

# IR MOSFET

DirectFET™ Power MOSFET ①②

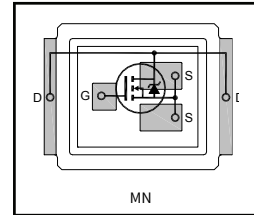
Typical values (unless otherwise specified)

| $V_{DS}$     | $V_{GS}$      | $R_{DS(on)}$ (typ.)  |
|--------------|---------------|----------------------|
| 100V min.    | $\pm 20V$ max | 10.3m $\Omega$ @ 10V |
| $Q_{g\ tot}$ | $Q_{gd}$      | $V_{gs(th)}$         |
| 28nC         | 9.0nC         | 3.7V                 |

Quality Requirement Category: Consumer

## Applications

- RoHS Compliant ①
- Lead-Free (Qualified up to 260°C Reflow)
- Application Specifies MOSFETs
- Ideal for High Performance Isolated Converter Primary Switch Socket
- Optimized for Synchronous Rectification
- Low Conduction Losses
- Low Profile (< 0.7mm)
- Dual Sided Cooling Compatible ①
- Compatible with existing Surface Mount Techniques ①



Applicable DirectFET® Outline and Substrate Outline (see pg. 13, 14 for details) ①

|    |    |    |  |    |    |  |  |  |  |  |  |
|----|----|----|--|----|----|--|--|--|--|--|--|
| SH | SJ | SP |  | MZ | MN |  |  |  |  |  |  |
|----|----|----|--|----|----|--|--|--|--|--|--|

## Description

The IRF6644PbF 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 a footprint of a 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 IRF6644PbF is optimized for primary side bridge topologies in isolated DC-DC applications, for wide range universal input Telecom applications (36V-75V), and for secondary side synchronous rectification in regulated DC-DC topologies. The reduced total losses in the device coupled with the high level of thermal performance enables high efficiency and low temperatures, which are key for system reliability improvements, and makes the device ideal for high performance isolated DC-DC converters.

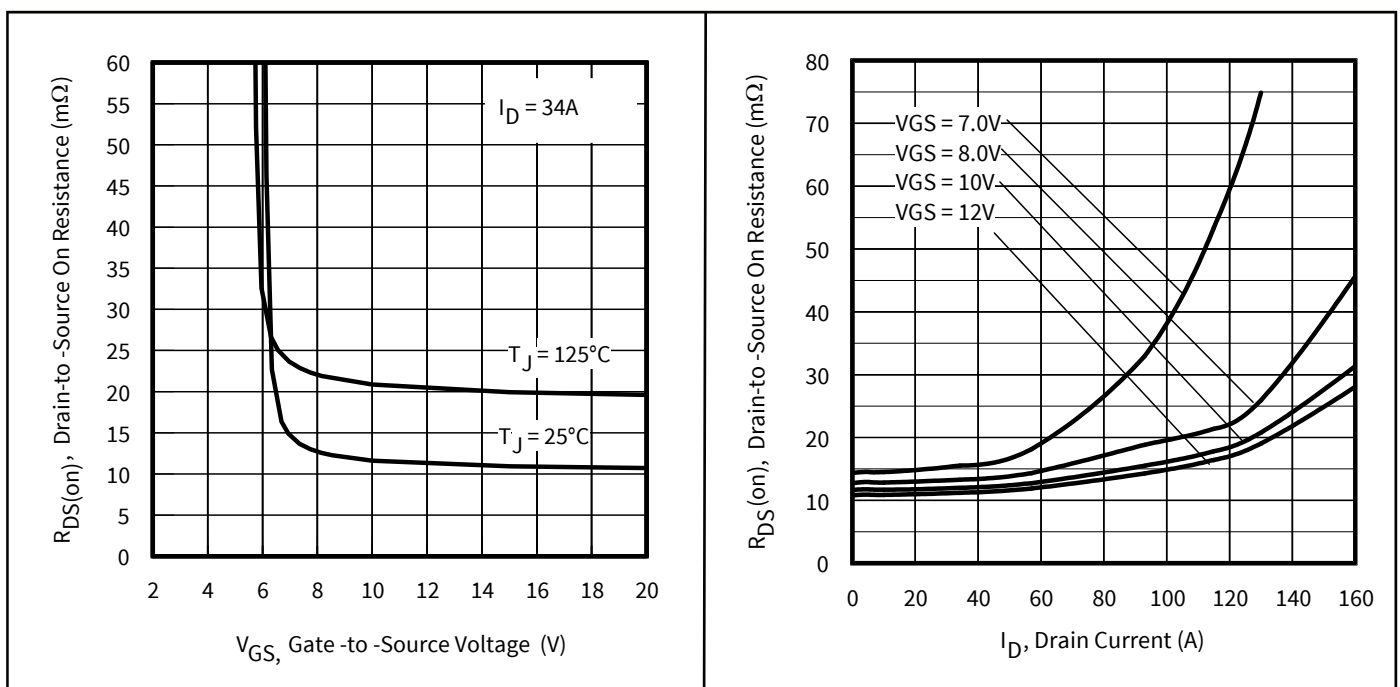


Figure 1 Typical On-Resistance vs. Gate Voltage

Figure 2 Typical On-Resistance vs. Drain Current



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## 1 Parameters

**Table1** Key performance parameters

| Parameter                      | Values | Units      |
|--------------------------------|--------|------------|
| $V_{DS}$                       | 100    | V          |
| $R_{DS(on) \max}$              | 13     | m $\Omega$ |
| $I_D @ T_C @ 25^\circ\text{C}$ | 57     | A          |
| $I_D @ T_A @ 25^\circ\text{C}$ | 10     | A          |

## 2 Maximum ratings and thermal characteristics

**Table 2 Maximum ratings (at  $T_J=25^\circ\text{C}$ , unless otherwise specified)**

| Parameter                                    | Symbol         | Conditions                                | Values      | Unit             |
|----------------------------------------------|----------------|-------------------------------------------|-------------|------------------|
| Continuous Drain Current (Silicon Limited) ④ | $I_D$          | $T_C = 25^\circ\text{C}$ , $V_{GS}$ @ 10V | 57          | A                |
| Continuous Drain Current (Silicon Limited) ④ | $I_D$          | $T_C = 70^\circ\text{C}$ , $V_{GS}$ @ 10V | 46          |                  |
| Continuous Drain Current (Silicon Limited) ③ | $I_D$          | $T_A = 25^\circ\text{C}$ , $V_{GS}$ @ 10V | 10          |                  |
| Pulsed Drain Current ⑤                       | $I_{DM}$       | $T_C = 25^\circ\text{C}$                  | 228         | W                |
| Maximum Power Dissipation ④                  | $P_D$          | $T_C = 25^\circ\text{C}$                  | 89          |                  |
| Maximum Power Dissipation ④                  | $P_D$          | $T_C = 70^\circ\text{C}$                  | 57          |                  |
| Maximum Power Dissipation ③                  | $P_D$          | $T_A = 25^\circ\text{C}$                  | 2.8         |                  |
| Gate-to-Source Voltage                       | $V_{GS}$       | -                                         | $\pm 20$    | V                |
| Peak Soldering Temperature                   | $T_P$          | -                                         | 270         | $^\circ\text{C}$ |
| Operating and Storage Temperature            | $T_J, T_{STG}$ | -                                         | -40 ... 150 |                  |

**Table 3 Thermal characteristics**

| Parameter               | Symbol              | Conditions | Min. | Typ. | Max. | Unit                      |
|-------------------------|---------------------|------------|------|------|------|---------------------------|
| Junction-to-Ambient ③   | $R_{\theta JA}$     | -          | -    | -    | 45   | $^\circ\text{C}/\text{W}$ |
| Junction-to-Ambient ⑧   | $R_{\theta JA}$     | -          | -    | 12.5 | -    |                           |
| Junction-to-Ambient ⑨   | $R_{\theta JA}$     | -          | -    | 20   | -    |                           |
| Junction-to-Case ④ ⑩    | $R_{\theta JC}$     | -          | -    | -    | 1.4  |                           |
| Junction-to-PCB Mounted | $R_{\theta JA-PCB}$ | -          | -    | 1.0  | -    |                           |

**Table 4 Avalanche characteristics**

| Parameter                       | Symbol   | Values | Unit |
|---------------------------------|----------|--------|------|
| Single Pulse Avalanche Energy ⑥ | $E_{AS}$ | 86     | mJ   |
| Avalanche Current ⑥             | $I_{AR}$ | 34     | A    |

**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 Surface mounted on 1 in. square Cu board, steady state.
- ④  $T_C$  measured with thermocouple mounted to top (Drain) of part.
- ⑤ Repetitive rating; pulse width limited by max. junction temperature.
- ⑥ (Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.15\text{mH}$ ,  $R_G = 50\Omega$ ,  $I_{AS} = 34\text{A}$ .)
- ⑦ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ⑧ Used double sided cooling, mounting pad with large heat sink.
- ⑨ Mounted on minimum footprint full size board with metalized back and with small clip heat sink.
- ⑩  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .

### 3 Electrical characteristics

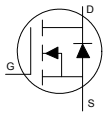
Table 5 Static characteristics

| Parameter                                | Symbol                          | Conditions                                     | Values |      |      | Unit  |
|------------------------------------------|---------------------------------|------------------------------------------------|--------|------|------|-------|
|                                          |                                 |                                                | Min.   | Typ. | Max. |       |
| Drain-to-Source Breakdown Voltage        | $V_{(BR)DSS}$                   | $V_{GS} = 0V, I_D = 250\mu A$                  | 100    | -    | -    | V     |
| Breakdown Voltage Temp. Coefficient      | $\Delta V_{(BR)DSS}/\Delta T_J$ | Reference to 25°C, $I_D = 1mA$                 | -      | 0.1  | -    | V/°C  |
| Static Drain-to-Source On-Resistance     | $R_{DS(on)}$                    | $V_{GS} = 10V, I_D = 34A$ ⑦                    | -      | 10.3 | 13   | mΩ    |
| Gate Threshold Voltage                   | $V_{GS(th)}$                    | $V_{DS} = V_{GS}, I_D = 150\mu A$              | 2.8    | 3.7  | 4.8  | V     |
| Gate Threshold Voltage Temp. Coefficient | $\Delta V_{GS(th)}/\Delta T_J$  |                                                | -      | -11  | -    | mV/°C |
| Drain-to-Source Leakage Current          | $I_{DSS}$                       | $V_{DS} = 100V, V_{GS} = 0V$                   | -      | -    | 20   | μA    |
|                                          |                                 | $V_{DS} = 80V, V_{GS} = 0V, T_J = 125^\circ C$ | -      | -    | 250  |       |
| Gate-to-Source Forward Leakage           | $I_{GSS}$                       | $V_{GS} = 20V$                                 | -      | -    | 100  | nA    |
|                                          | $I_{GSS}$                       | $V_{GS} = -20V$                                | -      | -    | -100 |       |
| Gate Resistance                          | $R_G$                           | -                                              | -      | 1.6  | -    | Ω     |

Table 6 Dynamic characteristics

| Parameter                            | Symbol       | Conditions                                                             | Values |      |      | Unit |
|--------------------------------------|--------------|------------------------------------------------------------------------|--------|------|------|------|
|                                      |              |                                                                        | Min.   | Typ. | Max. |      |
| Forward Trans conductance            | $g_{fs}$     | $V_{DS} = 10V, I_D = 34A$                                              | 65     | -    | -    | S    |
| Total Gate Charge                    | $Q_g$        | $I_D = 34A$<br>$V_{DS} = 50V$<br>$V_{GS} = 10V$<br>See Fig.8           | -      | 28   | 42   | nC   |
| Pre-Vth Gate-to-Source Charge        | $Q_{gs1}$    |                                                                        | -      | 7.0  | -    |      |
| Post-Vth Gate-to-Source Charge       | $Q_{gs2}$    |                                                                        | -      | 3.0  | -    |      |
| Gate-to-Drain Charge                 | $Q_{gd}$     |                                                                        | -      | 9.0  | -    |      |
| Gate Charge Overdrive                | $Q_{godr}$   |                                                                        | -      | 9.0  | -    |      |
| Switch Charge ( $Q_{gs2} + Q_{gd}$ ) | $Q_{sw}$     |                                                                        | -      | 16   | -    |      |
| Output Charge                        | $Q_{oss}$    | $V_{DS} = 16V, V_{GS} = 0V$                                            | -      | 18   | -    | nC   |
| Turn-On Delay Time                   | $t_{d(on)}$  | $V_{DD} = 50V$<br>$I_D = 34A$<br>$R_G = 1.8\Omega$<br>$V_{GS} = 10V$ ⑦ | -      | 9.5  | -    | ns   |
| Rise Time                            | $t_r$        |                                                                        | -      | 16   | -    |      |
| Turn-Off Delay Time                  | $t_{d(off)}$ |                                                                        | -      | 15   | -    |      |
| Fall Time                            | $t_f$        |                                                                        | -      | 5.7  | -    |      |
| Input Capacitance                    | $C_{iss}$    | $V_{GS} = 0V$<br>$V_{DS} = 50V$<br>$f = 1.0MHz$                        | -      | 1770 | -    | pF   |
| Output Capacitance                   | $C_{oss}$    |                                                                        | -      | 280  | -    |      |
| Reverse Transfer Capacitance         | $C_{rss}$    |                                                                        | -      | 60   | -    |      |
| Output Capacitance                   | $C_{oss}$    | $V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$                               | -      | 2025 | -    |      |
| Output Capacitance                   | $C_{oss}$    | $V_{GS} = 0V, V_{DS} = 80V, f = 1.0MHz$                                | -      | 245  | -    |      |

Table 7 Reverse Diode

| Parameter                              | Symbol   | Conditions                                                                                                                                          | Values |      |      | Unit |
|----------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|------|------|
|                                        |          |                                                                                                                                                     | Min.   | Typ. | Max. |      |
| Continuous Source Current (Body Diode) | $I_S$    | MOSFET symbol showing the integral reverse p-n junction diode.  | -      | -    | 57   | A    |
| Pulsed Source Current (Body Diode) ⑤   | $I_{SM}$ |                                                                                                                                                     | -      | -    | 228  |      |
| Diode Forward Voltage                  | $V_{SD}$ | $T_J = 25^\circ C, I_S = 34A, V_{GS} = 0V$ ⑦                                                                                                        | -      | -    | 1.3  | V    |
| Reverse Recovery Time                  | $t_{rr}$ | $T_J = 25^\circ C, I_F = 34A, V_{DD} = 50V$<br>$di/dt = 100A/\mu s$                                                                                 | -      | 53   | 80   | ns   |
| Reverse Recovery Charge                | $Q_{rr}$ |                                                                                                                                                     | -      | 97   | 146  | nC   |



4 Electrical characteristic diagrams

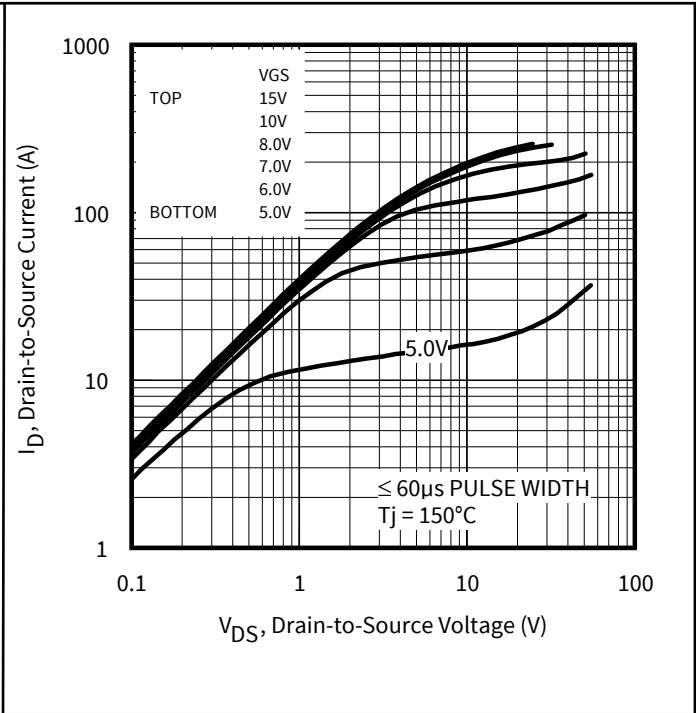
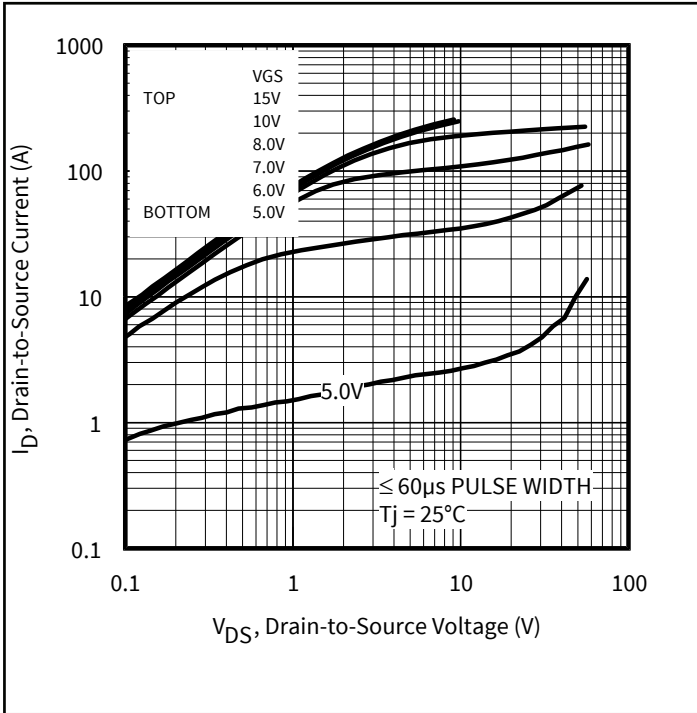


