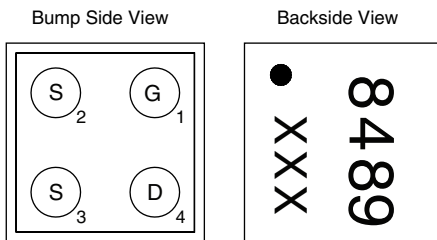


P-Channel 20 V (D-S) MOSFET

PRODUCT SUMMARY			
V_{DS} (V)	$R_{DS(on)}$ (Ω) Max.	I_D (A) ^{a, e}	Q_g (Typ.)
- 20	0.044 at $V_{GS} = - 10$ V	- 5.4	9.5 nC
	0.054 at $V_{GS} = - 4.5$ V	- 4.9	
	0.082 at $V_{GS} = - 2.5$ V	- 3.9	

MICRO FOOT



Device Marking: 8489
xxx = Date/Lot Traceability Code

Ordering Information:
Si8489EDB-T2-E1 (Lead (Pb)-free and Halogen-free)

FEATURES

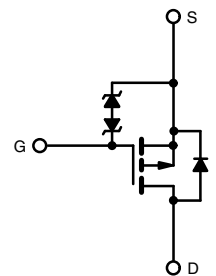
- TrenchFET[®] Power MOSFET
- Small 1 mm x 1 mm max. outline area
- Low 0.548 mm max. profile
- Typical ESD protection 2500 V HBM
- Material categorization:
For definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Load switches and charger switches
- Battery management
- For smart phones and tablet PCs



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}	± 12		
Continuous Drain Current ($T_J = 150$ °C)	I_D	$T_A = 25$ °C	- 5.4 ^a	A
		$T_A = 70$ °C	- 4.3 ^a	
		$T_A = 25$ °C	- 3.6 ^b	
		$T_A = 70$ °C	- 2.8 ^b	
Pulsed Drain Current ($t = 300$ μ s)	I_{DM}	- 20		
Continuous Source-Drain Diode Current	I_S	$T_C = 25$ °C	- 1.5 ^a	
		$T_A = 25$ °C	- 0.65 ^b	
Maximum Power Dissipation	P_D	$T_A = 25$ °C	1.8 ^a	W
		$T_A = 70$ °C	1.1 ^a	
		$T_A = 25$ °C	0.78 ^b	
		$T_A = 70$ °C	0.5 ^b	
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to 150		
Package Reflow Conditions ^c	VPR	260	°C	
	IR/Convection	260		

Notes:

- Surface mounted on 1" x 1" FR4 board with full copper, $t = 10$ s.
- Surface mounted on 1" x 1" FR4 board with minimum copper, $t = 10$ s.
- 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.
- Based on $T_A = 25$ °C.

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient ^{a, b}	$t = 10 \text{ s}$	55	70	°C/W
Maximum Junction-to-Ambient ^{c, d}	$t = 10 \text{ s}$	125	160	

Notes:

- a. Surface mounted on 1" x 1" FR4 board with full copper.
 b. Maximum under steady state conditions is 100 °C/W.
 c. Surface mounted on 1" x 1" FR4 board with minimum copper.
 d. Maximum under steady state conditions is 190 °C/W.

