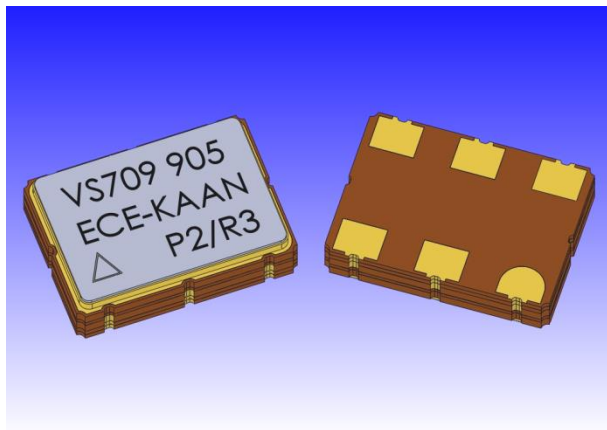


VS-709

Dual Frequency VCSO



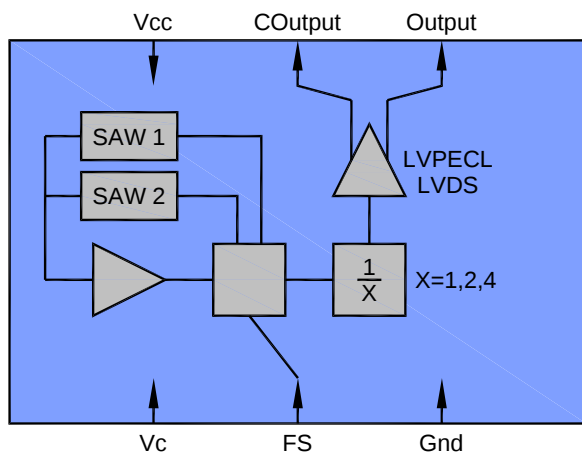
Features

- Industry Standard Package, 5.0 x 7.0 x 1.8 mm
- 5th Generation ASIC Technology for Ultra Low Jitter
 120 fs-rms ($f_N = 622.08$ MHz, 12 kHz to 20 MHz)
 105 fs-rms ($f_N = 622.08$ MHz, 50 kHz to 80 MHz)
- Output Frequencies from 150 MHz to 1000 MHz
- Spurious Suppression, 90 dBc Typical
- 2.5V or 3.3V Supply Voltage
- LVPECL or LVDS Output Configurations
- Tri-State Frequency Select (F1, OD, F2)
- Compliant to EC RoHS6 Directive 

Applications

PLL circuits for Clock Smoothing and Frequency Translation

Description	Standard
• SONET / SDH	GR-253-CORE
• OTN (Optical Transport Network)	ITU-T G.709/Y.1331
• 10 GbE (Gigabit Ethernet)	IEEE 802.3ae
• 10 GFC (Gigabit Fibre Channel)	INCITS 364-2003
• 40 GbE & 100 GbE	IEEE 802.3ba
• Synchronous Ethernet	ITU-T G.8261
• WiMax	IEEE 802.16



Description

The VS-709 is a Voltage Controlled SAW Oscillator that operates at the fundamental frequency from one of the two internal SAW filters. The SAW filters are high-Q Quartz devices that enable the circuit to achieve low phase jitter performance over a wide operating temperature range. A divider circuit is deployed for output frequencies less than 600 MHz. The selectable dual oscillator is housed in a hermetically sealed leadless surface mount package and offered on tape and reel. It has a tri-state Frequency Select function that provides one of three conditions: Frequency 1, Output Disable, or Frequency 2.

