

# NTLJD3181PZ

## Power MOSFET

–20 V, –4.0 A, Dual P–Channel, ESD,  
2x2 mm WDFN Package

### Features

- WDFN 2x2 mm Package with Exposed Drain Pads for Excellent Thermal Conduction
- Lowest  $R_{DS(on)}$  Solution in 2x2 mm Package
- Footprint Same as SC–88 Package
- Low Profile (< 0.8 mm) for Easy Fit in Thin Environments
- ESD Protected
- This is a Pb–Free Device

### Applications

- Optimized for Battery and Load Management Applications in Portable Equipment
- Li–Ion Battery Charging and Protection Circuits
- 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           | $T_A = 25^{\circ}\text{C}$ | $I_D$                      | -3.2       | A                  |
|                                                                   |                        | $T_A = 85^{\circ}\text{C}$ |                            | -2.3       |                    |
|                                                                   | $t \leq 5 \text{ s}$   | $T_A = 25^{\circ}\text{C}$ |                            | -4.0       |                    |
| Power Dissipation (Note 1)                                        | Steady State           | $T_A = 25^{\circ}\text{C}$ | $P_D$                      | 1.5        | W                  |
|                                                                   | $t \leq 5 \text{ s}$   |                            |                            | 2.3        |                    |
| Continuous Drain Current (Note 2)                                 | Steady State           | $T_A = 25^{\circ}\text{C}$ | $I_D$                      | -2.2       | A                  |
|                                                                   |                        | $T_A = 85^{\circ}\text{C}$ |                            | -1.6       |                    |
| Power Dissipation (Note 2)                                        |                        |                            | $T_A = 25^{\circ}\text{C}$ | $P_D$      | 0.71               |
| Pulsed Drain Current                                              | $t_p = 10 \mu\text{s}$ |                            | $I_{DM}$                   | -16        | A                  |
| Operating Junction and Storage Temperature                        |                        |                            | $T_J, T_{STG}$             | -55 to 150 | $^{\circ}\text{C}$ |
| Source Current (Body Diode) (Note 2)                              |                        |                            | $I_S$                      | -1.0       | A                  |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) |                        |                            | $T_L$                      | 260        | $^{\circ}\text{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

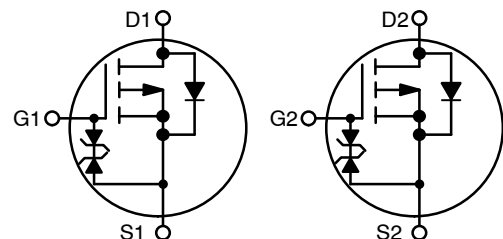
1. Surface Mounted on FR4 Board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).
2. Surface Mounted on FR4 Board using the minimum recommended pad size of 30 mm<sup>2</sup>, 2 oz Cu.



ON Semiconductor®

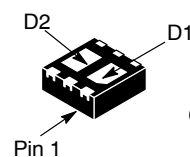
[www.onsemi.com](http://www.onsemi.com)

| $V_{(BR)DSS}$ | $R_{DS(on)}$ MAX        | $I_D$ MAX (Note 1) |
|---------------|-------------------------|--------------------|
| –20 V         | 100 m $\Omega$ @ –4.5 V | –4.0 A             |
|               | 144 m $\Omega$ @ –2.5 V |                    |
|               | 200 m $\Omega$ @ –1.8 V |                    |



P–CHANNEL MOSFET

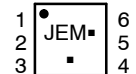
P–CHANNEL MOSFET



Pin 1

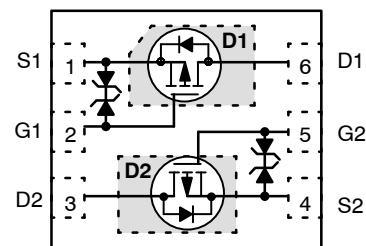
WDFN6  
CASE 506AN

### MARKING DIAGRAM



JE = 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†        |
|----------------|-----------------|------------------|
| NTLJD3181PZTAG | WDFN6 (Pb–Free) | 3000/Tape & Reel |
| NTLJD3181PZTBG | 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 Specification Brochure, BRD8011/D.

# NTLJD3181PZ

## 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 – $t \leq 5$ 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 – $t \leq 5$ 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<sup>2</sup>, 2 oz Cu).

# NTLJD3181PZ

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

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|-----------|--------|-----------------|-----|-----|-----|------|
|-----------|--------|-----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                           |                   |                                                             |                          |    |          |                      |
|-----------------------------------------------------------|-------------------|-------------------------------------------------------------|--------------------------|----|----------|----------------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$        | -20                      |    |          | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | $I_D = -250\text{ }\mu\text{A}$ , Ref to $25^\circ\text{C}$ |                          | 13 |          | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}$                | $T_J = 25^\circ\text{C}$ |    | -1.0     | $\mu\text{A}$        |
|                                                           |                   |                                                             | $T_J = 85^\circ\text{C}$ |    | -10      |                      |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 8.0\text{ V}$            |                          |    | $\pm 10$ | $\mu\text{A}$        |

### ON CHARACTERISTICS (Note 5)

|                                        |                  |                                                  |      |     |      |                      |
|----------------------------------------|------------------|--------------------------------------------------|------|-----|------|----------------------|
| Gate Threshold Voltage                 | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = -250\text{ }\mu\text{A}$ | -0.4 |     | -1.0 | V                    |
| Gate Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |                                                  |      | 2.0 |      | mV/ $^\circ\text{C}$ |
| Drain-to-Source On-Resistance          | $R_{DS(on)}$     | $V_{GS} = -4.5\text{ V}, I_D = -2.0\text{ A}$    |      | 68  | 100  | m $\Omega$           |
|                                        |                  | $V_{GS} = -2.5\text{ V}, I_D = -2.0\text{ A}$    |      | 90  | 144  |                      |
|                                        |                  | $V_{GS} = -1.8\text{ V}, I_D = -1.7\text{ A}$    |      | 125 | 200  |                      |
| Forward Transconductance               | $g_{FS}$         | $V_{DS} = -5.0\text{ V}, I_D = -2.0\text{ A}$    |      | 6.5 |      | S                    |

### CHARGES, CAPACITANCES AND GATE RESISTANCE

|                              |              |                                                                      |  |      |     |    |
|------------------------------|--------------|----------------------------------------------------------------------|--|------|-----|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = -10\text{ V}$     |  | 450  |     | pF |
| Output Capacitance           | $C_{OSS}$    |                                                                      |  | 90   |     |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |                                                                      |  | 62   |     |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = -4.5\text{ V}, V_{DS} = -10\text{ V}, I_D = -3.8\text{ A}$ |  | 5.2  | 7.8 | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                      |  | 0.3  |     |    |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                      |  | 0.84 |     |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                      |  | 1.5  |     |    |

### SWITCHING CHARACTERISTICS (Note 6)

|                     |              |                                                                                                |  |      |  |    |
|---------------------|--------------|------------------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = -4.5\text{ V}, V_{DD} = -5.0\text{ V}, I_D = -2.0\text{ A}, R_G = 2.0\text{ }\Omega$ |  | 6.6  |  | ns |
| Rise Time           | $t_r$        |                                                                                                |  | 9.0  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                                |  | 14   |  |    |
| Fall Time           | $t_f$        |                                                                                                |  | 12.5 |  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                          |          |                                                                                   |                           |    |       |      |   |
|--------------------------|----------|-----------------------------------------------------------------------------------|---------------------------|----|-------|------|---|
| Forward Recovery Voltage | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = -1.0\text{ A}$                                        | $T_J = 25^\circ\text{C}$  |    | -0.73 | -1.0 | V |
|                          |          |                                                                                   | $T_J = 125^\circ\text{C}$ |    | -0.62 |      |   |
| Reverse Recovery Time    | $t_{RR}$ | $V_{GS} = 0\text{ V}, dI_{SD}/dt = 100\text{ A}/\mu\text{s}, I_S = -1.0\text{ A}$ |                           | 23 |       | ns   |   |
| Charge Time              | $t_a$    |                                                                                   |                           | 13 |       |      |   |
| Discharge Time           | $t_b$    |                                                                                   |                           | 10 |       |      |   |
| Reverse Recovery Time    | $Q_{RR}$ |                                                                                   |                           | 10 |       | nC   |   |

5. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , 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)

