

# IRFR9024

## P-Channel Enhancement Mode Field Effect Transistor

### General Description

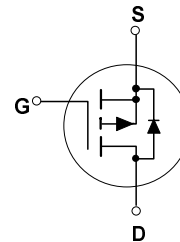
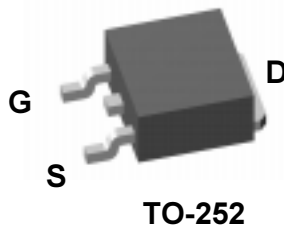
This P-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers.

These MOSFETs feature faster switching and lower gate charge than other MOSFETs with comparable  $R_{DS(ON)}$  specifications.

The result is a MOSFET that is easy and safer to drive (even at very high frequencies), and DC/DC power supply designs with higher overall efficiency.

### Features

- -8.8 A, -60 V.  $R_{DS(ON)} = 0.28 \Omega @ V_{GS} = -10 V$
- Low gate charge.
- Fast switching speed.
- High performance technology for low  $R_{DS(ON)}$ .



### Absolute Maximum Ratings $T_c=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Rated	Units
$V_{DSS}$	Drain-Source Voltage	-60	V
$V_{GSS}$	Gate-Source Voltage	$\pm 20$	V
$I_D$	Maximum Drain Current -Continuous (Note 1)	-8.8	A
	$T_C = 100^\circ\text{C}$ (Note 1)	-5.6	
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$ (Note 1)	42	W
	$T_A = 25^\circ\text{C}$ (Note 1a)	3.2	
	$T_A = 25^\circ\text{C}$ (Note 1b)	1.3	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	$^\circ\text{C}$

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction-to- Case (Note 1)	3.0	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to- Ambient (Note 1a)	38	$^\circ\text{C/W}$

### Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
IRFR9024	IRFR9024	13"	16mm	2500

\* Die and manufacturing source subject to change without prior notification.

## Electrical Characteristics

$T_C = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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### DRAIN-SOURCE AVALANCHE RATINGS (Note 2)

$W_{DSS}$	Single Pulse Drain-Source Avalanche Energy	$V_{DD} = -25\text{ V}$ , $I_D = -8.8\text{ A}$			300	mJ
$I_{AR}$	Maximum Drain-Source Avalanche Current				-8.8	A

### Off Characteristics

$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$ , $I_D = -250\ \mu\text{A}$	-60			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		-60		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -60\text{ V}$ , $V_{GS} = 0\text{ V}$			100	$\mu\text{A}$
		$V_{DS} = -48\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125^\circ\text{C}$			500	
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$			100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -20\text{ V}$ , $V_{DS} = 0\text{ V}$			-100	nA

### On Characteristics (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = -250\ \mu\text{A}$	-2	-2.3	-4	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = -250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		3.2		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = -10\text{ V}$ , $I_D = -5.3\text{ A}$			0.280	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = -25\text{ V}$ , $I_D = -5.3\text{ A}$	2.9			S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = -25\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$		560		pF
$C_{oss}$	Output Capacitance			130		pF
$C_{rss}$	Reverse Transfer Capacitance			35		pF

### Switching Characteristics (Note 2)

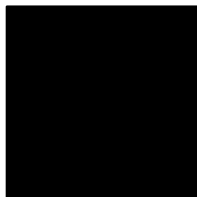
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -30\text{ V}$ , $I_D = -11\text{ A}$ , $V_{GS} = -10\text{ V}$ , $R_{GEN} = 18\ \Omega$		8		ns
$t_r$	Turn-On Rise Time			20		ns
$t_{d(off)}$	Turn-Off Delay Time			20		ns
$t_f$	Turn-Off Fall Time			5		ns
$Q_g$	Total Gate Charge	$V_{DS} = -48\text{ V}$ , $I_D = -11\text{ A}$ , $V_{GS} = -10\text{ V}$			19	nC
$Q_{gs}$	Gate-Source Charge				5.4	nC
$Q_{gd}$	Gate-Drain Charge				11	nC

### Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain-Source Diode Forward Current (Note 2)				-8.8	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current (Note 2)				-35	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}$ , $I_S = -8.8\text{ A}$ (Note 2)			-6.3	V
$t_{rr}$	Drain-Source Reverse Recovery Time	$I_F = -11\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$			200	nS

#### Notes:

- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the drain tab.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



■ a)  $R_{\theta JA} = 38^\circ\text{C/W}$  when mounted on a  
1 in<sup>2</sup> pad of 2oz copper.



