



## Bi-Directional N-Channel 20-V (D-S) MOSFET

| PRODUCT SUMMARY       |                                 |                       |
|-----------------------|---------------------------------|-----------------------|
| V <sub>S1S2</sub> (V) | r <sub>S1S2(on)</sub> (Ω)       | I <sub>S1S2</sub> (A) |
| 20                    | 0.045 @ V <sub>GS</sub> = 4.5 V | 5.0                   |
|                       | 0.048 @ V <sub>GS</sub> = 3.7 V | 4.8                   |
|                       | 0.057 @ V <sub>GS</sub> = 2.5 V | 4.4                   |
|                       | 0.072 @ V <sub>GS</sub> = 1.8 V | 3.9                   |

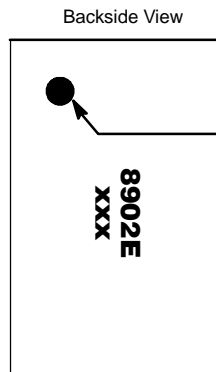
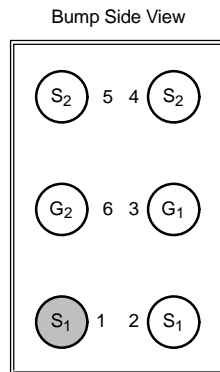
### FEATURES

- TrenchFET® Power MOSFET
- Ultra-Low r<sub>SS(on)</sub>
- ESD Protected: 4000 V
- New MICRO FOOT™ Chipscale Packaging Reduces Footprint Area, Profile (0.65 mm) and On-Resistance Per Footprint Area

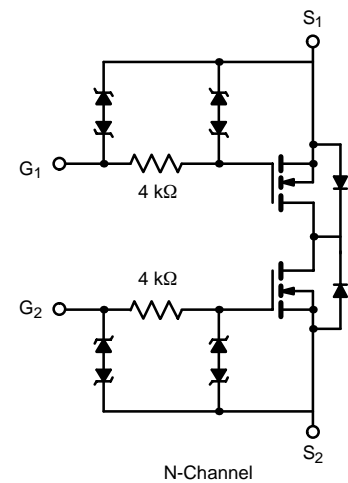
### APPLICATIONS

- Battery Protection Circuit
  - 1-2 Cell Li+/LiP Battery Pack for Portable Devices

### MICRO FOOT™



Device Marking:  
8902E = P/N Code  
xxx = Date/Lot Traceability Code



| ABSOLUTE MAXIMUM RATINGS (T <sub>A</sub> = 25°C UNLESS OTHERWISE NOTED)  |                                   |                       |              |      |
|--|-----------------------------------|-----------------------|--------------|------|
| Parameter  | Symbol                            | 5 secs                | Steady State | Unit |
| Source1—Source2 Voltage  | V <sub>S1S2</sub>                 | 20                    |              | V    |
| Gate-Source Voltage  | V <sub>GS</sub>                   | ±12                   |              |      |
| Continuous Source1—Source2 Current (T <sub>J</sub> = 150°C) <sup>a</sup> | I <sub>S1S2</sub>                 | T <sub>A</sub> = 25°C | 5.0          | A    |
|  |                                   | T <sub>A</sub> = 85°C | 3.4          |      |
| Pulsed Source1—Source2 Current   | I <sub>SM</sub>                   | 8                     |              |      |
| Maximum Power Dissipation <sup>a</sup>                                   | P <sub>D</sub>                    | T <sub>A</sub> = 25°C | 1.7          | W    |
|  |                                   | T <sub>A</sub> = 85°C | 0.8          |      |
| Operating Junction and Storage Temperature Range                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to 150            |              | °C   |
| Package Reflow Conditions <sup>c</sup>                                   | VPR                               | 215                   |              |      |
|  | IR/Convection                     | 220                   |              |      |

| THERMAL RESISTANCE RATINGS               |                   |              |         |      |
|--|-------------------|--------------|---------|------|
| Parameter                                | Symbol            | Typical      | Maximum | Unit |
| Maximum Junction-to-Ambient <sup>a</sup> | R <sub>thJA</sub> | t ≤ 5 sec    | 60      | °C/W |
|  |                   | Steady State | 95      |      |
| Maximum Junction-to-Foot <sup>b</sup>    | R <sub>thJF</sub> | 18           | 22      |      |

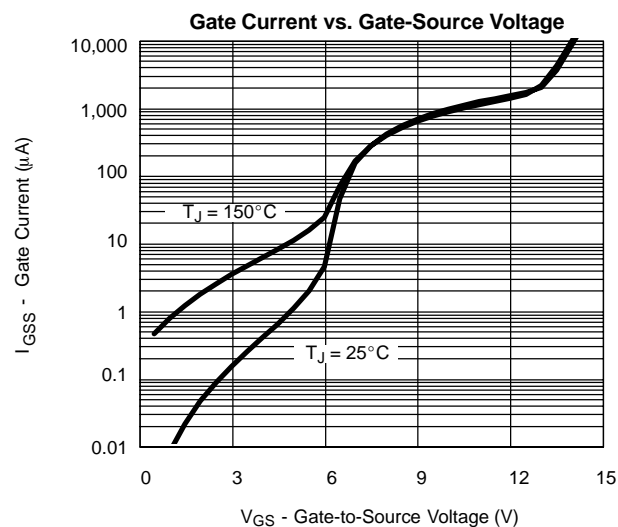
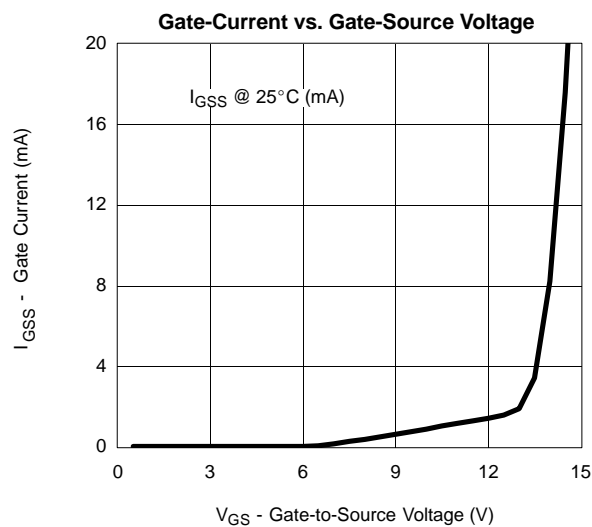
Notes  
a. Surface Mounted on 1" x 1" FR4 Board.  
b. The Foot is defined as the top surface of the package.  
c. Refer to IPC/JEDEC (J-STD-020A), no manual or hand soldering.

**SPECIFICATIONS ( $T_J = 25^\circ\text{C}$  UNLESS OTHERWISE NOTED)**

| Parameter  | Symbol         | Test Condition  | Min  | Typ   | Max      | Unit          |
|--|----------------|---|------|-------|----------|---------------|
| <b>Static</b>                                    |                |   |      |       |          |               |
| Gate Threshold Voltage                           | $V_{GS(th)}$   | $V_{SS} = V_{GS}, I_D = 980\ \mu\text{A}$   | 0.45 |       | 1.0      | V             |
| Gate-Body Leakage                                | $I_{GSS}$      | $V_{SS} = 0\ \text{V}, V_{GS} = \pm 4.5\ \text{V}$  |      |       | $\pm 4$  | $\mu\text{A}$ |
|  |                | $V_{SS} = 0\ \text{V}, V_{GS} = \pm 12\ \text{V}$   |      |       | $\pm 10$ | mA            |
| Zero Gate Voltage Source Current                 | $I_{S1S2}$     | $V_{SS} = 16\ \text{V}, V_{GS} = 0\ \text{V}$   |      |       | 1        | $\mu\text{A}$ |
|  |                | $V_{SS} = 16\ \text{V}, V_{GS} = 0\ \text{V}, T_J = 85^\circ\text{C}$   |      |       | 5        |               |
| On-State Source Current <sup>a</sup>             | $I_{S(on)}$    | $V_{SS} = 5\ \text{V}, V_{GS} = 4.5\ \text{V}$  | 5    |       |          | A             |
| Source1—Source2 On-State Resistance <sup>a</sup> | $r_{S1S2(on)}$ | $V_{GS} = 4.5\ \text{V}, I_{SS} = 1\ \text{A}$  |      | 0.038 | 0.045    | $\Omega$      |
|  |                | $V_{GS} = 3.7\ \text{V}, I_{SS} = 1\ \text{A}$  |      | 0.041 | 0.048    |               |
|  |                | $V_{GS} = 2.5\ \text{V}, I_{SS} = 1\ \text{A}$  |      | 0.048 | 0.057    |               |
|  |                | $V_{GS} = 1.8\ \text{V}, I_{SS} = 1\ \text{A}$  |      | 0.060 | 0.072    |               |
| Forward Transconductance <sup>a</sup>            | $g_{fs}$       | $V_{SS} = 10\ \text{V}, I_{SS} = 1\ \text{A}$   |      | 20    |          | S             |
| <b>Dynamic<sup>b</sup></b>                       |                |   |      |       |          |               |
| Turn-On Delay Time                               | $t_{d(on)}$    | $V_{SS} = 10\ \text{V}, R_L = 10\ \Omega$<br>$I_{SS} \cong 1\ \text{A}, V_{GEN} = 4.5\ \text{V}, R_G = 6\ \Omega$ |      | 1     | 1.5      | $\mu\text{s}$ |
| Rise Time  | $t_r$          |   |      | 3     | 4.5      |               |
| Turn-Off Delay Time                              | $t_{d(off)}$   |   |      | 17    | 26       |               |
| Fall Time  | $t_f$          |   |      | 10    | 15       |               |

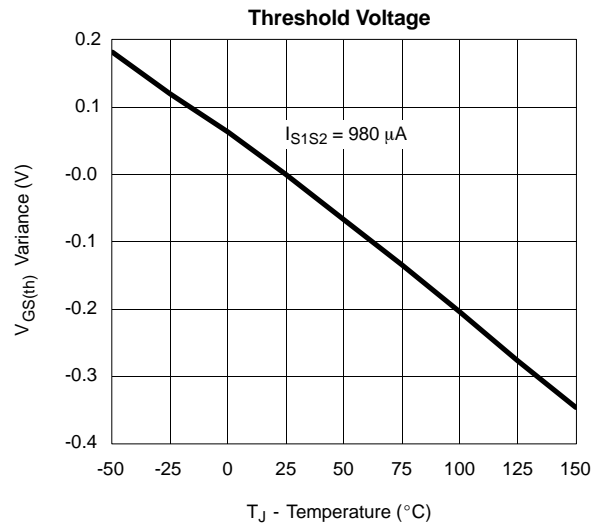
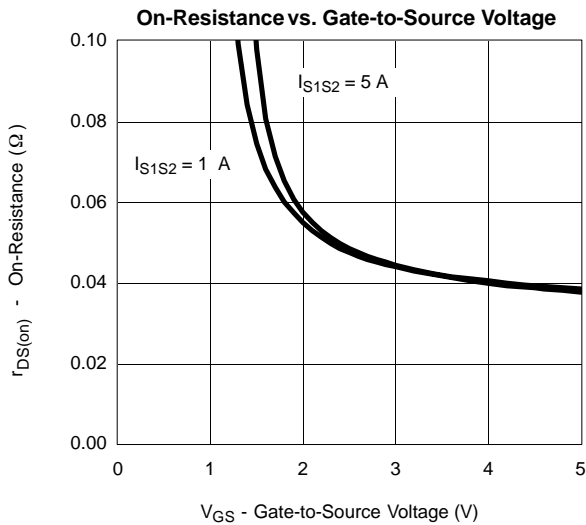
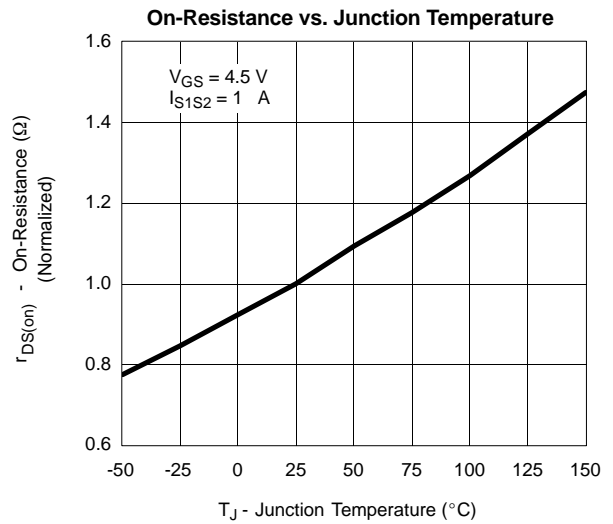
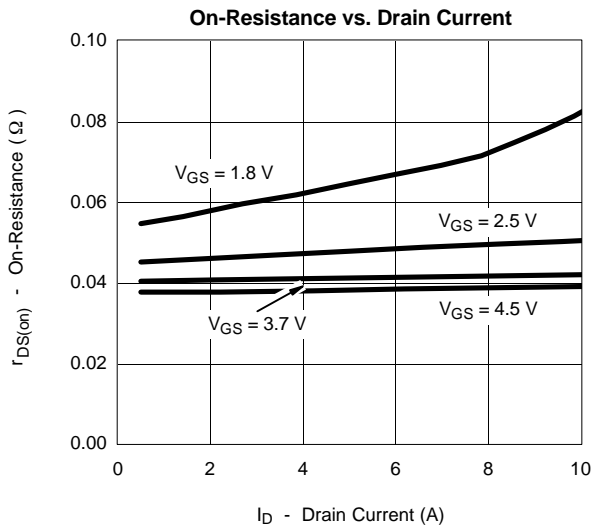
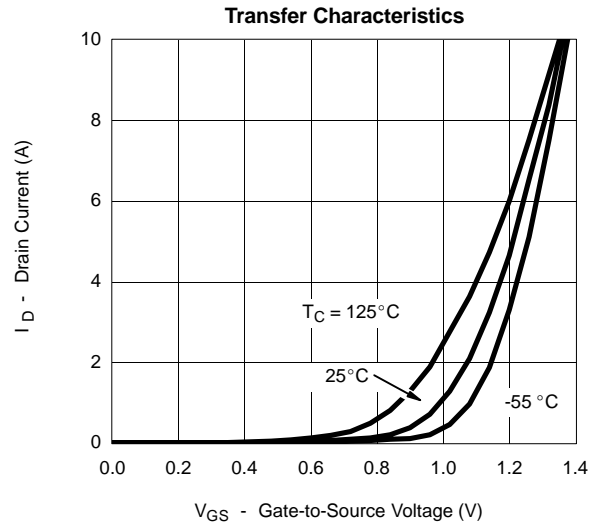
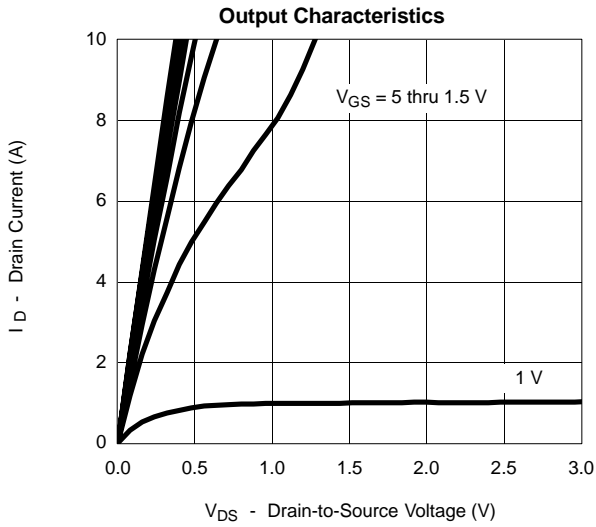
## Notes

- a. Pulse test; pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .  
b. Guaranteed by design, not subject to production testing.

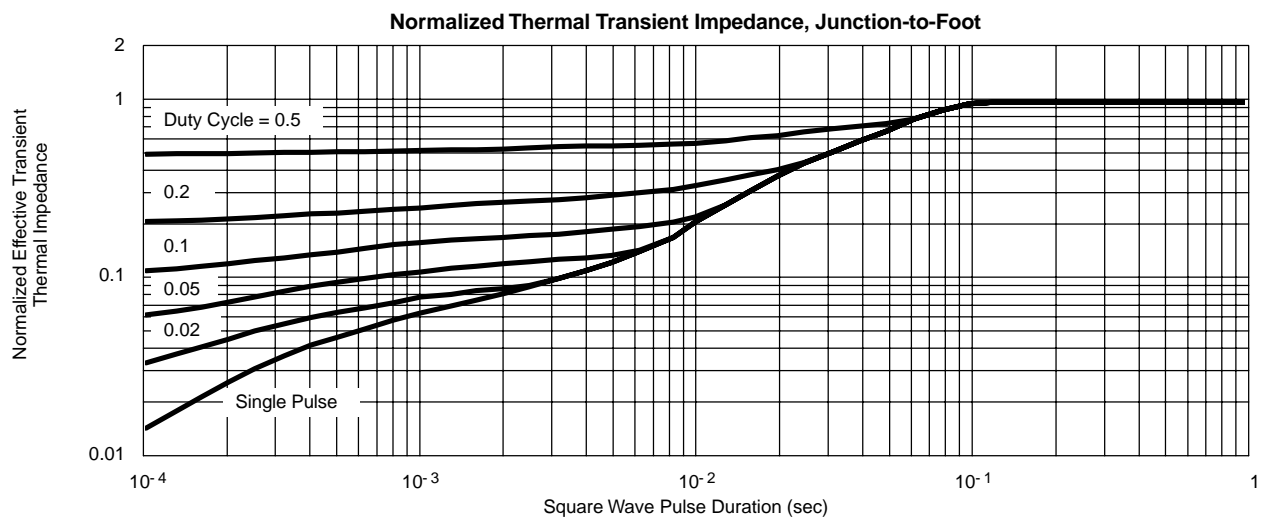
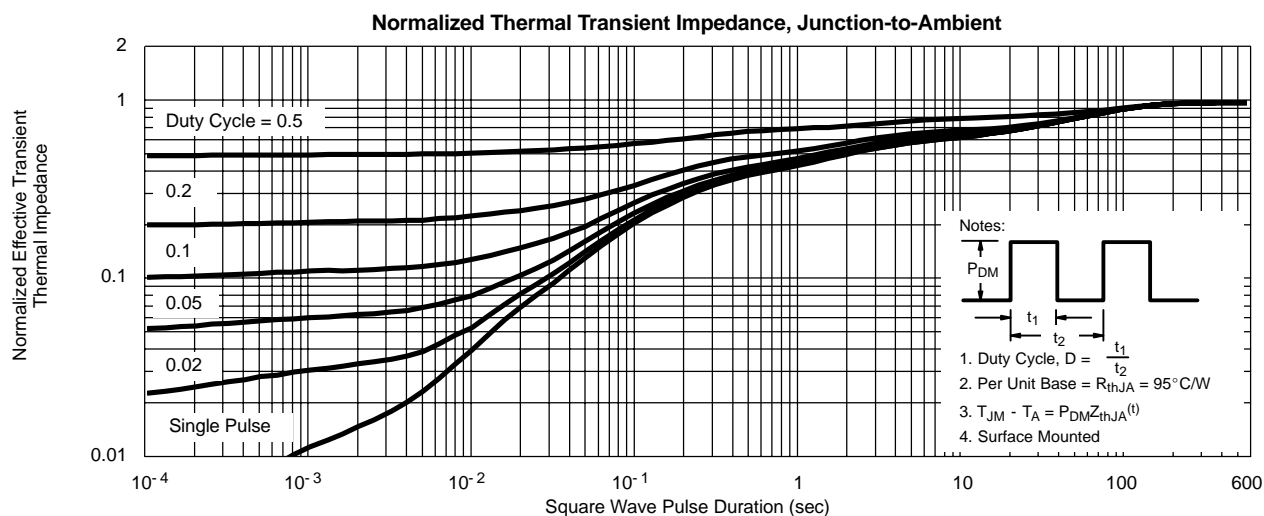
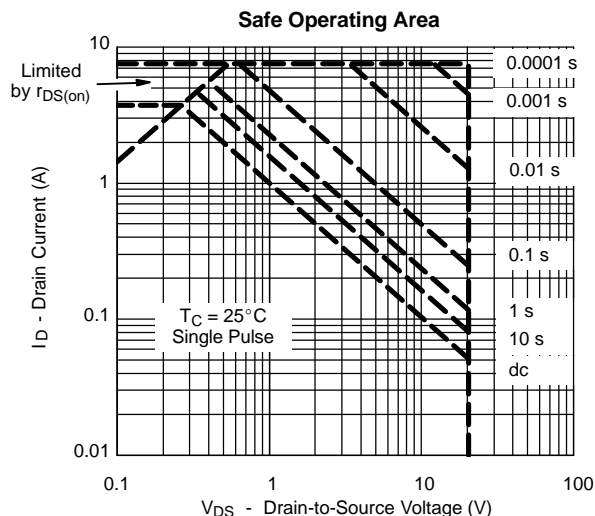
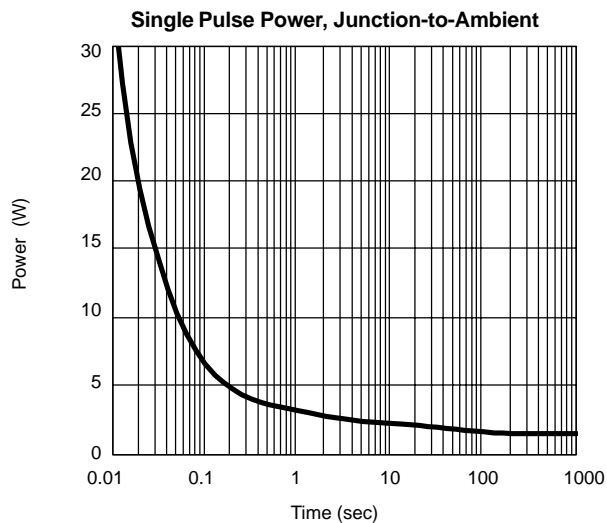
**TYPICAL CHARACTERISTICS ( $25^\circ\text{C}$  UNLESS NOTED)**



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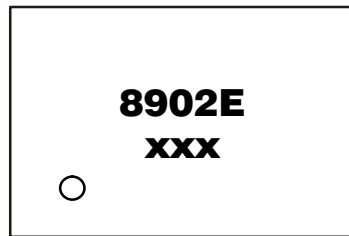
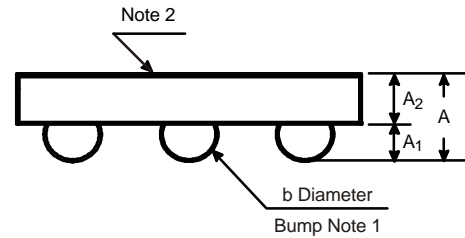
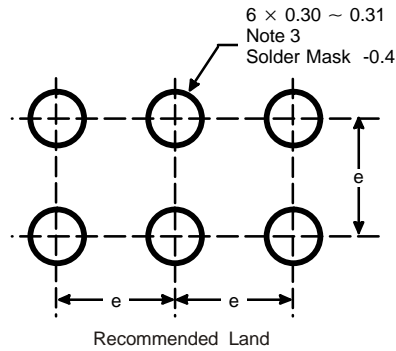


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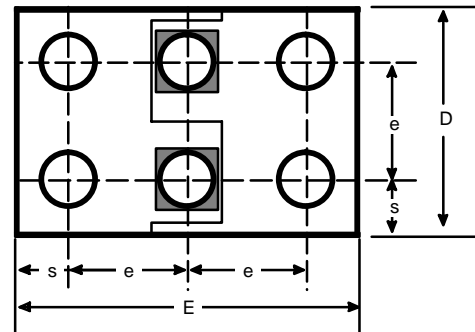


**PACKAGE OUTLINE**

**MICRO FOOT: 6-BUMP (2 X 3, 0.8-mm PITCH)**



Mark on Backside of Die



NOTES (Unless Otherwise Specified):

1. 6 solder bumps are Eutetic 63Sn/37Pb with diameter 0.37 - 0.41 mm
2. Backside surface is coated with a Ag/Ni/Ti layer
3. Non-solder mask defined copper landing pad.
4. Laser marks on the silicon die back

| Dim            | MILLIMETERS* |       | INCHES |        |
|----------------|--------------|-------|--------|--------|
|                | Min          | Max   | Min    | Max    |
| A              | 0.600        | 0.650 | 0.0236 | 0.0256 |
| A <sub>1</sub> | 0.260        | 0.290 | 0.102  | 0.114  |
| A <sub>2</sub> | 0.340        | 0.360 | 0.0134 | 0.0142 |
| b              | 0.370        | 0.410 | 0.0146 | 0.0161 |
| D              | 1.520        | 1.600 | 0.0598 | 0.0630 |
| E              | 2.320        | 2.400 | 0.0913 | 0.0945 |
| e              | 0.750        | 0.850 | 0.0295 | 0.0335 |
| s              | 0.380        | 0.400 | 0.0150 | 0.0157 |

\* Use millimeters as the primary measurement.