

*LIGO Laboratory / LIGO Scientific Collaboration*

LIGO- E1300832

**LIGO**

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**aLIGO HEPI H1 HAM6  
Assembly Validation Report**

**E1300832**

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Distribution of this document:  
Advanced LIGO Project

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## 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--HAM6

BSC HEPI load cell capacity → 3000 lbs

HAM HEPI load cell capacity → 2000 lbs

	Left Spring (lbs)	Right Spring (lbs)
<b>Pier 1</b>	1430	1510
<b>Pier 2</b>	1360	1480
<b>Pier 3</b>	1510	1500
<b>Pier 4</b>	1380	1440

### Acceptance criteria:

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

Test result:

Passed: X

Failed: \_\_\_\_

## 4. Boot Location—**Test Not Performed, HR**

	Pier 1	Pier 2	Pier 3	Pier 4
Point 1a (Tangential)				
Point 1b (Tangential)				
Point 2a (Tangential)				
Point 2b (Tangential)				
Point 3 (Radial Back)				
Point 4 (Radial Front)				

Point 5 (Vertical)				
	Pier 1	Pier 2	Pier 3	Pier 4
Point 1a (Tangential)				
Point 1b (Tangential)				
Point 2a (Tangential)				
Point 2b (Tangential)				
Point 3 (Radial Back)				
Point 4 (Radial Front)				
Point 5 (Vertical)				

Acceptance criteria:

- 

Test result: Passed: \_\_\_\_ Failed: \_\_\_\_

### 5. Check Stops Gaps—**Test Not Performed, HR**

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	Gap 4 above	Gap 4 under	Gap 5	Gap 1	Gap 2	Gap 3	Gap 4 above	Gap 4 under	Gap 5	Gap 1	Gap 2	Gap 3	Gap 4 above	Gap 4 under	Gap 5						
Pier 1																										
Pier 2																										
Pier 3																										
Pier 4																										

Test result: Passed: \_\_\_\_ Failed: \_\_\_\_

### 6. Gaps check—**Test Not Performed, HR**

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				
Pier 2				
Pier 3				
Pier 4				

Test result:

Passed: \_\_\_\_

Failed: \_\_\_\_

## 7. IPS Centering

### Scripts files for processing and plotting in SVN at:

/SeiSVN/seismic/HEPI/Common/Testing\_Functions\_HEPI/  
Offset\_STD\_IPS\_Readback\_HEPI.m

### Data in SVN at:

/ligo/svncommon/SeiSVN/seismic/HEPI/H1/HAM6/Data/Static\_Tests/  
LHO\_HPI\_HAM6\_IPS\_Read\_Back\_Unlocked\_20130917\_16:13.mat

All the loops must be turned off during this test.

	H1	H2	H3	H4	V1	V2	V3	V4
Mean (counts)	1785	1011	928	-3769	-1842	-2227	-1967	-1822
Acceptance	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000

Test result:

Passed: X

Failed: \_\_\_\_

As soon as any driven test is performed, system relaxes and appears to spread out. Near 10k counts on some IPS. Cartesian offsets <5000nm/urads. Maybe Actuators should be examined for clearance, possibly rezero'd (keep track of IAS position) and some of these tests reran.

## 8. Sensor ASD

Scripts files for processing and plotting in SVN at:

