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UKAS TESTING
2645

Test Report Number: 123456 Issue 1

Customer Name & Address:	Company Name Ltd Industrial Estate Cambridge WY1 2YZ
Customer Order Number:	PO987654-1
Test Sample(s) Description:	Electronic Control Unit

Highly Accelerated Life Testing (HALT)

Author:	**Approval:**	**Issue Date:**

The results detailed herein relate only to the test item(s) submitted for testing.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

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1 Introduction

This report details the Highly Accelerated Life Testing (HALT) carried out on two Electronic Control Units as supplied by Company Name Ltd.

The HALT was performed to determine the operational limits of the test items when subjected to extreme levels of temperature and vibration.

The test items were subjected to the test profiles defined in Section 0 of this report, following the guidelines of QualMark document 933-0336: Rev 04: QualMark HALT Testing Guideline.

The testing was performed between 4th and 6th November 2018.

2 Equipment Used

Description:	Serial No:	Calibration Due:
QualMark Typhoon HALT Chamber	25T03070774	6th Dec 2018
cDAQ-9171 Spectrum Analyser	177954F	6th Dec 2018
339A32 Triaxial Accelerometer	6277	17th Sep 2018
300-0224 Accelerometer	P152487	1st Nov 2018

Table 1: Equipment List

3 Test Item Serial Number

Description:	Part No:	Serial No:
Electronic Control Unit	ABC123	Test001
Electronic Control Unit	ABC123	Test002

Table 2: Test Item Serial Number

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4 Test Plan

4.1 Cold Step Stress

The test items were subjected to the following temperature profile until the operational limit was determined. Functional verification was performed throughout the applied test.

Start Temperature:	+20ºC
Temperature Step:	-10ºC
Dwell Time:	10 minutes minimum after temperature stabilised
Stop Temperature:	Operational Limit
Mounting:	See section 4.6

Table 3: Cold Step Stress Profile

4.2 Hot Step Stress

The test items were subjected to the following temperature profile until the operational limit was determined. Functional verification was performed throughout the applied test.

Start Temperature:	+20ºC
Temperature Step:	+10ºC
Dwell Time:	10 minutes minimum after temperature stabilised
Stop Temperature:	Operational Limit
Mounting:	See section 4.6

Table 4: Hot Step Stress Profile

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4.3 Rapid Thermal Transition Stress

The test items were subjected to the following temperature transition profile.
Functional verification was performed throughout the applied test.

Start Temperature:	+20ºC
Upper Temperature Limit:	Operational Limit less 10ºC
Lower Temperature Limit:	Operational Limit plus 10ºC
Dwell Times:	10 minutes minimum after temperature stabilised
Duration:	5 cycles total
Mounting:	See section 4.6

Table 5: Rapid Thermal Transition Stress Profile

4.4 Vibration Step Stress

The test items were subjected to the following vibration profile until the operational limit was determined.

Functional verification was performed throughout the applied test.

Temperature:	+20ºC
Start Vibration Level:	5Grms
Vibration Level Step:	5Grms
Dwell Time:	10 minutes minimum after vibration stabilised
Stop Vibration Level:	Operational Limit
Mounting:	See section 4.6

Table 6: Vibration Step Stress Profile

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4.5 Combined Environment Stress

The items were subjected to the following temperature transition and vibration profile.

The upper and lower temperature limits were the operational limits determined during the stepped temperature tests.
The vibration was incremented at each cycle in equal amounts up to the Operational Limit.
Functional verification was performed throughout the applied test.

Start Temperature:	+20ºC
Upper Temperature Limit:	Operational Limit less 10ºC
Lower Temperature Limit:	Operational Limit plus 10ºC
Dwell Times:	10 minutes minimum after temperature stabilised
Duration:	5 cycles
Start Vibration Level:	Operational Limit / 5
Vibration Level Step:	Operational Limit / 5
Mounting:	See section 4.6

Table 7: Combined Environment Stress Profile

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4.6 Test Item Mounting

The test items were mounted on the chamber table as depicted in Figure 1, utilising custom made mounting fixtures, with the chamber air ports positioned to direct air flow across the test items.

The product and auxiliary thermocouples were located on the test items as depicted below.

During the Vibration Step Stress test, accelerometers were positioned on the centre of the fixture (Tri-Axial) and on the test item (Single Axis).

