

## 2SK1636S-VB Datasheet

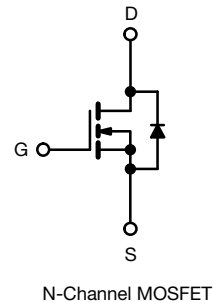
### Power MOSFET

#### PRODUCT SUMMARY

|                           |                        |      |
|---------------------------|------------------------|------|
| $V_{DS}$ (V)              | 250                    |      |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ | 0.23 |
| $Q_g$ max. (nC)           | 68                     |      |
| $Q_{gs}$ (nC)             | 11                     |      |
| $Q_{gd}$ (nC)             | 35                     |      |
| Configuration             | Single                 |      |

#### FEATURES

- Dynamic  $dV/dt$  rating
- Repetitive avalanche rated
- Fast switching
- Ease of paralleling
- Simple drive requirements



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

| PARAMETER                                                 |                         |                         | SYMBOL                            | LIMIT       | UNIT     |
|-----------------------------------------------------------|-------------------------|-------------------------|-----------------------------------|-------------|----------|
| Drain-Source Voltage                                      |                         |                         | V <sub>DS</sub>                   | 250         | 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>                    | 16          | A        |
|                                                           |                         | T <sub>C</sub> = 100 °C |                                   | 9.5         |          |
| Pulsed Drain Current <sup>a</sup>                         |                         |                         | I <sub>DM</sub>                   | 56          |          |
| Linear Derating Factor                                    |                         |                         |                                   | 1.0         | W/°C     |
| Single Pulse Avalanche Energy <sup>b</sup>                |                         |                         | E <sub>AS</sub>                   | 550         | mJ       |
| Repetitive Avalanche Current <sup>a</sup>                 |                         |                         | I <sub>AR</sub>                   | 14          | A        |
| Repetitive Avalanche Energy <sup>a</sup>                  |                         |                         | E <sub>AR</sub>                   | 13          | mJ       |
| Maximum Power Dissipation                                 | T <sub>C</sub> = 25 °C  |                         | P <sub>D</sub>                    | 125         | W        |
| Peak Diode Recovery dV/dt <sup>c</sup>                    |                         |                         | dV/dt                             | 4.8         | V/ns     |
| Operating Junction and Storage Temperature Range          |                         |                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150 | °C       |
| Soldering Recommendations (Peak temperature) <sup>d</sup> | for 10 s                |                         |                                   | 300         |          |
| Mounting Torque                                           | 6-32 or M3 screw        |                         |                                   | 10          | lbf · in |
|                                                           |                         |                         |                                   | 1.1         | N · m    |

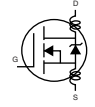
#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 4.5\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 14\text{ A}$  (see fig. 12).
- $I_{SD} \leq 14\text{ A}$ ,  $dI/dt \leq 150\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .
- 1.6 mm from case.

