

# NTLJS3113P

## Power MOSFET

-20 V, -9.5 A, Single P-Channel, SC-88FL 2x2 mm,  $\mu$ Cool™ Package

### Features

- $\mu$ Cool™ Package Provides Exposed Drain Pad for Excellent Thermal Conduction
- 2x2 mm Footprint Same as SC-88 Package
- Lowest  $R_{DS(on)}$  Solution in 2x2 mm Package
- 1.5 V  $R_{DS(on)}$  Rating for Operation at Low Voltage Logic Level Gate Drive
- Low Profile (< 0.8 mm) for Easy Fit in Thin Environments
- This is a Pb-Free Device

### Applications

- DC-DC Converters (Buck and Boost Circuits)
- Optimized for Battery and Load Management Applications in Portable Equipment such as, Cell Phones, PDA's, Media Players, etc.
- High Side Load Switch

### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		$V_{DSS}$	-20	V	
Gate-to-Source Voltage		$V_{GS}$	$\pm 8.0$	V	
Continuous Drain Current (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$	-6.4	A
			$T_A = 85^\circ\text{C}$	-4.6	
	$t \leq 5 \text{ s}$	$T_A = 25^\circ\text{C}$	-9.5		
Power Dissipation (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	$P_D$	2.3	W
			$t \leq 5 \text{ s}$	5.0	
Continuous Drain Current (Note 2)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$	-3.0	A
		$T_A = 85^\circ\text{C}$	-2.2		
Power Dissipation (Note 2)	Steady State	$T_A = 25^\circ\text{C}$	$P_D$	0.53	W
Pulsed Drain Current	$t_p = 10 \mu\text{s}$	$I_{DM}$	-30	A	
Operating Junction and Storage Temperature		$T_J, T_{STG}$	-55 to 150	$^\circ\text{C}$	
Source Current (Body Diode) (Note 2)		$I_S$	-4.0	A	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		$T_L$	260	$^\circ\text{C}$	

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

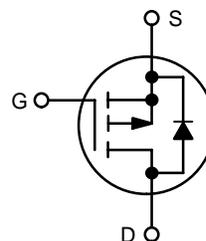
1. Surface Mounted on FR4 Board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).
2. Surface Mounted on FR4 Board using the minimum recommended pad size.



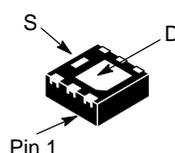
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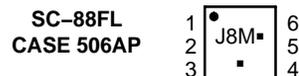
$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	$I_D$ MAX (Note 1)
-20 V	40 m $\Omega$ @ -4.5 V	-9.5 A
	50 m $\Omega$ @ -2.5 V	
	75 m $\Omega$ @ -1.8 V	
	200 m $\Omega$ @ -1.5 V	



P-CHANNEL MOSFET

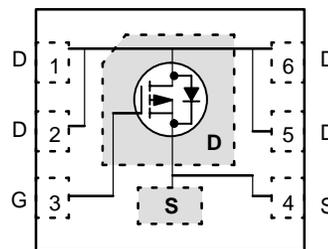


### MARKING DIAGRAM



J8 = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package  
(Note: Microdot may be in either location)

### PIN CONNECTIONS



(Top View)

### ORDERING INFORMATION

Device	Package	Shipping†
NTLJS3113PT1G	DFN6 (Pb-Free)	3000/Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

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## THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Ambient – Steady State (Note 3)	$R_{\theta JA}$	55	°C/W
Junction-to-Ambient – $t \leq 5$ s (Note 3)	$R_{\theta JA}$	25	
Junction-to-Ambient – Steady State Min Pad (Note 4)	$R_{\theta JA}$	235	

3. Surface Mounted on FR4 Board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).  
 4. Surface Mounted on FR4 Board using the minimum recommended pad size (30 mm<sup>2</sup>, 1 oz Cu).

