



SST DEPARTMENT
VIBRATION TEST FACILITY TEST REPORT

REPORT REF: AIV-2002-027-VIB

SPIRE : BSM & BSM Flex Pivot Up-screening Rig

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Oxfordshire OX11 0QX

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ANNEX A: ACCELEROMETER PLOTS FIGURES 1ab – 15ab + 16

1) TEST ITEM DESCRIPTION

The test item consisted of the SPIRE BSM (Beam Steering Mirror) and the BSM Flex Pivot Up-screening Rig. The BSM was identified as Development Model 1. All testing would be carried out on the head of the shaker.

2) TEST SPECIFICATION

The Qualification test specification levels were given in document ref. SPU-BSM-DOC-0008 Appendix B dated 31/10/01. A sine survey was to be followed by a sine sweep, random and a final sine survey for each axis. Initially short duration Random runs (20 seconds) at ¼ power would be carried out to assess the response of the test item. One Triaxial and three single axis accelerometers would be used for monitoring. (BSM only)

SINE SURVEY TEST

One sweep @ 0.5g from 5 Hz to 2000 Hz at 2 octaves per minute.

X AXIS

SINE SWEEP TEST

| FREQUENCY (Hz) | TEST LEVEL |
|----------------|--------------|
| 5 – 25.3 | 22mm pk-pk |
| 25.3 - 35 | 28.3g – 40 g |
| 35 - 100 | 40g |

One sweep at 2 octaves per minute.

Y AND Z AXES

SINE SWEEP TEST

| FREQUENCY (Hz) | TEST LEVEL |
|----------------|------------|
| 5 – 23.7 | 22mm pk-pk |
| 23.7 - 100 | 25g |

One sweep at 2 octaves per minute.

RANDOM

X AXIS

| FREQUENCY (Hz) | TEST LEVEL |
|----------------|-------------------------|
| 20 - 100 | +6 dB |
| 100 - 300 | 0.2 g ² / Hz |
| 300 - 2000 | -6 dB |

Overall Test Level = 9.89 g rms. for 2 minutes

RANDOM

Y AXIS

| FREQUENCY (Hz) | TEST LEVEL |
|----------------|-------------------------|
| 20 - 100 | +6 dB |
| 100 - 200 | 0.7 g ² / Hz |
| 200 - 400 | 0.1 g ² / Hz |
| 400 - 2000 | -6 dB |

Overall Test Level = 12.0 g rms. for 2 minutes

RANDOM

Z AXIS

| FREQUENCY (Hz) | TEST LEVEL |
|----------------|-------------------------|
| 20 - 100 | +6 dB |
| 100 - 200 | 0.3 g ² / Hz |
| 200 - 2000 | -6 dB |

Overall Test Level = 9.7 g rms. for 2 minutes

3) PRE-TEST ACCELEROMETER VERIFICATION

Control System:

The calibrated control accelerometer (Endevco Type 7254A-10 (9.85mV/g) Serial No. 11630) was fastened onto the head of the LDS 954 shaker.

At a Frequency of 44.226 Hz with a displacement of 0.1 inches peak to peak, thus acceleration of 10 g peak the response of the auxiliary accelerometers were recorded.

Also a 10 – 2000 Hz Sine Sweep run at 0.5 g at 2 octaves per minute was carried out to check the response of the accelerometers. Plots of the above runs are available for inspection, although not included in this report.

Auxiliary Accelerometers: -

ENDEVCO TRIAXIAL 2258AM2-10 Serial No. 10427

| SERIAL NUMBER | CALIBRATION mV/g | Date | SIGNAL CONDITIONER |
|----------------------|-------------------------|-------------|---------------------------|
| 10427 X | 9.84 | 22/01/02 | DYTRAN |
| 10427 Y | 9.90 | 22/01/02 | MODEL E4121 |
| 10427 Z | 9.83 | 22/01/02 | SERIAL No. 225 |

ENDEVCO 7250A-10

| SERIAL NUMBER | CALIBRATION mV/g | Date | SIGNAL CONDITIONER |
|----------------------|-------------------------|-------------|---------------------------|
| CNO5 | 10.58 | 05/03/02 | DYTRAN |
| CN10 | 10.00 | 05/03/02 | MODEL E4121 |
| CY25 | 9.96 | 29/05/01 | SERIAL No. 225 |
| | | | |

Control Accelerometer : Endevco Type 7254A-10 (9.85 mV/g) Serial No. 11630
Next Calibration due: 29/05/02

Signal Conditioner: Dytran model E4121 Serial No. 225
Next Calibration due: 16/07/02

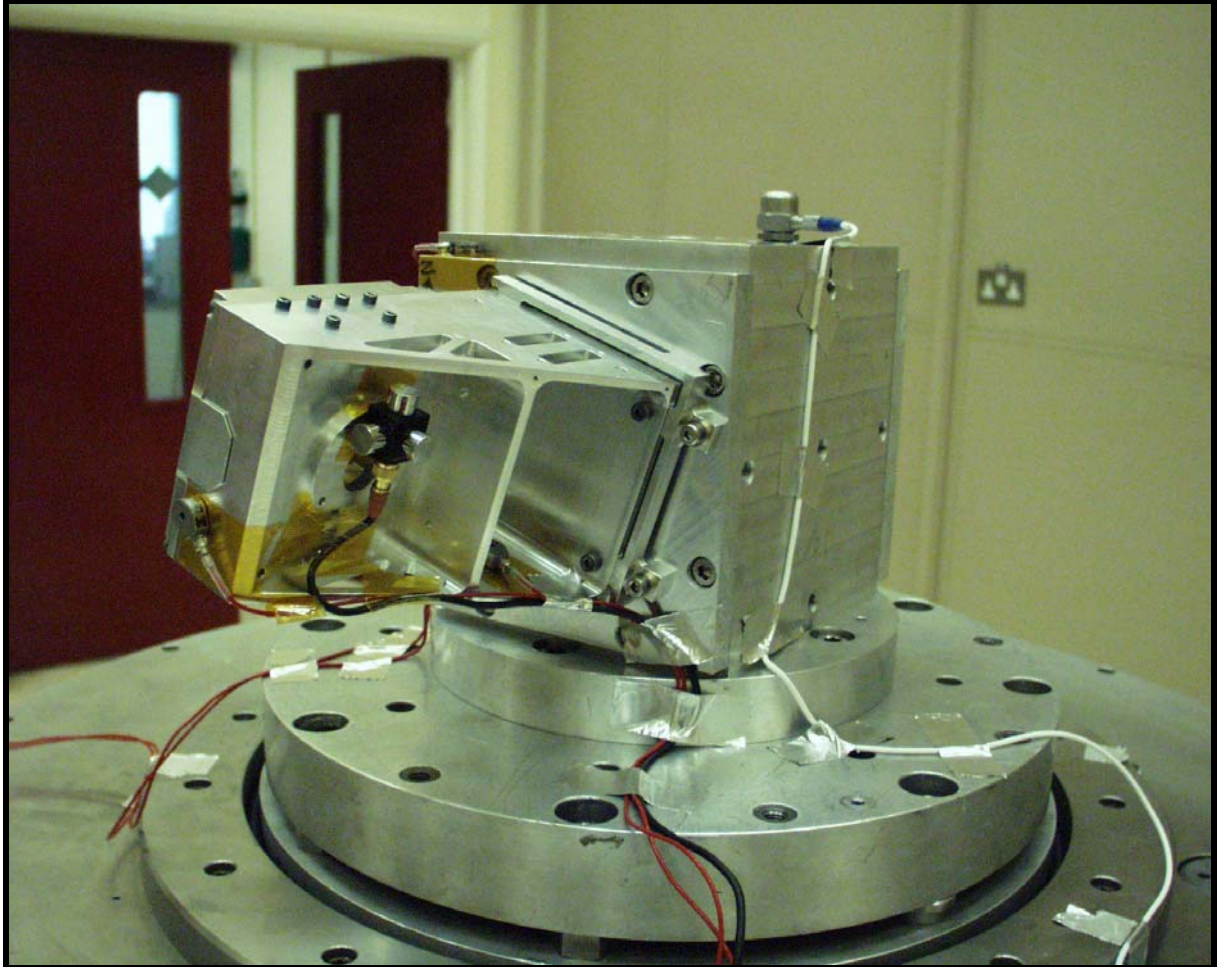
4) CLEANLINESS

Approved cleanroom gloves to be worn when handling the test items.

5) FIXTURE DETAILS

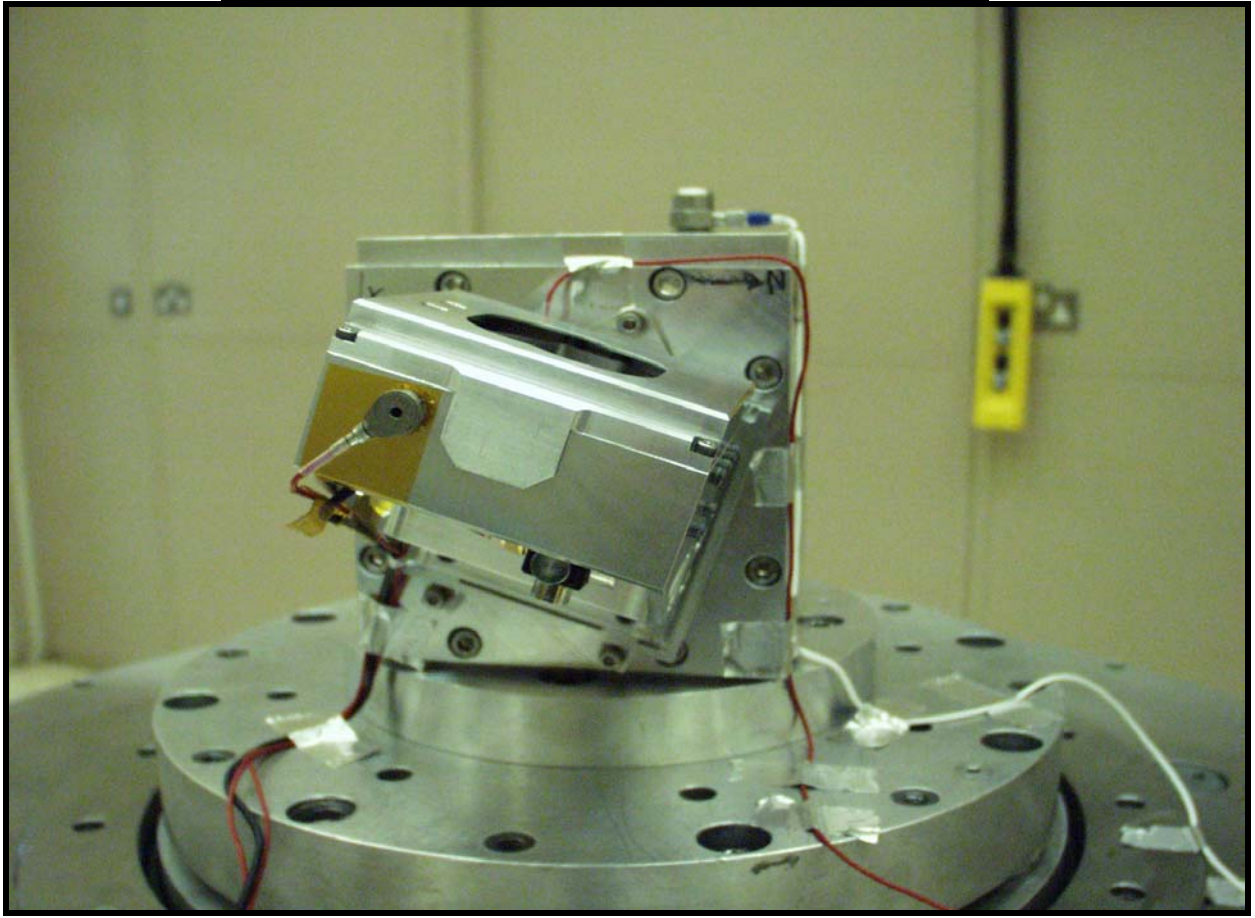
BSM

Z AXIS VIBRATION TEST CONFIGURATION

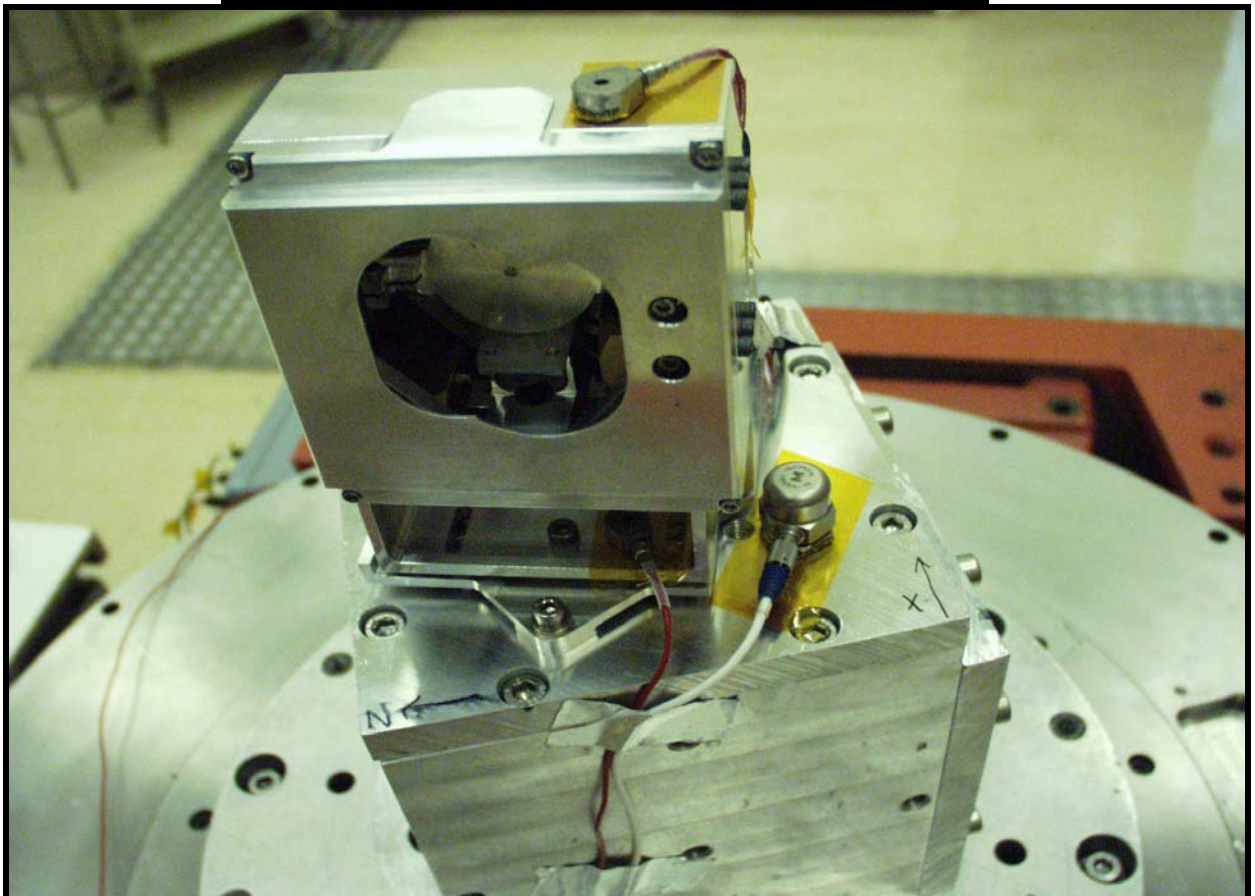


A view of the test item mounted on its vibration fixture.

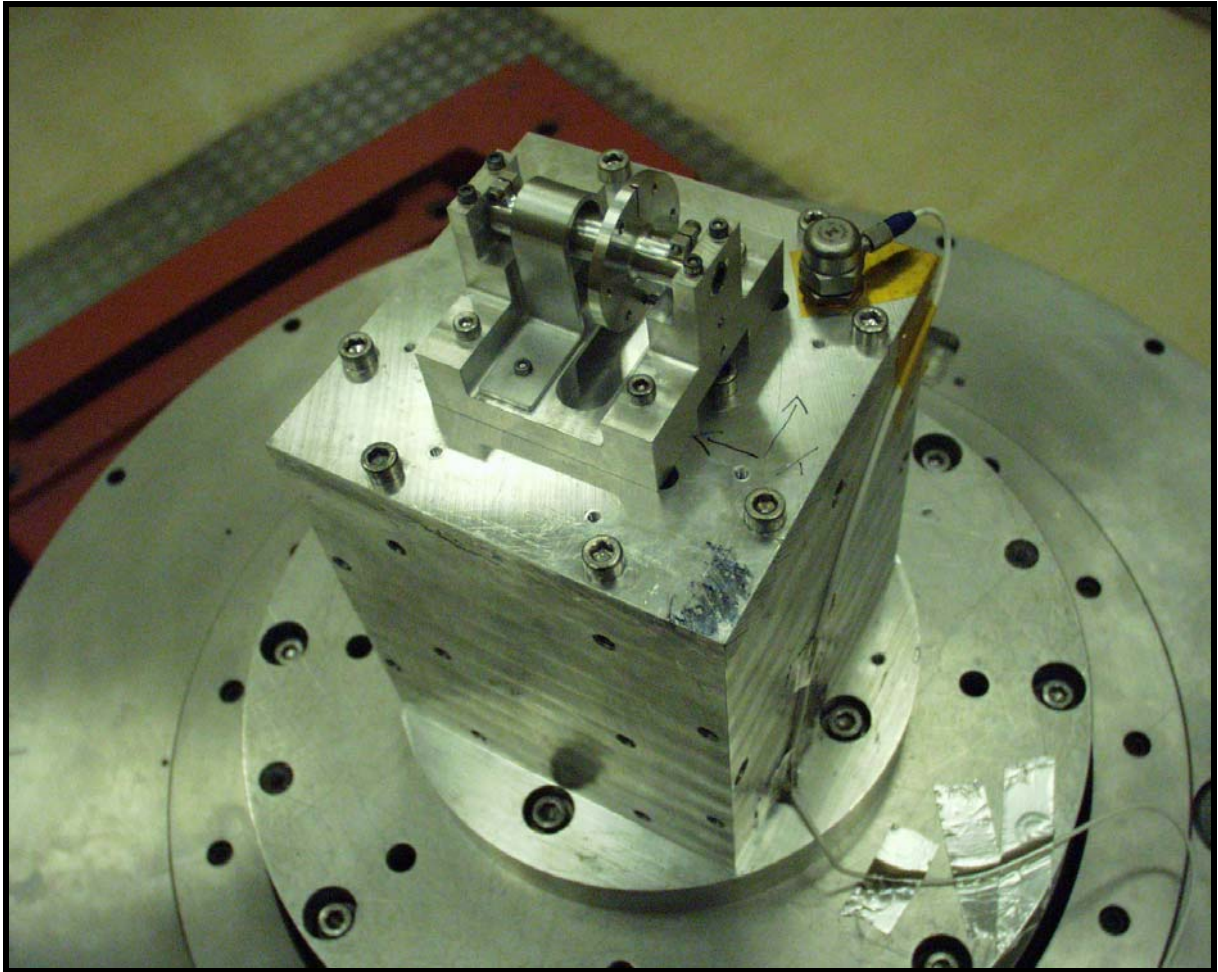
X AXIS VIBRATION TEST CONFIGURATION



Y AXIS VIBRATION TEST CONFIGURATION



BSM Flex Pivot Up-screening Rig
Y AXIS VIBRATION TEST CONFIGURATION



6) TEST SUMMARY

Test Date: 24 April 2002

Observer: Ian Pain

Organisation : UK Astronomy Technology Centre
Royal Observatory
Blackford Hill
Edinburgh
EH9 3HJ

CHANNEL ALLOCATION:

CONTROL:-

| Channel No. | Accelerometer Type/Serial No. | Testing Axis | Mounting Position |
|--------------------|--------------------------------------|---------------------|--------------------------|
| 1 | Endevco 11630 | In Axis | Fixture |

MONITORING:-

| Channel No. | Accelerometer Type/Serial No. | Testing Axis | Mounting Position |
|--------------------|--------------------------------------|---------------------|--------------------------|
| 2 | Endevco 10427 X | Y | PCAL Mount |
| 3 | Endevco 10427 Y | Z' | PCAL Mount |
| 4 | Endevco 10427 Z | X' | PCAL Mount |
| 5 | Endevco CN05 | Y | Structure Top |
| 6 | Endevco CN10 | Z' | Structure Bottom |
| 7 | Endevco CY25 | Y | Thermometer Mount |
| | | | |

NOTE

Where the testing axis has been defined as X' or Z' this indicates the accelerometer is not fully aligned in the true X or Z-axis.

ACCELEROMETER TEST PLOTS

BSM

VIBRATION TESTS in the Z-axis

RUN 00002 SINE SURVEY FIG 1ab

RUN 00002 SINE SWEEP FIG 2ab

RUN 00003 POST SINE SWEEP SINE SURVEY FIG 3ab

RUN 00003 RANDOM FIG 4ab

RUN 00004 POST RANDOM SINE SURVEY FIG 5ab

VIBRATION TESTS in the X-axis

RUN 00005 SINE SURVEY FIG 6ab

RUN 00003 SINE SWEEP FIG 7ab

RUN 00006 POST SINE SWEEP SINE SURVEY FIG 8ab

RUN 00002 RANDOM FIG 9ab

RUN 00007 POST RANDOM SINE SURVEY FIG 10ab

VIBRATION TESTS in the Y-axis

RUN 00008 SINE SURVEY FIG 11ab

RUN 00003 SINE SWEEP FIG 12ab

RUN 00009 POST SINE SWEEP SINE SURVEY FIG 13ab

RUN 00002 RANDOM FIG 14ab

RUN 00010 POST RANDOM SINE SURVEY FIG 15ab

BSM Flex Pivot Up-screening Rig

RUN 00004 SINE SWEEP FIG 16

7) CONCLUSION

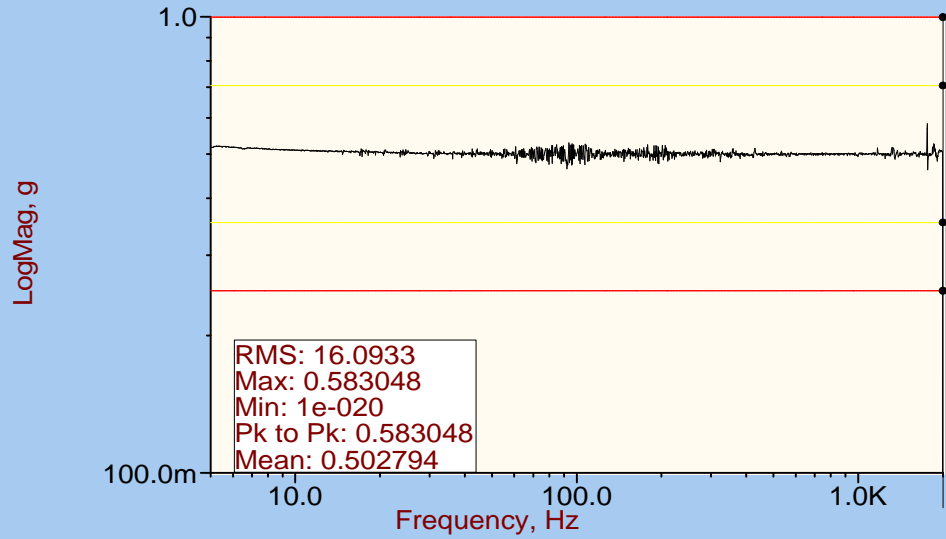
The test items were subjected to the Qualification levels of vibration as specified by ref. SPU-BSM-DOC-0008 Appendix B dated 31/10/01. No visible damage occurred to the BSM. The BSM Flex Pivot Up-screening Rig was examined after the Y-axis Sine Sweep and was found to have suffered damage to one of its flex pivots.

FACILITY OPERATOR: -

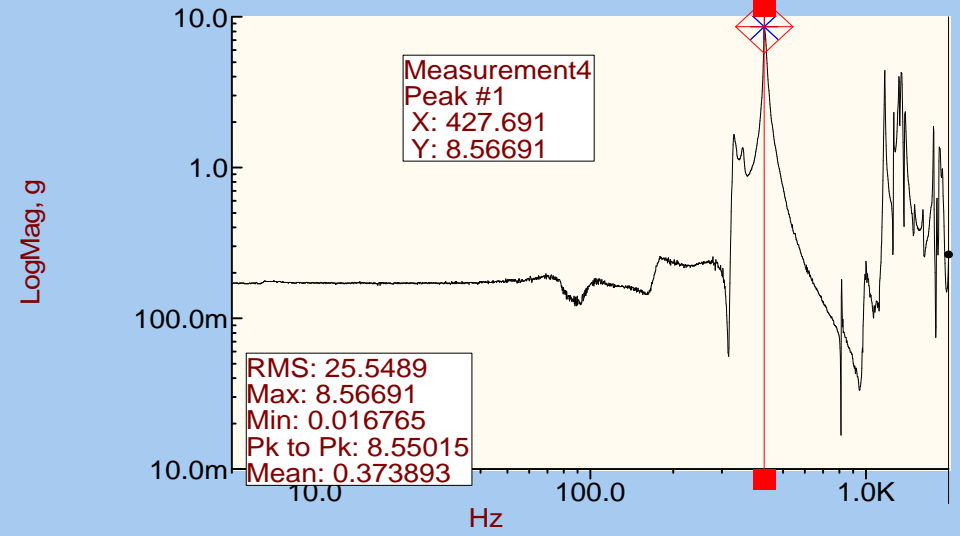
FACILITY MANAGER:-

ANNEX:A ACCELEROMETER PLOTS

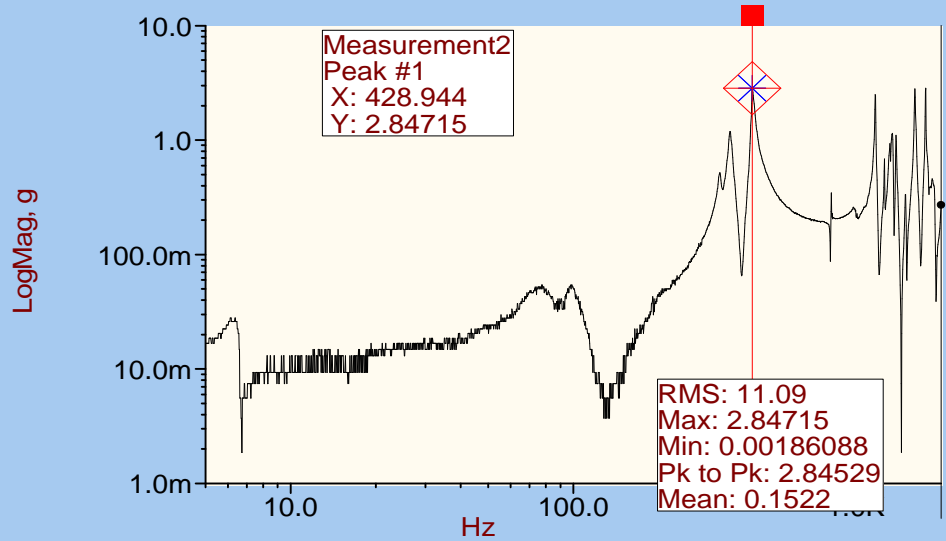
Control;AlarmLow;AlarmHigh;AbortLow;Abo



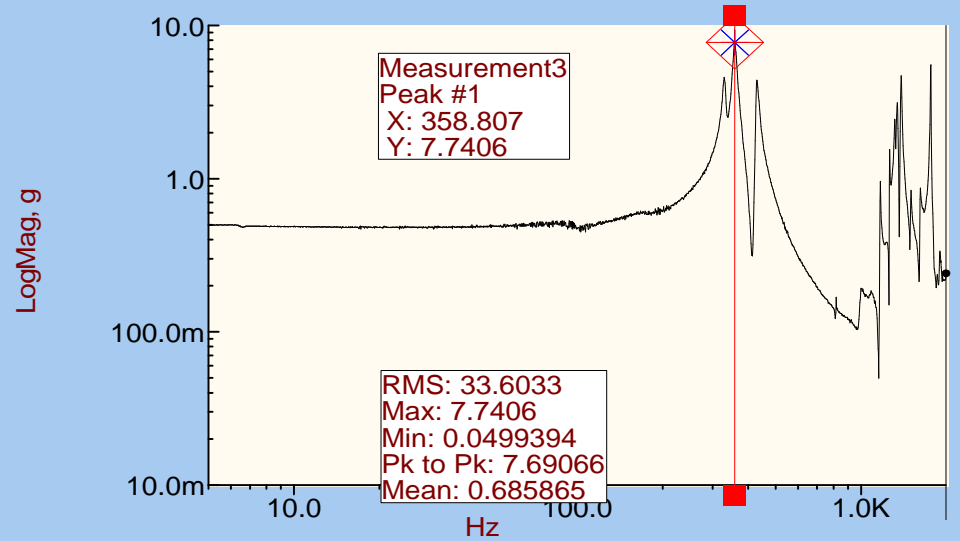
PCAL MOUNT X' AXIS



PCAL MOUNT Y AXIS



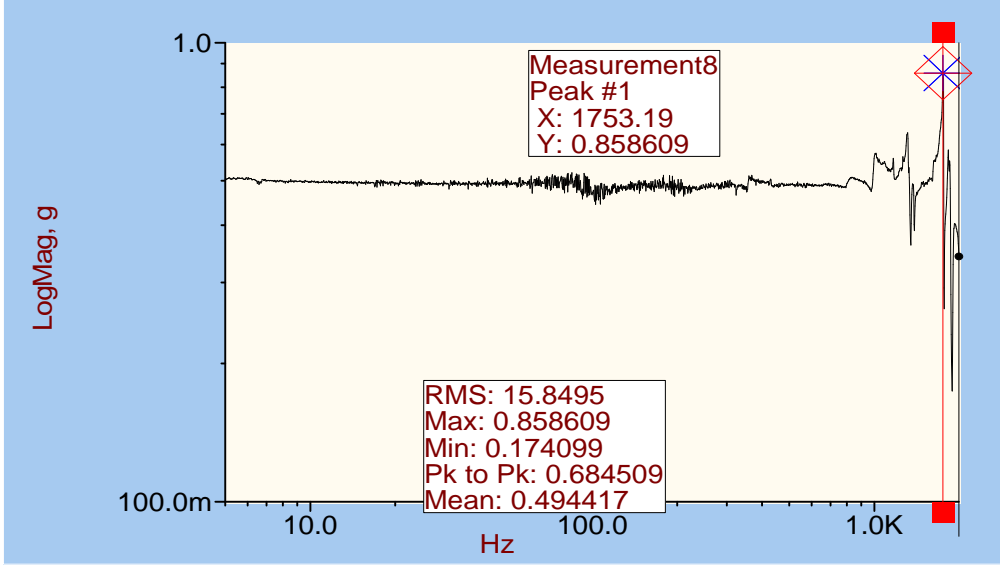
PCAL MOUNT Z' AXIS



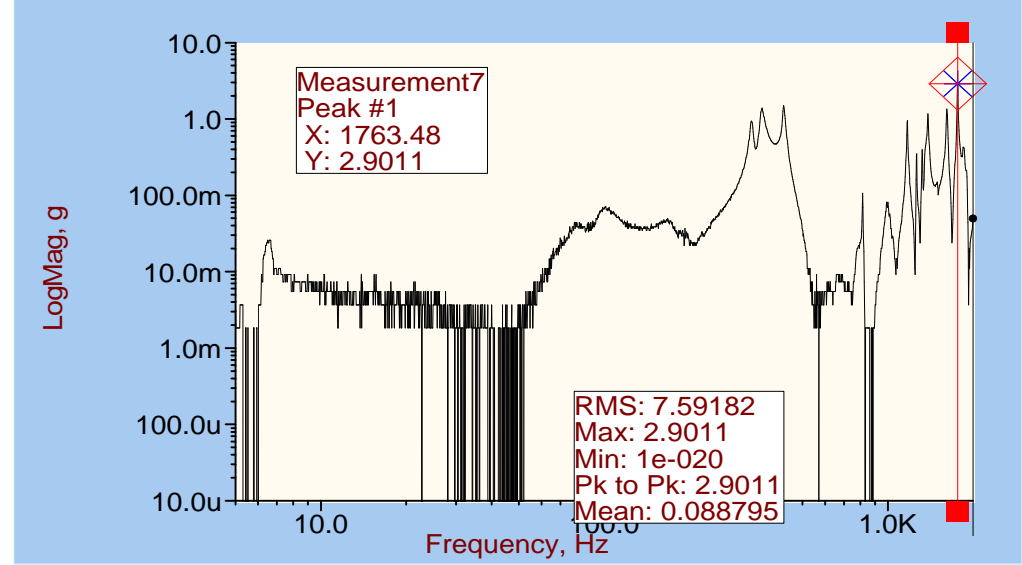
SPIRE- BEAM STEERING MIRROR SINE SURVEY
RUN 00002
Z AXIS
12:00:32 24/04/2002

Fig 1a

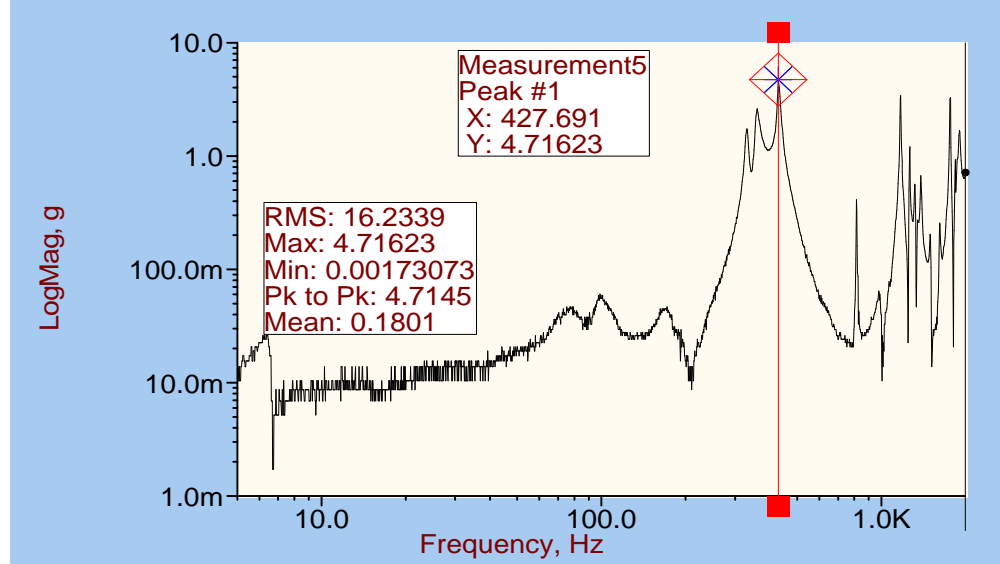
INTERFACE PLATE Z AXIS



THERMOMETER MOUNT Y AXIS



STRUCTURE TOP Y AXIS



STRUCTURE BOTTOM Z' AXIS

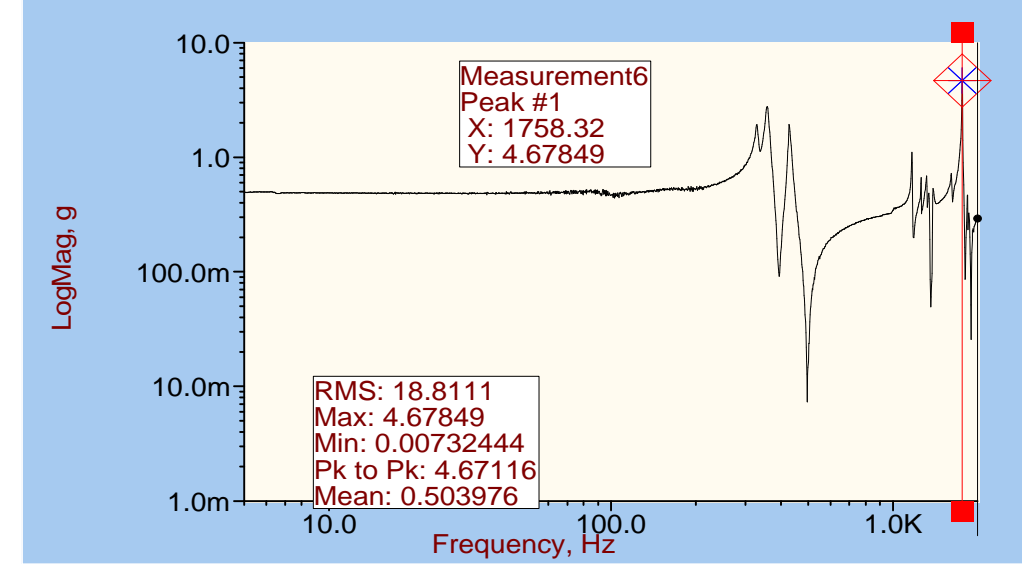
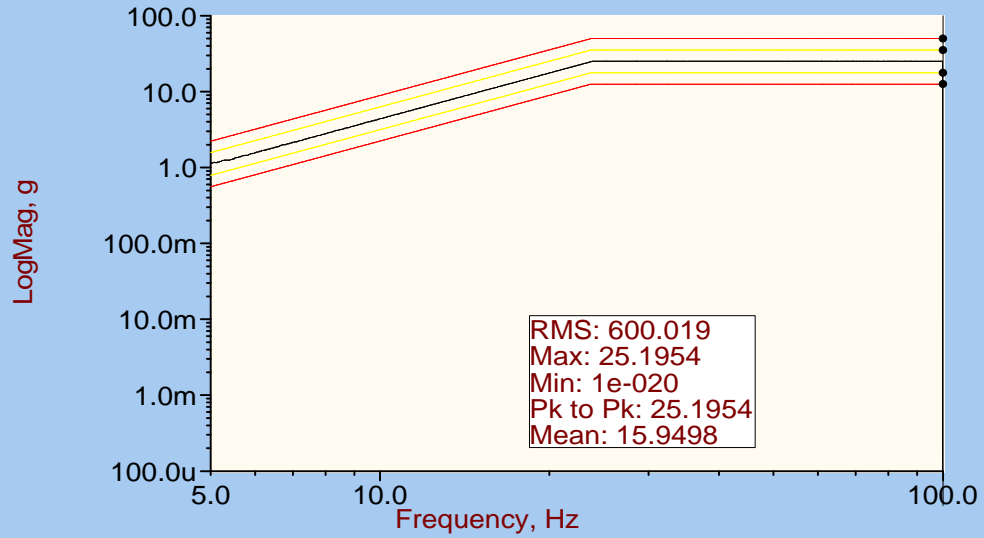
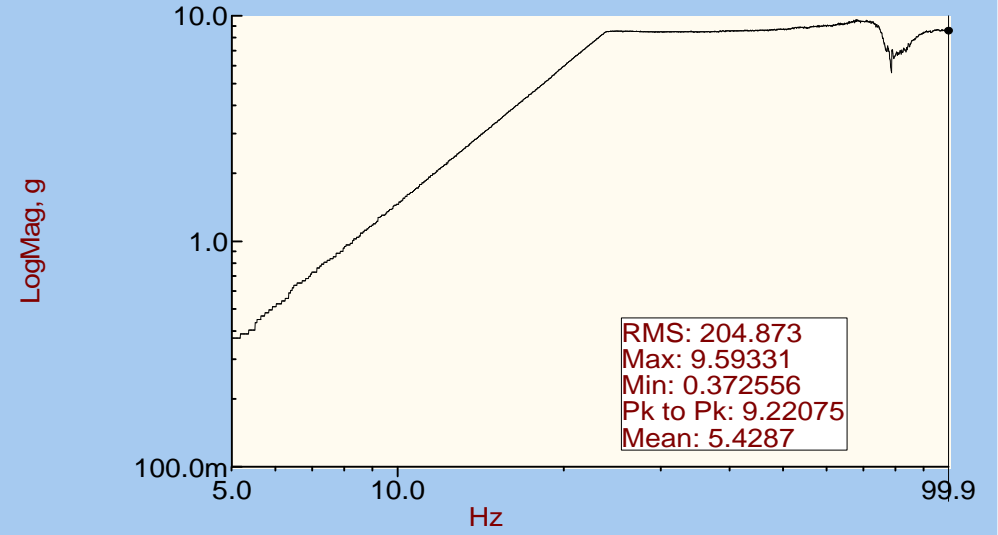


Fig 1b

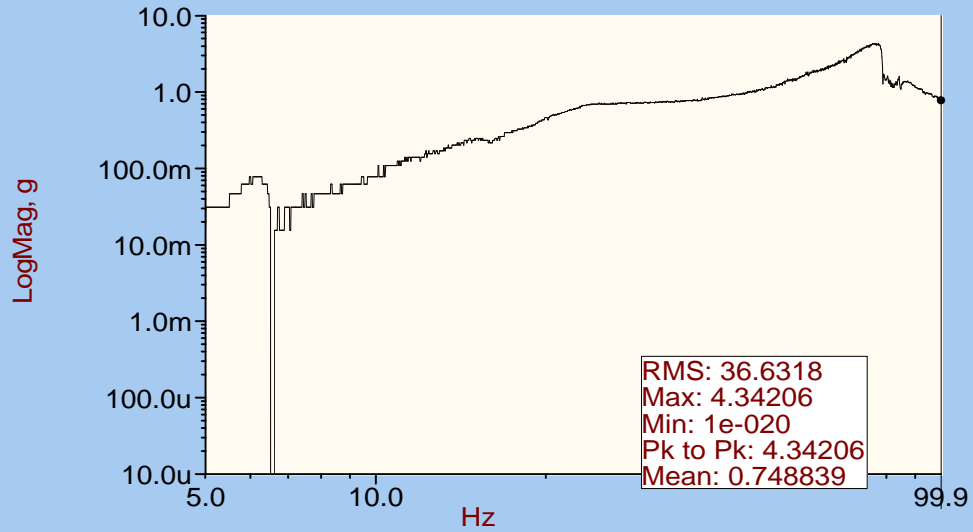
Control;AlarmLow;AlarmHigh;AbortLow;Abo



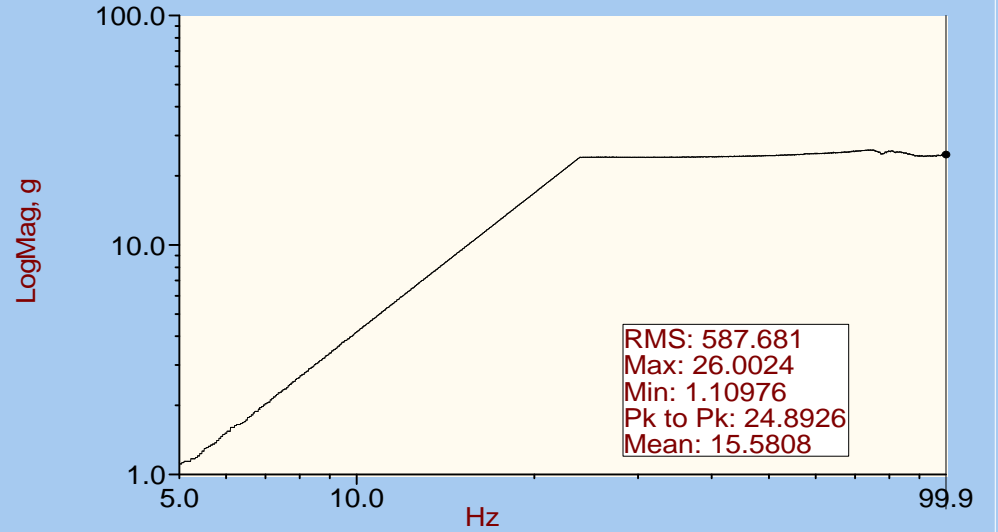
PCAL MOUNT X' AXIS



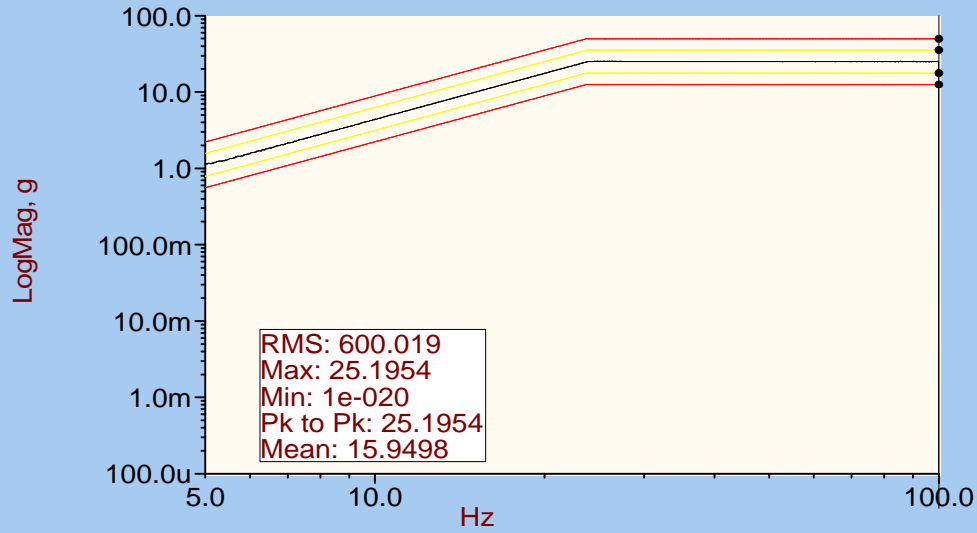
PCAL MOUNT Y AXIS



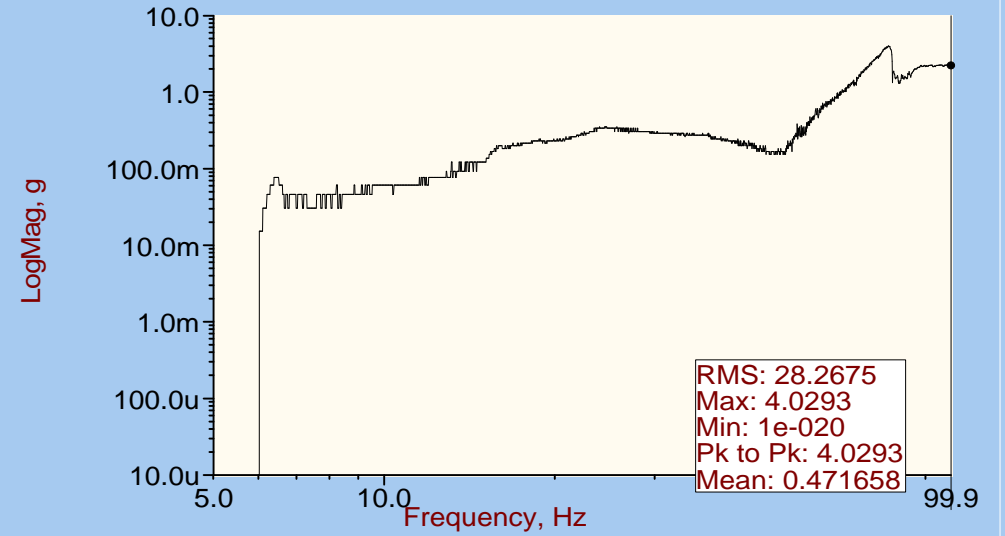
PCAL MOUNT Z' AXIS



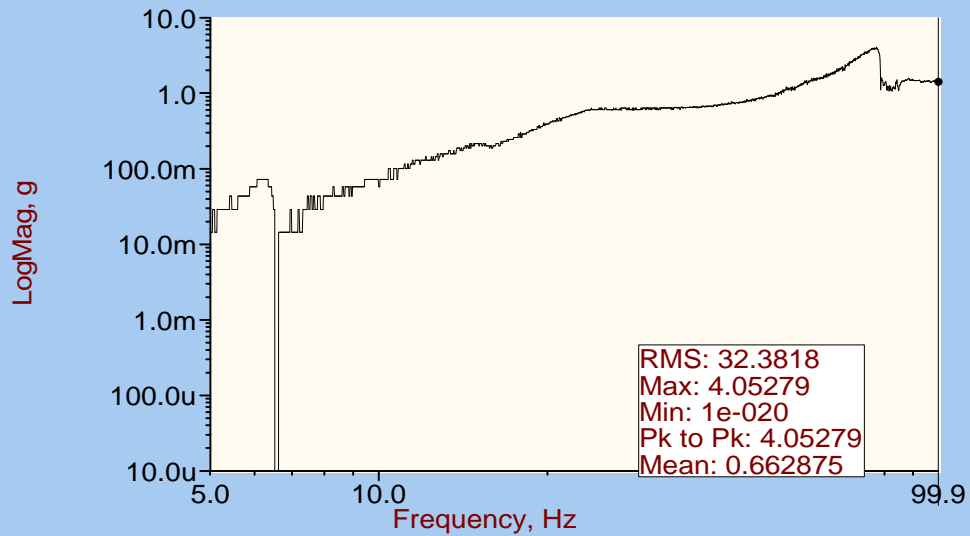
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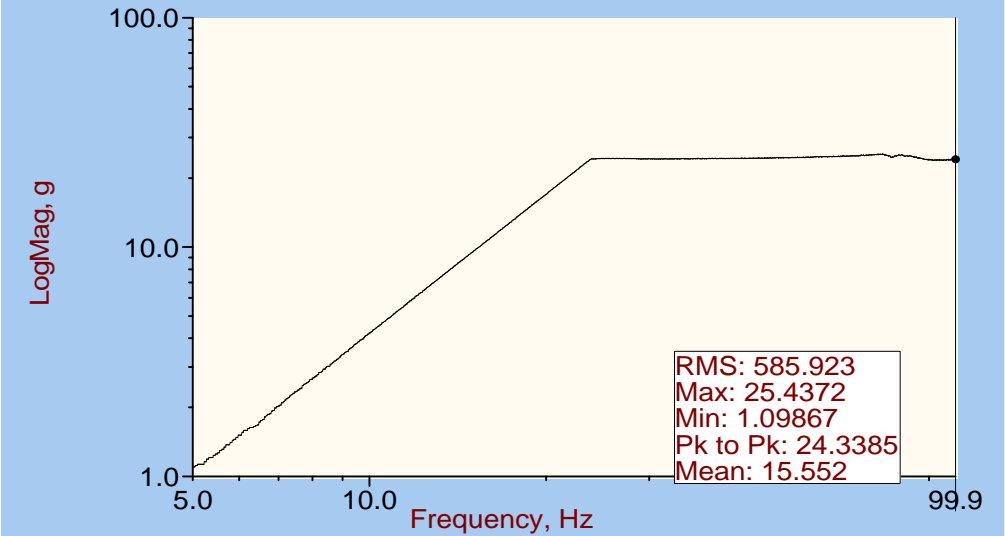
THERMOMETER MOUNT Y AXIS



STRUCTURE TOP Y AXIS



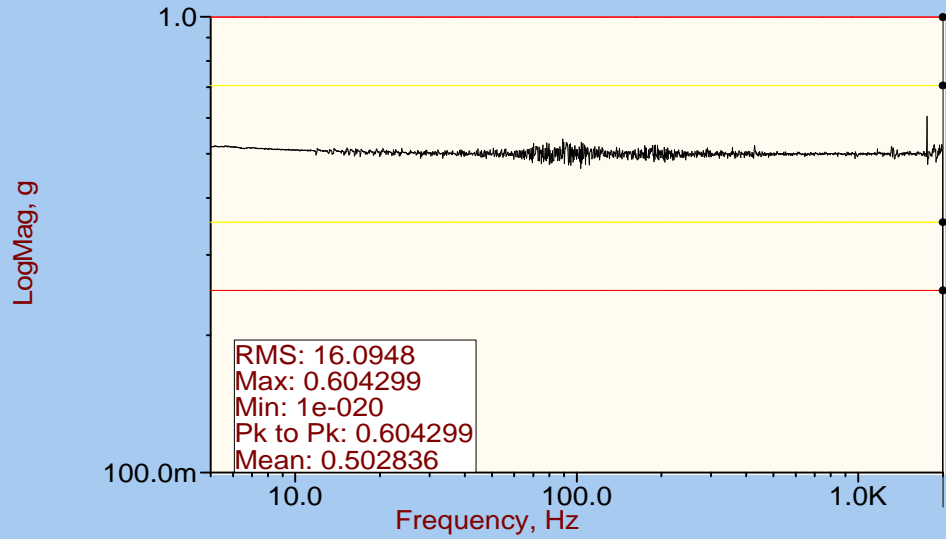
STRUCTURE BOTTOM Z' AXIS



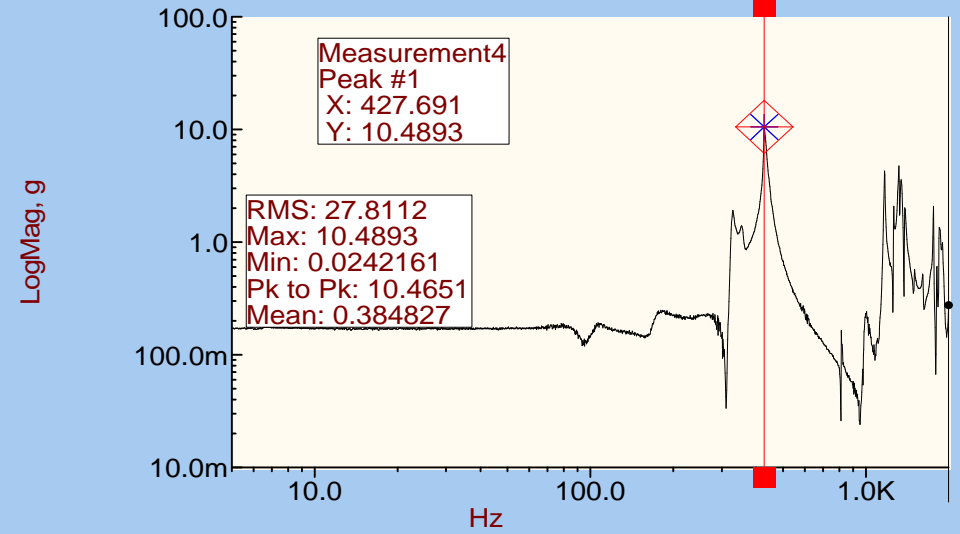
SPIRE- BEAM STEERING MIRROR SINE SWEEP
RUN 00002
Z AXIS
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Fig 2b

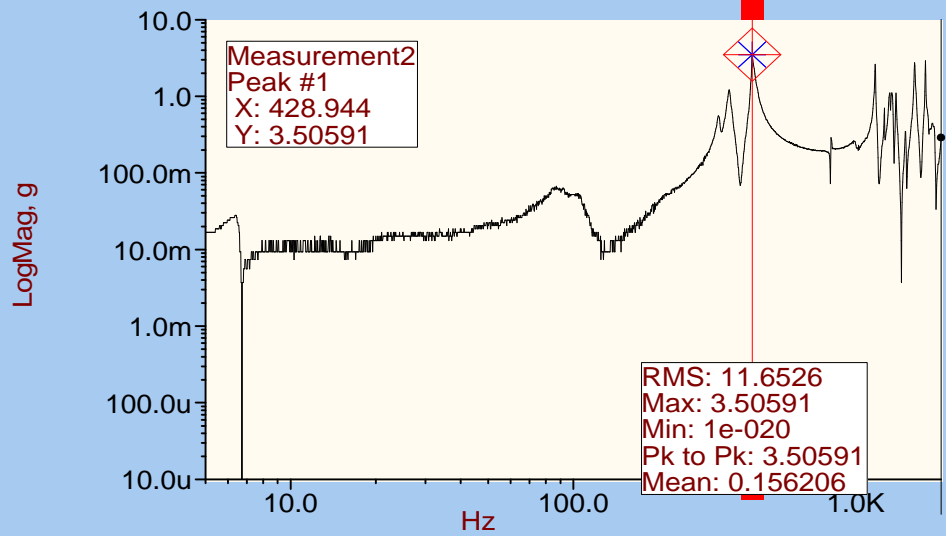
Control;AlarmLow;AlarmHigh;AbortLow;Abo



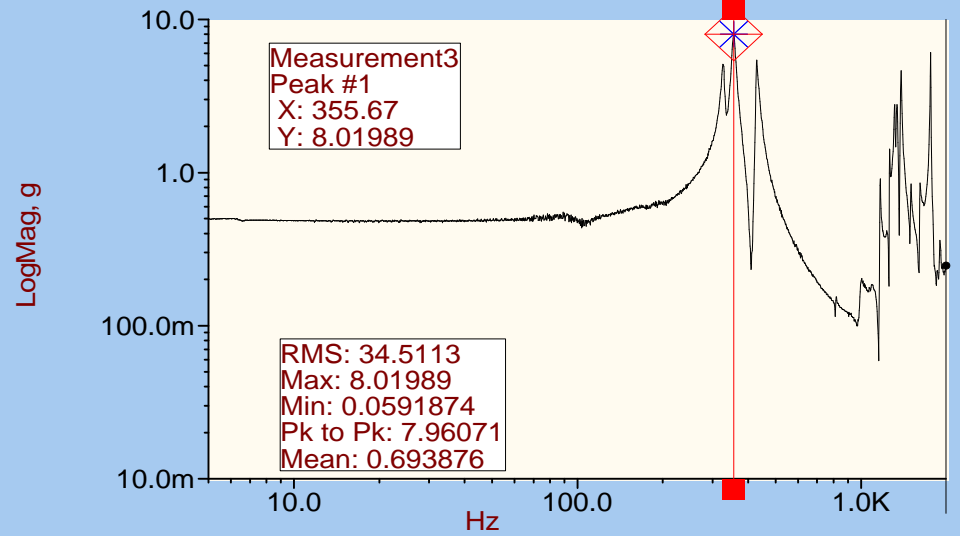
PCAL MOUNT X' AXIS



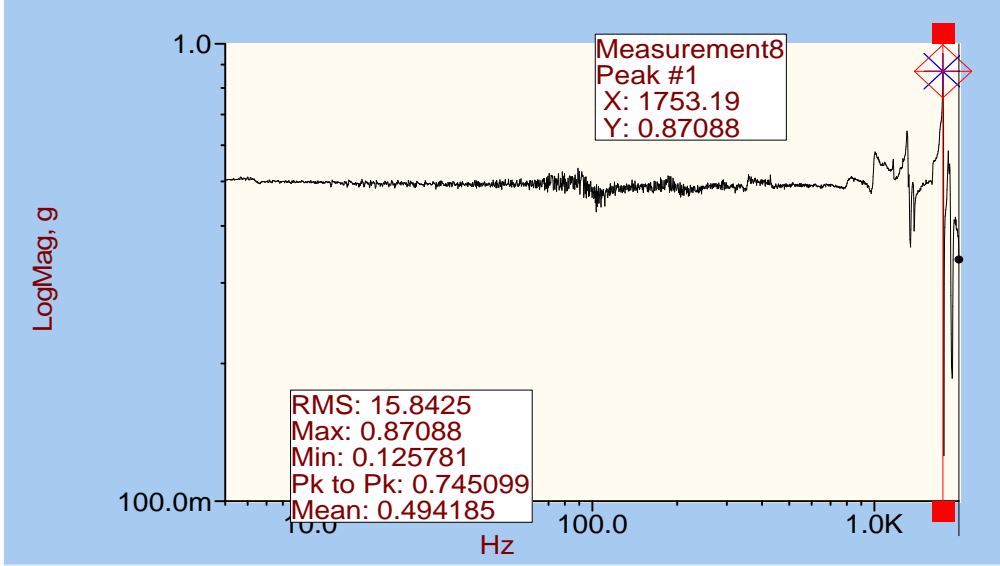
PCAL MOUNT Y AXIS



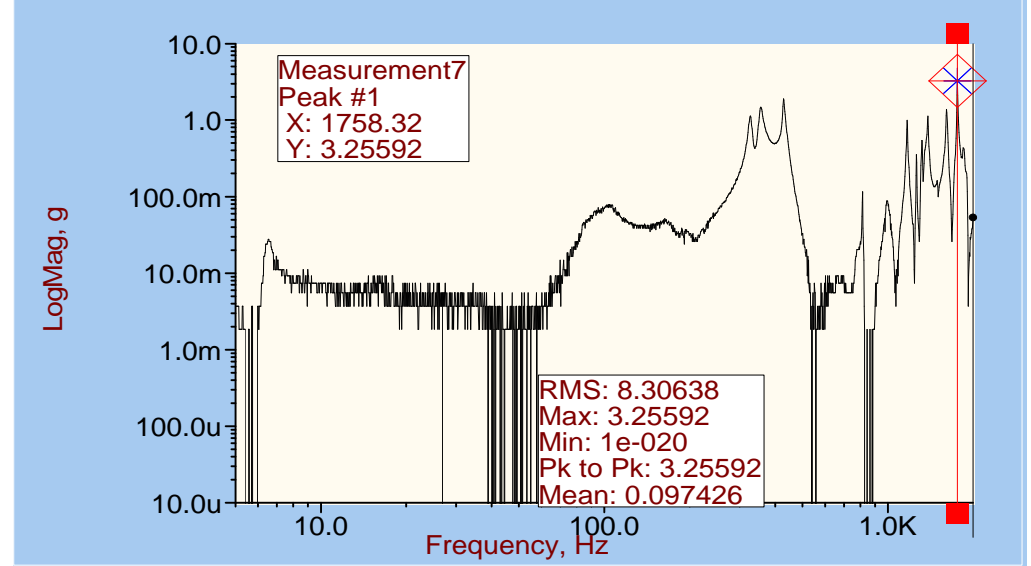
PCAL MOUNT Z' AXIS



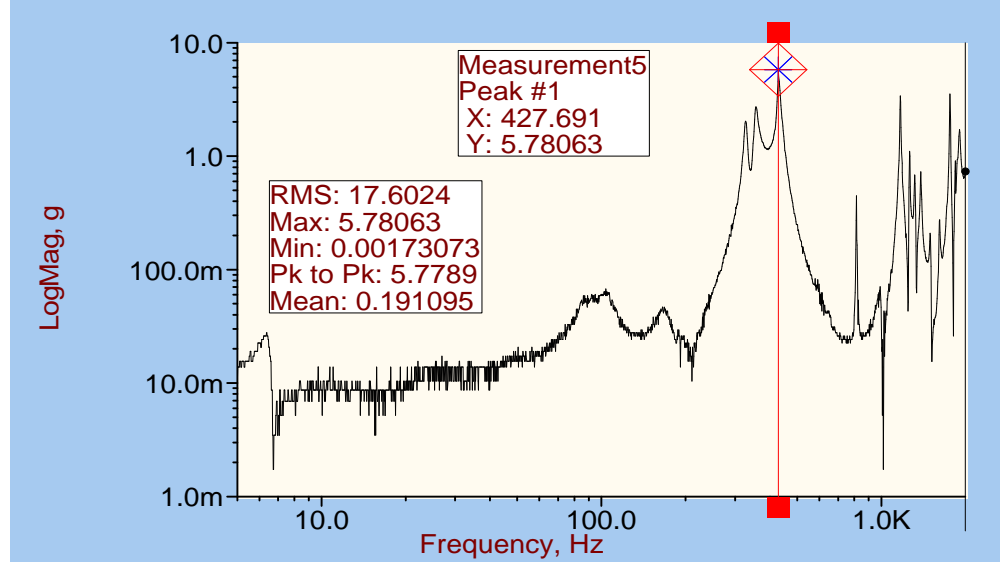
INTERFACE PLATE Z AXIS



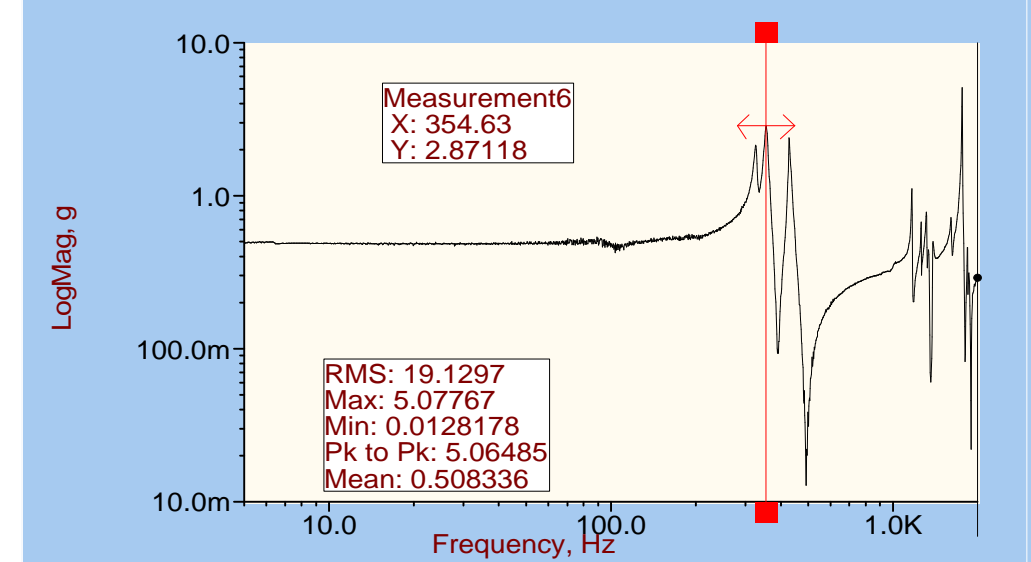
THERMOMETER MOUNT Y AXIS



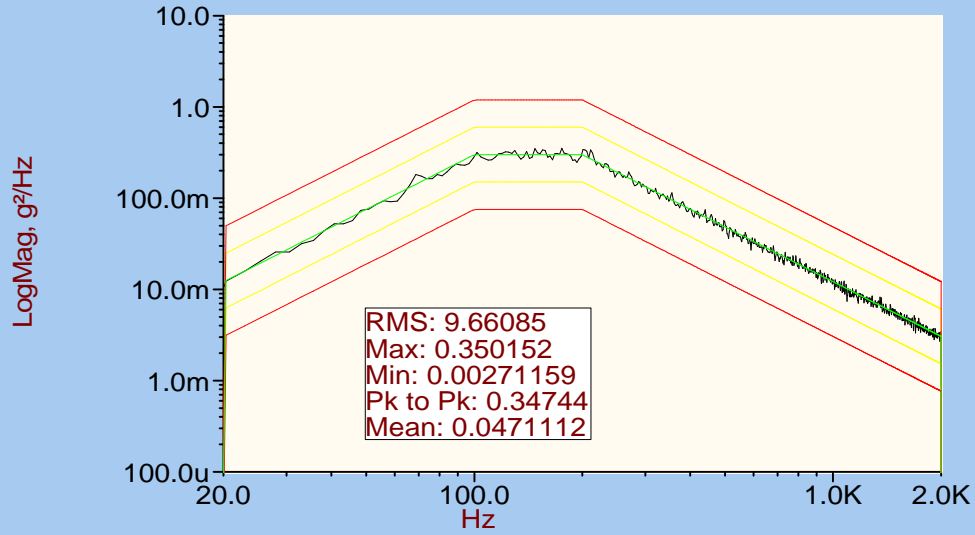
STRUCTURE TOP Y AXIS



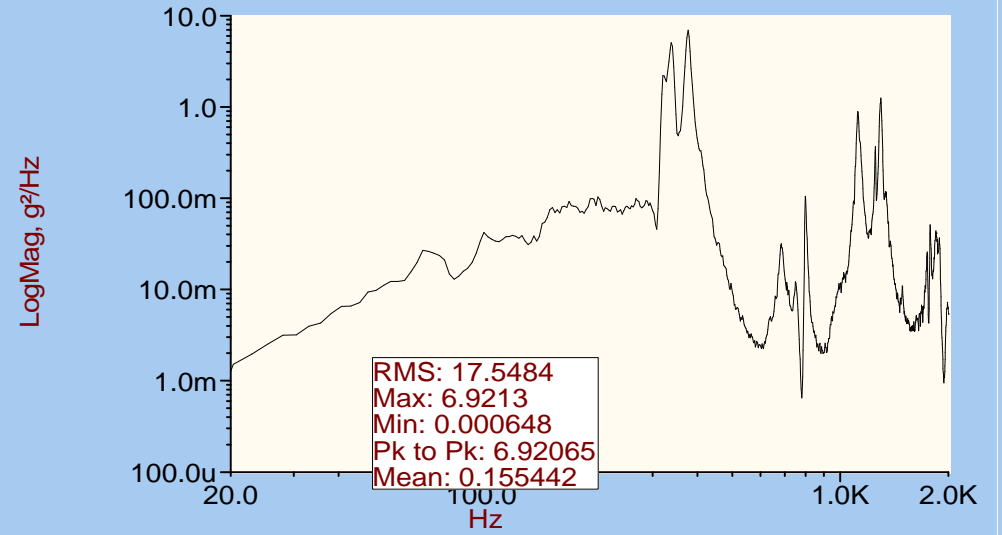
STRUCTURE BOTTOM Z' AXIS



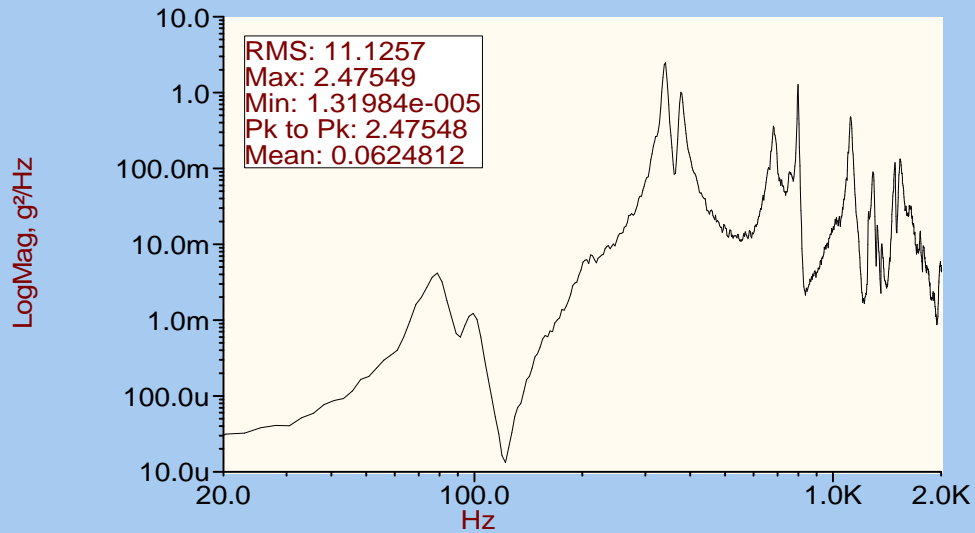
Control;AlarmLow;AlarmHigh;AbortLow;Abo



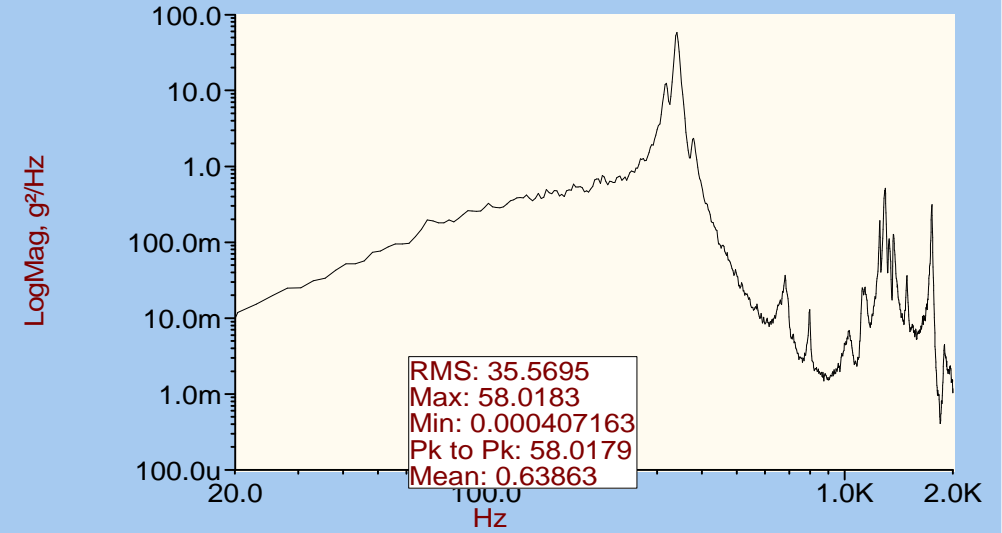
PCAL MOUNT X' AXIS



PCAL MOUNT Y AXIS



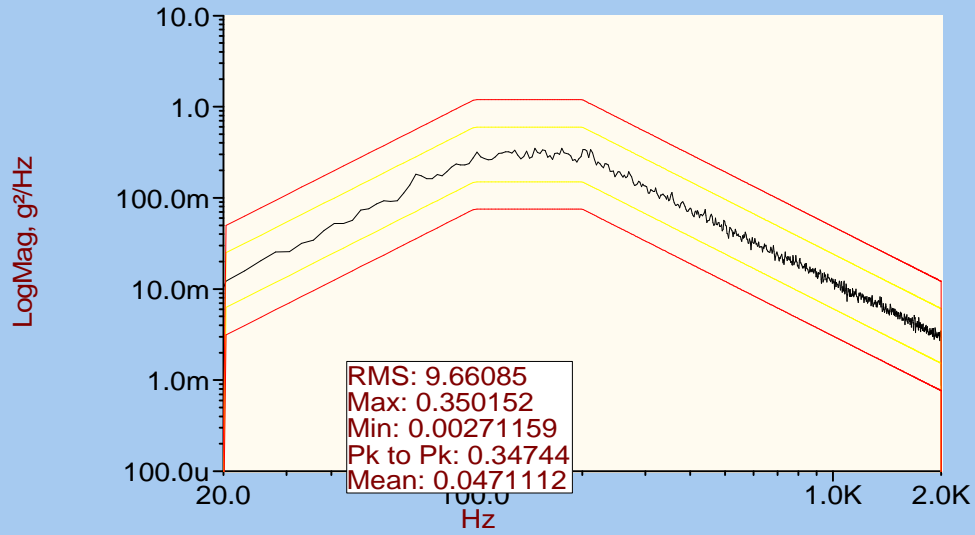
PCAL MOUNT Z' AXIS



SPIRE- BEAM STEERING MIRROR RANDOM
RUN 00003
Z AXIS
12:59:49 24/04/2002

Fig 4a

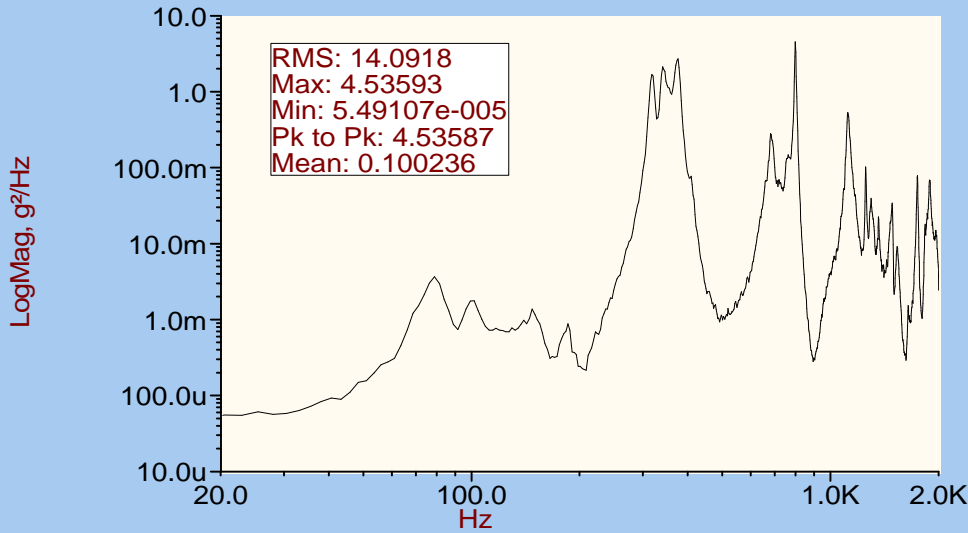
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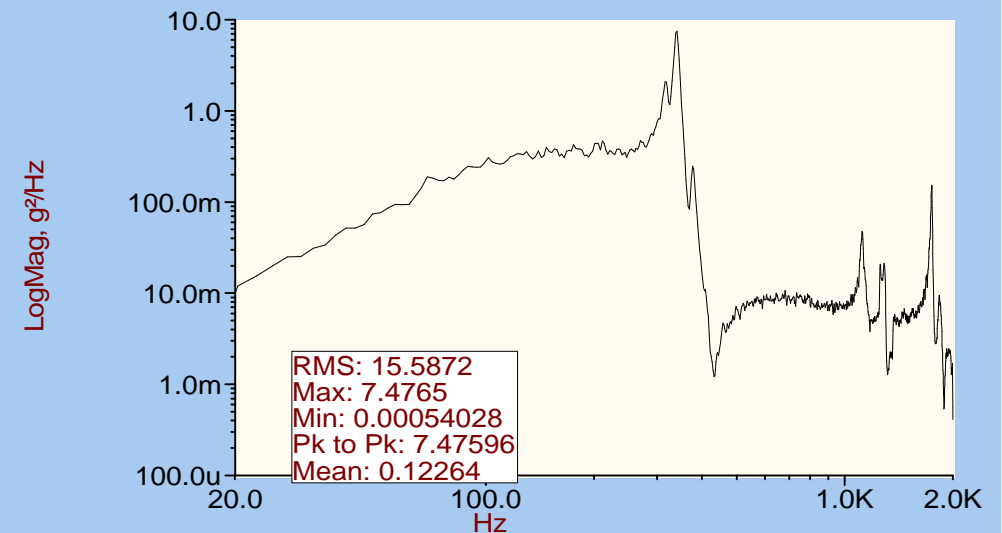
THERMOMETER MOUNT Y AXIS



STRUCTURE TOP Y AXIS



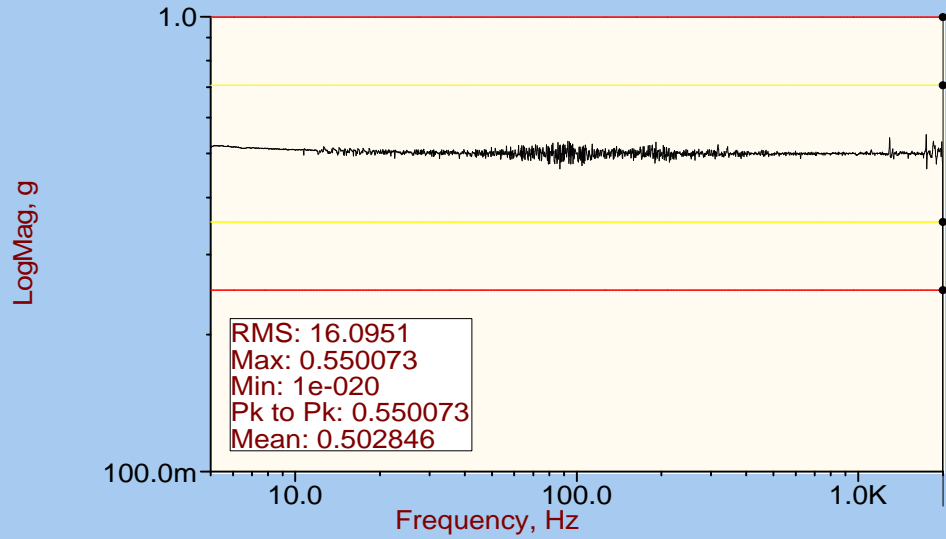
STRUCTURE BOTTOM Z' AXIS



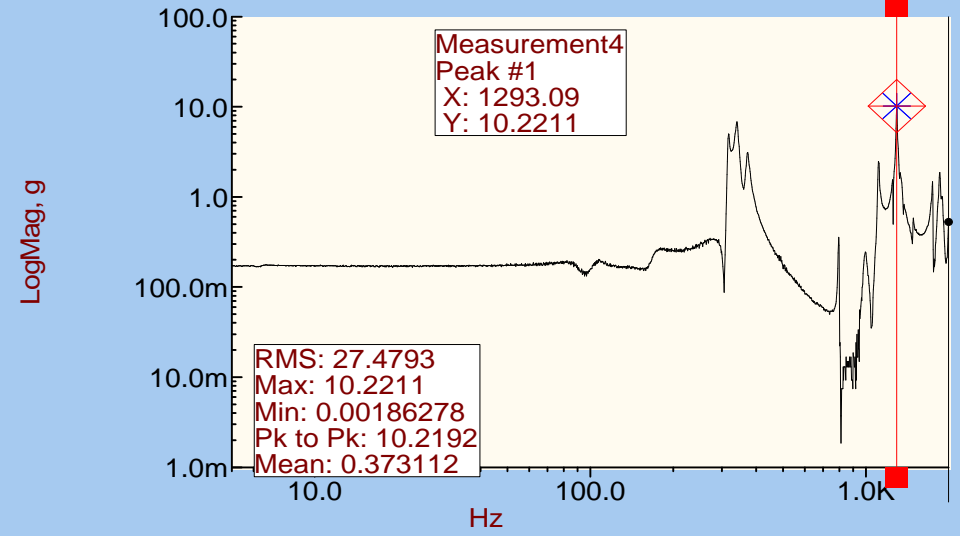
SPIRE- BEAM STEERING MIRROR RANDOM
RUN 00003
Z AXIS
12:59:49 24/04/2002

Fig 4b

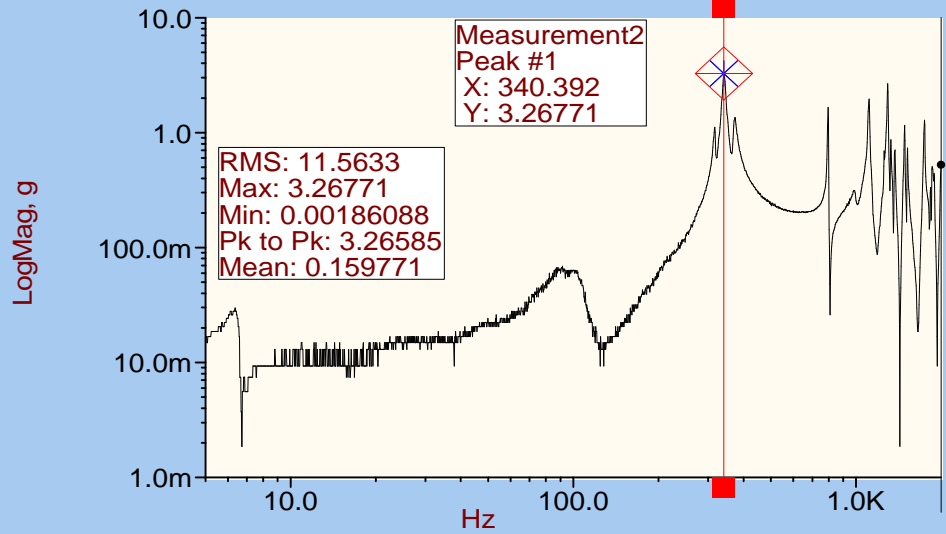
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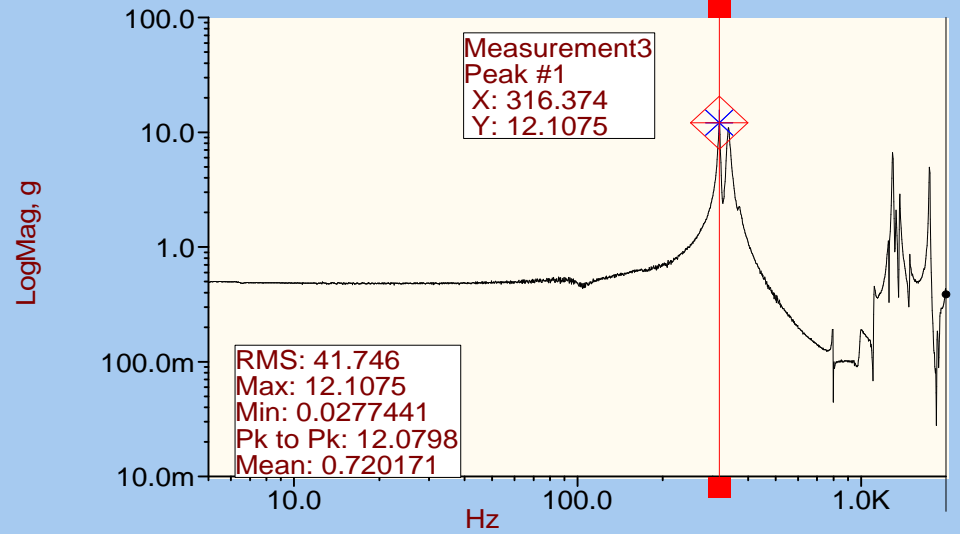
PCAL MOUNT X' AXIS



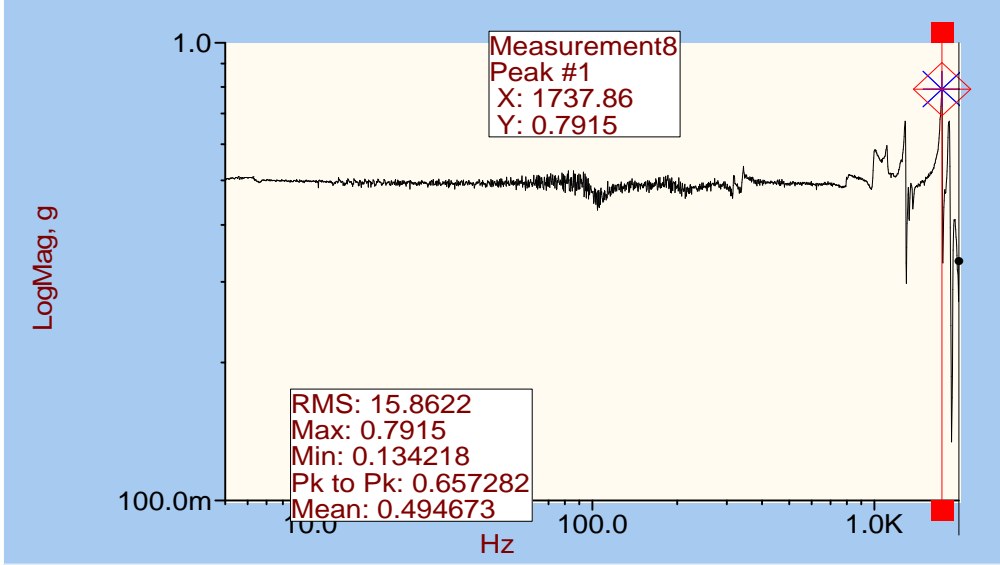
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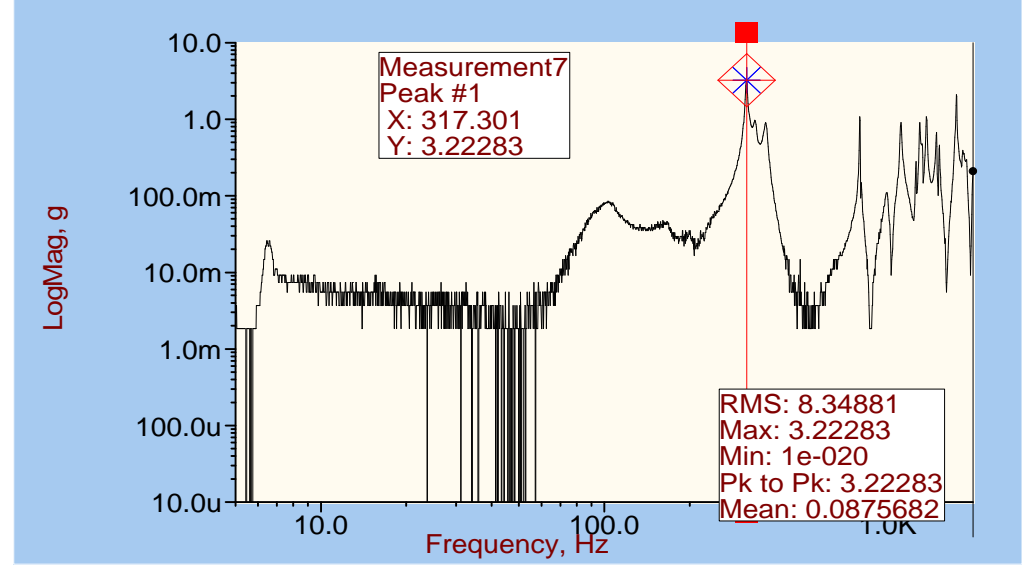
PCAL MOUNT Z' AXIS



