

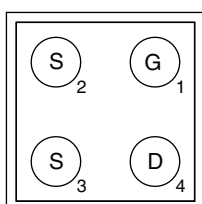
# P-Channel 30 V (D-S) MOSFET

## PRODUCT SUMMARY

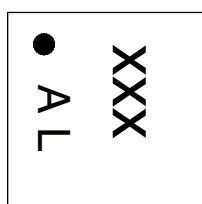
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω) Max.	I <sub>D</sub> (A) <sup>a, e</sup>	Q <sub>g</sub> (Typ.)
- 30	0.128 at V <sub>GS</sub> = - 4.5 V	- 2.3	5.2 nC
	0.143 at V <sub>GS</sub> = - 3.7 V	- 2.1	
	0.215 at V <sub>GS</sub> = - 2.5 V	- 1.8	

## MICRO FOOT

Bump Side View



Backside View



Device Marking: A L

xxx = Date/Lot Traceability Code

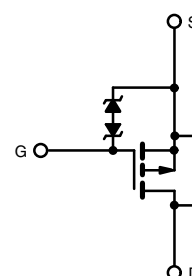
## FEATURES

- TrenchFET® Power MOSFET
- Small 0.8 mm x 0.8 mm outline area
- Low 0.4 mm max. profile
- Typical ESD protection 1400 V HBM
- 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 switches and chargers switches
- Battery management, power management
- DC/DC converters
- For smart phones, tablet PCs, and mobile computing



P-Channel MOSFET

Ordering Information: Si8821EDB-T2-E1 (Lead (Pb)-free and Halogen-free)

## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C, unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V <sub>DS</sub>	- 30	V
Gate-Source Voltage	V <sub>GS</sub>	± 12	
Continuous Drain Current (T <sub>J</sub> = 150 °C)	I <sub>D</sub>	T <sub>A</sub> = 25 °C	A
		T <sub>A</sub> = 70 °C	
		T <sub>A</sub> = 25 °C	
		T <sub>A</sub> = 70 °C	
Pulsed Drain Current (t = 300 μs)	I <sub>DM</sub>	- 15	A
Continuous Source-Drain Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	
		T <sub>A</sub> = 25 °C	
Maximum Power Dissipation	P <sub>D</sub>	T <sub>A</sub> = 25 °C	W
		T <sub>A</sub> = 70 °C	
		T <sub>A</sub> = 25 °C	
		T <sub>A</sub> = 70 °C	
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150	°C
Package Reflow Conditions <sup>c</sup>	VPR	260	
	IR/Convection	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. In this document, any reference to case represents the body of the MICRO FOOT device and foot is the bump.

e. Based on T<sub>A</sub> = 25 °C.

**THERMAL RESISTANCE RATINGS**

Parameter		Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient <sup>a, b</sup>	$t = 5 \text{ s}$	$R_{thJA}$	105	135	$^{\circ}\text{C/W}$
Maximum Junction-to-Ambient <sup>c, d</sup>	$t = 5 \text{ s}$		200	260	

Notes:

a. Surface mounted on 1" x 1" FR4 board with full copper.

b. Maximum under steady state conditions is 185  $^{\circ}\text{C/W}$ .

c. Surface mounted on 1" x 1" FR4 board with minimum copper.

