

# NB7L585

## 2.5V / 3.3V Differential 2:1 Mux Input to 1:6 LVPECL Clock/Data Fanout Buffer / Translator

### Multi-Level Inputs w/ Internal Termination

#### Description

The NB7L585 is a differential 1:6 LVPECL Clock/Data distribution chip featuring a 2:1 Clock/Data input multiplexer with an input select pin. The  $IN_x/\overline{IN}_x$  inputs incorporate internal  $50\ \Omega$  termination resistors and will accept LVPECL, CML, or LVDS logic levels.

The NB7L585 produces six identical output copies of Clock or Data operating up to 5 GHz or 8 Gb/s, respectively. As such, NB7L585 is ideal for SONET, GigE, Fiber Channel, Backplane and other Clock/Data distribution applications.

The NB7L585 is powered with either 2.5 V or 3.3 V supply and is offered in a low profile 5mm x 5mm 32-pin QFN package.

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

The NB7L585 is a member of the GigaComm™ family of high performance clock products.

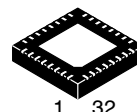
#### Features

- Maximum Input Data Rate > 8 Gb/s
- Data Dependent Jitter < 15 ps
- Maximum Input Clock Frequency > 5 GHz
- Random Clock Jitter < 0.8 ps RMS
- Low Skew 1:6 LVPECL Outputs, 20 ps max
- 2:1 Multi-Level Mux Inputs
- 175 ps Typical Propagation Delay
- 55 ps Typical Rise and Fall Times
- Differential LVPECL Outputs, 800 mV peak-to-peak, typical
- Operating Range:  $V_{CC} = 2.375\text{ V to }3.6\text{ V}$  with  $GND = 0\text{ V}$
- Internal  $50\ \Omega$  Input Termination Resistors
- VREFAC Reference Output
- QFN-32 Package, 5mm x 5mm
- $-40^\circ\text{C to }+85^\circ\text{C}$  Ambient Operating Temperature
- These Devices are Pb-Free and are RoHS Compliant



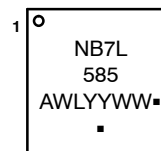
ON Semiconductor®

<http://onsemi.com>



**QFN32**  
**MN SUFFIX**  
**CASE 488AM**

#### MARKING DIAGRAM



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

(Note: Microdot may be in either location)

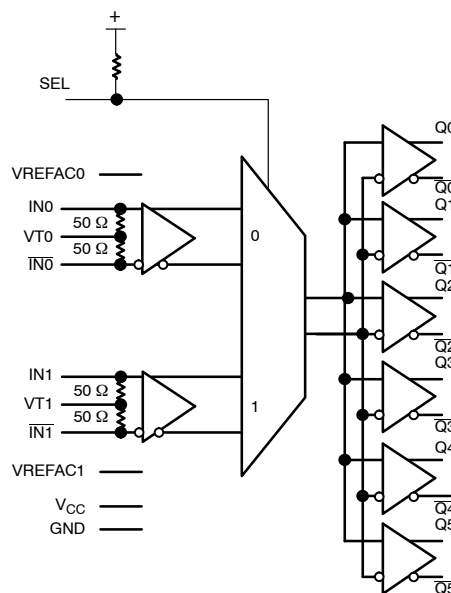


Figure 1. Simplified Block Diagram

#### ORDERING INFORMATION

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

## NB7L585

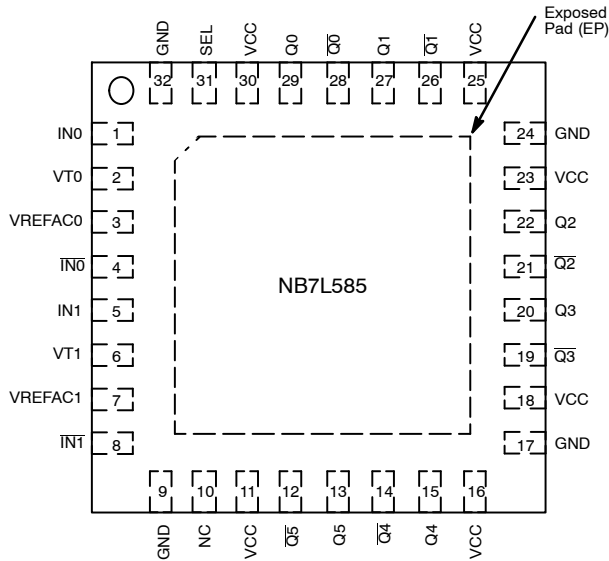


Figure 2. Pinout: QFN-32 (Top View)

Table 1. INPUT SELECT FUNCTION TABLE

| SEL* | CLK Input Selected |
|------|--------------------|
| 0    | IN0                |
| 1    | IN1                |

\*Defaults HIGH when left open.

