LIGO Laboratory / LIGO Scientific Collaboration

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aLIGO HEPI H1 HAM5 Assembly Validation Report

E1300831

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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--HAM4

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

	Left Spring (lbs)	**Right Spring (lbs)**
Pier 1	1290	1400
Pier 2	1430	1460
Pier 3	1325	1320
Pier 4	1245	1265

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/HAM5/Data/Static_Tests/
LHO_HPI_HAM5_IPS_Read_Back_Unlocked_date.mat

All the loops must be turned off during this test.

	H1	H2	H3	H4	V1	V2	V3	V4
Mean (counts)								
Accep-tance	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000

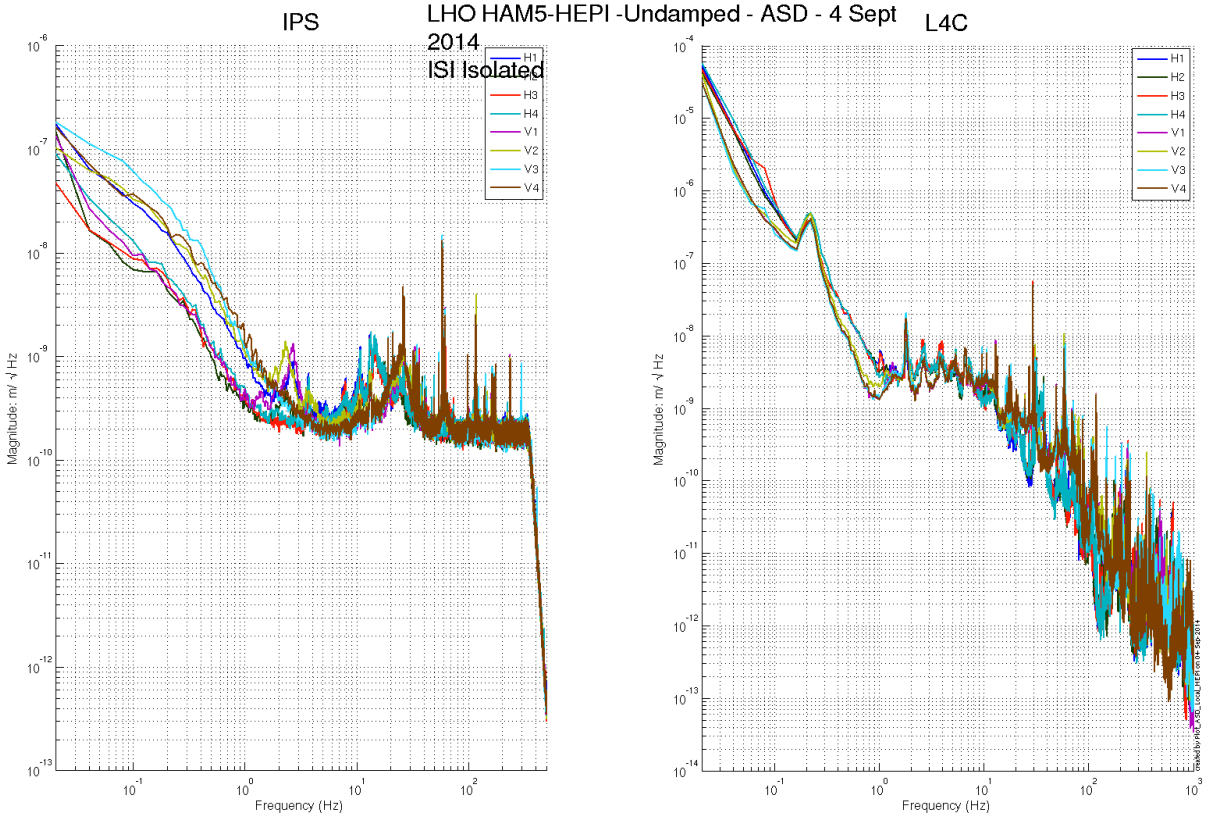
Test result: **Passed: _X_** **Failed: ___**
This data not in svn. Will attempt to collect. Data in section 10, Offset Local Drive and even more obvious, the Linearity Data in Section 11, will give a good indication of the unlocked free hanging position.

