

# NTUD3169CZ

## Small Signal MOSFET

20 V, 220 mA / -200 mA, Complementary,  
1.0 x 1.0 mm SOT-963 Package

### 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                                           |                      |                            | $V_{DSS}$      | 20         | V                  |
| Gate-to-Source Voltage                                            |                      |                            | $V_{GS}$       | $\pm 8$    | V                  |
| N-Channel Continuous Drain Current (Note 1)                       | Steady State         | $T_A = 25^{\circ}\text{C}$ | $I_D$          | 220        | mA                 |
|                                                                   |                      | $T_A = 85^{\circ}\text{C}$ |                | 160        |                    |
|                                                                   | $t \leq 5 \text{ s}$ | $T_A = 25^{\circ}\text{C}$ |                | 280        |                    |
| P-Channel Continuous Drain Current (Note 1)                       | Steady State         | $T_A = 25^{\circ}\text{C}$ |                | -200       |                    |
|                                                                   |                      | $T_A = 85^{\circ}\text{C}$ |                | -140       |                    |
|                                                                   | $t \leq 5 \text{ s}$ | $T_A = 25^{\circ}\text{C}$ |                | -250       |                    |
| Power Dissipation (Note 1)                                        | Steady State         | $T_A = 25^{\circ}\text{C}$ | $P_D$          | 125        | mW                 |
|                                                                   | $t \leq 5 \text{ s}$ |                            |                | 200        |                    |
| Pulsed Drain Current                                              | N-Channel            | $t_p = 10 \mu\text{s}$     | $I_{DM}$       | 800        | mA                 |
|                                                                   | P-Channel            |                            |                | -600       |                    |
| Operating Junction and Storage Temperature                        |                      |                            | $T_J, T_{STG}$ | -55 to 150 | $^{\circ}\text{C}$ |
| Source Current (Body Diode) (Note 2)                              |                      |                            | $I_S$          | 200        | mA                 |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) |                      |                            | $T_L$          | 260        | $^{\circ}\text{C}$ |

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 the minimum recommended pad size, 1 oz. Cu.
2. Pulse Test: pulse width  $\leq 300 \mu\text{s}$ , duty cycle  $\leq 2\%$

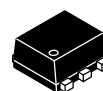
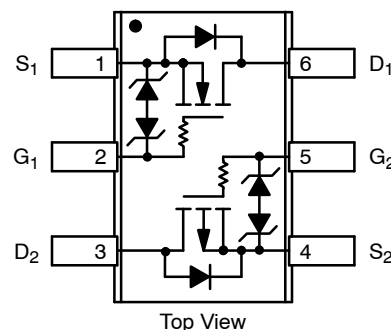


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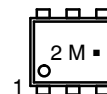
| $V_{(BR)DS}$      | $R_{DS(on)}$ Max      | $I_D$ Max |
|-------------------|-----------------------|-----------|
| N-Channel<br>20 V | 1.5 $\Omega$ @ 4.5 V  | 0.22 A    |
|                   | 2.0 $\Omega$ @ 2.5 V  |           |
|                   | 3.0 $\Omega$ @ 1.8 V  |           |
|         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

### MARKING DIAGRAM



- 2 = Specific Device Code
- M = Date Code
- = Pb-Free Package

### 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 | °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 |
|-----------|--------|-----|----------------|-----|-----|-----|------|
|-----------|--------|-----|----------------|-----|-----|-----|------|

### SWITCHING CHARACTERISTICS, $V_{GS} = 4.5\text{ V}$ (Note 4)

|                     |              |   |                                                                                          |  |      |  |    |
|---------------------|--------------|---|------------------------------------------------------------------------------------------|--|------|--|----|
| 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)

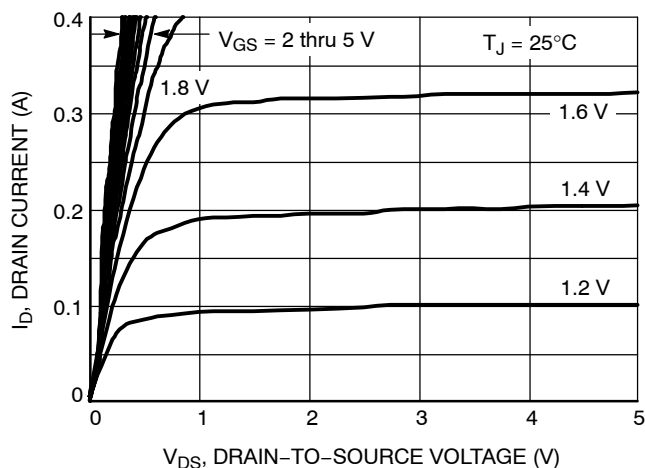


Figure 1. On-Region Characteristics

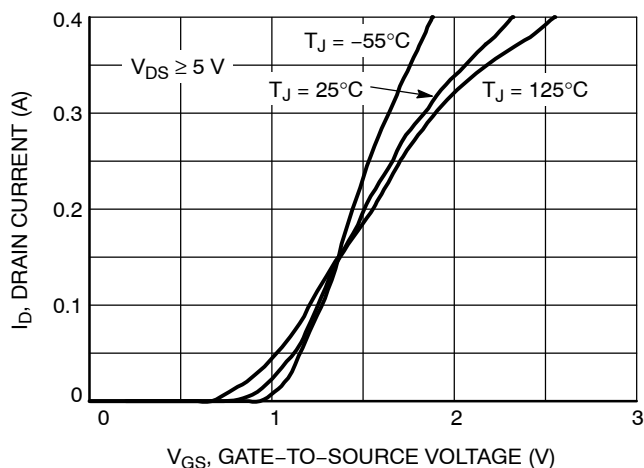


Figure 2. Transfer Characteristics

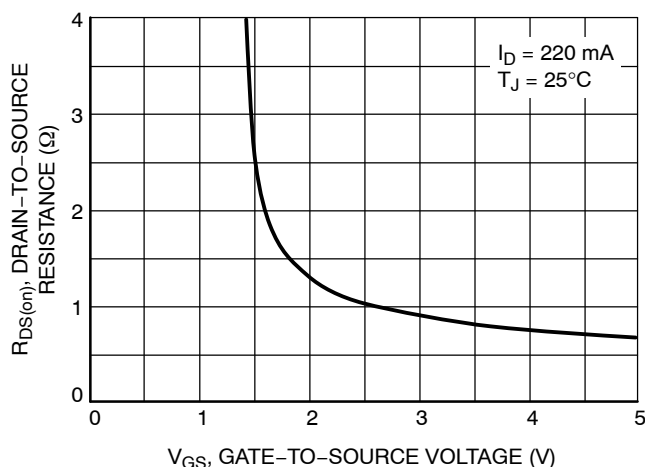


Figure 3. On-Resistance vs. Gate Voltage

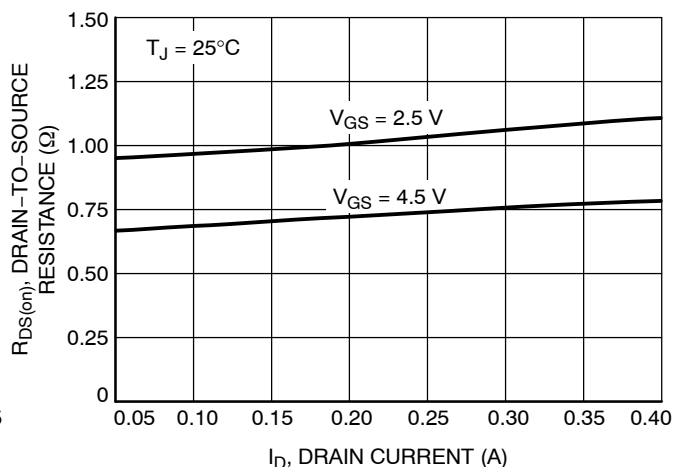


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

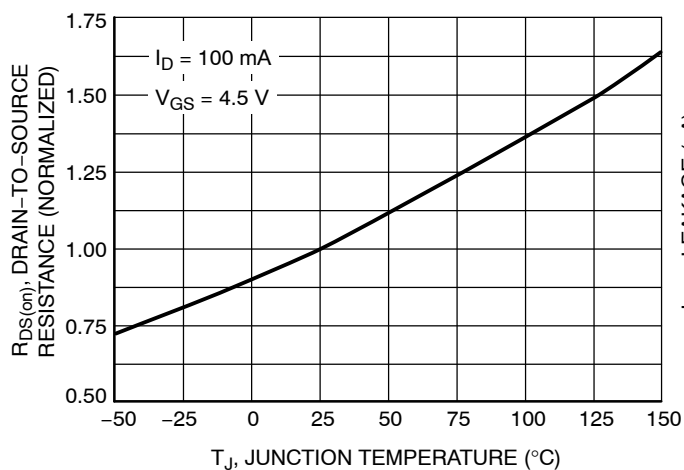


Figure 5. On-Resistance Variation with Temperature

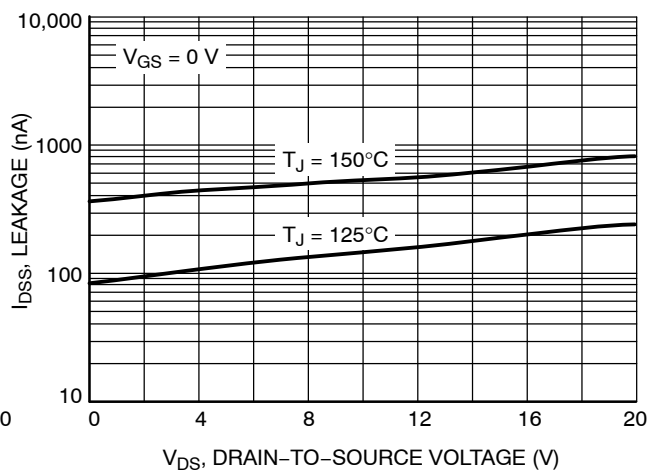


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS (N-CHANNEL)

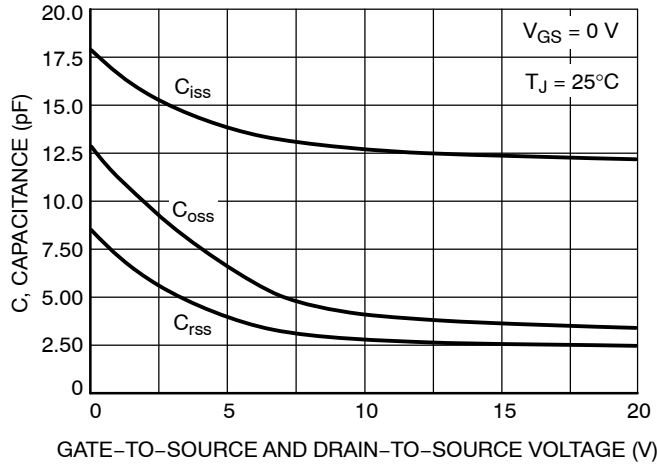


Figure 7. Capacitance Variation

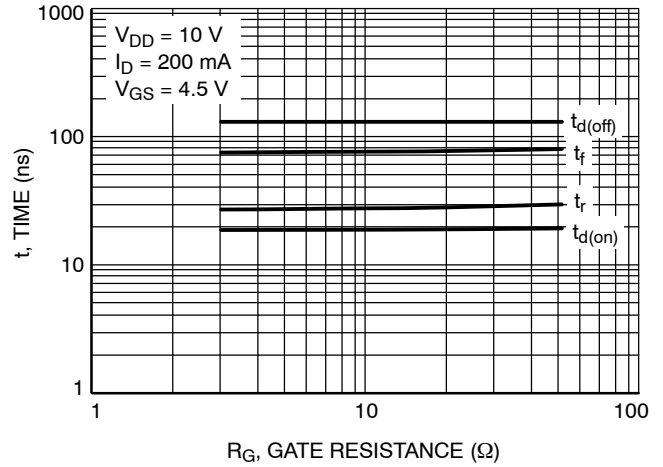


Figure 8. Resistive Switching Time Variation vs. Gate Resistance

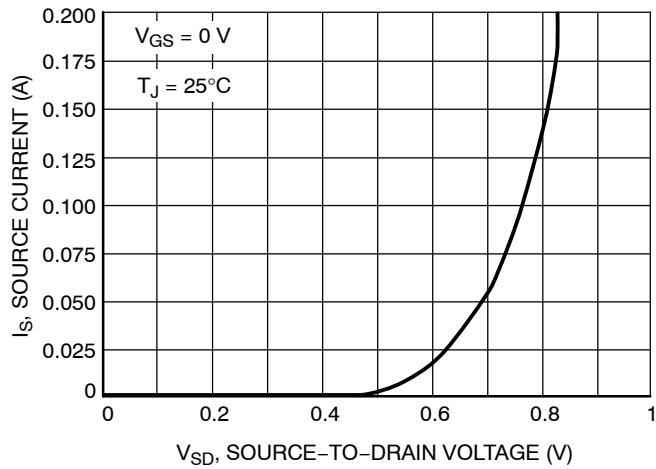


Figure 9. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS (P-CHANNEL)

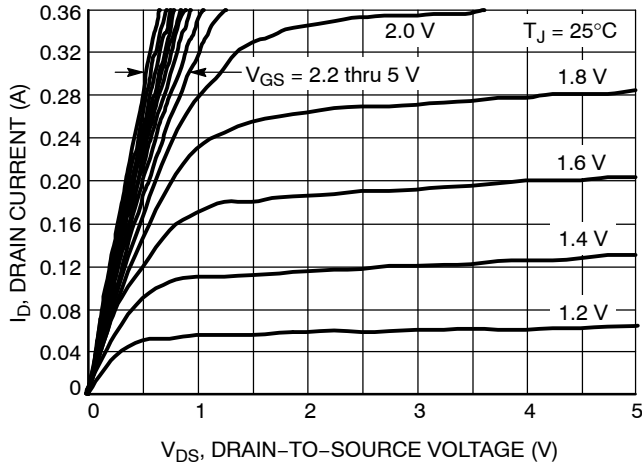


Figure 10. On-Region Characteristics

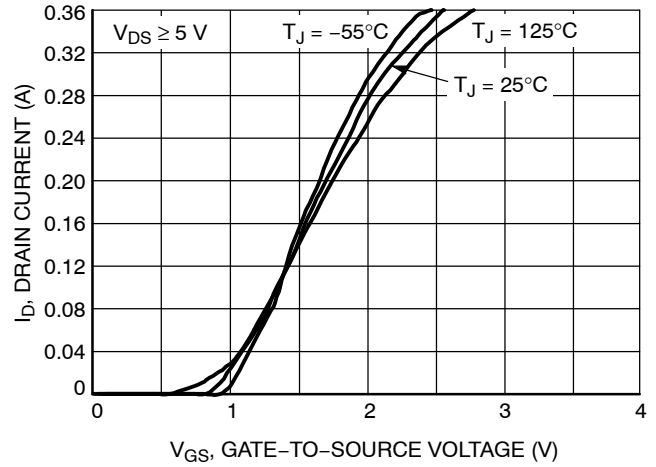


Figure 11. Transfer Characteristics

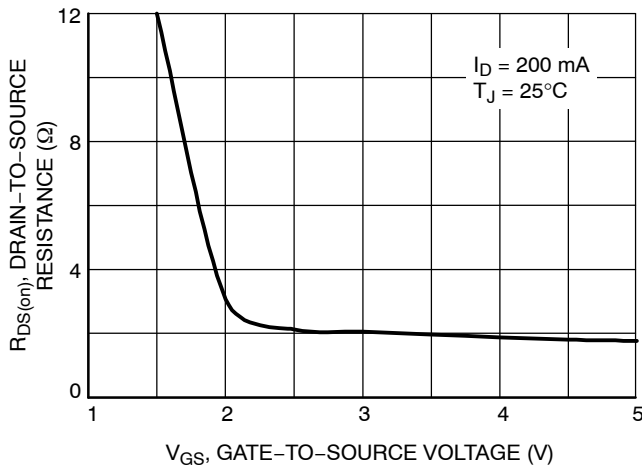


Figure 12. On-Resistance vs. Gate Voltage

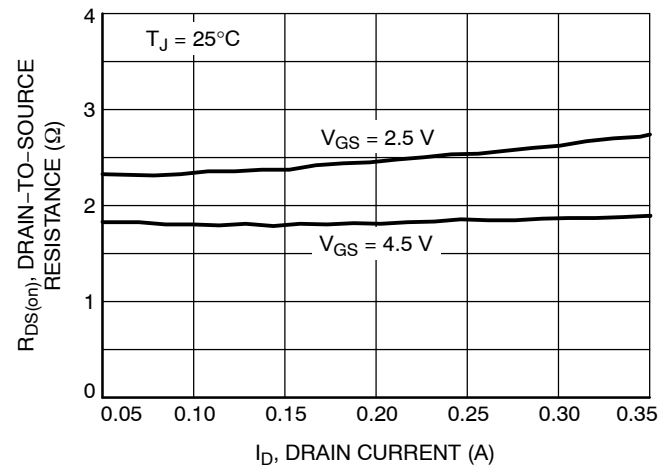


Figure 13. On-Resistance vs. Drain Current and Gate Voltage

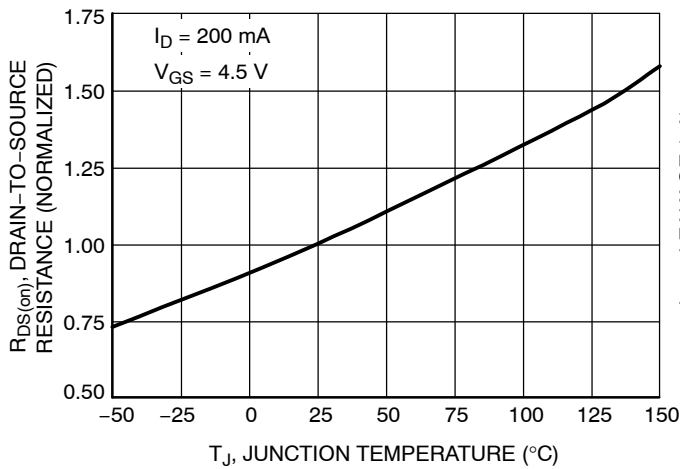


Figure 14. On-Resistance Variation with Temperature

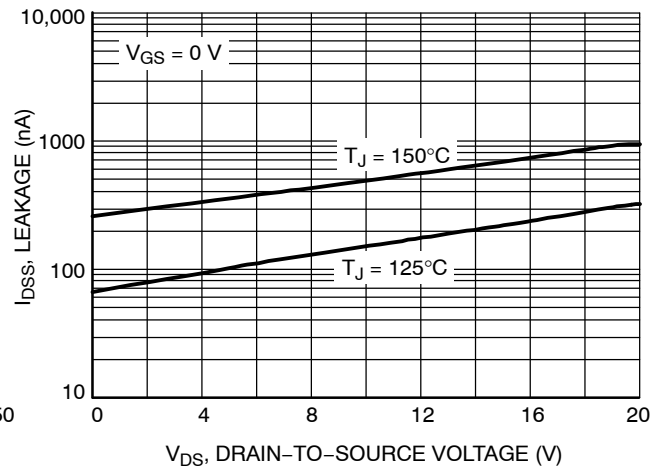


Figure 15. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS (P-CHANNEL)

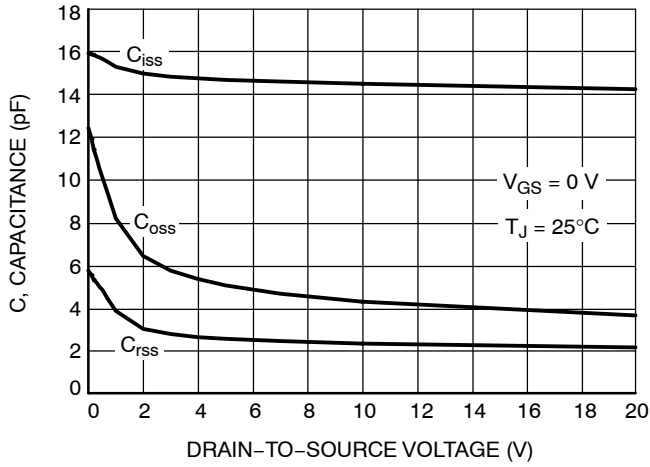


Figure 16. Capacitance Variation

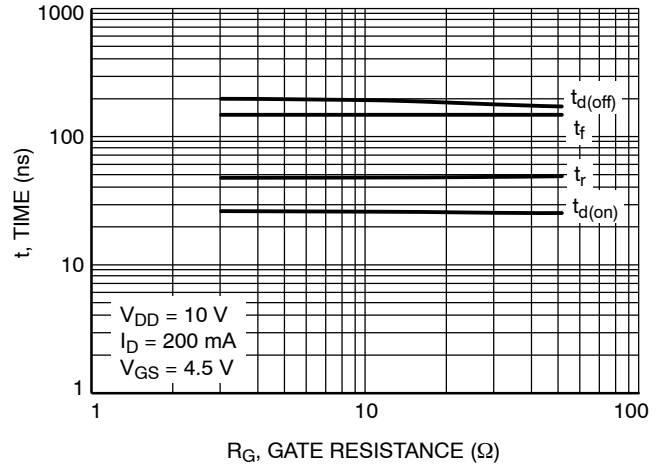


Figure 17. Resistive Switching Time Variation vs. Gate Resistance

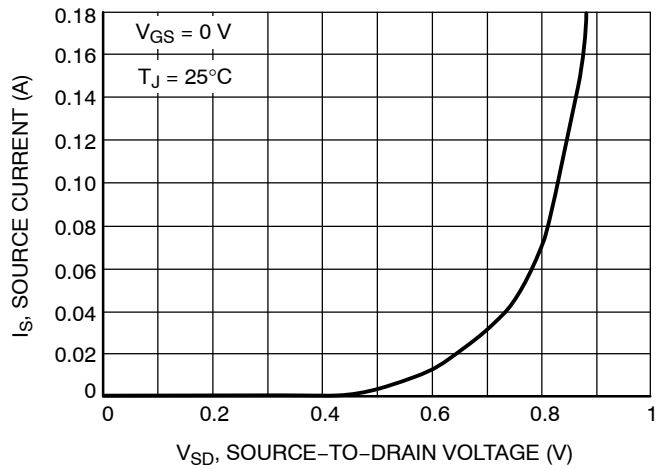
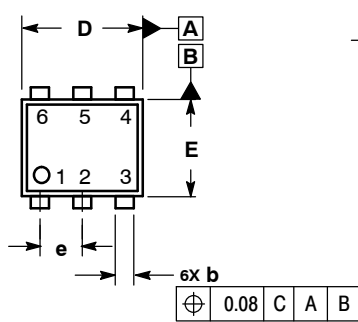


Figure 18. Diode Forward Voltage vs. Current

# NTUD3169CZ

## PACKAGE DIMENSIONS

SOT-963  
CASE 527AD-01  
ISSUE D

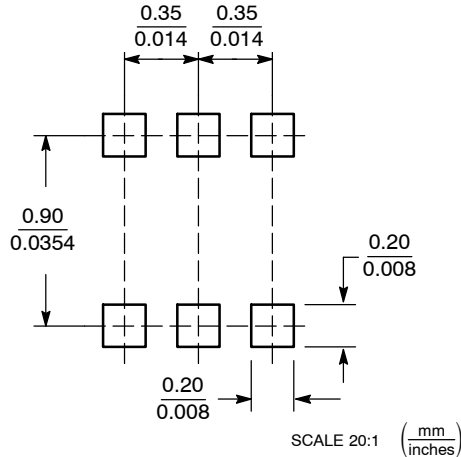


### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

| DIM | MILLIMETERS |      |      | INCHES    |       |       |
|-----|-------------|------|------|-----------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN       | NOM   | MAX   |
| A   | 0.34        | 0.37 | 0.40 |           |       |       |
| b   | 0.10        | 0.15 | 0.20 | 0.004     | 0.006 | 0.008 |
| C   | 0.07        | 0.12 | 0.17 | 0.003     | 0.005 | 0.007 |
| D   | 0.95        | 1.00 | 1.05 | 0.037     | 0.039 | 0.041 |
| E   | 0.75        | 0.80 | 0.85 | 0.03      | 0.032 | 0.034 |
| e   | 0.35 BSC    |      |      | 0.014 BSC |       |       |
| L   | 0.05        | 0.10 | 0.15 | 0.002     | 0.004 | 0.006 |
| H_E | 0.95        | 1.00 | 1.05 | 0.037     | 0.039 | 0.041 |

## SOLDERING FOOTPRINT\*



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

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