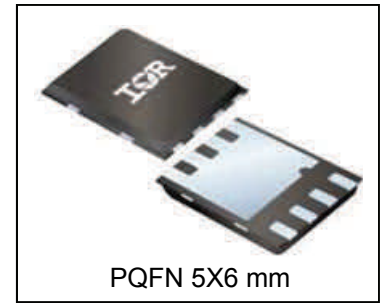
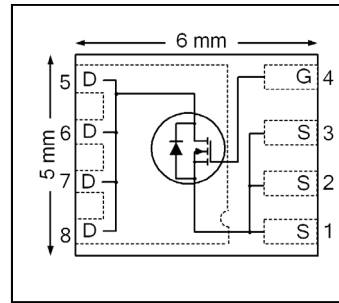


HEXFET® Power MOSFET

| | | |
|--|--------------|-----------|
| V_{DSS} | 25 | V |
| R_{DS(on)} max (@ V _{GS} = 10V) | 1.35 | mΩ |
| (@ V _{GS} = 4.5V) | 1.90 | |
| Qg (typical) | 26 | nC |
| I_D (@T _{C (Bottom)} = 25°C) | 204 Ⓞ | A |



PQFN 5X6 mm

Applications

- Synchronous Rectifier MOSFET for Synchronous Buck Converters
- Secondary Synchronous Rectifier MOSFET for isolated DC-DC converters
- Active ORing and Hot Swap
- Battery Operated DC Motor Inverters

Features

| |
|---|
| Low R _{DS(on)} (<1.35mΩ) |
| Low Thermal Resistance to PCB (<1.4°C/W) |
| Low Profile (<0.9 mm) |
| Industry-Standard Pinout |
| Compatible with Existing Surface Mount Techniques |
| RoHS Compliant, Halogen-Free |
| MSL1, Industrial Qualification |

results in
 ⇒

Benefits

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

| Base part number | Package Type | Standard Pack | | Orderable Part Number |
|------------------|-----------------|---------------|----------|-----------------------|
| | | Form | Quantity | |
| IRFH4213PbF | PQFN 5mm x 6 mm | Tape and Reel | 4000 | IRFH4213TRPbF |

Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|--------------|-------|
| V _{GS} | Gate-to-Source Voltage | ± 20 | V |
| I _D @ T _A = 25°C | Continuous Drain Current, V _{GS} @ 10V | 41 | A |
| I _D @ T _{C(Bottom)} = 25°C | Continuous Drain Current, V _{GS} @ 10V | 204Ⓞ | |
| I _D @ T _{C(Bottom)} = 100°C | Continuous Drain Current, V _{GS} @ 10V | 129Ⓞ | |
| I _{DM} | Pulsed Drain Current ① | 400 | |
| P _D @ T _A = 25°C | Power Dissipation ⑤ | 3.6 | W |
| P _D @ T _{C(Bottom)} = 25°C | Power Dissipation ⑤ | 89 | |
| | Linear Derating Factor ⑤ | 0.029 | W/°C |
| T _J T _{STG} | Operating Junction and Storage Temperature Range | -55 to + 150 | °C |

Notes ① through ⑥ are on page 9

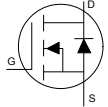
Static @ T_J = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions | |
|-------------------------------------|---|--|------|------|-------|--|---|
| BV _{DSS} | Drain-to-Source Breakdown Voltage | 25 | — | — | V | V _{GS} = 0V, I _D = 250μA | |
| ΔBV _{DSS} /ΔT _J | Breakdown Voltage Temp. Coefficient | — | 21 | — | mV/°C | Reference to 25°C, I _D = 1mA | |
| R _{DS(on)} | Static Drain-to-Source On-Resistance | — | 1.10 | 1.35 | mΩ | V _{GS} = 10V, I _D = 50A ③ | |
| | | — | 1.50 | 1.90 | | V _{GS} = 4.5V, I _D = 50A ③ | |
| V _{GS(th)} | Gate Threshold Voltage | 1.1 | 1.6 | 2.1 | V | V _{DS} = V _{GS} , I _D = 100μA | |
| ΔV _{GS(th)} | Gate Threshold Voltage Coefficient | — | -5.8 | — | mV/°C | | |
| I _{DSS} | Drain-to-Source Leakage Current | — | — | 1.0 | μA | V _{DS} = 20V, V _{GS} = 0V | |
| 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 | 228 | — | — | S | V _{DS} = 10V, I _D = 50A | |
| Q _g | Total Gate Charge | — | 54 | — | nC | V _{GS} = 10V, V _{DS} = 13V, I _D = 50A | |
| Q _g | Total Gate Charge | — | 26 | 39 | nC | V _{DS} = 13V V _{GS} = 4.5V I _D = 50A | |
| | Q _{gs1} | Pre-V _{th} Gate-to-Source Charge | — | 7.3 | | | — |
| | Q _{gs2} | Post-V _{th} Gate-to-Source Charge | — | 3.4 | | | — |
| | Q _{gd} | Gate-to-Drain Charge | — | 9.2 | | | — |
| | Q _{godr} | Gate Charge Overdrive | — | 6.1 | | | — |
| Q _{sw} | Switch Charge (Q _{gs2} + Q _{gd}) | — | 12.6 | — | | | |
| Q _{oss} | Output Charge | — | 25 | — | nC | V _{DS} = 16V, V _{GS} = 0V | |
| R _G | Gate Resistance | — | 1.5 | — | Ω | | |
| t _{d(on)} | Turn-On Delay Time | — | 14 | — | ns | V _{DD} = 13V, V _{GS} = 4.5V I _D = 50A R _G = 2.0Ω | |
| t _r | Rise Time | — | 35 | — | | | |
| t _{d(off)} | Turn-Off Delay Time | — | 17 | — | | | |
| t _f | Fall Time | — | 12 | — | | | |
| C _{iss} | Input Capacitance | — | 3420 | — | pF | V _{GS} = 0V V _{DS} = 13V f = 1.0MHz | |
| C _{oss} | Output Capacitance | — | 940 | — | | | |
| C _{rss} | Reverse Transfer Capacitance | — | 240 | — | | | |

