LIGO Laboratory / LIGO Scientific Collaboration

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aLIGO HEPI H1 HAM1
Assembly Validation Report

E1300823

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Advanced LIGO Project

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Contents

1. Introduction

This document summarizes the steps to be done to validate HEPI assemblies. Corresponding reports must be posted in :

LIGO-E1300454: aLIGO HEPI Testing Reports

2. Sub-Components Testing

- Kaman Inductive Position Sensors: calibration, linearity, factory data, noise measurements (E0900426 – HEPI Kaman Sensor Receiving Analysis - Results posted in the SVN)
- HEPI actuator linearity test (E1100338 – aLIGO HEPI Actuators Test Results)
- L4C test (Q0900007)

3. Load Cells assembly

BSC HEPI load cell capacity → 3000 lbs
HAM HEPI load cell capacity → 2000 lbs

	Left Spring (lbs)	Right Spring (lbs)
Pier 1	1347	949
Pier 2	1458	1631
Pier 3	1267	1157
Pier 4	1142	1722

Acceptance criteria:

- The values must not exceed 80% of the load cell capacity (2400lbs for BSC and 1600lbs for HAM).

Test result: **Passed: ___** **Failed: _X_**

4. Boot Location

	Pier 1	Pier 2	Pier 3	Pier 4	Nominal
Point 1 a (Tangential)	5.19	5.22	5.26	5.31	5.38
Point 1 b (Tangential)	5.20	5.23	5.28	5.26	5.38
Point 2 a (Tangential)	5.56	5.53	5.53	5.43	5.38
Point 2 b (Tangential)	5.54	5.53	5.49	5.49	5.38
Point 3 (Radial Back)	1.14	1.14	1.14	1.14	1.17
Point 4 (Radial Front)	1.35	1.41	1.31	1.34	1.42
Point 5 (Vertical)	0.44	0.44	0.44	0.47	0.32

	Pier 1	Pier 2	Pier 3	Pier 4	Requirements
Point 1 a (Tangential)	-0.19	-0.16	-0.12	-0.07	+/- 0.20
Point 1 b (Tangential)	-0.18	-0.15	-0.10	-0.12	+/- 0.20
Point 2 a (Tangential)	0.18	0.15	0.15	0.05	+/- 0.20
Point 2 b (Tangential)	0.16	0.15	0.11	0.11	+/- 0.20
Point 3 (Radial Back)	-0.03	-0.03	-0.03	-0.03	+/- 0.10
Point 4 (Radial Front)	-0.06	-0.01	-0.11	-0.08	+/- 0.15
Point 5 (Vertical)	0.12	0.12	0.12	0.15	+/- 0.20

Acceptance criteria:

-

Test result: **Passed: __--__** **Failed: ___**

5. Check Stops Gaps

The stops must not touch the boot. There is 15 stops per boot, 5 per F bracket.

	Bracket 1						Bracket 2						Bracket 3					
	Gap 1	**Gap 2**	**Gap 3**	**Gap4 above**	**Gap4 under**	**Gap 5**	**Gap 1**	**Gap 2**	**Gap 3**	**Gap4 above**	**Gap4 under**	**Gap 5**	**Gap 1**	**Gap 2**	**Gap 3**	**Gap4 above**	**Gap4 under**	**Gap 5**
Pier 1	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go
Pier 2	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go
Pier 3	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go
Pier 4	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go	Go

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

6. Gaps check

Four particular gaps need to be check.

Acceptance criteria:

- a 0.08" shim must fit in these two gaps

Issues/difficulties/comments regarding this test: Gap#1 is tricky to reach. At LASTI, the solution found was to tape the shim to an extension (rod, rigid ruler, etc.).
Gap#2 should be reachable by hand.
Gap#3 and 4 are tricky, but should also be doable (no picture)

	Gap#1	Gap#2	Gap#3	Gap#4
Pier 1	Go	Go	Go	Go
Pier 2	Go	Go	Go	Go
Pier 3	Go	Go	Go	Go
Pier 4	Go	Go	Go	Go

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

7. IPS Centering

Scripts files for processing and plotting in SVN at:
/SeiSVN/seismic/HEPI/Common/Testing_Functions_HEPI/Offset_STD_IPS_HEPI.m

All the loops must be turned off during this test.