**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)    | $R_{thJC}$ | -    | 1.0  |      |

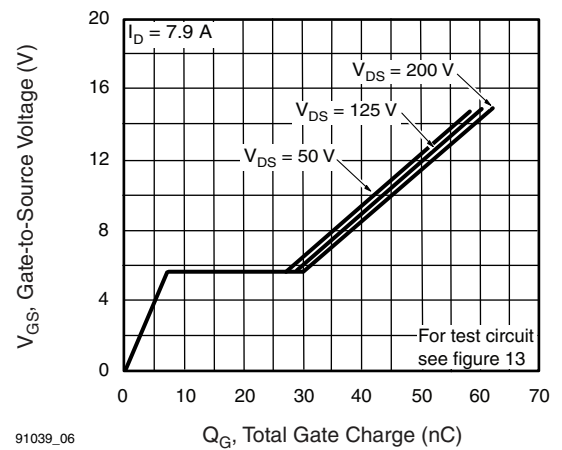
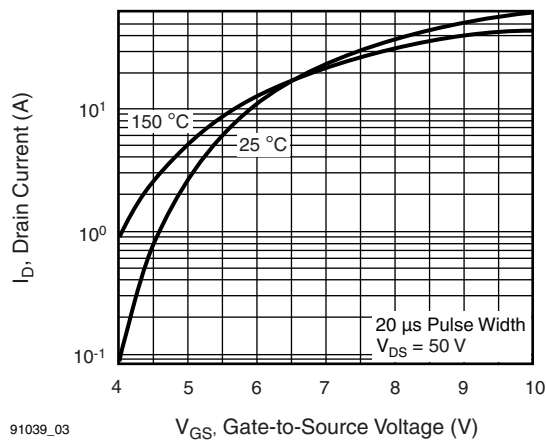
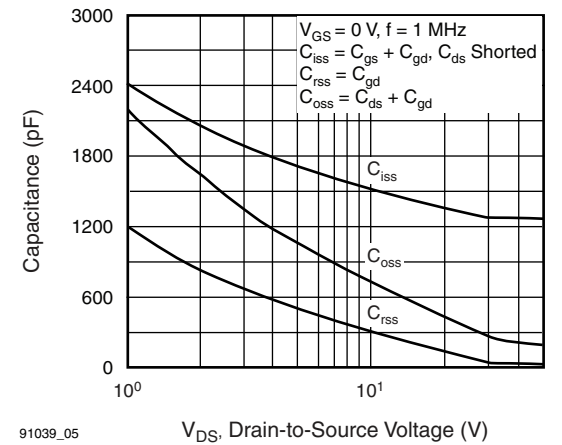
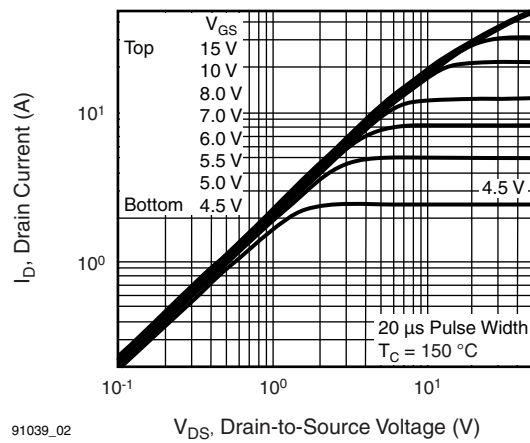
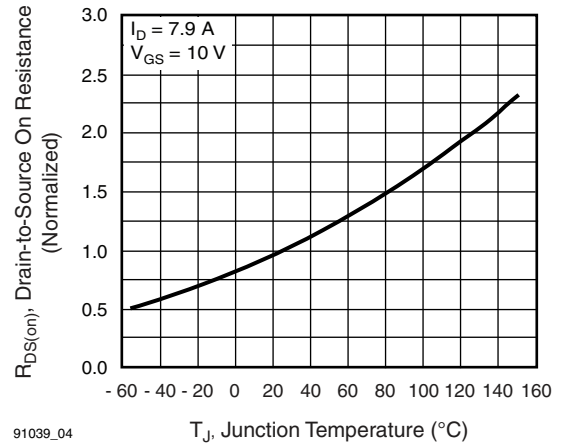
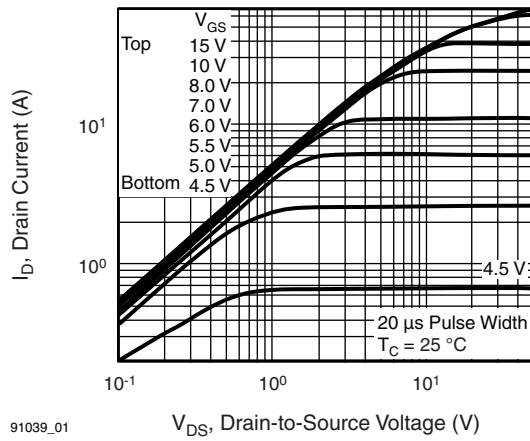
**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

