COMMERCIALIZATION ASSISTANCE PROGRAM

Low-Noise Vibration-Insensitive VHF Crystal Oscillator to Enhance Radar Performance

Business Opportunity:

Historically, one of the limitations in target detection in RADAR systems has been due to the vibration induced noise in the reference crystal oscillator. Now that a crystal resonator with lower vibration sensitivity has been developed, improved radar systems can be developed. The market for RADAR systems in ship board, aircraft and missile systems is over a billion dollar market annually. The oscillator and resonator market is over 10 million dollars annually. For RADAR applications, the company is looking for an industrial partner to incorporate this product in their design. A Prime Defense Supplier is looking to integrate the new technology on the Joint Strike Fighter as well as other classified platforms. For non-RADAR applications, the company is looking for industrial partners to define operational problems and user requirements; federal agency program managers with grant funds to define technical gaps in RF technologies; and researchers in radar systems to receive sponsored research. As a public company, we welcome investors interested in our RF/crystal/electronic technologies.

Company Background:

Company was founded in 1965 and has a staff of 300 full-time employees. It is a production company with two manufacturing operations in the United States; Yankton, South Dakota and Orlando, Florida that produce a full range of Frequency Control products. These products are used in a wide range of electronic systems including aerospace, telecommunications, avionics and instrumentation. The company works with industry leaders in each of these markets. The company brings custom engineered solutions to market.

Industry Problem:

Noise from the frequency reference, typically a low-noise oscillator will reduce the radar systems capability to identify real versus false threats due to the resulting system detection limits. In crystal oscillators phase noise is generated as a result of vibration. The noise level is set by the vibration sensitivity of the resonator used to make the crystal oscillator. The company will bring a solution to market that enhances the radar system detection limits.

Technology:

The reference oscillator performance is limited by the resonator vibration sensitivity. This company has developed a resonator that has an order less sensitivity than previously used resonators. This can result in a 20 dB (100 times) reduction of phase noise sideband levels.

Advantages

- Lower vibration sensitivity reference oscillators resulting in lower phase noise and better radar system performance.
- Smaller size for the same vibration induced noise, than alternate approaches. For weapon based radar applications, a smaller volume is critical for adding more capability to the system.

Differentiating Feature:

Low Vibration Sensitivity Crystal Oscillator

The product is a low noise VHF crystal oscillator with very low vibration sensitivity. It incorporates a newly designed resonator that has environmental vibration sensitivity approximately 10% that of standard quartz resonators. A view of one realization of the oscillator is shown in the photo.

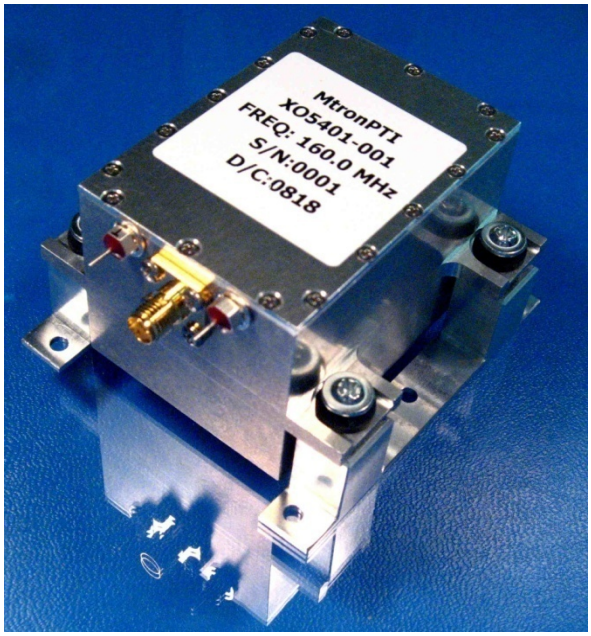

Figure 1 Complete Oscillator Assembly

This version of the oscillator includes vibration isolation in all axes and vibration sensitivity cancellation in up to 3 axes. The acceleration sensitivity performance of the oscillator, with compensation in only the most sensitive axis measured at VHF, is shown in the graph. It compares the performance to that of a high quality quartz oscillator. This result demonstrates that we have a product that can be transitioned to production status.

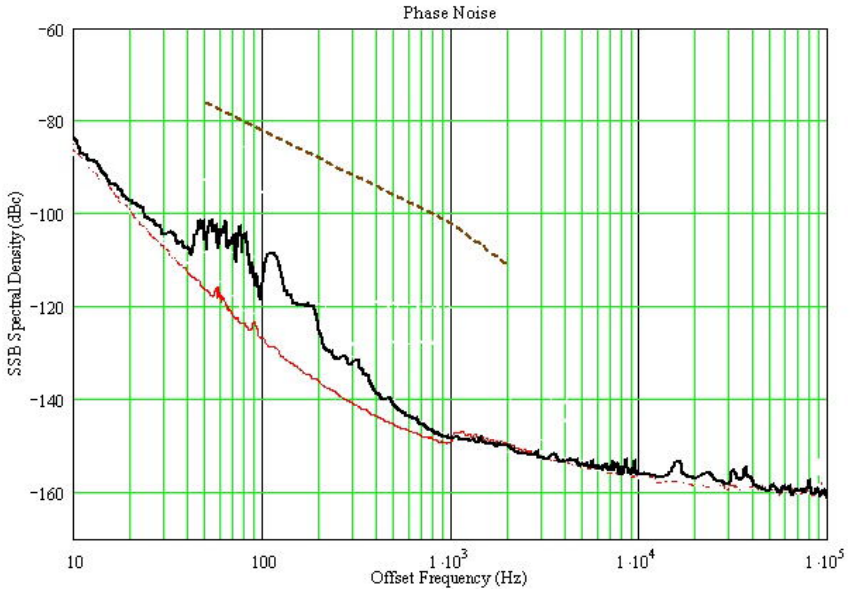

Figure 2 Phase Noise Under Vibration

The black line shows the oscillator under acceleration. For these tests the applied vibration was 0.02 g^2/Hz for 50 Hz to 1000 Hz reducing to 0.01 g^2/Hz at 2000 Hz. The red line shows the test oscillator under static conditions. The dotted line is the equivalent that would be obtained with standard resonators without either vibration isolation or compensation.

Stage of Development:

Needs assessment, proof of concept, feasibility, and initial prototyping of the product have been completed. Proof of concept was completed in an SBIR Phase II prototype. Refinement of the resonator processing and integrating the resonator into oscillators and validating the oscillator performance is the primary effort at this time.

Competing Technologies:

There are no competing devices that achieve this level of performance in the same size package. Current technology requires added complexity which in turn requires a larger enclosure. The new technology will allow a smaller package which is an enabler for new applications.

Applications:

- The prime application is RADAR applications on vibrating mobile platforms, such as Joint Strike Fighter and F-22.
- The size reduction is an enabler for weapon platforms, such as AMRAAM and Standard Missile.
- The secondary application is RADAR applications in static platforms, such as air traffic control.

Benefits:

The lower phase noise oscillator will provide the RADAR system integrator with a device that will enable the improved detection of threats. The smaller volume associated with the new technology will enable a broader range of use for this technology. For weapon platforms, the improved phase noise performance will improve target acquisition. More radar clarity in an air traffic control environment will assist in identifying all the air traffic in a region.

Intellectual Property:

A US patent has been applied for related to the resonator design. The resonator processing is proprietary.