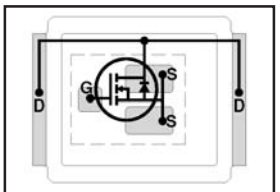
International
IOR Rectifier

# IRF6620PbF
# IRF6620TRPbF

DirectFET™ Power MOSFET ②

- RoHS Compliant ①
- Lead-Free (Qualified up to 260°C Reflow)
- Application Specific MOSFETs
- Ideal for CPU Core DC-DC Converters
- Low Conduction Losses
- High Cdv/dt Immunity
- Low Profile (<0.7mm)
- Dual Sided Cooling Compatible ①
- Compatible with existing Surface Mount Techniques ①

| $V_{DSS}$ | $R_{DS(on)}$ max | Qg(typ.) |
|---|---|---|
| 20V | 2.7mΩ@$V_{GS}$ = 10V | 28nC |
| | 3.6mΩ@$V_{GS}$ = 4.5V | |



MX


DirectFET™ ISOMETRIC

Applicable DirectFET Outline and Substrate Outline (see p.8,9 for details)

| SQ | SX | ST | | MQ | **MX** | MT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

## Description

The IRF6620PbF combines the latest HEXFET® Power MOSFET Silicon technology with the advanced DirectFET™ packaging to achieve the lowest on-state resistance in a package that has the footprint of an SO-8 and only 0.7 mm profile. The DirectFET package is compatible with existing layout geometries used in power applications, PCB assembly equipment and vapor phase, infra-red or convection soldering techniques, when application note AN-1035 is followed regarding the manufacturing methods and processes. The DirectFET package allows dual sided cooling to maximize thermal transfer in power systems, improving previous best thermal resistance by 80%.

The IRF6620PbF balances both low resistance and low charge along with ultra low package inductance to reduce both conduction and switching losses. The reduced total losses make this product ideal for high efficiency DC-DC converters that power the latest generation of processors operating at higher frequencies. The IRF6620PbF has been optimized for parameters that are critical in synchronous buck operating from 12 volt bus converters including Rds(on), gate charge and Cdv/dt-induced turn on immunity. The IRF6620PbF offers particularly low Rds(on) and high Cdv/dt immunity for synchronous FET applications.

## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-to-Source Voltage | 20 | V |
| $V_{GS}$ | Gate-to-Source Voltage | ±20 | |
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V ⑨ | 150 | A |
| $I_D$ @ $T_A$ = 25°C | Continuous Drain Current, $V_{GS}$ @ 10V ⑥ | 27 | |
| $I_D$ @ $T_A$ = 70°C | Continuous Drain Current, $V_{GS}$ @ 10V ⑥ | 22 | |
| $I_{DM}$ | Pulsed Drain Current ③ | 220 | |
| $P_D$ @$T_C$ = 25°C | Power Dissipation ⑨ | 89 | W |
| $P_D$ @$T_A$ = 70°C | Power Dissipation ⑥ | 1.8 | |
| $P_D$ @$T_A$ = 25°C | Power Dissipation ⑥ | 2.8 | |
| $E_{AS}$ | Single Pulse Avalanche Energy④ | 39 | mJ |
| $I_{AR}$ | Avalanche Current ⑤ | 22 | A |
| | Linear Derating Factor | 0.017 | W/°C |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -40 to + 150 | °C |

## Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JA}$ | Junction-to-Ambient ⑥⑩ | — | 45 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient ⑦⑩ | 12.5 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient ⑧⑩ | 20 | — | |
| $R_{\theta JC}$ | Junction-to-Case ⑨⑩ | — | 1.4 | |
| $R_{\theta J\text{-}PCB}$ | Junction-to-PCB Mounted | 1.0 | — | |

