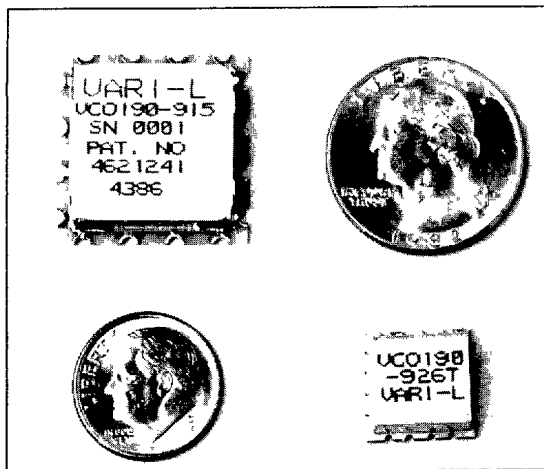


Low Cost Surface Mount VCO's



- Low Cost/Miniature Size
- Reliable/Surface Mount Technology
- 5 Volt Supply and Low Voltage Tuning
- Shielded/Surface Mount Package
- Application Specific for Lowest Phase Noise
- High Efficiency/Low Current Drain

The new VCO 190 Series Voltage Controlled Oscillators represent the latest high performance surface mount source designs for cost sensitive wireless applications.

Electrical

The VARI-L patented* oscillator circuit is applied as required, to provide the portable wireless designer with the very best combination of excellent power efficiency coupled with low output phase noise. In addition, each device contains a high isolation pad/buffer stage to provide flat spurious free power into almost any output load. All VARI-L VCO designs are fundamental single ended oscillators and therefore totally free of non-harmonic spurious outputs. Further, the harmonic outputs of these new oscillators are filtered and controlled as specified to provide for simplified end use designs.

A separate frequency modulation (FM) control port is supplied on some models for locked loop modulation, coarse/fine high speed dual loops, or DC fine tune requirements. This option is also special order available on other models shown.

Many of these oscillators are incorporated into the new award-winning** PLL 200 Programmable Phase Locked synthesizer modules for wireless and commercial applications. For this reason, the VCO-190 models shown were developed with full knowledge of the unique requirements for phase locked wireless applications.

Finally, all oscillators are 100% electrical tested using fully automatic computer controlled test stations. Simply, every part shipped is guaranteed specification compliant with S.P.C. data retained for monitoring quality and yield and associated continuous process tuning.

Assembly

The 190 Series of VCO's are available in tape and reel and are designed to withstand a minimum of two automatic reflow insertion exposures. (See Package Installation Notes for recommended installation temperatures.)

Mechanical

The unique surface mount package shown provides excellent mechanical solutions to shielding, low profile, ease of mounting, and repeatable in-circuit performance. These new VCO's are automatic re-flow assembled using the latest very high volume robotic manufacturing techniques. This results in superior electrical and mechanical product uniformity while allowing for low cost and virtually unlimited production capacity. Volume manufacturing is accomplished in an ISO 9000 compliant facility.

Temperature

Tuning linearity, output power, and phase noise are stable and flat over 0 to 70°C commercial temperature range. Operation from -35°C to +85°C is also specified with derated performance. (See notes.)

Supply

All specifications are published utilizing a 5 Volt supply. However, operation with a supply of 3 Volts or less is routinely possible with reduced parameter performance. Conversely, a series dropping resistor will allow proper operation at any greater supply voltage. The dropping resistor may be used in conjunction with an appropriate bypass capacitor (RC Filter) to yield: improved power supply, decoupling/noise suppression, improved oscillator supply voltage regulation with temperature, as well as improved oscillator pushing performance.

General

Detailed product data sheets for the models shown are available upon request. In addition to the standard catalog line, VARI-L offers a complete line of custom designed devices to meet specific customer requirements. These include tailored frequency ranges, custom output buffering, improved performance of selected parameters such as linearity, noise, modulation rate, etc., custom packaging, additional temperature range or temperature compensation and special power supply requirements. (For example contact VARI-L Sales Engineering for information on optimized 3V designs.)