SPECIFICATIONS ($T_J = 25 \text{ }^\circ\text{C}$, unless otherwise noted)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0 \text{ V}, I_D = -250 \mu\text{A}$	-20			V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250 \mu\text{A}$		-15		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$		2.4			
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250 \mu\text{A}$	-0.5		-1.2	V
Gate-Source Leakage	I_{GSS}	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 4.5 \text{ V}$			± 1	μA
		$V_{DS} = 0 \text{ V}, V_{GS} = \pm 12 \text{ V}$			± 5	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = -20 \text{ V}, V_{GS} = 0 \text{ V}$			-1	
		$V_{DS} = -20 \text{ V}, V_{GS} = 0 \text{ V}, T_J = 70 \text{ }^\circ\text{C}$			-10	
On-State Drain Current ^a	$I_{D(on)}$	$V_{DS} \leq -5 \text{ V}, V_{GS} = -4.5 \text{ V}$	-10			A
Drain-Source On-State Resistance ^a	$R_{DS(on)}$	$V_{GS} = -10 \text{ V}, I_D = -1.5 \text{ A}$		0.036	0.044	Ω
		$V_{GS} = -4.5 \text{ V}, I_D = -1.5 \text{ A}$		0.045	0.054	
		$V_{GS} = -2.5 \text{ V}, I_D = -1 \text{ A}$		0.065	0.082	
Forward Transconductance ^a	g_{fs}	$V_{DS} = -10 \text{ V}, I_D = -1.5 \text{ A}$		10		S
Dynamic^b						
Input Capacitance	C_{iss}	$V_{DS} = -10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		765		μF
Output Capacitance	C_{oss}		125			
Reverse Transfer Capacitance	C_{rss}		115			
Total Gate Charge	Q_g	$V_{DS} = -10 \text{ V}, V_{GS} = -10 \text{ V}, I_D = -1.5 \text{ A}$		17.5	27	nC
Gate-Source Charge	Q_{gs}	$V_{DS} = -10 \text{ V}, V_{GS} = -4.5 \text{ V}, I_D = -1.5 \text{ A}$		8.6	13	
Gate-Drain Charge	Q_{gd}			1.5		
Gate Resistance	R_g		$V_{GS} = -0.1 \text{ V}, f = 1 \text{ MHz}$		2.6	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10 \text{ V}, R_L = 10 \Omega$ $I_D \cong -1.5 \text{ A}, V_{GEN} = -4.5 \text{ V}, R_g = 1 \Omega$		27	50	ns
Rise Time	t_r			20	40	
Turn-Off Delay Time	$t_{d(off)}$			50	100	
Fall Time	t_f			25	50	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10 \text{ V}, R_L = 10 \Omega$ $I_D \cong -1.5 \text{ A}, V_{GEN} = -8 \text{ V}, R_g = 1 \Omega$		6	15	
Rise Time	t_r			8	20	
Turn-Off Delay Time	$t_{d(off)}$			68	130	
Fall Time	t_f			28	60	

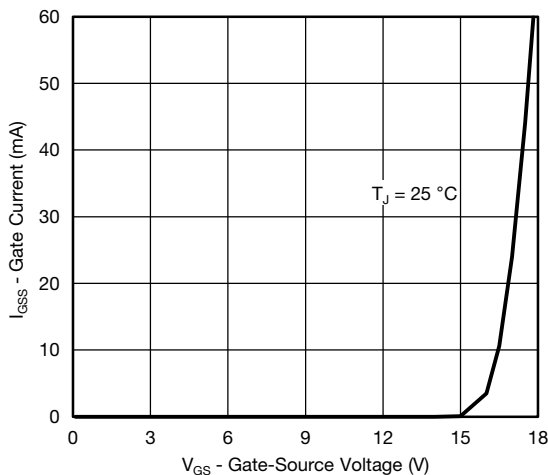
SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	$T_A = 25\text{ }^\circ\text{C}$			- 1.5	A
Pulse Diode Forward Current	I_{SM}				- 20	
Body Diode Voltage	V_{SD}	$I_S = -1.5\text{ A}, V_{GS} = 0\text{ V}$		- 0.8	- 1.2	V
Body Diode Reverse Recovery Time	t_{rr}	$I_F = -1.5\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		25	50	ns
Body Diode Reverse Recovery Charge	Q_{rr}		9	20	nC	
Reverse Recovery Fall Time	t_a		15		ns	
Reverse Recovery Rise Time	t_b		10			

Notes:

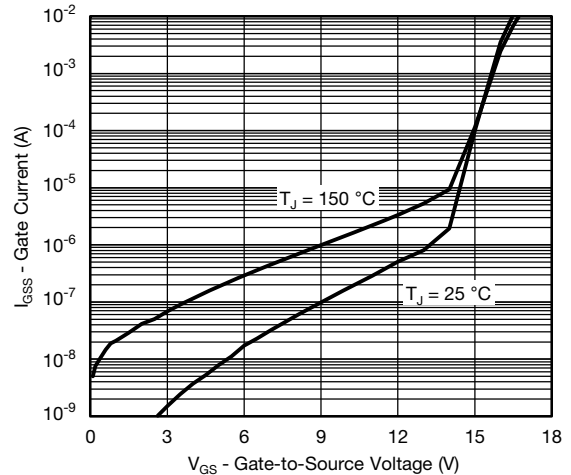
- a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.
- b. Guaranteed by design, not subject to production testing.

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.

