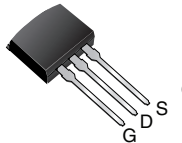
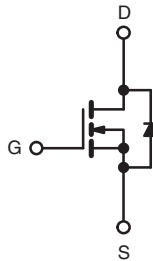
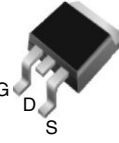


## Power MOSFET

### PRODUCT SUMMARY

|                           |                        |     |
|---------------------------|------------------------|-----|
| $V_{DS}$ (V)              | 600                    |     |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ | 1.2 |
| $Q_g$ (Max.) (nC)         | 60                     |     |
| $Q_{gs}$ (nC)             | 8.3                    |     |
| $Q_{gd}$ (nC)             | 30                     |     |
| 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 (IRFBC40S, SiHFBC40S)
- Low-Profile Through-Hole (IRFBC40L, SiHFBC40L)
- Available in Tape and Reel (IRFBC40S, SiHFBC40S)
- 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 the 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 (IRFBC40L, SiHFBC40L) is available for low-profile applications.

### ORDERING INFORMATION

| Package                         | 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 | SiHFBC40S-GE3               | SiHFBC40STRL-GE3 <sup>a</sup> | SiHFBC40L-GE3               |
| Lead (Pb)-free                  | IRFBC40SPbF                 | IRFBC40STRLPbF <sup>a</sup>   | IRFBC40LPbF                 |
|                                 | SiHFBC40S-E3                | SiHFBC40STL-E3 <sup>a</sup>   | SiHFBC40L-E3                |

#### Note

a. See device orientation.

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

| PARAMETER                                        | SYMBOL         | LIMIT                 | UNIT |
|--------------------------------------------------|----------------|-----------------------|------|
| Drain-Source Voltage <sup>e</sup>                | $V_{DS}$       | 600                   | V    |
| Gate-Source Voltage <sup>e</sup>                 | $V_{GS}$       | $\pm 20$              | V    |
| Continuous Drain Current                         | $I_D$          | $T_C = 25\text{ °C}$  | A    |
|                                                  |                | $T_C = 100\text{ °C}$ |      |
| Pulsed Drain Current <sup>a,e</sup>              | $I_{DM}$       | 25                    | A    |
| Linear Derating Factor                           |                | 1.0                   | W/°C |
| Single Pulse Avalanche Energy <sup>b,e</sup>     | $E_{AS}$       | 570                   | mJ   |
| Repetitive Avalanche Current <sup>a</sup>        | $I_{AR}$       | 6.2                   | A    |
| Repetitive Avalanche Energy <sup>a</sup>         | $E_{AR}$       | 13                    | mJ   |
| Maximum Power Dissipation                        | $P_D$          | $T_C = 25\text{ °C}$  | W    |
|                                                  |                | $T_A = 25\text{ °C}$  |      |
| Peak Diode Recovery dV/dt <sup>c,e</sup>         | dV/dt          | 3.0                   | 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>      |      |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 50\text{ V}$ ; starting  $T_J = 25\text{ °C}$ ,  $L = 27\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 6.2\text{ A}$  (see fig. 12).
- $I_{SD} \leq 6.2\text{ A}$ ,  $dI/dt \leq 80\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ °C}$ .
- 1.6 mm from case.
- Uses IRFBC40, SiHFBC40 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<br>(PCB Mounted, steady-state) <sup>a</sup> | $R_{thJA}$ | -    | 40   | °C/W |
| Maximum Junction-to-Case                                                | $R_{thJC}$ | -    | 1.0  |      |

