

# IRFPS37N50APbF

**SMPS MOSFET**

HEXFET® Power MOSFET

## Applications

- Switch Mode Power Supply (SMPS)
- Uninterruptable Power Supply
- High Speed Power Switching
- Lead-Free

|                        |                               |                      |
|------------------------|-------------------------------|----------------------|
| <b>V<sub>DSS</sub></b> | <b>R<sub>DS(on)</sub> max</b> | <b>I<sub>D</sub></b> |
| <b>500V</b>            | <b>0.13Ω</b>                  | <b>36A</b>           |

## Benefits

- Low Gate Charge Qg results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic dv/dt Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Effective Coss Specified (See AN 1001)



## Absolute Maximum Ratings

|   | Parameter                                       | Max.         | Units |
|---|---|--------------|-------|
| I <sub>D</sub> @ T <sub>C</sub> = 25°C  | Continuous Drain Current, V <sub>GS</sub> @ 10V | 36           | A     |
| I <sub>D</sub> @ T <sub>C</sub> = 100°C | Continuous Drain Current, V <sub>GS</sub> @ 10V | 23           |       |
| I <sub>DM</sub>                         | Pulsed Drain Current ①                          | 144          |       |
| P <sub>D</sub> @ T <sub>C</sub> = 25°C  | Power Dissipation                               | 446          | W     |
|   | Linear Derating Factor                          | 3.6          | W/°C  |
| V <sub>GS</sub>                         | Gate-to-Source Voltage                          | ± 30         | V     |
| dv/dt                                   | Peak Diode Recovery dv/dt ②                     | 3.5          | V/ns  |
| T <sub>J</sub>                          | Operating Junction and                          | -55 to + 150 | °C    |
| T <sub>STG</sub>                        | Storage Temperature Range                       |              |       |
|   | Soldering Temperature, for 10 seconds           |              |       |

## Typical SMPS Topologies

- Full Bridge Converters
- Power Factor Correction Boost

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

|               | Parameter                            | Min. | Typ. | Max. | Units    | Conditions  |
|---------------|--------------------------------------|------|------|------|----------|---|
| $V_{(BR)DSS}$ | Drain-to-Source Breakdown Voltage    | 500  | —    | —    | V        | $V_{GS} = 0V, I_D = 250\mu A$                         |
| $R_{DS(on)}$  | Static Drain-to-Source On-Resistance | —    | —    | 0.13 | $\Omega$ | $V_{GS} = 10V, I_D = 22A$ ④                           |
| $V_{GS(th)}$  | Gate Threshold Voltage               | 2.0  | —    | 4.0  | V        | $V_{DS} = V_{GS}, I_D = 250\mu A$                     |
| $I_{DSS}$     | Drain-to-Source Leakage Current      | —    | —    | 25   | $\mu A$  | $V_{DS} = 500V, V_{GS} = 0V$                          |
|               |                                      | —    | —    | 250  |          | $V_{DS} = 400V, V_{GS} = 0V, T_J = 150^\circ\text{C}$ |
| $I_{GSS}$     | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA       | $V_{GS} = 30V$  |
|               | Gate-to-Source Reverse Leakage       | —    | —    | -100 |          | $V_{GS} = -30V$                                       |

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

|                        | Parameter                       | Min. | Typ. | Max. | Units | Conditions                                      |
|------------------------|---------------------------------|------|------|------|-------|---|
| $g_{fs}$               | Forward Transconductance        | 20   | —    | —    | S     | $V_{DS} = 50V, I_D = 22A$                       |
| $Q_g$                  | Total Gate Charge               | —    | —    | 180  | nC    | $I_D = 36A$                                     |
| $Q_{gs}$               | Gate-to-Source Charge           | —    | —    | 46   |       | $V_{DS} = 400V$                                 |
| $Q_{gd}$               | Gate-to-Drain ("Miller") Charge | —    | —    | 71   |       | $V_{GS} = 10V$ , See Fig. 6 and 13 ④            |
| $t_{d(on)}$            | Turn-On Delay Time              | —    | 23   | —    | ns    | $V_{DD} = 250V$                                 |
| $t_r$                  | Rise Time                       | —    | 98   | —    |       | $I_D = 36A$                                     |
| $t_{d(off)}$           | Turn-Off Delay Time             | —    | 52   | —    |       | $R_G = 2.15\Omega$                              |
| $t_f$                  | Fall Time                       | —    | 80   | —    |       | $R_D = 7.0\Omega$ , See Fig. 10 ④               |
| $C_{iss}$              | Input Capacitance               | —    | 5579 | —    | pF    | $V_{GS} = 0V$                                   |
| $C_{oss}$              | Output Capacitance              | —    | 810  | —    |       | $V_{DS} = 25V$                                  |
| $C_{rss}$              | Reverse Transfer Capacitance    | —    | 36   | —    |       | $f = 1.0\text{MHz}$ , See Fig. 5                |
| $C_{oss}$              | Output Capacitance              | —    | 7905 | —    |       | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$ |
| $C_{oss}$              | Output Capacitance              | —    | 221  | —    |       | $V_{GS} = 0V, V_{DS} = 400V, f = 1.0\text{MHz}$ |
| $C_{oss \text{ eff.}}$ | Effective Output Capacitance    | —    | 400  | —    |       | $V_{GS} = 0V, V_{DS} = 0V \text{ to } 400V$ ⑤   |

