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# Low Cost 3.3 V Zero Delay Buffer

## Features

- 10 MHz to 100/133 MHz operating range, compatible with CPU and PCI bus frequencies
- Zero input-output propagation delay
- 60-ps typical cycle-to-cycle jitter (high drive)
- Multiple low skew outputs
  - 85 ps typical output-to-output skew
  - One input drives five outputs (CY2305)
  - One input drives nine outputs, grouped as 4 + 4 + 1 (CY2309)
- Compatible with Pentium-based systems
- Test Mode to bypass phase-locked loop (PLL) (CY2309)
- Packages:
  - 8-pin, 150-mil SOIC package (CY2305)
  - 16-pin 150-mil SOIC or 4.4-mm TSSOP (CY2309)
- 3.3 V operation
- Commercial and industrial temperature ranges

## Functional Description

The CY2309 is a low-cost 3.3 V zero delay buffer designed to distribute high speed clocks and is available in a 16-pin SOIC or TSSOP package. The CY2305 is an 8-pin version of the CY2309. It accepts one reference input, and drives out five low skew clocks. The -1H versions of each device operate at up to 100-/133 MHz frequencies, and have higher drive than the -1 devices. All parts have on-chip PLLs which lock to an input clock on the REF pin. The PLL feedback is on-chip and is obtained from the CLKOUT pad.

The CY2309 has two banks of four outputs each, which can be controlled by the select inputs as shown in [Select Input Decoding](#) on page 5. If all output clocks are not required, BankB can be three-stated. The select inputs also allow the input clock to be directly applied to the outputs for chip and system testing purposes.

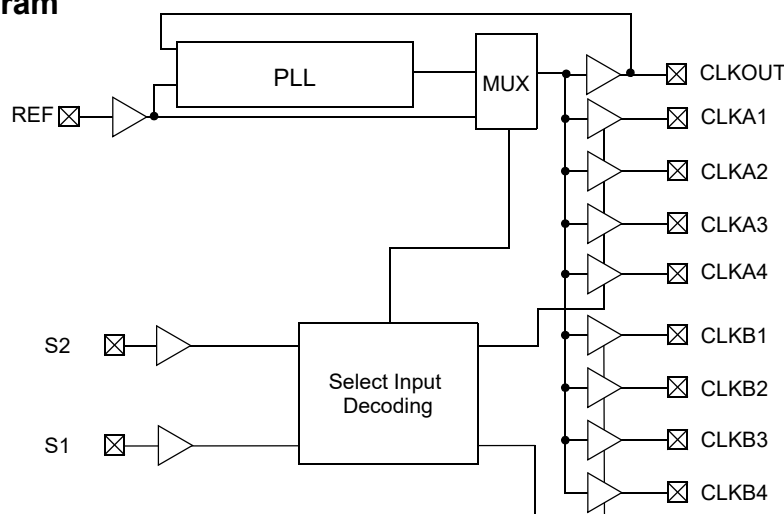
The CY2305 and CY2309 PLLs enter a power-down mode when there are no rising edges on the REF input. In this state, the outputs are three-stated and the PLL is turned off, resulting in less than 25.0  $\mu$ A current draw for these parts. The CY2309 PLL shuts down in one additional case as shown in [Select Input Decoding](#) on page 5.

Multiple CY2305 and CY2309 devices can accept the same input clock and distribute it. In this case, the skew between the outputs of two devices is guaranteed to be less than 700 ps.

The CY2305/CY2309 is available in two or three different configurations, as shown in [Ordering Information](#) on page 16. The CY2305-1/CY2309-1 is the base part. The CY2305-1H/CY2309-1H is the high-drive version of the -1, and its rise and fall times are much faster than the -1.

For a complete list of related documentation, click [here](#).

## Logic Block Diagram

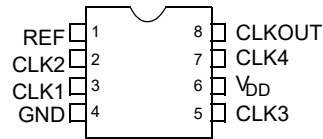


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## Pin Diagram

**Figure 1. 8-pin SOIC pinout  
CY2305**



## Pin Description

For CY2305

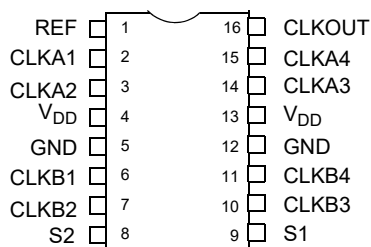
| Pin | Signal                | Description                                          |
|-----|-----------------------|------------------------------------------------------|
| 1   | REF <sup>[1]</sup>    | Input reference frequency, 5-V tolerant input        |
| 2   | CLK2 <sup>[2]</sup>   | Buffered clock output                                |
| 3   | CLK1 <sup>[2]</sup>   | Buffered clock output                                |
| 4   | GND                   | Ground                                               |
| 5   | CLK3 <sup>[2]</sup>   | Buffered clock output                                |
| 6   | V <sub>DD</sub>       | 3.3-V supply                                         |
| 7   | CLK4 <sup>[2]</sup>   | Buffered clock output                                |
| 8   | CLKOUT <sup>[2]</sup> | Buffered clock output, internal feedback on this pin |

### Notes

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

## Pin Diagram

**Figure 2. 16-pin SOIC / TSSOP pinout  
CY2309**



## Pin Description

For CY2309

| Pin | Signal                | Description                                    |
|-----|-----------------------|------------------------------------------------|
| 1   | REF <sup>[3]</sup>    | Input reference frequency, 5-V tolerant input  |
| 2   | CLKA1 <sup>[4]</sup>  | Buffered clock output, Bank A                  |
| 3   | CLKA2 <sup>[4]</sup>  | Buffered clock output, Bank A                  |
| 4   | V <sub>DD</sub>       | 3.3-V supply                                   |
| 5   | GND                   | Ground                                         |
| 6   | CLKB1 <sup>[4]</sup>  | Buffered clock output, Bank B                  |
| 7   | CLKB2 <sup>[4]</sup>  | Buffered clock output, Bank B                  |
| 8   | S2 <sup>[5]</sup>     | Select input, bit 2                            |
| 9   | S1 <sup>[5]</sup>     | Select input, bit 1                            |
| 10  | CLKB3 <sup>[4]</sup>  | Buffered clock output, Bank B                  |
| 11  | CLKB4 <sup>[4]</sup>  | Buffered clock output, Bank B                  |
| 12  | GND                   | Ground                                         |
| 13  | V <sub>DD</sub>       | 3.3-V supply                                   |
| 14  | CLKA3 <sup>[4]</sup>  | Buffered clock output, Bank A                  |
| 15  | CLKA4 <sup>[4]</sup>  | Buffered clock output, Bank A                  |
| 16  | CLKOUT <sup>[4]</sup> | Buffered output, internal feedback on this pin |

