



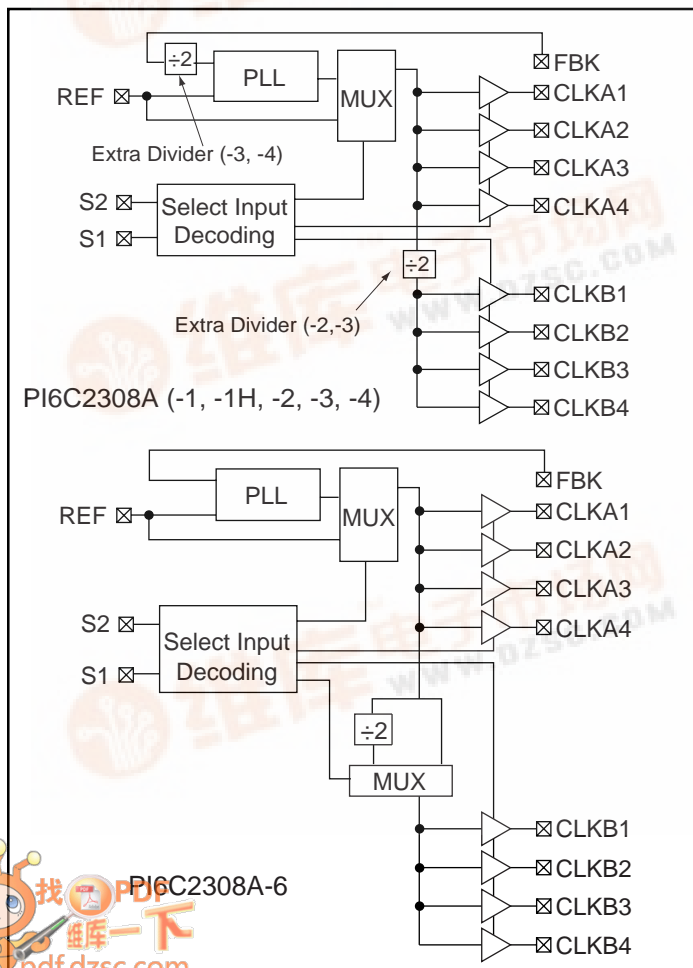
PI6C2308A

3.3V Zero-Delay Buffer

Product Features

- 10 MHz to 140 MHz operating range
- Zero input-output propagation delay, adjustable by capacitive load on FBK input
- Multiple configurations, see “Available PI6C2308A Configurations” table
- Input to output delay, less than 150ps
- Multiple low skew outputs
 - Output-output skew less than 200ps
 - Device-device skew less than 500ps
 - Two banks of four outputs, Hi-Z by two select inputs
- Low Jitter, less than 200ps
- 3.3V operation
- Available in industrial & commercial temperatures
- Packages:
 - Space-saving 16-pin, 150-mil SOIC (W)
 - 16-pin TSSOP (L)

Block Diagrams



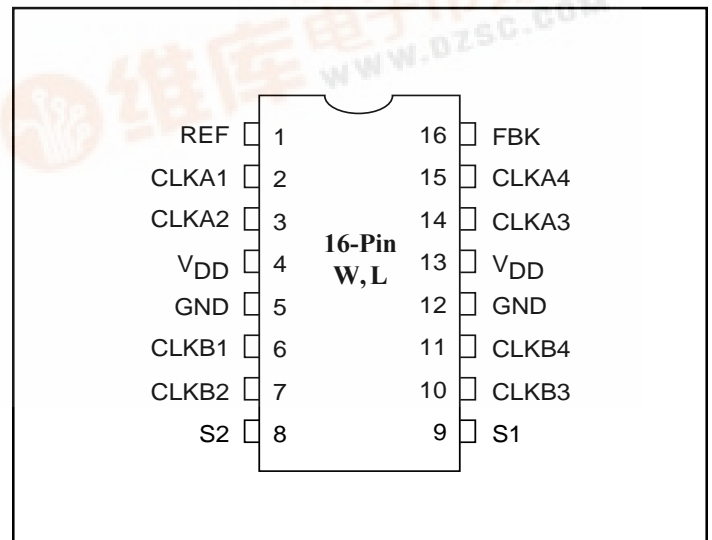
Functional Description

Providing two banks of four outputs, the PI6C2308A is a 3.3V zero-delay buffer designed to distribute clock signals in applications including PC, workstation, datacom, telecom, and high-performance systems. Each bank of four outputs can be controlled by the select inputs as shown in the Select Input Decoding Table.

