

## PCIe® 3.0 Clock Generator with 2 HCSL Outputs

### Features

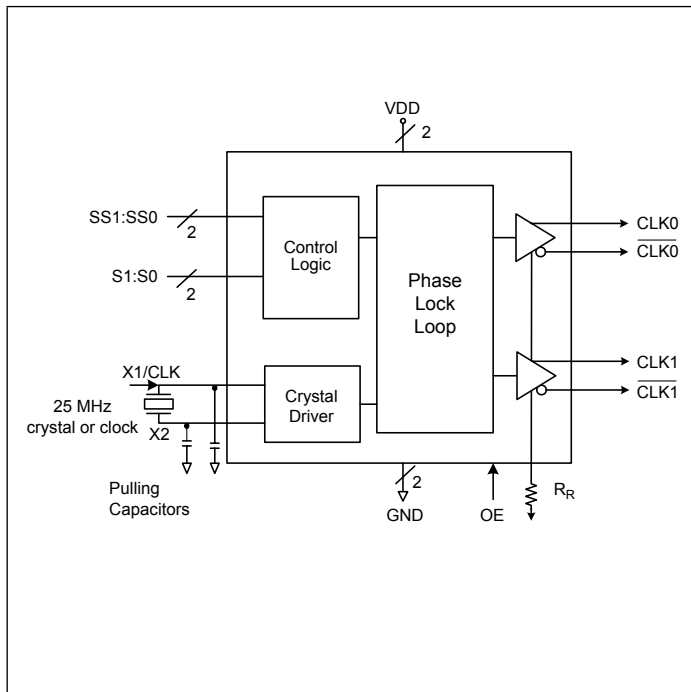
- PCIe® 3.0 compliant
  - PCIe 3.0 Phase jitter - 0.45ps RMS (High Freq. Typ.)
- LVDS compatible outputs
- Supply voltage of 3.3V ±10%
- 25MHz crystal or clock input frequency
- HCSL outputs, 0.8V Current mode differential pair
- Jitter 35ps cycle-to-cycle (typ)
- Spread of -0.5%, -0.75%, and no spread
- Industrial temperature range
- Spread Bypass option available
- Spread and frequency selection via external pins
- Packaging: (Pb-free and Green)
  - 16-pin TSSOP (L16)
  - 16-pin QSOP (Q16)

### Description

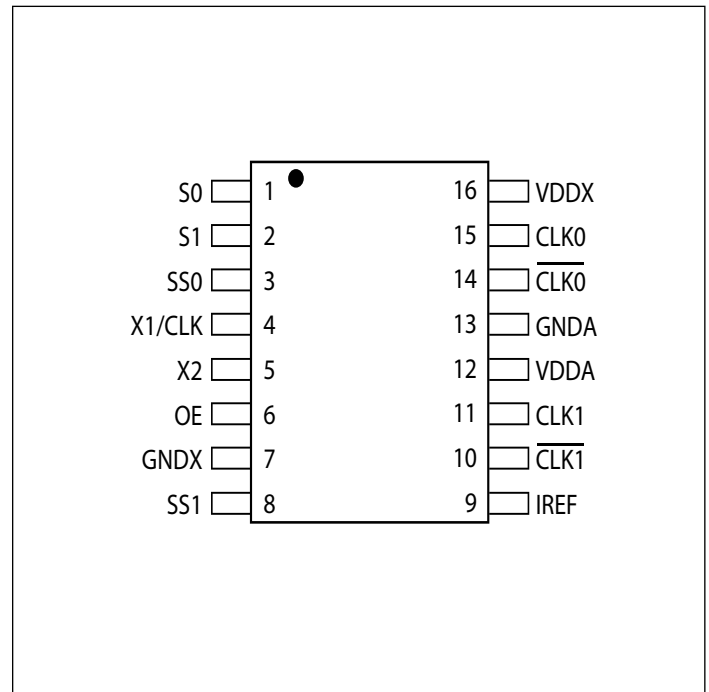
The PI6C557-03B is a spread spectrum clock generator compliant to PCI Express® 3.0 and Ethernet requirements. The device is used for PC or embedded systems to substantially reduce Electro-magnetic Interference (EMI).

The PI6C557-03B provides two differential (HCSL) or LVDS spread spectrum outputs. The PI6C557-03B is configured to select spread and clock selection. Using Pericom's patented Phase-Locked Loop (PLL) techniques, the device takes a 25MHz crystal input and produces two pairs of differential outputs (HCSL) at 25MHz, 100MHz, 125MHz and 200MHz clock frequencies. It also provides spread selection of -0.5%, -0.75%, and no spread.

### Block Diagram



### Pin Configuration (16-Pin TSSOP)



## Pin Description

| Pin # | Pin Name                 | I/O Type | Description                                                                             |
|-------|--------------------------|----------|-----------------------------------------------------------------------------------------|
| 1     | S0                       | Input    | Select pin 0 (Internal pull-up resistor). See Table 1.                                  |
| 2     | S1                       | Input    | Select pin 1 (Internal pull-up resistor). See Table 1.                                  |
| 3     | SS0                      | Input    | Spread Select pin 0 (Internal pull-up resistor). See Table 2.                           |
| 4     | X1/CLK                   | Input    | Crystal or clock input. Connect to a 25MHz crystal or single ended clock.               |
| 5     | X2                       | Output   | Crystal connection. Leave unconnected for clock input.                                  |
| 6     | OE                       | Input    | Output enable. Internal pull-up resistor.                                               |
| 7     | GNDX                     | Power    | Crystal ground pin.                                                                     |
| 8     | SS1                      | Input    | Spread Select pin 1 (Internal pull-up resistor). See Table 2.                           |
| 9     | IREF                     | Output   | Precision resistor attached to this pin is connected to the internal current reference. |
| 10    | $\overline{\text{CLK1}}$ | Output   | HCSL compliment clock output                                                            |
| 11    | CLK1                     | Output   | HCSL clock output                                                                       |
| 12    | VDDA                     | Power    | Connect to a +3.3V source.                                                              |
| 13    | GND A                    | Power    | Output and analog circuit ground.                                                       |
| 14    | $\overline{\text{CLK0}}$ | Output   | HCSL compliment clock output                                                            |
| 15    | CLK0                     | Output   | HCSL clock output                                                                       |
| 16    | VDDX                     | Power    | Connect to a +3.3V source.                                                              |

**Table 1: Output Select Table**

| S1 | S0 | CLK(MHz) |
|----|----|----------|
| 0  | 0  | 25       |
| 0  | 1  | 100      |
| 1  | 0  | 125      |
| 1  | 1  | 200      |

**Table 2: Spread Selection Table**

| SS1 | SS0 | Spread     |
|-----|-----|------------|
| 0   | 0   | No Spread  |
| 0   | 1   | Down -0.5  |
| 1   | 0   | Down -0.75 |
| 1   | 1   | No Spread  |

## Application Information

### Decoupling Capacitors

Decoupling capacitors of 0.01μF should be connected between each V<sub>DD</sub> pin and the ground plane and placed as close to the V<sub>DD</sub> pin as possible.

### Crystal

Use a 25MHz fundamental mode parallel resonant crystal with less than 300PPM of error across temperature.

### Crystal Capacitors

$C_L$  = Crystals's load capacitance in pF

Crystal Capacitors (pF) =  $(C_L - 8) * 2$

For example, for a crystal with 16pF load caps, the external effective crystal cap would be 16 pF.  $(16-8)*2=16$ .

### Current Source (IREF) Reference Resistor - $R_R$

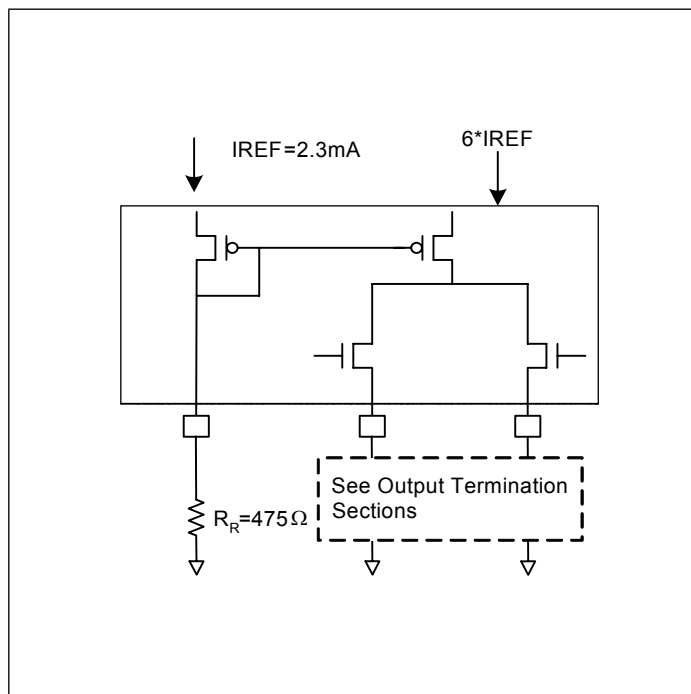
If board target trace impedance is 50Ω, then  $R_R = 475\Omega$  providing an IREF of 2.32 mA. The output current ( $I_{OH}$ ) is 6\*IREF.

### Output Termination

The PCI Express differential clock outputs of the PI6C557-03B are open source drivers and require an external series resistor and a resistor to ground. These resistor values and their allowable locations are shown in detail in the PCI Express Layout Guidelines section.

The PI6C557-03B can be configured for LVDS compatible voltage levels. See the LVDS Compatible Layout Guidelines section.

## Output Structures



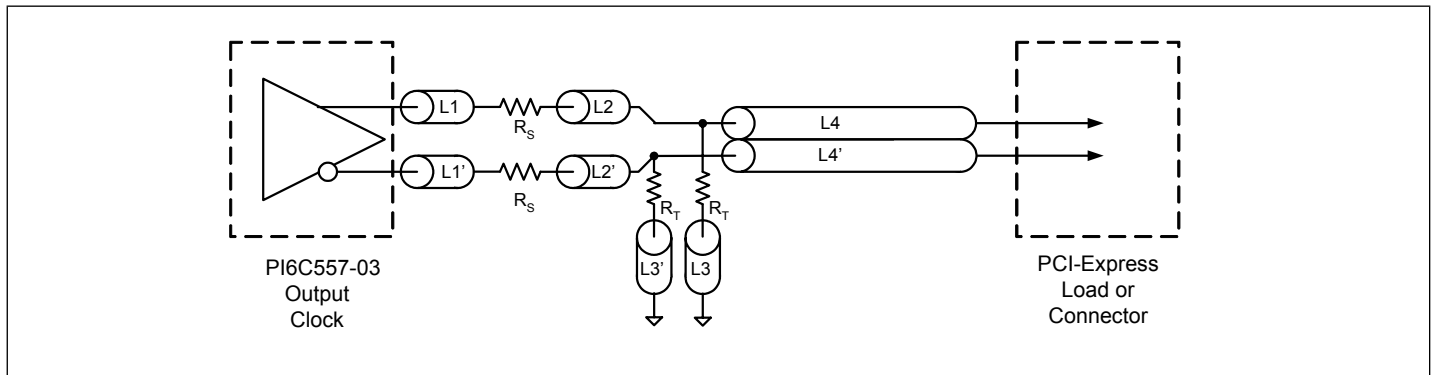
## PCI Express Layout Guidelines

| Common Recommendations for Differential Routing | Dimension or Value | Unit |
|-------------------------------------------------|--------------------|------|
| L1 length, route as non-coupled 50Ω trace.      | 0.5 max            | inch |
| L2 length, route as non-coupled 50Ω trace.      | 0.2 max            | inch |
| L3 length, route as non-coupled 50Ω trace.      | 0.2 max            | inch |
| $R_S$                                           | 33                 | Ω    |
| $R_T$                                           | 49.9               | Ω    |

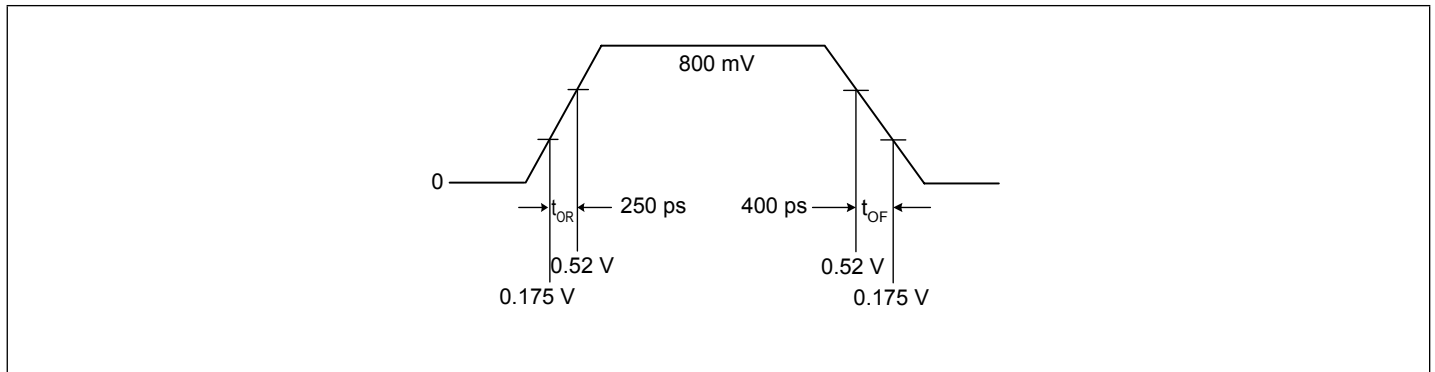
| Differential Routing on a Single PCB                            | Dimension or Value  | Unit |
|-----------------------------------------------------------------|---------------------|------|
| L4 length, route as coupled microstrip 100Ω differential trace. | 2 min to 16 max     | inch |
| L4 length, route as coupled stripline 100Ω differential trace.  | 1.8 min to 14.4 max | inch |

| Differential Routing to a PCI Express connector                 | Dimension or Value    | Unit |
|-----------------------------------------------------------------|-----------------------|------|
| L4 length, route as coupled microstrip 100Ω differential trace. | 0.25 min to 14 max    | inch |
| L4 length, route as coupled stripline 100Ω differential trace.  | 0.225 min to 12.6 max | inch |

## PCI Express Device Routing



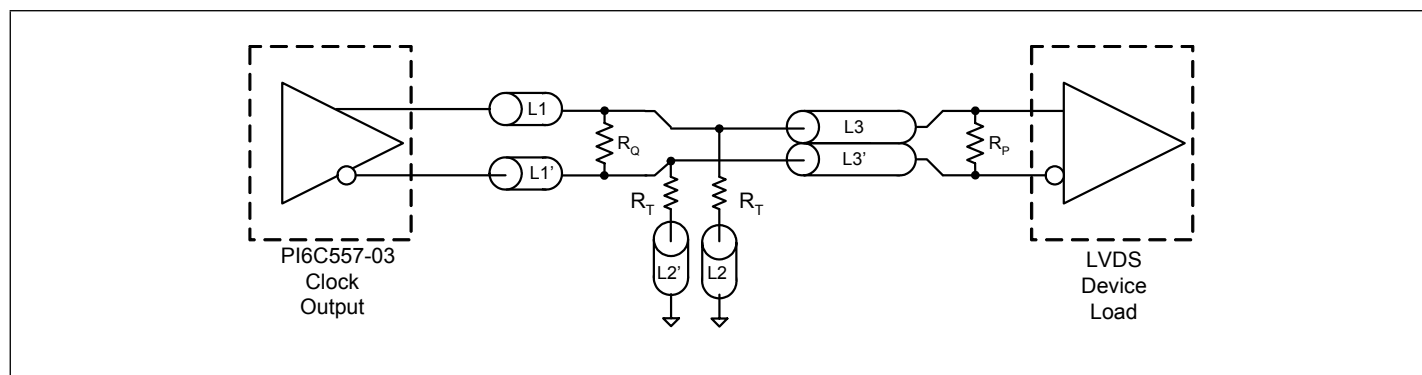
## Typical PCI Express (HCSL) Waveform



## Application Information

| LVDS Recommendations for Differential Routing | Dimension or Value | Unit |
|-----------------------------------------------|--------------------|------|
| L1 length, route as non-coupled 50Ω trace.    | 0.5 max            | inch |
| L2 length, route as non-coupled 50Ω trace.    | 0.2 max            | inch |
| RP                                            | 100                | Ω    |
| RQ                                            | 100                | Ω    |
| RT                                            | 150                | Ω    |
| L3 length, route as 100Ω differential trace.  |                    |      |
| L3 length, route as 100Ω differential trace.  |                    |      |

## LVDS Device Routing



## Maximum Ratings

(Above which useful life may be impaired. For user guidelines, not tested.)

|                                              |                        |
|----------------------------------------------|------------------------|
| Supply Voltage to Ground Potential . . . . . | 5.5V                   |
| All Inputs and Outputs . . . . .             | -0.5V to $V_{DD}+0.5V$ |
| Ambient Operating Temperature . . . . .      | -40 to +85°C           |
| Storage Temperature . . . . .                | -65 to +150°C          |
| Junction Temperature . . . . .               | 150°C                  |
| Soldering Temperature . . . . .              | 260°C                  |
| EDS Protection (Input) . . . . .             | 2000 V min (HBM)       |

Note:

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## Electrical Specifications

### Recommended Operation Conditions

| Parameter                                         | Min. | Typ. | Max. | Unit |
|---------------------------------------------------|------|------|------|------|
| Ambient Operating Temperature                     | -40  |      | +85  | °C   |
| Power Supply Voltage (measured in respect to GND) | +3.0 |      | +3.6 | V    |

### DC Characteristics ( $V_{DD} = 3.3V \pm 10\%$ , $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ )

| Symbol     | Parameter                         | Conditions                            | Min.                                 | Typ. | Max.           | Unit          |
|------------|-----------------------------------|---------------------------------------|--------------------------------------|------|----------------|---------------|
| $V_{DD}$   | Supply Voltage                    |                                       | 3.0                                  | 3.3  | 3.6            | V             |
| $V_{IH}$   | Input High Voltage <sup>(1)</sup> | OE, S0, S1, SS0, SS1                  | 2.0                                  |      | $V_{DD} + 0.3$ | V             |
| $V_{IL}$   | Input Low Voltage <sup>(1)</sup>  | OE, S0, S1, SS0, SS1                  | GND - 0.3                            |      | 0.8            | V             |
| $I_{IL}$   | Input Leakage Current             | $0 < V_{in} < V_{DD}$                 | With input pull-up and pull-downs    | -20  | 20             | $\mu\text{A}$ |
|            |                                   |                                       | Without input pull-up and pull-downs | -5   | 5              |               |
| $I_{DD}$   | Operating Supply Current          | $R_L = 50\Omega$ , $C_L = 2\text{pF}$ |                                      |      | 95             | mA            |
| $I_{DDOE}$ |                                   | OE = LOW                              |                                      |      | 50             | mA            |
| $C_{IN}$   | Input Capacitance                 | @ 55MHz                               |                                      |      | 7              | pF            |
| $C_{OUT}$  | Output Capacitance                | @ 55MHz                               |                                      |      | 6              | pF            |
| $L_{PIN}$  | Pin Inductance                    |                                       |                                      |      | 5              | nH            |
| $R_{OUT}$  | Output Resistance                 | CLK Outputs                           | 3.0                                  |      |                | k $\Omega$    |

Notes:

1. Single edge is monotonic when transitioning through region.

**HCSL Output AC Characteristics ( $V_{DD} = 3.3V \pm 10\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ )**

| Symbol           | Parameter                                 | Conditions                            | Min. | Typ. | Max. | Unit    |
|------------------|-------------------------------------------|---------------------------------------|------|------|------|---------|
| $F_{IN}$         | Input Frequency                           |                                       |      | 25   |      | MHz     |
| $V_{OUT}$        | Output Frequency                          |                                       | 25   |      | 200  | MHz     |
| $V_{OH}$         | Output High Voltage <sup>(1,2)</sup>      | 100 MHz HCSL output @ $V_{DD} = 3.3V$ | 660  | 800  | 900  | mV      |
| $V_{OL}$         | Output Low Voltage <sup>(1,2)</sup>       |                                       | -150 | 0    |      | mV      |
| $V_{CPA}$        | Crossing Point Voltage <sup>(1,2)</sup>   | Absolute                              | 250  | 350  | 550  | mV      |
| $V_{CN}$         | Crossing Point Voltage <sup>(1,2,4)</sup> | Variation over all edges              |      |      | 140  | mV      |
| $J_{CC}$         | Jitter, Cycle-to-Cycle <sup>(1,3)</sup>   |                                       |      | 35   | 60   | ps      |
| $J_{RMS2.0}$     | PCIe 2.0 RMS Jitter                       | PCIe 2.0 Test Method @ 100MHz Output  |      |      | 3.1  | ps      |
| $J_{RMS3.0}$     | PCIe 3.0 RMS Jitter                       | PLL L-BW @ 2M & 5M 1st H3             |      | 1.75 | 3    | ps      |
|                  |                                           | PLL L-BW @ 2M & 4M 1st H3             |      | 2.18 | 3    | ps      |
|                  |                                           | PLL H-BW @ 2M & 5M 1st H3             |      | 0.45 | 1    | ps      |
|                  |                                           | PLL H-BW @ 2M & 4M 1st H3             |      | 0.45 | 1    | ps      |
| $MF$             | Modulation Frequency                      | Spread Spectrum                       | 30   | 31.5 | 33   | kHz     |
| $t_{OR}$         | Rise Time <sup>(1,2)</sup>                | From 0.175V to 0.525V                 | 175  |      | 700  | ps      |
| $t_{OF}$         | Fall Time <sup>(1,2)</sup>                | From 0.525V to 0.175V                 | 175  |      | 700  | ps      |
| $T_{SKEW}$       | Skew between outputs                      | At Crossing Point Voltage             |      |      | 50   | ps      |
| $T_{DUTY-CYCLE}$ | Duty Cycle <sup>(1,3)</sup>               |                                       | 45   |      | 55   | %       |
| $T_{OE}$         | Output Enable Time <sup>(5)</sup>         | All outputs                           |      |      | 10   | $\mu s$ |
| $T_{OT}$         | Output Disable Time <sup>(5)</sup>        | All outputs                           |      |      | 10   | $\mu s$ |
| $t_{STABLE}$     | From power-up to $V_{DD}=3.3V$            | From Power-up $V_{DD}=3.3V$           |      | 3.0  |      | ms      |
| $t_{SPREAD}$     | Setting period after spread change        | Setting period after spread change    |      | 3.0  |      | ms      |

**Notes:**

1.  $R_L = 50\text{-}\Omega$  with  $C_L = 2\text{ pF}$
2. Single-ended waveform
3. Differential waveform
4. Measured at the crossing point
5. CLK pins are tri-stated when OE is LOW

### Thermal Characteristics

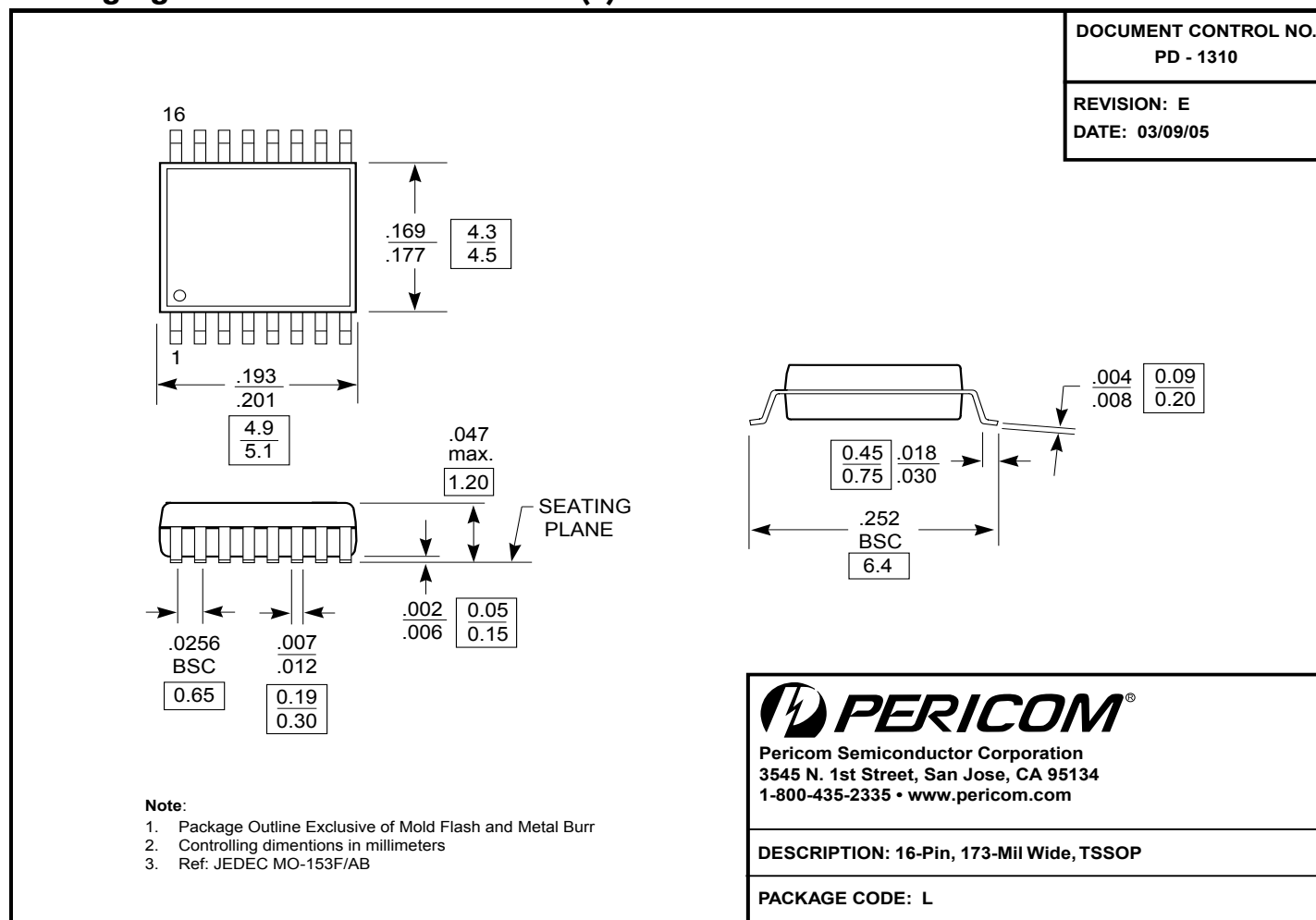
| Symbol        | Parameter                              | Conditions | Min. | Typ. | Max. | Unit |
|---------------|----------------------------------------|------------|------|------|------|------|
| $\theta_{JA}$ | Thermal Resistance Junction to Ambient | Still air  |      |      | 90   | °C/W |
| $\theta_{JC}$ | Thermal Resistance Junction to Case    |            |      |      | 24   | °C/W |

### Recommended Crystal Specification

Pericom recommends:

- a) GC2500003 XTAL 49S/SMD(4.0 mm), 25M, CL=18pF, +/-30ppm  
[http://www.pericom.com/pdf/datasheets/se/GC\\_GF.pdf](http://www.pericom.com/pdf/datasheets/se/GC_GF.pdf)
- b) FY2500081, SMD 5x3.2(4P), 25M, CL=18pF, +/-30ppm  
[http://www.pericom.com/pdf/datasheets/se/FY\\_F9.pdf](http://www.pericom.com/pdf/datasheets/se/FY_F9.pdf)
- c) FL2500047, SMD 3.2x2.5(4P), 25M, CL=18pF, +/-20ppm  
<http://www.pericom.com/pdf/datasheets/se/FL.pdf>

