

N-Channel 20 V (D-S) MOSFET

PRODUCT SUMMARY			
V _{DS} (V)	R _{DS(on)} (Ω) Max.	I _D (A)	Q _g (Typ.)
20	0.033 at V _{GS} = 4.5 V	16 ^e	7.5 nC
	0.037 at V _{GS} = 2.5 V	16 ^e	
	0.042 at V _{GS} = 1.8 V	15	

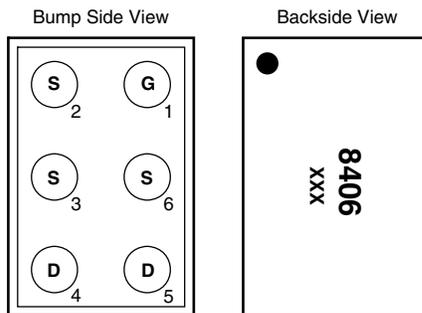
FEATURES

- TrenchFET[®] Power MOSFET
- Ultra-small 1.5 mm x 1 mm Maximum Outline
- Ultra-thin 0.59 mm Maximum Height
- Material categorization:
For definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE

MICRO FOOT

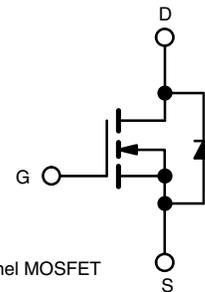


Device Marking: 8406
xxx = Date/Lot Traceability Code

Ordering Information:
Si8406DB-T2-E1 (Lead (Pb)-free and Halogen-free)

APPLICATIONS

- Load Switch
- Battery Management
- Boost Converter



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 _C = 25 °C	16 ^e
		T _C = 70 °C	13.5
		T _A = 25 °C	7.8 ^{a, b}
		T _A = 70 °C	6.2 ^{a, b}
Pulsed Drain Current (t = 300 μs)	I _{DM}	30	A
Continuous Source-Drain Diode Current	I _S	T _C = 25 °C	
		T _A = 25 °C	2.3 ^{a, b}
Maximum Power Dissipation	P _D	T _C = 25 °C	13
		T _C = 70 °C	8.4
		T _A = 25 °C	2.77 ^{a, b}
		T _A = 70 °C	1.77 ^{a, b}
Operating Junction and Storage Temperature Range	T _J , T _{stg}	- 55 to 150	°C
Package Reflow Conditions ^c	IR/Convection	260	

Notes:

- Surface mounted on 1" x 1" FR4 board.
- t = 10 s.
- Refer to IPC/JEDEC (J-STD-020), no manual or hand soldering.
- Case in defined as the top surface of the package.
- T_C = 25 °C package limited.

