



**THE DATASHEET OF  
NLA323USG**



# NLAS323

## Dual SPST Analog Switch, Low Voltage, Single Supply

The NLAS323 is a dual SPST (Single Pole, Single Throw) switch, similar to 1/2 a standard 4066. The device permits the independent selection of 2 analog/digital signals. Available in the US8 package.

The use of advanced 0.6 micron CMOS process, improves the  $R_{ON}$  resistance considerably compared to older higher voltage technologies.

### Features

- On Resistance is 20  $\Omega$  Typical at 5.0 V
- Matching is < 1.0  $\Omega$  Between Sections
- 2.0 to 6.0 V Operating Range
- Ultra Low < 5.0 pC Charge Injection
- Ultra Low Leakage < 1.0 nA at 5.0 V, 25 C
- Wide Bandwidth > 200 MHz, -3.0 dB
- 2000 V ESD (Human Body Model)
- Ron Flatness  $\pm 6.0 \Omega$  at 5.0 V
- US8 Package
- Independent, Positive Enable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

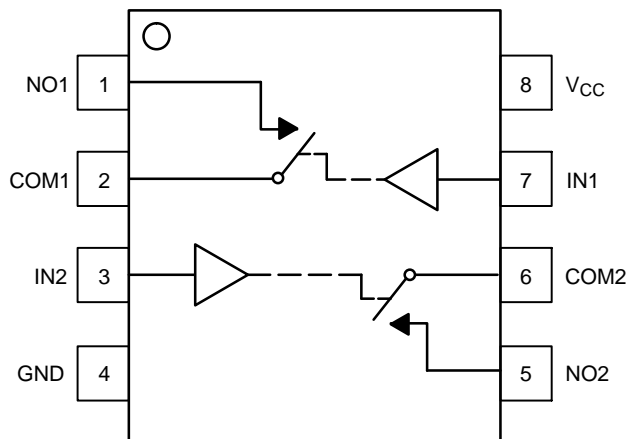


Figure 1. Pinout



ON Semiconductor®

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### MARKING DIAGRAM



A4 = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### PIN ASSIGNMENT

|   |                 |
|---|-----------------|
| 1 | NO1             |
| 2 | COM1            |
| 3 | IN2             |
| 4 | GND             |
| 5 | NO2             |
| 6 | COM2            |
| 7 | IN1             |
| 8 | V <sub>CC</sub> |

### FUNCTION TABLE

| On/Off Enable Input | State of Analog Switch |
|---------------------|------------------------|
| L                   | Off                    |
| H                   | On                     |

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

**MAXIMUM RATINGS**

| Symbol           | Parameter   | Value                  | Unit |
|------------------|---|------------------------|------|
| V <sub>CC</sub>  | DC Supply Voltage   | - 0.5 to +7.0          | V    |
| V <sub>I</sub>   | DC Input Voltage  | - 0.5 to +7.0          | V    |
| V <sub>O</sub>   | DC Output Voltage   | - 0.5 to +7.0          | V    |
| I <sub>IK</sub>  | DC Input Diode Current<br>V <sub>I</sub> < GND  | - 50                   | mA   |
| I <sub>OK</sub>  | DC Output Diode Current<br>V <sub>O</sub> < GND   | - 50                   | mA   |
| I <sub>O</sub>   | DC Output Sink Current  | ± 50                   | mA   |
| I <sub>CC</sub>  | DC Supply Current per Supply Pin  | ± 100                  | mA   |
| I <sub>GND</sub> | DC Ground Current per Ground Pin  | ± 100                  | mA   |
| T <sub>STG</sub> | Storage Temperature Range   | - 65 to + 150          | °C   |
| T <sub>L</sub>   | Lead Temperature, 1 mm from Case for 10 Seconds   | 260                    | °C   |
| T <sub>J</sub>   | Junction Temperature under Bias   | + 150                  | °C   |
| θ <sub>JA</sub>  | Thermal Resistance<br>(Note 1)  | 250                    | °C/W |
| P <sub>D</sub>   | Power Dissipation in Still Air at 85°C  | 250                    | mW   |
| MSL              | Moisture Sensitivity  | Level 1                |      |
| F <sub>R</sub>   | Flammability Rating<br>Oxygen Index: 28 to 34   | UL 94 V-0 @ 0.125 in   |      |
| V <sub>ESD</sub> | ESD Withstand Voltage<br>Human Body Model (Note 2)<br>Machine Model (Note 3)<br>Charged Device Model (Note 4) | > 2000<br>> 150<br>N/A | V    |

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. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2-ounce copper trace with no air flow.
2. Tested to EIA/JESD22-A114-A.
3. Tested to EIA/JESD22-A115-A.
4. Tested to JESD22-C101-A.