*U.S. Patent # 4.621.241

	Patent #		Patent #
Austria	0.207.650	Italy	0.207.650
Belgium	0.207.650	Netherlands	0.207.650
Germany	0.207.650	Sweden	86304343
France	0.207.650	Switzerland	P.207.650
Great Britain	0.207.650	Canada	1.267.941
Japan	Serial #91957/86 (Pending)		

**Winner of the *Microwaves & RF* Top 12 Product Award for 1993.

Model VCO-190 ¹	Frequency MHz	Tuning Voltage ^{4,5} Min/Max	RF Power ⁶ dBm	Supply Voltage ³ Volts	Supply Current mA	Phase Noise 10 KHz Offset ⁷ dBc/Hz	Average Modulation Sensitivity MHz/Volt	Modulation Bandwidth MHz	Harmonic Suppression dBc	Pushing MHz/V
45	44-46	1-4	0	5	9.5	116	.7	>.5	20	.05
70	68-72	1-4	0	5	9.5	116	1.0	>.5	20	.07
72	70.5-73.5	1-4	0	5	9.5	116	1.0	>.6	20	.07
72M	70.5-73.5	1-4	0	5	9.5	116	1.0	>.6	20	.07
112	75-150	1-16	0	5	9.5	114	4.8	>.5	10	.4
125	120-130	1-9	0	5	9.5	118	1.2	>.8	20	.10
135	130-140	1-9	0	5	9.5	117	1.3	>.8	20	.15
150	100-200	1-16	0	5	9.5	113	7.5	>.5	10	.5
200	150-250	1-16	0	5	9.5	113	10.0	>.75	10	.75
250	245-255	1-4	0	5	9.5	116	2.6	>1.0	20	.25
250A	200-300	1-12	0	5	9.5	113	12.0	>.75	12	1.0
300	250-350	1-10	0	5	9.5	113	13.0	>.75	12	1.1
350	300-400	1-9	0	5	9.5	112	15	>1.0	12	1.3
400	350-450	1-9	0	5	9.5	112	16	>1.0	12	1.4
422	415-430	1-4	0	5	10.0	118	7.0	>2.0	20	.5
422M	415-430	1-4	0	5	10.0	118	7.0	>2.0	20	.5
450	442-458	1-4	0	5	9.5	118	7.25	>2.0	20	.5
450M	442-458	1-4	0	5	9.5	118	7.25	>2.0	20	.5
450A	400-500	1-9	0	5	9.5	112	16	>1.0	12	1.5
450AM	400-500	1-9	0	5	9.5	112	16	>1.0	12	1.5
490	482-498	1-4	0	5	10.0	118	7.5	>2.0	20	.5
550	500-600	1-9	0	5	9.5	110	17	>1.0	12	1.8
675	600-750	1-9	0	5	10.0	108	23	>2.0	12	2.5
680	667-693	1-4	0	5	9.5	112	11	>1.0	20	.55
752	739-765	1-4	0	5	10.5	110	11	>1.0	20	.6
773	760-786	1-4	0	5	10.5	110	11	>1.0	20	.6
775	700-850	1-9	0	5	10.0	107	26	>2.0	12	3.0
810	797-823	1-4	0	5	10.5	110	11	>1.0	20	.65
836	823-849	1-4	0	5	10.5	110	10	>1.5	20	.7
836M	823-849	1-4	0	5	10.5	110	10	>1.5	20	.7
864	851-877	1-4	0	5	10.5	110	10	>2.0	20	.8
900	800-1000	1-9*	0	5	10.0	106	30	>2.0	12	3.5
902	889-915	1-4	0	5	10.5	110	10	>3.0	20	.8
915	902-928	1-4	0	5	10.5	110	10	>3.0	20	.8
926	913-939	1-4	0	5	10.5	110	11	>3.0	20	.8
947	934-960	1-4	0	5	10.5	109	11	>3.0	20	.85
964	951-977	1-4	0	5	10.5	108	11	>3.0	20	.85
992	979-1005	1-4	0	5	10.5	108	11	>3.0	18	.85
1100	1085-1115	1-4	0	5	10.75	106	11.5	>4.0	18	.85
1100A	1000-1200	1-9*	0	5	11.0	104	30	>2.0	12	4.5
1200	1185-1215	1-4	0	5	10.75	106	12.0	>5.0	18	1.0
1500	1450-1550	1-6	0	5	11.0	103	28	>10.0	15	1.2
1550	1500-1600	1-6	0	5	11.5	102	28	>10.0	15	1.3
1650	1600-1700	1-6	0	5	11.5	100	28.5	>10.0	15	1.4
1750	1700-1800	1-6	0	5	11.5	99	28.5	>10.0	15	1.5
1850	1800-1900	1-6	0	5	11.5	98	28.5	>10.0	15	1.5
1900	1500-2300	1-15	0	12	14.5	80	70	>10.0	10	2.5
1950	1900-2000	1-6	0	5	11.5	97	29	>10.0	15	1.6
2050	2000-2100	1-6	0	5	11.5	96	30	>10.0	15	1.7
2150	2100-2200	1-6	0	5	11.5	95	30	>10.0	15	2.0
2250	2200-2300	1-6	0	5	11.5	95	30	>10.0	15	2.5
2200	1800-2600	1-15	0	12	15.5	80	70	>10.0	10	3.8
2350	2300-2400	1-6	0	5	11.5	95	30	>10.0	15	2.9
2450	2400-2500	1-6	0	5	11.5	95	30	>10.0	15	3.0
2450A	2400-2500	1-4	0	4.5	11.5	90	50	>10.0	20	3.7

