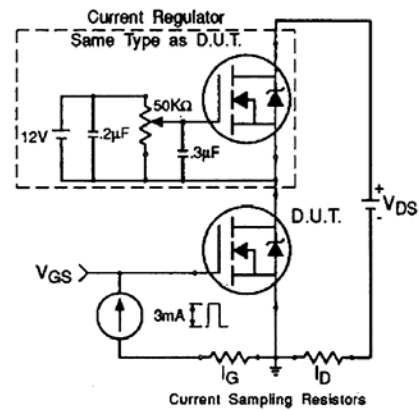
**Fig 12b. Unclamped Inductive Waveforms**



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

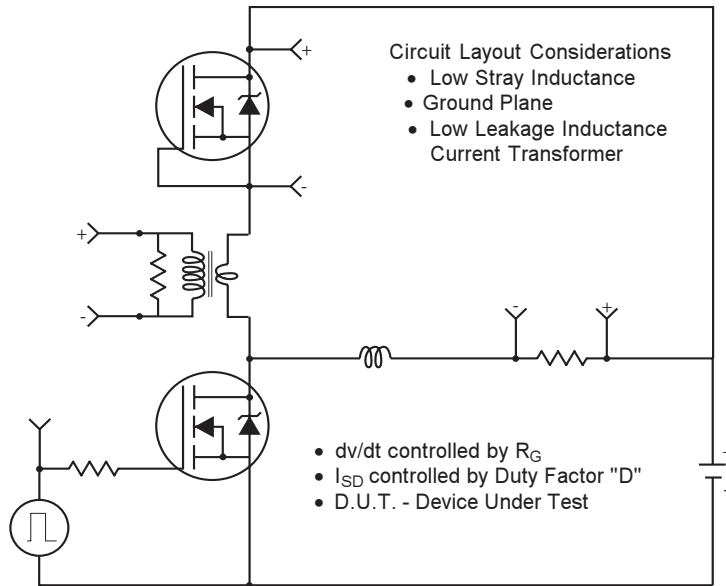


**Fig 13a. Basic Gate Charge Waveform**



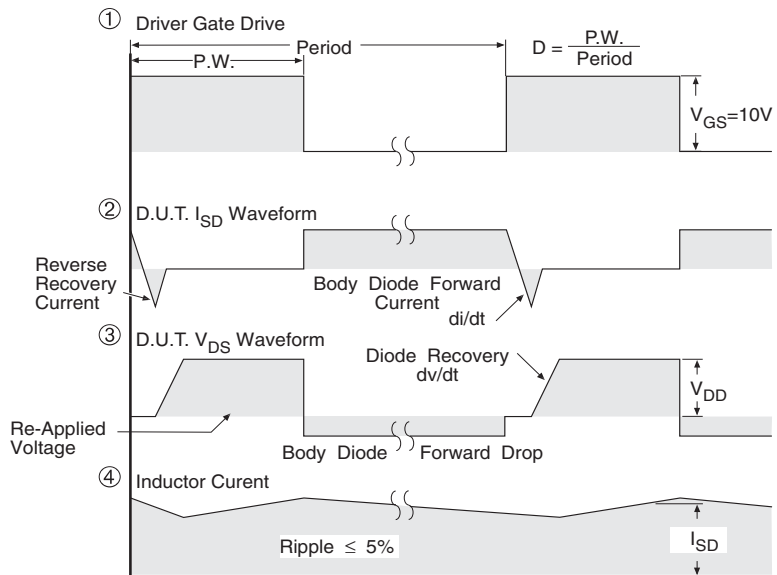
**Fig 13b. Gate Charge Test Circuit**

## Peak Diode Recovery dv/dt Test Circuit



\* Reverse Polarity for P-Channel

\*\* Use P-Channel Driver for P-Channel Measurements



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

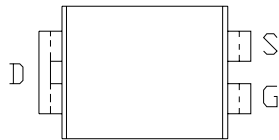
**Fig -14** For N Channel HEXFETS

# IRFD024PbF

## Hexdip Package Outline

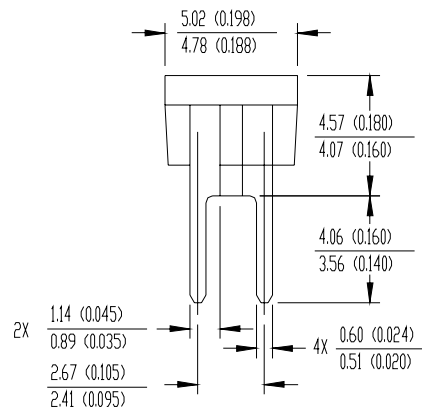
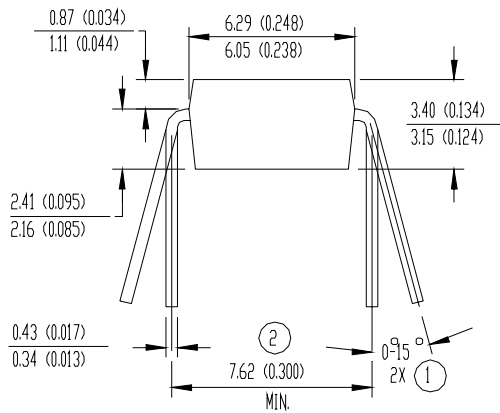
Dimensions are shown in millimeters (inches)

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**IR** Rectifier



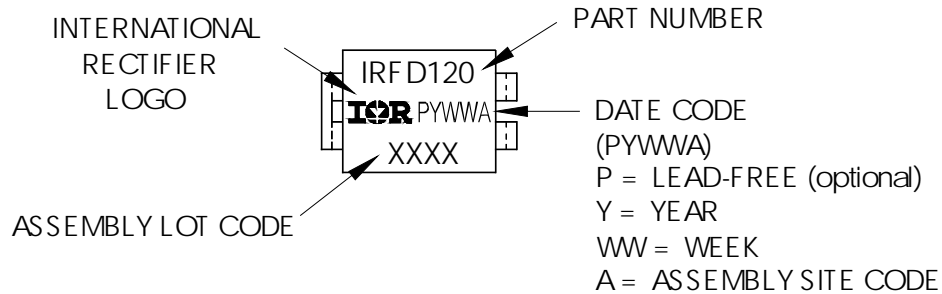
NOTES:

- ① APPLIES TO SPREAD OF LEADS PRIOR TO INSTALLATION
- ② APPLIES TO INSTALLED LEAD CENTERS
- 3 CONTROLLING DIMENSION: INCH.
- 4 DIMENSIONS ARE SHOWN MILLIMETERS (INCHES).
- 5 CASE STYLE HD-1 (SIMILAR TO JEDEC OUTLINE MO-001AN)
- 6 DIMENSIONS SHOWN ARE BEFORE SOLDER DIP  
SOLDER DIP MAX. + 0.16 (0.006)



## Hexdip Part Marking Information

EXAMPLE: THIS IS AN IRFD120



Data and specifications subject to change without notice.

International  
**IR** Rectifier

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08/05

Document Number: 91126

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