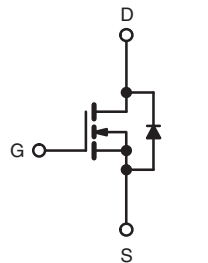
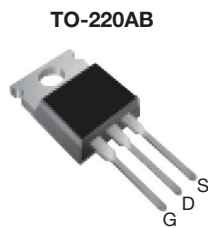


## Power MOSFET

| PRODUCT SUMMARY           |                 |       |
|---------------------------|-----------------|-------|
| $V_{DS}$ (V)              | 60              |       |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10$ V | 0.028 |
| $Q_g$ (Max.) (nC)         | 67              |       |
| $Q_{gs}$ (nC)             | 18              |       |
| $Q_{gd}$ (nC)             | 25              |       |
| Configuration             | Single          |       |



N-Channel MOSFET

### FEATURES

- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic  $dV/dt$  Rating
- 175 °C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Drop in Replacement of the IRFZ44, SiHFZ44 for Linear/Audio Applications
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
 COMPLIANT

### DESCRIPTION

Advanced Power MOSFETs from Vishay utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that Power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The TO-220AB package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220AB contribute to its wide acceptance throughout the industry.

| ORDERING INFORMATION |             |
|----------------------|-------------|
| Package              | TO-220AB    |
| Lead (Pb)-free       | IRFZ44RPbF  |
|                      | SiHFZ44R-E3 |
| SnPb                 | IRFZ44R     |
|                      | SiHFZ44R    |



| ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted) |                  |                |                |          |   |
|---|------------------|----------------|----------------|----------|---|
| PARAMETER   |                  | SYMBOL         | LIMIT          | UNIT     |   |
| Drain-Source Voltage  |                  | $V_{DS}$       | 60             | V        |   |
| Gate-Source Voltage   |                  | $V_{GS}$       | $\pm 20$       |          |   |
| Continuous Drain Current <sup>e</sup>                             | $V_{GS}$ at 10 V | $I_D$          | $T_C = 25$ °C  | 50       | A |
| Continuous Drain Current  |                  |                | $T_C = 100$ °C | 36       |   |
| Pulsed Drain Current <sup>a</sup>                                 |                  | $I_{DM}$       | 200            |          |   |
| Linear Derating Factor  |                  |                | 1.0            | W/°C     |   |
| Single Pulse Avalanche Energy <sup>b</sup>                        |                  | $E_{AS}$       | 100            | mJ       |   |
| Maximum Power Dissipation   | $T_C = 25$ °C    | $P_D$          | 150            | W        |   |
| Peak Diode Recovery $dV/dt^c$                                     |                  | $dV/dt$        | 4.5            | V/ns     |   |
| Operating Junction and Storage Temperature Range                  |                  | $T_J, T_{stg}$ | - 55 to + 175  | °C       |   |
| Soldering Recommendations (Peak Temperature) <sup>d</sup>         | for 10 s         |                | 300            |          |   |
| Mounting Torque   | 6-32 or M3 screw |                | 10             | lbf · in |   |
|   |                  |                | 1.1            | N · m    |   |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 25$  V, starting  $T_J = 25$  °C,  $L = 44$   $\mu$ H,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 51$  A (see fig. 12).
- $I_{SD} \leq 51$  A,  $dV/dt \leq 250$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175$  °C.
- 1.6 mm from case.
- Current limited by the package, (die current = 51 A).

\* Pb containing terminations are not RoHS compliant, exemptions may apply

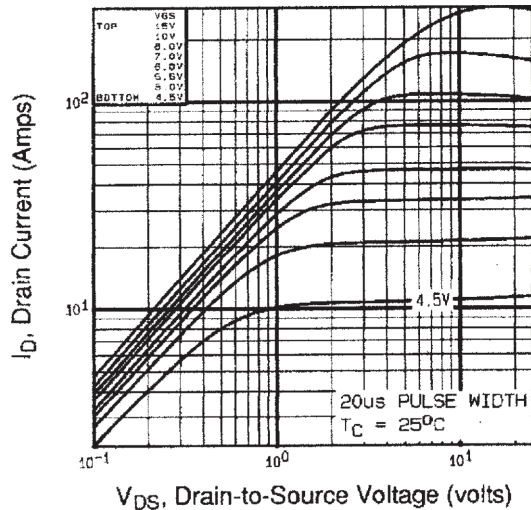
| THERMAL RESISTANCE RATINGS          |            |      |      |      |
|-------------------------------------|------------|------|------|------|
| PARAMETER                           | SYMBOL     | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient         | $R_{thJA}$ | -    | 62   | °C/W |
| Case-to-Sink, Flat, Greased Surface | $R_{thCS}$ | 0.50 | -    |      |
| Maximum Junction-to-Case (Drain)    | $R_{thJC}$ | -    | 1.0  |      |

| SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                     |   |      |       |                 |               |
|---|---------------------|---|------|-------|-----------------|---------------|
| PARAMETER   | SYMBOL              | TEST CONDITIONS   | MIN. | TYP.  | MAX.            | UNIT          |
| <b>Static</b>   |                     |   |      |       |                 |               |
| Drain-Source Breakdown Voltage  | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$  | 60   | -     | -               | V             |
| $V_{DS}$ Temperature Coefficient  | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$   | -    | 0.060 | -               | V/°C          |
| Gate-Source Threshold Voltage   | $V_{GS(th)}$        | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$  | 2.0  | -     | 4.0             | V             |
| Gate-Source Leakage   | $I_{GSS}$           | $V_{GS} = \pm 20$   | -    | -     | $\pm 100$       | nA            |
| Zero Gate Voltage Drain Current   | $I_{DSS}$           | $V_{DS} = 60\text{ V}$ , $V_{GS} = 0\text{ V}$  | -    | -     | 25              | $\mu\text{A}$ |
|   |                     | $V_{DS} = 48\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$  | -    | -     | 250             |               |
| Drain-Source On-State Resistance  | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$   $I_D = 31\text{ A}^b$  | -    | -     | 0.028           | $\Omega$      |
| Forward Transconductance  | $g_{fs}$            | $V_{DS} = 25\text{ V}$ , $I_D = 31\text{ A}^b$  | 15   | -     | -               | S             |
| <b>Dynamic</b>  |                     |   |      |       |                 |               |
| Input Capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = 25\text{ V}$ ,<br>$f = 1.0\text{ MHz}$ , see fig. 5  | -    | 1900  | -               | pF            |
| Output Capacitance  | $C_{oss}$           |   | -    | 920   | -               |               |
| Reverse Transfer Capacitance  | $C_{rss}$           |   | -    | 170   | -               |               |
| Total Gate Charge   | $Q_g$               | $V_{GS} = 10\text{ V}$   $I_D = 51\text{ A}$ , $V_{DS} = 48\text{ V}$ ,<br>see fig. 6 and 13 <sup>b</sup>   | -    | -     | 67              | nC            |
| Gate-Source Charge  | $Q_{gs}$            |   | -    | -     | 18              |               |
| Gate-Drain Charge   | $Q_{gd}$            |   | -    | -     | 25              |               |
| Turn-On Delay Time  | $t_{d(on)}$         | $V_{DD} = 30\text{ V}$ , $I_D = 51\text{ A}$ ,<br>$R_g = 9.1\text{ }\Omega$ , $R_D = 0.55\text{ }\Omega$ , see fig. 10 <sup>b</sup>                             | -    | 14    | -               | ns            |
| Rise Time   | $t_r$               |   | -    | 110   | -               |               |
| Turn-Off Delay Time   | $t_{d(off)}$        |   | -    | 45    | -               |               |
| Fall Time   | $t_f$               |   | -    | 92    | -               |               |
| Internal Drain Inductance   | $L_D$               | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact  | -    | 4.5   | -               | nH            |
| Internal Source Inductance  | $L_S$               |   | -    | 7.5   | -               |               |
| <b>Drain-Source Body Diode Characteristics</b>                              |                     |   |      |       |                 |               |
| Continuous Source-Drain Diode Current                                       | $I_S$               | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode    | -    | -     | 50 <sup>c</sup> | A             |
| Pulsed Diode Forward Current <sup>a</sup>                                   | $I_{SM}$            |   | -    | -     | 200             |               |
| Body Diode Voltage  | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}$ , $I_S = 51\text{ A}$ , $V_{GS} = 0\text{ V}^b$  | -    | -     | 2.5             | V             |
| Body Diode Reverse Recovery Time  | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}$ , $I_F = 51\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$   | -    | 120   | 180             | ns            |
| Body Diode Reverse Recovery Charge  | $Q_{rr}$            |   | -    | 0.53  | 0.80            | $\mu\text{C}$ |
| Forward Turn-On Time  | $t_{on}$            | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )   |      |       |                 |               |