Pulling ² MHz-PP	Drift MHz/°C	Separate Modulation Port			Package Style/Height See Table 1	
		Deviation 1 VPP at 1 KHz ³ KHz	Deviation Variation Over the Band %	Distortion 1 KHz at 1 VPP Bandpass .3 - 3 KHz %	S	T ⁴
.05	-.008				1	—
.07	-.01				1	—
.07	-.01				1	—
.07	-.01	10±2	±10	<.5	1	—
.25	-.02				1	—
.10	-.015				1	1
.15	-.015				1	—
.3	-.025				1	1
.4	-.028				1	—
.25	-.025				1	—
.5	-.03				1	—
.7	-.035				1	—
.8	-.037				1	—
.85	-.04				1	—
.5	-.04				1	3
.5	-.04	10±2	±10	<.5	1	3
.5	-.04				1	3
.5	-.04	10±2	±10	<.5	1	3
1.0	-.045				1	3
1.0	-.045	11±3	±35	<.5	1	3
.5	-.04				1	3
1.3	-.06				1	3
1.8	-.08				2	3
1.5	-.05				2	3
1.8	-.06				2	3
2.0	-.06				2	3
2.2	-.09				2	3
2.0	-.065				2	3
2.0	-.070				2	3
2.0	-.070	10±2	±10	<.25	2	3
2.0	-.075				2	3
2.5	-.10				2	3
2.0	-.08				2	3
2.0	-.08				2	3
2.0	-.08				2	3
2.0	-.085				2	3
2.0	-.085				2	3
2.2	-.085				2	3
2.2	-.085				2	3
3.5	-.13				2	3
2.3	-.09				2	3
2.5	-.13				2	3
2.7	-.15				2	3
2.7	-.16				2	3
3.0	-.18				2	3
3.1	-.19				2	3
5.0	-.3				2	3
3.2	-.2				2	3
3.4	-.26				2	3
3.5	-.28				2	3
3.7	-.30				2	3
7.5	-.4				2	3
3.9	-.3				2	3
4.0	-.22				2	3
6.0	-.37				—	4

Absolute Maximum Ratings

Operating Temp.	-35°C to +85°C
Tuning Voltage,	+16 VDC maximum
Power Dissipation,	100mW, maximum at 85°C

Environmental Performance

All units are designed to meet their specifications from -35°C to +85°C and after exposure to the moisture, shock, vibration, and thermal shock normally encountered in commercial hand held, mobile, and base station environments respectively.

Additional testing and/or specifications are usually determined on a TBD application specification basis.

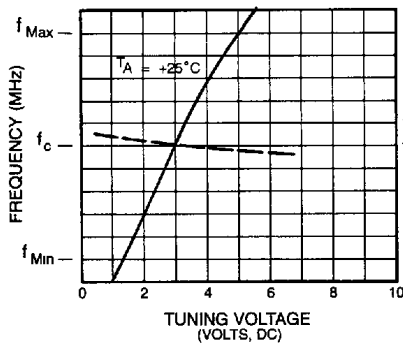
Limited Warranty

Vari-L Company, Inc. warrants its products against defects in parts and workmanship for a period of one year.

Notes

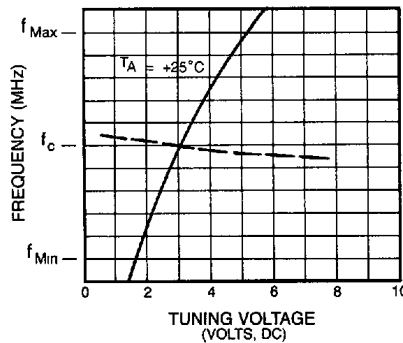
- All parameters are measured with all package ground pins properly RF grounded. All units are capacitively output coupled for 50 VDC isolation.
- Specifications for frequency pulling refers to all phases of a 12 dB return-loss load.
- Devices may be operated at lower supply voltage with reduced performance.
- Devices will oscillate normally with applied tuning voltages from 0 to at least 1.5 x Vt max.
- * Models VCO 190-112, 190-150, 190-200, 190-900, 190-1100A will oscillate normally with tuning voltages from 0 to at least 1.25 Vt max.
- Tuning voltages shown are the minimum and maximum voltages required to tune the frequency range, including temperature effects -35 to +85°C.
- Output power ±1.5 dB includes unit to unit variation and temperature effects -35 to +85°C. Power flatness is typically ±.5 dB max at any constant ambient.
- The typical phase noise shown is measured at 25°C with an input tuning port impedance of less than 100 ohms at ≥ 1 KHz. At higher tuning input impedance's ≥ 500 ohms phase noise will typically degrade 1-3 dB. Phase noise performance will degrade from the 25°C value, typically 1 db at ambients 0°C to +70°C and 2-3 dB at extremes of -35°C to +85°C. For typical phase noise at other offsets, see phase noise curves.
- Deviation is flat from DC to > 100 KHz.
- Models in the new 1/2" x 1/2" miniature "T" package are specified by adding a suffix "T" to the model number shown.

**TYPICAL
FREQUENCY/MODULATION SENSITIVITY
vs. TUNING VOLTAGE**



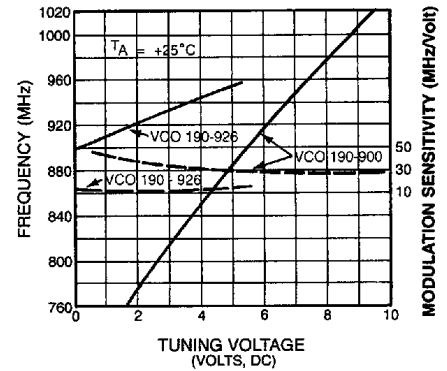
	f_c	f_{Min}	f_{Max}	Average Modulation Sensitivity MHz/Volt
Models	VCO 190-1500	1450	1550	28
	190-1550	1500	1600	28
	190-1650	1600	1700	28
	190-1750	1700	1800	28
	190-1850	1800	1900	28.5

