

**200V(D-S) N-Channel Enhancement Mode Power MOS FET**

**General Features**

- $V_{DS} = 200V, I_D = 2A$   
 $R_{DS(ON)} < 580m\Omega @ V_{GS}=10V$  (Typ:520m $\Omega$ )
- High density cell design for ultra low  $R_{dson}$
- Fully characterized avalanche voltage and current
- Excellent package for good heat dissipation



**Lead Free**

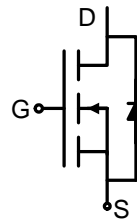
**Application**

- Power switching application
- Hard switched and high frequency circuits
- Uninterruptible power supply

**PIN Configuration**



TO-92 view



Schematic diagram

**Package Marking and Ordering Information**

| Device Marking | Device   | Device Package | Reel Size | Tape width | Quantity |
|----------------|----------|----------------|-----------|------------|----------|
|                | MSN2002T | TO-92          | -         | -          | -        |

**Absolute Maximum Ratings ( $T_A=25^\circ C$  unless otherwise noted)**

| Parameter  | Symbol         | Limit      | Unit       |
|--|----------------|------------|------------|
| Drain-Source Voltage                             | $V_{DS}$       | 200        | V          |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$   | V          |
| Drain Current-Continuous                         | $I_D$          | 2          | A          |
| Drain Current-Pulsed <sup>(Note 1)</sup>         | $I_{DM}$       | 8          | A          |
| Maximum Power Dissipation                        | $P_D$          | 3          | W          |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 To 150 | $^\circ C$ |

**Thermal Characteristic**

|   |                 |      |              |
|---|-----------------|------|--------------|
| Thermal Resistance, Junction-to-Ambient <sup>(Note 2)</sup> | $R_{\theta JA}$ | 41.7 | $^\circ C/W$ |
|---|-----------------|------|--------------|

**Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)**

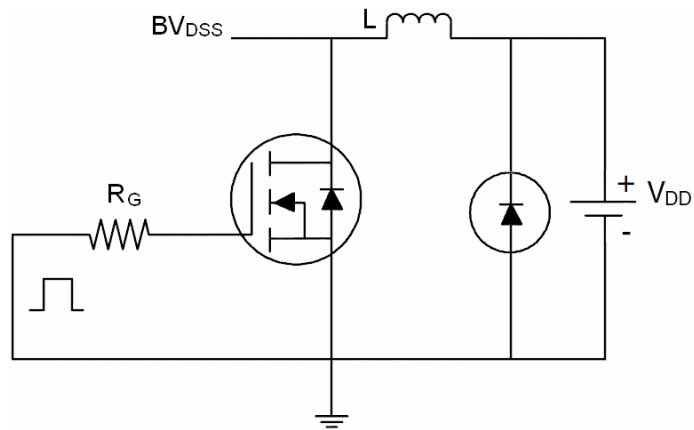
| Parameter                                 | Symbol              | Condition  | Min | Typ | Max  | Unit |
|---|---------------------|--|-----|-----|------|------|
| <b>Off Characteristics</b>                |                     |  |     |     |      |      |
| Drain-Source Breakdown Voltage            | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA  | 200 | -   | -    | V    |
| Zero Gate Voltage Drain Current           | I <sub>DSS</sub>    | V <sub>DS</sub> =200V, V <sub>GS</sub> =0V   | -   | -   | 1    | μA   |
| Gate-Body Leakage Current                 | I <sub>GSS</sub>    | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V   | -   | -   | ±100 | nA   |
| <b>On Characteristics</b> (Note 3)        |                     |  |     |     |      |      |
| Gate Threshold Voltage                    | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                 | 2.5 | 3.4 | 4.5  | V    |
| Drain-Source On-State Resistance          | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =2A   | -   | 520 | 580  | mΩ   |
| Forward Transconductance                  | g <sub>FS</sub>     | V <sub>DS</sub> =15V, I <sub>D</sub> =2A   | -   | 8   | -    | S    |
| <b>Dynamic Characteristics</b> (Note 4)   |                     |  |     |     |      |      |
| Input Capacitance                         | C <sub>ISS</sub>    | V <sub>DS</sub> =25V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                   | -   | 580 | -    | PF   |
| Output Capacitance                        | C <sub>OSS</sub>    |  | -   | 90  | -    | PF   |
| Reverse Transfer Capacitance              | C <sub>rss</sub>    |  | -   | 3   | -    | PF   |
| <b>Switching Characteristics</b> (Note 4) |                     |  |     |     |      |      |
| Turn-on Delay Time                        | t <sub>d(on)</sub>  | V <sub>DD</sub> =100V, R <sub>L</sub> =15Ω<br>V <sub>GS</sub> =10V, R <sub>G</sub> =2.5Ω | -   | 10  | -    | nS   |
| Turn-on Rise Time                         | t <sub>r</sub>      |  | -   | 12  | -    | nS   |
| Turn-Off Delay Time                       | t <sub>d(off)</sub> |  | -   | 15  | -    | nS   |
| Turn-Off Fall Time                        | t <sub>f</sub>      |  | -   | 15  | -    | nS   |
| Total Gate Charge                         | Q <sub>g</sub>      | V <sub>DS</sub> =100V, I <sub>D</sub> =2A,<br>V <sub>GS</sub> =10V                       | -   | 12  | -    | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>     |  | -   | 2.5 | -    | nC   |
| Gate-Drain Charge                         | Q <sub>gd</sub>     |  | -   | 3.8 | -    | nC   |
| <b>Drain-Source Diode Characteristics</b> |                     |  |     |     |      |      |
| Diode Forward Voltage (Note 3)            | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =2A  | -   | -   | 1.2  | V    |
| Diode Forward Current (Note 2)            | I <sub>S</sub>      |  | -   | -   | 2    | A    |

**Notes:**

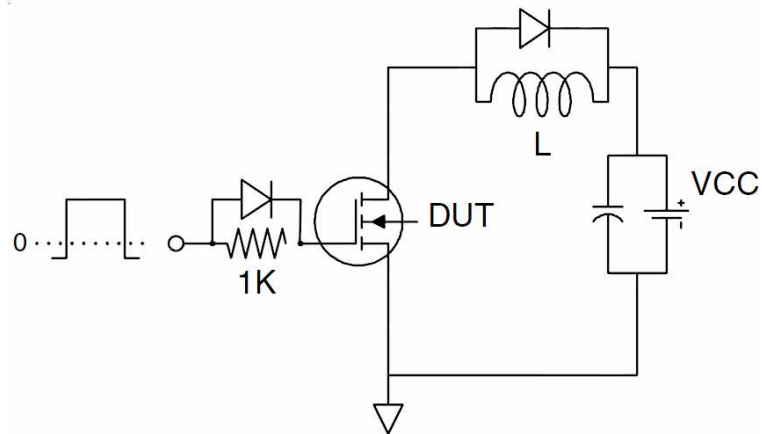
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production

**Test Circuit**

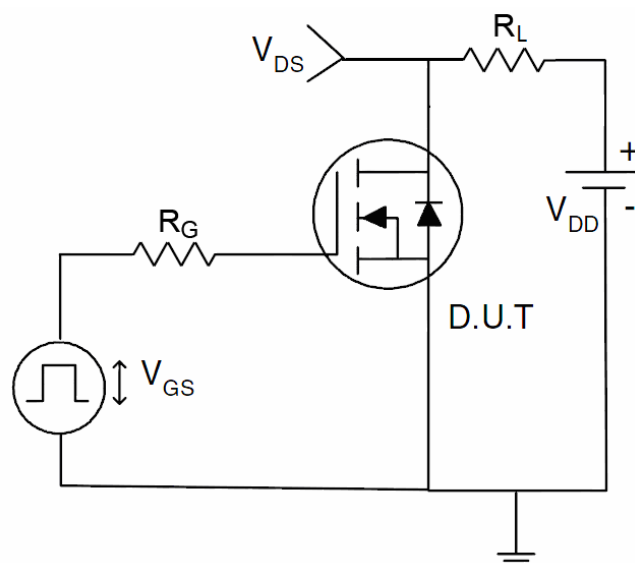
1)  $E_{AS}$  test circuit



2) Gate charge test circuit



3) Switch Time Test Circuit



Typical Electrical and Thermal Characteristics (Curves)

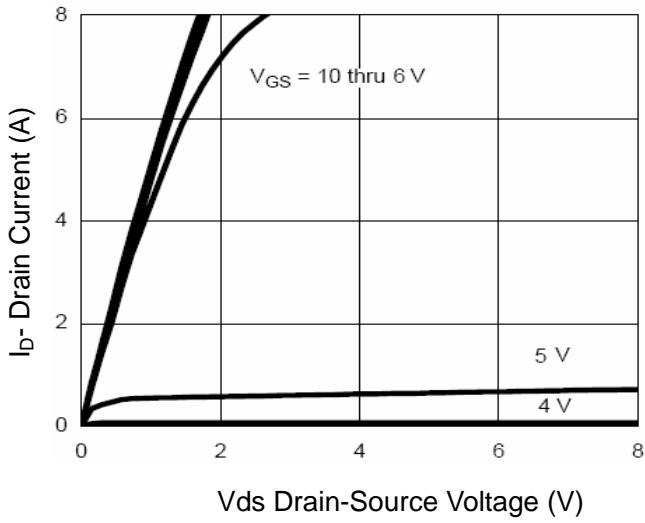


Figure 1 Output Characteristics

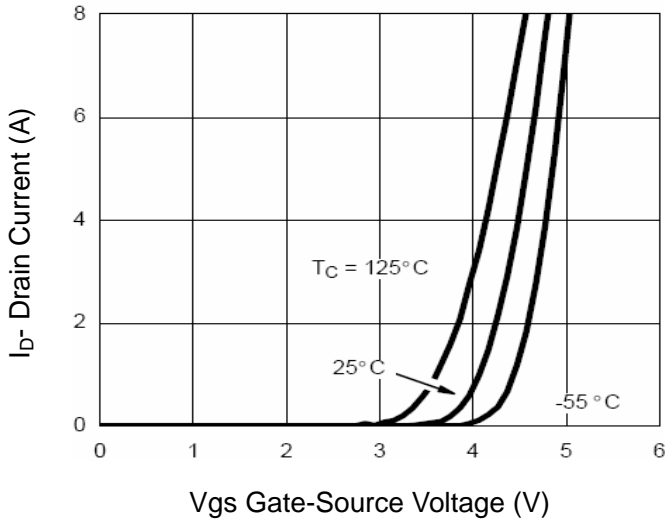


Figure 2 Transfer Characteristics

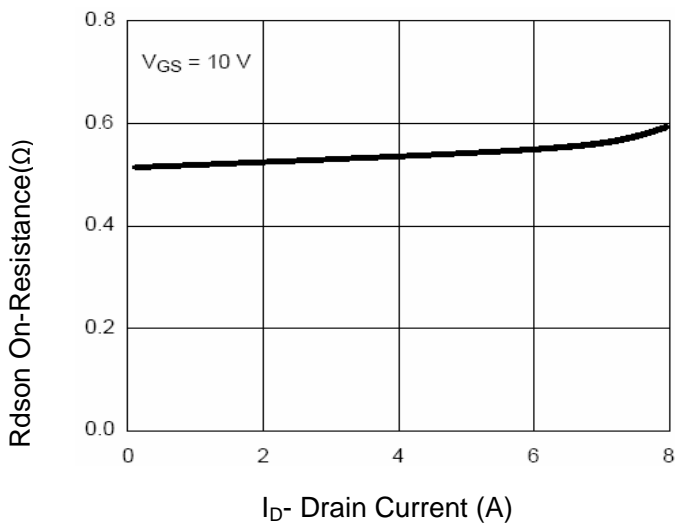


Figure 3 Rdson- Drain Current

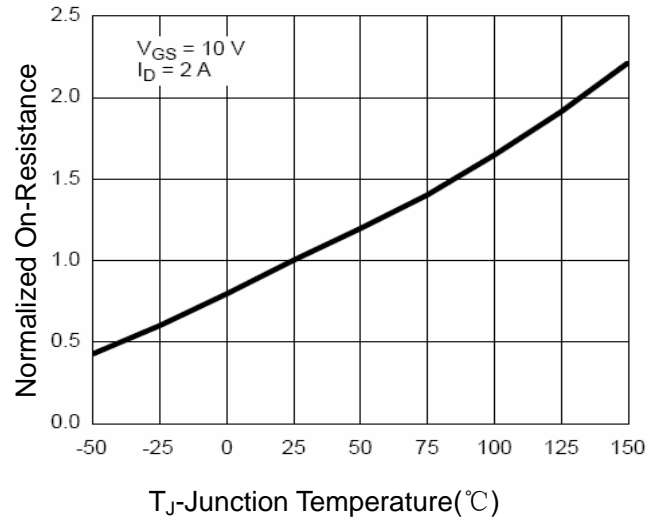


Figure 4 Rdson-Junction Temperature

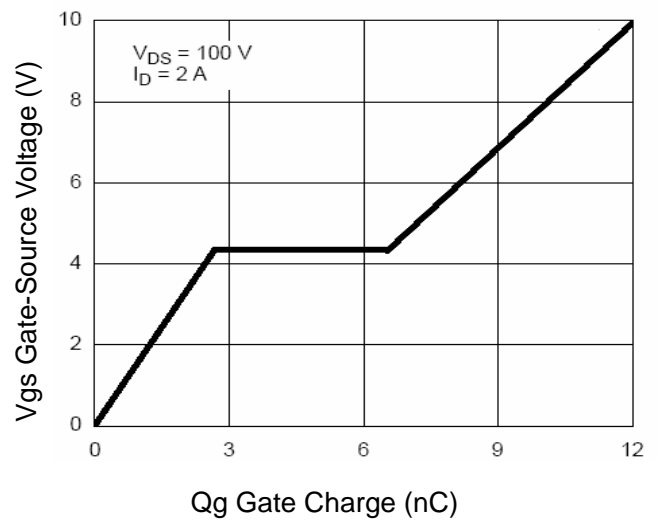


Figure 5 Gate Charge

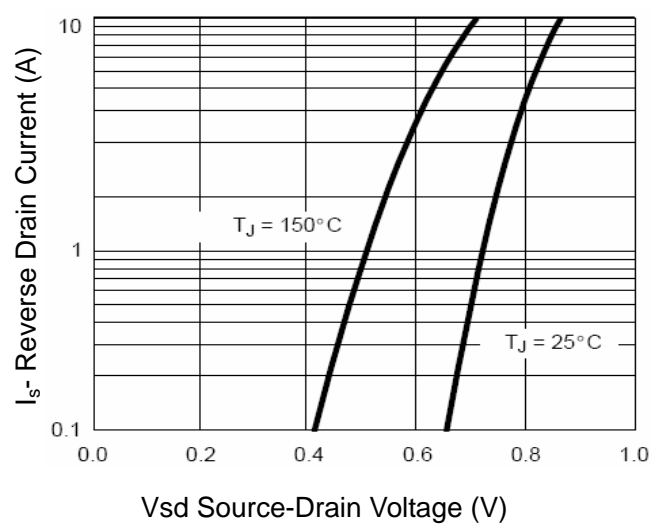


Figure 6 Source- Drain Diode Forward

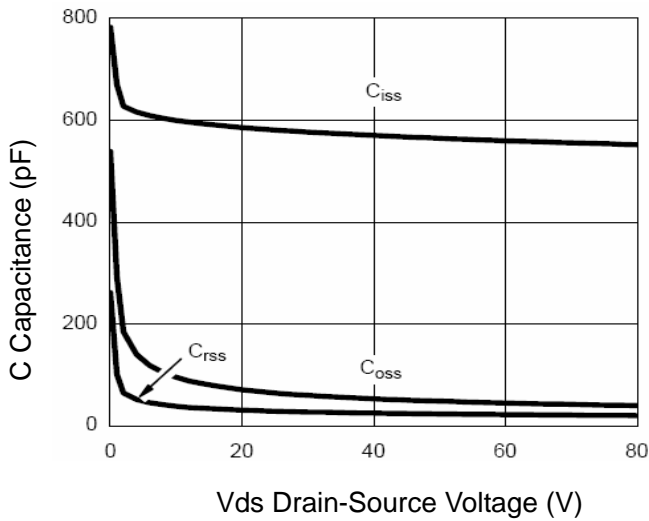


Figure 7 Capacitance vs Vds

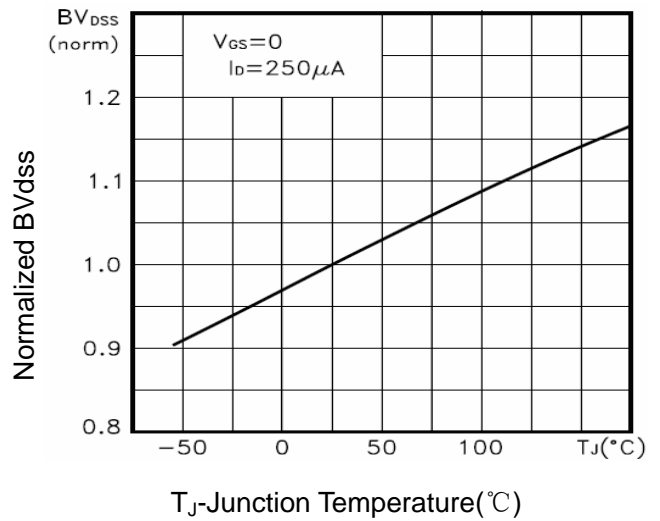


Figure 9  $BV_{DSS}$  vs Junction Temperature

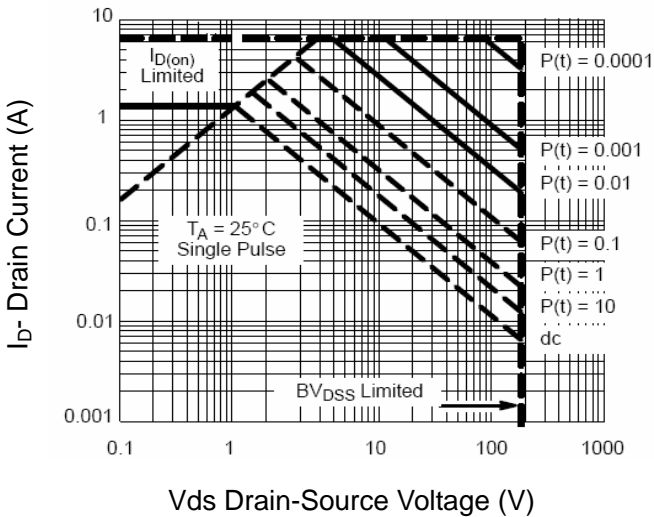


Figure 8 Safe Operation Area

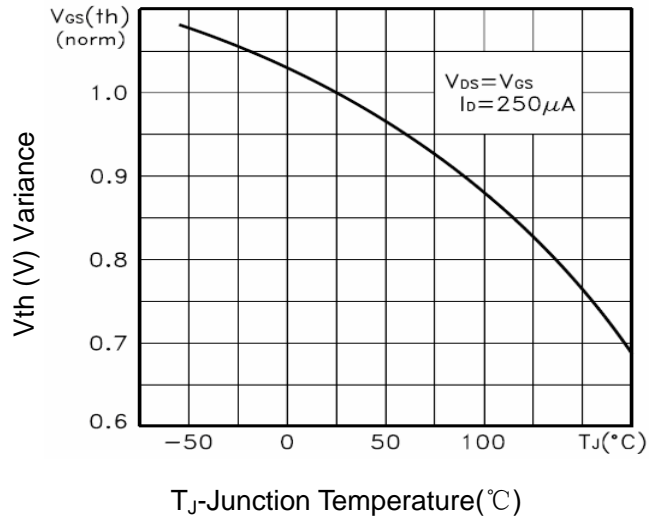


Figure 10  $V_{GS(th)}$  vs Junction Temperature

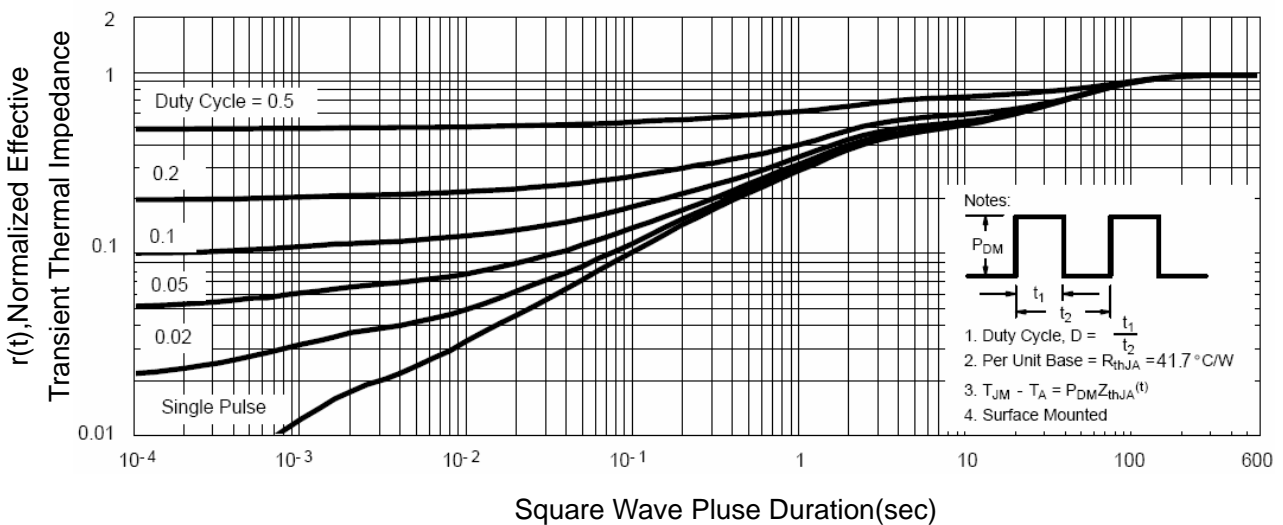
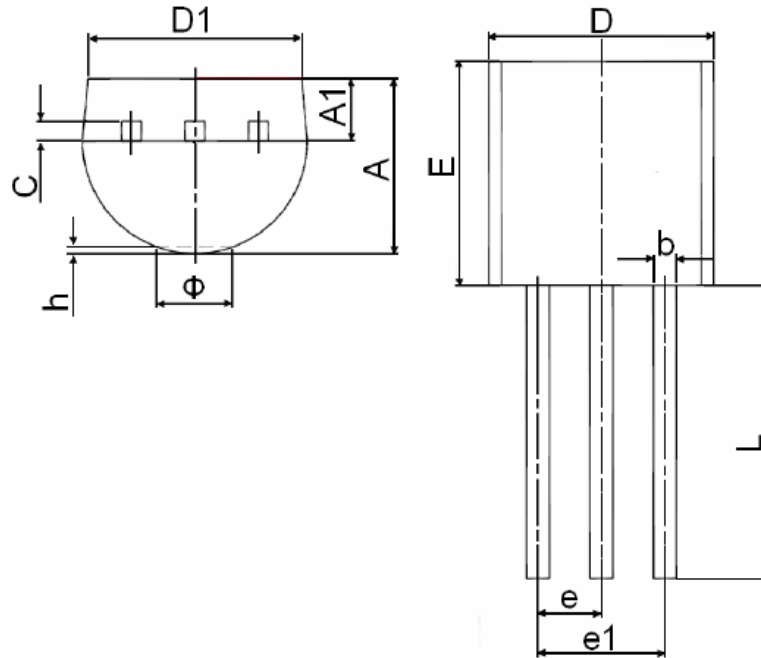


Figure 11 Normalized Maximum Transient Thermal Impedance

**TO-92 Package Information**



| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min                       | Max    | Min                  | Max   |
| A      | 3.300                     | 3.700  | 0.130                | 0.146 |
| A1     | 1.100                     | 1.400  | 0.043                | 0.055 |
| b      | 0.380                     | 0.550  | 0.015                | 0.022 |
| c      | 0.360                     | 0.510  | 0.014                | 0.020 |
| D      | 4.400                     | 4.700  | 0.173                | 0.185 |
| D1     | 3.430                     |        | 0.135                |       |
| E      | 4.300                     | 4.700  | 0.169                | 0.185 |
| e      | 1.270 TYP                 |        | 0.050 TYP            |       |
| e1     | 2.440                     | 2.640  | 0.096                | 0.104 |
| L      | 14.100                    | 14.500 | 0.555                | 0.571 |
| $\Phi$ |                           | 1.600  |                      | 0.063 |
| h      | 0.000                     | 0.380  | 0.000                | 0.015 |

**Notes**

1. All dimensions are in millimeters.
2. Tolerance  $\pm 0.10\text{mm}$  (4 mil) unless otherwise specified
3. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 5 mils.
4. Dimension L is measured in gauge plane.
5. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.