

## Low Jitter and Skew DC to 220 MHz Clock Buffer

### Key Features

- DC to 220 MHz operating frequency range
- Low output clock skew: 70ps-typ
- Low part-to-part output skew: 100 ps-typ
- Low output propagation delay: 3.5ns-typ
- 3.3V to 2.5V operation supply voltage range
- Low power dissipation
  - 11 mA-typ at 66MHz at VDD=3.3V
  - 10 mA-typ at 66MHz at VDD=2.5V
- One input to nine (9) output fanout buffer drivers
- Available in 16-pin SOIC package
- Available in Commercial and Industrial grades
- Available in Lead (Pb) free package
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### Applications

- General Purpose PCI/PCI-X Clock Buffer
- Printers, MFPs and Digital Copiers
- PCs and Work Stations
- Routers, Switches and Servers
- Datacom and Telecom
- High-Speed Digital Embedded Systems

### Description

The SL23EP09NZ is a low skew, jitter and power fanout buffer designed to produce up to nine (9) clock outputs from one (1) reference input clock, for high speed clock distribution.

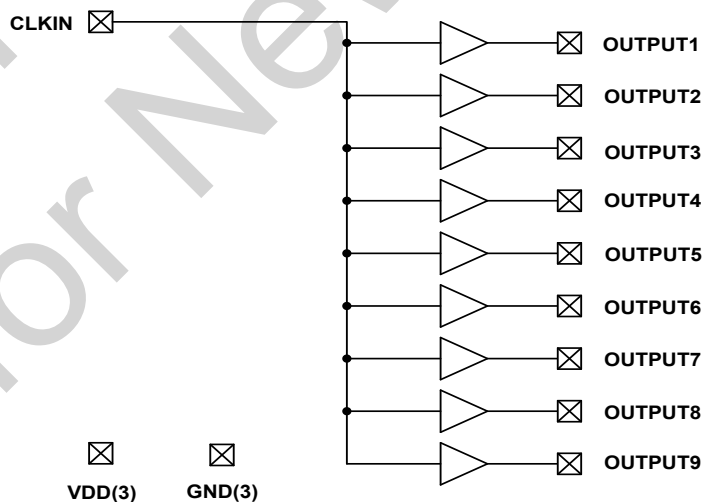
The SL23EP09NZ products operate from DC to 220MHz and within 3.3V to 2.5V power supply range.

Refer to SL2309NZ product for DC to 140MHz-max frequency range. Also refer to SL2304NZ or SL23EP04NZ products for 1:4 clock fanout buffers within 3.3V to 2.5V power supply and DC to 220MHz frequency range.

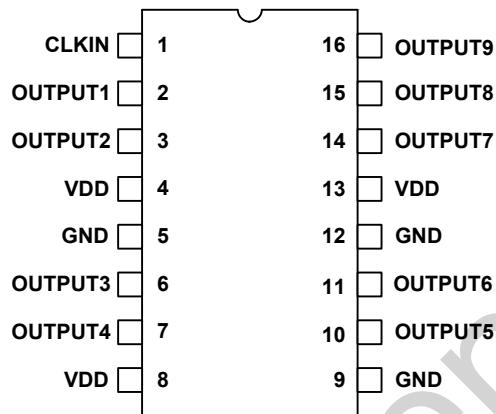
### Benefits

- Up to nine (9) distribution of input clock
- Low propagation delay
- Low output-to-output skew
- Low output clock jitter
- Low power dissipation

### Block Diagram



## Pin Configuration



**16-Pin SOIC**

## Pin Description

Pin Number	Pin Name	Pin Type	Pin Description
1	CLKIN	Input	Input Reference Clock
2	OUTPUT1	Output	Buffered Clock Output-1
3	OUTPUT2	Output	Buffered Clock Output-2
4	VDD	Power	3.3V +/-10% Power Supply
5	GND	Power	Power Ground
6	OUTPUT3	Output	Buffered Clock Output-3
7	OUTPUT4	Output	Buffered Clock Output-4
8	VDD	Power	3.3V and 2.5V +/-10% Power Supply
9	GND	Power	Power Ground
10	OUTPUT5	Output	Buffered Clock Output-5
11	OUTPUT6	Output	Buffered Clock Output-6
12	GND	Power	Power Ground
13	VDD	Power	3.3V and 2.5V +/-10% Power Supply
14	OUTPUT7	Output	Buffered Clock Output-7
15	OUTPUT8	Output	Buffered Clock Output-8
16	OUTPUT9	Output	Buffered Clock Output-9

### General Description

The SL23EP09NZ is a low skew, jitter and power fanout buffer designed to produce up to nine (9) clock outputs from one (1) reference input clock, for high speed clock distribution, including PCI/PCI-X applications.

### Input and output Frequency Range

The input and output frequency is the same (1x) for SL2309NZ and the product operates from DC to 220MHz clock range with 15pF and 134MHz with 30pF output loads at VDD=3.3V.

### High Drive Capability

The SL23EP09NZ is designed to meet high drive requirements for up to 30pF load condition per electrical specifications tables.

If lower drive levels are required refer to SL2309NZ fanout buffer product.

### Output Clock Skew

All outputs should drive the similar load to achieve output-to-output skew specifications as given in the switching electrical tables.

### Power Supply Range (VDD)

The SL23EP09NZ is designed to operate from 3.3V to 2.5V VDD power supply range. An internal on-chip voltage regulator is used to provide to constant power supply of 1.8V, leading to a consistent and stable electrical performance in terms of skew and jitter. The SL23EP09NZ I/O is powered by using VDD.

Refer to SL2309NZ product for DC to 140MHz-max frequency range.

Contact SLI for 1.8V power supply Buffers and ZDB products.

### Absolute Maximum Ratings (C-Grade and I-Grade)

Description	Condition	Min	Max	Unit
Supply voltage, VDD		-0.5	4.2	V
All Inputs and Outputs		-0.5	VDD+0.5	V
Ambient Operating Temperature	In operation, C-Grade	0	70	°C
Ambient Operating Temperature	In operation, I-Grade	-40	85	°C
Storage Temperature	No power is applied	-65	150	°C
Junction Temperature	In operation, power is applied	–	125	°C
Soldering Temperature		–	260	°C
ESD Rating (Human Body Model)	JEDEC22-A114D	-4,000	4,000	V
ESD Rating (Charge Device Model)	JEDEC22-C101C	-1,500	1,500	V
ESD Rating (Machine Model)	JEDEC22-A115D	-200	200	V

### Operating Conditions (C-Grade and I-Grade)

Unless otherwise stated VDD= 3.3V+/- 10%, CL=15pF

Description	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage	VDD	VDD+/-10%	2.97	3.3	3.63	V
Operating Temperature	TA1	Ambient Temperature C-Grade	0	–	70	°C
	TA2	Ambient Temperature I-Grade	-40	–	85	°C
Input Capacitance	VINC	Pin 1	–	5	7	pF
Load Capacitance	CL1	All outputs ≤ 220MHz, 3.3V	–	–	15	pF
	CL2	All outputs ≤ 134MHz, 3.3V	–	–	30	pF
Operating Frequency	CLKIN	Input Clock Range, CL=15pF	DC	–	220	MHz
Operating Frequency	CLKIN	Input Clock Range, CL=30pF	DC	–	134	MHz

### DC Electrical Characteristics (C-Grade)

Unless otherwise stated VDD= 3.3V+/- 10%, CL=15pF and Ambient Temperature range 0 to +70°C

Description	Symbol	Condition	Min	Typ	Max	Unit
Input LOW Voltage	VINL	CLKIN	–	–	0.8	V
Input HIGH Voltage	VINH	CLKIN	2.0	–	VDD+0.3	V
Input LOW Current	IINL	0 < VIN < 0.8V	–	–	10	µA
Input HIGH Current	IINH	2.4V < VIN < VDD	–	–	15	µA
Output Low Voltage	VOL	IoL=12mA	–	–	0.4	V
Output High Voltage	VOH	IoH=-12mA	2.4	–	–	V
Power Supply Current	IDD1	CLKIN=33.3MHz, CL=0	–	9	13	mA
Power Supply Current	IDD2	CLKIN=66.6MHz, CL=0	–	11	16	mA
Power Supply Current	IDD3	CLKIN=166MHz, CL=0	–	15	20	mA

### Switching Electrical Characteristics (C-Grade)

Unless otherwise stated VDD= 3.3V+/- 10%, CL=15pF and Ambient Temperature range 0 to +70°C

Description	Symbol	Condition	Min	Typ	Max	Unit
Output Frequency Range	FOUT1	CL=15pf	0	–	220	MHz
	FOUT2	CL=30pf	0	–	134	MHz
Input Duty Cycle	DC1	Measured at VDD/2	20	50	80	%
Output Duty Cycle	DC2	CL=15pF, Fout=166MHz Measured at VDD/2	45	50	55	%
Output Duty Cycle	DC3	CL=30pF, Fout=100MHz Measured at VDD/2	40	50	60	%
Output Rise/Fall Time	tr/f-1	Measured at 0.8V to 2.0V	–	–	1.2	ns

		CL=15pF				
Output Rise/Fall Time	tr/f-2	Measured at 0.8V to 2.0V CL=30pF	–	–	1.6	ns
Output Skew	SKW1	Measured at VDD/2 and Outputs are equally loaded	–	70	150	ps
Part to Part Skew	SKW2	Measured at VDD/2 and Outputs are equally loaded	–	100	200	ps
Propagation Delay Time	PDT	Measured at VDD/2 from CLKIN to Output Clock rising edge and Outputs are equally loaded	2.5	3.5	4.5	ns
Cycle-to-Cycle Jitter	CCJ1	CLKIN=66MHz and CL=0 (No Load)	–	35	70	ps
Cycle-to-Cycle Jitter	CCJ2	CLKIN=166MHz and CL=0 (No Load)	–	25	50	ps

### DC Electrical Characteristics (I-Grade)

Unless otherwise stated VDD= 3.3V+/- 10%, CL=15pF and Ambient Temperature range -40 to +85°C

Description	Symbol	Condition	Min	Typ	Max	Unit
Input LOW Voltage	VINL	CLKIN	–	–	0.8	V
Input HIGH Voltage	VINH	CLKIN	2.0	–	VDD+0.3	V
Input LOW Current	IINL	0 < VIN < 0.8V	–	–	10	µA
Input HIGH Current	IINH	2.4V < VIN < VDD	–	–	15	µA
Output Low Voltage	VOL	IOL=12mA	–	–	0.4	V
Output High Voltage	VOH	IOH=-12mA	2.4	–	–	V
Power Supply Current	IDD1	CLKIN=33.3MHz, CL=0	–	10	14	mA
Power Supply Current	IDD2	CLKIN=66.6MHz, CL=0	–	12	17	mA
Power Supply Current	IDD3	CLKIN=133.3MHz, CL=0	–	16	21	mA

### Switching Electrical Characteristics (I-Grade)

Unless otherwise stated VDD= 3.3V+/- 10%, CL=15pF and Ambient Temperature range -40 to +85°C

Description	Symbol	Condition	Min	Typ	Max	Unit
Output Frequency Range	FOUT1	CL=15pf	0	–	220	MHz
	FOUT2	CL=30pf	0	–	134	MHz
Input Duty Cycle	DC1	Measured at VDD/2	20	50	80	%
Output Duty Cycle	DC2	CL=15pF, Fout=166MHz Measured at VDD/2	45	50	55	%
Output Duty Cycle	DC3	CL=30pF, Fout=100MHz Measured at VDD/2	40	50	60	%
Output Rise/Fall Time	tr/f-1	Measured at 0.8V to 2.0V, CL=15pF	–	–	1.4	ns
Output Rise/Fall Time	tr/f-2	Measured at 0.8V to 2.0V, CL=30pF	–	–	1.8	ns

Output Skew	SKW1	Measured at VDD/2 and Outputs are equally loaded	–	80	160	ps
Part to Part Skew	SKW2	Measured at VDD/2 and Outputs are equally loaded	–	110	220	ps
Propagation Delay Time	PDT	Measured at VDD/2 from CLKIN to Output Clock rising edge and Outputs are equally loaded	2.0	3.5	4.8	ns
Cycle-to-Cycle Jitter	CCJ1	CLKIN=66MHz and CL=0 (No Load)	–	40	80	ps
Cycle-to-Cycle Jitter	CCJ2	CLKIN=133MHz and CL=0 (No Load)	–	30	60	ps

### Operating Conditions (C-Grade and I-Grade)

Unless otherwise stated VDD= 2.5V+/- 10%, CL=15pF

Description	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage	VDD	VDD+/-10%	2.25	2.5	2.75	V
Operating Temperature	TA1	Ambient Temperature C-Grade	0	–	70	°C
	TA2	Ambient Temperature I-Grade	-40	–	85	°C
Input Capacitance	VINC	Pin 1	–	5	7	pF
Load Capacitance	CL1	All outputs ≤180MHz	–	–	15	pF
	CL2	All outputs ≤100MHz	–	–	30	pF
Operating Frequency	CLKIN-1	Input Clock Range, CL=15pF	DC	–	180	MHz
Operating Frequency	CLKIN-2	Input Clock Range, CL=30pF	DC	–	80	MHz

### DC Electrical Characteristics (C-Grade)

Unless otherwise stated VDD= 2.5V+/- 10%, CL=15pF and Ambient Temperature range 0 to +70°C

Description	Symbol	Condition	Min	Typ	Max	Unit
Input LOW Voltage	VINL	CLKIN	–	–	0.7	V
Input HIGH Voltage	VINH	CLKIN	1.7	–	VDD+0.3	V
Input LOW Current	IINL	0 < VIN < 0.8V	–	–	15	μA
Input HIGH Current	IINH	2.4V < VIN < VDD	–	–	25	μA
Output Low Voltage	VOL	IOL=8mA	–	–	0.4	V
Output High Voltage	VOH	IOH=–8mA	VDD-0.6	–	–	V
Power Supply Current	IDD1	CLKIN=33.3MHz, CL=0	–	9	14	mA
Power Supply Current	IDD2	CLKIN=66MHz, CL=0	–	11	17	mA
Power Supply Current	IDD3	CLKIN=166MHz, CL=0	–	15	21	mA

### Switching Electrical Characteristics (C-Grade)

Unless otherwise stated VDD= 2.5V+/- 10%, CL=15pF and Ambient Temperature range 0 to +70°C

Description	Symbol	Condition	Min	Typ	Max	Unit
Output Frequency Range	FOUT1	CL=15pf	0	–	180	MHz
	FOUT2	CL=30pf	0	–	80	MHz
Input Duty Cycle	DC1	Measured at VDD/2	20	50	80	%
Output Duty Cycle	DC2	CL=15pF, Fout=166MHz Measured at VDD/2	45	50	55	%
Output Duty Cycle	DC3	CL=30pF, Fout=80MHz Measured at VDD/2	40	50	60	%
Output Rise/Fall Time	tr/f-1	Measured at 0.6V to 1.8V CL=15pF	–	–	1.6	ns
Output Rise/Fall Time	tr/f-2	Measured at 0.6V to 1.8V CL=30pF	–	–	2.0	ns
Output Skew	SKW1	Measured at VDD/2 and Outputs are equally loaded	–	90	180	ps
Part to Part Skew	SKW2	Measured at VDD/2 and Outputs are equally loaded	–	120	240	ps
Propagation Delay Time	PDT	Measured at VDD/2 from CLKIN to Output Clock rising edge and Outputs are equally loaded	3.0	4.0	5.0	ns
Cycle-to-Cycle Jitter	CCJ1	CLKIN=66MHz and CL=0 (No Load)	–	50	100	ps
Cycle-to-Cycle Jitter	CCJ2	CLKIN=166MHz and CL=0 (No Load)	–	35	70	ps

### DC Electrical Characteristics (I-Grade)

Unless otherwise stated VDD= 2.5V+/- 10%, CL=15pF and Ambient Temperature range -40 to +85°C

Description	Symbol	Condition	Min	Typ	Max	Unit
Input LOW Voltage	VINL	CLKIN	–	–	0.7	V
Input HIGH Voltage	VINH	CLKIN	1.7	–	VDD+0.3	V
Input LOW Current	IINL	0 < VIN < 0.8V	–	–	15	μA
Input HIGH Current	IINH	2.4V < VIN < VDD	–	–	25	μA
Output Low Voltage	VOL	IoL=8mA	–	–	0.4	V
Output High Voltage	VOH	IoH=-8mA	VDD-0.6	–	–	V
Power Supply Current	IDD1	CLKIN=33.3MHz, CL=0	–	10	14	mA
Power Supply Current	IDD2	CLKIN=66.6MHz, CL=0	–	12	17	mA
Power Supply Current	IDD3	CLKIN=133.3MHz, CL=0	–	16	23	mA

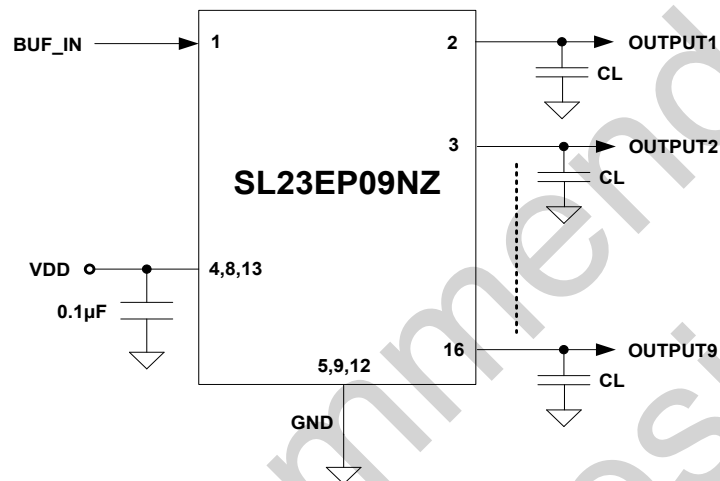
**Switching Electrical Characteristics (I-Grade)**

Unless otherwise stated VDD= 2.5V+/- 10%, CL=15pF and Ambient Temperature range -40 to +85°C

Description	Symbol	Condition	Min	Typ	Max	Unit
Output Frequency Range	FOUT1	CL=15pF	0	–	180	MHz
	FOUT2	CL=30pF	0	–	80	MHz
Input Duty Cycle	DC1	Measured at VDD/2	20	50	80	%
Output Duty Cycle	DC2	CL=15pF, Fout=166MHz Measured at VDD/2	45	50	55	%
Output Duty Cycle	DC3	CL=30pF, Fout=100MHz Measured at VDD/2	40	50	60	%
Output Rise/Fall Time	tr/f-1	Measured at 0.8V to 2.0V CL=15pF	–	–	1.8	ns
Output Rise/Fall Time	tr/f-2	Measured at 0.8V to 2.0V CL=30pF	–	–	2.2	ns
Output Skew	SKW1	Measured at VDD/2 and Outputs are equally loaded	–	100	200	ps
Part to Part Skew	SKW2	Measured at VDD/2 and Outputs are equally loaded	–	140	280	ps
Propagation Delay Time	PDT	Measured at VDD/2 from CLKIN to Output Clock rising edge and Outputs are equally loaded	2.5	4.0	5.5	ns
Cycle-to-Cycle Jitter	CCJ1	CLKIN=66MHz and CL=0 (No Load)	–	60	120	ps
Cycle-to-Cycle Jitter	CCJ2	CLKIN=133MHz and CL=0 (No Load)	–	50	100	ps

## External Components & Design Considerations

### Typical Application Schematic



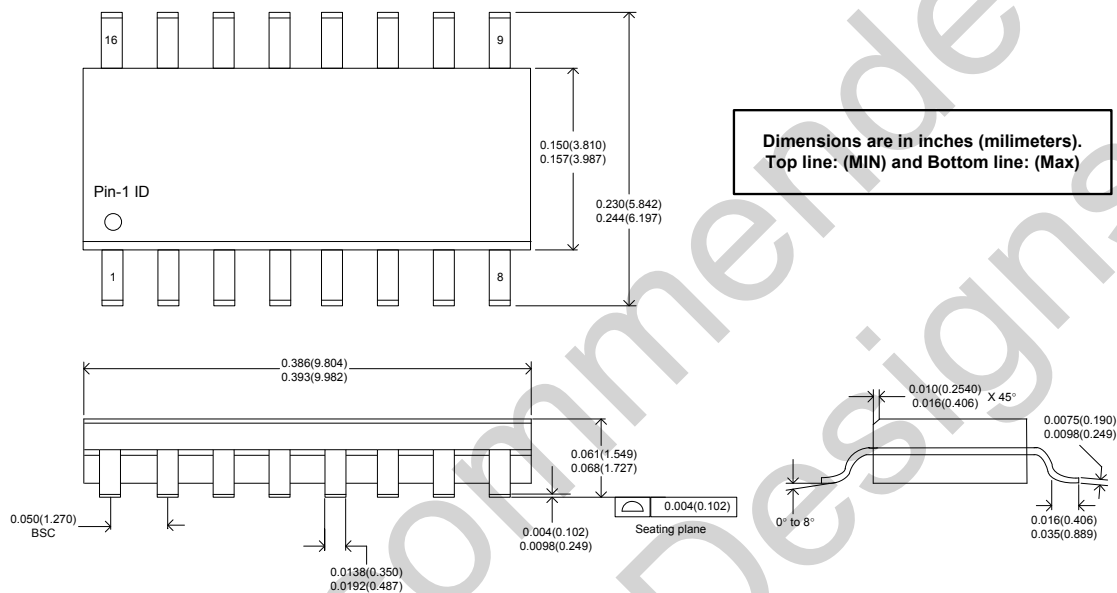
### Comments and Recommendations

**Decoupling Capacitor:** A decoupling capacitor of 0.1µF must be used between all VDD and VSS pins. Place the capacitor on the component side of the PCB as close to the VDD pin as possible. The PCB trace to the VDD pin and to the GND via should be kept as short as possible. Do not use vias between the decoupling capacitor and the VDD pin.

**Series Termination Resistor:** A series termination resistor is recommended if the distance between the output clocks and the load is over 1 ½ inch. Place the series termination resistors as close to the clock outputs as possible.

## Package Outline and Package Dimensions

### 16-Lead SOIC (150-Mil)



### Thermal Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Thermal Resistance Junction to Ambient	$\theta_{JA}$	Still air	-	78	-	°C/W
	$\theta_{JA}$	1m/s air flow	-	74	-	°C/W
	$\theta_{JA}$	3m/s air flow	-	70	-	°C/W
Thermal Resistance Junction to Case	$\theta_{JC}$	Independent of air flow	-	44	-	°C/W

## Ordering Information <sup>[1]</sup>

Ordering Number	Marking	Shipping Package	Package	Temperature
SL23EP09NZSC-1H	SL23EP09NZSC-1H	Tube	16-pin SOIC	0 to 70°C
SL23EP09NZSC-1HT	SL23EP09NZSC-1H	Tape and Reel	16-pin SOIC	0 to 70°C
SL23EP09NZSI-1H	SL23EP09NZSI-1H	Tube	16-pin SOIC	-40 to 85°C
SL23EP09NZSI-1HT	SL23EP09NZSI-1H	Tape and Reel	16-pin SOIC	-40 to 85°C

### Notes:

1. The SL23EP09NZ products are RoHS compliant.

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