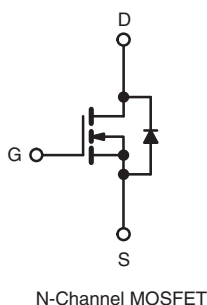
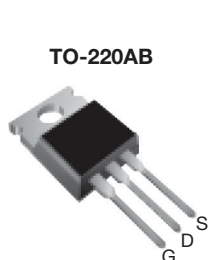


## Power MOSFET

### PRODUCT SUMMARY

|                           |                        |     |
|---------------------------|------------------------|-----|
| $V_{DS}$ (V)              | 800                    |     |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ | 6.5 |
| $Q_g$ (Max.) (nC)         | 38                     |     |
| $Q_{gs}$ (nC)             | 5.0                    |     |
| $Q_{gd}$ (nC)             | 21                     |     |
| Configuration             | Single                 |     |



### FEATURES

- Dynamic  $dV/dt$  Rating
- Repetitive Avalanche Rated
- 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 | IRFBE20PbF<br>SiHFBE20-E3 |
| SnPb           | IRFBE20<br>SiHFBE20       |

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

| PARAMETER                                        |                         |                         | SYMBOL                            | LIMIT            | UNIT  |
|--------------------------------------------------|-------------------------|-------------------------|-----------------------------------|------------------|-------|
| Drain-Source Voltage                             |                         |                         | V <sub>DS</sub>                   | 800              | V     |
| Gate-Source Voltage                              |                         |                         | V <sub>GS</sub>                   | ± 20             |       |
| Continuous Drain Current                         | V <sub>GS</sub> at 10 V | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | 1.8              | A     |
|                                                  |                         | T <sub>C</sub> = 100 °C |                                   | 1.2              |       |
| Pulsed Drain Current <sup>a</sup>                |                         |                         | I <sub>DM</sub>                   | 7.2              |       |
| Linear Derating Factor                           |                         |                         |                                   | 0.43             | W/°C  |
| Single Pulse Avalanche Energy <sup>b</sup>       |                         |                         | E <sub>AS</sub>                   | 180              | mJ    |
| Repetitive Avalanche Current <sup>a</sup>        |                         |                         | I <sub>AR</sub>                   | 1.8              | A     |
| Repetitive Avalanche Energy <sup>a</sup>         |                         |                         | E <sub>AR</sub>                   | 5.4              | mJ    |
| Maximum Power Dissipation                        | T <sub>C</sub> = 25 °C  |                         | P <sub>D</sub>                    | 54               | W     |
| Peak Diode Recovery dV/dt <sup>c</sup>           |                         |                         | dV/dt                             | 2.0              | V/ns  |
| Operating Junction and Storage Temperature Range |                         |                         | T <sub>J</sub> , T <sub>stg</sub> | - 55 to + 150    | °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).
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^{\circ}\text{C}$ ,  $L = 104\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 1.8\text{ A}$  (see fig. 12).
- $I_{SD} \leq 1.8\text{ A}$ ,  $dI/dt \leq 80\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 600$ ,  $T_J \leq 150\text{ }^{\circ}\text{C}$ .
- 1.6 mm from case.