**RECOMMENDED OPERATING CONDITIONS**

| Symbol                          | Characteristics  | Min | Max             | Unit |
|---------------------------------|--|-----|-----------------|------|
| V <sub>CC</sub>                 | Positive DC Supply Voltage   | 2.0 | 5.5             | V    |
| V <sub>IN</sub>                 | Digital Input Voltage (Enable)   | GND | 5.5             | V    |
| V <sub>IO</sub>                 | Static or Dynamic Voltage Across an Off Switch   | GND | V <sub>CC</sub> | V    |
| V <sub>IS</sub>                 | Analog Input Voltage (NO, COM)   | GND | V <sub>CC</sub> | V    |
| T <sub>A</sub>                  | Operating Temperature Range, All Package Types   | -55 | +125            | °C   |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise or Fall Time,<br>(Enable Input)<br>V <sub>CC</sub> = 3.3 V ± 0.3 V<br>V <sub>CC</sub> = 5.0 V ± 0.5 V | 0   | 100<br>20       | ns/V |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

**DEVICE JUNCTION TEMPERATURE VERSUS TIME TO 0.1% BOND FAILURES**

| Junction Temperature °C | Time, Hours | Time, Years |
|-------------------------|-------------|-------------|
| 80                      | 1,032,200   | 117.8       |
| 90                      | 419,300     | 47.9        |
| 100                     | 178,700     | 20.4        |
| 110                     | 79,600      | 9.4         |
| 120                     | 37,000      | 4.2         |
| 130                     | 17,800      | 2.0         |
| 140                     | 8,900       | 1.0         |

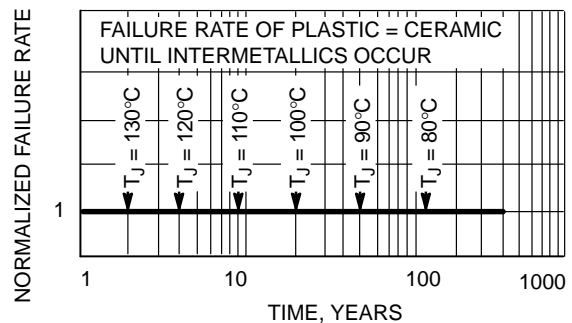


Figure 2. Failure Rate vs. Time Junction Temperature

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## DC CHARACTERISTICS – Digital Section (Voltages Referenced to GND)

| Symbol          | Parameter                                       | Condition   | V <sub>CC</sub> | Guaranteed Max Limit |       |        | Unit |
|-----------------|---|---|-----------------|----------------------|-------|--------|------|
|                 |   |   |                 | -55 to 25°C          | <85°C | <125°C |      |
| V <sub>IH</sub> | Minimum High-Level Input Voltage, Enable Inputs |   | 2.0             | 1.5                  | 1.5   | 1.5    | V    |
|                 |   |   | 3.0             | 2.1                  | 2.1   | 2.1    |      |
|                 |   |   | 4.5             | 3.15                 | 3.15  | 3.15   |      |
|                 |   |   | 5.5             | 3.85                 | 3.85  | 3.85   |      |
| V <sub>IL</sub> | Maximum Low-Level Input Voltage, Enable Inputs  |   | 2.0             | 0.5                  | 0.5   | 0.5    | V    |
|                 |   |   | 3.0             | 0.9                  | 0.9   | 0.9    |      |
|                 |   |   | 4.5             | 1.35                 | 1.35  | 1.35   |      |
|                 |   |   | 5.5             | 1.65                 | 1.65  | 1.65   |      |
| I <sub>IN</sub> | Maximum Input Leakage Current, Enable Inputs    | V <sub>IN</sub> = 5.5 V or GND                      | 0 V to 5.5 V    | ±0.1                 | ±1.0  | ±1.0   | µA   |
| I <sub>CC</sub> | Maximum Quiescent Supply Current (per package)  | Enable and V <sub>IS</sub> = V <sub>CC</sub> or GND | 5.5             | 1.0                  | 1.0   | 2.0    | µA   |

