

Low RMS Phase Jitter Programmable LVDS Clock Generator

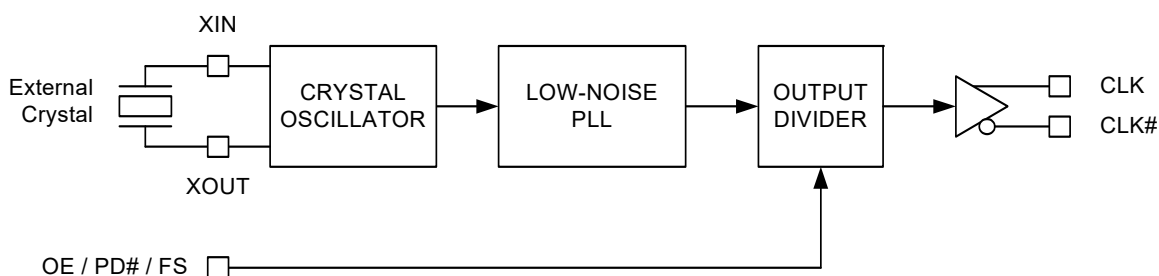
Features

- Programmable LVDS clock generator
- Low RMS Phase Jitter
- Available output frequencies: 50 MHz to 700 MHz
- Package: Pb-free 8-pin thin shrunk small outline package (TSSOP)
- Supply voltage: 3.3 V or 2.5 V
- Temperature: Industrial

Functional Description

The CY2XL12 is a phase locked loop (PLL)-based high-performance clock generator that uses Cypress's low-noise voltage control oscillator (VCO) technology to achieve less than 1 ps typical RMS phase jitter. The CY2XL12 uses an external crystal reference input and drives one LVDS output pair having programmable drive strength. CY2XL12 can be programmed as Output Enable (OE), or Power Down (PD#), or Frequency Select (FS) device by configuring the pin 5. The device can be programmed either to operate at 3.3 V or at 2.5 V.

Logic Block Diagram



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Pinouts

Figure 1. 8-pin TSSOP pinout

| | | | |
|------|---|---|-----------|
| VDD | 1 | 8 | VDD |
| VSS | 2 | 7 | CLK |
| XOUT | 3 | 6 | CLK# |
| XIN | 4 | 5 | OE/PD#/FS |

Pin Definitions

| Pin Number | Pin Name | I/O Type | Description |
|------------|---------------|-----------------------|--|
| 1, 8 | VDD | Power | 3.3 V or 2.5 V power supply. All supply current flows through pin 1 |
| 2 | VSS | Power | Ground |
| 3, 4 | XOUT, XIN | XTAL output and input | Parallel resonant crystal interface |
| 5 | OE / PD# / FS | CMOS input | Output enable pin: Active HIGH. If OE=1, CLK is enabled. When LOW, the output is high impedance Power-down pin: Active LOW. If PD# = 0, the device is powered down and the clock is disabled. Frequency Select pin: One of the two stored frequencies can be selected. |
| 6, 7 | CLK#, CLK | LVDS output | Differential clock output; drives one or two LVDS loads |

Frequency Table

| Part Number | Crystal Frequency | Output Frequency | Drive Strength | Pin 5 Function | RMS Phase Jitter (Random) | |
|--------------|-------------------|------------------|----------------|----------------|---------------------------|------------------|
| | | | | | Offset Range | Jitter (Typical) |
| CY2XL12ZXI01 | 25 MHz | 108 MHz | High | OE | 637 kHz to 10 MHz | 0.55 ps |
| CY2XL12ZXI02 | 25 MHz | 100 MHz | High | OE | 637 kHz to 10 MHz | 0.53 ps |
| CY2XL12ZXI03 | 25 MHz | 150 MHz | High | OE | 637 kHz to 10 MHz | 0.48 ps |
| CY2XL12ZXI06 | 25 MHz | 50 MHz | Normal | PD# | 12 kHz to 20 MHz | 1.0 ps |

Functional Overview

The CY2XL12 device with external crystal option has OE or PD# or FS feature of Pin 5. The OE function is used to enable or

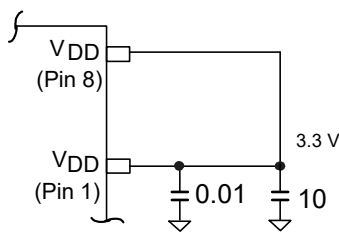
disable CLK output. PD# function can quickly put the device in low-power state, but it takes longer time to wake-up because of reacquire of PLL lock. FS feature is used to select two different output frequencies for multirate serializer application.

