

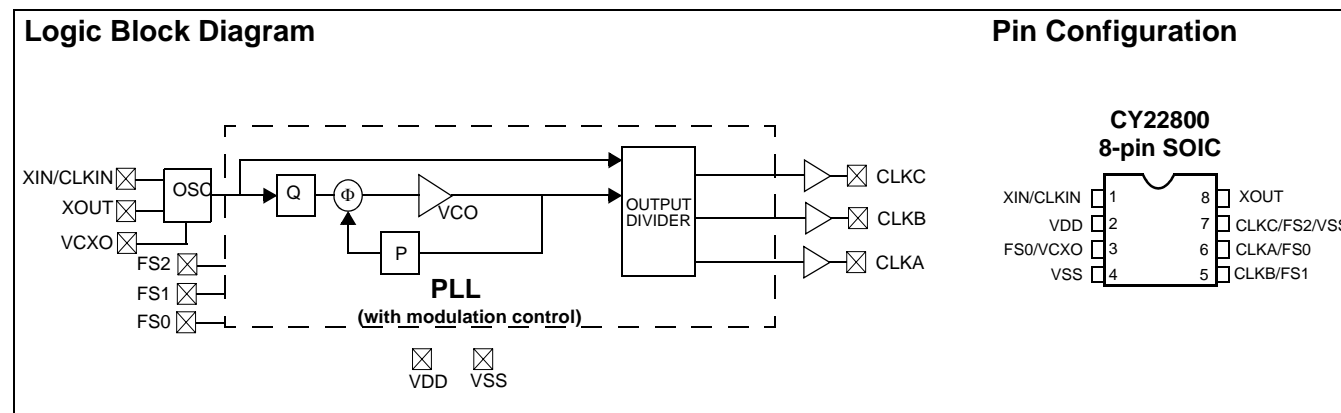
# Universal Programmable Clock Generator (UPCG)

## Features

- Spread Spectrum, VCXO, and Frequency Select
- Input frequency range:
  - Crystal: 8–30 MHz
  - CLKIN: 0.5–100 MHz
- Output frequency:
  - LVCMOS: 1–200 MHz
- Integrated phase-locked loop
- Low jitter, high accuracy outputs
- 3.3V operation
- 8-pin SOIC package

## Benefits

- Make inventory of only one device, CY22800, to use in various applications such as HDTV, STB, DVDR, etc.
- Multiple predefined configurations that can be programmed into a single chip
- Eliminates the need for expensive and difficult to use higher-order crystal
- High-performance PLL tailored for multiple applications
- Meets critical timing requirements in complex system designs
- Enables application compatibility
- Allows up to three different frequency selects



## Pin Description

Name	Pin Number	Description
XIN	1	Reference Input; Crystal or External Clock
VDD	2	3.3V Voltage Supply
FS0/VCXO	3	Frequency Select 0/VCXO Analog Control Voltage <sup>[1]</sup>
VSS	4	Ground
CLKB/FS1	5	Clock Output B/Frequency Select 1 <sup>[1]</sup>
CLKA/FS0	6	Clock Output A/Frequency Select 0 <sup>[1]</sup>
CLKC/FS2/VSS	7	Clock Output C/Frequency Select 2/VSS <sup>[1]</sup>
XOUT	8	Reference Output (No Connect when the reference is a clock)

### Note

1. Pin definition changes for different configurations. Refer to the specific one-page data sheet for more details.

## General Description

The CY22800 is a multi-function clock generator that supports various applications in consumer and communications markets. The device uses the Cypress proprietary PLL along with Spread Spectrum and VCXO technology to make it one of the most versatile clock synthesizer in the market place. The CY22800 is a field-programmable synthesizer that can be programmed using an easy-to-use programmer dongle, CY36800, with one of many predefined configuration files for fast sample generation of prototype builds. The CY22800 is a reprogrammable device that can be programmed up to five thousand times. The latest configurations available for this device are summarized in *Table 1*.

