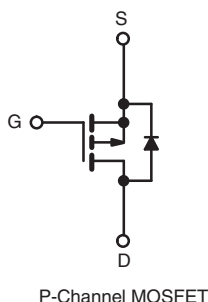
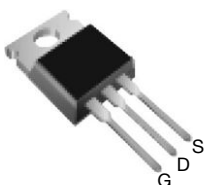


## Power MOSFET

### PRODUCT SUMMARY

|                           |                   |     |
|---------------------------|-------------------|-----|
| $V_{DS}$ (V)              | - 100             |     |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = - 10$ V | 1.2 |
| $Q_g$ (Max.) (nC)         | 8.7               |     |
| $Q_{gs}$ (nC)             | 2.2               |     |
| $Q_{gd}$ (nC)             | 4.1               |     |
| Configuration             | Single            |     |

**TO-220AB**


### FEATURES

- Dynamic  $dV/dt$  Rating
- Repetitive Avalanche Rated
- P-Channel
- 175 °C Operating Temperature
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC


**RoHS\***  
COMPLIANT

### DESCRIPTION

Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

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 | IRF9510PbF<br>SiHF9510-E3 |
| SnPb           | IRF9510<br>SiHF9510       |

### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)

| PARAMETER                                        | SYMBOL             | LIMIT            | UNIT  |
|--------------------------------------------------|--------------------|------------------|-------|
| Drain-Source Voltage                             | $V_{DS}$           | - 100            | V     |
| Gate-Source Voltage                              | $V_{GS}$           | $\pm 20$         |       |
| Continuous Drain Current                         | $V_{GS}$ at - 10 V | $T_C = 25$ °C    | A     |
|                                                  |                    | $T_C = 100$ °C   |       |
| Pulsed Drain Current <sup>a</sup>                | $I_{DM}$           | - 16             |       |
| Linear Derating Factor                           |                    | 0.29             | W/°C  |
| Single Pulse Avalanche Energy <sup>b</sup>       | $E_{AS}$           | 200              | mJ    |
| Repetitive Avalanche Current <sup>a</sup>        | $I_{AR}$           | - 4.0            | A     |
| Repetitive Avalanche Energy <sup>a</sup>         | $E_{AR}$           | 4.3              | mJ    |
| Maximum Power Dissipation                        | $P_D$              | 43               | W     |
| Peak Diode Recovery $dV/dt^c$                    | $dV/dt$            | - 5.5            | V/ns  |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$     | - 55 to + 175    | °C    |
| Soldering Recommendations (Peak Temperature)     | for 10 s           | 300 <sup>d</sup> |       |
| Mounting Torque                                  | 6-32 or M3 screw   | 10               |       |
|                                                  |                    | 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,  $L = 18$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = - 4.0$  A (see fig. 12).
- $I_{SD} \leq - 4.0$  A,  $dI/dt \leq 75$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 175$  °C.
- 1.6 mm from case.

\* 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)    | $R_{thJC}$ | -    | 3.5  |      |