Avalanche Characteristics

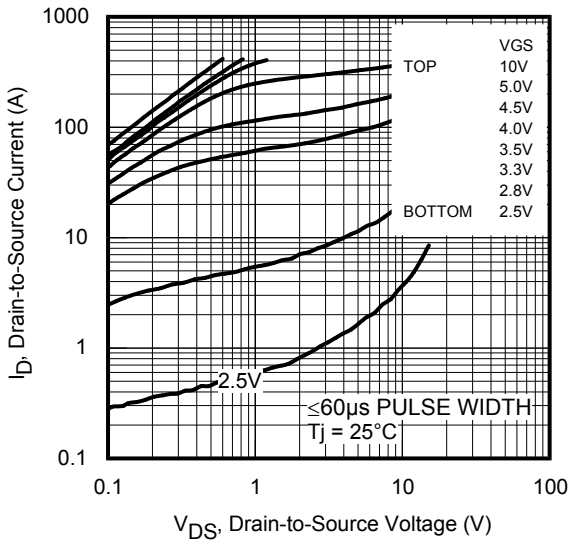
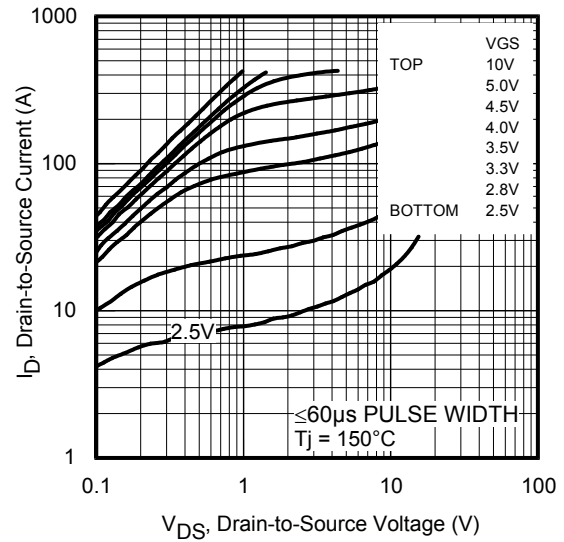
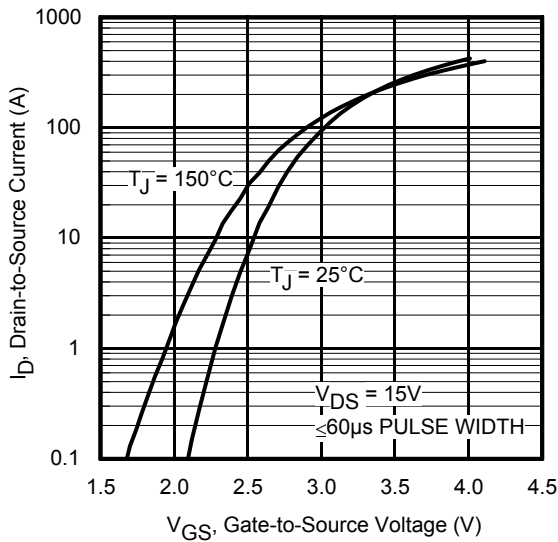
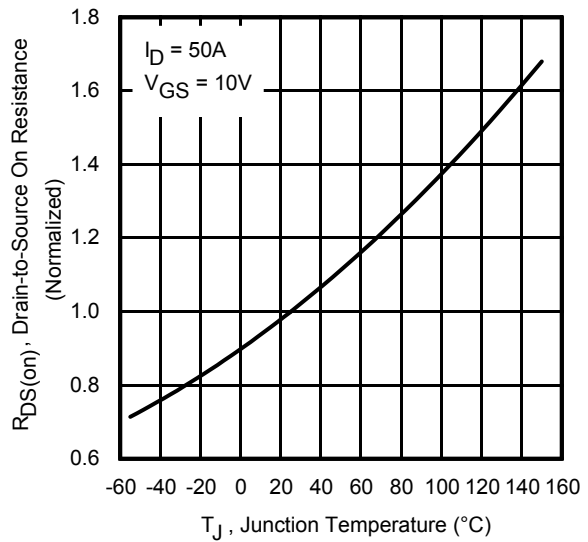
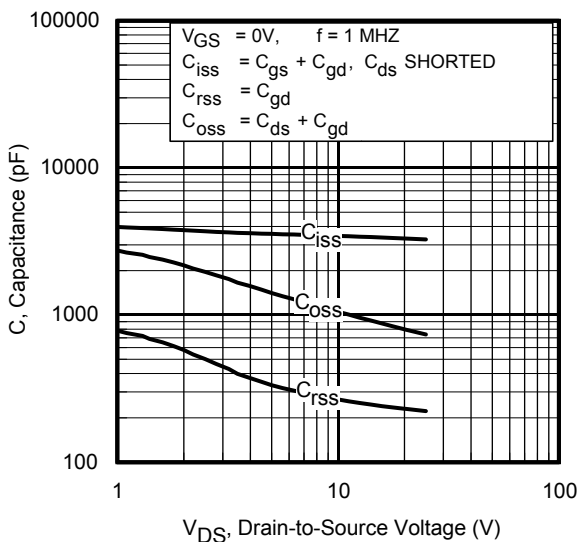
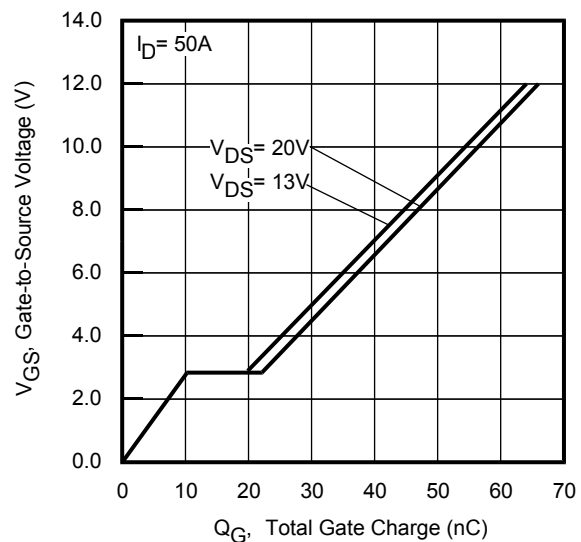
| | Parameter | Typ. | Max. |
|-----------------|---------------------------------|------|------|
| E _{AS} | Single Pulse Avalanche Energy ② | — | 134 |
| I _{AR} | Avalanche Current ① | — | 50 |

