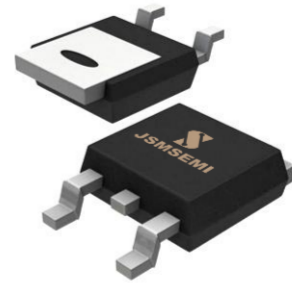


## Description:

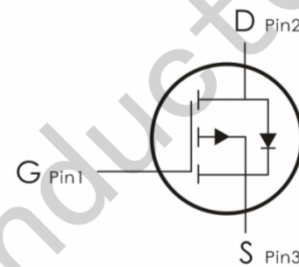
This P-Channel MOSFET uses advanced trench technology and design to provide excellent  $R_{DS(on)}$  with low gate charge.

It can be used in a wide variety of applications.



## Features:

- 1)  $V_{DS}=-60V, I_D=-15A, R_{DS(ON)}<0.090 \Omega @V_{GS}=-10V$
- 2) Low gate charge.
- 3) Green device available.
- 4) Advanced high cell density trench technology for ultra  $R_{DS(ON)}$ .
- 5) Excellent package for good heat dissipation.



## Absolute Maximum Ratings: ( $T_C=25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Ratings	Units
$V_{DS}$	Drain-Source Voltage	-60	V
$V_{GS}$	Gate-Source Voltage	$\pm 25$	V
$I_D$	Continuous Drain Current	-15	A
	Continuous Drain Current- $T_C=100^\circ\text{C}$	-9.5	
	Pulsed Drain Current <sup>1</sup>	-45	
$P_D$	Power Dissipation	36	W
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	$^\circ\text{C}$

## Thermal Characteristics:

Symbol	Parameter	Max	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	3.5	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	110	

## Package Marking and Ordering Information:

Part NO.	Marking	Package
IRFR9024N	FR9024N	TO-252

**Electrical Characteristics:** ( $T_C=25^{\circ}\text{C}$  unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\ \mu\text{A}$	-60	---	---	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{GS}=0V, V_{DS}=-60V$	---	---	-1	$\mu\text{A}$
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS}=\pm 25V, V_{DS}=0A$	---	---	$\pm 100$	nA
<b>On Characteristics</b>						
$V_{GS(th)}$	GATE-Source Threshold Voltage	$V_{GS}=V_{DS}, I_D=250\ \mu\text{A}$	-1	---	-3	V
$R_{DS(ON)}$	Drain-Source On Resistance <sup>2</sup>	$V_{GS}=-10V, I_D=-12A$	---	---	90	$m\ \Omega$
		$V_{GS}=-4.5V, I_D=-9A$	---	---	120	
$G_{FS}$	Forward Transconductance	$V_{DS}=-10V, I_D=-9A$	---	14	---	S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS}=-25V, V_{GS}=0V, f=1\text{MHz}$	---	1660	2660	pF
$C_{oss}$	Output Capacitance		---	160	---	
$C_{rss}$	Reverse Transfer Capacitance		---	100	---	
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time <sup>2</sup>	$V_{DS}=-30V, I_D=-9A,$ $R_{GEN}=3.3\ \Omega, V_{GS}=-10V$	---	10	---	ns
$t_r$	Rise Time		---	19	---	ns
$t_{d(off)}$	Turn-Off Delay Time		---	46	---	ns
$t_f$	Fall Time		---	53	---	ns
$Q_g$	Total Gate Charge <sup>2</sup>	$V_{GS}=-4.5V, V_{DS}=-48V,$ $I_D=-9A$	---	17	27	nC
$Q_{gs}$	Gate-Source Charge		---	5	---	nC
$Q_{gd}$	Gate-Drain "Miller" Charge		---	6	---	nC
<b>Drain-Source Diode Characteristics</b>						
$V_{SD}$	Source-Drain Diode Forward Voltage <sup>2</sup>	$V_{GS}=0V, I_S=-9A, T_J=25^{\circ}\text{C}$	---	---	-1.2	V
$T_{rr}$	Reverse Recovery Time <sup>2</sup>	$I_S=-9A, V_{GS}=0V.$ $dI/dt=100A/\mu\text{s}$	---	56	---	Ns
$Q_{rr}$	Reverse Recovery Charge		---	159	---	nc

Notes: 1.Pulse width limited by Max. junction temperature.

