Short term wander

Application note for PPCL700

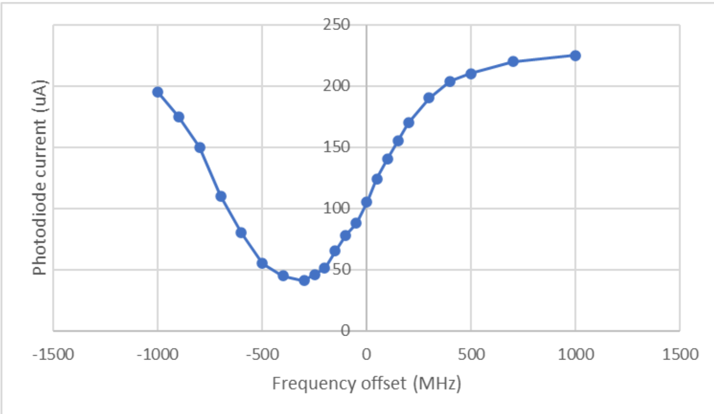
This note describes testing on a PPCL700 unit over a day, while monitoring the frequency and power in whispermode..

Contents

1. Test setup

Tunable laser in PP70BL007 in PPCL550 enclosure was powered with a stabilized voltage source (12V) and controlled through USB interface. The output of the module was guided through a gas-cell and the power was detected by a photo-diode. Due to specifics of the setup this photodiode was the power sensing diode in a wavelocker and the current was measured with a Keithley 2500.

The laser frequency was aligned to the slope of an absorption peak of the gas-cell. The characterized response of the system is below.



From this graph the slope of the response on the positive and negative slope was obtained as:

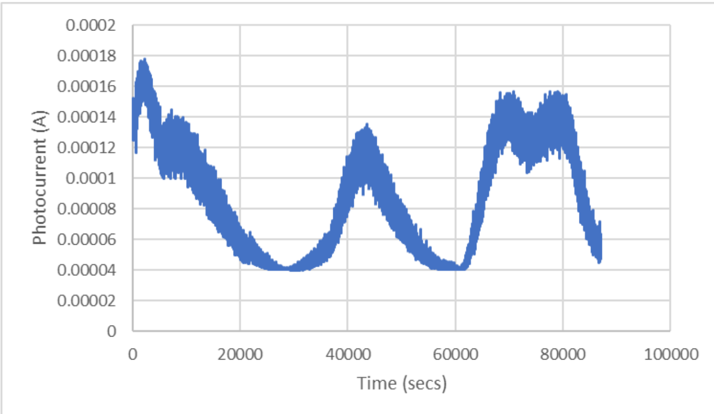
Negative: frequency = -340.1 MHz – 3.138 MHz/uA * current (uA)

Positive: frequency = -357.58 MHz + 3.297 MHz/uA * current (uA)

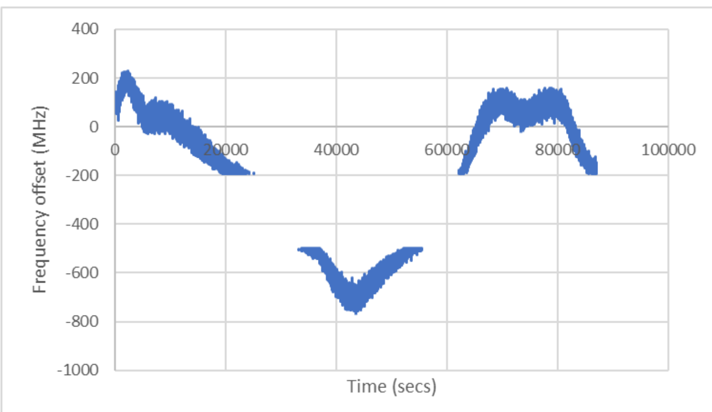
2. Test results

The device was activated at t=0 and left to run in dither mode for 10 minutes. Then it was switched to whispermode and left to run for 24hrs. Every 0.4 seconds (limited by communication time) the device data was obtained and photo-diode current measurement was made.

