LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

-LIGO-

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AdLIGO GS-13 Pre-Amp Test Procedure		
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1. Overview

The AdLIGO GS-13 Pre-Amp board is a replacement for the preamp that comes with the GS-13 Seismometers. Its job is to take in the signal from the Seismometer, and send it out as an amplified, differential signal.

The function of this procedure is to check each channel from its input to the respective output and to verify proper DC power consumption.

2. Test Equipment

2.1 Power Supply capable of +/- 15 volts
2.2 Function generator (Stanford Research DS360 or the like)
2.3 Oscilloscope
2.4 Stanford Research SR785 Network Analyzer
2.5 16 Pin Header to 15 Pin Dsub Connector (with correct pin arrangement)
2.6 15 pin Dsub breakout board

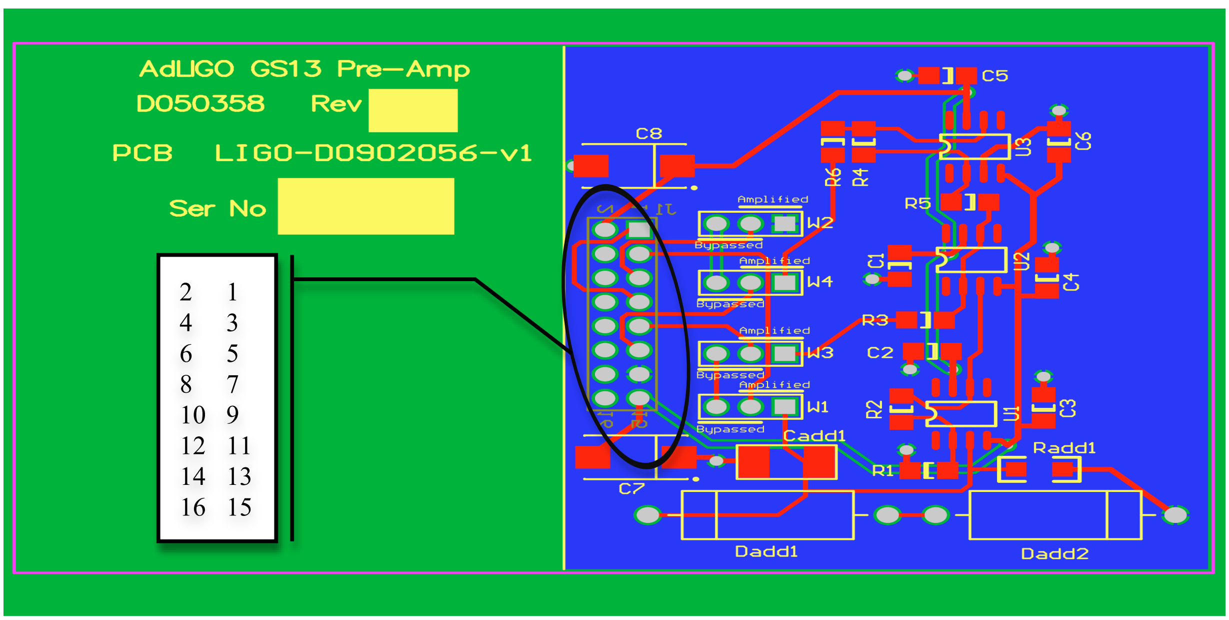

Figure 1: Preamp board schematic with pin numbering.

3. Preliminaries

3.1 Perform visual inspection on board to check for missing components or solder deficiencies.
3.2 Before connecting the power to the board, set power supplies to +/- 15 Volts, and then turn them off. Connect the power supply Positive lead to J1 Pin2, GND to J1 Pin13, and Negative to J1 Pin15 as shown in Figure 1.

****NOTE** This is the procedure to test one board. Before connecting or disconnecting any board, make sure the power supply is OFF.**

4. **DC Tests**

4.1 Turn on the power supply to the system under test and record the total current.

Measure	Voltage read	Current
+15V Supply	(+15V +/- 0.5) V	12mA +/- 5mA mA
-15V Supply	(-15V +/- 0.5) V	12mA +/- 5mA mA

5. **Dynamic Tests**

5.1 Bypass throughput check:

5.1.1. Set a function generator to a **5V** p-p, 10Hz sine wave.

5.1.2. Split this signal with a BNC Tee, with one signal going to the designated pins below, and the other going to channel 2 of an oscilloscope.

5.1.3. Place a jumper onto the four 3-pin headers on the board. Each should be in the "Bypassed" position (between pins 2 and 3). Observe the amplitude at the designated output pins. The outputs should be the same amplitude as the input, with no observable phase delay or high-frequency noise. Place a check in the correct cell if the signal looks correct.

NOTE: Turn the Power Supply to OFF before disconnecting the preamp.

Input		Output
J1-3 (+) / J1-5 (-)	**5Vp-p**	J1-9 (+) / J1-11 (-)

5.2 Gain/Filter Check:

5.2.1. Connect the BNC from the function generator to the scope, and set the function generator to a **0.1V** p-p, 10Hz sine wave.

5.2.2. Move the jumpers to the "Filtered" position (pins 1-2), apply the signal on the correct pins below, and observe the amplitude at the designated output pins differentially (A-B) relative to ground with two scope probes. The outputs should have a DC gain of 40.2 V/V (32dB), and will show up as 8V due to the high impedance of the preamp (not 50Ω like the function generator).

NOTE: Turn the Power Supply to OFF before disconnecting the preamp.

Input		Output Nominal 8.04V +/- 0.4V
J1-3 (+) / J1-5 (-)	**0.1Vp-p**	J1-9 (+) / GND and J1-11 (-) / GND

	V

5.3 Frequency Response:

5.3.1. Using a BNC-T connector, the analyzer output should be connected to CH1 A, the other connection should go **through a 9.03KΩ resistor inline with the Analyzer output** to Pin J1-3(+) and ground to J1-5(-).

5.3.2. Read out differentially on pins 9(+)/GND and pins 11(-)/GND of the micro Dsub breakout board, connected to Ch2 A and B.

5.3.3. Open an xterm window and navigate to the sei_scripts directory, then run *SEI_Measurement_Launcher* and follow the prompts. This script calls the python script which programs the SR785 to perform a100mV swept sine TF measurement from 10Hz to 100KHz, and writes the data file.

5.3.4. Once the measurement has finished, open Matlab and run *GS13_preamp_TF_processing.m*. There should be a pole at 1.2kHz +/- 1dB and a nominal gain of 32dB +/- 1dB. Enter values in spreadsheet for testing records. The plot should look similar to Figure 2.

NOTE: Turn the Power Supply to OFF before disconnecting the preamp.

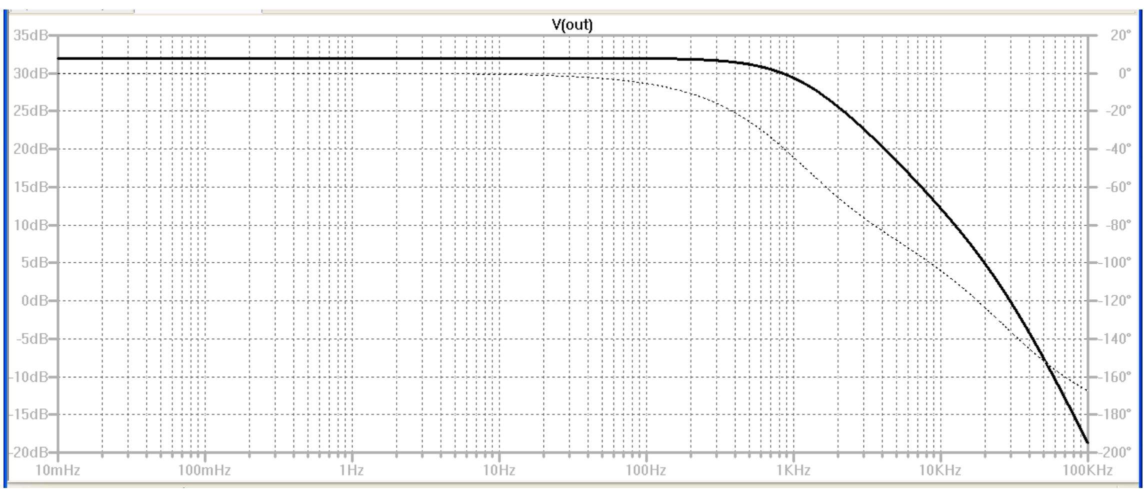

Figure 2: Expected Frequency Response.

Input	Output @ 10Hz (Nom. 32dB +/- 1dB)	Output @1.2KHz (Nom. 29dB +/-1 dB)
J1-3 (+) / J1-5 (-) **100mV**	dB	dB

5.4 Noise Measurement:

5.4.1. Short the input pins 3(+) and 5(-) together and ground them.

5.4.2. Connect the output of the preamp, pins 9(+) and 11(-), to CH 1 A of the SR785.

5.4.3. Open an xterm window and navigate to the sei_scripts directory, then run *SEI_Measurement_Launcher* and follow the prompts. This script calls the python script which programs the SR785 to perform noise measurement from 100mHz to 100Hz, and writes the data file.

5.4.4. Once the measurement has finished, open Matlab and run *GS13_preamp_noise_processing.m*. Disregarding 60Hz peaks, the noise should start at somewhere under 2.8uV/√Hz (-111dB), and fall like frequency until1-to-2Hz. It should not be higher than 1.2uV/√Hz (-120 dB) from 1Hz to 10Hz, and should not be higher than 650 nV/√Hz (-124 dB) from 10Hz to 1KHz. A simulated noise plot is shown in Figure 3.

5.4.5. Record values in a spreadsheet for record tracking.

NOTE: Turn the Power Supply to OFF before disconnecting the preamp.

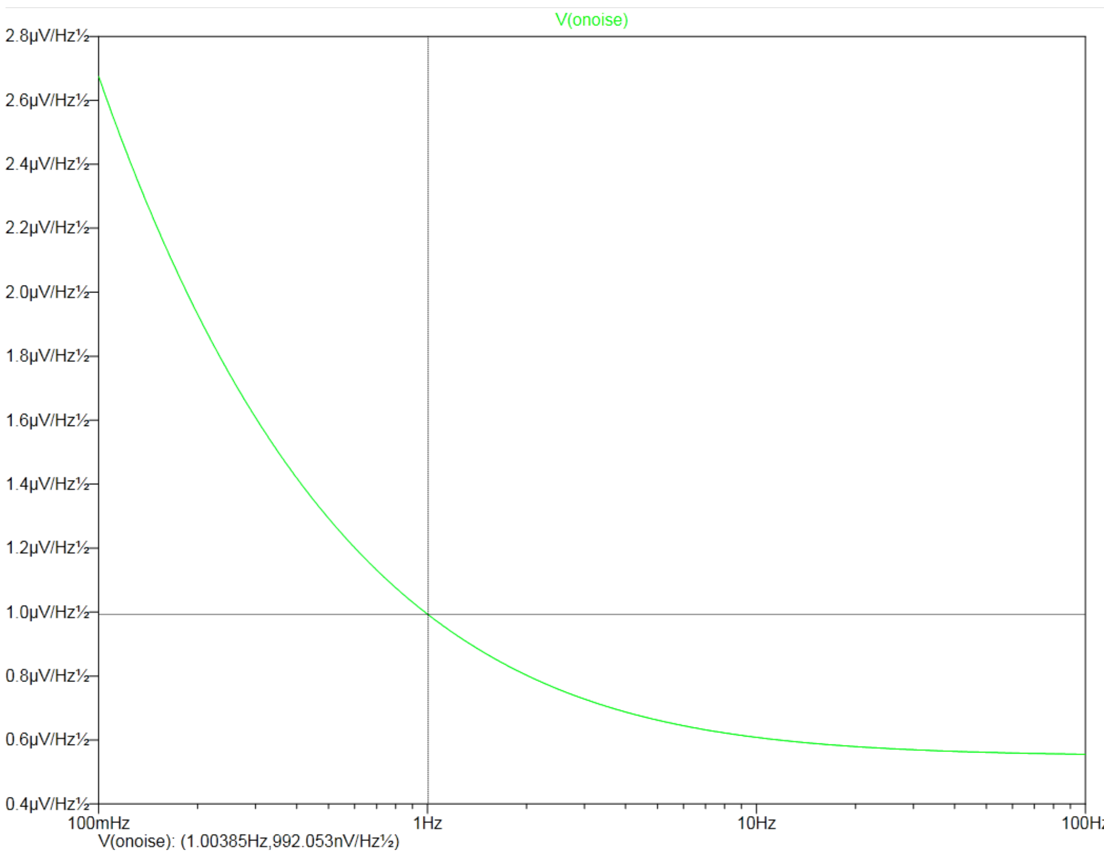

Figure 3: Simulated Noise Plot.

Figure 4 is a noise plot taken from an actual preamp, for comparison. There aren't enough points at low frequency to believe the following plot below ~0.6 Hz, or so. Use a low enough start frequency to get decent resolution for these measurements.

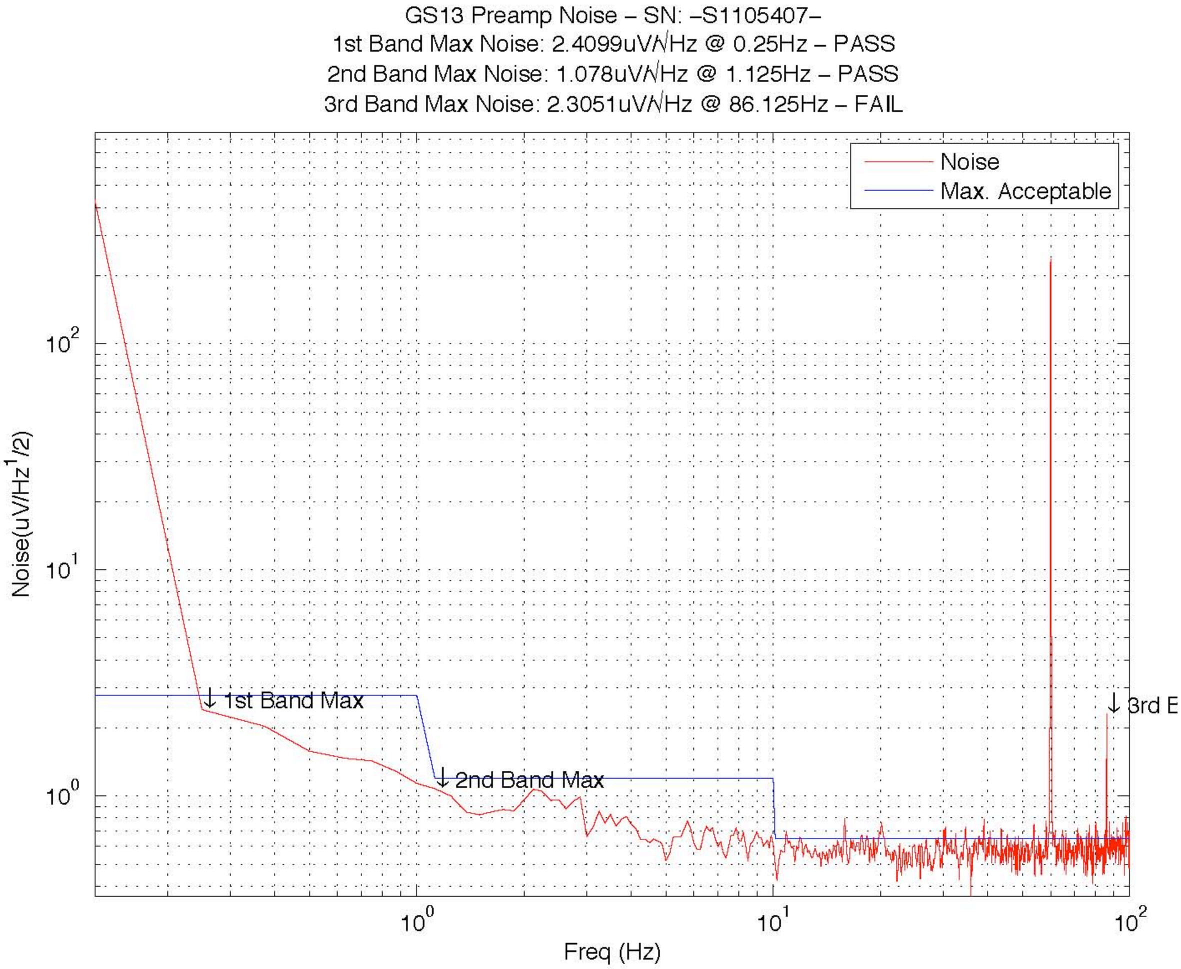

Figure 4: Actual noise measurement from a GS13 Preamp.

Input	0.1Hz – 1Hz Noise below 2.8uV/√Hz?	1Hz – 10Hz Noise below 1.2uV/√Hz?	10Hz – 1KHz Noise below 650nV/√Hz?
J1-3 (+) and J1-5 (-) Grounded			