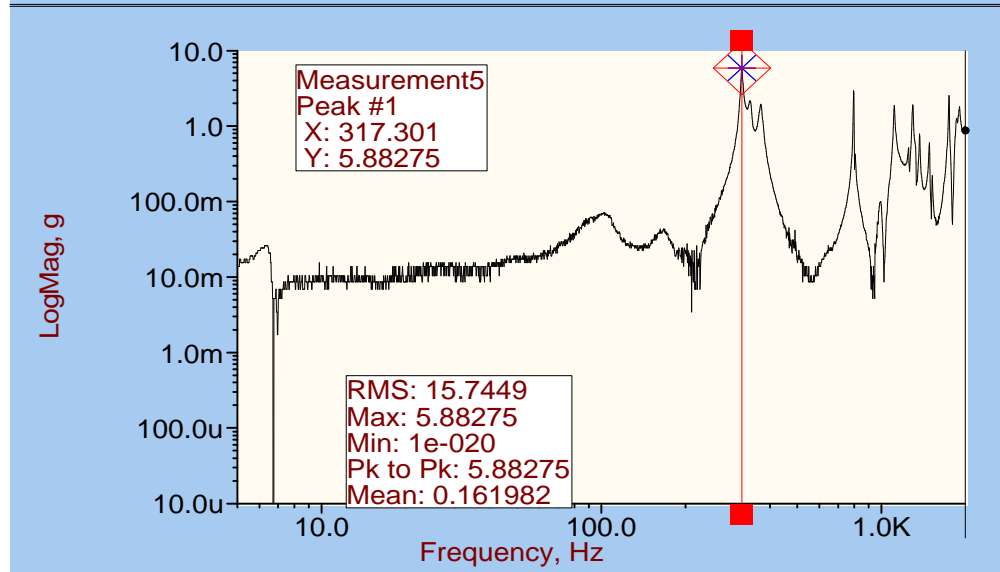
INTERFACE PLATE Z AXIS



THERMOMETER MOUNT Y AXIS



STRUCTURE TOP Y AXIS



STRUCTURE BOTTOM Z' AXIS

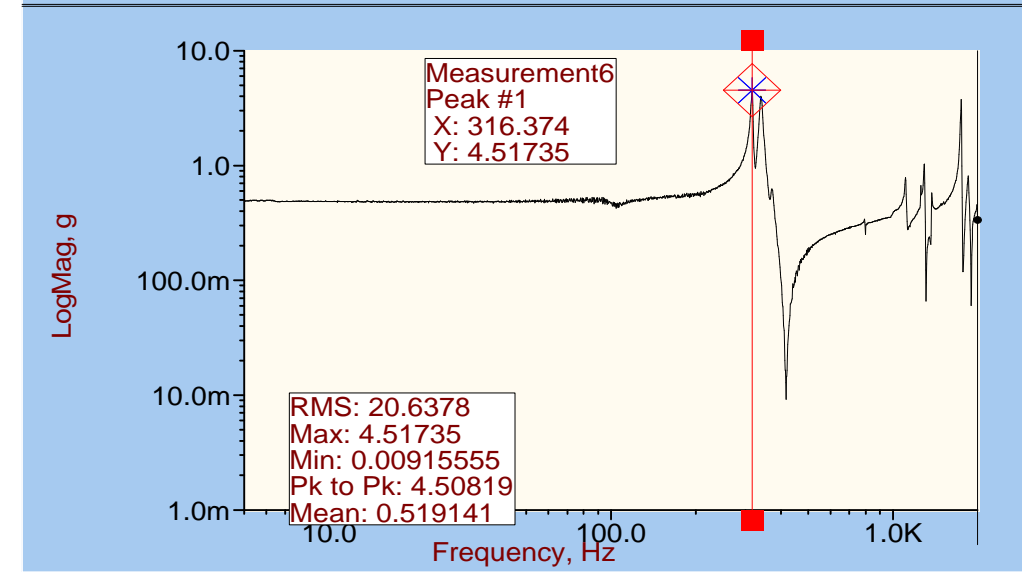
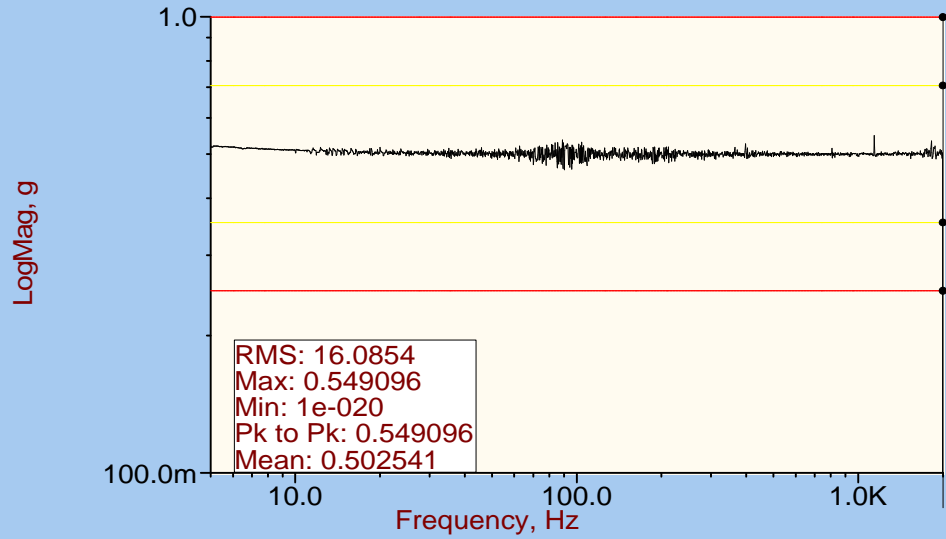
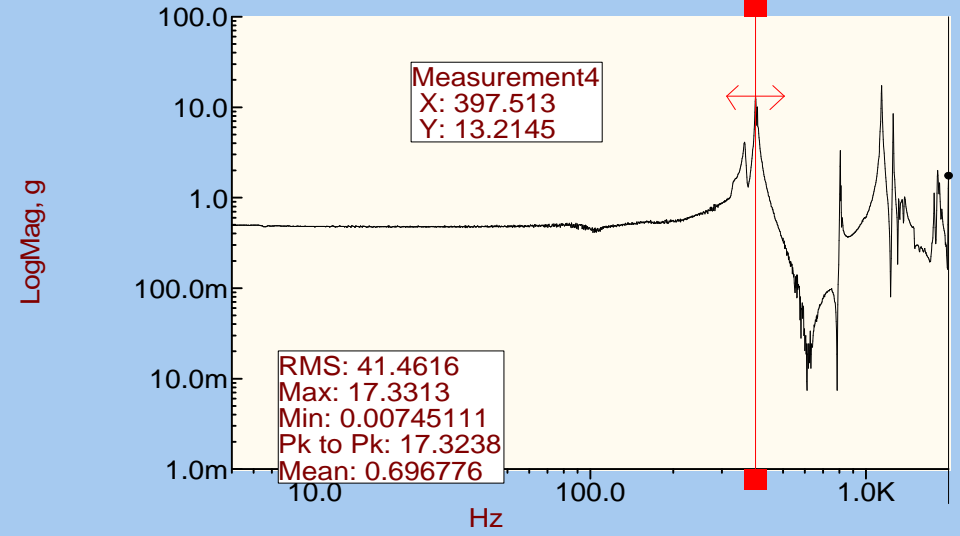


Fig 5b

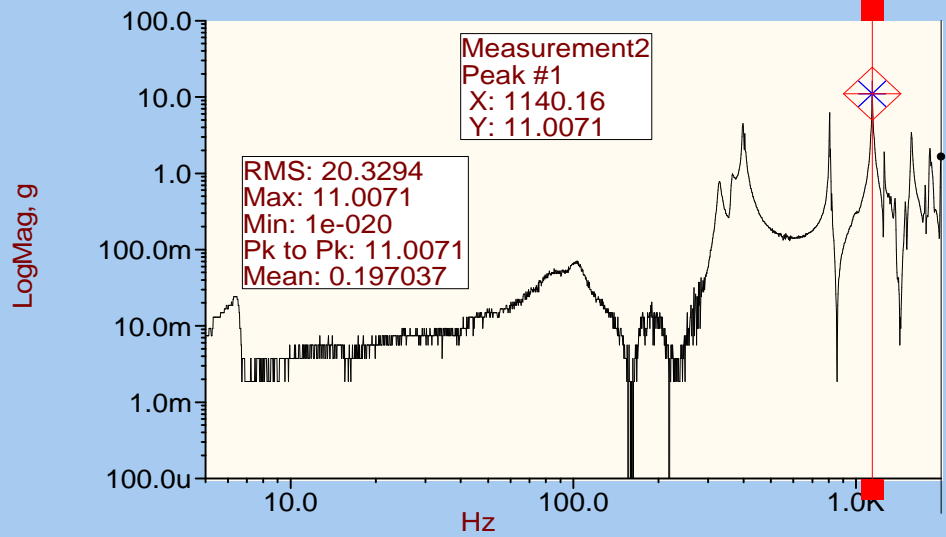
Control;AlarmLow;AlarmHigh;AbortLow;Abo



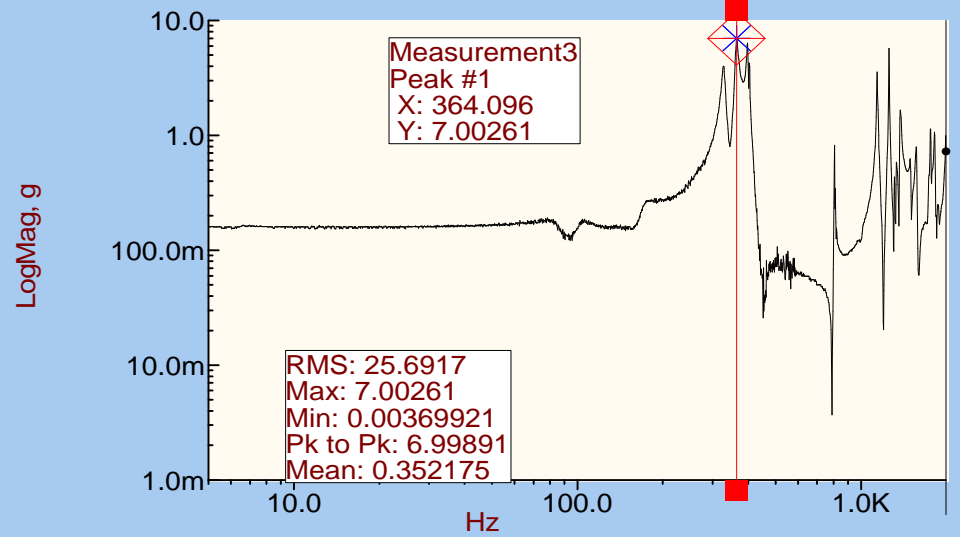
PCAL MOUNT X' AXIS



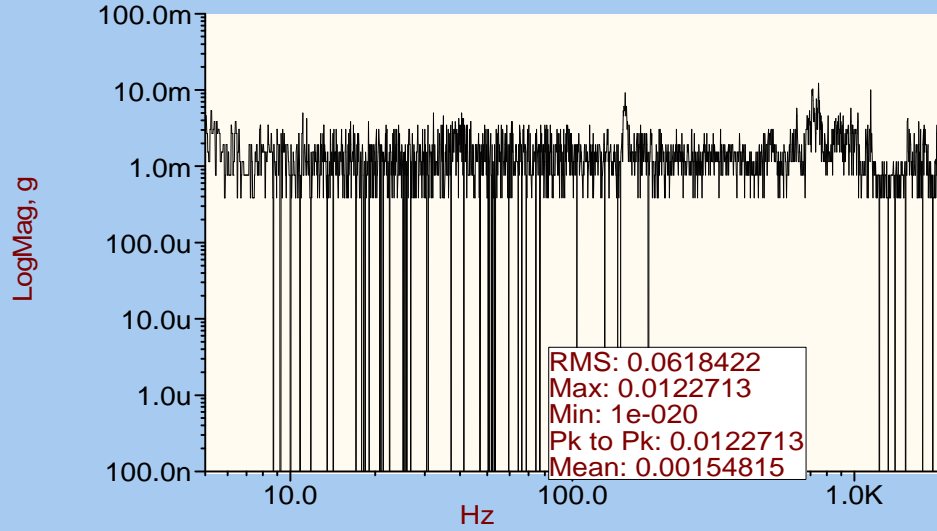
PCAL MOUNT Y AXIS



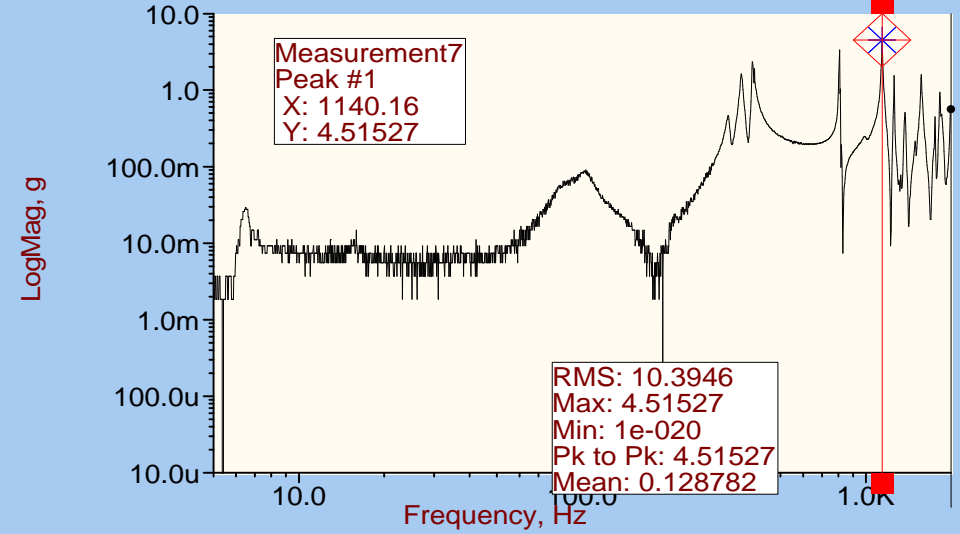
PCAL MOUNT Z' AXIS



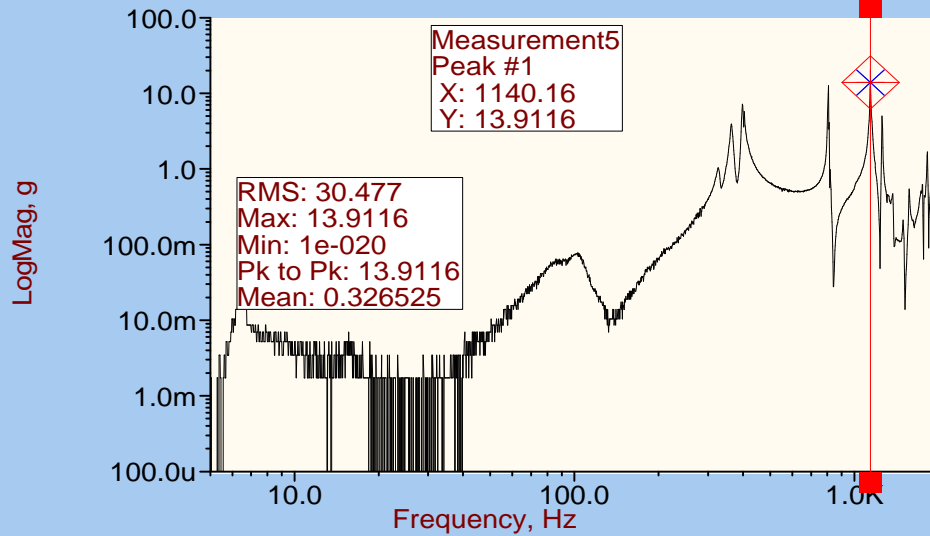
INTERFACE PLATE Z AXIS



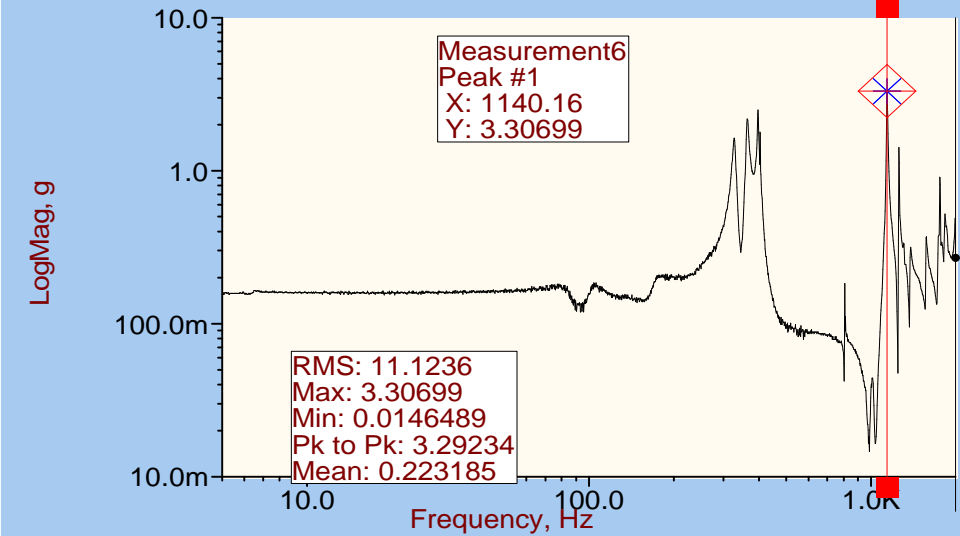
THERMOMETER MOUNT Y AXIS



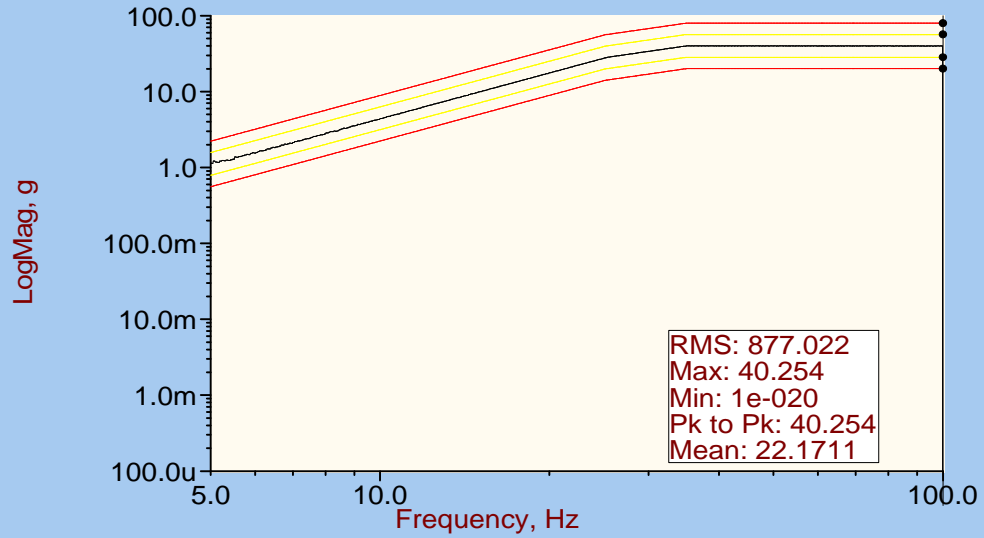
STRUCTURE TOP Y AXIS



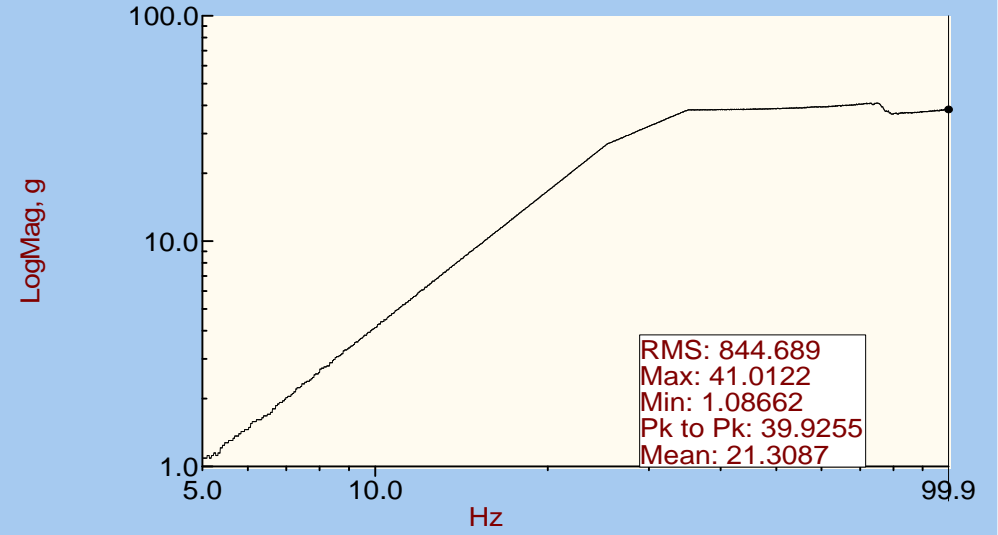
STRUCTURE BOTTOM Z' AXIS



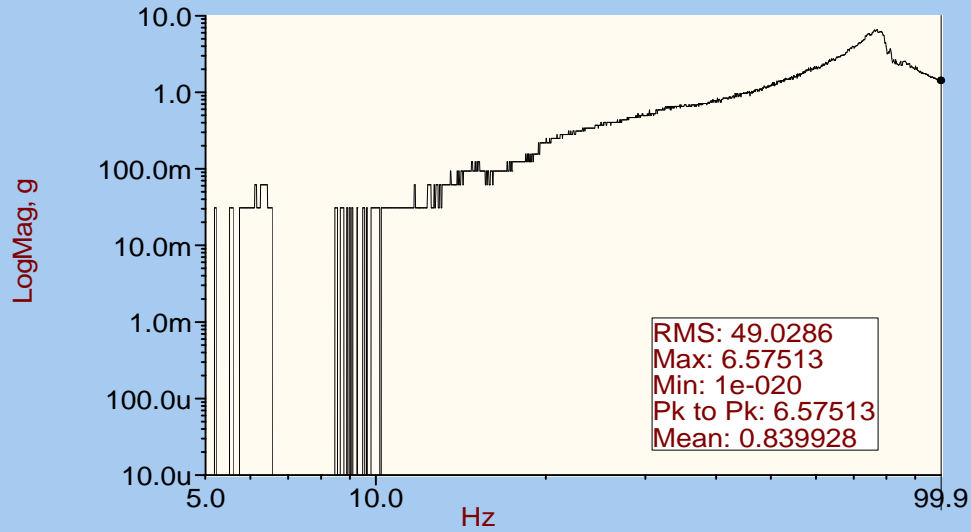
Control;AlarmLow;AlarmHigh;AbortLow;Abo



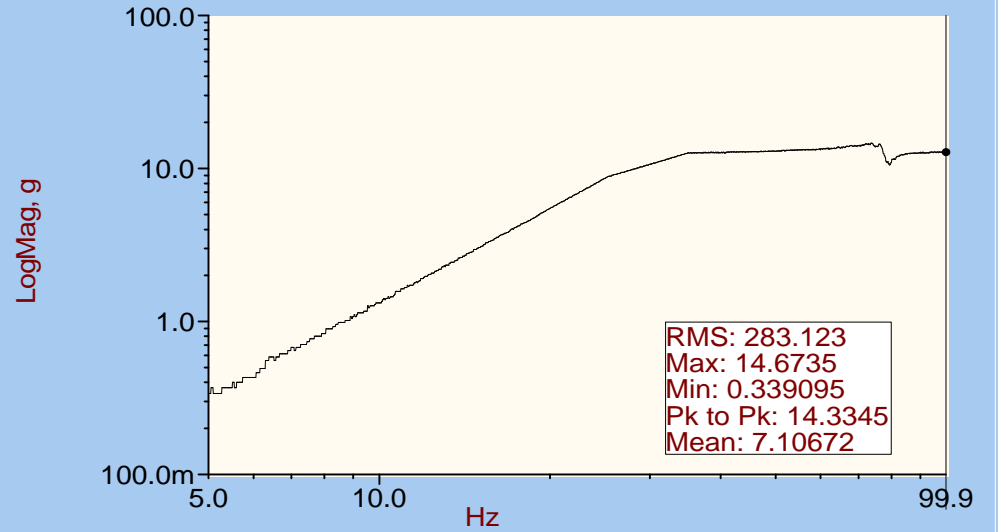
PCAL MOUNT X' AXIS



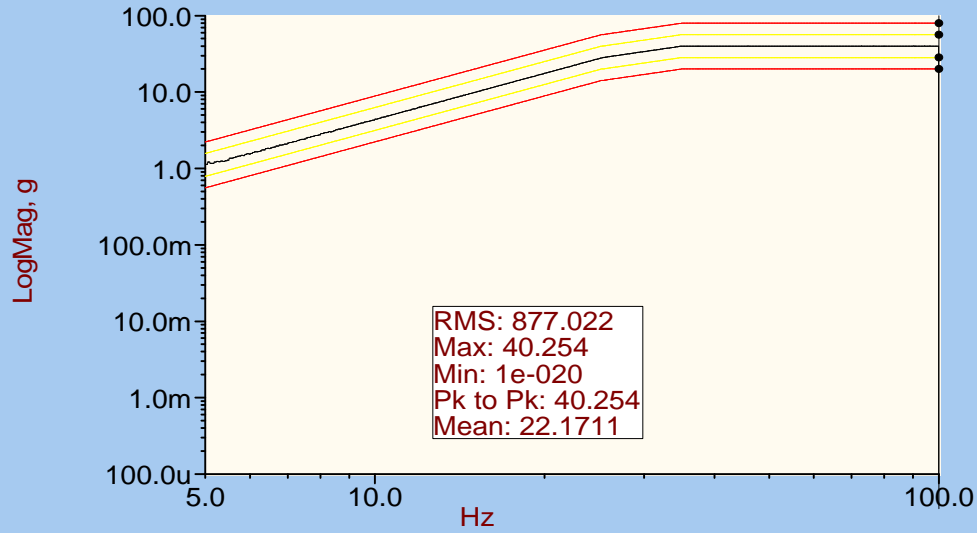
PCAL MOUNT Y AXIS



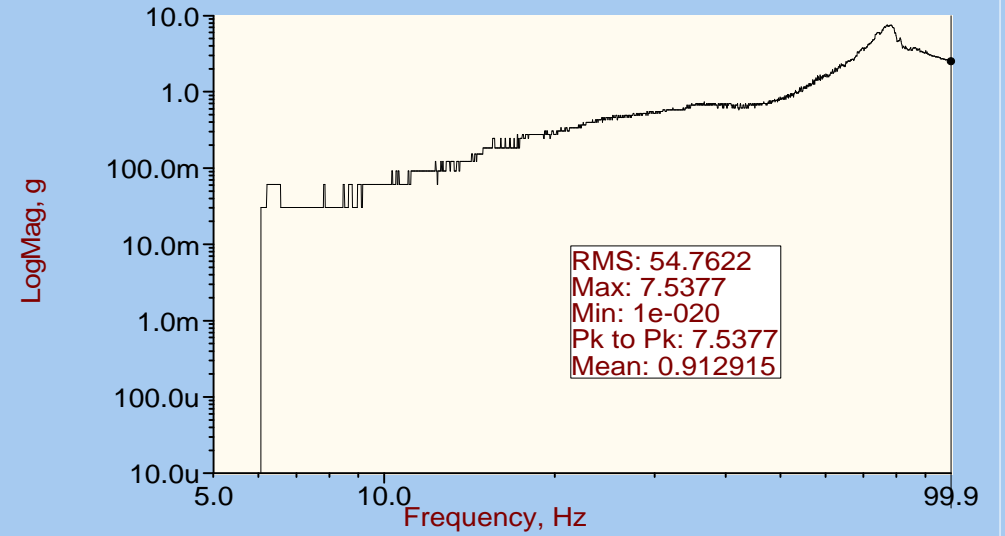
PCAL MOUNT Z' AXIS



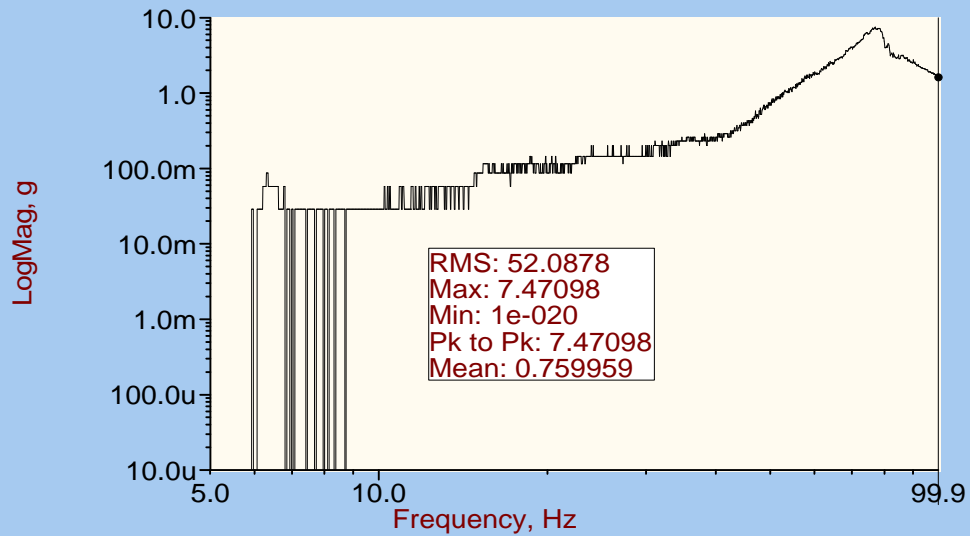
Control;AlarmLow;AlarmHigh;AbortLow;Abo



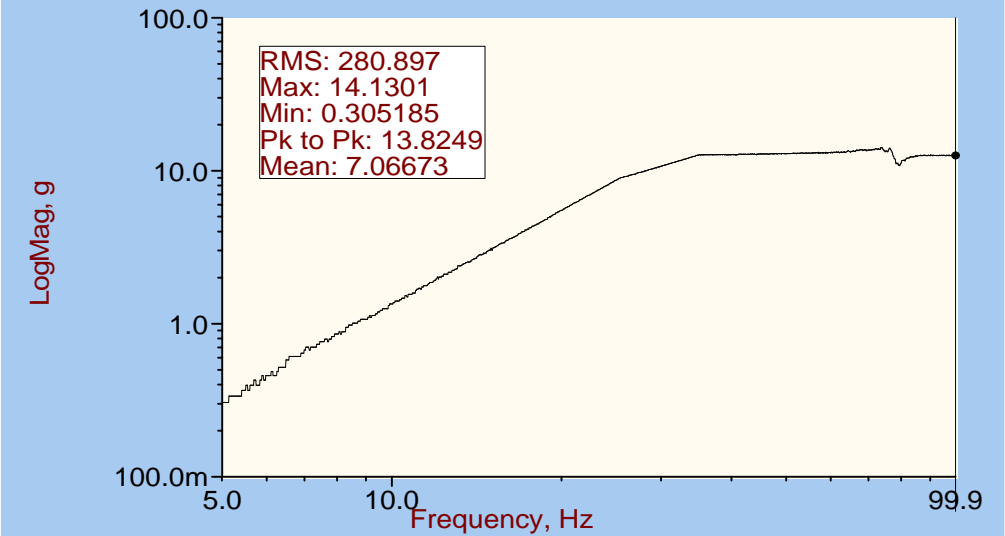
THERMOMETER MOUNT Y AXIS



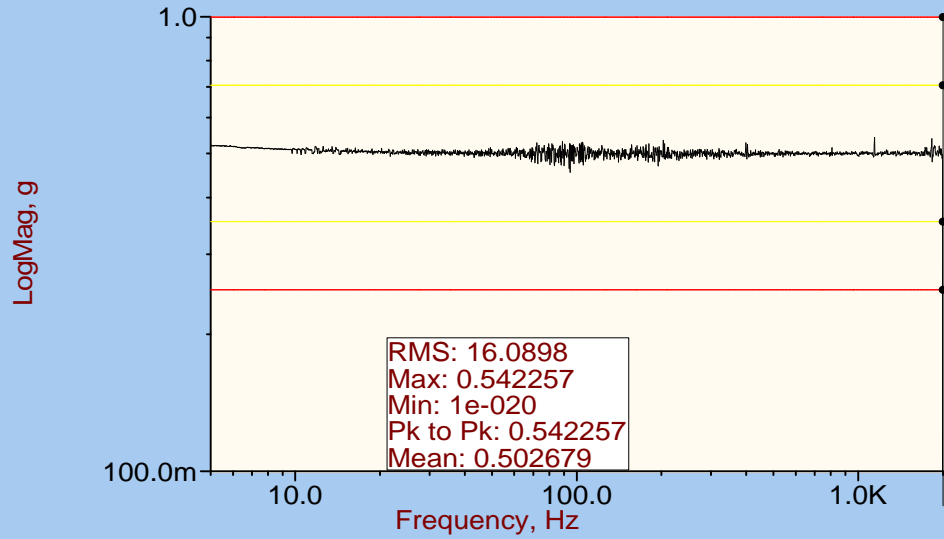
STRUCTURE TOP Y AXIS



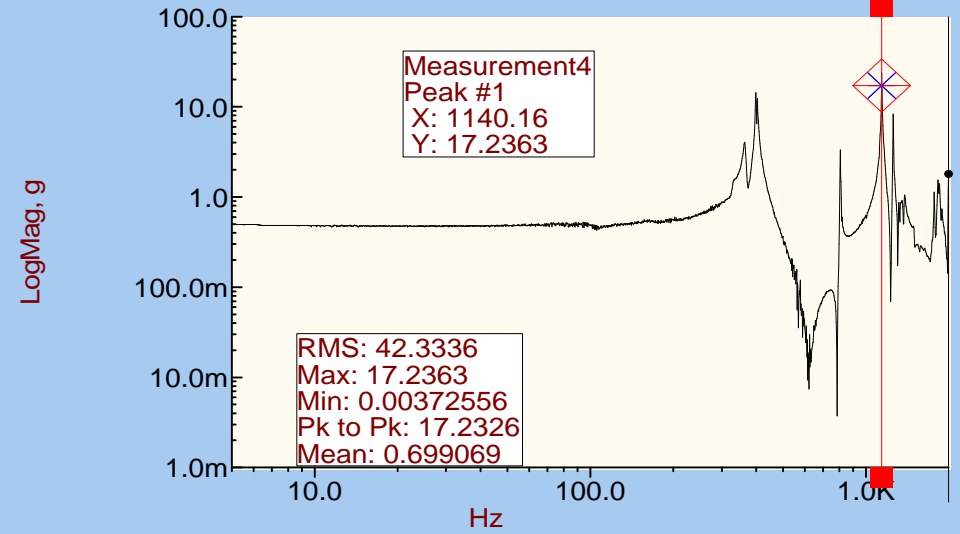
STRUCTURE BOTTOM Z' AXIS



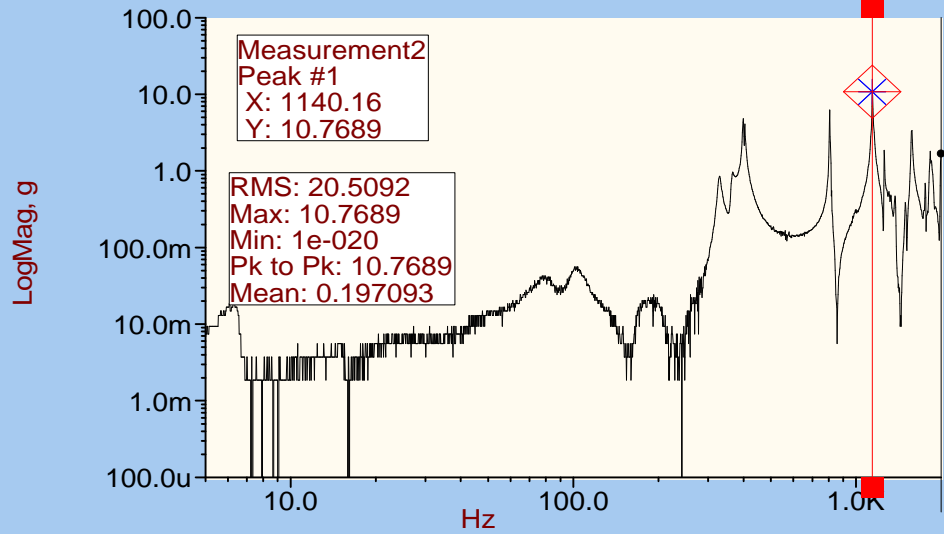
Control;AlarmLow;AlarmHigh;AbortLow;Abo



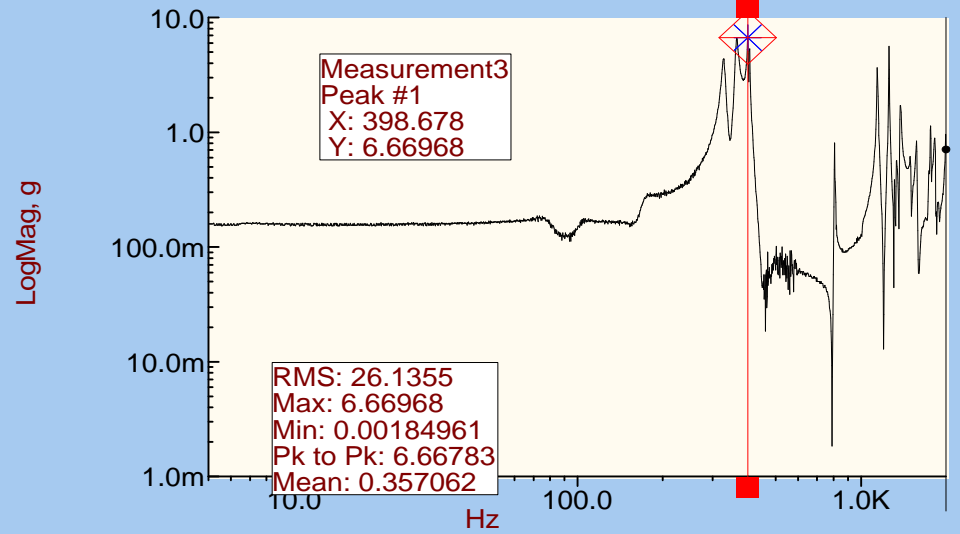
PCAL MOUNT X' AXIS



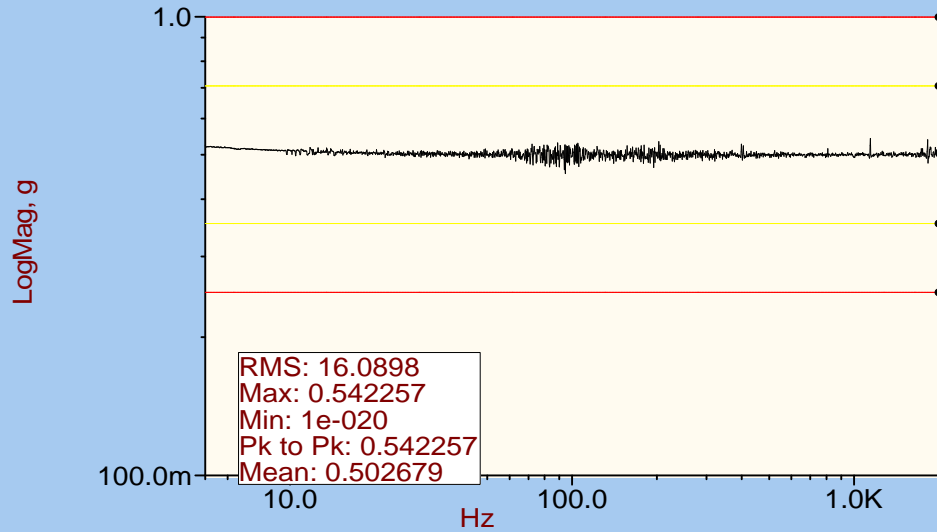
PCAL MOUNT Y AXIS



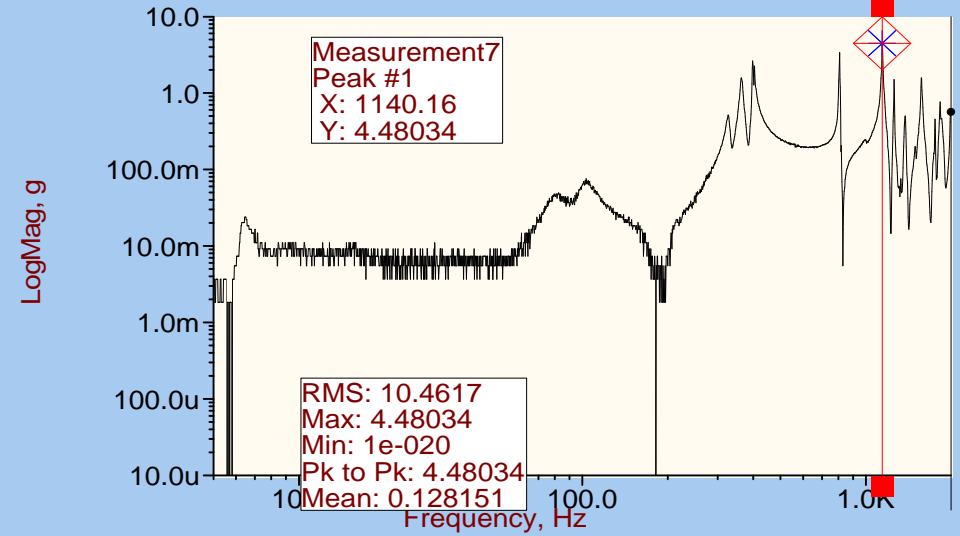
PCAL MOUNT Z' AXIS



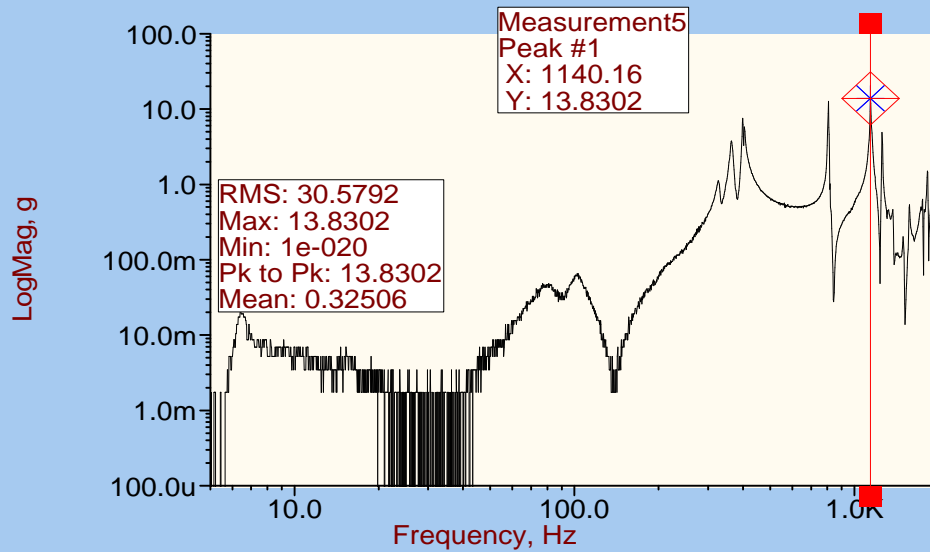
Control;AlarmLow;AlarmHigh;AbortLow;Abo



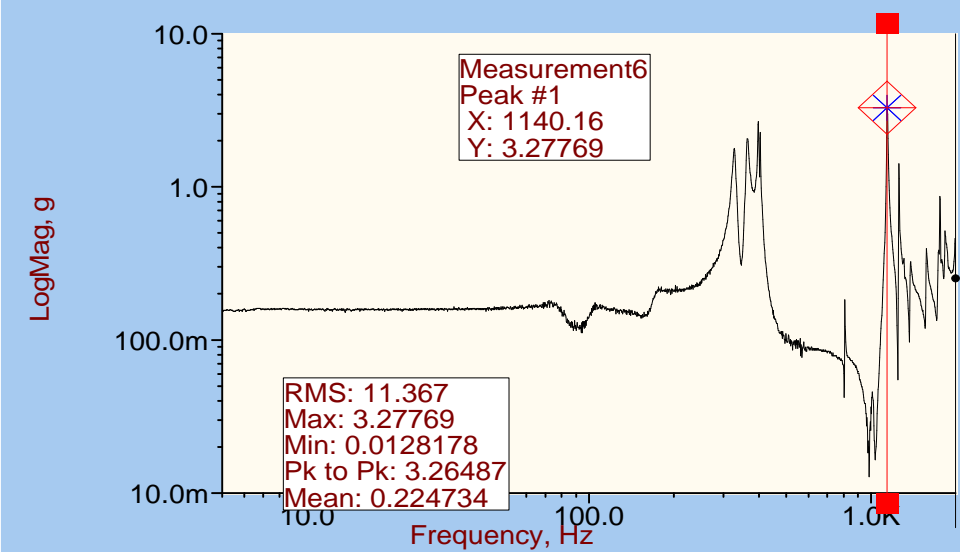
THERMOMETER MOUNT Y AXIS



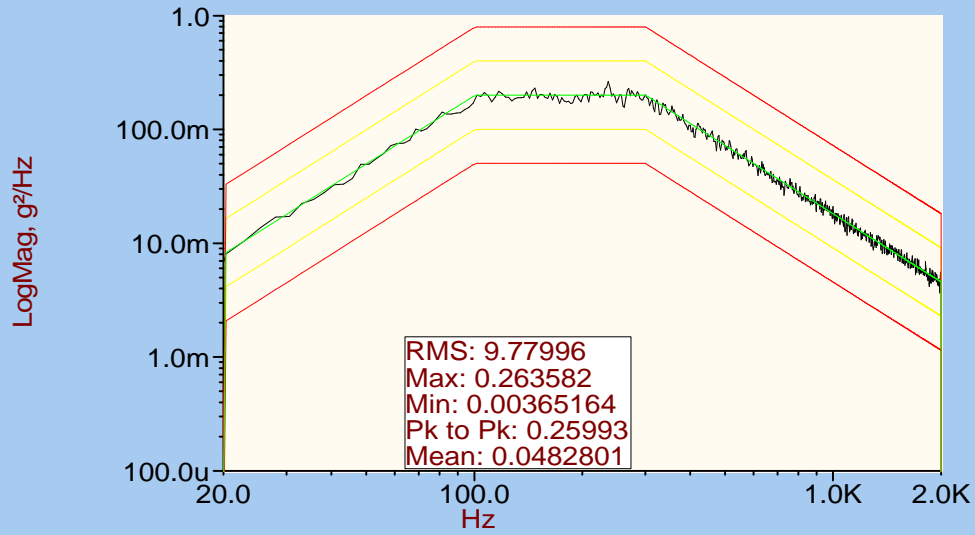
STRUCTURE TOP Y AXIS



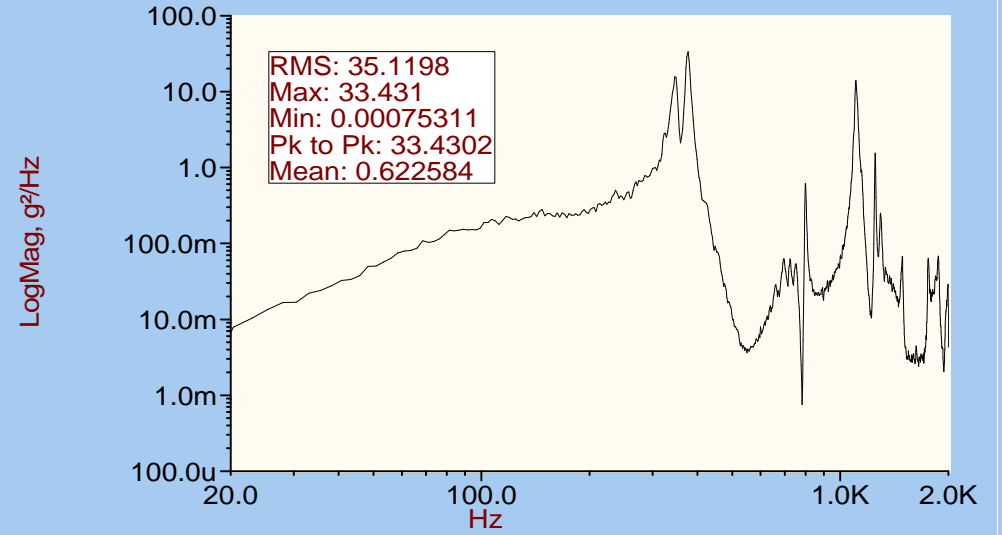
STRUCTURE BOTTOM Z' AXIS



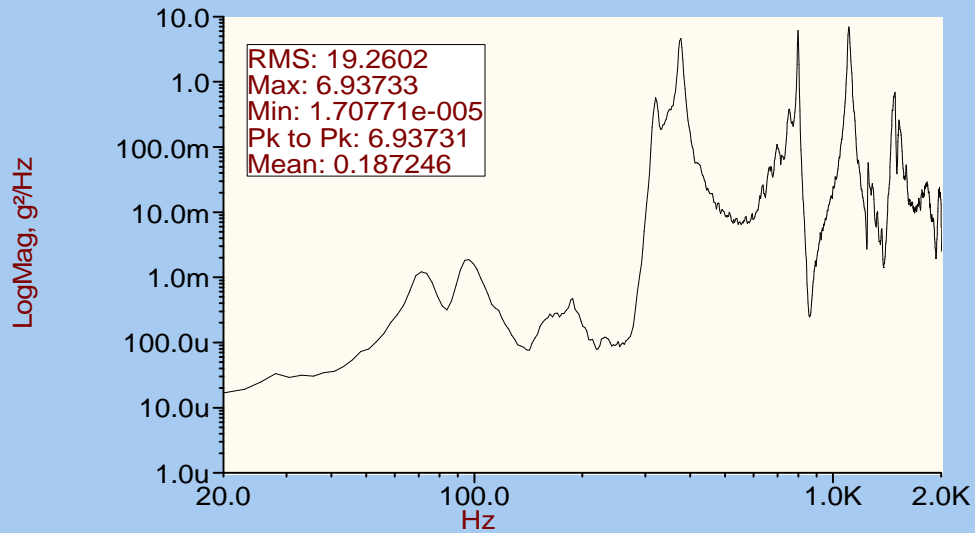
Control;AlarmLow;AlarmHigh;AbortLow;Abo



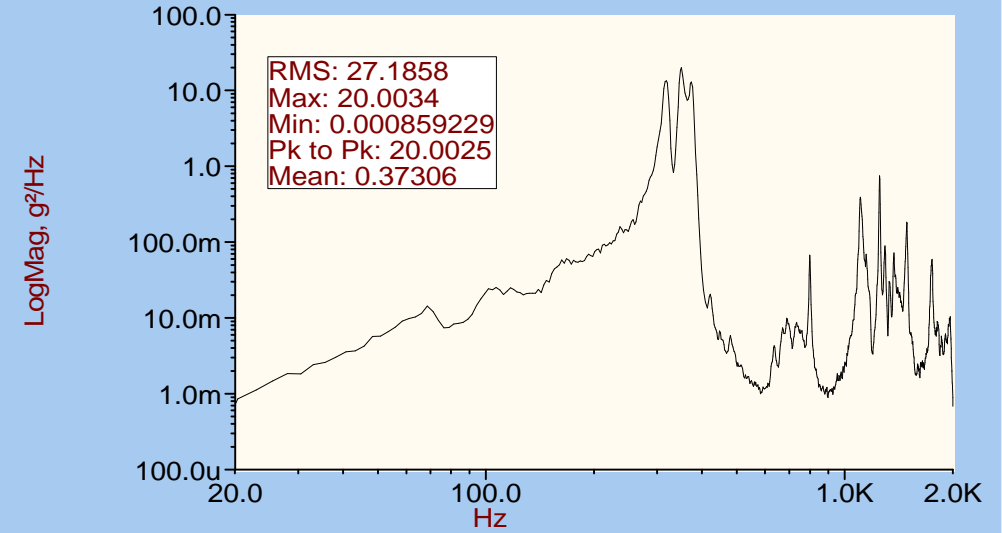
PCAL MOUNT X' AXIS



PCAL MOUNT Y AXIS



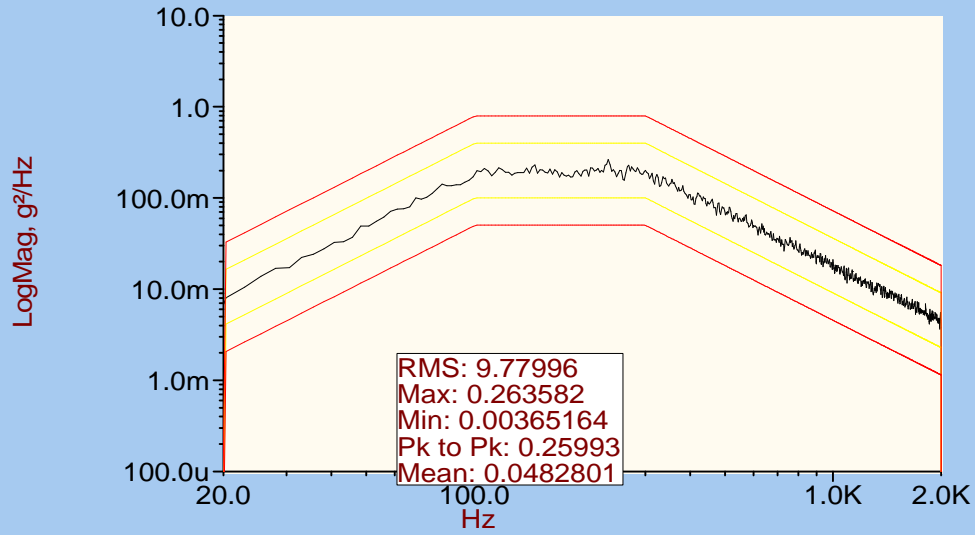
PCAL MOUNT Z' AXIS



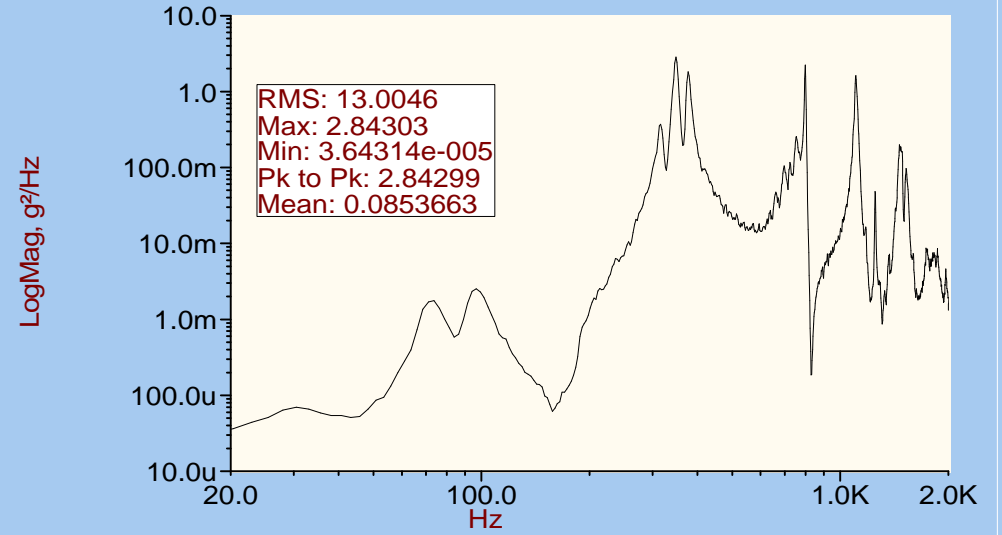
SPIRE- BEAM STEERING MIRROR RANDOM
RUN 00002
X AXIS
15:06:35 24/04/2002

