

## Advanced Power MOSFET

## IRLR/U024A

### FEATURES

- Avalanche Rugged Technology
- Rugged Gate Oxide Technology
- Lower Input Capacitance
- Improved Gate Charge
- Extended Safe Operating Area
- Lower Leakage Current : 10  $\mu$ A (Max.) @  $V_{DS} = 60V$
- Lower  $R_{DS(ON)}$  : 0.061  $\Omega$  (Typ.)

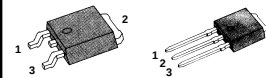
$$BV_{DSS} = 60 V$$

$$R_{DS(on)} = 0.075 \Omega$$

$$I_D = 15 A$$

**D-PAK**

**I-PAK**



1. Gate 2. Drain 3. Source

### Absolute Maximum Ratings

| Symbol         | Characteristic                                                          | Value        | Units         |
|----------------|-------------------------------------------------------------------------|--------------|---------------|
| $V_{DSS}$      | Drain-to-Source Voltage                                                 | 60           | V             |
| $I_D$          | Continuous Drain Current ( $T_C=25^\circ C$ )                           | 15           | A             |
|                | Continuous Drain Current ( $T_C=100^\circ C$ )                          | 9.5          |               |
| $I_{DM}$       | Drain Current-Pulsed ①                                                  | 52           | A             |
| $V_{GS}$       | Gate-to-Source Voltage                                                  | $\pm 20$     | V             |
| $E_{AS}$       | Single Pulsed Avalanche Energy ②                                        | 154          | mJ            |
| $I_{AR}$       | Avalanche Current ①                                                     | 15           | A             |
| $E_{AR}$       | Repetitive Avalanche Energy ①                                           | 3            | mJ            |
| dv/dt          | Peak Diode Recovery dv/dt ③                                             | 5.5          | V/ns          |
| $P_D$          | Total Power Dissipation ( $T_A=25^\circ C$ ) *                          | 2.5          | W             |
|                | Total Power Dissipation ( $T_C=25^\circ C$ )                            | 30           | W             |
|                | Linear Derating Factor                                                  | 0.24         | W/ $^\circ C$ |
| $T_J, T_{STG}$ | Operating Junction and Storage Temperature Range                        | - 55 to +150 | $^\circ C$    |
| $T_L$          | Maximum Lead Temp. for Soldering Purposes, 1/8" from case for 5-seconds | 300          |               |

### Thermal Resistance

| Symbol          | Characteristic        | Typ. | Max. | Units        |
|-----------------|-----------------------|------|------|--------------|
| $R_{\theta JC}$ | Junction-to-Case      | --   | 4.14 | $^\circ C/W$ |
| $R_{\theta JA}$ | Junction-to-Ambient * | --   | 50   |              |
| $R_{\theta JA}$ | Junction-to-Ambient   | --   | 110  |              |

\* When mounted on the minimum pad size recommended (PCB Mount).

