



**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 lfpm)
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,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  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		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,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^\circ\text{C}$  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		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,  $V_{DD} = 2.5V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^\circ\text{C}$  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		1.6	1.8	2.0	V
$I_{DD}$	Power Supply Current				10	mA
$I_{DDO}$	Output Supply Current				10	mA

**Table 4G. LVCMOS/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 $2.0\text{V}$ , $V_{IN} = 0\text{V}$	-5			$\mu\text{A}$
		OE, CLK_EN	$V_{DD} = 3.465\text{V}$ or $2.625\text{V}$ or $2.0\text{V}$ , $V_{IN} = 0\text{V}$	-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,  $V_{DD} = V_{DDO} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

Parameter	Symbol	Test Conditions	Minimum	Typical	Maximum	Units
$f_{MAX}$	Output Frequency				250	MHz
$t_{PLH}$	Propagation Delay, Low to High; NOTE 1	$f \leq 250\text{MHz}$	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
$t_{sk(o)}$	Output Skew; NOTE 2, 5				150	ps
$t_{sk(pp)}$	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	$f \leq 150\text{MHz}$	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,  $V_{DD} = V_{DDO} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

Parameter	Symbol	Test Conditions	Minimum	Typical	Maximum	Units
$f_{MAX}$	Output Frequency				250	MHz
$t_{PLH}$	Propagation Delay, Low to High; NOTE 1	$f \leq 250\text{MHz}$	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
$t_{sk(o)}$	Output Skew; NOTE 2, 5				155	ps
$t_{sk(pp)}$	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	$f \leq 150\text{MHz}$	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
$t_{PLH}$	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
$t_{sk(o)}$	Output Skew; NOTE 2, 5				160	ps
$t_{sk(pp)}$	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
$t_{PLH}$	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
$t_{sk(o)}$	Output Skew; NOTE 2, 5				150	ps
$t_{sk(pp)}$	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,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$** 

Parameter	Symbol	Test Conditions	Minimum	Typical	Maximum	Units
$f_{MAX}$	Output Frequency				200	MHz
$t_{PLH}$	Propagation Delay, Low to High; NOTE 1	$f \leq 200\text{MHz}$	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	$f \leq 100\text{MHz}$	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,  $V_{DD} = 2.5V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$** 

Parameter	Symbol	Test Conditions	Minimum	Typical	Maximum	Units
$f_{MAX}$	Output Frequency				200	MHz
$t_{PLH}$	Propagation Delay, Low to High; NOTE 1	$f \leq 200\text{MHz}$	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	$f \leq 100\text{MHz}$	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  $V_{DDO}/2$ .

