LIGO Laboratory / LIGO Scientific Collaboration

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aLIGO HAM-ISI, Installation Test Report, Phase II

Chamber-Side Testing & Initial Chamber Testing

LHO HAM3-ISI (unit #5)

E1200507-V5

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Advanced LIGO Project

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PHASE II Testing

The phase II of HAM-ISI testing corresponds to the tests performed after the *Assembly Validation*, and before the *Control and Commissioning* of the Units. It is divided in two parts. The present document is divided in two sections: One for each part of the Phase II testing:

Part.1 Chamber-Side testing
Part.2 Initial Chamber Testing

Chamber-Side Testing is a basic sensor check with a spectrum analyzer. Units can be inserted in their chamber of destination once they pass.

Initial Chamber Testing takes place in open chamber, with the optics off, and HEPI locked. The ISI is then connected to the electronic rack with the final in-field cables. Models are installed and running. Tests are performed with Matlab® scripts.

Optics and Suspensions can be installed right after the end of this phase of testing. No test is performed during their installation.

Final Chamber Testing starts once Optics and Suspensions are installed. The lockers and the CPSs usually need to be reset at this point.

Introduction

Chamber-Side Testing

HAM-ISI Unit #5 was intended to populate HAM3 chamber. The tests presented in this first part of the phase II testing report were performed between June 12th and June 13th 2012, in accordance with the second version of the *Pre-Integration Chamber-Side Testing* procedure (E1200513-v2).

At the beginning of the Chamber-Side Testing:

- Assembly validation testing has been performed on the ISI
- Phase I test report was validated (E1000314)
- The ISI was stored in a container, moved from the staging building to the LVEA, and installed under a clean room in the LVEA, on its container's base
- The container is sitting on lab-jacks to allow level adjustments without unlocking the ISI
- The Unit is equipped with production GS13s
- The optical table is not loaded with masses yet
- The ISI is locked

The goal of the Chamber-Side Testing is to ensure that the sensors and their electronics (ADE boxes of the CPSs) did not alter during storage/transportation.

At the end of the Chamber-Side Testing:

- All sensors have been checked
- Data related to the tests is available on the SVN
- The HAM-ISI is on the chamber-side, ready for the in-chamber insertion

I. CHAMBER SIDE TESTING

- ***Test 1 - CPS Check***

During this step, we want to make sure that the CPSs, their cables and their electronics are functional.

Corner	Direction	Voltage (No shim)	Sensor reacts to shim insertion
1	H	1.405	X
	V	4.63	X
2	H	1.781	X
	V	1.099	X
3	H	-0.202	X
	V	2.732	X

Table – CPS Check

Issues/difficulties/comments regarding this test:

- ADE boxes were connected to the same power supply
- ADE boxes must share the same ground.
- ADE boxes must be grounded to the test stand
- Not having the ADE boxes grounded to the test stand causes the CPS readouts to vary with the number of probes that are connected to the ADE boxes (LHO aLog #2972).

Acceptance Criteria:

- All CPS were tested
- All CPS react to shim insertion
- The voltages recorded with no shim are within $^{+}$/-5V.

Test result: **Passed: X** **Failed: ____**

- ***Test 2.1 – CPS noise spectra***

During this step, we want measure the noise spectra of the CPSs and make sure that it is not too high.

A spectrum analyzer is used. The maximum number of points available for the FFT (800) limits the frequency resolution. Measurements are performed in two sections that are combined afterwards to allow getting good resolution in low frequency. Sections overlap to allow checking for potential mismatch.

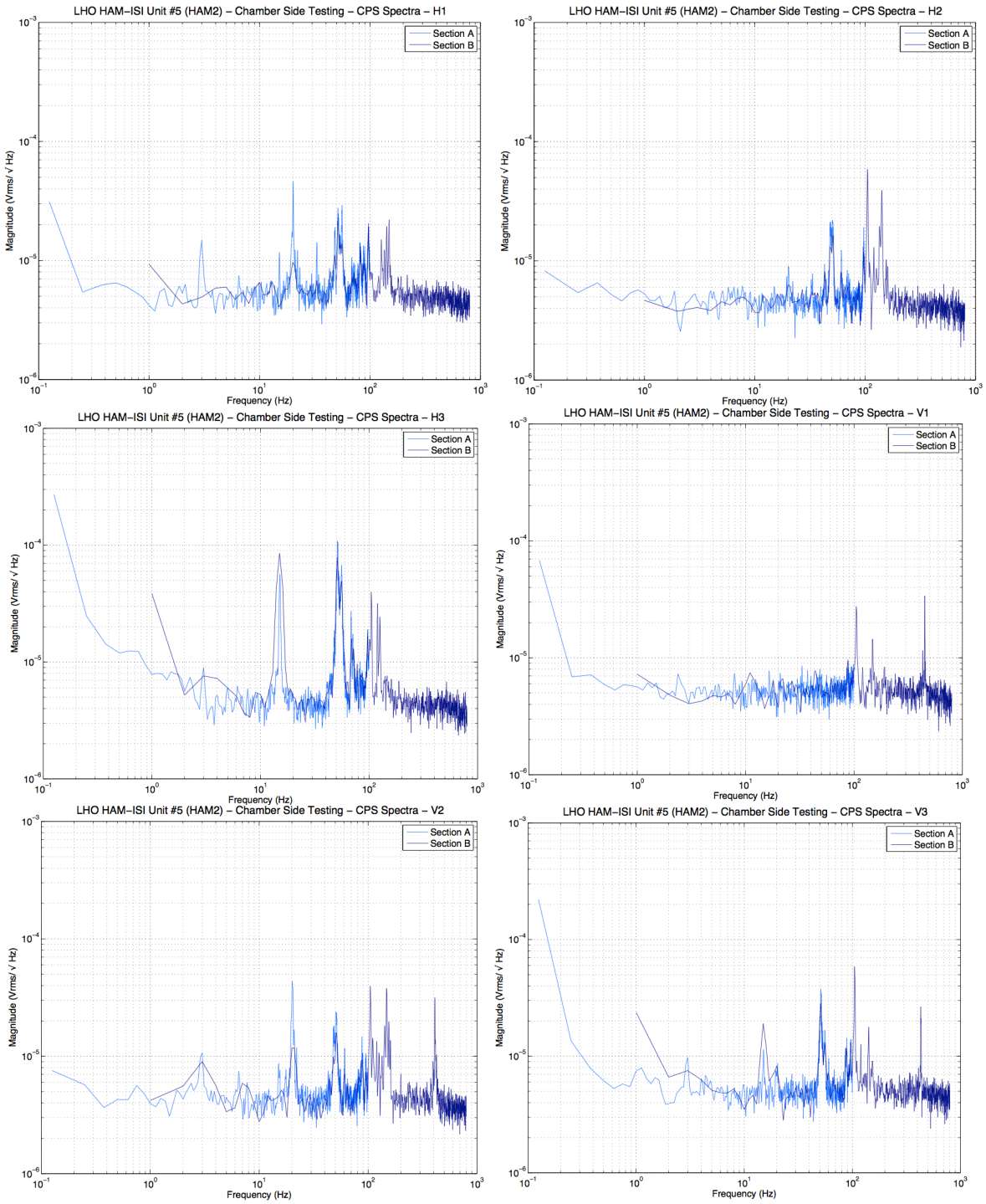


Figure – CPS Spectra - Section Check

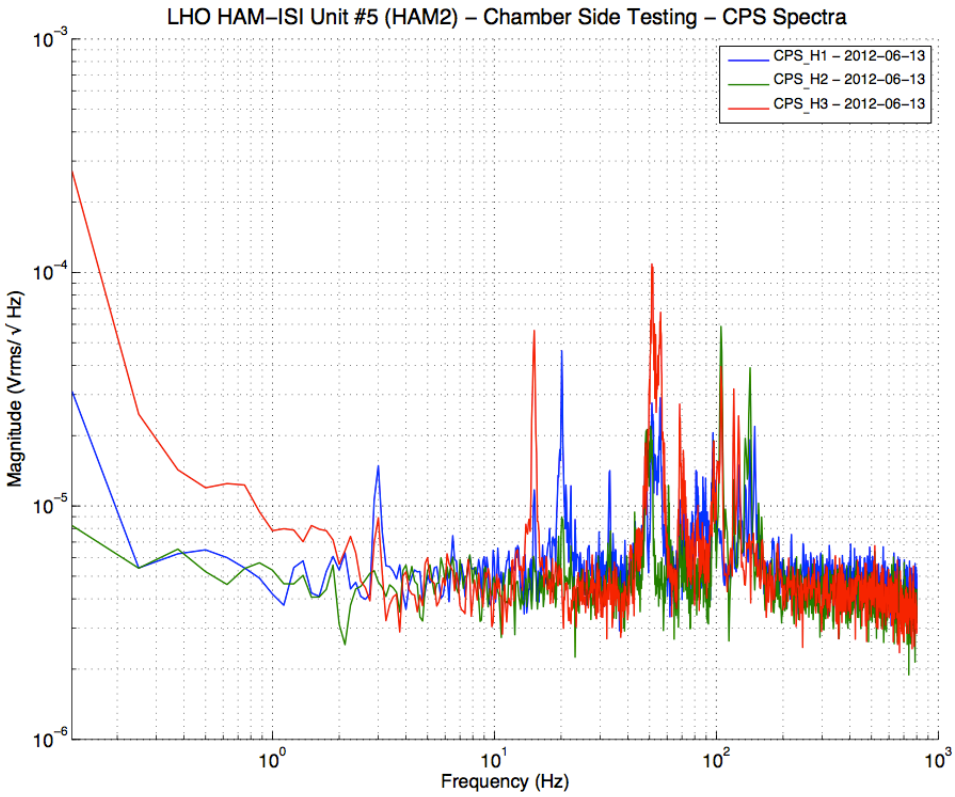


Figure – Horizontal CPSs spectra

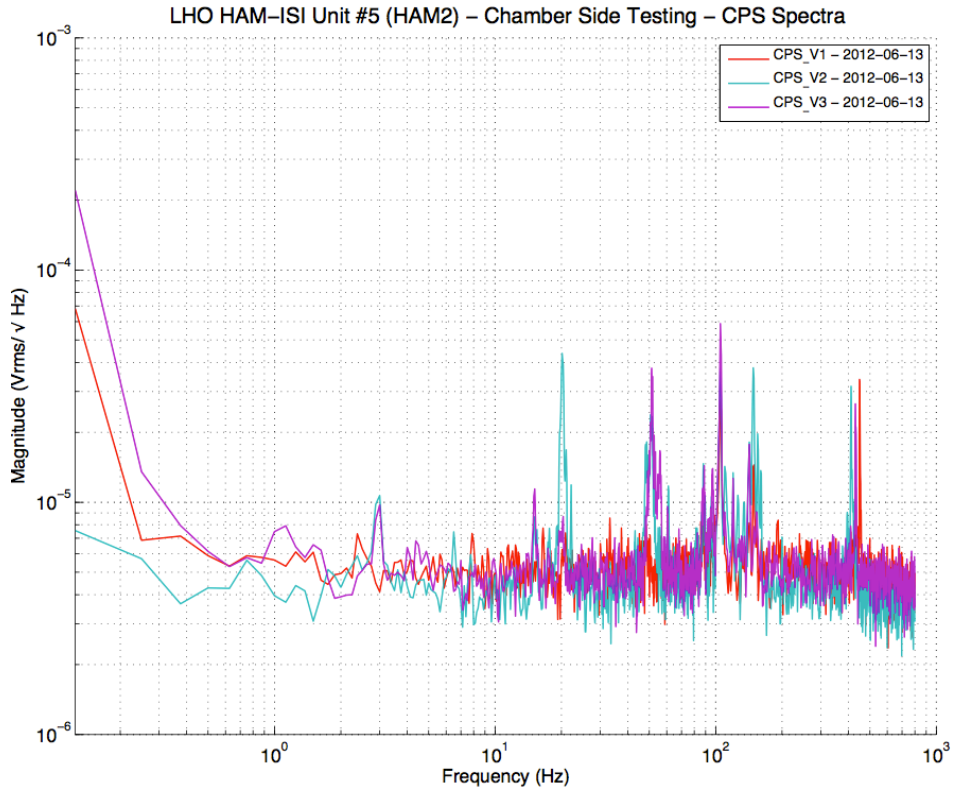


Figure – Vertical CPSs Spectra

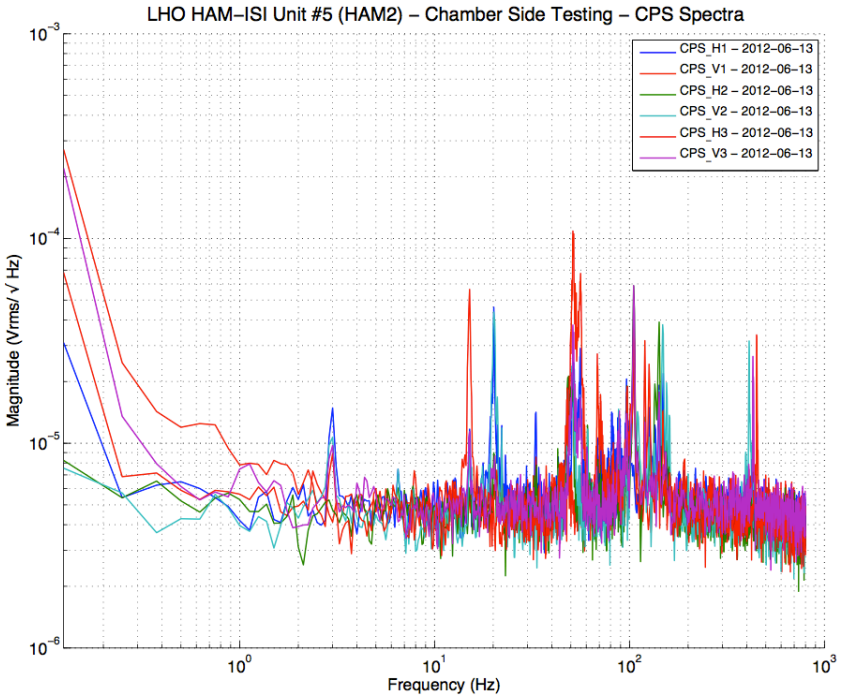


Figure – All CPSs Spectra

Data in the SVN at:
/SeiSVN/seismic/HAM-ISI/H1/HAM3/Data/Spectra/Chamber_Side/
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-CPS__Corner_1-Section_A-2012-06-13.182243.txt
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-CPS__Corner_1-Section_B-2012-06-13.182536.txt
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-CPS__Corner_2-Section_A-2012-06-13.173829.txt
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-CPS__Corner_2-Section_B-2012-06-13.174121.txt
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-CPS__Corner_3-Section_A-2012-06-13.183353.txt
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-CPS__Corner_3-Section_B-2012-06-13.183632.txt

Sections Check plots in the SVN at
/SeiSVN/seismic/HAM-ISI/H1/HAM3/Figures/Spectra/Chamber_Side/Sections_Check/
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_CPS__H1_ISI_Chamber_Side_Locked__2012_06_13.fig
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_CPS__V1_ISI_Chamber_Side_Locked__2012_06_13.fig
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_CPS__H2_ISI_Chamber_Side_Locked__2012_06_13.fig
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_CPS__V2_ISI_Chamber_Side_Locked__2012_06_13.fig
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_CPS__H3_ISI_Chamber_Side_Locked__2012_06_13.fig
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_CPS__V3_ISI_Chamber_Side_Locked__2012_06_13.fig

Sections Combined plots in the SVN at:
/SeiSVN/seismic/HAM-ISI/H1/HAM3/Figures/Spectra/Chamber_Side/Sections_Combined/
HAM_ISI_Unit_5_PSD_Volts_CPS__H_ISI_Chamber_Side_Locked___2012_06_13.fig
HAM_ISI_Unit_5_PSD_Volts_CPS__V_ISI_Chamber_Side_Locked___2012_06_13.fig
HAM_ISI_Unit_5_PSD_Volts_CPS__ISI_Chamber_Side_Locked___2012_06_13.fig

Programs to run the sr785 from a laptop under the SVN at:
/SeiSVN/seismic/HAM-ISI/H1/HAM3/Scripts/Chamber_Side/sr785_Programs/

Testing Scripts under the SVN at:
/SeiSVN/seismic/HAM-ISI/H1/HAM3/Scripts/Chamber_Side/Testing_Scripts /

Issues/difficulties/comments regarding this test:
Results in accordance with HAM2

Acceptance Criteria:

- Sections Match together
- CPS noise spectra must be below 10^{-4}Vrms/√Hz
- Plots of Spectra are saved under the SVN

Test result: **Passed: X** **Failed: ____**

- ***Test 2.2 – GS13 Spectra***

During this test we want to take spectra of the GS13s to make sure that they are still functional.

A spectrum analyzer is used. The maximum number of points available for the FFT (800) limits the frequency resolution. Measurements are performed in two sections that are combined afterwards to allow getting good resolution in low frequency. Sections overlap to allow checking for potential mismatch.