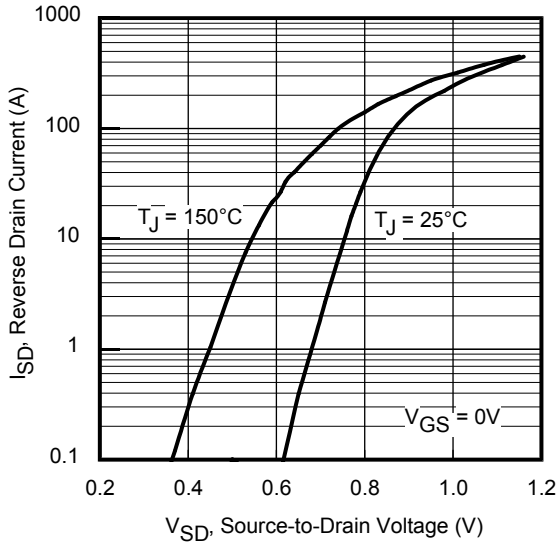
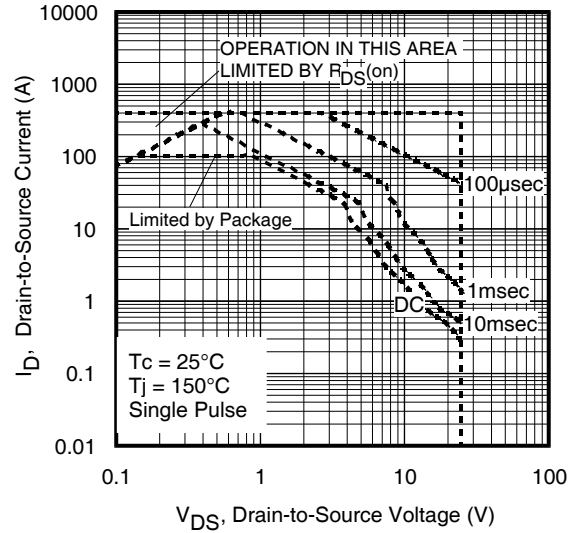
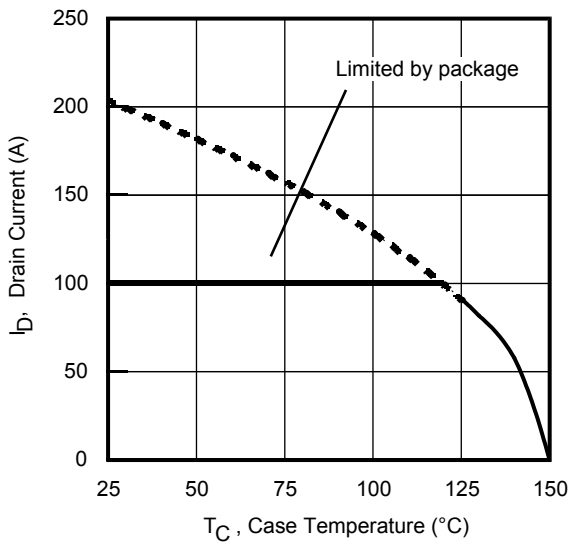
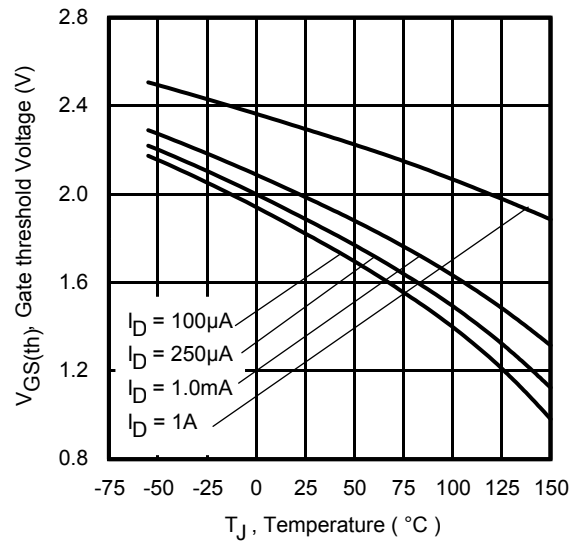
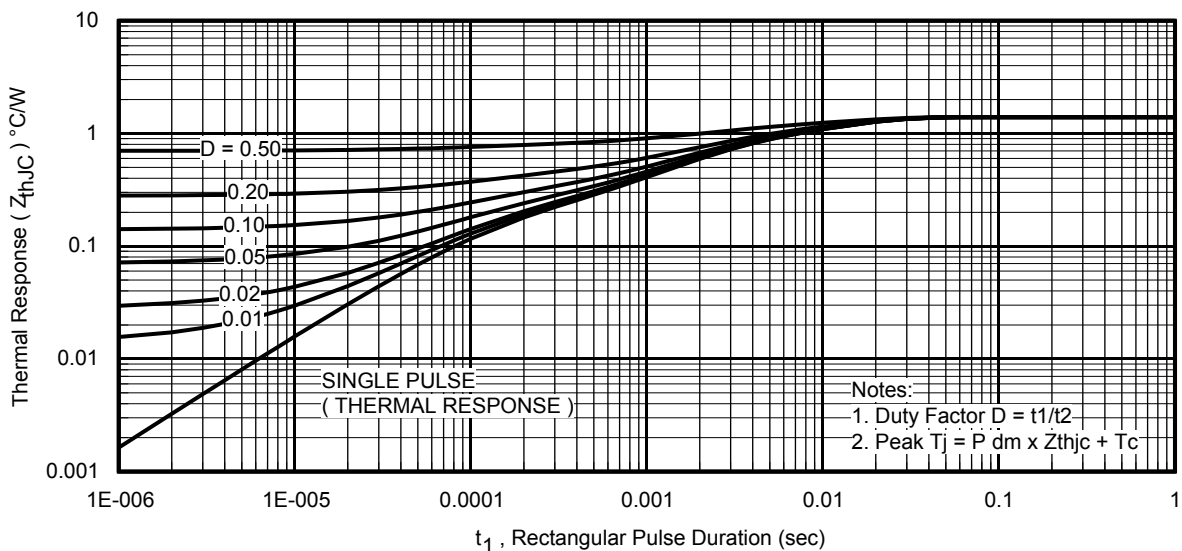
Diode Characteristics

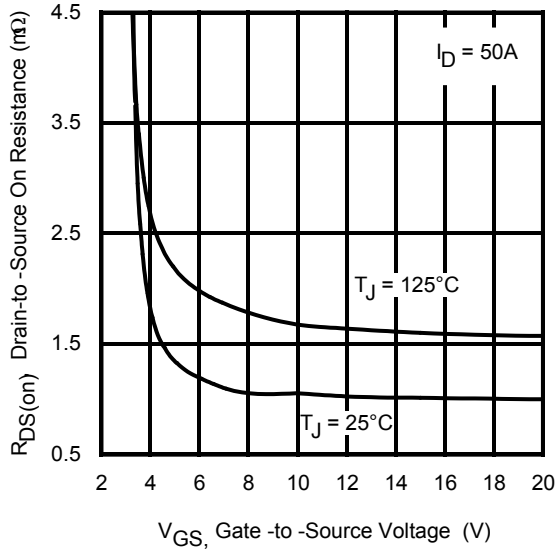
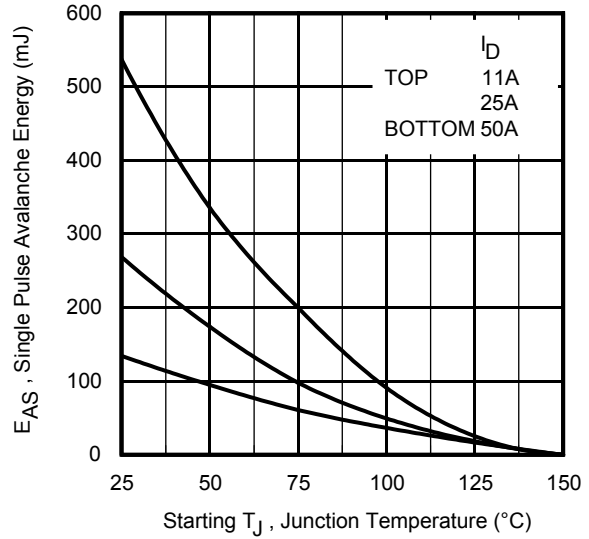
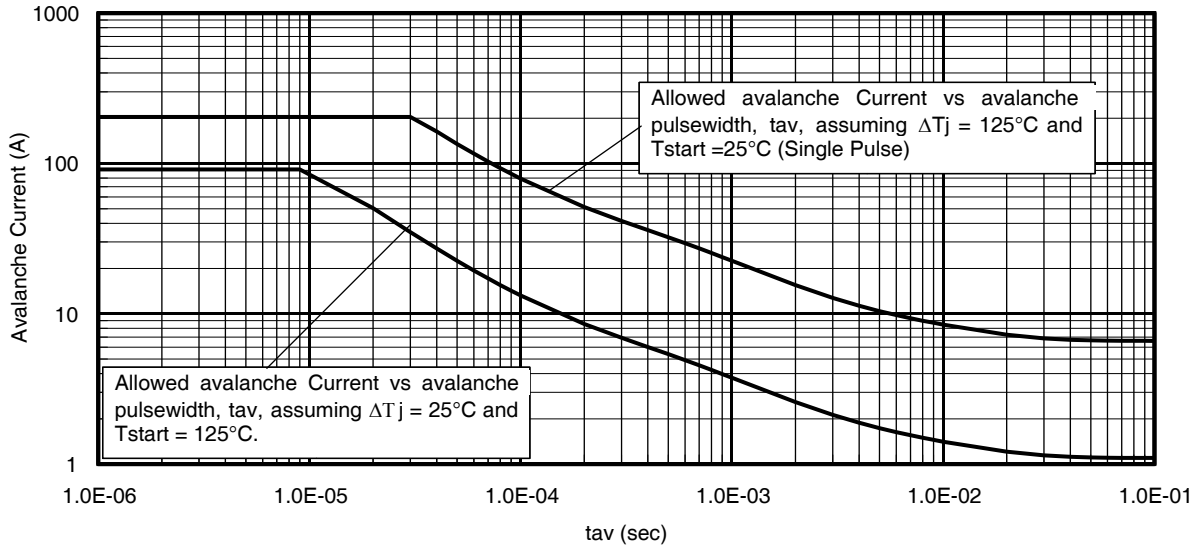
| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|-----------------|--|------|------|------|-------|--|
| I _S | Continuous Source Current (Body Diode) | — | — | 204⑥ | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I _{SM} | Pulsed Source Current (Body Diode) ① | — | — | 400 | | |
| V _{SD} | Diode Forward Voltage | — | — | 1.0 | V | T _J = 25°C, I _S = 50A, V _{GS} = 0V ③ |
| t _{rr} | Reverse Recovery Time | — | 23 | 35 | ns | T _J = 25°C, I _F = 50A, V _{DD} = 13V |
| Q _{rr} | Reverse Recovery Charge | — | 37 | 56 | nC | di/dt = 360A/μs ③ |

