

## N-Channel 20 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.) |
| 20                  | 0.080 at V <sub>GS</sub> = 4.5 V | 2.8                             | 3.2 nC                |
|                     | 0.090 at V <sub>GS</sub> = 2.5 V | 2.6                             |                       |
|                     | 0.105 at V <sub>GS</sub> = 1.8 V | 2.4                             |                       |
|                     | 0.150 at V <sub>GS</sub> = 1.5 V | 2.0                             |                       |

### FEATURES

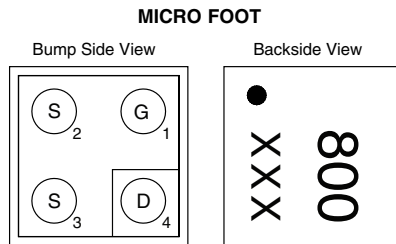
- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET<sup>®</sup> Power MOSFET
- Ultra Small 0.8 mm x 0.8 mm Outline
- Ultra Thin 0.357 mm Height
- Typical ESD Protection 1500 V
- Compliant to RoHS Directive 2002/95/EC



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

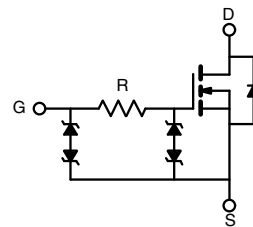
### APPLICATIONS

- Portable Devices such as Cell Phones, Smart Phones and MP3 Players
  - Load Switch
  - Small Signal Switch



Device Marking: 800  
xxx = Date/Lot Traceability Code

Ordering Information: Si8800EDB-T2-E1 (Lead (Pb)-free and Halogen-free)



| ABSOLUTE MAXIMUM RATINGS (T <sub>A</sub> = 25 °C, unless otherwise noted) |                                   |                        |                  |   |
|---|-----------------------------------|------------------------|------------------|---|
| Parameter   | Symbol                            | Limit                  | Unit             |   |
| Drain-Source Voltage  | V <sub>DS</sub>                   | 20                     | V                |   |
| Gate-Source Voltage   | V <sub>GS</sub>                   | ± 8                    |                  |   |
| Continuous Drain Current (T <sub>J</sub> = 150 °C)                        | I <sub>D</sub>                    | T <sub>A</sub> = 25 °C | 2.8 <sup>a</sup> | A |
|   |                                   | T <sub>A</sub> = 70 °C | 2.2 <sup>a</sup> |   |
|   |                                   | T <sub>A</sub> = 25 °C | 2 <sup>b</sup>   |   |
|   |                                   | T <sub>A</sub> = 70 °C | 1.6 <sup>b</sup> |   |
| Pulsed Drain Current  | I <sub>DM</sub>                   | 15                     |                  |   |
| Continuous Source-Drain Diode Current                                     | I <sub>S</sub>                    | T <sub>A</sub> = 25 °C | 0.7 <sup>a</sup> |   |
|   |                                   | T <sub>A</sub> = 25 °C | 0.4 <sup>b</sup> |   |
| Maximum Power Dissipation   | P <sub>D</sub>                    | T <sub>A</sub> = 25 °C | 0.9 <sup>a</sup> | W |
|   |                                   | T <sub>A</sub> = 70 °C | 0.6 <sup>a</sup> |   |
|   |                                   | T <sub>A</sub> = 25 °C | 0.5 <sup>b</sup> |   |
|   |                                   | T <sub>A</sub> = 70 °C | 0.3 <sup>b</sup> |   |
| Operating Junction and Storage Temperature Range                          | T <sub>J</sub> , T <sub>stg</sub> | - 55 to 150            | °C               |   |
| Soldering Recommendations (Peak Temperature) <sup>c</sup>                 |                                   | 260                    |                  |   |

| THERMAL RESISTANCE RATINGS                  |                   |         |         |      |
|---|-------------------|---------|---------|------|
| Parameter                                   | Symbol            | Typical | Maximum | Unit |
| Maximum Junction-to-Ambient <sup>a, d</sup> | R <sub>thJA</sub> | 105     | 135     | °C/W |
| Maximum Junction-to-Ambient <sup>b, e</sup> |                   | 200     | 260     |      |

Notes:

- Surface mounted on 1" x 1" FR4 board with full copper, t = 5 s.
- Surface mounted on 1" x 1" FR4 board with minimum copper, t = 5 s.
- Refer to IPC/JEDEC (J-STD-020C), no manual or hand soldering.
- Maximum under steady state conditions is 185 °C/W.
- Maximum under steady state conditions is 330 °C/W.

