

## IRFR2405TRPBF-VB Datasheet

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

#### PRODUCT SUMMARY

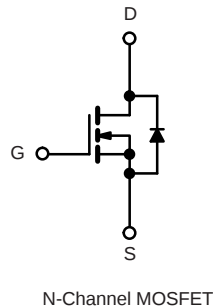
| $V_{DS}$ (V) | $R_{DS(on)}$ ( $\Omega$ ) | $I_D$ (A) <sup>a</sup> |
|--------------|---------------------------|------------------------|
| 60           | 0.010 at $V_{GS} = 10$ V  | 58                     |
|              | 0.013 at $V_{GS} = 4.5$ V | 56                     |

#### FEATURES

- 175 °C Junction Temperature
- Trench Power MOSFET
- Material categorization:



**RoHS**  
COMPLIANT



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

| Parameter                                               |                | Symbol         | Limit                                | Unit |
|---------------------------------------------------------|----------------|----------------|--------------------------------------|------|
| Gate-Source Voltage                                     |                | $V_{GS}$       | $\pm 20$                             | V    |
| Continuous Drain Current ( $T_J = 175$ °C) <sup>b</sup> | $T_C = 25$ °C  | $I_D$          | 58                                   | A    |
|                                                         | $T_C = 100$ °C |                | 48 <sup>a</sup>                      |      |
| Pulsed Drain Current                                    |                | $I_{DM}$       | 100                                  |      |
| Continuous Source Current (Diode Conduction)            |                | $I_S$          | 50 <sup>a</sup>                      |      |
| Avalanche Current                                       |                | $I_{AS}$       | 50                                   |      |
| Single Avalanche Energy (Duty Cycle $\leq 1$ %)         | $L = 0.1$ mH   | $E_{AS}$       | 125                                  | mJ   |
| Maximum Power Dissipation                               | $T_C = 25$ °C  | $P_D$          | 136                                  | W    |
|                                                         | $T_A = 25$ °C  |                | 3 <sup>b</sup> , 8.3 <sup>b, c</sup> |      |
| Operating Junction and Storage Temperature Range        |                | $T_J, T_{stg}$ | - 55 to 175                          | °C   |

#### THERMAL RESISTANCE RATINGS

| Parameter                                |                 | Symbol     | Typical | Maximum | Unit |
|------------------------------------------|-----------------|------------|---------|---------|------|
| Maximum Junction-to-Ambient <sup>a</sup> | $t \leq 10$ sec | $R_{thJA}$ | 15      | 18      | °C/W |
|                                          | Steady State    |            | 40      | 50      |      |
| Maximum Junction-to-Case                 |                 | $R_{thJC}$ | 0.85    | 1.1     |      |

Notes:

a. Package limited.

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

c.  $t \leq 10$  s.

