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NB3L8543S

2.5 V/3.3 V Differential 2:1 MUX to 4 LVDS Clock Fanout Buffer Outputs with Clock Enable and Clock Select

Description

The NB3L8543S is a high performance, low skew 1-to-4 LVDS Clock Fanout Buffer.

The NB3L8543S 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 CLK_SEL pin will select the differential CLK and $\overline{\text{CLK}}$ inputs when LOW (or left open and pulled LOW by the internal pull-down resistor). When CLK_SEL is HIGH, the differential PCLK and $\overline{\text{PCLK}}$ inputs are selected.

The common clock enable pin, CLK_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 on the outputs during asynchronous assertion/deassertion of the clock enable pin. 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.

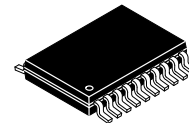
Features

- Four Differential LVDS Output Pairs
- Two Selectable Differential Clock Inputs
- CLK/ $\overline{\text{CLK}}$ Can Accept LVPECL, LVDS, HCSL, SSTL and HSTL
- PCLK/ $\overline{\text{PCLK}}$ Can Accept LVPECL, LVDS, CML and SSTL
- Maximum Output Frequency: 650 MHz
- Additive Phase Jitter, RMS: 50 fs (typical)
- Output Skew: 40 ps (maximum)
- Part-to-part Skew: 200 ps (maximum)
- Propagation Delay: 1.9 ns (maximum)
- Operating Range: $V_{\text{DD}} = 2.5 \text{ V} \pm 5\%$ or $3.3 \text{ V} \pm 10\%$
- -40°C to $+85^{\circ}\text{C}$ Ambient Operating Temperature Range
- TSSOP-20 Package
- These are Pb-Free Devices



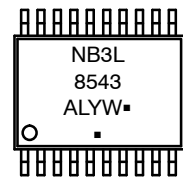
ON Semiconductor®

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TSSOP-20
DT SUFFIX
CASE 948E

MARKING DIAGRAM



A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb-Free Package

(Note: Microdot may be in either location)

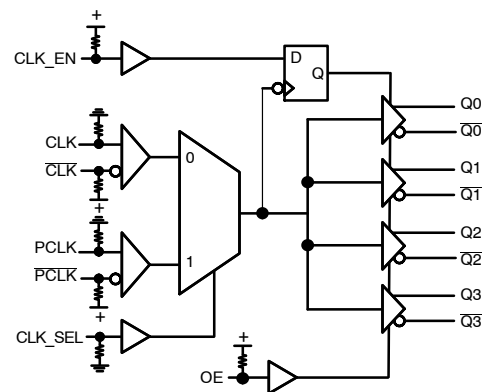


Figure 1. Simplified Logic Diagram

ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

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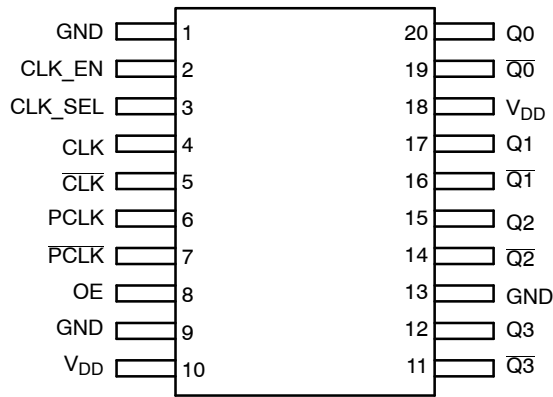


Figure 2. Pinout Diagram (Top View)

