

# IRFH3702PbF

HEXFET® Power MOSFET

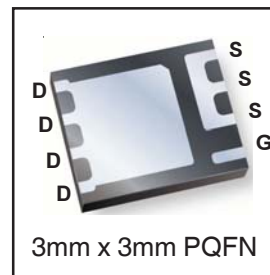
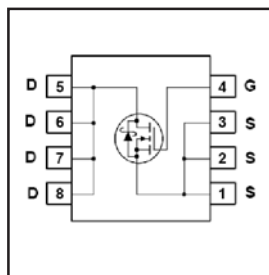
## Applications

- Synchronous Buck Converter for Computer Processor Power
- Isolated DC to DC Converters for Network and Telecom
- Buck Converters for Set-Top Boxes

| $V_{DS}$ | $R_{DS(on)}$ max               | Qg    |
|----------|--------------------------------|-------|
| 30V      | 7.1m $\Omega$ @ $V_{GS} = 10V$ | 9.6nC |

## Benefits

- Low  $R_{DS(on)}$
- Very Low Gate Charge
- Low Junction to PCB Thermal Resistance
- Fully Characterized Avalanche Voltage and Current
- 100% Tested for  $R_G$
- Lead-Free (Qualified up to 260°C Reflow)
- RoHS compliant (Halogen Free)



## Absolute Maximum Ratings

|                            | Parameter                                                  | Max.         | Units |
|----------------------------|------------------------------------------------------------|--------------|-------|
| $V_{DS}$                   | Drain-to-Source Voltage                                    | 30           | V     |
| $V_{GS}$                   | Gate-to-Source Voltage                                     | $\pm 20$     |       |
| $I_D$ @ $T_A = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$                   | 16           | A     |
| $I_D$ @ $T_A = 70^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$                   | 12           |       |
| $I_D$ @ $T_C = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$                   | 42           |       |
| $I_D$ @ $T_C = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ (Package Limited) | 25           |       |
| $I_{DM}$                   | Pulsed Drain Current ①                                     | 120          | W     |
| $P_D$ @ $T_A = 25^\circ C$ | Power Dissipation                                          | 2.8          |       |
| $P_D$ @ $T_A = 70^\circ C$ | Power Dissipation                                          | 1.8          | W/°C  |
|                            | Linear Derating Factor                                     | 0.02         |       |
| $T_J$                      | Operating Junction and                                     | -55 to + 150 | °C    |
| $T_{STG}$                  | Storage Temperature Range                                  |              |       |

## Thermal Resistance

|                 | Parameter                           | Typ. | Max. | Units |
|-----------------|-------------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case ④                  | —    | 6.0  | °C/W  |
| $R_{\theta JA}$ | Junction-to-Ambient ⑤⑥              | —    | 45   |       |
| $R_{\theta JA}$ | Junction-to-Ambient ( $t < 10s$ ) ⑥ | —    | 44   |       |

## ORDERING INFORMATION:

See detailed ordering and shipping information on the last page of this data sheet.

Notes ① through ⑥ are on page 10

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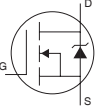
Static @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)

