

# Crystal to LVPECL Clock Generator

## Features

- One LVPECL output pair
- Selectable frequency multiplication:  $\times 2.5$  or  $\times 5$
- External crystal frequency: 25.0 MHz
- Output frequency: 62.5 MHz or 125 MHz
- Low RMS phase jitter at 125 MHz, using 25 MHz crystal (1.875 MHz to 20 MHz): 0.4 ps (typical)
- Phase noise at 125 MHz (typical):

Offset	Noise Power
1 kHz	-117 dBc/Hz
10 kHz	-126 dBc/Hz
100 kHz	-131 dBc/Hz
1 MHz	-131 dBc/Hz

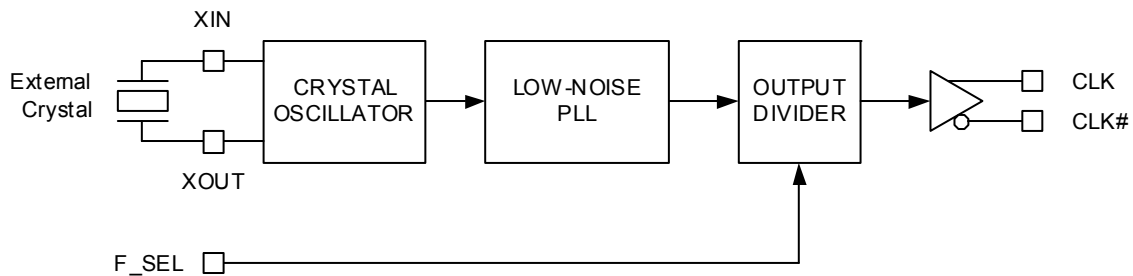
- Pb-free 8-pin TSSOP package
- Supply voltage: 3.3 V or 2.5 V
- Commercial and Industrial temperature range

## Functional Description

The CY2XP22 is a PLL (Phase Locked Loop) based high performance clock generator that uses an external reference crystal. It is specifically targeted at FibreChannel and Gigabit Ethernet applications. It produces a selectable output frequency that is 2.5 or 5 times the crystal frequency. With a 25 MHz crystal, the user can select either a 62.5 MHz or 125 MHz output. It uses Cypress's low noise VCO technology to achieve less than 1 ps typical RMS phase jitter. The CY2XP22 has a crystal oscillator interface input and one LVPECL output pair.

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

## Logic Block Diagram

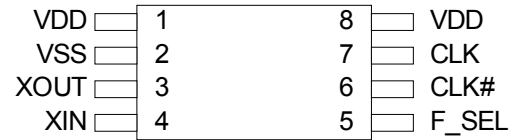


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## Pinouts

Figure 1. 8-pin TSSOP pinout



## Pin Definitions

8-pin TSSOP

Pin Number	Pin Name	I/O Type	Description
1, 8	VDD	Power	3.3 V or 2.5 V power supply
2	VSS	Power	Ground
3, 4	XOUT, XIN	XTAL output and input	Parallel resonant crystal interface
5	F_SEL	CMOS input	Frequency Select: see Frequency Table
6,7	CLK#, CLK	LVPECL output	Differential clock output

## Frequency Table

Inputs		PLL Multiplier Value	Output Frequency (MHz)
Crystal Frequency (MHz)	F_SEL		
25	0	5	125
	1	2.5	62.5

## Absolute Maximum Conditions

Parameter	Description	Conditions	Min	Max	Unit
V <sub>DD</sub>	Supply Voltage		-0.5	4.4	V
V <sub>IN</sub> <sup>[1]</sup>	Input Voltage, DC	Relative to V <sub>SS</sub>	-0.5	V <sub>DD</sub> + 0.5	V
T <sub>S</sub>	Temperature, Storage	Non operating	-65	150	°C
T <sub>J</sub>	Temperature, Junction		-	135	°C
ESD <sub>HBM</sub>	ESD Protection, Human Body Model	JEDEC STD 22-A114-B	2000	-	V
UL-94	Flammability Rating	At 1/8 in.	V-0		
Θ <sub>JA</sub> <sup>[2]</sup>	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 <sub>DD</sub>	3.3 V Supply Voltage	3.135	3.465	V
	2.5 V Supply Voltage	2.375	2.625	V
T <sub>A</sub>	Ambient Temperature, Commercial	0	70	°C
	Ambient Temperature, Industrial	-40	85	°C
T <sub>PU</sub>	Power up time for all V <sub>DD</sub> to reach minimum specified voltage (ensure power ramps is monotonic)	0.05	500	ms

