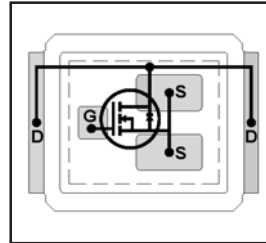


# IRF6608/IRF6608TR1

HEXFET® Power MOSFET

- Application Specific MOSFETs
- Ideal for CPU Core DC-DC Converters
- Low Conduction Losses
- Low Switching Losses
- Low Profile (<0.7 mm)
- Dual Sided Cooling Compatible
- Compatible with existing Surface Mount Techniques

| $V_{DS}$ | $R_{DS(on)}$ max            | $Q_g$ |
|----------|-----------------------------|-------|
| 30V      | $9.0m\Omega @ V_{GS} = 10V$ | 16nC  |
|          | $11m\Omega @ V_{GS} = 4.5V$ |       |



## Description

The IRF6608 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 a MICRO-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 IRF6608 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 IRF6608 has been optimized for parameters that are critical in synchronous buck converters including  $R_{DS(on)}$ , gate charge and  $C_{dv}/dt$ -induced turn on immunity. The IRF6608 has been optimized for parameters that are critical in synchronous buck converters including  $R_{DS(on)}$  and gate charge to minimize losses in the control FET socket.

## Absolute Maximum Ratings

|                          | Parameter                                | Max.         | Units |
|--------------------------|------------------------------------------|--------------|-------|
| $V_{DS}$                 | Drain-to-Source Voltage                  | 30           | V     |
| $V_{GS}$                 | Gate-to-Source Voltage                   | $\pm 12$     |       |
| $I_D @ T_C = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ | 55           | A     |
| $I_D @ T_A = 25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ | 13           |       |
| $I_D @ T_A = 70^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V$ | 10           |       |
| $I_{DM}$                 | Pulsed Drain Current ①                   | 100          |       |
| $P_D @ T_A = 25^\circ C$ | Power Dissipation ⑤                      | 2.1          | W     |
| $P_D @ T_A = 70^\circ C$ | Power Dissipation ⑤                      | 1.4          |       |
| $P_D @ T_C = 25^\circ C$ | Power Dissipation                        | 42           |       |
|                          | Linear Derating Factor                   | 0.017        | W/°C  |
| $T_J$                    | Operating Junction and                   | -40 to + 150 | °C    |
| $T_{STG}$                | Storage Temperature Range                |              |       |

## Thermal Resistance

|                    | Parameter               | Typ. | Max. | Units |
|--------------------|-------------------------|------|------|-------|
| $R_{\theta JA}$    | Junction-to-Ambient ④   | —    | 58   | °C/W  |
| $R_{\theta JA}$    | Junction-to-Ambient ⑤   | 12.5 | —    |       |
| $R_{\theta JA}$    | Junction-to-Ambient ⑥   | 20   | —    |       |
| $R_{\theta JC}$    | Junction-to-Case ⑦      | —    | 3.0  |       |
| $R_{\theta J-PCB}$ | Junction-to-PCB Mounted | 1.0  | —    |       |

