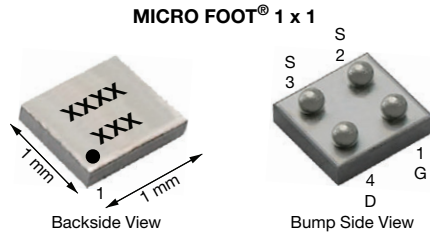


## N-Channel 20 V (D-S) MOSFET


**Marking code:** xxxx = 8410

xxx = Date / lot traceability code

PRODUCT SUMMARY	
$V_{DS}$ (V)	20
$R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = 4.5$ V	0.037
$R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = 2.5$ V	0.041
$R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = 1.8$ V	0.047
$R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = 1.5$ V	0.068
$Q_g$ typ. (nC)	5.9
$I_D$ (A) <sup>a</sup>	5.7
Configuration	Single

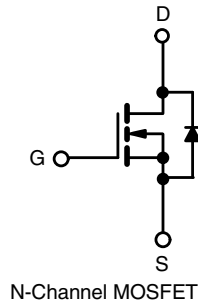
### FEATURES

- TrenchFET® power MOSFET
- Ultra small 1 mm x 1 mm maximum outline
- Ultra-thin 0.548 mm maximum height
- 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
- Power management
- High speed switching



ORDERING INFORMATION	
Package	MICRO FOOT
Lead (Pb)-free and halogen-free	Si8410DB-T2-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	5.7 <sup>a</sup>
		$T_A = 70$ °C	4.5 <sup>a</sup>
		$T_A = 25$ °C	3.8 <sup>c</sup>
		$T_A = 70$ °C	3 <sup>c</sup>
Pulsed drain current ( $t = 100$ $\mu$ s)	$I_{DM}$	20	
Continuous source-drain diode current	$I_S$	$T_C = 25$ °C	1.5 <sup>a</sup>
		$T_A = 25$ °C	0.65 <sup>c</sup>
Maximum power dissipation	$P_D$	$T_A = 25$ °C	1.8 <sup>a</sup>
		$T_A = 70$ °C	1.1 <sup>a</sup>
		$T_A = 25$ °C	0.78 <sup>c</sup>
		$T_A = 70$ °C	0.5 <sup>c</sup>
Operating junction and storage temperature range	$T_J, T_{stg}$	-55 to +150	
Package reflow conditions <sup>e</sup>	VPR	260	°C
	IR/convection	260	

THERMAL RESISTANCE RATINGS					
PARAMETER		SYMBOL	TYPICAL	MAXIMUM	UNIT
Maximum junction-to-ambient <sup>a, b</sup>	$t = 10$ s	$R_{thJA}$	55	70	°C/W
Maximum junction-to-ambient <sup>c, d</sup>	$t = 10$ 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 <sub>J</sub> = 25 °C, unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
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	-	17	-	mV/°C
V <sub>GS(th)</sub> temperature coefficient	ΔV <sub>GS(th)</sub> /T <sub>J</sub>		-	-2.6	-	
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	-	0.85	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> = 70 °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	10	-	-	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> = 1.5 A	-	0.030	0.037	Ω
		V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 1 A	-	0.033	0.041	
		V <sub>GS</sub> = 1.8 V, I <sub>D</sub> = 1 A	-	0.038	0.047	
		V <sub>GS</sub> = 1.5 V, I <sub>D</sub> = 0.5 A	-	0.044	0.068	
Forward transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1.5 A	-	17	-	S
<b>Dynamic <sup>b</sup></b>						
Input capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V, f = 1 MHz	-	620	-	pF
Output capacitance	C <sub>OSS</sub>		-	110	-	
Reverse transfer capacitance	C <sub>RSS</sub>		-	40	-	
Total gate charge	Q <sub>g</sub>	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 8 V, I <sub>D</sub> = 1.5 A	-	10.4	16	nC
		V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 1.5 A	-	5.9	9	
Gate-source charge	Q <sub>gs</sub>		-	0.7	-	
Gate-drain charge	Q <sub>gd</sub>		-	0.66	-	
Gate resistance	R <sub>g</sub>	V <sub>GS</sub> = 0.1 V, f = 1 MHz	-	5.3	-	Ω
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> = -10 V, R <sub>L</sub> = 6.7 Ω I <sub>D</sub> ≅ 1.5 A, V <sub>GEN</sub> = -4.5 V, R <sub>g</sub> = 1 Ω	-	5	10	ns
Rise time	t <sub>r</sub>		-	25	50	
Turn-off delay time	t <sub>d(off)</sub>		-	26	50	
Fall time	t <sub>f</sub>		-	10	20	
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> = -10 V, R <sub>L</sub> = 6.7 Ω I <sub>D</sub> ≅ -1.5 A, V <sub>GEN</sub> = -8 V, R <sub>g</sub> = 1 Ω	-	5	10	
Rise time	t <sub>r</sub>		-	22	45	
Turn-off delay time	t <sub>d(off)</sub>		-	23	45	
Fall time	t <sub>f</sub>		-	10	20	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous source-drain diode current	I <sub>S</sub>	T <sub>A</sub> = 25 °C	-	-	1.5	A
Pulse diode forward current	I <sub>SM</sub>		-	-	20	
Body diode voltage	V <sub>SD</sub>	I <sub>S</sub> = 1.5 A, V <sub>GS</sub> = 0	-	0.7	1.2	V
Body diode reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> = 1.5 A, di/dt = 100 A/μs, T <sub>J</sub> = 25 °C	-	15	30	ns
Body diode reverse recovery charge	Q <sub>rr</sub>		-	6	15	nC
Reverse recovery fall time	t <sub>a</sub>		-	8.5	-	ns
Reverse recovery rise time	t <sub>b</sub>		-	6.5	-	

