

# IRF540NSTRPBF-VB Datasheet

## N-Channel 100-V (D-S) MOSFET

### PRODUCT SUMMARY

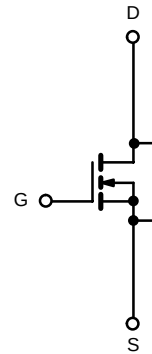
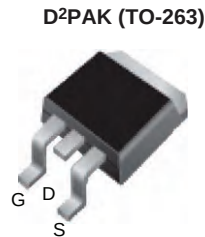
| $V_{(BR)DSS}$ (V) | $r_{DS(on)}$ ( $\Omega$ ) | $I_D$ (A) |
|-------------------|---------------------------|-----------|
| 100               | 0.030 at $V_{GS} = 10$ V  | 45        |
|                   | 0.035 at $V_{GS} = 4.5$ V | 40        |

### FEATURES

- Trench Power MOSFETS
- 175 °C Junction Temperature
- Low Thermal Resistance Package



Available  
**RoHS\***  
 COMPLIANT



N-Channel MOSFET

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

| Parameter                                        | Symbol         | Limit            | Unit |
|--------------------------------------------------|----------------|------------------|------|
| Drain-Source Voltage                             | $V_{DS}$       | 100              | V    |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$         |      |
| Continuous Drain Current ( $T_J = 175$ °C)       | $I_D$          | 45               | A    |
|                                                  |                | 30               |      |
| Pulsed Drain Current                             | $I_{DM}$       | 135              |      |
| Avalanche Current                                | $I_{AR}$       | 35               |      |
| Repetitive Avalanche Energy <sup>a</sup>         | $E_{AR}$       | 61               | mJ   |
| Maximum Power Dissipation <sup>a</sup>           | $P_D$          | 127 <sup>b</sup> | W    |
|                                                  |                | 3.75             |      |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$ | - 55 to 175      | °C   |

### THERMAL RESISTANCE RATINGS

| Parameter                | Symbol     | Limit | Unit |
|--------------------------|------------|-------|------|
| Junction-to-Ambient      | $R_{thJA}$ | 40    | °C/W |
| Junction-to-Case (Drain) | $R_{thJC}$ | 1.4   |      |

Notes:

a. Duty cycle  $\leq 1$  %.

b. See SOA curve for voltage derating.

c. When Mounted on 1" square PCB (FR-4 material).

\* Pb containing terminations are not RoHS compliant, exemptions may apply.