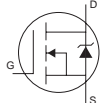
## Avalanche Characteristics

|          | Parameter                      | Typ. | Max. | Units |
|----------|--------------------------------|------|------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy② | —    | 1260 | mJ    |
| $I_{AR}$ | Avalanche Current①             | —    | 36   | A     |
| $E_{AR}$ | Repetitive Avalanche Energy①   | —    | 44   | mJ    |

## Thermal Resistance

|                 | Parameter                           | Typ. | Max. | Units              |
|-----------------|-------------------------------------|------|------|--------------------|
| $R_{\theta JC}$ | Junction-to-Case                    | —    | 0.28 | $^\circ\text{C/W}$ |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface | 0.24 | —    |                    |
| $R_{\theta JA}$ | Junction-to-Ambient                 | —    | 40   |                    |

## Diode Characteristics

|          | Parameter                              | Min.  | Typ. | Max. | Units         | Conditions   |
|----------|--|---|------|------|---------------|--|
| $I_S$    | Continuous Source Current (Body Diode) | —   | —    | 36   | A             | MOSFET symbol showing the integral reverse p-n junction diode.  |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ①   | —   | —    | 144  |               |  |
| $V_{SD}$ | Diode Forward Voltage                  | —   | —    | 1.5  | V             | $T_J = 25^\circ\text{C}, I_S = 36A, V_{GS} = 0V$ ④   |
| $t_{rr}$ | Reverse Recovery Time                  | —   | 570  | 860  | ns            | $T_J = 25^\circ\text{C}, I_F = 36A$  |
| $Q_{rr}$ | Reverse Recovery Charge                | —   | 8.6  | 13   | $\mu\text{C}$ | $di/dt = 100A/\mu\text{s}$ ④   |
| $t_{on}$ | Forward Turn-On Time                   | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S+L_D$ ) |      |      |               |  |

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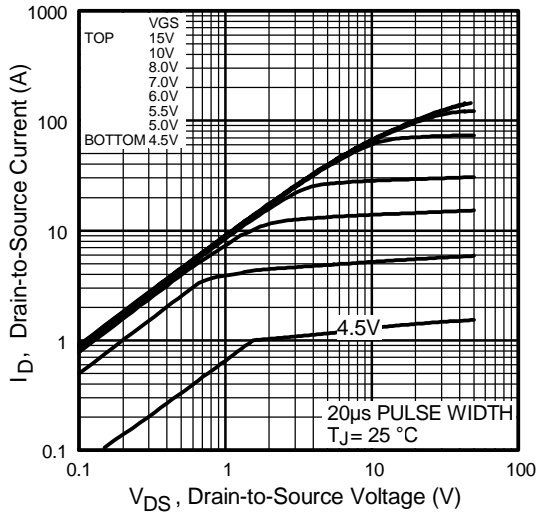


