

## STU8NM50N-VB Datasheet

## N-Channel 650 V (D-S) Super Junction Power MOSFET

## PRODUCT SUMMARY

|                                    |                 |     |
|------------------------------------|-----------------|-----|
| $V_{DS}$ (V) at $T_J$ max.         | 650             |     |
| $R_{DS(on)}$ at 25 °C ( $\Omega$ ) | $V_{GS} = 10$ V | 0.7 |
| $Q_g$ max. (nC)                    | 25              |     |
| $Q_{gs}$ (nC)                      | 2.0             |     |
| $Q_{gd}$ (nC)                      | 2.7             |     |
| Configuration                      | Single          |     |

## FEATURES

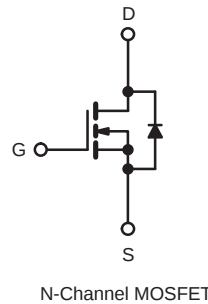
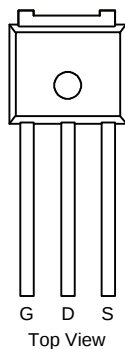
- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)



## APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial

TO-251



N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$  °C, unless otherwise noted)

| PARAMETER                                                 |                         |                         | SYMBOL                            | LIMIT        | UNIT |
|-----------------------------------------------------------|-------------------------|-------------------------|-----------------------------------|--------------|------|
| Drain-Source Voltage                                      |                         |                         | V <sub>DS</sub>                   | 650          | V    |
| Gate-Source Voltage                                       |                         |                         | V <sub>GS</sub>                   | ± 30         |      |
| Continuous Drain Current (T <sub>J</sub> = 150 °C)        | V <sub>GS</sub> at 10 V | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | 7            | A    |
|                                                           |                         | T <sub>C</sub> = 100 °C |                                   | 6            |      |
| Pulsed Drain Current <sup>a</sup>                         |                         |                         | I <sub>DM</sub>                   | 10           |      |
| Linear Derating Factor                                    |                         |                         |                                   | 1.67/1.5/0.3 | W/°C |
| Single Pulse Avalanche Energy <sup>b</sup>                |                         |                         | E <sub>AS</sub>                   | 86           | mJ   |
| Maximum Power Dissipation                                 |                         |                         | P <sub>D</sub>                    | 83/83/31     | W    |
| Operating Junction and Storage Temperature Range          |                         |                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150  | °C   |
| Drain-Source Voltage Slope                                | T <sub>J</sub> = 125 °C |                         | dV/dt                             | 50           | V/ns |
| Reverse Diode dV/dt <sup>d</sup>                          |                         |                         |                                   | 4.5          |      |
| Soldering Recommendations (Peak Temperature) <sup>c</sup> | for 10 s                |                         |                                   | 300          | °C   |

## Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature.  
 b.  $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 3.5$  A.  
 c. 1.6 mm from case.  
 d.  $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

### THERMAL RESISTANCE RATINGS

| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient      | $R_{thJA}$ | -    | 63   | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | -    | 0.6  |      |

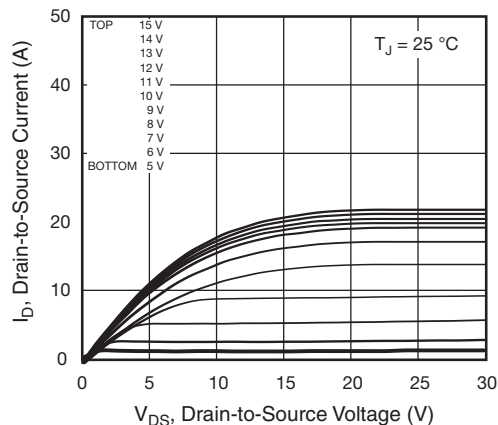
### SPECIFICATIONS ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

