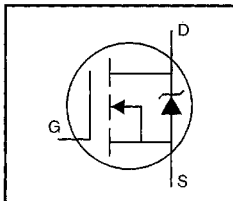


## HEXFET® Power MOSFET

- Dynamic  $dv/dt$  Rating
- Repetitive Avalanche Rated
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements



$$V_{DS} = 200V$$

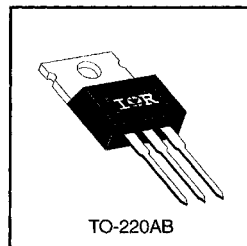
$$R_{DS(on)} = 1.5\Omega$$

$$I_D = 3.3A$$

## 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 TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.



TO-220AB

DATA  
SHEETS

## Absolute Maximum Ratings

|                           | Parameter                                        | Max.                  | Units |
|---------------------------|--------------------------------------------------|-----------------------|-------|
| $I_D @ T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS} @ 10 V$        | 3.3                   | A     |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ 10 V$        | 2.1                   |       |
| $I_{DM}$                  | Pulsed Drain Current ①                           | 10                    |       |
| $P_D @ T_C = 25^\circ C$  | Power Dissipation                                | 36                    | W     |
|                           | Linear Derating Factor                           | 0.29                  | W/°C  |
| $V_{GS}$                  | Gate-to-Source Voltage                           | $\pm 20$              | V     |
| $E_{AS}$                  | Single Pulse Avalanche Energy ②                  | 64                    | mJ    |
| $I_{AR}$                  | Avalanche Current ①                              | 3.3                   | A     |
| $E_{AR}$                  | Repetitive Avalanche Energy ①                    | 3.6                   | mJ    |
| $dv/dt$                   | Peak Diode Recovery $dv/dt$ ③                    | 5.0                   | V/ns  |
| $T_J$                     | Operating Junction and Storage Temperature Range | -55 to +150           | °C    |
| $T_{STG}$                 | Soldering Temperature, for 10 seconds            | 300 (1.6mm from case) |       |
|                           | Mounting Torque, 6-32 or M3 screw                | 10 lbf•in (1.1 N•m)   |       |

## Thermal Resistance

|                 | Parameter                           | Min. | Typ. | Max. | Units |
|-----------------|-------------------------------------|------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case                    | —    | —    | 3.5  | °C/W  |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface | —    | 0.50 | —    |       |
| $R_{\theta JA}$ | Junction-to-Ambient                 | —    | —    | 62   |       |

## 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    | 200  | —    | —    | V                  | $V_{GS}=0V, I_D=250\mu A$                                           |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.30 | —    | $V/^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D=1\text{mA}$                  |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | —    | 1.5  | $\Omega$           | $V_{GS}=10V, I_D=2.0A$ 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             | 0.80 | —    | —    | S                  | $V_{DS}=50V, I_D=2.0A$ ④                                            |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —    | 25   | $\mu A$            | $V_{DS}=200V, V_{GS}=0V$                                            |
|                                 |                                      | —    | —    | 250  |                    | $V_{DS}=160V, V_{GS}=0V, T_J=125^\circ\text{C}$                     |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA                 | $V_{GS}=20V$                                                        |
|                                 | Gate-to-Source Reverse Leakage       | —    | —    | -100 |                    | $V_{GS}=-20V$                                                       |
| $Q_g$                           | Total Gate Charge                    | —    | —    | 8.2  | nC                 | $I_D=3.3A$                                                          |
| $Q_{gs}$                        | Gate-to-Source Charge                | —    | —    | 1.8  |                    | $V_{DS}=160V$                                                       |
| $Q_{gd}$                        | Gate-to-Drain ("Miller") Charge      | —    | —    | 4.5  |                    | $V_{GS}=10V$ See Fig. 6 and 13 ④                                    |
| $t_{d(on)}$                     | Turn-On Delay Time                   | —    | 8.2  | —    | ns                 | $V_{DD}=100V$                                                       |
| $t_r$                           | Rise Time                            | —    | 17   | —    |                    | $I_D=3.3A$                                                          |
| $t_{d(off)}$                    | Turn-Off Delay Time                  | —    | 14   | —    |                    | $R_G=24\Omega$                                                      |
| $t_f$                           | Fall Time                            | —    | 8.9  | —    |                    | $R_D=30\Omega$ 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                    | —    | 140  | —    | pF                 | $V_{GS}=0V$                                                         |
| $C_{oss}$                       | Output Capacitance                   | —    | 53   | —    |                    | $V_{DS}=25V$                                                        |
| $C_{rss}$                       | Reverse Transfer Capacitance         | —    | 15   | —    |                    | $f=1.0\text{MHz}$ See Figure 5                                      |