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

**THERMAL RESISTANCE RATINGS**

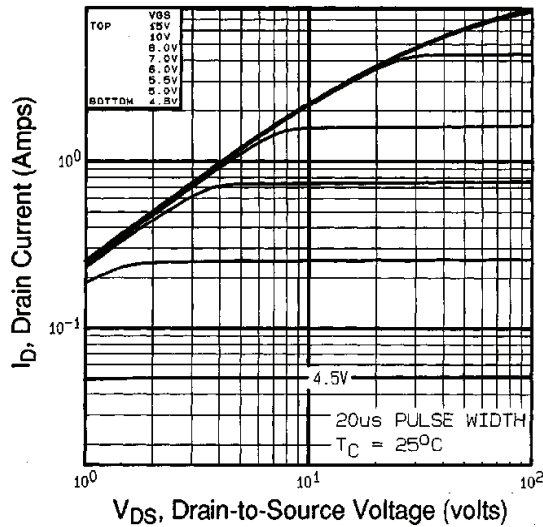
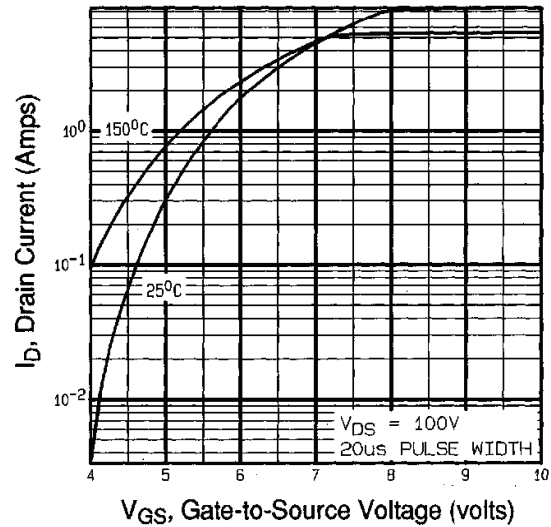
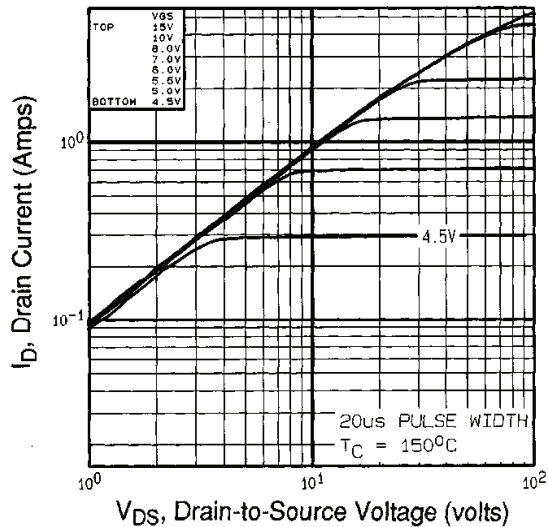
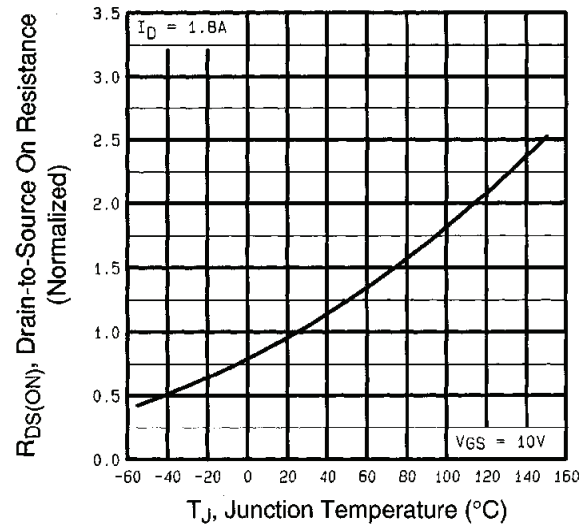
| PARAMETER                           | SYMBOL     | TYP. | MAX. | UNIT |
|-------------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient         | $R_{thJA}$ | -    | 62   | °C/W |
| Case-to-Sink, Flat, Greased Surface | $R_{thCS}$ | 0.50 | -    |      |
| Maximum Junction-to-Case (Drain)    | $R_{thJC}$ | -    | 2.3  |      |

