

# NTUD3169CZ

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

20 V, 220 mA / -200 mA



ON Semiconductor®

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### 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

$V_{(BR)DSS}$	$R_{DS(on)}$ Max	$I_D$ Max
N-Channel 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 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	

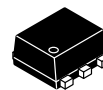
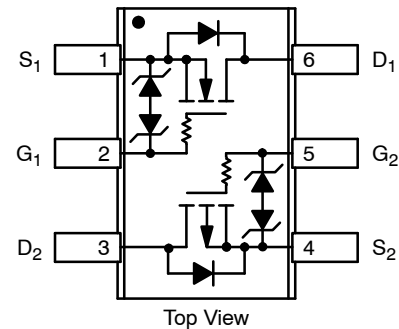
### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

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	$I_D$	$T_A = 25^\circ\text{C}$	220	mA
			$T_A = 85^\circ\text{C}$	160	
	$t \leq 5$ s		$T_A = 25^\circ\text{C}$	280	
			$T_A = 85^\circ\text{C}$	-200	
P-Channel Continuous Drain Current (Note 1)	Steady State	$I_D$	$T_A = 25^\circ\text{C}$	-200	mA
			$T_A = 85^\circ\text{C}$	-140	
	$t \leq 5$ s		$T_A = 25^\circ\text{C}$	-250	
			$T_A = 85^\circ\text{C}$	-250	
Power Dissipation (Note 1)	Steady State	$P_D$	$T_A = 25^\circ\text{C}$	125	mW
			$t \leq 5$ s	200	
Pulsed Drain Current	N-Channel	$I_{DM}$	$t_p = 10$ $\mu\text{s}$	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 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.

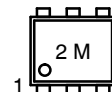
1. Surface-mounted on FR4 board using the minimum recommended pad size, 1 oz. Cu.
2. Pulse Test: pulse width  $\leq 300$   $\mu\text{s}$ , duty cycle  $\leq 2\%$

### PINOUT: SOT-963



SOT-963  
CASE 527AD

### MARKING DIAGRAM



- 2 = Specific Device Code  
M = Date Code

### ORDERING INFORMATION

Device	Package	Shipping†
NTUD3169CZT5G	SOT-963 (Pb-Free)	8000 / 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.

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## 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	$V_{GS} = 0\text{ V}$	$I_D = 250\ \mu\text{A}$	20		V
		P		$I_D = -250\ \mu\text{A}$	-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		$T_J = 25^\circ\text{C}$		-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	$V_{GS} = V_{DS}$	$I_D = 250\ \mu\text{A}$	0.4	1.0	V	
		P		$I_D = -250\ \mu\text{A}$	-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	1.0	V
		P	$V_{GS} = 0\text{ V}, I_S = -10\text{ mA}$			-0.6	-1.0	

## CAPACITANCES

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

4. Switching characteristics are independent of operating junction temperatures

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## 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)

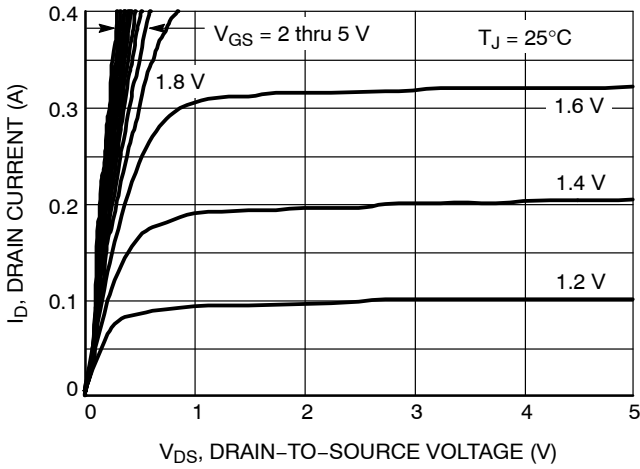


Figure 1. On-Region Characteristics

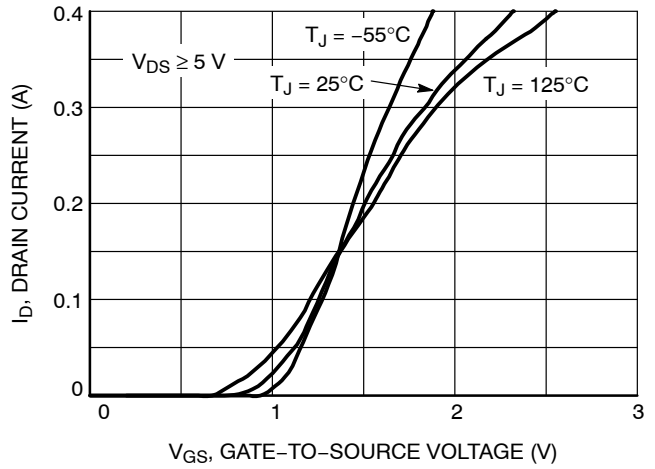


Figure 2. Transfer Characteristics

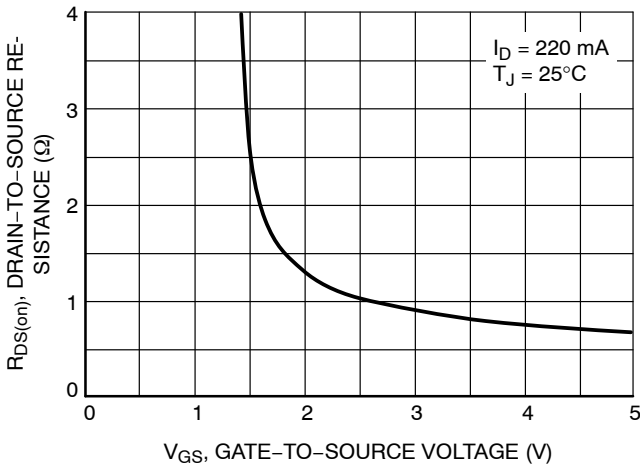


Figure 3. On-Resistance vs. Gate Voltage

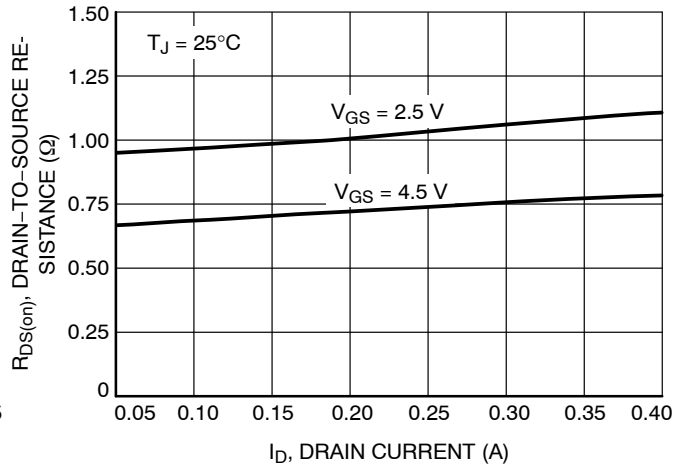


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

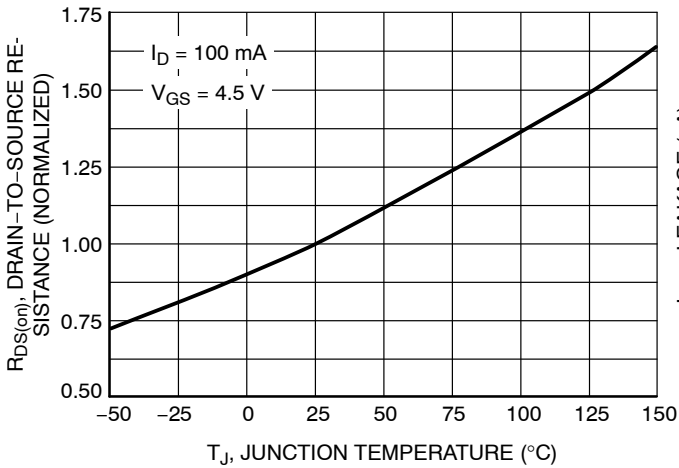


Figure 5. On-Resistance Variation with Temperature

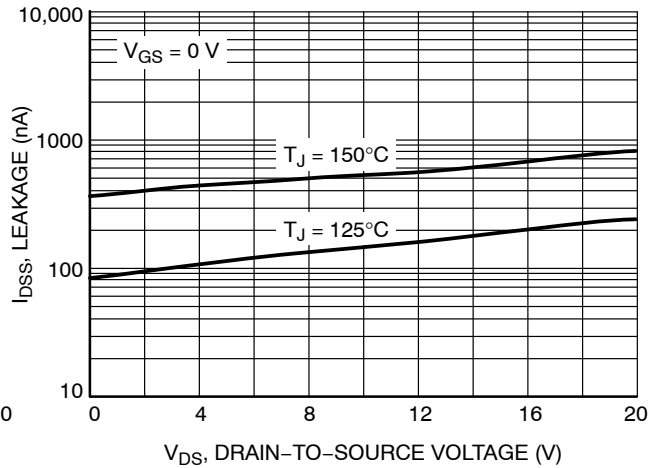


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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## TYPICAL CHARACTERISTICS (N-CHANNEL)

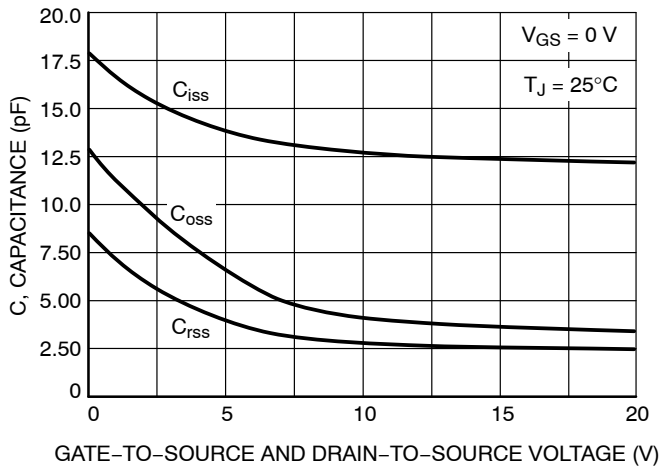


Figure 7. Capacitance Variation

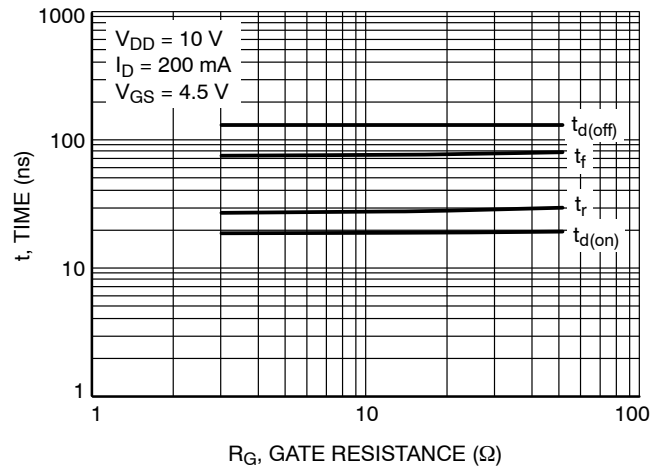


Figure 8. Resistive Switching Time Variation vs. Gate Resistance

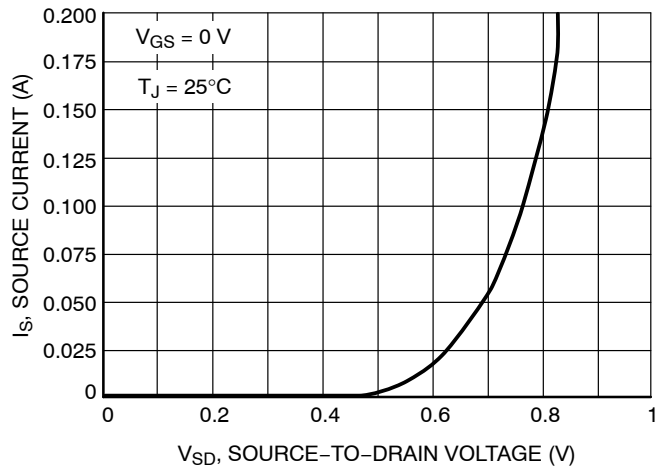


Figure 9. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS (P-CHANNEL)

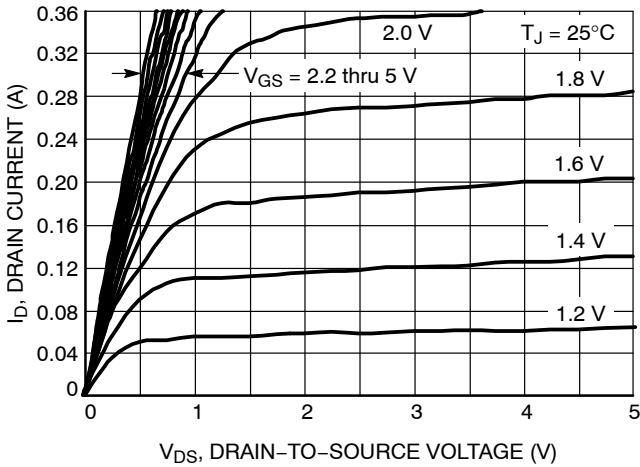


Figure 10. On-Region Characteristics

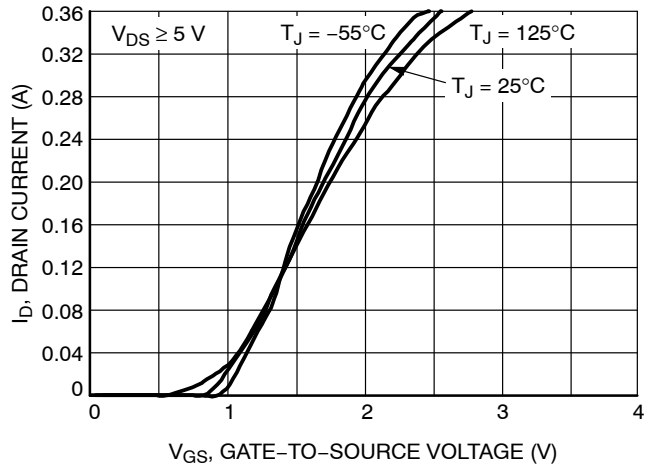


Figure 11. Transfer Characteristics

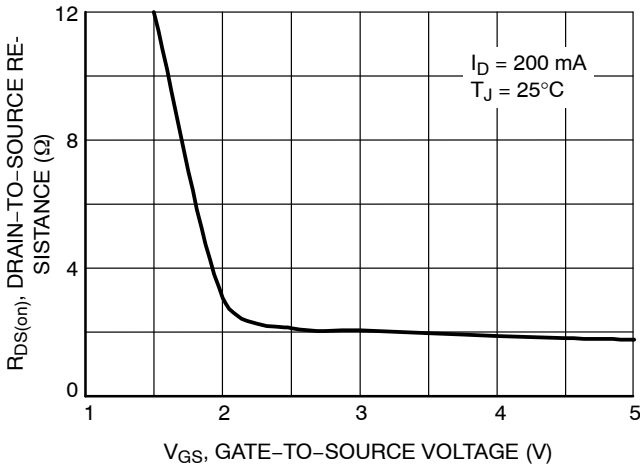


Figure 12. On-Resistance vs. Gate Voltage

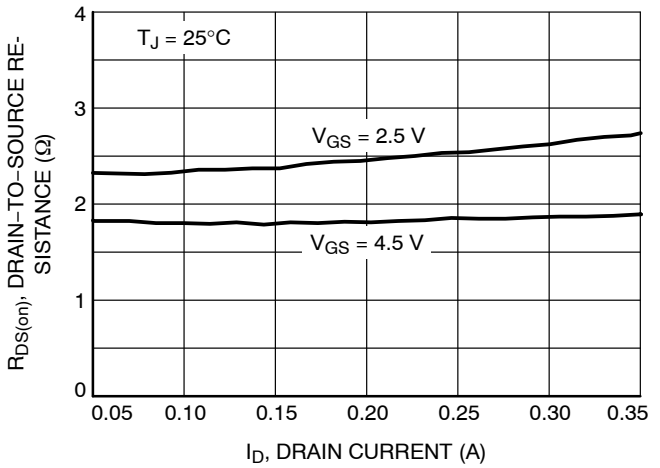


Figure 13. On-Resistance vs. Drain Current and Gate Voltage

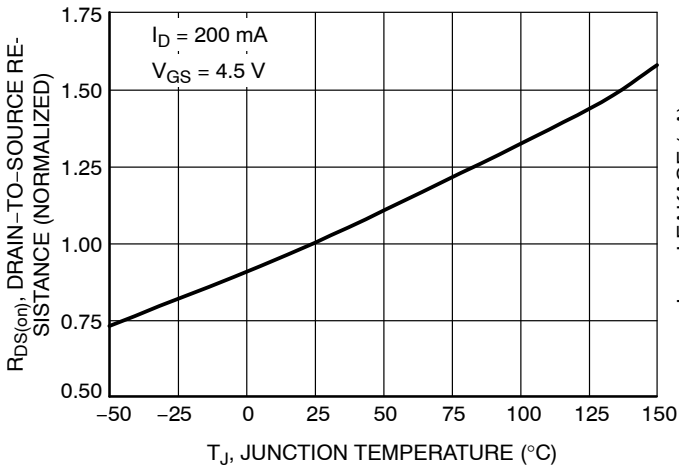


Figure 14. On-Resistance Variation with Temperature

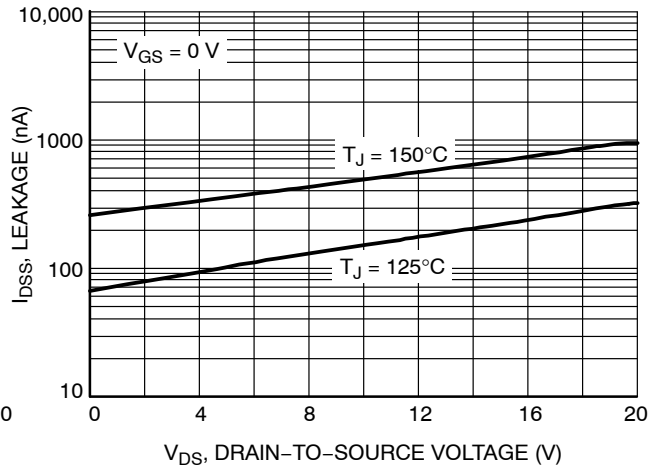


Figure 15. Drain-to-Source Leakage Current vs. Voltage

# NTUD3169CZ

## TYPICAL CHARACTERISTICS (P-CHANNEL)

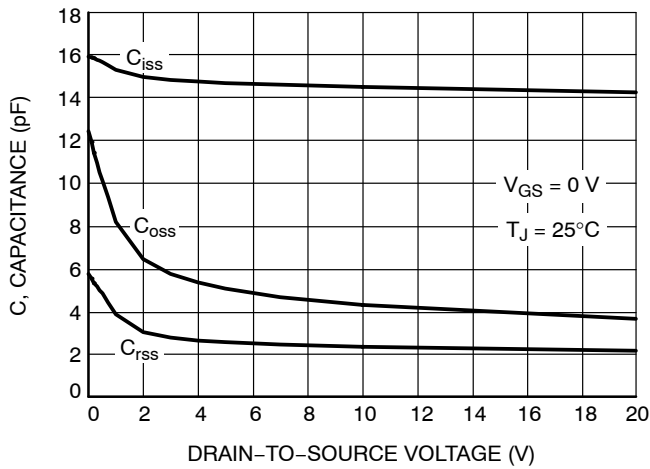


Figure 16. Capacitance Variation

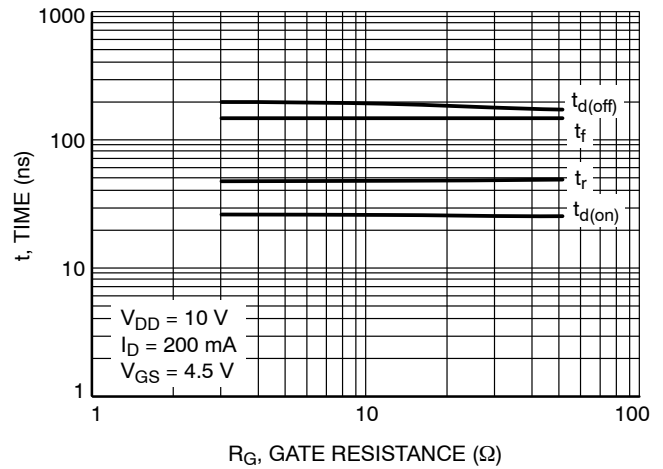


Figure 17. Resistive Switching Time Variation vs. Gate Resistance

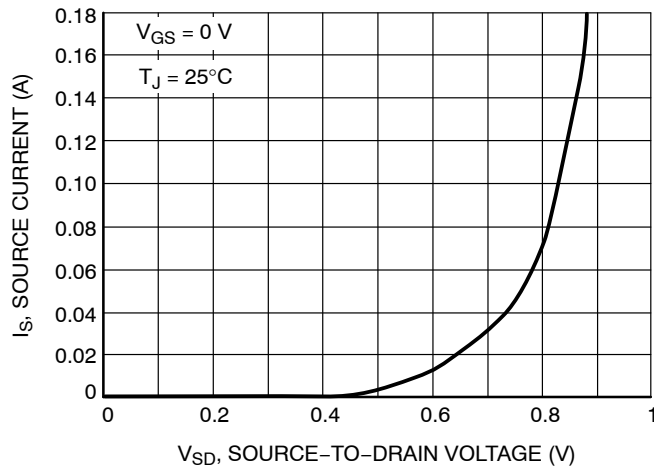


Figure 18. Diode Forward Voltage vs. Current

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

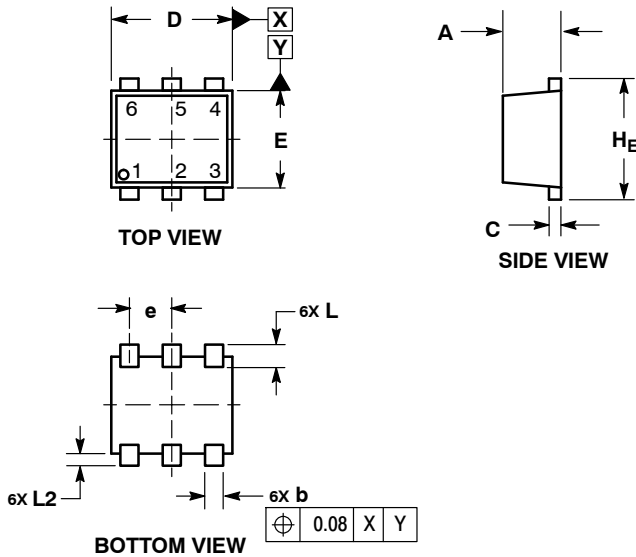
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SCALE 4:1

**SOT-963**  
CASE 527AD-01  
ISSUE E

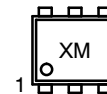
DATE 09 FEB 2010



- 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		
L2	0.05	0.10	0.15

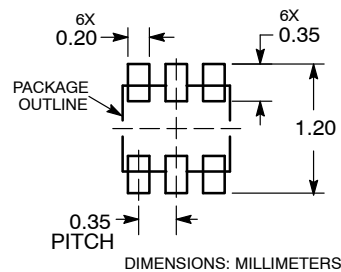
### GENERIC MARKING DIAGRAM\*



X = Specific Device Code  
M = Month 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.

### RECOMMENDED MOUNTING FOOTPRINT



- STYLE 1:**  
PIN 1. EMITTER 1  
2. BASE 1  
3. COLLECTOR 2  
4. EMITTER 2  
5. BASE 2  
6. COLLECTOR 1
- STYLE 2:**  
PIN 1. EMITTER 1  
2. EMITTER2  
3. BASE 2  
4. COLLECTOR 2  
5. BASE 1  
6. COLLECTOR 1
- STYLE 3:**  
PIN 1. CATHODE 1  
2. CATHODE 1  
3. ANODE/ANODE 2  
4. CATHODE 2  