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient ^{a, b}	R_{thJA}	37	45	°C/W
Maximum Junction-to-Case (Drain) ^c	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
Static						
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0, I_D = 250\ \mu\text{A}$	20			V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\ \mu\text{A}$		18		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$		-3			
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	0.4		0.85	V
Gate-Source Leakage	I_{GSS}	$V_{DS} = 0\ \text{V}, V_{GS} = \pm 8\ \text{V}$			± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 20\ \text{V}, V_{GS} = 0\ \text{V}$			1	μA
		$V_{DS} = 20\ \text{V}, V_{GS} = 0\ \text{V}, T_J = 70\text{ °C}$			10	
On-State Drain Current ^a	$I_{D(on)}$	$V_{DS} \geq 5\ \text{V}, V_{GS} = 4.5\ \text{V}$	5			A
Drain-Source On-State Resistance ^a	$R_{DS(on)}$	$V_{GS} = 4.5\ \text{V}, I_D = 1\ \text{A}$		0.026	0.033	Ω
		$V_{GS} = 2.5\ \text{V}, I_D = 1\ \text{A}$		0.028	0.037	
		$V_{GS} = 1.8\ \text{V}, I_D = 1\ \text{A}$		0.030	0.042	
Forward Transconductance ^a	g_{fs}	$V_{DS} = 10\ \text{V}, I_D = 1\ \text{A}$		20		S
Dynamic^b						
Input Capacitance	C_{iss}	$V_{DS} = 10\ \text{V}, V_{GS} = 0\ \text{V}, f = 1\ \text{MHz}$		830		pF
Output Capacitance	C_{oss}		146			
Reverse Transfer Capacitance	C_{rss}		61			
Total Gate Charge	Q_g	$V_{DS} = 10\ \text{V}, V_{GS} = 8\ \text{V}, I_D = 1\ \text{A}$		13	20	nC
		$V_{DS} = 10\ \text{V}, V_{GS} = 4.5\ \text{V}, I_D = 1\ \text{A}$		7.5	12	
Gate-Source Charge	Q_{gs}		1.1			
Gate-Drain Charge	Q_{gd}		0.8			
Gate Resistance	R_g	$V_{GS} = 0.1\ \text{V}, f = 1\ \text{MHz}$		3.6		Ω
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 10\ \text{V}, R_L = 10\ \Omega$ $I_D \cong 1\ \text{A}, V_{GEN} = 4.5\ \text{V}, R_g = 1\ \Omega$		7	15	ns
Rise Time	t_r		18	40		
Turn-Off Delay Time	$t_{d(off)}$		30	60		
Fall Time	t_f		10	20		
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 10\ \text{V}, R_L = 10\ \Omega$ $I_D = 1\ \text{A}, V_{GEN} = 8\ \text{V}, R_g = 1\ \Omega$		5	10	ns
Rise Time	t_r		17	35		
Turn-Off Delay Time	$t_{d(off)}$		25	50		
Fall Time	t_f		10	20		



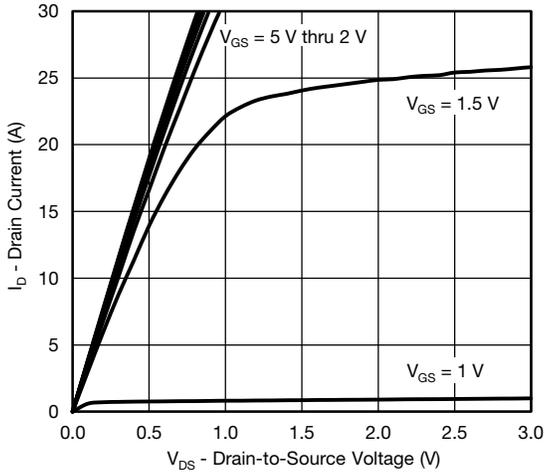
SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	$T_C = 25\text{ }^\circ\text{C}$			20	A
Pulse Diode Forward Current	I_{SM}				30	
Body Diode Voltage	V_{SD}	$I_S = 1\text{ A}, V_{GS} = 0$		0.7	1.2	V
Body Diode Reverse Recovery Time	t_{rr}	$I_F = 1\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		15	30	ns
Body Diode Reverse Recovery Charge	Q_{rr}			5	10	nC
Reverse Recovery Fall Time	t_a			8		ns
Reverse Recovery Rise Time	t_b			7		

Notes:

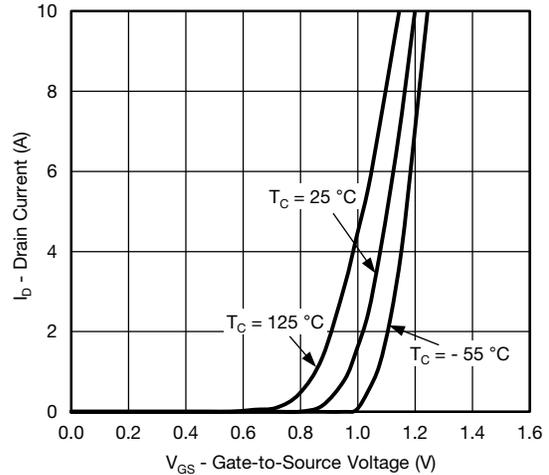
- a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.
- b. Guaranteed by design, not subject to production testing.

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.

