*LIGO Laboratory / LIGO Scientific Collaboration*

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**aLIGO HEPI H1 HAM1**

**Assembly Validation Report**

**E1300823**

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Distribution of this document:

Advanced LIGO Project

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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

BSC HEPI load cell capacity → 3000 lbs

HAM HEPI load cell capacity → 2000 lbs

|  |  |  |
| --- | --- | --- |
|  | **Left Spring (lbs)** | **Right Spring (lbs)** |
| **Pier 1** | 1347 | 949 |
| **Pier 2** | 1458 | 1631 |
| **Pier 3** | 1267 | 1157 |
| **Pier 4** | 1142 | 1722 |

**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 .**

# Boot Location





**Acceptance criteria:**



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

# Check Stops Gaps

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** | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go |
| **Pier 2** | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go |
| **Pier 3** | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go |
| **Pier 4** | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go | Go |

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

# Gaps check

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** | Go | Go | Go | Go |
| **Pier 2** | Go | Go | Go | Go |
| **Pier 3** | Go | Go | Go | Go |
| **Pier 4** | Go | Go | Go | Go |

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

# IPS Centering

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

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

All the loops must be turned off during this test.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | H1 | H2 | H3 | H4 | V1 | V2 | V3 | V4 |
| Mean (counts) | 5839.5 | 10365 | 187.03 | 3377.5 | -2795.2 | -5220.6 | 8743 | -3900.7 |
| 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

