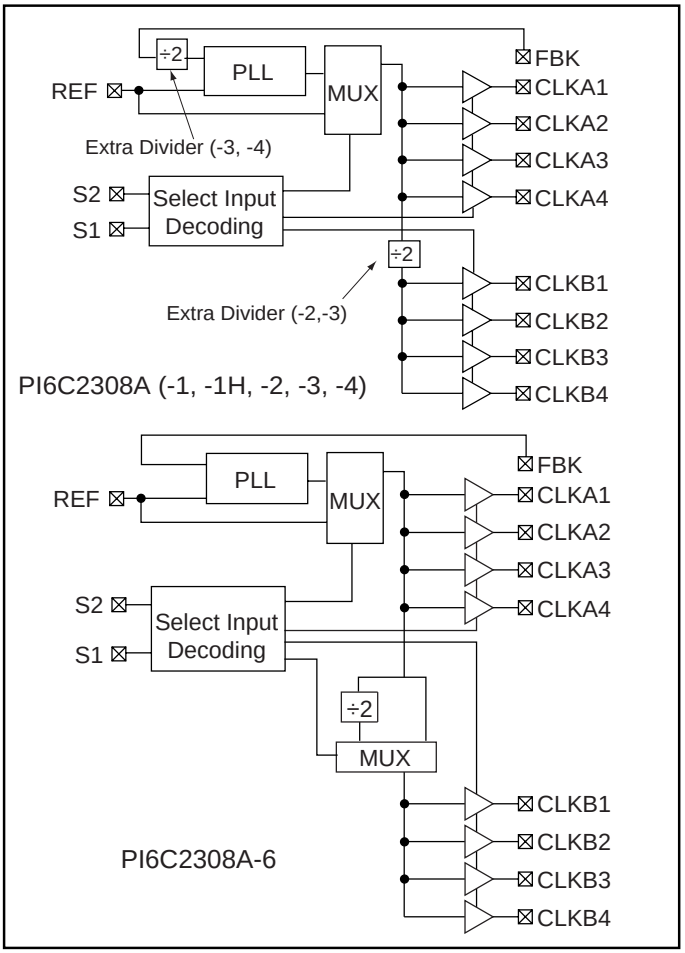
PI6C2308A

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



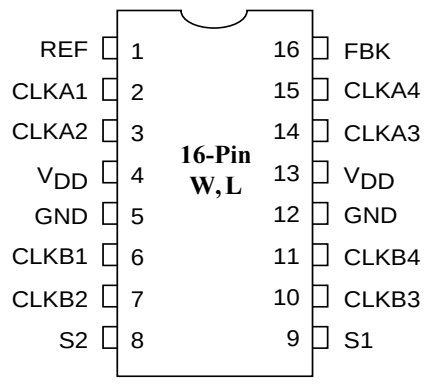
Functional Description

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)



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

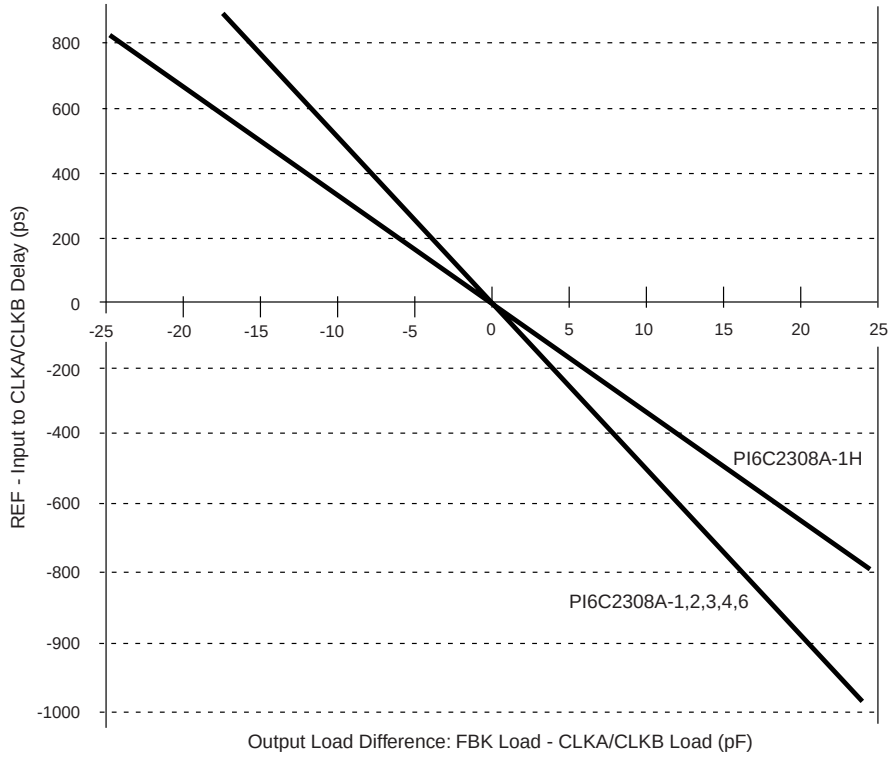
S2	S1	CLKA [1-4]	CLKB [1-4]	Output Source	PLL Shutdown
0	0	Hi-Z	Hi-Z	PLL	Y
0	1	Driven = Reference	Driven = Reference/2	Reference	Y
1	0	Driven = PLL	Driven = PLL	PLL	N
1	1	Driven = PLL	Driven = PLL/2	PLL	N

