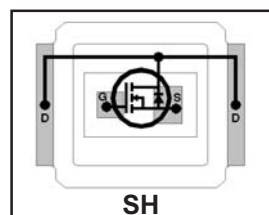


Features

- Latest MOSFET Silicon technology
- Key parameters optimized for Class-D audio amplifier applications
- Low $R_{DS(on)}$ for improved efficiency
- Low Q_g for better THD and improved efficiency
- Low Q_{rr} for better THD and lower EMI
- Low package stray inductance for reduced ringing and lower EMI
- Can deliver up to 100W per channel into 8 Ω with no heatsink ⑩
- Dual sided cooling compatible
- Compatible with existing surface mount technologies
- RoHS compliant containing no lead or bromide
- Lead-Free (Qualified up to 260°C Reflow)

Key Parameters

| | | |
|------------------------------------|-----|------------|
| V_{DS} | 100 | V |
| $R_{DS(on)}$ typ. @ $V_{GS} = 10V$ | 53 | m Ω |
| Q_g typ. | 8.7 | nC |
| $R_{G(int)}$ typ. | 1.9 | Ω |



Applicable DirectFET Outline and Substrate Outline (see p. 6, 7 for details)

| | | | | | | | | | | |
|----|----|----|-----------|----|----|----|----|--|--|--|
| SQ | SX | ST | SH | MQ | MX | MT | MN | | | |
|----|----|----|-----------|----|----|----|----|--|--|--|

Description

This Digital Audio MOSFET is specifically designed for Class-D audio amplifier applications. This MOSFET utilizes the latest processing techniques to achieve low on-resistance per silicon area. Furthermore, gate charge, body-diode reverse recovery and internal gate resistance are optimized to improve key Class-D audio amplifier performance factors such as efficiency, THD, and EMI.

The IRF6665PbF device utilizes DirectFET™ packaging technology. DirectFET™ packaging technology offers lower parasitic inductance and resistance when compared to conventional wirebonded SOIC packaging. Lower inductance improves EMI performance by reducing the voltage ringing that accompanies fast current transients. 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 method and processes. The DirectFET™ package also allows dual sided cooling to maximize thermal transfer in power systems, improving thermal resistance and power dissipation. These features combine to make this MOSFET a highly efficient, robust and reliable device for Class-D audio amplifier applications.

Absolute Maximum Ratings

| | Parameter | Max. | Units |
|----------------------------|--|--------------|---------------|
| V_{DS} | Drain-to-Source Voltage | 100 | V |
| V_{GS} | Gate-to-Source Voltage | ± 20 | |
| I_D @ $T_C = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ | 19 | A |
| I_D @ $T_A = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ | 4.2 | |
| I_D @ $T_A = 70^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ | 3.4 | |
| I_{DM} | Pulsed Drain Current ① | 34 | |
| P_D @ $T_C = 25^\circ C$ | Maximum Power Dissipation | 42 | W |
| P_D @ $T_A = 25^\circ C$ | Power Dissipation ③ | 2.2 | |
| P_D @ $T_A = 70^\circ C$ | Power Dissipation ③ | 1.4 | |
| | Linear Derating Factor | 0.017 | W/ $^\circ C$ |
| T_J | Operating Junction and | -40 to + 150 | $^\circ C$ |
| T_{STG} | Storage Temperature Range | | |

Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|--------------------|-------------------------|------|------|--------------|
| $R_{\theta JA}$ | Junction-to-Ambient ③⑨ | — | 58 | $^\circ C/W$ |
| $R_{\theta JA}$ | Junction-to-Ambient ⑥⑨ | 12.5 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient ⑦⑨ | 20 | — | |
| $R_{\theta JC}$ | Junction-to-Case ③⑨ | — | 3.0 | |
| $R_{\theta J-PCB}$ | Junction-to-PCB Mounted | 1.4 | — | |

Notes ① through ⑩ are on page 2

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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 | 100 | — | — | V | $V_{GS} = 0V, I_D = 250\mu A$ |
| $\Delta V_{(BR)DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.12 | — | V/°C | Reference to $25^\circ\text{C}, I_D = 1\text{mA}$ |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | 53 | 62 | m Ω | $V_{GS} = 10V, I_D = 5.0A$ ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 3.0 | — | 5.0 | V | $V_{DS} = V_{GS}, I_D = 250\mu A$ |
| I_{DSS} | Drain-to-Source Leakage Current | — | — | 20 | μA | $V_{DS} = 100V, V_{GS} = 0V$ |
| | | — | — | 250 | | $V_{DS} = 80V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ |
| I_{GSS} | Gate-to-Source Forward Leakage | — | — | 100 | nA | $V_{GS} = 20V$ |
| | Gate-to-Source Reverse Leakage | — | — | -100 | | $V_{GS} = -20V$ |
| $R_{G(int)}$ | Internal Gate Resistance | — | 1.9 | 2.9 | Ω | |