Notes ① through ⑩ are on page 2



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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | 20 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 16 | — | mV/°C | Reference to 25°C, $I_D$ = 1mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | 2.1 | 2.7 | mΩ | $V_{GS}$ = 10V, $I_D$ = 27A ⑤ |
| | | — | 2.8 | 3.6 | | $V_{GS}$ = 4.5V, $I_D$ = 22A ⑤ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 1.55 | — | 2.45 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Coefficient | — | -5.8 | — | mV/°C | |
| $I_{DSS}$ | Drain-to-Source Leakage Current | — | — | 1.0 | µA | $V_{DS}$ = 16V, $V_{GS}$ = 0V |
| | | — | — | 150 | | $V_{DS}$ = 16V, $V_{GS}$ = 0V, $T_J$ = 125°C |
| $I_{GSS}$ | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS}$ = 20V |
| | Gate-to-Source Reverse Leakage | — | — | -100 | | $V_{GS}$ = -20V |
| gfs | Forward Transconductance | 110 | — | — | S | $V_{DS}$ = 10V, $I_D$ = 22A |
| $Q_g$ | Total Gate Charge | — | 28 | 42 | | |
| $Q_{gs1}$ | Pre-Vth Gate-to-Source Charge | — | 9.5 | — | | $V_{DS}$ = 10V |
| $Q_{gs2}$ | Post-Vth Gate-to-Source Charge | — | 3.5 | — | nC | $V_{GS}$ = 4.5V |
| $Q_{gd}$ | Gate-to-Drain Charge | — | 8.8 | — | | $I_D$ = 22A |
| $Q_{godr}$ | Gate Charge Overdrive | — | 6.2 | — | | See Fig. 15 |
| $Q_{sw}$ | Switch Charge ($Q_{gs2}$ + $Q_{gd}$) | — | 12 | — | | |
| $Q_{oss}$ | Output Charge | — | 16 | — | nC | $V_{DS}$ = 10V, $V_{GS}$ = 0V |
| $t_{d(on)}$ | Turn-On Delay Time | — | 18 | — | | $V_{DD}$ = 16V, $V_{GS}$ = 4.5V ⑤ |
| $t_r$ | Rise Time | — | 80 | — | | $I_D$ = 22A |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 20 | — | ns | Clamped Inductive Load |
| $t_f$ | Fall Time | — | 6.6 | — | | |
| $C_{iss}$ | Input Capacitance | — | 4130 | — | | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | — | 1160 | — | pF | $V_{DS}$ = 10V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 560 | — | | $f$ = 1.0MHz |

## Diode Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current@ $T_C$=25°C (Body Diode) | — | — | 110 | A | MOSFET symbol showing the integral reverse p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ③ | — | — | 220 | | |
| $V_{SD}$ | Diode Forward Voltage | — | 0.8 | 1.0 | V | $T_J$ = 25°C, $I_S$ = 22A, $V_{GS}$ = 0V ⑤ |
| $t_{rr}$ | Reverse Recovery Time | — | 23 | 35 | ns | $T_J$ = 25°C, $I_F$ = 22A |
| $Q_{rr}$ | Reverse Recovery Charge | — | 13 | 20 | nC | di/dt = 100A/µs ⑤ |

**Notes:**

① Click on this section to link to the appropriate technical paper.
② Click on this section to link to the DirectFET Website.
③ Repetitive rating; pulse width limited by max. junction temperature.
④ Starting $T_J$ = 25°C, L = 0.16mH, $R_G$ = 25Ω, $I_{AS}$ = 22A.
⑤ Pulse width ≤ 400µs; duty cycle ≤ 2%.
⑥ Surface mounted on 1 in. square Cu board.
⑦ Used double sided cooling, mounting pad.
⑧ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.
⑨ $T_C$ measured with thermal couple mounted to top (Drain) of part.
⑩ $R_\theta$ is measured at $T_J$ of approximately 90°C.



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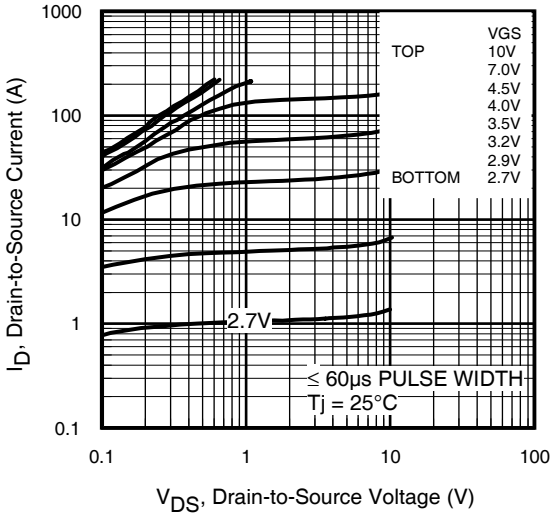



