

# NTUD3169CZ

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

20 V, 220 mA / -200 mA



ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)

### 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	

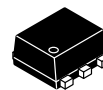
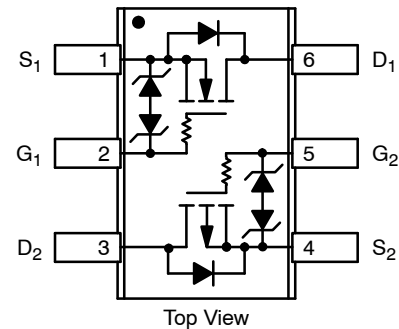
### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

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.

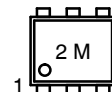
1. Surface-mounted on FR4 board using the minimum recommended pad size, 1 oz. Cu.
2. Pulse Test: pulse width  $\leq 300 \mu\text{s}$ , duty cycle  $\leq 2\%$

### 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.

# 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	$V_{GS} = 0\text{ V}$	$I_D = 250\ \mu\text{A}$	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

# 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)

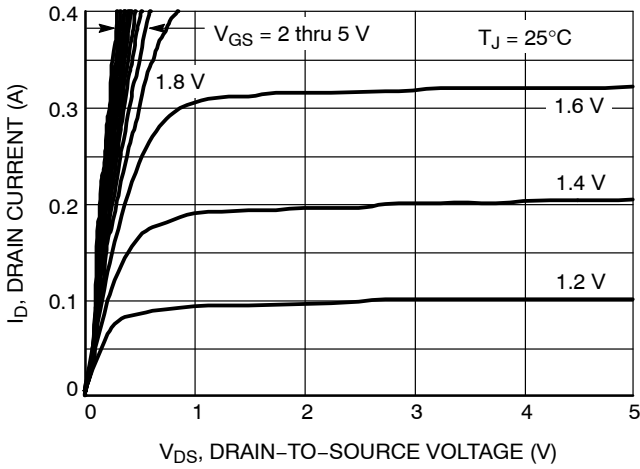


