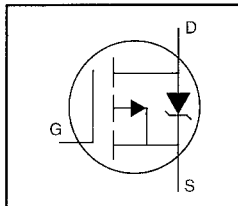


## HEXFET® Power MOSFET

- Dynamic  $dv/dt$  Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFR9110)
- Straight Lead (IRFU9110)
- Available in Tape & Reel
- P-Channel
- Fast Switching



$$V_{DSS} = -100V$$

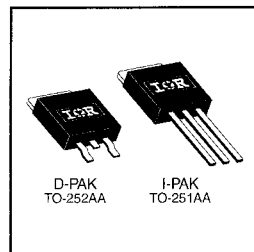
$$R_{DS(on)} = 1.2\Omega$$

$$I_D = -3.1A$$

## Description

Third Generation HEXFETs from International Rectifier provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

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.

D-PAK  
TO-252AAI-PAK  
TO-251AADATA  
SHEETS

## Absolute Maximum Ratings

|                             | Parameter                                  | Max.                  | Units |
|-----------------------------|--------------------------------------------|-----------------------|-------|
| $I_D$ @ $T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS}$ @ -10 V | -3.1                  | A     |
| $I_D$ @ $T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS}$ @ -10 V | -2.0                  |       |
| $I_{DM}$                    | Pulsed Drain Current ①                     | -12                   |       |
| $P_D$ @ $T_C = 25^\circ C$  | 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            | 140                   | mJ    |
| $I_{AR}$                    | Avalanche Current ①                        | -3.1                  | A     |
| $E_{AR}$                    | Repetitive Avalanche Energy ①              | 2.5                   | mJ    |
| $dv/dt$                     | Peak Diode Recovery $dv/dt$ ③              | -5.5                  | 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  | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB mount)** | ---  | ---  | 50   |       |
| $R_{\theta JA}$ | 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 @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)

|                                 | Parameter                            | Min. | Typ.   | Max. | Units              | Test Conditions                                                     |
|---------------------------------|--------------------------------------|------|--------|------|--------------------|---------------------------------------------------------------------|
| $V_{(BR)DSS}$                   | Drain-to-Source Breakdown Voltage    | -100 | —      | —    | V                  | $V_{GS}=0V$ , $I_D=-250\mu A$                                       |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | -0.093 | —    | $V/^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D=-1mA$                        |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | —      | 1.2  | $\Omega$           | $V_{GS}=-10V$ , $I_D=-1.9A$ ④                                       |
| $V_{GS(th)}$                    | Gate Threshold Voltage               | -2.0 | —      | -4.0 | V                  | $V_{DS}=V_{GS}$ , $I_D=-250\mu A$                                   |
| $g_{fs}$                        | Forward Transconductance             | 0.97 | —      | —    | S                  | $V_{DS}=-50V$ , $I_D=-1.9A$ ④                                       |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —      | -100 | $\mu A$            | $V_{DS}=-100V$ , $V_{GS}=0V$                                        |
|                                 |                                      | —    | —      | -500 |                    | $V_{DS}=-80V$ , $V_{GS}=0V$ , $T_J=125^\circ\text{C}$               |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —      | -100 | nA                 | $V_{GS}=-20V$                                                       |
|                                 | Gate-to-Source Reverse Leakage       | —    | —      | 100  |                    | $V_{GS}=20V$                                                        |
| $Q_g$                           | Total Gate Charge                    | —    | —      | 8.7  | nC                 | $I_D=-4.0A$                                                         |
| $Q_{gs}$                        | Gate-to-Source Charge                | —    | —      | 2.2  |                    | $V_{DS}=-80V$                                                       |
| $Q_{gd}$                        | Gate-to-Drain ("Miller") Charge      | —    | —      | 4.1  |                    | $V_{GS}=-10V$ See Fig. 6 and 13 ④                                   |
| $t_{d(on)}$                     | Turn-On Delay Time                   | —    | 10     | —    | ns                 | $V_{DD}=-50V$                                                       |
| $t_r$                           | Rise Time                            | —    | 27     | —    |                    | $I_D=-4.0A$                                                         |
| $t_{d(off)}$                    | Turn-Off Delay Time                  | —    | 15     | —    |                    | $R_G=24\Omega$                                                      |
| $t_f$                           | Fall Time                            | —    | 17     | —    |                    | $R_D=11\Omega$ See Figure 10 ④                                      |
| $L_D$                           | Internal Drain Inductance            | —    | 4.5    | —    | nH                 | Between lead, 6 mm (0.25in.) from package and center of die contact |
| $L_S$                           | Internal Source Inductance           | —    | 7.5    | —    |                    |                                                                     |
| $C_{iss}$                       | Input Capacitance                    | —    | 200    | —    | pF                 | $V_{GS}=0V$                                                         |
| $C_{oss}$                       | Output Capacitance                   | —    | 94     | —    |                    | $V_{DS}=-25V$                                                       |
| $C_{rss}$                       | Reverse Transfer Capacitance         | —    | 18     | —    |                    | $f=1.0MHz$ See Figure 5                                             |

