

## General Description

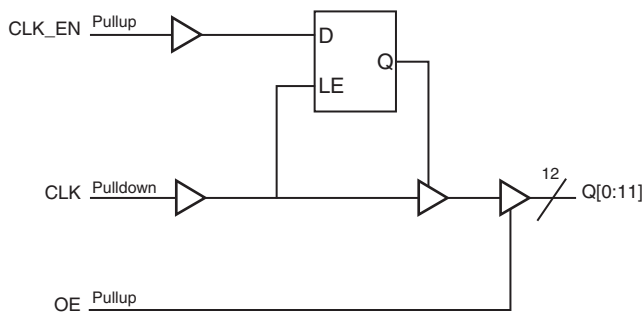
The 8312I is a low skew, 1-to-12 LVCMOS/ LVTTL Fanout Buffer and a member of the family of High Performance Clock Solutions from IDT. The 8312I single-ended clock input accepts LVCMOS or LVTTL input levels. The low impedance LVCMOS outputs are designed to drive 50Ω series or parallel terminated transmission lines. The effective fanout can be increased from 12 to 24 by utilizing the ability of the outputs to drive two series terminated lines.

The 8312I is characterized at full 3.3V, 2.5V, and 1.8V, mixed 3.3V/2.5V, 3.3V/1.8V and 2.5V/1.8V output operating supply modes. Guaranteed output and part-to-part skew characteristics along with the 1.8V output capabilities makes the 8312I ideal for high performance, single ended applications that also require a limited output voltage.

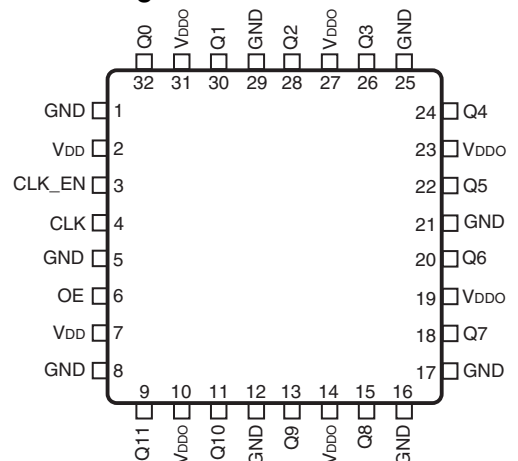
## Features

- Twelve LVCMOS/LVTTL outputs
- CLK input supports the following input types: LVCMOS, LVTTL
- Maximum output frequency: 250MHz
- Output skew: 160ps (maximum)
- Supply modes:  
Core/Output  
3.3V/3.3V  
3.3V/2.5V  
3.3V/1.8V  
2.5V/2.5V  
2.5V/1.8V  
1.8V/1.8V
- -40°C to 85°C ambient operating temperature
- Available in lead-free (RoHS 6) package

## Block Diagram



## Pin Assignment



8312I

32-Lead LQFP

7mm x 7mm x 1.4mm package body

Y Package

Top View

**Table 1. Pin Descriptions**

| Number                                        | Name                                             | Type   |          | Description                                                                                          |
|-----------------------------------------------|--------------------------------------------------|--------|----------|------------------------------------------------------------------------------------------------------|
| 1, 5, 8, 12, 16, 17, 21, 25, 29               | GND                                              | Power  |          | Power supply ground.                                                                                 |
| 2, 7                                          | V <sub>DD</sub>                                  | Power  |          | Positive supply pins.                                                                                |
| 3                                             | CLK_EN                                           | Input  | Pullup   | Synchronous control for enabling and disabling clock outputs. LVCMOS / LVTTTL interface levels.      |
| 4                                             | CLK                                              | Input  | Pulldown | Single-ended clock input. LVCMOS/LVTTTL interface levels.                                            |
| 6                                             | OE                                               | Input  | Pullup   | Output enable. Controls enabling and disabling of outputs Q[0:11]. LVCMOS / LVTTTL interface levels. |
| 9, 11, 13, 15, 18, 20, 22, 24, 26, 28, 30, 32 | Q11, Q10, Q9, Q8, Q7, Q6, Q5, Q4, Q3, Q2, Q1, Q0 | Output |          | Single-ended clock outputs. LVCMOS/LVTTTL interface levels.                                          |
| 10, 14, 19, 23, 27, 31                        | V <sub>DDO</sub>                                 | Power  |          | Output supply pins.                                                                                  |

NOTE: Pullup and Pulldown refer to internal input resistors. See Table 2, *Pin Characteristics*, for typical values.

**Table 2. Pin Characteristics**

| Symbol                | Parameter                                          | Test Conditions                | Minimum | Typical | Maximum | Units |
|-----------------------|----------------------------------------------------|--------------------------------|---------|---------|---------|-------|
| C <sub>IN</sub>       | Input Capacitance                                  |                                |         | 4       |         | pF    |
| R <sub>PULLUP</sub>   | Input Pullup Resistor                              |                                |         | 51      |         | kΩ    |
| R <sub>PULLDOWN</sub> | Input Pulldown Resistor                            |                                |         | 51      |         | kΩ    |
| C <sub>PD</sub>       | Power Dissipation Capacitance (per output); NOTE 1 | V <sub>DDO</sub> = 3.465V      |         |         | 19      | pF    |
|                       |                                                    | V <sub>DDO</sub> = 2.625V      |         |         | 18      | pF    |
|                       |                                                    | V <sub>DDO</sub> = 2.V         |         |         | 16      | pF    |
| R <sub>OUT</sub>      | Output Impedance                                   | V <sub>DDO</sub> = 3.3V ± 5%   |         | 7       |         | Ω     |
|                       |                                                    | V <sub>DDO</sub> = 2.5V ± 5%   |         | 7       |         | Ω     |
|                       |                                                    | V <sub>DDO</sub> = 1.8V ± 0.2V |         | 10      |         | Ω     |

## Function Tables

**Table 3A. Output Enable and Clock Enable Function Table**

| Inputs |        | Outputs           |
|--------|--------|-------------------|
| OE     | CLK_EN | Q [0:11]          |
| 0      | X      | Hi-Z              |
| 1      | 0      | LOW               |
| 1      | 1      | Follows CLK input |