**Note**

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

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

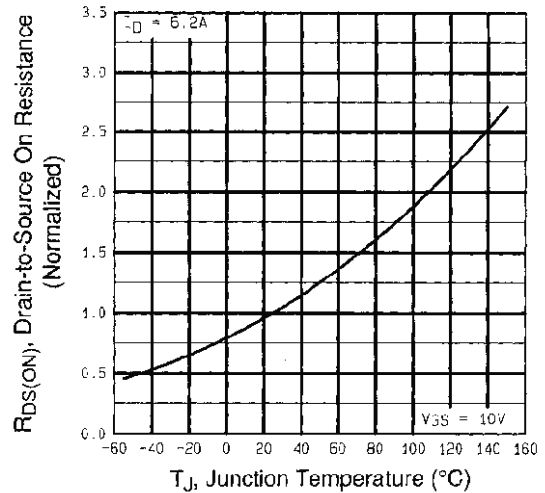
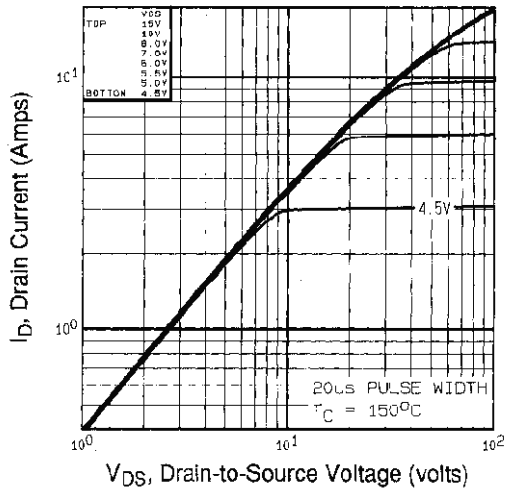
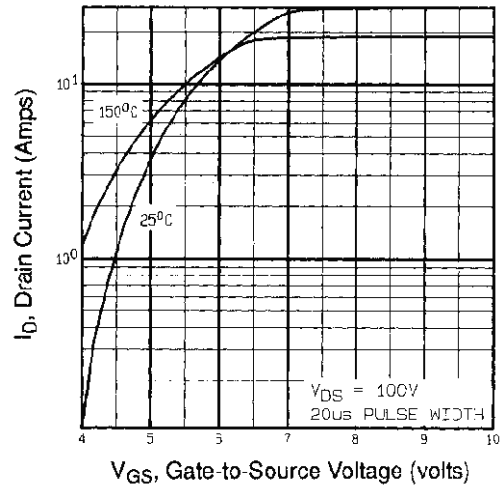
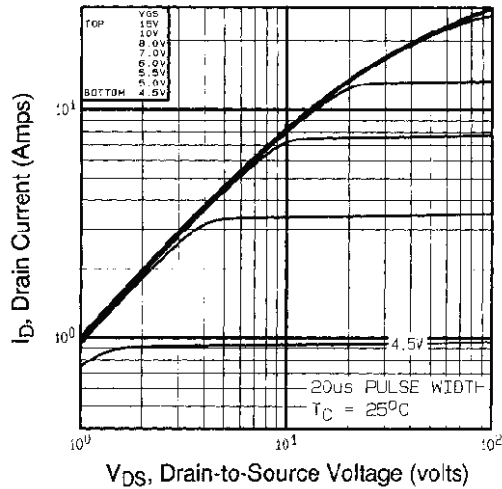
| PARAMETER                                      | SYMBOL              | TEST CONDITIONS                                                                                                                                         | MIN. | TYP. | MAX.      | UNIT          |
|------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-----------|---------------|
| <b>Static</b>                                  |                     |                                                                                                                                                         |      |      |           |               |
| Drain-Source Breakdown Voltage                 | $V_{DS}$            | $V_{GS} = 0$ , $I_D = 250\text{ }\mu\text{A}$                                                                                                           | 600  | -    | -         | V             |
| $V_{DS}$ Temperature Coefficient               | $\Delta V_{DS}/T_J$ | Reference to $25\text{ °C}$ , $I_D = 1\text{ mA}$                                                                                                       | -    | 0.70 | -         | 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                            | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$                                                                                                                              | -    | -    | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current                | $I_{DSS}$           | $V_{DS} = 600\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                                         | -    | -    | 100       | $\mu\text{A}$ |
|                                                |                     | $V_{DS} = 480\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ °C}$                                                                                 | -    | -    | 500       |               |
| Drain-Source On-State Resistance               | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$ , $I_D = 3.7\text{ A}^b$                                                                                                         | -    | -    | 1.2       | $\Omega$      |
| Forward Transconductance                       | $g_{fs}$            | $V_{DS} = 100\text{ V}$ , $I_D = 3.7\text{ A}^b$                                                                                                        | 4.7  | -    | -         | 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 <sup>c</sup>                                                   | -    | 1300 | -         | pF            |
| Output Capacitance                             | $C_{oss}$           |                                                                                                                                                         | -    | 160  | -         |               |
| Reverse Transfer Capacitance                   | $C_{rss}$           |                                                                                                                                                         | -    | 30   | -         |               |
| Total Gate Charge                              | $Q_g$               | $V_{GS} = 10\text{ V}$ ,<br>$I_D = 6.2\text{ A}$ , $V_{DS} = 480\text{ V}$ ,<br>see fig. 6 and 13 <sup>b, c</sup>                                       | -    | -    | 60        | nC            |
| Gate-Source Charge                             | $Q_{gs}$            |                                                                                                                                                         | -    | -    | 8.3       |               |
| Gate-Drain Charge                              | $Q_{gd}$            |                                                                                                                                                         | -    | -    | 30        |               |
| Turn-On Delay Time                             | $t_{d(on)}$         | $V_{DD} = 300\text{ V}$ , $I_D = 6.2\text{ A}$ ,<br>$R_g = 9.1\text{ }\Omega$ , $R_D = 47\text{ }\Omega$ ,<br>see fig. 10 <sup>b, c</sup>               | -    | 13   | -         | ns            |
| Rise Time                                      | $t_r$               |                                                                                                                                                         | -    | 18   | -         |               |
| Turn-Off Delay Time                            | $t_{d(off)}$        |                                                                                                                                                         | -    | 55   | -         |               |
| Fall Time                                      | $t_f$               |                                                                                                                                                         | -    | 20   | -         |               |
| Internal Source Inductance                     | $L_S$               | Between lead, and center of die contact                                                                                                                 | -    | 7.5  | -         | nH            |
| <b>Drain-Source Body Diode Characteristics</b> |                     |                                                                                                                                                         |      |      |           |               |
| Continuous Source-Drain Diode Current          | $I_S$               | MOSFET symbol showing the integral reverse p - n junction diode<br> | -    | -    | 6.2       | A             |
| Pulsed Diode Forward Current <sup>a</sup>      | $I_{SM}$            |                                                                                                                                                         | -    | -    | 25        |               |
| Body Diode Voltage                             | $V_{SD}$            | $T_J = 25\text{ °C}$ , $I_S = 6.2\text{ A}$ , $V_{GS} = 0\text{ V}^b$                                                                                   | -    | -    | 1.5       | V             |
| Body Diode Reverse Recovery Time               | $t_{rr}$            | $T_J = 25\text{ °C}$ , $I_F = 6.2\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$                                                                      | -    | 450  | 940       | ns            |
| Body Diode Reverse Recovery Charge             | $Q_{rr}$            |                                                                                                                                                         | -    | 3.8  | 7.9       | $\mu\text{C}$ |
| Forward Turn-On Time                           | $t_{on}$            | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )                                                                         |      |      |           |               |

