



# PL60203X

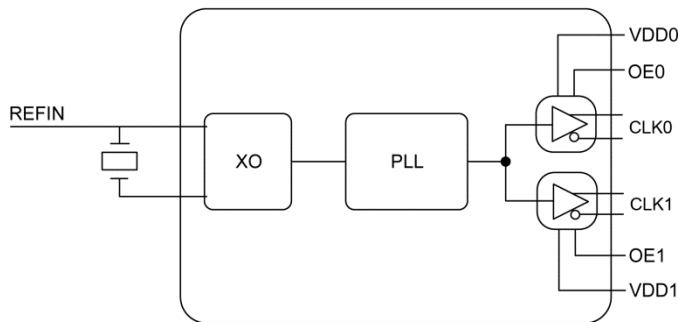
## HCSL-Compatible Clock Generator for PCI Express

### General Description

The PL60203X is the smallest, high performance, lowest power, 2 differential output clock IC available for HCSL timing applications. PL60203X offers -130dBc at 10kHz offset at 100MHz, with a very low jitter (2ps TIE RMS), making it ideal for HCSL applications requiring small size and low power.

Datasheets and support documentation are available on Micrel's web site at: [www.micrel.com](http://www.micrel.com).

### Block Diagram



### Features

- Input frequency:
  - Fundamental crystal or reference input: 25MHz.
- Output frequency:
  - PL602031: 2 x 25MHz differential outputs.
  - PL602032: 2 x 100MHz differential outputs.
  - PL602033: 2 x 125MHz differential outputs.
  - PL602034: 2 x 200MHz differential outputs.
- Very low jitter: 28ps peak-to-peak typical.
- Very low phase noise:
  - -130dBc at 10kHz offset at 100MHz.
- Compliant with PCI-Express Gen1, Gen2, and Gen3.
- Power supply range: 2.25V to 3.63V.
- Operating temperature range: -40°C to +85°C.
- Available in 16-pin QFN, RoHS and PFOS compliant package.

### Applications

- Servers
- Storage systems
- Switches and routers
- Gigabit Ethernet
- Set-top boxes/DVRs

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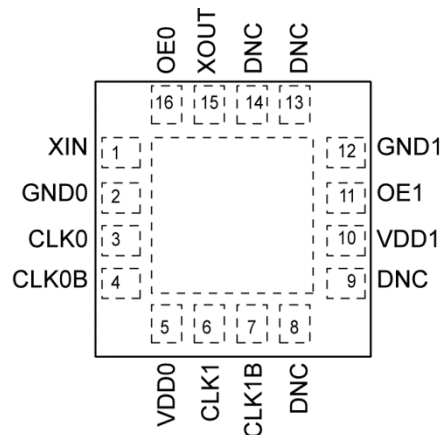
## Ordering Information

| Part Number <sup>(1)</sup> | Marking | Shipping      | Junction Temperature Range | Package              |
|----------------------------|---------|---------------|----------------------------|----------------------|
| PL602031UMG                | 602031  | Tube          | -40° to +85°C              | 16-Pin 3mm x 3mm QFN |
| PL602031UMG TR             | 602031  | Tape and Reel | -40° to +85°C              | 16-Pin 3mm x 3mm QFN |
| PL602032UMG                | 602032  | Tube          | -40° to +85°C              | 16-Pin 3mm x 3mm QFN |
| PL602032UMG TR             | 602032  | Tape and Reel | -40° to +85°C              | 16-Pin 3mm x 3mm QFN |
| PL602033UMG                | 602033  | Tube          | -40° to +85°C              | 16-Pin 3mm x 3mm QFN |
| PL602033UMG TR             | 602033  | Tape and Reel | -40° to +85°C              | 16-Pin 3mm x 3mm QFN |
| PL602034UMG                | 602034  | Tube          | -40° to +85°C              | 16-Pin 3mm x 3mm QFN |
| PL602034UMG TR             | 602034  | Tape and Reel | -40° to +85°C              | 16-Pin 3mm x 3mm QFN |

**Note:**

1. The devices are RoHS and PFOS compliant.

## Pin Configuration



16-Pin QFN (Top View)

## Pin Description

| Pin Number     | Pin Name  | Pin Type | Pin Function   |
|----------------|-----------|----------|--|
| 1              | XIN, FIN  | I        | Crystal input pin or reference clock input.  |
| 2              | GND0      | I        | GND connection for CLK0.   |
| 3, 4           | CLK0[0:1] | O        | Differential clock output pair   |
| 5              | VDD0      | P        | VDD connection for CLK0  |
| 6, 7           | CLK1[0:1] | O        | Differential clock output pair   |
| 10             | VDD1      | P        | VDD connection for CLK1  |
| 11             | OE1       | I        | Output enable pin for CLK1. High=Enabled, Low=Disabled. OE1 has a 60KΩ pull-up resistor. |
| 12             | GND1      | P        | GND connection for CLK1  |
| 15             | XOUT      | O        | Crystal output pin   |
| 16             | OE0       | I        | Output enable pin for CLK0. High=Enabled, Low=Disabled. OE0 has a 60KΩ pull-up resistor. |
| 8, 9<br>13, 14 | DNC       |          | Do not connect.  |
|                | ePad      |          | Center pad for thermal relief. Connect to GND.   |

