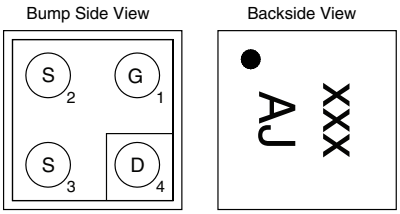
# N-Channel 20 V (D-S) MOSFET

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| $V_{DS}$ (V) | $R_{DS(on)}$ (Ω) Max. | $I_D$ (A)[a] | $Q_g$ (Typ.) |
| 20 | 0.072 at $V_{GS}$ = 4.5 V | 2.9 | 3 nC |
| | 0.079 at $V_{GS}$ = 2.5 V | 2.8 | |
| | 0.092 at $V_{GS}$ = 1.8 V | 2.6 | |
| | 0.125 at $V_{GS}$ = 1.5 V | 2.2 | |

MICRO FOOT




**Device Marking:** xxx = Date/Lot Traceability Code
AJ

**Ordering Information:** Si8810EDB-T2-E1 (Lead (Pb)-free and Halogen-free)

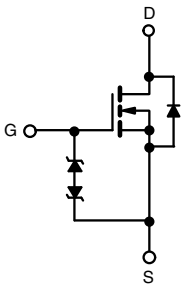
## FEATURES

- TrenchFET® Power MOSFET
- Ultra Small 0.8 mm x 0.8 mm Outline
- Ultra Thin 0.357 mm Height
- Typical ESD Protection 2000 V (HBM)
- Material categorization:
  For definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT
HALOGEN FREE

## APPLICATIONS

- Portable Devices such as Cell Phones, Smart Phones and Tablet PCs
  - Load Switch
  - Small Signal Switch
  - High Speed Switching




N-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25 °C, unless otherwise noted) | | | | |
|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Limit** | **Unit** |
| Drain-Source Voltage | | $V_{DS}$ | 20 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 8 | |
| Continuous Drain Current ($T_J$ = 150 °C) | $T_A$ = 25 °C | $I_D$ | 2.9[a] | A |
| | $T_A$ = 70 °C | | 2.3[a] | |
| | $T_A$ = 25 °C | | 2.1[b] | |
| | $T_A$ = 70 °C | | 1.7[b] | |
| Pulsed Drain Current (t = 300 µs) | | $I_{DM}$ | 15 | |
| Continuous Source-Drain Diode Current | $T_A$ = 25 °C | $I_S$ | 0.7[a] | |
| | $T_A$ = 25 °C | | 0.4[b] | |
| Maximum Power Dissipation | $T_A$ = 25 °C | $P_D$ | 0.9[a] | W |
| | $T_A$ = 70 °C | | 0.6[a] | |
| | $T_A$ = 25 °C | | 0.5[b] | |
| | $T_A$ = 70 °C | | 0.3[b] | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to 150 | °C |
| Soldering Recommendations (Peak Temperature)[c] | | | 260 | |

| THERMAL RESISTANCE RATINGS | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Typical** | **Maximum** | **Unit** |
| Maximum Junction-to-Ambient[a, d] | t ≤ 5 s | $R_{thJA}$ | 105 | 135 | °C/W |
| Maximum Junction-to-Ambient[b, e] | | | 200 | 260 | |

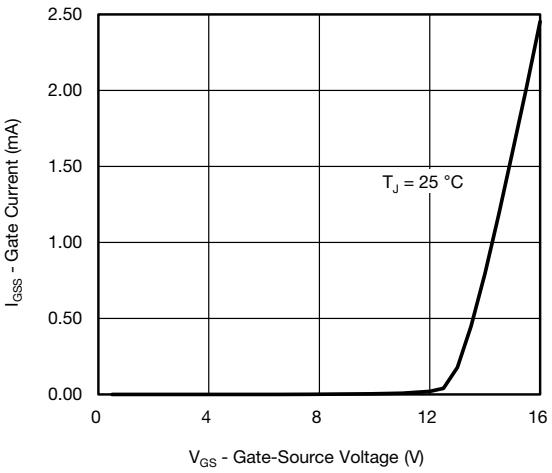
Notes:
a. Surface mounted on 1" x 1" FR4 board with full copper, t = 5 s.
b. Surface mounted on 1" x 1" FR4 board with minimum copper, t = 5 s.
c. Refer to IPC/JEDEC (J-STD-020), no manual or hand soldering.
d. Maximum under steady state conditions is 185 °C/W.
e. Maximum under steady state conditions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

| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Test Conditions** | **Min.** | **Typ.** | **Max.** | **Unit** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | 20 | | | V |
| $V_{DS}$ Temperature Coefficient | $\Delta V_{DS}/T_J$ | $I_D$ = 250 µA | | 21 | | mV/°C |
| $V_{GS(th)}$ Temperature Coefficient | $\Delta V_{GS(th)}/T_J$ | | | - 2.7 | | |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$ , $I_D$ = 250 µA | 0.4 | | 0.9 | V |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 4.5 V | | | ± 0.5 | µA |
| | | $V_{DS}$ = 0 V, $V_{GS}$ = ± 8 V | | | ± 5 | |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V | | | 1 | |
| | | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V, $T_J$ = 55 °C | | | 10 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{DS}$ ≥ 5 V, $V_{GS}$ = 4.5 V | 10 | | | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 4.5 V, $I_D$ = 1 A | | 0.058 | 0.072 | Ω |
| | | $V_{GS}$ = 2.5 V, $I_D$ = 1 A | | 0.063 | 0.079 | |
| | | $V_{GS}$ = 1.8 V, $I_D$ = 1 A | | 0.072 | 0.092 | |
| | | $V_{GS}$ = 1.5 V, $I_D$ = 0.5 A | | 0.080 | 0.125 | |
| Forward Transconductance[a] | $g_{fs}$ | $V_{DS}$ = 10 V, $I_D$ = 1 A | | 12 | | S |
| **Dynamic[b]** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V, f = 1 MHz | | 245 | | pF |
| Output Capacitance | $C_{oss}$ | | | 55 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 25 | | |
| Total Gate Charge | $Q_g$ | $V_{DS}$ = 10 V, $V_{GS}$ = 8 V, $I_D$ = 1 A | | 5.2 | 8 | nC |
| | | $V_{DS}$ = 10 V, $V_{GS}$ = 4.5 V, $I_D$ = 1 A | | 3 | 4.5 | |
| Gate-Source Charge | $Q_{gs}$ | | | 0.35 | | |
| Gate-Drain Charge | $Q_{gd}$ | | | 0.45 | | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 5 | | Ω |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 10 V, $R_L$ = 10 Ω<br>$I_D$ ≅ 1 A, $V_{GEN}$ = 4.5 V, $R_g$ = 1 Ω | | 7 | 15 | ns |
| Rise Time | $t_r$ | | | 12 | 25 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 25 | 50 | |
| Fall Time | $t_f$ | | | 7 | 15 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 10 V, $R_L$ = 10 Ω<br>$I_D$ ≅ 1 A, $V_{GEN}$ = 8 V, $R_g$ = 1 Ω | | 5 | 10 | |
| Rise Time | $t_r$ | | | 10 | 20 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 15 | 30 | |
| Fall Time | $t_f$ | | | 7 | 15 | |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Continuous Source-Drain Diode Current | $I_S$ | $T_C$ = 25 °C | | | 0.7 | A |
| Pulse Diode Forward Current | $I_{SM}$ | | | | 15 | |
| Body Diode Voltage | $V_{SD}$ | $I_S$ = 1 A, $V_{GS}$ = 0 V | | 0.7 | 1.2 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = 1 A, dI/dt = 100 A/µs, $T_J$ = 25 °C | | 11 | 20 | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | | 5 | 10 | nC |
| Reverse Recovery Fall Time | $t_a$ | | | 7 | | ns |
| Reverse Recovery Rise Time | $t_b$ | | | 4 | | |