## MOSFET ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	-20			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = -250\ \mu\text{A}, \text{Ref to } 25^\circ\text{C}$		-10.1		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -24\text{ V}, V_{GS} = 0\text{ V}$			-1.0	$\mu\text{A}$
					-10	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 8.0\text{ V}$			$\pm 1.0$	$\mu\text{A}$

### ON CHARACTERISTICS (Note 5)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = -250\ \mu\text{A}$	-0.45	-0.67	-1.0	V
Negative Gate Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			2.68		mV/°C
Drain-to-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = -4.5, I_D = -3.0\text{ A}$		32	40	m $\Omega$
		$V_{GS} = -2.5, I_D = -3.0\text{ A}$		44	50	
		$V_{GS} = -1.8, I_D = -2.0\text{ A}$		67	75	
		$V_{GS} = -1.5, I_D = -1.8\text{ A}$		90	200	
Forward Transconductance	$g_{FS}$	$V_{DS} = -16\text{ V}, I_D = -3.0\text{ A}$		5.9		S

### CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = -16\text{ V}$		1329		pF
Output Capacitance	$C_{OSS}$			213		
Reverse Transfer Capacitance	$C_{RSS}$			120		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -4.5\text{ V}, V_{DS} = -16\text{ V}, I_D = -3.0\text{ A}$		13	15.7	nC
Threshold Gate Charge	$Q_{G(TH)}$			1.5		
Gate-to-Source Charge	$Q_{GS}$			2.2		
Gate-to-Drain Charge	$Q_{GD}$			2.9		
Gate Resistance	$R_G$			14.4		

### SWITCHING CHARACTERISTICS (Note 6)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -4.5\text{ V}, V_{DD} = -10\text{ V}, I_D = -3.0\text{ A}, R_G = 3.0\ \Omega$		6.9		ns
Rise Time	$t_r$			17.5		
Turn-Off Delay Time	$t_{d(OFF)}$			60		
Fall Time	$t_f$			56.5		

### DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Recovery Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = -1.0\text{ A}$	$T_J = 25^\circ\text{C}$	-0.78	-1.2	V
			$T_J = 125^\circ\text{C}$	-0.67		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, d_{ISD}/d_t = 100\text{ A}/\mu\text{s}, I_S = -1.0\text{ A}$		70.8	106	ns
Charge Time	$t_a$			14.3		
Discharge Time	$t_b$			56.4		
Reverse Recovery Time	$Q_{RR}$			44		nC

5. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .  
 6. Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