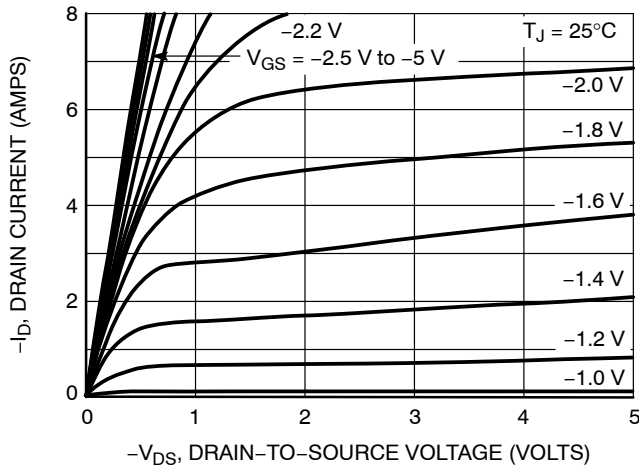


Figure 1. On-Region Characteristics

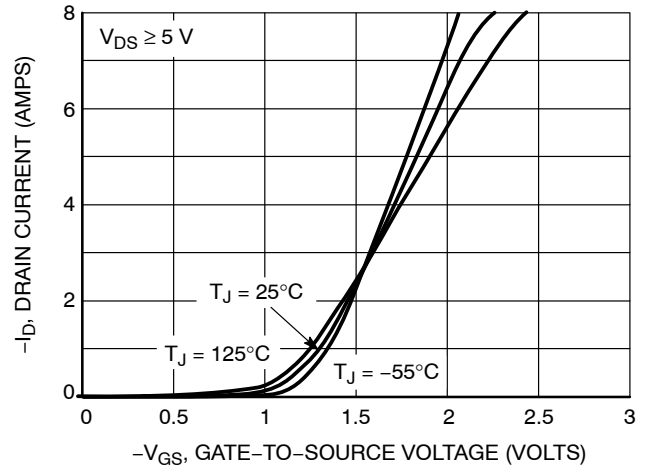


Figure 2. Transfer Characteristics

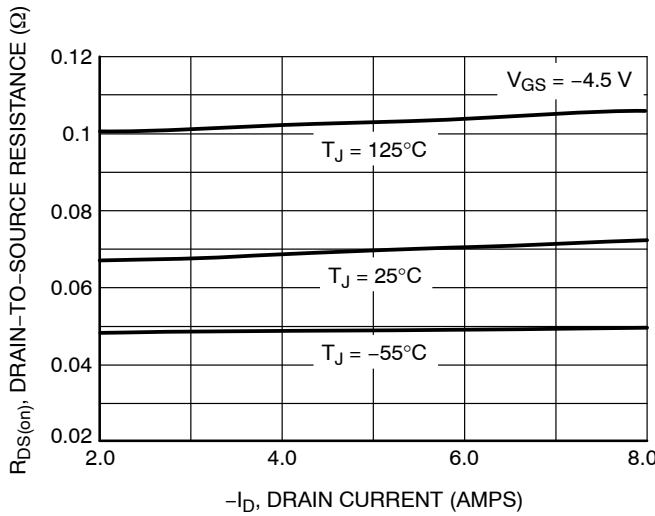


Figure 3. On-Resistance versus Drain Current

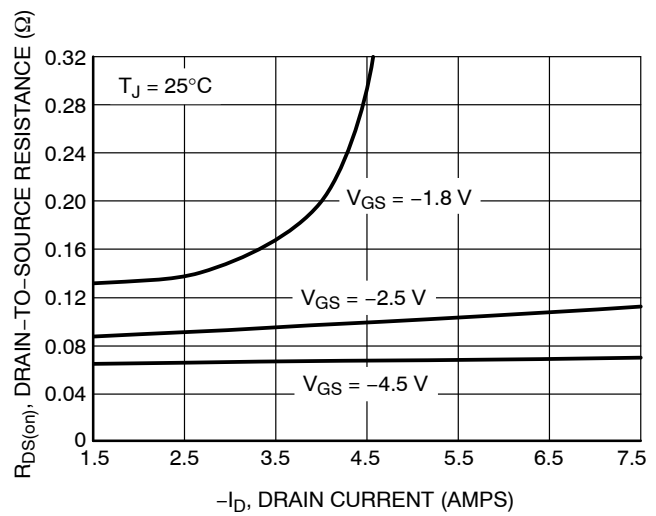


