

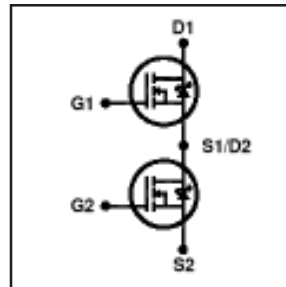
## DIGITAL AUDIO MOSFET

### Features

- Integrated Half-Bridge Package
- Reduces the Part Count by Half
- Facilitates Better PCB Layout
- Key Parameters Optimized for Class-D Audio Amplifier Applications
- Low  $R_{DS(ON)}$  for Improved Efficiency
- Low  $Q_g$  and  $Q_{sw}$  for Better THD and Improved Efficiency
- Low  $Q_{rr}$  for Better THD and Lower EMI
- Can Delivery up to 200W per Channel into  $8\Omega$  Load in Half-Bridge Configuration Amplifier
- Lead-Free Package

### Key Parameters ⑥

|                         |     |                    |
|-------------------------|-----|--------------------|
| $V_{DS}$                | 150 | V                  |
| $R_{DS(ON)}$ typ. @ 10V | 80  | m $\Omega$         |
| $Q_g$ typ.              | 13  | nC                 |
| $Q_{sw}$ typ.           | 4.1 | nC                 |
| $R_{G(int)}$ typ.       | 2.5 | $\Omega$           |
| $T_J$ max               | 150 | $^{\circ}\text{C}$ |



| G1, G2 | D1, D2 | S1, S2 |
|--------|--------|--------|
| Gate   | Drain  | Source |

### Description

This Digital Audio MosFET Half-Bridge is specifically designed for Class D audio amplifier applications. It consists of two power MosFET switches connected in half-bridge configuration. The latest process is used 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. These combine to make this Half-Bridge a highly efficient, robust and reliable device for Class D audio amplifier applications.

### Absolute Maximum Ratings ⑥

|                                     | Parameter                                                  | Max.             | Units                 |
|-------------------------------------|------------------------------------------------------------|------------------|-----------------------|
| $V_{DS}$                            | Drain-to-Source Voltage                                    | 150              | V                     |
| $V_{GS}$                            | Gate-to-Source Voltage                                     | $\pm 20$         |                       |
| $I_D$ @ $T_C = 25^{\circ}\text{C}$  | Continuous Drain Current, $V_{GS}$ @ 10V                   | 8.7              | A                     |
| $I_D$ @ $T_C = 100^{\circ}\text{C}$ | Continuous Drain Current, $V_{GS}$ @ 10V                   | 6.2              |                       |
| $I_{DM}$                            | Pulsed Drain Current ①                                     | 34               |                       |
| $E_{AS}$                            | Single Pulse Avalanche Energy②                             | 77               | mJ                    |
| $P_D$ @ $T_C = 25^{\circ}\text{C}$  | Power Dissipation ④                                        | 18               | W                     |
| $P_D$ @ $T_C = 100^{\circ}\text{C}$ | Power Dissipation ④                                        | 7.2              |                       |
|                                     | Linear Derating Factor                                     | 0.15             | W/ $^{\circ}\text{C}$ |
| $T_J$<br>$T_{STG}$                  | Operating Junction and<br>Storage Temperature Range        | -55 to + 150     | $^{\circ}\text{C}$    |
|                                     | Soldering Temperature, for 10 seconds<br>(1.6mm from case) | 300              |                       |
|                                     | Mounting torque, 6-32 or M3 screw                          | 10lb·in (1.1N·m) |                       |

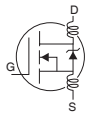
### Thermal Resistance ⑥

|                 | Parameter             | Typ. | Max. | Units |
|-----------------|-----------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case ④    | —    | 6.9  |       |
| $R_{\theta JA}$ | Junction-to-Ambient ④ | —    | 65   |       |

Notes ① through ⑥ are on page 2

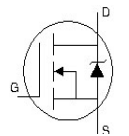
Electrical Characteristics @  $T_J = 25^\circ\text{C}$  (unless otherwise specified) ⑥