**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

| PARAMETER                                 | SYMBOL                           | TEST CONDITIONS                                                                                                               |                                                                                       | MIN.  | TYP.    | MAX.  | UNIT |
|-------------------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------|---------|-------|------|
| Static                                    |                                  |                                                                                                                               |                                                                                       |       |         |       |      |
| Drain-Source Breakdown Voltage            | V <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = - 250 μA                                                                              |                                                                                       | - 100 | -       | -     | V    |
| V <sub>DS</sub> Temperature Coefficient   | ΔV <sub>DS</sub> /T <sub>J</sub> | Reference to 25 °C, I <sub>D</sub> = - 1 mA                                                                                   |                                                                                       | -     | - 0.091 | -     | V/°C |
| Gate-Source Threshold Voltage             | V <sub>GS(th)</sub>              | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = - 250 μA                                                                 |                                                                                       | - 2.0 | -       | - 4.0 | V    |
| Gate-Source Leakage                       | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 20 V                                                                                                      |                                                                                       | -     | -       | ± 100 | nA   |
| Zero Gate Voltage Drain Current           | I <sub>DSS</sub>                 | V <sub>DS</sub> = - 100 V, V <sub>GS</sub> = 0 V                                                                              |                                                                                       | -     | -       | - 100 | μA   |
|                                           |                                  | V <sub>DS</sub> = - 80 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C                                                      |                                                                                       | -     | -       | - 500 |      |
| Drain-Source On-State Resistance          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = - 10 V                                                                                                      | I <sub>D</sub> = - 2.4 A <sup>b</sup>                                                 | -     | -       | 1.2   | Ω    |
| Forward Transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = - 50 V, I <sub>D</sub> = - 2.4 A <sup>b</sup>                                                               |                                                                                       | 1.0   | -       | -     | S    |
| Dynamic                                   |                                  |                                                                                                                               |                                                                                       |       |         |       |      |
| Input Capacitance                         | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = - 25 V,<br>f = 1.0 MHz, see fig. 5                                                |                                                                                       | -     | 200     | -     | pF   |
| Output Capacitance                        | C <sub>OSS</sub>                 |                                                                                                                               |                                                                                       | -     | 94      | -     |      |
| Reverse Transfer Capacitance              | C <sub>rss</sub>                 |                                                                                                                               |                                                                                       | -     | 18      | -     |      |
| Total Gate Charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = - 10 V                                                                                                      | I <sub>D</sub> = - 4.0 A, V <sub>DS</sub> = - 80 V,<br>see fig. 6 and 13 <sup>b</sup> | -     | -       | 8.7   | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>                  |                                                                                                                               |                                                                                       | -     | -       | 2.2   |      |
| Gate-Drain Charge                         | Q <sub>gd</sub>                  |                                                                                                                               |                                                                                       | -     | -       | 4.1   |      |
| Turn-On Delay Time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = - 50 V, I <sub>D</sub> = - 4.0 A,<br>R <sub>g</sub> = 24 Ω, R <sub>D</sub> = 11 Ω, see fig. 10 <sup>b</sup> |                                                                                       | -     | 10      | -     | ns   |
| Rise Time                                 | t <sub>r</sub>                   |                                                                                                                               |                                                                                       | -     | 27      | -     |      |
| Turn-Off Delay Time                       | t <sub>d(off)</sub>              |                                                                                                                               |                                                                                       | -     | 15      | -     |      |
| Fall Time                                 | t <sub>f</sub>                   |                                                                                                                               |                                                                                       | -     | 17      | -     |      |
| Internal Drain Inductance                 | L <sub>D</sub>                   | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact                                                    |                                                                                       | -     | 4.5     | -     | nH   |
| Internal Source Inductance                | L <sub>S</sub>                   |                                                                                                                               |                                                                                       | -     | 7.5     | -     |      |
| Drain-Source Body Diode Characteristics   |                                  |                                                                                                                               |                                                                                       |       |         |       |      |
| Continuous Source-Drain Diode Current     | I <sub>S</sub>                   | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode                                                      |                                                                                       | -     | -       | - 4.0 | A    |
| Pulsed Diode Forward Current <sup>a</sup> | I <sub>SM</sub>                  |                                                                                                                               |                                                                                       | -     | -       | - 16  |      |
| Body Diode Voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = - 4.0 A, V <sub>GS</sub> = 0 V <sup>b</sup>                                          |                                                                                       | -     | -       | - 5.5 | V    |
| Body Diode Reverse Recovery Time          | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = - 4.0 A, dI/dt = 100 A/μs <sup>b</sup>                                               |                                                                                       | -     | 82      | 160   | ns   |
| Body Diode Reverse Recovery Charge        | Q <sub>rr</sub>                  |                                                                                                                               |                                                                                       | -     | 0.15    | 0.30  | μC   |
| Forward Turn-On Time                      | t <sub>on</sub>                  | Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )                             |                                                                                       |       |         |       |      |

