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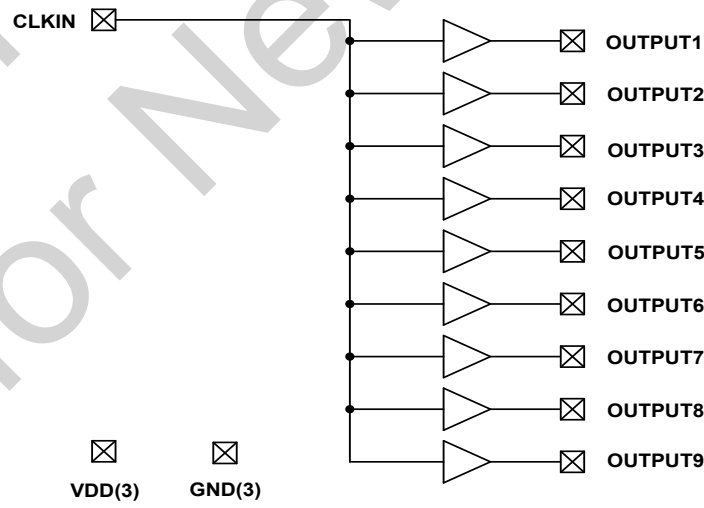
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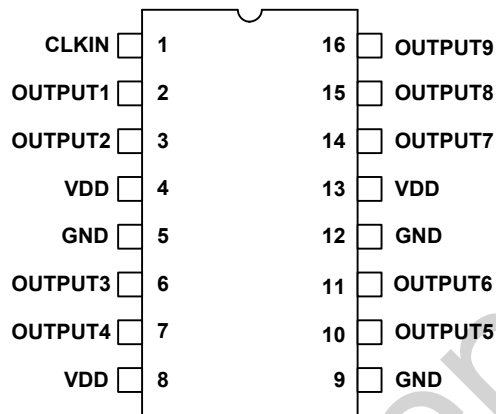
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Low Jitter and Skew DC to 220 MHz Clock Buffer

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| <p>Key Features</p> <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> - 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 • <p>Applications</p> <ul style="list-style-type: none"> • 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 | <p>Description</p> <p>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.</p> <p>The SL23EP09NZ products operate from DC to 220MHz and within 3.3V to 2.5V power supply range.</p> <p>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.</p> <p>Benefits</p> <ul style="list-style-type: none"> • Up to nine (9) distribution of input clock • Low propagation delay • Low output-to-output skew • Low output clock jitter • Low power dissipation |
| <p>Block Diagram</p>  <p>The block diagram illustrates the internal structure of the SL23EP09NZ clock buffer. A single input pin labeled CLKIN is connected to a common bus. This bus branches into nine separate signal paths, each leading to an output buffer (represented by a triangle symbol) and labeled OUTPUT1 through OUTPUT9. Additionally, the diagram shows three power pins: VDD(3) and GND(3), each represented by a square symbol with an 'X' inside.</p> | |

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 |

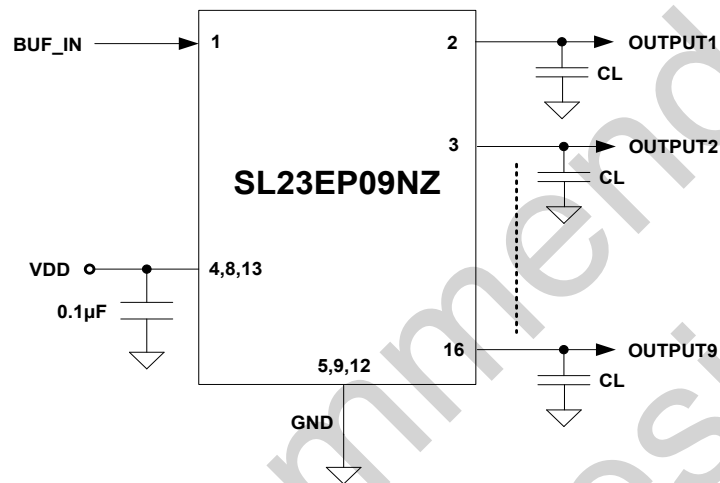
Switching Electrical Characteristics (I-Grade)

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



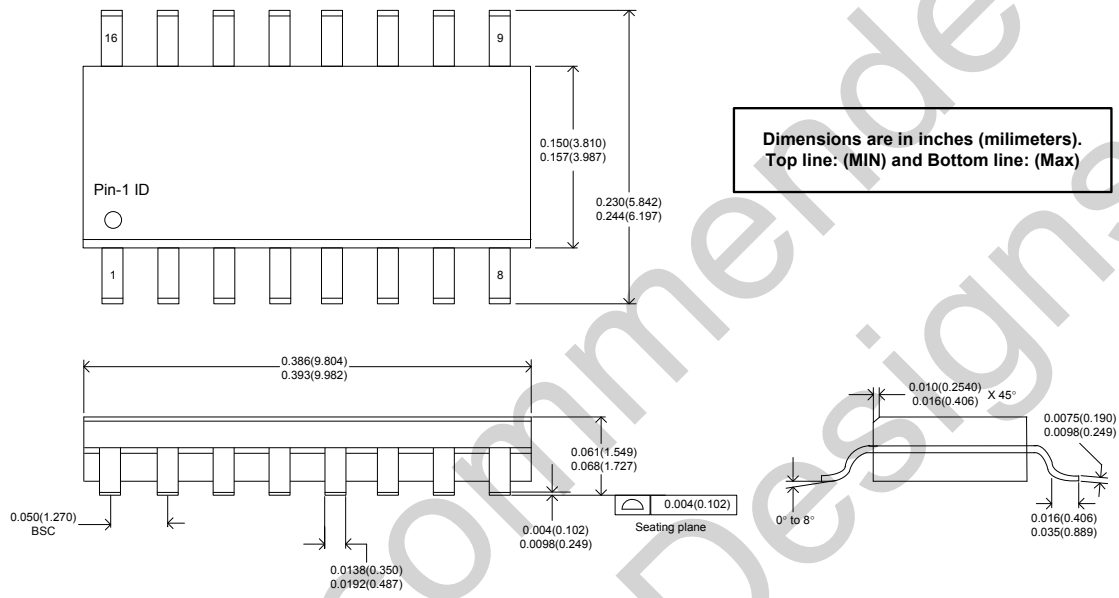
Comments and Recommendations

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 | θ_{JA} | Still air | - | 78 | - | °C/W |
| | θ_{JA} | 1m/s air flow | - | 74 | - | °C/W |
| | θ_{JA} | 3m/s air flow | - | 70 | - | °C/W |
| Thermal Resistance Junction to Case | θ_{JC} | Independent of air flow | - | 44 | - | °C/W |

Ordering Information ^[1]

| 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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