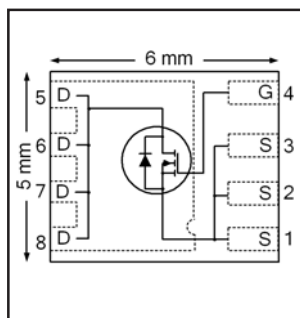


HEXFET® Power MOSFET

|                                            |             |           |
|--------------------------------------------|-------------|-----------|
| $V_{DS}$                                   | <b>100</b>  | <b>V</b>  |
| $V_{GS\ max}$                              | <b>± 20</b> | <b>V</b>  |
| $R_{DS(on)\ max}$<br>(@ $V_{GS} = 10V$ )   | <b>13.5</b> | <b>mΩ</b> |
| $Q_G$ (typical)                            | <b>58</b>   | <b>nC</b> |
| $R_G$ (typical)                            | <b>0.6</b>  | <b>Ω</b>  |
| $I_D$<br>(@ $T_{C(Bottom)} = 25^\circ C$ ) | <b>50</b> ⑦ | <b>A</b>  |



**Applications**

- Secondary Side Synchronous Rectification
- Inverters for DC Motors
- DC-DC Brick Applications
- Boost Converters

**Features and Benefits**

**Features**

|                                                              |
|--------------------------------------------------------------|
| Low $R_{DS(on)}$ (< 13.5mΩ)                                  |
| Low Thermal Resistance to PCB (< 1.2°C/W)                    |
| Low Profile (<0.9 mm)                                        |
| Industry-Standard Pinout                                     |
| Compatible with Existing Surface Mount Techniques            |
| RoHS Compliant Containing no Lead, no Bromide and no Halogen |
| MSL1, Industrial Qualification                               |

results in

⇒

**Benefits**

|                                    |
|------------------------------------|
| Lower Conduction Losses            |
| Enables better thermal dissipation |
| Increased Power Density            |
| Multi-Vendor Compatibility         |
| Easier Manufacturing               |
| Environmentally Friendlier         |
| Increased Reliability              |

| Orderable part number | Package Type   | Standard Pack |          | Note             |
|-----------------------|----------------|---------------|----------|------------------|
|                       |                | Form          | Quantity |                  |
| IRFH7110TRPBF         | PQFN 5mm x 6mm | Tape and Reel | 4000     |                  |
| IRFH7110TR2PBF        | PQFN 5mm x 6mm | Tape and Reel | 400      | EOL notice # 259 |

**Absolute Maximum Ratings**

|                                       | Parameter                                                  | Max.         | Units |
|---------------------------------------|------------------------------------------------------------|--------------|-------|
| $V_{DS}$                              | Drain-to-Source Voltage                                    | 100          | V     |
| $V_{GS}$                              | Gate-to-Source Voltage                                     | ± 20         |       |
| $I_D$ @ $T_A = 25^\circ C$            | Continuous Drain Current, $V_{GS}$ @ 10V                   | 11           | A     |
| $I_D$ @ $T_A = 70^\circ C$            | Continuous Drain Current, $V_{GS}$ @ 10V                   | 8.6          |       |
| $I_D$ @ $T_{C(Bottom)} = 25^\circ C$  | Continuous Drain Current, $V_{GS}$ @ 10V                   | 58 ⑦         |       |
| $I_D$ @ $T_{C(Bottom)} = 100^\circ C$ | Continuous Drain Current, $V_{GS}$ @ 10V                   | 37 ⑥         |       |
| $I_D$ @ $T_C = 25^\circ C$            | Continuous Drain Current, $V_{GS}$ @ 10V (Package Limited) | 50 ⑦         |       |
| $I_{DM}$                              | Pulsed Drain Current ①                                     | 240          |       |
| $P_D$ @ $T_A = 25^\circ C$            | Power Dissipation ⑤                                        | 3.6          | W     |
| $P_D$ @ $T_{C(Bottom)} = 25^\circ C$  | Power Dissipation ⑤                                        | 104          |       |
|                                       | Linear Derating Factor ⑤                                   | 0.029        | W/°C  |
| $T_J$                                 | Operating Junction and                                     | -55 to + 150 | °C    |
| $T_{STG}$                             | Storage Temperature Range                                  |              |       |

Notes ① through ⑦ are on page 9

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

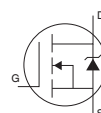
|                              | Parameter                            | Min. | Typ. | Max. | Units                | Conditions                                                       |
|------------------------------|--------------------------------------|------|------|------|----------------------|------------------------------------------------------------------|
| $BV_{DSS}$                   | Drain-to-Source Breakdown Voltage    | 100  | —    | —    | V                    | $V_{GS} = 0V, I_D = 250\mu A$                                    |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient  | —    | 0.09 | —    | V/ $^\circ\text{C}$  | Reference to $25^\circ\text{C}$ , $I_D = 1.0\text{mA}$           |
| $R_{DS(on)}$                 | Static Drain-to-Source On-Resistance | —    | 10.6 | 13.5 | m $\Omega$           | $V_{GS} = 10V, I_D = 35A$ ③                                      |
| $V_{GS(th)}$                 | Gate Threshold Voltage               | 2.0  | 3.0  | 4.0  | V                    | $V_{DS} = V_{GS}, I_D = 100\mu A$                                |
| $\Delta V_{GS(th)}$          | Gate Threshold Voltage Coefficient   | —    | -9.0 | —    | mV/ $^\circ\text{C}$ |                                                                  |
| $I_{DSS}$                    | Drain-to-Source Leakage Current      | —    | —    | 20   | $\mu A$              | $V_{DS} = 100V, V_{GS} = 0V$                                     |
|                              |                                      | —    | —    | 250  |                      | $V_{DS} = 100V, V_{GS} = 0V, T_J = 125^\circ\text{C}$            |
| $I_{GSS}$                    | Gate-to-Source Forward Leakage       | —    | —    | 100  | nA                   | $V_{GS} = 20V$                                                   |
|                              | Gate-to-Source Reverse Leakage       | —    | —    | -100 |                      | $V_{GS} = -20V$                                                  |
| $g_{fs}$                     | Forward Transconductance             | 74   | —    | —    | S                    | $V_{DS} = 50V, I_D = 35A$                                        |
| $Q_g$                        | Total Gate Charge                    | —    | 58   | 87   | nC                   | $V_{DS} = 50V$<br>$V_{GS} = 10V$<br>$I_D = 35A$                  |
| $Q_{gs1}$                    | Pre-Vth Gate-to-Source Charge        | —    | 11   | —    |                      |                                                                  |
| $Q_{gs2}$                    | Post-Vth Gate-to-Source Charge       | —    | 3.6  | —    |                      |                                                                  |
| $Q_{gd}$                     | Gate-to-Drain Charge                 | —    | 16   | —    |                      |                                                                  |
| $Q_{godr}$                   | Gate Charge Overdrive                | —    | 27.4 | —    |                      |                                                                  |
| $Q_{sw}$                     | Switch Charge ( $Q_{gs2} + Q_{gd}$ ) | —    | 19.6 | —    | nC                   | $V_{DS} = 16V, V_{GS} = 0V$                                      |
| $Q_{oss}$                    | Output Charge                        | —    | 17   | —    |                      |                                                                  |
| $R_G$                        | Gate Resistance                      | —    | 0.6  | —    |                      |                                                                  |
| $t_{d(on)}$                  | Turn-On Delay Time                   | —    | 11   | —    |                      |                                                                  |
| $t_r$                        | Rise Time                            | —    | 23   | —    |                      |                                                                  |
| $t_{d(off)}$                 | Turn-Off Delay Time                  | —    | 22   | —    | ns                   | $V_{DD} = 50V, V_{GS} = 10V$<br>$I_D = 35A$<br>$R_G = 1.8\Omega$ |
| $t_f$                        | Fall Time                            | —    | 18   | —    |                      |                                                                  |
| $C_{iss}$                    | Input Capacitance                    | —    | 3240 | —    | pF                   | $V_{GS} = 0V$                                                    |
| $C_{oss}$                    | Output Capacitance                   | —    | 300  | —    |                      | $V_{DS} = 25V$                                                   |
| $C_{rss}$                    | Reverse Transfer Capacitance         | —    | 140  | —    |                      | $f = 1.0\text{MHz}$                                              |