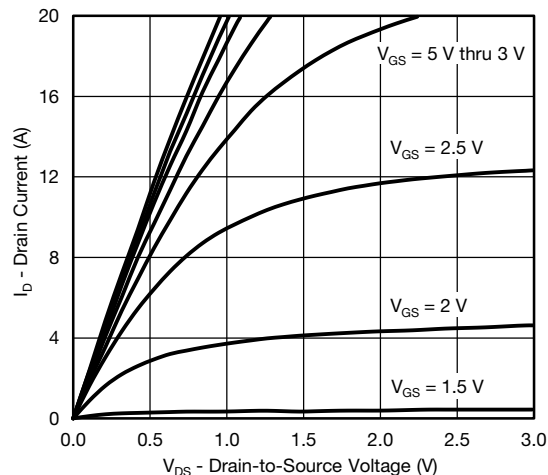
TYPICAL CHARACTERISTICS ($25\text{ }^\circ\text{C}$, unless otherwise noted)



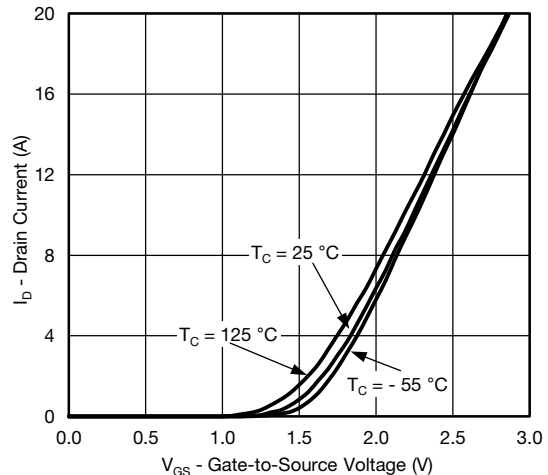
Gate Current vs. Gate-Source Voltage



Gate Current vs. Gate-Source Voltage

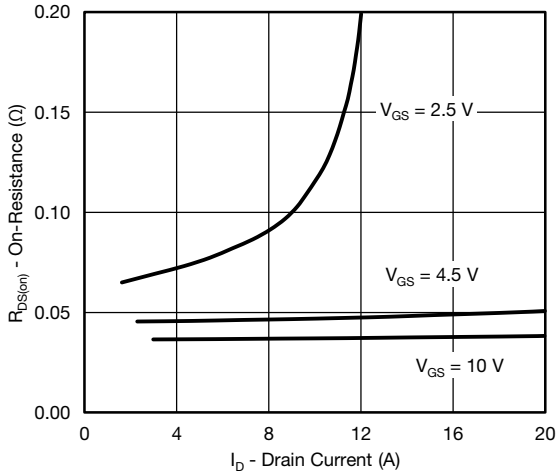


Output Characteristics

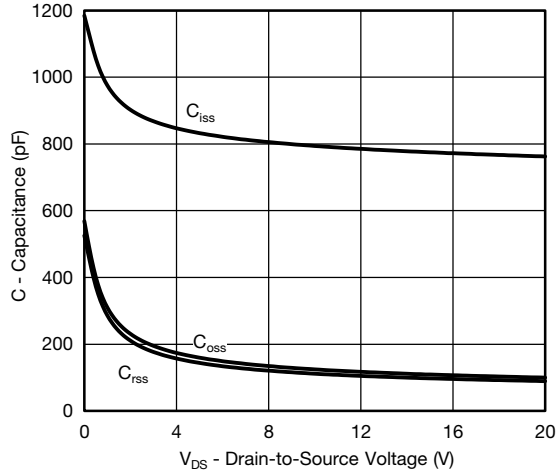


Transfer Characteristics

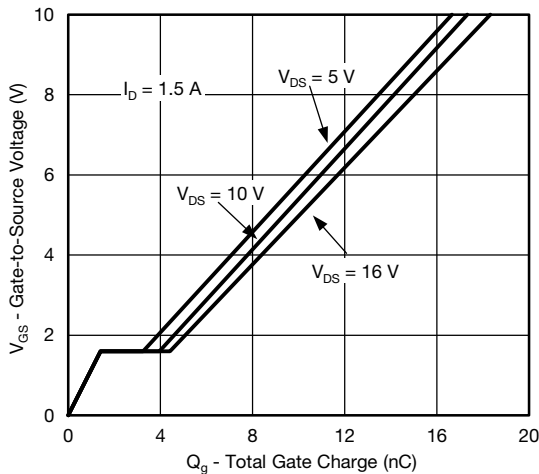
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



