

Product Feature

VCO Mixer Module VDM/1900-260L

Introduction:

The voltage controlled oscillator (VCO) and the mixer represent two key components in a wireless communications system. For many applications, the local oscillator (LO) drive of a mixer is provided by a VCO. Often, the VCO output is amplified and then filtered before being presented to the LO of the mixer. The signal for the RF port of the mixer is typically derived from a low noise amplifier (LNA) which ultimately comes from an antenna. The resulting intermediate frequency (IF) produced from mixing the two signals is then processed or possibly down converted again.

For higher performance communication systems, a low phase noise VCO is used along with a high third-order intercept point (IP3) mixer. Both of these components can be purchased or possibly developed internally. Simply connecting high performance components together will not necessarily yield a high performance system. For example, the correct LO drive level is critical in order to realize the optimum performance of the mixer. If the drive level is too low, the IP3 of the mixer will degrade considerably along with the RF to IF conversion loss. The proper grounding of a mixer is also critical to obtain high LO to RF isolation. There is a myriad of details that should be addressed to obtain optimal performance.

Traditionally, the above functions are purchased as individual components, or built from discrete chip parts, or a combination of both. As mentioned above, this can often result in unforeseen problems that ultimately lengthen development time. With ever increasing competition in the wireless communications market, the need to get to market quickly with a new product is paramount. Failure to introduce your products to the market in a timely manner may result in shorter product life cycles, lower profit margins, or limited sales opportunities.

In order to help our sub-system and system level customers get their products to market faster; TRAK Microwave has broken tradition and introduces model VDM/1900-260L. This module consists of a low phase noise VCO, amplifier, and band-pass filter along with a high IP3 mixer, all of which are housed in a 1.20-inch square surface mount package. (Figure 1 and 1a– Block Diagrams)

Applications:

With the available VCO sample output taken after the amplifier stage, the module is an ideal building block for a synthesized up converter or down converter.

This particular module was originally designed for a synthesized PCN down converter however; it may also be used as a building block for a low phase noise synthesized source. In this case, the RF might come from a multiplied crystal source. The IF resulting from mixing will be at a much lower frequency. This lower IF frequency is compared to the fundamental frequency of the crystal using a phase lock loop (PLL) chip. The output of the PLL then passes through a loop filter and is connected to the tune line of the VCO. By doing this, the divide by N number can be significantly reduced which in turn, will reduce the phase noise of the synthesizer. The sample output port is amplified and used as the final output frequency.

Benefits:

As a result of having the above-mentioned functions all in one module, a critical piece of a frequency synthesizer is complete. The designers of frequency synthesizers can spend more of their time on the phase lock loop section or demodulation performance. In addition, the chance of experiencing interface problems between components is significantly reduced. There is no concern for a load problem between the VCO and the amplifier or the proper drive level of the mixer LO. The module is tested as a complete unit and therefore no tuning or tweaking is required at the component level.

An additional benefit lies in the procurement area. The quantity of parts required for a sub-system is reduced, which results in fewer parts purchased and a decrease in incoming inspection time. Consequently, only one part needs to be qualified.

The unit was designed to be modular and therefore flexible. TRAK Microwave has many other VCO's and mixers to choose from that can be dropped into the same architecture. As a result, many other LO, RF, and IF frequencies can be accommodated. Lower phase noise VCO's along with higher IP3 mixers are also available. (Figure 2 – Photograph)

Design:

The VCO used for the LO in this circuit tunes from 1760 to 1830 MHz using a tune voltage of 0.5 to 4.5 volts dc. The typical phase noise at a 10kHz offset is -105 dBc/Hz. The VCO operates with an 8.0-volt supply and draws 25 mA's. A resistive pi-pad and an amplifier stage follow the VCO. A MMIC amplifier biased at 65 mA's is used and has a calculated MTBF of 30 years.

The amplifier is followed by a classic 5-pole band pass filter, which typically provides 45 dB of rejection for the 2nd harmonic. The filter is comprised of commercial 0603 size chip capacitors and chip inductors. The band pass filter is followed by a resistive pi-pad to attenuate any possible remixing of unwanted signals. The chain is then completed at the LO port of the mixer.

For the VCO, the amplifier/filter, and the mixer the ground plane was broken up to provide further isolation of LO to RF and also harmonic rejection. Placing a grounded metalized strip between functional areas provides further isolation on the signal plane.

Performance:

For the following measurements the LO frequency was set at 1780 MHz and the input RF at 1930 MHz at an input level of 0 dBm. (Figure 3a, 3b, 3c – Test Data Graphs)

Power Supply	+8.0 volts	IP3:	20.17 dBm
Current Supply	100 mA	LO to RF Isolation:	26.5 dBm
Conversion loss:	7.7 dB	LO to IF Isolation:	36.0 dBm
		Sample LO (SO):	-14 dBm

Note: The mixer that was used for this particular model was originally designed for use in an up converter. This is why the LO to IF isolation is so much greater than the LO to RF isolation.

Package:

The VCM/1900-260L is provided in a 1.20 square inch package with an overall height of 0.28 inches. It has a stamped and folded Cupro-Nickel lid for shielding. The base material is Rogers 4003. The unit is designed to be compatible with a surface mount production line. It is recommended to reflow the unit at 215 degrees Celsius or less.

Summary:

A module consisting of an integrated VCO, amplifier, band pass filter, and mixer has been presented. This module can be easily incorporated into a frequency synthesizer design. The module tuning is eliminated and reduces the design cycle time of a synthesized frequency source. The design is modular and can accept many other TRAK Microwave VCO's or mixers.