**Avalanche Characteristics**

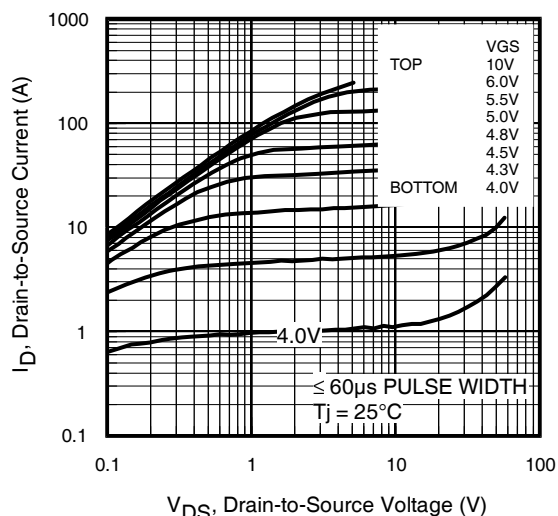
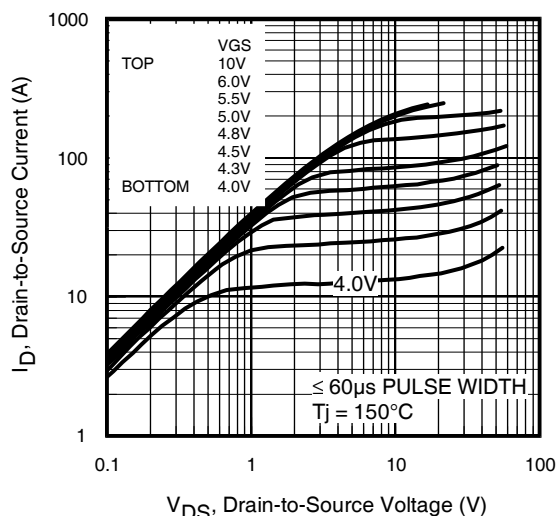
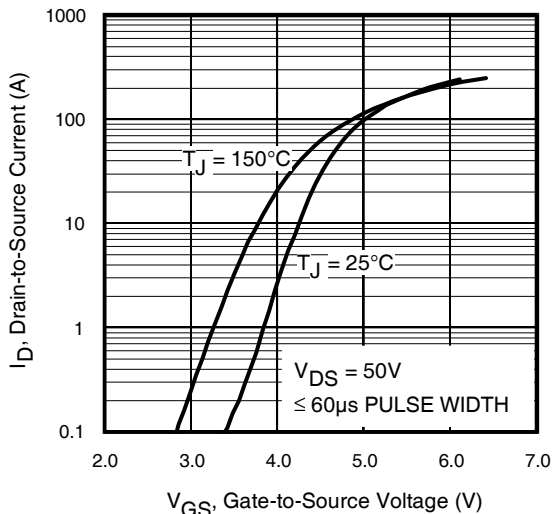
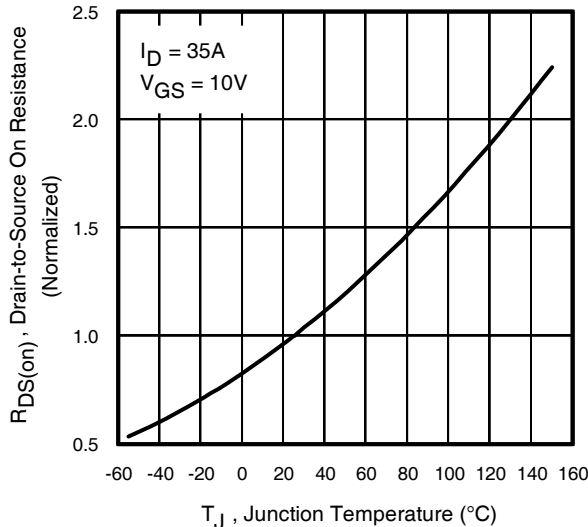
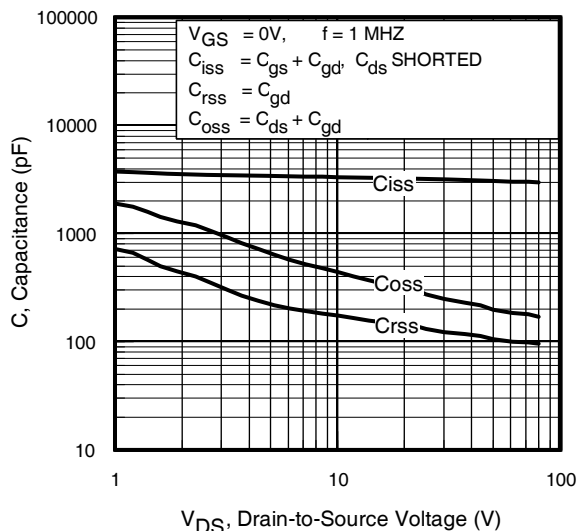
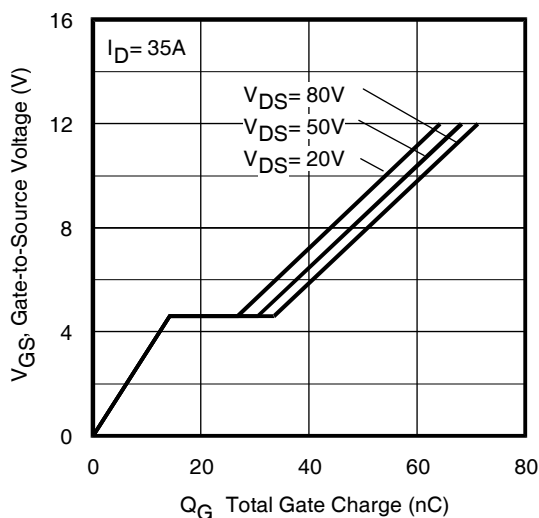
|          | Parameter                       | Typ. | Max. | Units |
|----------|---------------------------------|------|------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy ② | —    | 110  | mJ    |
| $I_{AR}$ | Avalanche Current ①             | —    | 35   | A     |