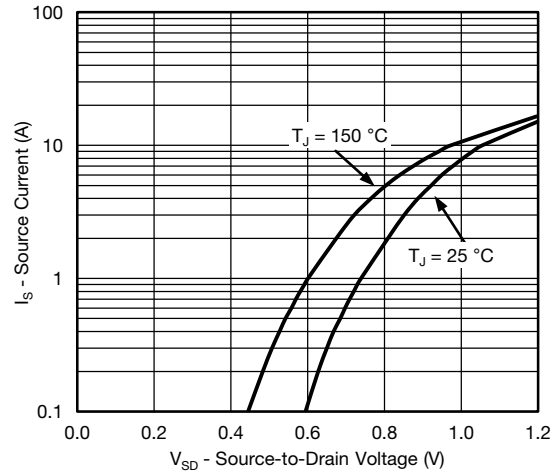
On-Resistance vs. Drain Current and Gate Voltage



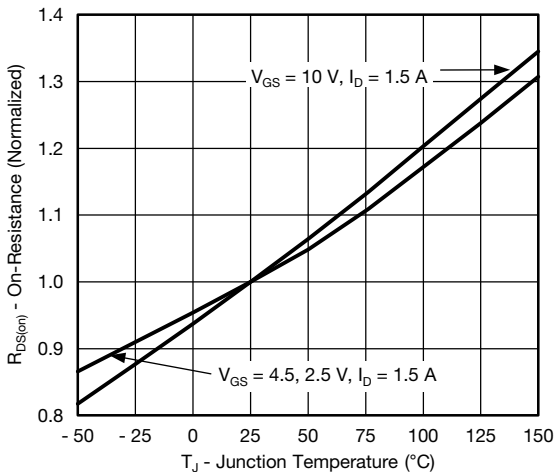
Capacitance



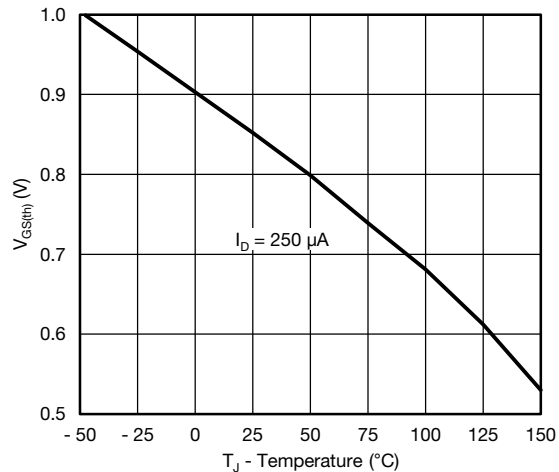
Gate Charge



Source-Drain Diode Forward Voltage

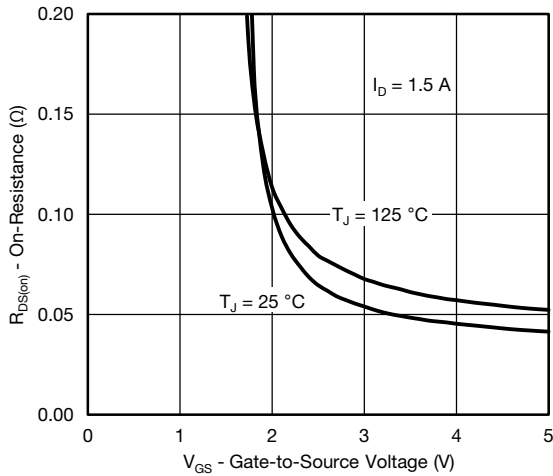


On-Resistance vs. Junction Temperature

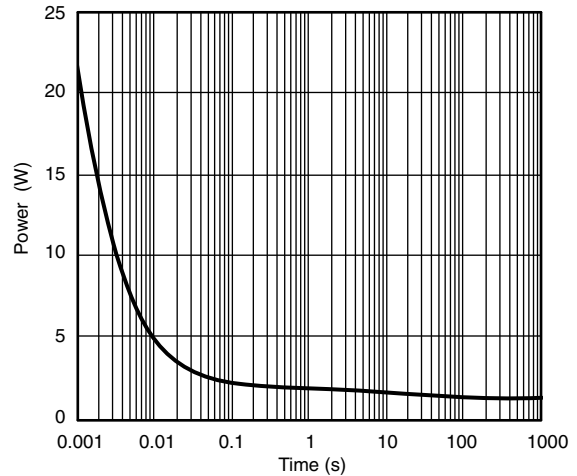