**Absolute Maximum Ratings<sup>(2)</sup>**

|                                   |       |
|-----------------------------------|-------|
| Supply Voltage ( $V_{IN}$ )       | +4.6V |
| Lead Temperature (soldering, 10s) | 260°C |
| Storage Temperature ( $T_S$ )     | 150°C |
| ESD Rating <sup>(3)</sup>         | 2.0kV |

**Operating Ratings<sup>(4)</sup>**

|   |                |
|---|----------------|
| Supply Voltage ( $V_{IN}$ )               | -0.5V to +4.6V |
| Ambient Temperature ( $T_A$ )             | -40°C to +85°C |
| Package Thermal Resistance <sup>(5)</sup> |                |
| QFN Still-air ( $\theta_{JA}$ )           | 60°C/W         |
| QFN Junction-to-board ( $\psi_{JB}$ )     | 33°C/W         |

**AC Electrical Characteristics<sup>(6)</sup>**

$V_{DD} = 3.3V \pm 10\%$  or  $2.5V \pm 10\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ , HCSL termination applied.

| Parameter                           | Condition  | Min. | Typ. | Max.     | Units           |
|-------------------------------------|--|------|------|----------|-----------------|
| Crystal input frequency             | Fundamental crystal  |      | 25   |          | MHz             |
| Input ( $F_{IN}$ ) frequency        |  |      | 25   |          | MHz             |
| Input ( $F_{IN}$ ) signal amplitude | Internally AC coupled  | 0.9  |      | $V_{DD}$ | V <sub>pp</sub> |
| Output frequency                    | PL602031   |      | 25   |          | MHz             |
|                                     | PL602032   |      | 100  |          | MHz             |
|                                     | PL602033   |      | 125  |          | MHz             |
|                                     | PL602034   |      | 200  |          | MHz             |
| Output enable time                  | OE function, $T_A=25^\circ C$ , add one clock period to this measurement for a useable clock output. |      |      | 10       | ns              |
| Output disable time                 | OE function, $T_A=25^\circ C$  |      |      | 10       | ns              |
| Setting time                        | At power up ( $V_{DD} \geq 2.25V$ )  |      |      | 10       | ms              |
| VDD sensitivity                     | Frequency vs. $V_{DD} \pm 10\%$ , crystal input only.  | -2   |      | 2        | ppm             |
| Output rise time                    | 20/80%   |      | 0.3  | 0.5      | ns              |
| Output fall time                    | 20/80%   |      | 0.3  | 0.5      | ns              |
| Duty cycle                          | At $V_{DD}/2$  | 45   | 50   | 55       | %               |
| Period jitter, peak-to-peak         | With capacitive decoupling between $V_{DD}$ and GND at 100MHz; 10,000 samples measured               |      | 28   |          | ps              |
| Phase jitter, RMS                   | For 10kHz to 10MHz integration range   |      | 2.1  |          | ps              |

**DC Electrical Characteristics<sup>(6)</sup>**

$V_{DD} = 3.3V \pm 10\%$  or  $2.5V \pm 10\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ , HCSL termination applied.

| Symbol   | Parameter               | Condition   | Min. | Typ. | Max. | Units |
|----------|-------------------------|---|------|------|------|-------|
| $I_{DD}$ | Supply current, dynamic | At 100MHz, no load  |      | 50   | 70   | mA    |
| $V_{DD}$ | Operating voltage       |   | 2.25 |      | 3.63 | V     |
| $V_{OL}$ | Output low voltage      | HCSL termination,<br>( $R_S = 150\Omega$ , $R_T = 49.9\Omega$ ) 3.3V<br>( $R_S = 100\Omega$ , $R_T = 49.9\Omega$ ) 2.5V |      |      | 0.05 | V     |
| $V_{OH}$ | Output high voltage     |   | 0.65 | 0.75 | 0.85 | V     |

## Crystal Characteristics<sup>(6)</sup>

$V_{DD} = 3.3V \pm 10\%$  or  $2.5V \pm 10\%$ ,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ .

| Symbol        | Parameter                                | Min. | Typ. | Max. | Units         |
|---------------|--|------|------|------|---------------|
| $F_{XIN}$     | Fundamental crystal resonator            |      | 25   |      | MHz           |
| $C_{L(XTAL)}$ | Crystal load rating                      |      | 18   |      | pF            |
|               | Maximum sustainable drive level          |      |      | 500  | $\mu\text{W}$ |
|               | Operating drive level                    |      | 100  |      | $\mu\text{W}$ |
| $C_0$         | Crystal shunt capacitance                |      |      | 6    | pF            |
| ESR           | Effective series resistance, fundamental |      |      | 45   | $\Omega$      |

### Notes:

- Exceeding the absolute maximum ratings may damage the device.
- Devices are ESD sensitive. Handling precautions are recommended. Human body model, 1.5k in series with 100pF.
- The device is not guaranteed to function outside its operating ratings.
- Package thermal resistance assumes exposed pad is soldered (or equivalent) to the device's most negative potential on the PCB.  $\theta_{JA}$  and  $\psi_{JB}$  values are determined for a 4-layer board in still-air number, unless otherwise stated.
- Specification for packaged product only

## PCI Express/HCSL Compatible Layout Guidelines

Figure 1 below demonstrates how to terminate the complementary LVCMOS outputs of PL60203X for use with HCSL inputs.

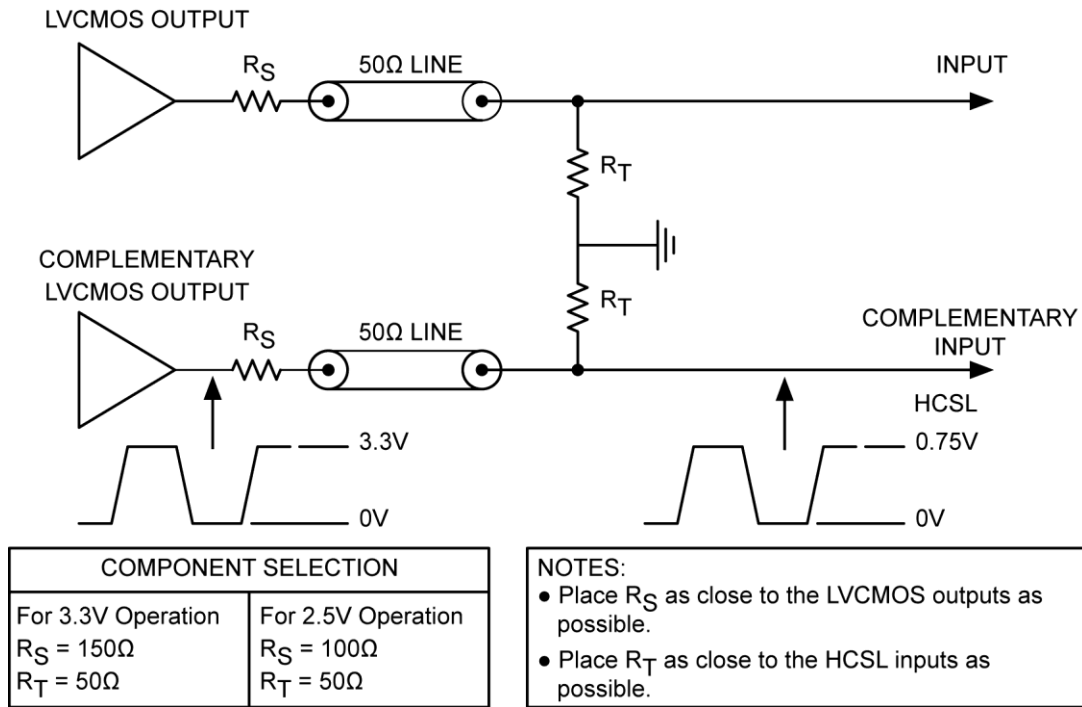


Figure 1. Terminating the complementary LVCMOS outputs for use with HCSL inputs.

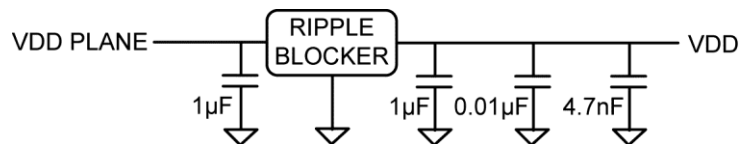
## PCB Layout Considerations for Performance Optimization

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

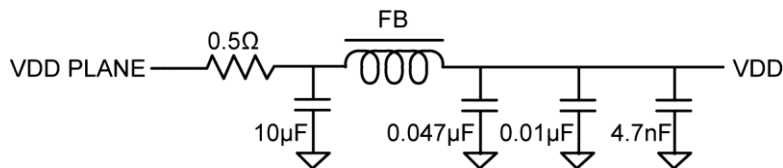
- Keep all the PCB traces to PL60203X as short as possible. Also keep all other traces as far away from PL60203X as possible.
- Place the crystal as close as possible to both crystal pins of the device. This will reduce the cross-talk between the crystal and the other signals.
- Separate crystal pin traces from the other signals on the PCB, but allow ample distance between the two crystal pin traces.
- Place a  $0.01\mu\text{F}$  decoupling capacitor between VDD and GND on the component side of the PCB, close to the VDD pin. It is not recommended to place this component on the backside of the PCB.
- It is highly recommended to keep the VDD and GND traces as short as possible.
- When connecting long traces (>1 inch) to a CMOS output, it is important to design the traces as a transmission line, or “stripline”, to avoid reflections or ringing. In this case, the CMOS output needs to be matched to the trace impedance. Usually, “striplines” are designed for  $50\Omega$  impedance and CMOS outputs usually have an impedance of less than  $50\Omega$ , so matching can be achieved by adding a resistor in series with the CMOS output pin to the “stripline” trace.

## Power Supply Filtering Recommendations

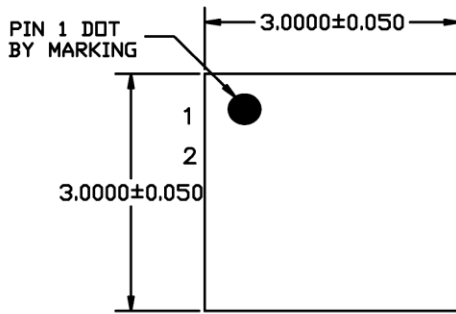
Preferred filter, using Micrel MIC94300 or MIC94310 Ripple Blocker™:



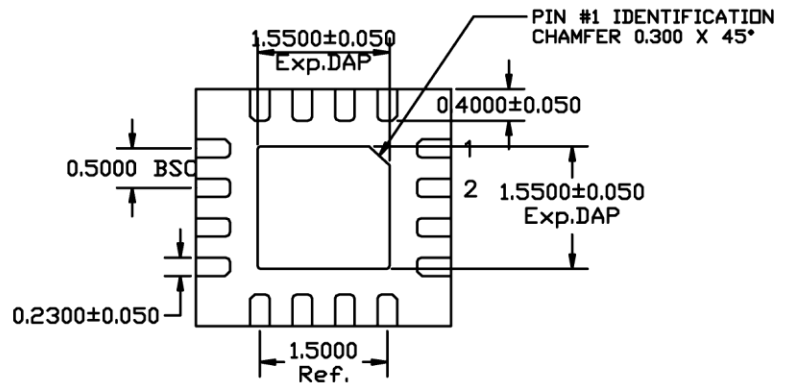
Alternative, traditional filter, using a ferrite bead:



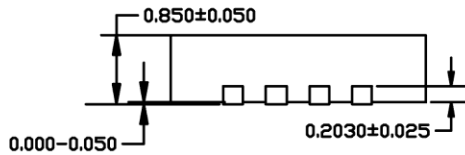
## Package Information<sup>(7)</sup>



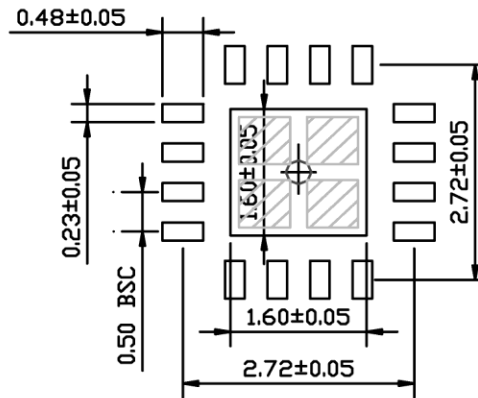
**TOP VIEW**  
NOTE: 1, 2, 3



**BOTTOM VIEW**  
NOTE: 1, 2, 3



**SIDE VIEW**  
NOTE: 1, 2, 3



**RECOMMENDED LAND PATTERN**  
NOTE: 4, 5

- NOTE:
1. MAX PACKAGE WARPAGE IS 0.05 MM
  2. MAX ALLOWABLE BURR IS 0.076MM IN ALL DIRECTIONS
  3. PIN #1 IS ON TOP WILL BE LASER MARKED
  4. RED CIRCLE IN LAND PATTERN INDICATE THERMAL VIA. SIZE SHOULD BE 0.30-0.3M IN DIAMETER AND SHOULD BE CONNECTED TO GND FOR MAX THERMAL PERFORMANCE
  5. GREEN RECTANGLES (SHADED AREA) INDICATE SOLDER STENCIL OPENING ON EXPOSED PAD AREA. SIZE SHOULD BE 0.60x0.60 MM IN SIZE, 0.20 MM SPACING.

### 16-Pin QFN

**Note:**

7. Package information is correct as of the publication date. For updates and most current information, go to: [www.micrel.com](http://www.micrel.com).



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