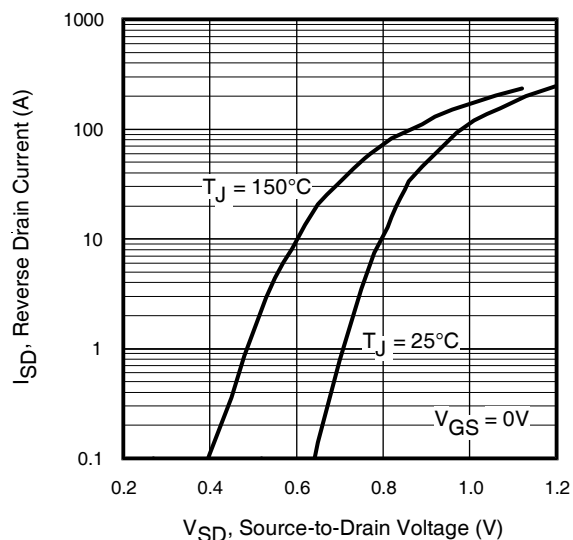
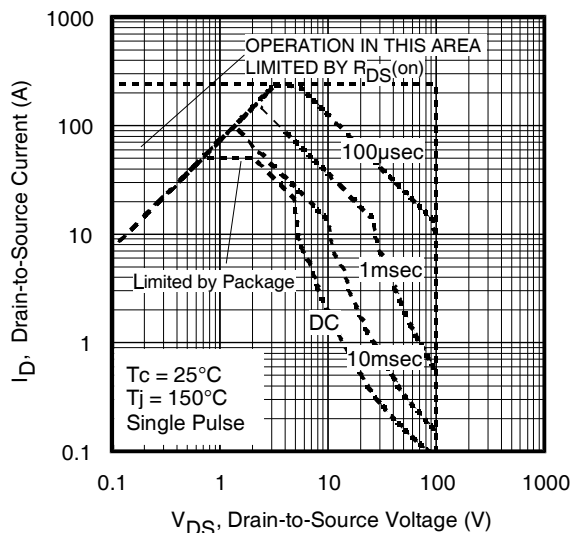
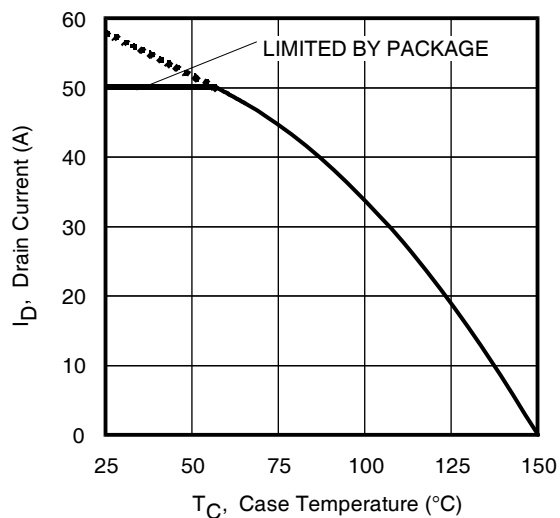
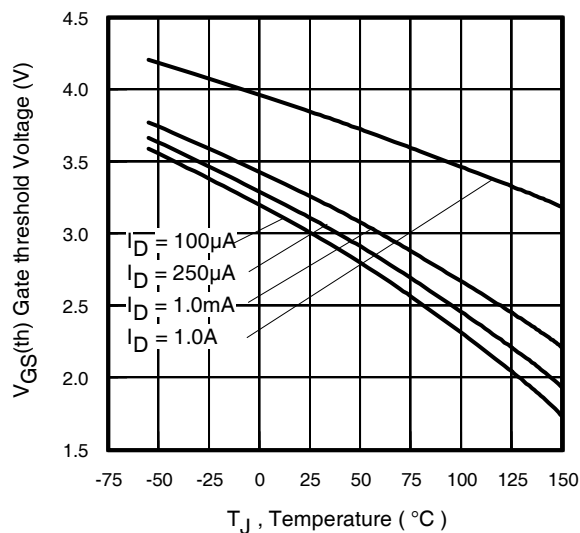
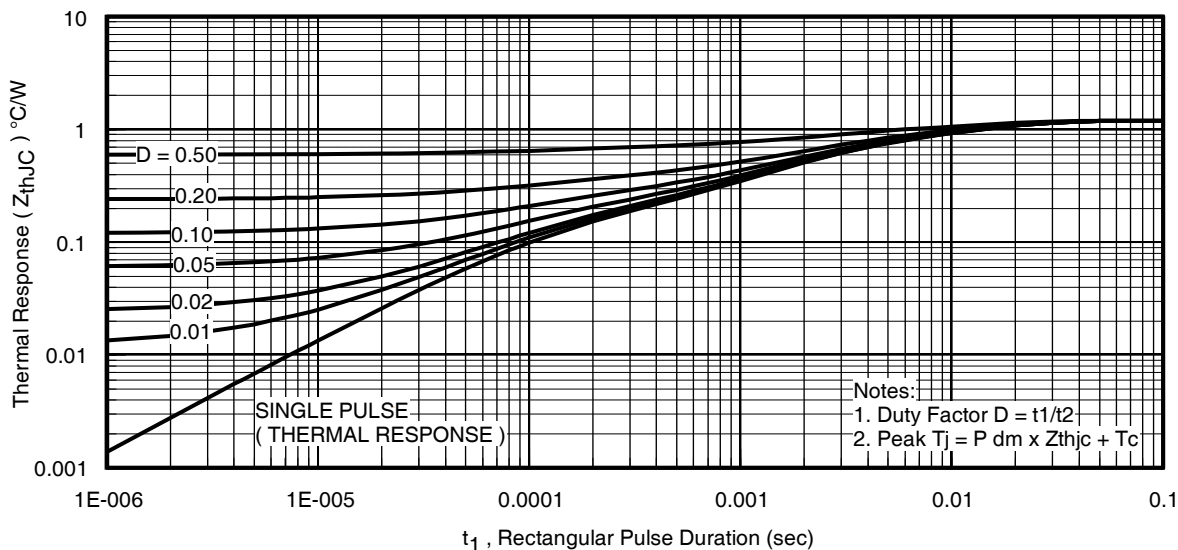
**Diode Characteristics**

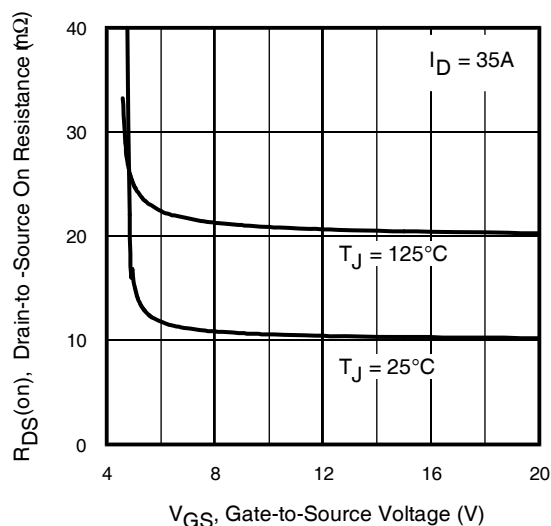
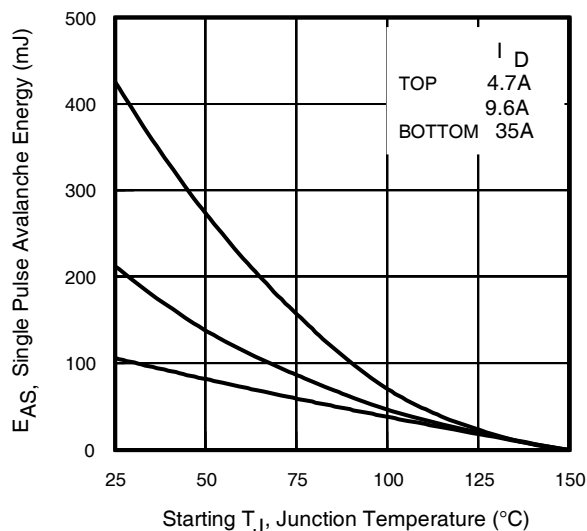
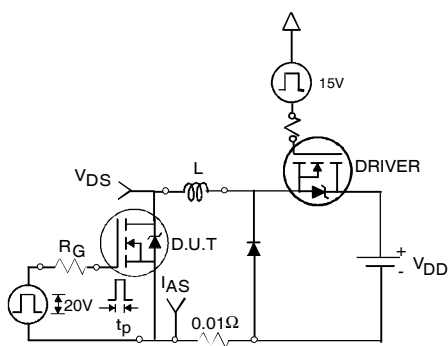
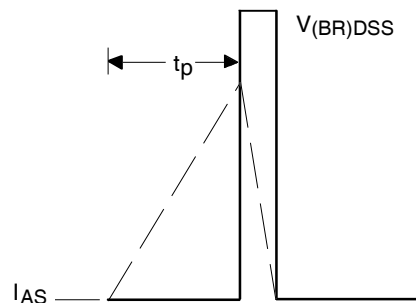
|          | Parameter                                 | Min.                                      | Typ. | Max. | Units | Conditions                                                              |
|----------|-------------------------------------------|-------------------------------------------|------|------|-------|-------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current<br>(Body Diode) | —                                         | —    | 50 ⑦ | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode) ①   | —                                         | —    | 240  |       |                                                                         |
| $V_{SD}$ | Diode Forward Voltage                     | —                                         | —    | 1.3  | V     | $T_J = 25^\circ\text{C}, I_S = 35A, V_{GS} = 0V$ ③                      |
| $t_{rr}$ | Reverse Recovery Time                     | —                                         | 27   | 41   | ns    | $T_J = 25^\circ\text{C}, I_F = 35A, V_{DD} = 50V$                       |
| $Q_{rr}$ | Reverse Recovery Charge                   | —                                         | 140  | 210  | nC    | $di/dt = 500A/\mu s$ ③                                                  |
| $t_{on}$ | Forward Turn-On Time                      | Time is dominated by parasitic Inductance |      |      |       |                                                                         |