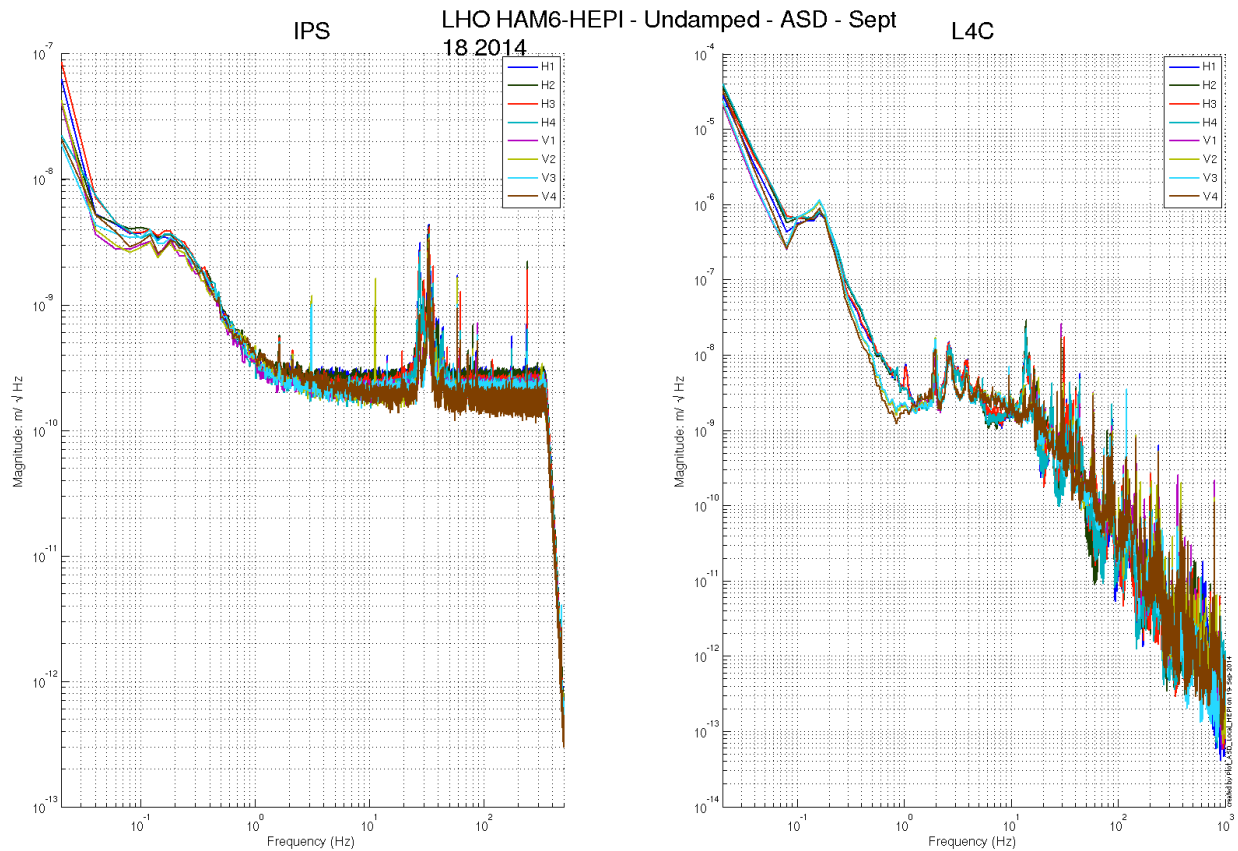
/SeiSVN/seismic/HEPI/Common/Testing\_Functions\_HEPI/ASD\_Measurements\_Local\_HEPI.m

Data in SVN at:

SeiSVN/seismic/HEPI/H1/HAM6/Data/Spectra/Undamped/  
LHO\_HPI\_HAM6\_ASD\_m\_IPS\_L4C\_20140918\_17:35:03.mat

Figures in SVN at:

/SeiSVN/seismic/HEPI/H1/ETMX/Data/Figures/Spectra/Undamped/  
LHO\_HPI\_HAM6\_ASD\_m\_IPS\_L4C\_20140918\_17:35:03.fig



Measurement length: 1900s - Sample window: 50s - Overlap: 50% - Frequency resolution: 20mHz - Averages: 75 - Measurement start (GPS): 1095122119

Issues/difficulties/comments regarding this test:

Measurements were performed with all PreFilters ON.

Acceptance criteria: ??????

■

Test result:

Passed:   ?  

