NTLJD2104P

Power MOSFET

−12 V, −4.3 A, μCOOL™ Dual P−Channel, 2x2 mm, WDFN package

Features

- WDFN 2x2 mm Package with Exposed Drain Pads for Excellent Thermal Conduction
- Lowest $R_{DS(on)}$ in 2x2 mm Package
- Footprint Same as SC−88 Package
- Low Profile (<0.8 mm) for Easy Fit in Thin Environments
- Bidirectional Current Flow with Common Source Configuration
- These are Pb−Free Devices

Applications

- Optimized for Battery and Load Management Applications in Portable Equipment
- Li Ion Battery Charging and Protection Circuits
- Dual High Side Load Switch

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Parameter			Symbol	Value	Unit
Drain−to−Source Voltage			V_{DSS}	−12	V
Gate−to−Source Voltage			V_{GS}	±8.0	V
Continuous Drain Current (Note 1)	Steady State	T_J = 25°C	I_D	−3.5	A
		T_J = 85°C		−2.5	
	t ≤ 5 s	T_J = 25°C		−4.3	
Power Dissipation (Note 1)	Steady State	T_J = 25°C	P_D	1.5	W
	t ≤ 5 s			2.3	
Continuous Drain Current (Note 2)	Steady State	T_J = 25°C	I_D	−2.4	A
		T_J = 85°C		−1.7	
Power Dissipation (Note 2)		T_J = 25°C	P_D	0.7	W
Pulsed Drain Current	t_p = 10 μs		I_{DM}	−20	A
Operating Junction and Storage Temperature			T_J, T_{STG}	−55 to 150	°C
Source Current (Body Diode) (Note 2)			I_S	−1.5	A
Lead Temperature for Soldering Purposes (1/8″ from case for 10 s)			T_L	260	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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 of 30 mm^2, 2 oz. Cu.

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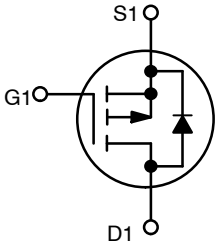
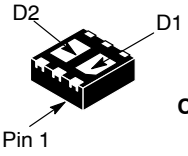
$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	I_D MAX
−12 V	60 mΩ @ −4.5 V	−3.0 A
	85 mΩ @ −2.5 V	−3.0 A
	110 mΩ @ −1.8 V	−0.7 A
	140 mΩ @ −1.5 V	−0.5 A
	190 mΩ @ −1.3 V	−0.2 A
	230 mΩ @ −1.2 V	−0.2 A



P−CHANNEL MOSFET **P−CHANNEL MOSFET**

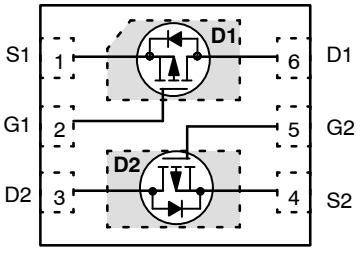


WDFN6
CASE 506AN

MARKING DIAGRAM

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

PIN CONNECTIONS



(Top View)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
SINGLE OPERATION (SELF−HEATED)			
Junction−to−Ambient − Steady State (Note 3)	$R_{\theta JA}$	83	°C/W
Junction−to−Ambient − Steady State Min Pad (Note 4)	$R_{\theta JA}$	177	
Junction−to−Ambient − t ≤ 5 s (Note 3)	$R_{\theta JA}$	54	
DUAL OPERATION (EQUALLY HEATED)			
Junction−to−Ambient − Steady State (Note 3)	$R_{\theta JA}$	58	°C/W
Junction−to−Ambient − Steady State Min Pad (Note 4)	$R_{\theta JA}$	133	
Junction−to−Ambient − t ≤ 5 s (Note 3)	$R_{\theta JA}$	40	