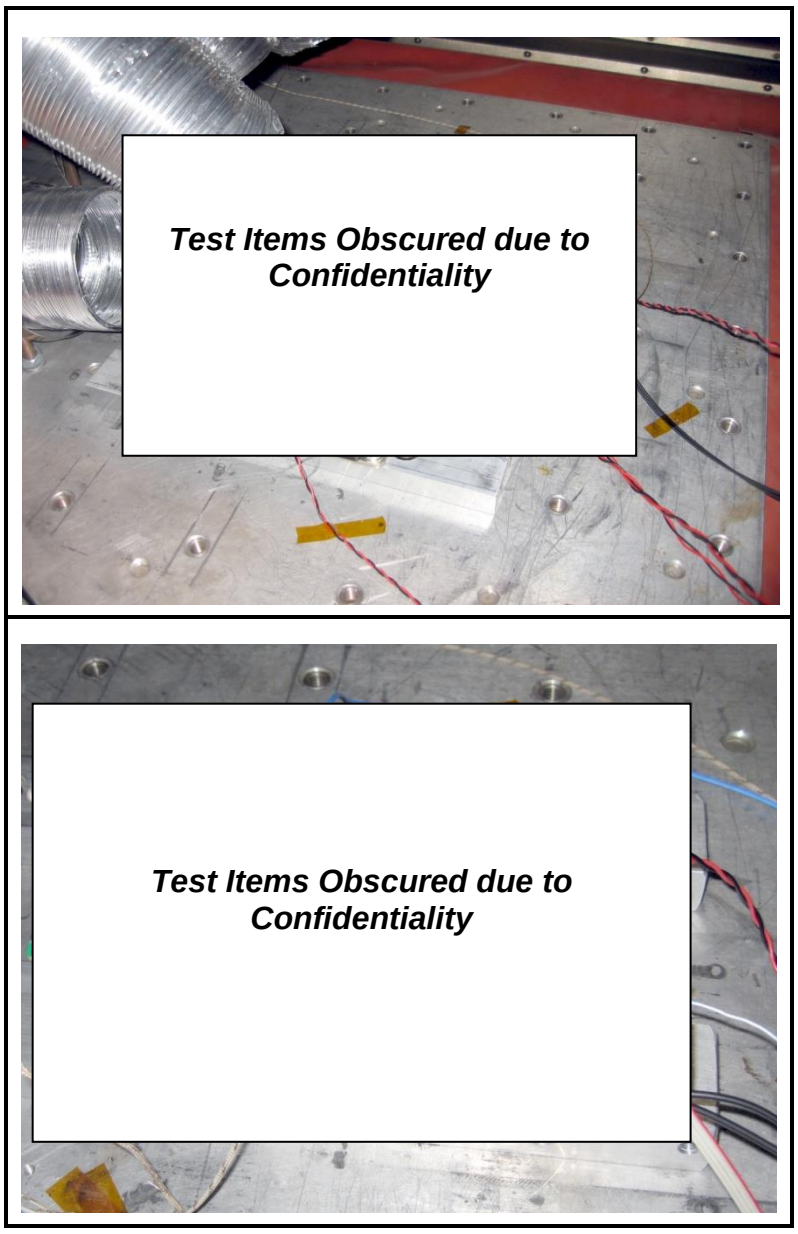

Figure 1: Test Item Mounting

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5 Test Results

The following sections present the results of the testing. Included are graphical representations of the test item temperatures and chamber and test item vibration response and details of any issues observed during the applied tests.

5.1 Summary

5.1.1 Cold Step

The test items remained functional down to -70°C, at which point the test was stopped as per the customer's request.

5.1.2 Hot Step

The test items remained functional up to +110°C.

At +120C, the test item failed and did not recover when returned to ambient.

The failure was attributed to a cable failure.

5.1.3 Rapid Thermal Transition Stress

The test items were cycled between -60°C and +100°C.
The test items remained functional during each of the five cycles.

5.1.4 Vibration Step Stress

The test items remained functional up to the chamber maximum of 48Grms.

5.1.5 Combined Environments

The test items were cycled between -60°C and +100°C, with the vibration incrementing by 10Grms for each cycle.
The test items remained functional during each of the first three cycles.

During the fourth cycle at +100°C, 40Grms, the test items failed and remained non-functional for the remainder of the testing.