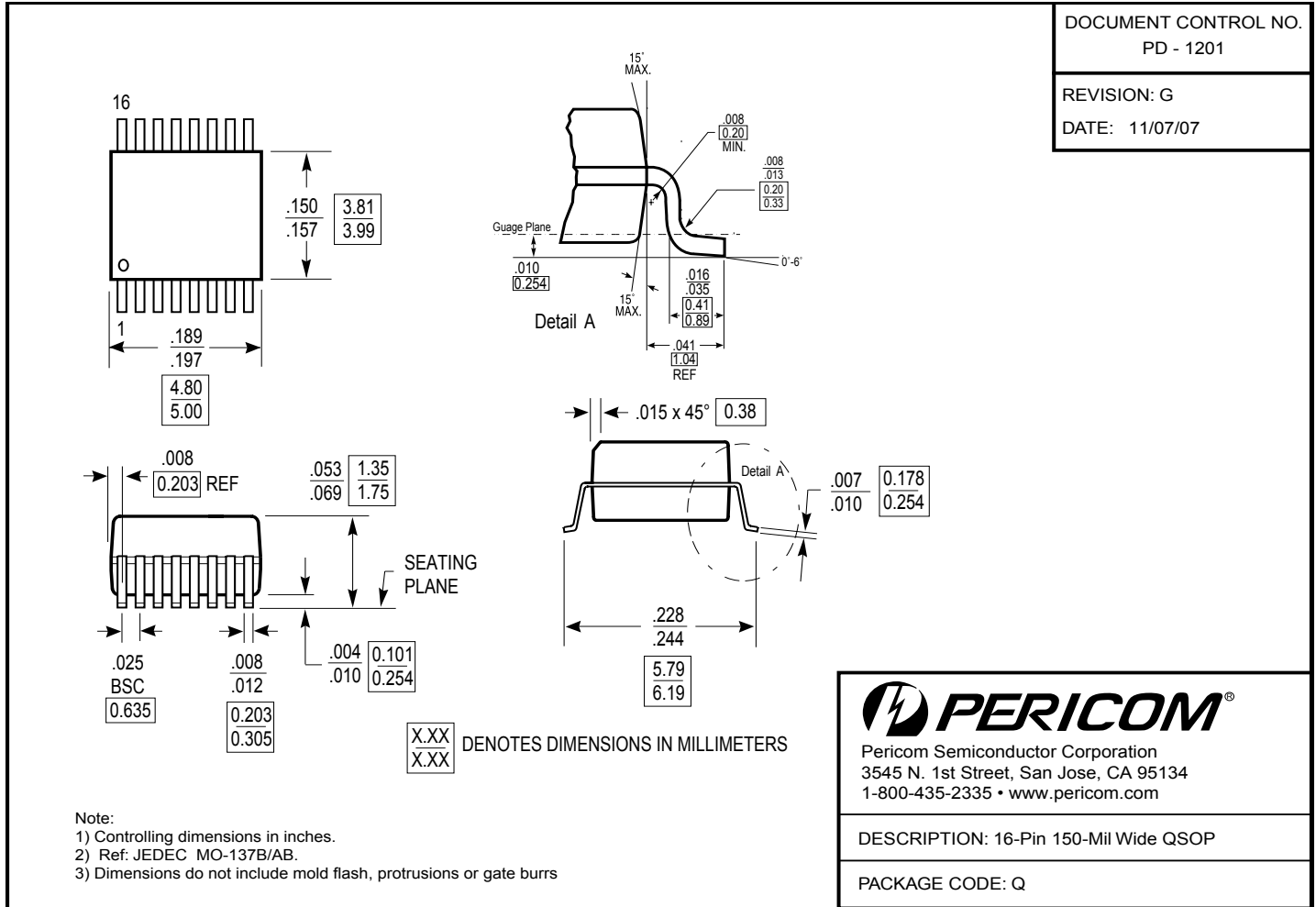
### Packaging Mechanical: 16-Pin TSSOP (L)



Note: For latest package info, please check: <http://www.pericom.com/products/packaging/mechanicals.php>



## Packaging Mechanical: 16-Pin QSOP (Q)



Note: For latest package info, please check: <http://www.pericom.com/products/packaging/mechanicals.php>

## Ordering Information

| Ordering Code | Package Code | Package Type                  |
|---------------|--------------|-------------------------------|
| PI6C557-03BLE | L            | Pb-free & Green, 16-pin TSSOP |
| PI6C557-03BQE | Q            | Pb-free & Green, 16-pin QSOP  |

### Notes:

- Thermal characteristics can be found on the company web site at [www.pericom.com/packaging/](http://www.pericom.com/packaging/)
- "E" denotes Pb-free and Green
- Adding an "X" at the end of the ordering code denotes tape and reel packaging