| PARAMETER                                      | SYMBOL              | TEST CONDITIONS                                                                                                                                                     | MIN. | TYP. | MAX.      | UNIT          |
|------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-----------|---------------|
| <b>Static</b>                                  |                     |                                                                                                                                                                     |      |      |           |               |
| Drain-Source Breakdown Voltage                 | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$                                                                                                              | 250  | -    | -         | V             |
| $V_{DS}$ Temperature Coefficient               | $\Delta V_{DS}/T_J$ | Reference to $25\text{ °C}$ , $I_D = 1\text{ mA}$                                                                                                                   | -    | 0.34 | -         | 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                | $I_{DSS}$           | $V_{DS} = 250\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                                                     | -    | -    | 25        | $\mu\text{A}$ |
|                                                |                     | $V_{DS} = 200\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ °C}$                                                                                             | -    | -    | 250       |               |
| Drain-Source On-State Resistance               | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$ , $I_D = 8.4\text{ A}^b$                                                                                                                     | -    | 0.23 | -         | $\Omega$      |
| Forward Transconductance                       | $g_{fs}$            | $V_{DS} = 50\text{ V}$ , $I_D = 8.4\text{ A}^b$                                                                                                                     | 6.7  | -    | -         | 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                                                                            | -    | 1300 | -         | pF            |
| Output Capacitance                             | $C_{oss}$           |                                                                                                                                                                     | -    | 330  | -         |               |
| Reverse Transfer Capacitance                   | $C_{rss}$           |                                                                                                                                                                     | -    | 85   | -         |               |
| Total Gate Charge                              | $Q_g$               | $V_{GS} = 10\text{ V}$ , $I_D = 7.9\text{ A}$ , $V_{DS} = 200\text{ V}$ ,<br>see fig. 6 and 13 <sup>b</sup>                                                         | -    | -    | 68        | nC            |
| Gate-Source Charge                             | $Q_{gs}$            |                                                                                                                                                                     | -    | -    | 11        |               |
| Gate-Drain Charge                              | $Q_{gd}$            |                                                                                                                                                                     | -    | -    | 35        |               |
| Turn-On Delay Time                             | $t_{d(on)}$         | $V_{DD} = 125\text{ V}$ , $I_D = 7.9\text{ A}$ ,<br>$R_g = 9.1\text{ }\Omega$ , $R_D = 8.7\text{ }\Omega$ , see fig. 10 <sup>b</sup>                                | -    | 11   | -         | ns            |
| Rise Time                                      | $t_r$               |                                                                                                                                                                     | -    | 24   | -         |               |
| Turn-Off Delay Time                            | $t_{d(off)}$        |                                                                                                                                                                     | -    | 53   | -         |               |
| Fall Time                                      | $t_f$               |                                                                                                                                                                     | -    | 49   | -         |               |
| Internal Drain Inductance                      | $L_D$               | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact<br> | -    | 4.5  | -         | nH            |
| Internal Source Inductance                     | $L_S$               |                                                                                                                                                                     | -    | 7.5  | -         |               |
| Gate Input Resistance                          | $R_g$               | $f = 1\text{ MHz}$ , open drain                                                                                                                                     | 0.3  | -    | 1.2       | $\Omega$      |
| <b>Drain-Source Body Diode Characteristics</b> |                     |                                                                                                                                                                     |      |      |           |               |
| Continuous Source-Drain Diode Current          | $I_S$               | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode<br>   | -    | -    | 14        | A             |
| Pulsed Diode Forward Current <sup>a</sup>      | $I_{SM}$            |                                                                                                                                                                     | -    | -    | 56        |               |
| Body Diode Voltage                             | $V_{SD}$            | $T_J = 25\text{ °C}$ , $I_S = 14\text{ A}$ , $V_{GS} = 0\text{ V}^b$                                                                                                | -    | -    | 1.8       | V             |
| Body Diode Reverse Recovery Time               | $t_{rr}$            | $T_J = 25\text{ °C}$ , $I_F = 7.9\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$                                                                                  | -    | 250  | 500       | ns            |
| Body Diode Reverse Recovery Charge             | $Q_{rr}$            |                                                                                                                                                                     | -    | 2.3  | 4.6       | $\mu\text{C}$ |
| 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  $\leq 2\%$ .

