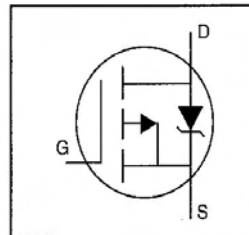


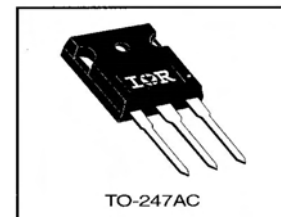
IRFP9140PbF

HEXFET® Power MOSFET

- Dynamic dv/dt Rating
- Repetitive Avalanche Rated
- P-Channel
- Isolated Central Mounting Hole
- 175°C Operating Temperature
- Fast Switching
- Ease of Paralleling
- Lead-Free



$V_{DSS} = -100V$
 $R_{DS(on)} = 0.20\Omega$
 $I_D = -21A$



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.

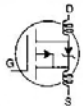
Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---------------------------|---|-----------------------|-------|
| $I_D @ T_C = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ -10 V$ | -21 | A |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ -10 V$ | -15 | |
| I_{DM} | Pulsed Drain Current ① | -84 | |
| $P_D @ T_C = 25^\circ C$ | Power Dissipation | 180 | W |
| | Linear Derating Factor | 1.2 | W/°C |
| V_{GS} | Gate-to-Source Voltage | ± 20 | V |
| E_{AS} | Single Pulse Avalanche Energy ② | 960 | mJ |
| I_{AR} | Avalanche Current ① | -21 | A |
| E_{AR} | Repetitive Avalanche Energy ① | 18 | mJ |
| dv/dt | Peak Diode Recovery dv/dt ③ | -5.5 | V/ns |
| T_J T_{STG} | Operating Junction and Storage Temperature Range | -55 to +175 | °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) | |

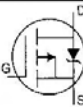
Thermal Resistance

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

| | Parameter | Min. | Typ. | Max. | Units | Test 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 | — | -0.087 | — | $V/^\circ\text{C}$ | Reference to 25°C , $I_D=-1mA$ |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | — | 0.20 | Ω | $V_{GS}=-10V, I_D=-13A$ 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 | 6.2 | — | — | S | $V_{DS}=-50V, I_D=-13A$ ④ |
| I_{DSS} | Drain-to-Source Leakage Current | — | — | -100 | μA | $V_{DS}=-100V, V_{GS}=0V$ |
| | | — | — | -500 | | $V_{DS}=-80V, V_{GS}=0V, T_J=150^\circ\text{C}$ |
| 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 | — | — | 61 | nC | $I_D=-19A$ |
| Q_{gs} | Gate-to-Source Charge | — | — | 14 | | $V_{DS}=-80V$ |
| Q_{gd} | Gate-to-Drain ("Miller") Charge | — | — | 29 | | $V_{GS}=-10V$ See Fig. 6 and 13 ④ |
| $t_{d(on)}$ | Turn-On Delay Time | — | 16 | — | ns | $V_{DD}=-50V$ |
| t_r | Rise Time | — | 73 | — | | $I_D=-19A$ |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 34 | — | | $R_G=9.1\Omega$ |
| t_f | Fall Time | — | 57 | — | | $R_D=2.4\Omega$ 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 | — | 1400 | — | pF | $V_{GS}=0V$ |
| C_{oss} | Output Capacitance | — | 590 | — | | $V_{DS}=-25V$ |
| C_{rss} | Reverse Transfer Capacitance | — | 140 | — | | $f=1.0MHz$ See Figure 5 |

Source-Drain Ratings and Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|----------|--|---|------|------|---------|--|
| I_S | Continuous Source Current (Body Diode) | — | — | -21 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I_{SM} | Pulsed Source Current (Body Diode) ① | — | — | -84 | | |
| V_{SD} | Diode Forward Voltage | — | — | -5.0 | V | $T_J=25^\circ\text{C}, I_S=-21A, V_{GS}=0V$ ④ |
| t_{rr} | Reverse Recovery Time | — | 130 | 260 | ns | $T_J=25^\circ\text{C}, I_F=-19A$ |
| Q_{rr} | Reverse Recovery Charge | — | 0.35 | 0.70 | μC | $di/dt=100A/\mu s$ ④ |
| 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 Figure 11)
- ② $V_{DD}=-25V$, starting $T_J=25^\circ\text{C}$, $L=3.3mH$, $R_G=25\Omega$, $I_{AS}=-21A$ (See Figure 12)
- ③ $I_{SD}\leq 21A$, $di/dt\leq 200A/\mu s$, $V_{DD}\leq V_{(BR)DSS}$, $T_J\leq 175^\circ\text{C}$
- ④ Pulse width $\leq 300\mu s$; duty cycle $\leq 2\%$.