**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

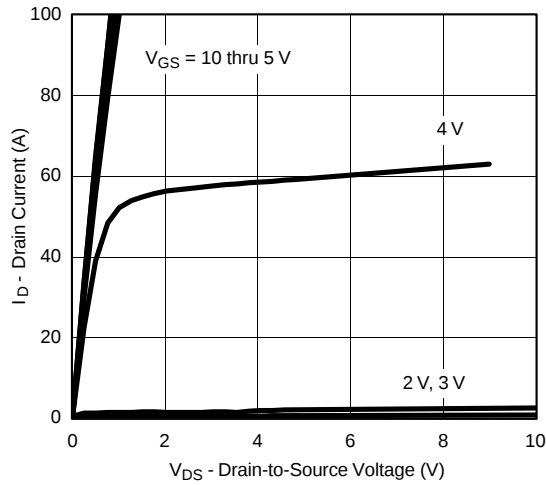
| Parameter                                                               | Symbol              | Test Conditions                                                                                                          | Min. | Typ. <sup>a</sup> | Max.  | Unit |
|-------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------|------|-------------------|-------|------|
| Static                                                                  |                     |                                                                                                                          |      |                   |       |      |
| Drain-Source Breakdown Voltage                                          | V <sub>DS</sub>     | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                                           | 60   |                   |       | V    |
| Gate Threshold Voltage                                                  | V <sub>GS(th)</sub> | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                                              | 1    | 2                 | 3     |      |
| Gate-Body 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> = 125 °C                                                   |      |                   | 50    |      |
|                                                                         |                     | V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 175 °C                                                   |      |                   | 250   |      |
| On-State Drain Current <sup>b</sup>                                     | I <sub>D(on)</sub>  | V <sub>DS</sub> = 5 V, V <sub>GS</sub> = 10 V                                                                            | 60   |                   |       | A    |
| Drain-Source On-State Resistance <sup>b</sup>                           | R <sub>DS(on)</sub> | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 20 A                                                                            |      | 0.010             |       | Ω    |
|                                                                         |                     | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 20 A, T <sub>J</sub> = 125 °C                                                   |      | 0.016             |       |      |
|                                                                         |                     | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 20 A, T <sub>J</sub> = 175 °C                                                   |      | 0.020             |       |      |
|                                                                         |                     | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 15 A                                                                           |      | 0.013             |       |      |
| Forward Transconductance <sup>b</sup>                                   | g <sub>fs</sub>     | V <sub>DS</sub> = 15 V, I <sub>D</sub> = 20 A                                                                            |      | 60                |       | S    |
| Dynamic                                                                 |                     |                                                                                                                          |      |                   |       |      |
| Input Capacitance                                                       | C <sub>iss</sub>    | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 25 V, f = 1 MHz                                                                 |      | 2650              |       | pF   |
| Output Capacitance                                                      | C <sub>oss</sub>    |                                                                                                                          |      | 470               |       |      |
| Reverse Transfer Capacitance                                            | C <sub>rss</sub>    |                                                                                                                          |      | 225               |       |      |
| Total Gate Charge <sup>c</sup>                                          | Q <sub>g</sub>      | V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 50 A                                                    |      | 47                | 70    | nC   |
| Gate-Source Charge <sup>c</sup>                                         | Q <sub>gs</sub>     |                                                                                                                          |      | 10                |       |      |
| Gate-Drain Charge <sup>c</sup>                                          | Q <sub>gd</sub>     |                                                                                                                          |      | 12                |       |      |
| Turn-On Delay Time <sup>c</sup>                                         | t <sub>d(on)</sub>  | V <sub>DD</sub> = 30 V, R <sub>L</sub> = 0.6 Ω<br>I <sub>D</sub> ≅ 50 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 2.5 Ω |      | 10                | 20    | ns   |
| Rise Time <sup>c</sup>                                                  | t <sub>r</sub>      |                                                                                                                          |      | 15                | 25    |      |
| Turn-Off Delay Time <sup>c</sup>                                        | t <sub>d(off)</sub> |                                                                                                                          |      | 35                | 50    |      |
| Fall Time <sup>c</sup>                                                  | t <sub>f</sub>      |                                                                                                                          |      | 20                | 30    |      |
| Source-Drain Diode Ratings and Characteristics (T <sub>C</sub> = 25 °C) |                     |                                                                                                                          |      |                   |       |      |
| Pulsed Current                                                          | I <sub>SM</sub>     |                                                                                                                          |      |                   | 60    | A    |
| Diode Forward Voltage                                                   | V <sub>SD</sub>     | I <sub>F</sub> = 20 A, V <sub>GS</sub> = 0 V                                                                             |      | 1                 | 1.5   | V    |
| Reverse Recovery Time                                                   | t <sub>rr</sub>     | I <sub>F</sub> = 20 A, di/dt = 100 A/μs                                                                                  |      | 45                | 100   | ns   |

Notes:

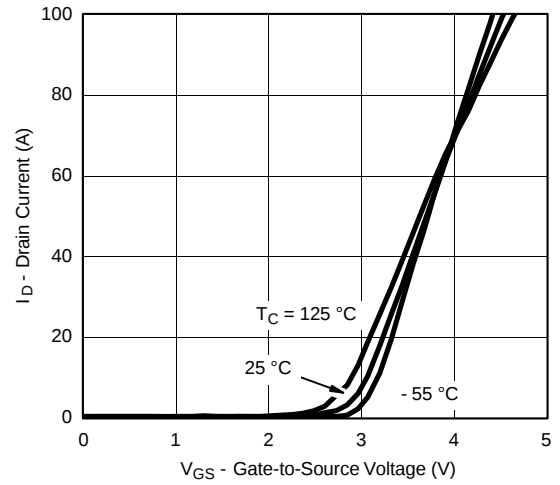
- a. For design aid only; not subject to production testing.  
 b. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 c. Independent of operating temperature.