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/HAM5/Data/Spectra/Undamped/
LHO_HPI_HAM5_ASD_m_IPS_L4C_20140904_10:43:17.mat

Figures in SVN at:
/SeiSVN/seismic/HEPI/H1/HAM5/Data/Figures/Spectra/Undamped/
LHO_HPI_HAM5_ASD_m_IPS_L4C_20140904_10:43:17.fig



Measurement length: 1900s - Sample window: 50s - Overlap: 50% - Frequency resolution: 20mHz - Averages: 75 - Measurement start (GPS): 1093887813

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 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: ___** **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	10897	-2440	-600	-5290	-311	-402	288	46
H2	-2108	11625	-5897	-836	-546	-483	243	237
H3	-335	-4970	10365	-2434	240	400	-425	-527
H4	-5156	-545	-2203	10792	376	295	-346	-45
V1	-317	-396	220	575	8305	969	-1753	768
V2	-339	-351	345	423	933	8127	802	-1708
V3	343	310	-412	-115	-1484	1072	7974	757
V4	134	328	-456	-167	744	-1233	1022	7513

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 good at 1mm except neg V1 & V4. These two dofs were good at 0.8mm but not at 0.9mm.

Scripts files for processing and plotting in SVN at:

/SeiSVN/seismic/HEPI/Common/Testing_Functions_HEPI/Linearity_Test_Awgstream_HEPI.m

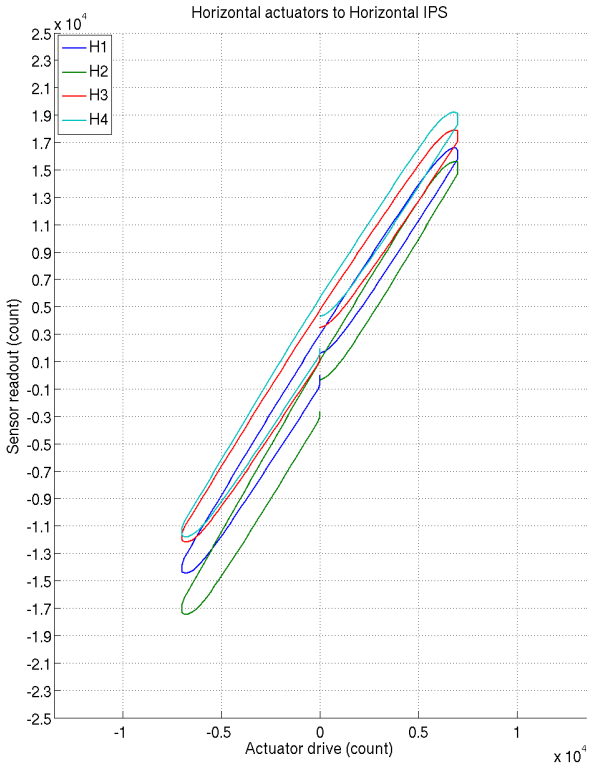
Data in SVN at:

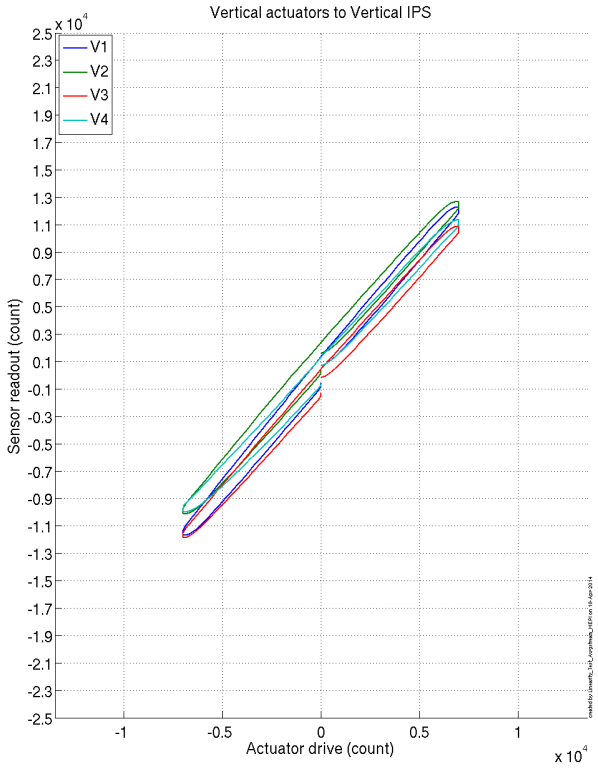
SeiSVN/seismic/HEPI/H1/HAM5/Data/Linearity_Test/
H1_HPI_HAM5_Linearity_test_20140418T153926.mat