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

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 ..... –65ºC to +150ºC
Maximum Soldering Temperature (10 seconds) 260ºC
Junction Temperature 150ºC
Static Discharge Voltage
(per MIL-STD-883, Method 3015) ..... >2000V

Operating Conditions (over the operating range, T_A = 0ºC to +70°C, V_{CC} = 3.3V ±0.3V)

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

Pin Description

Pin	Signal	Description
1	REF(1)	Input reference frequency, 5VTolerant 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 (–1,–2,–3,–4,–6) I_{OL} = 12mA (-1H)	—	0.4	V
V_{OH}	Output HIGH Voltage(5)	I_{OH} = –8mA (–1,–2,–3,–4,–6) 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] for Commercial Temperature Device

Parameters	Name	Test Conditions	Min.	Typ.	Max.	Units
t_1	Output Frequency	15pF to 30pF load	10		140	MHz
t_2	Duty Cycle[4] = $t_2 \div t_1$	Measured at $V_{DD}/2$	45	50	55	%
	Duty Cycle[4] = $t_2 \div t_1$ (-1H)	Measured at 1.4V, F_{OUT} ≤45 MHz	45	50	55	
	Duty Cycle[4] = $t_2 \div t_1$ (-1,-2,-3,-4,-6)	Measured at 1.4V	40	50	60	
t_3	Rise Time[4] @30pF	Measured between 0.8V and 2.0V			2.2	
	Rise Time[4] @15pF				1.5	
	Fall Time[4] @30pF (–1H)				1.5	
t_4	Fall Time[4] @30pF				2.2	
	Rise Time[4] @15pF				1.5	
	Fall Time[4] @30pF (–1H)				1.25	
t_5	Output to Output Skew[4] same bank on (–1,–1H,–2,–3,–4,–6)	All outputs equally loaded, $V_{DD}/2$			200	ps
	Output Bank A to Output Bank B Skew[4] (–1,–1H,–4)				200	
	Output Bank A to Output Bank B Skew[4] (–2,–3,–6)				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 $V_{DD}/2$ on the FBK pins of devices		0	500	
t_8	Output Slew Rate[4]	Measured between 0.8V and 2.0V on -1H device using Test Circuit #2	1			V/ns
t_J	Cycle to Cycle Jitter[4] (–1,–1H,–4)	Measured at 66.67 MHz, loaded outputs, 30pF load			200	ps
		Measured at 133 MHz, loaded outputs, 15pF load			100	
	Cycle to Cycle Jitter[4] (–2,–3,–6)	Measured at 66.67 MHz, loaded outputs, 30pF load			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 threshhold voltage of $V_{DD}/2$.
5. For definition of t_{1-8}, see Switching Waveforms on page 8.

