

# NB4N855S

## 3.3 V, 1.5 Gb/s Dual AnyLevel™ to LVDS Receiver/Driver/Buffer/Translator

### Description

NB4N855S is a clock or data Receiver/Driver/Buffer/Translator capable of translating AnyLevel input signal (LVPECL, CML, HSTL, LVDS, or LVTTL/LVCMOS) to LVDS. Depending on the distance, noise immunity of the system design, and transmission line media, this device will receive, drive or translate data or clock signals up to 1.5 Gb/s or 1.0 GHz, respectively. This device is pin-for-pin plug in compatible to the SY55855V in a 3.3 V applications.

The NB4N855S has a wide input common mode range of  $GND + 50\text{ mV}$  to  $V_{CC} - 50\text{ mV}$ . This feature is ideal for translating differential or single-ended data or clock signals to 350 mV typical LVDS output levels.

The device is offered in a small 10 lead MSOP package. NB4N855S is targeted for data, wireless and telecom applications as well as high speed logic interface where jitter and package size are main requirements.

Application notes, models, and support documentation are available at [www.onsemi.com](http://www.onsemi.com).

### Features

- Guaranteed Input Clock Frequency up to 1.0 GHz
- Guaranteed Input Data Rate up to 1.5 Gb/s
- 490 ps Maximum Propagation Delay
- 1.0 ps Maximum RMS Jitter
- 180 ps Maximum Rise/Fall Times
- Single Power Supply;  $V_{CC} = 3.3\text{ V} \pm 10\%$
- Temperature Compensated TIA/EIA-644 Compliant LVDS Outputs
- $GND + 50\text{ mV}$  to  $V_{CC} - 50\text{ mV}$   $V_{CMR}$  Range
- Pb-Free Package is Available

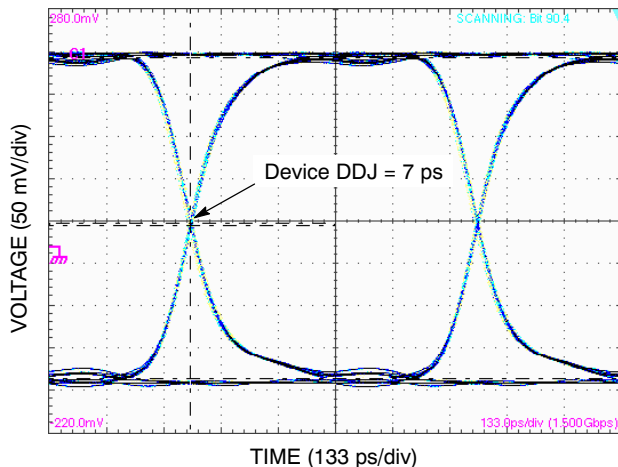
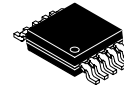


Figure 1. Typical Output Waveform at 1.5 Gb/s with K28.5 ( $V_{INPP} = 100\text{ mV}$ , Input Signal DDJ = 24 ps)



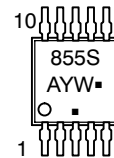
ON Semiconductor®

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1  
Micro-10  
M SUFFIX  
CASE 846B

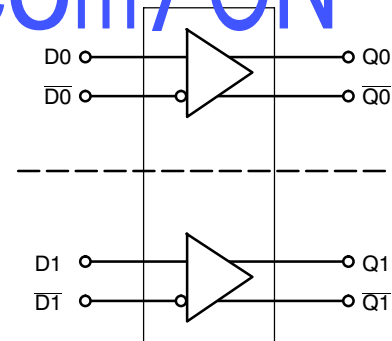
### MARKING DIAGRAM\*



- A = Assembly Location
- Y = Year
- W = Work Week
- = Pb-Free Package

(Note: Microdot may be in either location)