## Spread Spectrum Clock Generation (SSCG)

The CY22800 is capable of generating Spread Spectrum Clocks (SSCG) for the purpose of reducing EMI found in today's high-speed digital electronic systems.

The device uses proprietary Spread Spectrum Clock (SSC) technology to synthesize and modulate the frequency of the input clock. By modulating the frequency of the clock, the measured EMI at the fundamental and harmonic frequencies is greatly reduced. This reduction in radiated energy can significantly reduce the cost of complying with regulatory agency (EMC) requirements and improve time-to-market without degrading system performance.

The CY22800 uses a preprogrammed configuration of memory arrays to synthesize output frequency and offers eight different spread percentages (refer to *Table 1* – Code numbers -015 to -022), and an additional option to turn the spread on and off.

For the above-mentioned configurations, the modulation frequency varies with the reference frequency as follows:

$$f_{\text{mod}} = \frac{f_{\text{ref}}}{1000}$$

## VCXO

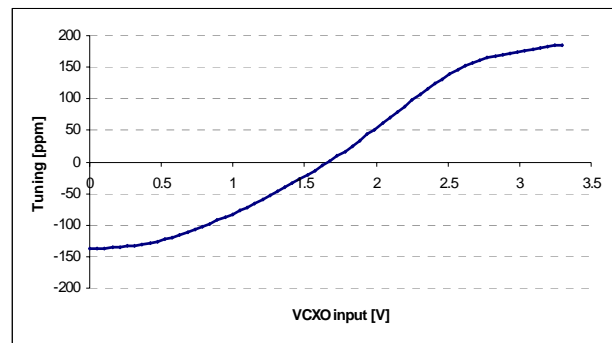
One of the key components of the CY22800 device is the VCXO. The VCXO is used to “pull” the reference crystal higher or lower in order to lock the system frequency to an external source. This is ideal for applications where the output frequency needs to track along with an external reference frequency that is constantly shifting.

A special pullable crystal must be used in order to have adequate VCXO pull range. Pullable Crystal specifications are included in this data sheet.

## VCXO Profile

*Figure 1* shows an example of what a VCXO profile looks like. The analog voltage input is on the X-axis and the PPM range is on the Y-axis. An increase in the VCXO input voltage results in a corresponding increase in the output frequency. This has the effect of moving the PPM from a negative to positive offset.

