

Report Details

Products tested	VCCR300-xx
Products Description	300W DC-DC power supply.
Design Phase	3 – Verification
Product Serials	
Test Goals	Test according to EN50155:2021 cl. 13.4.10.3 (Shock) & cl. 13.4.10.4 (Functional Vibration)
Test dates	1 ST to 25 TH April 2023
Report date	28 TH April 2023

Authorisation

Jorge Almendros

28/4/23

Test performed by (Print)

Date

Brian McDonald

28/4/23

Test report written by (Print)

Date

1. Objective

Functional vibration and shock testing are mandatory tests required to comply with EN50155 standard. The objective of this report is to show compliance with the requirements of EN50155 clause 13.4.10.3 for shock and 13.4.10.4 for functional vibration.

2. Executive summary

Performance tests were carried out on a number of product samples at the Vox Power R&D laboratory and the results recorded. The units were then shipped to a specialist external laboratory to perform the shock and vibration testing according to the relevant EN50155 standard. The samples were then returned to the Vox Power R&D laboratory and the performance tests were repeated and compared with the original results. A visual inspection was also carried out to ensure no mechanical damage had occurred during testing.

The details of the performance tests before and after testing are shown in appendix 1.

The details of the visual inspection are shown in appendix 2.

The details of the external shock and vibration testing are shown in appendix 3.

3. Conclusions

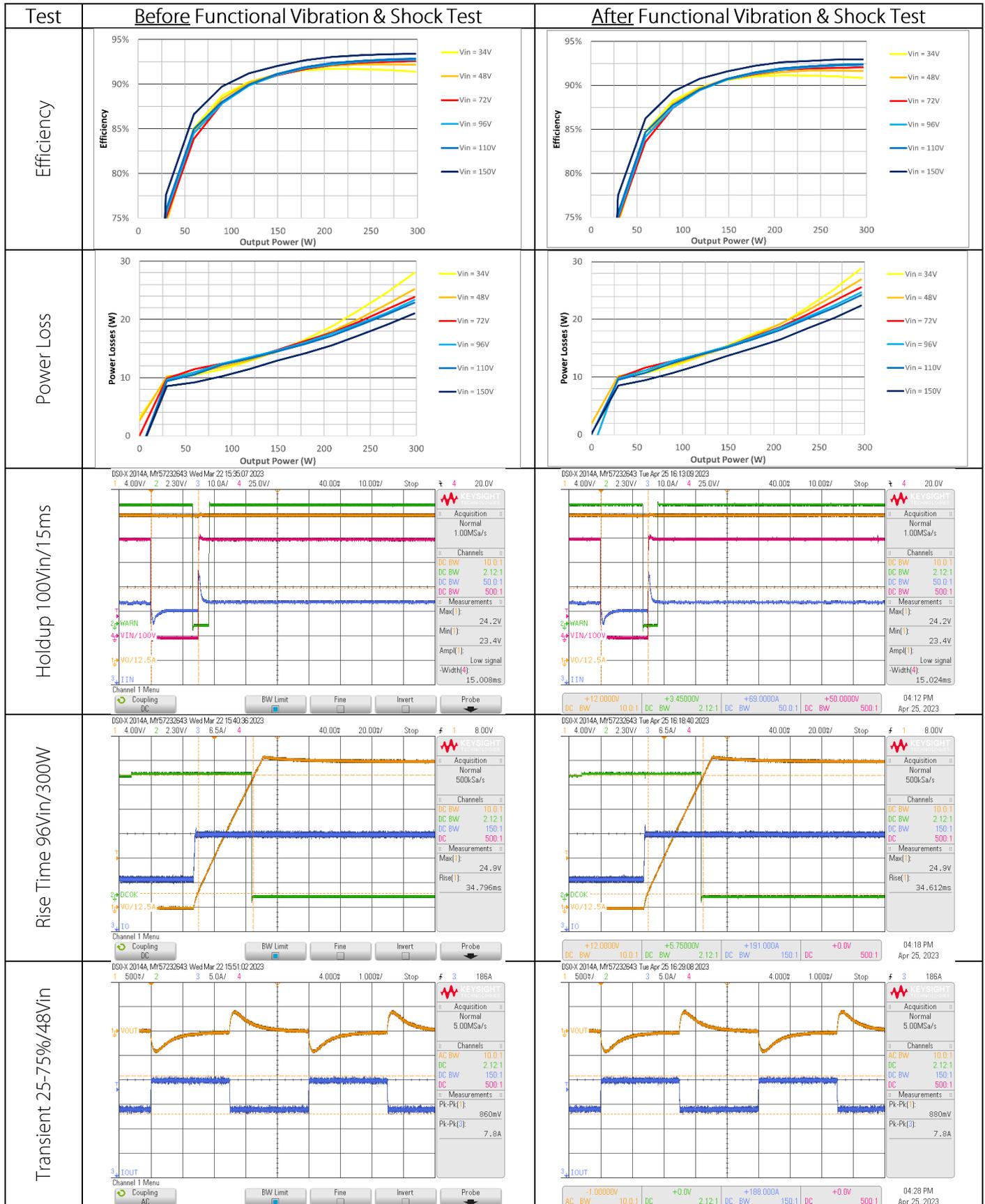
The performance test results for the tested samples before and after the Functional Vibration & Shock tests show no variation in performance.

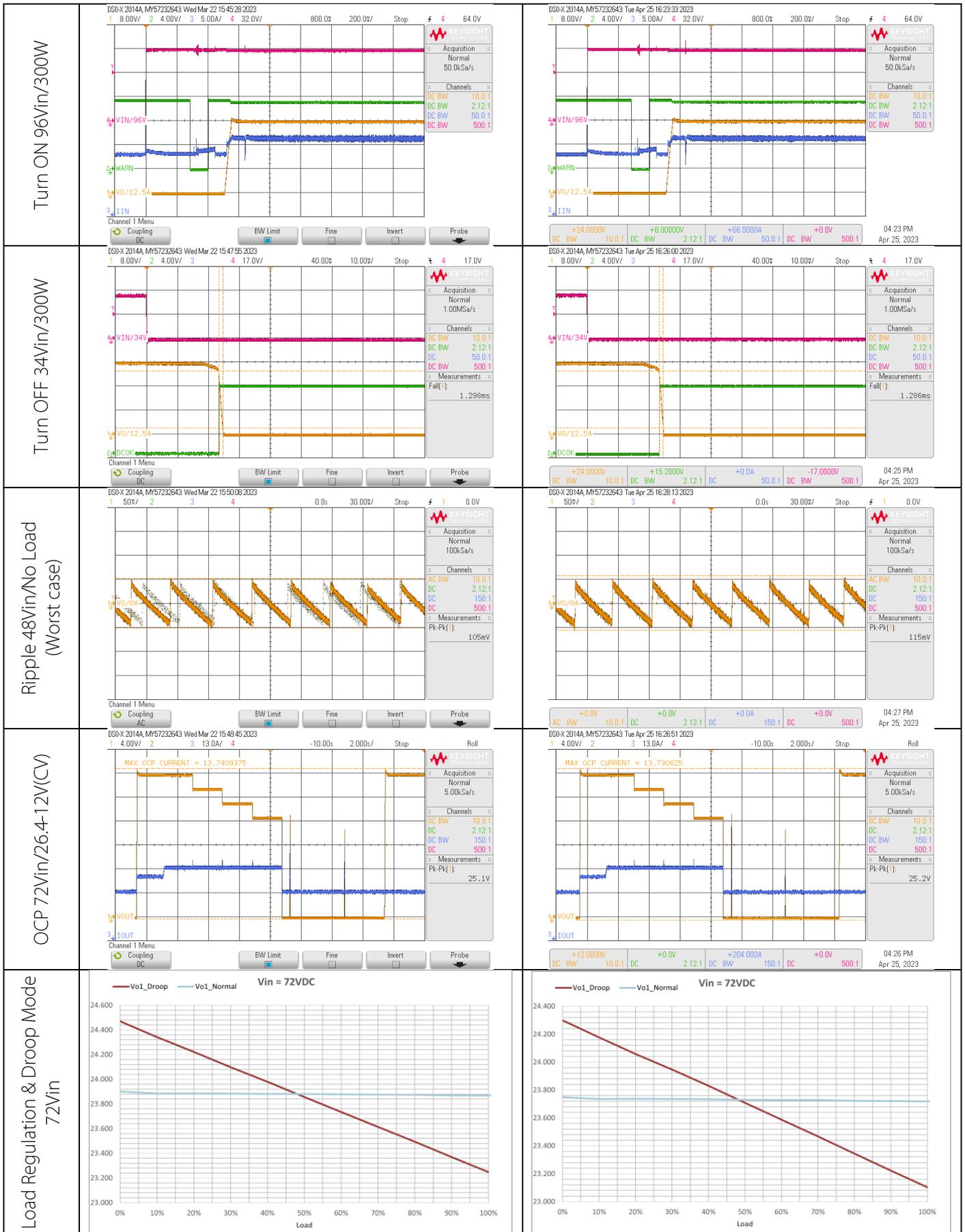
The visual inspection does not show any damage or issues.

It can be concluded that the Functional Vibration & Shock Tests were passed successfully.

Appendix 1 - Performance Test Results

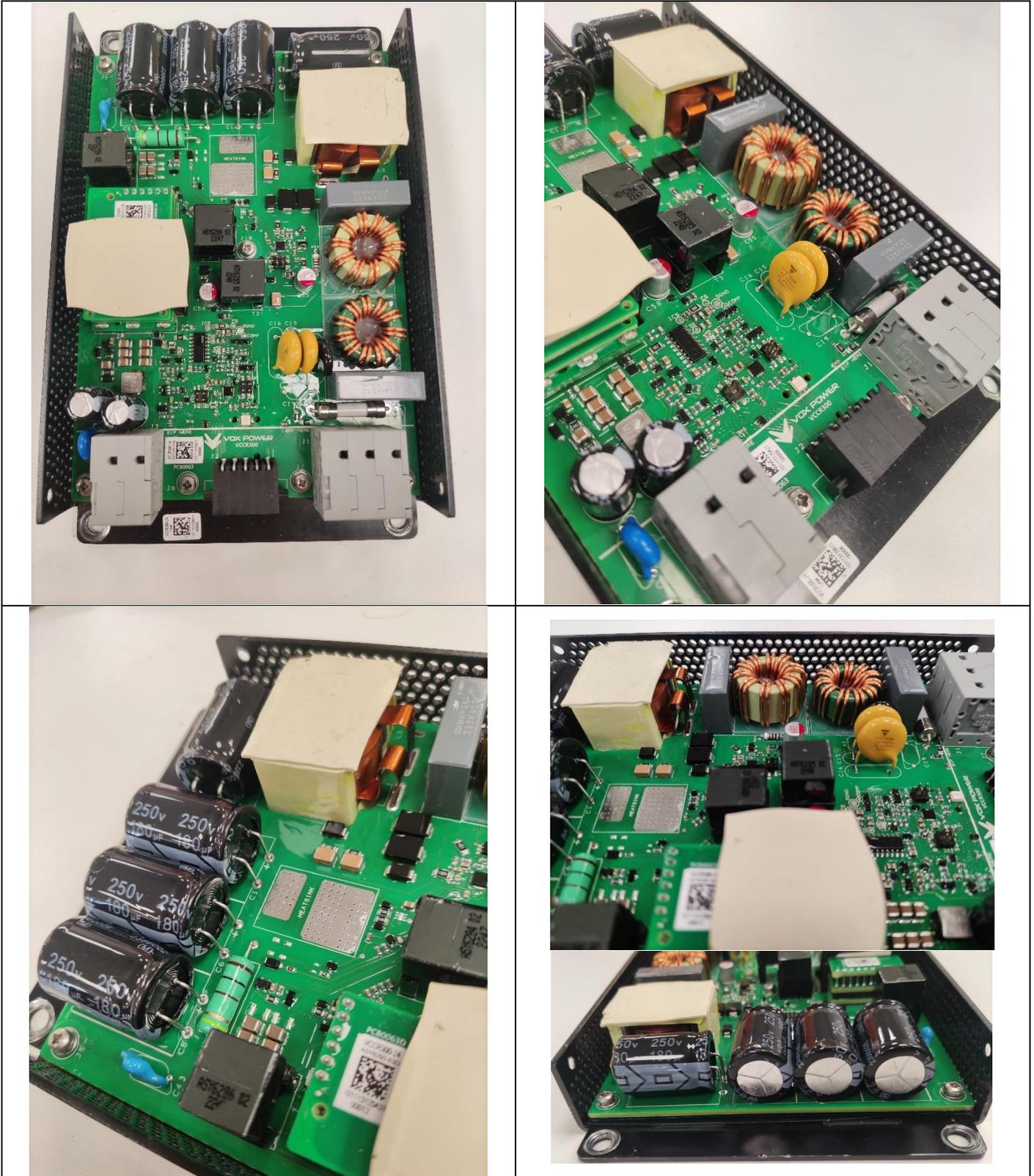
VCCR300-24 Engineering Sample (Functional Vibration & Shock) S/N: 2313C080005