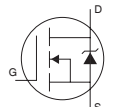
Dynamic @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|-----------------|--------------------------------------|------|------|------|-------|--|
| gfs | Forward Transconductance | 6.6 | — | — | S | $V_{DS} = 10V, I_D = 5.0A$ |
| Q_g | Total Gate Charge | — | 8.4 | 13 | nC | $V_{DS} = 50V$ $V_{GS} = 10V$ $I_D = 5.0A$ See Fig. 6 and 17 |
| Q_{gs1} | Pre-Vth Gate-to-Source Charge | — | 2.2 | — | | |
| Q_{gs2} | Post-Vth Gate-to-Source Charge | — | 0.64 | — | | |
| Q_{gd} | Gate-to-Drain Charge | — | 2.8 | — | | |
| Q_{godr} | Gate Charge Overdrive | — | 2.8 | — | | |
| Q_{sw} | Switch Charge ($Q_{gs2} + Q_{gd}$) | — | 3.4 | — | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 7.4 | — | ns | $V_{DD} = 50V$ $I_D = 5.0A$ $R_G = 6.0\Omega$ $V_{GS} = 10V$ ④ |
| t_r | Rise Time | — | 2.8 | — | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 14 | — | | |
| t_f | Fall Time | — | 4.3 | — | | |
| C_{iss} | Input Capacitance | — | 530 | — | pF | $V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1.0\text{MHz}$ $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$ $V_{GS} = 0V, V_{DS} = 80V, f = 1.0\text{MHz}$ $V_{GS} = 0V, V_{DS} = 0V$ to $80V$ ⑤ |
| C_{oss} | Output Capacitance | — | 110 | — | | |
| C_{rss} | Reverse Transfer Capacitance | — | 29 | — | | |
| C_{oss} | Output Capacitance | — | 510 | — | | |
| C_{oss} | Output Capacitance | — | 67 | — | | |
| $C_{oss\ eff.}$ | Effective Output Capacitance | — | 130 | — | | |

Avalanche Characteristics

| | Parameter | Typ. | Max. | Units |
|----------|---------------------------------|------|------|-------|
| E_{AS} | Single Pulse Avalanche Energy ② | — | 11 | mJ |
| I_{AR} | Avalanche Current ① | — | 5.0 | A |

Diode Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|----------|---|------|------|------|-------|--|
| I_S | Continuous Source Current (Body Diode) | — | — | 38 | A | MOSFET symbol showing the integral reverse p-n junction diode.  |
| I_{SM} | Pulsed Source Current (Body Diode) ① | — | — | 34 | | |
| V_{SD} | Diode Forward Voltage | — | — | 1.3 | V | $T_J = 25^\circ\text{C}, I_S = 5.0A, V_{GS} = 0V$ ④ |
| t_{rr} | Reverse Recovery Time | — | 31 | — | ns | $T_J = 25^\circ\text{C}, I_F = 5.0A, V_{DD} = 25V$ |
| Q_{rr} | Reverse Recovery Charge | — | 37 | — | nC | $di/dt = 100A/\mu s$ ④ |

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting $T_J = 25^\circ\text{C}, L = 0.89\text{mH}, R_G = 25\Omega, I_{AS} = 5.0A$.
- ③ Surface mounted on 1 in. square Cu board.
- ④ Pulse width $\leq 400\mu s$; 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} .

- ⑥ Used double sided cooling, mounting pad.
- ⑦ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.
- ⑧ T_C measured with thermal couple mounted to top (Drain) of part.
- ⑨ R_{θ} is measured at T_J of approximately 90°C .
- ⑩ Based on testing done using a typical device & evaluation board at $V_{bus} = \pm 45V, f_{SW} = 400\text{kHz}$, and $T_A = 25^\circ\text{C}$. The delta case temperature ΔT_C is 55°C .