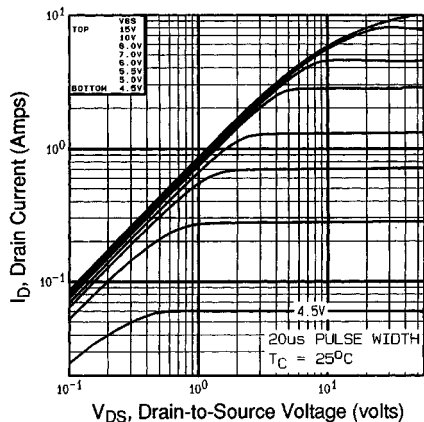


## Source-Drain Ratings and Characteristics

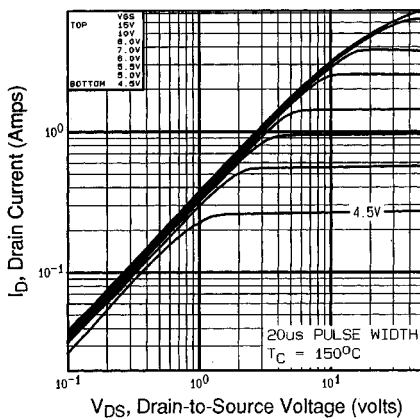
|          | Parameter                              | Min.                                                                      | Typ. | Max. | Units   | Test Conditions                                                |
|----------|----------------------------------------|---------------------------------------------------------------------------|------|------|---------|----------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —                                                                         | —    | 3.3  | A       | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —                                                                         | —    | 10   |         |                                                                |
| $V_{SD}$ | Diode Forward Voltage                  | —                                                                         | —    | 2.0  | V       | $T_J=25^\circ\text{C}, I_S=3.3A, V_{GS}=0V$ ④                  |
| $t_{rr}$ | Reverse Recovery Time                  | —                                                                         | 150  | 310  | ns      | $T_J=25^\circ\text{C}, I_F=3.3A$                               |
| $Q_{rr}$ | Reverse Recovery Charge                | —                                                                         | 0.60 | 1.4  | $\mu C$ | $di/dt=100A/\mu s$ ④                                           |
| $t_{on}$ | Forward Turn-On Time                   | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S+L_D$ ) |      |      |         |                                                                |

### Notes:

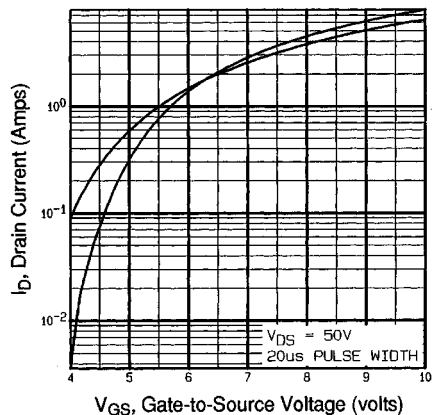
- ① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)
- ②  $V_{DD}=50V$ , starting  $T_J=25^\circ\text{C}$ ,  $L=8.8\text{mH}$ ,  $R_G=25\Omega$ ,  $I_{AS}=3.3A$  (See Figure 12)
- ③  $I_{SD}\leq 3.3A$ ,  $di/dt\leq 70A/\mu s$ ,  $V_{DD}\leq V_{(BR)DSS}$ ,  $T_J\leq 150^\circ\text{C}$
- ④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .



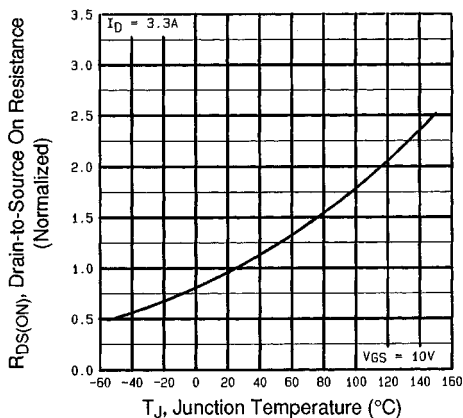
**Fig 1.** Typical Output Characteristics,  
 $T_C = 25^\circ\text{C}$



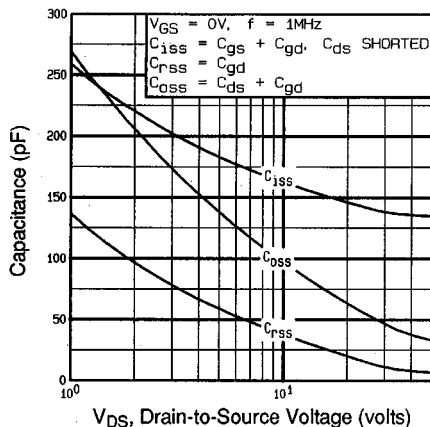
**Fig 2.** Typical Output Characteristics,  
 $T_C = 150^\circ\text{C}$



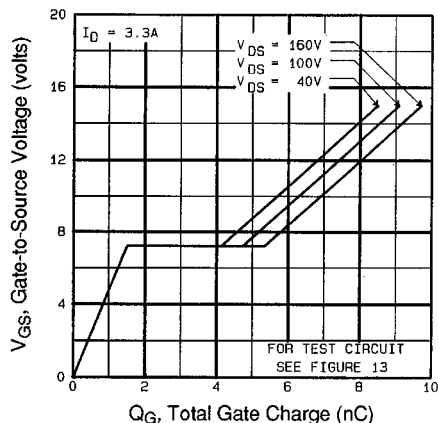
**Fig 3.** Typical Transfer Characteristics



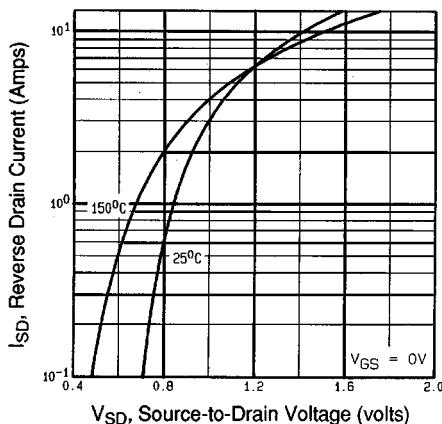
**Fig 4.** Normalized On-Resistance  
Vs. Temperature



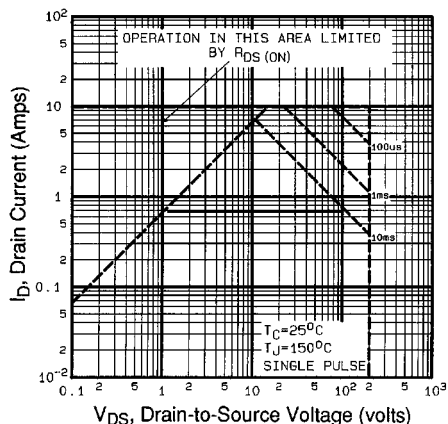
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



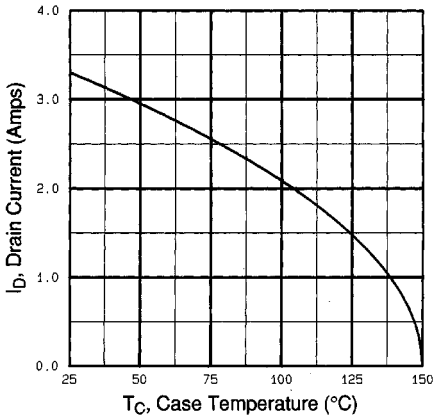
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



