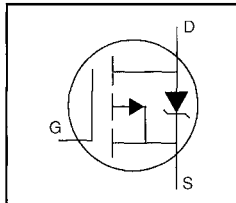


## HEXFET® Power MOSFET

- Dynamic dv/dt Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFR9210)
- Straight Lead (IRFU9210)
- Available in Tape & Reel
- P-Channel
- Fast Switching



$$V_{DSS} = -200V$$

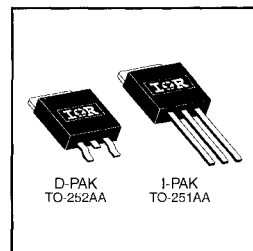
$$R_{DS(on)} = 3.0\Omega$$

$$I_D = -1.9A$$

## Description

The HEXFET technology is the key to International Rectifier's advanced line of power MOSFET transistors. The efficient geometry and unique processing of the HEXFET design achieve very low on-state resistance combined with high transconductance and extreme device ruggedness.

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



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## Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ -10 V$	-1.9	
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ -10 V$	-1.2	A
$I_{DM}$	Pulsed Drain Current ①	-7.6	
$P_D @ T_C = 25^\circ C$	Power Dissipation	25	W
$P_D @ T_A = 25^\circ C$	Power Dissipation (PCB Mount)**	2.5	
	Linear Derating Factor	0.20	W/°C
	Linear Derating Factor (PCB Mount)**	0.020	
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy ②	300	mJ
$I_{AR}$	Avalanche Current ①	-1.9	A
$E_{AR}$	Repetitive Avalanche Energy ①	2.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-5.0	V/ns
$T_J, T_{STG}$	Junction and Storage Temperature Range	-55 to +150	°C
	Soldering Temperature, for 10 seconds	260 (1.6mm from case)	

## Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	—	5.0	
$R_{\theta JA}$	Junction-to-Ambient (PCB mount)**	—	—	50	°C/W
$R_{\theta JA}$	Junction-to-Ambient	—	—	110	

\*\* When mounted on 1" square PCB (FR-4 or G-10 Material).

For recommended footprint and soldering techniques refer to application note #AN-994.

## 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	-200	—	—	V	V <sub>GS</sub> =0V, I <sub>D</sub> =-250μA
ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	-0.23	—	V/°C	Reference to 25°C, I <sub>D</sub> =-1mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	—	3.0	Ω	V <sub>GS</sub> =-10V, I <sub>D</sub> =-1.1A 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	0.98	—	—	S	V <sub>DS</sub> =-50V, I <sub>D</sub> =-1.1A ④
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	-100	μA	V <sub>DS</sub> =-200V, V <sub>GS</sub> =0V
		—	—	-500		V <sub>DS</sub> =-160V, V <sub>GS</sub> =0V, T <sub>J</sub> =125°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	—	—	8.9	nC	I <sub>D</sub> =-1.3A
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	2.1		V <sub>DS</sub> =-160V
Q <sub>gd</sub>	Gate-to-Drain ("Miller") Charge	—	—	3.9		V <sub>GS</sub> =-10V See Fig. 6 and 13 ④
t <sub>d(on)</sub>	Turn-On Delay Time	—	8.0	—	ns	V <sub>DD</sub> =-100V
t <sub>r</sub>	Rise Time	—	12	—		I <sub>D</sub> =-2.3A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	11	—		R <sub>G</sub> =24Ω
t <sub>f</sub>	Fall Time	—	13	—		R <sub>D</sub> =41Ω See Figure 10 ④
L <sub>D</sub>	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6 mm (0.25in.) from package and center of die contact
L <sub>S</sub>	Internal Source Inductance	—	7.5	—		
C <sub>iss</sub>	Input Capacitance	—	170	—	pF	V <sub>GS</sub> =0V
C <sub>oss</sub>	Output Capacitance	—	54	—		V <sub>DS</sub> =-25V
C <sub>rss</sub>	Reverse Transfer Capacitance	—	16	—		f=1.0MHz See Figure 5



