

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
- 3.3V to 2.5V operation supply voltage range
- Low power dissipation:
 - - 9 mA-typ at 33MHz
 - - 11 mA-typ at 66MHz
 - - 15 mA-typ at 166MHz
- 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

Applications

- General Purpose PCI/PCI-X Clock Buffer
- Printers, MFPs and Digital Copiers
- PCs and Work Stations
- Routers, Switchers 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.

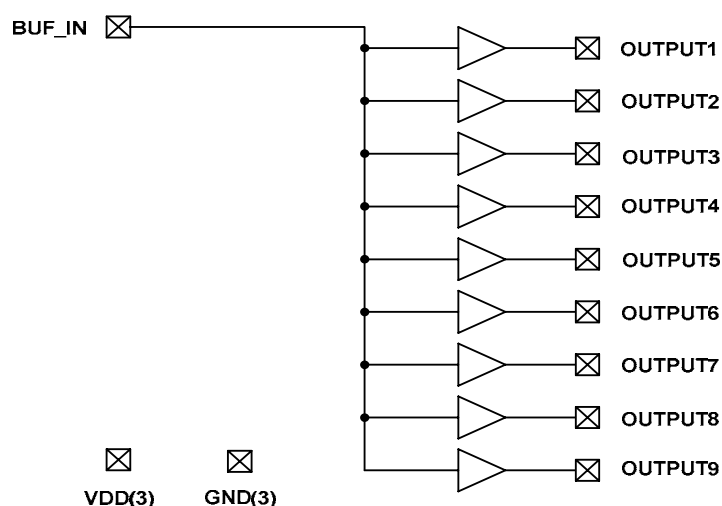
The SL23EP09NZ products operate from DC to 140MHz.

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

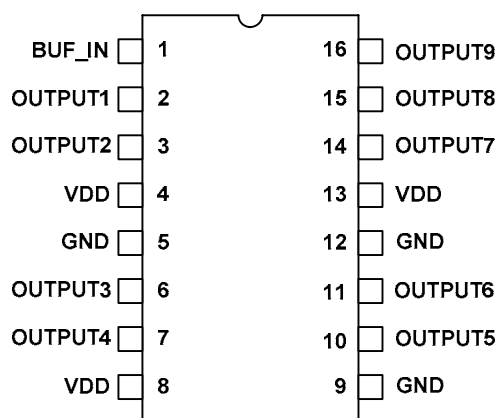
Benefits

- Up to nine (9) distribution of input clock
- Low skew
- Low Jitter
- Low power dissipation

Block Diagram



Pin Configuration



16-Pin SOIC/TSSOP

Pin Description

Pin Number	Pin Name	Pin Type	Pin Description
1	BUF_IN	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 100MHz with 30pF output loads.

High Drive Capability

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

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	4.6	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)	MIL-STD-883, Method 3015	2000	–	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	VIH	Pin 1	–	5	7	pF
Load Capacitance	CL1	All outputs <100MHz	–	–	30	pF
	CL2	All outputs 100MHz to 220MHz	–	–	15	pF
Operating Frequency	FBUF_IN	Fanout Buffer Range	DC	–	220	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	BUF_IN	–	–	0.8	V
Input HIGH Voltage	VINH	BUF_IN	2.0	–	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	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	22	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	–	100	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 Time	tr	Measured at 0.8V to 2.0V CL=0 to 30pF	–	–	1.4	ns

Switching Electrical Characteristics (C-Grade – Cont.)

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

Output Fall Time	tf	Measured at 0.8V to 2.0V CL=0 to 30pF	–	–	1.4	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	–	4.0	6.5	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	BUF_IN	–	–	0.8	V
Input HIGH Voltage	VINH	BUF_IN	2.0	–	VDD+0.3	V
Input LOW Current	IINL	0 < VIN < 0.8V	–	–	30	μA
Input HIGH Current	IINH	2.4V < VIN < VDD	–	–	50	μA
Output Low Voltage	VOL	IOL=8mA	–	–	0.4	V
Output High Voltage	VOH	IOH=–8mA	2.4	–	–	V
Power Supply Current	IDD1	CLKIN=33.3MHz, CL=0	–	10	15	mA
Power Supply Current	IDD2	CLKIN=66.6MHz, CL=0	–	12	18	mA
Power Supply Current	IDD3	CLKIN=133.3MHz, CL=0	–	16	24	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	–	100	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	%

Switching Electrical Characteristics (I-Grade – Cont.)

