

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

PRODUCT SUMMARY			
V _{DS} (V)	R _{DS(on)} (Ω)	I _D (A) ^e	Q _g (Typ.)
- 20	0.084 at V _{GS} = - 4.5 V	- 9.8	9.5 nC
	0.100 at V _{GS} = - 2.5 V	- 9.0	
	0.120 at V _{GS} = - 1.8 V	- 5.0	
	0.155 at V _{GS} = - 1.5 V	- 2.0	
	0.495 at V _{GS} = - 1.2 V	- 0.5	

FEATURES

- TrenchFET[®] Power MOSFET
- Ultra Small 1.2 mm Length x 1 mm Width
- Ultra Thin 0.59 mm Height

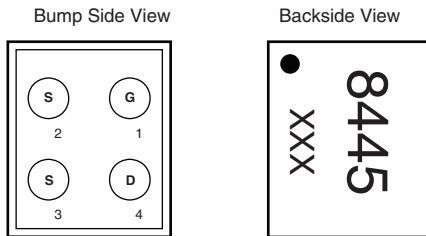


RoHS
COMPLIANT

APPLICATIONS

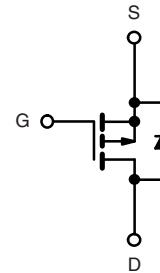
- Portable Devices
 - Battery Management
 - Low Threshold Load Switch
 - Battery Protection

MICRO FOOT



Device Marking: 8445
xxx = Date/Lot Traceability Code

Ordering Information: Si8445DB-T2-E1 (Lead (Pb)-free)



P-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}	± 5	
Continuous Drain Current (T _J = 150 °C)	I _D	T _C = 25 °C	- 9.8
		T _C = 70 °C	- 7.9
		T _A = 25 °C	- 3.9 ^{a, b}
		T _A = 70 °C	- 3.1 ^{a, b}
Pulsed Drain Current	I _{DM}	- 10	A
Continuous Source-Drain Diode Current	I _S	T _C = 25 °C	
		T _A = 25 °C	- 1.5 ^{a, b}
Maximum Power Dissipation	P _D	T _C = 25 °C	11.4
		T _C = 70 °C	7.3
		T _A = 25 °C	1.8 ^{a, b}
		T _A = 70 °C	1.1 ^{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 = 5 s.
- Refer to IPC/JEDEC (J-STD-020C), 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_C = 25 °C.

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient ^{a, b}	R_{thJA}	55	70	°C/W
Maximum Junction-to-Foot (Drain)	Steady State R_{thJF}	8.5	11	

Notes:

- a. Surface Mounted on 1" x 1" FR4 board.
b. Maximum under Steady State conditions is 100 °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}	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	-20			V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		-19		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$		2.3			
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	-0.35		-0.85	V
Gate-Source Leakage	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 5\text{ V}$			± 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	$I_{D(on)}$	$V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$	-5			A
Drain-Source On-State Resistance ^a	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -1\text{ A}$		0.070	0.084	Ω
		$V_{GS} = -2.5\text{ V}, I_D = -1\text{ A}$		0.082	0.100	
		$V_{GS} = -1.8\text{ V}, I_D = -1\text{ A}$		0.097	0.120	
		$V_{GS} = -1.5\text{ V}, I_D = -0.7\text{ A}$		0.115	0.155	
		$V_{GS} = -1.2\text{ V}, I_D = -0.2\text{ A}$		0.165	0.495	
Forward Transconductance ^a	g_{fs}	$V_{DS} = -10\text{ V}, I_D = -1\text{ A}$		6.5		S
Dynamic^b						
Input Capacitance	C_{iss}	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		700		pF
Output Capacitance	C_{oss}		130			
Reverse Transfer Capacitance	C_{rss}		80			
Total Gate Charge	Q_g	$V_{DS} = -10\text{ V}, V_{GS} = -5\text{ V}, I_D = -1\text{ A}$		10.5	16	nC
Gate-Source Charge	Q_{gs}	$V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = 1\text{ A}$		9.5	15	
Gate-Drain Charge	Q_{gd}		2.2			
Gate Resistance	R_g	$V_{GS} = -0.1\text{ V}, f = 1\text{ MHz}$		5.5		Ω
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10\text{ V}, R_L = 10\text{ }\Omega$ $I_D \cong -1\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$		11	20	ns
Rise Time	t_r		25	40		
Turn-Off Delay Time	$t_{d(off)}$		37	55		
Fall Time	t_f		10	15		