 2.Pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .

Typical Characteristics: ( $T_c=25^\circ\text{C}$  unless otherwise noted)

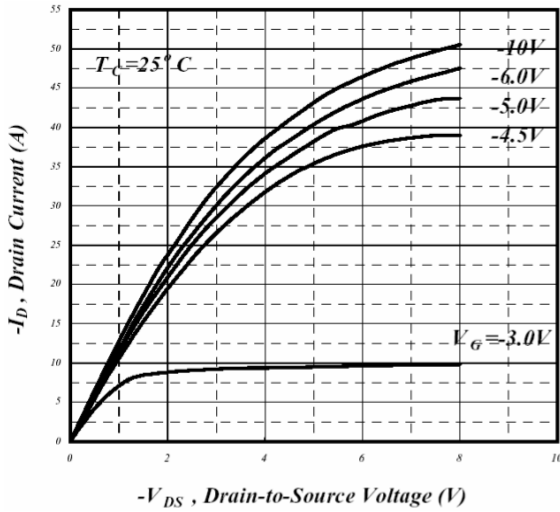


Fig 1. Typical Output Characteristics

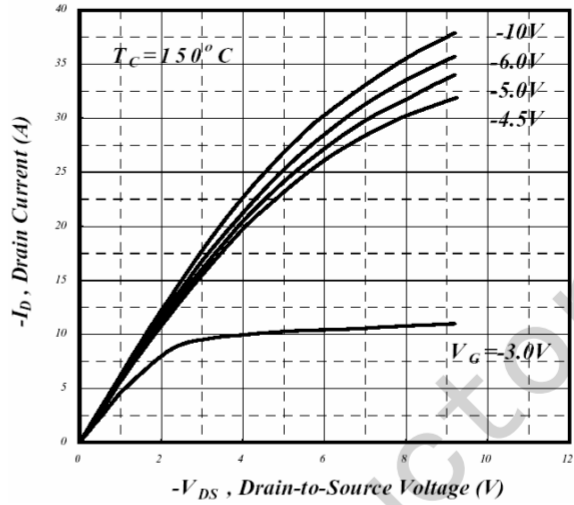


Fig 2. Typical Output Characteristics

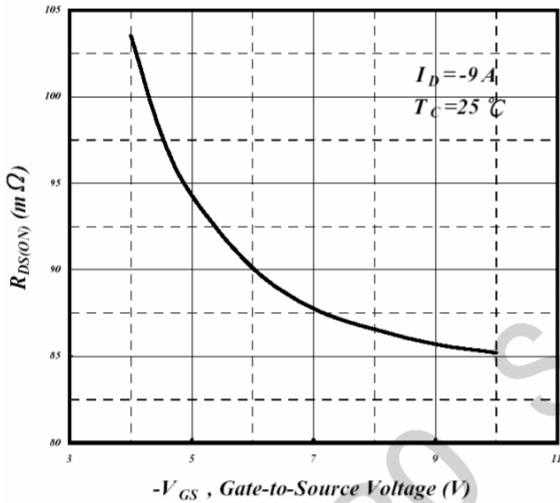


Fig 3. On-Resistance v.s. Gate Voltage

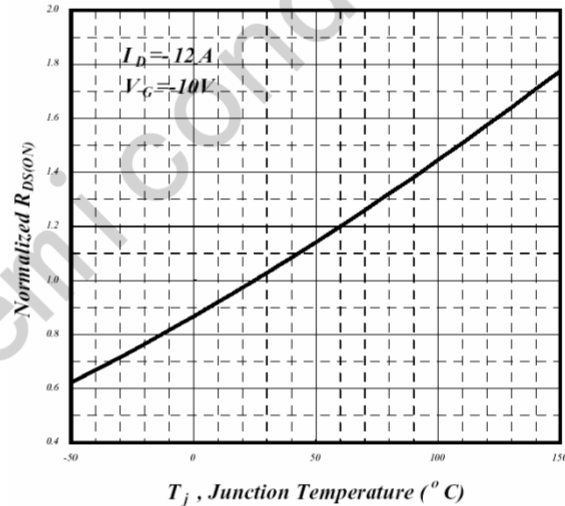