**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

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

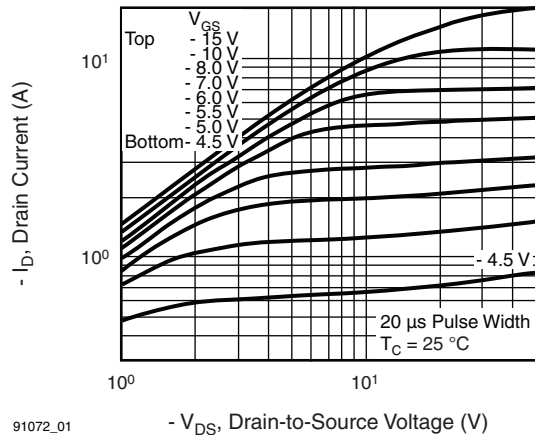


Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$

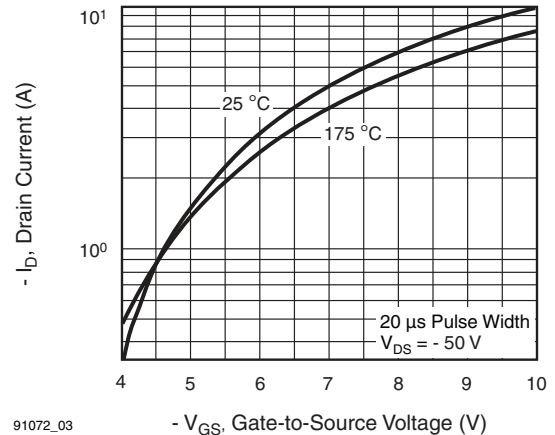


Fig. 3 - Typical Transfer Characteristics

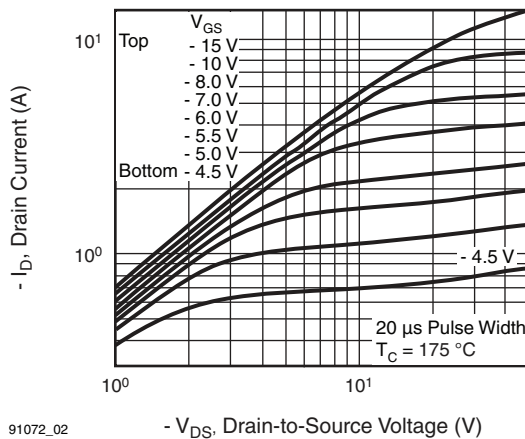


Fig. 2 - Typical Output Characteristics,  $T_C = 175^\circ\text{C}$

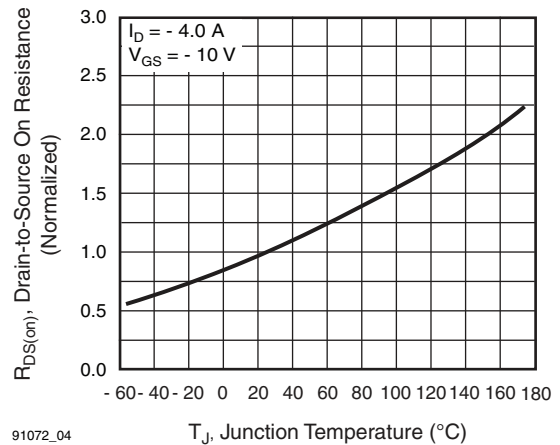
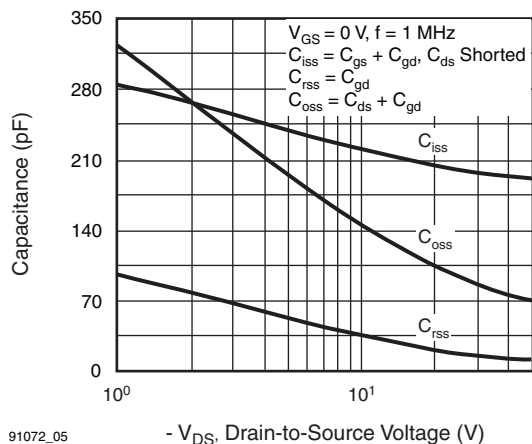
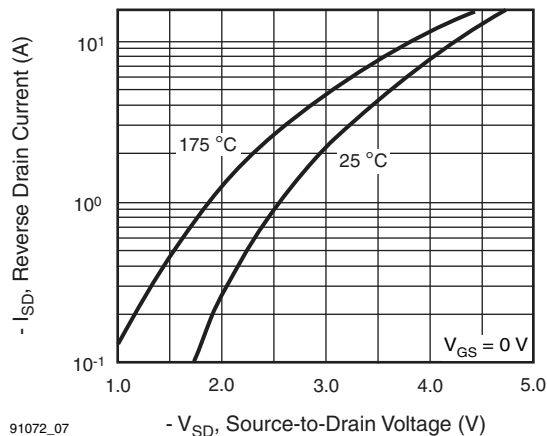