Threshold Voltage

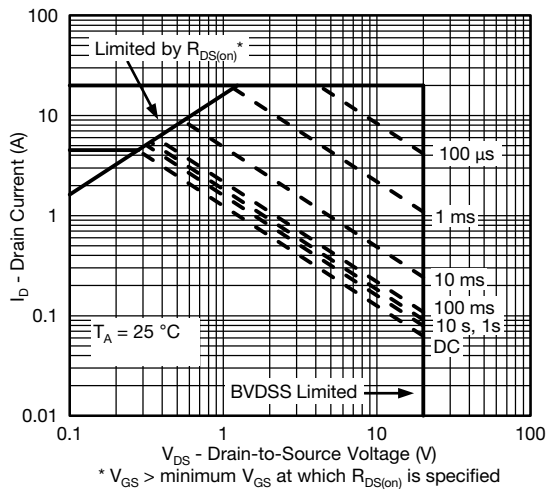
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



On-Resistance vs. Gate-to-Source Voltage



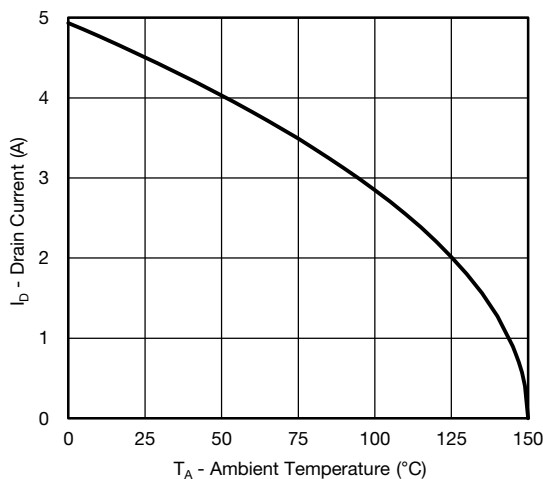
Single Pulse Power, Junction-to-Ambient



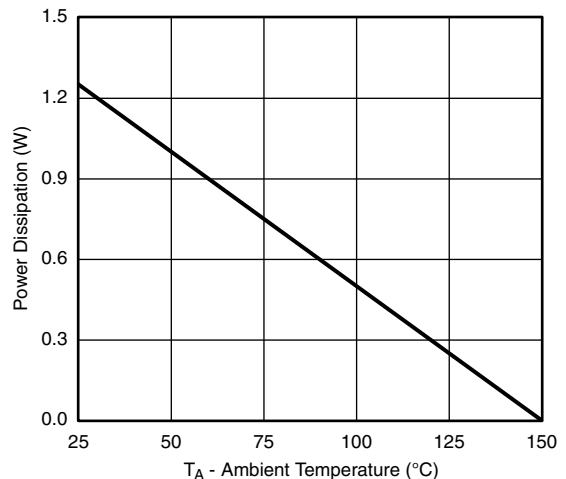
Safe Operating Area, Junction-to-Ambient

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.