**Electrical Characteristics** ( $T_C=25^\circ\text{C}$  unless otherwise specified)

| Symbol                 | Characteristic                          | Min. | Typ.  | Max.  | Units        | Test Condition                                                             |
|------------------------|-----------------------------------------|------|-------|-------|--------------|----------------------------------------------------------------------------|
| $BV_{DSS}$             | Drain-Source Breakdown Voltage          | 60   | --    | --    | V            | $V_{GS}=0V, I_D=250\mu A$                                                  |
| $\Delta BV/\Delta T_J$ | Breakdown Voltage Temp. Coeff.          | --   | 0.056 | --    | $V/^\circ C$ | $I_D=250\mu A$ <b>See Fig 7</b>                                            |
| $V_{GS(th)}$           | Gate Threshold Voltage                  | 1.0  | --    | 2.0   | V            | $V_{DS}=5V, I_D=250\mu A$                                                  |
| $I_{GSS}$              | Gate-Source Leakage, Forward            | --   | --    | 100   | nA           | $V_{GS}=20V$                                                               |
|                        | Gate-Source Leakage, Reverse            | --   | --    | -100  |              | $V_{GS}=-20V$                                                              |
| $I_{DSS}$              | Drain-to-Source Leakage Current         | --   | --    | 10    | $\mu A$      | $V_{DS}=60V$                                                               |
|                        |                                         | --   | --    | 100   |              | $V_{DS}=48V, T_C=125^\circ C$                                              |
| $R_{DS(on)}$           | Static Drain-Source On-State Resistance | --   | --    | 0.075 | $\Omega$     | $V_{GS}=5V, I_D=7.5A$ ④                                                    |
| $g_{fs}$               | Forward Transconductance                | --   | 9.1   | --    | $\Omega$     | $V_{DS}=30V, I_D=7.5A$ ④                                                   |
| $C_{iss}$              | Input Capacitance                       | --   | 560   | 730   | pF           | $V_{GS}=0V, V_{DS}=25V, f=1MHz$<br><b>See Fig 5</b>                        |
| $C_{oss}$              | Output Capacitance                      | --   | 195   | 225   |              |                                                                            |
| $C_{rss}$              | Reverse Transfer Capacitance            | --   | 77    | 90    |              |                                                                            |
| $t_{d(on)}$            | Turn-On Delay Time                      | --   | 12    | 35    | ns           | $V_{DD}=30V, I_D=17A,$<br>$R_G=9\Omega$<br><b>See Fig 13</b> ④ ⑤           |
| $t_r$                  | Rise Time                               | --   | 21    | 55    |              |                                                                            |
| $t_{d(off)}$           | Turn-Off Delay Time                     | --   | 32    | 75    |              |                                                                            |
| $t_f$                  | Fall Time                               | --   | 21    | 55    |              |                                                                            |
| $Q_g$                  | Total Gate Charge                       | --   | 15    | 20    | nC           | $V_{DS}=48V, V_{GS}=5V,$<br>$I_D=17A$<br><b>See Fig 6 &amp; Fig 12</b> ④ ⑤ |
| $Q_{gs}$               | Gate-Source Charge                      | --   | 4.4   | --    |              |                                                                            |
| $Q_{gd}$               | Gate-Drain("Miller") Charge             | --   | 7.3   | --    |              |                                                                            |

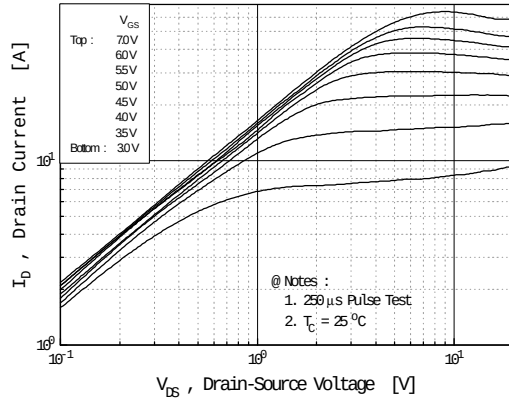
**Source-Drain Diode Ratings and Characteristics**

| Symbol   | Characteristic            | Min. | Typ.  | Max. | Units   | Test Condition                          |
|----------|---------------------------|------|-------|------|---------|-----------------------------------------|
| $I_S$    | Continuous Source Current | --   | --    | 15   | A       | Integral reverse pn-diode in the MOSFET |
| $I_{SM}$ | Pulsed-Source Current ①   | --   | --    | 52   |         |                                         |
| $V_{SD}$ | Diode Forward Voltage ④   | --   | --    | 1.5  | V       | $T_J=25^\circ C, I_S=15A, V_{GS}=0V$    |
| $t_{rr}$ | Reverse Recovery Time     | --   | 55    | --   | ns      | $T_J=25^\circ C, I_F=17A$               |
| $Q_{rr}$ | Reverse Recovery Charge   | --   | 0.091 | --   | $\mu C$ | $di_F/dt=100A/\mu s$ ④                  |

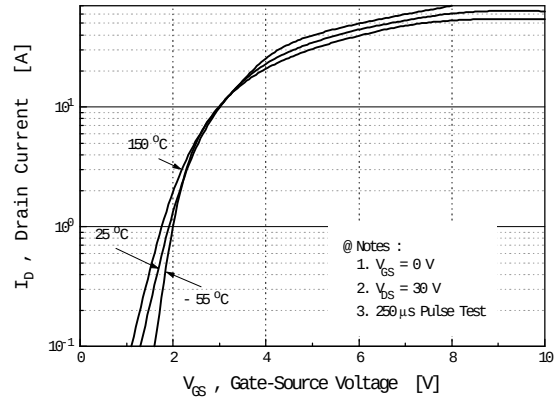
**Notes ;**

- ① Repetitive Rating : Pulse Width Limited by Maximum Junction Temperature  
 ②  $L=0.8mH, I_{AS}=15A, V_{DD}=25V, R_G=27\Omega$ , Starting  $T_J=25^\circ C$   
 ③  $I_{SD} \leq 17A, di/dt \leq 250A/\mu s, V_{DD} \leq BV_{DSS}$ , Starting  $T_J=25^\circ C$   
 ④ Pulse Test : Pulse Width = 250  $\mu s$ , Duty Cycle  $\leq 2\%$   
 ⑤ Essentially Independent of Operating Temperature

