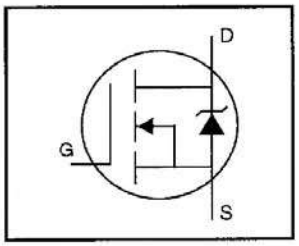
International
IOR Rectifier

# IRFP440PbF

HEXFET® Power MOSFET

- Dynamic dv/dt Rating
- Repetitive Avalanche Rated
- Isolated Central Mounting Hole
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Lead-Free




$V_{DSS}$ = 500V

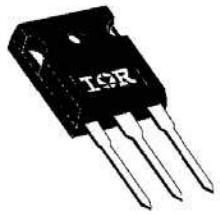
$R_{DS(on)}$ = 0.85Ω

$I_D$ = 8.8A

## Description

Third Generation HEXFETs from International Rectifier provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-247 package is preferred for commercial–industrial applications where higher power levels preclude the use of TO-220 devices. The TO-247 is similar but superior to the earlier TO-218 package because of its isolated mounting hole. It also provides greater creepage distance between pins to meet the requirements of most safety specifications.




TO-247AC

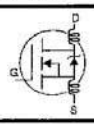
## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10 V | 8.8 | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10 V | 5.6 | |
| $I_{DM}$ | Pulsed Drain Current ① | 35 | |
| $P_D$ @ $T_C$ = 25°C | 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 ② | 480 | mJ |
| $I_{AR}$ | Avalanche Current ① | 8.8 | A |
| $E_{AR}$ | Repetitive Avalanche Energy ① | 15 | mJ |
| dv/dt | Peak Diode Recovery dv/dt ③ | 3.5 | V/ns |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -55 to +150 | °C |
| | Soldering Temperature, for 10 seconds | 300 (1.6mm from case) | |
| | Mounting Torque, 6-32 or M3 screw | 10 lbf•in (1.1 N•m) | |

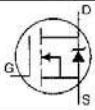
## Thermal Resistance

| | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | — | — | 0.83 | °C/W |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface | — | 0.24 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient | — | — | 40 | |

## Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 500 | — | — | V | $V_{GS}$=0V, $I_D$= 250µA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.78 | — | V/°C | Reference to 25°C, $I_D$= 1mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | — | 0.85 | Ω | $V_{GS}$=10V, $I_D$=5.3A ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | — | 4.0 | V | $V_{DS}$=$V_{GS}$, $I_D$= 250µA |
| $g_{fs}$ | Forward Transconductance | 5.3 | — | — | S | $V_{DS}$=50V, $I_D$=5.3A ④ |
| $I_{DSS}$ | Drain-to-Source Leakage Current | — | — | 25 | µA | $V_{DS}$=500V, $V_{GS}$=0V |
| | | — | — | 250 | | $V_{DS}$=400V, $V_{GS}$=0V, $T_J$=125°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 | — | — | 63 | nC | $I_D$=8.0A |
| $Q_{gs}$ | Gate-to-Source Charge | — | — | 11 | | $V_{DS}$=400V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | — | — | 30 | | $V_{GS}$=10V See Fig. 6 and 13 ④ |
| $t_{d(on)}$ | Turn-On Delay Time | — | 14 | — | ns | $V_{DD}$=250V |
| $t_r$ | Rise Time | — | 23 | — | | $I_D$=8.0A |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 49 | — | | $R_G$=9.1Ω |
| $t_f$ | Fall Time | — | 20 | — | | $R_D$=31Ω See Figure 10 ④ |
| $L_D$ | Internal Drain Inductance | — | 5.0 | — | nH | Between lead, 6 mm (0.25in.) from package and center of die contact  |
| $L_S$ | Internal Source Inductance | — | 13 | — | | |
| $C_{iss}$ | Input Capacitance | — | 1300 | — | pF | $V_{GS}$=0V |
| $C_{oss}$ | Output Capacitance | — | 310 | — | | $V_{DS}$= 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 120 | — | | $f$=1.0MHz See Figure 5 |