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.

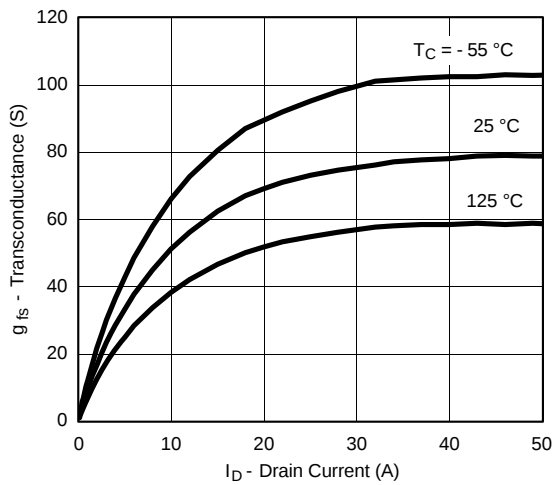
**TYPICAL CHARACTERISTICS** (25 °C unless noted)



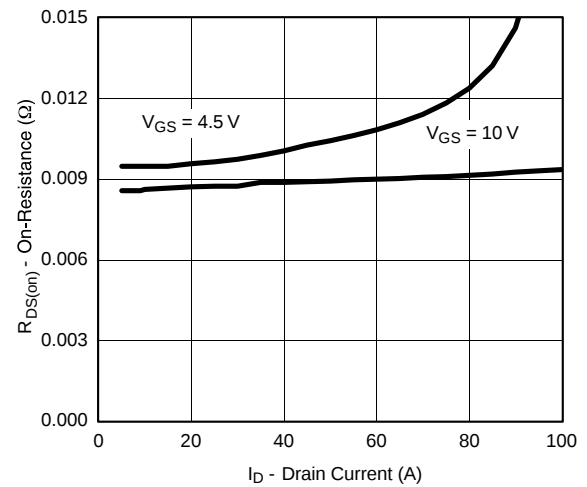
**Output Characteristics**



**Transfer Characteristics**



**Transconductance**



**On-Resistance vs. Drain Current**



**Capacitance**

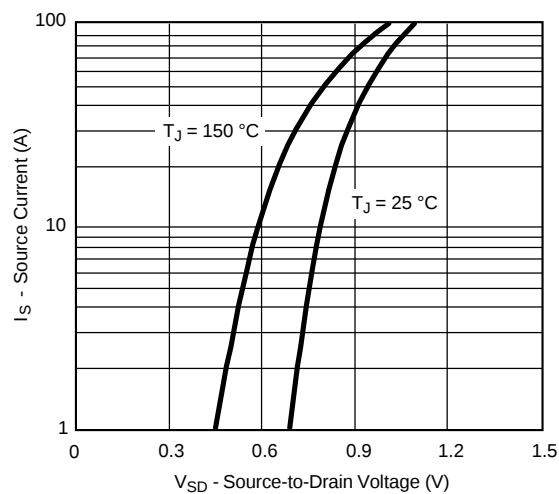


**Gate Charge**

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



On-Resistance vs. Junction Temperature



Source-Drain Diode Forward Voltage

The graph shows the relationship between Drain Current ( $I_D$ ) and Ambient Temperature ( $T_A$ ) for the 2N3866 JFET. The current is constant at 50 A for temperatures up to 100°C. Beyond 100°C, the current decreases as temperature increases, reaching 0 A at 175°C.

| $T_A$ - Ambient Temperature ( $^{\circ}\text{C}$ ) | $I_D$ - Drain Current (A) |
|----------------------------------------------------|---------------------------|
| 0                                                  | 50                        |
| 25                                                 | 50                        |
| 50                                                 | 50                        |
| 75                                                 | 50                        |
| 100                                                | 50                        |
| 125                                                | 40                        |
| 150                                                | 28                        |
| 175                                                | 0                         |

**Safe Operating Area**

$I_D$  - Drain Current (A)