Fig 1. Typical Output Characteristics

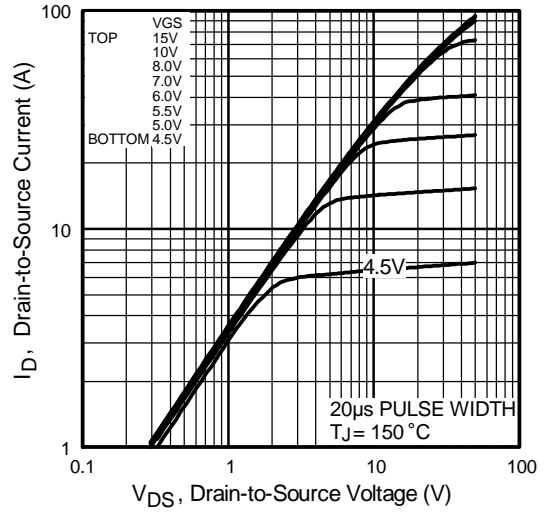


Fig 2. Typical Output Characteristics

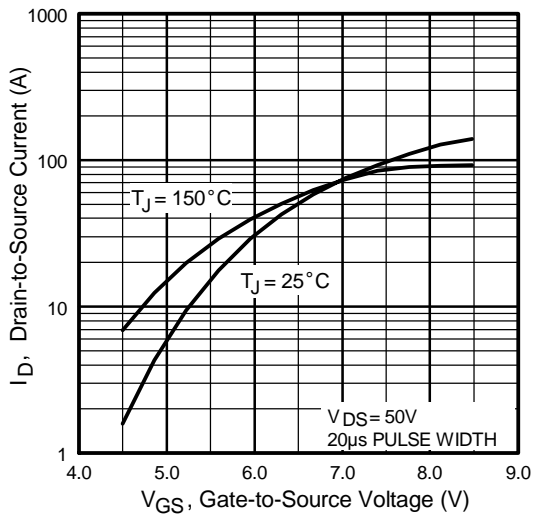


Fig 3. Typical Transfer Characteristics

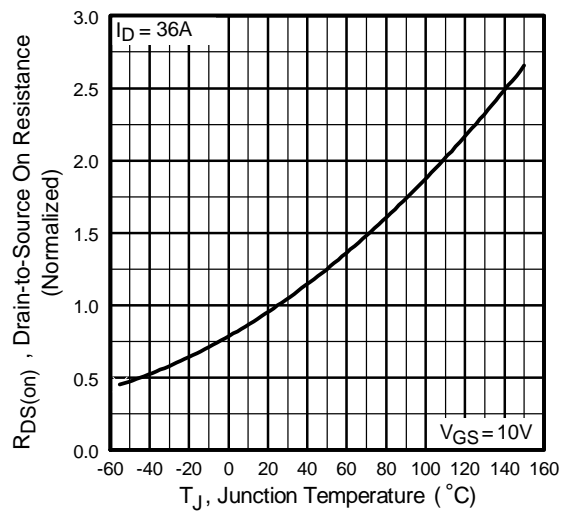
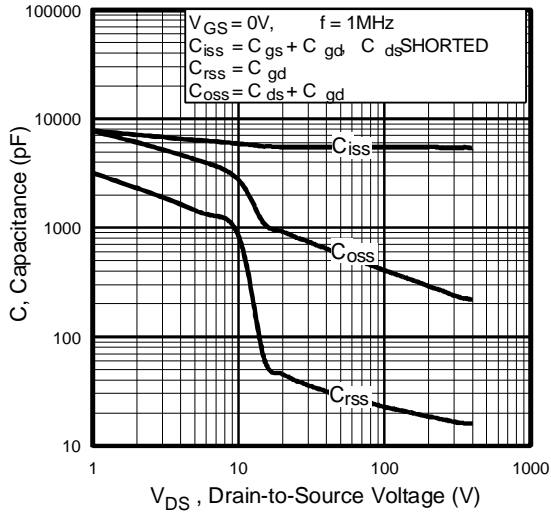


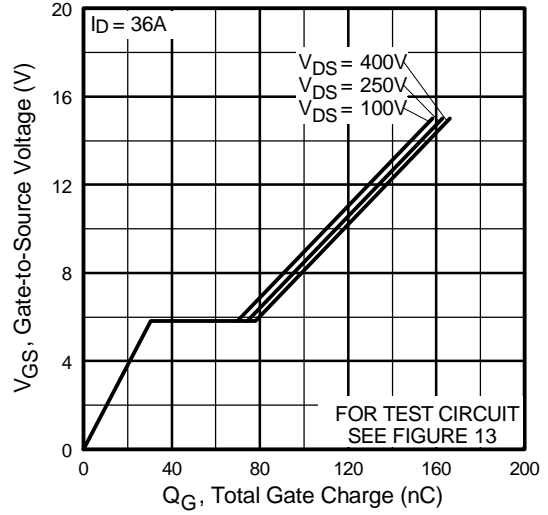
Fig 4. Normalized On-Resistance Vs. Temperature