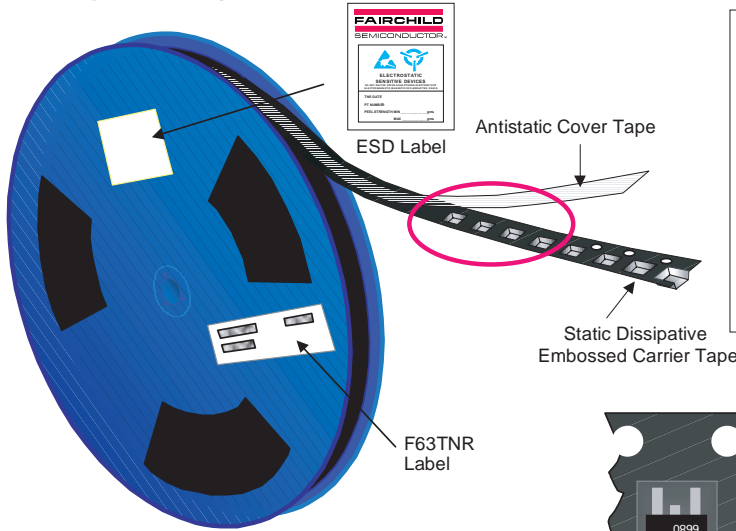
■ b)  $R_{\theta JA} = 96^\circ\text{C/W}$  when mounted on a  
minimum pad.

- Scale 1 : 1 on letter size paper  
2. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

# TO-252 Tape and Reel Data and Package Dimensions



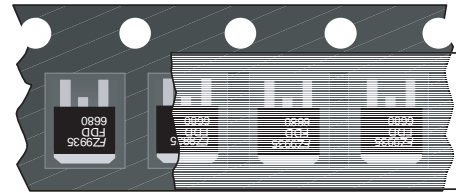
## D-PAK (TO-252) Packaging Configuration: Figure 1.0



### Packaging Description:

TO-252 parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 2500 units per 13" or 330mm diameter reel. The reels are dark blue in color and is made of polystyrene plastic (anti-static coated). This and some other options are further described in the Packaging Information table.

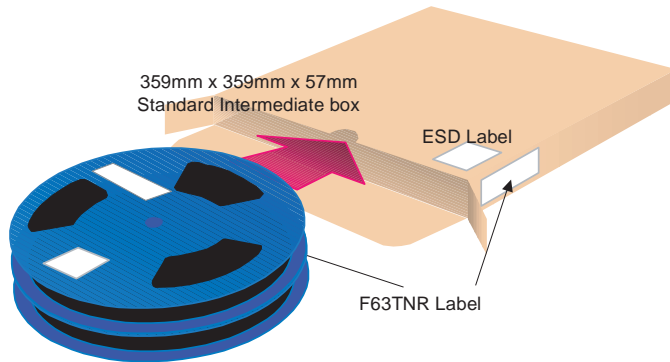
These full reels are individually barcode labeled and placed inside a standard intermediate box (illustrated in figure 1.0) made of recyclable corrugated brown paper. One box contains two reels maximum. And these boxes are placed inside a barcode labeled shipping box which comes in different sizes depending on the number of parts shipped.



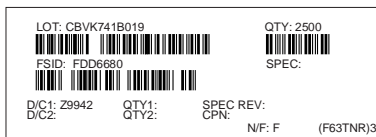
D-PAK (TO-252) Unit Orientation

D-PAK (TO-252) Packaging Information	
Packaging Option	Standard (no flow code)
Packaging type	TNR
Qty per Reel/Tube/Bag	2,500
Reel Size	13" Dia
Box Dimension (mm)	359x359x57
Max qty per Box	5,000
Weight per unit (gm)	0.300
Weight per Reel(kg)	1.200
Note/Comments	

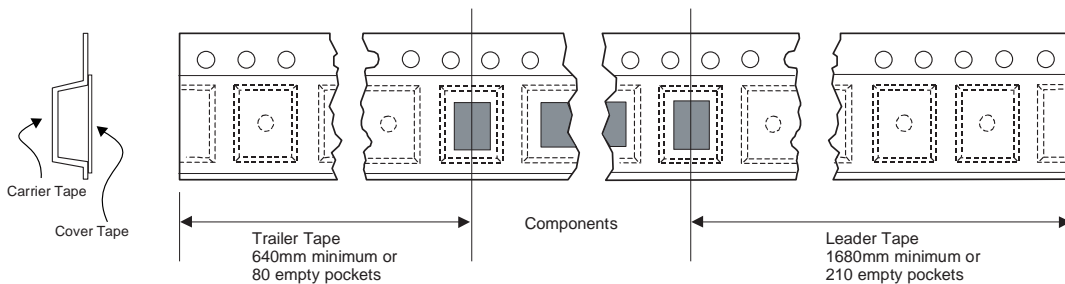
359mm x 359mm x 57mm  
Standard Intermediate box