| PARAMETER                                                 | SYMBOL              | TEST CONDITIONS                                                                                                                                         | MIN. | TYP. | MAX.      | UNIT          |
|-----------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-----------|---------------|
| <b>Static</b>                                             |                     |                                                                                                                                                         |      |      |           |               |
| Drain-Source Breakdown Voltage                            | $V_{DS}$            | $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$                                                                                                  | 650  | -    | -         | V             |
| $V_{DS}$ Temperature Coefficient                          | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^{\circ}\text{C}$ , $I_D = 1\text{ mA}$                                                                                         | -    | 0.65 | -         | V/°C          |
| Gate-Source Threshold Voltage (N)                         | $V_{GS(th)}$        | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                                                                                      | 2    | -    | 4         | V             |
| Gate-Source Leakage                                       | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$                                                                                                                              | -    | -    | $\pm 100$ | nA            |
|                                                           |                     | $V_{GS} = \pm 30\text{ V}$                                                                                                                              | -    | -    | $\pm 1$   | $\mu\text{A}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$           | $V_{DS} = 650\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                                         | -    | -    | 1         | $\mu\text{A}$ |
|                                                           |                     | $V_{DS} = 520\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$                                                                   | -    | -    | 10        |               |
| Drain-Source On-State Resistance                          | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$ , $I_D = 4\text{ A}$                                                                                                             | -    | 0.7  | -         | $\Omega$      |
| Forward Transconductance                                  | $g_{fs}$            | $V_{DS} = 30\text{ V}$ , $I_D = 4\text{ A}$                                                                                                             | -    | 16   | -         | S             |
| <b>Dynamic</b>                                            |                     |                                                                                                                                                         |      |      |           |               |
| Input Capacitance                                         | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = 100\text{ V}$ ,<br>$f = 1\text{ MHz}$                                                                              | -    | 360  | -         | pF            |
| Output Capacitance                                        | $C_{oss}$           |                                                                                                                                                         | -    | 25   | -         |               |
| Reverse Transfer Capacitance                              | $C_{rss}$           |                                                                                                                                                         | -    | 12   | -         |               |
| Effective Output Capacitance, Energy Related <sup>a</sup> | $C_{o(er)}$         | $V_{DS} = 0\text{ V to } 520\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                          | -    | 45   | -         |               |
| Effective Output Capacitance, Time Related <sup>b</sup>   | $C_{o(tr)}$         |                                                                                                                                                         | -    | 62   | -         |               |
| Total Gate Charge                                         | $Q_g$               | $V_{GS} = 10\text{ V}$ ,<br>$I_D = 4\text{ A}$ , $V_{DS} = 520\text{ V}$                                                                                | -    | 25   | -         | nC            |
| Gate-Source Charge                                        | $Q_{gs}$            |                                                                                                                                                         | -    | 2.0  | -         |               |
| Gate-Drain Charge                                         | $Q_{gd}$            |                                                                                                                                                         | -    | 2.7  | -         |               |
| Turn-On Delay Time                                        | $t_{d(on)}$         | $V_{DD} = 520\text{ V}$ , $I_D = 4\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_g = 9.1\text{ }\Omega$                                                    | -    | 25   | -         | ns            |
| Rise Time                                                 | $t_r$               |                                                                                                                                                         | -    | 55   | -         |               |
| Turn-Off Delay Time                                       | $t_{d(off)}$        |                                                                                                                                                         | -    | 70   | -         |               |
| Fall Time                                                 | $t_f$               |                                                                                                                                                         | -    | 40   | -         |               |
| Gate Input Resistance                                     | $R_g$               | $f = 1\text{ MHz}$ , open drain                                                                                                                         | -    | 3.5  | -         | $\Omega$      |
| <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> | -    | -    | 7         | A             |
| Pulsed Diode Forward Current                              | $I_{SM}$            |                                                                                                                                                         | -    | -    | 18        |               |
| Diode Forward Voltage                                     | $V_{SD}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_S = 4\text{ A}$ , $V_{GS} = 0\text{ V}$                                                                         | -    | -    | 1.5       | V             |
| Reverse Recovery Time                                     | $t_{rr}$            | $T_J = 25\text{ }^{\circ}\text{C}$ , $I_F = I_S = 4\text{ A}$ ,<br>$dI/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 400\text{ V}$                            | -    | 190  | -         | ns            |
| Reverse Recovery Charge                                   | $Q_{rr}$            |                                                                                                                                                         | -    | 2.3  | -         | $\mu\text{C}$ |
| Reverse Recovery Current                                  | $I_{RRM}$           |                                                                                                                                                         | -    | 10   | -         | A             |