Figure 1. On-Region Characteristics

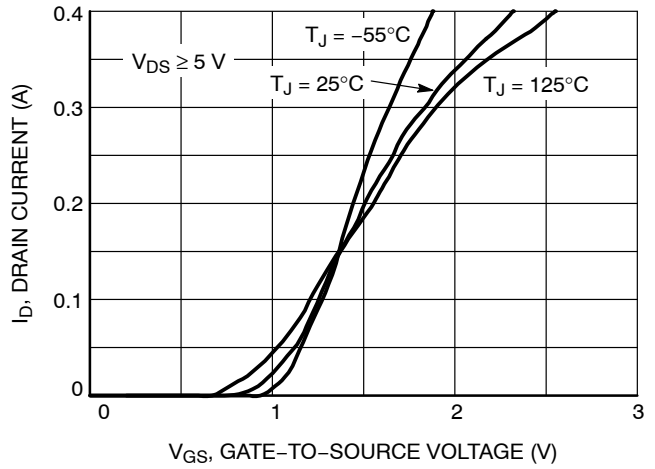


Figure 2. Transfer Characteristics

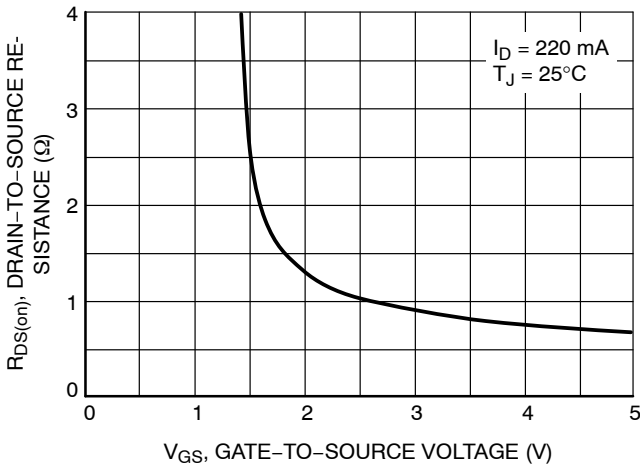


Figure 3. On-Resistance vs. Gate Voltage

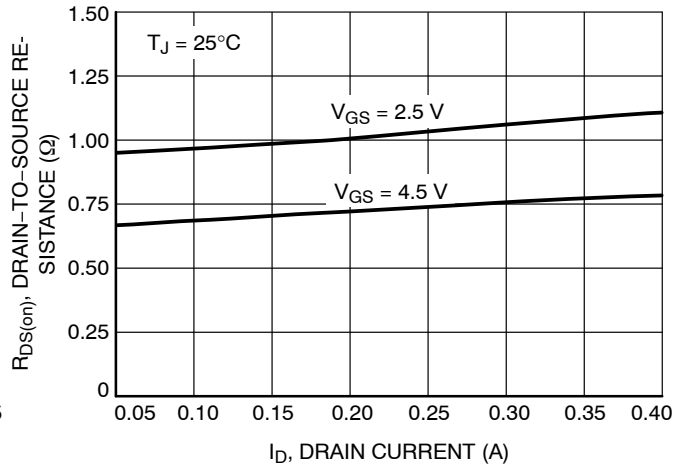


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

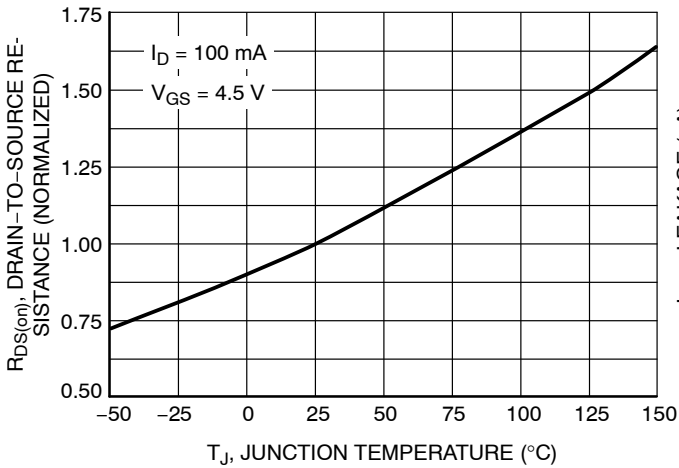


Figure 5. On-Resistance Variation with Temperature

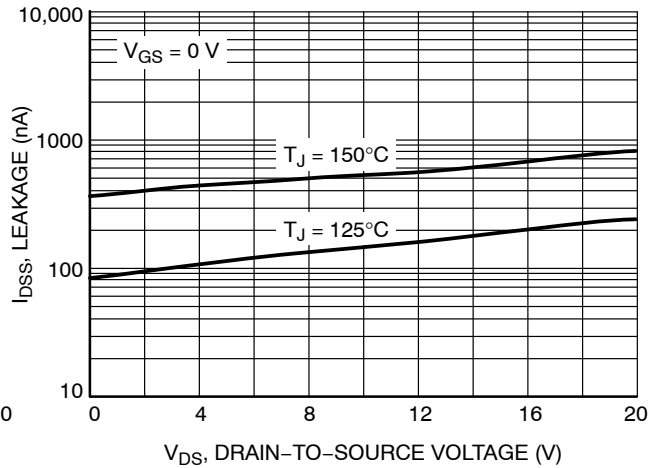


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTUD3169CZ

## TYPICAL CHARACTERISTICS (N-CHANNEL)

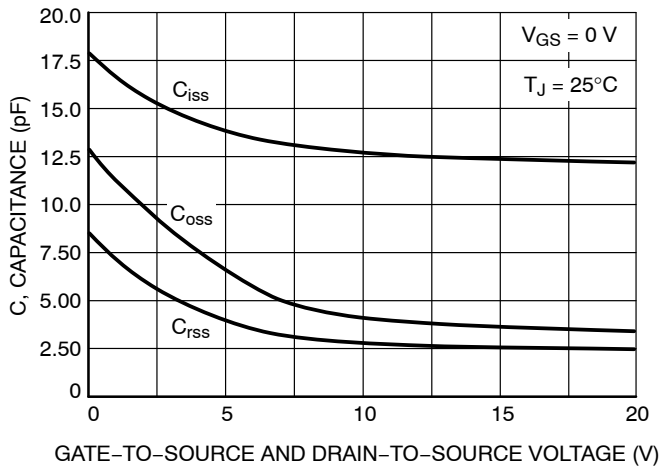


Figure 7. Capacitance Variation

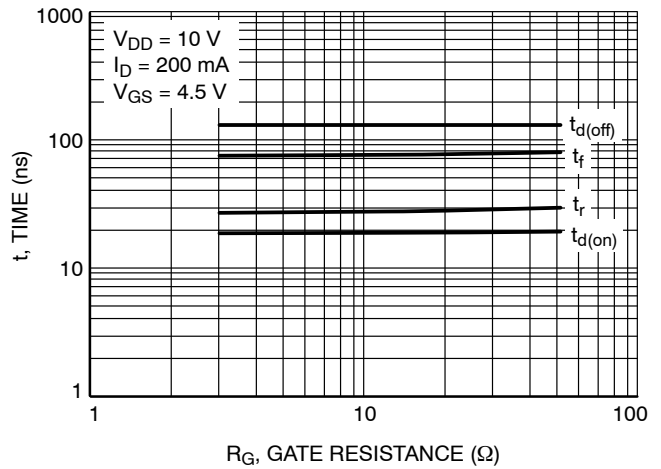


Figure 8. Resistive Switching Time Variation vs. Gate Resistance

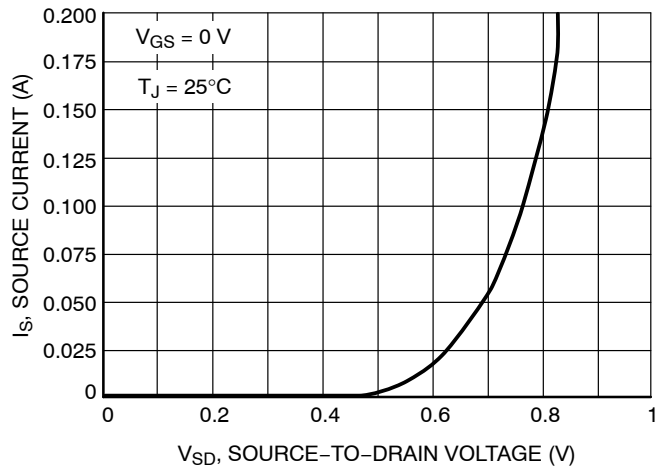


Figure 9. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS (P-CHANNEL)