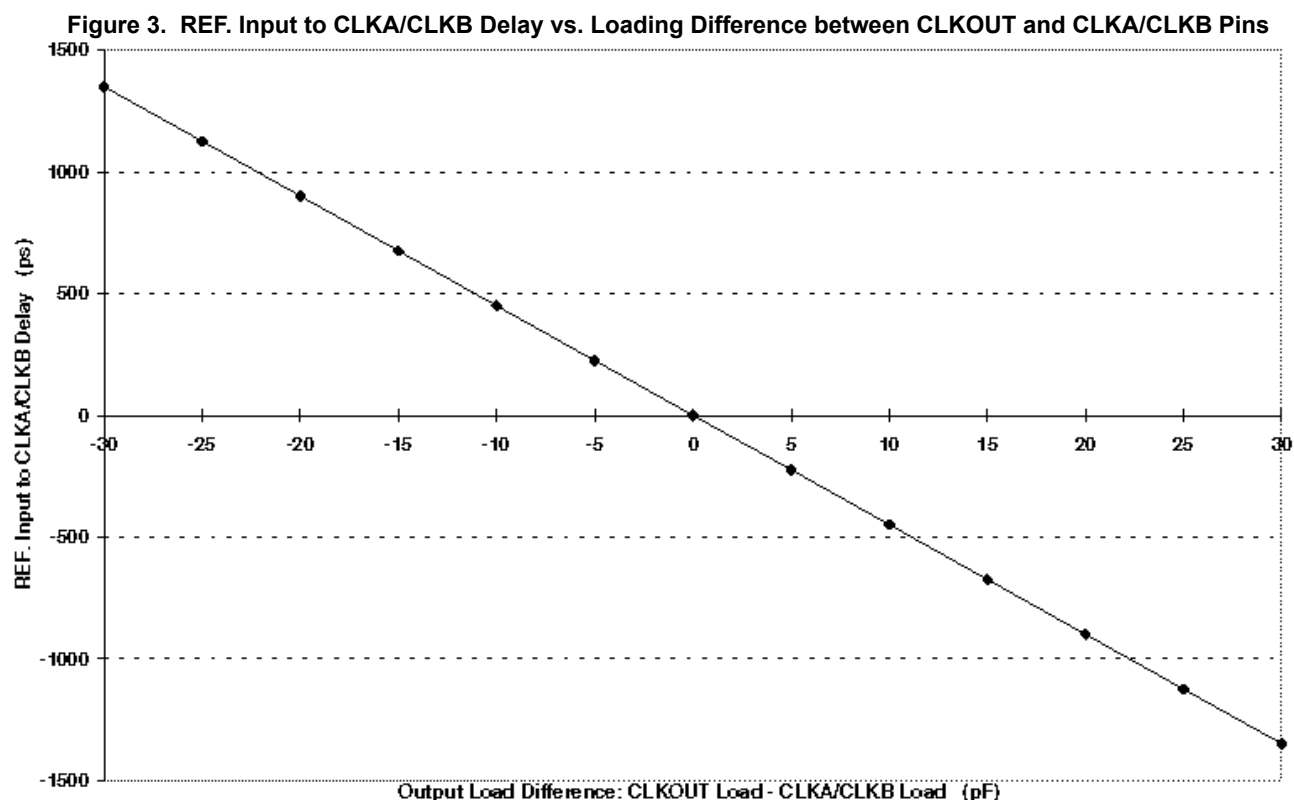
### Notes

3. Weak pull down.
4. Weak pull down on all outputs.
5. Weak pull ups on these inputs.

## Select Input Decoding

For CY2309

| S2 | S1 | CLOCK A1–A4 | CLOCK B1–B4 | CLKOUT <sup>[6]</sup> | Output Source | PLL Shutdown |
|----|----|-------------|-------------|-----------------------|---------------|--------------|
| 0  | 0  | Three-state | Three-state | Driven                | PLL           | N            |
| 0  | 1  | Driven      | Three-state | Driven                | PLL           | N            |
| 1  | 0  | Driven      | Driven      | Driven                | Reference     | Y            |
| 1  | 1  | Driven      | Driven      | Driven                | PLL           | N            |



## Zero Delay and Skew Control

All outputs must be uniformly loaded to achieve zero delay between the input and output. Because the CLKOUT pin is the internal feedback to the PLL, its relative loading can adjust the input-output delay. This is shown in the above graph.

For applications requiring zero input-output delay, all outputs, including CLKOUT, must be equally loaded. Even if CLKOUT is not used, it must have a capacitive load, equal to that on other outputs, for obtaining zero input-output delay. If input to output delay adjustments are required, use [Figure 3](#) to calculate loading differences between the CLKOUT pin and other outputs.

### Note

6. This output is driven and has an internal feedback for the PLL. The load on this output can be adjusted to change the skew between the reference and output.

## Absolute Maximum Conditions

Supply voltage to ground potential ..... -0.5 V to +7.0 V  
 DC input voltage (Except REF) ..... -0.5 V to  $V_{DD} + 0.5$  V  
 DC input voltage REF ..... -0.5 V to 7 V

Storage temperature ..... -65°C to +150°C  
 Junction temperature ..... 150°C  
 Static discharge voltage  
 (per MIL-STD-883, Method 3015) ..... > 2,000 V

## Operating Conditions

For CY2305SC-XX and CY2309SC-XX 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, below 100 MHz                                                                     | —    | 30  | pF   |
| $C_L$     | Load capacitance, from 100 MHz to 133 MHz                                                           | —    | 10  | pF   |
| $C_{IN}$  | Input capacitance                                                                                   | —    | 7   | pF   |
| $t_{PU}$  | Power-up time for all $V_{DD}$ s to reach minimum specified voltage (power ramps must be monotonic) | 0.05 | 50  | ms   |

## Electrical Characteristics

For CY2305SC-XX and CY2309SC-XX Commercial Temperature Devices

| Parameter          | Description                        | Test Conditions                                          | Min | Max   | Unit |
|--------------------|------------------------------------|----------------------------------------------------------|-----|-------|------|
| $V_{IL}$           | Input LOW voltage <sup>[7]</sup>   |                                                          | —   | 0.8   | V    |
| $V_{IH}$           | Input HIGH voltage <sup>[7]</sup>  |                                                          | 2.0 | —     | V    |
| $I_{IL}$           | Input LOW current                  | $V_{IN} = 0$ V                                           | —   | 50.0  | μA   |
| $I_{IH}$           | Input HIGH current                 | $V_{IN} = V_{DD}$                                        | —   | 100.0 | μA   |
| $V_{OL}$           | Output LOW voltage <sup>[8]</sup>  | $I_{OL} = 8$ mA (–1)                                     | —   | 0.4   | V    |
|                    |                                    | $I_{OL} = 12$ mA (–1H)                                   |     |       |      |
| $V_{OH}$           | Output HIGH voltage <sup>[8]</sup> | $I_{OH} = -8$ mA (–1)                                    | 2.4 | —     | V    |
|                    |                                    | $I_{OH} = -12$ mA (–1H)                                  |     |       |      |
| $I_{DD}$ (PD mode) | Power-down supply current          | REF = 0 MHz                                              | —   | 12.0  | μA   |
| $I_{DD}$           | Supply current                     | Unloaded outputs at 66.67 MHz,<br>SEL inputs at $V_{SS}$ | —   | 32.0  | mA   |

### Notes

7. REF input has a threshold voltage of  $V_{DD}/2$ .  
 8. Parameter is guaranteed by design and characterization. Not 100% tested in production.

## Operating Conditions

For CY2305SI-XX and CY2309SI-XX 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, below 100 MHz                                                                     | –    | 30  | pF   |
| $C_L$     | Load capacitance, from 100 MHz to 133 MHz                                                           | –    | 10  | pF   |
| $C_{IN}$  | Input capacitance                                                                                   | –    | 7   | pF   |
| $t_{PU}$  | Power-up time for all $V_{DD}$ s to reach minimum specified voltage (power ramps must be monotonic) | 0.05 | 50  | ms   |

## Electrical Characteristics

For CY2305SI-XX and CY2309SI-XX Industrial Temperature Devices

| Parameter          | Description                         | Test Conditions                                       | Min | Max   | Unit |
|--------------------|-------------------------------------|-------------------------------------------------------|-----|-------|------|
| $V_{IL}$           | Input LOW voltage <sup>[9]</sup>    |                                                       | –   | 0.8   | V    |
| $V_{IH}$           | Input HIGH voltage <sup>[9]</sup>   |                                                       | 2.0 | –     | V    |
| $I_{IL}$           | Input LOW current                   | $V_{IN} = 0\text{ V}$                                 | –   | 50.0  | μA   |
| $I_{IH}$           | Input HIGH current                  | $V_{IN} = V_{DD}$                                     | –   | 100.0 | μA   |
| $V_{OL}$           | Output LOW voltage <sup>[10]</sup>  | $I_{OL} = 8\text{ mA} (-1)$                           | –   | 0.4   | V    |
|                    |                                     | $I_{OL} = 12\text{ mA} (-1H)$                         |     |       |      |
| $V_{OH}$           | Output HIGH voltage <sup>[10]</sup> | $I_{OH} = -8\text{ mA} (-1)$                          | 2.4 | –     | V    |
|                    |                                     | $I_{OH} = -12\text{ mA} (-1H)$                        |     |       |      |
| $I_{DD}$ (PD mode) | Power-down supply current           | REF = 0 MHz                                           | –   | 25.0  | μA   |
| $I_{DD}$           | Supply current                      | Unloaded outputs at 66.67 MHz, SEL inputs at $V_{SS}$ | –   | 35.0  | mA   |

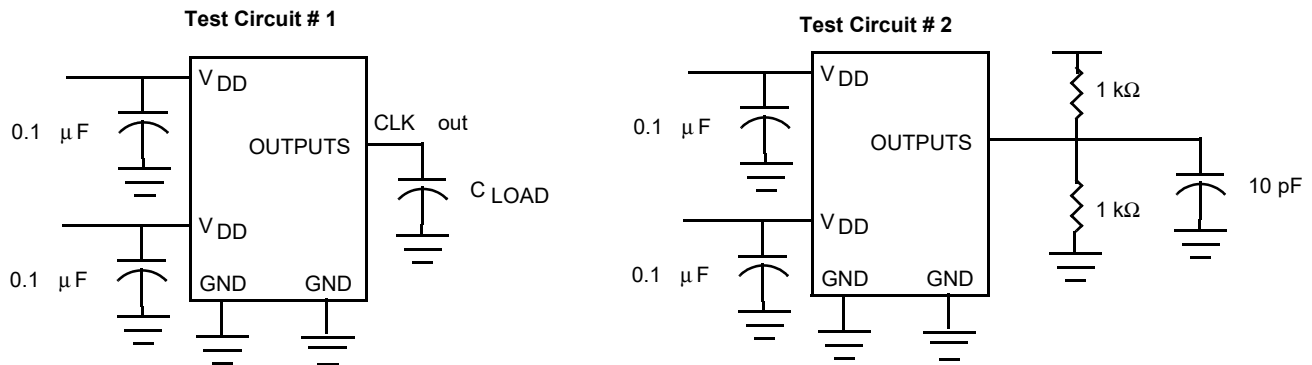
### Notes

9. REF input has a threshold voltage of  $V_{DD}/2$ .

10. Parameter is guaranteed by design and characterization. Not 100% tested in production.

## Test Circuits

Figure 4. Test Circuits



For parameter  $t_b$  (output slew rate) on -1H devices

## Thermal Resistance

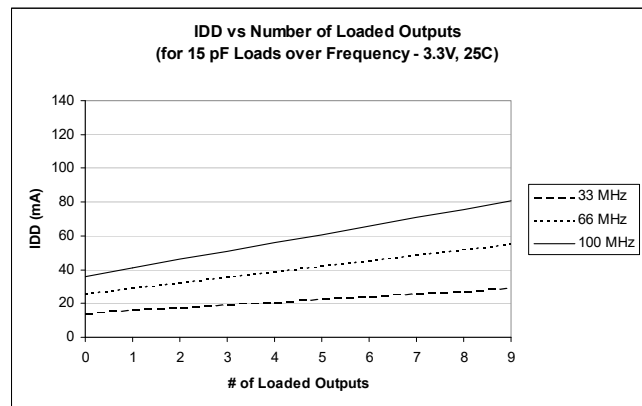
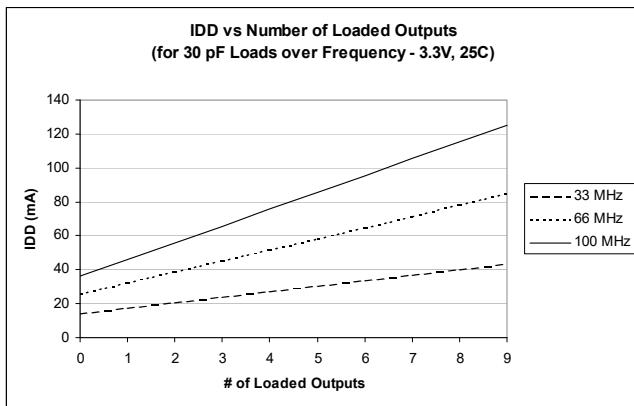
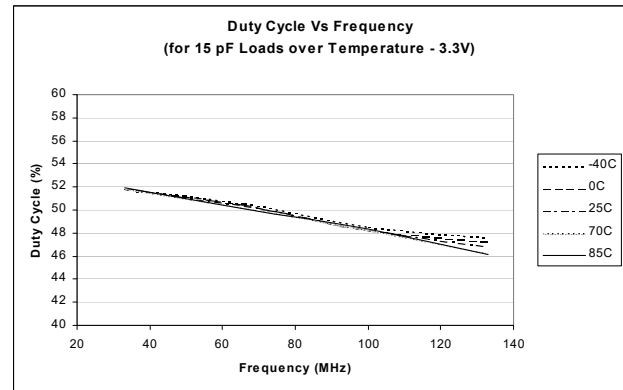
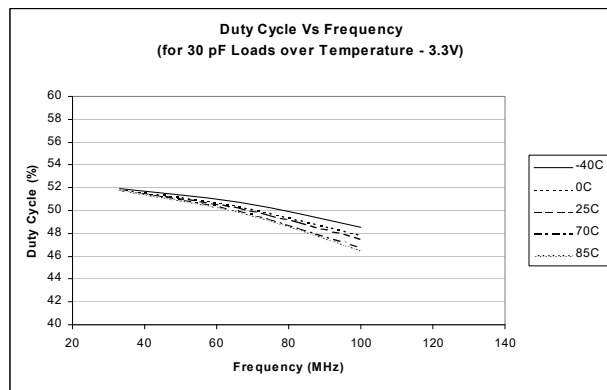
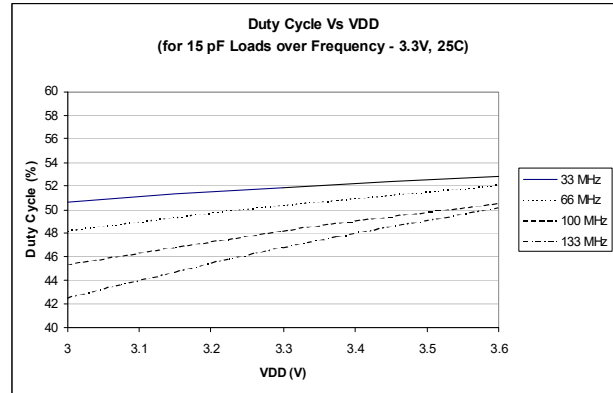
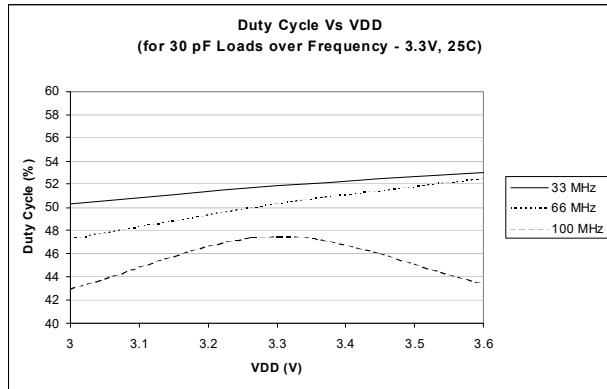
| Parameter <sup>[11]</sup> | Description                              | Test Conditions                                                                                                             | 8-pin SOIC | 16-pin SOIC | 16-pin TSSOP | Unit |
|---------------------------|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------|-------------|--------------|------|
| $\theta_{JA}$             | Thermal resistance (junction to ambient) | Test conditions follow standard test methods and procedures for measuring thermal impedance, in accordance with EIA/JESD51. | 140        | 111         | 117          | °C/W |
| $\theta_{JC}$             | Thermal resistance (junction to case)    |                                                                                                                             | 54         | 60          | 22           | °C/W |

### Note

11. These parameters are guaranteed by design and are not tested.

## Typical Duty Cycle and $I_{DD}$ Trends

For CY2305-1 and CY2309-1 [12, 13]



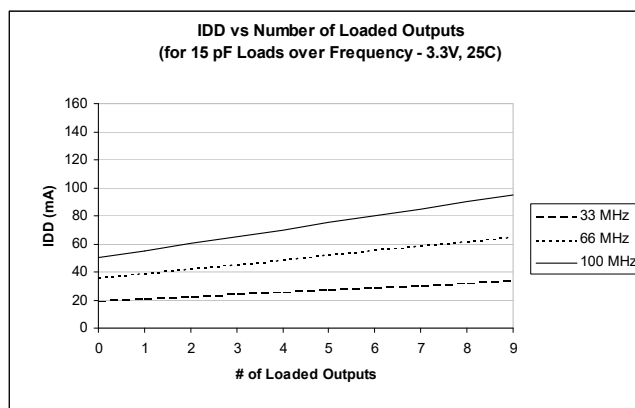
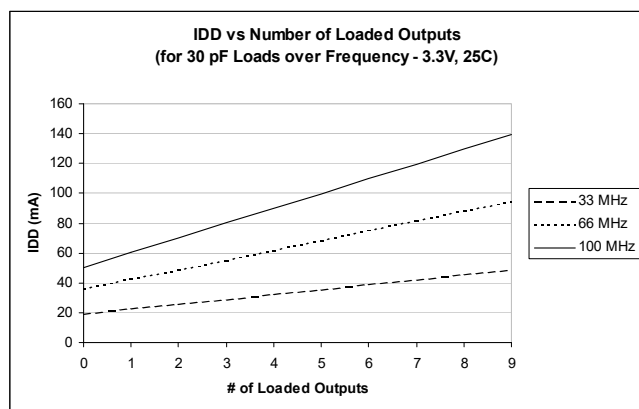
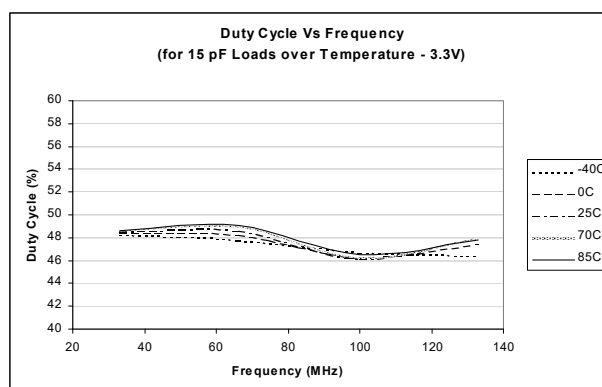
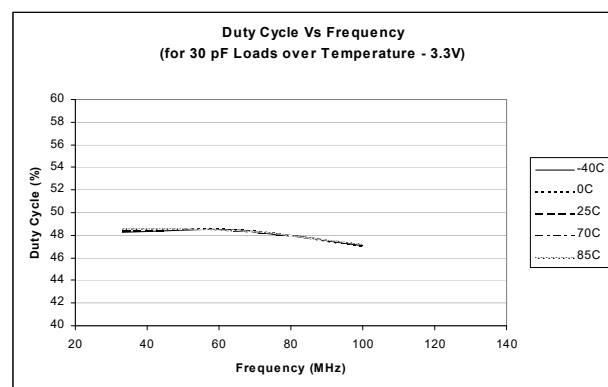
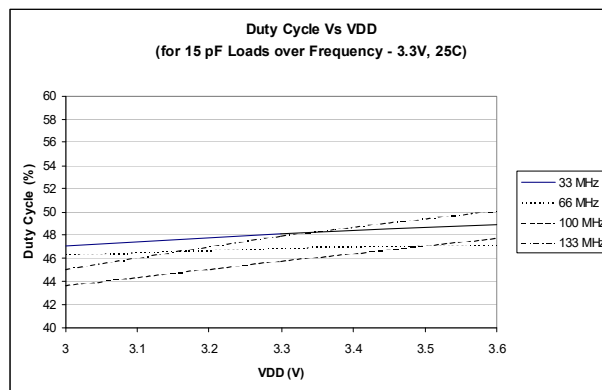
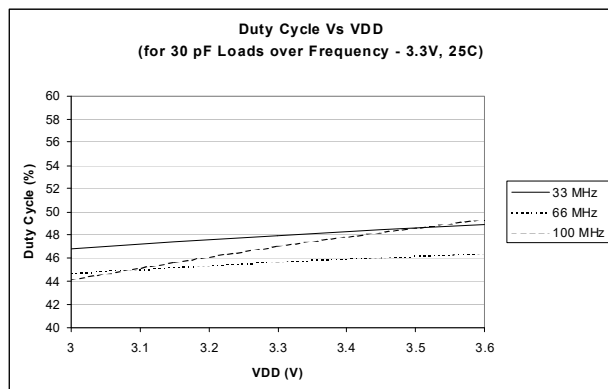
### Notes