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} = 8mA (–1,–2,–3,–4,–6) I_{OL} = 12mA (–1H)		0.4	V
V_{OH}	Output HIGH Voltage[4]	I_{OH} = –8mA (–1,–2,–3,–4,–6) I_{OH} = –12mA (–1H)	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	

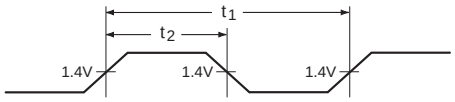
Switching Characteristics for Industrial Temperature Devices[5]

Parameter	Name	Test Conditions	Min.	Typ.	Max.	Units
t_1	Output Frequency	30pF load, All devices	10		100	MHz
		20pF load, –1H device			140	
		15pF load, –1,–2,–3,–4,–6 devices			140	
t_2	Duty Cycle[4] = $t_2 \div t_1$ (–1,–2,–3,–4,–6)	Measured at 1.4V, F_{OUT} <66.66 MHz 30pF load	40.0	50.0	60.0	%
		Measured at 1.4V, F_{OUT} <133 MHz 30pF load				
		Measured at 1.4V, F_{OUT} <45 MHz 30pF load	45.0		55.0	
	Duty Cycle[4] = $t_2 \div t_1$ (–1H,)	Measured at 1.4V, F_{OUT} < 66.6 MHz 30pF load	45.0		55.0	
		Measured at 1.4V, F_{OUT} <133 MHz 15pF load	40.0		60.0	
		Measured at 1.4V, F_{OUT} <45 MHz 30pF load	45.0		55.0	
t_3	Rise Time[4] (–1,–2,–3,–4,–6)	Measured between 0.8V and 2.0V, 30pF load			2.2	ns
		Measured between 0.8V and 2.0V, 15pF load			1.50	
	Rise Time[4] (–1H)	Measured between 0.8V and 2.0V, 30pF load				
t_4	Fall Time[4] (–1,–2,–3,–4)	Measured between 0.8V and 2.0V, 30pF load			2.50	
		Measured between 0.8V and 2.0V, 15pF load			1.50	
	Fall Time[4] (–1H)	Measured between 0.8V and 2.0V, 30pF load			1.25	
t_5	Output to Output Skew on same Bank (–1,–2,–3,–4,–6)[4]	All outputs equally loaded			200	ps
	Output Bank A to Output Bank B Skew (–1, –1H,–4)					
	Output Bank A to Output Bank B Skew (–2,– 3,–6)				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 between 0.8V & 2.0V on 1H,–5 device using Test Circuit #2.	1			V/ns
t_J	Cycle to Cycle Jitter[4], (–1,– 1H,– 4)	Measured at 66.67 MHz, loaded outputs, 30pF Load			200	ps
		Measured at 133 MHz, loaded outputs, 15pF Load			100	
	Cycle to Cycle Jitter[4], (–2,–3,–6)	Measured at 66.67 MHz, loaded outputs, 30pF load			400	
t_{LOCK}	PLL Lock Time[4]	Stable power supply, valid clocks presented on REF and FBK pins			1.0	ms

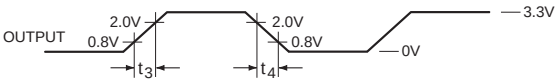
Notes:
1. Weak pull-down.
2. Weak pull-down on all outputs.
3. Weak pull-ups on these inputs.
4. REF and FBK inputs have a threshhold voltage of $V_{DD}/2$.
5. For definition of $t_{1\text{-}8}$, see Switching Waveforms on page 8.

Switching Waveforms

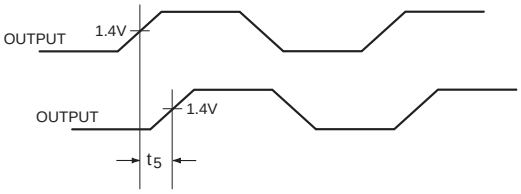
Duty Cycle Timing



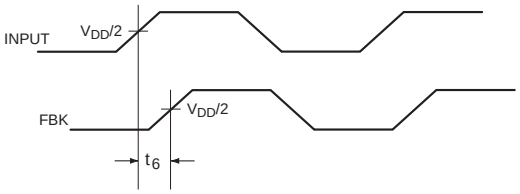
All Outputs Rise/Fall Time



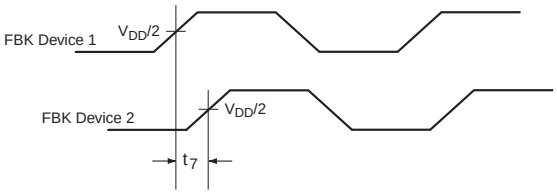
Output-Output Skew



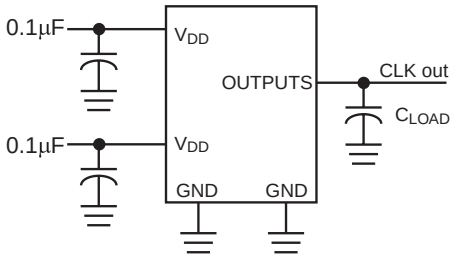
Input-Output Propagation Delay



Device-Device Skew

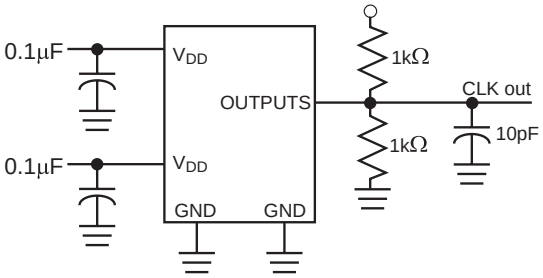


Test Circuit #1