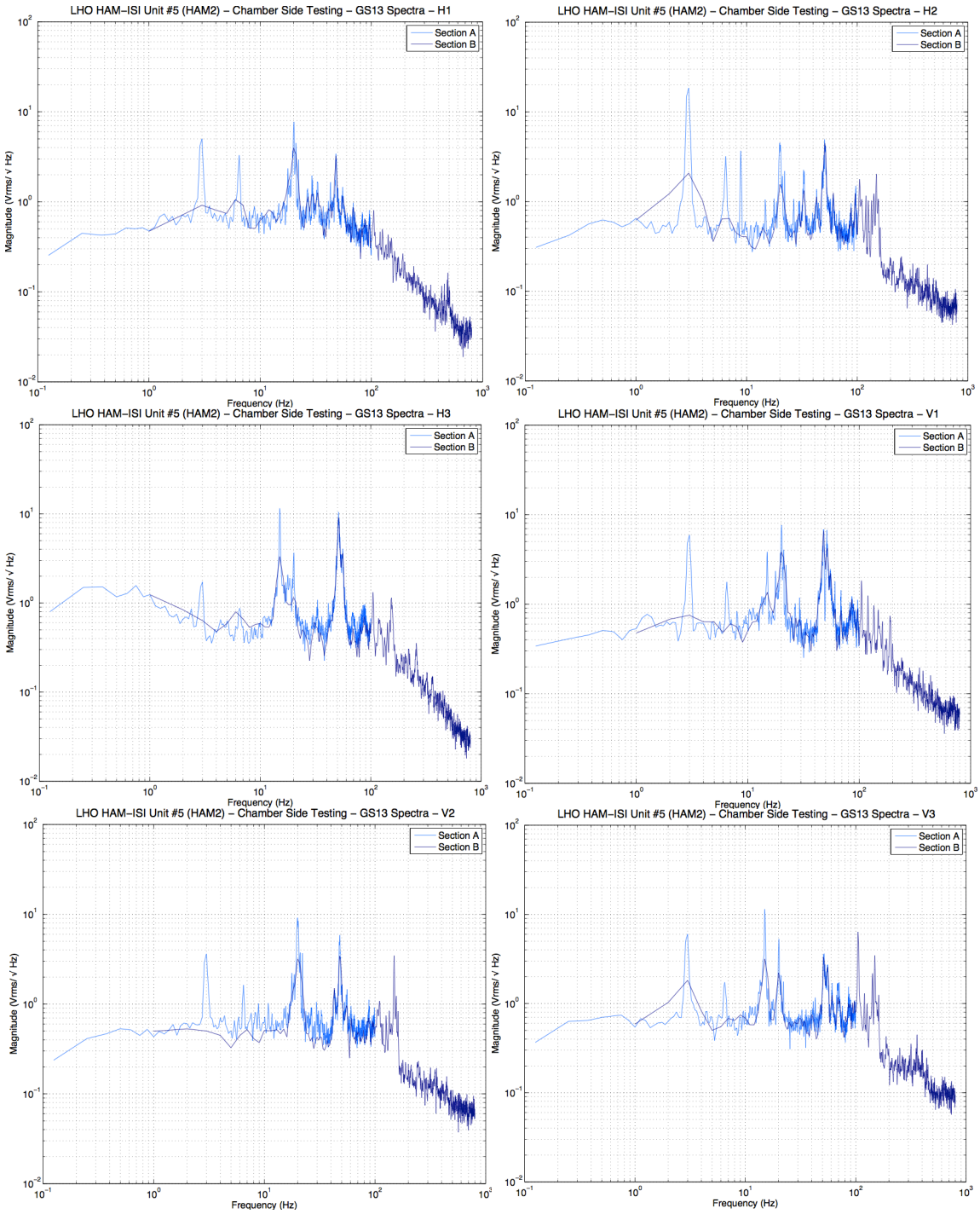


Figure – GS13 Spectra- Section Check

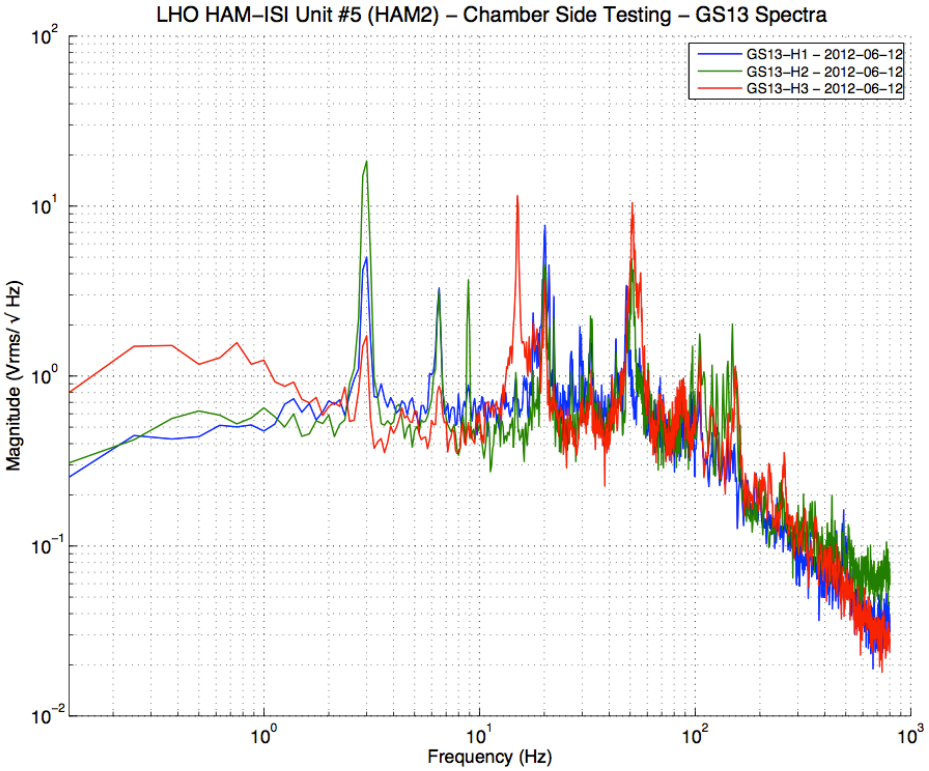


Figure – Horizontal GS13s Spectra

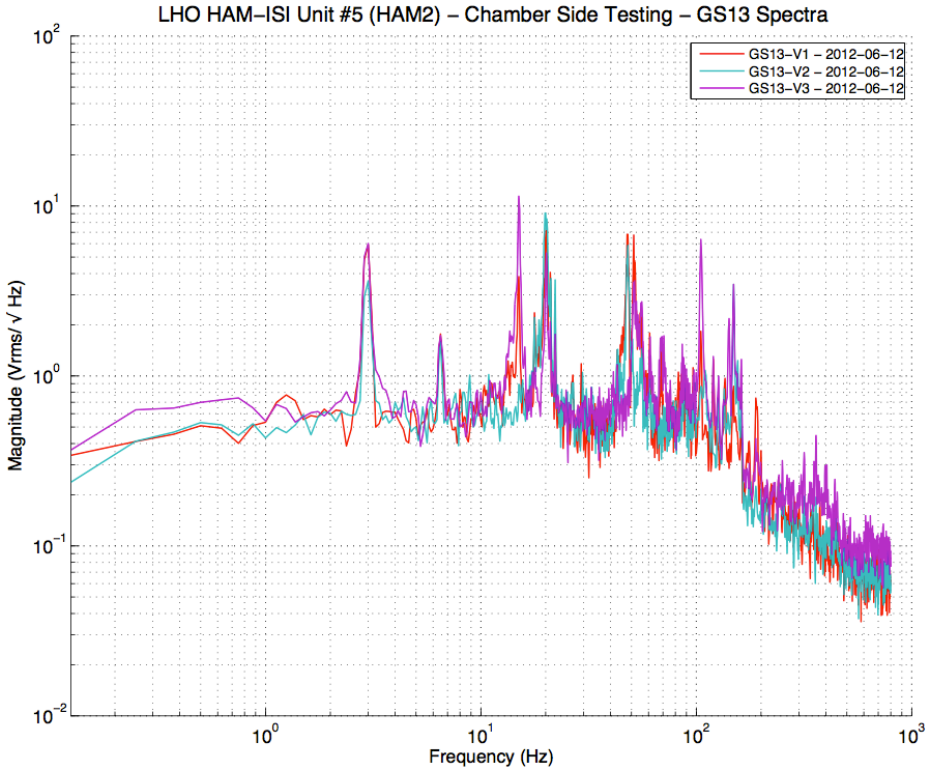


Figure – Vertical GS13s Spectra

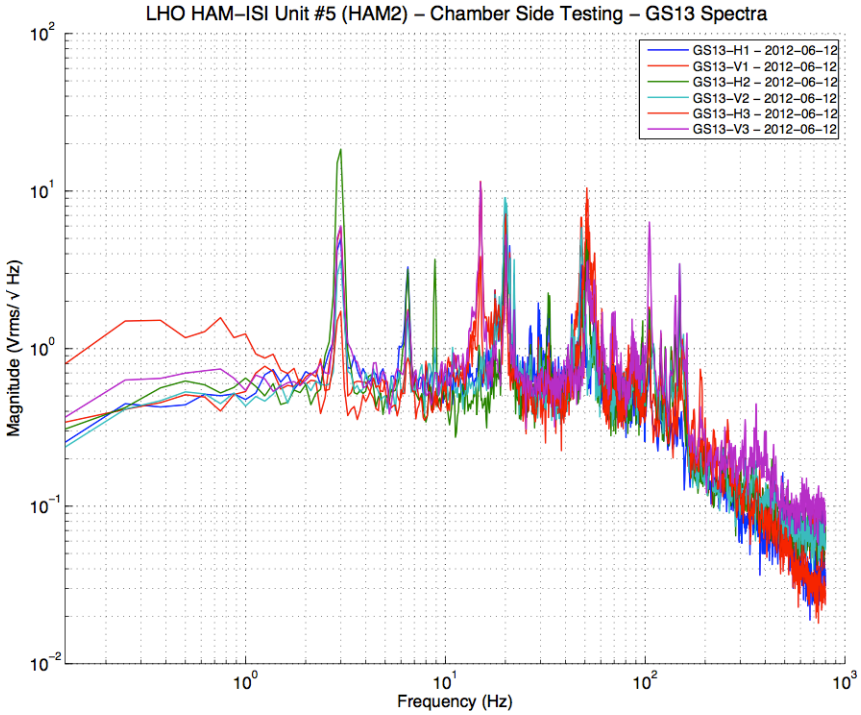


Figure – Horizontal and Vertical GS13s Spectra

Data in the SVN at:
/SeiSVN/seismic/HAM-ISI/H1/HAM3/Data/Spectra/Chamber_Side/
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-GS13_Corner_1-Section_A-2012-06-12.225110.txt
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-GS13_Corner_1-Section_B-2012-06-12.225350.txt
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-GS13_Corner_2-Section_A-2012-06-12.224428.txt
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-GS13_Corner_2-Section_B-2012-06-12.224715.txt
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-GS13_Corner_3-Section_A-2012-06-12.231439.txt
SEI-HAM_ISI_Unit_5_Chamber_Side_Locked__-GS13_Corner_3-Section_B-2012-06-12.231742.txt

Sections Check plots in the SVN at
/SeiSVN/seismic/HAM-ISI/H1/HAM3/Figures/Spectra/Chamber_Side/Sections_Check/
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_GS13_H1_ISI_Chamber_Side_Locked__2012_06_12.fig
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_GS13_H2_ISI_Chamber_Side_Locked__2012_06_12.fig
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_GS13_H3_ISI_Chamber_Side_Locked__2012_06_12.fig
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_GS13_V1_ISI_Chamber_Side_Locked__2012_06_12.fig
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_GS13_V2_ISI_Chamber_Side_Locked__2012_06_12.fig
HAM_ISI_Unit_5_ASD_Volts_SECTION_CHECK_GS13_V3_ISI_Chamber_Side_Locked__2012_06_12.fig

Sections Combined plots in the SVN at:
/SeiSVN/seismic/HAM-ISI/H1/HAM3/Figures/Spectra/Chamber_Side/Sections_Combined/
HAM_ISI_Unit_5_PSD_Volts_GS13_H_ISI_Chamber_Side_Locked___2012_06_12.fig
HAM_ISI_Unit_5_PSD_Volts_GS13_V_ISI_Chamber_Side_Locked___2012_06_12.fig
HAM_ISI_Unit_5_PSD_Volts_GS13_ISI_Chamber_Side_Locked___2012_06_12.fig

Programs to run the sr785 from a laptop under the SVN at:
/SeiSVN/seismic/HAM-ISI/H1/HAM2/Scripts/Chamber_Side/sr785_Programs/

Testing Scripts under the SVN at:
/SeiSVN/seismic/HAM-ISI/H1/HAM2/Scripts/Chamber_Side/Testing_Scripts /

Issues/difficulties/comments regarding this test:
- One can notice a bump below 1Hz on H3 spectrum. Measurements were performed in the LVEA, one corner at a time. It is very likely that this bump comes from a change in the spectral content of the activities (Grouting, welding, craning, …) that were on-going in the LVEA.
- Results are in accordance with HAM2

Acceptance Criteria:
- Sections Match together
- GS13s responses must not drop in low frequency
- Plots of powerspectra are saved under the SVN

Test result: **Passed: X** **Failed: ____**

Conclusion

Chamber-Side Testing

HAM-ISI Unit #5 was intended to populate HAM3 chamber. The tests presented here were performed between June 12th and June 13th 2012, in accordance with the second version of the *Pre-Integration Chamber-Side Testing* procedure (E1200513-v2).

All sensors appeared to be functional.

This Unit is ready to be inserted in HAM3 chamber. Initial Chamber Testing can then proceed.

Introduction

Initial Chamber Testing

This part of the Phase II testing takes place in open chamber, with the optics off, and HEPI locked. The ISI is then connected to the electronic rack with the final in-field cables. Models are installed and running. Tests are performed with Matlab® scripts.

Optics and Suspensions can be installed right after the end of this phase of testing. No test is performed during their installation.

Final Chamber Testing starts once Optics and Suspensions are installed. The lockers and the CPSs usually need to be reset at this point.

II. INITIAL IN CHAMBER TESTING

HAM3-ISI was installed in in its chamber on June 15th 2012. In field cables were received on July 25th. Their installation finished on July 27th. This initial in chamber testing was conducted in the following 4 days until the chamber was relinquished for installation of Optics and Suspensions on August 1st.

- ***Step 1: Cables Inventory***

Actuator cables were replaced in chamber to reach the feedthrough. S/N were recorded.

Cable Connects		Cable S/N		
Part Name	Configuration	Corner 1	Corner 2	Corner 3
GS13	Horizontal	S1104712	S1106659	S1106664
	Vertical			
L4C	Horizontal	NA	NA	NA
	Vertical	NA	NA	NA
Actuator	Horizontal	S1104756 – 95”	S1104492 - 70”	S1106678
	Vertical	S1106679	S1104490	S1105207

Table – Cables inventory

Acceptance Criteria:

Inventory is complete

Test result: **Passed: X** **Failed: ____**

- ***Step 2: Electronics Inventory***

Hardware	LIGO reference	S/N
Coil driver	D0902744	S1103321
		S1103358
Anti Image filter	D1100202	S1202068
Anti aliasing filter	D1000269	S1202074
		S1202075
Interface chassis	D1000067	S1201752
		S1201753

Acceptance Criteria:

Inventory is complete

Test result: **Passed: X** **Failed: ____**

- ***Step 3: Level of Stage 1***

The optical table is within a $^{+}$/.0.1mm levelness (LHO aLog #3586).
The biggest difference between two corners is then 0.2mm, which corresponds, approximately, to 8mils.

Max angle = 0.008" / 86" = 93µrad

Acceptance Criteria

- The maximum angle of the table with the horizontal mustn't exceed ~100µrad

Test result: **Passed: X** **Failed: ____**

- ***Step 4: Mass Budget***

	00	01	02	03	04	05	06		
	0.6	1.1	2.2	4.5	7.9	15.6	27.2	lbs	kgs
w9			1	3				15.7	7.12
w1	1	0	1	1				7.3	3.31
w2					2			15.8	7.17
w3			1	3				15.7	7.12
w4			1	2				11.2	5.08
w5				2	0			9	4.08
w6			1	1	1			14.6	6.62
w7	1	1						1.7	0.77
w8					2			15.8	7.17
Side Masses Total	2	1	5	12	5	0	0	106.8	48.44

Table – Wall masses distribution

	00	01	02	03	04	05	06		
	0.6	1.1	2.2	4.5	7.9	15.6	27.2	lbs	kgs
k1					1		1	35.1	15.92
k2						2		31.2	14.15
k3					1		1	35.1	15.92
k4						2		31.2	14.15
k5					1		1	35.1	15.92
k6						2		31.2	14.15
Keel Masses Total	0	0	0	0	3	6	3	198.9	90.22

Table – Keel masses distribution

50lbs	597lbs	10kg	Total (kg)
4	1	6	421.51

Table – Optic table masses distribution

	Side	Keel	Top	Total
Weigh (kg)	48.44	90.22	421.51	560.18

Table – Mass budget sum up

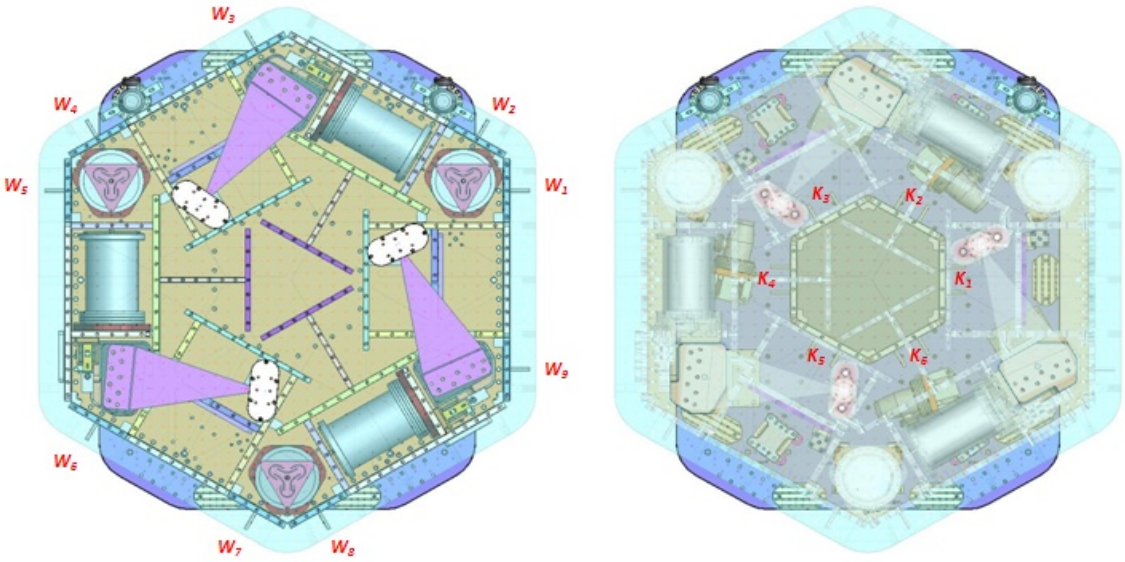


Figure – Wall Masses (W) and Keel masses (K) location. *South of picture = corner 1*

Issues/difficulties/comments regarding this test:
The mass budget was reported to be 565.10kgs during Assembly Validation. It is now 5kg lighter.

- Bundles of ISC cables were installed on the ISI between the two phases of testing.
- The ISI was roughly balanced for the Initial In Chamber Testing.

Acceptance Criteria
The Mass budget must be

- 579.1 Kg (cf. E1100427)+/-25Kg (5%)

Test result: **Passed: __X__** **Failed: ____**

- ***Step 5: Shim Thickness***

Issues/difficulties/comments regarding this test:

- Shims were not changed since Assembly Validation Testing. The results presented here come from the Assembly Validation testing report.
- Locker D is hard to close. It will be reset once Suspensions are installed.

Lockers	Shim thickness (mils)
A	120
B	120
C	121
D	122

Table – Shims Thickness

Test result: **Passed: X** **Failed:**

- ***Step 6: Blade Spring Profile***

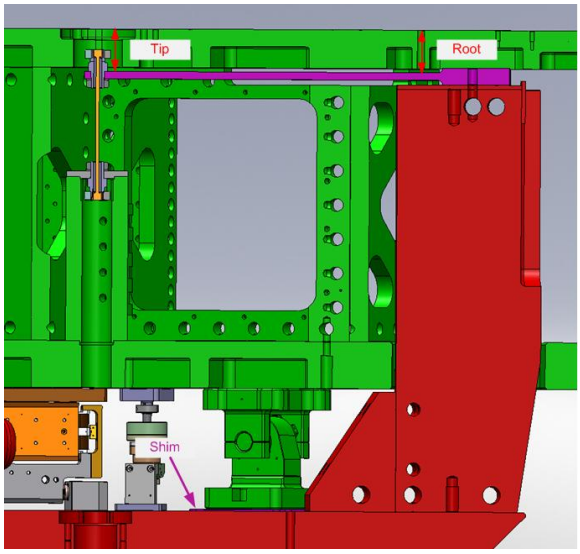


figure – Blade spring profile measurement points

Blade #	Root (Mils)	Tip(Mils)	Flatness (mils)
1	388	375	13
2	399	381	18
3	390	378	12

Table – Blade Spring Profile

Issues/difficulties/comments regarding this test:
Blade #2 is slightly out of the preferred range. The measurement was performed on a locked ISI. The locked position is not optimal, as lockers need to be reset.

Acceptance Criteria:

- Recorded for traceability.
- Flatness preferred within 0.015" inches.

Test result: **Passed: X** **Failed:**

- ***Step 7: Lockers Adjustment***

The maximum difference recorded on the CPSs between the unlocked and the locked positions is about 1V which roughly corresponds to 3280cts

Issues/difficulties/comments regarding this test:

- The maximum difference recorded on the CPSs between the unlocked and the locked positions is out of the preferred $^{+}/_{-}$1600cts range.
- Lockers should be set up with CPS Gaps, after this phase of testing.
- Lockers are reset after the installation of suspensions.

Acceptance criteria:

- Recorded for traceability
- Preferred within $^{+}/_{-}$1600cts

Test result: **Passed: ____** **Failed: X**

- ***Step 8: CPS Gap***

H1 readout (count)	1426
H2 readout (count)	3444
H3 readout (count)	-374
V1 readout (count)	-1071
V2 readout (count)	2678
V3 readout (count)	904

Table – CPS sensor readouts – ISI Unlocked, no drive

Issues/difficulties/comments regarding this test:

- CPS mean readouts are out of the preferred $^{+}/_{-}$400cts range.
- CPS Gap should not be set up during this phase of testing.
- CPSs are reset after the installation of suspensions.

Acceptance criteria:

- Recorded for traceability
- Preferred within $^{+}/_{-}$400cts

Test result: **Passed: X** **Failed: ____**

- ***Step 9: CPS and GS13 Spectra - ISI Unlocked***

Data files in SVN at:
/seismic/HAM-ISI/H1/HAM3/Data/Spectra/Undamped/
- LHO_ISI_HAM3_ASD_m_CPS_T240_L4C_GS13_Locked_vs_Unlocked_2012_08_01.mat

Scripts files for taking and processing the data, and plotting it in SVN at:
seismic/HAM-ISI/Common/Testing_Functions_HAM_ISI/
- Plot_ASD_Unlocked_Locked_HAM_ISI.m
- Plot_ASD_Unlocked_Locked_Group_HAM_ISI.m

Figures in SVN at:
seismic/HAM-ISI/H1/HAM3/Data/Figures/Spectra/Undamped/
- LHO_ISI_HAM3_ASD_m_GS13_Requirements_Locked_vs_Unlocked_2012_08_01.fig
- LHO_ISI_HAM3_ASD_m_CPS_Requirements_Locked_vs_Unlocked_2012_08_01.fig

CPS calibration:
The CPS power spectrums are calibrated by using a sensitivity of 30.2 nm/count.