The PI6C2308A provides 8 copies of a clock signal that has 150ps phase error compared to a reference clock. The skew between the output clock signals for PI6C2308A is less than 200ps. When there are no rising edges on the REF input, the PI6C2308A enters a power down state. In this mode, the PLL is off and all outputs are Hi-Z. This results in less than 12μA of current draw. The Select Input Decoding table shows additional examples when the PLL shuts down. The PI6C2308A configuration table shows all available devices.

The base part, PI6C2308A-1, provides output clocks in sync with a reference clock. With faster rise and fall times, the PI6C2308A-1H is the high-drive version of the PI6C2308A-1. Depending on which output drives the feedback pin, PI6C2308A-2 provides 2X and 1X clock signals on each output bank. The PI6C2308A-3 allows the user to obtain 4X and 2X frequencies on the outputs. The PI6C2308A-4 provides 2X clock signals on all outputs. PI6C2308A (-1, -2, -3, -4) allows bank B to be Hi-Z when all output clocks are not required. The PI6C2308A-6 allows bank B to switch from Reference clock to half of the frequency of Reference clock using the control inputs S1 and S2 if Bank A is connected to feedback FBK. In addition, using the control inputs S1 and S2, the PI6C2308A-6 allows bank A to switch from Reference clock to 2X the frequency of Reference clock if Bank B is connected to feedback FBK. For testing purposes, the select inputs connect the input clock directly to outputs.

Pin Configuration PI6C2308A (-1, -1H, -2, -3, -4, -6)





PI6C2308A 3.3V Zero Delay Buffer

Select Input Decoding for PI6C2308A (-1, -1H, -2, -3, -4)

S2	S1	CLKA [1-4]	CLKB [1-4]	Output Source	PLL Shutdown
0	0	Hi-Z	Hi-Z	PLL	Y
0	1	Driven	Hi-Z	PLL	N
1	0	Driven	Driven	Reference	Y
1	1	Driven	Driven	PLL	N

Select Input Decoding for PI6C2308A-6

S2	S1	CLKA [1-4]	CLKB [1-4]	Output Source	PLL Shutdown
0	0	Hi-Z	Hi-Z	PLL	Y
0	1	Driven = Reference	Driven = Reference/2	Reference	Y
1	0	Driven = PLL	Driven = PLL	PLL	N
1	1	Driven = PLL	Driven = PLL/2	PLL	N