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

MOSFET ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
OFF CHARACTERISTICS							
Drain−to−Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = −250 μA		−12			V
Drain−to−Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	I_D = −250 μA, Ref to 25°C			−7.0		mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = −12 V, V_{GS} = 0 V	T_J = 25°C			−1.0	μA
			T_J = 85°C			−10	
Gate−to−Source Leakage Current	I_{GSS}	V_{DS} = 0 V, V_{GS} = ±8.0 V				±100	nA
ON CHARACTERISTICS (Note 5)							
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = −250 μA		−0.35	−0.6	−0.8	V
Gate Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$				2.4		mV/°C
Drain−to−Source On−Resistance	$R_{DS(on)}$	V_{GS} = −4.5, I_D = −3.0 A			60	90	mΩ
		V_{GS} = −2.5, I_D = −3.0 A			85	120	
		V_{GS} = −1.8, I_D = −0.7 A			110	150	
		V_{GS} = −1.5, I_D = −0.5 A			140	200	
		V_{GS} = −1.3, I_D = −0.2 A			190		
		V_{GS} = −1.2, I_D = −0.2 A			230		
Forward Transconductance	g_{FS}	V_{DS} = −10 V, I_D = −3.0 A			6.0		S
CHARGES, CAPACITANCES AND GATE RESISTANCE							
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1.0 MHz, V_{DS} = −6.0 V			467		pF
Output Capacitance	C_{OSS}				125		
Reverse Transfer Capacitance	C_{RSS}				79		
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = −4.5 V, V_{DS} = −6.0 V, I_D = −3.0 A			5.5	8.0	nC
Threshold Gate Charge	$Q_{G(TH)}$				0.3		
Gate−to−Source Charge	Q_{GS}				0.8		
Gate−to−Drain Charge	Q_{GD}				1.5		
Gate Resistance	R_G				12.2		Ω

5. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
6. Switching characteristics are independent of operating junction temperatures.

MOSFET ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS (Note 6)							
Turn−On Delay Time	$t_{d(ON)}$	V_{GS} = −4.5 V, V_{DD} = −6.0 V, I_D = −3.0 A, R_G = 2.0 Ω			6.6		ns
Rise Time	t_r				12.3		
Turn−Off Delay Time	$t_{d(OFF)}$				14		
Fall Time	t_f				16.2		
DRAIN−SOURCE DIODE CHARACTERISTICS							
Forward Recovery Voltage	V_{SD}	V_{GS} = 0 V, I_S = −1.0 A	T_J = 25°C		−0.7	−1.0	V
			T_J = 85°C		−0.65		
Reverse Recovery Time	t_{RR}	V_{GS} = 0 V, d_{ISD}/d_t = 100 A/μs, I_S = −1.0 A			23	45	ns
Charge Time	t_a				8.0		
Discharge Time	t_b				15		
Reverse Recovery Time	Q_{RR}				10	20	nC

5. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
6. Switching characteristics are independent of operating junction temperatures.

ORDERING INFORMATION

Device	Package	Shipping†
NTLJD2104PTBG	WDFN6 (Pb−Free)	3000 / Tape & Reel
NTLJD2104PTAG	WDFN6 (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 Specifications Brochure, BRD8011/D.