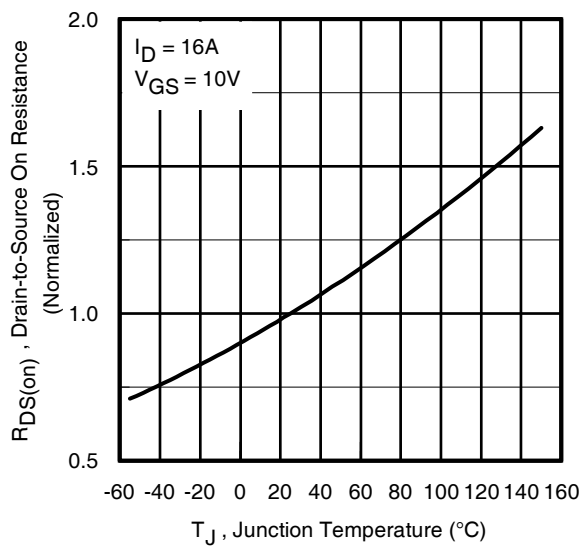
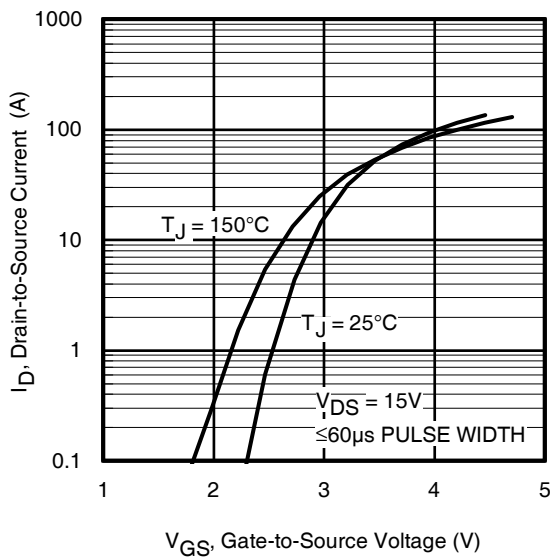
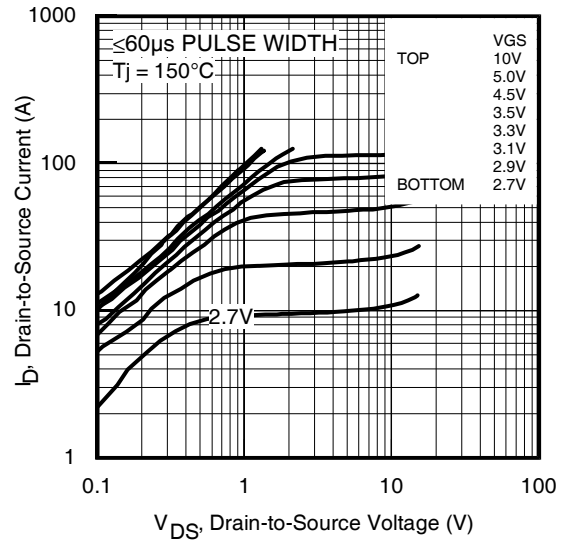
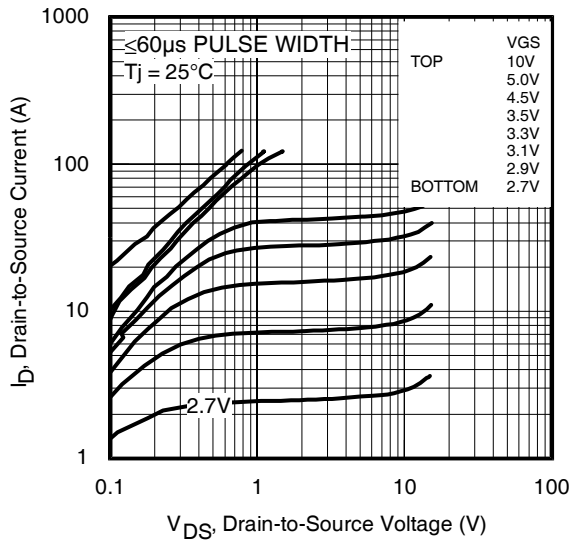
|                              | Parameter                            | Min. | Typ. | Max. | Units | Conditions                                                                      |
|------------------------------|--------------------------------------|------|------|------|-------|---------------------------------------------------------------------------------|
| $BV_{DSS}$                   | Drain-to-Source Breakdown Voltage    | 30   | —    | —    | V     | $V_{GS} = 0V, I_D = 250\mu A$                                                   |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.02 | —    | V/°C  | Reference to $25^\circ\text{C}$ , $I_D = 1mA$                                   |
| $R_{DS(on)}$                 | Static Drain-to-Source On-Resistance | —    | 5.7  | 7.1  | mΩ    | $V_{GS} = 10V, I_D = 16A$ ③                                                     |
|                              |                                      | —    | 8.7  | 11.8 |       | $V_{GS} = 4.5V, I_D = 12A$ ③                                                    |
| $V_{GS(th)}$                 | Gate Threshold Voltage               | 1.35 | 1.8  | 2.35 | V     | $V_{DS} = V_{GS}, I_D = 25\mu A$                                                |
| $\Delta V_{GS(th)}$          | Gate Threshold Voltage Coefficient   | —    | -6.5 | —    | mV/°C |                                                                                 |
| $I_{DSS}$                    | Drain-to-Source Leakage Current      | —    | —    | 1.0  | μA    | $V_{DS} = 24V, V_{GS} = 0V$                                                     |
|                              |                                      | —    | —    | 150  |       | $V_{DS} = 24V, V_{GS} = 0V, T_J = 125^\circ\text{C}$                            |
| $I_{GSS}$                    | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA    | $V_{GS} = 20V$                                                                  |
|                              | Gate-to-Source Reverse Leakage       | —    | —    | -100 |       | $V_{GS} = -20V$                                                                 |
| $g_{fs}$                     | Forward Transconductance             | 37   | —    | —    | S     | $V_{DS} = 15V, I_D = 12A$                                                       |
| $Q_g$                        | Total Gate Charge                    | —    | 9.6  | 14   | nC    | $V_{DS} = 15V$<br>$V_{GS} = 4.5V$<br>$I_D = 12A$<br>See Fig.17 & 18             |
| $Q_{gs1}$                    | Pre-Vth Gate-to-Source Charge        | —    | 2.4  | —    |       |                                                                                 |
| $Q_{gs2}$                    | Post-Vth Gate-to-Source Charge       | —    | 1.2  | —    |       |                                                                                 |
| $Q_{gd}$                     | Gate-to-Drain Charge                 | —    | 3.1  | —    |       |                                                                                 |
| $Q_{godr}$                   | Gate Charge Overdrive                | —    | 2.9  | —    |       |                                                                                 |
| $Q_{sw}$                     | Switch Charge ( $Q_{gs2} + Q_{gd}$ ) | —    | 4.3  | —    |       |                                                                                 |
| $Q_{oss}$                    | Output Charge                        | —    | 7.4  | —    | nC    | $V_{DS} = 16V, V_{GS} = 0V$                                                     |
| $R_G$                        | Gate Resistance                      | —    | 2.2  | —    | Ω     |                                                                                 |
| $t_{d(on)}$                  | Turn-On Delay Time                   | —    | 9.6  | —    | ns    | $V_{DD} = 15V, V_{GS} = 4.5V$<br>$I_D = 12A$<br>$R_G = 1.8\Omega$<br>See Fig.15 |
| $t_r$                        | Rise Time                            | —    | 15   | —    |       |                                                                                 |
| $t_{d(off)}$                 | Turn-Off Delay Time                  | —    | 11   | —    |       |                                                                                 |
| $t_f$                        | Fall Time                            | —    | 5.8  | —    |       |                                                                                 |
| $C_{iss}$                    | Input Capacitance                    | —    | 1510 | —    | pF    | $V_{GS} = 0V$                                                                   |
| $C_{oss}$                    | Output Capacitance                   | —    | 306  | —    |       | $V_{DS} = 15V$                                                                  |
| $C_{rss}$                    | Reverse Transfer Capacitance         | —    | 120  | —    |       | $f = 1.0MHz$                                                                    |

## Avalanche Characteristics

|          | Parameter                       | Typ. | Max. | Units |
|----------|---------------------------------|------|------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy ② | —    | 77   | mJ    |
| $I_{AR}$ | Avalanche Current ①             | —    | 12   | A     |

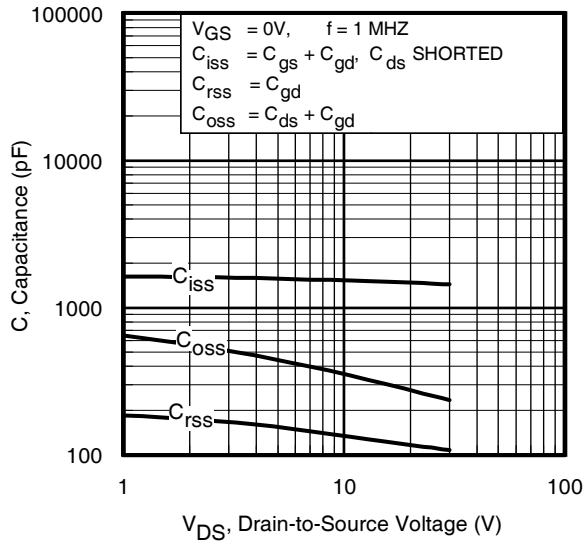
## Diode Characteristics

|          | Parameter                                 | Min.                                                                 | Typ. | Max. | Units | Conditions                                                                                                                                                       |
|----------|-------------------------------------------|----------------------------------------------------------------------|------|------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current<br>(Body Diode) | —                                                                    | —    | 3.5  | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode.<br> |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode) ①   | —                                                                    | —    | 120  |       |                                                                                                                                                                  |
| $V_{SD}$ | Diode Forward Voltage                     | —                                                                    | —    | 1.0  | V     | $T_J = 25^\circ\text{C}, I_S = 12A, V_{GS} = 0V$ ③                                                                                                               |
| $t_{rr}$ | Reverse Recovery Time                     | —                                                                    | 17   | 26   | ns    | $T_J = 25^\circ\text{C}, I_F = 12A, V_{DD} = 15V$                                                                                                                |
| $Q_{rr}$ | Reverse Recovery Charge                   | —                                                                    | 15   | 23   | nC    | $di/dt = 225A/\mu s$ ③                                                                                                                                           |
| $t_{on}$ | Forward Turn-On Time                      | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD) |      |      |       |                                                                                                                                                                  |