Available PI6C2308A Configurations

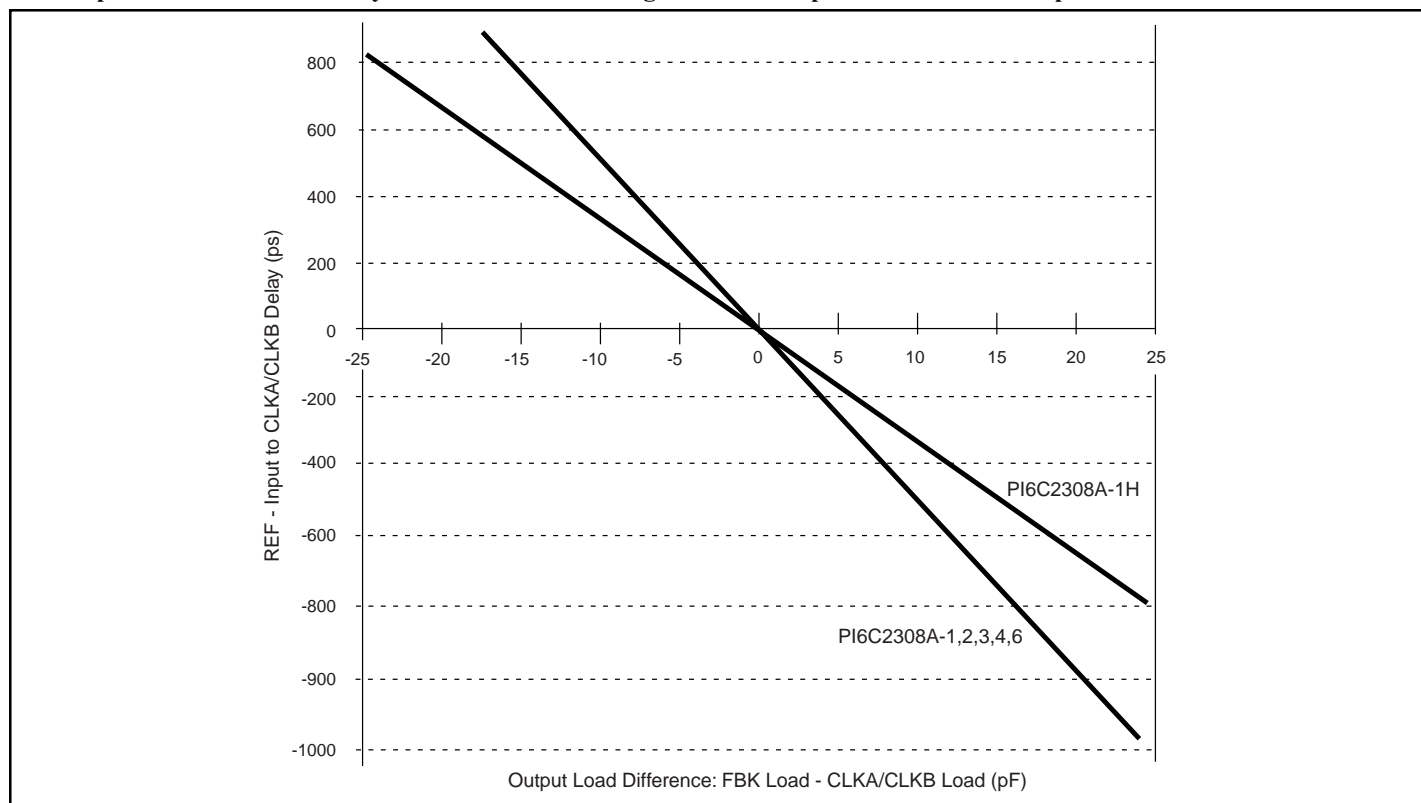
Device	Feedback From	Bank A Frequency	Bank B Frequency
PI6C2308A-1	Bank A or Bank B	Reference	Reference
PI6C2308A-1H	Bank A or Bank B	Reference	Reference
PI6C2308A-2	Bank A	Reference	Reference/2
PI6C2308A-2	Bank B	2X Reference	Reference
PI6C2308A-3	Bank A	2X Reference	Reference
PI6C2308A-3	Bank B	4X Reference	2X Reference
PI6C2308A-4	Bank A or Bank B	2X Reference	2X Reference
PI6C2308A-6	Bank A	Reference	Reference or Reference/2
PI6C2308A-6	Bank B	Reference or 2X Reference	Reference



PI6C2308A 3.3V Zero Delay Buffer

Zero Delay and Skew Control

REF. Input to CLKA/CLKB Delay vs. Difference in Loading between FBK pin and CLKA/CLKB pins



To close the feedback loop of the PI6C2308A, the FBK pin can be driven from any of the 8 available output pins. The output driving the FBK pin will be driving a total load of 7pF plus any additional load that it drives. The relative loading of this output (with respect to the remaining outputs) can adjust the input-output delay. This is shown in the graph above.

For applications requiring zero input-output delay, all outputs including the one providing feedback should be equally loaded. If input-output delay adjustments are required, use the above graph to calculate loading differences between the feedback output and remaining outputs.

