

## Spread-Compatible Low Skew Zero Delay Buffer

### FEATURES

- Frequency Range 10MHz to 134 MHz
- Output Options:
  - 5 outputs *PL123S-05*
  - 9 outputs *PL123S-09*
- Zero input - output delay
- Optional Drive Strength:
  - Standard (8mA) *PL123S-05/-09*
  - High (12mA) *PL123S-05H/-09H*
- 3.3V,  $\pm 10\%$  operation
- Available in Commercial and Industrial temperature ranges
- Available in 16-Pin SOP, SSOP or TSSOP (*PL123S-09*), and 8-Pin SOP (*PL123S-05*) packages
- Spread-compatible with spread-spectrum modulation clock inputs

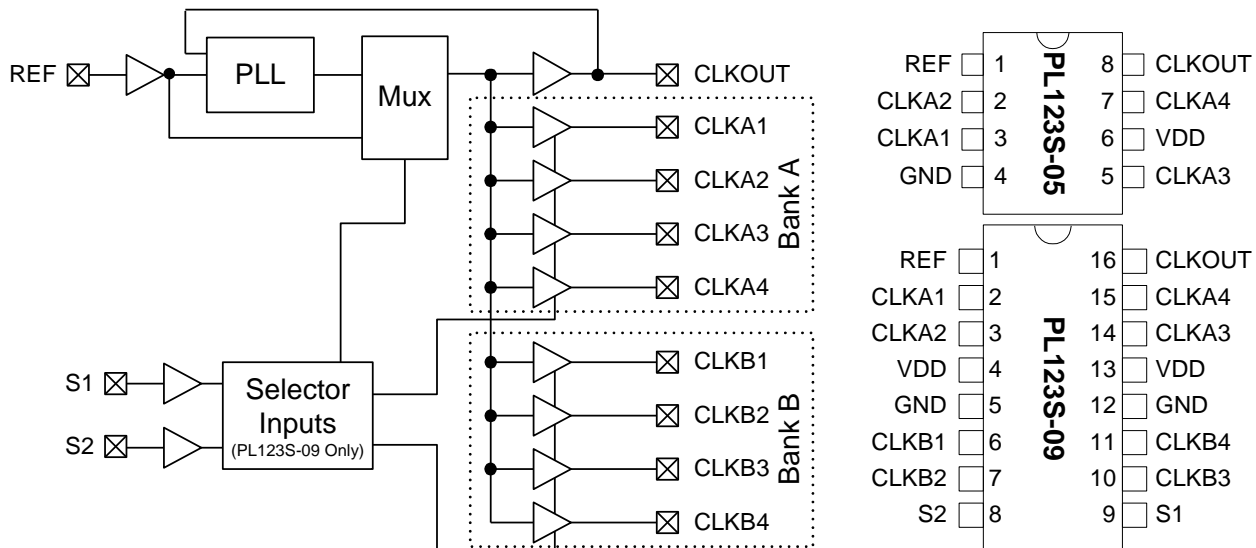
### DESCRIPTION

The PL123S-05/-09 (-05H/-09H for High Drive) are high performance, low skew, low jitter zero delay buffers designed to distribute high speed clocks. They have one (*PL123S-05*) or two (*PL123S-09*) low-skew output banks, of 4 outputs each, that are synchronized with the input. The *PL123S-09* allows control of the banks of outputs by using the S1 and S2 inputs as shown in the Selector Definition table on page 2.

The synchronization is established via CLKOUT feed back to the input of the PLL. Since the skew between the input and output is less than  $\pm 100\text{ps}$ , the device acts as a zero delay buffer. The input output propagation delay can be advanced or delayed by adjusting the load on the CLKOUT pin.

These parts are not intended for 5V input-tolerant applications.

### BLOCK DIAGRAM



## Spread-Compatible Low Skew Zero Delay Buffer

### PIN DESCRIPTIONS

| Name                  | PL123S-09                    | PL123S-05 | Type | Description   |
|-----------------------|------------------------------|-----------|------|---|
|                       | TSSOP-16L, SOP-16L, SSOP-16L | SOP-8L    |      |   |
| REF <sup>[1]</sup>    | 1                            | 1         | I    | Input reference frequency.                            |
| CLKA1 <sup>[2]</sup>  | 2                            | 3         | O    | Buffered clock output, Bank A                         |
| CLKA2 <sup>[2]</sup>  | 3                            | 2         | O    | Buffered clock output, Bank A                         |
| VDD                   | 4,13                         | 6         | P    | VDD connection  |
| GND                   | 5,12                         | 4         | P    | GND connection  |
| CLKB1 <sup>[2]</sup>  | 6                            | -         | O    | Buffered clock output, Bank B                         |
| CLKB2 <sup>[2]</sup>  | 7                            | -         | O    | Buffered clock output, Bank B                         |
| S2 <sup>[3]</sup>     | 8                            | -         | I    | Selector input  |
| S1 <sup>[3]</sup>     | 9                            | -         | I    | Selector input  |
| CLKB3 <sup>[2]</sup>  | 10                           | -         | O    | Buffered clock output, Bank B                         |
| CLKB4 <sup>[2]</sup>  | 11                           | -         | O    | Buffered clock output, Bank B                         |
| CLKA3 <sup>[2]</sup>  | 14                           | 5         | O    | Buffered clock output, Bank A                         |
| CLKA4 <sup>[2]</sup>  | 15                           | 7         | O    | Buffered clock output, Bank A                         |
| CLKOUT <sup>[2]</sup> | 16                           | 8         | O    | Buffered clock output. Internal feedback on this pin. |

**Notes:** 1: Weak pull-down. 2: Weak pull-down on all outputs. 3: Weak Pull-Up on S1 and S2

### SELECTOR DEFINITION FOR PL123S-09

| S2 | S1 | CLOCK A1-A4<br>(Bank A) | CLOCK B1-B4<br>(Bank B) | CLKOUT | Output Source | PLL Shutdown |
|----|----|-------------------------|-------------------------|--------|---------------|--------------|
| 0  | 0  | Three-state             | Three-state             | Driven | PLL           | N            |
| 0  | 1  | Driven                  | Three-state             | Driven | PLL           | N            |
| 1  | 0  | Driven                  | Driven                  | Driven | Reference     | Y            |
| 1  | 1  | Driven                  | Driven                  | Driven | PLL           | N            |

### INPUT / OUTPUT SKEW CONTROL

The PL123S-05/-09 will achieve Zero Delay from input to output when all the outputs are loaded equally. Adjustments to the input/output delay can be made by adding additional loading to the CLKOUT pin.

Please contact PhaseLink for more information.

## Spread-Compatible Low Skew Zero Delay Buffer

### SPREAD COMPATIBLE

Many products today utilize spread-spectrum modulation clocking to reduce electromagnetic interference (EMI) and pass FCC regulations. This product was designed to pass spread-spectrum input clock modulation frequencies to the output. When a buffer is not designed to pass spread spectrum, there will exist significant tracking jitter between input and output clocks, which may result in problems with system timing and synchronization.

### LAYOUT RECOMMENDATIONS

The following guidelines are to assist you with a performance optimized PCB design:

#### Signal Integrity and Termination Considerations

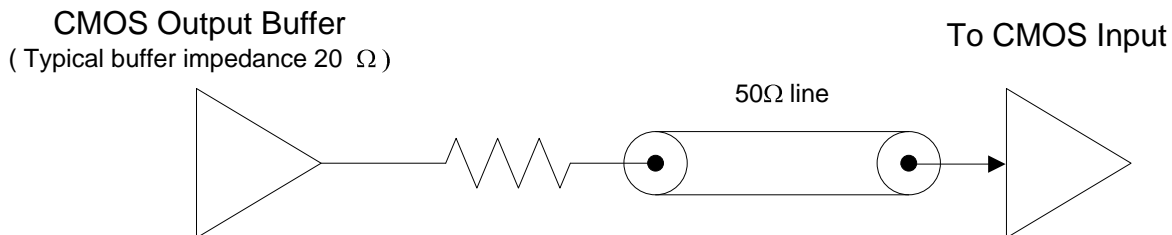
- Keep traces short!
- Trace = Inductor. With a capacitive load this equals ringing!
- Long trace = Transmission Line. Without proper termination this will cause reflections ( looks like ringing ).
- Design long traces as “striplines” or “microstrips” with defined impedance.
- Match trace at one side to avoid reflections bouncing back and forth.

#### Decoupling and Power Supply Considerations

- Place decoupling capacitors as close as possible to the VDD pin(s) to limit noise from the power supply
- Addition of a ferrite bead in series with VDD can help prevent noise from other board sources
- Value of decoupling capacitor is frequency dependant. Typical values to use are 0.1 $\mu$ F for designs using frequencies < 50MHz and 0.01 $\mu$ F for designs using frequencies > 50MHz.

#### Typical CMOS termination

Place Series Resistor as close as possible to CMOS output



Connect a 33  $\Omega$  series resistor at each of the output clocks to enhance the stability of the output signal

**Spread-Compatible Low Skew Zero Delay Buffer**

**ABSOLUTE MAXIMUM CONDITIONS**

|  |                         |                                     |         |
|--|-------------------------|-------------------------------------|---------|
| Supply Voltage to Ground Potential ..... | -0.5V to 4.6V           | Junction Temperature.....           | 150°C   |
| DC Input Voltage .....                   | $V_{SS} - 0.5V$ to 4.6V | Static Discharge Voltage            |         |
| Storage Temperature .....                | -65°C to 150°C          | (per MIL-STD-883, Method 3015)..... | > 2000V |

**OPERATING CONDITIONS**

| Parameter | Description   | Min. | Max. | Unit |
|-----------|---|------|------|------|
| $V_{DD}$  | Supply Voltage  | 3.0  | 3.6  | V    |
| $T_A$     | Commercial Operating Temperature (ambient temperature)  | 0    | 70   | °C   |
|           | Industrial Operating Temperature (ambient temperature)  | -40  | 85   | °C   |
| $C_L$     | Load Capacitance, below 100 MHz   | —    | 30   | pF   |
|           | Load Capacitance, above 100 MHz   | —    | 10   | pF   |
| $C_{IN}$  | Input Capacitance   | —    | 7    | pF   |
| $t_{PU}$  | Power-up time for all $V_{DD}$ s to reach minimum specified voltage (power ramps must be monotonic) | 0.05 | 250  | ms   |

**ELECTRICAL CHARACTERISTICS**

| Parameter | Description                        | Test Conditions                                     | Min. | Max. | Unit |
|-----------|------------------------------------|---|------|------|------|
| $V_{IL}$  | Input LOW Voltage                  |   | —    | 0.8  | V    |
| $V_{IH}$  | Input HIGH Voltage                 |   | 2.5  | —    | V    |
| $I_{IL}$  | Input LOW Current                  | $V_{IN} = 0V$                                       | —    | 50   | µA   |
| $I_{IH}$  | Input HIGH Current                 | $V_{IN} = V_{DD}$                                   | —    | 100  | µA   |
| $V_{OL}$  | Output LOW Voltage <sup>[4]</sup>  | $I_{OL} = 8\text{ mA}$<br>$I_{OL} = 12\text{ mA}$   | —    | 0.4  | V    |
| $V_{OH}$  | Output HIGH Voltage <sup>[4]</sup> | $I_{OH} = -8\text{ mA}$<br>$I_{OH} = -12\text{ mA}$ | 2.4  | —    | V    |
| $I_{DD}$  | Supply Current (Unloaded Outputs)  | 66.67MHz with unloaded outputs<br>Commercial Temp.  | —    | 32   | mA   |
|           |                                    | 66.67MHz with unloaded outputs<br>Industrial Temp.  | —    | 45   | mA   |

**Notes:** 4. Parameter is guaranteed by design and characterization. Not 100% tested in production.

**Spread-Compatible Low Skew Zero Delay Buffer**

**SWITCHING CHARACTERISTICS <sup>[5]</sup>**

| Parameter         | Name  | Test Conditions   | Min. | Typ. | Max. | Unit |
|-------------------|---|---|------|------|------|------|
| t <sub>1</sub>    | Output Frequency  | 30-pF load  | 10   | –    | 100  | MHz  |
|                   |   | 10-pF load  | 10   | –    | 134  | MHz  |
|                   | Duty Cycle <sup>[4]</sup> = t <sub>2</sub> ÷ t <sub>1</sub> | Measured at 1.4V, F <sub>OUT</sub> = 66.67MHz                   | 40   | 50   | 60   | %    |
|                   | Duty Cycle <sup>[4]</sup> = t <sub>2</sub> ÷ t <sub>1</sub> | Measured at 1.4V, F <sub>OUT</sub> <50MHz                       | 45   | 50   | 55   | %    |
| t <sub>3</sub>    | Rise Time <sup>[4]</sup>                                    | Measured between 0.8V and 2.0V                                  | –    | 2.5  | –    | ns   |
|                   | Rise Time <sup>[4]</sup> (High Drive)                       | Measured between 0.8V and 2.0V                                  | –    | 1.5  | –    | ns   |
| t <sub>4</sub>    | Fall Time <sup>[4]</sup>                                    | Measured between 0.8V and 2.0V                                  | –    | 2.5  | –    | ns   |
|                   | Fall Time <sup>[4]</sup> (High Drive)                       | Measured between 0.8V and 2.0V                                  | –    | 1.5  | –    | ns   |
| t <sub>5</sub>    | Output to Output Skew                                       | All outputs equally loaded                                      | –    | –    | 250  | ps   |
| t <sub>6A</sub>   | Delay, REF Rising Edge to CLKOUT Rising Edge <sup>[4]</sup> | Measured at VDD/2   | –    | 0    | ±350 | ps   |
| t <sub>6B</sub>   | Delay, REF Rising Edge to CLKOUT Rising Edge <sup>[4]</sup> | Measured at VDD/2. Measured in PLL bypass mode, PL123S-09 only. | 1    | 5    | 8.5  | ns   |
| t <sub>7</sub>    | Device to Device Skew <sup>[4]</sup>                        | Measured at VDD/2 on the CLKOUT pin                             | –    | 0    | 700  | ps   |
| t <sub>8</sub>    | Output Slew Rate <sup>[4]</sup>                             | Measured between 0.8V and 2.0V using Test Circuit #2            | 1    | –    | –    | V/ns |
| t <sub>J</sub>    | Cycle to Cycle Jitter <sup>[4]</sup>                        | Measured at 66.67 MHz, loaded outputs                           | –    | 75   | 200  | ps   |
| t <sub>LOCK</sub> | PLL Lock Time <sup>[4]</sup>                                | Stable power supply, valid clock presented on REF pin           | –    | –    | 1.0  | ms   |

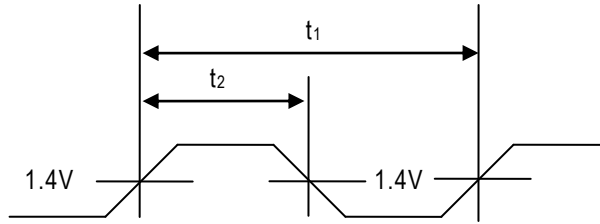
**Notes:**

- 4. Parameter is guaranteed by design and characterization. Not 100% tested in production.
- 5. All parameters are specified with loaded outputs.

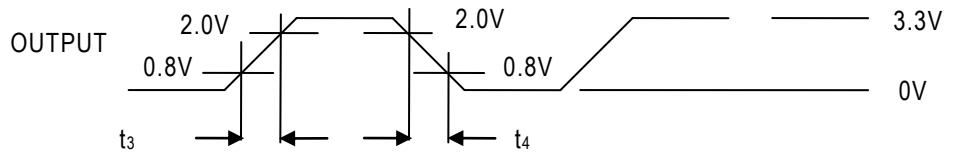
**Spread-Compatible Low Skew Zero Delay Buffer**

**SWITCHING WAVEFORMS**

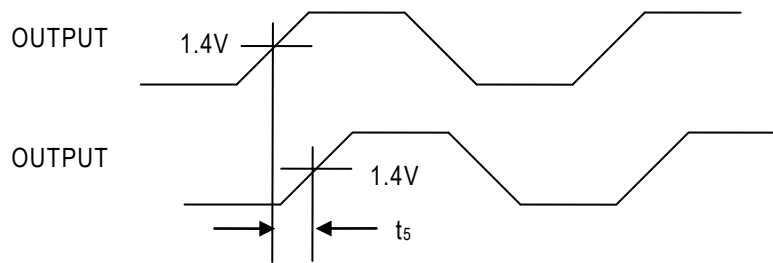
**Duty Cycle Timing**



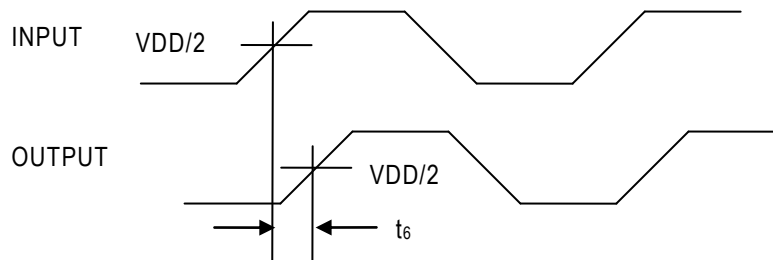
**All Outputs Rise/Fall Time**



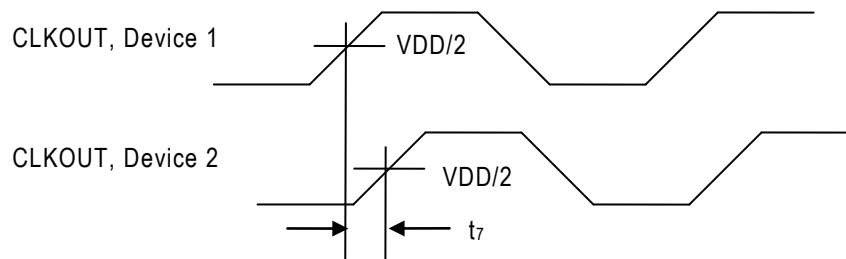
**Output-Output Skew**



**Input-Output Propagation Delay**

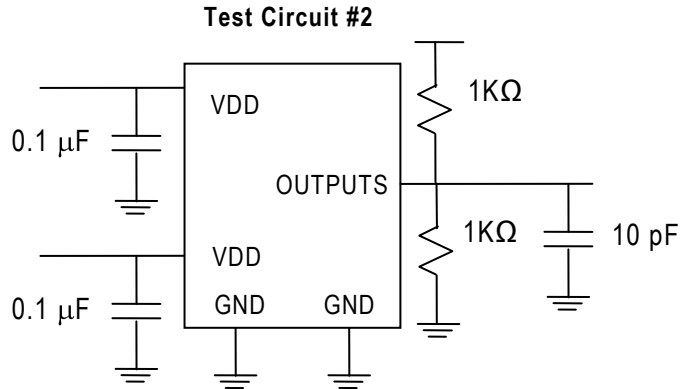
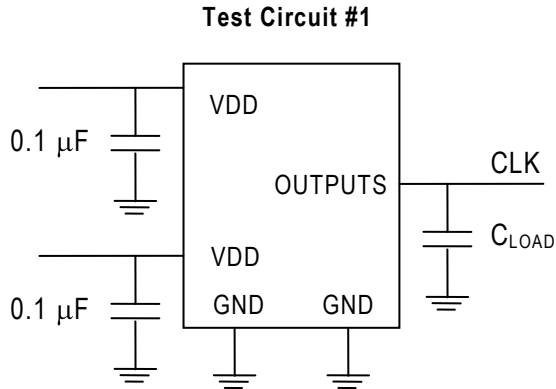


**Device-Device Skew**



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**TEST CIRCUITS**

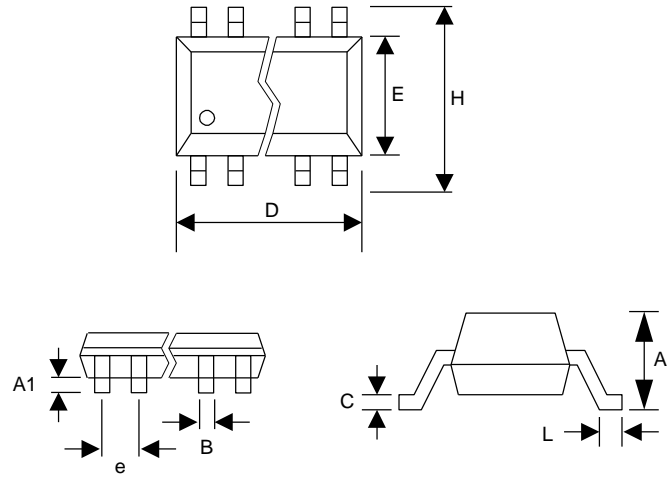


**Spread-Compatible Low Skew Zero Delay Buffer**

**PACKAGE DRAWINGS (GREEN PACKAGE COMPLIANT)**

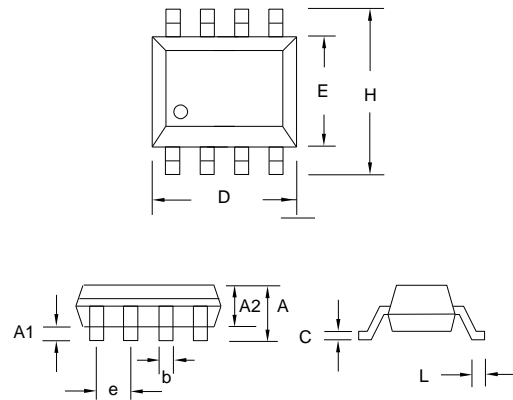
**SOP-16L, SSOP-16L, TSSOP-16L ( mm )**

| Symbol | SOP      |       | SSOP      |      | TSSOP    |      |
|--------|----------|-------|-----------|------|----------|------|
|        | Min.     | Max.  | Min.      | Max. | Min.     | Max. |
| A      | 1.35     | 1.75  | 1.35      | 1.75 | -        | 1.20 |
| A1     | 0.10     | 0.25  | 0.05      | 0.15 | 0.05     | 0.15 |
| B      | 0.33     | 0.51  | 0.2       | 0.3  | 0.19     | 0.30 |
| C      | 0.19     | 0.25  | 0.18      | 0.25 | 0.09     | 0.20 |
| D      | 9.80     | 10.00 | 4.8       | 5.0  | 4.90     | 5.10 |
| E      | 3.80     | 4.00  | 3.8       | 3.98 | 4.30     | 4.50 |
| H      | 5.80     | 6.20  | 5.80      | 6.20 | 6.40 BSC |      |
| L      | 0.40     | 1.27  | 0.40      | 1.27 | 0.45     | 0.75 |
| e      | 1.27 BSC |       | 0.635 BSC |      | 0.65 BSC |      |



**SOP 8L**

| Symbol | Dimension in mm |      |
|--------|-----------------|------|
|        | Min.            | Max. |
| A      | 1.35            | 1.75 |
| A1     | 0.10            | 0.25 |
| A2     | 1.25            | 1.50 |
| B      | 0.33            | 0.53 |
| C      | 0.19            | 0.27 |
| D      | 4.80            | 5.00 |
| E      | 3.80            | 4.00 |
| H      | 5.80            | 6.20 |
| L      | 0.40            | 0.89 |
| e      | 1.27 BSC        |      |



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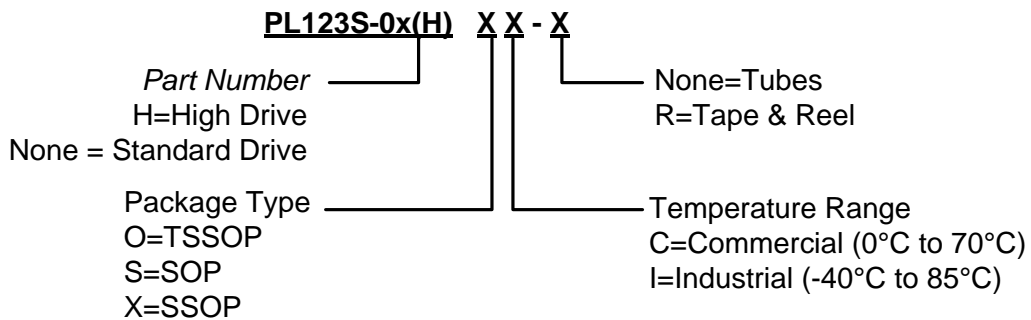
**ORDERING INFORMATION**

**For part ordering, please contact our Sales Department:**

2880 Zanker Road, Suite 103 San Jose CA95134 USA  
Tel (408) 571-1668 Fax (408) 571-1688

**PART NUMBER**

The order number for this device is a combination of the following:  
Part number, Package type and Operating temperature range



| Part/Order Number | Marking     | Package Option               |
|-------------------|-------------|------------------------------|
| PL123S-05SC       | P123S05     | 8-Pin SOP Tube               |
| PL123S-05SC-R     | SC<br>LLLLL | 8-Pin SOP (Tape and Reel)    |
| PL123S-05HSC      | P123S05H    | 8-Pin SOP Tube               |
| PL123S-05HSC-R    | SC<br>LLLLL | 8-Pin SOP (Tape and Reel)    |
| PL123S-09OC       | P123S09     | 16-Pin TSSOP Tube            |
| PL123S-09OC-R     | OC<br>LLLLL | 16-Pin TSSOP (Tape and Reel) |
| PL123S-09HOC      | P123S09H    | 16-Pin TSSOP Tube            |
| PL123S-09HOC-R    | OC<br>LLLLL | 16-Pin TSSOP (Tape and Reel) |
| PL123S-09SC       | P123S09     | 16-Pin SOP Tube              |
| PL123S-09SC-R     | SC<br>LLLLL | 16-Pin SOP (Tape and Reel)   |
| PL123S-09HSC      | P123S09H    | 16-Pin SOP Tube              |
| PL123S-09HSC-R    | SC<br>LLLLL | 16-Pin SOP (Tape and Reel)   |

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