

LIGO Laboratory / LIGO Scientific Collaboration

LIGO- E1300838-v1

LIGO

02/12/15

**aLIGO HEPI H1 ITMX
Assembly Validation Report**

E1300838

Hugh Radkins, Hugo Paris, Fabrice Matichard for the SEI Team

Distribution of this document:
Advanced LIGO Project

This is an internal working note
of the LIGO Laboratory

California Institute of Technology
LIGO Project – MS 18-34
1200 E. California Blvd.
Pasadena, CA 91125
Phone (626) 395-2129
Fax (626) 304-9834
E-mail: info@ligo.caltech.edu

LIGO Hanford Observatory
P.O. Box 1970
Mail Stop S9-02
Richland WA 99352
Phone 509-372-8106
Fax 509-372-8137

Massachusetts Institute of Technology
LIGO Project – NW22-295
185 Albany St
Cambridge, MA 02139
Phone (617) 253-4824
Fax (617) 253-7014
E-mail: info@ligo.mit.edu

LIGO Livingston Observatory
P.O. Box 940
Livingston, LA 70754
Phone 225-686-3100
Fax 225-686-7189

Contents

1.Introduction.....	5
2.Sub-Components Testing.....	5
3.Load Cells assembly--BSC1.....	5
4.Boot Location—Test Not Performed, HR.....	7
5.Check Stops Gaps—Test Not Performed, HR.....	8
6.Gaps check—Test Not Performed, HR.....	8
7.IPS Centering-BSC10.....	9
8.Sensor ASD.....	10
9.SUS-watchdogs interaction test—Test not performed.....	11
10.Static Test local drive-BSC10.....	11
11.Linearity Test/Range of motion in the local basis.....	12
12.Actuator Plate to Shields gap—Test Not Performed, HR.....	13
13.Valve Check—BSC-10, Test Not Performed.....	14
14.Local-to-local measurements.....	15
15. Alignment offsets:.....	18

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--BSC3

BSC HEPI load cell capacity → 3000 lbs

HAM HEPI load cell capacity → 2000 lbs

	Left Spring (lbs)	Right Spring (lbs)
Pier 1	2260	2120
Pier 2	2130	2060
Pier 3	2220	2110
Pier 4	2480	2280

Acceptance criteria:

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

Test result:

Passed: ??

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-BSC3

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/ITMX/Data/Static_Tests/
 Test not performed or data not stored 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

