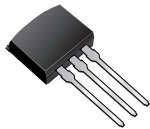


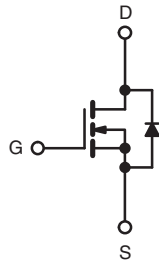
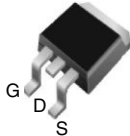
## Power MOSFET

| PRODUCT SUMMARY           |                     |
|---------------------------|---------------------|
| $V_{DS}$ (V)              | 900                 |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10$ V 8.0 |
| $Q_g$ (Max.) (nC)         | 38                  |
| $Q_{gs}$ (nC)             | 4.7                 |
| $Q_{gd}$ (nC)             | 21                  |
| Configuration             | Single              |

I<sup>2</sup>PAK (TO-262)



D<sup>2</sup>PAK (TO-263)



N-Channel MOSFET

### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Surface Mount (IRFBF20S, SiHFBF20S)
- Low-Profile Through-Hole (IRFBF20L, SiHFBF20L)
- Available in Tape and Reel (IRFBF20S, SiHFBF20S)
- Dynamic dV/dt Rating
- 150 °C Operating Temperature
- Fast Switching
- Fully Avalanche Rated
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT  
**HALOGEN**  
**FREE**  
Available

### 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 D<sup>2</sup>PAK is a surface mount power package capable of accommodating die sizes up to HEX-4. It provides the highest power capability and the lowest possible on-resistance in any existing surface mount package. The D<sup>2</sup>PAK is suitable for high current applications because of its low internal connection resistance and can dissipate up to 2.0 W in a typical surface mount application. The through-hole version (IRFBF20L, SiHFBF20L) is available for low-profile applications.

| ORDERING INFORMATION            |                             |                                |                               |                             |
|---------------------------------|-----------------------------|--------------------------------|-------------------------------|-----------------------------|
| Package                         | D <sup>2</sup> PAK (TO-263) | D <sup>2</sup> PAK (TO-263)    | D <sup>2</sup> PAK (TO-263)   | I <sup>2</sup> PAK (TO-262) |
| Lead (Pb)-free and Halogen-free | SiHFBF20S-GE3               | SiHFBF20STR-L-GE3 <sup>a</sup> | SiHFBF20STRR-GE3 <sup>a</sup> | SiHFBF20L-GE3               |
| Lead (Pb)-free                  | IRFBF20SPbF                 | IRFBF20STR-L-PbF <sup>a</sup>  | IRFBF20STRR-PbF <sup>a</sup>  | IRFBF20LPbF                 |
|                                 | SiHFBF20S-E3                | SiHFBF20STL-E3 <sup>a</sup>    | SiHFBF20STR-E3 <sup>a</sup>   | SiHFBF20L-E3                |

#### Note

a. See device orientation.

| ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted) |                  |                  |      |   |
|---|------------------|------------------|------|---|
| PARAMETER   | SYMBOL           | LIMIT            | UNIT |   |
| Drain-Source Voltage <sup>e</sup>                                 | $V_{DS}$         | 900              | V    |   |
| Gate-Source Voltage <sup>e</sup>                                  | $V_{GS}$         | $\pm 20$         |      |   |
| Continuous Drain Current  | $V_{GS}$ at 10 V | $T_C = 25$ °C    | 1.7  | A |
|   |                  | $T_C = 100$ °C   | 1.1  |   |
| Pulsed Drain Current <sup>a,e</sup>                               | $I_{DM}$         | 6.8              |      |   |
| Linear Derating Factor  |                  | 0.43             | W/°C |   |
| Single Pulse Avalanche Energy <sup>b, e</sup>                     | $E_{AS}$         | 180              | mJ   |   |
| Repetitive Avalanche Current <sup>a</sup>                         | $I_{AR}$         | 1.7              | A    |   |
| Repetitive Avalanche Energy <sup>a</sup>                          | $E_{AR}$         | 5.4              | mJ   |   |
| Maximum Power Dissipation   | $P_D$            | $T_C = 25$ °C    | 54   | W |
|   |                  | $T_A = 25$ °C    | 3.1  |   |
| Peak Diode Recovery dV/dt <sup>c, e</sup>                         | dV/dt            | 1.5              | V/ns |   |
| Operating Junction and Storage Temperature Range                  | $T_J, T_{stg}$   | - 55 to + 150    | °C   |   |
| Soldering Recommendations (Peak Temperature)                      | for 10 s         | 300 <sup>d</sup> |      |   |
| Mounting Torque   | 6-32 or M3 screw | 10               | N    |   |

#### Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).

b.  $V_{DD} = 50$  V; starting  $T_J = 25$  °C,  $L = 117$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 1.7$  A (see fig. 12).

c.  $I_{SD} \leq 1.7$  A,  $dI/dt \leq 70$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150$  °C.

d. 1.6 mm from case.

e. Uses IRFBF20, SiHFBF20 data and test conditions.


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

| THERMAL RESISTANCE RATINGS   |            |      |      |      |
|--|------------|------|------|------|
| PARAMETER  | SYMBOL     | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient (PCB Mounted, steady-state) <sup>a</sup> | $R_{thJA}$ | -    | 40   | °C/W |
| Maximum Junction-to-Case   | $R_{thJC}$ | -    | 2.3  |      |

**Note**

a. When mounted on 1" square PCB (FR-4 or G-10 material).

| SPECIFICATIONS ( $T_J = 25\text{ °C}$ , unless otherwise noted) |                     |   |      |      |           |               |
|---|---------------------|---|------|------|-----------|---------------|
| PARAMETER   | SYMBOL              | TEST CONDITIONS   | MIN. | TYP. | MAX.      | UNIT          |
| <b>Static</b>   |                     |   |      |      |           |               |
| Drain-Source Breakdown Voltage                                  | $V_{DS}$            | $V_{GS} = 0, I_D = 250\ \mu\text{A}$  | 900  | -    | -         | V             |
| $V_{DS}$ Temperature Coefficient                                | $\Delta V_{DS}/T_J$ | Reference to $25\text{ °C}$ , $I_D = 1\text{ mA}$   | -    | 1.1  | -         | mV/°C         |
| Gate-Source Threshold Voltage                                   | $V_{GS(th)}$        | $V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$   | 2.0  | -    | 4.0       | V             |
| Gate-Source Leakage   | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$  | -    | -    | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current                                 | $I_{DSS}$           | $V_{DS} = 900\text{ V}, V_{GS} = 0\text{ V}$  | -    | -    | 100       | $\mu\text{A}$ |
|   |                     | $V_{DS} = 720\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ °C}$   | -    | -    | 500       |               |
| Drain-Source On-State Resistance                                | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$   $I_D = 1.0\text{ A}^b$   | -    | -    | 8.0       | $\Omega$      |
| Forward Transconductance  | $g_{fs}$            | $V_{DS} = 50\text{ V}, I_D = 1.0\text{ A}^b$  | 0.6  | -    | -         | 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                              | -    | 490  | -         | pF            |
| Output Capacitance  | $C_{oss}$           |   | -    | 55   | -         |               |
| Reverse Transfer Capacitance                                    | $C_{rss}$           |   | -    | 18   | -         |               |
| Total Gate Charge   | $Q_g$               | $V_{GS} = 10\text{ V}$   $I_D = 1.7\text{ A}, V_{DS} = 360\text{ V},$<br>see fig. 6 and 13 <sup>b</sup>             | -    | -    | 38        | nC            |
| Gate-Source Charge  | $Q_{gs}$            |   | -    | -    | 4.7       |               |
| Gate-Drain Charge   | $Q_{gd}$            |   | -    | -    | 21        |               |
| Turn-On Delay Time  | $t_{d(on)}$         | $V_{DD} = 450\text{ V}, I_D = 1.7\text{ A},$<br>$R_g = 18\ \Omega, V_{GS} = 10\text{ V}$ , see fig. 10 <sup>b</sup> | -    | 8.0  | -         | ns            |
| Rise Time   | $t_r$               |   | -    | 21   | -         |               |
| Turn-Off Delay Time   | $t_{d(off)}$        |   | -    | 56   | -         |               |
| Fall Time   | $t_f$               |   | -    | 32   | -         |               |

| SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted) |                 |   |      |      |      |      |
|---|-----------------|---|------|------|------|------|
| PARAMETER   | SYMBOL          | TEST CONDITIONS   | MIN. | TYP. | MAX. | UNIT |
| <b>Drain-Source Body Diode Characteristics</b>                  |                 |   |      |      |      |      |
| Continuous Source-Drain Diode Current                           | I <sub>S</sub>  | MOSFET symbol showing the integral reverse p - n junction diode  | -    | -    | 1.7  | A    |
| Pulsed Diode Forward Current <sup>a</sup>                       | I <sub>SM</sub> |   | -    | -    | 6.8  |      |
| Body Diode Voltage  | V <sub>SD</sub> | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 1.7 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> = 1.7 A, dI/dt = 100 A/μs <sup>b</sup>   | -    | 350  | 530  | ns   |
| Body Diode Reverse Recovery Charge                              | Q <sub>rr</sub> |   | -    | 0.85 | 1.3  | 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 ≤ 300 μs; duty cycle ≤ 2 %.
- c. Uses IRFBF20/SiHFBF20 data and test conditions.

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

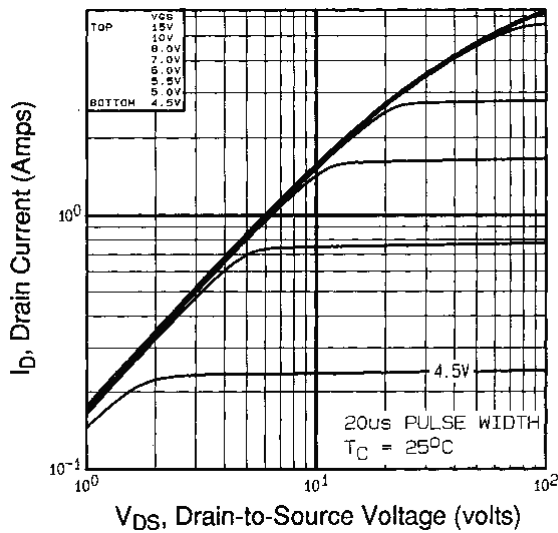


Fig. 1 - Typical Output Characteristics

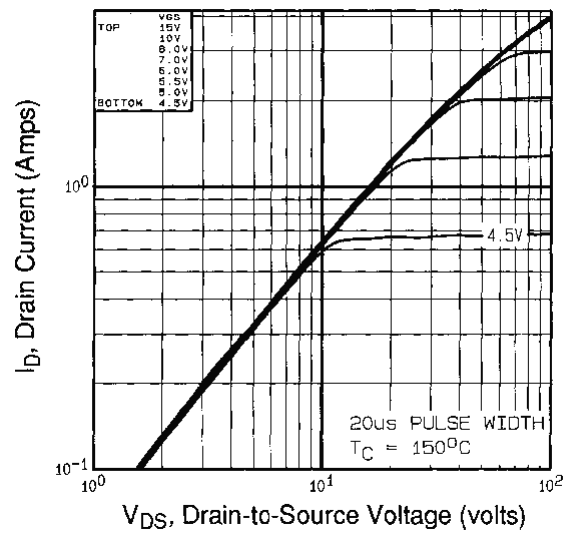


Fig. 2 - Typical Output Characteristics

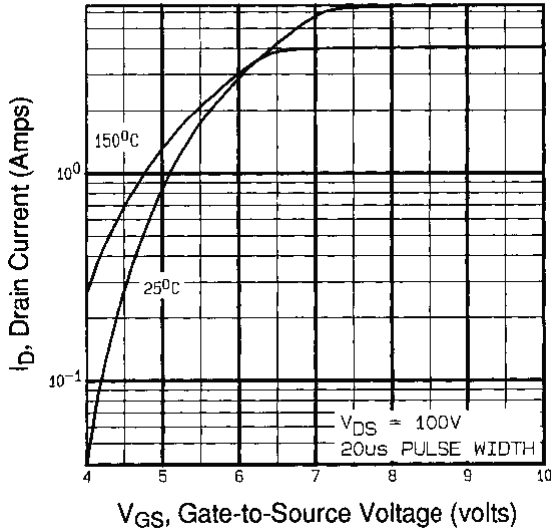


Fig. 3 - Typical Transfer Characteristics

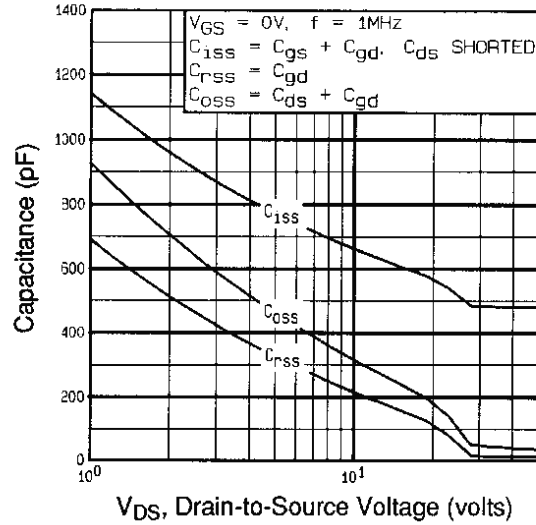


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

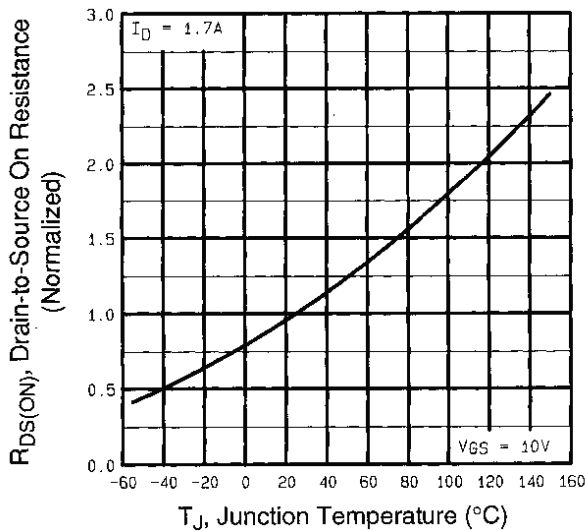


Fig. 4 - Normalized On-Resistance vs. Temperature

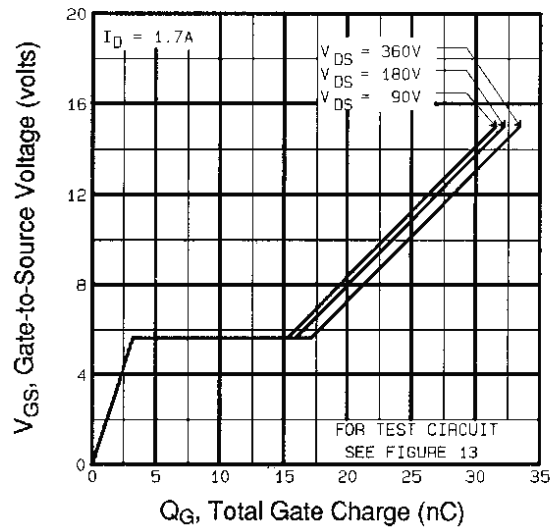


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

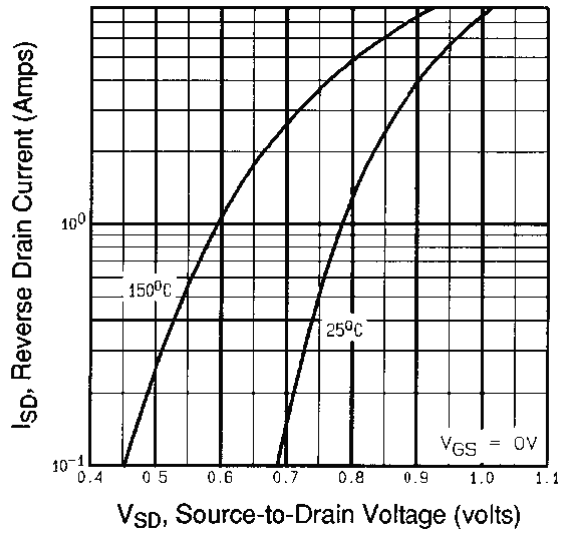


Fig. 7 - Typical Source-Drain Diode Forward Voltage

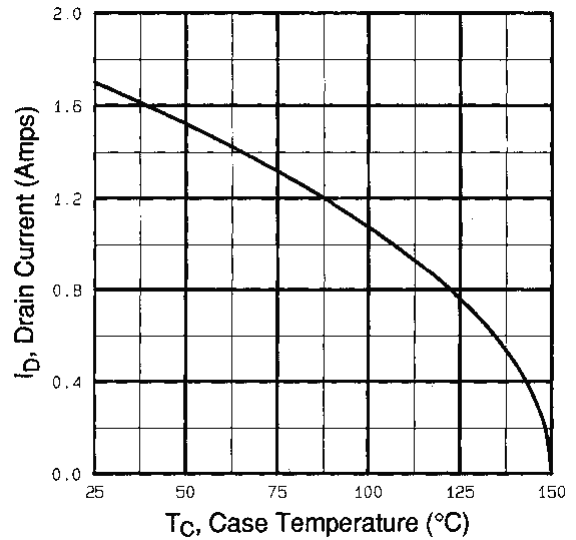


Fig. 9 - Maximum Drain Current vs. Case Temperature

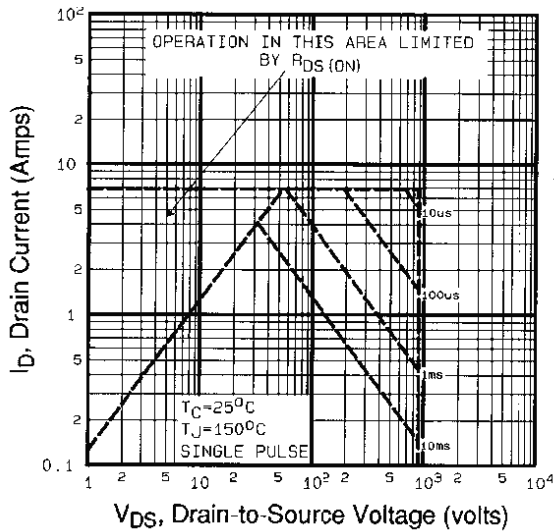


Fig. 8 - Maximum Safe Operating Area

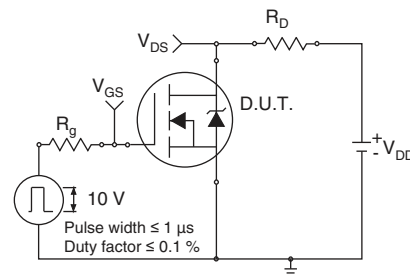


