International
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AUTOMOTIVE MOSFET

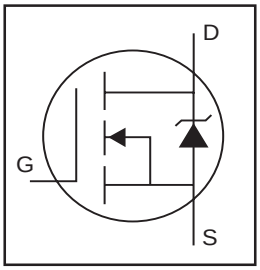
PD - 96040

IRF1404ZPbF
IRF1404ZSPbF
IRF1404ZLPbF

HEXFET® Power MOSFET

Features

- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax
- Lead-Free



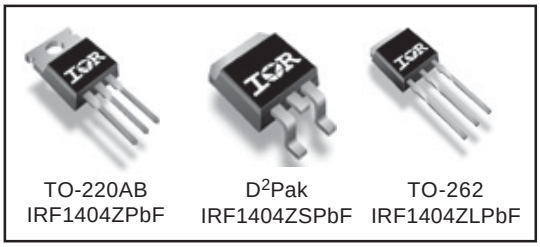
V_{DSS} = 40V

$R_{DS(on)}$ = 3.7mΩ

I_D = 75A

Description

Specifically designed for Automotive applications, this HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°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 Automotive applications and a wide variety of other applications.



TO-220AB	D^2Pak	TO-262
IRF1404ZPbF	IRF1404ZSPbF	IRF1404ZLPbF

Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	180	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	120	
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Package Limited)	75	
I_{DM}	Pulsed Drain Current ①	710	
P_D @T_C = 25°C	Power Dissipation	200	W
	Linear Derating Factor	1.3	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS} (Thermally limited)	Single Pulse Avalanche Energy②	330	mJ
E_{AS} (Tested)	Single Pulse Avalanche Energy Tested Value ⑥	480	
I_{AR}	Avalanche Current ①	See Fig.12a, 12b, 15, 16	A
E_{AR}	Repetitive Avalanche Energy ⑤		mJ
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	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	——	0.75 ⑨	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat Greased Surface ⑦	0.50	——	
$R_{\theta JA}$	Junction-to-Ambient ⑦	——	62	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount) ⑧	——	40	

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	—	—	V	V_{GS} = 0V, I_D = 250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.033	—	V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	2.7	3.7	mΩ	V_{GS} = 10V, I_D = 75A ③
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	V_{DS} = V_{GS}, I_D = 250µA
gfs	Forward Transconductance	170	—	—	V	V_{DS} = 25V, I_D = 75A
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	µA	V_{DS} = 40V, V_{GS} = 0V
		—	—	250		V_{DS} = 40V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	V_{GS} = 20V
	Gate-to-Source Reverse Leakage	—	—	-200		V_{GS} = -20V
Q_g	Total Gate Charge	—	100	150		I_D = 75A
Q_{gs}	Gate-to-Source Charge	—	31	—	nC	V_{DS} = 32V
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	42	—		V_{GS} = 10V ③
$t_{d(on)}$	Turn-On Delay Time	—	18	—		V_{DD} = 20V
t_r	Rise Time	—	110	—		I_D = 75A
$t_{d(off)}$	Turn-Off Delay Time	—	36	—	ns	R_G = 3.0 Ω
t_f	Fall Time	—	58	—		V_{GS} = 10V ③
L_D	Internal Drain Inductance	—	4.5	—		Between lead,
					nH	6mm (0.25in.)
L_S	Internal Source Inductance	—	7.5	—		from package
						and center of die contact
C_{iss}	Input Capacitance	—	4340	—		V_{GS} = 0V
C_{oss}	Output Capacitance	—	1030	—		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	—	550	—	pF	f = 1.0MHz
C_{oss}	Output Capacitance	—	3300	—		V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz
C_{oss}	Output Capacitance	—	920	—		V_{GS} = 0V, V_{DS} = 32V, f = 1.0MHz
C_{oss} eff.	Effective Output Capacitance	—	1350	—		V_{GS} = 0V, V_{DS} = 0V to 32V ④

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current	—	—	75		MOSFET symbol
	(Body Diode)				A	showing the
I_{SM}	Pulsed Source Current	—	—	750		integral reverse
	(Body Diode) ①					p-n junction diode.
V_{SD}	Diode Forward Voltage	—	—	1.3	V	T_J = 25°C, I_S = 75A, V_{GS} = 0V ③
t_{rr}	Reverse Recovery Time	—	28	42	ns	T_J = 25°C, I_F = 75A, V_{DD} = 20V
Q_{rr}	Reverse Recovery Charge	—	34	51	nC	di/dt = 100A/µs ③
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