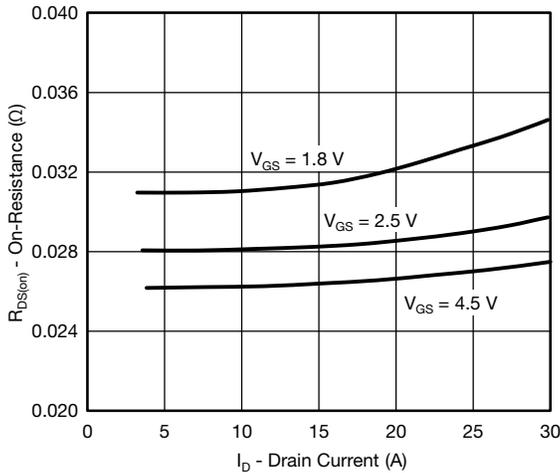
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



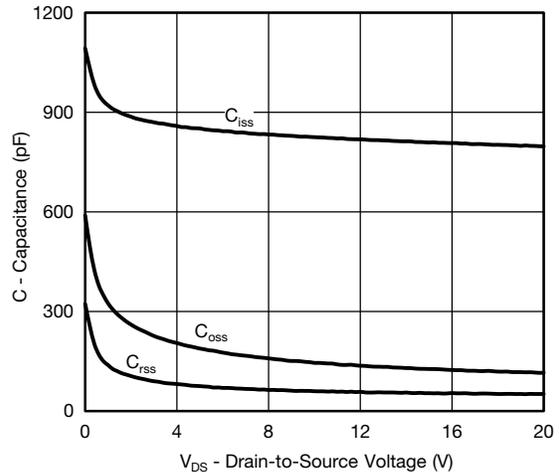
Output Characteristics



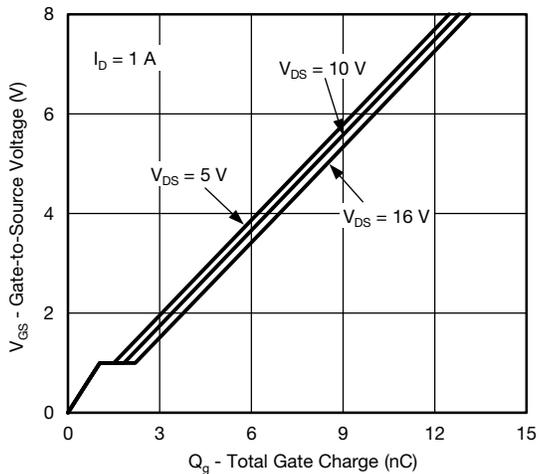
Transfer Characteristics



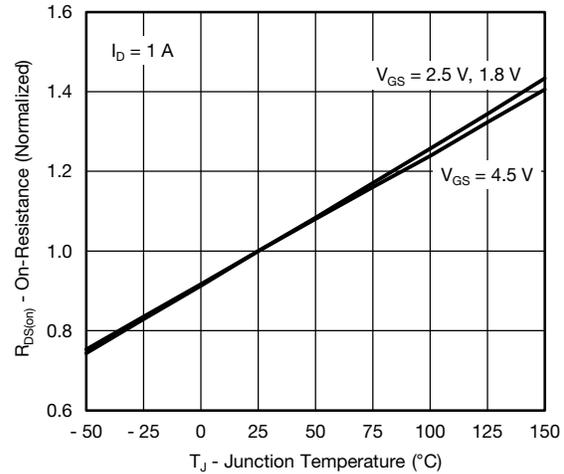
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