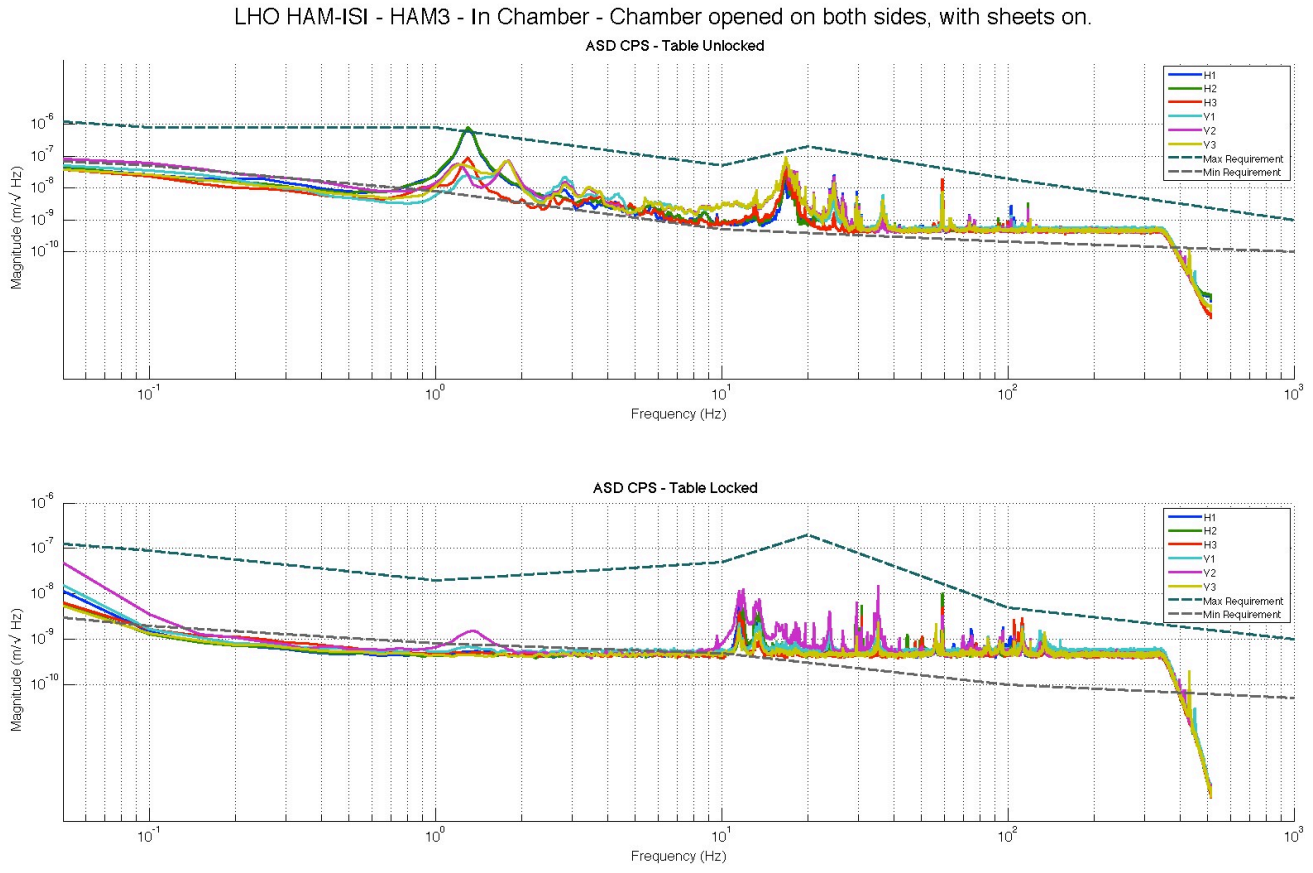


Figure - Calibrated CPS power spectrum – ISI Unlocked/Locked

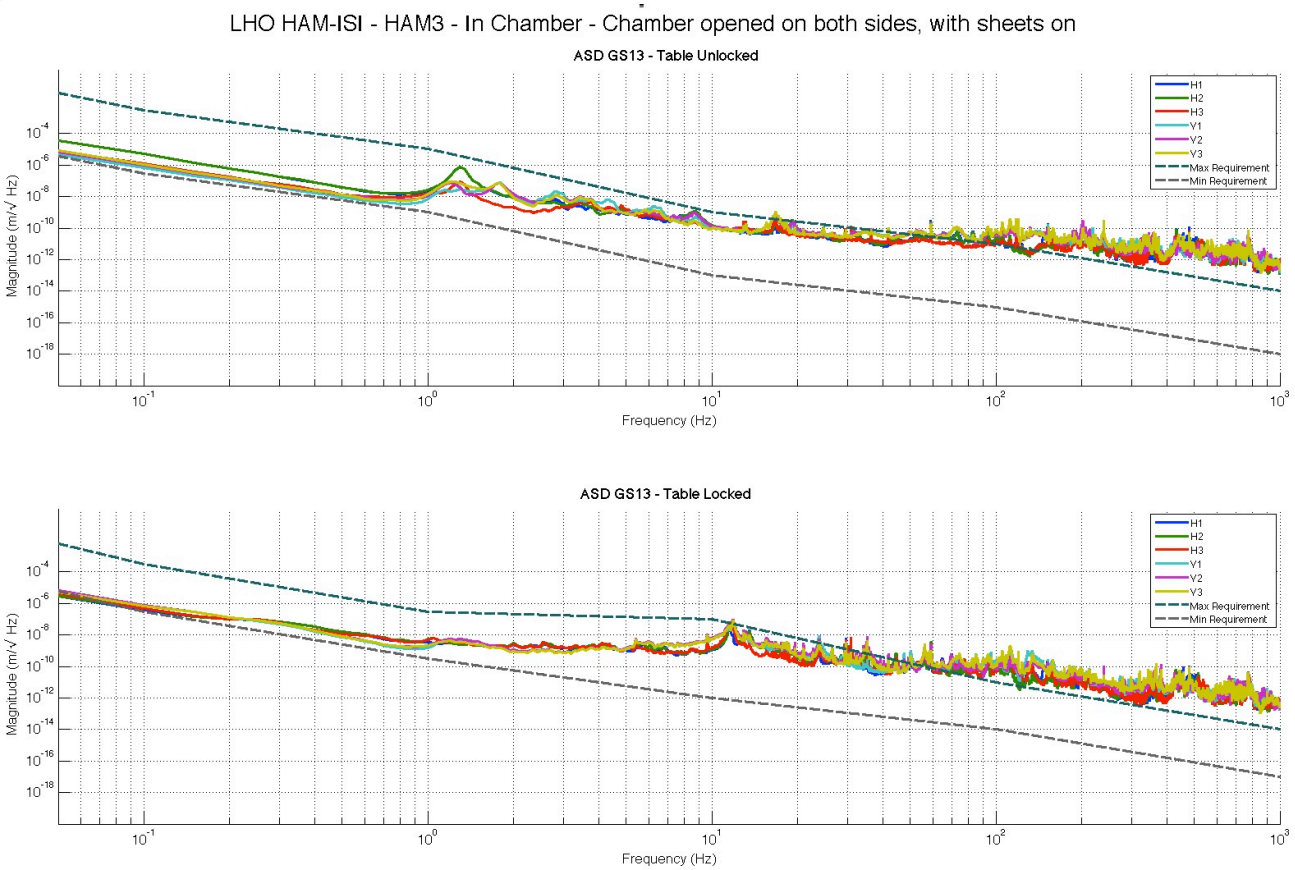


Figure – Power spectrum Calibrated GS13 – ISI Unlocked/Locked

Issues/difficulties/comments regarding this test:

- Locked data was recorded during the weekend, after the optical table payload was removed (421.51kg).

Acceptance criteria:

- No cross talk (peaks at low frequencies + harmonics on measurements)
- Magnitudes of power spectra must be between requirement curves such as in the following figures (dashed lines)

Test result: **Passed: X** **Failed: ____**

Comment:
GS13 requirement curves need to be updated.

- ***Step 10: GS13 ASD - Tabled Tilted***

The figure below presents the GS13 power spectrum when the table is unlocked and loaded with a 10Kg mass at each of its corner.

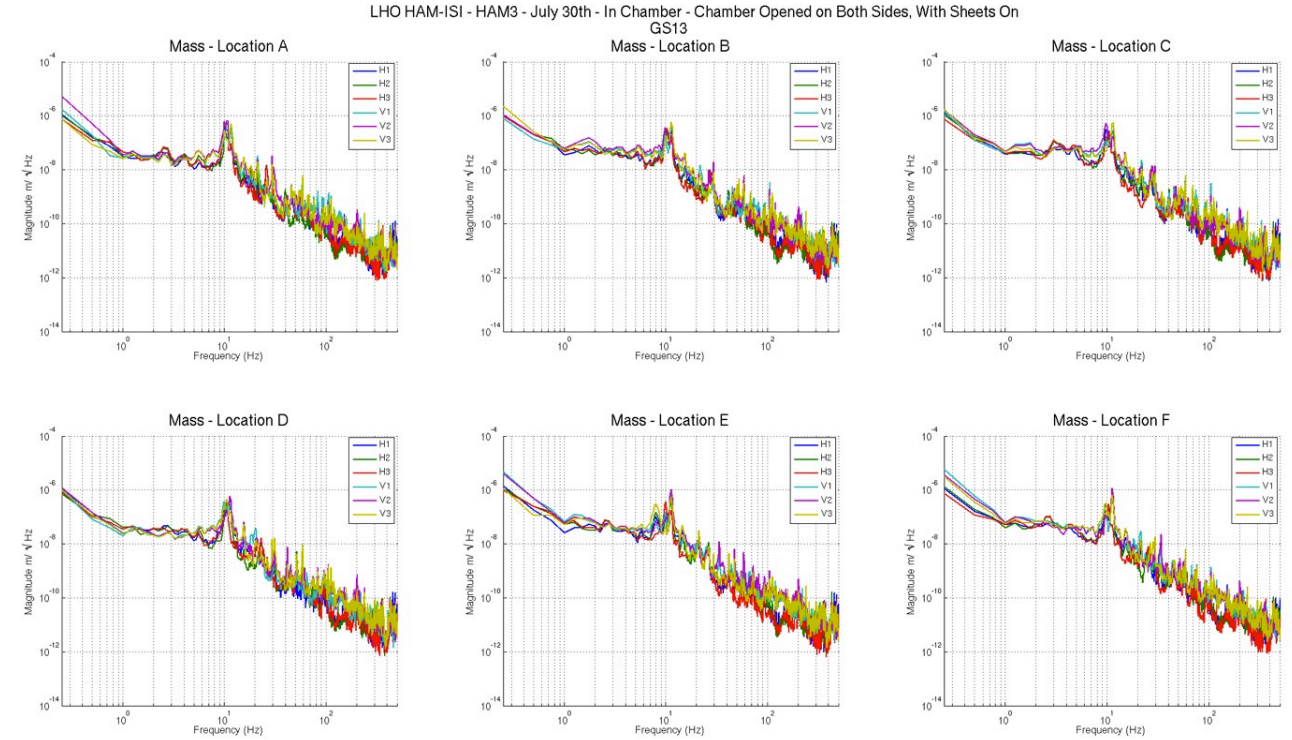


Figure – ASD Calibrated GS13 with mass at corner

Data files in SVN at:
/seismic/HAM-ISI/H1/HAM3/Data/Spectra/Undamped/
- LHO_ISI_HAM3_ASD_m_GS13_Stage_Tilted_2012_07_30.mat

Scripts files for taking and processing the data, and plotting it in SVN at:
seismic/HAM-ISI/Common/Testing_Functions_HAM_ISI/
- Plot_ASD_Tilted_Stage_HAM_ISI.m

Figures in SVN at:
seismic/HAM-ISI/H1/HAM3/Data/Figures/Spectra/Undamped/
- LHO_ISI_HAM3_m_PSD_GS13_Tilted_2012_07_30.fig

Issues/difficulties/comments regarding this test:
- Good concordance between sensors of the same type and direction.
- No drop of response in low frequency

Test result: **Passed: X** **Failed: ____**

- ***Step 11: GS13 pressure readout***

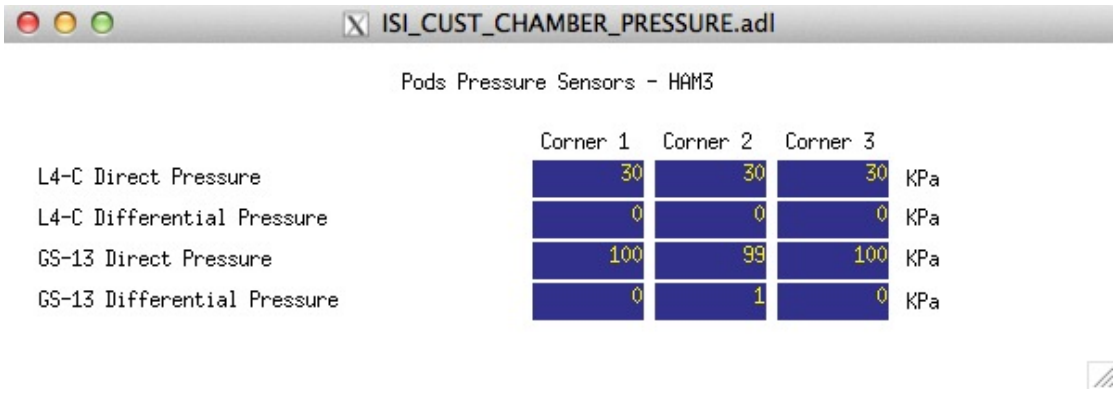


Figure – Pressure Readouts (07/16/2012)

Acceptance criteria:
- The pressure on *GS13_P* channels must be 102KPa +/-8 KPa (25000 counts +/- 3000 counts)
- *GS13_P* must vary the same way in each corner and *GS13_DIFF* must be constant (channels follow comparable trend)

Test result: **Passed: X** **Failed: ____**

- ***Step 12: Actuators Sign and range of motion (Local drive)***

	Negative drive	No Drive	Positive drive
H1 readout (count)	-24490	1426	23074
H2 readout (count)	-23748	3444	24363
H3 readout (count)	-25384	-374	23516
V1 readout (count)	-19328	-1071	19568
V2 readout (count)	-23790	2678	27001
V3 readout (count)	-22602	904	21003

Table - Range of motion - Local drive

Acceptance criteria:
- Main couplings sensors readout must be at least 16000 counts (~0.02")
- A positive offset drive on one actuator must give positive sensor readout on the collocated sensor. Signs will also be tested when measuring local-to-local transfer functions.

Test result: **Passed: X** **Failed: ____**

- ***Step 13: Static Testing (Tests in the local basis)***

	Sensors (counts)					
	H1	H2	H3	V1	V2	V3
H1	1767	1187	1081	37	3	-6
H2	1093	2025	1054	23	16	5
H3	1101	1228	1821	6	31	-5
V1	30	304	-298	1298	6	-525
V2	-349	236	207	-548	1371	-74
V3	-43	-269	41	18	-594	1270

Table - Main couplings and cross couplings

Issues/difficulties/comments regarding this test:
Are slightly out of requirement:
H1-H1
H1-H3
H2-H1
H2-H3

Acceptance criteria:

- **Vertical**
  For a +1000 count offset drive on vertical actuators
  - Collocated sensors must be 1400 counts +/- 10%

- **Horizontal**
  For a +1000 count offset drive on horizontal actuators
  - Collocated sensors must be 2000 counts +/- 10%
  - Non-collocated horizontal sensors must be 1250 counts +/-10%

Test result: **Passed: X** **Failed: ____**

- ***Step 14: Linearity test***

	Slope	Offset	Average slope	Variation from average(%)
H1	1.870777269	1347.670059	1.87	-0.22
H2	1.894068116	3340.203042		1.03
H3	1.859687541	-436.1386068		-0.81
V1	1.352814518	-900.9032343	1.35	0.00
V2	1.354952394	2654.182689		0.16
V3	1.350689415	742.9662125		-0.16

Table - Slopes and offset of the triplet Actuators - HAM-ISI - Sensors

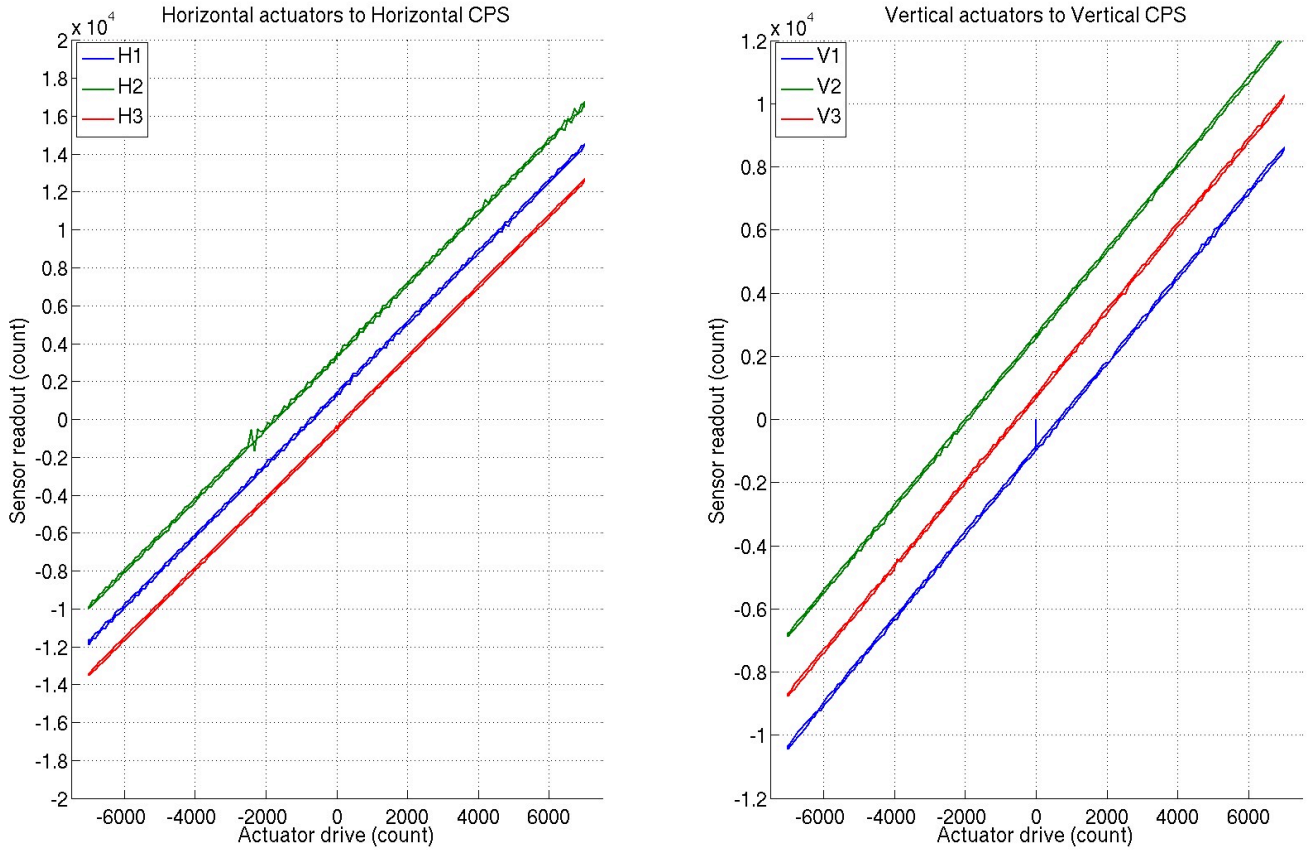


Figure - Horizontal and vertical actuators x HAM-ISI x sensors

Scripts files for taking data in SVN at:
seismic/HAM-ISI/Common/Testing_Functions_HAM_ISI/

- Linearity_Test_Awgstream_HAM_ISI.m
- Reprocess_Linearity_Test.m

Data files in SVN at: seismic/HAM-ISI/L1/HAM3/Data/Linearity_Test/

- LHO_ISI_HAM3_Linearity_test_20120801.mat

Figures in SVN at:
seismic/HAM-ISI/H1/HAM3/Data/Figures/Linearity_Test/

- LHO_ISI_HAM3_Linearity_test_20120801.fig

Issues/difficulties/comments regarding this test:
Needed to right a script to reprocess test data. The original scrip did not account for the new data rate on the CPSs.

Acceptance criteria:

- Horizontal and vertical slopes of the triplet actuators x HAM-ISI x sensors = Average slope +/- 1.5%

Test result: **Passed: X** **Failed: ____**

- ***Step 15: Frequency response***

All input/output filters are ON. HEPI is locked. The chamber is closed with sheets on.

- ***Step 15.1: Local to local measurements***

Data files in SVN at:
seismic/HAM-ISI/H1/HAM3/Data/Transfer_Functions/Measurements/Undamped/
- LHO_ISI_HAM3_Data_TF_L2L_200Hz_1000Hz_20120731-193225.mat
- LHO_ISI_HAM3_Data_TF_L2L_5Hz_200Hz_20120731-204959.mat
- LHO_ISI_HAM3_Data_TF_L2L_500mHz_5Hz_20120731-190148.mat
- LHO_ISI_HAM3_Data_TF_L2L_100mHz_500mHz_20120801-093231.mat

Data collection script files:
seismic/HAM-ISI/H1/HAM3/Scripts/Data_Collection/
- Run_Exc_Batch_H1_HAM3.m

Scripts files for processing and plotting in SVN at:
seismic/HAM-ISI/H1/HAM3/Scripts/Control_Scripts/Version_0/
- Step_1_TF_Loc_to_Loc_H1_ISI_HAM3.m

Figures in SVN at:
seismic/HAM-ISI/H1/HAM3/Data/Figures/Transfer_Functions/Measurements/Undamped/
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_to_CPS_2012_08_01.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_to_GS13_2012_08_01.fig

Storage of measured transfer functions in the SVN at:
seismic/HAM-ISI/H1/HAM3/Data/Transfer_Functions/Simulations/Undamped/
- H1_ISI_HAM3_TF_L2L_Raw_2012_08_01.mat

The local to local transfer functions and presented below.