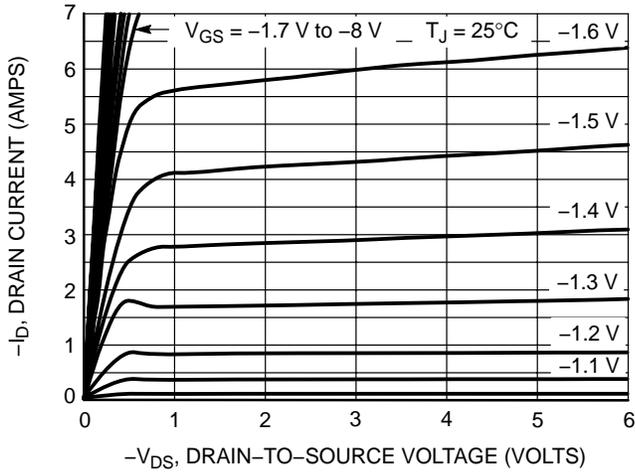


Figure 1. On-Region Characteristics

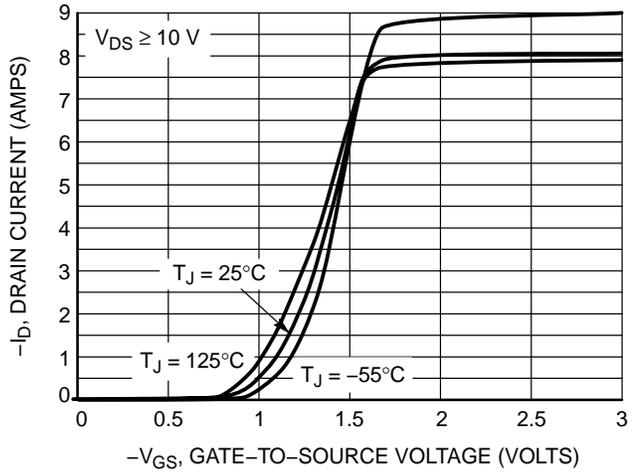


Figure 2. Transfer Characteristics

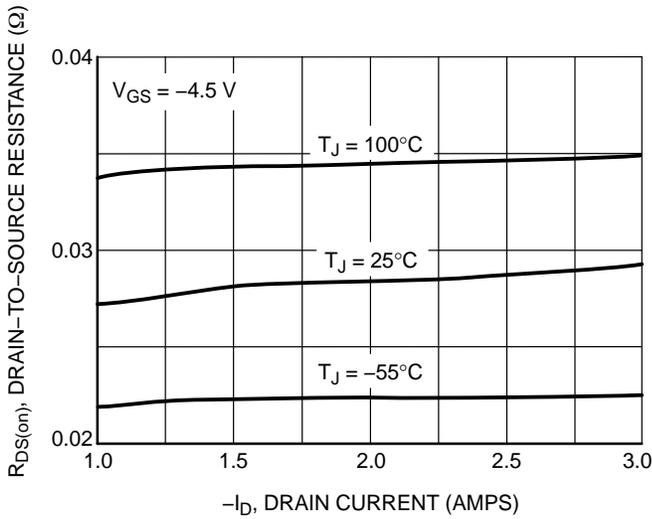


Figure 3. On-Resistance versus Drain Current

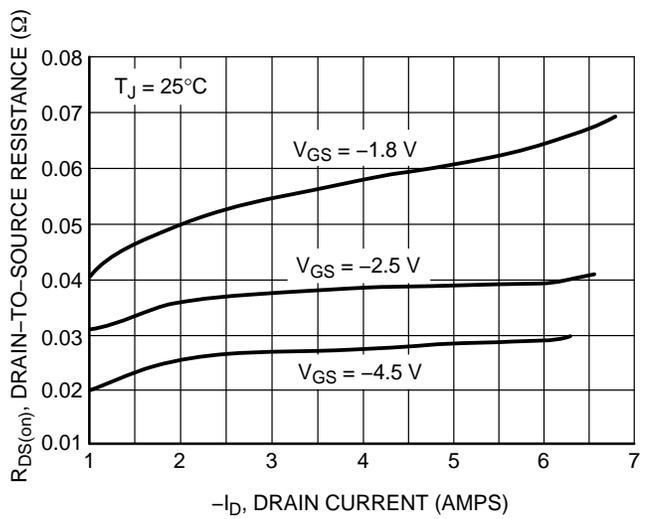


Figure 4. On-Resistance versus Drain Current and Gate Voltage

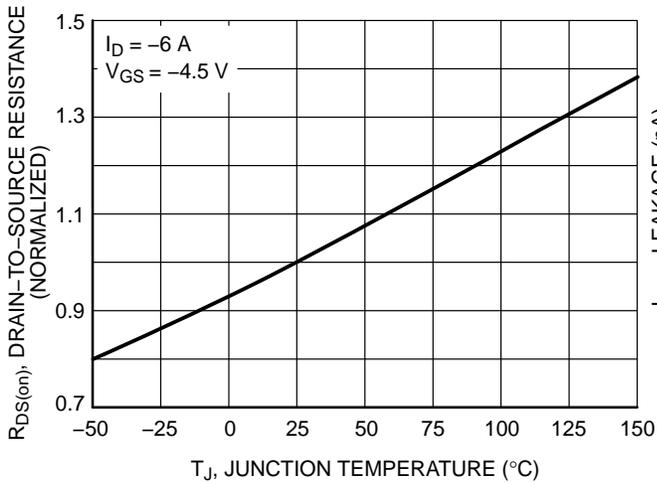


Figure 5. On-Resistance Variation with Temperature

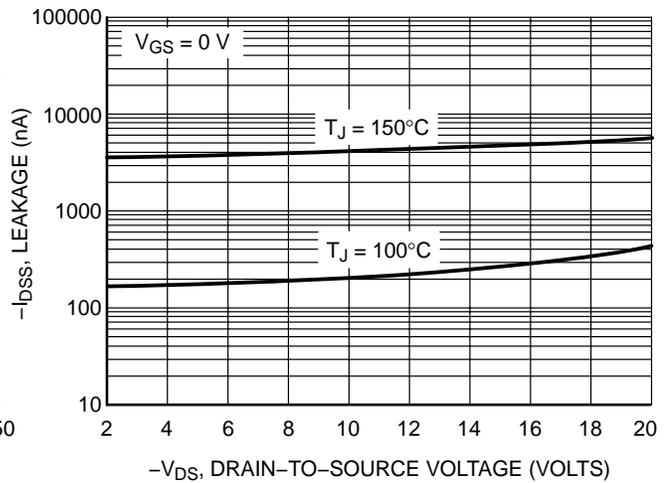


Figure 6. Drain-to-Source Leakage Current versus Voltage

TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

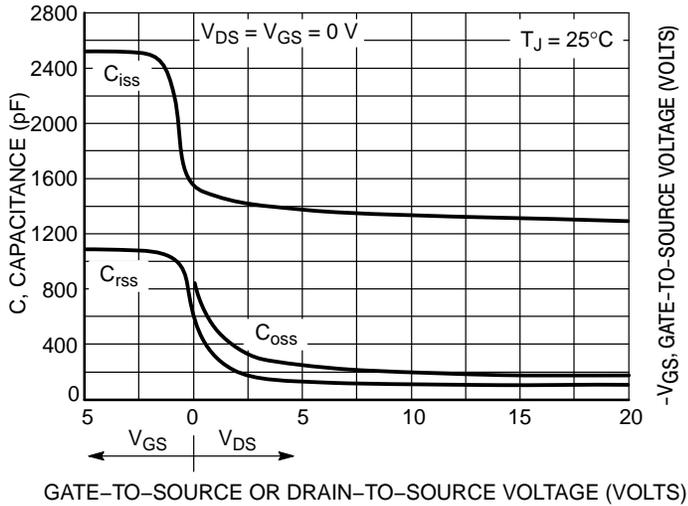


Figure 7. Capacitance Variation

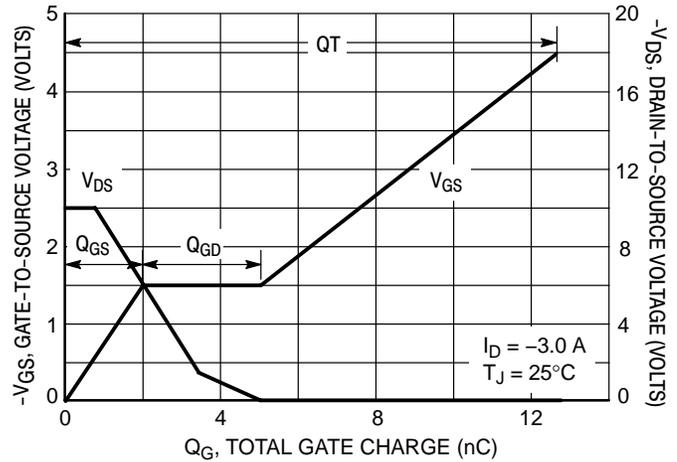


Figure 8. Gate-To-Source and Drain-To-Source Voltage versus Total Charge

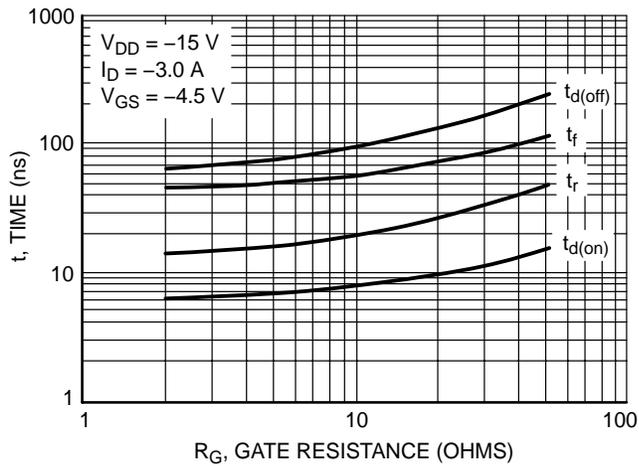