Table 2. PIN DESCRIPTION

| Pin Number                                               | Pin Name                                                                                                                                                                         | I/O                        | Pin Description                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1, 4<br>5, 8                                             | IN0, $\overline{\text{IN0}}$<br>IN1, $\overline{\text{IN1}}$                                                                                                                     | LVPECL, CML,<br>LVDS Input | Non-inverted, Inverted, Differential Data Inputs internally biased to $V_{CC}/2$                                                                                                                                                                                                                                  |
| 2, 6                                                     | VT0, VT1                                                                                                                                                                         |                            | Internal 100 $\Omega$ Center-tapped Termination Pin for IN0 / $\overline{\text{IN0}}$ and IN1 / $\overline{\text{IN1}}$                                                                                                                                                                                           |
| 31                                                       | SEL                                                                                                                                                                              | LVTTTL/LVCMOS<br>Input     | Input Select pin; LOW for IN0 Inputs, HIGH for IN1 Inputs; defaults HIGH when left open                                                                                                                                                                                                                           |
| 10                                                       | NC                                                                                                                                                                               | –                          | No Connect                                                                                                                                                                                                                                                                                                        |
| 11, 16, 18<br>23, 25, 30                                 | $V_{CC}$                                                                                                                                                                         | –                          | Positive Supply Voltage. All $V_{CC}$ pins must be connected to the positive power supply for correct DC and AC operation.                                                                                                                                                                                        |
| 29, 28<br>27, 26<br>22, 21<br>20, 19<br>15, 14<br>13, 12 | Q0, $\overline{\text{Q0}}$<br>Q1, $\overline{\text{Q1}}$<br>Q2, $\overline{\text{Q2}}$<br>Q3, $\overline{\text{Q3}}$<br>Q4, $\overline{\text{Q4}}$<br>Q5, $\overline{\text{Q5}}$ | LVPECL Output              | Non-inverted, Inverted Differential Outputs Note 1.                                                                                                                                                                                                                                                               |
| 9, 17, 24, 32                                            | GND                                                                                                                                                                              |                            | Negative Supply Voltage, connected to Ground                                                                                                                                                                                                                                                                      |
| 3<br>7                                                   | VREFAC0<br>VREFAC1                                                                                                                                                               | –                          | Output Voltage Reference for Capacitor-Coupled Inputs                                                                                                                                                                                                                                                             |
| –                                                        | EP                                                                                                                                                                               | –                          | The Exposed Pad (EP) on the QFN-32 package bottom is thermally connected to the die for improved heat transfer out of package. The exposed pad must be attached to a heat-sinking conduit. The pad is electrically connected to the die, and must be electrically and thermally connected to GND on the PC board. |

1. In the differential configuration when the input termination pins (VT0, VT1) are connected to a common termination voltage or left open, and if no signal is applied on INn/ $\overline{\text{INn}}$  input, then the device will be susceptible to self-oscillation.
2. All  $V_{CC}$  and GND pins must be externally connected to a power supply for proper operation.

Table 3. ATTRIBUTES

| Characteristics                                        |                                   | Value                                          |
|--------------------------------------------------------|-----------------------------------|------------------------------------------------|
| ESD Protection                                         | Human Body Model<br>Machine Model | > 2 kV<br>> 200 V                              |
| R <sub>PU</sub> – SEL Input Pullup Resistor            |                                   | 75 kΩ                                          |
| Moisture Sensitivity (Note 3)                          |                                   | QFN-32<br>Level 1                              |
| Flammability Rating                                    |                                   | Oxygen Index: 28 to 34<br>UL 94 V-0 @ 0.125 in |
| Transistor Count                                       |                                   | 288                                            |
| Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test |                                   |                                                |

