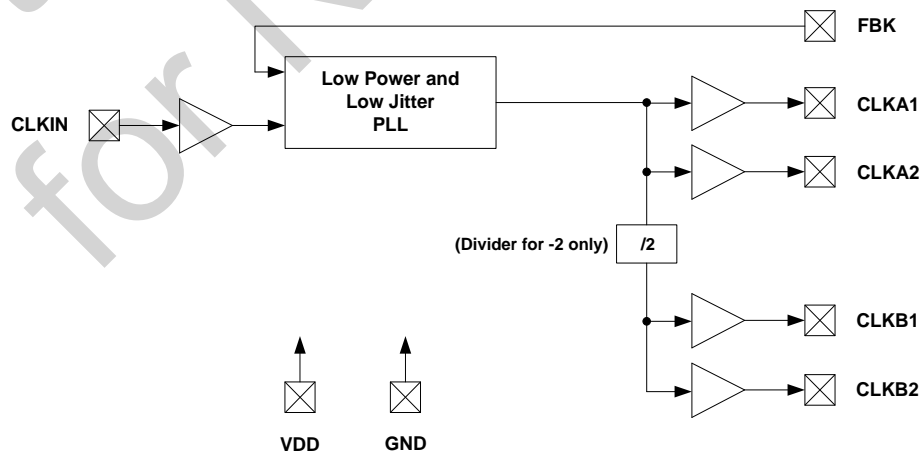




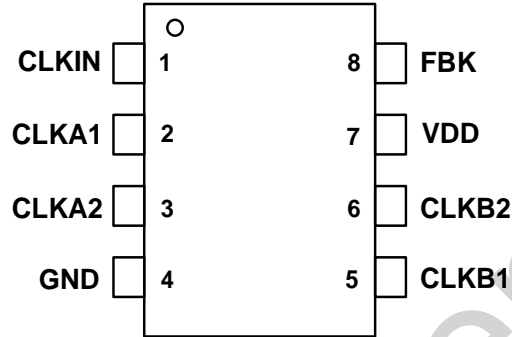
## Low Jitter and Skew 10 to 220 MHz Zero Delay Buffer (ZDB)

| Key Features  | Description  |
|---|--|
| <ul style="list-style-type: none"> <li>• 10 to 220 MHz operating frequency range</li> <li>• Low output clock skew: 60ps-typ</li> <li>• Low output clock Jitter:</li> <li>• Low part-to-part output skew: 150 ps-typ</li> <li>• 3.3V to 2.5V power supply range</li> <li>• Low power dissipation:               <ul style="list-style-type: none"> <li>- 12 mA-typ at 66MHz and VDD=3.3V</li> <li>- 10 mA-typ at 66MHz and VDD=2.5V</li> </ul> </li> <li>• One input drives 4 outputs</li> <li>• Multiple configurations and drive options</li> <li>• SpreadThru™ PLL that allows use of SSCG</li> <li>• Available in 8-pin SOIC package</li> <li>• Available in Commercial and Industrial grades</li> </ul> | <p>The SL23EP04 is a low skew, low jitter and low power Zero Delay Buffer (ZDB) designed to produce up to four (4) clock outputs from one (1) reference input clock, for high speed clock distribution applications.</p> <p>The product has an on-chip PLL and a feedback pin (FBK) which can be used to obtain feedback from any one of the 4 output clocks. The SL23EP04 offers X/2, 1X and 2X frequency options at the output with respect to input reference clock. Refer to the "Product Configuration Table" for the details of these options.</p> <p>The SL23EP04-1H and -2H High Drive version operates up to 220 MHz and 200MHz at 3.3 and 2.5V power supplies respectively. The standard versions -1 and -2 operate up to 167MHz and 135MHz at 3.3V and 2.5V power supplies respectively with CL=15pF output load.</p> <p>The SL23EP04 enter into Power Down (PD) mode if the input at CLKIN is DC (GND to VDD). In this state all 4 output clocks are tri-stated and the PLL is turned off, leading to 8µA-typ power supply current draw.</p> |
| <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>• Printers, MFPs and Digital Copiers</li> <li>• PCs and Work Stations</li> <li>• Routers, Switchers and Servers</li> <li>• Datacom and Telecom</li> <li>• High-Speed Digital Embedded Systems</li> </ul>  | <p><b>Benefits</b></p> <ul style="list-style-type: none"> <li>• Up to four (4) distribution of input clock</li> <li>• Standard and High-Drive levels to control impedance level, frequency range and EMI</li> <li>• Low skew, jitter and power dissipation</li> </ul>  |

### Block Diagram



**Pin Configuration**



**8-Pin SOIC**

**Pin Description**

| Pin Number | Pin Name | Pin Type | Pin Description   |
|------------|----------|----------|---|
| 1          | CLKIN    | Input    | Reference Frequency Clock Input. Weak pull-down (250kΩ).                    |
| 2          | CLKA1    | Output   | Buffered Clock Output Weak pull-down (250kΩ).                               |
| 3          | CLKA2    | Output   | Buffered Clock Output. Weak pull-down (250kΩ).                              |
| 4          | GND      | Power    | Power Ground.   |
| 5          | CLKB1    | Output   | Buffered Clock Output. Weak pull-down (250kΩ).                              |
| 6          | CLKB2    | Output   | Buffered Clock Output. Weak pull-down (250kΩ).                              |
| 7          | VDD      | Power    | 2.5V to 3.3V Power Supply.  |
| 8          | FBK      | Input    | PLL Feedback Input. This pin must be connected to one of the clock outputs. |

**General Description**

The SL23EP04 is a low skew, low jitter Zero Delay Buffer with very low operating current.

The product includes an on-chip high performance PLL that locks into the input reference clock and produces four (4) output clock drivers tracking the input reference clock for systems requiring clock distribution.

in addition to FBK pin used for internal PLL feedback, there are two (2) banks with two (2) outputs in each bank, bringing the number of total available output clocks to four (4).

**Input and output Frequency Range**

The input and output frequency is the same (1x) for SL23EP04-1 and -1H versions. For SL23EP04-2 and -2H versions, the output frequency is 1/2x, 1x or 2x of the CLKIN as given in the “Available SL23EP04 Configurations” Table 1. But, the frequency range depends on VDD, drive levels and CL (Load Capacitance) as given in the electrical specifications tables.

When the input clock frequency is DC (from GND to VDD), this input state is detected by an input level detection circuitry and all four (4) clock outputs are forced to Hi-Z. The PLL is shutdown to save power. In this shutdown state, the product draws less than 12  $\mu$ A (8  $\mu$ A –typ) supply current.

**SpreadThru™ Feature**

If a Spread Spectrum Clock (SSC) were to be used as an input clock, the SL23EP04 is designed to pass the modulated Spread Spectrum Clock (SSC) signal from its reference CLKIN input to the output clocks. The same spread spectrum characteristics at the input are passed through the PLL and drivers without any degradation in spread percent (%), spread profile and modulation frequency.

**High and Low-Drive Product Options**

All SL23EP04 products are offered with the high drive “-1H” and “-2H” as well as the standard drive “-1” and “-2” options. These drive options enable the user to control load levels, frequency range and EMI levels. Refer to the electrical tables for the details of the drive levels.

**Skew and Zero Delay**

All outputs should drive the similar load to achieve output-to-output skew and input-to-output delay specifications as given in the switching electrical tables. However, the delay between input and outputs can be adjusted by changing the load at FBK pin relative to the banks A and B clocks since FBK pin is the feedback to the internal PLL.

In addition, the input reference clock rise and fall time should be similar to the output rise and fall time to obtain the best skew results.

**Power Supply Range (VDD)**

The SL23EP04 is designed to operate from 3.3V (3.63V-max) to 2.5V (2.25V-min) VDD power supply range. An internal on-chip voltage regulator is used to provide to PLL constant power supply of 1.8V internally. This leads to a consistent and stable PLL electrical performance in terms of skew, jitter and power dissipation. The SL23EP04 I/O is powered by using VDD.

Contact SLI for 1.8V power supply ZDB called SL23EPL04.

| Device             | Feedback From    | Bank-A Frequency | Bank-B Frequency |
|--------------------|------------------|------------------|------------------|
| SL23EP04-1 and 1H  | Bank-A or Bank-B | Reference        | Reference        |
| SL23EP04-2 and -2H | Bank-A           | Reference        | Reference / 2    |
| SL23EP04-2 and -2H | Bank-B           | 2 x Reference    | Reference        |

**Table 1. Available SL23EP04 Configurations**

**Absolute Maximum Ratings (All Products)**

| 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)    | JEDEC ESDA-A114D               | -4000 | 4000    | V    |
| ESD Rating (Change Device Model) | JEDEC ESDA-C101C               | -1500 | 1500    | V    |
| ESD Rating (Machine Model)       | JEDEC ESDA-A115D               | -200  | 200     | V    |

**Operating Conditions (C-Grade and VDD=3.3V)**

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

| Description           | Symbol | Condition                  | Min  | Typ | Max  | Unit |
|-----------------------|--------|----------------------------|------|-----|------|------|
| Operating Voltage     | VDD    | VDD +/- 10%                | 2.97 | 3.3 | 3.63 | V    |
| Operating Temperature | TA     | Ambient Temperature        | 0    | -   | 70   | °C   |
| Input Capacitance     | VIH    | Pins 1 and 8               | -    | 5   | 7    | pF   |
| Output Impedance      | ROUT-1 | High Drive (-1H and -2H)   | -    | 28  | -    | Ω    |
| Output Impedance      | ROUT-2 | Standard Drive (-1 and -2) | -    | 40  | -    | Ω    |

**DC Electrical Characteristics (C-Grade and VDD=3.3V)**

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   | Pins 1 and 8                     | -   | -   | 0.8     | V    |
| Input HIGH Voltage | VINH   | Pins 1 and 8                     | 2.0 | -   | VDD+0.3 | V    |
| Input LOW Current  | IINL   | 0 < VIN < 0.8V, Pins 1 and 8     | -   | 20  | 50      | μA   |
| Input HIGH Current | IINH   | 2.4V < VIN < VDD<br>Pins 1 and 8 | -   | 20  | 50      | μA   |
| Output LOW Voltage | VOL    | IOL = 8 mA (-1, -2 drives)       | -   | -   | 0.4     | V    |
|                    |        | IOL = 12 mA (-1H, -2H drives)    | -   | -   | 0.4     | V    |

**DC Electrical Characteristics (C-Grade and VDD=3.3V – Cont.)**

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 HIGH Voltage       | VOH    | IOH = –8 mA (-1, -2 drives)                       | 2.4 | –   | –   | V    |
|                           |        | IOH = –12 mA (-1H, -2H drives)                    | 2.4 | –   | –   | V    |
| Power Down Supply Current | IDDPD  | Measured when CLKIN= GND to VDD or floating       | –   | 8   | 12  | µA   |
| Power Supply Current      | IDD1   | All Outputs CL=0, 33.3 MHz CLKIN<br>All versions  | –   | 10  | 14  | mA   |
| Power Supply Current      | IDD2   | All Outputs CL=0, 66.6 MHz CLKIN<br>All versions  | –   | 12  | 17  | mA   |
| Power Supply Current      | IDD3   | All Outputs CL=0, 133.3 MHz CLKIN<br>All versions | –   | 14  | 20  | mA   |
| Power Supply Current      | IDD4   | All Outputs CL=0, 166.6 MHz CLKIN<br>All versions | –   | 16  | 23  | mA   |
| Pull-down Resistors       | RPD    | Pin-1, 2, 3, 5, and 6                             | 150 | 250 | 350 | kΩ   |

**Switching Electrical Characteristics (C-Grade and VDD=3.3V)**

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, -1H and -2H versions                              | 10  | -   | 220 | MHz  |
|                        | FOUT2  | CL=22pf, -1H and -2H versions                              | 10  | -   | 180 | MHz  |
|                        | FOUT3  | CL=30pf, -1H and -2H versions                              | 10  | -   | 135 | MHz  |
|                        | FOUT4  | CL=15pf, -1, and -2 versions                               | 10  | -   | 180 | MHz  |
|                        | FOUT5  | CL=22pf, -1 and -2 versions                                | 10  | -   | 135 | MHz  |
|                        | FOUT6  | CL=30pf, -1 and -2 versions                                | 10  | -   | 100 | MHz  |
| Input Duty Cycle       | DC1    | Measured at VDD/2, all versions                            | 30  | 50  | 70  | %    |
| Output Duty Cycle      | DC2    | CL=30pF, Fout=66 MHz, all versions<br>Measured at 1.4V     | 40  | 50  | 60  | %    |
| Output Duty Cycle      | DC3    | CL=15pF, Fout=66 MHz, all versions<br>Measured at VDD/2    | 45  | 50  | 55  | %    |
| Output Duty Cycle      | DC4    | CL=15pF, Fout=133 MHz, all versions<br>Measured at VDD/2   | 45  | 50  | 55  | %    |
| Output Duty Cycle      | DC5    | CL=15pF, Fout=166 MHz, all versions<br>Measured at VDD/2   | 45  | 50  | 55  | %    |
| Output Rise/Fall Time  | tr/f1  | CL=30pF, -1 and -2 versions,<br>measured from 0.8V to 2.0V | -   | -   | 2.2 | ns   |
| Output Rise/Fall Time  | tr/f2  | CL=15pF, -1 and -2 versions,<br>measured from 0.8V to 2.0V | -   | -   | 1.5 | ns   |

**Switching Electrical Characteristics (C-Grade and VDD=3.3V – Cont.)**

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

|  |       |  |      |       |     |    |
|--|-------|--|------|-------|-----|----|
| Output Rise/Fall Time                        | tr/f3 | CL=30pF -1H and -2H version, measured from 0.8V to 2.0V                                  | -    | -     | 1.5 | ns |
| Output Rise/Fall Time                        | tr/f4 | CL=15pF -1H and -2H version, measured from 0.8V to 2.0V                                  | -    | -     | 1.2 | ns |
| Output-to-Output Skew on Same Bank           | SKW1  | -1 and -2 measured at VDD/2 and outputs are equally loaded                               | -    | 70    | 150 | ps |
| Output-to-Output Skew on Same Bank           | SKW2  | -1H and -2H measured at VDD/2 and outputs are equally loaded                             | -    | 60    | 125 | ps |
| Output-to-Output Skew Between Bank A and B   | SKW3  | -1 and -2 measured at VDD/2 and outputs are equally loaded                               | -    | 110   | 250 | ps |
| Output-to-Output Skew Between Bank A and B   | SKW4  | -1H and -2H measured at VDD/2 and outputs are equally loaded                             | -    | 90    | 200 | ps |
| Device-to-Device Skew                        | SKW5  | All versions, measured at VDD/2 and outputs are equally loaded                           | -    | 150   | 400 | ps |
| Input-to-Output Delay                        | Dt    | All versions, CLKIN to FBK rising edge, measured at VDD/2 and outputs are equally loaded | -200 | +/-70 | 200 | ps |
| Cycle-to-Cycle Jitter (-1 and, -1H Versions) | CCJ1  | Fout=66.6 MHz and CL=15pF  | -    | -     | 100 | ps |
|  |       | Fout=133.3MHz and CL=15PF  | -    | -     | 100 | ps |
|  |       | Fout=66.6MHz and CL=30pF   | -    | -     | 100 | ps |
| Cycle-to-Cycle Jitter (-2 and -2H Versions)  | CCJ2  | Fout=66.6 MHz and CL=15pF  | -    | -     | 400 | ps |
|  |       | Fout=166.6MHz and CL=15pF  | -    | -     | 400 | ps |
|  |       | Fout=66.6 MHz and CL=30pF  | -    | -     | 400 | ps |
| PLL Lock Time                                | tLOCK | From 0.95VDD and valid clock presented at CLKIN  | -    | -     | 1.0 | ms |

**Operating Conditions (I-Grade and VDD=3.3V)**

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

| Description           | Symbol | Condition                  | Min  | Typ | Max  | Unit |
|-----------------------|--------|----------------------------|------|-----|------|------|
| Operating Voltage     | VDD    | VDD+/-10%                  | 2.97 | 3.3 | 3.63 | V    |
| Operating Temperature | TA     | Ambient Temperature        | -40  | -   | 85   | °C   |
| Input Capacitance     | VIH    | Pins 1 and 8               | -    | 5   | 8    | pF   |
| Output Impedance      | ROUT-1 | High Drive (-1H and -2H)   | -    | 28  | -    | Ω    |
| Output Impedance      | ROUT-2 | Standard Drive (-1 and -2) | -    | 40  | -    | Ω    |

**DC Electrical Characteristics (I-Grade and VDD=3.3V)**

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

| Description               | Symbol | Condition   | Min | Typ | Max     | Unit |
|---------------------------|--------|---|-----|-----|---------|------|
| Input LOW Voltage         | VINL   | Pins 1 and 8                                      | -   | -   | 0.8     | V    |
| Input HIGH Voltage        | VINH   | Pins 1 and 8                                      | 2.0 | -   | VDD+0.3 | V    |
| Input LOW Current         | IINL   | 0 < VIN < 0.8V, Pins 1 and 8                      | -   | 20  | 50      | μA   |
| Input HIGH Current        | IINH   | 2.4V < VIN < VDD<br>Pins 1 and 8                  | -   | 20  | 50      | μA   |
| Output LOW Voltage        | VOL    | IOL = 8 mA ( -1, -2 drives)                       | -   | -   | 0.4     | V    |
|                           |        | IOL = 12 mA ( -1H, -2H drives)                    | -   | -   | 0.4     | V    |
| Output HIGH Voltage       | VOH    | IOH = -8 mA (-1, -2 drives)                       | 2.4 | -   | -       | V    |
|                           |        | IOH = -12 mA ( -1H, -2H drives)                   | 2.4 | -   | -       | V    |
| Power Down Supply Current | IDDPD  | Measured when CLKIN= GND to VDD or floating       | -   | 12  | 18      | μA   |
| Power Supply Current      | IDD1   | All Outputs CL=0, 33.3 MHz CLKIN<br>All versions  | -   | 12  | 17      | mA   |
| Power Supply Current      | IDD2   | All Outputs CL=0, 66.6 MHz CLKIN<br>All versions  | -   | 14  | 20      | mA   |
| Power Supply Current      | IDD3   | All Outputs CL=0, 133.3 MHz CLKIN<br>All versions | -   | 16  | 22      | mA   |
| Power Supply Current      | IDD4   | All Outputs CL=0, 166.6 MHz CLKIN<br>All versions | -   | 18  | 25      | mA   |
| Pull-down Resistors       | RPD    | Pin-1, 2, 3, 5 and 6                              | 125 | 250 | 375     | kΩ   |

**Switching Electrical Characteristics (I-Grade and VDD=3.3V)**

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, -1H and -2H versions                          | 10  | -   | 220 | MHz  |
|                        | FOUT2  | CL=22pf, -1H and -2H versions                          | 10  | -   | 180 | MHz  |
|                        | FOUT3  | CL=30pf, -1H and -2H versions                          | 10  | -   | 135 | MHz  |
|                        | FOUT4  | CL=15pf, -1, and -2 versions                           | 10  | -   | 180 | MHz  |
|                        | FOUT5  | CL=22pf, -1 and -2 versions                            | 10  | -   | 135 | MHz  |
|                        | FOUT6  | CL=30pf, -1 and -2 versions                            | 10  | -   | 100 | MHz  |
| Input Duty Cycle       | DC1    | Measured at VDD/2                                      | 30  | 50  | 70  | %    |
| Output Duty Cycle      | DC2    | CL=30pF, Fout=66 MHz, all versions<br>Measured at 1.4V | 40  | 50  | 60  | %    |

**Switching Electrical Characteristics (I-Grade and VDD=3.3V – Cont.)**

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

|   |       |   |      |       |     |    |
|---|-------|---|------|-------|-----|----|
| Output Duty Cycle                               | DC3   | CL=15pF, Fout=66 MHz, all versions<br>Measured at VDD/2   | 45   | 50    | 55  | %  |
| Output Duty Cycle                               | DC4   | CL=15pF, Fout=133 MHz, all versions<br>Measured at VDD/2  | 45   | 50    | 55  | %  |
| Output Duty Cycle                               | DC5   | CL=15pF, Fout=166 MHz, all versions<br>Measured at VDD/2  | 45   | 50    | 55  | %  |
| Output Rise/Fall Time                           | tr/f1 | CL=30pF, -1 and -2 versions,<br>measured from 0.8V to 2.0V  | -    | -     | 2.2 | ns |
| Output Rise/Fall Time                           | tr/f2 | CL=15pF, -1 and -2 versions,<br>measured from 0.8V to 2.0V  | -    | -     | 1.5 | ns |
| Output Rise/Fall Time                           | tr/f3 | CL=30pF -1H and -2H version,<br>measured from 0.8V to 2.0V  | -    | -     | 1.5 | ns |
| Output Rise/Fall Time                           | tr/f4 | CL=15pF -1H and -2H version,<br>measured from 0.8V to 2.0V  | -    | -     | 1.2 | ns |
| Output-to-Output Skew<br>on Same Bank           | SKW1  | -1 and -2 measured at VDD/2<br>and outputs are equally loaded                                     | -    | 70    | 150 | ps |
| Output-to-Output Skew<br>on Same Bank           | SKW2  | -1H and -2H measured at<br>VDD/2<br>and outputs are equally loaded                                | -    | 60    | 125 | ps |
| Output-to-Output Skew<br>Between Bank A and B   | SKW3  | -1 and -2 measured at VDD/2<br>and outputs are equally loaded                                     | -    | 110   | 250 | ps |
| Output-to-Output Skew<br>Between Bank A and B   | SKW4  | -1H and -2H measured at<br>VDD/2<br>and outputs are equally loaded                                | -    | 90    | 200 | ps |
| Device-to-Device Skew                           | SKW5  | All versions, measured at<br>VDD/2 and outputs are equally<br>loaded                              | -    | 150   | 400 | ps |
| Input-to-Output Delay                           | Dt    | All versions, CLKIN to FBK<br>rising edge, measured at<br>VDD/2 and outputs are equally<br>loaded | -200 | +/-70 | 200 | ps |
| Cycle-to-Cycle Jitter<br>(-1 and, -1H Versions) | CCJ1  | Fout=66.6 MHz and CL=15pF   | -    | -     | 100 | ps |
|   |       | Fout=133.3MHz and CL=15pF   | -    | -     | 100 | ps |
|   |       | Fout=66.6 MHz and CL=30pF   | -    | -     | 100 | ps |

**Switching Electrical Characteristics (I-Grade and VDD=3.3V – Cont.)**

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

|   |       |   |   |   |     |    |
|---|-------|---|---|---|-----|----|
| Cycle-to-Cycle Jitter<br>(-1H and -2H Versions) | CCJ2  | Fout=66.6 MHz and CL=15pF                       | - | - | 400 | ps |
|   |       | Fout=166.6MHz and CL=15pF                       | - | - | 400 | ps |
|   |       | Fout=66.6 MHz and CL=30pF                       | - | - | 400 | ps |
| PLL Lock Time                                   | tLOCK | From 0.95VDD and valid clock presented at CLKIN | - | - | 1.0 | ms |

**Operating Conditions (C-Grade and VDD=2.5V)**

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

| Description           | Symbol | Condition                  | Min  | Typ | Max  | Unit |
|-----------------------|--------|----------------------------|------|-----|------|------|
| Operating Voltage     | VDD    | VDD+/-10%                  | 2.25 | 2.5 | 2.75 | V    |
| Operating Temperature | TA     | Ambient Temperature        | -40  | -   | 85   | °C   |
| Input Capacitance     | VIH    | Pins 1 and 8               | -    | 5   | 8    | pF   |
| Output Impedance      | ROUT-1 | High Drive (-1H and -2H)   | -    | 36  | -    | Ω    |
| Output Impedance      | ROUT-2 | Standard Drive (-1 and -2) | -    | 42  | -    | Ω    |

**DC Electrical Characteristics (C-Grade and VDD=2.5V)**

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   | Pins 1 and 8                                    | -   | -   | 0.7     | V    |
| Input HIGH Voltage        | VINH   | Pins 1 and 8                                    | 1.7 | -   | VDD+0.3 | V    |
| Input LOW Current         | IINL   | 0 < VIN < 0.8V, pins 1 and 8                    | -   | 20  | 50      | μA   |
| Input HIGH Current        | IINH   | 2.4V < VIN < VDD, pins 1 and 8                  | -   | 20  | 50      | μA   |
| Output LOW Voltage        | VOL    | IOL = 6 mA, -1 and -2                           | -   | -   | 0.3     | V    |
|                           |        | IOL = 8 mA, -1H and -2H                         | -   | -   | 0.3     | V    |
| Output HIGH Voltage       | VOH    | IOH = -6 mA, -1 and -2                          | 2.0 | -   | -       | V    |
|                           |        | IOH = -8 mA, -1H and -2H                        | 2.0 | -   | -       | V    |
| Power Down Supply Current | IDDPD  | Measured when CLKIN= GND to VDD                 | -   | 10  | 18      | μA   |
| Power Supply Current      | IDD1   | All Outputs CL=0, 33.3 MHz CLKIN                | -   | 8   | 11      | mA   |
| Power Supply Current      | IDD2   | All Outputs CL=0, 66.6 MHz CLKIN, all versions  | -   | 10  | 14      | mA   |
| Power Supply Current      | IDD3   | All Outputs CL=0, 133.3 MHz CLKIN, all versions | -   | 12  | 17      | mA   |
| Power Supply Current      | IDD4   | All Outputs CL=0, 166.6 MHz CLKIN, all versions | -   | 14  | 20      | mA   |
| Pull-down Resistors       | RPD    | Pin-1, 2, 3, 5 and 6                            | 150 | 250 | 350     | kΩ   |

**Switching Electrical Characteristics (C-Grade and VDD=2.5V)**

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

| Description                                 | Symbol | Condition  | Min  | Typ   | Max | Unit |
|---|--------|--|------|-------|-----|------|
| Output Frequency Range                      | FOUT1  | CL=15pf, -1H and -2H versions  | 10   | -     | 170 | MHz  |
|   | FOUT2  | CL=22pf, -1H and -2H versions  | 10   | -     | 135 | MHz  |
|   | FOUT1  | CL=30pf, -1H and -2H versions  | 10   | -     | 100 | MHz  |
|   | FOUT4  | CL=15pf, -1 and -2 versions  | 10   | -     | 135 | MHz  |
|   | FOUT5  | CL=22pf, -1 and -2 versions  | 10   | -     | 100 | MHz  |
|   | FOUT6  | CL=30pf, -1 and -2 versions  | 10   | -     | 75  | MHz  |
| Input Duty Cycle                            | DC1    | Measured at VDD/2, all versions  | 40   | 50    | 60  | %    |
| Output Duty Cycle                           | DC2    | CL=15pF, Fout=66 MHz, all versions<br>Measured at VDD/2                                  | 45   | 50    | 55  | %    |
| Output Duty Cycle                           | DC3    | CL=15pF, Fout=133 MHz, all versions<br>Measured at VDD/2                                 | 45   | 50    | 55  | %    |
| Output Duty Cycle                           | DC4    | CL=15pF, Fout=166 MHz, all versions<br>Measured at VDD/2                                 | 40   | 50    | 60  | %    |
| Output Rise/Fall Time                       | tr/f1  | CL=30pF, -1 and -2 versions<br>Measured at 0.6 to 1.8V                                   | -    | -     | 3.0 | ns   |
| Output Rise/Fall Time                       | tr/f2  | CL=15pF, -1 and -2 versions<br>Measured at 0.6 to 1.8V                                   | -    | -     | 2.0 | ns   |
| Output Rise/Fall Time                       | tr/f3  | CL=30pF, -1H and -2H versions<br>Measured at 0.6 to 1.8V                                 | -    | -     | 2.0 | ns   |
| Output Rise/Fall Time                       | tr/f4  | CL=15pF, -1H and -2H versions<br>Measured at 0.6 to 1.8V                                 | -    | -     | 1.4 | ns   |
| Output-to-Output Skew on Same Bank          | SKW1   | -1 and -2, measured at VDD/2 and outputs are equally loaded                              | -    | 80    | 175 | ps   |
| Output-to-Output Skew on Same Bank          | SKW2   | -1H and -2H, measured at VDD/2 and outputs are equally loaded                            | -    | 70    | 150 | ps   |
| Output-to-Output Skew Between Bank A and B  | SKW3   | -1 and -2, measured at VDD/2 and outputs are equally loaded                              | -    | 125   | 300 | ps   |
| Output-to-Output Skew Between Bank A and B  | SKW4   | -1H and -2H, measured at VDD/2 and outputs are equally loaded                            | -    | 110   | 250 | ps   |
| Device-to-Device Skew                       | SKW5   | All versions, measured at VDD/2 and outputs are equally loaded                           | -    | 175   | 450 | ps   |
| Input-to-Output Delay                       | Dt     | All versions, CLKIN to FBK rising edge, measured at VDD/2 and outputs are equally loaded | -250 | +/-90 | 250 | ps   |
| Cycle-to-Cycle Jitter (-1 and -1H Versions) | CCJ1   | Fout=66.6 MHz and CL=15pF  | -    | -     | 150 | ps   |
|   |        | Fout=133.3 MHz and CL=15pF   | -    | -     | 150 | ps   |

### Switching Electrical Characteristics (C-Grade and VDD=2.5V-Cont.)

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

|   |       |   |   |   |     |    |
|---|-------|---|---|---|-----|----|
| Cycle-to-Cycle Jitter<br>(-1H and -2H Versions) | CCJ2  | Fout=66.6 MHz and CL=15pF                       | - | - | 400 | ps |
|   |       | Fout=166.6 MHz and CL=15pF                      | - | - | 400 | ps |
| PLL Lock Time                                   | tLOCK | From 0.95VDD and valid clock presented at CLKIN | - | - | 1.0 | ms |

### Operating Conditions (I-Grade and VDD=2.5V)

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

| Description           | Symbol | Condition                  | Min  | Typ | Max  | Unit |
|-----------------------|--------|----------------------------|------|-----|------|------|
| Operating Voltage     | VDD    | VDD+/-10%                  | 2.25 | 2.5 | 2.75 | V    |
| Operating Temperature | TA     | Ambient Temperature        | -40  | -   | 85   | °C   |
| Input Capacitance     | VIH    | Pins 1 and 8               | -    | 5   | 8    | pF   |
| Output Impedance      | ROUT-1 | High Drive (-1H and -2H)   | -    | 36  | -    | Ω    |
| Output Impedance      | ROUT-2 | Standard Drive (-1 and -2) | -    | 42  | -    | Ω    |

### DC Electrical Characteristics (I-Grade and VDD=2.5V)

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   | Pins 1 and 8                                      | -   | -   | 0.7     | V    |
| Input HIGH Voltage        | VINH   | Pins 1 and 8                                      | 1.7 | -   | VDD+0.3 | V    |
| Input LOW Current         | IINL   | 0 < VIN < 0.8V, pins 1 and 8                      | -   | 30  | 60      | μA   |
| Input HIGH Current        | IINH   | 2.4V < VIN < VDD, pins 1 and 8                    | -   | 30  | 60      | μA   |
| Output LOW Voltage        | VOL    | IOL = 6 mA, -1 and -2 versions                    | -   | -   | 0.3     | V    |
|                           |        | IOL = 8 mA, -1H and -2H versions                  | -   | -   | 0.3     | V    |
| Output HIGH Voltage       | VOH    | IOH = -6 mA, -1 and -2 versions                   | 2.0 | -   | -       | V    |
|                           |        | IOH = -8 mA, -1H and -2H versions                 | 2.0 | -   | -       | V    |
| Power Down Supply Current | IDDPD  | Measured when CLKIN= GND to VDD or floating       | -   | 15  | 25      | μA   |
| Power Supply Current      | IDD1   | All Outputs CL=0, 33.3 MHz CLKIN<br>All versions  | -   | 10  | 14      | mA   |
| Power Supply Current      | IDD2   | All Outputs CL=0, 66.6 MHz CLKIN<br>All versions  | -   | 12  | 17      | mA   |
| Power Supply Current      | IDD3   | All Outputs CL=0, 133.3 MHz CLKIN<br>All versions | -   | 14  | 20      | mA   |
| Power Supply Current      | IDD4   | All Outputs CL=0, 133.3 MHz CLKIN<br>All versions | -   | 16  | 24      | mA   |
| Pull-down Resistors       | RPUD   | Pin-1, 2, 3, 5 and 6                              | 125 | 250 | 375     | kΩ   |

**Switching Electrical Characteristics (I-Grade and VDD=2.5V)**

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, -1H and -2H versions  | 10   | -      | 170 | MHz  |
|  | FOUT2  | CL=22pf, -1H and -2H versions  | 10   | -      | 135 | MHz  |
|  | FOU3   | CL=30pF, -1H and -2H versions  | 10   | -      | 100 | MHz  |
|  | FOUT4  | CL=15pf, -1 and -2 versions  | 10   | -      | 135 | MHz  |
|  | FOUT5  | CL=22pf, -1 and -2 versions  | 10   | -      | 100 | MHz  |
|  | FOUT6  | CL=30pf, -1 and -2 versions  | 10   | -      | 75  | MHz  |
| Input Duty Cycle                           | DC1    | Measured at VDD/2, all versions  | 40   | 50     | 60  | %    |
| Output Duty Cycle                          | DC2    | CL=30pF, Fout=66 MHz, all versions<br>Measured at VDD/2                                  | 40   | 50     | 60  | %    |
| Output Duty Cycle                          | DC3    | CL=15pF, Fout=66 MHz, all versions<br>Measured at VDD/2                                  | 45   | 50     | 55  | %    |
| Output Duty Cycle                          | DC4    | CL=15pF, Fout=133 MHz, all versions<br>Measured at VDD/2                                 | 45   | 50     | 55  | %    |
| Output Duty Cycle                          | DC5    | CL=15pF, Fout=166 MHz, all versions<br>Measured at VDD/2                                 | 40   | 50     | 60  | %    |
| Output Rise/Fall Time                      | tr/f1  | CL=30pF, -1 and -2 versions<br>Measured at 0.6 to 1.8V                                   | -    | -      | 3.2 | ns   |
| Output Rise/Fall Time                      | tr/f2  | CL=15pF, -1 and -2 versions<br>Measured at 0.6 to 1.8V                                   | -    | -      | 2.0 | ns   |
| Output Rise/Fall Time                      | tr/f3  | CL=30pF, -1H and -2H versions<br>Measured at 0.6 to 1.8V                                 | -    | -      | 2.0 | ns   |
| Output Rise/Fall Time                      | tr/f4  | CL=15pF, -1H and -2H version<br>Measured at 0.6 to 1.8V                                  | -    | -      | 1.5 | ns   |
| Output-to-Output Skew on Same Bank         | SKW1   | -1 and -2, measured at VDD/2, and outputs are equally loaded                             | -    | 100    | 220 | ps   |
| Output-to-Output Skew on Same Bank         | SKW2   | -1H and -2H, measured at VDD/2 and outputs are equally loaded                            | -    | 100    | 220 | ps   |
| Output-to-Output Skew Between Bank A and B | SKW3   | -1 and -2, measured at VDD/2, and outputs are equally loaded                             | -    | 100    | 220 | ps   |
| Output-to-Output Skew Between Bank A and B | SKW4   | -1H and -2H, measured at VDD/2 and outputs are equally loaded                            | -    | 180    | 375 | ps   |
| Device-to-Device Skew                      | SKW5   | All versions, measured at VDD/2 and outputs are equally loaded                           | -    | 225    | 550 | ps   |
| Input-to-Output Delay                      | Dt     | All versions, CLKIN to FBK rising edge, measured at VDD/2 and outputs are equally loaded | -300 | +/-125 | 300 | ps   |

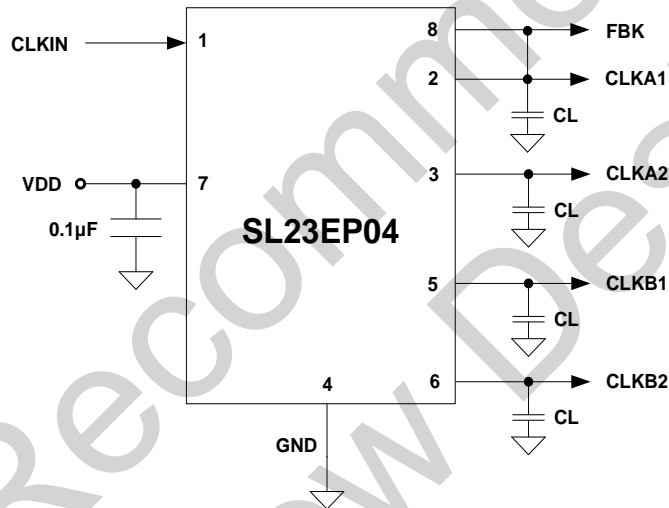
**Switching Electrical Characteristics (I-Grade and VDD=2.5V – Cont.)**

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

|   |       |                              |   |   |     |    |
|---|-------|------------------------------|---|---|-----|----|
| Cycle-to-Cycle Jitter<br>(-1 and -2 Versions)   | CCJ1  | Fout=66.6 MHz and CL=15pF    | - | - | 150 | ps |
|   |       | Fout=133.3 MHz and CL=15pF   | - | - | 150 | ps |
| Cycle-to-Cycle Jitter<br>(-1H and -2H Versions) | CCJ2  | Fout=66.6 MHz and CL=15pF    | - | - | 400 | ps |
|   |       | Fout=166.6 MHz and CL=15pF   | - | - | 400 | ps |
| PLL Lock Time                                   | tLOCK | From 0.95VDD and valid CLKIN | - | - | 1.0 | ms |

**External Components & Design Considerations**

**Typical Application Schematic**



**Comments and Recommendations**

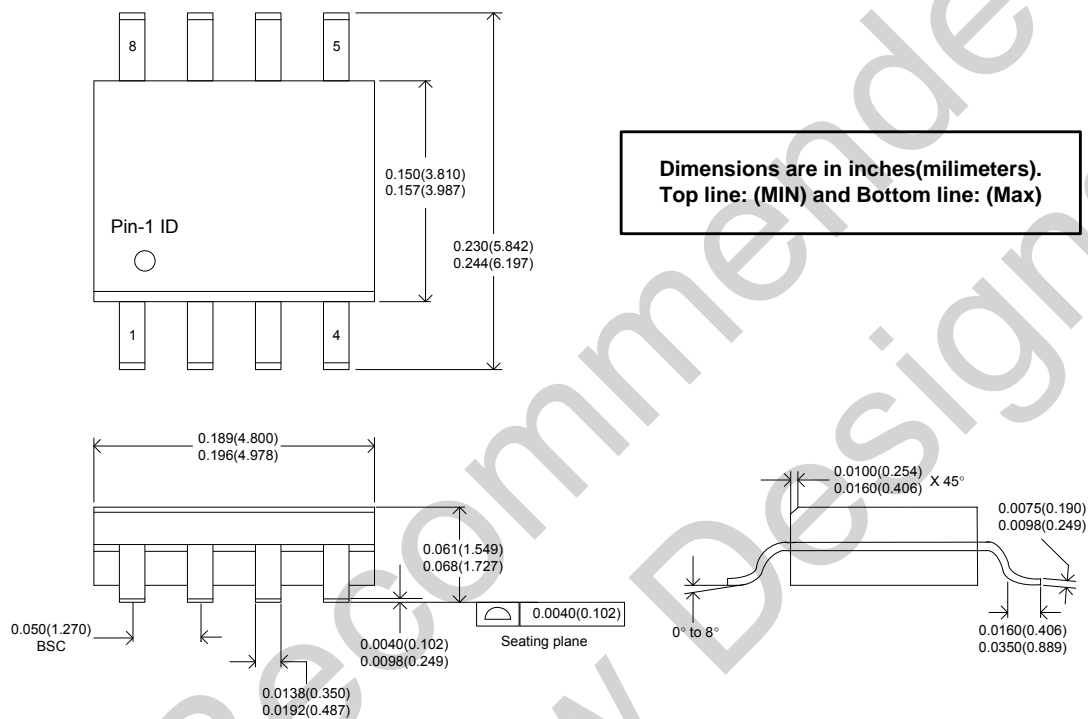
**Decoupling Capacitor:** A decoupling capacitor of 0.1µF must be used between VDD and VSS pins. Place the capacitor on the component side of the PCB as close to the VDD pin as possible. The PCB trace to the VDD pin and to the GND via should be kept as short as possible. Do not use vias between the decoupling 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. The nominal impedance of the clock outputs is given in the Operating Condition Tables. Place the series termination resistors as close to the clock outputs as possible.

**Zero Delay and Skew Control:** All outputs and CLKIN pins should be loaded with the same load to achieve “Zero Delay” between the CLKIN and the outputs. The FBK pin is connected to PLL internally on-chip for feedback and should be connected to one of the output clocks externally. For applications requiring zero input/output delay, the load at all output pins including the FBK pin must be the same. If any delay adjustment is required, the capacitance at the FBK pin could be increased or decreased to increase or decrease the delay between Bank A and B clocks relative to CLKIN. For minimum pin-to-pin skew, the external load at all the Bank A and B clocks must be the same. In addition, the rise and fall time of the reference clock at CLKIN pin should be similar to rise and fall times at the CLKA and CLK B bank outputs.

**Package Outline and Package Dimensions**

**8-Pin SOIC (150 Mil)**



**Thermal Characteristics**

| Parameter                              | Symbol        | Condition               | Min | Typ | Max | Unit |
|--|---------------|-------------------------|-----|-----|-----|------|
| Thermal Resistance Junction to Ambient | $\theta_{JA}$ | Still air               | -   | 157 | -   | °C/W |
|  | $\theta_{JA}$ | 1m/s air flow           | -   | 142 | -   | °C/W |
|  | $\theta_{JA}$ | 3m/s air flow           | -   | 131 | -   | °C/W |
| Thermal Resistance Junction to Case    | $\theta_{JC}$ | Independent of air flow | -   | 42  | -   | °C/W |

**Ordering Information** <sup>[3]</sup>

| Ordering Number | Marking       | Shipping Package | Package    | Temperature |
|-----------------|---------------|------------------|------------|-------------|
| SL23EP04SC-1    | SL23EP04SC-1  | Tube             | 8-pin SOIC | 0 to 70°C   |
| SL23EP04SC-1T   | SL23EP04SC-1  | Tape and Reel    | 8-pin SOIC | 0 to 70°C   |
| SL23EP04SI-1    | SL23EP04SI-1  | Tube             | 8-pin SOIC | -40 to 85°C |
| SL23EP04SI-1T   | SL23EP04SI-1  | Tape and Reel    | 8-pin SOIC | -40 to 85°C |
| SL23EP04SC-1H   | SL23EP04SC-1H | Tube             | 8-pin SOIC | 0 to 70°C   |
| SL23EP04SC-1HT  | SL23EP04SC-1H | Tape and Reel    | 8-pin SOIC | 0 to 70°C   |
| SL23EP04SI-1H   | SL23EP04SI-1H | Tube             | 8-pin SOIC | -40 to 85°C |
| SL23EP04SI-1HT  | SL23EP04SI-1H | Tape and Reel    | 8-pin SOIC | -40 to 85°C |
| SL23EP04SC-2    | SL23EP04SC-2  | Tube             | 8-pin SOIC | 0 to 70°C   |
| SL23EP04SC-2T   | SL23EP04SC-2  | Tape and Reel    | 8-pin SOIC | 0 to 70°C   |
| SL23EP04SI-2    | SL23EP04SI-2  | Tube             | 8-pin SOIC | -40 to 85°C |
| SL23EP04SI-2T   | SL23EP04SI-2  | Tape and Reel    | 8-pin SOIC | -40 to 85°C |
| SL23EP04SC-2H   | SL23EP04SC-2H | Tube             | 8-pin SOIC | 0 to 70°C   |
| SL23EP04SC-2HT  | SL23EP04SC-2H | Tape and Reel    | 8-pin SOIC | 0 to 70°C   |
| SL23EP04SI-2H   | SL23EP04SI-2H | Tube             | 8-pin SOIC | -40 to 85°C |
| SL23EP04SI-2HT  | SL23EP04SI-2H | Tape and Reel    | 8-pin SOIC | -40 to 85°C |

**Notes:**

1. The SL23EP04 products are RoHS compliant.



## ClockBuilder Pro

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