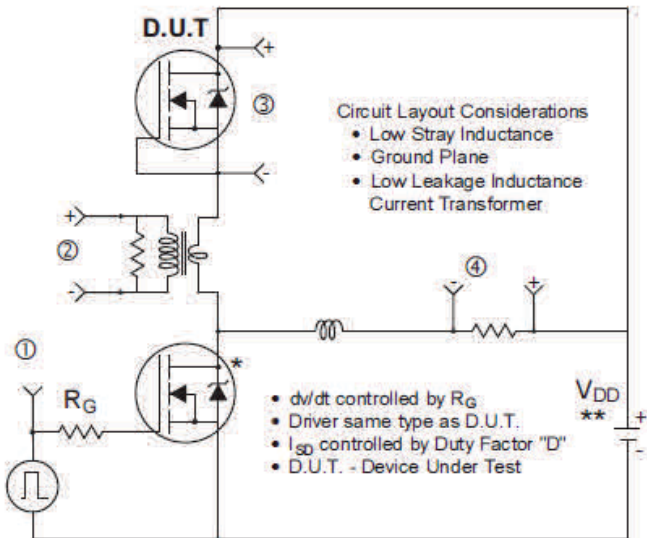
Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---------------------------|-----------------------|------|------|-------|
| R _{θJC} (Bottom) | Junction-to-Case ④ | — | 1.4 | °C/W |
| R _{θJC} (Top) | Junction-to-Case ④ | — | 21 | |
| R _{θJA} | Junction-to-Ambient ⑤ | — | 35 | |
| R _{θJA} (<10s) | Junction-to-Ambient ⑤ | — | 21 | |