**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .  
c. Uses IRFBC40, SiHFBC40 data and test conditions.



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



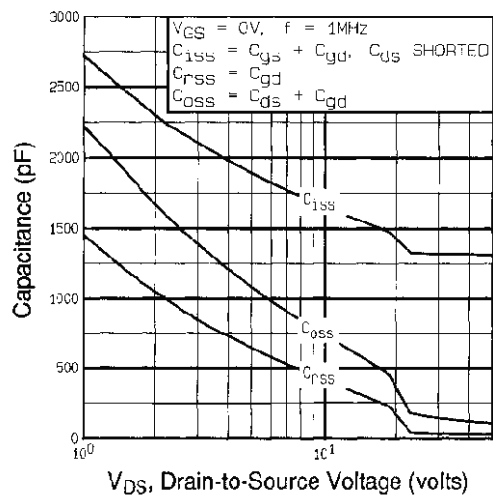


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

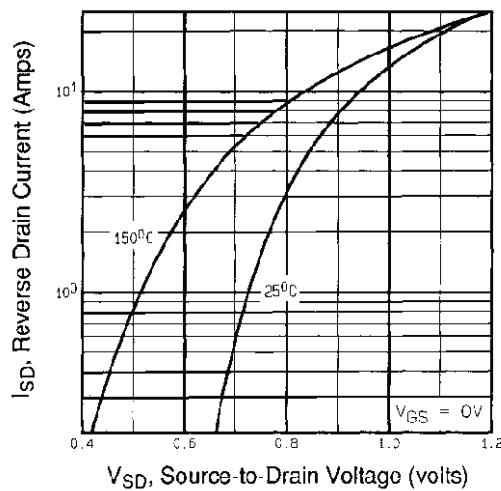


Fig. 7 - Typical Source-Drain Diode Forward Voltage

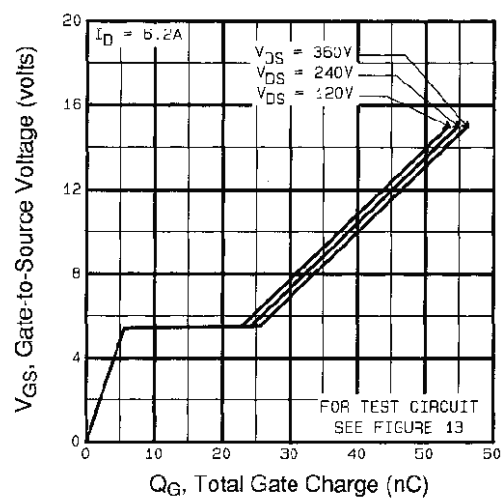


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