## Source-Drain Ratings and Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 8.8 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | — | — | 35 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 2.0 | V | $T_J$=25°C, $I_S$=8.8A, $V_{GS}$=0V ④ |
| $t_{rr}$ | Reverse Recovery Time | — | 460 | 970 | ns | $T_J$=25°C, $I_F$=8.0A |
| $Q_{rr}$ | Reverse Recovery Charge | — | 3.5 | 7.6 | µC | di/dt=100A/µs ④ |
| $t_{on}$ | Forward Turn-On Time | Intrinsic turn-on time is neglegible (turn-on is dominated by $L_S$+$L_D$) | | | | |

Notes:

① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)

② $V_{DD}$=50V, starting $T_J$=25°C, L=11mH $R_G$=25Ω, $I_{AS}$=8.8A (See Figure 12)

③ $I_{SD}$≤8.8A, di/dt≤100A/µs, $V_{DD}$≤$V_{(BR)DSS}$, $T_J$≤150°C

④ Pulse width ≤ 300 µs; duty cycle ≤2%.

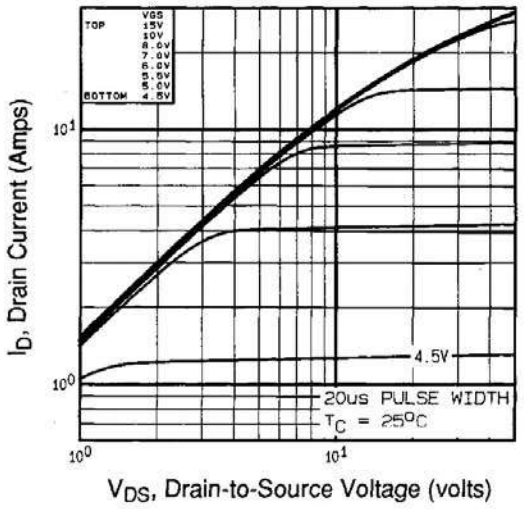



**Fig 1.** Typical Output Characteristics, $T_C$=25°C

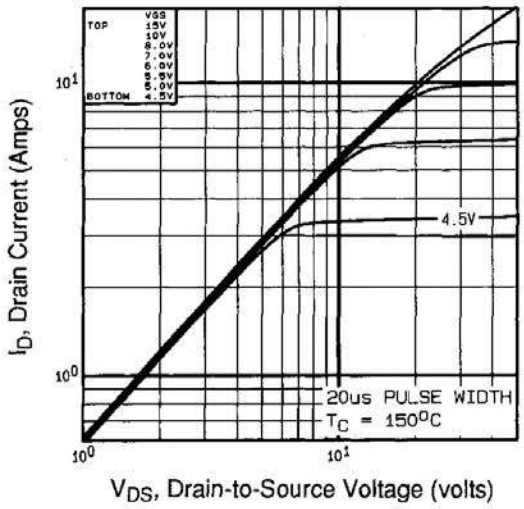



**Fig 2.** Typical Output Characteristics, $T_C$=150°C

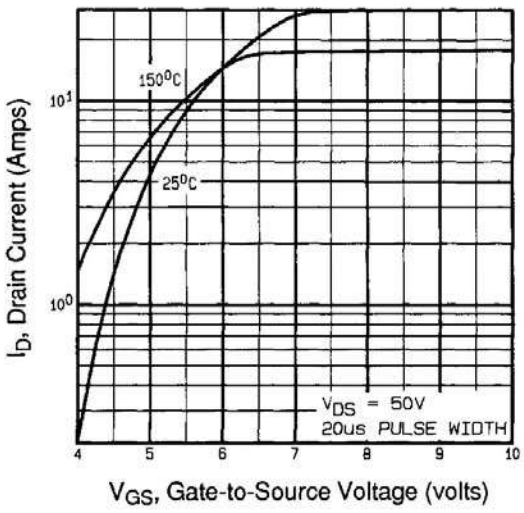



**Fig 3.** Typical Transfer Characteristics

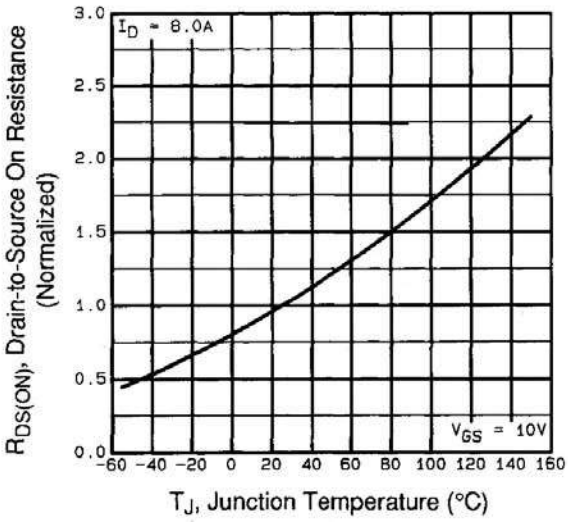



**Fig 4.** Normalized On-Resistance Vs. Temperature

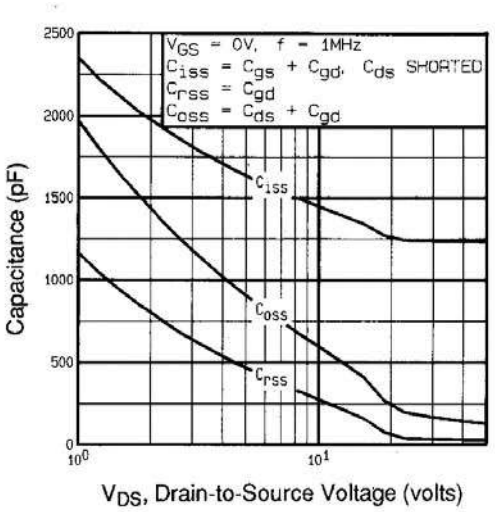



**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

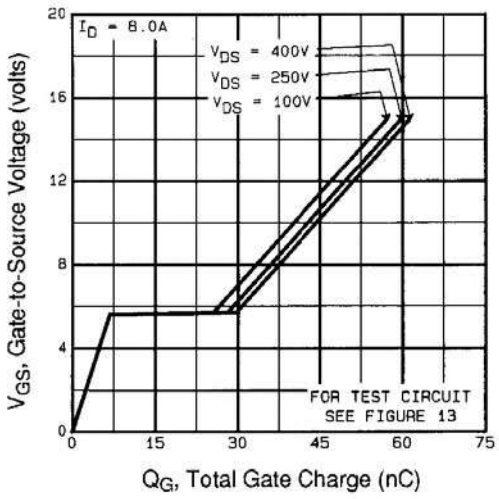



**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage

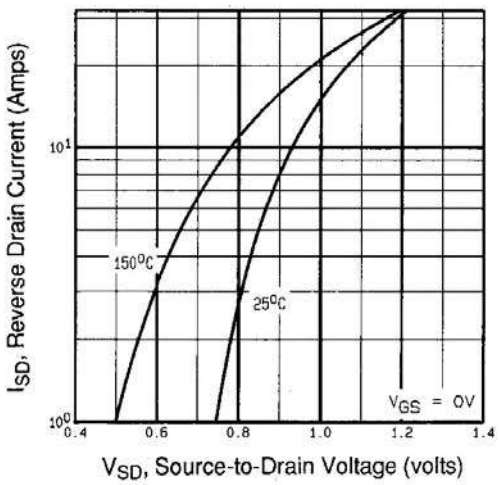



**Fig 7.** Typical Source-Drain Diode Forward Voltage

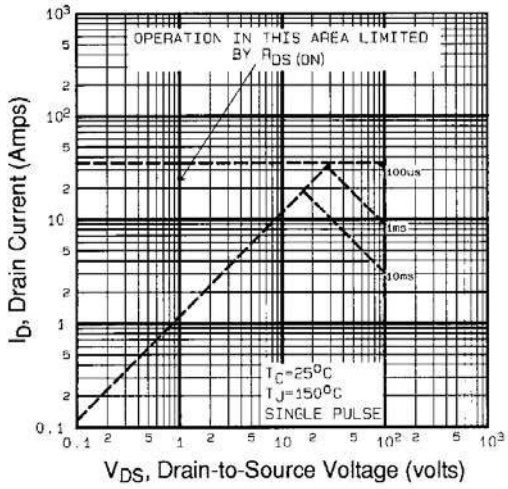



**Fig 8.** Maximum Safe Operating Area

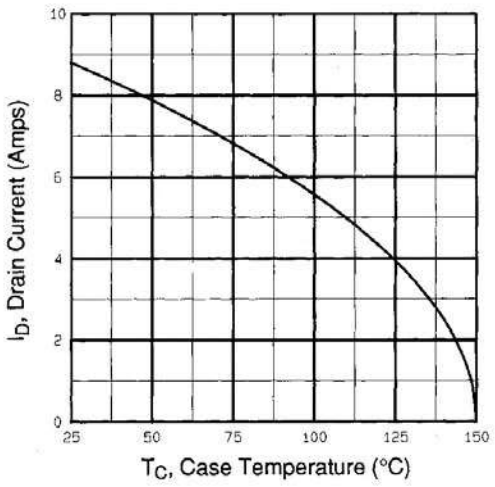



**Fig 9.** Maximum Drain Current Vs. Case Temperature

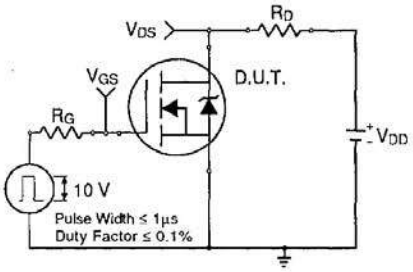



**Fig 10a.** Switching Time Test Circuit

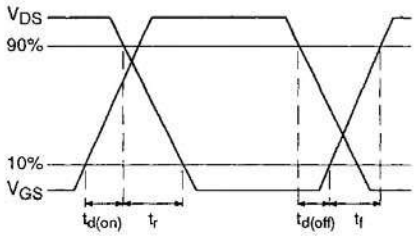



**Fig 10b.** Switching Time Waveforms

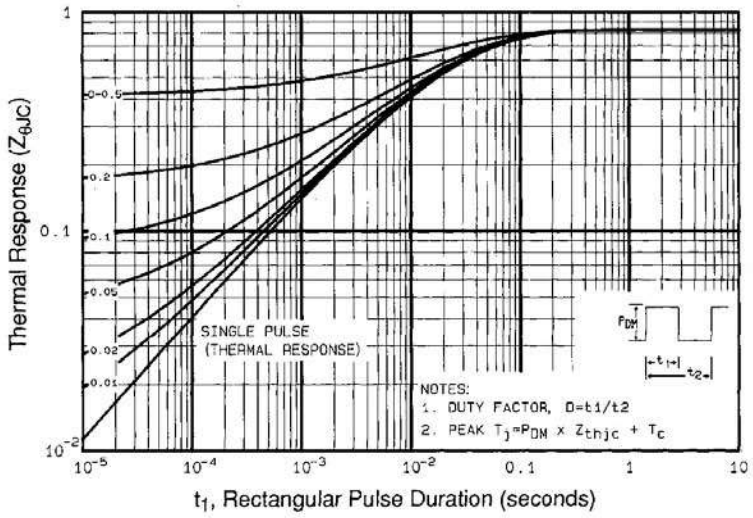



**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

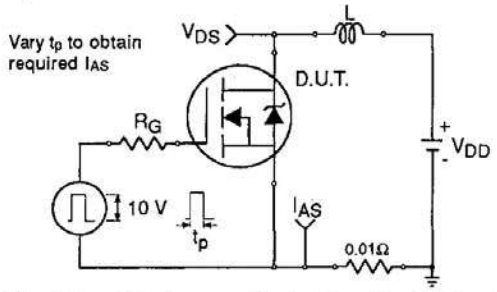



**Fig 12a.** Unclamped Inductive Test Circuit

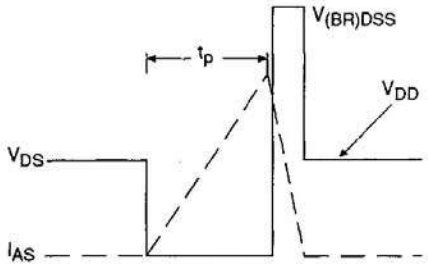



**Fig 12b.** Unclamped Inductive Waveforms

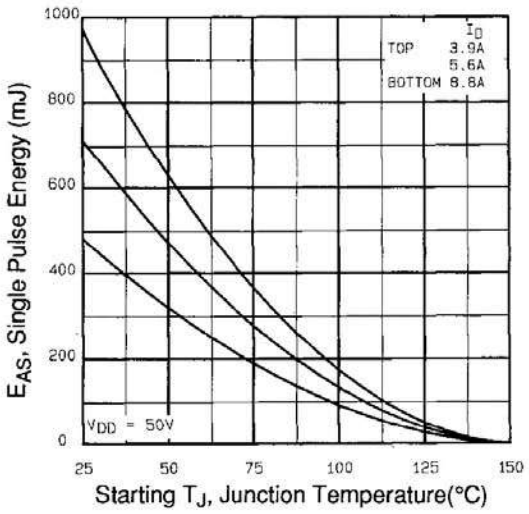



**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current

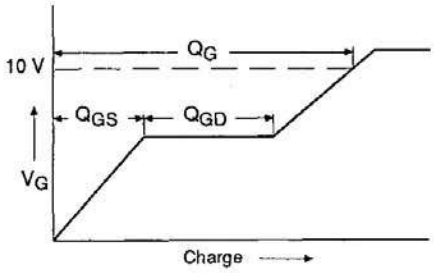