Fig. 10a - Switching Time Test Circuit

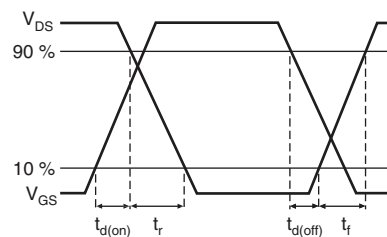


Fig. 10b - Switching Time Waveforms

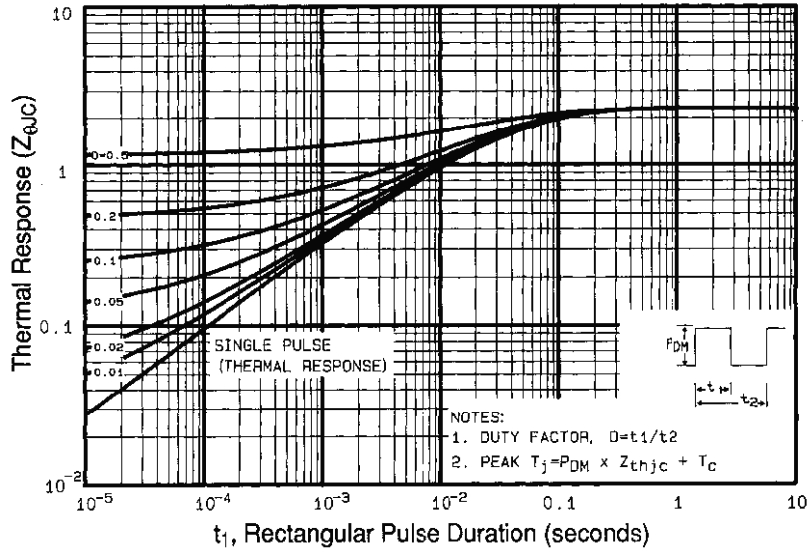


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

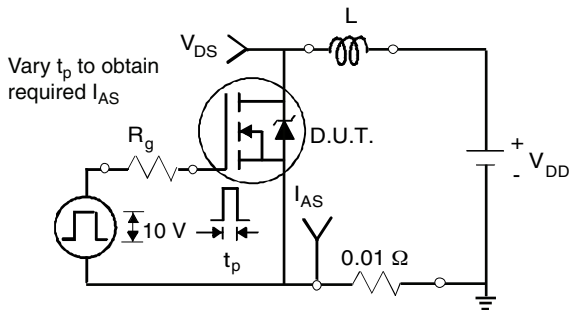


Fig. 12a - Unclamped Inductive Test Circuit

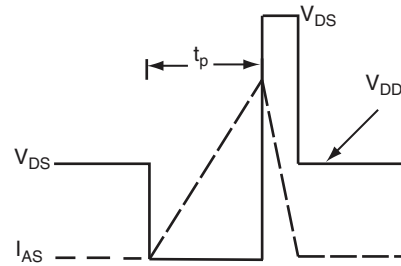


Fig. 12b - Unclamped Inductive Waveforms

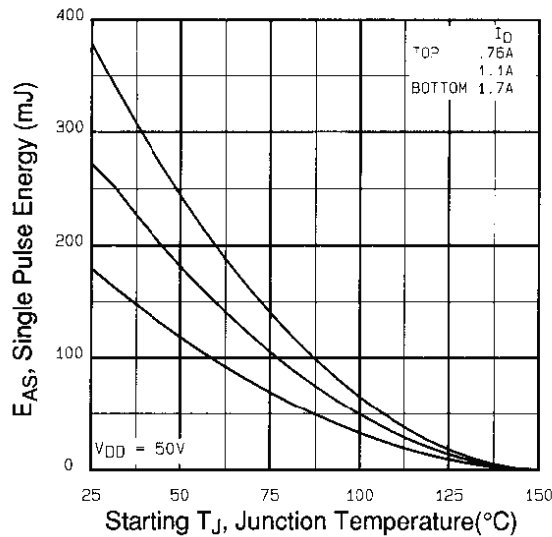


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

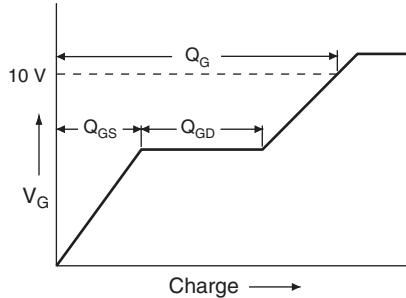


Fig. 13a - Basic Gate Charge Waveform

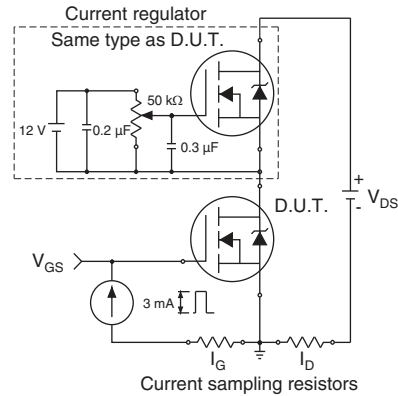
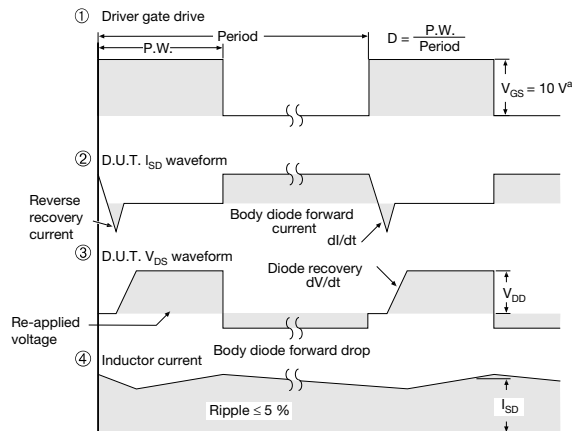
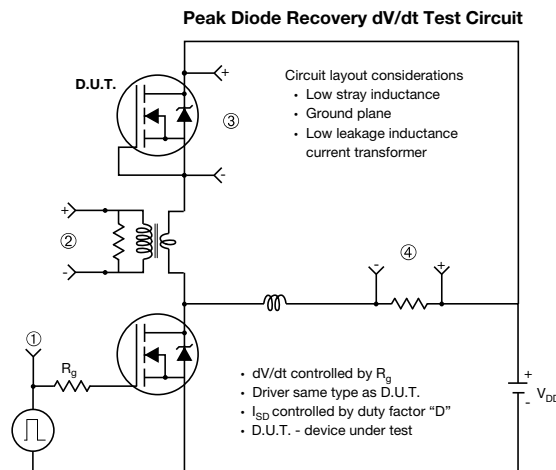


Fig. 13b - Gate Charge Test Circuit



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

Fig. 14 - For N-Channel

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### TO-263AB (HIGH VOLTAGE)



| DIM. | MILLIMETERS |      | INCHES |       |
|------|-------------|------|--------|-------|
|      | MIN.        | MAX. | MIN.   | MAX.  |
