

### General Description

The IDT8R9306I 2.5V differential clock buffer is a user-selectable differential input to six LVDS outputs. The fanout from a differential input to six LVDS outputs reduces loading on the preceding driver and provides an efficient clock distribution network. The IDT8R9306I can act as a translator from a differential HSTL, eHSTL, LVPECL (2.5V), LVPECL (3.3V), CML, or LVDS input to LVDS outputs. A single-ended 3.3V, 2.5V LVTTTL input can also be used to translate to LVDS outputs. The redundant input capability allows for an asynchronous change-over from a primary clock source to a secondary clock source. Selectable reference inputs are controlled by SEL.

The IDT8R9306I outputs can be asynchronously enabled/disabled. When disabled, the outputs will drive to the value selected by the GL pin. Multiple power and grounds reduce noise.

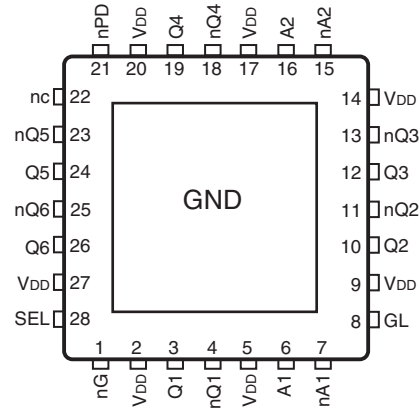
### Applications

- Clock distribution

### Features

- Guaranteed low skew: 40ps (maximum)
- Very low duty cycle distortion: <125ps (maximum)
- High speed propagation delay: <1.75ns (maximum)
- Up to 1GHz operation
- Selectable inputs
- Hot insertable and over-voltage tolerant inputs
- 3.3V/2.5V LVTTTL, HSTL eHSTL, LVPECL (2.5V), LVPECL (3.3V), CML or LVDS input interface
- Selectable differential inputs to six LVDS outputs
- Power-down mode
- 2.5V V<sub>DD</sub>
- -40°C to 85°C ambient operating temperature
- Available in VFQFPN package

### Pin Assignment



### IDT8R9306I

28-Lead VFQFPN

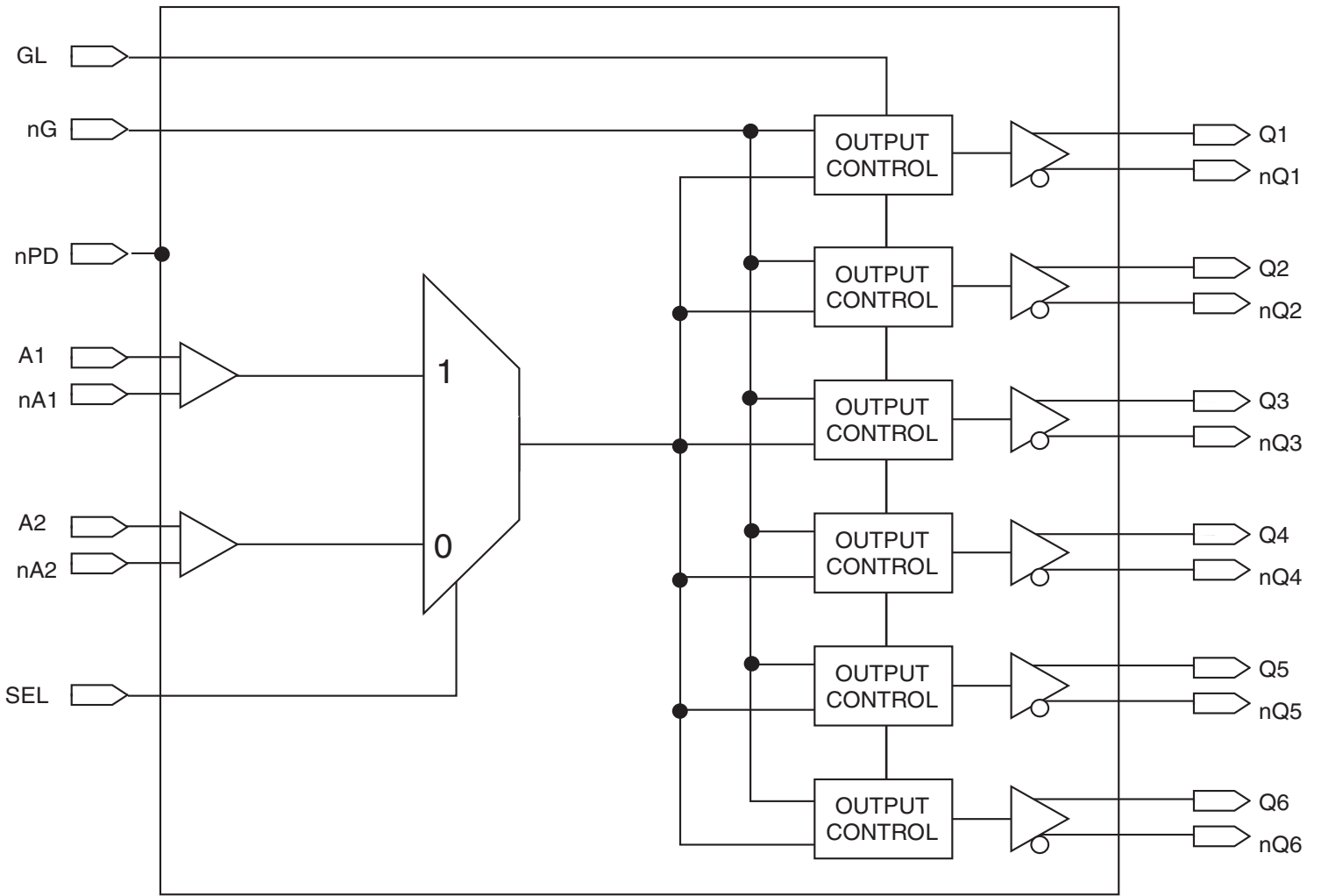
6mm x 6mm x 0.9mm package body

EPad 4.8mm x 4.8mm

NL Package

Top View

### Block Diagram



## Pin Descriptions and Characteristics

**Table 1. Pin Descriptions**

| Name            | Type   |                              | Description                                                                                                                                                                                                                                     |
|-----------------|--------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A[1:2]          | Input  | Adjustable <sup>(1, 4)</sup> | Clock input. A[1:2] is the "true" side of the differential clock input.                                                                                                                                                                         |
| nA[1:2]         | Input  | Adjustable <sup>(1, 4)</sup> | Complementary clock inputs. nA[1:2] is the complementary side of A[1:2]. For LVTTTL single-ended operation, nA[1:2] should be set to the desired toggle voltage for A[1:2]:<br>3.3V LVTTTL VREF = 1650mV<br>2.5V LVTTTL VREF = 1250mV           |
| nG              | Input  | LVTTTL                       | Gate control for differential outputs Q[1:6] and nQ[1:6]. When nG is LOW, the differential outputs are active. When nG is HIGH, the differential outputs are asynchronously driven to the level designated by GL <sup>(2)</sup> . See Table 3A. |
| GL              | Input  | LVTTTL                       | Specifies output disable level. If HIGH, "true" outputs disable HIGH and "complementary" outputs disable LOW. If LOW, "true" outputs disable LOW and "complementary" outputs disable HIGH. See Table 3A.                                        |
| Q[1:6]          | Output | LVDS                         | Clock outputs.                                                                                                                                                                                                                                  |
| nQ[1:6]         | Output | LVDS                         | Complementary clock outputs.                                                                                                                                                                                                                    |
| SEL             | Input  | LVTTTL                       | Reference clock select. When LOW, selects A2 and nA2. When HIGH, selects A1 and nA1. See Table 3B.                                                                                                                                              |
| nPD             | Input  | LVTTTL                       | Power-down control. Shuts off entire chip. If LOW, the device goes into low power mode. Inputs and outputs are disabled. Both "true" and "complementary" outputs will pull to VDD. Set HIGH for normal operation. <sup>(3)</sup>                |
| V <sub>DD</sub> |        | Power                        | Power supply for the device core and inputs.                                                                                                                                                                                                    |
| GND             |        | Power                        | Power supply return for all power.                                                                                                                                                                                                              |
| nc              |        |                              | No connect; recommended to connect to GND.                                                                                                                                                                                                      |

**NOTES:**

- Inputs are capable of translating the following interface standards:  
Single-ended 3.3V and 2.5V LVTTTL levels  
Differential HSTL and eHSTL levels  
Differential LVPECL (2.5V) and LVPECL (3.3V) levels  
Differential LVDS levels  
Differential CML levels
- Because the gate controls are asynchronous, runt pulses are possible. It is the user's responsibility to either time the gate control signals to minimize the possibility of runt pulses or be able to tolerate them in down stream circuitry.
- It is recommended that the outputs be disabled before entering power-down mode. It is also recommended that the outputs remain disabled until the device completes power-up after asserting nPD.
- The user must take precautions with any differential input interface standard being used in order to prevent instability when there is no input signal.

**Table 2. Pin Characteristics, T<sub>A</sub> = +25°C, F = 1.0MHz)**

| Symbol          | Parameter         | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------------|-------------------|-----------------|---------|---------|---------|-------|
| C <sub>IN</sub> | Input Capacitance |                 |         |         | 3       | pF    |

NOTE: This parameter is measured at characterization but not tested.

## Function Tables

**Table 3A. Gate Control Output Table**

| Control Output |    | Outputs  |          |
|----------------|----|----------|----------|
| GL             | nG | Q[1:6]   | nQ[1:6]  |
| 0              | 0  | Toggling | Toggling |
| 0              | 1  | LOW      | HIGH     |
| 1              | 0  | Toggling | Toggling |
| 1              | 1  | HIGH     | LOW      |

**Table 3B. Input Selection Table**

| Selection SEL pin | Inputs  |
|-------------------|---------|
| 0                 | A2, nA2 |
| 1                 | A1, nA1 |

## Absolute Maximum Ratings

NOTE: Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These ratings are stress specifications only. Functional operation of product at these conditions or any conditions beyond those listed in the *DC Characteristics* or *AC Characteristics* is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

| Item                                        | Rating                  |
|---------------------------------------------|-------------------------|
| Power Supply Voltage, $V_{DD}$              | -0.5V to +3.6V          |
| Input Voltage, $V_I$                        | -0.5V to +3.6V          |
| Output Voltage, $V_O$<br>Not to exceed 3.6V | -0.5 to $V_{DD} + 0.5V$ |
| Storage Temperature, $T_{STG}$              | -65°C to 150°C          |
| Junction Temperature, $T_J$                 | 150°C                   |

## Recommended Operating Range

| Symbol   | Description                   | Minimum | Typical | Maximum | Units |
|----------|-------------------------------|---------|---------|---------|-------|
| $T_A$    | Ambient Operating Temperature | -40     | +25     | +85     | °C    |
| $V_{DD}$ | Internal Power Supply Voltage | 2.3     | 2.5     | 2.7     | V     |

## DC Electrical Characteristics

**Table 4A. LVDS Power Supply DC Characteristics<sup>(1)</sup>,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

| Symbol    | Parameter                               | Test Conditions                                                                        | Minimum | Typical <sup>(2)</sup> | Maximum | Units |
|-----------|-----------------------------------------|----------------------------------------------------------------------------------------|---------|------------------------|---------|-------|
| $I_{DDQ}$ | Quiescent $V_{DD}$ Power Supply Current | $V_{DD} = \text{Max.}$ ,<br>All Input Clocks = LOW <sup>(2)</sup> ;<br>Outputs enabled |         |                        | 240     | mA    |
| $I_{TOT}$ | Total Power $V_{DD}$ Supply Current     | $V_{DD} = 2.7\text{V}$ ;<br>$F_{\text{REFERENCE}}$ Clock = 1GHz                        |         |                        | 250     | mA    |
| $I_{PD}$  | Total Power Down Supply Current         | nPD = LOW                                                                              |         |                        | 5       | mA    |

NOTE 1: These power consumption characteristics are for all the valid input interfaces and cover the worst case conditions.

NOTE 2: The true input is held LOW and the complementary input is held HIGH.

**Table 4B. LVCMOS/LVTTL DC Characteristics<sup>(1)</sup>,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

| Symbol    | Parameter                                     | Test Conditions                                  | Minimum | Typical <sup>(2)</sup> | Maximum | Units         |
|-----------|-----------------------------------------------|--------------------------------------------------|---------|------------------------|---------|---------------|
| $I_{IH}$  | Input High Current                            | $V_{DD} = 2.7\text{V}$                           |         |                        | $\pm 5$ | $\mu\text{A}$ |
| $I_{IL}$  | Input Low Current                             | $V_{DD} = 2.7\text{V}$                           |         |                        | $\pm 5$ | $\mu\text{A}$ |
| $V_{IK}$  | Clamp Diode Voltage                           | $V_{DD} = 2.3\text{V}$ , $I_{IN} = -18\text{mA}$ |         | -0.7                   | -1.2    | V             |
| $V_{IN}$  | DC Input Voltage                              |                                                  | -0.3    |                        | 3.6     | V             |
| $V_{IH}$  | DC Input High Voltage                         |                                                  | 1.7     |                        |         | V             |
| $V_{IL}$  | DC Input Low Voltage                          |                                                  |         |                        | 0.7     | V             |
| $V_{THI}$ | DC Input Threshold Crossing Voltage           |                                                  |         | $V_{DD}/2$             |         | V             |
| $V_{REF}$ | Single-Ended Reference Voltage <sup>(3)</sup> | 3.3V LVTTL                                       |         | 1.65                   |         | V             |
|           |                                               | 2.5V LVTTL                                       |         | 1.25                   |         | V             |

NOTE 1: See *Recommended Operating Range* table.

NOTE 2: Typical values are at  $V_{DD} = 2.5\text{V}$ ,  $+25^\circ\text{C}$  ambient.

NOTE 3: For A[1:2] single-ended operation, nA[1:2] is tied to a DC reference voltage.

**Table 4C. Differential DC Characteristics<sup>(1)</sup>,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

| Symbol    | Parameter                              | Test Conditions                                  | Minimum | Typical <sup>(2)</sup> | Maximum  | Units         |
|-----------|----------------------------------------|--------------------------------------------------|---------|------------------------|----------|---------------|
| $I_{IH}$  | Input High Current                     | $V_{DD} = 2.7\text{V}$                           |         |                        | $\pm 5$  | $\mu\text{A}$ |
| $I_{IL}$  | Input Low Current                      | $V_{DD} = 2.7\text{V}$                           |         |                        | $\pm 5$  | $\mu\text{A}$ |
| $V_{IK}$  | Clamp Diode Voltage                    | $V_{DD} = 2.3\text{V}$ , $I_{IN} = -18\text{mA}$ |         | -0.7                   | -1.2     | V             |
| $V_{IN}$  | DC Input Voltage                       |                                                  | -0.3    |                        | 3.6      | V             |
| $V_{DIF}$ | DC Differential Voltage <sup>(3)</sup> |                                                  | 0.1     |                        |          | V             |
| $V_{CM}$  | DC Common Mode Input Voltage           |                                                  | 0.05    |                        | $V_{DD}$ | V             |

NOTE 1: See *Recommended Operating Range* table.

NOTE 2: Typical values are at  $V_{DD} = 2.5\text{V}$ ,  $+25^\circ\text{C}$  ambient.

NOTE 3:  $V_{DIF}$  specifies the minimum input differential voltage ( $V_{TR} - V_{CP}$ ) required for switching where  $V_{TR}$  is the "true" input level and  $V_{CP}$  is the "complement" input level. The DC differential voltage must be maintained to guarantee retaining the existing HIGH or LOW input. The AC differential voltage must be achieved to guarantee switching to a new state.

NOTE 4:  $V_{CM}$  specifies the maximum allowable range of  $(V_{TR} + V_{CP})/2$ .

**Table 4D. LVDS DC Characteristics<sup>(1)</sup>,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$** 

| Symbol          | Parameter                                              | Test Conditions                | Minimum | Typical <sup>(2)</sup> | Maximum | Units |
|-----------------|--------------------------------------------------------|--------------------------------|---------|------------------------|---------|-------|
| $V_{OT(+)}$     | Differential Output Voltage for the True Binary State  |                                | 247     |                        | 454     | mV    |
| $V_{OT(-)}$     | Differential Output Voltage for the False Binary State |                                | 247     |                        | 454     | mV    |
| $\Delta V_{OT}$ | Change in $V_{OT}$ Between Complementary Output States |                                |         |                        | 50      | mV    |
| $V_{OS}$        | Output Common Mode Voltage (Offset Voltage)            |                                | 1.125   | 1.2                    | 1.375   | V     |
| $\Delta V_{OS}$ | Change in $V_{OS}$ Between Complementary Output States |                                |         |                        | 50      | mV    |
| $I_{OS}$        | Outputs Short Circuit Current                          | $V_{OUT+}$ and $V_{OUT-} = 0V$ |         | 12                     | 24      | mA    |
| $I_{OSD}$       | Differential Outputs Short Circuit Current             | $V_{OUT+} = V_{OUT-}$          |         | 6                      | 12      | mA    |

NOTE 1: See *Recommended Operating Range* table.

NOTE 2: Typical values are at  $V_{DD} = 2.5V$ ,  $+25^\circ\text{C}$  ambient.

## AC Electrical Characteristics

**Table 5A. HSTL Differential Input AC Characteristics,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$** 

| Symbol      | Parameter                                               | Value          | Units |
|-------------|---------------------------------------------------------|----------------|-------|
| $V_{DIF}$   | Input Signal Swing <sup>(1)</sup>                       | 1              | V     |
| $V_X$       | Differential Input Signal Crossing Point <sup>(2)</sup> | 750            | mV    |
| $D_H$       | Duty Cycle                                              | 50             | %     |
| $V_{THI}$   | Input Timing Measurement Reference Level <sup>(3)</sup> | Crossing Point | V     |
| $t_R / t_F$ | Input Signal Edge Rate <sup>(4)</sup>                   | 2              | V/ns  |

NOTE 1. The 1V peak-to-peak input pulse level is specified to allow consistent, repeatable results in an automatic test equipment (ATE) environment. This device meets the  $V_{DIF}$  (AC) specification under actual use conditions.

NOTE 2. A 750mV crossing point level is specified to allow consistent, repeatable results in an automatic test equipment (ATE) environment. This device meets the  $V_X$  specification under actual use conditions.

NOTE 3. In all cases, input waveform timing is marked at the differential cross-point of the input signals.

NOTE 4. The input signal edge rate of 2V/ns or greater is to be maintained in the 20% to 80% range of the input waveform.

**Table 5B. eHSTL AC Differential Input Characteristics,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$** 

| Symbol      | Parameter                                               | Value          | Units |
|-------------|---------------------------------------------------------|----------------|-------|
| $V_{DIF}$   | Input Signal Swing <sup>(1)</sup>                       | 1              | V     |
| $V_X$       | Differential Input Signal Crossing Point <sup>(2)</sup> | 900            | mV    |
| $D_H$       | Duty Cycle                                              | 50             | %     |
| $V_{THI}$   | Input Timing Measurement Reference Level <sup>(3)</sup> | Crossing Point | V     |
| $t_R / t_F$ | Input Signal Edge Rate <sup>(4)</sup>                   | 2              | V/ns  |

NOTE 1: The 1V peak-to-peak input pulse level is specified to allow consistent, repeatable results in an automatic test equipment (ATE) environment. This device meets the  $V_{DIF}$  (AC) specification under actual use conditions.

NOTE 2: A 900mV crossing point level is specified to allow consistent, repeatable results in an automatic test equipment (ATE) environment. This device meets the  $V_X$  specification under actual use conditions.

NOTE 3: In all cases, input waveform timing is marked at the differential cross-point of the input signals.

NOTE 4: The input signal edge rate of 2V/ns or greater is to be maintained in the 20% to 80% range of the input waveform.

**Table 5C. LVPECL (2.5V) and LVPECL (3.3V) Differential Input AC Characteristics,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$** 

| Symbol      | Parameter                                               | Maximum        | Units |
|-------------|---------------------------------------------------------|----------------|-------|
| $V_{DIF}$   | Input Signal Swing <sup>(1)</sup>                       | 732            | mV    |
| $V_X$       | Differential Input Cross Point Voltage <sup>(2)</sup>   | LVPECL         | 1082  |
|             |                                                         | LVPECL         | 1880  |
| $D_H$       | Duty Cycle                                              | 50             | %     |
| $V_{THI}$   | Input Timing Measurement Reference Level <sup>(3)</sup> | Crossing Point | V     |
| $t_R / t_F$ | Input Signal Edge Rate <sup>(4)</sup>                   | 2              | V/ns  |

NOTE 1: The 732mV peak-to-peak input pulse level is specified to allow consistent, repeatable results in an automatic test equipment (ATE) environment. This device meets the  $V_{DIF}$  (AC) specification under actual use conditions.

NOTE 2: A 1082mV LVPECL (2.5V) and 1880 LVPECL (3.3V) crossing point level is specified to allow consistent, repeatable results in an automatic test equipment (ATE) environment. This device meets the  $V_X$  specification under actual use conditions.

NOTE 3: In all cases, input waveform timing is marked at the differential cross-point of the input signals.

NOTE 4: The input signal edge rate of 2V/ns or greater is to be maintained in the 20% to 80% range of the input waveform.

**Table 5D. LVDS Differential Input AC Characteristics,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$** 

| Symbol      | Parameter                                               | Maximum        | Units |
|-------------|---------------------------------------------------------|----------------|-------|
| $V_{DIF}$   | Input Signal Swing <sup>(1)</sup>                       | 400            | mV    |
| $V_X$       | Differential Input Cross Point Voltage <sup>(2)</sup>   | 1.2            | V     |
| $D_H$       | Duty Cycle                                              | 50             | %     |
| $V_{THI}$   | Input Timing Measurement Reference Level <sup>(3)</sup> | Crossing Point | V     |
| $t_R / t_F$ | Input Signal Edge Rate <sup>(4)</sup>                   | 2              | V/ns  |

NOTE 1: The 400mV peak-to-peak input pulse level is specified to allow consistent, repeatable results in an automatic test equipment (ATE) environment. This device meets the  $V_{DIF}$  (AC) specification under actual use conditions.

NOTE 2: A 1.2V crossing point level is specified to allow consistent, repeatable results in an automatic test equipment (ATE) environment. This device meets the  $V_X$  specification under actual use conditions.

NOTE 3: In all cases, input waveform timing is marked at the differential cross-point of the input signals.

NOTE 4: The input signal edge rate of 2V/ns or greater is to be maintained in the 20% to 80% range of the input waveform.

**Table 5E. AC Differential Input Characteristics<sup>(1)</sup>,  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$** 

| Symbol    | Parameter                                      | Minimum | Typical | Maximum  | Units |
|-----------|------------------------------------------------|---------|---------|----------|-------|
| $V_{DIF}$ | AC Differential Voltage <sup>(2)</sup>         | 0.1     |         | 3.6      | V     |
| $V_X$     | Differential Input Cross Point Voltage         | 0.05    |         | $V_{DD}$ | V     |
| $V_{CM}$  | Common Mode Input Voltage Range <sup>(3)</sup> | 0.05    |         | $V_{DD}$ | V     |
| $V_{IN}$  | Input Voltage                                  | -0.3    |         | 3.6      | V/ns  |

NOTE 1: The output will not change state until the inputs have crossed and the minimum differential voltage range defined by  $V_{DIF}$  has been met or exceeded.

NOTE 2:  $V_{DIF}$  specifies the minimum input voltage ( $V_{TR} - V_{CP}$ ) required for switching where  $V_{TR}$  is the “true” input level and  $V_{CP}$  is the “complement” input level. The AC differential voltage must be achieved to guarantee switching to a new state.

NOTE 3:  $V_{CM}$  specified the maximum allowable range of  $(V_{TR} + V_{CP}) / 2$ .

**Table 5F. AC Characteristics<sup>(1,5)</sup>,  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$** 

| Symbol       | Parameter                                                                                        | Test Conditions                               | Minimum | Typical | Maximum | Units         |
|--------------|--------------------------------------------------------------------------------------------------|-----------------------------------------------|---------|---------|---------|---------------|
| $t_{sk(o)}$  | Same Device Output Pin-to-Pin Skew <sup>(2)</sup>                                                |                                               |         |         | 40      | ps            |
| $t_{sk(p)}$  | Pulse Skew <sup>(3)</sup>                                                                        |                                               |         |         | 125     | ps            |
| $t_{sk(pp)}$ | Part-to-Part Skew <sup>(4)</sup>                                                                 |                                               |         |         | 300     | ps            |
| $t_{JIT}$    | RMS Additive Phase Jitter                                                                        | 25MHz, Integration Range<br>12kHz – 10MHz     |         | 0.541   |         | ps            |
|              |                                                                                                  | 125MHz, Integration Range<br>12kHz – 20MHz    |         | 0.159   |         | ps            |
|              |                                                                                                  | 156.25MHz, Integration<br>Range 12kHz – 20MHz |         | 0.185   |         | ps            |
| $t_{PLH}$    | Propagation Delay, Low-to-High                                                                   | A Crosspoint to Qx, nQx<br>Crosspoint         |         | 1.25    | 1.75    | ns            |
| $t_{PHL}$    | Propagation Delay, High-to-Low                                                                   |                                               |         | 1.25    | 1.75    | ns            |
| $f_o$        | Frequency Range <sup>(6)</sup>                                                                   |                                               |         |         | 1       | GHz           |
| $t_{PGE}$    | Output Gate Enable Crossing<br>$V_{THI}$ -to-Qx, nQx Crosspoint                                  |                                               |         |         | 3.5     | ns            |
| $t_{PGD}$    | Output Gate Enable Crossing<br>$V_{THI}$ -to-Qx, nQx Crosspoint Driven to<br>GL Designated Level |                                               |         |         | 3.5     | ns            |
| $t_{PWRDN}$  | nPD Crossing $V_{THI}$ -to-Qx = $V_{DD}$ ,<br>nQx = $V_{DD}$                                     |                                               |         |         | 100     | $\mu\text{S}$ |
| $t_{PWRUP}$  | Output Gate Disable Crossing $V_{THI}$ to<br>nQx Driven to GL Designated Level                   |                                               |         |         | 100     | $\mu\text{S}$ |
| $t_R / t_F$  | Output Rise/Fall Time <sup>(6)</sup>                                                             |                                               | 125     |         | 600     | ps            |

NOTE: Electrical parameters are guaranteed over the specified ambient operating temperature range, which is established when the device is mounted in a test socket with maintained transverse airflow greater than 500 lfm. The device will meet specifications after thermal equilibrium has been reached under these conditions.

NOTE 1: AC propagation measurements should not be taken within the first 100 cycles of startup.

NOTE 2: Skew measured between crosspoints of all differential output pairs under identical input and output interfaces, transitions and load conditions on any one device.

NOTE 3: Skew measured is the difference between propagation delay times  $t_{PHL}$  and  $t_{PLH}$  of any differential output pair under identical input and output interfaces, transitions and load conditions on any one device.

NOTE 4: Skew measured is the magnitude of the difference in propagation times between any single differential output pair of two devices, given identical transitions and load conditions at identical  $V_{DD}$  levels and temperature.

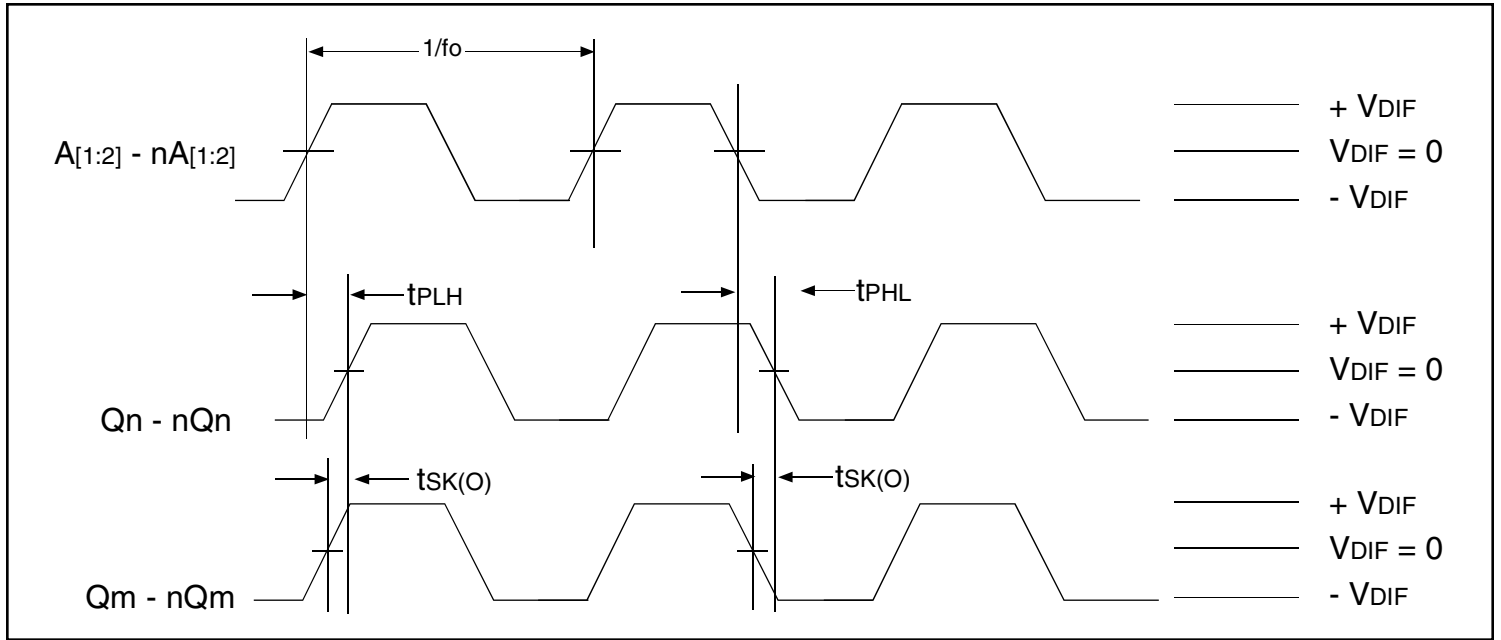
NOTE 5: All parameters are tested with a 50% input duty cycle.

NOTE 6: Guaranteed by design but not production tested.



## Differential AC Timing Waveforms

### Output Propagation and Skew Waveforms



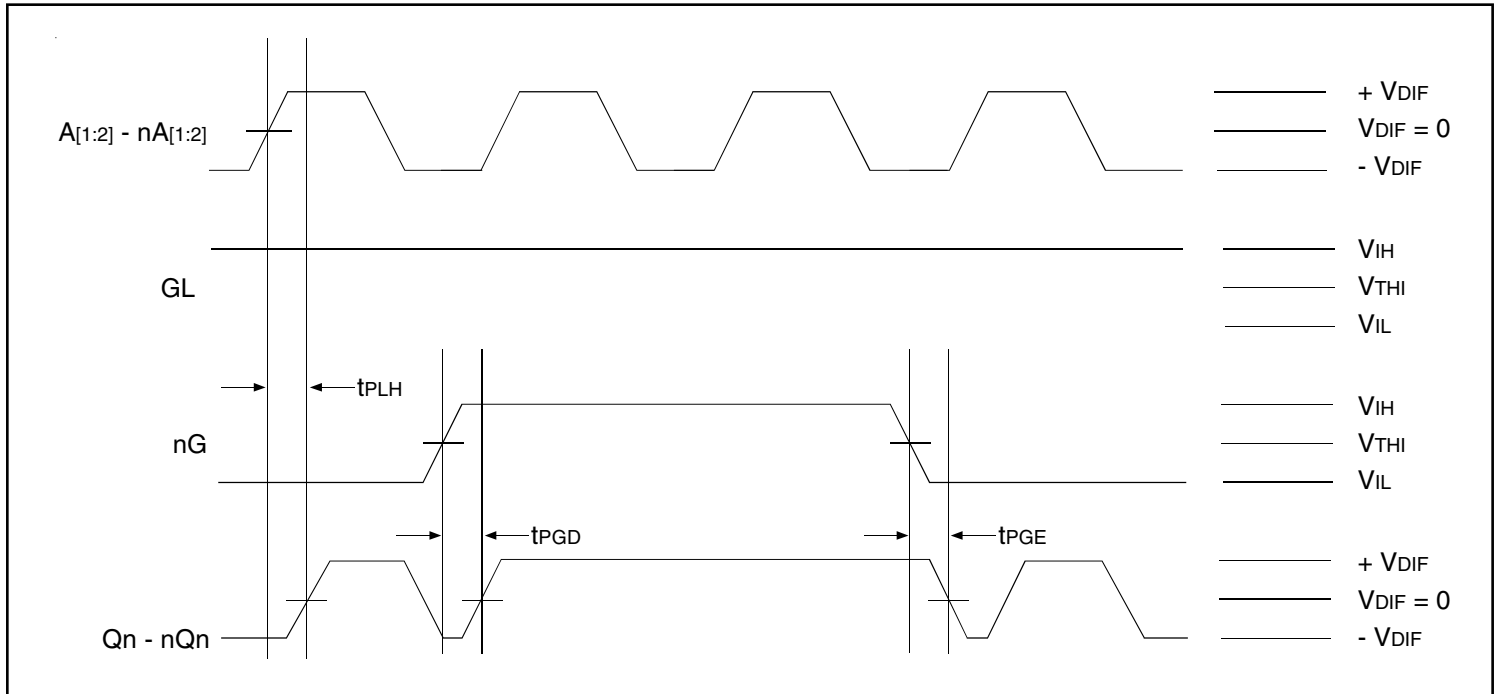
NOTE 1: Pulse skew is calculated using the following expression:

$$t_{sk(p)} = |t_{p_{HL}} - t_{p_{LH}}|$$

Note that the  $t_{p_{HL}}$  and  $t_{p_{LH}}$  shown above are not valid measurements for this calculation because they are not taken from the same pulse.

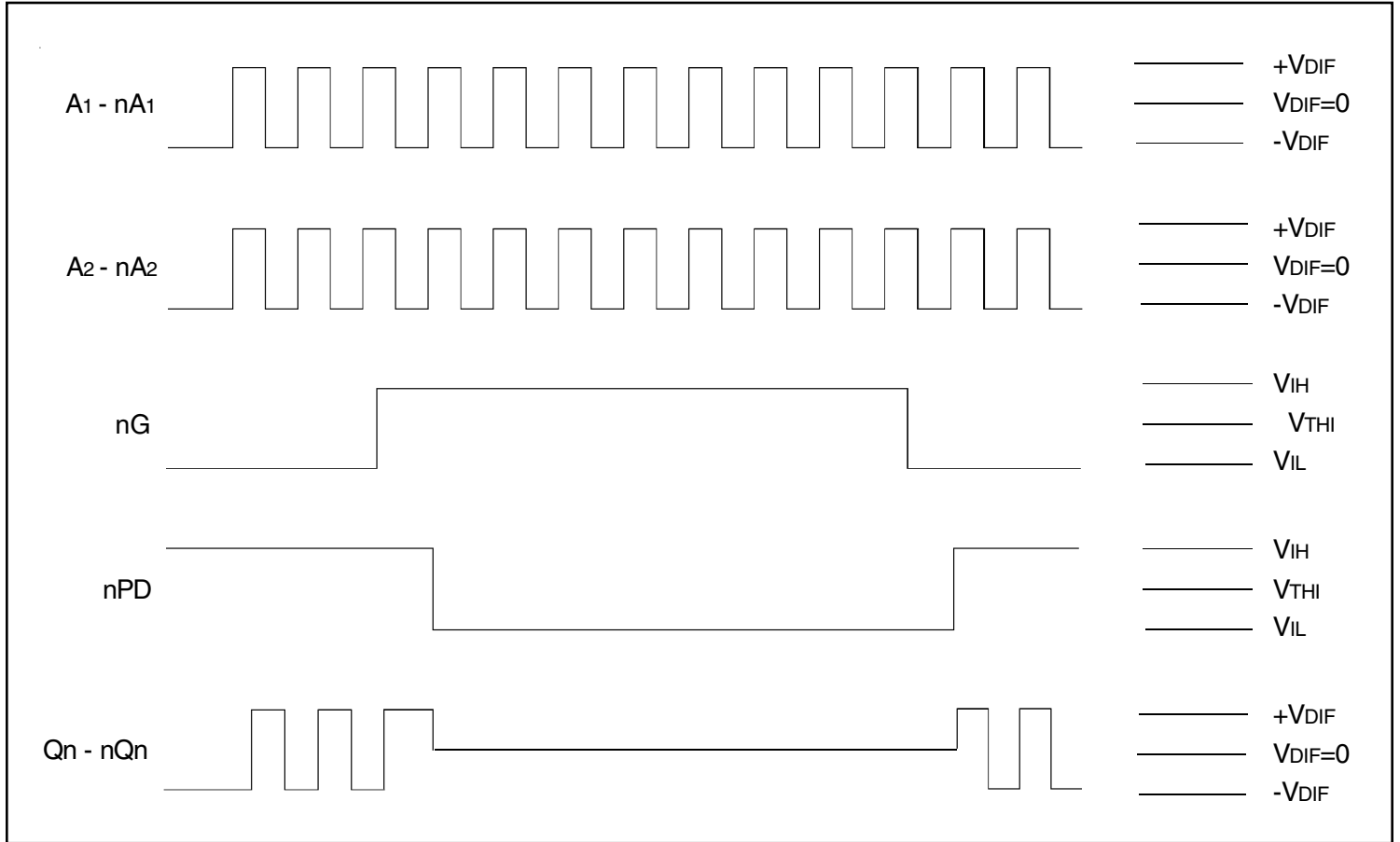
NOTE 2: AC propagation measurements should not be taken within the first 100 cycles of startup.

### Differential Gate Disabled/Enable Showing Runt Pulse Generation



NOTE 1: As shown, it is possible to generate runt pulses on gate disable and enable of the outputs. It is the user's responsibility to time the  $nG$  signal to avoid this problem.

**Power Down Timing**

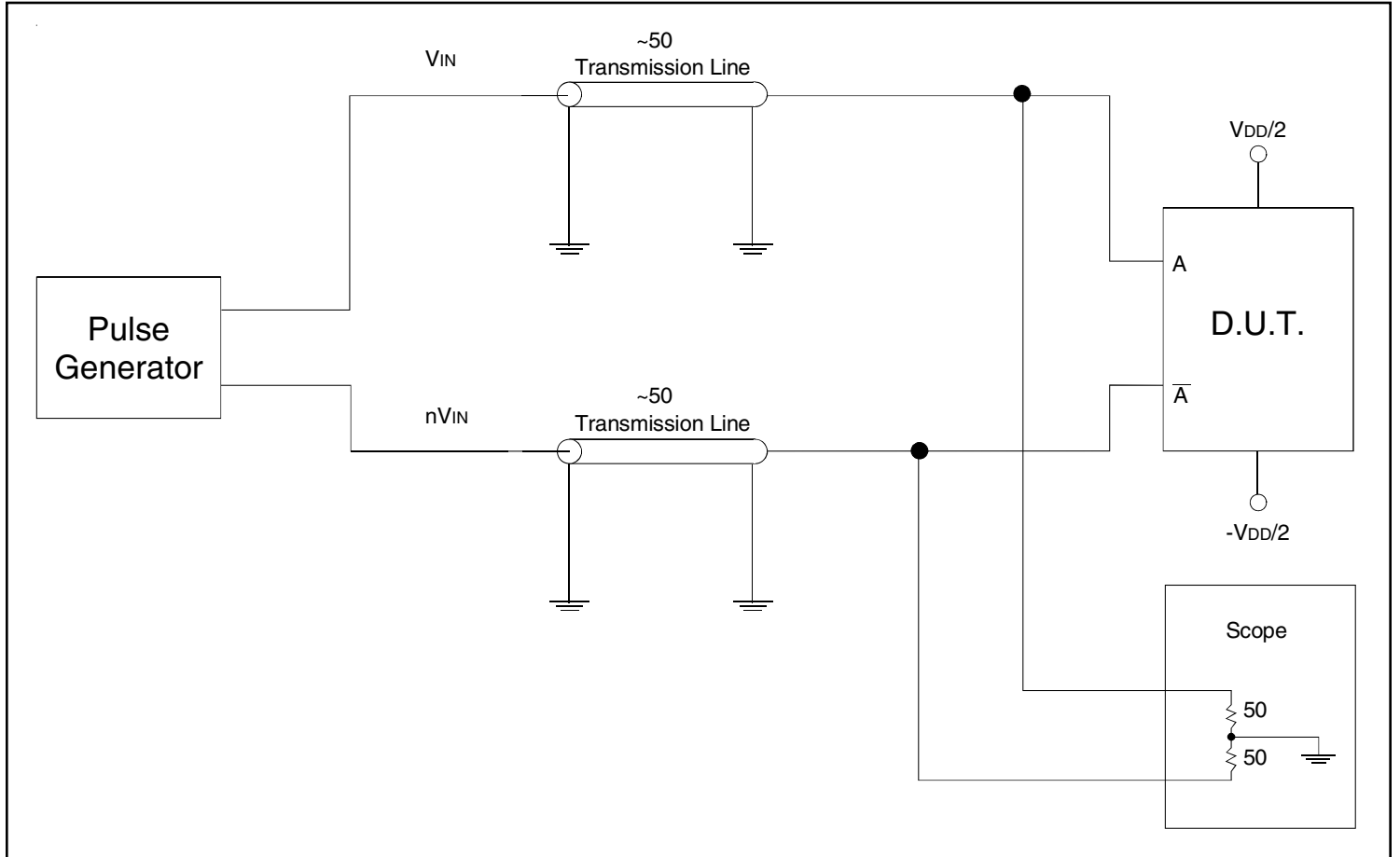


NOTE 1: It is recommended that outputs be disabled before entering power-down mode. It is also recommended that the outputs remain disabled until the device completes power-up after asserting nPD.

NOTE 2: The *Power Down Timing* diagram assumes that GL is HIGH.

NOTE 3: It should be noted that during power-down mode, the outputs are both pulled to  $V_{DD}$ . In the *Power Down Timing* diagram this is shown when Qx, nQx goes to  $V_{DIF} = 0$ .

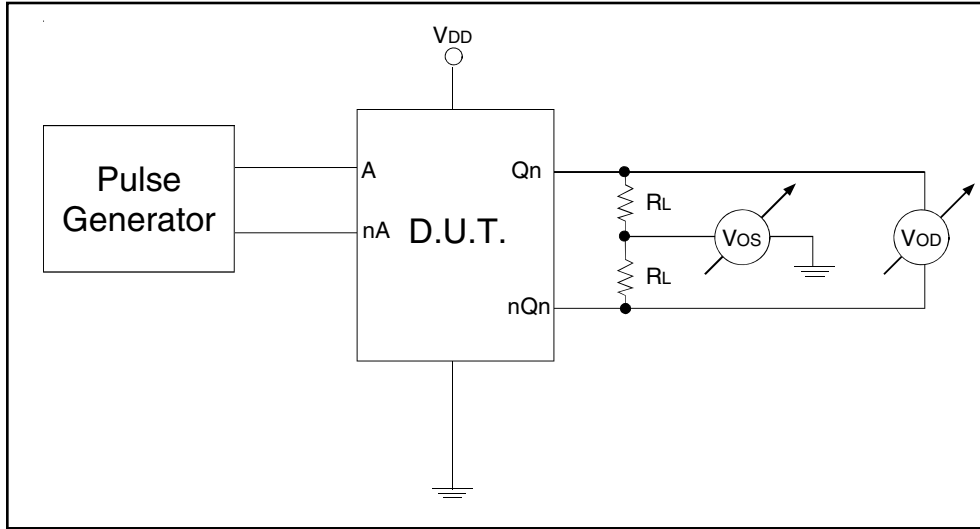
**Test Circuit for Differential Input**



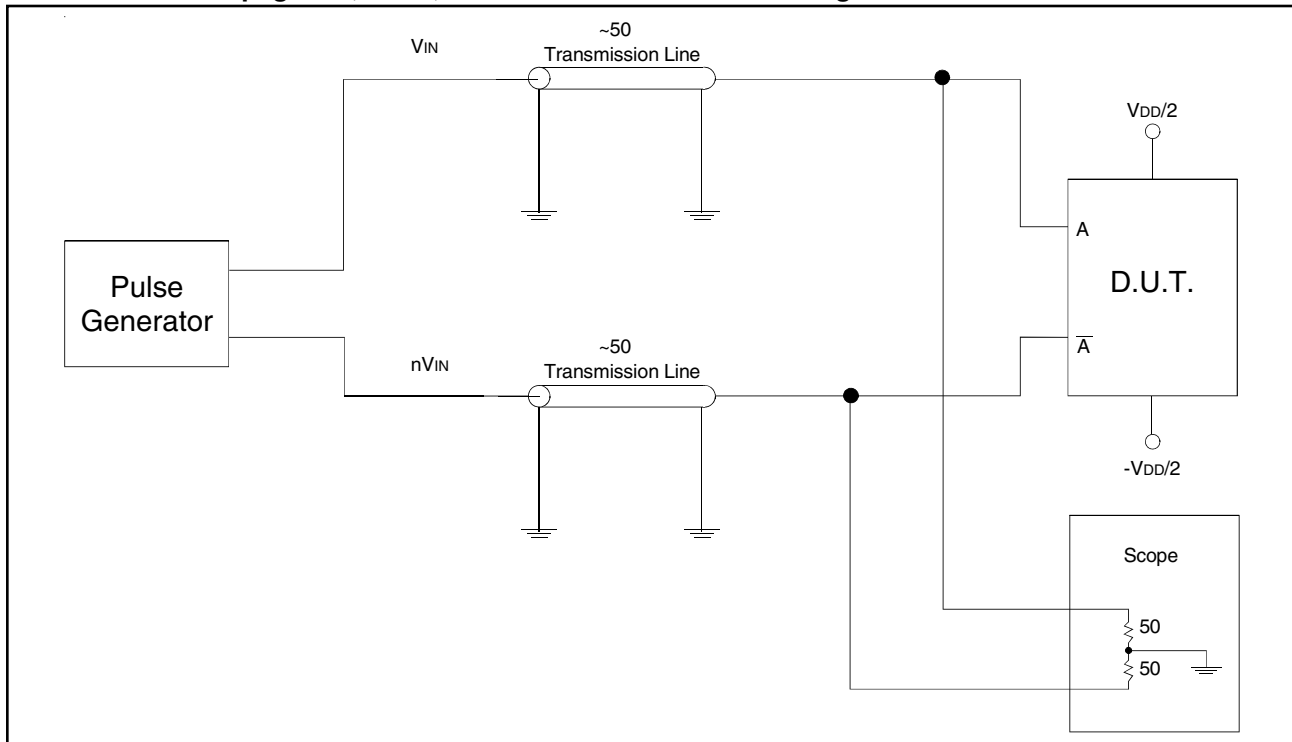
**Table 6A. Differential Input Test Conditions**

| Symbol    | $V_{DD} = 2.5V \pm 0.2V$ | Unit |
|-----------|--------------------------|------|
| $V_{THI}$ | Crossing of A and nA     | V    |

**Test Circuit for DC Outputs and Power Down Tests**



**Test Circuit for Propagation, Skew, and Gate Enable/Disable Timing**



**Table 6B. LVDS Differential Output Test Conditions**

| Symbol | $V_{DD} = 2.5V \pm 0.2V$ | Unit     |
|--------|--------------------------|----------|
| $C_L$  | 0 <sup>(1)</sup>         | pF       |
|        | 8 <sup>(1,2)</sup>       | pF       |
| $R_L$  | 50                       | $\Omega$ |

NOTE 1: Specifications only apply to “Normal Operations” test condition. The  $T_{IA}/E_{IA}$  specification load is for reference only.  
 NOTE 2: The scope inputs are assumed to have a 2pF load to ground.  $T_{IA}/E_{IA} - 644$  specifies 5pF between the output pair. With  $C_L = 8pF$ , this gives the test circuit appropriate 5pF equivalent load.

## Applications Information

### Recommendations for Unused Output Pins

#### Inputs:

##### LVC MOS Control Pins

The input controls must not be treated as unused inputs. All control pins are floating and have no default state. Each must be configured by tying a 1k $\Omega$  resistor to either ground or  $V_{DD}$ .

##### Clock Input

For applications not requiring the use of the second input clock  $Ax/nAx$ , it can be left floating. Though not required, but for additional protection, a 1k $\Omega$  resistor can be tied from  $Ax$  to ground and a 1k $\Omega$  resistor can be tied from  $nAx$  to  $V_{DD}$ .

#### Outputs:

##### LVDS Outputs

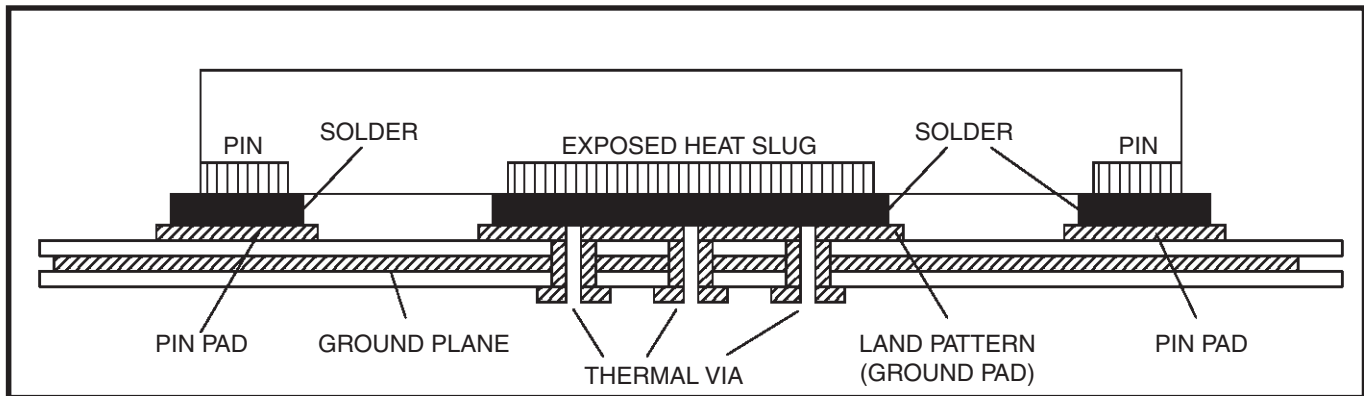
All unused LVDS output pairs can be either left floating or terminated with 100 $\Omega$  across. If they are left floating, we recommend that there is no trace attached.

## VFQFPN EPAD Thermal Release Path

In order to maximize both the removal of heat from the package and the electrical performance, a land pattern must be incorporated on the Printed Circuit Board (PCB) within the footprint of the package corresponding to the exposed metal pad or exposed heat slug on the package, as shown in *Figure 1*. The solderable area on the PCB, as defined by the solder mask, should be at least the same size/shape as the exposed pad/slug area on the package to maximize the thermal/electrical performance. Sufficient clearance should be designed on the PCB between the outer edges of the land pattern and the inner edges of pad pattern for the leads to avoid any shorts.

While the land pattern on the PCB provides a means of heat transfer and electrical grounding from the package to the board through a solder joint, thermal vias are necessary to effectively conduct from the surface of the PCB to the ground plane(s). The land pattern must be connected to ground through these vias. The vias act as “heat pipes”. The number of vias (i.e. “heat pipes”) are application specific

and dependent upon the package power dissipation as well as electrical conductivity requirements. Thus, thermal and electrical analysis and/or testing are recommended to determine the minimum number needed. Maximum thermal and electrical performance is achieved when an array of vias is incorporated in the land pattern. It is recommended to use as many vias connected to ground as possible. It is also recommended that the via diameter should be 12 to 13mils (0.30 to 0.33mm) with 1oz copper via barrel plating. This is desirable to avoid any solder wicking inside the via during the soldering process which may result in voids in solder between the exposed pad/slug and the thermal land. Precautions should be taken to eliminate any solder voids between the exposed heat slug and the land pattern. Note: These recommendations are to be used as a guideline only. For further information, please refer to the Application Note on the Surface Mount Assembly of Amkor's Thermally/Electrically Enhance Leadframe Base Package, Amkor Technology.



**Figure 1. P.C. Assembly for Exposed Pad Thermal Release Path – Side View (drawing not to scale)**




# Package Drawing and Dimensions, Continued

## 28 Lead VFQFPN Package Outline and Package Dimensions

| JEDEC VARIATION VJLC-3 |          |      |      |
|------------------------|----------|------|------|
| Symbol                 | MIN.     | NOM. | MAX. |
| $N_0$                  | 0.85 BSC |      |      |
| $N_1$                  | 28       |      |      |
| $N_2$                  |          |      | 2    |
| $N_3$                  | 7        |      | 2    |
| $N_4$                  | 0.25     | 0.30 | 0.35 |
| $N_5$                  | 4.8      |      | 10   |
| $N_6$                  | 4.8      |      | 10   |

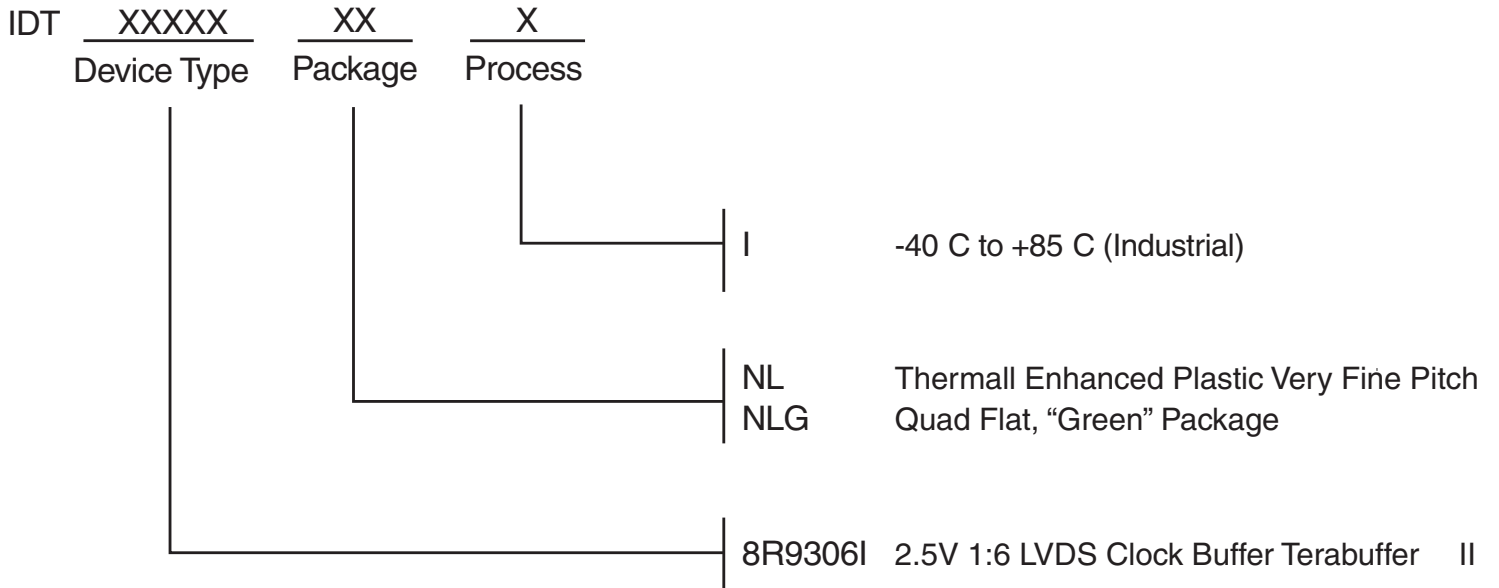
| COMMON DIMENSIONS |      |           |      |
|-------------------|------|-----------|------|
| Symbol            | MIN. | NOM.      | MAX. |
| A                 | 0.00 | 0.90      | 1.00 |
| A1                | 0.00 | 0.02      | 0.05 |
| A3                |      | 0.20 REF. |      |
| D                 |      | 6.00 BSC  |      |
| E                 |      | 6.00 BSC  |      |
| K                 | 0.20 |           |      |
| L                 | 0.35 | 0.40      | 0.45 |

- NOTES:
1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M, - 1994.
  2.  $N_0$  IS THE NUMBER OF TERMINALS.  
 $N_1$  IS THE NUMBER OF TERMINALS IN X-DIRECTION &  
 $N_2$  IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
  3. ALL DIMENSIONS ARE IN MILLIMETERS.
  4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.30mm FROM TERMINAL TIP.
  5. THE PIN #1 IDENTIFIER MUST EXIST ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR OTHER FEATURE OF PACKAGE BODY.
  6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
  7. APPLIED TO EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDED PART OF EXPOSED PAD FROM MEASURING.
  8. APPLIED ONLY FOR TERMINALS.
  9. THIS OUTLINE CONFORMS TO JEDEC PUBLICATION 95 REGISTRATION MO-220, VARIATION VJLC-3 & VJLC-5 WITH THE EXCEPTION OF D2 & E2.

|                                                                                                       |                       |
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| TITLE: NI/NUG28 PACKAGE OUTLINE<br>SIZE: 6.0 X 6.0 mm BODY<br>4.8 X 4.8 mm EPAD VFQFP-N               |                       |
| REV                                                                                                   | 00                    |
| DO NOT SCALE DRAWING                                                                                  | SHEET 2 OF 2          |



## Ordering Information



**Table 8. Ordering Information**

| Part/Order Number | Marking       | Package                    | Shipping Packaging | Temperature   |
|-------------------|---------------|----------------------------|--------------------|---------------|
| 8R9306NLGI        | IDT8R9306NLGI | "Lead-Free" 28 Lead VFQFPN | Tray               | -40°C to 85°C |
| 8R9306NLGI8       | IDT8R9306NLGI | "Lead-Free" 28 Lead VFQFPN | Tape & Reel        | -40°C to 85°C |

## Revision History Sheet

| Rev | Table             | Page                 | Description of Change                                                                                                                                                                                                            | Date      |
|-----|-------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| B   | T5F               | 9                    | Changed fo, Frequency Range Maximum from 1MHz to 1GHz.                                                                                                                                                                           | 4/11/2012 |
| C   | 4A<br>5F<br><br>8 | 1                    | Features, first bullet: changed 25ps to 40ps<br>Features, eighth bullet: changed two LVDS outputs to six LVDS outputs<br>Pin Assignment: changed dimensions from 5mm x 5mm to 6mm x 6mm<br>Pin Assignment: added EPad dimensions | 6/26/2013 |
|     |                   | 5                    | $I_{TOT}$ , Test Conditions: changed $F_{REF}$ Clock from 450MHz to 1GHz                                                                                                                                                         |           |
|     |                   | 8                    | $t_{sk(o)}$ : changed 25ps Max to 40ps Max                                                                                                                                                                                       |           |
|     |                   | 13                   | Added: Recommendations for Unused Output Pins                                                                                                                                                                                    |           |
|     |                   | 15, 16               | Updated Package Drawing                                                                                                                                                                                                          |           |
|     |                   | 17                   | Deleted quantity from Tape & Reel                                                                                                                                                                                                |           |
| D   |                   | 1, 14, 15,<br>16, 17 | Changed VFQFN to VFQFPN.                                                                                                                                                                                                         | 7/25/2013 |
| D   | T1                | 3                    | First row: Corrected typo - A[1:2].                                                                                                                                                                                              | 8/16/2013 |
|     |                   | 17                   | Added 'I' to Ordering Information diagram.                                                                                                                                                                                       |           |

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