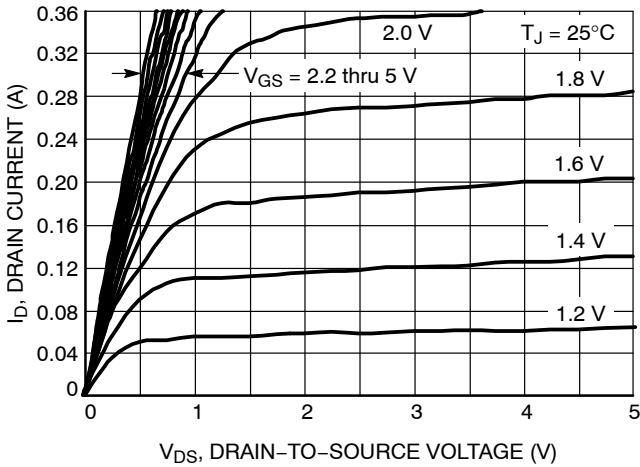


Figure 10. On-Region Characteristics

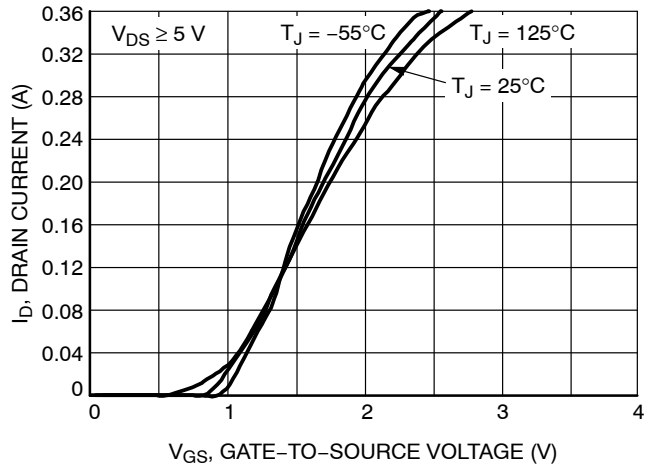


Figure 11. Transfer Characteristics

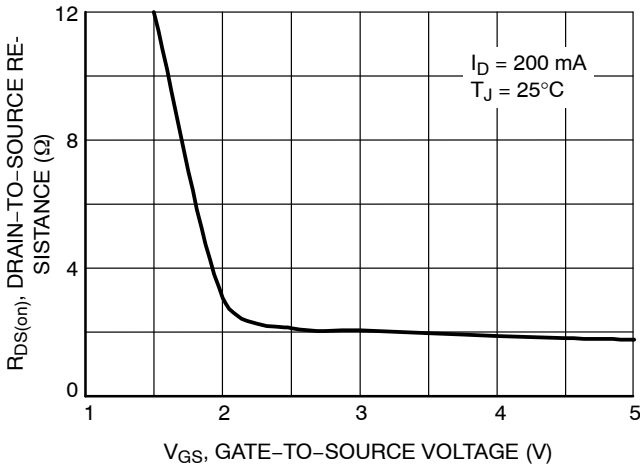


Figure 12. On-Resistance vs. Gate Voltage

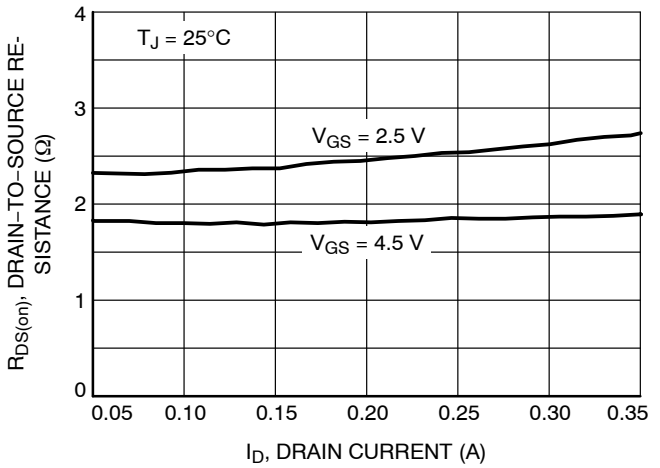


Figure 13. On-Resistance vs. Drain Current and Gate Voltage

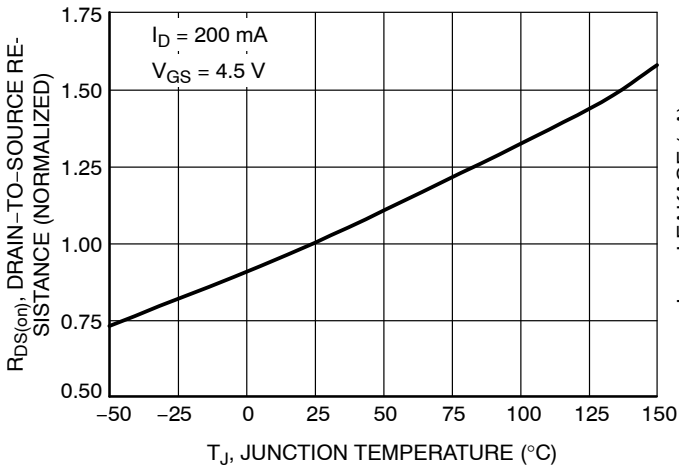


Figure 14. On-Resistance Variation with Temperature

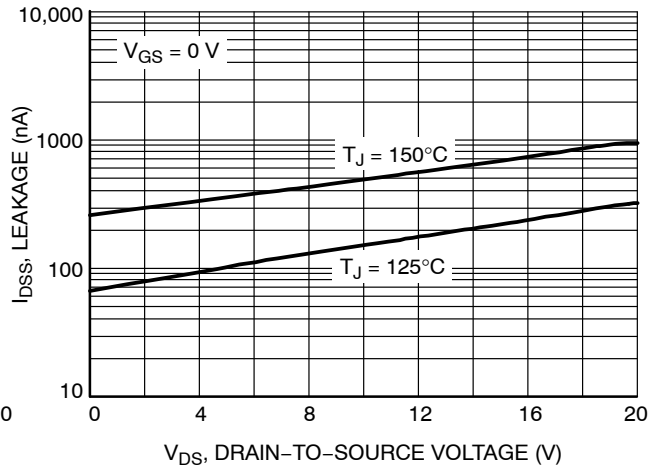


Figure 15. Drain-to-Source Leakage Current vs. Voltage

# NTUD3169CZ

## TYPICAL CHARACTERISTICS (P-CHANNEL)

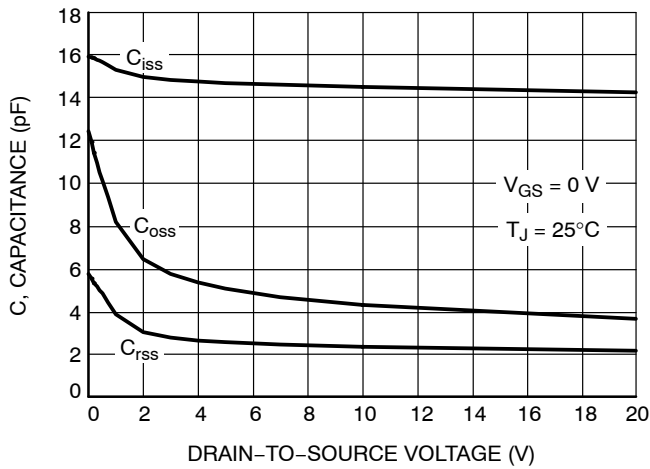


Figure 16. Capacitance Variation

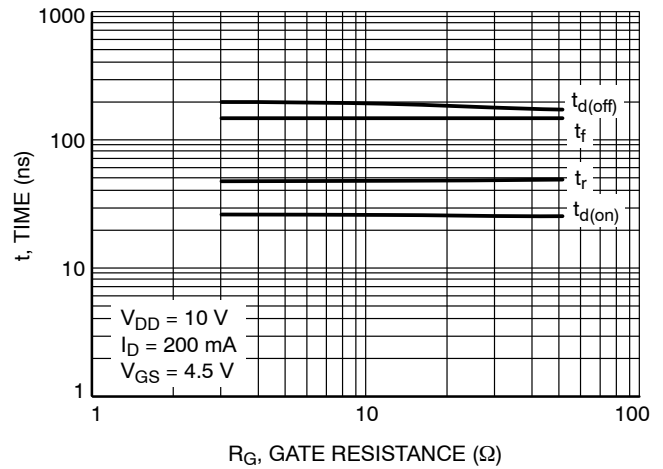


Figure 17. Resistive Switching Time Variation vs. Gate Resistance

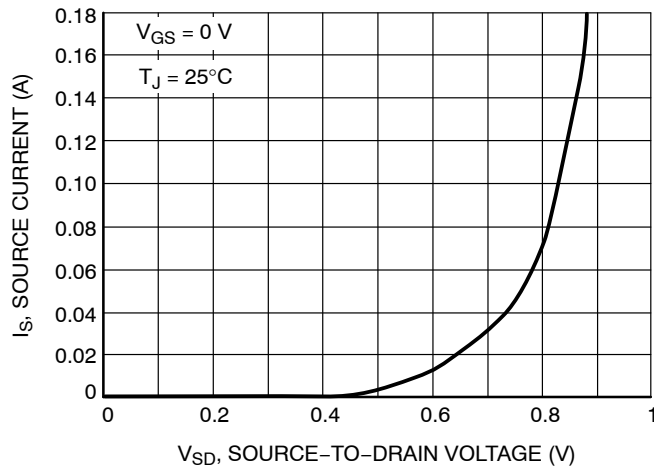


Figure 18. Diode Forward Voltage vs. Current

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

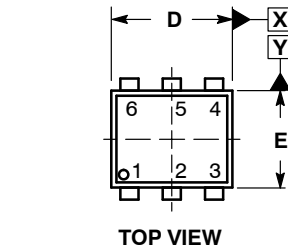
ON Semiconductor®



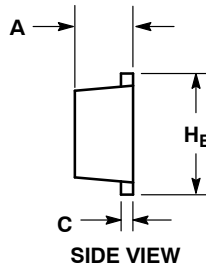
SCALE 4:1

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

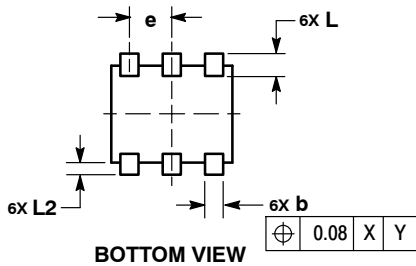
DATE 09 FEB 2010



TOP VIEW



SIDE VIEW



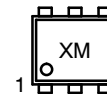
BOTTOM VIEW

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

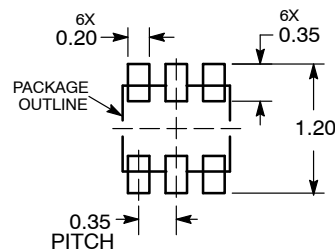
**GENERIC MARKING DIAGRAM\***



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

<b>DOCUMENT NUMBER:</b>	<b>98AON26456D</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>SOT-963, 1X1, 0.35P</b>	<b>PAGE 1 OF 1</b>

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.



**onsemi**, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Email Requests to: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**onsemi Website:** [www.onsemi.com](http://www.onsemi.com)

### TECHNICAL SUPPORT

**North American Technical Support:**

Voice Mail: 1 800-282-9855 Toll Free USA/Canada

Phone: 011 421 33 790 2910

**Europe, Middle East and Africa Technical Support:**

Phone: 00421 33 790 2910

For additional information, please contact your local Sales Representative