**Figure 1. VCXO Profile**



**Table 1. CY22800 Configurations**

Base part #	Code #	Code name	Input freq. (MHz)	Output freq. (MHz)	SS	VCXO
CY22800	001A	X2 multiplier	CLKIN: 0.5 - 100.0 XTAL: 8.0 - 30.0	CLKA: 1.0 - 200.0	N	N
CY22800	002A	X3 multiplier	CLKIN: 0.5 - 66.666 XTAL: 8.0 - 30.0	CLKA: 1.5 - 200.0	N	N
CY22800	003A	X4 multiplier	CLKIN: 0.5 - 50.0 XTAL: 8.0 - 30.0	CLKA: 2.0 - 200.0	N	N
CY22800	004A	X5 multiplier	CLKIN: 0.5 - 40.0 XTAL: 8.0 - 30.0	CLKA: 2.5 - 200.0	N	N
CY22800	005A	X6 multiplier	CLKIN: 0.5 - 33.333 XTAL: 8.0 - 30.0	CLKA: 3.0 - 200.0	N	N
CY22800	006A	X8 multiplier	CLKIN: 0.5 - 25 XTAL: 8.0 - 30.0	CLKA: 4.0 - 200.0	N	N
CY22800	007A	Clock multiplier for consumer & communication applications	14.318 [1]	CLKA: 33.33/66.66/50/75/80/100/133.33 See data sheet	N	N
CY22800	008A	Clock multiplier for consumer & communication applications	14.318 [1]	CLKA: 12/24/48/60/82.5/106.25/125 See data sheet	N	N
CY22800	009A	Clock multiplier for consumer & communication applications	20 [1]	CLKA: 33.33/66.66/50/75/80/100/133.33 See data sheet	N	N
CY22800	010A	Clock multiplier for consumer & communication applications	20 [1]	CLKA: 12/24/48/60/82.5/106.25/125 See data sheet	N	N
CY22800	011A	Clock multiplier for consumer & communication applications	25 [1]	CLKA: 33.33/66.66/50/75/80/100/133.33 See data sheet	N	N
CY22800	012A	Clock multiplier for consumer & communication applications	25 [1]	CLKA: 12/24/48/60/82.5/106.25/125 See data sheet	N	N
CY22800	013A	Clock multiplier for consumer & communication applications	27 [1]	CLKA: 33.33/66.66/50/75/80/100/133.33 See data sheet	N	N
CY22800	014A	Clock multiplier for consumer & communication applications	27 [1]	CLKA: 12/24/48/60/82.5/106.25/125 See data sheet	N	N
CY22800	015A	Spread spectrum for consumer and communication applications	CLKIN: 25.0 - 100.0 XTAL: 25.0 - 30.0	CLKA: 25.0 - 100.0 (+/-0.25%)	Y	N
CY22800	016A	Spread spectrum for consumer and communication applications	CLKIN: 25.0 - 100.0 XTAL: 25.0 - 30.1	CLKA: 25.0 - 100.0 (+/-0.5%)	Y	N
CY22800	017A	Spread spectrum for consumer and communication applications	CLKIN: 25.0 - 100.0 XTAL: 25.0 - 30.0	CLKA: 25.0 - 100.0 (+/-0.75%)	Y	N
CY22800	018A	Spread spectrum for consumer and communication applications	CLKIN: 25.0 - 100.0 XTAL: 25.0 - 30.3	CLKA: 25.0 - 100.0 (+/-1.0%)	Y	N
CY22800	019A	Spread spectrum for consumer and communication applications	CLKIN: 25.0 - 100.0 XTAL: 25.0 - 30.0	CLKA: 25.0 - 100.0 (+/-1.25%)	Y	N
CY22800	020A	Spread spectrum for consumer and communication applications	CLKIN: 25.0 - 100.0 XTAL: 25.0 - 30.0	CLKA: 25.0 - 100.0 (+/-1.5%)	Y	N
CY22800	021A	Spread spectrum for consumer and communication applications	CLKIN: 25.0 - 100.0 XTAL: 25.0 - 30.1	CLKA: 25.0 - 100.0 (+/-1.75%)	Y	N
CY22800	022A	Spread spectrum for consumer and communication applications	CLKIN: 25.0 - 100.0 XTAL: 25.0 - 30.0	CLKA: 25.0 - 100.0 (+/-2.0%)	Y	N
CY22800	023A	MPEG-2 clock generator for DTV and STB w/ VCXO	XTAL: 13.5	CLKA: 27 CLKB: 54, CLKC: 27	N	Y
CY22800	024A	MPEG-2 clock generator for DTV and STB w/ VCXO	XTAL: 13.5	CLKA: 13.5 CLKB: 54, CLKC: 27	N	Y
CY22800	025A	MPEG-2 clock generator for DTV and STB w/ VCXO	XTAL: 13.5/27.0 (Selectable)	CLKB: 27/27	N	Y
CY22800	026A	MPEG-2 clock generator for DTV and STB w/ VCXO	XTAL: 13.5/27.0 (Selectable)	CLKB: 27/27 CLKC: 27/27	N	Y
CY22800	027A	MPEG-2 clock generator for DTV and STB w/ VCXO	XTAL: 27	CLKB: 27/27 CLKC: 27/27.027 (-1 ppm)	N	Y
CY22800	028A	MPEG-2 clock generator for DTV and STB w/ VCXO	XTAL: 27	CLKB: 27/27 CLKC: 27/27.027 (0 ppm)	N	Y
CY22800	029A	HDTV, STB clock generator (USB/Ethernet/Link clock)	XTAL/CLKIN: 27	CLKA: 24.576/25/20/48 CLKB: REFOUT	N	N
CY22800	030A	HDTV, STB clock generator (Ethernet/PCI/Microprocessor clock)	XTAL/CLKIN: 27	CLKA: 25/20 CLKB: REFOUT, CLKC 33.33/66.66	N	N
CY22800	031A	HDTV, STB clock generator (PCI/Microprocessor clock)	XTAL/CLKIN: 48	CLKA: 33.33/66.66/100/133.33 CLKB: REFOUT	N	N
CY22800	032A	HDTV, STB clock generator (pixel clocks)	XTAL/CLKIN: 27	CLKA: 74.25/74.175824/148.5/148.351648 CLKB: REFOUT	N	N
CY22800	033A	Audio clock generator for HDTV & STB (256fs)	XTAL/CLKIN: 27	CLKA: (32K/44.1K/48K) X 256 CLKB: REFOUT	N	N
CY22800	034A	Audio clock generator for HDTV & STB (384fs)	XTAL/CLKIN: 27	CLKA: (32K/44.1K/48K) X 384 CLKB: REFOUT	N	N
CY22800	035A	Audio clock generator for HDTV & STB (512fs)	XTAL/CLKIN: 27	CLKA: (32K/44.1K/48K) X 512 CLKB: REFOUT	N	N
CY22800	036A	Audio clock generator for HDTV & STB (768fs)	XTAL/CLKIN: 27	CLKA: (32K/44.1K/48K) X 768 CLKB: REFOUT	N	N