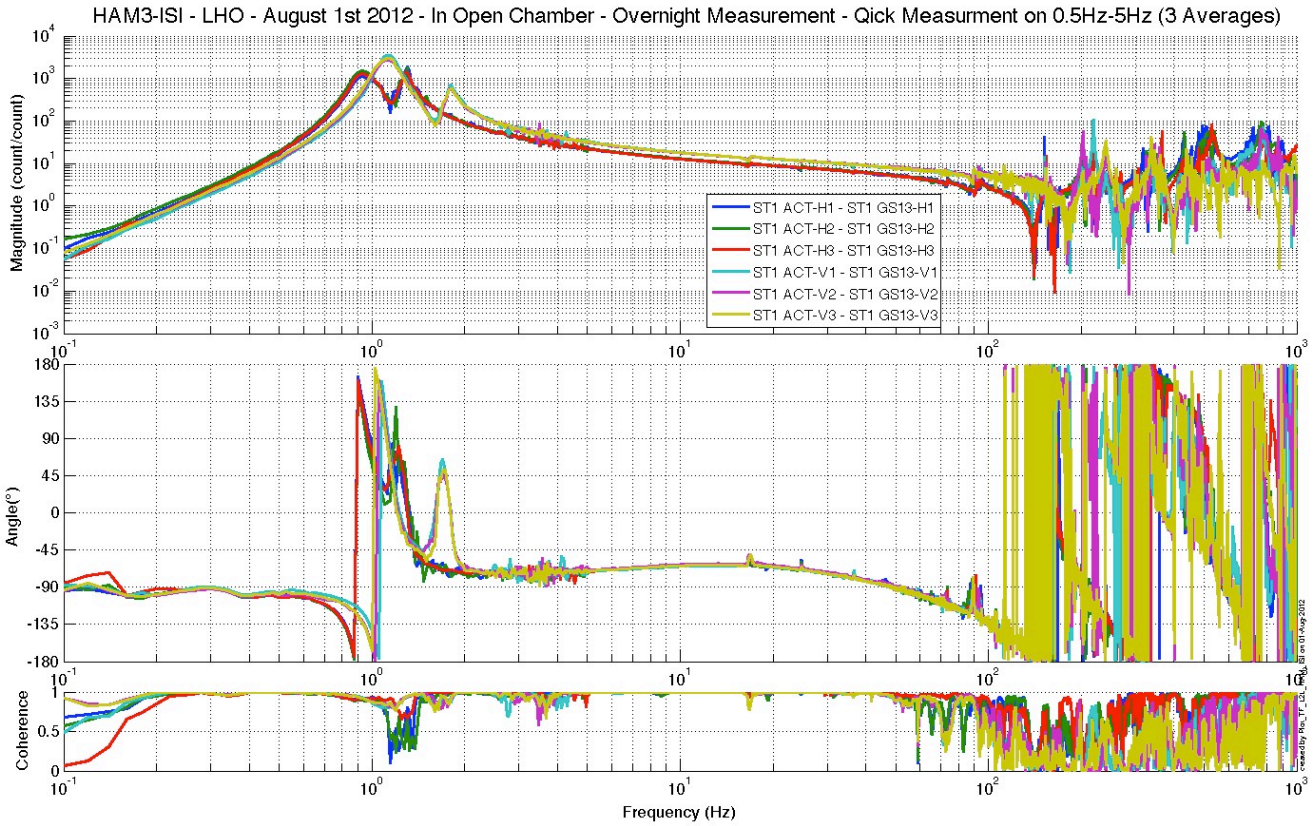


Figure - Local to Local Measurements –Capacitive Position Sensors

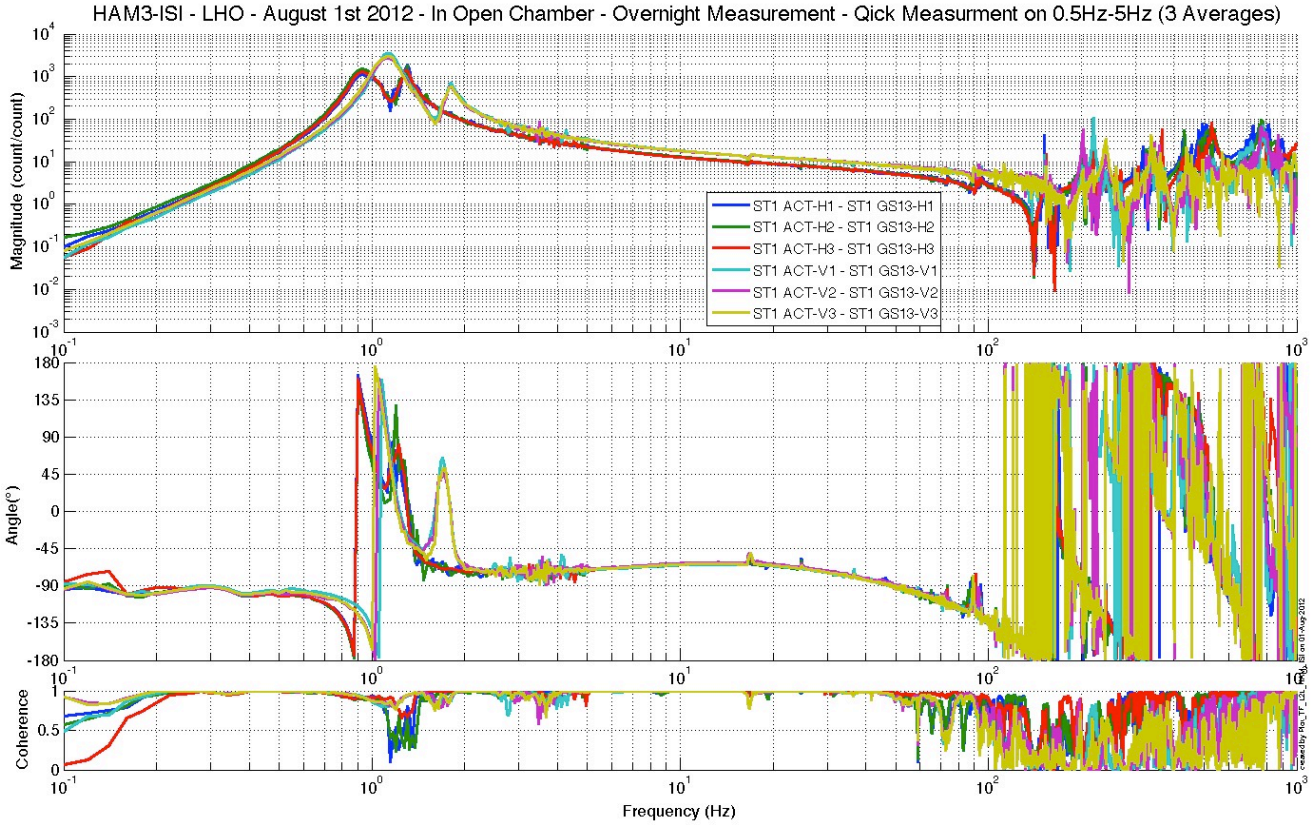


Figure - Local to Local Measurements – Inertial sensors

- ***Step 15.2: Local to local measurements V.S. LLO***

Data files in SVN at:

LHO:

seismic/HAM-ISI/H1/HAM3/Data/Transfer_Functions/Measurements/Undamped/

- LHO_ISI_HAM3_Data_TF_L2L_200Hz_1000Hz_20120731-193225.mat
- LHO_ISI_HAM3_Data_TF_L2L_5Hz_200Hz_20120731-204959.mat
- LHO_ISI_HAM3_Data_TF_L2L_500mHz_5Hz_20120731-190148.mat
- LHO_ISI_HAM3_Data_TF_L2L_100mHz_500mHz_20120801-093231.mat

LLO:

seismic/HAM-ISI/L1/HAM3/Data/Transfer_Functions/Simulations/Undamped/

- LLO_ISI_HAM3_TF_L2L_Raw_2012_02_18.mat

Scripts files for processing and plotting in SVN at:

seismic/HAM-ISI/H1/HAM3/Scripts/Control_Scripts/Version_0/

- Step_1_TF_Loc_to_Loc_H1_ISI_HAM3.m
- Plot_TF_L2L_HAM_with_LLO.m

Figures in SVN at:

seismic/HAM-ISI/H1/HAM3/Data/Figures/Transfer_Functions/Comparisons/L2L/

- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_H_to_CPS_H_vs_LLO_2012_02_18.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_V_to_CPS_V_vs_LLO_2012_02_18.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_H_to_GS13_H_vs_LLO_2012_02_18.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_V_to_GS13_V_vs_LLO_2012_02_18.fig

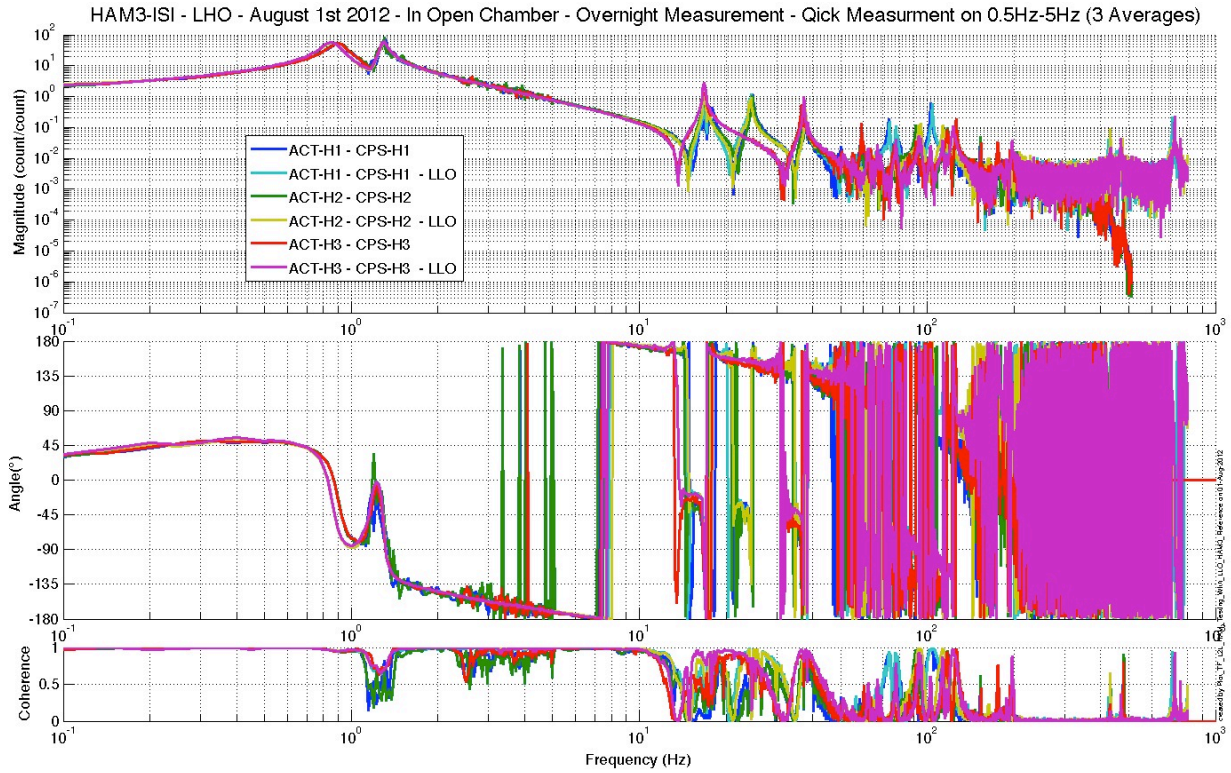


Figure – TF L2L – Horizontal CPS

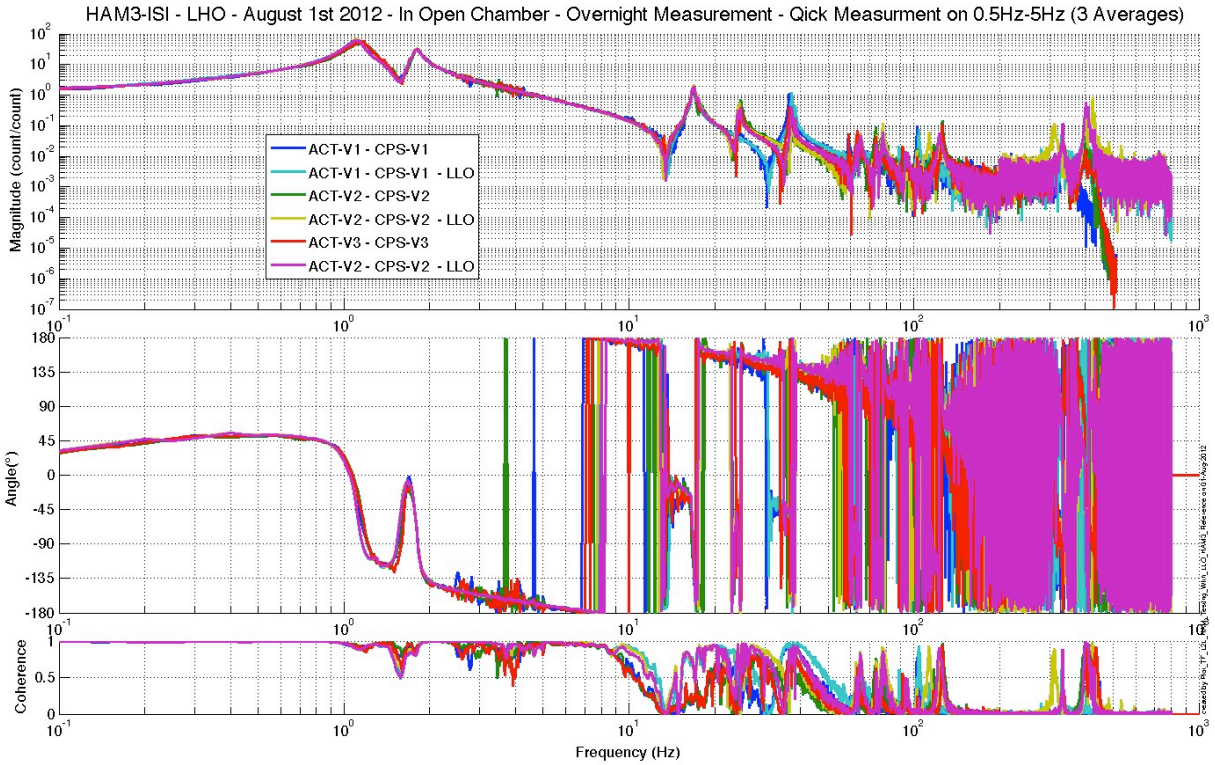


Figure – TF L2L – Vertical CPS

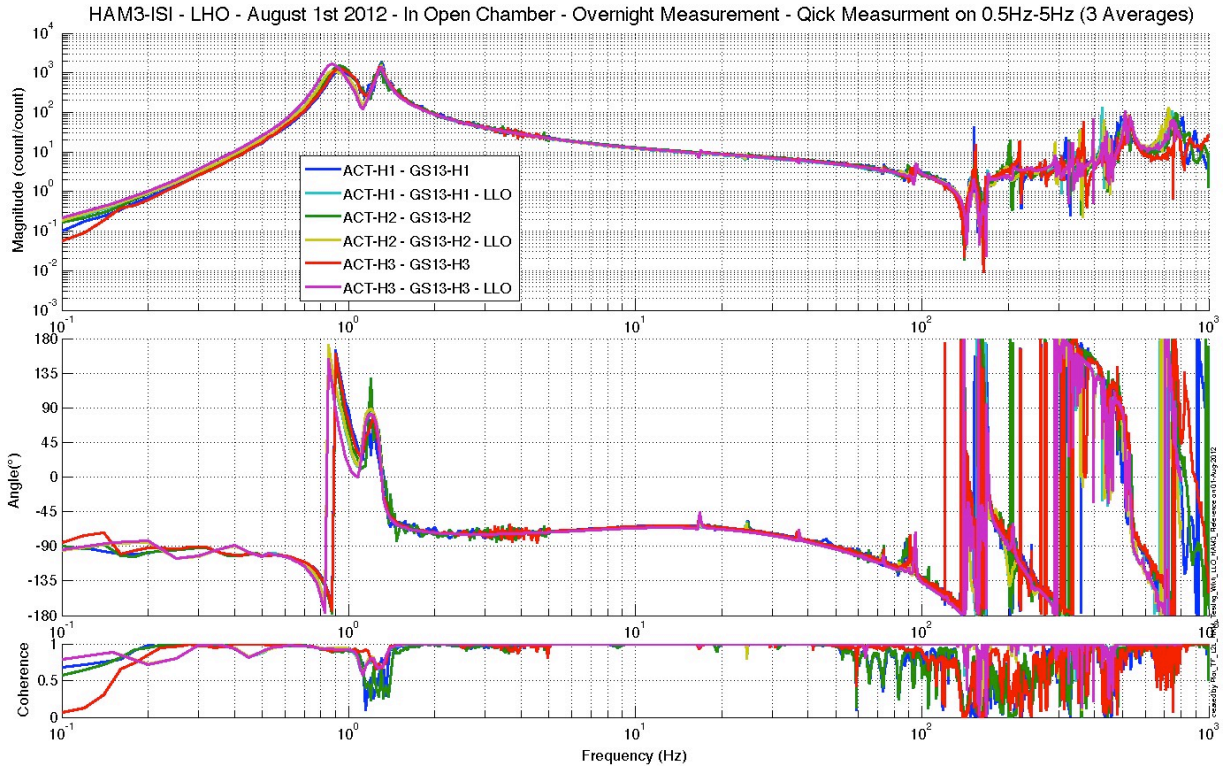


Figure – TF L2L – Horizontal GS13

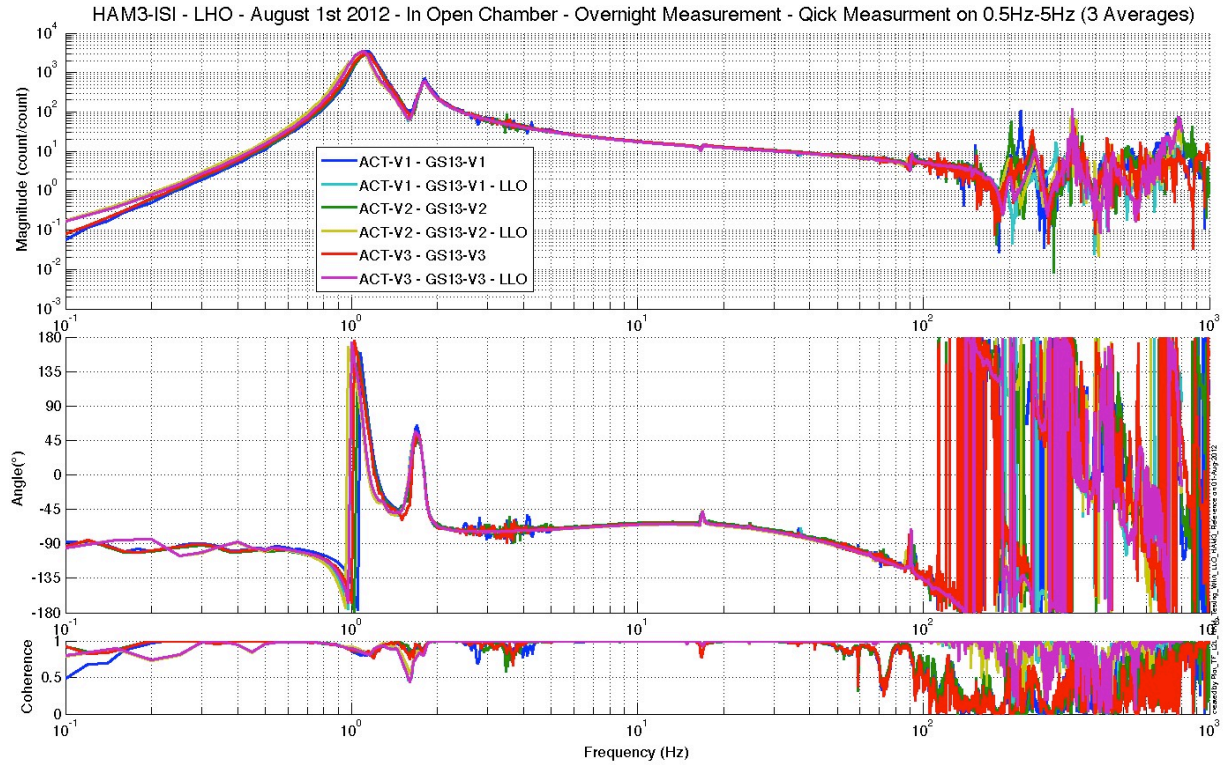


Figure – TF L2L – Vertical GS13

Acceptance criteria:

- Good concordance with TF measured under the same conditions at LLO.
- Local to local measurements
  - On CPS, the phase must be 0º at DC
  - On Geophones, the phase must be -90º at DC
  - Identical shape in each corner
- Cartesian to Cartesian measurements
  - On CPS, the phase must be 0º at DC
  - On Geophones, the phase must be -90º at DC
  - Identical shape X/Y and RX/RY

Test result: **Passed: X** **Failed: ____**

Conclusion

Initial In-Chamber testing

The ISI was tested between Friday July 27th and Wednesday August 1st 2012. All the tests presented here were performed during that period. Other tasks were also performed then:

- Models were installed
- In-field cables were installed
- Electronic rack was troubleshooted:
    - BIO-related cables missing fifth pin
    - DAC/ADC card numbers in the IO chassis figured out
    - BIO card used by the model figured out

Very few issues were found during the *Initial In-Chamber Testing* of this unit. The known issues are summed up here:

- CPSs and lockers will need to be reset after SUS install, as expected
- Some readouts are slightly under requirements on Local to Local static test.
- Overnight Transfer Function crashed du to incompatibility between Ubuntu OS and Mac computers.