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

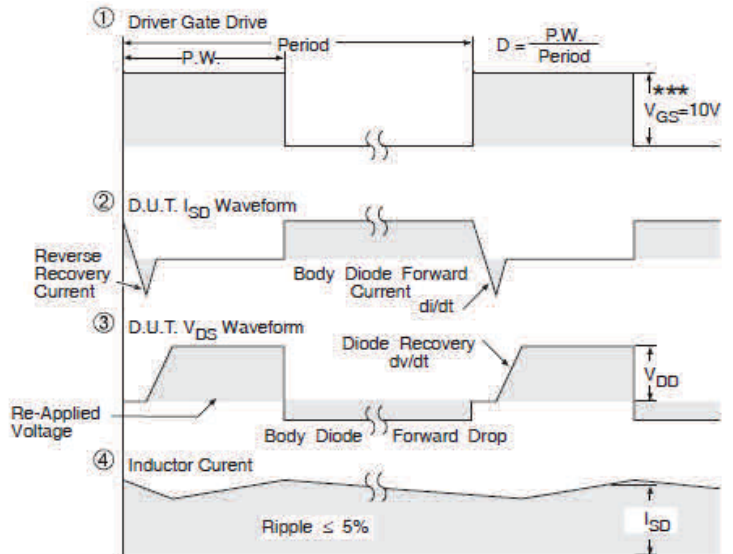

Fig 7. Typical Source-Drain Diode Forward Voltage

Fig 8. Maximum Safe Operating Area

Fig 9. Maximum Drain Current vs. Case Temperature

Fig 10. Threshold Voltage Vs. Temperature

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


Fig 12. On-Resistance vs. Gate Voltage

Fig 13. Maximum Avalanche Energy vs. Drain Current

Fig 14. Typical Avalanche Current vs. Pulsewidth



* Use P-Channel Driver for P-Channel Measurements

** Reverse Polarity for P-Channel



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

Fig 15. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET[®] Power MOSFETs

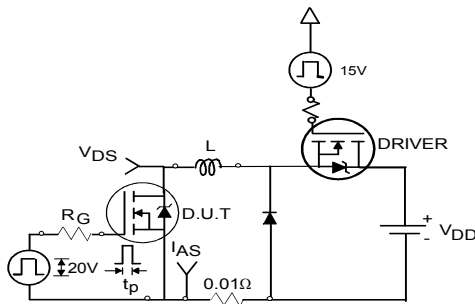


Fig 16a. Unclamped Inductive Test Circuit

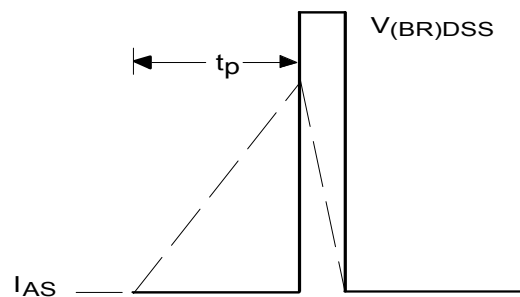


Fig 16b. Unclamped Inductive Waveforms

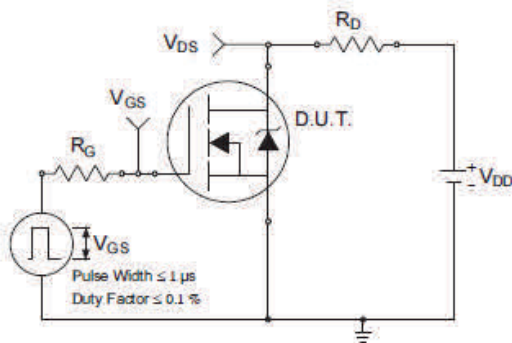


Fig 17a. Switching Time Test Circuit

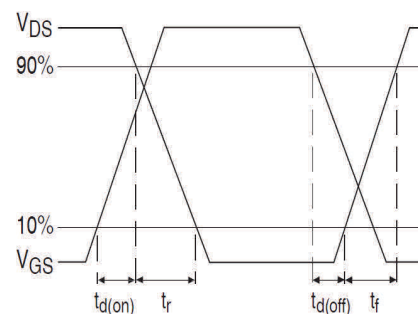


Fig 17b. Switching Time Waveforms

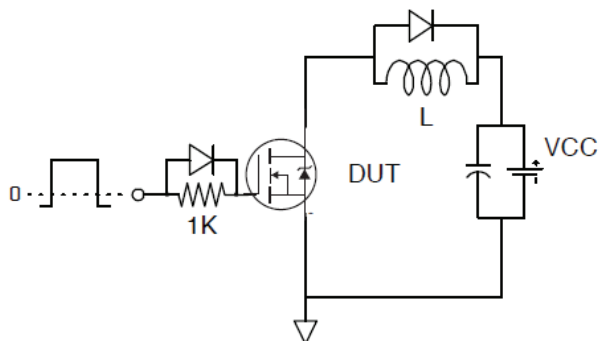


Fig 18. Gate Charge Test Circuit

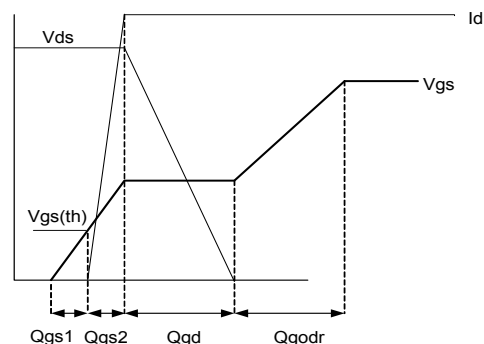
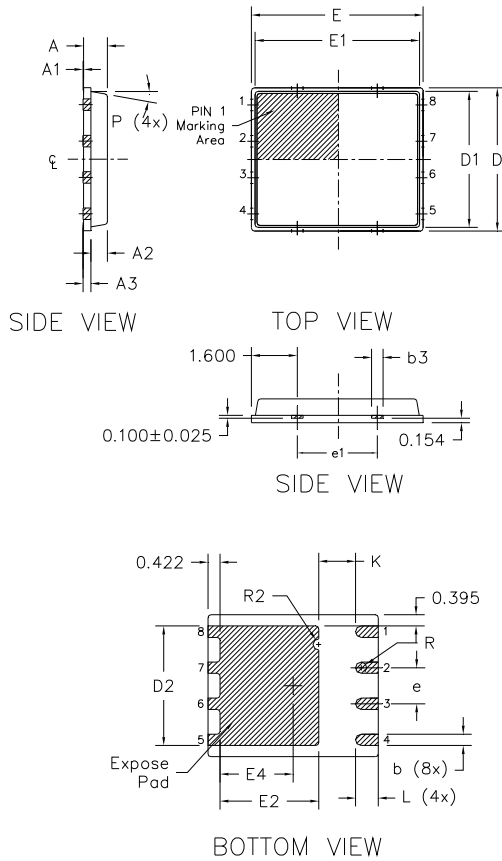