## DC ELECTRICAL CHARACTERISTICS – Analog Section

| Symbol                | Parameter                              | Condition   | V <sub>CC</sub> | Guaranteed Max Limit |       |        | Unit |
|-----------------------|--|---|-----------------|----------------------|-------|--------|------|
|                       |  |   |                 | -55 to 25°C          | <85°C | <125°C |      |
| R <sub>ON</sub>       | Maximum On Resistance (Figures 8 – 12) | V <sub>IN</sub> = V <sub>IH</sub><br>V <sub>IS</sub> = V <sub>CC</sub> to GND<br> I <sub>S</sub>   ≤ 10.0 mA                                    | 3.0             | 45                   | 50    | 55     | Ω    |
|                       |  |   | 4.5             | 30                   | 35    | 40     |      |
|                       |  |   | 5.5             | 25                   | 30    | 35     |      |
| R <sub>FLAT(ON)</sub> | On Resistance Flatness                 | V <sub>IN</sub> = V <sub>IH</sub><br> I <sub>S</sub>   ≤ 10.0 mA<br>V <sub>IS</sub> = 1 V, 2 V, 3.5 V   | 4.5             | 4.0                  | 4.0   | 5.0    | Ω    |
| I <sub>NO(OFF)</sub>  | Off Leakage Current, Pin 2 (Figure 3)  | V <sub>IN</sub> = V <sub>IL</sub><br>V <sub>NO</sub> = 1.0 V, V <sub>COM</sub> = 4.5 V or<br>V <sub>COM</sub> = 1.0 V and V <sub>NO</sub> 4.5 V | 5.5             | 1.0                  | 10    | 100    | nA   |
| I <sub>COM(OFF)</sub> | Off Leakage Current, Pin 1 (Figure 3)  | V <sub>IN</sub> = V <sub>IL</sub><br>V <sub>NO</sub> = 4.5 V or 1.0 V<br>V <sub>COM</sub> = 1.0 V or 4.5 V                                      | 5.5             | 1.0                  | 10    | 100    | nA   |

## AC ELECTRICAL CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0 ns)

| Symbol           | Parameter     | Test Conditions  | V <sub>CC</sub><br>(V) | Guaranteed Max Limit |      |     |       |     |     |        |     |     | Unit |
|------------------|---------------|--|------------------------|----------------------|------|-----|-------|-----|-----|--------|-----|-----|------|
|                  |               |  |                        | -55 to 25°C          |      |     | <85°C |     |     | <125°C |     |     |      |
|                  |               |  |                        | Min                  | Typ  | Max | Min   | Typ | Max | Min    | Typ | Max |      |
| t <sub>ON</sub>  | Turn-On Time  | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>(Figures 4, 5, and 13) | 2.0                    |                      | 7.0  | 14  |       |     | 16  |        |     | 16  | ns   |
|                  |               |  | 3.0                    |                      | 5.0  | 10  |       |     | 12  |        |     | 12  |      |
|                  |               |  | 4.5                    |                      | 4.5  | 9.0 |       |     | 11  |        |     | 11  |      |
|                  |               |  | 5.5                    |                      | 4.5  | 9.0 |       |     | 11  |        |     | 11  |      |
| t <sub>OFF</sub> | Turn-Off Time | R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF<br>(Figures 4, 5, and 13) | 2.0                    |                      | 11.0 | 22  |       |     | 24  |        |     | 24  | ns   |
|                  |               |  | 3.0                    |                      | 7.0  | 14  |       |     | 16  |        |     | 16  |      |
|                  |               |  | 4.5                    |                      | 5.0  | 10  |       |     | 12  |        |     | 12  |      |
|                  |               |  | 5.5                    |                      | 5.0  | 10  |       |     | 12  |        |     | 12  |      |

|                                    |   | Typical @ 25, V <sub>CC</sub> = 5.0 V |  |  |    |
|------------------------------------|---|---------------------------------------|--|--|----|
| C <sub>IN</sub>                    | Maximum Input Capacitance, Select Input | 8.0                                   |  |  | pF |
| C <sub>NO</sub> or C <sub>NC</sub> | Analog I/O (switch off)                 | 10                                    |  |  |    |
| C <sub>COM(OFF)</sub>              | Common I/O (switch off)                 | 10                                    |  |  |    |
| C <sub>COM(ON)</sub>               | Feedthrough (switch on)                 | 20                                    |  |  |    |

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## ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted)