**Table 3B. Output Enable and Clock Enable Function Table**

| Inputs |        |     | Outputs  |
|--------|--------|-----|----------|
| OE     | CLK_EN | CLK | Q [0:11] |
| 1      | 1      | 0   | LOW      |
| 1      | 1      | 1   | HIGH     |

## 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                    |
|------------------------------------------|---------------------------|
| Supply Voltage, $V_{DD}$                 | 4.6V                      |
| Inputs, $V_I$                            | -0.5V to $V_{DD} + 0.5V$  |
| Outputs, $V_O$                           | -0.5V to $V_{DDO} + 0.5V$ |
| Package Thermal Impedance, $\theta_{JA}$ | 47.9°C/W (0 lfm)          |
| Storage Temperature, $T_{STG}$           | -65°C to 150°C            |

## DC Electrical Characteristics

**Table 4A. Power Supply DC Characteristics,  $V_{DD} = V_{DDO} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

| Symbol    | Parameter               | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-------------------------|-----------------|---------|---------|---------|-------|
| $V_{DD}$  | Positive Supply Voltage |                 | 3.135   | 3.3     | 3.465   | V     |
| $V_{DDO}$ | Output Supply Voltage   |                 | 3.135   | 3.3     | 3.465   | V     |
| $I_{DD}$  | Power Supply Current    |                 |         |         | 10      | mA    |
| $I_{DDO}$ | Output Supply Current   |                 |         |         | 10      | mA    |

**Table 4B. Power Supply DC Characteristics,  $V_{DD} = V_{DDO} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

| Symbol    | Parameter               | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-------------------------|-----------------|---------|---------|---------|-------|
| $V_{DD}$  | Positive Supply Voltage |                 | 2.375   | 2.5     | 2.625   | V     |
| $V_{DDO}$ | Output Supply Voltage   |                 | 2.375   | 2.5     | 2.625   | V     |
| $I_{DD}$  | Power Supply Current    |                 |         |         | 10      | mA    |
| $I_{DDO}$ | Output Supply Current   |                 |         |         | 10      | mA    |

**Table 4C. Power Supply DC Characteristics,  $V_{DD} = V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

| Symbol    | Parameter               | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-------------------------|-----------------|---------|---------|---------|-------|
| $V_{DD}$  | Positive Supply Voltage |                 | 1.6     | 1.8     | 2.0     | V     |
| $V_{DDO}$ | Output Supply Voltage   |                 | 1.6     | 1.8     | 2.0     | V     |
| $I_{DD}$  | Power Supply Current    |                 |         |         | 10      | mA    |
| $I_{DDO}$ | Output Supply Current   |                 |         |         | 10      | mA    |

**Table 4D. Power Supply DC Characteristics,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 2.5V \pm 5\%$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$** 

| Symbol    | Parameter               | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-------------------------|-----------------|---------|---------|---------|-------|
| $V_{DD}$  | Positive Supply Voltage |                 | 3.135   | 3.3     | 3.465   | V     |
| $V_{DDO}$ | Output Supply Voltage   |                 | 2.375   | 2.5     | 2.625   | V     |
| $I_{DD}$  | Power Supply Current    |                 |         |         | 10      | mA    |
| $I_{DDO}$ | Output Supply Current   |                 |         |         | 10      | mA    |

**Table 4E. Power Supply DC Characteristics,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$** 

| Symbol    | Parameter               | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-------------------------|-----------------|---------|---------|---------|-------|
| $V_{DD}$  | Positive Supply Voltage |                 | 3.135   | 3.3     | 3.465   | V     |
| $V_{DDO}$ | Output Supply Voltage   |                 | 1.6     | 1.8     | 2.0     | V     |
| $I_{DD}$  | Power Supply Current    |                 |         |         | 10      | mA    |
| $I_{DDO}$ | Output Supply Current   |                 |         |         | 10      | mA    |

**Table 4F. Power Supply DC Characteristics,  $V_{DD} = 2.5V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$** 

| Symbol    | Parameter               | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-------------------------|-----------------|---------|---------|---------|-------|
| $V_{DD}$  | Positive Supply Voltage |                 | 2.375   | 2.5     | 2.625   | V     |
| $V_{DDO}$ | Output Supply Voltage   |                 | 1.6     | 1.8     | 2.0     | V     |
| $I_{DD}$  | Power Supply Current    |                 |         |         | 10      | mA    |
| $I_{DDO}$ | Output Supply Current   |                 |         |         | 10      | mA    |

