

# Phase-Aligned Clock Multiplier

## Features

- 3-multiplier configuration (1x, 2x, 4x Ref)
- 10 MHz to 166.67 MHz operating range (reference input from 10 MHz to 41.67 MHz)
- Phase Alignment
- 80 ps typical period jitter
- Output enable pin
- 3.3V operation
- 5V Tolerant input
- 8-pin 150-mil SOIC package
- Commercial and Industrial Temperature available

## Functional Description

The CY2303 is a 3 output 3.3V phase-aligned system clock designed to distribute high-speed clocks in PC, workstation, datacom, telecom, and other high-performance applications.

The part allows user to obtain 1x, 2x, and 4x Ref output frequencies on respective output pins.

The CY2303 has an on-chip PLL, which locks to an input clock presented on the REFIN pin. The PLL feedback is internally connected to the REF output. The input-to-output skew is guaranteed to be less than  $\pm 200$  ps, and output-to-output skew is guaranteed to be less than 200 ps.

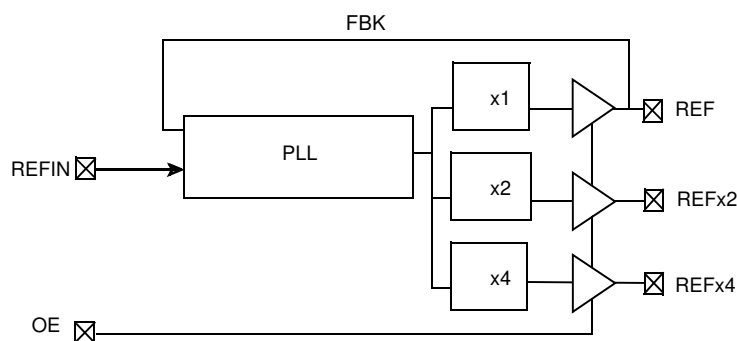
Multiple CY2303 devices can accept the same input clock and distribute it in a system. In this case, the skew between the outputs of two devices is guaranteed to be less than 400 ps.

The CY2303 is available in commercial and industrial temperature ranges.

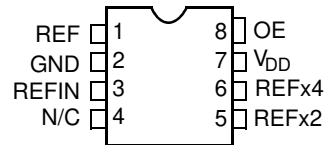
## Selector Guide

| Part Number | Outputs | Input Frequency Range | Output Frequency Range | Specifics              |
|-------------|---------|-----------------------|------------------------|------------------------|
| CY2303SXC   | 3       | 10 MHz–41.67 MHz      | 10 MHz–166.67 MHz      | Commercial Temperature |
| CY2303SXI   | 3       | 10 MHz–41.67 MHz      | 10 MHz–166.67 MHz      | Industrial Temperature |

## Logic Block Diagram



## Pinouts

**Figure 1. CY2303 - 8-pin SOIC Top View**


## Pin Description

| Pin | Signal <sup>[1]</sup> | Description                                  |
|-----|-----------------------|--|
| 1   | REF                   | REF output (1x Reference input)              |
| 2   | GND                   | Ground                                       |
| 3   | REFIN                 | Input reference frequency, 5V tolerant input |
| 4   | N/C                   | No Connect                                   |
| 5   | REFx2                 | 2x Reference input                           |
| 6   | REFx4                 | 4x Reference input                           |
| 7   | VDD                   | 3.3V Supply                                  |
| 8   | OE                    | Output Enable (weak pull up)                 |

## Maximum Ratings

|   |                          |  |                 |
|---|--------------------------|--|-----------------|
| Supply Voltage to Ground Potential..... | -0.5V to +7.0V           | Storage Temperature .....  | -65°C to +150°C |
| DC Input Voltage (Except Ref) .....     | -0.5V to $V_{DD} + 0.5V$ | Junction Temperature .....                                       | 150°C           |
| DC Input Voltage REFIN.....             | -0.5 to 7V               | Static Discharge Voltage<br>(per MIL-STD-883, Method 3015) ..... | >2000V          |

## Operating Conditions for CY2303SC Commercial Temperature Devices

| Parameter | Description   | Min  | Max | Unit |
|-----------|---|------|-----|------|
| $V_{DD}$  | Supply Voltage  | 3.0  | 3.6 | V    |
| $T_A$     | Operating Temperature (Ambient Temperature)   | 0    | 70  | °C   |
| $C_L$     | Load Capacitance, $F_{out} < 133.33$ MHz  | –    | 18  | pF   |
|           | Load Capacitance, $133.33$ MHz $< F_{out} < 166.67$ MHz                                       | –    | 12  | pF   |
| $C_{IN}$  | Input Capacitance   | –    | 7   | pF   |
| $t_{PU}$  | Power up time for all VDDs to reach minimum specified voltage (power ramps must be monotonic) | 0.05 | 50  | ms   |

## Electrical Characteristics for CY2303SC Commercial Temperature Devices

| Parameter | Description                       | Test Conditions   | Min. | Max. | Unit    |
|-----------|-----------------------------------|-------------------|------|------|---------|
| $V_{IL}$  | Input LOW Voltage                 |                   | –    | 0.8  | V       |
| $V_{IH}$  | Input HIGH Voltage                |                   | 2.0  | –    | V       |
| $I_{IL}$  | Input LOW Current                 | $V_{IN} = 0V$     | –    | 100  | $\mu A$ |
| $I_{IH}$  | Input HIGH Current                | $V_{IN} = V_{DD}$ | –    | 50   | $\mu A$ |
| $V_{OL}$  | Output LOW Voltage <sup>[2]</sup> | $I_{OL} = 8$ mA   | –    | 0.4  | V       |

### Notes

1. Weak pull-down on all outputs.
2. Parameter is guaranteed by design and characterization. It is not 100% tested in production.

**Electrical Characteristics for CY2303SC Commercial Temperature Devices**

|          |                                    |                                     |     |    |    |
|----------|------------------------------------|-------------------------------------|-----|----|----|
| $V_{OH}$ | Output HIGH Voltage <sup>[2]</sup> | $I_{OH} = -8 \text{ mA}$            | 2.4 | –  | V  |
| $I_{DD}$ | Supply Current                     | Unloaded outputs, REFIN = 41.67 MHz | –   | 45 | mA |
|          |                                    | Unloaded outputs, REFIN = 25 MHz    | –   | 32 | mA |
|          |                                    | Unloaded outputs, REFIN = 10 MHz    | –   | 18 | mA |

**Switching Characteristics for CY2303SC Commercial Temperature Devices**

| Parameter  | Name   | Test Conditions   | Min | Typ. | Max    | Unit |
|------------|--|---|-----|------|--------|------|
| $1/t_1$    | Output Frequency   | 18-pF load  | 10  | –    | 133.33 | MHz  |
|            |  | 12-pF load  | –   | –    | 166.67 | MHz  |
|            | Duty Cycle <sup>[3]</sup> = $t_2 \div t_1$                 | Measured at $V_{DD}/2$  | 40  | 50   | 60     | %    |
| $t_3$      | Rise Time <sup>[3]</sup>                                   | Measured between 0.8V and 2.0V  | –   | –    | 1.20   | ns   |
| $t_4$      | Fall Time <sup>[3]</sup>                                   | Measured between 0.8V and 2.0V  | –   | –    | 1.20   | ns   |
| $t_5$      | Output to Output Skew on rising edges <sup>[3]</sup>       | All outputs equally loaded<br>Measured at $V_{DD}/2$                    | –   | –    | 200    | ps   |
| $t_6$      | Delay, REFIN Rising Edge to REF Rising Edge <sup>[3]</sup> | Measured at $V_{DD}/2$ from REFIN to any output                         | –   | –    | ±200   | ps   |
| $t_7$      | Device to Device Skew <sup>[3]</sup>                       | Measured at $V_{DD}/2$ on the REF pin of the device (pin 1)             | –   | –    | 400    | ps   |
| $t_J$      | Period Jitter <sup>[3]</sup>                               | Measured at $F_{out} < 133.33 \text{ MHz}$ , loaded outputs, 18-pF load | –   | 80   | ±175   | ps   |
| $t_{LOCK}$ | PLL Lock Time <sup>[3]</sup>                               | Stable power supply, valid clocks presented on REFIN                    | –   | –    | 1.0    | ms   |

**Operating Conditions for CY2303SI Industrial Temperature Devices**

| Parameter | Description   | Min. | Max. | Unit |
|-----------|---|------|------|------|
| $V_{DD}$  | Supply Voltage  | 3.0  | 3.6  | V    |
| $T_A$     | Operating Temperature (Ambient Temperature)   | –40  | 85   | °C   |
| $C_L$     | Load Capacitance, $F_{out} < 133.33 \text{ MHz}$  | –    | 15   | pF   |
|           | Load Capacitance, $133.33 \text{ MHz} < F_{out} < 166.67 \text{ MHz}$ ,                       | –    | 10   | pF   |
| $t_{PU}$  | Power up time for all VDDs to reach minimum specified voltage (power ramps must be monotonic) | 0.05 | 50   | ms   |

**Electrical Characteristics for CY2303SI Industrial Temperature Devices**

| Parameter | Description                        | Test Conditions                     | Min | Max. | Unit |
|-----------|------------------------------------|-------------------------------------|-----|------|------|
| $V_{IL}$  | Input LOW Voltage                  |                                     | –   | 0.8  | V    |
| $V_{IH}$  | Input HIGH Voltage                 |                                     | 2.0 | –    | V    |
| $I_{IL}$  | Input LOW Current                  | $V_{IN} = 0V$                       | –   | 100  | μA   |
| $I_{IH}$  | Input HIGH Current                 | $V_{IN} = V_{DD}$                   | –   | 50   | μA   |
| $V_{OL}$  | Output LOW Voltage <sup>[2]</sup>  | $I_{OL} = 8 \text{ mA}$             | –   | 0.4  | V    |
| $V_{OH}$  | Output HIGH Voltage <sup>[2]</sup> | $I_{OH} = -8 \text{ mA}$            | 2.4 | –    | V    |
| $I_{DD}$  | Supply Current                     | Unloaded outputs, REFIN = 41.67 MHz | –   | 48   | mA   |
|           |                                    | Unloaded outputs, REFIN = 25 MHz    | –   | 35   | mA   |
|           |                                    | Unloaded outputs, REFIN = 10 MHz    | –   | 20   | mA   |

**Note**

3. All parameters are specified with loaded outputs.

### Switching Characteristics for CY2303SI Industrial Temperature Devices

| Parameter         | Name  | Test Conditions   | Min | Typ. | Max    | Unit |
|-------------------|---|---|-----|------|--------|------|
| 1/t <sub>1</sub>  | Output Frequency  | 15-pF load  | 10  | –    | 133.33 | MHz  |
|                   |   | 10-pF load  | –   | –    | 166.67 | MHz  |
|                   | Duty Cycle <sup>[3]</sup> = t <sub>2</sub> ÷ t <sub>1</sub> | Measured at V <sub>DD</sub> /2  | 40  | 50   | 60     | %    |
| t <sub>3</sub>    | Rise Time <sup>[3]</sup>                                    | Measured between 0.8V and 2.0V  | –   | –    | 1.20   | ns   |
| t <sub>4</sub>    | Fall Time <sup>[3]</sup>                                    | Measured between 0.8V and 2.0V  | –   | –    | 1.20   | ns   |
| t <sub>5</sub>    | Output to Output Skew on rising edges <sup>[3]</sup>        | All outputs equally loaded<br>Measured at V <sub>DD</sub> /2          | –   | –    | 200    | ps   |
| t <sub>6</sub>    | Delay, REFIN Rising Edge to REF Rising Edge <sup>[3]</sup>  | Measured at V <sub>DD</sub> /2 from REFIN to any output               | –   | –    | ±200   | ps   |
| t <sub>7</sub>    | Device to Device Skew <sup>[3]</sup>                        | Measured at V <sub>DD</sub> /2 on the REF pin of the device (pin 1)   | –   | –    | 400    | ps   |
| t <sub>J</sub>    | Period Jitter <sup>[3]</sup>                                | Measured at F <sub>out</sub> < 133.33 MHz, loaded outputs, 15-pF load | –   | 80   | ±175   | ps   |
| t <sub>LOCK</sub> | PLL Lock Time <sup>[3]</sup>                                | Stable power supply, valid clocks presented on REFIN                  | –   | –    | 1.0    | ms   |

### Switching Waveforms

Figure 2. Duty Cycle Timing

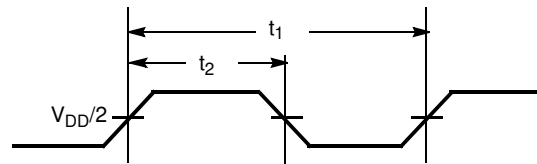


Figure 3. All Outputs Rise/Fall Time

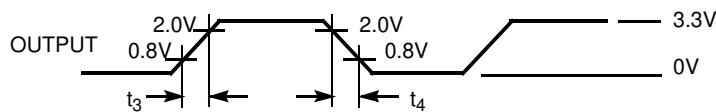
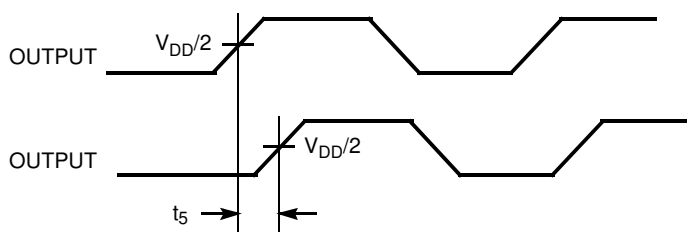


Figure 4. Output-Output Skew



Switching Waveforms (continued)

Figure 5. Input-Output Propagation Delay

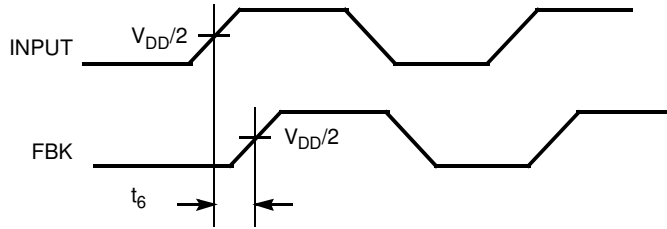
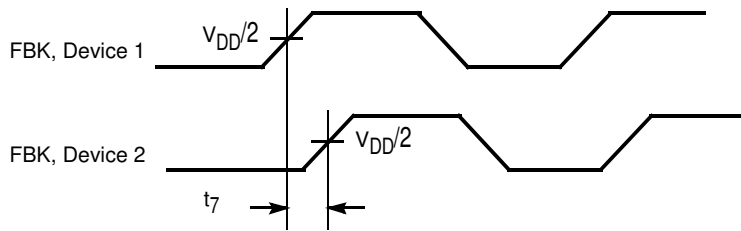
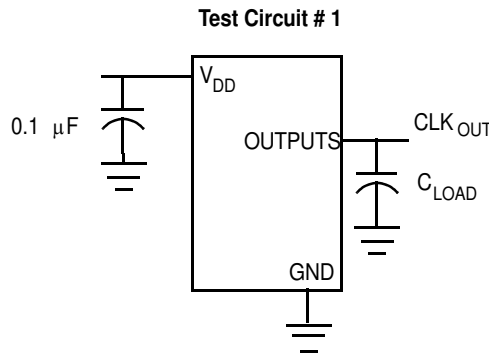


Figure 6. Device-Device Skew



Test Circuits

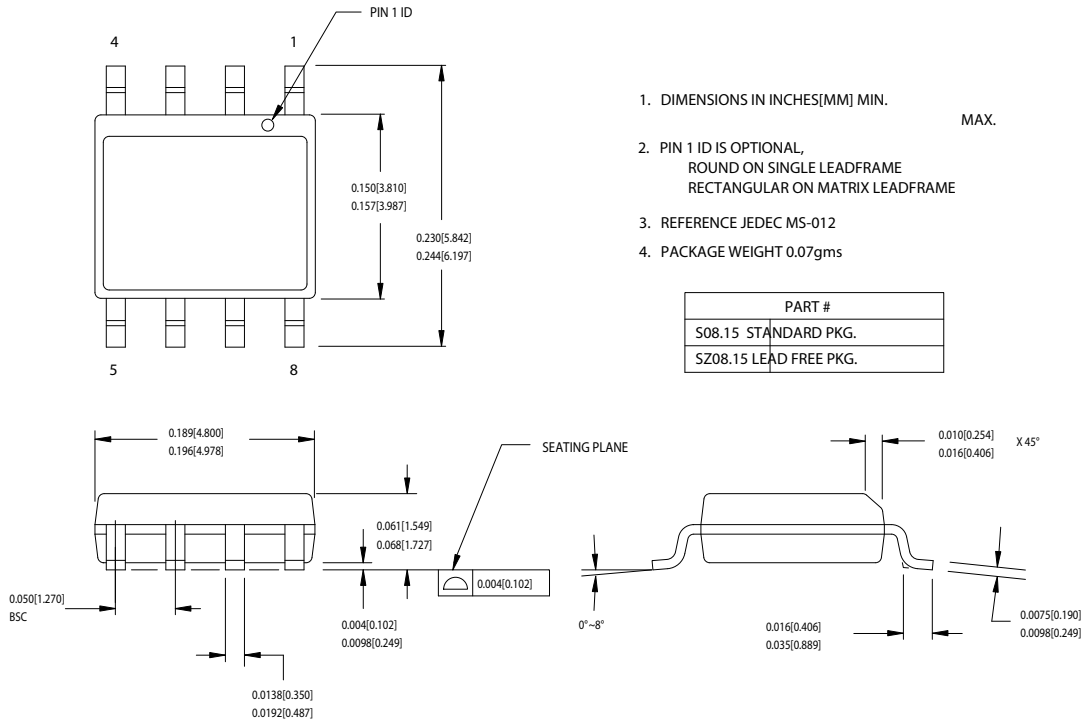


Ordering Information

| Ordering Code  | Package Type                       | Operating Range |
|----------------|------------------------------------|-----------------|
| <b>Pb-free</b> |                                    |                 |
| CY2303SXC      | 8-Pin 150-mil SOIC                 | Commercial      |
| CY2303SXCT     | 8-Pin 150-mil SOIC - Tape and Reel | Commercial      |
| CY2303SXI      | 8-Pin 150-mil SOIC                 | Industrial      |
| CY2303SXIT     | 8-Pin 150-mil SOIC - Tape and Reel | Industrial      |

Package Diagram

Figure 7. 8-Pin (150-Mil) SOIC S8



51-85066-°C

## Document History Page

| Document Title: CY2303 Phase-Aligned Clock Multiplier<br>Document Number: 38-07249 |         |                 |                 |  |
|--|---------|-----------------|-----------------|--|
| REV.   | ECN     | Orig. of Change | Submission Date | Description of Change  |
| **   | 110514  | SZV             | 01/07/02        | Change from Spec number: 38-01036 to 38-07249  |
| *A   | 121852  | RBI             | 12/14/02        | Power up requirements added to Operating Conditions Information  |
| *B   | 390413  | RGL             | 08/10/05        | Added Lead-free devices<br>Added typical values for jitter   |
| *C   | 2568533 | AESA            | 09/23/08        | Updated template.<br>Removed part number CY2303SC and CY2303SI from Selector Guide table.<br>Removed part number CY2303SC, CY2303SCT, CY2303SI, and CY2303SIT. |

## Sales, Solutions, and Legal Information

### Worldwide Sales and Design Support

Cypress maintains a worldwide network of offices, solution centers, manufacturer’s representatives, and distributors. To find the office closest to you, visit us at [cypress.com/sales](http://cypress.com/sales).

### Products

|                  |  |
|------------------|--|
| PSoC             | <a href="http://psoc.cypress.com">psoc.cypress.com</a>         |
| Clocks & Buffers | <a href="http://clocks.cypress.com">clocks.cypress.com</a>     |
| Wireless         | <a href="http://wireless.cypress.com">wireless.cypress.com</a> |
| Memories         | <a href="http://memory.cypress.com">memory.cypress.com</a>     |
| Image Sensors    | <a href="http://image.cypress.com">image.cypress.com</a>       |

### PSoC Solutions

|                       |  |
|-----------------------|--|
| General               | <a href="http://psoc.cypress.com/solutions">psoc.cypress.com/solutions</a>               |
| Low Power/Low Voltage | <a href="http://psoc.cypress.com/low-power">psoc.cypress.com/low-power</a>               |
| Precision Analog      | <a href="http://psoc.cypress.com/precision-analog">psoc.cypress.com/precision-analog</a> |
| LCD Drive             | <a href="http://psoc.cypress.com/lcd-drive">psoc.cypress.com/lcd-drive</a>               |
| CAN 2.0b              | <a href="http://psoc.cypress.com/can">psoc.cypress.com/can</a>                           |
| USB                   | <a href="http://psoc.cypress.com/usb">psoc.cypress.com/usb</a>                           |

© Cypress Semiconductor Corporation, 2002-2008. The information contained herein is subject to change without notice. Cypress Semiconductor Corporation assumes no responsibility for the use of any circuitry other than circuitry embodied in a Cypress product. Nor does it convey or imply any license under patent or other rights. Cypress products are not warranted nor intended to be used for medical, life support, life saving, critical control or safety applications, unless pursuant to an express written agreement with Cypress. Furthermore, Cypress does not authorize its products for use as critical components in life-support systems where a malfunction or failure may reasonably be expected to result in significant injury to the user. The inclusion of Cypress products in life-support systems application implies that the manufacturer assumes all risk of such use and in doing so indemnifies Cypress against all charges.

Any Source Code (software and/or firmware) is owned by Cypress Semiconductor Corporation (Cypress) and is protected by and subject to worldwide patent protection (United States and foreign), United States copyright laws and international treaty provisions. Cypress hereby grants to licensee a personal, non-exclusive, non-transferable license to copy, use, modify, create derivative works of, and compile the Cypress Source Code and derivative works for the sole purpose of creating custom software and/or firmware in support of licensee product to be used only in conjunction with a Cypress integrated circuit as specified in the applicable agreement. Any reproduction, modification, translation, compilation, or representation of this Source Code except as specified above is prohibited without the express written permission of Cypress.

Disclaimer: CYPRESS MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Cypress reserves the right to make changes without further notice to the materials described herein. Cypress does not assume any liability arising out of the application or use of any product or circuit described herein. Cypress does not authorize its products for use as critical components in life-support systems where a malfunction or failure may reasonably be expected to result in significant injury to the user. The inclusion of Cypress’ product in a life-support systems application implies that the manufacturer assumes all risk of such use and in doing so indemnifies Cypress against all charges.

Use may be limited by and subject to the applicable Cypress software license agreement.