**Fig 1.** Typical Output Characteristics

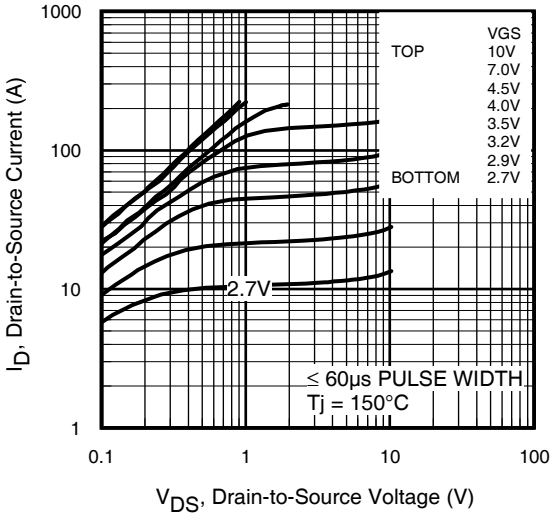



**Fig 2.** Typical Output Characteristics

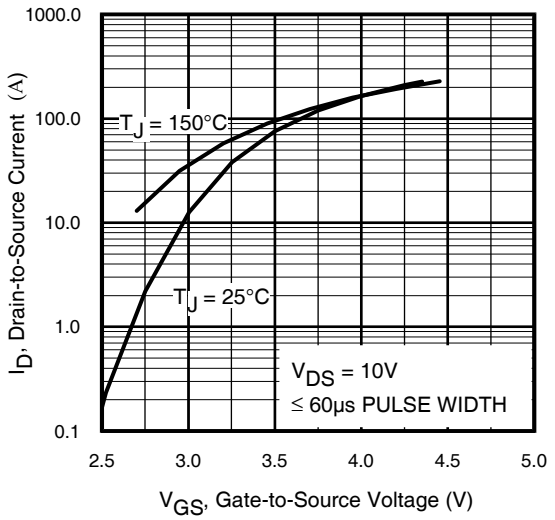



**Fig 3.** Typical Transfer Characteristics

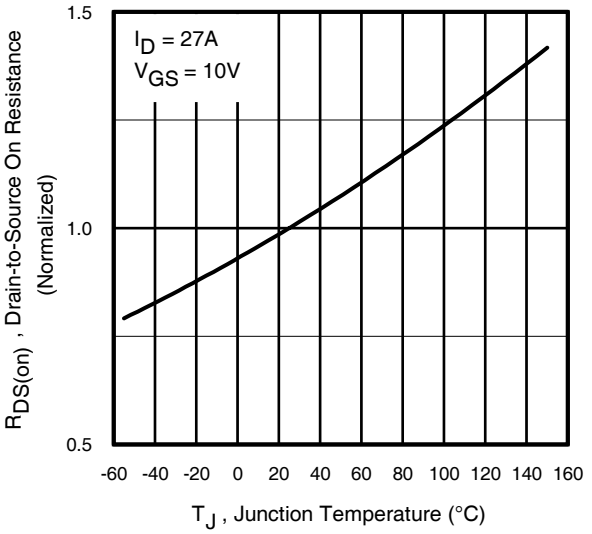



**Fig 4.** Normalized On-Resistance vs. Temperature

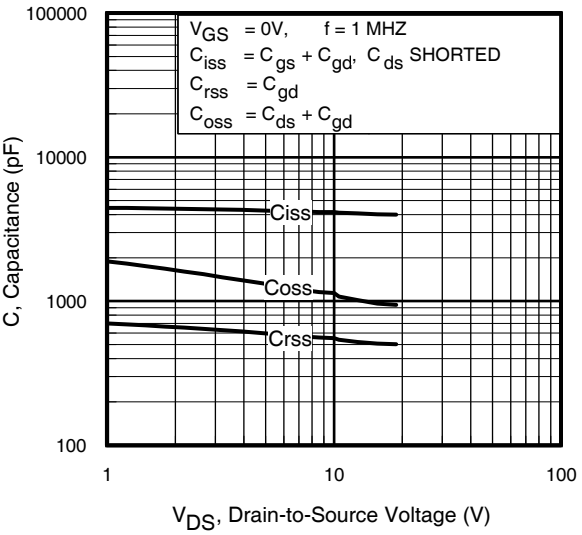



**Fig 5.** Typical Capacitance vs.Drain-to-Source Voltage

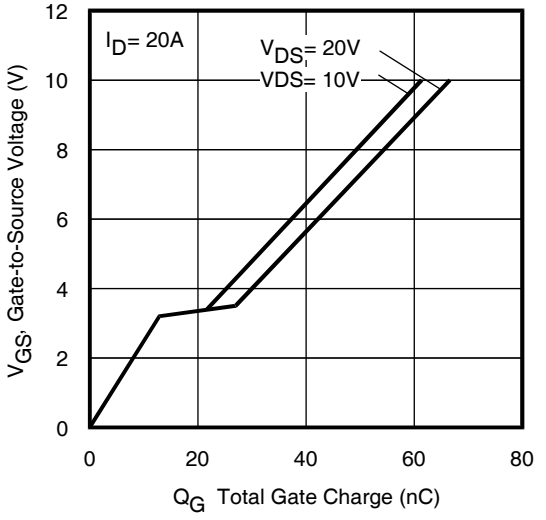



**Fig 6.** Typical Gate Charge vs.Gate-to-Source Voltage



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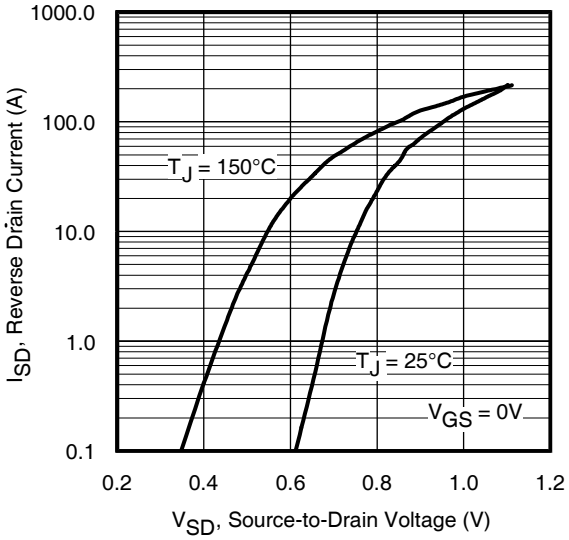