Note [1]: Fixed CLKIN/Xtal frequency. Refer to the 1 page datasheet corresponding to the Code # for detailed input and output ranges.

Cypress offers a wide range of programmable clock synthesizers that can be used to generate any other frequencies not covered by the CY22800. Table 2 summarizes all Cypress programmable devices including CY22800.

**Table 2. Cypress Programmable Clocks<sup>[2]</sup>**

Part #	No. of PLL	Input Freq.	Output Freq.	Package	No. of Outputs	Spread Spectrum	VCXO	I <sup>2</sup> C
CY22800	1	0.5–100	1–200	8-SOIC	up to 3	Yes	Yes	No
CY22050	1	1–133	0.08–200	16-TSSOP	up to 6	No	No	No
CY22150	1	1–133	0.08–200	16-TSSOP	up to 6	No	No	Yes
CY25100	1	8–166	3–200	8-SOIC/TSSOP	up to 2	Yes	No	No
CY25200	1	3–166	3–200	16-TSSOP	up to 6	Yes	No	No
CY241V08	1	27/13.5	27/13.5	8-SOIC	up to 2	No	Yes	No
CY22392	3	1–166	1–200	16-TSSOP	up to 6	No	No	No
CY22381	3	1–166	1–200	8-SOIC	up to 3	No	No	No
CY22393	3	1–166	1–200	16-TSSOP	up to 6	No	No	Yes
CY22394/5	3	1–166	1–200	16-TSSOP	up to 5	No	No	No
CY22388/89/91	4	1–100	4.2–166	16/20-TSSOP, 32-QFN	up to 8	No	Yes	No

**Note**

2. The CY3672 programmer can be used to program all Cypress chips. Refer to the CY3672 data sheet for programming procedures.

### Absolute Maximum Conditions

Parameter	Description	Min.	Max.	Unit
V <sub>DD</sub>	Supply Voltage	-0.5	4.6	V
T <sub>S</sub>	Storage Temperature	-65	125	°C
T <sub>J</sub>	Junction Temperature	-	125	°C
	Digital Inputs	V <sub>SS</sub> - 0.3	V <sub>DD</sub> + 0.3	V
	Digital Outputs referred to V <sub>DD</sub>	V <sub>SS</sub> - 0.3	V <sub>DD</sub> + 0.3	V
	Electro-Static Discharge	2	-	kV

### Recommended Operating Conditions

Parameter	Description	Min.	Typ.	Max.	Unit
V <sub>DD</sub>	Operating Voltage	3.14	3.3	3.47	V
T <sub>A</sub>	Ambient Temperature	0	-	70	°C
C <sub>LOAD</sub>	Max. Load Capacitance on the CLK output	-	-	15	pF
f <sub>REF</sub> <sup>[3]</sup>	Reference Frequency	0.5	-	100	MHz
t <sub>PU</sub>	Power-up time for all VDDs to reach minimum specified voltage (power ramps must be monotonic)	0.05	-	500	ms