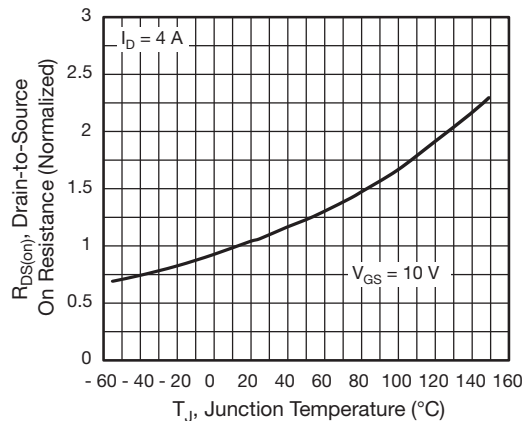
#### Notes

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .  
b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .

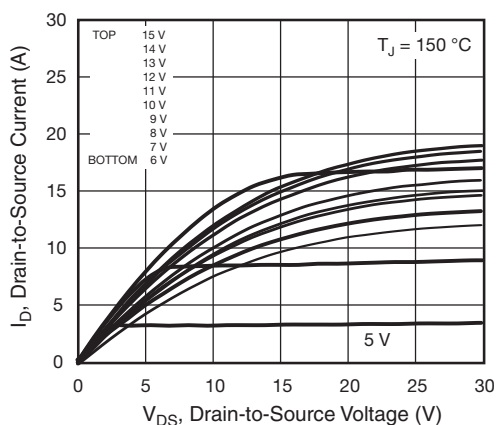
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



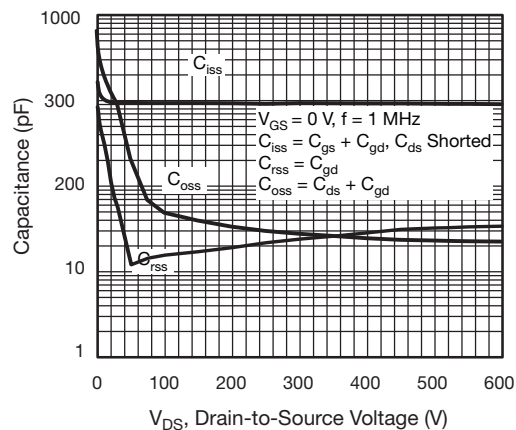
**Fig. 1 - Typical Output Characteristics**



**Fig. 4 - Normalized On-Resistance vs. Temperature**



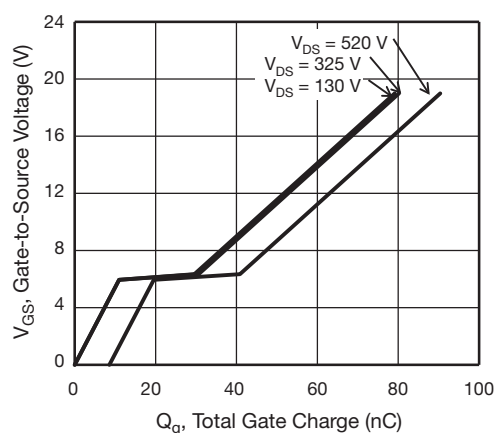
**Fig. 2 - Typical Output Characteristics**