\*For additional marking information, refer to Application Note AND8003/D

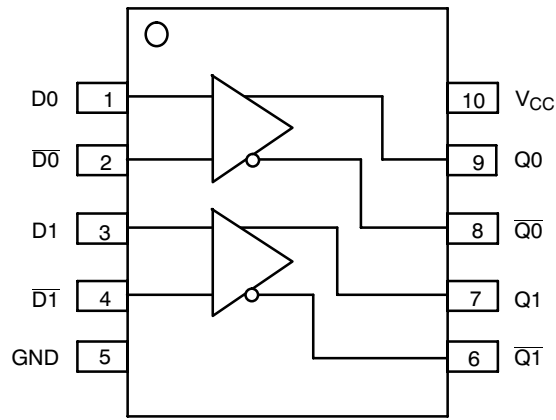


Functional Block Diagram

### ORDERING INFORMATION

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

## NB4N855S



**Figure 2. Pin Configuration and Block Diagram  
(Top View)**

**Table 1. PIN DESCRIPTION**

| Pin | Name            | I/O                               | Description   |
|-----|-----------------|-----------------------------------|---|
| 1   | D0              | LVPECL, CML, LVCMOS, LVTTTL, LVDS | Noninverted Differential Clock/Data D0 Input.   |
| 2   | $\overline{D0}$ | LVPECL, CML, LVCMOS, LVTTTL, LVDS | Inverted Differential Clock/Data $\overline{D0}$ Input.   |
| 3   | D1              | LVPEL, CML, LVDS LVCMOS, LVTTTL   | Noninverted Differential Clock/Data D1 Input.   |
| 4   | $\overline{D1}$ | LVPECL, CML, LVDS LVCMOS LVTTTL   | Inverted Differential Clock/Data $\overline{D1}$ Input.   |
| 5   | GND             | -                                 | Ground, 0 V.  |
| 6   | $\overline{Q1}$ | LVDS Output                       | Inverted Q1 output. Typically loaded with 100 $\Omega$ receiver termination resistor across differential pair.              |
| 7   | Q1              | LVDS Output                       | Noninverted Q1 output. Typically loaded with 100 $\Omega$ receiver termination resistor across differential pair.           |
| 8   | $\overline{Q0}$ | LVDS Output                       | Inverted $\overline{Q0}$ output. Typically loaded with 100 $\Omega$ receiver termination resistor across differential pair. |
| 9   | Q0              | LVDS Output                       | Noninverted Q0 output. Typically loaded with 100 $\Omega$ receiver termination resistor across differential pair.           |
| 10  | VCC             | -                                 | Positive Supply Voltage.  |

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**Table 2. ATTRIBUTES**

| Characteristics  |   | Value                       |             |
|--|---|-----------------------------|-------------|
| Moisture Sensitivity (Note 1)                          |   | Pb Pkg                      | Pb-Free Pkg |
| Micro-10   |   | Level 1                     | Level 1     |
| Flammability Rating                                    | Oxygen Index: 28 to 34                                    | UL 94 V-0 @ 0.125 in        |             |
| ESD Protection   | Human Body Model<br>Machine Model<br>Charged Device Model | > 2 kV<br>> 200 V<br>> 1 kV |             |
| Transistor Count                                       | 281   |                             |             |
| Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test |   |                             |             |

