*LIGO Laboratory / LIGO Scientific Collaboration*

LIGO- E1300841 *LIGO* Date (fixed)

**aLIGO HEPI H1 ETMY**

**Assembly Validation Report**

**E1300841**

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Distribution of this document:

Advanced LIGO Project

This is an internal working note

of the LIGO Laboratory

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# 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

# 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)

# Load Cells assembly--BSC10

BSC HEPI load cell capacity → 3000 lbs

HAM HEPI load cell capacity → 2000 lbs

|  |  |  |
| --- | --- | --- |
|  | **Left Spring (lbs)** | **Right Spring (lbs)** |
| **Pier 1** | 1900 | 2110 |
| **Pier 2** | 2185 | 2090 |
| **Pier 3** | 2145 | 2260 |
| **Pier 4** | 1990 | 2250 |

**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: .**

# 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: .**

# 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** | | | | | | | | | | | | | | | |
|  | **Gap1** | **Gap2** | **Gap3** | **Gap4 above** | **Gap4 under** | **Gap5** | **Gap1** | **Gap2** | **Gap3** | **Gap4 above** | **Gap4 under** | **Gap5** | **Gap1** | **Gap2** | **Gap3** | **Gap4 above** | **Gap4 under** | **Gap5** |
| **Pier 1** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Pier 2** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Pier 3** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Pier 4** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Test result: Passed: Failed:**

# 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: .**

# 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/ETMY/Data/Static\_Tests/

LHO\_HPI\_ETMY\_IPS\_Read\_Back\_Unlocked\_20140312\_11:30.mat

All the loops must be turned off during this test.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | H1 | H2 | H3 | H4 | V1 | V2 | V3 | V4 |
| Mean (counts) | -335 | -252 | -281 | -293 | 129 | 136 | 69 | 283 |
| Acceptance | +/- 15000 | +/- 15000 | +/- 15000 | +/- 15000 | +/- 15000 | +/- 15000 | +/- 15000 | +/- 15000 |