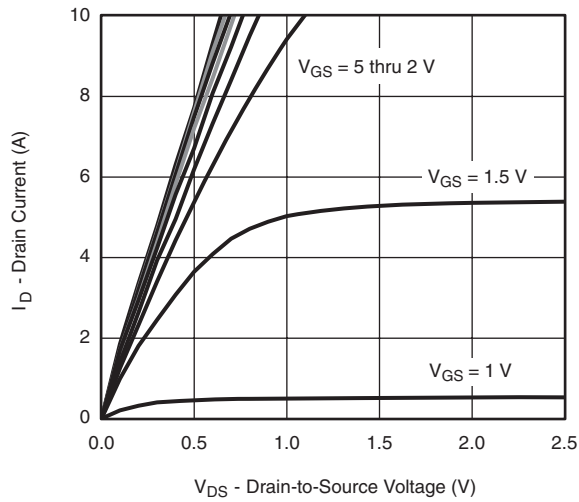
SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	$T_C = 25\text{ }^\circ\text{C}$			- 9.5	A
Pulse Diode Forward Current	I_{SM}				- 10	
Body Diode Voltage	V_{SD}	$I_S = - 1\text{ A}, V_{GS} = 0\text{ V}$		- 0.7	- 1.2	V
Body Diode Reverse Recovery Time	t_{rr}	$I_F = - 1\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		25	50	ns
Body Diode Reverse Recovery Charge	Q_{rr}			10	20	nC
Reverse Recovery Fall Time	t_a			9		ns
Reverse Recovery Rise Time	t_b			16		

Notes:

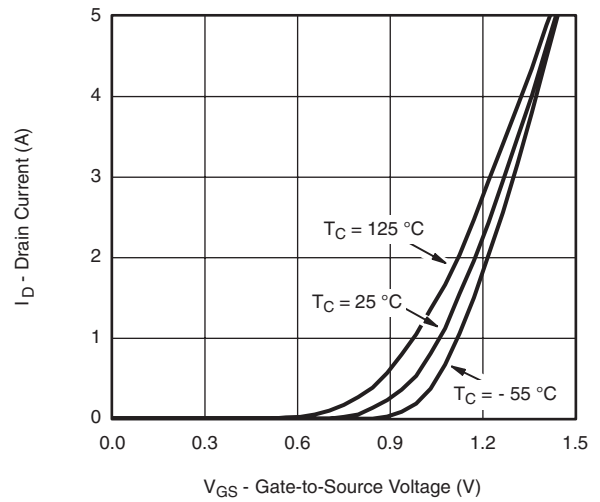
- a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.
- b. Guaranteed by design, not subject to production testing.

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.

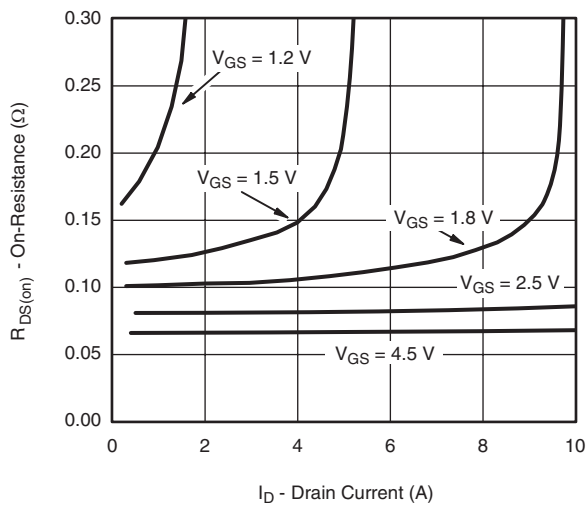
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