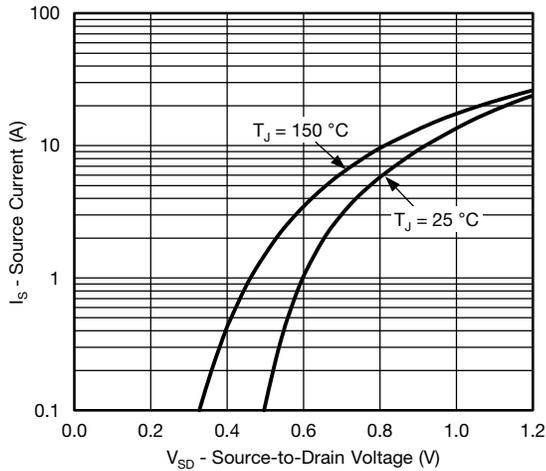


Gate Charge

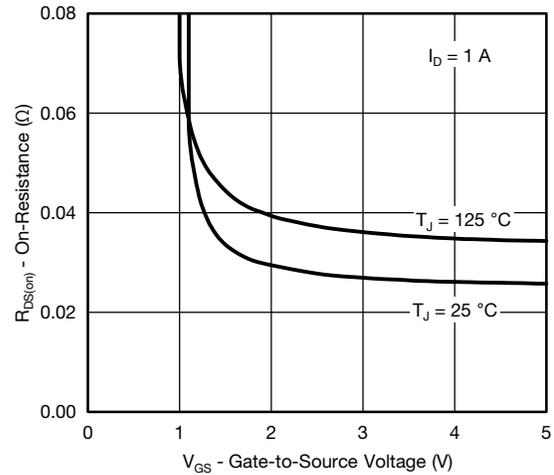


On-Resistance vs. Junction Temperature

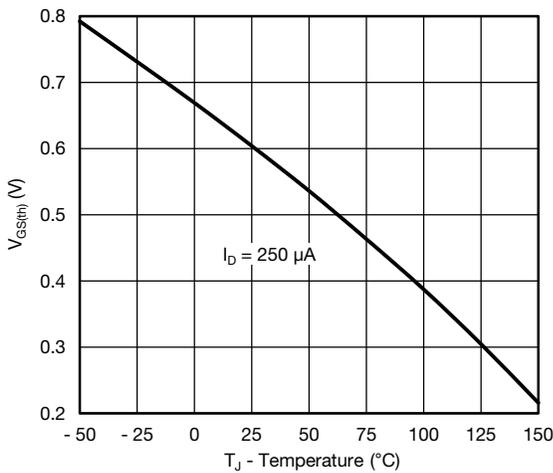
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



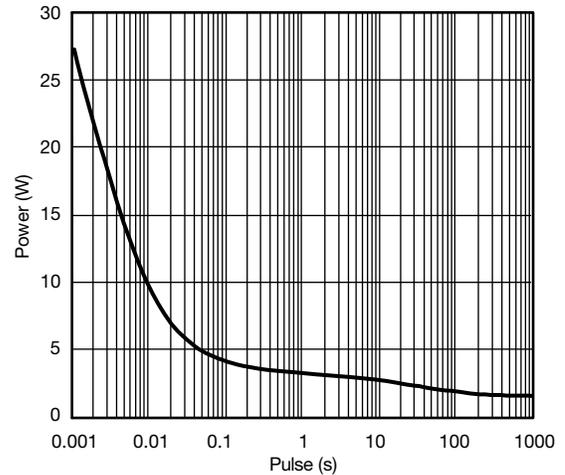
Source-Drain Diode Forward Voltage



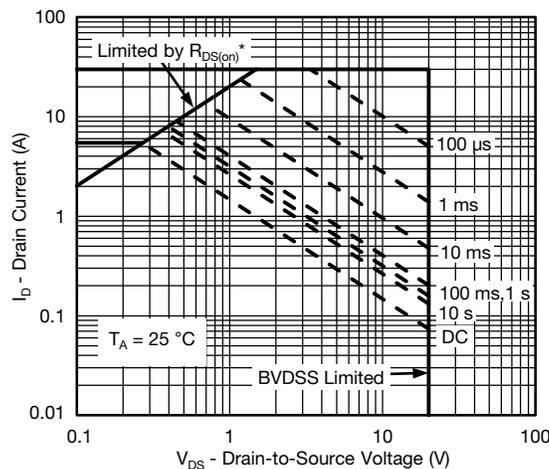
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage

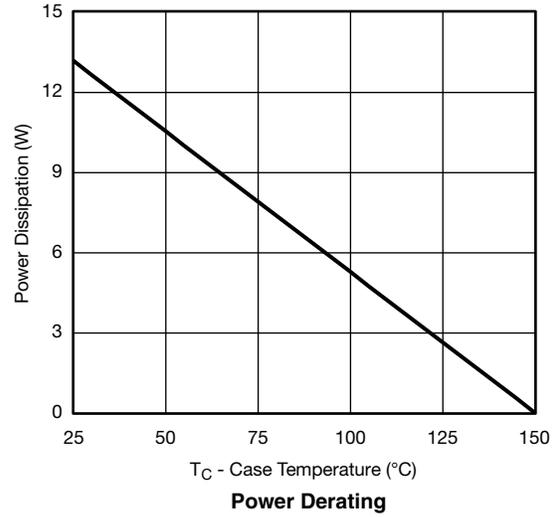
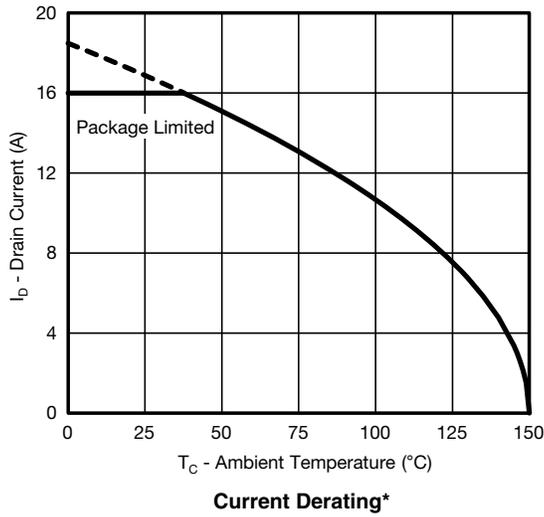


Single Pulse Power, Junction-to-Ambient



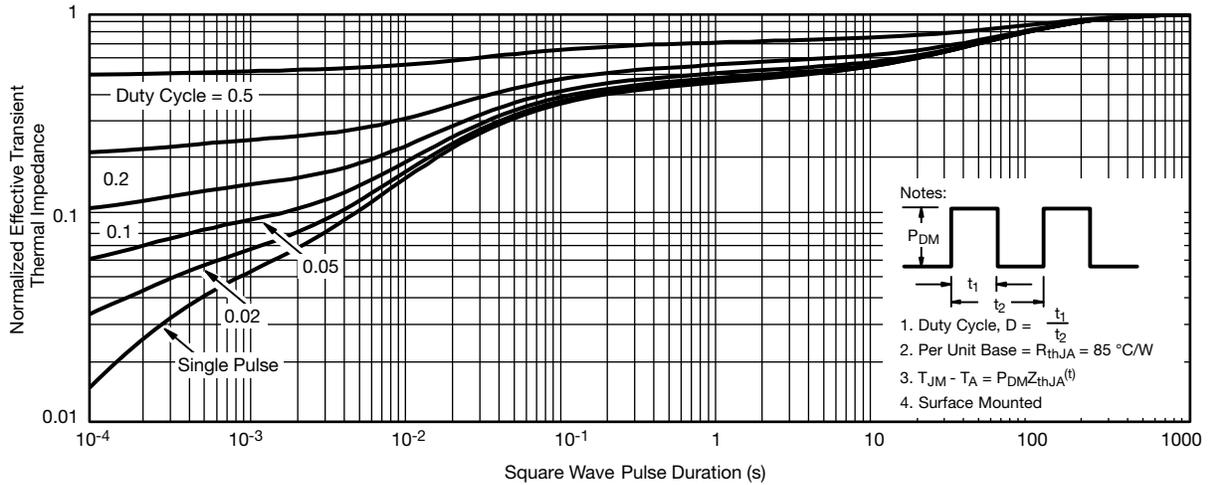
Safe Operating Area, Junction-to-Ambient

