

LIGO Laboratory / LIGO Scientific Collaboration

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LIGO

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**aLIGO HEPI H1 BS
Assembly Validation Report**

E1300839

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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--BSC1

BSC HEPI load cell capacity → 3000 lbs

HAM HEPI load cell capacity → 2000 lbs

	Left Spring (lbs)	Right Spring (lbs)
Pier 1	1990	1930
Pier 2	2540	1970
Pier 3	2170	2160
Pier 4	2090	2100

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—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-BSC10

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/BS/Data/Static_Tests/
 Data not collected or not saved, not in SVN

All the loops must be turned off during this test.

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

Test result: **Passed:** ____ **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

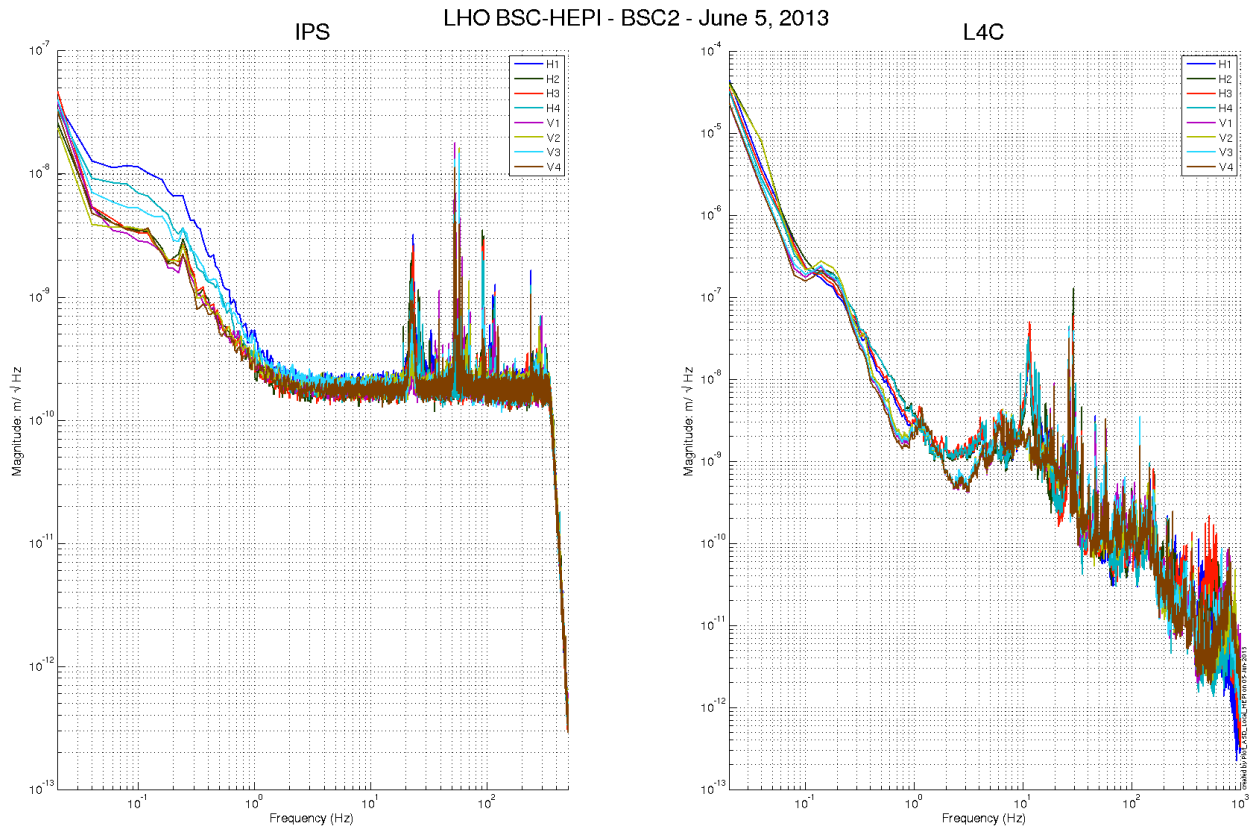
Data in SVN at:
 SeiSVN/seismic/HEPI/H1/BS/Data/Spectra/Undamped/

LHO_HPI_BSC2_ASD_m_IPS_L4C_2013_06_05_045004.mat

Figures in SVN at:

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

LHO_HPI_BSC2_ASD_m_IPS_L4C_2013_06_05_045004.fig



Measurement length: 1900s - Sample window: 50s - Overlap: 50% - Frequency resolution: 20mHz - Averages: 75 - Measurement start (GPS): 1054468220

Issues/difficulties/comments regarding this test:

Acceptance criteria:

■

Test result:

Passed: X

Failed:

9. SUS-watchdogs interaction test—**Test not performed**

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-BSC10

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/BS/Data/Static_tests/

H1_HPI_BS_Offset_Local_Drive_20130626.mat

. Drive of 5000 counts

	H1	H2	H3	H4	V1	V2	V3	V4
H1	8980	-3373	-739	-2708	-190	371	25	-341
H2	-2873	8385	-2734	-799	-108	59	-292	-62
H3	-554	-2520	9479	-3702	-113	-110	-39	39
H4	-2683	-574	-3018	8416	-405	230	86	-110
V1	204	245	444	-507	6444	1189	-1687	1162
V2	425	35	150	-248	1024	6565	1122	-1671
V3	282	-135	411	-196	-1727	1720	6157	870
V4	47	204	491	-368	1152	-1096	1181	6584

Table - Main couplings and cross couplings

Issues/difficulties encountered during this test:

Acceptance criteria:

-

Test result:

Passed: X

Failed: ____

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

Range of Motion Test not run or data not saved in svn.

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:

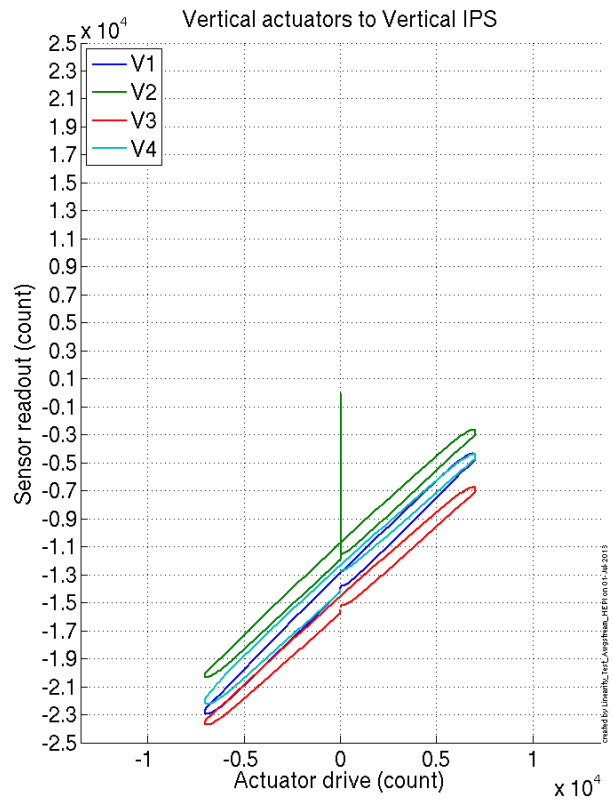
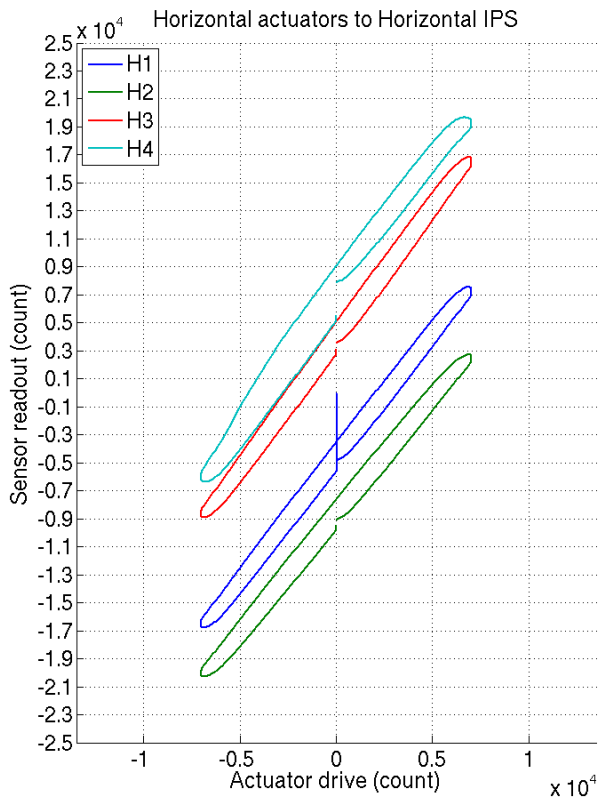
SeiSVN/seismic/HEPI/H1/BS/Data/Linearity_Test/