Table 1. PIN DESCRIPTION

| Number | Name | I/O | Open Default | Description |
|----------------|---------|--------|--------------|--|
| 1, 9, 13 | GND | Power | | Negative (Ground) Power Supply pins must be externally connected to power supply to guarantee proper operation. |
| 2 | CLK_EN | NC | Pullup | Synchronized Clock Enable when HIGH. When LOW, outputs are disabled (Qx HIGH, Q \bar{x} LOW). See Figure 3. |
| 3 | CLK_SEL | NC | Pulldown | Clock Input Select (HIGH selects PCLK/PCLK, LOW selects CLK/CLK input) |
| 4 | CLK | Input | Pulldown | True Standard Clock Input. Float open when unused. |
| 5 | CLK | Input | Pullup | Invert Standard Clock Inputs. Float open when unused. |
| 6 | PCLK | Input | Pulldown | True Peripheral Clock Input. Float open when unused. |
| 7 | PCLK | Input | Pullup | Invert Peripheral Clock Inputs. Float open when unused. |
| 8 | OE | NC | Pullup | Output Enable Control. When HIGH, the outputs are active and enabled. When LOW, the outputs are high impedance disabled. |
| 10, 18 | VDD | Power | | Positive Power Supply pin must be externally connected to power supply to guarantee proper operation. |
| 11, 14, 16, 19 | Q[3:0] | Output | | Invert LVDS Outputs |
| 12, 15, 17, 20 | Q[3:0] | Output | | True LVDS Outputs |

Table 2. FUNCTIONS

| OE | Inputs | | | Outputs | | |
|----|--------|---------|---------------------|-----------------|------|-----------------|
| | CLK_EN | CLK_SEL | Input Function | Output Function | Qx | \overline{Qx} |
| 0 | X | X | | | HI-Z | HI-Z |
| 1 | 0 | 0 | CLK input selected | Disabled | LOW | HIGH |
| 1 | 0 | 1 | PCLK Input Selected | Disabled | LOW | HIGH |
| 1 | 1 | 0 | CLK input selected | Enabled | CLK | Invert of CLK |
| 1 | 1 | 1 | PCLK Input Selected | Enabled | PCLK | Invert of PCLK |

1. After CLK_EN switches, the clock outputs are disabled or enabled following a rising and falling input clock edge as show in Figure 3.

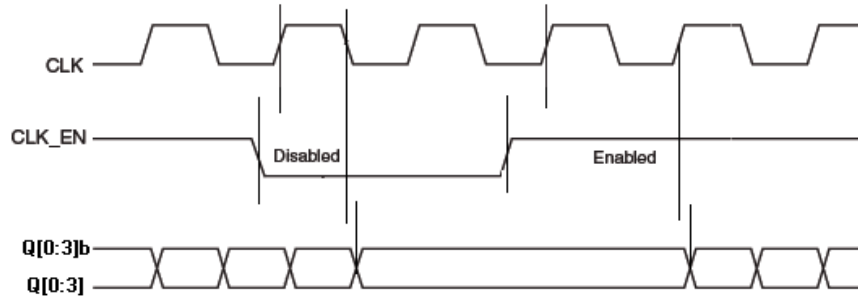


Figure 3. CLK_EN TIMING DIAGRAM

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Table 3. ATTRIBUTES (Note 2)

| Characteristics | Value |
|---|-----------------------------------|
| Internal Input Pullup Resistor | 50 kΩ |
| Internal Input Pulldown Resistor | 50 kΩ |
| ESD Protection | Human Body Model Machine Model |
| | > 2 kV > 200 V |
| Moisture Sensitivity, Indefinite Time Out of Drypack (Note 2) | Level 1 |
| Flammability Rating Oxygen Index | UL 94 V-0 @ 0.125 in 28 to 34 |
| Transistor Count | 430 |
| Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test | |

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

Table 4. MAXIMUM RATINGS (Note 3)

| Symbol | Parameter | Condition 1 | Condition 2 | Rating | Unit |
|---------------|--|---------------------|-------------|-----------------------------------|--------------|
| V_{DD} | Supply Voltage | | | 4.6 | V |
| V_{in} | Input Voltage | | | $-0.5 \leq V_I \leq V_{DD} + 0.5$ | V |
| C_{in} | Input Capacitance | | | 4 | pF |
| I_D | Output Current | Continuous Surge | | 10 15 | mA |
| T_A | Operating Temperature Range, Industrial | | | -40 to \leq +85 | °C |
| T_{stg} | Storage Temperature Range | | | -65 to +150 | °C |
| θ_{JA} | Thermal Resistance (Junction-to-Ambient) | 0 lfpm 500 lfpm | TSSOP-20 | 140 50 | °C/W °C/W |
| θ_{JC} | Thermal Resistance (Junction-to-Case) | (Note 4) | TSSOP-20 | 23 to 41 | °C/W |
| T_{sol} | Wave Solder | | | 265 | °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.

3. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and not valid simultaneously.

If stress limits are exceeded device functional operation is not implied, damage may occur and reliability may be affected.

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

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Table 5. DC CHARACTERISTICS $V_{DD} = 2.5\text{ V} \pm 5\%$ or $3.3\text{ V} \pm 10\%$, $GND = 0\text{ V}$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ (Note 5)

| Symbol | Characteristic | Min | Typ | Max | Unit | |
|---------------------|----------------------|--|---------------|------------|---------------|----|
| POWER SUPPLY | | | | | | |
| V_{DD} | Power Supply Voltage | $V_{DD} = 3.3\text{ V}$ $V_{DD} = 2.5\text{ V}$ | 2.97 2.375 | 3.3 2.5 | 3.63 2.625 | V |
| I_{DD} | Power Supply Current | | | | 50 | mA |

LVCMOS/LVTTL INPUTS (CLK_EN, CLK_SEL, OE)

| | | | | | | |
|----------|--|--|------------|--|----------------|---------------|
| V_{IH} | Input HIGH Voltage | $V_{DD} = 3.3\text{ V}$ $V_{DD} = 2.5\text{ V}$ | 2 1.7 | | $V_{DD} + 0.3$ | V |
| V_{IL} | Input LOW Voltage | $V_{DD} = 3.3\text{ V}$ $V_{DD} = 2.5\text{ V}$ | | | 0.8 0.7 | V |
| I_{IH} | Input High Current ($V_{DD} = V_{IN} = 3.63\text{ V}$) | CLK_EN, OE CLK_SEL | | | 5 150 | μA |
| I_{IL} | Input LOW Current ($V_{DD} = 3.63\text{ V}$, $V_{IN} = 0\text{ V}$) | CLK_EN, OE CLK_SEL | -150 -5 | | | μA |

DIFFERENTIAL INPUTS (see Figures 5 and 6) (Note 8)

| | | | | | | |
|-------------|--|---|--------------|--|-------------------------------|---------------|
| V_{IHD} | Differential Input HIGH Voltage | CLK PCLK | 0.5 1.5 | | $V_{DD} - 0.85$ V_{DD} | V |
| V_{ILD} | Differential Input LOW Voltage | CLK PCLK | 0 0.5 | | $V_{IHD} - 0.15$ V_{IHD} | V |
| V_{ID} | Differential Input Voltage ($V_{IHD} - V_{ILD}$) | CLK PCLK | 0.15 0.30 | | 1.3 1.0 | V |
| V_{IHCMR} | Common Mode Input Voltage; (Note 9) | CLK PCLK | 0.5 1.5 | | $V_{DD} - 0.85$ V_{DD} | V |
| I_{IH} | Input HIGH Current | $V_{DD} = V_{IN} = 3.63\text{ V}$ CLK, PCLK CLK, PCLK | | | 150 5 | μA |
| I_{IL} | Input LOW Current | $V_{DD} = 3.63\text{ V}$, $V_{IN} = 0\text{ V}$ CLK, PCLK CLK, PCLK | -5 -150 | | | μA |

LVDS OUTPUTS

| | | | | | | |
|-----------------|--|--|-------|------|-------|---------------|
| V_{OD} | Differential Output Voltage | | 200 | 300 | 360 | mV |
| ΔV_{OD} | VOD Magnitude Change | | | 0 | 40 | mV |
| V_{OS} | Differential Output Voltage Offset Voltage | | 1.125 | 1.25 | 1.375 | V |
| ΔV_{OS} | VOS Magnitude Change | | | 5 | 25 | mV |
| I_{OZ} | Output High Impedance Leakage Current | | -10 | | +10 | μA |
| I_{OS} | Output Short Circuit Current | | | -5 | | mA |
| V_{OH} | Output HIGH Voltage | | | 1.34 | 1.6 | V |
| V_{OL} | Output LOW Voltage | | 0.9 | 1.06 | | V |

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.

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.

5. Outputs terminated 100 Ω across Q_x and $\overline{Q_x}$, see Figure 4. DC Measurements per Figure 10 reference.
6. V_{th} , V_{IH} , V_{IL} , and V_{ISE} parameters must be complied with simultaneously.
7. V_{th} is applied to the complementary input when operating in single-ended mode.
8. V_{IHD} , V_{ILD} , V_{ID} and V_{CMR} parameters must be complied with simultaneously.
9. The common mode voltage is defined as V_{IH} .

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Table 6. AC CHARACTERISTICS $V_{DD} = 2.5\text{ V} \pm 5\%$ or $3.3\text{ V} \pm 10\%$, $GND = 0\text{ V}$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ (Note 10)

| Symbol | Characteristic | Min | Typ | Max | Unit |
|---------------|---|------------|------|------------|------|
| f_{MAX} | Maximum Operating Frequency, $V_{OUTPP} \geq 200\text{ mV}$ $V_{DD} = 3.3\text{ V}$ $V_{DD} = 2.5\text{ V}$ | 0 0 | | 650 500 | MHz |
| t_{PD} | Propagation Delay | 0.9 | | 1.9 | ns |
| $t_{j\phi n}$ | Additive Phase Jitter, RMS; $f_C = 156.25\text{ MHz}$ Integration Range: 12 kHz – 20 MHz | | 0.05 | | ps |
| $t_{SKEWO-O}$ | Output-to-Output Skew Within A Device | | 15 | 40 | ps |
| $t_{SKEWD-D}$ | Device-to-Device Skew, similar path and conditions | | | 200 | ps |
| tr/tf | Output rise and fall times @ 50 MHz, 20% to 80% $V_{DD} = 3.3\text{ V}$ $V_{DD} = 2.5\text{ V}$ | 150 150 | 250 | 500 550 | ps |
| ODC | Output Clock Duty Cycle | 45 | 50 | 55 | % |

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.

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.

10. Outputs terminated $100\ \Omega$ across Q_x and \overline{Q}_x , see Figure 4. Measured from differential crosspoints to differential crosspoints, see Figure 11.

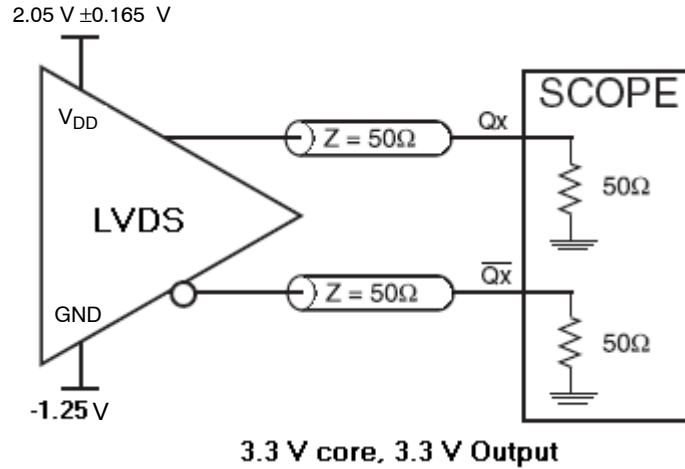


Figure 4. Typical Test Setup and Termination for Evaluation. The V_{DD} of $2.05\text{ V} \pm 0.165\text{ V}$ and GND of -1.25 V Split supply allows a direct connection to an oscilloscope $50\ \Omega$ impedance input module.

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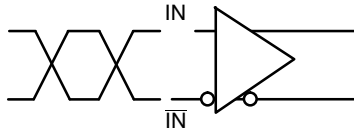


Figure 5. Differential Inputs Driven Differentially

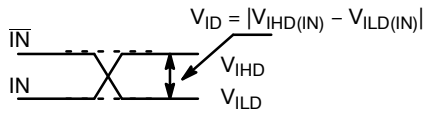


Figure 6. Differential Inputs Driven Differentially

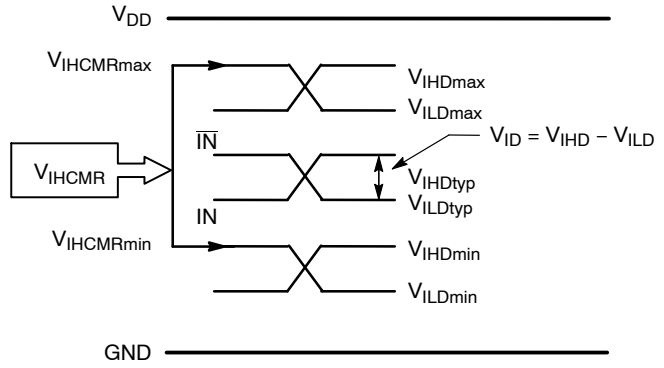


Figure 7. V_{IHCMR} Diagram

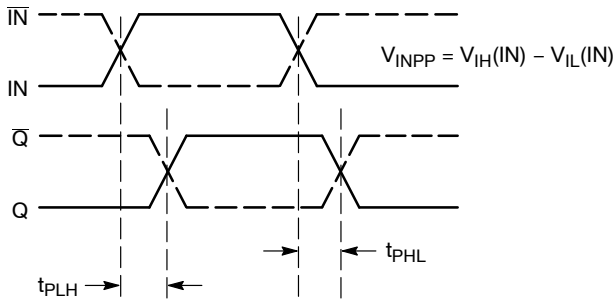


Figure 8. AC Reference Measurement

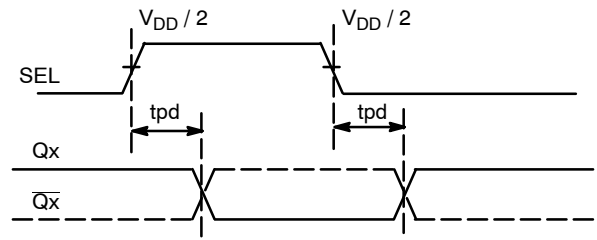
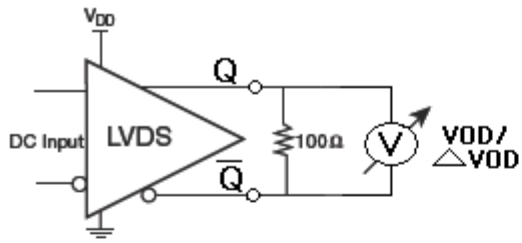
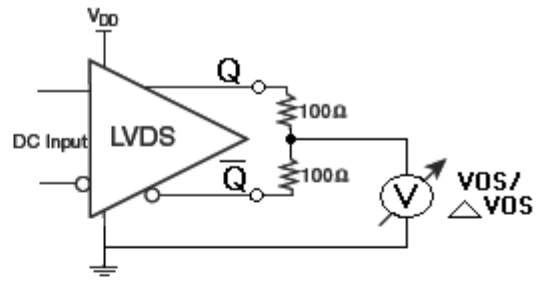


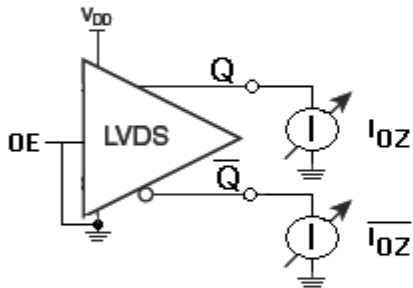
Figure 9. SEL to Qx Timing Diagram



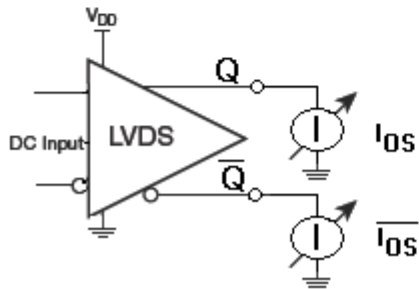
DIFFERENTIAL OUTPUT VOLTAGE



OFFSET VOLTAGE



HIGH IMPEDANCE LEAKAGE CURRENT

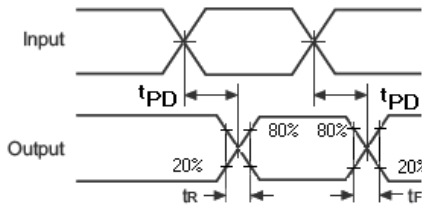


OUTPUT SHORT CIRCUIT CURRENT

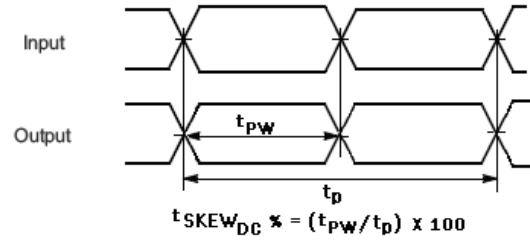
Figure 10. DC Measurement Reference

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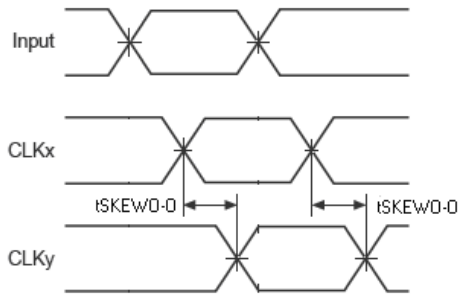
Propagation Delay



