



TRACE LABORATORIES, INC – CHICAGO

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TEST REPORT

ARS UNIT QUALIFICATION

Prepared For:

Mr. Ryan Welsh

Boulder Engineering Studio

2516 49th Street, Unit 2

Boulder, CO 80301

FILE NO.:	40640
P.O. NO.:	L6293
DATE TESTING STARTED:	02/04/13
DATE TESTING COMPLETED:	03/13/13
SAMPLE SUBMISSION:	ARS Unit
SAMPLE CONDITION:	Samples Were Visually Inspected Prior To Testing and were Deemed Acceptable For Testing.
SAMPLE DISPOSITION:	Unit was returned to the customer for further evaluation.
REVISION DETAILS OF TEST REPORT (IF ANY):	R0

Approval:

PREPARED BY:	Tracey Bird – Accounting Supervisor	
APPROVED BY:	Leo Bityou – Laboratory Manager	

Unless otherwise stated herein, all equipment used to generate the test results contained herein meets the requirements of ANSI/NCSL Z540-1 and ISO/IEC 17025-2005 and is in calibration and traceable to NIST. As a mutual protection to clients, the public and Trace Laboratories-Central, this report is submitted for the exclusive use of the client to whom it is addressed. This report applies only to the sample(s) tested and is not necessarily indicative of the qualities of apparently similar or identical products. Use of this report, whether in whole or in part, or anything else connected therewith, in any advertising or publicity matter, without prior written authorization from Trace Laboratories-Central is prohibited.



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TEST RESULTS SUMMARY

Test Name	Test Dates	Test Summary	Test Result
Temperature Variation	02/04/13 to 02/05/13	Samples test according to RTCA DO-160G Section 4 Category B2 Section 5 Category B	Conformed to Specifications
Altitude	02/06/13 to 02/07/13	Samples test according to RTCA DO-160G Section 4 Category B2	Conformed to Specifications
Decompression	02/06/13 to 02/07/13	Samples test according to RTCA DO-160G Section 4 Category B2	Conformed to Specifications
Overpressure	02/06/13 to 02/07/13	Samples test according to RTCA DO-160G Section 4 Category B2	Conformed to Specifications
Vibration	02/13 to 02/18/13	Samples test according to RTCA DO-160G Section 8 Category S	Conformed to Specifications
Crash Safety Shock	02/28/13 to 03/01/13	Samples test according to RTCA DO-160G Section 7 Category B	Conformed to Specifications
Flammability	03/13/13 to 03/14/13	RTCA DO-160 Section 26, Category C	Conformed to Specifications
Sustained Acceleration	03/08/13	Samples test according to RTCA DO-160G Section 7 Table 7-1 (Helicopter type "R")	Conformed to Specifications

ANY DEVIATION/EXCLUSION FROM AGREED TEST METHOD

None



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TEMPERATURE VARIATION TEST REPORT

TEST DATES

02/04/13 to 02/05/13

TEST SPECIMENS

ARS-500C-201220

TEST SPECIFICATION

RTCA DO-160G Section 4 Category B2.

REQUIREMENTS

The specification for the procedure is taken from RTCA DO-160G Section 4 Cat B2 and Section 5 Category B. The compliance to these requirements is validated by performing a combined test. The temperature variation test is combined to include the procedures of the ground survival low temperature, short-time operating low temperature, operating low temperature, ground survival high temperature, short-time operating high temperature, and operating high temperature tests.

PROCEDURE

1. At the ambient pressure with the equipment not operating, allow the equipment temperature to stabilize at the appropriate ground survival low temperature (-55°C). Maintain this temperature for at least three hours.
2. With the equipment operating, subject it to the short time operating low temperature (-45°C) for a period of not less than one hour.
3. Raise the temperature in the chamber towards the operating high temperature ($+85^{\circ}\text{C}$). During this temperature change, verify the EUT. Permit the EUT temperature to stabilize.
4. At the ambient pressure with the equipment not operating, raise the temperature and allow the equipment temperature to stabilize at the appropriate ground survival high temperature ($+85^{\circ}\text{C}$) maintain temperature for at least three hours.
5. With the equipment not operating, decrease the temperature to the short time operating high temperature ($+70^{\circ}\text{C}$) and allow the temperature to stabilize. Operate the EUT for a period of not less than two hours.
6. With the equipment operating, decrease the test chamber air temperature to the appropriate operating high temperature ($+55^{\circ}\text{C}$) at the ambient air pressure.
7. Allow the equipment temperature to stabilize.
8. Operate the equipment for a minimum of ninety minutes while maintaining the temperature of the air in the test chamber at the operating high temperature ($+55^{\circ}\text{C}$), and then operate the equipment for at least one hour.
9. Change the temperature of the chamber towards the ambient temperature.
10. Stabilize the chamber and the equipment at ambient temperature.

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Notes:

All temperature change rates were at 5°C minimum per minute.

A minimum of two cycles were completed.

INSTRUMENTATION

EQUIPMENT	MANUFACTURER	MODEL#	LAB#	LAST CAL.	NEXT CAL.
Temperature Cycle Chamber	Tenney HAL-12	T5-1	TL745	N/A	N/A
Chart Recorder	Honeywell	DR45AT	TL617	11/08/12	11/08/13
Power Supply	Topward	3303A	TL1379	N/A	N/A
DMM	Fluke	21 III	TL886	02/04/13	02/04/14

TEST RESULTS

One ARS Unit was tested per RTCA DO160G Section 4 Cat B2 and section 5 Cat B. All samples conformed to specifications before, during, and at the conclusion of the test.



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PHOTOS



Samples Setup



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Sample Operating During Test



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Sample Operating During Test



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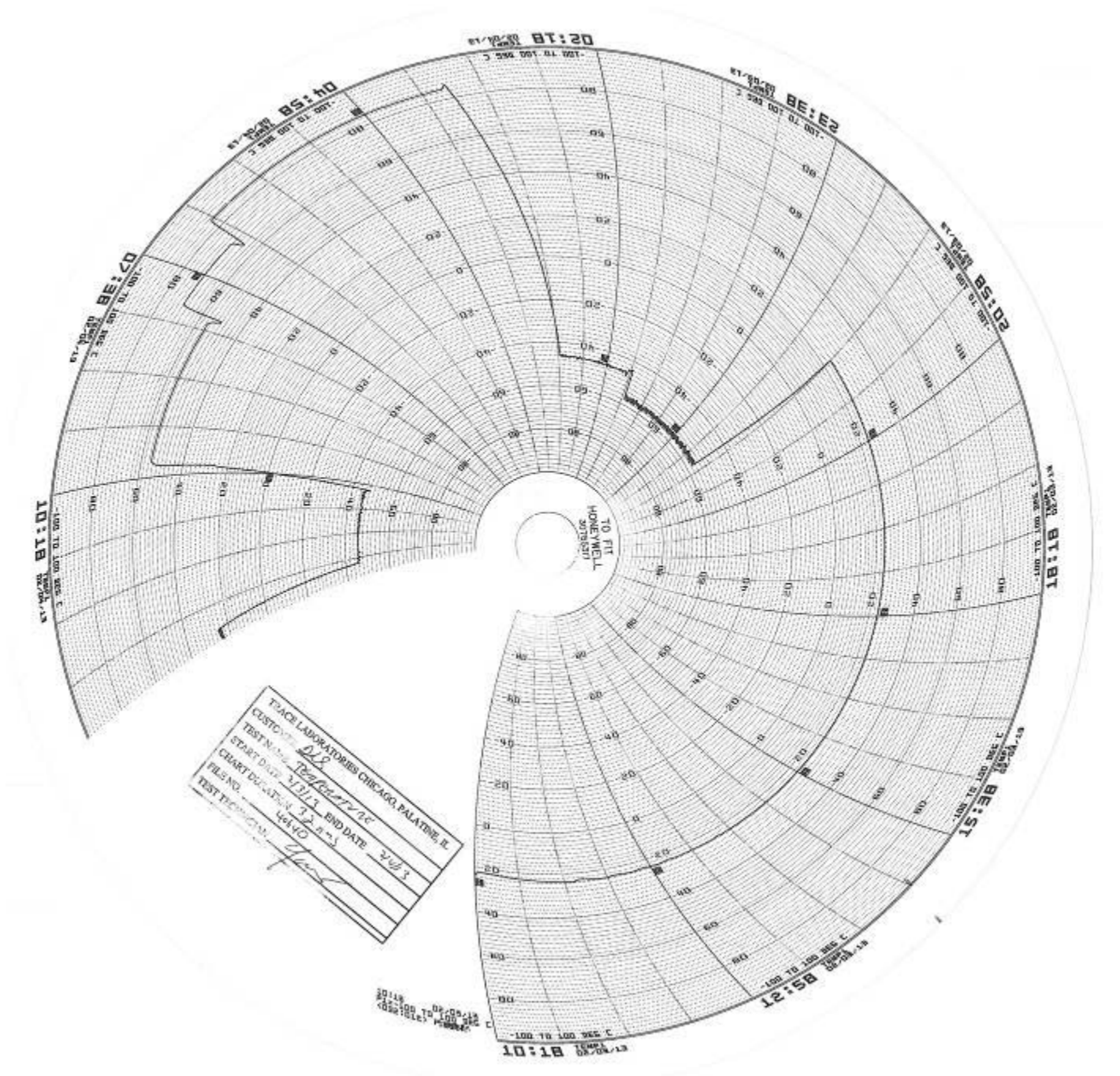
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CHARTS





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ALTITUDE TEST REPORT**TEST DATES**

02/06/13

TEST SPECIMENS

ARS-500C-201220

TEST SPECIFICATION

RTCA/DO-160G Section 4.6.1 Category B2

REQUIREMENTS

The UUT will be placed in a pressure-controlled chamber and subjected to low-pressure conditions per RTCA/DO160G Section 4.6.1 Category B2.

PROCEDURE

1. Perform pre-test performance verification.
2. Ramp from ambient to +15,000Ft. (rate unspecified).
3. Stabilized at +15,000Ft and maintain for 2 hours. (Perform OT in chamber).
4. Monitor operation at +15,000Ft.
5. Return to ambient. Perform post-test performance verification.

INSTRUMENTATION

EQUIPMENT	MANUFACTURER	MODEL#	LAB#	LAST CAL.	NEXT CAL.
Temperature Altitude Chamber	Thermotron	F-8-CHA-3-3	TL495	As Used	As Used
Manometer, 15psig	Wallace & Tiernan	FA160	TL496	01/14/10	01/14/11
Chart Recorder	Honeywell	DR45AT	TL638	05/11/10	05/11/11
Power Supply	Topward	3303A	TL1379	N/A	N/A

TEST RESULTS

One ARS Unit was tested per RTCA DO160G Section 4 Category B2. The sample conformed to specifications before, during, and at the conclusion of the test.



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PHOTOS



Sample Set up



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Altitude of 15,000 Feet



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DECOMPRESSION TEST REPORT**TEST DATES**

02/07/12

TEST SPECIMENS

ARS-500C-201220

TEST SPECIFICATION

RTCA-DO-160G, section 4.6.2, Category B2

REQUIREMENTS

One ARS Unit shall function properly during and after exposure to the simulated atmosphere change from 8,000 feet (564 mm Hg) to 25,000 feet (283 mm Hg) in 15 seconds or less as described in RTCA-DO-160G, section 4.6. The unit shall then be held at a simulated atmosphere of 25,000 feet for ten (10) minutes.

PROCEDURE

One ARS Unit was subjected to a simulated atmosphere change from 8,000 feet (564 mm Hg) to 25,000 feet (283 mm Hg) in 15 seconds or less as described in RTCA-DO-160G, section 4.6.2. The unit was then held at a simulated atmosphere of 15,000 feet for ten (10) minutes and was operating.

INSTRUMENTATION

EQUIPMENT	MANUFACTURER	MODEL#	LAB#	LAST CAL.	NEXT CAL.
Temperature Altitude Chamber	Thermotron	F-8-CHA-3-3	TL495	As Used	As Used
Manometer, 15psig	Wallace & Tiernan	FA160	TL496	01/14/10	01/14/11
Chart Recorder	Honeywell	DR45AT	TL638	05/11/10	05/11/11
Power Supply	Topward	3303A	TL1379	N/A	N/A

TEST RESULTS

One ARS Unit was tested per RTCA DO160G Section 4. The sample conformed to specifications before, during, and at the conclusion of the test.



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PHOTOS



Altitude of 8,000 Feet



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Altitude of 25,000 Feet



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OVERPRESSURE TEST REPORT**TEST DATES**

02//07/13

TEST SPECIMENS

ABS Cabin Phone with content loader

Serial Number P3

TEST SPECIFICATION

RTCA/DO-160G Section 4.6.3

Document Number D14545 Revision B

REQUIREMENTS

The ABS Cabin Phone with content loader shall not be operating the exposure of the simulated atmosphere of -15,000 feet for ten (10) minutes as described in RTCA-DO-160G, section 4.6.3 and Document Number D14545 Revision B.

PROCEDURE

1. Perform pre-test performance verification.
2. Perform baseline OT at ambient conditions.
3. Ramp from ambient to -15,000Ft (rate unspecified).
4. Maintain chamber at -15,000Ft for at least 10 minutes.
5. Return to ambient.
6. Power on UUT, perform post-test OT.

INSTRUMENTATION

EQUIPMENT	MANUFACTURER	MODEL#	LAB#	LAST CAL.	NEXT CAL.
Pressure Gauge	Marsh	0-30 PSI	TL511	04/09/12	04/09/13
Temperature Altitude Chamber	Thermotron	F-8-CHA-3-3	TL495	As Used	As Used
Manometer, 15psig	Wallace & Tiernan	FA160	TL496	01/14/10	01/14/11
Chart Recorder	Honeywell	DR45AT	TL638	05/11/10	05/11/11

TEST RESULTS

One ABS Cabin Phone with content loader was tested per RTCA DO160G Section 4.6.3 and Document Number D14545 Revision B. The sample conformed to specifications before, and at the conclusion of the test.



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PHOTOS



Sample Set up



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-15000 Feet



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Overpressure Chamber



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VIBRATION TEST REPORT**TEST DATES**

02/13 to 02/18/13

TEST SPECIMENS

ARS-500C-201220

TEST SPECIFICATION

RTCA/DO-160G, Section 8, Category S (Curves C, L, M and Y)

REQUIREMENTS

The sample shall be subjected to testing per RTCA/DO-160G, Section 8, Category S (Curves C, L, M and Y) in all three axes. The sample shall be powered and operational during and post vibration testing.

PROCEDURE

The sample was subjected to testing per the requirements section above. One (1) control accelerometer was used to measure and adjust the input vibration level. One (1) response accelerometer was used to measure the output response of the sample. Pictures were taken to depict the test setup in each axis.

INSTRUMENTATION**Category S, Curve C Equipment List**

EQUIPMENT	MANUFACTURER	MODEL#	LAB#	LAST CAL.	NEXT CAL.
Signal Conditioner	PCB Piezotronics	Y482C16	TL-1331	04/16/12	04/16/13
Electrodynamic Shaker	Unholtz-Dickie	T2000	TL-1243	NA	NA
Vibration Controller	Unholtz-Dickie	UD VWIN II	TL-1213	06/14/12	06/14/13
Accelerometer	PCB	353B18	TL-1355	01/02/13	01/02/14
Accelerometer	PCB	352C22	TL-1316	01/02/13	01/02/14

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INSTRUMENTATION CONTINUED**Category S, Curve L, M, and Y**

EQUIPMENT	MANUFACTURER	MODEL#	LAB#	LAST CAL.	NEXT CAL.
Signal Conditioner	PCB Piezotronics	Y482C16	TL-1331	04/16/12	04/16/13
Electrodynamic Shaker	Unholtz-Dickie	T2000	TL-1243	NA	NA
Vibration Controller	Unholtz-Dickie	UD VWIN II	TL-1213	06/14/12	06/14/13
Accelerometer	PCB	353B18	TL-1355	01/02/13	01/02/14
Accelerometer	PCB	352C22	TL-1316	01/02/13	01/02/14

TEST RESULTS

Testing was performed per the requirements section above. The sample experienced difficulty booting up after performing axis two of category S, Curve Y. The solid state drive was replaced and it began to boot up properly again.



