

# 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.

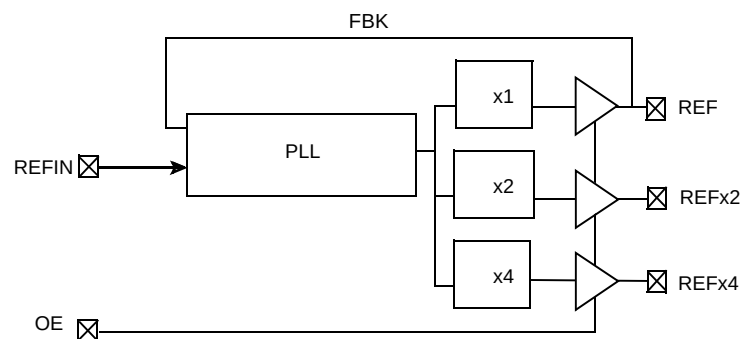
Multiple CY2303 devices can accept the same input clock and distribute it in a system. In this case, the skew between the outputs of two devices is guaranteed to be less than 400 ps.

The CY2303 is available in commercial and industrial temperature ranges.

## Selector Guide

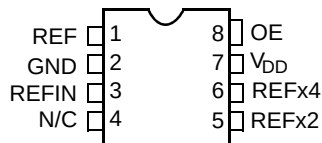
| Part Number | Outputs | Input Frequency Range | Output Frequency Range | Specifics              |
|-------------|---------|-----------------------|------------------------|------------------------|
| CY2303SXC   | 3       | 10 MHz–41.67 MHz      | 10 MHz–166.67 MHz      | Commercial Temperature |
| 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  | μA   |
| $I_{IH}$  | Input HIGH Current                | $V_{IN} = V_{DD}$ | –    | 50   | μA   |
| $V_{OL}$  | Output LOW Voltage <sup>[2]</sup> | $I_{OL} = 8$ mA   | –    | 0.4  | V    |

### Notes

- Weak pull-down on all outputs.
- 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**

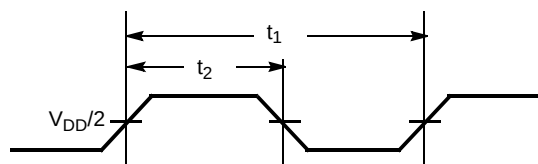
3. All parameters are specified with loaded outputs.

## Switching Characteristics for CY2303SI Industrial Temperature Devices

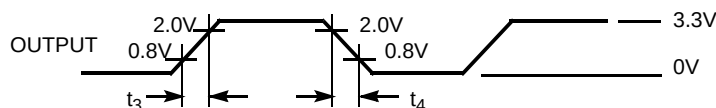
| Parameter  | Name                                                       | Test Conditions                                                | Min | Typ. | Max    | Unit |
|------------|------------------------------------------------------------|----------------------------------------------------------------|-----|------|--------|------|
| $1/t_1$    | Output Frequency                                           | 15-pF load                                                     | 10  | –    | 133.33 | MHz  |
|            |                                                            | 10-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 $f_{out} < 133.33$ MHz, loaded outputs, 15-pF load | –   | 80   | ±175   | ps   |
| $t_{LOCK}$ | PLL Lock Time <sup>[3]</sup>                               | Stable power supply, valid clocks presented on REFIN           | –   | –    | 1.0    | ms   |

## Switching Waveforms

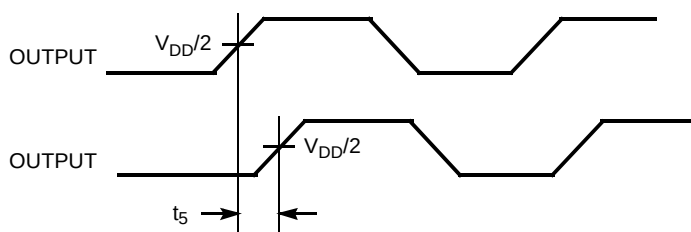
**Figure 2. Duty Cycle Timing**



**Figure 3. All Outputs Rise/Fall Time**

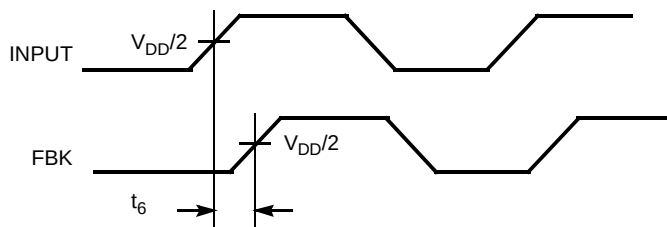


**Figure 4. Output-Output Skew**

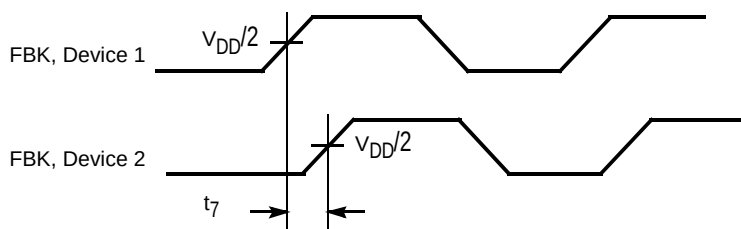


## Switching Waveforms (continued)

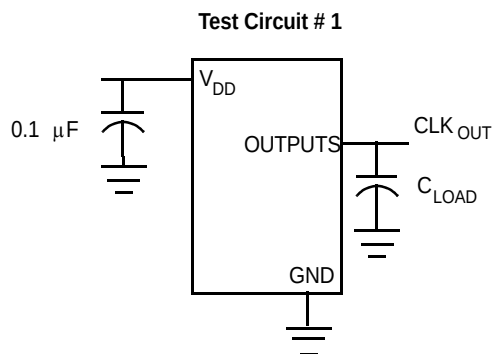
**Figure 5. Input-Output Propagation Delay**



**Figure 6. Device-Device Skew**



## Test Circuits

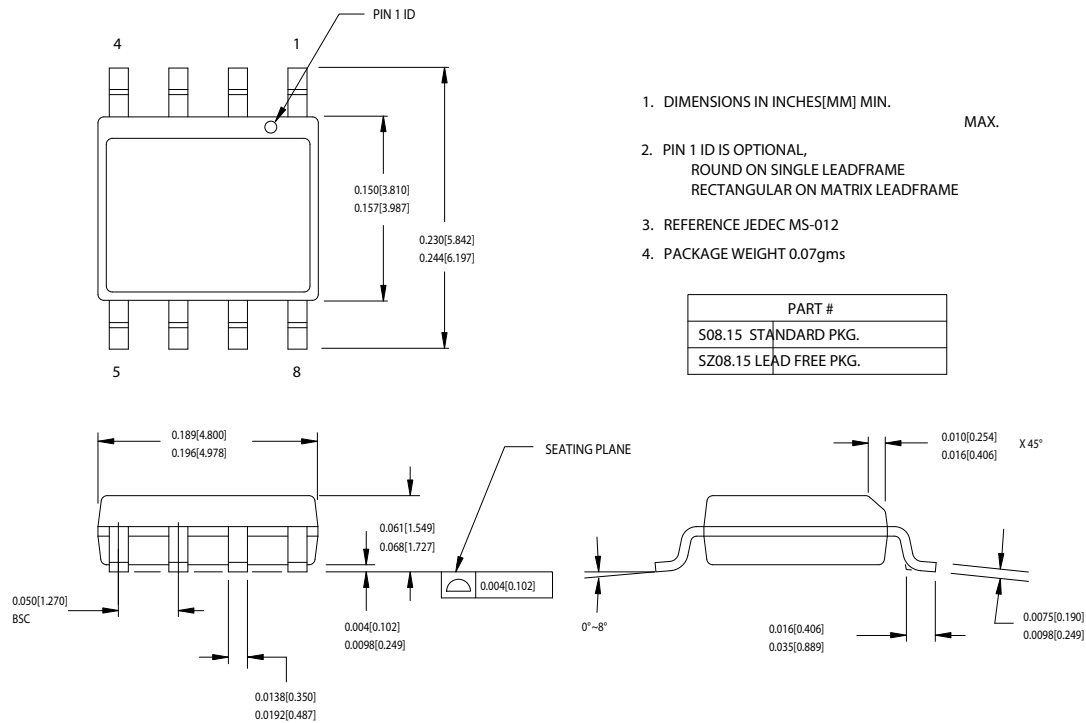


## Ordering Information

| 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. |

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