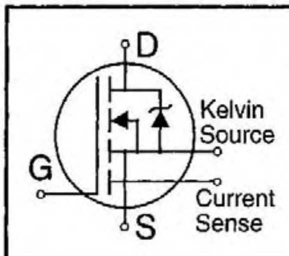
PD- 96002B

International Rectifier

# IRC540PbF

HEXFET® Power MOSFET

- Dynamic dv/dt Rating
- Repetitive Avalanche Rated
- Current Sense
- 175°C Operating Temperature
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Lead-Free




$V_{DSS}$ = 100V

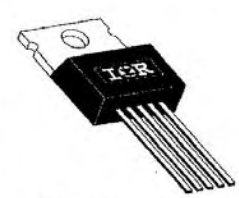
$R_{DS(on)}$ = 0.077Ω

$I_D$ = 28A

## 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 HEXSense device provides an accurate fraction of the drain current through the additional two leads to be used for control or protection of the device. These devices exhibit similar electrical and thermal characteristics as their IRF-series equivalent part numbers. The provision of a kelvin source connection effectively eliminates problems of common source inductance when the HEXSense is used as a fast, high-current switch in non current-sensing applications.



TO-220 HexSense

## Absolute Maximum Ratings

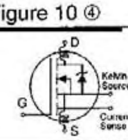
| | Parameter | Max. | Units |
|---|---|---|---|
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10 V | 28 | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current, $V_{GS}$ @ 10 V | 20 | |
| $I_{DM}$ | Pulsed Drain Current ① | 110 | |
| $P_D$ @ $T_C$ = 25°C | Power Dissipation | 150 | W |
| | Linear Derating Factor | 1.0 | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ±20 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy ② | 100 | mJ |
| $I_{AR}$ | Avalanche Current ① | 28 | A |
| $E_{AR}$ | Repetitive Avalanche Energy ① | 15 | mJ |
| dv/dt | Peak Diode Recovery dv/dt ③ | 5.5 | V/ns |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>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

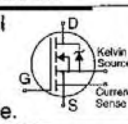
| | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | — | — | 1.0 | °C/W |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface | — | 0.50 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient | — | — | 62 | |

2/10/05

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

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage | 100 | — | — | V | $V_{GS}$=0V, $I_D$= 250µA |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.13 | — | V/°C | Reference to 25°C, $I_D$= 1mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | — | 0.077 | Ω | $V_{GS}$=10V, $I_D$=17A ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | — | 4.0 | V | $V_{DS}$=$V_{GS}$, $I_D$= 250µA |
| $g_{fs}$ | Forward Transconductance | 5.8 | — | — | S | $V_{DS}$=50V, $I_D$=17A ④ |
| $I_{DSS}$ | Drain-to-Source Leakage Current | — | — | 25 | µA | $V_{DS}$=100V, $V_{GS}$=0V |
| | | — | — | 250 | | $V_{DS}$=80V, $V_{GS}$=0V, $T_J$=150°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 | — | — | 69 | nC | $I_D$=29A |
| $Q_{gs}$ | Gate-to-Source Charge | — | — | 13 | | $V_{DS}$=80V |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | — | — | 37 | | $V_{GS}$=10V See Fig. 6 and 13 ④ |
| $t_{d(on)}$ | Turn-On Delay Time | — | 13 | — | ns | $V_{DD}$=50V |
| $t_r$ | Rise Time | — | 77 | — | | $I_D$=29A |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 40 | — | | $R_G$=9.1Ω |
| $t_f$ | Fall Time | — | 48 | — | | $R_D$=1.7Ω See Figure 10 ④ |
| $L_D$ | Internal Drain Inductance | — | 4.5 | — | nH | Between lead, 6 mm (0.25in.) from package and center of die contact  |
| $L_S$ | Internal Source Inductance | — | 7.5 | — | | |
| $C_{iss}$ | Input Capacitance | — | 1300 | — | pF | $V_{GS}$=0V |
| $C_{oss}$ | Output Capacitance | — | 630 | — | | $V_{DS}$= 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 130 | — | | $f$=1.0MHz See Figure 5 |
| r | Current Sensing Ratio | 2550 | — | 2810 | — | $I_D$=29A, $V_{GS}$=10V |
| $C_{oss}$ | Output Capacitance of Sensing Cells | — | 9.0 | — | pF | $V_{GS}$=0V, $V_{DS}$= 25V, $f$=1.0MHz |