## Source-Drain Ratings and Characteristics

|          | Parameter                              | Min.                                                                      | Typ. | Max. | Units   | Test Conditions                                                |
|----------|----------------------------------------|---------------------------------------------------------------------------|------|------|---------|----------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —                                                                         | —    | -3.1 | A       | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —                                                                         | —    | -12  |         |                                                                |
| $V_{SD}$ | Diode Forward Voltage                  | —                                                                         | —    | -5.5 | V       | $T_J=25^\circ\text{C}$ , $I_S=-3.1A$ , $V_{GS}=0V$ ④           |
| $t_{rr}$ | Reverse Recovery Time                  | —                                                                         | 80   | 160  | ns      | $T_J=25^\circ\text{C}$ , $I_F=-4.0A$                           |
| $Q_{rr}$ | Reverse Recovery Charge                | —                                                                         | 0.17 | 0.30 | $\mu C$ | $di/dt=100A/\mu s$ ④                                           |
| $t_{on}$ | 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)

③  $I_{SD} \leq 4.0A$ ,  $di/dt \leq 75A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 150^\circ\text{C}$

②  $V_{DD} = -25V$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 21mH$ ,  $R_G = 25\Omega$ ,  $I_{AS} = -3.1A$  (See Figure 12)

④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .

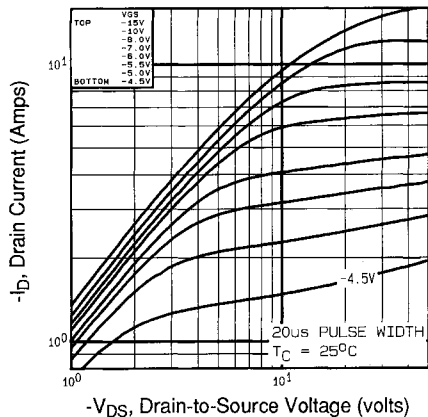


Fig 1. Typical Output Characteristics,  
 $T_C = 25^\circ\text{C}$

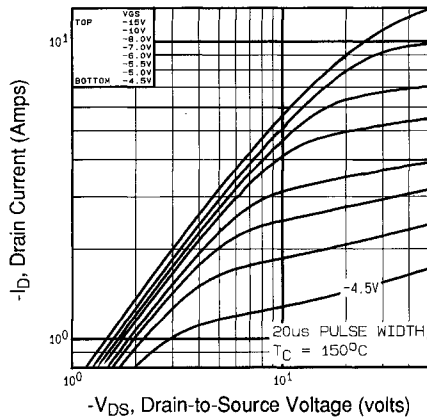


Fig 2. Typical Output Characteristics,  
 $T_C = 150^\circ\text{C}$

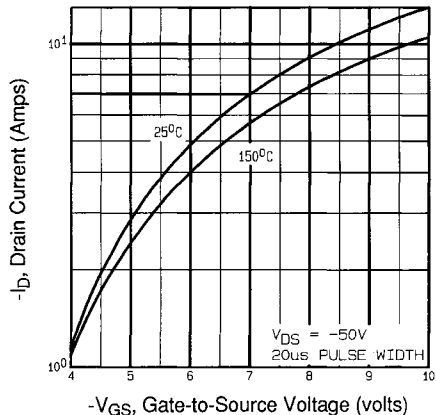


Fig 3. Typical Transfer Characteristics

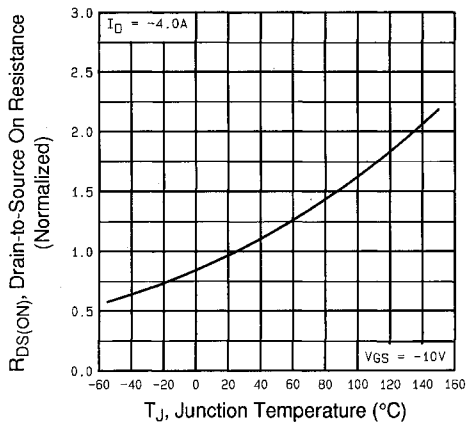
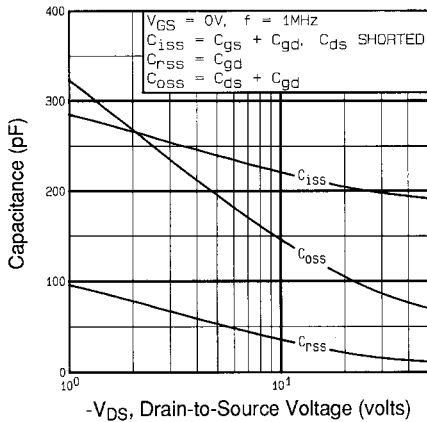
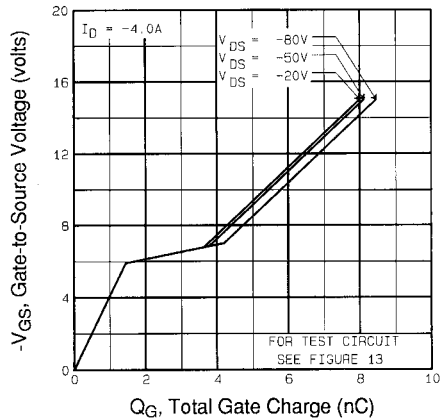


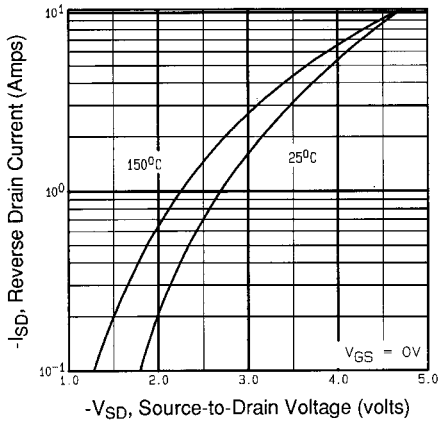
Fig 4. Normalized On-Resistance  
Vs. Temperature



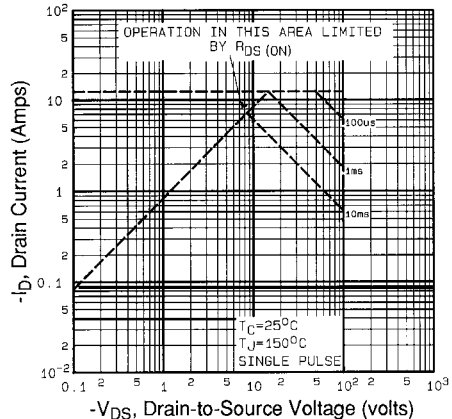
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



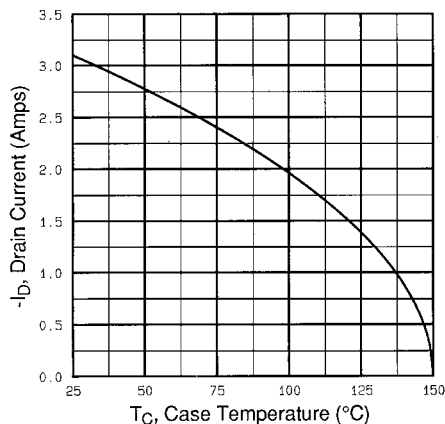
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



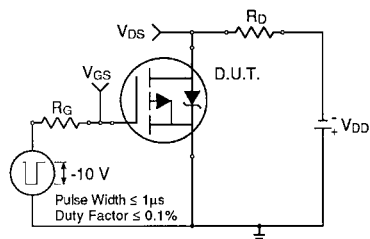
**Fig 7.** Typical Source-Drain Diode Forward Voltage



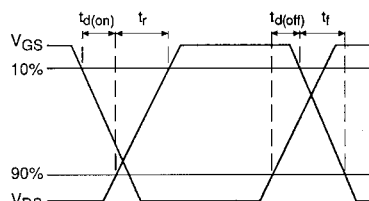
**Fig 8.** Maximum Safe Operating Area



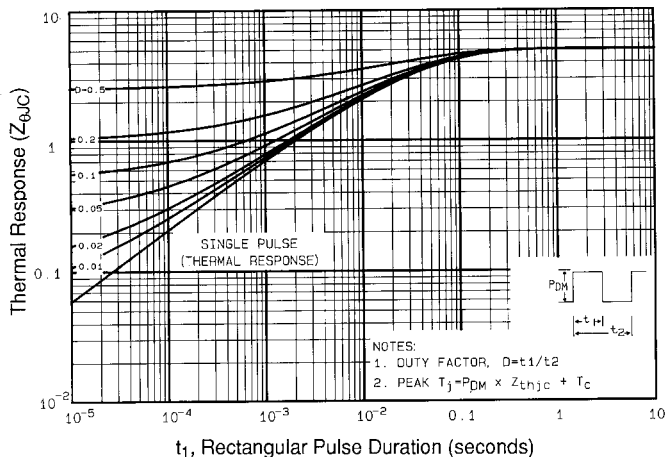
**Fig 9.** Maximum Drain Current Vs. Case Temperature



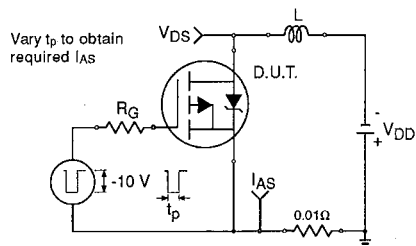
**Fig 10a.** Switching Time Test Circuit



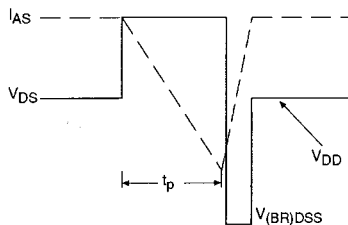
**Fig 10b.** Switching Time Waveforms



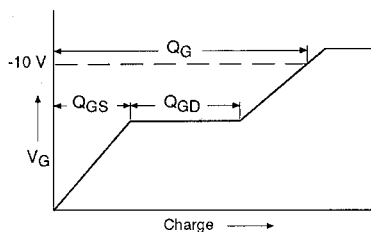
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



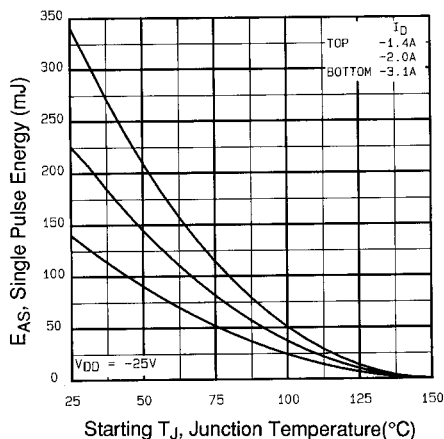
**Fig 12a.** Unclamped Inductive Test Circuit



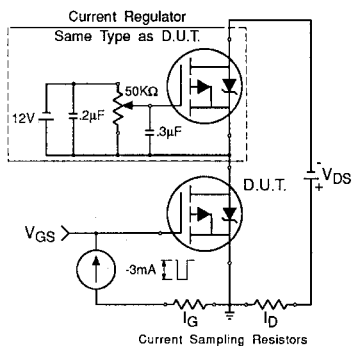
**Fig 12b.** Unclamped Inductive Waveforms



**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