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PHOTOS

**Axis One
Test Setup Picture
Depiction for all vibration tests**





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**Axis Two
Test Setup Picture
Depiction for all vibration tests**





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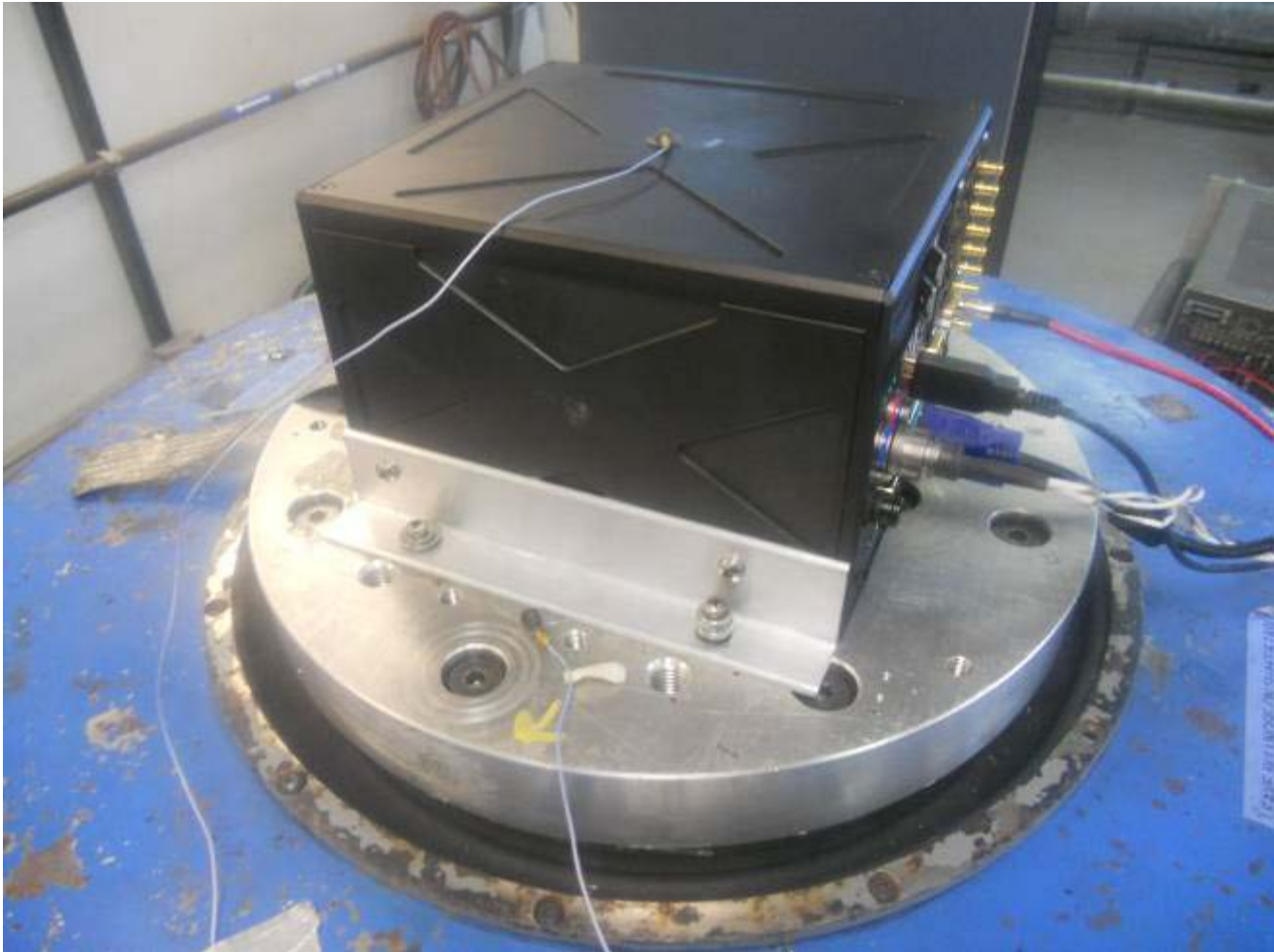
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**Axis Three
Test Setup Picture
Depiction for all vibration tests**





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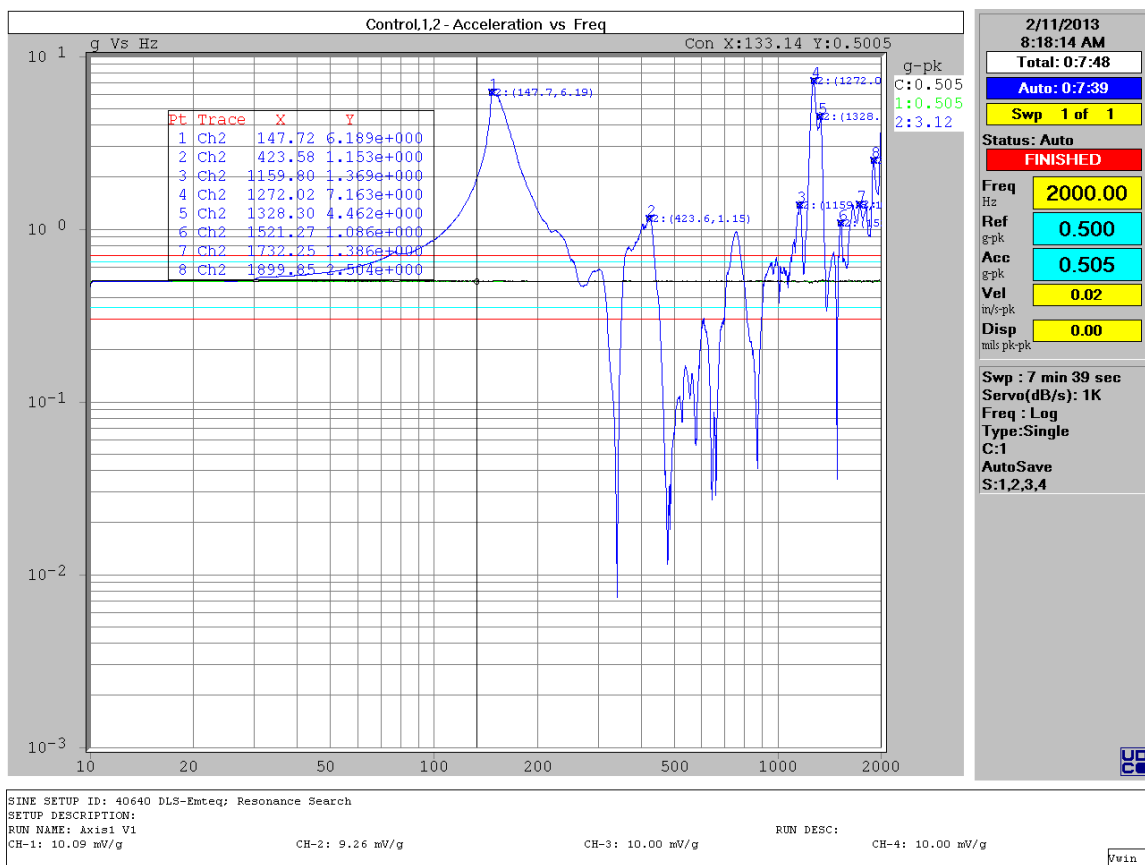
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GRAPHS

**Axis One
Resonance Search
Pre Random Vibration
Category S, Curve C**





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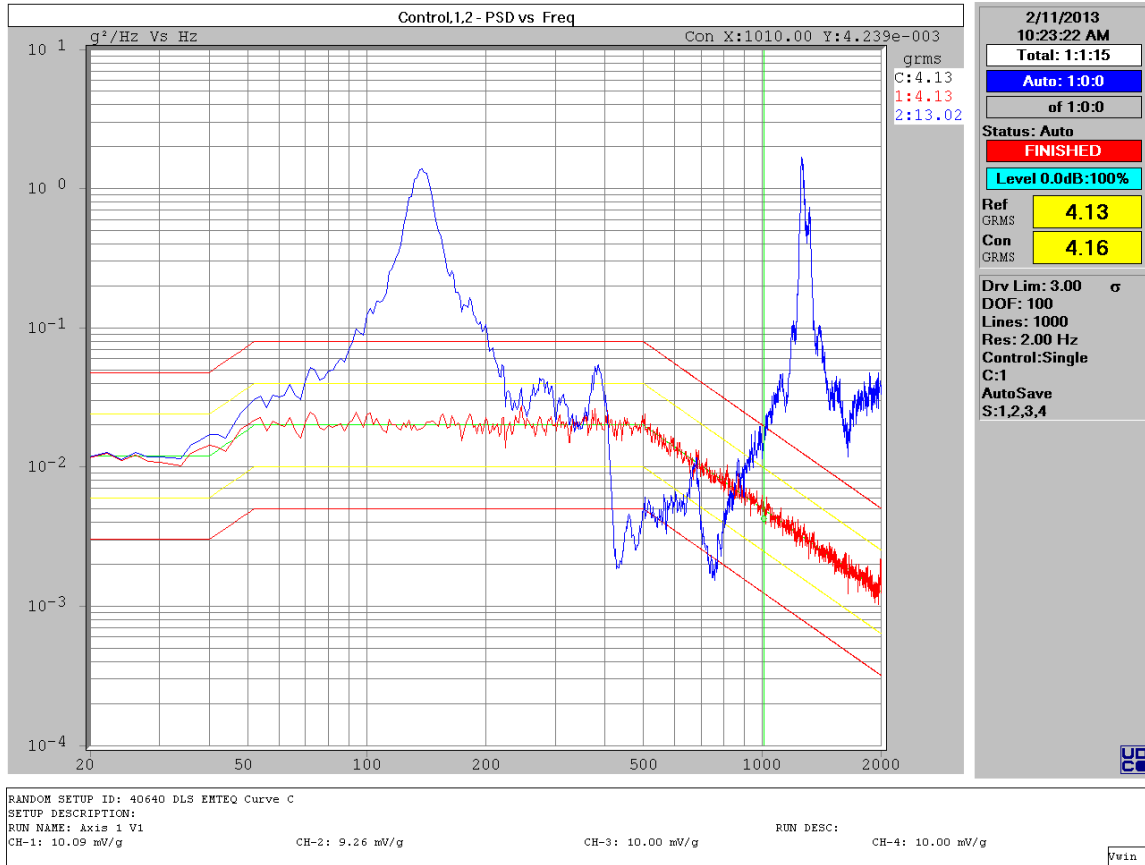
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Axis One
Random Vibration
Category S, Curve C



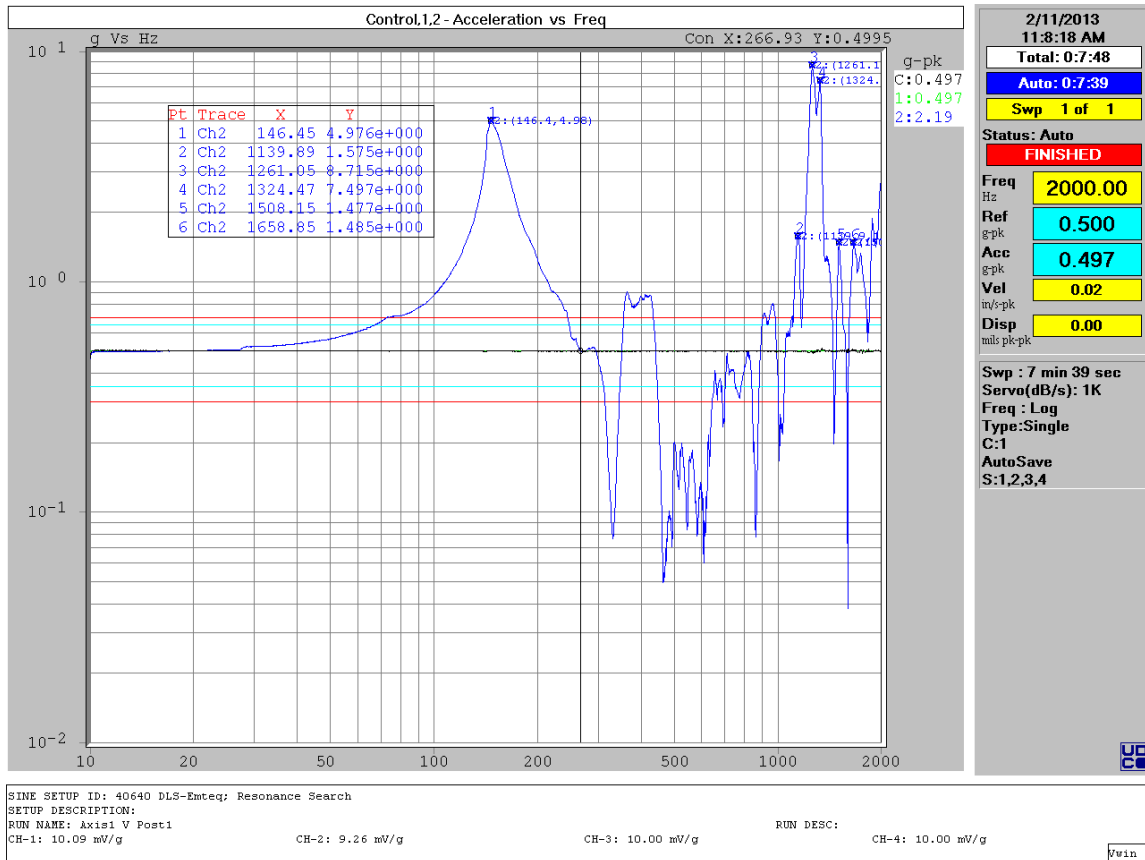


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Axis One
Resonance Search
Post Random Vibration
Category S, Curve C



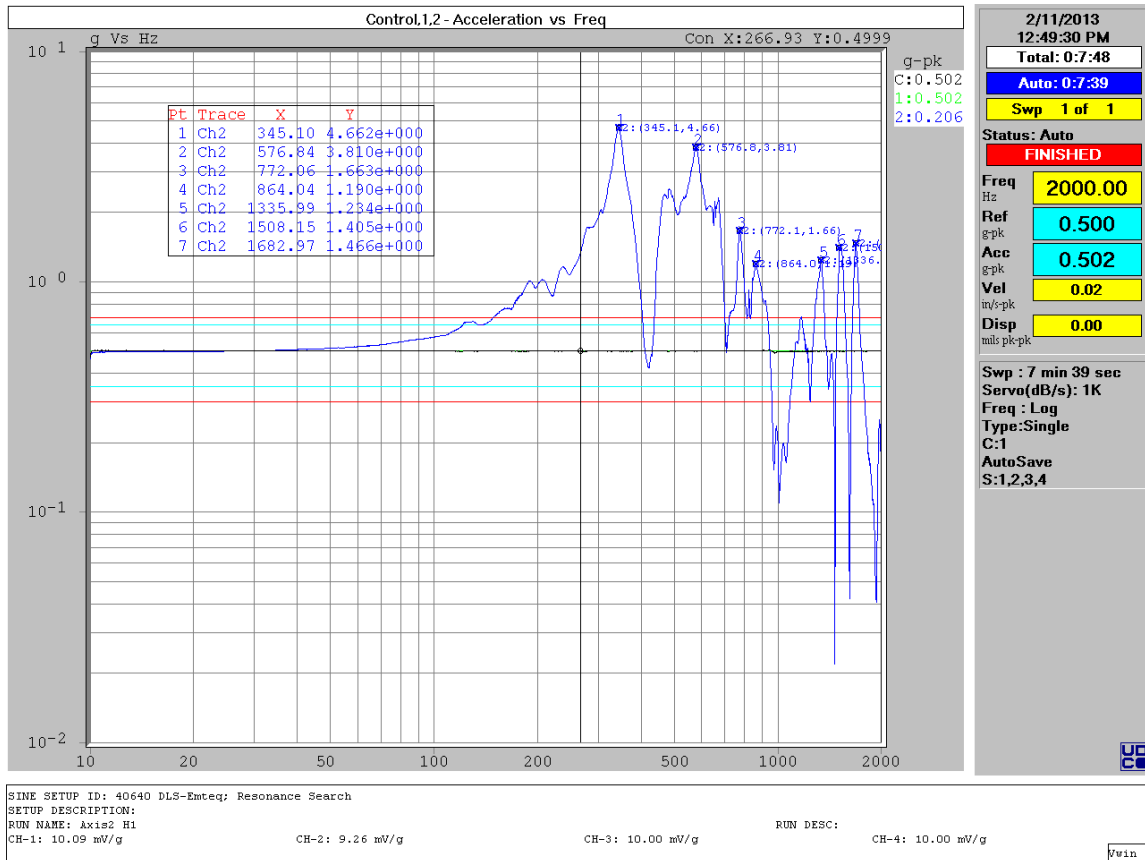


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Axis Two
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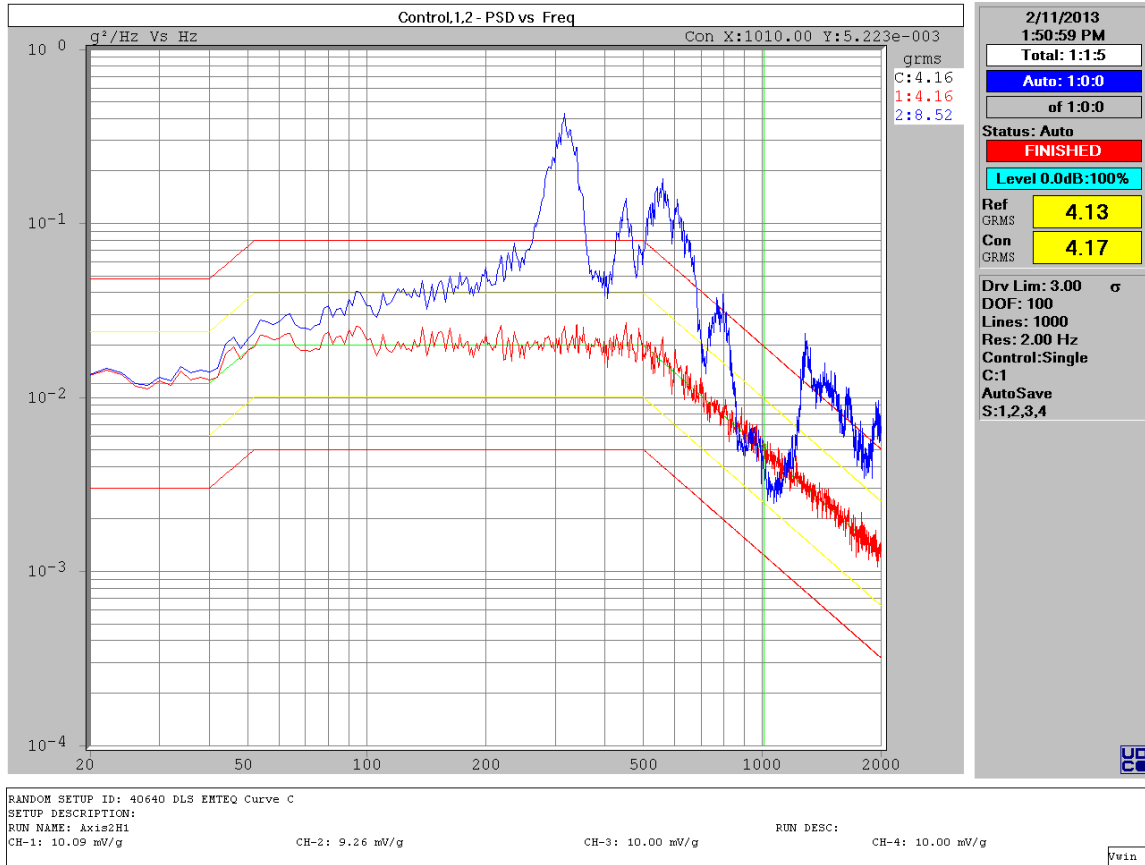
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Random Vibration
Category S, Curve C