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

**Table 3. MAXIMUM RATINGS**

| Symbol           | Parameter   | Condition 1                             | Condition 2                      | Rating      | Unit         |
|------------------|---|---|----------------------------------|-------------|--------------|
| V <sub>CC</sub>  | Positive Power Supply   | GND = 0 V                               |                                  | 3.8         | V            |
| V <sub>I</sub>   | Positive Input  | GND = 0 V                               | V <sub>I</sub> = V <sub>CC</sub> | 3.8         | V            |
| I <sub>OSC</sub> | Output Short Circuit Current<br>Line-to-Line (Q to $\bar{Q}$ )<br>Line-to-End (Q or $\bar{Q}$ to GND) | Q to $\bar{Q}$<br>Q or $\bar{Q}$ to GND | Continuous<br>Continuous         | 12<br>24    | mA           |
| T <sub>A</sub>   | Operating Temperature Range   | Micro-10                                |                                  | -40 to +85  | °C           |
| T <sub>stg</sub> | Storage Temperature Range   |   |                                  | -65 to +150 | °C           |
| θ <sub>JA</sub>  | Thermal Resistance (Junction-to-Ambient) (Note 2)   | 0 lfpm<br>500 lfpm                      | Micro-10<br>Micro-10             | 177<br>132  | °C/W<br>°C/W |
| θ <sub>JC</sub>  | Thermal Resistance (Junction-to-Case)   | 1S2P (Note 4)                           | Micro-10                         | 40          | °C/W         |
| T <sub>sol</sub> | Wave Solder   | Pb<br>Pb-Free                           | <3 Sec @ 248°C<br><3 Sec @ 230°C | 265<br>265  | °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.

2. JEDEC standard multilayer board - 1S2P (1 signal, 2 power).

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**Table 4. DC CHARACTERISTICS, CLOCK INPUTS, LVDS OUTPUTS**  $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ ,  $GND = 0\text{ V}$ ,  $T_A = -40^\circ\text{C to }+85^\circ\text{C}$

| Symbol   | Characteristic                | Min | Typ | Max | Unit |
|----------|-------------------------------|-----|-----|-----|------|
| $I_{CC}$ | Power Supply Current (Note 3) |     | 40  | 53  | mA   |

**DIFFERENTIAL INPUTS DRIVEN SINGLE-ENDED** (Figures 10 and 12)

|          |  |                |  |                |    |
|----------|--|----------------|--|----------------|----|
| $V_{th}$ | Input Threshold Reference Voltage Range (Note 4) | GND +100       |  | $V_{CC} - 100$ | mV |
| $V_{IH}$ | Single-ended Input HIGH Voltage                  | $V_{th} + 100$ |  | $V_{CC}$       | mV |
| $V_{IL}$ | Single-ended Input LOW Voltage                   | GND            |  | $V_{th} - 100$ | mV |

**DIFFERENTIAL INPUTS DRIVEN DIFFERENTIALLY** (Figures 11 and 13)

|           |  |          |  |                |    |
|-----------|--|----------|--|----------------|----|
| $V_{IHD}$ | Differential Input HIGH Voltage                      | 100      |  | $V_{CC}$       | mV |
| $V_{ILD}$ | Differential Input LOW Voltage                       | GND      |  | $V_{CC} - 100$ | mV |
| $V_{CMR}$ | Input Common Mode Range (Differential Configuration) | GND + 50 |  | $V_{CC} - 50$  | mV |
| $V_{ID}$  | Differential Input Voltage ( $V_{IHD} - V_{ILD}$ )   | 100      |  | $V_{CC}$       | mV |

**LVDS OUTPUTS** (Note 5)

|                 |  |      |      |      |    |
|-----------------|--|------|------|------|----|
| $V_{OD}$        | Differential Output Voltage  | 250  |      | 450  | mV |
| $\Delta V_{OD}$ | Change in Magnitude of $V_{OD}$ for Complementary Output States (Note 6) | 0    | 1.0  | 25   | mV |
| $V_{OS}$        | Offset Voltage (Figure 9)  | 1125 |      | 1375 | mV |
| $\Delta V_{OS}$ | Change in Magnitude of $V_{OS}$ for Complementary Output States (Note 6) | 0    | 1.0  | 25   | mV |
| $V_{OH}$        | Output HIGH Voltage (Note 7)   |      | 1425 | 1600 | mV |
| $V_{OL}$        | Output LOW Voltage (Note 8)  | 900  | 1075 |      | mV |

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

3.  $Dx/\overline{Dx}$  at the DC level.  $V_{IH}$ ,  $V_{CMR}$  and output pins loaded with  $R_L = 100\ \Omega$  across all pins.

4.  $V_{th}$  is applied to the complementary input when operating in single-ended mode.

5. LVDS outputs require  $100\ \Omega$  receiver termination resistor between differential pair. See Figure 8.

6. Parameter guaranteed by design verification not tested in production.

7.  $V_{OHmax} = V_{OSmax} + \frac{1}{2} V_{ODmax}$ .

8.  $V_{OLmax} = V_{OSmin} - \frac{1}{2} V_{ODmax}$ .

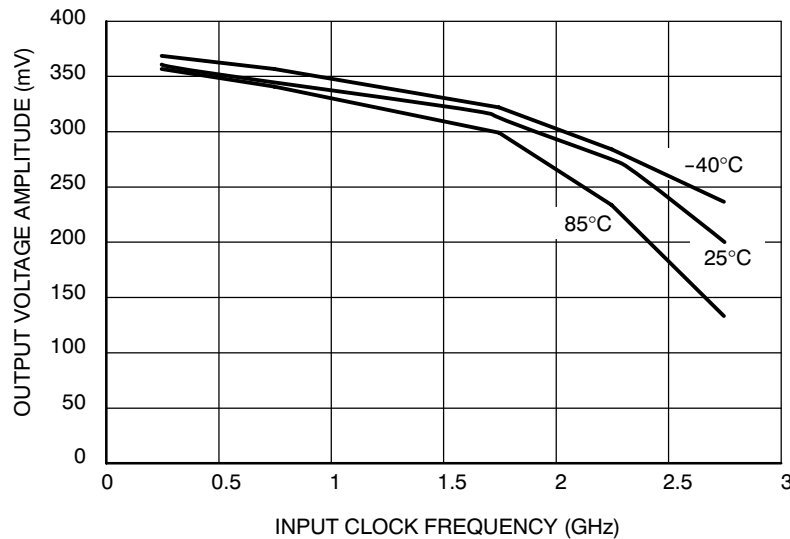
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**Table 5. AC CHARACTERISTICS**  $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ ,  $GND = 0\text{ V}$ ; (Note 9)

| Symbol                   | Characteristic   | -40°C      |                                  |                                | 25°C       |                                  |                                | 85°C       |                                  |                                | Unit |
|--------------------------|--|------------|----------------------------------|--------------------------------|------------|----------------------------------|--------------------------------|------------|----------------------------------|--------------------------------|------|
|                          |  | Min        | Typ                              | Max                            | Min        | Typ                              | Max                            | Min        | Typ                              | Max                            |      |
| $V_{OUTPP}$              | Output Voltage Amplitude (@ $V_{INPPMIN}$ ) $f_{in} \leq 1.0\text{ GHz}$<br>(Figure 3) $f_{in} = 1.5\text{ GHz}$   | 230<br>200 | 350<br>300                       |                                | 230<br>200 | 350<br>300                       |                                | 230<br>200 | 350<br>300                       |                                | mV   |
| $f_{DATA}$               | Maximum Operating Data Rate  | 1.5        | 2.5                              |                                | 1.5        | 2.5                              |                                | 1.5        | 2.5                              |                                | Gb/s |
| $t_{PLH}$ ,<br>$t_{PHL}$ | Differential Input to Differential Output Propagation Delay  | 330        | 410                              | 490                            | 330        | 410                              | 490                            | 330        | 410                              | 490                            | ps   |
| $t_{SKEW}$               | Duty Cycle Skew (Note 10)<br>Within -Device Skew (Note 11)<br>Device to Device Skew (Note 12)  |            | 8<br>10<br>20                    | 45<br>35<br>100                |            | 8<br>10<br>20                    | 45<br>35<br>100                |            | 8<br>10<br>20                    | 45<br>35<br>100                | ps   |
| $t_{JITTER}$             | RMS Random Clock Jitter (Note 13) $f_{in} = 1.0\text{ GHz}$<br>Deterministic Jitter (Note 14) $f_{DATA} = 622\text{ Mb/s}$<br>$f_{DATA} = 1.5\text{ Gb/s}$<br>$f_{DATA} = 2.488\text{ Gb/s}$<br>Crosstalk Induced Jitter (Note 15) |            | 0.5<br>0.5<br>6<br>7<br>10<br>20 | 1<br>1<br>15<br>20<br>25<br>40 |            | 0.5<br>0.5<br>6<br>7<br>10<br>20 | 1<br>1<br>15<br>20<br>25<br>40 |            | 0.5<br>0.5<br>6<br>7<br>10<br>20 | 1<br>1<br>15<br>20<br>25<br>40 | ps   |
| $V_{INPP}$               | Input Voltage Swing/Sensitivity (Differential Configuration) (Note 16)   | 100        |                                  | $V_{CC}-GND$                   | 100        |                                  | $V_{CC}-GND$                   | 100        |                                  | $V_{CC}-GND$                   | mV   |
| $t_r$<br>$t_f$           | Output Rise/Fall Times @ 250 MHz (20% - 80%) $Q, \bar{Q}$  | 50         | 110                              | 180                            | 50         | 110                              | 180                            | 50         | 110                              | 180                            | ps   |

