

## IRFU9024PBF-VB Datasheet

### P-Channel 60-V (D-S) MOSFET

#### PRODUCT SUMMARY

| $V_{DS}$ (V) | $R_{DS(on)}$ ( $\Omega$ )   | $I_D$ (A) <sup>a</sup> | $Q_g$ (Typ.) |
|--------------|-----------------------------|------------------------|--------------|
| - 60         | 0.066 at $V_{GS} = - 10$ V  | - 20                   | 40 nC        |
|              | 0.080 at $V_{GS} = - 4.5$ V | - 18                   |              |

#### FEATURES

- Trench Power MOSFET
- 100 % UIS Tested

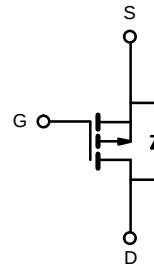
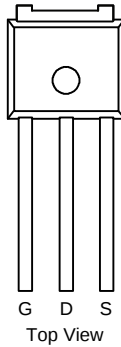
#### APPLICATIONS

- Load Switch



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

TO-251



P-Channel MOSFET

#### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise noted)

| Parameter                                        |               | Symbol         | Limit              | Unit |
|--------------------------------------------------|---------------|----------------|--------------------|------|
| Drain-Source Voltage                             |               | $V_{DS}$       | - 60               | V    |
| Gate-Source Voltage                              |               | $V_{GS}$       | $\pm 20$           |      |
| Continuous Drain Current ( $T_J = 150$ °C)       | $T_C = 25$ °C | $I_D$          | - 20 <sup>a</sup>  | A    |
|                                                  | $T_C = 70$ °C |                | - 16               |      |
|                                                  | $T_A = 25$ °C |                | - 11 <sup>b</sup>  |      |
|                                                  | $T_A = 70$ °C |                | - 9 <sup>b</sup>   |      |
| Pulsed Drain Current                             |               | $I_{DM}$       | - 100              |      |
| Avalanche Current Pulse                          |               | $I_{AS}$       | - 35               | mJ   |
| Single Pulse Avalanche Energy                    |               | $E_{AS}$       | 101                |      |
| Continuous Source-Drain Diode Current            | $T_C = 25$ °C | $I_S$          | - 29 <sup>a</sup>  | A    |
|                                                  | $T_A = 25$ °C |                | - 2.1 <sup>b</sup> |      |
| Maximum Power Dissipation                        | $T_C = 25$ °C | $P_D$          | 35 <sup>a</sup>    | W    |
|                                                  | $T_C = 70$ °C |                | 20 <sup>a</sup>    |      |
|                                                  | $T_A = 25$ °C |                | 3.0 <sup>b</sup>   |      |
|                                                  | $T_A = 70$ °C |                | 2 <sup>b</sup>     |      |
| Operating Junction and Storage Temperature Range |               | $T_J, T_{stg}$ | - 55 to 150        | °C   |

#### THERMAL RESISTANCE RATINGS

| Parameter                                |              | Symbol     | Typical | Maximum | Unit |
|------------------------------------------|--------------|------------|---------|---------|------|
| Maximum Junction-to-Ambient <sup>b</sup> | Steady State | $R_{thJA}$ | 33      | 40      | °C/W |
|                                          | Steady State | $R_{thJC}$ | 0.98    | 1.2     |      |

Notes:

a. Based on  $T_C = 25$  °C.

b. Surface mounted on 1" x 1" FR4 board.

| SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted) |                                      |                                                                                                                           |       |       |       |       |
|-----------------------------------------------------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|-------|
| Parameter                                                       | Symbol                               | Test Conditions                                                                                                           | Min.  | Typ.  | Max.  | Unit  |
| Static                                                          |                                      |                                                                                                                           |       |       |       |       |
| Drain-Source Breakdown Voltage                                  | V <sub>DS</sub>                      | V <sub>GS</sub> = 0 V, I <sub>D</sub> = - 250 μA                                                                          | - 60  |       |       | V     |
| V <sub>DS</sub> Temperature Coefficient                         | ΔV <sub>DS</sub> /T <sub>J</sub>     | I <sub>D</sub> = - 250 μA                                                                                                 |       | 68    |       | mV/°C |
| V <sub>GS(th)</sub> Temperature Coefficient                     | ΔV <sub>GS(th)</sub> /T <sub>J</sub> |                                                                                                                           |       | - 5.2 |       |       |
| Gate-Source Threshold Voltage                                   | V <sub>GS(th)</sub>                  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = - 250 μA                                                             | - 1.0 |       | - 2.5 | V     |
| Gate-Source Leakage                                             | I <sub>GSS</sub>                     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V                                                                           |       |       | ± 100 | nA    |
| Zero Gate Voltage Drain Current                                 | I <sub>DSS</sub>                     | V <sub>DS</sub> = - 60 V, V <sub>GS</sub> = 0 V                                                                           |       |       | - 1   | μA    |
|                                                                 |                                      | V <sub>DS</sub> = - 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 55 °C                                                   |       |       | - 10  |       |
| On-State Drain Current <sup>a</sup>                             | I <sub>D(on)</sub>                   | V <sub>DS</sub> = - 5 V, V <sub>GS</sub> = - 10 V                                                                         | - 120 |       |       | A     |
| Drain-Source On-State Resistance <sup>a</sup>                   | R <sub>DS(on)</sub>                  | V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 30 A                                                                         |       | 0.066 |       | Ω     |
|                                                                 |                                      | V <sub>GS</sub> = - 4.5 V, I <sub>D</sub> = - 20 A                                                                        |       | 0.080 |       |       |
| Forward Transconductance <sup>a</sup>                           | g <sub>fs</sub>                      | V <sub>DS</sub> = - 15 V, I <sub>D</sub> = - 50 A                                                                         | 20    |       |       | S     |
| Dynamic <sup>b</sup>                                            |                                      |                                                                                                                           |       |       |       |       |
| Input Capacitance                                               | C <sub>iss</sub>                     | V <sub>DS</sub> = - 25 V, V <sub>GS</sub> = 0 V, f = 1 MHz                                                                |       | 1200  |       | pF    |
| Output Capacitance                                              | C <sub>oss</sub>                     |                                                                                                                           |       | 200   |       |       |
| Reverse Transfer Capacitance                                    | C <sub>rss</sub>                     |                                                                                                                           |       | 150   |       |       |
| Total Gate Charge                                               | Q <sub>g</sub>                       | V <sub>DS</sub> = - 30 V, V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 55 A                                               |       | 40    |       | nC    |
|                                                                 |                                      | V <sub>DS</sub> = - 30 V, V <sub>GS</sub> = - 4.5 V, I <sub>D</sub> = - 55 A                                              |       | 38    |       |       |
| Q <sub>gs</sub>                                                 |                                      |                                                                                                                           | 16    |       |       |       |
| Q <sub>gd</sub>                                                 |                                      |                                                                                                                           | 19    |       |       |       |
| Gate Resistance                                                 | R <sub>g</sub>                       | f = 1 MHz                                                                                                                 |       | 5.2   |       | Ω     |
| Turn-On Delay Time                                              | t <sub>d(on)</sub>                   | V <sub>DD</sub> = - 2 V, R <sub>L</sub> = 2 Ω<br>I <sub>D</sub> ≡ - 10 A, V <sub>GEN</sub> = - 10 V, R <sub>g</sub> = 1 Ω |       | 10    | 15    | ns    |
| Rise Time                                                       | t <sub>r</sub>                       |                                                                                                                           |       | 7     | 15    |       |
| Turn-Off Delay Time                                             | t <sub>d(off)</sub>                  |                                                                                                                           |       | 70    | 110   |       |
| Fall Time                                                       | t <sub>f</sub>                       |                                                                                                                           |       | 40    | 60    |       |
| Drain-Source Body Diode Characteristics                         |                                      |                                                                                                                           |       |       |       |       |
| Continuous Source-Drain Diode Current                           | I <sub>S</sub>                       | T <sub>C</sub> = 25 °C                                                                                                    |       |       | - 66  | A     |
| Pulse Diode Forward Current <sup>a</sup>                        | I <sub>SM</sub>                      |                                                                                                                           |       |       | - 150 |       |
| Body Diode Voltage                                              | V <sub>SD</sub>                      | I <sub>S</sub> = - 30 A                                                                                                   |       | - 1   | - 1.5 | V     |
| Body Diode Reverse Recovery Time                                | t <sub>rr</sub>                      | I <sub>F</sub> = - 50 A, di/dt = 100 A/μs, T <sub>J</sub> = 25 °C                                                         |       | 45    | 68    | ns    |
| Body Diode Reverse Recovery Charge                              | Q <sub>rr</sub>                      |                                                                                                                           |       | 59    | 120   | nC    |
| Reverse Recovery Fall Time                                      | t <sub>a</sub>                       |                                                                                                                           |       | 29    |       | ns    |
| Reverse Recovery Rise Time                                      | t <sub>b</sub>                       |                                                                                                                           |       | 16    |       |       |

