General

The VCO models shown are presented in a format to provide all performance information over the −55°C to +100°C temperature range. The standard VCO part numbers shown are tested and guaranteed over the 0 to 70°C temperature range to minimize test costs. For applications requiring full −55°C to +100°C operation, addition of the suffix "TC" to the Vari-L P/N will insure additional testing to guarantee this performance.

For example:

Model No.	Guaranteed	Notes
VCO-103	0 to +70°C Full Specs.	Lower cost for non-critical temperature environments.
VCO-103TC	−55°C to +100°C Full Specs.	Slightly higher cost for Full Temperature Range Applications.

Description

The Standard VCO models listed are single-ended, Fundamental Frequency Oscillators and therefore exhibit a complete absence of Sub Harmonic and Spurious outputs. The internal power dissipation in Vari-L VCOs is kept exceptionally low by virtue of a highly efficient patented circuit design. U.S. Patent #4621241, Canadian Patent #1267941, and E.P.O. Patent #0,207,650.

For this reason, the total semiconductor junction temperature rise is held to approximately 10°C above package ambient, which results in a calculated MTBF typically greater than 300,000* hours for continuous 100°C operation. Obviously these devices can be operated in even higher temperature environments with good semiconductor safety margins; however, internal design material selections require factory contact for higher temperature applications.

Vari-L oscillators are manufactured with gold wire bonding to precious metal pads, and all inductive components are gap welded and staked with non-conductive epoxy. The final assembly is encapsulated with a high mechanical damping foam which also features nearly perfect dimensional integrity versus temperature. Prior to cover welding all Vari-L Hybrids are vacuum baked in a multicycle purged dry nitrogen atmosphere.

*Airborne Manned Fighter Environment.

All completed VCO assemblies undergo 100% Final Testing and 100% gross and Fine Seal Testing.

In addition, 100% Screening to MIL-STD-883 Method 5008 is routinely costed and performed upon customer request. Vari-L Voltage Controlled Oscillators are designed and constructed to meet these "B" level Screening requirements over the temperature range of −55°C to +100°C.

Special "S" space level Hybrids are program quoted and managed on an individual application basis. Contact Vari-L directly for Program Flow and pricing information.

Quality

The paragraphs above illustrate a few of the salient design and process criteria used to produce a truly reliable Hybrid component for application in demanding design environments. Many additional steps of formal process control are flowed to our operators as well as our suppliers, resulting in a truly unified Quality System approach to cost effective manufacturing. Constant improvement in the Quality of design, production, and Customer Service are on-going goals of the Vari-L "Cost Effective Excellence" program.

Custom VCO Designs

Since the introduction of the standard Vari-L VCO series, much work has been done on enhanced performance oscillators as well as super component oscillator assemblies. The following is a list of typical examples of custom VCO design capabilities available:

- Improved harmonic rejection performance, all harmonics greater than 20 dBC over the octave.
- Buffered outputs, 6 to 10 dB additional load isolation with no increase in DC input power.
- Wide modulation bandwidths, greater than 5% of the VCO's low end starting frequency typically available.
- Special VCOs for dual negative and positive supply and/or tuning voltages.
- Frequency hopping via internal switching for operation at two or more center frequencies at the same tuning voltage setting.
- Oscillator on/off, internal switching capability with low power TTL command signal.

- Alternate package configurations, SMA, flatpak, surface mount as well as the standard TO-8 package are all available options (see pages 39 and 40).
- Special narrow band oscillators providing:
  - —Improved phase noise and reduced harmonic output.
  - —Tailored tuning characteristic with controlled modulation sensitivity.
  - —Higher tuning speeds.
  - —Improved linearity.
  - —High Power output up to +27 dBm.
  - —Multiple coupler or power divider outputs.

New VCO Models

The new models introduced in this catalog provide the design engineer with the latest in significant VCO performance improvements.

Features for Octave Tuning:

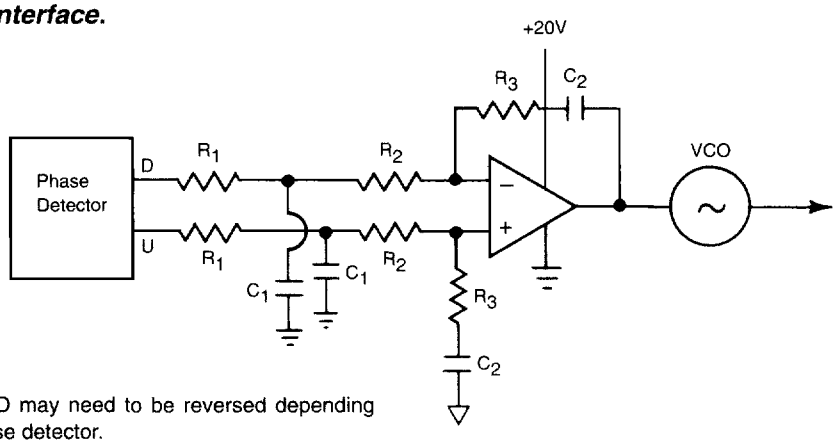
- Greatly reduced phase noise
- Superior Harmonic suppression
- High Modulation Bandwidth
- Improved Temperature Stability