	Slopes	Offsets
H1	2.26	1270
H2	2.41	-769
H3	2.19	3073
H4	2.26	3845
V1	1.74	398
V2	1.65	1392
V3	1.64	-419
V4	1.56	558

Figures in SVN at:

/SeiSVN/seismic/HEPI/H1/HAM5/Data/Figures/Linearity_Test/





Issues/difficulties encountered during this test: No issues, first try results.

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

	Horizontal	Vertical				
	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 yet.

Scripts files for processing and plotting in SVN at:
/SeiSVN/seismic/HEPI/H1/HAM5/Scripts/Valve_Check/plot_valve_check.m

Data in SVN at:
SeiSVN/seismic/HEPI/H1/HAM5/Data/Spectra/Undamped/
/SeiSVN/seismic/HEPI/H1/HAM5/Scripts/Valve_Check

Figures in SVN at:
/SeiSVN/seismic/HEPI/H1/HAM5/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)
500-1000	0.25	0.5x1500 – 1500	250	4176*	69.6	1*
100 - 500	0.5	1500 – 1500	250	4176*	69.6	1.2*
10 - 100	0.25	1500 – 1500	200	6592*	109.9	1.8*
0.7 - 10	0.05	0.75x1500 – 1500	75	12320*	205.3	3.4*
0.1 - 0.7	0.025	0.75x1500 – 1500	30	10080*	168.0	2.8*
0.01 - 0.1	0.01	0.5x1500 – 1500	10	8960*	149.3	2.5*
0.002 - 0.01	0.002	0.5x1500 – 1500	2	12160*	202.7	3.4*
						16.1*

*: Values Need to be updated

Data files in SVN at:
/SeiSVN/seismic/HEPI/H1/HAM5/Data/Transfer_Functions/Measurements/Undamped/

- LHO_HPI_HAM5_Data_L2L_500Hz_1000Hz_20140904-152405.mat
- LHO_HPI_HAM5_Data_L2L_100Hz_500Hz_20140904-162031.mat
- LHO_HPI_HAM5_Data_L2L_10Hz_100Hz_20140904-164947.mat
- LHO_HPI_HAM5_Data_L2L_700mHz_10Hz_20140904-173253.mat
- LHO_HPI_HAM5_Data_L2L_100mHz_700mHz_20140904-195337.mat
- LHO_HPI_HAM5_Data_L2L_10mHz_100mHz_20140904-215302.mat
- LHO_HPI_HAM5_Data_L2L_2mHz_10mHz_20140905-000831.mat

Data is called by Case #2 of:
/ligo/svncommon/SeiSVN/seismic/HEPI/H1/HAM5/Data/Transfer_Functions/Measurements/
Measurements_List_H1_HPI_HAM5.m

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

- Run_TF_L2L_500Hz_1000Hz.m
- Run_TF_L2L_100Hz_500Hz.m
- Run_TF_L2L_10Hz_100Hz.m
- Run_TF_L2L_700mHz_10Hz.m
- Run_TF_L2L_100mHz_700mHz.m
- Run_TF_L2L_10mHz_100mHz.m

- Run_TF_L2L_2mHz_10mHz.m

Scripts files for processing and plotting in SVN at:
/SeiSVN/seismic/HEPI/H1/HAM5/Scripts/Control_Scripts/Version_5/

- Step_1_TF_Loc_to_Loc_H1_HEPI_HAM5.m

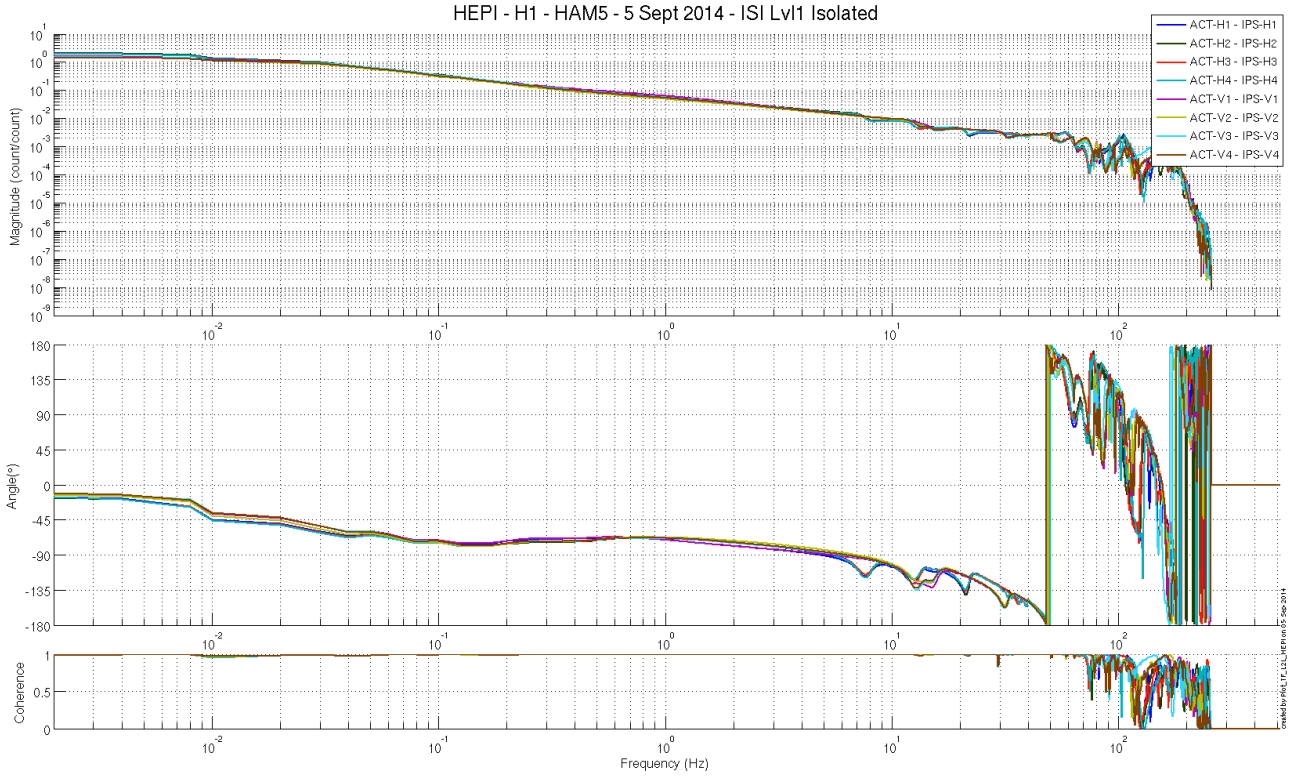
Figures in SVN at:
/SeiSVN/seismic/HEPI/H1/HAM5/Data/ Figures/Transfer_Functions/Measurements/Undamped/