Application Information

Power Supply Filtering Techniques

As in any high-speed analog circuitry, noise at the power-supply pins can degrade performance. To achieve optimum jitter performance, use good power-supply isolation practices. Figure 2 illustrates a typical filtering scheme. Because all the current flows through pin 1, the resistance and inductance between this pin and the supply is minimized. A 0.01 or 0.1 μF ceramic chip capacitor is also located close to this pin to provide a short and low-impedance AC path to ground. A 1 to 10 μF ceramic or tantalum capacitor is located in the general vicinity of this device and may be shared with other devices.

Figure 2. Power Supply Filtering



Board Layout and OE Pin

If the Output Enable (OE) function on pin 5 is not needed, it may be connected directly to the V_{DD} plane by a wide trace and multiple vias. This improves heat dissipation. A resistor between OE and V_{DD} is not necessary.

Termination for LVDS Output

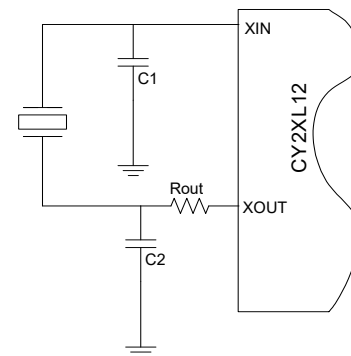
The CY2XL12 is designed with programmable output drive-strength. When it is configured with High-drive, it can drive two standard LVDS loads, each one with a 100 Ω termination resistor. Figure 5 on page 5 shows the standard termination scheme. When it is programmed for Normal-drive, it can drive only one standard LVDS load (100 Ω termination resistor) as

shown in Figure 6. The termination resistors should always be located very close to the receivers, and the trace branches should be located close to the CY2XL12 output. To minimize signal reflections from the receivers, the differential impedance (Z_0) of each trace pair should be 100 Ω to match the termination resistor.

Crystal Interface

CY2XL12 should have minimum 8 pF load capacitor parallel to the resonant crystal. The capacitors C1 and C2 as shown in Figure 3 are chosen to minimize the ppm error. These optimum values of C1 and C2 can be derived based on the parasitic trace capacitance (C_p), and capacitance of the CY2XL12 device pins (XIN and XOUT). Values of C1 and C2 are layout dependant and can be calculated as $C1 = C2 = 2 \times (CL - C_p)$. When the drive level of the crystal is low and the drive level of CY2XL12 is high, the application may need an additional resistor R_{out} . When R_{out} is added, C2 is also required to be readjusted for the precise frequency calculation.

Figure 3. Crystal Input Interface



Termination Circuits

Figure 4. Test Load

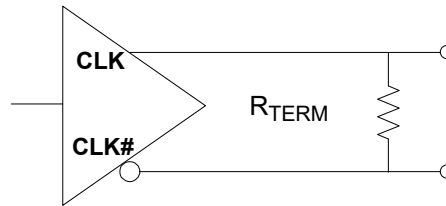


Figure 5. Application Load (High drive strength device)