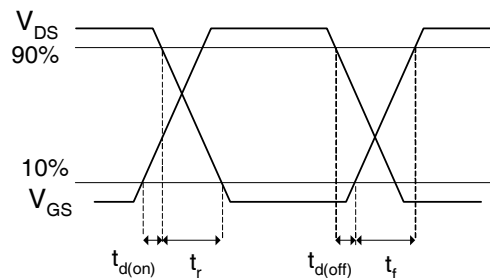

**Thermal Resistance**

|                          | Parameter               | Typ. | Max. | Units              |
|--------------------------|-------------------------|------|------|--------------------|
| $R_{\theta JC}$ (Bottom) | Junction-to-Case ④      | —    | 1.2  | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ (Top)    | Junction-to-Case ④      | —    | 32   |                    |
| $R_{\theta JA}$          | Junction-to-Ambient ④ ⑤ | —    | 35   |                    |
| $R_{\theta JA}$ (<10s)   | Junction-to-Ambient ⑤   | —    | 22   |                    |


**Fig 1.** Typical Output Characteristics

**Fig 2.** Typical Output Characteristics

**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

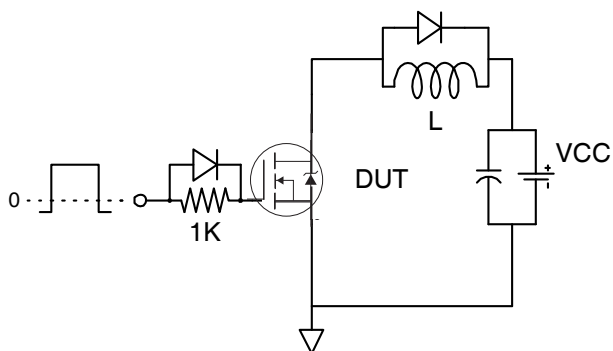

**Fig 7.** Typical Source-Drain Diode Forward Voltage

**Fig 8.** Maximum Safe Operating Area

**Fig 9.** Maximum Drain Current vs. Case (Bottom) Temperature

**Fig 10.** Threshold Voltage vs. Temperature

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


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

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

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

**Fig 14b.** Unclamped Inductive Waveforms

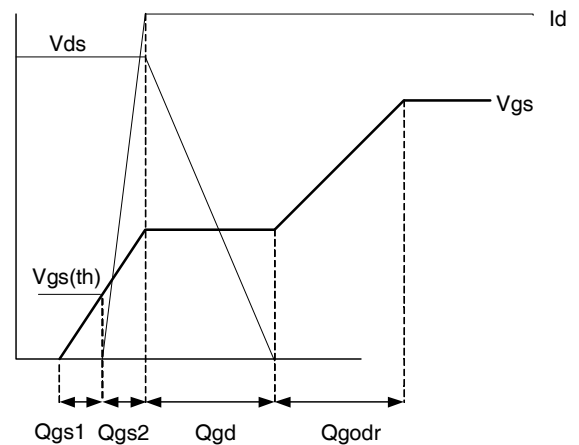
**Fig 15a.** Switching Time Test Circuit