Failed:

## 9. SUS-watchdogs interaction test

**This test will be obsolete very soon, as the payload-HEPI WD connection is planned for removal.**

- . Set up a zero value on the payload watchdogs.
- . 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:** \_\_\_\_

**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

Data File: /SeiSVN/seismic/HEPI/H1/HAM5/Data/Static\_tests/

LHO\_HPI\_HAM5\_Offset\_Local\_Drive\_20140422.mat

### . Drive of 5000 counts

	H1	H2	H3	H4	V1	V2	V3	V4
H1	8814	-1728	-341	-4170	-122	-285	200	140
H2	-2097	9439	-4758	-350	-375	-181	68	284
H3	-455	-4265	8915	-1868	227	117	-82	-368
H4	-5133	-322	-1865	8832	135	246	-333	-272
V1	-197	-404	285	135	9172	1080	-1972	1065
V2	-362	-203	129	238	1606	7834	707	-1786
V3	196	42	-18	-263	-830	1426	7368	845
V4	94	233	-256	-192	1531	-942	771	8013

*Table - Main couplings and cross couplings*

Issues/difficulties encountered during this test: No issues.

### Acceptance criteria:

- 

**Test result:**

**Passed:**  X

**Failed:** \_\_\_\_

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

Range of Motion: All dofs 0.7mm

/SeiSVN/seismic/HEPI/H1/HAM6/Data/Static/Tests

LHO\_HPI\_HAM6\_Range\_Of\_Motion\_20140930.mat

**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/H1/HAM6/Data/Linearity\_Test/

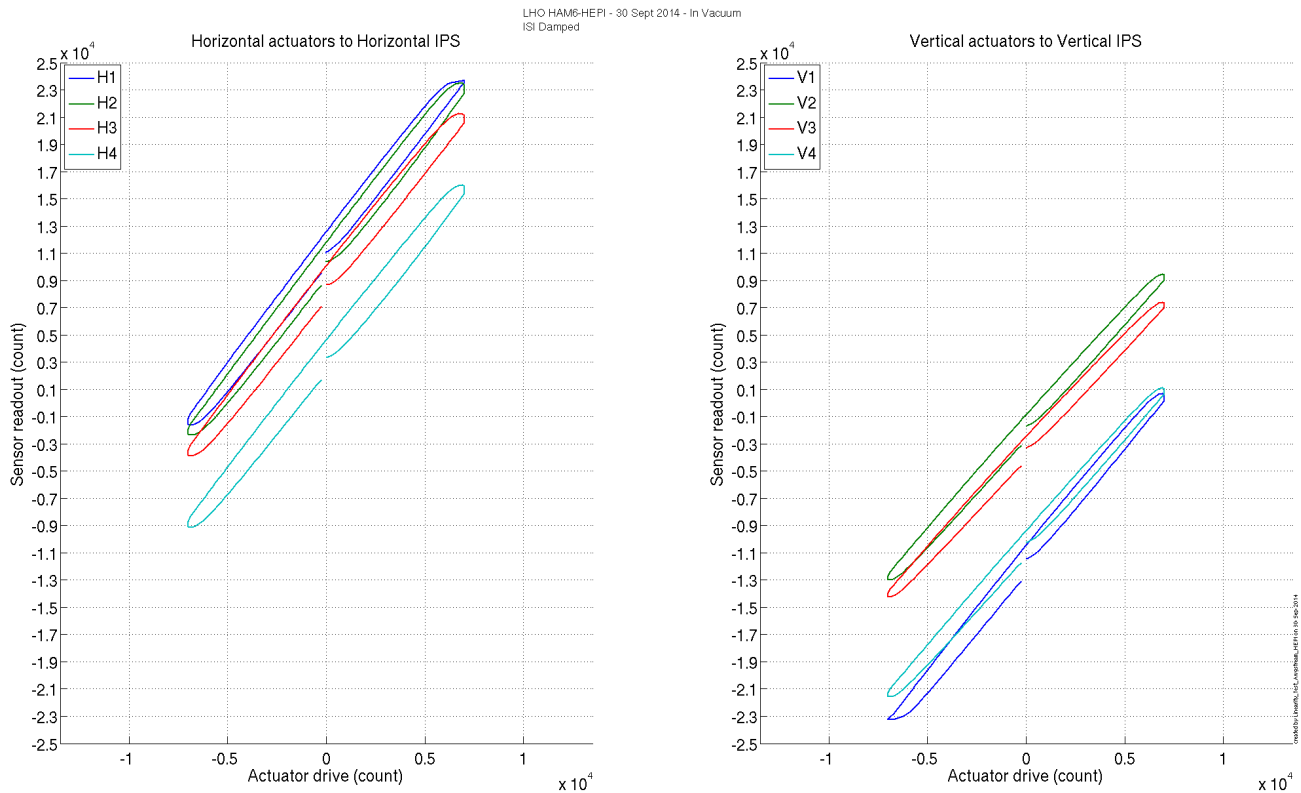
LHO\_HPI\_HAM6\_Linearity\_test\_20140930T153703.mat

	Slopes	Offsets
H1	1.86	11365
H2	1.87	10554
H3	1.82	8817
H4	1.81	3472
V1	1.76	-11442
V2	1.62	-1699
V3	1.56	-3284
V4	1.64	-10215

**Figures in SVN at:**

/SeiSVN/seismic/HEPI/H1/HAM6/Data/Figures/Linearity\_Test/

LHO\_HPI\_HAM6\_Linearity\_test\_20140930T153703.fig \ .pdf





Issues/difficulties encountered during this test: No issues.

Acceptance criteria: Looks good enough

- ???????

Test result:

Passed:   X  

Failed:     

### 12. Actuator Plate to Shields gap—**Test Not Performed, HR**

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

	Horizo	Vertical					
	ntal	Gap #1	Gap #2	Gap #3	Gap #1	Gap #2	Gap #3
Pier 1							
Pier 2							
Pier 3							
Pier 4							

Test result:

Passed:     

Failed:     

### 13. Valve Check—**Test Not performed.**

Scripts files for processing and plotting in SVN at:

/SeiSVN/seismic/HEPI/H1//Scripts/Valve\_Check/plot\_valve\_check.m

Data in SVN at:

SeiSVN/seismic/HEPI/H1//Data/Spectra/Undamped/

/SeiSVN/seismic/HEPI/H1//Scripts/Valve\_Check

Figures in SVN at:

/SeiSVN/seismic/HEPI/H1//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)
<b>500-1000</b>	0.25	0.5x1500 - 1500	125	-	-	1
<b>100 - 500</b>	0.5	1500 - 1500	125	-	-	0.6
<b>10 - 100</b>	0.25	1500 - 1500	100	-	-	1
<b>0.7 - 10</b>	0.05	0.75x1500 - 1500	50	-	-	2.3
<b>0.1 - 0.7</b>	0.025	0.75x1500 - 1500	15	-	-	1.5
<b>0.01 - 0.1</b>	0.01	0.5x1500 - 1500	5	-	-	1.25
<b>0.002 - 0.01</b>	0.002	0.5x1500 - 1500	3	-	-	4
						<b>16.1</b>

\*: Values Need to be updated

#### Data files in SVN at:

/SeiSVN/seismic/HEPI/H1/HAM6/Data/Transfer\_Functions/Measurements/Undamped/

- LHO\_HPI\_BSC9\_Data\_L2L\_500Hz\_1000Hz\_20140923-231240.mat
- LHO\_HPI\_BSC9\_Data\_L2L\_100Hz\_500Hz\_20140924\_002234.mat
- LHO\_HPI\_BSC9\_Data\_L2L\_10Hz\_100Hz\_20140924-005825.mat
- LHO\_HPI\_BSC9\_Data\_L2L\_700mHz\_10Hz\_20140924-015449.mat
- LHO\_HPI\_BSC9\_Data\_L2L\_100mHz\_700mHz\_20140924-041536.mat
- LHO\_HPI\_BSC9\_Data\_L2L\_10mHz\_100mHz\_20140924-054822.mat
- LHO\_HPI\_BSC9\_Data\_L2L\_2mHz\_10mHz\_20140925-031007.mat

#### Data is called by Case #3 of:

/SeiSVN/seismic/HEPI/H1/HAM6/Scripts/Control\_Scripts/Version\_5/  
Measurements\_List\_H1\_HPI\_HAM6.m

#### Scripts files for processing and plotting in SVN at:

/SeiSVN/seismic/HEPI/H1/HAM6/Scripts/Control\_Scripts/Version\_5/  
- Step\_1\_TF\_Loc\_to\_Loc\_H1\_HEPI\_HAM6.m