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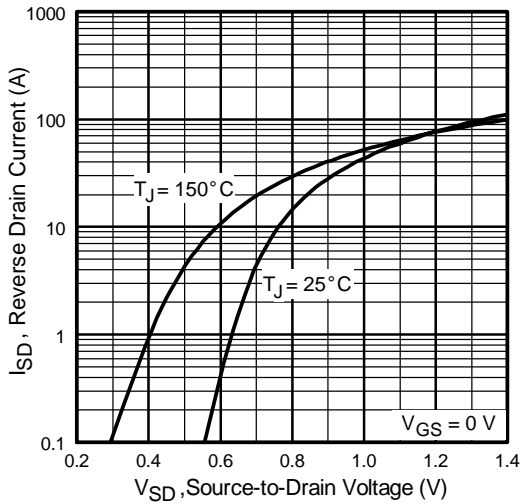
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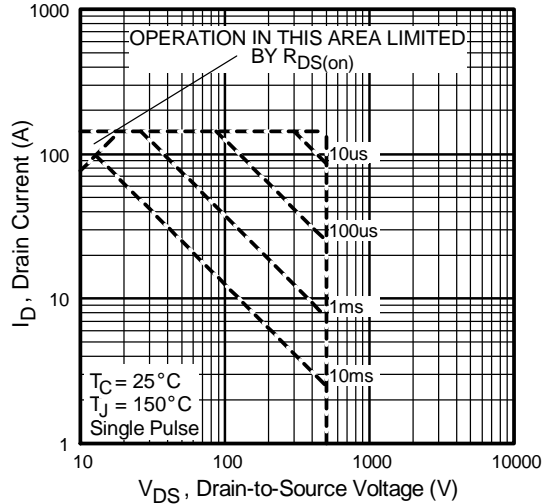
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



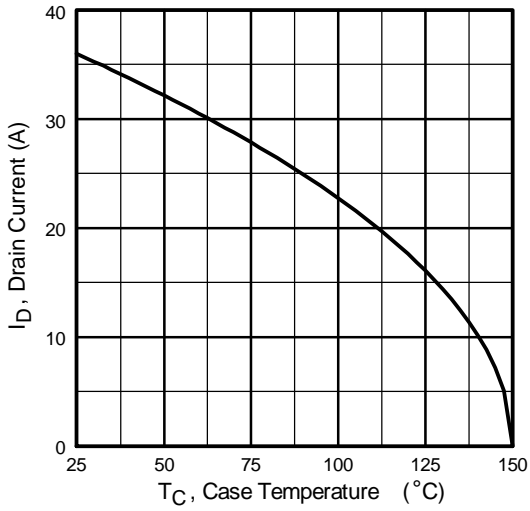
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



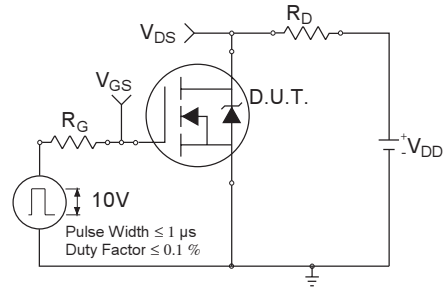
**Fig 7.** Typical Source-Drain Diode Forward Voltage