Figure 3 Typical Output Characteristics

Figure 4 Typical Output Characteristics

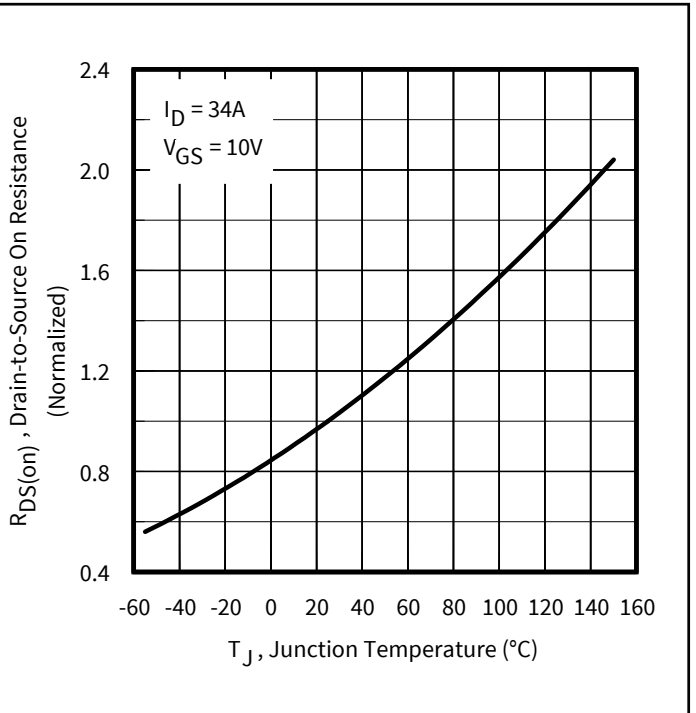
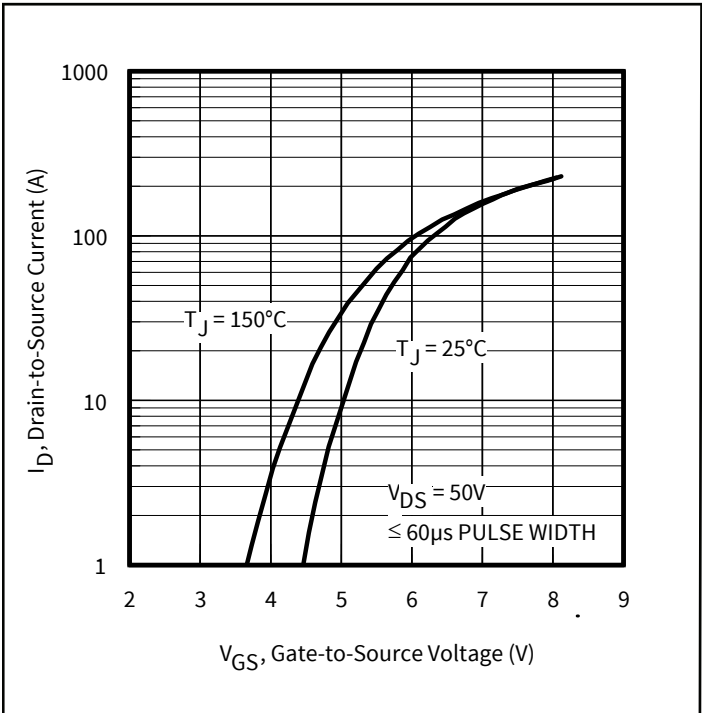


Figure 5 Typical Transfer Characteristics

Figure 6 Normalized On-Resistance vs. Temperature

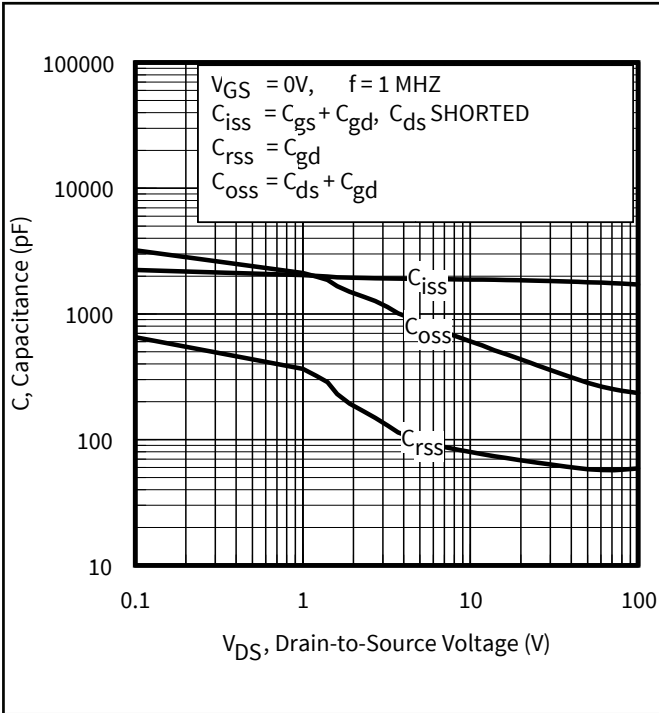


Figure 7 Typical Capacitance vs. Drain-to-Source Voltage

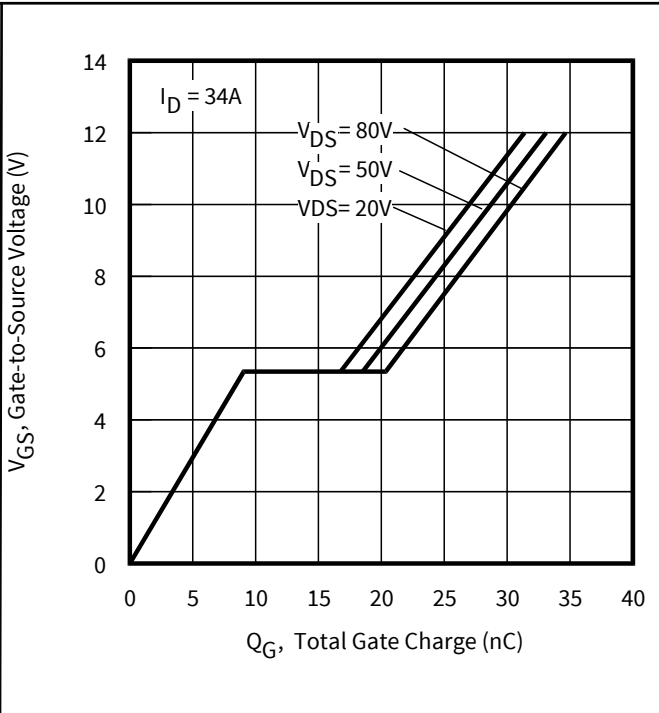


Figure 8 Typical Gate Charge vs. Gate-to-Source Voltage

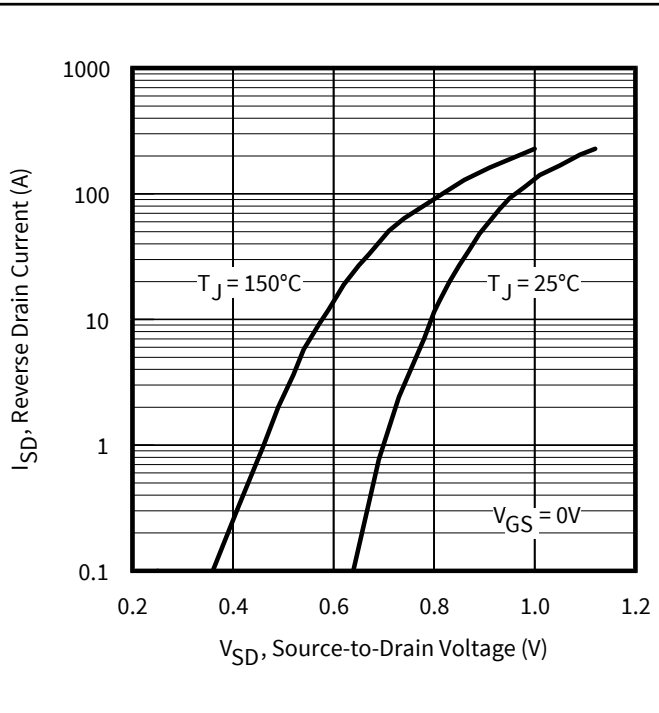