#### Figures in SVN at:

/SeiSVN/seismic/HEPI/H1/HAM6/Data/ Figures/Transfer\_Functions/Measurements/Undamped/  
- H1\_HPI\_HAM6\_TF\_L2L\_Raw\_from\_ACT\_to\_IPS\_2014\_09\_23.fig

# E1300832

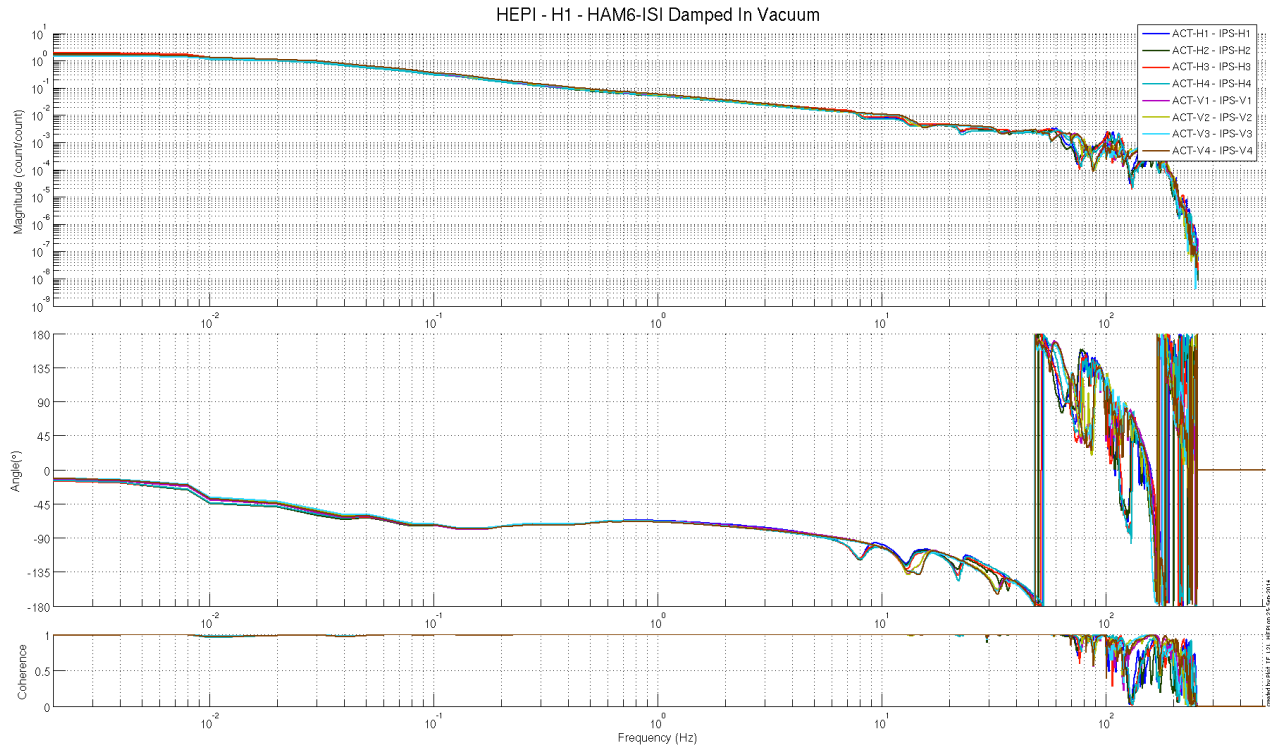
- H1\_HPI\_HAM6\_TF\_L2L\_Raw\_from\_ACT\_to\_L4C\_2014\_09\_23.fig