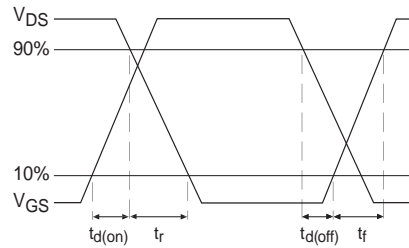
**Fig 8.** Maximum Safe Operating Area



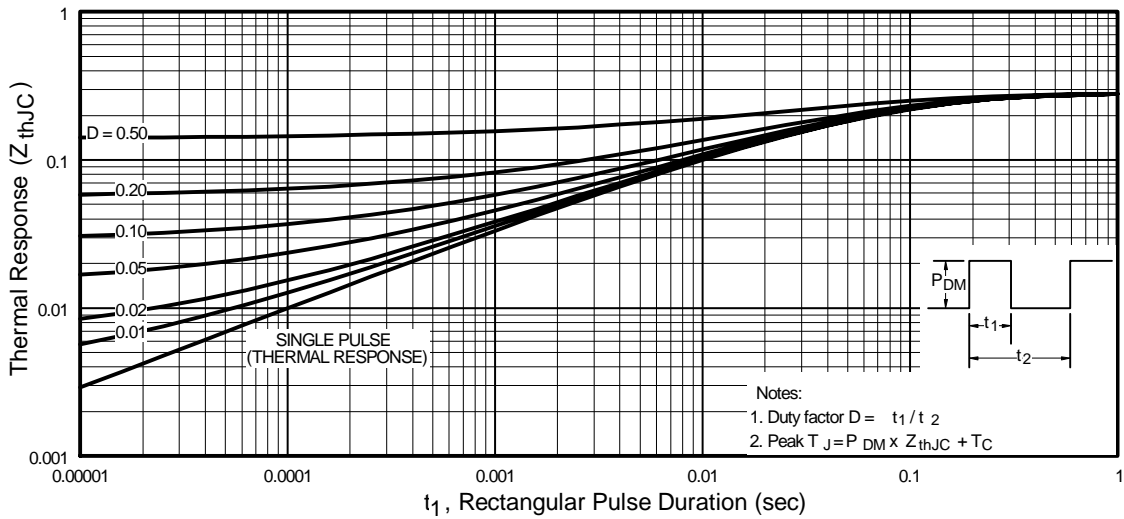
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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



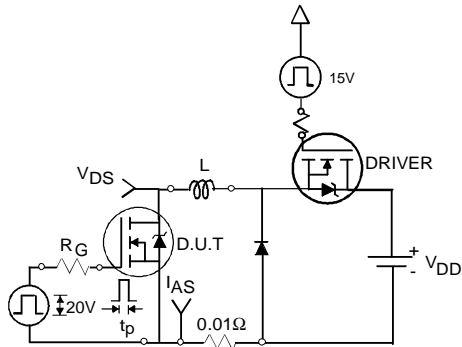
**Fig 10b.** Switching Time Waveforms



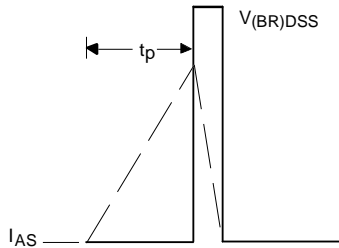
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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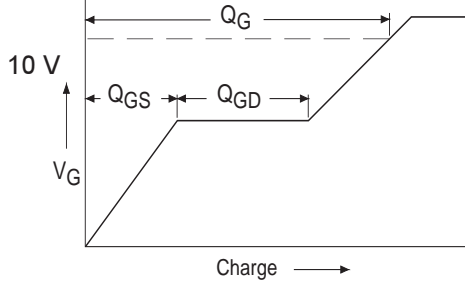
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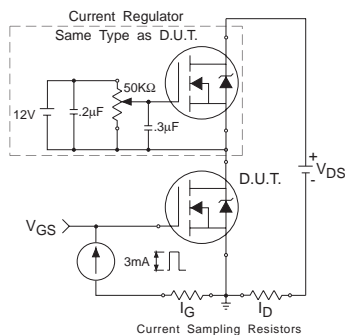
**Fig 12a.** Unclamped Inductive Test Circuit



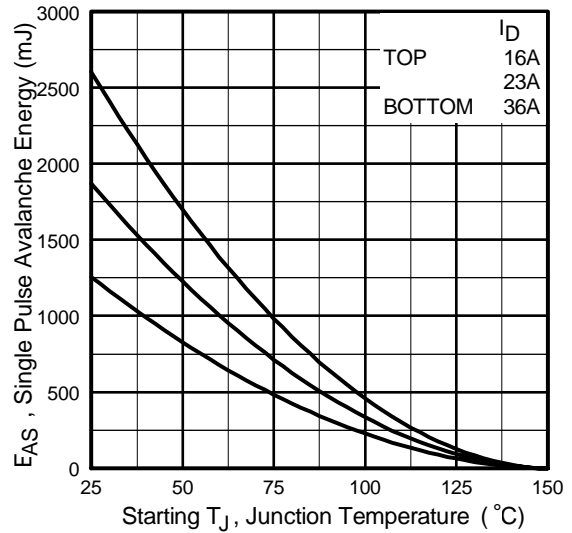
**Fig 12b.** Unclamped Inductive Waveforms



