# NTLJD3115P

# Power MOSFET

## –20 V, –4.1 A, μCool™ Dual P–Channel, 2x2 mm WDFN Package

### Features

- WDFN Package Provides Exposed Drain Pad for Excellent Thermal Conduction
- 2x2 mm Footprint Same as SC–88
- Lowest $R_{DS(on)}$ Solution in 2x2 mm Package
- 1.8 V $R_{DS(on)}$ Rating for Operation at Low Voltage Gate Drive Logic Level
- Low Profile (< 0.8 mm) for Easy Fit in Thin Environments
- Bidirectional Current Flow with Common Source Configuration
- 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°C unless otherwise noted)

| Parameter | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain–to–Source Voltage | | | $V_{DSS}$ | –20 | V |
| Gate–to–Source Voltage | | | $V_{GS}$ | ±8.0 | V |
| Continuous Drain Current (Note 1) | Steady State | $T_A$ = 25°C | $I_D$ | –3.3 | A |
| | | $T_A$ = 85°C | | –2.4 | |
| | t ≤ 5 s | $T_A$ = 25°C | | –4.1 | |
| Power Dissipation (Note 1) | Steady State | $T_A$ = 25°C | $P_D$ | 1.5 | W |
| | t ≤ 5 s | | | 2.3 | |
| Continuous Drain Current (Note 2) | Steady State | $T_A$ = 25°C | $I_D$ | –2.3 | A |
| | | $T_A$ = 85°C | | –1.6 | |
| Power Dissipation (Note 2) | | $T_A$ = 25°C | $P_D$ | 0.71 | 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) | | | $I_S$ | –1.9 | 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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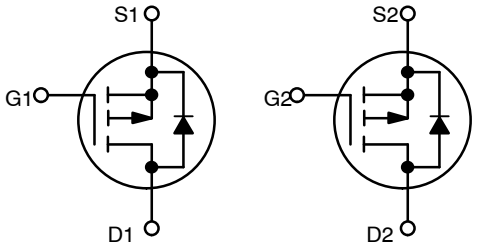
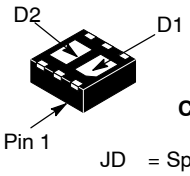
| $V_{(BR)DSS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX (Note 1) |
|---|---|---|
| –20 V | 100 mΩ @ –4.5 V | –4.1 A |
| | 135 mΩ @ –2.5 V | |
| | 200 mΩ @ –1.8 V | |




**P–CHANNEL MOSFET** **P–CHANNEL MOSFET**

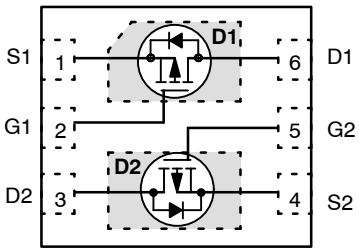



**WDFN6**
**CASE 506AN**

**MARKING DIAGRAM**


JD = 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† |
|---|---|---|
| NTLJD3115PT1G | WDFN6 (Pb–Free) | 3000/Tape & Reel |
| NTLJD3115PTAG | 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.