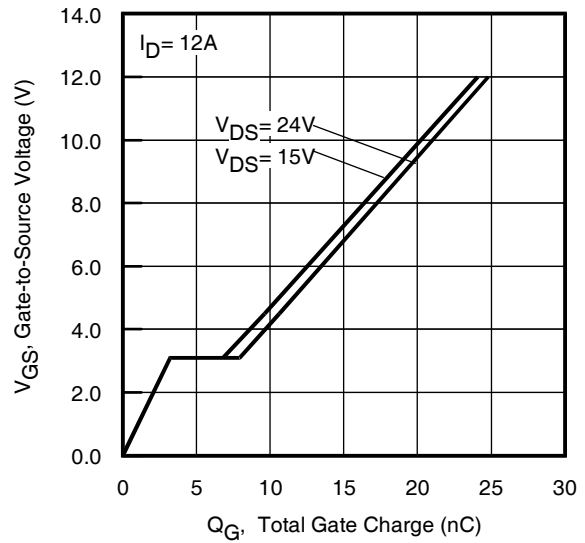


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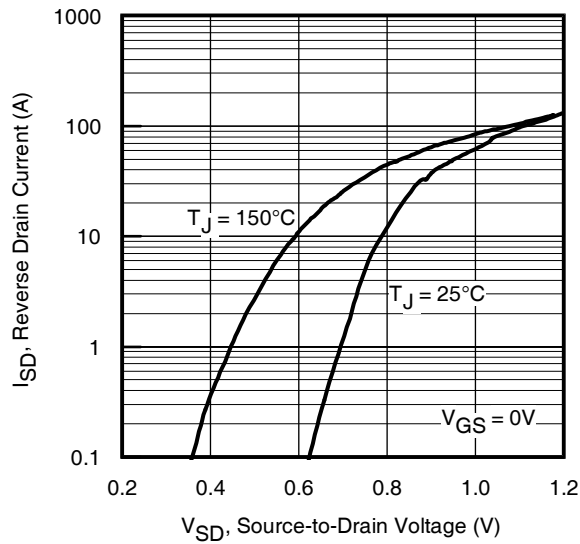
International  
**IR** Rectifier



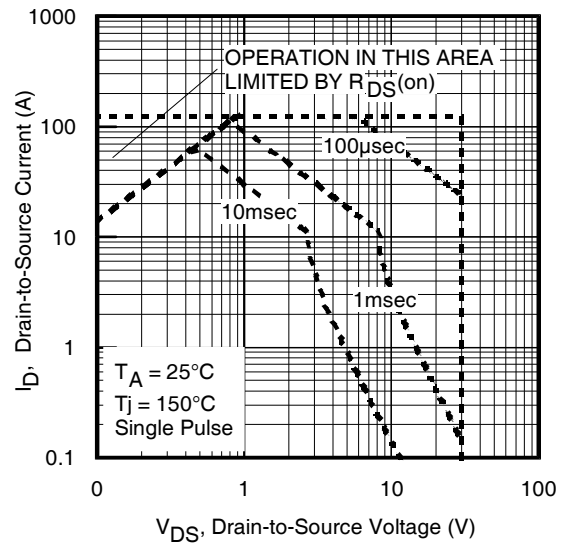
**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage



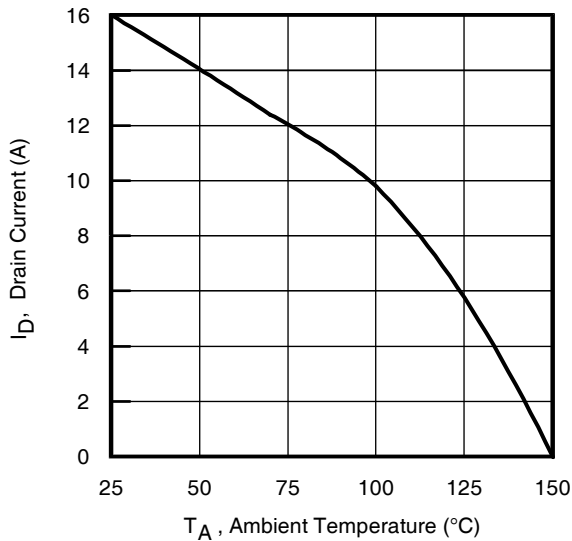
**Fig 6.** Typical Gate Charge vs. Gate-to-Source Voltage



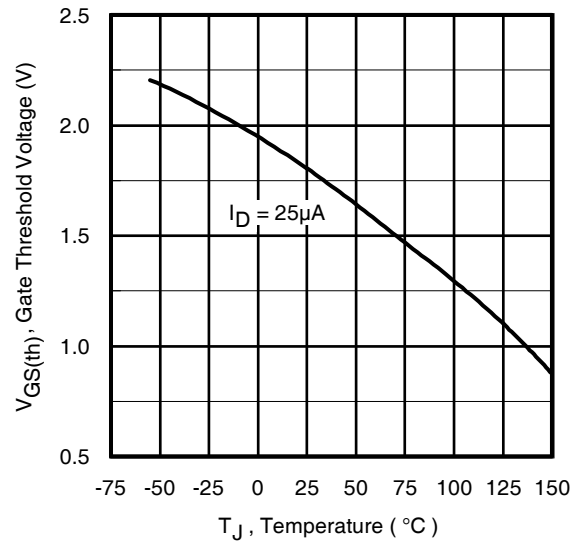
**Fig 7.** Typical Source-Drain Diode Forward Voltage