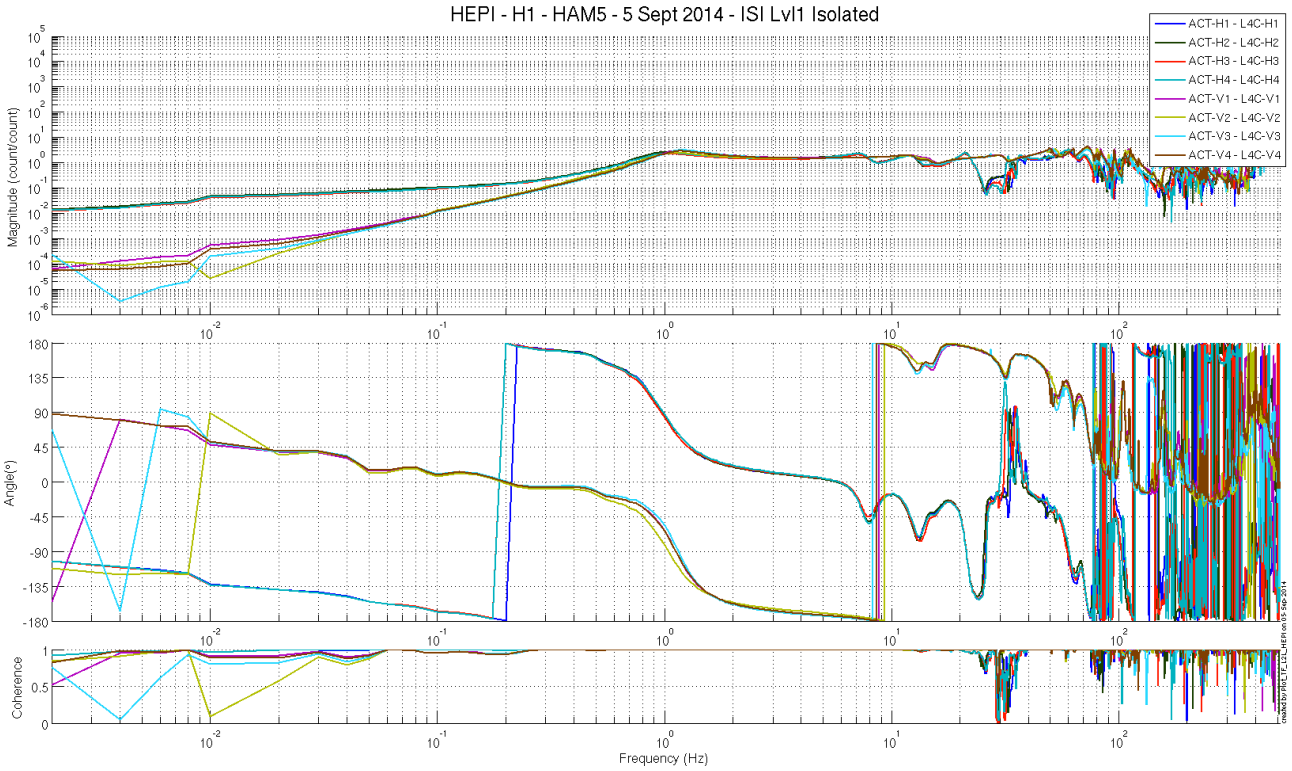
- H1_HPI_HAM5_TF_L2L_Raw_from_ACT_to_IPS_2014_09_05.fig
- H1_HPI_HAM5_TF_L2L_Raw_from_ACT_to_L4C_2014_09_05.fig

Storage of measured transfer functions in the SVN at:
/SeiSVN/seismic/HEPI/H1/HAM5/Data/Transfer_Functions/Simulations/Undamped/

- H1_HPI_HAM5_TF_L2L_Raw_2014_09_05.mat

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





Issues/difficulties/comments regarding this test: Low coherence at lowest frequencies on the L4C. Look at phase above these frequencies.

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: ___**

15. Alignment offsets:

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

	IPS Readouts HEPI Isolated	Cartesian DOF	TARGET
H1	-500	X	47400
H2	-460	Y	-10280
H3	5320	Z	-16600
H4	2990	RX	96900
V1	1760	RY	-13100
V2	1710	RZ	12500
V3	-3610	HP	71300
V4	-1560	VP	-19000

Issues/difficulties encountered during this test:

Readings were retrieved from medm H1:HPI-HAM5_Cart_BIAS 4 Feb 2015.

Acceptance criteria:

Offsets were recorded.

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