Figure 9. Resistive Switching Time Variation versus Gate Resistance

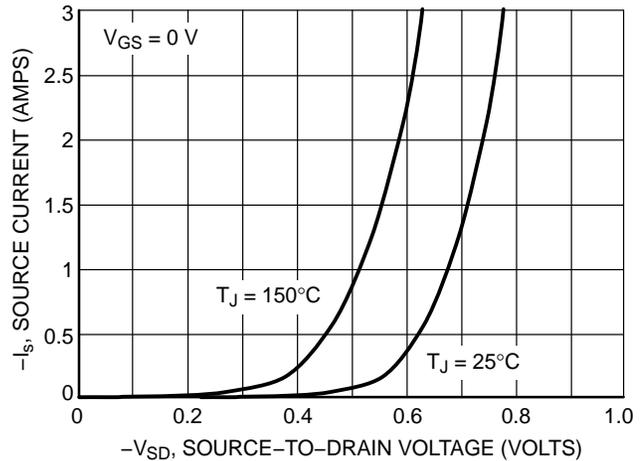


Figure 10. Diode Forward Voltage versus Current

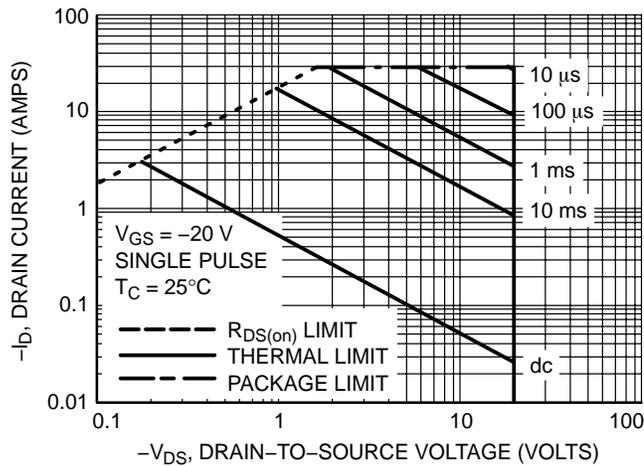


Figure 11. Maximum Rated Forward Biased Safe Operating Area

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## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

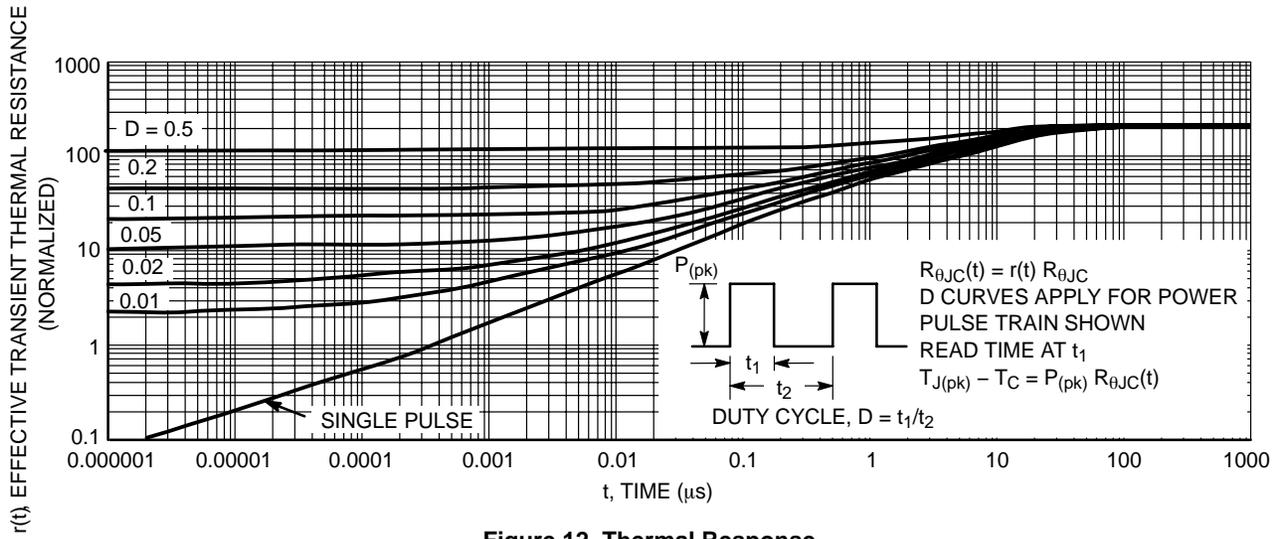
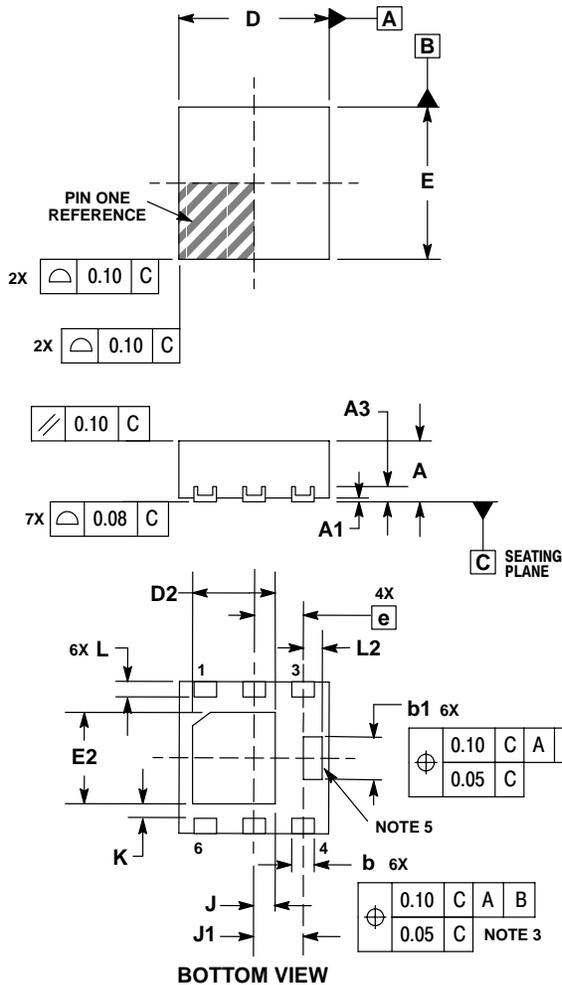


