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Frequency Stability

Frequency stability is defined as the instantaneous rate of change of an emission frequency. Due to the complex nature of different measurement techniques, Spectra-Physics chose to report frequency stability values based on heterodyne measurements between two HeNe lasers. A model 117A laser was tested against a Zeeman stabilized laser. Reported here is typical data.

Figure 1 shows the frequency stability of the 117A over a typical 8 hour work day and Figure 2 shows the frequency stability over a one minute time interval.

It is commonly known that frequency stability is directly related to the length stability of a resonator cavity. Two factors can affect length stability: mechanical vibration and thermal expansion. The 117A exhibits excellent frequency versus temperature stability and can be cycled over a 20 °C range without mode hopping. Mechanical vibrations are minimized by mounting the 117A as indicated on the back page of this data sheet.

Allan Variance

The Allan Variance (σ^2) is a measurement of the relative frequency differences from one time interval to the next, expressed as a fraction of the mean frequency. The Allan Variance is computed from frequency as a function of time with numerical integration to determine the average frequency over ever increasing time spans. For the Model 117A, typical values are as follows:

fractional frequency stability (σ) vs time interval

1 minute	2.0×10^{-9}
1 hour	1.0×10^{-10}
1 day	1.0×10^{-10}

Intensity Stability

The Model 117A stabilized laser represents a major improvement over what was available in previous lasers. Intensity stability measurements of the 117A indicate a less than 0.1% variation over time intervals of several hours. This intensity variation represents the limit of commercially available precision radiometer measurement capability.

Use of Mode Selection

The Model 117A is configured to allow use of the laser in either the frequency stable mode or the intensity stable mode. A key on the front of the power supply can be turned to either mode and then removed to prevent inadvertent change from one operating mode to the other.

Modulation Feature

The Model 117A has provision for external, low frequency modulation. The nominal range of input signals is ±15 volts. Input signals in excess of 20 volts may cause unstable operation and loss of lock point.

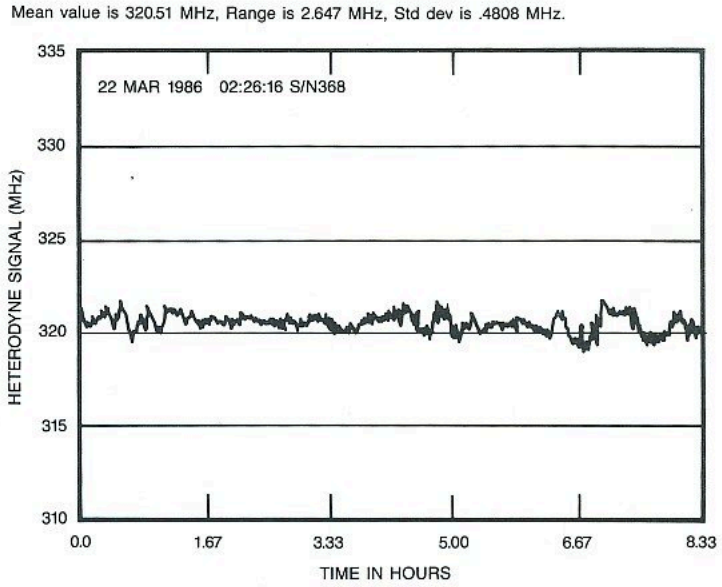


Figure 1. Frequency vs. Time: Model 117A heterodyne signal with Zeeman Stabilized Laser. Sample time 1/10 second.

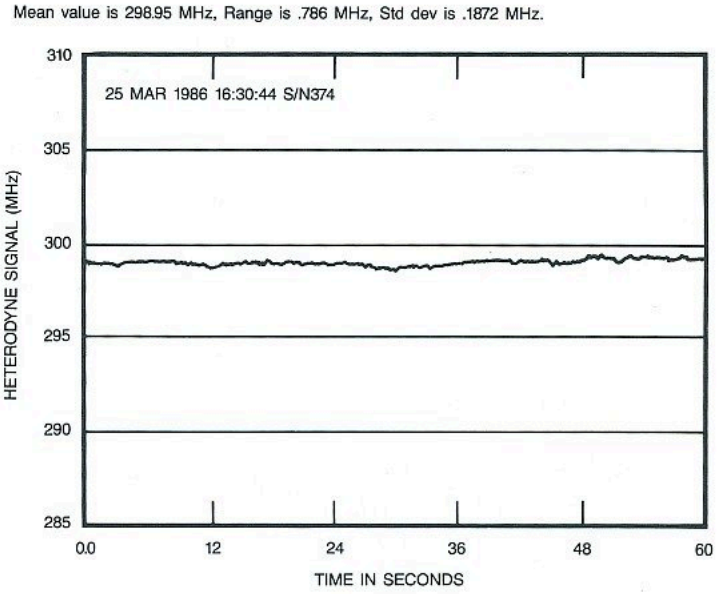


Figure 2. Frequency vs. Time: Model 117A heterodyne signal with Zeeman Stabilized Laser. Sample time 1/10 second.

In the frequency stabilized mode, the nominal modulation response is 10 MHz/Volt.

In the intensity stabilized mode, the nominal modulation response is −2 percent/Volt.

Initially and during the pre-heat cycle, any modulator signal should be removed to allow the laser to achieve stabilization before any external modulation is employed.

ALL VALUES ARE NOMINAL AND WILL VARY FROM LASER TO LASER

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