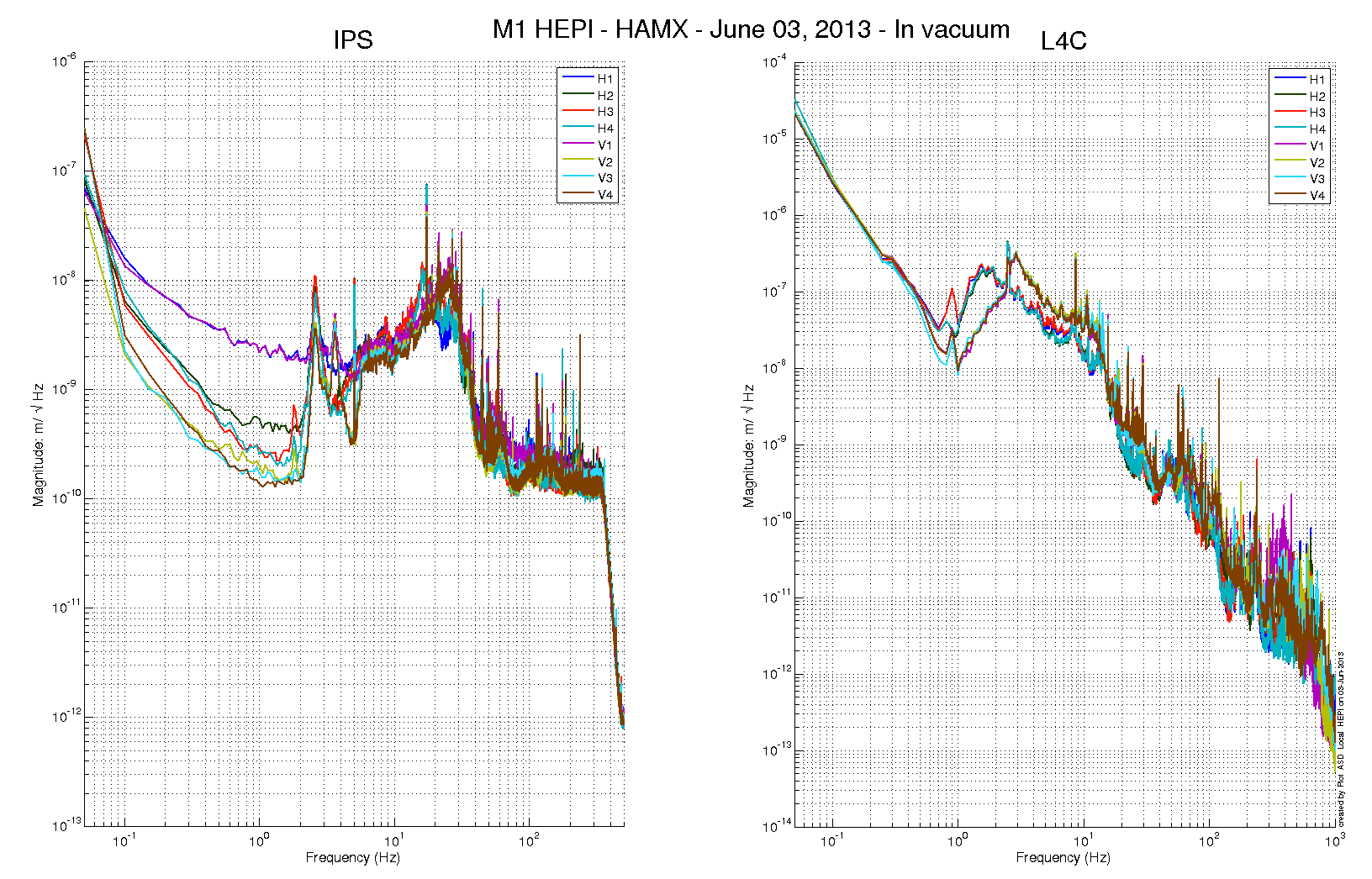
**Data in SVN at:**

SeiSVN/seismic/HEPI/M1/HAMX/Data/Spectra/Undamped/

M1\_HPI\_HAMX\_ASD\_m\_IPS\_L4C\_2013\_06\_03\_120859.mat

**Figures in SVN at:**

/SeiSVN/seismic/HEPI/M1/HAMX/Data/Figures/Spectra/Undamped



Issues/difficulties/comments regarding this test:

Measurements were performed with all PreFilters ON.

**Acceptance criteria:**



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

# SUS-watchdogs interaction test

. 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: X Failed: .**

When this test is done, reset everything (OVERRIDE button OFF, put back the value on the payload watchdog).

# Static Test local drive

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

/SeiSVN/seismic/HEPI/Common/Testing\_Functions\_HEPI/Static\_Test\_Local\_Basis\_HEPI.m

. ***Drive of 100 counts (in progress)***

*Table - Main couplings and cross couplings*



. ***Drive of 1000 counts (in progress)***

*Table - Main couplings and cross couplings*



. ***Drive of 2500 counts***

*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 xxx%)

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

# Linearity Test/Range of motion in the local basis

**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/M1/HAMX/Data/Spectra/Undamped/

M1\_ISI\_HAMX\_ASD\_m\_CPS\_T240\_L4C\_GS13\_Locked\_vs\_Unlocked\_2012\_02\_07.mat

**Figures in SVN at:**

/SeiSVN/seismic/HEPI/M1/HAMX/Data/Figures/Spectra/Undamped

Issues/difficulties encountered during this test:

**Acceptance criteria:**

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

# Actuator Plate to Shields gap

**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** | Go | Go | Go | Go | Go | Go |
| **Pier 2** | Go | Go | Go | Go | Go | Go |
| **Pier 3** | Go | Go | Go | Go | Go | Go |
| **Pier 4** | Go | Go | Go | Go | Go | Go |

