

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
- LIGO -
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Technical Note	LIGO-T1400398-v1	2014/06/10
Proposal: Automatic System Identification of Photodetectors in a Gravitational Wave Detector		
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1 Transimpedance measurement of photodiodes:

A diode laser is used to illuminate the PDs. There are a total of 16 PDs that need to be sequentially analyzed. The output power of the laser is amplitude modulated by the drive current into the diode laser. This drive current modulation is provided by the RF output of a Network Analyzer (Agilent 4395A). The NA produces a swept sine wave over a range of preset measurement frequencies and at each measurement frequency the NA measures the amplitude and phase response of the output of the PD under test. An ILX LDC 3744C diode laser controller will be used to provide the DC current.

The diode laser output power is divided using a 1x16 Optical Splitter and each of the output fibers is routed to separate PDs. The output of the PDs will be fed to the network analyzer using a 16x1 RF switch and the transfer function of the PDs is measured. This will allow us to select each photodiode individually and feed the signal into the network analyzer. TCP/IP is used to communicate with the switch and inform it to move to the next PD after one set of data has been collected. The block diagram of the setup has been shown in Figure ??.

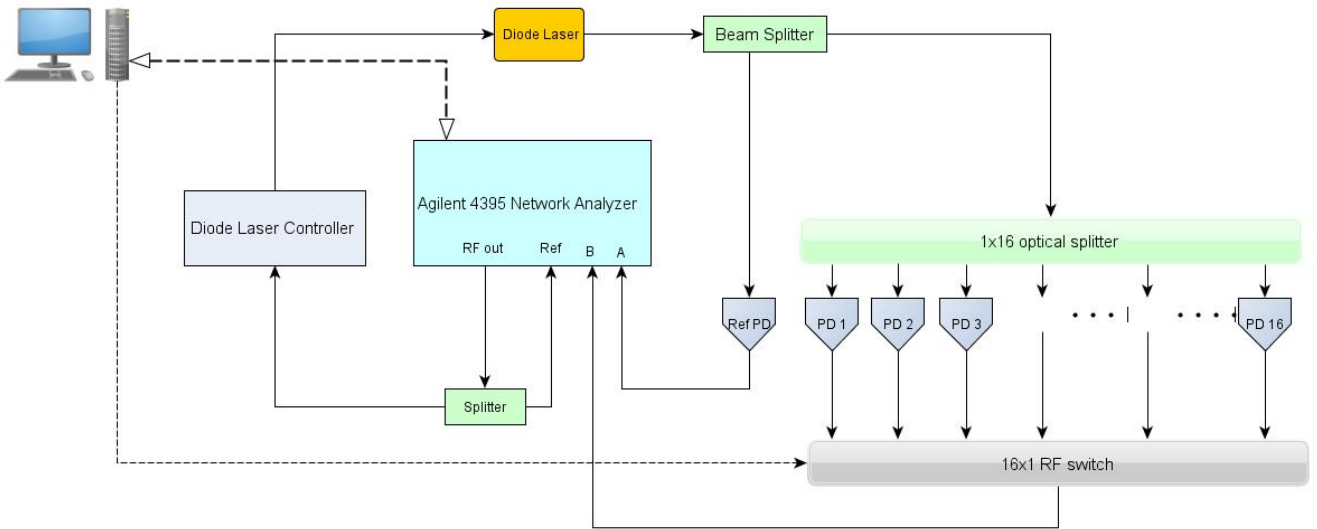


Figure 1: Block Diagram of setup

The output of the PD under test is compared to a known Reference PD to make sure that any variations in laser output power are normalized out. The Network Analyzer divides the Test PDs output by the Ref PDs output to account for variation in laser output power and sends transfer function data back to the control room computer.

2 Progress so far:

1. Extensive documentation of RF photoreceivers, Diode Laser Module, and 1x16 Optical Splitter.

2. The 1x16 Optical Splitter, RF Switch, Diode Laser Module, and Laser Power Supply have been mounted at the 40m interferometer.
3. The laser's fiber has been connected to the optical splitter such that its output can go to all of the photodetectors being considered. Several of the photodetectors have launchers sending laser light distributed from the 1x16 Optical Splitter to their inputs.
4. Code to automate the collection of data by running a scan on the NA and downloading the results as .dat files. These files can be used to generate Bode plots using MATLAB.
5. Plotting the data, save figures to file, use vectfit4 to fit data and compare with canonical set.

3 Results expected from the automated system:

Eventually, we plan to have two plots (which are also saved to file) corresponding to each photodiode:

1. Comparison of the new data with the canonical set's data.
2. Plot that shows the fit of the function.

Both figures will feature subplots that focus on regions of interest specific to each photodiode. One of the subplots will also output measured locations of peaks and notches as well as their Q factors.

4 WORK PLAN FOR SUMMER 2014:

1. Week 1 : Lab safety training, understanding the work done so far, manual operation of NA and calculation of transimpedance for a Broadband photodiode.
2. Week 2: Background reading about lasers, clearly understanding the steps involved in calculation and plotting of the transimpedance, understand and review all the data plotting code already present, understand how the data is to be presented according to the needs of lab personnel, hunt for schematics and datasheets of all the photodetectors that will be used. Also start learning python.
3. Week 3: Write computer programs for the analysis part of the project, which takes the .dat files from the NA, computes on MATLAB the bode plots (Amplitude vs. frequency and Phase vs. frequency) of transimpedance of the PDs and displays it on the computer monitor.
4. Week 4 and 5: Install the optical fibers and their fiber launchers for all of the 16 PDs taken into consideration. Currently about half of them are installed. Review and test the three or four RF PD cables already installed. Then build the remainder of

the cables, test them and finally complete the fiber routing to all of the Photodiodes. Also, get a strong grip on python simultaneously.

5. Week 6 and 7: Review the data taking code already present and make it perform the same measurements while also being able to switch between PD's remotely. A clear hold over python will be needed for this, which should have been achieved by then.
6. Week 8: BUFFER Week- In case of hold ups or difficulty in getting any of the components to work. The system will hopefully be performing satisfactorily by the end of this week.
7. Week 9 and 10: Testing and Debugging. Proper documentation. System cost estimation. Presentations.

In case you have pulled off all this - Party!!!!