Appendix 2 - Visual Inspection

VCCR300-24 Engineering Sample (Functional Vibration & Shock) S/N: 2313C080005



Appendix 3 – Functional Vibration & Shock Testing

FUNCTIONAL VIBRATION AND SHOCK TEST REPORT FOR VOX POWER

Author: (Name)	Author: (Signature)	Date:
Daniel Grimes	<i>Daniel Grimes</i>	2023-04-18
Approver: (Name)	Approver: (Signature)	Date:
Mary Dowey	<i>Mary Dowey</i>	2023-04-18

CONTRACT INFORMATION

Customer:	Vox Power
PO Number:	PO: 10914
Contact Name:	Brian McDonald
Customer Address:	Vox Power Ltd Unit 2, Redcow Interchange Estate Ballymount Dublin 22, D22 Y8H2, Ireland
Test Specimen:	P/N: VCCR300-24 S/N: 2313C0E0005
Specimen Receipt Date:	2023-03-30
Date of Test:	2023-04-12 to 2023-04-13
Date of Report:	Iss 01: 2023-04-18
Test Method to be Used:	Testing was carried out according to IEC 61373:2010: Clause 8 for functional random vibration testing and Clause 10 for shock testing, as per the customers specification: VCCR300 external environmental test plan.
Any Deviation from Test Method:	For shock testing, the test specimen was subjected to the longitudinal axes test severity (highest severity) in all three axes, at the request of Brian McDonald via email on Sat 01/04/2023 11:15AM
Results summary:	Testing was carried out as per customer's specification without witnessing. No determination on the pass/fail of the test specimen has been made.
Customer onsite representatives:	None
<p>All testing is carried out in compliance with the requirements and specifications detailed above, and the results apply to the specimen tested. Opinions and interpretations are not given by Resonate Testing Ltd.</p> <p>Testing was carried out on these test specimen only and provides no verification for the performance of other items in the same batch, or production run.</p>	

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1 Test Specimen

Customer Description:	Conduction cooled power supply VCCR300 series
Customer Unique ID:	P/N: VCCR300-24; S/N: 2313C0E0005
Condition on receipt:	Suitable for testing
Testing was carried out on these test specimen only and provides no verification for the performance of other items in the same batch, or production run.	

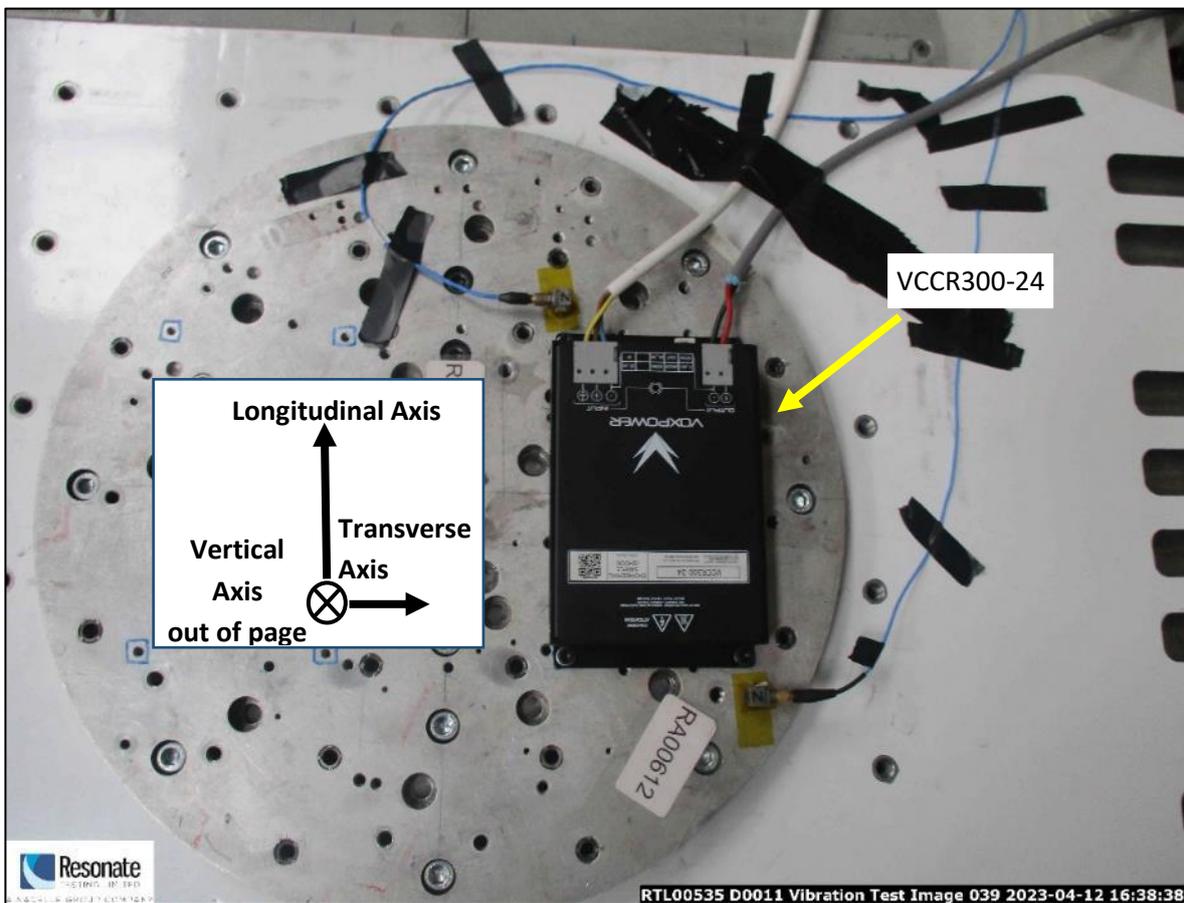


Figure 1: Test specimen and principal axis directions

 <p>Resonate TESTING LIMITED A NACELLE GROUP COMPANY</p>	<p>Test Report</p> <h1 style="text-align: center;">Vibration and Shock</h1>	<p>Record No: RTL00535 D0011 Rev No: 1 2023-04-18 Document Status: Approved</p>
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2 Test Specification

2.1 General

Testing was carried out in accordance with the customers' requirements as specified in:

Document reference:	Testing was carried out according to IEC 61373:2010: Clause 8 for functional random vibration testing and Clause 10 for shock testing, as per the customers specification: VCCR300 external environmental test plan.
Date of receipt:	Received via email from Brian McDonald on Monday 2023-03-13 at 11:54am and additional email on Sat 01/04/2023 11:15am defining levels.

2.2 Environmental Conditions

The test was carried out under standard laboratory conditions:

Temperature: +15 to +35°C.

Relative Humidity: Not greater than 85%.

Ambient Pressure: 84 to 107 kPa (equivalent to +5,000 to -1,500 ft) (+1525 to -460m).

2.3 Functional Random Vibration Test

The test specimen was subjected to a random vibration profile in each orthogonal axes, for a duration of 10 minutes, in accordance with the customer's test specification.

For all three axes, the vertical test level (highest level) was used as per the customer's request as the orientation of which the test specimen is installed is undefined, *'the test shall be carried out in the three axes with the r.m.s value given for the vertical axes'*, this is line with section 8.1 of IEC 61373:2010.

The test specimen mass was less than 500kg, therefore the functional random vibration test was carried out to the requirements detailed in Figure 2.

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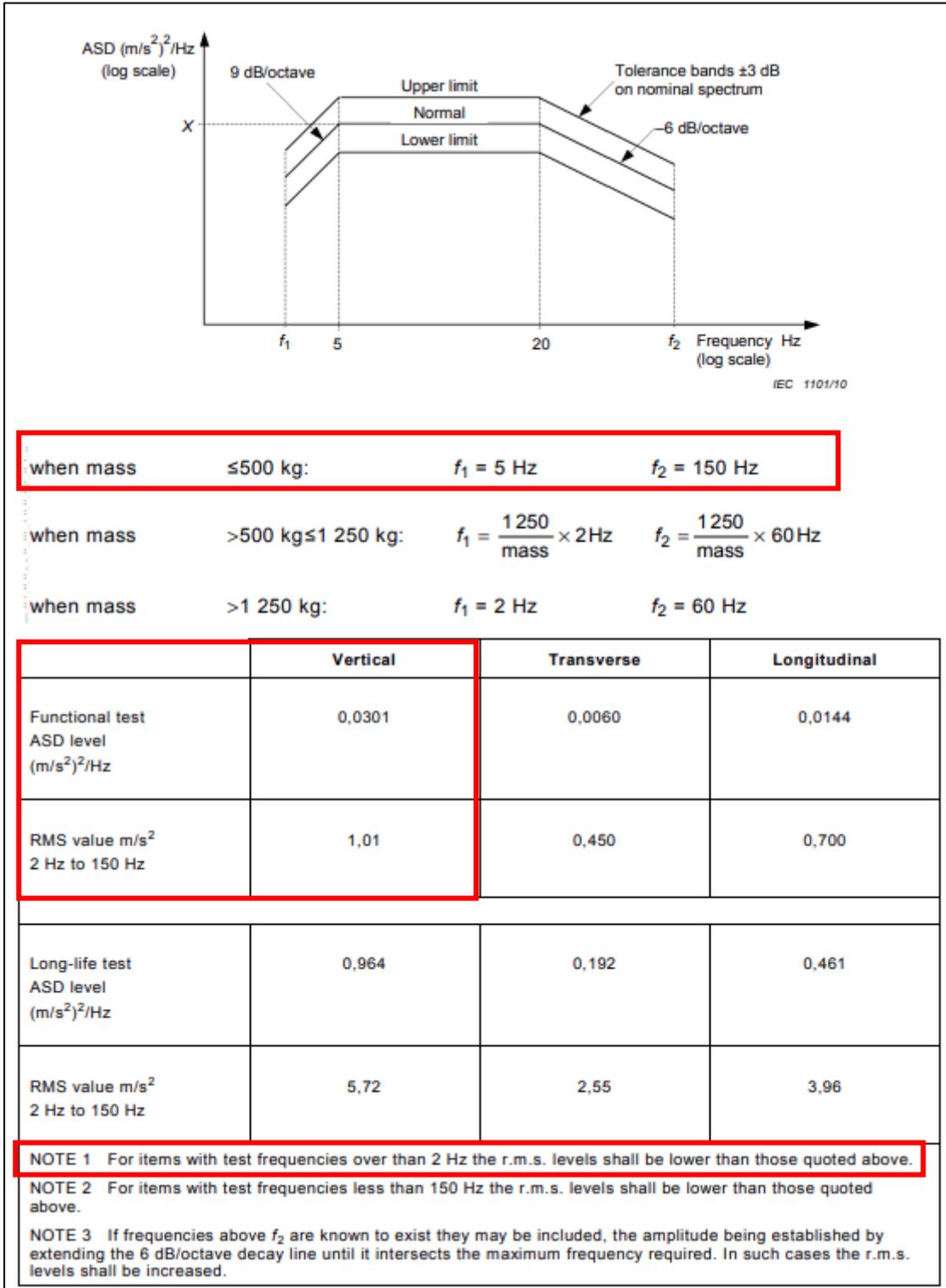


Figure 2: Extract from IEC 61373-2010 – Category 1 class B body-mounted ASD spectrum - functional random vibration test

2.4 Shock Test

The test specimen was subjected to shock testing in each orthogonal axes, in accordance with the customer's test specification.

For all three axes, the longitudinal test severity (highest severity) was used as per the customer request. The shock test was carried out to the requirements detailed in Table 1.

Table 1: Shock test severity

Peak acceleration (m/s ²)	Nominal duration (ms)
50	30
3 shocks positive and negative per axis	

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2.5 Functional Test

During the random vibration and shock testing, the test specimen was functional with the output voltage being monitored throughout testing, under the instruction of the customer by Resonate Testing staff, to ensure that the output voltage lies within $\pm 1V$ of the initial output voltage.

3 Test Equipment and Instrumentation

3.1 Test Laboratory

Laboratory Address:	Resonate Testing Limited Unit 1 Bridge Technology Park Carnagat Lane Carnagat Newry BT35 8XF
Test Technician:	Daniel Grimes
Customer Onsite representatives:	None

3.2 Test Equipment

Testing was carried out using the equipment outlined in the following specification (See Table 2).

Table 2: Vibration equipment specification

Shaker			
	Manufacturer:	IMV Corporation	
	Model:	EM2605	
	Frequency range:	5-2600 Hz	
	Serial No:	51000167	
	Max. Force:	Sine	54 kN
		Random	54 kN rms
		Shock	112 kN
	Max. Acceleration:	Sine	857 m/s ²
		Random	600 m/s ²
		Shock	1777 m/s ²
Max. Velocity:	Sine	2.4 m/s	
	Shock	3.5 m/s	
Max. Displacement:	Sine (peak to peak)	100 mm	

3.3 Fixturing

The test specimen was fixed so that the vibration and shock motion was parallel to each of its three major orthogonal axes. The test specimen was attached to the test fixture, using four M5 bolts with washers and torqued to 6.6 Nm as shown in Figure 3.

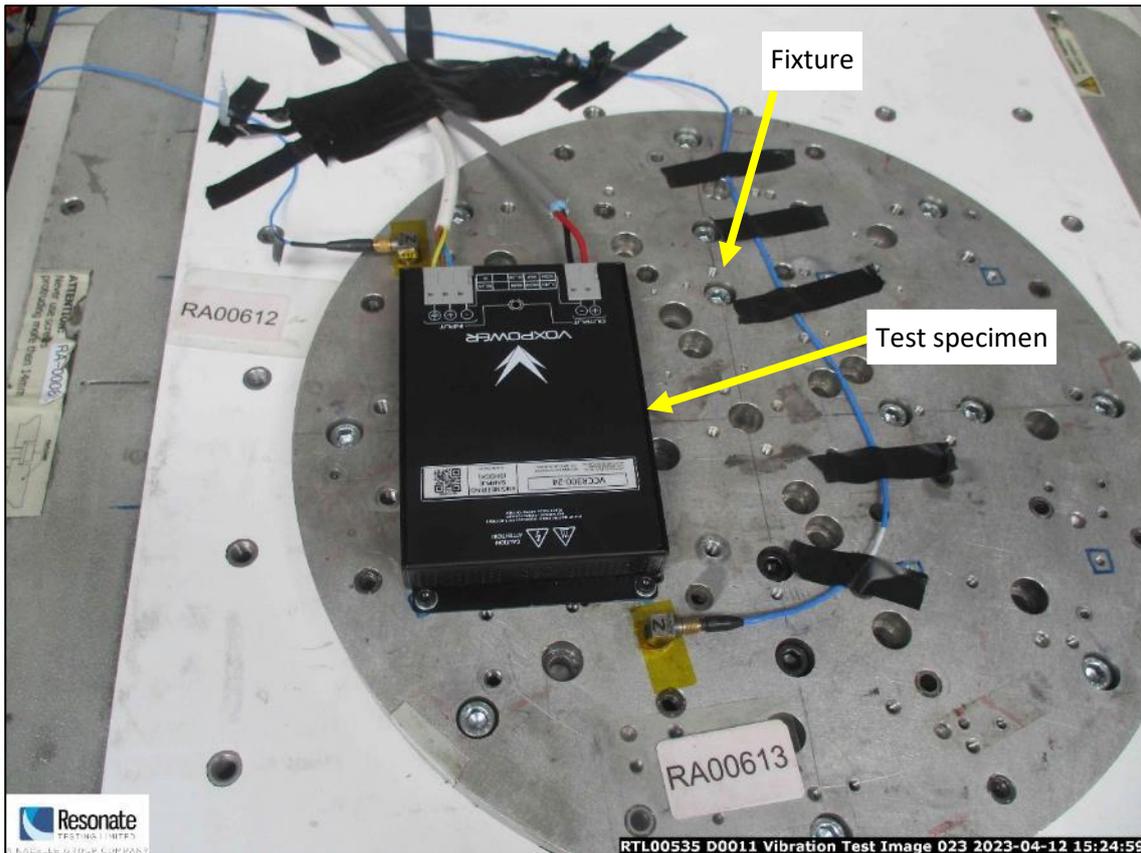


Figure 3: Representative attachment of test specimen to fixture

3.4 Test Instrumentation

3.4.1 Control Accelerometers

The control accelerometer(s) were attached to the test fixture as near as practicable to the test specimen's mounting locations for each axis of test, as shown in Figure 4.

Only one control accelerometer was used for shock testing. The location of this accelerometer is shown in Figure 5.

Where more than one accelerometer has been used, the average of the accelerometer signals has been used for control. APSD plots and acceleration time history plots are given to demonstrate that the control levels meet the test level requirements – See Section 5.

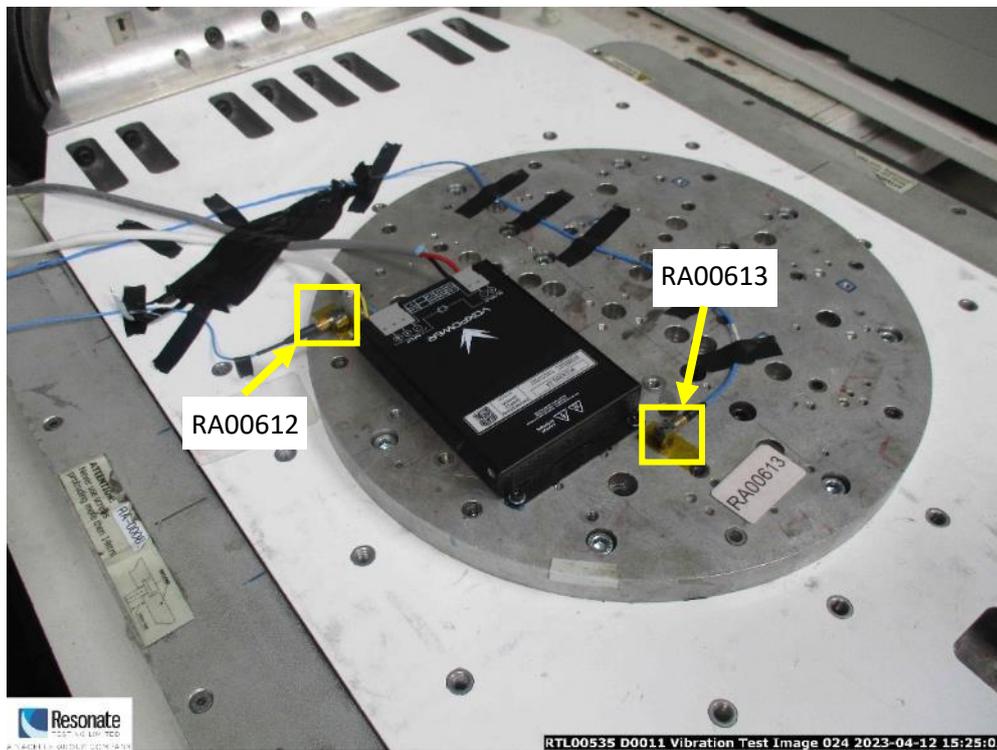


Figure 4: Location of control accelerometers for functional random vibration testing – Location for all axes [RA00612 and RA00613]

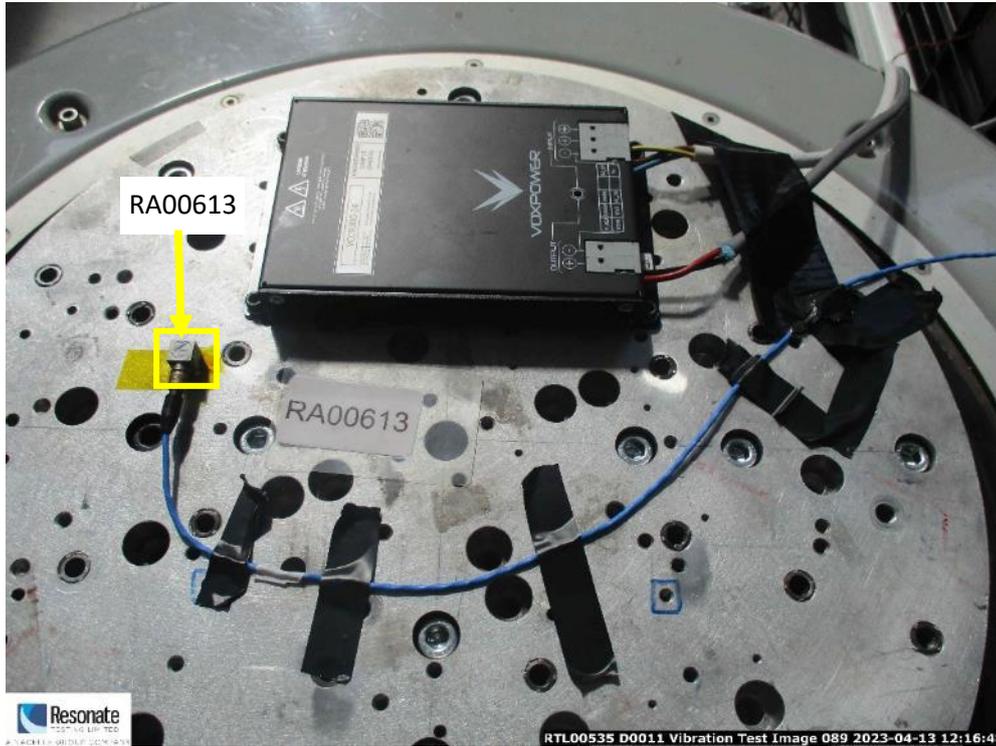


Figure 5: location of control accelerometer for shock testing – Location for all axes [RA00613]

3.4.2 Traceability

All equipment has been calibrated as required using standards traceable to National or International standards.

Table 3: List of instrumentation used

Ref No:	Serial No:	Use	Type:	Cal Status:	Cal Expiry:	Accuracy %
RA00085	51000167	Control	Controller	Calibrated	2023-11-02	± 1.88
RA00612	LW251435	Control	Tri-axial	Calibrated	2023-06-15	± 1.61
RA00613	LW251487	Control	Tri-axial	Calibrated	2023-06-15	± 1.77
RA00079	6WT3D26	Monitoring output voltage	Datalogger	Calibrated	2023-11-18	± 0.19

4 Procedure

4.1 Vibration and Shock Testing

The test specimen was subjected to random vibration and shock testing in each of the three orthogonal axes, in accordance with the customer's specification.

Below is the order of which testing was carried out.

1. Vertical axis, functional random vibration testing – 10 minutes
2. Longitudinal axis, functional random vibration testing – 10 minutes
3. Transverse axis, functional random vibration testing – 10 minutes
4. Transverse axis, shock testing – Three shocks positive followed by three shocks negative
5. Longitudinal axis, shock testing – Three shocks positive followed by three shocks negative
6. Vertical axis, shock testing – Three shocks positive followed by three shocks negative

Representative photographs of the test setup for each test are shown in Figure 6 and Figure 7.

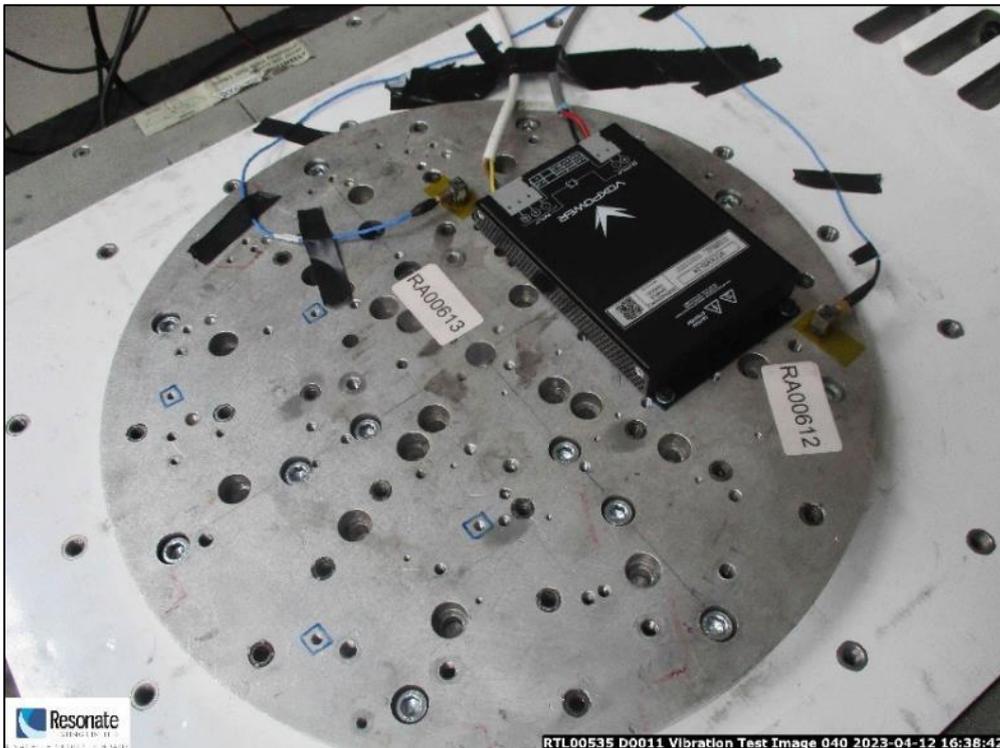


Figure 6: Representative test set-up – Functional random vibration test



Figure 7: Representative test set-up – Shock test

5 Test Results

5.1 Functional Random Vibration Test

The test specimen completed the random vibration tests in accordance with the customer specification in each of the three orthogonal axes as defined in Table 5. Note the vertical level (highest levels) were run in all three axes.