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

Table 4. MAXIMUM RATINGS

| Symbol              | Parameter                                                   | Condition 1         | Condition 2    | Rating                       | Unit |
|---------------------|-------------------------------------------------------------|---------------------|----------------|------------------------------|------|
| V <sub>CC</sub>     | Positive Power Supply                                       | GND = 0 V           |                | +4.0                         | V    |
| V <sub>IO</sub>     | Input/Output Voltage                                        | GND = 0 V           |                | -0.5 to V <sub>CC</sub> +0.5 | V    |
| V <sub>INPP</sub>   | Differential Input Voltage  I <sub>N</sub> – I <sub>N</sub> |                     |                | 1.89                         | V    |
| I <sub>IN</sub>     | Input Current Through R <sub>T</sub> (50 Ω Resistor)        |                     |                | ± 40                         | mA   |
| I <sub>out</sub>    | Output Current                                              | Continuous<br>Surge |                | 50<br>100                    | mA   |
| I <sub>VREFAC</sub> | VREFAC Sink or Source Current                               |                     |                | ± 1.5                        | mA   |
| T <sub>A</sub>      | Operating Temperature Range                                 |                     |                | -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 4)           | 0 lfpm<br>500 lfpm  | QFN32<br>QFN32 | 31<br>27                     | °C/W |
| θ <sub>JC</sub>     | Thermal Resistance (Junction-to-Case) (Note 4)              |                     | QFN32          | 12                           | °C/W |
| T <sub>sol</sub>    | Wave Solder                                                 |                     |                | 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.

4. JEDEC standard multilayer board – 2S2P (2 signal, 2 power) with 8 filled thermal vias under exposed pad.

**Table 5. DC CHARACTERISTICS POSITIVE LVPECL OUTPUT**  $V_{CC} = 2.375 \text{ V to } 3.6 \text{ V}$ ;  $GND = 0 \text{ V}$ ;  $T_A = -40^\circ\text{C to } 85^\circ\text{C}$   
(Note 5)

| Symbol | Characteristic | Min | Typ | Max | Unit |
|--------|----------------|-----|-----|-----|------|
|--------|----------------|-----|-----|-----|------|

**POWER SUPPLY**

|          |                                                                              |              |            |              |    |
|----------|------------------------------------------------------------------------------|--------------|------------|--------------|----|
| $V_{CC}$ | Power Supply Voltage<br>$V_{CC} = 3.3 \text{ V}$<br>$V_{CC} = 2.5 \text{ V}$ | 3.0<br>2.375 | 3.3<br>2.5 | 3.6<br>2.625 | V  |
| $I_{CC}$ | Power Supply Current (Inputs and Outputs Open)                               |              | 185        | 225          | mA |

**LVPECL Outputs**

|          |                                                                                      |                                 |  |                                 |    |
|----------|--------------------------------------------------------------------------------------|---------------------------------|--|---------------------------------|----|
| $V_{OH}$ | Output HIGH Voltage (Note 6)<br>$V_{CC} = 3.3 \text{ V}$<br>$V_{CC} = 2.5 \text{ V}$ | $V_{CC} - 1145$<br>2155<br>1355 |  | $V_{CC} - 800$<br>2500<br>1700  | mV |
| $V_{OL}$ | Output LOW Voltage (Note 6)<br>$V_{CC} = 3.3 \text{ V}$<br>$V_{CC} = 2.5 \text{ V}$  | $V_{CC} - 2000$<br>1300<br>500  |  | $V_{CC} - 1500$<br>1800<br>1000 | mV |

**DIFFERENTIAL CLOCK INPUTS DRIVEN SINGLE-ENDED** (Note 7) (Figures 5 & 6)

|           |                                                  |                |  |                |    |
|-----------|--------------------------------------------------|----------------|--|----------------|----|
| $V_{IH}$  | Single-ended Input HIGH Voltage                  | $V_{th} + 100$ |  | $V_{CC}$       | mV |
| $V_{IL}$  | Single-ended Input LOW Voltage                   | GND            |  | $V_{th} - 100$ | mV |
| $V_{th}$  | Input Threshold Reference Voltage Range (Note 8) | 1100           |  | $V_{CC} - 100$ | mV |
| $V_{ISE}$ | Single-ended Input Voltage ( $V_{IH} - V_{IL}$ ) | 200            |  | 1200           | mV |

**VREFACx** (for Capacitor- Coupled Inputs, Only)

|             |                                                                                 |                 |                 |                 |    |
|-------------|---------------------------------------------------------------------------------|-----------------|-----------------|-----------------|----|
| $V_{REFAC}$ | Output Reference Voltage @100 $\mu\text{A}$ for Capacitor- Coupled Inputs, Only | $V_{CC} - 1500$ | $V_{CC} - 1200$ | $V_{CC} - 1000$ | mV |
|-------------|---------------------------------------------------------------------------------|-----------------|-----------------|-----------------|----|