| Symbol           | Parameter   | Condition   | V <sub>CC</sub><br>V | Limit             | Unit |
|------------------|---|---|----------------------|-------------------|------|
|                  |   |   |                      | 25°C              |      |
| BW               | Maximum On-Channel -3dB Bandwidth or Minimum Frequency Response | V <sub>IS</sub> = 0 dBm<br>V <sub>IS</sub> centered between V <sub>CC</sub> and GND<br>(Figures 6 and 14)   | 3.0<br>4.5<br>5.5    | 190<br>200<br>220 | MHz  |
| V <sub>ONL</sub> | Maximum Feedthrough On Loss                                     | V <sub>IS</sub> = 0 dBm @ 10 kHz<br>V <sub>IS</sub> centered between V <sub>CC</sub> and GND<br>(Figure 6)  | 3.0<br>4.5<br>5.5    | -2<br>-2<br>-2    | dB   |
| V <sub>ISO</sub> | Off-Channel Isolation   | f = 100 kHz; V <sub>IS</sub> = 1.0 V RMS<br>V <sub>IS</sub> centered between V <sub>CC</sub> and GND<br>(Figures 6 and 15)  | 3.0<br>4.5<br>5.5    | -93               | dB   |
| Q                | Charge Injection<br>Enable Input to Common I/O                  | V <sub>IS</sub> = V <sub>CC</sub> to GND, F <sub>IS</sub> = 20 kHz<br>t <sub>r</sub> = t <sub>f</sub> = 3.0 ns<br>R <sub>IS</sub> = 0 Ω, C <sub>L</sub> = 1000 pF<br>Q = C <sub>L</sub> * ΔV <sub>OUT</sub><br>(Figures 6 and 16) | 3.0<br>5.5           | 1.5<br>3.0        | pC   |
| THD              | Total Harmonic Distortion<br>THD + Noise                        | F <sub>IS</sub> = 20 Hz to 1 MHz, R <sub>L</sub> = R <sub>gen</sub> = 600 Ω, C <sub>L</sub> = 50 pF<br>V <sub>IS</sub> = 3.0 V <sub>PP</sub> sine wave<br>V <sub>IS</sub> = 5.0 V <sub>PP</sub> sine wave<br><br>(Figure 17)      | 3.3<br>5.5           | 0.3<br>0.15       | %    |