Introduction

Final Chamber Testing

This part of the Phase II testing takes place in open chamber. All the suspensions and opticas are on. HEPI is locked.

This is the last phase of testing before the chamber is closed for the IMC test.

IO was done with installing optics on December 4th 2012. No tests could be performed during the day, due to IO alignment work, until December 7th.

Tests presented here were performed between December 4th and December 8th 2012.

III. Final In-Chamber Testing

- ***Step 1: Parts Inventory (E1000052)***

DCC Number	Part name	Configuration	Corner 1 S/N	Corner 2 S/N	Corner 3 S/N
D071001	Stage 0 base	NA	10		
D071051	Stage 1 base	NA	12		
D071050	Optical table	NA	11		
D071002	Spring Post	NA	2	3	8
D071100	Spring	NA	38	13	29
D071102	Flexure	NA	2	4	14
ADE	Position sensor	Horizontal	12007 Master 0	12022 S1ave 180	12035 Slave 0
		Vertical	11983 Slave 180	12006 Slave 0	12027 Slave 180
D047812	GS-13 pod	Horizontal	13	38	71
		Vertical	74	72	4
D047823	L4C pod	Horizontal	NA	NA	NA
		Vertical	NA	NA	NA
D0902749	Actuator	Horizontal	23	115	117
		Vertical	105	98	116

Table – Parts inventory

NA: Not applicable

	Corner	S/N
TMD	1	10
	2	11
	3	12

Table – Tuned Mass Dampers

Issues/difficulties/comments regarding this test:
Same parts as during the Assembly Validation testing. Only TMDs were added since.

Acceptance Criteria:
Inventory is complete

Test result: **Passed: X** **Failed: ____**

- ***Step 2: Cables inventory:***

Issues/difficulties/comments regarding this test:
No cables were changed since the *Initial In-Chamber testing*. Please refer to the *Initial In-Chamber testing* section of this report for details.

Acceptance Criteria:
Inventory is complete

Test result: **Passed: X** **Failed: ____**

- ***Step 3: Electronics inventory***

Issues/difficulties/comments regarding this test:
No electronics were changed since the *Initial In-Chamber testing*. Please refer to the *Initial In-Chamber testing* section of this report for details.

Acceptance Criteria:
Inventory is complete

Test result: **Passed: X** **Failed: ____**

- ***Step 4: Payload Survey***

During this step, the ISI is fully payloaded with suspensions and optics. The masses added to finish loading and balancing the ISI were recorded. See table below.

	00	01	02	03	04	05	06		
	0.6	1.1	2.2	4.5	7.9	15.6	27.2	lbs	kgs
w9	0	0	0	0	0	0	0	0	0.00
w1	2	1	2	1				11.2	5.08
w2	1		1	1				7.3	3.31
w3	1		0	1				5.1	2.31
w4	2		1	1	1			15.8	7.17
w5			1					2.2	1.00
w6	1							0.6	0.27
w7		1		1				5.6	2.54
w8		1		1	1			13.5	6.12
Side Masses Total	7	3	5	6	2	0	0	61.3	27.81

Table – Wall Mass Distribution

	00	01	02	03	04	05	06		
	0.6	1.1	2.2	4.5	7.9	15.6	27.2	lbs	kgs
k1					1		1	35.1	15.92
k2						2		31.2	14.15
k3					1		1	35.1	15.92
k4						2		31.2	14.15
k5					1		1	35.1	15.92
k6						2		31.2	14.15
Keel Masses Total	0	0	0	0	3	6	3	198.9	90.22

Table – Keel Mass Distribution

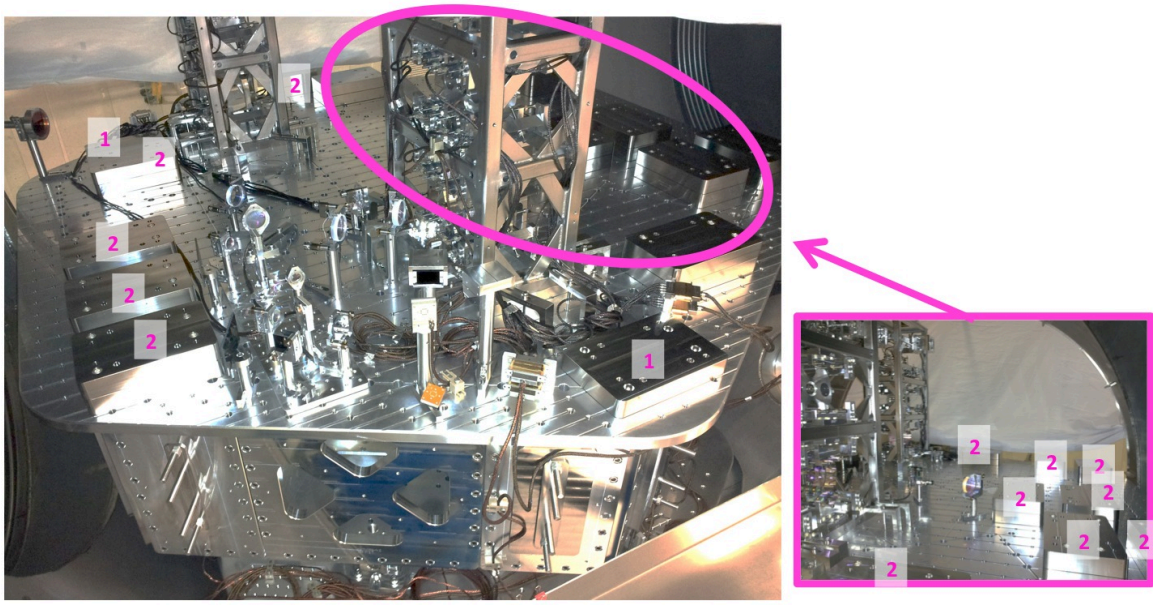


Figure – Optical Table Mass Distribution (280kg added with 10kg masses)

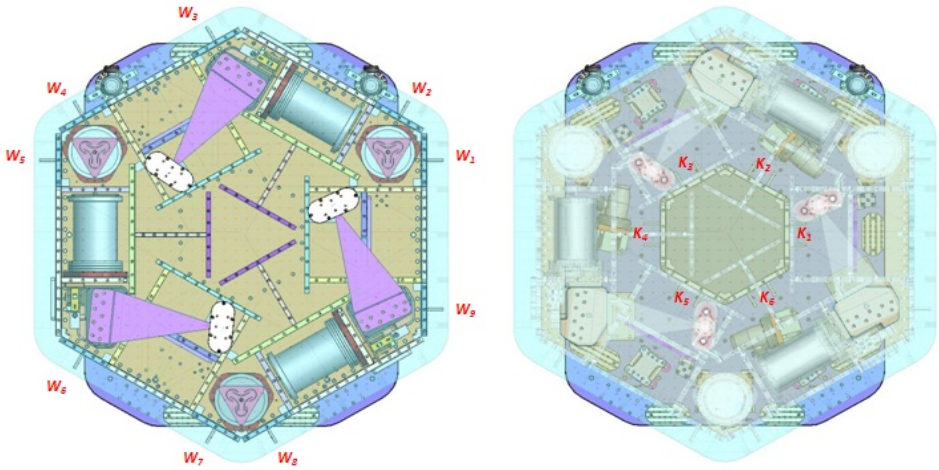


Figure – Wall Masses (W) and Keel masses (K) location. *South of picture = corner 1*

Issues/difficulties/comments regarding this test:
Only wall masses and optical table masses were changed since the Initial In-Chamber testing. Keel masses were retrieved from this phase. Please refer to the related section for details.

Acceptance Criteria:
- Amount and position of wall masses is recorded
- Amount and position of keel masses is recorded
- Amount and position of optical table masses is recorded

Test result: **Passed: X** **Failed: ____**

- ***Step 5: Locked/Unlocked Spectra***

GPS time of measurement:
Locked = 1039370100 ;
UnLocked = 1039341393 ;

Data files in SVN at:
/seismic/HAM-ISI/H1/HAM3/Data/Spectra/Undamped/
- LHO_ISI_HAM3_ASD_m_CPS_T240_L4C_GS13_Locked_vs_Unlocked_2012_12_12.mat

Scripts files for taking and processing the data, and plotting it in SVN at:
seismic/HAM-ISI/Common/Testing_Functions_HAM_ISI/
- ASD_Measurements_Locked_Unlocked_HAM_ISI.m
- Plot_ASD_Unlocked_Locked_HAM_ISI.m
- Plot_ASD_Unlocked_Locked_Group_HAM_ISI.m

Figures in SVN at:
seismic/HAM-ISI/H1/HAM3/Data/Figures/Spectra/Undamped/
- LHO_ISI_HAM3_ASD_m_GS13_Requirements_Locked_vs_Unlocked_2012_12_12.fig
- LHO_ISI_HAM3_ASD_m_CPS_Requirements_Locked_vs_Unlocked_2012_12_12.fig

Issues/difficulties/comments regarding this test:
- The testing functions used here need to load the calibration filters. The way we save these filters recently changed. The functions were updated to reflect these changes. Refer to SEI aLog #147 for more details.
  - The CPS power spectra are calibrated by using a sensitivity of 30.2 nm/count.
- Even though *asd2.m* is now available, the functions used here still use *pwelch*.

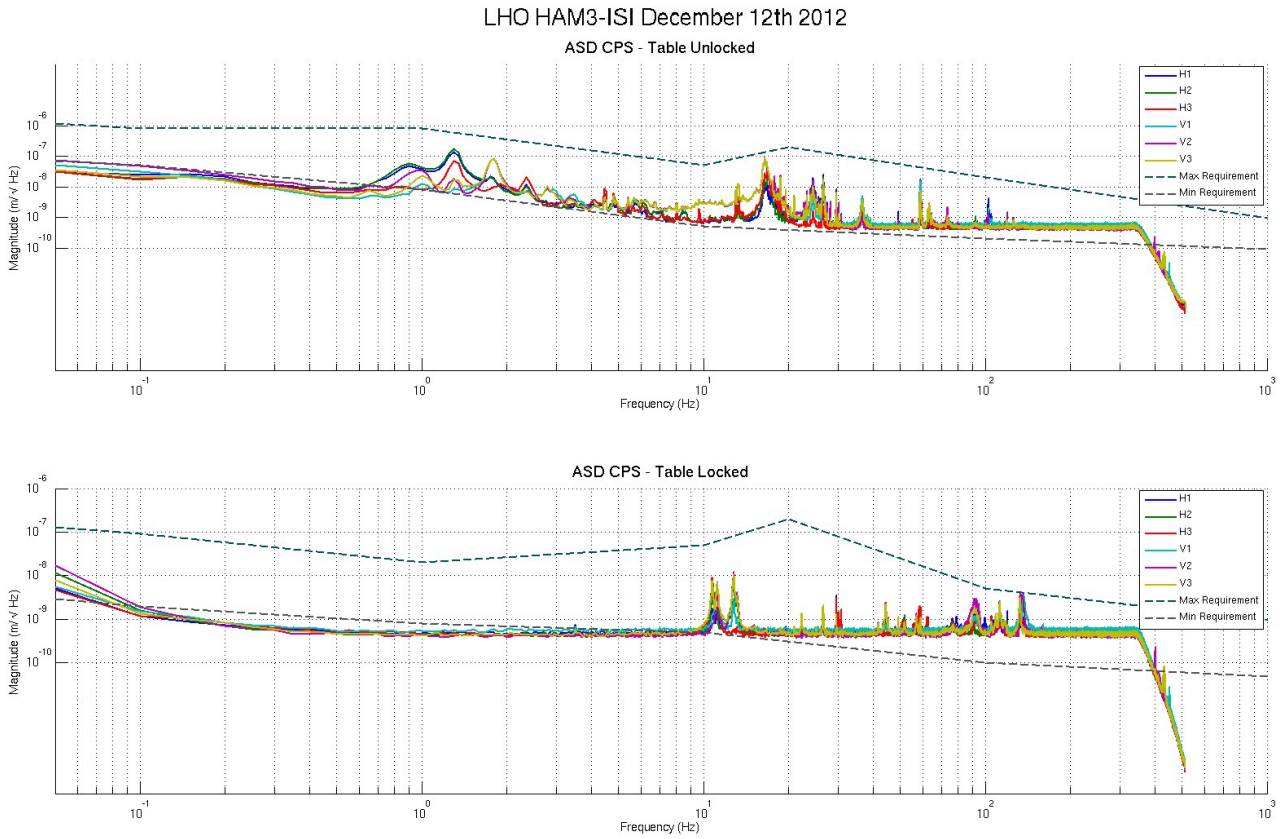


Figure - Calibrated CPS power spectrum – ISI Unlocked/Locked

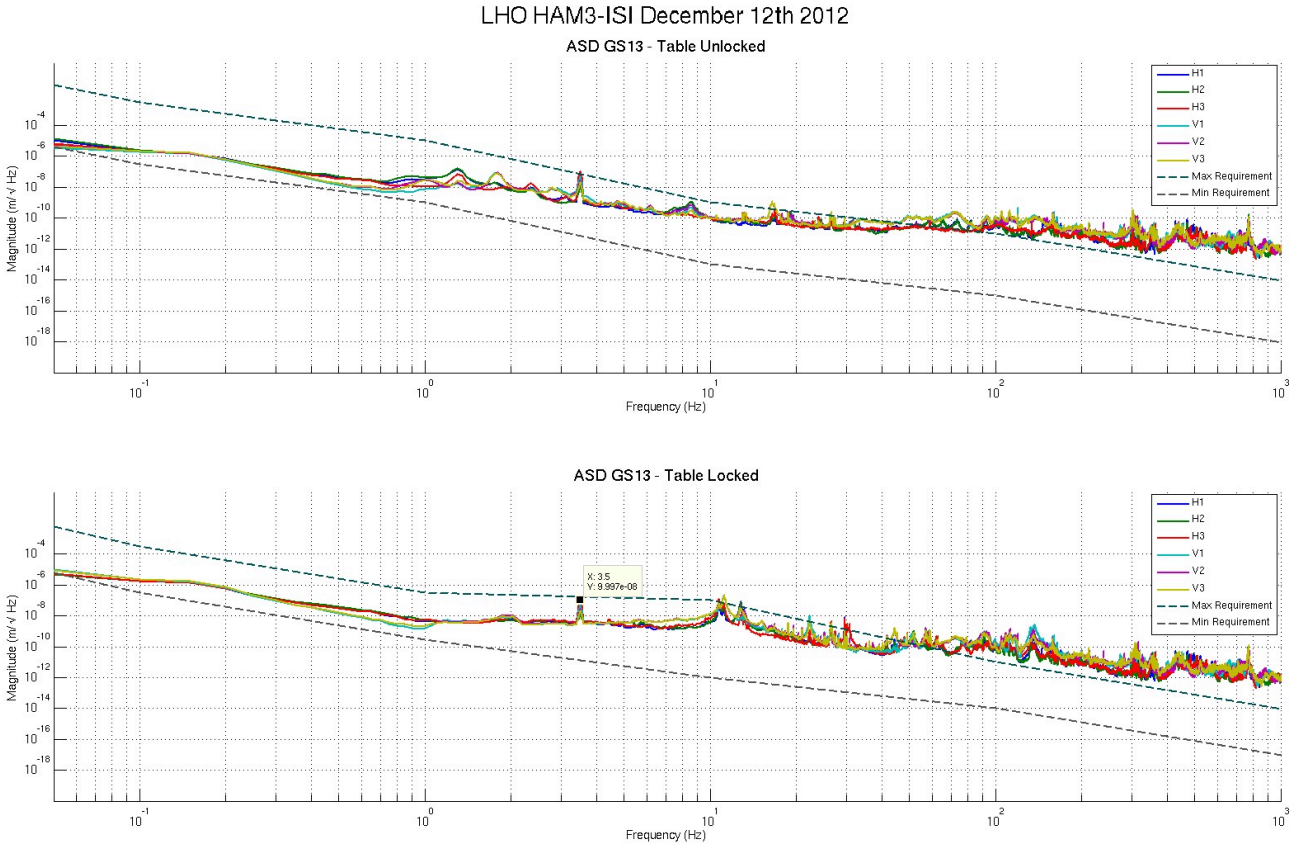


Figure – Power spectrum Calibrated GS13 – ISI Unlocked/Locked

Issues/difficulties/comments regarding this test:

- The unusual peak seen at 3.5Hz on the GS13 spectra comes from Robert Schofield's magnetic coupling test, for which he inject a magnetign field 5 order of magnitude stronger than regular ambient level, under BSC1, right next to HAM3. See LHO aLog #4920 for more details.
- Good concordance between sensors of the same type and direction.
- No drop of response in low frequency.
- The testing functions used here need to load the calibration filters. The way we save these filters recently changed. The functions were updated to reflect these changes. Refer to SEI aLog #147 for more details.
- The CPS power spectra are calibrated by using a sensitivity of 30.2 nm/count.
- Even though *asd2.m* is now available, the functions used here still use *pwelch*.

Acceptance criteria:

- No cross talk (peaks at low frequencies + harmonics on measurements)
- Magnitudes of power spectra must be between requirement curves such as in the following figures (dashed lines)

Test result: **Passed: X** **Failed: ____**

Comment:
GS13 requirement curves need to be updated.

- ***Step 6: Tilted Spectra***

Spectra with the ISI titled were already taken during the initial in-chamber testing.. The GS13s were not changed nor moved since. Locked and unlocked spectra are fine We are confident that the GS13s are fully functional.

Refer to the Initial In-Chamber Testing section, step 10 for details.

Test result: **Passed: X** **Failed: ____**

- ***Step 7: Pressure Readouts***

Pods Pressure Sensors - HAM3

	Corner 1	Corner 2	Corner 3	
L4-C Direct Pressure	30	30	30	KPa
L4-C Differential Pressure	0	0	0	KPa
GS-13 Direct Pressure	99	99	100	KPa
GS-13 Differential Pressure	0	1	0	KPa

Figure – Pressure Readouts December 7th 2012

Pods Pressure Sensors - HAM3

	Corner 1	Corner 2	Corner 3	
L4-C Direct Pressure	30	30	30	KPa
L4-C Differential Pressure	0	0	0	KPa
GS-13 Direct Pressure	99	99	100	KPa
GS-13 Differential Pressure	0	1	0	KPa

Figure – Pressure Readouts December 13th 2012

Issues/difficulties/comments regarding this test:

- Pressure readouts are exactly the same after 6 days.
- Pressure readouts are within requirements
- The ISI is in air, with sheet covers on the chamber

Acceptance criteria:

- The pressure on GS13_P channels must be 102KPa +/-8 KPa (25000 counts +/- 3000 counts)
- GS13_P must vary the same way in each corner and GS13_DIFF must be constant (channels follow comparable trend)

Test result: **Passed: X** **Failed: ___**

- ***Step 8: Lockers/CPS Adjustment***

Lockers' adjustments were performed on December 4th after IO finalized the payload of HAM3-ISI. Details about this operation can be found in LHO aLog #4831.

The zero of the CPS was reset after working on the lockers.

The goal of this step is to make sure that the locked/unlocked shift read with the CPSs is within requirement. If the zeroing was performed correctly, CPS readout values should also be within requirements.