TYPICAL CHARACTERISTICS

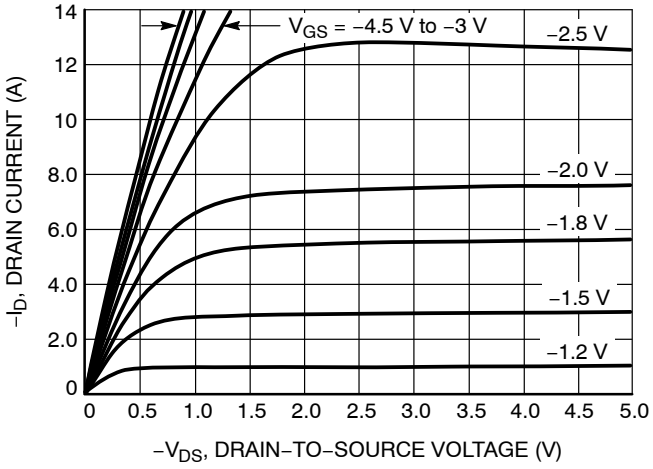


Figure 1. On−Region Characteristics

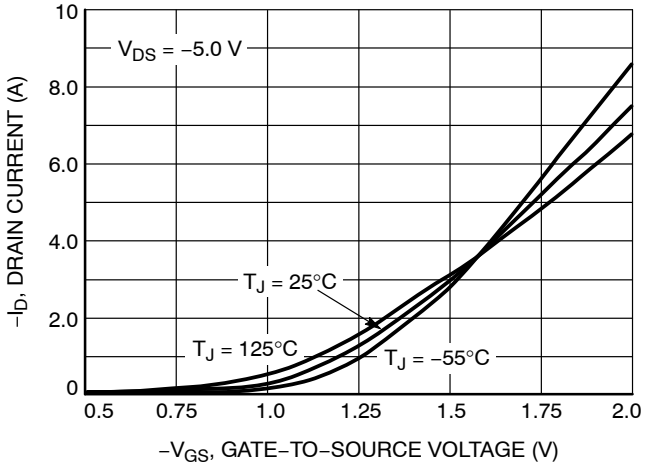


Figure 2. Transfer Characteristics

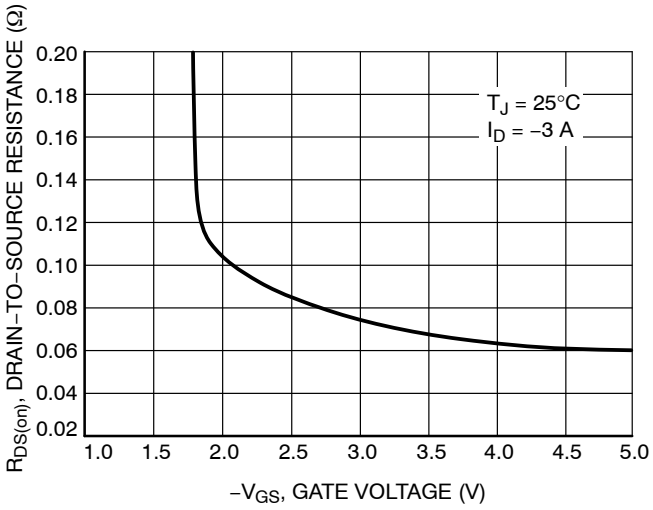


Figure 3. On−Resistance vs. Gate−to−Source Voltage

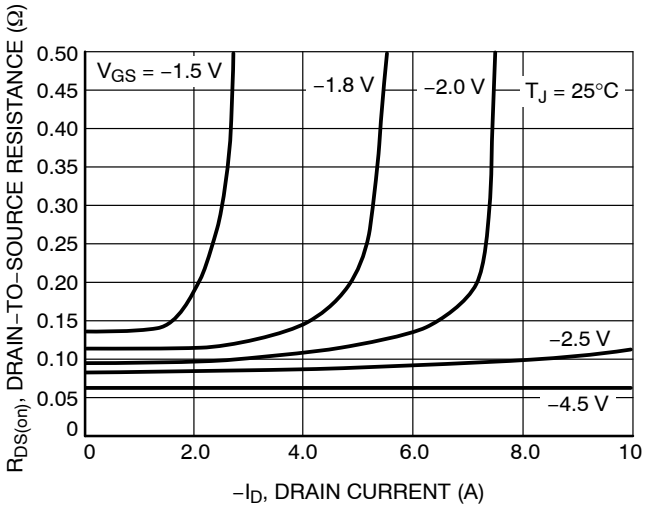


Figure 4. On−Resistance vs. Drain Current and Gate Voltage

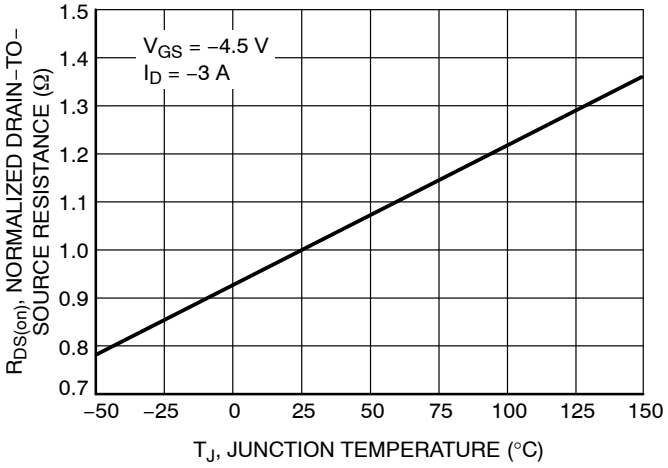