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

# 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:**

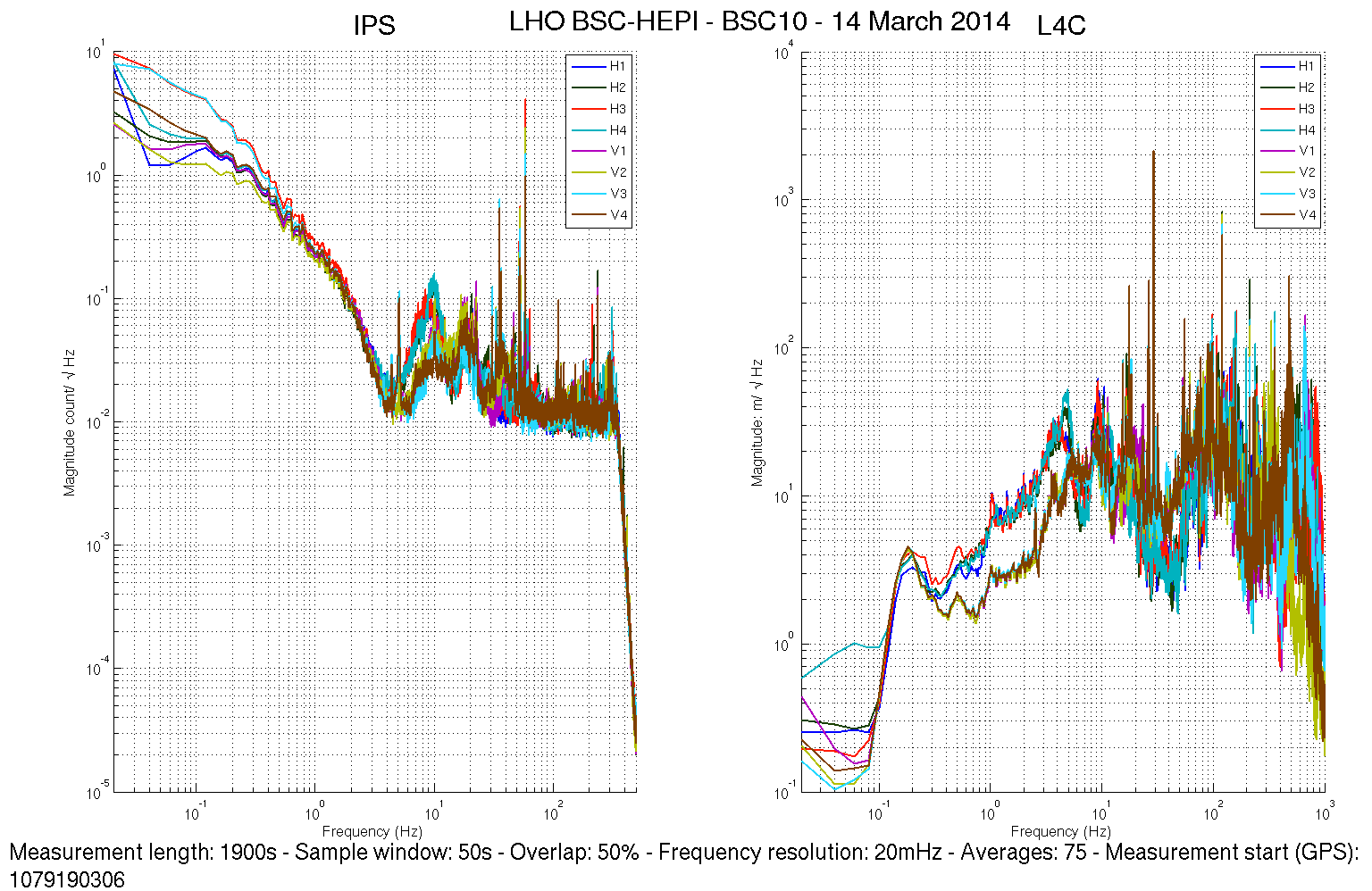
SeiSVN/seismic/HEPI/H1/ETMY/Data/Spectra/Undamped/

H1\_HPI\_BSC10\_ASD\_m\_IPS\_L4C\_20140318\_08:04:50.mat

**Figures in SVN at:**

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

H1\_HPI\_BSC10\_ASD\_m\_IPS\_L4C\_20140318\_08:04:50.fig



Issues/difficulties/comments regarding this test:

Measurements were performed with ISI Lock.

**Acceptance criteria: ??????**



**Test result: Passed: ? Failed: .**

# SUS-watchdogs interaction test—BSC10 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 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).

# 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/ETMY/Data/Static\_tests/

LHO\_HPI\_BSC10\_Offset\_Local\_Drive\_20140313.mat

. ***Drive of 5000 counts***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | H1 | H2 | H3 | H4 | V1 | V2 | V3 | V4 |
| H1 | 9811 | -3311 | -821 | -3436 | -74 | -239 | 78 | 112 |
| H2 | -3051 | 9704 | -3725 | -755 | -193 | 144 | 202 | 50 |
| H3 | -737 | -3358 | 9810 | -3162 | 72 | 56 | -88 | -256 |
| H4 | -3396 | -771 | -3409 | 9894 | 159 | 77 | -302 | -58 |
| V1 | -104 | -160 | 84 | 176 | 6810 | 1449 | -1794 | 1037 |
| V2 | -236 | 182 | 47 | 64 | 1510 | 7036 | 1046 | -1836 |
| V3 | 132 | 243 | -100 | -279 | -1803 | 1088 | 6788 | 1402 |
| V4 | 168 | 103 | -299 | -5 | 1196 | -1960 | 1554 | 7382 |

*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 ???%)If you drive different amounts, why would you expect the results to be the same? HR

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

# Linearity Test/Range of motion in the local basis

Ran Range of Motion Script and it reported 'Short Range of Motion on V2'

However, the data viewer suggests all the IPS respond very similarly and I'd say the script is not evaluating this properly. Using possibly an old version (Vincent era, from H2 ETMy.)