**DIFFERENTIAL INPUTS DRIVEN DIFFERENTIALLY** (Figures 7 & 8) (Note 9)

|           |                                                                          |      |  |                 |               |
|-----------|--------------------------------------------------------------------------|------|--|-----------------|---------------|
| $V_{IHD}$ | Differential Input HIGH Voltage ( $I_N, \bar{I}_N$ )                     | 1200 |  | $V_{CC}$        | mV            |
| $V_{ILD}$ | Differential Input LOW Voltage ( $I_N, \bar{I}_N$ )                      | GND  |  | $V_{IHD} - 100$ | mV            |
| $V_{ID}$  | Differential Input Voltage ( $I_N, \bar{I}_N$ ) ( $V_{IHD} - V_{ILD}$ )  | 100  |  | 1200            | mV            |
| $V_{CMR}$ | Input Common Mode Range (Differential Configuration, Note 10) (Figure 9) | 1050 |  | $V_{CC} - 50$   | mV            |
| $I_{IH}$  | Input HIGH Current $I_N/\bar{I}_N$ ( $V_{TIN}/\bar{V}_{TIN}$ Open)       | -150 |  | 150             | $\mu\text{A}$ |
| $I_{IL}$  | Input LOW Current $I_N/\bar{I}_N$ ( $V_{TIN}/\bar{V}_{TIN}$ Open)        | -150 |  | 150             | $\mu\text{A}$ |

**CONTROL INPUT** (SEL Pin)

|          |                                    |      |  |          |               |
|----------|------------------------------------|------|--|----------|---------------|
| $V_{IH}$ | Input HIGH Voltage for Control Pin | 2.0  |  | $V_{CC}$ | mV            |
| $V_{IL}$ | Input LOW Voltage for Control Pin  | GND  |  | 0.8      | mV            |
| $I_{IH}$ | Input HIGH Current                 | -150 |  | 150      | $\mu\text{A}$ |
| $I_{IL}$ | Input LOW Current                  | -150 |  | 150      | $\mu\text{A}$ |

**TERMINATION RESISTORS**

|           |                                                                        |    |    |    |          |
|-----------|------------------------------------------------------------------------|----|----|----|----------|
| $R_{TIN}$ | Internal Input Termination Resistor (Measured from $I_N$ to $V_{Tx}$ ) | 45 | 50 | 55 | $\Omega$ |
|-----------|------------------------------------------------------------------------|----|----|----|----------|

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 lfm. 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. Input and output parameters vary 1:1 with  $V_{CC}$ .

6. LVPECL outputs ( $Q_n/\bar{Q}_n$ ) loaded with 50  $\Omega$  to  $V_{CC} - 2 \text{ V}$  for proper operation.

7.  $V_{th}$ ,  $V_{IH}$ ,  $V_{IL}$ , and  $V_{ISE}$  parameters must be complied with simultaneously.

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

9.  $V_{IHD}$ ,  $V_{ILD}$ ,  $V_{ID}$  and  $V_{CMR}$  parameters must be complied with simultaneously.

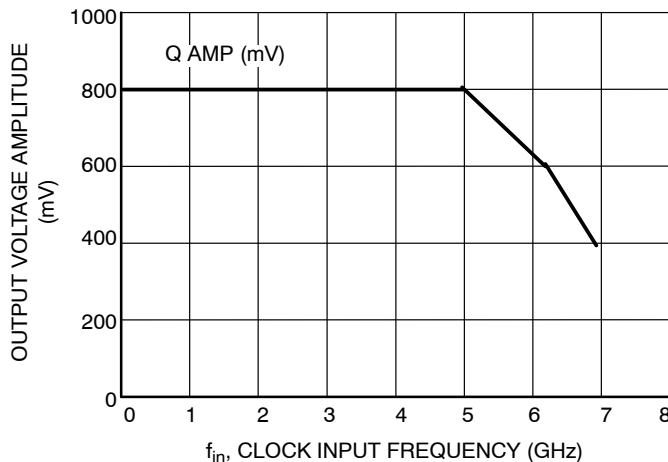
10.  $V_{CMR}$  min varies 1:1 with GND,  $V_{CMR}$  max varies 1:1 with  $V_{CC}$ . The  $V_{CMR}$  range is referenced to the most positive side of the differential input signal.

**Table 6. AC CHARACTERISTICS**  $V_{CC} = 2.375\text{ V to }3.6\text{ V}$ ;  $GND = 0\text{ V}$ ;  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (Note 11)

| Symbol                   | Characteristic                                                                                                                                     | Min        | Typ                                          | Max        | Unit                 |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------------------------------|------------|----------------------|
| $f_{MAX}$                | Maximum Input Clock Frequency; $V_{OUTpp} \geq 400\text{ mV}$                                                                                      | 5          | 7                                            |            | GHz                  |
| $f_{DATAMAX}$            | Maximum Operating Data Rate (PRBS23)                                                                                                               | 8          | 10                                           |            | Gbps                 |
| $f_{SEL}$                | Maximum Toggle Frequency, SEL                                                                                                                      | 1.0        | 1.5                                          |            | GHz                  |
| $V_{OUTpp}$              | Output Voltage Amplitude (@ $V_{INPPmin}$ )<br>(Note 12) (Figures 8 and 10)<br>$f_{in} \leq 4\text{ GHz}$<br>$f_{in} \leq 5\text{ GHz}$            | 550<br>400 | 800<br>650                                   |            | mV                   |
| $t_{PLH}$ ,<br>$t_{PHL}$ | Propagation Delay to Differential Outputs, @ 1 GHz,<br>measured at differential crosspoint<br>$IN/\overline{IN}$ to $Q/\overline{Q}$<br>SEL to Q   | 125<br>75  | 175<br>200                                   | 250<br>300 | ps                   |
| $t_{PLH\ TC}$            | Propagation Delay Temperature Coefficient                                                                                                          |            | 50                                           |            | $\Delta fs/^\circ C$ |
| tskew                    | Output – Output skew (within device) (Note 13)<br>Device – Device skew (tpd max – tpdmin)                                                          |            |                                              | 20<br>100  | ps                   |
| $t_{DC}$                 | Output Clock Duty Cycle (Reference Duty Cycle = 50%)<br>$f_{in} \leq 5.0\text{ GHz}$                                                               | 45         | 50                                           | 55         | %                    |
| $\Phi_N$                 | Phase Noise, $f_{in} = 1\text{ GHz}$<br>10 kHz<br>100 kHz<br>1 MHz<br>10 MHz<br>20 MHz<br>40 MHz                                                   |            | -135<br>-137<br>-149<br>-150<br>-150<br>-151 |            | dBc                  |
| $t_{J\Phi N}$            | Integrated Phase Jitter (Figure x) $f_{in} = 1\text{ GHz}$ , 12 kHz – 20 MHz Offset (RMS)                                                          |            | 36                                           |            | fs                   |
| $t_{JITTER}$             | RJ – Output Random Jitter (Note 14)<br>DJ – Residual Output Deterministic Jitter (Note 15)<br>$f_{in} \leq 5.0\text{ GHz}$<br>$\leq 8\text{ Gbps}$ |            | 0.2<br>5                                     | 0.8<br>15  | ps rms<br>ps pk-pk   |
|                          | Crosstalk Induced Jitter (Adjacent Channel) (Note 17)                                                                                              |            |                                              | 0.7        | psRMS                |
| $V_{INPP}$               | Input Voltage Swing (Differential Configuration) (Note 16)                                                                                         | 100        |                                              | 1200       | mV                   |
| $t_r$ , $t_f$            | Output Rise/Fall Times @ 1 GHz (20% – 80%), Q, $\overline{Q}$                                                                                      | 25         | 55                                           | 85         | 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 lfm. 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.

11. Measured using a 400 mV pk-pk source, 50% duty cycle clock source. All output loading with external  $50\ \Omega$  to  $V_{CC} - 2\text{ V}$ . Input edge rates 40 ps (20% – 80%).
12. Output voltage swing is a single-ended measurement operating in differential mode.
13. Skew is measured between outputs under identical transitions and conditions. Duty cycle skew is defined only for differential operation when the delays are measured from cross-point of the inputs to the crosspoint of the outputs.
14. Additive RMS jitter with 50% duty cycle clock signal.
15. Additive Peak-to-Peak data dependent jitter with input NRZ data at PRBS23.
16. Input voltage swing is a single-ended measurement operating in differential mode.
17. Crosstalk is measured at the output while applying two similar clock frequencies that are asynchronous with respect to each other at the inputs.

