



Why YIG Technology

- **YIG Microwave Resonators, YMR, are controlled by the spin of atomic electrons.**
 - YMR generate microwave resonances without actual capacitors, inductors, or resistors
 - YMR has virtually no phase distortion due to the resonator small size
 - YMRs have played a major part in our military success in radar, electronic countermeasures, and there is a great deal of history on their applications
 - The YMR is tuned only by the magnetic bias field at approximately 2.8 MHz/ Gauss
 - Since there is no intrinsic YMR resistance loss, the Q is extremely high and can be controlled by design from ~50 to >10,000 over frequencies from 2GHz to 60GHz

Current State of Competitive YMR

- **YMR manufacturing complications are mitigated by larger product dimensions**
- **This is diametrically opposed to existing “SWAPC” needs**
- **Skillful tuning is essential to take advantage of YMR unique capabilities**
- **Producing the required magnetic field entails power that is excessive compared to other existing technologies**
- **No Competitive YMR producers that can make use of foundry processes**
- **Environmental issues, especially vibration and shock, require special and costly design structures**

What VIDA YMR Resolves 1

- **VIDA has a patented filter design that supports direct YMR to YMR coupling to reduce magnetic gap size and lower loss**
 - Coupling precision between resonators is fundamental in filter design and determines filter characteristics
 - Removing the need for YMR RF coupling structures (CS) reduce the length of the magnetic gap
 - Resonator interstage isolation is improved by eliminating CS to CS leakage
 - Reduce complexity in adding stages of YMR

What Vida Resolves 1, Continued

- **Foundry manufacture coupling structures that can be created in mass**
 - Some coupling structures are needed at present to adapt the YMR to supporting circuitry.
 - A path forward to include the coupling structures in the production of the filter or oscillator body.
- **Distributed electromagnetic structure**
- **Embedded RFIC capability in the filter topology**
- **(More claims in the patent)**

What VIDA Resolves 2

- **VIDA has an international patent on a two dimension coupling structure to promote foundry manufacturing and improve performance and lower cost**
- **VIDA also has a patent on using differential YMR coupling to interface directly with antennas and RFIC devices**
 - Differential YMR coupling solves the problems of isolation because the ground currents are eliminated
 - Also the YMR coupling losses are greatly reduced and the magnetic gap can be further reduced
- **VIDA has proof of concept prototype YIG RFIC Oscillators using the above patents.**
- **RFIC oscillator demonstrated at the 2016 IMS in San Francisco (pictures in presentation)**

VIDA RFIC YMR Oscillator

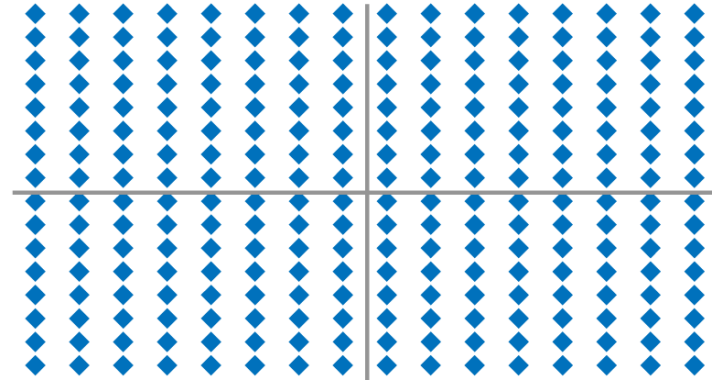
- **Data and testing confirmed the performance over a 8 to 15 GHz tuning range. (Data available)**
- **Original market was to be Radar and Cell phone radios**
- **Only 1 design spin was completed but the coupling structure was part of the IC design**
- **We had many positive responses to the size and performance**
- **Tyco commodity buyer wanted to know if we could bid on 2 million units per year to put into a new cell radio module (the phase noise performance was a driver)**
- **The market that is most interesting at this point (Low Hanging Fruit) is clock oscillators**