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

/SeiSVN/seismic/HEPI/Common/Testing\_Functions\_HEPI/Linearity\_Test\_Awgstream\_HEPI.m

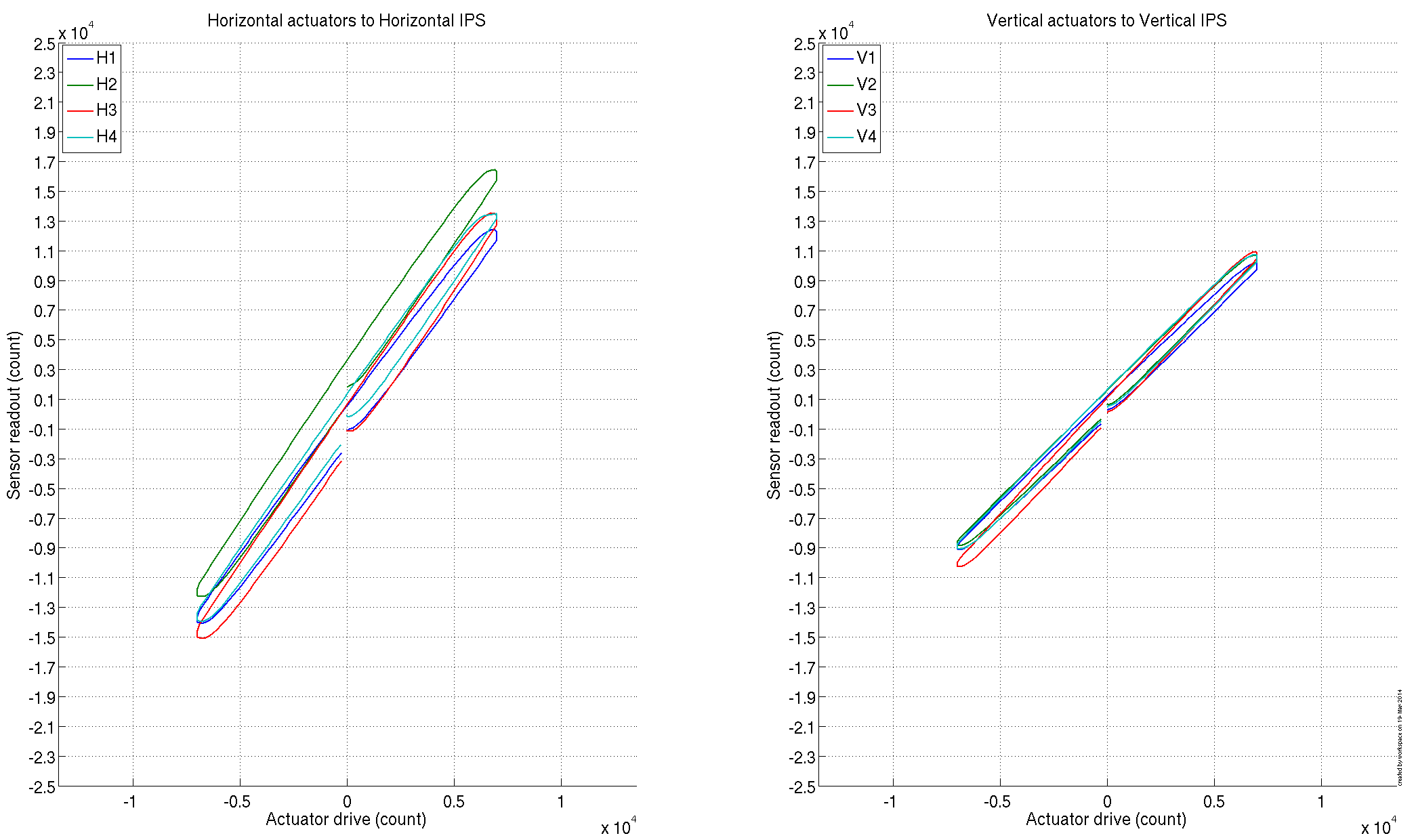
**Data in SVN at:**

SeiSVN/seismic/HEPI/H1/ETMY/Data/Linearity\_Test/ LHO\_HPI\_BSC10\_Linearity\_test\_20140319T115413.mat