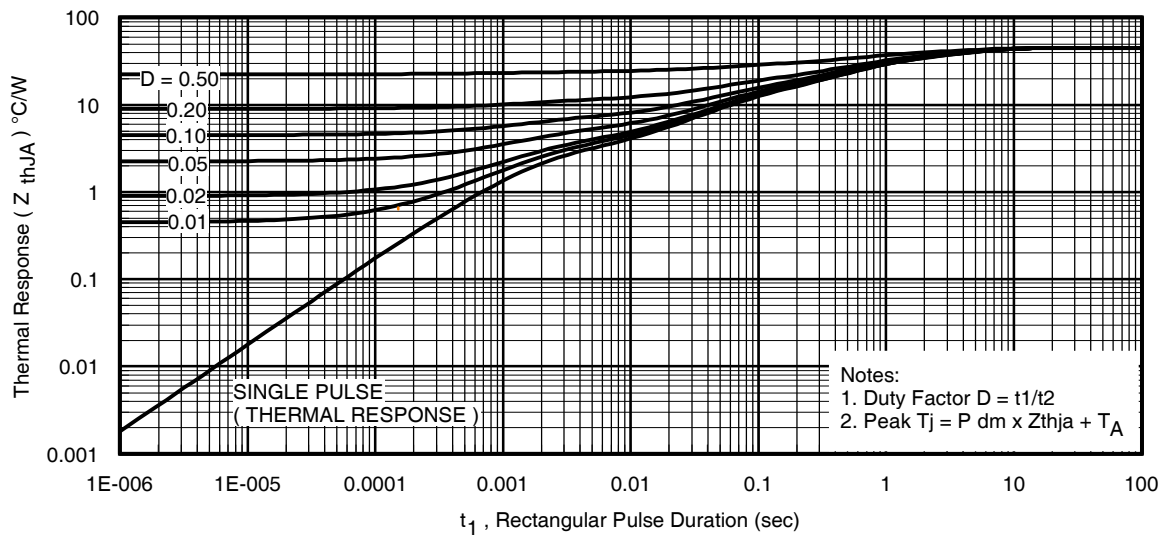
**Fig 8.** Maximum Safe Operating Area



**Fig 9.** Maximum Drain Current vs. Ambient Temperature



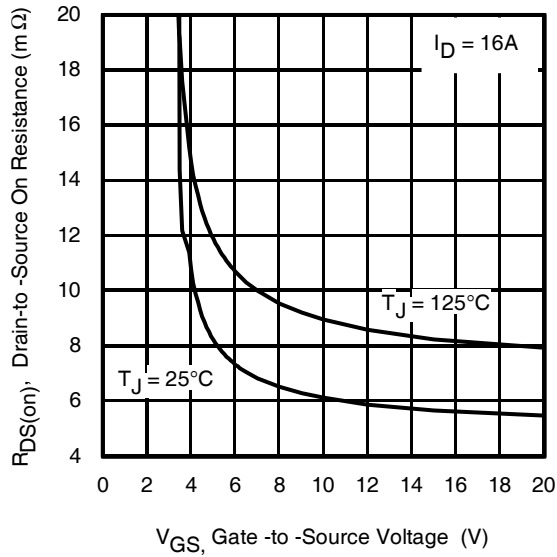
**Fig 10.** Threshold Voltage Vs. Temperature



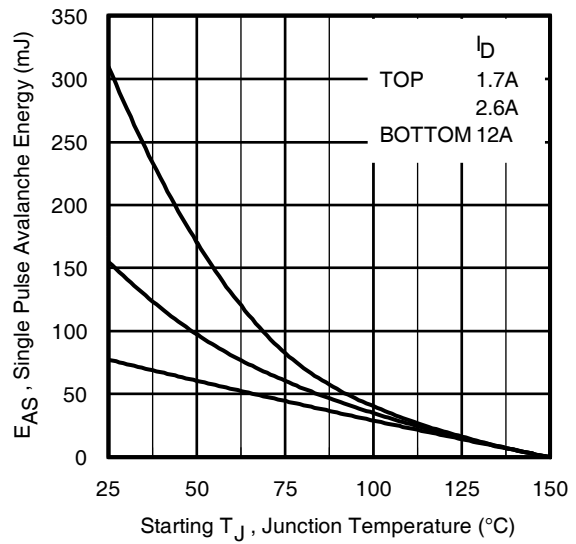
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