Fig 19. Gate Charge Waveform

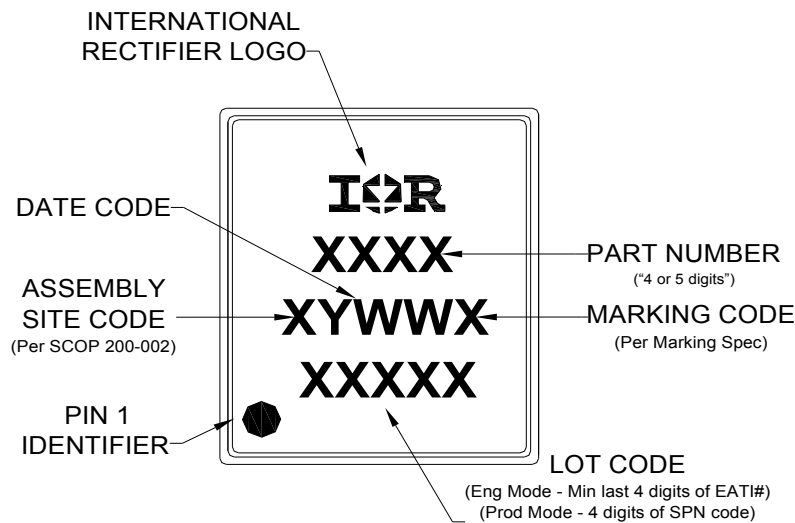
PQFN 5x6 Outline "B" Package Details


| DIM SYMBOL | MILLIMETERS | | INCH | |
|---------------|-------------|-------|--------|--------|
| | MIN | MAX | MIN | MAX |
| A | 0.800 | 0.900 | 0.0315 | 0.0543 |
| A1 | 0.000 | 0.050 | 0.0000 | 0.0020 |
| A3 | 0.200 | REF | 0.0079 | REF |
| b | 0.350 | 0.470 | 0.0138 | 0.0185 |
| b1 | 0.025 | 0.125 | 0.0010 | 0.0049 |
| b2 | 0.210 | 0.410 | 0.0083 | 0.0161 |
| b3 | 0.150 | 0.450 | 0.0059 | 0.0177 |
| D | 5.000 | BSC | 0.1969 | BSC |
| D1 | 4.750 | BSC | 0.1870 | BSC |
| D2 | 4.100 | 4.300 | 0.1614 | 0.1693 |
| E | 6.000 | BSC | 0.2362 | BSC |
| E1 | 5.750 | BSC | 0.2264 | BSC |
| E2 | 3.380 | 3.780 | 0.1331 | 0.1488 |
| e | 1.270 | REF | 0.0500 | REF |
| e1 | 2.800 | REF | 0.1102 | REF |
| K | 1.200 | 1.420 | 0.0472 | 0.0559 |
| L | 0.710 | 0.900 | 0.0280 | 0.0354 |
| P | 0° | 12° | 0° | 12° |
| R | 0.200 | REF | 0.0079 | REF |
| R2 | 0.150 | 0.200 | 0.0059 | 0.0079 |

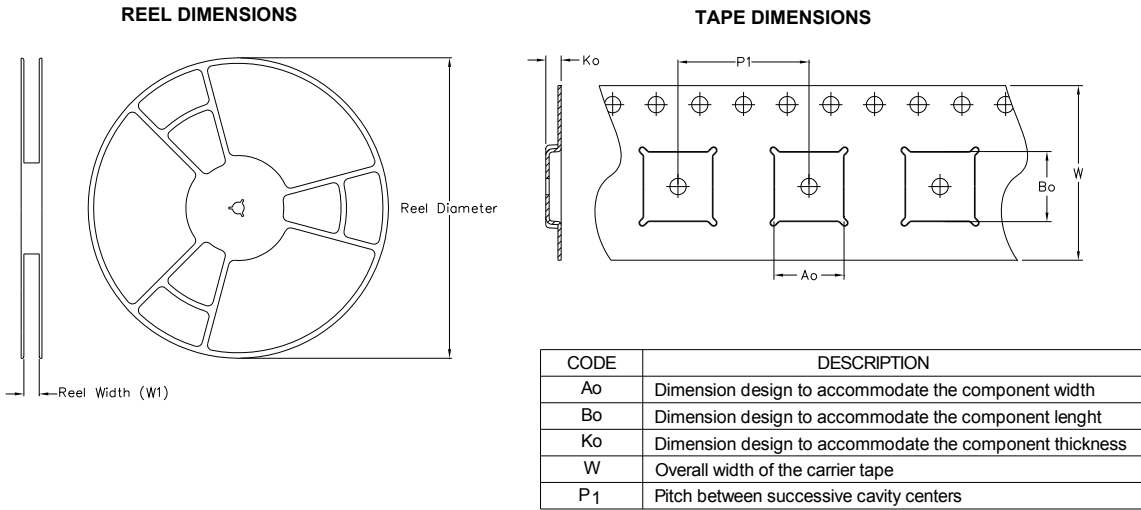
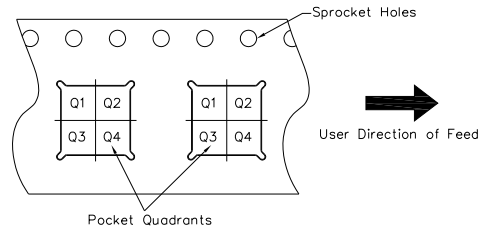
Note:

1. Dimensions and tolerancing confirm to ASME Y14.5M-1994
2. Dimension L represents terminal full back from package edge up to 0.1mm is acceptable
3. Coplanarity applies to the expose Heat Slug as well as the terminal
4. 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>

PQFN 5x6 Part Marking


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

PQFN 5x6 Tape and Reel

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


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[†]

| | | |
|-----------------------------------|---|---|
| Qualification Level | Industrial [†] (per JEDEC JESD47F ^{††} guidelines) | |
| Moisture Sensitivity Level | PQFN 5mm x 6mm | MSL1 (per JEDEC J-STD-020D ^{††}) |
| RoHS Compliant | Yes | |

† Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/product-info/reliability/>

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

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting $T_J = 25^\circ\text{C}$, $L = 0.107\text{mH}$, $R_G = 50\Omega$, $I_{AS} = 50\text{A}$.
- ③ Pulse width $\leq 400\mu\text{s}$; duty cycle $\leq 2\%$.
- ④ R_θ is measured at T_J of approximately 90°C .
- ⑤ When mounted on 1 inch square PCB (FR-4). Please refer to AN-994 for more details:
<http://www.irf.com/technical-info/appnotes/an-994.pdf>
- ⑥ Calculated continuous current based on maximum allowable junction temperature. Package is limited to 100A by production test capability.

Revision History

| Date | Comments |
|-------------|--|
| 5/13/2013 | <ul style="list-style-type: none"> • Updated package 3D drawing, on page 1. • Updated current rating based on max rating not limited by package, on pages 1 and 2. |
| 08/07/2013 | <ul style="list-style-type: none"> • Added "Fast/RFET™" above part number on page1 |
| 03/11/2015 | <ul style="list-style-type: none"> • Updated package outline and tape and reel on pages 7 and 8. |

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