**Table 4G. LVC MOS/LVTTL DC Characteristics,  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$** 

| Symbol   | Parameter                   |            | Test Conditions                                                                        | Minimum             | Typical | Maximum             | Units         |
|----------|-----------------------------|------------|----------------------------------------------------------------------------------------|---------------------|---------|---------------------|---------------|
| $V_{IH}$ | Input High Voltage          |            | $V_{DD} = 3.465\text{V}$                                                               | 2                   |         | $V_{DD} + 0.3$      | V             |
|          |                             |            | $V_{DD} = 2.625\text{V}$                                                               | 1.7                 |         | $V_{DD} + 0.3$      | V             |
|          |                             |            | $V_{DD} = 2.0\text{V}$                                                                 | $0.65 \cdot V_{DD}$ |         | $V_{DD} + 0.3$      | V             |
| $V_{IL}$ | Input Low Voltage           |            | $V_{DD} = 3.465\text{V}$                                                               | -0.3                |         | 1.3                 | V             |
|          |                             |            | $V_{DD} = 2.625\text{V}$                                                               | -0.3                |         | 0.7                 | V             |
|          |                             |            | $V_{DD} = 2.0\text{V}$                                                                 | -0.3                |         | $0.35 \cdot V_{DD}$ | V             |
| $I_{IH}$ | Input High Current          | CLK        | $V_{DD} = V_{IN} = 3.465\text{V}$ or $2.625\text{V}$ or $2.0\text{V}$                  |                     |         | 150                 | $\mu\text{A}$ |
|          |                             | OE, CLK_EN | $V_{DD} = V_{IN} = 3.465\text{V}$ or $2.625\text{V}$ or $2.0\text{V}$                  |                     |         | 5                   | $\mu\text{A}$ |
| $I_{IL}$ | Input Low Current           | CLK        | $V_{DD} = 3.465\text{V}$ or $2.625\text{V}$ or $2.0\text{V}$ ,<br>$V_{IN} = 0\text{V}$ | -5                  |         |                     | $\mu\text{A}$ |
|          |                             | OE, CLK_EN | $V_{DD} = 3.465\text{V}$ or $2.625\text{V}$ or $2.0\text{V}$ ,<br>$V_{IN} = 0\text{V}$ | -150                |         |                     | $\mu\text{A}$ |
| $V_{OH}$ | Output High Voltage; NOTE 1 |            | $V_{DDO} = 3.3\text{V} \pm 5\%$                                                        | 2.6                 |         |                     | V             |
|          |                             |            | $V_{DDO} = 2.5\text{V} \pm 5\%$ ;                                                      | 1.8                 |         |                     | V             |
|          |                             |            | $V_{DDO} = 2.5\text{V} \pm 5\%$ ; $I_{OH} = -1\text{mA}$                               | 2                   |         |                     | V             |
|          |                             |            | $V_{DDO} = 1.8\text{V} \pm 0.2\text{V}$                                                | $V_{DD} - 0.3$      |         |                     | V             |
|          |                             |            | $V_{DDO} = 1.8\text{V} \pm 0.2\text{V}$ ; $I_{OH} = -100\mu\text{A}$                   | $V_{DD} - 0.2$      |         |                     | V             |
| $V_{OL}$ | Output Low Voltage; NOTE 1  |            | $V_{DDO} = 3.3\text{V} \pm 5\%$                                                        |                     |         | 0.5                 | V             |
|          |                             |            | $V_{DDO} = 2.5\text{V} \pm 5\%$ ;                                                      |                     |         | 0.45                | V             |
|          |                             |            | $V_{DDO} = 2.5\text{V} \pm 5\%$ ; $I_{OL} = 1\text{mA}$                                |                     |         | 0.4                 | V             |
|          |                             |            | $V_{DDO} = 1.8\text{V} \pm 0.2\text{V}$                                                |                     |         | 0.35                | V             |
|          |                             |            | $V_{DDO} = 1.8\text{V} \pm 0.2\text{V}$ ; $I_{OL} = 100\mu\text{A}$                    |                     |         | 0.2                 | V             |

NOTE 1: Outputs terminated with  $50\Omega$  to  $V_{DDO}/2$ . See Parameter Measurement Information, *Output Load Test Circuit diagrams*.

# AC Electrical Characteristics

**Table 5A. AC Characteristics,  $V_{DD} = V_{DDO} = 3.3V \pm 5\%$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$**

| Parameter   | Symbol                                                                    | Test Conditions                          | Minimum | Typical | Maximum | Units |
|-------------|---------------------------------------------------------------------------|------------------------------------------|---------|---------|---------|-------|
| $f_{MAX}$   | Output Frequency                                                          |                                          |         |         | 250     | MHz   |
| $tp_{LH}$   | Propagation Delay, Low to High; NOTE 1                                    | $f \leq 250MHz$                          | 1.2     | 2.0     | 2.7     | ns    |
| $t_{jit}$   | Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter Section | 100MHz, Integration Range: 12kHz – 20MHz |         | 0.037   |         | ps    |
| $tsk(o)$    | Output Skew; NOTE 2, 5                                                    |                                          |         |         | 150     | ps    |
| $tsk(pp)$   | Part-to-Part Skew; NOTE 3, 5                                              |                                          |         |         | 850     | ps    |
| $t_R / t_F$ | Output Rise/Fall Time; NOTE 5                                             | 20% to 80%                               | 175     |         | 800     | ps    |
| odc         | Output Duty Cycle                                                         | $f \leq 150MHz$                          | 45      |         | 55      | %     |

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

NOTE 1: Measured from the  $V_{DD}/2$  of the input to  $V_{DDO}/2$  of the output.

NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at  $V_{DDO}/2$ .

NOTE 3: Defined as skew between outputs on different devices operating at the same supply voltage and with equal load conditions. Using the same type of input on each device, the output is measured at  $V_{DDO}/2$ .

NOTE 4: These parameters are guaranteed by characterization. Not tested in production.

NOTE 5: This parameter is defined in accordance with JEDEC Standard 65.

**Table 5B. AC Characteristics,  $V_{DD} = V_{DDO} = 2.5V \pm 5\%$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$**

| Parameter   | Symbol                                                                    | Test Conditions                          | Minimum | Typical | Maximum | Units |
|-------------|---------------------------------------------------------------------------|------------------------------------------|---------|---------|---------|-------|
| $f_{MAX}$   | Output Frequency                                                          |                                          |         |         | 250     | MHz   |
| $tp_{LH}$   | Propagation Delay, Low to High; NOTE 1                                    | $f \leq 250MHz$                          | 1.25    | 2.4     | 3.5     | ns    |
| $t_{jit}$   | Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter Section | 100MHz, Integration Range: 12kHz – 20MHz |         | 0.022   |         | ps    |
| $tsk(o)$    | Output Skew; NOTE 2, 5                                                    |                                          |         |         | 155     | ps    |
| $tsk(pp)$   | Part-to-Part Skew; NOTE 3, 5                                              |                                          |         |         | 1.1     | ns    |
| $t_R / t_F$ | Output Rise/Fall Time; NOTE 5                                             | 20% to 80%                               | 200     |         | 800     | ps    |
| odc         | Output Duty Cycle                                                         | $f \leq 150MHz$                          | 45      |         | 55      | %     |

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

NOTE 1: Measured from the  $V_{DD}/2$  of the input to  $V_{DDO}/2$  of the output.

NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at  $V_{DDO}/2$ .