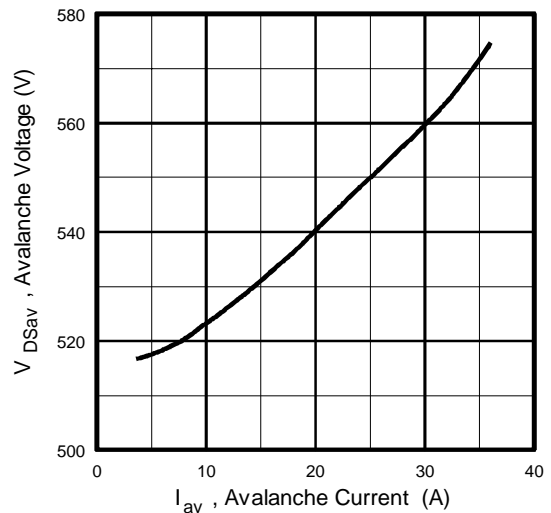
**Fig 13a.** Basic Gate Charge Waveform



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



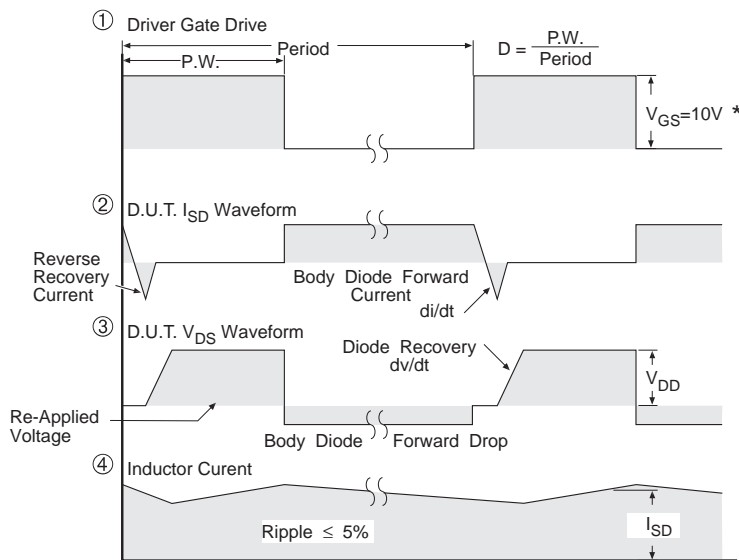
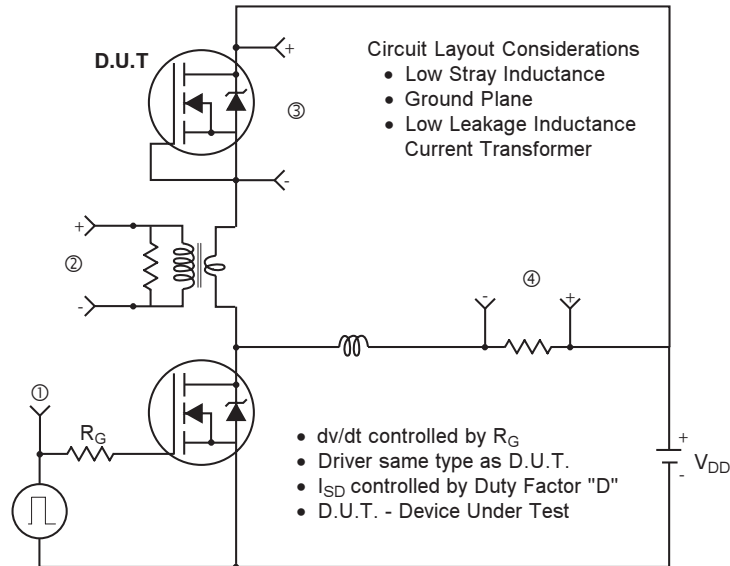
**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



**Fig 12d.** Typical Drain-to-Source Voltage Vs. Avalanche Current

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## Peak Diode Recovery dv/dt Test Circuit