**Fig 13a.** Basic Gate Charge Waveform

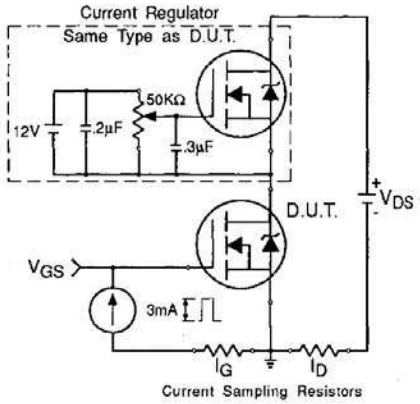
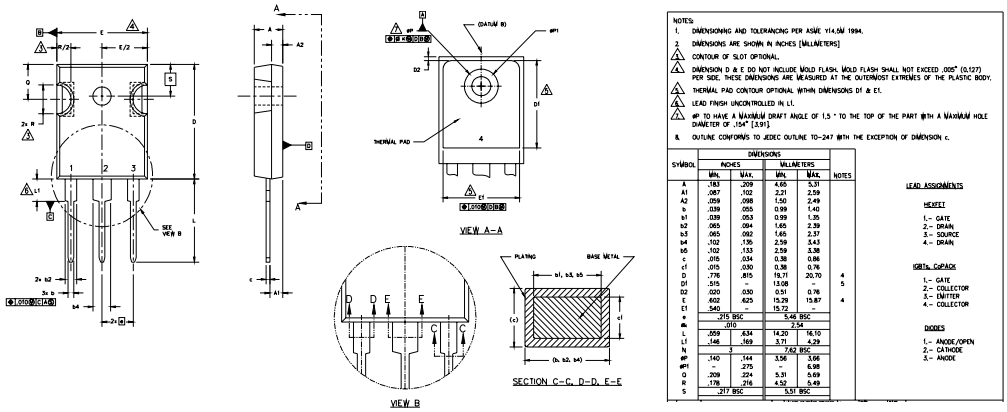



**Fig 13b.** Gate Charge Test Circuit

**Appendix A:** Figure 14, Peak Diode Recovery dv/dt Test Circuit – See page 1505

## TO-247AC Package Outline

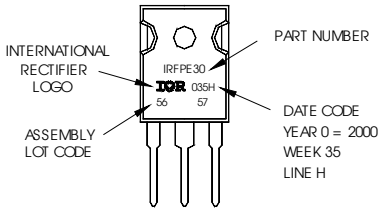
Dimensions are shown in millimeters (inches)




## TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2000
IN THE ASSEMBLY LINE "H"

**Note:** "P" in assembly line position indicates "Lead-Free"




Data and specifications subject to change without notice.

International
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04/04

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