

## PCIe 2.0 Clock Generator with 2 HCSL Outputs for Automotive Applications

### Features

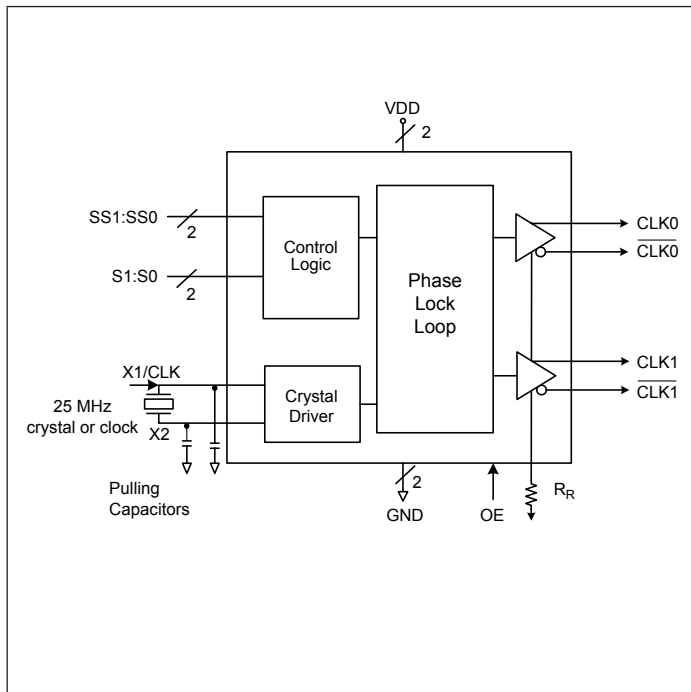
- PCIe® 2.0 compliant
  - Phase jitter - 2.1ps RMS (typ)
- LVDS compatible outputs
- Supply voltage of 3.3V ±10%
- 25MHz crystal or clock input frequency
- HCSL outputs, 0.8V Current mode differential pair
- Jitter 35ps cycle-to-cycle (typ)
- Spread of -0.5%, -0.75%, and no spread
- AEC-Q100 qualified
- Spread Bypass option available
- Spread and frequency selection via external pins
- Packaging: (Pb-free and Green)
  - 16-pin TSSOP (L16)

### Description

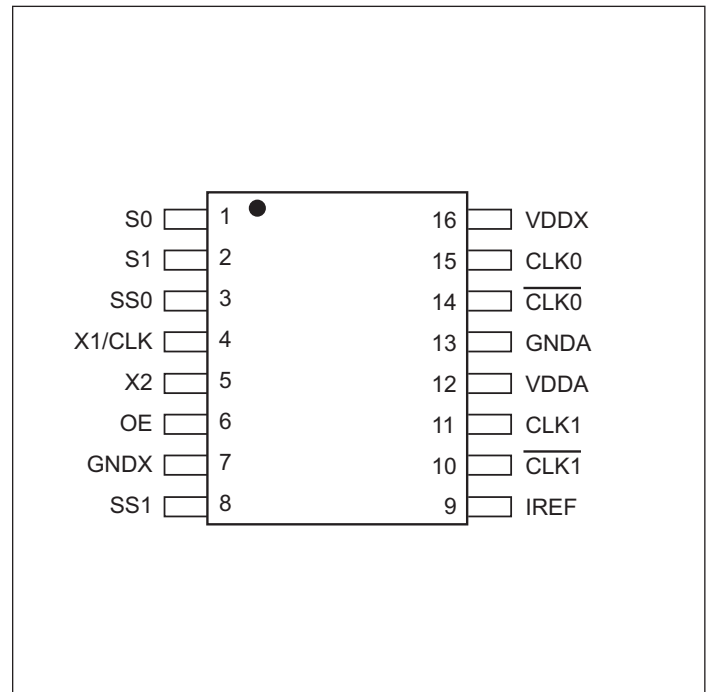
The PI6C557-03AQ is a spread spectrum clock generator compliant to PCI Express® 2.0 and Ethernet requirements. The device is used for PC or embedded systems to substantially reduce Electro-magnetic Interference (EMI).

The PI6C557-03AQ provides two differential (HCSL) or LVDS spread spectrum outputs. The PI6C557-03AQ 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<sub>R</sub>

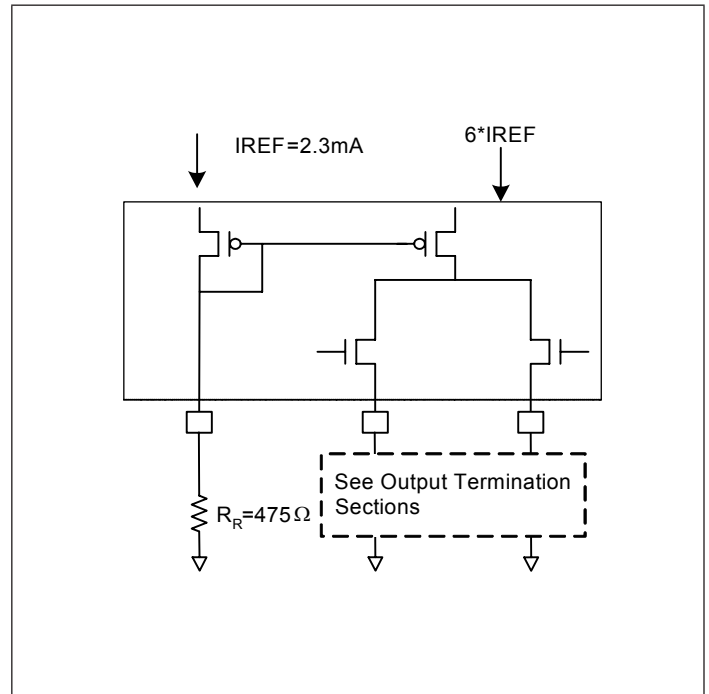
If board target trace impedance is 50Ω, then  $R_R = 475\Omega$  providing an IREF of 2.32 mA. The output current (I<sub>OH</sub>) is 6\*IREF.

### Output Termination

The PCI Express differential clock outputs of the PI6C557-03AQ 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 PI6C557-03AQ can be configured for LVDS compatible voltage levels. See the LVDS Compatible Layout Guidelines section.

## Output Structures



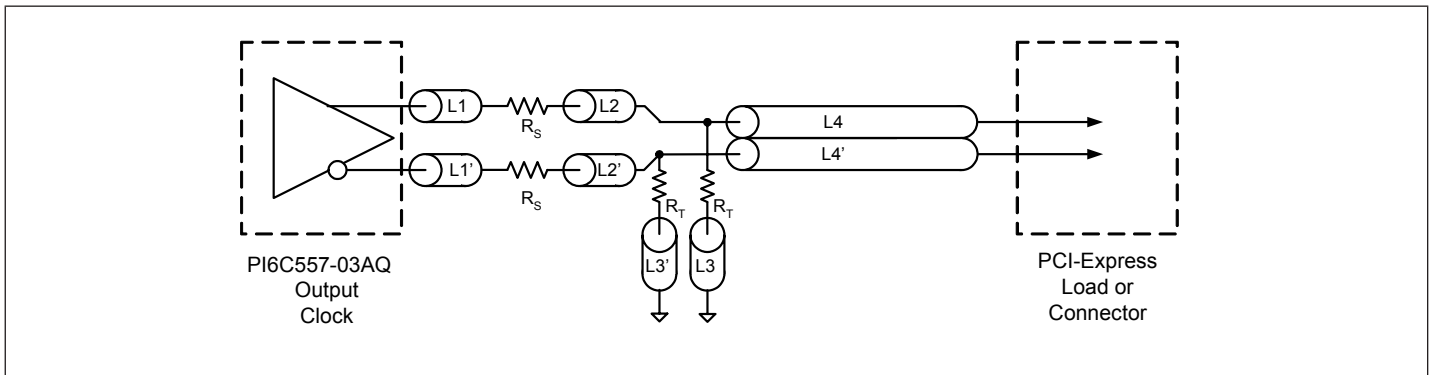
### PCI Express Layout Guidelines

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

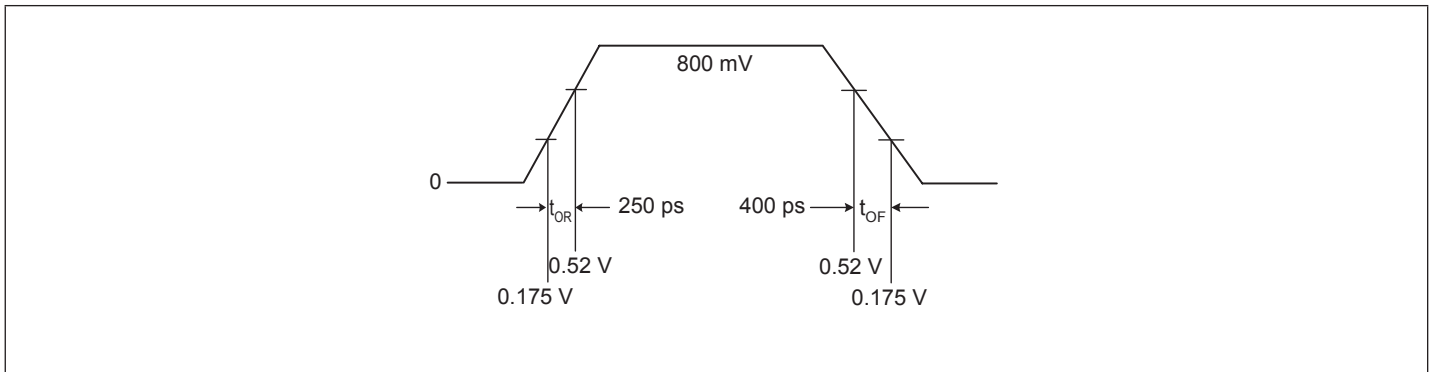
Differential Routing on a Single PCB	Dimension or Value	Unit
L4 length, route as coupled microstrip 100Ω differential trace.	2 min to 16 max	inch
L4 length, route as coupled stripline 100Ω differential trace.	1.8 min to 14.4 max	inch

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



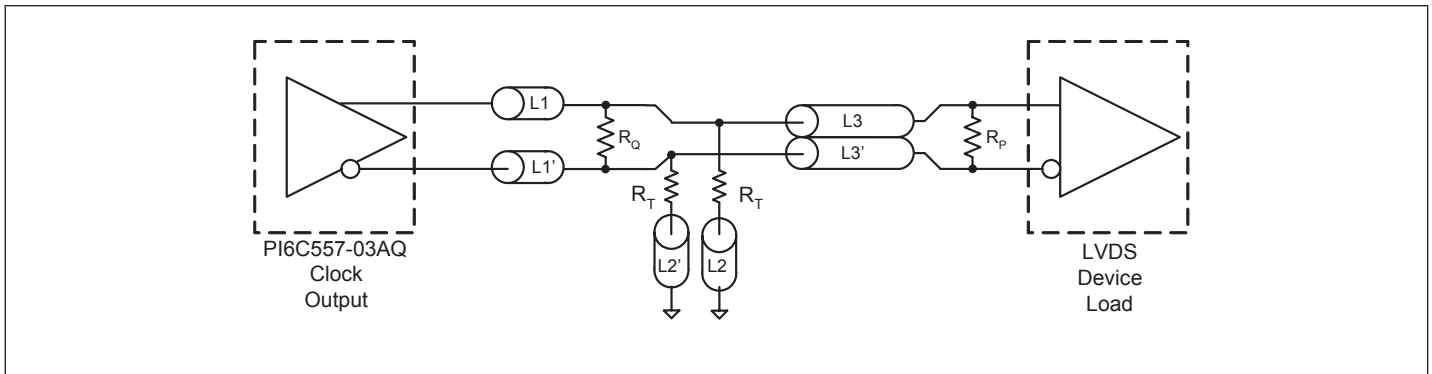
### Typical PCI Express (HCSL) Waveform



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

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	2.0		$V_{DD} + 0.3$	V
$V_{IL}$	Input Low Voltage <sup>(1)</sup>	OE	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	$\mu A$
			Without input pull-up and pull-downs	-5	5	
$I_{DD}$	Operating Supply Current	$R_L = 50\Omega$ , $C_L = 2pF$			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
$J_{RMS}$	PCIe RMS Jitter	PCIe 2.0 Test Method @ 100MHz Output			3.1	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		500	ps
$t_{OF}$	Fall Time <sup>(1,2)</sup>	From 0.525V to 0.175V	175		500	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.  $R_L = 50\text{-Ohm}$  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	$^\circ C/W$
$\theta_{JC}$	Thermal Resistance Junction to Case				24	$^\circ C/W$

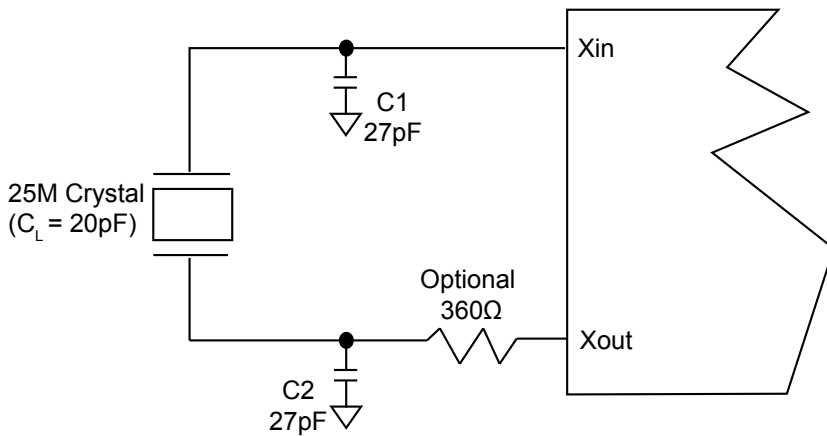
## Recommended Crystal Specification

Pericom recommends:

- a) FL2500184Q, SMD 3.2x2.5(4P), 25M, CL=20pF, Frequency Tolerance  $\pm 15$ ppm, Stability  $\pm 20$ ppm  
 (<http://www.pericom.com/pdf/datasheets/se/FL.pdf>)

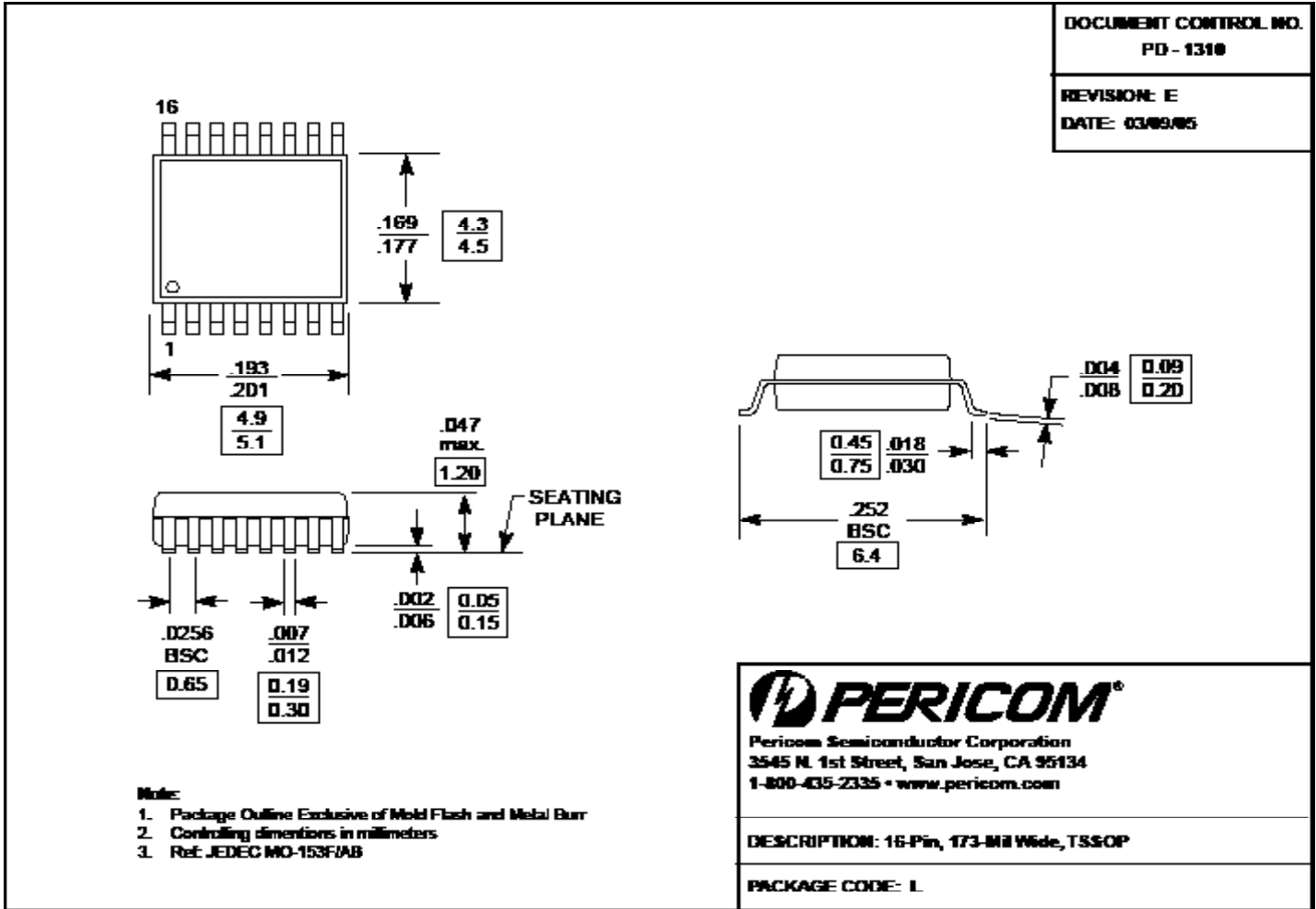
## Recommended Crystal Circuit

The following diagram shows PI6C557-03AQ crystal circuit connection with a parallel crystal. For the CL=20pF parallel crystal, it is suggested to use C1=27 pF, C2=27 pF in general. C1 and C2 can be adjusted to fine tune the target ppm of crystal oscillation according to different board layouts. R1=360 ohm is recommended in layout for smaller size crystal drive level adjustment.





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



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

**Ordering Information**

Ordering Code	Package Code	Package Type
PI6C557-03AQL	L	Pb-free & Green, 16-pin TSSOP

**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

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