Notes ① through ⑦ are on page 10

# IRF6608/IRF6608TR1

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

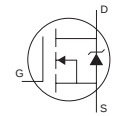
|                                | Parameter                                  | Min. | Typ. | Max. | Units                | Conditions                                                                |
|--------------------------------|--------------------------------------------|------|------|------|----------------------|---------------------------------------------------------------------------|
| $BV_{DSS}$                     | 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        | —    | 29   | —    | mV/ $^\circ\text{C}$ | Reference to $25^\circ\text{C}$ , $I_D = 1mA$                             |
| $R_{DS(on)}$                   | Static Drain-to-Source On-Resistance       | —    | 7.0  | 9.0  | $m\Omega$            | $V_{GS} = 10V, I_D = 13A$ ③                                               |
|                                |                                            | —    | 8.0  | 11   |                      | $V_{GS} = 4.5V, I_D = 10A$ ③                                              |
| $V_{GS(th)}$                   | Gate Threshold Voltage                     | 1.0  | —    | 3.0  | V                    | $V_{DS} = V_{GS}, I_D = 250\mu A$                                         |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Coefficient         | —    | -5.4 | —    | mV/ $^\circ\text{C}$ |                                                                           |
| $I_{DSS}$                      | Drain-to-Source Leakage Current            | —    | —    | 30   | $\mu A$              | $V_{DS} = 24V, V_{GS} = 0V$                                               |
|                                |                                            | —    | —    | 100  |                      | $V_{DS} = 24V, V_{GS} = 0V, T_J = 125^\circ\text{C}$                      |
| $I_{GSS}$                      | Gate-to-Source Forward Leakage             | —    | —    | 100  | nA                   | $V_{GS} = 12V$                                                            |
|                                | Gate-to-Source Reverse Leakage             | —    | —    | -100 |                      | $V_{GS} = -12V$                                                           |
| $g_{fs}$                       | Forward Transconductance                   | 28   | —    | —    | S                    | $V_{DS} = 15V, I_D = 8.8A$                                                |
| $Q_g$                          | Total Gate Charge                          | —    | 16   | 24   | nC                   | $V_{DS} = 15V$<br>$V_{GS} = 4.5V$<br>$I_D = 8.8A$<br>See Fig. 16          |
| $Q_{gs1}$                      | Pre-V <sub>th</sub> Gate-to-Source Charge  | —    | 4.6  | —    |                      |                                                                           |
| $Q_{gs2}$                      | Post-V <sub>th</sub> Gate-to-Source Charge | —    | 1.4  | —    |                      |                                                                           |
| $Q_{gd}$                       | Gate-to-Drain Charge                       | —    | 5.3  | —    |                      |                                                                           |
| $Q_{godr}$                     | Gate Charge Overdrive                      | —    | 4.7  | —    |                      |                                                                           |
| $Q_{sw}$                       | Switch Charge ( $Q_{gs2} + Q_{gd}$ )       | —    | 6.7  | —    |                      |                                                                           |
| $Q_{oss}$                      | Output Charge                              | —    | 11   | —    | nC                   | $V_{DS} = 15V, V_{GS} = 0V$                                               |
| $t_{d(on)}$                    | Turn-On Delay Time                         | —    | 13   | —    | ns                   | $V_{DD} = 15V, V_{GS} = 4.5V$ ③<br>$I_D = 8.8A$<br>Clamped Inductive Load |
| $t_r$                          | Rise Time                                  | —    | 12   | —    |                      |                                                                           |
| $t_{d(off)}$                   | Turn-Off Delay Time                        | —    | 16   | —    |                      |                                                                           |
| $t_f$                          | Fall Time                                  | —    | 3.4  | —    |                      |                                                                           |
| $C_{iss}$                      | Input Capacitance                          | —    | 2120 | —    | pF                   | $V_{GS} = 0V$                                                             |
| $C_{oss}$                      | Output Capacitance                         | —    | 440  | —    |                      | $V_{DS} = 15V$                                                            |
| $C_{rss}$                      | Reverse Transfer Capacitance               | —    | 260  | —    |                      | $f = 1.0MHz$                                                              |

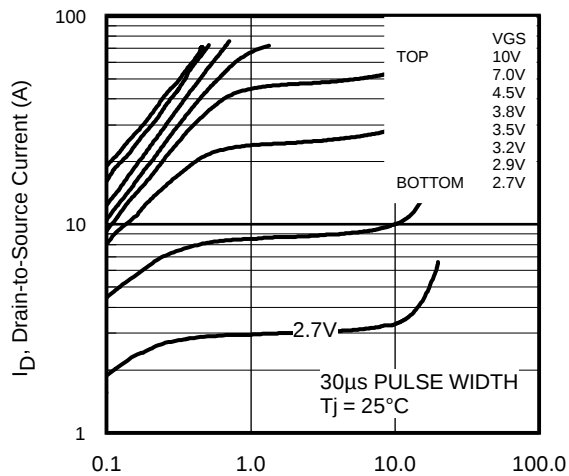
## Avalanche Characteristics

|          | Parameter                       | Typ. | Max. | Units |
|----------|---------------------------------|------|------|-------|
| $E_{AS}$ | Single Pulse Avalanche Energy ② | —    | 54   | mJ    |
| $I_{AR}$ | Avalanche Current ①             | —    | 8.8  | A     |
| $E_{AR}$ | Repetitive Avalanche Energy ①   | —    | 0.21 | mJ    |