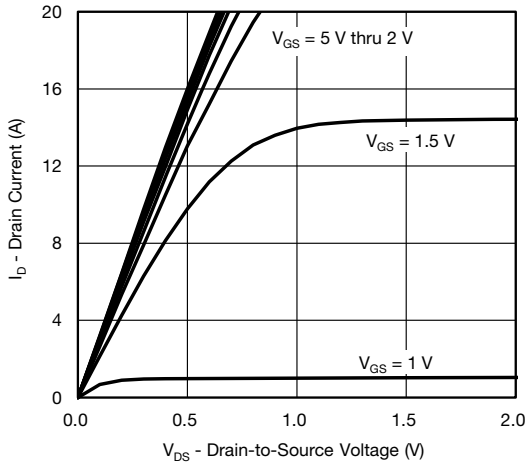
**Notes**

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

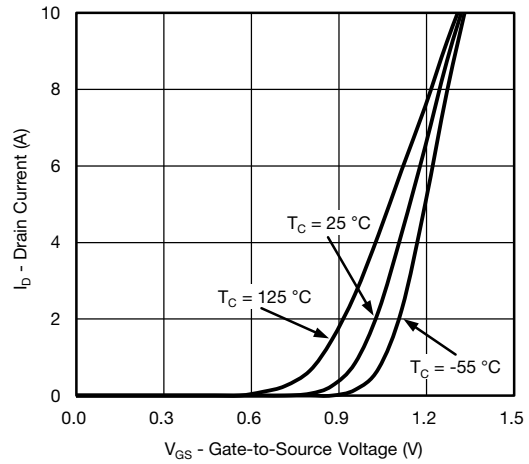
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



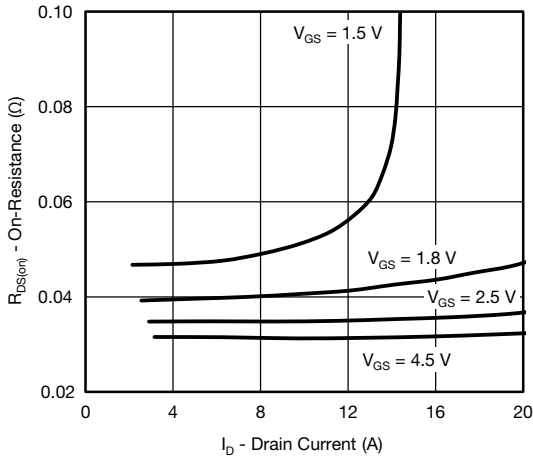
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