Duty Cycle Skew - tSKEWDC



Output to Output Skew tSKEW0-0



Device to Device Skew

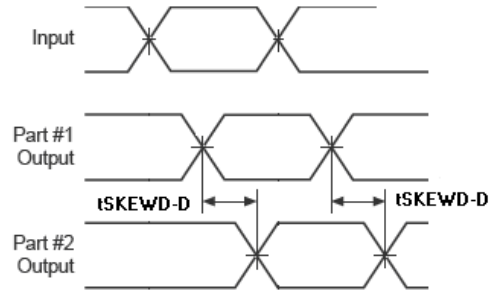


Figure 11. AC Measurement Reference

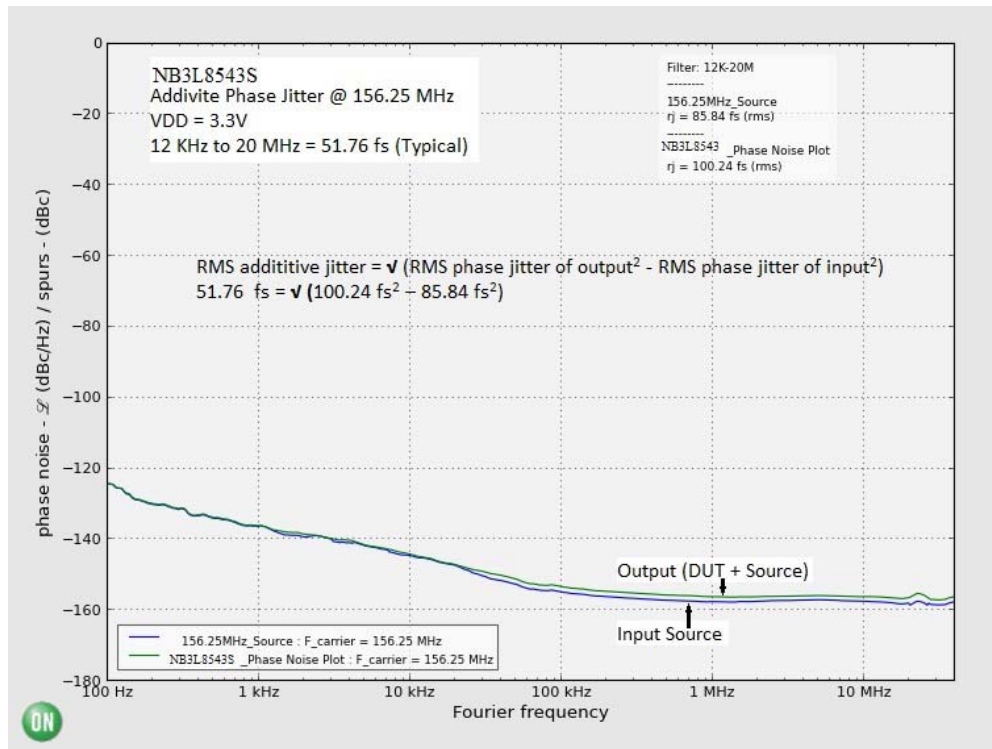


Figure 12. Typical Phase Noise Plot at $f_{\text{carrier}} = 156.25$ MHz at an Operating Voltage of 3.3 V, Room Temperature

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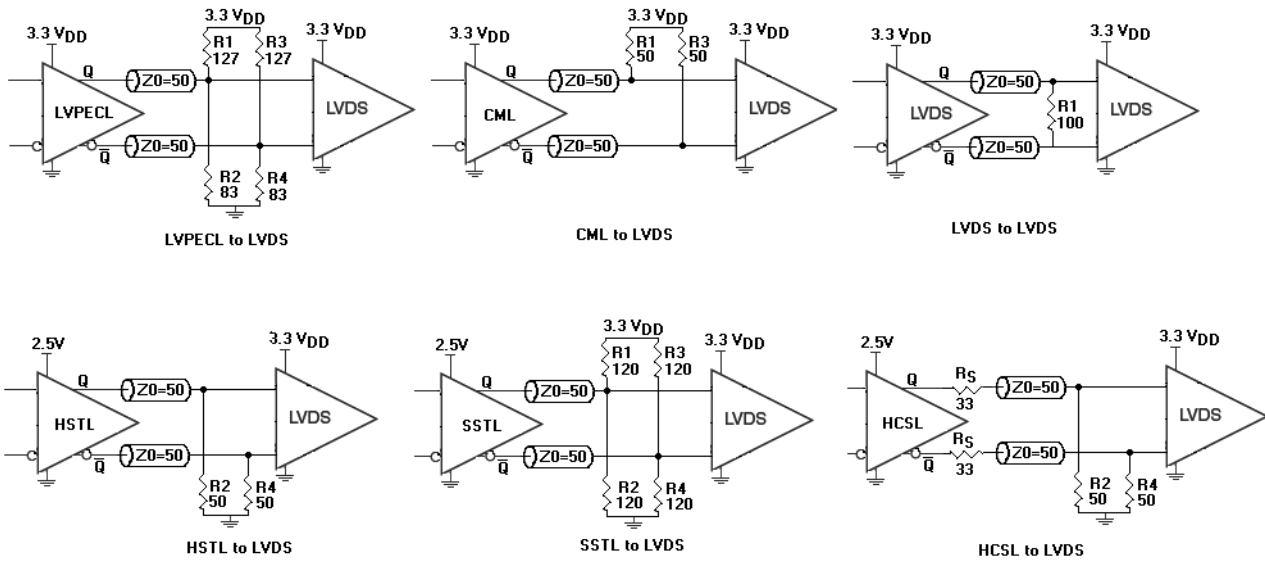


Figure 13. Differential Input Interface From LVPECL, CML, LVDS, HSTL, SSTL, or HCSL

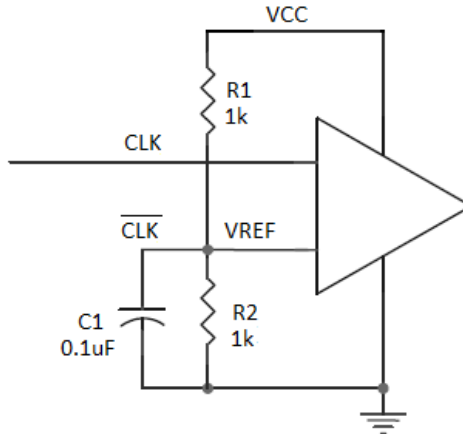


Figure 14. Differential Input Driven Single-ended

Differential Clock Input to Accept Single-ended Input

Figure 14 shows how the CLK input can be driven by a single-ended Clock signal. C1 is connected to the V_{ref} node

as a bypass capacitor. Locate these components close to the device pins. R1 and R2 must be adjusted to position V_{ref} to the center of the input swing on CLK.

