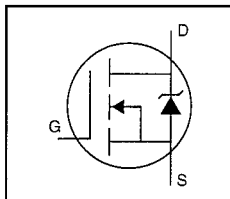


**HEXFET® Power MOSFET**

- Surface Mount
- Available in Tape & Reel
- Dynamic  $dv/dt$  Rating
- Repetitive Avalanche Rated
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements



$$V_{DS} = 400V$$

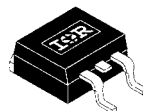
$$R_{DS(on)} = 3.6\Omega$$

$$I_D = 2.0A$$

**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 SMD-220 is a surface mount power package capable of accommodating die sizes up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface mount package. The SMD-220 is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0W in a typical surface mount application.


**SMD-220**
**Absolute Maximum Ratings**

|                           | Parameter                                 | Max.                  | Units |
|---------------------------|-------------------------------------------|-----------------------|-------|
| $I_D @ T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS} @ 10 V$ | 2.0                   | A     |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ 10 V$ | 1.2                   |       |
| $I_{DM}$                  | Pulsed Drain Current ①                    | 6.0                   |       |
| $P_D @ T_C = 25^\circ C$  | Power Dissipation                         | 36                    | W     |
| $P_D @ T_A = 25^\circ C$  | Power Dissipation (PCB Mount)**           | 3.1                   |       |
|                           | Linear Derating Factor                    | 0.29                  | W/°C  |
|                           | Linear Derating Factor (PCB Mount)**      | 0.025                 |       |
| $V_{GS}$                  | Gate-to-Source Voltage                    | $\pm 20$              | V     |
| $E_{AS}$                  | Single Pulse Avalanche Energy ②           | 120                   | mJ    |
| $I_{AR}$                  | Avalanche Current ①                       | 2.0                   | A     |
| $E_{AR}$                  | Repetitive Avalanche Energy ①             | 3.6                   | mJ    |
| $dv/dt$                   | Peak Diode Recovery $dv/dt$ ③             | 4.0                   | V/ns  |
| $T_J, T_{STG}$            | Junction and Storage Temperature Range    | -55 to +150           | °C    |
|                           | Soldering Temperature, for 10 seconds     | 300 (1.6mm from case) |       |

**Thermal Resistance**

|                 | Parameter                         | Min. | Typ. | Max. | Units |
|-----------------|-----------------------------------|------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case                  | —    | —    | 3.5  | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB mount)** | —    | —    | 40   |       |
| $R_{\theta JA}$ | Junction-to-Ambient               | —    | —    | 62   |       |

\*\* 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    | 400  | —    | —    | V                   | $V_{GS}=0V$ , $I_D=250\mu A$                                        |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.47 | —    | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D=1mA$                         |
| $R_{DS(on)}$                    | Static Drain-to-Source On-Resistance | —    | —    | 3.6  | $\Omega$            | $V_{GS}=10V$ , $I_D=1.2A$ 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             | 1.0  | —    | —    | S                   | $V_{DS}=50V$ , $I_D=1.2A$ ④                                         |
| $I_{DSS}$                       | Drain-to-Source Leakage Current      | —    | —    | 25   | $\mu A$             | $V_{DS}=400V$ , $V_{GS}=0V$                                         |
|                                 |                                      | —    | —    | 250  |                     | $V_{DS}=320V$ , $V_{GS}=0V$ , $T_J=125^\circ\text{C}$               |
| $I_{GSS}$                       | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA                  | $V_{GS}=20V$                                                        |
|                                 | Gate-to-Source Reverse Leakage       | —    | —    | -100 |                     | $V_{GS}=-20V$                                                       |
| $Q_g$                           | Total Gate Charge                    | —    | —    | 17   | nC                  | $I_D=2.0A$                                                          |
| $Q_{gs}$                        | Gate-to-Source Charge                | —    | —    | 3.4  |                     | $V_{DS}=320V$                                                       |
| $Q_{gd}$                        | Gate-to-Drain ("Miller") Charge      | —    | —    | 8.5  |                     | $V_{GS}=10V$ See Fig. 6 and 13 ④                                    |
| $t_{d(on)}$                     | Turn-On Delay Time                   | —    | 8.0  | —    | ns                  | $V_{DD}=200V$                                                       |
| $t_r$                           | Rise Time                            | —    | 9.9  | —    |                     | $I_D=2.0A$                                                          |
| $t_{d(off)}$                    | Turn-Off Delay Time                  | —    | 21   | —    |                     | $R_G=24\Omega$                                                      |
| $t_f$                           | Fall Time                            | —    | 11   | —    |                     | $R_D=95\Omega$ 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                    | —    | 170  | —    | pF                  | $V_{GS}=0V$                                                         |
| $C_{oss}$                       | Output Capacitance                   | —    | 34   | —    |                     | $V_{DS}=25V$                                                        |
| $C_{rss}$                       | Reverse Transfer Capacitance         | —    | 6.3  | —    |                     | $f=1.0MHz$ See Figure 5                                             |