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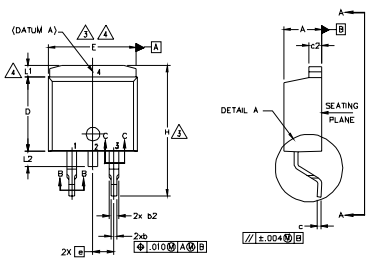
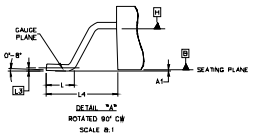
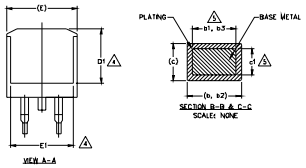
D²Pak Package Outline (Dimensions are shown in millimeters (inches))







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 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	–	.270		4
E	9.65	10.67	.380	.420	3,4
E1	6.22	–	.245		4
e	2.54 BSC		.100 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1	–	1.65	–	.066	4
L2	1.27	1.78	–	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	

LEAD ASSIGNMENTS

HEXFET

1.– GATE
2, 4.– DRAIN
3.– SOURCE

IGBTs, CoPACK

1.– GATE
2, 4.– COLLECTOR
3.– EMITTER

DIODES

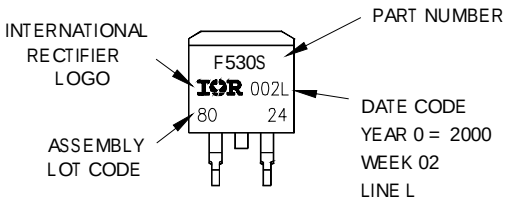
1.– ANODE *
2, 4.– CATHODE
3.– ANODE

* PART DEPENDENT.

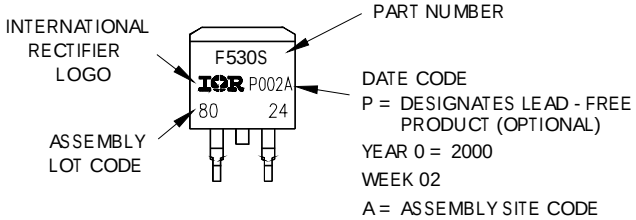
D²Pak Part Marking Information

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



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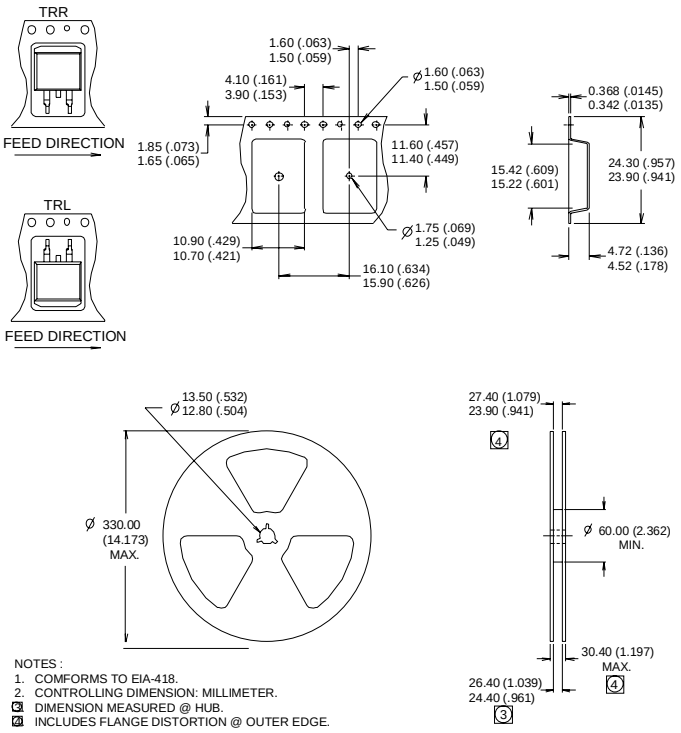
D²Pak Tape & Reel Information



Notes:

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

② Limited by T_{Jmax}, starting T_J = 25°C, L = 0.11mH R_G = 25Ω, I_{AS} = 75A, V_{GS} =10V. Part not recommended for use above this value.

③ Pulse width ≤ 1.0ms; duty cycle ≤ 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 only applied to TO-220AB pakcage.

⑧ 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.

⑨ TO-220 device will have an Rth value of 0.65°C/W.

TO-220AB package is not recommended for Surface Mount Application.

Data and specifications subject to change without notice.
This product has been designed and qualified for the Automotive [Q101]market.

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