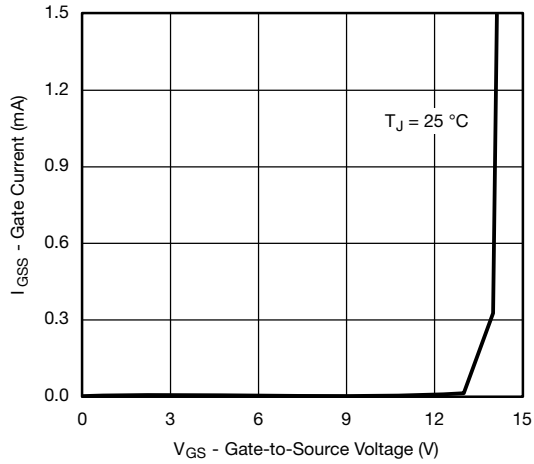
| SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                         |   |      |       |           |                      |
|---|-------------------------|---|------|-------|-----------|----------------------|
| Parameter   | Symbol                  | Test Conditions   | Min. | Typ.  | Max.      | Unit                 |
| <b>Static</b>   |                         |   |      |       |           |                      |
| Drain-Source Breakdown Voltage  | $V_{DS}$                | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$   | 20   |       |           | V                    |
| $V_{DS}$ Temperature Coefficient  | $\Delta V_{DS}/T_J$     | $I_D = 250\text{ }\mu\text{A}$  |      | 18    |           | mV/ $^\circ\text{C}$ |
| $V_{GS(th)}$ Temperature Coefficient  | $\Delta V_{GS(th)}/T_J$ |   |      | - 2.3 |           |                      |
| Gate-Source Threshold Voltage   | $V_{GS(th)}$            | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$   | 0.4  |       | 1         | V                    |
| Gate-Source Leakage   | $I_{GSS}$               | $V_{DS} = 0\text{ V}, V_{GS} = \pm 4.5\text{ V}$  |      |       | $\pm 0.5$ | $\mu\text{A}$        |
|   |                         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$  |      |       | $\pm 6$   |                      |
| Zero Gate Voltage Drain Current   | $I_{DSS}$               | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$   |      |       | 1         |                      |
|   |                         | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$   |      |       | 10        |                      |
| On-State Drain Current <sup>a</sup>   | $I_{D(on)}$             | $V_{DS} \geq 5\text{ V}, V_{GS} = 4.5\text{ V}$   | 10   |       |           | A                    |
| Drain-Source On-State Resistance <sup>a</sup>                               | $R_{DS(on)}$            | $V_{GS} = 4.5\text{ V}, I_D = 1\text{ A}$   |      | 0.066 | 0.080     | $\Omega$             |
|   |                         | $V_{GS} = 2.5\text{ V}, I_D = 1\text{ A}$   |      | 0.072 | 0.090     |                      |
|   |                         | $V_{GS} = 1.8\text{ V}, I_D = 1\text{ A}$   |      | 0.082 | 0.105     |                      |
|   |                         | $V_{GS} = 1.5\text{ V}, I_D = 0.5\text{ A}$   |      | 0.095 | 0.150     |                      |
| Forward Transconductance <sup>a</sup>                                       | $g_{fs}$                | $V_{DS} = 10\text{ V}, I_D = 1\text{ A}$  |      | 10    |           | S                    |
| <b>Dynamic<sup>b</sup></b>  |                         |   |      |       |           |                      |
| Total Gate Charge   | $Q_g$                   | $V_{DS} = 10\text{ V}, V_{GS} = 8\text{ V}, I_D = 1\text{ A}$   |      | 5.5   | 8.3       | nC                   |
|   |                         | $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 1\text{ A}$   |      | 3.2   | 5         |                      |
| Gate-Source Charge  | $Q_{gs}$                |   |      | 0.42  |           |                      |
| Gate-Drain Charge   | $Q_{gd}$                |   |      | 0.5   |           |                      |
| Gate Resistance   | $R_g$                   | $f = 1\text{ MHz}$  |      | 1     |           | k $\Omega$           |
| Turn-On Delay Time  | $t_{d(on)}$             | $V_{DD} = 10\text{ V}, R_L = 10\text{ }\Omega$<br>$I_D \cong 1\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\text{ }\Omega$ |      | 65    | 130       | ns                   |
| Rise Time   | $t_r$                   |   |      | 85    | 170       |                      |
| Turn-Off Delay Time   | $t_{d(off)}$            |   |      | 900   | 1800      |                      |
| Fall Time   | $t_f$                   |   |      | 350   | 700       |                      |
| Turn-On Delay Time  | $t_{d(on)}$             | $V_{DD} = 10\text{ V}, R_L = 10\text{ }\Omega$<br>$I_D \cong 1\text{ A}, V_{GEN} = 8\text{ V}, R_g = 1\text{ }\Omega$   |      | 25    | 50        |                      |
| Rise Time   | $t_r$                   |   |      | 40    | 80        |                      |
| Turn-Off Delay Time   | $t_{d(off)}$            |   |      | 1100  | 2200      |                      |
| Fall Time   | $t_f$                   |   |      | 350   | 700       |                      |
| <b>Drain-Source Body Diode Characteristics</b>                              |                         |   |      |       |           |                      |
| Continuous Source-Drain Diode Current                                       | $I_S$                   | $T_C = 25\text{ }^\circ\text{C}$  |      |       | 0.7       | A                    |
| Pulse Diode Forward Current   | $I_{SM}$                |   |      |       | 15        |                      |
| Body Diode Voltage  | $V_{SD}$                | $I_S = 1\text{ A}, V_{GS} = 0\text{ V}$   |      | 1     | 1.5       | V                    |
| Body Diode Reverse Recovery Time  | $t_{rr}$                | $I_F = 1\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$                                    |      | 13    | 25        | ns                   |
| Body Diode Reverse Recovery Charge  | $Q_{rr}$                |   |      | 5     | 10        | nC                   |
| Reverse Recovery Fall Time  | $t_a$                   |   |      | 8     |           | ns                   |
| Reverse Recovery Rise Time  | $t_b$                   |   |      | 5     |           |                      |