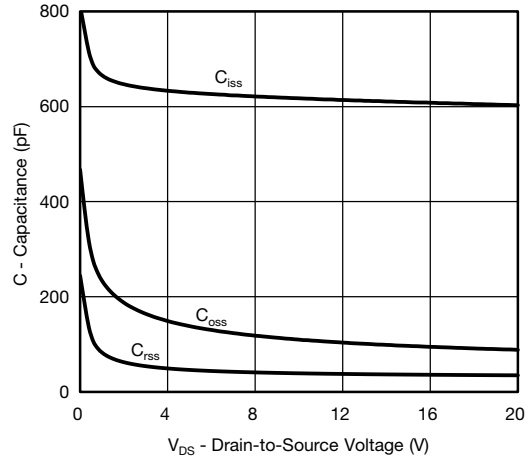
Output Characteristics



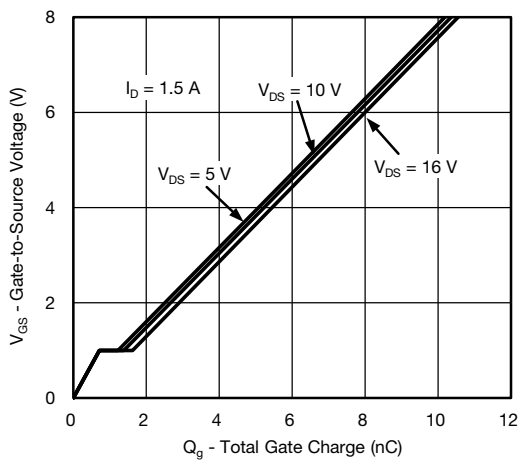
Transfer Characteristics



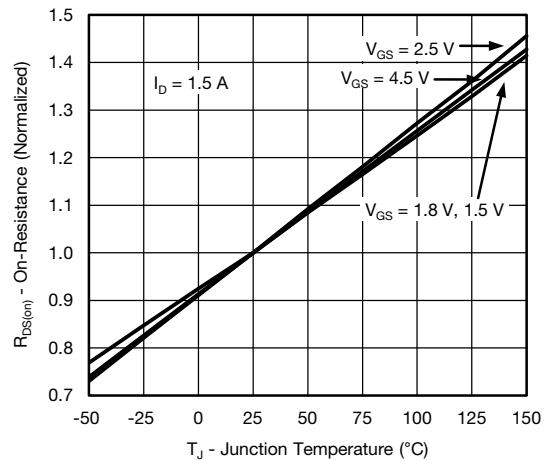
On-Resistance vs. Drain Current and Gate Voltage



Capacitance



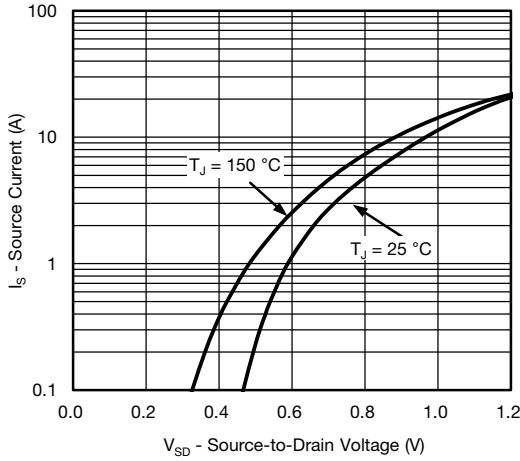
Gate Charge



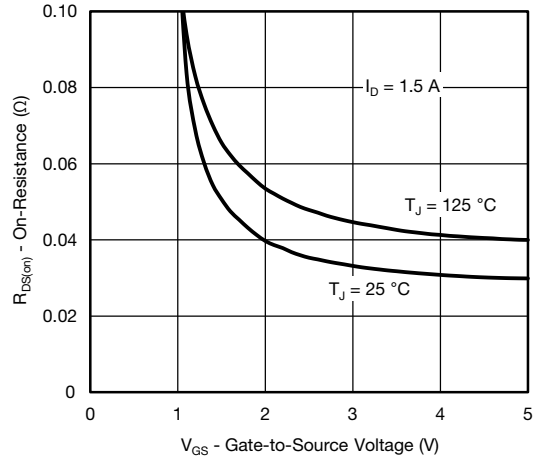
On-Resistance vs. Junction Temperature



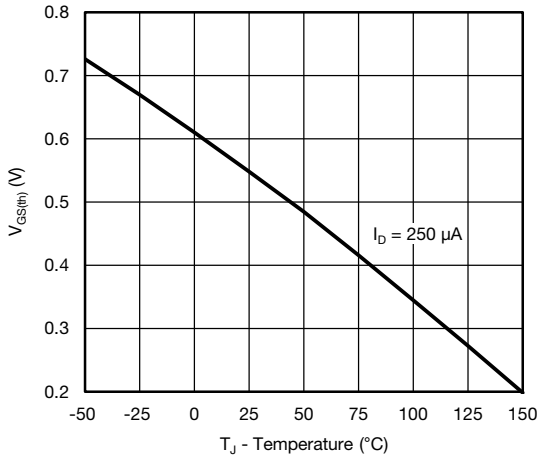
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