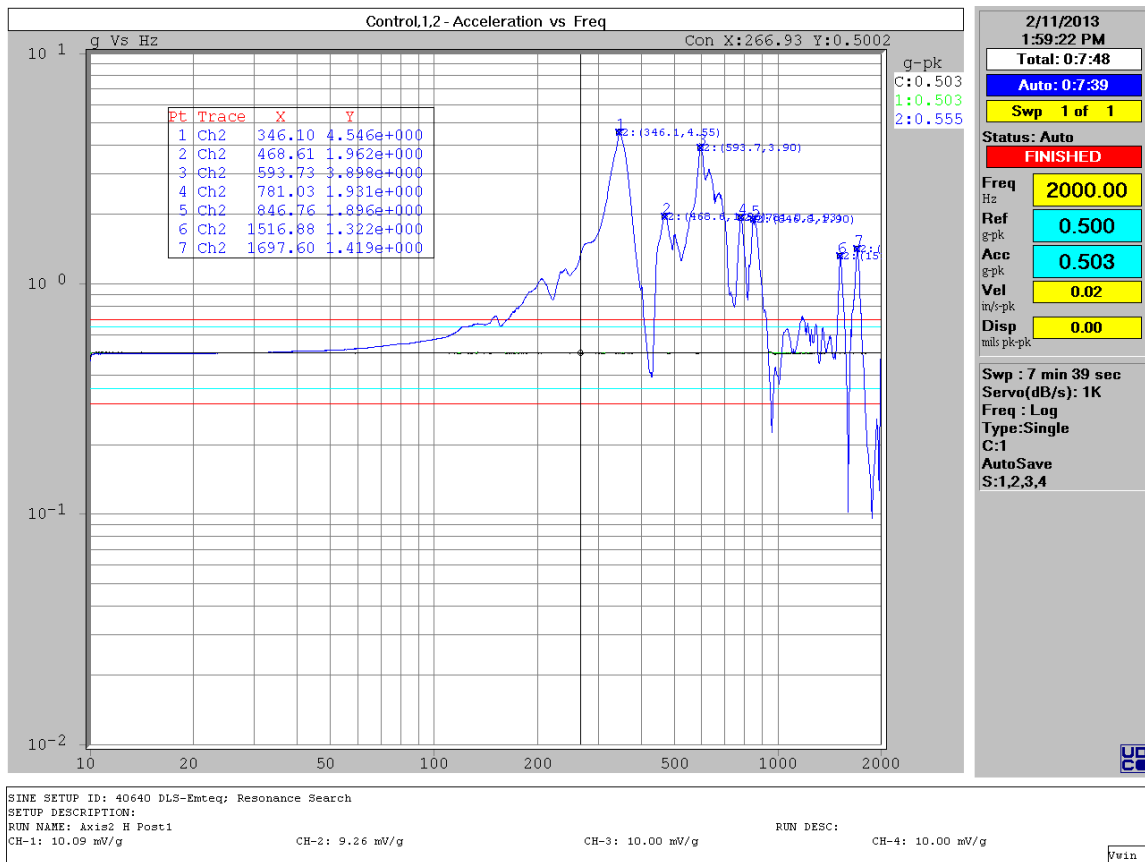


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Resonance Search
Post Random Vibration
Category S, Curve C



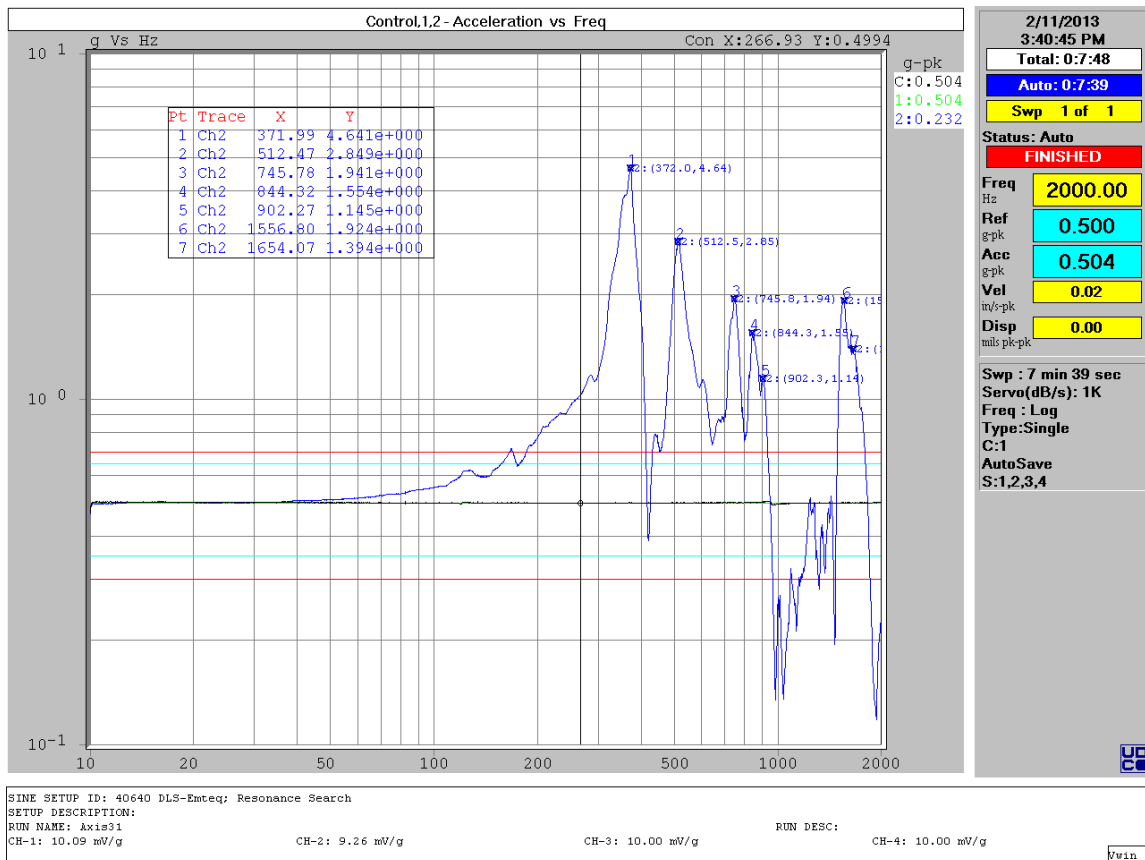


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Resonance Search
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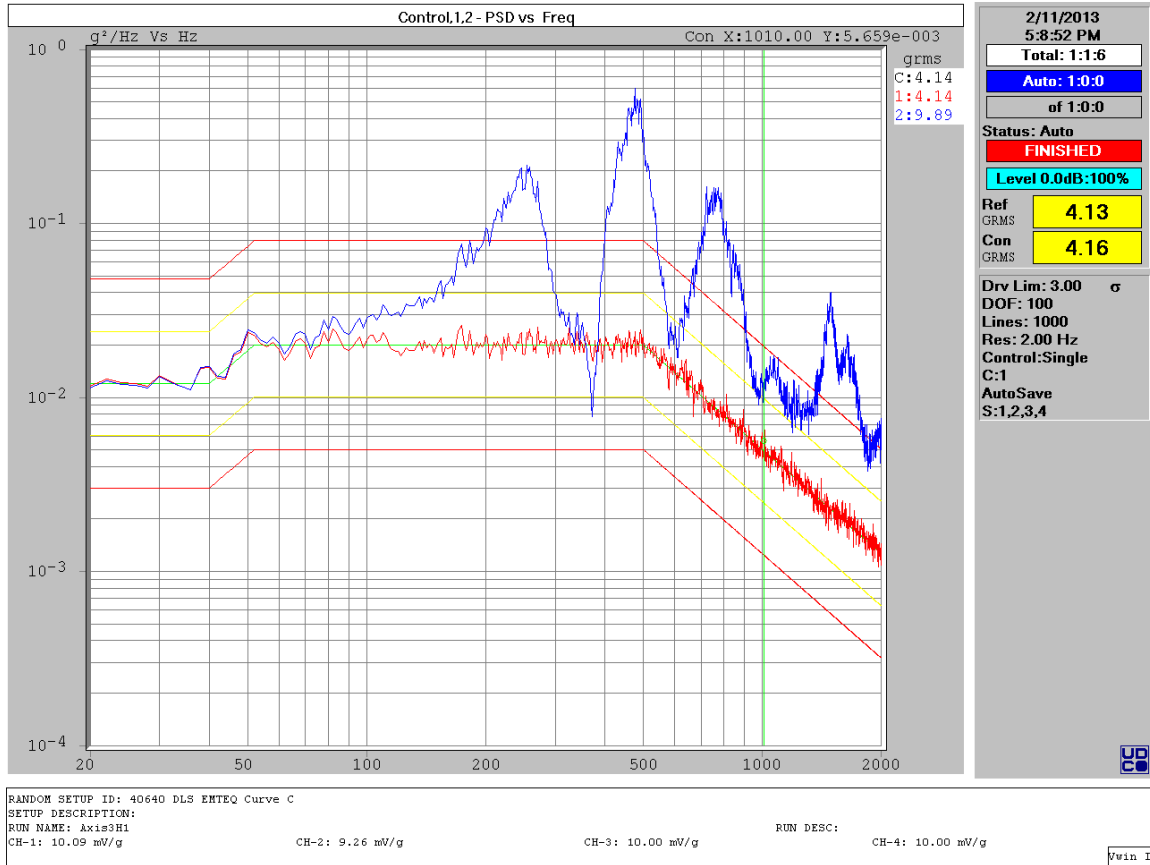
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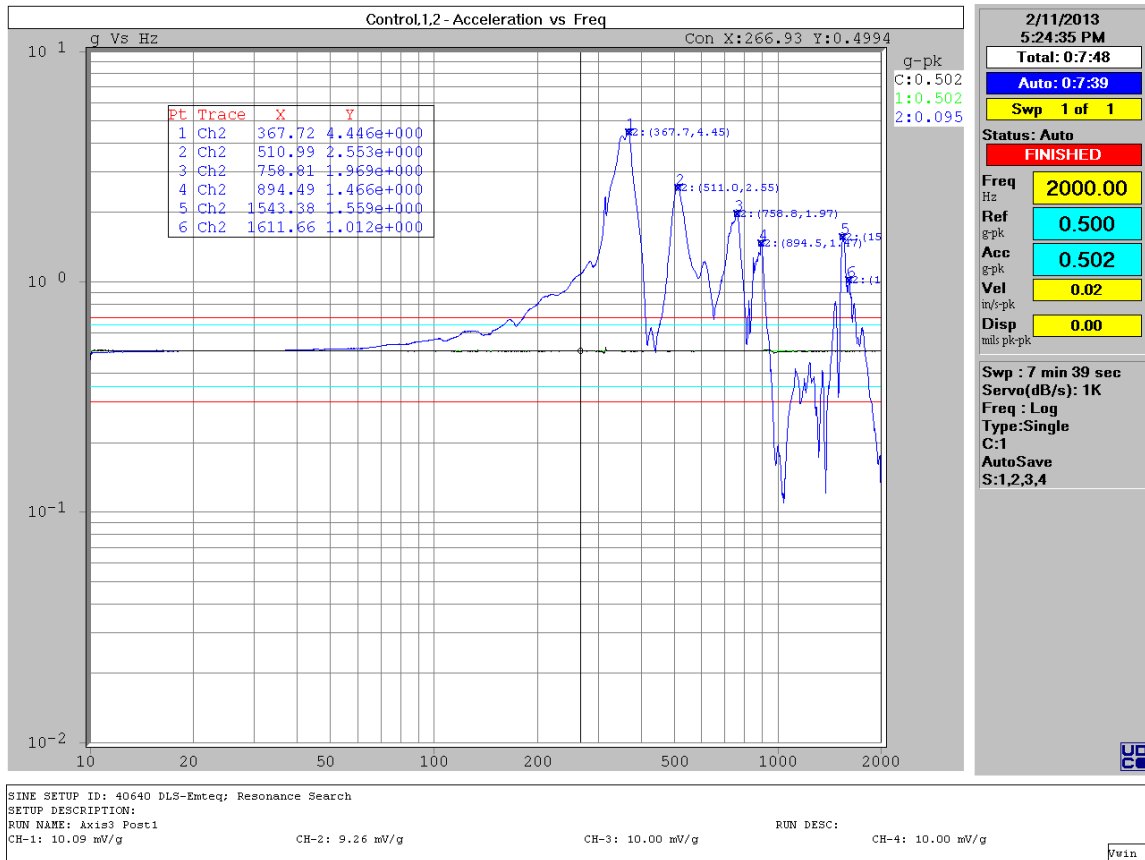


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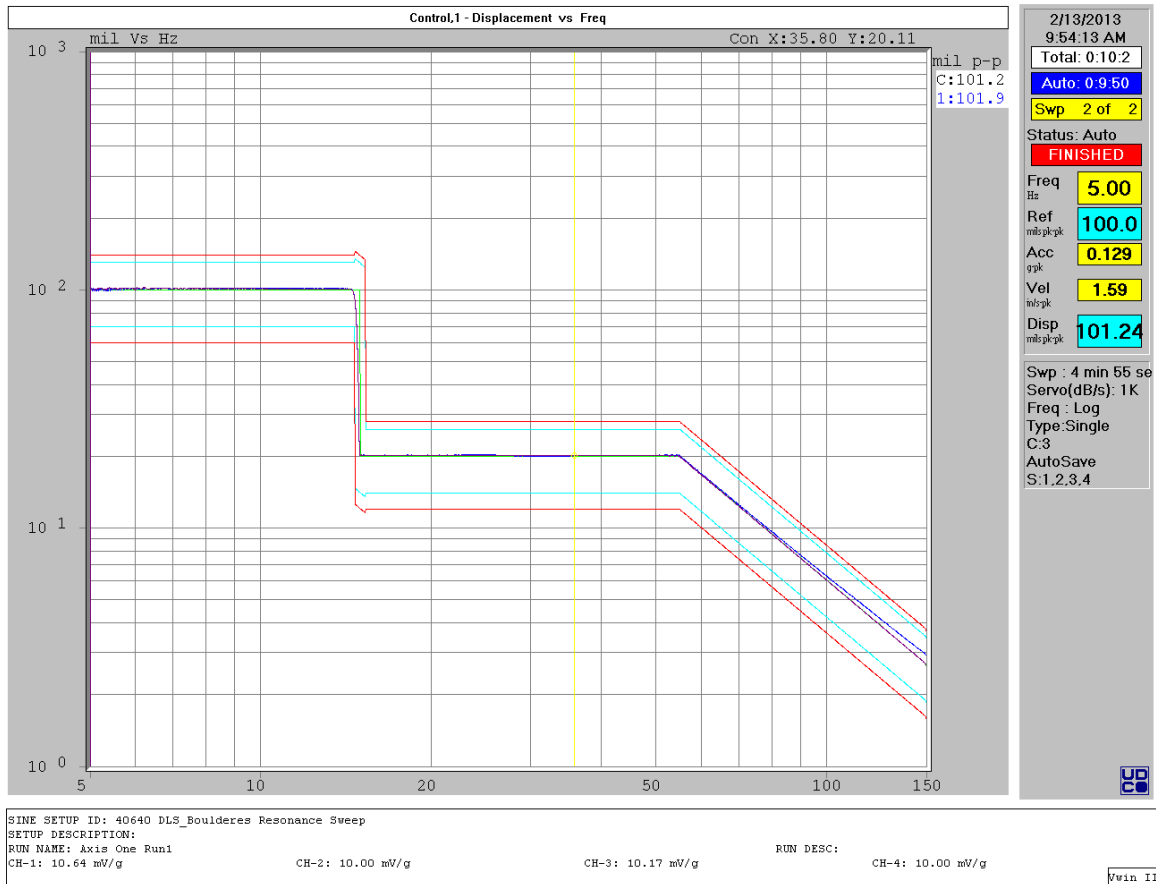
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Axis One
Resonance Search
Pre Sinusoidal Vibration
Category S, Curve L





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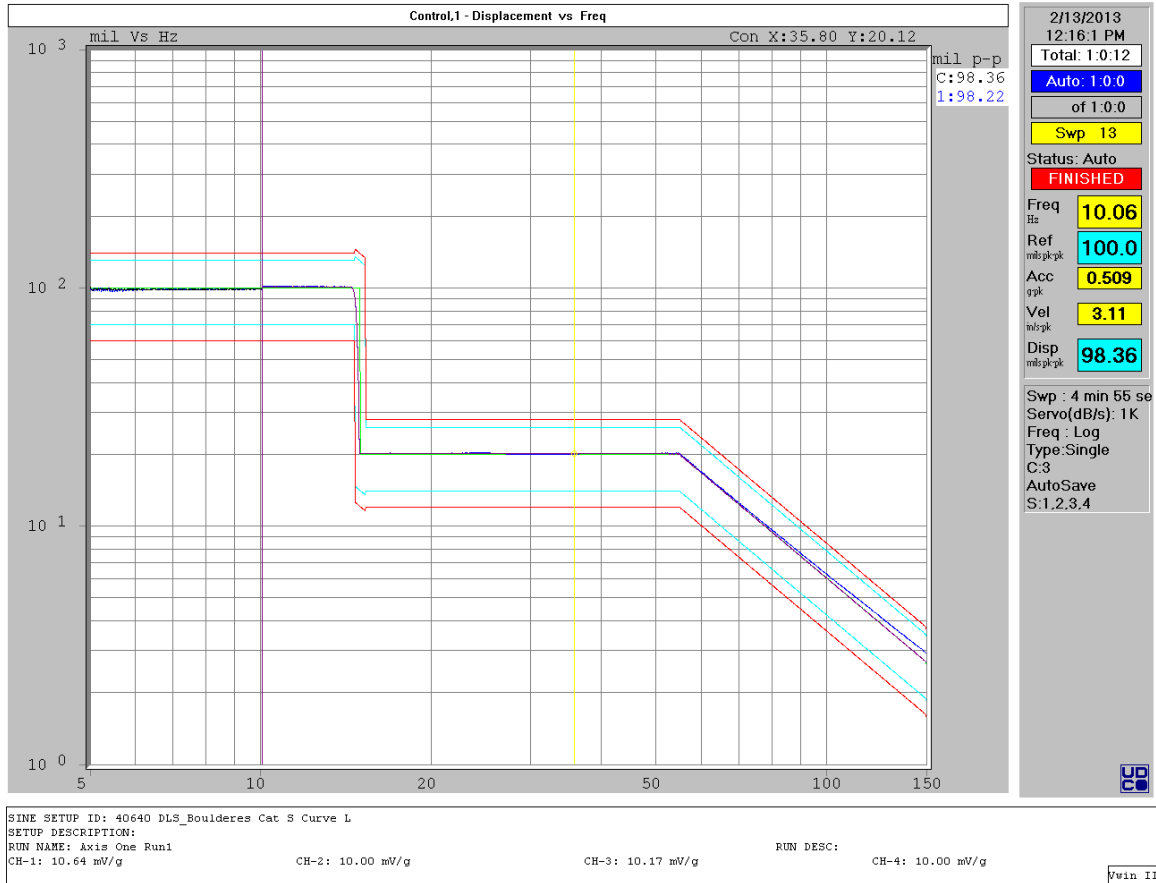
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Axis One
Sinusoidal Vibration
Cat S Curve L





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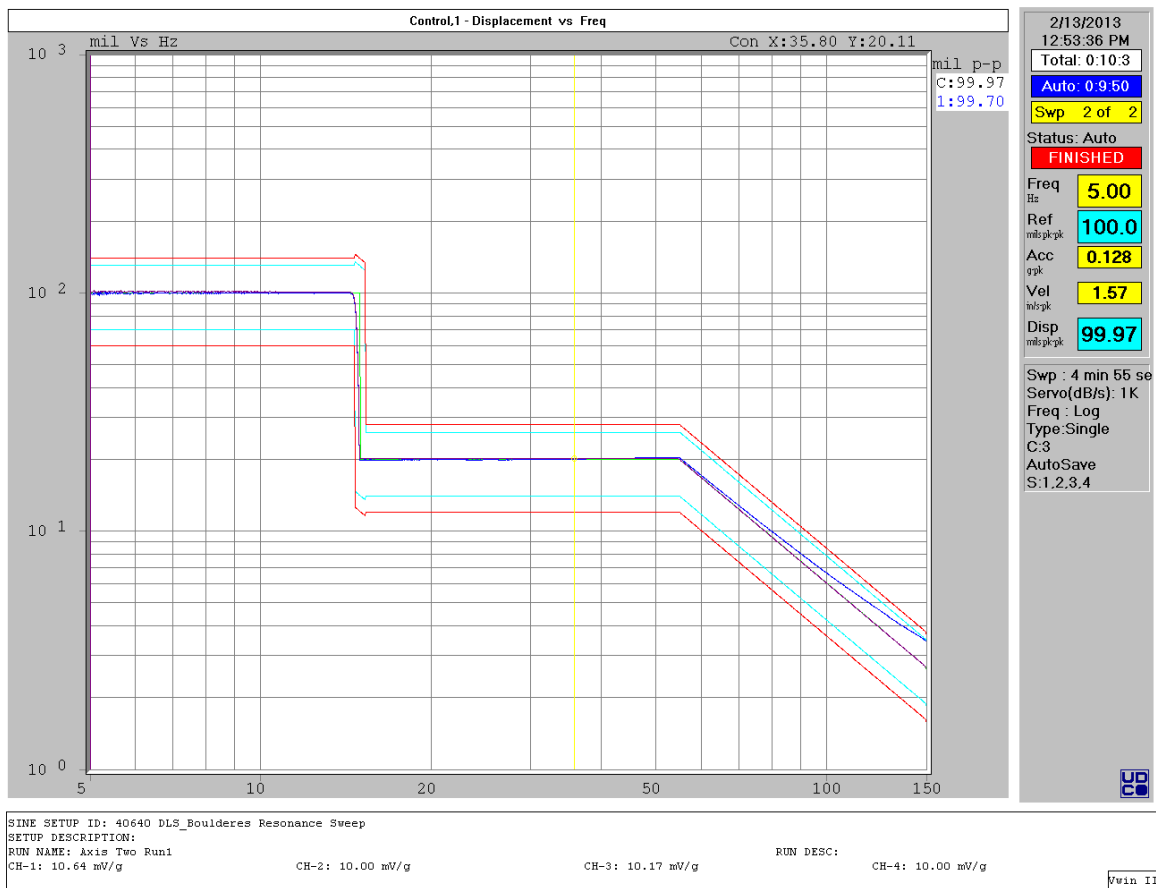
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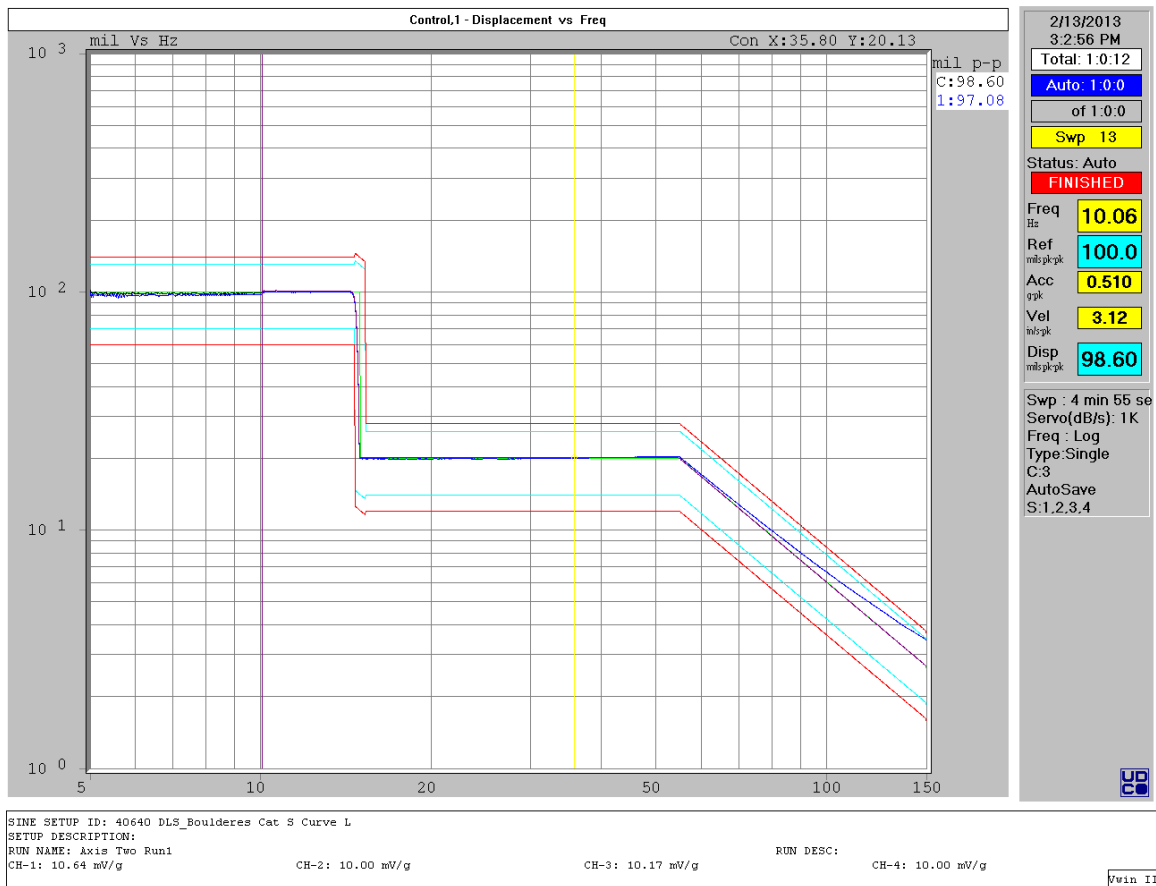
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Cat S Curve L





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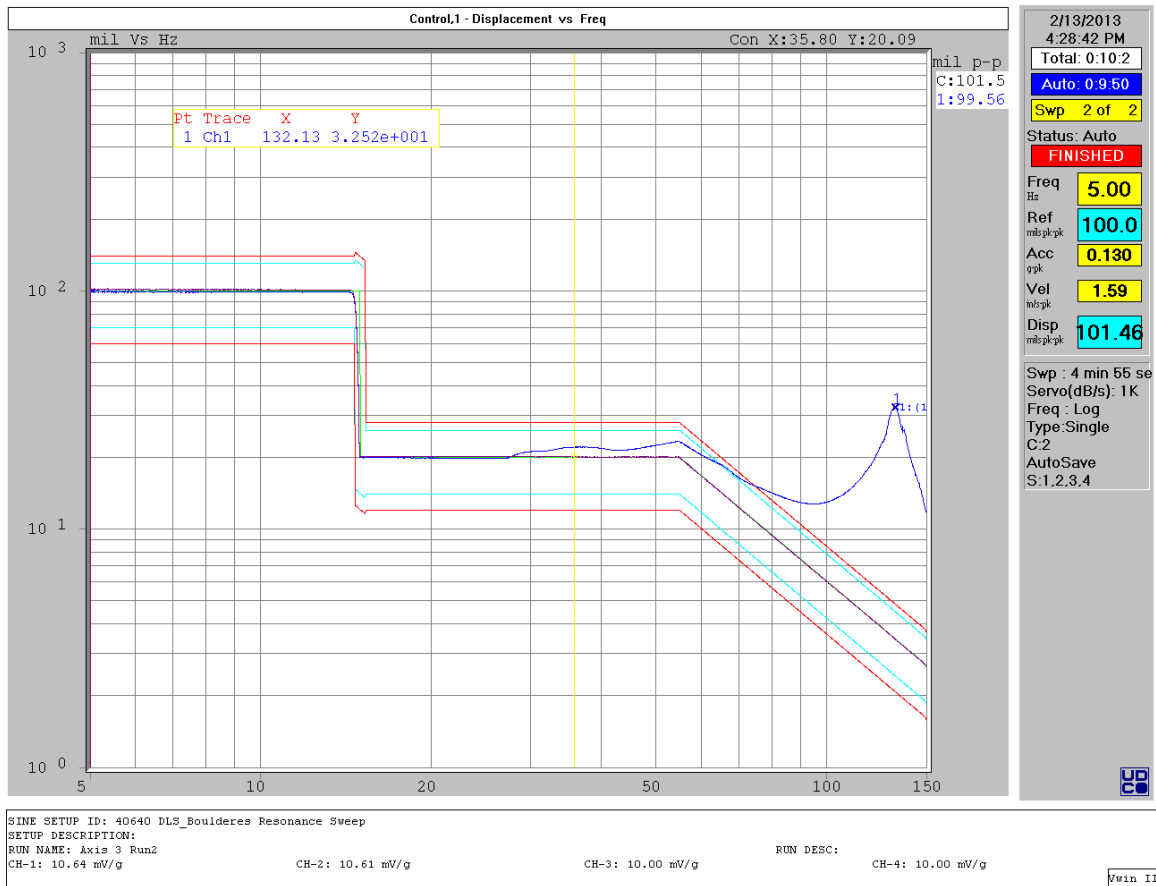
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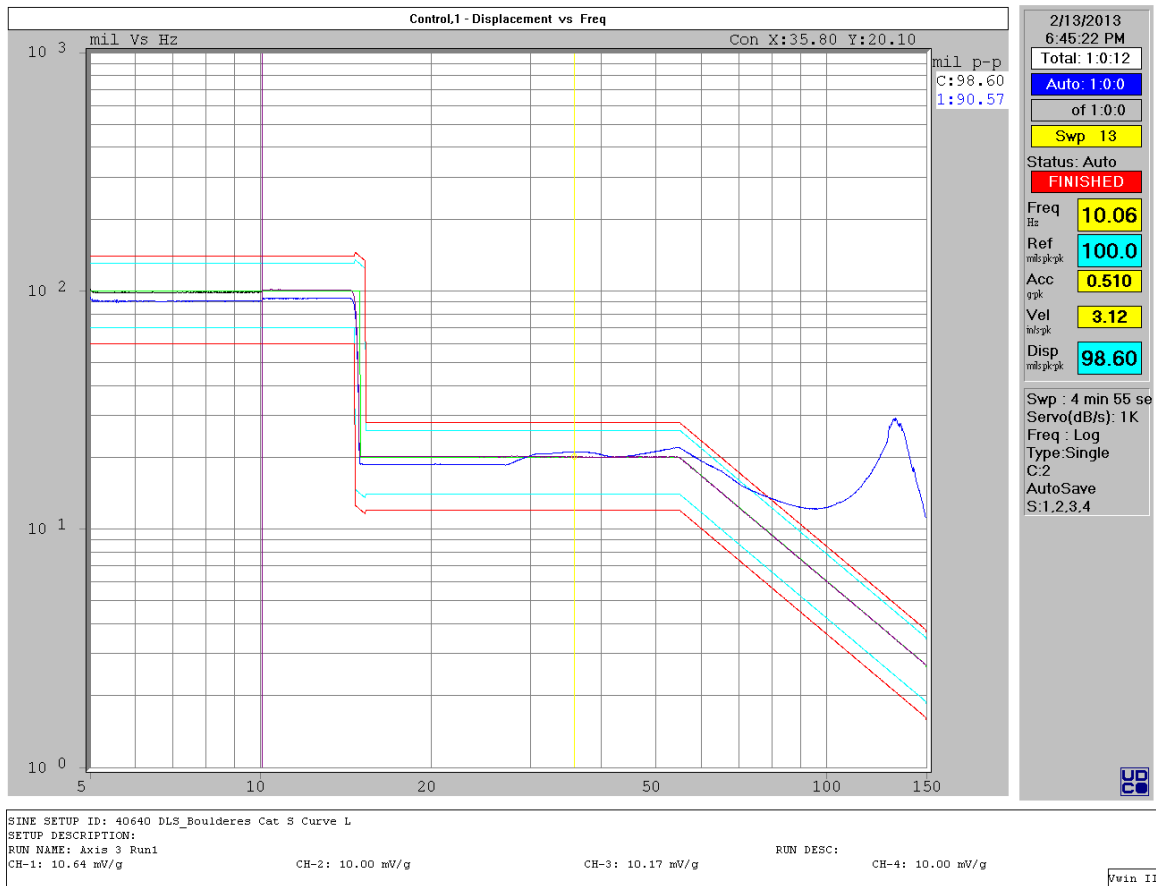
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Axis Three
Sinusoidal Vibration
Cat S Curve L





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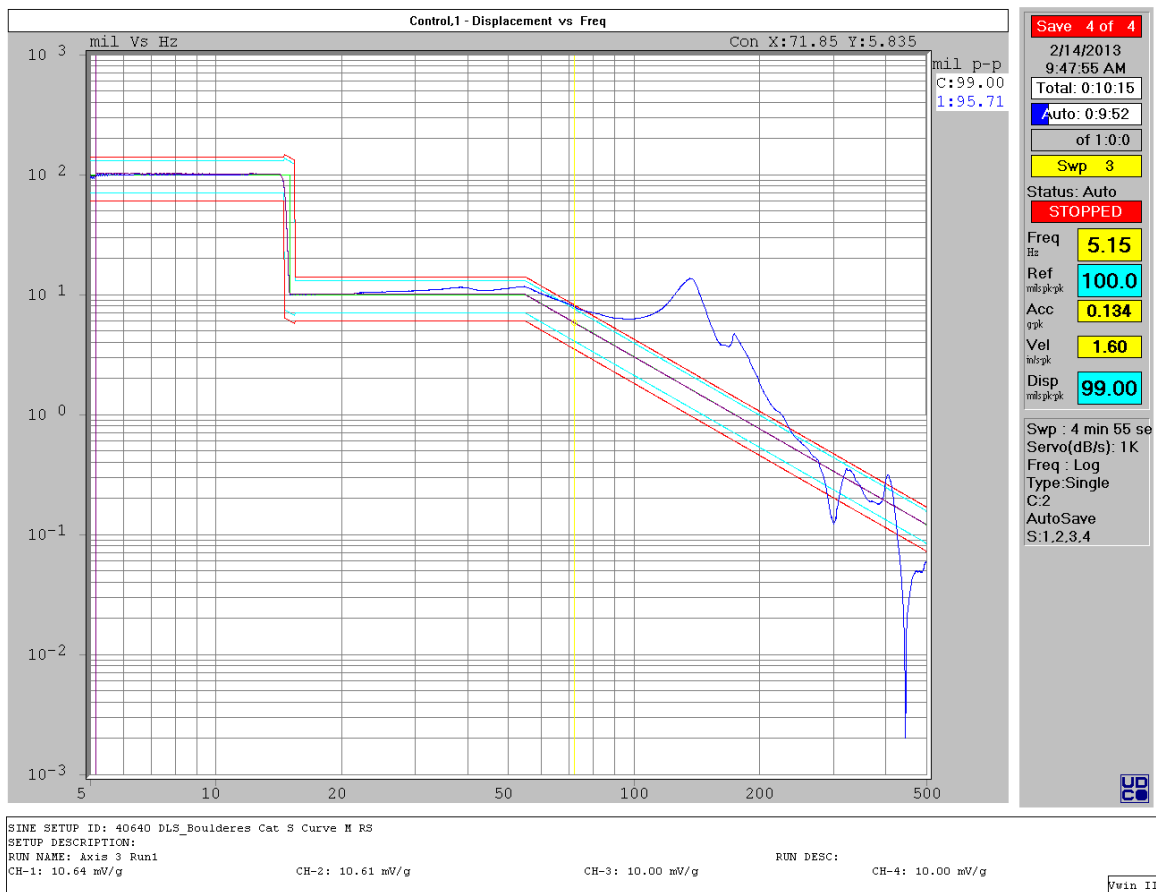
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Axis Three
Resonance Search
Pre Sinusoidal Vibration
Category S, Curve M





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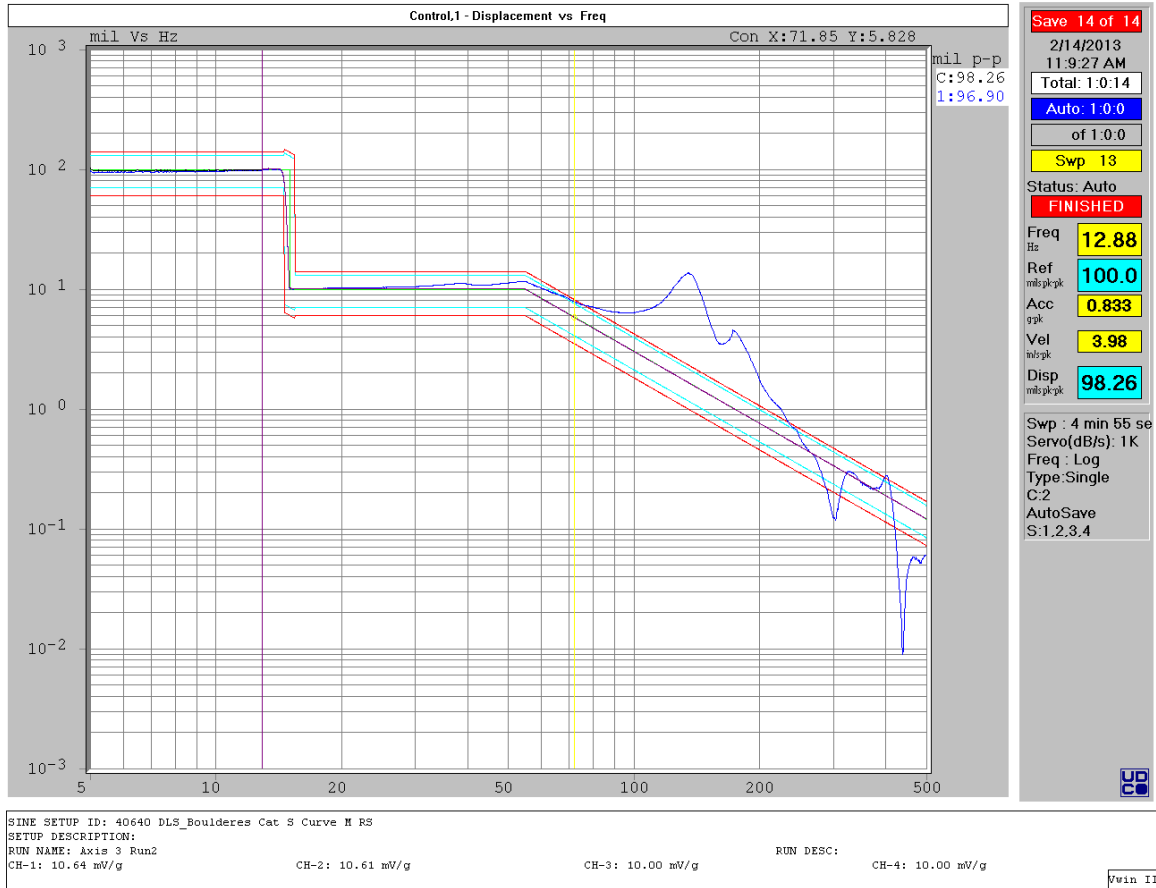
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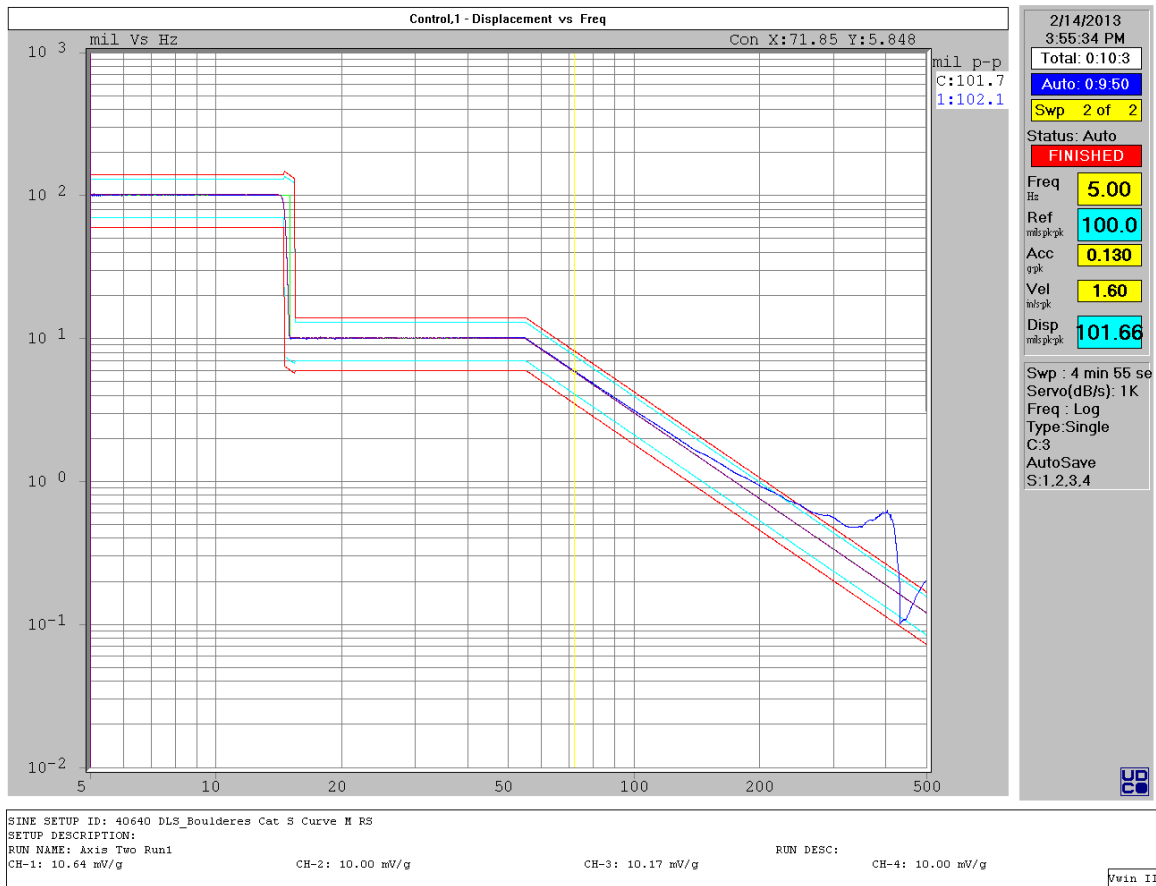
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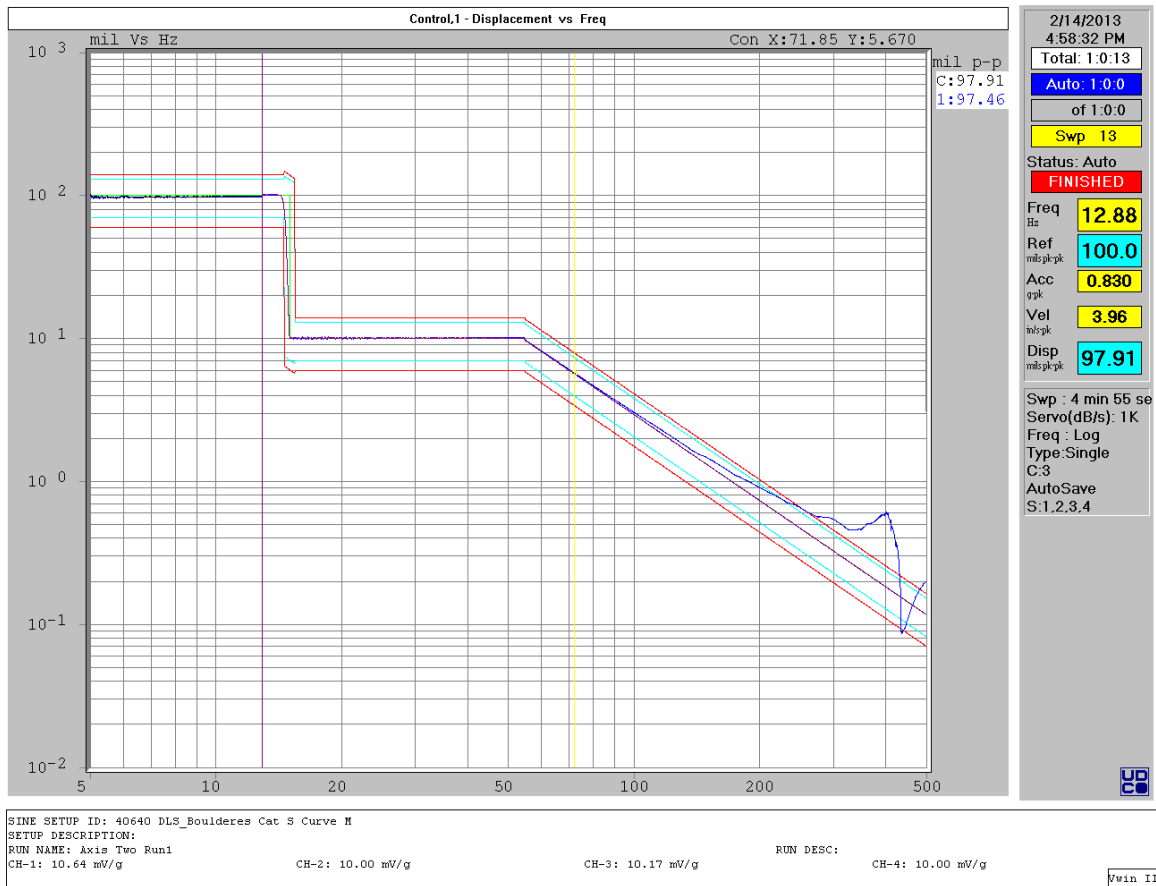
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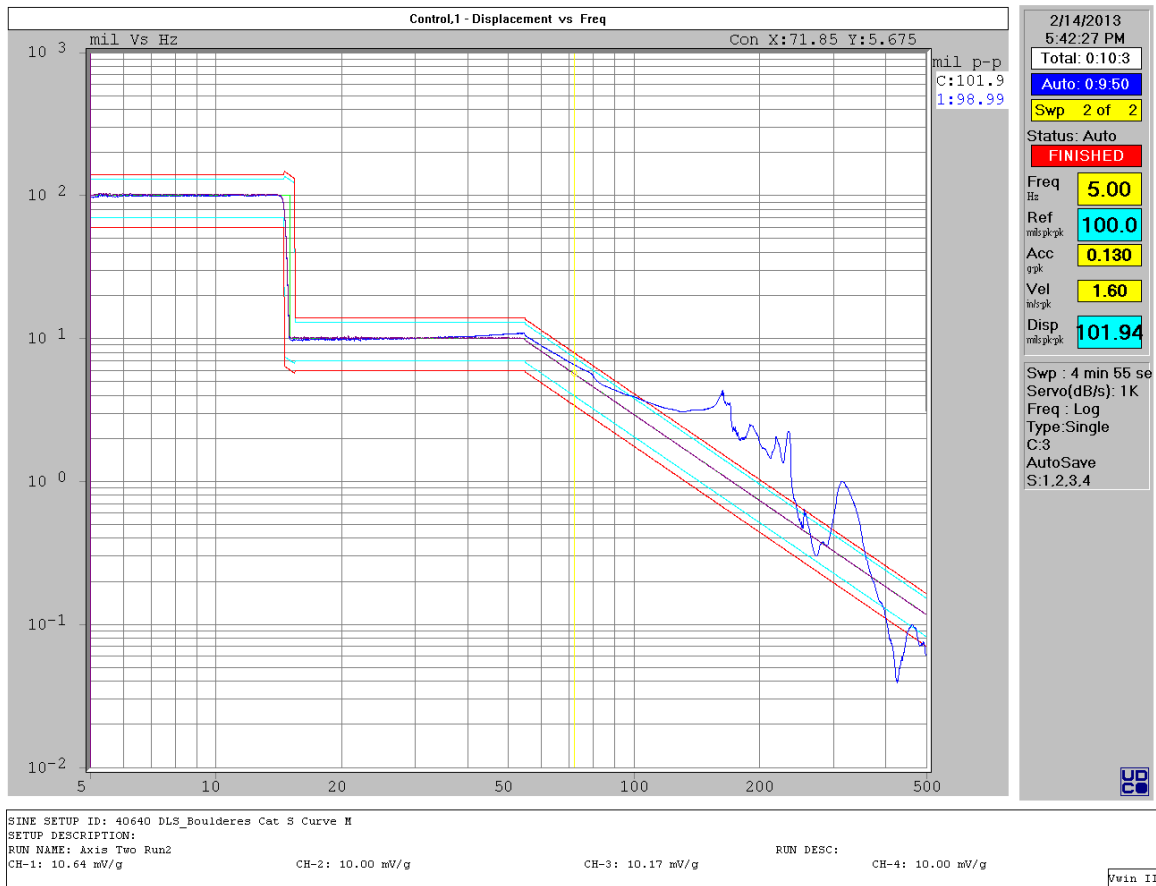
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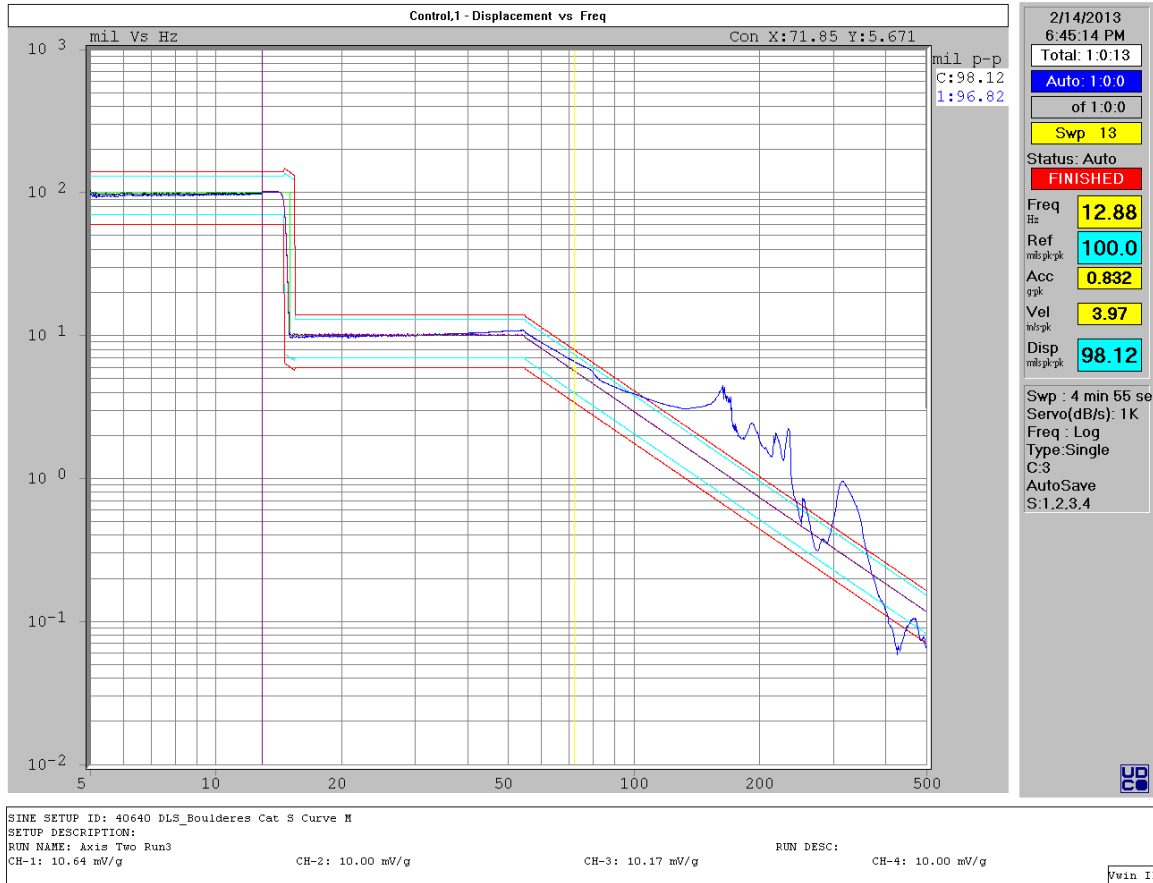
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Axis One Sinusoidal Vibration Category S, Curve M





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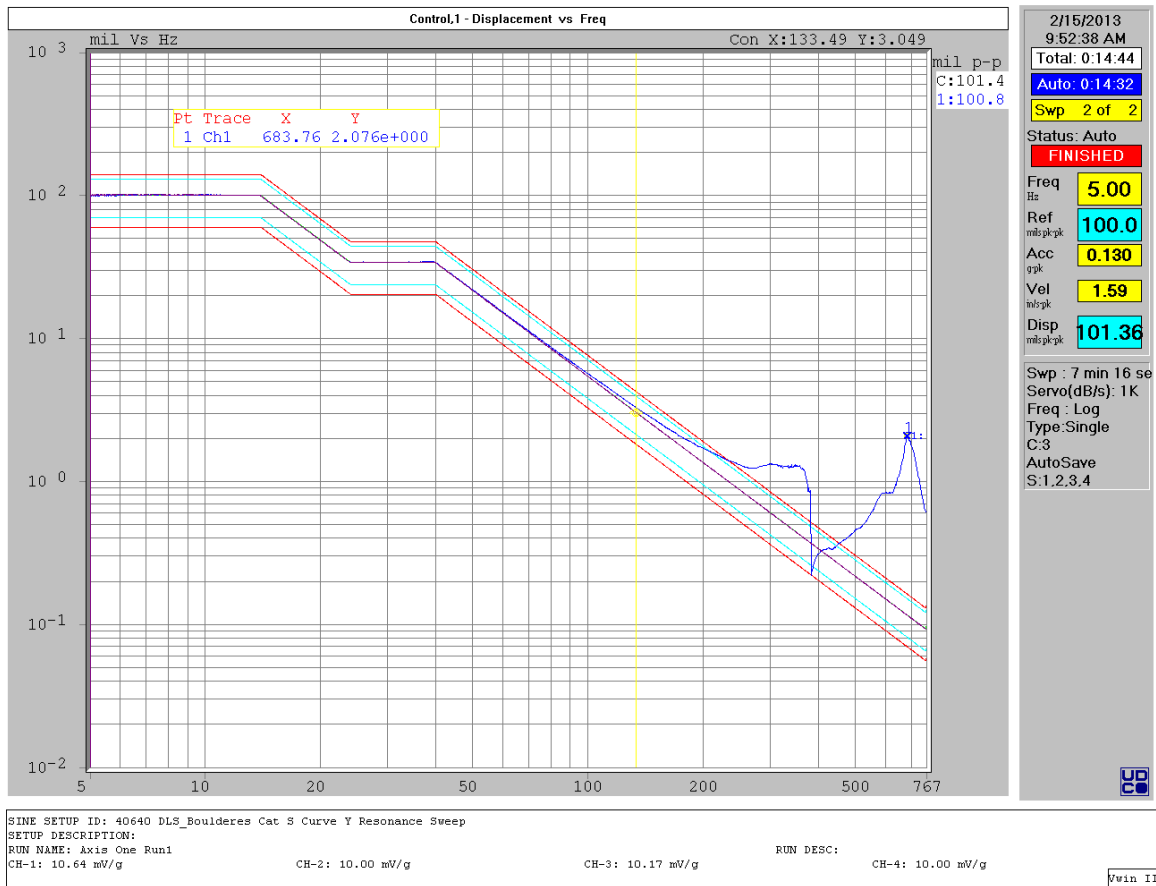
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Axis One
Resonance Search
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Category S, Curve Y





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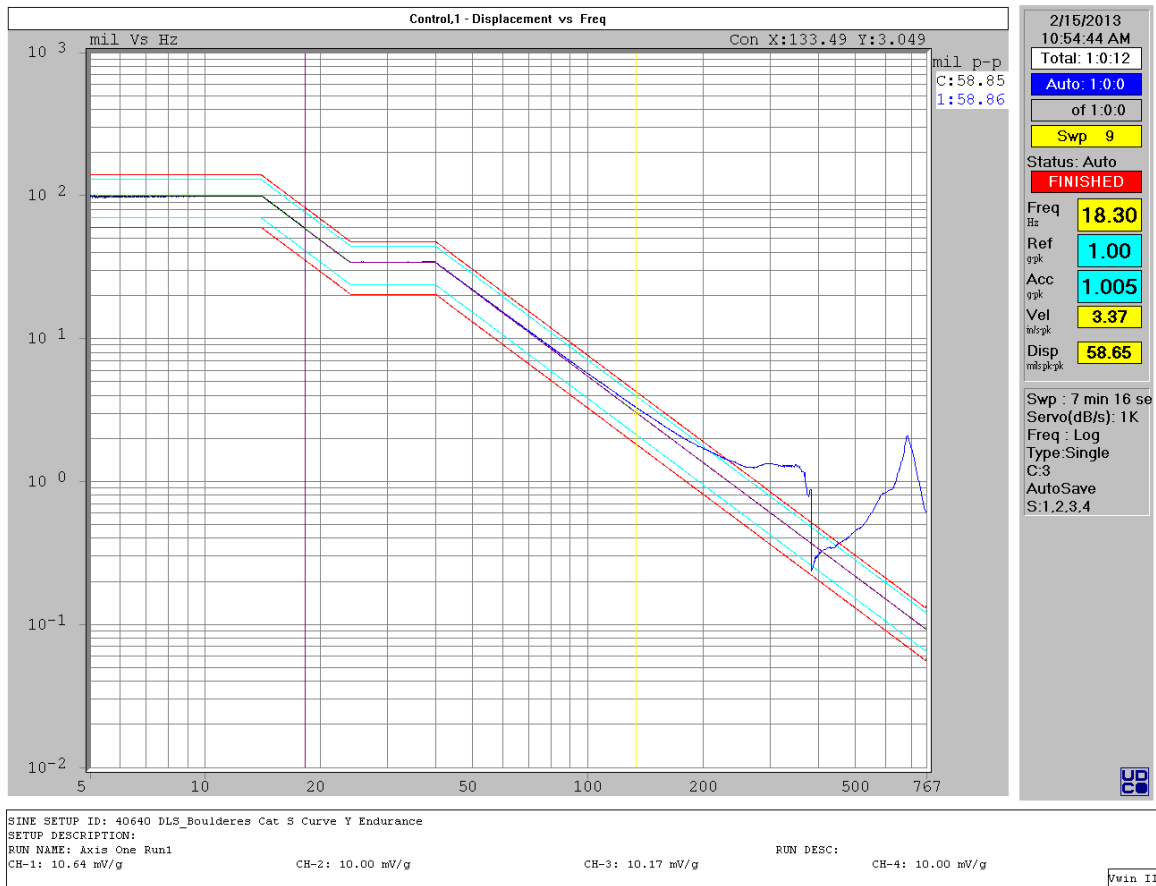
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Axis One
Sinusoidal Vibration
Category S, Curve Y





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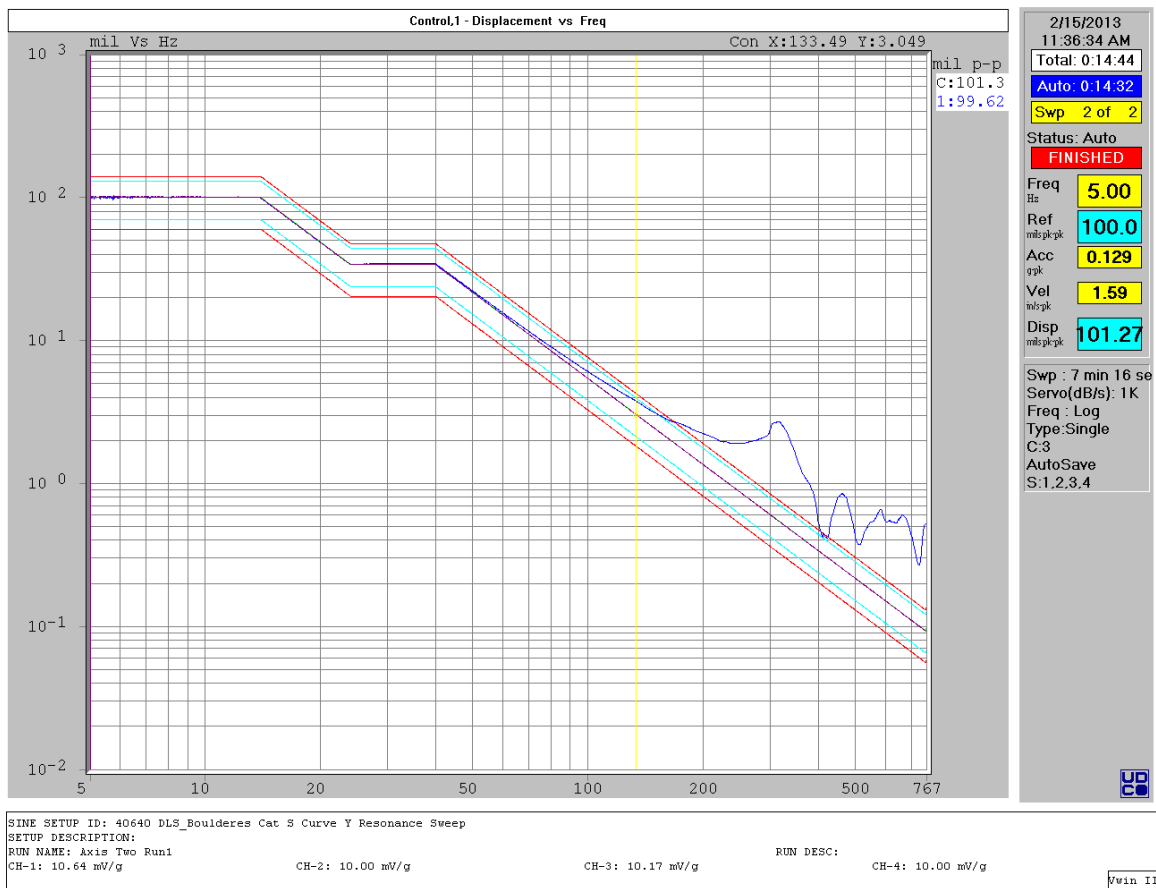
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Category S, Curve Y





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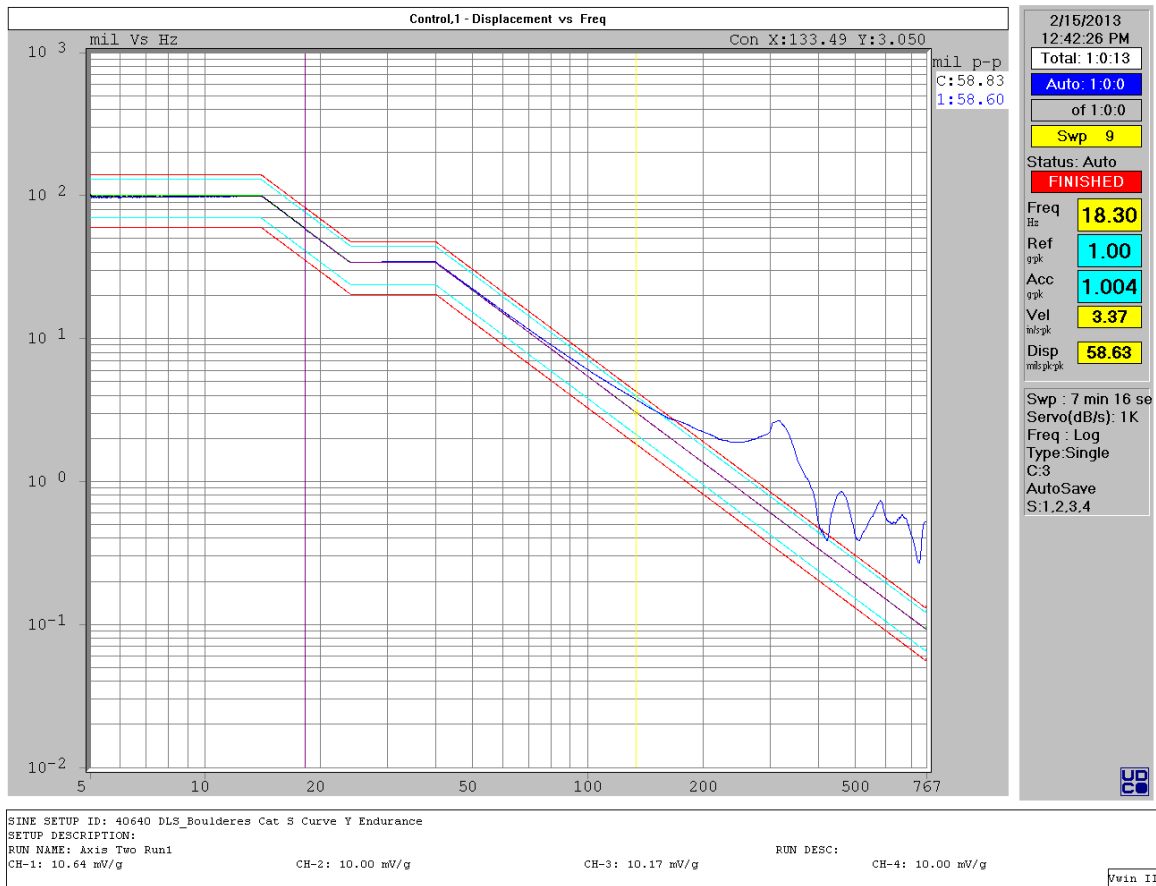
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Axis Two Sinusoidal Vibration Category S, Curve Y





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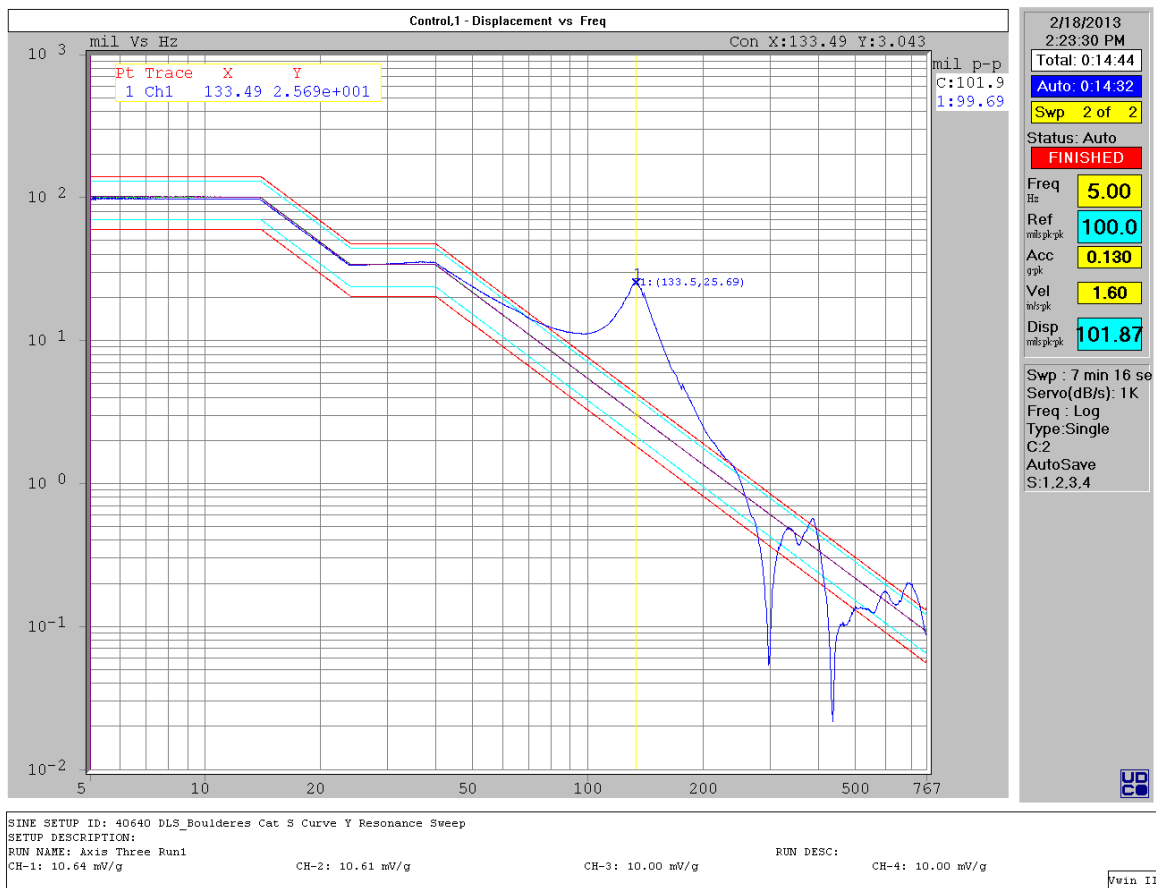
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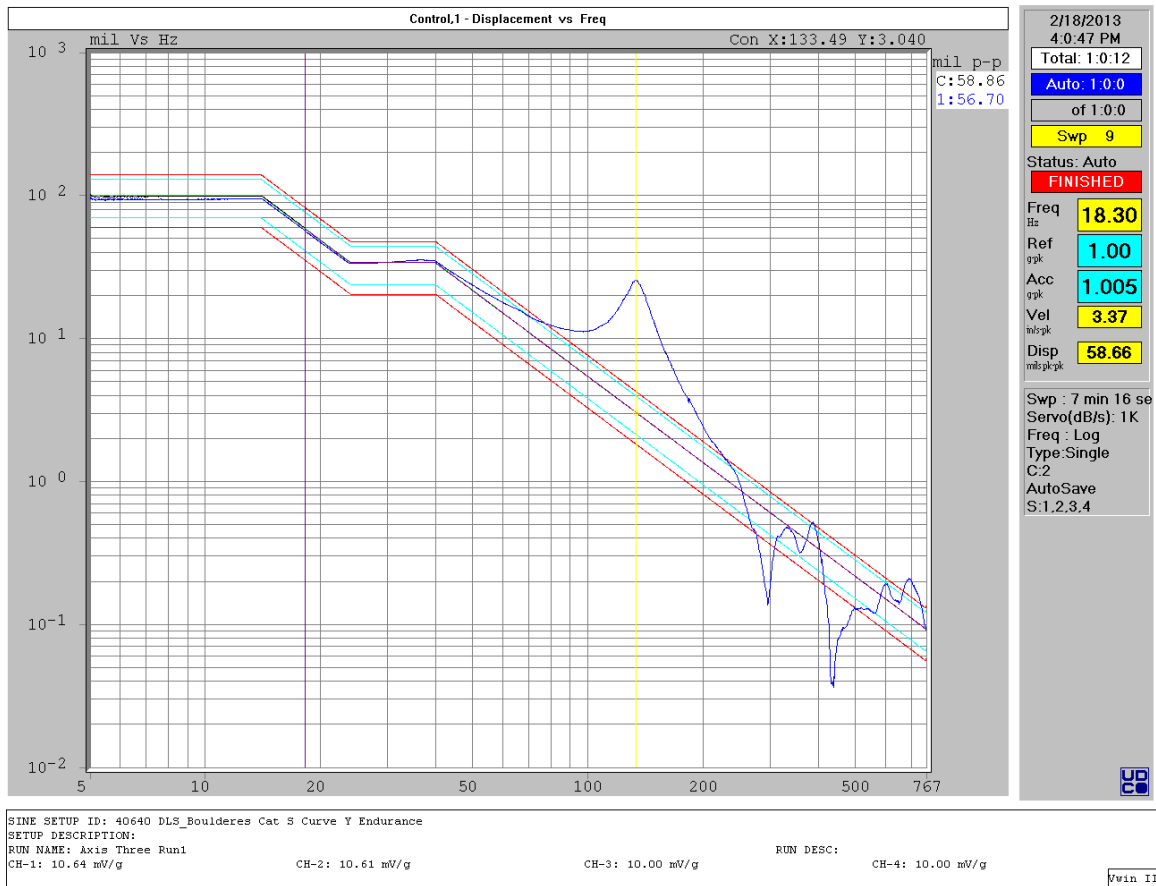
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Axis Three
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Category S, Curve Y





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CRASH SAFETY SHOCK TEST REPORT

TEST DATES

02/28/13 to 03/01/13

TEST SPECIMENS

ARS-500C-201220

TEST SPECIFICATION

RTCA/DO-160G, Section 7, Category B

REQUIREMENTS

The sample shall be subjected to crash safety shock testing per RTCA/DO-160G, Section 7, Category B. One (1) positive and One (1) negative shock with an acceleration level of 20g and a duration of 11ms shall be applied in all three axes for a total of six (6) shocks. The sample shall not be powered during the test.

PROCEDURE

Testing was performed per the requirements section above. One (1) control accelerometer was used to measure and adjust the input vibration level. One (1) response was used to measure the output of the sample. Pictures were taken to depict the test setup in all three axes.