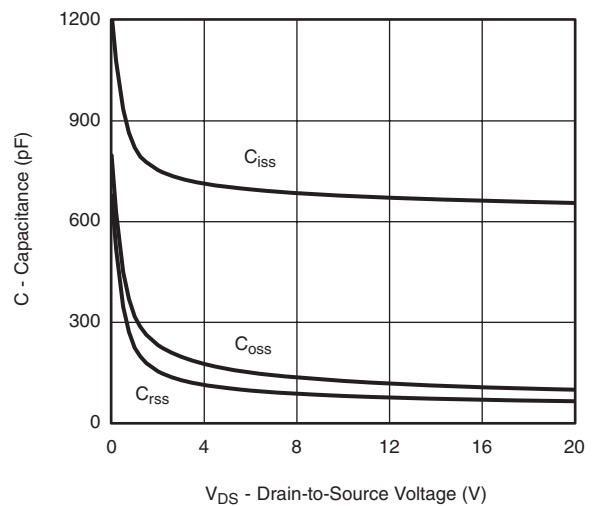
Output Characteristics



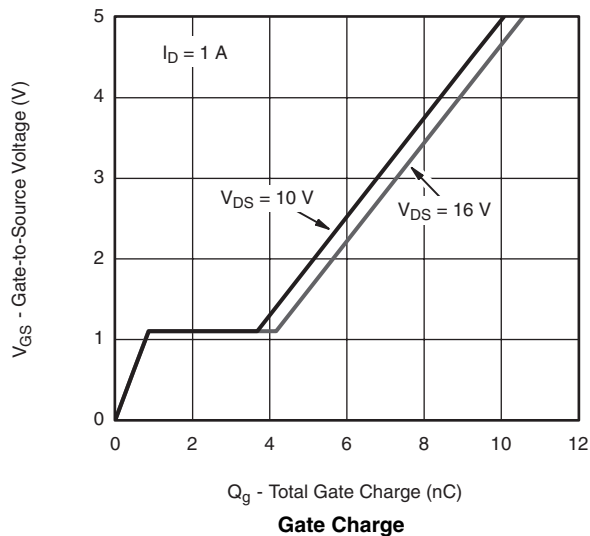
Transfer Characteristics



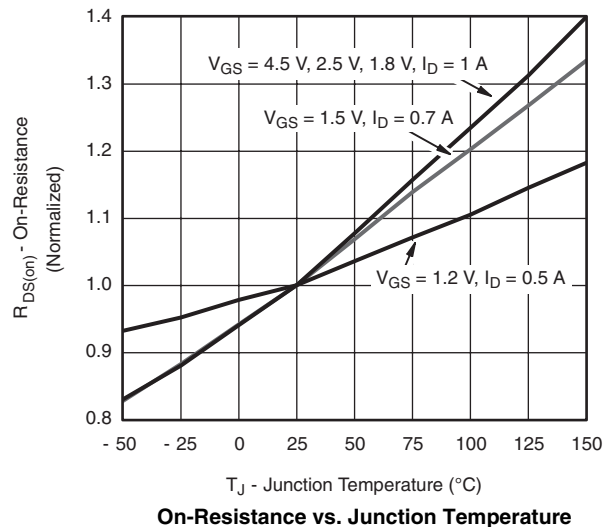
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