|                                | Parameter                                  | Min. | Typ. | Max. | Units                | Conditions                                                                                                 |
|--------------------------------|--------------------------------------------|------|------|------|----------------------|------------------------------------------------------------------------------------------------------------|
| $BV_{DSS}$                     | Drain-to-Source Breakdown Voltage          | 150  | —    | —    | V                    | $V_{GS} = 0V, I_D = 250\mu A$                                                                              |
| $\Delta BV_{DSS}/\Delta T_J$   | Breakdown Voltage Temp. Coefficient        | —    | 0.19 | —    | V/ $^\circ\text{C}$  | Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$                                                       |
| $R_{DS(on)}$                   | Static Drain-to-Source On-Resistance       | —    | 80   | 95   | m $\Omega$           | $V_{GS} = 10V, I_D = 5.2A$ ③                                                                               |
| $V_{GS(th)}$                   | Gate Threshold Voltage                     | 3.0  | —    | 4.9  | V                    | $V_{DS} = V_{GS}, I_D = 50\mu A$                                                                           |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Coefficient         | —    | -11  | —    | mV/ $^\circ\text{C}$ |                                                                                                            |
| $I_{DSS}$                      | Drain-to-Source Leakage Current            | —    | —    | 20   | $\mu A$              | $V_{DS} = 150V, V_{GS} = 0V$                                                                               |
|                                |                                            | —    | —    | 250  |                      | $V_{DS} = 150V, V_{GS} = 0V, T_J = 125^\circ\text{C}$                                                      |
| $I_{GSS}$                      | Gate-to-Source Forward Leakage             | —    | —    | 100  | nA                   | $V_{GS} = 20V$                                                                                             |
|                                | Gate-to-Source Reverse Leakage             | —    | —    | -100 |                      | $V_{GS} = -20V$                                                                                            |
| $g_{fs}$                       | Forward Transconductance                   | 11   | —    | —    | S                    | $V_{DS} = 50V, I_D = 5.2A$                                                                                 |
| $Q_g$                          | Total Gate Charge                          | —    | 13   | 20   | nC                   | $V_{DS} = 75V$<br>$V_{GS} = 10V$<br>$I_D = 5.2A$<br>See Fig. 6 and 19                                      |
| $Q_{gs1}$                      | Pre-V <sub>th</sub> Gate-to-Source Charge  | —    | 3.3  | —    |                      |                                                                                                            |
| $Q_{gs2}$                      | Post-V <sub>th</sub> Gate-to-Source Charge | —    | 0.8  | —    |                      |                                                                                                            |
| $Q_{gd}$                       | Gate-to-Drain Charge                       | —    | 3.9  | —    |                      |                                                                                                            |
| $Q_{godr}$                     | Gate Charge Overdrive                      | —    | 5.0  | —    |                      |                                                                                                            |
| $Q_{sw}$                       | Switch Charge ( $Q_{gs2} + Q_{gd}$ )       | —    | 4.1  | —    |                      |                                                                                                            |
| $R_{G(int)}$                   | Internal Gate Resistance                   | —    | 2.5  | —    | $\Omega$             |                                                                                                            |
| $t_{d(on)}$                    | Turn-On Delay Time                         | —    | 7.0  | —    | ns                   | $V_{DD} = 75V, V_{GS} = 10V$ ③<br>$I_D = 5.2A$<br>$R_G = 2.4\Omega$                                        |
| $t_r$                          | Rise Time                                  | —    | 6.6  | —    |                      |                                                                                                            |
| $t_{d(off)}$                   | Turn-Off Delay Time                        | —    | 13   | —    |                      |                                                                                                            |
| $t_f$                          | Fall Time                                  | —    | 3.1  | —    |                      |                                                                                                            |
| $C_{iss}$                      | Input Capacitance                          | —    | 810  | —    | pF                   | $V_{GS} = 0V$<br>$V_{DS} = 25V$<br>$f = 1.0\text{MHz}$ , See Fig.5<br>$V_{GS} = 0V, V_{DS} = 0V$ to $120V$ |
| $C_{oss}$                      | Output Capacitance                         | —    | 100  | —    |                      |                                                                                                            |
| $C_{rss}$                      | Reverse Transfer Capacitance               | —    | 15   | —    |                      |                                                                                                            |
| $C_{oss}$                      | Effective Output Capacitance               | —    | 97   | —    |                      |                                                                                                            |
| $L_D$                          | Internal Drain Inductance                  | —    | 4.5  | —    | nH                   | Between lead,<br>6mm (0.25in.)<br>from package<br>and center of die contact                                |
| $L_S$                          | Internal Source Inductance                 | —    | 7.5  | —    |                      |                                                                                                            |