Figure 5. On−Resistance Variation with Temperature

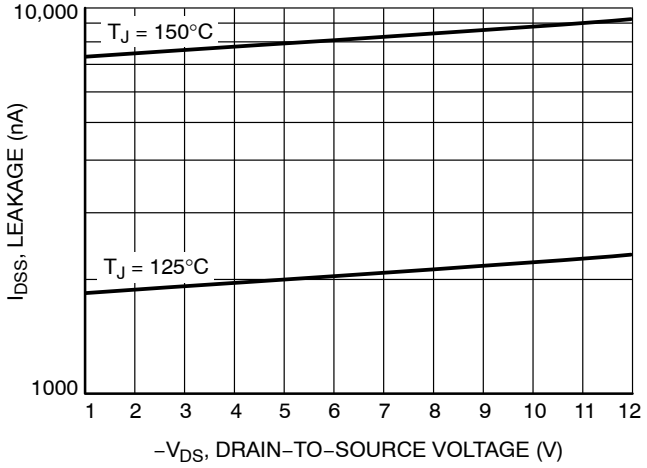


Figure 6. Drain−to−Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

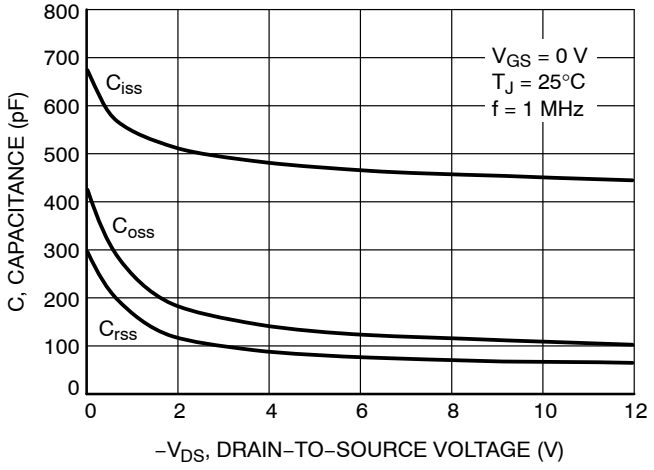


Figure 7. Capacitance Variation

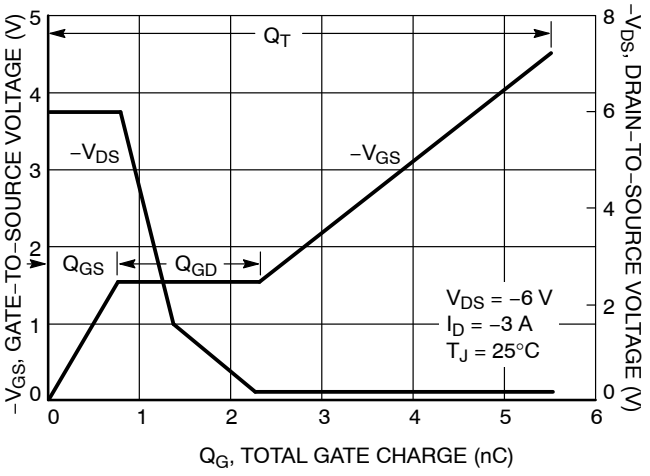


Figure 8. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge

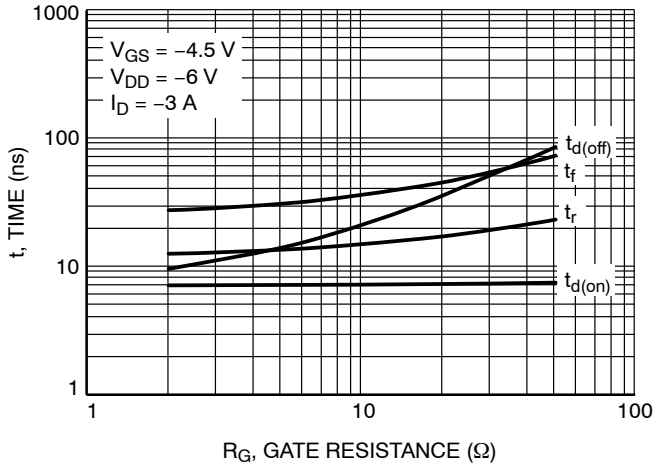


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

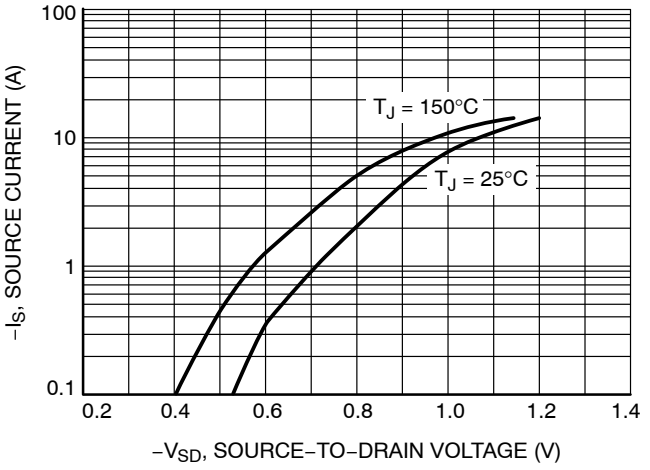


Figure 10. Diode Forward Voltage vs. Current

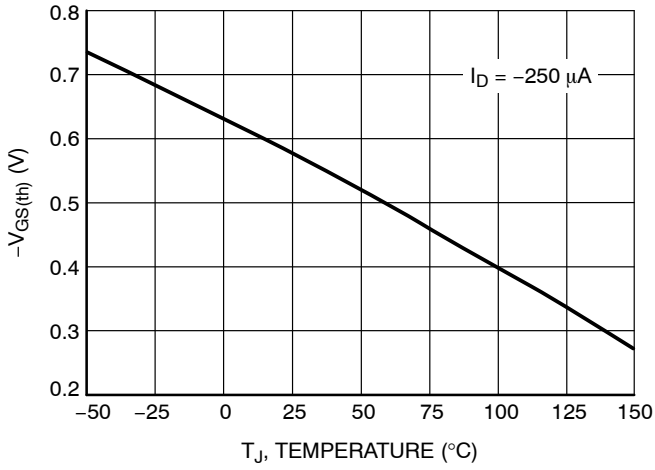


Figure 11. Threshold Voltage

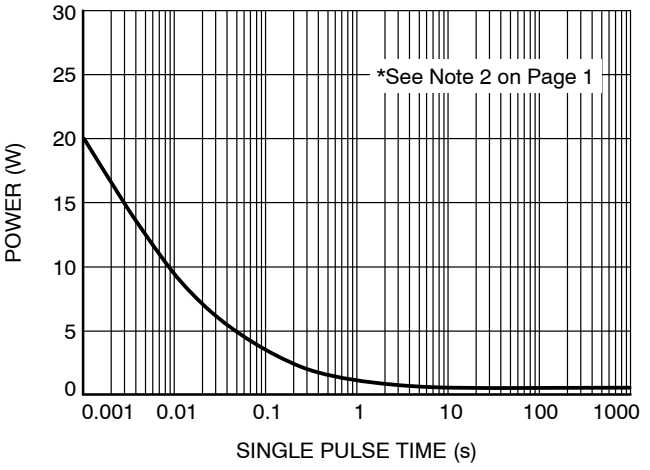


Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS

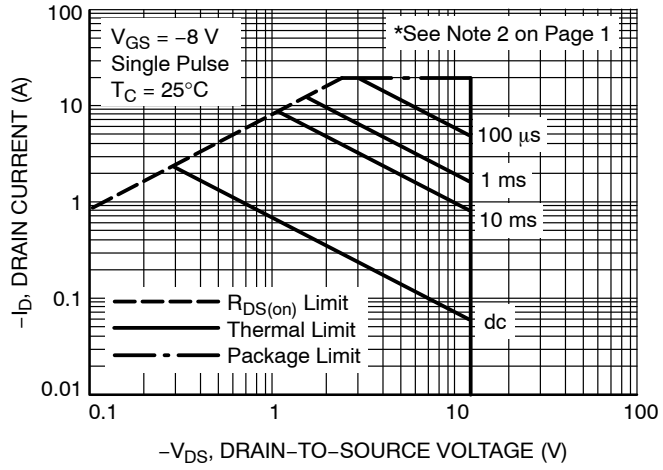


Figure 13. Maximum Rated Forward Biased Safe Operating Area

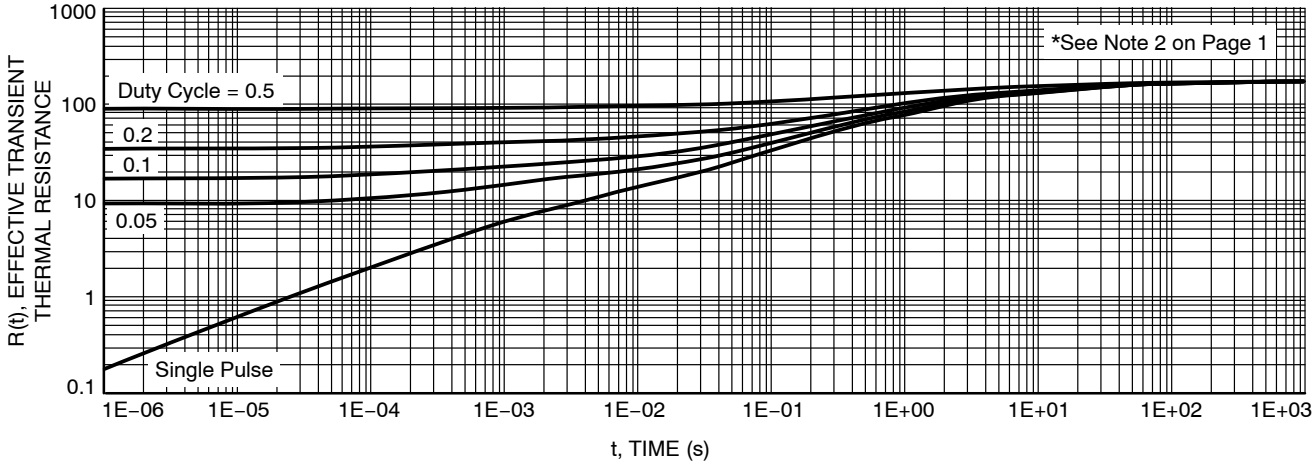
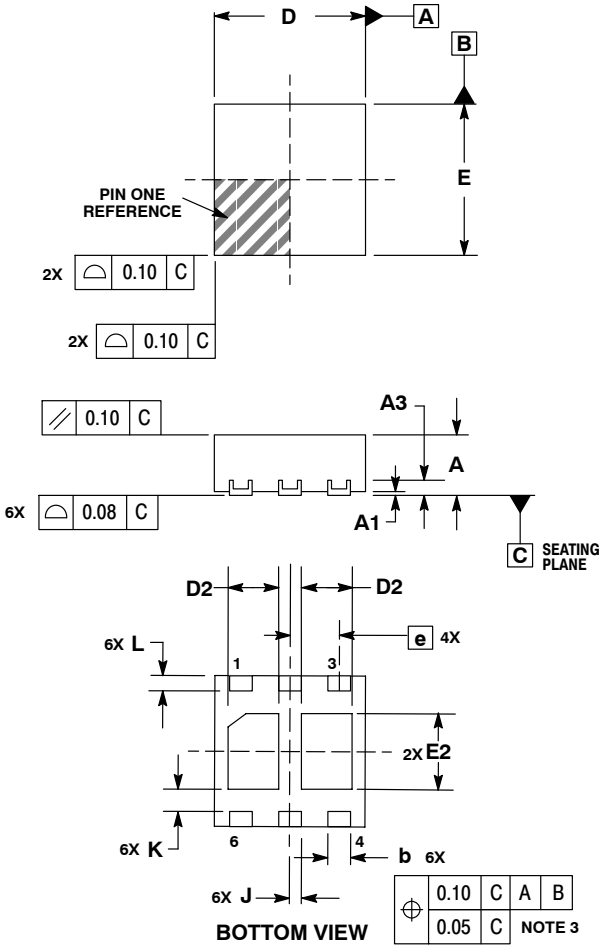


Figure 14. FET Thermal Response