## 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 | | −20 | | | V |
| Drain−to−Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | $I_D$ = −250 μA, Ref to 25°C | | | 9.95 | | mV/°C |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = −16 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 | | −0.4 | −0.7 | −1.0 | V |
| Negative Gate Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | | | | 2.44 | | mV/°C |
| Drain−to−Source On−Resistance | $R_{DS(on)}$ | $V_{GS}$ = −4.5, $I_D$ = −2.0 A | | | 75 | 100 | mΩ |
| | | $V_{GS}$ = −2.5, $I_D$ = −2.0 A | | | 101 | 135 | |
| | | $V_{GS}$ = −1.8, $I_D$ = −1.6 A | | | 150 | 200 | |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ = −5.0 V, $I_D$ = −2.0 A | | | 6.0 | | S |
| **CHARGES, CAPACITANCES AND GATE RESISTANCE** | | | | | | | |
| Input Capacitance | $C_{ISS}$ | $V_{GS}$ = 0 V, f = 1.0 MHz, $V_{DS}$ = −10 V | | | 531 | | pF |
| Output Capacitance | $C_{OSS}$ | | | | 91 | | |
| Reverse Transfer Capacitance | $C_{RSS}$ | | | | 56 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = −4.5 V, $V_{DS}$ = −10 V, $I_D$ = −2.0 A | | | 5.5 | 6.2 | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | | 0.7 | | |
| Gate−to−Source Charge | $Q_{GS}$ | | | | 1.0 | | |
| Gate−to−Drain Charge | $Q_{GD}$ | | | | 1.4 | | |
| Gate Resistance | $R_G$ | | | | 8.8 | | Ω |
| **SWITCHING CHARACTERISTICS** (Note 6) | | | | | | | |
| Turn−On Delay Time | $t_{d(ON)}$ | $V_{GS}$ = −4.5 V, $V_{DD}$ = −5.0 V, $I_D$ = −1.0 A, $R_G$ = 6.0 Ω | | | 6.0 | | ns |
| Rise Time | $t_r$ | | | | 11 | | |
| Turn−Off Delay Time | $t_{d(OFF)}$ | | | | 21 | | |
| Fall Time | $t_f$ | | | | 8.0 | | |
| Turn−On Delay Time | $t_{d(ON)}$ | $V_{GS}$ = −4.5 V, $V_{DD}$ = −10 V, $I_D$ = −2.0 A, $R_G$ = 2.0 Ω | | | 6.0 | | ns |
| Rise Time | $t_r$ | | | | 12 | | |
| Turn−Off Delay Time | $t_{d(OFF)}$ | | | | 19 | | |
| Fall Time | $t_f$ | | | | 6.0 | | |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** | | | | | | | |
| Forward Recovery Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, IS = −1.0 A | $T_J$ = 25°C | | −0.75 | −1.0 | V |
| | | | $T_J$ = 125°C | | −0.64 | | |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS}$ = 0 V, $d_{ISD}/d_t$ = 100 A/μs, $I_S$ = −1.0 A | | | 12.6 | | ns |
| Charge Time | $t_a$ | | | | 7.0 | | |
| Discharge Time | $t_b$ | | | | 5.6 | | |
| Reverse Recovery Time | $Q_{RR}$ | | | | 5.0 | | nC |

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

## TYPICAL PERFORMANCE CURVES ($T_J$ = 25°C unless otherwise noted)

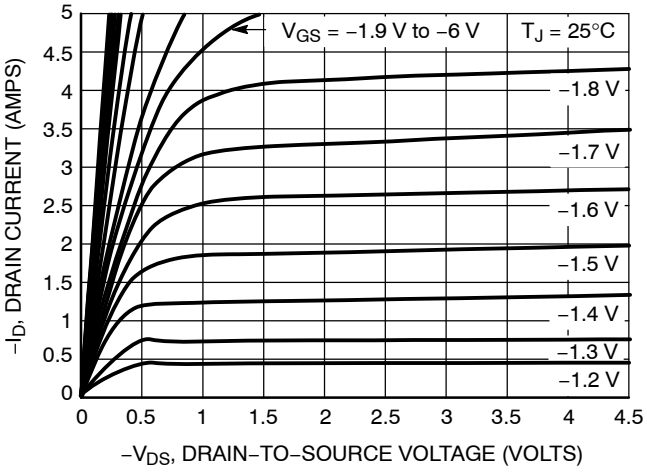



**Figure 1. On−Region Characteristics**

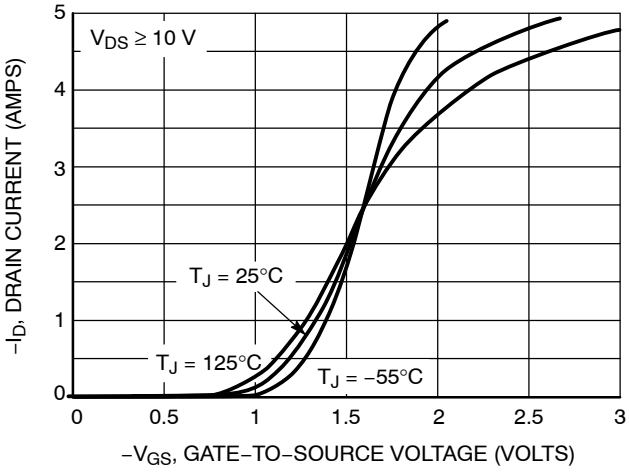



**Figure 2. Transfer Characteristics**

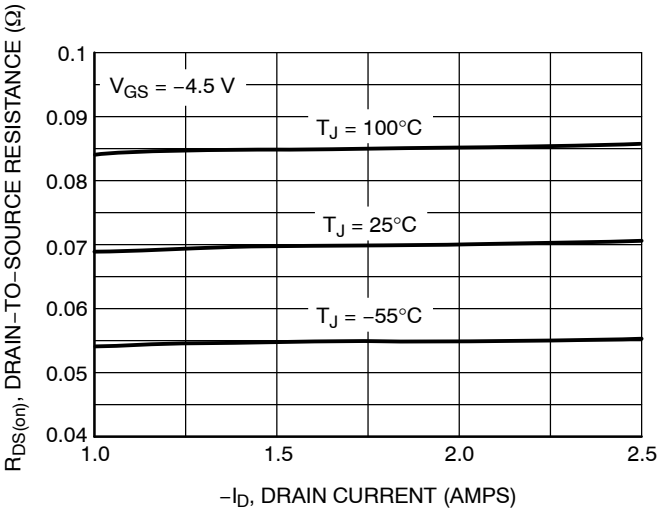



**Figure 3. On−Resistance versus Drain Current**

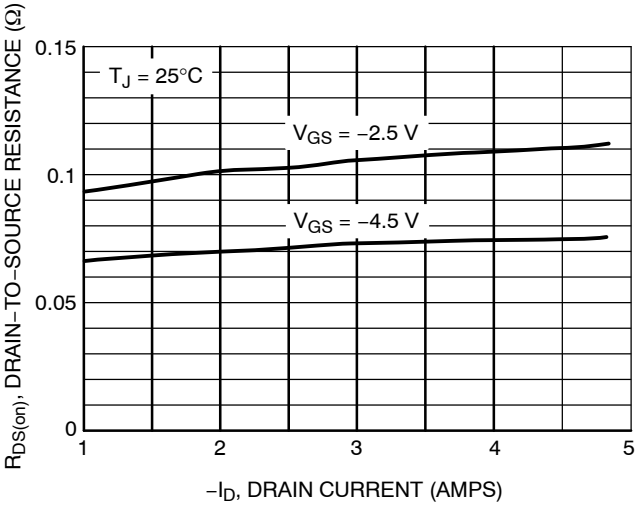



**Figure 4. On−Resistance versus Drain Current and Gate Voltage**

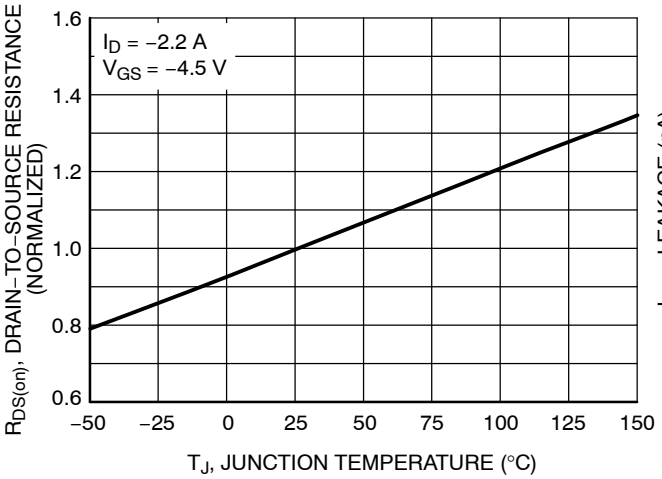



**Figure 5. On−Resistance Variation with Temperature**

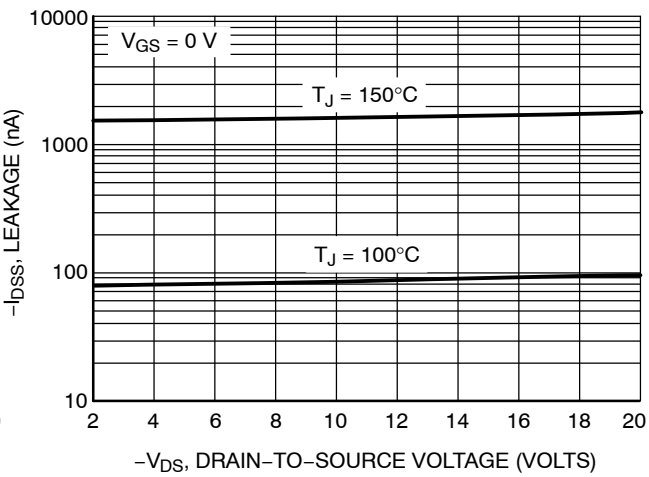



**Figure 6. Drain−to−Source Leakage Current versus Voltage**

## TYPICAL PERFORMANCE CURVES ($T_J$ = 25°C unless otherwise noted)

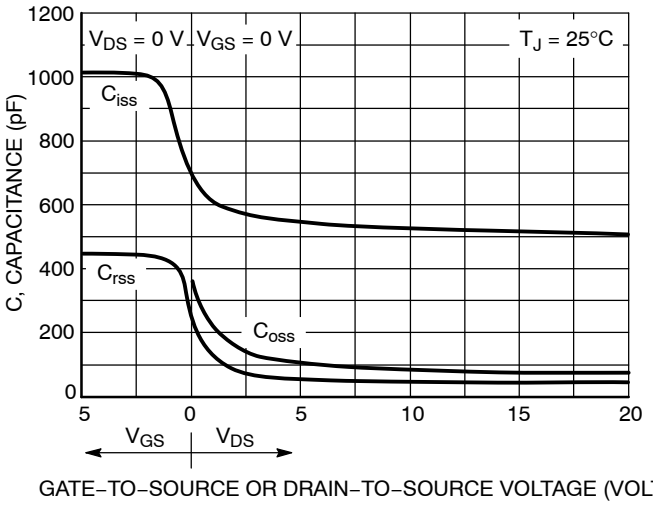



**Figure 7. Capacitance Variation**

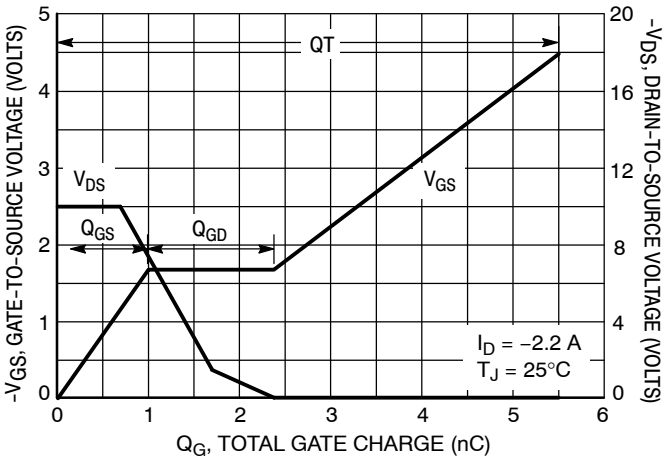