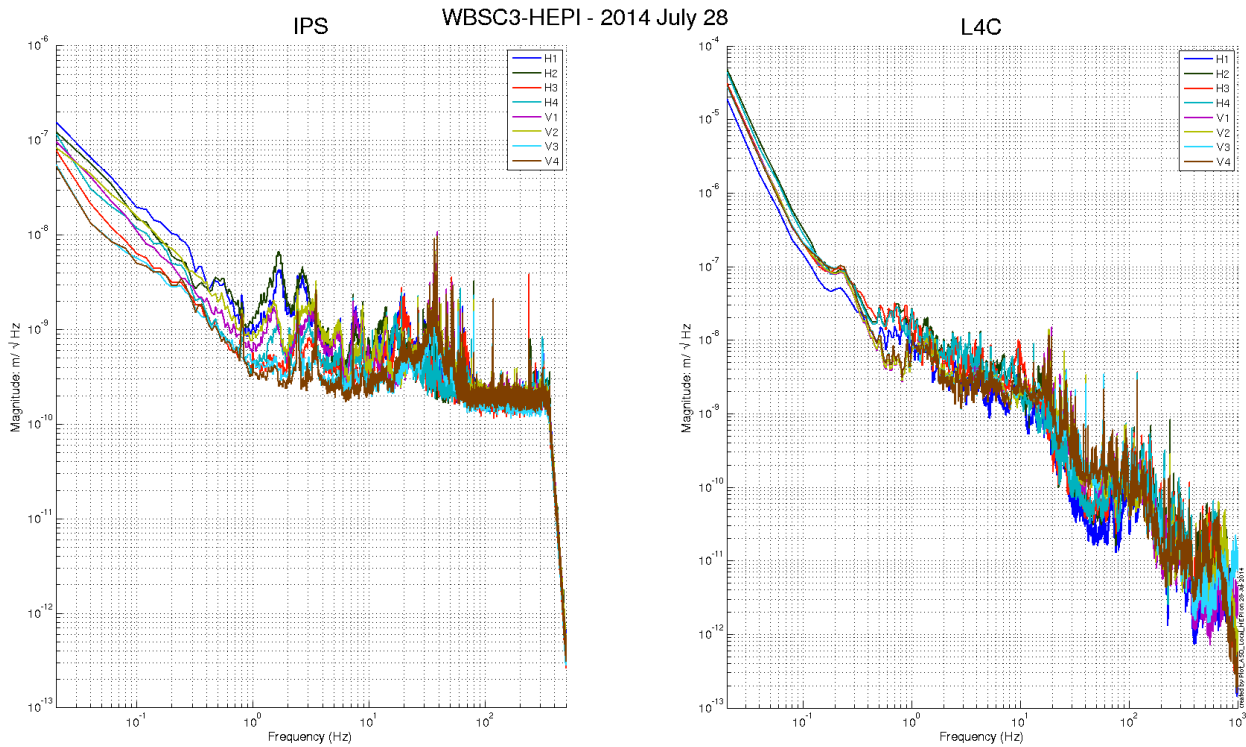
Data in SVN at:
 SeiSVN/seismic/HEPI/H1/ITMX/Data/Spectra/Undamped/

H1_HPI_BSC3_ASD_m_IPS_L4C_20140728_03:57:14.mat

Figures in SVN at:

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

H1_HPI_BSC3_ASD_m_IPS_L4C_20140728_03:57:14.fig



Measurement length: 1900s - Sample window: 50s - Overlap: 50% - Frequency resolution: 20mHz - Averages: 75 - Measurement start (GPS): 1090580250

Issues/difficulties/comments regarding this test:

Acceptance criteria:

■

Test result:

Passed: ?

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-BSC3—Test not performed as of 12 Feb 2015

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/ITMX/Data/Static_tests/

. Drive of 5000 counts

	H1	H2	H3	H4	V1	V2	V3	V4
H1								
H2								
H3								
H4								
V1								
V2								
V3								
V4								

Table - Main couplings and cross couplings

Issues/difficulties encountered during this test:

Acceptance criteria:

-

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

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

0.8mm clear range of Motion: see ../HEPI/H1/Data/Static_Tests/
H1_HPI_BSC3_Range_Of_Motion_20140625.mat

Scripts files for processing and plotting in SVN at:

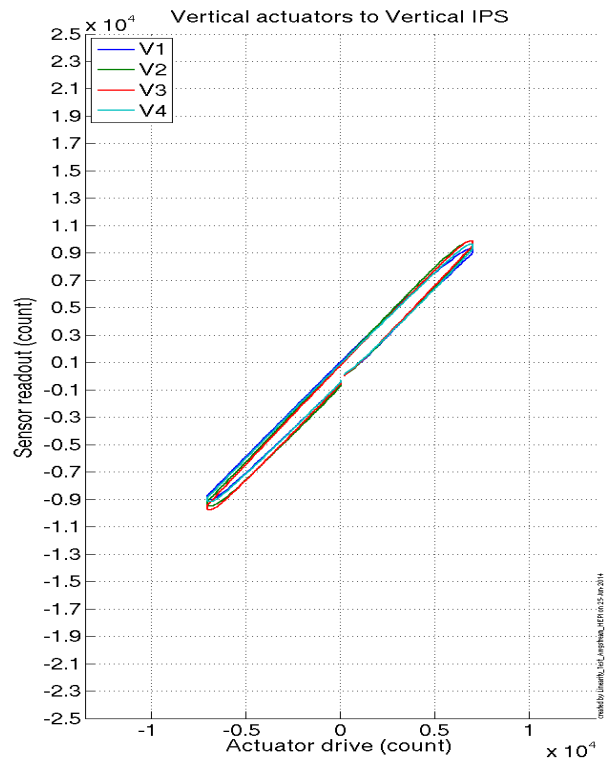
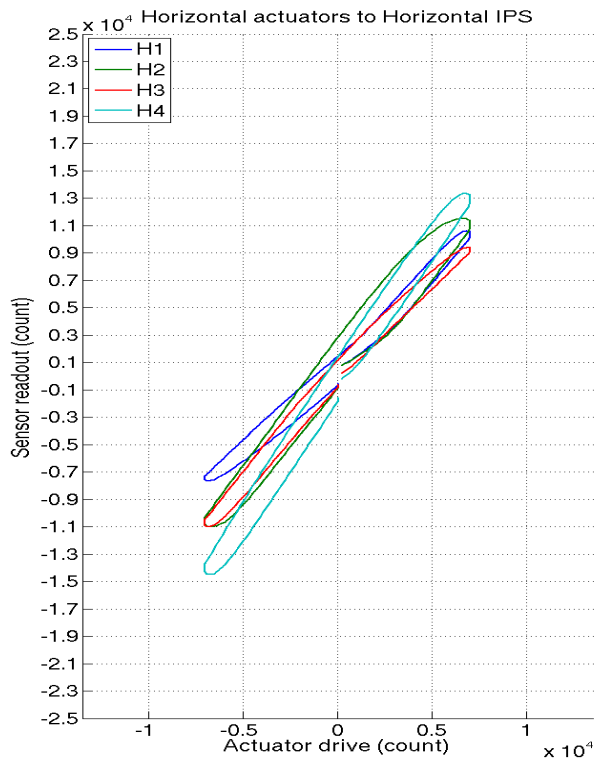
/SeiSVN/seismic/HEPI/Common/Testing_Functions_HEPI/Linearity_Test_Awstream_HEPI.m

Data in SVN at:

SeiSVN/seismic/HEPI/H1/ITMX/Data/Linearity_Test/
H1_HPI_BSC3_Linearity_test_20140625T082612.mat

Figures in SVN at:

/SeiSVN/seismic/HEPI/H1/ITMX/Data/Figures/Linearity_Test/
H1_HPI_BSC3_Linearity_test_20140625T082612.fig



	Slopes	Offsets
H1	1.30	930
H2	1.64	631
H3	1.48	-171
H4	2.02	-298
V1	1.33	255
V2	1.40	151
V3	1.41	100
V4	1.35	223

Issues/difficulties encountered during this test: The variation in slope for the Horizontals may be too large--HR

Acceptance criteria:

- ???????

Test result:

Passed: ?

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—BSC3, 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/ETMY/Data/Transfer_Functions/Measurements/Undamped/
LHO_HPI_BSC3_Data_L2L_2mHz_10mHz_20140103-062128_Reordered.mat
LHO_HPI_BSC3_Data_L2L_10mHz_100mHz_20140103-001203_Reorderedmat
LHO_HPI_BSC3_Data_L2L_100mHz_700mHz_20140102-211922_Reordered.mat
LHO_HPI_BSC3_Data_L2L_700mHz_10Hz_20140103-025408_Reordered.mat
LHO_HPI_BSC3_Data_L2L_10Hz_100Hz_20140102-192938_Reordered.mat
LHO_HPI_BSC3_Data_L2L_100Hz_500Hz_20140102-182027_Reordered.mat
LHO_HPI_BSC3_Data_L2L_500Hz_1000Hz_20140102-160404_Reordered.mat

Data is called by Case #2 of:

/ligo/svncommon/SeiSVN/seismic/HEPI/H1/ITMX/Data/Transfer_Functions/Measurements/
/Measurements_List_H1_HPI_ITMX.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/ITMX/Scripts/Control_Scripts/Version_5/