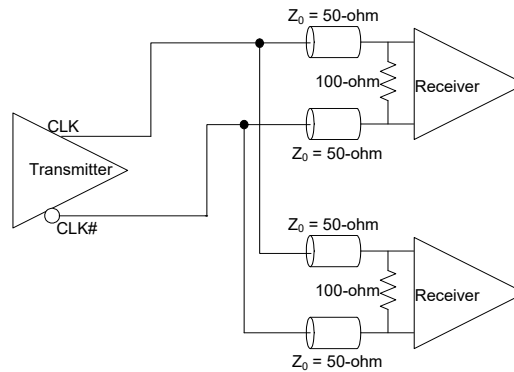
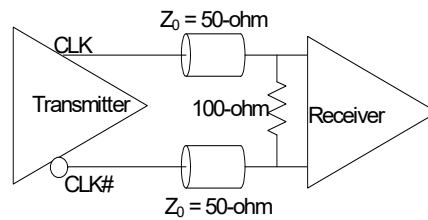
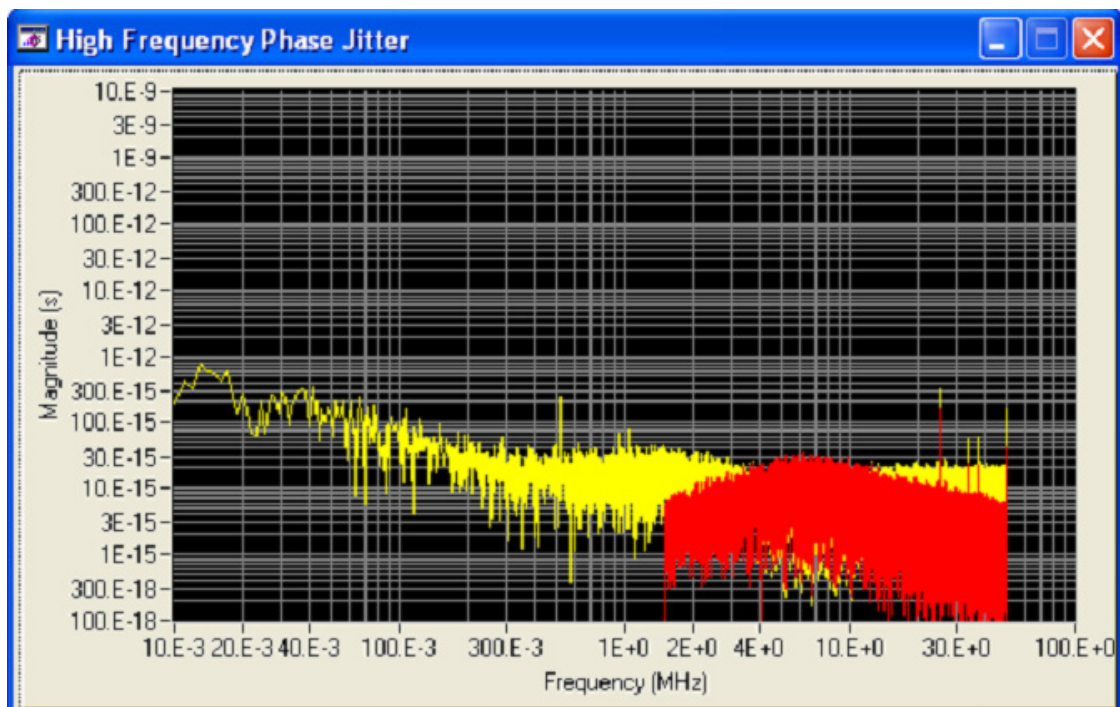
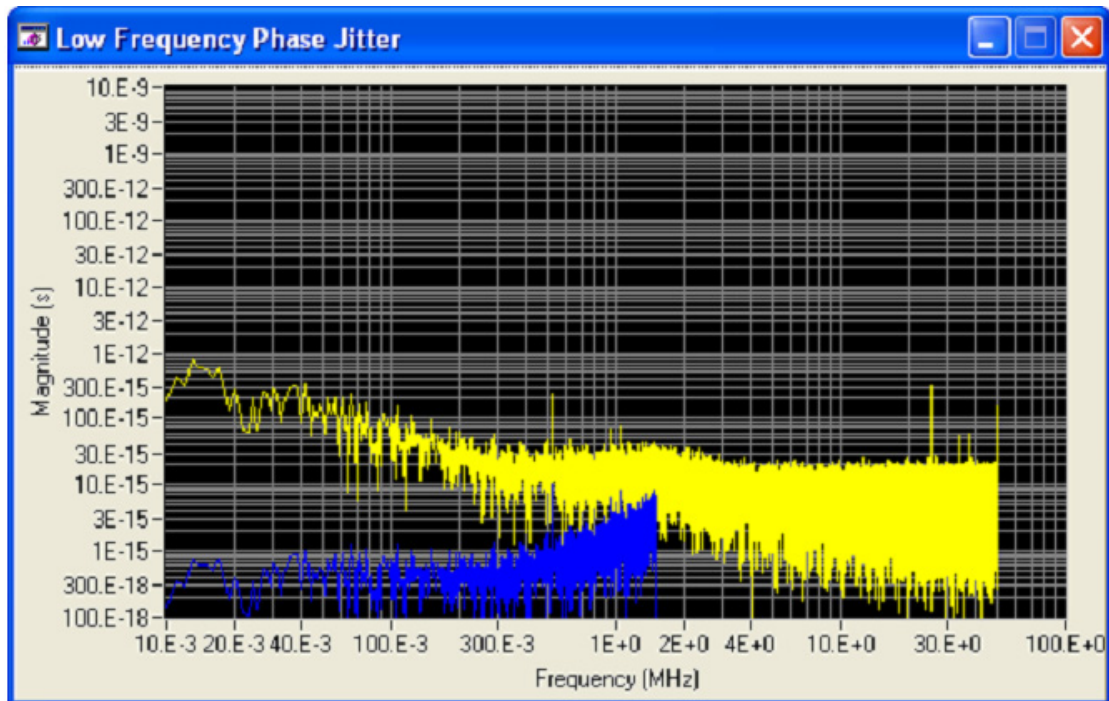


Figure 6. Application Load (Nominal drive strength device)



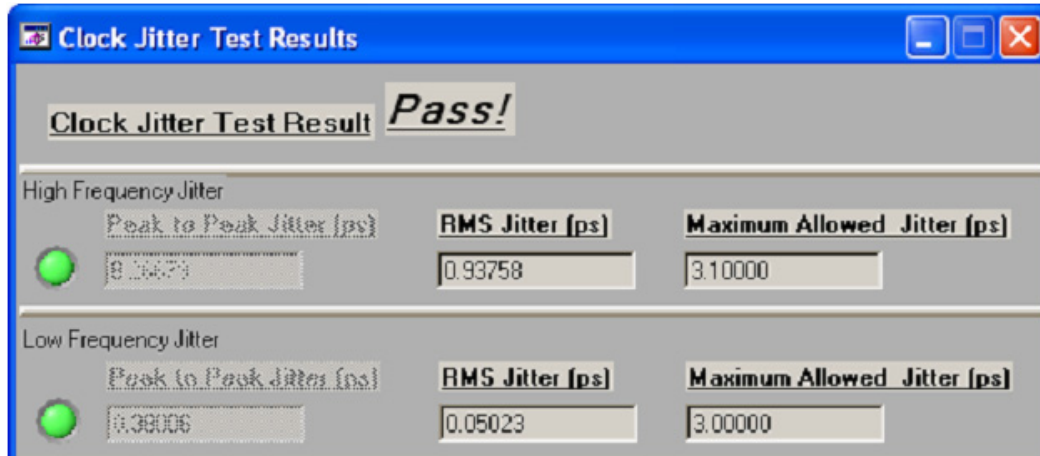
Phase Jitter

(PCIe 2.0 Check using Clock Jitter 1.3 Tool)



Phase Jitter (continued)

(PCIe 2.0 Check using Clock Jitter 1.3 Tool)



Absolute Maximum Conditions

| Parameter | Description | Condition | Min | Max | Unit |
|--------------------------------|---|-----------------------------|------|-----------------------|------|
| V _{DD} | Supply voltage | | −0.5 | 4.4 | V |
| V _{IN} ^[1] | Input voltage, DC | Relative to V _{SS} | −0.5 | V _{DD} + 0.5 | V |
| T _S | Temperature, Storage | Non operating | −65 | 150 | °C |
| T _J | Temperature, Junction | | − | 135 | °C |
| ESD _{HBM} | Electrostatic discharge (ESD) protection (human body model) | JEDEC STD 22-A114-B | 2000 | − | V |
| UL−94 | Flammability rating | At 1/8 in. | V−0 | | − |
| Θ _{JA} ^[2] | Thermal resistance, junction to ambient | 0 m/s airflow | 100 | | °C/W |
| | | 1 m/s airflow | 91 | | |
| | | 2.5 m/s airflow | 87 | | |