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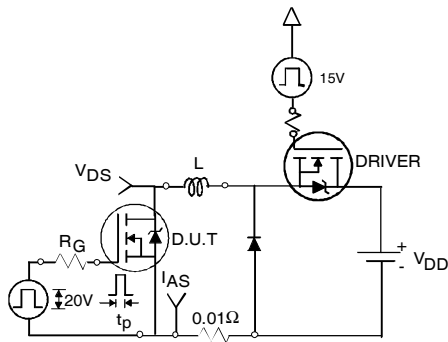
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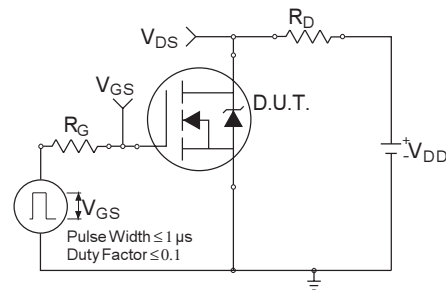
**Fig 12.** On-Resistance vs. Gate Voltage



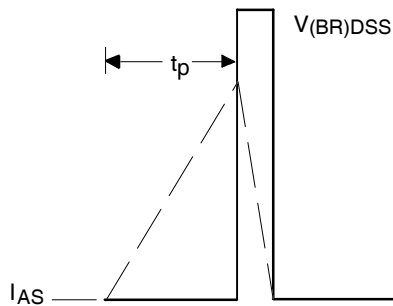
**Fig 13.** Maximum Avalanche Energy vs. Drain Current



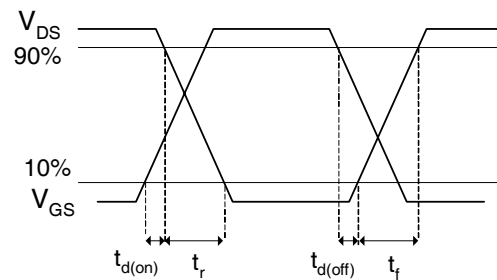
**Fig 14a.** Unclamped Inductive Test Circuit



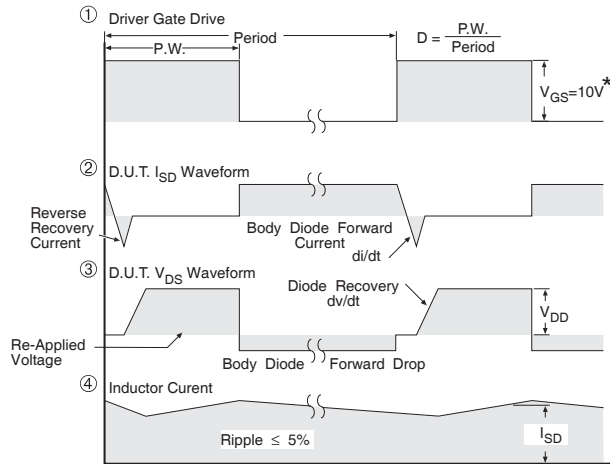
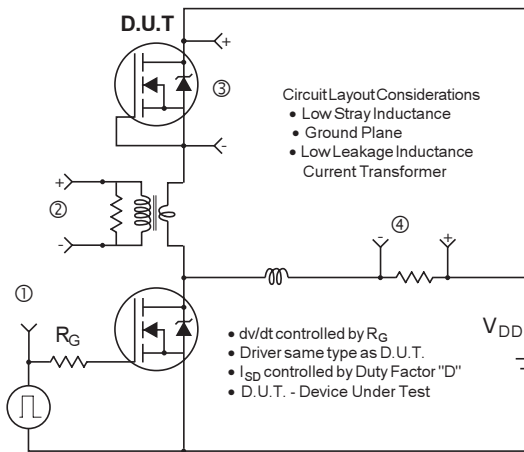
**Fig 15a.** Switching Time Test Circuit



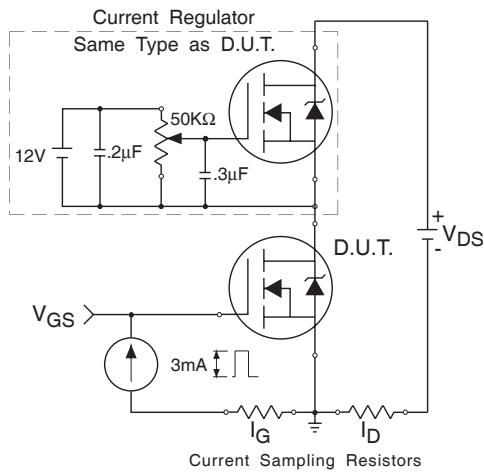
**Fig 14b.** Unclamped Inductive Waveforms



