T231

VCXO Clock Generator IC
100 MHz to 200 MHz

P R E L I M I N A R Y

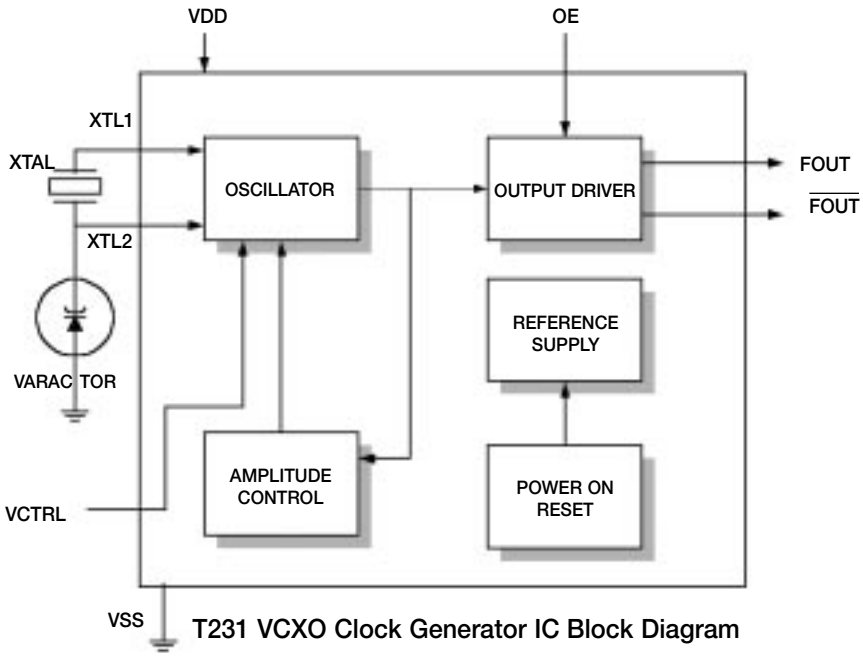
GENERAL DESCRIPTION

TLSI's family of VCXO Clock Generators is ideally suited for a wide range of applications in which cost, size, power, and the number of discrete components need to be minimized. These ICs are designed to exhibit excellent temperature stability and phase noise performance. The T231 features fundamental crystal operation over a frequency range that includes SONET and other communication protocols. Typical tuning frequency range is ± 50 PPM (crystal and varactor dependent). Differential PECL outputs are provided in the T231 to help reduce the effects of noise and distortion.

FEATURES

- Fundamental Crystal Frequency
- Supply Voltage 3.0V to 5.5V
- Operating Temperature -40°C to +85°C
- Power Less than 150 mW
- Start-Up Time Less than 5 mS
- Phase Noise at 100 kHz Offset from Fc less than –135 dBc/Hz
- Rise and Fall Times Less than 1 nS
- Nominal Output Duty Cycle 45% to 55%
- Output Drive Capability of 5 pF at 200 MHz
- Tuning Input Impedance 50 kΩ
- Internal Crystal Load Capacitance 15pF

BLOCK DIAGRAM



T231 VCXO Clock Generator IC Block Diagram

ISO9001 A8898

tlsi Silicon Driven™

ABSOLUTE MAXIMUM RATINGS*

* Operation of the device at or beyond these specifications may result in permanent damage or affect operation and reliability of the product.

PARAMETER	CONDITIONS	UNITS
Supply Voltage	V_{SS} - 0.5 ≤ V_{DD} ≤ 5.5	V
DC Input Voltage	V_{SS} - 0.5 ≤ V_{IN} ≤ V_{DD} + 0.5	V
DC Output Voltage	V_{SS} - 0.5 ≤ V_{OUT} ≤ V_{DD} + 0.5	V
Storage Temperature	-65 < T_S < +150	°C
Ambient Temperature	-40 < T_A < +85	°C
Junction Temperature	-65 < T_J < +125	°C
Soldering Temperature	T_{SLDR} < 260 for less than 10 seconds	°C

ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

V_{DD} = 5.0 V, -40 °C < T_A < +85 °C unless otherwise specified

PARAMETER	CONDITIONS	SYMBOL	MIN	TYP	MAX	UNITS
Supply Voltage		V_{DD}	3.0	5.0	5.5	V
High-Level Output Voltage		V_{OH}	V_{DD}-1.02			V
Low-Level Output Voltage		V_{OL}			V_{DD}-1.62	V
High-Level Input Voltage		V_{IH}	4.0			
Low-Level Input Voltage		V_{IL}			1.0	V
OE High-Level Input Current		I_{IH}			1.0	µA
OE Low-Level Input Current		I_{IL}		-50		µA
Supply Current	F=200 MHz, C_L=5 pF	I_{DD}		18.0	25.0	mA
Tuning Range (See Tuning Range Section)		Δf		±50		ppm
Crystal Drive		V_{XTL}		1.0		Vpp
Short-Circuit Source Current	< 20 seconds	I_{OSH}		-24		mA
Short-Circuit Sink Current	< 20 seconds`	I_{OSL}		24		mA

ELECTRICAL CHARACTERISTICS (continued)

AC CHARACTERISTICS

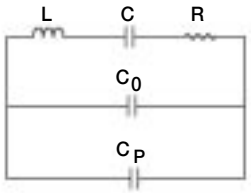
V_{DD} = 5.0 V, -40 °C < T_A < +85 °C unless otherwise specified

PARAMETER	CONDITIONS	SYMBOL	MIN	TYP	MAX	UNITS
Crystal Frequency Range		F_{XTL}	100		200	MHz
Output Duty Cycle		ODC	45		55	%
Power-Up Interval		T_{ON}		2.5	5.0	mS
Output Jitter	RMS, 12kHz to 20 MHz	J_O			1	pS
Rise and Fall Time	C_L=5 pF	t_r, t_f			2	nS
Rise and Fall Time, High Speed Version	C_L=5 pF	t_r, t_f			1	nS
Phase Noise	100 kHz offset from F_c	N_{PH}			-135	dBc/Hz
Temperature Stability		ΔF_{TEMP}		±15		ppm
Frequency vs. Load Capacitance		ΔF_{LC}		1		ppm
Frequency vs. Supply Voltage		ΔF_{SV}		2		ppm
Tuning Input Impedance		Z_{TUNE}		50	100	kΩ

TUNING RANGE

Tuning Range depends on the design of the crystal, the capacitance loading of the printed circuit board and the variable capacitance of the varactor loading the T231 IC. The parallel resonant frequency of the crystal with any external capacitive loading is greater than the fixed series resonant frequency of the crystal by Δf: $\Delta f = Cx10^6/2(C_O+C_P)$ ppm

where C is the series mechanical capacitance of the crystal, C_O is the parallel capacitance of the crystal, and C_P is the additional loading capacitance used to tune the crystal. The loading capacitance is the equivalent capacitance of the 15 pF internal load capacitance in series with the varactor capacitance. All capacitance are in units of picofarads.



Oscillator Equivalent Circuit

Example: For a typical crystal, C = 0.05 pF and C_O= 4 pF. Using a Hyperabrupt Tuning Diode, the typical capacitance of the diode is 12.3 pF at 1 volt and 2.60 pf at 3 volts. The varactor diode appears in series with the 15 pF internal chip capacitance. In addition, assuming 2 pF stray board wiring capacitance across both the varactor and the chip terminals, the following calculations determine the pullability of the oscillator:

Frequency shift with 1 volt across the varactor diode:

C_P = 15 pF + 2 pF in series with 12.3 pF + 2 pF = (17.0x14.3)/(17.0+14.3) pF = 7.77 pF

$\Delta f_1 = 0.005x10^6/(2(4.00+7.77)$ ppm = 212.4 ppm

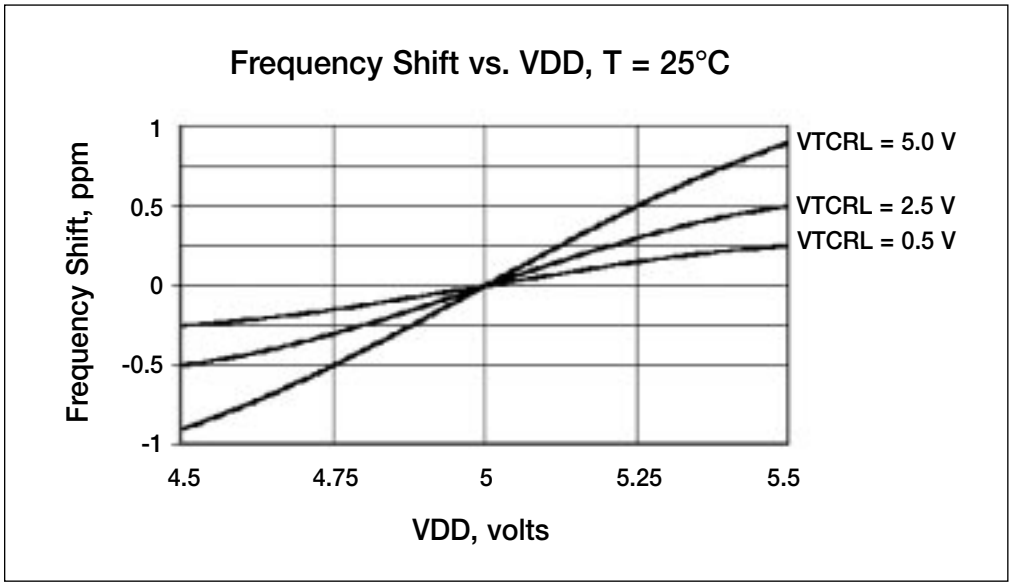
Frequency shift with 3 volts across the varactor diode:

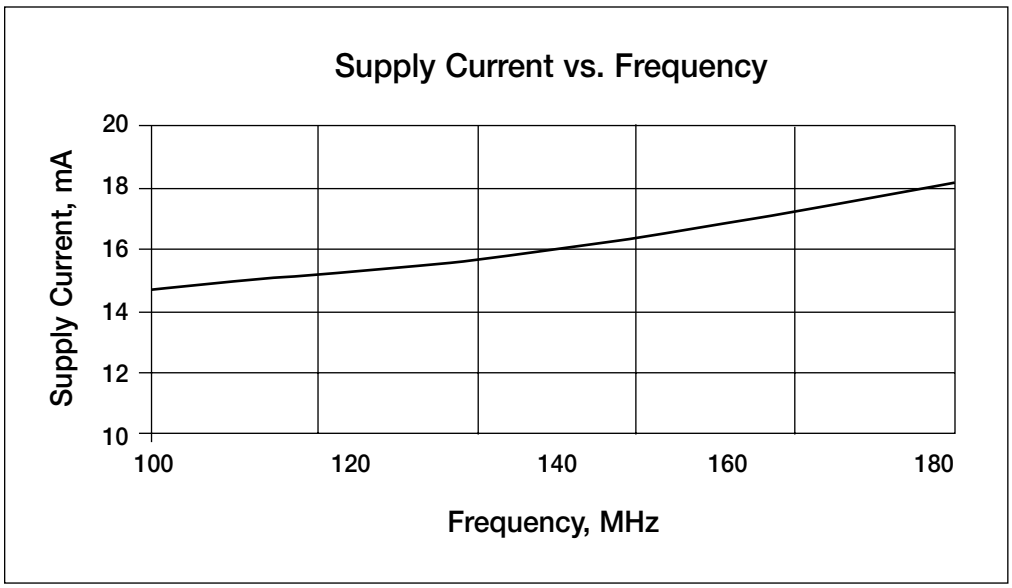
C_P = 15 pF + 2 pF in series with 2.60 pF + 2 pF = (17.0x4.60)/(17.0+4.60) pF = 3.62 pF

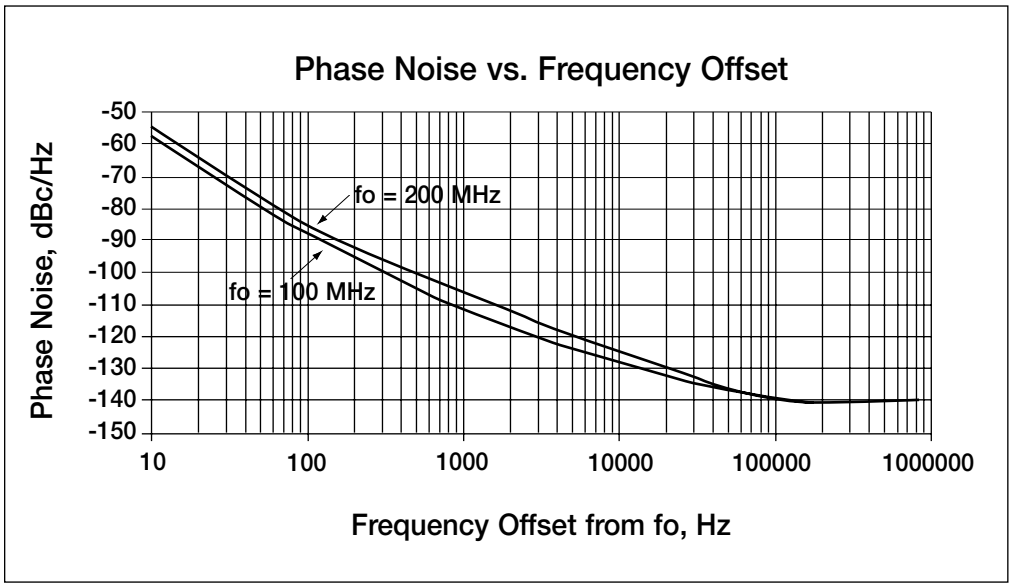
$\Delta f_2 = 0.005x10^6/(2(4.00+3.62)$ ppm = 328.1 ppm

