

# NTLUS3A40PZC

## Power MOSFET

-20 V, -9.4 A,  $\mu$ Cool™ Single P-Channel, ESD, 2.0x2.0x0.55 mm UDFN Package

### Features

- UDFN Package with Exposed Drain Pads for Excellent Thermal Conduction
- Low Profile UDFN 2.0x2.0x0.55 mm for Board Space Saving
- Lowest RDS(on) in 2.0x2.0 Package
- ESD Protected
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- High Side Load Switch
- PA Switch and Battery Switch
- Optimized for Power Management Applications for Portable Products, such as Cell Phones, PMP, DSC, GPS, and others

### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise stated)

| Parameter   |              | Symbol                            | Value          | Units |   |
|---|--------------|-----------------------------------|----------------|-------|---|
| Drain-to-Source Voltage   |              | V <sub>DSS</sub>                  | -20            | V     |   |
| Gate-to-Source Voltage  |              | V <sub>GS</sub>                   | ±8.0           | V     |   |
| Continuous Drain Current (Note 1)                                 | Steady State | T <sub>A</sub> = 25°C             | I <sub>D</sub> | -6.4  | A |
|   |              | T <sub>A</sub> = 85°C             |                | -4.6  |   |
|   | t ≤ 5 s      | T <sub>A</sub> = 25°C             |                | -9.4  |   |
| Power Dissipation (Note 1)  | Steady State | T <sub>A</sub> = 25°C             | P <sub>D</sub> | 1.7   | W |
|   |              | T <sub>A</sub> = 25°C             |                | 3.8   |   |
| Continuous Drain Current (Note 2)                                 | Steady State | T <sub>A</sub> = 25°C             | I <sub>D</sub> | -4.0  | A |
|   |              | T <sub>A</sub> = 85°C             |                | -2.9  |   |
| Power Dissipation (Note 2)  |              | T <sub>A</sub> = 25°C             | P <sub>D</sub> | 0.7   | W |
| Pulsed Drain Current  | tp = 10 μs   | I <sub>DM</sub>                   | -30            | A     |   |
| Operating Junction and Storage Temperature                        |              | T <sub>J</sub> , T <sub>STG</sub> | -55 to 150     | °C    |   |
| Source Current (Body Diode) (Note 2)                              |              | I <sub>S</sub>                    | -1.0           | A     |   |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) |              | T <sub>L</sub>                    | 260            | °C    |   |
| ESD Rating (HBM) per JEDEC22-A114F                                |              | ESD                               | >2000          | V     |   |

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<sup>2</sup>, 2 oz. Cu.

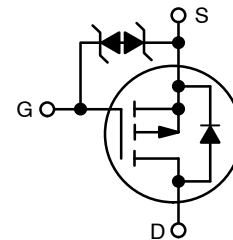


ON Semiconductor®

<http://onsemi.com>

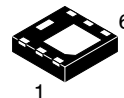
### MOSFET

| V <sub>(BR)DSS</sub> | R <sub>DS(on)</sub> MAX | I <sub>D</sub> MAX |
|----------------------|-------------------------|--------------------|
| -20 V                | 29 mΩ @ -4.5 V          | -9.4 A             |
|                      | 39 mΩ @ -2.5 V          |                    |
|                      | 60 mΩ @ -1.8 V          |                    |
|                      | 120 mΩ @ -1.5 V         |                    |

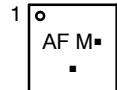


P-Channel MOSFET

### MARKING DIAGRAM



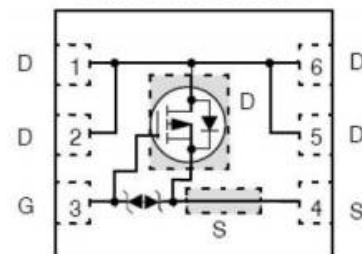
UDFN6  
CASE 517BG  
 $\mu$ COOL™



AF = 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 5 of this data sheet.