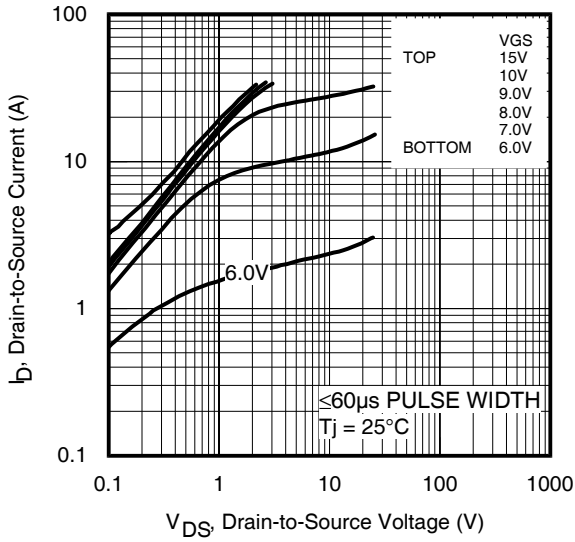


Fig 1. Typical Output Characteristics

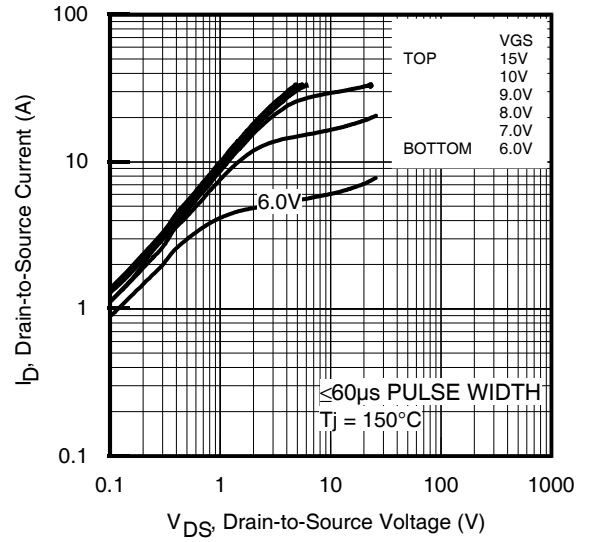


Fig 2. Typical Output Characteristics

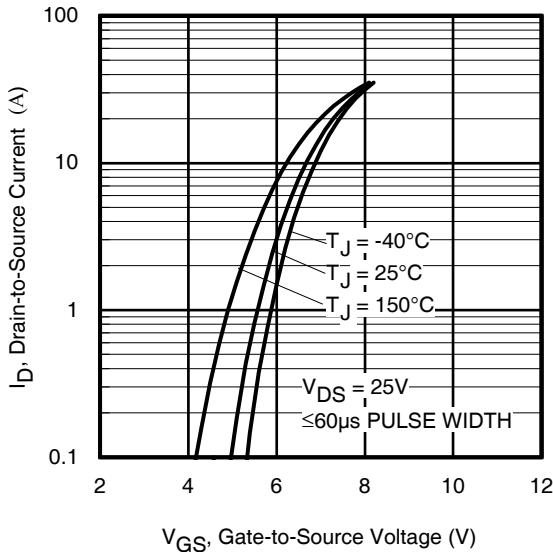


Fig 3. Typical Transfer Characteristics

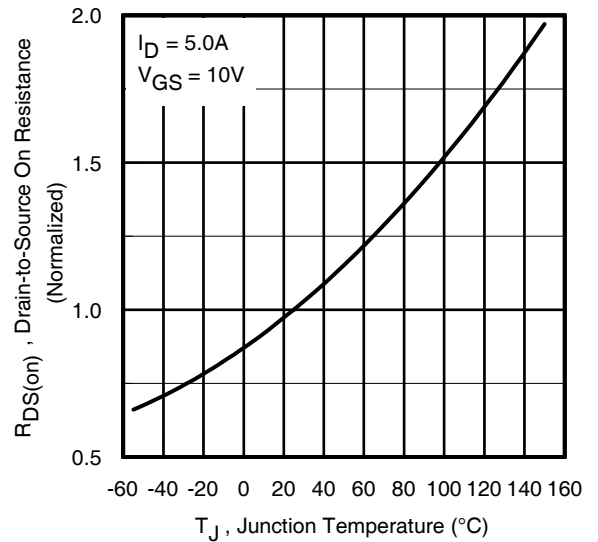


Fig 4. Normalized On-Resistance vs. Temperature

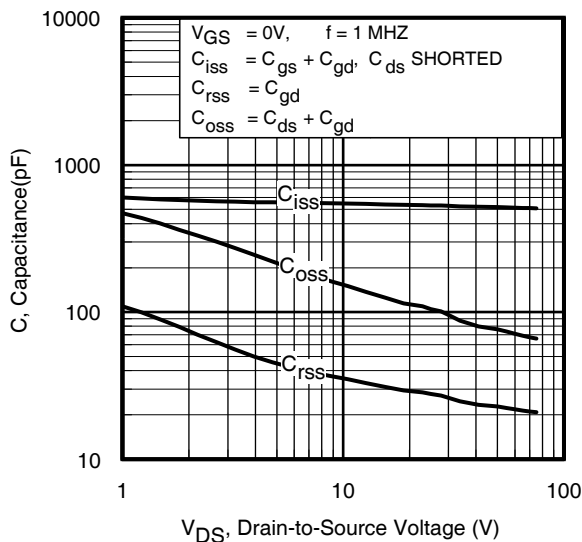


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