d. Maximum under steady state conditions is 330  $^{\circ}\text{C/W}$ .**SPECIFICATIONS** ( $T_J = 25^{\circ}\text{C}$ , unless otherwise noted)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0 \text{ V}, I_D = -250 \mu\text{A}$	-30			V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250 \mu\text{A}$		-21		$\text{mV}/^{\circ}\text{C}$
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			0.5		
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250 \mu\text{A}$	-0.6		-1.3	V
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 4.5 \text{ V}$			$\pm 0.1$	$\mu\text{A}$
		$V_{DS} = 0 \text{ V}, V_{GS} = \pm 12 \text{ V}$			$\pm 5$	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -30 \text{ V}, V_{GS} = 0 \text{ V}$			-1	$\mu\text{A}$
		$V_{DS} = -30 \text{ V}, V_{GS} = 0 \text{ V}, T_J = 70^{\circ}\text{C}$			-10	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \leq -5 \text{ V}, V_{GS} = -4.5 \text{ V}$	-5			A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -4.5 \text{ V}, I_D = -1 \text{ A}$		0.105	0.128	$\Omega$
		$V_{GS} = -3.7 \text{ V}, I_D = -1 \text{ A}$		0.115	0.143	
		$V_{GS} = -2.5 \text{ V}, I_D = -0.5 \text{ A}$		0.150	0.215	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -5 \text{ V}, I_D = -1 \text{ A}$		4.8		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = -15 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		440		pF
Output Capacitance	$C_{oss}$			50		
Reverse Transfer Capacitance	$C_{rss}$			40		
Total Gate Charge	$Q_g$	$V_{DS} = -15 \text{ V}, V_{GS} = -10 \text{ V}, I_D = -1 \text{ A}$		11	17	nC
				5.2	8	
Gate-Source Charge	$Q_{gs}$	$V_{DS} = -15 \text{ V}, V_{GS} = -4.5 \text{ V}, I_D = -1 \text{ A}$		0.9		
Gate-Drain Charge	$Q_{gd}$			1.6		
Gate Resistance	$R_g$	$V_{GS} = -0.1 \text{ V}, f = 1 \text{ MHz}$		15		$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -15 \text{ V}, R_L = 15 \Omega$ $I_D \cong -1 \text{ A}, V_{GEN} = -4.5 \text{ V}, R_g = 1 \Omega$		25	50	ns
Rise Time	$t_r$			20	40	
Turn-Off Delay Time	$t_{d(off)}$			40	80	
Fall Time	$t_f$			15	30	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -15 \text{ V}, R_L = 15 \Omega$ $I_D \cong -1 \text{ A}, V_{GEN} = -10 \text{ V}, R_g = 1 \Omega$		5	10	
Rise Time	$t_r$			10	20	
Turn-Off Delay Time	$t_{d(off)}$			50	100	
Fall Time	$t_f$			15	30	

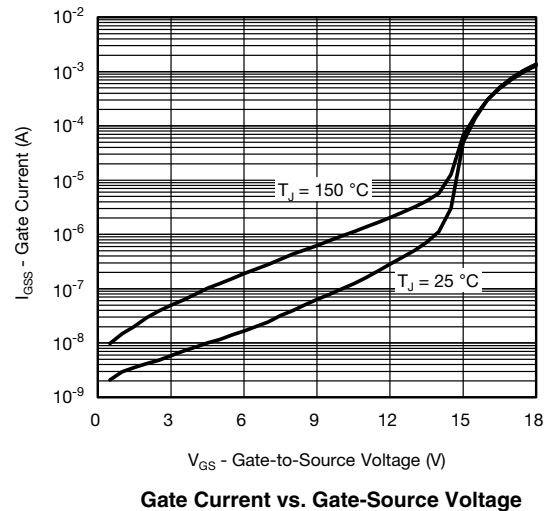
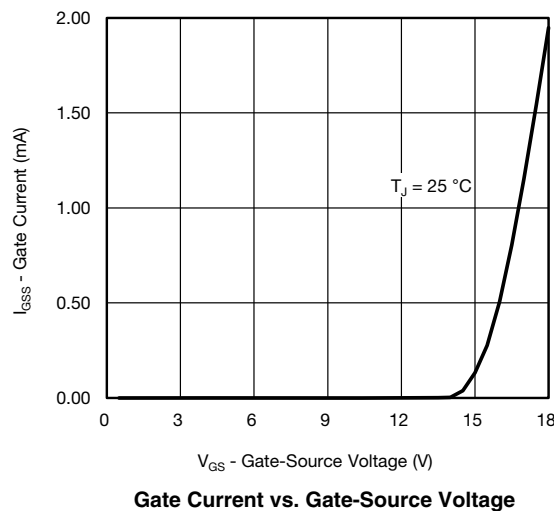
SPECIFICATIONS ( $T_J = 25^\circ\text{C}$ , unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	$I_S$	$T_A = 25^\circ\text{C}$			- 0.7	A
Pulse Diode Forward Current	$I_{SM}$				- 15	
Body Diode Voltage	$V_{SD}$	$I_S = -1\text{ A}, V_{GS} = 0\text{ V}$		- 0.82	- 1.2	V
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = -1\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, T_J = 25^\circ\text{C}$		11	20	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			4	10	nC
Reverse Recovery Fall Time	$t_a$			6.5		ns
Reverse Recovery Rise Time	$t_b$			4.5		