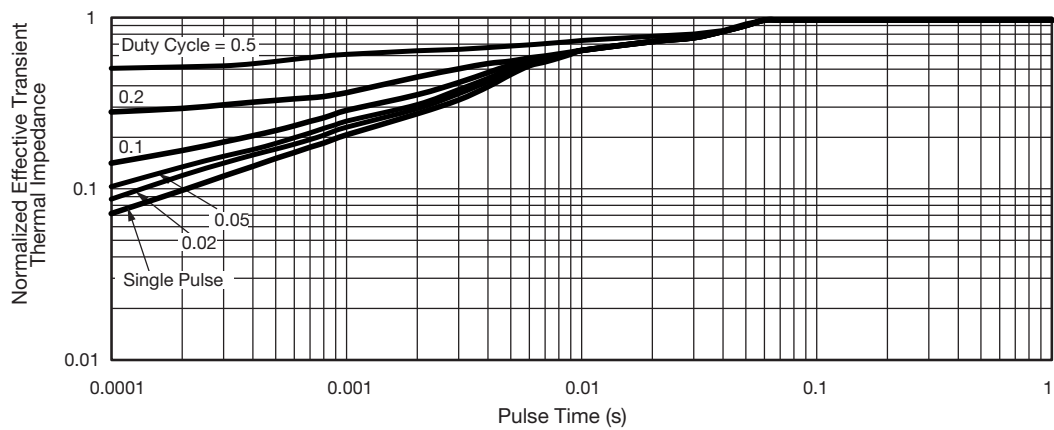
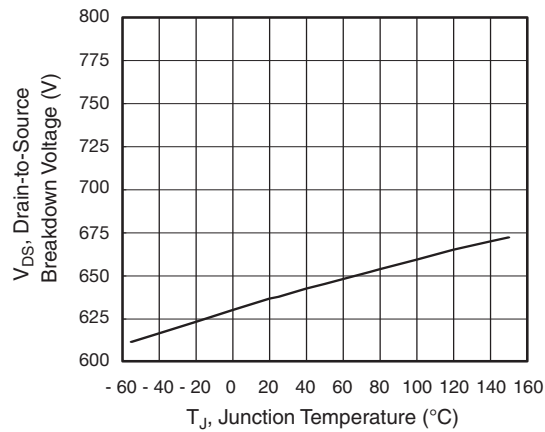
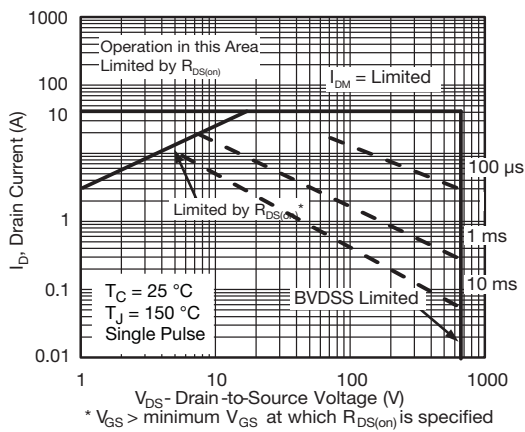
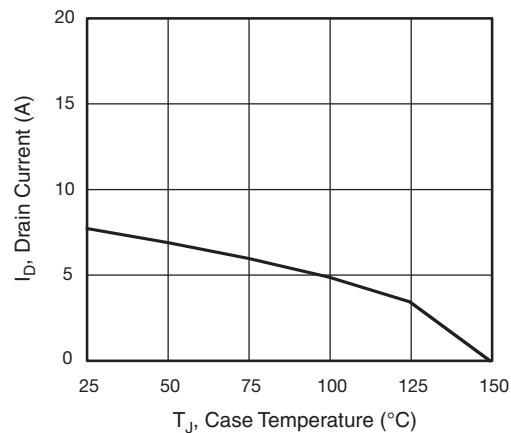
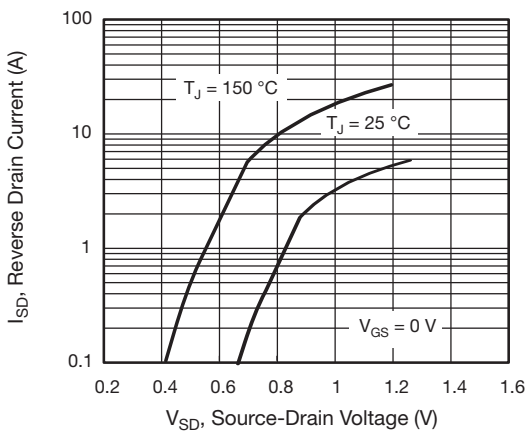
**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**



