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### Description

The VS-702 is a SAW Based Voltage Controlled Oscillator that achieves low phase noise and very low jitter performance. The VS-702 is housed in an industry standard hermetically sealed LCC package and available in tape and reel.

### Features

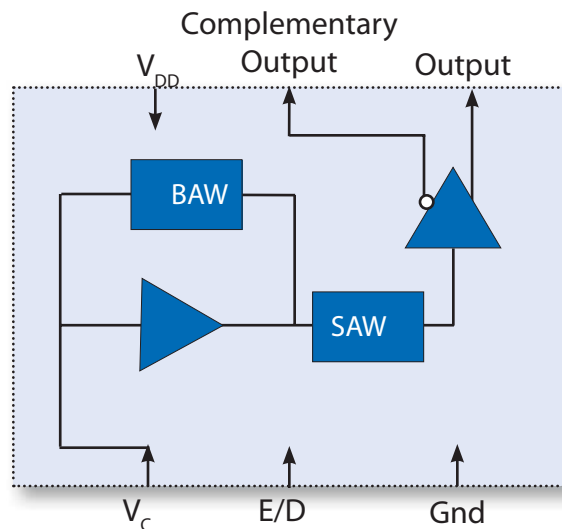
- Industry Standard Package, 5.0 x 7.5 x 2.0 mm
- ASIC Technology for Ultra Low Jitter  
0.100 ps-rms typical across 12 kHz to 20 MHz BW  
0.120 ps-rms typical across 50 kHz to 80 MHz BW
- Output Frequencies from 150 MHz to 1 GHz
- 3.3 V Operation
- LV-PECL or LVDS Configuration with Fast Transition Times
- Improved Temperature Stability over Standard VCSCO ( $\pm 20$  ppm)
- Output Disable Feature
- 0/70°C or -40/85°C operating temperature
- Product is free of lead and compliant to EC RoHS Directive



### Applications

- Ideal for PLL circuits for clock smoothing and frequency translation
- SONET, SDH
  - Synchronous Ethernet
  - Fiber Channel
  - LAN / WAN
  - Test and Measurement

### Block Diagram



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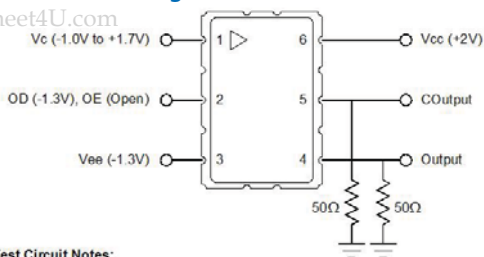
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# Performance Specifications

Table 1. Electrical Performance					
Parameter	Symbol	Min	Typical	Maximum	Units
<b>Supply</b>					
Voltage <sup>1</sup>	$V_{DD}$	2.97	3.3	3.63	V
Current (No Load)	$I_{DD}$		55	70	mA
<b>Frequency</b>					
Nominal Frequency <sup>2</sup>	$f_N$	150		1000	MHz
Absolute Pull Range <sup>3,6</sup>	APR	$\pm 50$			ppm
Linearity <sup>3</sup>	Lin		5	10	%
Gain Transfer Positive <sup>3</sup> (See pg 5)	$K_V$		+100		ppm/V
Temperature Stability <sup>3</sup>	$f_{STAB}$		$\pm 20$		ppm
<b>Outputs</b>					
Mid Level <sup>3</sup>		$V_{DD}-1.5$	$V_{DD}-1.3$	$V_{DD}-1.2$	V
Single Ended Swing <sup>3</sup>			750		mV-pp
Double Ended Swing <sup>3</sup>			1.5		V-pp
Current	$I_{OUT}$			20	mA
Rise Time <sup>4</sup>	$t_R$			500	ps
Fall Time <sup>4</sup>	$t_F$			500	ps
Symmetry <sup>3</sup>	SYM	45	50	55	%
Jitter (12 kHz - 20 MHz BW) <sup>6,22.08MHz<sup>5</sup></sup>	$\phi_J$		0.1	0.250	ps-rms
Jitter (50 kHz - 80 MHz BW) <sup>155.52MHz<sup>5</sup></sup>	$\phi_J$		0.12	0.300	ps-rms
Period Jitter, RMS (622.08MHz) <sup>7</sup>	$\phi_J$		2.5	3.0	ps
Period Jitter, Peak - Peak (622.08MHz) <sup>7</sup>	$\phi_J$		16	24	ps
Spurious Suppression <sup>2</sup>			-60	-50	dBc
<b>Control Voltage</b>					
Control Voltage Range for APR	$V_C$	0.3		3.0	V
Control Voltage Input Impedance	$Z_{IN}$	75			K $\Omega$
Control Voltage Modulation BW	BW	50			kHz
<b>Enable/Disable</b>					
Output Enabled, Option A	$V_{IH}$	$0.7 \cdot V_{DD}$			V
Output Disabled, Option A	$V_{IL}$			$0.3 \cdot V_{DD}$	V
Output Enabled, Option C	$V_{IL}$	$0.7 \cdot V_{DD}$		$0.2 \cdot V_{DD}$	V
Output Disabled, Option C	$V_{IH}$				V
Operating Temperature	$T_{OP}$	0/70 or -40/85			$^{\circ}\text{C}$
Package Size		5.0 x 7.5 x 2.0			mm

