

October 2002

### 1.0 Features

- One-chip tunable voltage controlled crystal oscillator (VCXO) allows precise system frequency tuning
- 3.3V operation
- 8 pin SOIC and MSOP packages
- Uses inexpensive 20pF pullable crystals with no external capacitors required.
- 12mA drive capability at TTL levels

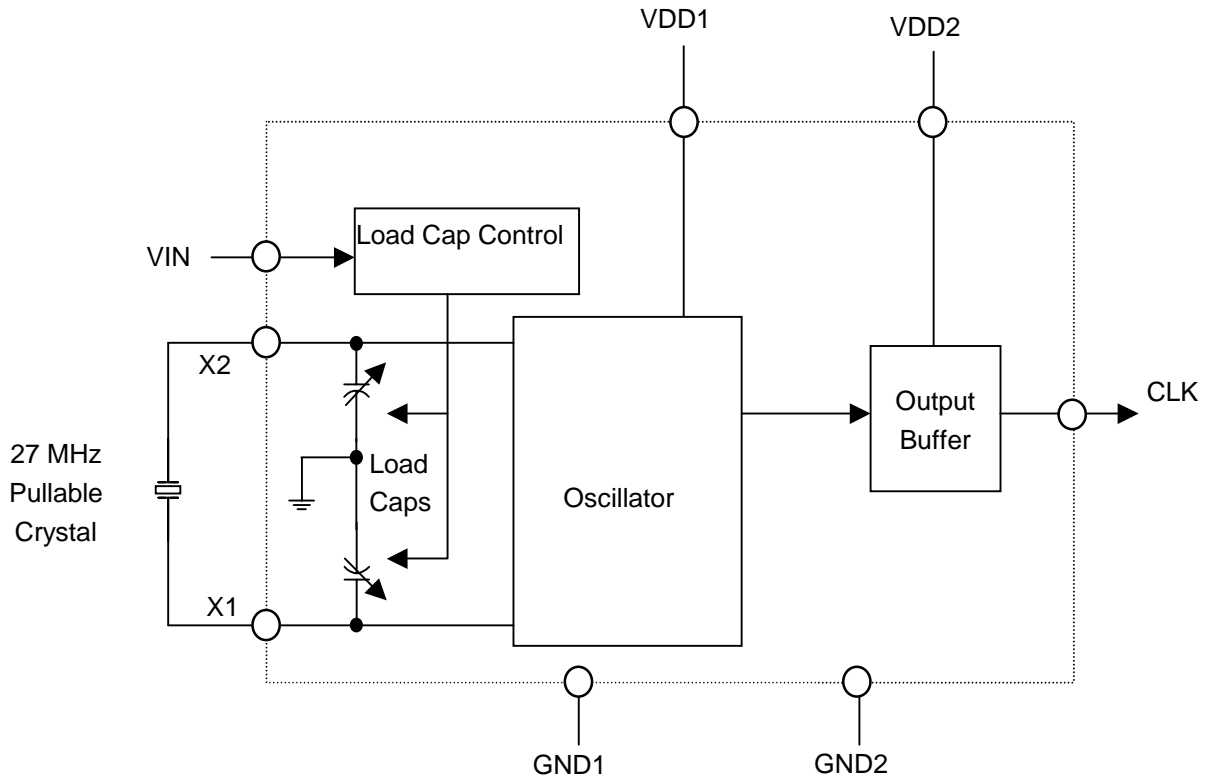
### 2.0 Applications

- Set-top boxes
- MPEG Video clock source
- Oscillator replacement

### 3.0 Description

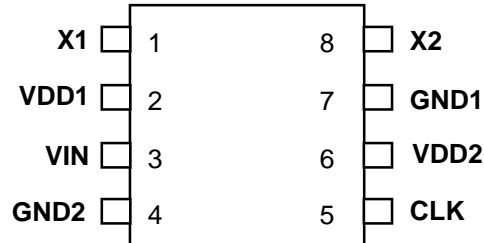
The T73227 is a single-chip, low-jitter Voltage-Controlled-Crystal-Oscillator. The device accepts a 27 MHz, 20 pF crystal, and produces a low jitter output at the same frequency. A 0 to 3.0V control signal is used to fine tune the output clock frequency in the  $\pm 100$ ppm range. This finds use in systems that have frequency matching requirements, such as digital satellite receivers.

