

# NB3L853141

## 2.5V/3.3V 1:5 LVPECL Fanout Buffer

### Description

The NB3L853141 is a low skew 1:5 LVPECL Clock fanout buffer designed explicitly for low output skew applications.

The NB3L853141 features a multiplexed input which can be driven by either a differential or single-ended input to allow for the distribution of a lower speed clock along with the high speed system clock.

The SEL pin will select the differential clock inputs, CLK0 & CLK0, when LOW (or left open and pulled LOW by the internal pull-down resistor). When SEL is HIGH, the single-ended CLK1 input is selected.

The common enable ( $\overline{EN}$ ) is synchronous so that the outputs will only be enabled/disabled when they are already in the LOW state. This avoids any chance of generating a runt clock pulse when the device is enabled/disabled as can happen with an asynchronous control. The internal flip flop is clocked on the falling edge of the input clock, therefore, all associated specification limits are referenced to the negative edge of the clock input.

### Features

- 700 MHz Maximum Clock Output Frequency
- CLK0 and  $\overline{CLK0}$  can Accept Differential LVPECL, LVDS, HCSL, LVHSTL, SSTL, LVCMOS
- CLK1 can Accept LVCMOS and LVTTTL
- Five Differential LVPECL Clock Outputs
- 1.5 ns Maximum Propagation Delay
- Operating Range:  $V_{CC} = 2.375\text{ V to }3.8\text{ V}$
- LVCMOS Compatible Control Inputs
- Selectable Differential or LVCMOS Clock Inputs
- Synchronous Clock Enable
- 30 ps Max. Skew Between Outputs
- $-40^{\circ}\text{C to }+85^{\circ}\text{C}$  Ambient Operating Temperature Range
- TSSOP-20 Package
- These are Pb-Free Devices

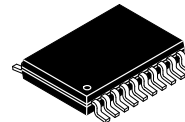
### Applications

- Computing and Telecom
- Routers, Servers and Switches
- Backplanes



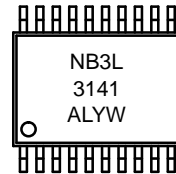
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TSSOP-20  
DT SUFFIX  
CASE 948E

### MARKING DIAGRAM



A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G = Pb-Free Package

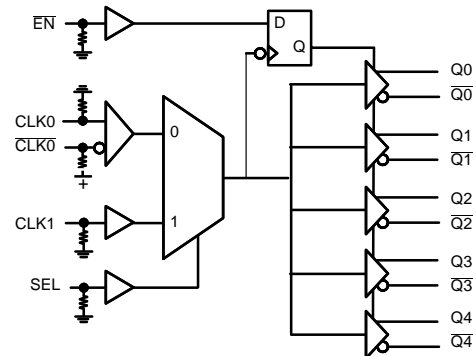
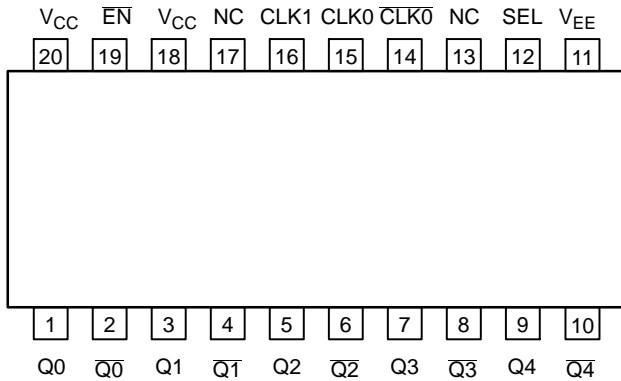


Figure 1. Simplified Logic Diagram of NB3L853141

### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

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Note: All V<sub>CC</sub> and V<sub>EE</sub> pins must be externally connected to Power Supply to guarantee proper operation.