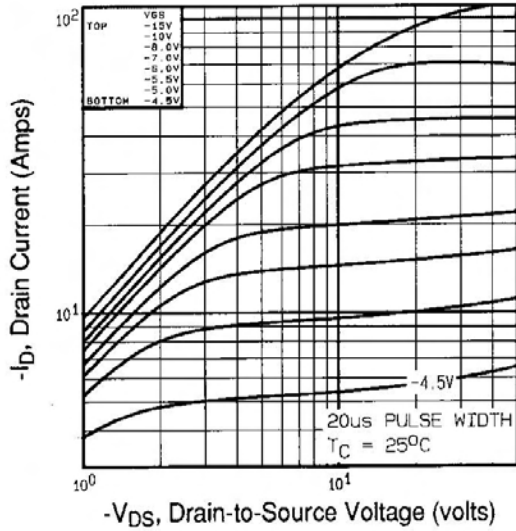


Fig 1. Typical Output Characteristics,
 $T_C=25^\circ\text{C}$

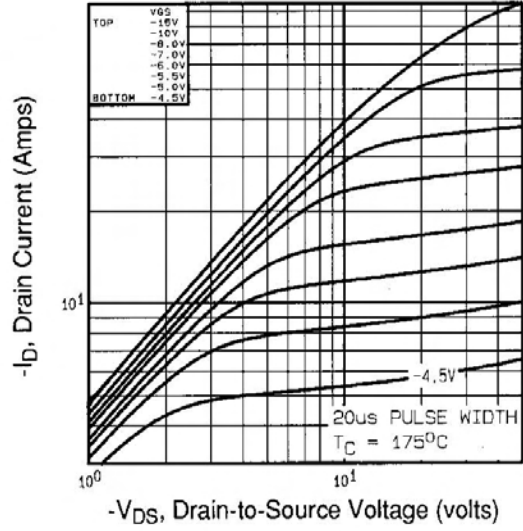


Fig 2. Typical Output Characteristics,
 $T_C=175^\circ\text{C}$

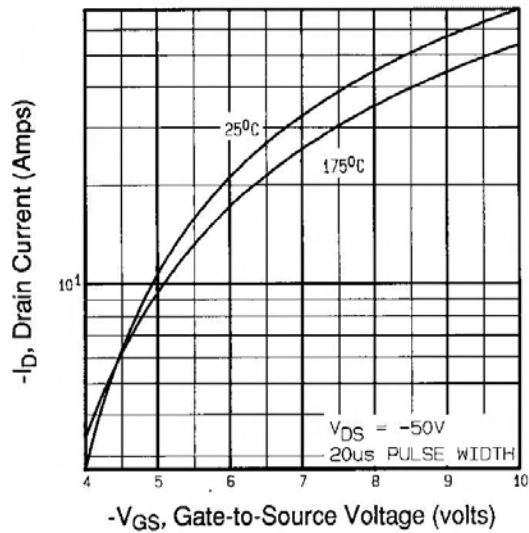


Fig 3. Typical Transfer Characteristics

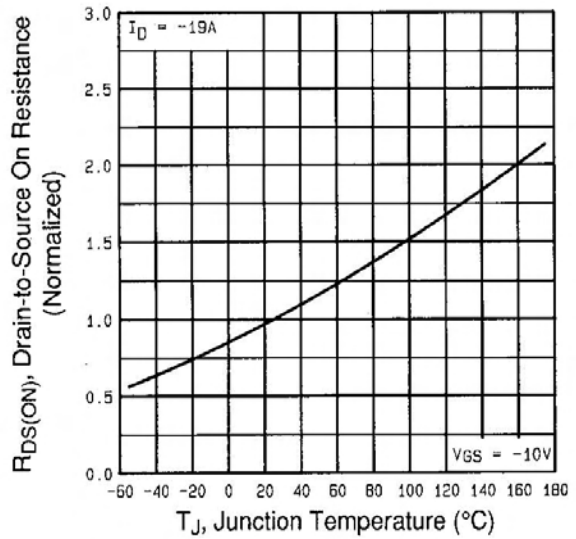


Fig 4. Normalized On-Resistance
Vs. Temperature

IRFP9140PbF

International
IR Rectifier