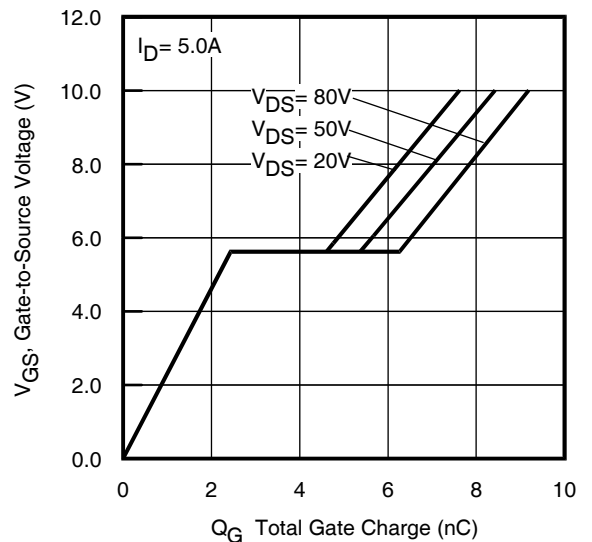


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

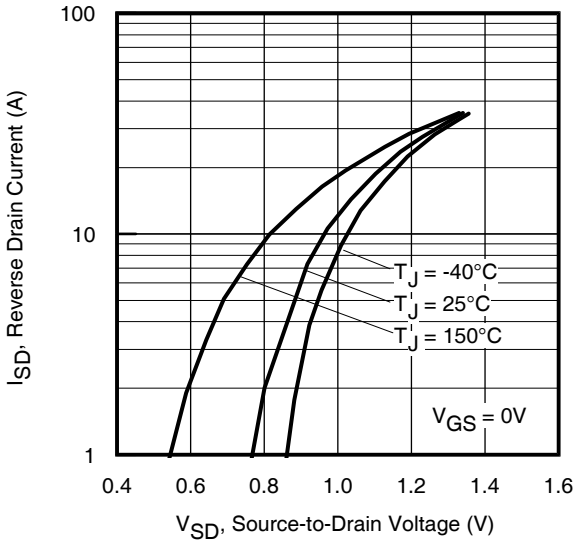


Fig 7. Typical Source-Drain Diode Forward Voltage

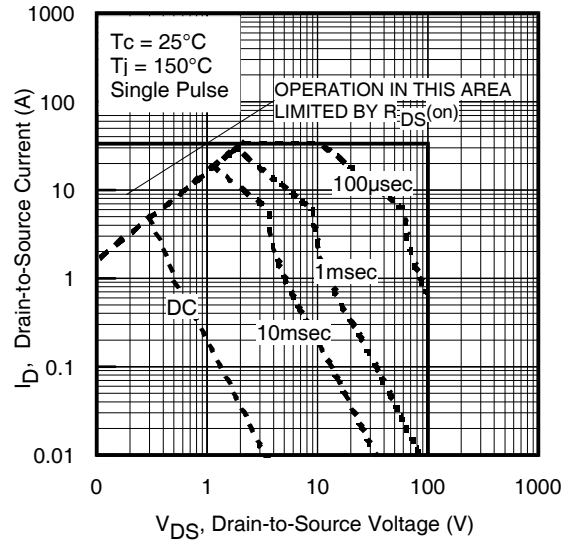


Fig 8. Maximum Safe Operating Area

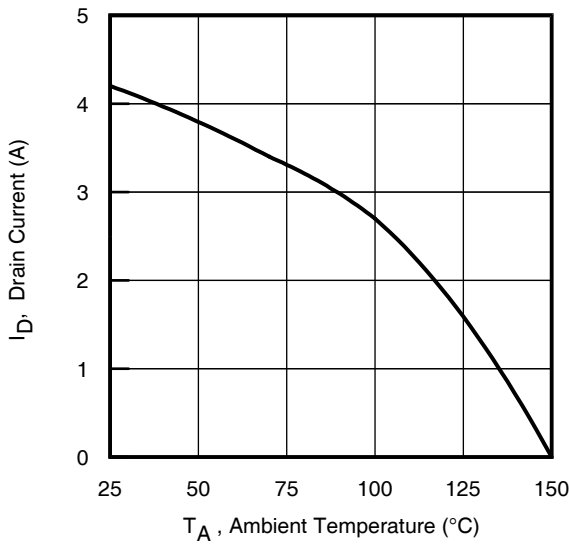


Fig 9. Maximum Drain Current vs. Ambient Temperature

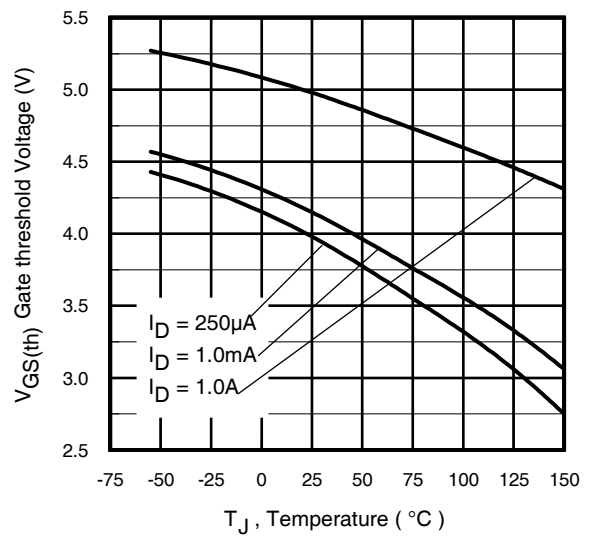


Fig 10. Threshold Voltage vs. Temperature