**Figure 1. Pinout (Top View) and Logic Diagram**

**Table 1. FUNCTION TABLE**

| CLK0 | CLK1 | SEL | EN | Q  |
|------|------|-----|----|----|
| L    | X    | L   | L  | L  |
| H    | X    | L   | L  | H  |
| X    | L    | H   | L  | L  |
| X    | H    | H   | L  | H  |
| X    | X    | X   | H  | L* |

\*On next negative transition of CLK0 or CLK1  
X = Don't Care

**Table 2. PIN DESCRIPTION**

| Pin Number | Name | I/O                    | Open Default | Description  |
|------------|------|------------------------|--------------|--|
| 1          | Q0   | LVPECL Output          |              | Non-Inverted Differential Clock Output   |
| 2          | Q0   | LVPECL Output          |              | Inverted Differential Clock Output   |
| 3          | Q1   | LVPECL Output          |              | Non-Inverted Differential Clock Output   |
| 4          | Q1   | LVPECL Output          |              | Inverted Differential Clock Output   |
| 5          | Q2   | LVPECL Output          |              | Non-Inverted Differential Clock Output   |
| 6          | Q2   | LVPECL Output          |              | Inverted Differential Clock Output   |
| 7          | Q3   | LVPECL Output          |              | Non-Inverted Differential Clock Output   |
| 8          | Q3   | LVPECL Output          |              | Inverted Differential Clock Output   |
| 9          | Q4   | LVPECL Output          |              | Non-Inverted Differential Clock Output   |
| 10         | Q4   | LVPECL Output          |              | Inverted Differential Clock Output   |
| 11         | VEE  | Power                  |              | Negative Supply Voltage  |
| 12         | SEL  | LVC MOS / LV TTL Input | Low          | Clock Select Input. When HIGH, selects CLK1 input. When LOW, selects CLK0, CLK0 inputs. Internal Pull-down Resistor.             |
| 13         | NC   |                        |              | No Connect   |
| 14         | CLK0 | Multi-Level Input      | High         | Inverted Differential Clock Input. Internal Pull-up Resistor.  |
| 15         | CLK0 | Multi-Level Input      | Low          | Non-Inverted Differential Clock Input. Internal Pull-down Resistor.  |
| 16         | CLK1 | LVC MOS / LV TTL Input | Low          | Single-ended Clock Input. Internal Pull-down Resistor.   |
| 17         | NC   |                        |              | No Connect   |
| 18         | VCC  | Power                  |              | Positive Supply Voltage  |
| 19         | EN   | LVC MOS / LV TTL Input | Low          | Synchronous Clock Enable Input. When Low, outputs are enabled. When High, outputs are disabled Low. Internal Pull-down Resistor. |
| 20         | VCC  | Power                  |              | Positive Supply Voltage  |

All VCC and VEE pins must be externally connected to a power supply to guarantee proper operation. Bypass each supply pin with 0.01 μF to GND.

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**Table 3. ATTRIBUTES** (Note 1)

| Characteristics  |                                   | Value                     |
|--|-----------------------------------|---------------------------|
| ESD Protection   | Human Body Model<br>Machine Model | > 2 kV<br>> 200 V         |
| $R_{PU}$ – Pull-up Resistor                            |                                   | 50 k $\Omega$             |
| $R_{PD}$ – Pull-down Resistor                          |                                   | 50 k $\Omega$             |
| Moisture Sensitivity (Note 1)                          | TSSOP–20                          | Level 1                   |
| Flammability Rating                                    | Oxygen Index: 28 to 34            | UL*94 code V*0 @ 0.125 in |
| Transistor Count                                       |                                   | 300                       |
| Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test |                                   |                           |

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

**Table 4. MAXIMUM RATINGS**

| Symbol        | Parameter                                | Condition 1                          | Condition 2          | Rating                 | Unit                        |
|---------------|--|--------------------------------------|----------------------|------------------------|-----------------------------|
| $V_{CC}$      | LVPECL Mode Power Supply                 | $V_{EE} = 0\text{ V}$                |                      | 4.6                    | V                           |
| $V_I$         | LVPECL Mode Input Voltage                | $V_{EE} = 0\text{ V}$                | $V_I \leq V_{CC}$    | -0.5 to $V_{CC} + 0.5$ | V                           |
| $I_{out}$     | Output Current                           | Continuous<br>Surge                  |                      | 50<br>100              | mA<br>mA                    |
| $T_A$         | Operating Temperature Range              |                                      |                      | -40 to +85             | $^{\circ}\text{C}$          |
| $T_{stg}$     | Storage Temperature Range                |                                      |                      | -65 to +150            | $^{\circ}\text{C}$          |
| $\theta_{JA}$ | Thermal Resistance (Junction-to-Ambient) | 0 lfpm<br>500 lfpm                   | TSSOP–20<br>TSSOP–20 | 140<br>50              | $^{\circ}\text{C}/\text{W}$ |
| $\theta_{JC}$ | Thermal Resistance (Junction-to-Case)    | Standard Board                       | TSSOP–20             | 23 to 41               | $^{\circ}\text{C}/\text{W}$ |
| $T_{sol}$     | Wave Solder                              | <2 to 3 sec @ 260 $^{\circ}\text{C}$ |                      | 265                    | $^{\circ}\text{C}$          |

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.

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**Table 5. DC CHARACTERISTICS**  $V_{CC} = 2.375\text{ V to }3.8\text{ V}$ ;  $V_{EE} = 0\text{ V}$  (Note 2);  $T_A = -40^\circ\text{C to }+85^\circ\text{C}$

| Symbol  | Characteristic   | Min          | Typ | Max                          | Unit          |
|---|--|--------------|-----|------------------------------|---------------|
| <b>POWER SUPPLY</b>   |  |              |     |                              |               |
| $V_{CC}$  | Power Supply Voltage   | 2.375        |     | 3.8                          | V             |
| $I_{EE}$  | Power Supply Current (Outputs Open)  |              | 40  | 55                           | mA            |
| <b>LVPECL OUTPUTS</b> (Note 3)  |  |              |     |                              |               |
| $V_{OH}$  | Output HIGH Voltage  | $V_{CC}-1.4$ |     | $V_{CC}-0.9$                 | V             |
| $V_{OL}$  | Output LOW Voltage   | $V_{CC}-2.0$ |     | $V_{CC}-1.7$                 | V             |
| $V_{SWING}$   | Output Voltage Swing, Peak-to-Peak   | 0.6          |     | 1.0                          | V             |
| <b>DIFFERENTIAL INPUTS DRIVEN SINGLE-ENDED</b> (Note 4) (Figures 3 and 4)       |  |              |     |                              |               |
| $V_{IH}$  | Single-ended Input HIGH Voltage  | 0.5          |     | $V_{CC}+0.3$                 | V             |
| $V_{IL}$  | Single-ended Input LOW Voltage   | -0.3         |     | $V_{CC}-1.0$                 | V             |
| $V_{th}$  | Input Threshold Reference Voltage Range (Note 5)   | 0.35         |     | $V_{CC}-0.85$                | V             |
| $V_{ISE}$   | Single-ended Input Voltage ( $V_{IH} - V_{IL}$ )   | 0.3          |     | $V_{CC}$                     | V             |
| <b>DIFFERENTIAL INPUTS DRIVEN DIFFERENTIALLY</b> (see Figures 5 and 6) (Note 6) |  |              |     |                              |               |
| $V_{IHD}$   | Differential Input HIGH Voltage  | 0.5          |     | $V_{CC}-0.85$                | mV            |
| $V_{ILD}$   | Differential Input LOW Voltage   | 0            |     | $V_{IHD}-150$                | mV            |
| $V_{ID}$  | Differential Input Voltage ( $V_{IHD} - V_{ILD}$ )                                       | 0.15         |     | 1.3                          | V             |
| $V_{CMR}$   | Common Mode Input Voltage; (Note 7)  | 0.5          |     | $V_{CC}-0.85$                |               |
| $I_{IH}$  | Input HIGH Current<br>$V_{CC} = V_{IN} = 3.8\text{ V}$ CLK0<br>CLK0                      |              |     | 150<br>5                     | $\mu\text{A}$ |
| $I_{IL}$  | Input LOW Current<br>$V_{CC} = 3.8\text{ V}$ , $V_{IN} = 0\text{ V}$ CLK0<br>CLK0        | -5<br>-150   |     |                              | $\mu\text{A}$ |
| <b>SINGLE-ENDED INPUTS (SEL, <math>\overline{\text{EN}}</math>, CLK1)</b>       |  |              |     |                              |               |
| $V_{IH}$  | Input HIGH Voltage<br>SEL, $\overline{\text{EN}}$<br>CLK1                                | 2.0<br>2.0   |     | $V_{CC}+0.3$<br>$V_{CC}+0.3$ | V             |
| $V_{IL}$  | Input LOW Voltage<br>SEL, $\overline{\text{EN}}$<br>CLK1                                 | -0.3<br>-0.3 |     | 0.8<br>$V_{CC}\times 0.35$   | V             |
| $I_{IH}$  | Input HIGH Current $V_{CC} = V_{IN} = 3.8\text{ V}$<br>CLK1, SEL, $\overline{\text{EN}}$ |              |     | 150                          | $\mu\text{A}$ |
| $I_{IL}$  | CLK1, SEL, $\overline{\text{EN}}$<br>CLK1, SEL, $\overline{\text{EN}}$                   | -5           |     |                              | $\mu\text{A}$ |

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 lfpm.

2. Input and Output parameters vary 1:1 with  $V_{CC}$ .
3. LVPECL outputs loaded with  $50\ \Omega$  to  $V_{CC} - 2\text{ V}$  for proper operation.
4.  $V_{th}$ ,  $V_{IH}$ ,  $V_{IL}$ , and  $V_{ISE}$  parameters must be complied with simultaneously.
5.  $V_{th}$  is applied to the complementary input when operating in single-ended mode.
6.  $V_{IHD}$ ,  $V_{ILD}$ ,  $V_{ID}$  and  $V_{CMR}$  parameters must be complied with simultaneously.
7. The common mode voltage is defined as  $V_{IH}$ .

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**Table 6. AC CHARACTERISTICS**,  $V_{CC} = 2.375\text{ V to }3.8\text{ V}$ ,  $T_A = -40^\circ\text{C to }+85^\circ\text{C}$  (Note 8)

| Symbol                   | Characteristic  | Min   | Typ   | Max        | Unit       |    |
|--------------------------|---|---|---|------------|------------|----|
| $f_{MAX}$                | Maximum Input Clock Frequency: $V_{OUTpp} \geq 400\text{ mV}$ CLK0/ $\overline{\text{CLK0}}$ , $V_{INPPmin} \geq 250\text{ mV}$ CLK1  | 700<br>300  |   |            | MHz        |    |
| $\Phi_N$                 | Phase Noise, $f_C = 155.52\text{ MHz}$<br>10 Hz<br>100 Hz<br>1 kHz<br>10 kHz<br>100 kHz<br>1 MHz<br>10 MHz<br>20 MHz  |   | Offset from Carrier<br>-100.5<br>-128.2<br>-138.6<br>-147.1<br>-149.7<br>-154.2<br>-154.2<br>-154.2 |            | dBc/<br>Hz |    |
| $t_{PLH}$ ,<br>$t_{PHL}$ | Propagation Delay to Differential Outputs, @ 50 MHz Note 9<br>Note 10   | CLK0/ $\overline{\text{CLK0}}$ to Q/ $\overline{\text{Q}}$<br>CLK1 to Q | 0.8<br>0.8  | 1.0<br>1.0 | 1.5<br>1.5 | ns |
| $t_{j\Phi N}$            | Additive Phase Jitter, RMS; $f_C = 155.52\text{ MHz}$ ,<br>Integration Range: 12 kHz – 20 MHz   |   | 0.05  |            | ps         |    |
| $t_{sk(o)}$              | Output-to-output skew; (Note 11)  |   |   | 30         | ps         |    |
| $t_{sk(pp)}$             | Part-to-Part Skew; (Note 12)  |   |   | 150        | ps         |    |
| $V_{INpp}$               | Input Voltage Swing/Sensitivity (Differential Configuration) (Note 14)  | 150   |   | 1300       | mV         |    |
| $t_r/t_f$                | Output rise and fall times, 20% to 80%, Q, $\overline{\text{Q}}$  | 200   |   | 700        | ps         |    |
| ODC                      | Output Clock Duty Cycle CLK0/ $\overline{\text{CLK0}}$ , $f \leq 700\text{ MHz}$ , $V_{INPPmin} \geq 250\text{ mV}$<br>Input Duty Cycle = 50% CLK1, $f \leq 250\text{ MHz}$ | 45<br>45  |   | 55<br>55   | %          |    |

All parameters measured at  $f_{MAX}$  unless noted otherwise.

The cycle-to-cycle jitter on the input will equal the jitter on the output. The part does not add jitter

8. Measured using a  $V_{INPPmin}$  source, Reference Duty Cycle = 50% duty cycle clock source. All output loading with external  $50\ \Omega$  to  $V_{CC} - 2\text{ V}$ .

9. Measured from the differential input crossing point to the differential output crossing point.

10. Measured from  $V_{CC}/2$  input crossing point to the differential output crossing point.

11. Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at the output differential cross points.

12. Defined as skew between outputs on different devices operating at the same supply voltages and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at the differential cross points.

13. Output voltage swing is a single-ended measurement operating in differential mode.

14. Input voltage swing is a single-ended measurement operating in differential mode.

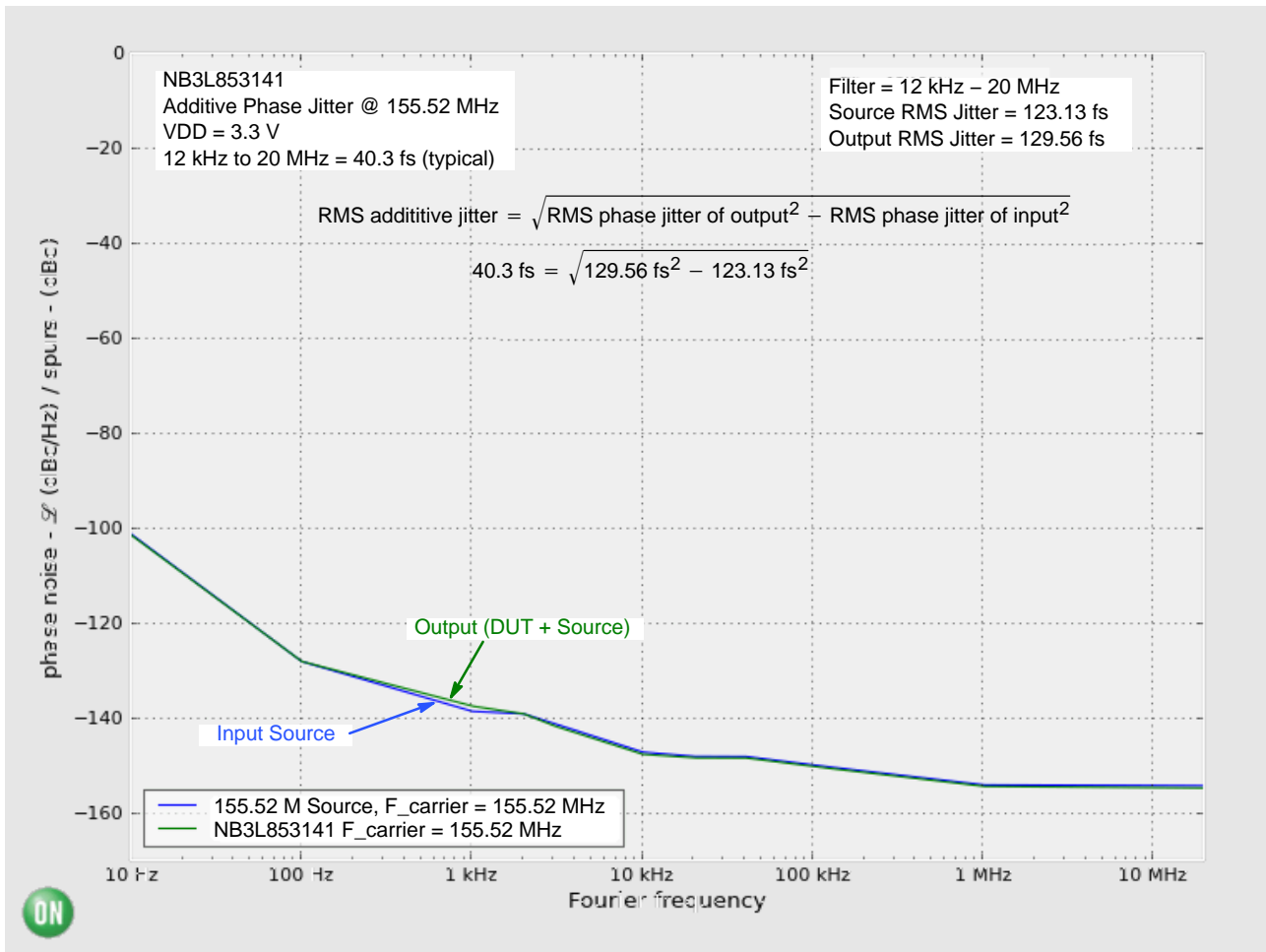


Figure 2. Typical Phase Noise Plot at  $f_{\text{carrier}} = 155.52 \text{ MHz}$  at an Operating Voltage of 3.3 V, Room Temperature

The above phase noise data was captured using Agilent E5052A/B. The data displays the input phase noise and output phase noise used to calculate the additive phase jitter at a specified integration range. The RMS Phase Jitter contributed by the device (integrated between 12 kHz and 20 MHz) is 40.3 fs.

The additive phase jitter performance of the fanout buffer is highly dependent on the phase noise of the input source.

To obtain the most accurate additive phase noise measurement, it is vital that the source phase noise be

notably lower than that of the DUT. If the phase noise of the source is greater than the device under test output, the source noise will dominate the additive phase jitter calculation and lead to an artificially low result for the additive phase noise measurement within the integration range. The Figure above is a good example of the NB3L853141 source generator phase noise having a significantly higher floor such that the DUT output results in an additive phase jitter of 40.3 fs.

$$\text{RMS additive jitter} = \sqrt{\text{RMS phase jitter of output}^2 - \text{RMS phase jitter of input}^2}$$