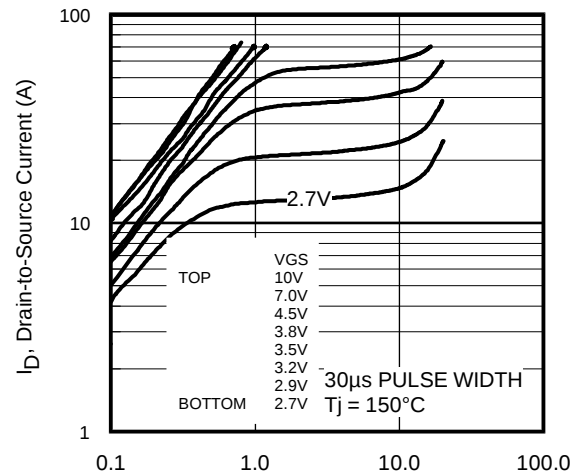
## Diode Characteristics

|          | Parameter                                 | Min. | Typ. | Max. | Units | Conditions                                                              |
|----------|-------------------------------------------|------|------|------|-------|-------------------------------------------------------------------------|
| $I_S$    | Continuous Source Current<br>(Body Diode) | —    | —    | 13   | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$ | Pulsed Source Current<br>(Body Diode) ①   | —    | —    | 100  |       |                                                                         |
| $V_{SD}$ | Diode Forward Voltage                     | —    | 0.94 | 1.2  | V     | $T_J = 25^\circ\text{C}, I_S = 8.8A, V_{GS} = 0V$ ③                     |
| $t_{rr}$ | Reverse Recovery Time                     | —    | 31   | 47   | ns    | $T_J = 25^\circ\text{C}, I_F = 8.8A$                                    |
| $Q_{rr}$ | Reverse Recovery Charge                   | —    | 33   | 50   | nC    | $di/dt = 100A/\mu s$ ③                                                  |

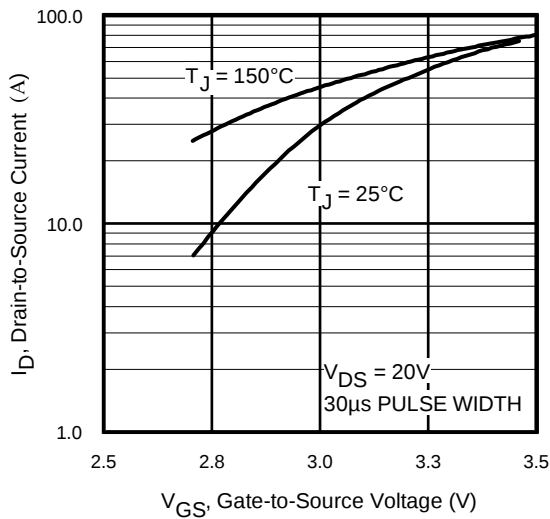




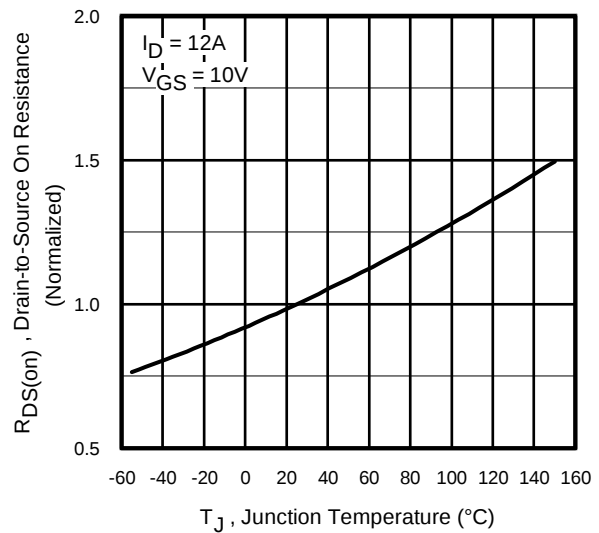
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics



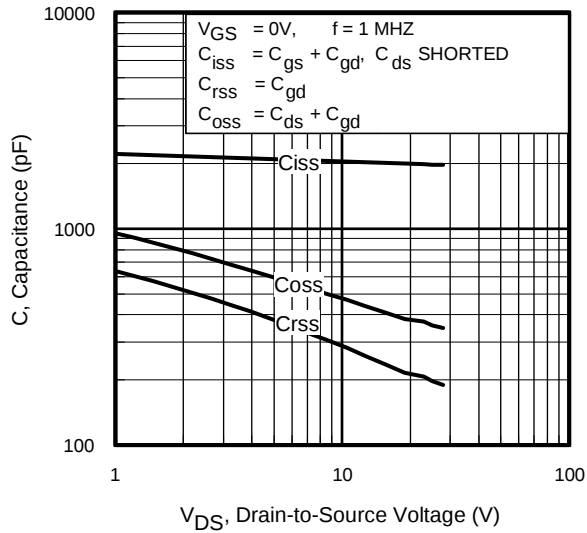
**Fig 3.** Typical Transfer Characteristics