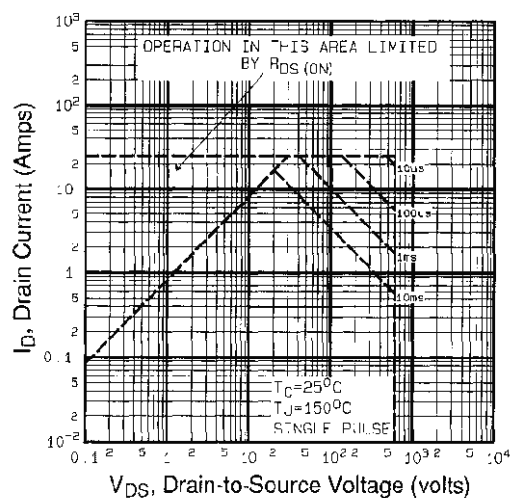


Fig. 8 - Maximum Safe Operating Area

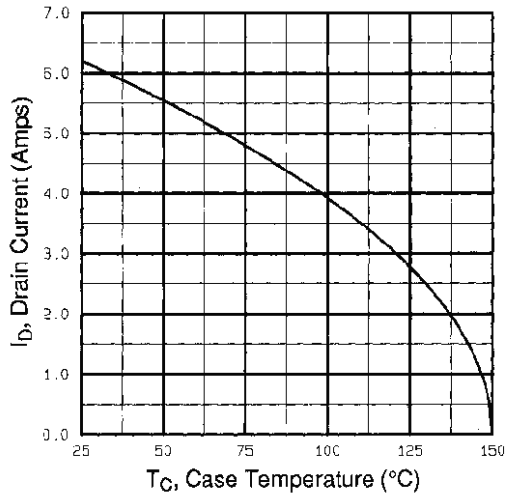


Fig. 9 - Maximum Drain Current vs. Case Temperature

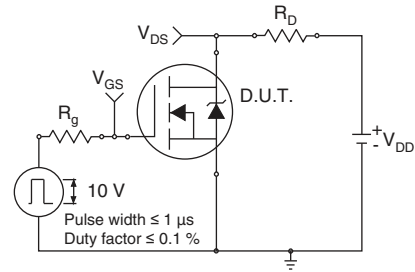


Fig. 10a - Switching Time Test Circuit

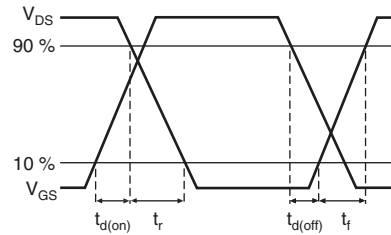


Fig. 10b - Switching Time Waveforms

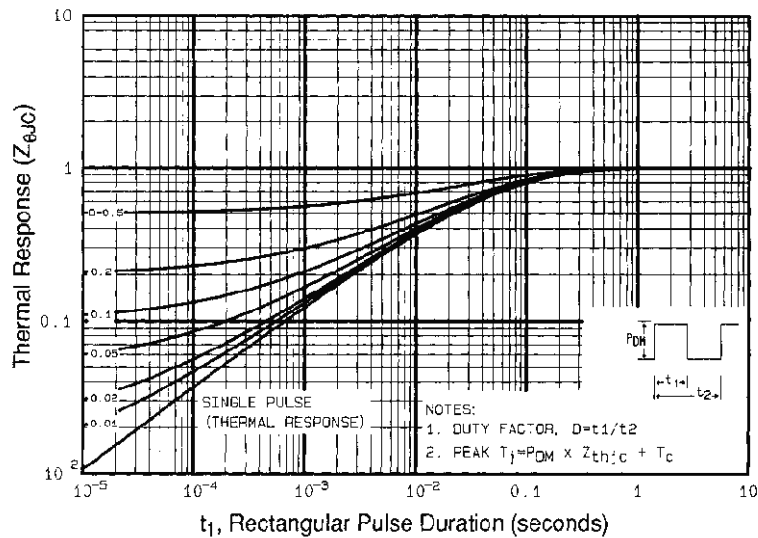


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