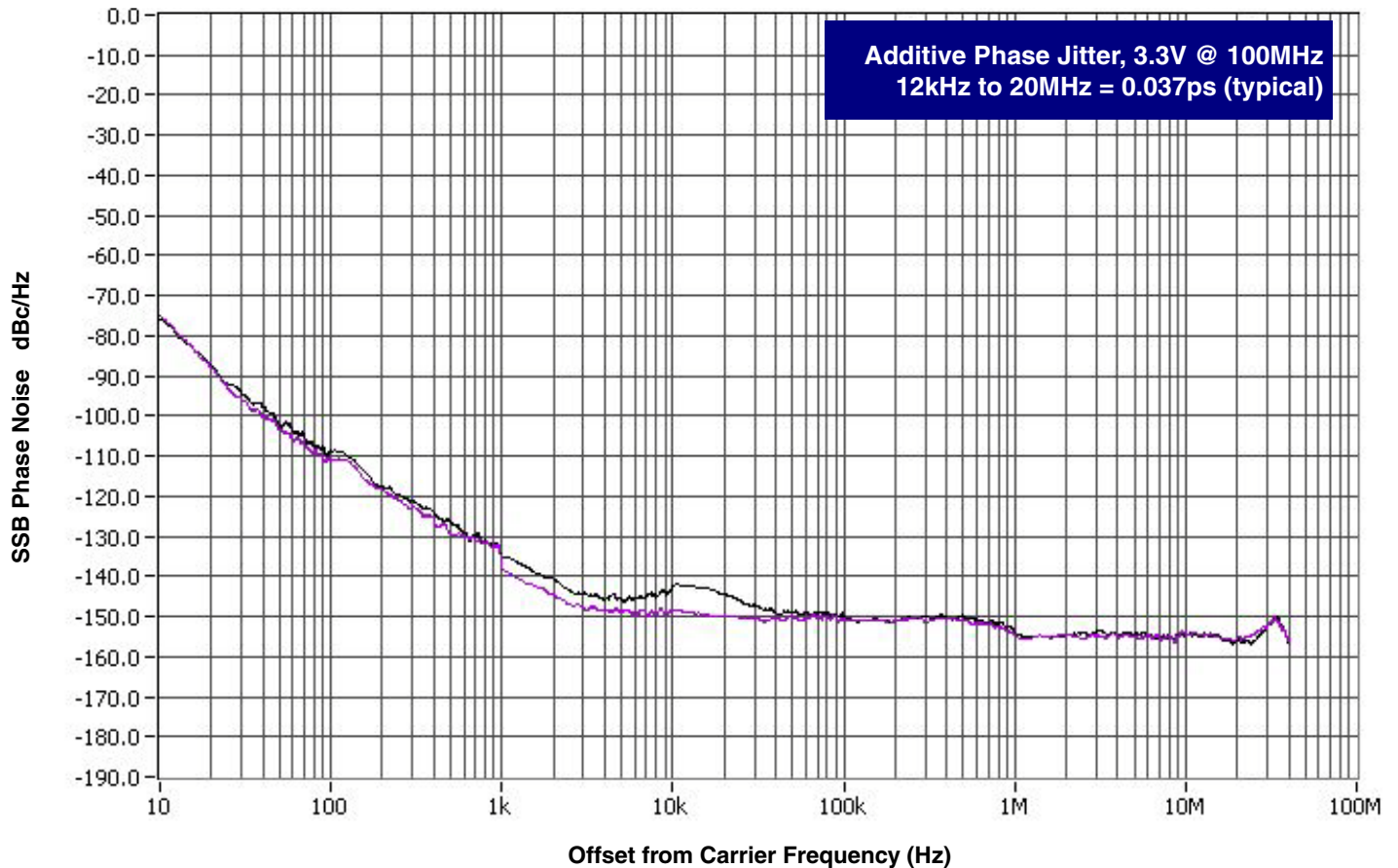
NOTE 4: These parameters are guaranteed by characterization. Not tested in production.

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

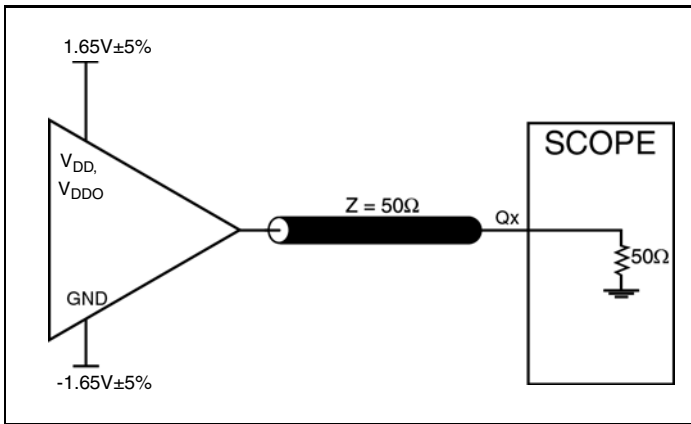
to the power in the fundamental. When the required offset is specified, the phase noise is called a **dBc** value, which simply means dBm at a specified offset from the fundamental. By investigating jitter in the frequency domain, we get a better understanding of its effects on the desired application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



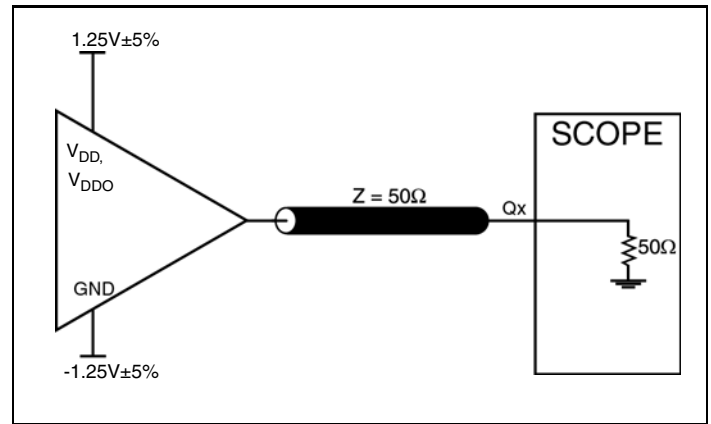
As with most timing specifications, phase noise measurements has issues relating to the limitations of the equipment. Often the noise floor of the equipment is higher than the noise floor of the