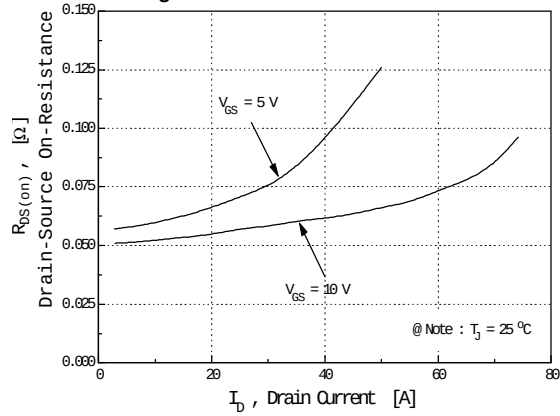
**Fig 1. Output Characteristics**



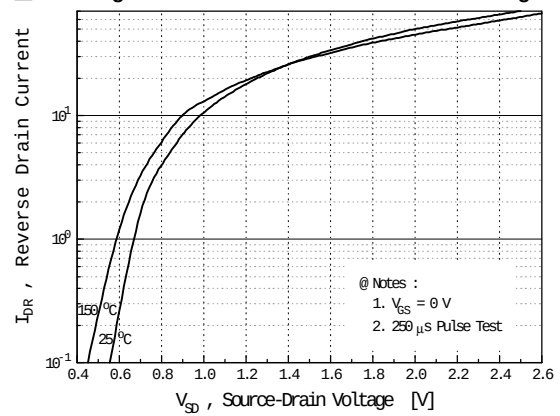
**Fig 2. Transfer Characteristics**



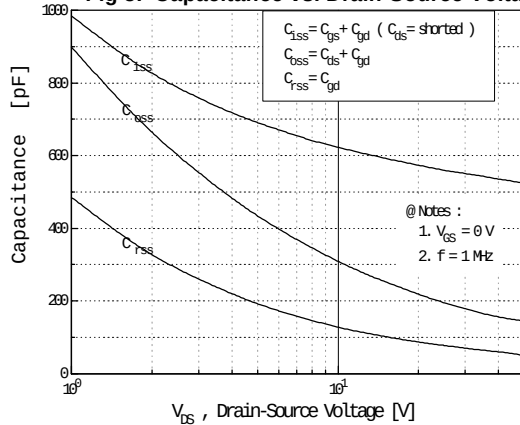
**Fig 3. On-Resistance vs. Drain Current**



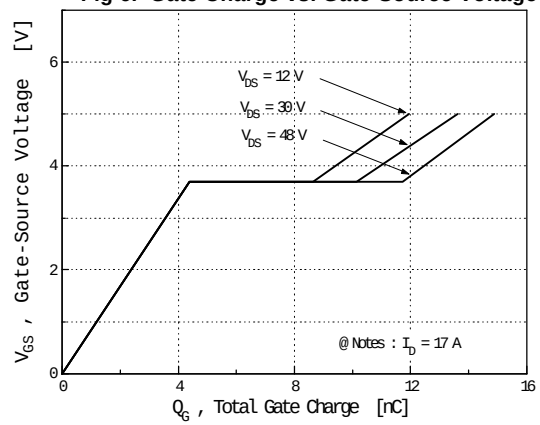
**Fig 4. Source-Drain Diode Forward Voltage**