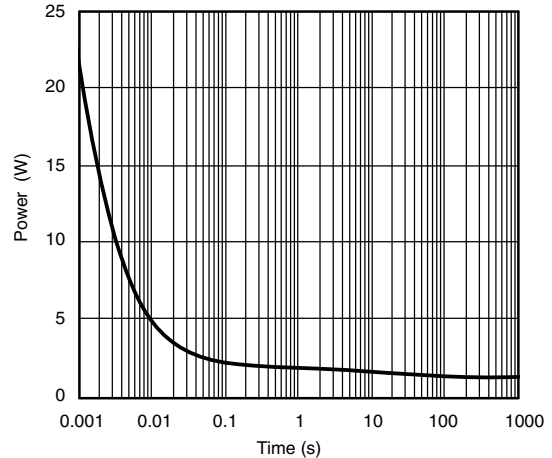
**Source-Drain Diode Forward Voltage**



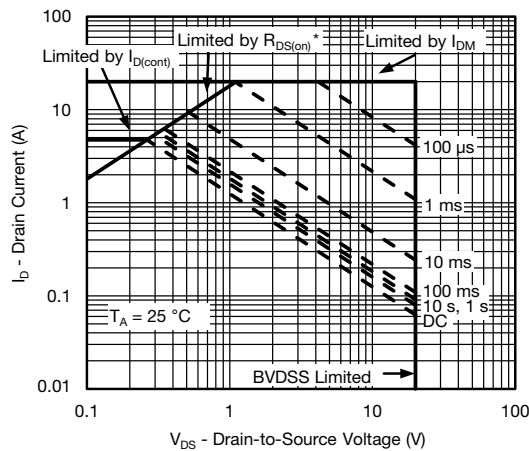
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**



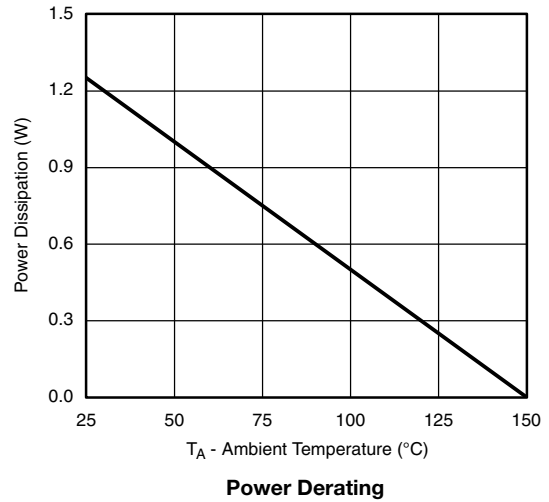
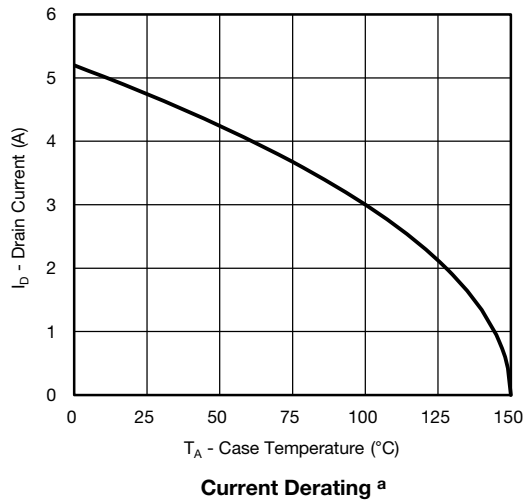
**Single Pulse Power, Junction-to-Ambient**