### Notes

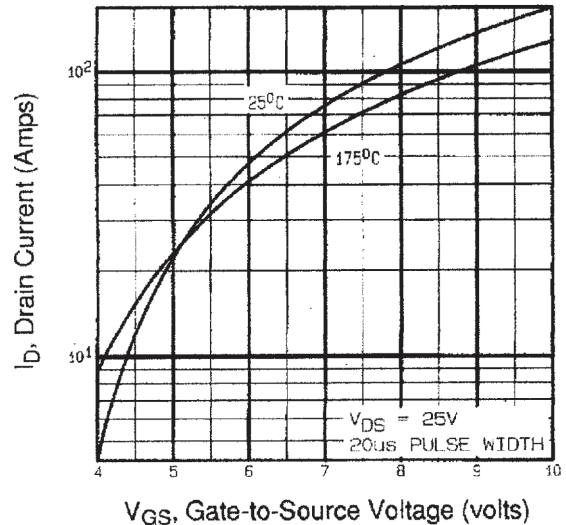
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- Current limited by the package (die current = 51 A).

## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



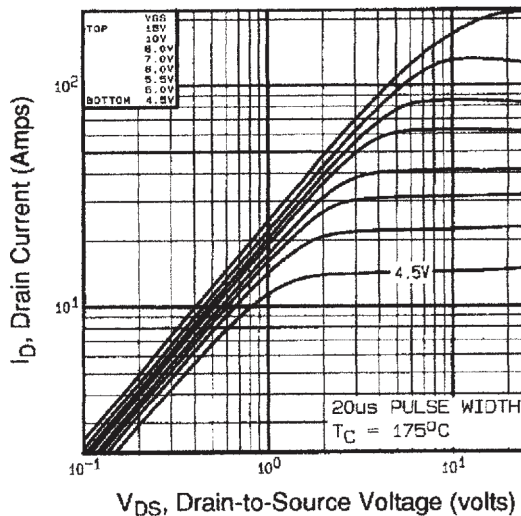
$V_{DS}$ , Drain-to-Source Voltage (volts)

Fig. 1 - Typical Output Characteristics



$V_{GS}$ , Gate-to-Source Voltage (volts)

Fig. 3 - Typical Transfer Characteristics



$V_{DS}$ , Drain-to-Source Voltage (volts)

