

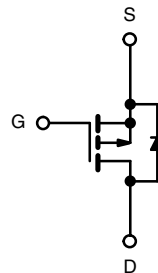
## 4P0409-VB TO263 Datasheet

### P-Channel 40-V (D-S) MOSFET

| PRODUCT SUMMARY     |                                    |                                 |                       |
|---------------------|------------------------------------|---------------------------------|-----------------------|
| V <sub>DS</sub> (V) | r <sub>DS(on)</sub> (Ω)            | I <sub>D</sub> (A) <sup>a</sup> | Q <sub>g</sub> (Typ.) |
| - 40                | 0.0041 at V <sub>GS</sub> = - 10 V | - 110                           | 185 nC                |

#### FEATURES

- TrenchFET<sup>®</sup> Power MOSFET



P-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted |                                   |                        |                      |   |
|---|-----------------------------------|------------------------|----------------------|---|
| Parameter   | Symbol                            | Limit                  | Unit                 |   |
| Drain-Source Voltage  | V <sub>DS</sub>                   | - 40                   | V                    |   |
| Gate-Source Voltage   | V <sub>GS</sub>                   | ± 20                   |                      |   |
| Continuous Drain Current (T <sub>J</sub> = 175 °C)                      | I <sub>D</sub>                    | T <sub>C</sub> = 25 °C | - 110 <sup>a</sup>   | A |
|   |                                   | T <sub>C</sub> = 70 °C | - 110 <sup>a</sup>   |   |
|   |                                   | T <sub>A</sub> = 25 °C | 39 <sup>b, c</sup>   |   |
|   |                                   | T <sub>A</sub> = 70 °C | 33 <sup>b, c</sup>   |   |
| Pulsed Drain Current  | I <sub>DM</sub>                   | 240                    |                      |   |
| Continuous Source-Drain Diode Current                                   | I <sub>S</sub>                    | T <sub>C</sub> = 25 °C | 110                  |   |
|   |                                   | T <sub>A</sub> = 25 °C | 10 <sup>b, c</sup>   |   |
| Avalanche Current   | I <sub>AS</sub>                   | 75                     |                      |   |
| Single-Pulse Avalanche Energy   | E <sub>AS</sub>                   | 281                    | mJ                   |   |
| Maximum Power Dissipation   | P <sub>D</sub>                    | T <sub>C</sub> = 25 °C | 375                  | W |
|   |                                   | T <sub>C</sub> = 70 °C | 262                  |   |
|   |                                   | T <sub>A</sub> = 25 °C | 15 <sup>b, c</sup>   |   |
|   |                                   | T <sub>A</sub> = 70 °C | 10.5 <sup>b, c</sup> |   |
| Operating Junction and Storage Temperature Range                        | T <sub>J</sub> , T <sub>stg</sub> | - 55 to 175            | °C                   |   |
| Soldering Recommendations (Peak Temperature) <sup>d, e</sup>            |                                   | 260                    |                      |   |

| THERMAL RESISTANCE RATINGS                  |              |                   |         |         |      |
|---|--------------|-------------------|---------|---------|------|
| Parameter                                   |              | Symbol            | Typical | Maximum | Unit |
| Maximum Junction-to-Ambient <sup>b, d</sup> | t ≤ 10 s     | R <sub>thJA</sub> | 8       | 10      | °C/W |
| Maximum Junction-to-Case (Drain)            | Steady State | R <sub>thJC</sub> | 0.33    | 0.4     |      |

Notes:

- Package limited.
- Surface Mounted on 1" x 1" FR4 board.
- t = 10 s.
- Maximum under Steady State conditions is 40 °C/W.