Operating Conditions

| Parameter | Description | Min | Max | Unit |
|-----------|--|-------|-------|------|
| V_{DD} | 3.3 V supply voltage | 3.135 | 3.465 | V |
| | 2.5 V supply voltage | 2.375 | 2.625 | V |
| T_A | Ambient temperature, industrial | −40 | 85 | °C |
| T_{PU} | Power-up time for all V_{DD} to reach minimum specified voltage (ensure power ramp is monotonic) | 0.05 | 500 | ms |

Notes

1. The voltage on any input or I/O pin cannot exceed the V_{DD} pins during power-up.
2. Simulated using Apache Sentinel TI software. The board is derived from the JEDEC multilayer standard. It measures 76 × 114 × 1.6 mm and has four layers of copper (2/1/1/2 oz.). The internal layers are 100% copper planes, while the top and bottom layers have 50% metallization. No vias are included in the model.

DC Electrical Characteristics

| Parameter | Description | Test Conditions | Min | Typ | Max | Unit |
|-----------------------|--|--|---------------------|-----|---------------------|---------------|
| $I_{DD}^{[3]}$ | Power supply current with output terminated | $V_{DD} = 3.465\text{ V}$, $OE = V_{DD}$, output terminated | – | – | 125 | mA |
| | | $V_{DD} = 2.625\text{ V}$, $OE = V_{DD}$, output terminated | – | – | 120 | mA |
| $V_{OD}^{[4]}$ | LVDS differential output voltage | $V_{DD} = 3.3\text{ V}$ or 2.5 V . $R_{TERM} = 50\ \Omega$ between CLK and CLK#, High Drive Strength $R_{TERM} = 100\ \Omega$ between CLK and CLK#, Normal Drive Strength | 247 | – | 454 | mV |
| $\Delta V_{OD}^{[4]}$ | Change in V_{OD} between complementary output states | $V_{DD} = 3.3\text{ V}$ or 2.5 V . $R_{TERM} = 50\ \Omega$ between CLK and CLK#, High Drive Strength $R_{TERM} = 100\ \Omega$ between CLK and CLK#, Normal Drive Strength | – | – | 50 | mV |
| $V_{OS}^{[5]}$ | LVDS offset output voltage | $V_{DD} = 3.3\text{ V}$ or 2.5 V . $R_{TERM} = 50\ \Omega$ between CLK and CLK#, High Drive Strength $R_{TERM} = 100\ \Omega$ between CLK and CLK#, Normal Drive Strength | 1.125 | – | 1.375 | V |
| ΔV_{OS} | Change in V_{OS} between complementary output states | $V_{DD} = 3.3\text{ V}$ or 2.5 V . $R_{TERM} = 50\ \Omega$ between CLK and CLK#, High Drive Strength $R_{TERM} = 100\ \Omega$ between CLK and CLK#, Normal Drive Strength | – | – | 50 | mV |
| I_{OZ} | Output leakage current | Three-state output, unterminated, measured on one pin while floating the other pin, $OE = V_{SS}$ | –35 | – | 35 | μA |
| I_{SB} | Standby supply current. | $PD\# = V_{SS}$ | | | 200 | μA |
| V_{IH} | Input high voltage, pin 5 | | $0.7 \times V_{DD}$ | – | $V_{DD} + 0.3$ | V |
| V_{IL} | Input low voltage, pin 5 | | –0.3 | – | $0.3 \times V_{DD}$ | V |
| I_{IH} | Input high current, pin 5 | Input = V_{DD} | – | – | 115 | μA |
| I_{IL} | Input low current, pin 5 | Input = V_{SS} | –50 | – | – | μA |
| C_{IN} | Input capacitance, pin 5 | | – | 15 | – | pF |
| C_{INX} | Pin capacitance, XIN & XOUT | | – | 4.5 | – | pF |

Notes

- I_{DD} includes ~8 mA of current that is dissipated externally in the output termination resistor.
- Refer to [Figure 7 on page 11](#).
- Refer to [Figure 8 on page 11](#) and [Figure 9 on page 11](#).