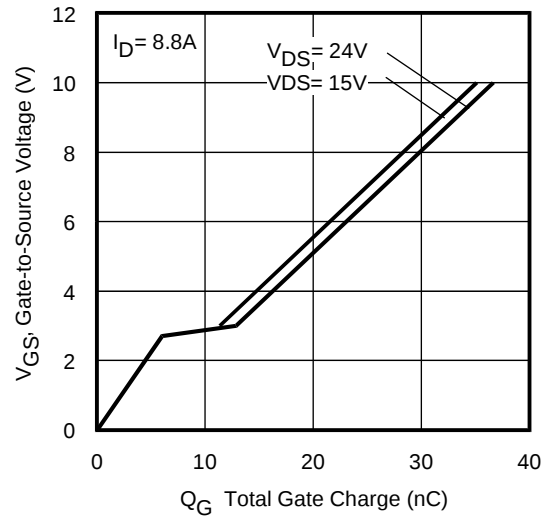
**Fig 4.** Normalized On-Resistance Vs. Temperature

# IRF6608/IRF6608TR1

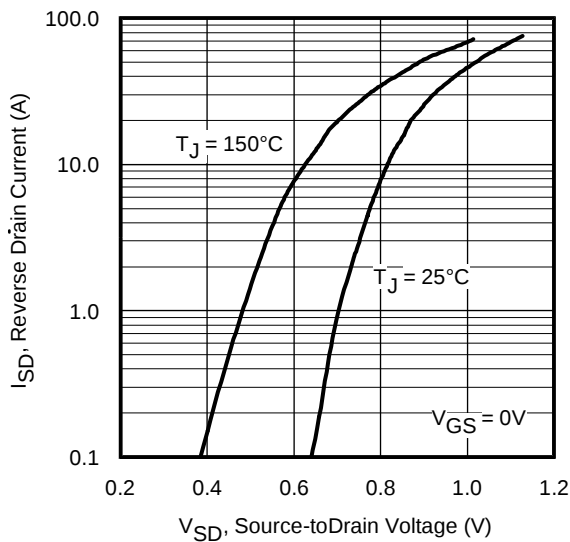
International  
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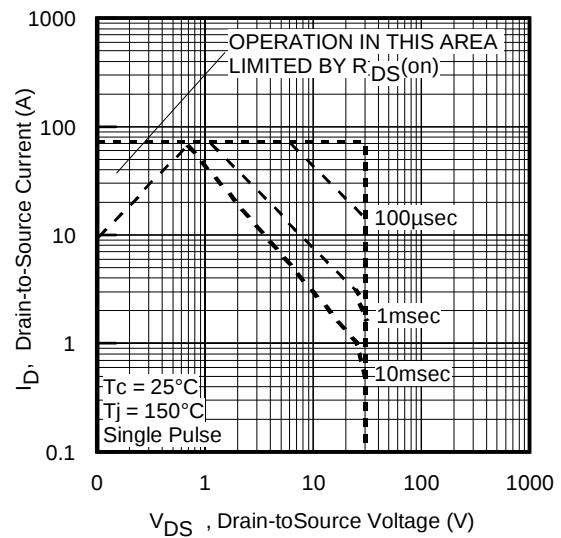
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



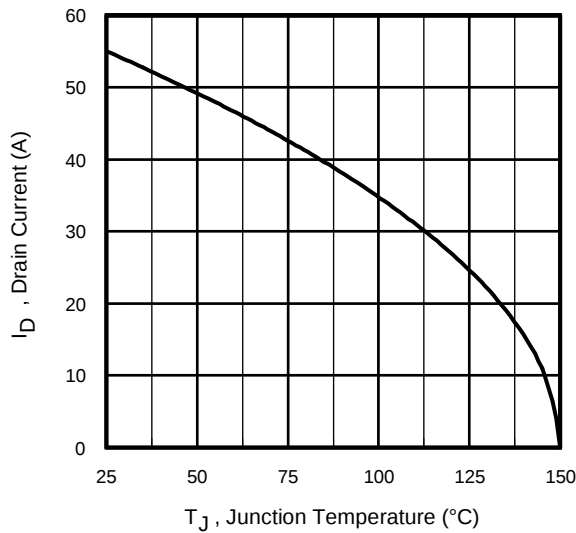
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



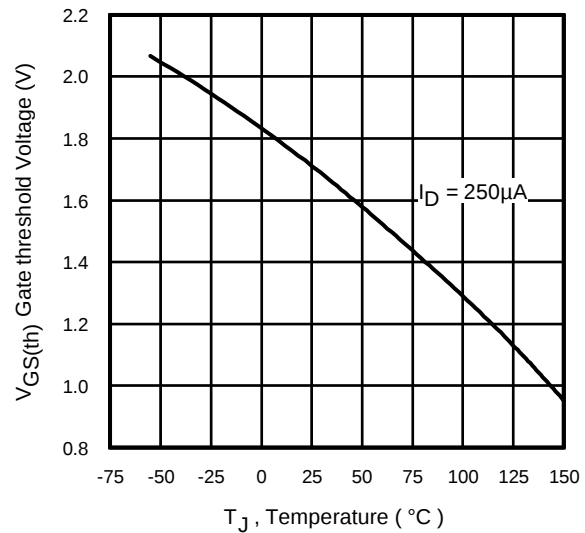
**Fig 7.** Typical Source-Drain Diode Forward Voltage