**TYPICAL
FREQUENCY/MODULATION SENSITIVITY
vs. TUNING VOLTAGE**

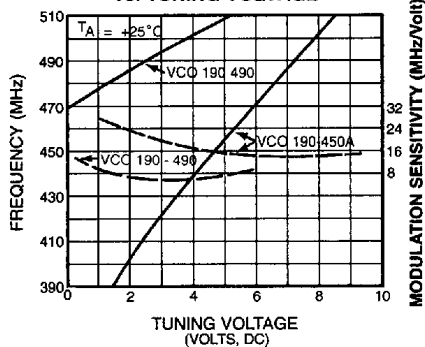


	f_c	f_{Min}	f_{Max}	Average Modulation Sensitivity MHz/Volt
Models	VCO 190-1950	1900	2000	29
	190-2050	2000	2100	30
	190-2150	2100	2200	30
	190-2250	2200	2300	30
	190-2350	2300	2400	30
	190-2450	2400	2500	30

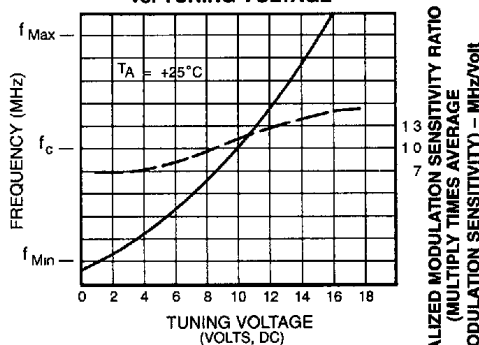
**TYPICAL
FREQUENCY / MODULATION SENSITIVITY
vs. TUNING VOLTAGE**



**TYPICAL
FREQUENCY / MODULATION SENSITIVITY
vs. TUNING VOLTAGE**

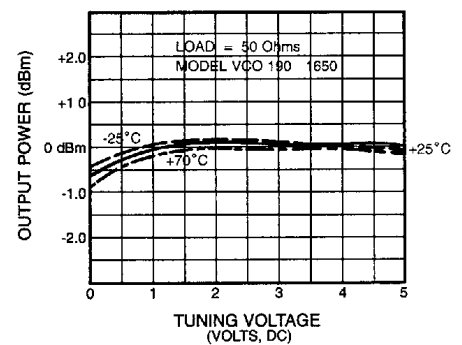


**TYPICAL
FREQUENCY/MODULATION SENSITIVITY
vs. TUNING VOLTAGE**



	f_c	f_{Min}	f_{Max}	Average Modulation Sensitivity MHz/Volt
Models	VCO 190-150	100	200	7.5
	190-200	150	250	10.0
	190-250A	200	300	12.0

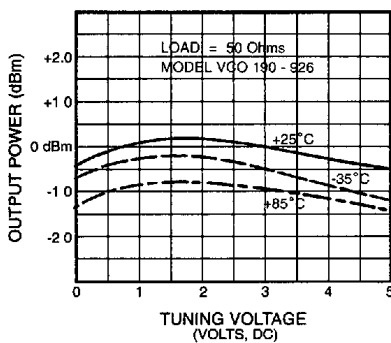
**TYPICAL
OUTPUT POWER vs. TUNING VOLTAGE/
TEMPERATURE**



Models	VCO 190-1500	VCO 190-1850	VCO 190-2250
	190-1550	190-1950	190-2350
	190-1650	190-2050	190-2450
	190-1750	190-2150	