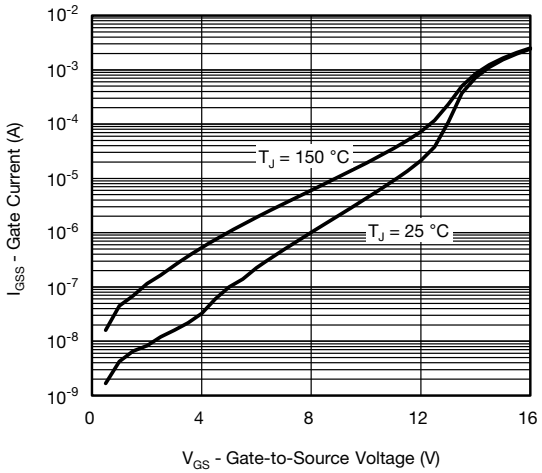
Notes:
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %
b. Guaranteed by design, not subject to production testing.

*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**

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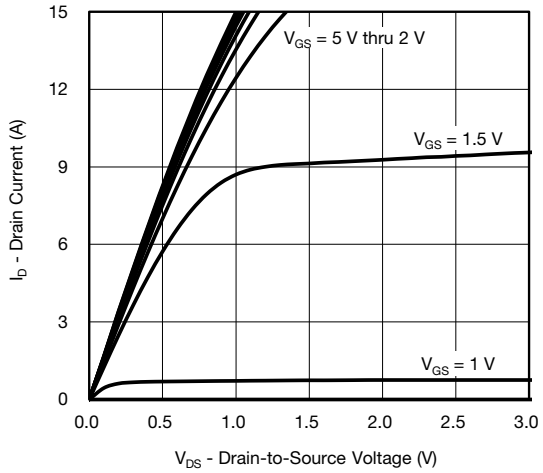
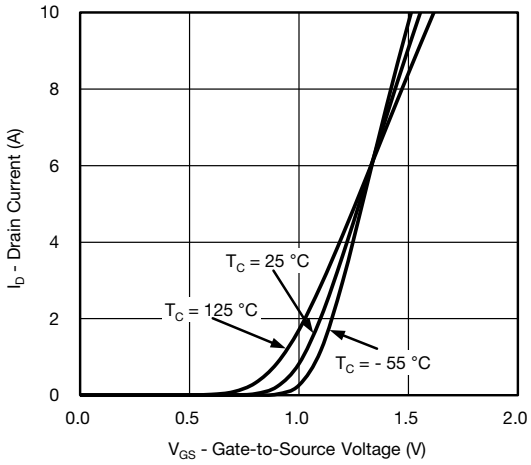
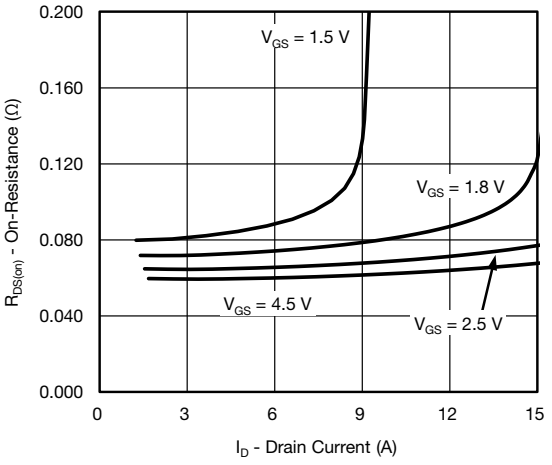


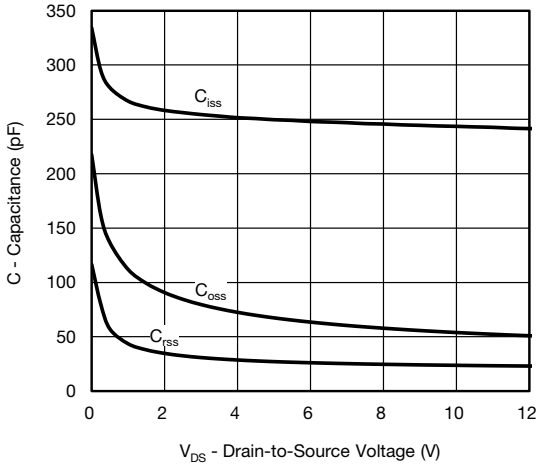

**Output Characteristics**




**Transfer Characteristics**

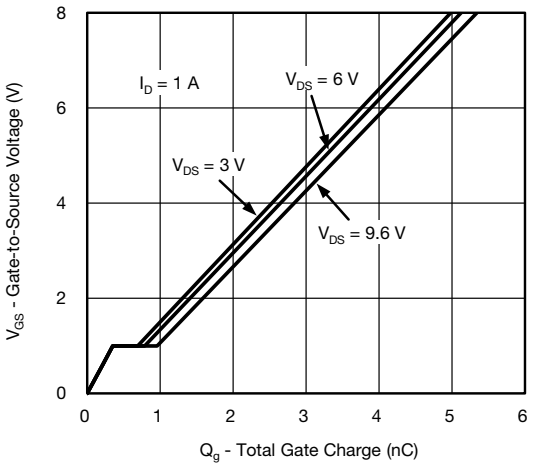



**On-Resistance vs. Drain Current**

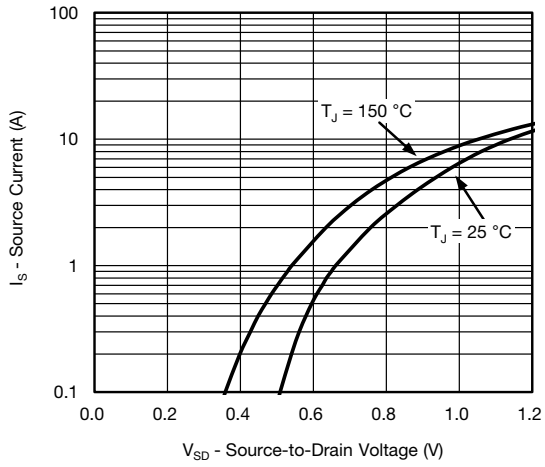



**Capacitance vs. Drain-to-Source Voltage**

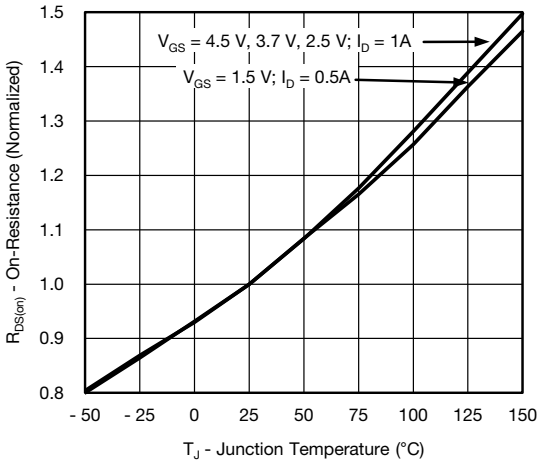
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



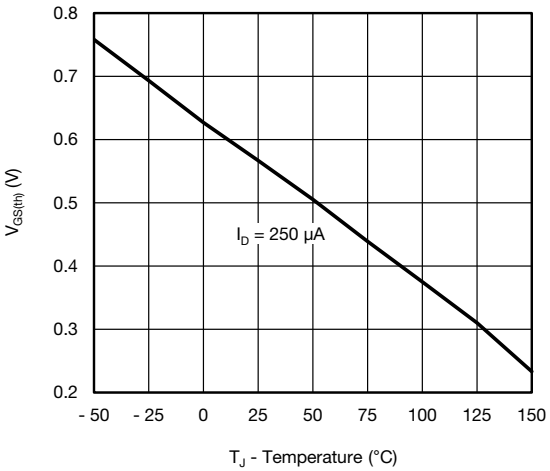

**Gate Charge**



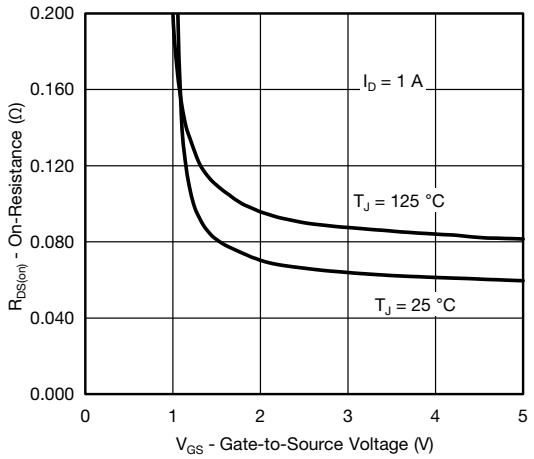

**Source-Drain Diode Forward Voltage**



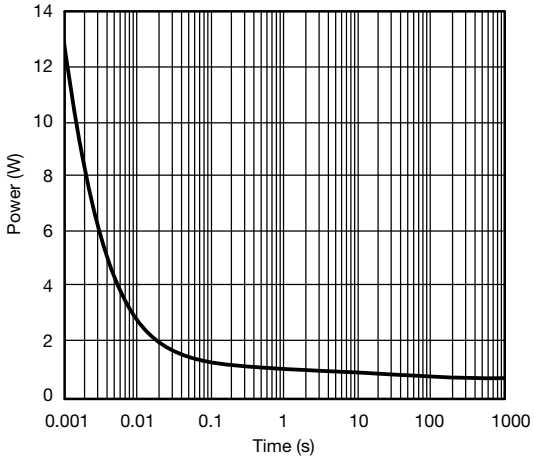

**On-Resistance vs. Junction Temperature**




**Threshold Voltage**



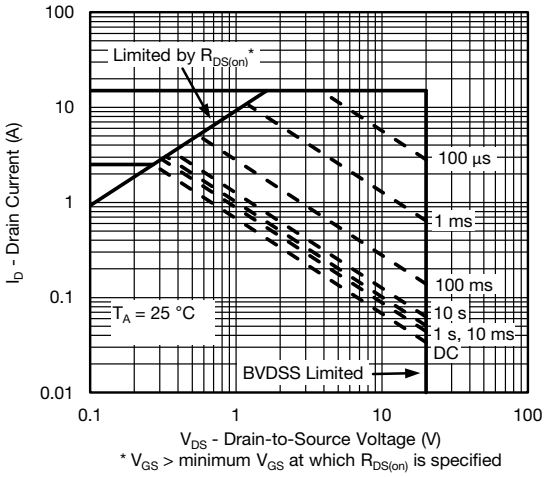

**On-Resistance vs. Gate-to-Source Voltage**



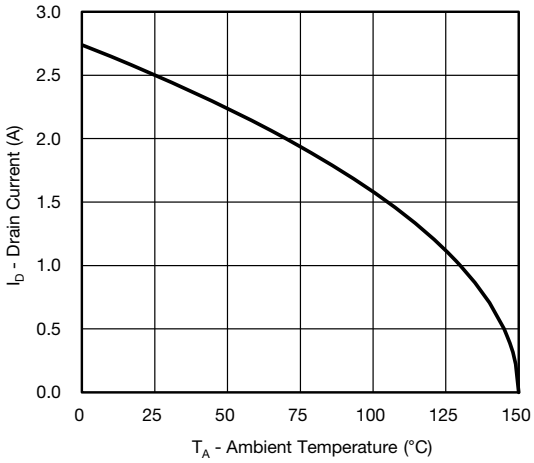

**Single Pulse Power (Junction-to-Ambient)**


For technical questions, contact: pmostechsupport@vishay.com
Document Number: 62829
S13-0198-Rev. A, 28-Jan-13

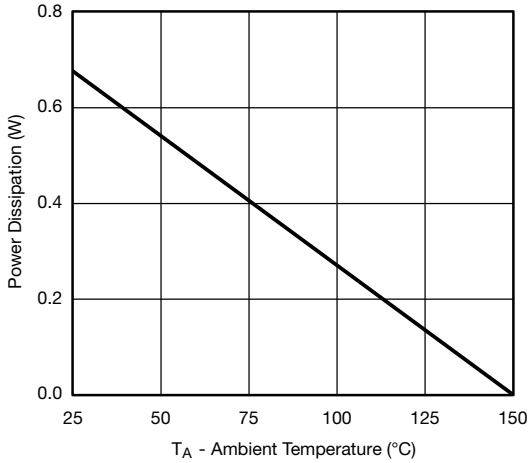
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)




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




**Current Derating***

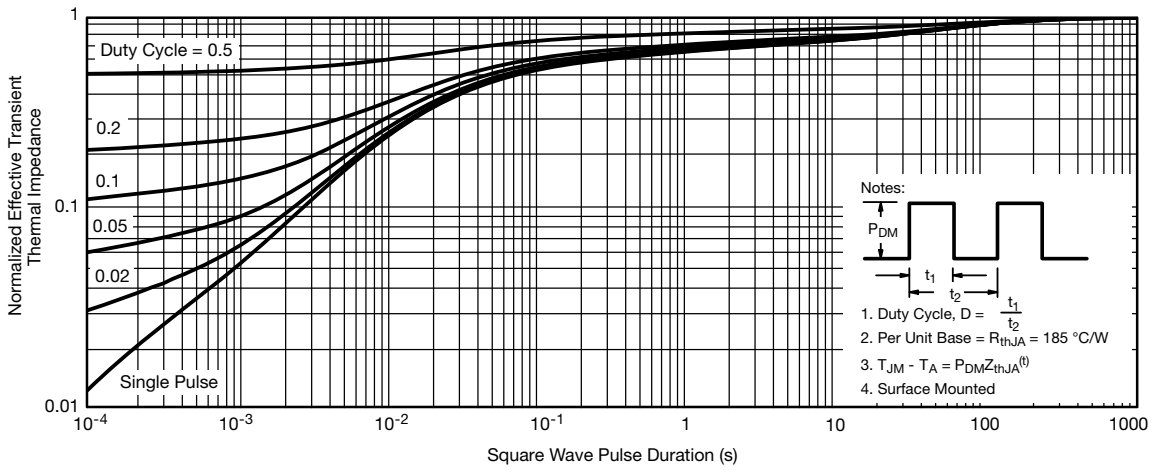



**Power Derating**

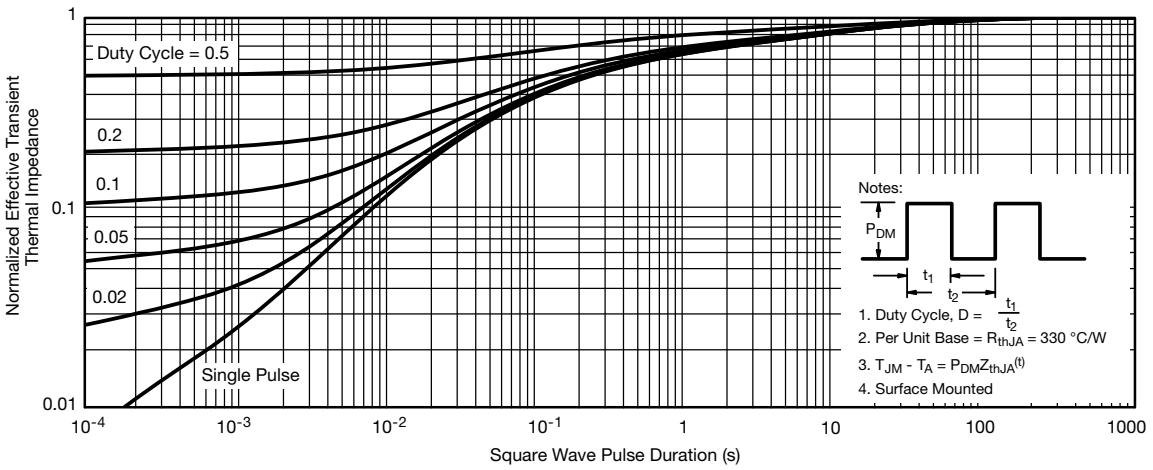
Note:
When mounted on 1" x 1" FR4 with full copper.

* 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)



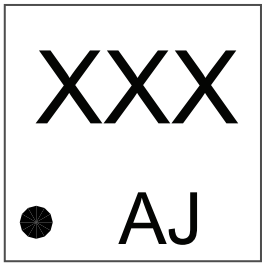

**Normalized Thermal Transient Impedance, Junction-to-Ambient (On 1" x 1" FR4 board with maximum copper)**



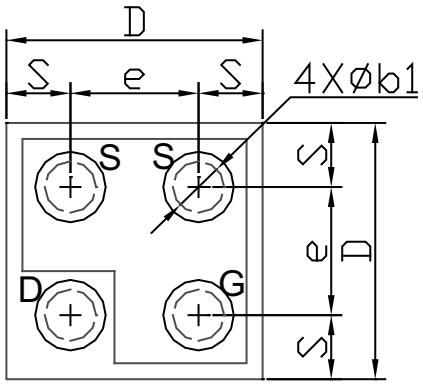

**Normalized Thermal Transient Impedance, Junction-to-Ambient (on 1" x 1" FR4 board with minimum copper)**

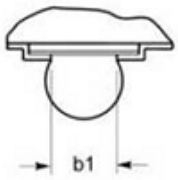
## PACKAGE OUTLINE

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

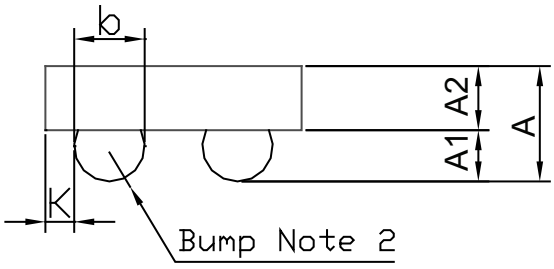



Mark on Backside of die




NOTE 4




Notes (Unless otherwise specified):
1. Laser mark on the backside surface of die.
2. Bumps are 95.5 % Sn,3.8 % Ag,0.7 % Cu.
3. • is location of pin 1.
4. " b1 " is the diameter of the solderable substrate surface, defined by an opening in the solder solder resist layer solder mask defined.

| Dim. | Millimeters[a] | | | Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Nom. | Max. | Min. | Nom. | Max. |
| **A** | 0.320 | 0.360 | 0.400 | 0.0125 | 0.0141 | 0.0157 |
| **$A_1$** | 0.136 | 0.160 | 0.184 | 0.0053 | 0.0062 | 0.0072 |
| **$A_2$** | 0.199 | 0.200 | 0.201 | 0.0078 | 0.0078 | 0.0079 |
| **b** | 0.200 | 0.220 | 0.240 | 0.0078 | 0.0086 | 0.0094 |
| **$b_1$** | | 0.175 | | | 0.0068 | |
| **e** | | 0.400 | | | 0.0157 | |
| **s** | 0.180 | 0.200 | 0.220 | 0.0070 | 0.0078 | 0.0086 |
| **D** | 0.760 | 0.800 | 0.840 | 0.0299 | 0.0314 | 0.0330 |
| **K** | 0.060 | 0.090 | 0.120 | 0.0023 | 0.0035 | 0.0047 |

Notes:
a. Use millimeters as the primary measurement.

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