12. Duty cycle is taken from typical chip measured at 1.4 V.

13.  $I_{DD}$  data is calculated from  $I_{DD} = I_{CORE} + nCVf$ , where  $I_{CORE}$  is the unloaded current. ( $n$  = # of outputs;  $C$  = Capacitance load per output (F);  $V$  = Supply Voltage (V);  $f$  = frequency (Hz)).

## Typical Duty Cycle and $I_{DD}$ Trends

For CY2305-1H and CY2309-1H [14, 15]



### Notes

14. Duty cycle is taken from typical chip measured at 1.4 V.

15.  $I_{DD}$  data is calculated from  $I_{DD} = I_{CORE} + nCVf$ , where  $I_{CORE}$  is the unloaded current. ( $n$  = # of outputs;  $C$  = Capacitance load per output (F);  $V$  = Supply Voltage (V);  $f$  = frequency (Hz)).

## Switching Characteristics

For CY2305SC-1 and CY2309SC-1 Commercial Temperature Devices

| Parameter <sup>[16]</sup> | Description                                                  | Test Conditions                                                                        | Min  | Typ  | Max    | Unit |
|---------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------|------|------|--------|------|
| t <sub>1</sub>            | Output frequency                                             | 30-pF load                                                                             | 10   | –    | 100    | MHz  |
|                           |                                                              | 10-pF load                                                                             | 10   | –    | 133.33 | MHz  |
| t <sub>DC</sub>           | Duty cycle <sup>[17]</sup> = $t_2 \div t_1$                  | Measured at 1.4 V,<br>F <sub>out</sub> = 66.67 MHz                                     | 40.0 | 50.0 | 60.0   | %    |
| t <sub>3</sub>            | Rise time <sup>[17]</sup>                                    | Measured between 0.8 V and 2.0 V                                                       | –    | –    | 2.50   | ns   |
| t <sub>4</sub>            | Fall time <sup>[17]</sup>                                    | Measured between 0.8 V and 2.0 V                                                       | –    | –    | 2.50   | ns   |
| t <sub>5</sub>            | Output-to-output skew <sup>[17]</sup>                        | All outputs equally loaded                                                             | –    | 85   | 250    | ps   |
| t <sub>6A</sub>           | Delay, REF rising edge to CLKOUT rising edge <sup>[17]</sup> | Measured at V <sub>DD</sub> /2                                                         | –    | 0    | ±350   | ps   |
| t <sub>6B</sub>           | Delay, REF rising edge to CLKOUT rising edge <sup>[17]</sup> | Measured at V <sub>DD</sub> /2.<br>Measured in PLL Bypass Mode,<br>CY2309 device only. | 1    | 5    | 8.7    | ns   |
| t <sub>7</sub>            | Device-to-device skew <sup>[17]</sup>                        | Measured at V <sub>DD</sub> /2 on the CLKOUT pins of devices                           | –    | –    | 700    | ps   |
| t <sub>J</sub>            | Cycle-to-cycle jitter <sup>[17]</sup>                        | Measured at 66.67 MHz,<br>loaded outputs                                               | –    | 70   | 200    | ps   |
| t <sub>LOCK</sub>         | PLL lock time <sup>[17, 18, 19]</sup>                        | Stable power supply, valid clock presented on REF pin                                  | –    | –    | 1.0    | ms   |

### Notes

16. All parameters specified with loaded outputs.

17. Parameter is guaranteed by design and characterization. Not 100% tested in production.

18. The clock outputs are undefined until PLL is locked.

19. For on the fly change in reference input frequency, PLL lock time is only guaranteed when stop time between change in input reference frequency is > 10 μs, [Figure 10](#).

## Switching Characteristics

For CY2305SC-1H and CY2309SC-1H Commercial Temperature Devices

| Parameter <sup>[20]</sup> | Description                                                  | Condition                                                                              | Min  | Typ  | Max    | Unit |
|---------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------|------|------|--------|------|
| t <sub>1</sub>            | Output frequency                                             | 30 pF load                                                                             | 10   | –    | 100    | MHz  |
|                           |                                                              | 10 pF load                                                                             | 10   | –    | 133.33 | MHz  |
| t <sub>DC</sub>           | Duty cycle <sup>[21]</sup> = t <sub>2</sub> ÷ t <sub>1</sub> | Measured at 1.4 V, F <sub>out</sub> = 66.67 MHz                                        | 40.0 | 50.0 | 60.0   | %    |
| t <sub>DC</sub>           | Duty cycle <sup>[21]</sup> = t <sub>2</sub> ÷ t <sub>1</sub> | Measured at 1.4 V, F <sub>out</sub> < 50 MHz                                           | 45.0 | 50.0 | 55.0   | %    |
| t <sub>3</sub>            | Rise time <sup>[21]</sup>                                    | Measured between 0.8 V and 2.0 V                                                       | –    | –    | 1.50   | ns   |
| t <sub>4</sub>            | Fall time <sup>[21]</sup>                                    | Measured between 0.8 V and 2.0 V                                                       | –    | –    | 1.50   | ns   |
| t <sub>5</sub>            | Output-to-output skew <sup>[21]</sup>                        | All outputs equally loaded                                                             | –    | 85   | 250    | ps   |
| t <sub>6A</sub>           | Delay, REF rising edge to CLKOUT rising edge <sup>[21]</sup> | Measured at V <sub>DD</sub> /2                                                         | –    | –    | ±350   | ps   |
| t <sub>6B</sub>           | Delay, REF rising edge to CLKOUT rising edge <sup>[21]</sup> | Measured at V <sub>DD</sub> /2.<br>Measured in PLL Bypass Mode,<br>CY2309 device only. | 1    | 5    | 8.7    | ns   |
| t <sub>7</sub>            | Device-to-device skew <sup>[21]</sup>                        | Measured at V <sub>DD</sub> /2 on the CLKOUT pins of devices                           | –    | –    | 700    | ps   |
| t <sub>8</sub>            | Output slew rate <sup>[21]</sup>                             | Measured between 0.8 V and 2.0 V using Test Circuit #2                                 | 1    | –    |        | V/ns |
| t <sub>J</sub>            | Cycle-to-cycle jitter <sup>[21]</sup>                        | Measured at 66.67 MHz, loaded outputs                                                  | –    | 60   | 200    | ps   |
| t <sub>LOCK</sub>         | PLL lock time <sup>[21, 22, 23]</sup>                        | Stable power supply, valid clock presented on REF pin                                  | –    | –    | 1.0    | ms   |

### Notes

20. All parameters specified with loaded outputs.

21. Parameter is guaranteed by design and characterization. Not 100% tested in production.

22. The clock outputs are undefined until PLL is locked.

23. For on the fly change in reference input frequency, PLL lock time is only guaranteed when stop time between change in input reference frequency is > 10 µs, [Figure 10](#).

## Switching Characteristics

For CY2305SI-1 and CY2309SI-1 Industrial Temperature Devices

| Parameter <sup>[24]</sup> | Description                                                  | Test Conditions                                                                  | Min  | Typ  | Max    | Unit |
|---------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------|------|------|--------|------|
| t <sub>1</sub>            | Output frequency                                             | 30 pF load                                                                       | 10   | –    | 100    | MHz  |
|                           |                                                              | 10 pF load                                                                       | 10   | –    | 133.33 | MHz  |
| t <sub>DC</sub>           | Duty cycle <sup>[25]</sup> = $t_2 \div t_1$                  | Measured at 1.4 V, F <sub>out</sub> = 66.67 MHz                                  | 40.0 | 50.0 | 60.0   | %    |
| t <sub>3</sub>            | Rise time <sup>[25]</sup>                                    | Measured between 0.8 V and 2.0 V                                                 | –    | –    | 2.50   | ns   |
| t <sub>4</sub>            | Fall time <sup>[25]</sup>                                    | Measured between 0.8 V and 2.0 V                                                 | –    | –    | 2.50   | ns   |
| t <sub>5</sub>            | Output-to-output skew <sup>[25]</sup>                        | All outputs equally loaded                                                       | –    | 85   | 250    | ps   |
| t <sub>6A</sub>           | Delay, REF rising edge to CLKOUT rising edge <sup>[25]</sup> | Measured at V <sub>DD</sub> /2                                                   | –    | –    | ±350   | ps   |
| t <sub>6B</sub>           | Delay, REF rising edge to CLKOUT rising edge <sup>[25]</sup> | Measured at V <sub>DD</sub> /2. Measured in PLL Bypass Mode, CY2309 device only. | 1    | 5    | 8.7    | ns   |
| t <sub>7</sub>            | Device-to-device skew <sup>[25]</sup>                        | Measured at V <sub>DD</sub> /2 on the CLKOUT pins of devices                     | –    | –    | 700    | ps   |
| t <sub>J</sub>            | Cycle-to-cycle jitter <sup>[25]</sup>                        | Measured at 66.67 MHz, loaded outputs                                            | –    | 70   | 200    | ps   |
| t <sub>LOCK</sub>         | PLL lock time <sup>[25, 26, 27]</sup>                        | Stable power supply, valid clock presented on REF pin                            | –    | –    | 1.0    | ms   |

### Notes

24. All parameters specified with loaded outputs.

25. Parameter is guaranteed by design and characterization. Not 100% tested in production.

26. The clock outputs are undefined until PLL is locked.

27. For on the fly change in reference input frequency, PLL lock time is only guaranteed when stop time between change in input reference frequency is > 10 μs, [Figure 10](#).

## Switching Characteristics

For CY2305SI-1H and CY2309SI-1H Industrial Temperature Devices

| Parameter <sup>[28]</sup> | Description                                                  | Conditions                                                                       | Min  | Typ  | Max    | Unit |
|---------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------|------|------|--------|------|
| t <sub>1</sub>            | Output frequency                                             | 30 pF load                                                                       | 10   | –    | 100    | MHz  |
|                           |                                                              | 10 pF load                                                                       | 10   | –    | 133.33 | MHz  |
| t <sub>DC</sub>           | Duty cycle <sup>[29]</sup> = t <sub>2</sub> ÷ t <sub>1</sub> | Measured at 1.4 V, F <sub>out</sub> = 66.67 MHz                                  | 40.0 | 50.0 | 60.0   | %    |
| t <sub>DC</sub>           | Duty cycle <sup>[29]</sup> = t <sub>2</sub> ÷ t <sub>1</sub> | Measured at 1.4 V, F <sub>out</sub> < 50 MHz                                     | 45.0 | 50.0 | 55.0   | %    |
| t <sub>3</sub>            | Rise time <sup>[29]</sup>                                    | Measured between 0.8 V and 2.0 V                                                 | –    | –    | 1.50   | ns   |
| t <sub>4</sub>            | Fall time <sup>[29]</sup>                                    | Measured between 0.8 V and 2.0 V                                                 | –    | –    | 1.50   | ns   |
| t <sub>5</sub>            | Output-to output skew <sup>[29]</sup>                        | All outputs equally loaded                                                       | –    | 85   | 250    | ps   |
| t <sub>6A</sub>           | Delay, REF rising edge to CLKOUT rising edge <sup>[29]</sup> | Measured at V <sub>DD</sub> /2                                                   | –    | –    | ±350   | ps   |
| t <sub>6B</sub>           | Delay, REF rising edge to CLKOUT rising edge <sup>[29]</sup> | Measured at V <sub>DD</sub> /2. Measured in PLL Bypass Mode, CY2309 device only. | 1    | 5    | 8.7    | ns   |
| t <sub>7</sub>            | Device-to-device skew <sup>[29]</sup>                        | Measured at V <sub>DD</sub> /2 on the CLKOUT pins of devices                     | –    | –    | 700    | ps   |
| t <sub>8</sub>            | Output slew rate <sup>[29]</sup>                             | Measured between 0.8 V and 2.0 V using Test Circuit #2                           | 1    | –    | –      | V/ns |
| t <sub>J</sub>            | Cycle-to-cycle jitter <sup>[29]</sup>                        | Measured at 66.67 MHz, loaded outputs                                            | –    | 60   | 200    | ps   |
| t <sub>LOCK</sub>         | PLL lock time <sup>[29, 30, 31]</sup>                        | Stable power supply, valid clock presented on REF pin                            | –    | –    | 1.0    | ms   |

### Notes

28. All parameters specified with loaded outputs.

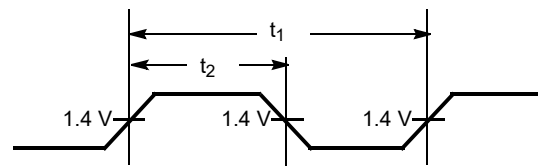
29. Parameter is guaranteed by design and characterization. Not 100% tested in production.

30. The clock outputs are undefined until PLL is locked.

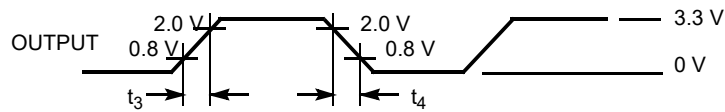
31. For on the fly change in reference input frequency, PLL lock time is only guaranteed when stop time between change in input reference frequency is > 10 µs, [Figure 10](#).

## Switching Waveforms

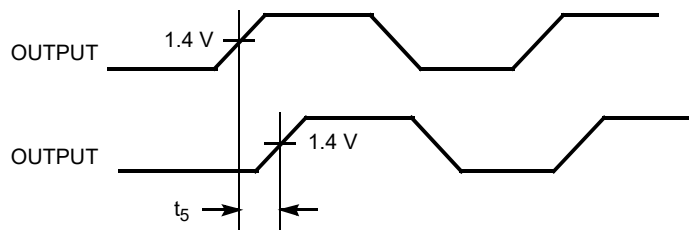
**Figure 5. Duty Cycle Timing**



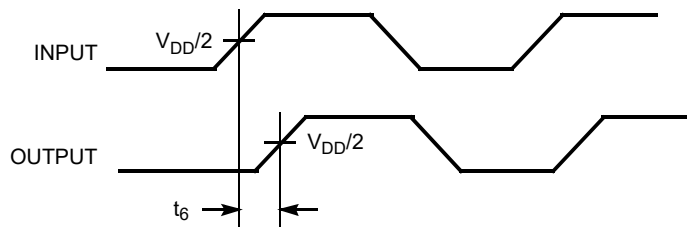
**Figure 6. All Outputs Rise/Fall Time**



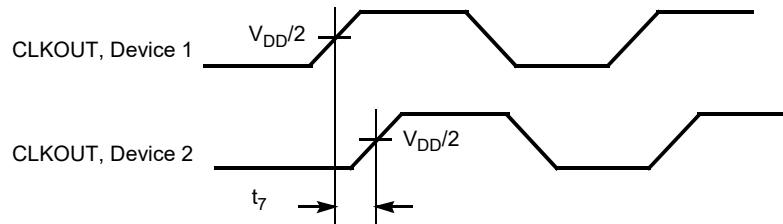
**Figure 7. Output-Output Skew**



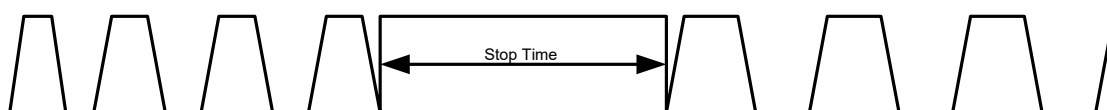
**Figure 8. Input-Output Propagation Delay**



**Figure 9. Device-Device Skew**



**Figure 10. Stop Time between Change in Input Reference Frequency**



## Ordering Information

For CY2305

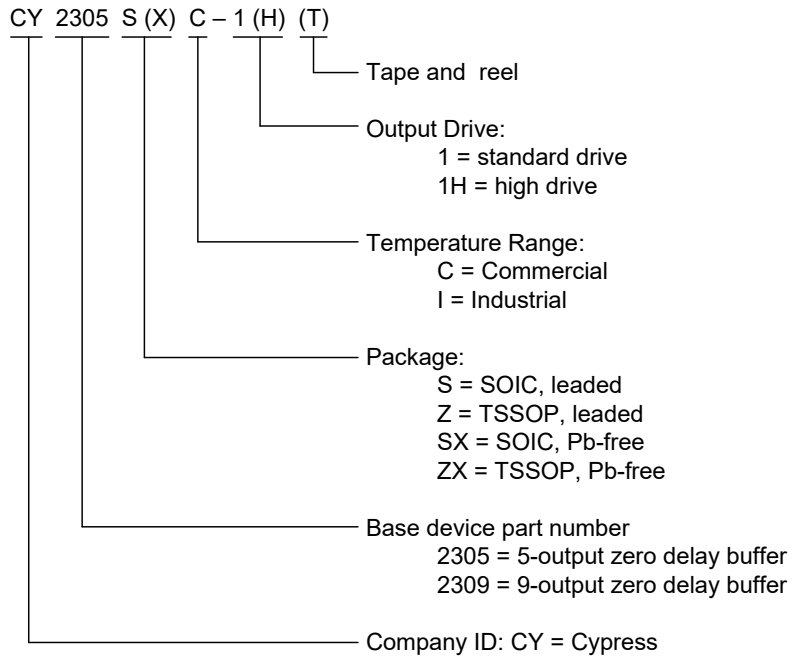
| Ordering Code  | Package Type                          | Operating Range |
|----------------|---------------------------------------|-----------------|
| CY2305SC-1     | 8-pin SOIC (150 Mils)                 | Commercial      |
| CY2305SC-1T    | 8-pin SOIC (150 Mils) – Tape and Reel | Commercial      |
| <b>Pb-free</b> |                                       |                 |
| CY2305SXC-1    | 8-pin SOIC (150 Mils)                 | Commercial      |
| CY2305SXC-1T   | 8-pin SOIC (150 Mils) – Tape and Reel | Commercial      |
| CY2305SXI-1    | 8-pin SOIC (150 Mils)                 | Industrial      |
| CY2305SXI-1T   | 8-pin SOIC (150 Mils) – Tape and Reel | Industrial      |
| CY2305SXC-1H   | 8-pin SOIC (150 Mils)                 | Commercial      |
| CY2305SXC-1HT  | 8-pin SOIC (150 Mils) – Tape and Reel | Commercial      |
| CY2305SXI-1H   | 8-pin SOIC (150 Mils)                 | Industrial      |
| CY2305SXI-1HT  | 8-pin SOIC (150 Mils) – Tape and Reel | Industrial      |

## Ordering Information

For CY2309

| Ordering Code  | Package Type                           | Operating Range |
|----------------|----------------------------------------|-----------------|
| <b>Pb-free</b> |                                        |                 |
| CY2309SXC-1    | 16-pin SOIC (150 Mils)                 | Commercial      |
| CY2309SXC-1T   | 16-pin SOIC (150 Mils) – Tape and Reel | Commercial      |
| CY2309SXI-1    | 16-pin SOIC (150 Mils)                 | Industrial      |
| CY2309SXI-1T   | 16-pin SOIC (150 Mils) – Tape and Reel | Industrial      |
| CY2309SXC-1H   | 16-pin SOIC (150 Mils)                 | Commercial      |
| CY2309SXC-1HT  | 16-pin SOIC (150 Mils) – Tape and Reel | Commercial      |
| CY2309SXI-1H   | 16-pin SOIC (150 Mils)                 | Industrial      |
| CY2309SXI-1HT  | 16-pin SOIC (150 Mils) – Tape and Reel | Industrial      |
| CY2309ZXC-1H   | 16-pin TSSOP (4.4 mm)                  | Commercial      |
| CY2309ZXC-1HT  | 16-pin TSSOP (4.4 mm) – Tape and Reel  | Commercial      |
| CY2309ZXI-1H   | 16-pin TSSOP (4.4 mm)                  | Industrial      |
| CY2309ZXI-1HT  | 16-pin TSSOP (4.4 mm) – Tape and Reel  | Industrial      |

## Ordering Code Definitions

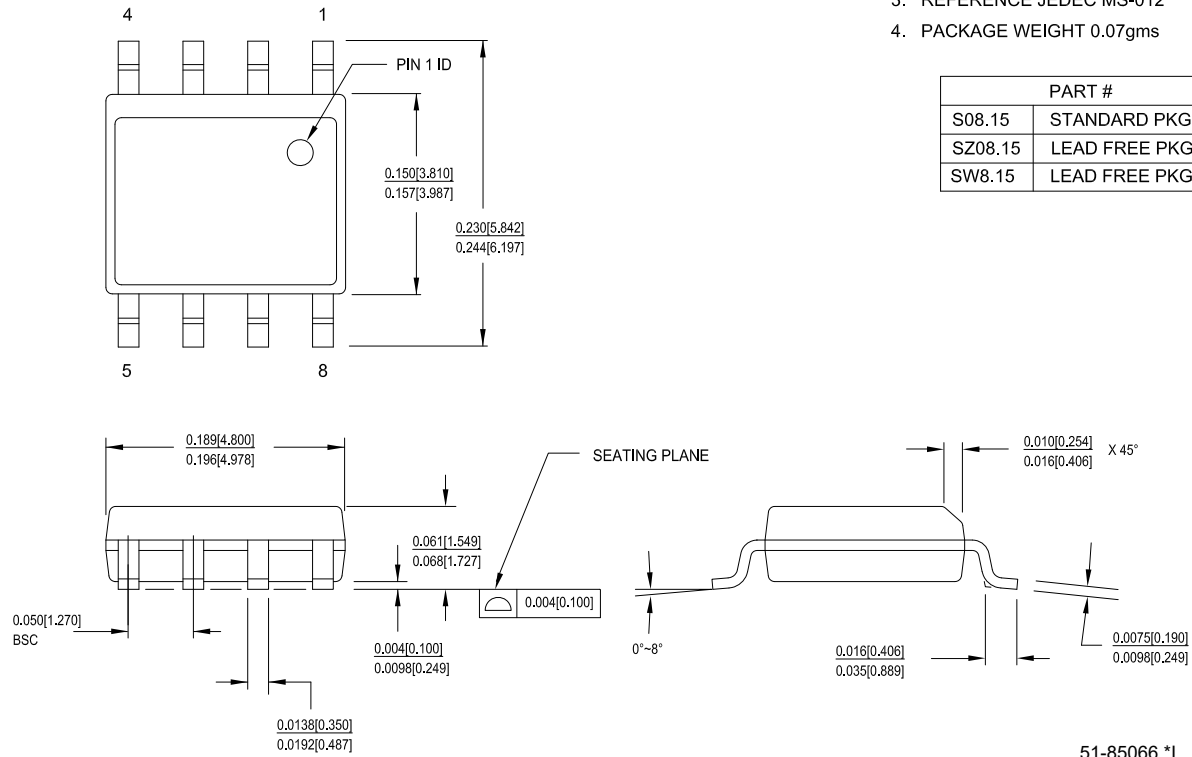


## Package Drawing and Dimensions

Figure 11. 8-pin SOIC (150 Mils) S0815/SZ815/SW815 Package Outline, 51-85066

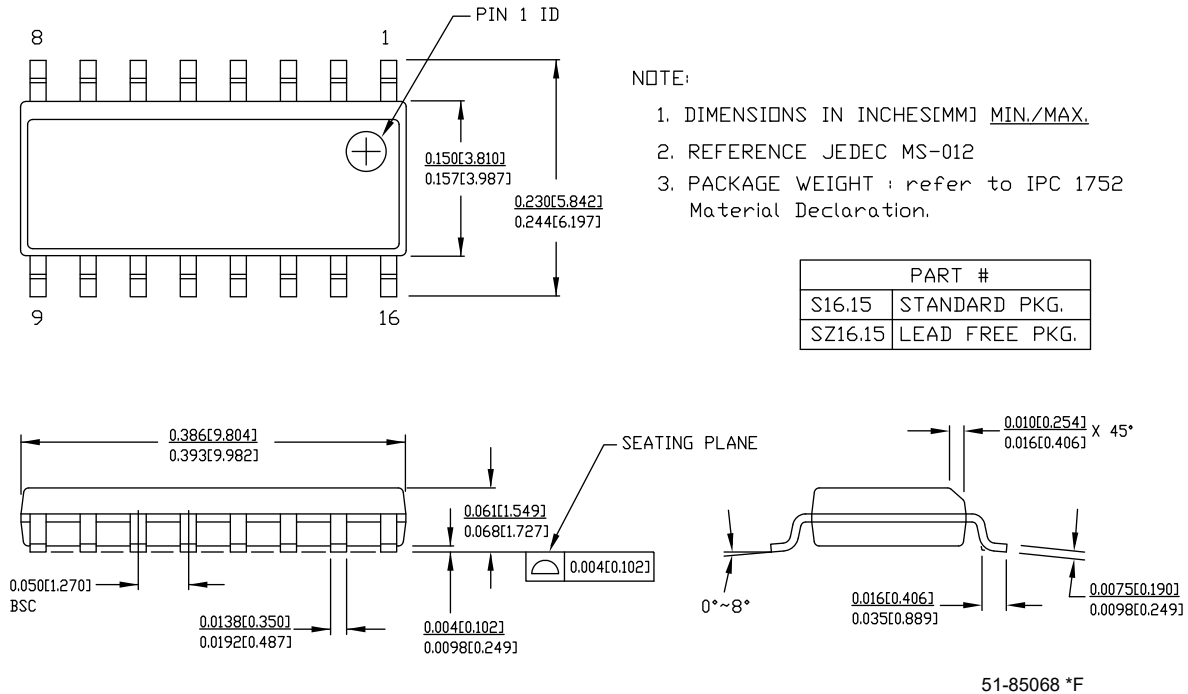
1. DIMENSIONS IN INCHES[MM] MIN.  
MAX.
2. PIN 1 ID IS OPTIONAL,  
ROUND ON SINGLE LEADFRAME  
RECTANGULAR ON MATRIX LEADFRAME
3. REFERENCE JEDEC MS-012
4. PACKAGE WEIGHT 0.07gms

| PART #  |               |
|---------|---------------|
| S08.15  | STANDARD PKG  |
| SZ08.15 | LEAD FREE PKG |
| SW8.15  | LEAD FREE PKG |

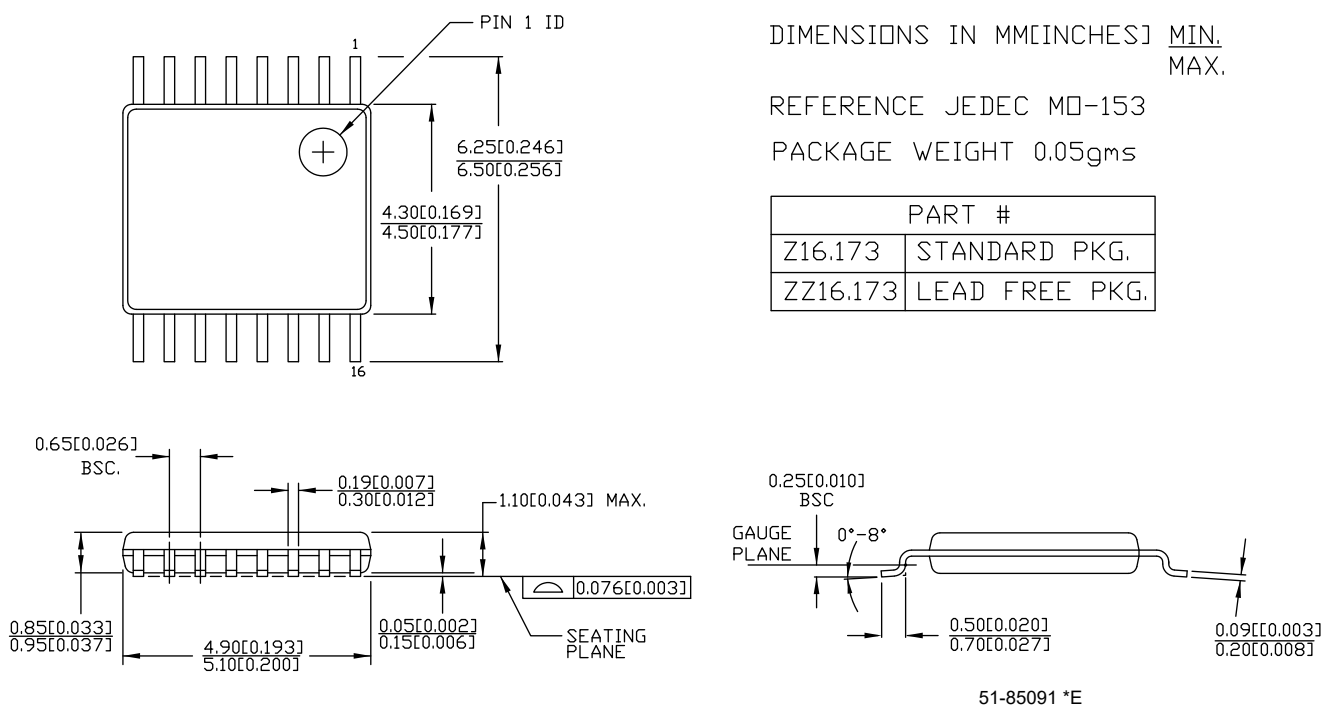


## Package Drawing and Dimensions (continued)

**Figure 12. 16-pin SOIC (150 Mils) S16.15/SZ16.15 Package Outline, 51-85068**



**Figure 13. 16-pin TSSOP (4.40 mm Body) Z16.173/ZZ16.173 Package Outline, 51-85091**



## Acronyms

| Acronym | Description                              |
|---------|------------------------------------------|
| PCI     | Personal Computer Interconnect           |
| PLL     | Phase Locked Loop                        |
| SDRAM   | Synchronous Dynamic Random Access Memory |
| SOIC    | Small Outline Integrated Circuit         |
| TSSOP   | Thin Small Outline Package               |
| ZDB     | Zero Delay Buffer                        |

## Document Conventions

### Units of Measure

| Symbol | Unit of Measure |
|--------|-----------------|
| °C     | degree Celsius  |
| μA     | microampere     |
| mA     | milliampere     |
| ms     | millisecond     |
| MHz    | megahertz       |
| ns     | nanosecond      |
| pF     | picofarad       |
| ps     | picosecond      |
| V      | volt            |

## Errata

This section describes the errata for Cypress Zero Delay Clock Buffers of the family CY2305/CY2309. Details include errata trigger conditions, scope of impact, available workaround, and silicon revision applicability. Contact your local Cypress Sales Representative if you have questions.

### Part Numbers Affected

| Part Number     | Device Characteristics |
|-----------------|------------------------|
| CY2305SC-1      | All Variants           |
| CY2305SC-1T     | All Variants           |
| CY2305SC-1H     | All Variants           |
| CY2305SC-1HT    | All Variants           |
| CY2305SI-1H     | All Variants           |
| CY2305SI-1HT    | All Variants           |
| CY2305SXC-1     | All Variants           |
| CY2305SXC-1T    | All Variants           |
| CY2305SXI-1     | All Variants           |
| CY2305SXI-1H    | All Variants           |
| CY2305SXC-1HT   | All Variants           |
| CY2305SXI-1H    | All Variants           |
| CY2305SXI-1HT   | All Variants           |
| CY2309NZSXC-1H  | All Variants           |
| CY2309NZSXC-1HT | All Variants           |
| CY2309NZSXI-1H  | All Variants           |
| CY2309NZSXI-1HT | All Variants           |
| CY2309SC-1HT    | All Variants           |
| CY2309SXC-1H    | All Variants           |
| CY2309SXC-1HT   | All Variants           |
| CY2309SXI-1H    | All Variants           |
| CY2309SXI-1HT   | All Variants           |
| CY2309ZC-1H     | All Variants           |
| CY2309ZC-1HT    | All Variants           |
| CY2309ZXC-1H    | All Variants           |
| CY2309ZXC-1HT   | All Variants           |
| CY2309ZXI-1H    | All Variants           |
| CY2309ZXI-1HT   | All Variants           |
| CY2309SXC-1     | All Variants           |
| CY2309SXC-1T    | All Variants           |
| CY2309SXI-1     | All Variants           |
| CY2309SXI-1T    | All Variants           |
| CY2309SC-1      | All Variants           |
| CY2309SC-1T     | All Variants           |
| CY2309SXC-1     | All Variants           |
| CY2309SXC-1T    | All Variants           |
| CY2309SXI-1     | All Variants           |
| CY2309SXI-1T    | All Variants           |

## CY2305/CY2309 Qualification Status

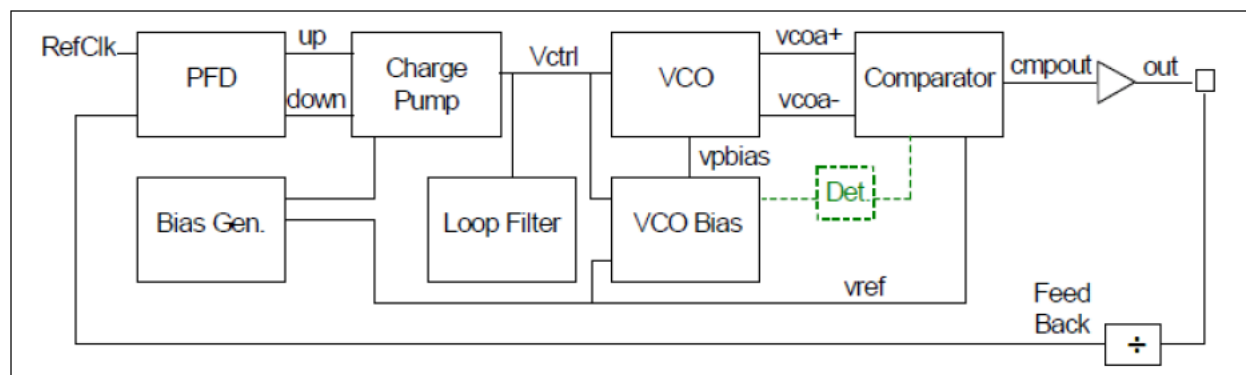
Product Status: In production

Qualification report last updated on 11/27/2012 (<http://www.cypress.com/?rID=72595>)

## CY2305/CY2309 Errata Summary

| Items                          | Part Number | Silicon Revision | Fix Status                                              |
|--------------------------------|-------------|------------------|---------------------------------------------------------|
| [1.] Start up lock time issue. | CY2305      | B                | Silicon fixed. New silicon available from WW 25 of 2011 |
|                                | CY2309      |                  | Silicon fixed. New silicon available from WW 10 of 2013 |

| 1. Start up lock time issue. |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Problem Definition</b>    | Output of CY2305/CY2309 fails to locks within 1 ms (as per data sheet spec).                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Parameters Affected</b>   | PLL lock time.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Trigger Condition(s)</b>  | Start up.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Scope of Impact</b>       | It can impact the performance of system and its throughput.                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Workaround</b>            | Apply reference input (RefClk) before power up (VDD) Input noise propagates to output due to absence of reference input signal during power up. If reference input is present during power up, the noise will not propagate to output and device will start normally without problems.                                                                                                                                                        |
| <b>Fix Status</b>            | <p>This issue is due to design marginality. Two minor design modifications have been made to address this problem.</p> <ul style="list-style-type: none"> <li>□ Addition of VCO bias detector block as shown in the following figure which keeps comparator power down till VCO bias is present and thereby eliminating the propagation of noise to feedback.</li> <li>□ Bias generator enhancement for successful initialization.</li> </ul> |



## Document History Page

| Document Title: CY2305/CY2309, Low Cost 3.3 V Zero Delay Buffer<br>Document Number: 38-07140 |         |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------|---------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Revision                                                                                     | ECN     | Submission Date | Description of Change                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| **                                                                                           | 110249  | 10/19/01        | Change from Spec number: 38-00530 to 38-07140                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| *A                                                                                           | 111117  | 03/01/02        | Added t6B row to the Switching Characteristics Table; also added the letter "A" to the t6A row<br>Corrected the table title from CY2305SC-IH and CY2309SC-IH to CY2305SI-IH and CY2309SI-IH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| *B                                                                                           | 117625  | 10/21/02        | Added eight-pin TSSOP packages (CY2305ZC-1 and CY2305ZC-1T) to the ordering information table.<br>Added the Tape and Reel option to all the existing packages:<br>CY2305SC-1T, CY2305SI-1T, CY2305SC-1HT, CY2305SI-1HT, CY2305ZC-1T, CY2309SC-1T, CY2309SI-1T, CY2309SC-1HT, CY2309SI-1HT, CY2309ZC-1HT, CY2309ZI-1HT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| *C                                                                                           | 121828  | 12/14/02        | Power up requirements added to Operating Conditions information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| *D                                                                                           | 131503  | 12/12/03        | Added Lead-free for all the devices in the ordering information table                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| *E                                                                                           | 214083  | See ECN         | Added a Lead-free with the new coding for all SOIC devices in the ordering information table                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| *F                                                                                           | 291099  | See ECN         | Added TSSOP Lead-free devices                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| *G                                                                                           | 390582  | See ECN         | Added typical values for jitter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| *H                                                                                           | 2542461 | 07/23/08        | Updated template. Added Note "Not recommended for new designs."<br>Added part number CY2305ESXC-1, CY2305ESXC-1T, CY2305ESXI-1, CY2305ESXI-1T, CY2305ESXC-1H, CY2305ESXC-1HT, CY2305ESXI-1H, CY2305ESXI-1HT, CY2309ESXC-1, CY2309ESXC-1T, CY2309ESXI-1, CY2309ESXI-1T, CY2309ESXC-1H, CY2309ESXC-1HT, CY2309ESXI-1H, CY2309ESXI-1HT, CY2309EZXC-1H, CY2309EZXC-1HT, CY2309EZXI-1H, and CY2309EZXI-1HT in ordering information table.<br>Removed part number CY2305SZC-1, CY2305SZC-1T, CY2305SZI-1, CY2305SZI-1T, CY2305SZC-1H, CY2305SZC-1HT, CY2305SZI-1H, CY2305SZI-1HT, CY2309SZC-1, CY2309SZC-1T, CY2309SZI-1, CY2309SZI-1T, CY2309SZC-1H, CY2309SZC-1HT, CY2309SZI-1H, CY2309SZI-1HT, CY2309ZZC-1H, CY2309ZZC-1HT, CY2309ZI-1H, CY2309ZI-1HT, CY2309ZZI-1H, and CY2309ZZI-1HT in Ordering Information table.<br>Changed Lead-Free to Pb-Free. |
| *I                                                                                           | 2565153 | 09/18/08        | Removed part number CY2305ESXC-1, CY2305ESXC-1T, CY2305ESXI-1, CY2305ESXI-1T, CY2305ESXC-1H, CY2305ESXC-1HT, CY2305ESXI-1H, CY2305ESXI-1HT, CY2309ESXC-1, CY2309ESXC-1T, CY2309ESXI-1, CY2309ESXI-1T, CY2309ESXC-1H, CY2309ESXC-1HT, CY2309ESXI-1H, CY2309ESXI-1HT, CY2309EZXC-1H, CY2309EZXC-1HT, CY2309EZXI-1H, and CY2309EZXI-1HT in ordering information table.<br>Removed note references to note 10 in Pb-Free sections of ordering information table.<br>Changed IDD (PD mode) from 12.0 to 25.0 $\mu$ A for commercial temperature devices<br>Deleted Duty Cycle parameters for $F_{out} < 50$ MHz commercial and industrial devices.                                                                                                                                                                                                       |
| *J                                                                                           | 2673353 | 03/13/09        | Reverted IDD (PD mode) and Duty Cycle parameters back to the values in revision *H:<br>Changed IDD (PD mode) from 25 to 12 $\mu$ A for commercial devices.<br>Added Duty Cycle parameters for $F_{out} < 50$ MHz for commercial and industrial devices.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| *K                                                                                           | 2904641 | 04/05/10        | Updated <a href="#">Ordering Information</a> :<br>Removed parts CY2305SI-1, CY2305SI-1T, CY2309SI-1, CY2309SI-1H, CY2309SI-1HT, CY2309SI-1T.<br>Updated <a href="#">Package Drawing and Dimensions</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| *L                                                                                           | 3047136 | 10/04/2010      | Added <a href="#">Ordering Code Definitions</a> under <a href="#">Ordering Information</a> .<br>Updated <a href="#">Package Drawing and Dimensions</a> .<br>Added <a href="#">Acronyms</a> and <a href="#">Units of Measure</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| *M                                                                                           | 3146330 | 01/18/2011      | Added "Not recommended for new designs" statement to Features on page 1. Added 'not recommended for new designs' footnote to all parts in the ordering information table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

**Document History Page** (continued)

| Document Title: CY2305/CY2309, Low Cost 3.3 V Zero Delay Buffer<br>Document Number: 38-07140 |         |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------|---------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Revision                                                                                     | ECN     | Submission Date | Description of Change                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| *N                                                                                           | 3241160 | 05/09/2011      | Added Footnote 9 on page 6 (CDT 97105).<br>Removed first bullet point "Not recommended for new designs. The CY2305C and CY2309C are form, fit, function compatible devices with improved specifications." from Features section. (CDT 99798).<br>Removed Footnote 20 and all its references from document. (CDT 99798).                                                                                                                                                                          |
| *O                                                                                           | 3400613 | 10/10/2011      | Added Footnote 19 and its reference to all PLL lock time parameters throughout the document.<br>Added <a href="#">Figure 10</a> for Stop Time Illustration.                                                                                                                                                                                                                                                                                                                                      |
| *P                                                                                           | 3859773 | 01/07/2013      | Updated <a href="#">Ordering Information</a> (Updated part numbers).<br>Updated <a href="#">Ordering Information</a> (Updated part numbers).<br>Updated <a href="#">Package Drawing and Dimensions</a> :<br>spec 51-85068 – Changed revision from *D to *E.                                                                                                                                                                                                                                      |
| *Q                                                                                           | 3997602 | 05/11/2013      | Updated <a href="#">Package Drawing and Dimensions</a> :<br>spec 51-85066 – Changed revision from *E to *F.<br>Added <a href="#">Errata</a> .                                                                                                                                                                                                                                                                                                                                                    |
| *R                                                                                           | 4124780 | 10/24/2013      | Updated to new template.<br>Completing Sunset Review.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| *S                                                                                           | 4307827 | 03/13/2014      | Updated <a href="#">Errata</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| *T                                                                                           | 4578443 | 11/25/2014      | Updated <a href="#">Functional Description</a> :<br>Added "For a complete list of related documentation, click <a href="#">here</a> ." at the end.<br>Updated <a href="#">Ordering Information</a> (Updated part numbers).<br>Updated <a href="#">Ordering Information</a> (Updated part numbers).                                                                                                                                                                                               |
| *U                                                                                           | 5206812 | 04/05/2016      | Updated <a href="#">Zero Delay and Skew Control</a> :<br>Updated description.<br>Updated <a href="#">Package Drawing and Dimensions</a> :<br>spec 51-85066 – Changed revision from *F to *H.<br>Updated to new template.                                                                                                                                                                                                                                                                         |
| *V                                                                                           | 5242499 | 04/26/2016      | Updated <a href="#">Electrical Characteristics</a> :<br>Updated details in "Test Conditions" column corresponding to V <sub>OL</sub> and V <sub>OH</sub> parameters.<br>Updated <a href="#">Operating Conditions</a> :<br>Added t <sub>PU</sub> parameter and its details.<br>Updated <a href="#">Electrical Characteristics</a> :<br>Updated details in "Test Conditions" column corresponding to V <sub>OL</sub> and V <sub>OH</sub> parameters.<br>Added <a href="#">Thermal Resistance</a> . |
| *W                                                                                           | 5516682 | 11/10/2016      | Updated to new template.<br>Completing Sunset Review.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| *X                                                                                           | 5708778 | 04/27/2017      | Updated Cypress Logo and Copyright.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| *Y                                                                                           | 6897833 | 06/12/2020      | Updated <a href="#">Package Drawing and Dimensions</a> :<br>spec 51-85066 – Changed revision from *H to *I.<br>spec 51-85068 – Changed revision from *E to *F.<br>Updated to template.                                                                                                                                                                                                                                                                                                           |

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