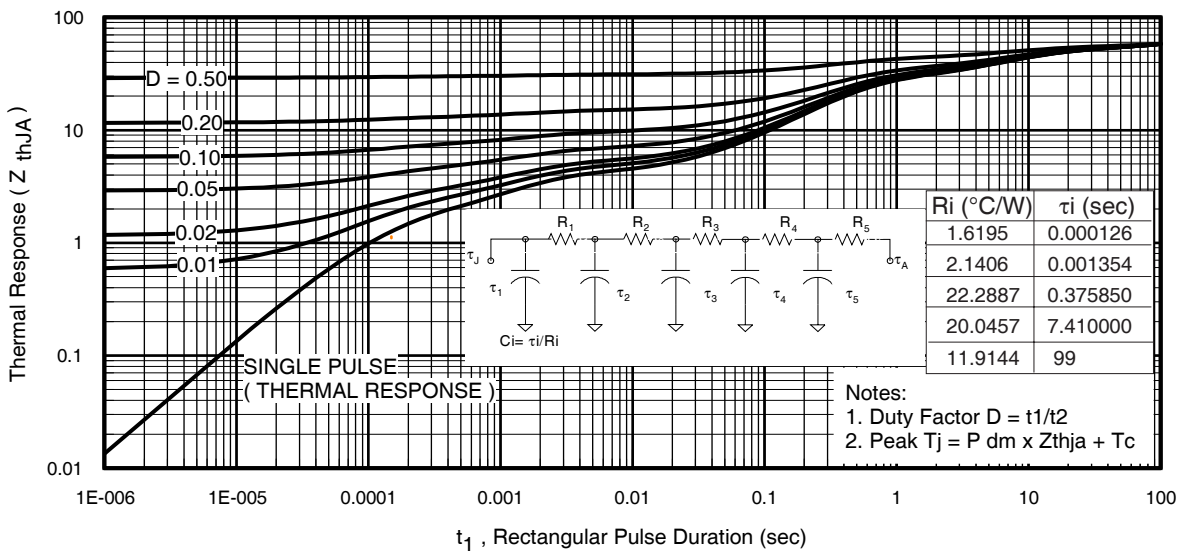


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient ©

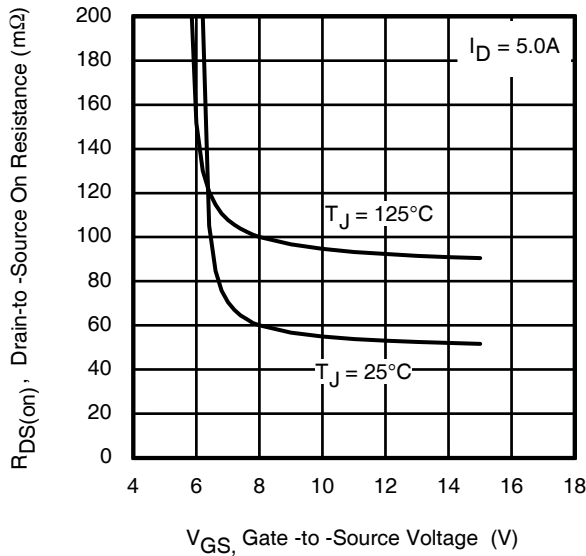


Fig 12. On-Resistance vs. Gate Voltage

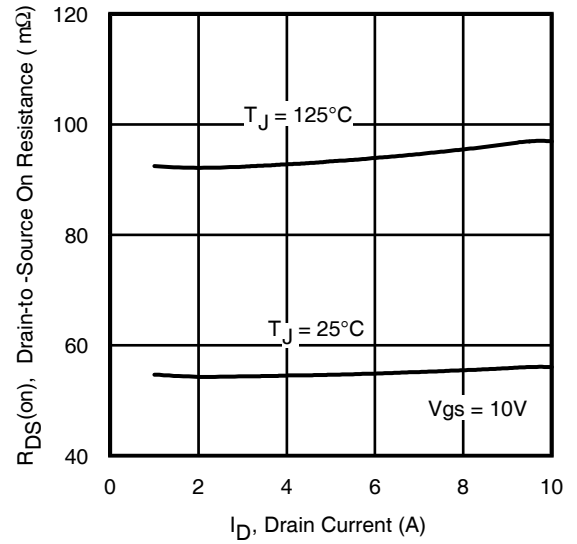


Fig 13. On-Resistance vs. Drain Current

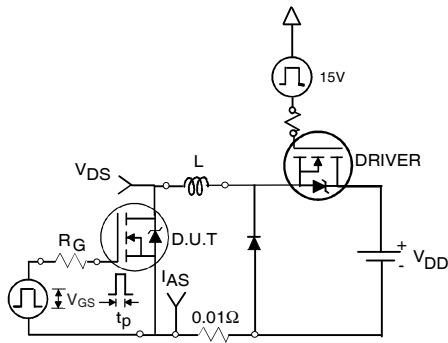


Fig 15a. Unclamped Inductive Test Circuit

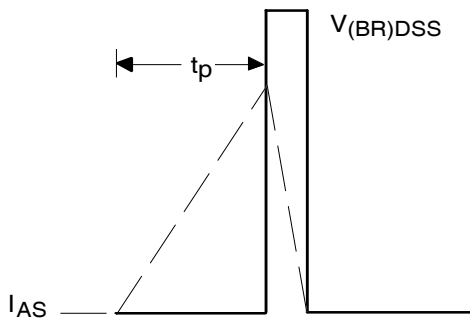


Fig 15b. Unclamped Inductive Waveforms