**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , 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                                                                              |                                                                                    | 800  | -    | -     | 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                                                                                   |                                                                                    | -    | 0.98 | -     | 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> = 800 V, V <sub>GS</sub> = 0 V                                                                              |                                                                                    | -    | -    | 100   | μA   |
|                                           |                                  | V <sub>DS</sub> = 640 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> = 1.1 A <sup>b</sup>                                                | -    | -    | 6.5   | Ω    |
| Forward Transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 100 V, I <sub>D</sub> = 1.1 A <sup>b</sup>                                                                |                                                                                    | 0.80 | -    | -     | 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                                                |                                                                                    | -    | 530  | -     | pF   |
| Output Capacitance                        | C <sub>oss</sub>                 |                                                                                                                             |                                                                                    | -    | 150  | -     |      |
| Reverse Transfer Capacitance              | C <sub>rss</sub>                 |                                                                                                                             |                                                                                    | -    | 90   | -     |      |
| Total Gate Charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                      | I <sub>D</sub> = 1.8 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>                  |                                                                                                                             |                                                                                    | -    | -    | 5.0   |      |
| Gate-Drain Charge                         | Q <sub>gd</sub>                  |                                                                                                                             |                                                                                    | -    | -    | 21    |      |
| Turn-On Delay Time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 400 V, I <sub>D</sub> = 1.8 A,<br>R <sub>g</sub> = 18 Ω, R <sub>D</sub> = 230 Ω, see fig. 10 <sup>b</sup> |                                                                                    | -    | 8.2  | -     | ns   |
| Rise Time                                 | t <sub>r</sub>                   |                                                                                                                             |                                                                                    | -    | 17   | -     |      |
| Turn-Off Delay Time                       | t <sub>d(off)</sub>              |                                                                                                                             |                                                                                    | -    | 58   | -     |      |
| Fall Time                                 | t <sub>f</sub>                   |                                                                                                                             |                                                                                    | -    | 27   | -     |      |
| 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                                                    |                                                                                    | -    | -    | 1.8   | A    |
| Pulsed Diode Forward Current <sup>a</sup> | I <sub>SM</sub>                  |                                                                                                                             |                                                                                    | -    | -    | 7.2   |      |
| Body Diode Voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 1.8 A, V <sub>GS</sub> = 0 V <sup>b</sup>                                          |                                                                                    | -    | -    | 1.4   | V    |
| Body Diode Reverse Recovery Time          | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = 1.8 A, dI/dt = 100 A/μs <sup>b</sup>                                               |                                                                                    | -    | 380  | 570   | ns   |
| Body Diode Reverse Recovery Charge        | Q <sub>rr</sub>                  |                                                                                                                             |                                                                                    | -    | 0.94 | 1.4   | 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**