**Fig 15b.** Switching Time Waveforms



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

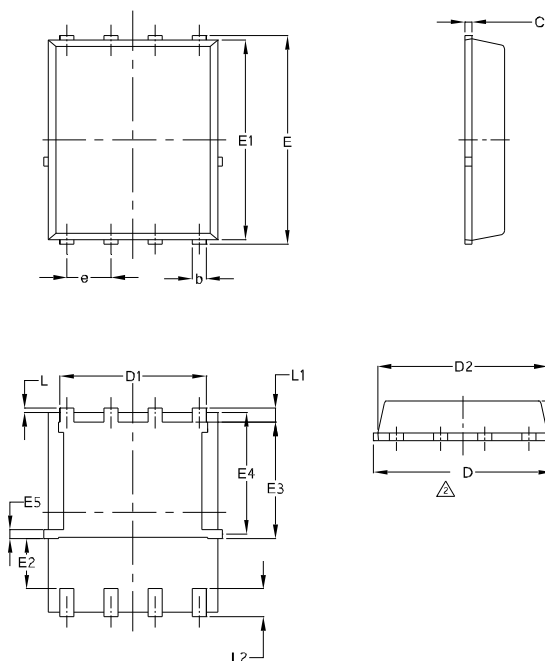


**Fig 17.** Gate Charge Test Circuit



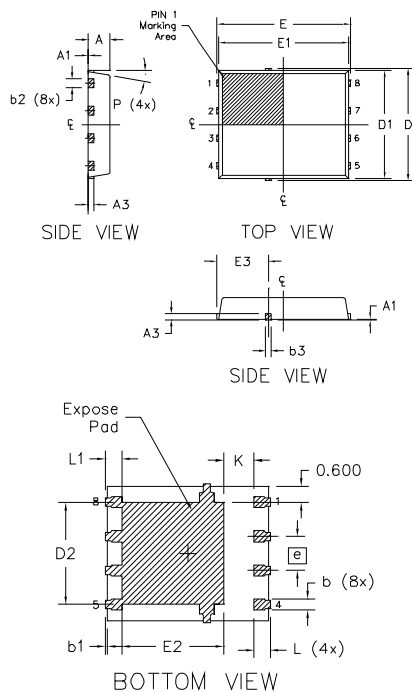
**Fig 18.** Gate Charge Waveform

## PQFN 5x6 Outline "E" Package Details



| SYMBOL | COMMON |       |        |        |
|--------|--------|-------|--------|--------|
|        | MM     |       | INCH   |        |
|        | MIN.   | MAX.  | MIN.   | MAX.   |
| A      | 0.90   | 1.17  | 0.0354 | 0.0461 |
| b      | 0.33   | 0.48  | 0.0130 | 0.0189 |
| C      | 0.195  | 0.300 | 0.0077 | 0.0118 |
| D      | 4.80   | 5.15  | 0.1890 | 0.2028 |
| D1     | 3.91   | 4.31  | 0.1539 | 0.1697 |
| D2     | 4.80   | 5.00  | 0.1890 | 0.1968 |
| E      | 5.90   | 6.15  | 0.2323 | 0.2421 |
| E1     | 5.65   | 6.00  | 0.2224 | 0.2362 |
| E2     | 1.51   | —     | 0.0594 | —      |
| E3     | 3.32   | 3.78  | 0.1307 | 0.1480 |
| E4     | 3.42   | 3.58  | 0.1346 | 0.1409 |
| E5     | 0.18   | 0.32  | 0.0071 | 0.0126 |
| e      | 1.27   | BSC   | 0.050  | BSC    |
| L      | 0.05   | 0.25  | 0.0020 | 0.0098 |
| L1     | 0.38   | 0.66  | 0.0150 | 0.0260 |
| L2     | 0.51   | 0.86  | 0.0201 | 0.0339 |
| I      | 0      | 0.18  | 0      | 0.0071 |

## PQFN 5x6 Outline "G" Package Details



| DIM<br>SYMBOL | MILLIMETERS |        | INCH   |        |
|---------------|-------------|--------|--------|--------|
|               | MIN.        | MAX.   | MIN.   | MAX.   |
| A             | 0.950       | 1.050  | 0.0374 | 0.0413 |
| A1            | 0.000       | 0.050  | 0.0000 | 0.0020 |
| A3            | 0.254       | REF    | 0.0100 | REF    |
| b             | 0.310       | 0.510  | 0.0122 | 0.0201 |
| b1            | 0.025       | 0.125  | 0.0010 | 0.0049 |
| b2            | 0.210       | 0.410  | 0.0083 | 0.0161 |
| b3            | 0.180       | 0.450  | 0.0071 | 0.0177 |
| D             | 5.150       | BSC    | 0.2028 | BSC    |
| D1            | 5.000       | BSC    | 0.1969 | BSC    |
| D2            | 3.700       | 3.900  | 0.1457 | 0.1535 |
| E             | 6.150       | BSC    | 0.2421 | BSC    |
| E1            | 6.000       | BSC    | 0.2362 | BSC    |
| E2            | 3.560       | 3.760  | 0.1402 | 0.1488 |
| E3            | 2.270       | 2.470  | 0.0894 | 0.0972 |
| e             | 1.27        | REF    | 0.050  | REF    |
| K             | 0.830       | 1.400  | 0.0327 | 0.0551 |
| L             | 0.510       | 0.710  | 0.0201 | 0.0280 |
| L1            | 0.510       | 0.710  | 0.0201 | 0.0280 |
| P             | 10 deg      | 12 deg | 0 deg  | 12 deg |

**Note:**

- Dimensions and tolerancing confirm to ASME Y14.5M-1994
- Dimension L represents terminal full back from package edge up to 0.1mm is acceptable
- Coplanarity applies to the expose Heat Slug as well as the terminal
- Radius on terminal is Optional

For more information on board mounting, including footprint and stencil recommendation, please refer to application note AN-1136:

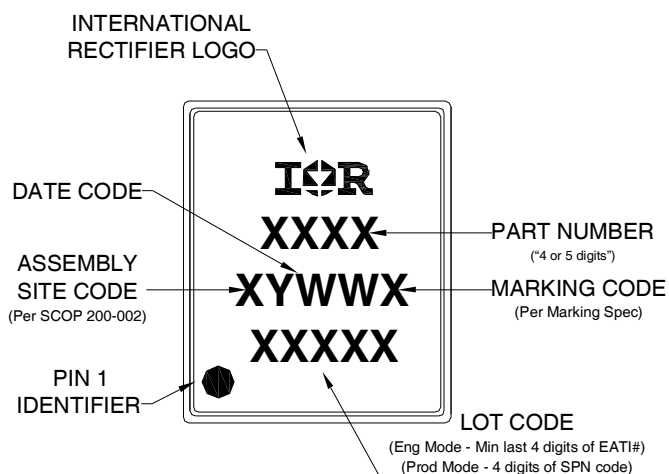
<http://www.irf.com/technical-info/appnotes/an-1136.pdf>

For more information on package inspection techniques, please refer to application note AN-1154:

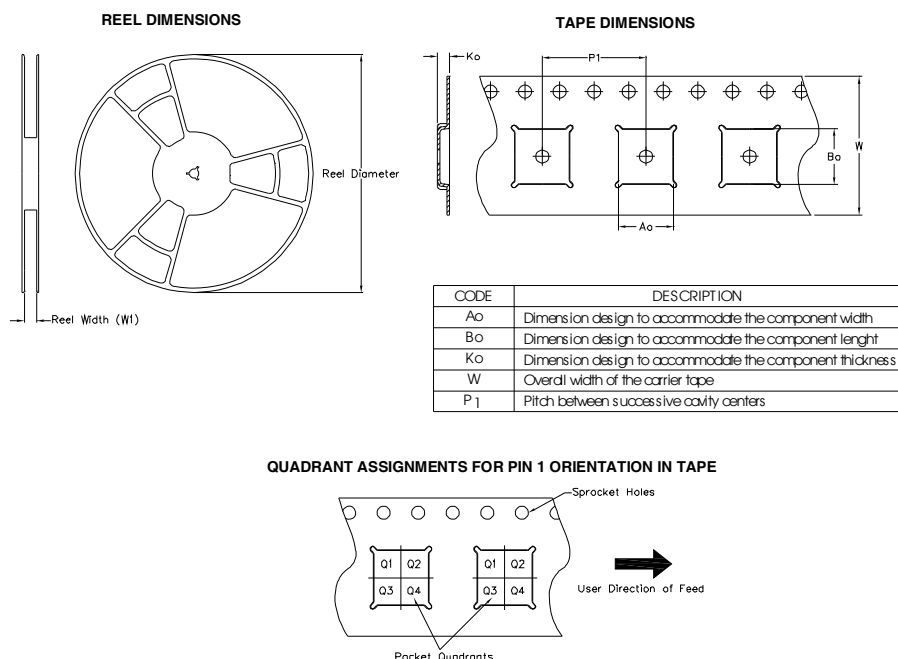
<http://www.irf.com/technical-info/appnotes/an-1154.pdf>

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

## PQFN 5x6 Outline Part Marking



## PQFN 5x6 Outline Tape and Reel



Note: All dimension are nominal

| Package Type | Reel Diameter (Inch) | QTY  | Reel Width W1 (mm) | Ao (mm) | Bo (mm) | Ko (mm) | P1 (mm) | W (mm) | Pin 1 Quadrant |
|--------------|----------------------|------|--------------------|---------|---------|---------|---------|--------|----------------|
| 5 X 6 PQFN   | 13                   | 4000 | 12.4               | 6.300   | 5.300   | 1.20    | 8.00    | 12     | Q1             |

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

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

|                            |                                                                           |                                                 |
|----------------------------|---------------------------------------------------------------------------|-------------------------------------------------|
| Qualification level        | Industrial <sup>††</sup><br>(per JEDEC JESD47F <sup>†††</sup> guidelines) |                                                 |
| Moisture Sensitivity Level | PQFN 5mm x 6mm                                                            | MSL 1<br>(per JEDEC J-STD-020D <sup>†††</sup> ) |
| RoHS compliant             | Yes                                                                       |                                                 |

<sup>†</sup> Qualification standards can be found at International Rectifier's web site

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

<sup>††</sup> 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/>

<sup>†††</sup> Applicable version of JEDEC standard at the time of product release.

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^{\circ}\text{C}$ ,  $L = 0.174\text{mH}$ ,  $R_G = 50\Omega$ ,  $I_{AS} = 35\text{A}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④  $R_{\theta}$  is measured at  $T_J$  of approximately  $90^{\circ}\text{C}$ .
- ⑤ When mounted on 1 inch square 2 oz copper pad on 1.5x1.5 in. board of FR-4 material.
- ⑥ Calculated continuous current based on maximum allowable junction temperature.
- ⑦ Package is limited to 50A by die-source to lead-frame bonding technology

### Revision History

| Date      | Comment                                                                                                                                                                                                                                                                                                            |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5/13/2014 | <ul style="list-style-type: none"> <li>Updated ordering information to reflect the End-Of-life (EOL) of the mini-reel option (EOL notice #259)</li> <li>Updated Package outline on page 7.</li> <li>Updated Tape and Reel on page 8.</li> <li>Updated data sheet based on corporate template.</li> </ul>           |
| 6/2/2015  | <ul style="list-style-type: none"> <li>Corrected typo test condition for GFS from "25V" to "50V" on page 2.</li> <li>Updated package outline for "option E" and added package outline for "option G" on page 7</li> <li>Updated "IFX" logo on page 1 &amp; 9.</li> <li>Updated tape and reel on page 8.</li> </ul> |

International  
 Rectifier

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