INSTRUMENTATION

EQUIPMENT	MANUFACTURER	MODEL#	LAB#	LAST CAL.	NEXT CAL.
Electrodynamic Shaker	Unholtz Dickie	T2000	TL-1099	NA	NA
Vibration Controller	Unholtz-Dickie	UD VWIN II	TL-1103	09/17/12	09/17/13
Signal Conditioner	PCB Piezotronics	482A16	TL-1198	05/24/12	05/24/13
Accelerometer	PCB Piezotronics	352C22	TL-1316	01/02/13	01/02/14
Accelerometer	PCB	352C22	TL-1402	07/16/12	07/16/13

TEST RESULTS

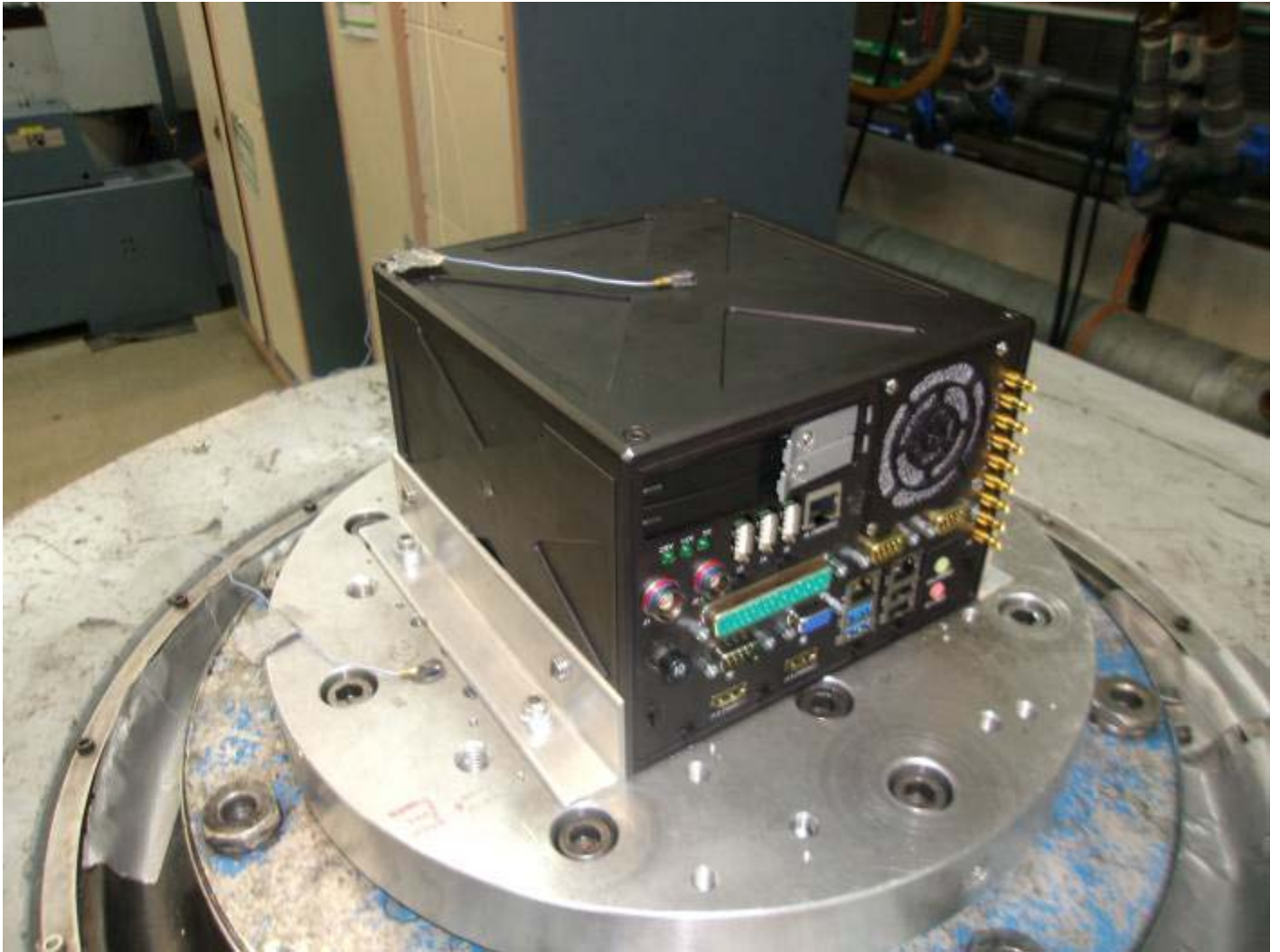
Testing was performed per the requirements section above. No damage was noted to the sample upon completion of testing.



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PHOTOS

Axis One Test Setup Picture





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**Axis Two
Test Setup Picture**





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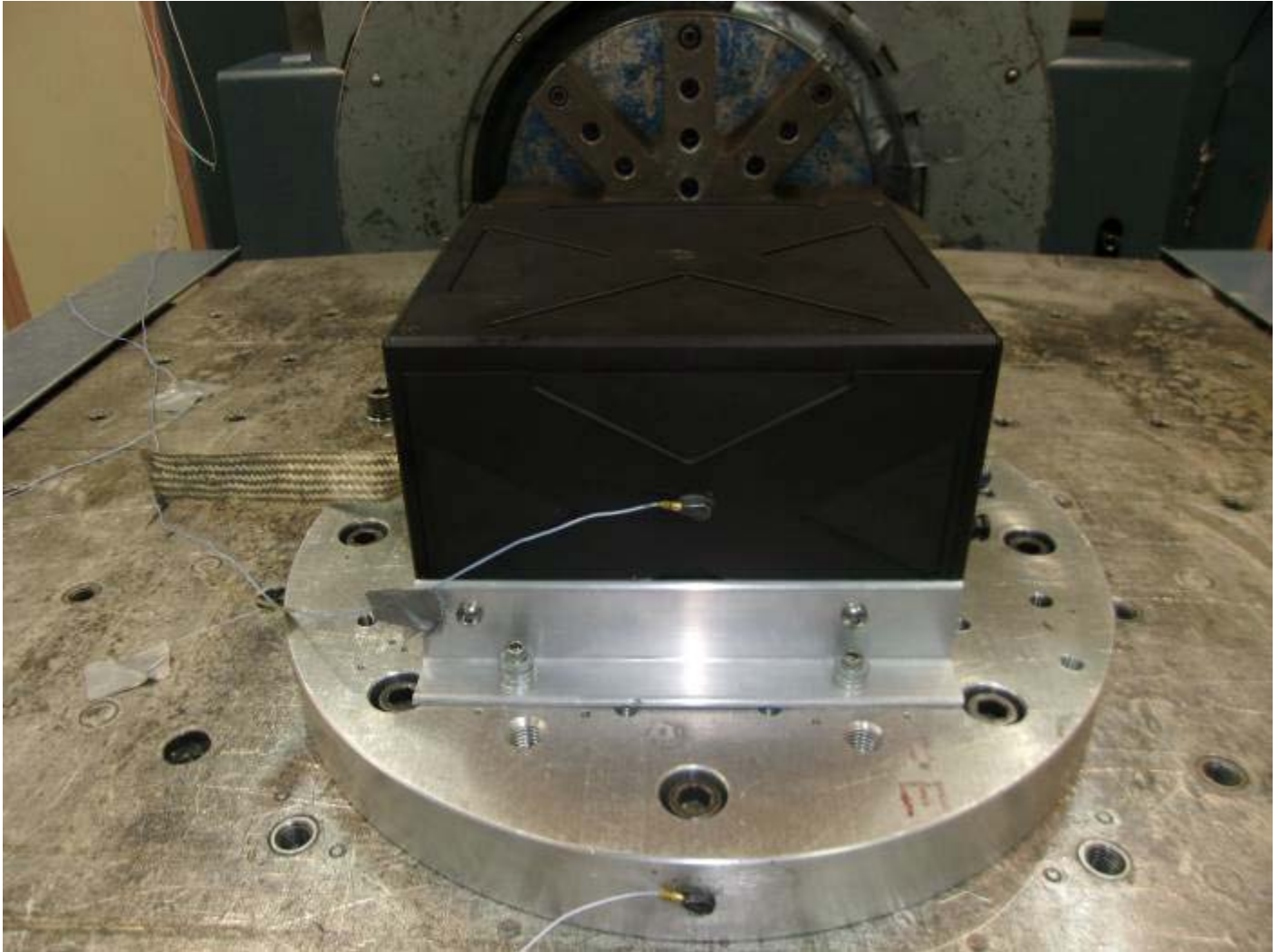
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**Axis Three
Test Setup Picture**





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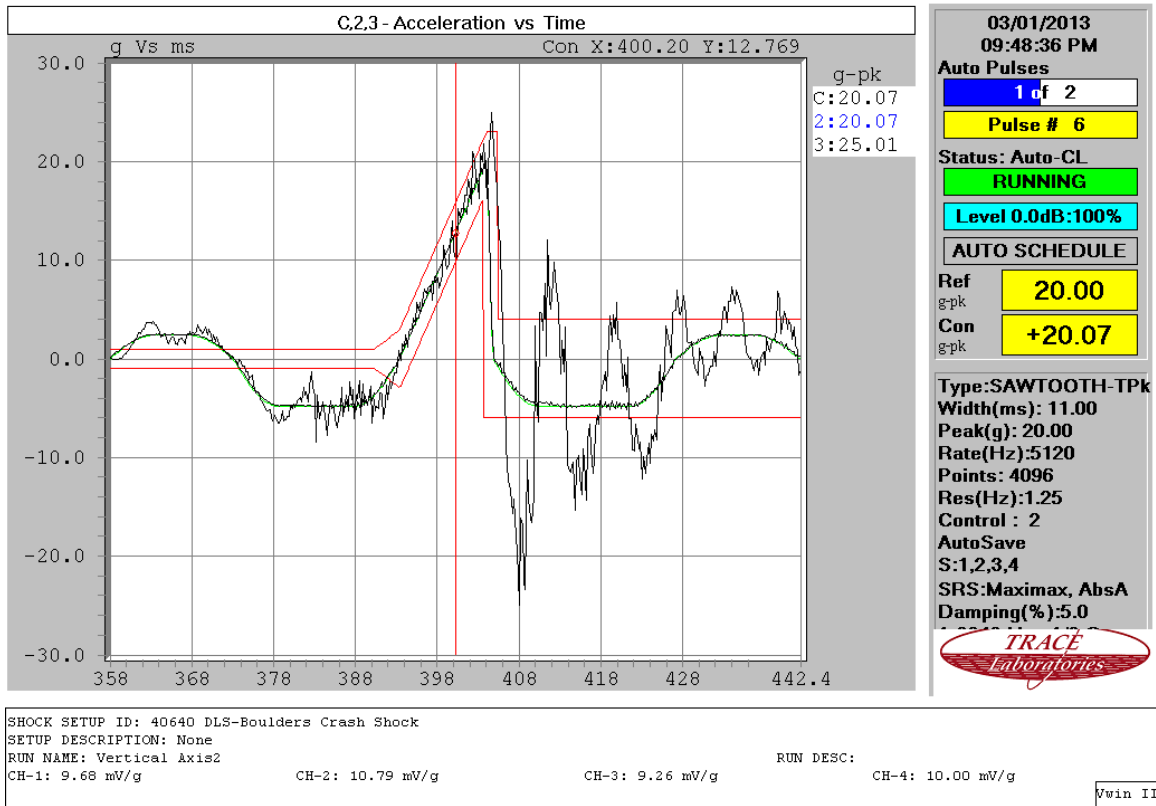
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GRAPHS

**Axis One
Vertical
Positive Shock**





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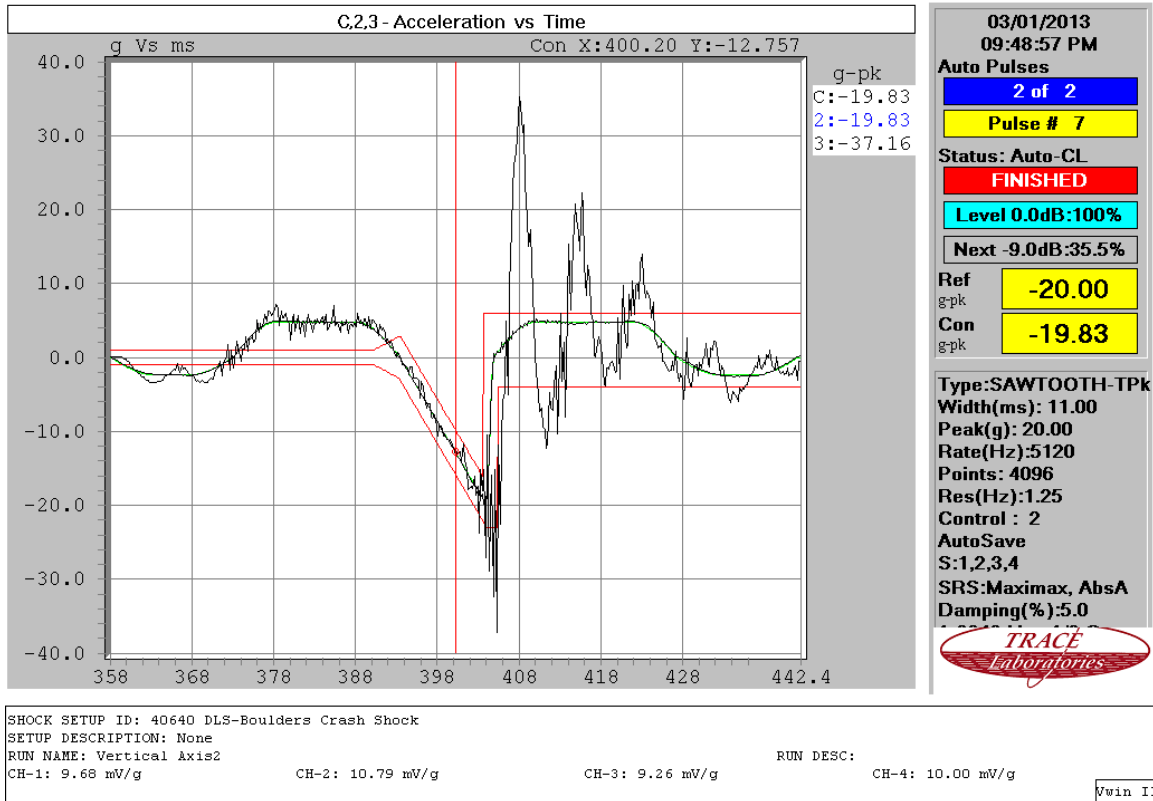
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Axis One
Vertical
Negative Shock





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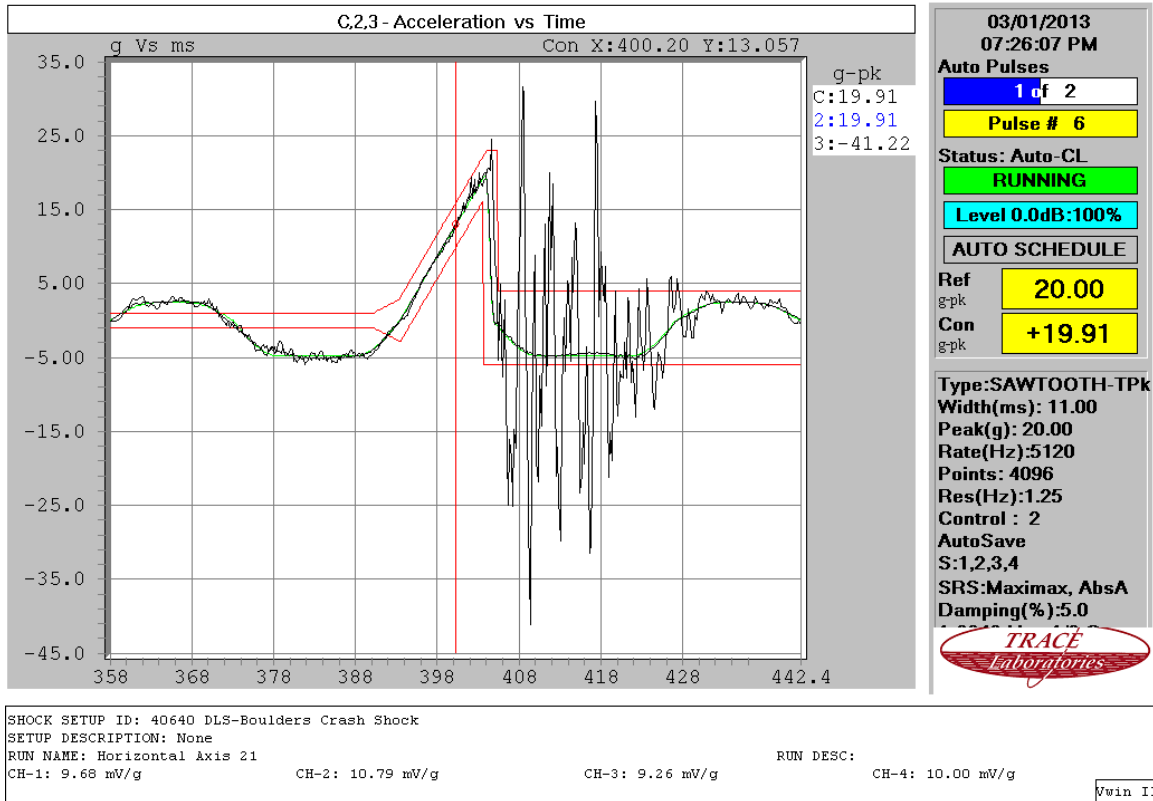
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Axis Two
Horizontal
Positive Shock





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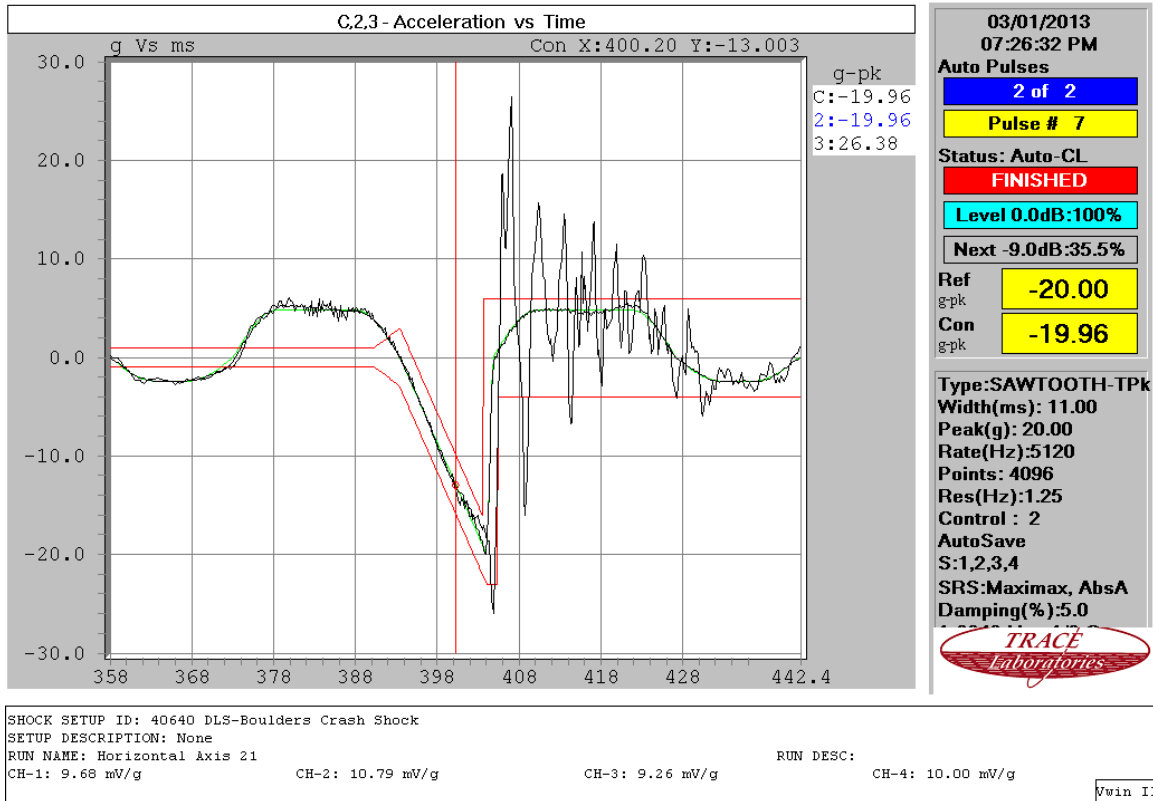
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Axis Two
Horizontal
Negative Shock





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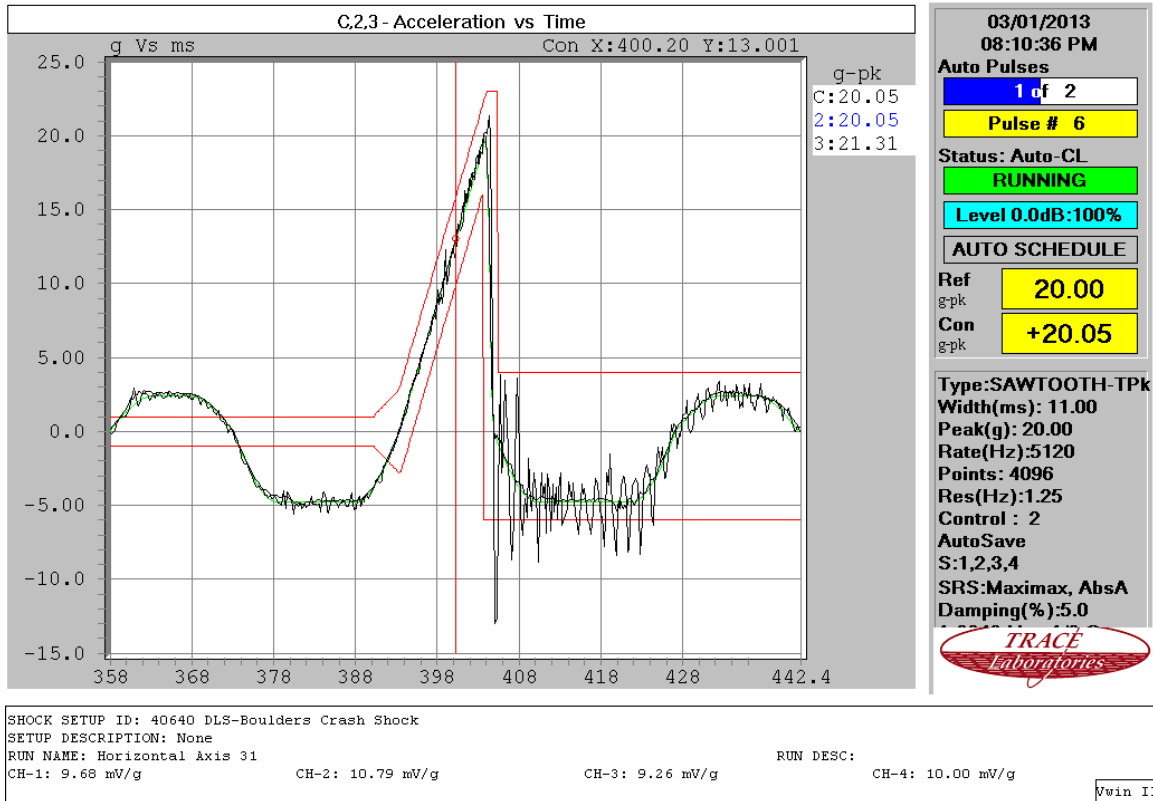
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Axis Three
Horizontal
Positive Shock





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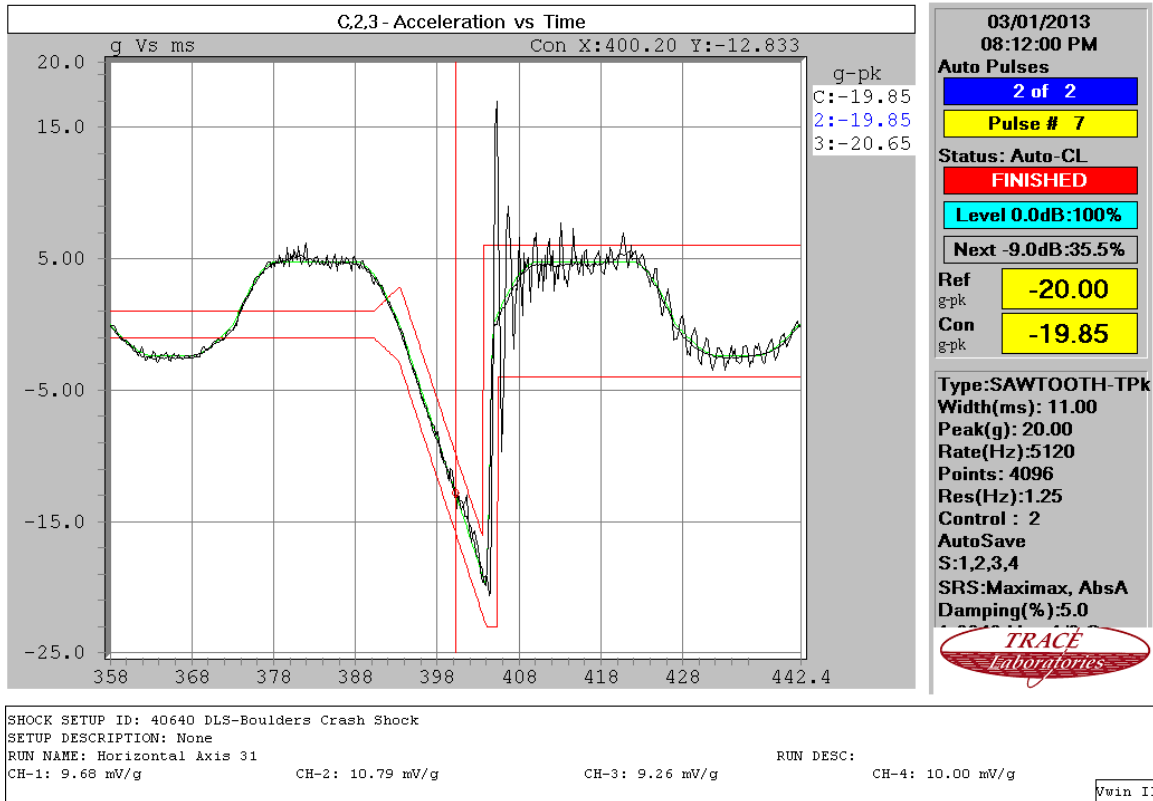
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Axis Three
Horizontal
Negative Shock





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FLAMMABILITY TEST REPORT**TEST DATES**

03/12/13 to 03/13/13

TEST SPECIMENS

ABS Cabin Phone with content loader

Serial Number P3

TEST SPECIFICATION

Sample was tested per RTCA-DO 160G, Section 26, Category C

REQUIREMENTS

The flame to be applied shall be a methane burner with its output adjusted so that the blue inner cone is approximately 7/8 inches in height and the tip of the flame is 1.5 inches in height. The flame shall be applied for a period of twelve seconds with the burner positioned .75 inches below the sample. Burn time after the removal of the source, as well as the burn length shall be recorded. If flaming drips fall from the sample and continue burning, the longest burn time of a drip will also be recorded. The sample shall have a flame time of less than fifteen seconds, and a drip flame time of less than five seconds.

PROCEDURE

A flame as specified above was applied to the bottom front edge of the sample and a timer was started. The source flame was removed after being applied to the sample for twelve seconds. The time the sample continued burning and the burn length was recorded. The sample was tested at two points on the front face of the unit containing the electrical connection and at two points on the opposite face.

INSTRUMENTATION

EQUIPMENT	MANUFACTURER	MODEL#	LAB#	LAST CAL.	NEXT CAL.
Fume Hood	Iroquis Industrial	44" X 21" X 24"	TL254	N/A	N/A
Ruler 18"	Fowler	52-340-018	TL426	05/17/12	05/17/13
Stop Watch	Sportline	220	TL1315	06/14/12	06/14/13

TEST RESULTS

Testing was conducted per RTCA-DO 160G, Section 26, Category C and as outlined in the requirements and procedures above. The sample was tested at two points along the front face and two points along the opposite face. With an ignition time of twelve seconds the sample did not continue to burn when the source flame was removed and showed no signs of damage upon inspection.



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PHOTOS



Sample Preconditioning



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Flame Height Measurement



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Flammability Set Up



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Flame Application (Location 1)



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Post Flammability Location 1



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Post Flammability Location 4



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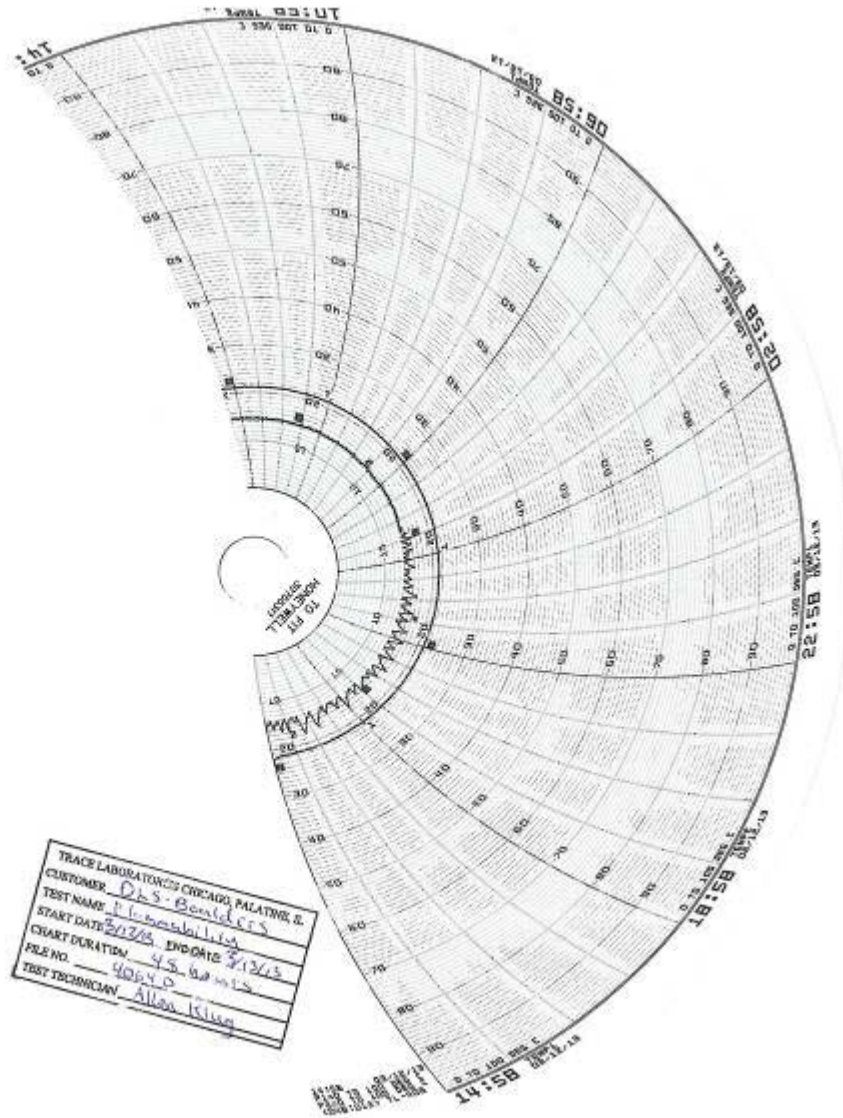
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CHARTS



Flammability Preconditioning



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SUSTAINED ACCELERATION (CRASH SAFETY) TEST REPORT**TEST DATES**

03/08/13

TEST SPECIMENS

ARS-500C-201220

TEST SPECIFICATION

RTCA/DO 160G, section 7, Table 7-1, Aircraft Type Helicopter, Test Type R

REQUIREMENTS

The unit shall be subjected to 20 G's of force in each of the 6 mutually perpendicular directions. The unit shall not be operating during the test. No functional test shall be performed before or after the test. There shall be no physical damage to the unit during or after the testing. The unit shall be shaken by hand after each direction, and there shall be no rattling of loose parts inside the unit.

PROCEDURE

The units were tested according to the Requirements section of this report. All data was recorded. Test setup photos and a sample graph appear in the Data section of this report.

INSTRUMENTATION

EQUIPMENT	MANUFACTURER	MODEL#	LAB#	LAST CAL.	NEXT CAL.
Rotary Accelerator	Schavitz Machine	G-G-H(HP5512A	TL-935	Verified As Used	Verified As Used.
Tachometer	Monarch Ins.	ACT 3X	TL-1390	11/16/12	11/16/13
Stop Watch	Sportline	FA160	TL-1315	06/14/12	06/14/13
Ruler	Fowler	53-340-018	TL-426	05/17/12	05/17/13

TEST RESULTS

The unit was tested according to the Requirements section of this report. The unit conformed to the specification. There was no damage to the unit. There was no indication of any loose parts rattling inside the unit after all the testing. The unit was returned to the customer for further evaluation.

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TEST DATA**DATA SHEET**Customer Name: DLS\ BoulderesFile No: 40640Customer P.O. No L6274Tested By: Ronald PienkowskiTest Description: Sustained AccelerationTest Specification: RTCA/DO-160G, sec. 7Specification Rev: N/A

Equipment Used/Calibration Status:

Sample Description: Cabin PhoneSample Part No(s): ARS-500C-201220Sample Serial No(s): Not GivenTest Date: 03/08/13Lab Conditions: Temperature (C): 25Humidity (%): 7

TL	935	Cal Due	n/a	TL	1390	Cal Due	01/15/13
TL	1379	Cal Due	n/a	TL	1315	Cal Due	06/04/13
TL	426	Cal Due	05/17/13	TL		Cal Due	

Additional Test Information/Deviations From Specifications: _____

20 G's for 3 seconds in each of the 6 mutually perpendicular directionsUnit not operating during test.

Direction	Distance from center inches	RPM
+X	29.0	156
+Y	29.0	156
-X	29.0	156
-Y	29.0	156
+Z	27.5	160
-Z	31.0	151

No functional testing was performed.**There was no physical damage to the unit.****There was no sound of rattling parts inside the unit.**



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PHOTOS

Positive X Axis





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Positive X Axis





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Negative X Axis





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Negative X Axis





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Positive Y Axis





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Positive Y Axis





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Negative Y Axis





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Negative Y Axis





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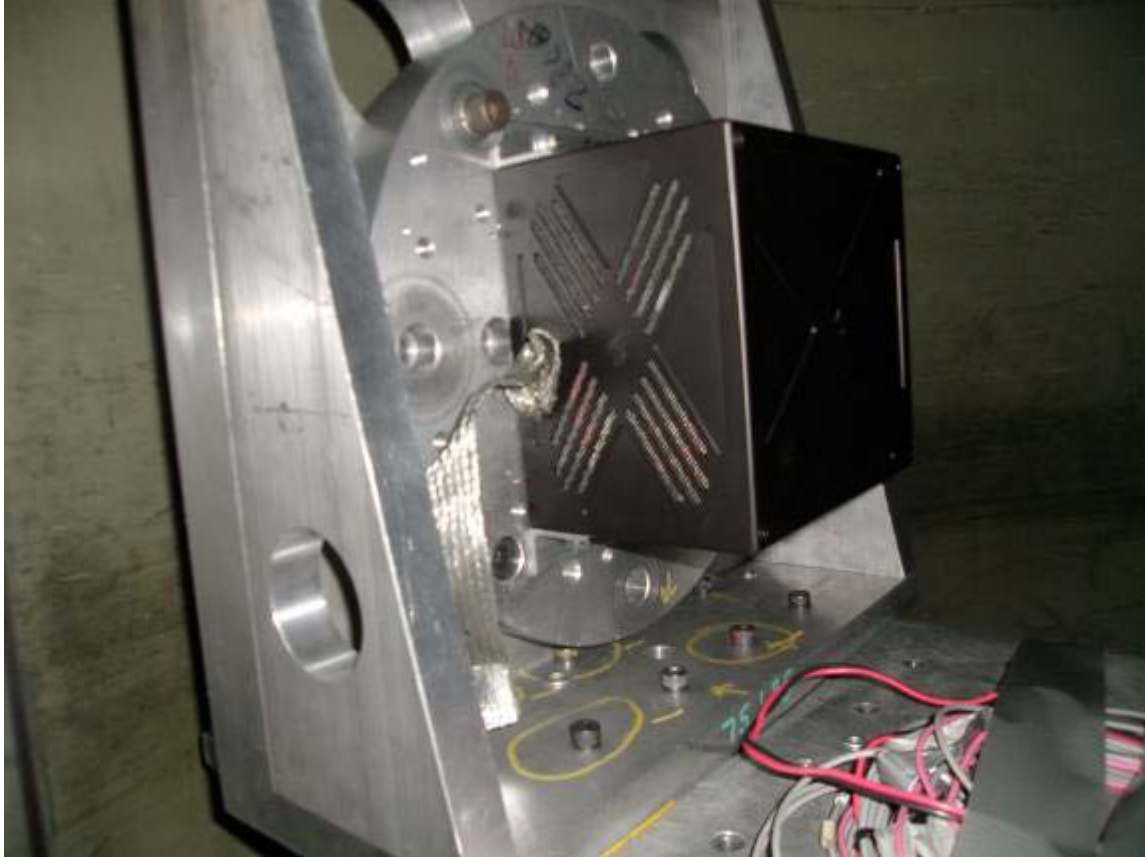
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Positive Z Axis





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Negative Z Axis