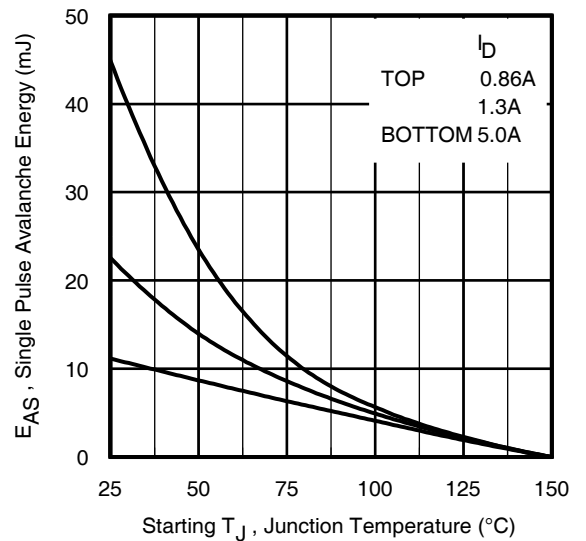


Fig 14. Maximum Avalanche Energy vs. Drain Current

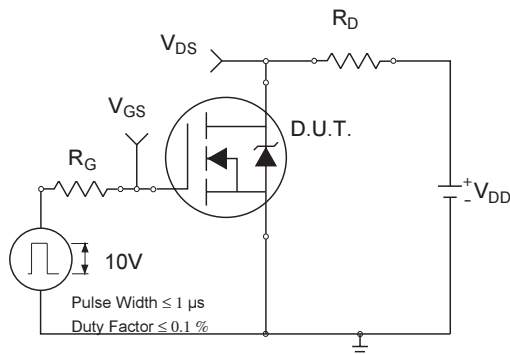


Fig 16a. Switching Time Test Circuit

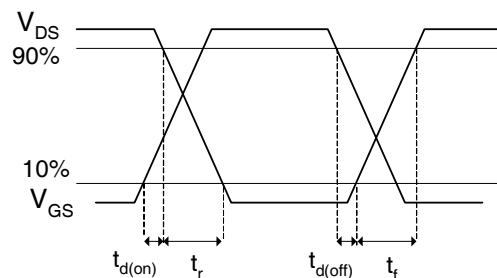


Fig 16b. Switching Time Waveforms

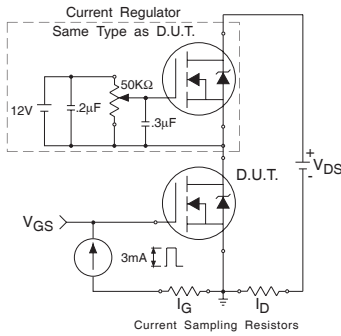


Fig 17a. Gate Charge Test Circuit

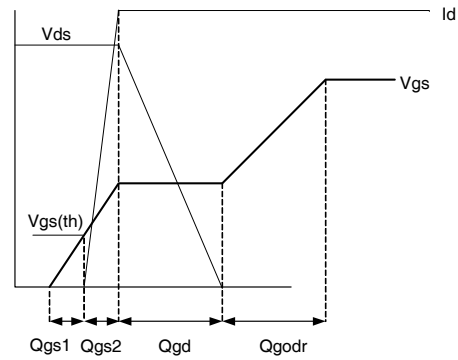
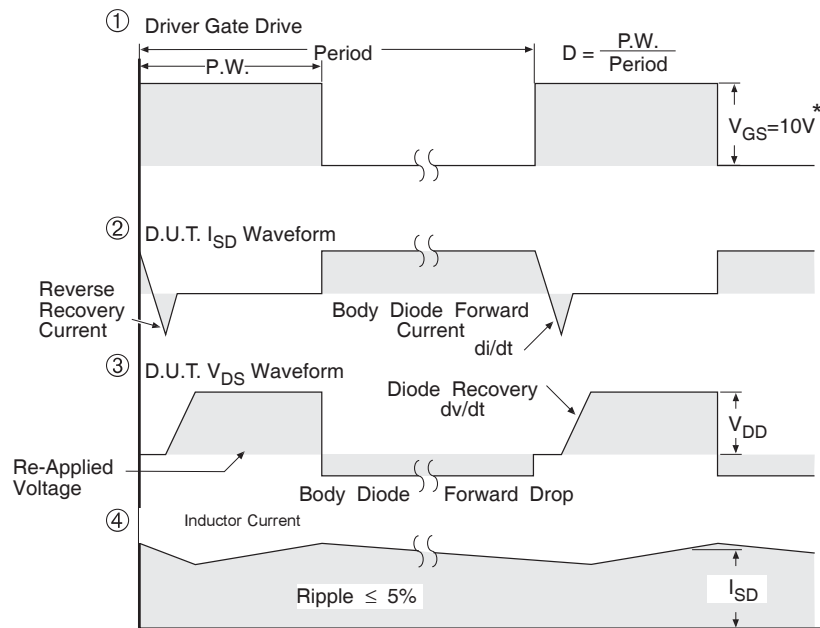
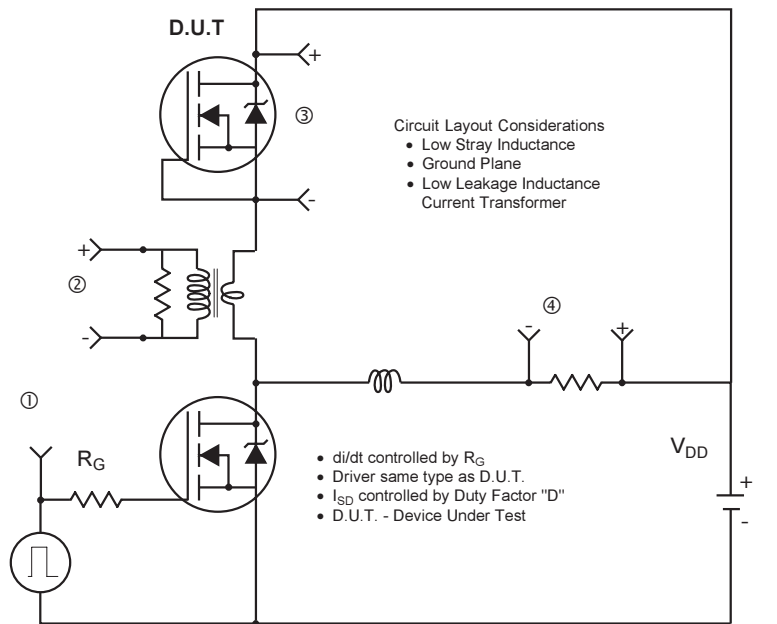