## Diode Characteristics ⑥

|                                | Parameter                                 | Min. | Typ. | Max. | Units | Conditions                                                              |
|--------------------------------|-------------------------------------------|------|------|------|-------|-------------------------------------------------------------------------|
| $I_S @ T_C = 25^\circ\text{C}$ | Continuous Source Current<br>(Body Diode) | —    | —    | 8.7  | A     | MOSFET symbol<br>showing the<br>integral reverse<br>p-n junction diode. |
| $I_{SM}$                       | Pulsed Source Current<br>(Body Diode) ①   | —    | —    | 34   |       |                                                                         |
| $V_{SD}$                       | Diode Forward Voltage                     | —    | —    | 1.3  | V     | $T_J = 25^\circ\text{C}, I_S = 5.2A, V_{GS} = 0V$ ③                     |
| $t_{rr}$                       | Reverse Recovery Time                     | —    | 57   | 86   | ns    | $T_J = 25^\circ\text{C}, I_F = 5.2A$                                    |
| $Q_{rr}$                       | Reverse Recovery Charge                   | —    | 140  | 210  | nC    | $di/dt = 100A/\mu s$ ③                                                  |



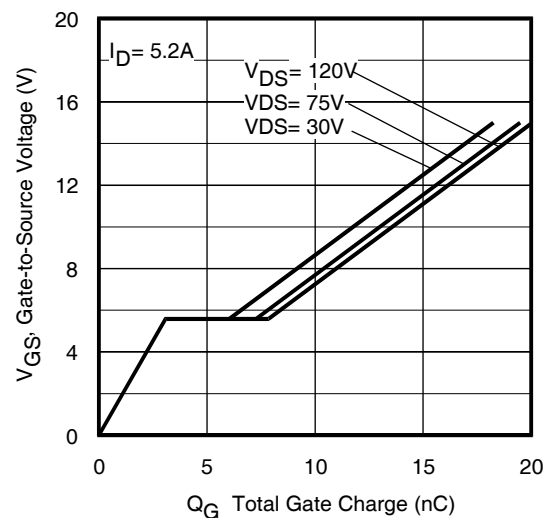
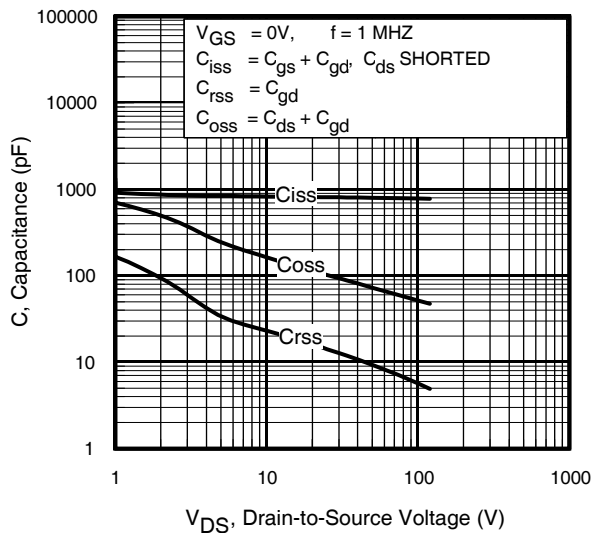
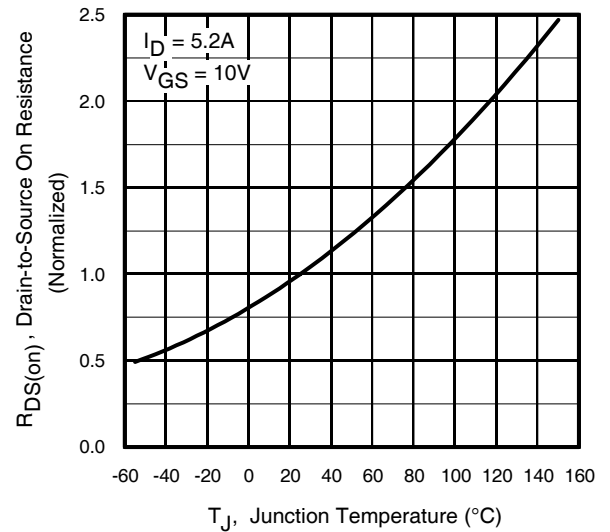
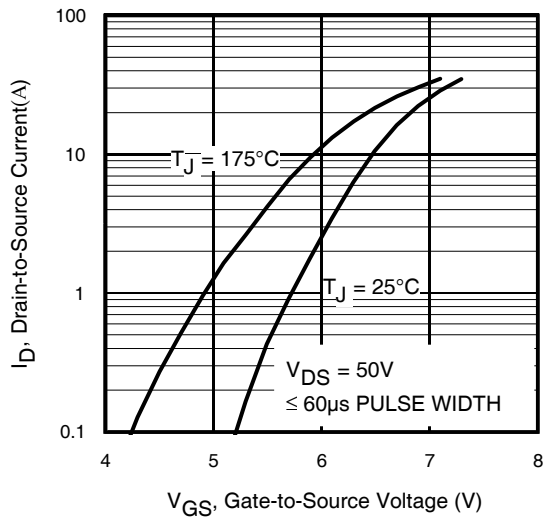
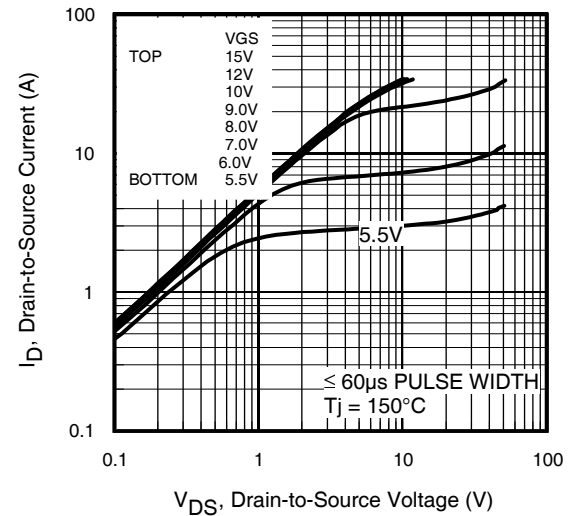
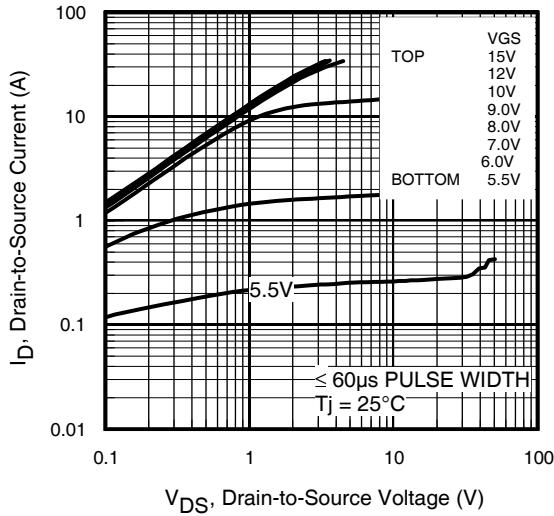
## Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.  
 ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 5.8\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 5.2A$ .  
 ③ Pulse width  $\leq 400\mu s$ ; duty cycle  $\leq 2\%$ .