Figure 4. On-Resistance versus Drain Current and Gate Voltage

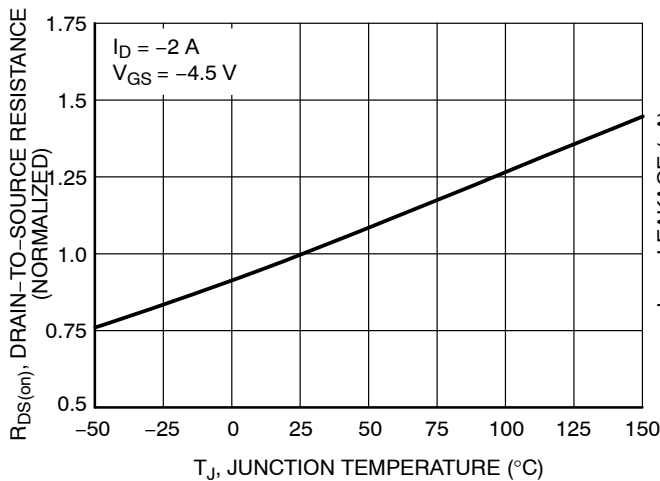


Figure 5. On-Resistance Variation with Temperature

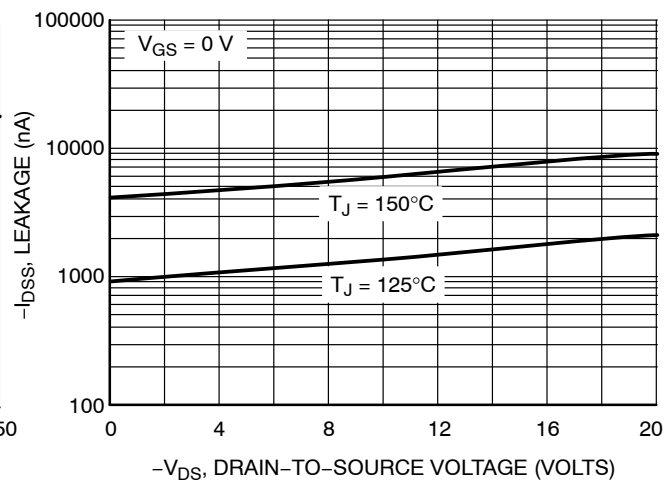
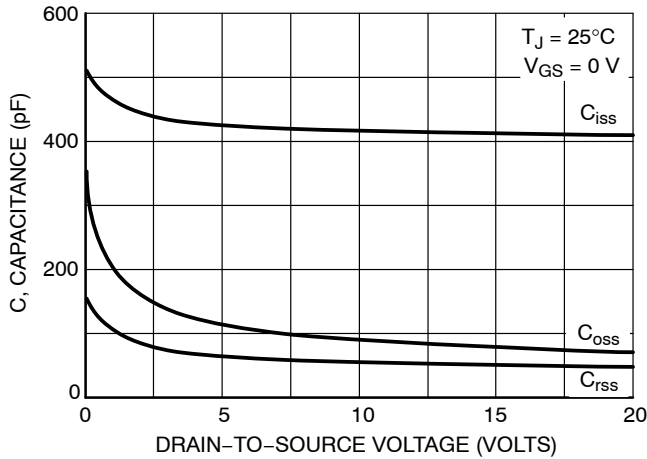
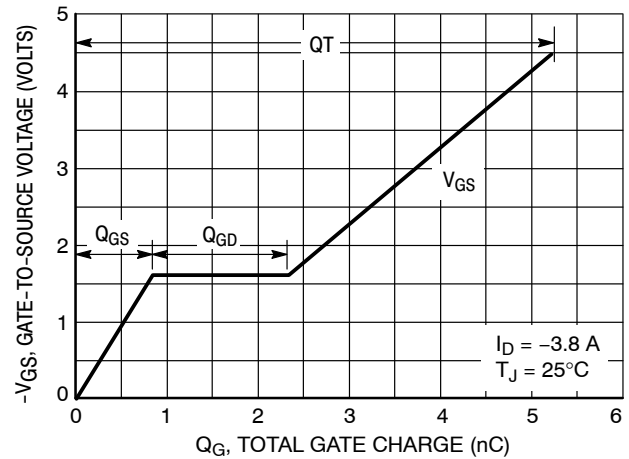