Fig 17b. Gate Charge Waveform

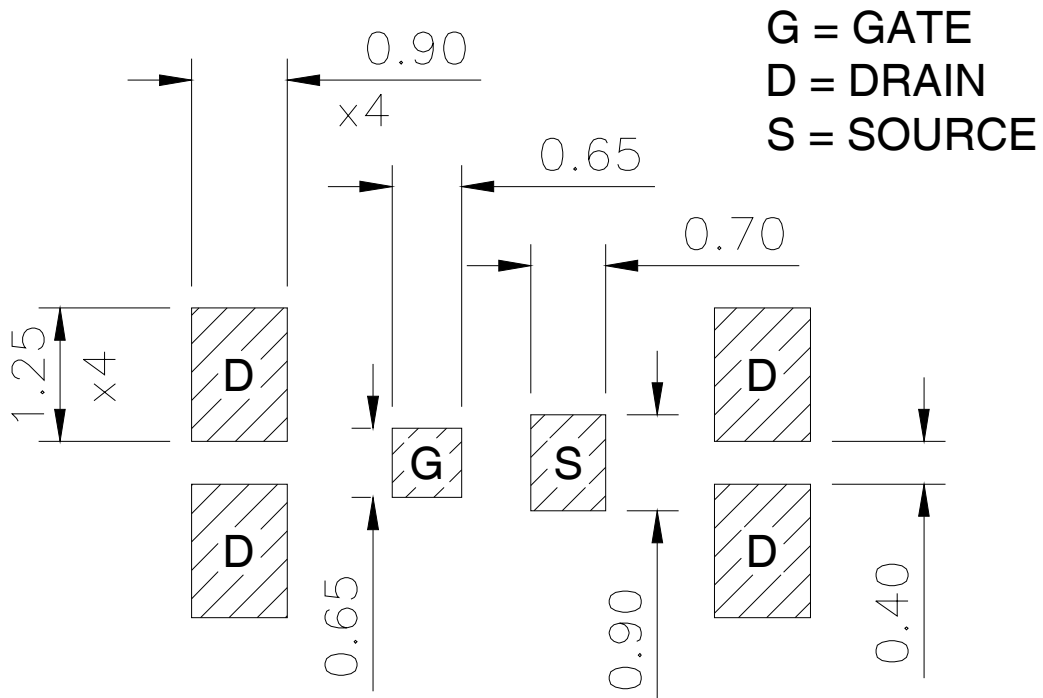
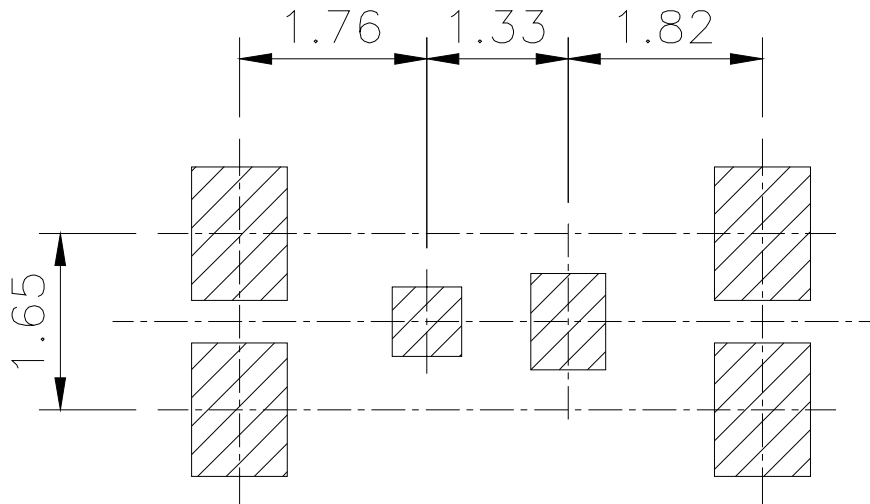