## Source-Drain Ratings and Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 28 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | — | — | 110 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 2.5 | V | $T_J$=25°C, $I_S$=28A, $V_{GS}$=0V ④ |
| $t_{rr}$ | Reverse Recovery Time | — | 120 | 260 | ns | $T_J$=25°C, $I_F$=29A |
| $Q_{rr}$ | Reverse Recovery Charge | — | 0.52 | 1.2 | 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 $V_{DD}$=25V, starting $T_J$=25°C, L=191µH $R_G$=25Ω, $I_{AS}$=28A (See Figure 12)

③ $I_{SD}$≤28A, di/dt≤170A/µs, $V_{DD}$≤$V_{(BR)DSS}$, $T_J$≤175°C

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

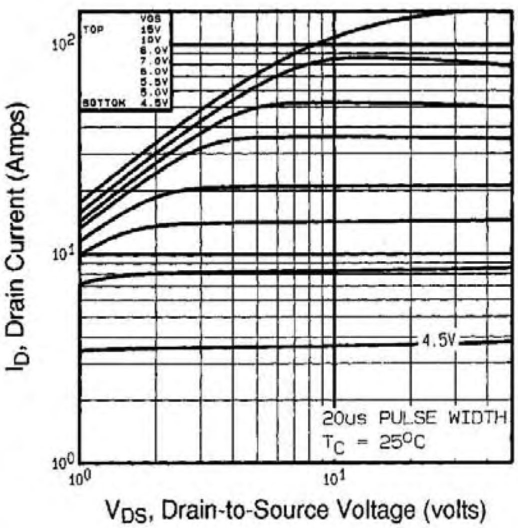



**Fig 1.** Typical Output Characteristics, $T_C$=25°C

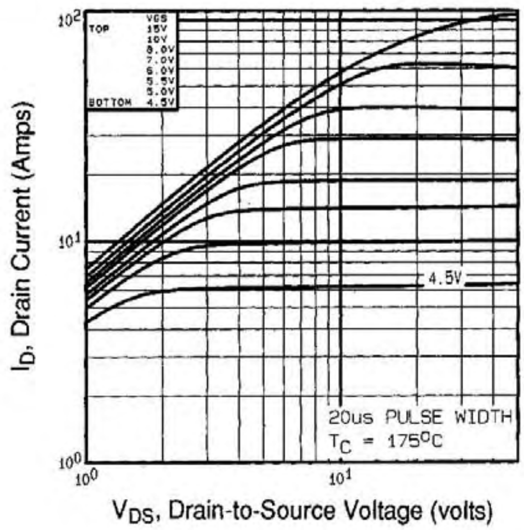



