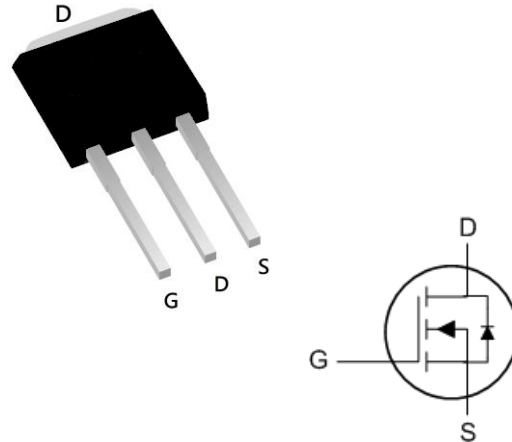


### Description

The I-PAK is designed for surface mounting using vapor phase, infrared or wave soldering techniques. Power dissipation levels up to 1.5 watts are possible in typical surface mount applications.

### TO251 Pin Configuration



### Features

$V_{DS}$  (V) = 100V

$I_D$  = 9.4A ( $V_{GS}$  = 10V)

$R_{DS(ON)}$  = 210m $\Omega$  ( $V_{GS}$  = 10V)

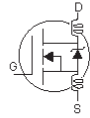
### Absolute Maximum Ratings

|                                   | Parameter                                | Max.                   | Units               |
|-----------------------------------|------------------------------------------|------------------------|---------------------|
| $I_D$ @ $T_C = 25^\circ\text{C}$  | Continuous Drain Current, $V_{GS}$ @ 10V | 9.4                    | A                   |
| $I_D$ @ $T_C = 100^\circ\text{C}$ | Continuous Drain Current, $V_{GS}$ @ 10V | 6.6                    |                     |
| $I_{DM}$                          | Pulsed Drain Current ①⑥                  | 38                     |                     |
| $P_D$ @ $T_C = 25^\circ\text{C}$  | Power Dissipation                        | 48                     | W                   |
|                                   | Linear Derating Factor                   | 0.32                   | W/ $^\circ\text{C}$ |
| $V_{GS}$                          | Gate-to-Source Voltage                   | $\pm 20$               | V                   |
| $E_{AS}$                          | Single Pulse Avalanche Energy②⑥          | 91                     | mJ                  |
| $I_{AR}$                          | Avalanche Current①⑥                      | 5.7                    | A                   |
| $E_{AR}$                          | Repetitive Avalanche Energy①⑥            | 4.8                    | mJ                  |
| dv/dt                             | Peak Diode Recovery dv/dt ③              | 5.0                    | V/ns                |
| $T_J$                             | Operating Junction and                   | -55 to + 175           | $^\circ\text{C}$    |
| $T_{STG}$                         | Storage Temperature Range                |                        |                     |
|                                   | Soldering Temperature, for 10 seconds    | 300 (1.6mm from case ) |                     |

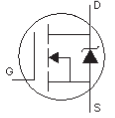
### Thermal Resistance

|                 | Parameter                          | Typ. | Max. | Units                     |
|-----------------|------------------------------------|------|------|---------------------------|
| $R_{\theta JC}$ | Junction-to-Case                   | ---  | 3.1  | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB mount) ** | ---  | 50   |                           |
| $R_{\theta JA}$ | Junction-to-Ambient                | ---  | 110  |                           |