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



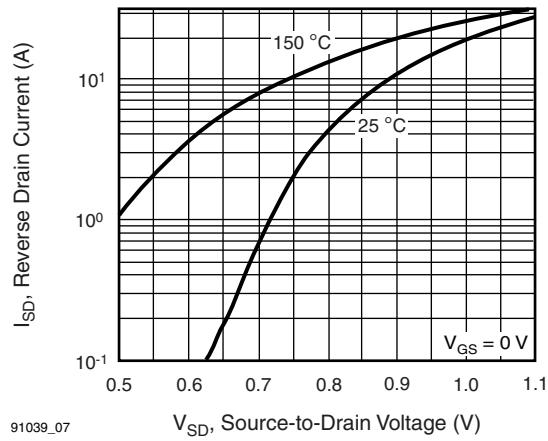


Fig. 7 - Typical Source-Drain Diode Forward Voltage

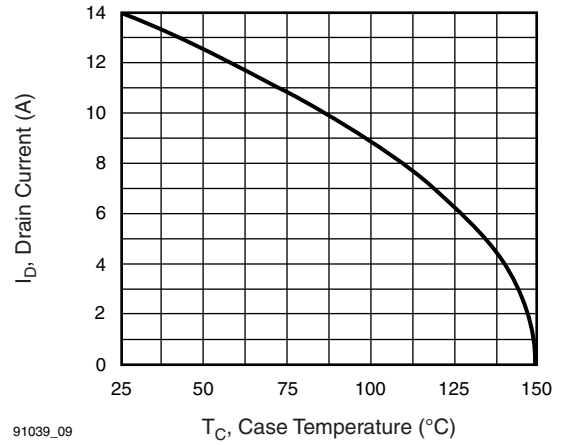


Fig. 9 - Maximum Drain Current vs. Case Temperature

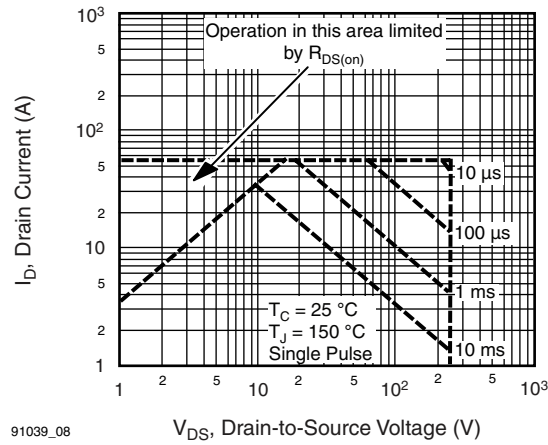


Fig. 8 - Maximum Safe Operating Area

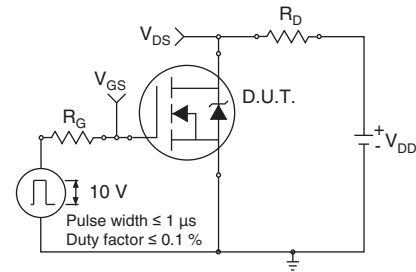