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

# Valve Check

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

/SeiSVN/seismic/HEPI/M1/HAMX/Scripts/Valve\_Check/plot\_valve\_check.m

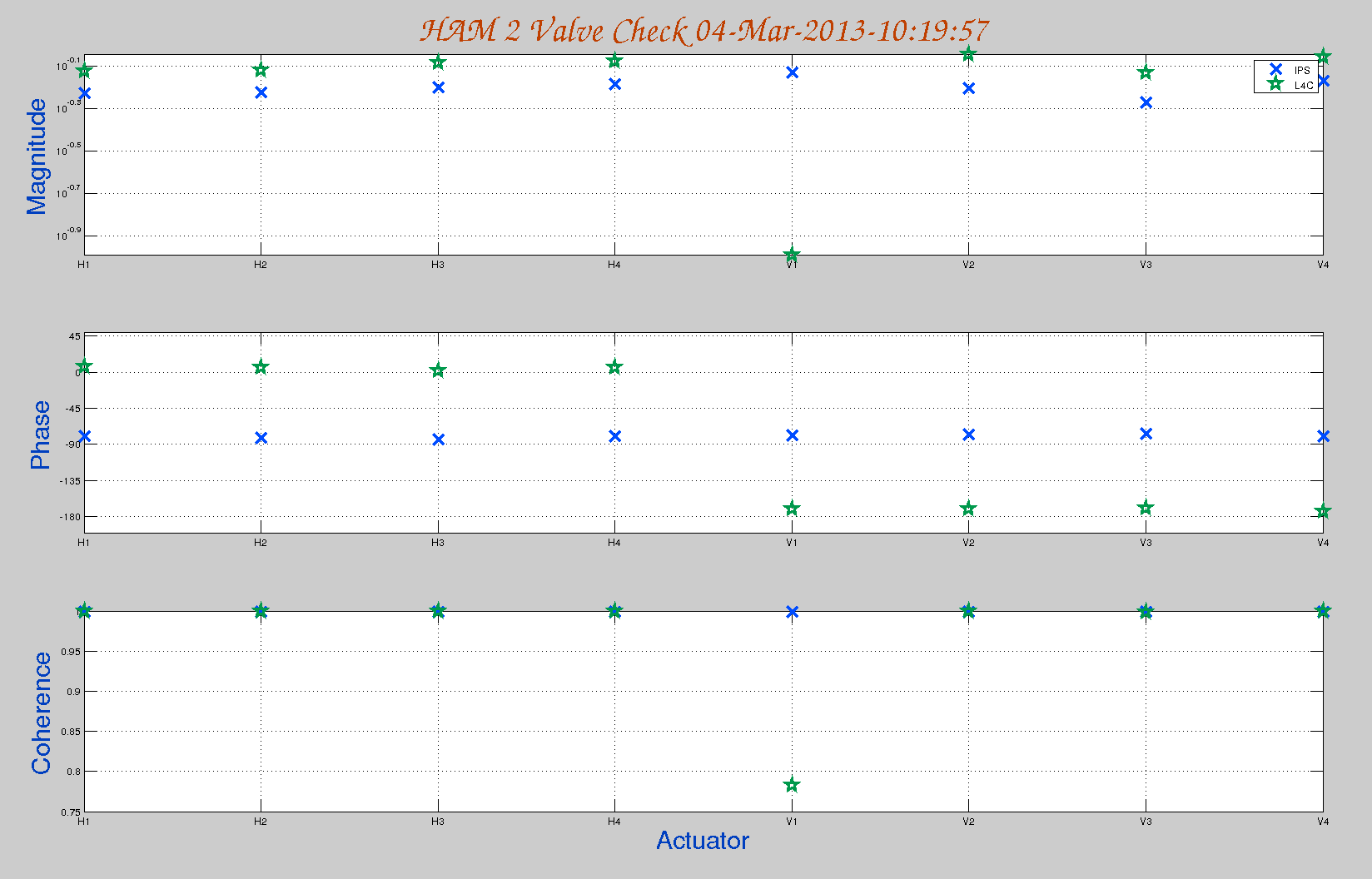
**Data in SVN at:**

SeiSVN/seismic/HEPI/M1/HAMX/Data/Spectra/Undamped/

/SeiSVN/seismic/HEPI/M1/HAMX/Scripts/Valve\_Check

**Figures in SVN at:**

/SeiSVN/seismic/HEPI/M1/HAMX/Scripts/Valve\_Check



**Acceptance criteria:**

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

# Local-to-local measurements

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Band (Hz)** | **Resolution** | **Amplitude** | **Nreps** | **Time (s)** | **Time (min)** | **Time (h)** |
| **100 - 500** | 0.5 | 4000 - 4000 | 250 | 4176 | 69.6 | 1.2 |
| **10 - 100** | 0.25 | 4000 - 4000 | 200 | 6592 | 109.9 | 1.8 |
| **0.7 - 10** | 0.05 | 4000 - 4000 | 75 | 12320 | 205.3 | 3.4 |
| **0.1 - 0.7** | 0.025 | 4000 - 4000 | 30 | 10080 | 168.0 | 2.8 |
| **0.01 - 0.1** | 0.01 | 4000 - 4000 | 10 | 8960 | 149.3 | 2.5 |
| **0.002 - 0.01** | 0.002 | 4000 - 4000 | 2 | 12160 | 202.7 | 3.4 |
|  |  |  |  |  |  | **15.1** |

**Data files in SVN at:**

/SeiSVN/seismic/HEPI/M1/HAMX/Data/Transfer\_Functions/Measurements/Undamped/

* M1\_HPI\_HAMX\_Data\_TF\_L2L\_200Hz\_1000Hz\_20120201-174407.mat
* M1\_HPI\_HAMX\_Data\_TF\_L2L\_5Hz\_200Hz\_20120201-183140.mat
* M1\_HPI\_HAMX\_Data\_TF\_L2L\_500mHz\_5Hz\_20120201-191513.mat
* M1\_HPI\_HAMX\_Data\_TF\_L2L\_100mHz\_500mHz\_20120201-202848.mat
* M1\_HPI\_HAMX\_Data\_TF\_L2L\_10mHz\_100mHz\_20120201-212025.mat

**Data collection script files:**

/SeiSVN/seismic/HEPI/Common//Transfer\_Function\_Scripts/

* Run\_TF\_L2L\_10mHz\_100mHz.m
* Run\_TF\_L2L\_100mHz\_500mHz.m
* Run\_TF\_L2L\_500mHz\_5Hz.m
* Run\_TF\_L2L\_5Hz\_100Hz.m
* Run\_TF\_L2L\_100Hz\_1000Hz.m