④  $R_{\theta}$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .

⑤ Limited by  $T_{jmax}$ . See Figs. 14, 15, 17a, 17b for repetitive avalanche information

⑥ Specifications refer to single MosFET.



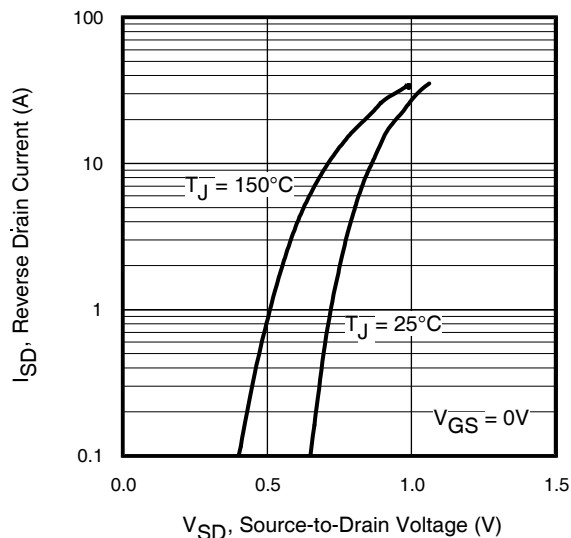


Fig 7. Typical Source-Drain Diode Forward Voltage

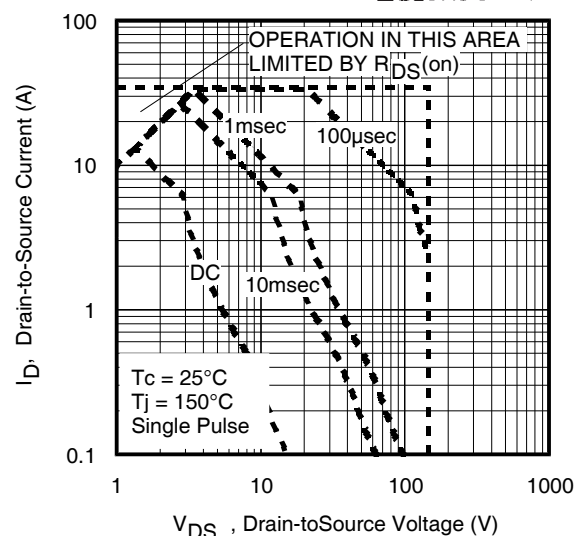