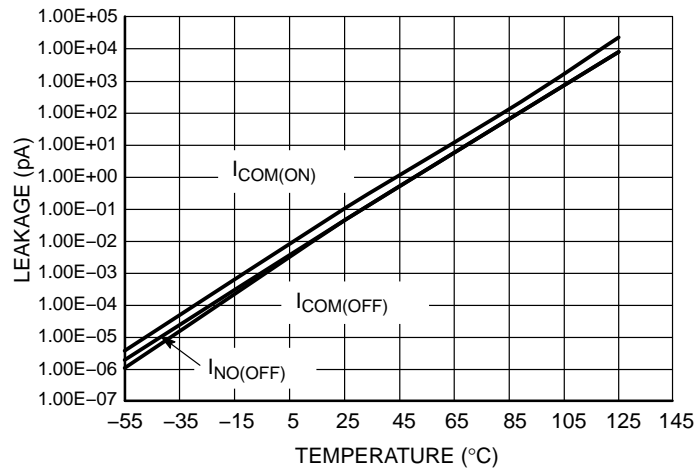


Figure 3. Switch Leakage vs. Temperature

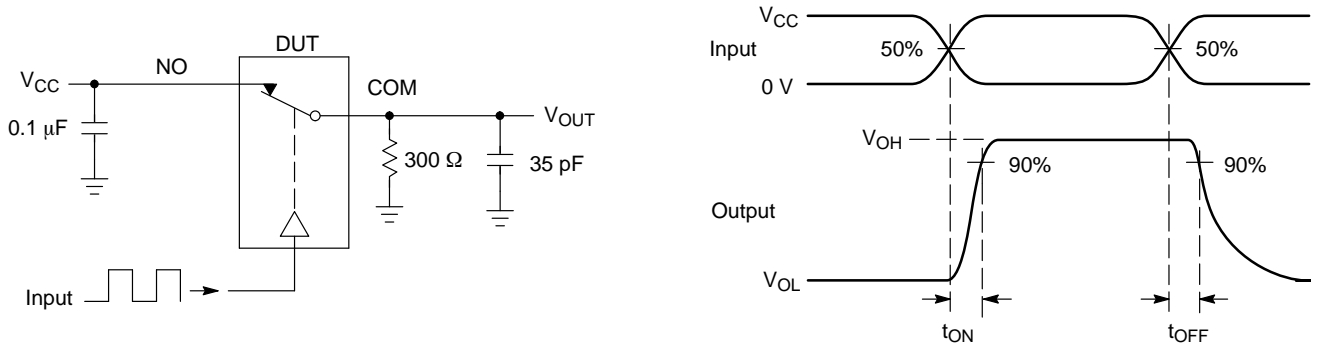


Figure 4.  $t_{ON}/t_{OFF}$

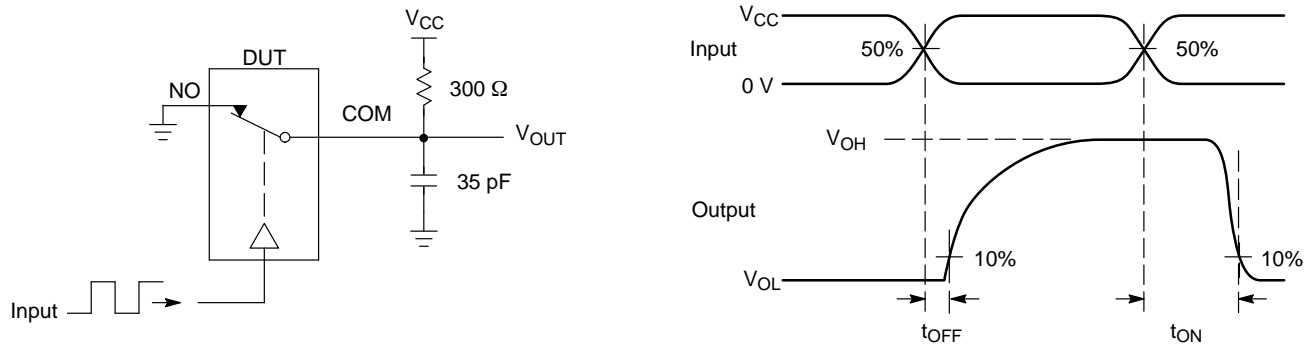
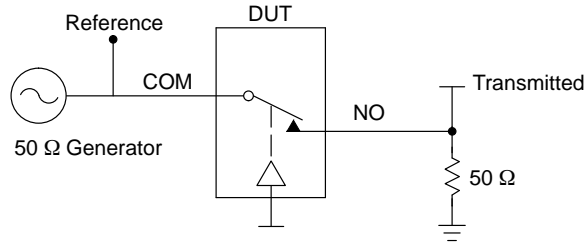


Figure 5.  $t_{ON}/t_{OFF}$



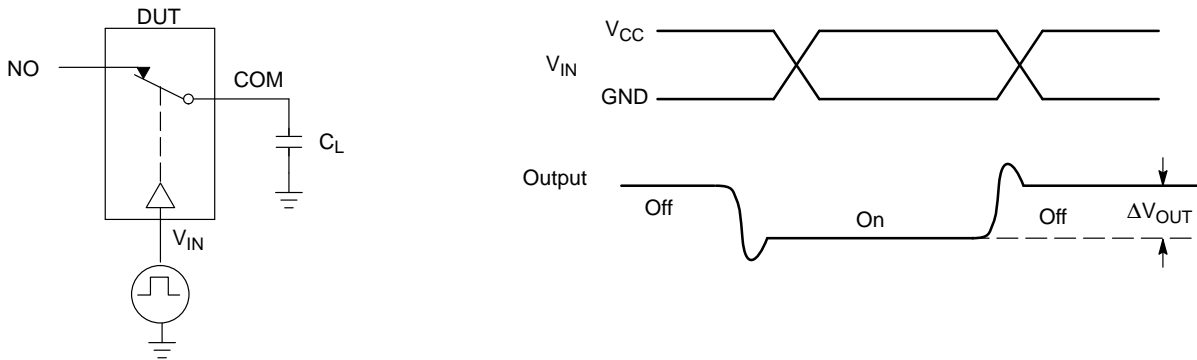
Channel switch control/s test socket is normalized. Off isolation is measured across an off channel. On loss is the bandwidth of an On switch.  $V_{ISO}$ , Bandwidth and  $V_{ONL}$  are independent of the input signal direction.

$$V_{ISO} = \text{Off Channel Isolation} = 20 \text{ Log} \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz}$$

$$V_{ONL} = \text{On Channel Loss} = 20 \text{ Log} \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz to } 50 \text{ MHz}$$

Bandwidth (BW) = the frequency 3.0 dB below  $V_{ONL}$

**Figure 6. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/ $V_{ONL}$**



**Figure 7. Charge Injection: (Q)**

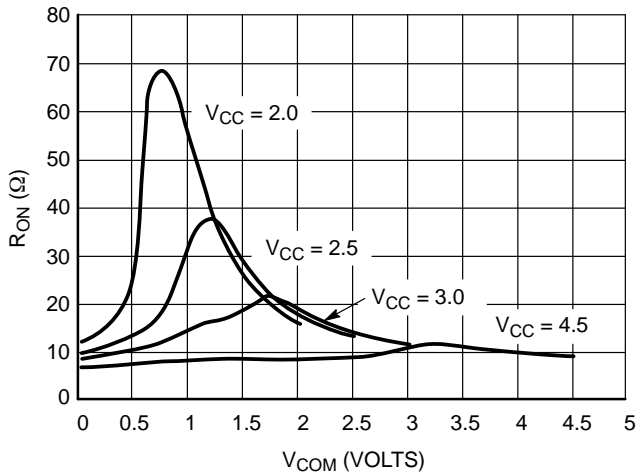


Figure 8.  $R_{ON}$  vs.  $V_{COM}$  and  $V_{CC}$  (@25°C)