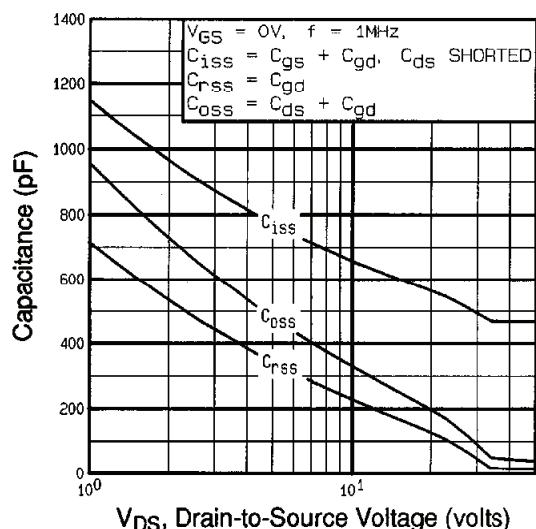


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

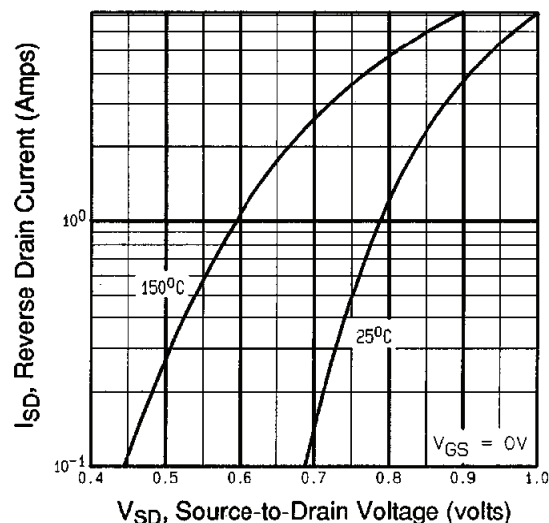


Fig. 7 - Typical Source-Drain Diode Forward Voltage

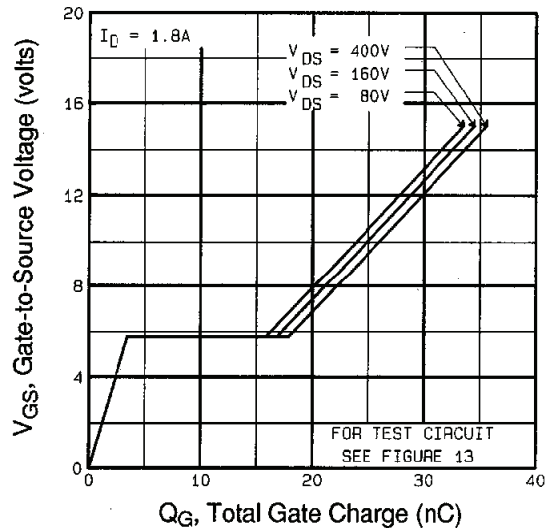


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

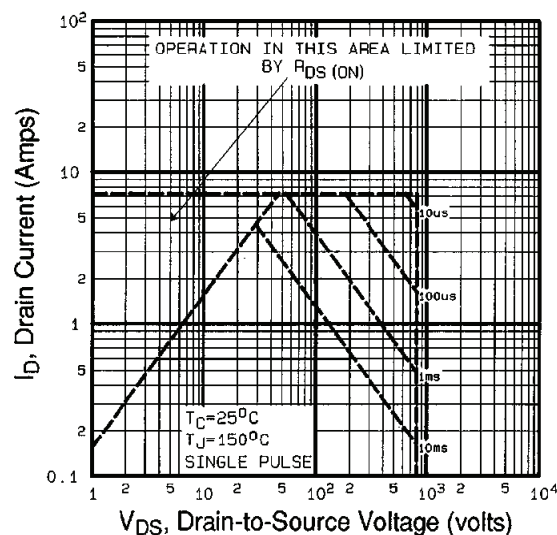


Fig. 8 - Maximum Safe Operating Area

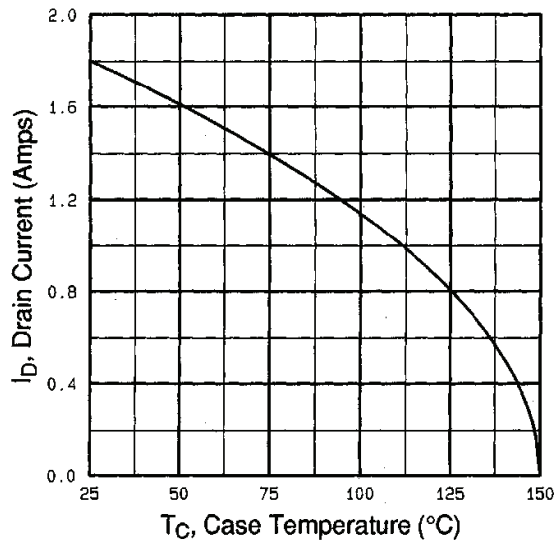


Fig. 9 - Maximum Drain Current vs. Case Temperature

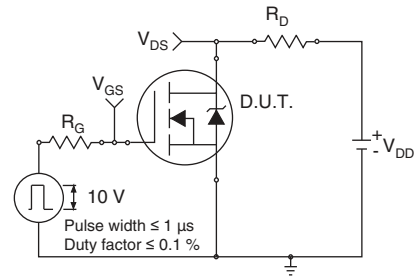


Fig. 10a - Switching Time Test Circuit

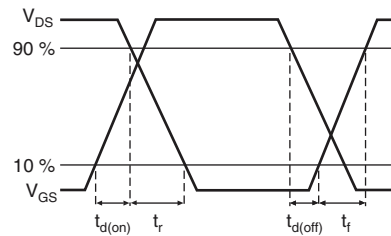


Fig. 10b - Switching Time Waveforms

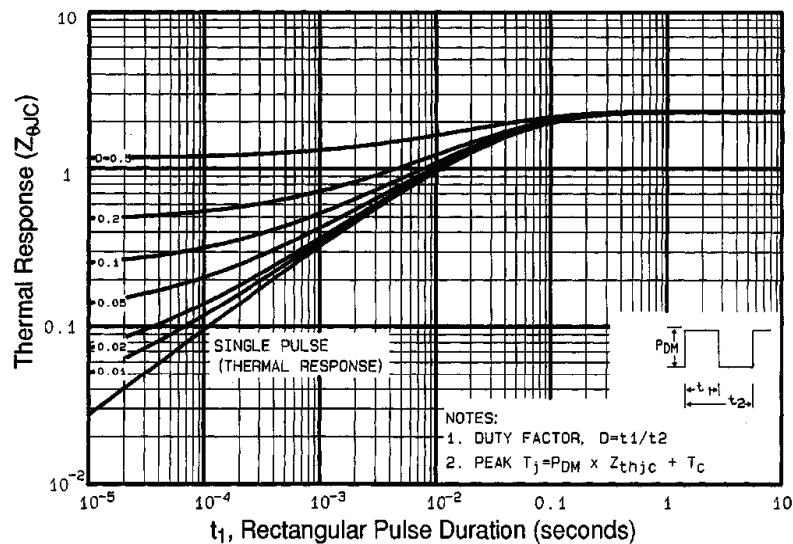


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

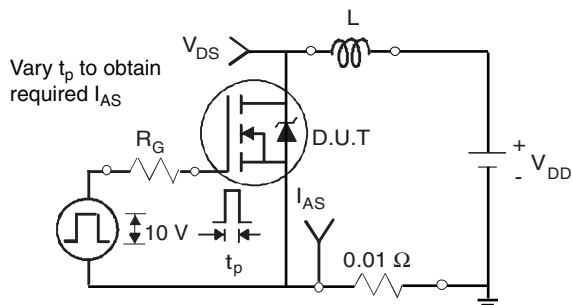


Fig. 12a - Unclamped Inductive Test Circuit

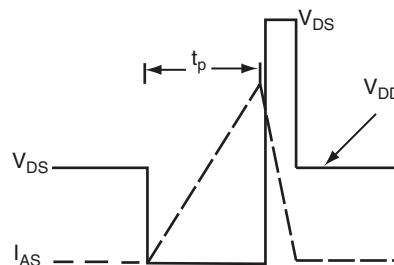


Fig. 12b - Unclamped Inductive Waveforms

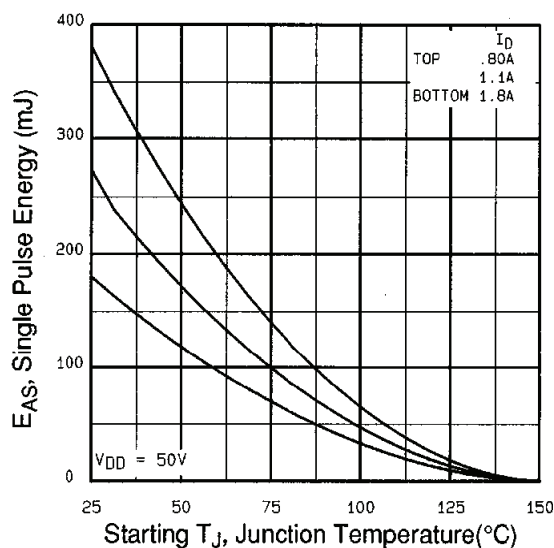


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

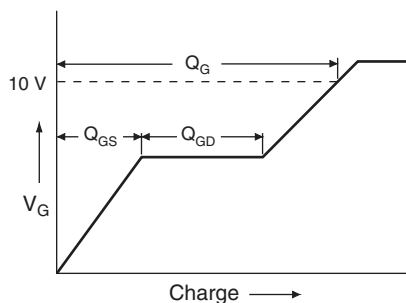


Fig. 13a - Basic Gate Charge Waveform

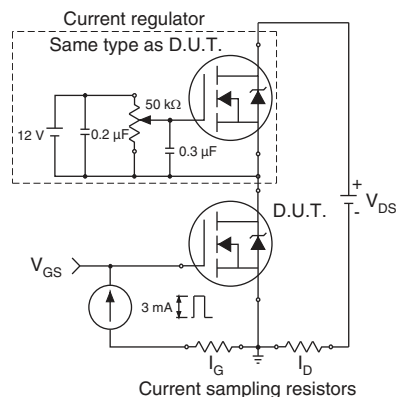
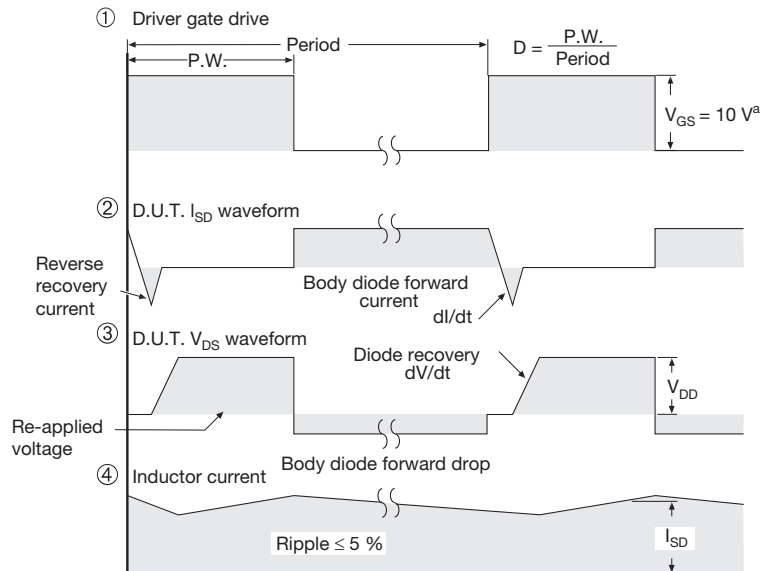
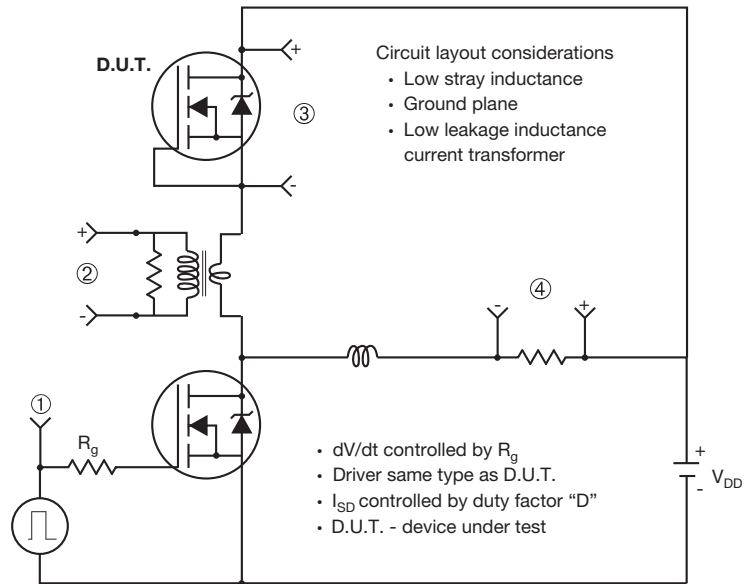


Fig. 13b - Gate Charge Test Circuit

## Peak Diode Recovery dV/dt Test Circuit



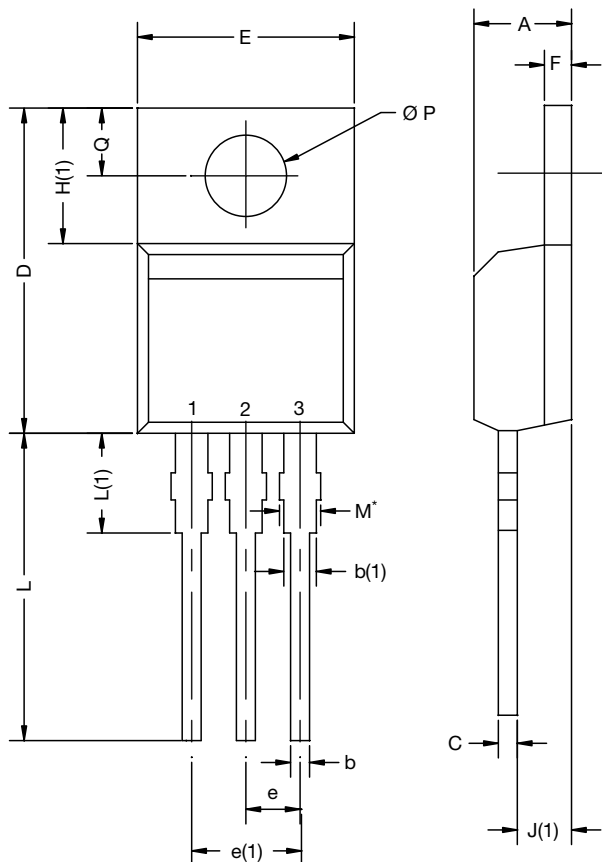
### Note

a.  $V_{GS} = 5\text{ V}$  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?91117](http://www.vishay.com/ppg?91117).

## TO-220-1



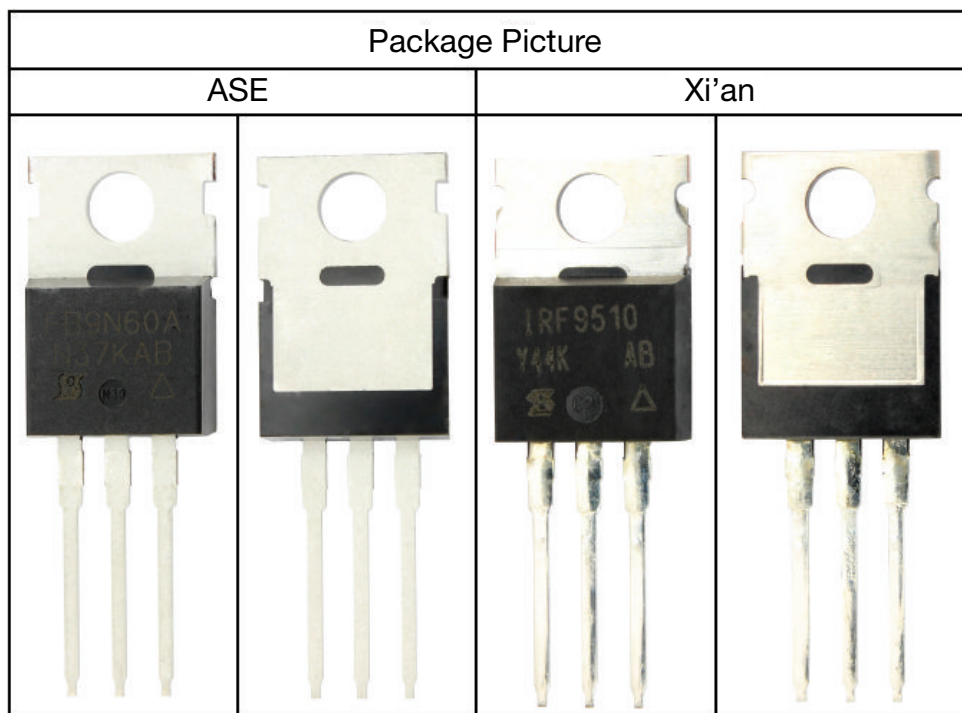
| DIM.            | MILLIMETERS |       | INCHES |       |
|-----------------|-------------|-------|--------|-------|
|                 | MIN.        | MAX.  | MIN.   | MAX.  |
| A               | 4.24        | 4.65  | 0.167  | 0.183 |
| b               | 0.69        | 1.02  | 0.027  | 0.040 |
| b(1)            | 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 |
| $\varnothing P$ | 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

## Package Picture







## Disclaimer

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