

# NBA3N011S

## 3.3 V Automotive Grade LVDS Driver

### Description

The NBA3N011S is a Low Voltage Differential Signaling (LVDS) driver for low power and high data rate applications. The device accepts LVCMOS/TTL input and translates it to LVDS and is designed to support data rates higher than 400 Mbps (200 MHz).

The driver provides low EMI with a typical output swing of 350 mV. The device can be paired with its companion single line receiver NBA3N012C or with any other LVDS receiver for high speed LVDS interface.

The LVDS output is designed as a 3.5 mA (typical) current mode driver allowing low power dissipation even at the high frequency.

NBA3N011S is offered in a 5 lead SOT23 package, shipping in 3000 pcs tape & reel.

### Features

- Compatible with TIA/EIA-644A Standard
- Automotive Grade AECQ-100 Grade 1
- > 400 Mbps (200 MHz) Data Rate
- Operating Range:  $V_{DD} = 3.3 \text{ V} \pm 0.3 \text{ V}$
- Maximum 700 ps Differential Skew
- Maximum Propagation Delay of 1.5 ns
- Low Power Dissipation (Typical 23 mW @ 3.3 V)
- SOT23-5 Lead Package with Pinout optimized for easy PCB Layout
- $\pm 350 \text{ mV}$  Differential Signaling
- Power Off Protection (Outputs in Tri-state)
- Temperature Operating Range  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$
- These are Pb-Free Devices

### Typical Applications:

- Automotive: Head Lamp Lighting for Cars
- Telecom: Wireless, Microwave and Optical

**Table 1. PIN DESCRIPTION**

| Pin Number | Pin Name  | I/O Type | Description          |
|------------|-----------|----------|----------------------|
| 1          | $V_{DD}$  |          | Power Supply Pin     |
| 2          | GND       |          | Ground Pin           |
| 3          | $\bar{Q}$ | Output   | Inverting Output Pin |
| 4          | Q         | Output   | Non-Inverting Output |
| 5          | IN        | Input    | Input Pin            |



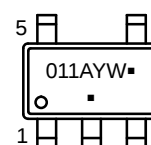
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**SOT23-5  
DT SUFFIX  
CASE 527AH**

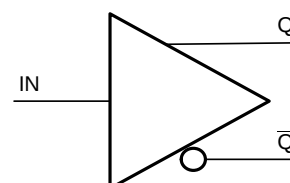
### MARKING DIAGRAM



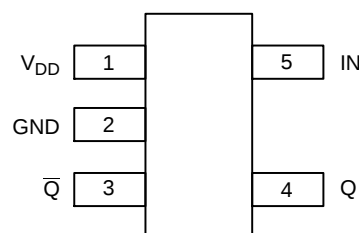
011 = Specific Device Code  
A = Assembly Code  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### LOGIC DIAGRAM



### PINOUT DIAGRAM



### ORDERING INFORMATION

| Device         | Package           | Shipping†          |
|----------------|-------------------|--------------------|
| NBA3N011SSNT1G | SOT23-5 (Pb-Free) | 3000 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# NBA3N011S

**Table 2. ATTRIBUTES** (Note 1)

| Characteristics               |                                                       |          | Value                                 |
|-------------------------------|-------------------------------------------------------|----------|---------------------------------------|
| ESD Protection                | Human Body Model (JEDEC Standard 22, Method A114-E)   | All Pins | $\geq 8$ kV                           |
|                               | Charge Device Model (JEDEC Standard 22, Method C101D) | All Pins | $\geq 1.25$ kV                        |
| Moisture Sensitivity (Note 1) |                                                       |          | Level 1                               |
| Flammability Rating           | Oxygen Index: 28 to 34                                |          | UL 94 Code V-0 A<br>0.125 in 28 to 34 |

1. For additional information, see Application Note AND8003/D

**Table 3. MAXIMUM RATINGS**

| Symbol        | Parameter                                                            | Rating                       | Unit |
|---------------|----------------------------------------------------------------------|------------------------------|------|
| $V_{DD}$      | Supply voltage                                                       | $-0.30 \leq V_{DD} \leq 4.0$ | V    |
| $V_{IN}$      | Input Voltage (IN) LVCMOS                                            | $-0.30$ to $(V_{DD} + 0.30)$ | V    |
| $V_Q$         | Output Voltage (Q/Q) LVDS                                            | $-0.30$ to $+3.90$           | V    |
| $I_{OS}$      | Output Short Circuit Current LVDS                                    | 24                           | mA   |
| $T_j$         | Maximum Junction Temperature                                         | 135                          | °C   |
| $T_{stg}$     | Storage Temperature Range                                            | $-65$ to $+150$              | °C   |
| $\theta_{JC}$ | Thermal resistance (Junction-to-Case) – (Note 3)                     | 107                          | °C/W |
| $\theta_{JA}$ | Thermal resistance (Junction-to-Ambient) – (Note 3)                  | 138.5                        | °C/W |
| $T_{sol}$     | Lead Temperature Soldering (4 Seconds) – SOLDERM/D                   | 260                          | °C   |
| PD            | Package Power Dissipation @ 25°C – Derating of 7.22 mW/°C above 25°C | 794                          | mW   |

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.