Fig. 10a - Switching Time Test Circuit

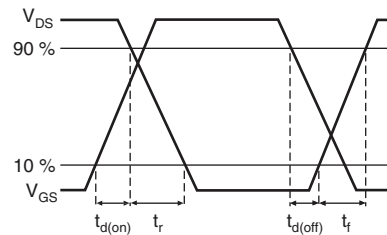


Fig. 10b - Switching Time Waveforms

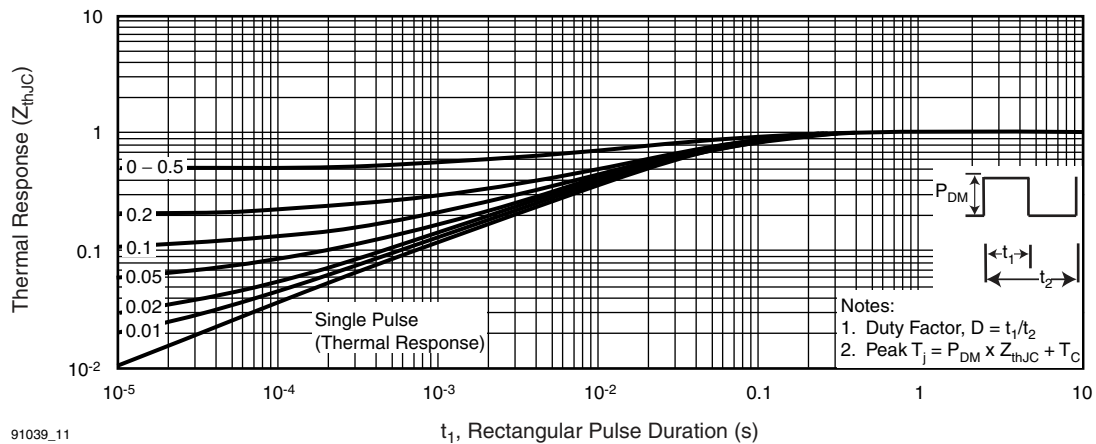


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

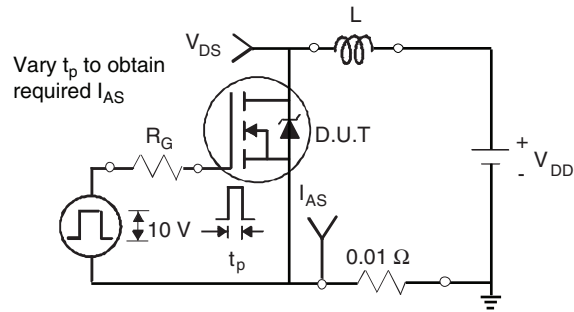


Fig. 12a - Unclamped Inductive Test Circuit

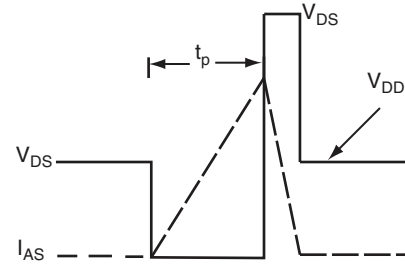