	H1	H2	H3	H4	V1	V2	V3	V4
Mean (counts)	5839.5	10365	187.03	3377.5	-2795.2	-5220.6	8743	-3900.7
Acceptance	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000

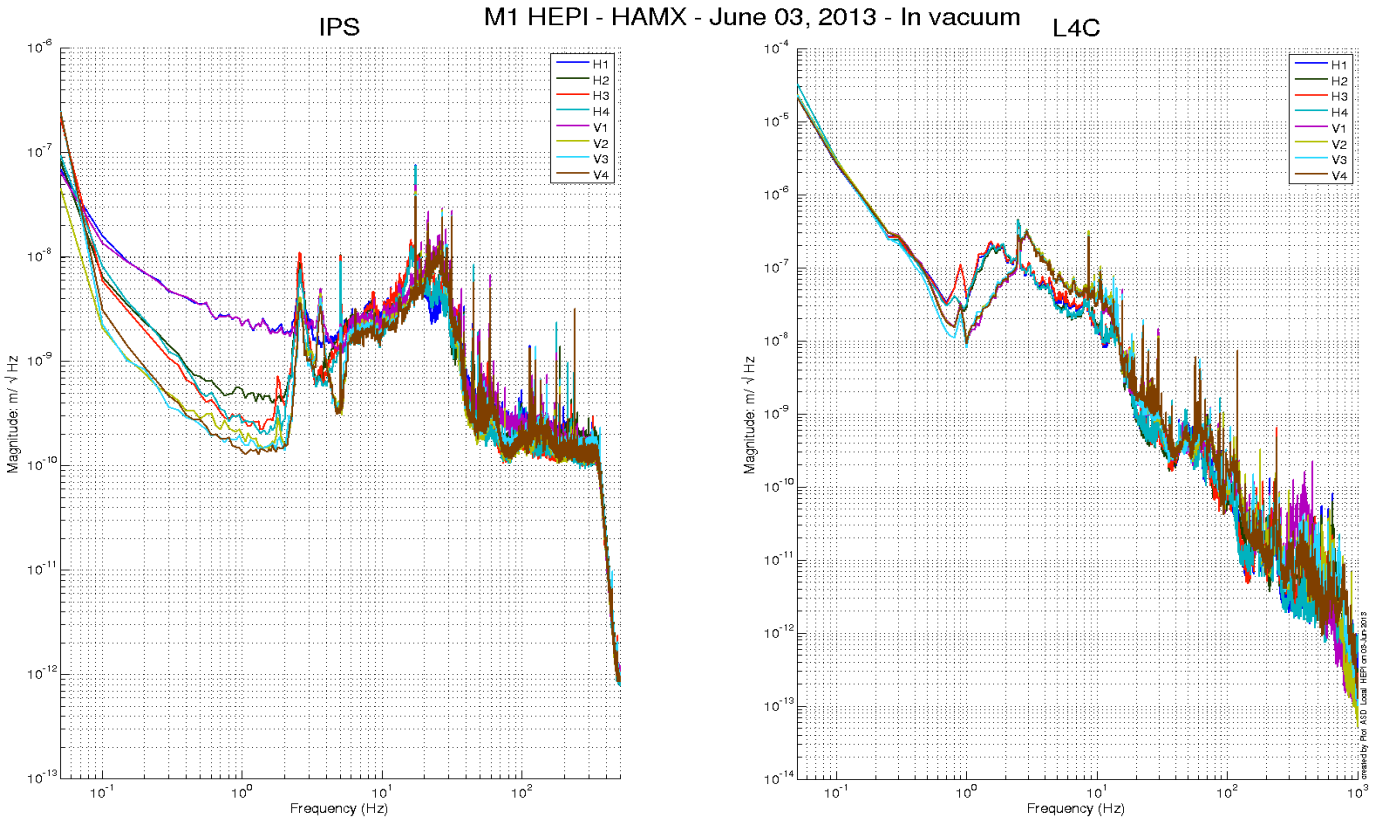
Test result: **Passed: X** **Failed:**

8. Sensor ASD

Scripts files for processing and plotting in SVN at:
/SeiSVN/seismic/HEPI/Common/Testing_Functions_HEPI/ASD_Measurements_Local_HEPI.m

Data in SVN at:
SeiSVN/seismic/HEPI/M1/HAMX/Data/Spectra/Undamped/
M1_HPI_HAMX_ASD_m_IPS_L4C_2013_06_03_120859.mat

Figures in SVN at:
/SeiSVN/seismic/HEPI/M1/HAMX/Data/Figures/Spectra/Undamped



Issues/difficulties/comments regarding this test:
Measurements were performed with all PreFilters ON.

Acceptance criteria:

-

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

9. SUS-watchdogs interaction test

. Set up a zero value on the payload watchogs.
. Check that the payload watchdog screen of HEPI tripped.

. In the payload watchdog screen, click on the OVERRIDE button and reset the watchdog.

. Do the same process for all the payloads

Acceptance criteria:

- The HEPI must trip when the payload watchdogs are tripped

- The HEPI watchdogs could be reset when the OVERRIDE button is ON

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

When this test is done, reset everything (OVERRIDE button OFF, put back the value on the payload watchdog).

10.Static Test local drive

Scripts files for processing in SVN at:
/SeiSVN/seismic/HEPI/Common/Testing_Functions_HEPI/Static_Test_Local_Basis_HEPI.m

. ***Drive of 100 counts (in progress)***

	Ratio Sensor/Drive							
	H1	**H2**	**H3**	**H4**	**V1**	**V2**	**V3**	**V4**
H1	2.208	-0.62948	-0.064624	-1.2706	-0.32968	-0.32498	-0.015506	0.09572
H2	-0.17567	1.2689	-0.55091	-0.10186	-0.13498	-0.27458	-0.006952	0.067702
H3	-0.044356	-0.37003	0.90958	-0.21321	-0.03813	-0.18195	-0.083802	0.042838
H4	-1.9	0.013204	-0.77958	2.959	-0.03978	-0.20653	-0.37341	0.13325
V1	0.032556	-0.14838	0.029006	0.1669	1.798	-0.094454	-0.38248	0.36493
V2	-0.19006	-0.033738	0.04624	0.24634	0.13939	1.9873	0.013866	-0.36868
V3	0.12973	0.56732	-0.27828	-0.40593	-1.5142	0.59764	6.8797	0.70687
V4	0.13454	-0.008362	-0.12761	0.11086	0.086062	-0.58092	0.12565	1.8724

Table - Main couplings and cross couplings

. ***Drive of 1000 counts (in progress)***

	Ratio Sensor/Drive							
	H1	**H2**	**H3**	**H4**	**V1**	**V2**	**V3**	**V4**
H1	2.9655	-0.69069	-0.19093	-1.6117	-0.052953	-0.092558	0.048682	0.044174
H2	-0.45537	2.0478	-1.1288	-0.18636	-0.052843	-0.03117	0.04621	0.041174
H3	-0.054435	-0.61899	1.2639	-0.35981	0.048106	0.022135	-0.10542	-0.077009
H4	-2.1163	-0.23301	-0.79769	3.6783	0.11205	0.089513	-0.2077	-0.12337
V1	-0.093547	-0.11973	0.1186	0.056356	2.7589	0.24053	-0.49405	0.24697
V2	-0.14039	-0.12523	0.11253	0.093923	0.38601	2.9811	0.29055	-0.66158
V3	0.21003	0.24238	-0.37505	-0.44379	-1.6363	0.89874	7.8145	0.79808
V4	0.1263	0.054134	-0.10006	-0.087651	0.28177	-0.45432	0.38196	2.6149

Table - Main couplings and cross couplings

. ***Drive of 2500 counts***

	Ratio Sensor/Drive							
	H1	**H2**	**H3**	**H4**	**V1**	**V2**	**V3**	**V4**
H1	3.44364	-0.7524	-0.237368	-1.84116	-0.0937	-0.116172	0.058352	0.070276
H2	-0.78828	3.4	-1.7786	-0.246032	-0.11386	-0.090172	0.07714	0.094336
H3	-0.120564	-0.85724	2.12044	-0.45148	0.045556	0.027586	-0.059264	-0.061176
H4	-2.239	-0.176648	-0.73144	3.9266	0.090772	0.089616	-0.178328	-0.096596
V1	-0.11926	-0.070028	0.147788	0.07312	3.03824	0.262524	-0.54192	0.29368
V2	-0.1729	-0.079924	0.14086	0.101192	0.396524	3.14852	0.325796	-0.6922
V3	0.225604	0.3091	-0.380688	-0.43828	-1.71896	0.864	8.09	0.83928
V4	0.102296	0.136772	-0.09592	-0.10122	0.292396	-0.52	0.36778	2.8058

Table - Main couplings and cross couplings

Issues/difficulties encountered during this test:

Acceptance criteria:

-
- The results in these three tables must be the same (within xxx%)

Test result: **Passed: ___** **Failed: ____**

11.Linearity Test/Range of motion in the local basis

Scripts files for processing and plotting in SVN at:
/SeiSVN/seismic/HEPI/Common/Testing_Functions_HEPI/Linearity_Test_Awgstream_HEPI.m

Data in SVN at:
SeiSVN/seismic/HEPI/M1/HAMX/Data/Spectra/Undamped/
M1_ISI_HAMX_ASD_m_CPS_T240_L4C_GS13_Locked_vs_Unlocked_2012_02_07.mat

Figures in SVN at:
/SeiSVN/seismic/HEPI/M1/HAMX/Data/Figures/Spectra/Undamped

Issues/difficulties encountered during this test:

Acceptance criteria:

-

Test result: **Passed: _X_** **Failed: ____**

12. Actuator Plate to Shields gap

Perform this test ONLY if the range of motion test failed.

Three gaps per actuator need to be checked.
Acceptance criteria:

- A 0.1" shim must fit into the gap #1
- A 0.05 shim must fit into gap #2 and #3

	Horizontal			Vertical		
	Gap #1	**Gap #2**	**Gap #3**	**Gap #1**	**Gap #2**	**Gap #3**
Pier 1	Go	Go	Go	Go	Go	Go
Pier 2	Go	Go	Go	Go	Go	Go
Pier 3	Go	Go	Go	Go	Go	Go
Pier 4	Go	Go	Go	Go	Go	Go