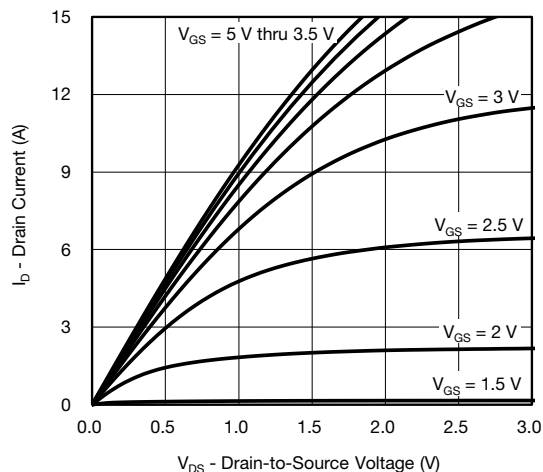
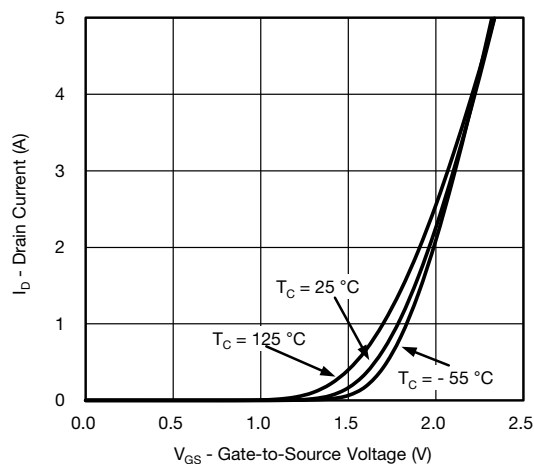
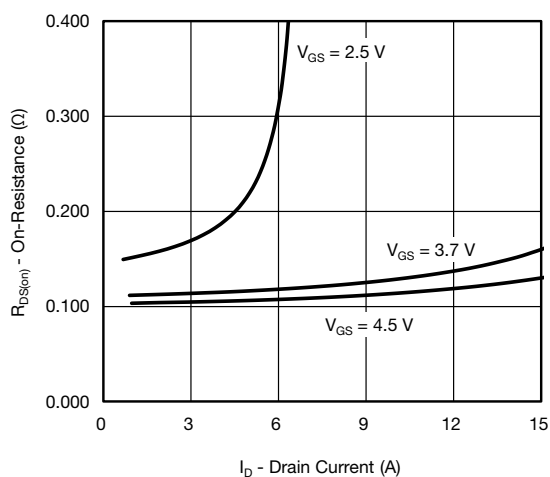
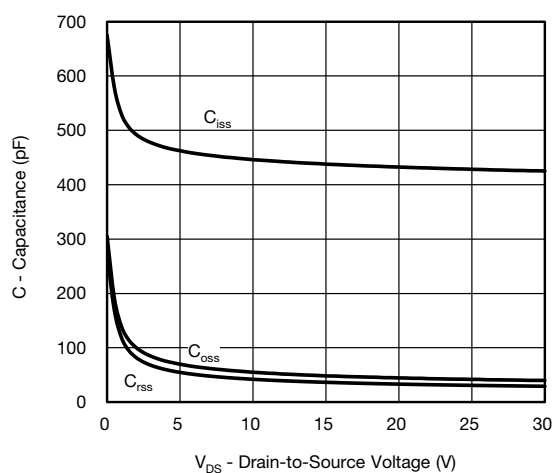
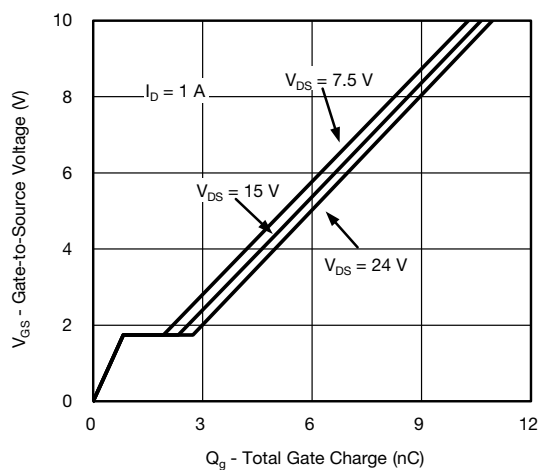
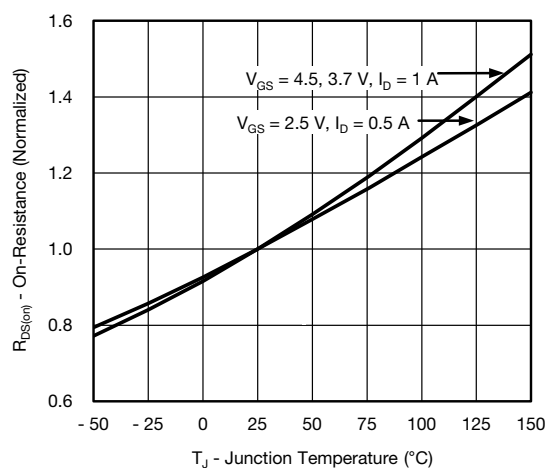
Notes:

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

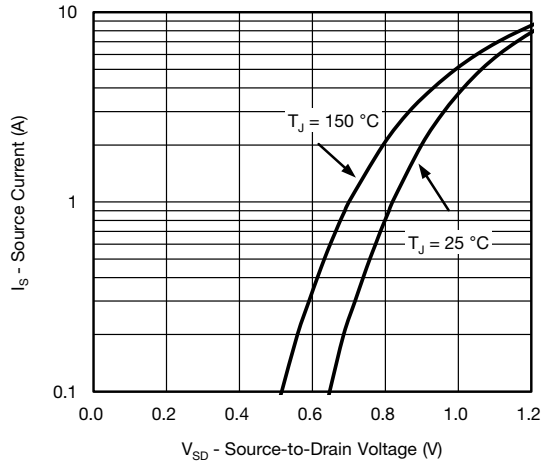
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

## TYPICAL CHARACTERISTICS ( $25^\circ\text{C}$ , unless otherwise noted)

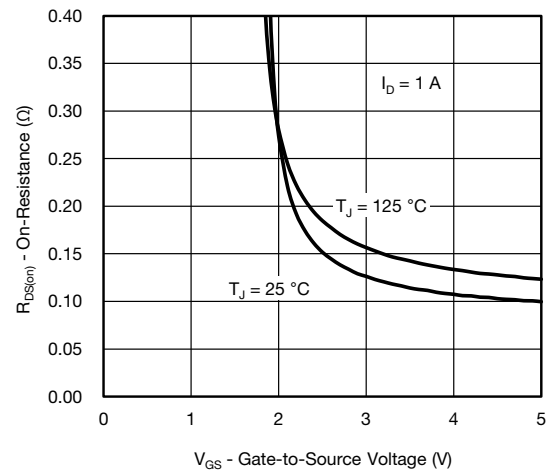


**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)**Output Characteristics****Transfer Characteristics****On-Resistance vs. Drain Current and Gate Voltage****Capacitance****Gate Charge****On-Resistance vs. Junction Temperature**