Fig. 4 - Normalized On-Resistance vs. Temperature



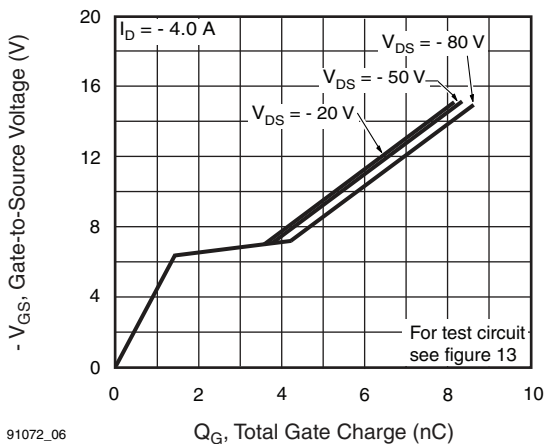
91072\_05

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



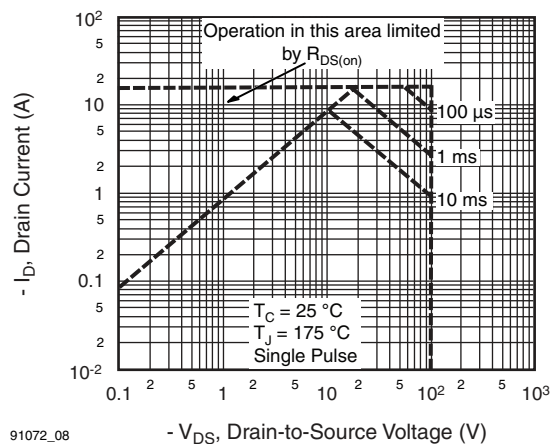
91072\_07

Fig. 7 - Typical Source-Drain Diode Forward Voltage



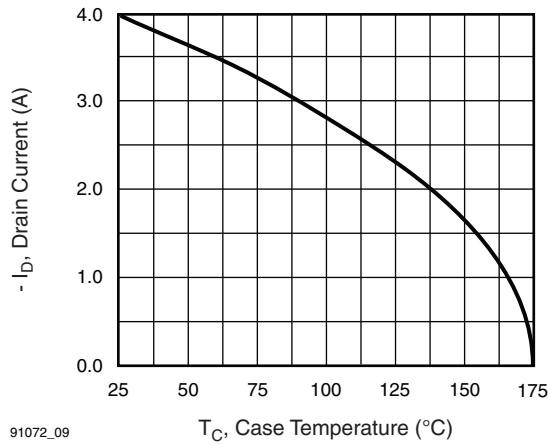
91072\_06

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

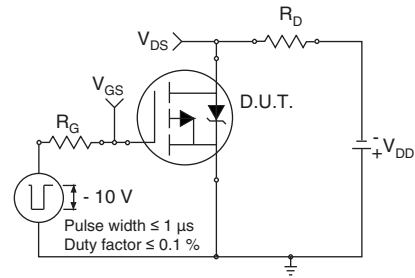


91072\_08

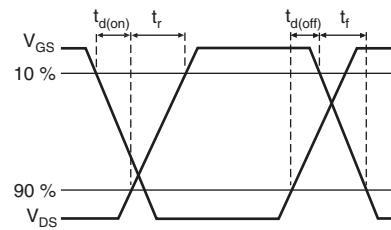
Fig. 8 - Maximum Safe Operating Area



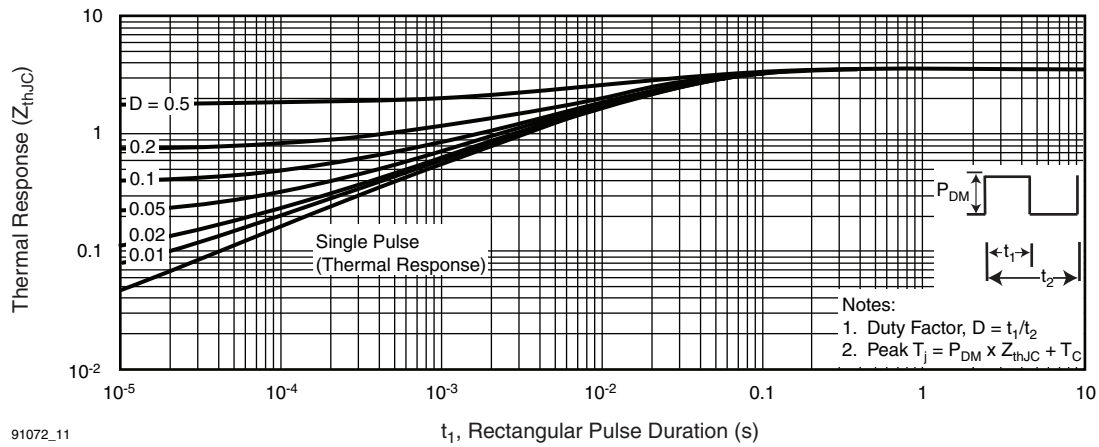
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