## Notes:

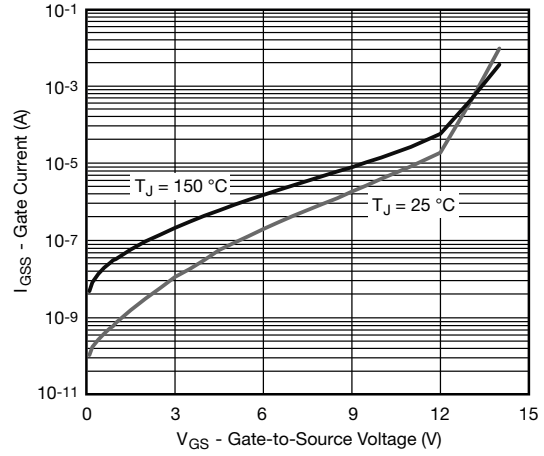
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$   
b. Guaranteed by design, not subject to production testing.

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.

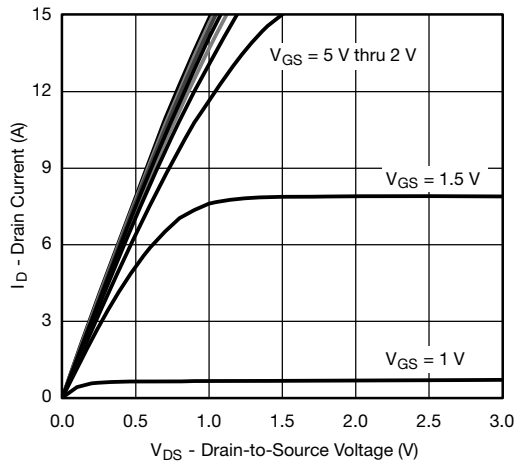
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



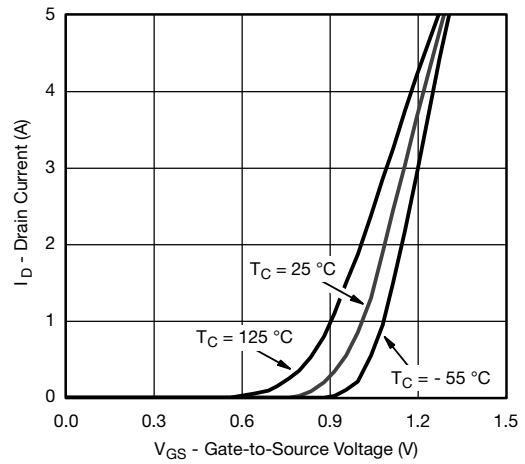
**Gate Current vs. Gate-Source Voltage**



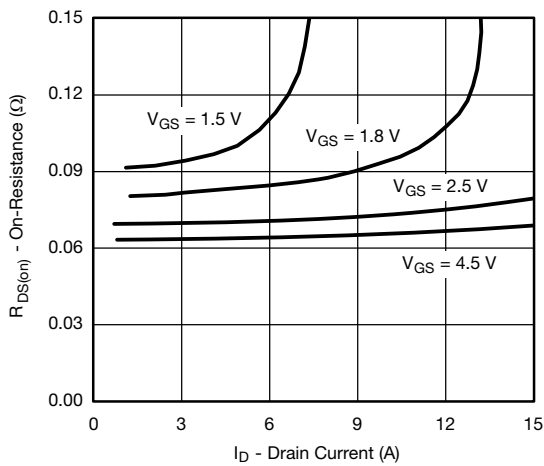
**Gate Current vs. Gate-Source Voltage**



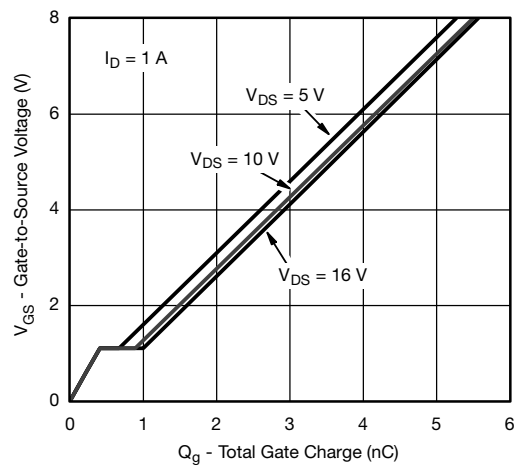
**Output Characteristics**



**Transfer Characteristics**

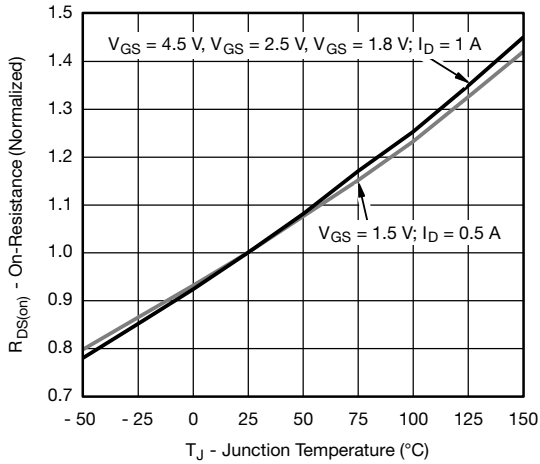


**On-Resistance vs. Drain Current**

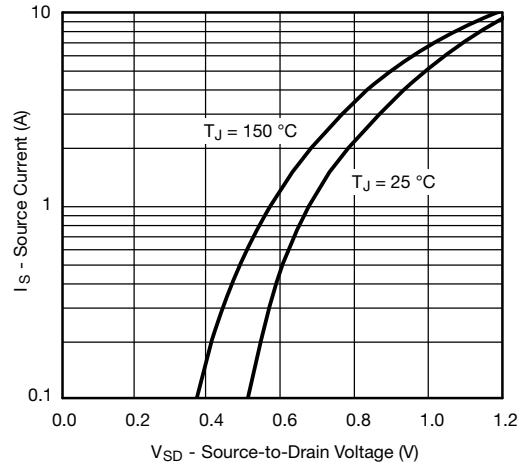


**Gate Charge**

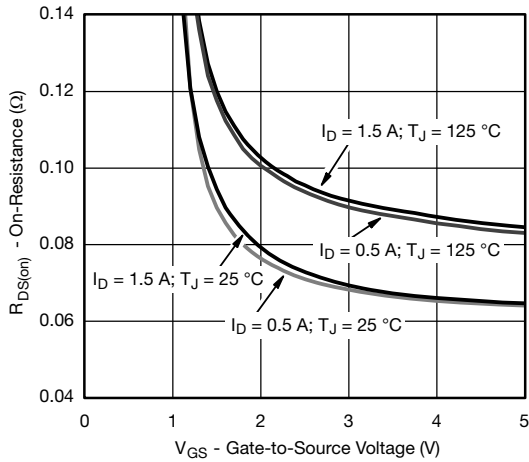
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



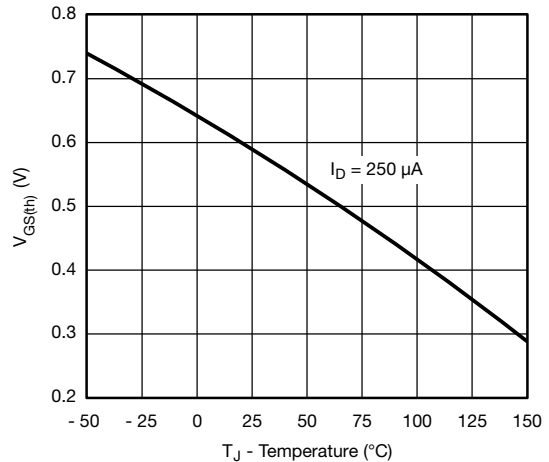
**On-Resistance vs. Junction Temperature**



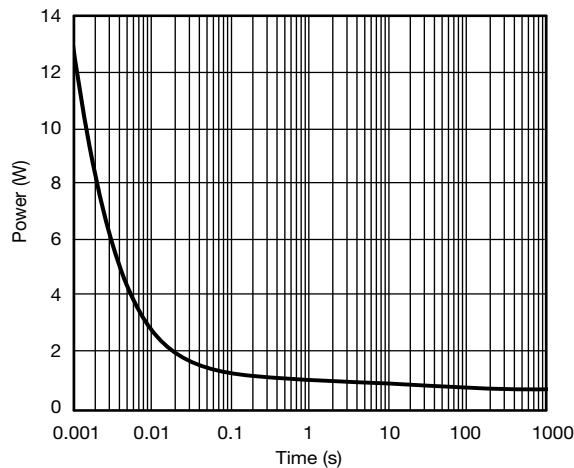
**Source-Drain Diode Forward Voltage**



**On-Resistance vs. Gate-to-Source Voltage**

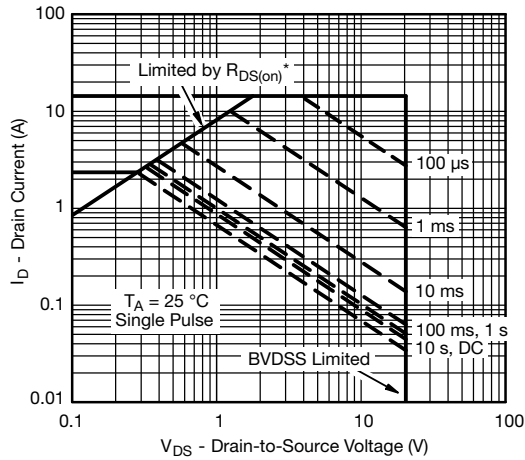


**Threshold Voltage**

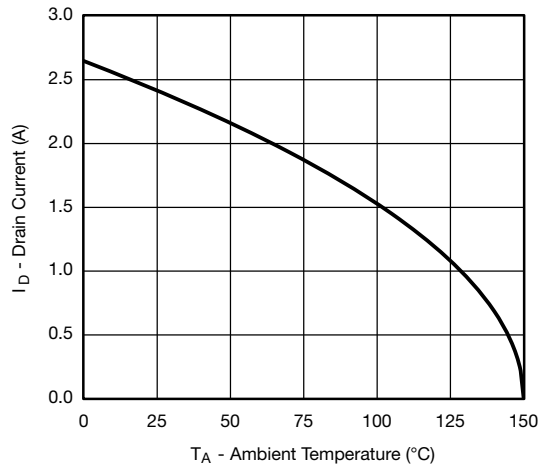


**Single Pulse Power (Junction-to-Ambient)**

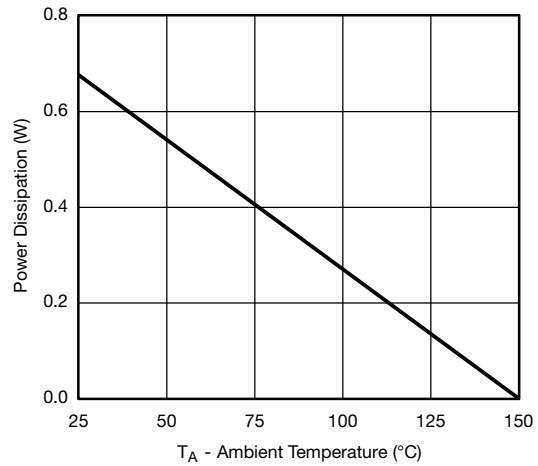
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified  
**Safe Operating Area, Junction-to-Ambient**



**Current Derating\***

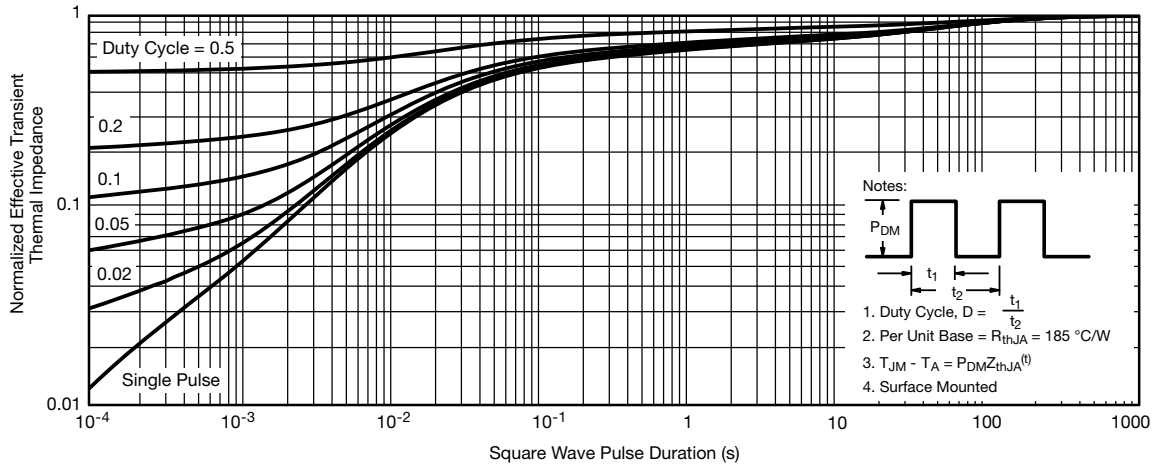


**Power Derating**

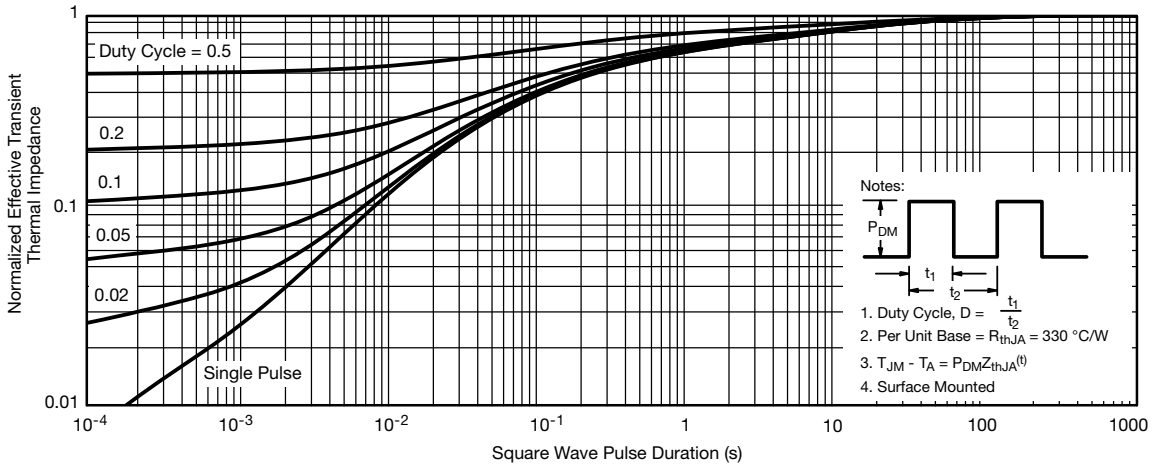
Note:  
When mounted on 1" x 1" FR4 with full copper.

\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-ambient 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.

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



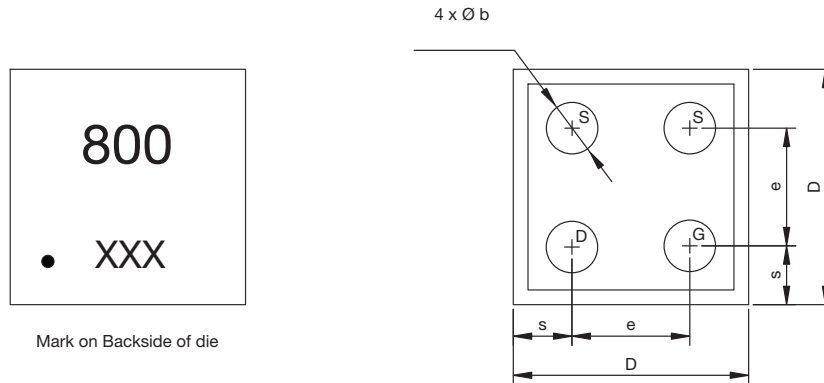
**Normalized Thermal Transient Impedance, Junction-to-Ambient (On 1" x 1" FR4 board with maximum copper)**



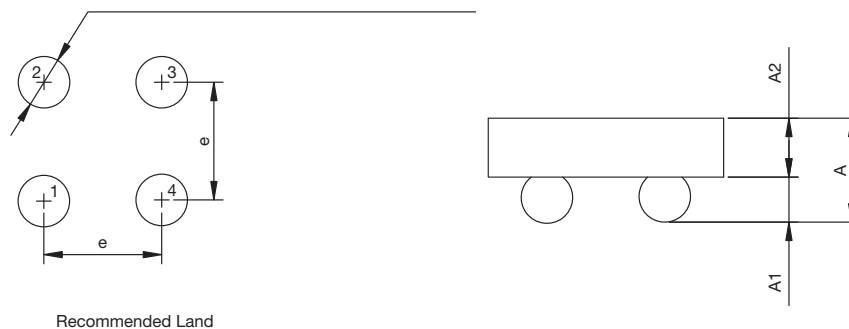
**Normalized Thermal Transient Impedance, Junction-to-Ambient (on 1" x 1" FR4 board with minimum copper)**

**PACKAGE OUTLINE**

**MICRO FOOT 0.8 mm x 0.8 mm: 4-BUMP (2 mm x 2 mm, 0.4 mm PITCH)**



4 x  $\varnothing$  0.205 to 0.225 Note 4  
Solder Mask ~  $\varnothing$  0.215



Notes (Unless otherwise specified):

1. All dimensions are in millimeters.
2. Four (4) solder bumps are lead (Pb)-free 95.5Sn/3.8Ag/0.7Cu with diameter  $\varnothing$  0.165 mm to  $\varnothing$  0.185 mm.
3. Backside surface is coated with a Ti/Ni/Ag layer.
4. Non-solder mask defined copper landing pad.
5. • is location of pin 1.

| Dim.                 | Millimeters <sup>a</sup> |       |       | Inches |        |        |
|----------------------|--------------------------|-------|-------|--------|--------|--------|
|                      | Min.                     | Nom.  | Max.  | Min.   | Nom.   | Max.   |
| <b>A</b>             | 0.314                    | 0.357 | 0.400 | 0.0124 | 0.0141 | 0.0157 |
| <b>A<sub>1</sub></b> | 0.127                    | 0.157 | 0.187 | 0.0050 | 0.0062 | 0.0074 |
| <b>A<sub>2</sub></b> | 0.187                    | 0.200 | 0.213 | 0.0074 | 0.0079 | 0.0084 |
| <b>b</b>             | 0.165                    | 0.175 | 0.185 | 0.0064 | 0.0068 | 0.0072 |
| <b>e</b>             |                          | 0.400 |       |        | 0.0157 |        |
| <b>s</b>             | 0.180                    | 0.200 | 0.220 | 0.0070 | 0.0078 | 0.0086 |
| <b>D</b>             | 0.760                    | 0.800 | 0.840 | 0.0299 | 0.0314 | 0.0330 |

Notes:

- a. Use millimeters as the primary measurement.

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