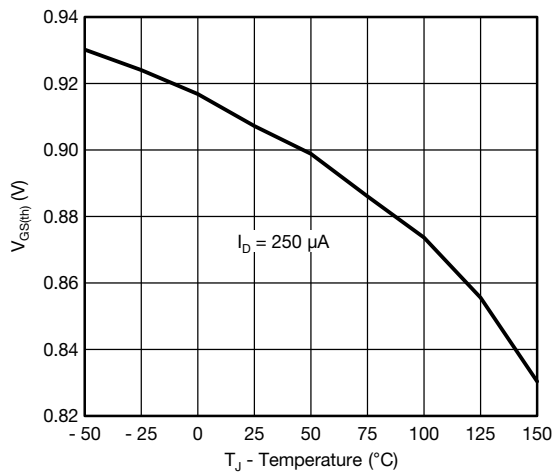
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



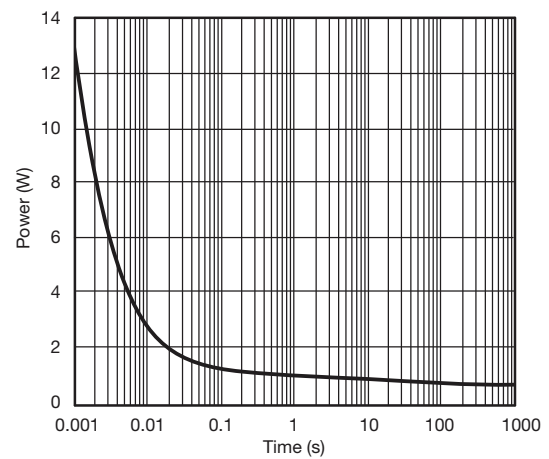
Source-Drain Diode Forward Voltage



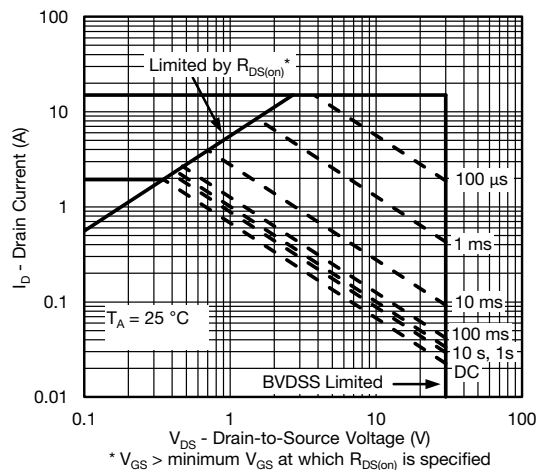
On-Resistance vs. Gate-to-Source Voltage



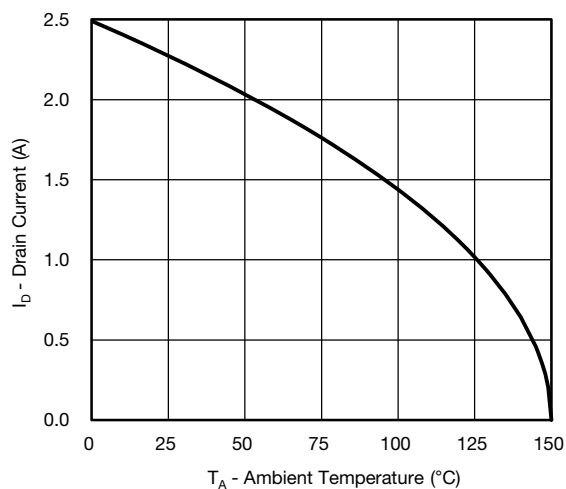
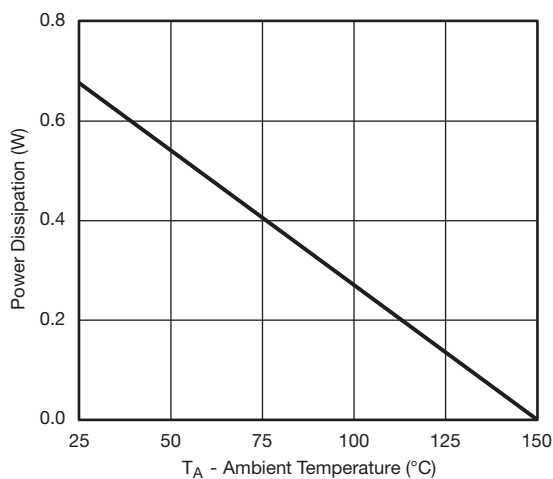
Threshold Voltage



Single Pulse Power, Junction-to-Ambient



Safe Operating Area, Junction-to-Ambient

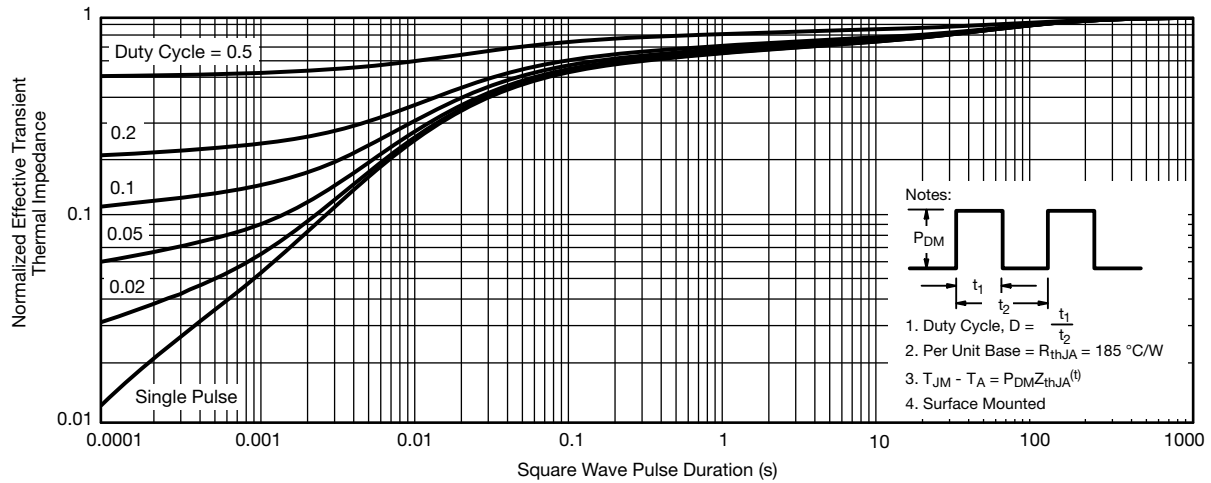
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)**Current Derating\*****Power Derating**

Note:

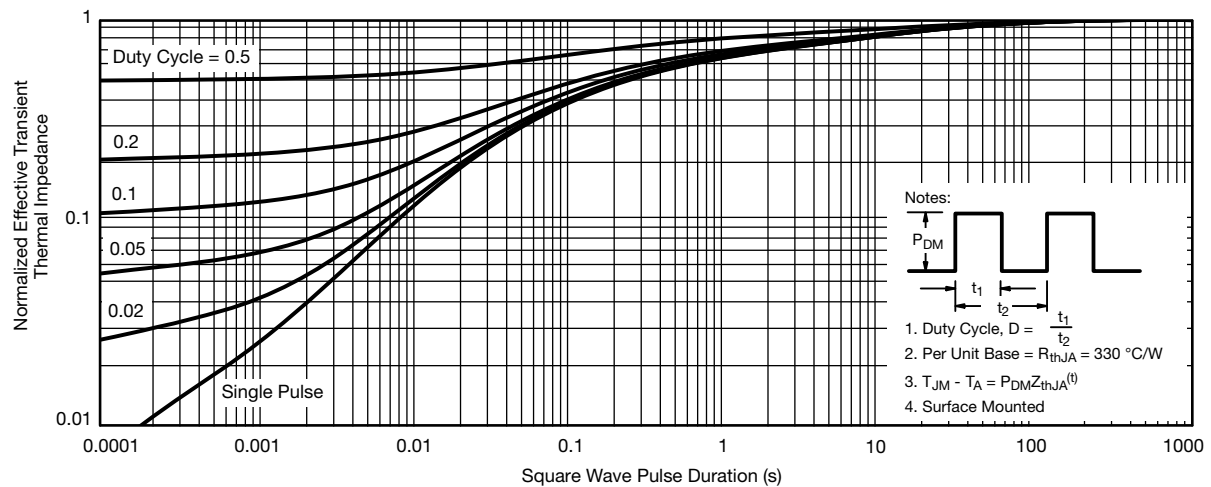
When mounted on 1" x 1" FR4 with full copper.

\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150$  °C, using junction-to-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)



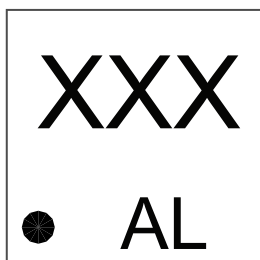
**Normalized Thermal Transient Impedance, Junction-to-Ambient (on 1" x 1" FR4 Board with maximum Copper)**



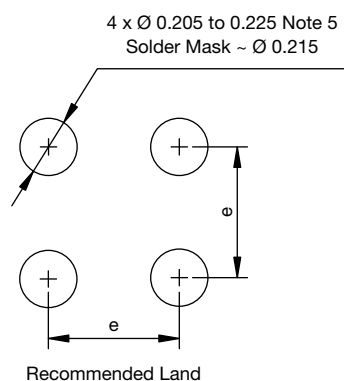
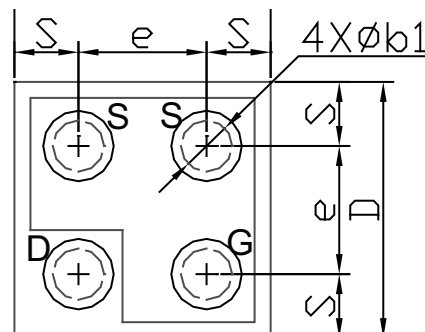
**Normalized Thermal Transient Impedance, Junction-to-Ambient (on 1" x 1" FR4 Board with minimum Copper)**

## PACKAGE OUTLINE

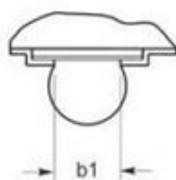
## MICRO FOOT 0.8 mm x 0.8 mm: 4-BUMP (0.4 mm PITCH)



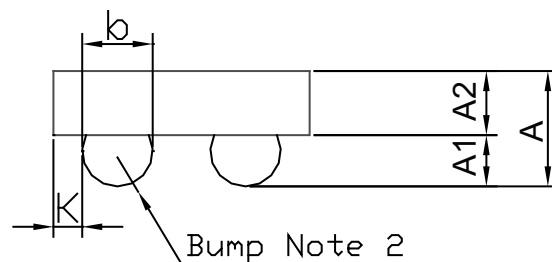
Mark on Backside of die



Recommended Land



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 resist solder mask defined.
5. Non-solder mask defined copper landing pad.

Dim.	Millimeters <sup>a</sup>			Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.320	0.360	0.400	0.0125	0.0141	0.0157
A <sub>1</sub>	0.136	0.160	0.184	0.0053	0.0062	0.0072
A <sub>2</sub>	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 <sub>1</sub>	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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