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

Output Rise Time	tr	Measured at 0.8V to 2.0V CL=0 to 30pF	–	–	1.5	ns
Output Fall Time	tf	Measured at 0.8V to 2.0V CL=0 to 30pF	–	–	1.5	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	–	4.5	7.5	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	VIH	Pin 1	–	5	7	pF
Load Capacitance	CL1	All outputs <100MHz	–	–	30	pF
	CL2	All outputs 100MHz to 180MHz	–	–	15	pF
Operating Frequency	FBUF_IN	Fanout Buffer Range	DC	–	180	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	BUF_IN	–	–	0.7	V
Input HIGH Voltage	VINH	BUF_IN	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	2.4	–	–	V
Power Supply Current	IDD1	CLKIN=33.3MHz, CL=0	–	8	12	mA
Power Supply Current	IDD2	CLKIN=66.6MHz, CL=0	–	10	15	mA
Power Supply Current	IDD3	CLKIN=166MHz, CL=0	–	14	20	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	–	220	MHz
	FOUT2	CL=30pf	0	–	100	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 Time	tr	Measured at 0.6V to 1.8V CL=0 to 30pF	–	–	1.5	ns

Switching Electrical Characteristics (C-Grade – Cont.)

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

Output Fall Time	tf	Measured at 0.6V to 1.8V CL=0 to 30pF	–	–	1.5	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	–	110	220	ps
Propagation Delay Time	PDT	Measured at VDD/2 from CLKIN to Output Clock rising edge and Outputs are equally loaded	–	4.0	6.5	ns
Cycle-to-Cycle Jitter	CCJ1	CLKIN=66MHz and CL=0 (No Load)	–	40	80	ps
Cycle-to-Cycle Jitter	CCJ2	CLKIN=166MHz and CL=0 (No Load)	–	30	60	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	BUF_IN	–	–	0.7	V
Input HIGH Voltage	VINH	BUF_IN	1.7	–	VDD+0.3	V
Input LOW Current	IINL	0 < VIN < 0.8V	–	–	30	μA
Input HIGH Current	IINH	2.4V < VIN < VDD	–	–	50	μA
Output Low Voltage	VOL	IOL=8mA	–	–	0.4	V
Output High Voltage	VOH	IOH=-8mA	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=133.3MHz, CL=0	–	15	22	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	–	100	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	%

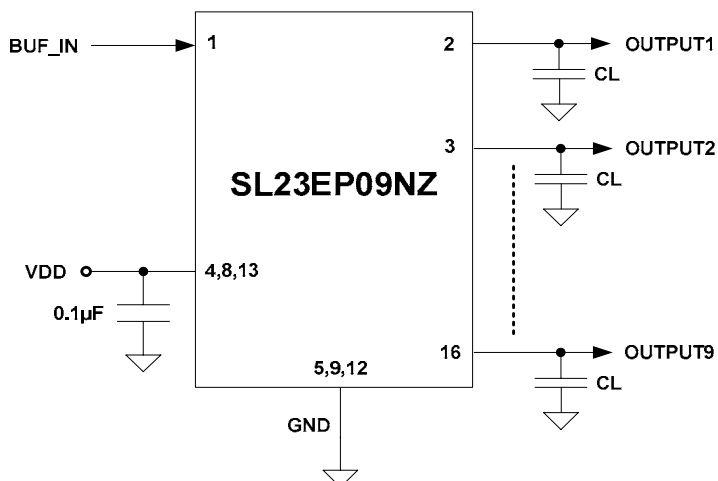
Switching Electrical Characteristics (I-Grade – Cont.)

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

Output Rise Time	tr	Measured at 0.8V to 2.0V CL=0 to 30pF	–	–	1.6	ns
Output Fall Time	tf	Measured at 0.8V to 2.0V CL=0 to 30pF	–	–	1.6	ns
Output Skew	SKW1	Measured at VDD/2 and Outputs are equally loaded	–	110	180	ps
Part to Part Skew	SKW2	Measured at VDD/2 and Outputs are equally loaded	–	120	220	ps
Propagation Delay Time	PDT	Measured at VDD/2 from CLKIN to Output Clock rising edge and Outputs are equally loaded	–	4.5	7.5	ns
Cycle-to-Cycle Jitter	CCJ1	CLKIN=66MHz and CL=0 (No Load)	–	45	90	ps
Cycle-to-Cycle Jitter	CCJ2	CLKIN=133MHz and CL=0 (No Load)	–	35	70	ps

External Components & Design Considerations

Typical Application Schematic



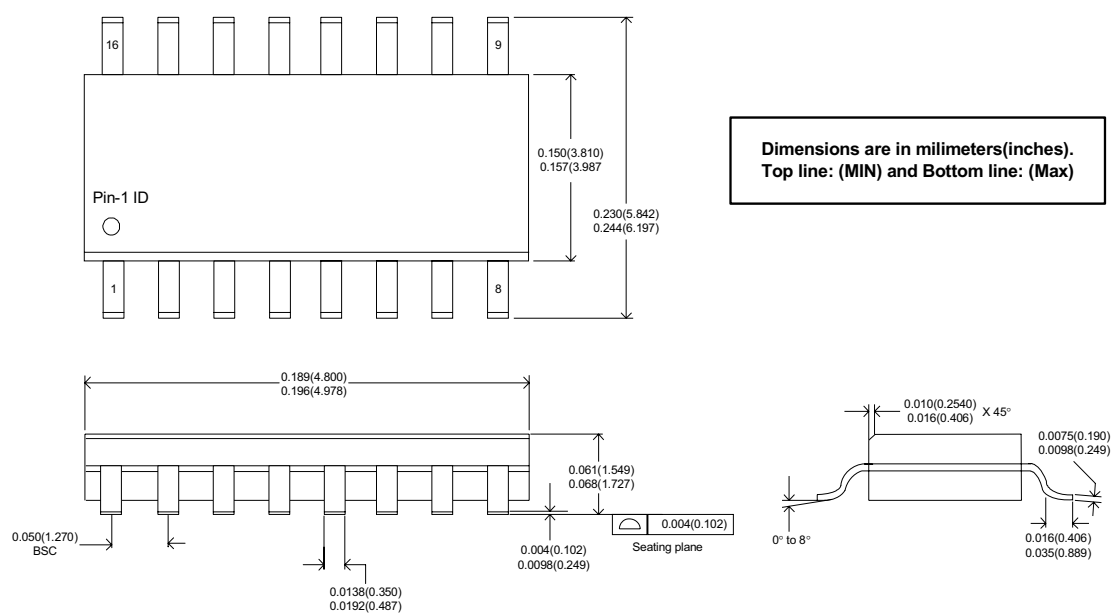
Comments and Recommendations

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	θ_{JA}	Still air	-	120	-	$^{\circ}\text{C/W}$
	θ_{JA}	1m/s air flow	-	115	-	$^{\circ}\text{C/W}$
	θ_{JA}	3m/s air flow	-	105	-	$^{\circ}\text{C/W}$
Thermal Resistance Junction to Case	θ_{JC}	Independent of air flow	-	60	-	$^{\circ}\text{C/W}$

Ordering Information ^[3]

Ordering Number	Marking	Shipping Package	Package	Temperature
SL2309NZSC-1H	SL2304NZSC-1H	Tube	16-pin SOIC	0 to 70°C
SL2309NZSC-1HT	SL2304NZSC-1H	Tape and Reel	16-pin SOIC	0 to 70°C
SL2309NZSI-1H	SL2304NZSI-1H	Tube	16-pin SOIC	-40 to 85°C
SL2309NZSI-1HT	SL2304NZSI-1H	Tape and Reel	16-pin SOIC	-40 to 85°C

Notes:

3. The SL23EP09NZ products are RoHS compliant.

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