2. The maximum ratings applied are individual stress limit values and not valid simultaneously.

3. JEDEC standard multilayer board –2S2P (2 signal 2 power)

**Table 4. DC CHARACTERISTICS**  $V_{DD} = 3.3 \text{ V} \pm 0.3 \text{ V}$ , GND = 0 V,  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$

| Symbol   | Parameter            | Test Conditions                                              | Min  | Typ     | Max      | Unit          |
|----------|----------------------|--------------------------------------------------------------|------|---------|----------|---------------|
| $I_{DD}$ | Power Supply Current | No-Load (Pin: $V_{DD}$ ; $V_{IN} = V_{DD}$ or GND)           |      | 5       | 8        | mA            |
|          |                      | RL = 100 $\Omega$ (Pin: $V_{DD}$ ; $V_{IN} = V_{DD}$ or GND) |      | 7       | 10       | mA            |
| $V_{IH}$ | Input High Voltage   | Pin: IN                                                      | 2.0  |         | $V_{DD}$ | V             |
| $V_{IL}$ | Input Low Voltage    | Pin: IN                                                      | GND  |         | 0.8      | V             |
| $I_{IH}$ | Input High Current   | Pin: IN; $V_{IN} = 3.3 \text{ V}$ or $2.4 \text{ V}$         |      | $\pm 2$ | $\pm 10$ | $\mu\text{A}$ |
| $I_{IL}$ | Input Low Current    | Pin: IN; $V_{IN} = \text{GND}$ or $0.5 \text{ V}$            |      | $\pm 1$ | $\pm 10$ | $\mu\text{A}$ |
| $V_{CL}$ | Input Clamp Voltage  | $I_{CL} = -18 \text{ mA}$                                    | -1.5 | -0.6    |          | V             |
| $C_{IN}$ | Input Capacitance    |                                                              |      | 3       |          | pF            |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

**Table 5. ELECTRICAL CHARACTERISTICS**  $V_{DD} = 3.3 \text{ V} \pm 0.3 \text{ V}$ ,  $GND = 0 \text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ , Pin: Q/ $\overline{Q}$

| Symbol           | Parameter                                          | Test Conditions                                         | Min   | Typ     | Max      | Unit          |
|------------------|----------------------------------------------------|---------------------------------------------------------|-------|---------|----------|---------------|
| $ V_{OD} $       | Differential Output Voltage                        | $R_L = 100 \Omega$ , Figures 1 & 2                      | 250   | 350     | 450      | mV            |
| $\Delta V_{OD} $ | Change in Differential Output Voltage magnitude    |                                                         |       | 3       | 35       | mV            |
| $V_{OS}$         | Offset Voltage                                     | $R_L = 100 \Omega$ , Figure 1                           | 1.125 | 1.220   | 1.375    | V             |
| $\Delta V_{OS}$  | Change in Offset Voltage magnitude                 |                                                         | 0     | 1       | 50       | mV            |
| $I_{OFF}$        | Leakage Current – Power-off                        | $V_Q = 3.6 \text{ V}$ or $GND$ , $V_{DD} = 0 \text{ V}$ |       | $\pm 1$ | $\pm 10$ | $\mu\text{A}$ |
| $I_{OSD}$        | Differential Short Circuit Output Current (Note 4) | $V_{OD} = 0 \text{ V}$                                  |       | -5      | -12      | mA            |
| $I_{OS}$         | Output Short Circuit Current (Note 4)              | $V_Q$ and $\overline{V_Q} = 0 \text{ V}$                |       | -6      | -24      | mA            |
| $C_{OUT}$        | Output Capacitance                                 |                                                         |       | 3       |          | pF            |

4. – minus sign indicated only direction. Current into the device is defined as positive.  $I_{OS}/I_{OSD}$  is specified as magnitude only.