**Fig 2.** Typical Output Characteristics, $T_C$=175°C

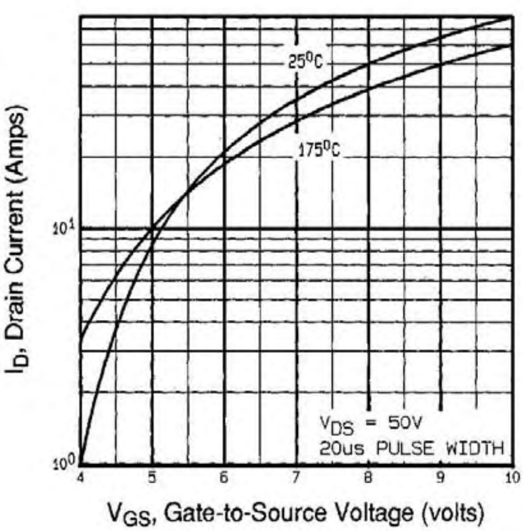



**Fig 3.** Typical Transfer Characteristics

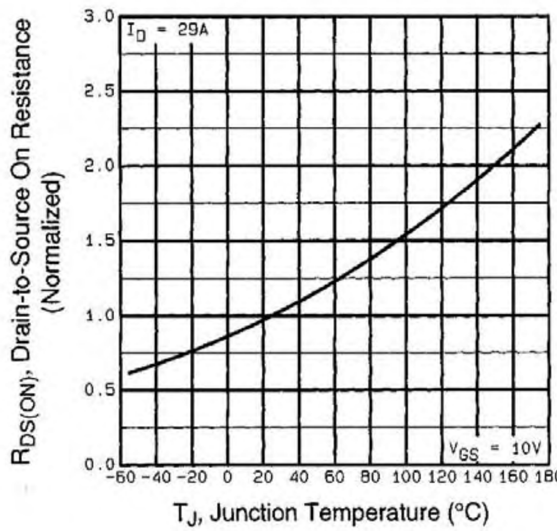



**Fig 4.** Normalized On-Resistance Vs. Temperature

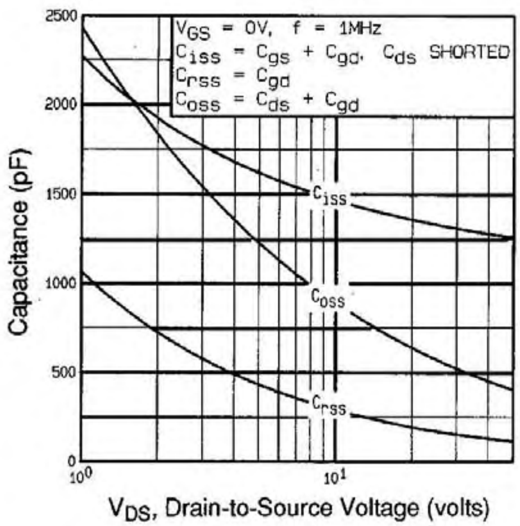



**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

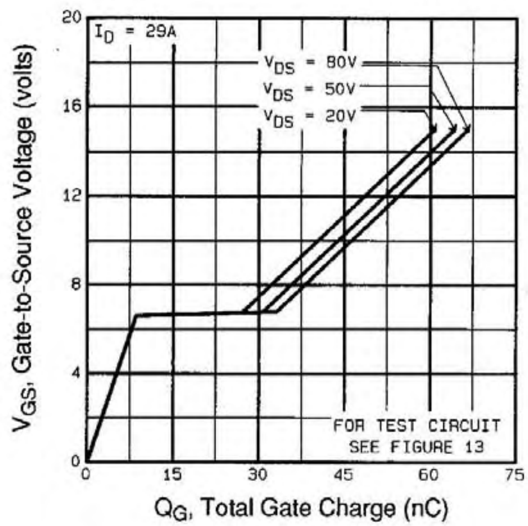



**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage

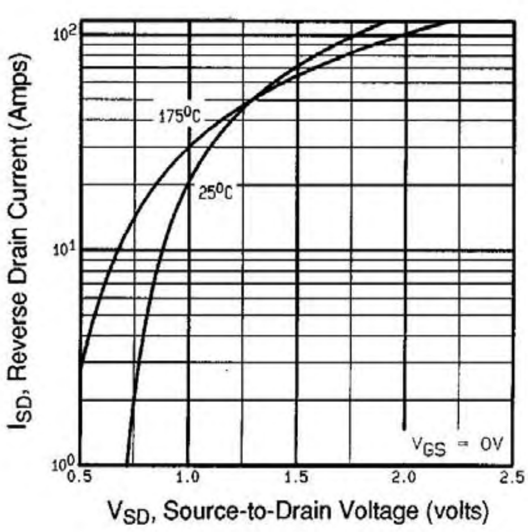



**Fig 7.** Typical Source-Drain Diode Forward Voltage

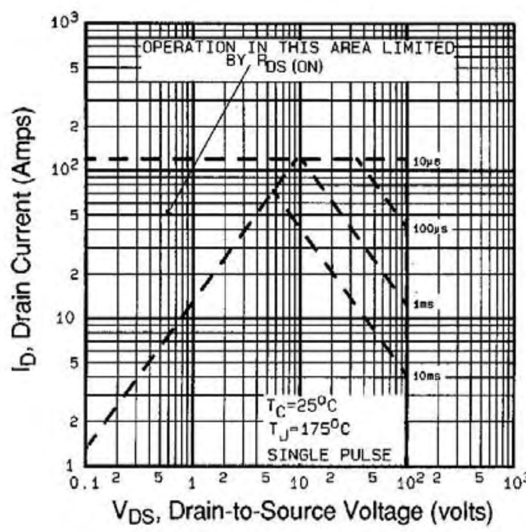



**Fig 8.** Maximum Safe Operating Area

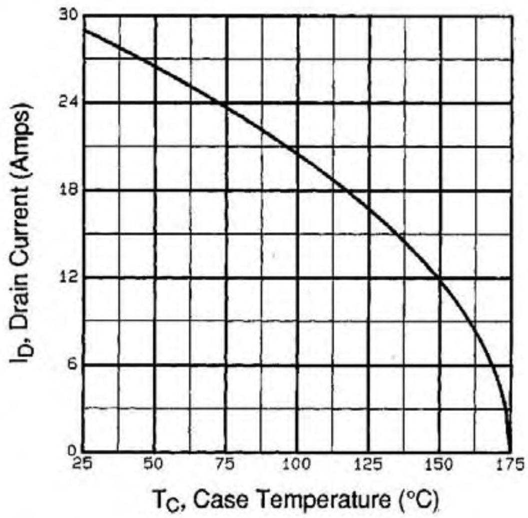



**Fig 9.** Maximum Drain Current Vs. Case Temperature

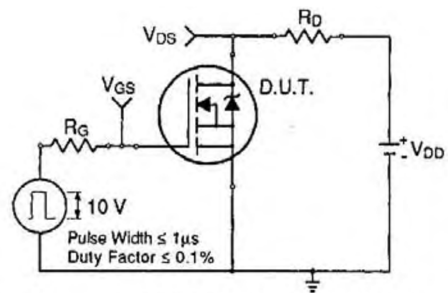



