LASER INTERFEROMETER GRAVITATIONAL
WAVE OBSERVATORY
- LIGO -
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Analog Electronics Test Plan

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Seismic Attenuation Teams (SEI, SAS)

This is an internal working note
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Introduction

This document briefly describes the steps necessary to check the analog electronics, in-vacuum sensors and actuators before HAM-SAS is placed under vacuum.

The following setup and tests can be performed without the HAM-SAS digital system but just with the analog boards in place, a 4 channel digital oscilloscope, a multimeter, a function generator and a spectrum analyzer.

Antaliasing and whitening board setup and tests are not addressed.

1 LVDTs Board Setup and Test

The board is supposed to be configured with all external oscillator (channel 1 to 8 EXT) and channel one as master oscillator. Master oscillator amplitude should be set to 29Vpp at the differential output (TP22 and 23). Prototype labeled ver. 2.2 in the HAM-SAS web site monitors output 7 and 8 swapped. ADC mapping is correct.

1.1 Channel Calibration

1. connect the oscilloscope to the monitor output channel you want to test.
2. Send to the read-back input a sinusoid with ~50mV amplitude at the LVDT master oscillator oscillator frequency. Frequency should be accurately measured within 5Hz. The monitor output should show a sinusoid with a frequency the difference between the master oscillator and the external oscillator.
3. Set the frequency difference to about 5Hz. With a decent oscillator this frequency should drift less than 1 Hz / minute.
4. Maximize the amplitude acting on the phase lag lead circuit using R18.
5. Acting on R11 change the amplitude of the sinusoid to the required value.

2 L4C Geophones Board Setup and Test

TBD

3 Coil Driver Setup and Test

TBD

4 Stepper Motor Driver Setup and Test

TBD

5 Sensors and Actuator Setup and Test

Sensors and actuators are supposed to be cabled.

HAM-SAS is supposed to be outside the vacuum chamber, aligned and locked.

WARNING: LVDT WIRES ARE ABOUT AGW36($\sim$100μm) AND CAN BE EASILY CUT BY JUST PINCHING THEM WITH SPACERS CALIPERS AND OTHER TOOLS.

5.1 Horizontal LVDTs

HAM-SAS on the cart and below the elevator. IP table and MGAS filter are locked . Spacers are necessary for the calibration of the displacement sensors.

5.1.1 Calibration Procedure

1. Use the LVDT monitor outputs (montiors on the front panel). Monitor output 7 and 8 are swapped.
2. Loose the four bolts locking the aluminum box which hold the LVDT secondary coil.
3. Use spacer between the two LVDT coils to take 5 data points. Ensure that the coils are properly aligned. Use the spacer dimensions for such a purpose.
4. Be sure to record the direction of the displacement.
5. Make a linear fit.

5.1.2 Electronic Gain Setting

1. Center the LVDTs by zeroing the monitor signal. To center the LVDT loose the 4 bolts securing the LVDT aluminum box to the HAM-SAS base.
2. Apply a pressure to understand to which direction and how much one should overshoot to properly zero the signal; lock the 4 bolts,
3. Iterate steps 1 to 2 until proper result is obtained.
4. Set the final stage gain of the LVDT board outputs to 1V/mm for low resolution, 5V/mm for high resolution. Use procedure explained in section 1
5. Measure the power spectral density using the spectrum analyzer.

5.2 Vertical LVDTs

HAM-SAS on the cart and below the elevator. IP table and MGAS filter are locked.

5.2.1 Calibration Procedure

1. Use the LVDT monitor outputs (montiors on the front panel). Monitor output 7 and 8 are swapped.
2. Loose the three bolts locking the permanent magnet support of the vertical actuator.
3. Monitoring the signal, lower the support until you are close to signal saturation,
4. Ensure that the support is horizontal.
5. Make a quarter of turn on each of the three screws and record the signal voltage.
6. Repeat step 5 five times, at least. Be sure to record the direction of the displacement
7. Make a linear fit considering that the the screw pitch is 1 turn/mm (M6 ? TO BE CONFIRMED).

5.2.2 Electronic Gain Setting

1. Center the LVDTs by zeroing the monitor signal and using the proper screws,
2. Lock the permanent magnet plate with the three screws. Consider some overshoot to improve centering.
3. Iterate steps 1 to 2 until proper result is obtained.
4. Set the final stage gain of the LVDT board outputs to 1V/mm for low resolution, 5V/mm for high resolution. Use procedure explained in section 1
5. Measure the power spectral densities using the spectrum analyzer.