VS-709 Dual Frequency VCSO

Electrical Performance: 3.3V LV-PECL

Parameter	Symbol	Minimum	Typical	Maximum	Units	Notes
Frequency						
Nominal Frequency	f_N	150		1000	MHz	1,2,3
Absolute Pull Range	APR	± 50			ppm	1,2,3,9
Linearity	Lin		± 7		%	2,4,9
Gain Transfer	K_V		+445		ppm/V	2,9
Temperature Stability	f_{STAB}		± 100		ppm	1,7
Supply						
Voltage ($\pm 10\%$)	V_{CC}	2.97	3.3	3.63	V	2,3
Current (Typical 50 Ω Load)	I_{CC}		73		mA	3
Current (No Load)	I_{CC}		60	75	mA	3
Outputs						
Mid Level		$V_{CC}-1.5$	$V_{CC}-1.3$	$V_{CC}-1.1$	mV	2,3
Single Ended Swing			750		mV-pp	2,3
Differential Swing			1.5		V-pp	2,3
Current	I_{OUT}			20	mA	7
Rise Time	t_R		180	250	ps-pp	6,7
Fall Time	t_F		180	250	ps-pp	6,7
Symmetry	SYM	45	50	55	%	2,3
Spurious Suppression		85	90		dBc	7
Jitter ($600 \leq f_N \leq 1000$)	ϕ_J		150		fs-rms	7,8
Jitter ($300 \leq f_N \leq 500$)	ϕ_J		190		fs-rms	7,8
Jitter ($150 \leq f_N \leq 250$)	ϕ_J		280		fs-rms	7,8
Control Voltage						
Input Impedance (F1 or F2 Enabled)	Z_C		123		k Ω	7
Input Impedance (Output Disabled)	Z_C		472		k Ω	7
Modulation Bandwidth	BW		200		kHz	7
Operating Temperature						
	T_{OP}	-40		+85	$^{\circ}\text{C}$	1,3
Package Size						
		5.0 x 7.0 x 1.8			mm	

1. See Standard Frequencies and Ordering Information (Pg 8).
2. Parameters are tested with production test circuit (Pg 3).
3. Parameters are tested at ambient temperature with test limits guard-banded for specified operating temperature.
4. Measured as the maximum deviation from the best straight-line fit, per MIL-0-55310.
5. The Vc Model is described below (Fig 1).
6. Parameters are described with waveform diagram below (Fig 2).
7. Not tested in production, guaranteed by design, verified at qualification.
8. For Frequencies > 600 MHz, Jitter is integrated across 50 kHz to 80 MHz.
For Frequencies < 600 MHz, Jitter is integrated across 12 kHz to 20 MHz. (Both per GR-253-CORE Issue3)
9. Tested with Vc = 0.3V to 3.0V.