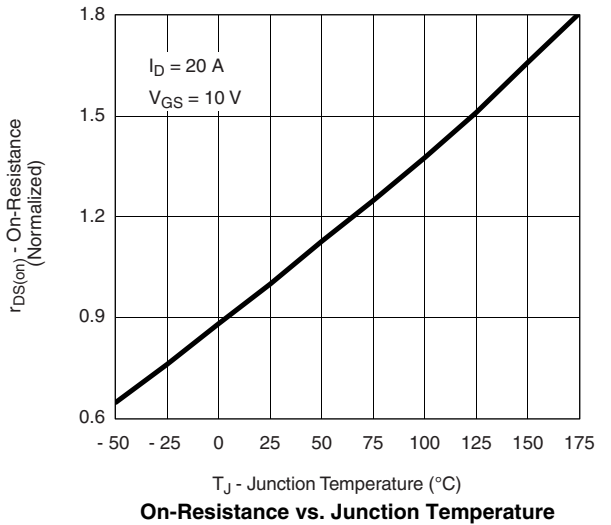
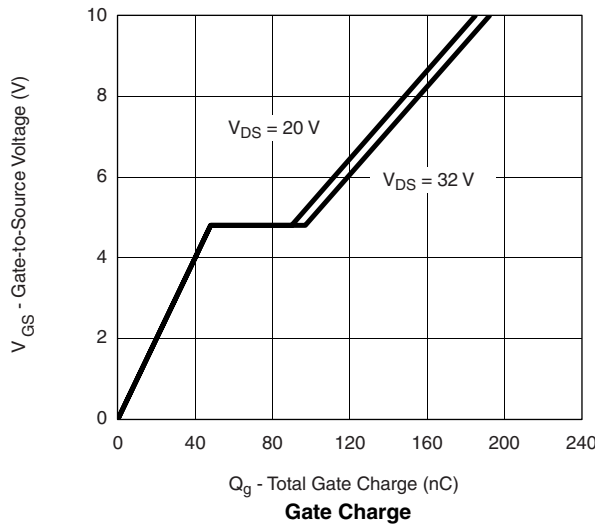
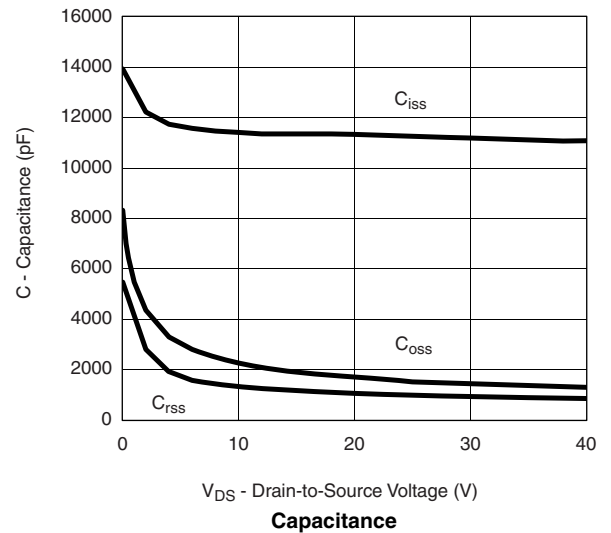
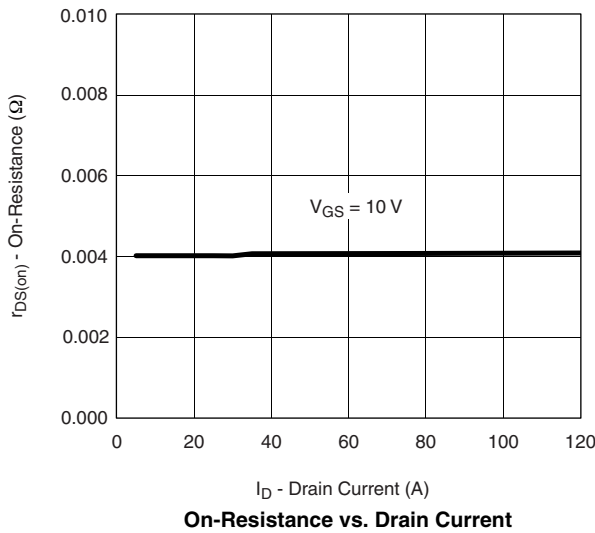
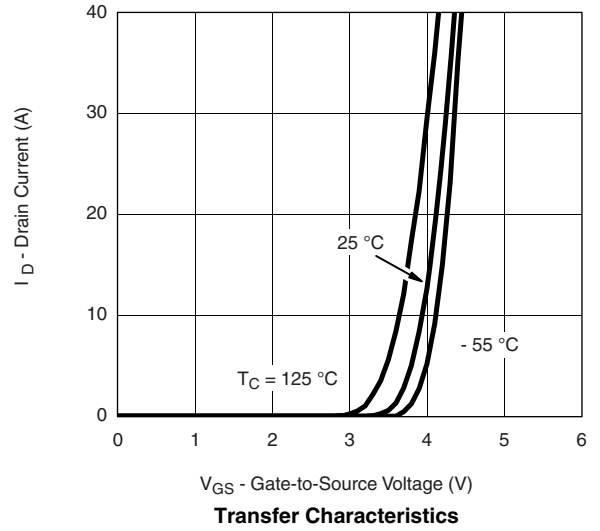
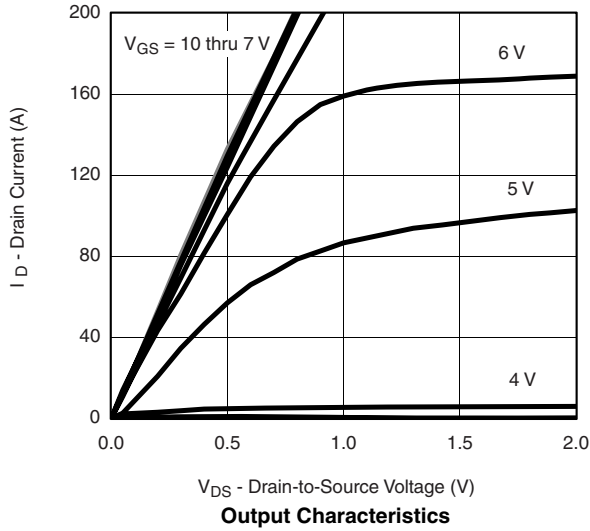
| <b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted |                         |   |       |        |           |               |
|---|-------------------------|---|-------|--------|-----------|---------------|
| Parameter   | Symbol                  | Test Conditions   | Min.  | Typ.   | Max.      | Unit          |
| <b>Static</b>   |                         |   |       |        |           |               |
| Drain-Source Breakdown Voltage  | $V_{DS}$                | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$  | - 40  |        |           | V             |
| $V_{DS}$ Temperature Coefficient  | $\Delta V_{DS}/T_J$     | $I_D = -250\text{ }\mu\text{A}$   |       | - 40   |           | mV/°C         |
| $V_{GS(th)}$ Temperature Coefficient  | $\Delta V_{GS(th)}/T_J$ |   |       | - 5.5  |           |               |
| Gate-Source Threshold Voltage   | $V_{GS(th)}$            | $V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$  | - 2   | - 3    | - 4       | V             |
| Gate-Source Leakage   | $I_{GSS}$               | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$   |       |        | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current   | $I_{DSS}$               | $V_{DS} = -40\text{ V}, V_{GS} = 0\text{ V}$  |       |        | - 1       | $\mu\text{A}$ |
|   |                         | $V_{DS} = -40\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$  |       |        | - 10      |               |
| On-State Drain Current <sup>a</sup>   | $I_{D(on)}$             | $V_{DS} \geq 5\text{ V}, V_{GS} = -10\text{ V}$   | - 120 |        |           | A             |
| Drain-Source On-State Resistance <sup>a</sup>                                   | $r_{DS(on)}$            | $V_{GS} = -10\text{ V}, I_D = -20\text{ A}$   |       | 0.0041 |           | $\Omega$      |
| Forward Transconductance <sup>a</sup>   | $g_{fs}$                | $V_{DS} = -15\text{ V}, I_D = -20\text{ A}$   |       | 75     |           | S             |
| <b>Dynamic<sup>b</sup></b>  |                         |   |       |        |           |               |