Application and Interface Data

The components shown are typical examples of special VCO assemblies currently in production at Vari-L. They are presented simply to showcase the wide range of integration capabilities resident within our company. All components shown are standard catalog Vari-L designs and represent a fraction of our total product and integration experience.

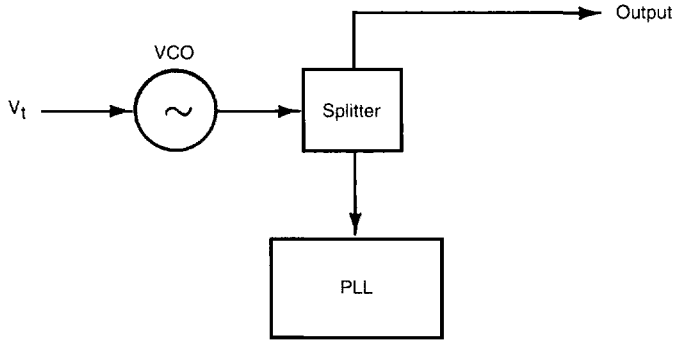
Standard Octave Tuning VCO's require +1 to +20 Vdc to tune the frequency range of the oscillator. It is com-

Figure 1. Tune Line Interface.



Notes:
The connections to V and D may need to be reversed depending upon the polarity of the phase detector.

Figure 2. Output Interface.



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mon to utilize a digital phase detector which provides +5V digital up and down pulses to steer the VCO. An operational amplifier can be used to convert the +5V digital pulses to the +20 Volts required by the VCO. (See Figure 1.)

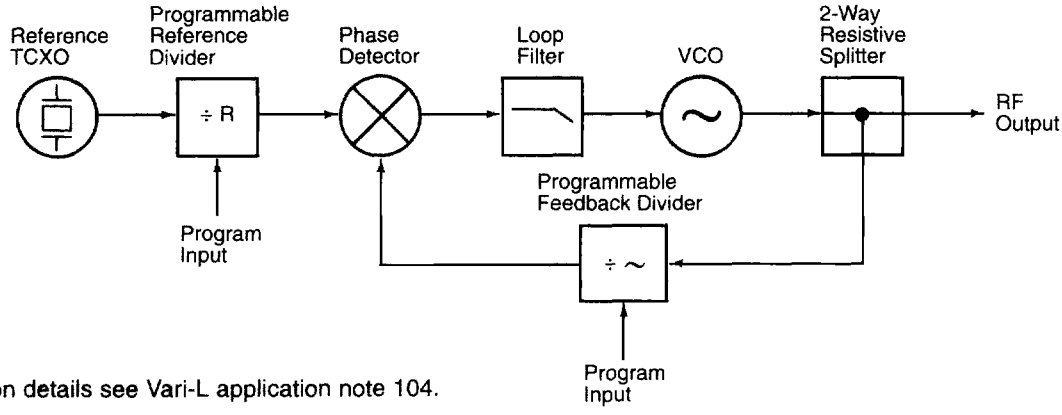
The OP Amp acts as a differential to single ended converter as well as the controlling loop filter for the phase locked loop. The filter shown is for a second order type two control loop. The added pole of R1 and C1 is pulse suppression filter to prevent the OP Amp from saturating. This pole is normally set 6 to 10 times greater than the desired loop bandwidth. Other loop filter configurations can be formed by adding poles and zeros (resistors and capacitors) to the loop transfer function as required.

The VCO output will need to be split into two outputs to build a phase locked loop. (See Figure 2.)

One output of the splitter will be used for the feedback portion of the phase locked loop, the other is available for your application. The output of the VCO is a 50Ω radio frequency device. Therefore proper selection of the power splitter is required. Either a resistive 6dB splitter or a 3dB reactive splitter can be used. The frequency range of the splitter should be wider than the frequency range of the VCO.

The layout of the VCO and splitter circuit should follow standard 50Ω radio frequency practices. That is, trace length should be minimized (typically less than 0.5 inches) and the trace width should be designed for a 50Ω impedance, taking board thickness, dielectric constant and tangent loss factors into consideration when designing the line.

Figure 3. Typical Phase Locked Loop.



For application details see Vari-L application note 104.

Figure 4. Converter Module.