Notes:

a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**Output Characteristics**



**Transconductance**



**Transfer Characteristics**



**Transconductance**

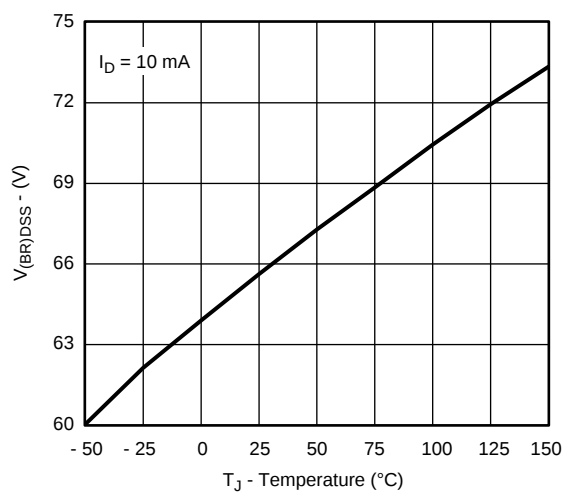
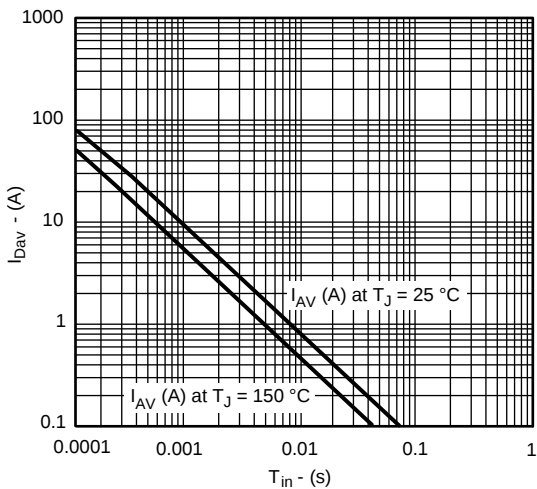
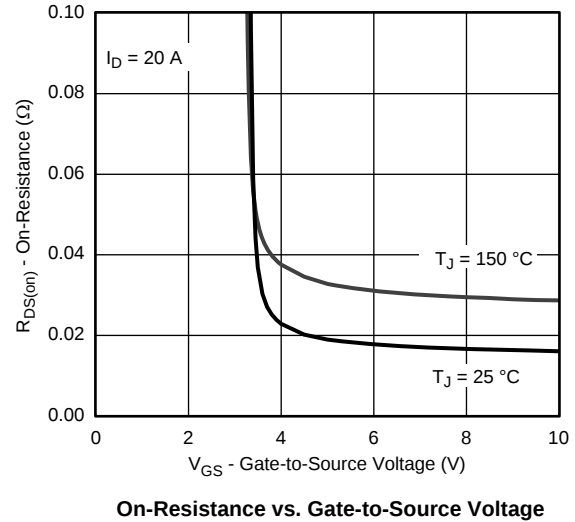
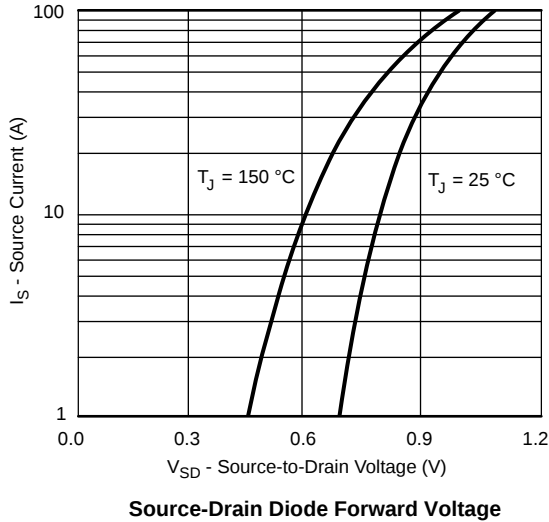
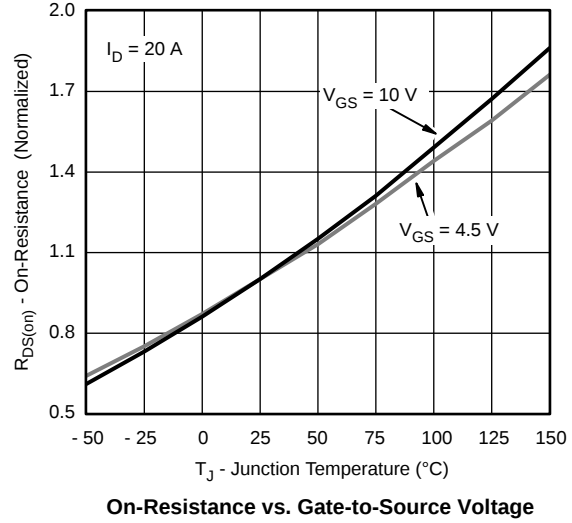
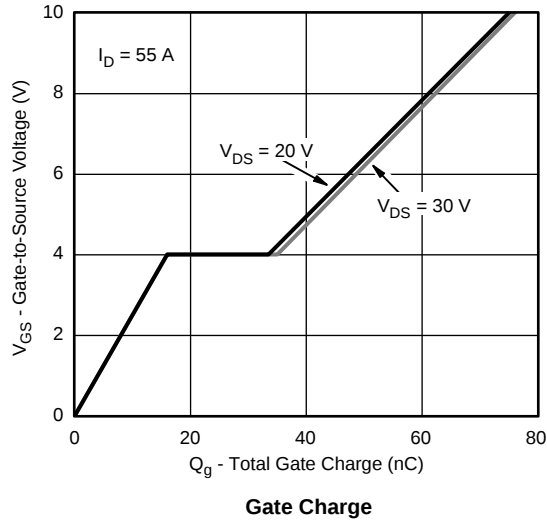


