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Evaluation of Micro Lambda MLMS-0820 Synthesizer

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Introduction

The Micro Lambda MLMS series synthesizer is a YIG based synthesizer designed to fit in a single slot PXI chassis. It is available in several frequency bands from 250 MHz to 32 GHz. It can be operated from an internal crystal oscillator reference (100 MHz as implied by interface software) and also can be locked to an external 10 MHz Source. A sample unit covering 8 to 20 GHz was obtained for evaluation for potential use in the ngVLA local oscillator system.

Power Consumption

The MLMS-0820 was found to require about 8 watts of power. The 5 volt supply required 400 mA and the 15 volt supply required 600 mA. This required the use of a heatsink when operated on the bench with no forced air cooling.

Phase Noise

Phase noise was taken at 4 frequencies to 100 MHz offset with the Keysight E5505A phase noise test set. The MLMS was provided with a Wenzel low noise external 10 MHz reference with the following phase noise data typical from the manufacturer:

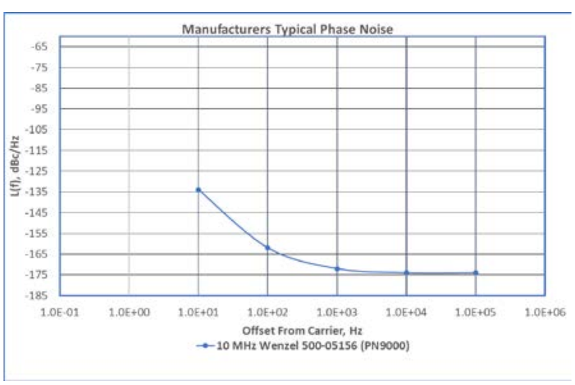

Figure 1. 10 MHz Reference Phase Noise

The 10 MHz phase noise is undoubtably superior to the MLMS internal standard, if it contains an oscillator. It may just have a divider for the 100 MHz oscillator it does contain. The external reference probably improves close in phase noise, depending on the bandwidth of the reference lock loop in the MLMS. There is no way to measure the internal 100 MHz oscillator phase noise. Common practice seems to be using a combination of reference oscillators to achieve the best phase noise. 10 MHz oscillators are generally superior to 100 MHz oscillators at offsets below about 10 kHz. 100 MHz oscillators are generally better above that offset and are better than multiplied 10 MHz oscillators.

The Keysight E5505A phase noise test set is a mixer type measuring system. An equal frequency reference must be provided to the L port of the instrument at +15 dBm for best phase noise sensitivity. The test set reference was a Keysight E8257D option UNY (Low Phase Noise) microwave synthesizer. Manufacturers data was used to produce the following plot:

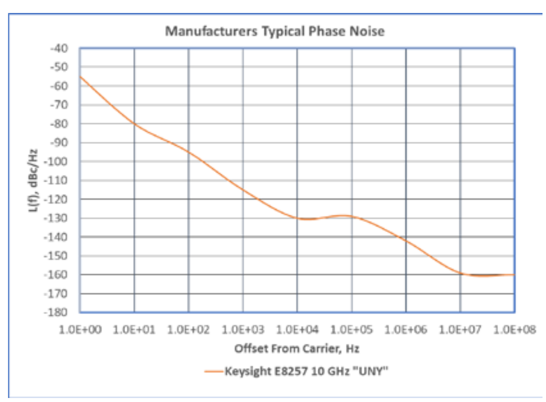

Figure 2 Keysight Synthesizer used as Phase Noise Reference

Therefore, the measured phase noise can be only equal to or higher than this.

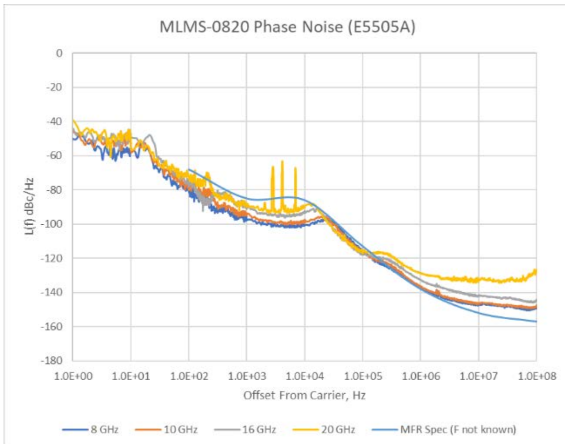

Figure 3 MLMS Measured Absolute Phase Noise with Manufacturers Specification

Integrated Phase Jitter was calculated from 1 Hz to 100 MHz:

8 GHz	234 fs
10 GHz	248 fs
16 GHz	388 fs
20 GHz	434 fs

Table 1 Time Jitter at 4 Oscillator Frequencies

The deviation from the manufacturers specifications could be a result of the unit being overheated during testing. Also, there is no clear indication of the frequency at which the specification is given. It appears to reasonably meet or exceed the 10 GHz data up to about 30 MHz offset from the carrier.

Spurious

Searching for narrow band spurs can be particularly difficult and hard to measure as they require wide sweeps and narrow resolution bandwidth and that results in long multiple sweeps at various offsets from the carrier. Furthermore, they might differ at different synthesizer settings. This investigation is limited in scope. A proper investigation might require searching the entire bandwidth of the receiver to which it is attached. Also, it should include different LO frequencies. The manufacturer reports that this synthesizer uses the HMC704 as the synthesizer chip and the HMC573 as the multiplier.

Micro Lambda lists "Harmonic and Subharmonics" at -15 dBc and "Non-Harmonic Spurious" at -54 dBc. This is wholly unsuitable for ngVLA where the current spurious requirement is -104 dBc. Possibly, they could be reduced with aggressive filtering since the LOs are fixed (almost).

The following is a full span showing harmonics and a subharmonic of the 10 GHz carrier.

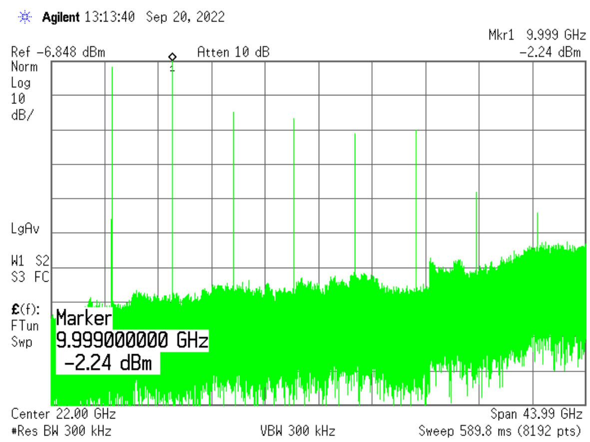

Figure 4 MLMS Harmonics at 10 GHz Output

The following are spurs measured around the carrier. In both cases, the carrier is at the reference level and the vertical scale is 10 dB per division.

Carrier at center:

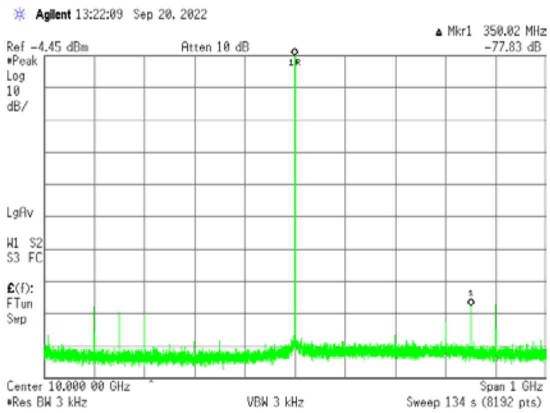

Figure 5 Spurious in 1 GHz Span around Carrier

Carrier offset -500 MHz:

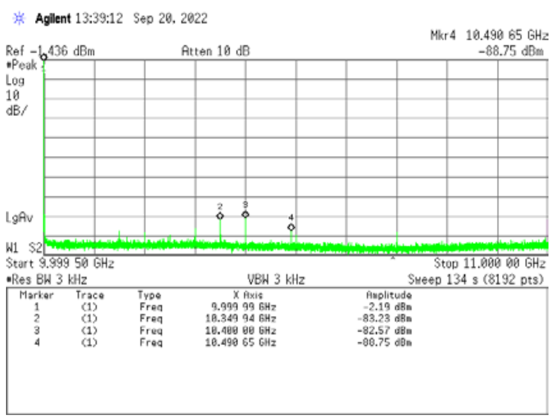

Figure 6 Spurious From Carrier to 1 GHz Above Carrier

Conclusion

The MLMS is a good example of what is possible given the physical size. It may also be a good representation of power requirements of a similarly designed device. The synthesizer and active multiplier as well as the probable amplifiers included are all reasonably modern components. If it could meet specifications, it would be an excellent COTS part that could constitute a "core" oscillator that could provide fundamental signals and signals to multiplier chains. Discussion with representatives at IMS 2022 indicate that this is intended to be an off-the-shelf item and does not seem interested in refinement for our use.

Appendix

MLMS-0820 Data Sheet

https://www.microlambdawireless.com/uploads/pdfs/MLMS-25-32-GHz-datasheet.pdf

HMC704 8 GHz Frac-N PLL Data Sheet:

https://www.analog.com/en/products/hmc704.html#product-overview

HMC573 8-22 GHz Frequency Multiplier Data Sheet

https://www.analog.com/en/products/hmc573.html#product-overview