Fig 8. Maximum Safe Operating Area

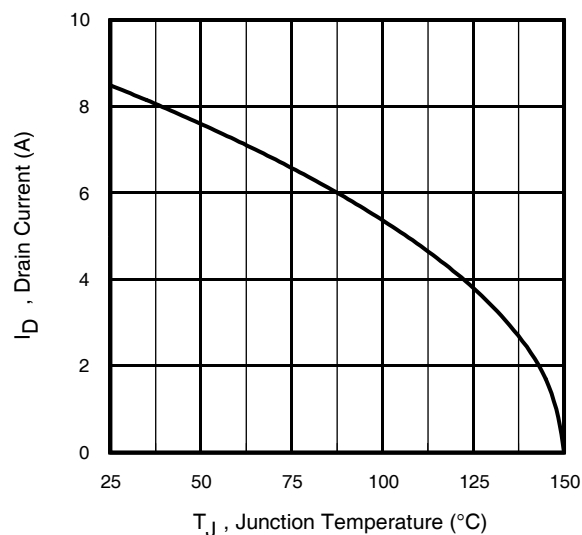


Fig 9. Maximum Drain Current vs. Case Temperature

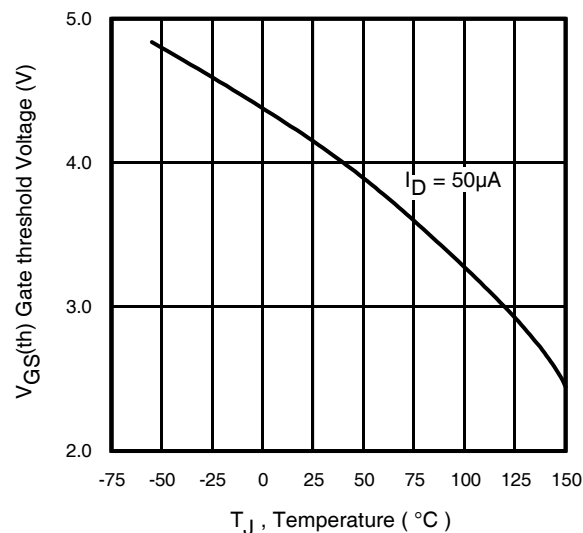


Fig 10. Threshold Voltage vs. Temperature

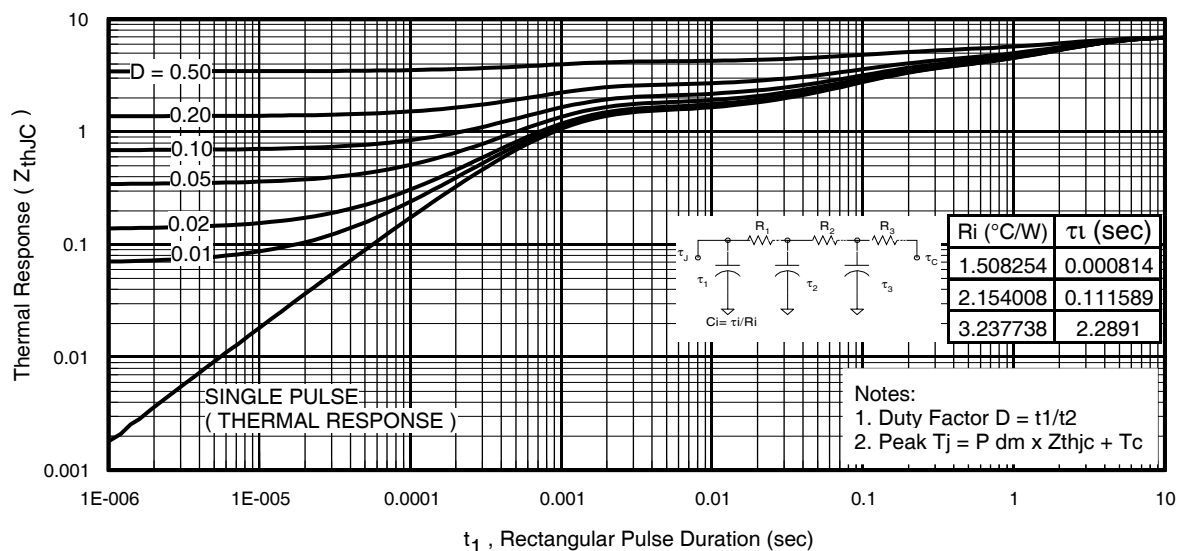
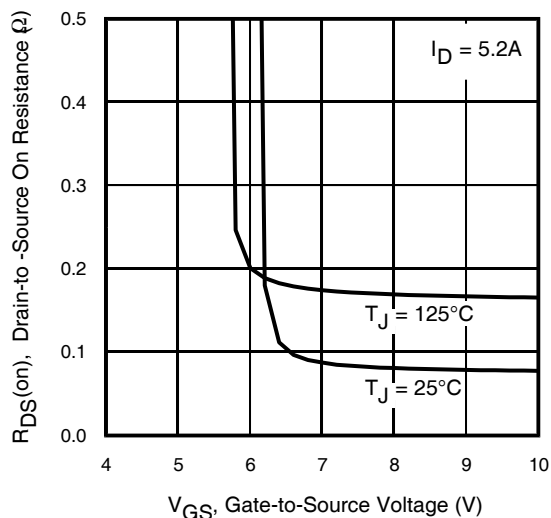
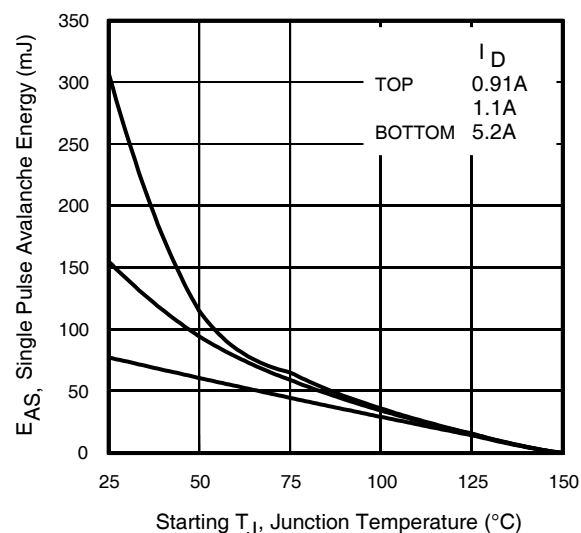