| Input Capacitance   | $C_{iss}$               | $V_{DS} = -25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$  |       | 11300  |           | pF            |
| Output Capacitance  | $C_{oss}$               |   |       | 1510   |           |               |
| Reverse Transfer Capacitance  | $C_{rss}$               |   |       | 1000   |           |               |
| Total Gate Charge   | $Q_g$                   | $V_{DS} = -20\text{ V}, V_{GS} = -10\text{ V}, I_D = -110\text{ A}$   |       | 185    | 280       | nC            |
| Gate-Source Charge  | $Q_{gs}$                |   |       | 48     |           |               |
| Gate-Drain Charge   | $Q_{gd}$                |   |       | 42     |           |               |
| Gate Resistance   | $R_g$                   | $f = 1\text{ MHz}$  |       | 4.0    |           | $\Omega$      |
| Turn-On Delay Time  | $t_{d(on)}$             | $V_{DD} = -20\text{ V}, R_L = 0.18\text{ }\Omega$<br>$I_D \cong -110\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$ |       | 25     | 40        | ns            |
| Rise Time   | $t_r$                   |   |       | 290    | 440       |               |
| Turn-Off Delay Time   | $t_{d(off)}$            |   |       | 110    | 165       |               |
| Fall Time   | $t_f$                   |   |       | 35     | 55        |               |
|   |                         |   |       |        |           |               |
| <b>Drain-Source Body Diode Characteristics</b>                                  |                         |   |       |        |           |               |
| Continuous Source-Drain Diode Current   | $I_S$                   | $T_C = 25\text{ }^\circ\text{C}$  |       |        | - 110     | A             |
| Pulse Diode Forward Current <sup>a</sup>  | $I_{SM}$                |   |       |        | - 240     |               |
| Body Diode Voltage  | $V_{SD}$                | $I_S = -20\text{ A}$  |       | - 0.8  | - 1.5     | V             |
| Body Diode Reverse Recovery Time  | $t_{rr}$                | $I_F = -20\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$  |       | 70     | 105       | ns            |
| Body Diode Reverse Recovery Charge  | $Q_{rr}$                |   |       | 130    | 200       | nC            |
| Reverse Recovery Fall Time  | $t_a$                   |   |       | 37     |           | ns            |
| Reverse Recovery Rise Time  | $t_b$                   |   |       | 33     |           |               |