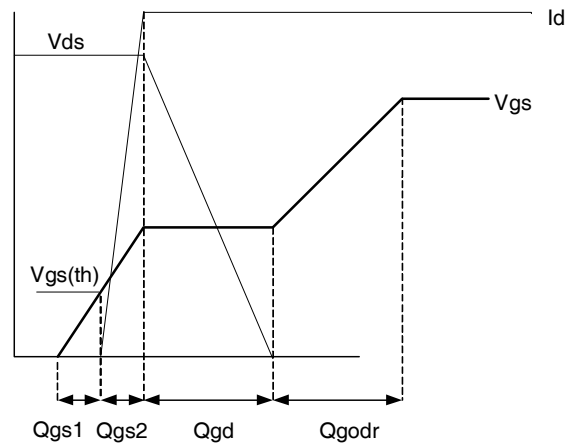
**Fig 15b.** Switching Time Waveforms



**Fig 16. Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs**



**Fig 17. Gate Charge Test Circuit**

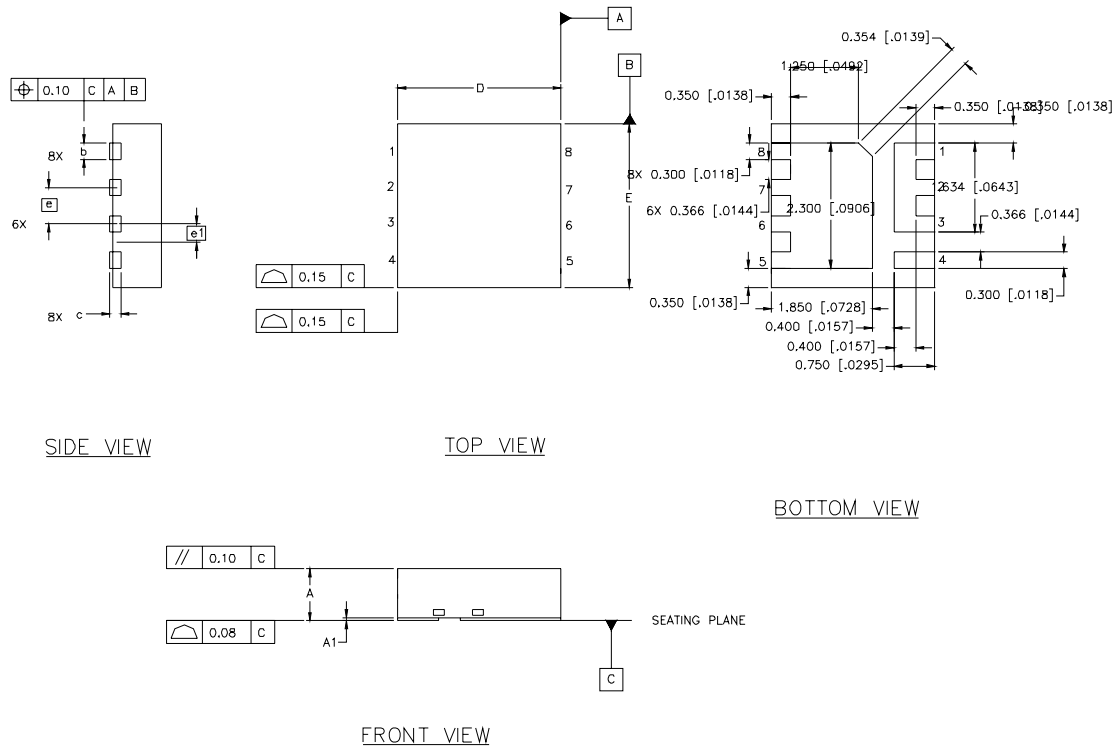


**Fig 18. Gate Charge Waveform**

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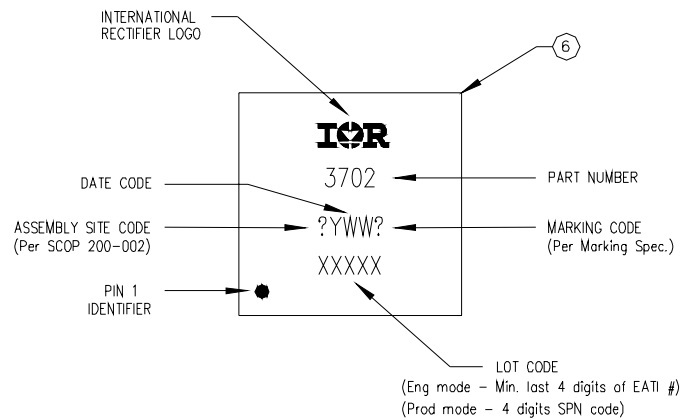
## PQFN Package Details