**Fig. 10a - Switching Time Test Circuit**



**Fig. 10b - Switching Time Waveforms**



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

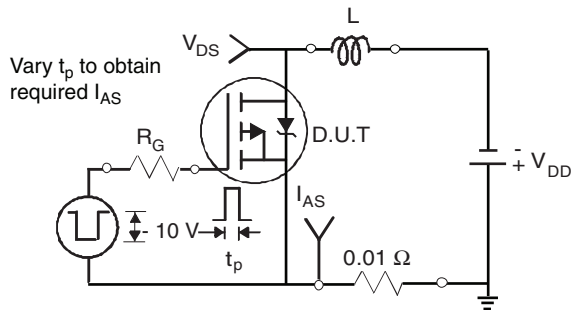


Fig. 12a - Unclamped Inductive Test Circuit

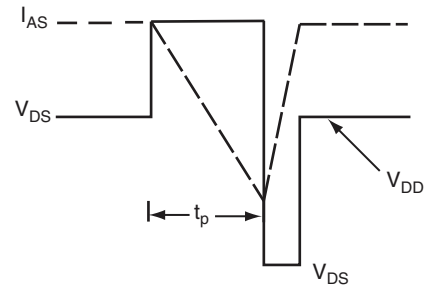


Fig. 12b - Unclamped Inductive Waveforms

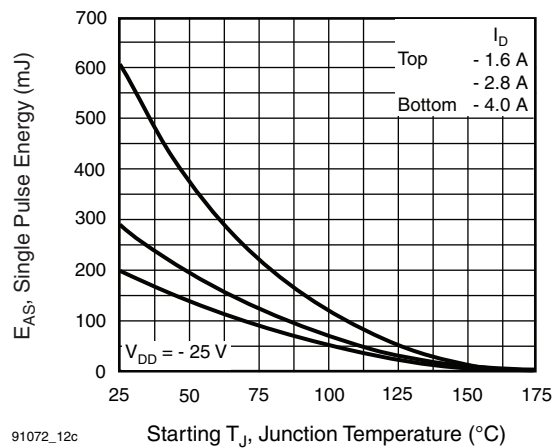


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

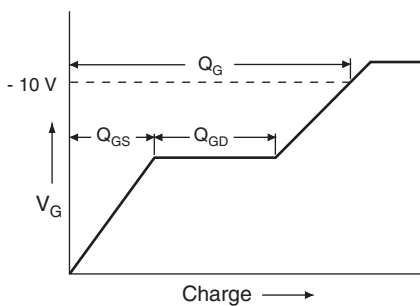


Fig. 13a - Basic Gate Charge Waveform

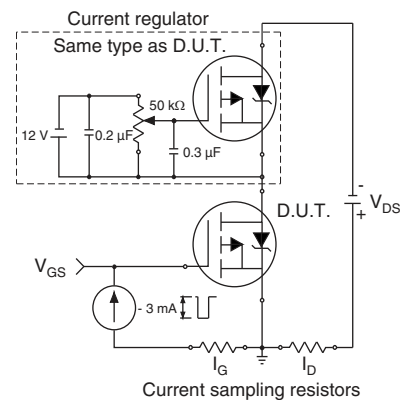
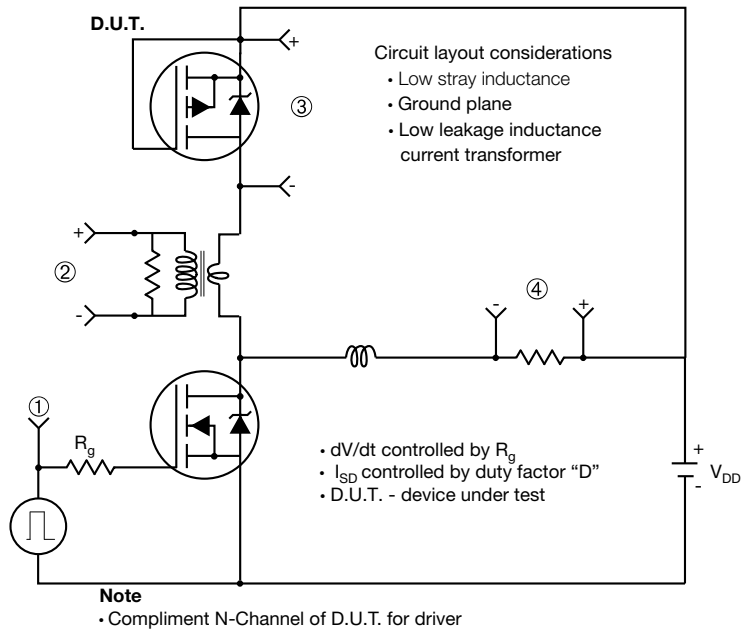


Fig. 13b - Gate Charge Test Circuit

## Peak Diode Recovery $dV/dt$ Test Circuit



**Fig. 14 - For P-Channel**

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## TO-220AB



| DIM.            | MILLIMETERS |       | INCHES |       |
|-----------------|-------------|-------|--------|-------|
|                 | MIN.        | MAX.  | MIN.   | MAX.  |
| A               | 4.25        | 4.65  | 0.167  | 0.183 |
| b               | 0.69        | 1.01  | 0.027  | 0.040 |
| b(1)            | 1.20        | 1.73  | 0.047  | 0.068 |
| c               | 0.36        | 0.61  | 0.014  | 0.024 |
| D               | 14.85       | 15.49 | 0.585  | 0.610 |
| E               | 10.04       | 10.51 | 0.395  | 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)            | 6.09        | 6.48  | 0.240  | 0.255 |
| J(1)            | 2.41        | 2.92  | 0.095  | 0.115 |
| L               | 13.35       | 14.02 | 0.526  | 0.552 |
| L(1)            | 3.32        | 3.82  | 0.131  | 0.150 |
| $\varnothing P$ | 3.54        | 3.94  | 0.139  | 0.155 |
| Q               | 2.60        | 3.00  | 0.102  | 0.118 |

ECN: X12-0208-Rev. N, 08-Oct-12  
DWG: 5471

### Notes

- \*  $M = 1.32$  mm to  $1.62$  mm (dimension including protrusion)  
Heatsink hole for HVM
- Xi'an and Mingxin actual photo





## Disclaimer

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**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

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Электрон  
Связь**

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