**Figures in SVN at:**

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

|  |  |  |
| --- | --- | --- |
|  | Slopes | Offsets |
| H1 | 1.910 | -757 |
| H2 | 2.081 | 2180 |
| H3 | 2.071 | -837 |
| H4 | 2.003 | 8 |
| V1 | 1.383 | 529 |
| V2 | 1.409 | 911 |
| V3 | 1.526 | 358 |
| V4 | 1.425 | 837 |



Issues/difficulties encountered during this test: Script modified to insure data retrieval--HR

**Acceptance criteria:**

* ???????

**Test result: Passed: ? Failed: .**

# 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:**

# Valve Check—BSC-10, Test Not Performed

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

/SeiSVN/seismic/HEPI/H1/HAM2/Scripts/Valve\_Check/plot\_valve\_check.m

**Data in SVN at:**

SeiSVN/seismic/HEPI/H1/HAM2/Data/Spectra/Undamped/

/SeiSVN/seismic/HEPI/H1/HAM2/Scripts/Valve\_Check

**Figures in SVN at:**

/SeiSVN/seismic/HEPI/H1/HAM2/Scripts/Valve\_Check

**Acceptance criteria: ????**

**Test result: Passed: Failed: .**

# 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\_BSC10\_Data\_L2L\_500Hz\_1000Hz\_20140314-042923.mat
* LHO\_HPI\_BSC10\_Data\_L2L\_100Hz\_500Hz\_20140314-194824.mat
* LHO\_HPI\_BSC10\_Data\_L2L\_10Hz\_100Hz\_20140314-205735.mat
* LHO\_HPI\_BSC10\_Data\_L2L\_700mHz\_10Hz\_20140314-224718.mat
* LHO\_HPI\_BSC10\_Data\_L2L\_100mHz\_700mHz\_20140315-021437.mat
* LHO\_HPI\_BSC10\_Data\_L2L\_10mHz\_100mHz\_20140315-050717.mat
* LHO\_HPI\_BSC10\_Data\_L2L\_2mHz\_10mHz\_20140315-074917.mat

**Data is called by** **Case #2 of:**/ligo/svncommon/SeiSVN/seismic/HEPI/H1/ETMY/Data/Transfer\_Functions/Measurements/

Undamped/Measurements\_List\_H1\_HPI\_ETMY.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/ETMY/Scripts/Control\_Scripts/Version\_5/

* Step\_1\_TF\_Loc\_to\_Loc\_H1\_HEPI\_ETMY.m

**Figures in SVN at:**

/SeiSVN/seismic/HEPI/H1/ETMY/Data/ Figures/Transfer\_Functions/Measurements/Undamped/