Test Circuit for all parameters except t_8

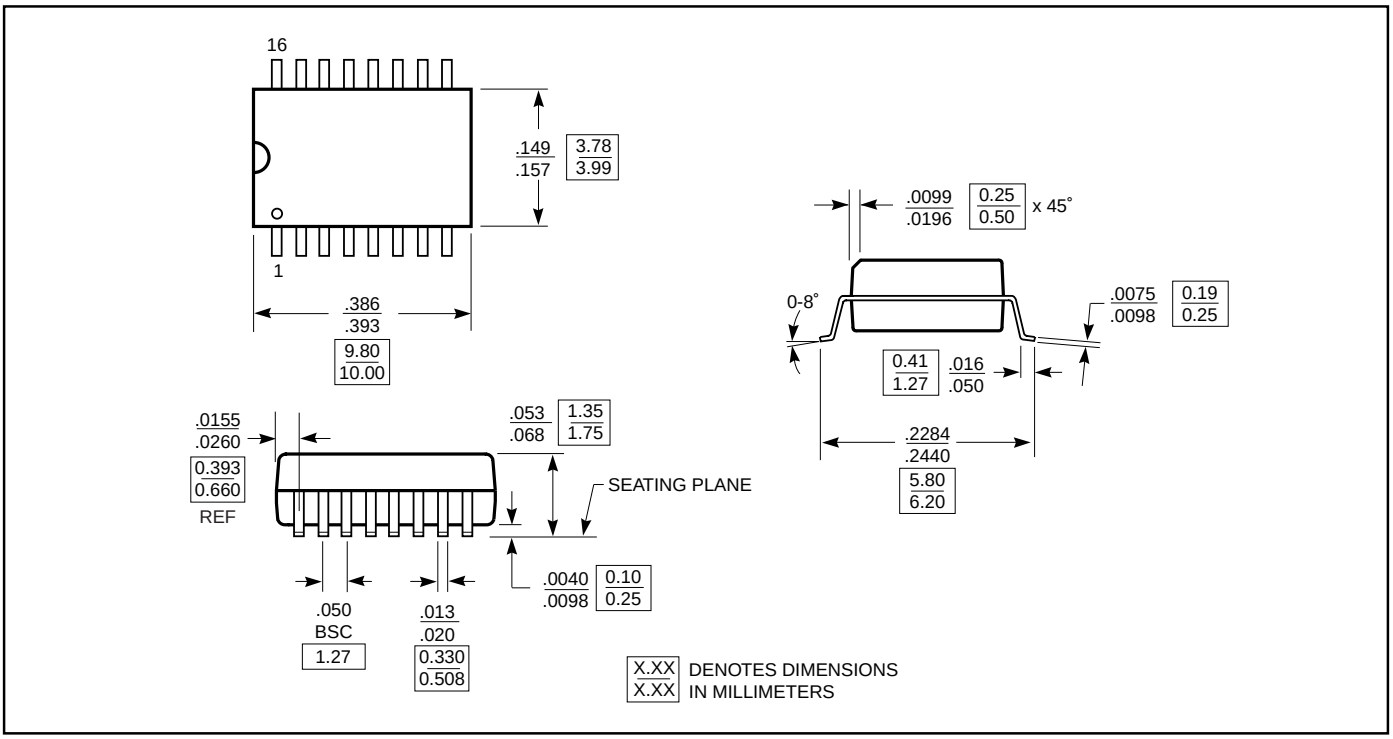
Test Circuit #2



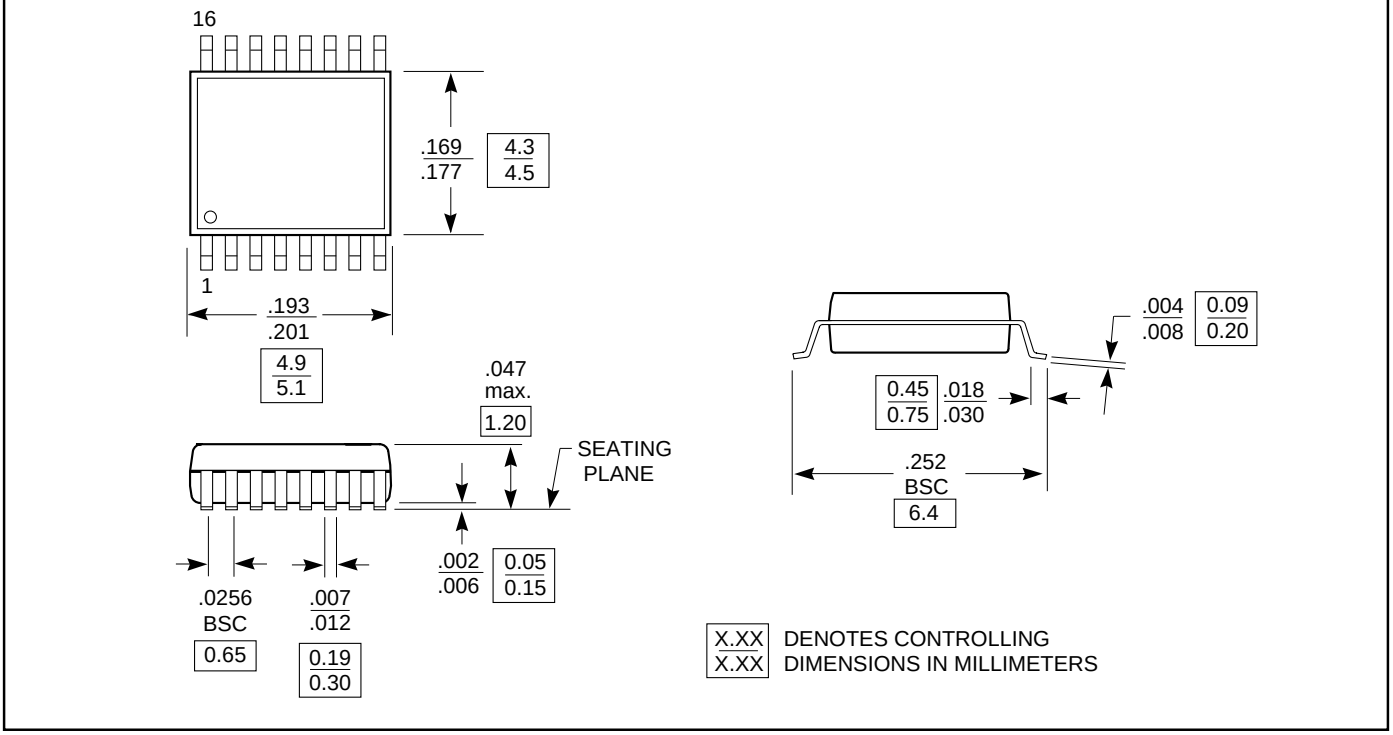
Test Circuit for t_8 ,Output slew rate on -1H device

Package Diagrams

16-Pin SOIC (W)



16-Pin TSSOP (L)



Note: Controlling dimensions in millimeters. Ref: JEDEC MS - 012 AC

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			