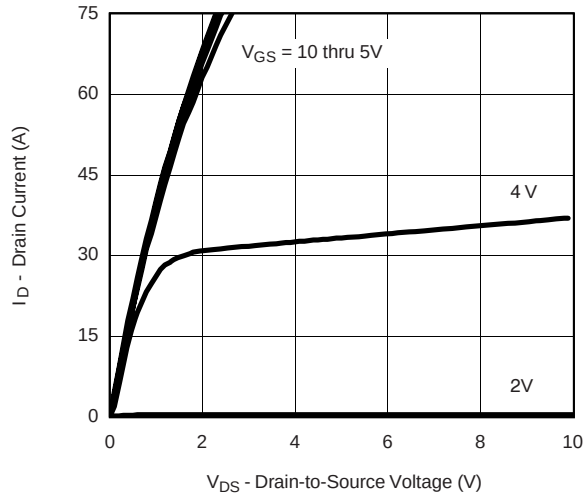
| SPECIFICATIONS $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted          |               |                                                                                                                                      |      |       |           |               |
|-------------------------------------------------------------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------|------|-------|-----------|---------------|
| Parameter                                                                           | Symbol        | Test Conditions                                                                                                                      | Min. | Typ.  | Max.      | Unit          |
| Static                                                                              |               |                                                                                                                                      |      |       |           |               |
| Drain-Source Breakdown Voltage                                                      | $V_{(BR)DSS}$ | $V_{SS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$                                                                               | 100  |       |           | V             |
| Gate-Threshold Voltage                                                              | $V_{GS(th)}$  | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$                                                                                   | 1    |       | 3         |               |
| Gate-Body Leakage                                                                   | $I_{GSS}$     | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$                                                                                   |      |       | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current                                                     | $I_{DSS}$     | $V_{DS} = 80\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                       |      |       | 1         | $\mu\text{A}$ |
|                                                                                     |               | $V_{DS} = 80\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$                                                 |      |       | 50        |               |
|                                                                                     |               | $V_{DS} = 80\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 175\text{ }^{\circ}\text{C}$                                                 |      |       | 250       |               |
| On-State Drain Current <sup>a</sup>                                                 | $I_{D(on)}$   | $V_{DS} \geq 5\text{ V}$ , $V_{GS} = 10\text{ V}$                                                                                    | 75   |       |           | A             |
| Drain-Source On-State Resistance <sup>a</sup>                                       | $r_{DS(on)}$  | $V_{GS} = 10\text{ V}$ , $I_D = 5\text{ A}$                                                                                          |      | 0.030 |           | $\Omega$      |
|                                                                                     |               | $V_{GS} = 4.5\text{ V}$ , $I_D = 3\text{ A}$                                                                                         |      | 0.035 |           |               |
|                                                                                     |               | $V_{GS} = 10\text{ V}$ , $I_D = 5\text{ A}$ , $T_J = 125\text{ }^{\circ}\text{C}$                                                    |      | 0.050 |           |               |
|                                                                                     |               | $V_{GS} = 10\text{ V}$ , $I_D = 3\text{ A}$ , $T_J = 175\text{ }^{\circ}\text{C}$                                                    |      | 0.062 |           |               |
| Forward Transconductance <sup>a</sup>                                               | $g_{fs}$      | $V_{DS} = 15\text{ V}$ , $I_D = 15\text{ A}$                                                                                         | 10   |       |           | S             |
| Dynamic <sup>b</sup>                                                                |               |                                                                                                                                      |      |       |           |               |
| Input Capacitance                                                                   | $C_{iss}$     | $V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$                                                                  |      | 3100  |           | pF            |
| Output Capacitance                                                                  | $C_{oss}$     |                                                                                                                                      |      | 410   |           |               |
| Reverse Transfer Capacitance                                                        | $C_{rss}$     |                                                                                                                                      |      | 150   |           |               |
| Total Gate Charge <sup>c</sup>                                                      | $Q_g$         | $V_{DS} = 50\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 40\text{ A}$                                                                |      | 35    | 60        | nC            |
| Gate-Source Charge <sup>c</sup>                                                     | $Q_{gs}$      |                                                                                                                                      |      | 11    |           |               |
| Gate-Drain Charge <sup>c</sup>                                                      | $Q_{gd}$      |                                                                                                                                      |      | 9     |           |               |
| Gate Resistance                                                                     | $R_G$         |                                                                                                                                      |      | 1.7   |           | $\Omega$      |
| Turn-On Delay Time <sup>c</sup>                                                     | $t_{d(on)}$   | $V_{DD} = 50\text{ V}$ , $R_L = 1.25\text{ }\Omega$<br>$I_D \cong 40\text{ A}$ , $V_{GEN} = 10\text{ V}$ , $R_G = 2.5\text{ }\Omega$ |      | 11    | 20        | ns            |
| Rise Time <sup>c</sup>                                                              | $t_r$         |                                                                                                                                      |      | 12    | 20        |               |
| Turn-Off Delay Time <sup>c</sup>                                                    | $t_{d(off)}$  |                                                                                                                                      |      | 30    | 45        |               |
| Fall Time <sup>c</sup>                                                              | $t_f$         |                                                                                                                                      |      | 12    | 20        |               |
| Source-Drain Diode Ratings and Characteristics $T_C = 25\text{ }^{\circ}\text{C}^b$ |               |                                                                                                                                      |      |       |           |               |
| Continuous Current                                                                  | $I_S$         |                                                                                                                                      |      |       | 40        | A             |
| Pulsed Current                                                                      | $I_{SM}$      |                                                                                                                                      |      |       | 120       |               |
| Forward Voltage <sup>a</sup>                                                        | $V_{SD}$      | $I_F = 30\text{ A}$ , $V_{GS} = 0\text{ V}$                                                                                          |      | 1.0   | 1.5       | V             |
| Reverse Recovery Time                                                               | $t_{rr}$      | $I_F = 30\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$                                                                             |      | 60    | 100       | ns            |
| Peak Reverse Recovery Current                                                       | $I_{RM(REC)}$ |                                                                                                                                      |      | 5     | 8         | A             |
| Reverse Recovery Charge                                                             | $Q_{rr}$      |                                                                                                                                      |      | 0.15  | 0.4       | $\mu\text{C}$ |

Notes:

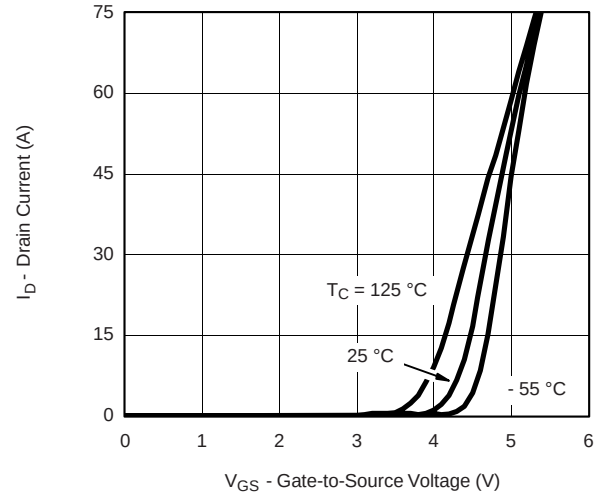
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$   
 b. Guaranteed by design, not subject to production testing.  
 c. Independent of operating temperature.

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.

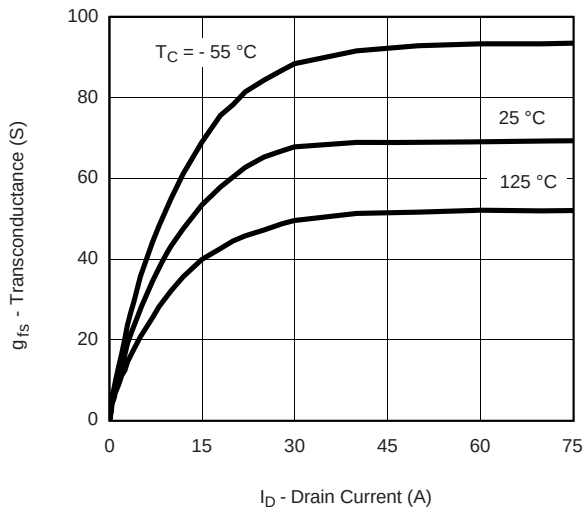
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



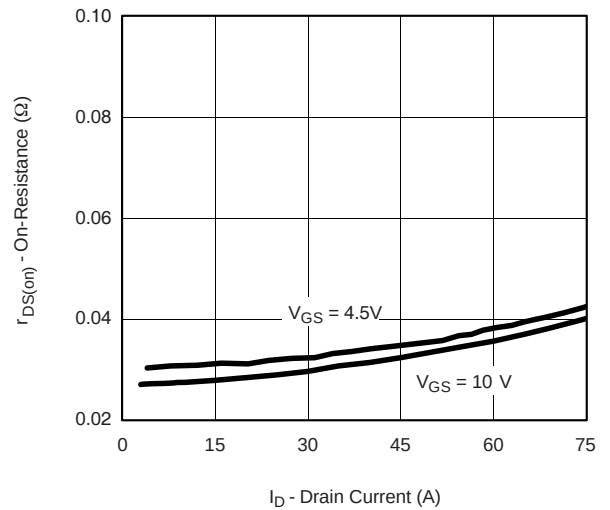
**Output Characteristics**



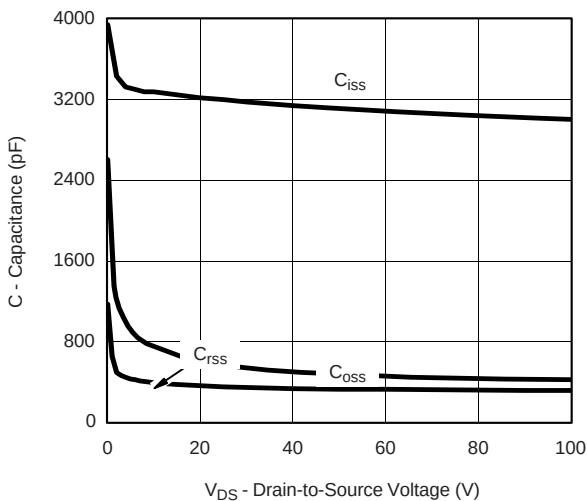
**Transfer Characteristics**



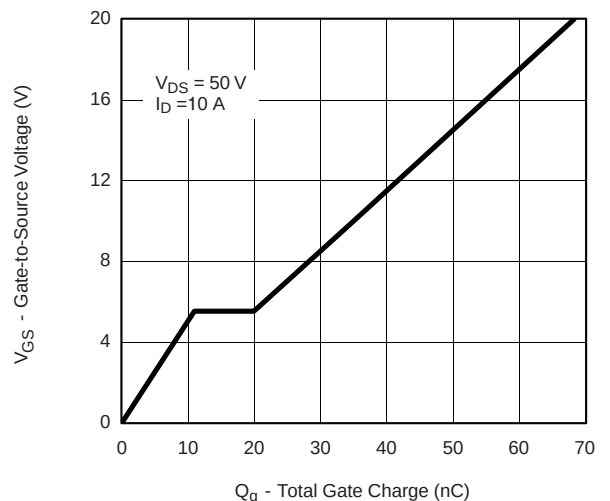
**Transconductance**



**On-Resistance vs. Drain Current**

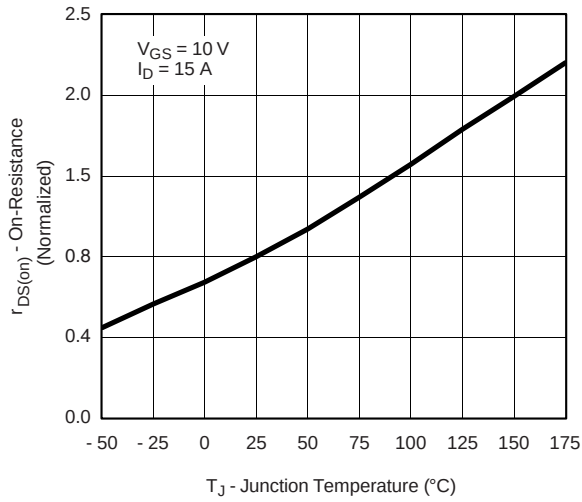


**Capacitance**

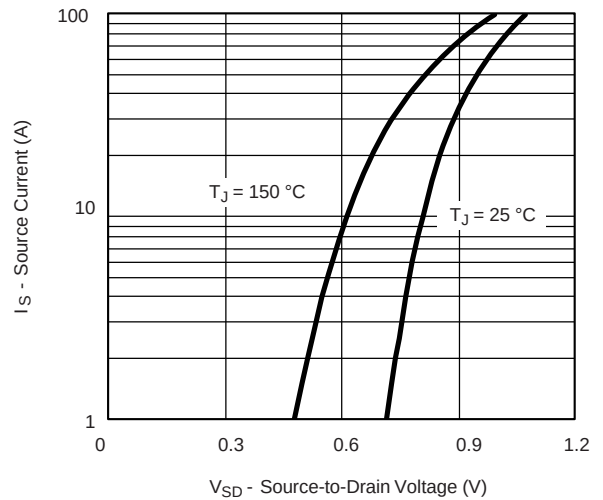


**Gate Charge**

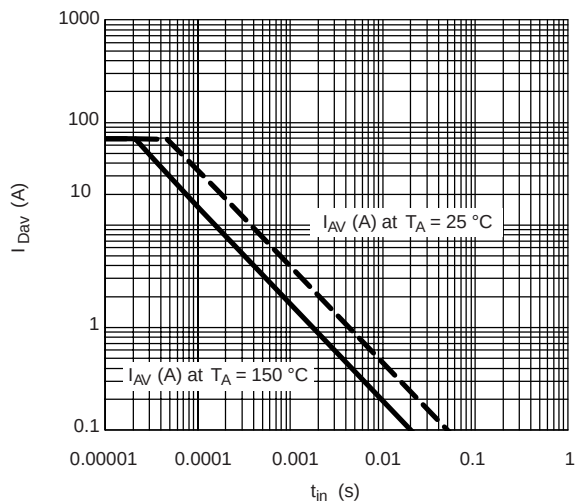
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



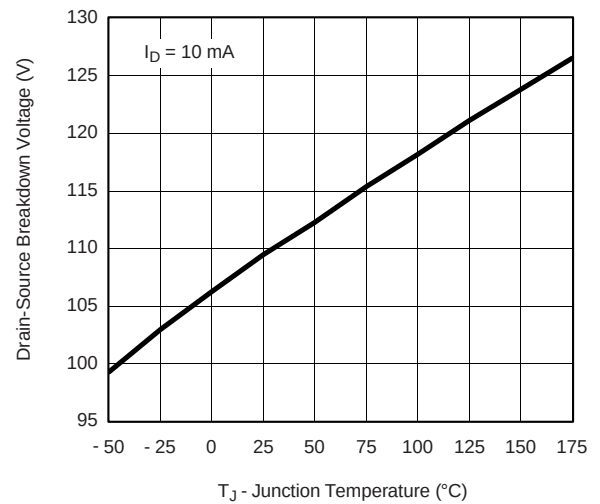
**On-Resistance vs. Junction Temperature**



**Source-Drain Diode Forward Voltage**

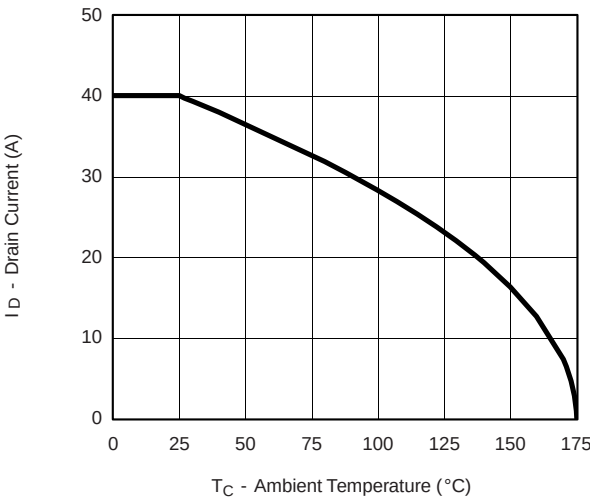


**Avalanche Current vs. Time**

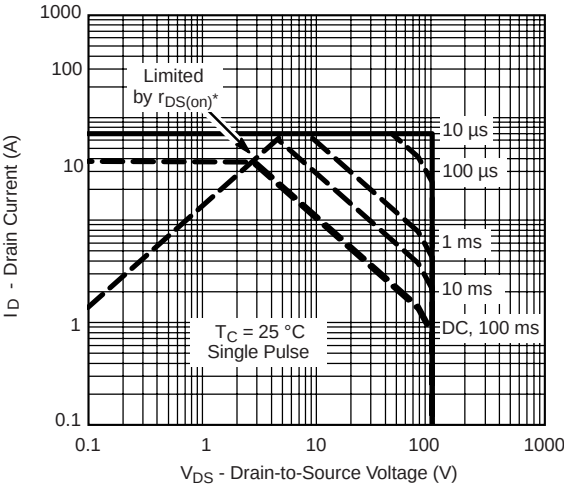


**Drain-Source Breakdown Voltage vs. Junction Temperature**

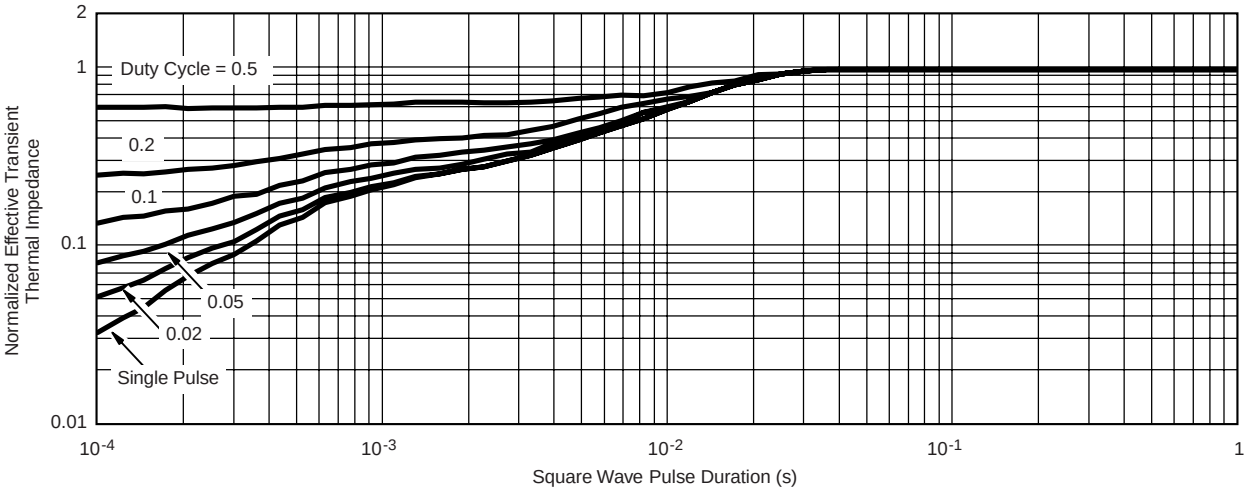
**THERMAL RATINGS**



**Maximum Avalanche and Drain Current  
vs. Case Temperature**

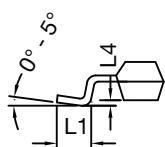
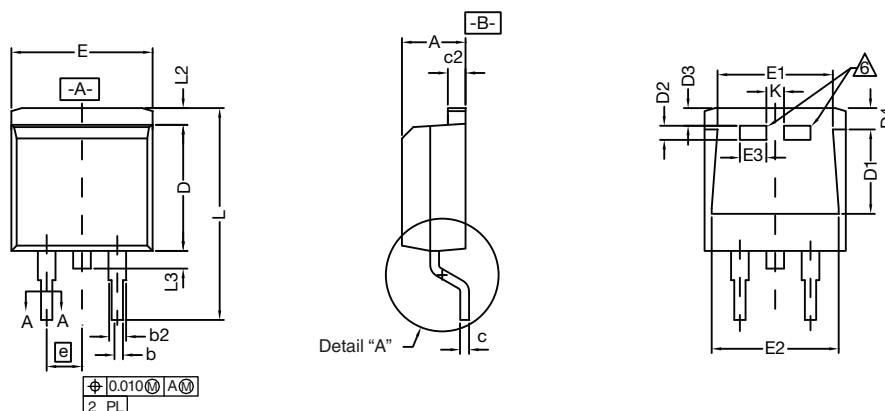


**Safe Operating Area**  
\*  $V_{GS} > \text{minimum } V_{GS} \text{ at which } r_{DS(on)} \text{ is specified}$

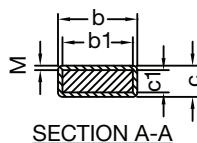


**Normalized Thermal Transient Impedance, Junction-to-Case**

## TO-263 (D<sup>2</sup>PAK): 3-LEAD



DETAIL A (ROTATED 90°)



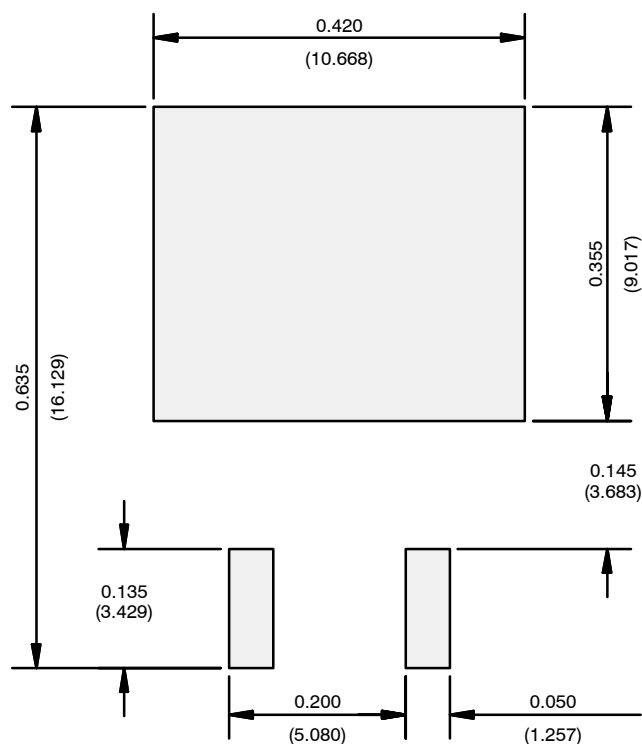
SECTION A-A

### Notes

1. Plane B includes maximum features of heat sink tab and plastic.
2. No more than 25 % of L1 can fall above seating plane by max. 8 mils.
3. Pin-to-pin coplanarity max. 4 mils.
4. \*: Thin lead is for SUB, SYB.  
Thick lead is for SUM, SYM, SQM.
5. Use inches as the primary measurement.
6. This feature is for thick lead.

| DIM.                            |            | INCHES    |       | MILLIMETERS |        |
|---------------------------------|------------|-----------|-------|-------------|--------|
|                                 |            | MIN.      | MAX.  | MIN.        | MAX.   |
| A                               |            | 0.160     | 0.190 | 4.064       | 4.826  |
| b                               |            | 0.020     | 0.039 | 0.508       | 0.990  |
| b1                              |            | 0.020     | 0.035 | 0.508       | 0.889  |
| b2                              |            | 0.045     | 0.055 | 1.143       | 1.397  |
| c*                              | Thin lead  | 0.013     | 0.018 | 0.330       | 0.457  |
|                                 | Thick lead | 0.023     | 0.028 | 0.584       | 0.711  |
| c1                              | Thin lead  | 0.013     | 0.017 | 0.330       | 0.431  |
|                                 | Thick lead | 0.023     | 0.027 | 0.584       | 0.685  |
| c2                              |            | 0.045     | 0.055 | 1.143       | 1.397  |
| D                               |            | 0.340     | 0.380 | 8.636       | 9.652  |
| D1                              |            | 0.220     | 0.240 | 5.588       | 6.096  |
| D2                              |            | 0.038     | 0.042 | 0.965       | 1.067  |
| D3                              |            | 0.045     | 0.055 | 1.143       | 1.397  |
| D4                              |            | 0.044     | 0.052 | 1.118       | 1.321  |
| E                               |            | 0.380     | 0.410 | 9.652       | 10.414 |
| E1                              |            | 0.245     | -     | 6.223       | -      |
| E2                              |            | 0.355     | 0.375 | 9.017       | 9.525  |
| E3                              |            | 0.072     | 0.078 | 1.829       | 1.981  |
| e                               |            | 0.100 BSC |       | 2.54 BSC    |        |
| K                               |            | 0.045     | 0.055 | 1.143       | 1.397  |
| L                               |            | 0.575     | 0.625 | 14.605      | 15.875 |
| L1                              |            | 0.090     | 0.110 | 2.286       | 2.794  |
| L2                              |            | 0.040     | 0.055 | 1.016       | 1.397  |
| L3                              |            | 0.050     | 0.070 | 1.270       | 1.778  |
| L4                              |            | 0.010 BSC |       | 0.254 BSC   |        |
| M                               |            | -         | 0.002 | -           | 0.050  |
| ECN: T13-0707-Rev. K, 30-Sep-13 |            |           |       |             |        |
| DWG: 5843                       |            |           |       |             |        |

**RECOMMENDED MINIMUM PADS FOR D<sup>2</sup>PAK: 3-Lead**



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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