Fig 9a

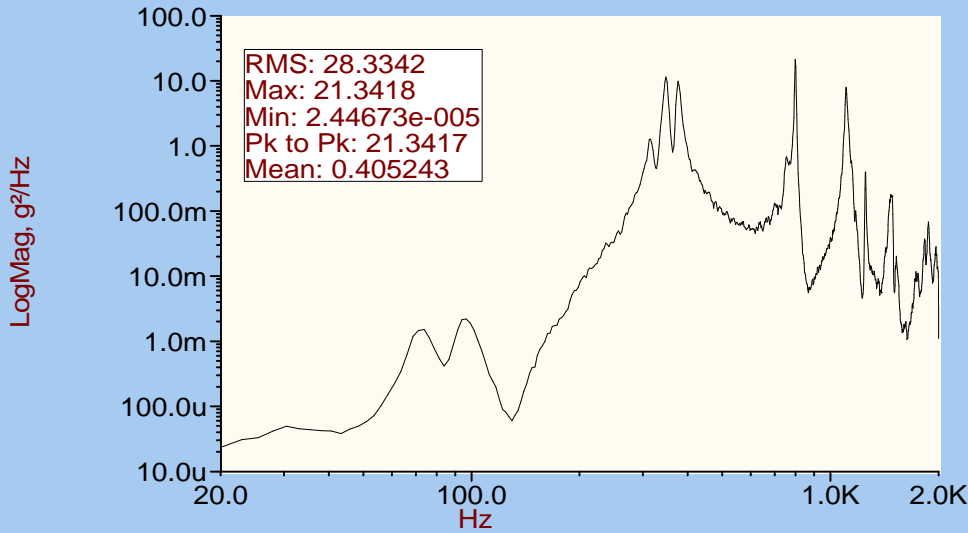
Control;AlarmLow;AlarmHigh;AbortLow;Abo



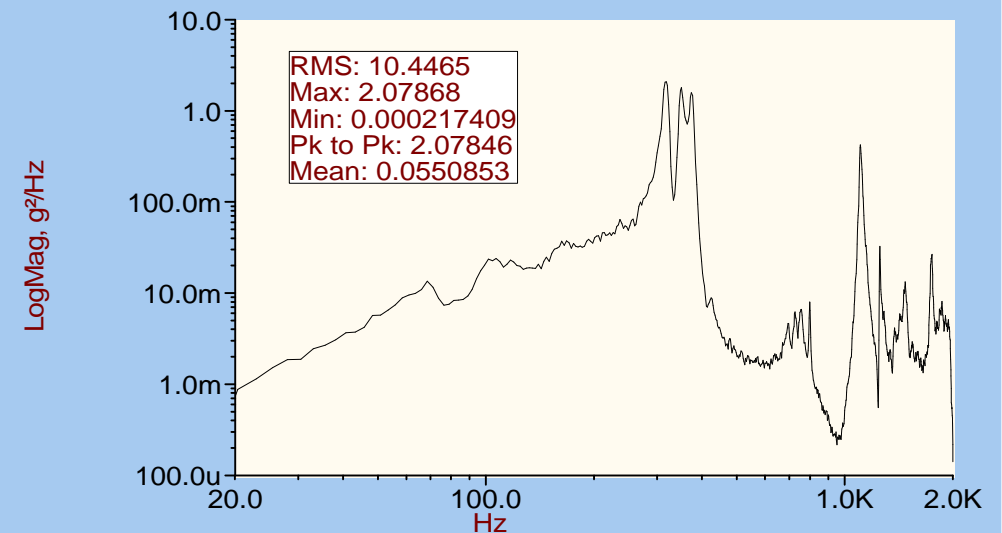
THERMOMETER MOUNT Y AXIS



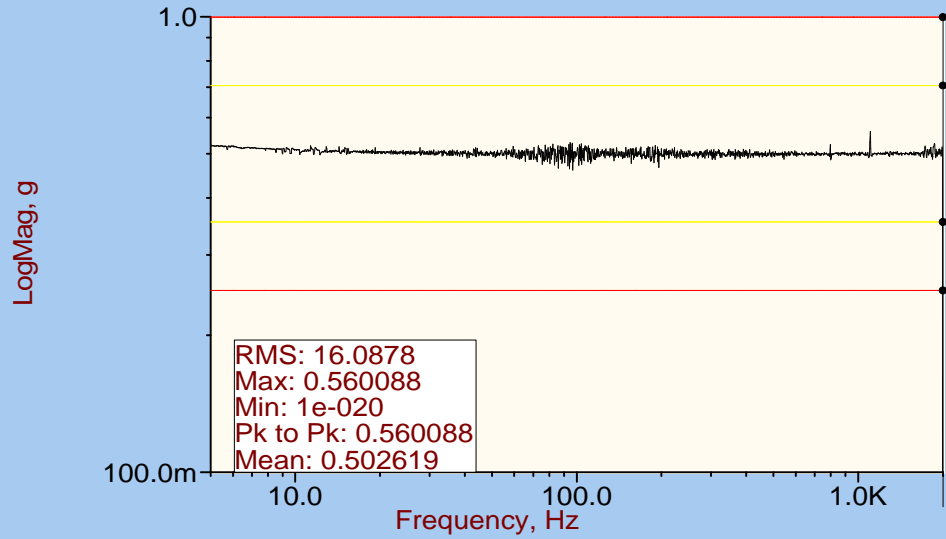
STRUCTURE TOP Y AXIS



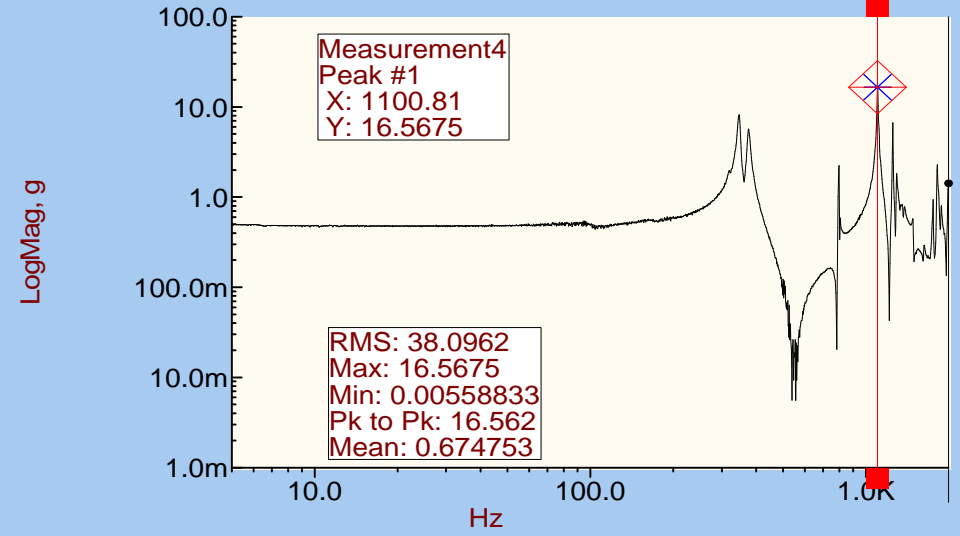
STRUCTURE BOTTOM Z' AXIS



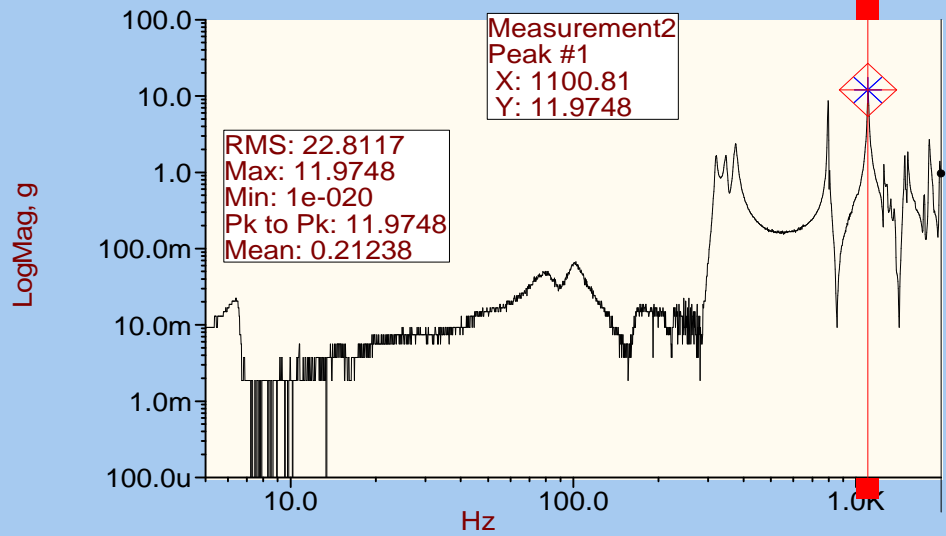
Control;AlarmLow;AlarmHigh;AbortLow;Abo



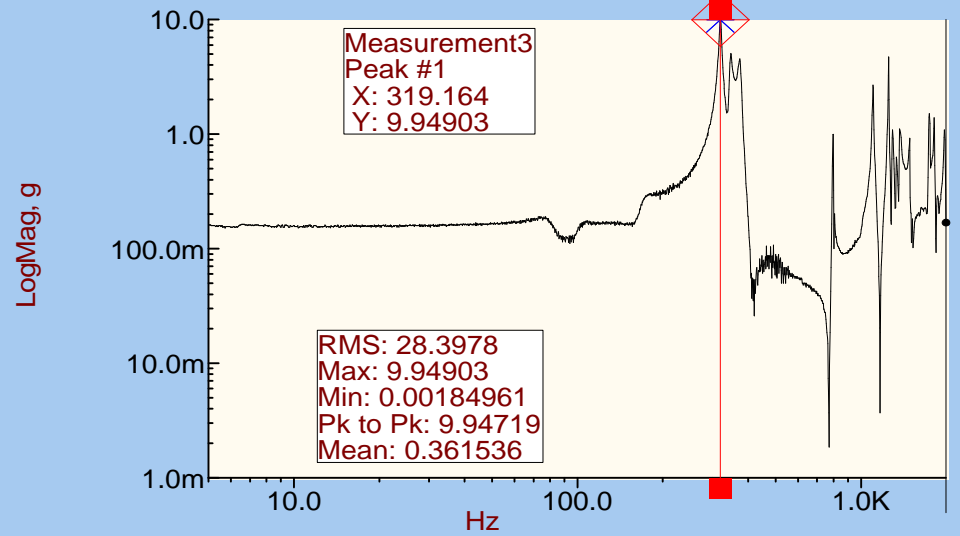
PCAL MOUNT X' AXIS



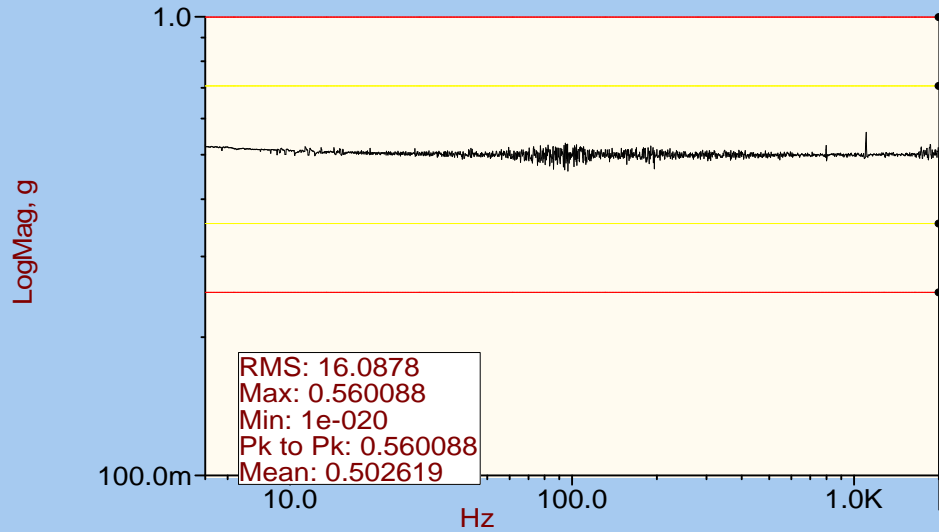
PCAL MOUNT Y AXIS



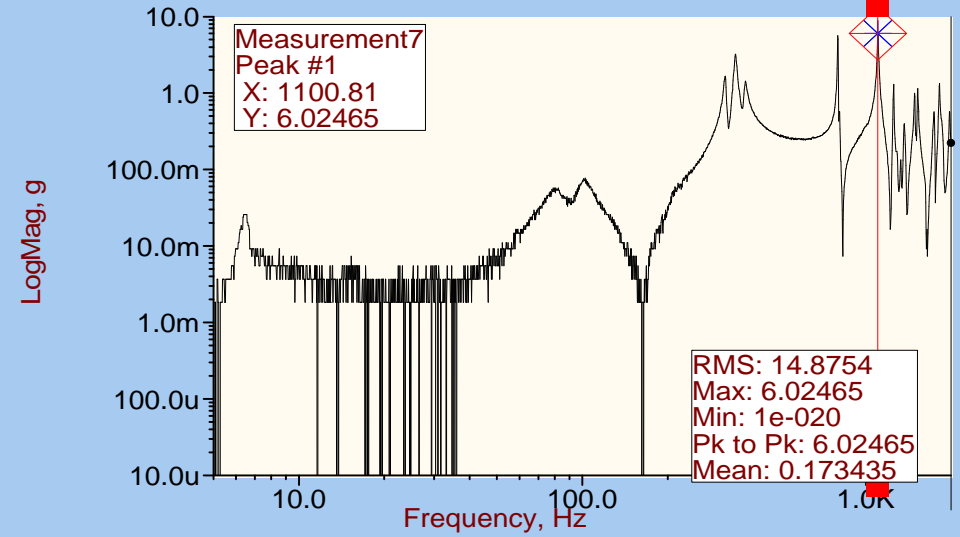
PCAL MOUNT Z' AXIS



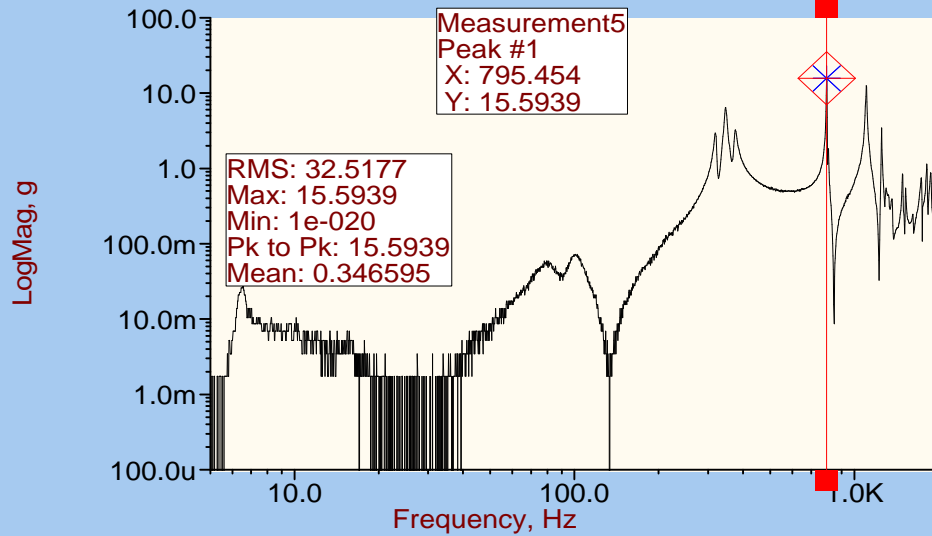
Control;AlarmLow;AlarmHigh;AbortLow;Abo



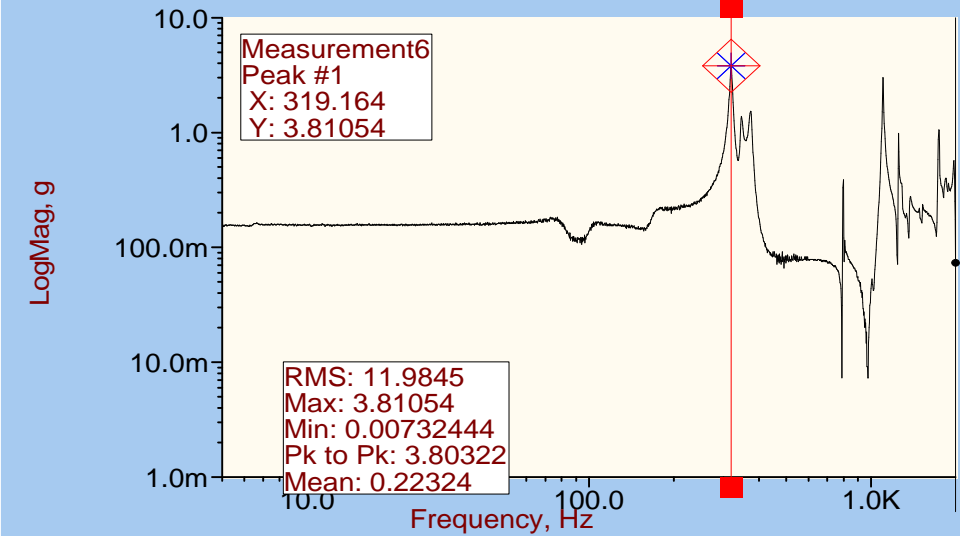
THERMOMETER MOUNT Y AXIS



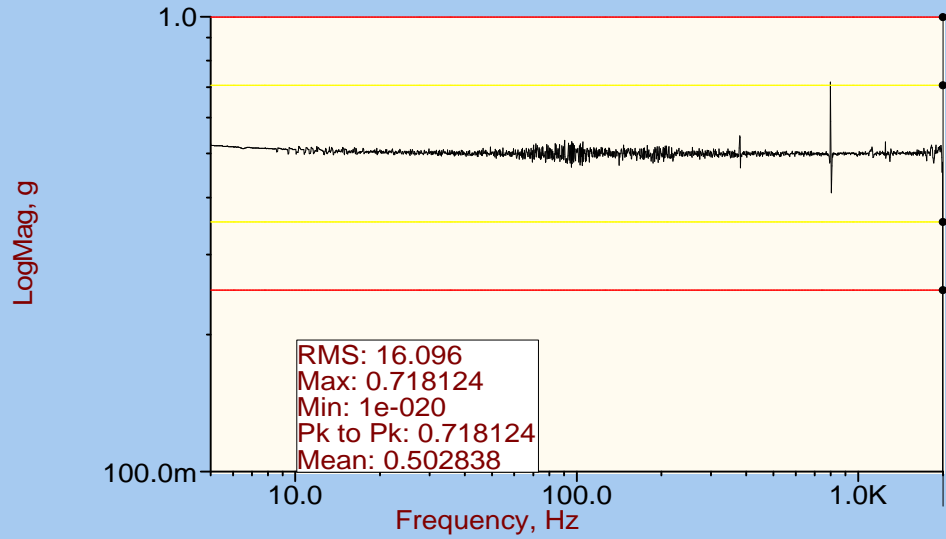
STRUCTURE TOP Y AXIS



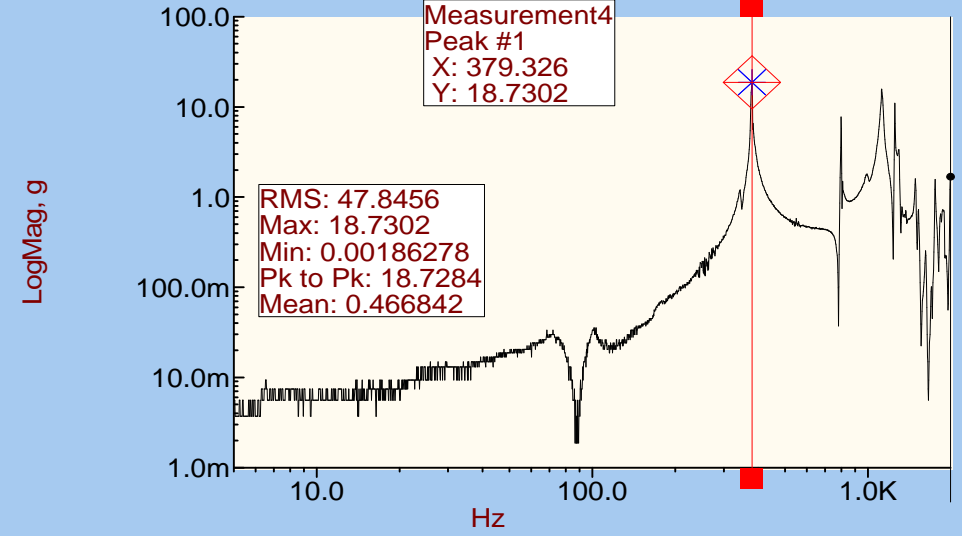
STRUCTURE BOTTOM Z' AXIS



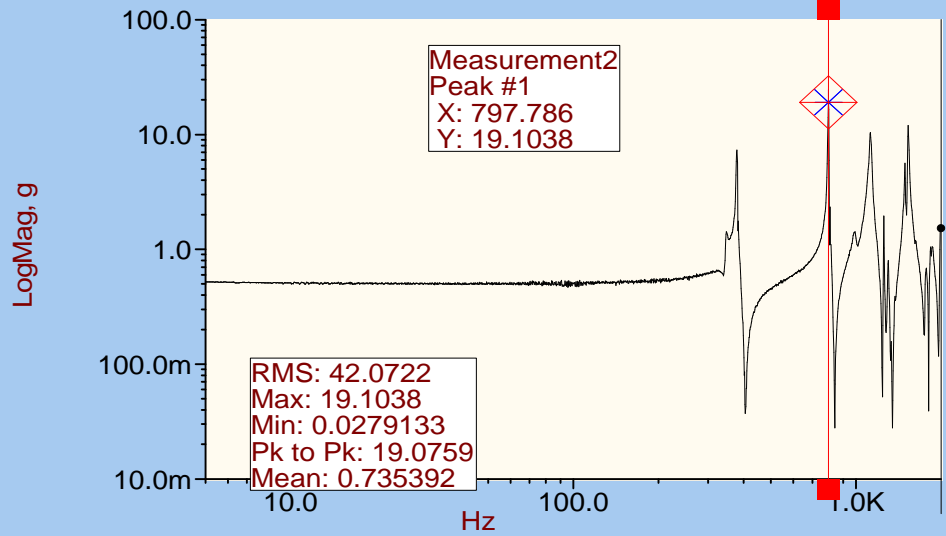
Control;AlarmLow;AlarmHigh;AbortLow;Abo



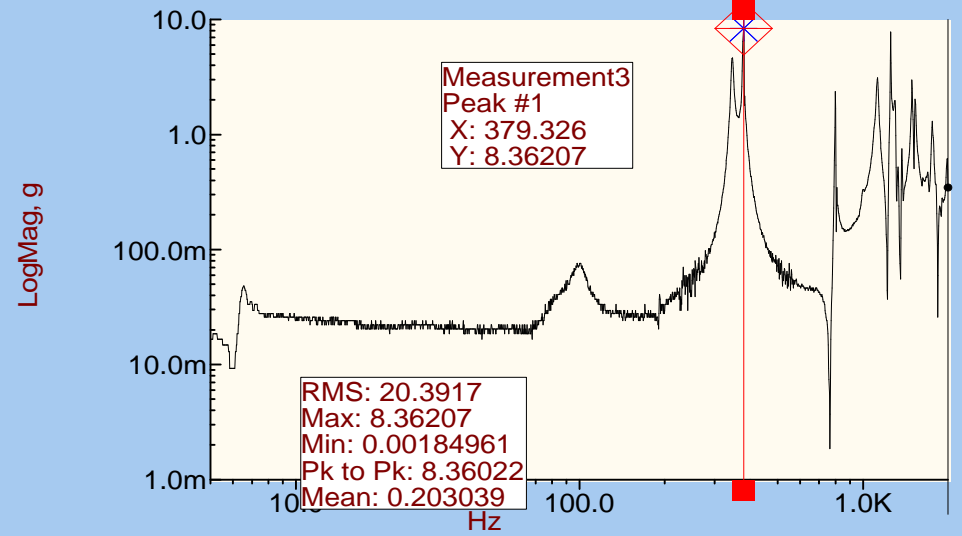
PCAL MOUNT X' AXIS



PCAL MOUNT Y AXIS



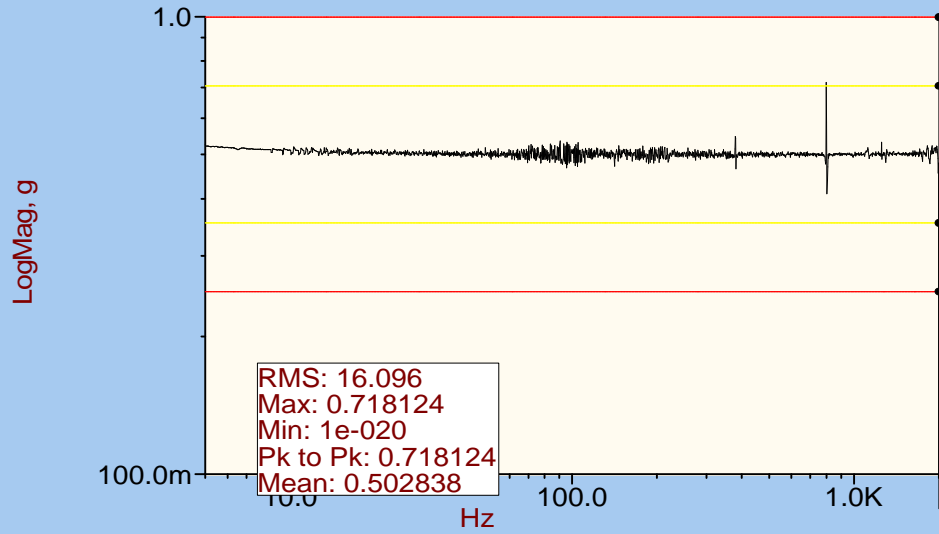
PCAL MOUNT Z' AXIS



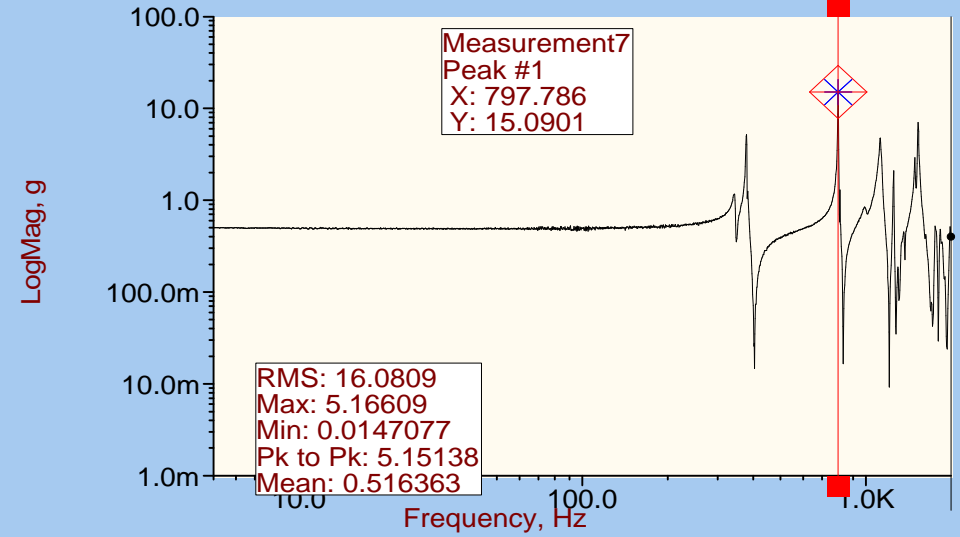
SPIRE- BEAM STEERING MIRROR SINE SURVEY
RUN 00008
Y AXIS
15:37:40 24/04/2002

Fig 11a

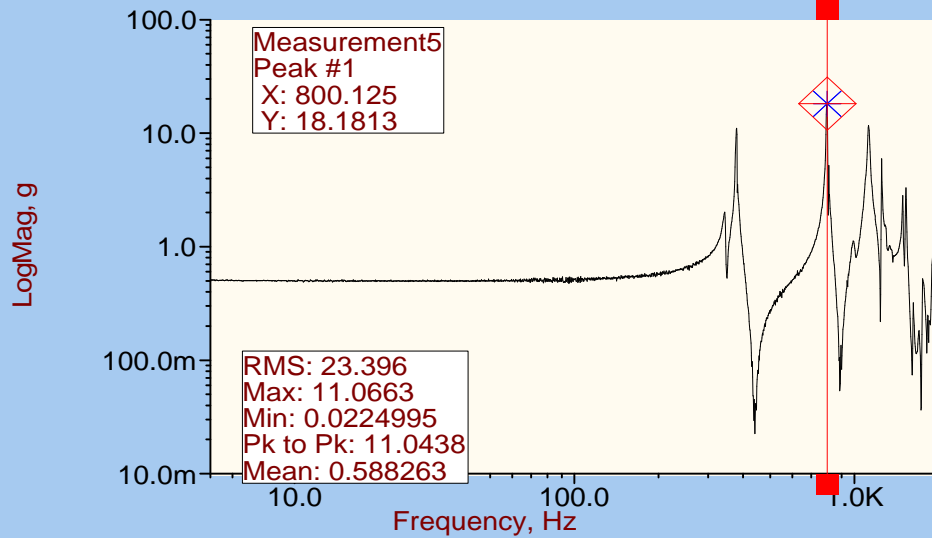
Control;AlarmLow;AlarmHigh;AbortLow;Abo



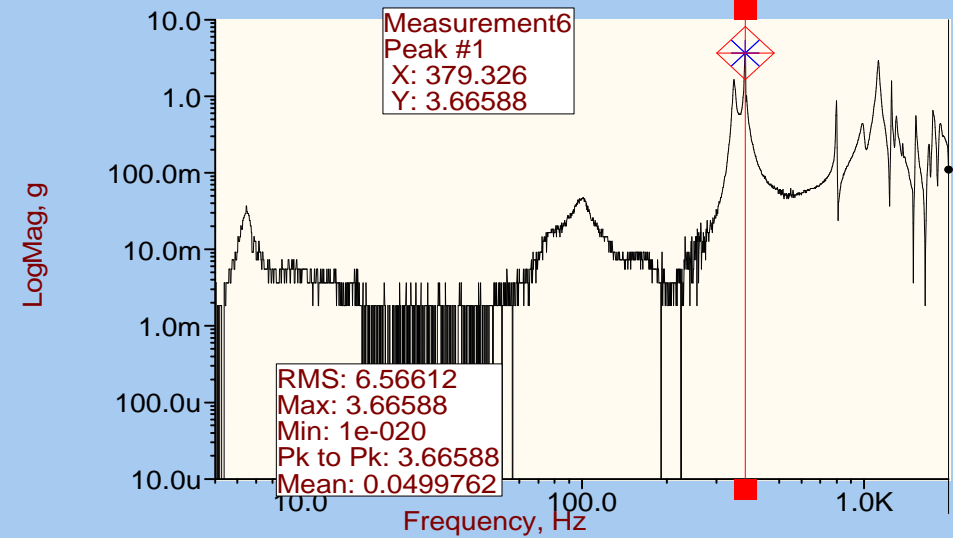
THERMOMETER MOUNT Y AXIS



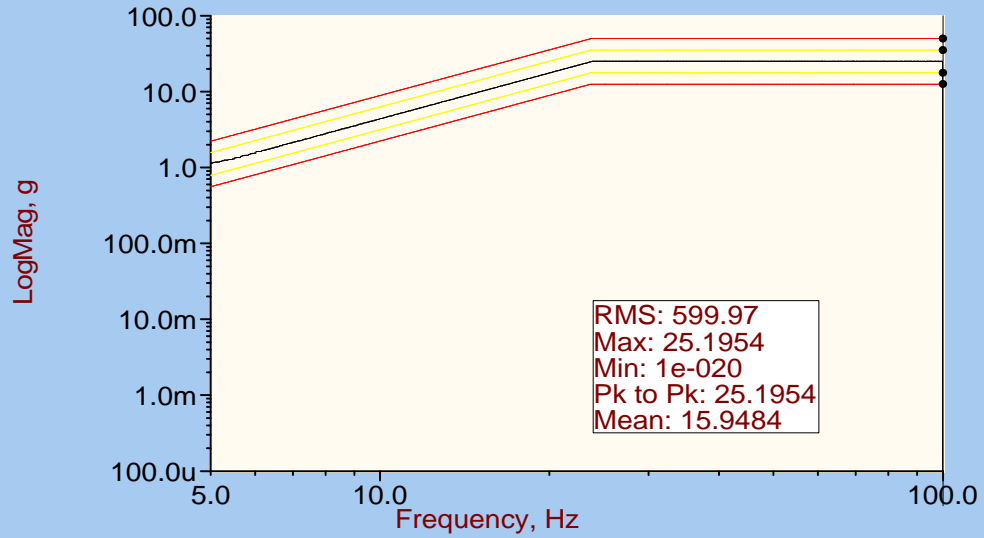
STRUCTURE TOP Y AXIS



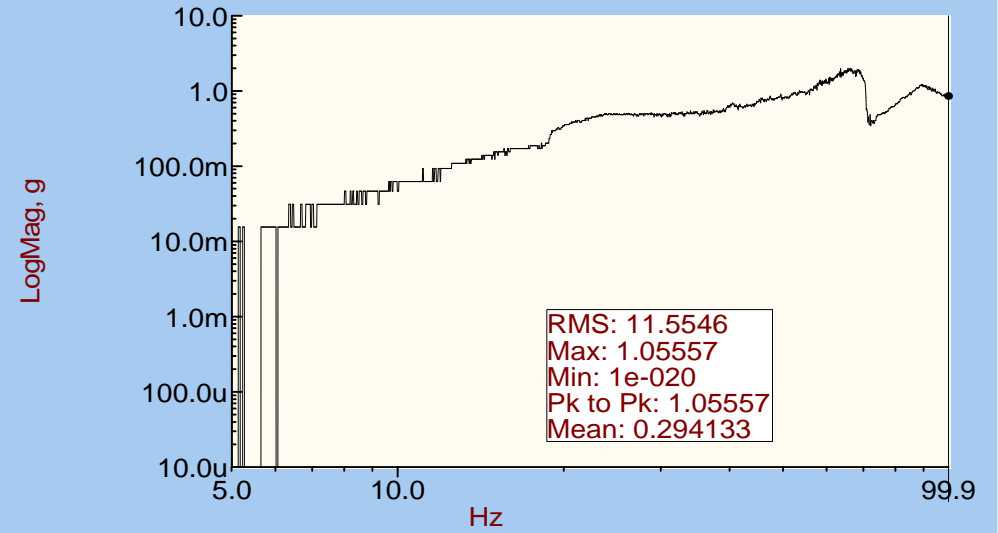
STRUCTURE BOTTOM Z' AXIS



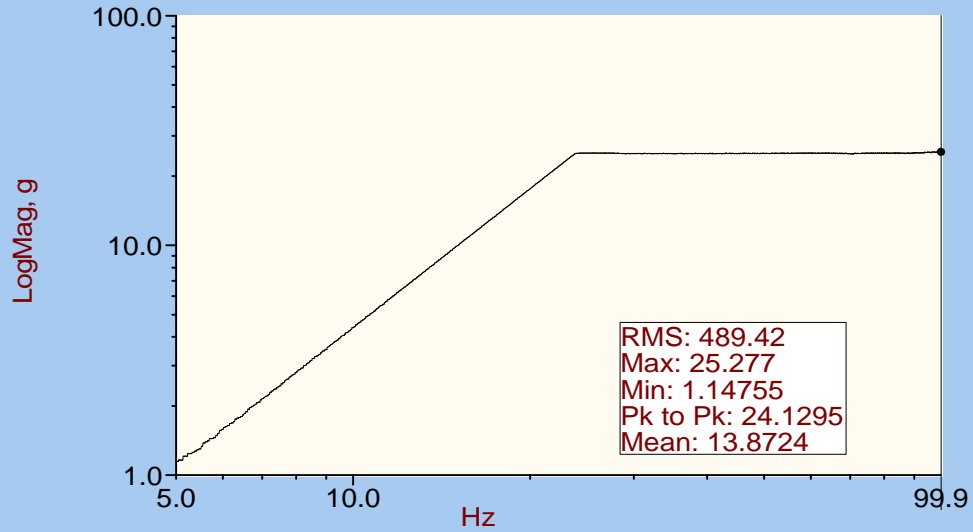
Control;AlarmLow;AlarmHigh;AbortLow;Abo



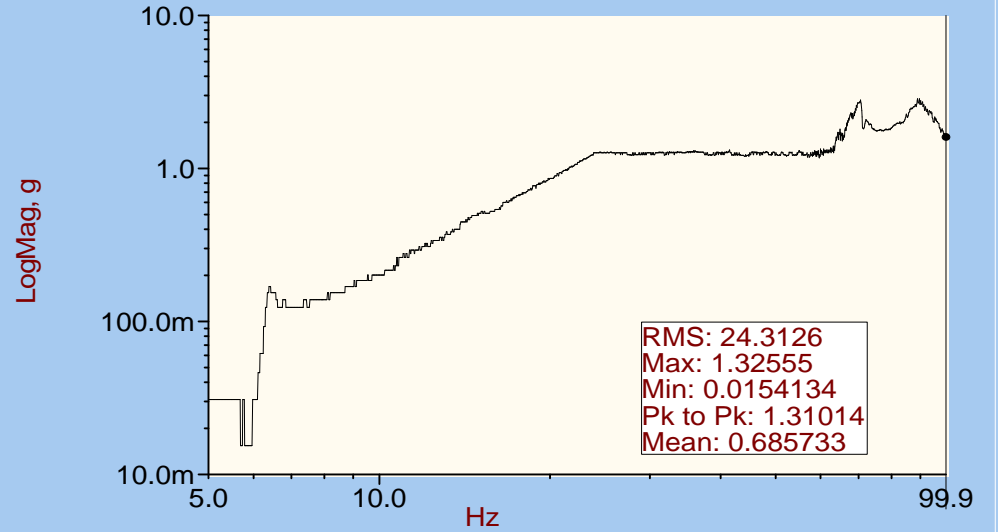
PCAL MOUNT X' AXIS



PCAL MOUNT Y AXIS



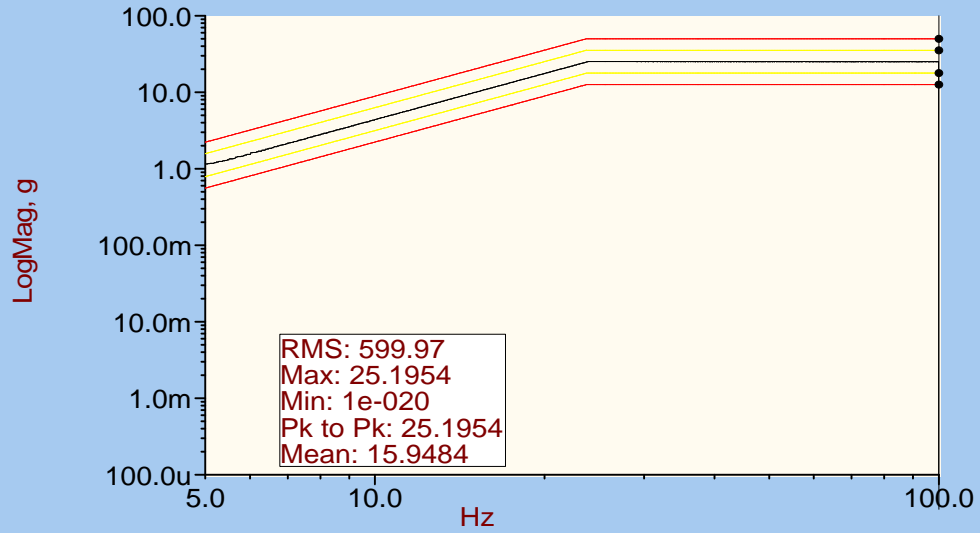
PCAL MOUNT Z' AXIS



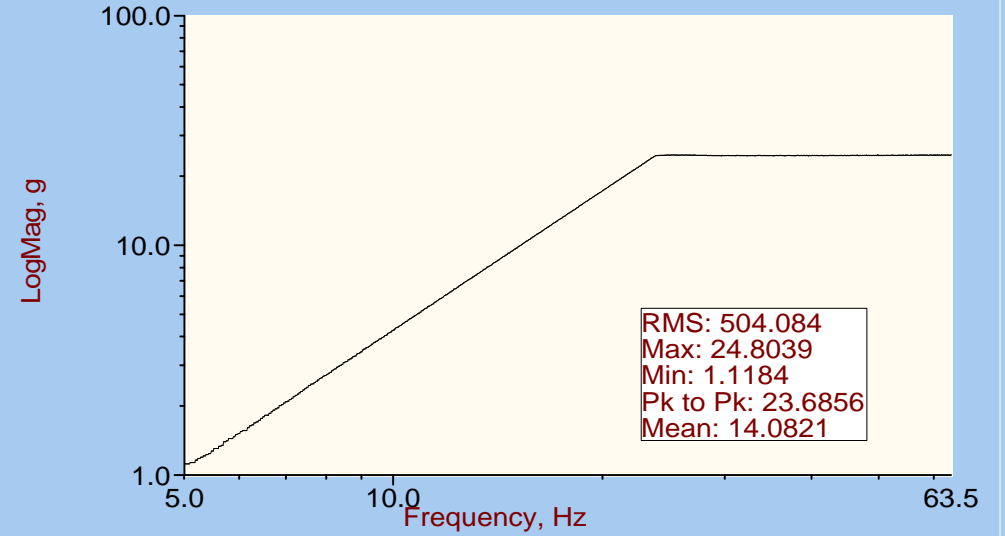
SPIRE- BEAM STEERING MIRROR SINE SWEEP
RUN 00003
Y AXIS
15:49:02 24/04/2002

Fig 12a

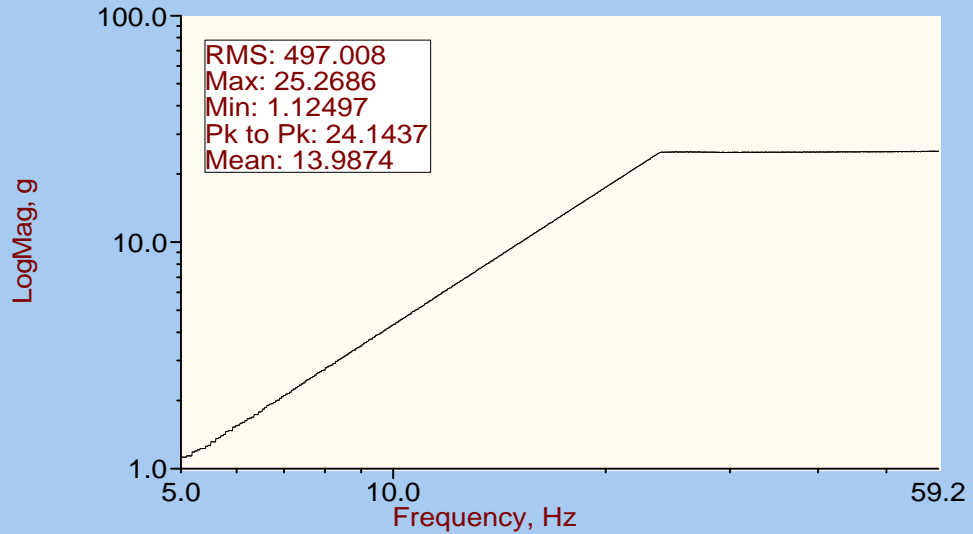
Control;AlarmLow;AlarmHigh;AbortLow;Abo



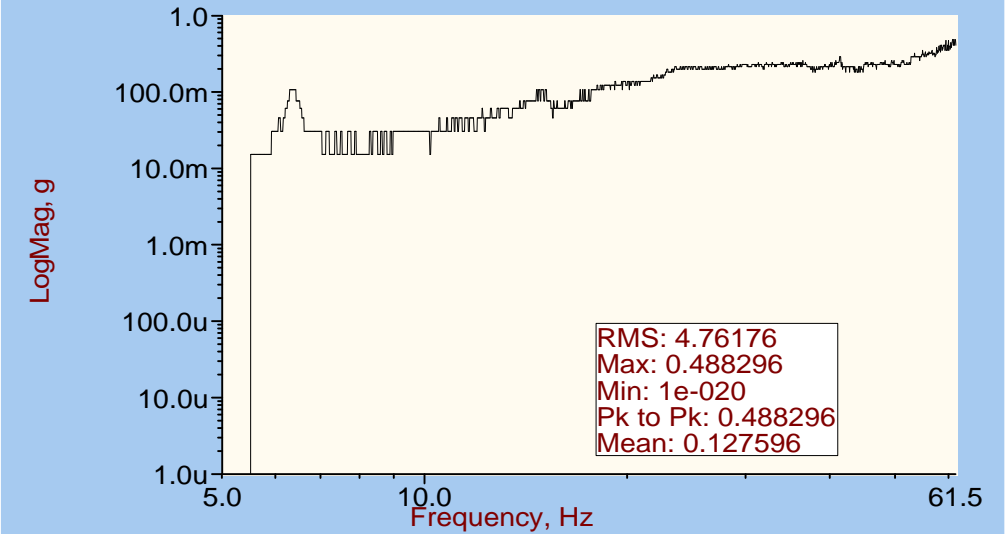
THERMOMETER MOUNT Y AXIS



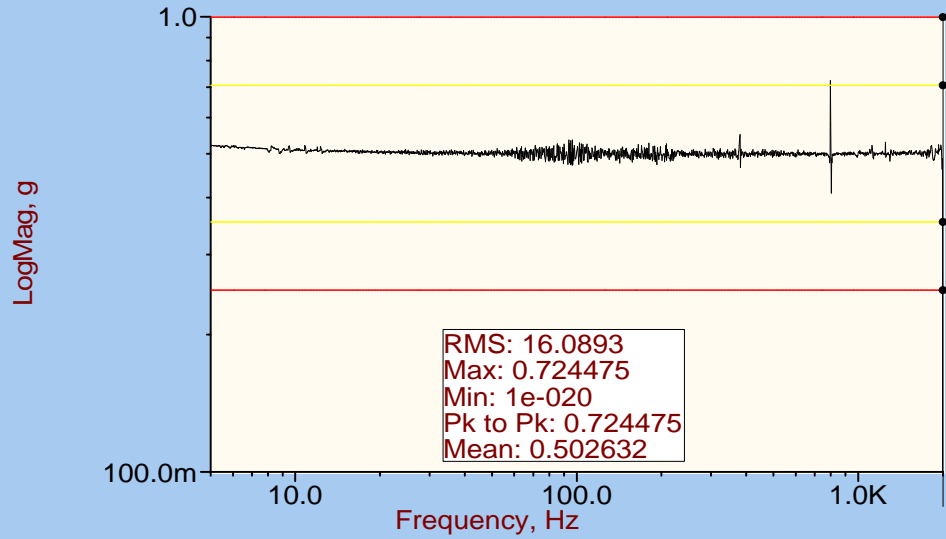
STRUCTURE TOP Y AXIS



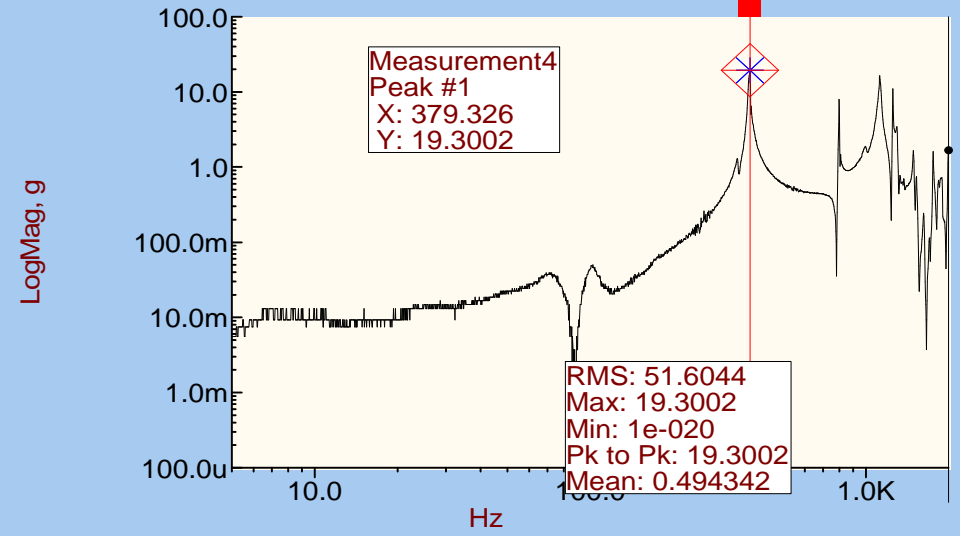
STRUCTURE BOTTOM Z' AXIS



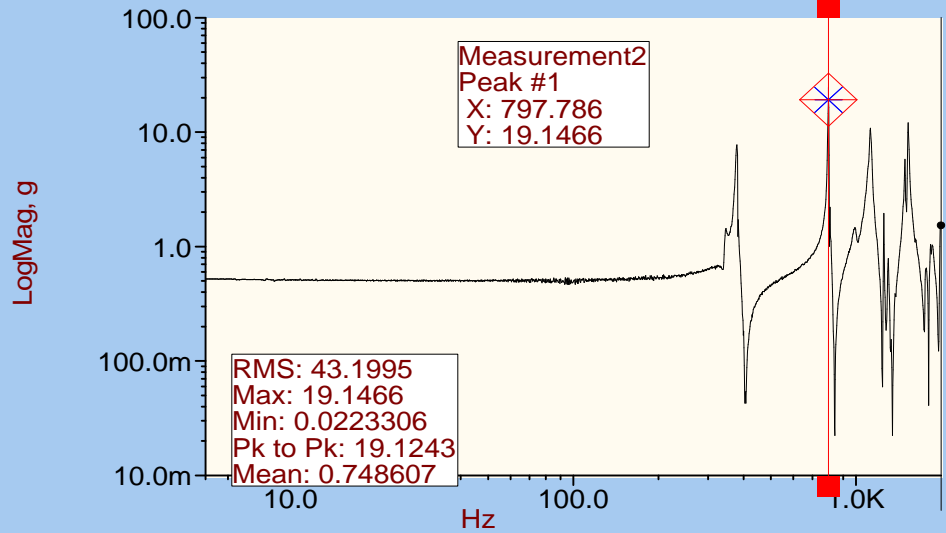
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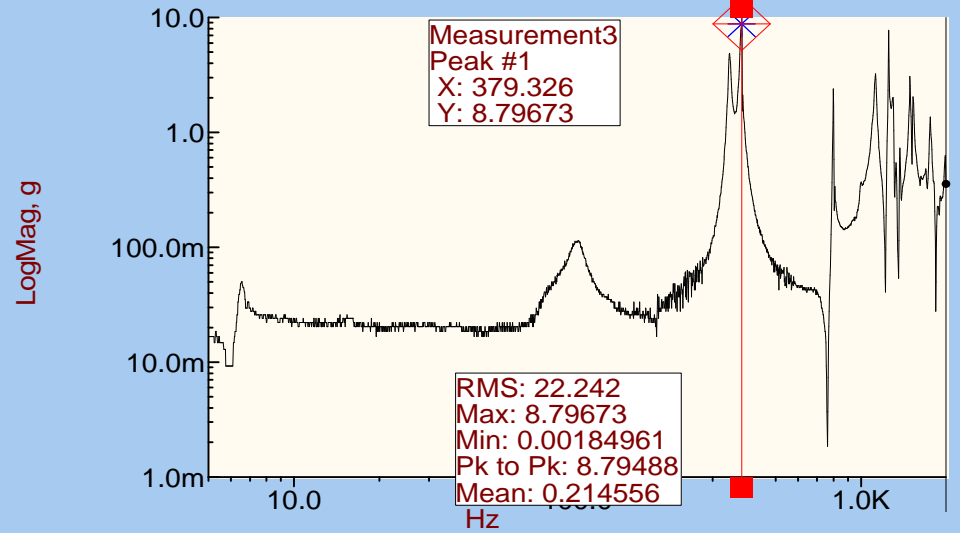
PCAL MOUNT X' AXIS



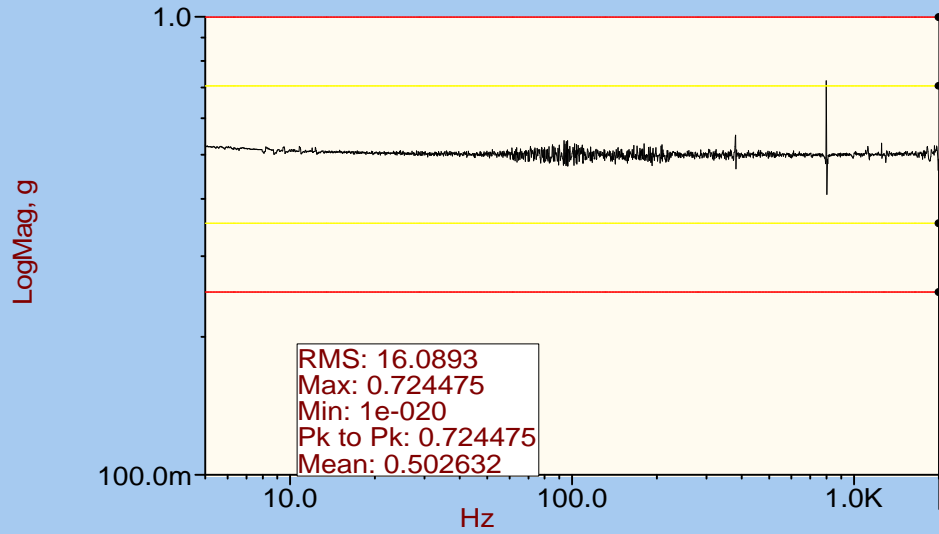
PCAL MOUNT Y AXIS



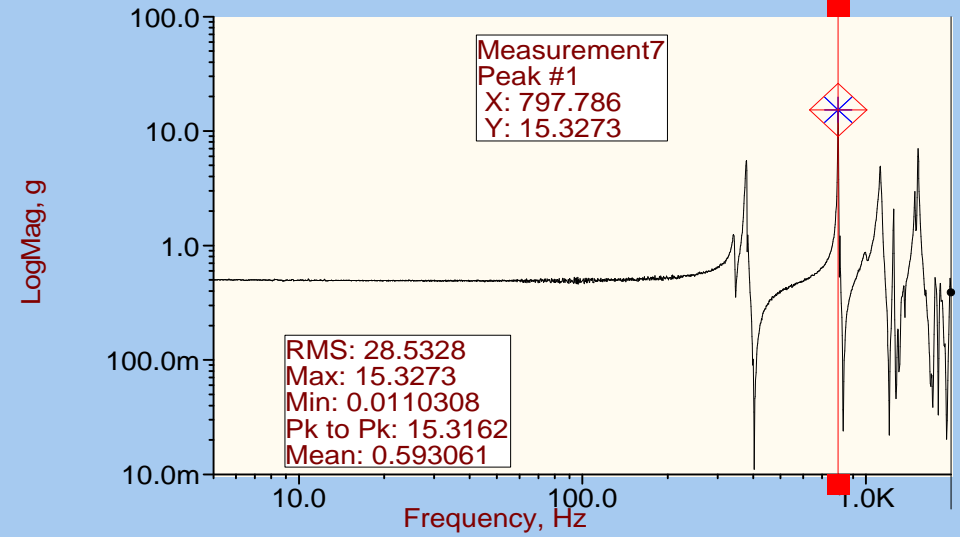
PCAL MOUNT Z' AXIS



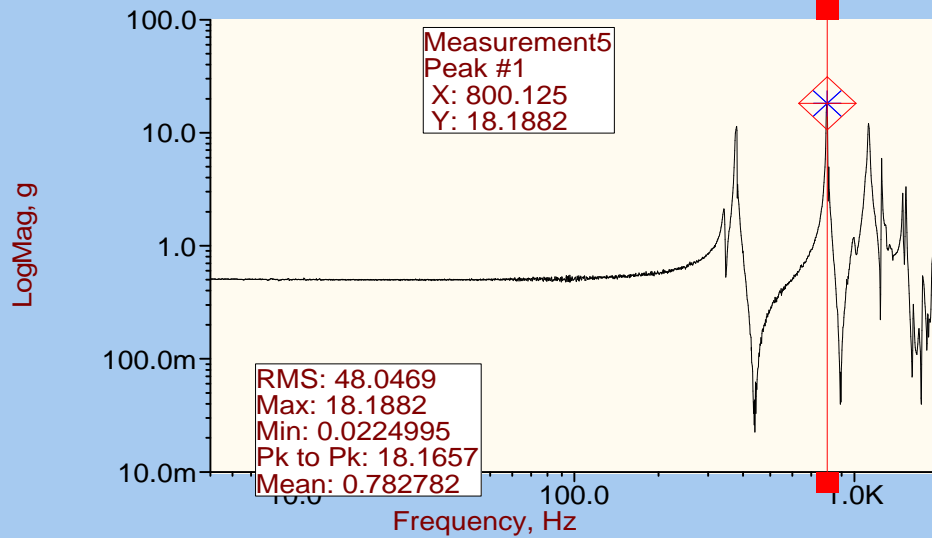
Control;AlarmLow;AlarmHigh;AbortLow;Abo



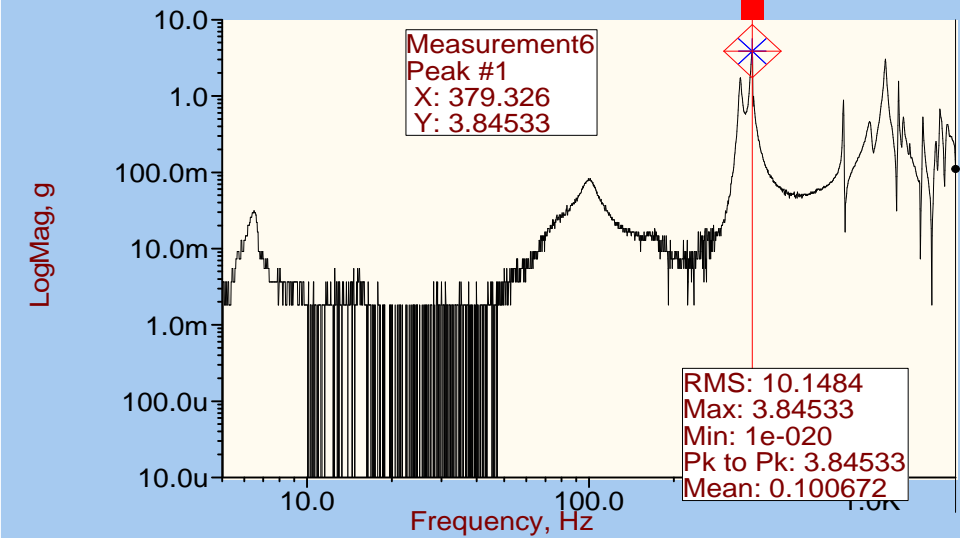
THERMOMETER MOUNT Y AXIS



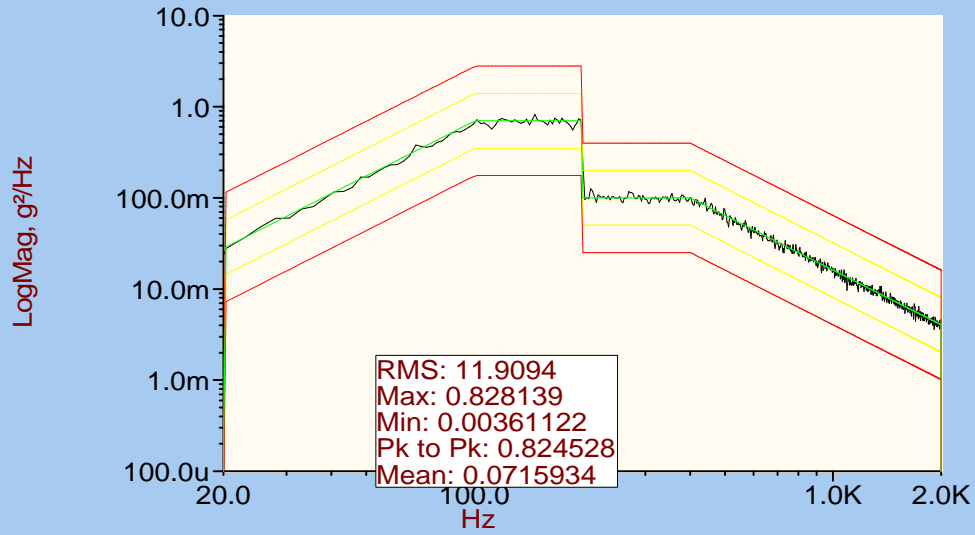
STRUCTURE TOP Y AXIS



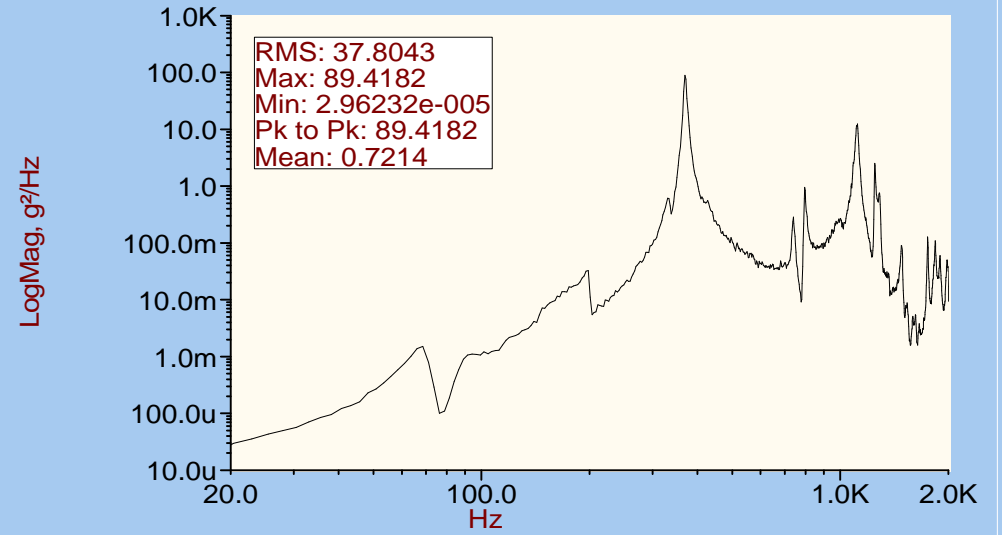
STRUCTURE BOTTOM Z' AXIS



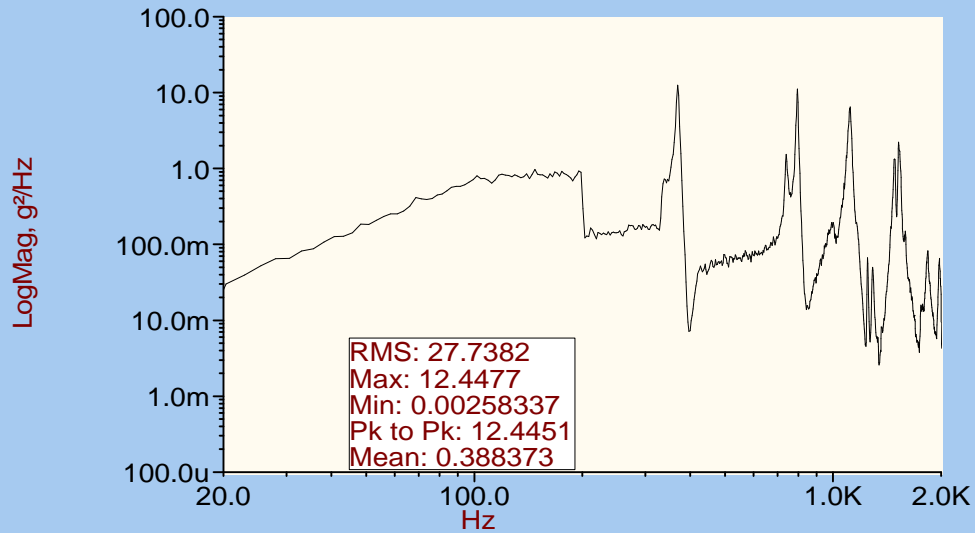
Control;AlarmLow;AlarmHigh;AbortLow;Abo



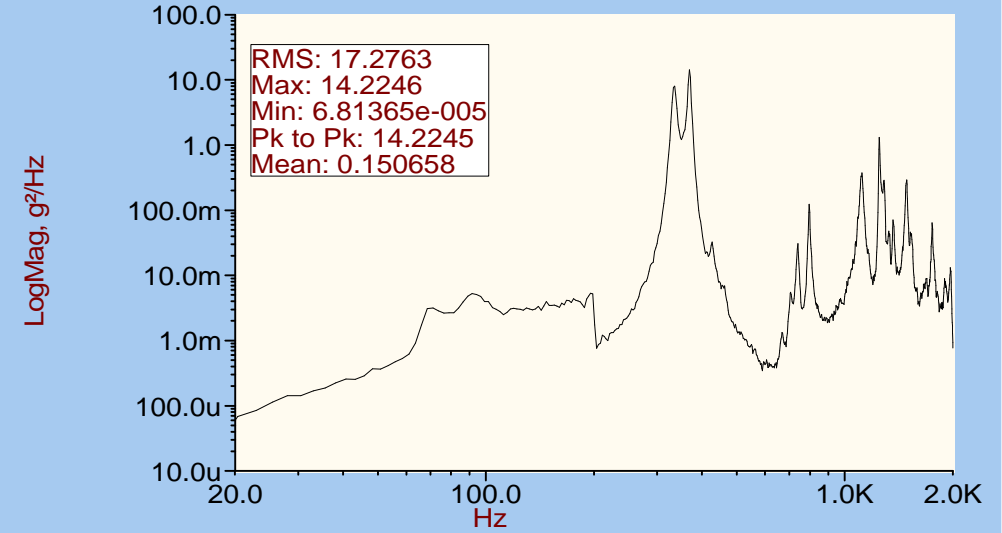
PCAL MOUNT X' AXIS



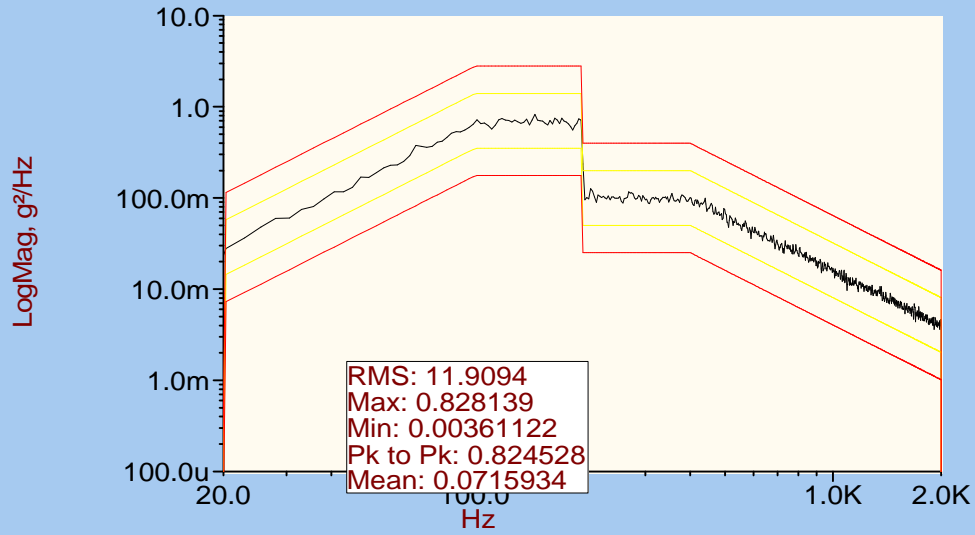
PCAL MOUNT Y AXIS



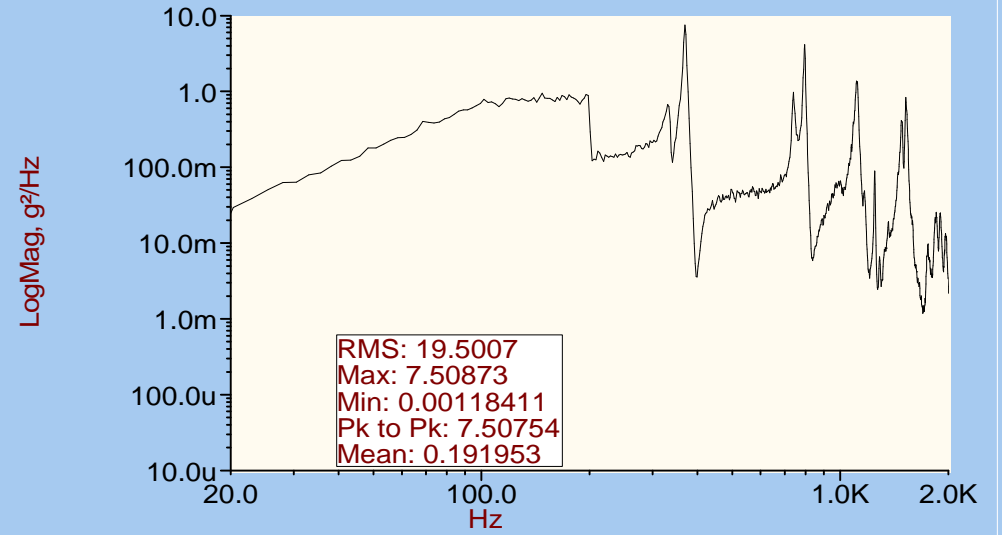
PCAL MOUNT Z' AXIS



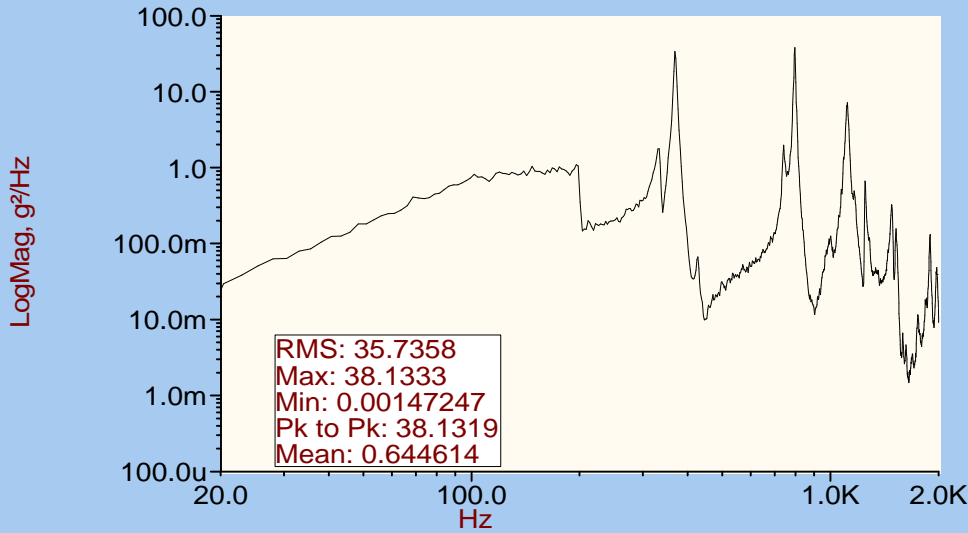
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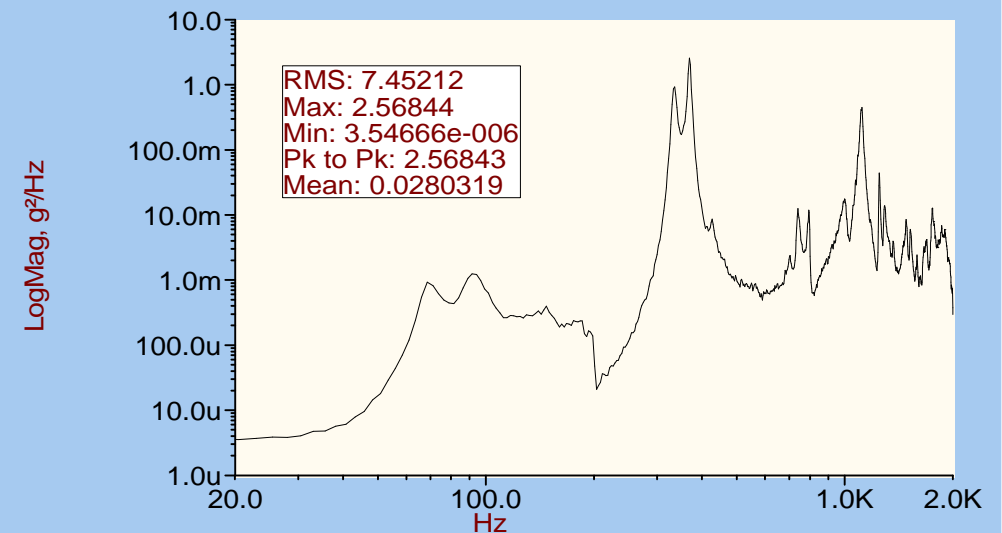
THERMOMETER MOUNT Y AXIS



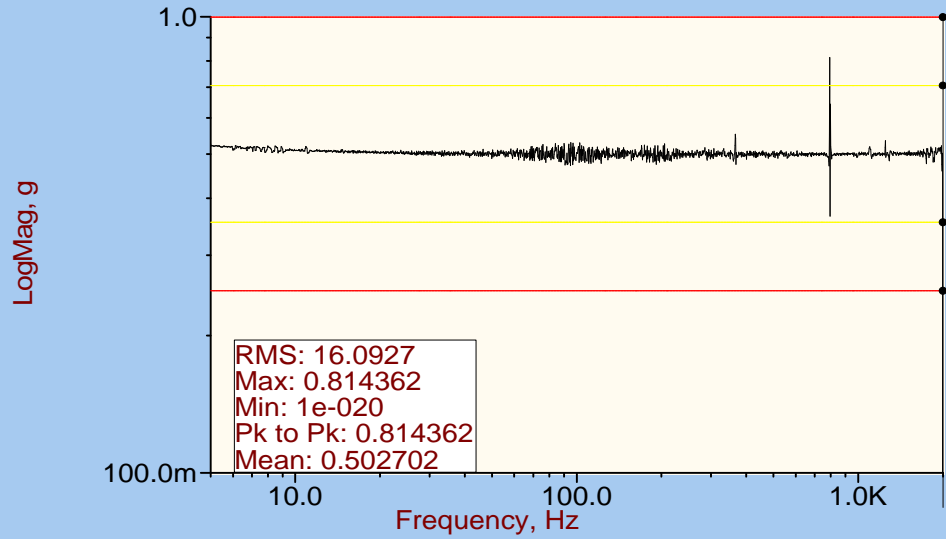
STRUCTURE TOP Y AXIS



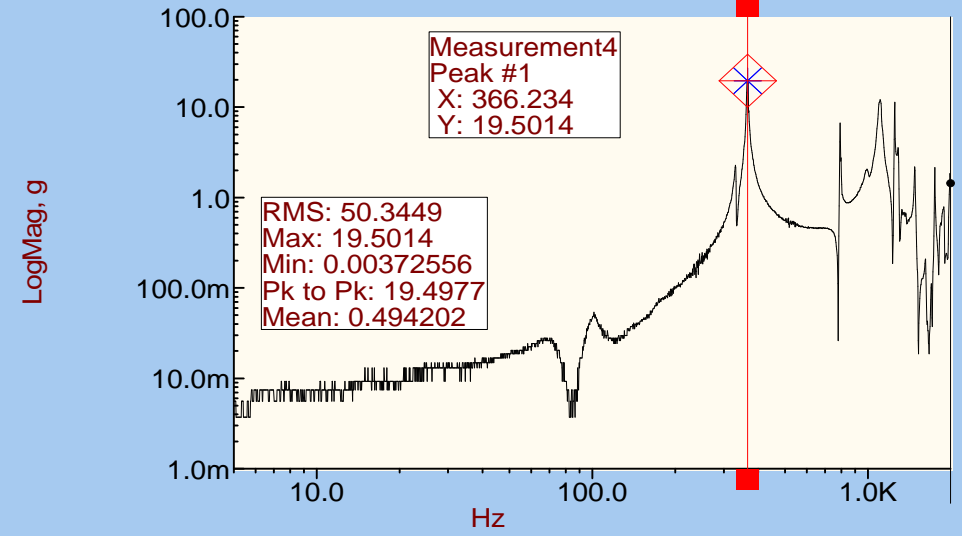
STRUCTURE BOTTOM Z' AXIS



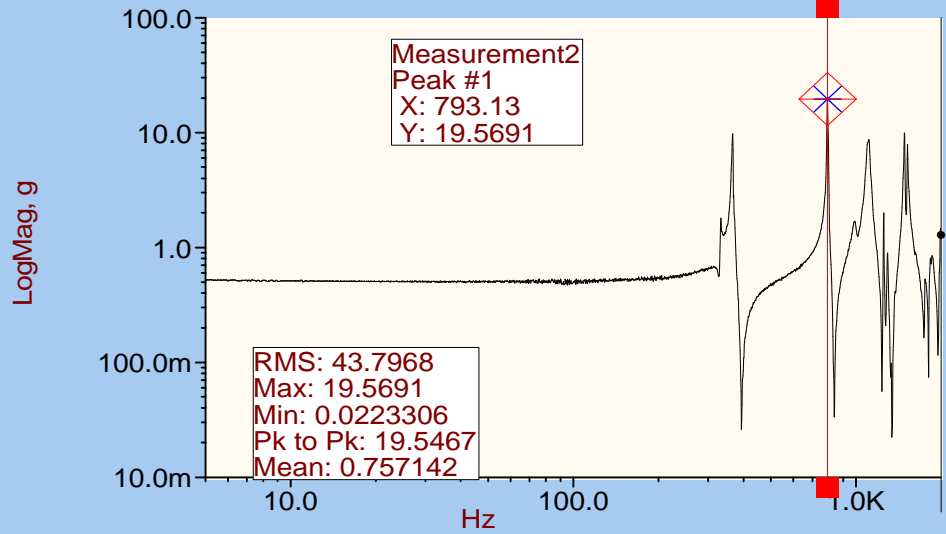
Control;AlarmLow;AlarmHigh;AbortLow;Abo



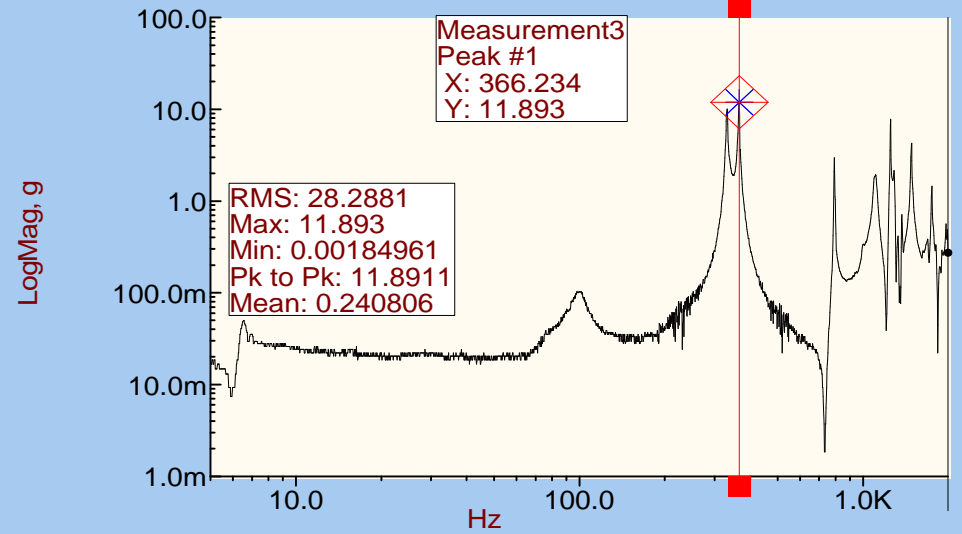
PCAL MOUNT X' AXIS



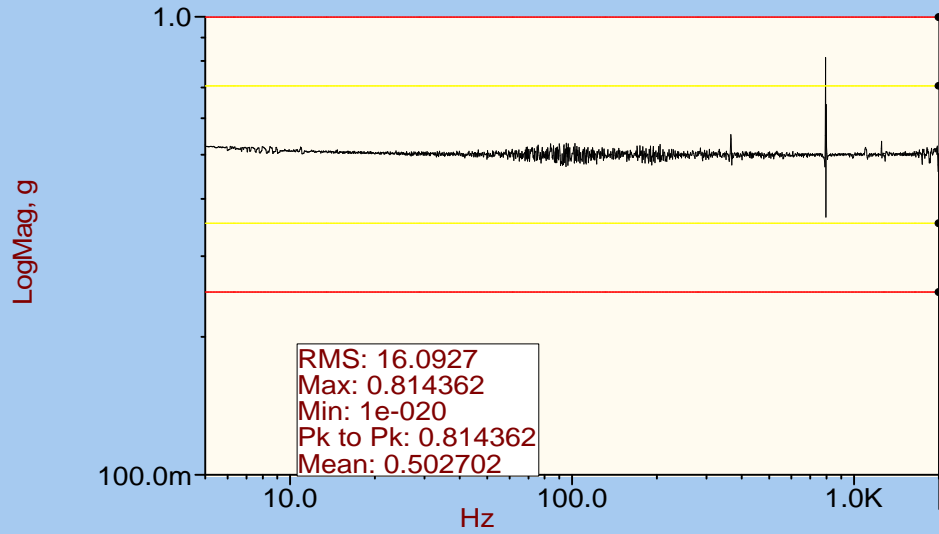
PCAL MOUNT Y AXIS



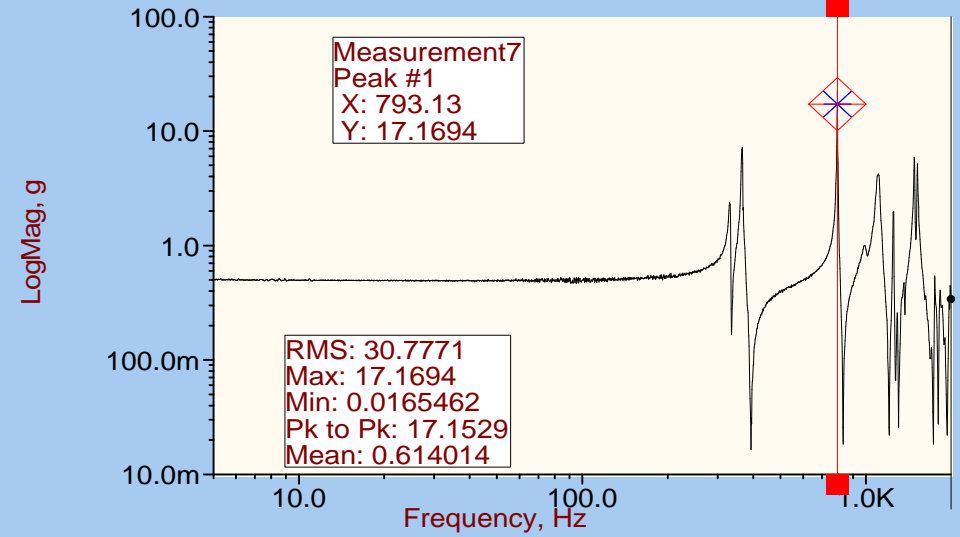
PCAL MOUNT Z' AXIS



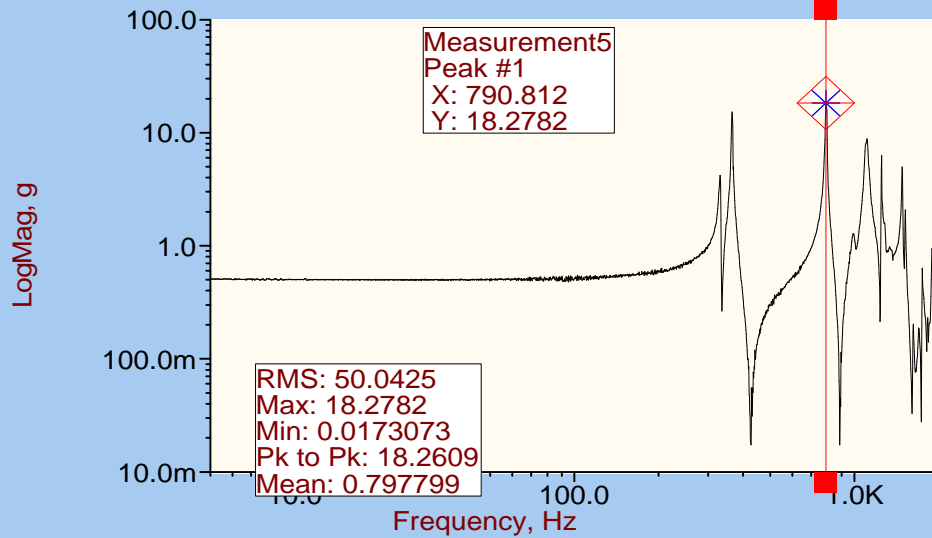
Control;AlarmLow;AlarmHigh;AbortLow;Abo



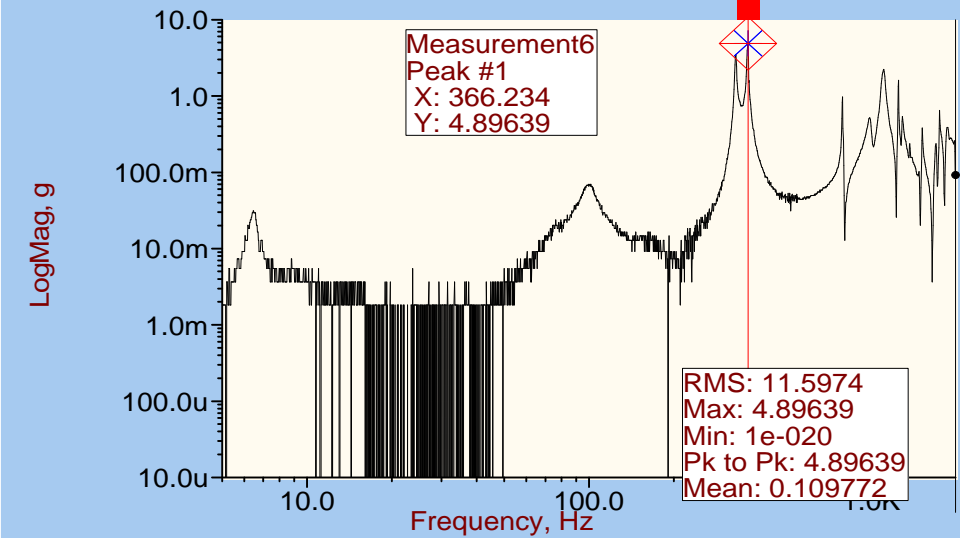
THERMOMETER MOUNT Y AXIS



STRUCTURE TOP Y AXIS



STRUCTURE BOTTOM Z' AXIS



Control;AlarmLow;AlarmHigh;AbortLow;Abo