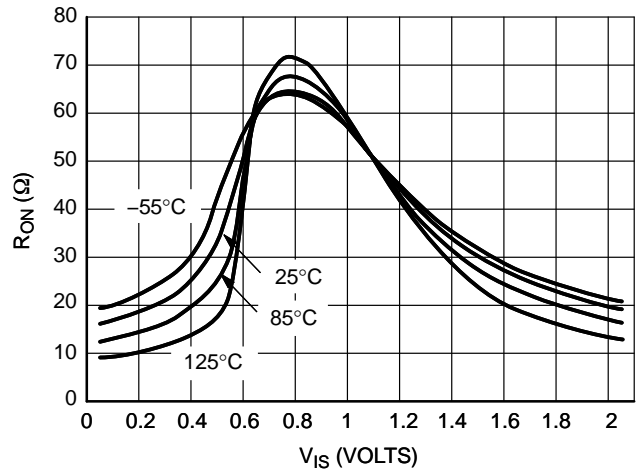


Figure 9.  $R_{ON}$  vs.  $V_{COM}$  and Temperature,  $V_{CC} = 2.0$  V

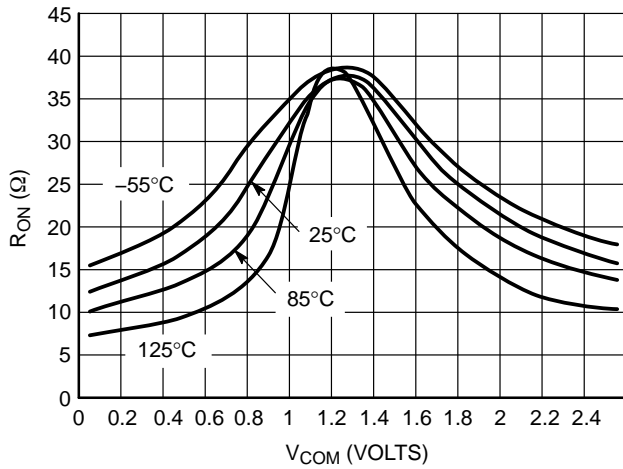


Figure 10.  $R_{ON}$  vs.  $V_{COM}$  and Temperature,  $V_{CC} = 2.5$  V

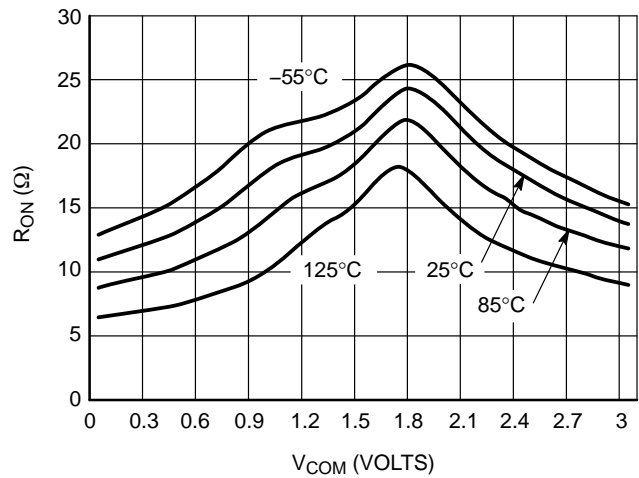


Figure 11.  $R_{ON}$  vs.  $V_{COM}$  and Temperature,  $V_{CC} = 3.0$  V

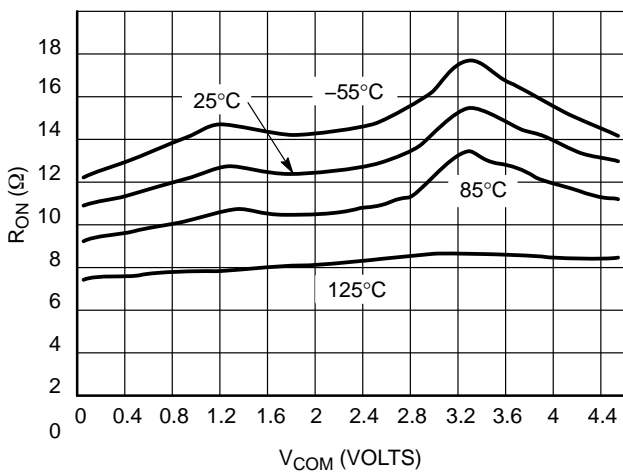


Figure 12.  $R_{ON}$  vs.  $V_{COM}$  and Temperature,  $V_{CC} = 4.5$  V

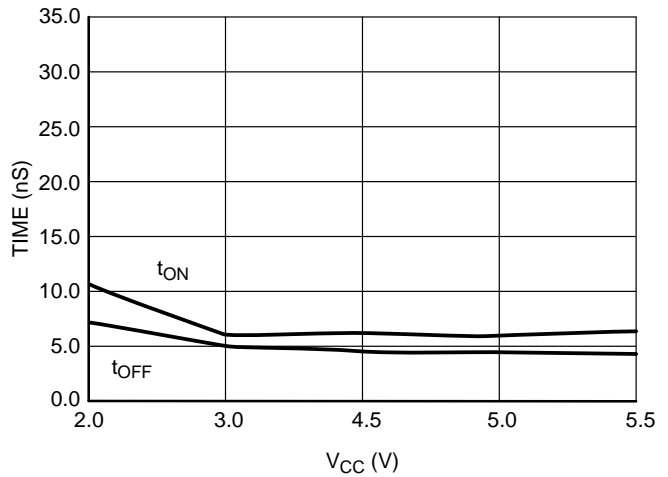


Figure 13. Switching Time vs. Supply Voltage,  $T = 25^\circ\text{C}$

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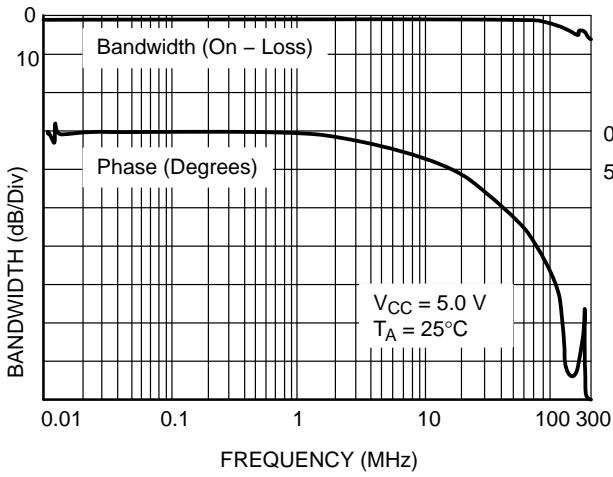


