Zero-Delay Clock Buffer

Product Features

- Maximum rated frequency: 133 MHz
- Low cycle-to-cycle jitter
- Input to output delay, less than 200ps
- Internal feedback allows outputs to be synchronized to the clock input
- Operates at 3.3V V_{DD}
- Space-saving Packages:
  150-mil SOIC (W)
  173-mil TSSOP (L)

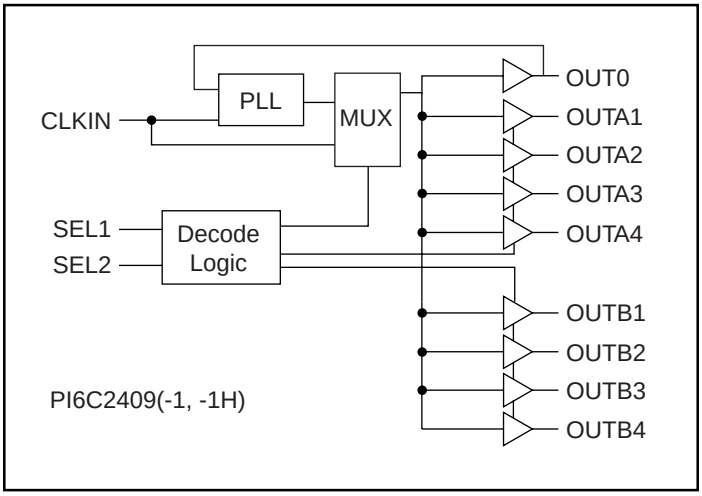
Functional Description

The PI6C2409 is a PLL based, zero-delay buffer, with the ability to distribute nine outputs of up to 133MHz at 3.3V. All the outputs are distributed from a single clock input CLKIN and output OUT0 performs zero delay by connecting a feedback to PLL.

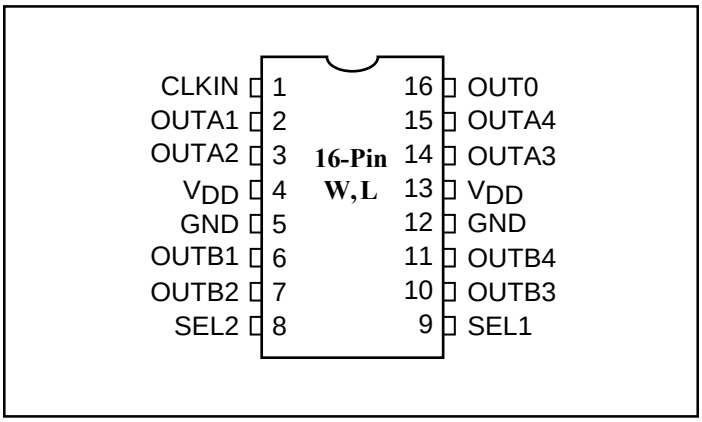
PI6C2409 has two banks of four outputs that can be controlled by the selection inputs, SEL1 & SEL2. It also has a powersparing feature: when input SEL1 is 0 and SEL2 is 1, PLL is turned off and all outputs are referenced from CLKIN. PI6C2409 is available in high drive and industrial environment versions.

An internal feedback on OUT0 is used to synchronize the outputs to the input; the relationship between loading of this signal and the outputs determines the input-output delay. PI6C2409 are characterized for both commercial and industrial operation

Block Diagram



Pin Configuration



Input Select Decoding

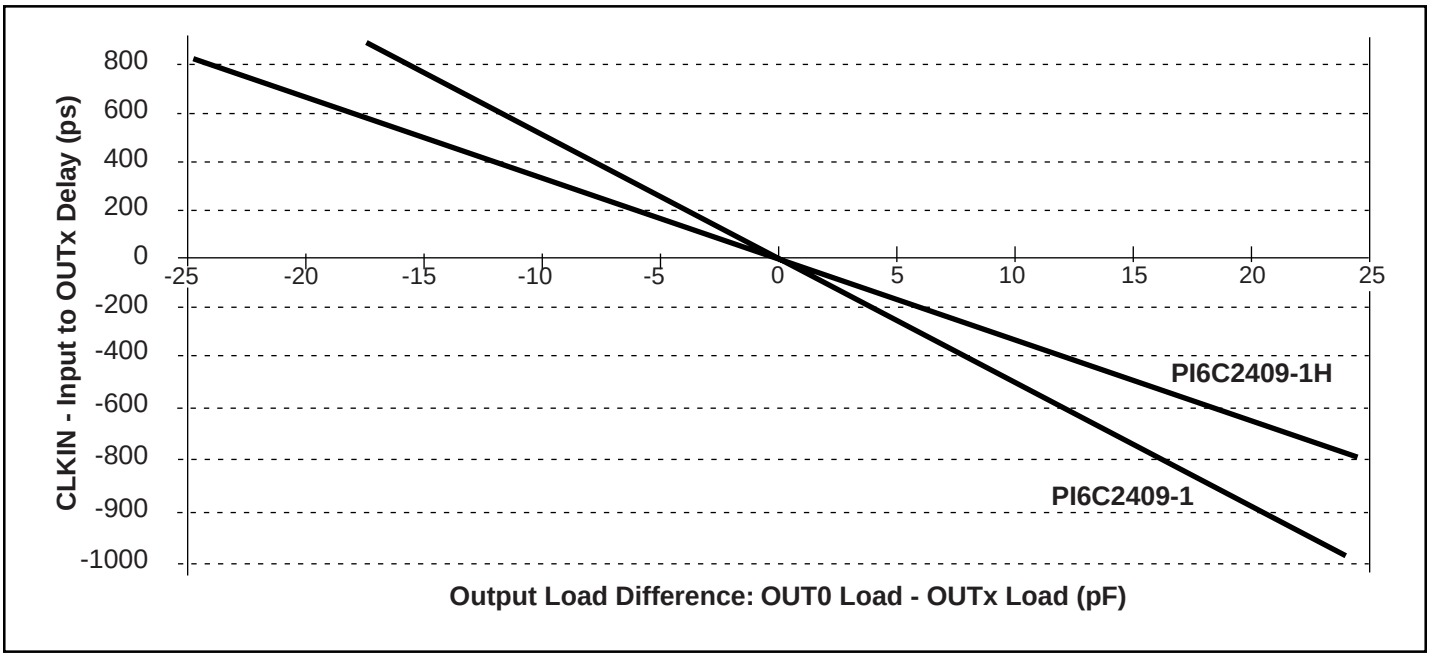
SEL2	SEL1	OUTA [1-4]	OUTB [1-4]	Output Source (OUT0)	PLL
0	0	3-State	3-State	PLL	ON
0	1	PLL	3-State	PLL	ON
1	0	CLKIN	CLKIN	CLKIN	OFF
1	1	PLL	PLL	PLL	ON

Pin Description

Pin	Signal	Description
1	CLKIN	Input clock reference frequency (weak pull-down)
2, 3, 14, 15	OUTA[1-4]	Clock outputs, Bank A
4, 13	V_{DD}	3.3V supply
5, 12	GND	Ground
6, 7, 10 ,11	OUTB[1-4]	Clock outputs, Bank B
8	SEL2	Select input, bit 2 (weak pull-up)
9	SEL1	Select input, bit 1 (weak pull-up)
16	OUT0	Clock Output , internal PLL feedback

Zero Delay and Skew Control

CLKIN Input to OUTx Delay vs. Difference in Loading between OUT0 pin and OUTx pins



The relationship between loading of the OUT0 signal and other outputs determines the input-output delay. Zero delay is achieved when all outputs, including feedback, are loaded equally.

Maximum Ratings

Supply Voltage to Ground Potential	–0.5V to +7.0V
DC Input Voltage (Except CLKIN)	–0.5V to V_{DD} +0.5V
DC Input Voltage CLKIN	–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 (V_{CC} = 3.3V ±0.3V)

Parameter	Description	Min.	Max.	Units
V_{DD}	Supply Voltage	3.0	3.6	V
T_A	Commerical Operating Temperature	0	70	ºC
	Industrial Operating Temperature	–40	85	
C_L	Load Capacitance, below 100 MHz	—	30	pF
	Load Capacitance, from 100 MHz to 133 MHz	—	15	
C_{IN}	Input Capacitance	—	7	

DC 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}		125	
V_{OL}	Output LOW Voltage	I_{OL} = 8mA (–1); I_{OL} = 12mA (–1H)		0.4	V
V_{OH}	Output HIGH Voltage	I_{OH} = –8mA (–1); I_{OH} = –12mA (–1H)	2.4		
I_{DD}	Bypass, PLL OFF	SEL1 = 0, SEL2 = 1		1.0	mA
I_{DD}	Supply Current	Unloaded outputs 100 MHz, Select inputs at V_{DD} or GND		54.0	mA
		Unloaded outputs 66 MHz, CLKIN		39.0	

AC Electrical Characteristics for Industrial Temperature Devices

Parameters	Name	Test Conditions	Min.	Typ.	Max.	Units
F_O	Output Frequency	30pF load (–1, –1H)	10.0		100	MHz
		10pF load, (–1, –1H)			133	
t_{DC}	Duty Cycle(1) (–1, –1H)	Measured at V_{DD}/2, F_{OUT} = 66.67MHz	40.0	50	60.0	%
	Duty Cycle(1) (–1H)	Measured at V_{DD}/2V, F_{OUT} <50MHz	45.0		55.0	
t_R	Rise Time(1) (–1)	Measured between 0.8V and 2.0V			2.5	ns
	Rise Time(1) (–1H)	Measured between 0.8V and 2.0V			1.5	
t_F	Fall Time(1) (–1)	Measured between 0.8V and 2.0V			2.5	
	Fall Time(1) (–1H)	Measured between 0.8V and 2.0V			1.5	
$t_{SK(O)}$	Output to Output Skew (–1,–1H)(1)	All outputs equally loaded			250	ps
t_0	Delay, CLKIN Rising Edge to OUT0 Rising Edge(1) (–1, –1H)	Measured at V_{DD}/2		0	±350	
$t_{SK(D)}$	Device-to-Device Skew(1) (–1, –1H)	Measured at V_{DD}/2 on OUT0 pins of devices		0	700	
t_{SLEW}	Output Slew Rate(1) (–1, –1H)	Measured between 0.8V & 2.0V on –1H device using Test Crt #2	1			V/ns
t_{JIT}	Cycle-to-Cycle Jitter(1) (–1,–1H)	Measured at 66.67 MHz, loaded 30pF load			200	ps
t_{LOCK}	PLL Lock Time(1) (–1, –1H)	Stable power supply, valid clocks presented on CLKIN pin			1.0	ms

Notes: 1.See Switching Waveforms on page 6.

DC Electrical Characteristics for Commercial 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	µA
I_{IH}	Input HIGH Current	V_{IN} = V_{DD}	—	125	
V_{OL}	Output LOW Voltage	I_{OL} = 8mA (–1); I_{OL} = 12mA (–1H)	—	0.4	V
V_{OH}	Output HIGH Voltage	I_{OH} = –8mA (–1); I_{OH} = –12mA (–1H)	2.4	—	
I_{DD}	Bypass, PLL off	SEL1 = 0 SEL2 = 1	—	1.0	mA
I_{DD}	Supply Current	Unloaded outputs, 66.67 MHz, Select inputs at V_{DD} or GND	—	39	
I_{DD}	Supply Current	Unloaded outputs 100 MHz Select Inputs @ V_{DD} or GND	—	54	

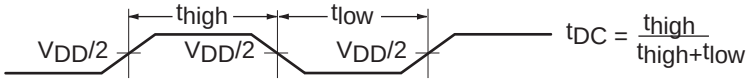
AC Electrical Characteristics for Commercial Temperature Device

Parameters	Name[1]	Test Conditions	Min.	Typ.	Max.	Units
F_O	Output Frequency	30pF load (–1, –1H)	10		100	MHz
		10pF load, (–1, –1H)			133	
t_{DC}	Duty Cycle (–1H)	Measured at V_{DD}/2, F_O< 50 MHz	45	50	55	%
	Duty Cycle (–1,–1H)	Measured at V_{DD}/2, F_O= 66 MHz	40	50	60	
t_R	Rise Time (–1)	Measured between 0.8V and 2.0V			2.5	ns
	Rise Time (–1H)				1.5	
t_F	Fall Time (–1)				2.5	
	Fall Time (–1H)				1.5	
$t_{SK(O)}$	Output to Output Skew (–1,–1H)	All outputs equally loaded, V_{DD}/2			250	ps
t_0	Input to Output Delay, CLKIN Rising Edge to OUT0 Rising Edge (–1,–1H)	Measured at V_{DD}/2		0	±350	
$t_{SK(D)}$	Device to Device Skew (–1,–1H)	Measured at V_{DD}/2 on OUT0 pins of devices		0	700	
t_{SLEW}	Output Slew Rate (–1,–1H)	Measured between 0.8V and 2.0V on –1H device using Test Circuit #2	1			V/ns
t_{JIT}	Cycle-to-Cycle Jitter (–1,–1H)	Measured at 66.67 MHz, loaded 30pF outputs			200	ps
t_{LOCK}	PLL Lock Time (–1,–1H)	Stable power supply, valid clocks presented on CLKIN pins			1.0	ms

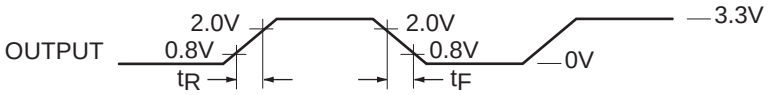
Notes:
1. See Switching Waveforms on page 6