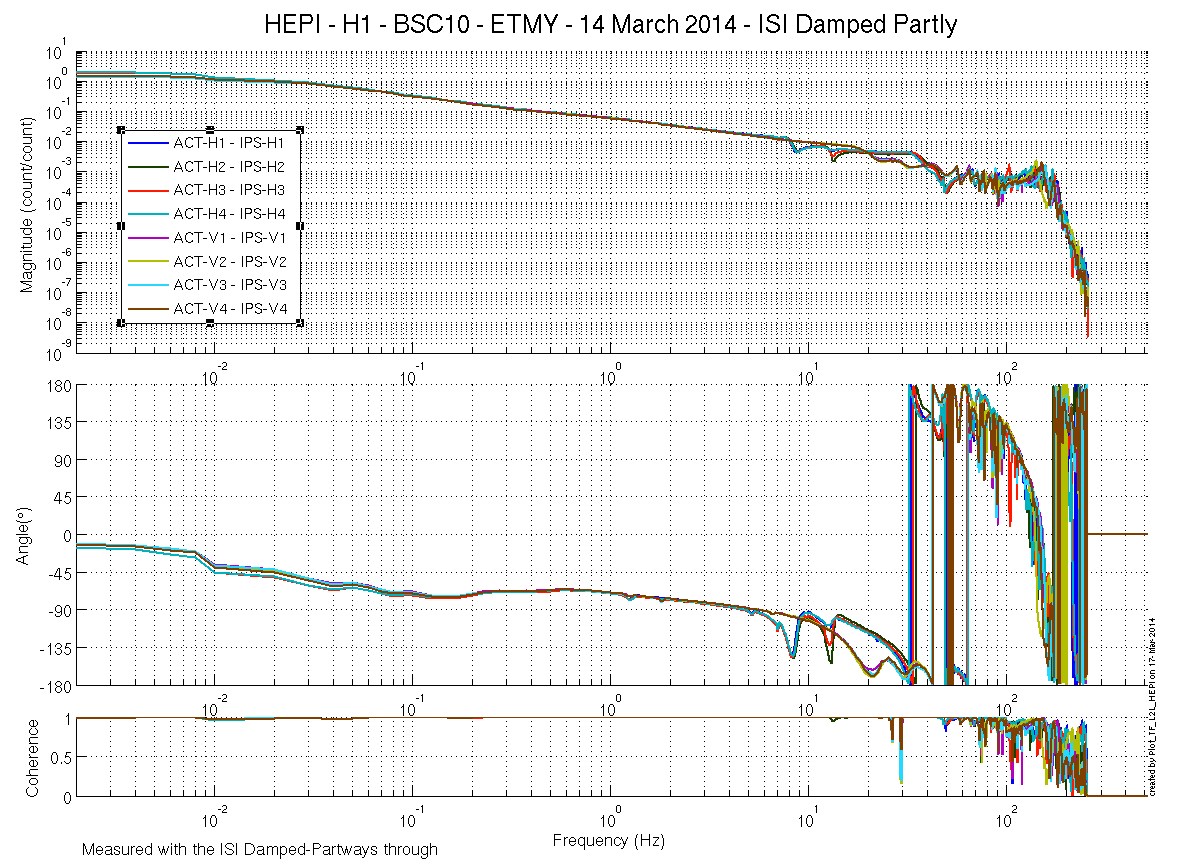
* H1\_HPI\_ETMY\_TF\_L2L\_Raw\_from\_ACT\_to\_IPS\_2014\_03\_14.fig
* H1\_HPI\_ETMY\_TF\_L2L\_Raw\_from\_ACT\_to\_L4C\_2014\_03\_14.fig

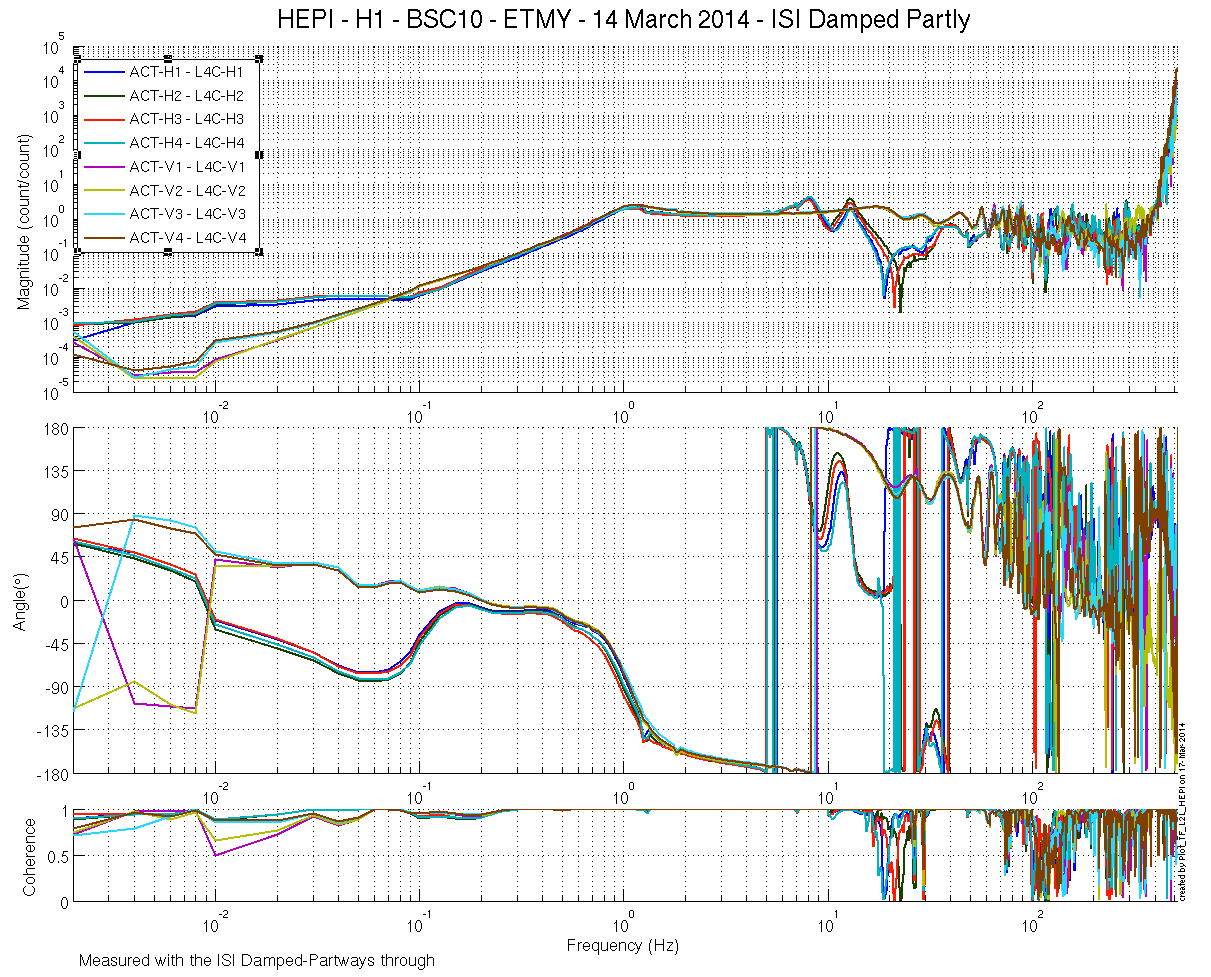
**Storage of measured transfer functions in the SVN at:**

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

* H1\_HPI\_ETMY\_TF\_L2L\_Raw\_2014\_03\_14.mat

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





![A description...](data:None;base64,)

Issues/difficulties/comments regarding this test: – BSC10, SYM filters on—this may be an issue? Also, started ISI damped but Stage2 tripped at the beginning of the H1 .7—10Hz band, and Stage1 tripped during the V2 2-10mHz TF. Will rerun w/o sym filter if possible.

**Acceptance criteria:**

* On IPS, the phase must be 0º at DC
* On geophones, the phase must be 90º at DC—Not sure if this is true, HR
* Identical shape in each corner

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

# Alignment offsets:

Those are the IPS readouts that were recorded with HEPI locked, after alignment work was performed. The opposite[NOT] of those values is to be installed as offset of the IPS filter banks when the Isolation loops are turned on. This way, HEPI will be operating in its *preferred alignment* state.

This text should be rewritten in respect of the now Bias Position alignment, HR

|  |  |  |
| --- | --- | --- |
|  | IPS Readouts HEPI Locked | Offset Value |
| H1 | 0 | 0 |
| H2 | 0 | 0 |
| H3 | 0 | 0 |
| H4 | 0 | 0 |
| V1 | 0 | 0 |
| V2 | 0 | 0 |
| V3 | 0 | 0 |
| V4 | 0 | 0 |
|  |  |  |
|  |  |  |

Issues/difficulties encountered during this test:

Readings were retrieved from LHO aLog # 10659. IPS zero'd after Actuator attachment and alignment verification.

**Acceptance criteria:**

Offsets were recorded.

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