- Step_1_TF_Loc_to_Loc_H1_HEPI_ITMX.m

Figures in SVN at:

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

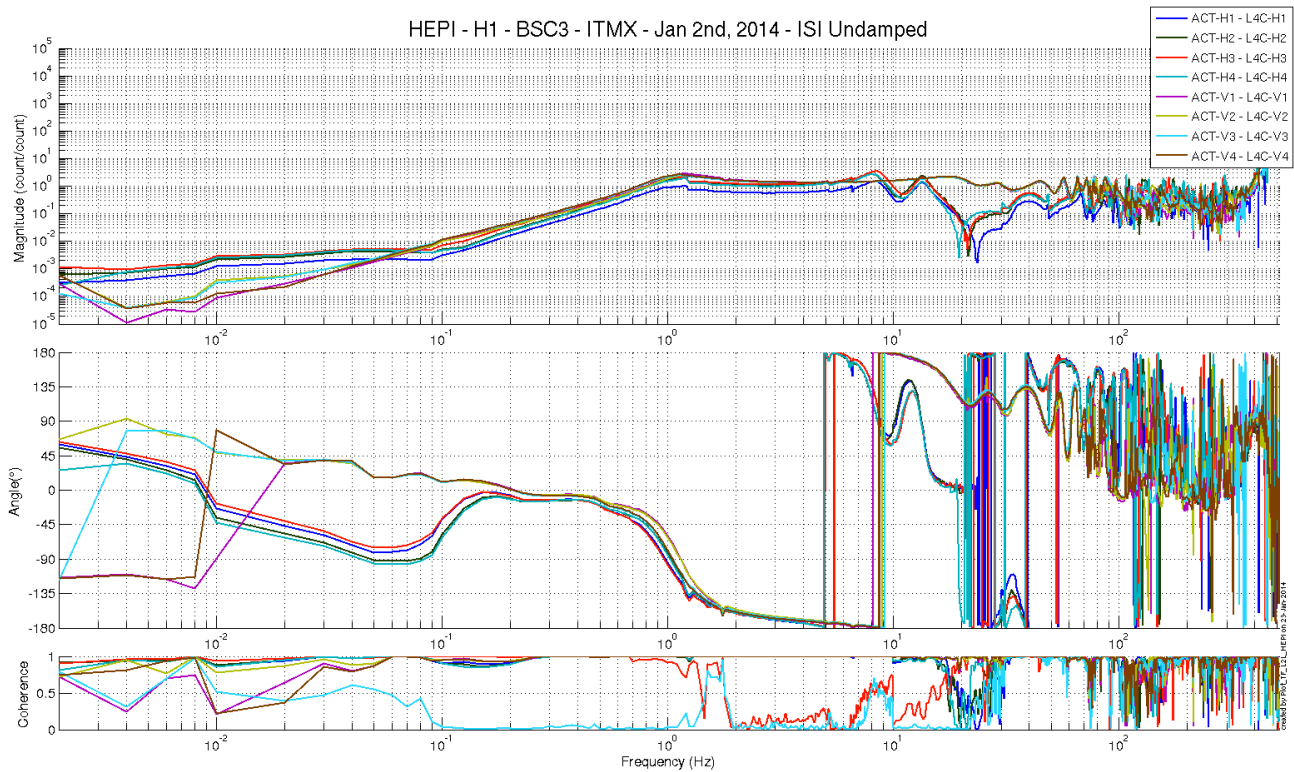
- H1_HPI_ITMX_TF_L2L_Raw_from_ACT_to_IPS_2014_01_02_Reordered.fig
- H1_HPI_ITMX_TF_L2L_Raw_from_ACT_to_L4C_2014_01_02_Reordered.fig

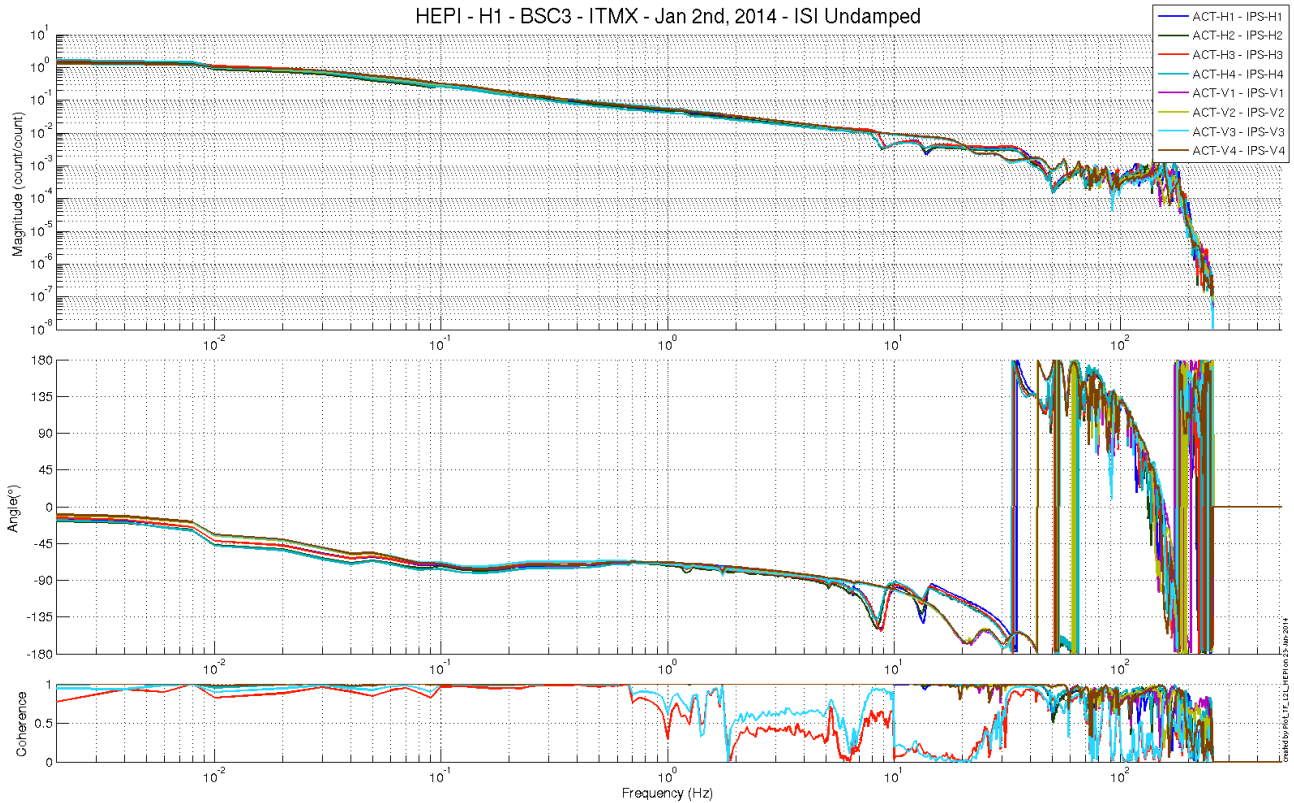
Storage of measured transfer functions in the SVN at:

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

- H1_HPI_ITMX_TF_L2L_Raw_2014_01_02_Reordered.mat

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





Issues/difficulties/comments regarding this test: – Reordering of the TFs was done to repair a field mis-wiring. The reordering allowed the use of the TFs rather than having to rerun them.

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	6060	X	-117800
H2	-5630	Y	12700
H3	1300	Z	127000
H4	-1800	RX	32200
V1	5500	RY	-19900
V2	3470	RZ	70000
V3	1630	HP	-900
V4	2530	VP	11200

Issues/difficulties encountered during this test:

Readings were retrieved from medms 12 Feb 2015.

Acceptance criteria:

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

Test result:

Passed: X

Failed: