

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 | 0.037 at V _{GS} = 4.5 V | 5.7 | 5.9 nC |
| | 0.041 at V _{GS} = 2.5 V | 5.4 | |
| | 0.047 at V _{GS} = 1.8 V | 5.0 | |
| | 0.068 at V _{GS} = 1.5 V | 4.2 | |

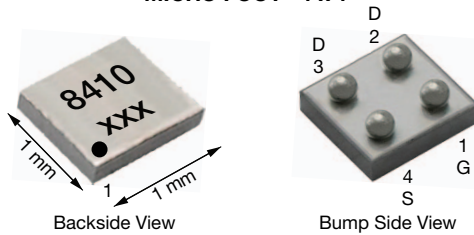
FEATURES

- TrenchFET[®] power MOSFET
- Ultra small 1 mm x 1 mm maximum outline
- Ultra-thin 0.54 mm maximum height
- Material categorization:
For definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE

MICRO FOOT[®] 1 x 1



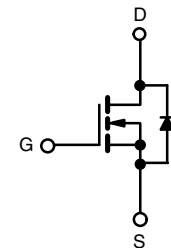
Marking Code: 8410

Ordering Information:

Si8410DB-T2-E1 (Lead (Pb)-free and Halogen-free)

APPLICATIONS

- Load switch
- Power management
- 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) | I _D | T _A = 25 °C | 5.7 ^a |
| | | T _A = 70 °C | 4.5 ^a |
| | | T _A = 25 °C | 3.8 ^c |
| | | T _A = 70 °C | 3.0 ^c |
| Pulsed Drain Current (t = 100 μs) | I _{DM} | 20 | A |
| Continuous Source-Drain Diode Current | I _S | T _C = 25 °C | |
| | | T _A = 25 °C | 0.65 ^c |
| Maximum Power Dissipation | P _D | T _A = 25 °C | 1.8 ^a |
| | | T _A = 70 °C | 1.1 ^a |
| | | T _A = 25 °C | 0.78 ^c |
| | | T _A = 70 °C | 0.5 ^c |
| Operating Junction and Storage Temperature Range | T _J , T _{stg} | -55 to 150 | °C |
| Package Reflow Conditions ^e | VPR | 260 | |
| | IR/Convection | 260 | |

| THERMAL RESISTANCE RATINGS | | | | | |
|---|----------|-------------------|---------|---------|------|
| PARAMETER | | SYMBOL | TYPICAL | MAXIMUM | UNIT |
| Maximum Junction-to-Ambient ^{a, b} | t = 10 s | R _{thJA} | 55 | 70 | °C/W |
| Maximum Junction-to-Ambient ^{c, d} | t = 10 s | | 125 | 160 | |

Notes

- Surface mounted on 1" x 1" FR4 board with full copper, t = 10 s, T_A = 25 °C.
- Maximum under steady state conditions is 100 °C/W.
- Surface mounted on 1" x 1" FR4 board with minimum copper, t = 10 s.
- Maximum under steady state conditions is 190 °C/W.
- 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.



| 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 | ΔV _{DS} /T _J | I _D = 250 μA | - | 17 | - | mV/°C |
| V _{GS(th)} Temperature Coefficient | ΔV _{GS(th)} /T _J | | - | -2.6 | - | |
| Gate-Source Threshold Voltage | V _{GS(th)} | V _{DS} = V _{GS} , I _D = 250 μA | 0.4 | - | 0.85 | V |
| Gate-Source Leakage | I _{GSS} | V _{DS} = 0 V, V _{GS} = ± 8 V | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} = 20 V, V _{GS} = 0 V | - | - | 1 | μA |
| | | V _{DS} = 20 V, V _{GS} = 0 V, T _J = 70 °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 = 1.5 A | - | 0.030 | 0.037 | Ω |
| | | V _{GS} = 2.5 V, I _D = 1 A | - | 0.033 | 0.041 | |
| | | V _{GS} = 1.8 V, I _D = 1 A | - | 0.038 | 0.047 | |
| | | V _{GS} = 1.5 V, I _D = 0.5 A | - | 0.044 | 0.068 | |
| Forward Transconductance ^a | g _{fs} | V _{DS} = 10 V, I _D = 1.5 A | - | 17 | - | S |
| Dynamic ^b | | | | | | |
| Input Capacitance | C _{ISS} | V _{DS} = 10 V, V _{GS} = 0 V, f = 1 MHz | - | 620 | - | pF |
| Output Capacitance | C _{OSS} | | - | 110 | - | |
| Reverse Transfer Capacitance | C _{RSS} | | - | 40 | - | |
| Total Gate Charge | Q _g | V _{DS} = 10 V, V _{GS} = 8 V, I _D = 1.5 A | - | 10.4 | 16 | nC |
| | | V _{DS} = 10 V, V _{GS} = 4.5 V, I _D = 1.5 A | - | 5.9 | 9 | |
| Gate-Source Charge | Q _{gs} | | - | 0.7 | - | |
| Gate-Drain Charge | Q _{gd} | | - | 0.66 | - | |
| Gate Resistance | R _g | V _{GS} = 0.1 V, f = 1 MHz | - | 5.3 | - | Ω |
| Turn-On Delay Time | t _{d(on)} | V _{DD} = -10 V, R _L = 6.7 Ω I _D ≅ 1.5 A, V _{GEN} = -4.5 V, R _g = 1 Ω | - | 5 | 10 | ns |
| Rise Time | t _r | | - | 25 | 50 | |
| Turn-Off Delay Time | t _{d(off)} | | - | 26 | 50 | |
| Fall Time | t _f | | - | 10 | 20 | |
| Turn-On Delay Time | t _{d(on)} | V _{DD} = -10 V, R _L = 6.7 Ω I _D ≅ -1.5 A, V _{GEN} = -8 V, R _g = 1 Ω | - | 5 | 10 | |
| Rise Time | t _r | | - | 22 | 45 | |
| Turn-Off Delay Time | t _{d(off)} | | - | 23 | 45 | |
| Fall Time | t _f | | - | 10 | 20 | |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous Source-Drain Diode Current | I _S | T _A = 25 °C | - | - | 1.5 | A |
| Pulse Diode Forward Current | I _{SM} | | - | - | 20 | |
| Body Diode Voltage | V _{SD} | I _S = 1.5 A, V _{GS} = 0 | - | 0.7 | 1.2 | V |
| Body Diode Reverse Recovery Time | t _{rr} | I _F = 1.5 A, dI/dt = 100 A/μs, T _J = 25 °C | - | 15 | 30 | ns |
| Body Diode Reverse Recovery Charge | Q _{rr} | | - | 6 | 15 | nC |
| Reverse Recovery Fall Time | t _a | | - | 8.5 | - | ns |
| Reverse Recovery Rise Time | t _b | | - | 6.5 | - | |

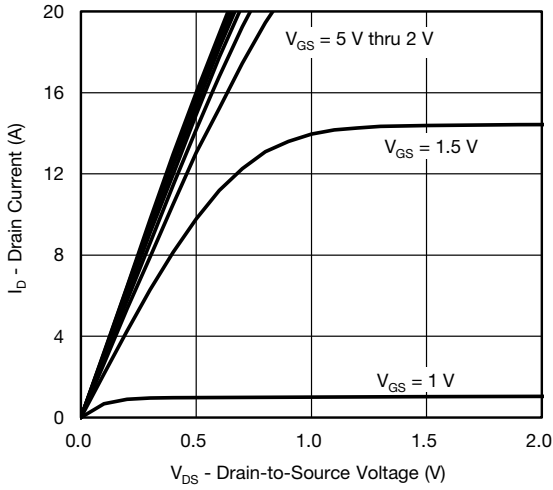
Notes

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

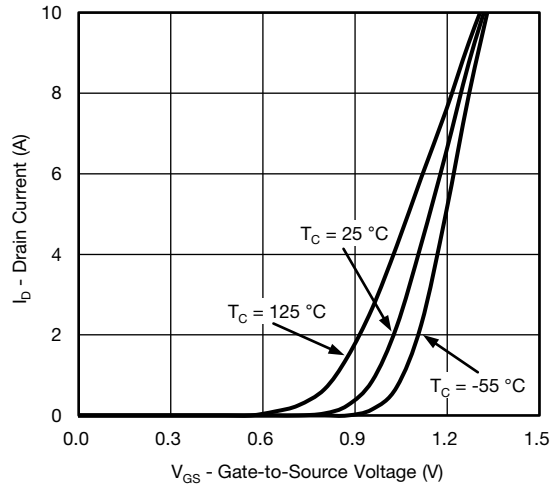
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



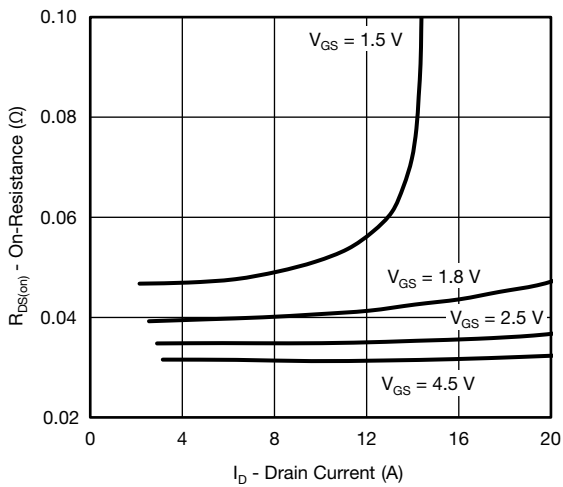
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



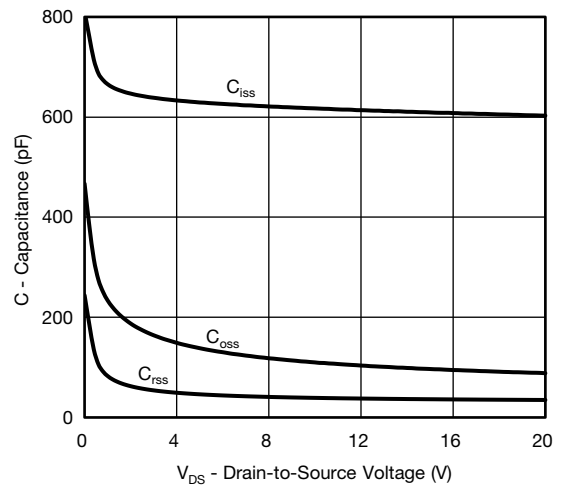
Output Characteristics



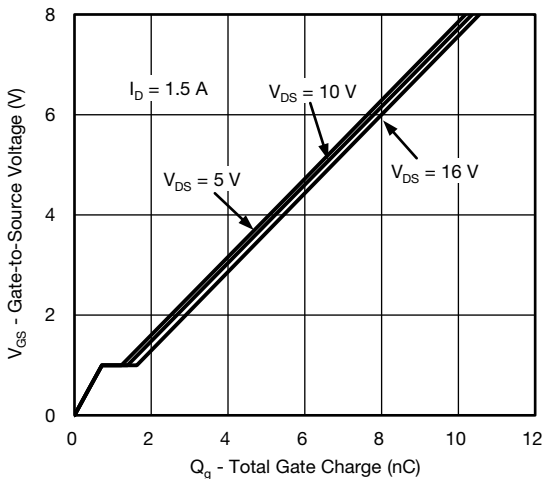
Transfer Characteristics



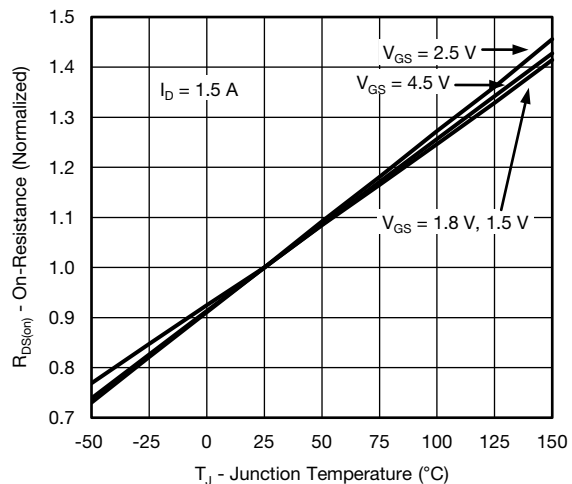
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

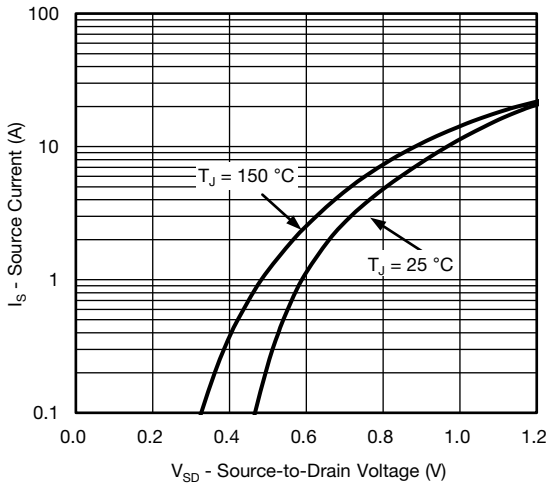


Gate Charge

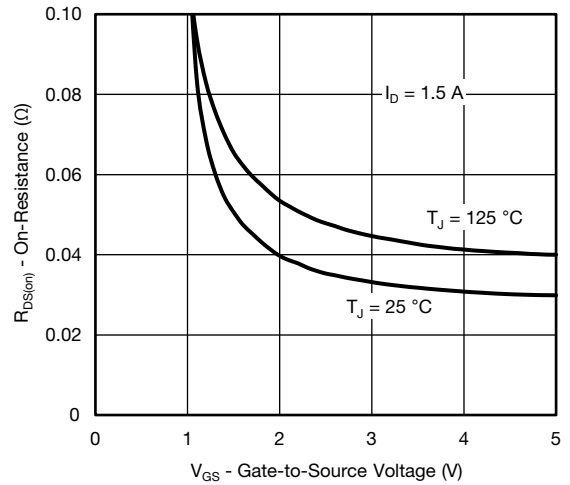


On-Resistance vs. Junction Temperature

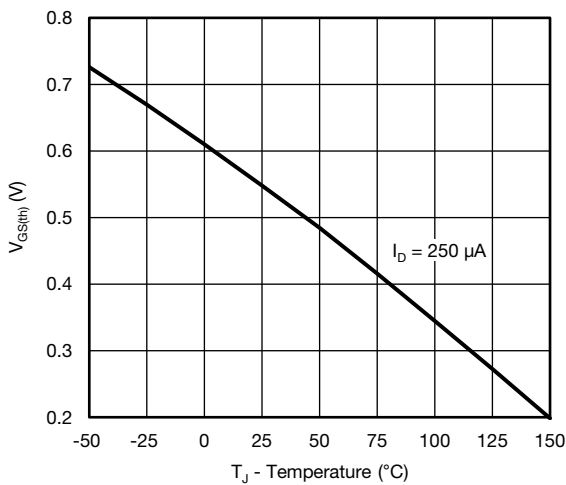
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



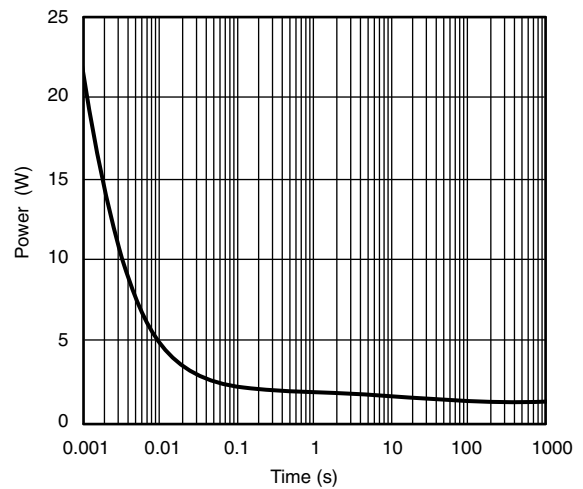
Source-Drain Diode Forward Voltage



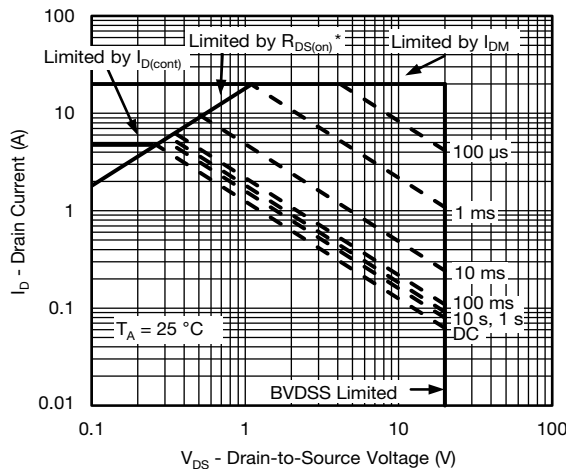
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



Single Pulse Power, Junction-to-Ambient

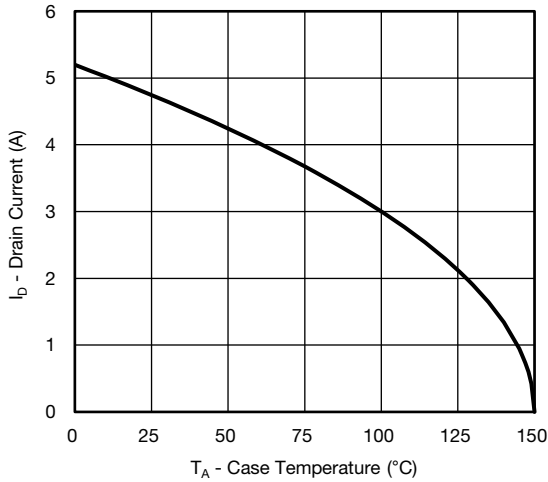


* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

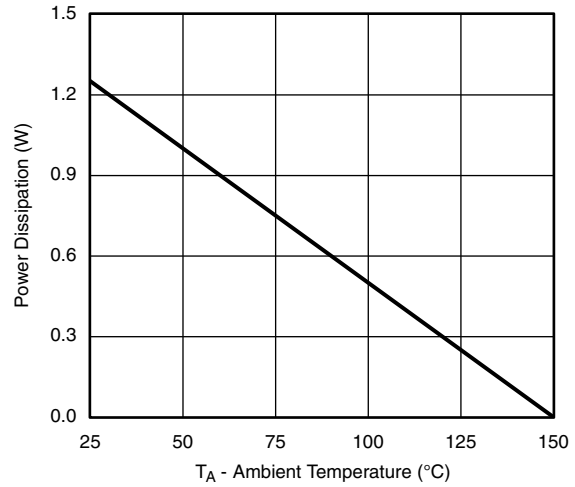
Safe Operating Area, Junction-to-Ambient



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Current Derating*



Power Derating

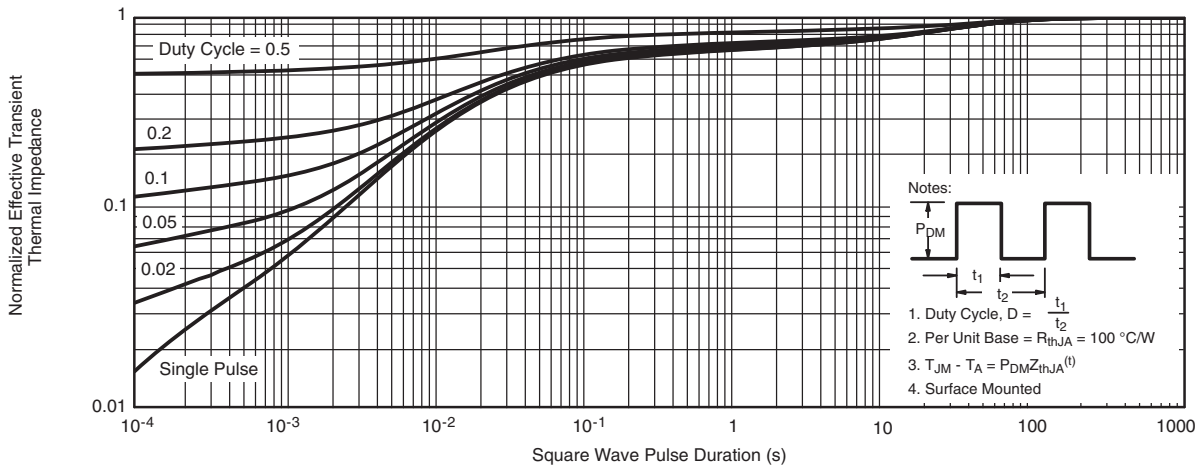
Note

- When mounted on 1" x 1" FR4 with full copper.

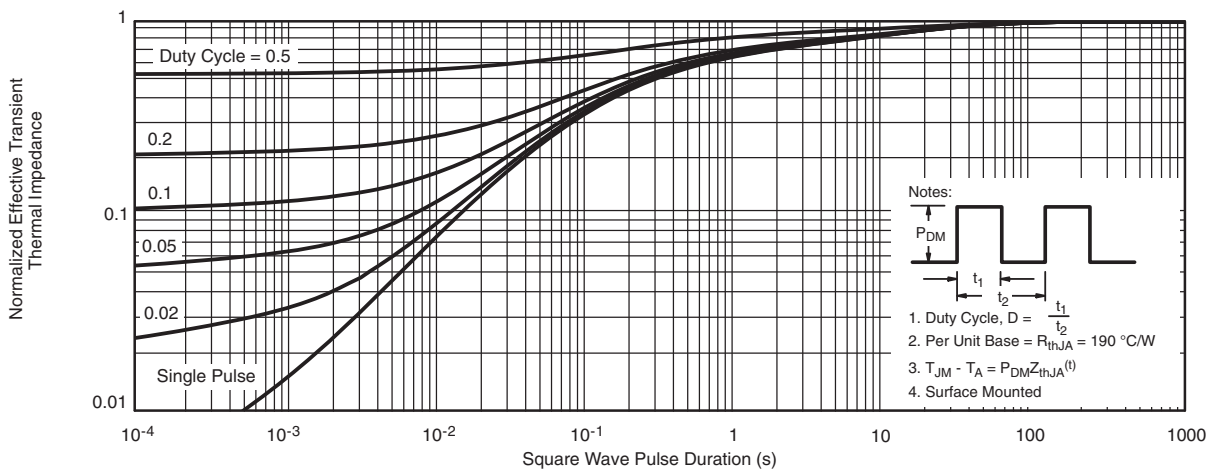
* The power dissipation P_D is based on $T_{J(max)} = 150\text{ °C}$, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package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



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



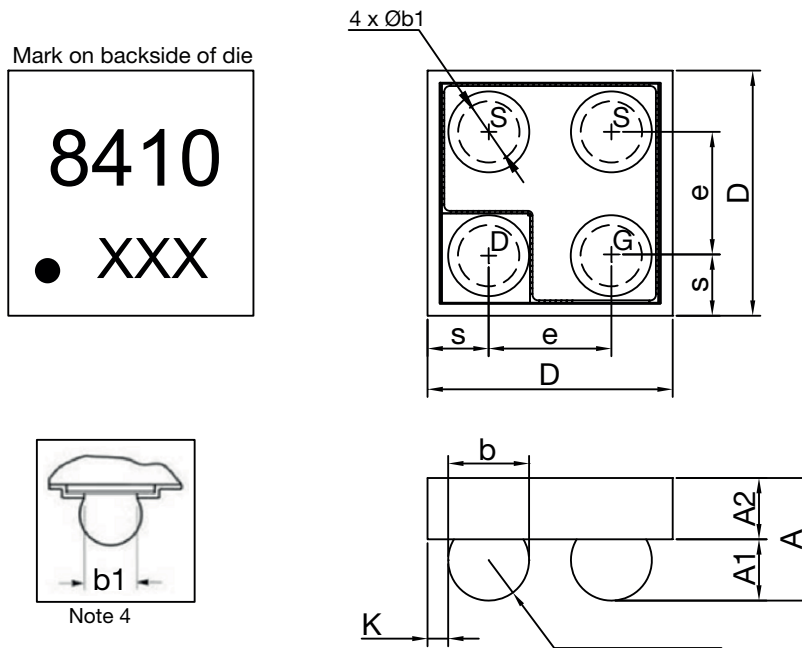
Normalized Thermal Transient Impedance, Junction-to-Ambient (1" x 1" FR4 Board with Full Copper)



Normalized Thermal Transient Impedance, Junction-to-Ambient (1" x 1" FR4 Board with Minimum Copper)

PACKAGE OUTLINE

MICRO FOOT 1 mm x 1 mm: 4-Bump (0.5 mm pitch)



Notes

- (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 resist layer solder mask defined.
- (5) Non-solder mask defined copper landing pad.

| DIMENSION | MILLIMETERS ^a | | | INCHES | | |
|-----------|--------------------------|---------|---------|---------|---------|---------|
| | MINIMUM | NOMINAL | MAXIMUM | MINIMUM | NOMINAL | MAXIMUM |
| A | 0.460 | 0.500 | 0.540 | 0.0181 | 0.0196 | 0.0212 |
| A1 | 0.214 | 0.250 | 0.286 | 0.0084 | 0.0098 | 0.0112 |
| A2 | 0.244 | 0.254 | 0.264 | 0.0096 | 0.0100 | 0.0104 |
| b | 0.297 | 0.330 | 0.363 | 0.0116 | 0.0129 | 0.0142 |
| b1 | | 0.250 | | | 0.0098 | |
| e | | 0.500 | | | 0.0197 | |
| s | 0.210 | 0.230 | 0.250 | 0.0008 | 0.0090 | 0.0098 |
| D | 0.920 | 0.960 | 1.000 | 0.0362 | 0.0377 | 0.0393 |
| K | 0.028 | 0.065 | 0.101 | 0.0011 | 0.0025 | 0.0039 |

Note

- a. Use millimeters as the primary measurement.

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