Test statuses are captured in Table 4. Vibration control spectra from the random vibration tests are shown in Figure 8 to Figure 10.

Plots of the output voltage which was monitored for each axis are shown in Figure 11 to Figure 13.

Table 4: Vibration test status – Functional random vibration test

	Vertical axis	Longitudinal axis	Transverse axis
Start	12/04/2023 11:06:27	12/04/2023 15:47:06	12/04/2023 16:47:13
End	12/04/2023 11:18:59	12/04/2023 15:58:09	12/04/2023 16:58:10
Status	Excitation is completed. (Test time is completed.)	Excitation is completed. (Test time is completed.)	Excitation is completed. (Test time is completed.)
Reference	0.9897 m/s ² rms	0.9956 m/s ² rms	0.9956 m/s ² rms
Response	1.0006 m/s ² rms	1.0058 m/s ² rms	0.9976 m/s ² rms
Elapsed time	00:10:00	00:10:00	00:10:00
Alarm	OK	OK	OK
Abort	OK	OK	OK

Table 5: Functional random vibration test control reference

Control Reference				
Acceleration	0.996 m/s ² rms			
Velocity	0.013 m/s rms			
Displacement	0.310 mm rms			
Break point PSD				
No.	Frequency (Hz)	Level/Slope		
1	5.00	3.010e-2	(m/s ²) ² /Hz	
2	20.00	3.010e-2	(m/s ²) ² /Hz	
3	150.00	-6.00	dB/octave	
Tolerance				
Abort upper (dB) Abort lower (dB) Abort A.B.W. (Hz) Alarm upper (dB) Alarm lower (dB) Alarm A.B.W. (Hz)				
3.00	6.00	-3.00	-6.00	5.00
Extended tolerance (0 items)				

5.2 Shock Test

The test specimen completed the shock testing in accordance with the customer specification in each of the three orthogonal axes as defined in Table 7. Note the longitudinal levels (highest levels) were run in all three axes.

Test statuses are captured in Table 6. Acceleration time history plots from the shock tests are shown in Figure 14 to Figure 19.

Plots of the output voltage which was monitored for each axis are shown in Figure 20 to Figure 22.

Table 6: Shock test status – Shock test

	Vertical axis	Longitudinal axis	Transverse axis
Start	13/04/2023 12:32	13/04/2023 11:35	13/04/2023 10:58
End	13/04/2023 12:34	13/04/2023 11:42	13/04/2023 10:59
Status	Excitation is completed. (Test time is completed.)	Excitation is completed. (Test time is completed.)	Excitation is completed. (Test time is completed.)
Number of Shocks	3 positive 3 negative	3 positive 3 negative	3 positive 3 negative

Table 7: Shock test control reference

Reference		
Reference waveform type	Classical Shock	
Waveform type	Half-sine	
Sampling frequency	1024.00 Hz	
Peak amplitude	50.0 m/s ²	
Pulse width	30.0 ms	
Pulse position	0.0 %	
Rest time:Pre-pulse	0.0 ms	
Rest time:Post-pulse	0.0 ms	
Tolerance type	IEC (JIS C) 60068-2-27	
Compensation wave	Asymmetry	
Compensation wave type	Type4	
Peak level:Pre-pulse	90.0 %	
Peak level:Post-pulse	90.0 %	
Total length	499.0234 ms (512 points)	
	Min.	Max.
Acceleration	-8.1638 m/s ²	50.0 m/s ²
Velocity	-0.4756 m/s	0.4755 m/s
Displacement	-10.6302 mm	8.7279 mm

