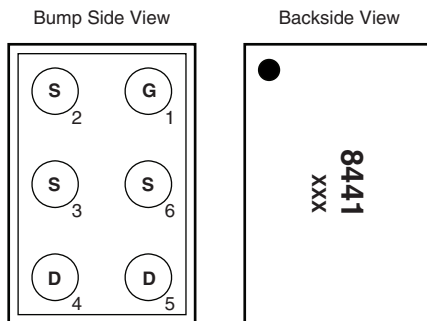


## P-Channel 20-V (D-S) MOSFET

### PRODUCT SUMMARY

| V <sub>DS</sub> (V) | R <sub>DS(on)</sub> (Ω)            | I <sub>D</sub> (A) <sup>e</sup> | Q <sub>g</sub> (Typ.) |
|---------------------|------------------------------------|---------------------------------|-----------------------|
| - 20                | 0.080 at V <sub>GS</sub> = - 4.5 V | - 10.5                          | 7.7 nC                |
|                     | 0.102 at V <sub>GS</sub> = - 2.5 V | - 9.3                           |                       |
|                     | 0.128 at V <sub>GS</sub> = - 1.8 V | - 3.5                           |                       |
|                     | 0.198 at V <sub>GS</sub> = - 1.5 V | - 2.5                           |                       |
|                     | 0.600 at V <sub>GS</sub> = - 1.2 V | - 0.5                           |                       |

### MICRO FOOT



Device Marking: 8441

xxx = Date/Lot Traceability Code

Ordering Information: Si8441DB-T2-E1 (Lead (Pb)-free)

### FEATURES

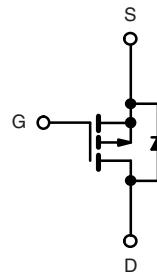
- TrenchFET<sup>®</sup> Power MOSFET

### APPLICATIONS

- Low Threshold Load Switch for Portable Devices
- Low Power Consumption
- Increased Battery Life



**RoHS**  
COMPLIANT



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>                   | - 20                   | V                     |
| Gate-Source Voltage                                | V <sub>GS</sub>                   | ± 5                    |                       |
| Continuous Drain Current (T <sub>J</sub> = 150 °C) | I <sub>D</sub>                    | T <sub>C</sub> = 25 °C | A                     |
|                                                    |                                   | T <sub>C</sub> = 70 °C |                       |
|                                                    |                                   | T <sub>A</sub> = 25 °C |                       |
|                                                    |                                   | T <sub>A</sub> = 70 °C |                       |
| Pulsed Drain Current                               | I <sub>DM</sub>                   | - 15                   | A                     |
| Continuous Source-Drain Diode Current              | I <sub>S</sub>                    | T <sub>C</sub> = 25 °C |                       |
|                                                    |                                   | T <sub>A</sub> = 25 °C | - 2.3 <sup>a, b</sup> |
| Maximum Power Dissipation                          | P <sub>D</sub>                    | T <sub>C</sub> = 25 °C | W                     |
|                                                    |                                   | T <sub>C</sub> = 70 °C |                       |
|                                                    |                                   | T <sub>A</sub> = 25 °C |                       |
|                                                    |                                   | T <sub>A</sub> = 70 °C |                       |
| Operating Junction and Storage Temperature Range   | T <sub>J</sub> , T <sub>stg</sub> | - 55 to 150            | °C                    |
| Package Reflow Conditions <sup>c</sup>             | IR/Convection                     | 260                    |                       |

Notes:

a. Surface Mounted on 1" x 1" FR4 board.

b. t = 10 s.

c. Refer to IPC/JEDEC (J-STD-020C), no manual or hand soldering.

d. In this document, any reference to case represents the body of the MICRO FOOT device and foot is the bump.

e. Based on T<sub>C</sub> = 25 °C.

**THERMAL RESISTANCE RATINGS**

| Parameter                                   | Symbol                  | Typical | Maximum | Unit |
|---------------------------------------------|-------------------------|---------|---------|------|
| Maximum Junction-to-Ambient <sup>a, b</sup> | $R_{thJA}$              | 37      | 45      | °C/W |
| Maximum Junction-to-Case (Drain)            | Steady State $R_{thJC}$ | 7       | 9.5     |      |

Notes:

a. Surface Mounted on 1" x 1" FR4 board.

b. Maximum under Steady State conditions is 85 °C/W.

c. Case is defined as top surface of the package.

**SPECIFICATIONS**  $T_J = 25\text{ °C}$ , 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              | $\Delta V_{DS}/T_J$     | $I_D = -250\text{ }\mu\text{A}$                                                                                            |       | -20   |           | mV/°C         |
| $V_{GS(th)}$ Temperature Coefficient          | $\Delta V_{GS(th)}/T_J$ |                                                                                                                            |       | 2.2   |           |               |
| Gate-Source Threshold Voltage                 | $V_{GS(th)}$            | $V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$                                                                           | -0.35 |       | -0.7      | V             |
| Gate-Source Leakage                           | $I_{GSS}$               | $V_{DS} = 0\text{ V}, V_{GS} = \pm 5\text{ V}$                                                                             |       |       | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current               | $I_{DSS}$               | $V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$                                                                               |       |       | -1        | $\mu\text{A}$ |
|                                               |                         | $V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, T_J = 70\text{ °C}$                                                           |       |       | -10       |               |
| On-State Drain Current <sup>a</sup>           | $I_{D(on)}$             | $V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$                                                                          | -5    |       |           | 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     | $\Omega$      |
|                                               |                         | $V_{GS} = -2.5\text{ V}, I_D = -1\text{ A}$                                                                                |       | 0.085 | 0.102     |               |
|                                               |                         | $V_{GS} = -1.8\text{ V}, I_D = -1\text{ A}$                                                                                |       | 0.105 | 0.128     |               |
|                                               |                         | $V_{GS} = -1.5\text{ V}, I_D = -1\text{ A}$                                                                                |       | 0.145 | 0.198     |               |
|                                               |                         | $V_{GS} = -1.2\text{ V}, I_D = -0.5\text{ A}$                                                                              |       | 0.200 | 0.600     |               |
| Forward Transconductance <sup>a</sup>         | $g_{fs}$                | $V_{DS} = -10\text{ V}, I_D = -1\text{ A}$                                                                                 |       | 7     |           | S             |
| <b>Dynamic<sup>b</sup></b>                    |                         |                                                                                                                            |       |       |           |               |
| Input Capacitance                             | $C_{iss}$               | $V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$                                                             |       | 600   |           | pF            |
| Output Capacitance                            | $C_{oss}$               |                                                                                                                            |       | 130   |           |               |
| Reverse Transfer Capacitance                  | $C_{rss}$               |                                                                                                                            |       | 70    |           |               |
| Total Gate Charge                             | $Q_g$                   | $V_{DS} = -10\text{ V}, V_{GS} = -5\text{ V}, I_D = -1\text{ A}$                                                           |       | 8.5   | 13        | nC            |
| Gate-Source Charge                            | $Q_{gs}$                | $V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = 1\text{ A}$                                                          |       | 7.7   | 12        |               |
| Gate-Drain Charge                             | $Q_{gd}$                |                                                                                                                            |       | 0.85  |           |               |
| Gate Resistance                               | $R_g$                   |                                                                                                                            |       | 1.6   |           |               |
| Gate Resistance                               | $R_g$                   | $V_{GS} = -0.1\text{ V}, f = 1\text{ MHz}$                                                                                 |       | 6.2   |           | $\Omega$      |
| Turn-On Delay Time                            | $t_{d(on)}$             | $V_{DD} = -10\text{ V}, R_L = 10\text{ }\Omega$<br>$I_D \cong -1\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$ |       | 15    | 25        | ns            |
| Rise Time                                     | $t_r$                   |                                                                                                                            |       | 30    | 45        |               |
| Turn-Off Delay Time                           | $t_{d(off)}$            |                                                                                                                            |       | 35    | 55        |               |
| Fall Time                                     | $t_f$                   |                                                                                                                            |       | 10    | 15        |               |

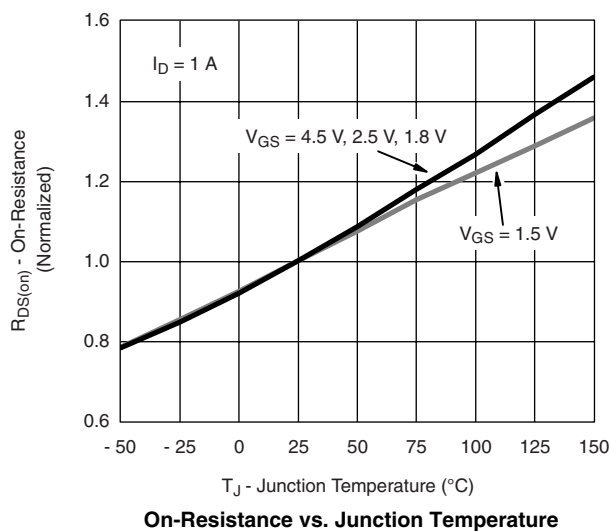
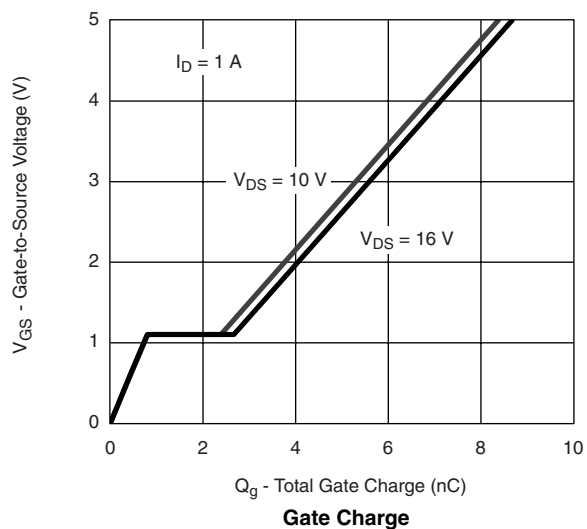
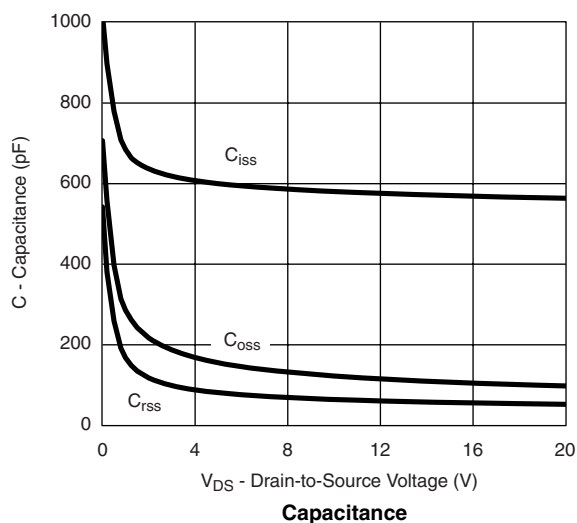
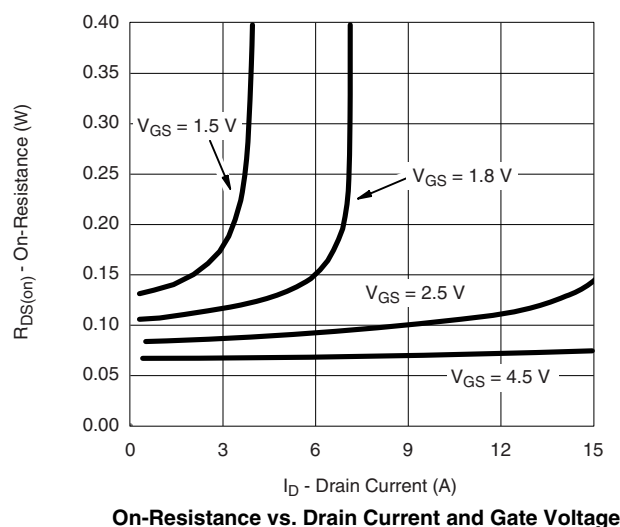
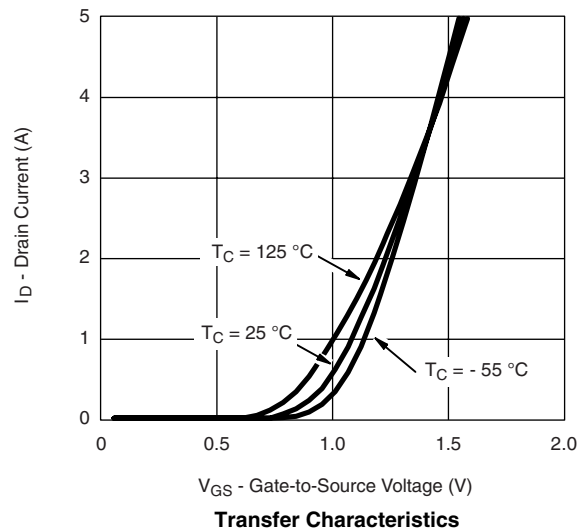
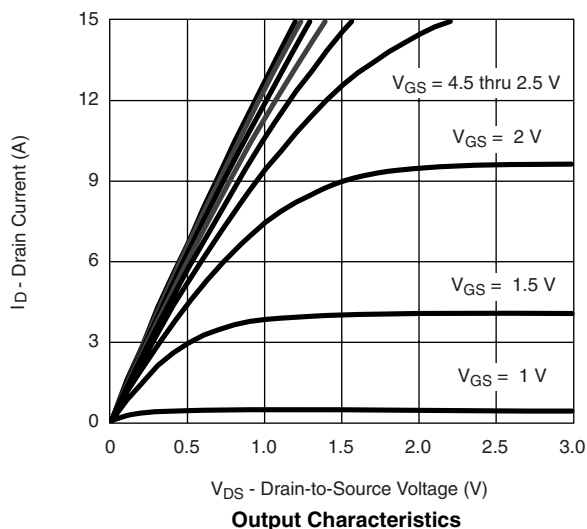


| <b>SPECIFICATIONS</b> $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted |          |                                                                                               |      |       |        |      |
|-----------------------------------------------------------------------------------|----------|-----------------------------------------------------------------------------------------------|------|-------|--------|------|
| Parameter                                                                         | Symbol   | Test Conditions                                                                               | Min. | Typ.  | Max.   | Unit |
| <b>Drain-Source Body Diode Characteristics</b>                                    |          |                                                                                               |      |       |        |      |
| Continuous Source-Drain Diode Current                                             | $I_S$    | $T_C = 25\text{ }^{\circ}\text{C}$                                                            |      |       | - 10.5 | A    |
| Pulse Diode Forward Current                                                       | $I_{SM}$ |                                                                                               |      |       | - 15   |      |
| Body Diode Voltage                                                                | $V_{SD}$ | $I_S = -1\text{ A}$ , $V_{GS} = 0\text{ V}$                                                   |      | - 0.7 | - 1.2  | V    |
| Body Diode Reverse Recovery Time                                                  | $t_{rr}$ | $I_F = -1\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}$ , $T_J = 25\text{ }^{\circ}\text{C}$ |      | 20    | 40     | ns   |
| Body Diode Reverse Recovery Charge                                                | $Q_{rr}$ |                                                                                               |      | 7     | 15     | nC   |
| Reverse Recovery Fall Time                                                        | $t_a$    |                                                                                               |      | 11    |        | ns   |
| Reverse Recovery Rise Time                                                        | $t_b$    |                                                                                               |      | 9     |        |      |

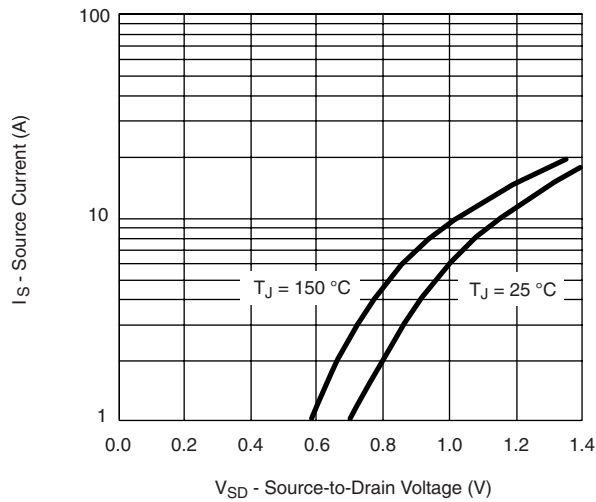
Notes:

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

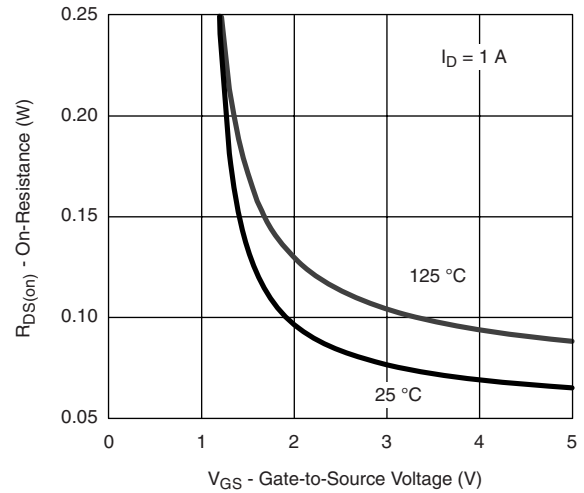
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

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

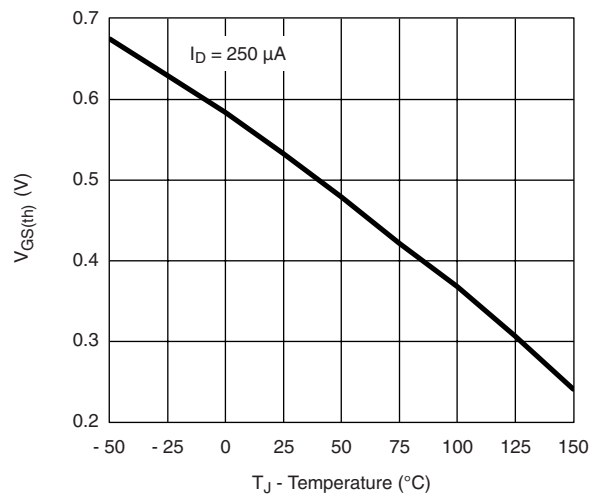
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



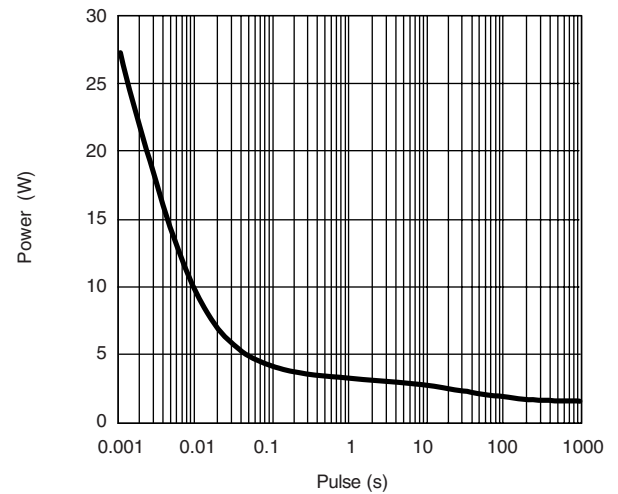
Source-Drain Diode Forward Voltage



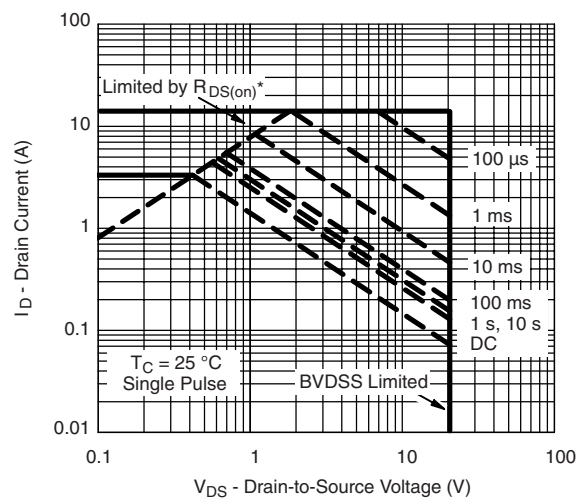
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage

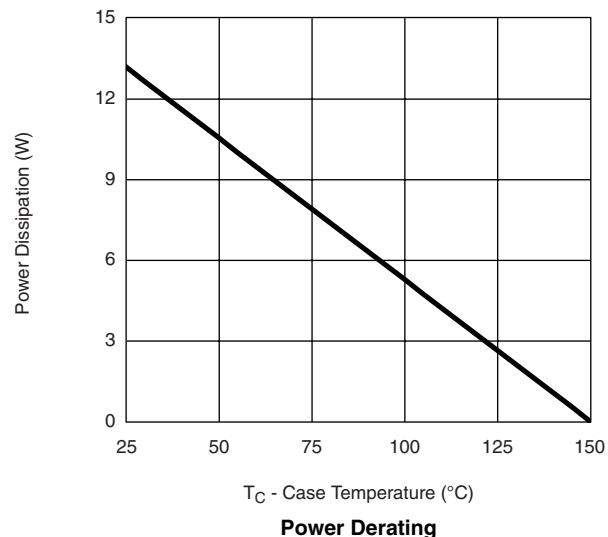
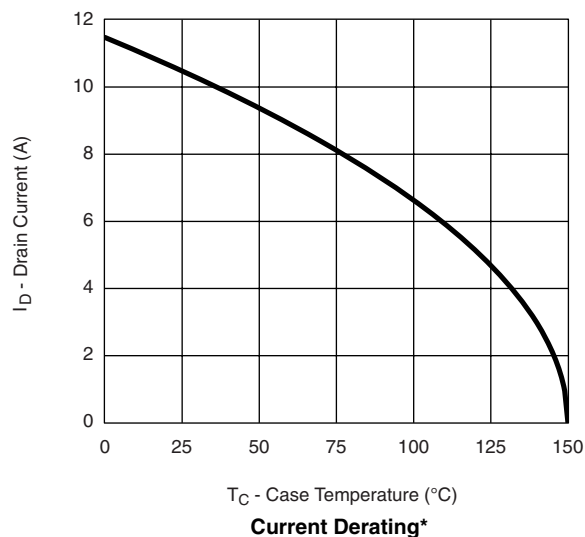


Single Pulse Power, Junction-to-Ambient



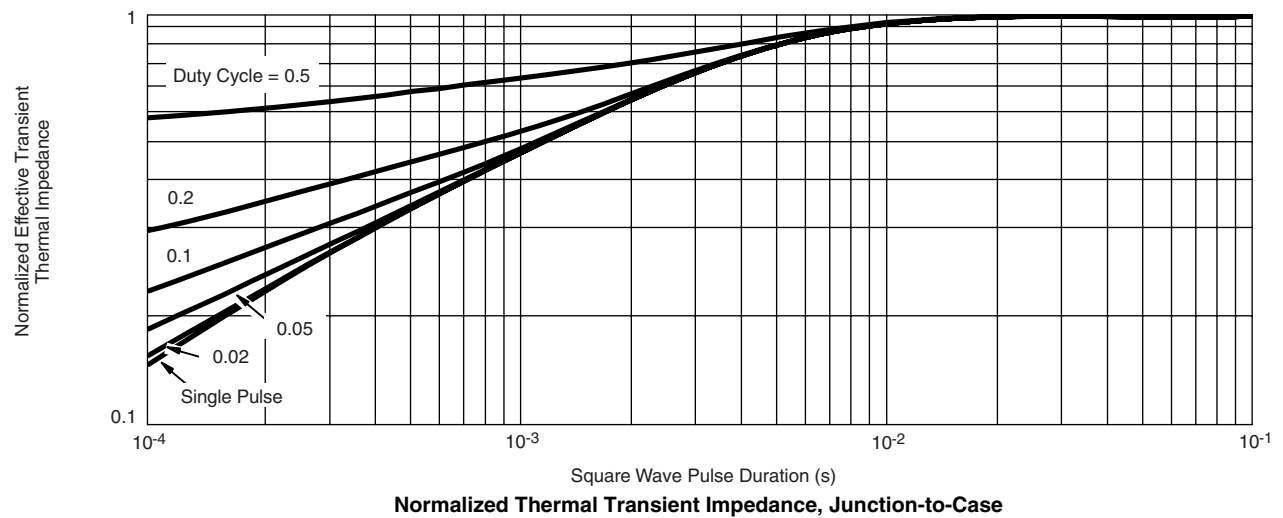
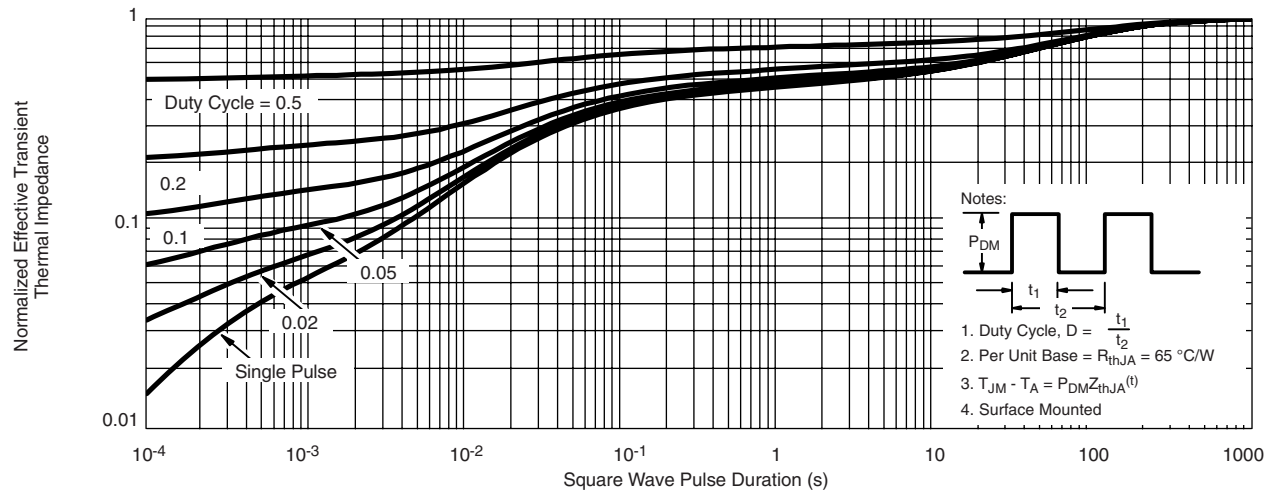
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

Safe Operating Area, Junction-to-Ambient

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

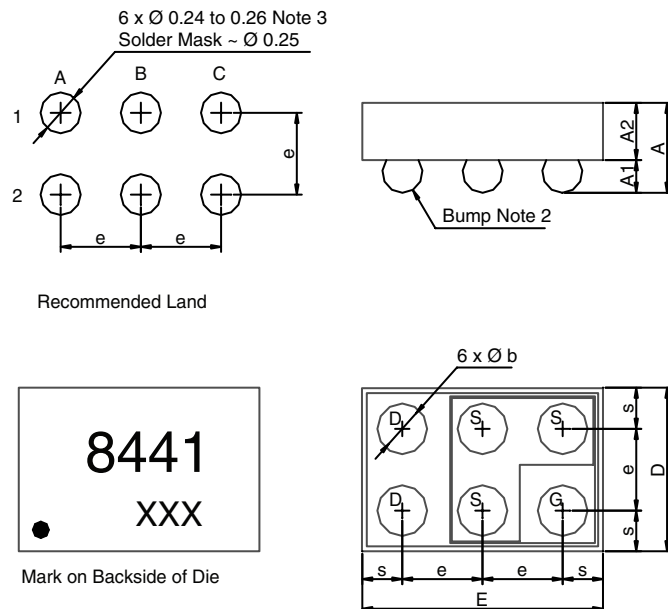
\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

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



## PACKAGE OUTLINE

## MICRO FOOT: 6-BUMP (2 x 3, 0.5 mm PITCH)



Notes (Unless Otherwise Specified):

1. All dimensions are in millimeters.
2. Six (6) solder bumps are lead (Pb)-free 95.5Sn, 3.8Ag, 0.7Cu with diameter  $\varnothing$  0.30 to 0.32 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.   |
| A              | 0.510                    | 0.575 | 0.590 | 0.0201 | 0.0224 | 0.0232 |
| A <sub>1</sub> | 0.220                    | 0.250 | 0.280 | 0.0087 | 0.0098 | 0.0110 |
| A <sub>2</sub> | 0.290                    | 0.300 | 0.310 | 0.0114 | 0.0118 | 0.0122 |
| b              | 0.300                    | 0.310 | 0.320 | 0.0118 | 0.0122 | 0.0126 |
| e              | 0.500                    |       |       | 0.0197 |        |        |
| s              | 0.230                    | 0.250 | 0.270 | 0.0090 | 0.0098 | 0.0106 |
| D              | 0.920                    | 0.960 | 1.000 | 0.0362 | 0.0378 | 0.0394 |
| E              | 1.420                    | 1.460 | 1.500 | 0.0559 | 0.0575 | 0.0591 |

Notes:

- a. Use millimeters as the primary measurement.

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