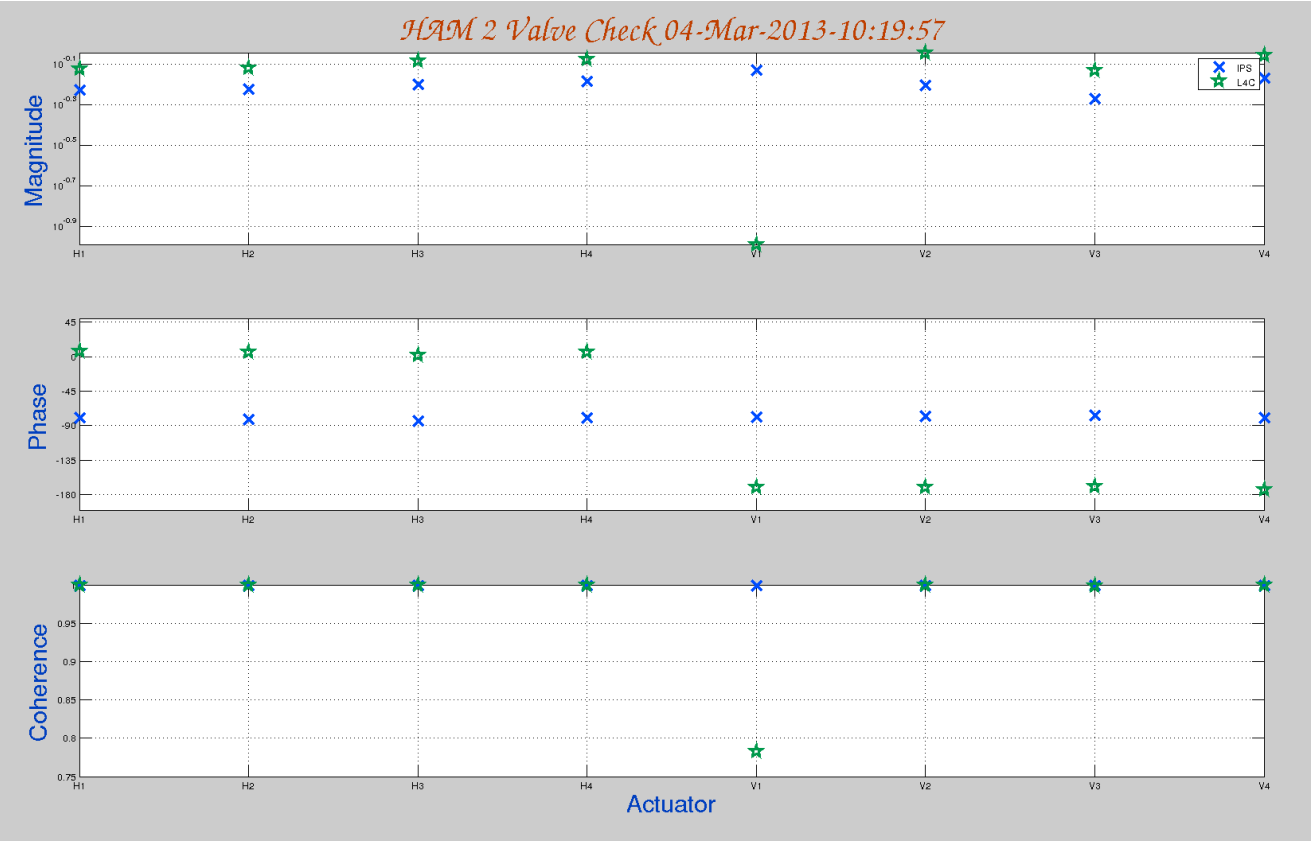
Test result: **Passed: X** **Failed:**

13. Valve Check

Scripts files for processing and plotting in SVN at:
/SeiSVN/seismic/HEPI/M1/HAMX/Scripts/Valve_Check/plot_valve_check.m

Data in SVN at:
SeiSVN/seismic/HEPI/M1/HAMX/Data/Spectra/Undamped/
/SeiSVN/seismic/HEPI/M1/HAMX/Scripts/Valve_Check

Figures in SVN at:
/SeiSVN/seismic/HEPI/M1/HAMX/Scripts/Valve_Check



Acceptance criteria:

-

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

14.Local-to-local measurements

Band (Hz)	Resolution	Amplitude	Nreps	Time (s)	Time (min)	Time (h)
100 - 500	0.5	4000 - 4000	250	4176	69.6	1.2
10 - 100	0.25	4000 - 4000	200	6592	109.9	1.8
0.7 - 10	0.05	4000 - 4000	75	12320	205.3	3.4
0.1 - 0.7	0.025	4000 - 4000	30	10080	168.0	2.8
0.01 - 0.1	0.01	4000 - 4000	10	8960	149.3	2.5
0.002 - 0.01	0.002	4000 - 4000	2	12160	202.7	3.4
						15.1

Data files in SVN at:
/SeiSVN/seismic/HEPI/M1/HAMX/Data/Transfer_Functions/Measurements/Undamped/

- M1_HPI_HAMX_Data_TF_L2L_200Hz_1000Hz_20120201-174407.mat
- M1_HPI_HAMX_Data_TF_L2L_5Hz_200Hz_20120201-183140.mat
- M1_HPI_HAMX_Data_TF_L2L_500mHz_5Hz_20120201-191513.mat
- M1_HPI_HAMX_Data_TF_L2L_100mHz_500mHz_20120201-202848.mat
- M1_HPI_HAMX_Data_TF_L2L_10mHz_100mHz_20120201-212025.mat