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5.2 Cold Step Stress

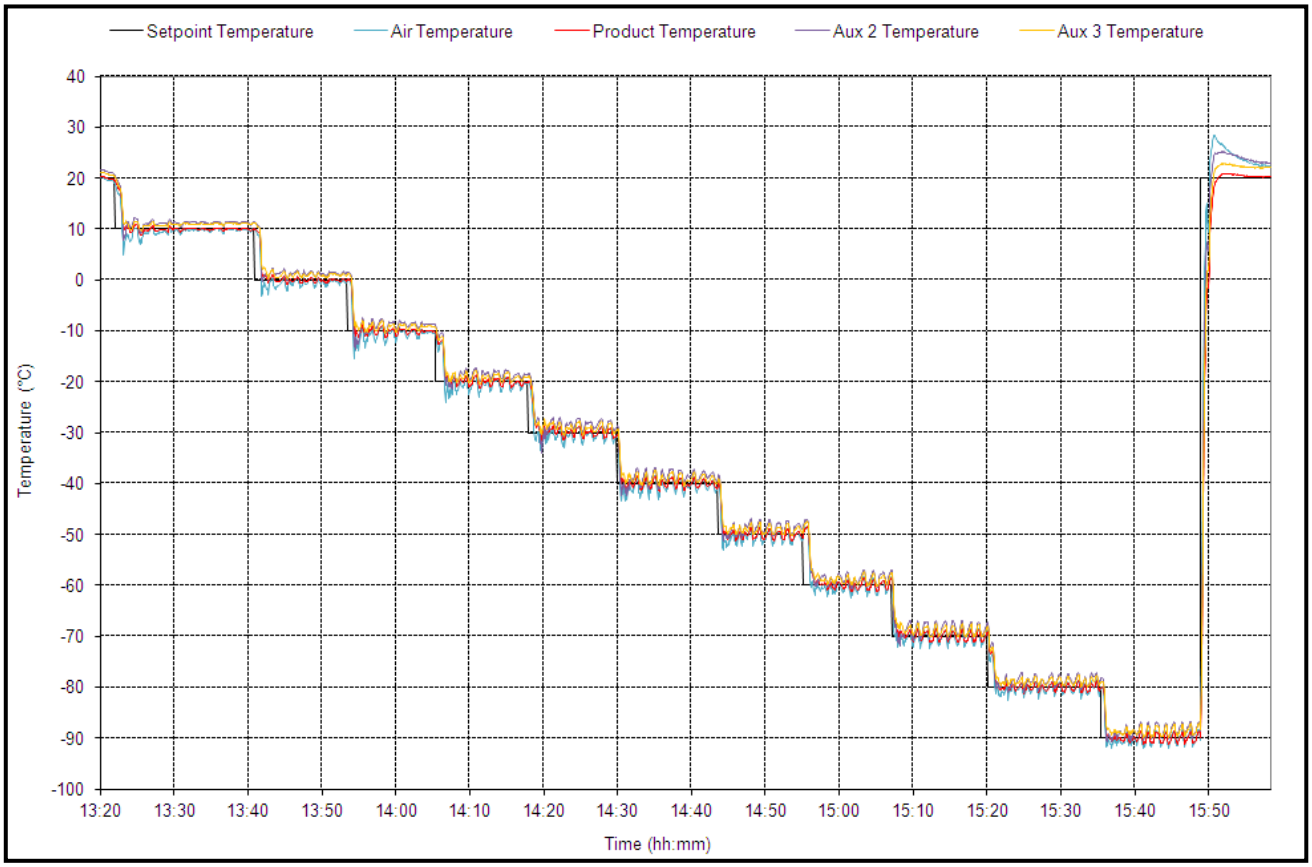

Figure 2: Cold Step Stress

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5.3 Hot Step Stress

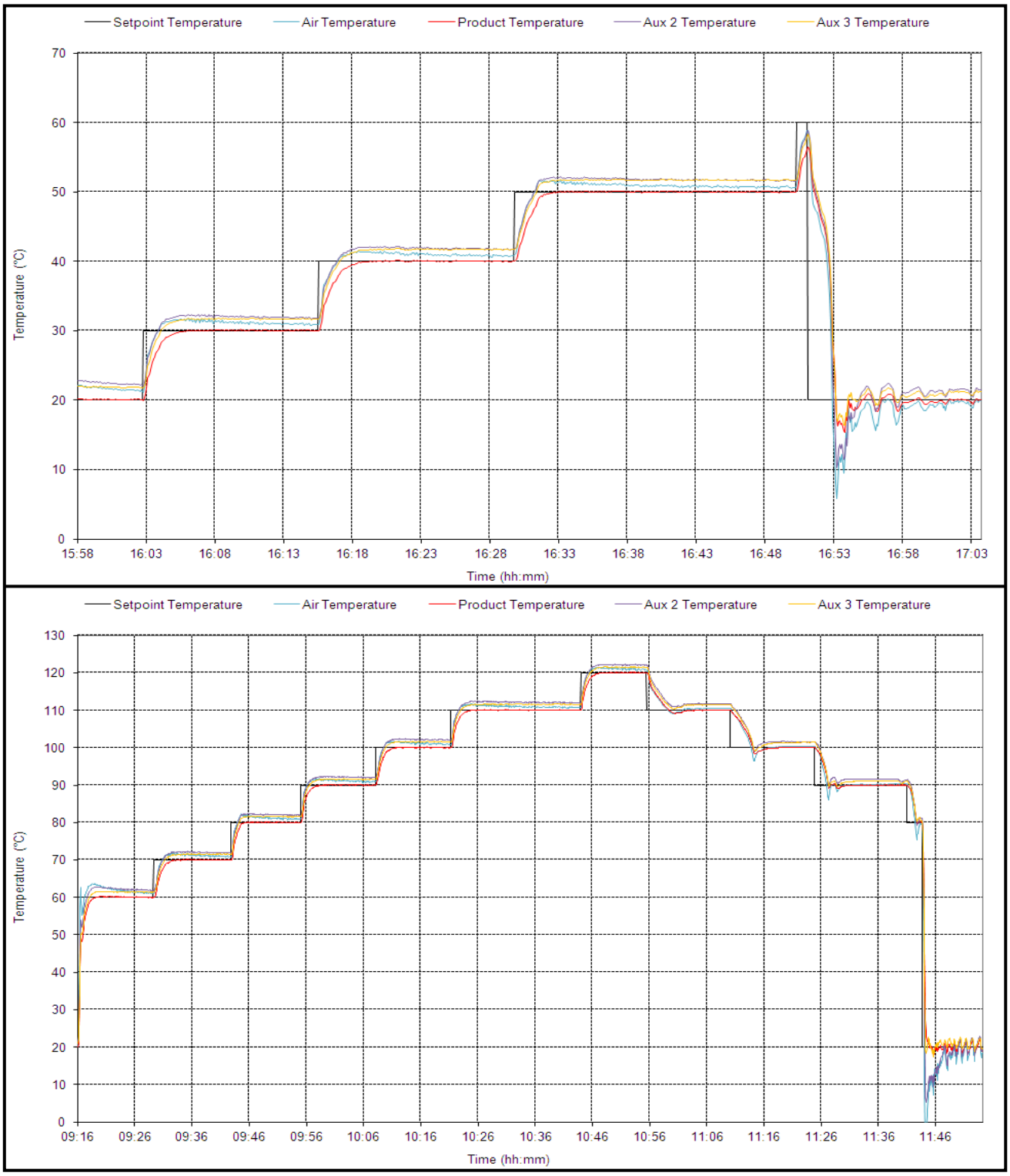

Figure 3: Hot Step Stress

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5.4 Rapid Thermal Transition Stress

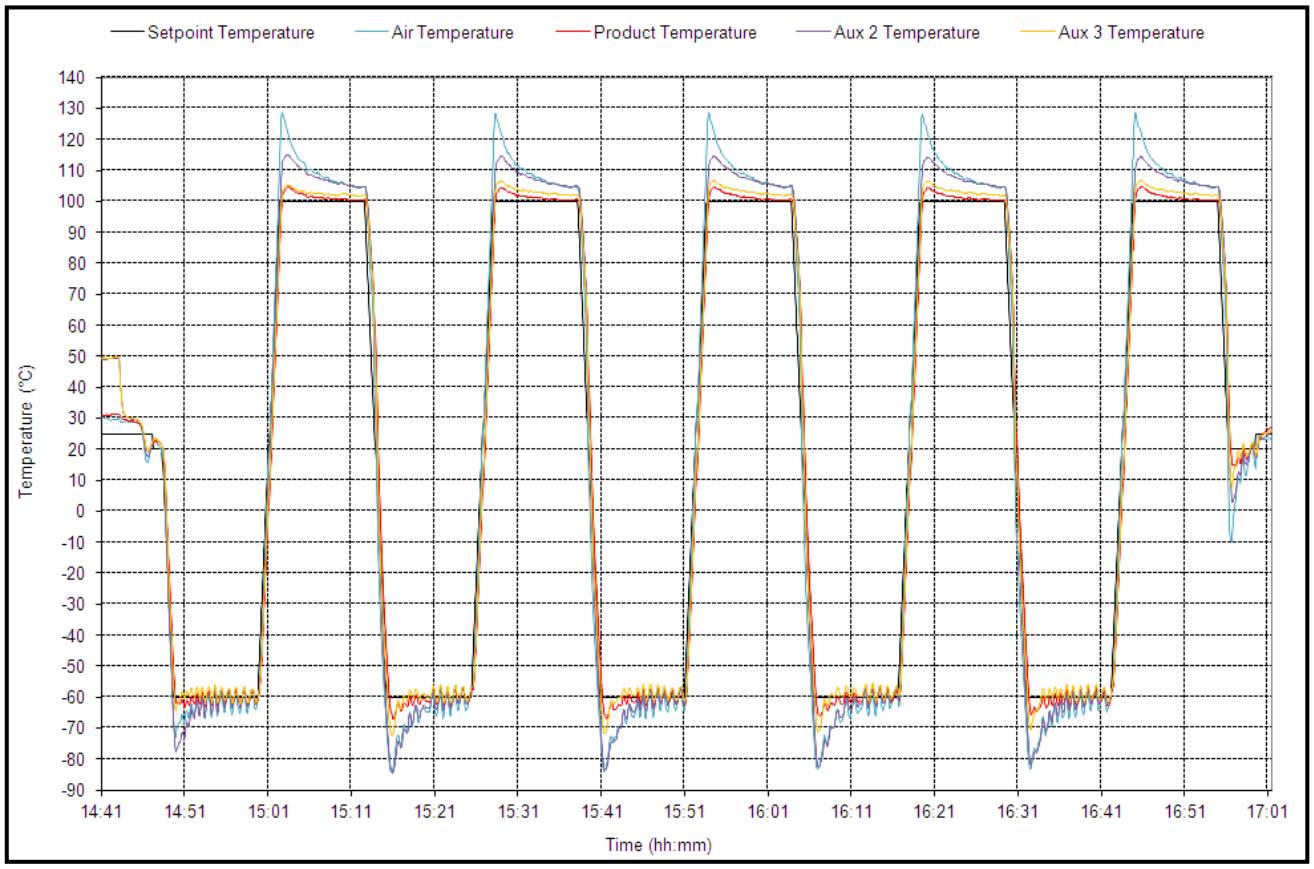

Figure 4: Rapid Thermal Transition Stress

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5.5 Vibration Step Stress – Chamber

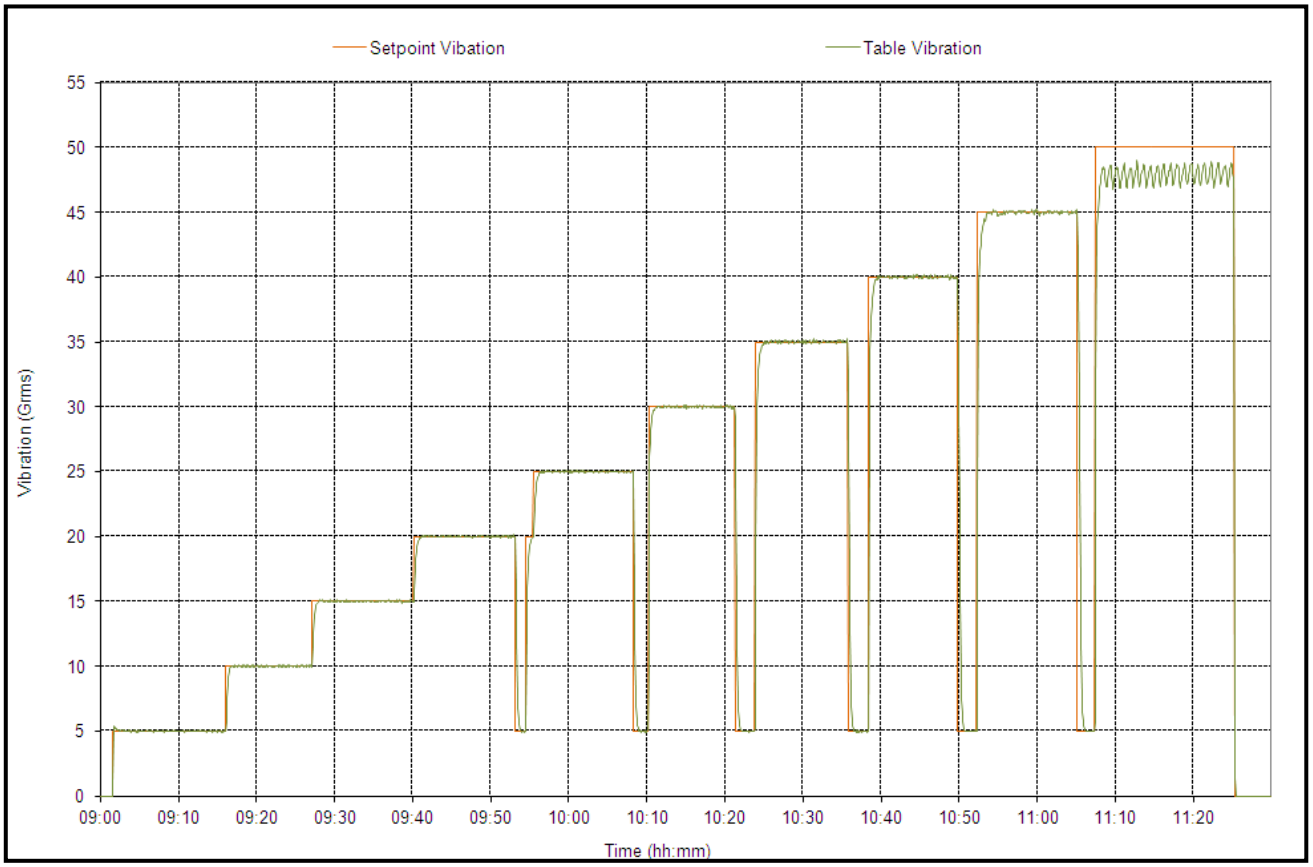

Figure 5: Vibration Step Stress – Chamber

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5.6 Vibration Step Stress – Test Item