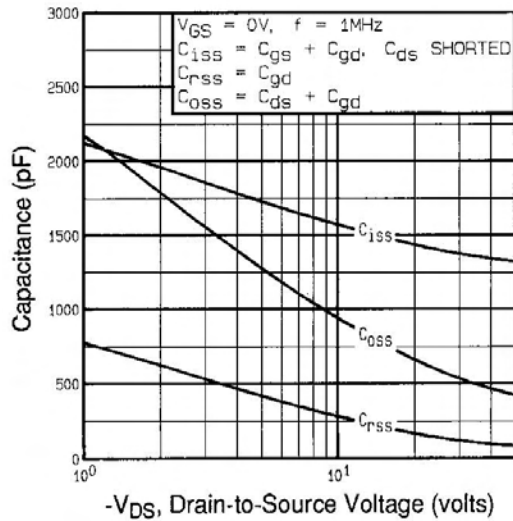


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

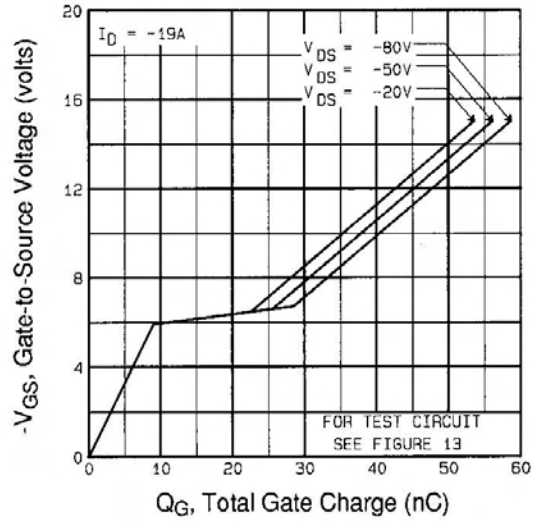


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

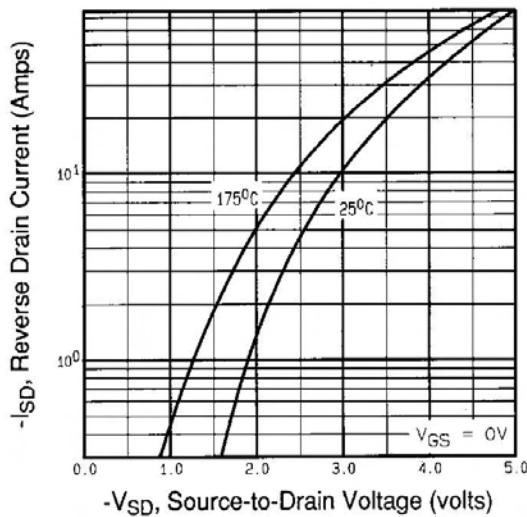


Fig 7. Typical Source-Drain Diode Forward Voltage

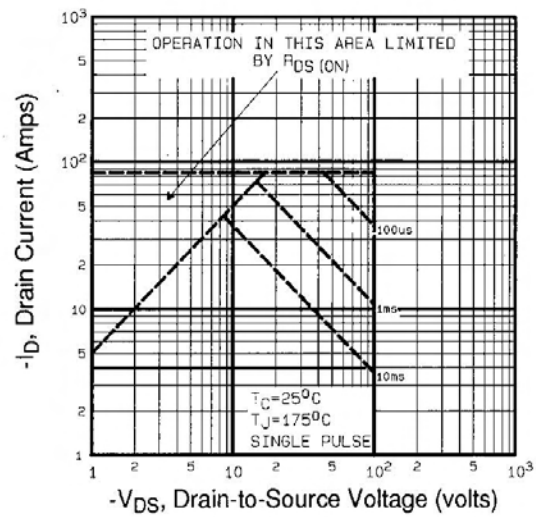


Fig 8. Maximum Safe Operating Area

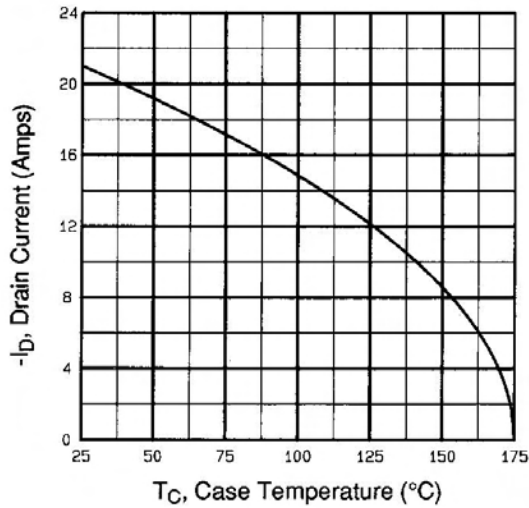


Fig 9. Maximum Drain Current Vs. Case Temperature

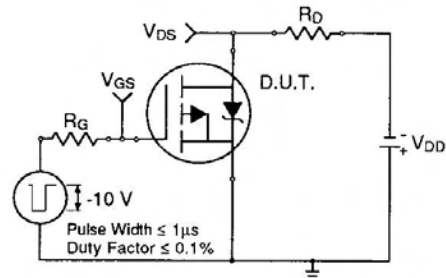


Fig 10a. Switching Time Test Circuit

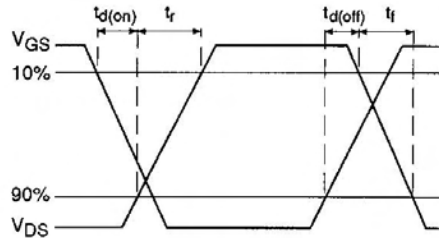


Fig 10b. Switching Time Waveforms

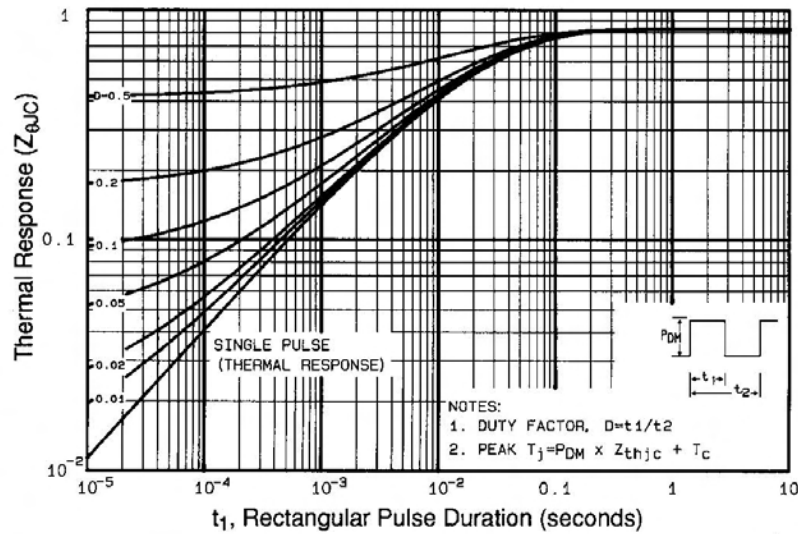


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRFP9140PbF

International
IR Rectifier

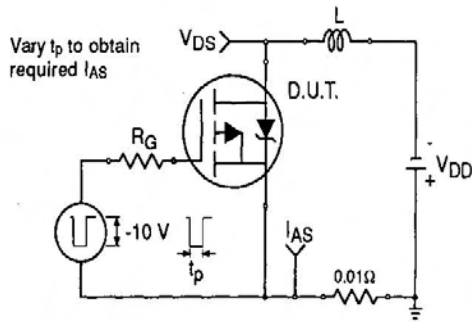


Fig 12a. Unclamped Inductive Test Circuit

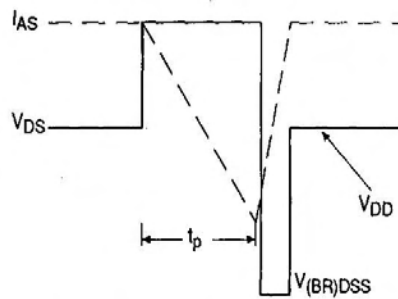


Fig 12b. Unclamped Inductive Waveforms

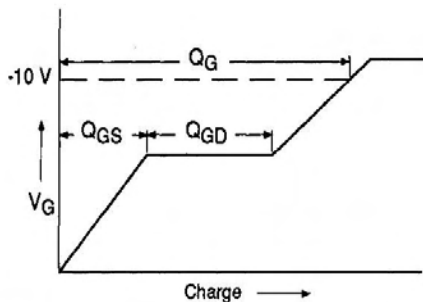


Fig 13a. Basic Gate Charge Waveform

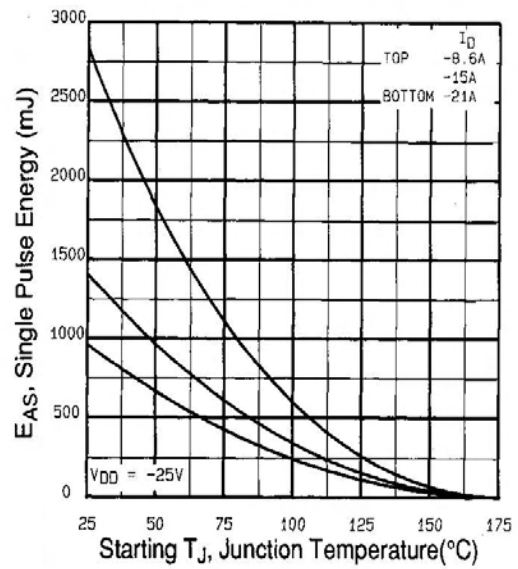


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

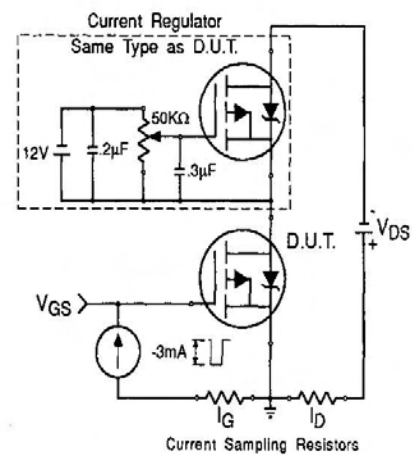
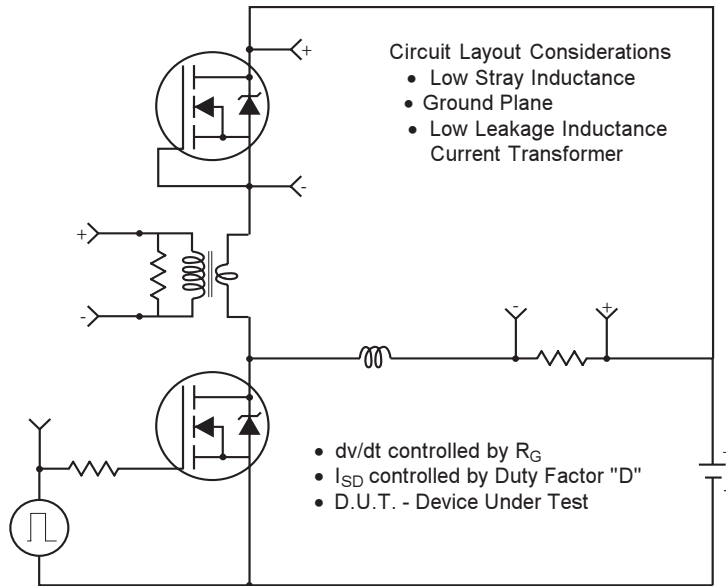


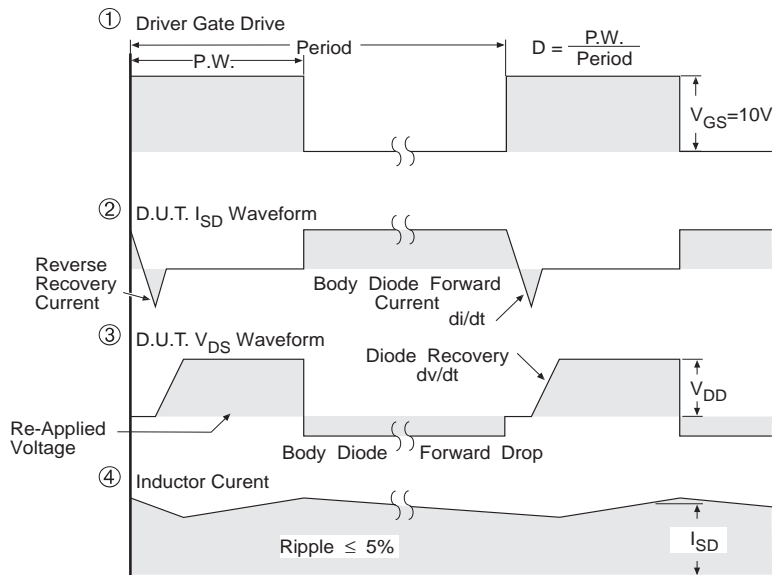
Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



* Reverse Polarity for P-Channel

** Use P-Channel Driver for P-Channel Measurements



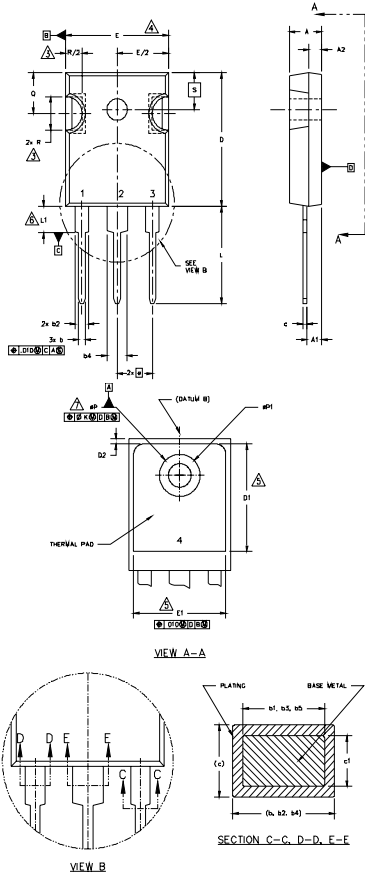
*** $V_{GS} = 5.0V$ for Logic Level and 3V Drive Devices

Fig -14 For P Channel HEXFETS

IRFP9140PbF

International
IR Rectifier

TO-247AC Package Outline Dimensions are shown in millimeters (inches)



NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M 1994.
- DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]
- CONTOUR OF SLOT OPTIONAL.
- DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
- LEAD FINISH UNCONTROLLED IN L1.
- ØP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154" [3.91]
- OUTLINE CONFORMS TO JEDEC OUTLINE TO-247 WITH THE EXCEPTION OF DIMENSION c.

| SYMBOL | DIMENSIONS | | | | NOTES |
|--------|------------|------|-------------|-------|-------|
| | INCHES | | MILLIMETERS | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | .183 | .209 | 4.65 | 5.31 | |
| A1 | .087 | .102 | 2.21 | 2.59 | |
| A2 | .059 | .098 | 1.50 | 2.49 | |
| b | .039 | .055 | 0.99 | 1.40 | |
| b1 | .039 | .053 | 0.99 | 1.35 | |
| b2 | .065 | .094 | 1.65 | 2.39 | |
| b3 | .065 | .092 | 1.65 | 2.37 | |
| b4 | .102 | .135 | 2.59 | 3.43 | |
| b5 | .102 | .133 | 2.59 | 3.38 | |
| c | .015 | .034 | 0.38 | 0.86 | |
| c1 | .015 | .030 | 0.38 | 0.76 | |
| D | .776 | .815 | 19.71 | 20.70 | 4 |
| D1 | .515 | - | 13.08 | - | 5 |
| D2 | .020 | .030 | 0.51 | 0.76 | |
| E | .602 | .625 | 15.29 | 15.87 | 4 |
| E1 | .540 | - | 15.72 | - | |
| e | .215 BSC | | 5.46 BSC | | |
| Øk | .010 | | 2.54 | | |
| L | .559 | .634 | 14.20 | 16.10 | |
| L1 | .146 | .169 | 3.71 | 4.29 | |
| N | 3 | | 7.62 BSC | | |
| ØP1 | .140 | .144 | 3.56 | 3.66 | |
| ØP1 | - | .275 | - | 6.98 | |
| Q | .209 | .224 | 5.31 | 5.69 | |
| R | .178 | .216 | 4.52 | 5.49 | |
| S | .217 BSC | | 5.51 BSC | | |

LEAD ASSIGNMENTS

HEXFET

- GATE
- DRAIN
- SOURCE
- DRAIN

IGBTs, CoPACK

- GATE
- COLLECTOR
- EMITTER
- COLLECTOR

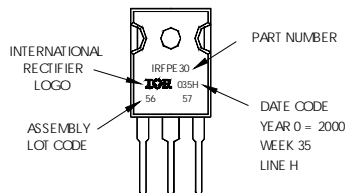
DIODES

- ANODE/OPEN
- CATHODE
- ANODE

TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5667
ASSEMBLED ON VW35, 2000
IN THE ASSEMBLY LINE "H"

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



Data and specifications subject to change without notice.

International
IR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105

TAC Fax: (310) 252-7903

Visit us at www.irf.com for sales contact information. 12/04

www.irf.com