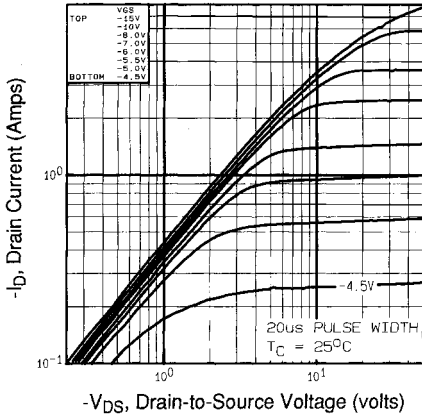
## Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	-1.9	A	MOSFET symbol showing the integral reverse p-n junction diode.
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	-7.6		
V <sub>SD</sub>	Diode Forward Voltage	—	—	-5.8	V	T <sub>J</sub> =25°C, I <sub>S</sub> =-1.9A, V <sub>GS</sub> =0V ④
t <sub>rr</sub>	Reverse Recovery Time	—	110	220	ns	T <sub>J</sub> =25°C, I <sub>F</sub> =-2.3A
Q <sub>rr</sub>	Reverse Recovery Charge	—	0.56	1.1	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> )				

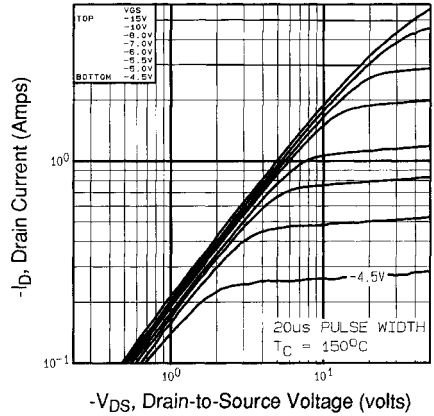


### Notes:

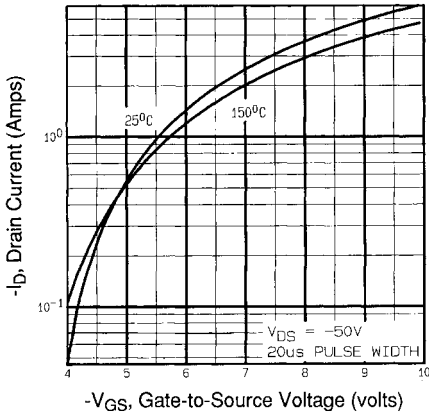
- ① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)
- ② V<sub>DD</sub>=-50V, starting T<sub>J</sub>=25°C, L=124mH R<sub>G</sub>=25Ω, I<sub>AS</sub>=-1.9A (See Figure 12)
- ③ I<sub>SD</sub>≤-1.9A, di/dt≤70A/μs, V<sub>DD</sub>≤V<sub>(BR)DSS</sub>, T<sub>J</sub>≤150°C
- ④ Pulse width ≤ 300 μs; duty cycle ≤2%.



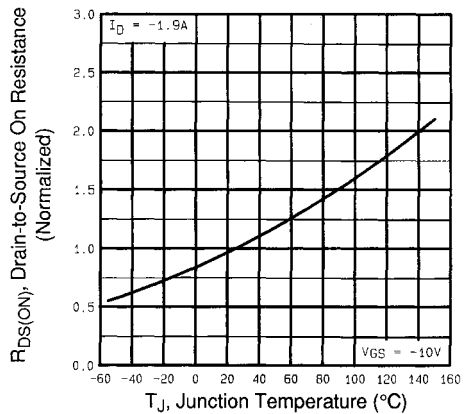
**Fig 1.** Typical Output Characteristics,  $T_C=25^\circ\text{C}$



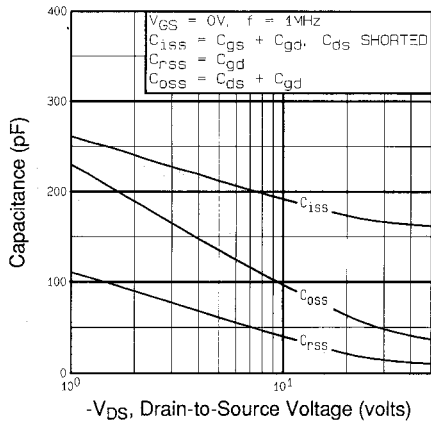
**Fig 2.** Typical Output Characteristics,  $T_C=150^\circ\text{C}$



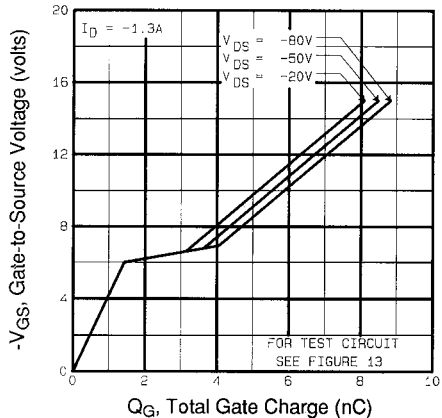
**Fig 3.** Typical Transfer Characteristics



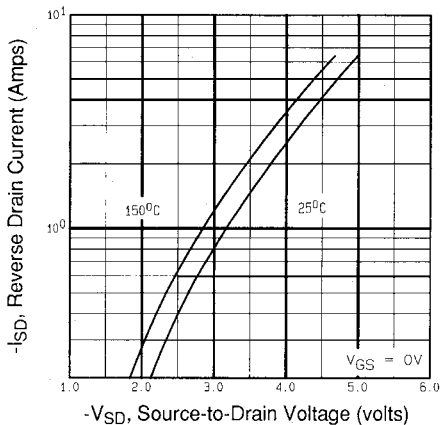
**Fig 4.** Normalized On-Resistance Vs. Temperature



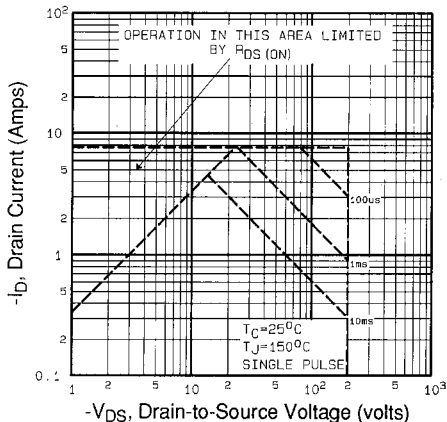
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



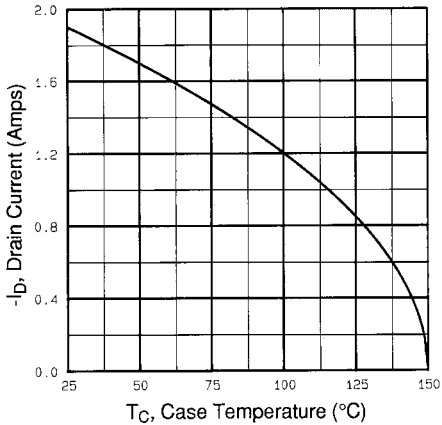
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



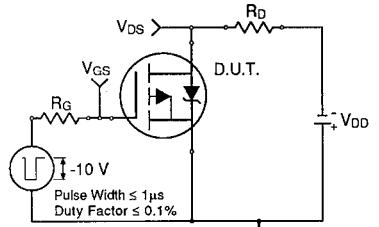
**Fig 7.** Typical Source-Drain Diode Forward Voltage



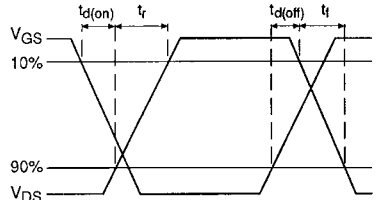
**Fig 8.** Maximum Safe Operating Area



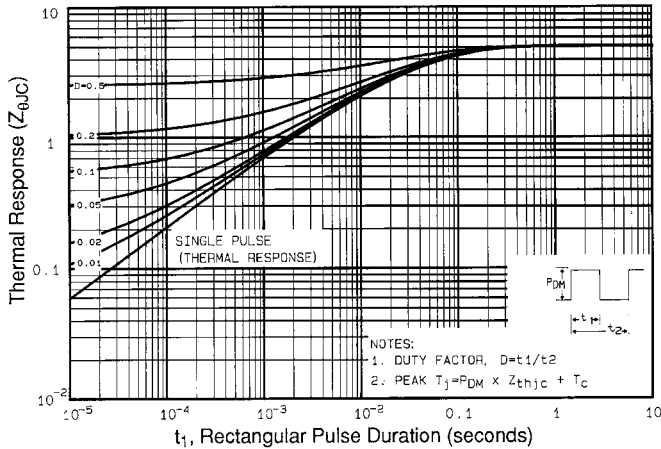
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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

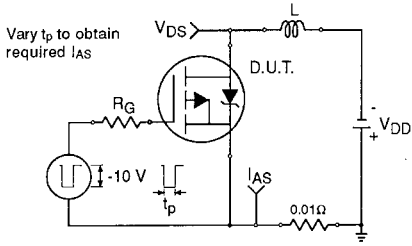


**Fig 10b.** Switching Time Waveforms

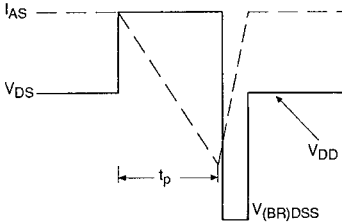


**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

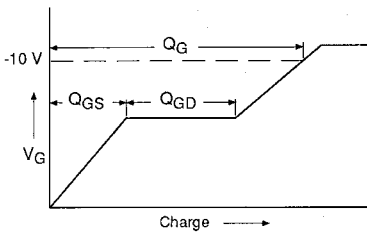
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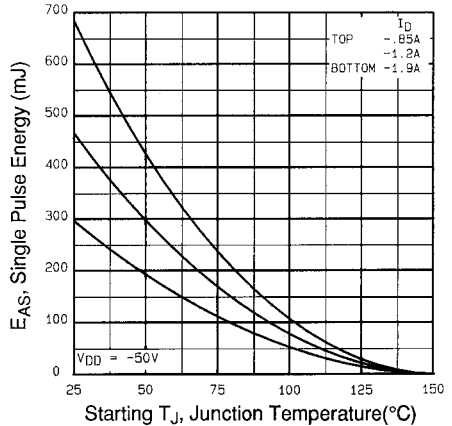
**Fig 12a.** Unclamped Inductive Test Circuit



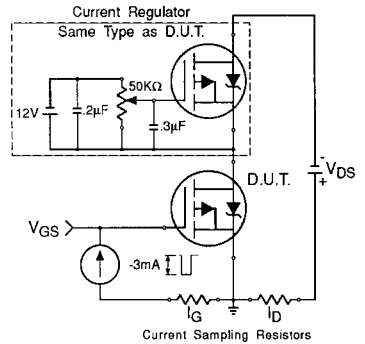
**Fig 12b.** Unclamped Inductive Waveforms



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



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



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

**Appendix A:** Figure 14, Peak Diode Recovery  $dv/dt$  Test Circuit – See page 1506

**Appendix B:** Package Outline Mechanical Drawing – See pages 1512, 1513

**Appendix C:** Part Marking Information – See page 1518

**Appendix D:** Tape & Reel Information – See page 1523