Shift	Unlocked (Counts)	Locked (Counts)	Shift
H1	-380	87.98	467.98
H2	170	504.36	334.36
H3	-60	139.12	199.12
V1	120	145.64	25.64
V2	-350	-518.82	168.82
V3	250	108.37	141.63

Table – Locker's Adjustments December 4th 2012

Issues/difficulties/comments regarding this test:

- Locked-Unlocked shift is way below requirements. Same comment applies to the readouts.
- The cavity was flashing before unlocking the ISI. We unlocked and it was still flashing.
- We turned the damping on, and the cavity was still flashing
- We turned the Level 2 controllers designed during the pre-commissioning control tests and the cavity was still flashing.

Acceptance criteria (per E1000309-v12):

- Shift < 1600 cts
- Readouts < 2000 cts

Test result: **Passed: X** **Failed: ___**

- ***Step 9: Shim Thickness***

Lockers	Shim thickness (mil)
A	120
B	120
C	121
D	129

Table – Shim Thicknesses, October 11th 2012

Issues/difficulties/comments regarding this test:

- Only the shim of locker D was changed since the initial in-Chamber testing.
- The shim of locker D was changed from 122 mils to 129 mils.
- The thickness of the shims of lockers A, B and C, were retrieved from the initial In-Chamber section.

Acceptance Criteria

- The shim thickness should be 125 mils +/-5

Test result: **Passed: X** **Failed: ___**

- ***Step 10: Blade Spring Profile***

Issues/difficulties/comments regarding this test:

- Only the profile of corner 2 blade could be measured due to lack of access once suspensions are installed. We measured 17 mils for the flatness of this blade.
- The flatness of the blade of corner 2 is slightly out of requirements but there is not much we can do about it because the lockers seem to be set right.
- Transfer functions, Pre-commissioning tests, and experience show that this is not an issue. Team SEI decided to move forward, keeping this feature in mind.

Acceptance Criteria:

- Blades must be flat within 0.015" inches.

Note that the tip measurement should be constant and that root value can be impacted by shims change.

Test result: **Passed:** ____ **Failed:** X

- ***Step 11: Level of Stage 1***

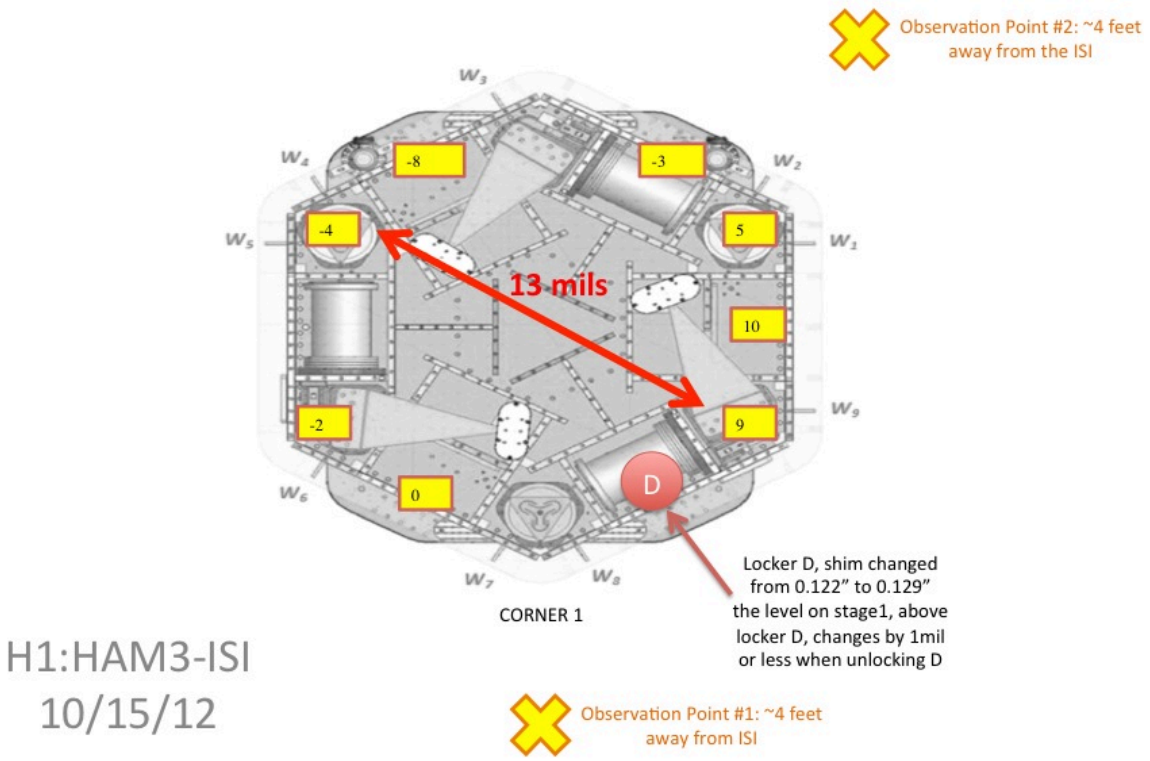


Figure – Level of Stage 1

Max angle = 0.013" / 78.61" ~ 165 µrad

Issues/difficulties/comments regarding this test:

- This measurement was performed after changing the shim on locker D (see step 8)
- Level is out of requirements
- Transfer functions, Pre-commissioning tests, and experience show that this is not an issue. Team SEI decided to move forward, keeping this feature in mind.

Acceptance Criteria

- The maximum angle of the table with the horizontal mustn't exceed ~100µrad

Test result: **Passed:** ____ **Failed:** X

- ***Step 12: Range of Motion***

	Negative drive	No Drive	Positive drive	ROM (Counts)
H1 readout (count)	-22700	97	23400	46100
H2 readout (count)	-22700	437	23400	46100
H3 readout (count)	-23200	121	24200	47400
V1 readout (count)	-18900	115	19500	38400
V2 readout (count)	-20100	-479	20500	40600
V3 readout (count)	-20500	175	19000	39500

Table – Range of Motion, Dec 7th

ROM: Range Of Motion

Issues/difficulties/comments regarding this test:
- Compensation filters are ON.
- Symmetrization filters are OFF

Acceptance criteria:
- Main couplings sensors readout must be at least 16000 counts (~0.02")
- A positive offset drive on one actuator must give positive sensor readout on the collocated sensor. Signs will also be tested when measuring local-to-local transfer functions.

Test result: **Passed: X** **Failed: ___**

- ***Step 13: Static Testing***

Local to Cartesian transform matrices were already proofed during assembly-validation and Pre-commissioning. Hence, static testing is only performed in the local basis.

The following test was performed on December 11th 2012.

		Sensor Readouts (counts)					
		H1	H2	H3	V1	V2	V3
Drive (Counts)	H1	**1891**	1098	1180	-12	29	51
	H2	1219	1908	1245	-89	27	-106
	H3	1182	1140	1879	20	18	-100
	V1	147	124	-379	1399	-39	-696
	V2	-329	120	172	-646	1396	-59
	V3	213	-405	239	-95	-592	1295

Table – Local Static Testing, Decembre 11th 2012

Issues/difficulties/comments regarding this test:
- H2 response to H1 drive is slightly below requirement.
- Transfer functions, Pre-commissioning tests, and experience show that this is not an issue.

Acceptance criteria:

- **Vertical axis**
  For a +1000 count offset drive on vertical actuators
  - Collocated sensors must be 1400 counts +/- 10%

- **Horizontal axis**
  For a +1000 count offset drive on horizontal actuators
  - Collocated sensors must be 2000 counts +/- 10%
  - Non-collocated horizontal sensors must be 1250 counts +/-10%

Test result: **Passed: X** **Failed: ___**

- ***Step 14: Linearity Test***

This test was performed on December 5th 2012. Similar results were observed on December 7th, even though the covers were not rubbing, and thus were rubbing against the ISI.

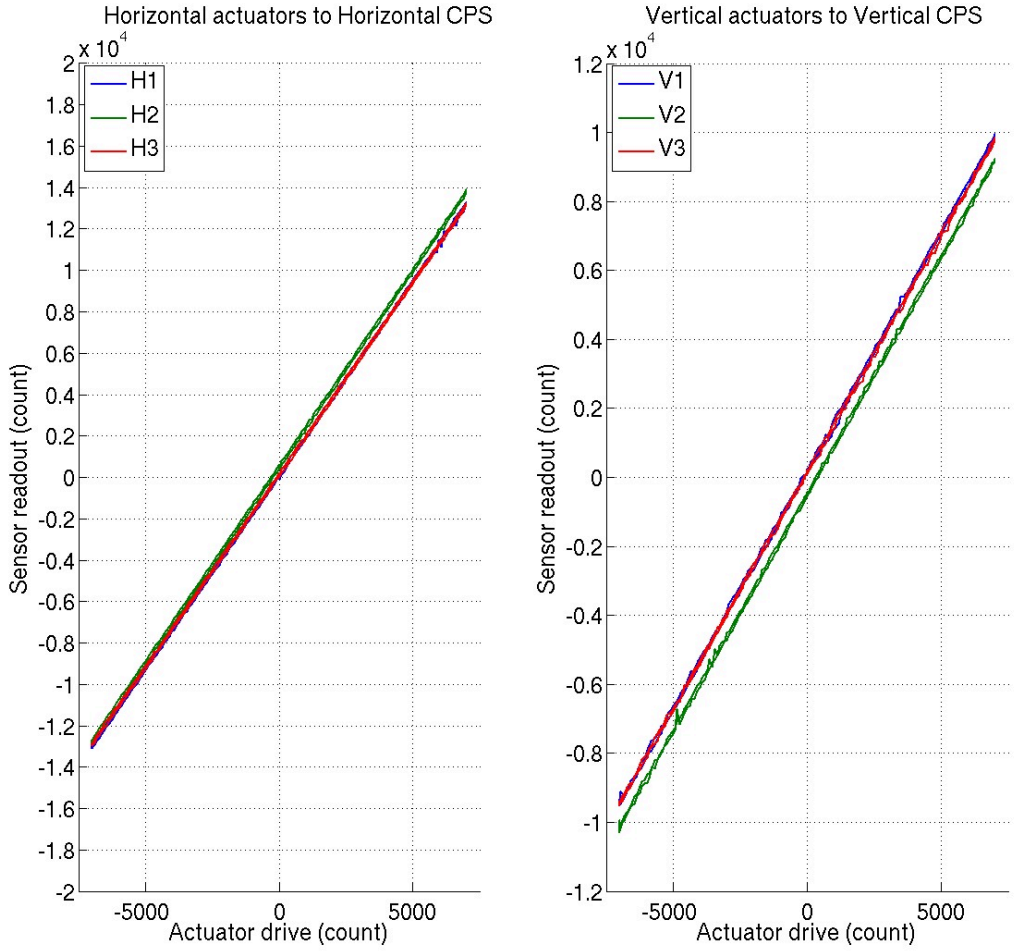


Table – Linearity test, December 5th 2012

	Slope	Offset	Average slope	Variation from average (%)
H1	1.87	90.04	1.88	-0.19
H2	1.89	506.96		0.98
H3	1.86	118.85		-0.80
V1	1.38	203.39	1.38	0.27
V2	1.38	-478.64		0.01
V3	1.37	154.30		-0.28

Table – Linearity test, slopes and offsets, December 5th 2012

Issues/difficulties/comments regarding this test:
Average slopes are more consistent now that the ISI is finely balanced and that we use the final in-field cables.
Linearity_Test_Awgstream_HAM_ISI___Updated_Data_Rate.m is used instead of the regular script to account for the new data rate of the CPSs (1024, instead of 2048)

Scripts files for taking data in SVN at:
seismic/HAM-ISI/Common/Testing_Functions_HAM_ISI/
- Linearity_Test_Awgstream_HAM_ISI___Updated_Data_Rate.m

Data files in SVN at:
seismic/HAM-ISI/L1/HAM3/Data/Linearity_Test/
- LHO_ISI_HAM3_Linearity_test_20121205.mat

Figures in SVN at:
seismic/HAM-ISI/H1/HAM3/Data/Figures/Linearity_Test/
- LHO_ISI_HAM3_Linearity_test_20121205.fig

Acceptance criteria:

- Horizontal and vertical slopes of the triplet actuators x HAM-ISI x sensors = Average slope +/- 1.5%

Test result: **Passed: X** **Failed: ____**

- ***Step 15: Local to Local Transfer Function Measurements***

All input/output filters are ON. HEPI is locked. The chamber is closed with sheets on.

- ***Step 15.1: Local to local measurements***

Data files in SVN at:
seismic/HAM-ISI/H1/HAM3/Data/Transfer_Functions/Measurements/Undamped/
- LHO_ISI_HAM3_Data_TF_L2L_10mHz_100mHz_20121208-100239.mat
- LHO_ISI_HAM3_Data_TF_L2L_100mHz_500mHz_20121208-081113.mat
- LHO_ISI_HAM3_Data_TF_L2L_500mHz_5Hz_20121207-224150.mat
- LHO_ISI_HAM3_Data_TF_L2L_5Hz_200Hz_20121207-195823.mat
- LHO_ISI_HAM3_Data_TF_L2L_200Hz_1000Hz_20121207-172553.mat

Data collection script files:
seismic/HAM-ISI/H1/HAM3/Scripts/Data_Collection/
- Run_Exc_Batch_H1_HAM3.m

Scripts files for processing and plotting in SVN at:
seismic/HAM-ISI/H1/HAM3/Scripts/Control_Scripts/Version_2/
- Step_1_TF_Loc_to_Loc_H1_ISI_HAM3.m

seismic/HAM-ISI/H1/HAM3/Data/Transfer_Functions/Simulations/Undamped/
- Measurements_List_H1_ISI_HAM3.m (Measurement # 18)

Figures in SVN at:
seismic/HAM-ISI/H1/HAM3/Data/Figures/Transfer_Functions/Measurements/Undamped/
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_to_CPS_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_to_GS13_2012_12_08.fig

Storage of measured transfer functions in the SVN at:
seismic/HAM-ISI/H1/HAM3/Data/Transfer_Functions/Simulations/Undamped/
- H1_ISI_HAM3_TF_L2L_Raw_2012_12_08ßß.mat

The local to local transfer functions and presented below.

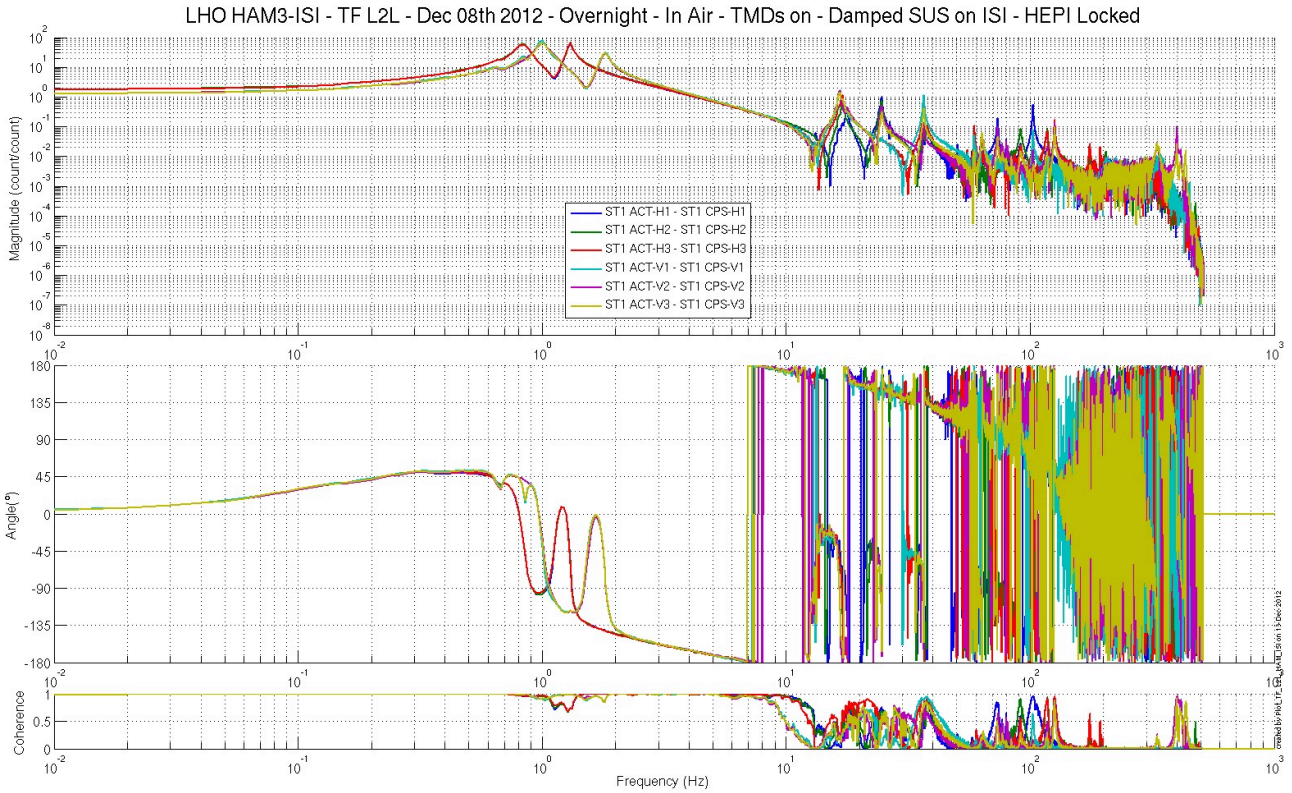
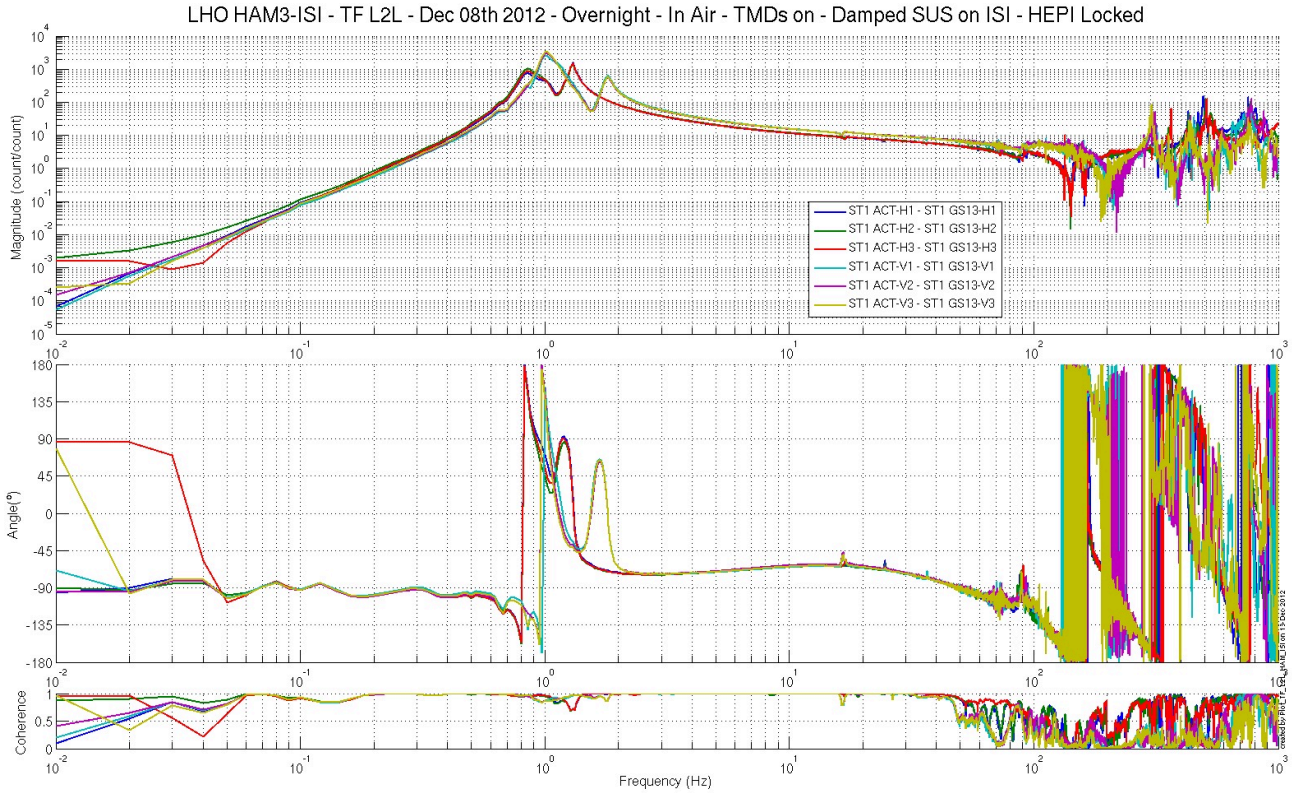