Fig. 12b - Unclamped Inductive Waveforms

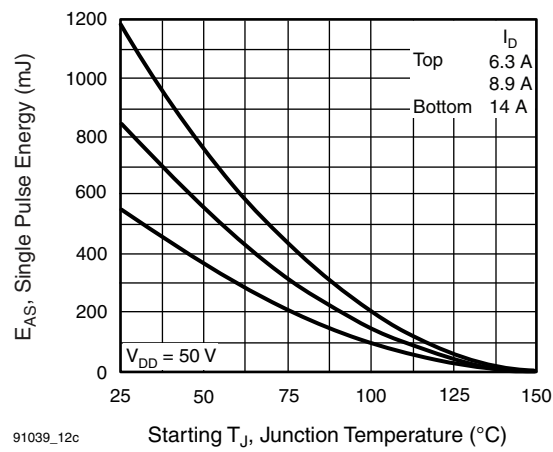


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

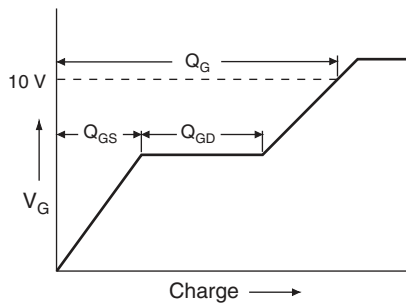


Fig. 13a - Basic Gate Charge Waveform

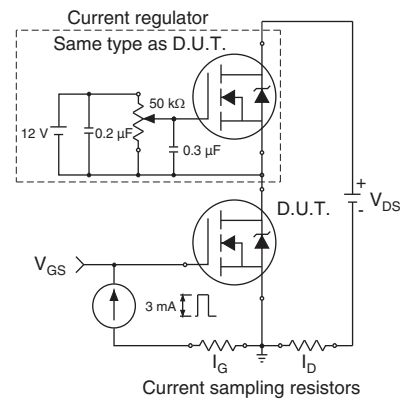
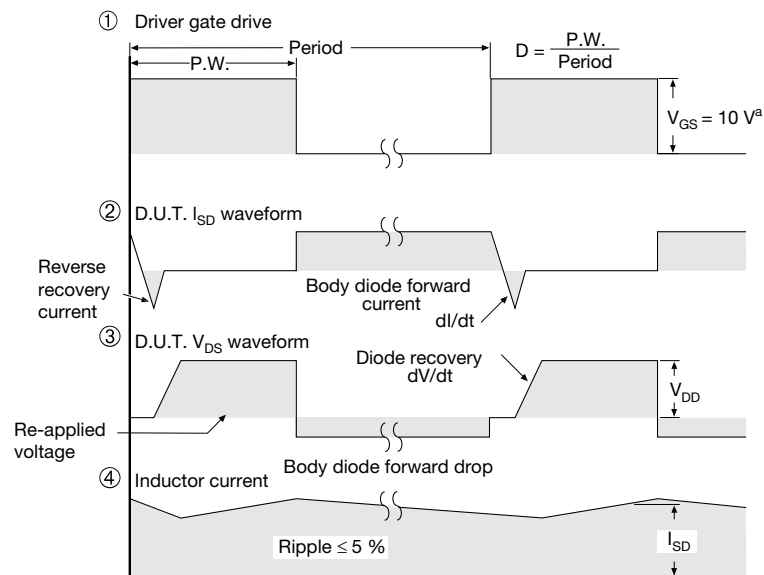
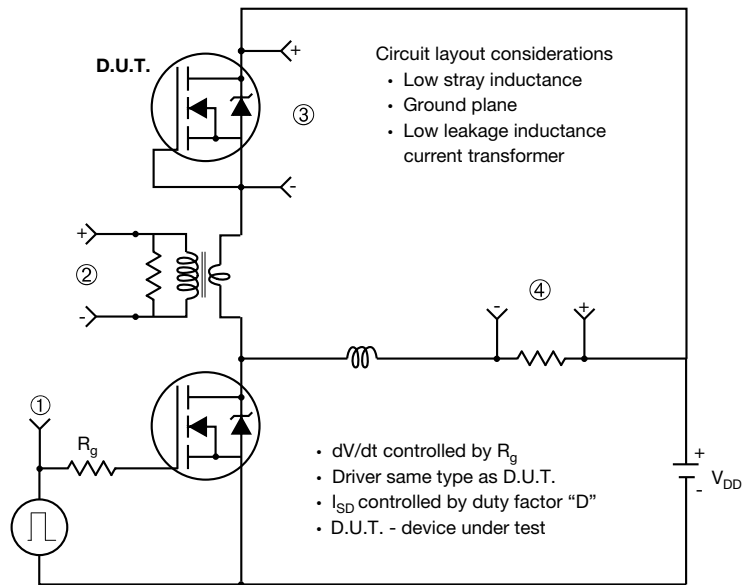