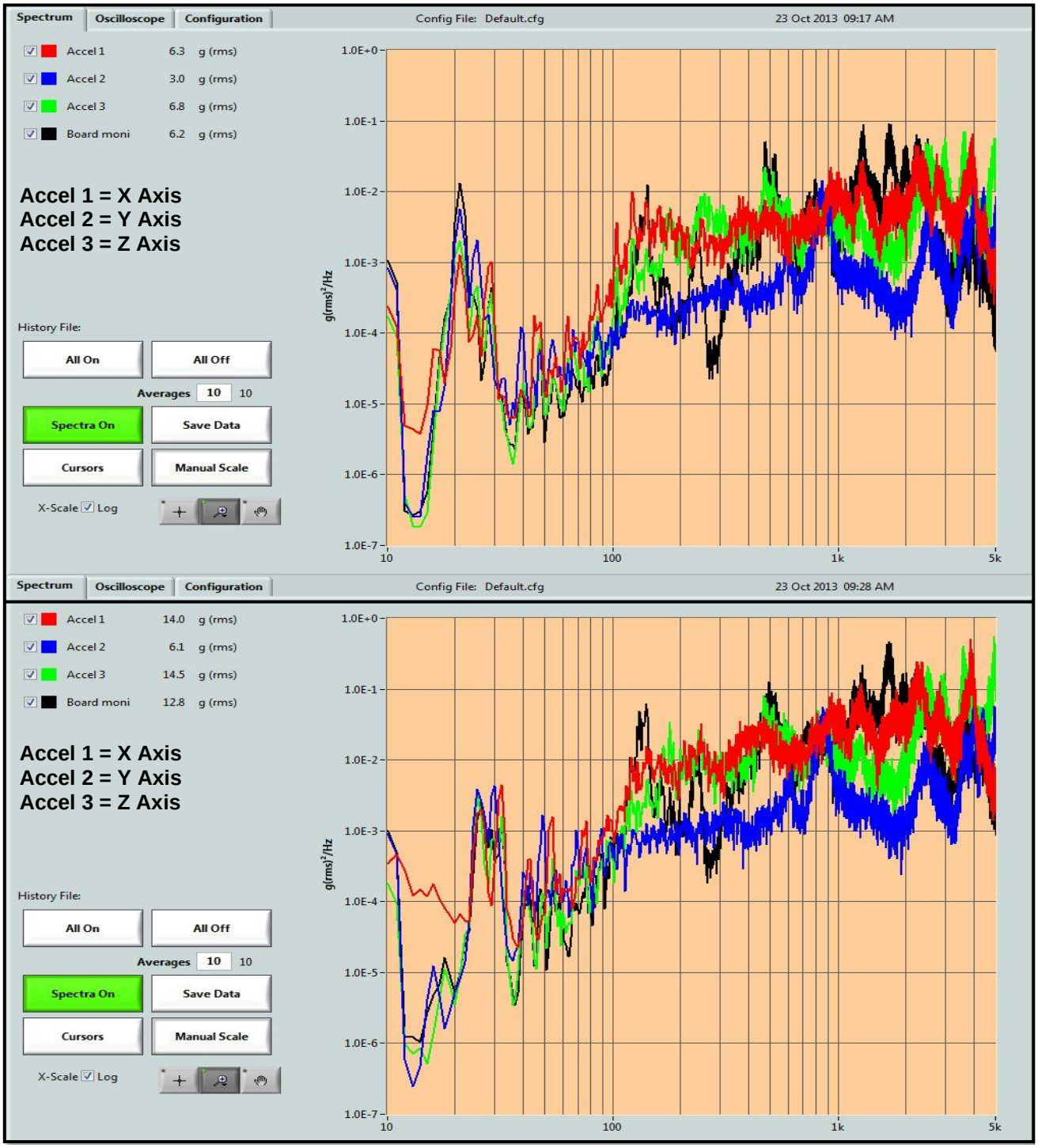

Figure 6: Vibration Step Stress – Test Item 5Grms & 10Grms

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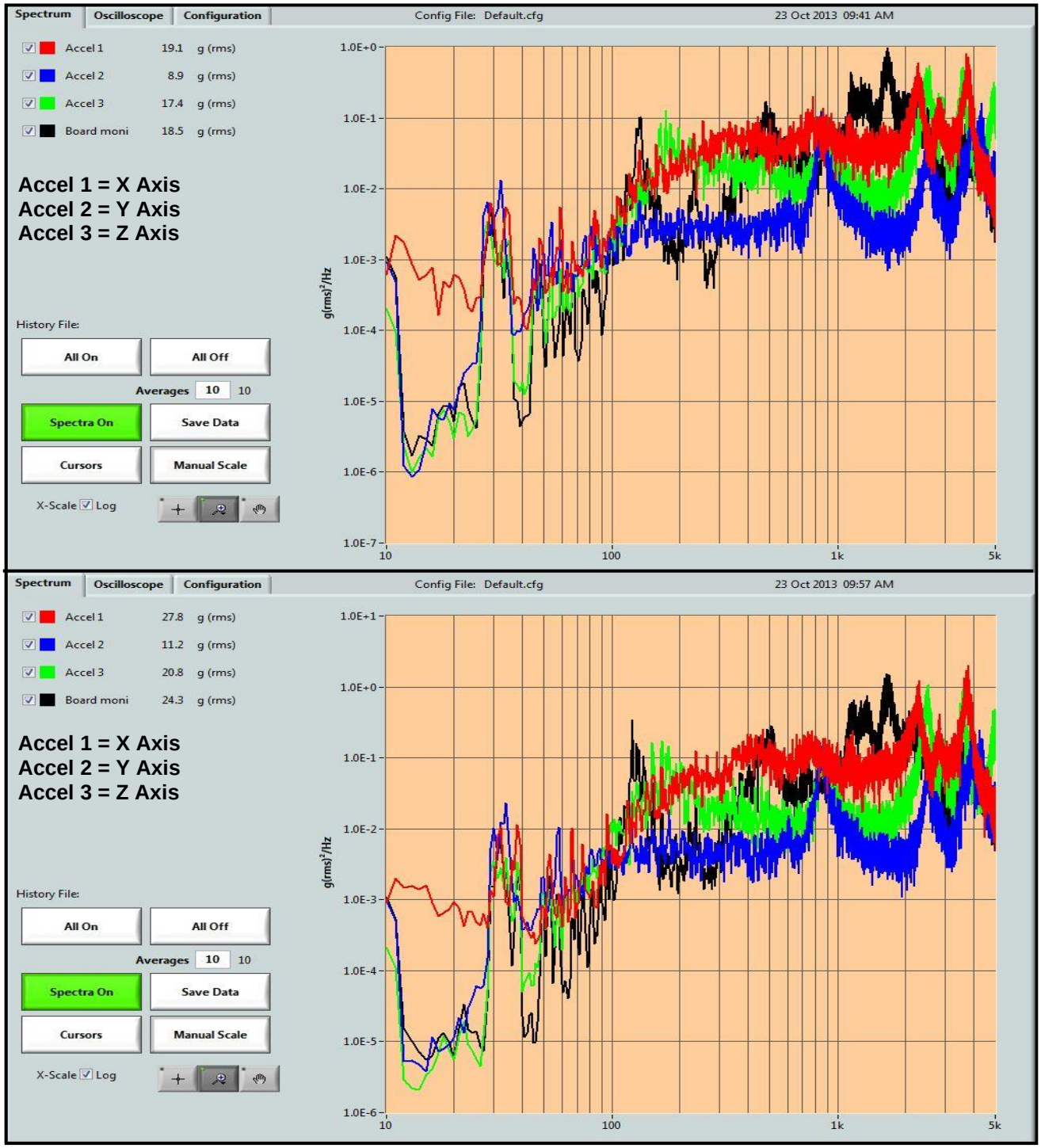

Figure 7: Vibration Step Stress – Test Item 15Grms & 20Grms

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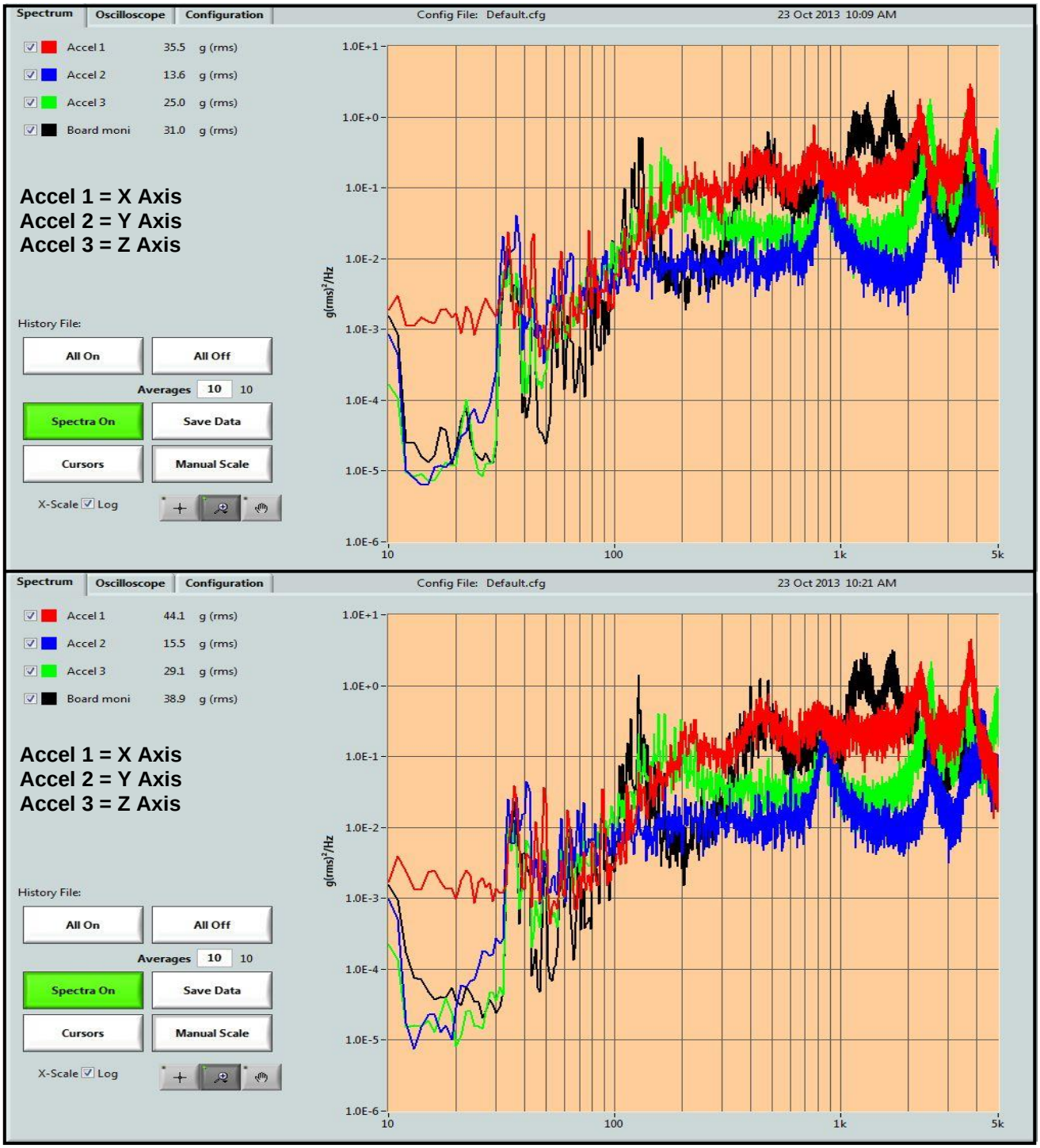

Figure 8: Vibration Step Stress – Test Item 25Grms & 30Grms

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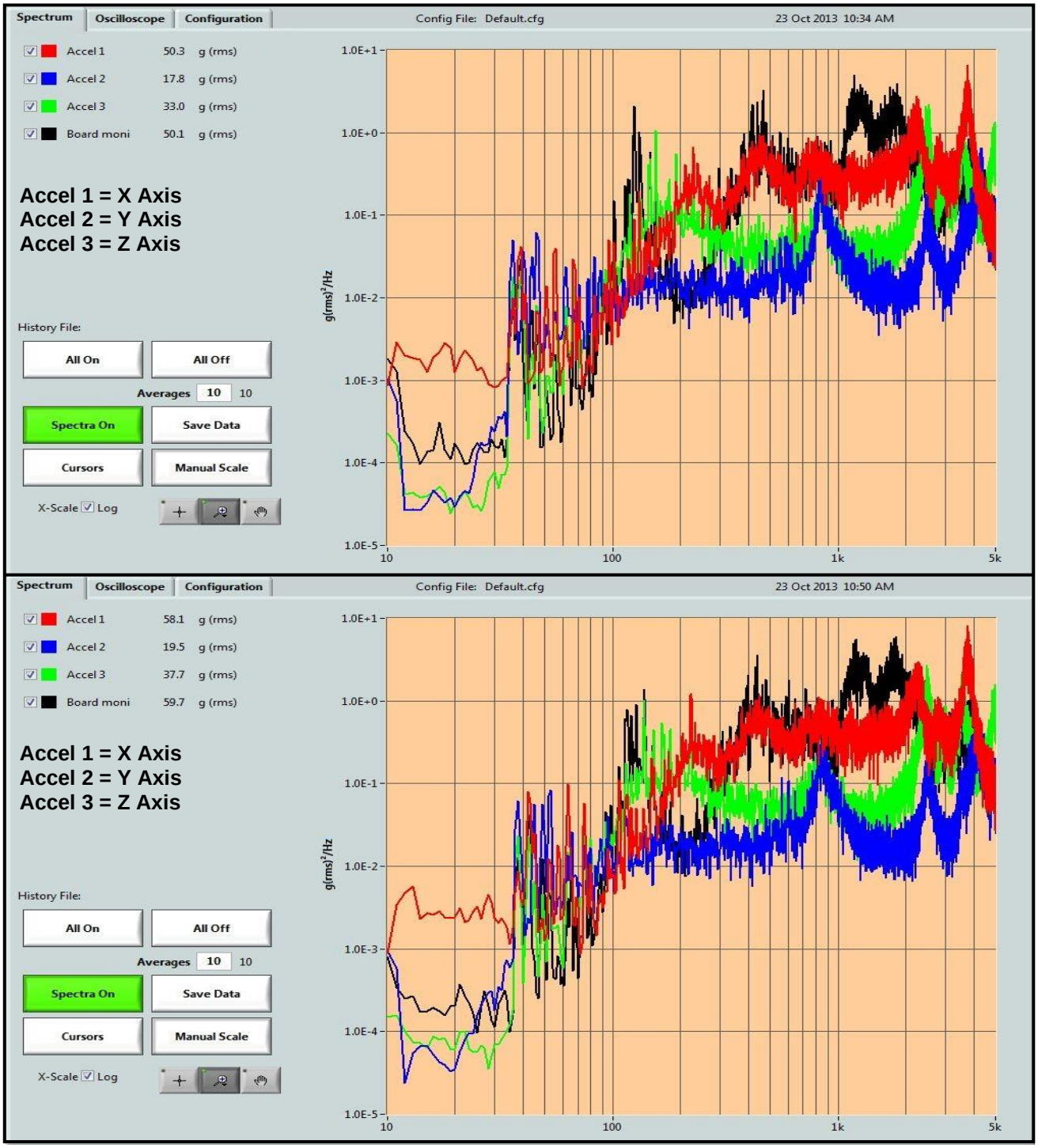

Figure 9: Vibration Step Stress – Test Item 35Grms & 40Grms

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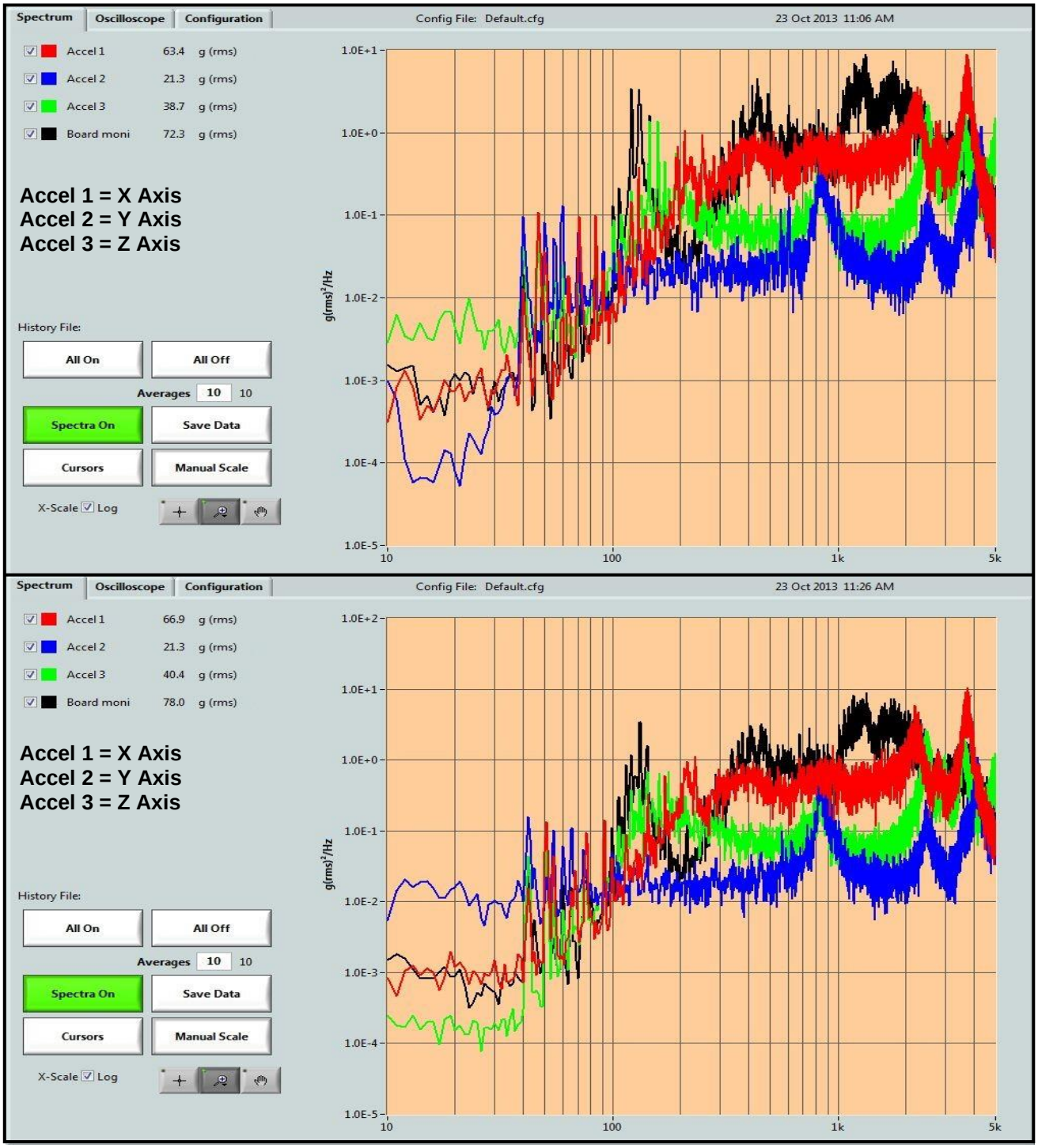