Fig. 2 - Typical Output Characteristics

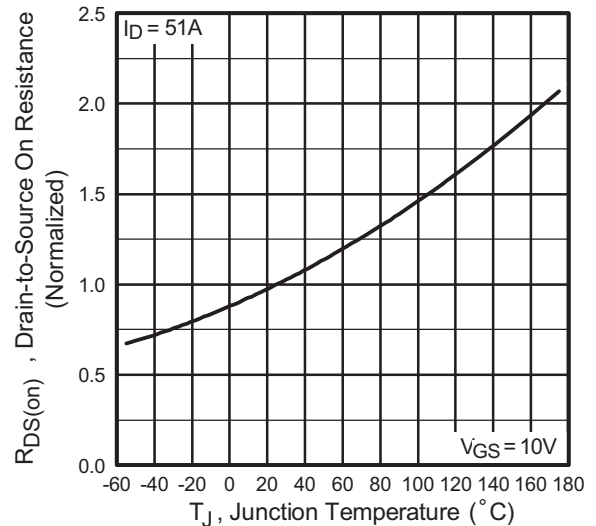


Fig. 4 - Normalized On-Resistance vs. Temperature

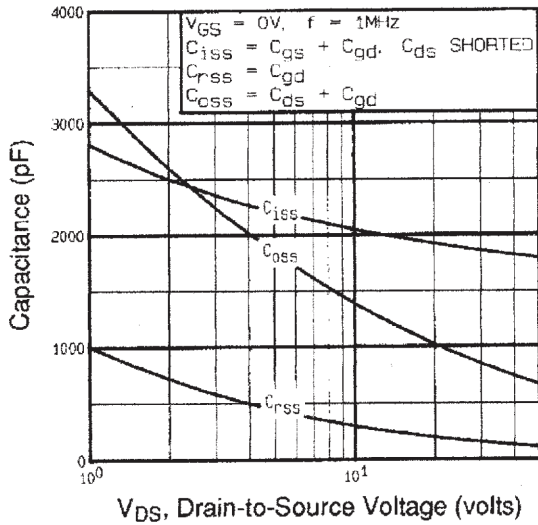


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

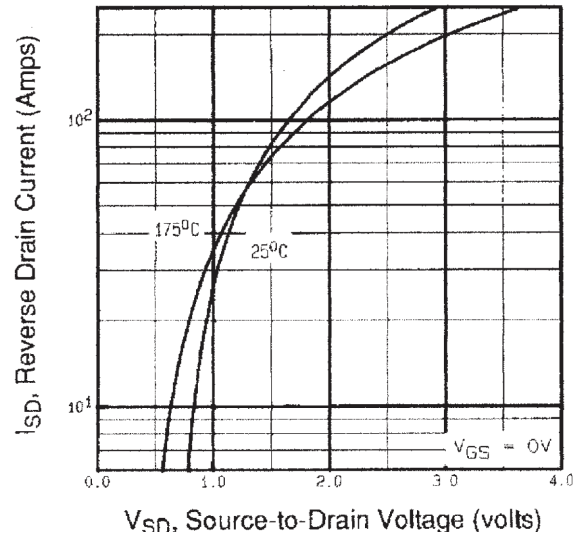


Fig. 7 - Typical Source-Drain Diode Forward Voltage

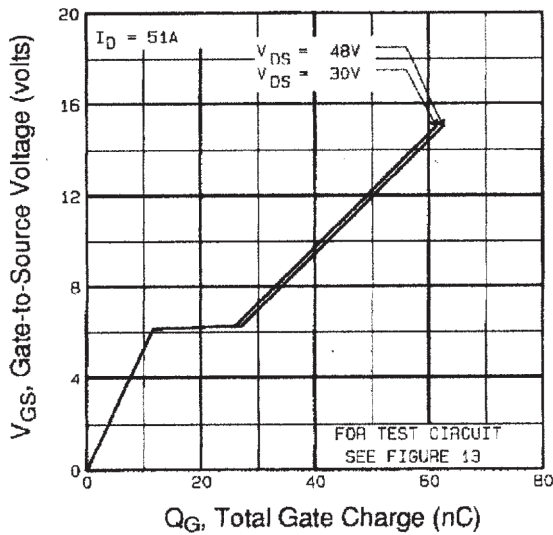


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

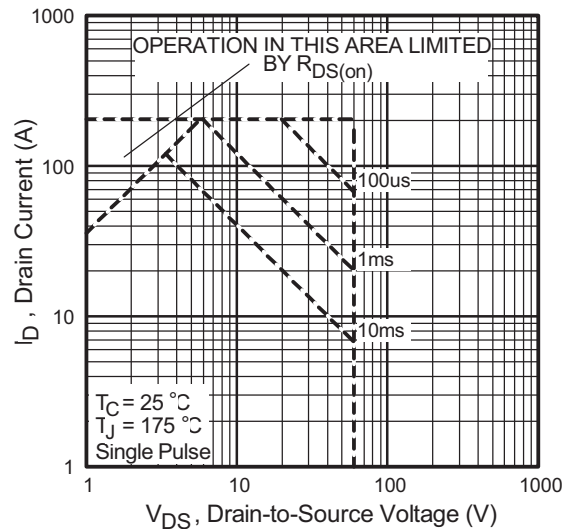


Fig. 8 - Maximum Safe Operating Area

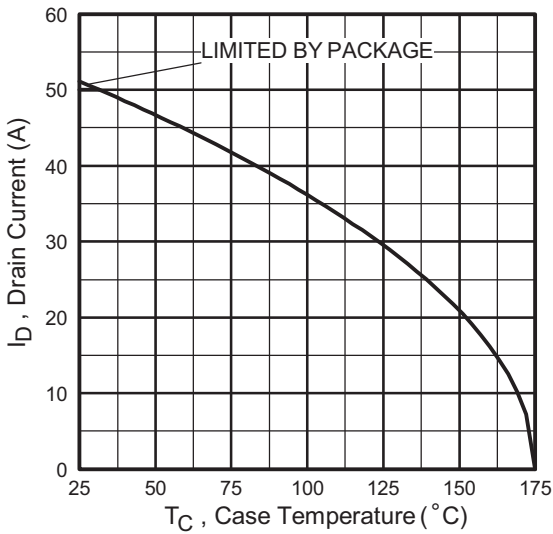


Fig. 9 - Maximum Drain Current vs. Case Temperature

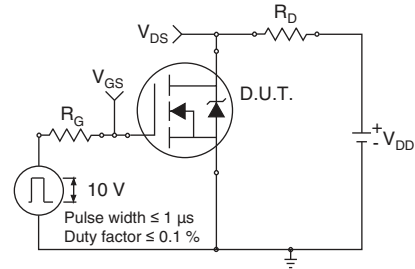


Fig. 10a - Switching Time Test Circuit



Fig. 10b - Switching Time Waveforms

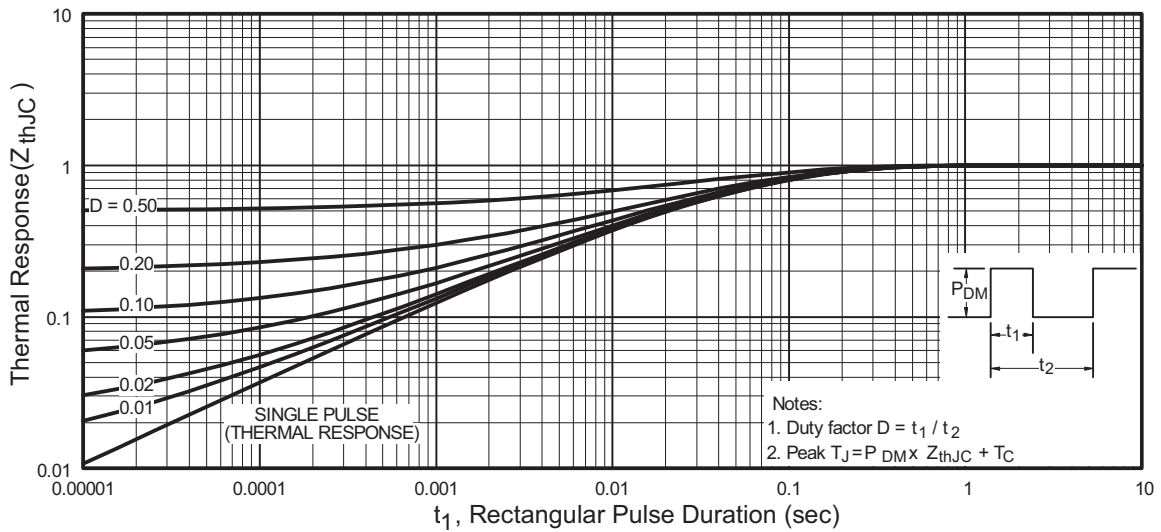


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

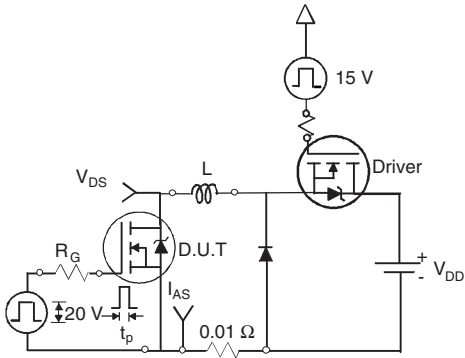


Fig. 12a - Unclamped Inductive Test Circuit

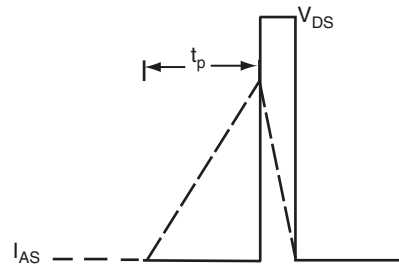


Fig. 12b - Unclamped Inductive Waveforms

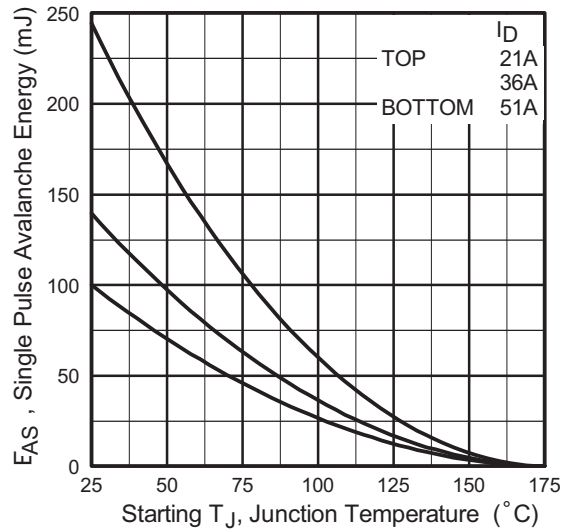


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

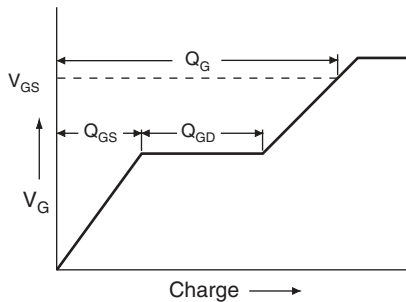


Fig. 13a - Basic Gate Charge Waveform

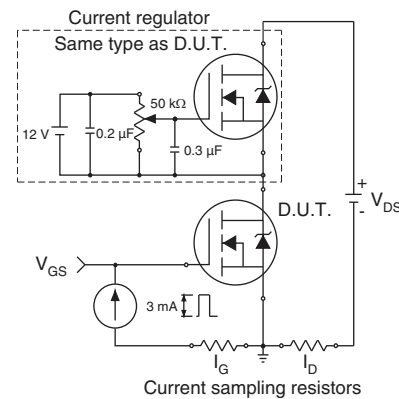
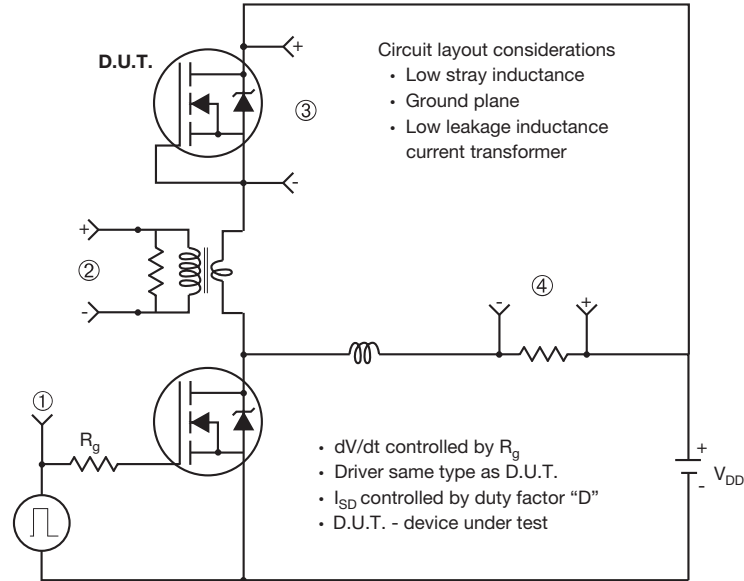


Fig. 13b - Gate Charge Test Circuit

### Peak Diode Recovery dV/dt Test Circuit



**Note**

a.  $V_{GS} = 5 V$  for logic level devices

**Fig. 14 - For N-Channel**

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?91292](http://www.vishay.com/ppg?91292).

## TO-220-1



| DIM. | MILLIMETERS |       | INCHES |       |
|------|-------------|-------|--------|-------|
|      | MIN.        | MAX.  | MIN.   | MAX.  |
| A    | 4.24        | 4.65  | 0.167  | 0.183 |
| b    | 0.69        | 1.02  | 0.027  | 0.040 |
| b(1) | 1.14        | 1.78  | 0.045  | 0.070 |
| c    | 0.36        | 0.61  | 0.014  | 0.024 |
| D    | 14.33       | 15.85 | 0.564  | 0.624 |
| E    | 9.96        | 10.52 | 0.392  | 0.414 |
| e    | 2.41        | 2.67  | 0.095  | 0.105 |
| e(1) | 4.88        | 5.28  | 0.192  | 0.208 |
| F    | 1.14        | 1.40  | 0.045  | 0.055 |
| H(1) | 6.10        | 6.71  | 0.240  | 0.264 |
| J(1) | 2.41        | 2.92  | 0.095  | 0.115 |
| L    | 13.36       | 14.40 | 0.526  | 0.567 |
| L(1) | 3.33        | 4.04  | 0.131  | 0.159 |
| Ø P  | 3.53        | 3.94  | 0.139  | 0.155 |
| Q    | 2.54        | 3.00  | 0.100  | 0.118 |

ECN: X15-0364-Rev. C, 14-Dec-15  
DWG: 6031

**Note**

- M\* = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM







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