- 1] The VS-702 power supply should be filtered, eg, 0.1 and 0.01  $\mu\text{F}$  to ground
- 2] See Standard Frequencies and Ordering Information tables for more specific information
- 3] Parameters are tested with production test circuit below (Fig 1).
- 4] Measured from 20% to 80% of a full output swing (Fig 2).
- 5] Integrated across stated bandwidth.
- 6] Tested with  $V_C = 0.3\text{V}$  to  $3.0\text{V}$  unless otherwise stated in part description
- 7] Broadband Period Jitter measured using Lecroy Wavemaster 8600A 6 GHz Oscilloscope, 25K samples taken. See application note.

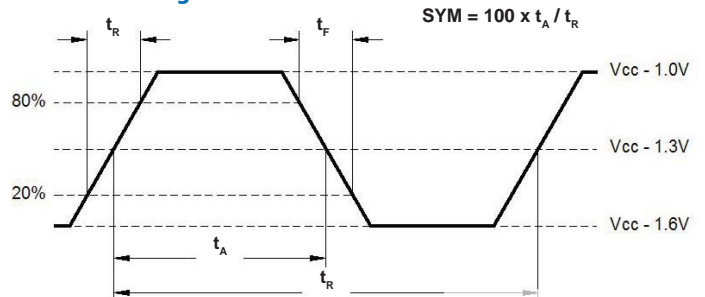
**Fig 1: Test Circuit**



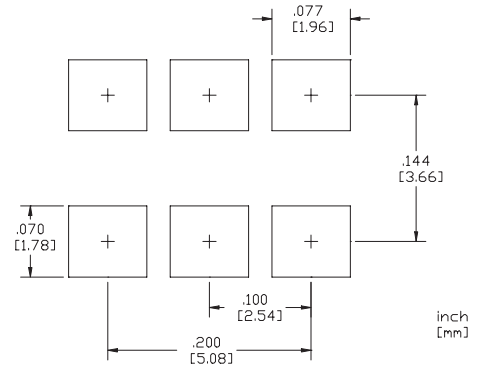
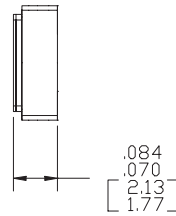
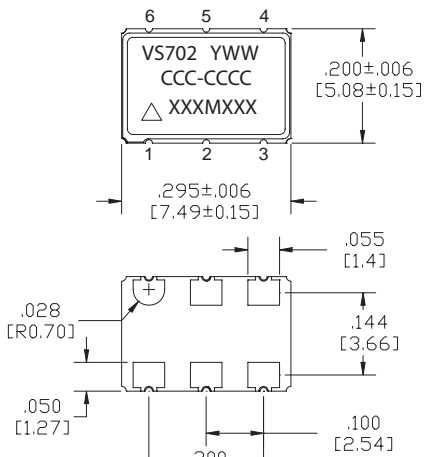
**Test Circuit Notes:**

- 1) To Permit 50 $\Omega$  Measurement of Outputs, all DC Inputs are Biased Down 1.3V.
- 2) All Voltage Sources Contain Bypass Capacitors to Minimize Supply Noise.
- 3) 50 $\Omega$  Terminations are Within Test Equipment.

**Fig 2: LVPECL Waveform**



# Outline Drawing & Pad Layout

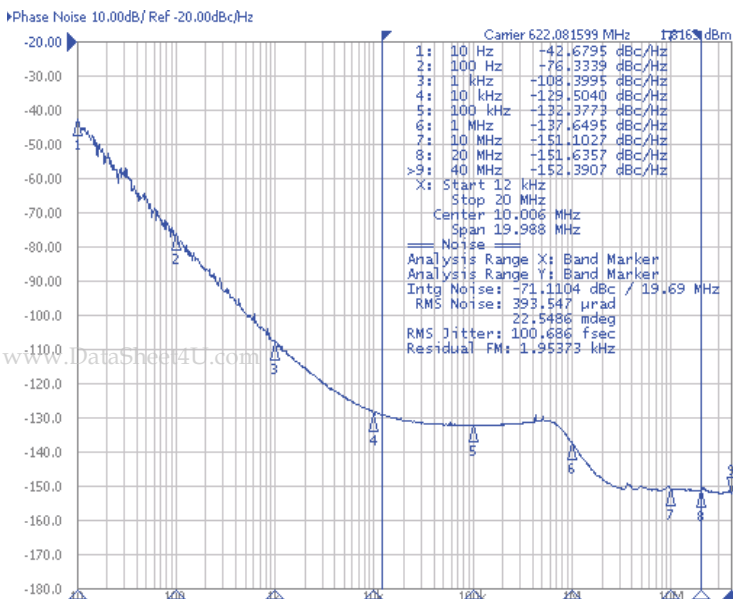


Dimensions in inches (mm)

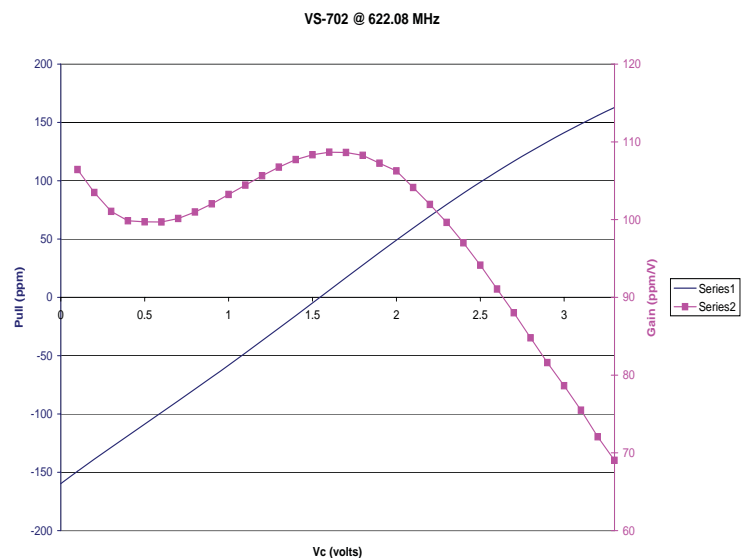
**Table 2. Pin Out**

Pin	Symbol	Function
1	$V_C$	VCXO Control Voltage
2	OE	Enable/Disable **See Ordering Options**
3	GND	Case and Electrical Ground
4	Output	Output
5	COutput	Complementary Output
6	$V_{DD}$	Power Supply Voltage (3.3V ±10%)

## Typical Phase Noise



## Typical Gain



## Suggested Output Load Configurations

The VS-702 incorporates a standard PECL output scheme, which are un-terminated emitters as shown in Figure 3. There are numerous application notes on terminating and interfacing PECL logic and the two most common methods are a single resistor to ground, Figure 4, and a pull-up/pull-down scheme as shown in Figure 5. An AC coupling capacitor is optional, depending on the application and the input logic requirements of the next stage.

One of the most important considerations is terminating the Output and Complementary Outputs equally. An unused output should not be left un-terminated, and if one of the two outputs is left open it will result in excessive jitter on both. PC board layout must take this and 50 ohm impedance matching into account. Load matching and power supply noise are the main contributors to jitter related problems.

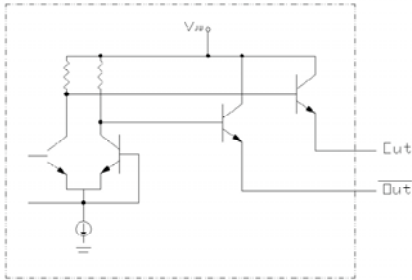


Figure 3 Standard PECL Output Configuration

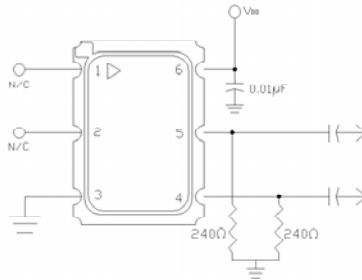


Figure 4 Single Resistor Termination Scheme  
Resistor values are typically 120 to 240 ohms

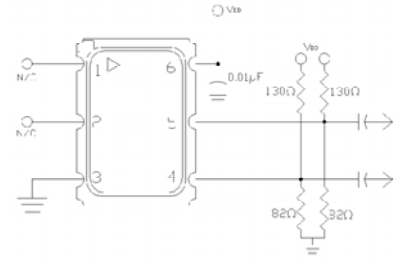


Figure 5 Pull-Up Pull-Down Termination

## Reliability

VI qualification includes aging at various extreme temperatures, shock and vibration, temperature cycling, and IR reflow simulation. The VS-702 family is capable of meeting the following qualification tests:

Table 3. Environmental Compliance

Parameter	Conditions
Mechanical Shock	MIL-STD-883, Method 2002
Mechanical Vibration	MIL-STD-883, Method 2007
Solderability	MIL-STD-883, Method 2003
Gross and Fine Leak	MIL-STD-883, Method 1014
Resistance to Solvents	MIL-STD-883, Method 2015
Moisture Sensitivity Level	MSL 1
Contact Pads	Gold over Nickel

Stresses in excess of the absolute maximum ratings can permanently damage the device. Functional operation is not implied at these or any other conditions in excess of conditions represented in the operational sections of this datasheet. Exposure to absolute maximum ratings for extended periods may adversely affect device reliability. Permanent damage is also possible if OD or Vc is applied before Vcc.

Table 4. Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Power Supply	$V_{DD}$	0 to 6	V
Output Current	$I_{OUT}$	25	mA
Voltage Control Range	$V_C$	0 to $V_{DD}$	V
Storage Temperature	TS	-55 to 125	°C
Soldering Temp/Time	$T_{LS}$	260 / 40	°C / sec

Although ESD protection circuitry has been designed into the VS-702 proper precautions should be taken when handling and mounting. VI employs a human body model (HBM) and a charged device model (CDM) for ESD susceptibility testing and design protection evaluation.

Table 5. ESD Ratings

Model	Minimum	Conditions
Human Body Model	500V	MIL-STD-883, Method 3015
Charged Device Model	500V	JESD22-C101

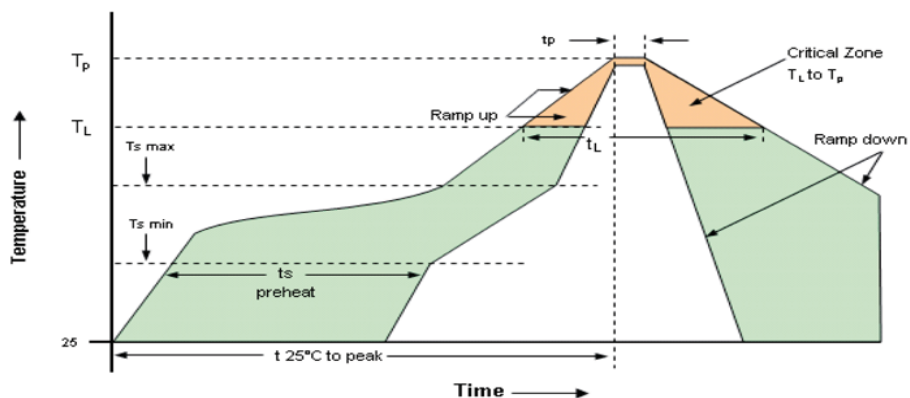
**Table 6. Reflow Profile (IPC/JEDEC J-STD-020C)**

Parameter	Symbol	Value
PreHeat Time Ts-min Ts-max	$t_s$	60 sec Min, 180 sec Max 150°C 200°C
Ramp Up	$R_{UP}$	3 °C/sec Max
Time Above 217 °C	$t_L$	60 sec Min, 150 sec Max
Time To Peak Temperature	$T_{25C \text{ to peak}}$	480 sec Max
Time at 260 °C	$t_p$	20 sec Min, 40 sec Max
Ramp Down	$R_{DN}$	6 °C/sec Max

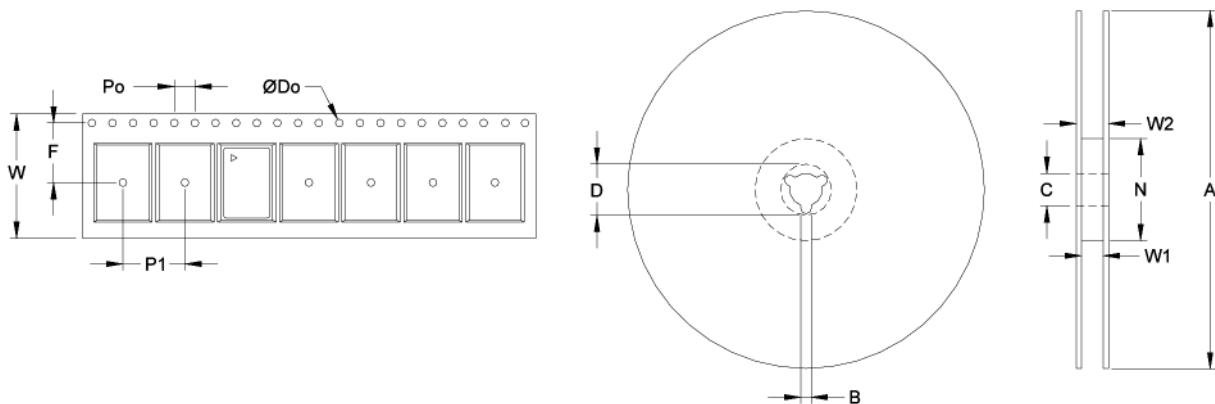
The device is qualified to meet the JEDEC standard for Pb-Free assembly. The temperatures and time intervals listed are based on the Pb-Free small body requirements. The VS-702 device is hermetically sealed so an aqueous wash is not an issue.

Termination Plating:  
Electroless Gold Plate over Nickel Plate

**Solderprofile:**



## Tape & Reel (EIA-481-2-A)



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Table 7. Tape and Reel Information													
Tape Dimensions (mm)						Reel Dimensions (mm)							
Dimension	W	F	Do	Po	P1	A	B	C	D	N	W1	W2	# Per Reel
Tolerance	Typ	Typ	Typ	Typ	Typ	Typ	Min	Typ	Min	Min	Typ	Max	
VS-702	16	7.5	1.5	4	8	178	1.5	13	20.2	50	16.4	22.4	200

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**Table 8. Standard Output Frequencies (MHz)**

155M520000	156M250000	160M000000	162M000000	175M000000	187M500000	200M000000	212M500000
240M000000	245M760000	250M000000	260M000000	268M800000	300M000000	311M040000	312M500000
320M000000	324M000000	350M000000	375M000000	384M000000	389M600000	400M000000	480M000000
491M520000	500M000000	531M250000	532M000000	533M000000	537M600000	622M080000	625M000000
635M040000	637M500000	640M000000	644M531300	657M421900	666M514300	669M326600	672M162700
690M569200	693M483000	704M380600	707M352700	720M000000	742M434700	768M000000	796M875000
800M000000	901M120000	1000M000000					

## Ordering Information

### VS-702- E C E - K X A N - xxxMxxxxxx

**Product Family**

VS: VCSO

**Package**

702: 5 x 7.5 x 2.0 mm

**Input**

E: 3.3 Vdc ±10%

**Output**

C: LVPECL (45/55% Symmetry)

D: LVDS (45/55% Symmetry)

**Operating Temperature**

T: 0/70°C

E: -40/85°C

Frequency in MHz

**Other (Future Use)**

N: Standard

**Enable/Disable**

A: Enable High

C: Enable Low

**Stability**

X: Standard

E: ±20ppm Temperature Stability

**Absolute Pull Range**

K: ±50ppm

*\*Note: not all combination of options are available.  
Other specifications may be available upon request.*

**Example: VS-702-ECE-KXAN-622M080000**

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