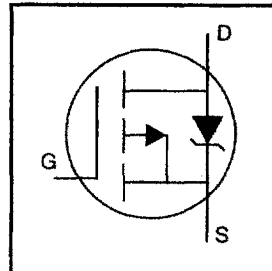
International
IOR Rectifier

PD - 9.1506A

IRFR/U9024N

HEXFET® Power MOSFET

- Ultra Low On-Resistance
- P-Channel
- Surface Mount (IRFR9024N)
- Straight Lead (IRFU9024N)
- Advanced Process Technology
- Fast Switching
- Fully Avalanche Rated



V_{DSS} = -55V

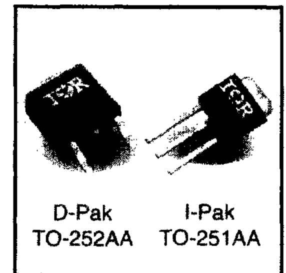
$R_{DS(on)}$ = 0.175Ω

I_D = -11A

Description

Fifth Generation HEXFET® Power MOSFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design for which HEXFET Power MOSFETs are well known, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The D-Pak is designed for surface mounting using vapor phase, infrared, or wave soldering techniques. The straight lead, I-Pak, version (IRFU series) is for through-hole mounting applications. Power dissipation levels up to 1.5 watts are possible in typical surface mount applications.



D-Pak TO-252AA I-Pak TO-251AA

Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ -10V	-11	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ -10V	-8	
I_{DM}	Pulsed Drain Current ①	-44	
P_D @T_C = 25°C	Power Dissipation	38	W
	Linear Derating Factor	0.30	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy ②⑥	62	mJ
I_{AR}	Avalanche Current ①	-6.6	A
E_{AR}	Repetitive Avalanche Energy ①	3.8	mJ
dv/dt	Peak Diode Recovery dv/dt ③⑥	-5.0	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	

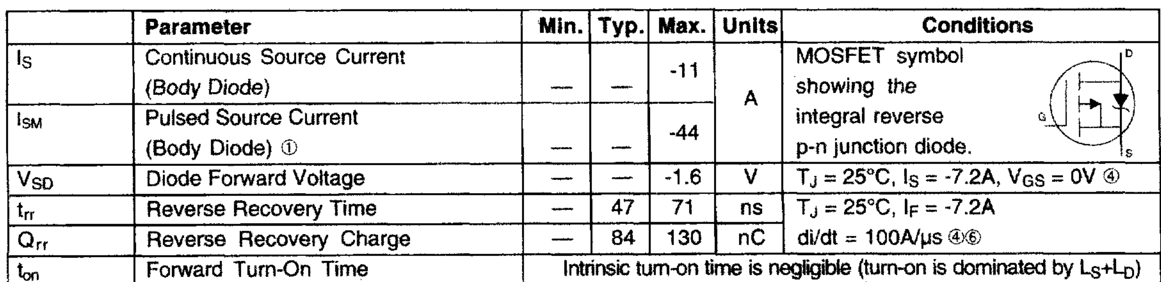
Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	3.3	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB mount)**	—	50	
$R_{\theta JA}$	Junction-to-Ambient	—	110	

Electrical Characteristics @ T_J = 25°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 = -250μA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	-0.05	—	V/°C	Reference to 25°C, I_D = -1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.175	Ω	V_{GS} = -10V, I_D = -6.6A ④
$V_{GS(th)}$	Gate Threshold Voltage	-2.0	—	-4.0	V	V_{DS} = V_{GS}, I_D = -250μA
g_{fs}	Forward Transconductance	2.5	—	—	S	V_{DS} = -25V, I_D = -7.2A ⑥
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°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 figure 6 and 13 ④⑥
$t_{d(on)}$	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 = 24Ω
t_f	Fall Time	—	37	—		R_D = 3.7Ω, see figure 10 ④⑥
L_D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.)
L_S	Internal Source Inductance	—	7.5	—		from package and center of die contact ⑤
C_{iss}	Input Capacitance	—	350	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	170	—		V_{DS} = -25V
C_{rss}	Reverse Transfer Capacitance	—	92	—		f = 1.0MHz, see figure 5 ⑥

Source-Drain Ratings and Characteristics



	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	-11	A	MOSFET symbol showing the
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	-44		integral reverse p-n junction diode.
V_{SD}	Diode Forward Voltage	—	—	-1.6	V	T_J = 25°C, I_S = -7.2A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	—	47	71	ns	T_J = 25°C, I_F = -7.2A
Q_{rr}	Reverse Recovery Charge	—	84	130	nC	di/dt = 100A/μs ④⑥
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 figure 11)

② Starting T_J = 25°C, L = 2.8mH, R_G = 25Ω, I_{AS} = -6.6A. (see figure 12)

③ $I_{SD} \leq$ -6.6A, di/dt ≤ 240A/μs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 150°C

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

⑤ This is applied for I-Pak, L_S of D-Pak is measured between lead and center of die contact

⑥ Uses IRF9Z24N data and test conditions.

** When mounted on 1" square PCB (FR-4 or G-10 material). For recommended footprint and soldering techniques refer to application note #AN-994.

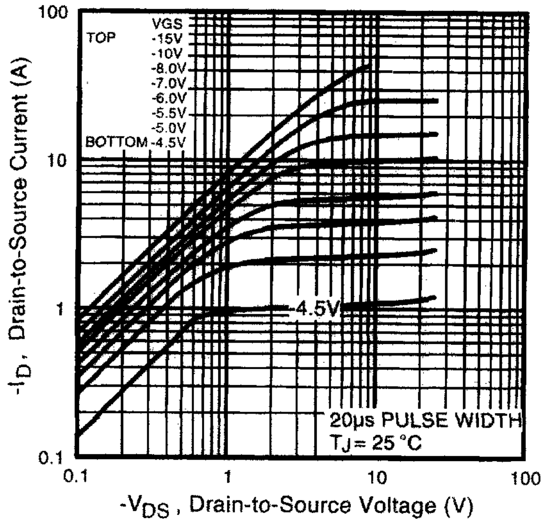


Fig 1. Typical Output Characteristics

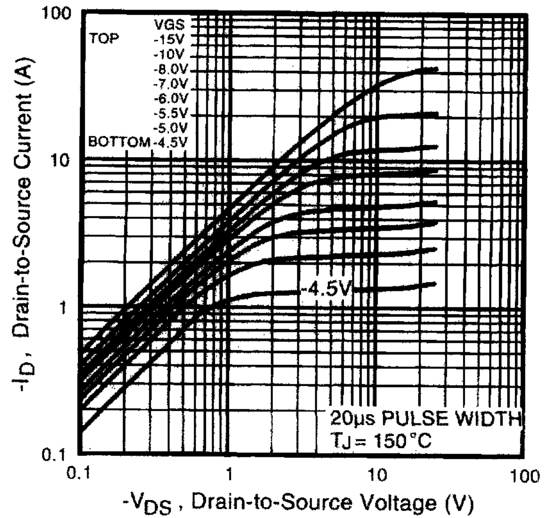


Fig 2. Typical Output Characteristics

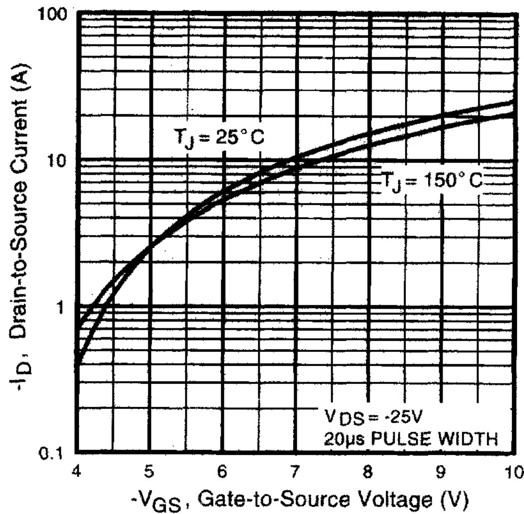


Fig 3. Typical Transfer Characteristics

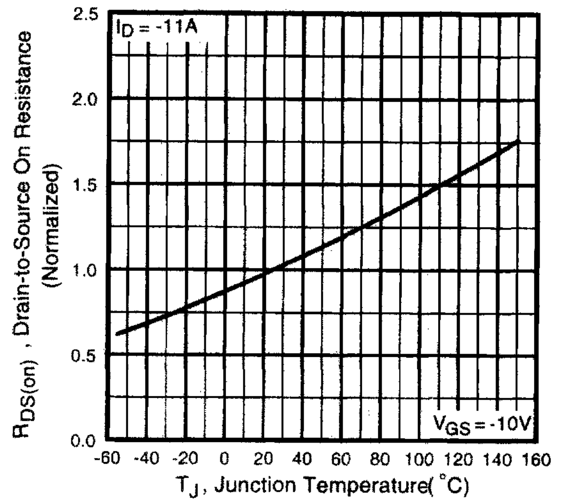