AC Electrical Characteristics

| Parameter ^[6, 7] | Description | Test Conditions | Min | Typ | Max | Unit |
|------------------------------|---------------------------|---|------------|-----|-----|------|
| $F_{OUT}^{[8]}$ | Output frequency | | See note 8 | | | MHz |
| $T_R, T_F^{[9]}$ | Output rise or fall time | 20% to 80% of full output swing | – | 0.5 | 1.0 | ns |
| $T_{Jitter(\phi)}^{[8, 10]}$ | RMS phase jitter (Random) | | See note 8 | | | ps |
| $T_{DC}^{[11]}$ | Duty cycle | Measured at zero crossing point | 45 | – | 55 | % |
| $T_{OHZ}^{[12]}$ | Output disable time | Time from falling edge on OE to stopped outputs (asynchronous) | – | – | 100 | ns |
| $T_{OE}^{[12]}$ | Output enable time | Time from rising edge on OE to outputs at a valid frequency (asynchronous) | – | – | 120 | ns |
| T_{LOCK} | Startup time | Time for CLK to reach valid frequency measured from the time $V_{DD} = V_{DD(min)}$ | – | – | 5 | ms |

Crystal Characteristics

For SMD Package

| Parameter | Description | Range 1 | Range 2 | Range 3 | Unit |
|-----------|--|---------|---------|---------|----------|
| F_{IN} | Crystal frequency | 8–14 | 14–28 | 28–48 | MHz |
| R1 | Maximum motional resistance (ESR) | 135 | 50 | 30 | Ω |
| CL | Parallel load capacitance (see Note 6 below) | 8–18 | 8–14 | 8–12 | pF |
| DL(max) | Maximum crystal drive level | 300 | 300 | 300 | μW |

Notes

6. Not 100% tested, guaranteed by design and characterization.
7. Outputs are terminated with 50 Ω between CLK and CLK#. Refer to [Figure 4 on page 5](#).
8. Crystal frequency, output frequency, and typical phase jitter are listed in [Frequency Table on page 3](#).
9. Refer to [Figure 9 on page 11](#).
10. Refer to [Figure 13 on page 12](#).
11. Refer to [Figure 10 on page 11](#).
12. Refer to [Figure 11 on page 11](#).

Switching Waveforms

Figure 7. Output Voltage Swing

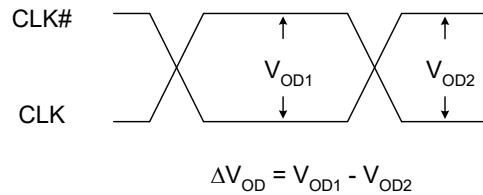


Figure 8. Output Offset Voltage (High Drive Strength)

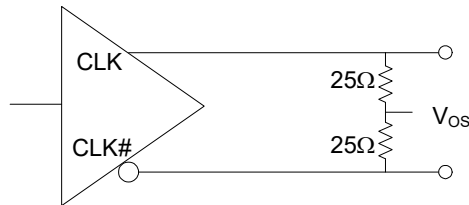


Figure 9. Output Rise or Fall Time (Normal Drive Strength)

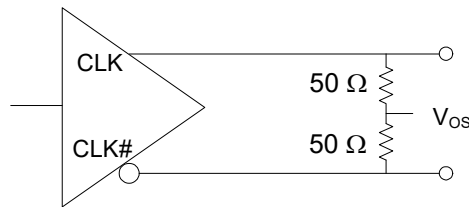


Figure 10. Duty Cycle Timing

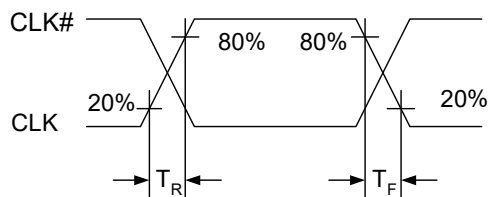
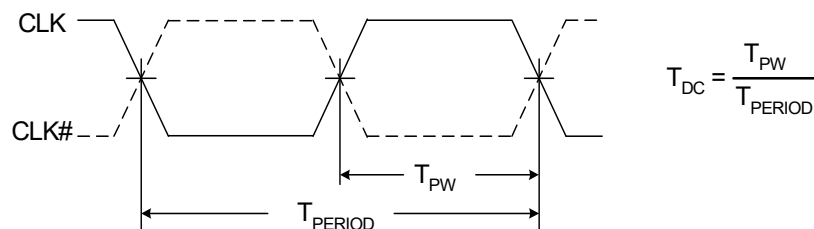


Figure 11. Output Enable and Disable Timing



Switching Waveforms (continued)

Figure 12. Output Enable and Disable Timing

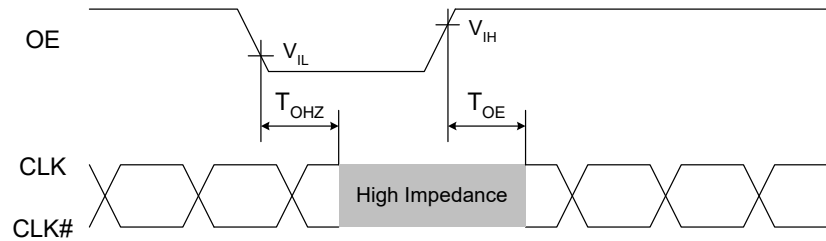


Figure 13. RMS Phase Jitter

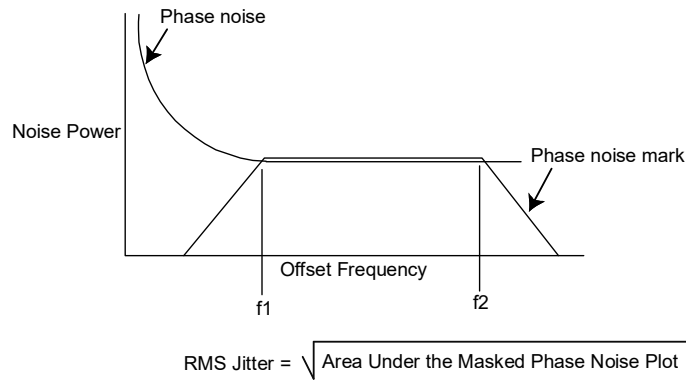
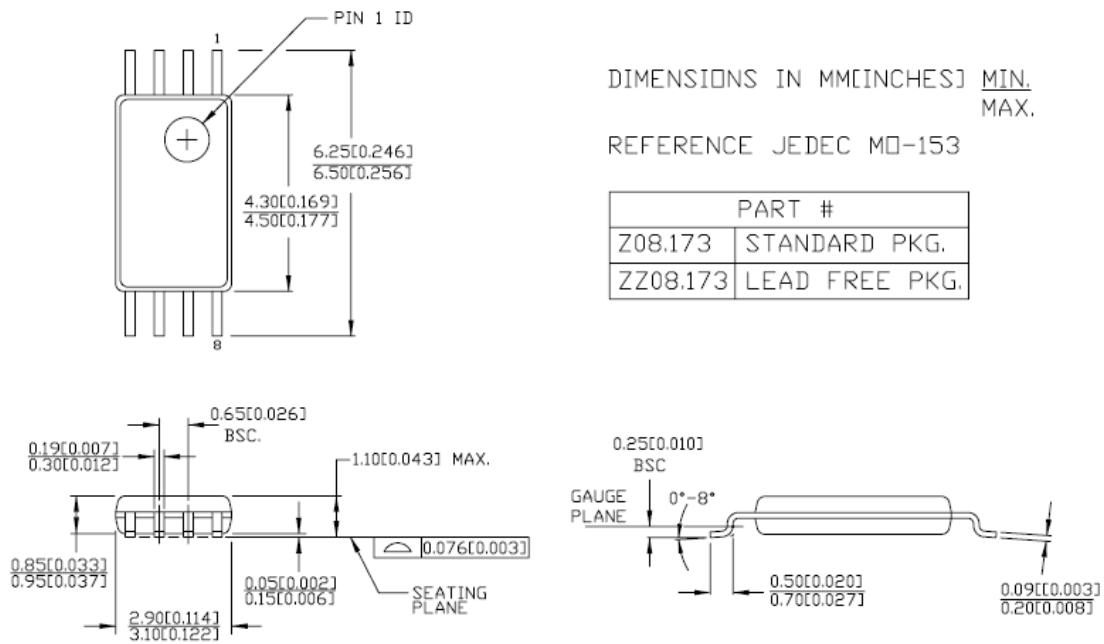