### Notes

1. The voltage on any input or IO pin cannot exceed the power pin during power up.
2. Simulated using Apache Sentinel TI software. The board is derived from the JEDEC multilayer standard. It measures 76 x 114 x 1.6 mm and has 4-layers of copper (2/1/1/2 oz.). The internal layers are 100% copper planes, while the top and bottom layers have 50% metalization. No vias are included in the model.

**DC Electrical Characteristics**

Parameter	Description	Test Conditions	Min	Typ	Max	Unit
I <sub>DD</sub>	Operating Supply Current with output unterminated	V <sub>DD</sub> = 3.465 V, F <sub>OUT</sub> = 125 MHz, output unterminated	–	–	125	mA
		V <sub>DD</sub> = 2.625 V, F <sub>OUT</sub> = 125 MHz, output unterminated	–	–	120	mA
I <sub>DDT</sub>	Operating Supply Current with output terminated	V <sub>DD</sub> = 3.465 V, F <sub>OUT</sub> = 125 MHz, output terminated	–	–	150	mA
		V <sub>DD</sub> = 2.625 V, F <sub>OUT</sub> = 125 MHz, output terminated	–	–	145	mA
V <sub>OH</sub>	LVPECL Output High Voltage	V <sub>DD</sub> = 3.3 V or 2.5 V, R <sub>TERM</sub> = 50 Ω to V <sub>DD</sub> – 2.0 V	V <sub>DD</sub> – 1.15	–	V <sub>DD</sub> – 0.75	V
V <sub>OL</sub>	LVPECL Output Low Voltage	V <sub>DD</sub> = 3.3 V or 2.5 V, R <sub>TERM</sub> = 50 Ω to V <sub>DD</sub> – 2.0 V	V <sub>DD</sub> – 2.0	–	V <sub>DD</sub> – 1.625	V
V <sub>OD1</sub>	LVPECL Peak-to-Peak Output Voltage Swing	V <sub>DD</sub> = 3.3 V or 2.5 V, R <sub>TERM</sub> = 50 Ω to V <sub>DD</sub> – 2.0 V	600	–	1000	mV
V <sub>OD2</sub>	LVPECL Output Voltage Swing (V <sub>OH</sub> – V <sub>OL</sub> )	V <sub>DD</sub> = 2.5 V, R <sub>TERM</sub> = 50 Ω to V <sub>DD</sub> – 1.5 V	500	–	1000	mV
V <sub>OCM</sub>	LVPECL Output Common Mode Voltage (V <sub>OH</sub> + V <sub>OL</sub> )/2	V <sub>DD</sub> = 2.5 V, R <sub>TERM</sub> = 50 Ω to V <sub>DD</sub> – 1.5 V	1.2	–	–	V
V <sub>IH</sub>	Input High Voltage, F_SEL		0.7 × V <sub>DD</sub>	–	V <sub>DD</sub> + 0.3	V
V <sub>IL</sub>	Input Low Voltage, F_SEL		–0.3	–	0.3 × V <sub>DD</sub>	V
I <sub>IH</sub>	Input High Current, F_SEL	F_SEL = V <sub>DD</sub>	–	–	115	μA
I <sub>IL</sub>	Input Low Current, F_SEL	F_SEL = V <sub>SS</sub>	–50	–	–	μA
C <sub>IN</sub> <sup>[3]</sup>	Input Capacitance, F_SEL		–	15	–	pF
C <sub>INX</sub> <sup>[3]</sup>	Pin Capacitance, XIN & XOUT		–	4.5	–	pF