* $V_{GS} = 5V$ for Logic Level Devices

Fig 18. Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs

**DirectFET™ Substrate and PCB Layout, SH Outline
 (Small Size Can, H-Designation).**

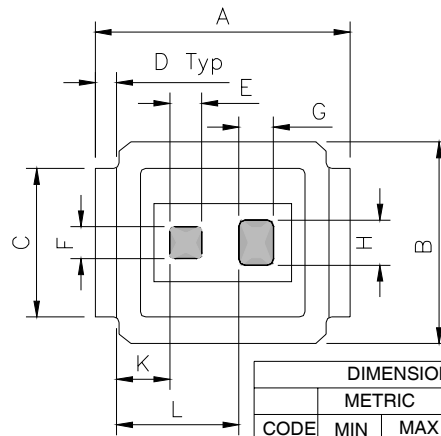
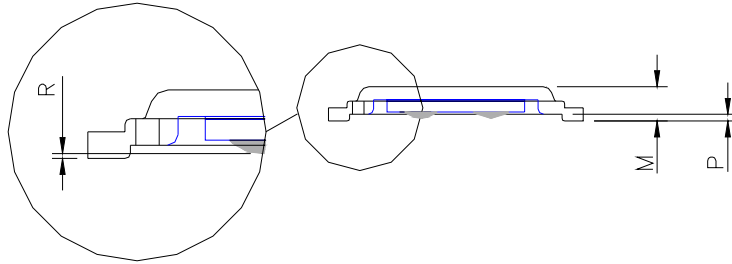
Please see DirectFET application note AN-1035 for all details regarding PCB assembly using DirectFET. This includes all recommendations for stencil and substrate designs.



IRF6665PbF

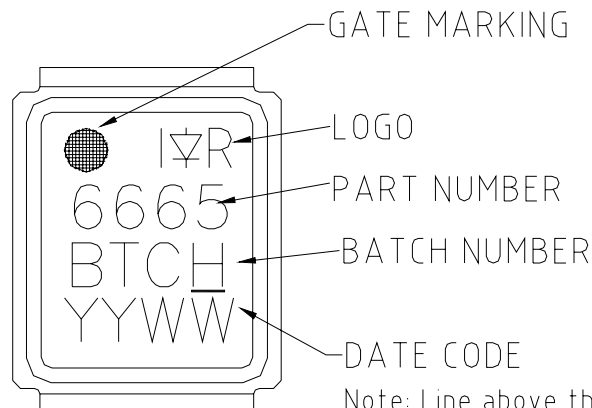
DirectFET™ Outline Dimension, SH Outline (Small Size Can, H-Designation).

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



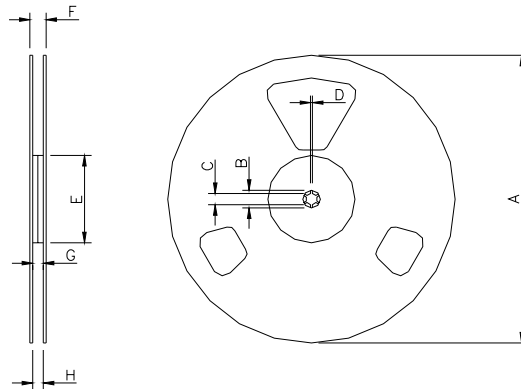
| CODE | DIMENSIONS | | DIMENSIONS | |
|------|------------|-------|------------|--------|
| | MIN | MAX | MIN | MAX |
| A | 4.75 | 4.85 | 0.187 | 0.191 |
| B | 3.70 | 3.95 | 0.146 | 0.156 |
| C | 2.75 | 2.85 | 0.108 | 0.112 |
| D | 0.35 | 0.45 | 0.014 | 0.018 |
| E | 0.58 | 0.62 | 0.023 | 0.024 |
| F | 0.58 | 0.62 | 0.023 | 0.024 |
| G | 0.63 | 0.67 | 0.025 | 0.026 |
| H | 0.83 | 0.87 | 0.033 | 0.034 |
| K | 0.99 | 1.03 | 0.039 | 0.041 |
| L | 2.29 | 2.33 | 0.090 | 0.092 |
| 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".

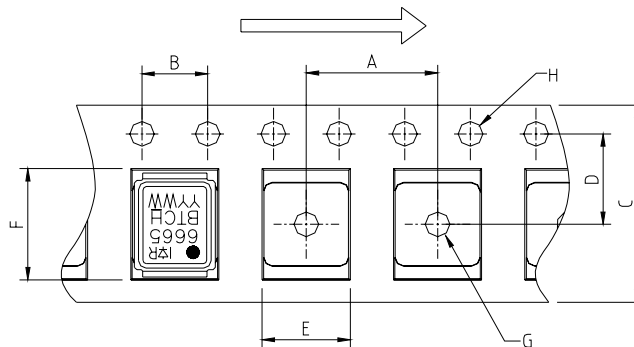
DirectFET™ Tape & Reel Dimension (Showing component orientation).



NOTE: Controlling dimensions in mm
 Std reel quantity is 4800 parts. (ordered as IRF6665TRPBF). For 1000 parts on 7" reel, order IRF6665TR1PBF

| REEL DIMENSIONS | | | | | | | | |
|-----------------|----------------------------|------|----------|-------|-----------------------|-------|----------|------|
| CODE | STANDARD OPTION (QTY 4800) | | | | TR1 OPTION (QTY 1000) | | | |
| | METRIC | | IMPERIAL | | METRIC | | IMPERIAL | |
| | 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



| CODE | DIMENSIONS | | | |
|------|------------|-------|----------|-------|
| | METRIC | | IMPERIAL | |
| | 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 | 4.00 | 4.20 | 0.158 | 0.165 |
| F | 5.00 | 5.20 | 0.197 | 0.205 |
| 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.

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