Figure 1: Block Diagram



October 2002

8-pin SOIC/MSOP



**Table 1: Pin Descriptions**

PIN	TYPE	NAME	DESCRIPTION
1	Xi	X1	Crystal Connection. Connect to a 27 MHz Pullable Crystal
2	P	VDD1	Core $V_{DD}$ . Connect to 3.3V
3	I	VIN	Voltage input to VCXO. Zero to 3.3V Signal Controls the Frequency of the VCXO.
4	P	GND2	Connect to Ground.
5	O	CLK	Clock Output
6	P	VDD2	Pad Driver $V_{DD}$ . Connect to 3.3V
7	P	GND1	Connect to Ground.
8	Xi	X2	Crystal Connection. Connect to a 27 MHz pullable crystal.

Legend: I = Input

O = Output

P = Power supply connection

Xi = Crystal connections.

October 2002

### 4.0 Functional Block Description

The VCXO provides a tunable, low-jitter frequency reference. Loading capacitance for the crystal is internal to the T73227. No external components (other than the crystal resonator itself) are required for operation of the VCXO.

Tuning of the VCXO frequency is accomplished by varying the voltage on Vin (Pin 3).

The oscillator operates the crystal resonator in the parallel-resonant mode. Crystal warping, or the “pulling” of the crystal oscillation frequency, is accomplished by altering the effective load capacitance presented to the crystal by the oscillator circuit. The actual amount that changing the load capacitance alters the oscillator frequency will be dependent on the characteristics of the crystal as well as the oscillator circuit itself.

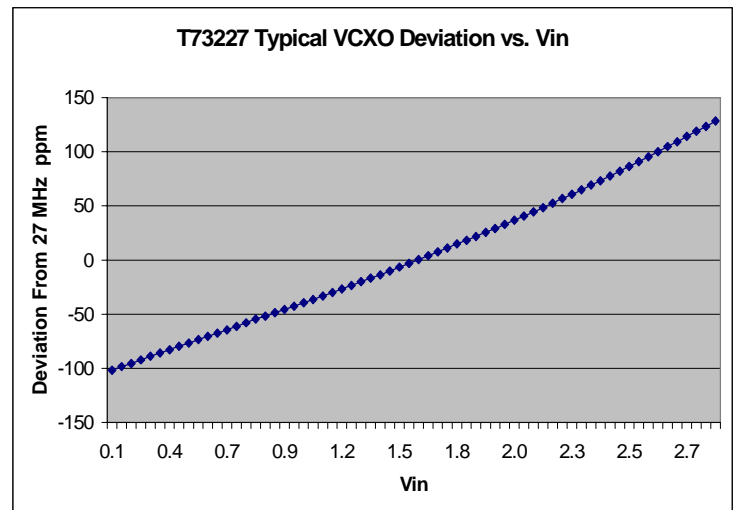
Specifically, the motional capacitance of the crystal (usually referred to by crystal manufacturers as  $C_1$ ), the static capacitance of the crystal ( $C_0$ ), and the load capacitance ( $C_L$ ) of the oscillator determine the “warping” or “pulling” capability of the crystal in the oscillator circuit. A simple formula to obtain the warping capability of a crystal oscillator is:

$$\Delta f (ppm) = \frac{C_1 \times (C_{L2} - C_{L1}) \times 10^6}{2 \times (C_0 + C_{L2}) \times (C_0 + C_{L1})}$$

where  $C_{L1}$  and  $C_{L2}$  are the two extremes of the applied load capacitance.