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

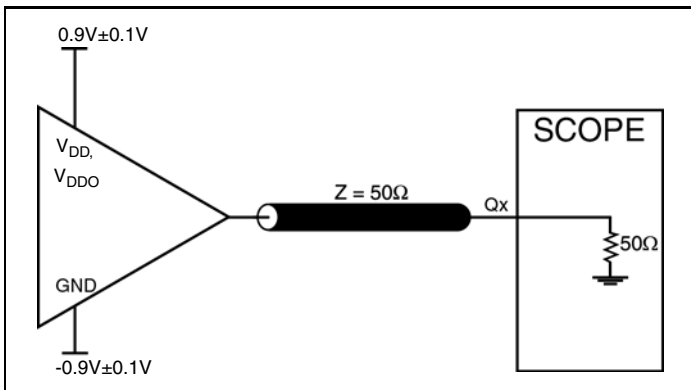
## Parameter Measurement Information



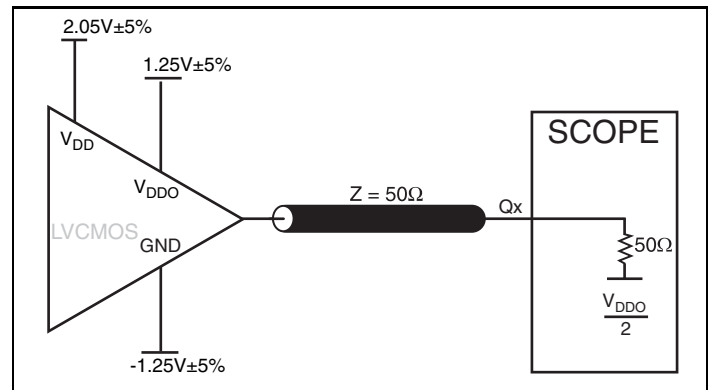
3.3V Core/3.3V LVCMOS Output Load AC Test Circuit



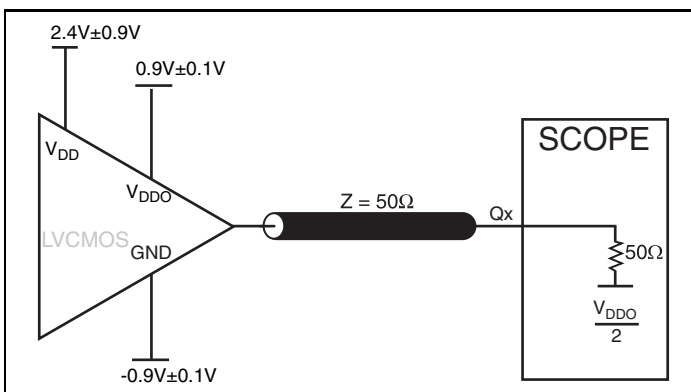
2.5V Core/2.5V LVCMOS Output Load AC Test Circuit



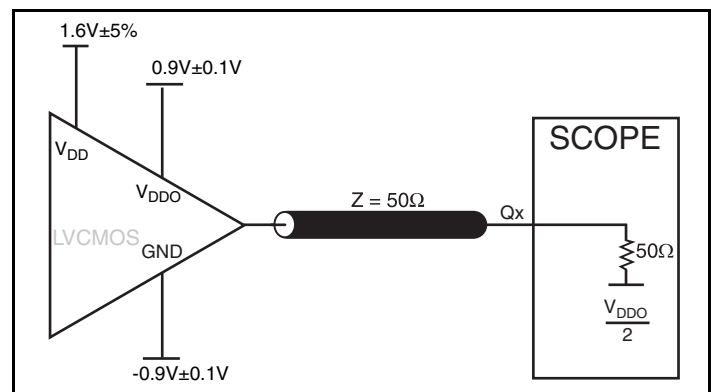
1.8V Core/1.8V LVCMOS Output Load AC Test Circuit



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

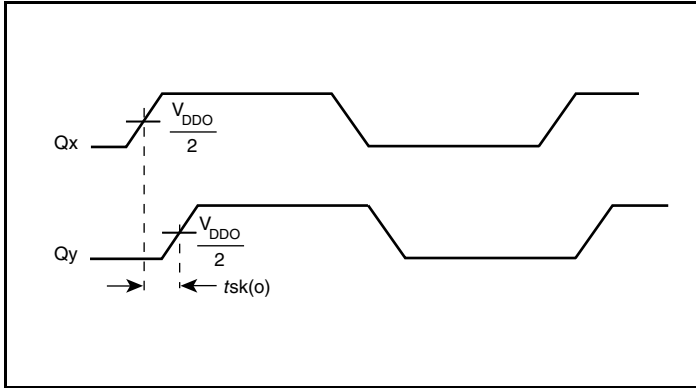


3.3V Core/1.8V LVCMOS Output Load AC Test Circuit

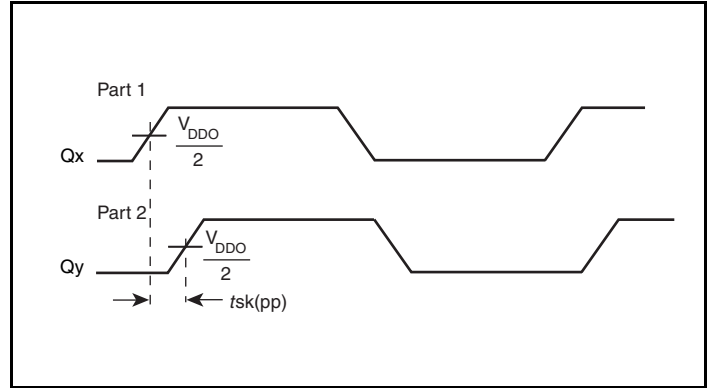


2.5V Core/1.8V LVCMOS Output Load AC Test Circuit

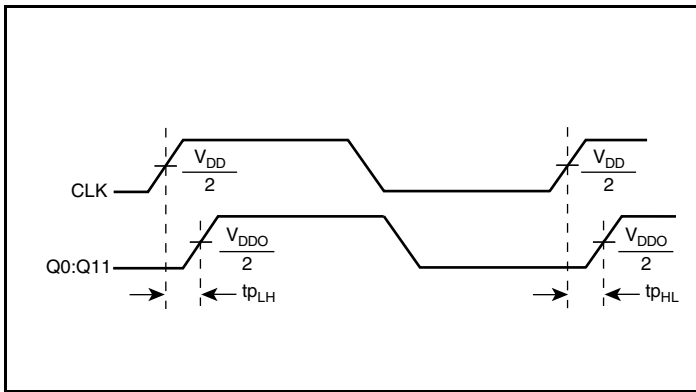
## Parameter Measurement Information, continued