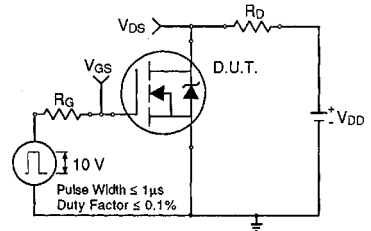
**Fig 7.** Typical Source-Drain Diode Forward Voltage



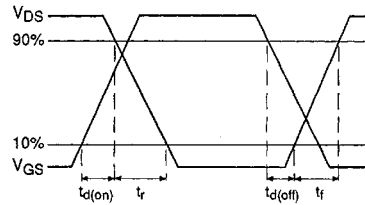
**Fig 8.** Maximum Safe Operating Area



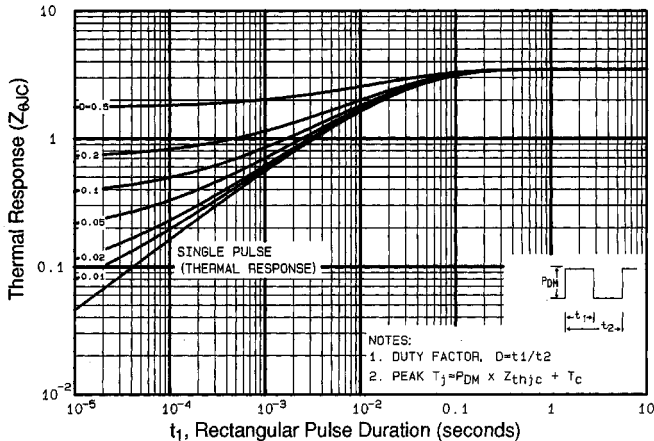
**Fig 9.** Maximum Drain Current Vs. Case Temperature



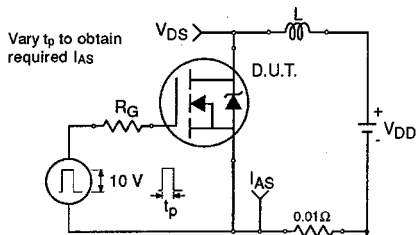
**Fig 10a.** Switching Time Test Circuit



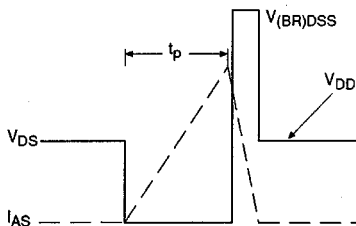
**Fig 10b.** Switching Time Waveforms



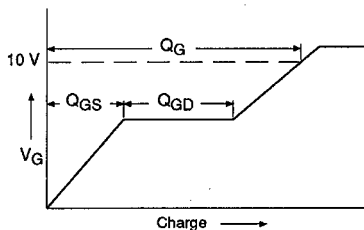
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



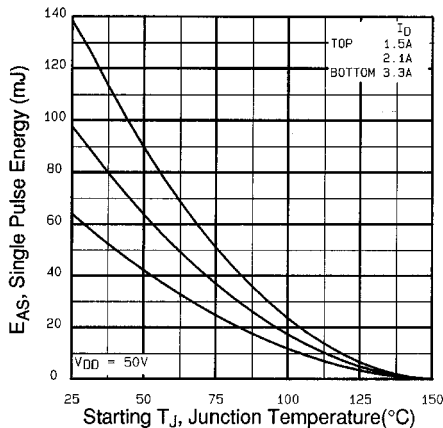
**Fig 12a.** Unclamped Inductive Test Circuit



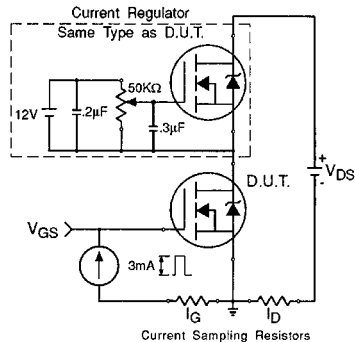
**Fig 12b.** Unclamped Inductive Waveforms



**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 1505

**Appendix B:** Package Outline Mechanical Drawing – See page 1509

**Appendix C:** Part Marking Information – See page 1516

**Appendix E:** Optional Leadforms – See page 1525

**International Rectifier**