Figure 6. Drain-to-Source Leakage Current versus Voltage

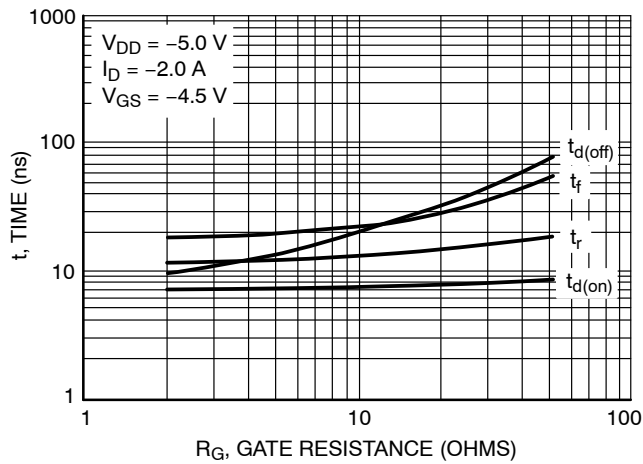
**TYPICAL PERFORMANCE CURVES** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)



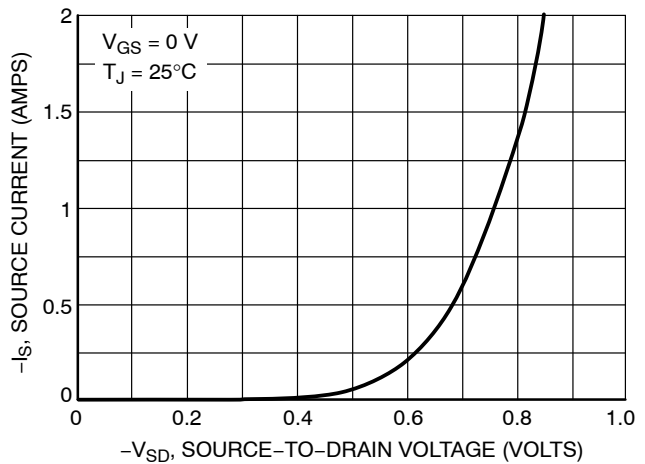
**Figure 7. Capacitance Variation**



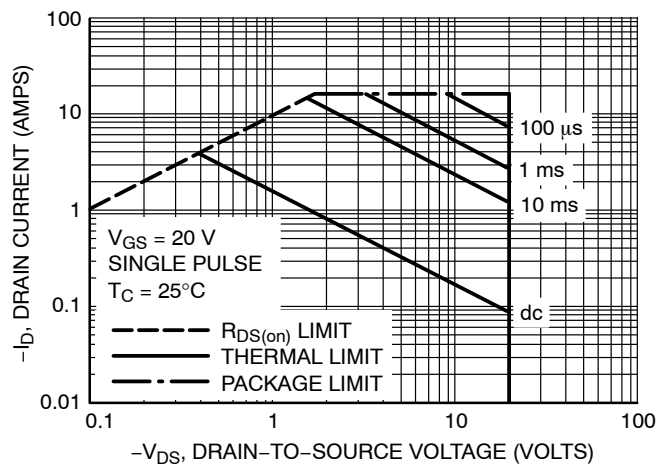
**Figure 8. Gate-To-Source and Drain-To-Source Voltage versus Total Charge**