**Table 6. SWITCHING CHARACTERISTICS**

$V_{DD} = 3.3 \text{ V} \pm 0.3 \text{ V}$ ,  $GND = 0 \text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ ,  $F = 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r, t_f \leq 1 \text{ ns}$  (10% to 90%) – (Note 5)

| Symbol         | Parameters                                               | Min | Typ | Max | Unit |
|----------------|----------------------------------------------------------|-----|-----|-----|------|
| $t_{PHLD}$     | High to Low Differential Propagation Delay               | 0.3 | 1.0 | 1.5 | ns   |
| $t_{PLHD}$     | Low to High Differential Propagation Delay               | 0.3 | 1.1 | 1.5 | ns   |
| $t_r$          | Rise Time – Transition Low to High                       | 0.2 | 0.5 | 1.0 | ns   |
| $t_f$          | Fall Time – Transition High to Low                       | 0.2 | 0.5 | 1.0 | ns   |
| $t_{SKD(P)}$   | Differential Pulse Skew $ t_{PHLD} - t_{PLHD} $ (Note 6) | 0   | 0.1 | 0.7 | ns   |
| $t_{SKD(PP)1}$ | Differential Part to Part Skew – (Note 7)                | 0   | 0.2 | 1.0 | ns   |
| $t_{SKD(PP)2}$ | Differential Part to Part Skew – (Note 8)                | 0   | 0.4 | 1.2 | ns   |
| $f_{MAX}$      | Maximum Operating Frequency – (Note 9)                   |     | 250 |     | MHz  |

5. Test Conditions for the above –  $R_L = 100 \Omega$ ,  $C_L = 15 \text{ pF}$  (includes Load & Jig Capacitance), Figures 3 and 4

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions

6.  $|t_{PHLD} - t_{PLHD}|$ , is the magnitude difference in differential propagation delay time between the positive going edge and the negative going edge of the same channel.

7. Differential Part to Part Skew, is defined as the difference between the minimum and maximum specified differential propagation delays. This specification applies to devices at the same  $V_{DD}$  and within  $5^\circ\text{C}$  of each other within the operating temperature range.

8. Part to part skew, is the differential channel to channel skew of any event between devices. This specification applies to devices over recommended operating temperature and voltage ranges, and across process distribution.  $t_{SKD2}$  is defined as  $|Max - Min|$  differential propagation delay.

9.  $f_{MAX}$  Input Conditions:  $t_r = t_f < 1 \text{ ns}$  (0% to 100%), Duty Cycle 50%, 0 V to 3 V.  $f_{MAX}$  Output Conditions:  $V_{OD} > 250 \text{ mV}$ , Duty Cycle = 45%/55%

PARAMETER MEASUREMENT:

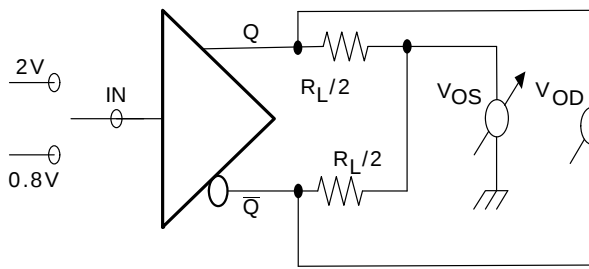


Figure 1. DC Test Circuit for Differential Driver

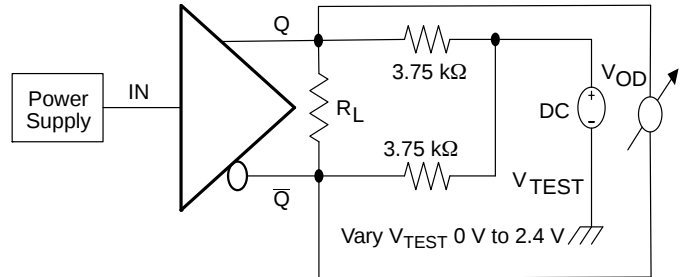


Figure 2. Full Load DC Test Circuit for Differential Driver

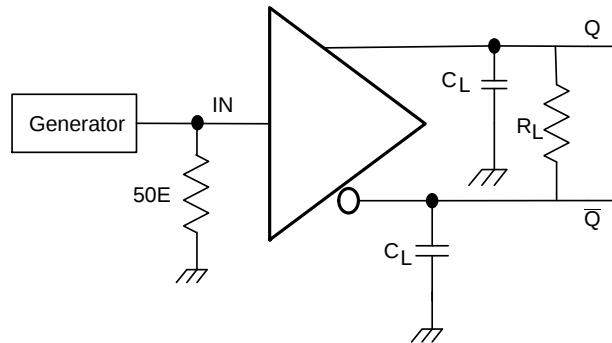


Figure 3. Propagation Delay & Transition Time Test Circuit for Differential Driver