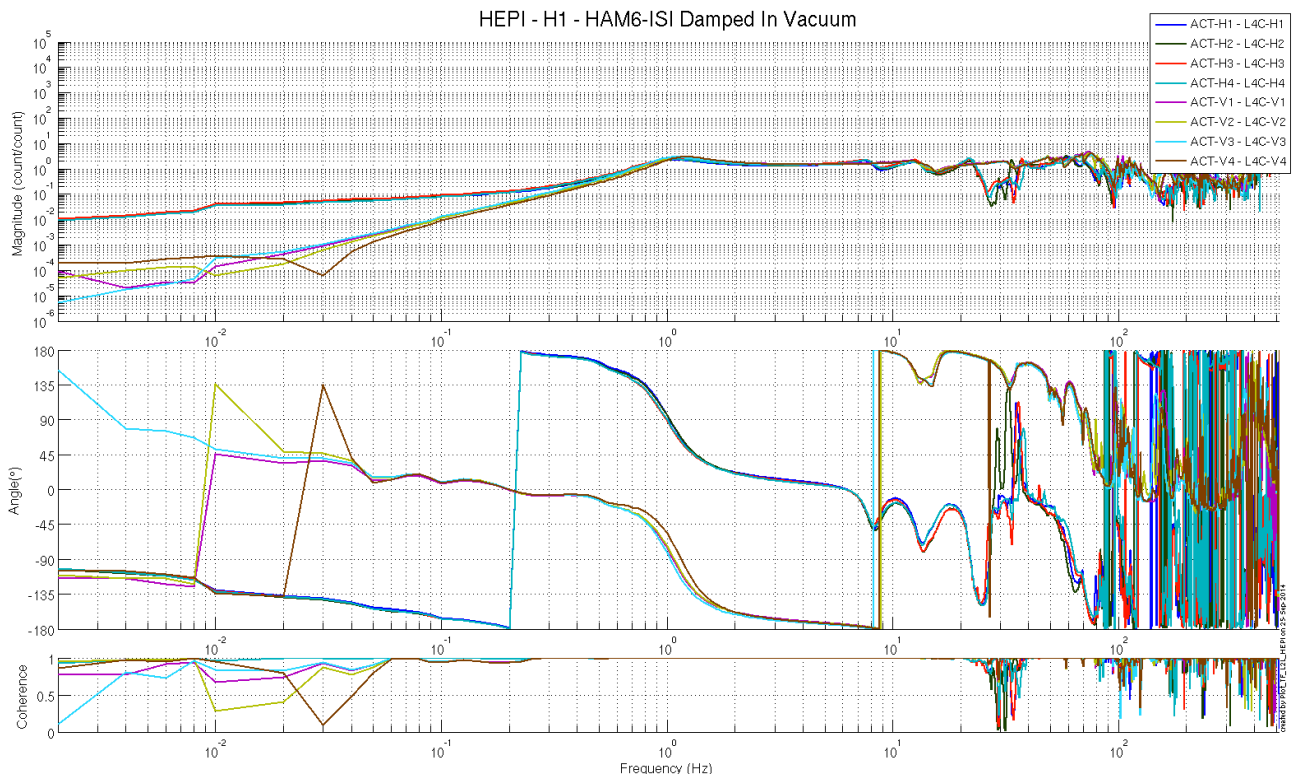
## Storage of measured transfer functions in the SVN at:

/SeiSVN/seismic/HEPI/H1/HAM6/Data/Transfer\_Functions/Simulations/Undamped/

- H1\_HPI\_HAM6\_TF\_L2L\_Raw\_2014\_09\_23.mat

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





Issues/difficulties/comments regarding this test:

**Acceptance criteria:**

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

**Test result:**

**Passed:**   X  

**Failed:**

**15. Alignment offsets:**

Those are the IPS readouts that were recorded with HEPI isolated, after alignment work by commissioners.

	IPS Readouts HEPI Locked	Cartesian DOF	TARGET
H1	9370	X	111300
H2	12065	Y	107800
H3	7290	Z	-282500
H4	4420	RX	500
V1	-12555	RY	114500
V2	-1992	RZ	950
V3	-3401	HP	320000
V4	-11192	VP	-28000

Issues/difficulties encountered during this test:

Readings were retrieved from medm H1:HPI-HAM6\_Cart\_BIAS 3 Feb 2015.

**Acceptance criteria:**

Offsets were recorded.

**Test result:**

**Passed:**   X  

**Failed:**