Total Tuning Range = 328.1 ppm - 212.4 ppm = 116 ppm

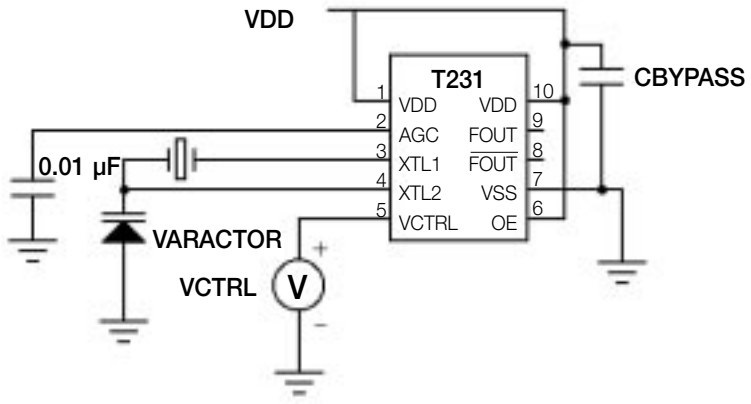
GRAPHS OF TYPICAL OPERATING CONDITIONS



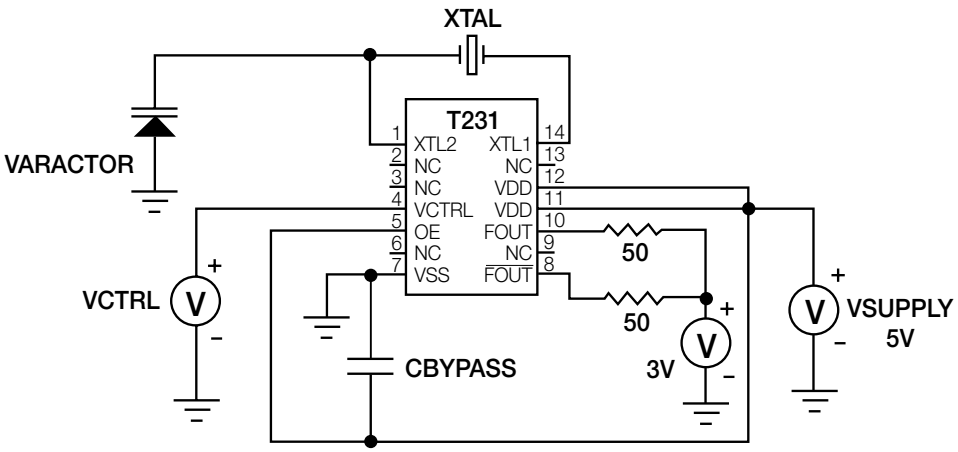




TEST CIRCUIT SCHEMATIC

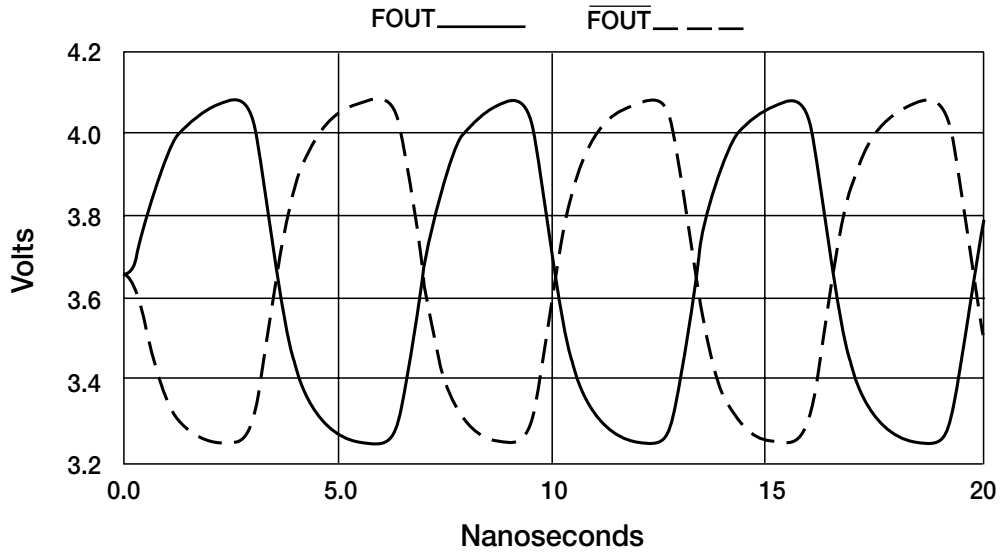


T231 TEST CIRCUIT 10-Pin MSOP Configuration



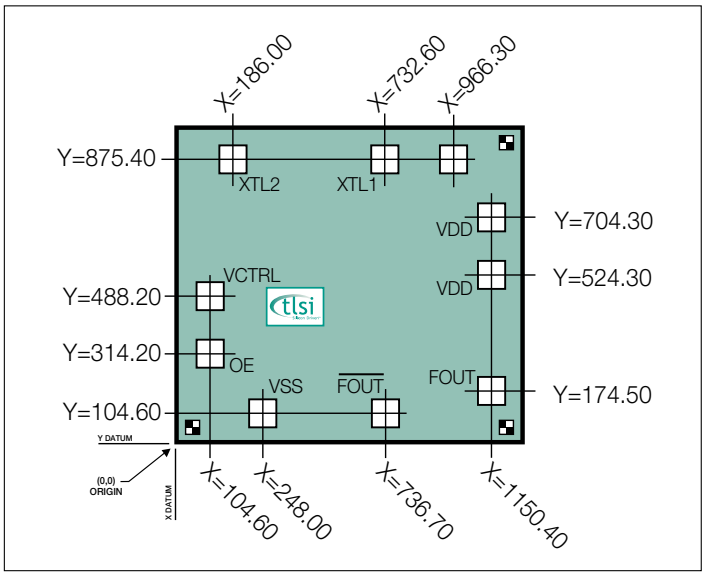
T231 TEST CIRCUIT 14-Pin SOIC Configuration