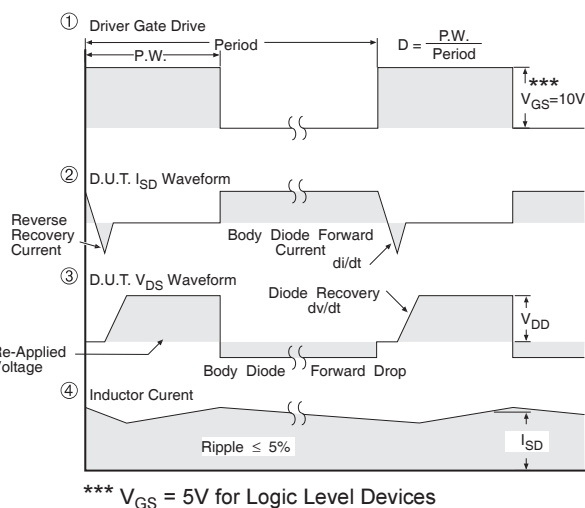
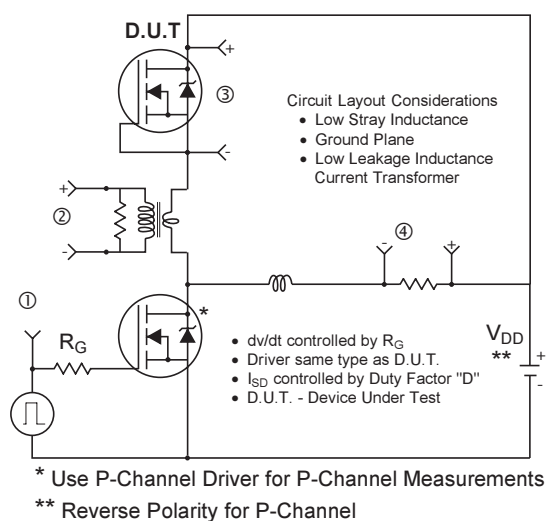
Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case



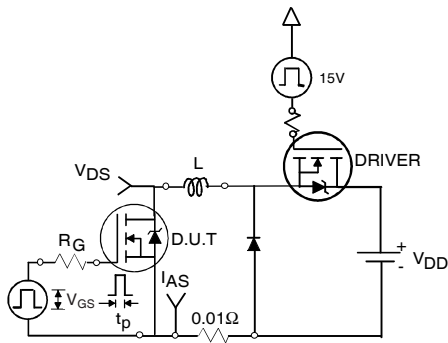
**Fig 12.** On-Resistance Vs. Gate Voltage



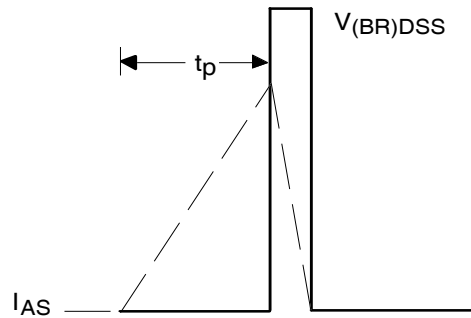
**Fig 13.** Maximum Avalanche Energy Vs. Drain Current



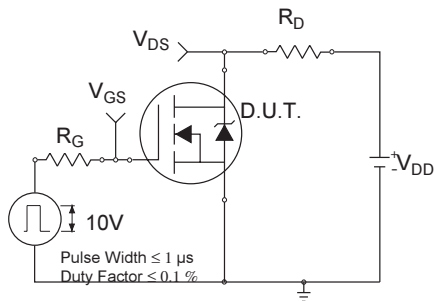
**Fig 14.** Diode Reverse Recovery Test Circuit for HEXFET® Power MOSFETs



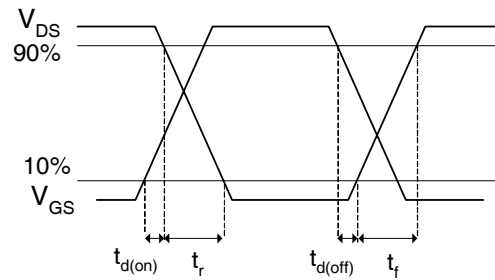
**Fig 15a.** Unclamped Inductive Test Circuit



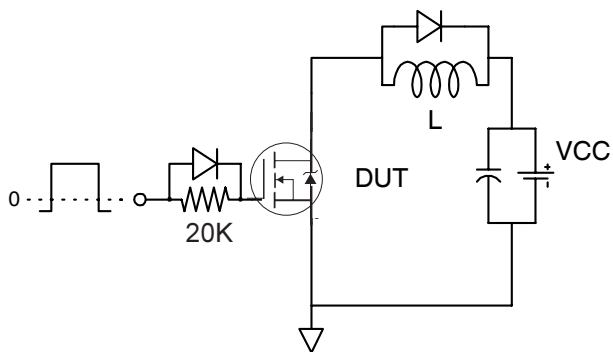
**Fig 15b.** Unclamped Inductive Waveforms



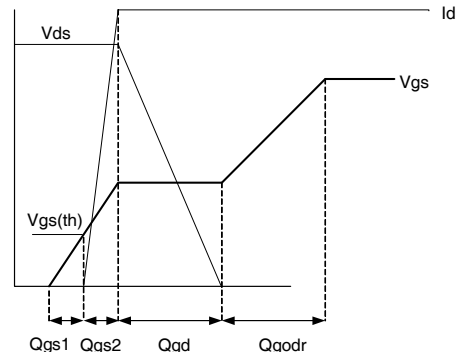
**Fig 16a.** Switching Time Test Circuit



**Fig 16b.** Switching Time Waveforms



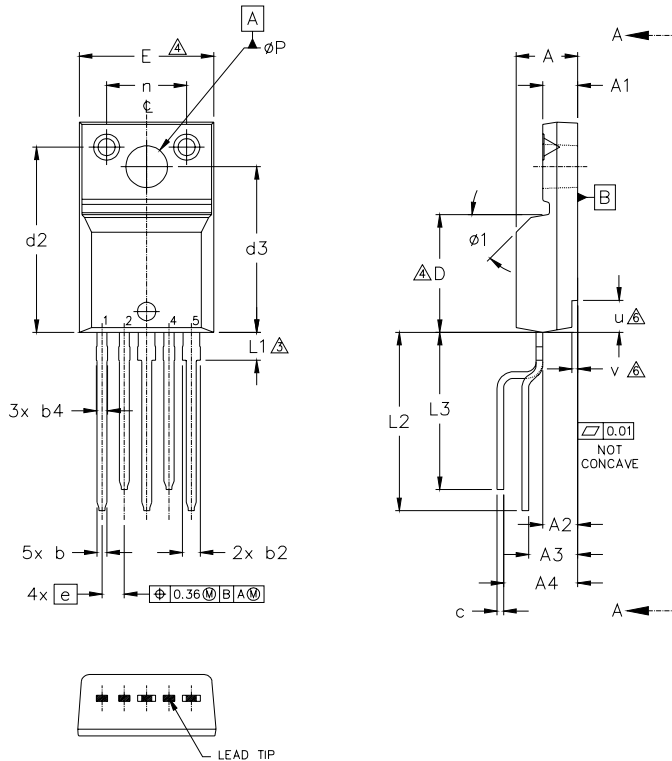
**Fig 17a.** Gate Charge Test Circuit



**Fig 17b** Gate Charge Waveform

## TO-220 Full-Pak 5-Pin Package Outline, Lead-Form Option 117

(Dimensions are shown in millimeters (inches))