High Power Multiple Output

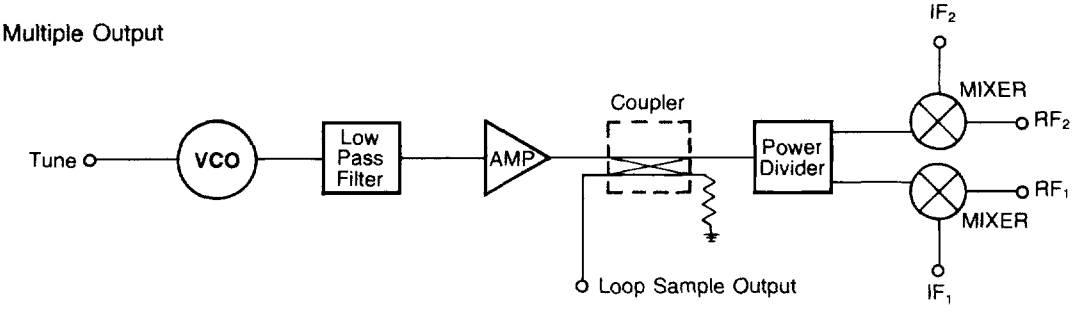


Figure 5. Multi-Band VCO Module.

Common Tuning Voltage

Mutually Exclusive TTL Band Selection Control

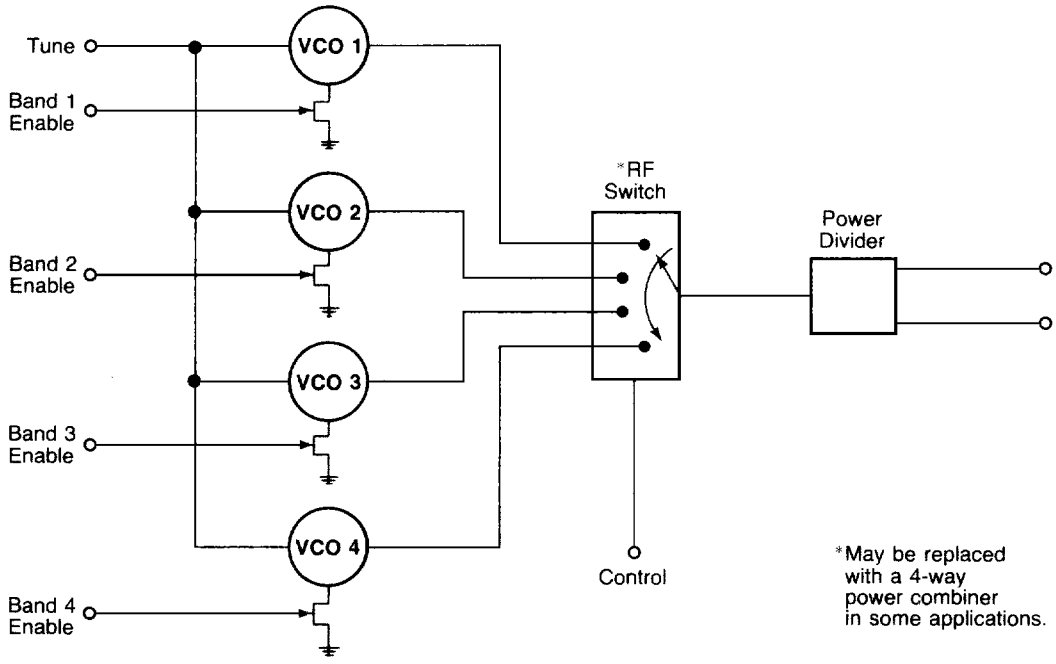
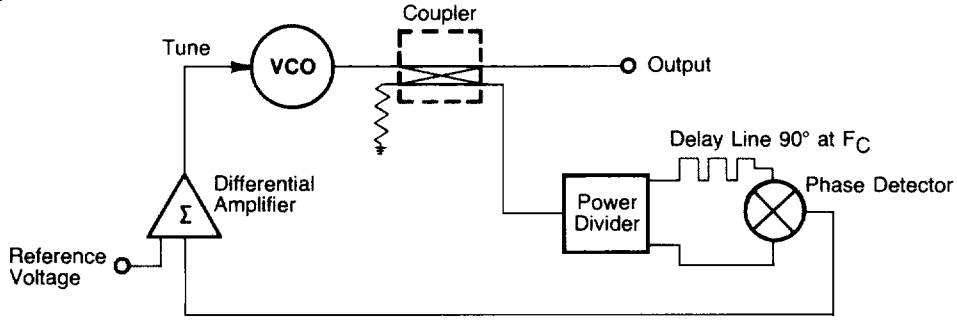


Figure 6. Temperature Stabilized Module.

Loop Discriminator

Compensates Temperature Drift



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