**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

|                                        | Parameter                            | Min. | Typ. | Max. | Units | Conditions                                                                          |
|----------------------------------------|--------------------------------------|------|------|------|-------|-------------------------------------------------------------------------------------|
| V <sub>(BR)DSS</sub>                   | Drain-to-Source Breakdown Voltage    | 100  | —    | —    | V     | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                                        |
| ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub> | Breakdown Voltage Temp. Coefficient  | —    | 0.12 | —    | V/°C  | Reference to 25°C, I <sub>D</sub> = 1mA                                             |
| R <sub>DS(on)</sub>                    | Static Drain-to-Source On-Resistance | —    | —    | 0.21 |       | V <sub>GS</sub> = 10V, I <sub>D</sub> = 5.6A 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             | 2.7  | —    | —    | S     | V <sub>DS</sub> = 25V, I <sub>D</sub> = 5.7A⑥                                       |
| I <sub>DSS</sub>                       | Drain-to-Source Leakage Current      | —    | —    | 25   | μA    | V <sub>DS</sub> = 100V, V <sub>GS</sub> = 0V                                        |
|                                        |                                      | —    | —    | 250  |       | V <sub>DS</sub> = 80V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 150°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                    | —    | —    | 25   | nC    | I <sub>D</sub> = 5.7A                                                               |
| Q <sub>gs</sub>                        | Gate-to-Source Charge                | —    | —    | 4.8  |       | V <sub>DS</sub> = 80V                                                               |
| Q <sub>gd</sub>                        | Gate-to-Drain ("Miller") Charge      | —    | —    | 11   |       | V <sub>GS</sub> = 10V, See Fig. 6 and 13 ④⑥                                         |
| t <sub>d(on)</sub>                     | Turn-On Delay Time                   | —    | 4.5  | —    |       | V <sub>DD</sub> = 50V                                                               |
| t <sub>r</sub>                         | Rise Time                            | —    | 23   | —    | ns    | I <sub>D</sub> = 5.7A                                                               |
| t <sub>d(off)</sub>                    | Turn-Off Delay Time                  | —    | 32   | —    |       | R <sub>G</sub> = 22Ω                                                                |
| t <sub>f</sub>                         | Fall Time                            | —    | 23   | —    |       | R <sub>D</sub> = 8.6Ω, See Fig. 10 ④⑥                                               |
| L <sub>D</sub>                         | Internal Drain Inductance            | —    | 4.5  | —    | nH    | Between lead,<br>6mm (0.25in.)<br>from package<br>and center of die contact⑤        |
| L <sub>S</sub>                         | Internal Source Inductance           | —    | 7.5  | —    |       |  |
| C <sub>ISS</sub>                       | Input Capacitance                    | —    | 330  | —    | pF    | V <sub>GS</sub> = 0V                                                                |
| C <sub>OSS</sub>                       | Output Capacitance                   | —    | 92   | —    |       | V <sub>DS</sub> = 25V                                                               |
| C <sub>rSS</sub>                       | Reverse Transfer Capacitance         | —    | 54   | —    |       | f = 1.0MHz, See Fig. 5⑥                                                             |

**Source-Drain Ratings and Characteristics**

|                 | Parameter                                 | Min.                                                                                           | Typ. | Max. | Units | Conditions                                                                                                                                                       |
|-----------------|-------------------------------------------|------------------------------------------------------------------------------------------------|------|------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I <sub>S</sub>  | Continuous Source Current<br>(Body Diode) | —                                                                                              | —    | 9.4  | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode.<br> |
| I <sub>SM</sub> | Pulsed Source Current<br>(Body Diode) ①⑥  | —                                                                                              | —    | 38   |       |                                                                                                                                                                  |
| V <sub>SD</sub> | Diode Forward Voltage                     | —                                                                                              | —    | 1.3  | V     | T <sub>J</sub> = 25°C, I <sub>S</sub> = 5.5A, V <sub>GS</sub> = 0V ④                                                                                             |
| t <sub>rr</sub> | Reverse Recovery Time                     | —                                                                                              | 99   | 150  | ns    | T <sub>J</sub> = 25°C, I <sub>F</sub> = 5.7A                                                                                                                     |
| Q <sub>rr</sub> | Reverse Recovery Charge                   | —                                                                                              | 390  | 580  | nC    | di/dt = 100A/μs ④⑥                                                                                                                                               |
| 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 fig. 11 )
- ② V<sub>DD</sub> = 25V, starting T<sub>J</sub> = 25°C, L = 4.7mH, R<sub>G</sub> = 25Ω, I<sub>AS</sub> = 5.7A. (See Figure 12)
- ③ I<sub>SD</sub> ≤ 5.7A, di/dt ≤ 240A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>J</sub> ≤ 175°C
- ④ Pulse width ≤ 300μs; duty cycle ≤ 2%
- ⑤ This is applied for I-PAK, L<sub>s</sub> of D-PAK is measured between lead and center of die contact
- ⑥ Uses IRF520N 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

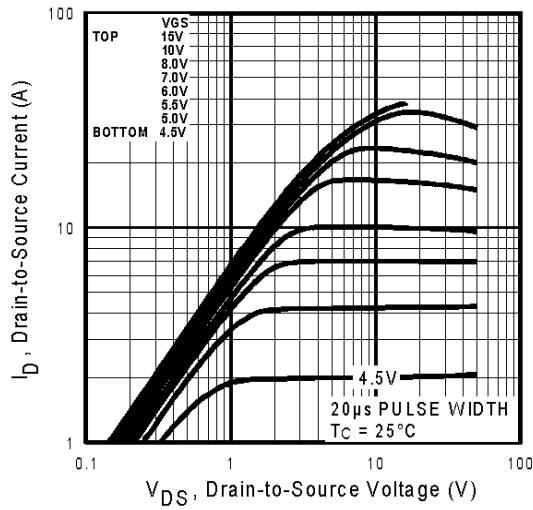


Fig 1. Typical Output Characteristics

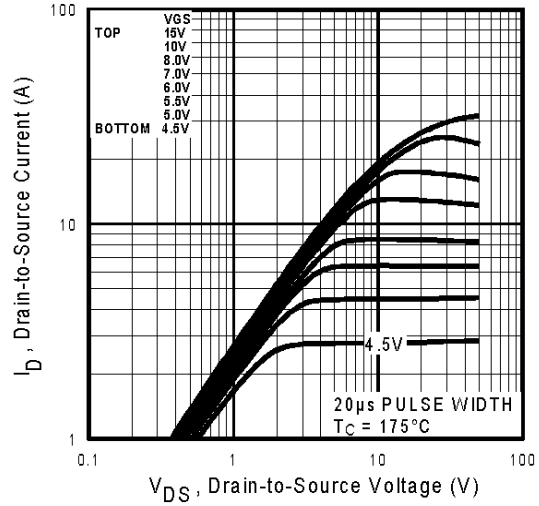


Fig 2. Typical Output Characteristics

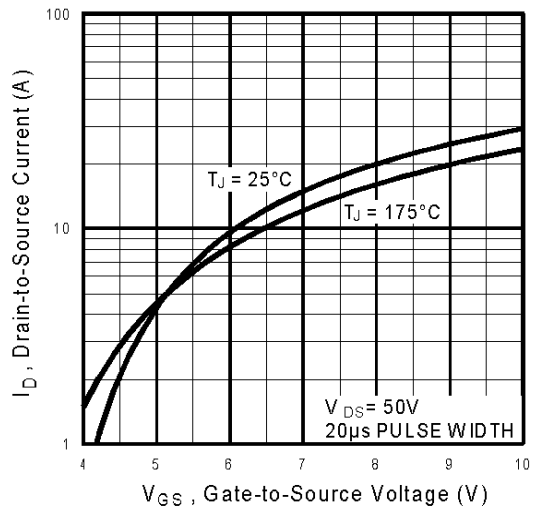


Fig 3. Typical Transfer Characteristics

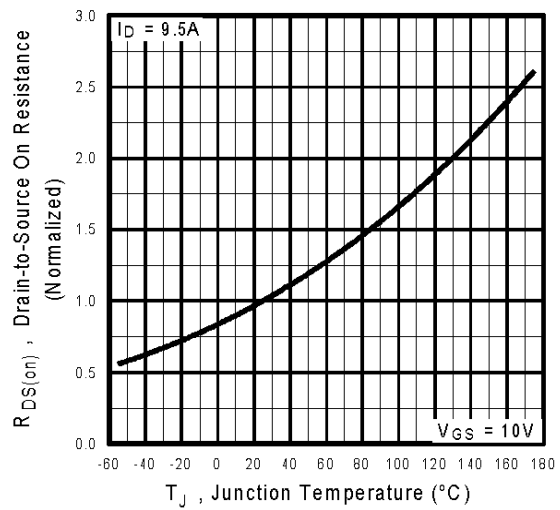
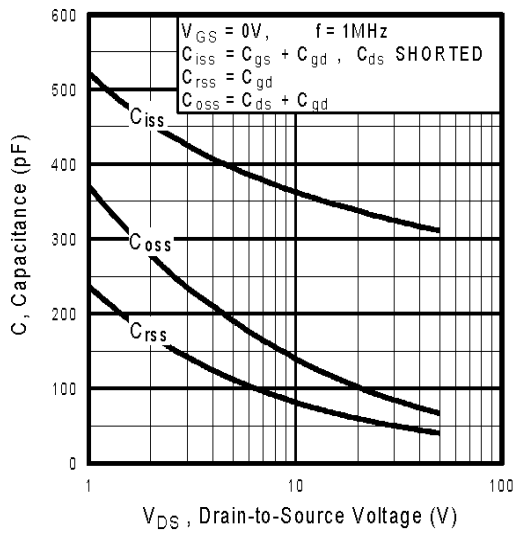
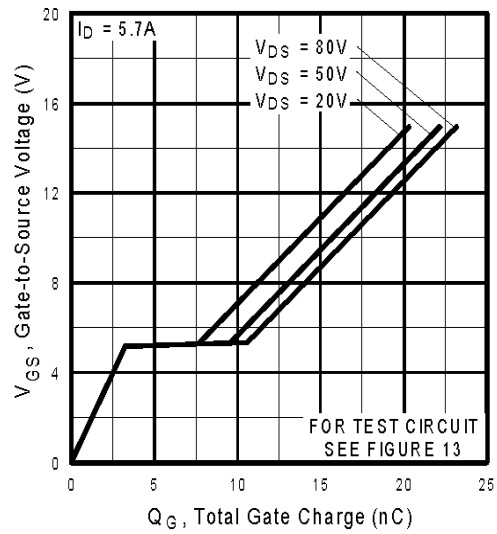


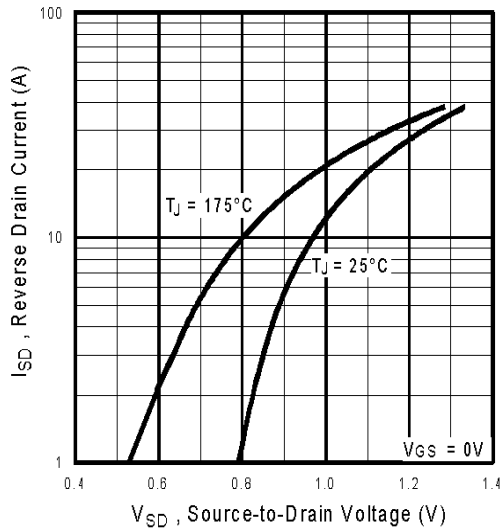
Fig 4. Normalized On-Resistance Vs. Temperature



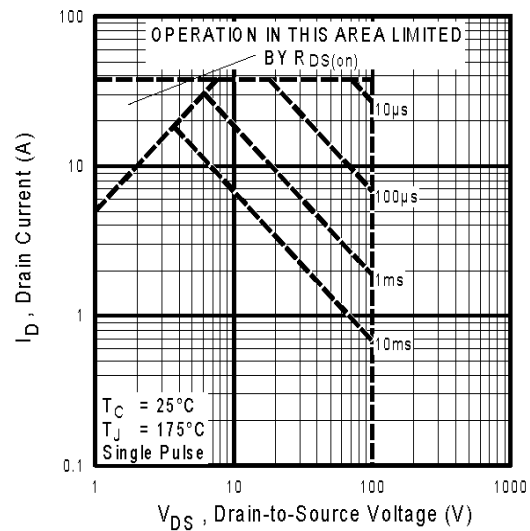
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



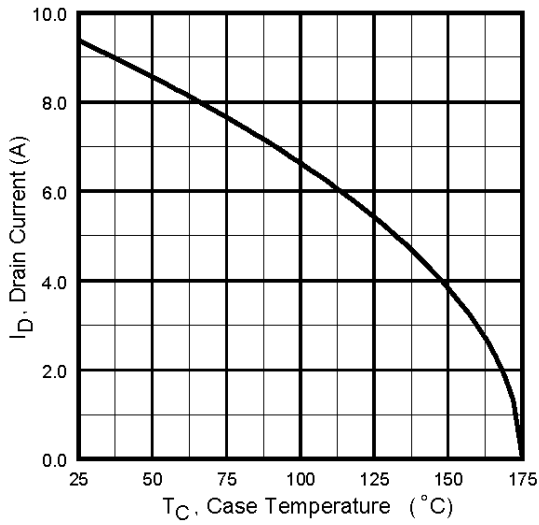
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



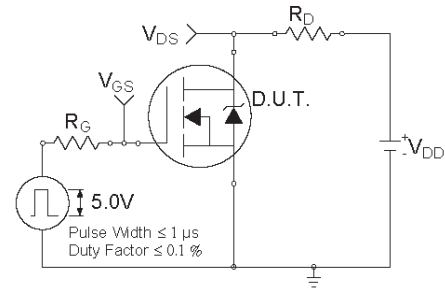
**Fig 7.** Typical Source-Drain Diode Forward Voltage



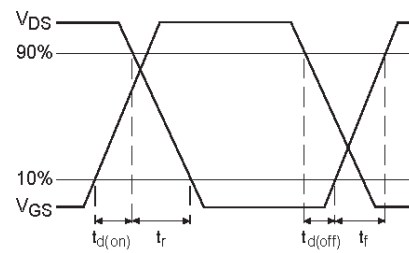
**Fig 8.** Maximum Safe Operating Area



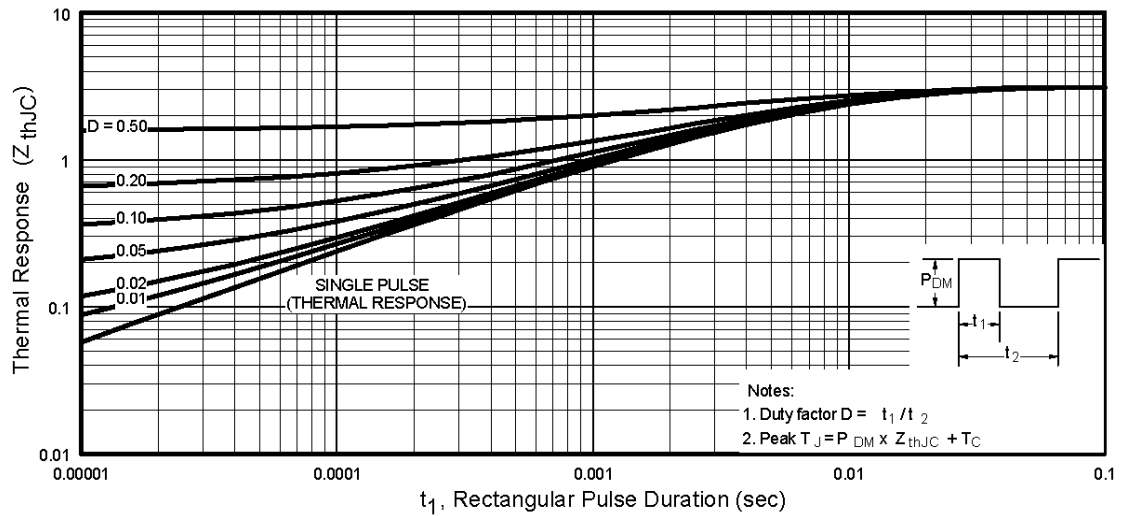
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



**Fig 10b.** Switching Time Waveforms



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

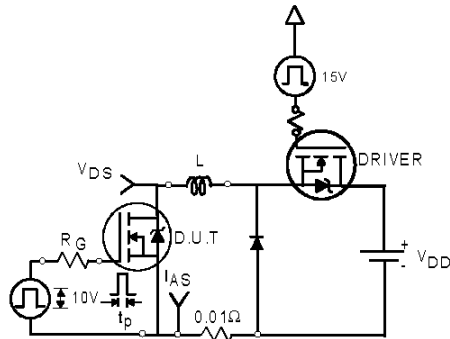


Fig 12a. Unclamped Inductive Test Circuit

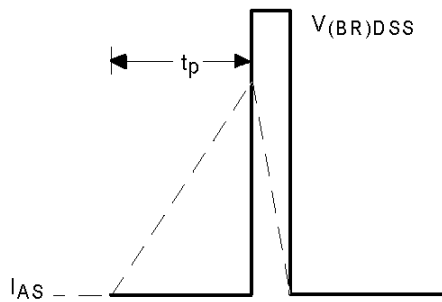


Fig 12b. Unclamped Inductive Waveforms

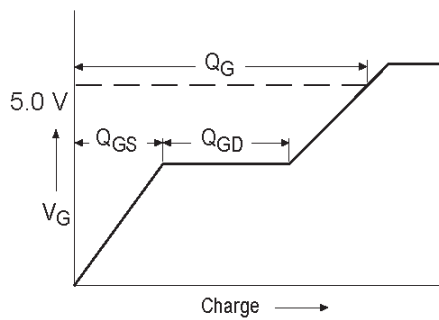


Fig 13a. Basic Gate Charge Waveform

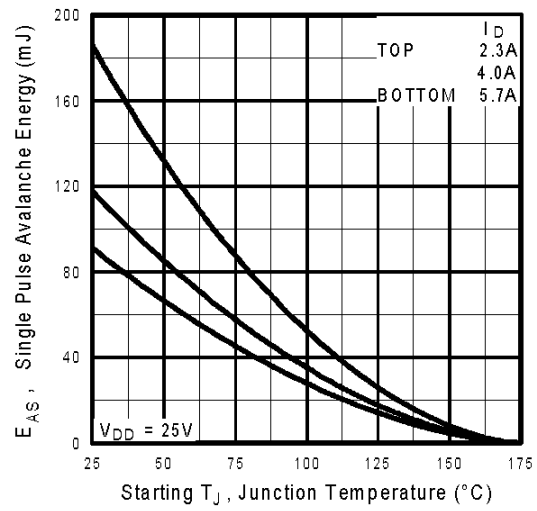


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

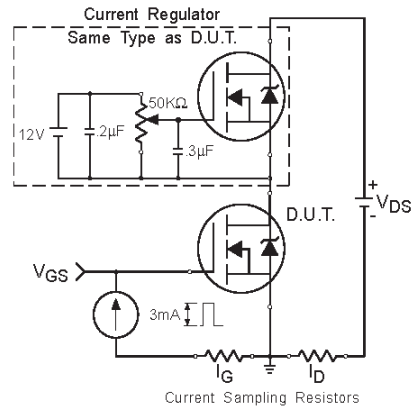


Fig 13b. Gate Charge Test Circuit