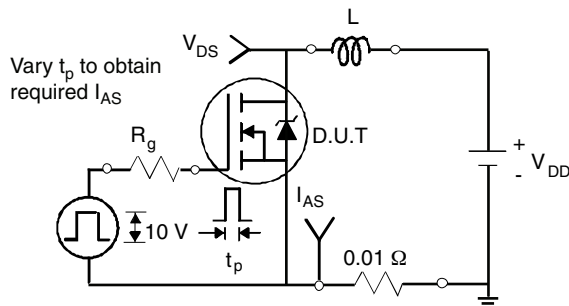


Fig. 12a - Unclamped Inductive Test Circuit

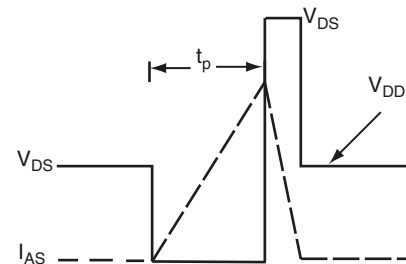


Fig. 12b - Unclamped Inductive Waveforms

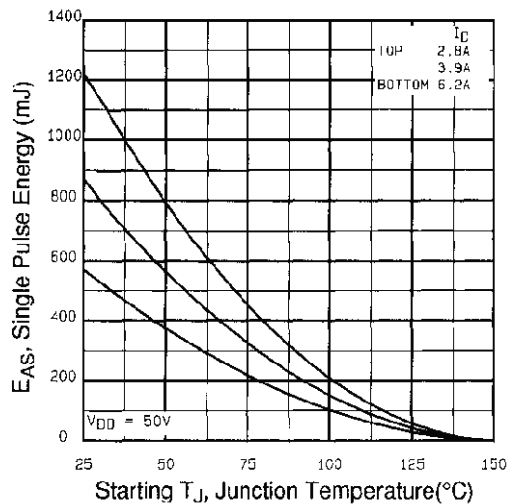


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

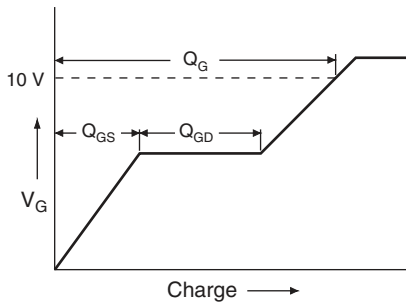


Fig. 13a - Basic Gate Charge Waveform

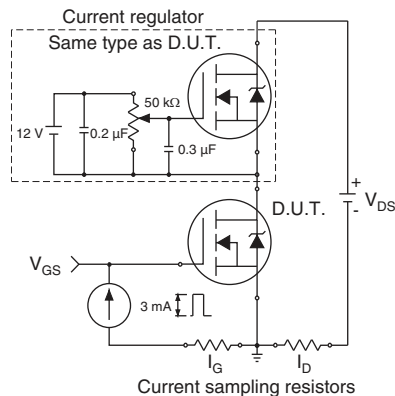
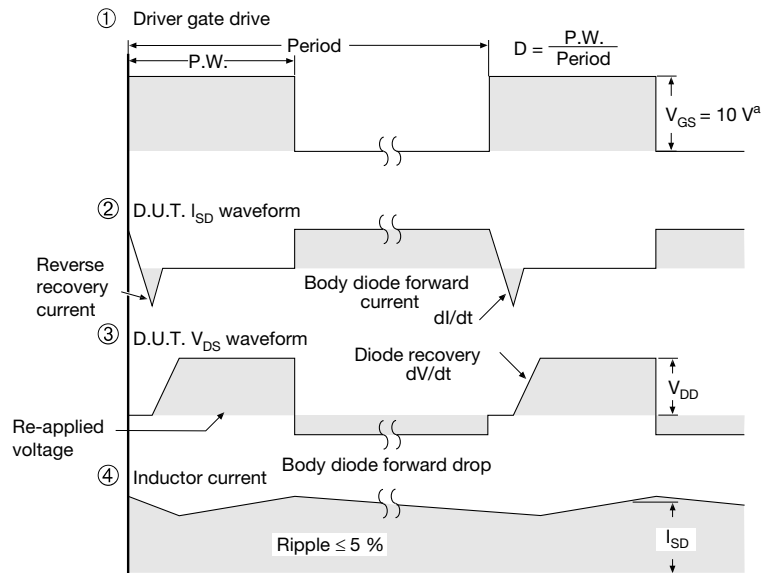
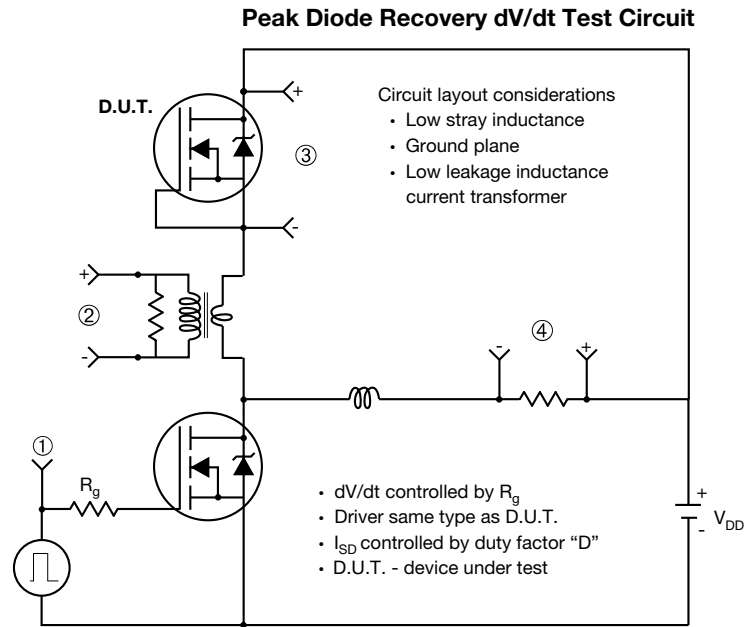