**Fig. 3 - Typical Transfer Characteristics**



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



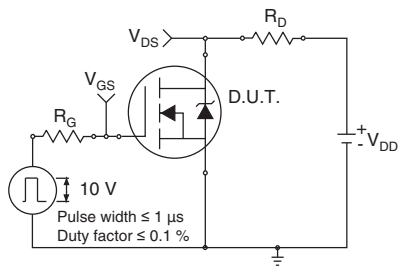


Fig. 12 - Switching Time Test Circuit

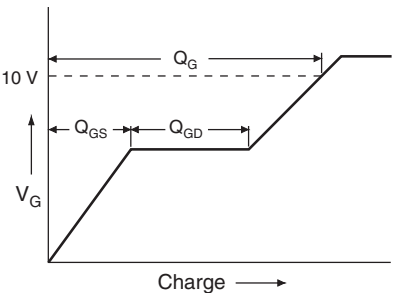


Fig. 16 - Basic Gate Charge Waveform

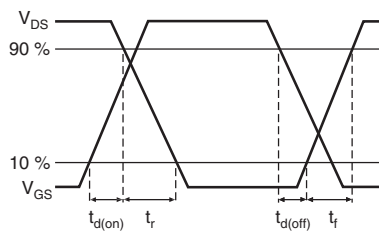


Fig. 13 - Switching Time Waveforms

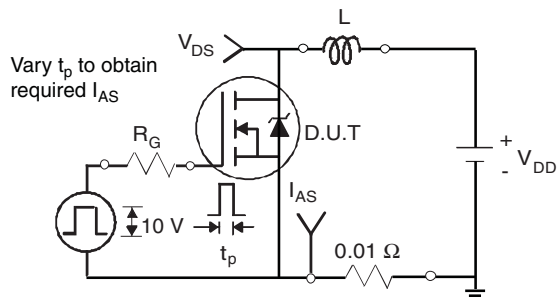


Fig. 14 - Unclamped Inductive Test Circuit

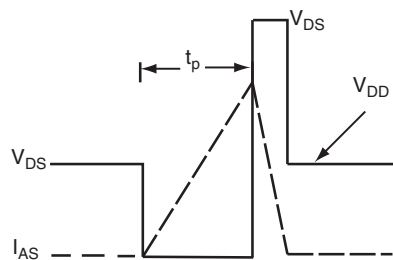


Fig. 15 - Unclamped Inductive Waveforms

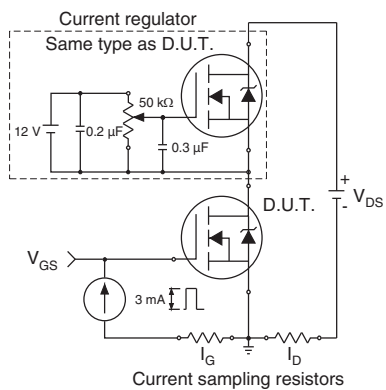
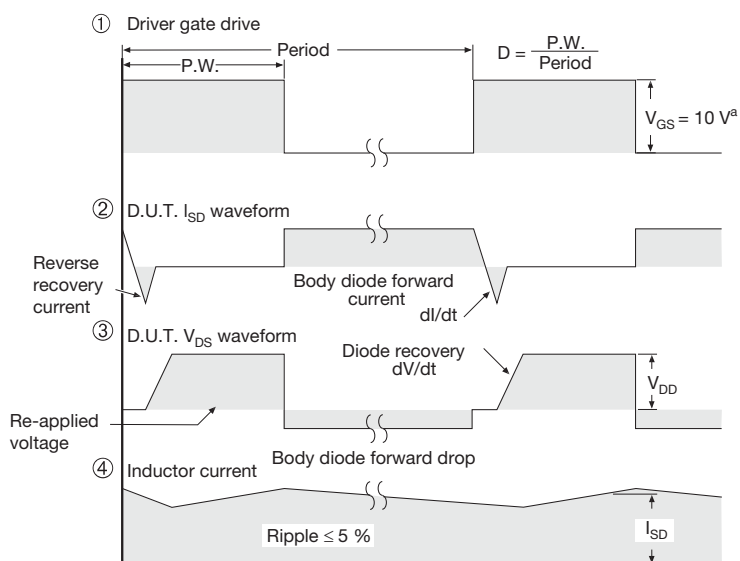
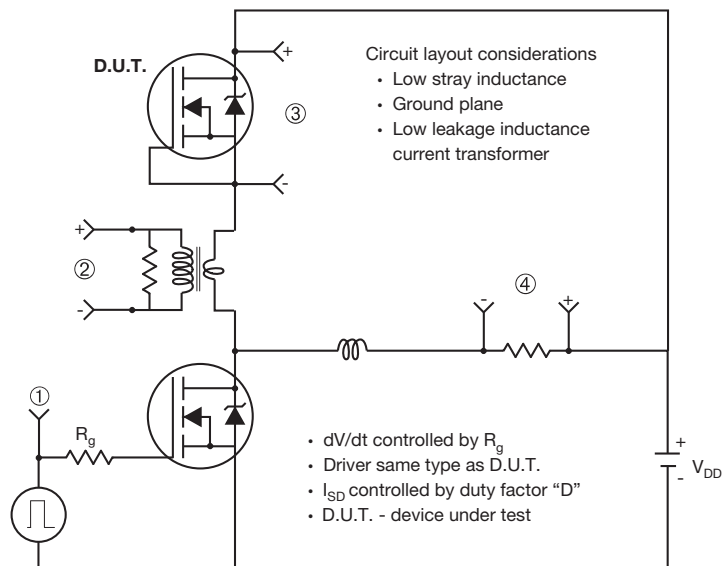


Fig. 17 - Gate Charge Test Circuit

### Peak Diode Recovery dV/dt Test Circuit

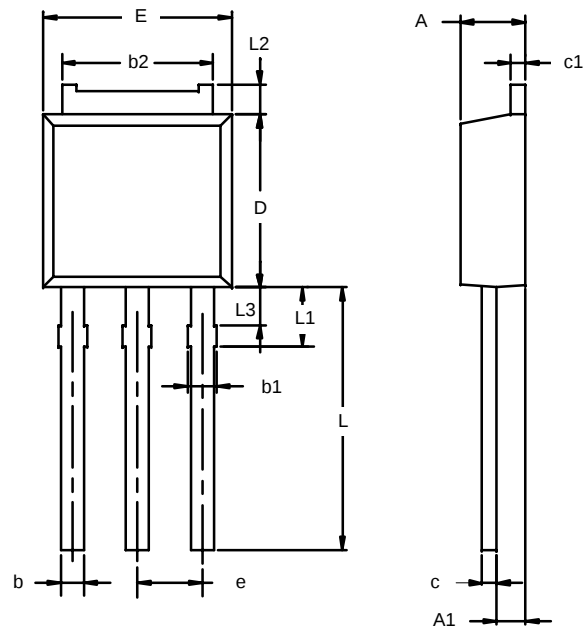


**Note**

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

**Fig. 18 - For N-Channel**

TO-251AA (DPAK)



Note: Dimension L3 is for reference only.

| Dim                                         | MILLIMETERS |      | INCHES    |       |
|---------------------------------------------|-------------|------|-----------|-------|
|                                             | Min         | Max  | Min       | Max   |
| A                                           | 2.21        | 2.38 | 0.087     | 0.094 |
| A1                                          | 0.89        | 1.14 | 0.035     | 0.045 |
| b                                           | 0.71        | 0.89 | 0.028     | 0.035 |
| b1                                          | 0.76        | 1.14 | 0.030     | 0.045 |
| b2                                          | 5.23        | 5.43 | 0.206     | 0.214 |
| c                                           | 0.46        | 0.58 | 0.018     | 0.023 |
| c1                                          | 0.46        | 0.58 | 0.018     | 0.023 |
| D                                           | 5.97        | 6.22 | 0.235     | 0.245 |
| E                                           | 6.48        | 6.73 | 0.255     | 0.265 |
| e                                           | 2.28 BSC    |      | 0.090 BSC |       |
| L                                           | 8.89        | 9.53 | 0.350     | 0.375 |
| L1                                          | 1.91        | 2.28 | 0.075     | 0.090 |
| L2                                          | 0.89        | 1.27 | 0.035     | 0.050 |
| L3                                          | 1.15        | 1.52 | 0.045     | 0.060 |
| ECN: S-03946—Rev. E, 09-Jul-01<br>DWG: 5346 |             |      |           |       |

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