H1_HPI_BS_Linearity_test_20130701T104903.mat

Figures in SVN at:

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

H1_HPI_BS_Linearity_test_20130701T104903.fig



	Slopes	Offsets
H1	1.75	-4554
H2	1.66	-8717
H3	1.86	3950
H4	1.91	7269
V1	1.33	-13584
V2	1.27	-11338
V3	1.22	-15162
V4	1.29	-13089

Issues/difficulties encountered during this test:

Acceptance criteria:

- ???????

Test result: Slopes Fine **Offset Large**

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)	Res	Amplitude	Nreps	Time (s)	Time (min)	Time (h)
500-1000	0.25	1.0x1500 - 1500	250	4176*	69.6	1*
100 - 500	0.5	1.0x4000 - 4000	250	4176*	69.6	1.2*
10 - 100	0.25	1.0x4000 - 4000	200	6592*	109.9	1.8*
0.7 - 10	0.05	1.0x4000 - 4000	75	12320*	205.3	3.4*
0.1 - 0.7	0.025	1.0x4000 - 4000	30	10080*	168.0	2.8*
0.01 - 0.1	0.01	1.0x4000 - 4000	10	8960*	149.3	2.5*
0.002 - 0.01	0.002	1.0x4000 - 4000	2	12160*	202.7	3.4*
						16.1*

*: Values Need to be updated

Data files in SVN at:

/SeiSVN/seismic/HEPI/H1/BS/Data/Transfer_Functions/Measurements/Undamped/

BSC2 (BS) TFs were taken from BSC6 (H2 ETMY) for use in control development. So while data exists in BS area of SVN, this data is not from BSC2. No TFs were taken for BS.

H1_HPI_BS_Data_L2L_2mHz_10mHz_20130501-064244.mat

H1_HPI_BS_Data_L2L_10mHz_100mHz_20130501-003326.mat

H1_HPI_BS_Data_L2L_100mHz_700mHz_20130430-214047.mat

H1_HPI_BS_Data_L2L_700mHz_10Hz_20130501-031525.mat

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H1_HPI_BS_Data_L2L_10Hz_100Hz_20130430-195100.mat
H1_HPI_BS_Data_L2L_100Hz_500Hz_20130430-184146.mat
H1_HPI_BS_Data_L2L_500Hz_1000Hz_20130430-162523.mat

Data is called by Case #1 of:

/ligo/svncommon/SeiSVN/seismic/HEPI/H1/BS/Data/Transfer_Functions/Measurements/
/Measurements_List_H1_HPI_BS.m

Data collection script files:

/SeiSVN/seismic/HEPI/Common//Transfer_Function_Scripts/

- Run_TF_L2L_500Hz_1000Hz_HEPI.m
- Run_TF_L2L_100Hz_500Hz_HEPI.m
- Run_TF_L2L_10Hz_100Hz_HEPI.m
- Run_TF_L2L_700mHz_10Hz_HEPI.m
- Run_TF_L2L_100mHz_700mHz_HEPI.m
- Run_TF_L2L_10mHz_100mHz_HEPI.m
- Run_TF_L2L_2mHz_10mHz_HEPI.m

Scripts files for processing and plotting in SVN at:

/SeiSVN/seismic/HEPI/H1/BS/Scripts/Control_Scripts/Version_5/

- Step_1_TF_Loc_to_Loc_H1_HEPI_BS.m

Figures in SVN at:

/SeiSVN/seismic/HEPI/H1/BS/Data/Figures/Transfer_Functions/Measurements/Undamped/