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

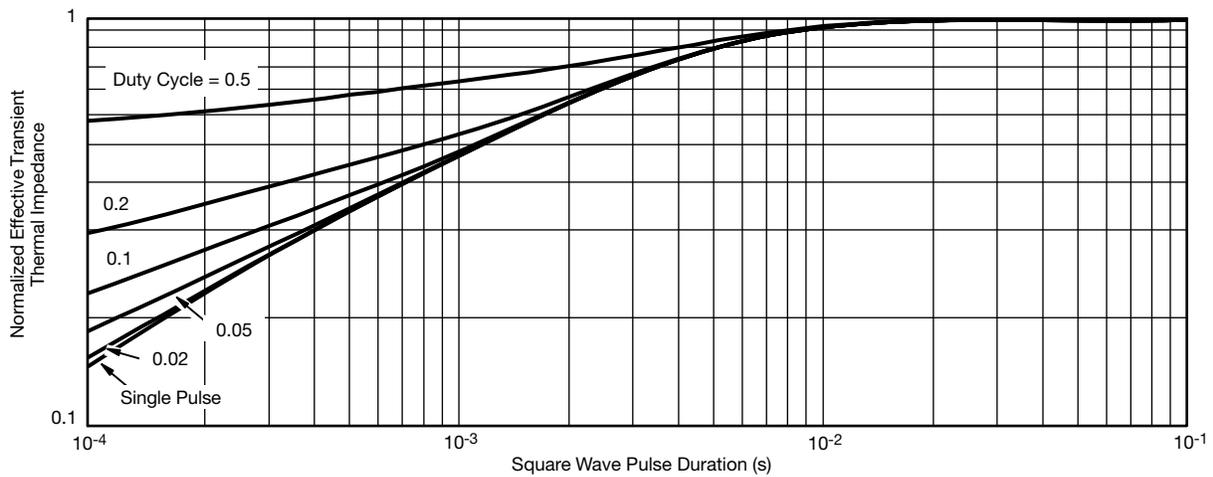


* The power dissipation P_D is based on T_{J(max)} = 150 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



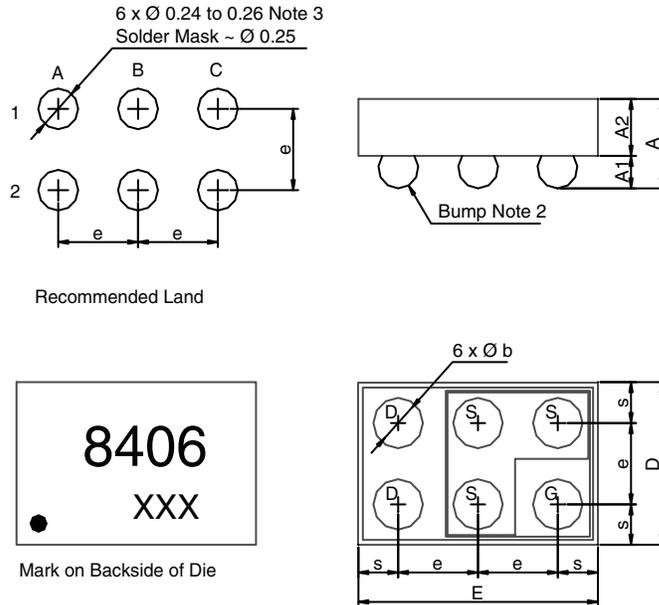
Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Case

PACKAGE OUTLINE

MICRO FOOT: 6-BUMP (0.5 mm PITCH)



Notes (unless otherwise specified):

- All dimensions are in millimeters.
- Six (6) solder bumps are lead (Pb)-free 95.5Sn, 3.8Ag, 0.7Cu with diameter \varnothing 0.30 mm to 0.32 mm.
- Backside surface is coated with a Ti/Ni/Ag layer.
- Non-solder mask defined copper landing pad.
- * is location of pin 1.

Dim.	Millimeters ^a			Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.510	0.575	0.590	0.0201	0.0224	0.0232
A ₁	0.220	0.250	0.280	0.0087	0.0098	0.0110
A ₂	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

Note:

- a. Use millimeters as the primary measurement.

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