### F63TNR Label sample

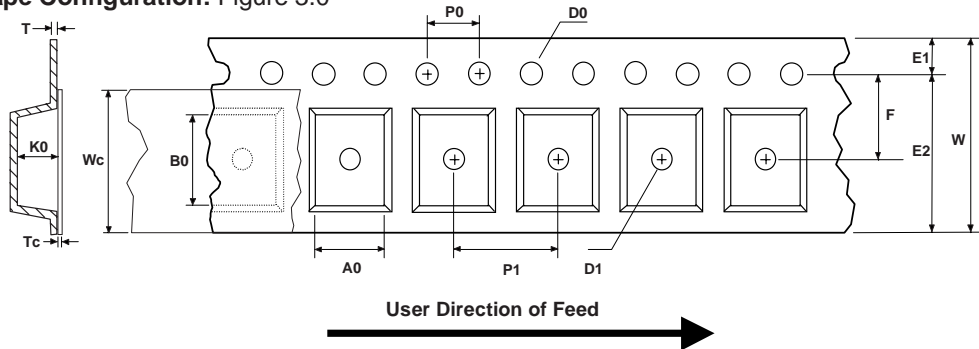


## TO-252 (D-PAK) Tape Leader and Trailer Configuration: Figure 2.0



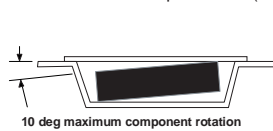
# TO-252 Tape and Reel Data and Package Dimensions

## D-PAK (TO-252) Embossed Carrier Tape Configuration: Figure 3.0

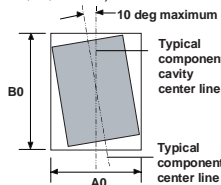


Dimensions are in millimeter														
Pkg type	A0	B0	W	D0	D1	E1	E2	F	P1	P0	K0	T	Wc	Tc
TO252 (24mm)	6.90 +/-0.10	10.50 +/-0.10	16.0 +/-0.3	1.55 +/-0.05	1.5 +/-0.10	1.75 +/-0.10	14.25 min	7.50 +/-0.10	8.0 +/-0.1	4.0 +/-0.1	2.65 +/-0.10	0.30 +/-0.05	13.0 +/-0.3	0.06 +/-0.02

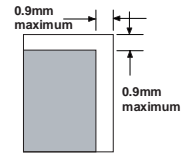
Notes: A0, B0, and K0 dimensions are determined with respect to the EIA/Jedec RS-481 rotational and lateral movement requirements (see sketches A, B, and C).