Figure 9 Typical Source-Drain Diode Forward Voltage

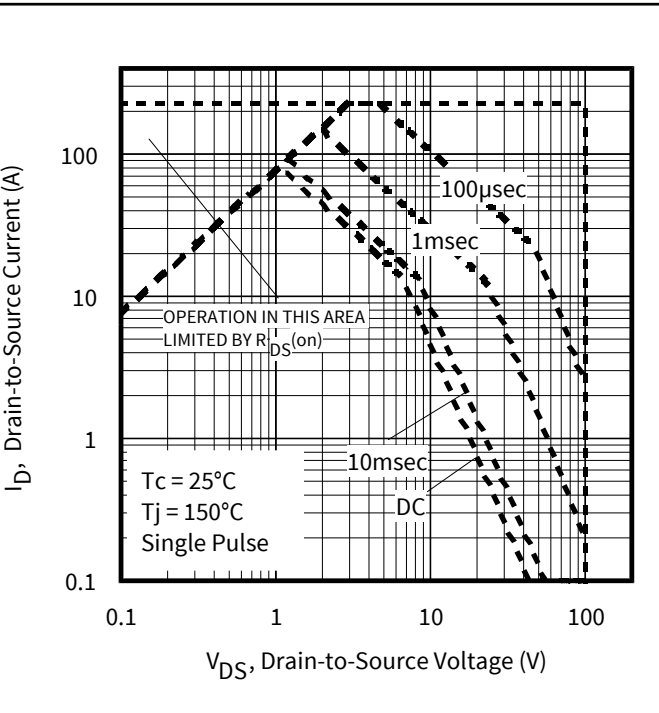


Figure 10 Maximum Safe Operating Area

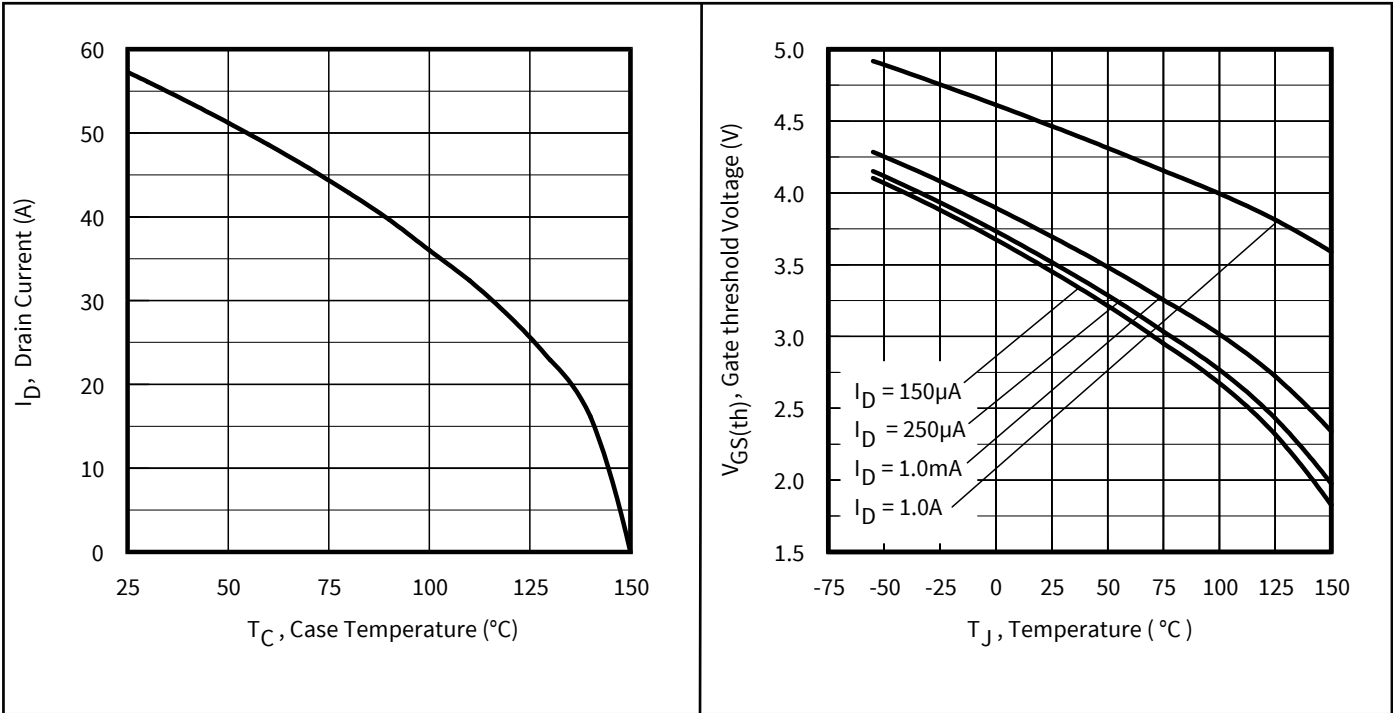


Figure 11 Maximum Drain Current vs. Case Temperature

Figure 12 Typical Threshold Voltage vs. Junction Temperature

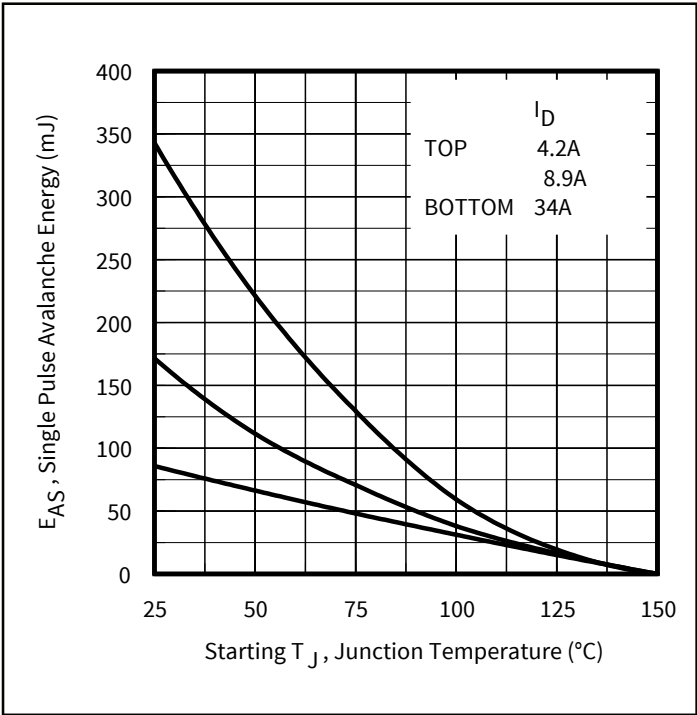


Figure 13 Maximum Avalanche Energy vs. Drain Current

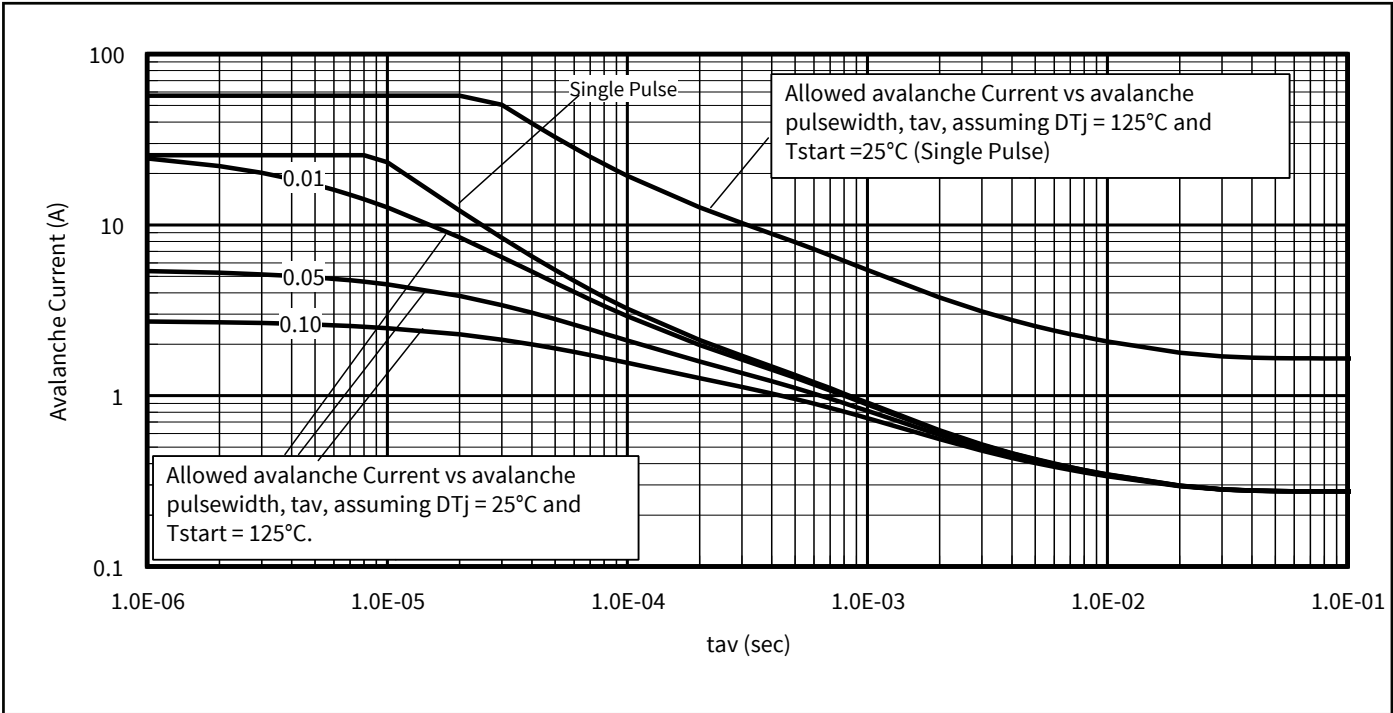


Figure 14 Typical Avalanche Current vs. Pulse Width

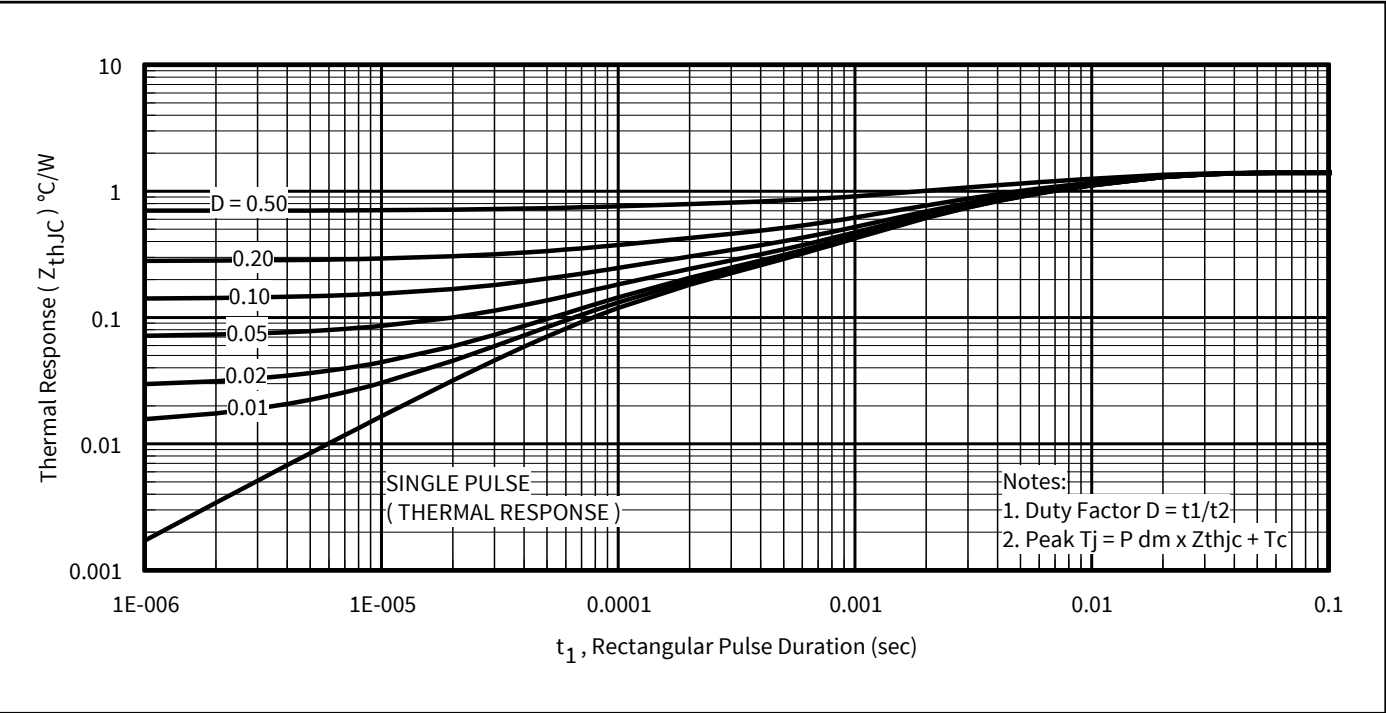
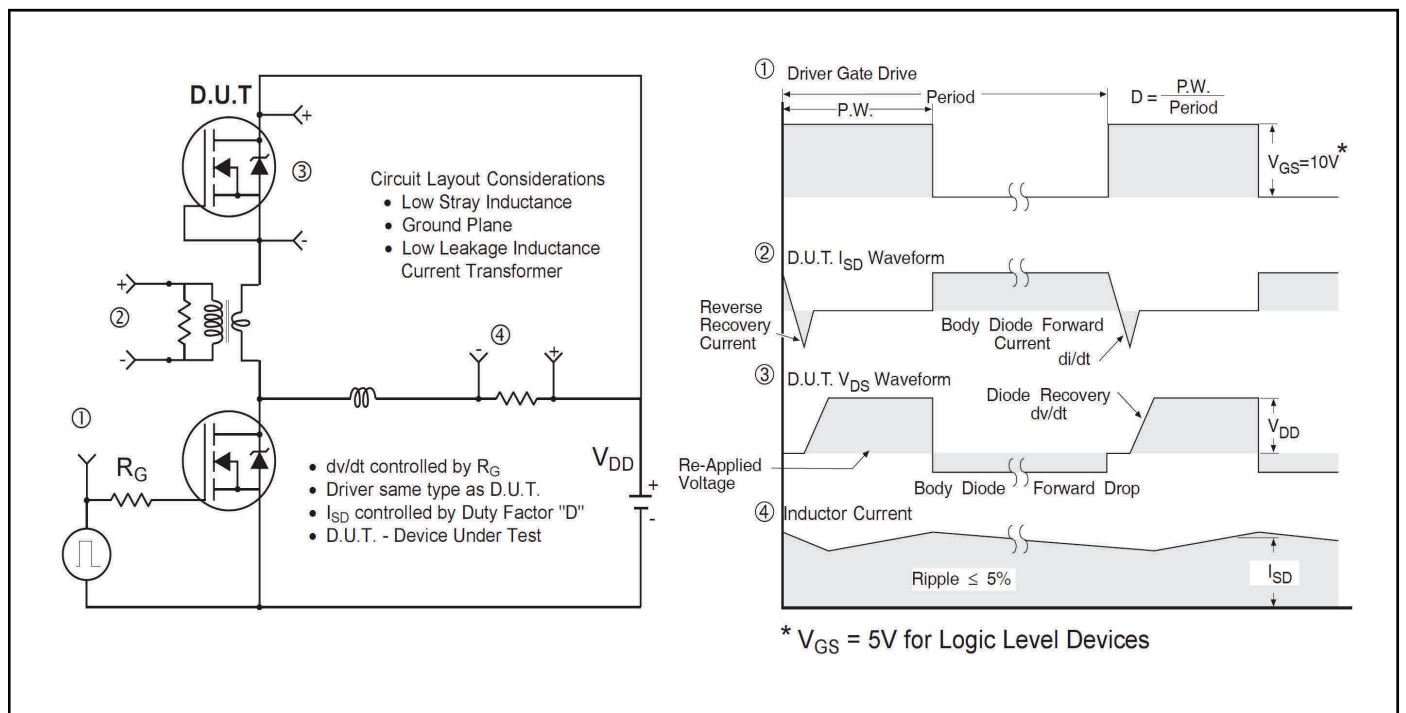
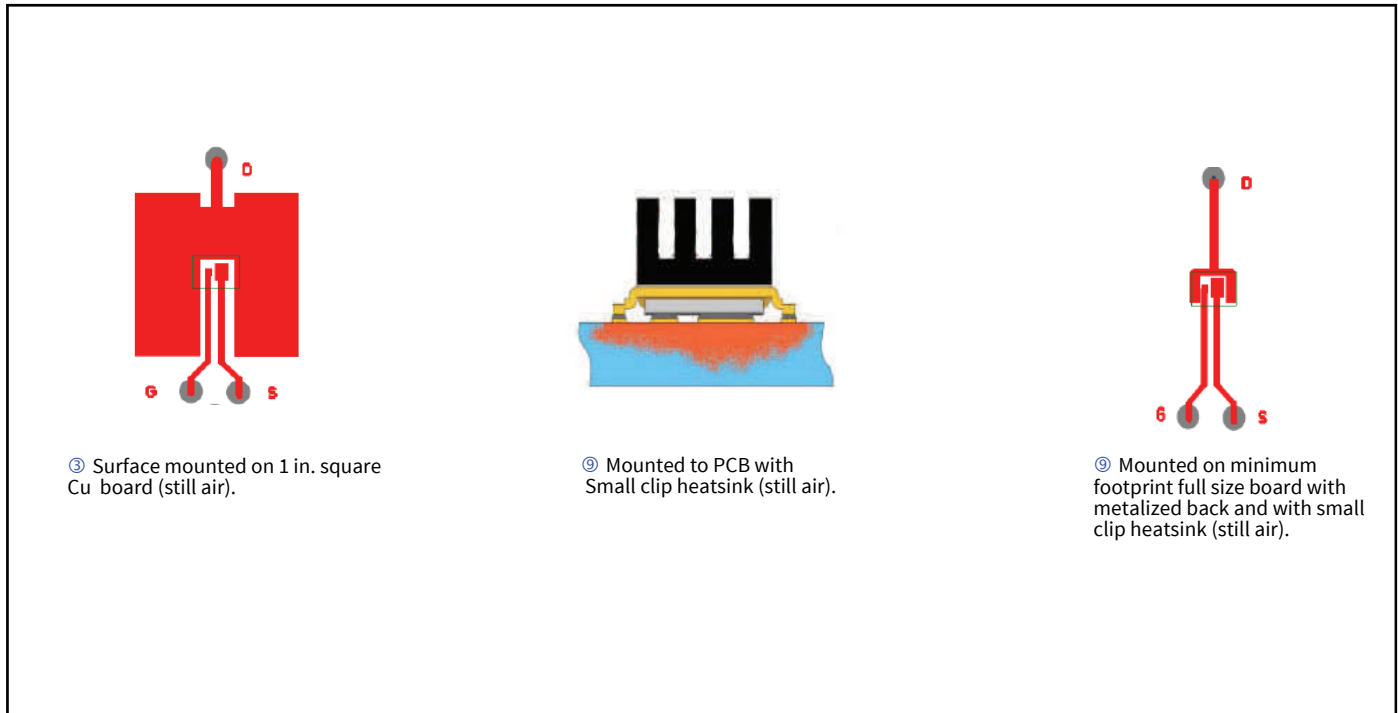


Figure 15 Maximum Effective Transient Thermal Impedance, Junction-to-Case



**Figure 16 Peak Diode Recovery  $dv/dt$  Test Circuit for N-Channel HEXFET™ Power MOSFETs**

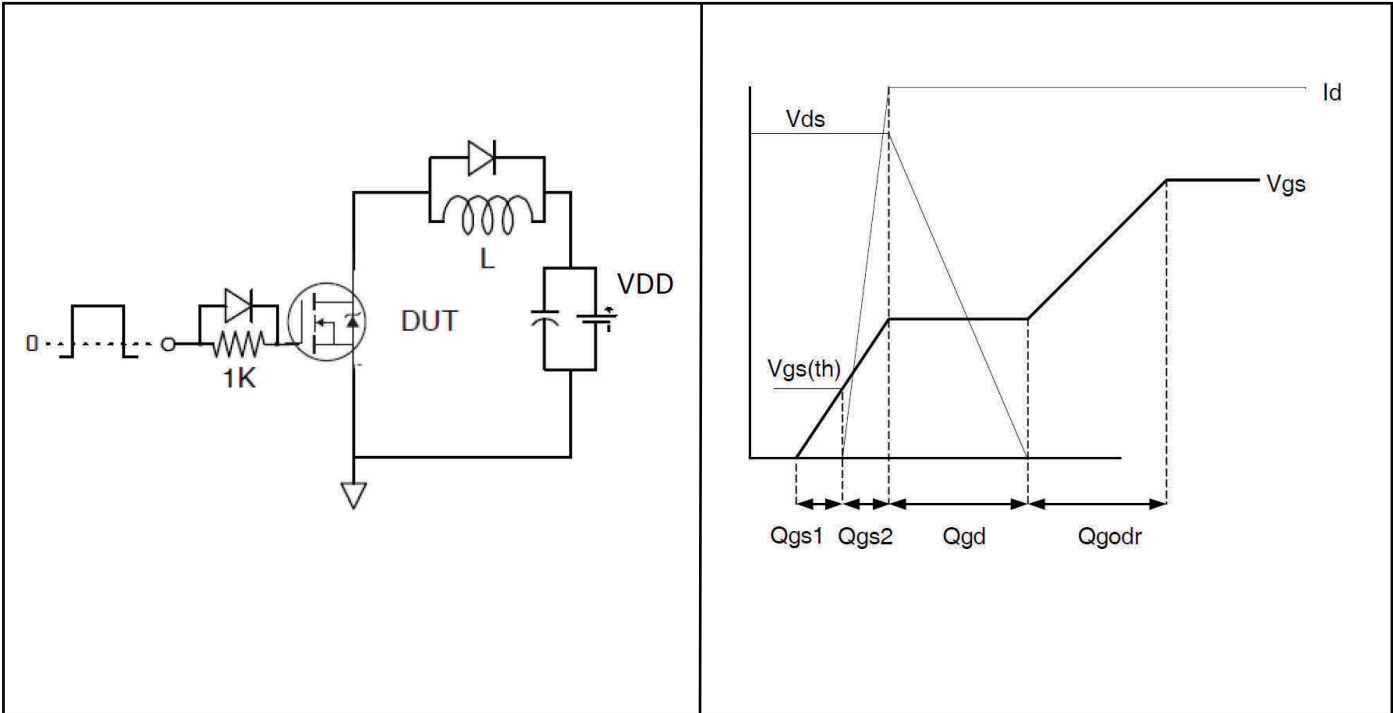


Figure 17a Gate Charge Test Circuit

Figure 17b Gate Charge Waveform

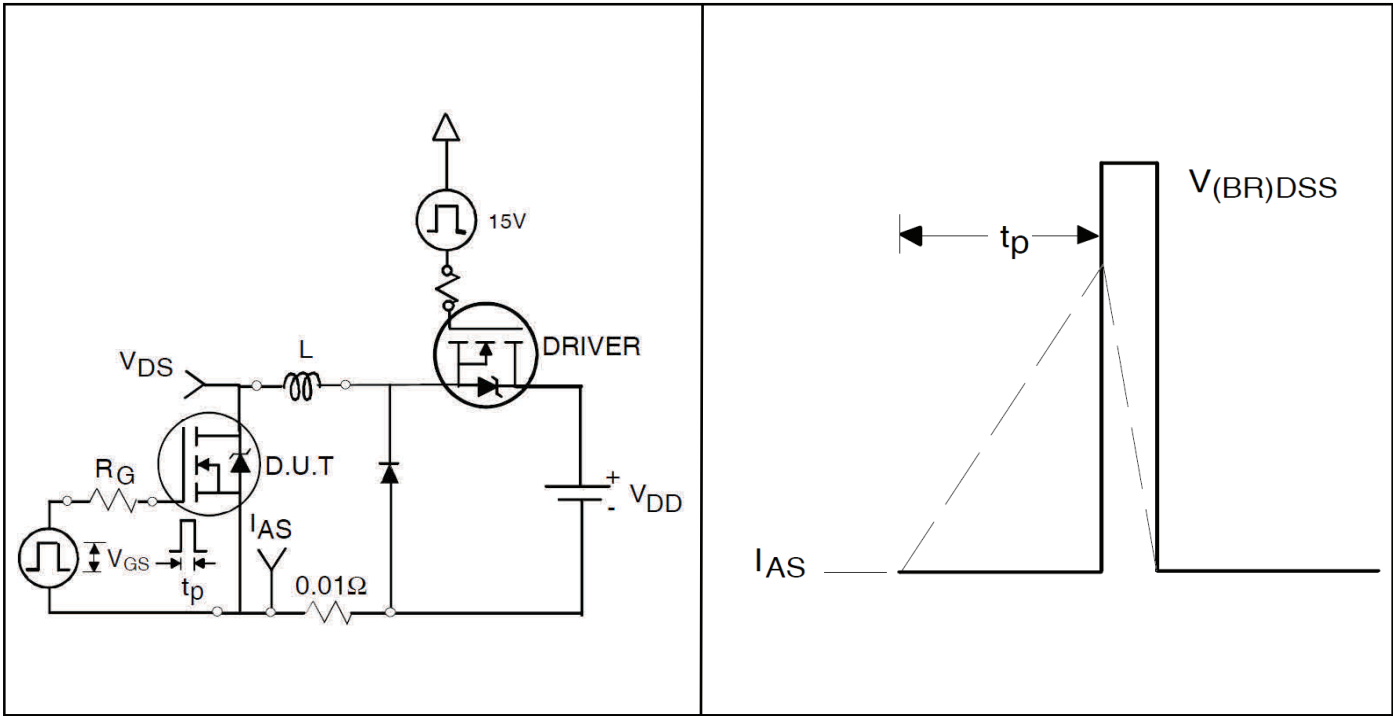


Figure 18a Unclamped Inductive Test Circuit

Figure 18b Unclamped Inductive Waveforms

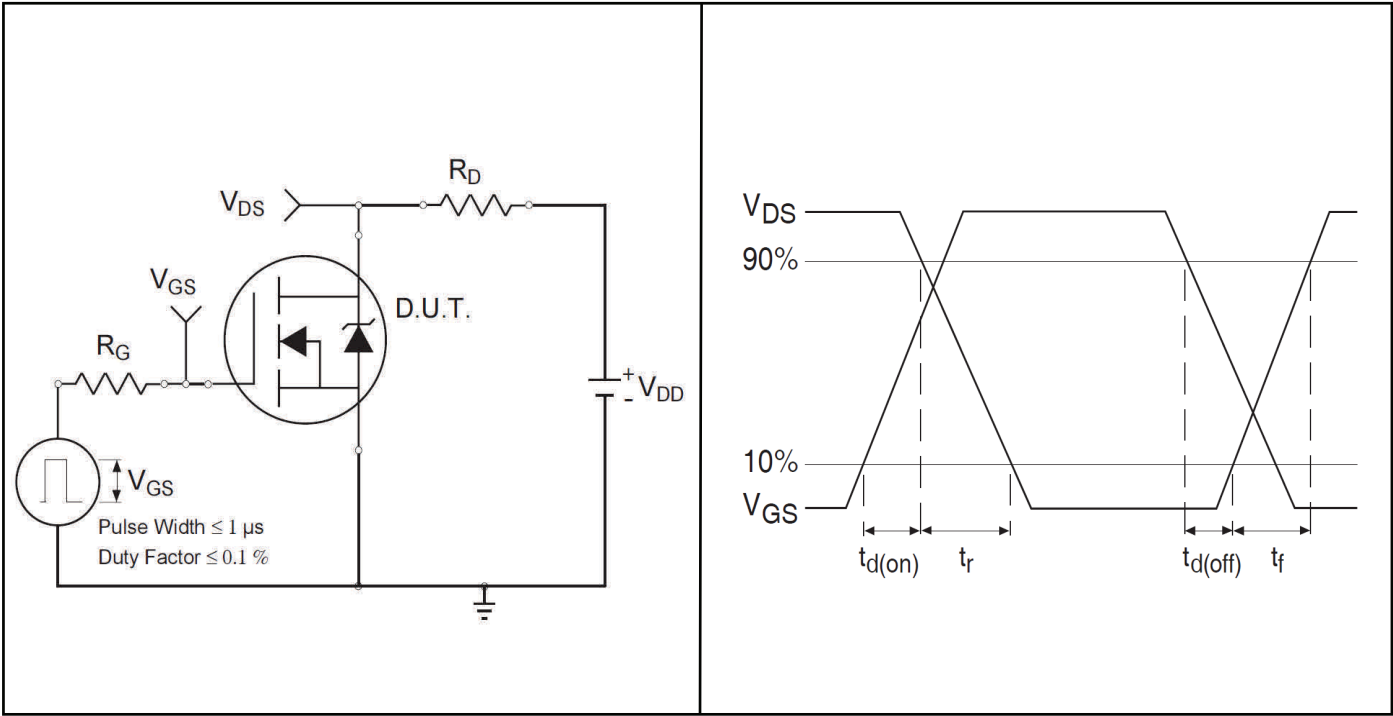


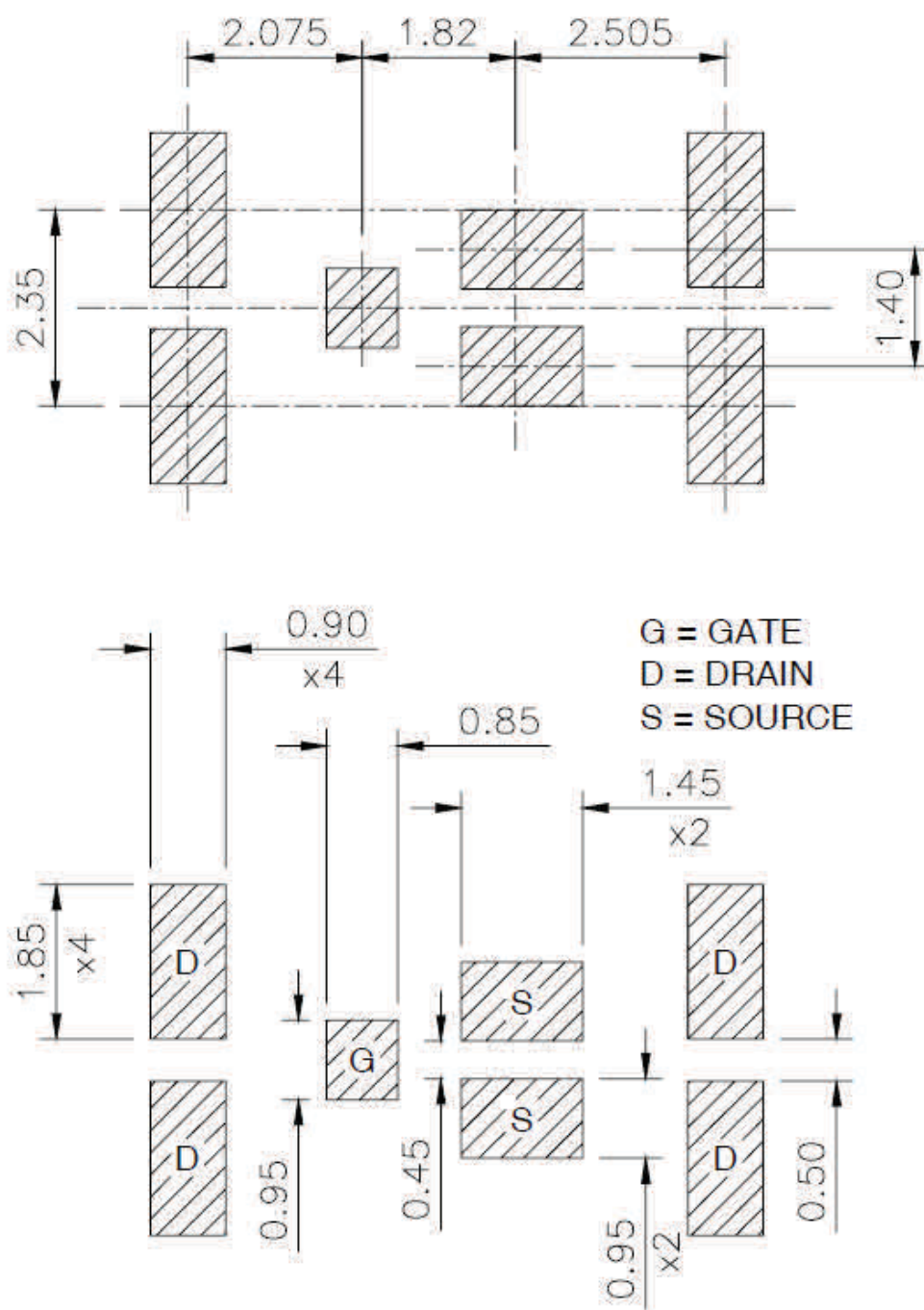
Figure 19a Switching Time Test Circuit

Figure 19b Switching Time Waveforms

## 5 Package Information

### DirectFET™ Board Footprint, MN Outline

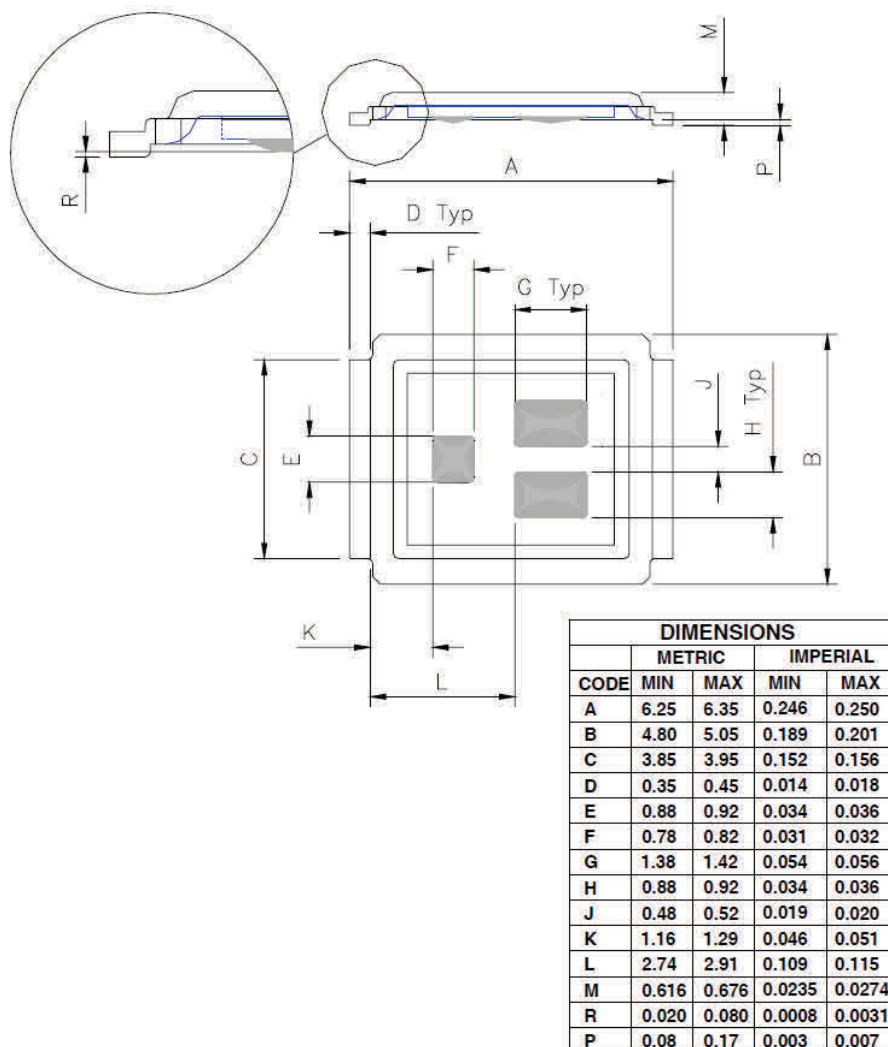
Please see DirectFET™ application note [AN-1035](#) for all details regarding the assembly of DirectFET™. This includes all recommendations for stencil and substrate designs.



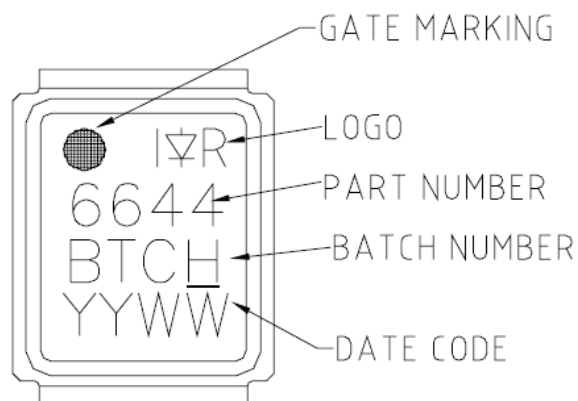
Note: For the most current drawing please refer to website at : [www.irf.com/package/](http://www.irf.com/package/)

#### DirectFET™ Outline Dimension, MN Outline (Medium Size Can, N-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™ Part Marking

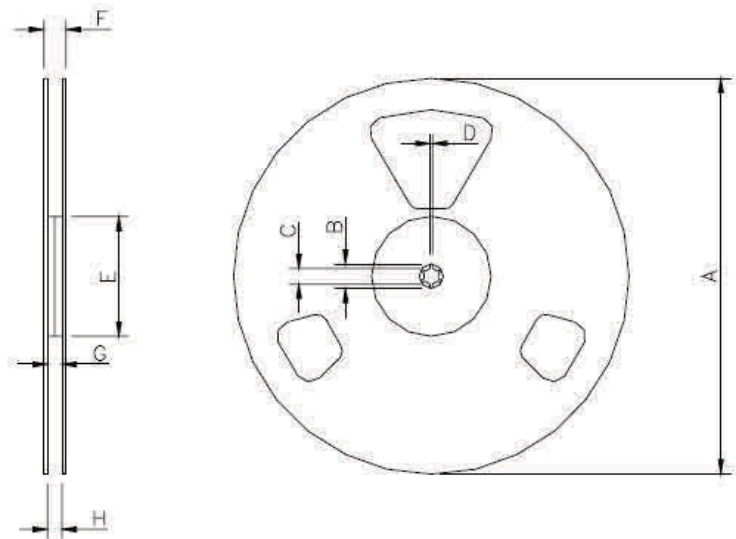


Note: Line above the last character of the date-code indicates "Lead-Free".

Note: For the most current drawing please refer to website at : [www.irf.com/package/](http://www.irf.com/package/)

Tape & Reel Information

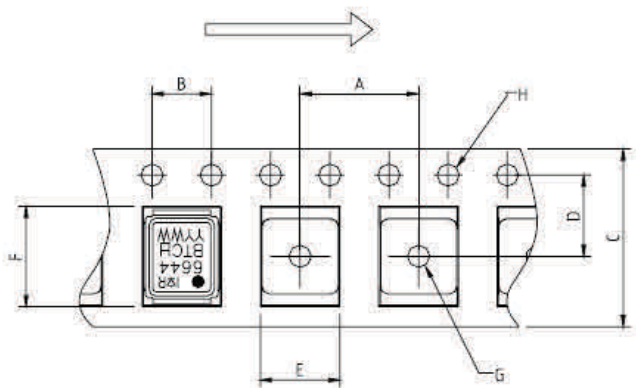
DirectFET™ Tape & Reel Dimension (Showing component orientation).



NOTE: Controlling dimensions in mm  
Std reel quantity is 4800 parts. (ordered as IRF6644TRPBF). For 1000 parts on 7" reel, order IRF6644TR1PBF

| 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 |

Note: For the most current drawing please refer to website at : [www.irf.com/package/](http://www.irf.com/package/)

## 6 Qualification Information

### Qualification Information

| Qualification Level        | Consumer<br>(per JEDEC JESD47F) † |                                  |
|----------------------------|-----------------------------------|----------------------------------|
| Moisture Sensitivity Level | DirectFET™ Medium Can             | MSL1<br>(per JEDEC J-STD-020D) † |
| RoHS Compliant             | Yes                               |                                  |

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

## Revision History

### Major changes since the last revision

| Page or Reference | Revision | Date       | Description of changes                                                                                                                                                            |
|-------------------|----------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| All pages         | 1.0      | 2006-08-18 | <ul style="list-style-type: none"><li>• First release data sheet.</li></ul>                                                                                                       |
| All page          | 2.0      | 2017-03-28 | <ul style="list-style-type: none"><li>• This is Unique datasheet Project with Id Ratings based on RthJC.</li><li>• The datasheet is converted in New Infineon Template.</li></ul> |

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