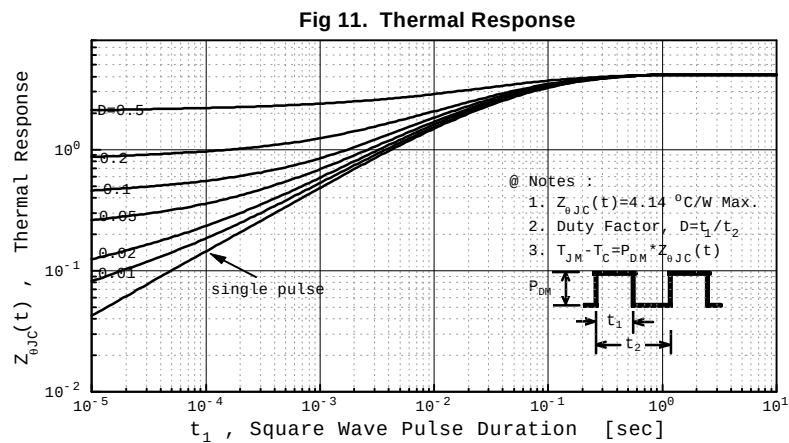
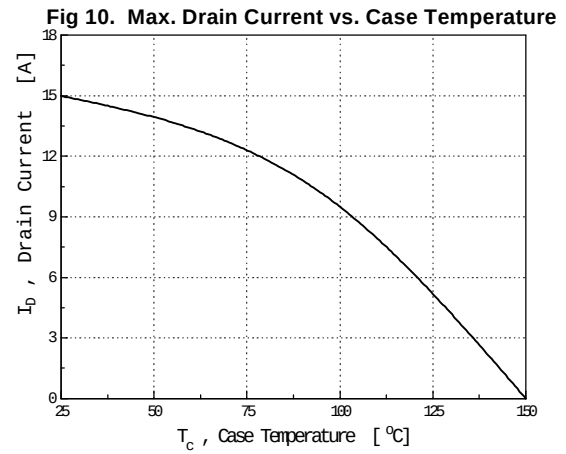
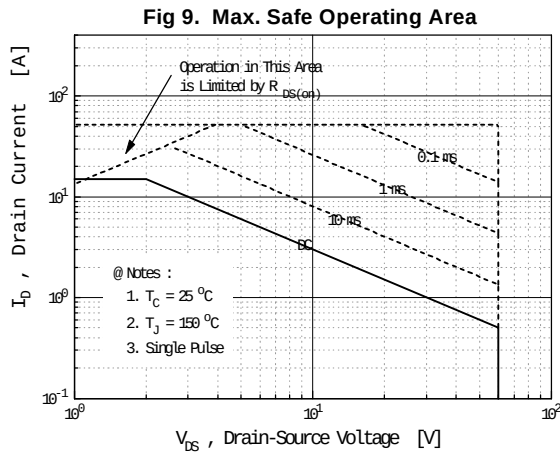
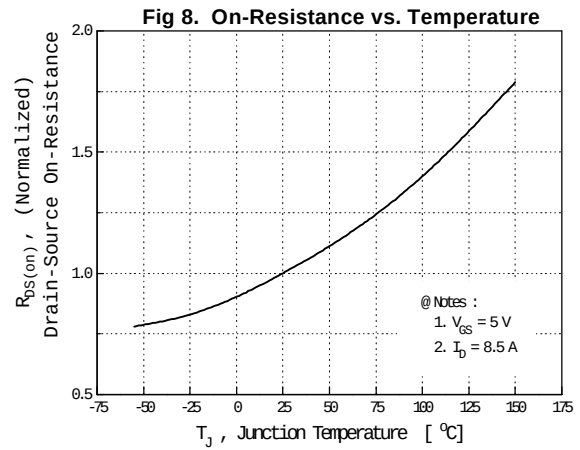
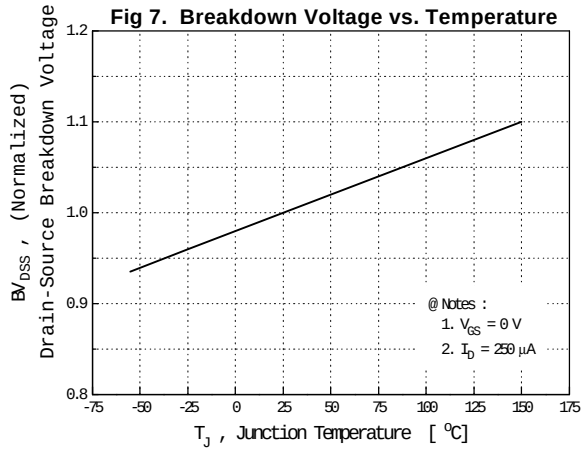