| DIM | INCHES      |       | MILLIMETERS |       |
|-----|-------------|-------|-------------|-------|
|     | MIN         | MAX   | MIN         | MAX   |
| A   | .0315       | .0394 | 0.800       | 1.000 |
| A1  | .0000       | .0020 | 0.000       | 0.050 |
| b   | .0098       | .0138 | 0.250       | 0.350 |
| c   | .0080 REF.  |       | 0.203 REF.  |       |
| D   | .1181 BASIC |       | 3.000 BASIC |       |
| E   | .1181 BASIC |       | 3.000 BASIC |       |
| e   | .0262 BASIC |       | 0.666 BASIC |       |
| e1  | .0131 BASIC |       | 0.333 BASIC |       |

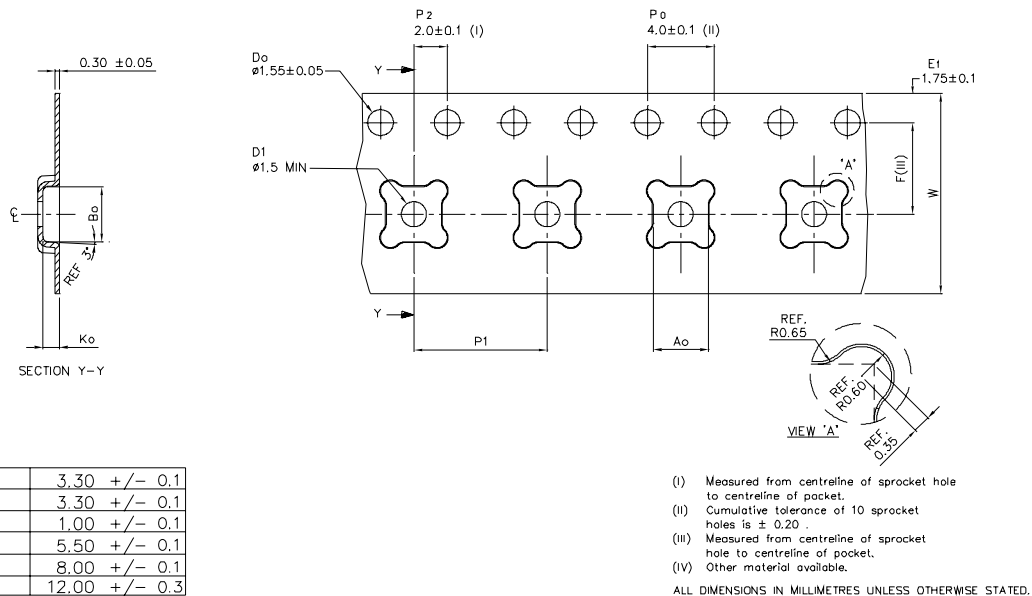
Note: For the most current drawing please refer to IR website at: <http://www.irf.com/package/>

## PQFN Part Marking



TOP MARKING (LASER)

## PQFN Tape and Reel



Note: For the most current drawing please refer to IR website at: <http://www.irf.com/package/>  
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| Orderable part number | Package Type   | Standard Pack |          | Note |
|-----------------------|----------------|---------------|----------|------|
|                       |                | Form          | Quantity |      |
| IRFH3702TRPBF         | PQFN 3mm x 3mm | Tape and Reel | 4000     |      |

## Qualification information<sup>†</sup>

|                            |                                                                          |                                                     |
|----------------------------|--------------------------------------------------------------------------|-----------------------------------------------------|
| Qualification level        | Consumer <sup>††</sup><br>(per JEDEC JESD47F <sup>†††</sup> guidelines ) |                                                     |
| Moisture Sensitivity Level | PQFN 3mm x 3mm                                                           | MSL 1<br>(per IPC/JEDEC J-STD-020D <sup>†††</sup> ) |
| RoHS compliant             | Yes                                                                      |                                                     |

† Qualification standards can be found at International Rectifier's web site

<http://www.irf.com/product-info/reliability>

†† Higher qualification ratings may be available should the user have such requirements.

Please contact your International Rectifier sales representative for further information:

<http://www.irf.com/whoto-call/salesrep/>

††† Applicable version of JEDEC standard at the time of product release.

**Note:** For the most current drawing please refer to IR website at: <http://www.irf.com/package/>

## Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.0\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 12\text{A}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④  $R_{thjc}$  is guaranteed by design.
- ⑤ When mounted on 1 inch square 2 oz copper pad on 1.5x1.5 in. board of FR-4 material.
- ⑥ Refer to [application note #AN-994](#).

Data and specifications subject to change without notice

International  
**IR** Rectifier

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