**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**

# NTLJD3181PZ

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

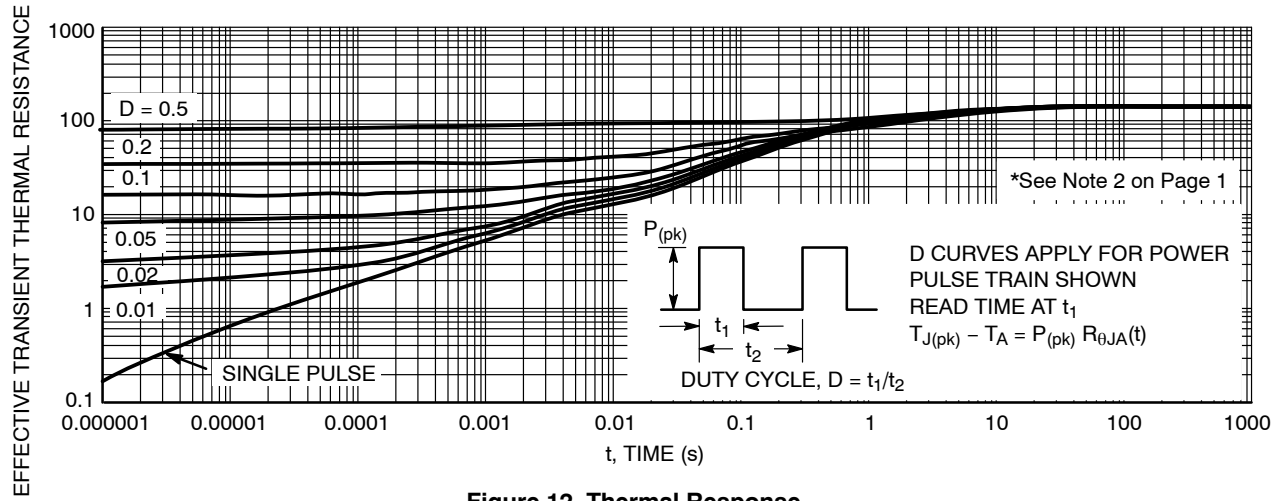
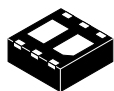


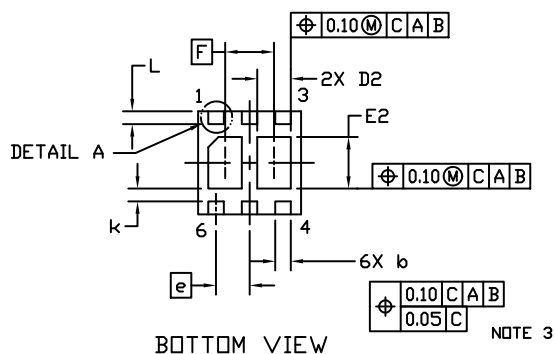
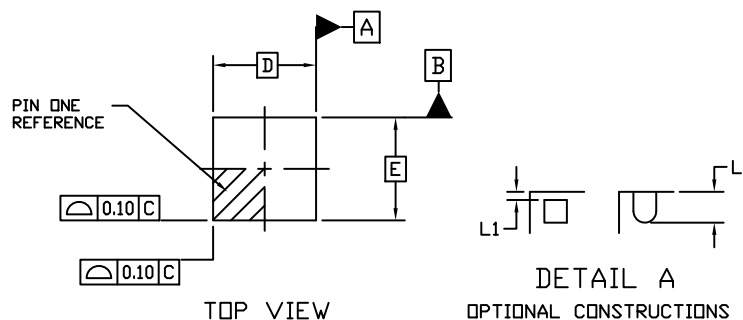
Figure 12. Thermal Response

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



WDFN6 2x2, 0.65P  
CASE 506AN  
ISSUE H

DATE 25 JAN 2022



## GENERIC MARKING DIAGRAM\*



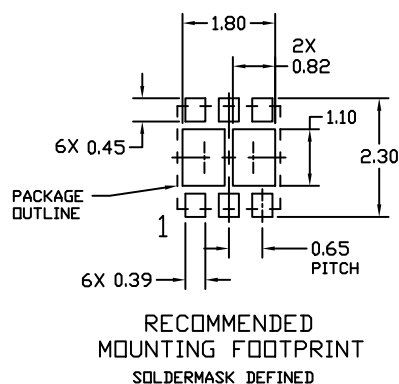
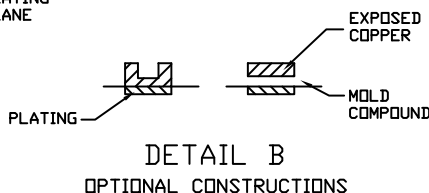
XX = Specific Device Code  
M = Date Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

## 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 0.30 MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | 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    |      |
| F   | 0.95 BSC    |      |
| k   | 0.25 REF    |      |
| L   | 0.20        | 0.30 |
| L1  | ---         | 0.10 |



|                  |                  |                                                                                                                                                                                  |
|------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| DESCRIPTION:     | WDFN6 2x2, 0.65P | PAGE 1 OF 1                                                                                                                                                                      |

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