**Figure 3. Clock Output Voltage Amplitude ( $V_{OUTpp}$ ) vs. Input Frequency ( $f_{in}$ ) at Ambient Temperature (Typical)**

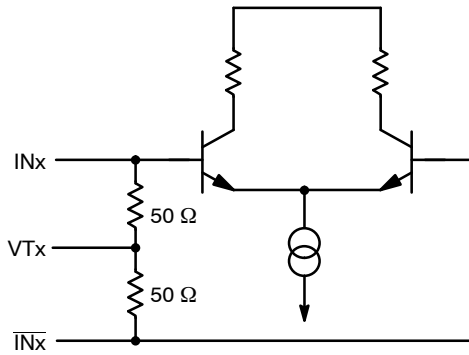


Figure 4. Input Structure

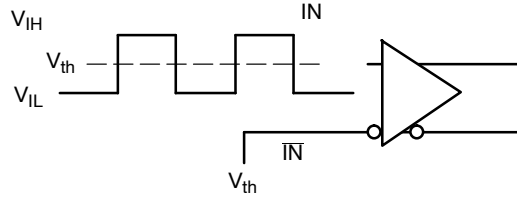


Figure 5. Differential Input Driven Single-Ended

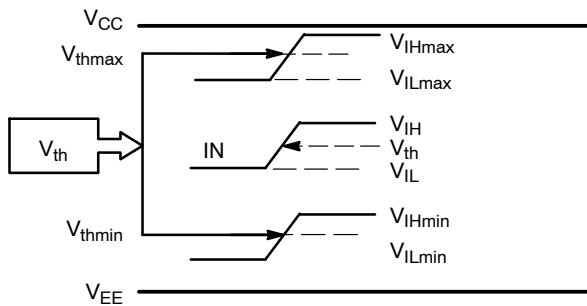


Figure 6.  $V_{th}$  Diagram

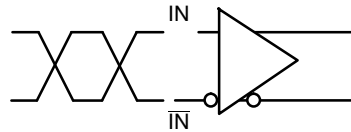


Figure 7. Differential Inputs Driven Differentially

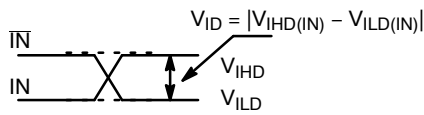


Figure 8. Differential Inputs Driven Differentially

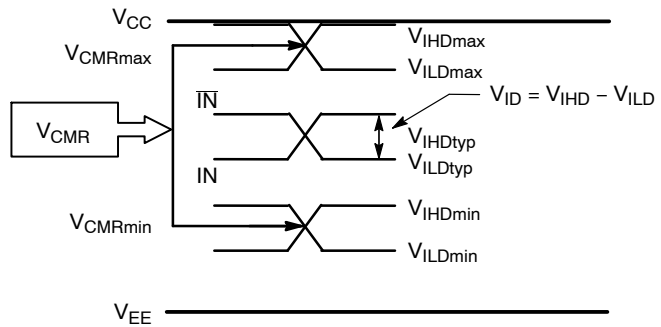


Figure 9. VCMR Diagram