- H1_HPI_BS_TF_L2L_Raw_from_ACT_to_IPS_2013_04_30.fig
- H1_HPI_BS_TF_L2L_Raw_from_ACT_to_L4C_2013_04_30.fig

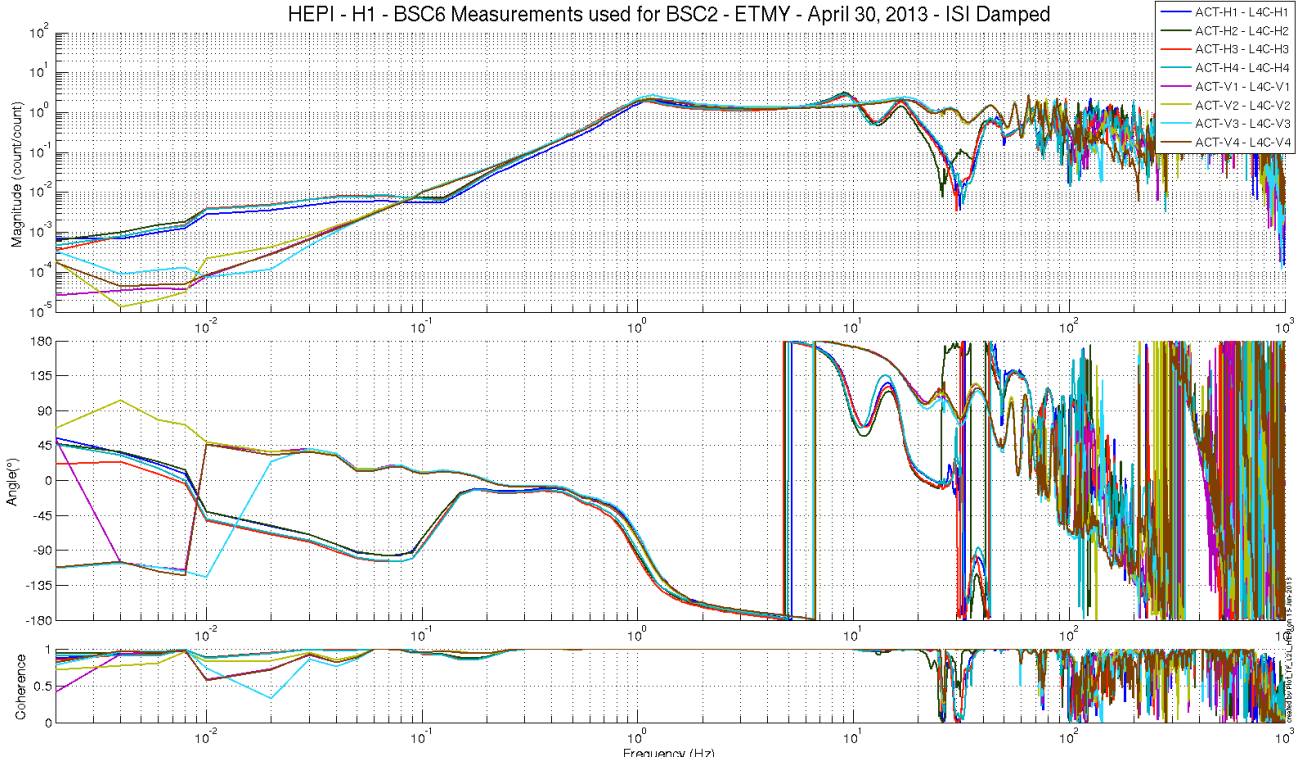
Storage of measured transfer functions in the SVN at:

/SeiSVN/seismic/HEPI/H1/BS/Data/Transfer_Functions/Simulations/Undamped/

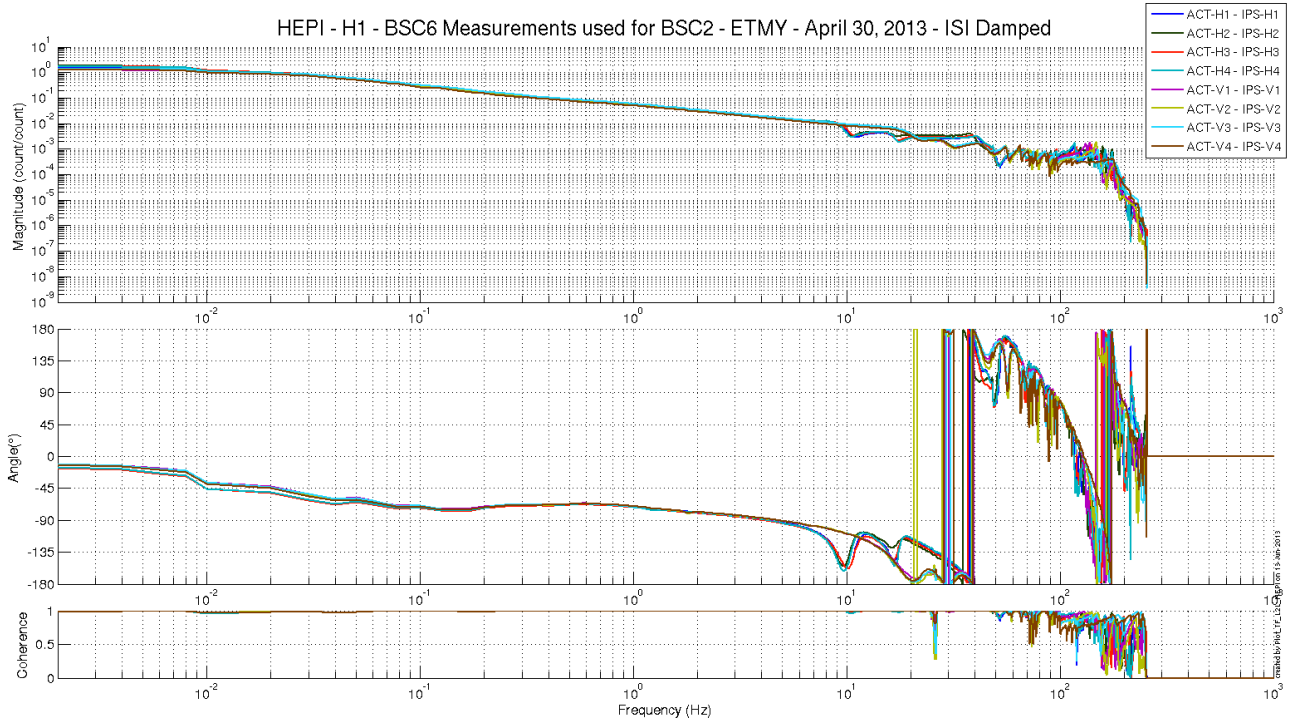
- H1_HPI_BS_TF_L2L_Raw_2013_04_30.mat

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

HEPI - H1 - BSC6 Measurements used for BSC2 - ETMY - April 30, 2013 - ISI Damped



HEPI - H1 - BSC6 Measurements used for BSC2 - ETMY - April 30, 2013 - ISI Damped



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Issues/difficulties/comments regarding this test: – This data is actually from BSC6.

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, after alignment work was performed—These numbers would nominally be all zero because after alignment and we attached the actuator and got a confirm that alignment was good, the IPS would be set to zero. However, once testing commences, the platforms will settle more, splay out if you will etc.

The numbers below are with the platform now in its nominal alignment and where the system operates. These values are good for the performance of the IPS. Much above 15000 would start to approach badness where the response loses linearity

	IPS Readouts HEPI Isolated	Cartesian DOF	TARGET
H1	-3240	X	3300
H2	-5440	Y	39200
H3	-1930	Z	-105000
H4	-3890	RX	-162300
V1	-3690	RY	-177400
V2	-13800	RZ	-19700
V3	-4500	HP	-139700
V4	11500	VP	-58300

Issues/difficulties encountered during this test:

Readings were retrieved from medms 11 Feb 2015. These IPS values are barely held within acceptable range with a large displacement on Z. When HEPI loops are not closed, V2 drops o near -25000 and is in a bad area of linearity. The solution is to raise the platform with the HEPI large springs.

Acceptance criteria:

IPS Values near and certainly above 15000 should be reduced by centering or other action.

Test result:

Passed: X

Failed: