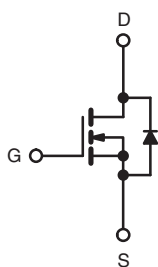
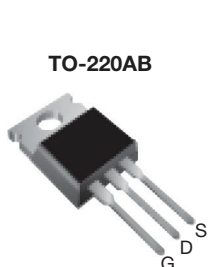


## Power MOSFET

### PRODUCT SUMMARY

|                           |                        |    |
|---------------------------|------------------------|----|
| $V_{DS}$ (V)              | 1000                   |    |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ | 11 |
| $Q_g$ (Max.) (nC)         | 38                     |    |
| $Q_{gs}$ (nC)             | 4.9                    |    |
| $Q_{gd}$ (nC)             | 22                     |    |
| Configuration             | Single                 |    |



N-Channel MOSFET

### FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC



Available  
**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 | IRFBG20PbF<br>SiHFBG20-E3 |
| SnPb           | IRFBG20<br>SiHFBG20       |

### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)

| PARAMETER                                        | SYMBOL           | LIMIT                             | UNIT                |
|--------------------------------------------------|------------------|-----------------------------------|---------------------|
| Drain-Source Voltage                             | $V_{DS}$         | 1000                              | V                   |
| Gate-Source Voltage                              | $V_{GS}$         | $\pm 20$                          |                     |
| Continuous Drain Current                         | $I_D$            | $T_C = 25\text{ }^\circ\text{C}$  | A                   |
|                                                  |                  | $T_C = 100\text{ }^\circ\text{C}$ |                     |
| Pulsed Drain Current <sup>a</sup>                | $I_{DM}$         | 5.6                               |                     |
| Linear Derating Factor                           |                  | 0.43                              | W/ $^\circ\text{C}$ |
| Single Pulse Avalanche Energy <sup>b</sup>       | $E_{AS}$         | 200                               | mJ                  |
| Repetitive Avalanche Current <sup>a</sup>        | $I_{AR}$         | 1.4                               | A                   |
| Repetitive Avalanche Energy <sup>a</sup>         | $E_{AR}$         | 5.4                               | mJ                  |
| Maximum Power Dissipation                        | $P_D$            | 54                                | W                   |
| Peak Diode Recovery dV/dt <sup>c</sup>           | dV/dt            | 1.0                               | V/ns                |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$   | - 55 to + 150                     | $^\circ\text{C}$    |
| Soldering Recommendations (Peak Temperature)     | for 10 s         | 300 <sup>d</sup>                  |                     |
| Mounting Torque                                  | 6-32 or M3 screw | 10                                | lbf · in            |
|                                                  |                  | 1.1                               | N · m               |

#### Notes

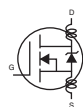
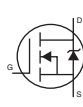
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 193\text{ }\mu\text{H}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 1.4\text{ A}$  (see fig. 12).
- $I_{SD} \leq 1.4\text{ A}$ ,  $dI/dt \leq 60\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 600$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .
- 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)    | $R_{thJC}$ | -    | 2.3  |      |

**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                                                                                                                     |                                                                                    | 1000 | -    | -     | 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                                                                                                                          |                                                                                    | -    | 1.2  | -     | 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> = 1000 V, V <sub>GS</sub> = 0 V                                                                                                                    |                                                                                    | -    | -    | 100   | μA   |
|                                           |                                  | V <sub>DS</sub> = 800 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                                                            |                                                                                    | -    | -    | 500   |      |
| Drain-Source On-State Resistance          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 10 V                                                                                                                                             | I <sub>D</sub> = 0.84 A <sup>b</sup>                                               | -    | -    | 11    | Ω    |
| Forward Transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 50 V, I <sub>D</sub> = 0.84 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                                                                                       |                                                                                    | -    | 500  | -     | pF   |
| Output Capacitance                        | C <sub>oss</sub>                 |                                                                                                                                                                    |                                                                                    | -    | 52   | -     |      |
| Reverse Transfer Capacitance              | C <sub>rss</sub>                 |                                                                                                                                                                    |                                                                                    | -    | 17   | -     |      |
| Total Gate Charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                                                             | I <sub>D</sub> = 1.4 A, V <sub>DS</sub> = 400 V,<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 38    | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>                  |                                                                                                                                                                    |                                                                                    | -    | -    | 4.9   |      |
| Gate-Drain Charge                         | Q <sub>gd</sub>                  |                                                                                                                                                                    |                                                                                    | -    | -    | 22    |      |
| Turn-On Delay Time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 500 V, I <sub>D</sub> = 1.4 A,<br>R <sub>g</sub> = 18 Ω, R <sub>D</sub> = 370 Ω, see fig. 10 <sup>b</sup>                                        |                                                                                    | -    | 9.4  | -     | ns   |
| Rise Time                                 | t <sub>r</sub>                   |                                                                                                                                                                    |                                                                                    | -    | 17   | -     |      |
| Turn-Off Delay Time                       | t <sub>d(off)</sub>              |                                                                                                                                                                    |                                                                                    | -    | 58   | -     |      |
| Fall Time                                 | t <sub>f</sub>                   |                                                                                                                                                                    |                                                                                    | -    | 31   | -     |      |
| Internal Drain Inductance                 | L <sub>D</sub>                   | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact<br> |                                                                                    | -    | 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<br>   |                                                                                    | -    | -    | 1.4   | A    |
| Pulsed Diode Forward Current <sup>a</sup> | I <sub>SM</sub>                  |                                                                                                                                                                    |                                                                                    | -    | -    | 5.6   |      |
| Body Diode Voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 1.4 A, V <sub>GS</sub> = 0 V <sup>b</sup>                                                                                 |                                                                                    | -    | -    | 1.5   | V    |
| Body Diode Reverse Recovery Time          | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = 1.4 A, dI/dt = 100 A/μs <sup>b</sup>                                                                                      |                                                                                    | -    | 130  | 190   | ns   |
| Body Diode Reverse Recovery Charge        | Q <sub>rr</sub>                  |                                                                                                                                                                    |                                                                                    | -    | 0.46 | 0.69  | 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)

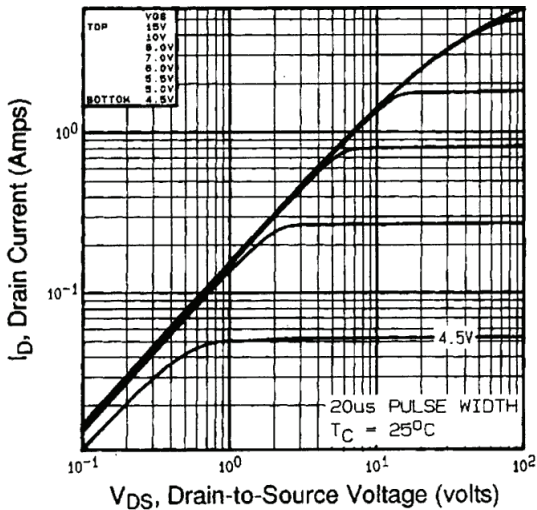


Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$

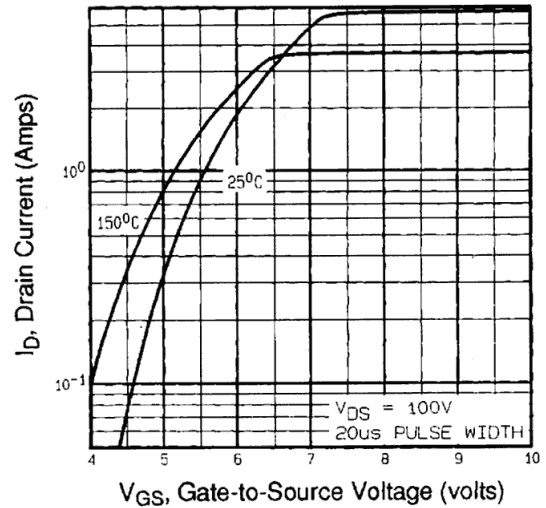


Fig. 3 - Typical Transfer Characteristics

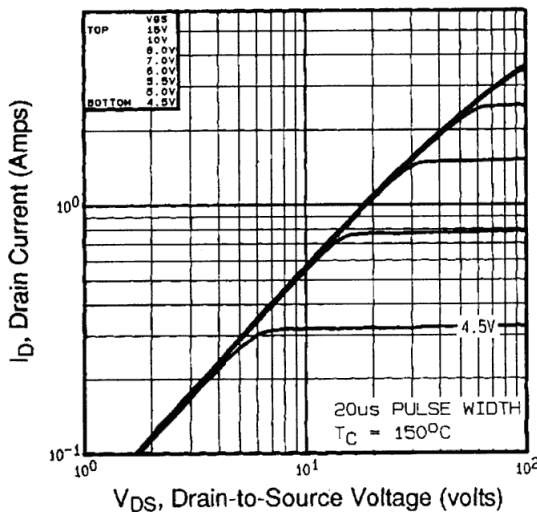


Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$

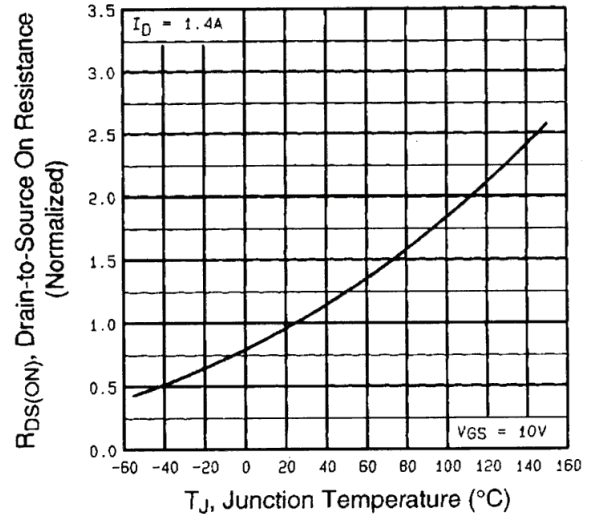


Fig. 4 - Normalized On-Resistance vs. Temperature

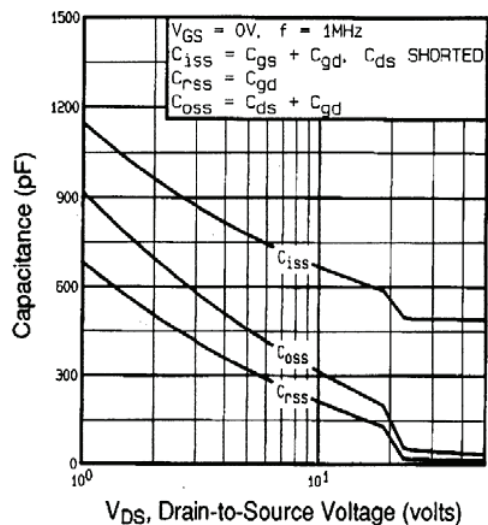


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

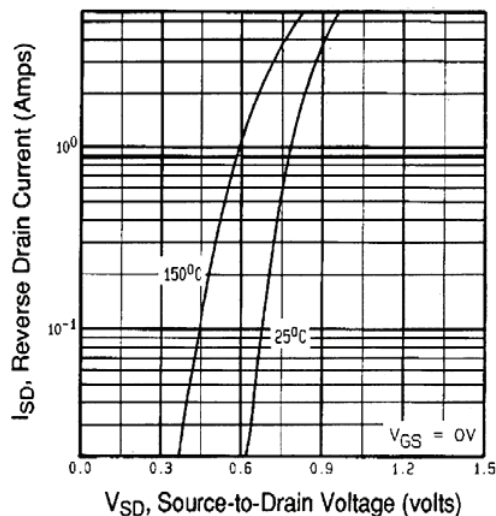


Fig. 7 - Typical Source-Drain Diode Forward Voltage

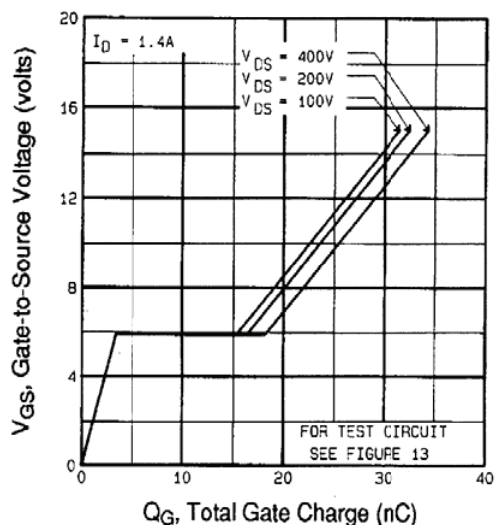


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

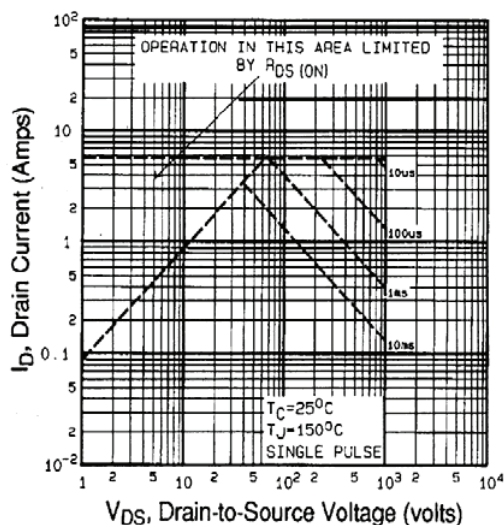


Fig. 8 - Maximum Safe Operating Area

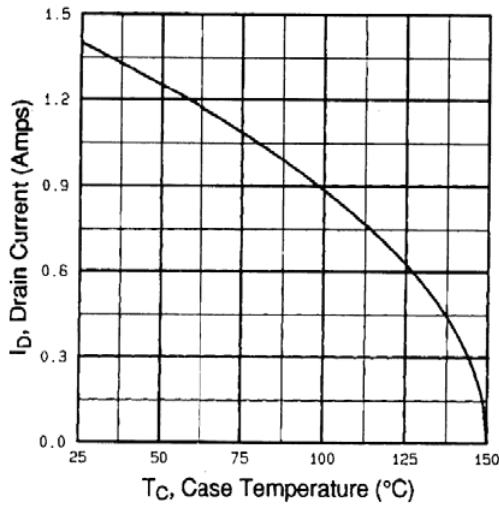


Fig. 9 - Maximum Drain Current vs. Case Temperature

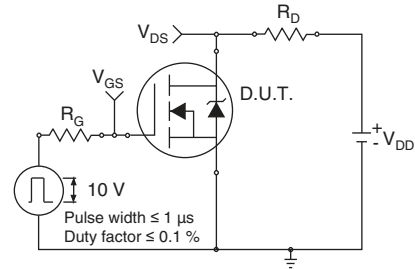


Fig. 10a - Switching Time Test Circuit



Fig. 10b - Switching Time Waveforms

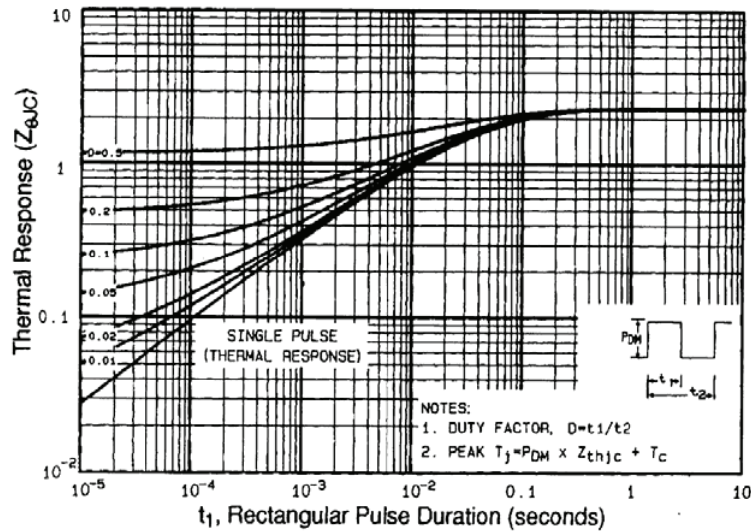


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

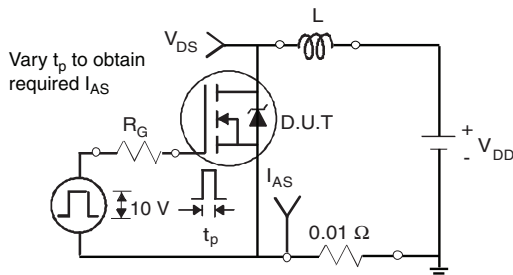


Fig. 12a - Unclamped Inductive Test Circuit

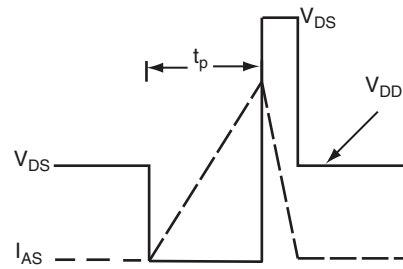


Fig. 12b - Unclamped Inductive Waveforms

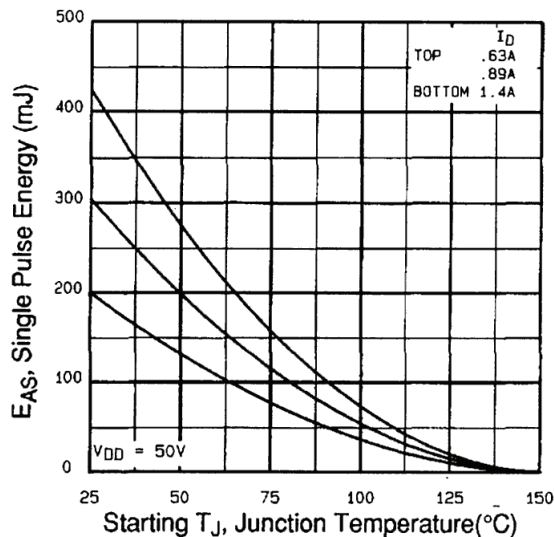


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

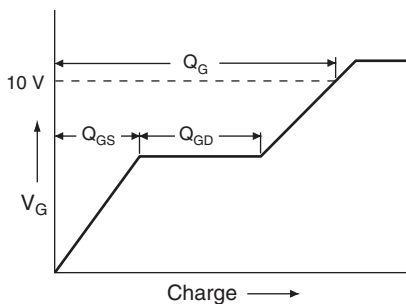


Fig. 13a - Basic Gate Charge Waveform

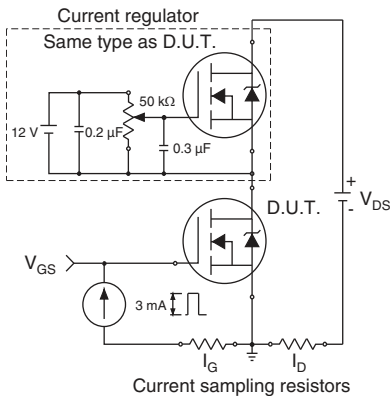
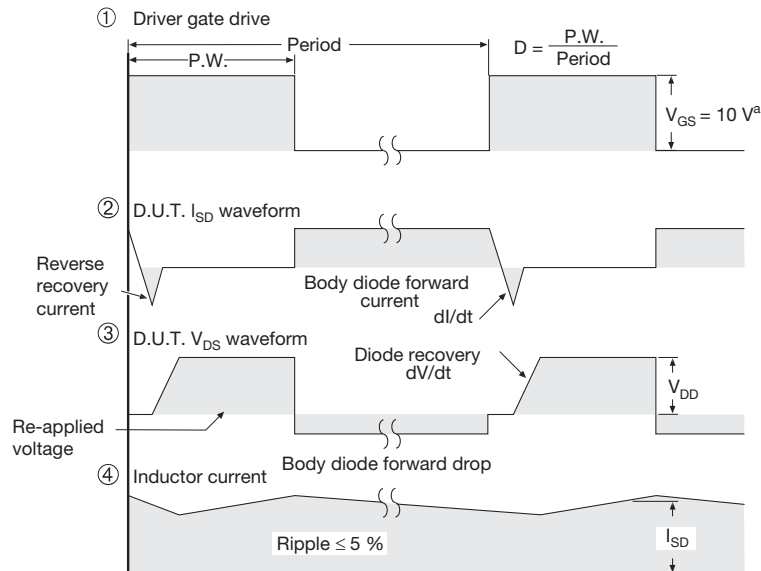
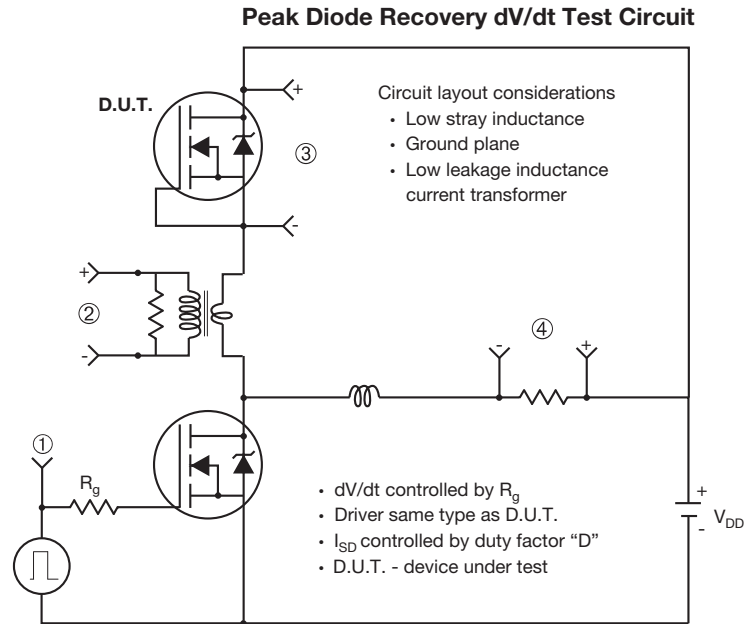


Fig. 13b - Gate Charge Test Circuit



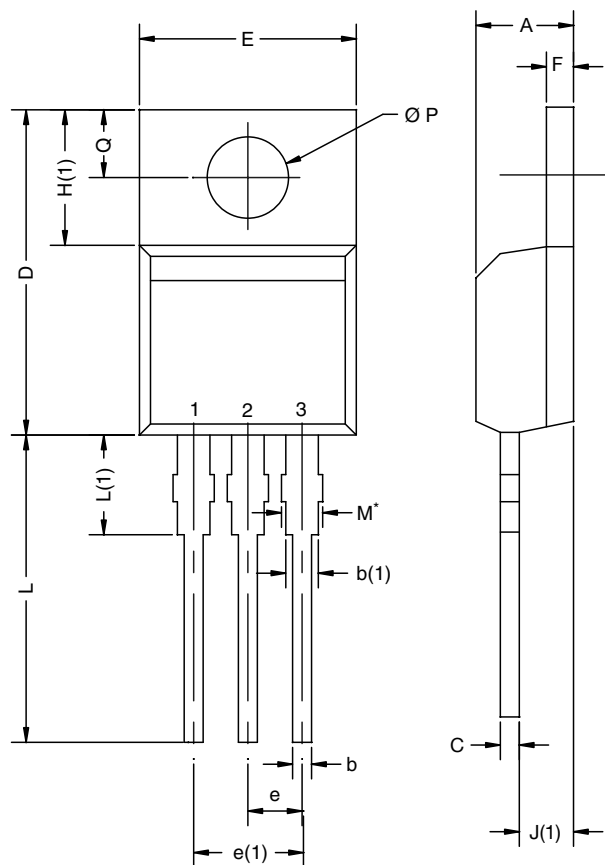
**Note**

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?91123](http://www.vishay.com/ppg?91123).

## 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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