NOTE 3: Defined as skew between outputs on different devices operating at the same supply voltage and with equal load conditions. Using the same type of input on each device, the output is measured at  $V_{DDO}/2$ .

NOTE 4: These parameters are guaranteed by characterization. Not tested in production.

NOTE 5: This parameter is defined in accordance with JEDEC Standard 65.

**Table 5C. AC Characteristics,  $V_{DD} = V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$** 

| Parameter   | Symbol                                                                    | Test Conditions                          | Minimum | Typical | Maximum | Units |
|-------------|---------------------------------------------------------------------------|------------------------------------------|---------|---------|---------|-------|
| $f_{MAX}$   | Output Frequency                                                          |                                          |         |         | 200     | MHz   |
| $tp_{LH}$   | Propagation Delay, Low to High; NOTE 1                                    | $f \leq 200MHz$                          | 1.6     | 3.3     | 4.9     | ns    |
| $t_{jit}$   | Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter Section | 100MHz, Integration Range: 12kHz – 20MHz |         | 0.172   |         | ps    |
| $tsk(o)$    | Output Skew; NOTE 2, 5                                                    |                                          |         |         | 160     | ps    |
| $tsk(pp)$   | Part-to-Part Skew; NOTE 3, 5                                              |                                          |         |         | 2.4     | ns    |
| $t_R / t_F$ | Output Rise/Fall Time; NOTE 5                                             | 20% to 80%                               | 175     |         | 875     | ps    |
| odc         | Output Duty Cycle                                                         | $f \leq 100MHz$                          | 45      |         | 55      | %     |

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

NOTE 1: Measured from the  $V_{DD}/2$  of the input to  $V_{DDO}/2$  of the output.

NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at  $V_{DDO}/2$ .

NOTE 3: Defined as skew between outputs on different devices operating at the same supply voltage and with equal load conditions. Using the same type of input on each device, the output is measured at  $V_{DDO}/2$ .

NOTE 4: These parameters are guaranteed by characterization. Not tested in production.

NOTE 5: This parameter is defined in accordance with JEDEC Standard 65.

**Table 5D. AC Characteristics,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 2.5V \pm 5\%$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$** 

| Parameter   | Symbol                                                                    | Test Conditions                          | Minimum | Typical | Maximum | Units |
|-------------|---------------------------------------------------------------------------|------------------------------------------|---------|---------|---------|-------|
| $f_{MAX}$   | Output Frequency                                                          |                                          |         |         | 250     | MHz   |
| $tp_{LH}$   | Propagation Delay, Low to High; NOTE 1                                    | $f \leq 250MHz$                          | 1.5     | 2.1     | 2.8     | ns    |
| $t_{jit}$   | Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter Section | 100MHz, Integration Range: 12kHz – 20MHz |         | 0.045   |         | ps    |
| $tsk(o)$    | Output Skew; NOTE 2, 5                                                    |                                          |         |         | 150     | ps    |
| $tsk(pp)$   | Part-to-Part Skew; NOTE 3, 5                                              |                                          |         |         | 1       | ns    |
| $t_R / t_F$ | Output Rise/Fall Time; NOTE 5                                             | 20% to 80%                               | 200     |         | 800     | ps    |
| odc         | Output Duty Cycle                                                         | $f \leq 150MHz$                          | 45      |         | 55      | %     |

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

NOTE 1: Measured from the  $V_{DD}/2$  of the input to  $V_{DDO}/2$  of the output.

NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at  $V_{DDO}/2$ .

NOTE 3: Defined as skew between outputs on different devices operating at the same supply voltage and with equal load conditions. Using the same type of input on each device, the output is measured at  $V_{DDO}/2$ .

NOTE 4: These parameters are guaranteed by characterization. Not tested in production.

NOTE 5: This parameter is defined in accordance with JEDEC Standard 65.

**Table 5E. AC Characteristics,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$** 

| Parameter    | Symbol                                                                    | Test Conditions                          | Minimum | Typical | Maximum | Units |
|--------------|---------------------------------------------------------------------------|------------------------------------------|---------|---------|---------|-------|
| $f_{MAX}$    | Output Frequency                                                          |                                          |         |         | 200     | MHz   |
| $t_{PLH}$    | Propagation Delay, Low to High; NOTE 1                                    | $f \leq 200MHz$                          | 1.5     | 2.5     | 3.5     | ns    |
| $t_{jit}$    | Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter Section | 100MHz, Integration Range: 12kHz – 20MHz |         | 0.136   |         | ps    |
| $t_{sk(o)}$  | Output Skew; NOTE 2, 5                                                    |                                          |         |         | 150     | ps    |
| $t_{sk(pp)}$ | Part-to-Part Skew; NOTE 3, 5                                              |                                          |         |         | 1.4     | ns    |
| $t_R / t_F$  | Output Rise/Fall Time; NOTE 5                                             | 20% to 80%                               | 200     |         | 800     | ps    |
| odc          | Output Duty Cycle                                                         | $f \leq 100MHz$                          | 45      |         | 55      | %     |

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

NOTE 1: Measured from the  $V_{DD}/2$  of the input to  $V_{DDO}/2$  of the output.

NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at  $V_{DDO}/2$ .

NOTE 3: Defined as skew between outputs on different devices operating at the same supply voltage and with equal load conditions.

Using the same type of input on each device, the output is measured at  $V_{DDO}/2$ .

NOTE 4: These parameters are guaranteed by characterization. Not tested in production.

NOTE 5: This parameter is defined in accordance with JEDEC Standard 65.

**Table 5F. AC Characteristics,  $V_{DD} = 2.5V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$** 

| Parameter    | Symbol                                                                    | Test Conditions                          | Minimum | Typical | Maximum | Units |
|--------------|---------------------------------------------------------------------------|------------------------------------------|---------|---------|---------|-------|
| $f_{MAX}$    | Output Frequency                                                          |                                          |         |         | 200     | MHz   |
| $t_{PLH}$    | Propagation Delay, Low to High; NOTE 1                                    | $f \leq 200MHz$                          | 1.4     | 2.7     | 3.9     | ns    |
| $t_{jit}$    | Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter Section | 100MHz, Integration Range: 12kHz – 20MHz |         | 0.114   |         | ps    |
| $t_{sk(o)}$  | Output Skew; NOTE 2, 5                                                    |                                          |         |         | 160     | ps    |
| $t_{sk(pp)}$ | Part-to-Part Skew; NOTE 3, 5                                              |                                          |         |         | 1.6     | ns    |
| $t_R / t_F$  | Output Rise/Fall Time; NOTE 5                                             | 20% to 80%                               | 200     |         | 800     | ps    |
| odc          | Output Duty Cycle                                                         | $f \leq 100MHz$                          | 45      |         | 55      | %     |

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

NOTE 1: Measured from the  $V_{DD}/2$  of the input to  $V_{DDO}/2$  of the output.

NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at  $V_{DDO}/2$ .

NOTE 3: Defined as skew between outputs on different devices operating at the same supply voltage and with equal load conditions.

Using the same type of input on each device, the output is measured at  $V_{DDO}/2$ .

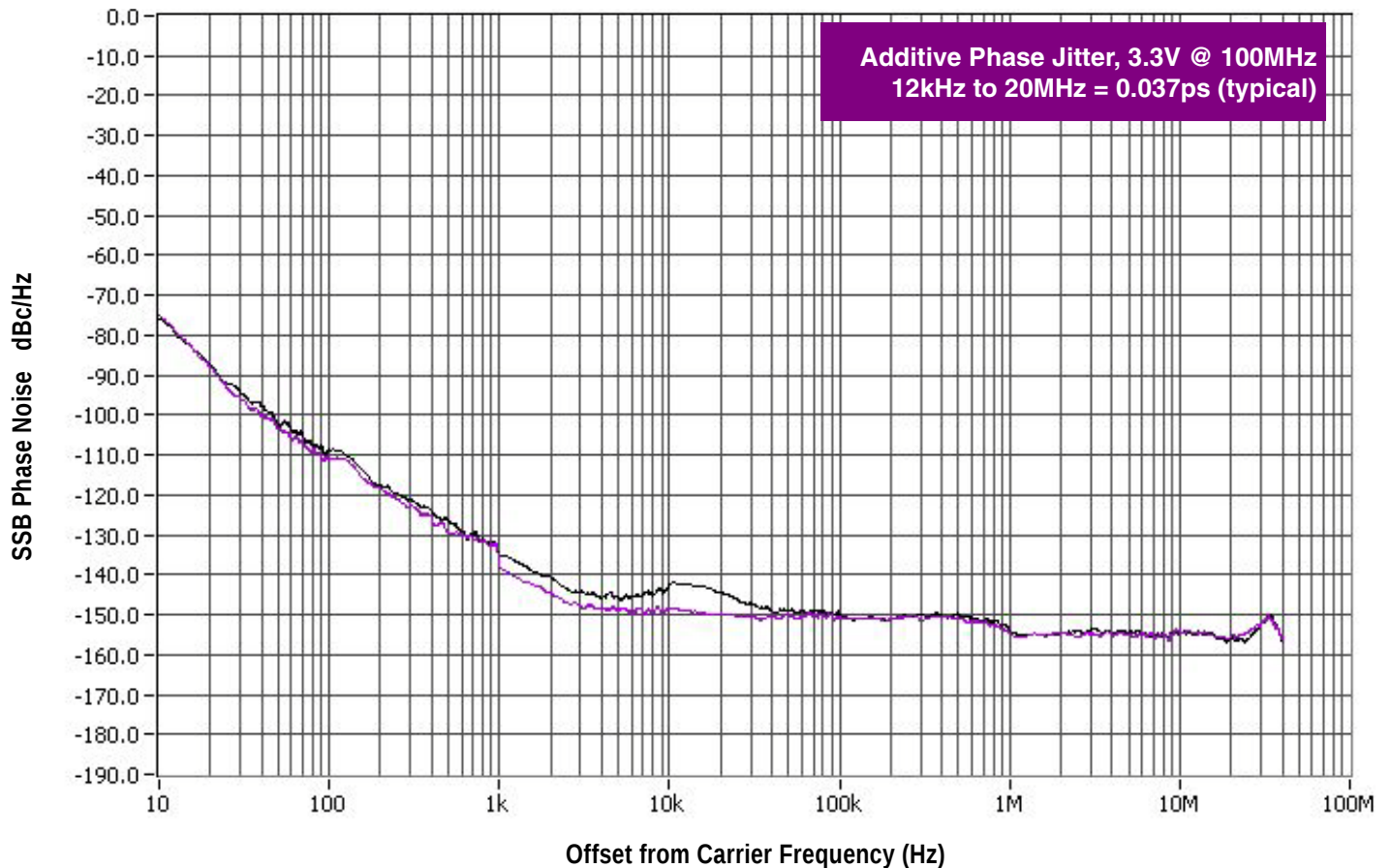
NOTE 4: These parameters are guaranteed by characterization. Not tested in production.

NOTE 5: This parameter is defined in accordance with JEDEC Standard 65.

## Additive Phase Jitter

The spectral purity in a band at a specific offset from the fundamental compared to the power of the fundamental is called the **dBc Phase Noise**. This value is normally expressed using a Phase noise plot and is most often the specified plot in many applications. Phase noise is defined as the ratio of the noise power present in a 1Hz band at a specified offset from the fundamental frequency to the power value of the fundamental. This ratio is expressed in decibels (dBm) or a ratio of the power in the 1Hz band

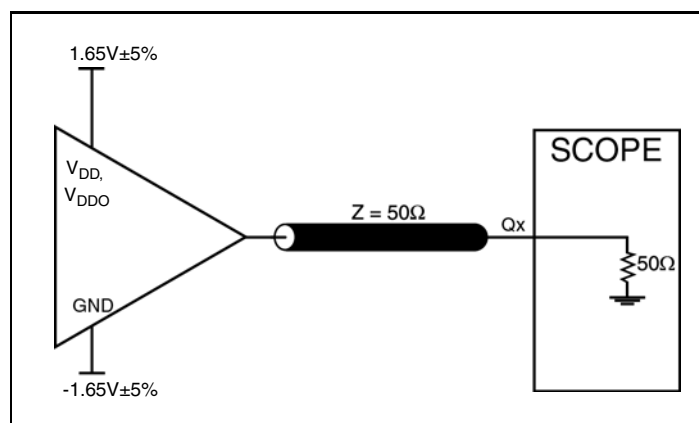
to the power in the fundamental. When the required offset is specified, the phase noise is called a **dBc** value, which simply means dBm at a specified offset from the fundamental. By investigating jitter in the frequency domain, we get a better understanding of its effects on the desired application over the entire time record of the signal. It is mathematically possible to calculate an expected bit error rate given a phase noise plot.



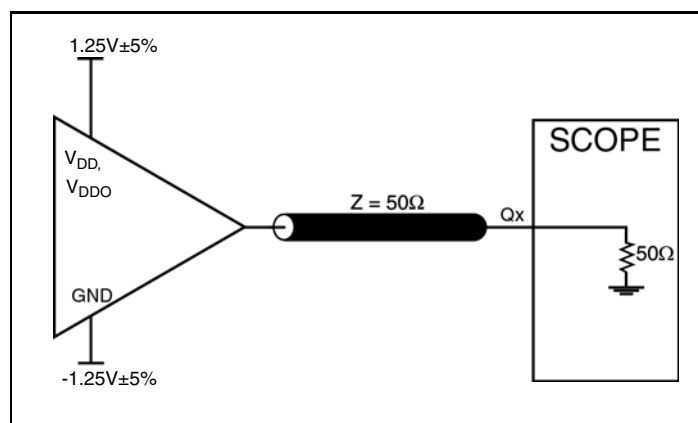
As with most timing specifications, phase noise measurements has issues relating to the limitations of the equipment. Often the noise floor of the equipment is higher than the noise floor of the

device. This is illustrated above. The device meets the noise floor of what is shown, but can actually be lower. The phase noise is dependent on the input source and measurement equipment.

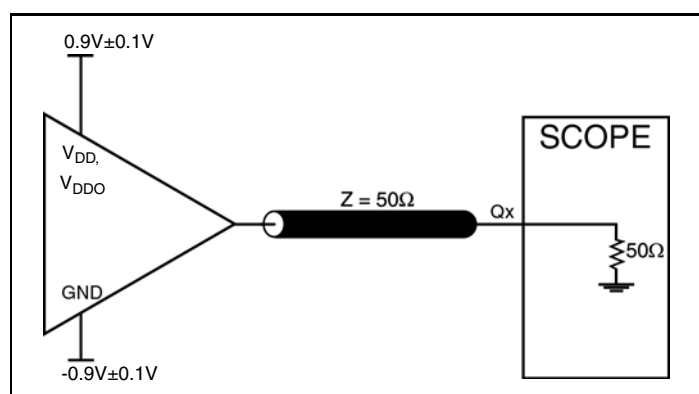
# Parameter Measurement Information



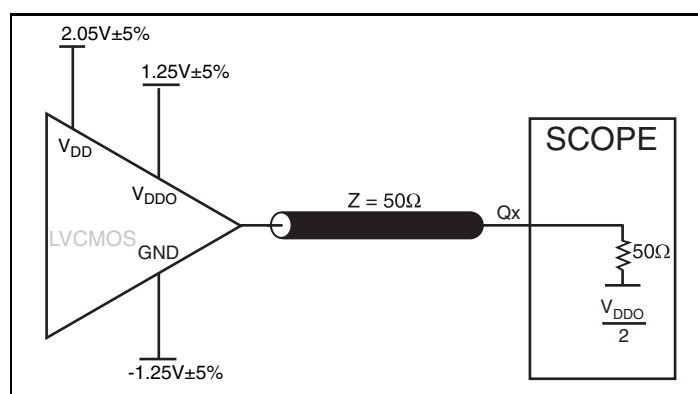
3.3V Core/3.3V LVCMOS Output Load AC Test Circuit



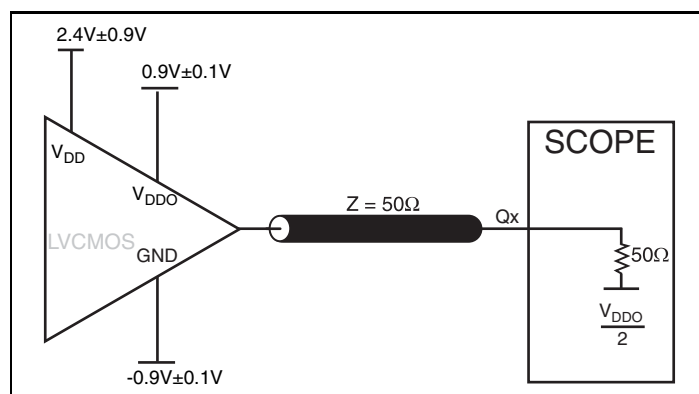
2.5V Core/2.5V LVCMOS Output Load AC Test Circuit



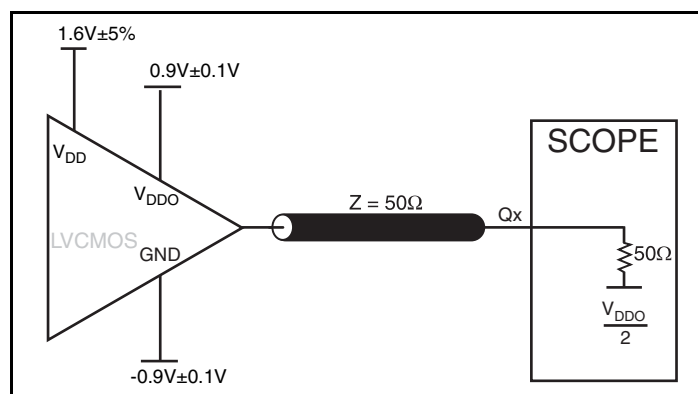
1.8V Core/1.8V LVCMOS Output Load AC Test Circuit



3.3V Core/2.5V LVCMOS Output Load AC Test Circuit

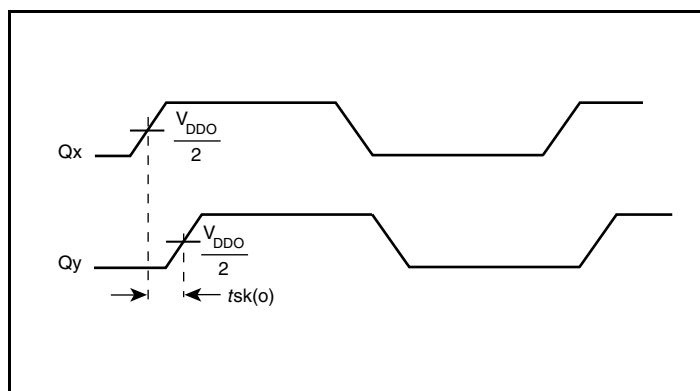


3.3V Core/1.8V LVCMOS Output Load AC Test Circuit

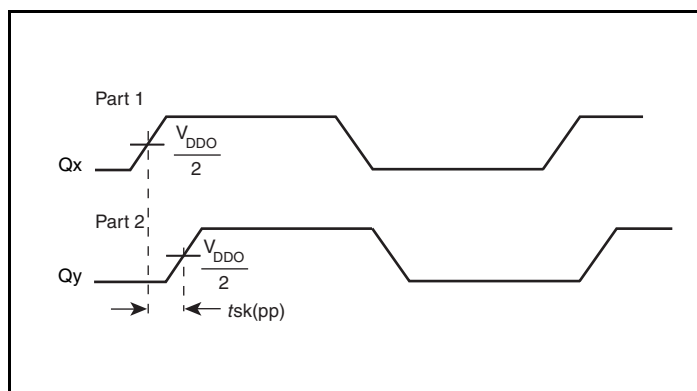


2.5V Core/1.8V LVCMOS Output Load AC Test Circuit

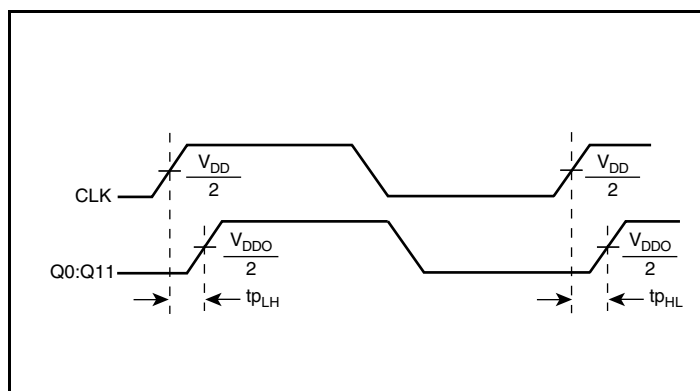
## Parameter Measurement Information, continued



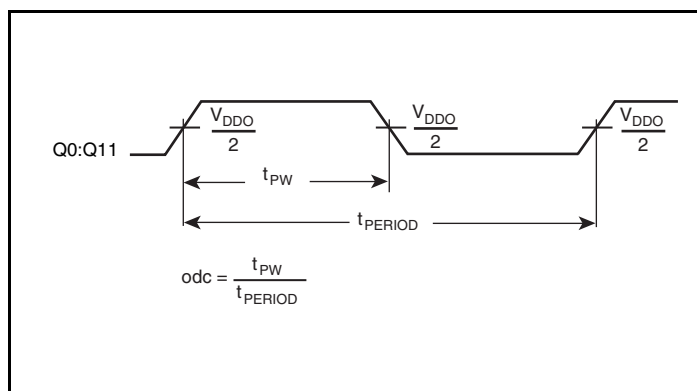
Output Skew



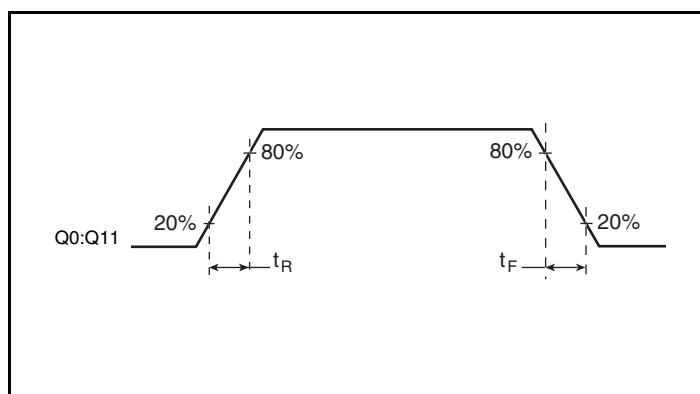
Part-to-Part Skew



Propagation Delay



Output Duty Cycle/Pulse Width/Period



Output Rise/Fall Time

## Application Information

### Recommendations for Unused Input and Output Pins

#### Inputs:

##### LVC MOS Control Pins:

All control pins have internal pull-ups or pull-downs; additional resistance is not required but can be added for additional protection. A 1k $\Omega$  resistor can be used.

#### Outputs:

##### LVC MOS Outputs:

All unused LVC MOS output can be left floating. There should be no trace attached.

## Reliability Information

**Table 6.  $\theta_{JA}$  vs. Air Flow Table for a 32 Lead LQFP**

| $\theta_{JA}$ vs. Air Flow                   |          |          |          |
|----------------------------------------------|----------|----------|----------|
| Linear Feet per Minute                       | 0        | 200      | 500      |
| Single-Layer PCB, JEDEC Standard Test Boards | 67.8°C/W | 55.9°C/W | 50.1°C/W |
| Multi-Layer PCB, JEDEC Standard Test Boards  | 47.9°C/W | 42.1°C/W | 39.4°C/W |

NOTE: Most modern PCB design use multi-layered boards. The data in the second row pertains to most designs.

## Transistor Count

The transistor count for 8312I is: 339

# Package Outline and Package Dimensions

## Package Outline - Y Suffix for 32 Lead LQFP

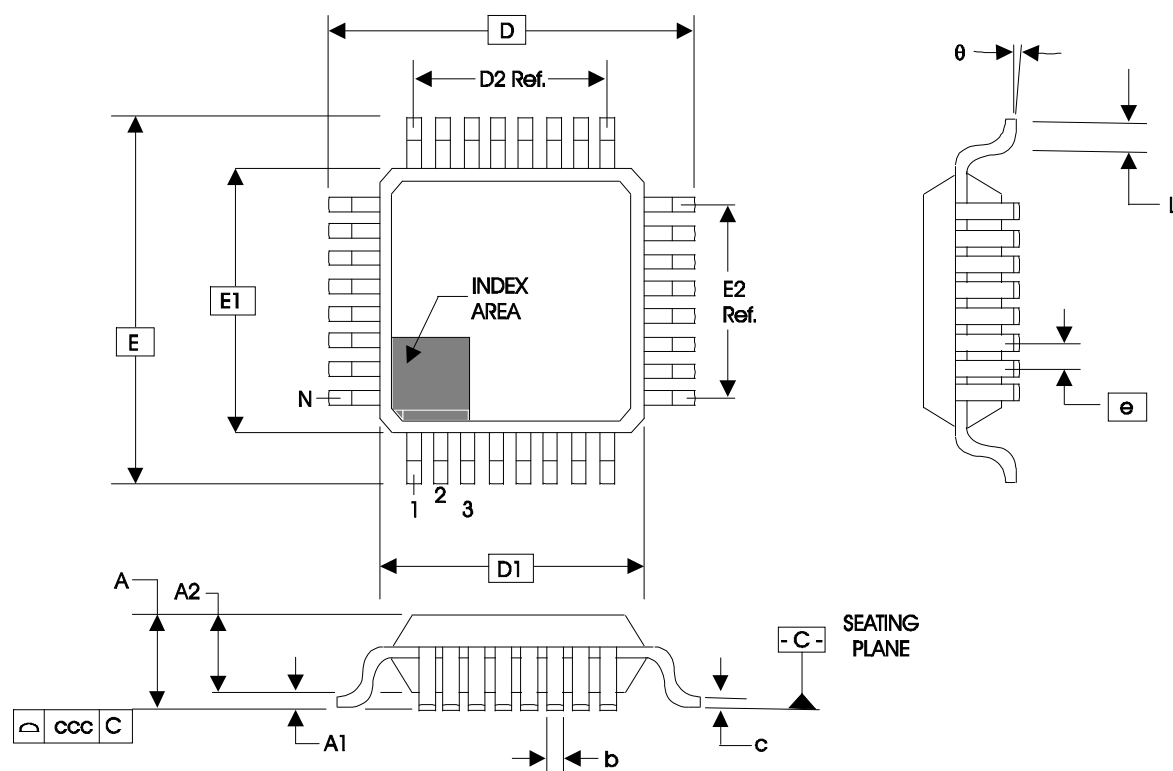


Table 7. Package Dimensions for 32 Lead LQFP

| JEDEC Variation: ABC - HD<br>All Dimensions in Millimeters |            |         |         |
|------------------------------------------------------------|------------|---------|---------|
| Symbol                                                     | Minimum    | Nominal | Maximum |
| N                                                          | 32         |         |         |
| A                                                          |            |         | 1.60    |
| A1                                                         | 0.05       | 0.10    | 0.15    |
| A2                                                         | 1.35       | 1.40    | 1.45    |
| b                                                          | 0.30       | 0.37    | 0.45    |
| c                                                          | 0.09       |         | 0.20    |
| D & E                                                      | 9.00 Basic |         |         |
| D1 & E1                                                    | 7.00 Basic |         |         |
| D2 & E2                                                    | 5.60 Ref.  |         |         |
| e                                                          | 0.80 Basic |         |         |
| L                                                          | 0.45       | 0.60    | 0.75    |
| θ                                                          | 0°         |         | 7°      |
| ccc                                                        |            |         | 0.10    |
| N                                                          | 32         |         |         |

Reference Document: JEDEC Publication 95, MS-026

## Ordering Information

Table 8. Ordering Information

| Part/Order Number | Marking      | Package                  | Shipping Packaging | Temperature   |
|-------------------|--------------|--------------------------|--------------------|---------------|
| 8312AYILF         | ICS8312AYILF | "Lead-Free" 32 Lead LQFP | Tray               | -40°C to 85°C |
| 8312AYILFT        | ICS8312AYILF | "Lead-Free" 32 Lead LQFP | 1000 Tape & Reel   | -40°C to 85°C |

## Revision History Sheet

| Rev | Table     | Page         | Description of Change                                                                                                                                                                                 | Date     |
|-----|-----------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| A   | T8        | 1<br>9<br>12 | Features section - added lead-free bullet.<br>Added <i>Recommendations for Unused Input &amp; Output Pins</i> section.<br>Ordering Information Table - added Lead-Free part number, marking and note. | 6/28/06  |
| B   | T5A - T5F | 7 - 9<br>10  | Added Additive Phase Jitter specs to AC Tables.<br>Added Additive Phase Jitter Plot.<br>Updated datasheet to new format.                                                                              | 6/6/08   |
| B   | 8         | 1<br>16      | Updated Datasheet format<br>Ordering Information - removed leaded devices - PDN CQ-13-02 expired.                                                                                                     | 11/4/14  |
| B   |           | 1<br>16      | Removed HiPerClockS from the description section.<br>Removed LF note below the Ordering information table.<br>Updated datasheet header and footer.                                                    | 12/14/15 |



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### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

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[NB7LQ572MNG](#) [HMC940LC4BTR](#) [ADCLK946BCPZ-REEL7](#) [ADCLK946BCPZ](#) [ADCLK846BCPZ-REEL7](#) [ADCLK854BCPZ-REEL7](#)  
[ADCLK905BCPZ-R2](#)