### NOTES:

- 1.0 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
- 2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
- 4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY.
- 5.0 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.
- 6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
- 7.0 CONTROLLING DIMENSION : INCHES.

| SYM<br>BO<br>L | DIMENSIONS  |       |        |      | NOTES |
|----------------|-------------|-------|--------|------|-------|
|                | MILLIMETERS |       | INCHES |      |       |
|                | MIN.        | MAX.  | MIN.   | MAX. |       |
| A              | 4.57        | 4.83  | .180   | .190 |       |
| A1             | 2.57        | 2.83  | .101   | .111 |       |
| A2             | 2.51        | 2.85  | .099   | .112 |       |
| A3             | 3.73        | 4.24  | .147   | .167 |       |
| A4             | 5.79        | 6.29  | .228   | .248 |       |
| b              | 0.61        | 0.95  | 0.24   | .037 |       |
| b1             | 0.56        | 0.90  | .022   | 0.35 | 5     |
| b2             | 1.13        | 1.48  | 0.44   | .058 |       |
| b3             | 1.08        | 1.43  | 0.42   | .056 | 5     |
| b4             | 0.76        | 1.06  | .030   | .042 |       |
| b5             | 0.71        | 1.01  | .028   | .040 | 5     |
| c              | 0.33        | 0.63  | .013   | .025 |       |
| c1             | 0.28        | 0.58  | .011   | .023 | 5     |
| D              | 8.65        | 9.80  | .341   | .386 | 4     |
| d1             | 15.80       | 16.12 | .622   | .635 |       |
| d2             | 13.97       | 14.22 | .550   | .560 |       |
| d3             | 12.30       | 12.92 | .484   | .509 |       |
| E              | 9.63        | 10.63 | .379   | .419 | 4     |

| SYM<br>BO<br>L | DIMENSIONS  |       |        |      | NOTES |
|----------------|-------------|-------|--------|------|-------|
|                | MILLIMETERS |       | INCHES |      |       |
|                | MIN.        | MAX.  | MIN.   | MAX. |       |
| e              | 1.70        | BSC   | .067   | BSC  |       |
| L              | 13.20       | 13.73 | .520   | .541 |       |
| L1             | 1.91        | 2.31  | .075   | .091 | 3     |
| L2             | 12.7        | 13.46 | .500   | .530 |       |
| L3             | 10.92       | 11.68 | .430   | .460 |       |
| n              | 6.05        | 6.15  | .238   | .242 |       |
| øP             | 3.05        | 3.45  | .120   | .136 |       |
| u              | 2.40        | 2.50  | .094   | .098 | 6     |
| v              | 0.40        | 0.50  | .016   | .020 | 6     |
| ø1             | -           | 45°   | -      | 45°  |       |

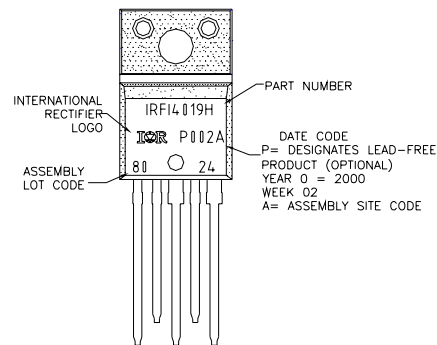
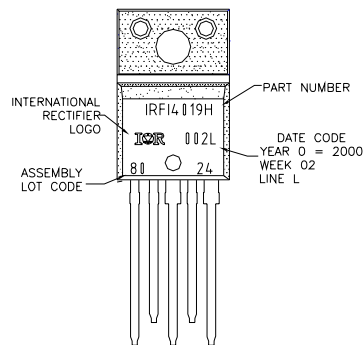
### LEAD ASSIGNMENTS

- 1 - SOURCE 2
- 2 - GATE 2
- 3 - DRAIN 2 / SOURCE 1
- 4 - GATE 1
- 5 - DRAIN 1

## TO-220 Full-Pak 5-Pin Part Marking Information

EXAMPLE: THIS IS AN IRFI4019H WITH  
LOT CODE 8024  
ASSEMBLED ON WW02.2000  
IN THE ASSEMBLY LINE "L"

Note: "P" in assembly line  
position indicates "Lead Free"



TO-220AB Full-Pak 5-Pin package is not recommended for Surface Mount Application.

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/>