Using an EOT ET-Series Photodetector to Detect Beat Notes

Vescent Photonics

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1 Introduction

In many laser-based experiments and devices, multiple lasers must operate at different, but strictly defined wavelengths. In this situation, it is often expeditious to reference one of these lasers, the so-called leader, to a primary wavelength standard such as an atomic transition and reference all the other lasers to this leader taking into account the wavelength offsets required by the goal of the device. An effective way to achieve this is an offset phase lock between the leader and follower laser where the difference between the observed offset and the target offset is used as an error signal to dynamically correct the offset via a servo loop. The standard method of measuring the offset between the leader and follower lasers is via optical heterodyne beat note detection. In this technique, the leader and follower laser are mixed on a fast photodetector. The resulting signal varies at the frequency difference between the two lasers (the beat note).

The Vescent D2-260 Beat Note Detector is optimized to detect this signal for wavelengths below about 860nm. For experiments based on the D1 transitions of cesium, offsets up to 9.3GHz at a nominal wavelength of 895 nm may be required and so another detector must be used. The EOT ET-Series photodetectors are simple and relatively inexpensive detectors for detecting a beat note from the optical heterodyne of two lasers at these longer wavelengths. This application note will discuss a method for, and the results of detecting a beat note from two 895nm lasers using several of the ET-Series photodetectors and some inexpensive 3rd party amplifiers.

2 Setup

A basic optical heterodyne setup was used to test the effectiveness of the ET-Series photodetectors. The two 895nm lasers were combined in a Vescent D2-250 Heterodyne Module, and the beat note was detected by the ET series photodetector. This signal was then amplified by a Mini Circuits ZX60-06183LN+ and used as the error signal input to the Vescent D2-135 Offset Phase Lock Servo. A system diagram can be seen in Figure 1.

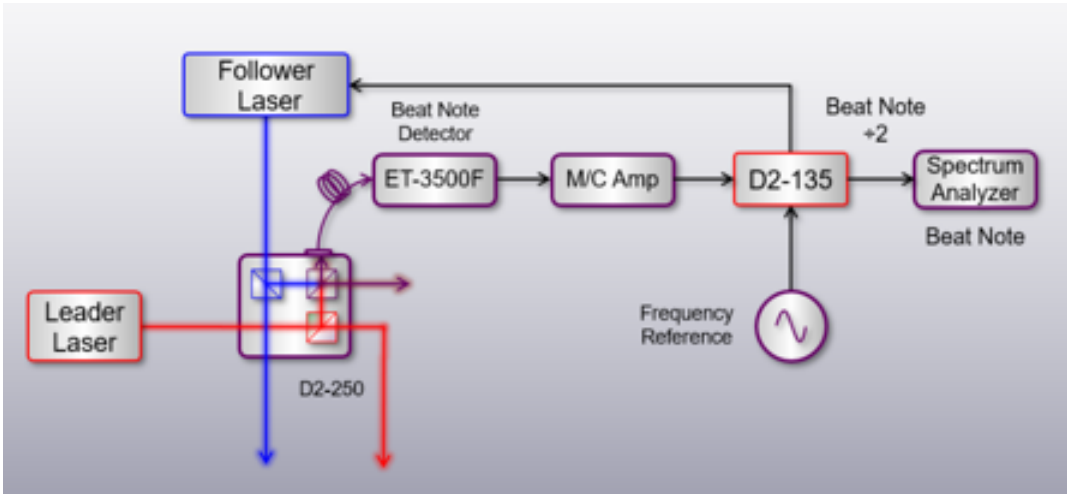


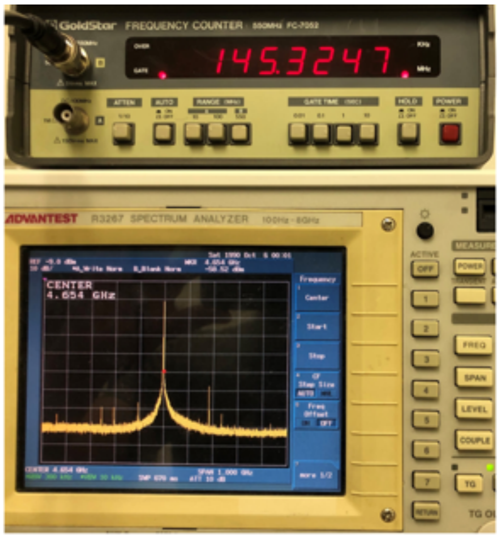
Figure 1: Block diagram of the test setup.

The beat note ÷2 monitor of the D2-135 was viewed on a spectrum analyzer to determine the feasibility of using the photodetectors to detect the beat note.

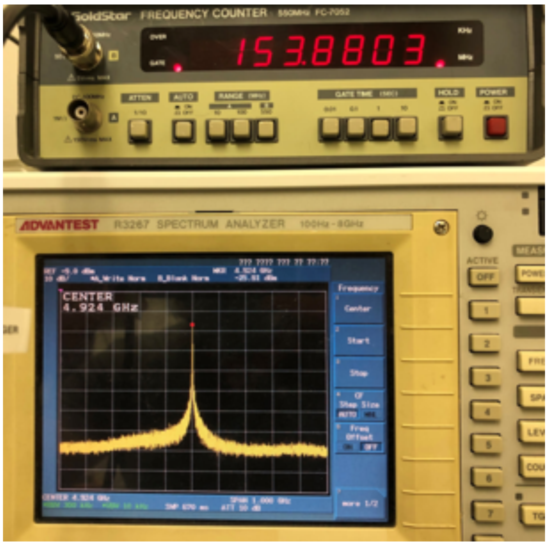
3 Results

The ET-2030 and ET-4000AF were seen to be inappropriate due to a bandwidth limitation of 1.2-1.5 GHz and poor responsivity at 895 nm, respectively. The ET-3500F was tested both with and without an amplifier. Without amplification, the beat note was barely visible at the spectrum analyzer. However, usable beat notes were observed with the ET-3500F after amplification at 9.3GHz, 9.8GHz, and 10.3GHz, where the detector began to reach its bandwidth limit. Pictures of these beat notes are shown in Figures 2-4. Although the amplified version of this detector, the ET-3500AF, was not available to us at the time of these tests, it can be inferred that it would also work well, since the two models have the same detector element, and the amplifier is specified to support the required bandwidth.

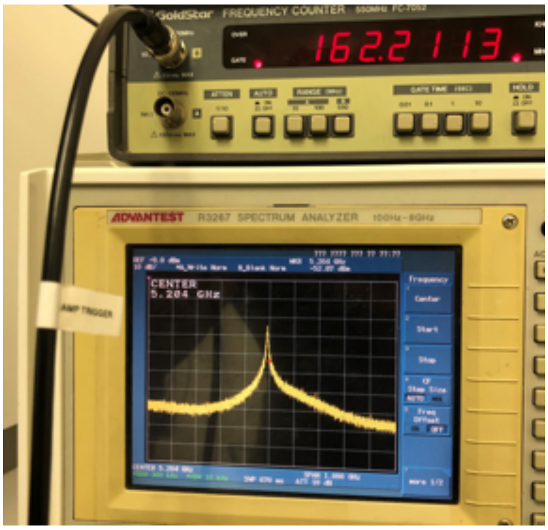
Pictures of these beat notes are shown in Figures 2-4.



(a) 9.3 GHz Beat Note



(b) 9.8GHz Beat Note



(c) 10.3GHz Beat Note

Figure 2: Beat notes at different offset frequencies as shown by the spectrum analyzer. A frequency counter displays the divided beat note signal in MHz. The dividing factor is N=64.

4 Summary

The EOT ET-3500F photodetector, when appropriately amplified, can act as a beat note detector for a heterodyned laser system at 895 nm. Beat notes as high as 10.3GHz were observed in such a system. Other ET-Series photodetectors were tested as well, but none of them performed well enough to be used.

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