Fig. 13b - Gate Charge Test Circuit

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

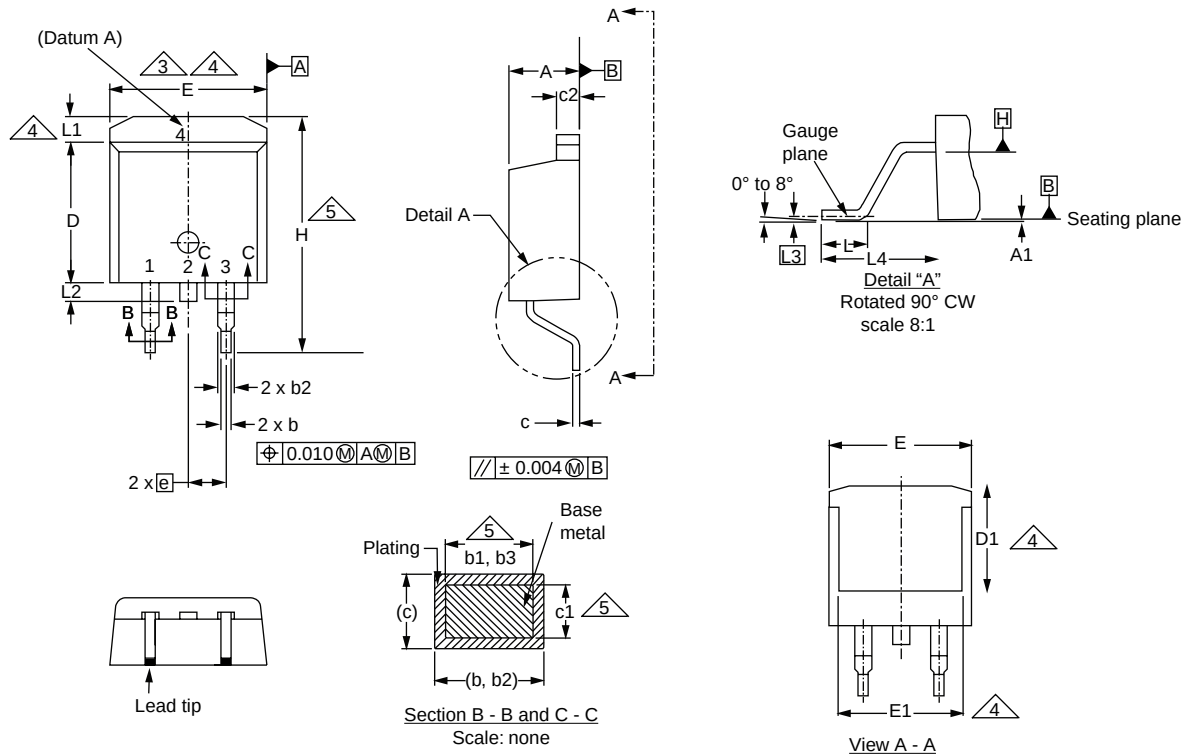


**Note**

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

**Fig. 14 - For N-Channel**

**TO-263AB (HIGH VOLTAGE)**



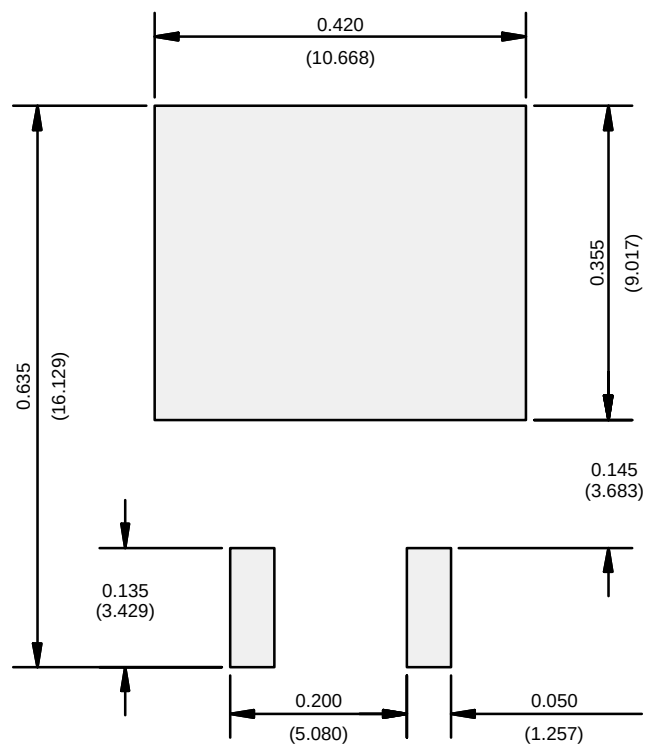
|      | MILLIMETERS |      | INCHES |       |
|------|-------------|------|--------|-------|
| DIM. | MIN.        | MAX. | MIN.   | MAX.  |
| A    | 4.06        | 4.83 | 0.160  | 0.190 |
| A1   | 0.00        | 0.25 | 0.000  | 0.010 |
| b    | 0.51        | 0.99 | 0.020  | 0.039 |
| b1   | 0.51        | 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 |

|      | MILLIMETERS |       | INCHES    |       |
|------|-------------|-------|-----------|-------|
| DIM. | 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)



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