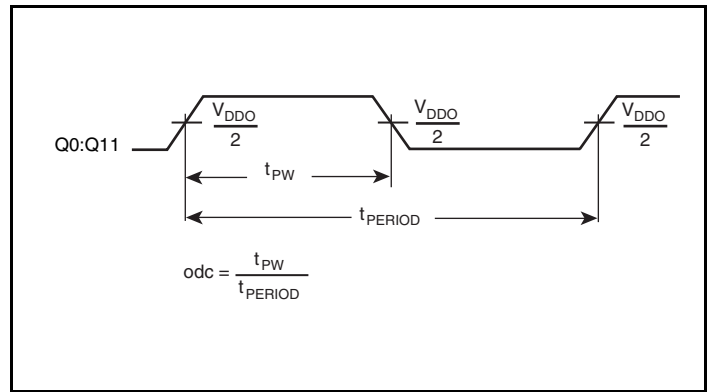
**Output Skew**



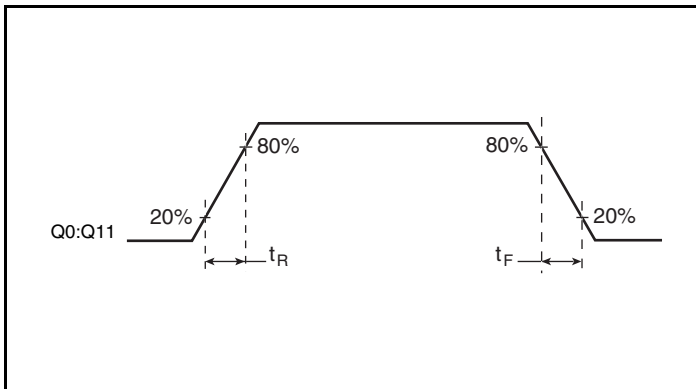
**Part-to-Part Skew**



**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

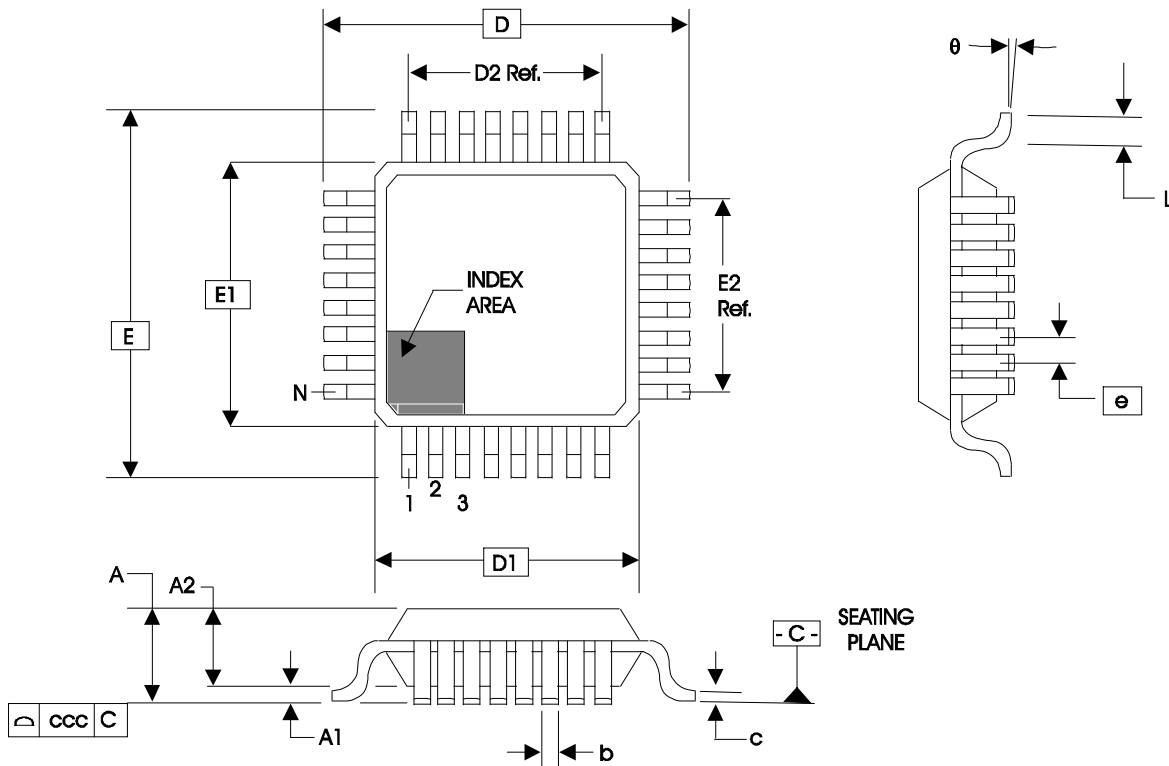
NOTE: Most modern PCB design use multi-layered boards. The data in the second row pertains to most designs.

## 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 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
$\theta$	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

NOTE: Parts that are ordered with an "LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.



## Revision History Sheet

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



**Corporate Headquarters**  
6024 Silver Creek Valley Road  
San Jose, CA 95138 USA

**Sales**  
1-800-345-7015 or 408-284-8200  
Fax: 408-284-2775  
www.IDT.com

**Tech Support**  
email: [clocks@idt.com](mailto:clocks@idt.com)

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