Switching Waveforms

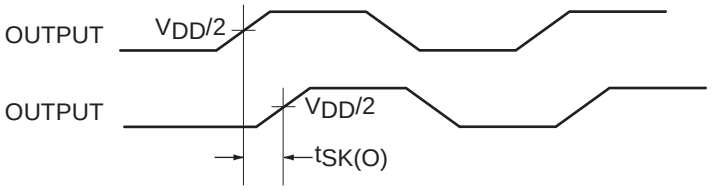
Duty Cycle Timing



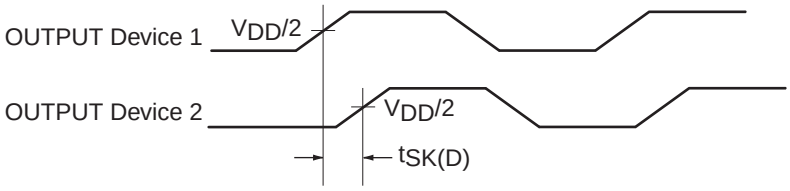
All Outputs Rise/Fall Time



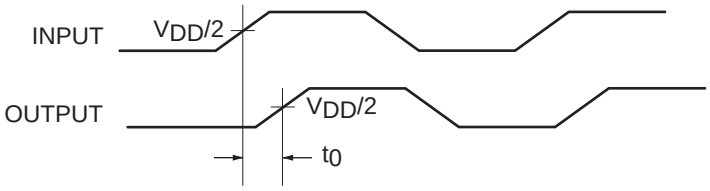
Output-Output Skew



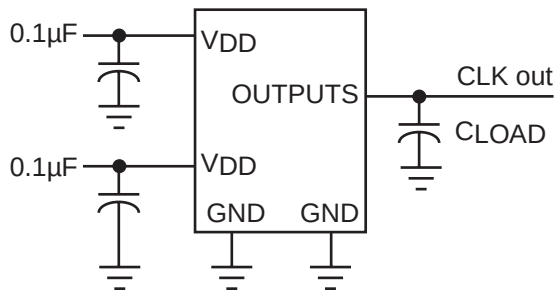
Device-Device Skew



Input-Output Propagation Delay

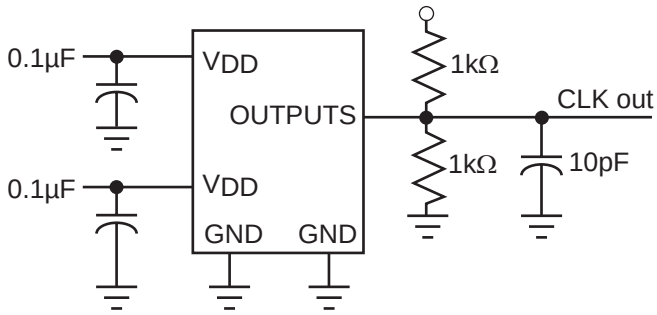


Test Circuit 1



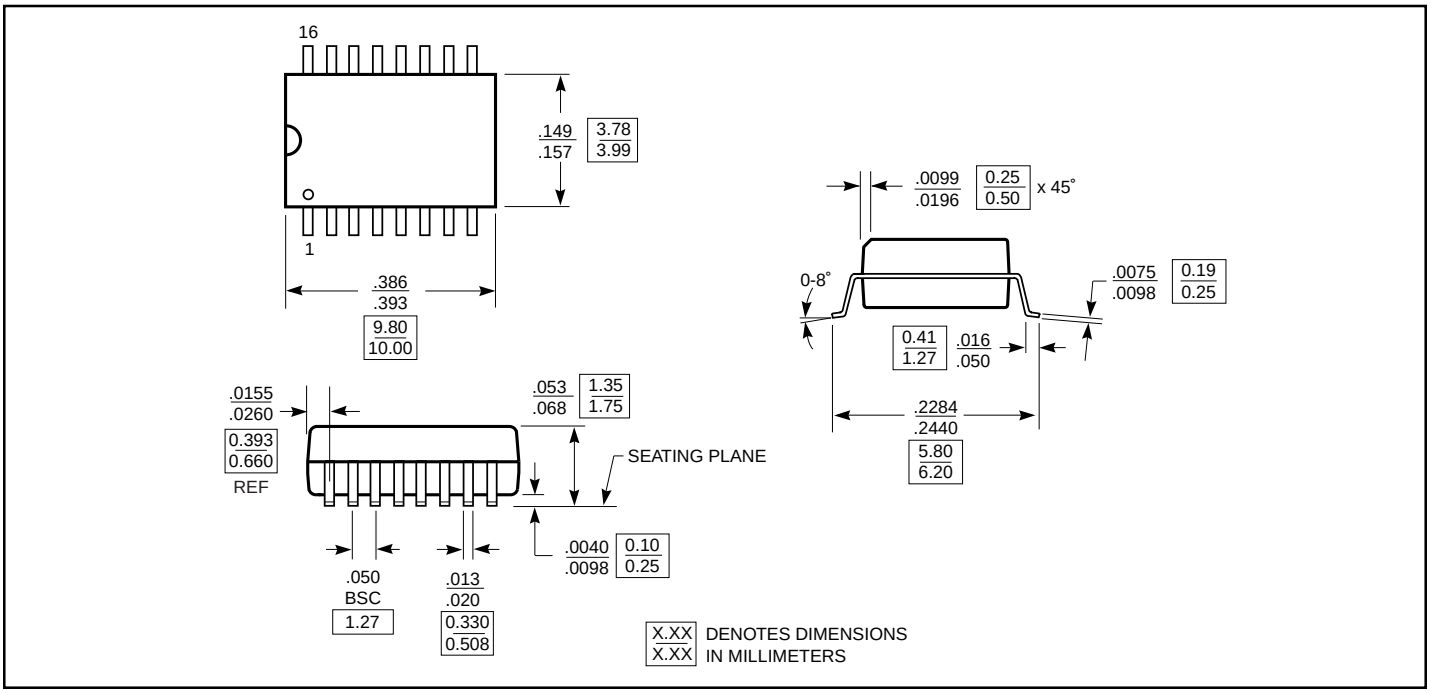
Test Circuit for all parameters except t_{SLEW}

Test Circuit 2

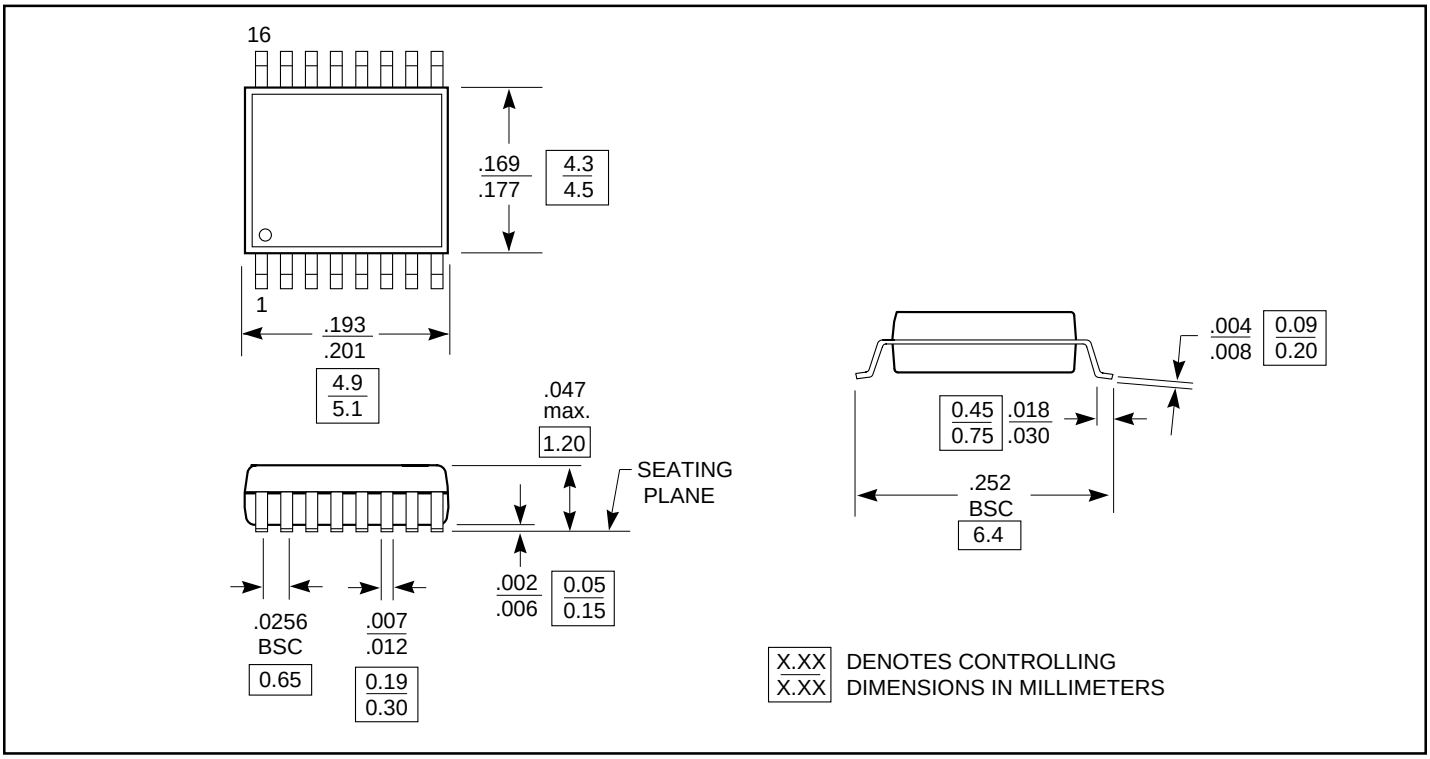


Test Circuit for t_{SLEW} ,Output slew rate on –1H device

Packaging Mechanical: 16-Pin SOIC (W16)



Packaging Mechanical: 16-Pin TSSOP (L16)



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

Ordering Information

Ordering Code	Package Name	Package Type	Operating Range
PI6C2409 -1W	W16	16-pin 150-mil SOIC	Commercial
PI6C2409-1HW			
PI6C2409-1HL	L16	16-pin TSSOP	
PI6C2409-1HWI	W16	16-pin 150-mil SOIC	Industrial
PI6C2409-1LI	L16	16-pin TSSOP	
PI6C2409-1HLI			