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

/SeiSVN/seismic/HEPI/M1/HAMX/Scripts/Control\_Scripts/release/

* Step\_1\_TF\_Loc\_to\_Loc\_M1\_HEPI\_HAMX.m

**Figures in SVN at:**

/SeiSVN/seismic/HEPI/M1/HAMX/Data/ Figures/Transfer\_Functions/Measurements/Undamped/

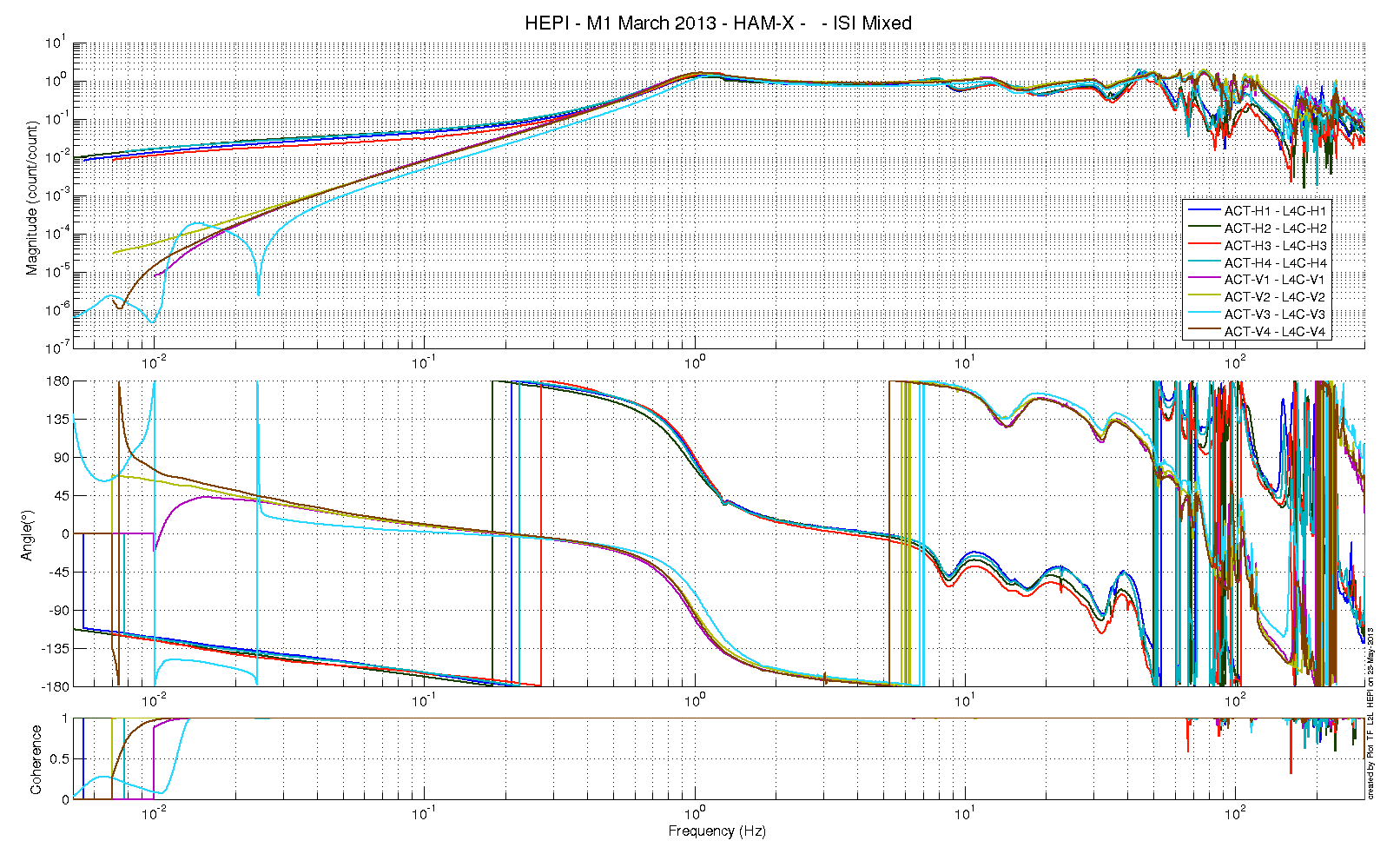
* M1\_HPI\_Unit\_1\_TF\_L2L\_Raw\_from\_ACT\_to\_CPS\_2012\_02\_02\_With\_3\_Washers\_Under\_Top\_Mass.fig
* M1\_HPI\_Unit\_1\_TF\_L2L\_Raw\_from\_ACT\_to\_GS13\_2012\_02\_02\_With\_3\_Washers\_Under\_Top\_Mass.fig