Figure 10: Vibration Step Stress – Test Item 45Grms & 50Grms

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5.7 Combined Environments Stress

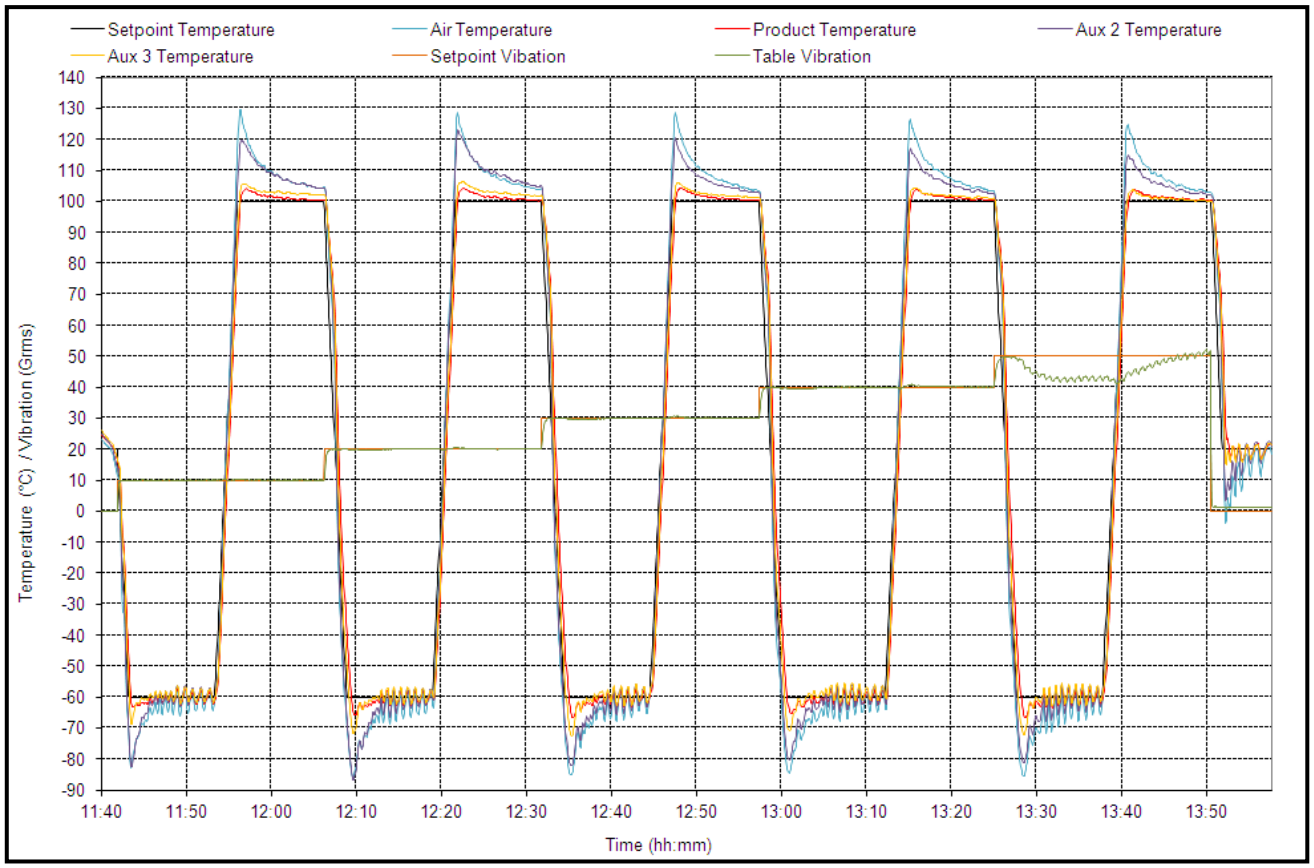

Figure 11: Combined Environments Stress

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6 Conclusions

The table below defines the Operating and Destruct Limits for the test items:

Limit	Product Temperature
Lower Operating Temperature Limit	-90°C
Lower Destruct Temperature Limit	< -90ºC
Upper Operating Temperature Limit	+110ºC
Upper Destruct Temperature Limit	> +120ºC
Operating Vibration Limit	48Grms
Destruct Vibration Limit	> 48Grms
Operating Limits: The last chamber setpoint at which the test item is fully functional. Destruct Limits: The chamber setpoint that causes an unrecoverable failure.	

Table 8: Operating and Destruct Limits

7 Document Revision History

Revision Level	Summary of Changes
1	Initial Release

Table 9: Revision History

END OF REPORT

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