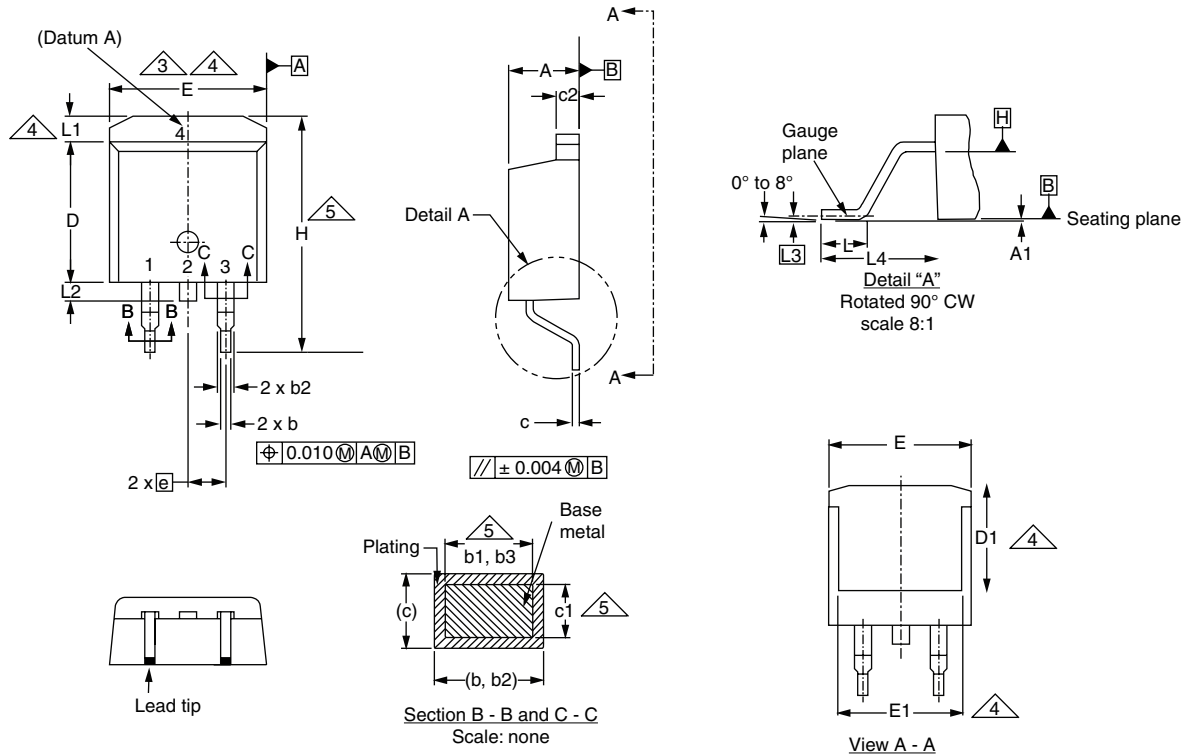
Fig. 13b - Gate Charge Test Circuit



**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 |

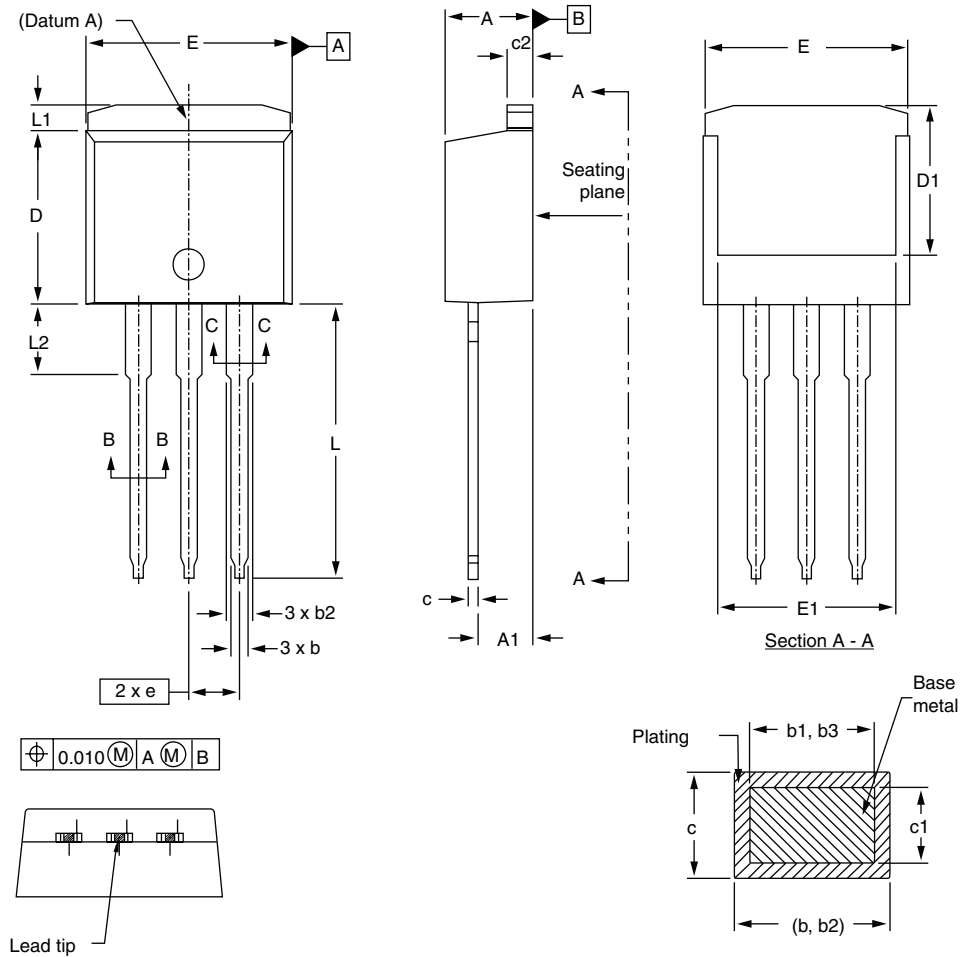
ECN: S-82110-Rev. A, 15-Sep-08  
DWG: 5970

