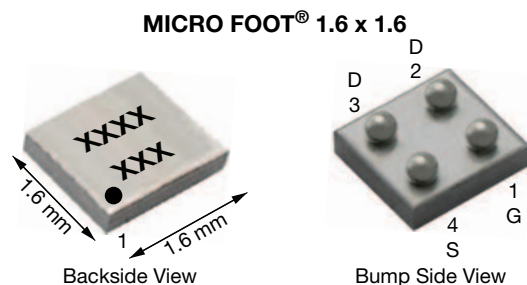


# P-Channel 20 V (D-S) MOSFET



## FEATURES

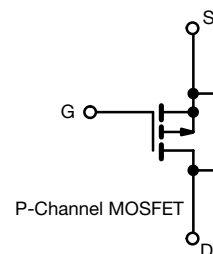
- TrenchFET® Gen III p-channel power MOSFET
- Low 0.6 mm maximum height
- Low on-resistance
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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

## APPLICATIONS

- Load switch
  - With low voltage drop
- Power management in battery-operated, mobile, and wearable devices



| PRODUCT SUMMARY                                     |                   |
|-----------------------------------------------------|-------------------|
| $V_{DS}$ (V)                                        | -20               |
| $R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = -4.5$ V | 0.021             |
| $R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = -2.5$ V | 0.025             |
| $R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = -1.8$ V | 0.039             |
| $Q_g$ typ. (nC)                                     | 31.2              |
| $I_D$ (A)                                           | -9.7 <sup>a</sup> |
| Configuration                                       | Single            |

## ORDERING INFORMATION

|                                 |                |
|---------------------------------|----------------|
| Package                         | MICRO FOOT     |
| Lead (Pb)-free and halogen-free | Si8481DB-T1-E1 |

## ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise noted)

| PARAMETER                                        | SYMBOL          | LIMIT         | UNIT               |
|--------------------------------------------------|-----------------|---------------|--------------------|
| Drain-source voltage                             | $V_{DS}$        | -20           | V                  |
| Gate-source voltage                              | $V_{GS}$        | $\pm 8$       |                    |
| Continuous drain current ( $T_J = 150$ °C)       | $I_D$           | $T_A = 25$ °C | -9.7 <sup>a</sup>  |
|                                                  |                 | $T_A = 70$ °C | -7.8 <sup>a</sup>  |
|                                                  |                 | $T_A = 25$ °C | -6.2 <sup>b</sup>  |
|                                                  |                 | $T_A = 70$ °C | -5 <sup>b</sup>    |
| Pulsed drain current ( $t = 100$ $\mu$ s)        | $I_{DM}$        | -30           |                    |
| Continuous source-drain diode current            | $I_S$           | $T_A = 25$ °C | -2.3 <sup>a</sup>  |
|                                                  |                 | $T_A = 70$ °C | -0.92 <sup>b</sup> |
| Maximum power dissipation                        | $P_D$           | $T_A = 25$ °C | 2.8 <sup>a</sup>   |
|                                                  |                 | $T_A = 70$ °C | 1.8 <sup>a</sup>   |
|                                                  |                 | $T_A = 25$ °C | 1.1 <sup>b</sup>   |
|                                                  |                 | $T_A = 70$ °C | 0.73 <sup>b</sup>  |
| Operating junction and storage temperature range | $T_J, T_{stg}$  | -55 to +150   |                    |
| Package reflow conditions <sup>c</sup>           | VPR             | 260           | °C                 |
|                                                  | IR / convection |               |                    |

## THERMAL RESISTANCE RATINGS

| PARAMETER                                   | SYMBOL     | TYPICAL | MAXIMUM | UNIT |
|---------------------------------------------|------------|---------|---------|------|
| Maximum junction-to-ambient <sup>a, f</sup> | $R_{thJA}$ | 35      | 45      | °C/W |
| Maximum junction-to-ambient <sup>b, g</sup> |            | 85      | 110     |      |

### 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-020), no manual or hand soldering.
- In this document, any reference to case represents the body of the MICRO FOOT device and foot is the bump.
- Based on  $T_A = 25$  °C.
- Maximum under steady state conditions is 85 °C/W.
- Maximum under steady state conditions is 175 °C/W.