Notes:

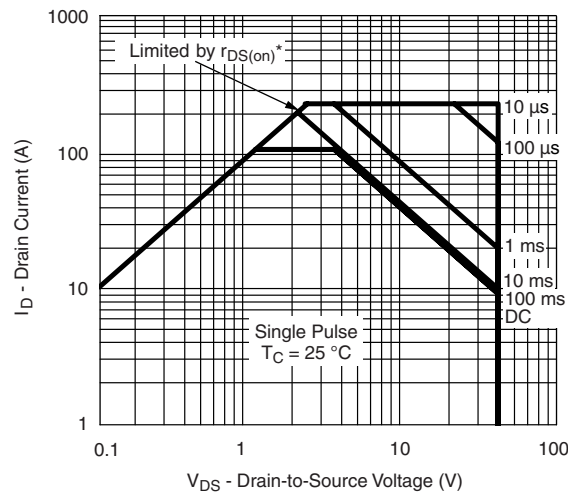
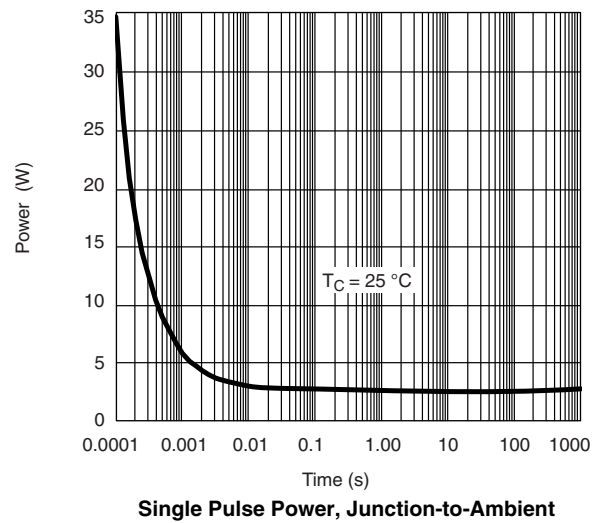
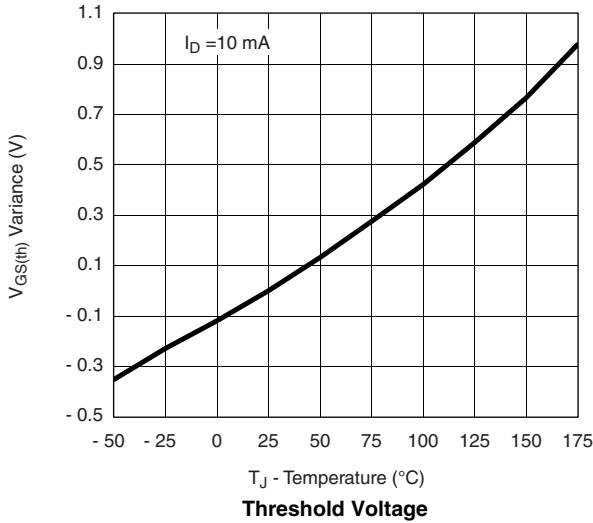
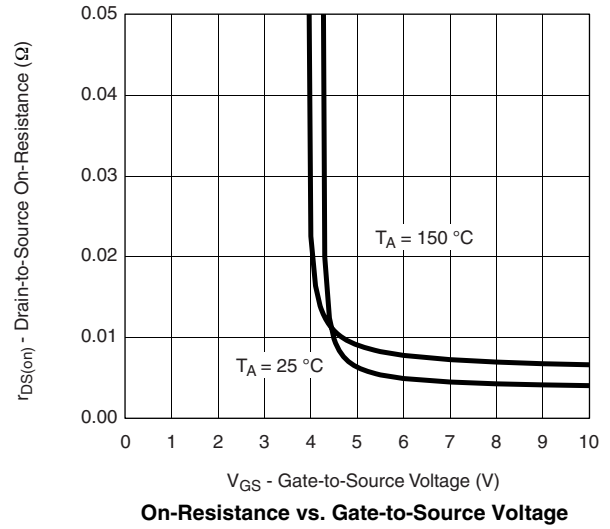
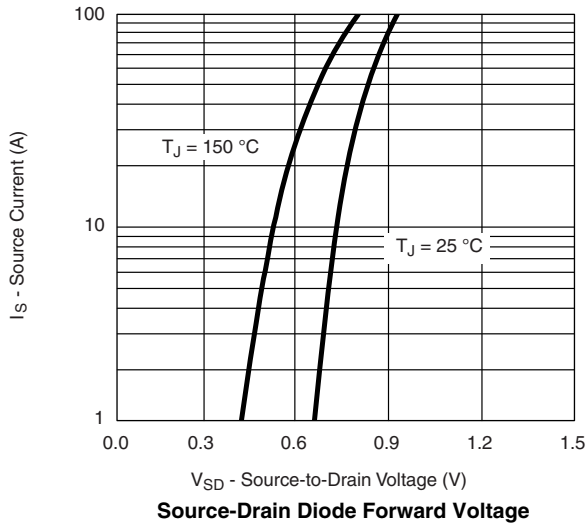
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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