Maximum Ratings

Supply Voltage to Ground Potential	-0.5V to +7.0V
DC Input Voltage (Except REF)	-0.5V to $V_{DD}+0.5V$
DC Input Voltage REF	-0.5 to 7V
Storage Temperature	-65°C to +150°C
Maximum Soldering Temperature (10 seconds)	260°C
Junction Temperature	150°C
Static Discharge Voltage (per MIL-STD-883, Method 3015)	>2000V

Operating Conditions (over the operating range, $T_A=0^{\circ}C$ to $+70^{\circ}C$, $V_{CC}=3.3V \pm 0.3V$)

Parameter	Description	Min.	Max.	Units
V_{DD}	Supply Voltage	3.0	3.6	V
T_A	Operating Temperature (Ambient)	0	70	°C
C_l	Load Capacitance	—	30	pF
C_{in}	Input Capacitance	—	7	



PI6C2308A
3.3V Zero Delay Buffer

Pin Description

Pin	Signal	Description
1	REF ⁽¹⁾	Input reference frequency, 5V Tolerant input, allows spread spectrum clock input
2	CLKA1 ⁽²⁾	Clock output, Bank A
3	CLKA2 ⁽²⁾	Clock output, Bank A
4	V _{DD}	3.3V supply
5	GND	Ground
6	CLKB1 ⁽²⁾	Clock output, Bank B
7	CLKB2 ⁽²⁾	Clock output, Bank B
8	S2 ⁽³⁾	Select input, bit 2
9	S1 ⁽³⁾	Select input, bit 1
10	CLKB3 ⁽²⁾	Clock output, Bank B
11	CLKB4 ⁽²⁾	Clock output, Bank B
12	GND	Ground
13	V _{DD}	3.3V, supply
14	CLKA3 ⁽²⁾	Clock output, Bank A
15	CLKA4 ⁽²⁾	Clock output, Bank A
16	FBK	PLL feedback input

Electrical Characteristics for Commercial Temperature Device

Parameter	Description	Test Conditions	Min.	Max.	Units
V _{IL}	Input LOW Voltage ⁽⁴⁾	—	—	0.8	V
V _{IH}	Input HIGH Voltage ⁽⁴⁾	—	2.0	—	
I _{IL}	Input LOW Current	V _{IN} = 0V	—	50.0	μA
I _{IH}	Input HIGH Current	V _{IN} = V _{DD}	—	200.0	
V _{OL}	Output LOW Voltage ⁽⁵⁾	I _{OL} = 8mA I _{OL} = 12mA (-1H)	—	0.4	V
V _{OH}	Output HIGH Voltage ⁽⁵⁾	I _{OH} = -8mA I _{OH} = -12mA (-1H)	2.4	—	
I _{DD} (PD mode)	Power Down Supply Current	REF = 0 MHz	—	12.0	μA
I _{DD}	Supply Current	Unloaded outputs, 66.66 MHz, Select inputs at V _{DD} or GND	—	39	mA
I _{DD}	Supply Current	Unloaded outputs, 100 MHz, Select inputs at V _{DD} or GND	—	54	



Switching Characteristics^(5,6) for Commercial Temperature Device

Parameters	Name	Test Conditions	Min.	Typ.	Max.	Units
F _{CLK}	Output Frequency	15pF to 30pF load	10		140	MHz
t ₂	Duty Cycle ⁽⁵⁾ = t ₂ ÷ t ₁	Measured at V _{DD} /2	45	50	55	%
	Duty Cycle ⁽⁵⁾ = t ₂ ÷ t ₁ (-1H)	Measured at 1.4V, F _{OUT} ≤45 MHz	45	50	55	
	Duty Cycle = t ₂ ÷ t ₁ (-1,-2,-3,-4,-6)	Measured at 1.4V	40	50	60	
t ₃	Rise Time ⁽⁵⁾ @30pF	Measured between 0.8V and 2.0V			2.2	ns
t ₃	Rise Time ⁽⁵⁾ @15pF				1.5	
t ₃	Rise Time ⁽⁵⁾ @30pF (-1H)				1.5	
t ₄	Fall Time ⁽⁵⁾ @30pF				2.2	
t ₄	Fall Time ⁽⁵⁾ @15pF				1.5	
t ₄	Fall Time ⁽⁵⁾ @30pF (-1H)				1.25	
t ₅	Output to Output Skew ⁽⁵⁾ same bank	All outputs equally loaded, V _{DD} /2			200	ps
t ₅	Output to Output Skew ⁽⁵⁾ different bank (-2,-3,-6)	All outputs equally loaded, V _{DD} /2			400	
t ₆	Delay, REF Rising Edge to FBK Rising Edge ⁽⁵⁾	Measured at V _{DD} /2		0	±150	
t ₇	Device to Device Skew ⁽⁵⁾	Measured at V _{DD} /2 on the FBK pins of devices		0	500	
t ₈	Output Slew Rate ⁽⁵⁾	Measured between 0.8V and 2.0V on -1H device using Test Circuit #2	1			V/ns
t _J	Cycle to Cycle Jitter ⁽⁵⁾	Measured at 66.67 MHz, loaded outputs			200	ps
t _{LOCK}	PLL Lock Time ⁽⁵⁾	Stable power supply, valid clocks presented on REF and FBK pins			1.0	ms