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



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

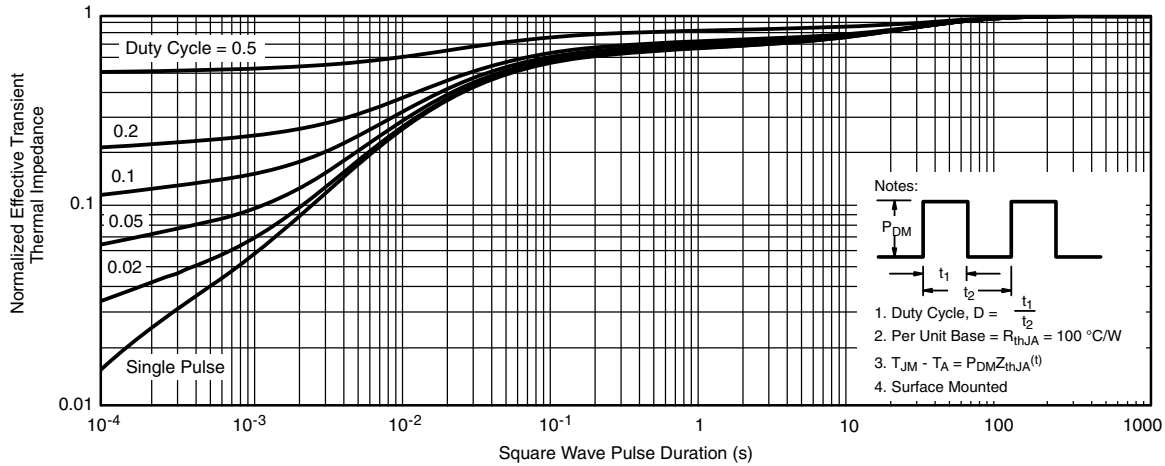


**Note**

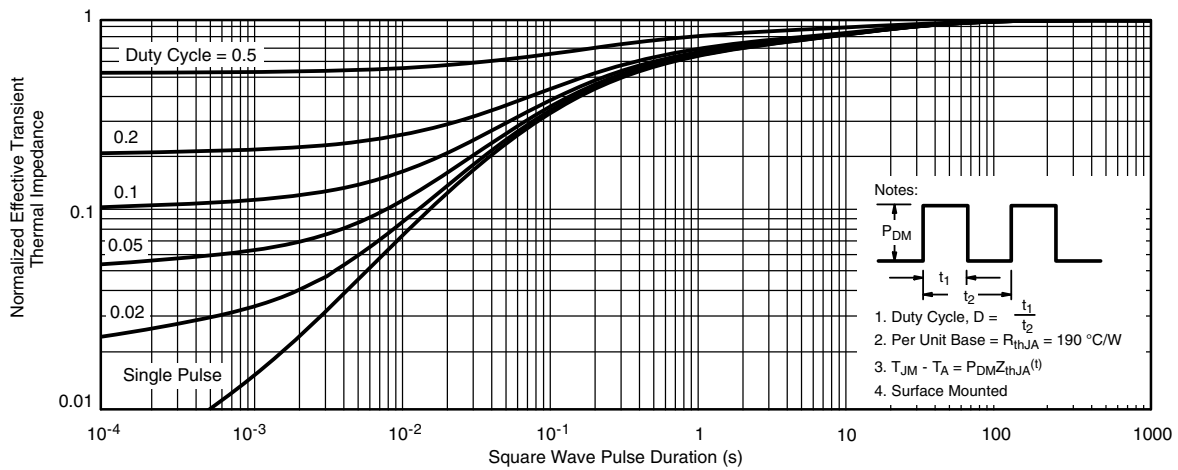
- When mounted on 1" x 1" FR4 with full copper
- a. The power dissipation  $P_D$  is based on  $T_J$  max. = 150 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



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)

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## MICRO FOOT<sup>®</sup>: 4-Bumps (1 mm x 1 mm, 0.5 mm Pitch, 0.286 mm Bump Height)



### Notes

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

DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.458	0.504	0.550	0.0180	0.0198	0.0217
A1	0.214	0.250	0.286	0.0084	0.0098	0.0113
A2	0.244	0.254	0.264	0.0096	0.0100	0.0104
b	0.297	0.330	0.363	0.0117	0.0130	0.0143
b1	0.250			0.0098		
e	0.500			0.0197		
s	0.210	0.230	0.250	0.0083	0.0091	0.0096
D	0.920	0.960	1.000	0.0362	0.0378	0.0394
K	0.029	0.065	0.102	0.0011	0.0026	0.0040

### Note

- Use millimeters as the primary measurement.

ECN: T15-0176-Rev. A, 27-Apr-15  
DWG: 6039



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