Data collection script files:
/SeiSVN/seismic/HEPI/Common//Transfer_Function_Scripts/

- Run_TF_L2L_10mHz_100mHz.m
- Run_TF_L2L_100mHz_500mHz.m
- Run_TF_L2L_500mHz_5Hz.m
- Run_TF_L2L_5Hz_100Hz.m
- Run_TF_L2L_100Hz_1000Hz.m

Scripts files for processing and plotting in SVN at:
/SeiSVN/seismic/HEPI/M1/HAMX/Scripts/Control_Scripts/release/

- Step_1_TF_Loc_to_Loc_M1_HEPI_HAMX.m

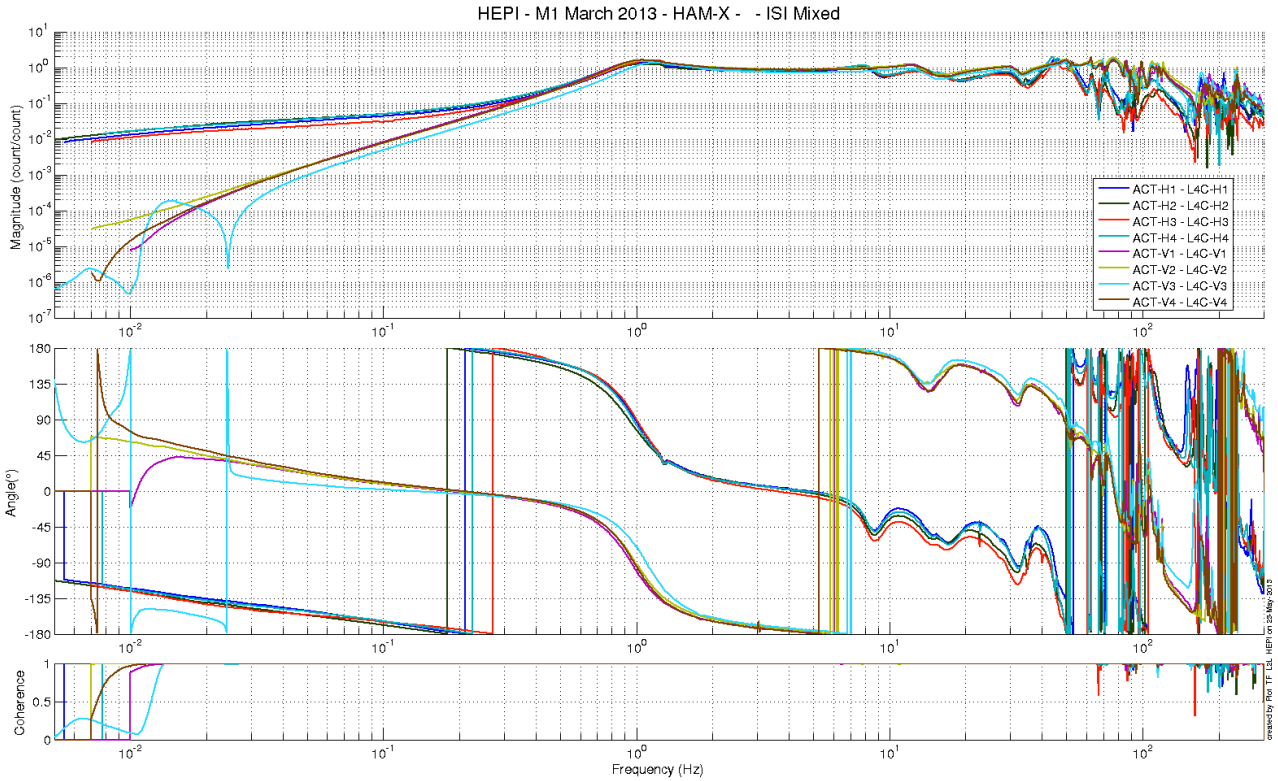
Figures in SVN at:
/SeiSVN/seismic/HEPI/M1/HAMX/Data/ Figures/Transfer_Functions/Measurements/Undamped/