# NTLUS3A40PZC

## THERMAL RESISTANCE RATINGS

| Parameter   | Symbol          | Max | Units |
|---|-----------------|-----|-------|
| Junction-to-Ambient – Steady State (Note 3)         | $R_{\theta JA}$ | 72  | °C/W  |
| Junction-to-Ambient – $t \leq 5$ s (Note 3)         | $R_{\theta JA}$ | 33  |       |
| Junction-to-Ambient – Steady State min Pad (Note 4) | $R_{\theta JA}$ | 189 |       |

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

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|-----------|--------|----------------|-----|-----|-----|-------|
|-----------|--------|----------------|-----|-----|-----|-------|

### 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 | $V_{(BR)DSS}/T_J$ | $I_D = -250\ \mu\text{A}$ , ref to $25^\circ\text{C}$ |                          | -5.0 |          | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = -20\text{ V}$          | $T_J = 25^\circ\text{C}$ |      | -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               | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = -250\ \mu\text{A}$    | -0.4 |     | -1.0 | V          |
| Negative Threshold Temp. Coefficient | $V_{GS(TH)}/T_J$ |   |      | 3.0 |      | mV/°C      |
| Drain-to-Source On Resistance        | $R_{DS(on)}$     | $V_{GS} = -4.5\text{ V}, I_D = -6.4\text{ A}$ |      | 23  | 29   | m $\Omega$ |
|                                      |                  | $V_{GS} = -2.5\text{ V}, I_D = -4.8\text{ A}$ |      | 31  | 39   |            |
|                                      |                  | $V_{GS} = -1.8\text{ V}, I_D = -2.5\text{ A}$ |      | 43  | 60   |            |
|                                      |                  | $V_{GS} = -1.5\text{ V}, I_D = -1.5\text{ A}$ |      | 60  | 120  |            |
| Forward Transconductance             | $g_{FS}$         | $V_{DS} = -15\text{ V}, I_D = -4.0\text{ A}$  |      | 18  |      | S          |

### CHARGES, CAPACITANCES & GATE RESISTANCE

|                              |              |  |  |      |  |    |
|------------------------------|--------------|--|--|------|--|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = -15\text{ V}$       |  | 2600 |  | pF |
| Output Capacitance           | $C_{OSS}$    |  |  | 200  |  |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |  |  | 190  |  |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = -4.5\text{ V}, V_{DS} = -15\text{ V}; I_D = -4.0\text{ A}$ |  | 29   |  | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |  |  | 1.4  |  |    |
| Gate-to-Source Charge        | $Q_{GS}$     |  |  | 3.7  |  |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |  |  | 8.1  |  |    |

### SWITCHING CHARACTERISTICS, $V_{GS} = 4.5\text{ V}$ (Note 6)

|                     |              |   |  |     |  |    |
|---------------------|--------------|---|--|-----|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = -4.5\text{ V}, V_{DD} = -15\text{ V}, I_D = -4.0\text{ A}, R_G = 1\ \Omega$ |  | 9.0 |  | ns |
| Rise Time           | $t_r$        |   |  | 18  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |   |  | 126 |  |    |
| Fall Time           | $t_f$        |   |  | 71  |  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |          |   |                           |      |      |     |   |
|-------------------------|----------|---|---------------------------|------|------|-----|---|
| Forward Diode Voltage   | VSD      | $V_{GS} = 0\text{ V}, I_S = -1.0\text{ A}$  | $T_J = 25^\circ\text{C}$  |      | 0.65 | 1.0 | V |
|                         |          |   | $T_J = 125^\circ\text{C}$ |      | 0.55 |     |   |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, \text{dis}/\text{dt} = 100\text{ A}/\mu\text{s}, I_S = -1.0\text{ A}$ |                           | 25   |      | ns  |   |
| Charge Time             | $t_a$    |   |                           | 10   |      |     |   |
| Discharge Time          | $t_b$    |   |                           | 15   |      |     |   |
| Reverse Recovery Charge | $Q_{RR}$ |   |                           | 13.6 |      | nC  |   |

- Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).
- Surface-mounted on FR4 board using the minimum recommended pad size of 30 mm<sup>2</sup>, 2 oz. Cu.
- Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Switching characteristics are independent of operating junction temperatures.

# NTLUS3A40PZC

## TYPICAL CHARACTERISTICS

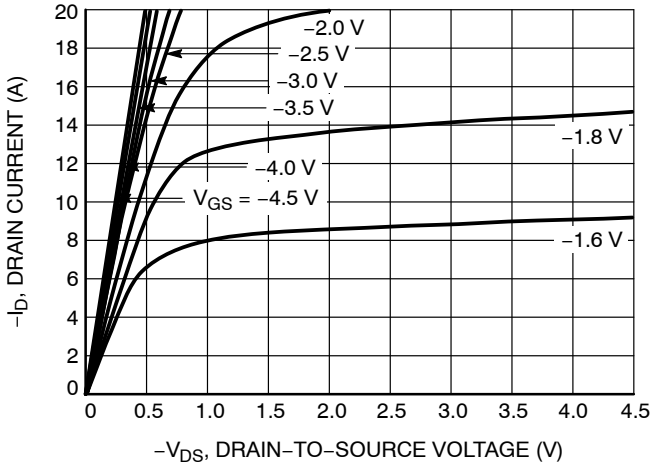


Figure 1. On-Region Characteristics

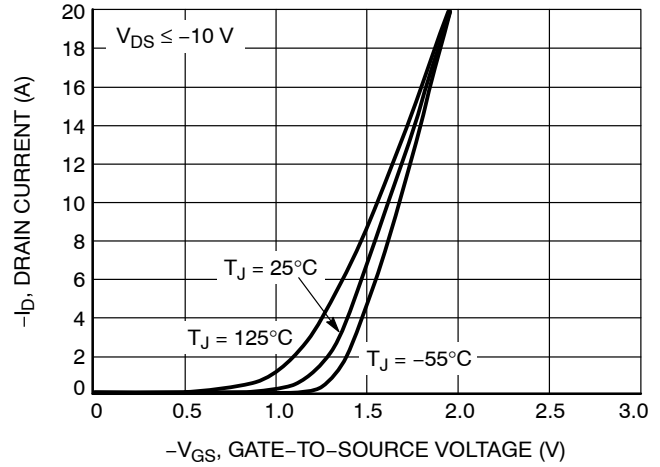


Figure 2. Transfer Characteristics

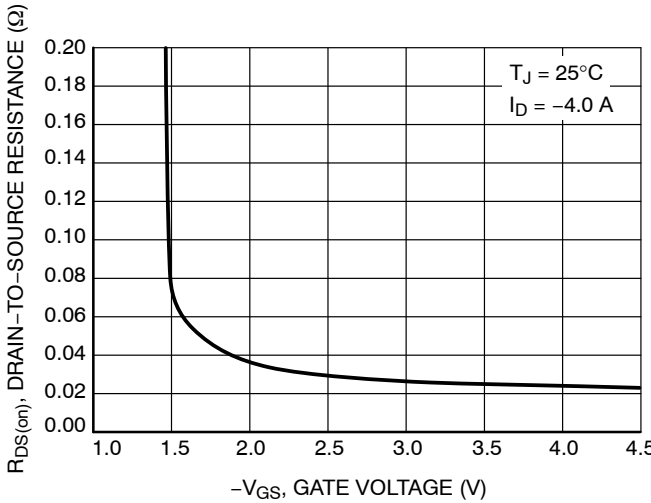


Figure 3. On-Resistance vs. Gate-to-Source Voltage