Fig 4. Normalized On-Resistance Vs. Temperature

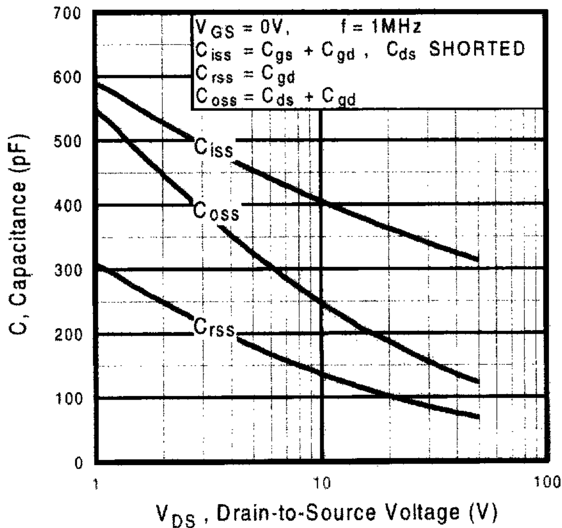


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

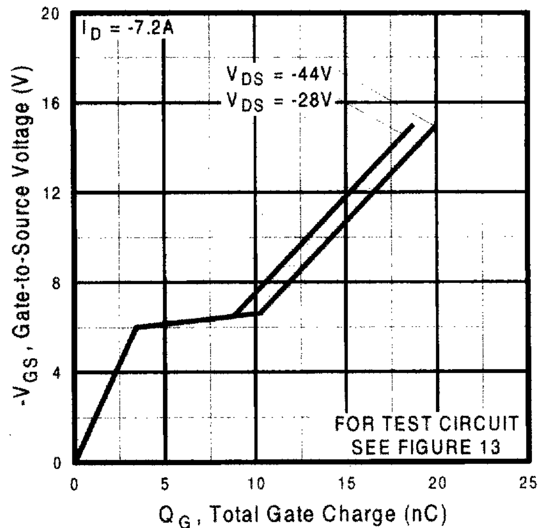


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

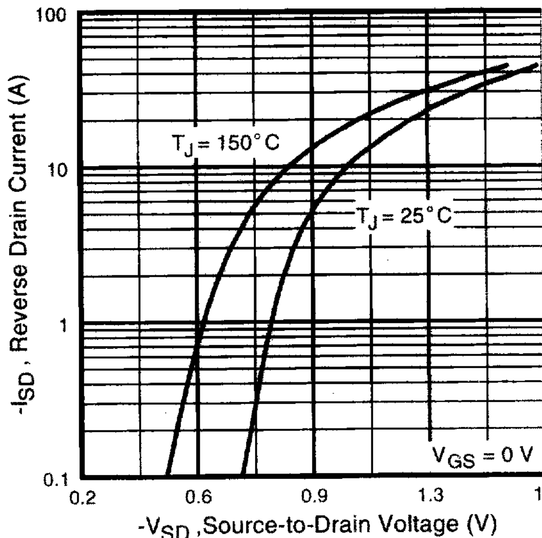


Fig 7. Typical Source-Drain Diode Forward Voltage

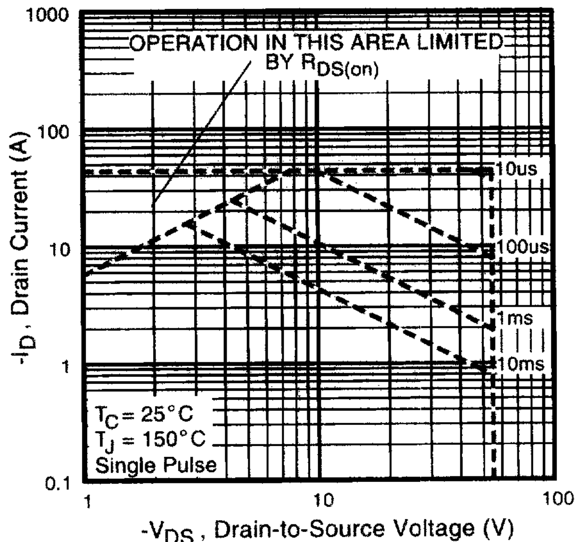


