

# IRFM450 (JANTX2N7228)

PD-90493J

## Power MOSFET Thru-Hole (TO-254AA) 500V, 12A, N-channel, HEXFET™ MOSFET Technology

### Features

- Simple drive requirements
- Hermetically sealed
- Electrically isolated
- Dynamic dv/dt rating
- Light weight
- Ceramic eyelets
- ESD rating: class 3A per MIL-STD-750, Method 1020

### Potential Applications

- DC-DC converter
- Motor drives

### Product Summary

- **BV<sub>DSS</sub>**: 500V
- **I<sub>D</sub>**: 12A
- **R<sub>DS(on),max</sub>**: 415mΩ
- **Q<sub>G,max</sub>**: 120nC
- **REF**: MIL-PRF-19500/592



### Product Validation

Qualified to JANTXV screening flow according to MIL-PRF-19500 for high-reliability applications

### Description

IR HiRel HEXFET™ technology is advanced line of power MOSFET transistors. The efficient geometry design achieves very low on-state resistance combined with high transconductance. HEXFET™ transistors also feature all of the well-established advantages of MOSFETs, such as voltage control, fast switching and electrical parameter temperature stability. They are well-suited for applications such as switching power supplies, motor controls, inverters, high energy pulse circuits, and virtually any application where high reliability is required. The HEXFET™ transistor's totally isolated package eliminates the need for additional isolating material between the device and the heatsink. This improves thermal efficiency and reduces drain capacitance.

### Ordering Information

**Table 1** Ordering options

| Part number  | Package  | Screening Level |
|--------------|----------|-----------------|
| IRFM450      | TO-254AA | COTS            |
| JANTX2N7228  | TO-254AA | JANTX           |
| JANTXV2N7228 | TO-254AA | JANTXV          |

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**Absolute Maximum Ratings**

**1 Absolute Maximum Ratings**

**Table 2 Absolute Maximum Ratings**

| Symbol                                     | Parameter  | Value                                     | Unit |
|--|--|---|------|
| $I_{D1} @ V_{GS} = 10V, T_C = 25^\circ C$  | Continuous Drain Current                         | 12  | A    |
| $I_{D2} @ V_{GS} = 10V, T_C = 100^\circ C$ | Continuous Drain Current                         | 8.0                                       | A    |
| $I_{DM} @ T_C = 25^\circ C$                | Pulsed Drain Current <sup>1</sup>                | 48  | A    |
| $P_D @ T_C = 25^\circ C$                   | Maximum Power Dissipation                        | 150                                       | W    |
|  | Linear Derating Factor                           | 1.2                                       | W/°C |
| $V_{GS}$                                   | Gate-to-Source Voltage                           | ± 20                                      | V    |
| $E_{AS}$                                   | Single Pulse Avalanche Energy <sup>2</sup>       | 750                                       | mJ   |
| $I_{AR}$                                   | Avalanche Current <sup>1</sup>                   | 12  | A    |
| $E_{AR}$                                   | Repetitive Avalanche Energy <sup>1</sup>         | 15  | mJ   |
| dv/dt                                      | Peak Diode Reverse Recovery <sup>3</sup>         | 3.5                                       | V/ns |
| $T_J$<br>$T_{STG}$                         | Operating Junction and Storage Temperature Range | -55 to +150                               | °C   |
|  | Lead Temperature                                 | 300 (0.063 in. /1.6 mm from case for 10s) |      |
|  | Weight   | 9.3 (Typical)                             | g    |

<sup>1</sup> Repetitive Rating; Pulse width limited by maximum junction temperature.

<sup>2</sup>  $V_{DD} = 50V$ , starting  $T_J = 25^\circ C$ ,  $L = 10.4mH$ , Peak  $I_L = 12A$ ,  $V_{GS} = 10V$

<sup>3</sup>  $I_{SD} \leq 12A$ ,  $di/dt \leq 130A/\mu s$ ,  $V_{DD} \leq 500V$ ,  $T_J \leq 150^\circ C$

**Device Characteristics**

**2 Device Characteristics**

**2.1 Electrical Characteristics**

**Table 3 Electrical Characteristics @ T<sub>j</sub> = 25°C (Unless Otherwise Specified)**

| Symbol                              | Parameter                                  | Min. | Typ. | Max. | Unit | Test Conditions  |
|-------------------------------------|--|------|------|------|------|--|
| BV <sub>DSS</sub>                   | Drain-to-Source Breakdown Voltage          | 500  | —    | —    | V    | V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA   |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | Breakdown Voltage Temp. Coefficient        | —    | 0.68 | —    | V/°C | Reference to 25°C, I <sub>D</sub> = 1.0mA  |
| R <sub>DS(on)</sub>                 | Static Drain-to-Source On-State Resistance | —    | —    | 415  | mΩ   | V <sub>GS</sub> = 10V, I <sub>D2</sub> = 8.0A <sup>1</sup>   |
|                                     |  | —    | —    | 515  |      | V <sub>GS</sub> = 10V, I <sub>D1</sub> = 12A <sup>1</sup>  |
| 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                   | 6.5  | —    | —    | S    | V <sub>DS</sub> = 15V, I <sub>D2</sub> = 8.0A  |
| I <sub>DSS</sub>                    | Zero Gate Voltage Drain Current            | —    | —    | 25   | μA   | V <sub>DS</sub> = 400V, V <sub>GS</sub> = 0V   |
|                                     |  | —    | —    | 250  |      | V <sub>DS</sub> = 400V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C   |
| I <sub>GSS</sub>                    | Gate-to-Source Leakage Forward             | —    | —    | 100  | nA   | V <sub>GS</sub> = 20V  |
|                                     | Gate-to-Source Leakage Reverse             | —    | —    | -100 |      | V <sub>GS</sub> = -20V   |
| Q <sub>G</sub>                      | Total Gate Charge                          | —    | —    | 120  | nC   | I <sub>D1</sub> = 12A  |
| Q <sub>GS</sub>                     | Gate-to-Source Charge                      | —    | —    | 19   |      | V <sub>DS</sub> = 250V   |
| Q <sub>GD</sub>                     | Gate-to-Drain ('Miller') Charge            | —    | —    | 70   |      | V <sub>GS</sub> = 10V  |
| t <sub>d(on)</sub>                  | Turn-On Delay Time                         | —    | —    | 35   | ns   | I <sub>D1</sub> = 12A **<br>V <sub>DD</sub> = 250V<br>R <sub>G</sub> = 2.35Ω<br>V <sub>GS</sub> = 10V  |
| t <sub>r</sub>                      | Rise Time                                  | —    | —    | 190  |      |  |
| t <sub>d(off)</sub>                 | Turn-Off Delay Time                        | —    | —    | 170  |      |  |
| t <sub>f</sub>                      | Fall Time                                  | —    | —    | 130  |      |  |
| L <sub>s</sub> + L <sub>D</sub>     | Total Inductance                           | —    | 6.8  | —    | nH   | Measured from Drain lead (6mm / 0.25 in from package) to Source lead (6mm/ 0.25 in from package) with Source wire internally bonded from Source pin to Drain pad |
| C <sub>iss</sub>                    | Input Capacitance                          | —    | 2700 | —    | pF   | V <sub>GS</sub> = 0V<br>V <sub>DS</sub> = 25V<br>f = 1.0MHz  |
| C <sub>oss</sub>                    | Output Capacitance                         | —    | 600  | —    |      |  |
| C <sub>rss</sub>                    | Reverse Transfer Capacitance               | —    | 240  | —    |      |  |

\*\* Switching speed maximum limits are based on manufacturing test equipment and capability.

<sup>1</sup> Pulse width ≤ 300 μs; Duty Cycle ≤ 2%

**Device Characteristics**

**2.2 Source-Drain Diode Ratings and Characteristics**

**Table 4 Source-Drain Diode Characteristics**

| Symbol   | Parameter                                       | Min.  | Typ. | Max. | Unit          | Test Conditions   |
|----------|---|---|------|------|---------------|---|
| $I_S$    | Continuous Source Current (Body Diode)          | —   | —    | 12   | A             |   |
| $I_{SM}$ | Pulsed Source Current (Body Diode) <sup>1</sup> | —   | —    | 48   | A             |   |
| $V_{SD}$ | Diode Forward Voltage                           | —   | —    | 1.7  | V             | $T_J = 25^\circ\text{C}$ , $I_S = 12\text{A}$ , $V_{GS} = 0\text{V}$ <sup>2</sup>                             |
| $t_{rr}$ | Reverse Recovery Time                           | —   | —    | 1600 | ns            | $T_J = 25^\circ\text{C}$ , $I_F = 12\text{A}$ , $V_{DD} \leq 50\text{V}$<br>$di/dt = 100\text{A}/\mu\text{s}$ |
| $Q_{rr}$ | Reverse Recovery Charge                         | —   | 9.3  | —    | $\mu\text{C}$ |   |
| $t_{on}$ | Forward Turn-On Time                            | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S+L_D$ ) |      |      |               |   |

**2.3 Thermal Characteristics**

**Table 5 Thermal Resistance**

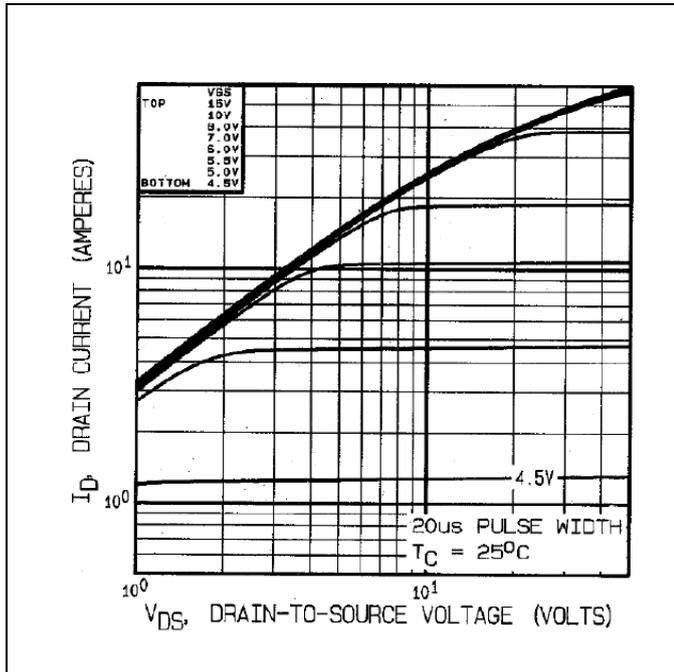
| Symbol          | Parameter                                  | Min. | Typ. | Max. | Unit                      |
|-----------------|--|------|------|------|---------------------------|
| $R_{\theta JC}$ | Junction-to-Case                           | —    | —    | 0.83 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta CS}$ | Case-to-Sink                               | —    | 0.21 | —    |                           |
| $R_{\theta JA}$ | Junction-to-Ambient (Typical socket mount) | —    | —    | 48   |                           |

<sup>1</sup> Repetitive Rating; Pulse width limited by maximum junction temperature.

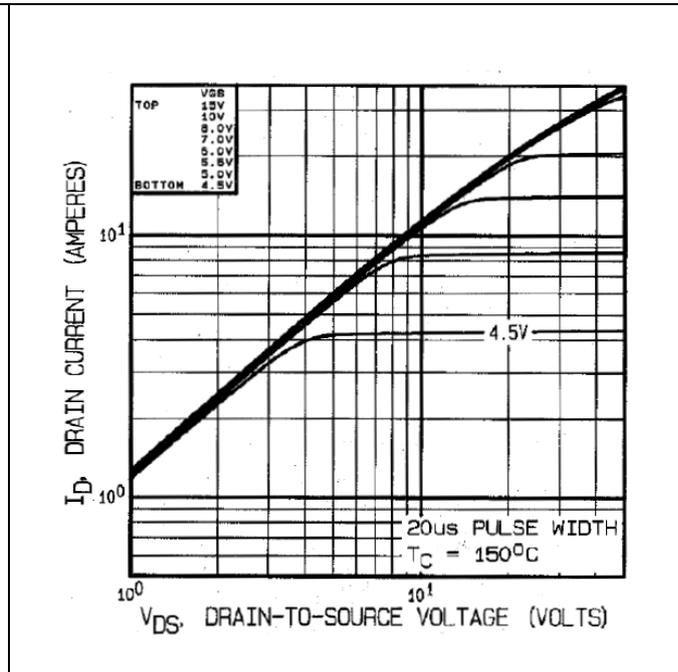
<sup>2</sup> Pulse width  $\leq 300 \mu\text{s}$ ; Duty Cycle  $\leq 2\%$

**IRFM450 (JANTX2N7228)**  
**Power MOSFET Thru - Hole (TO-254AA)**  
**Electrical Characteristics Curves**

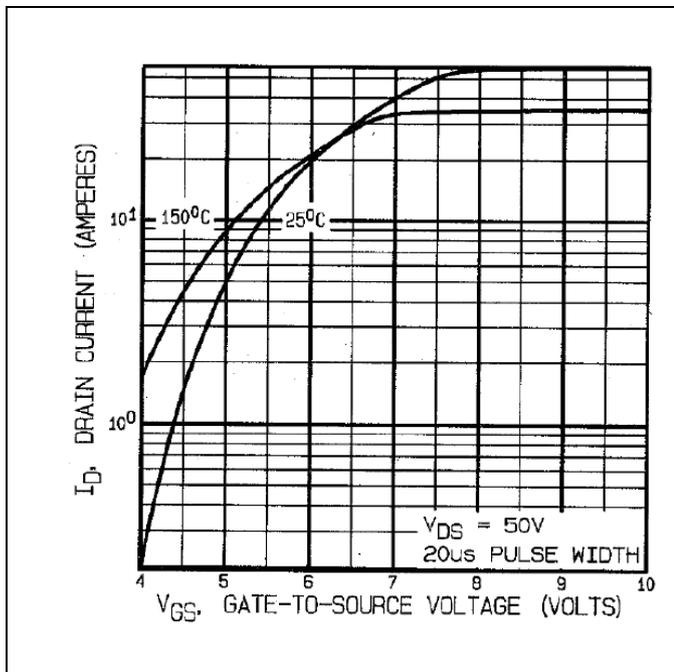
**3 Electrical Characteristics Curves**



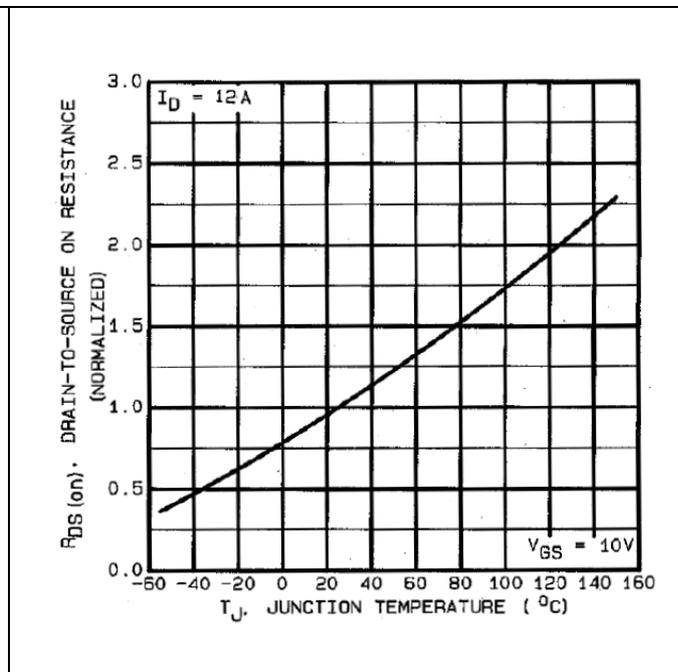
**Figure 1 Typical Output Characteristics**



**Figure 2 Typical Output Characteristics**

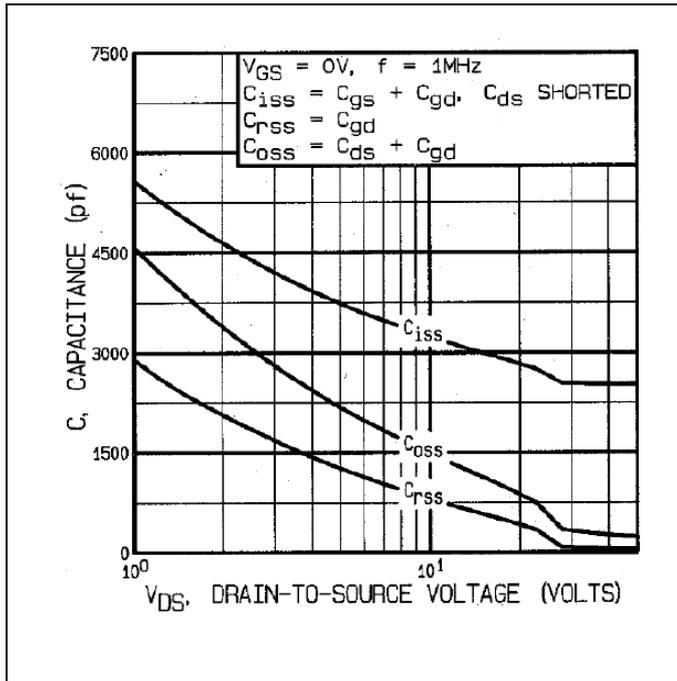


**Figure 3 Typical Transfer Characteristics**

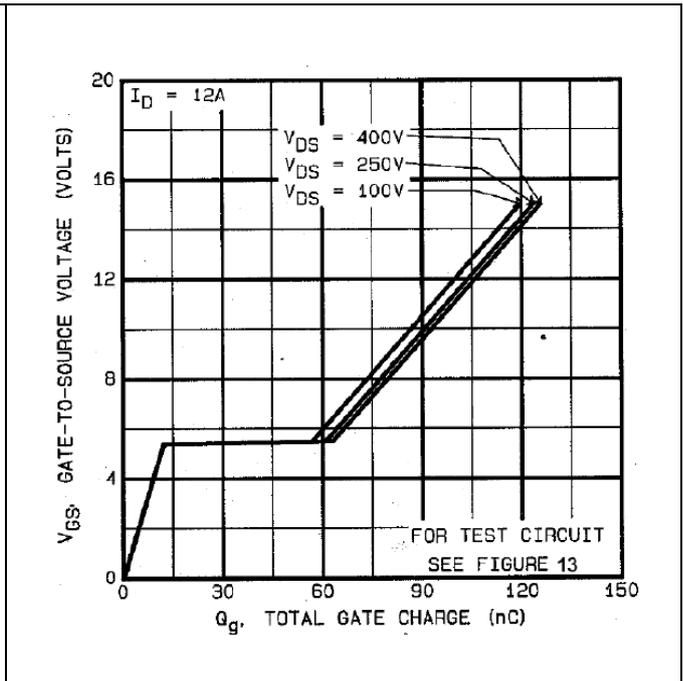


**Figure 4 Normalized On-Resistance Vs. Temperature**

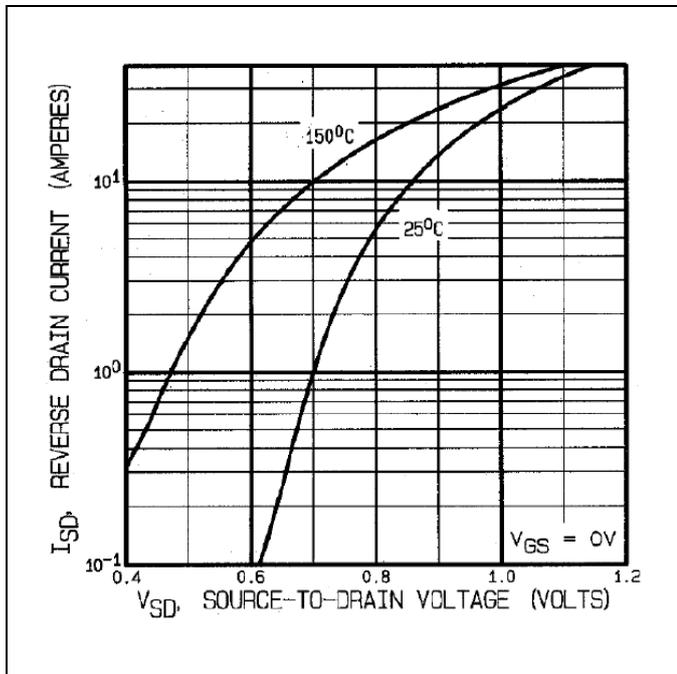
**IRFM450 (JANTX2N7228)**  
**Power MOSFET Thru - Hole (TO-254AA)**  
**Electrical Characteristics Curves**



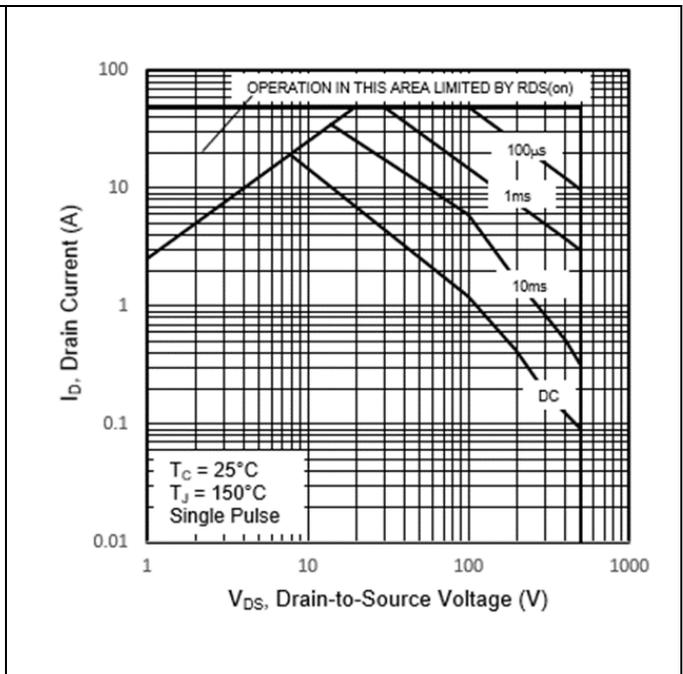
**Figure 5 Typical Capacitance Vs. Drain-to-Source Voltage**



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

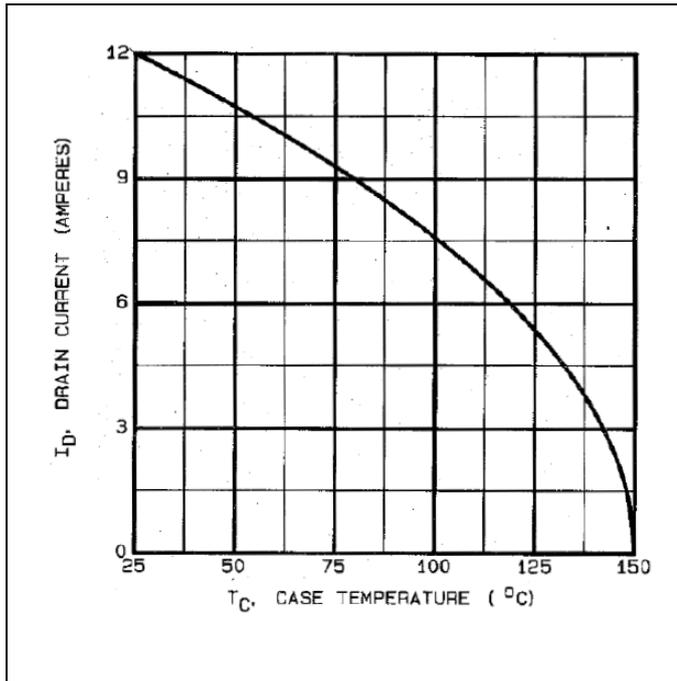


**Figure 7 Typical Source-Drain Current Vs. Diode Forward Voltage**

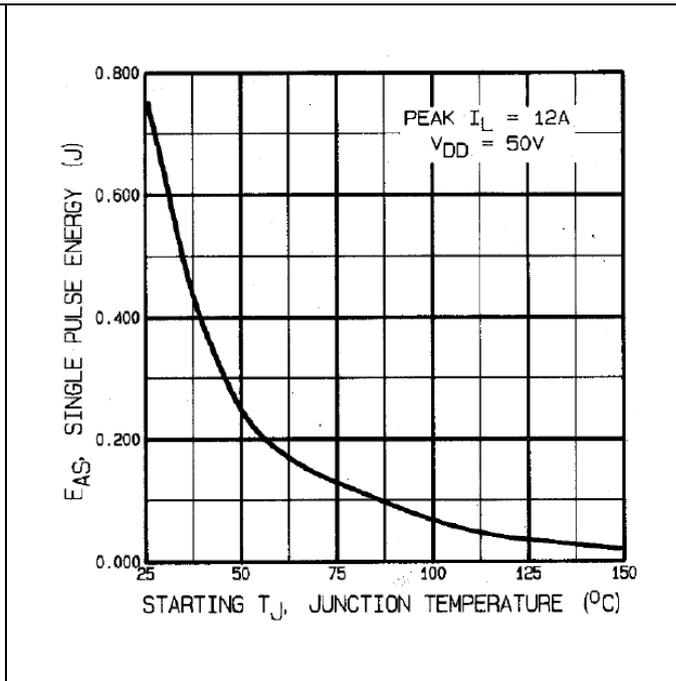


**Figure 8 Maximum Safe Operating Area**

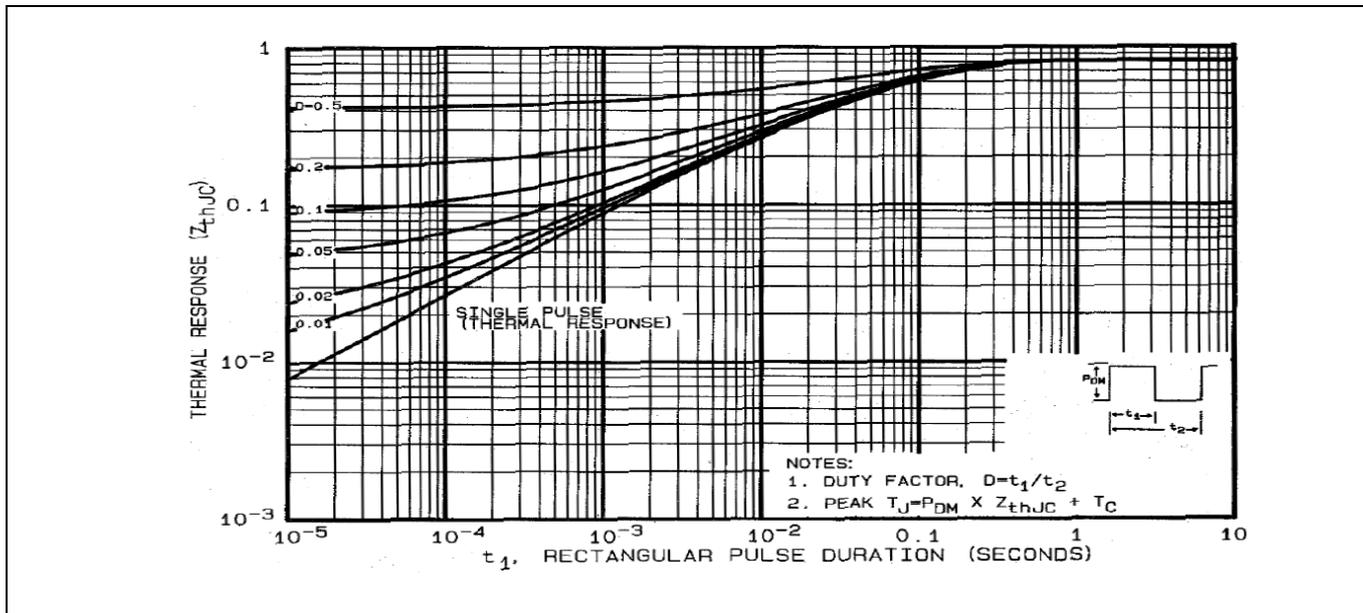
**IRFM450 (JANTX2N7228)**  
**Power MOSFET Thru - Hole (TO-254AA)**  
**Electrical Characteristics Curves**



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



**Figure 10 Maximum Avalanche Energy Vs. Junction Temperature**

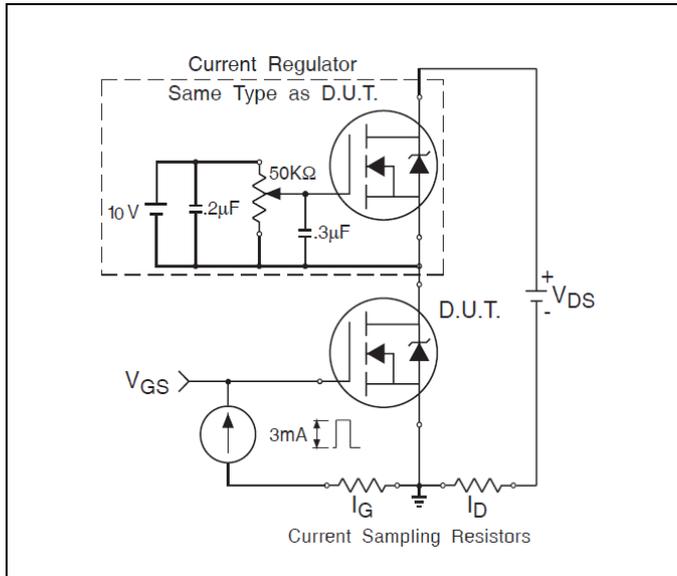


**Figure 11 Maximum Effective Transient Thermal Impedance, Junction-to-Case**

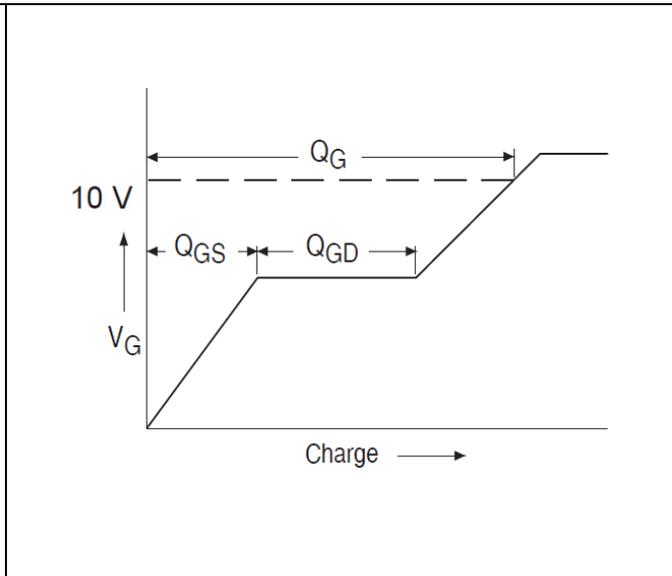
**IRFM450 (JANTX2N7228)**  
**Power MOSFET Thru - Hole (TO-254AA)**

**Test Circuits**

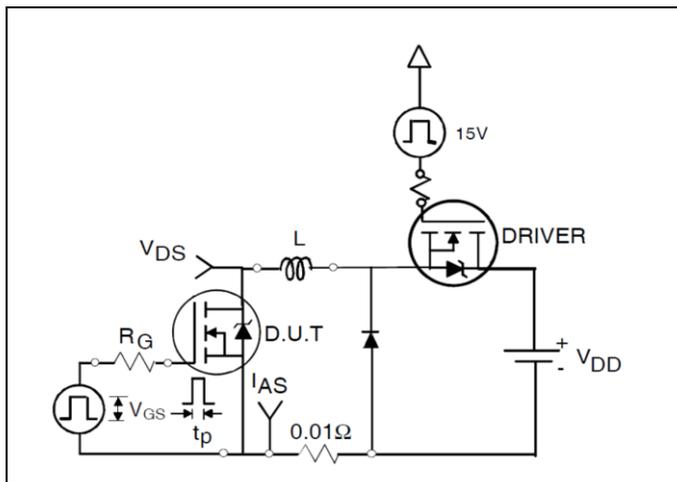
**4 Test Circuits**



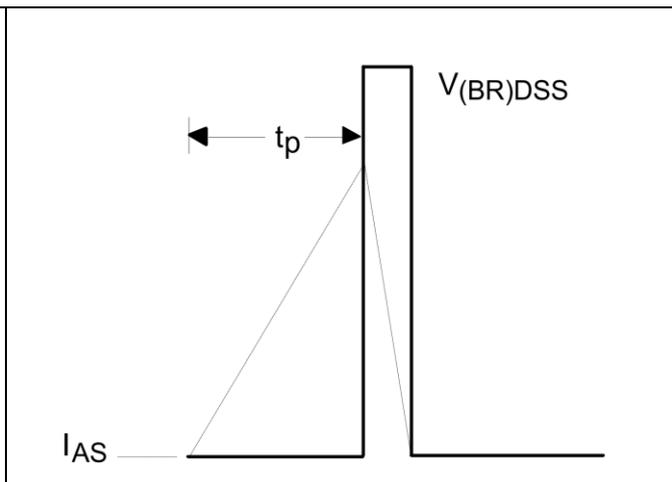
**Figure 12 Gate Charge Test Circuit**



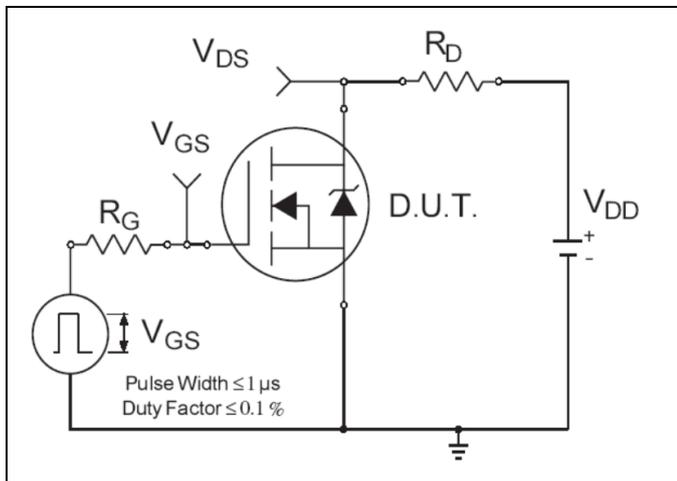
**Figure 13 Gate Charge Waveform**



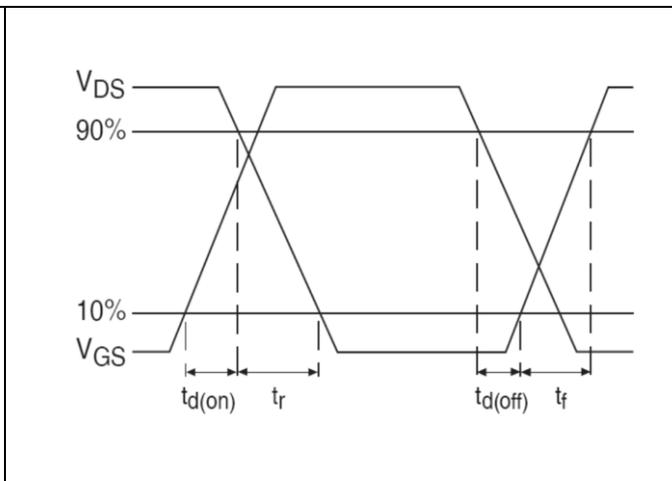
**Figure 14 Unclamped Inductive Test Circuit**



**Figure 15 Unclamped Inductive Waveform**



**Figure 16 Switching Time Test Circuit**



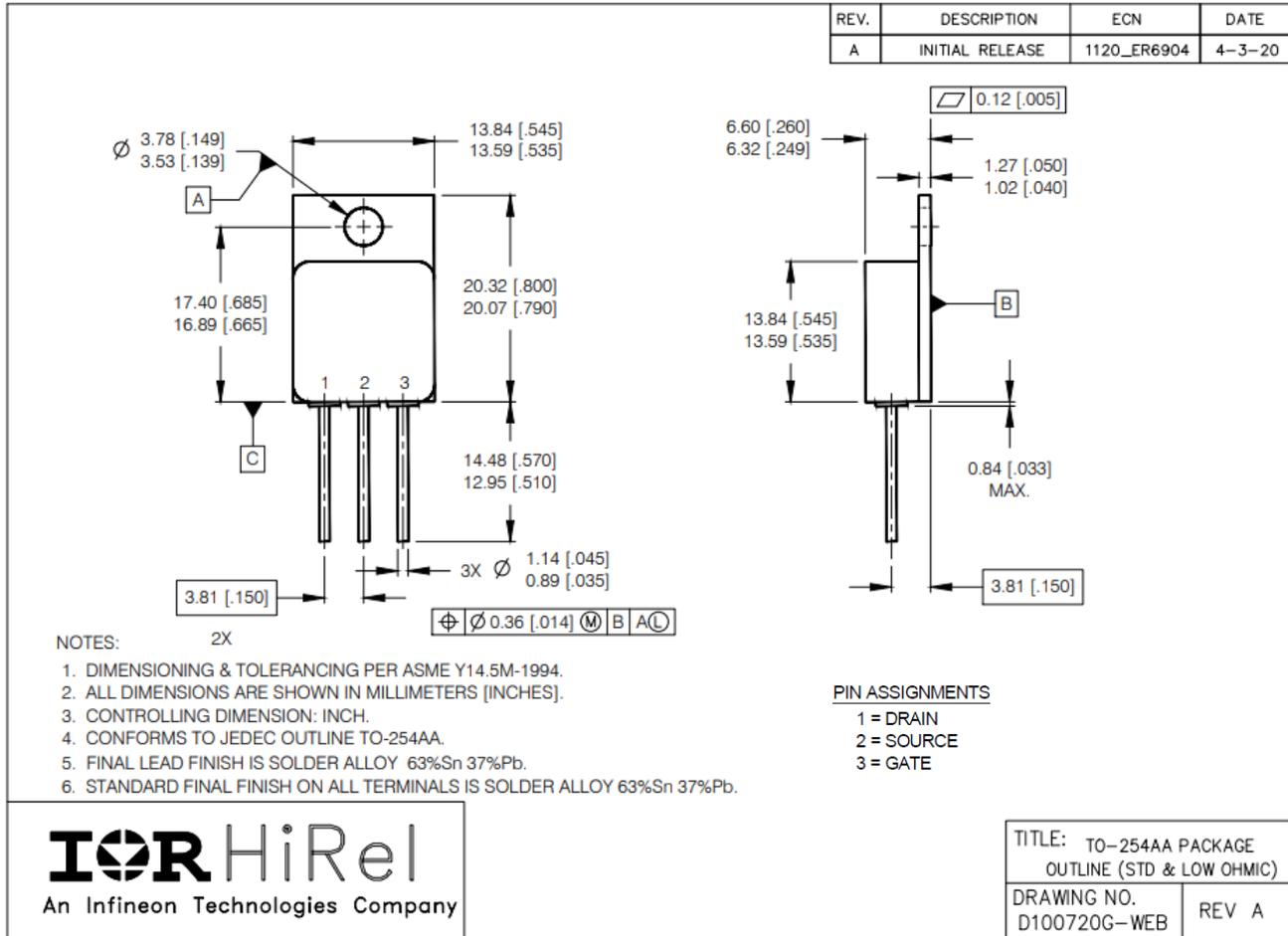
**Figure 17 Switching Time Waveforms**

**IRFM450 (JANTX2N7228)**  
**Power MOSFET Thru - Hole (TO-254AA)**

**Package Outline**

**5 Package Outline**

**Note:** For the most updated package outline, please see the website: [TO-254AA](http://www.infineon.com/toc-254aa)



**BERYLLIA WARNING PER MIL-PRF-19500**

Package containing beryllia shall not be ground, sandblasted, machined, or have other operations performed on them which will produce beryllia or beryllium dust. Furthermore, beryllium oxide packages shall not be placed in acids that will produce fumes containing beryllium.

**IRFM450 (JANTX2N7228)**  
**Power MOSFET Thru - Hole (TO-254AA)**

**Revision history**

**Revision history**

| <b>Document version</b> | <b>Date of release</b> | <b>Description of changes</b>   |
|-------------------------|------------------------|---------------------------------|
| Rev F                   | 02/05/2002             | Datasheet (PD-90493)            |
| Rev G                   | 06/16/2016             | Updated based on ECN-104401     |
| Rev H                   | 04/30/2021             | Updated based on ECN-1120_08526 |
| Rev J                   | 08/06/2024             | Updated based on ECN-1120_10008 |

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