Why YMR RFIC Oscillators Are Perfect for Digital Clocks

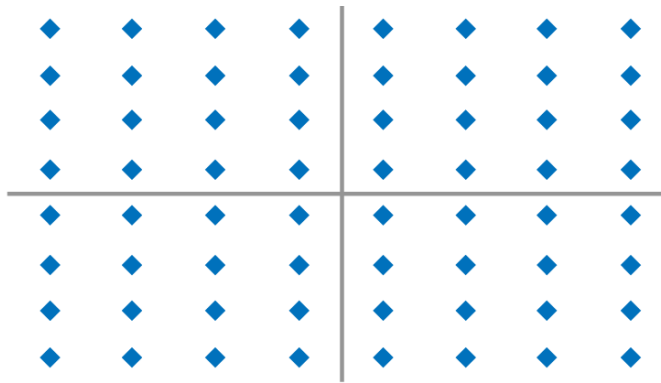
- **The jitter requirements digital clocks is becoming impossible with current methods**
 - There are two basic strategies
 - Multiply a precision clock to the required frequency for accuracy
 - Phase lock a low noise oscillator to a precision clock that is at the required frequency
 - Both of these methods have been fully exploited and will not be useful in the evolving designs
 - Software designed radios and frequency sources are being used on some military hardware but one these units has a cost of over a million dollars that I know about
 - Simply put the locked oscillator looks to be the best and most economical solution but the only way of locking inductor, capacitor, and resistor oscillator is to pull it of its fundamental frequency and that lowers to Q and increases phase noise
 - YMR Q's are practically independent of tuned frequency and just dependent on the magnetic gap strength.
 - Oscillator phase noise is not dependent on any Phase lock requirements
 - Vibration and Shock resistance is greatly improved
 - The VIDA Products RFIC has demonstrated Phase Noise performance at up to 15 GHz of -150dB/Hz