Figure 12. Thermal Response

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## PACKAGE DIMENSIONS

DFN6  
CASE 506AP-01  
ISSUE A

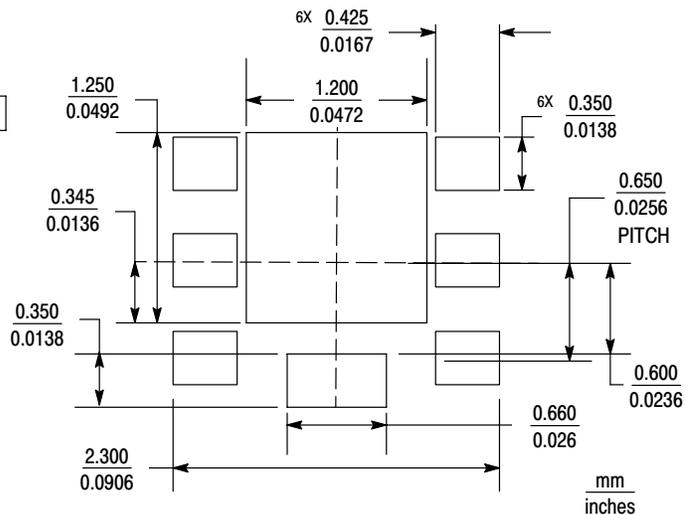


### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.20mm FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. CENTER TERMINAL LEAD IS OPTIONAL. TERMINAL LEAD IS CONNECTED TO TERMINAL LEAD # 4.
6. PINS 1, 2, 5 AND 6 ARE TIED TO THE FLAG.

DIM	MILLIMETERS	
	MIN	MAX
A	0.70	0.80
A1	0.00	0.05
A3	0.20 REF	
b	0.25	0.35
b1	0.51	0.61
D	2.00 BSC	
D2	1.00	1.20
E	2.00 BSC	
E2	1.10	1.30
e	0.65 BSC	
K	0.15 REF	
L	0.20	0.30
L2	0.20	0.30
J	0.27 REF	
J1	0.65 REF	

### MOUNTING FOOTPRINT



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