### 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.



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



|      | MILLIMETERS |      | INCHES |       |
|------|-------------|------|--------|-------|
| DIM. | MIN.        | MAX. | MIN.   | MAX.  |
| A    | 4.06        | 4.83 | 0.160  | 0.190 |
| A1   | 2.03        | 3.02 | 0.080  | 0.119 |
| 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 |

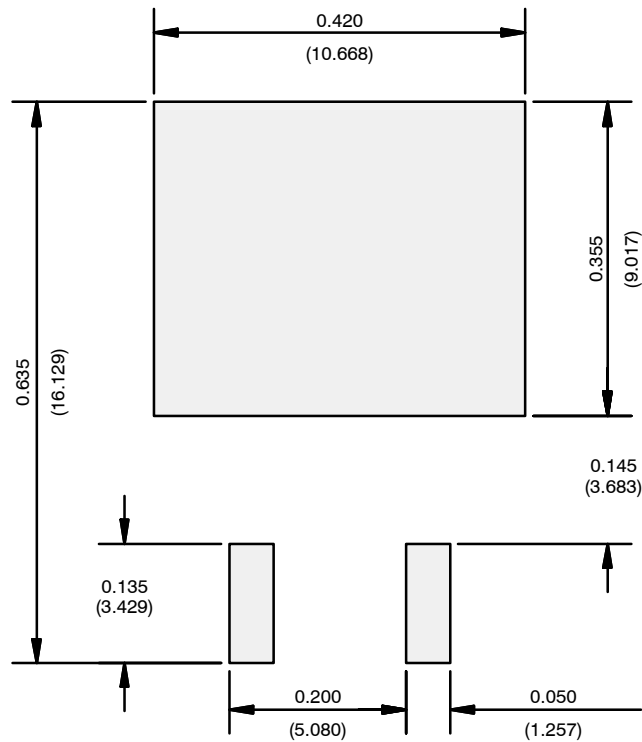
|      | MILLIMETERS |       | INCHES    |       |
|------|-------------|-------|-----------|-------|
| DIM. | MIN.        | MAX.  | MIN.      | MAX.  |
| D    | 8.38        | 9.65  | 0.330     | 0.380 |
| D1   | 6.86        | -     | 0.270     | -     |
| E    | 9.65        | 10.67 | 0.380     | 0.420 |
| E1   | 6.22        | -     | 0.245     | -     |
| e    | 2.54 BSC    |       | 0.100 BSC |       |
| L    | 13.46       | 14.10 | 0.530     | 0.555 |
| L1   | -           | 1.65  | -         | 0.065 |
| L2   | 3.56        | 3.71  | 0.140     | 0.146 |

ECN: S-82442-Rev. A, 27-Oct-08  
DWG: 5977

### Notes

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm per side. These dimensions are measured at the outmost extremes of the plastic body.
3. Thermal pad contour optional within dimension E, L1, D1, and E1.
4. Dimension b1 and c1 apply to base metal only.

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



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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