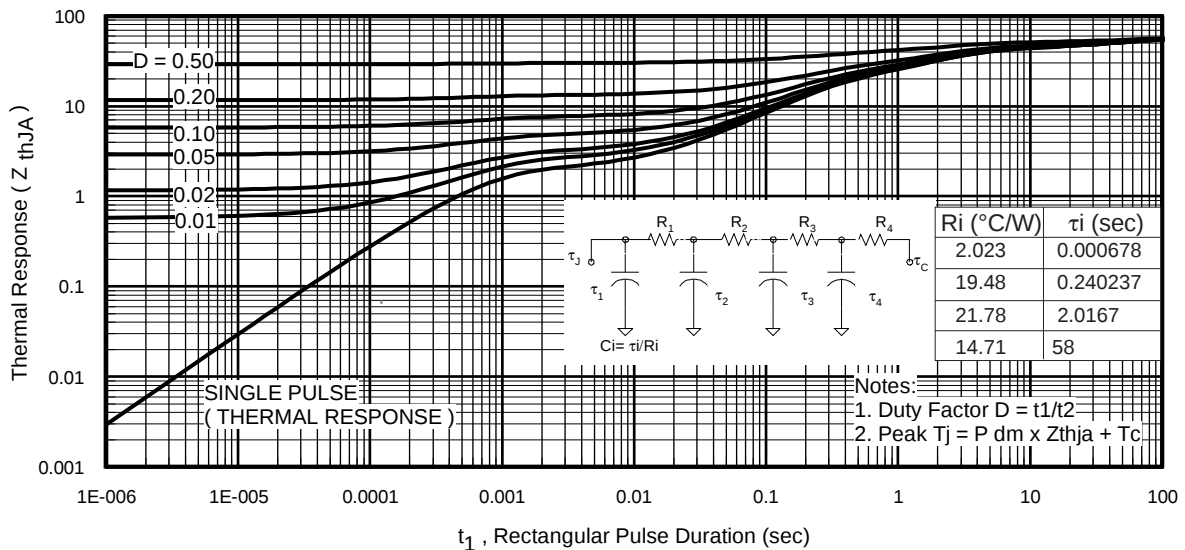
**Fig 8.** Maximum Safe Operating Area



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



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



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

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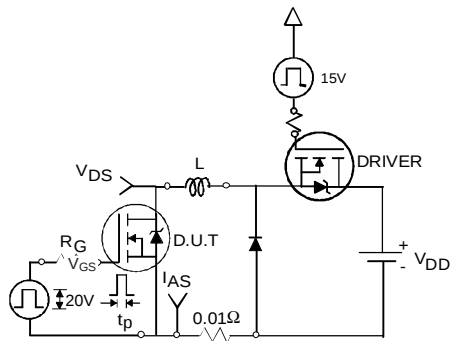
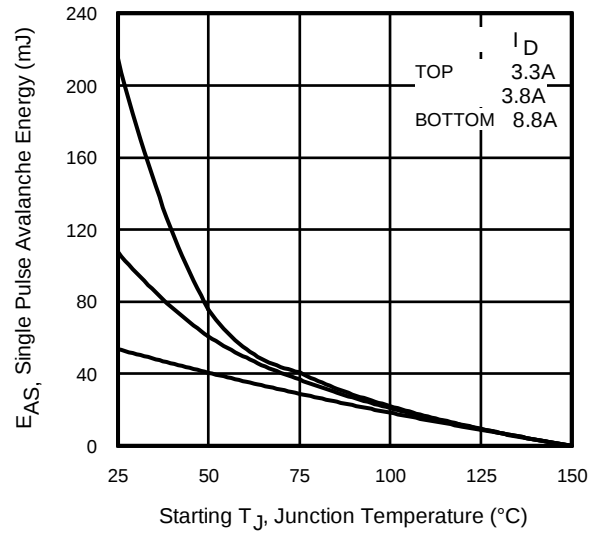
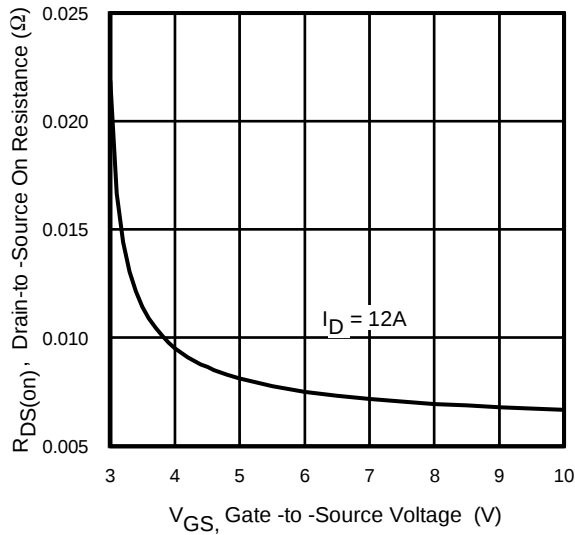