**Fig 5. Capacitance vs. Drain-Source Voltage**

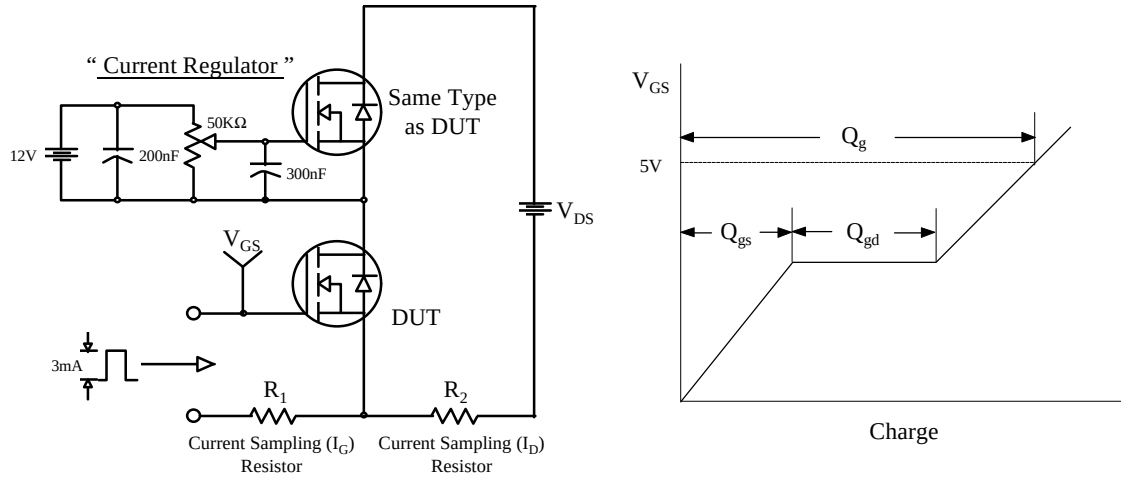


**Fig 6. Gate Charge vs. Gate-Source Voltage**

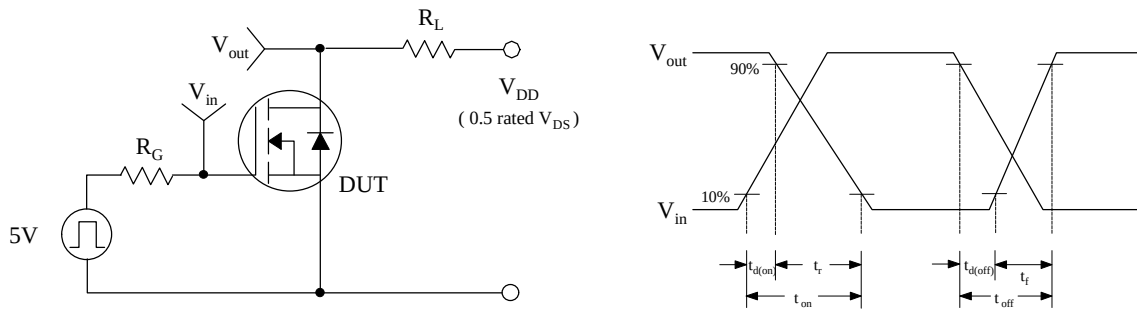




**Fig 12. Gate Charge Test Circuit & Waveform**



**Fig 13. Resistive Switching Test Circuit & Waveforms**



**Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms**

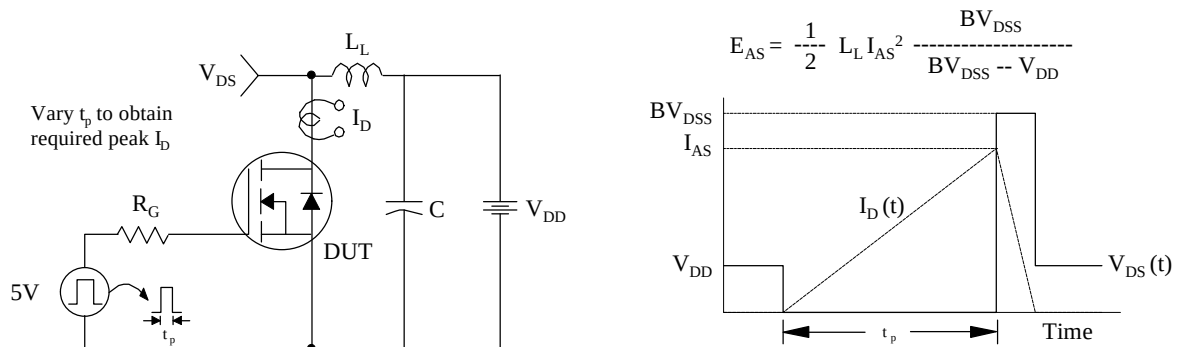


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