PACKAGE DIMENSIONS

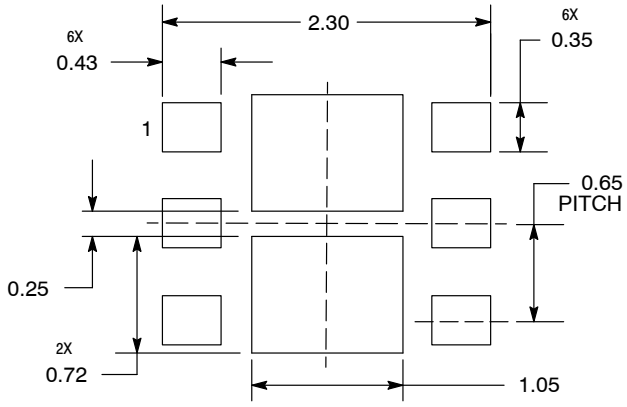
WDFN6 2x2
CASE 506AN−01
ISSUE C



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.

	MILLIMETERS	
DIM	MIN	MAX
A	0.70	0.80
A1	0.00	0.05
A3	0.20 REF	
b	0.25	0.35
D	2.00 BSC	
D2	0.57	0.77
E	2.00 BSC	
E2	0.90	1.10
e	0.65 BSC	
K	0.25 REF	
L	0.20	0.30
J	0.15 REF	

SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
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