Fig 14a. Unclamped Inductive Test Circuit

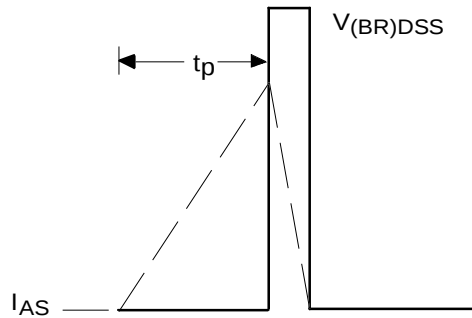


Fig 14b. Unclamped Inductive Waveforms

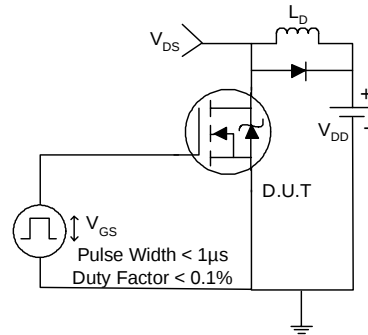


Fig 15a. Switching Time Test Circuit

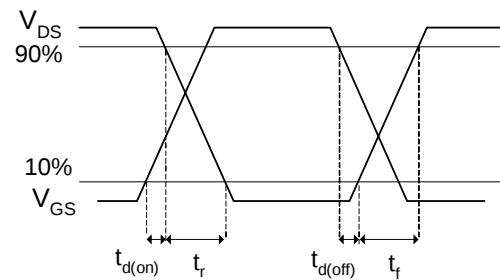
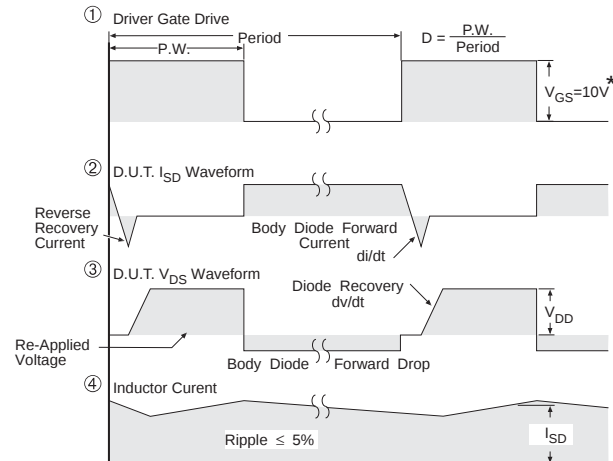
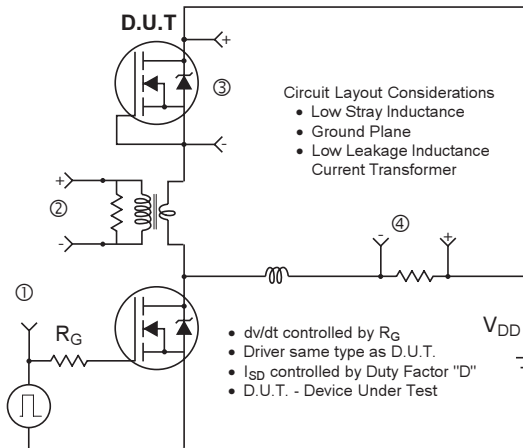
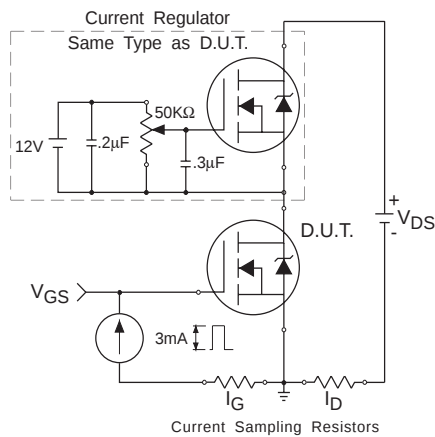


Fig 15b. Switching Time Waveforms

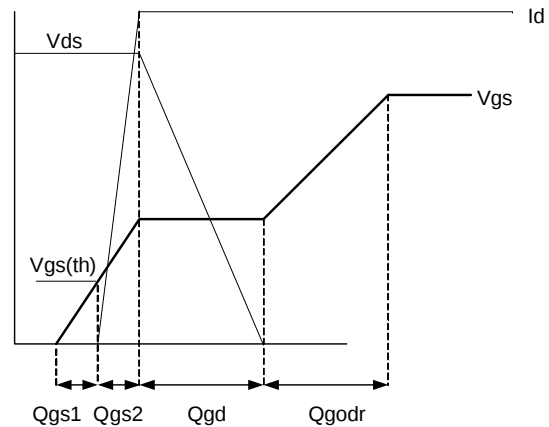
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**Fig 16. Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET® Power MOSFETs**



**Fig 17. Gate Charge Test Circuit**



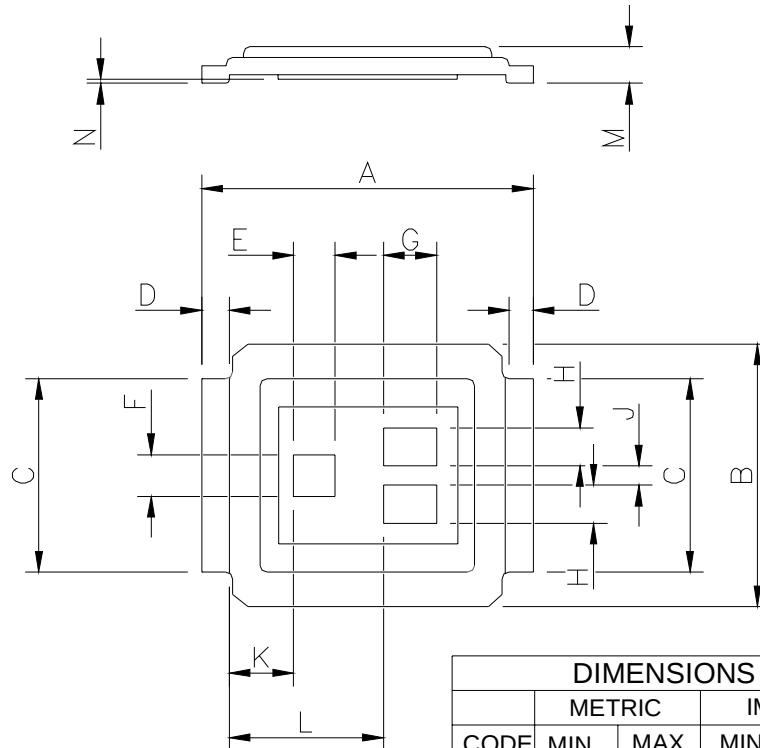
**Fig 18. Gate Charge Waveform**

# IRF6608/IRF6608TR1

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**IR** Rectifier

## DirectFET™ Outline Dimension, ST Outline (Small Size Can, T-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.

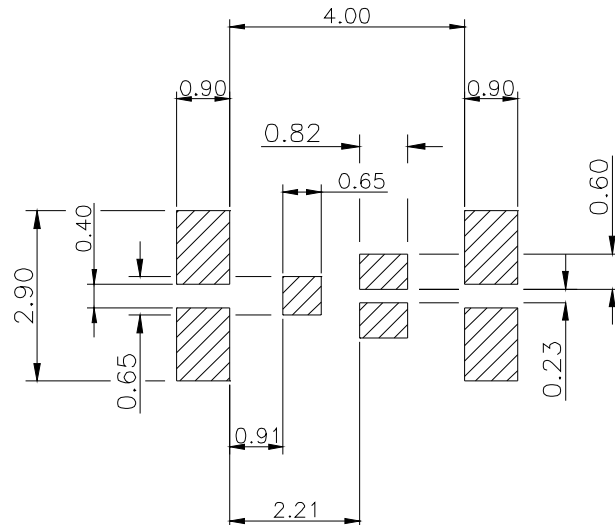


Note: Controlling  
dimensions are in mm

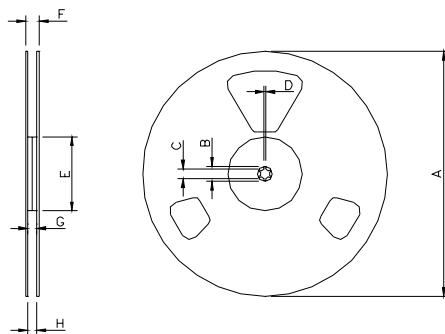
| DIMENSIONS |        |      |          |       |
|------------|--------|------|----------|-------|
|            | METRIC |      | IMPERIAL |       |
| CODE       | MIN    | MAX  | MIN      | MAX   |
| A          | 4.75   | 4.85 | 0.187    | 0.191 |
| B          | 3.70   | 3.95 | 0.146    | 0.156 |
| 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          | 0.75   | 0.79 | 0.030    | 0.031 |
| H          | 0.53   | 0.57 | 0.021    | 0.022 |
| J          | 0.26   | 0.30 | 0.010    | 0.012 |
| K          | 0.88   | 0.98 | 0.035    | 0.039 |
| L          | 2.18   | 2.28 | 0.086    | 0.090 |
| M          | 0.48   | 0.58 | 0.019    | 0.023 |
| N          | 0.03   | 0.08 | 0.001    | 0.003 |