**Fig 7.** Typical Source-Drain Diode Forward Voltage

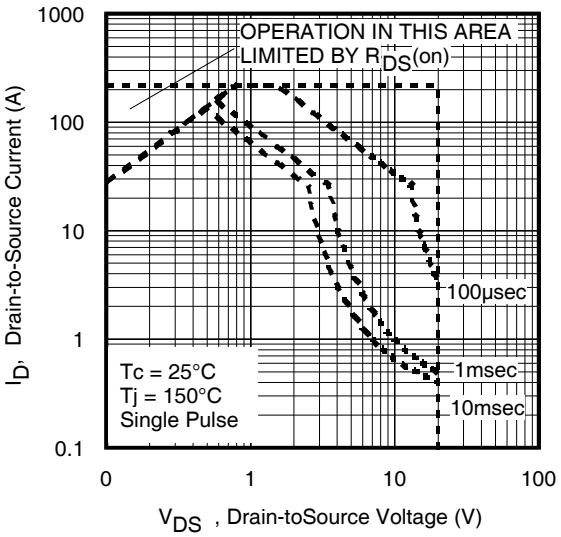



**Fig 8.** Maximum Safe Operating Area

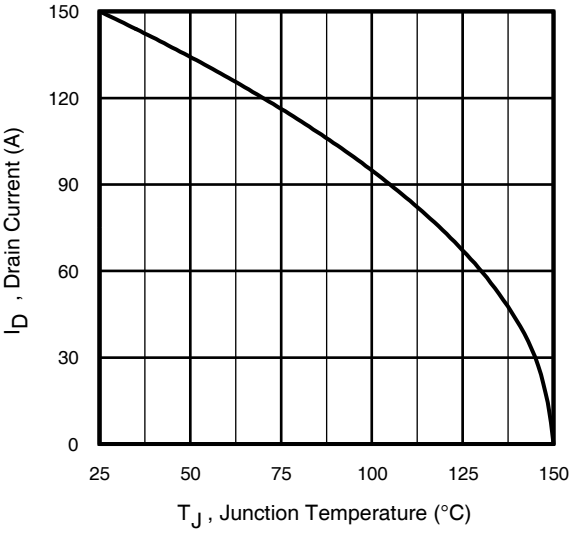



**Fig 9.** Maximum Drain Current vs. Case Temperature

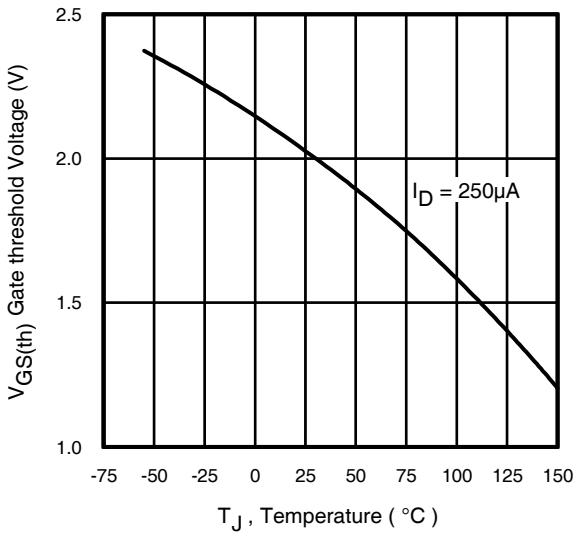
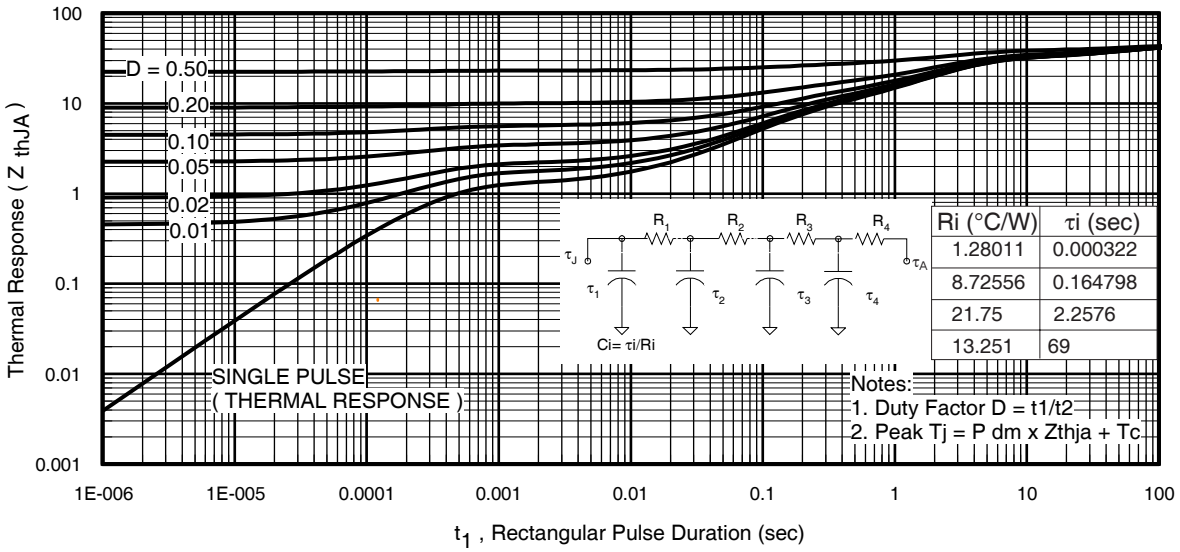