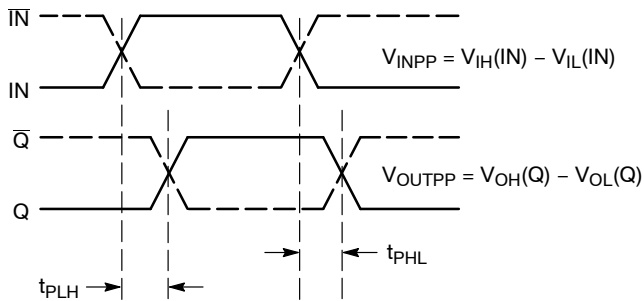


Figure 10. AC Reference Measurement

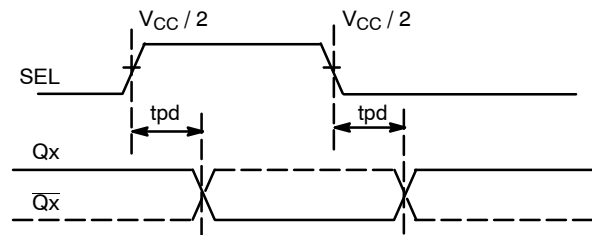
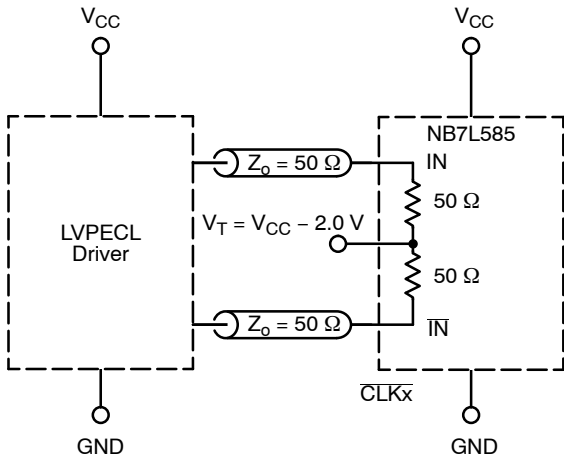
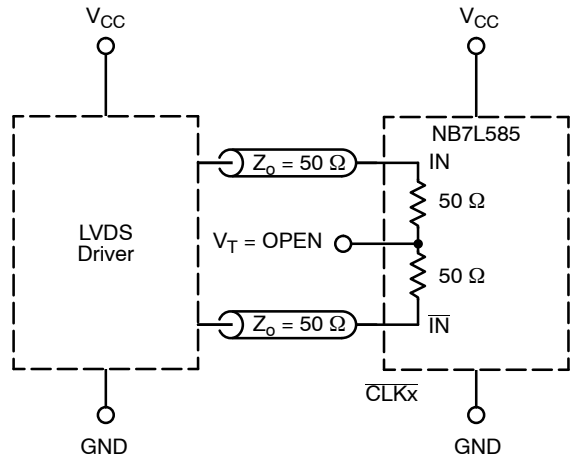


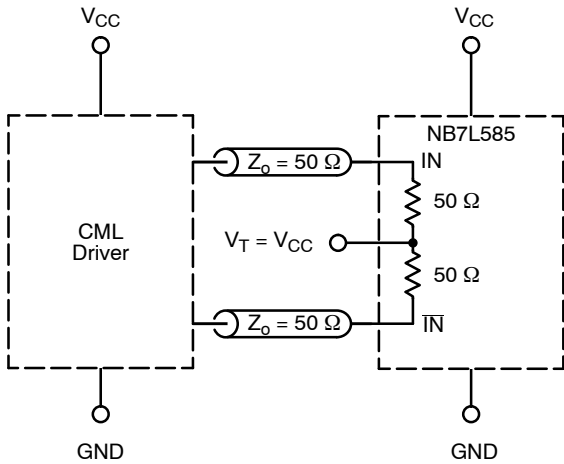
Figure 11. SEL to Qx Timing Diagram

**NB7L585**

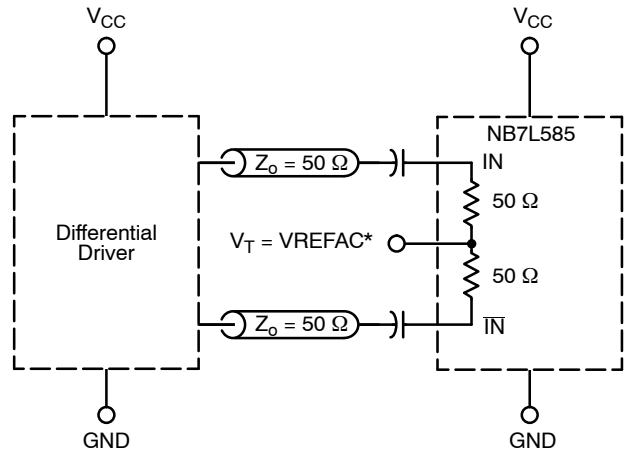
### Figure 12. LVPECL Interface



### Figure 13. LVDS Interface

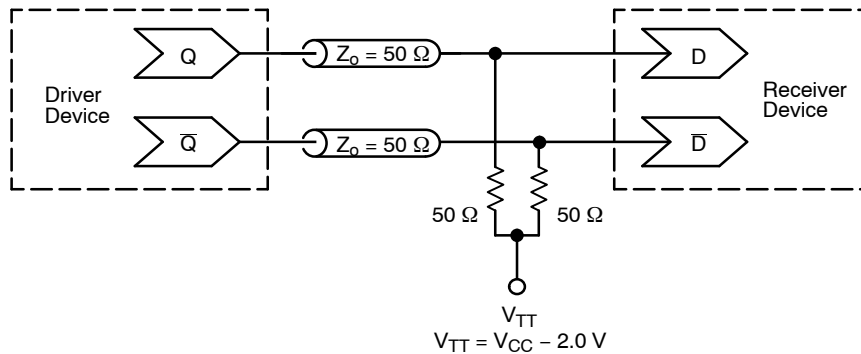


### Figure 14. Standard 50 $\Omega$ Load CML Interface



**Figure 15. Capacitor-Coupled Differential Interface ( $V_T$  Connected to  $V_{REFAC}$ )**

\*VREFAC bypassed to ground with a 0.01  $\mu$ F capacitor.