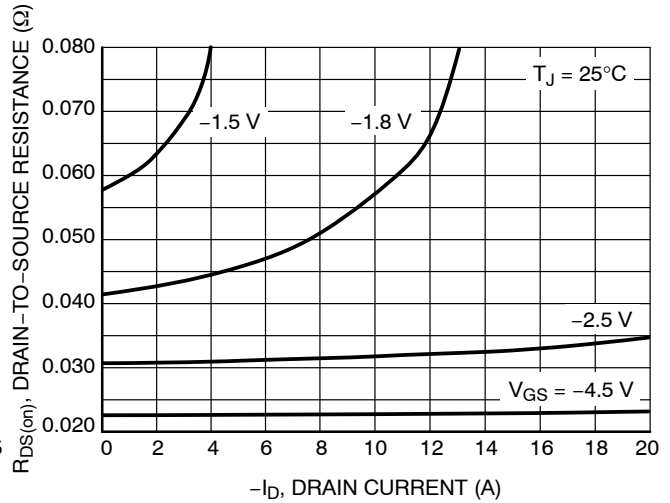


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

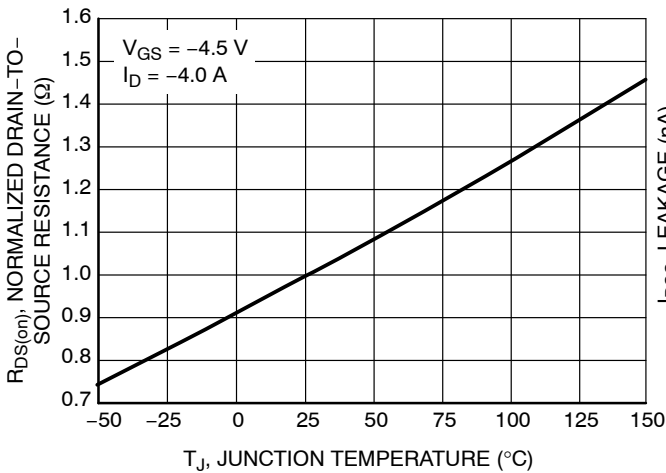


Figure 5. On-Resistance Variation with Temperature

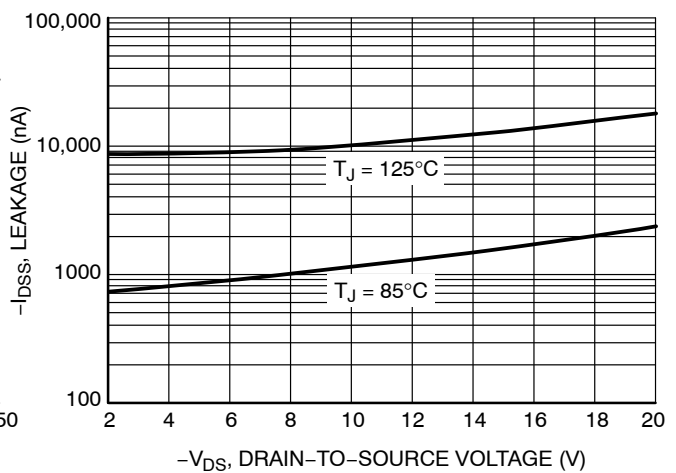


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTLUS3A40PZC

## TYPICAL CHARACTERISTICS

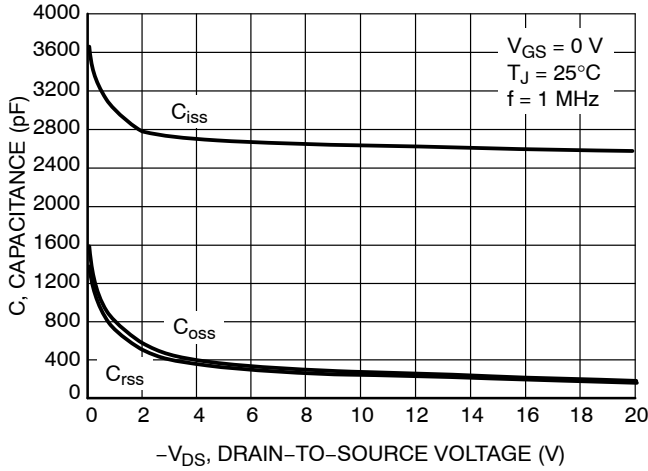


Figure 7. Capacitance Variation

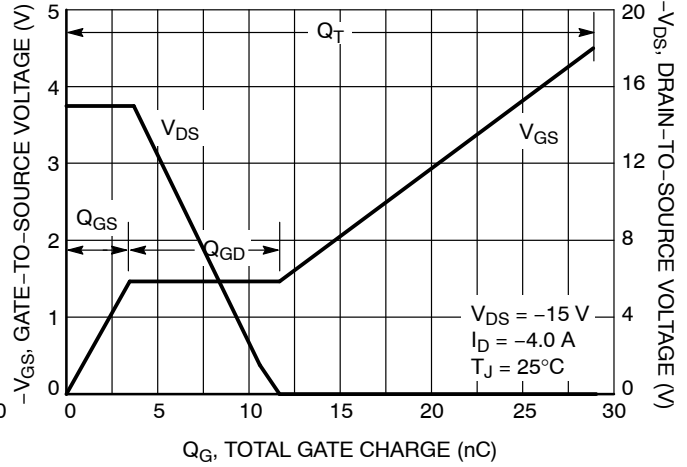


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

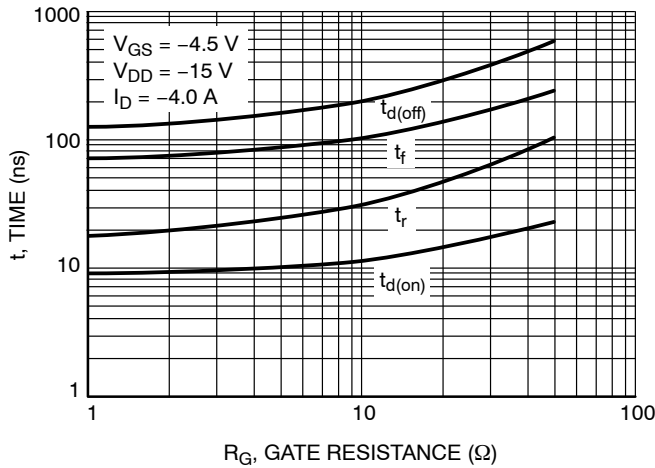


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

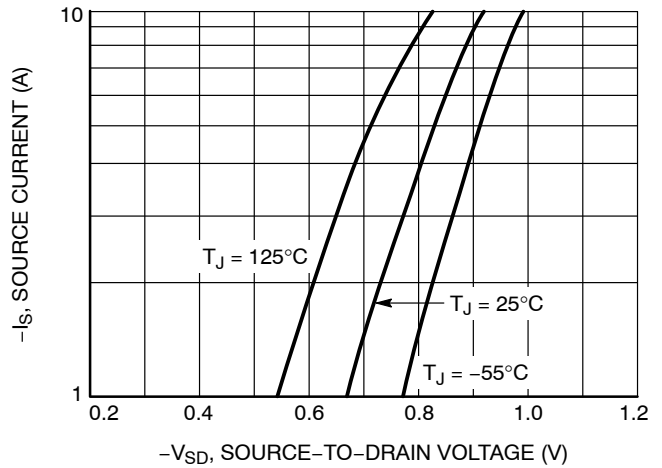


Figure 10. Diode Forward Voltage vs. Current

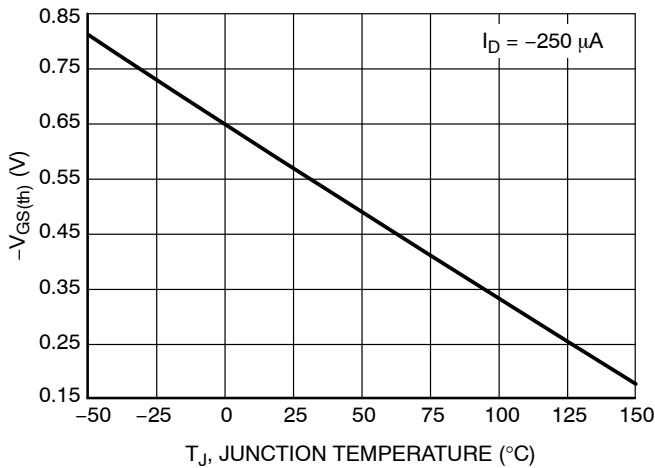


Figure 11. Threshold Voltage

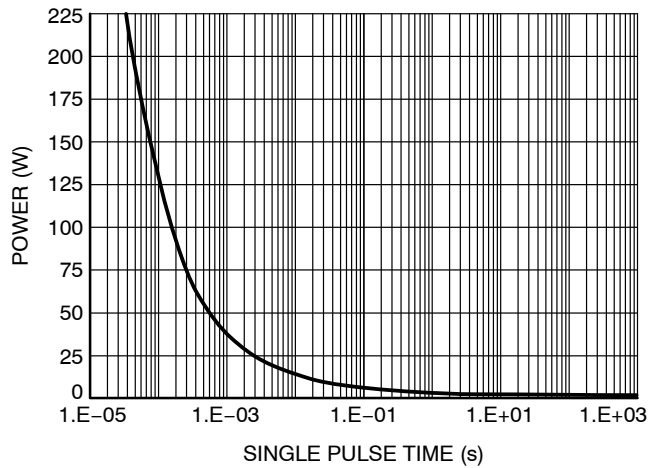
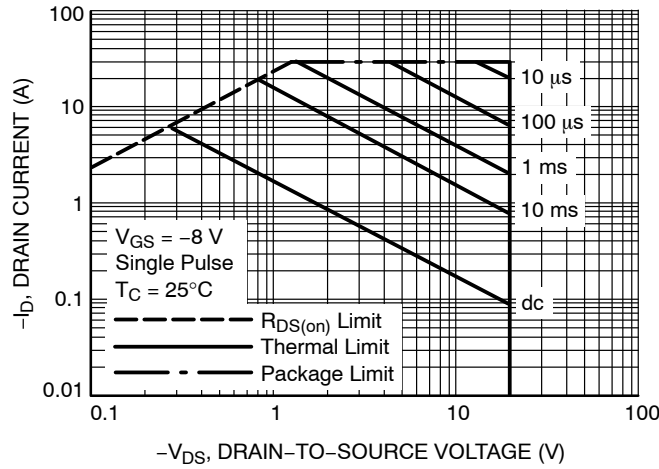


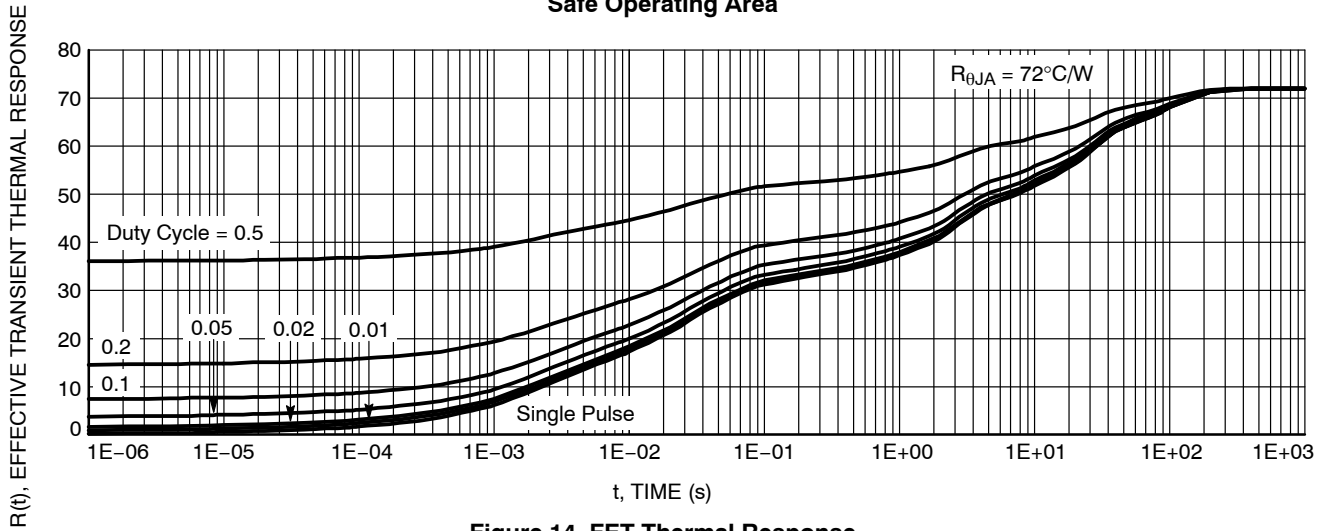
Figure 12. Single Pulse Maximum Power Dissipation

# NTLUS3A40PZC

## TYPICAL CHARACTERISTICS



**Figure 13. Maximum Rated Forward Biased Safe Operating Area**



**Figure 14. FET Thermal Response**

### DEVICE ORDERING INFORMATION

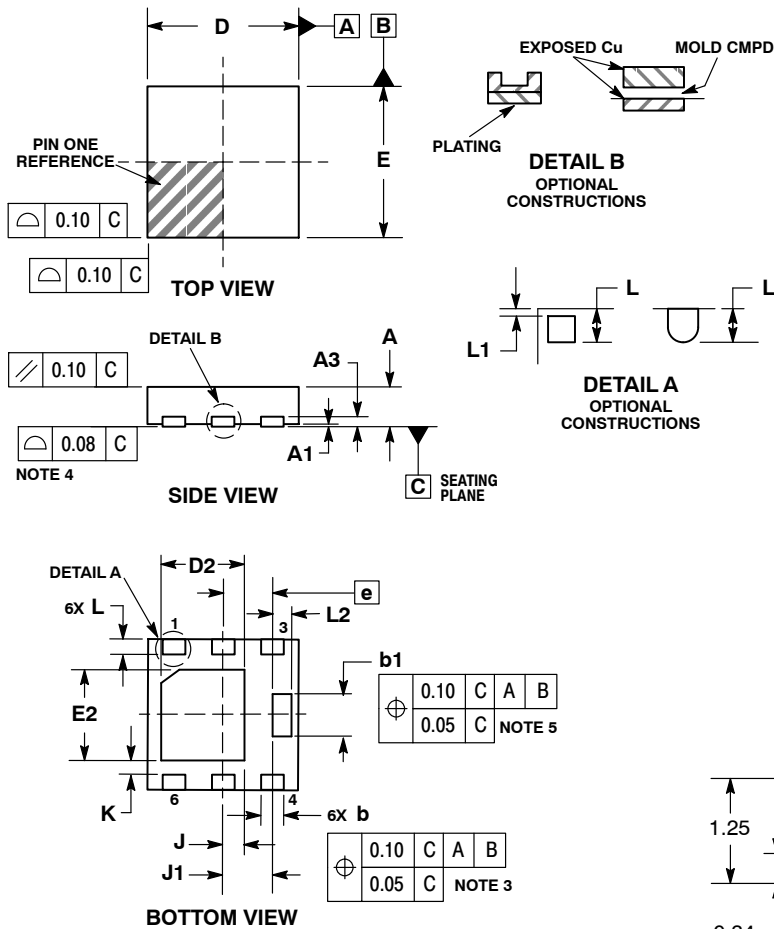
| Device          | Package            | Shipping <sup>†</sup> |
|-----------------|--------------------|-----------------------|
| NTLUS3A40PZCTAG | UDFN6<br>(Pb-Free) | 3000 / Tape & Reel    |
| NTLUS3A40PZCTBG | UDFN6<br>(Pb-Free) | 3000 / Tape & Reel    |

<sup>†</sup>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.

# NTLUS3A40PZC

## PACKAGE DIMENSIONS

UDFN6 2x2, 0.65P  
CASE 517BG  
ISSUE A

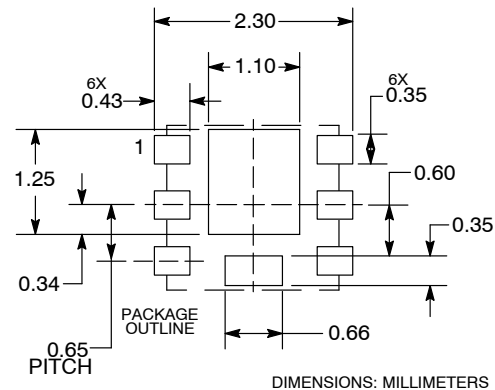


**NOTES:**

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 0.30 mm FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. CENTER TERMINAL LEAD IS OPTIONAL. CENTER TERMINAL IS CONNECTED TO TERMINAL LEAD # 4.
6. LEADS 1, 2, 5 AND 6 ARE TIED TO THE FLAG.

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 0.45        | 0.55 |
| A1  | 0.00        | 0.05 |
| A3  | 0.13 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    |      |
| J   | 0.27 BSC    |      |
| J1  | 0.65 BSC    |      |
| L   | 0.20        | 0.30 |
| L1  | ---         | 0.10 |
| L2  | 0.20        | 0.30 |

### RECOMMENDED MOUNTING FOOTPRINT



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