Figure – Local-to-Local Transfer Function – Capacitive Position Sensors



Figure– Local-to-Local Transfer Function – InertialSensors

- ***Step 15.2: Local to local measurements V.S. LLO***

Data files in SVN at:

LHO:

seismic/HAM-ISI/H1/HAM3/Data/Transfer_Functions/Measurements/Undamped/

- LHO_ISI_HAM3_Data_TF_L2L_10mHz_100mHz_20121208-100239.mat
- LHO_ISI_HAM3_Data_TF_L2L_100mHz_500mHz_20121208-081113.mat
- LHO_ISI_HAM3_Data_TF_L2L_500mHz_5Hz_20121207-224150.mat
- LHO_ISI_HAM3_Data_TF_L2L_5Hz_200Hz_20121207-195823.mat
- LHO_ISI_HAM3_Data_TF_L2L_200Hz_1000Hz_20121207-172553.mat

LLO:

seismic/HAM-ISI/L1/HAM3/Data/Transfer_Functions/Simulations/Undamped/

- L1_ISI_HAM3_TF_L2L_Raw_2012_05_12.mat

Scripts files for processing and plotting in SVN at:

seismic/HAM-ISI/H1/HAM3/Scripts/Control_Scripts/Version_2/

- Step_1_TF_Loc_to_Loc_H1_ISI_HAM3.m

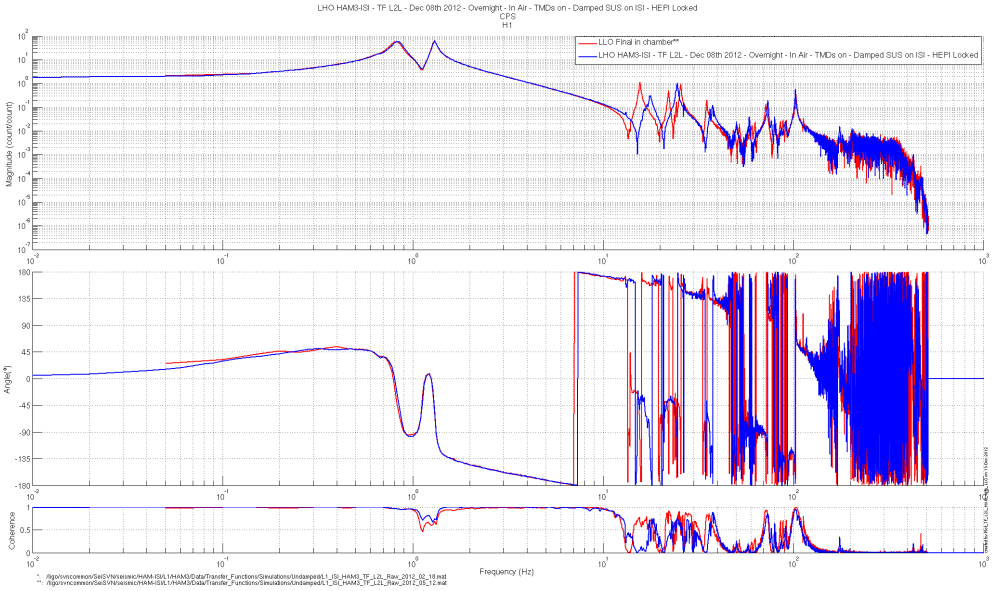
seismic/HAM-ISI/H1/HAM3/Scripts/Control_Scripts/Version_2/New_Functions/

- Plot_TF_L2L_HAM_with_LLO.m

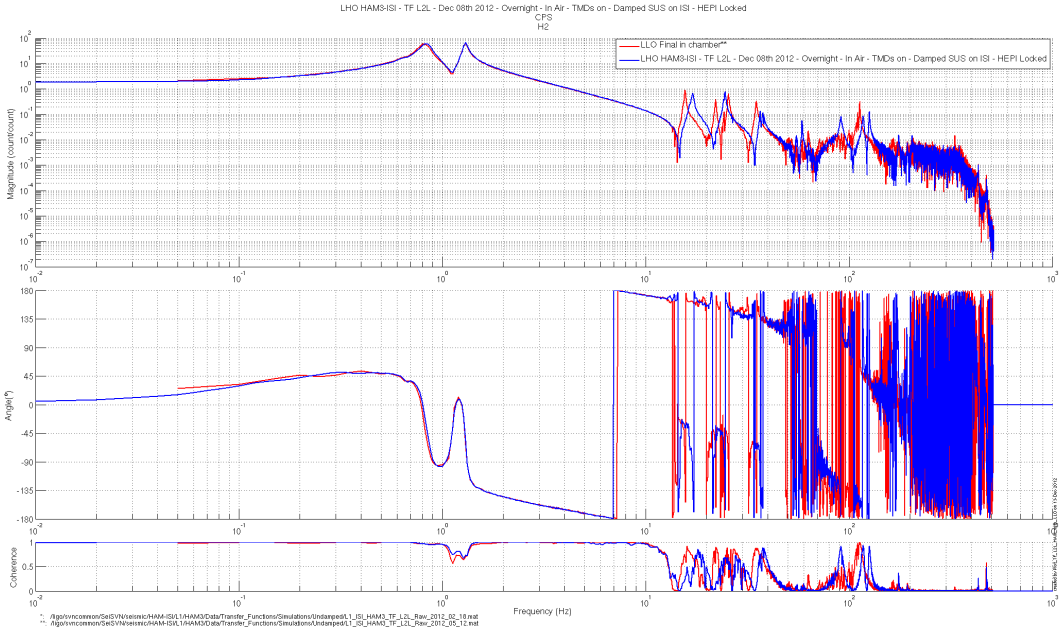
Figures in SVN at:

seismic/HAM-ISI/H1/HAM3/Data/Figures/Transfer_Functions/Comparisons/L2L/

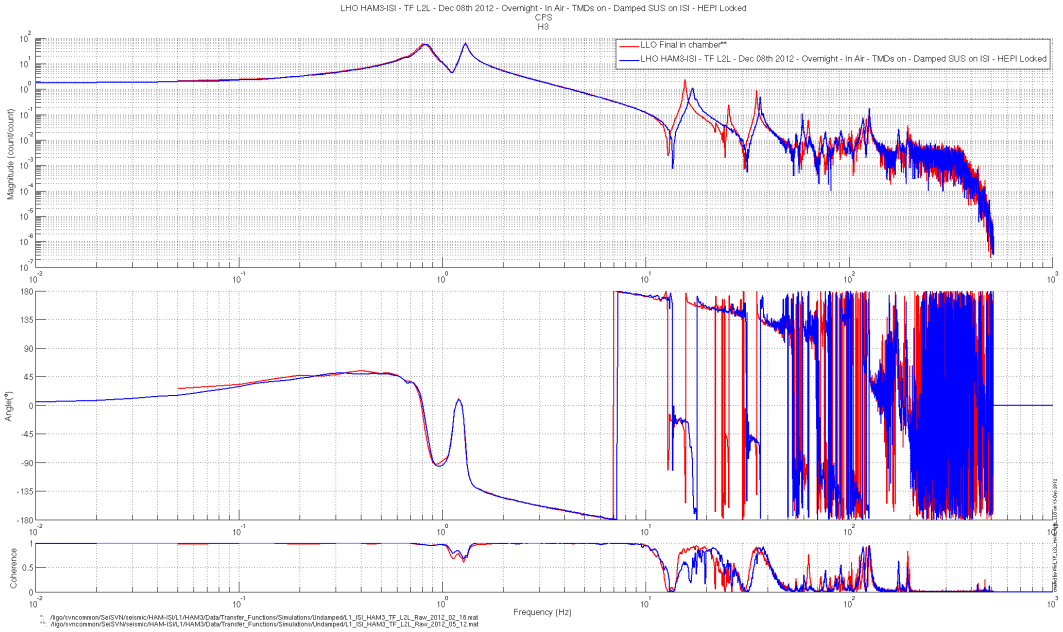
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_H1_to_CPS_H1_vs_LLO_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_H1_to_GS13_H1_vs_LLO_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_H2_to_CPS_H2_vs_LLO_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_H2_to_GS13_H2_vs_LLO_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_H3_to_CPS_H3_vs_LLO_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_H3_to_GS13_H3_vs_LLO_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_V1_to_CPS_V1_vs_LLO_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_V1_to_GS13_V1_vs_LLO_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_V2_to_CPS_V2_vs_LLO_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_V2_to_GS13_V2_vs_LLO_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_V3_to_CPS_V3_vs_LLO_2012_12_08.fig
- H1_ISI_HAM3_TF_L2L_Raw_from_ACT_V3_to_GS13_V3_vs_LLO_2012_12_08.fig



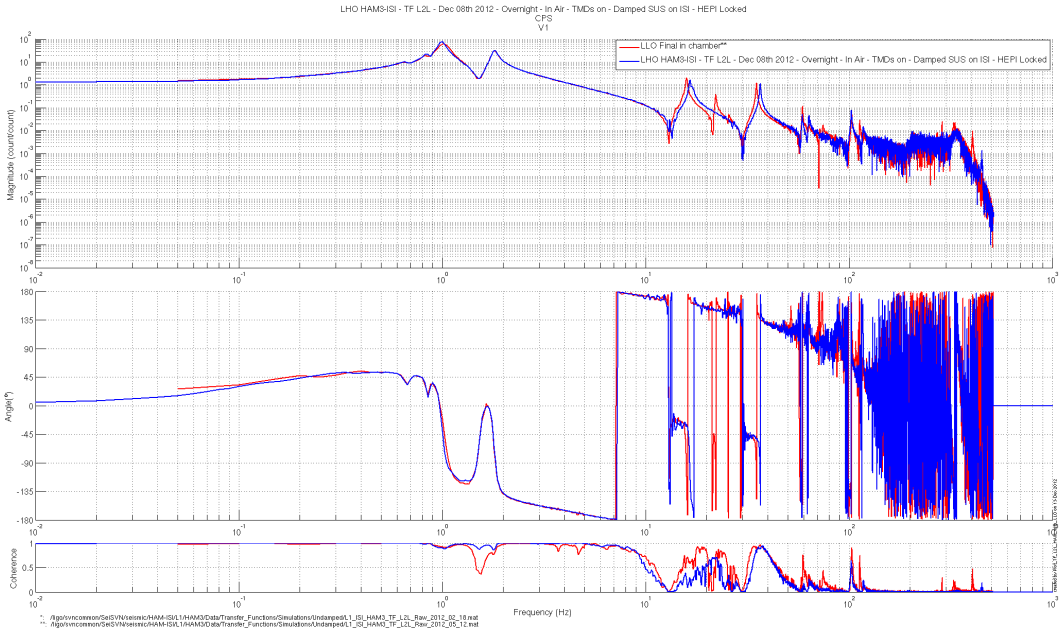
Figure– Local-to-Local Transfer Function – CPS H1 – Comparison with LLO



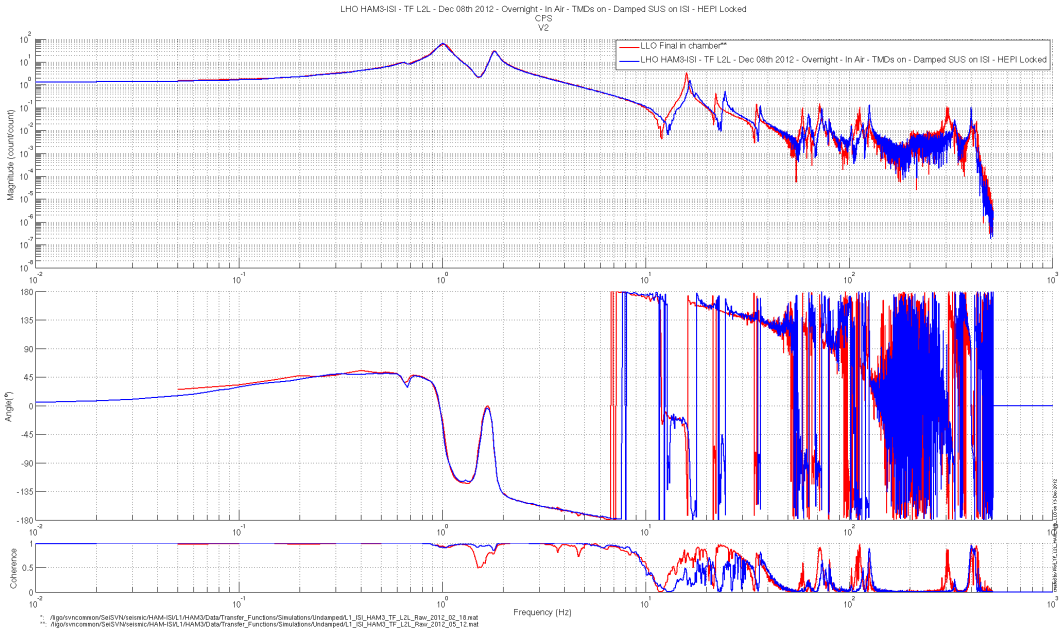
Figure– Local-to-Local Transfer Function – CPS H2 – Comparison with LLO



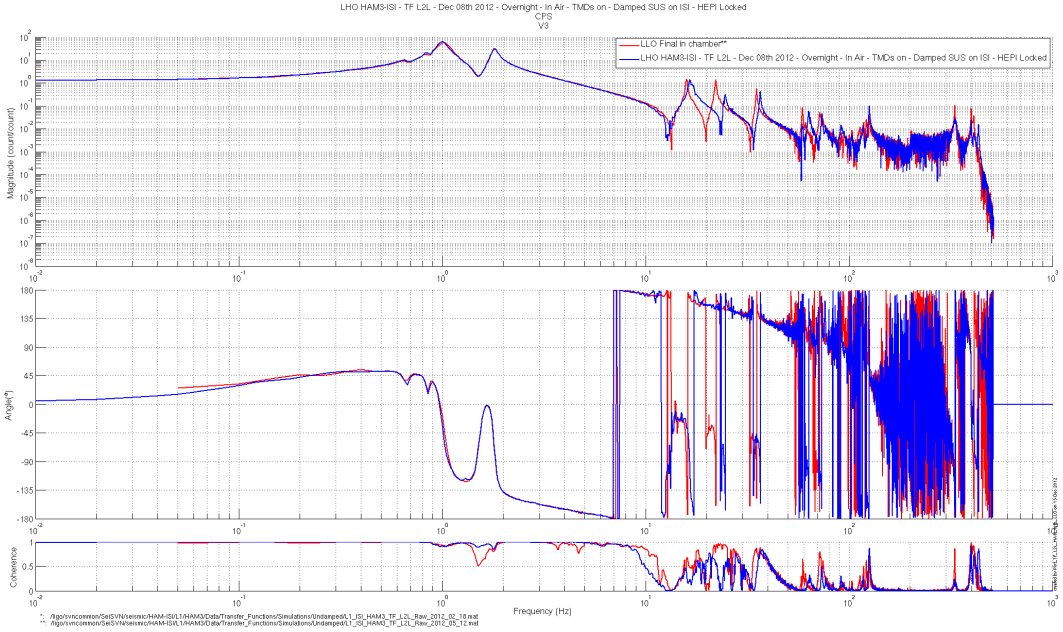
Figure– Local-to-Local Transfer Function – CPS H3 – Comparison with LLO



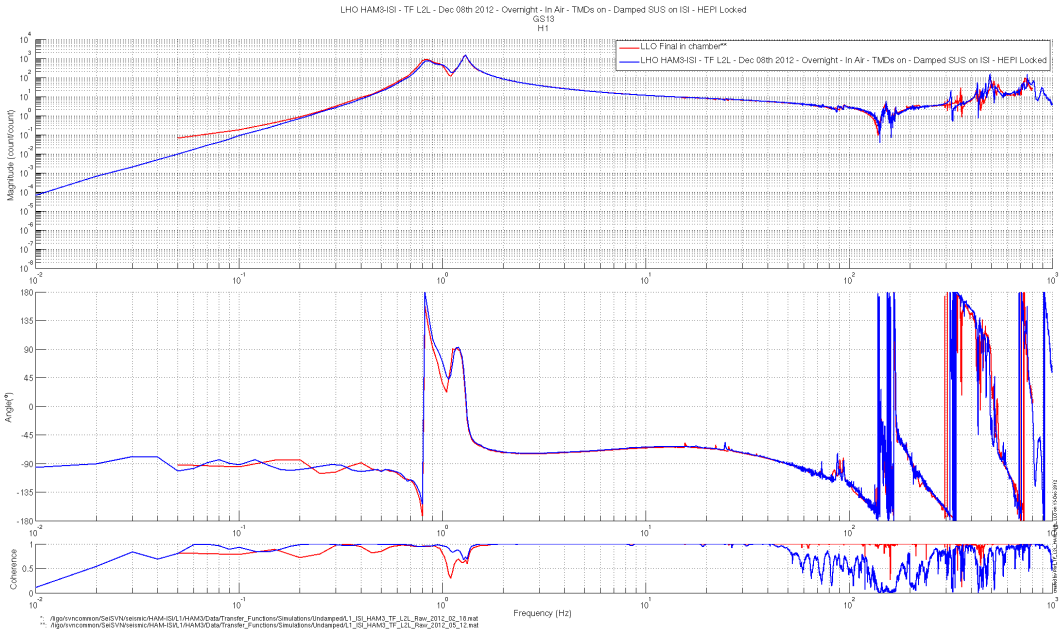
Figure– Local-to-Local Transfer Function – CPS V1 – Comparison with LLO



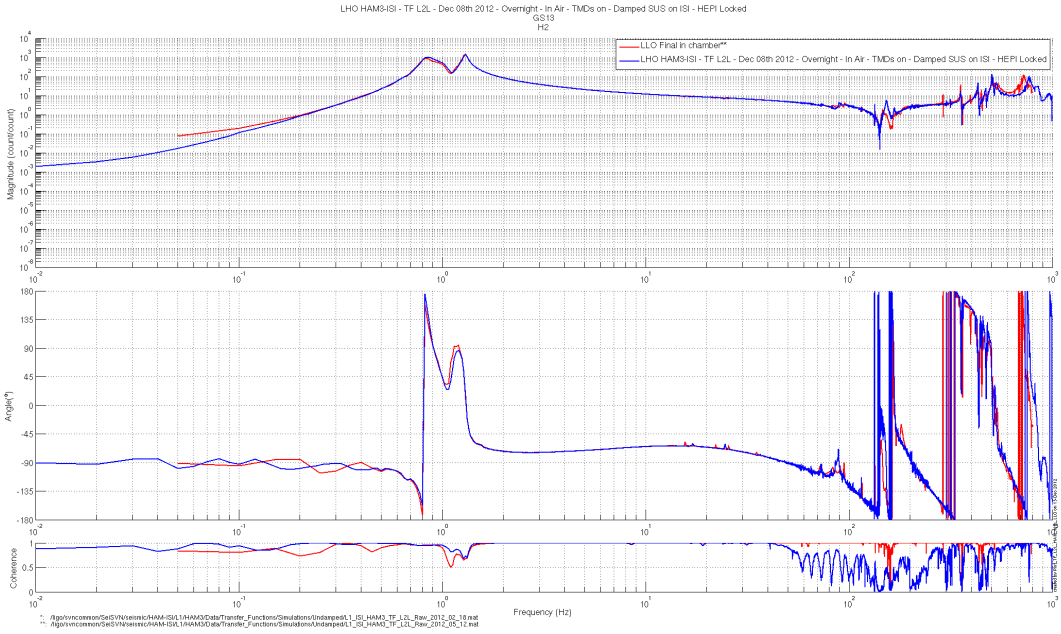
Figure– Local-to-Local Transfer Function – CPS V2 – Comparison with LLO



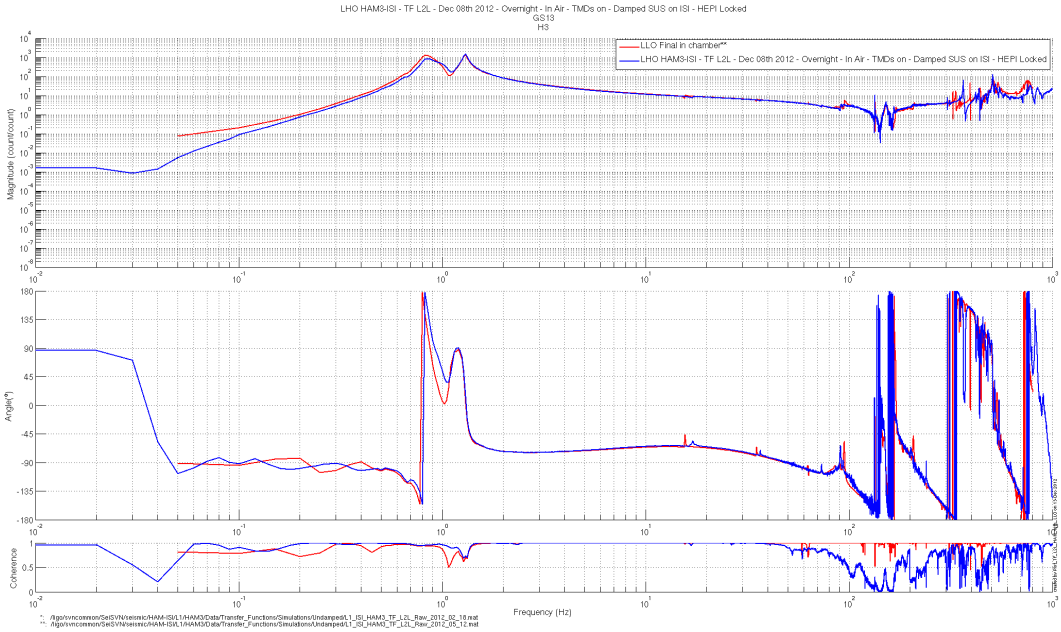
Figure– Local-to-Local Transfer Function – CPS V3 – Comparison with LLO