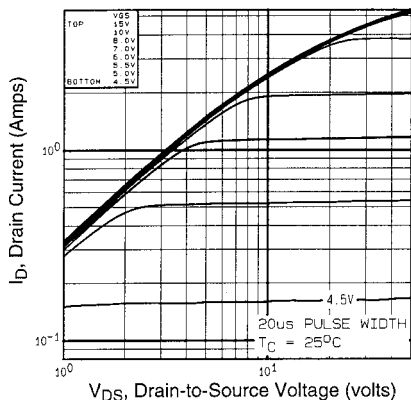


## Source-Drain Ratings and Characteristics

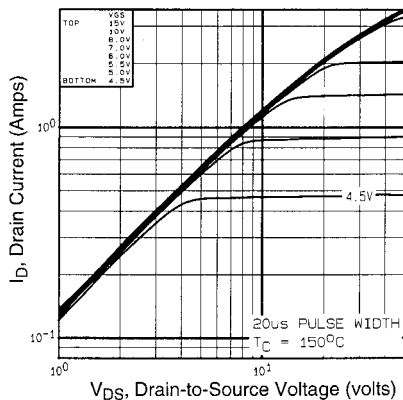
|          | Parameter                              | Min.                                                                      | Typ. | Max. | Units   | Test Conditions                                                |
|----------|----------------------------------------|---------------------------------------------------------------------------|------|------|---------|----------------------------------------------------------------|
| $I_S$    | Continuous Source Current (Body Diode) | —                                                                         | —    | 2.0  | A       | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —                                                                         | —    | 6.0  |         |                                                                |
| $V_{SD}$ | Diode Forward Voltage                  | —                                                                         | —    | 1.6  | V       | $T_J=25^\circ\text{C}$ , $I_S=2.0A$ , $V_{GS}=0V$ ④            |
| $t_{rr}$ | Reverse Recovery Time                  | —                                                                         | 240  | 540  | ns      | $T_J=25^\circ\text{C}$ , $I_r=2.0A$                            |
| $Q_{rr}$ | Reverse Recovery Charge                | —                                                                         | 0.85 | 1.6  | $\mu C$ | $di/dt=100A/\mu s$ ④                                           |
| $t_{on}$ | Forward Turn-On Time                   | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S+L_D$ ) |      |      |         |                                                                |

Notes:

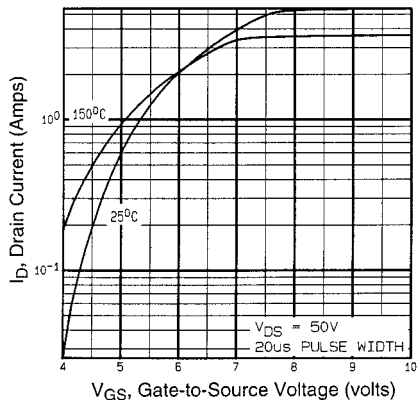
- ① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)
- ②  $V_{DD}=50V$ , starting  $T_J=25^\circ\text{C}$ ,  $L=52mH$ ,  $R_G=25\Omega$ ,  $I_{AS}=2.0A$  (See Figure 12)
- ③  $I_{SD}\leq 2.0A$ ,  $di/dt\leq 40A/\mu s$ ,  $V_{DD}\leq V_{(BR)DSS}$ ,  $T_J\leq 150^\circ\text{C}$
- ④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .



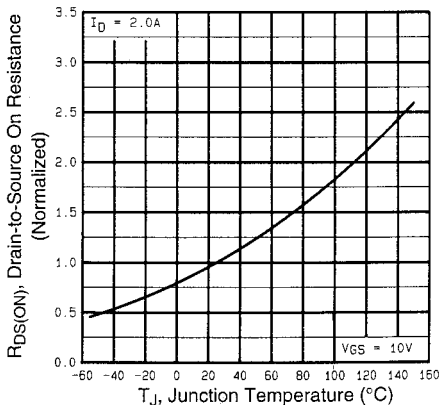
**Fig 1.** Typical Output Characteristics,  
 $T_C = 25^\circ\text{C}$



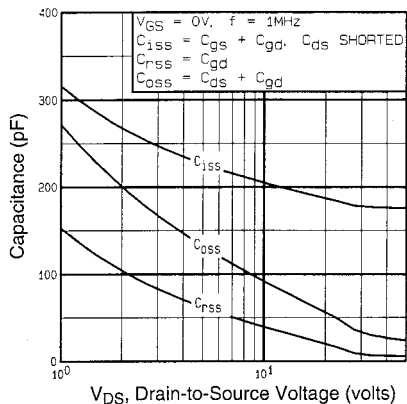
**Fig 2.** Typical Output Characteristics,  
 $T_C = 150^\circ\text{C}$



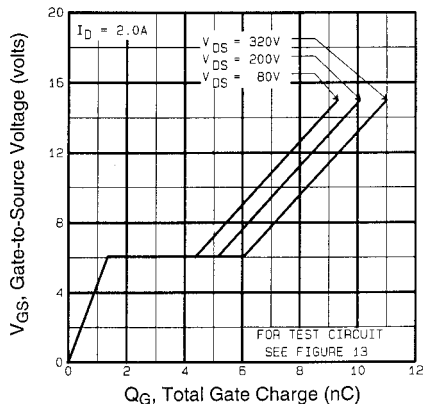
**Fig 3.** Typical Transfer Characteristics



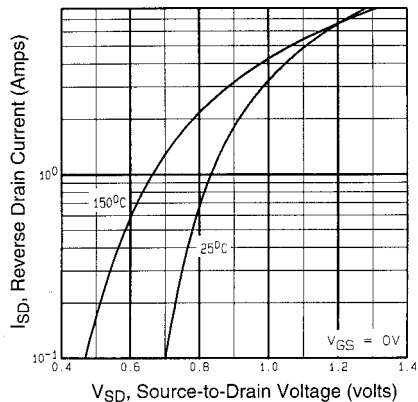
**Fig 4.** Normalized On-Resistance  
Vs. Temperature



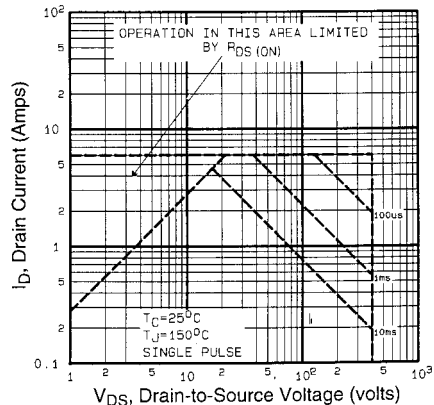
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



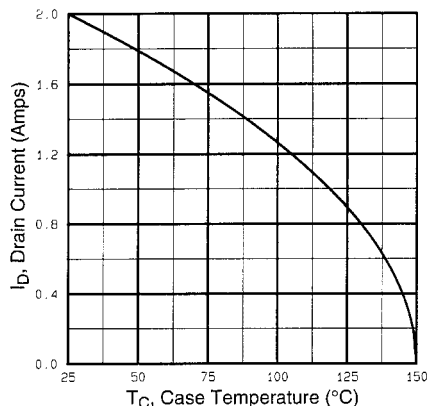
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



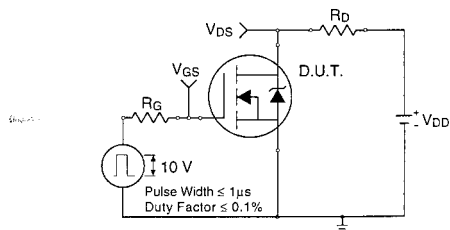
**Fig 7.** Typical Source-Drain Diode Forward Voltage



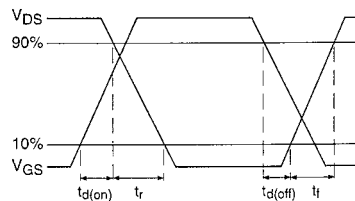
**Fig 8.** Maximum Safe Operating Area



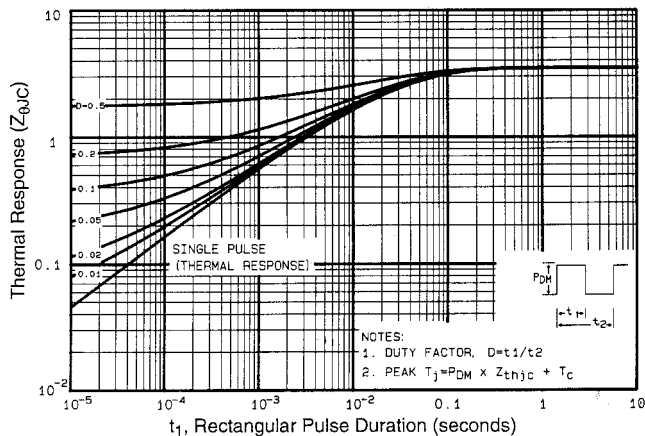
**Fig 9.** Maximum Drain Current Vs. Case Temperature



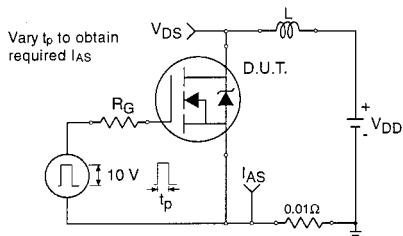
**Fig 10a.** Switching Time Test Circuit



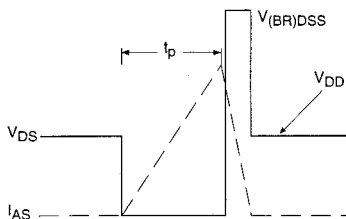
**Fig 10b.** Switching Time Waveforms



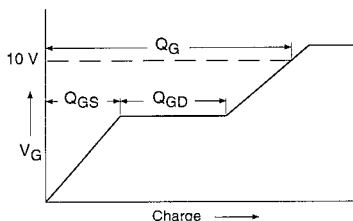
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



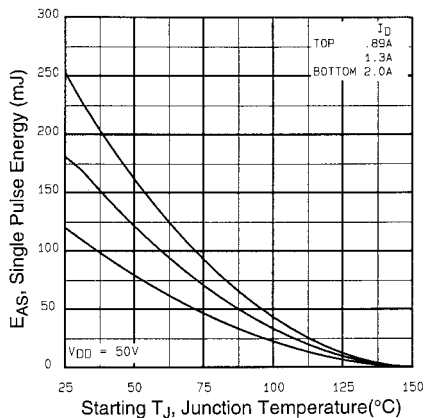
**Fig 12a.** Unclamped Inductive Test Circuit



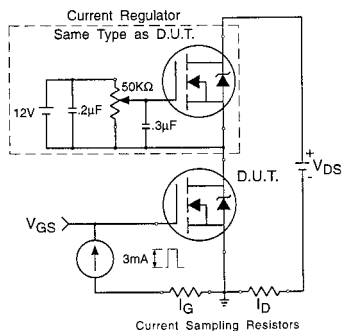
**Fig 12b.** Unclamped Inductive Waveforms



**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

**Appendix B:** Package Outline Mechanical Drawing

**Appendix C:** Part Marking Information

**Appendix D:** Tape & Reel Information