5. CATHODE 2  
6. ANODE/ANODE 1
- STYLE 4:**  
PIN 1. COLLECTOR  
2. COLLECTOR  
3. BASE  
4. EMITTER  
5. COLLECTOR  
6. COLLECTOR
- STYLE 5:**  
PIN 1. CATHODE  
2. CATHODE  
3. ANODE  
4. ANODE  
5. CATHODE  
6. CATHODE
- STYLE 6:**  
PIN 1. CATHODE  
2. ANODE  
3. CATHODE  
4. CATHODE  
5. CATHODE  
6. CATHODE
- STYLE 7:**  
PIN 1. CATHODE  
2. ANODE  
3. CATHODE  
4. CATHODE  
5. ANODE  
6. CATHODE
- STYLE 8:**  
PIN 1. DRAIN  
2. DRAIN  
3. GATE  
4. SOURCE3  
5. DRAIN  
6. DRAIN
- STYLE 9:**  
PIN 1. SOURCE 1  
2. GATE 1  
3. DRAIN 2  
4. SOURCE 2  
5. GATE 2  
6. DRAIN 1
- STYLE 10:**  
PIN 1. CATHODE 1  
2. N/C  
3. CATHODE 2  
4. ANODE 2  
5. N/C  
6. ANODE 1

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<b>DESCRIPTION:</b>	<b>SOT-963, 1X1, 0.35P</b>	<b>PAGE 1 OF 1</b>

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