Fig 4. Normalized On-Resistance v.s. Junction Temperature

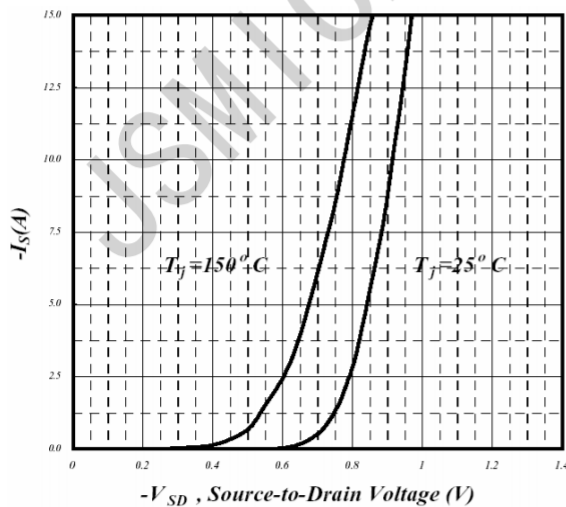


Fig 5. Forward Characteristics of Reverse Diode

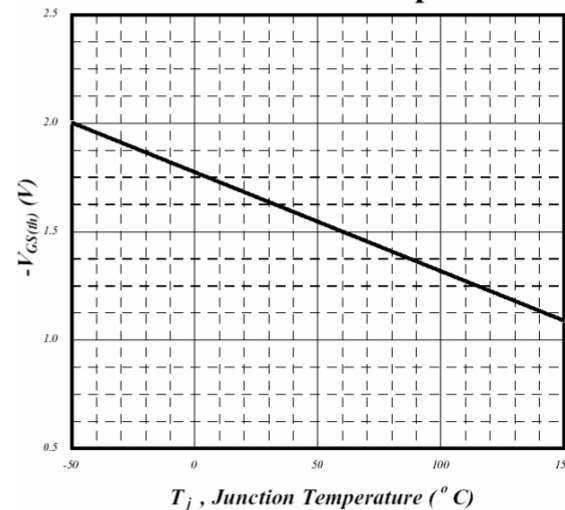


Fig 6. Gate Threshold Voltage v.s. Junction Temperature

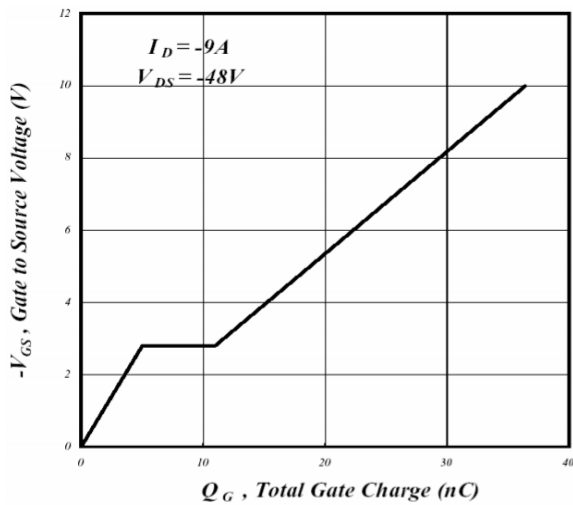


Fig 7. Gate Charge Characteristics

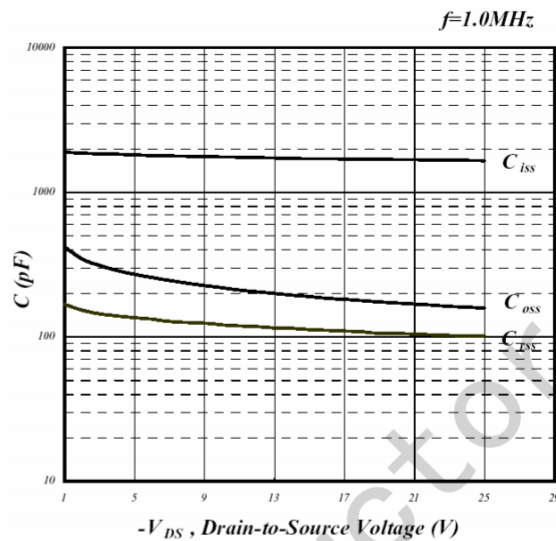


Fig 8. Typical Capacitance Characteristics

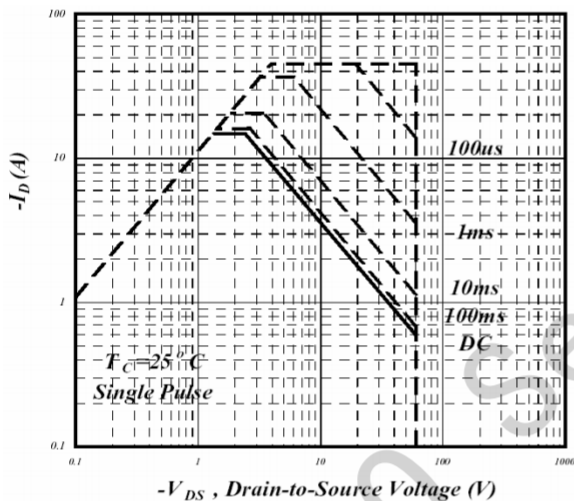


Fig 9. Maximum Safe Operating Area

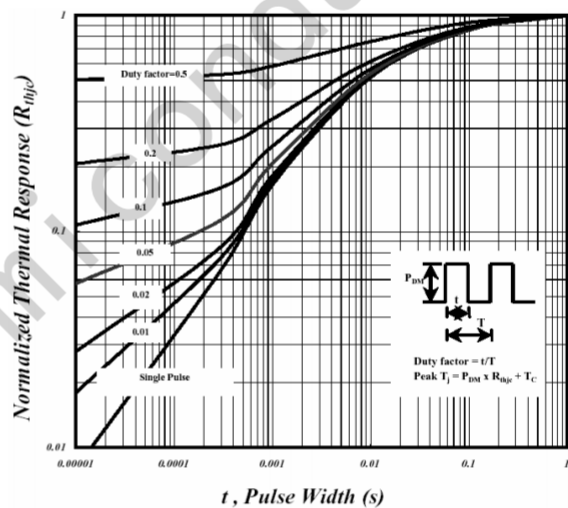


Fig 10. Effective Transient Thermal Impedance

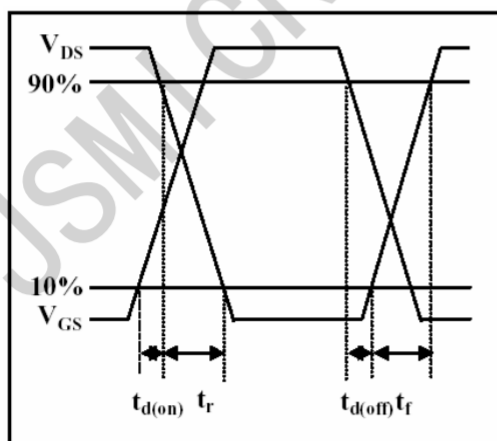


Fig 11. Switching Time Waveform

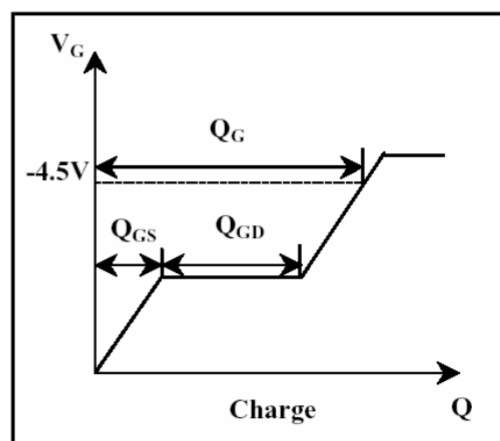
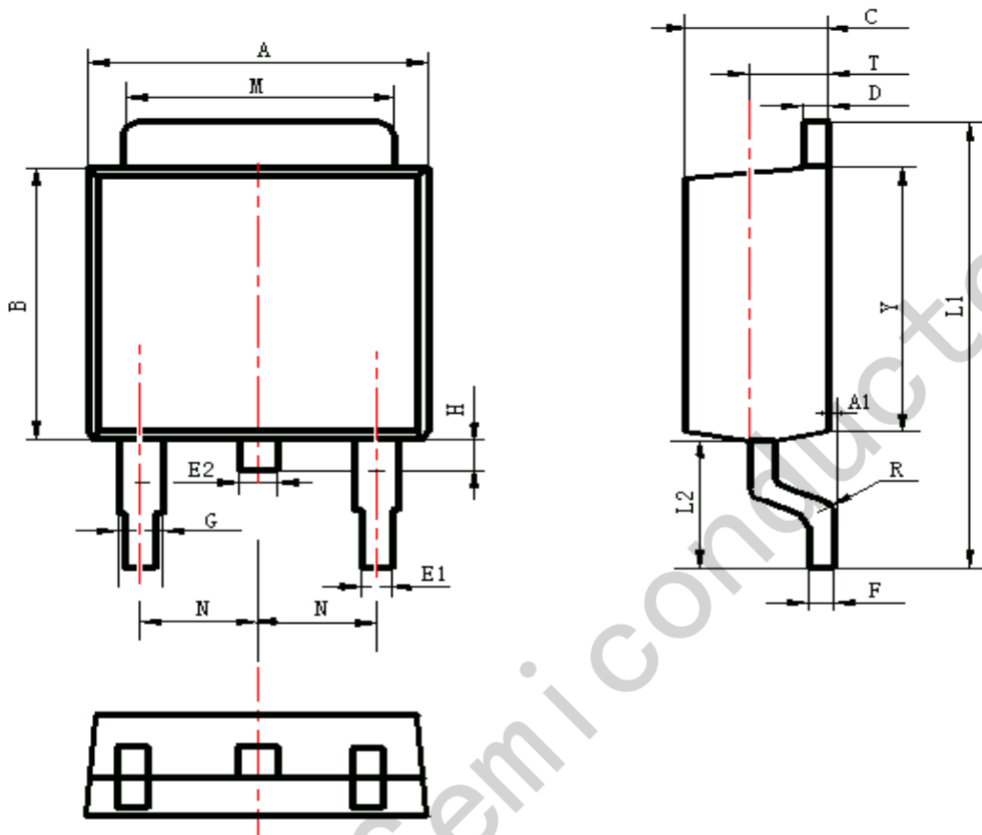


Fig 12. Gate Charge Waveform

## Package Information

TO-252



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	6.30	6.90	0.248	0.272
A1	0.00	0.16	0.000	0.006
B	5.70	6.30	0.224	0.248
C	2.10	2.50	0.083	0.098
D	0.30	0.70	0.012	0.028
E1	0.60	0.90	0.024	0.035
E2	0.70	1.00	0.028	0.039
F	0.30	0.60	0.012	0.024
G	0.70	1.20	0.028	0.047
L1	9.60	10.50	0.378	0.413
L2	2.70	3.10	0.106	0.122
H	0.40	1.00	0.016	0.039
M	5.10	5.50	0.201	0.217
N	2.09	2.49	0.082	0.098
R	0.30		0.012	
T	1.40	1.60	0.055	0.063
Y	5.10	6.30	0.201	0.248