All have similar output power curves

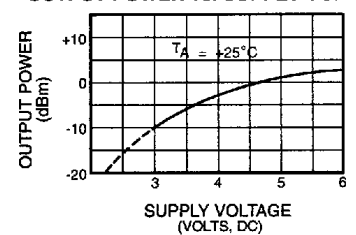
**TYPICAL
OUTPUT POWER vs. TUNING VOLTAGE/
TEMPERATURE**



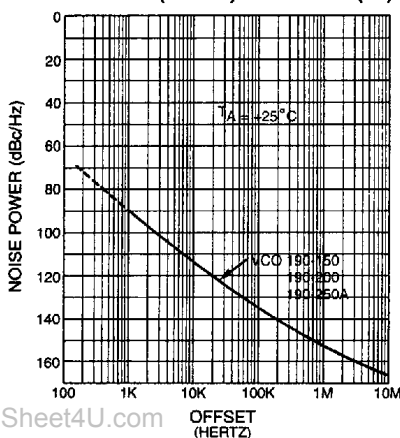
Models	VCO 190-680	VCO 190-836	VCO 190-915
	190-752	190-864	190-926
	190-773	190-900	190-947
	190-810	190-902	190-992

All have similar output power curves

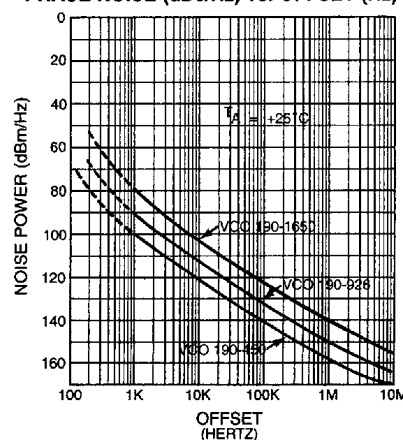
**TYPICAL
OUTPUT POWER vs. SUPPLY VOLTAGE**



**TYPICAL
PHASE NOISE (dBc/Hz) vs. OFFSET (Hz)**



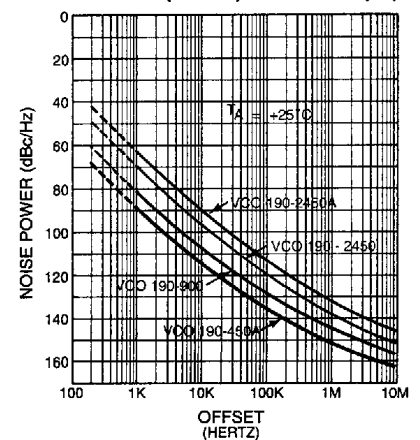
**TYPICAL
PHASE NOISE (dBc/Hz) vs. OFFSET (Hz)**



Models	VCO 190-1550	VCO 190-1750	VCO 190-1850
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Have similar noise curve shapes to VCO 190-1650

**TYPICAL
PHASE NOISE (dBc/Hz) vs. OFFSET (Hz)**

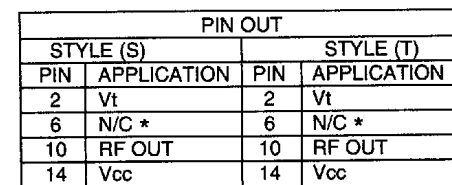


Models	VCO 190-1950	VCO 190-2350
	190-2050	190-2450
	190-2150	190-2450A
	190-2250	

Have similar noise curve shapes to VCO 190-2450.



1. The metal case is ground and is composed of tin electroplated brass.
2. This dimension is between the metal case and the edge of the board.
3. All half via contacts are plated thru from the pad on the top side to the pad on the bottom side of the board.
4. All dimensions shown in Detail-A and B are typical of all isolated contact pads.
5. Cross hatched areas are ground and are covered with LPI solder mask. All contact areas are plated with SN-63 solder.
6. Substrate material: FR-4.
8. For surface mount pad patterns, request Bulletin 101 "Surface Mount Package User's Information."



*Optional Audio Modulation Port (types with suffix "M" on Part No)

TABLE A	
HEIGHT DIM.	
-1	.250
-2	.180
-3	.200
-4	.100
-5	

Note: For special height requirements contact VARI-L Sales Engineering.

VARIL *We Have A Part In Your Future*

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