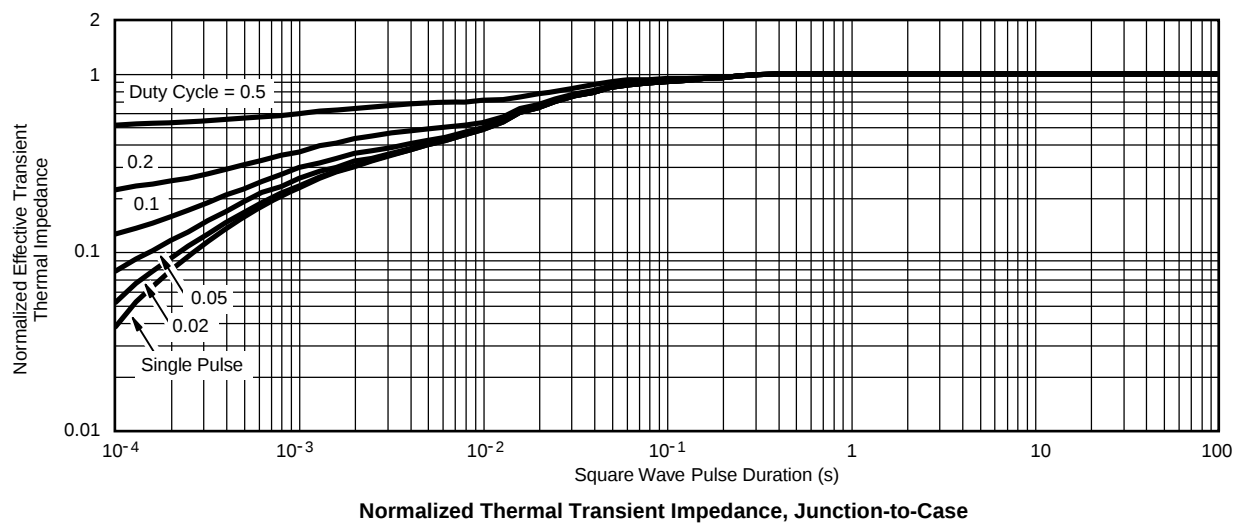
$V_{DS}$  - Drain-to-Source Voltage (V)

Limited by  $R_{DS(on)}^*$

$T_C = 25\text{ }^\circ\text{C}$   
Single Pulse

\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

10  $\mu\text{s}$   
100  $\mu\text{s}$   
1 ms  
10 ms  
100 ms  
DC



TO-252AA CASE OUTLINE



| DIM.                            | MILLIMETERS |       | INCHES    |       |
|---------------------------------|-------------|-------|-----------|-------|
|                                 | MIN.        | MAX.  | MIN.      | MAX.  |
| A                               | 2.18        | 2.38  | 0.086     | 0.094 |
| A1                              | -           | 0.127 | -         | 0.005 |
| b                               | 0.64        | 0.88  | 0.025     | 0.035 |
| b2                              | 0.76        | 1.14  | 0.030     | 0.045 |
| b3                              | 4.95        | 5.46  | 0.195     | 0.215 |
| C                               | 0.46        | 0.61  | 0.018     | 0.024 |
| C2                              | 0.46        | 0.89  | 0.018     | 0.035 |
| D                               | 5.97        | 6.22  | 0.235     | 0.245 |
| D1                              | 5.21        | -     | 0.205     | -     |
| E                               | 6.35        | 6.73  | 0.250     | 0.265 |
| E1                              | 4.32        | -     | 0.170     | -     |
| H                               | 9.40        | 10.41 | 0.370     | 0.410 |
| e                               | 2.28 BSC    |       | 0.090 BSC |       |
| e1                              | 4.56 BSC    |       | 0.180 BSC |       |
| L                               | 1.40        | 1.78  | 0.055     | 0.070 |
| L3                              | 0.89        | 1.27  | 0.035     | 0.050 |
| L4                              | -           | 1.02  | -         | 0.040 |
| L5                              | 1.14        | 1.52  | 0.045     | 0.060 |
| ECN: X12-0247-Rev. M, 24-Dec-12 |             |       |           |       |
| DWG: 5347                       |             |       |           |       |

**Note**

- Dimension L3 is for reference only.

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