

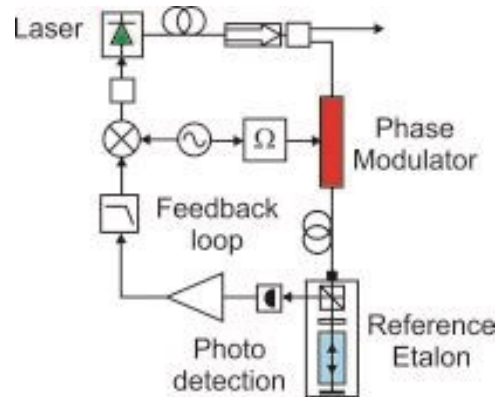
RAM and PDH

June-2018

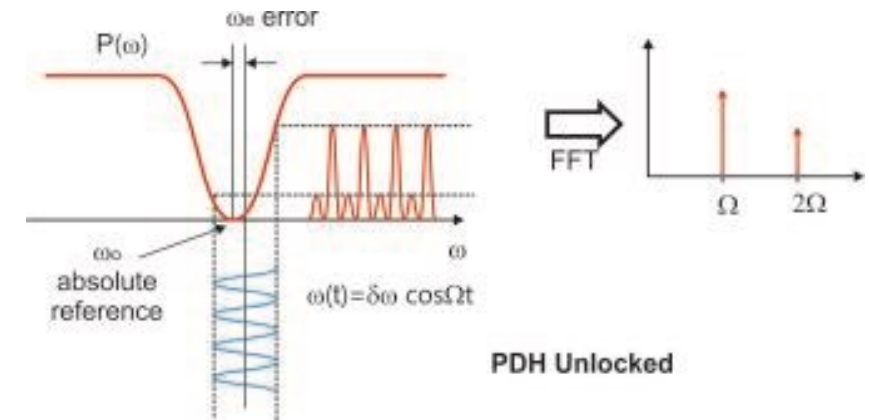
PDH and RAM

Optical frequency Locking by PDH

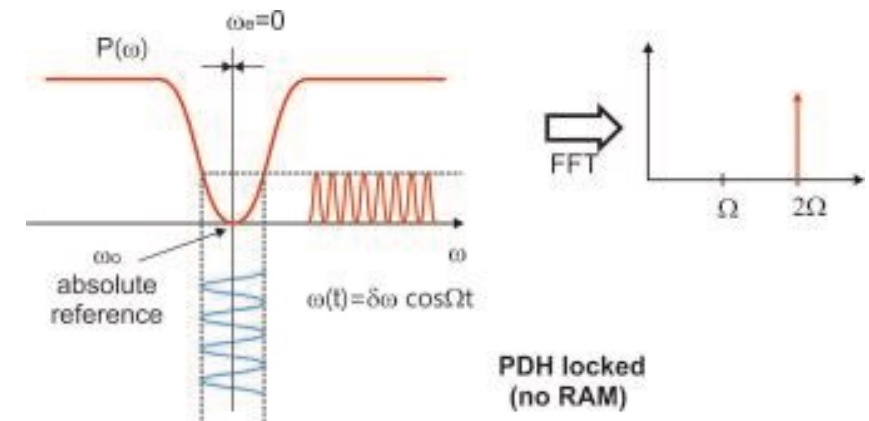
- PDH : Pound Drever Hall = stabilization of the wavelength / optical frequency of a laser source thanks to an absolute reference (Etalon, spectroscopic gas cell, ...)
- Phase modulation at Ω is applied to the source to generate frequency modulation on a range $\delta\Omega$



- Frequency modulation is converted into amplitude modulation by discrimination on the slopes of the reference Etalon
- Feedback loop locks the laser at the absolute reference thanks to harmonics optimization.
- The modulator is a NIR-MPX-LN-0.1, NIR-MPX800-LN-0.1, MPX-LN-0.1 depending on the operating laser wavelength.



PDH Unlocked



PDH locked (no RAM)

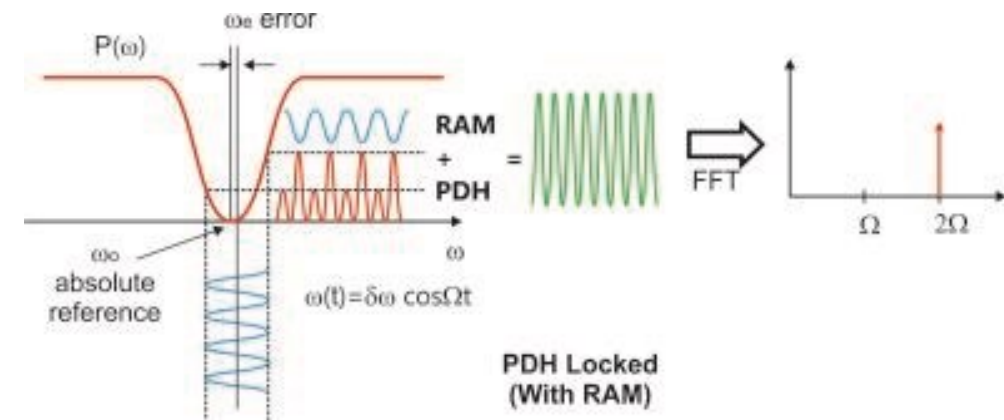
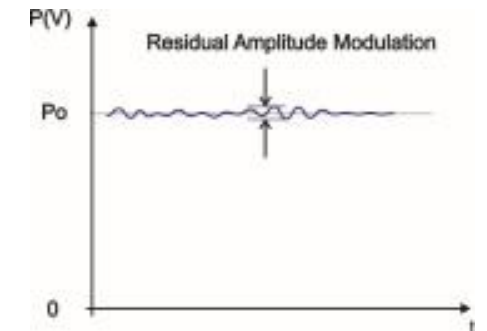
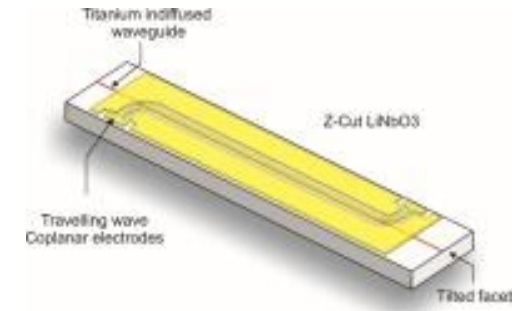
PDH and RAM

Consequence of RAM on frequency locking accuracy

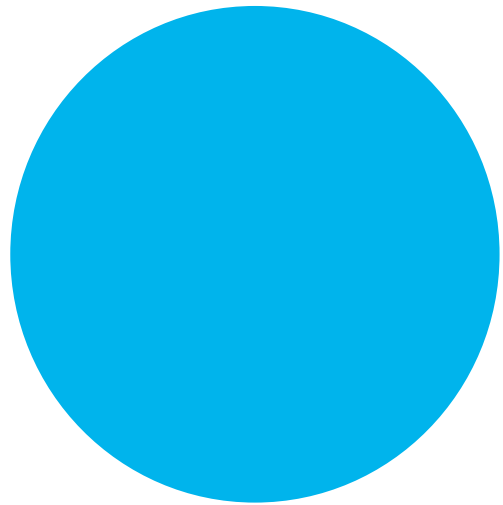
- RAM = Residual Amplitude Modulation = ratio between the voltage dependent power modulation and the total average power transmitted by the phase modulator.
- In case of use in PDH application, the amplitude harmonics can be combined with harmonics issued from PDH frequency to amplitude discrimination
- Consequence : wavelength lock-in occurs with an error value ω_e proportional to the modulation range $\delta\omega$ and to the $RAM = \epsilon V / P_o$.
- Residual amplitude modulation results from coupling with a deep electrical induced waveguide.
- Low permanent DC voltage (5-15V) is enough to reduce RAM by more than 10dB, compared to an unbiased modulator
- The phase modulator MPX-LN-0.1 family does not embed an internal RF load and thus, it handles without modulator damage a the permanent DC signal
- Resulting RAM >30dB fits the requirements of PDH where sensitivity limitations is related to shot and thermal noise

$$P(t) = P_o + \epsilon V(t)$$

$$RAM_{dB} = 10 \log_{10} \frac{\epsilon V_{pp}}{P_o}$$



NB: PDH efficiency can be ultimately limited by the frequency noise of the laser source.



For any questions, prices, feel free to contact us
contact.photonics@ixblue.com, we will be glad to support you.

iXblue Photonics Sales Team