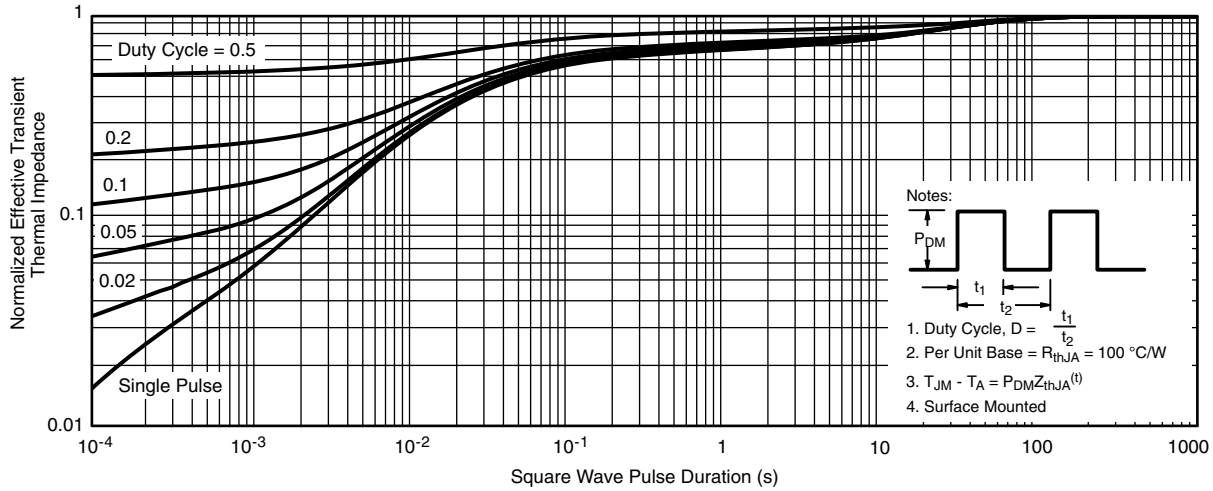


Current Derating*

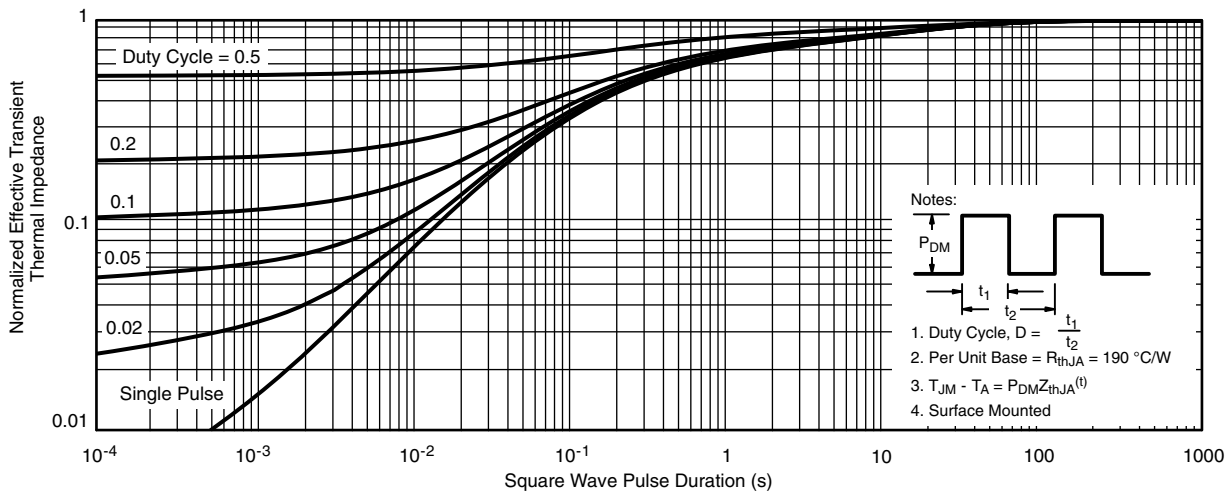


Power Derating

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



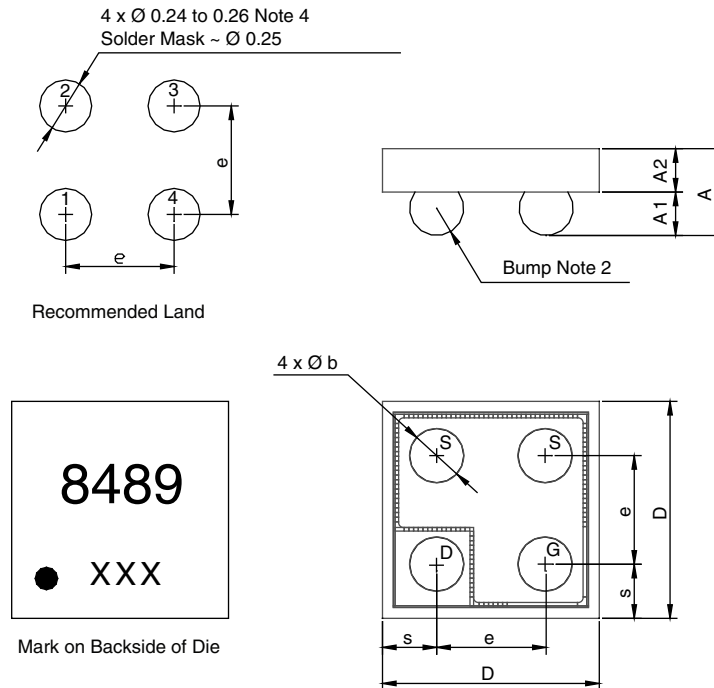
Normalized Thermal Transient Impedance, Junction-to-Ambient (1" x 1" FR4 Board with Full Copper)



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

PACKAGE OUTLINE

MICRO FOOT: 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 mm 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	0.462	0.505	0.548	0.0181	0.0198	0.0215
A₁	0.220	0.250	0.280	0.0086	0.0098	0.0110
A₂	0.242	0.255	0.268	0.0095	0.0100	0.0105
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

Notes:

- a. Use millimeters as the primary measurement.

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