Diagram illustrating the part number structure for CY2XL12ZXP01-060:

- CY**: Company ID: CY = Cypress
- 2XL12**: Base Part Number
- Z**: Package Type: Z = 8-pin TSSOP
- X**: Pb-free
- I**: Temperature Range: I = Industrial
- XX**: Part Configuration Code: XX = 01 or 02 or 03 or 06
- X**: blank or T
blank = Tube; T = Tape and Reel

Package Drawing and Dimensions

Figure 14. 8-pin TSSOP (4.40 mm Body) Z08.173/ZZ08.173 Package Outline, 51-85093



51-85093 *E

Acronyms

| Acronym | Description |
|---------|--|
| CMOS | Complementary Metal Oxide Semiconductor |
| ESD | Electrostatic Discharge |
| ESR | Equivalent Series Resistance |
| HBM | Human Body Model |
| I/O | Input/Output |
| JEDEC | Joint Electron Devices Engineering Council |
| LVDS | Low-Voltage Differential Signal |
| OE | Output Enable |
| PLL | Phase-Locked Loop |
| RMS | Root Mean Square |
| TSSOP | Thin Shrunk Small Outline Package |
| VCO | Voltage Controlled Oscillator |
| XO | Crystal Oscillator |

Document Conventions

Units of Measure

| Symbol | Units of Measure |
|--------|-------------------|
| °C | degree Celsius |
| kHz | kilohertz |
| MHz | megahertz |
| μA | microampere |
| mA | milliampere |
| mm | millimeter |
| ms | millisecond |
| mV | millivolt |
| ns | nanosecond |
| Ω | ohm |
| ppm | parts per million |
| % | percent |
| pF | picofarad |
| ps | picosecond |
| V | volt |
| W | watt |

Document History Page

| Document Title: CY2XL12, Low RMS Phase Jitter Programmable LVDS Clock Generator Document Number: 001-63176 | | | | |
|---|---------|-----------------|-----------------|---|
| Rev. | ECN No. | Orig. of Change | Submission Date | Description of Change |
| ** | 2991849 | KVM | 07/28/2010 | New data sheet. |
| *A | 3117362 | BASH | 12/21/2010 | Updated Features : Added "LVDS PCIe 2.0 Low Jitter XO". Added Phase Jitter . Added Units of Measure . |
| *B | 3432906 | BASH | 11/09/2011 | Updated Features : Added 150 MHz frequency related information. Updated Frequency Table : Added 150 MHz frequency related information. Updated Ordering Information : Updated part numbers (Added new part numbers CY2XL12ZXI03 and CY2XL12ZXI03T). Updated Package Drawing and Dimensions : spec 51-85093 – Changed revision from *C to *D. Updated to new template. |
| *C | 4120381 | CINM | 09/11/2013 | Updated to new template. Completing Sunset Review. |
| *D | 4700492 | TAVA | 03/26/2015 | Updated Document Title to read as "CY2XL12, Low RMS Phase Jitter Programmable LVDS Clock Generator". Updated Logic Block Diagram . Updated Pinouts : Updated Figure 1 . Updated Package Drawing and Dimensions : spec 51-85093 – Changed revision from *D to *E. |
| *E | 5449404 | XHT | 09/26/2016 | Updated to new template. Completing Sunset Review. |
| *F | 6013629 | XHT | 01/04/2018 | Updated Ordering Information : Updated part numbers. Updated to new template. |

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