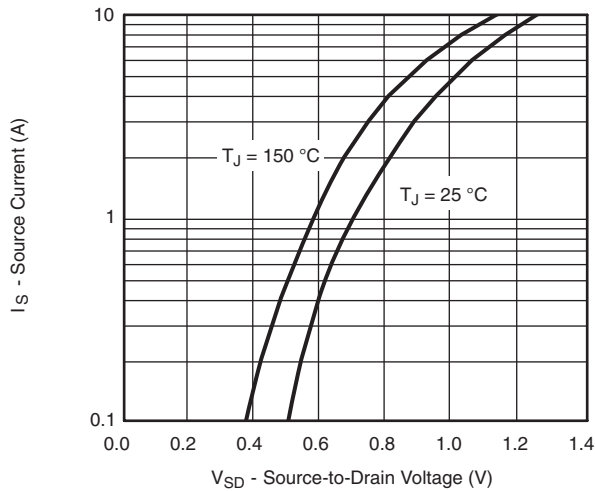


Gate Charge

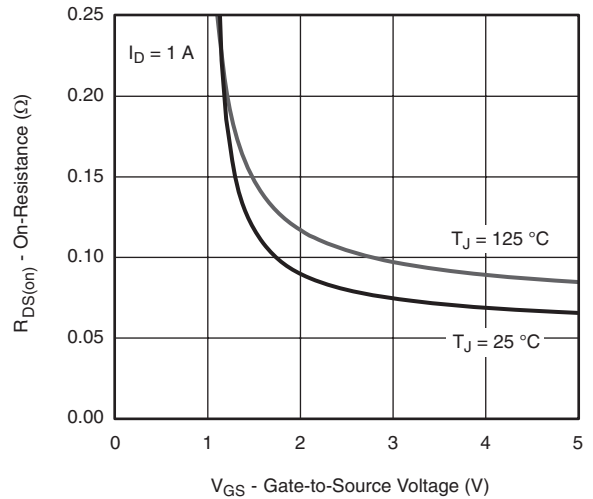


On-Resistance vs. Junction Temperature

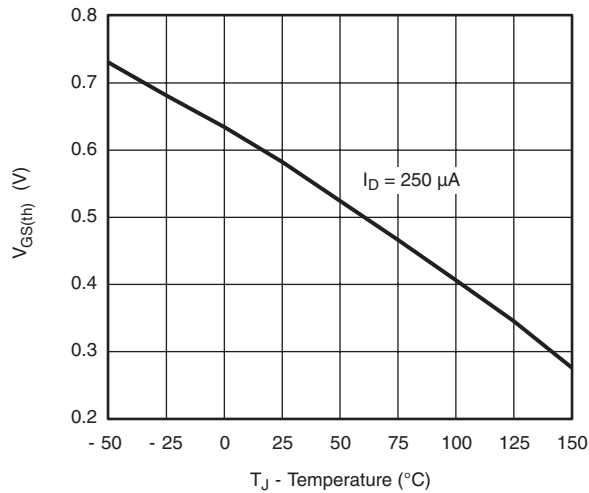
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



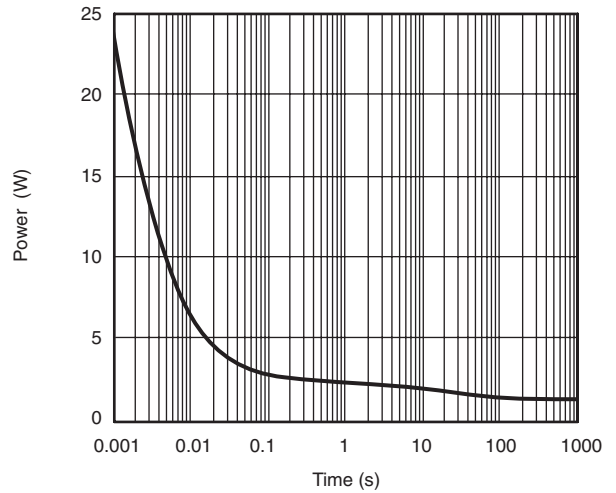
Source-Drain Diode Forward Voltage



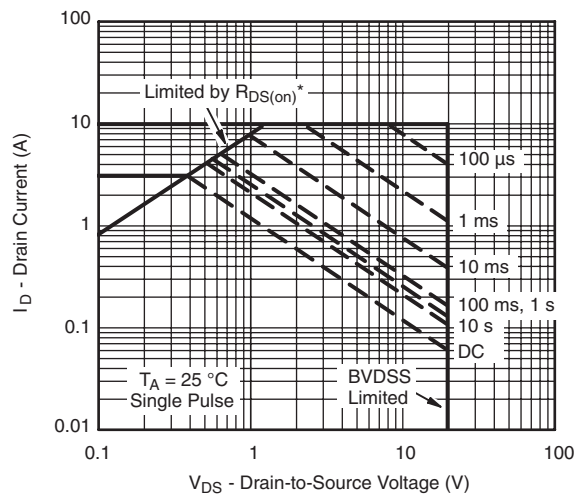
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



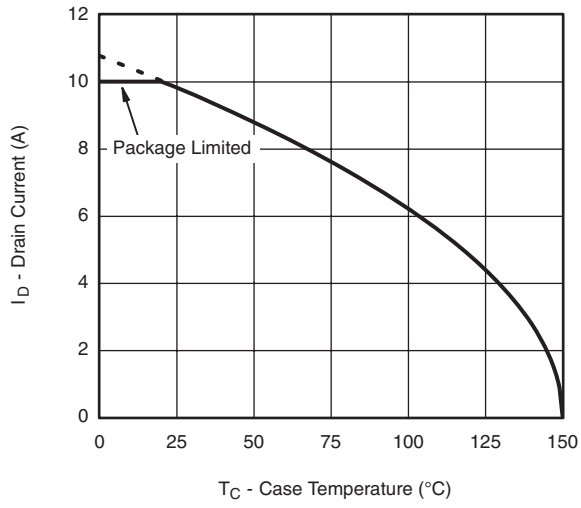
Single Pulse Power, Junction-to-Ambient



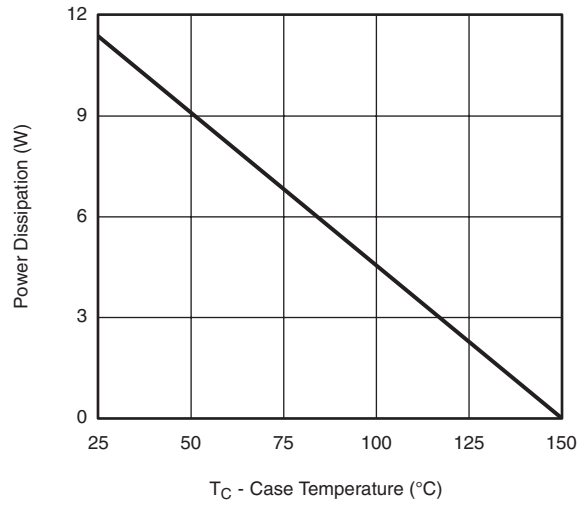
* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



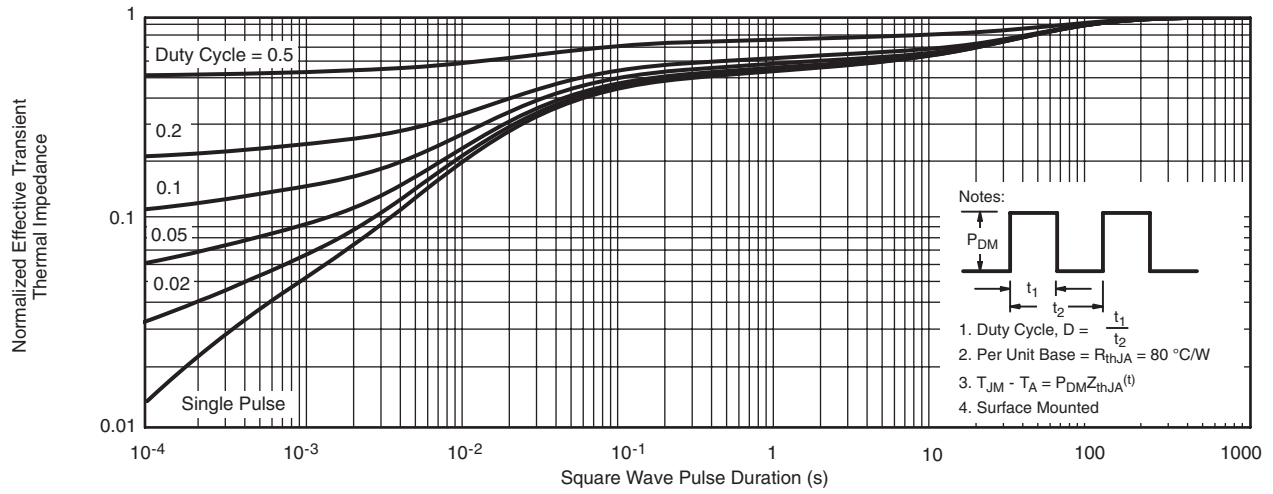
Current Derating*



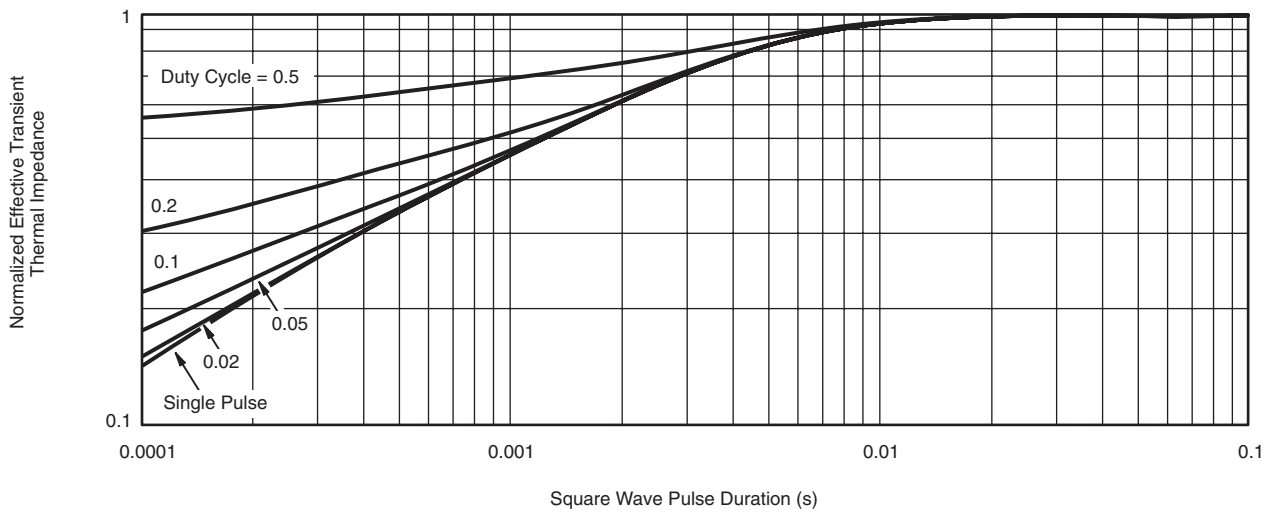
Power Derating

* 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



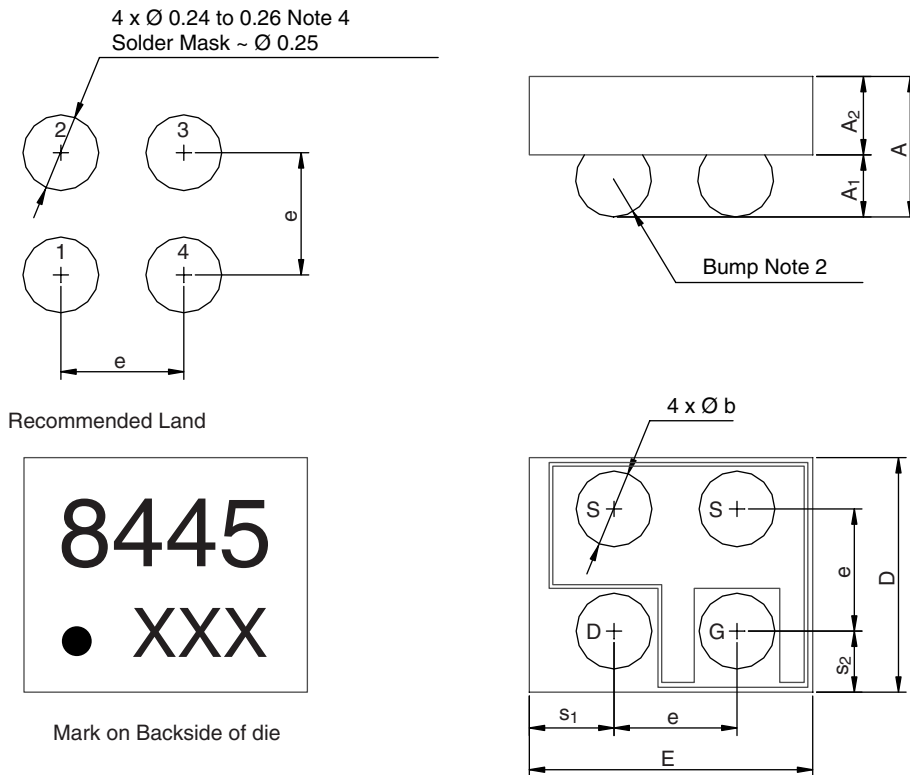
Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Foot

PACKAGE OUTLINE

MICRO FOOT: 4-BUMP (2 x 2, 0.5 mm PITCH)



Notes (Unless otherwise specified):

1. All dimensions are in millimeters.
2. Four (4) solder bumps are lead (Pb)-free 95.5Sn/3.8Ag/0.7Cu with diameter \varnothing 0.30 to 0.32 mm.
3. Backside surface is coated with a Ti/Ni/Ag layer.
4. Non-solder mask defined copper landing pad.
5. • is location of pin 1.

Dim.	Millimeters ^a			Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.510	0.550	0.590	0.0201	0.0217	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 ₁	0.330	0.340	0.350	0.0130	0.0134	0.0138
s ₂	0.230	0.240	0.250	0.0090	0.0094	0.0098
D	0.960	0.980	1.000	0.0378	0.0388	0.0394
E	1.160	1.180	1.200	0.0457	0.0465	0.0472

Notes:

- a. Use millimeters as the primary measurement.

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