

# NTUD3169CZ

## MOSFET – Small Signal, Complementary, SOT-963, 1.0 x 1.0 mm

20 V, 220 mA / -200 mA

### Features

- Complementary MOSFET Device
- Offers a Low  $R_{DS(on)}$  Solution in the Ultra Small 1.0x1.0 mm Package
- 1.5 V Gate Voltage Rating
- Ultra Thin Profile (< 0.5 mm) Allows It to Fit Easily into Extremely Thin Environments such as Portable Electronics.
- This is a Pb-Free Device

### Applications

- Load Switch with Level Shift
- Optimized for Power Management in Ultra Portable Equipment

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

| Parameter                                                            |                 |                        | Symbol                               | Value         | Unit |
|----------------------------------------------------------------------|-----------------|------------------------|--------------------------------------|---------------|------|
| Drain-to-Source Voltage                                              |                 |                        | V <sub>DSS</sub>                     | 20            | V    |
| Gate-to-Source Voltage                                               |                 |                        | V <sub>GS</sub>                      | ±8            | V    |
| N-Channel<br>Continuous Drain<br>Current (Note 1)                    | Steady<br>State | T <sub>A</sub> = 25°C  | I <sub>D</sub>                       | 220           | mA   |
|                                                                      |                 | T <sub>A</sub> = 85°C  |                                      | 160           |      |
|                                                                      | t ≤ 5 s         | T <sub>A</sub> = 25°C  |                                      | 280           |      |
| P-Channel<br>Continuous Drain<br>Current (Note 1)                    | Steady<br>State | T <sub>A</sub> = 25°C  |                                      | -200          |      |
|                                                                      |                 | T <sub>A</sub> = 85°C  |                                      | -140          |      |
|                                                                      | t ≤ 5 s         | T <sub>A</sub> = 25°C  |                                      | -250          |      |
| Power Dissipation<br>(Note 1)                                        | Steady<br>State | T <sub>A</sub> = 25°C  | P <sub>D</sub>                       | 125           | mW   |
|                                                                      | t ≤ 5 s         |                        |                                      | 200           |      |
| Pulsed Drain Current                                                 | N-Channel       | t <sub>p</sub> = 10 μs | I <sub>DM</sub>                      | 800           | mA   |
|                                                                      | P-Channel       |                        |                                      | -600          |      |
| Operating Junction and Storage Temperature                           |                 |                        | T <sub>J</sub> ,<br>T <sub>STG</sub> | -55 to<br>150 | °C   |
| Source Current (Body Diode) (Note 2)                                 |                 |                        | I <sub>S</sub>                       | 200           | mA   |
| Lead Temperature for Soldering Purposes<br>(1/8" from case for 10 s) |                 |                        | T <sub>L</sub>                       | 260           | °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 the minimum recommended pad size, 1 oz. Cu.
2. Pulse Test: pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$

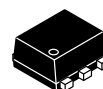
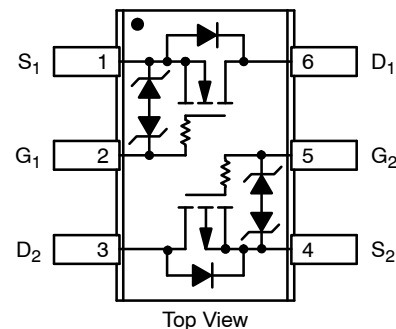


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| $V_{(BR)DSS}$     | $R_{DS(on)}$ Max      | $I_D$ Max |
|-------------------|-----------------------|-----------|
| N-Channel<br>20 V | 1.5 $\Omega$ @ 4.5 V  | 0.22 A    |
|                   | 2.0 $\Omega$ @ 2.5 V  |           |
|                   | 3.0 $\Omega$ @ 1.8 V  |           |
|                   | 4.5 $\Omega$ @ 1.5 V  |           |
| P-Channel<br>20 V | 5.0 $\Omega$ @ -4.5 V | -0.2 A    |
|                   | 6.0 $\Omega$ @ -2.5 V |           |
|                   | 7.0 $\Omega$ @ -1.8 V |           |
|                   | 10 $\Omega$ @ -1.5 V  |           |

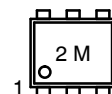
### PINOUT: SOT-963



SOT-963  
CASE 527AD

2 = Specific Device Code  
M = Date Code

### MARKING DIAGRAM



### ORDERING INFORMATION

| Device        | Package              | Shipping†             |
|---------------|----------------------|-----------------------|
| NTUD3169CZT5G | SOT-963<br>(Pb-Free) | 8000 /<br>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.

# NTUD3169CZ

## THERMAL RESISTANCE RATINGS

| Parameter                                                | Symbol          | Max  | Unit                 |
|----------------------------------------------------------|-----------------|------|----------------------|
| Junction-to-Ambient – Steady State, Minimum Pad (Note 3) | $R_{\theta JA}$ | 1000 | $^{\circ}\text{C/W}$ |
| Junction-to-Ambient – $t \leq 5$ s (Note 3)              |                 | 600  |                      |

3. Surface-mounted on FR4 board using the minimum recommended pad size, 1 oz. Cu.

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

| Parameter                         | Symbol        | N/P | Test Condition                                   | Min                             | Typ | Max       | Unit |
|-----------------------------------|---------------|-----|--------------------------------------------------|---------------------------------|-----|-----------|------|
| <b>OFF CHARACTERISTICS</b>        |               |     |                                                  |                                 |     |           |      |
| Drain-to-Source Breakdown Voltage | $V_{(BR)DSS}$ | N   | $V_{GS} = 0\text{ V}$                            | $I_D = 250\text{ }\mu\text{A}$  | 20  |           | V    |
|                                   |               | P   |                                                  | $I_D = -250\text{ }\mu\text{A}$ | -20 |           |      |
| Zero Gate Voltage Drain Current   | $I_{DSS}$     | N   | $V_{GS} = 0\text{ V}, V_{DS} = 5.0\text{ V}$     | $T_J = 25^{\circ}\text{C}$      |     | 50        | nA   |
|                                   |               |     |                                                  | $T_J = 85^{\circ}\text{C}$      |     | 200       |      |
|                                   |               | P   | $V_{GS} = 0\text{ V}, V_{DS} = -5.0\text{ V}$    | $T_J = 25^{\circ}\text{C}$      |     | -50       |      |
|                                   |               |     |                                                  | $T_J = 85^{\circ}\text{C}$      |     | -200      |      |
| Zero Gate Voltage Drain Current   | $I_{DSS}$     | N   | $V_{GS} = 0\text{ V}, V_{DS} = 16\text{ V}$      | $T_J = 25^{\circ}\text{C}$      |     | 100       | nA   |
|                                   |               | P   | $V_{GS} = 0\text{ V}, V_{DS} = -16\text{ V}$     |                                 |     | -100      |      |
| Gate-to-Source Leakage Current    | $I_{GSS}$     | N   | $V_{DS} = 0\text{ V}, V_{GS} = \pm 5.0\text{ V}$ |                                 |     | $\pm 100$ | nA   |
|                                   |               | P   |                                                  |                                 |     | $\pm 100$ |      |

## ON CHARACTERISTICS (Note 4)

|                               |              |   |                                                |                                 |      |      |          |
|-------------------------------|--------------|---|------------------------------------------------|---------------------------------|------|------|----------|
| Gate Threshold Voltage        | $V_{GS(TH)}$ | N | $V_{GS} = V_{DS}$                              | $I_D = 250\text{ }\mu\text{A}$  | 0.4  | 1.0  | V        |
|                               |              | P |                                                | $I_D = -250\text{ }\mu\text{A}$ | -0.4 | -1.0 |          |
| Drain-to-Source On Resistance | $R_{DS(on)}$ | N | $V_{GS} = 4.5\text{ V}, I_D = 100\text{ mA}$   |                                 | 0.75 | 1.5  | $\Omega$ |
|                               |              | P | $V_{GS} = -4.5\text{ V}, I_D = -100\text{ mA}$ |                                 | 2.0  | 5.0  |          |
|                               |              | N | $V_{GS} = 2.5\text{ V}, I_D = 50\text{ mA}$    |                                 | 1.0  | 2.0  |          |
|                               |              | P | $V_{GS} = -2.5\text{ V}, I_D = -50\text{ mA}$  |                                 | 2.6  | 6.0  |          |
|                               |              | N | $V_{GS} = 1.8\text{ V}, I_D = 20\text{ mA}$    |                                 | 1.4  | 3.0  |          |
|                               |              | P | $V_{GS} = -1.8\text{ V}, I_D = -20\text{ mA}$  |                                 | 3.4  | 7.0  |          |
|                               |              | N | $V_{GS} = 1.5\text{ V}, I_D = 10\text{ mA}$    |                                 | 1.8  | 4.5  |          |
|                               |              | P | $V_{GS} = -1.5\text{ V}, I_D = -10\text{ mA}$  |                                 | 4.0  | 10   |          |
|                               |              | N | $V_{GS} = 1.2\text{ V}, I_D = 1.0\text{ mA}$   |                                 | 2.8  |      |          |
|                               |              | P | $V_{GS} = -1.2\text{ V}, I_D = -1.0\text{ mA}$ |                                 | 6.0  |      |          |
| Forward Transconductance      | $g_{FS}$     | N | $V_{DS} = 5.0\text{ V}, I_D = 125\text{ mA}$   |                                 | 0.48 |      | S        |
|                               |              | P | $V_{DS} = -5.0\text{ V}, I_D = -125\text{ mA}$ |                                 | 0.35 |      |          |
| Source-Drain Diode Voltage    | $V_{SD}$     | N | $V_{GS} = 0\text{ V}, I_S = 10\text{ mA}$      | $T_J = 25^{\circ}\text{C}$      |      | 0.6  | V        |
|                               |              | P | $V_{GS} = 0\text{ V}, I_S = -10\text{ mA}$     |                                 |      | -0.6 |          |

## CAPACITANCES

|                              |           |   |                                                                    |  |      |  |    |
|------------------------------|-----------|---|--------------------------------------------------------------------|--|------|--|----|
| Input Capacitance            | $C_{ISS}$ | N | $f = 1\text{ MHz}, V_{GS} = 0\text{ V}$<br>$V_{DS} = 15\text{ V}$  |  | 12.5 |  | pF |
| Output Capacitance           | $C_{OSS}$ |   |                                                                    |  | 3.6  |  |    |
| Reverse Transfer Capacitance | $C_{RSS}$ |   |                                                                    |  | 2.6  |  |    |
| Input Capacitance            | $C_{ISS}$ | P | $f = 1\text{ MHz}, V_{GS} = 0\text{ V}$<br>$V_{DS} = -15\text{ V}$ |  | 13.5 |  |    |
| Output Capacitance           | $C_{OSS}$ |   |                                                                    |  | 3.8  |  |    |
| Reverse Transfer Capacitance | $C_{RSS}$ |   |                                                                    |  | 2.0  |  |    |

4. Switching characteristics are independent of operating junction temperatures

# NTUD3169CZ

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

| Parameter                                                                     | Symbol       | N/P | Test Condition                                                                           | Min | Typ  | Max | Unit |
|-------------------------------------------------------------------------------|--------------|-----|------------------------------------------------------------------------------------------|-----|------|-----|------|
| <b>SWITCHING CHARACTERISTICS, <math>V_{GS} = 4.5\text{ V}</math> (Note 4)</b> |              |     |                                                                                          |     |      |     |      |
| Turn-On Delay Time                                                            | $t_{d(ON)}$  | N   | $V_{GS} = 4.5\text{ V}, V_{DD} = 10\text{ V}, I_D = 200\text{ mA}, R_G = 2.0\ \Omega$    |     | 16.5 |     | ns   |
| Rise Time                                                                     | $t_r$        |     |                                                                                          |     | 25.5 |     |      |
| Turn-Off Delay Time                                                           | $t_{d(OFF)}$ |     |                                                                                          |     | 142  |     |      |
| Fall Time                                                                     | $t_f$        |     |                                                                                          |     | 80   |     |      |
| Turn-On Delay Time                                                            | $t_{d(ON)}$  | P   | $V_{GS} = -4.5\text{ V}, V_{DD} = -15\text{ V}, I_D = -200\text{ mA}, R_G = 2.0\ \Omega$ |     | 26   |     |      |
| Rise Time                                                                     | $t_r$        |     |                                                                                          |     | 46   |     |      |
| Turn-Off Delay Time                                                           | $t_{d(OFF)}$ |     |                                                                                          |     | 196  |     |      |
| Fall Time                                                                     | $t_f$        |     |                                                                                          |     | 145  |     |      |

4. Switching characteristics are independent of operating junction temperatures

TYPICAL CHARACTERISTICS (N-CHANNEL)

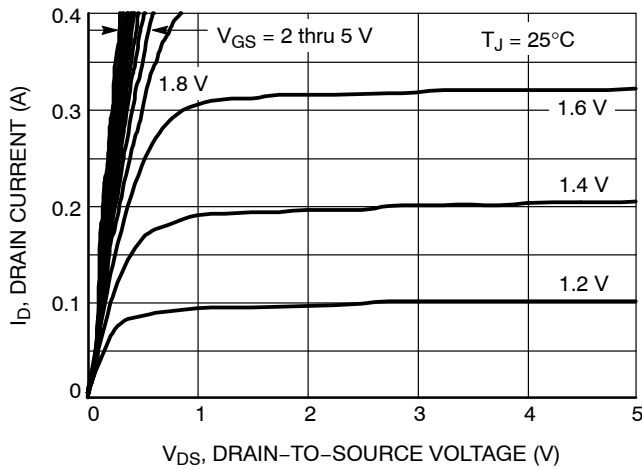


Figure 1. On-Region Characteristics

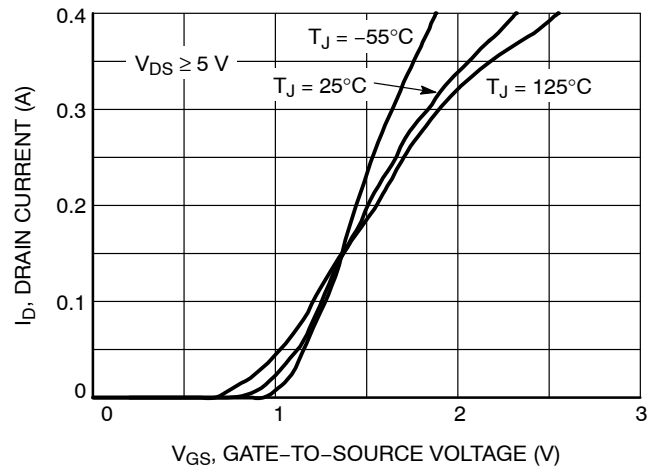


Figure 2. Transfer Characteristics

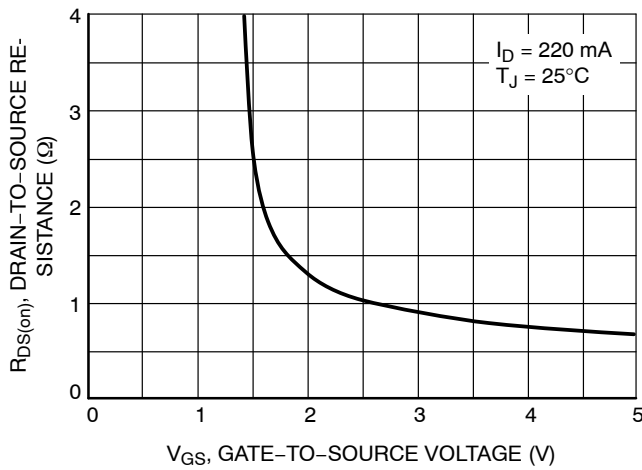


Figure 3. On-Resistance vs. Gate Voltage

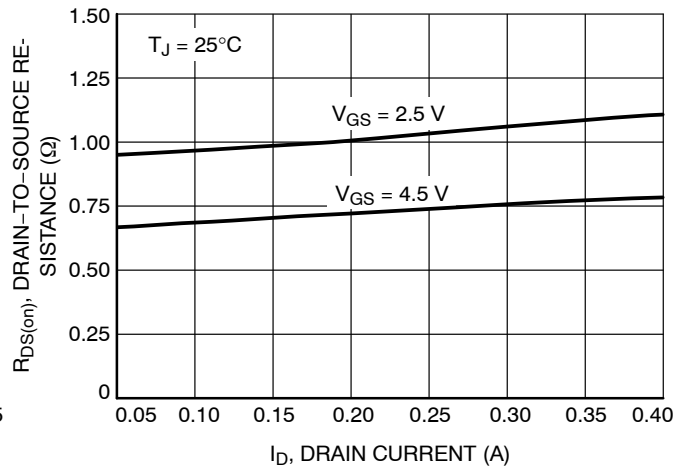


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

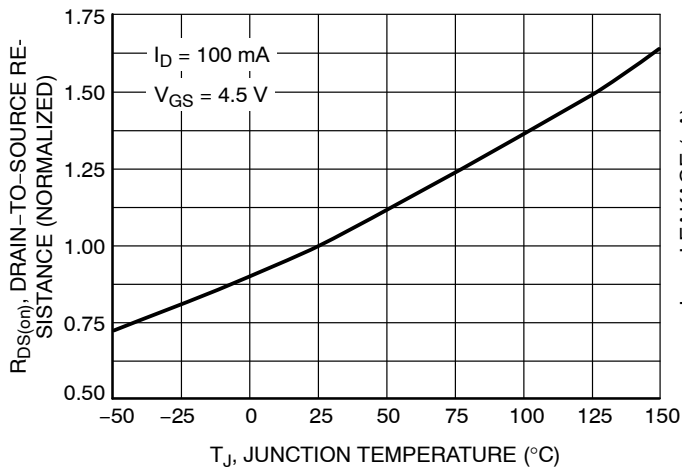


Figure 5. On-Resistance Variation with Temperature

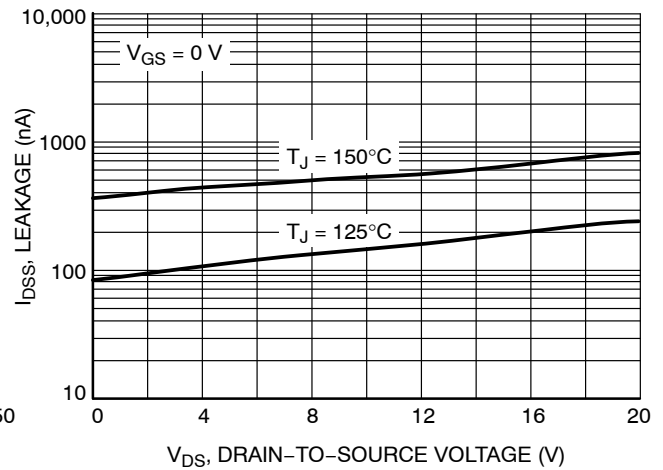


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS (N-CHANNEL)

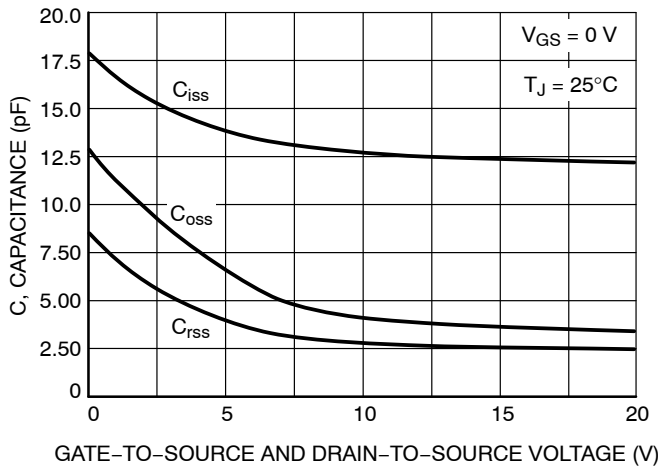


Figure 7. Capacitance Variation

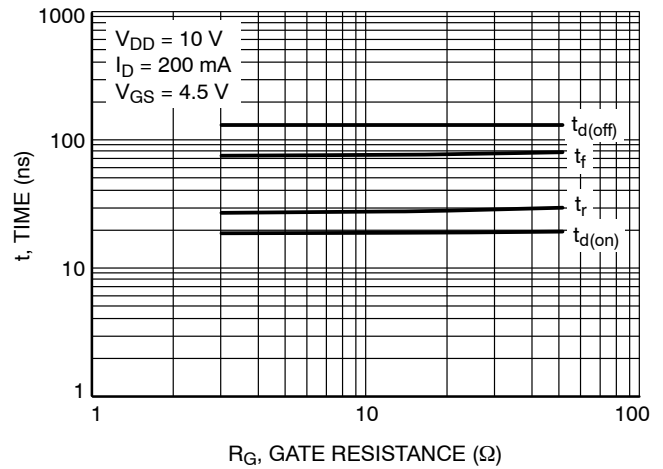


Figure 8. Resistive Switching Time Variation vs. Gate Resistance

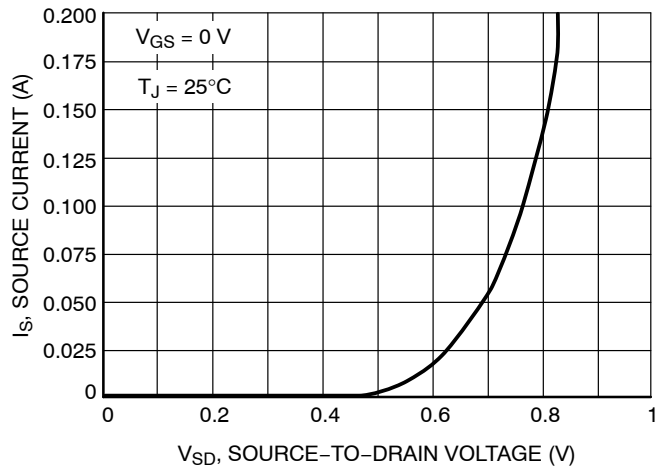


Figure 9. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS (P-CHANNEL)

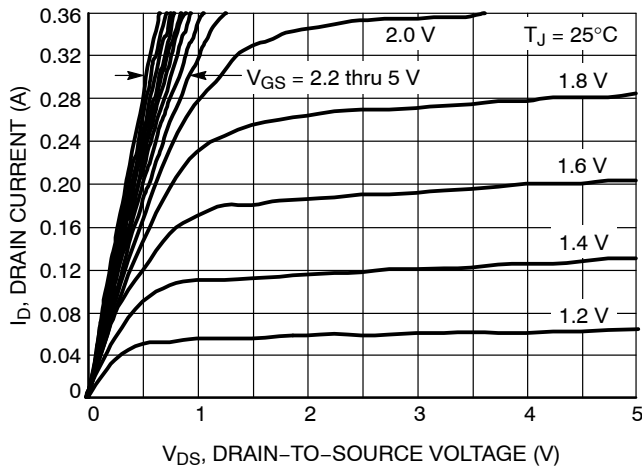


Figure 10. On-Region Characteristics

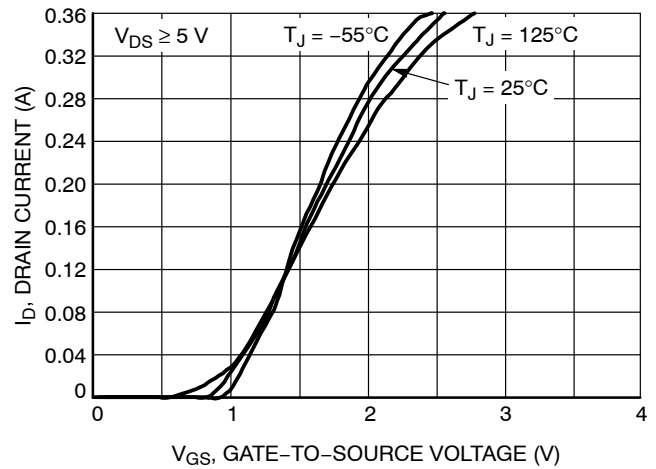


Figure 11. Transfer Characteristics

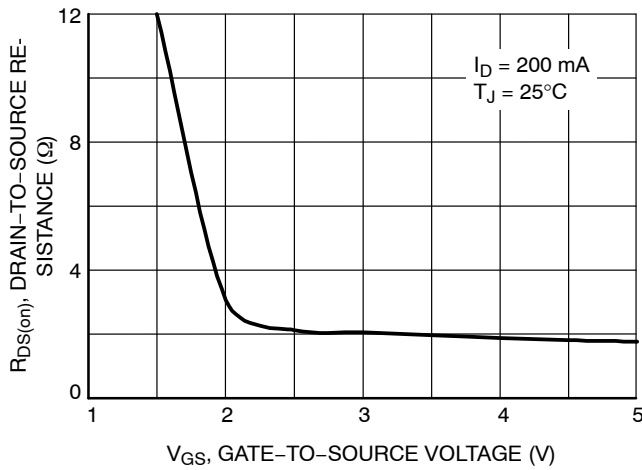


Figure 12. On-Resistance vs. Gate Voltage

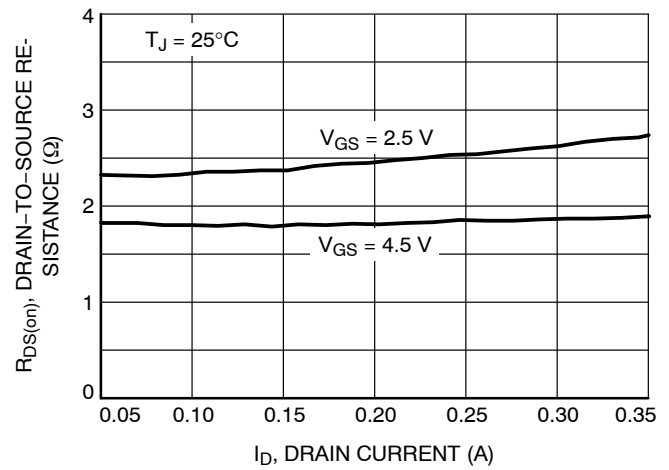


Figure 13. On-Resistance vs. Drain Current and Gate Voltage

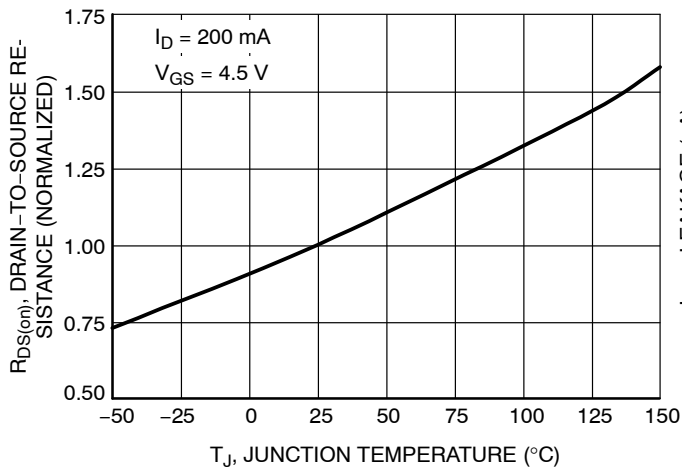


Figure 14. On-Resistance Variation with Temperature

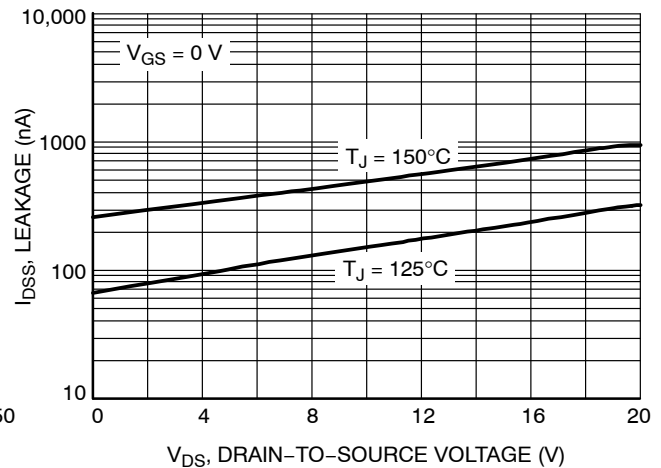


Figure 15. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS (P-CHANNEL)

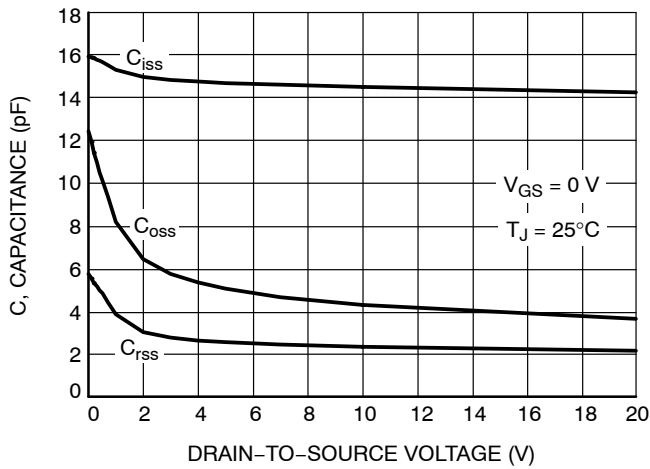


Figure 16. Capacitance Variation

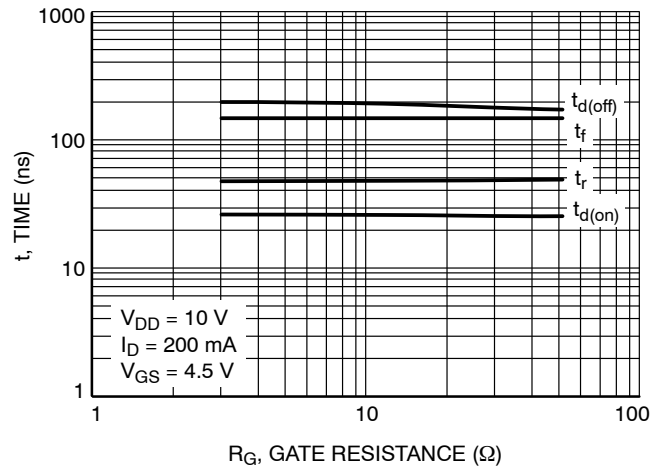


Figure 17. Resistive Switching Time Variation vs. Gate Resistance

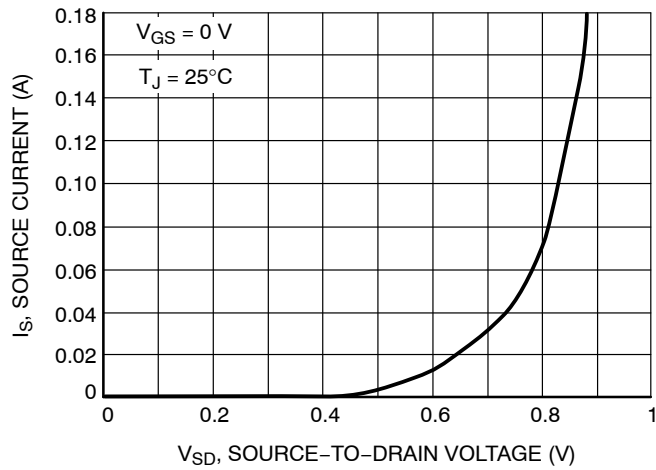
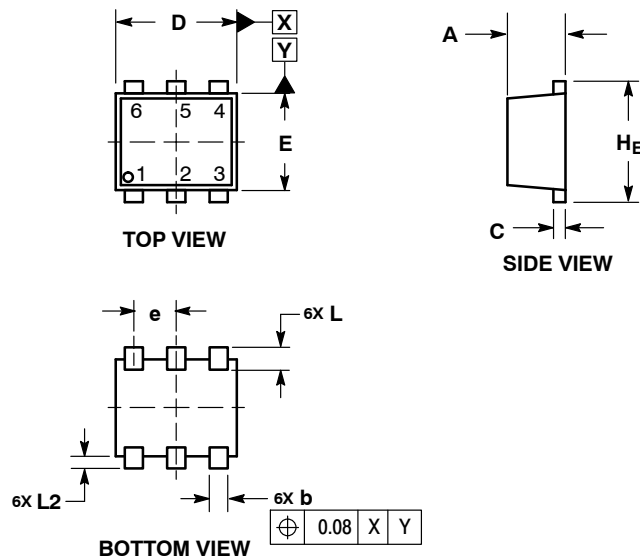


Figure 18. Diode Forward Voltage vs. Current

# NTUD3169CZ

## PACKAGE DIMENSIONS

**SOT-963**  
CASE 527AD  
ISSUE E

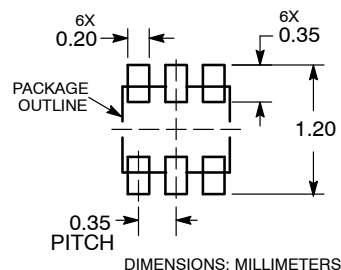


### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| MILLIMETERS    |          |      |      |
|----------------|----------|------|------|
| DIM            | MIN      | NOM  | MAX  |
| A              | 0.34     | 0.37 | 0.40 |
| b              | 0.10     | 0.15 | 0.20 |
| C              | 0.07     | 0.12 | 0.17 |
| D              | 0.95     | 1.00 | 1.05 |
| E              | 0.75     | 0.80 | 0.85 |
| e              | 0.35 BSC |      |      |
| H <sub>E</sub> | 0.95     | 1.00 | 1.05 |
| L              | 0.19 REF |      |      |
| L <sub>2</sub> | 0.05     | 0.10 | 0.15 |

### RECOMMENDED MOUNTING FOOTPRINT



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