$$40.3 \text{ fs} = \sqrt{129.56 \text{ fs}^2 - 123.13 \text{ fs}^2}$$

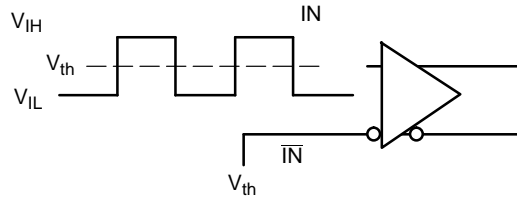


Figure 3. Differential Input Driven Single-Ended

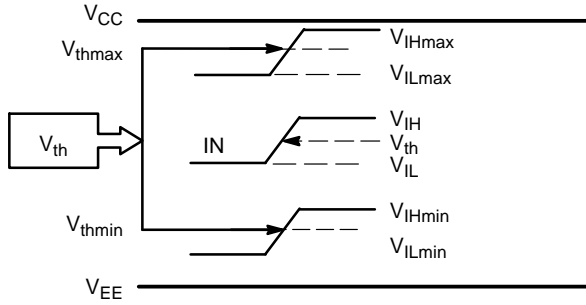


Figure 4.  $V_{th}$  Diagram

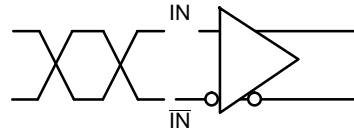


Figure 5. Differential Inputs Driven Differentially

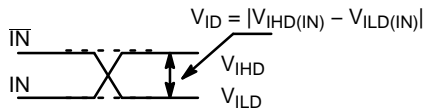


Figure 6. Differential Inputs Driven Differentially

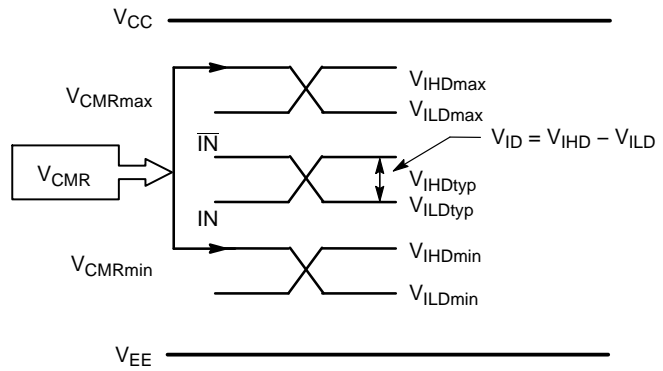


Figure 7. VCMR Diagram

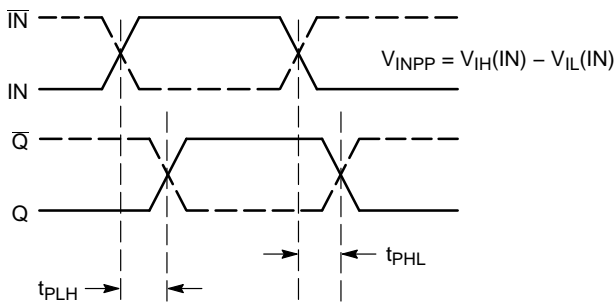


Figure 8. AC Reference Measurement

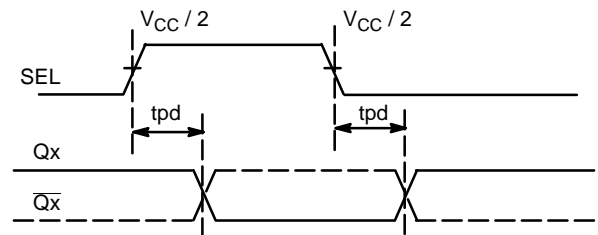
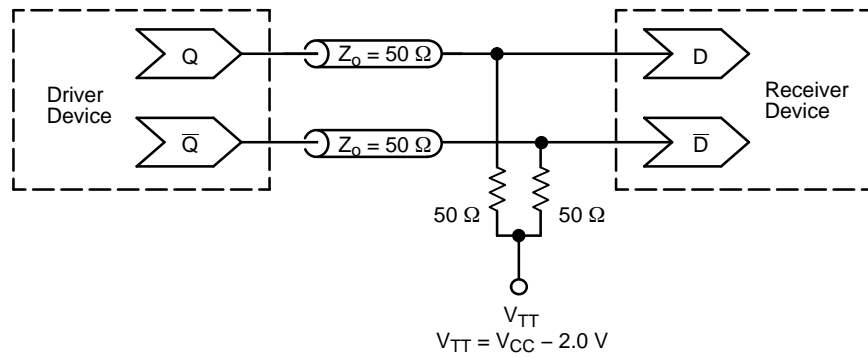


Figure 9. SEL to Qx Timing Diagram

## NB3L853141



**Figure 10. Typical Termination for Output Driver and Device Evaluation  
(See Application Note AND8020/D – Termination of ECL Logic Devices.)**