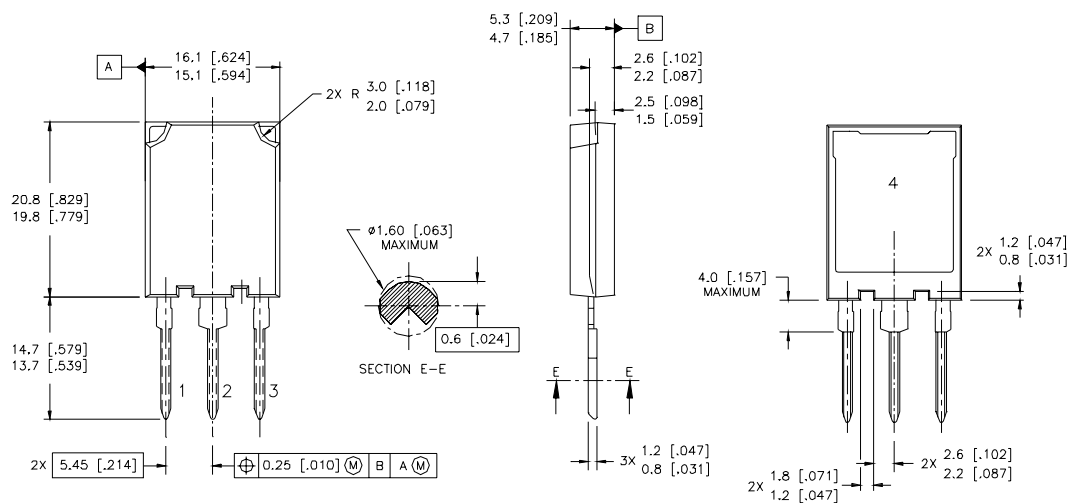
\*  $V_{GS} = 5V$  for Logic Level Devices

**Fig 14.** For N-channel HEXFET<sup>®</sup> Power MOSFETs

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## Case Outline and Dimensions — Super-247



**NOTES:**

1. DIMENSIONS & TOLERANCING PER ASME Y14.5M-1994
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETRES [INCHES]

**LEAD ASSIGNMENTS**

| MOSFET     | IGBT          |
|------------|---------------|
| 1 - GATE   | 1 - GATE      |
| 2 - DRAIN  | 2 - COLLECTOR |
| 3 - SOURCE | 3 - EMITTER   |
| 4 - DRAIN  | 4 - COLLECTOR |

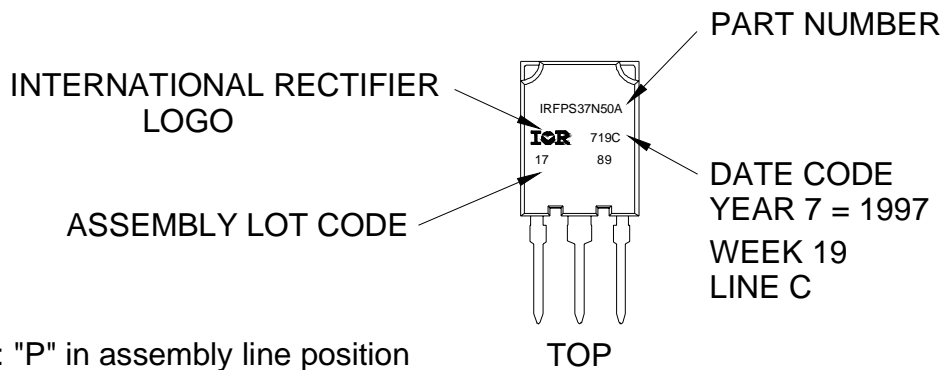
**Notes:**

- ① Repetitive rating; pulse width limited by max. junction temperature. ( See fig. 11 )
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.94\text{mH}$   
 $R_G = 25\Omega$ ,  $I_{AS} = 36\text{A}$ . (See Figure 12)
- ③  $I_{SD} \leq 36\text{A}$ ,  $di/dt \leq 145\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  
 $T_J \leq 150^\circ\text{C}$
- ④ Pulse width  $\leq 300\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ⑤  $C_{OSS}$  eff. is a fixed capacitance that gives the same charging time as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$



## Super-247 (TO-274AA) Part Marking Information

EXAMPLE: THIS IS AN IRFPS37N50A WITH  
ASSEMBLY LOT CODE 1789  
ASSEMBLED ON WW 19, 1997  
IN THE ASSEMBLY LINE "C"



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

\*\* When mounted on 1" square PCB (FR-4 or G-10 Material) .  
For recommended footprint and soldering techniques refer to application note #AN-994

Data and specifications subject to change without notice.

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