Notes:

1. Weak pull-down.
2. Weak pull-down on all outputs.
3. Weak pull-ups on these inputs.
4. REF and FBK inputs have a threshold voltage of V_{DD}/2.
5. Parameter is guaranteed by design and characterization. Not 100% tested in production.
6. For definition of t₁₋₈, see Switching Waveforms on page 6



Operating Conditions for Industrial Temperature Devices

Parameter	Description	Min.	Max.	Units
V _{DD}	Supply Voltage	3.0	3.6	V
T _A	Operating Temperature (Ambient Temperature)	−40	85	°C
C _L	Load Capacitance, below 100 MHz		30	pF
	Load Capacitance, from 100 MHz to 133 MHz		15	
C _{IN}	Input Capacitance		7	

Electrical Characteristics for Industrial Temperature Devices

Parameter	Description	Test Conditions	Min.	Max.	Units
V _{IL}	Input LOW Voltage			0.8	V
V _{IH}	Input HIGH Voltage		2.0		
I _{IL}	Input LOW Current	V _{IN} = 0V		50.0	μA
I _{IH}	Input HIGH Current	V _{IN} = V _{DD}		100.0	
V _{OL}	Output LOW Voltage ⁽⁴⁾	I _{OL} = 8 mA (−1,−2,−3,−4) I _{OL} = 12 mA (−1H,−5)		0.4	V
V _{OH}	Output HIGH Voltage ⁽⁴⁾	I _{OH} = −8 mA (−1,−2,−3,−4) I _{OH} = −12 mA (−1H,−5)	2.4		
I _{DD} (PD mode)	Power Down Supply Current	REF = 0 MHz		25.0	μA
I _{DD}	Supply Current	Unloaded outputs, 100 MHz, Select inputs at V _{DD} or GND		45.0	mA
				70.0 (−1H)	
		Unloaded outputs, 66 MHz, REF, except −1H		35.0	
		Unloaded outputs, 33 MHz, REF, except −1H		20.0	