Fig 8. Maximum Safe Operating Area

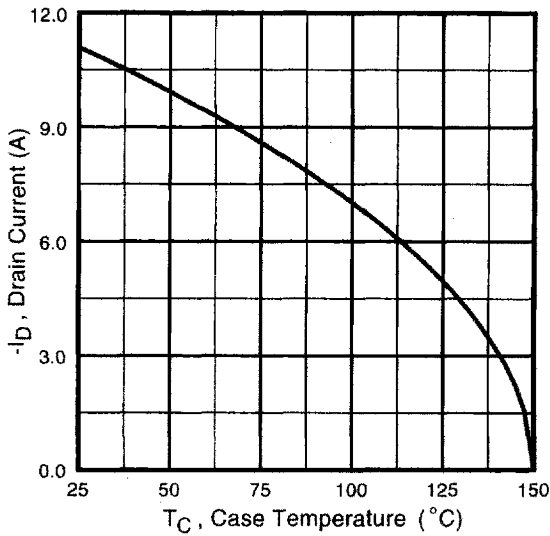


Fig 9. Maximum Drain Current Vs. Case Temperature

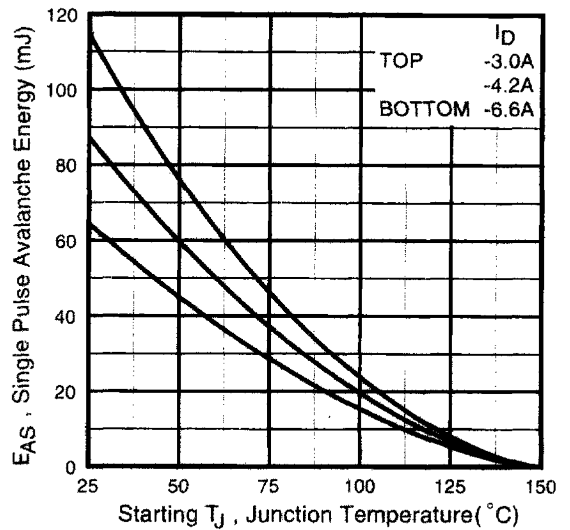


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

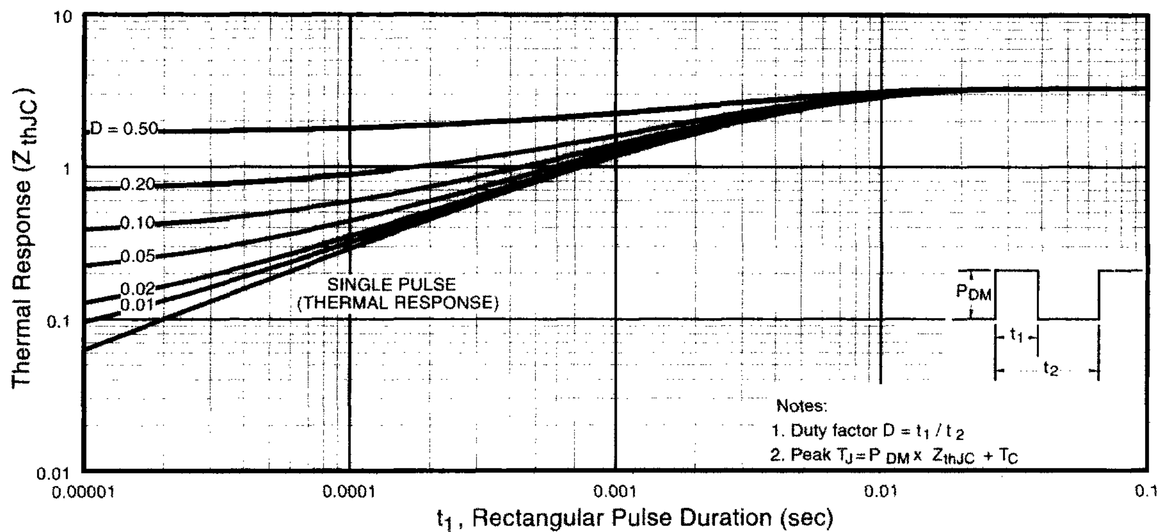


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

Mechanical drawings, Appendix A
Part marking information, Appendix B
Test Circuit diagrams, Appendix C