**On-Resistance vs. Drain Current**



**Capacitance**

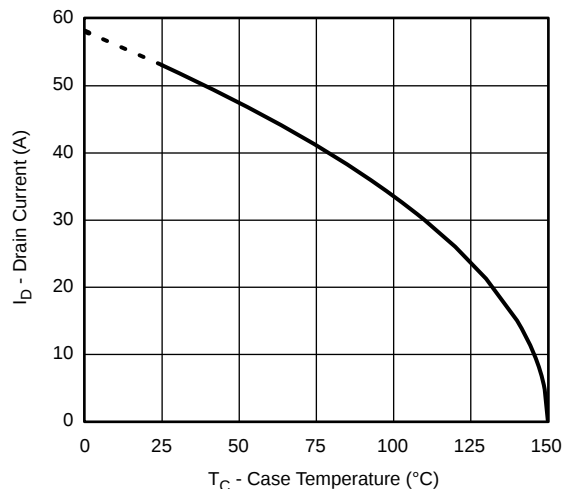
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



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Threshold Voltage



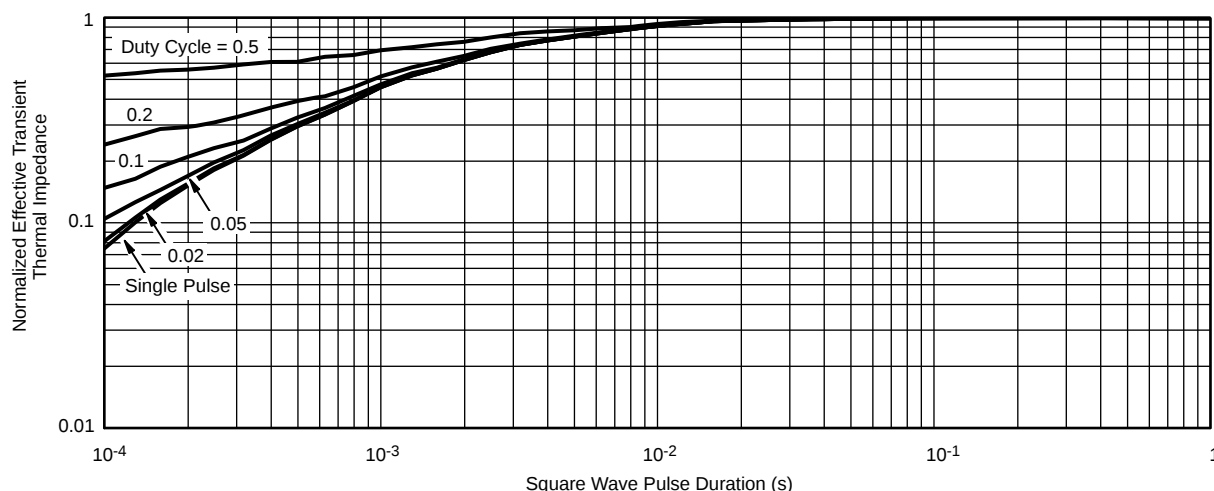
Max. Drain Current vs. Case Temperature



Power Derating, Junction-to-Case

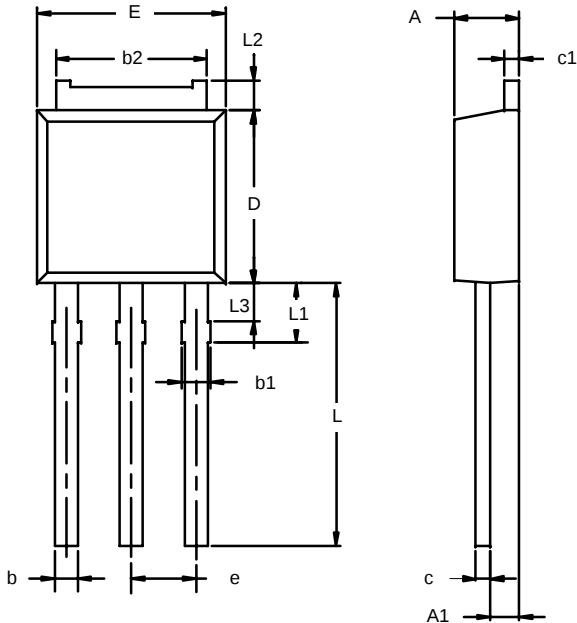


Safe Operating Area, Junction-to-Case



Normalized Thermal Transient Impedance, Junction-to-Case

TO-251AA (DPAK)



Note: Dimension L3 is for reference only.

| Dim                                         | MILLIMETERS |      | INCHES    |       |
|---------------------------------------------|-------------|------|-----------|-------|
|                                             | Min         | Max  | Min       | Max   |
| A                                           | 2.21        | 2.38 | 0.087     | 0.094 |
| A1                                          | 0.89        | 1.14 | 0.035     | 0.045 |
| b                                           | 0.71        | 0.89 | 0.028     | 0.035 |
| b1                                          | 0.76        | 1.14 | 0.030     | 0.045 |
| b2                                          | 5.23        | 5.43 | 0.206     | 0.214 |
| c                                           | 0.46        | 0.58 | 0.018     | 0.023 |
| c1                                          | 0.46        | 0.58 | 0.018     | 0.023 |
| D                                           | 5.97        | 6.22 | 0.235     | 0.245 |
| E                                           | 6.48        | 6.73 | 0.255     | 0.265 |
| e                                           | 2.28 BSC    |      | 0.090 BSC |       |
| L                                           | 8.89        | 9.53 | 0.350     | 0.375 |
| L1                                          | 1.91        | 2.28 | 0.075     | 0.090 |
| L2                                          | 0.89        | 1.27 | 0.035     | 0.050 |
| L3                                          | 1.15        | 1.52 | 0.045     | 0.060 |
| ECN: S-03946—Rev. E, 09-Jul-01<br>DWG: 5346 |             |      |           |       |

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