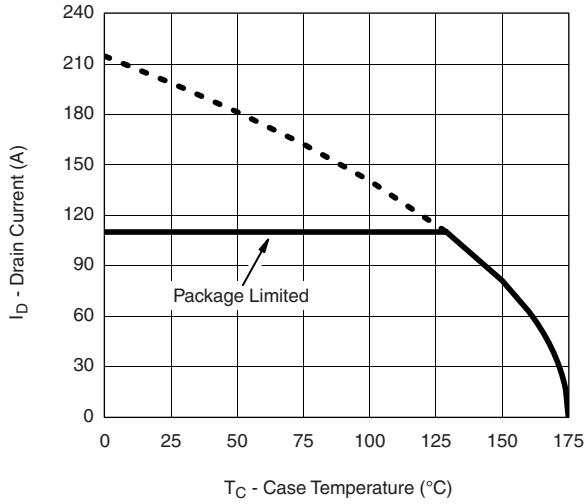


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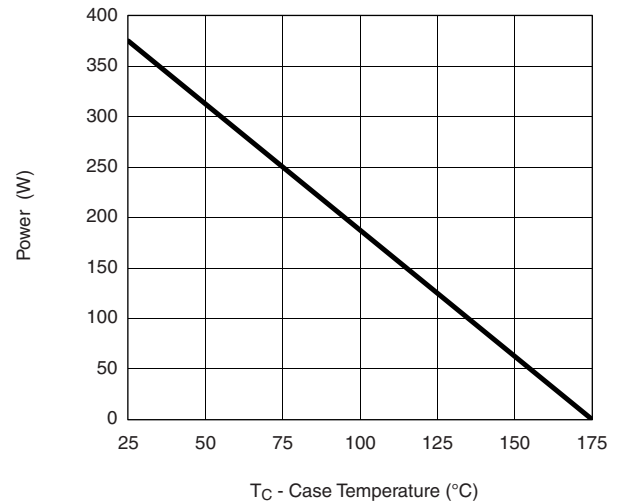