Sketch A (Side or Front Sectional View)  
Component Rotation

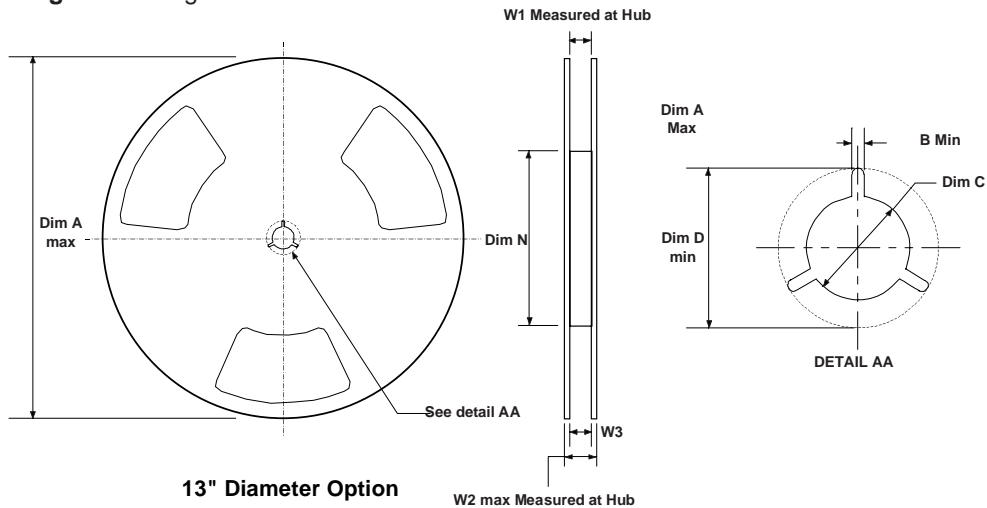


Sketch B (Top View)  
Component Rotation



Sketch C (Top View)  
Component lateral movement

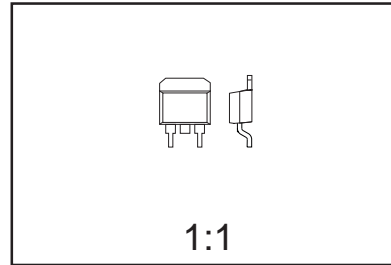
## D-PAK (TO-252) Reel Configuration: Figure 4.0



Dimensions are in inches and millimeters									
Tape Size	Reel Option	Dim A	Dim B	Dim C	Dim D	Dim N	Dim W1	Dim W2	Dim W3 (LSL-USL)
164mm	13" Dia	13.00 330	0.059 1.5	512 +0.020/-0.008 13 +0.5/-0.2	0.795 20.2	4.00 100	0.646 +0.078/-0.000 16.4 +2/0	0.882 22.4	0.626 - 0.764 15.9 - 19.4

# TO-252 Tape and Reel Data and Package Dimensions

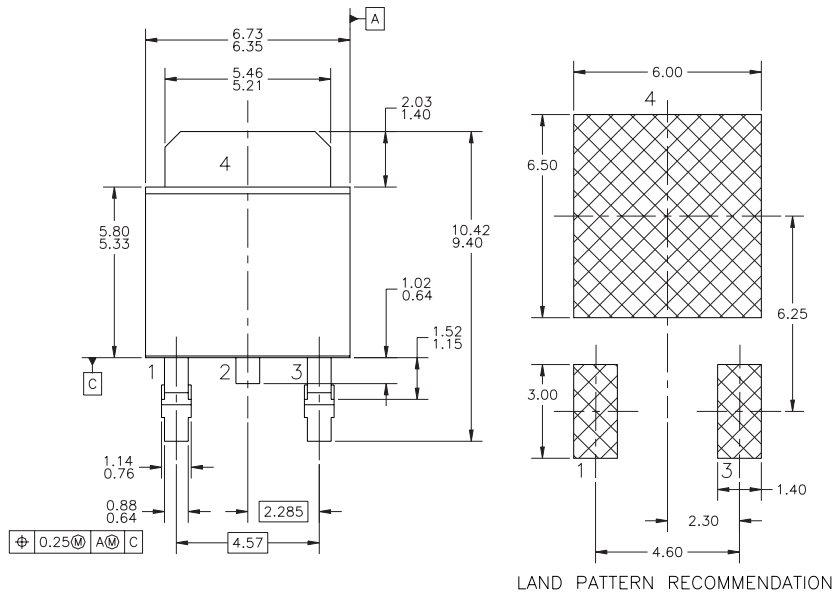
## TO-252 (FS PKG Code AA)



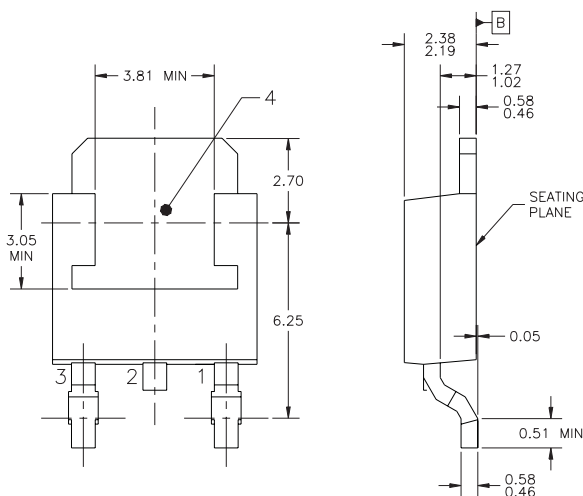
Scale 1:1 on letter size paper

Dimensions shown below are in:  
inches [millimeters]

Part Weight per unit (gram): 0.300



LAND PATTERN RECOMMENDATION



NOTES: UNLESS OTHERWISE SPECIFIED

- A) ALL DIMENSIONS ARE IN MILLIMETERS.
- B) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE B, VARIATION AB, ITEM 10.268, DATED SEPTEMBER 1988.

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