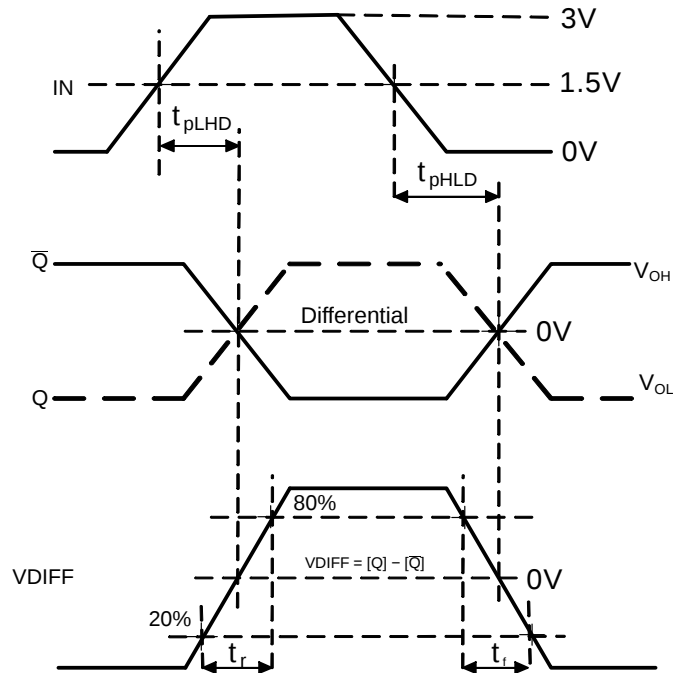
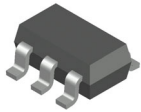
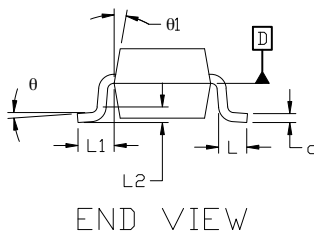
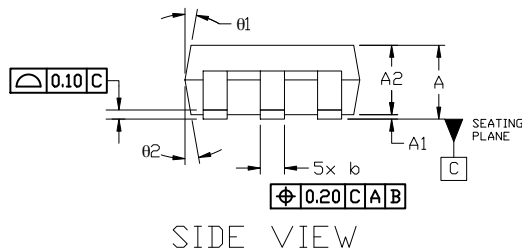
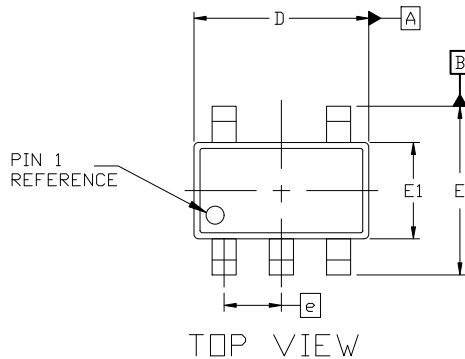


Figure 4. Propagation Delay & Transition Time Waveforms for Differential Driver

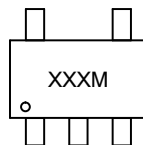


### SOT-23, 5 Lead CASE 527AH ISSUE A

DATE 09 JUN 2021



### GENERIC MARKING DIAGRAM\*



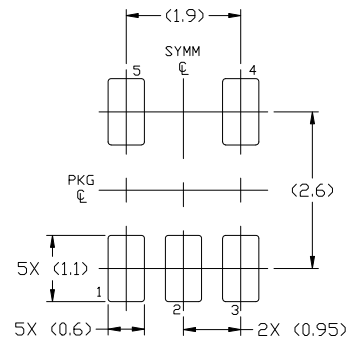
XXX = Specific Device Code  
M = Date Code

\*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. Some products may not follow the Generic Marking.

### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1989A
2. CONTROLLING DIMENSION: MILLIMETERS
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.25 PER SIDE. D AND E1 DIMENSIONS ARE DETERMINED AT DATUM D.
5. DIMENSION 'b' DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08mm TOTAL IN EXCESS OF THE 'b' DIMENSION AT MAXIMUM MATERIAL CONDITION. MINIMUM SPACE BETWEEN PROTRUSION AND AN ADJACENT LEAD SHALL NOT BE LESS THAN 0.07mm.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.90        | —    | 1.45 |
| A1  | 0.00        | —    | 0.15 |
| A2  | 0.90        | 1.15 | 1.30 |
| b   | 0.30        | —    | 0.50 |
| c   | 0.08        | —    | 0.22 |
| D   | 2.90 BSC    |      |      |
| E   | 2.80 BSC    |      |      |
| E1  | 1.60 BSC    |      |      |
| e   | 0.95 BSC    |      |      |
| L   | 0.30        | 0.45 | 0.60 |
| L1  | 0.60 REF    |      |      |
| L2  | 0.25 REF    |      |      |
| θ   | 0°          | 4°   | 8°   |
| θ1  | 0°          | 10°  | 15°  |
| θ2  | 0°          | 10°  | 15°  |



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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