Figure 14. ON Channel Bandwidth and Phase Shift Over Frequency

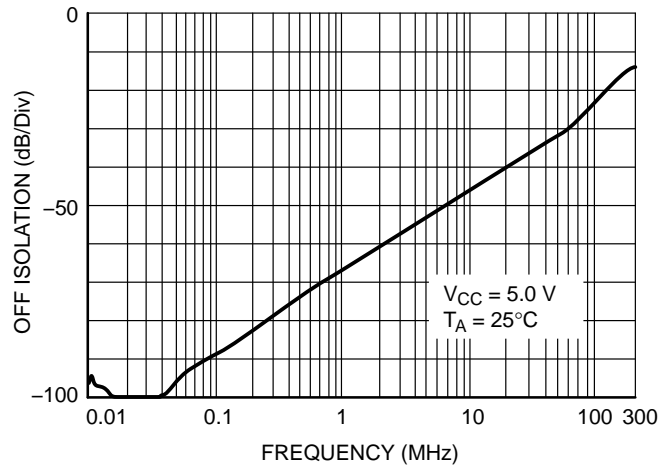


Figure 15. Off Channel Isolation

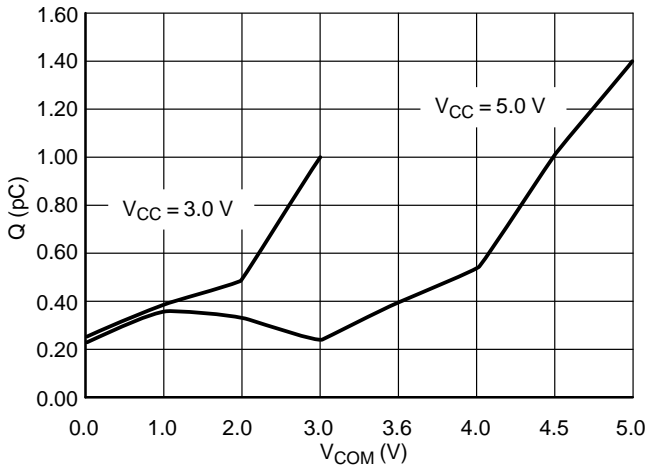


Figure 16. Charge Injection vs.  $V_{COM}$

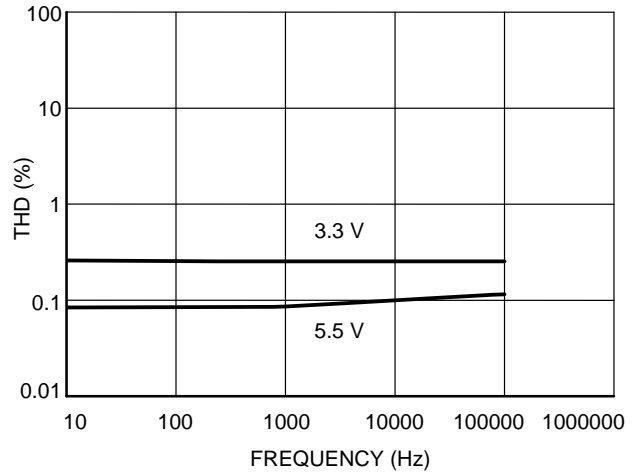


Figure 17. THD vs. Frequency

## DEVICE ORDERING INFORMATION

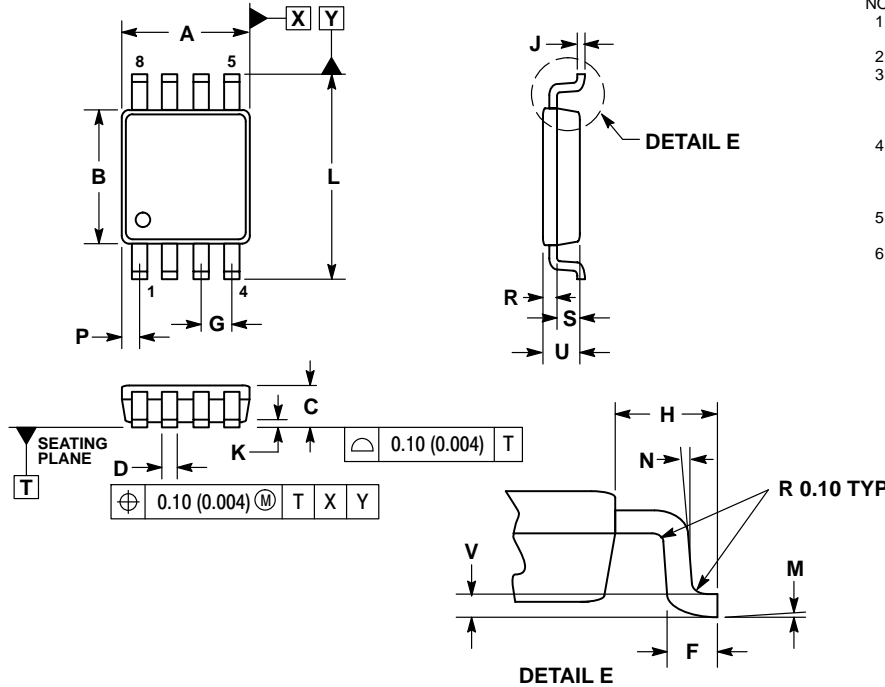
| Device Order Number | Package          | Shipping <sup>†</sup> |
|---------------------|------------------|-----------------------|
| NLAS323USG          | US8<br>(Pb-Free) | 3000 / Tape & Reel    |

<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.

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## PACKAGE DIMENSIONS

### US8 US SUFFIX CASE 493-02 ISSUE D

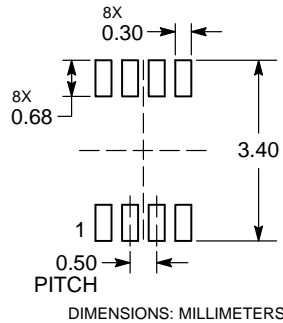


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURR. MOLD FLASH, PROTRUSION AND GATE BURR SHALL NOT EXCEED 0.14MM (0.0055") PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH AND PROTRUSION SHALL NOT EXCEED 0.14MM (0.0055") PER SIDE.
5. LEAD FINISH IS SOLDER PLATING WITH THICKNESS OF 0.0076-0.0203MM (0.003-0.008").
6. ALL TOLERANCE UNLESS OTHERWISE SPECIFIED  $\pm 0.0508\text{MM}$  (0.0002").

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 1.90        | 2.10 | 0.075     | 0.083 |
| B   | 2.20        | 2.40 | 0.087     | 0.094 |
| C   | 0.60        | 0.90 | 0.024     | 0.035 |
| D   | 0.17        | 0.25 | 0.007     | 0.010 |
| F   | 0.20        | 0.35 | 0.008     | 0.014 |
| G   | 0.50 BSC    |      | 0.020 BSC |       |
| H   | 0.40 REF    |      | 0.016 REF |       |
| J   | 0.10        | 0.18 | 0.004     | 0.007 |
| K   | 0.00        | 0.10 | 0.000     | 0.004 |
| L   | 3.00        | 3.20 | 0.118     | 0.128 |
| M   | 0°          | 6°   | 0°        | 6°    |
| N   | 0°          | 10°  | 0°        | 10°   |
| P   | 0.23        | 0.34 | 0.010     | 0.013 |
| R   | 0.23        | 0.33 | 0.009     | 0.013 |
| S   | 0.37        | 0.47 | 0.015     | 0.019 |
| U   | 0.60        | 0.80 | 0.024     | 0.031 |
| V   | 0.12 BSC    |      | 0.005 BSC |       |

### RECOMMENDED 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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**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)

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