**Figure 16. Typical Termination for Output Driver and Device Evaluation**  
(See Application Note AND8020/D – Termination of ECL Logic Devices.)

## NB7L585

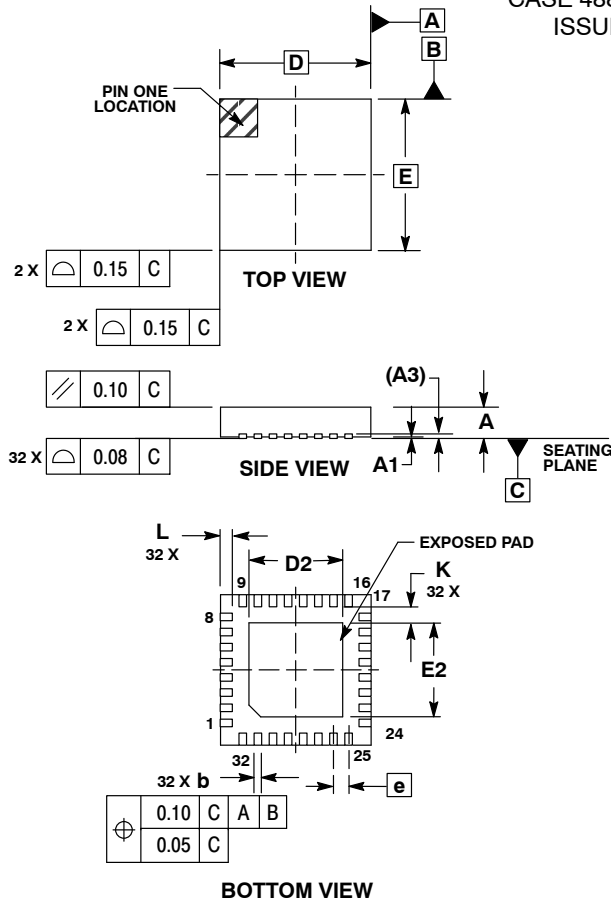
### DEVICE ORDERING INFORMATION

| Device       | Package             | Shipping <sup>†</sup> |
|--------------|---------------------|-----------------------|
| NB7L585MNG   | QFN-32<br>(Pb-Free) | 74 Units / Rail       |
| NB7L585MNR4G | QFN-32<br>(Pb-Free) | 1000 / 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.

## PACKAGE DIMENSIONS

QFN32 5\*5\*1 0.5 P  
CASE 488AM-01  
ISSUE O

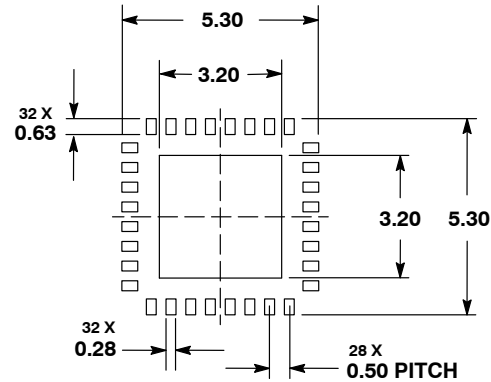


## NOTES:

1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| MILLIMETERS |           |       |       |
|-------------|-----------|-------|-------|
| DIM         | MIN       | NOM   | MAX   |
| A           | 0.800     | 0.900 | 1.000 |
| A1          | 0.000     | 0.025 | 0.050 |
| A3          | 0.200 REF |       |       |
| b           | 0.180     | 0.250 | 0.300 |
| D           | 5.00 BSC  |       |       |
| D2          | 2.950     | 3.100 | 3.250 |
| E           | 5.00 BSC  |       |       |
| E2          | 2.950     | 3.100 | 3.250 |
| e           | 0.500 BSC |       |       |
| K           | 0.200     | ---   | ---   |
| L           | 0.300     | 0.400 | 0.500 |

## 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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