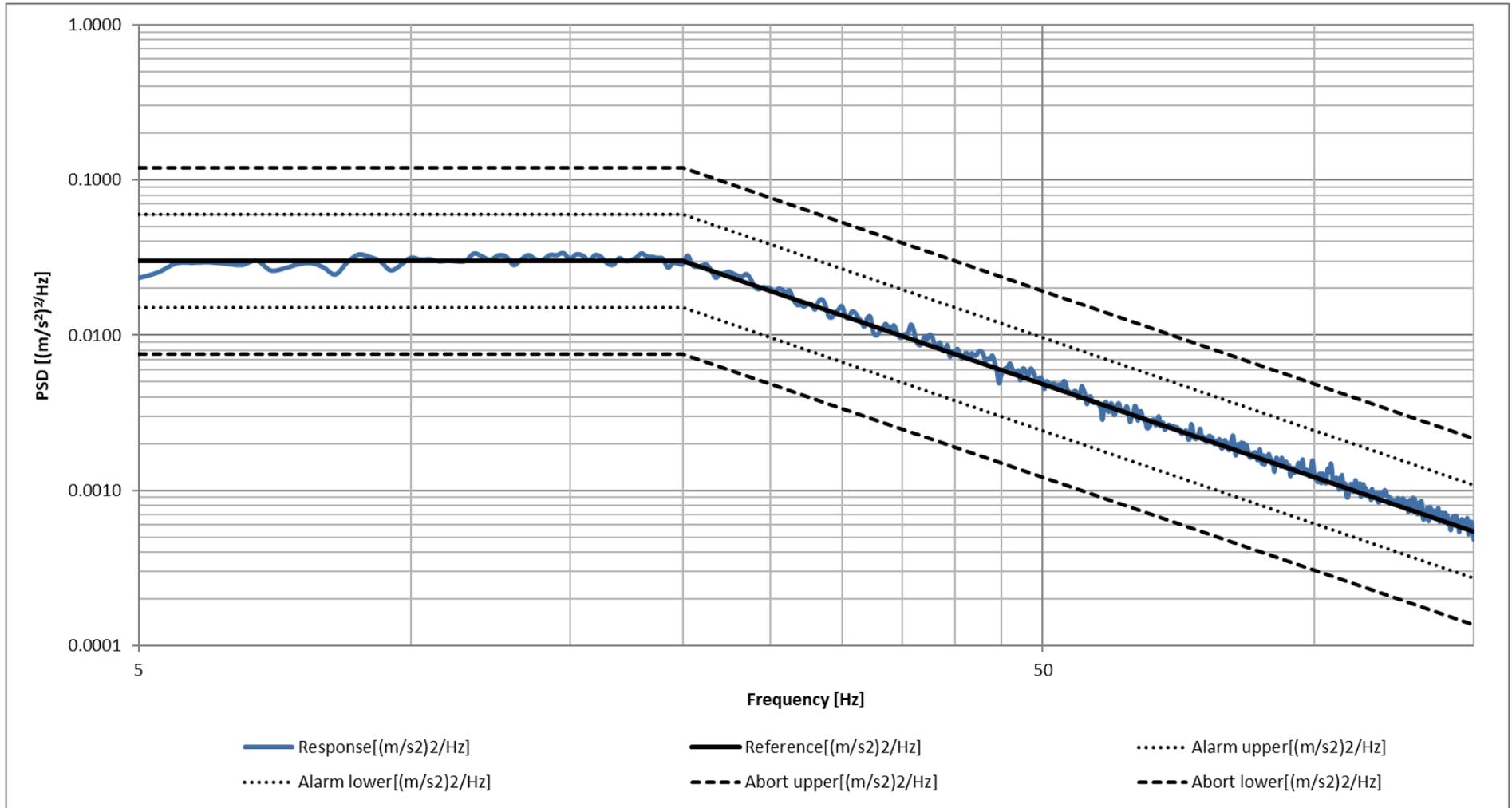


Figure 8: Functional random vibration control plot – Vertical axis

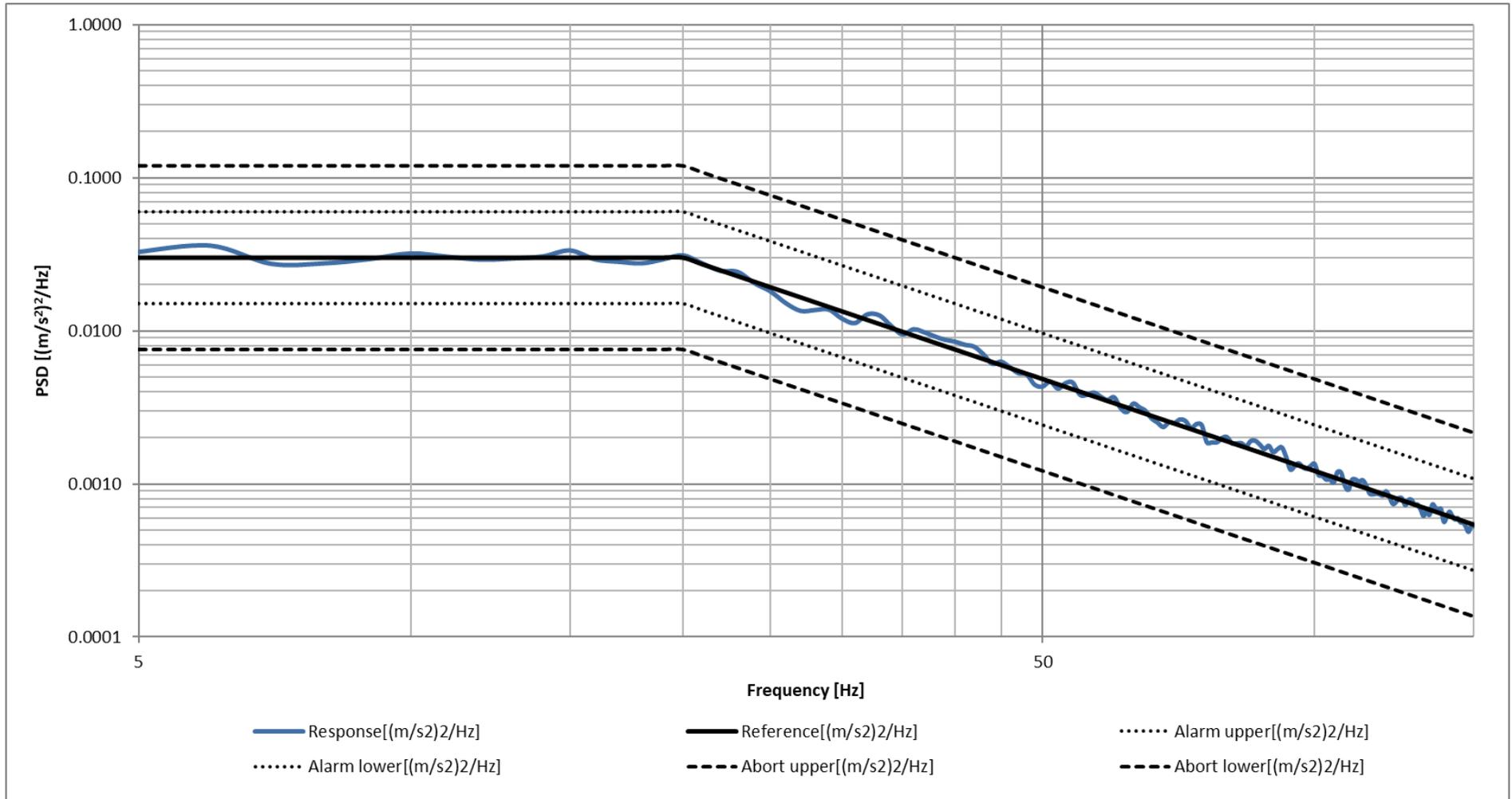


Figure 9: Functional random vibration control plot – Longitudinal axis

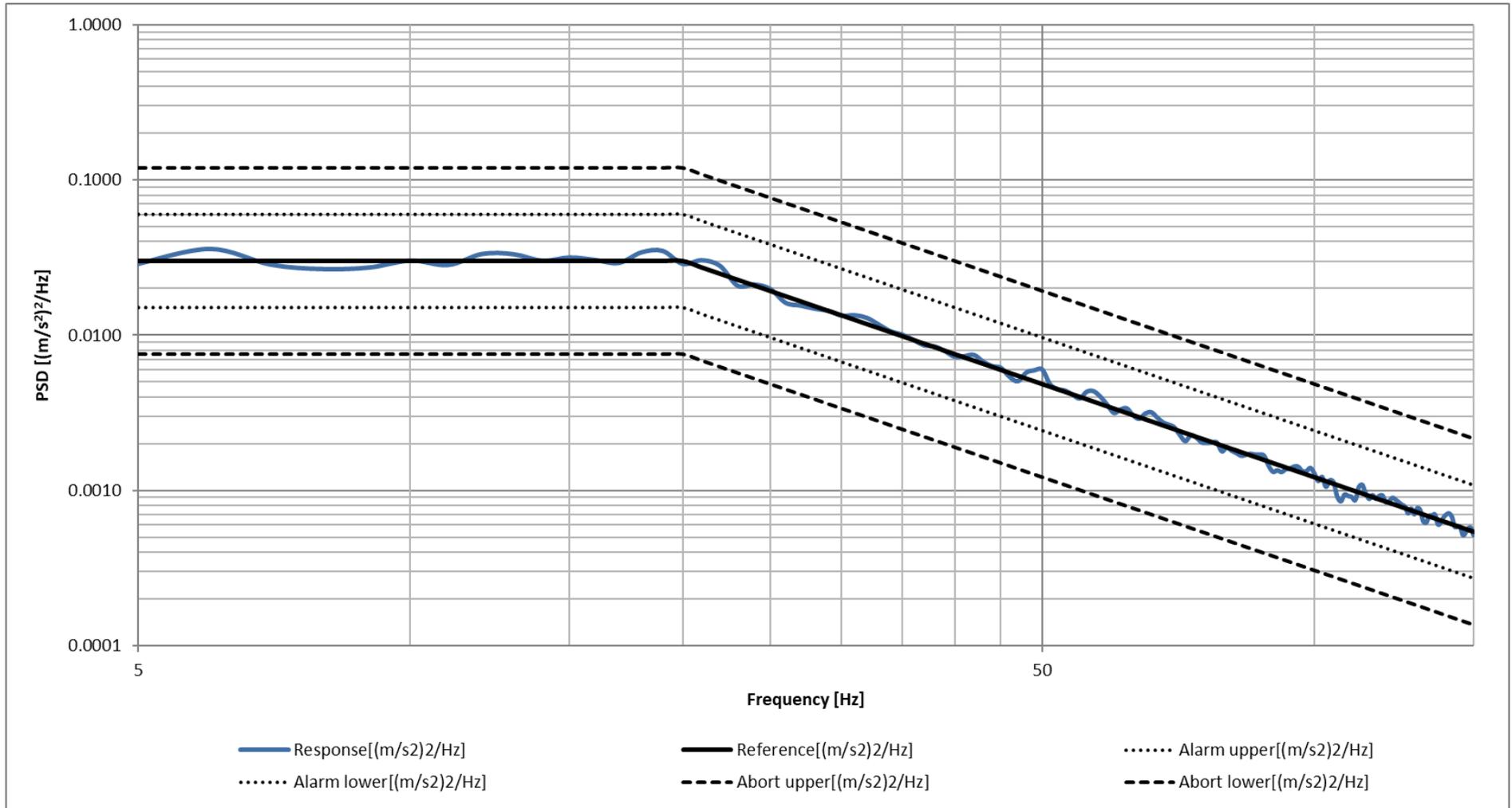


Figure 10:Functional random vibration control plot in – Transverse axis

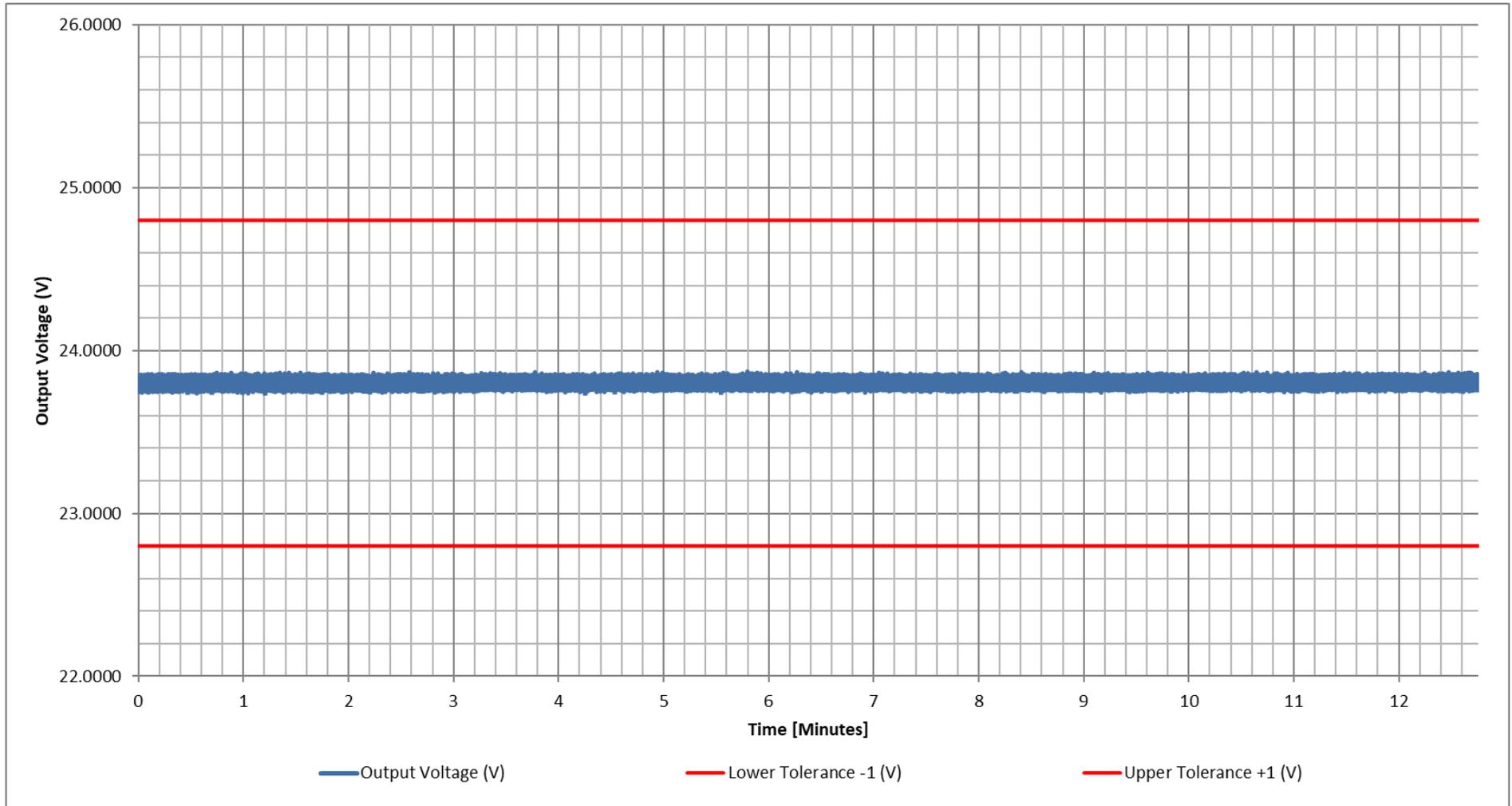


Figure 11: Output Voltage – Vertical axis functional random vibration test

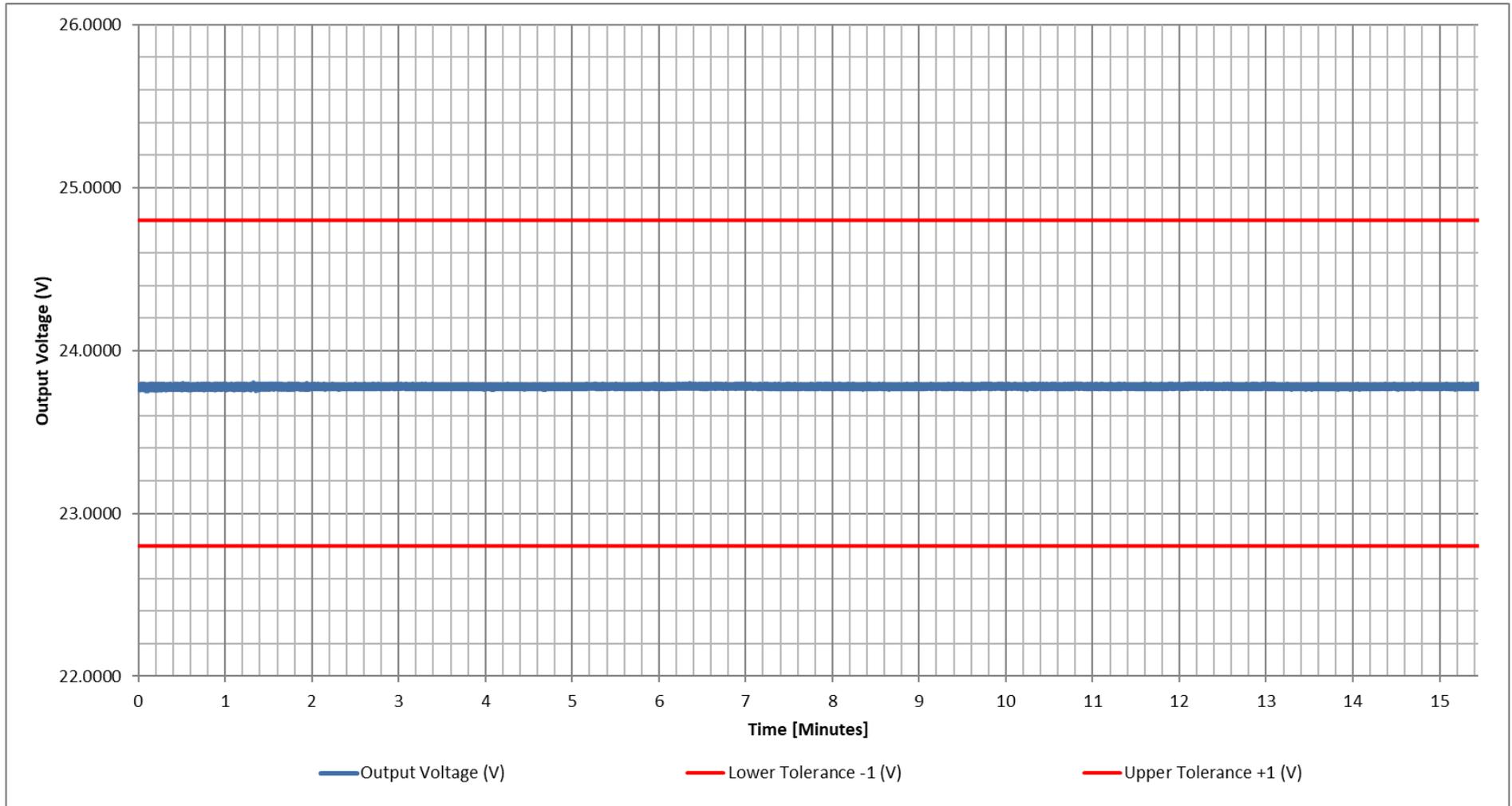


Figure 12: Output Voltage – Longitudinal axis functional random vibration test

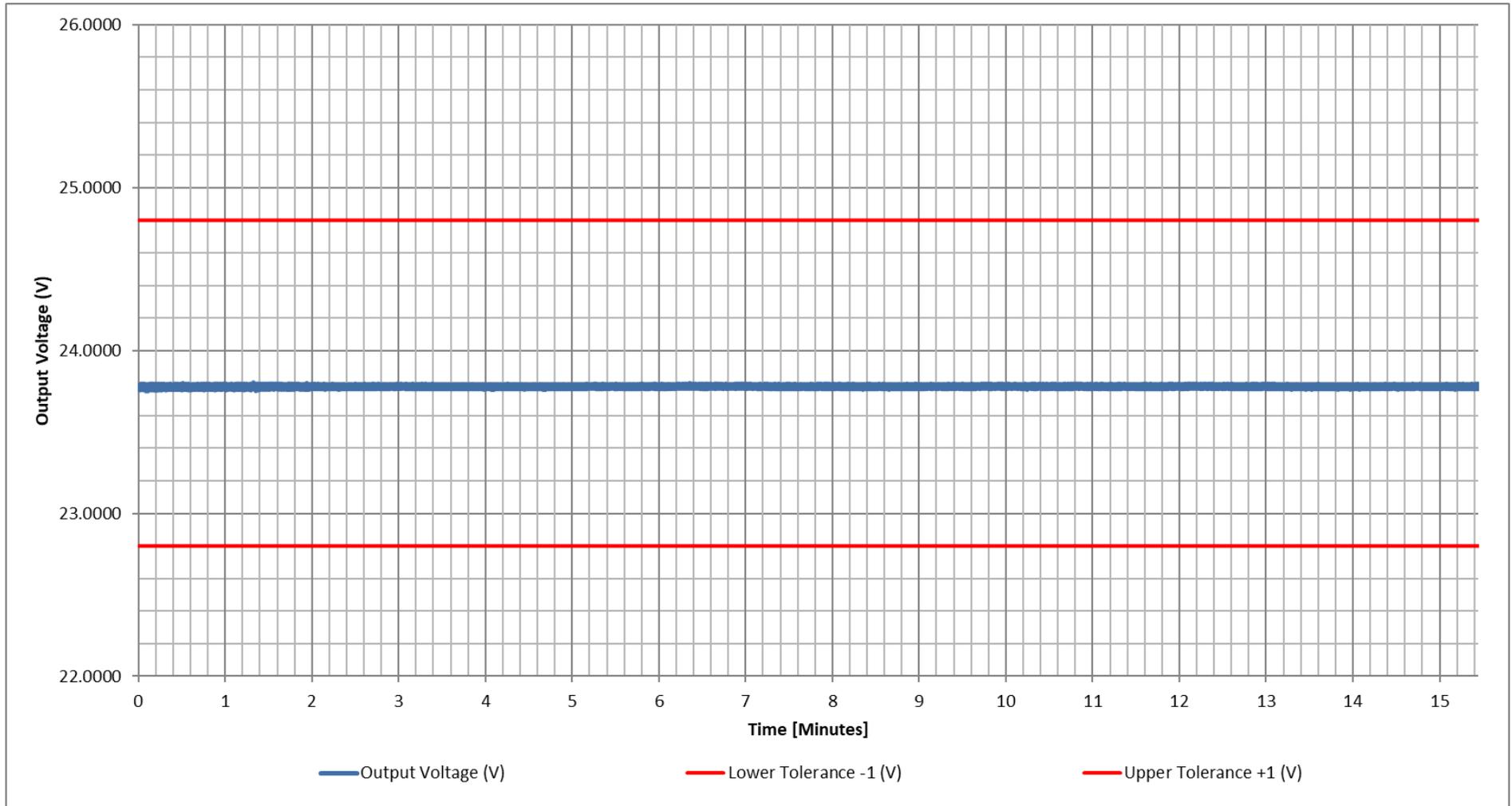


Figure 13: Output Voltage – Transverse axis functional random vibration test

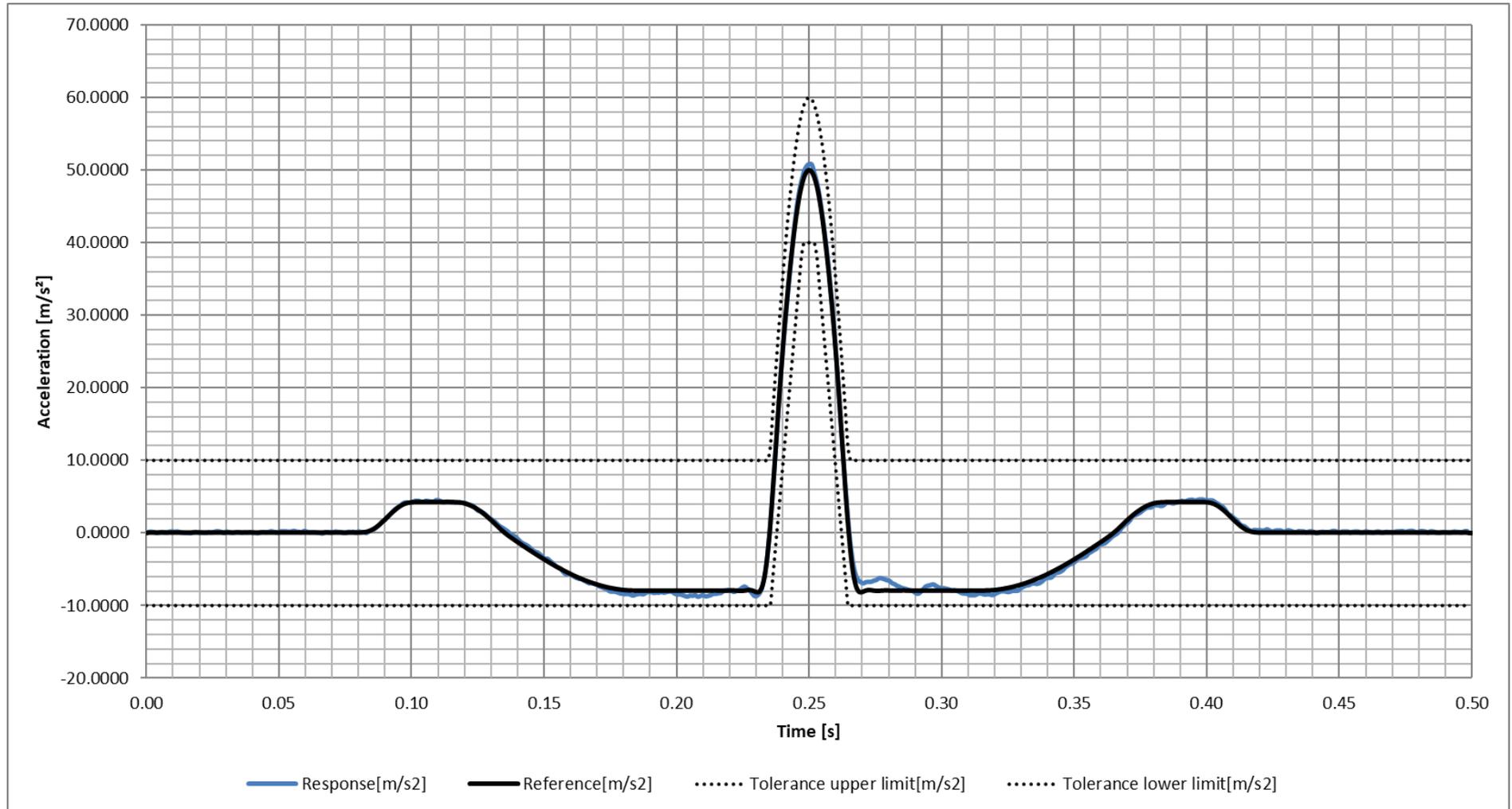


Figure 14: Shock test response – Shock 1 of 6 – Vertical axis positive

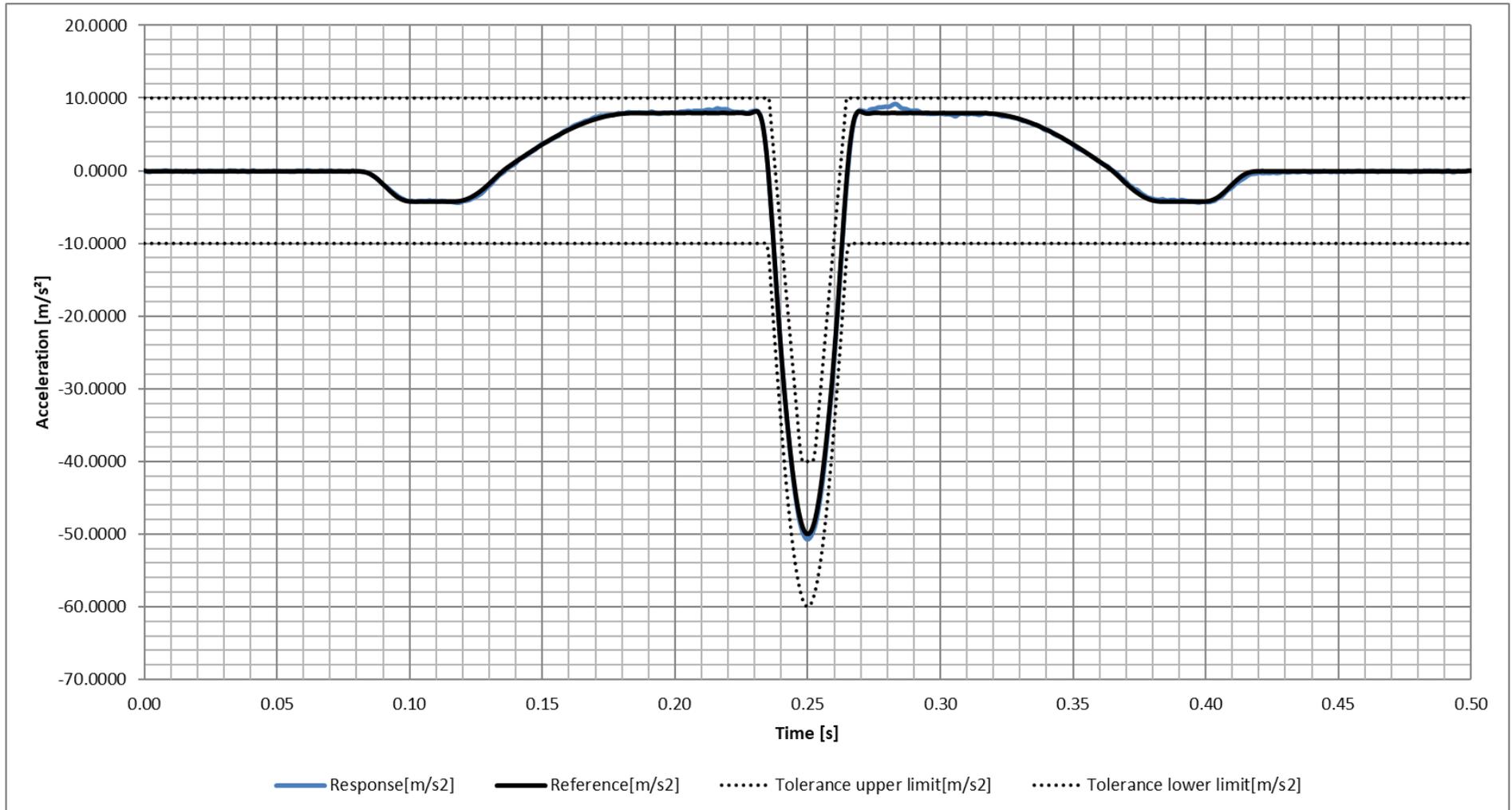


Figure 15: Shock test response – Shock 6 of 6 – Vertical axis negative

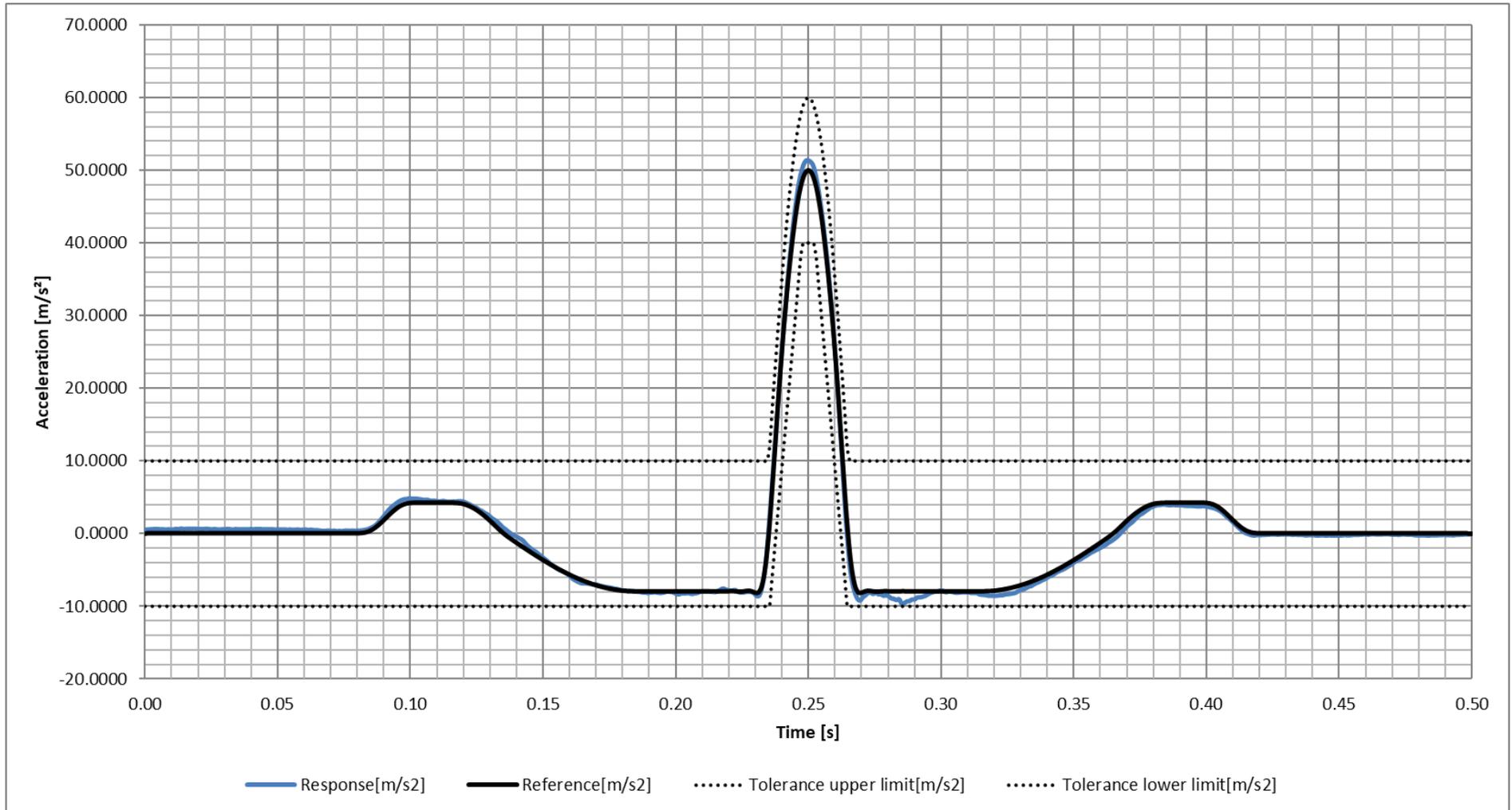


Figure 16: Shock test response – Shock 1 of 6 – Longitudinal axis positive

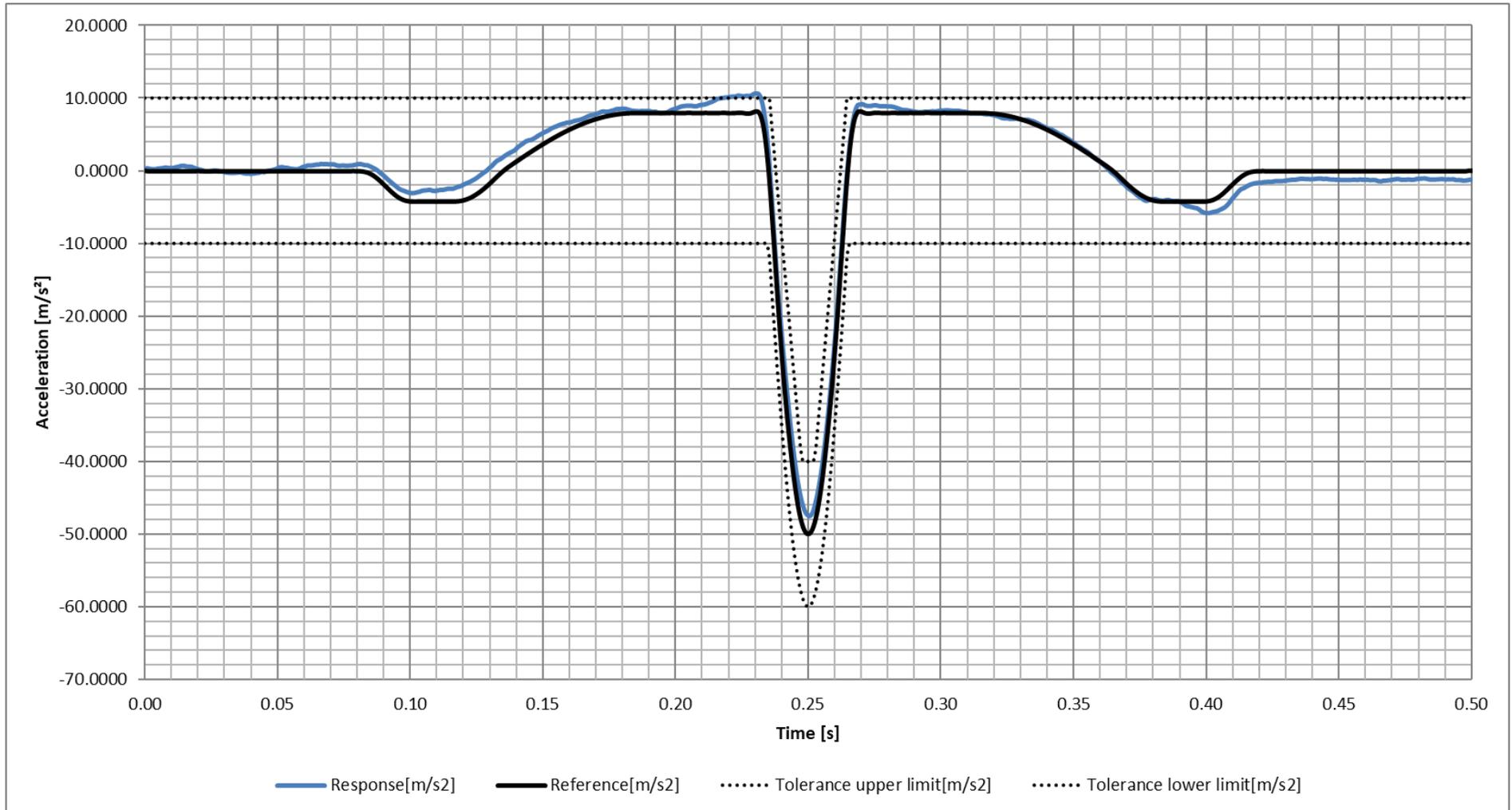


Figure 17: Shock test response – Shock 6 of 6 – Longitudinal axis negative

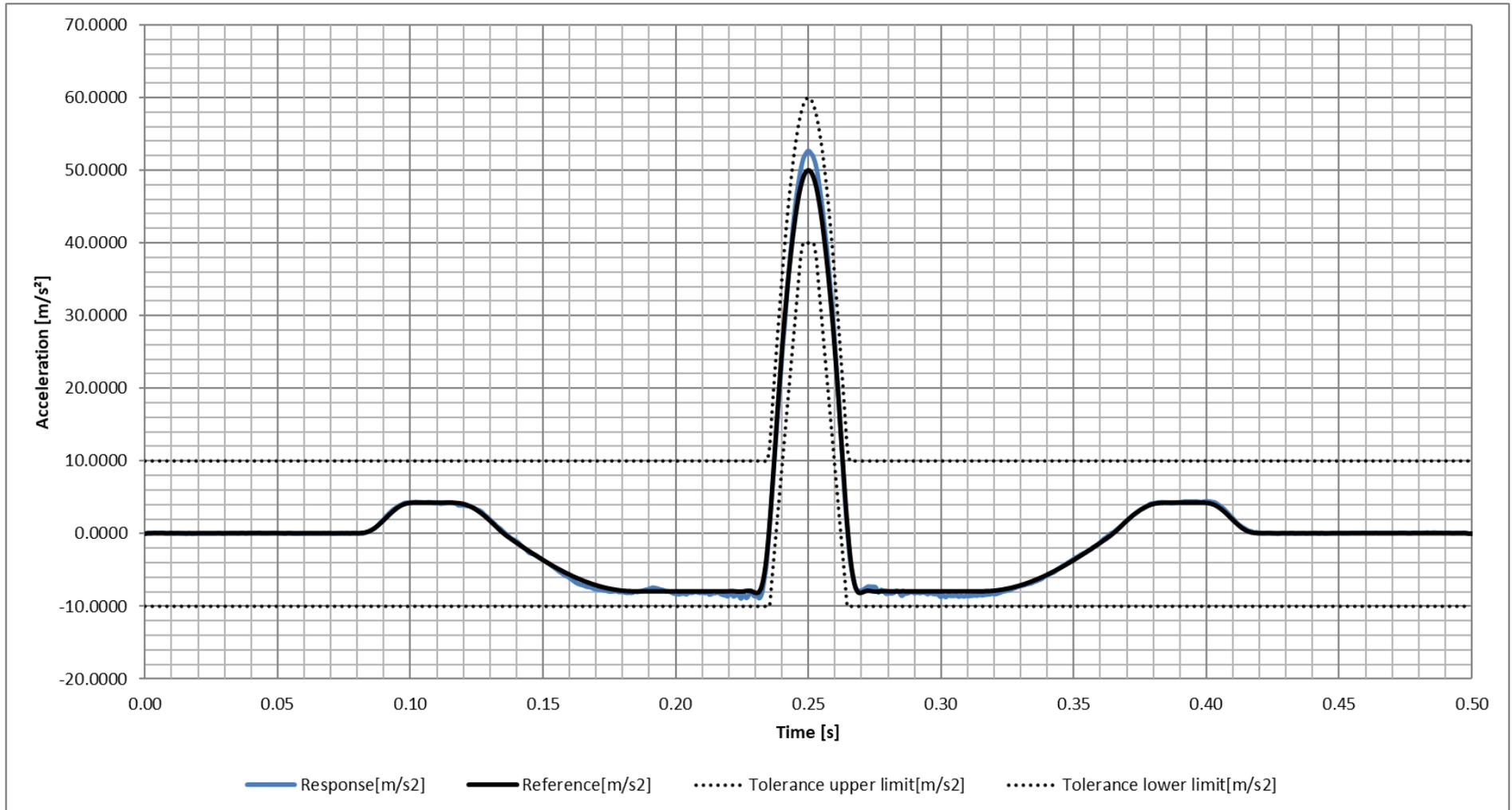


Figure 18: Shock test response – Shock 1 of 6 – Transverse axis positive

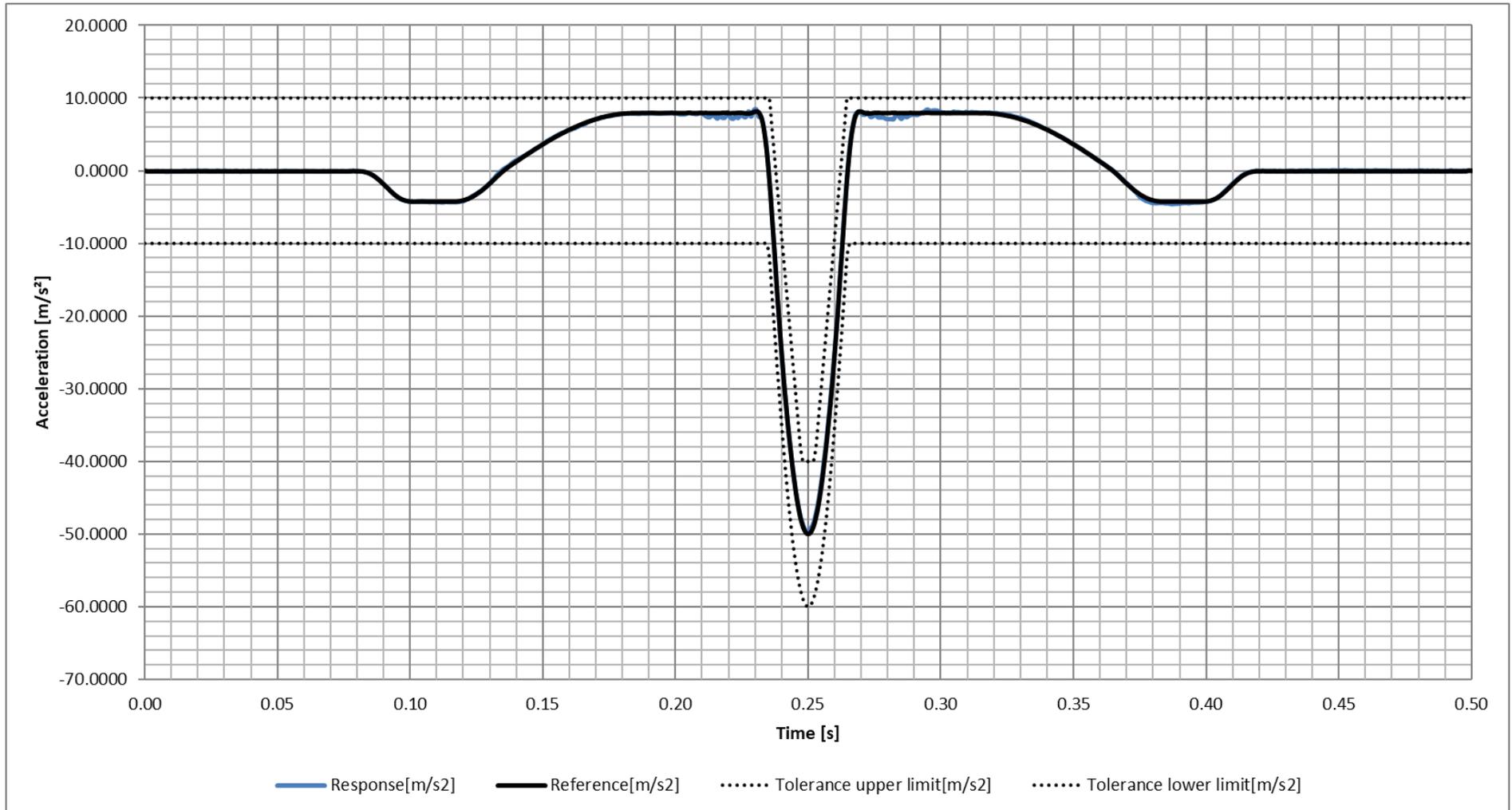


Figure 19: Shock test response – Shock 6 of 6 – Transverse axis negative

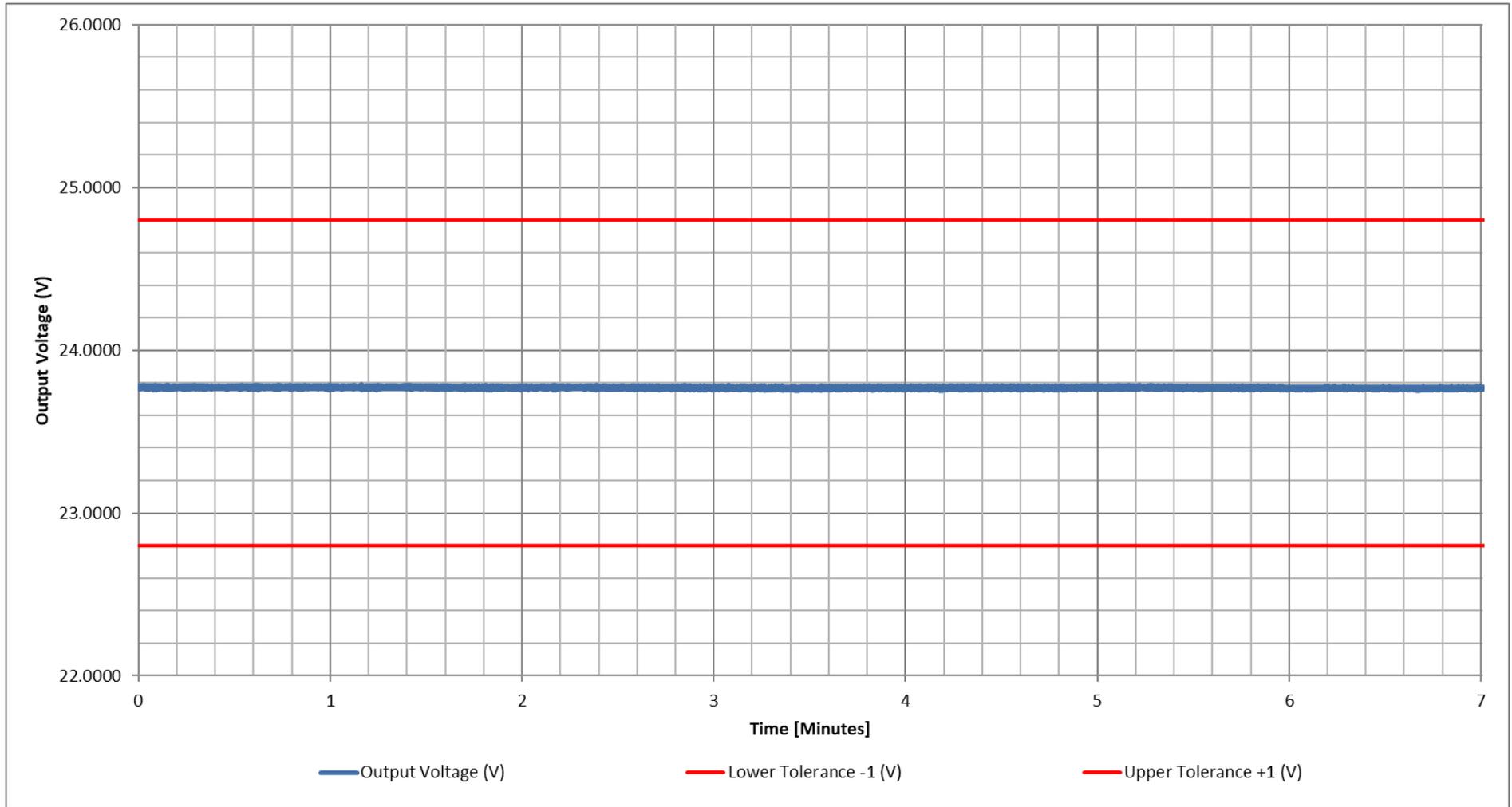


Figure 20: Output Voltage – Vertical axis shock test

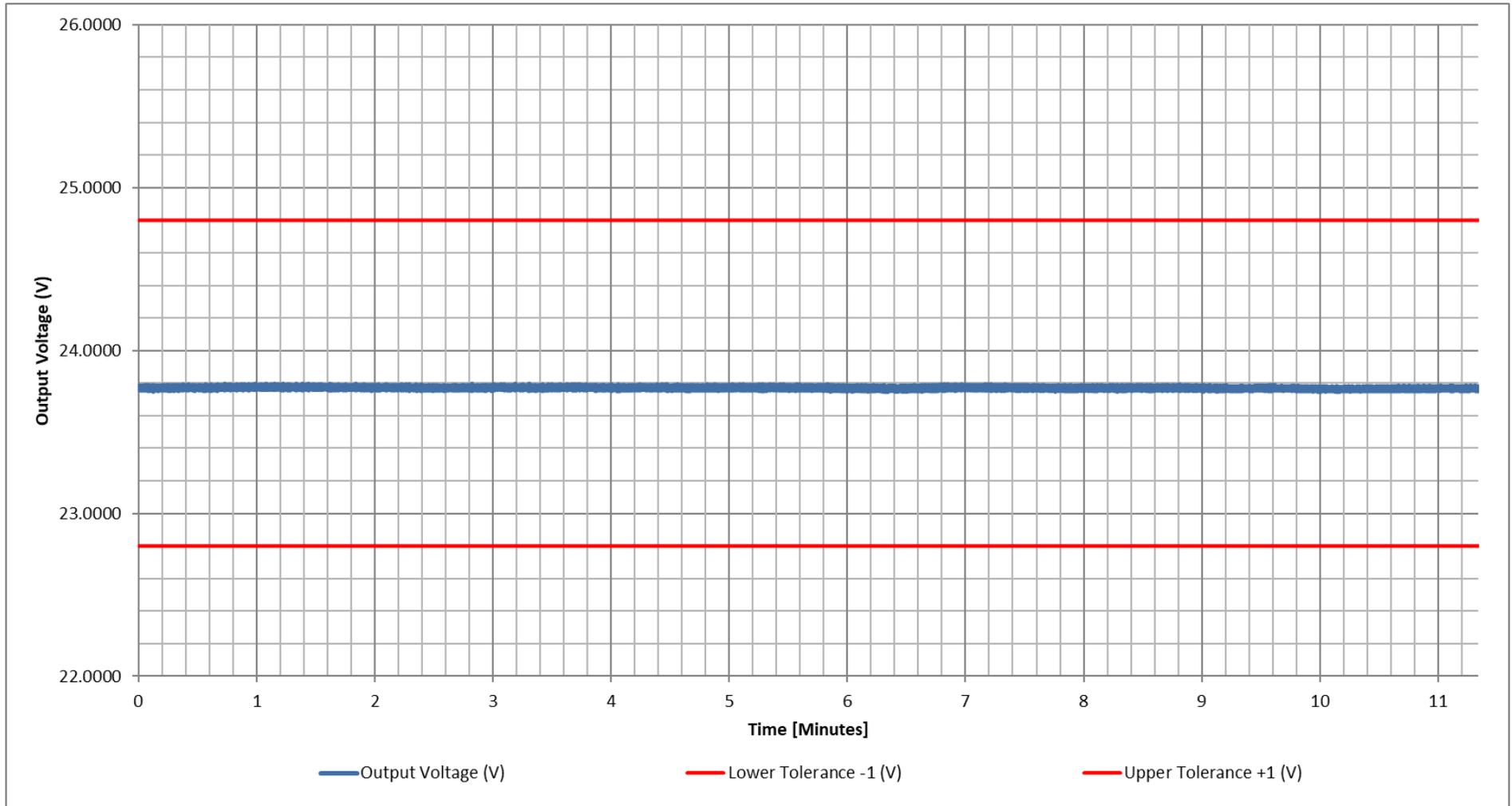


Figure 21: Output Voltage – Longitudinal axis shock test

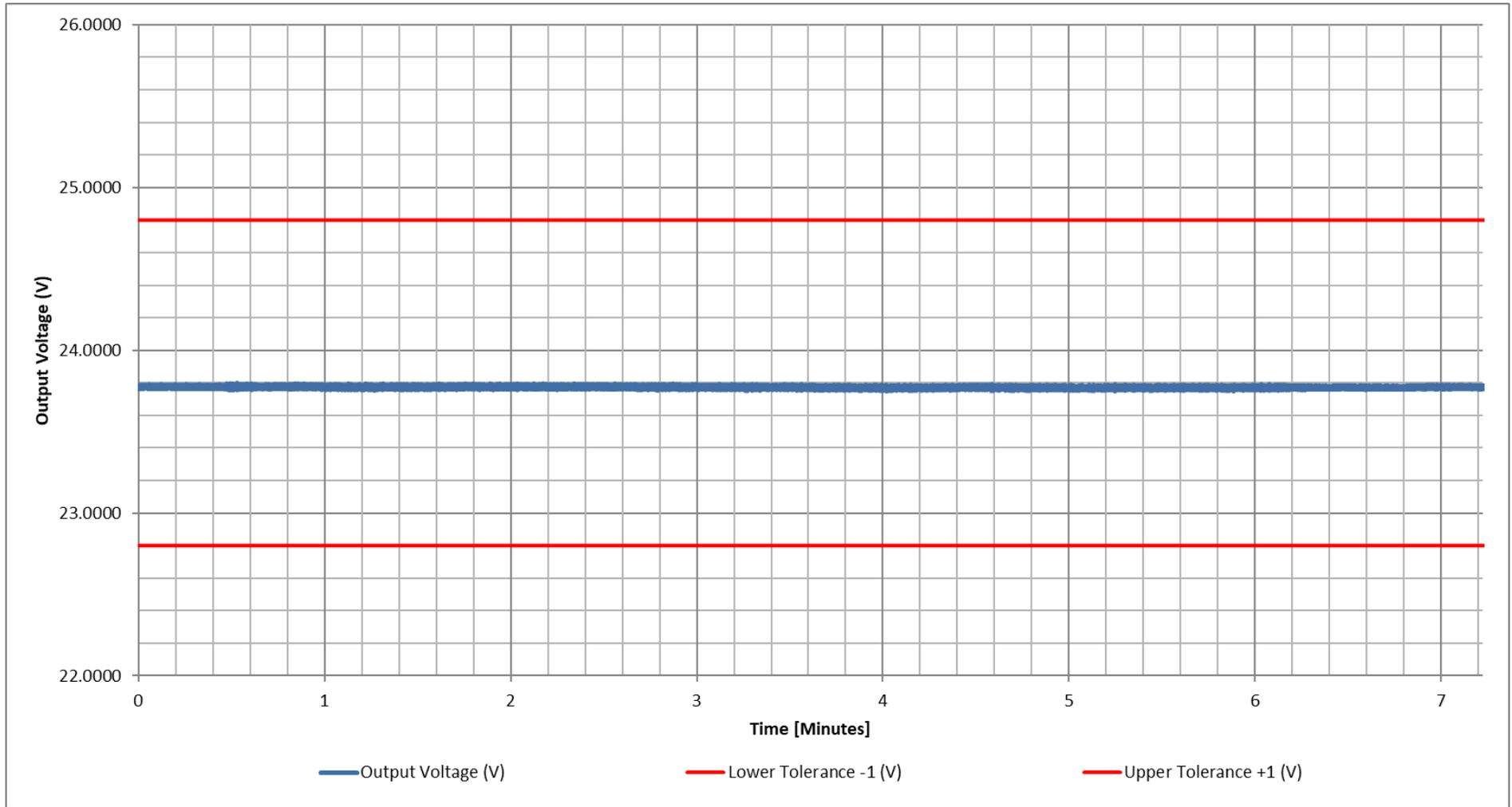


Figure 22: Output Voltage – Transverse axis shock test

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6 Quality Assurance

Our technical competence and quality control arrangements are in accordance with the conditions of our quality management system.

7 Summary

Random vibration and shock tests were carried out in all three orthogonal axes in accordance with the customer specification.

During the random vibration and shock testing, the test specimen was functional with the output voltage being monitored throughout testing, under the instruction of the customer by Resonate Testing staff, to ensure that the output voltage lies within $\pm 1V$ of the initial output voltage.

For all three axes, the test specimen was subjected to the vertical random vibration test level and the longitudinal shock severity as per the customer's request, for the duration required by the test specification.

The plots of the control spectra from the random vibration test and acceleration time histories from the shock test have been provided to show that the test requirements have been adhered to. Output voltage plots from each test have also been provided.

End of Report