**Fig 10.** Threshold Voltage vs. Temperature




| Ri (°C/W) | τi (sec) |
|---|---|
| 1.28011 | 0.000322 |
| 8.72556 | 0.164798 |
| 21.75 | 2.2576 |
| 13.251 | 69 |

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



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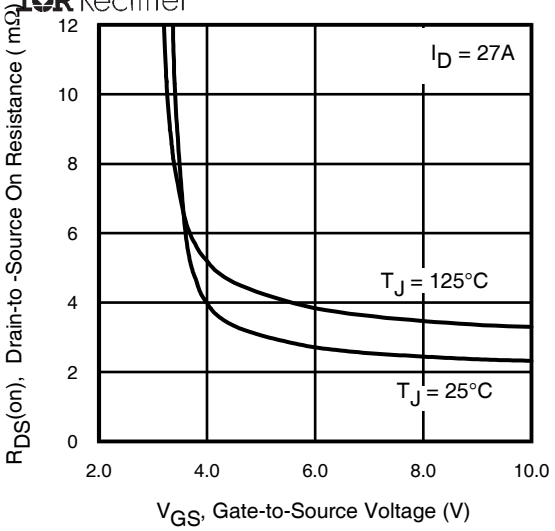



**Fig 12.** On-Resistance Vs. Gate Voltage

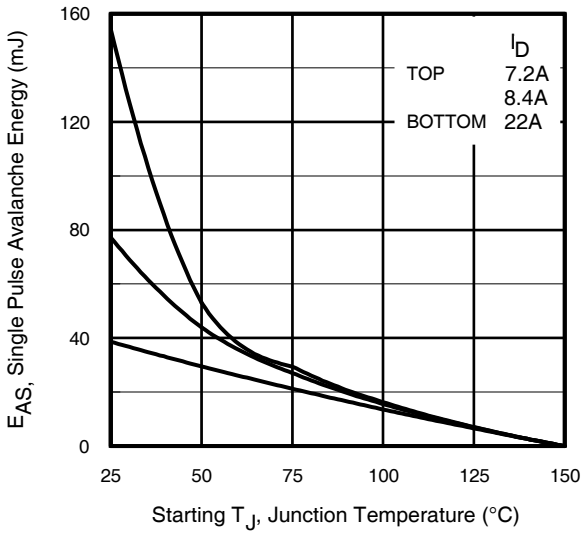



**Fig 13c.** Maximum Avalanche Energy Vs. Drain Current

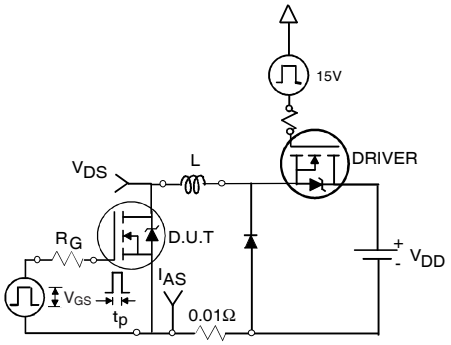



**Fig 13a.** Unclamped Inductive Test Circuit

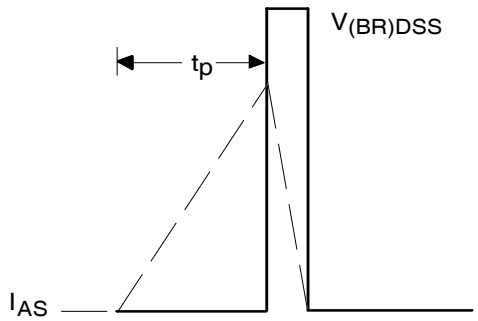



**Fig 13b.** Unclamped Inductive Waveforms

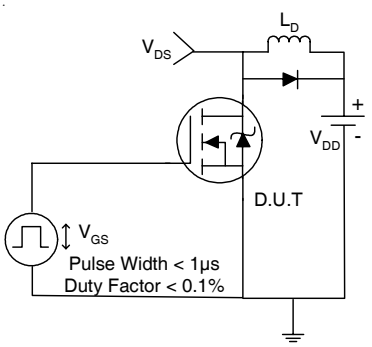



**Fig 14a.** Switching Time Test Circuit

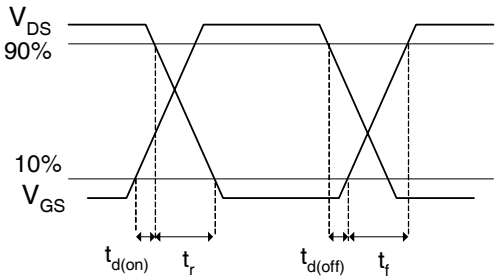



**Fig 14b.** Switching Time Waveforms

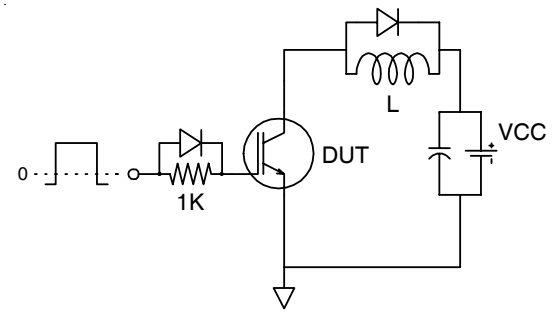



**Fig 15a.** Gate Charge Test Circuit

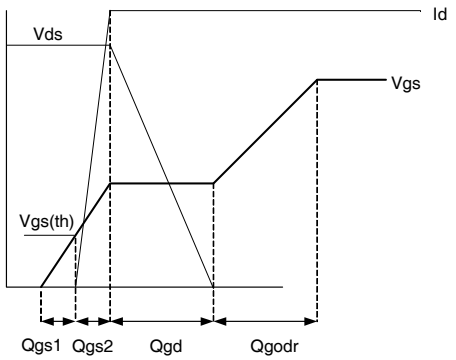



**Fig 15b.** Gate Charge Waveform



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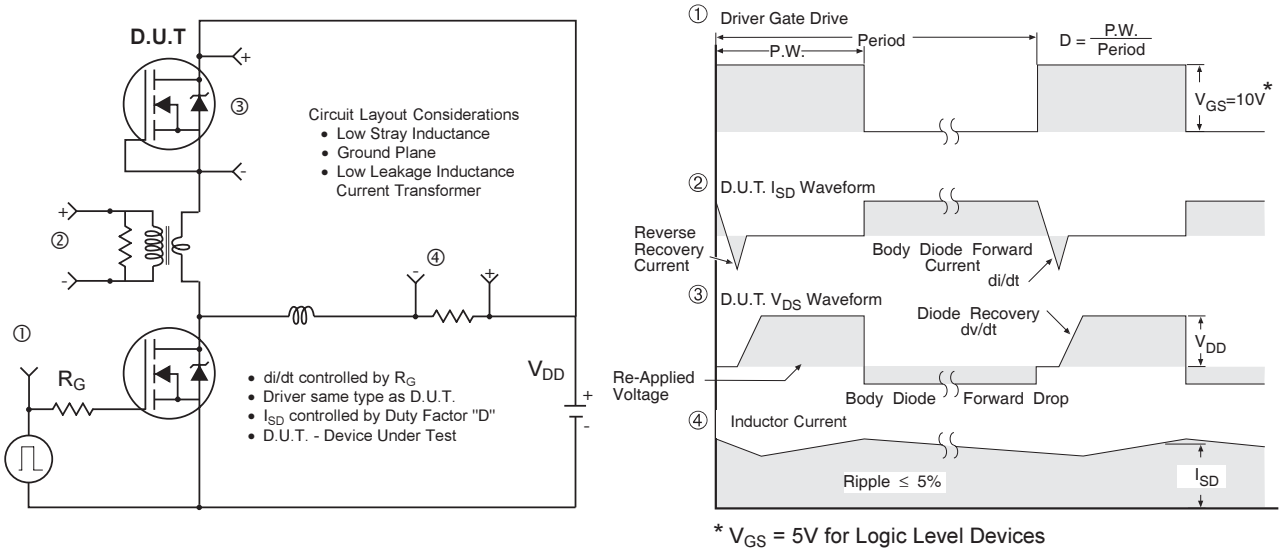
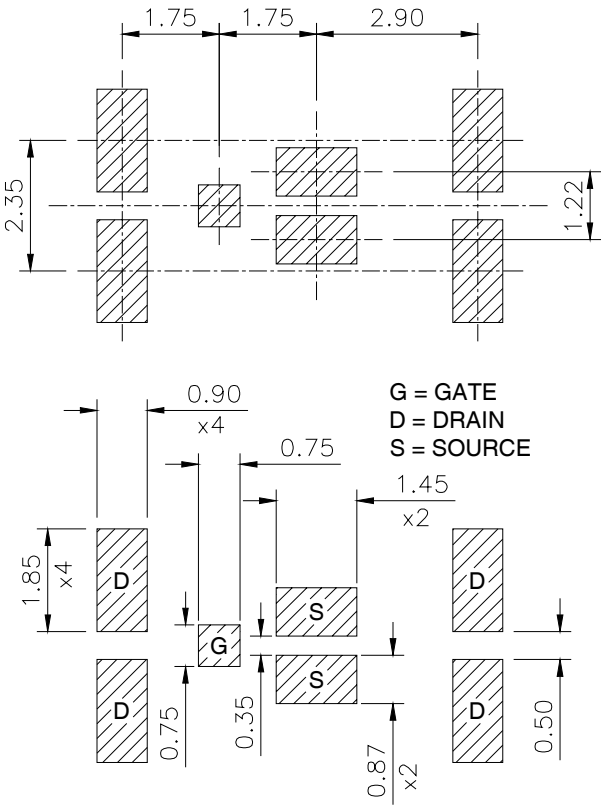



**Fig 16.** Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs

## DirectFET™ Substrate and PCB Layout, MX Outline (Medium Size Can, X-Designation).

Please see DirectFET application note AN-1035 for all details regarding the assembly of DirectFET.
This includes all recommendations for stencil and substrate designs.

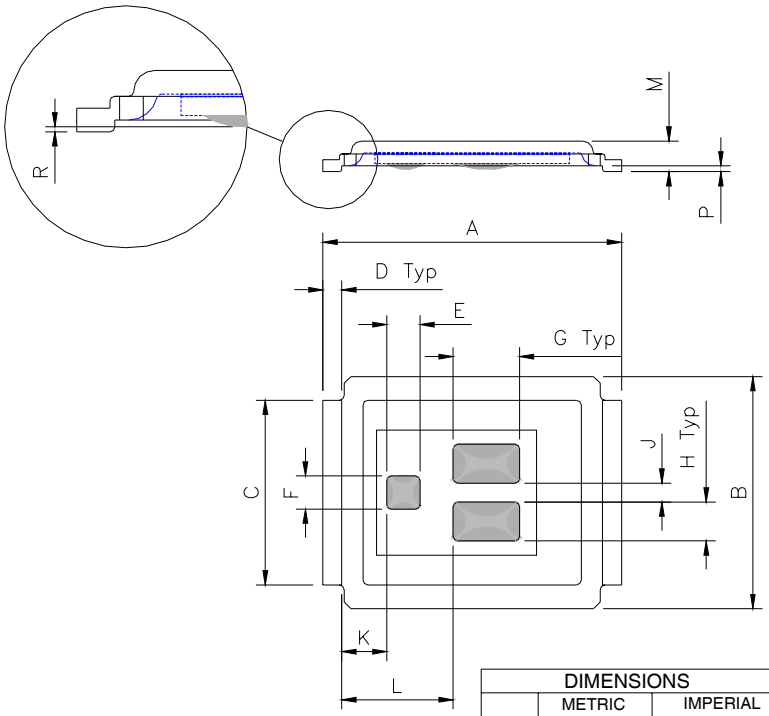





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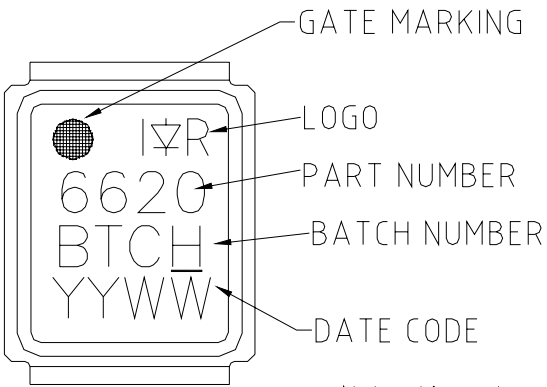
## DirectFET™ Outline Dimension, MX Outline (Medium Size Can, X-Designation).