\* $V_{GS} >$  minimum  $V_{GS}$  at which  $r_{DS(on)}$  is specified

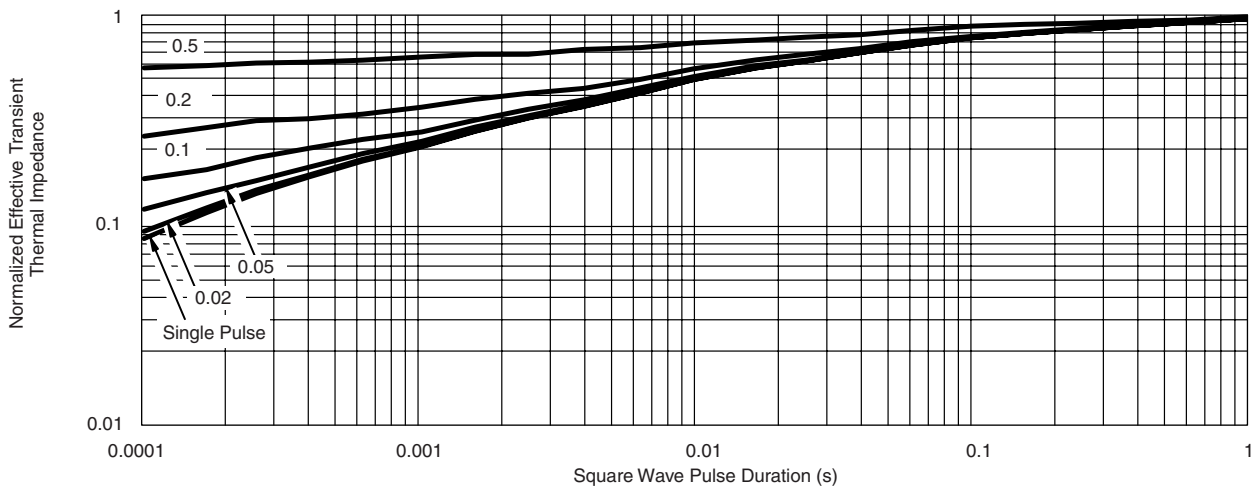
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



**Max. Avalanche and Drain Current vs. Case Temperature\***



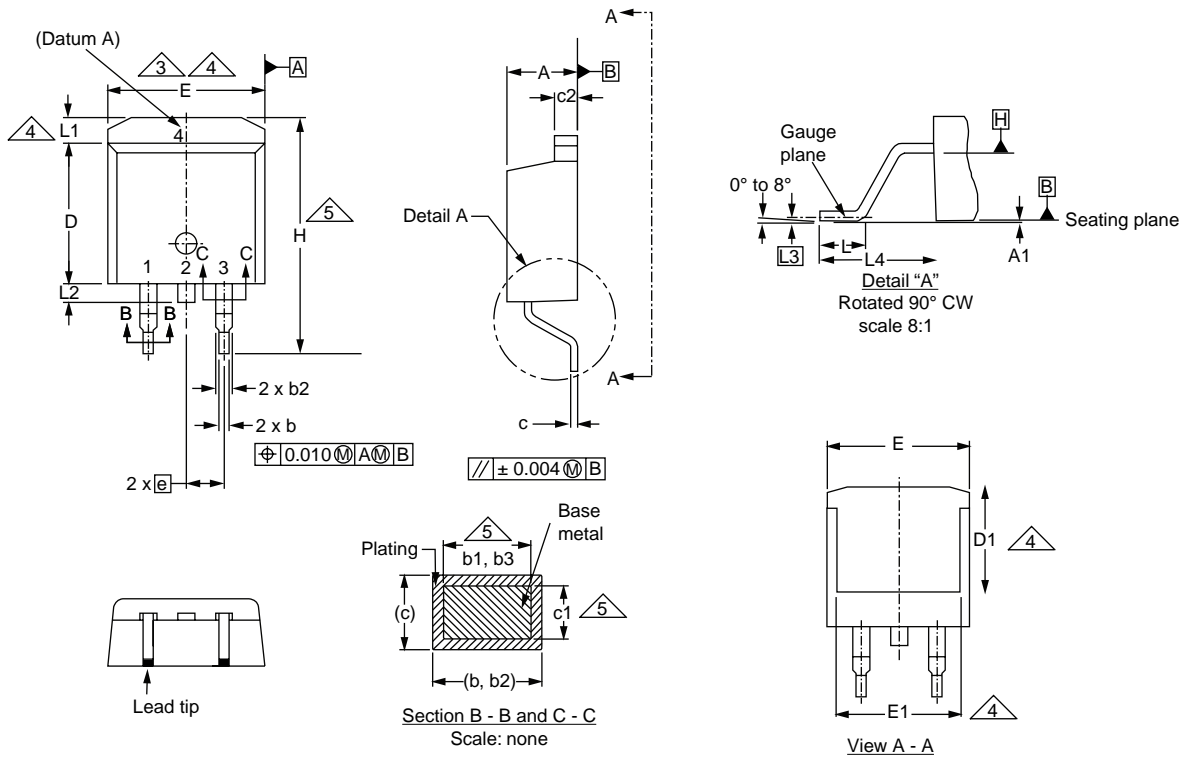
**Power Derating, Junction-to-Case**



**Normalized Thermal Transient Impedance, Junction-to-Case**

\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 175\text{ °C}$ , using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

**TO-263AB**



| 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.

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