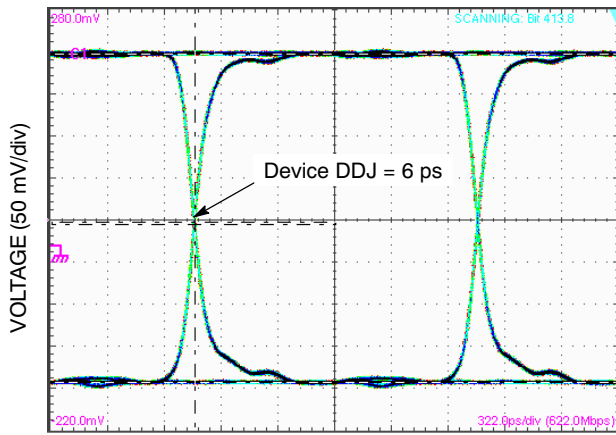
NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

9. Measured by forcing  $V_{INPPMIN}$  with 50% duty cycle clock source and  $V_{CC} - 1400\text{ mV}$  offset. All loading with an external  $R_L = 100\ \Omega$  across "D" and "D" of the receiver. Input edge rates 150 ps (20%-80%).
10. See Figure 7 differential measurement of  $t_{skew} = |t_{PLH} - t_{PHL}|$  for a nominal 50% differential clock input waveform @ 250 MHz.
11. The worst case condition between  $Q0/\bar{Q}0$  and  $Q1/\bar{Q}1$  from either  $D0/\bar{D}0$  or  $D1/\bar{D}1$ , when both outputs have the same transition.
12. Skew is measured between two outputs under identical transition @ 250 MHz.
13. RMS jitter with 50% Duty Cycle clock signal.
14. Deterministic jitter with input NRZ data at PRBS  $2^{23}-1$  and K2 = 5.
15. Crosstalk Induced Jitter is the additive Deterministic jitter to channel one with channel two active both running at 622 Gb/s PRBS  $2^{23}-1$  as an asynchronous signals.
16. Input voltage swing is a single-ended measurement operating in differential mode.

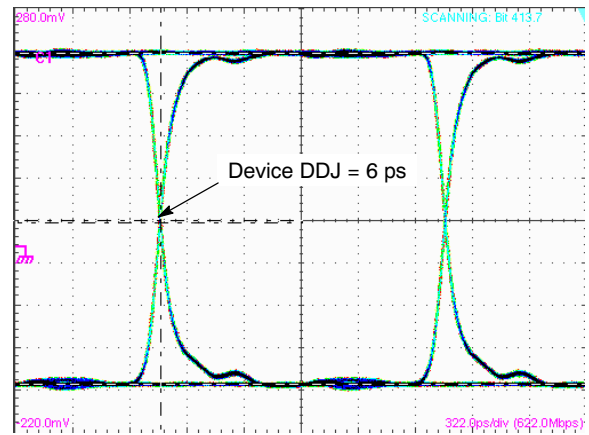


**Figure 3. Output Voltage Amplitude ( $V_{OUTPP}$ ) versus Input Clock Frequency ( $f_{in}$ ) and Temperature (@  $V_{CC} = 3.3\text{ V}$ )**

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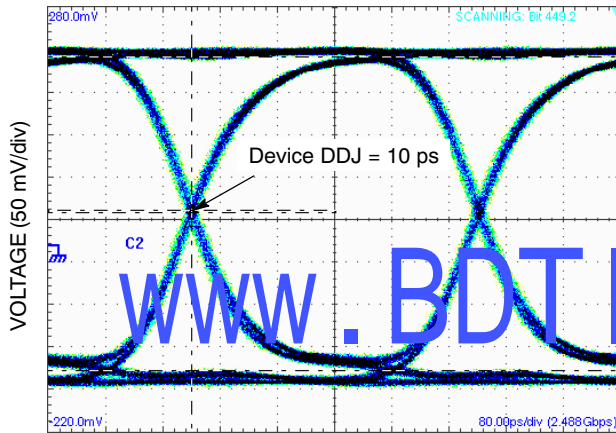


TIME (322 ps/div)

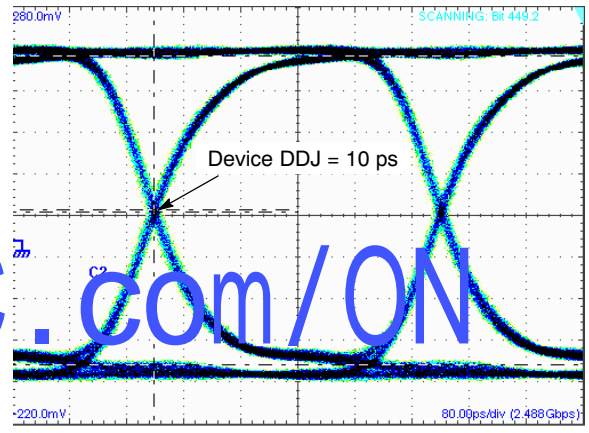


TIME (322 ps/div)

**Figure 4. Typical Output Waveform at 1.5 Gb/s with  $2^{23}-1$  ( $V_{INPP} = 100$  mV (left) &  $V_{INPP} = 400$  mV (right), Input Signal DDJ = 24 ps)**

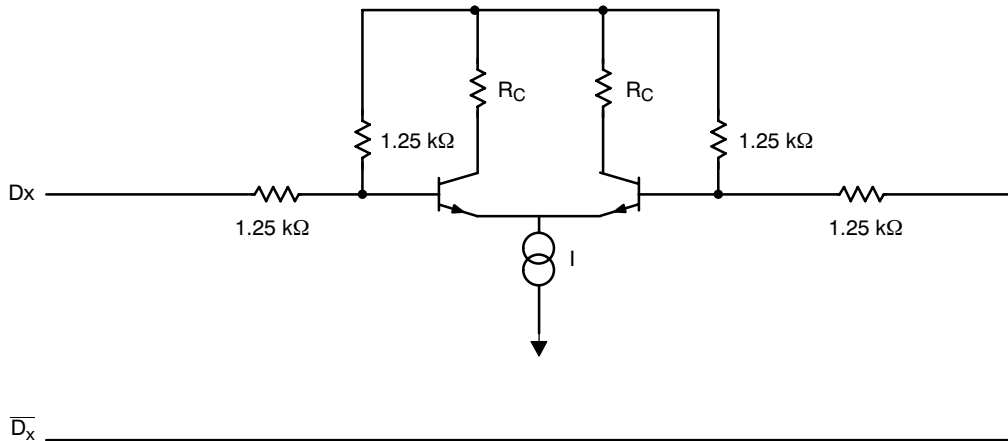


TIME (80 ps/div)



TIME (80 ps/div)

**Figure 5. Typical Output Waveform at 2.488 Gb/s with  $2^{23}-1$  ( $V_{INPP} = 100$  mV (left) &  $V_{INPP} = 400$  mV (right), Input Signal DDJ = 30 ps)**



**Figure 6. Input Structure**

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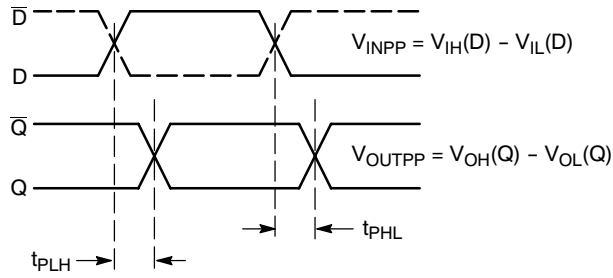


Figure 7. AC Reference Measurement

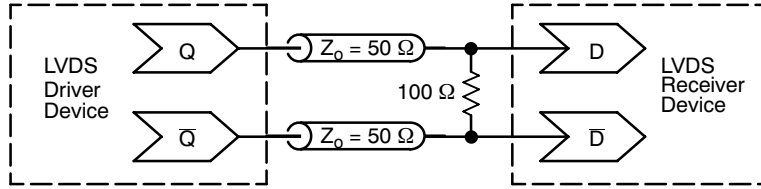
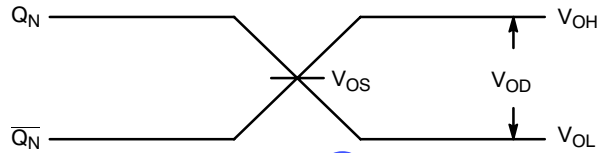


Figure 8. Typical LVDS Termination for Output Driver and Device Evaluation



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Figure 9. LVDS Output

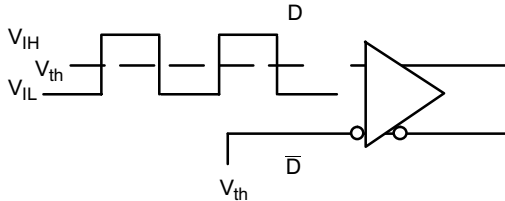


Figure 10. Differential Input Driven Single-Ended

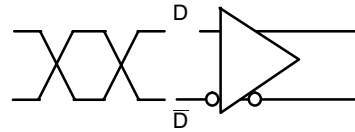


Figure 11. Differential Inputs Driven Differentially

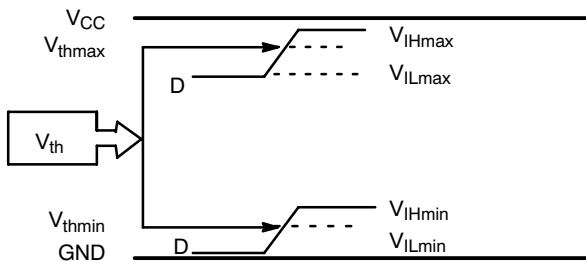


Figure 12.  $V_{th}$  Diagram

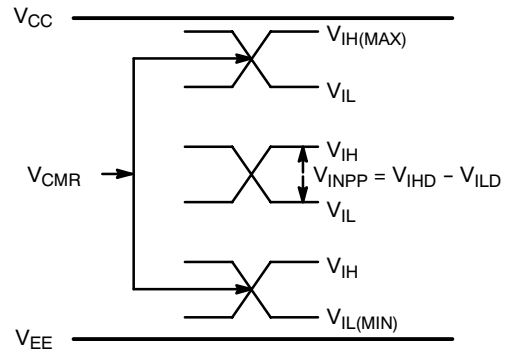


Figure 13.  $V_{CMR}$  Diagram

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## ORDERING INFORMATION

| Device       | Package               | Shipping†          |
|--------------|-----------------------|--------------------|
| NB4N855SMR4  | Micro-10              | 1000 / Tape & Reel |
| NB4N855SMR4G | Micro-10<br>(Pb-Free) | 1000 / 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

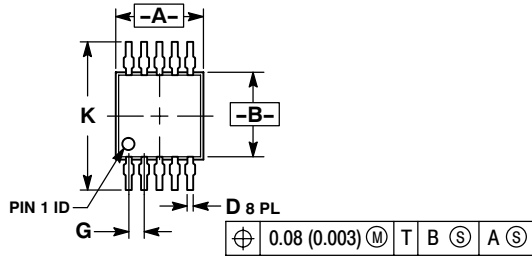
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## PACKAGE DIMENSIONS

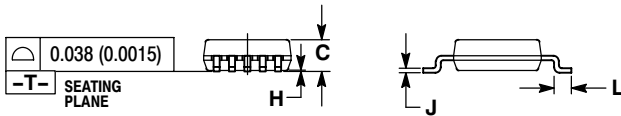
Micro-10  
CASE 846B-03  
ISSUE D



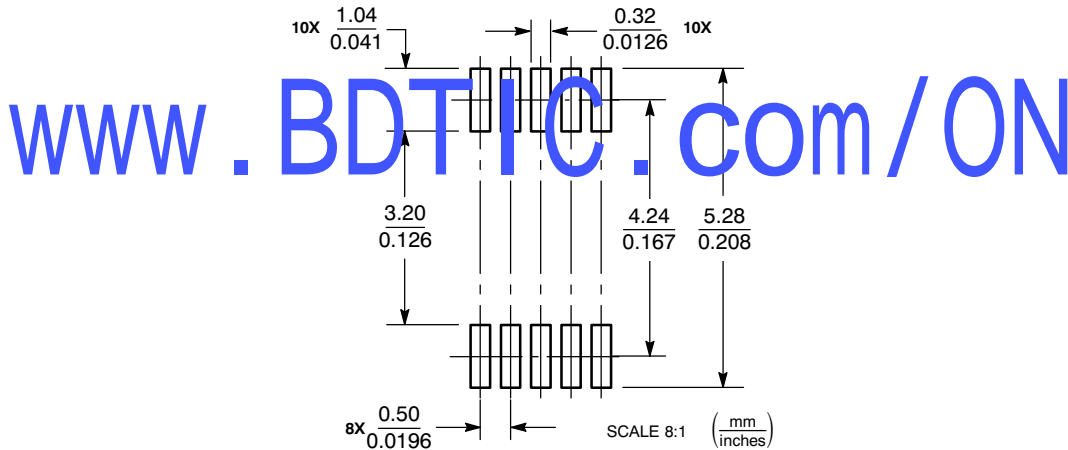
**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION "A" DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION "B" DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. 846B-01 OBSOLETE. NEW STANDARD 846B-02

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 2.90        | 3.10 | 0.114     | 0.122 |
| B   | 2.90        | 3.10 | 0.114     | 0.122 |
| C   | 0.95        | 1.10 | 0.037     | 0.043 |
| D   | 0.20        | 0.30 | 0.008     | 0.012 |
| G   | 0.50 BSC    |      | 0.020 BSC |       |
| H   | 0.05        | 0.15 | 0.002     | 0.006 |
| J   | 0.10        | 0.21 | 0.004     | 0.008 |
| K   | 4.75        | 5.05 | 0.187     | 0.199 |
| L   | 0.40        | 0.70 | 0.016     | 0.028 |



### 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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