Switching Characteristics for Industrial Temperature Devices⁽⁵⁾

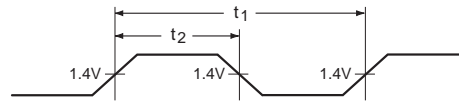
Parameter	Name	Test Conditions	Min.	Typ.	Max.	Units
t ₁	Output Frequency	30pF load, All devices	10		100	MHz
		20pF load, −1H, −5, devices			140	
		15pF load, −1,−2,−3,−4 devices			140	
t ₂	Duty Cycle ⁽⁴⁾ = t ₂ ÷ t ₁ (−1,−2,−3,−4)	Measured at 1.4V, F _{OUT} <66.66MHz 30-pF load	40.0	50.0	60.0	%
		Measured at 1.4V, F _{OUT} <100 MHz 15-pF load				
		Measured at 1.4V, F _{OUT} <133 MHz 15-pF load	35.0			
	Duty Cycle ⁽⁴⁾ = t ₂ ÷ t ₁ (−1H,−5)	Measured at 1.4V, F _{OUT} < 45MHz	40.0		55.0	
		Measured at 1.4V, F _{OUT} <66.66 MHz 15-pF load				
	Duty Cycle ⁽⁴⁾ = t ₂ ÷ t ₁ (−1H,−5)	Measured at 1.4V, F _{OUT} <45MHz	45.0			
t ₃	Rise Time ⁽⁴⁾ (−1,−2,−3,−4)	Measured between 0.8V and 2.0V, 30-pF load			2.2	ns
	Rise Time ⁽⁴⁾ (−1,−2,−3,−4)	Measured between 0.8V and 2.0V, 15-pF load			1.50	
	Rise Time ⁽⁴⁾ (−1H,−5)	Measured between 0.8V and 2.0V, 30-pF load			1.50	
t ₄	Fall Time ⁽⁴⁾ (−1,−2,−3,−4)	Measured between 0.8V and 2.0V, 30-pF load			2.50	
	Fall Time ⁽⁴⁾ (−1,−2,−3,−4)	Measured between 0.8V and 2.0V, 15-pF load			1.50	
	Fall Time ⁽⁴⁾ (−1H,−5)	Measured between 0.8V and 2.0V, 30-pF load			1.25	
t ₅	Output to Output Skew on same Bank (−1,−2,−3,−4) ⁽⁴⁾	All outputs equally loaded			200	ps
	Output to Output Skew (−1H,−5)					
	Output Bank A to Output Bank B Skew (−1,− 4,− 5)					
	Output Bank A to Output Bank B Skew (−2,− 3)				400	
t ₆	Delay, REF Rising Edge to FBK Rising Edge ⁽⁴⁾	Measured at V _{DD} /2		0	±150	
t ₇	Device to Device Skew ⁽⁴⁾	Measured at V _{DD} /2 MHz, on the FBK pins of devices			500	
t ₈	Output Slew Rate ⁽⁴⁾	Measured twx 0.8V & 2.0V on 1H,−5 device using Test Circuit #2.	1			V/ns
t _j	Cycle to Cycle Jitter ⁽⁴⁾ , (−1,− 1H,−5,− 4)	Measured at 66.67 MHz, loaded outputs, 30pF Load			200	ps
	Cycle to Cycle Jitter ⁽⁴⁾ , (−2,−3)	Measured at 66.67 MHz, loaded outputs, 15pF Load			100	
	Cycle to Cycle Jitter ⁽⁴⁾ , (−2,−3)	Measured at 66.67 MHz, loaded outputs			400	
t _{LOCK}	PLL Lock Time ⁽⁴⁾	Stable power supply, valid clocks presented on REF and FBK pins			1.0	ms

Notes:

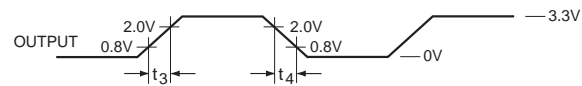
1. Weak pull-down.
2. Weak pull-down on all outputs.
3. Weak pull-ups on these inputs.
4. REF and FBK inputs have a threshold voltage of V_{DD}/2.
5. Parameter is guaranteed by design and characterization. Not 100% tested in production.
6. For definition of t₁₋₈, see Switching Waveforms on page 6

Switching Waveforms

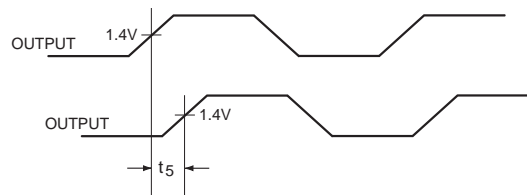
Duty Cycle Timing



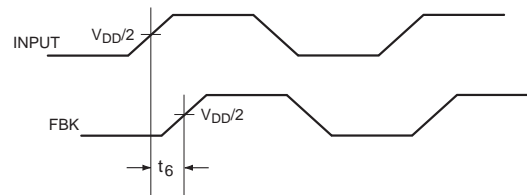
All Outputs Rise/Fall Time



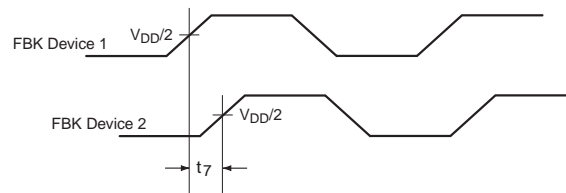
Output-Output Skew



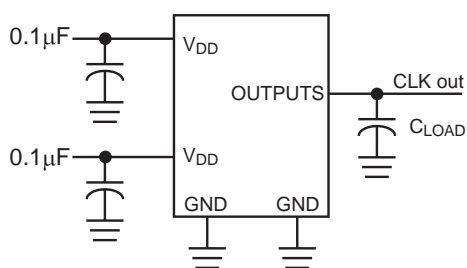
Input-Output Propagation Delay



Device-Device Skew

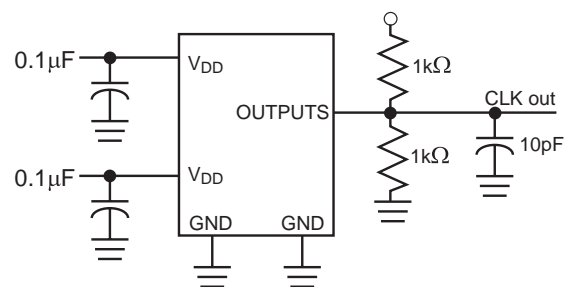


Test Circuit #1



Test Circuit for all parameters except t_8

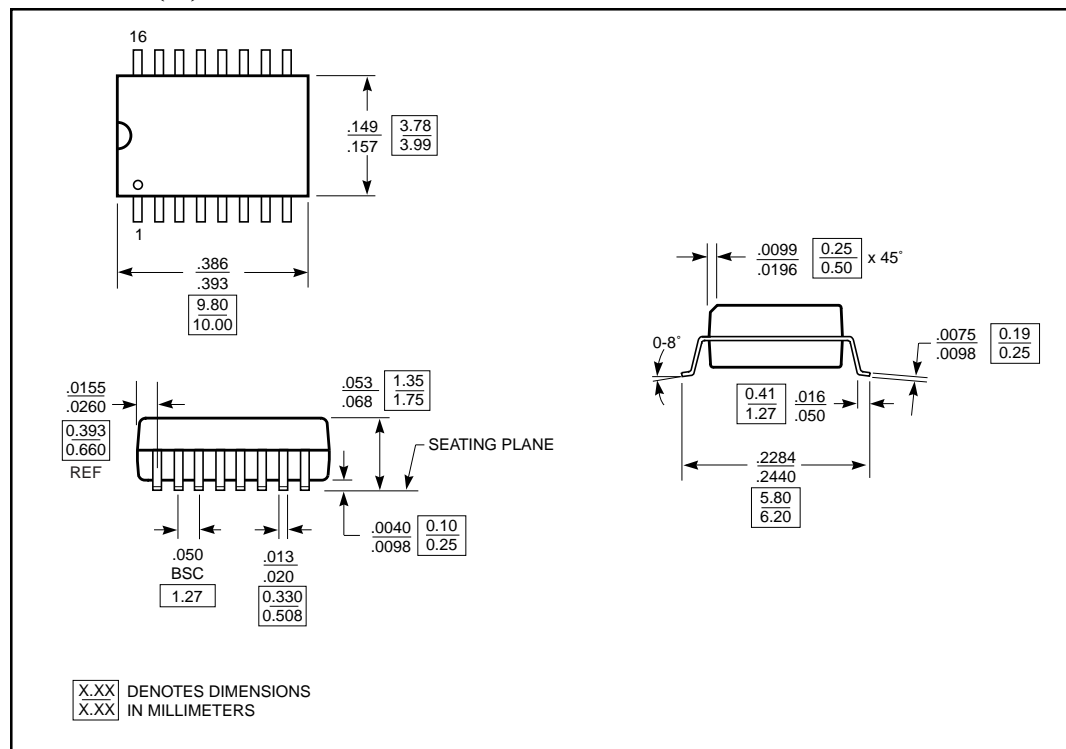
Test Circuit #2



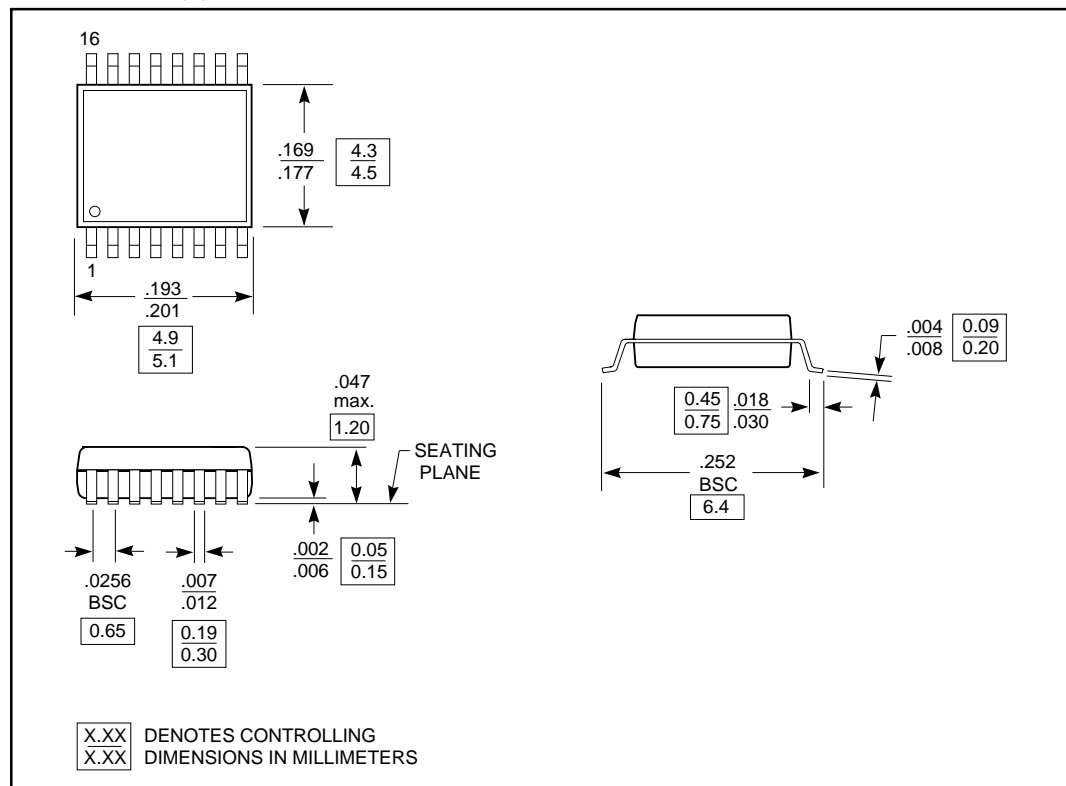
Test Circuit for t_8 , Output slew rate on -1H device

Package Diagrams

16-Pin SOIC (W)



16-Pin TSSOP (L)





PI6C2308A
3.3V Zero Delay Buffer

Ordering Information (Commercial Temperature Device)

Ordering Code	Package Name	Package Type	Operating Range
PI6C2308A-1W	W16	16-pin 150-mil SOIC	Commercial
PI6C2308A-1HW			
PI6C2308A-2W			
PI6C2308A-3W			
PI6C2308A-4W			
PI6C2308A-6W			
PI6C2308A-1L	L16	16-pin TSSOP	
PI6C2308A-1HL			
PI6C2308A-2L			
PI6C2308A3L			
PI6C2308A4L			
PI6C2308A-6L			

Ordering Information (Industrial Temperature Device)

Ordering Code	Package Name	Package Type	Operating Range
PI6C2308A-1WI	W16	16-pin 150-mil SOIC	Industrial
PI6C2308A-1HWI			
PI6C2308A-2WI			
PI6C2308A-3WI			
PI6C2308A-4WI			
PI6C2308A-6WI			
PI6C2308A-1LI	L16	16-pin TSSOP	
PI6C2308A-1HLI			
PI6C2308A-2LI			
PI6C2308A-3LI			
PI6C2308A-4LI			
PI6C2308A-6LII			