## DirectFET™ Board Footprint, ST Outline (Small Size Can, T-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.

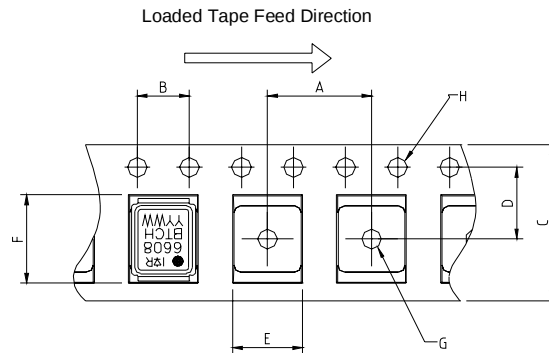


## DirectFET™ Tape & Reel Dimension (Showing component orientation).



NOTE: Controlling dimensions in mm  
Std reel quantity is 4800 parts. (ordered as IRF6618). For 1000 parts on 7" reel,  
order IRF6618TR1

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



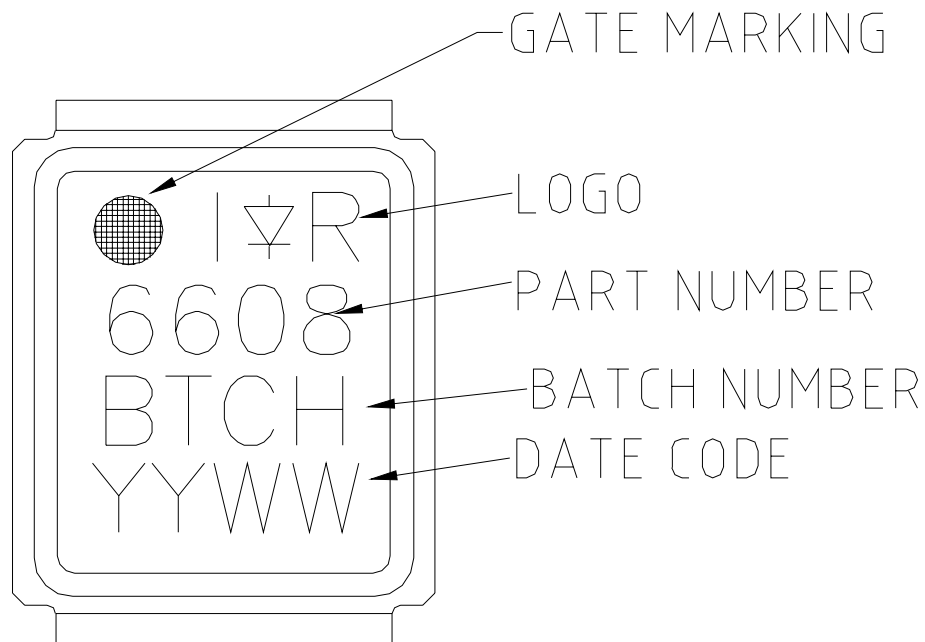
NOTE: CONTROLLING  
DIMENSIONS IN MM

| DIMENSIONS |       |       |       |       |
|------------|-------|-------|-------|-------|
| 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 |

# IRF6608/IRF6608TR1

International  
**IR** Rectifier

## DirectFET™ Part Marking



### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^{\circ}\text{C}$ ,  $L = 1.38\text{mH}$   
 $R_G = 25\Omega$ ,  $I_{AS} = 8.8\text{A}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④ Surface mounted on 1 in. square Cu board.
- ⑤ Used double sided cooling, mounting pad.
- ⑥ Mounted on minimum footprint full size board with metalized back and with small clip heatsink.
- ⑦  $T_C$  measured with thermal couple mounted to top (Drain) of part.

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.

International  
**IR** Rectifier

**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
TAC Fax: (310) 252-7903

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