**Figure 8. Gate−To−Source and Drain−To−Source Voltage versus Total Charge**

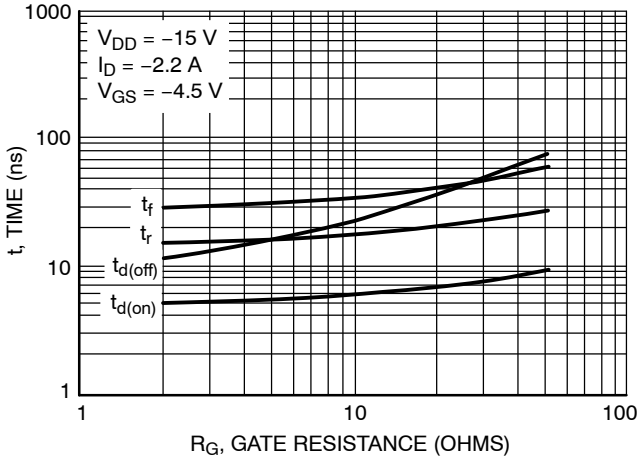



**Figure 9. Resistive Switching Time Variation versus Gate Resistance**

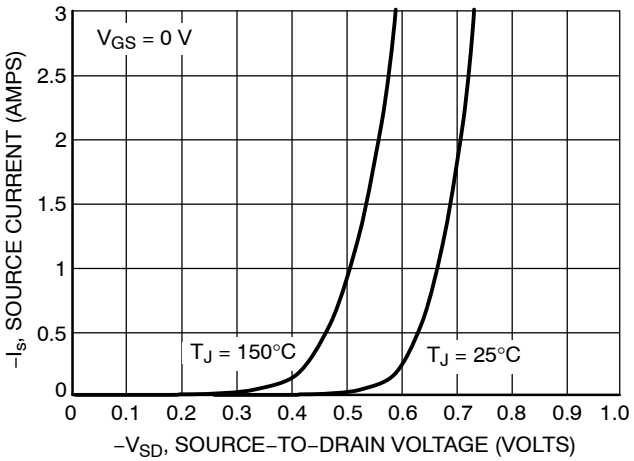



**Figure 10. Diode Forward Voltage versus Current**

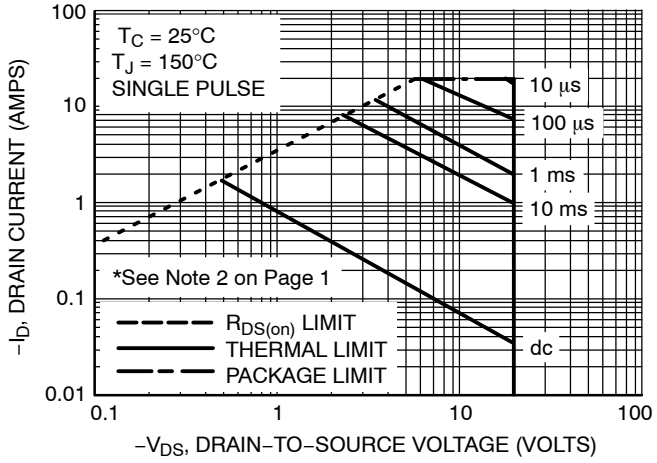



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

## TYPICAL PERFORMANCE CURVES ($T_J$ = 25°C unless otherwise noted)

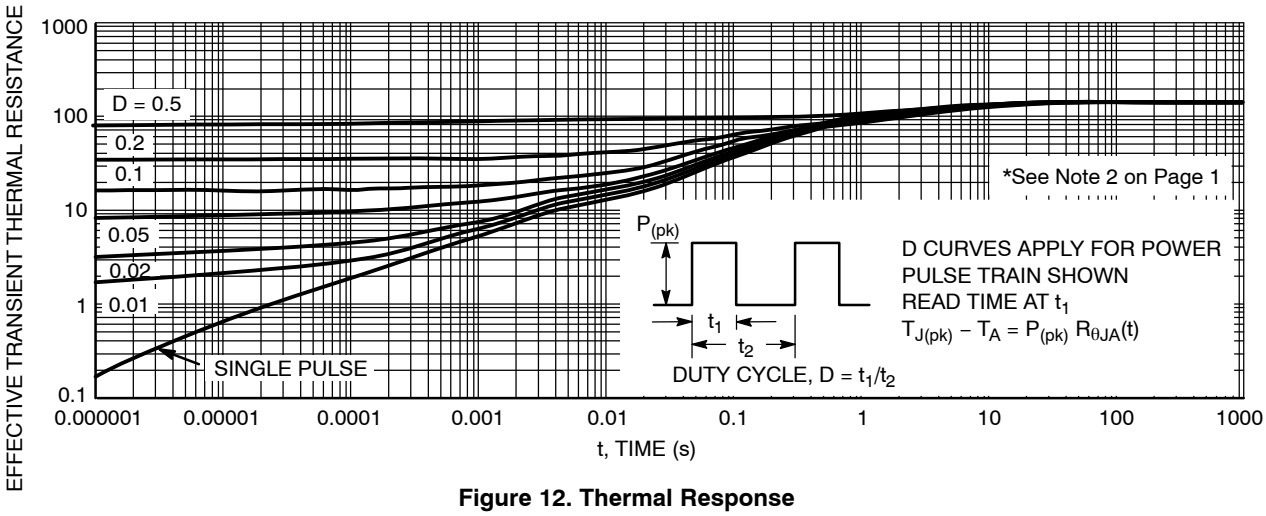
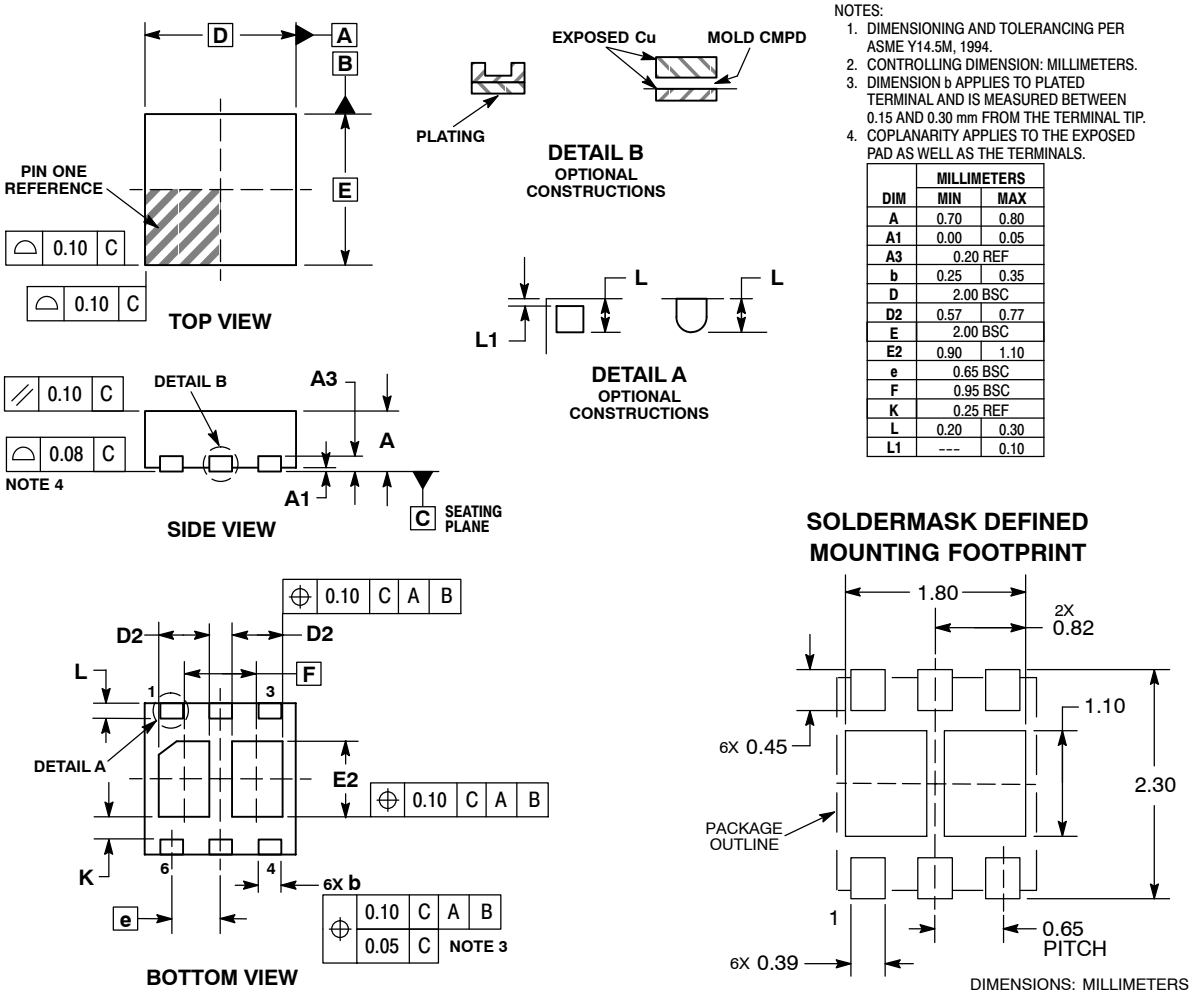



**Figure 12. Thermal Response**

## PACKAGE DIMENSIONS

**WDFN6, 2x2**
CASE 506AN
ISSUE G




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 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 | |
| F | 0.95 BSC | |
| K | 0.25 REF | |
| L | 0.20 | 0.30 |
| L1 | --- | 0.10 |

**SOLDERMASK DEFINED MOUNTING FOOTPRINT**




DIMENSIONS: MILLIMETERS

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