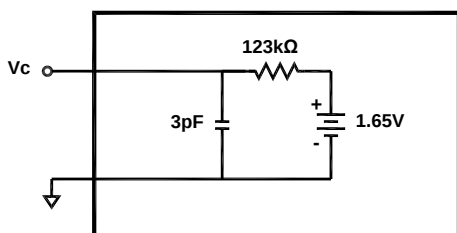


Figure 1. Vc Model – F1 or F2 Enabled

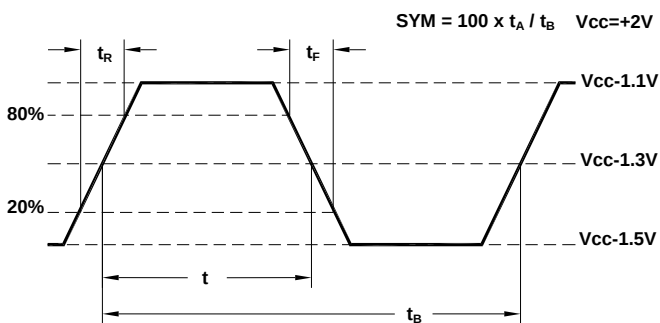


Figure 2. 10K LV-PECL Waveform

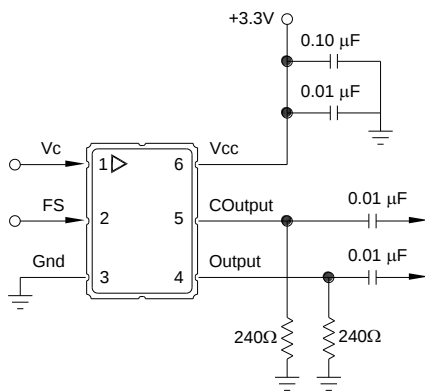
VS-709 Dual Frequency VCSO

Absolute Maximum Ratings

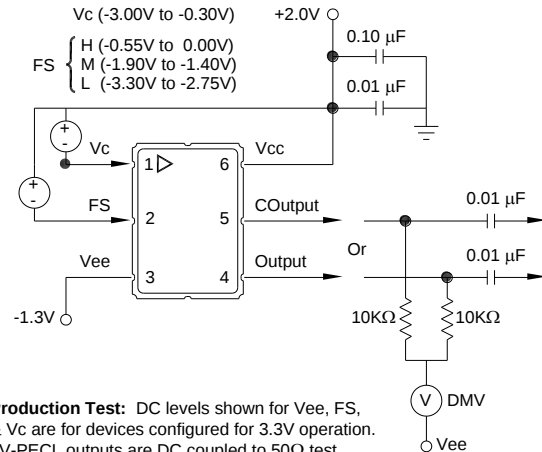
Parameter	Symbol	Ratings	Unit
Power Supply	V_{CC}	0 to 6	V
Input Current	I_{IN}	100	mA
Output Current	I_{OUT}	25	mA
Voltage Control Range	V_C	0 to V_{CC}	V
Frequency Select	FS	0 to V_{CC}	V
Storage Temperature	T_{STR}	-55 to 125	°C
Soldering Temperature / Duration	T_{PEAK} / t_P	260 / 40	°C / sec

Stresses in excess of the absolute maximum ratings can permanently damage the device. Also, exposure to these absolute maximum ratings for extended periods may adversely affect device reliability. Functional operation is not implied at these or any other conditions in excess of those represented in the operational sections of this datasheet. Permanent damage is also possible if any device input (V_C or FS) draws >100 mA.

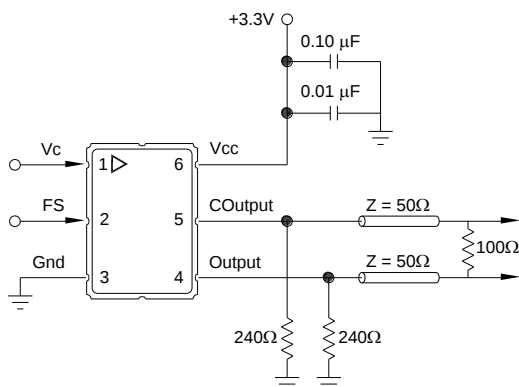
Test Circuits & Output Load Configurations



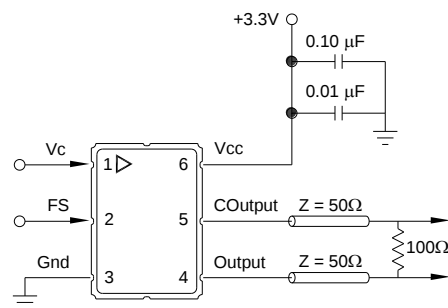
Functional Test: Allows use of standard power supply biasing configuration. Pull down resistors are used for LV-PECL outputs and are removed for with LVDS outputs. Since the LVDS outputs are AC coupled, the output DC levels cannot be measured.



Production Test: DC levels shown for Vee, FS, & V_C are for devices configured for 3.3V operation. LV-PECL outputs are DC coupled to 50Ω test equipment. LVDS outputs are connected to a digital voltmeter, then AC coupled to the test equipment. The digital voltmeter allows for Mid Level & Swing measurements.



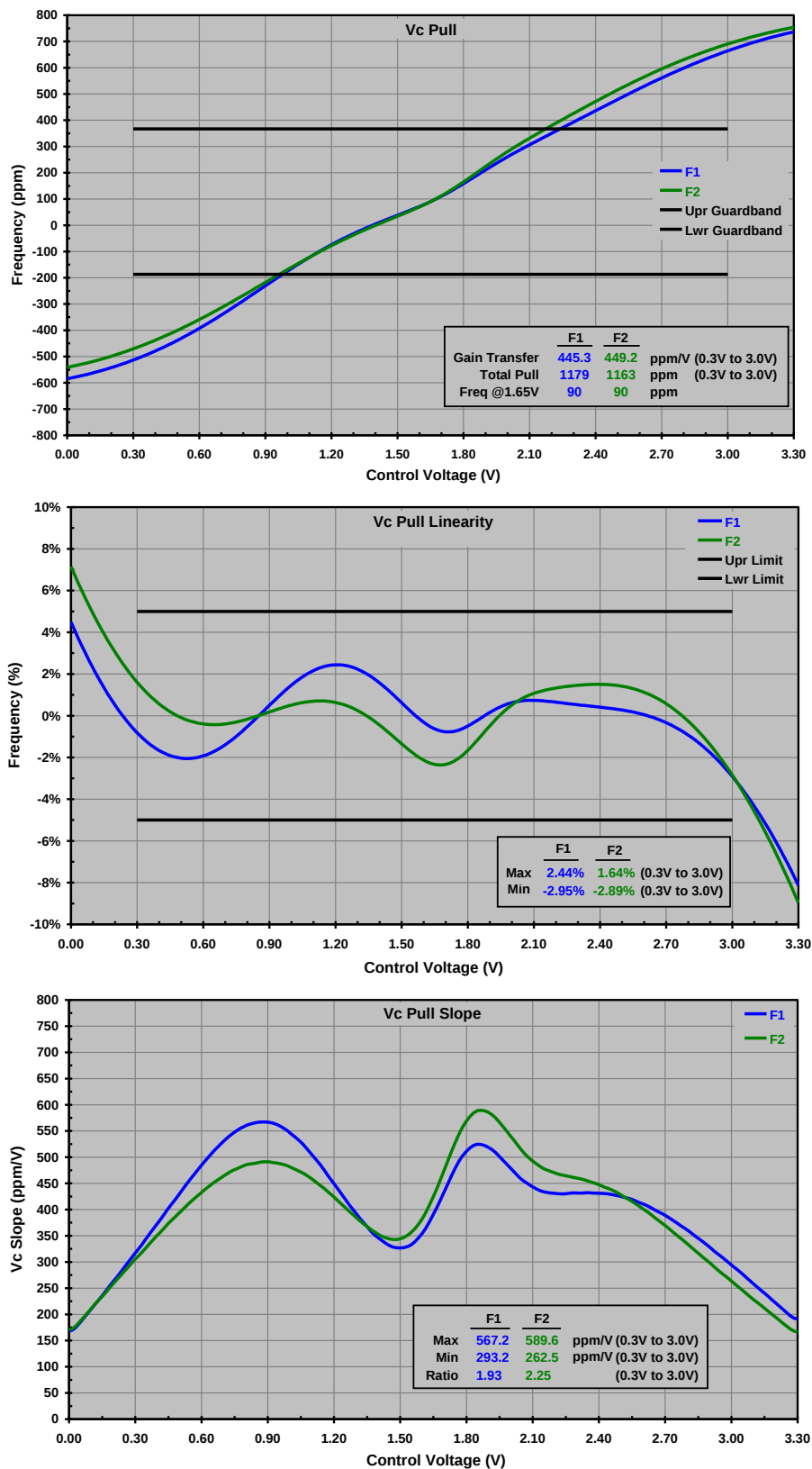
LV-PECL to LV-PECL: For short transmission lengths, the pull down resistor values shown provide reasonable power consumption and waveform performance.



LVDS to LVDS: The 100Ω resistor should be removed if this load is provided internally within the LVDS receiver.

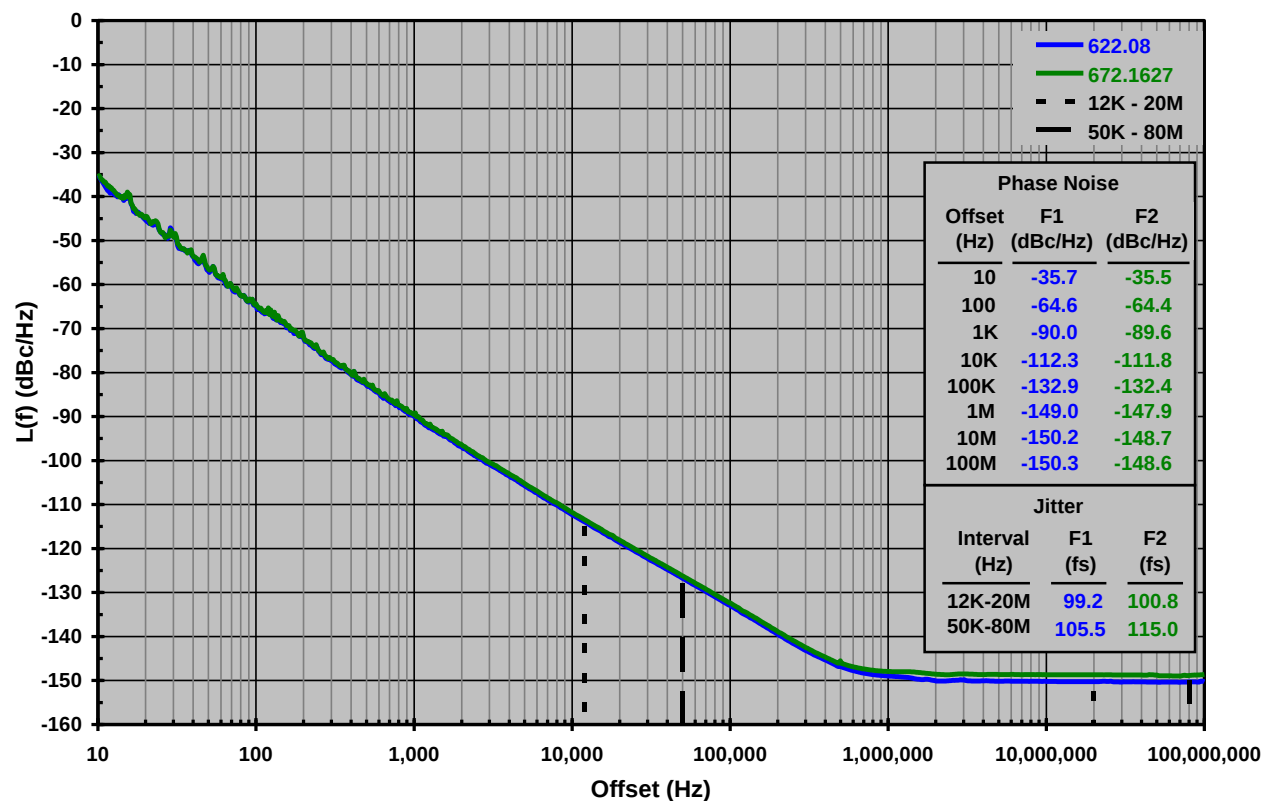
VS-709 Dual Frequency VCSO

Typical Characteristics: Vc Pull, Vc Pull Linearity, & Vc Pull Slope



VS-709 Dual Frequency VCSO

Typical Characteristics: Phase Noise & Jitter



	F1	F2	F1	F2	F1	F2	F1	F2	
PN / Jitter	622.08	669.33	644.53	698.81	657.42	707.35	718.86	909.71	Units
L(f) @ 10	-32.9	-33.6	-36.1	-34.6	-33.1	-32.2	-31.9	-31.6	dBc/Hz
L(f) @ 100	-62.6	-62.6	-64.6	-63.6	-62.0	-61.4	-62.0	-60.2	dBc/Hz
L(f) @ 1K	-88.4	-88.1	-90.2	-89.2	-88.4	-87.6	-87.0	-84.7	dBc/Hz
L(f) @ 10K	-111.1	-110.7	-112.1	-111.2	-111.0	-110.0	-109.0	-106.3	dBc/Hz
L(f) @ 100K	-132.2	-131.8	-132.6	-131.7	-132.0	-131.0	-129.6	-126.8	dBc/Hz
L(f) @ 1M	-148.8	-147.6	-149.0	-147.4	-148.5	-147.0	-148.0	-144.6	dBc/Hz
L(f) @ 10M	-149.9	-148.3	-150.2	-147.9	-149.7	-147.2	-149.3	-144.0	dBc/Hz
L(f) @ 100M	-149.9	-148.4	-150.5	-147.6	-149.8	-147.4	-148.8	-144.2	dBc/Hz
12K - 20M	111.2	112.7	98.0	104.2	107.9	115.7	120.3	138.3	fs-rms
50K - 80M	110.7	121.1	100.9	119.6	106.5	120.8	108.1	147.6	fs-rms

VS-709 Dual Frequency VCSO

Reliability

VI qualification includes aging at various extreme temperatures, shock and vibration, temperature cycling, and IR reflow simulation. The VS-709 family is capable of meeting the following qualification tests:

Environmental Compliance

Parameter	Conditions
Mechanical Shock	MIL-STD-883, Method 2002 B
Mechanical Vibration	MIL-STD-883, Method 2007 A
Solderability	MIL-STD-883, Method 2003
Gross and Fine Leak	MIL-STD-883, Method 1014
Resistance to Solvents	MIL-STD-883, Method 2016
Moisture Sensitivity Level	IPC/JEDEC J-STD-020, MSL1

Handling Precautions

Although ESD protection circuitry has been designed into the VS-709 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.

ESD Ratings

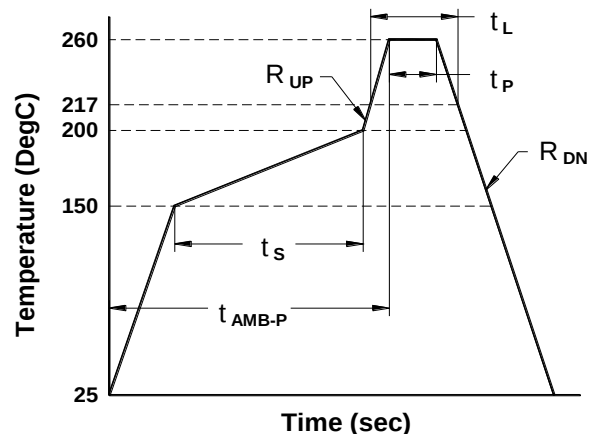
Model	Minimum	Conditions
Human Body Model	2000 V	MIL-STD 883, Method 3015
Charged Device Model	1000 V	JEDEC, JESD22-C101
Machine Model	200 V	JEDEC, JESD22-A115-A

Reflow Profile (IPC/JEDEC J-STD-020)

Parameter	Symbol	Value
PreHeat Time	t_s	60 sec Min, 180 sec Max
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_{AMB-P}	480 sec Max
Time At 260 °C	t_P	20 sec Min, 40 sec Max
Ramp Down	R_{DN}	6 °C/sec Max

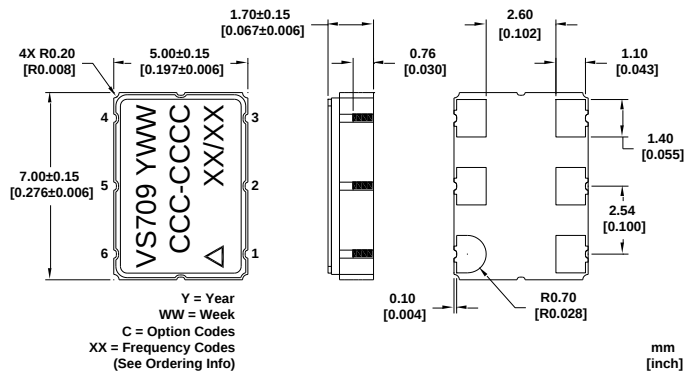
The VS-709 is qualified to meet the JEDEC standard for Pb-Free assembly. The temperatures and time intervals listed are based on the Pb-Free small body requirements. The temperatures refer to the topside of the package, measured on the package body surface. The VS-709 device is hermetically sealed so an aqueous wash is not an issue.

Terminal Plating: Electroless Au > 1.50 μm over
Electroless Ni > 1.90 μm

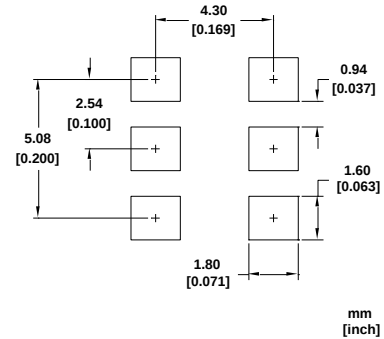


VS-709 Dual Frequency VCSO

Outline & Marking Diagram



Suggested Pad Layout



Pin Out

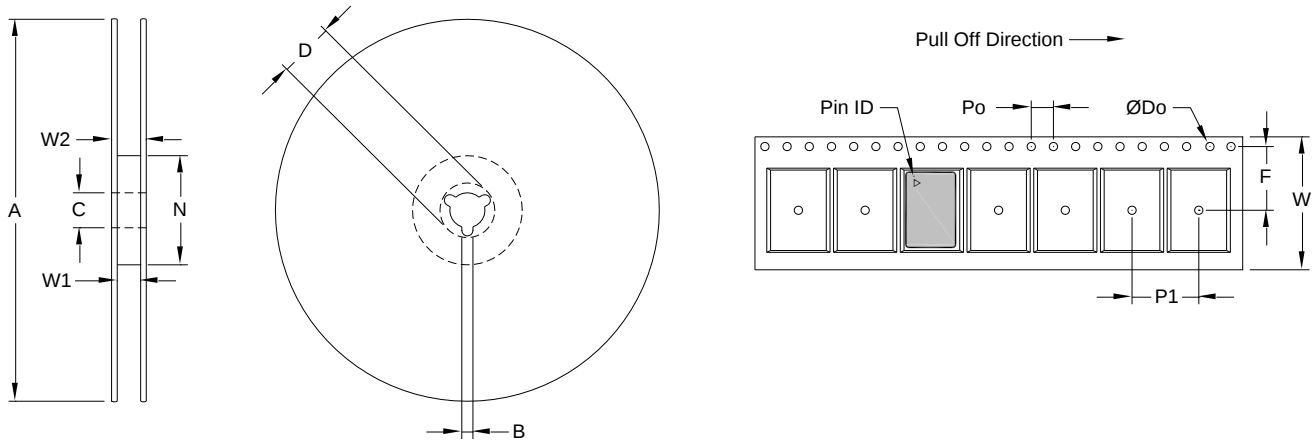
Pin	Symbol	Function
1	V _c	Control Voltage
2	FS	Frequency Select
3	GND	Case and Electrical Ground
4	Output	Output
5	COutput	Complementary Output
6	V _{cc}	Power Supply Voltage

Frequency Select (Tri-State LV-CMOS)

FS	Voltage Range	Result
H	(5V _{cc} / 6) to V _{cc}	F2
M	(V _{cc} / 2) ± 15%(V _{cc} / 2)	OD
L	Gnd to (V _{cc} / 6)	F1

LV-CMOS Tri-State Control
Floating FS Results in OD

Tape and Reel (EIA-481-2-A)



Tape Dimensions (mm)

Reel Dimensions (mm)

Dimension	W	F	Do	Po	P1	A	B	C	D	N	W1	W2	# Per
Tolerance	Typ	Typ	Typ	Typ	Typ	Typ	Min	Typ	Min	Min	Typ	Max	Reel
VS-709	16	7.5	1.5	4	8	178	1.5	13	20.2	50	16.4	22.4	200

VS-709 Dual Frequency VCSO

Standard Frequencies (MHz)

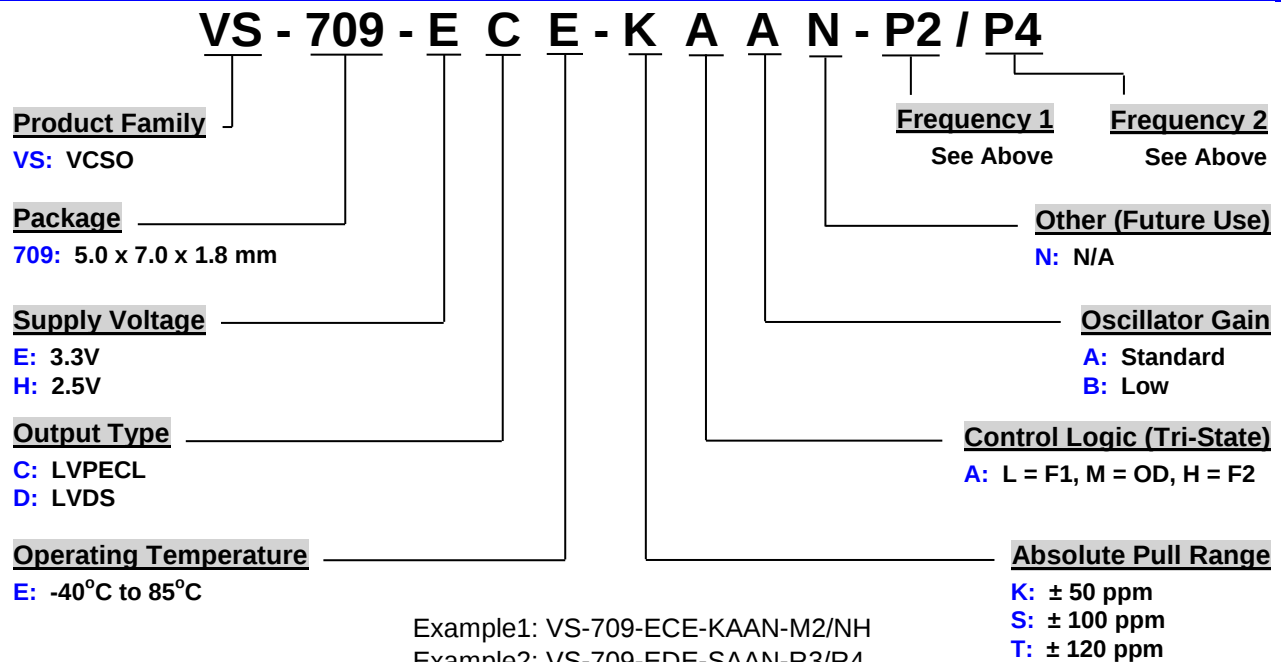
155.520000 M2	156.250000 M3	161.132813 M4	166.628572 M5	167.331646 N2	168.040678 N3
173.370748 ND	184.320000 NH	307.200000 RX	311.040000 P1	368.640000 RY	614.400000 RG
622.080000 P2	625.000000 P3	644.531250 P4	657.421875 PB	666.514286 P5	669.326582 R3
672.162712 R5	690.569196 R4	693.482991 R6	696.421478 V1	696.614900 V8	697.500000 VV
698.812330 VC	699.426250 VM	700.000000 W6	707.352650 TC	718.863800 V6	737.280000 TL
753.621100 VN	753.800000 W7	780.500000 W8	781.025550 VR	794.727800 VP	802.500000 VW
873.515414 WJ	905.499558 V7	993.409500 WK			

Other Frequencies Available Upon Request.

Frequency F1 Must Be Lower Than Frequency F2.

Frequencies F1 & F2 Must Be Selected Within One Frequency Range: (150 - 250), (300 - 500), (600 - 1000) [MHz]

Ordering Information



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VS-709 Dual Frequency VCSO

Revision History

Date	Approved	Description
30Jul2008	JM, BW	Preliminary Release.
09Jan2009	BW	Supply voltage, output type, operating temperature codes changed to universal part number codes.
30Jan2009	JM	New rendering, phase noise plot, additional freq code.
05Nov2009	BW	Additional frequency codes added.
24Feb2010	JM	Rendering, outline, & order info modified to show "f" between F1 and F2. Updated frequency codes. New Vc Pull & Phase Noise Plots.
08Mar2010	JM	Modified Jitter Note 8 on Pg2 for frequencies < 600 MHz. Updated Vc Pull Plots.
23Mar2010	BW	Official Release.
08Aug2011	JM	Corrected production test notes on Pg3. Corrected contact phone numbers, added ± 120 ppm APR order option and frequency codes (VC,VM,VN,VP,VR,VV,VW) on Pg8.
22Mar2012	JM	Added Phase Noise / Jitter Table on Pg5.
08Aug2012	BW	Added following frequency codes (W6, W7, W8) on Pg8.
02Dec2013	TM, MK	Added following frequency codes (WJ, WK) on Pg8. Added Address for Teltow
02Mar2014	MK	Vectron Logo changed, Vectron Address Shanghai changed