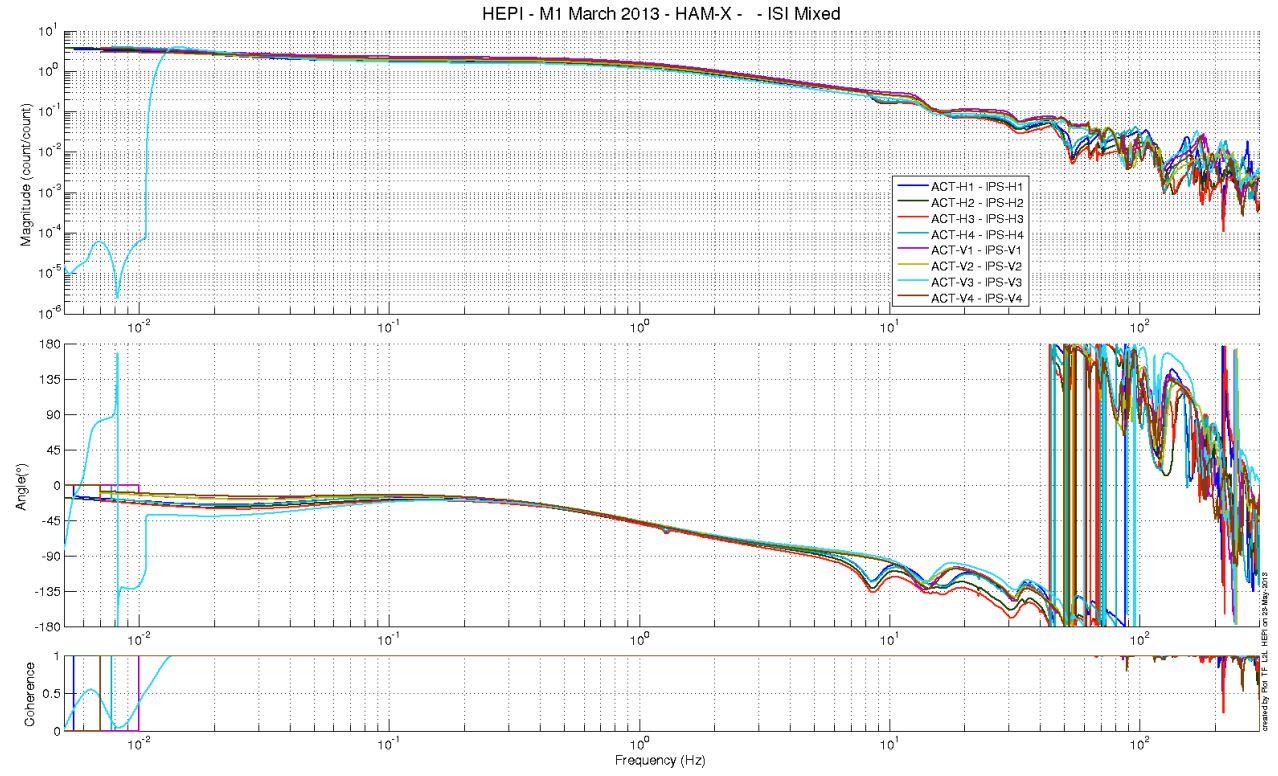
- M1_HPI_Unit_1_TF_L2L_Raw_from_ACT_to_CPS_2012_02_02_With_3_Washers_Under_Top_Mass.fig
- M1_HPI_Unit_1_TF_L2L_Raw_from_ACT_to_GS13_2012_02_02_With_3_Washers_Under_Top_Mass.fig

Storage of measured transfer functions in the SVN at:
/SeiSVN/seismic/HEPI/M1/HAMX/Data/Transfer_functions/ Simulations/Undamped/

- M1_HPI_Unit_1_TF_L2L_Raw_2012_02_02_With_3_Washers_Under_Top_Mass.mat

The local-to-local transfer functions are presented below.





Issues/difficulties/comments regarding this test:

Acceptance criteria:

- On IPS, the phase must be 0º at DC
- On geophones, the phase must be 90º at DC
- Identical shape in each corner

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