### Pullable Crystal Specifications for VCXO Application ONLY

Parameter	Name	Min.	Typ.	Max.	Unit
C <sub>LNOM</sub>	Crystal Load Capacitance	-	14	-	pF
R <sub>1</sub>	Equivalent Series Resistance	-	-	25	Ω
R <sub>3</sub> /R <sub>1</sub>	Ratio of Third Overtone Mode ESR to Fundamental Mode ESR. Ratio used because typical R <sub>1</sub> values are much less than the maximum spec	3	-	-	-
DL	Crystal Drive Level. No external series resistor assumed	-	0.5	2	mW
F <sub>3SEPHI</sub>	Third overtone separation from 3*F <sub>NOM</sub> (High Side)	300	-	-	ppm
F <sub>3SEPLO</sub>	Third overtone separation from 3*F <sub>NOM</sub> (Low Side)	-	-	-150	ppm
C <sub>0</sub>	Crystal shunt capacitance			7	pF
C <sub>0</sub> /C <sub>1</sub>	Ratio of Shunt to motional capacitance	180	-	250	
C <sub>1</sub>	Crystal motional capacitance	14.4	18	21.6	pF

### Recommended Crystal Specifications for ALL other Applications

Parameter	Name	Description	Min.	Typ.	Max.	Unit
F <sub>NOM</sub>	Nominal Crystal Frequency	Parallel resonance, fundamental mode, and AT cut	8	-	30	MHz
C <sub>LNOM</sub>	Nominal Load Capacitance		-	12	-	pF
R <sub>1</sub>	Equivalent Series Resistance (ESR)	Fundamental mode	-	35	50	Ω
DL	Crystal Drive Level	No external series resistor assumed	-	0.5	2	mW

**Note**

3. Configuration dependent, see the one-page document.

## DC Electrical Specifications

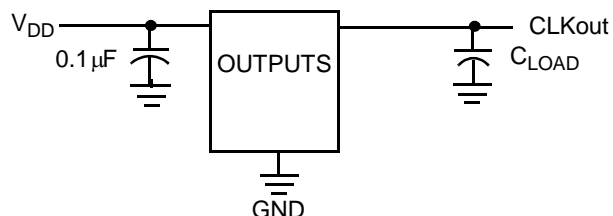
Parameter	Name	Description	Min.	Typ.	Max.	Unit
$I_{OH}$	Output High Current	$V_{OH} = V_{DD} - 0.5$ , $V_{DD} = 3.3V$ (source)	12	24	–	mA
$I_{OL}$	Output Low Current	$V_{OL} = 0.5$ , $V_{DD} = 3.3V$ (sink)	12	24	–	mA
$C_{IN1}$	Input Capacitance	All input pins except XIN and XOUT	–	–	7	pF
$C_{IN2}$	Input Capacitance	XIN and XOUT pins	–	24	–	pF
$I_{IH}$	Input High Current	$V_{IH} = V_{DD}$	–	5	10	$\mu A$
$I_{IL}$	Input Low Current	$V_{IL} = 0V$	–	–	50	$\mu A$
$f_{\Delta XO}$	VCXO Pullability Range		$\pm 150$	–		ppm
$V_{VCXO}$	VCXO Input Range		0	–	$V_{DD}$	V
$V_{IH}$	Input High Voltage	CMOS levels, 70% of $V_{DD}$	0.7	–	–	$V_{DD}$
$V_{IL}$	Input Low Voltage	CMOS levels, 30% of $V_{DD}$	–	–	0.3	$V_{DD}$

## AC Electrical Characteristics ( $V_{DD} = 3.3V$ )

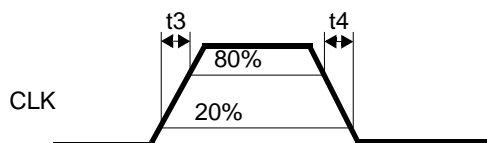
Parameter	Name	Description	Min.	Typ.	Max.	Unit
DC	Output Duty Cycle	Duty Cycle is defined in <i>Figure 3</i> , 50% of $V_{DD}$	45	50	55	%
$t_3$	Rising Edge Slew Rate	Output Clock Rise Time, 20% - 80% of $V_{DD}$	0.8	1.4	–	V/ns
$t_4$	Falling Edge Slew Rate	Output Clock Fall Time, 80% - 20% of $V_{DD}$	0.8	1.4	–	V/ns
$t_{10}$	PLL Lock Time		–	–	3	ms

## Test Circuit

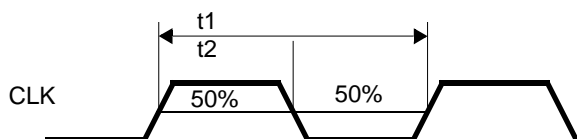
**Figure 2. Test Circuit Diagram**



**Figure 4. Rise and Fall Time Definitions**



**Figure 3. Duty Cycle Definition; DC =  $t_2/t_1$**

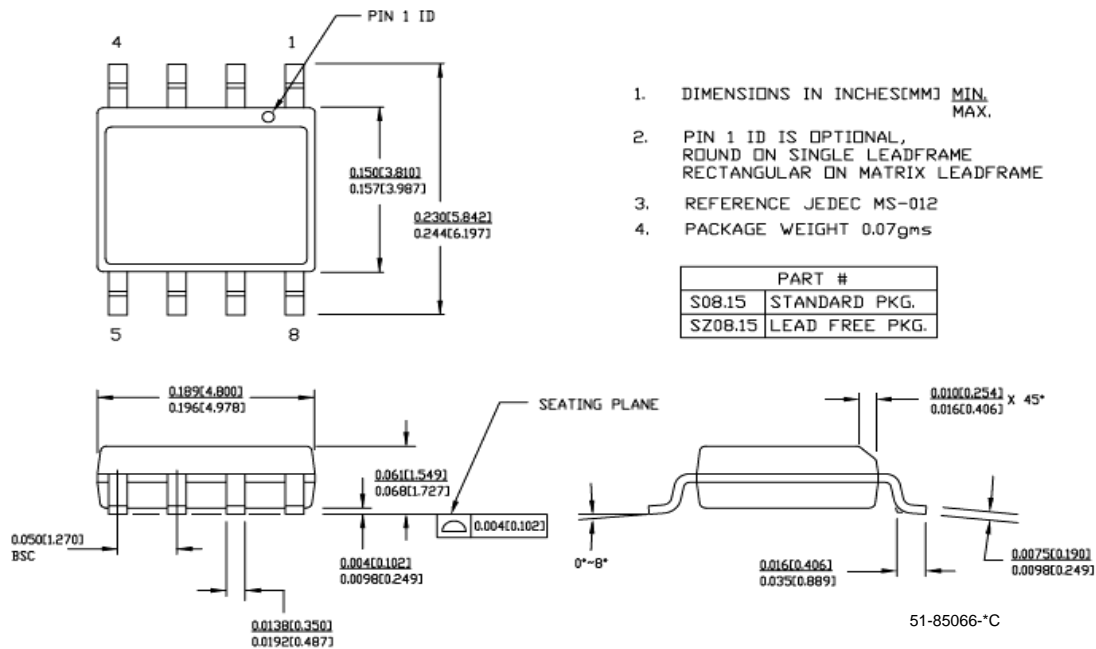


## Ordering Information

Ordering Code	Package Type	Operating Range	Operating Voltage
CY22800FXC	8-Pin SOIC	Commercial	3.3V

## Package Diagram

**Figure 5. 8-Lead (150-Mil) SOIC S8**



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**Document History Page**

Document Title: CY22800 Universal Programmable Clock Generator  
(UPCG)  
Document Number: 001-07704

REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	478688	See ECN	KKVTMP	New data sheet