5.3 Witness LVDTs

HAM-SAS DOFs are supposed to be free.

1. Check electrical signals by simply manually shaking HAM-SAS DOFs,
2. Center the LVDTs to the nominal position at best,
3. Calibrate the horizontal LVDT using the horizontal and the vertical LVDTs,
4. Set the final stage gain of the LVDT board outputs to 1V/mm looking at the the
5. Measure the power spectral densities using the spectrum analyzer.

5.4 Horizontal and Vertical Coil Actuators

1. Check actuators sending an DC or an AC signal and looking at the LVDTs signals,
2. DC Calibrate the actuators relatively to the displacement produced in the LVDTs signals,

5.5 Horizontal and Vertical Stepper Motors

1. Check actuators sending an DC or an AC signal and looking at the LVDTs signals,
2. DC Calibrate the actuators relatively to the displacement produced in the LVDTs signals,

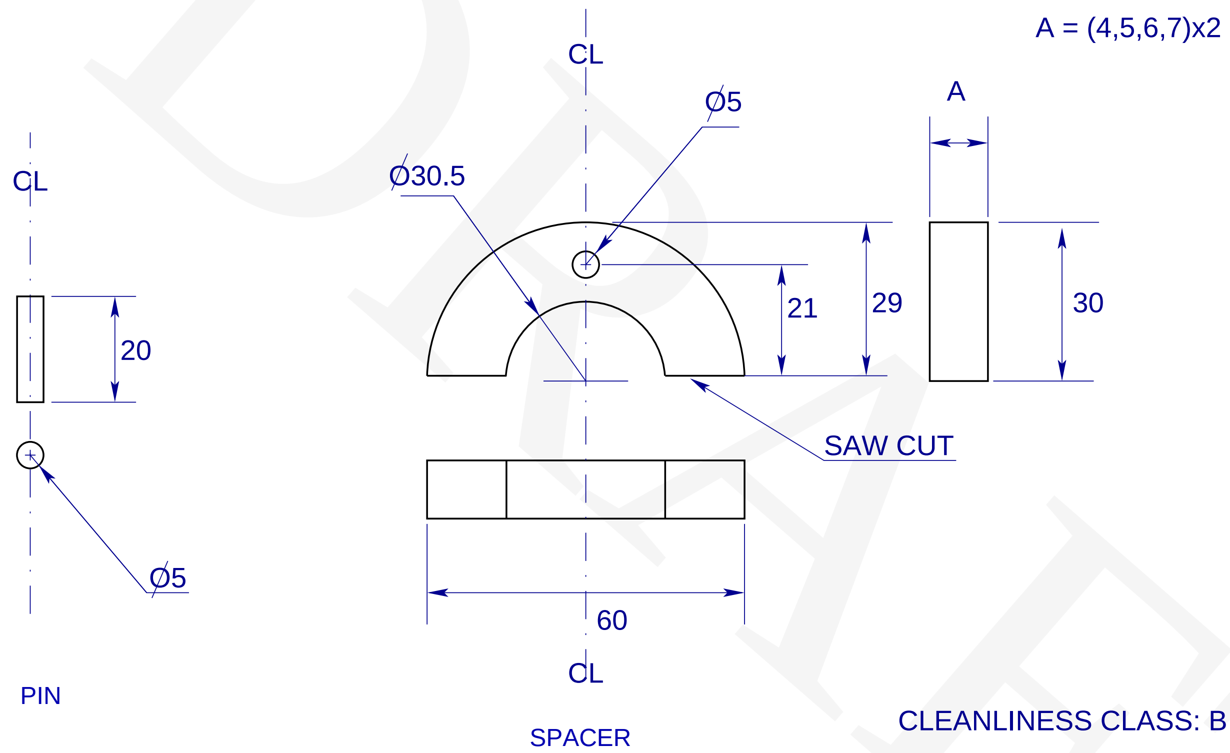
5.6 LC4 Geophones Sensors

TBD

6 LVDT Spacers

LVDT spacers are stacked and placed on top of the horizontal primary LVDT coil. Then a small force must be used to push them against the plate holding the primary coil and the the secondary coil.

Relative transverse alignment is done by moving the secondary coil holder and having the spacer surfaces aligned to the secondary coil external diameter.



CLEANLINESS CLASS: B

PIN IN SPACER TO HAVE TIGHT SLIDING FIT

SCALE: 1:1	UNITS: mm
MATERIAL: PEEK	
HORIZONTAL LVDT CALIBRATION SPACERS	
DATE 5/11/07	