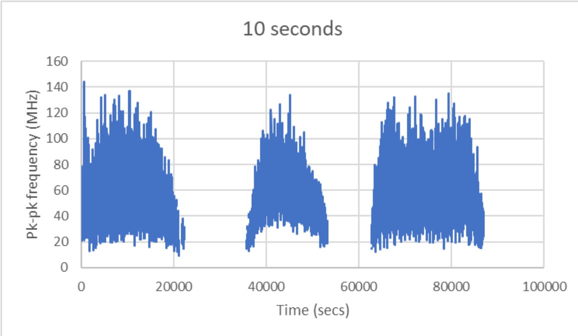
The below chart shows the raw current measurements. It can be seen that the frequency drifts down the peak and then up again. It is assumed that the laser continues to drift and moves from the positive slope to the negative slope.

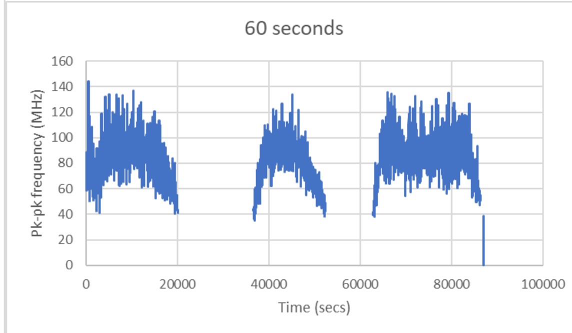


This graph is converted to frequency offset using the measurement in section 1. The part where the photocurrent is less than 50uA is ignored as the error is too large there.



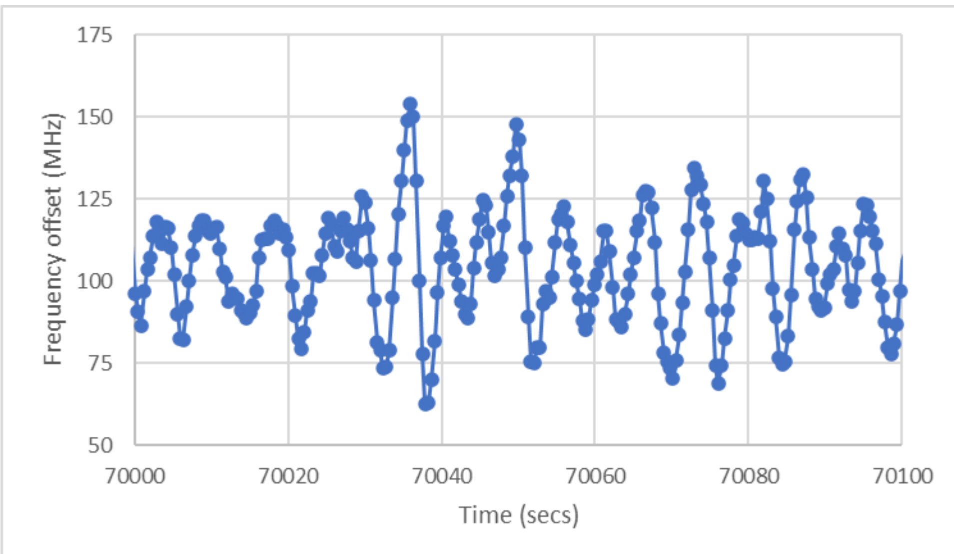
The pk-pk over a 10 and 60 second period is determined from this graph and displayed below.





Clearly the longer time period does not result in more drift/wander (the maximum in both graphs remains the same). Over a 10 second period the pk-pk varies between 20MHz and 120MHz. Over a 60 second period the pk-pk varies between 50 and 120MHz.

We are showing below the frequency over a 100 second period. Though there is a random contribution, there also seems to be a ~8 second period in the results, which we believe can be traced back to some variation in the control loop for the phase current.



During the testing the power remained stable within 0.15dB (4%) and moved along with the frequency (and presumably the temperature). At the end of the test the power had fully recovered (temperature being about the same at start and end of the test).

3. Conclusions

In general, the testing data shows a bigger variation than we would have expected and have seen in the past. Some error terms, such as changes in ambient temperature, photo-diode stability and current measurement error may have contributed to these results.

The longer term drift is attributed to the ambient temperature changes. This is a known effect and likeley the temperature of the module swung around 10 degrees during this test (not measured).

The shorter term variation is partly attributed to inherent behaviour of the module. We are aware of this and have not been able (thus far) to identify root cause conclusively and develop a fix. To our knowledge, this wander is in the range of 50MHz over 10 seconds.

During this testing we did observe a weak correlation with changes in the phase control current. This is controlled by a control loop and it may indicated that we need to further optimize this control loop to not result in oscillations.