Please see DirectFET application note AN-1035 for all details regarding the assembly of DirectFET. This includes all recommendations for stencil and substrate designs.




| DIMENSIONS | | | | |
|---|---|---|---|---|
| | METRIC | | IMPERIAL | |
| CODE | MIN | MAX | MIN | MAX |
| A | 6.25 | 6.35 | 0.246 | 0.250 |
| B | 4.80 | 5.05 | 0.189 | 0.201 |
| C | 3.85 | 3.95 | 0.152 | 0.156 |
| D | 0.35 | 0.45 | 0.014 | 0.018 |
| E | 0.68 | 0.72 | 0.027 | 0.028 |
| F | 0.68 | 0.72 | 0.027 | 0.028 |
| G | 1.38 | 1.42 | 0.054 | 0.056 |
| H | 0.80 | 0.84 | 0.032 | 0.033 |
| J | 0.38 | 0.42 | 0.015 | 0.017 |
| K | 0.88 | 1.01 | 0.035 | 0.039 |
| L | 2.28 | 2.41 | 0.090 | 0.095 |
| M | 0.616 | 0.676 | 0.0235 | 0.0274 |
| R | 0.020 | 0.080 | 0.0008 | 0.0031 |
| P | 0.08 | 0.17 | 0.003 | 0.007 |

## DirectFET™ Part Marking

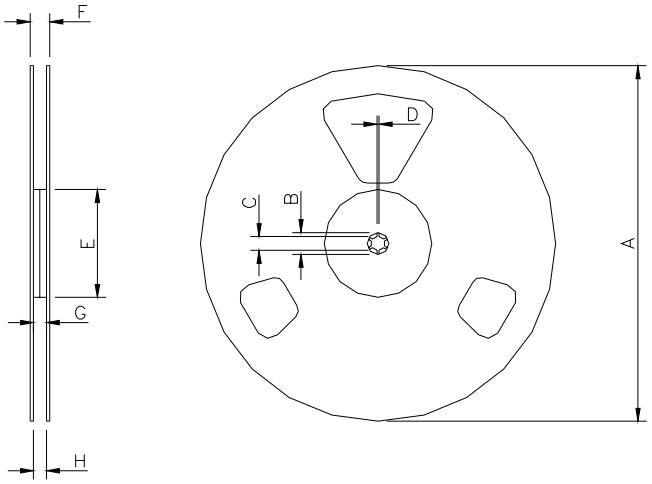



Note: Line above the last character of the date-code indicates "Lead-Free".



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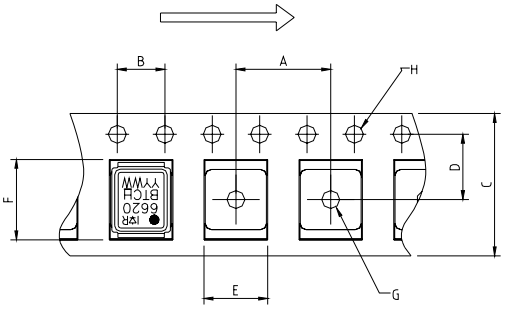
## DirectFET™ Tape & Reel Dimension (Showing component orientation).




NOTE: Controlling dimensions in mm
Std reel quantity is 4800 parts. (ordered as IRF6620TRPBF). For 1000 parts on 7" reel, order IRF6620TR1PBF

| REEL DIMENSIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| STANDARD OPTION (**QTY 4800**) | | | | | TR1 OPTION (**QTY 1000**) | | | |
| | METRIC | | IMPERIAL | | METRIC | | IMPERIAL | |
| CODE | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX |
| A | 330.0 | N.C | 12.992 | N.C | 177.77 | N.C | 6.9 | N.C |
| B | 20.2 | N.C | 0.795 | N.C | 19.06 | N.C | 0.75 | N.C |
| C | 12.8 | 13.2 | 0.504 | 0.520 | 13.5 | 12.8 | 0.53 | 0.50 |
| D | 1.5 | N.C | 0.059 | N.C | 1.5 | N.C | 0.059 | N.C |
| E | 100.0 | N.C | 3.937 | N.C | 58.72 | N.C | 2.31 | N.C |
| F | N.C | 18.4 | N.C | 0.724 | N.C | 13.50 | N.C | 0.53 |
| G | 12.4 | 14.4 | 0.488 | 0.567 | 11.9 | 12.01 | 0.47 | N.C |
| H | 11.9 | 15.4 | 0.469 | 0.606 | 11.9 | 12.01 | 0.47 | N.C |

LOADED TAPE FEED DIRECTION




| DIMENSIONS | | | | |
|---|---|---|---|---|
| | METRIC | | IMPERIAL | |
| CODE | MIN | MAX | MIN | MAX |
| A | 7.90 | 8.10 | 0.311 | 0.319 |
| B | 3.90 | 4.10 | 0.154 | 0.161 |
| C | 11.90 | 12.30 | 0.469 | 0.484 |
| D | 5.45 | 5.55 | 0.215 | 0.219 |
| E | 5.10 | 5.30 | 0.201 | 0.209 |
| F | 6.50 | 6.70 | 0.256 | 0.264 |
| G | 1.50 | N.C | 0.059 | N.C |
| H | 1.50 | 1.60 | 0.059 | 0.063 |

Data and specifications subject to change without notice.
This product has been designed and qualified for the Consumer market.
Qualification Standards can be found on IR's Web site.

**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information.5/06



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

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## IMPORTANT NOTICE

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The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

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