**Fig 10a.** Switching Time Test Circuit

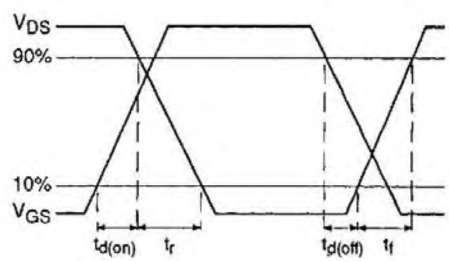



**Fig 10b.** Switching Time Waveforms

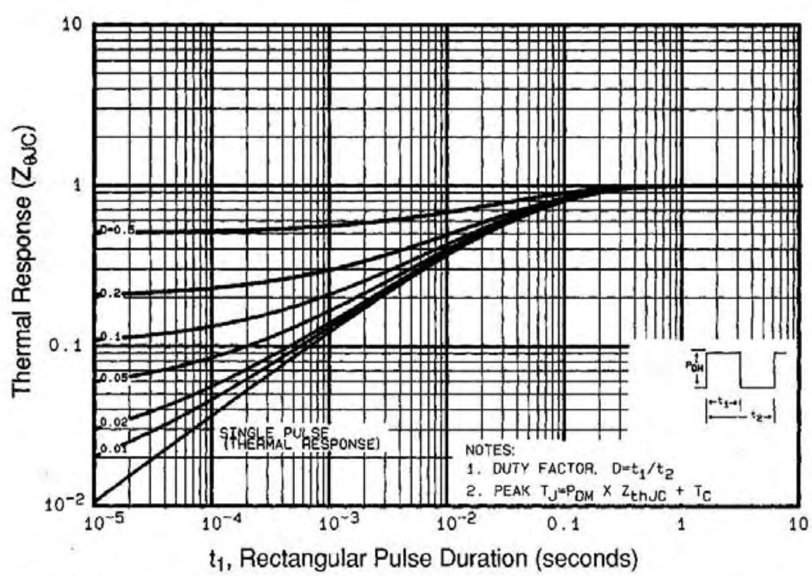



**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

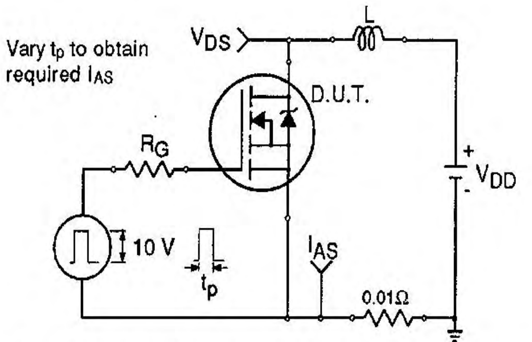



**Fig 12a.** Unclamped Inductive Test Circuit

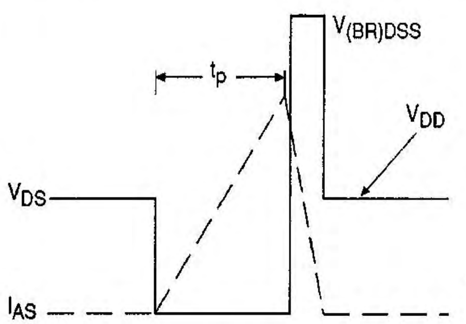



**Fig 12b.** Unclamped Inductive Waveforms

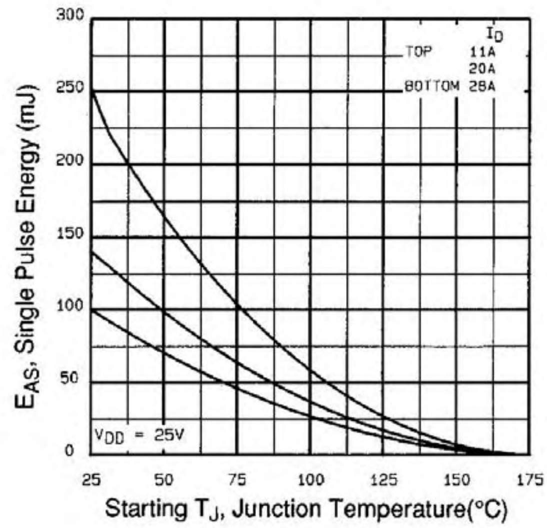



**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current

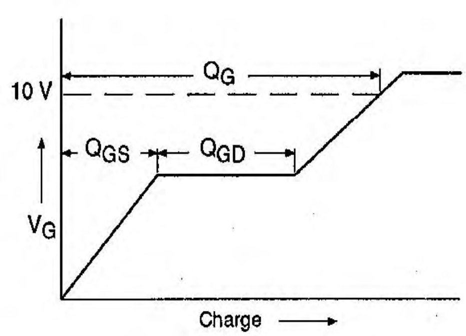



**Fig 13a.** Basic Gate Charge Waveform

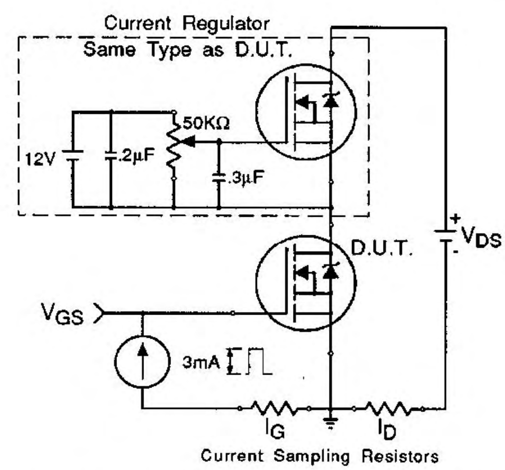



**Fig 13b.** Gate Charge Test Circuit

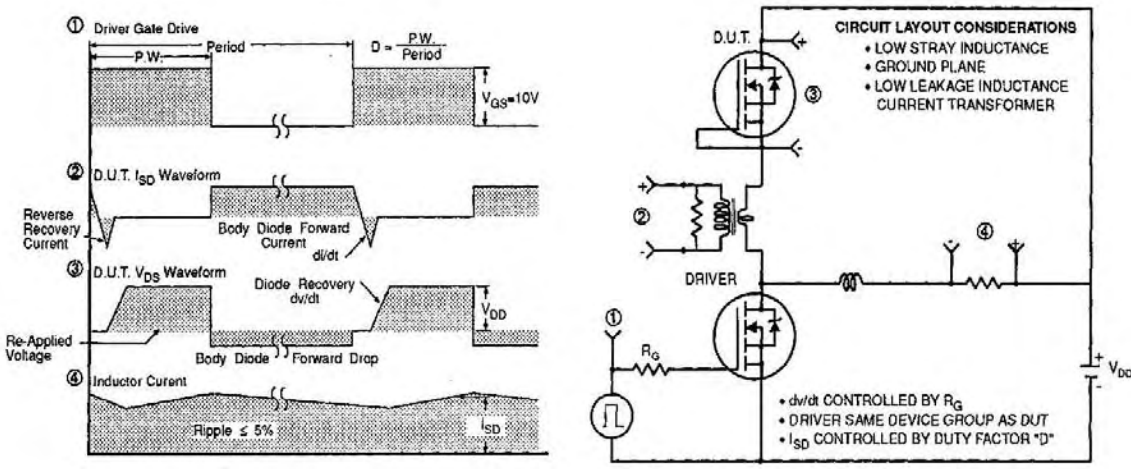



