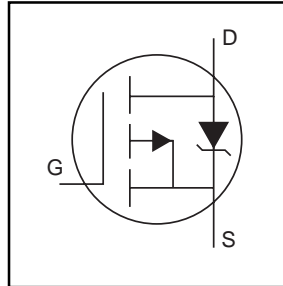


- Ultra Low On-Resistance
- P-Channel
- Surface Mount (IRFR5410)
- Straight Lead (IRFU5410)
- Advanced Process Technology
- Fast Switching
- Fully Avalanche Rated

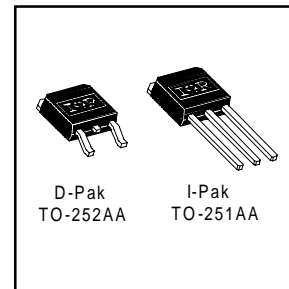


| |
|----------------------------|
| $V_{DSS} = -100V$ |
| $R_{DS(on)} = 0.205\Omega$ |
| $I_D = -13A$ |

Description

Fifth Generation HEXFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET Power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The D-Pak is designed for surface mounting using vapor phase, infrared, or wave soldering techniques. The straight lead version (IRFU series) is for through-hole mounting applications. Power dissipation levels up to 1.5 watts are possible in typical surface mount applications.



D-Pak
TO-252AA

I-Pak
TO-251AA

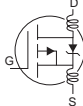
Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---------------------------|-------------------------------------------|------------------------|-------|
| $I_D @ T_C = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ -10V$ | -13 | A |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ -10V$ | -8.2 | |
| I_{DM} | Pulsed Drain Current ① | -52 | |
| $P_D @ T_C = 25^\circ C$ | Power Dissipation | 66 | W |
| | Linear Derating Factor | 0.53 | W/°C |
| V_{GS} | Gate-to-Source Voltage | ± 20 | V |
| E_{AS} | Single Pulse Avalanche Energy② | 194 | mJ |
| I_{AR} | Avalanche Current① | -8.4 | A |
| E_{AR} | Repetitive Avalanche Energy① | 6.3 | mJ |
| dv/dt | Peak Diode Recovery dv/dt ③ | -5.0 | V/ns |
| T_J | Operating Junction and | -55 to + 150 | °C |
| T_{STG} | Storage Temperature Range | | |
| | Soldering Temperature, for 10 seconds | 300 (1.6mm from case) | |

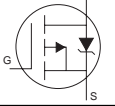
Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|-----------------|-----------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case | — | 1.9 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB mount)** | — | 50 | |
| $R_{\theta JA}$ | Junction-to-Ambient | — | 110 | |

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---------------------------------|--------------------------------------|------|-------|-------|---------------------|--------------------------------------------------------------------------------------|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | -100 | — | — | V | $V_{GS} = 0V, I_D = -250\mu A$ |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | -0.12 | — | V/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}, I_D = -1.0\text{mA}$ |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | — | 0.205 | Ω | $V_{GS} = -10V, I_D = -7.8A$ ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | -2.0 | — | -4.0 | V | $V_{DS} = V_{GS}, I_D = -250\mu A$ |
| g_{fs} | Forward Transconductance | 3.2 | — | — | S | $V_{DS} = -50V, I_D = -7.8A$ |
| I_{DSS} | Drain-to-Source Leakage Current | — | — | -25 | μA | $V_{DS} = -100V, V_{GS} = 0V$ |
| | | — | — | -250 | | $V_{DS} = -80V, V_{GS} = 0V, T_J = 150^\circ\text{C}$ |
| I_{GSS} | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS} = 20V$ |
| | Gate-to-Source Reverse Leakage | — | — | -100 | | $V_{GS} = -20V$ |
| Q_g | Total Gate Charge | — | — | 58 | nC | $I_D = -8.4A$ |
| Q_{gs} | Gate-to-Source Charge | — | — | 8.3 | | $V_{DS} = -80V$ |
| Q_{gd} | Gate-to-Drain ("Miller") Charge | — | — | 32 | | $V_{GS} = -10V$, See Fig. 6 and 13 ④⑥ |
| $t_{d(on)}$ | Turn-On Delay Time | — | 15 | — | ns | $V_{DD} = 50V$ |
| t_r | Rise Time | — | 58 | — | | $I_D = -8.4A$ |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 45 | — | | $R_G = 9.1\Omega$ |
| t_f | Fall Time | — | 46 | — | | $R_D = 6.2\Omega$, See Fig. 10 ④⑥ |
| L_D | Internal Drain Inductance | — | 4.5 | — | nH | Between lead, 6mm (0.25in.) from package and center of die contact⑤ |
| L_S | Internal Source Inductance | — | 7.5 | — | |  |
| C_{iss} | Input Capacitance | — | 760 | — | pF | $V_{GS} = 0V$ |
| C_{oss} | Output Capacitance | — | 260 | — | | $V_{DS} = -25V$ |
| C_{rss} | Reverse Transfer Capacitance | — | 170 | — | | $f = 1.0\text{MHz}$, See Fig. 5⑥ |

Source-Drain Ratings and Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|----------|-------------------------------------------|---------------------------------------------------------------------------|------|------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I_S | Continuous Source Current (Body Diode) | — | — | -13 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I_{SM} | Pulsed Source Current (Body Diode) ① | — | — | -52 | | |
| V_{SD} | Diode Forward Voltage | — | — | -1.6 | V | $T_J = 25^\circ\text{C}, I_S = -7.8A, V_{GS} = 0V$ ④ |
| t_{rr} | Reverse Recovery Time | — | 130 | 190 | ns | $T_J = 25^\circ\text{C}, I_F = -8.4A$ |
| Q_{rr} | Reverse Recovery Charge | — | 650 | 970 | nC | $di/dt = 100A/\mu s$ ④⑥ |
| t_{on} | Forward Turn-On Time | Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D) | | | | |

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
- ② Starting $T_J = 25^\circ\text{C}$, $L = 6.4\text{mH}$
 $R_G = 25\Omega, I_{AS} = -7.8A$. (See Figure 12)
- ③ $I_{SD} \leq -7.8A, di/dt \leq 200A/\mu s, V_{DD} \leq V_{(BR)DSS}, T_J \leq 150^\circ\text{C}$
- ④ Pulse width $\leq 300\mu s$; duty cycle $\leq 2\%$.
- ⑤ This is applied for I-PAK, L_S of D-PAK is measured between lead and center of die contact
- ⑥ Uses IRF9530N 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

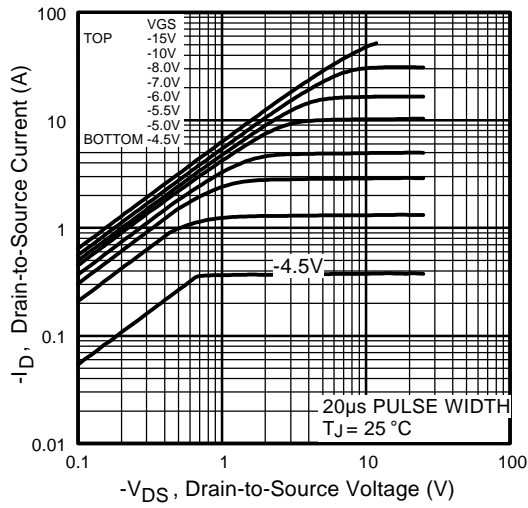


Fig 1. Typical Output Characteristics

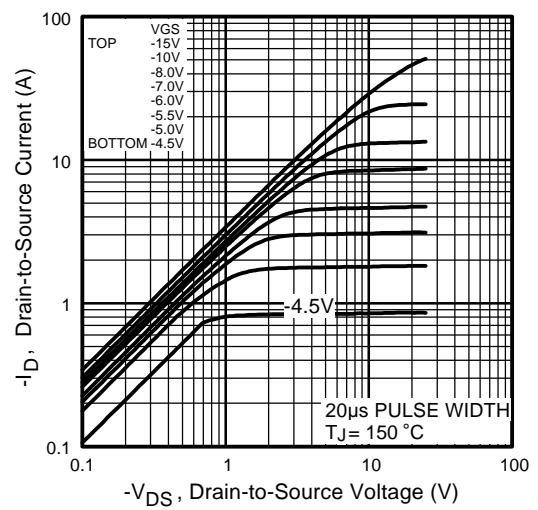


Fig 2. Typical Output Characteristics

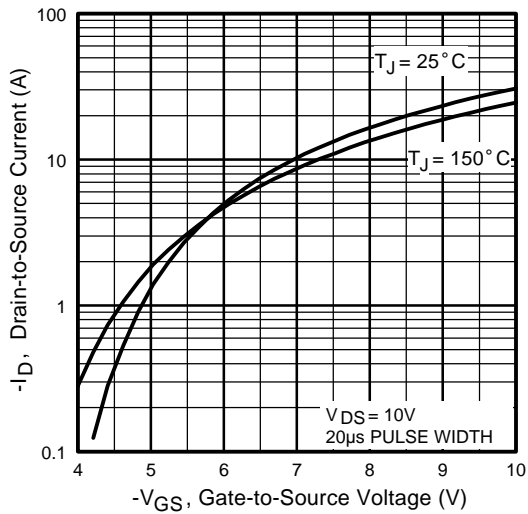


Fig 3. Typical Transfer Characteristics

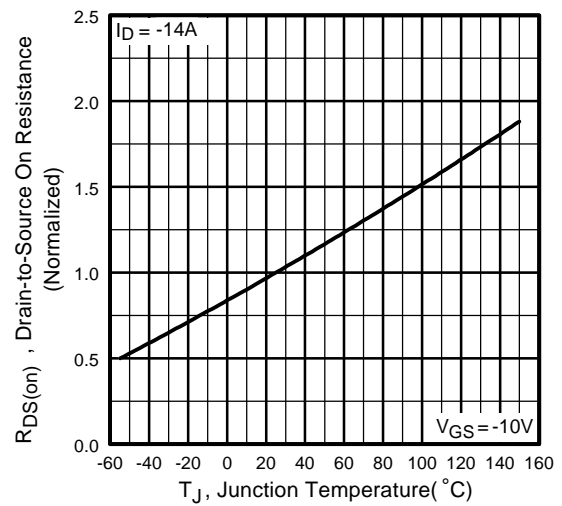


Fig 4. Normalized On-Resistance Vs. Temperature

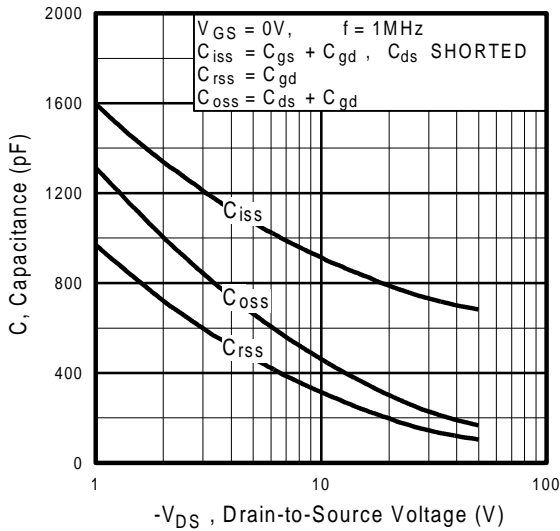


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

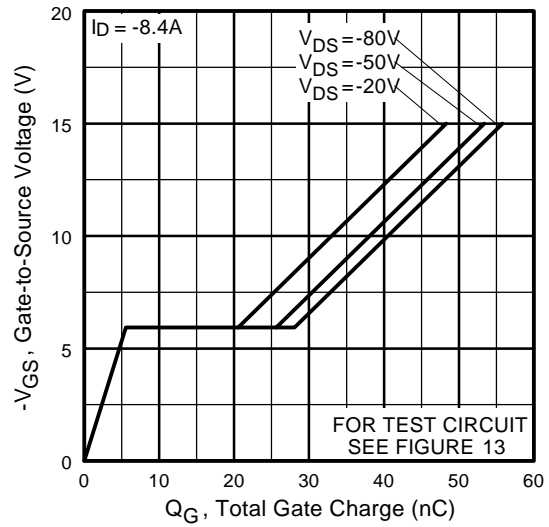


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

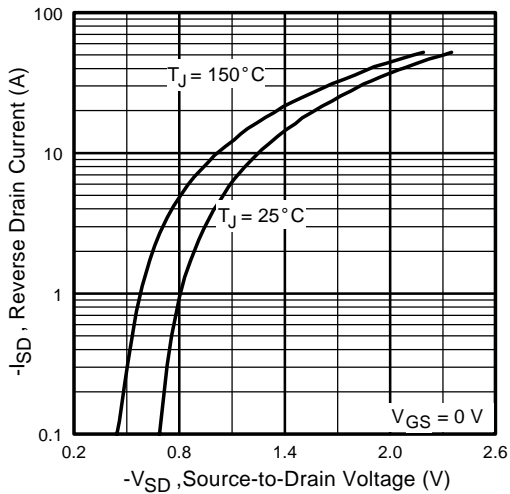


Fig 7. Typical Source-Drain Diode Forward Voltage

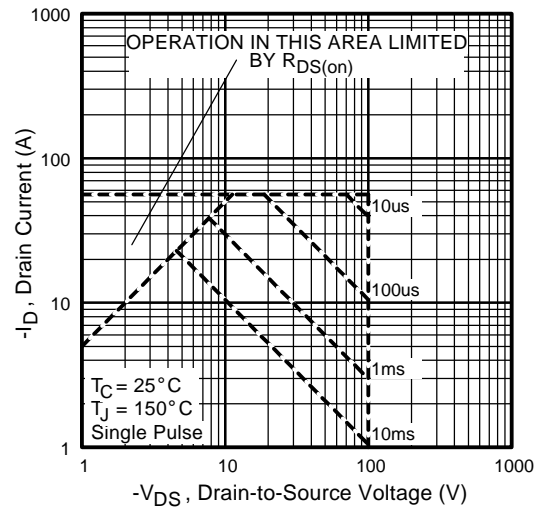


Fig 8. Maximum Safe Operating Area

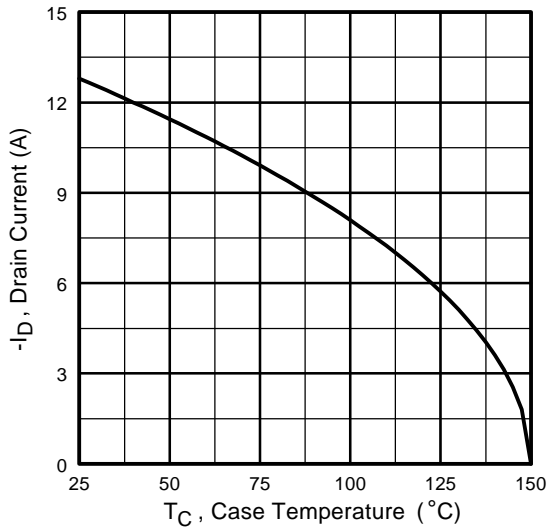


Fig 9. Maximum Drain Current Vs. Case Temperature

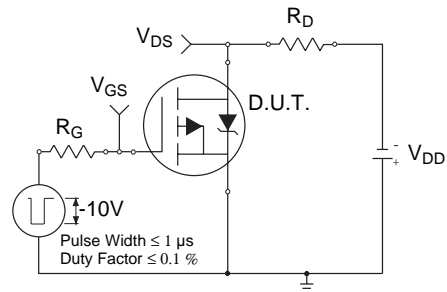


Fig 10a. Switching Time Test Circuit

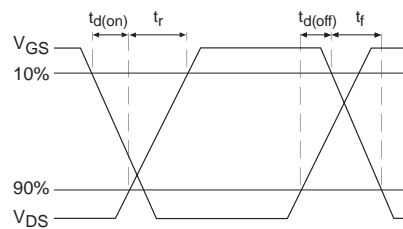


Fig 10b. Switching Time Waveforms

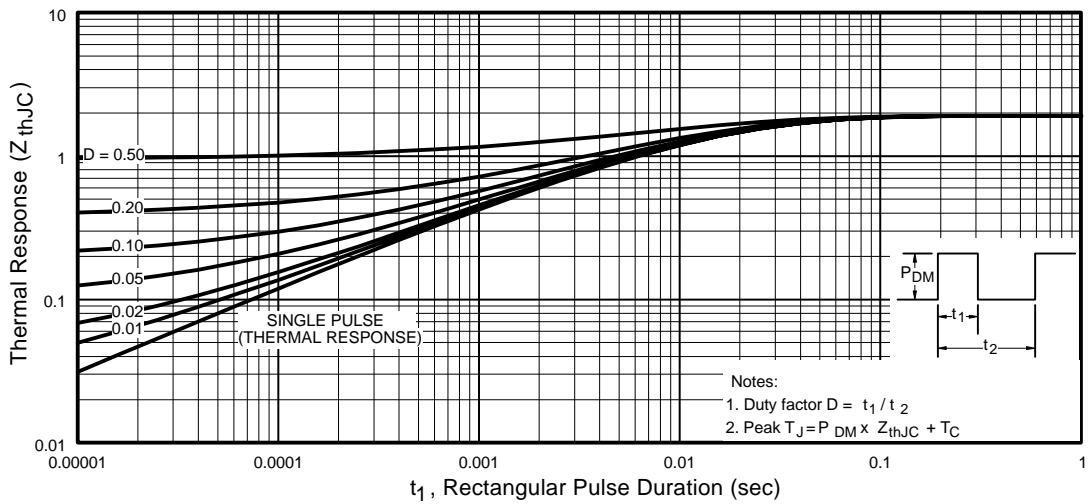


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

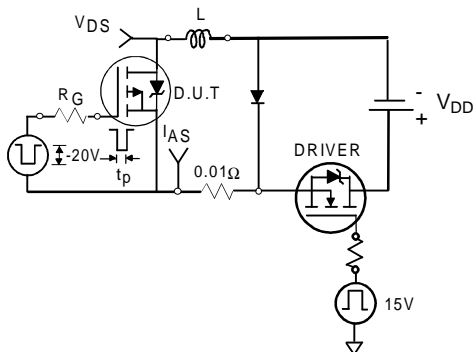


Fig 12a. Unclamped Inductive Test Circuit

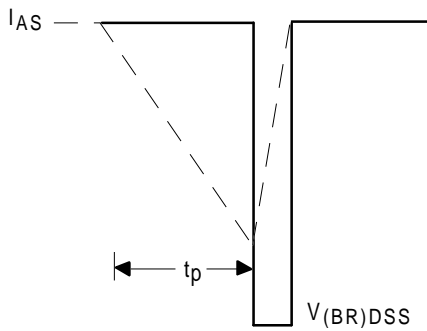


Fig 12b. Unclamped Inductive Waveforms

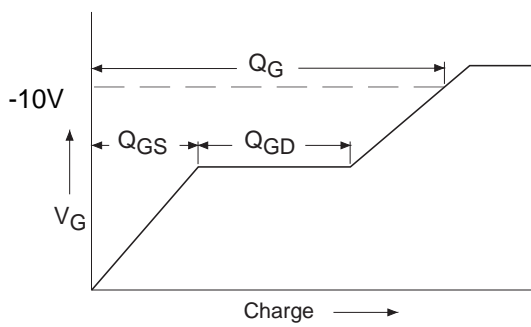


Fig 13a. Basic Gate Charge Waveform

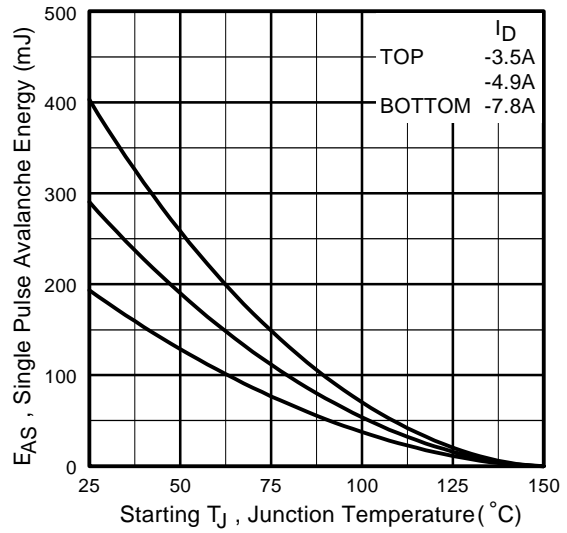


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

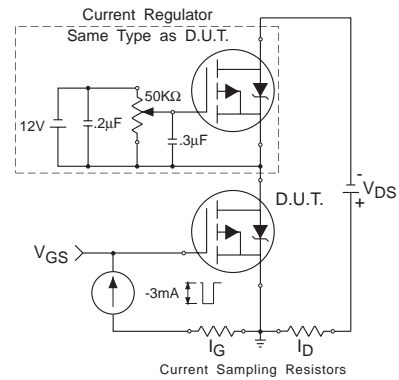
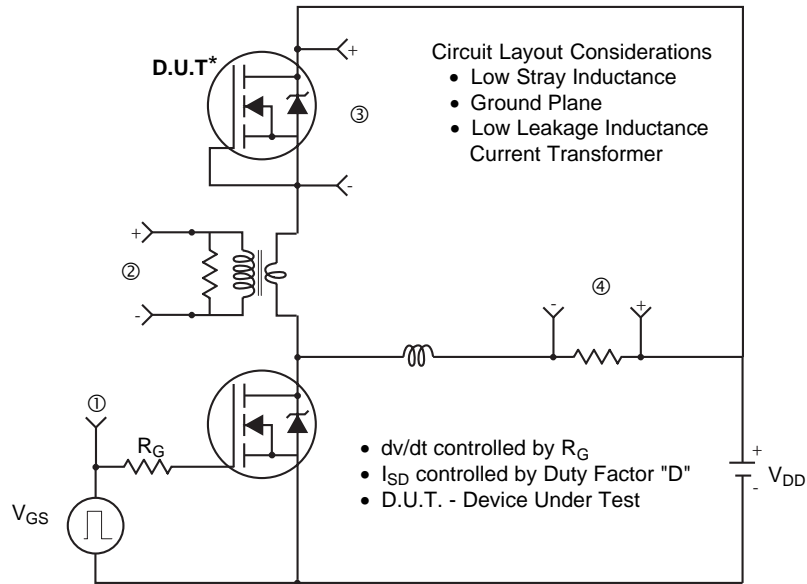
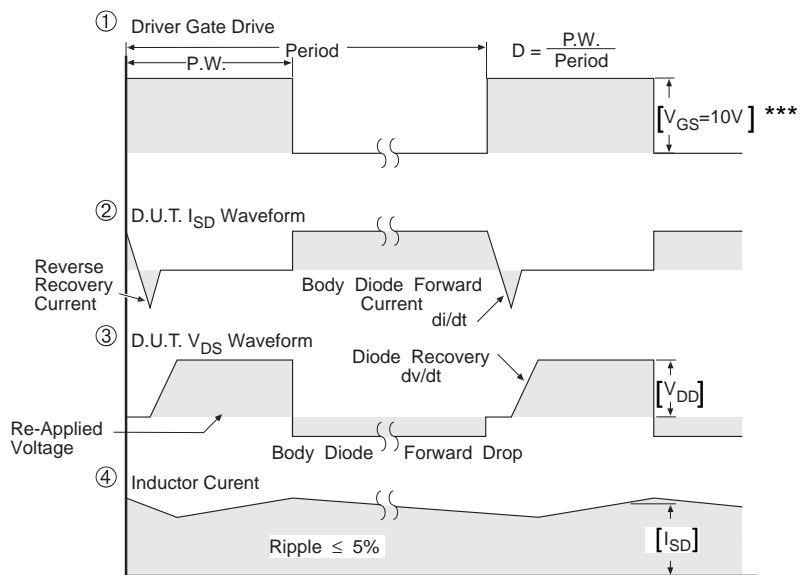


Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



* Reverse Polarity of D.U.T for P-Channel



*** $V_{GS} = 5.0V$ for Logic Level and 3V Drive Devices

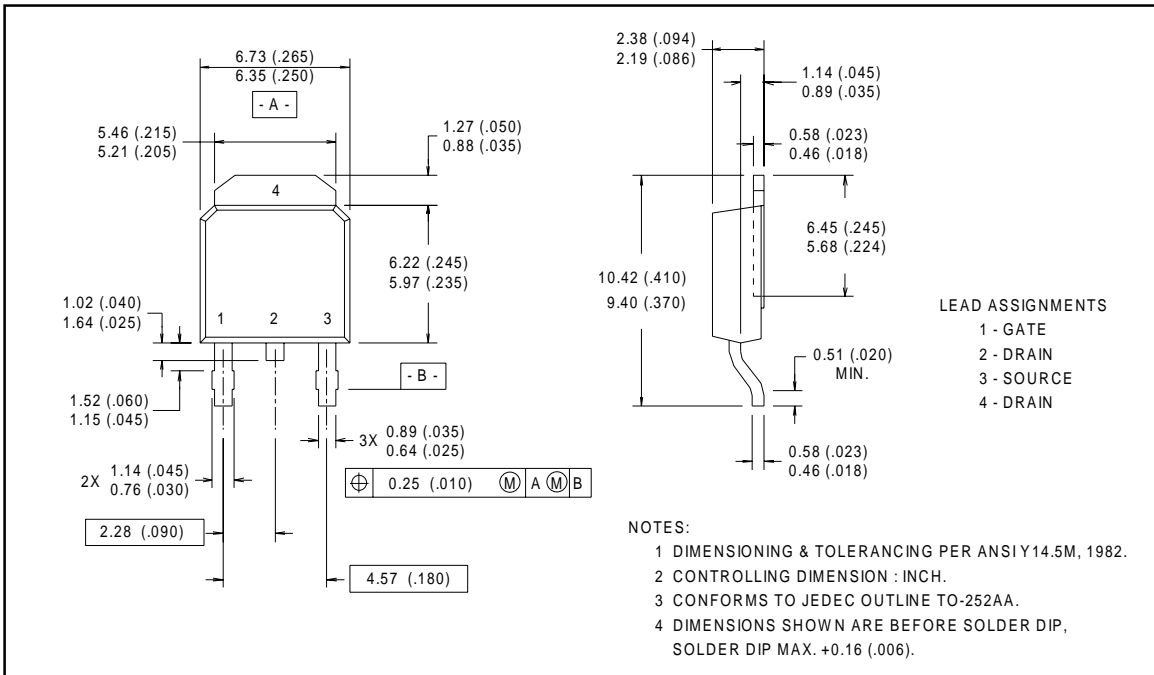
Fig 14. For P-Channel HEXFETS

IRFR/U5410

Package Outline

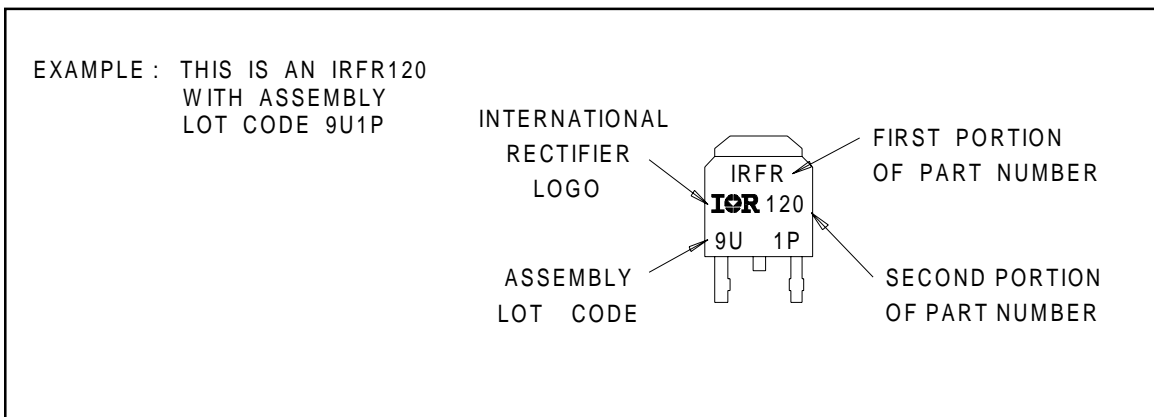
TO-252AA Outline

Dimensions are shown in millimeters (inches)



Part Marking Information

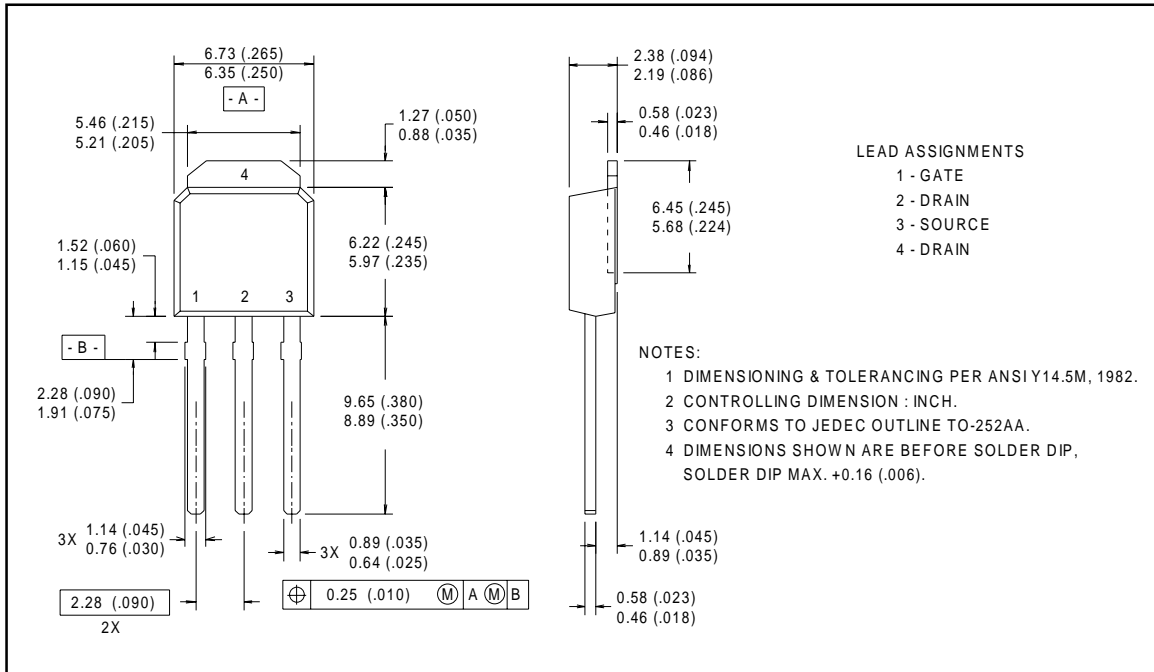
TO-252AA (D-Pak)



Package Outline

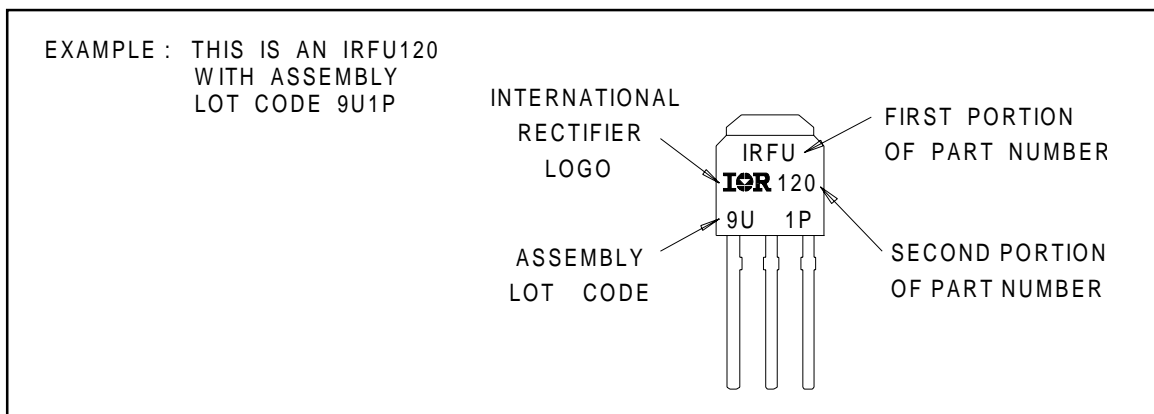
TO-251AA Outline

Dimensions are shown in millimeters (inches)



Part Marking Information

TO-251AA (I-Pak)

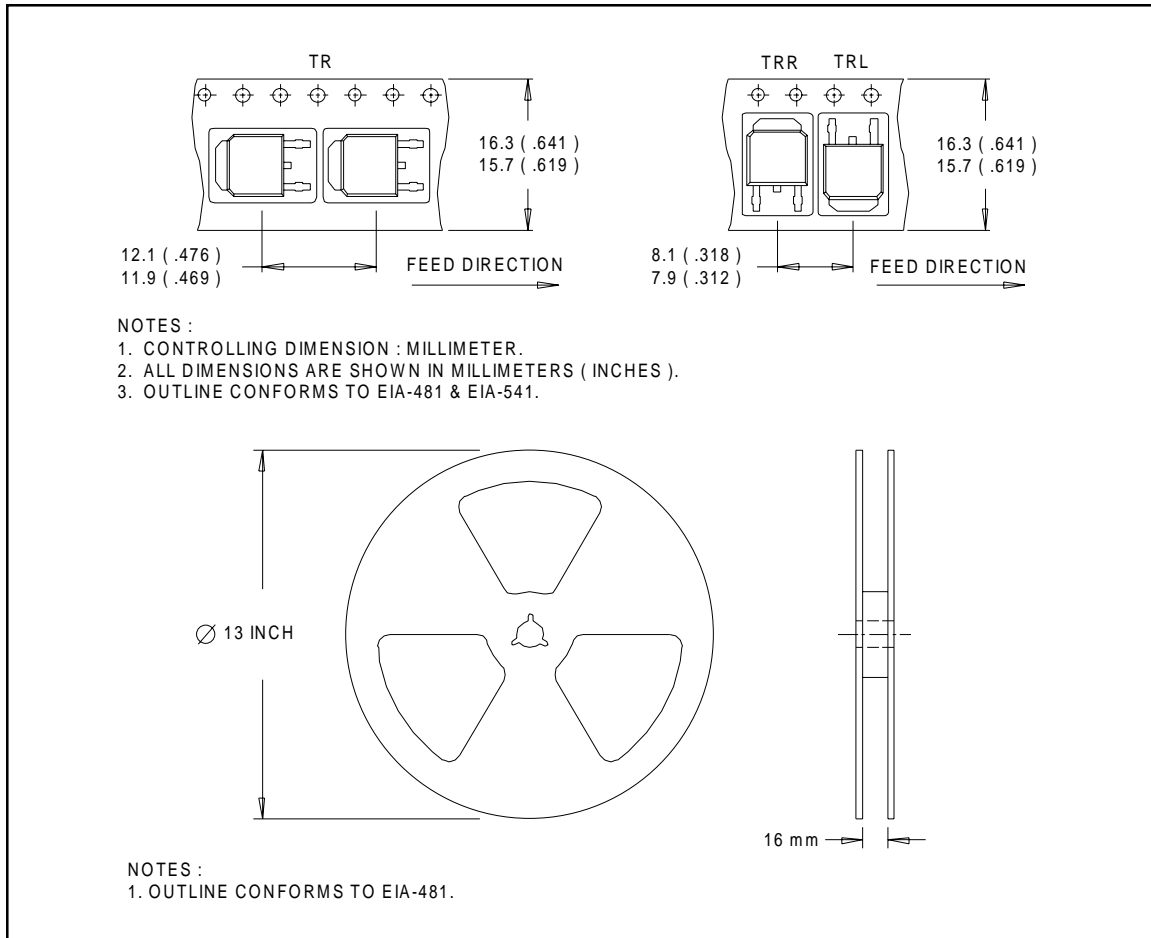


IRFR/U5410

International
IOR Rectifier

Tape & Reel Information

TO-252AA



International
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