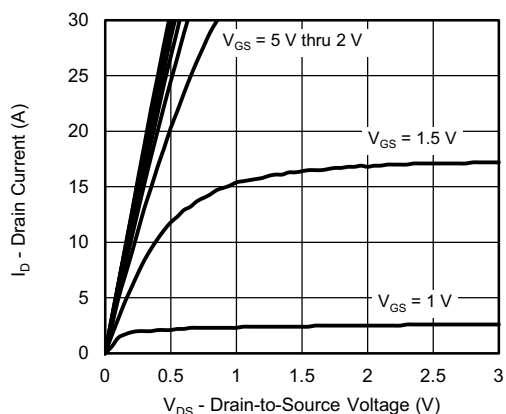
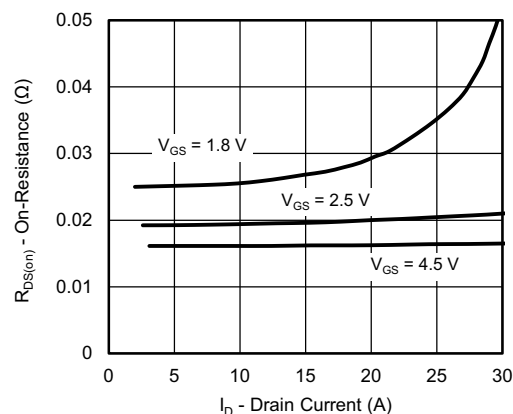
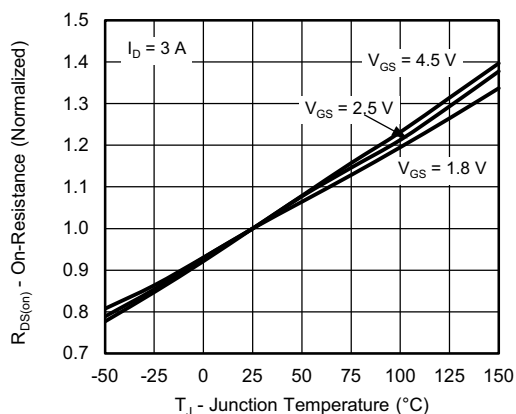
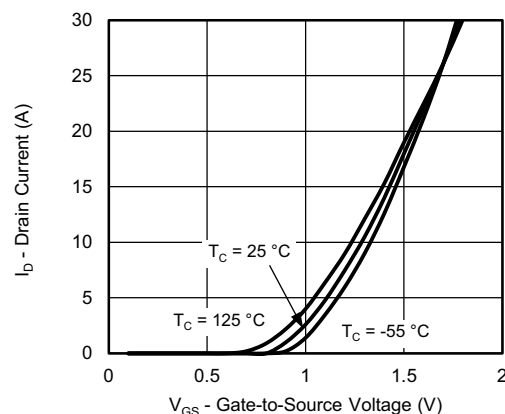
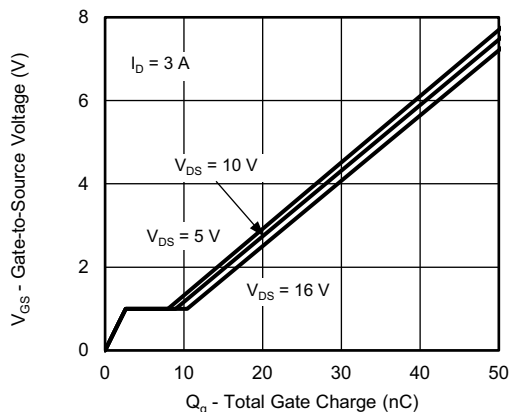
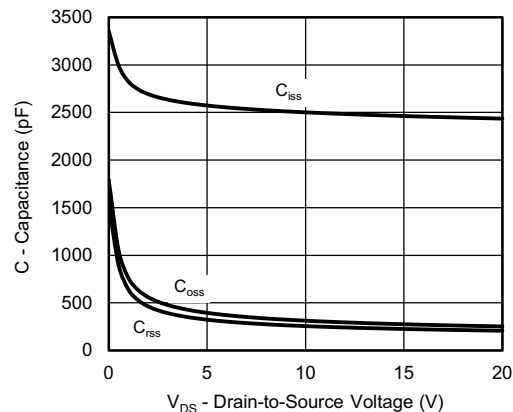