**Fig 14.** Peak Diode Recovery dv/dt Test Circuit

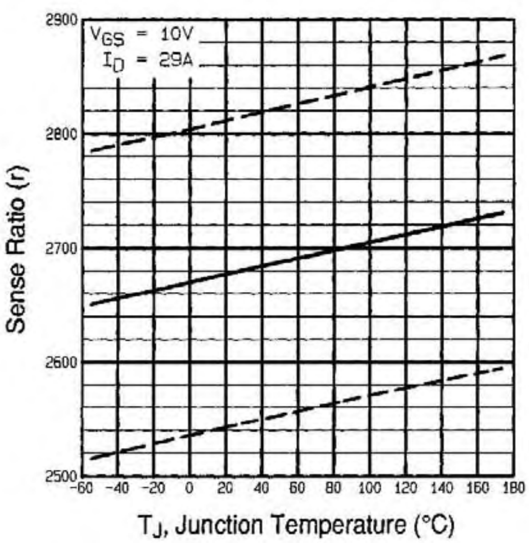



**Fig 15.** Typical HEXSense Ratio Vs. Junction Temperature

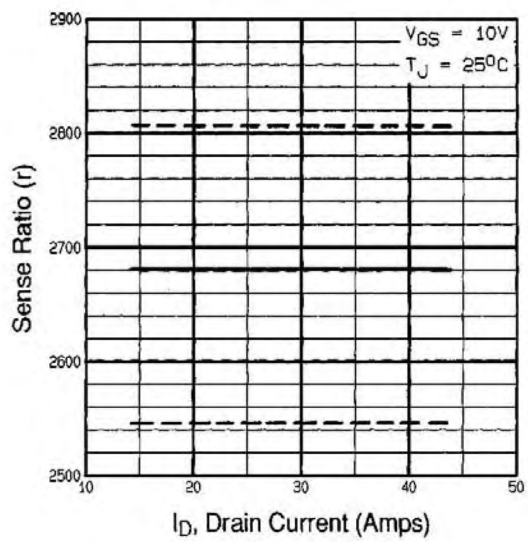



**Fig 16.** Typical HEXSense Ratio Vs. Drain Current

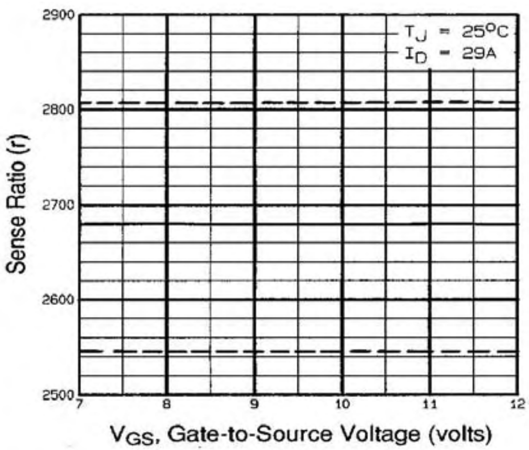



**Fig 17.** Typical HEXSense Ratio Vs. Gate Voltage

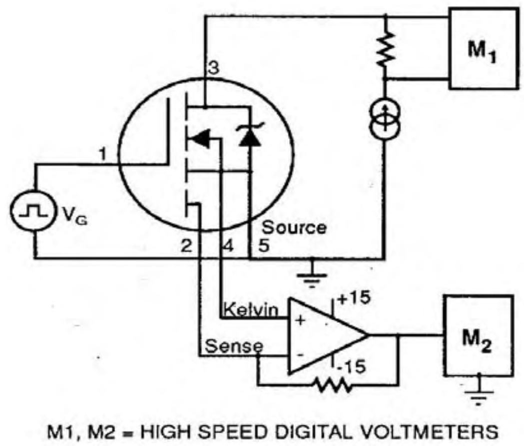



**Fig 18.** HEXSense Ratio Test Circuit

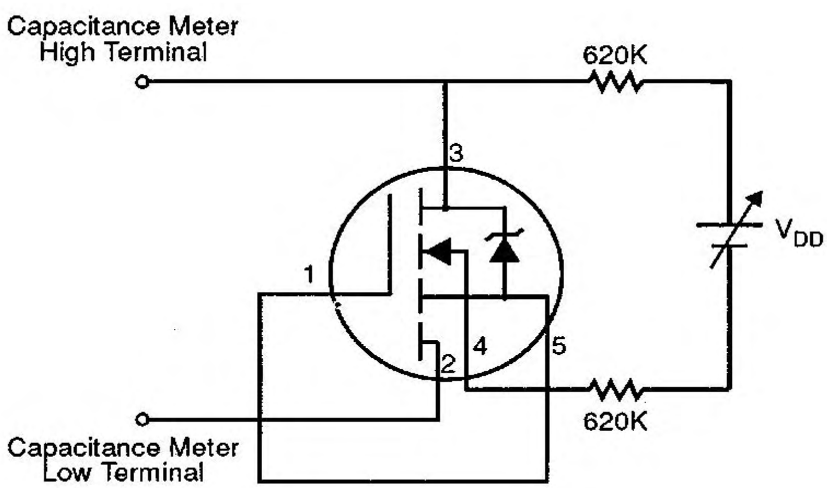
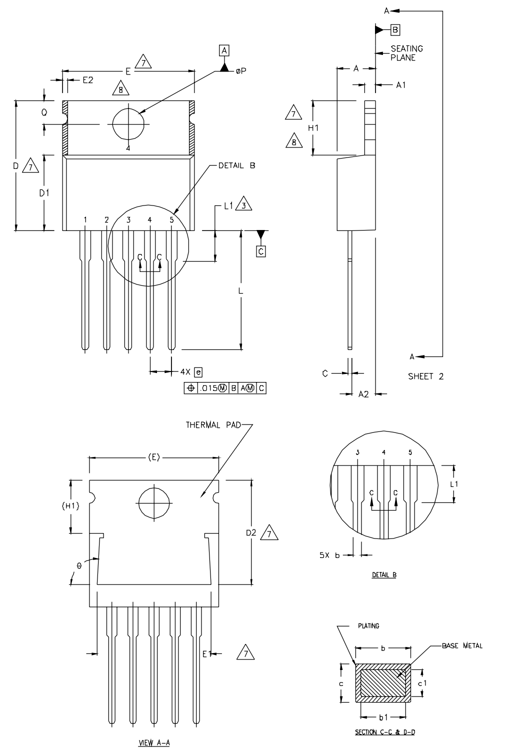



**Fig 19.** HEXSense Sensing Cell Output Capacitance Test Circuit

## HexsenseTO-220 5L Package Outline

( Dimensions are shown in millimeters (inches)



NOTES:

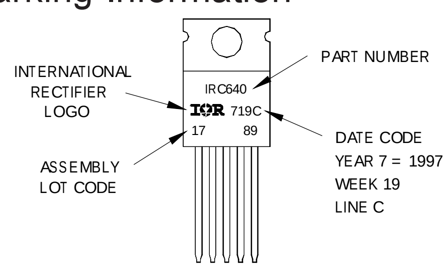
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
2. DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
3. LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5. DIMENSION b1 & c1 APPLY TO BASE METAL ONLY.
6. CONTROLLING DIMENSION : INCHES.
7. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
8. DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.

| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 3.56 | 4.82 | .140 | .190 | |
| A1 | 0.51 | 1.40 | .020 | .055 | |
| A2 | 2.04 | 2.92 | .080 | .115 | |
| b | 0.64 | 0.88 | .025 | .035 | |
| b1 | 0.64 | 0.84 | .025 | .033 | 5 |
| c | 0.36 | 0.61 | .014 | .024 | |
| c1 | 0.36 | 0.56 | .014 | .022 | 5 |
| D | 14.22 | 16.51 | .560 | .650 | 4 |
| D1 | 8.38 | 9.02 | .330 | .355 | |
| D2 | 12.19 | 12.88 | .480 | .507 | 7 |
| E | 9.66 | 10.66 | .380 | .420 | 4,7 |
| E1 | 8.38 | 8.89 | .330 | .350 | 7 |
| e | 1.70 BSC | | .067 BSC | | |
| H1 | 5.85 | 6.55 | .230 | .270 | 7,8 |
| L | 13.47 | 14.09 | .530 | .555 | |
| L1 | – | 6.35 | – | .250 | 3 |
| øP | 3.54 | 4.08 | .139 | .161 | |
| Q | 2.54 | 3.42 | .100 | .135 | |
| ø | 90°–93° | | 90°–93° | | |

## Hexsense TO-220 5L Part Marking Information

EXAMPLE: THIS IS AN IRC640
WITH ASSEMBLY
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

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




Data and specifications subject to change without notice.

International
IOR Rectifier

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02/05

# Notice

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