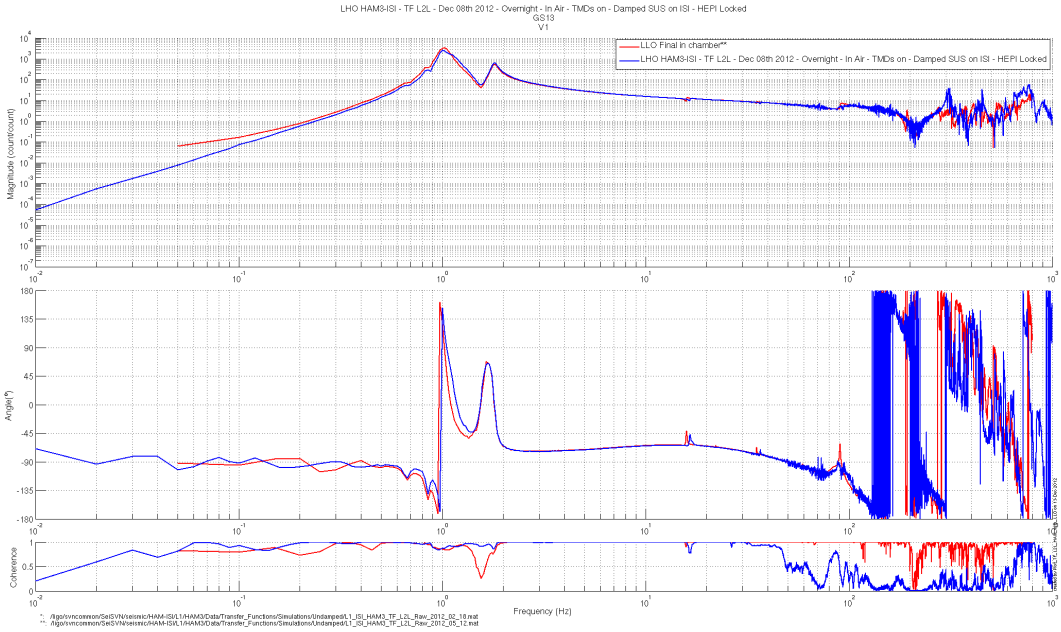
Figure– Local-to-Local Transfer Function – GS13 H1 – Comparison with LLO



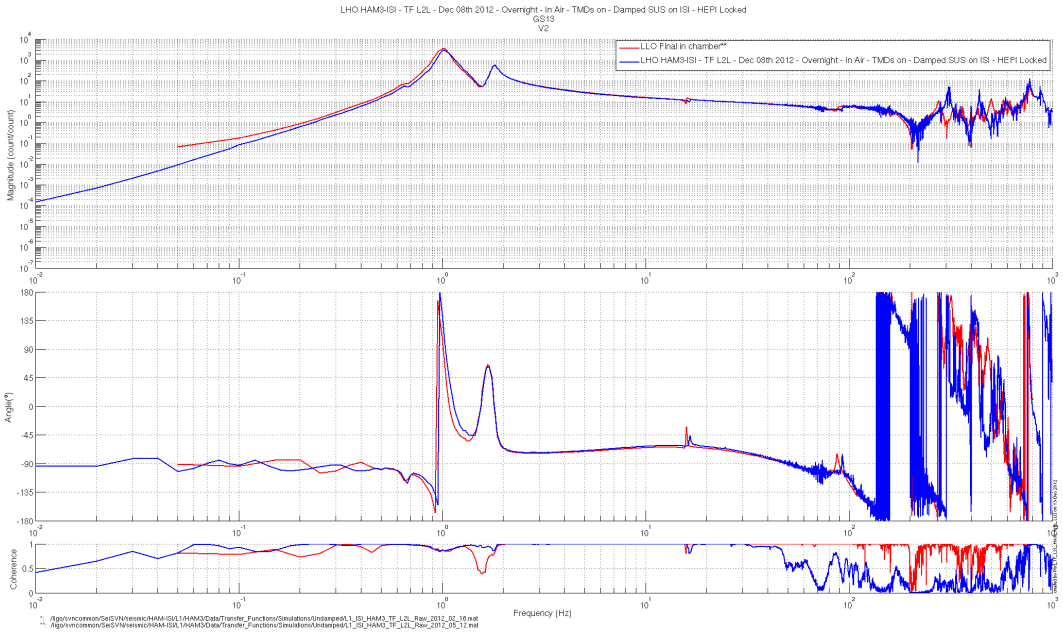
Figure– Local-to-Local Transfer Function – GS13 H2 – Comparison with LLO



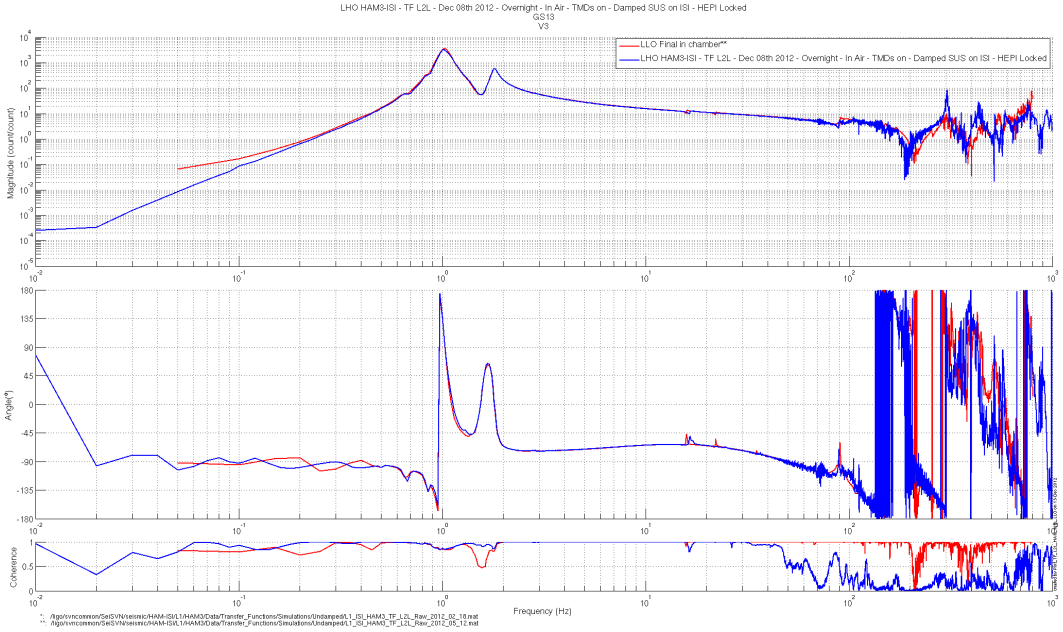
Figure– Local-to-Local Transfer Function – GS13 H3 – Comparison with LLO



Figure– Local-to-Local Transfer Function – GS13 V1 – Comparison with LLO



Figure– Local-to-Local Transfer Function – GS13 V2 – Comparison with LLO



Figure– Local-to-Local Transfer Function – GS13 V3 – Comparison with LLO

Issues/difficulties/comments regarding this test:

- Transfer functions measured with vertical GS13s are slightly noisier than LLO, above ~150Hz.
- As it should not be an issue for the input mode cleaner test, we decide to move on, while keeping this feature in mind.

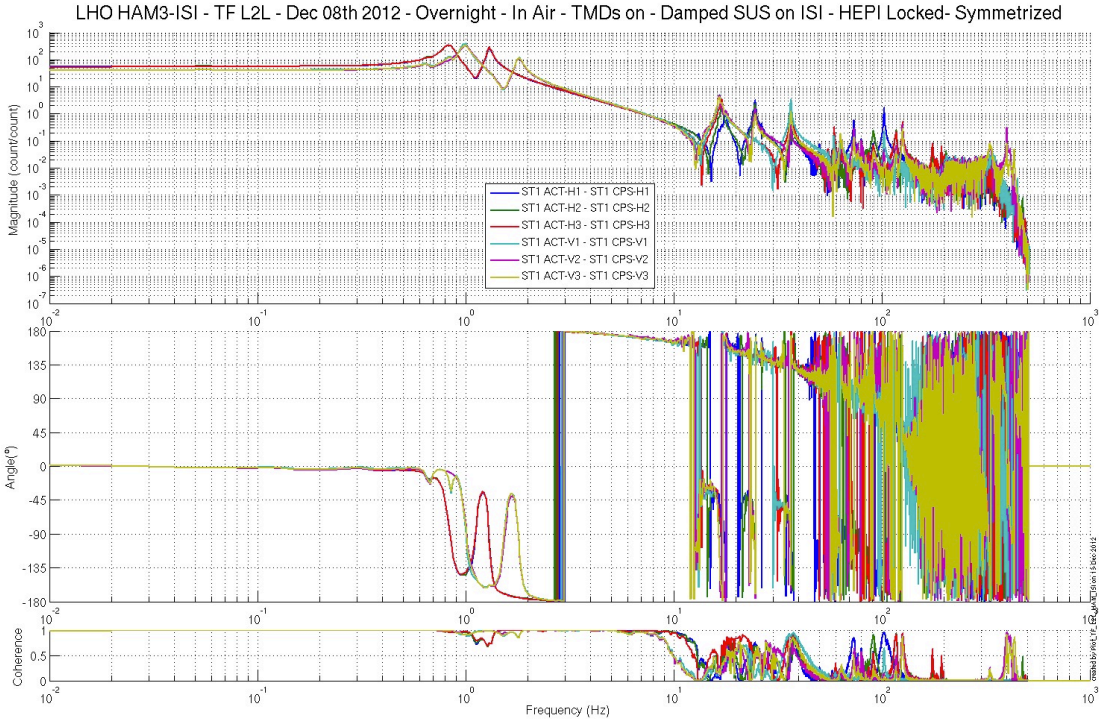
Acceptance criteria:

- Good concordance with TF measured under the same conditions at LLO.
- Local to local measurements
  - On CPS, the phase must be 0º at DC
  - On Geophones, the phase must be -90º at DC
  - Identical shape in each corner
- Cartesian to Cartesian measurements
  - On CPS, the phase must be 0º at DC
  - On Geophones, the phase must be -90º at DC
  - Identical shape X/Y and RX/RY

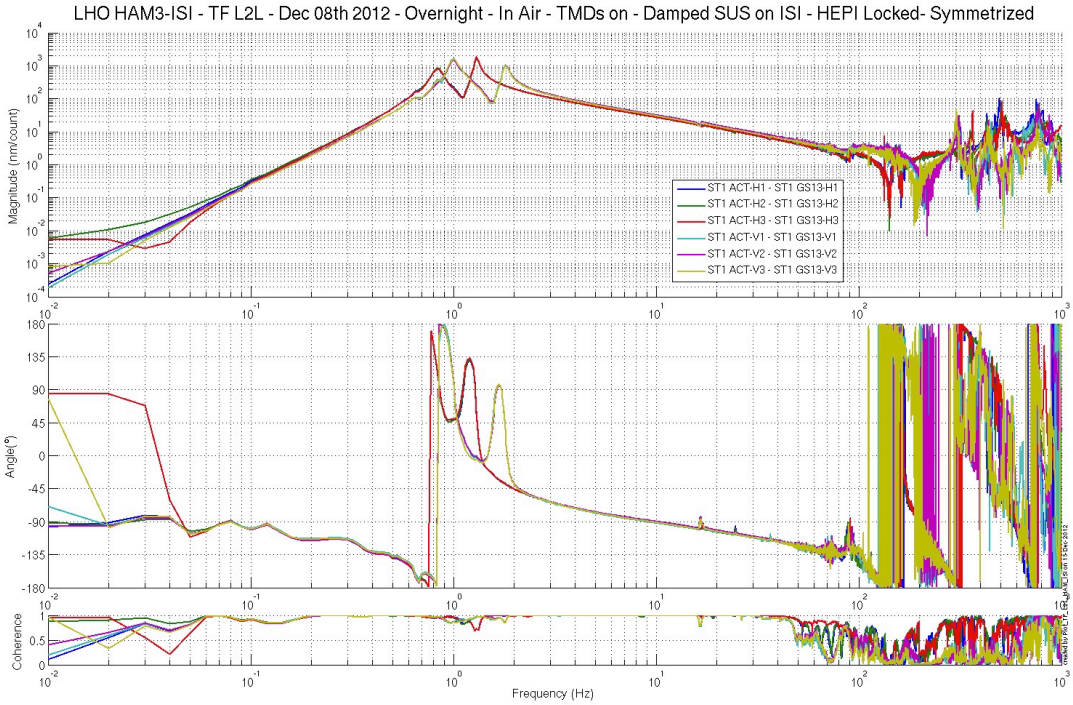
Test result: **Passed: X** **Failed: ____**

- ***Step 16: Symmetrized Transfer functions***

The following symmetrized transfer functions were calculated from the Local-to-Local transfer functions presented above, in step 15. They are provided as extra material. Hence, they are not subject to acceptance (fail/pass).



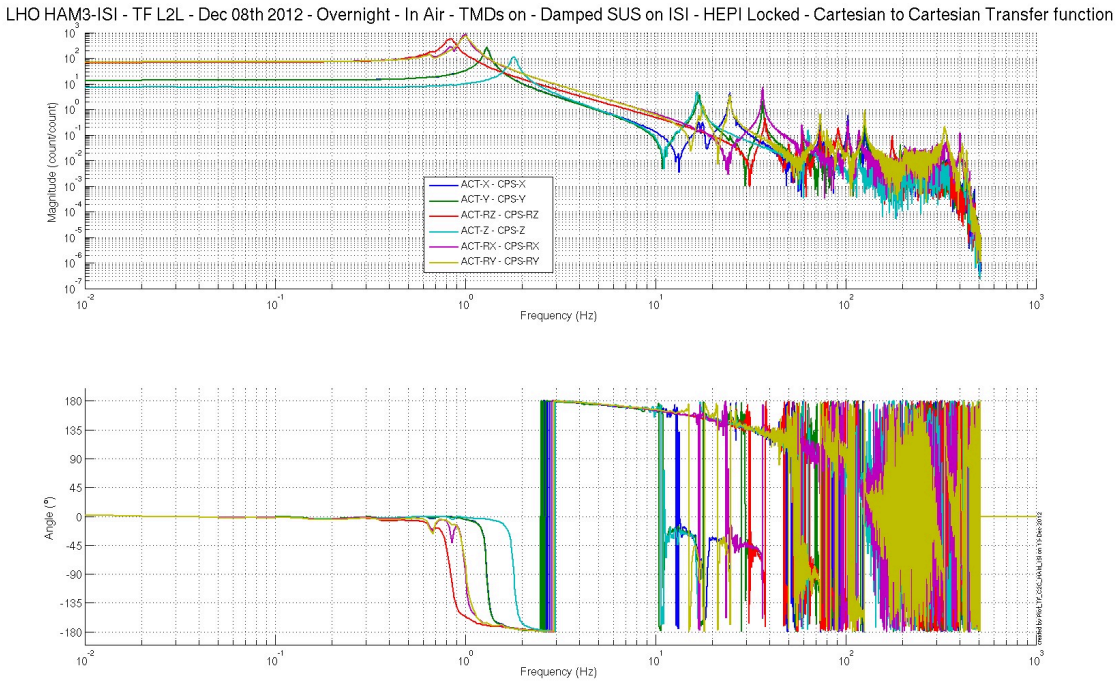
Figure– Local-to-Local Transfer Function – Capacitive Position Sensors – Symmetrized



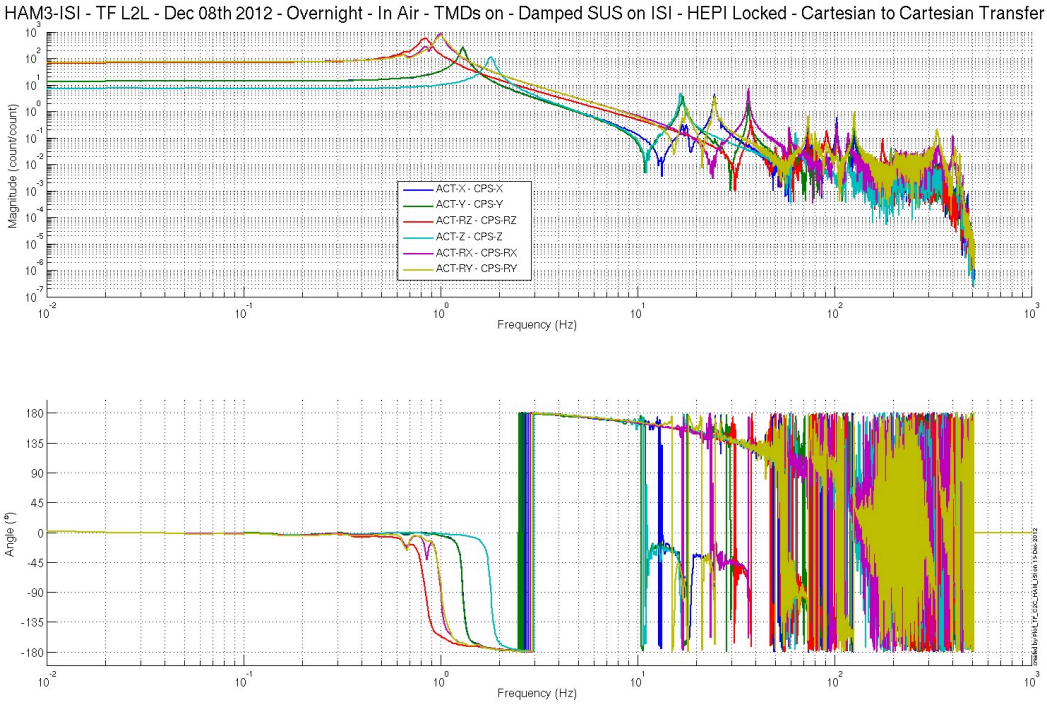
Figure– Local-to-Local Transfer Function – GS13s – Symmetrized

- ***Step 17: Cartesian-to-Cartesian Transfer functions.***

The following symmetrized transfer functions were calculated from the Local-to-Local transfer functions presented above, in step 15. They are provided as extra material. Hence, they are not subject to acceptance (fail/pass).



Figure– Cartesian-to-Cartesian Transfer Function – CPSs – Symmetrized



Figure– Cartesian-to-Cartesian Transfer Function – CPSs – Symmetrized

Conclusion

Final Chamber Testing

This part of the Phase II testing takes place in open chamber. All the suspensions and optics were on. HEPI was locked.

This was the last phase of testing before the chamber is closed for the IMC test. Once this section of the Phase II report is validated, the report is closed.

Next step is removal of the first contact from the optics of MC2 and PR2. The suspensions will be locked for this operation. They will be left unlocked, and damped after this operation. The ISI is locked for this operation and will be unlocked once it is done.

A final set of transfer functions will be taken before the doors come on the chamber. This set of transfer functions should be approved by the SEI team before closing up the chamber.

Tests that failed:

- The level of stage 1 is slightly out of requirement. The pre-commissioning work performed on the ISI (installation of damping loops and first 2 levels of isolation, without suspensions) did not seem to be impacted. As there is not much that could be done, the SEI team decided to move on while keeping this feature in mind.
- The blade of corner 2, which is the only one that can be measured is bent slightly out of requirement (17 mils of flatness instead of 15 mils). Like for the level of the optical table, SEI decided to move on while keeping this feature in mind.

Waved Tests:

- LZMP: It is a lengthy measurement that needs tweaking before being run with suspensions on. Indeed, suspensions trip when the test is run.

Particularities to be kept in mind:

- The optical table is slightly out of level (165µrad instead of 100µrad)
- The blade of corner 2 is bent more that recommended (17 mils of inflation, instead of 15 mils)
- TFs measured with vertical GS13s are slightly noisier than they are at LLO, above ~150Hz.
- A small screw (4-40 x 0.112) was dropped while populating the optical table. The screw could not be found. Details available in LHO aLog #4354