### ORDERING INFORMATION

| Device          | Package               | Shipping <sup>†</sup> |
|-----------------|-----------------------|-----------------------|
| NB3L853141DTG   | TSSOP-20<br>(Pb-Free) | 75 Units / Rail       |
| NB3L853141DTR2G | TSSOP-20<br>(Pb-Free) | 2500 / Tape & Reel    |

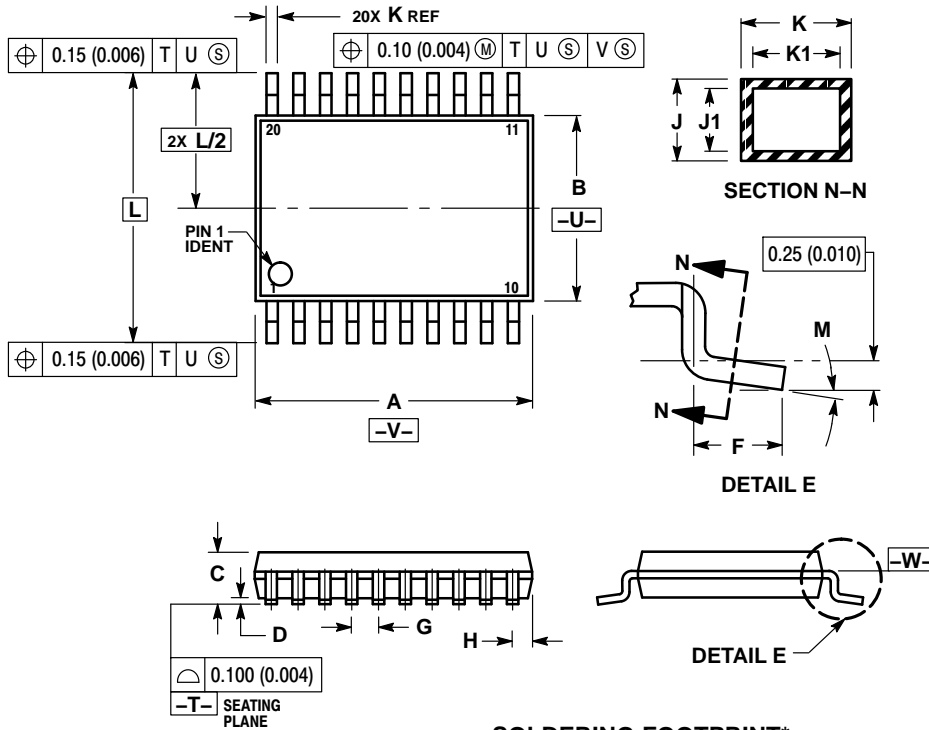
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



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## PACKAGE DIMENSIONS

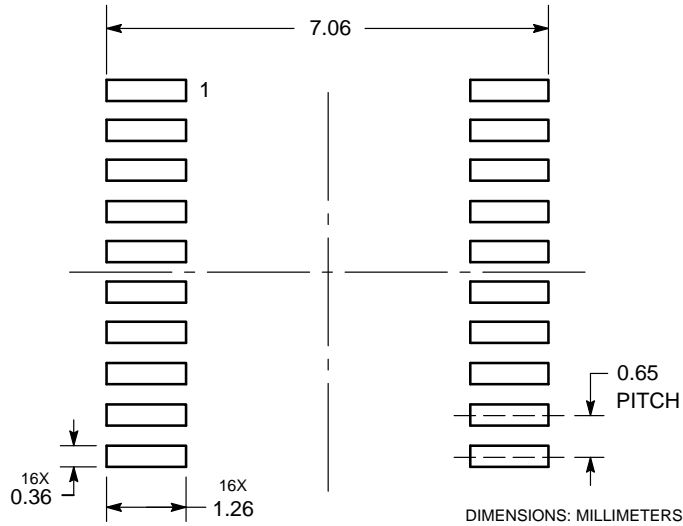
TSSOP-20  
CASE 948E-02  
ISSUE C




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 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. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

### 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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