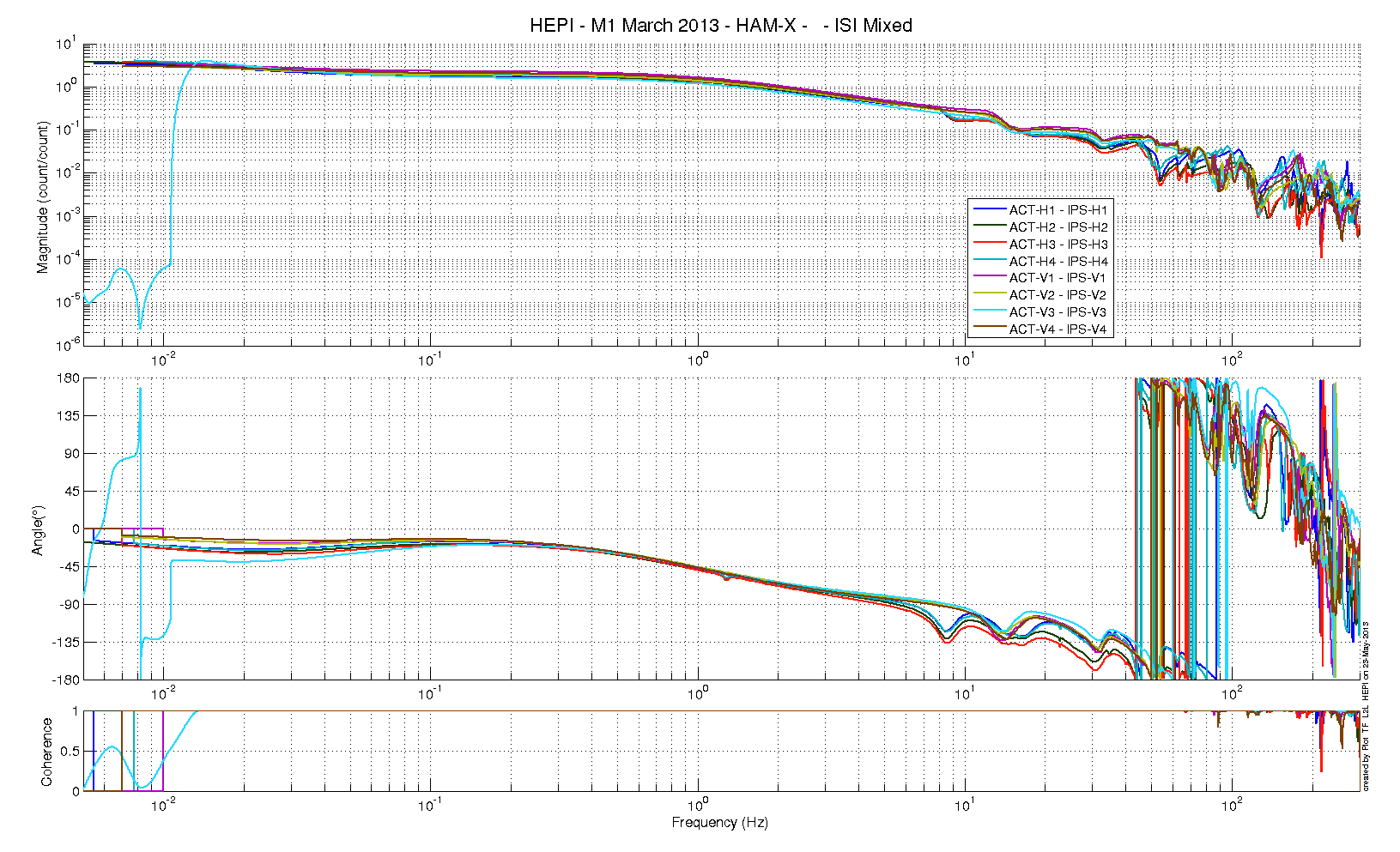
**Storage of measured transfer functions in the SVN at:**

/SeiSVN/seismic/HEPI/M1/HAMX/Data/Transfer\_functions/ Simulations/Undamped/

* M1\_HPI\_Unit\_1\_TF\_L2L\_Raw\_2012\_02\_02\_With\_3\_Washers\_Under\_Top\_Mass.mat

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





Issues/difficulties/comments regarding this test:

**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: .**