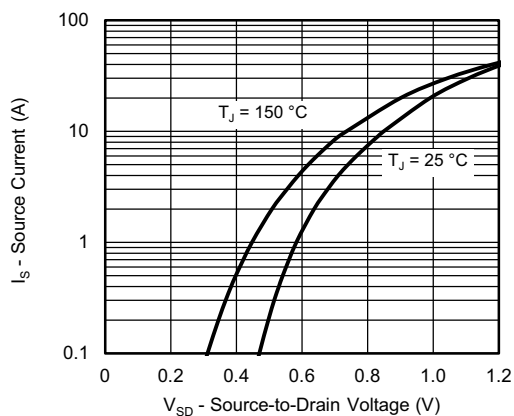
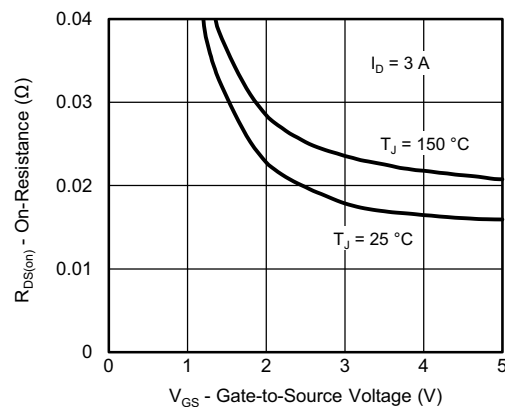
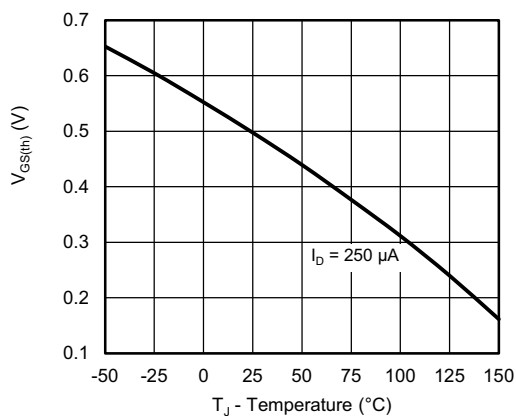
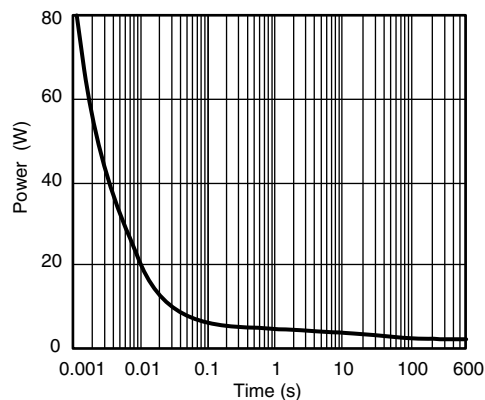
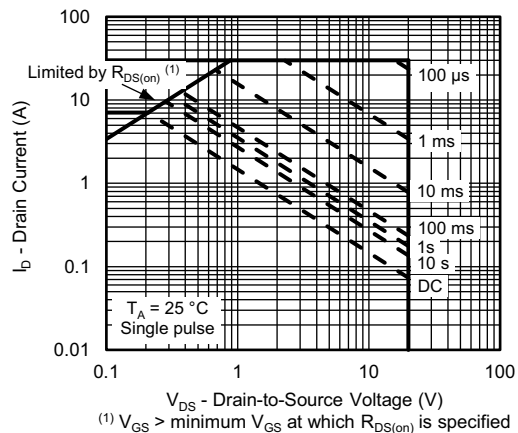
| SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted) |                                      |                                                                                                                         |      |       |                   |       |
|-----------------------------------------------------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------|-------|-------------------|-------|
| PARAMETER                                                       | SYMBOL                               | TEST CONDITIONS                                                                                                         | MIN. | TYP.  | MAX.              | UNIT  |
| Static                                                          |                                      |                                                                                                                         |      |       |                   |       |
| Drain-source breakdown voltage                                  | V <sub>DS</sub>                      | V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA                                                                         | -20  | -     | -                 | V     |
| V <sub>DS</sub> temperature coefficient                         | ΔV <sub>DS</sub> /T <sub>J</sub>     | I <sub>D</sub> = -250 μA                                                                                                | -    | -13   | -                 | mV/°C |
| V <sub>GS(th)</sub> temperature coefficient                     | ΔV <sub>GS(th)</sub> /T <sub>J</sub> |                                                                                                                         | -    | 2.5   | -                 |       |
| Gate-source threshold voltage                                   | V <sub>GS(th)</sub>                  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA                                                            | -0.4 | -     | -0.9              | V     |
| Gate-source leakage                                             | I <sub>GSS</sub>                     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 8 V                                                                          | -    | -     | ± 100             | nA    |
| Zero gate voltage drain current                                 | I <sub>DSS</sub>                     | V <sub>DS</sub> = -20 V, V <sub>GS</sub> = 0 V                                                                          | -    | -     | -1                | μA    |
|                                                                 |                                      | V <sub>DS</sub> = -20 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 55 °C                                                  | -    | -     | -10               |       |
| On-state drain current <sup>a</sup>                             | I <sub>D(on)</sub>                   | V <sub>DS</sub> ≤ -5 V, V <sub>GS</sub> = -4.5 V                                                                        | -5   | -     | -                 | A     |
| Drain-source on-state resistance <sup>a</sup>                   | R <sub>DS(on)</sub>                  | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -3 A                                                                         | -    | 0.017 | 0.021             | Ω     |
|                                                                 |                                      | V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -3 A                                                                         | -    | 0.020 | 0.025             |       |
|                                                                 |                                      | V <sub>GS</sub> = -1.8 V, I <sub>D</sub> = -1 A                                                                         | -    | 0.026 | 0.039             |       |
| Forward transconductance <sup>a</sup>                           | g <sub>fs</sub>                      | V <sub>DS</sub> = -5 V, I <sub>D</sub> = -3 A                                                                           | -    | 22    | -                 | S     |
| Dynamic <sup>b</sup>                                            |                                      |                                                                                                                         |      |       |                   |       |
| Input capacitance                                               | C <sub>iss</sub>                     | V <sub>DS</sub> = -10 V, V <sub>GS</sub> = 0 V, f = 1 MHz                                                               | -    | 2500  | -                 | pF    |
| Output capacitance                                              | C <sub>oss</sub>                     |                                                                                                                         | -    | 320   | -                 |       |
| Reverse transfer capacitance                                    | C <sub>rss</sub>                     |                                                                                                                         | -    | 260   | -                 |       |
| Total gate charge                                               | Q <sub>g</sub>                       | V <sub>DS</sub> = -10 V, V <sub>GS</sub> = -8 V, I <sub>D</sub> = -3 A                                                  | -    | 54    | 81                | nC    |
|                                                                 |                                      | V <sub>DS</sub> = -10 V, V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -3 A                                                | -    | 31.2  | 47                |       |
| Gate-source charge                                              | Q <sub>gs</sub>                      | V <sub>DS</sub> = -10 V, V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -3 A                                                | -    | 2.7   | -                 |       |
| Gate-drain charge                                               | Q <sub>gd</sub>                      |                                                                                                                         | -    | 6.3   | -                 |       |
| Gate resistance                                                 | R <sub>g</sub>                       | f = 1 MHz                                                                                                               | -    | 17    | -                 | Ω     |
| Turn-on delay time                                              | t <sub>d(on)</sub>                   | V <sub>DD</sub> = -10 V, R <sub>L</sub> = 3.3 Ω, I <sub>D</sub> ≅ -3 A, V <sub>GEN</sub> = -4.5 V, R <sub>g</sub> = 1 Ω | -    | 16    | 30                | ns    |
| Rise time                                                       | t <sub>r</sub>                       |                                                                                                                         | -    | 25    | 50                |       |
| Turn-off delay time                                             | t <sub>d(off)</sub>                  |                                                                                                                         | -    | 300   | 600               |       |
| Fall time                                                       | t <sub>f</sub>                       |                                                                                                                         | -    | 110   | 220               |       |
| Turn-on delay time                                              | t <sub>d(on)</sub>                   | V <sub>DD</sub> = -10 V, R <sub>L</sub> = 3.3 Ω, I <sub>D</sub> ≅ -3 A, V <sub>GEN</sub> = -8 V, R <sub>g</sub> = 1 Ω   | -    | 7     | 15                |       |
| Rise time                                                       | t <sub>r</sub>                       |                                                                                                                         | -    | 20    | 40                |       |
| Turn-off delay time                                             | t <sub>d(off)</sub>                  |                                                                                                                         | -    | 400   | 800               |       |
| Fall time                                                       | t <sub>f</sub>                       |                                                                                                                         | -    | 110   | 220               |       |
| Drain-Source Body Diode Characteristics                         |                                      |                                                                                                                         |      |       |                   |       |
| Continuous source-drain diode current                           | I <sub>S</sub>                       | T <sub>A</sub> = 25 °C                                                                                                  | -    | -     | -2.3 <sup>c</sup> | A     |
| Pulse diode forward current                                     | I <sub>SM</sub>                      |                                                                                                                         | -    | -     | -15               |       |
| Body diode voltage                                              | V <sub>SD</sub>                      | I <sub>S</sub> = -3 A, V <sub>GS</sub> = 0 V                                                                            | -    | -0.8  | -1.2              | V     |
| Body diode reverse recovery time                                | t <sub>rr</sub>                      | I <sub>F</sub> = -3 A, dI/dt = 100 A/μs, T <sub>J</sub> = 25 °C                                                         | -    | 150   | 300               | ns    |
| Body diode reverse recovery charge                              | Q <sub>rr</sub>                      |                                                                                                                         | -    | 235   | 470               | nC    |
| Reverse recovery fall time                                      | t <sub>a</sub>                       |                                                                                                                         | -    | 47    | -                 | ns    |
| Reverse recovery rise time                                      | t <sub>b</sub>                       |                                                                                                                         | -    | 103   | -                 |       |

**Notes**

- Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Guaranteed by design, not subject to production testing.
- Surface mounted on 1" x 1" FR4 board with full copper,  $t = 5\text{ s}$ .

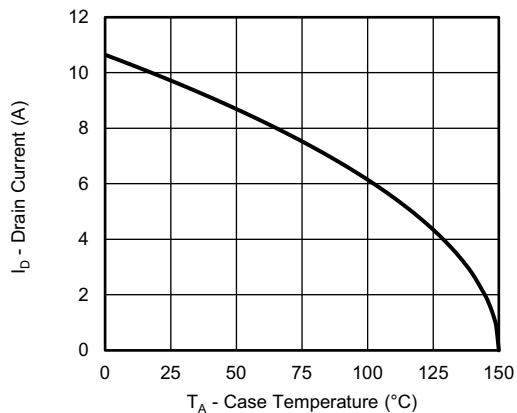
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

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

**Output Characteristics**

**On-Resistance vs. Drain Current and Gate Voltage**

**On-Resistance vs. Junction Temperature**

**Transfer Characteristics**

**Gate Charge**

**Capacitance**

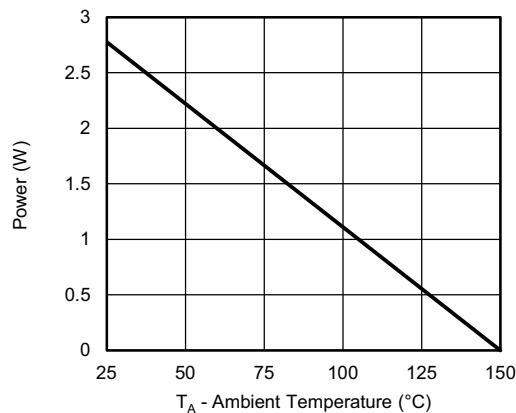
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Source-Drain Diode Forward Voltage**

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

**Threshold Voltage**

**Single Pulse Power, Junction-to-Ambient**

**Safe Operating Area, Junction-to-Ambient**



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



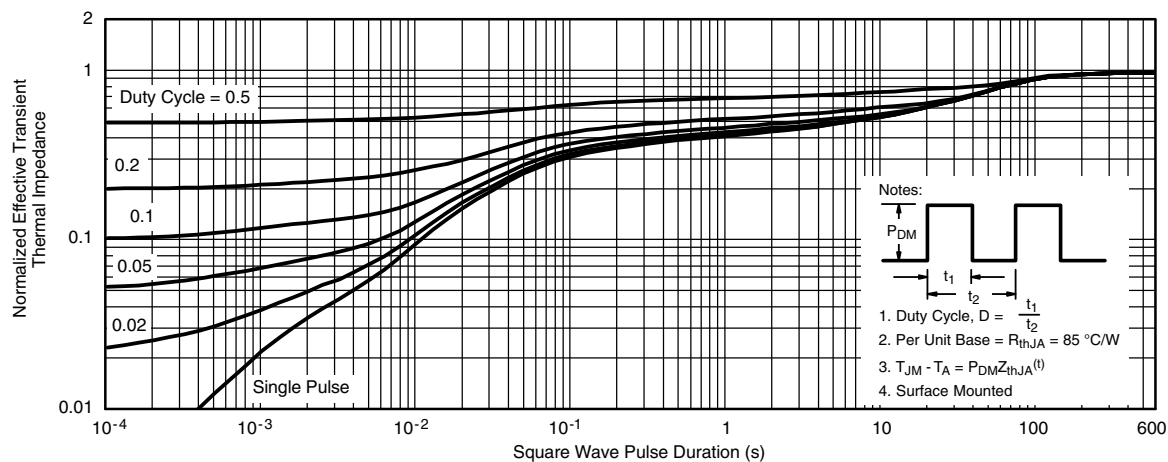
**Current Derating <sup>a</sup>**



**Power, Junction-to-Ambient <sup>a</sup>**

**Note**

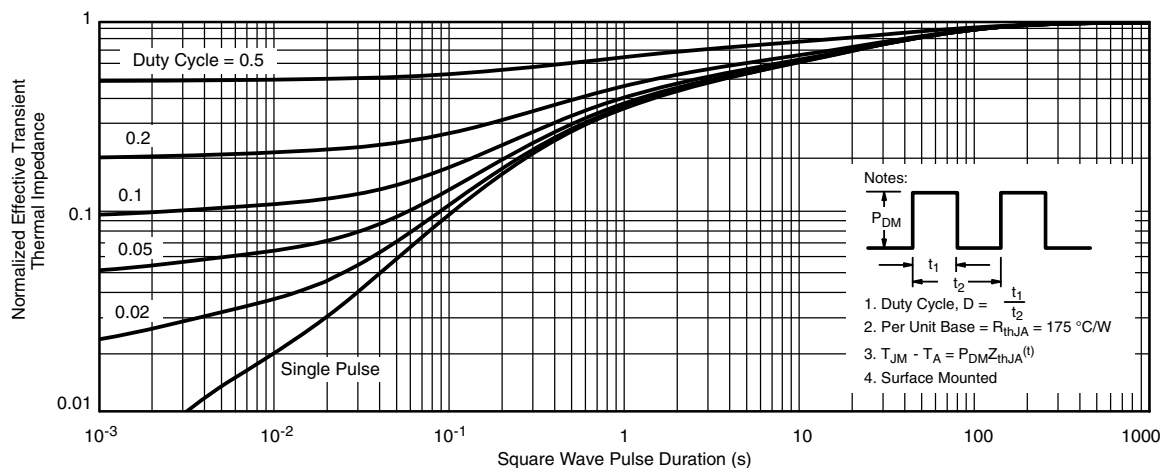
a. When surface mounted on 1" x 1" FR4 board with full copper,  $t = 5$  s.



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



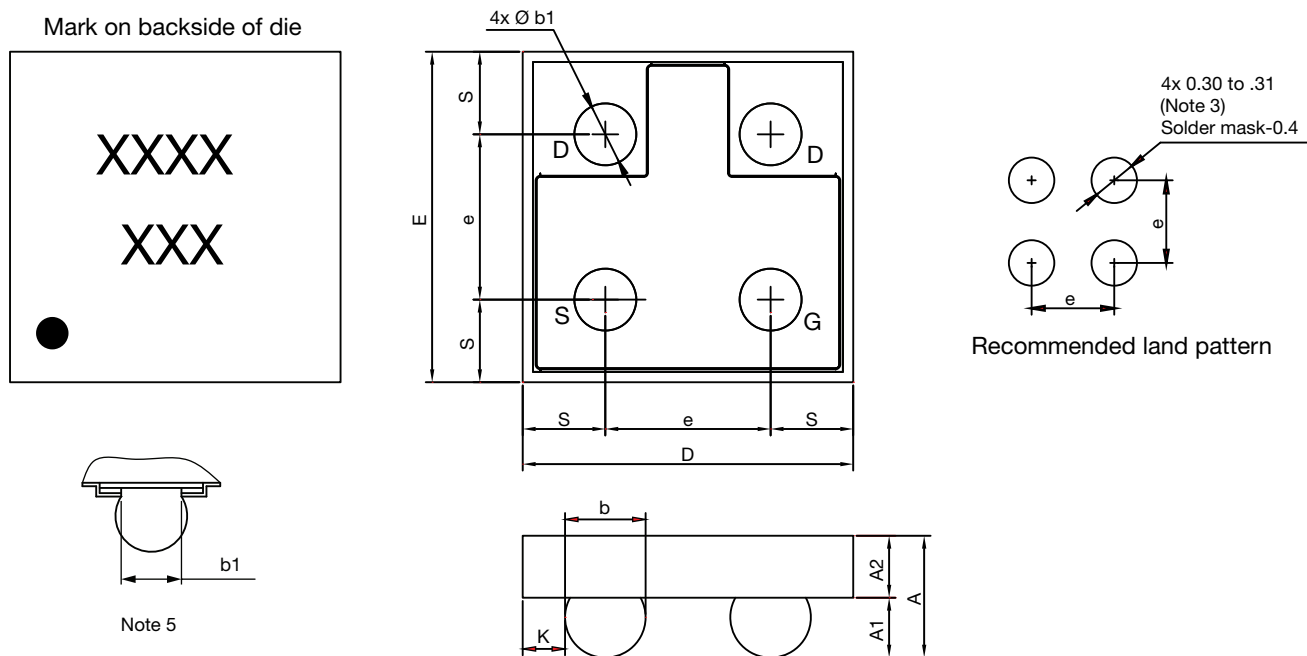
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



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

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## MICRO FOOT®: 4-Bumps (1.6 mm x 1.6 mm, 0.8 mm Pitch, 0.290 mm Bump Height)



### Notes

- Bumps are 95.5/3.8/0.7 Sn/Ag/Cu.
- Backside surface is coated with a Ti/Ni/Ag layer.
- Non-solder mask defined copper landing pad.
- Laser marks on the silicon die back.
- "b1" is the diameter of the solderable substrate surface, defined by an opening in the solder resist layer solder mask defined.
- is the location of pin 1

| DIM. | MILLIMETERS |       |       | INCHES |        |        |
|------|-------------|-------|-------|--------|--------|--------|
|      | MIN.        | NOM.  | MAX.  | MIN.   | NOM.   | MAX.   |
| A    | 0.550       | 0.575 | 0.600 | 0.0217 | 0.0226 | 0.0236 |
| A1   | 0.260       | 0.275 | 0.290 | 0.0102 | 0.0108 | 0.0114 |
| A2   | 0.290       | 0.300 | 0.310 | 0.0114 | 0.0118 | 0.0122 |
| b    | 0.370       | 0.390 | 0.410 | 0.0146 | 0.0153 | 0.0161 |
| b1   | 0.300       |       |       | 0.0118 |        |        |
| e    | 0.800       |       |       | 0.0314 |        |        |
| s    | 0.360       | 0.380 | 0.400 | 0.0141 | 0.0150 | 0.0157 |
| D    | 1.520       | 1.560 | 1.600 | 0.0598 | 0.0614 | 0.0630 |
| E    | 1.520       | 1.560 | 1.600 | 0.0598 | 0.0614 | 0.0630 |
| K    | 0.155       | 0.185 | 0.215 | 0.0061 | 0.0073 | 0.0085 |

### Note

- Use millimeters as the primary measurement.

ECN: T15-0175-Rev. A, 27-Apr-15  
DWG: 6038



## Disclaimer

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