**Note**

3. Not 100% tested, guaranteed by design and characterization.

## AC Electrical Characteristics

Parameter <sup>[4]</sup>	Description	Conditions	Min	Typ	Max	Unit
F <sub>OUT</sub>	Output Frequency		62.5	–	125	MHz
T <sub>R</sub> , T <sub>F</sub>	Output Rise or Fall Time	20% to 80% of full output swing	–	0.5	1.0	ns
T <sub>Jitter(φ)</sub>	RMS Phase Jitter (Random)	125 MHz, (1.875–20 MHz)	–	0.4	–	ps
T <sub>DC</sub>	Output Duty Cycle	Measured at zero crossing point	48	50	52	%
T <sub>LOCK</sub>	Startup Time	Time for CLK to reach valid frequency measured from the time V <sub>DD</sub> = V <sub>DD(min.)</sub>	–	–	5	ms
T <sub>LFS</sub>	Re-lock Time	Time for CLK to reach valid frequency from F_SEL pin change	–	–	1	ms

## Recommended Crystal Specifications

Parameter <sup>[5]</sup>	Description	Min	Max	Unit
Mode	Mode of Oscillation	Fundamental		
F	Frequency	25	25	MHz
ESR	Equivalent Series Resistance	–	50	Ω
C <sub>0</sub>	Shunt Capacitance	–	7	pF

### Notes

4. Not 100% tested, guaranteed by design and characterization.
5. Characterized using an 18 pF parallel resonant crystal.

Parameter Measurements

Figure 2. 3.3 V Output Load AC Test Circuit

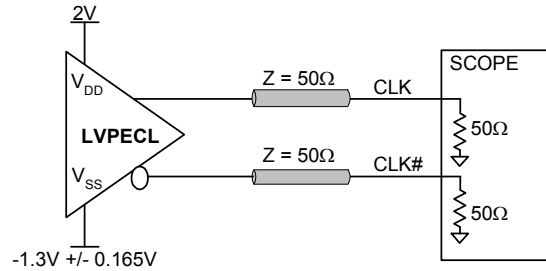


Figure 3. 2.5 V Output Load AC Test Circuit

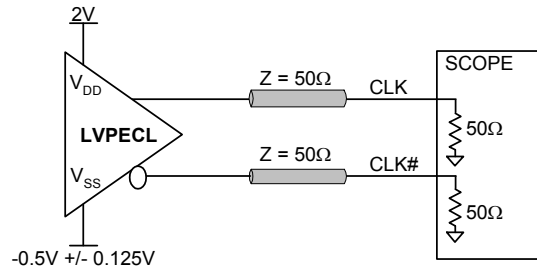


Figure 4. Output DC Parameters

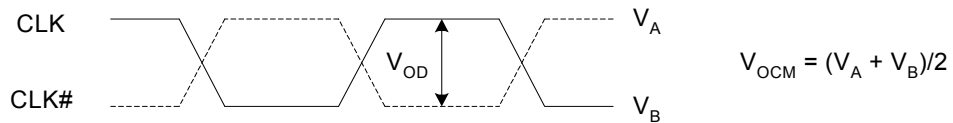
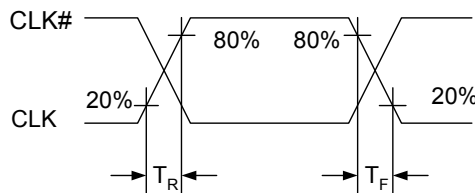


Figure 5. Output Rise and Fall Time



Parameter Measurements (continued)

Figure 6. RMS Phase Jitter

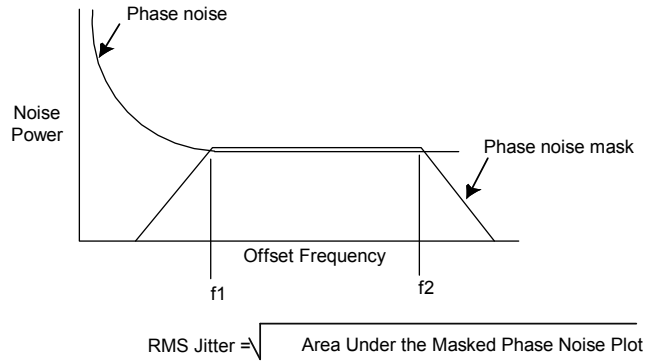
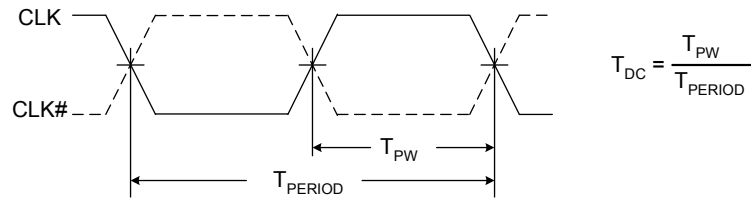


Figure 7. Output Duty Cycle



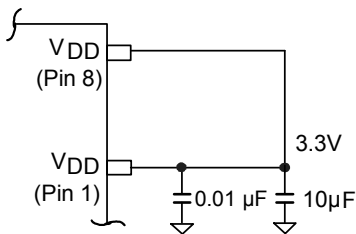


## Application Information

### 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 8 illustrates a typical filtering scheme. Since 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  $\mu\text{F}$  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  $\mu\text{F}$  ceramic or tantalum capacitor is located in the general vicinity of this device and may be shared with other devices.

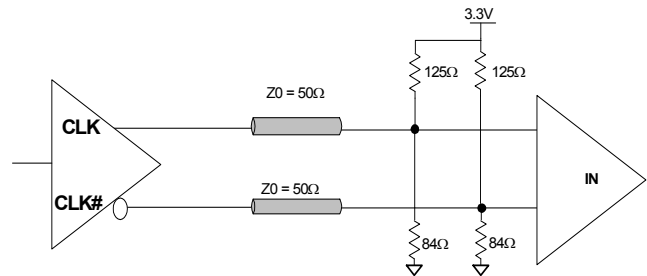
Figure 8. Power Supply Filtering



### Termination for LVPECL Output

The CY2XP22 implements its LVPECL driver with a current steering design. For proper operation, it requires a 50 ohm dc termination on each of the two output signals. For 3.3 V operation, this data sheet specifies output levels for termination to  $V_{\text{DD}} - 2.0 \text{ V}$ . This same termination voltage can also be used for  $V_{\text{DD}} = 2.5 \text{ V}$  operation, or it can be terminated to  $V_{\text{DD}} - 1.5 \text{ V}$ . Note that it is also possible to terminate with 50 ohms to ground ( $V_{\text{SS}}$ ), but the high and low signal levels differ from the data sheet values. Termination resistors are best located close to the destination device. To avoid reflections, trace characteristic impedance ( $Z_0$ ) should match the termination impedance. Figure 9 shows a standard termination scheme.

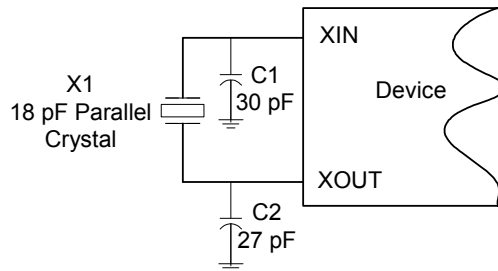
Figure 9. LVPECL Output Termination



### Crystal Interface

The CY2XP22 is characterized with 18 pF parallel resonant crystals. The capacitor values shown in Figure 10 are determined using a 25 MHz 18 pF parallel resonant crystal and are chosen to minimize the ppm error. Note that the optimal values for C1 and C2 depend on the parasitic trace capacitance and are thus layout dependent.

Figure 10. Crystal Input Interface

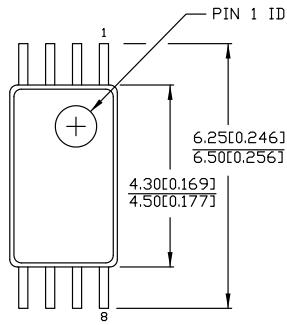




Package Drawing and Dimensions

Figure 11. 8-pin TSSOP (4.40 mm Body) Package Outline, 51-85093

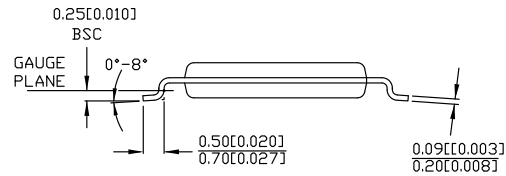
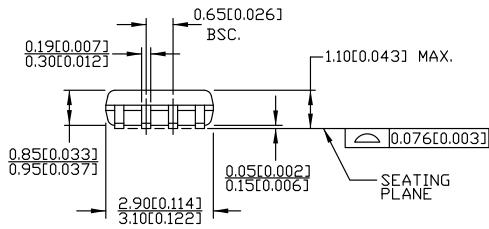
8 Lead TSSOP 4.40 MM BODY



DIMENSIONS IN MM [INCHES] MIN. MAX.

REFERENCE JEDEC MO-153

PART #	
Z08.173	STANDARD PKG.
ZZ08.173	LEAD FREE PKG.



51-85093 \*E

## Acronyms

Acronym	Description
CLKOUT	Clock Output
CMOS	Complementary Metal Oxide Semiconductor
DPM	Die Pick Map
EPROM	Erasable Programmable Read Only Memory
LVDS	Low-Voltage Differential Signaling
LVPECL	Low-Voltage Positive Emitter Coupled Logic
NTSC	National Television System Committee
OE	Output Enable
PAL	Phase Alternate Line
PD	Power-Down
PLL	Phase Locked Loop
TTL	Transistor-Transistor Logic

## Document Conventions

### Units of Measure

Symbol	Unit of Measure
°C	degree Celsius
kHz	kilohertz
kΩ	kilohm
MHz	megahertz
MΩ	megaohm
μA	microampere
μs	microsecond
μV	microvolt
μVrms	microvolts root-mean-square
mA	milliampere
mm	millimeter
ms	millisecond
mV	millivolt
nA	nanoampere
ns	nanosecond
nV	nanovolt
Ω	ohm
ppm	parts per million
V	volt

Document History Page

Document Title: CY2XP22, Crystal to LVPECL Clock Generator				
Document Number: 001-10229				
Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	506262	RGL	See ECN	New data sheet
*A	838060	RGL	See ECN	Changed status from Advance to Preliminary
*B	2700242	KVM / PYRS	04/30/2009	Reformatted Revised phase noise values Replaced VCC with VDD; VEE with VSS; updated pin names Removed pull-up resistor on F_SEL Corrected temperature range, added industrial temperature range Increased IDD from 120 / 100 mA to 150 / 140 mA Added CINX parameter, revised CIN parameter Revised LVPECL output specs Added thermal resistance information Changed VIL, VIH, IIL & IIH specs Revised suggested crystal load capacitor values
*C	2718898	WWZ	06/15/09	Minor ECN to post data sheet to external web
*D	2767298	KVM	09/22/09	Add I <sub>DD</sub> spec for unterminated outputs Change parameter name for I <sub>DD</sub> (terminated outputs) from I <sub>DD</sub> to I <sub>DDT</sub> Remove I <sub>DD</sub> footnote about externally dissipated current Add footnote reference to C <sub>IN</sub> and C <sub>INX</sub> :not 100% tested Add max limit for T <sub>R</sub> , T <sub>F</sub> : 1.0 ns Change T <sub>LOCK</sub> max from 10 ms to 5 ms Split out parameter T <sub>LFS</sub> from T <sub>LOCK</sub>
*E	2896121	KVM	03/19/2010	Updated Package Diagram (Figure 11)
*F	3219081	BASH	04/07/2011	Changed status from preliminary to final. Added ordering code definitions. Updated package diagram to *C. Added Acronyms, and Units of Measure. Template and style updates as per current Cypress standards.
*G	4336622	XHT	05/02/2014	spec 51-85093 – Changed revision from *C to *D. Updated in new template. Completing Sunset Review.
*H	4570097	XHT	11/14/2014	Added related documentation hyperlink in page 1. Removed the prune part numbers CY2XP22ZXC and CY2XP22ZXCT in <a href="#">Ordering Information</a> . Updated <a href="#">Figure 11 in Package Drawing and Dimensions</a> (spec 51-85093 *D to *E).

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