ORDERING INFORMATION

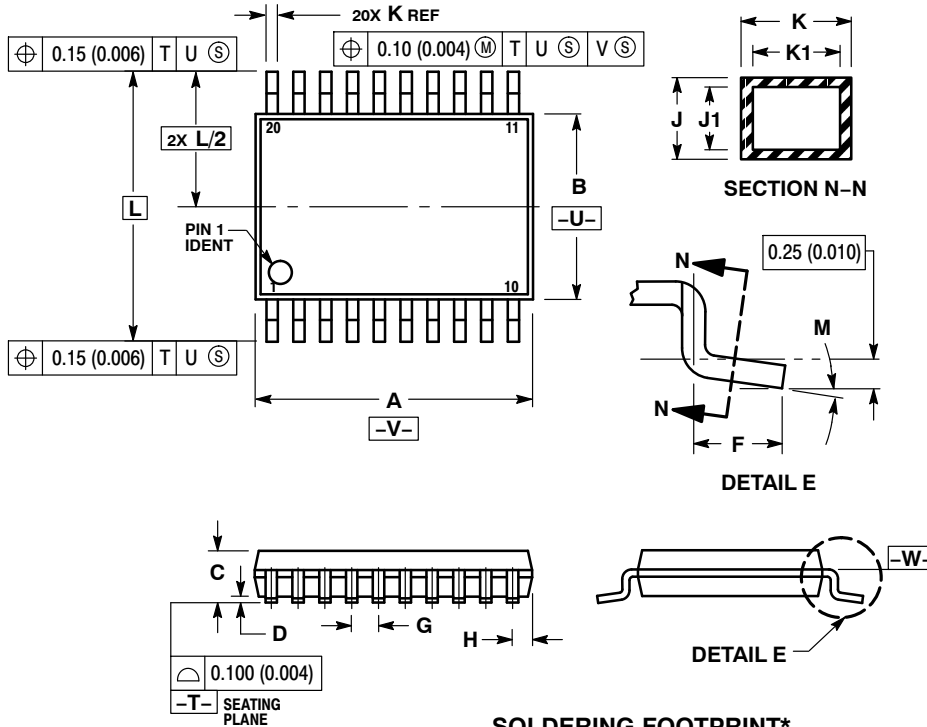
| Device | Package | Shipping [†] |
|----------------|-----------------------|-----------------------|
| NB3L8543SDTG | TSSOP-20 (Pb-Free) | 75 Units / Rail |
| NB3L8543SDTR2G | TSSOP-20 (Pb-Free) | 2500 / Tape & Reel |

[†]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

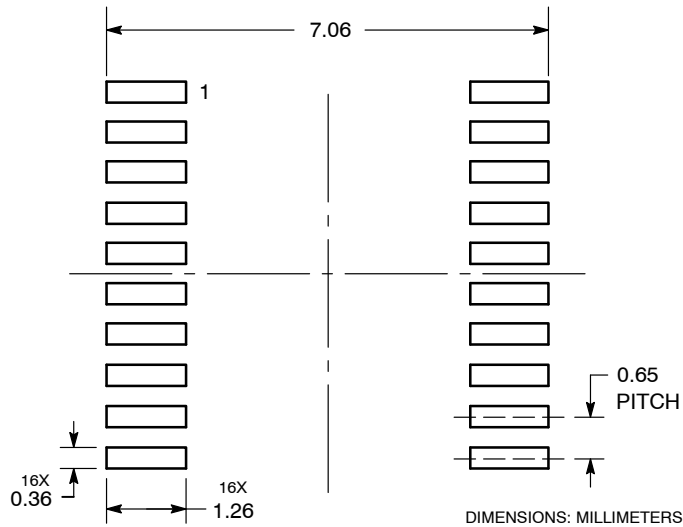
TSSOP-20
CASE 948E-02
ISSUE C




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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