OUTPUT WAVEFORMS



FOUT 155.52MHz

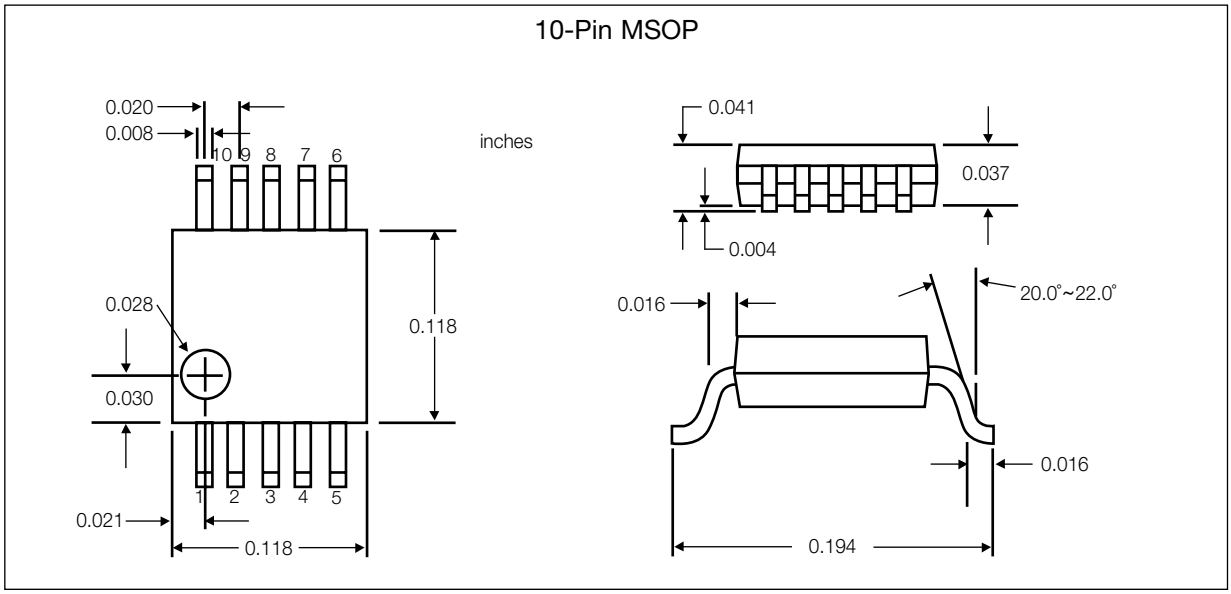
DIE CONFIGURATION

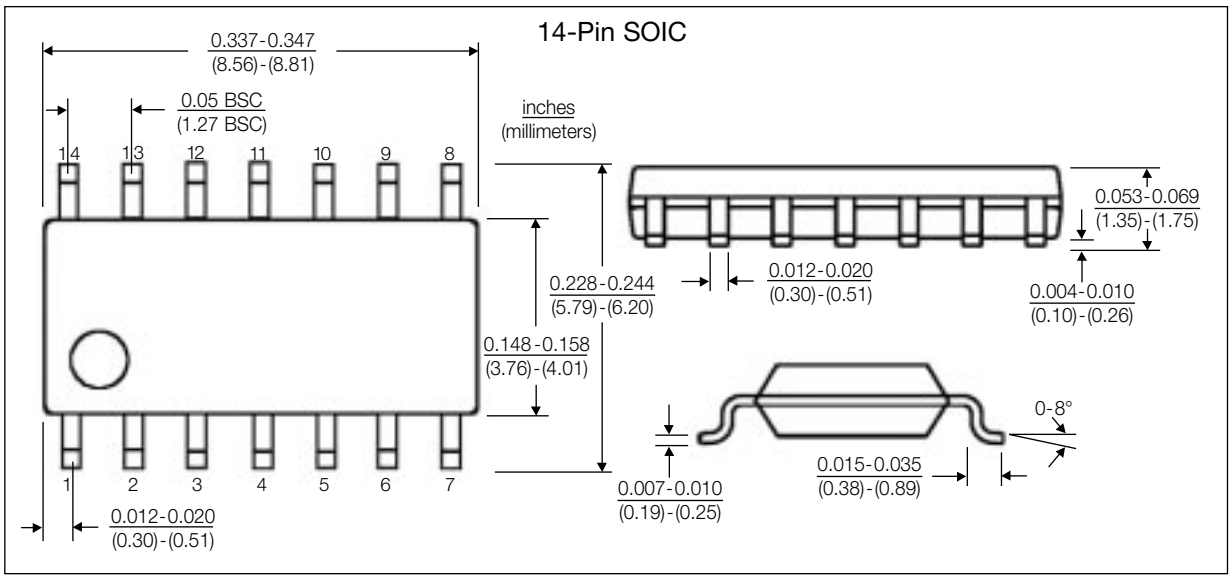


NOTES:

1) All dimensions are in microns.
2) Standard pad size = 90 X 90 microns.
3) The (0,0) origin is located on the outside edge of the inner scribe.
4) Substrate = VSS

PACKAGE INFORMATION





PIN FUNCTIONS

10-Pin MSOP

NUMBER	NAME	FUNCTION
1	VDD	Power Supply
2	AGC	Enhanced Noise Performance
3	XTL1	Crystal Connection, Lead 1
4	XTL2	Crystal Connection, Lead 2
5	VCTRL	Frequency Control
6	OE	Output Enable
7	VSS	Power Supply Reference
8	$\overline{\text{FOUT}}$	Inverted Frequency Output
9	FOUT	Frequency Output
10	VDD	Power Supply

14-Pin SOIC

NUMBER	NAME	FUNCTION
1	XTL2	Crystal Connection, Lead 2
2	NC	No Connection
3	NC	No Connection
4	VCTRL	Frequency Control
5	OE	Output Enable
6	NC	No Connection
7	VSS	Power Supply Reference
8	$\overline{\text{FOUT}}$	Inverted Frequency Output
9	NC	No Connection
10	FOUT	Frequency Output
11	VDD	Power Supply
12	VDD	Power Supply
13	NC	No Connection
14	XTL1	Crystal Connection, Lead 1

ORDERING INFORMATION

PART NUMBER	PACKAGE
T231-DPW	Die-Probed Wafer
T231-DIE	Die-Waffle Pack
T231-M10	10-Pin MSOP
T231-S14	14-Pin SOIC

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