| A    | 4.06        | 4.83 | 0.160  | 0.190 |
| A1   | 0.00        | 0.25 | 0.000  | 0.010 |
| b    | 0.51        | 0.99 | 0.020  | 0.039 |
| b1   | 0.51        | 0.89 | 0.020  | 0.035 |
| b2   | 1.14        | 1.78 | 0.045  | 0.070 |
| b3   | 1.14        | 1.73 | 0.045  | 0.068 |
| c    | 0.38        | 0.74 | 0.015  | 0.029 |
| c1   | 0.38        | 0.58 | 0.015  | 0.023 |
| c2   | 1.14        | 1.65 | 0.045  | 0.065 |
| D    | 8.38        | 9.65 | 0.330  | 0.380 |

| DIM. | MILLIMETERS |       | INCHES    |       |
|------|-------------|-------|-----------|-------|
|      | MIN.        | MAX.  | MIN.      | MAX.  |
| D1   | 6.86        | -     | 0.270     | -     |
| E    | 9.65        | 10.67 | 0.380     | 0.420 |
| E1   | 6.22        | -     | 0.245     | -     |
| e    | 2.54 BSC    |       | 0.100 BSC |       |
| H    | 14.61       | 15.88 | 0.575     | 0.625 |
| L    | 1.78        | 2.79  | 0.070     | 0.110 |
| L1   | -           | 1.65  | -         | 0.066 |
| L2   | -           | 1.78  | -         | 0.070 |
| L3   | 0.25 BSC    |       | 0.010 BSC |       |
| L4   | 4.78        | 5.28  | 0.188     | 0.208 |

ECN: S-82110-Rev. A, 15-Sep-08  
DWG: 5970

#### Notes

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimensions are shown in millimeters (inches).
3. Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body at datum A.
4. Thermal PAD contour optional within dimension E, L1, D1 and E1.
5. Dimension b1 and c1 apply to base metal only.
6. Datum A and B to be determined at datum plane H.
7. Outline conforms to JEDEC outline to TO-263AB.



**RECOMMENDED MINIMUM PADS FOR D<sup>2</sup>PAK: 3-Lead**



Recommended Minimum Pads  
Dimensions in Inches/(mm)

[Return to Index](#)



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**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**

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## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,  
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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