EXAMPLE: A crystal with the following parameters is used. With  $C_1 = 0.025\text{pF}$ ,  $C_0 = 6\text{pF}$ ,  $C_{L1} = 10\text{pF}$ , and  $C_{L2} = 20\text{pF}$ , the tuning range is

$$\Delta f = \frac{0.025 \times (20 - 10) \times 10^6}{2 \times (6 + 20) \times (6 + 10)} = 300 \text{ ppm}.$$



### 5.0 Electrical Specifications

**Table 2: Absolute Maximum Ratings**

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. These conditions represent a stress rating only, and functional operation of the device at these or any other conditions above the operational limits noted in this specification is not implied. Exposure to maximum rating conditions for extended conditions may affect device performance, functionality, and reliability.

PARAMETER	SYMBOL	MIN.	MAX.	UNITS
Supply Voltage ( $V_{SS} = \text{ground}$ )	$V_{DD}$	$V_{SS}-0.5$	5	V
Input Voltage, dc	$V_I$	$V_{SS}-0.5$	$V_{DD}+0.5$	V
Output Voltage, dc	$V_O$	$V_{SS}-0.5$	$V_{DD}+0.5$	V
Input Clamp Current, dc ( $V_I < 0$ or $V_I > V_{DD}$ )	$I_{IK}$	-25	25	mA
Output Clamp Current, dc ( $V_I < 0$ or $V_I > V_{DD}$ )	$I_{OK}$	-50	50	mA
Storage Temperature Range (non-condensing)	$T_S$	-65	150	°C
Ambient Temperature Range, Under Bias	$T_A$	-55	125	°C
Junction Temperature	$T_J$		125	°C
Lead Temperature (soldering, 10s)			260	°C
Input Static Discharge Voltage Protection			2	KV

October 2002

**Table 3: Operating Conditions**

PARAMETER	SYMBOL	CONDITIONS/DESCRIPTION	MIN.	TYP.	MAX.	UNITS
Core Supply Voltage ( $V_{DD}$ )	$V_{DD}$		3.15	3.3	3.45	V
VCXO Control Voltage, $V_{IN}$	$V_{IN}$		0		$V_{DD}$	V
Ambient Operating Temperature Range	$T_A$		0		70	°C
Crystal Resonator Frequency	$f_{XTAL}$	Fundamental Mode	20	27	30	MHz
Crystal Load Capacitance	$C_{L(xtal)}$	AT cut		20		pF

**Table 4: DC Electrical Specifications**

Unless otherwise stated,  $V_{DD} = 3.15V$  to  $3.45V$ , no load on any output, and ambient temperature range  $T_A = 0^\circ C$  to  $70^\circ C$ .

PARAMETER	SYMBOL	CONDITIONS/DESCRIPTION	MIN.	TYP.	MAX.	UNITS
<b>Overall</b>						
Supply Current, Dynamic, with no load	$I_{DD}$	$f_{XTAL} = 27MHz$		25		mA
Output High Voltage	$V_{OH}$	$I_{OH} = -12mA$	2.4			V
Output Low Voltage	$V_{OL}$	$I_{OL} = 12mA$			0.4	V
<b>Voltage Controlled Crystal Oscillator - <math>V_{DD}=3.3V</math></b>						
Crystal Loading Capacitance	$C_{L(xtal)}$	As seen by a crystal connected to XIN and XOUT (@ $V_{XTUNE} = 1.65V$ )		20		pF
Crystal Gamma	$C_0/C_1$				240	
VCXO Tuning Range		$f_{XTAL} = 27MHz$ ; $C_{L(xtal)} = 20pF$ ; $\gamma = 240$		250		ppm
VCXO Tuning Characteristic		Note: positive $\Delta F$ for positive $\Delta V$		75		ppm/V
Crystal ESR					50	$\Omega$

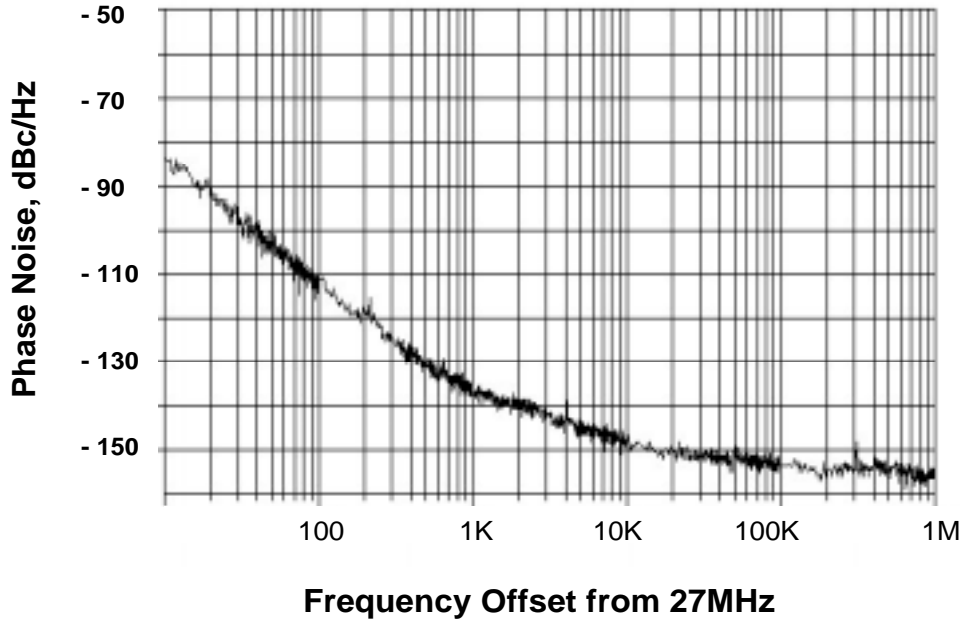
**Table 5: AC Timing Specifications**

Unless otherwise stated,  $V_{DD} = 3.15V$  to  $3.45V$ , no load on any output, and ambient temperature range  $T_A = 0^\circ C$  to  $70^\circ C$ . Parameters denoted with an asterisk ( \* ) represent nominal characterization data and are not production tested to any specific limits.

PARAMETER	SYMBOL	CONDITIONS/DESCRIPTION	MIN.	TYP.	MAX.	UNITS
<b>Clock Output (CLK)</b>						
Duty Cycle *		Ratio of high pulse width (as measured from rising edge to next falling edge at $V_{DD}/2$ ) to one clock period	40		60	%
Jitter, Period (peak-peak) *	$t_{j(\Delta P)}$	From rising edge to next rising edge at $V_{DD}/2$ , $C_L = 10pF$			150	ps
Rise Time *	$t_r$	Measured 0.8V to 2.0V, $C_L = 10pF$			1.5	ns
Fall Time *	$t_f$	Measured 2.0V to 0.8V; $C_L = 10pF$			1.5	ns

October 2002

**Phase Noise vs. Frequency Offset**



## 6.0 Ordering Information

ORDERING PART NUMBER	PACKAGE TYPE	SHIPPING CONFIGURATION
<b>T73227-S08</b>	8-pin SOIC	Tubes
<b>T73227-S08-TNR</b>	8-pin SOIC	Tape and Reel
<b>T73227-M08</b>	8-pin MSOP	Tubes
<b>T73227-M08-TNR</b>	8-pin MSOP	Tape and Reel
<b>T73227-DIE</b>	DIE	Waffle-Pack

TLSI reserves the right to make changes to its products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgment, including those pertaining to warranty, patent infringement, and limitation of liability.

TLSI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TLSI's standard warranty. Testing and other quality control techniques are utilized to the extent TLSI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Customers are responsible for their applications using TLSI devices.

Information furnished by TLSI is believed to be accurate and reliable. However, no responsibility is assumed by TLSI for its use, nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent rights of TLSI.

TLSI and Silicon Driven are trademarks of TLSI, Inc. All other trademarks are the property of their respective owners.

**TLSI Incorporated, 770 Park Avenue, Huntington NY 11743 • (631) 755-7005 • Fax 631-755-7626 • [www.tlsi.com](http://www.tlsi.com)**