Higher data-rate modulation

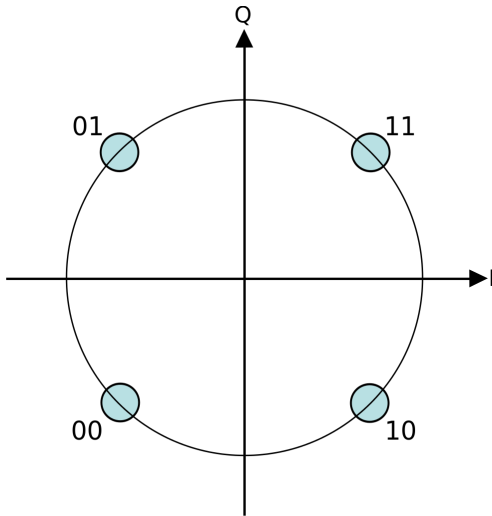
256-QAM
8 bits/symbol



64-QAM
6 bits/symbol

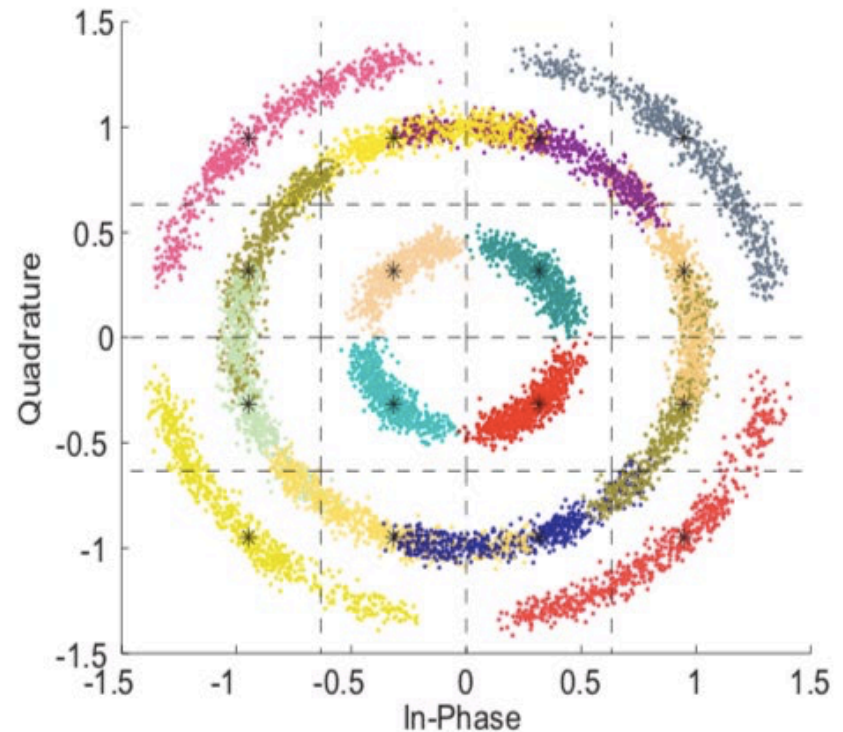
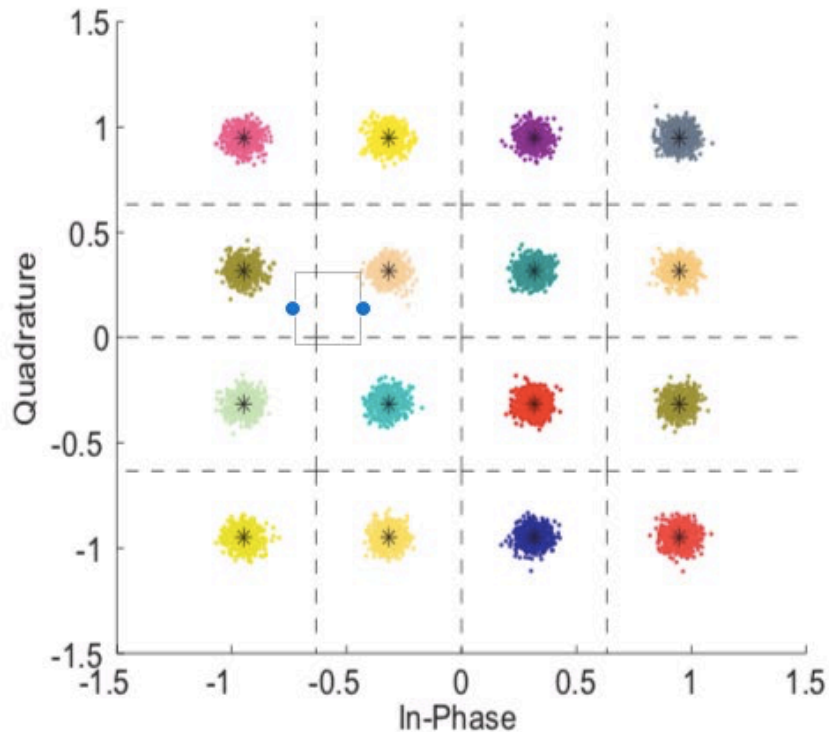


QPSK
2 bits/symbol

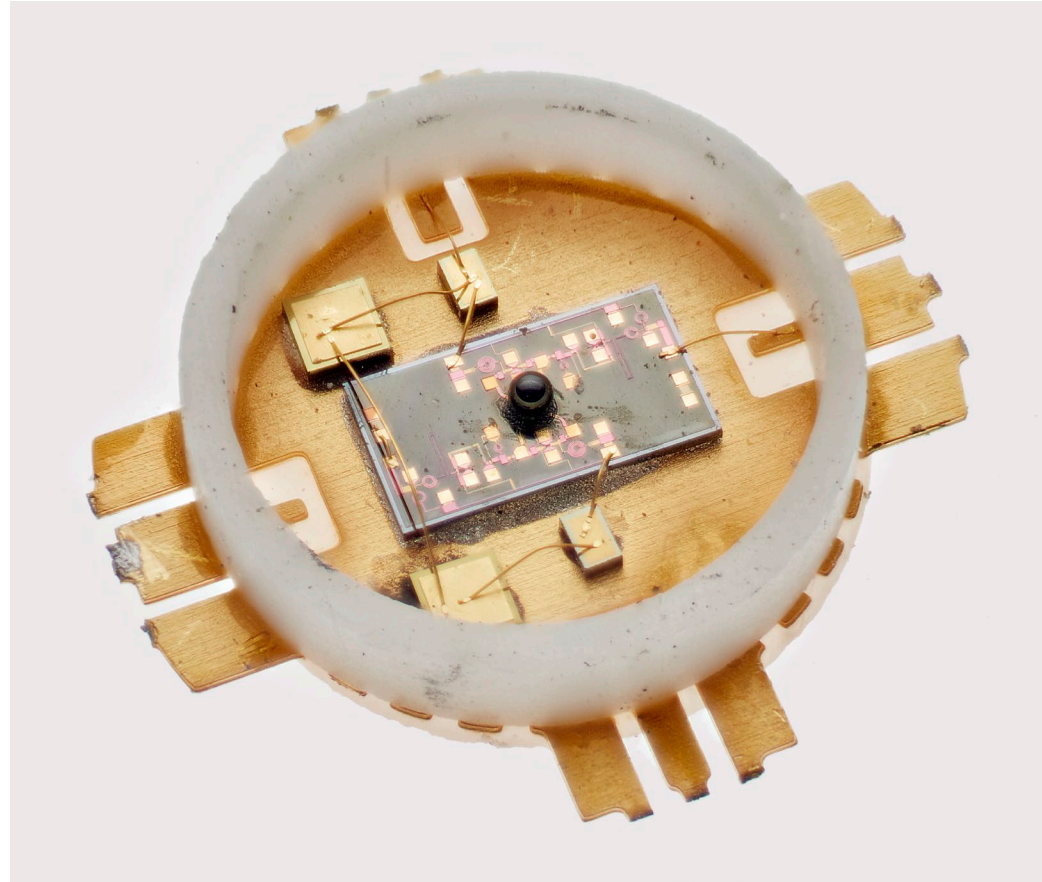


Introducing Phase Noise

Possible degree of modulation depends critically on “Phase Noise”



VIDA's™ DOMIC Technology



VIDA YIG DYO (YOMIC)

Die layout GCS

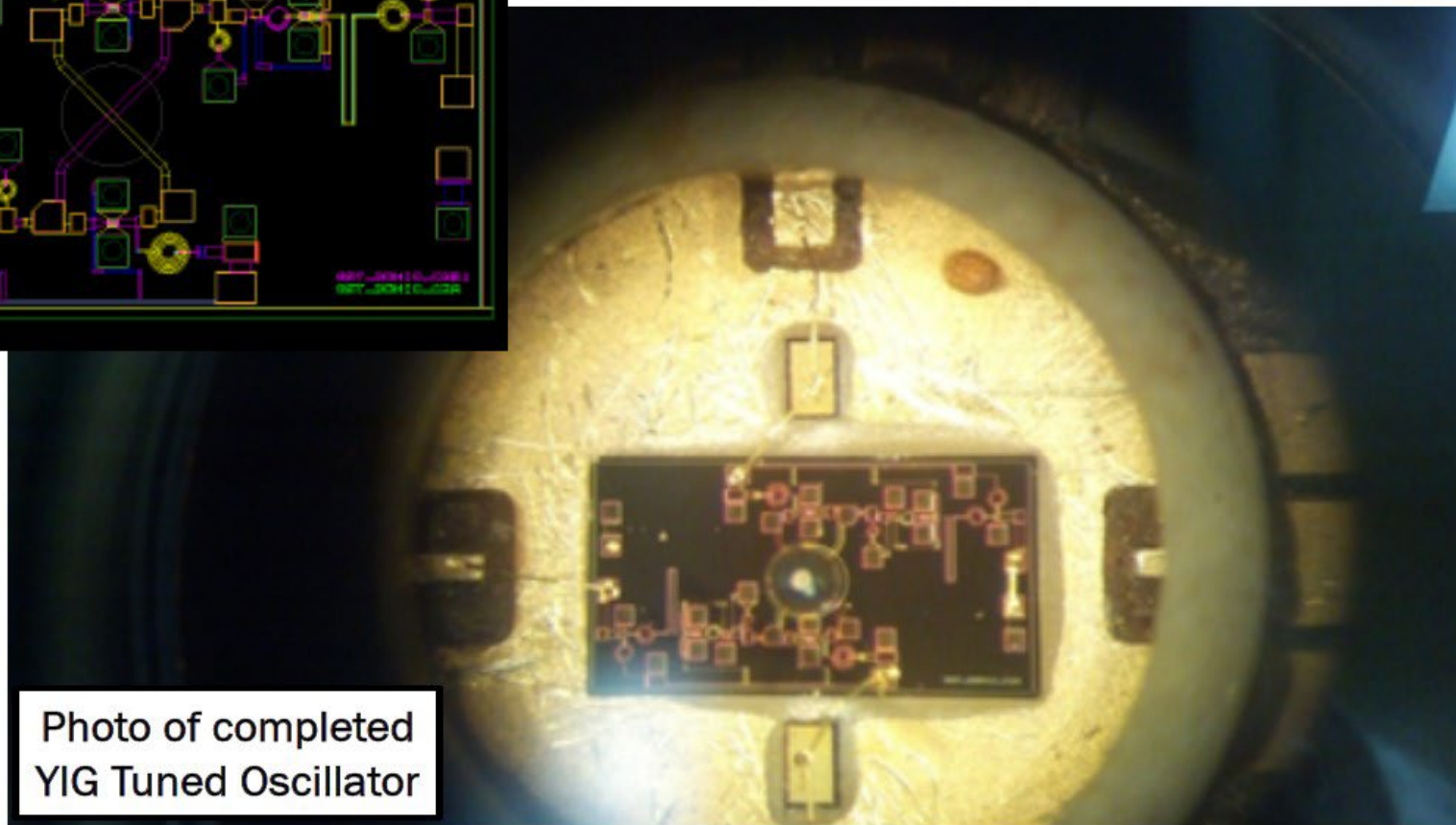
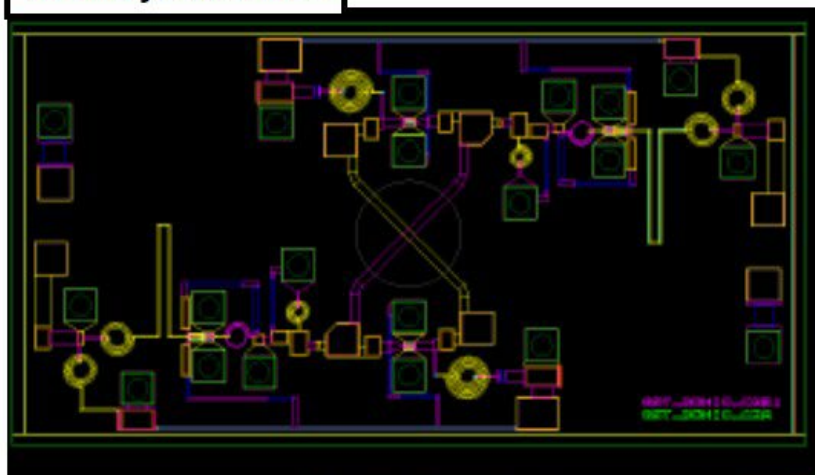
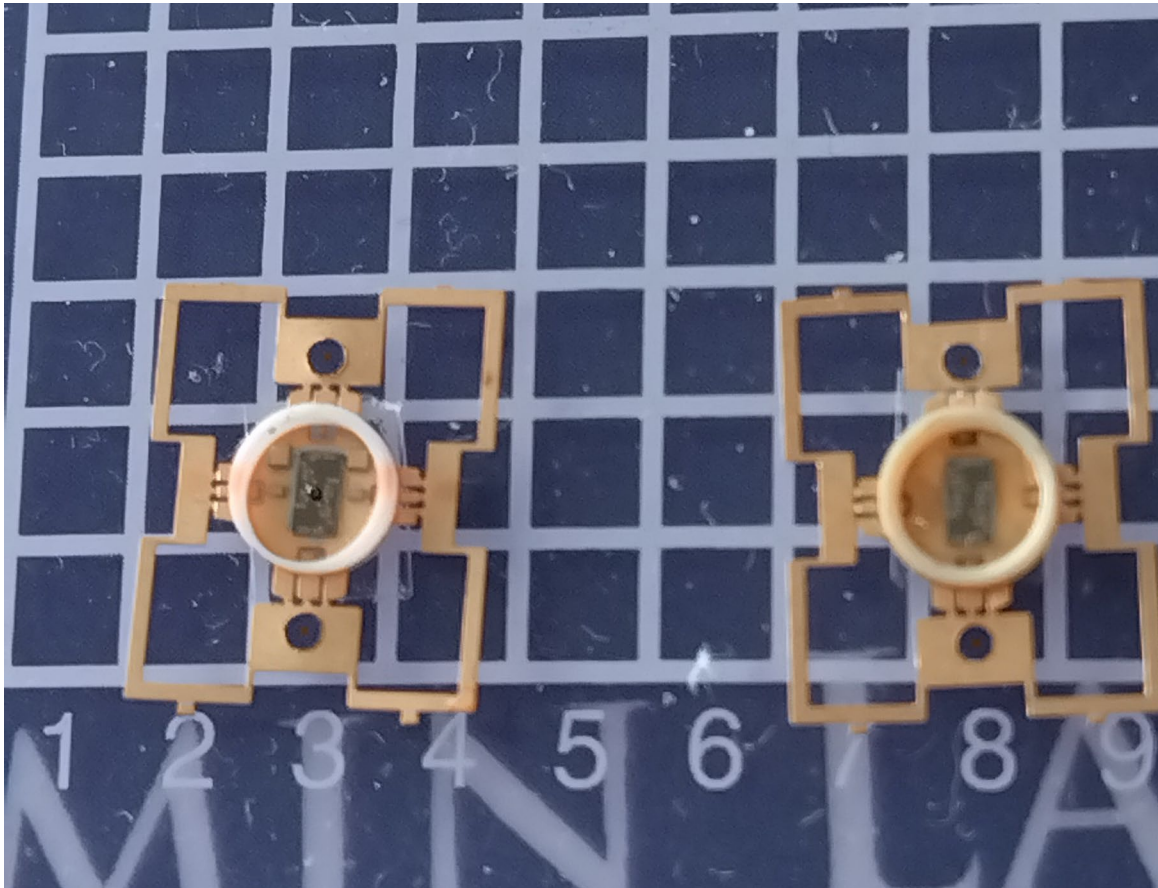
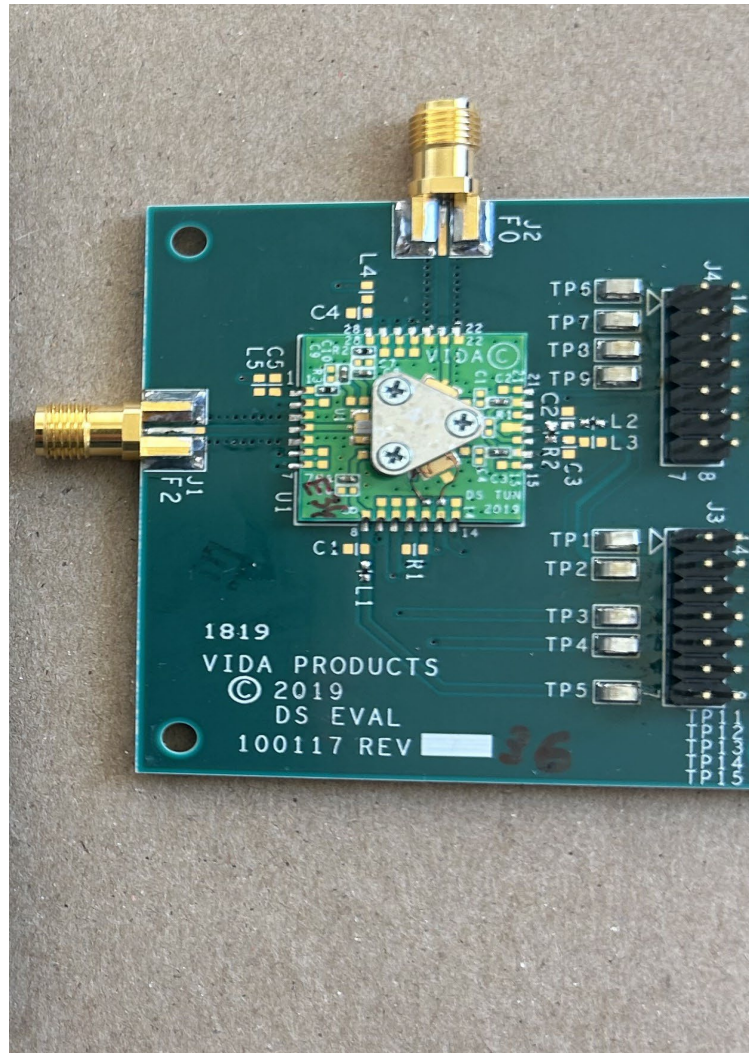


Photo of completed
YIG Tuned Oscillator

RFIC Oscillators In Process



YIG Oscillator RFIC Test CKT



Intellectual Property

Patent Topic	Patent # and Status
DOMIC Phase 1 (Sphere)	US Patent #8,350,629 1/2015 Provisional 62682624 6/2018
DOMIC Phase 2 (Nano-Film)	WO2016100713A1 / 2015
DOMIC Phase 3 (Wafer scale integration)	Recent advancement – evaluate for IP
Novel YIG design	Pending

Thank You

