element

Environmental Testing

For

Panorama Antennas Limited

On

TRNM(G) and TRNC(G) Series Train Antennas

Report No. TRA-032056-21-CR-01B

JULY 2016

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On

TRNM(G) and TRNC(G) Series Train Antennas

Issue Number	Issue Date	Comments
A	22.07.16	Original
B	28.07.16	Product description corrected

Engineer

Approval

Darren Wheatley

Environmental Lead
Test Engineer

Rob Sutton

Verification Controller

Environmental Testing

For

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On

TRNM(G) and TRNC(G) Series Train Antennas

SUMMARY

At the request of Panorama Antennas Limited, two sets each of TRNM(G) and TRNC(G) series train antennas were subjected to an environmental test programme in accordance with Element quotation TRA-032056-00, dated 26th May 2016 referencing BS EN 50155:2007 and BS EN 61373:2010. The objective of the test programme was to demonstrate the specimens' mechanical and functional integrity when subjected to the specified tests.

The specimens completed the test programme with no conspicuous signs of external damage or degradation. On completion of the test the specimens were returned to the customer for further inspection, and a full performance check.

Client:	Panorama Antennas Limited Frogmore Wandsworth Town London SW18 1HF United Kingdom
Specimen Receipt:	21st June 2016
Date of Test:	11th to 12th July 2016

The work that forms the subject of this report was carried out on behalf of Panorama Antennas Limited in accordance with their Order No. 416823 under the terms of conditions of Element Materials Technology Warwick Ltd Works Order No. TRA-032056-00.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure Number	LIST OF FIGURES (Continued)	Page Number

1. INTRODUCTION

At the request of Panorama Antennas Limited, two sets each of TRNM(G) and TRNC(G) series train antennas were subjected to an environmental test programme in accordance with Element quotation TRA-032056-00, dated 26th May 2016 referencing BS EN 50155:2007 and BS EN 61373:2010. The objective of the test programme was to demonstrate the specimens' mechanical and functional integrity when subjected to the specified tests.

2. SPECIMENS

Part Name	TRNM(G) Series Train Antenna
Part No:	TRNMG-7-60-NJ
Serial No:	Test Sample Number 1
Element Stores No:	TRA-032056-S1
Date Received:	21st June 2016

Part Name	TRNC(G) Series Train Antenna
Part No:	TRNCG-7-60
Serial No:	Test Sample Number 1
Element Stores No:	TRA-032056-S3
Date Received:	21st June 2016

The specimens detailed above were subjected to the vibration and shock tests defined in Section 3.

Part Name	TRNM(G) Series Train Antenna
Part No:	TRNMG-7-60-NJ
Serial No:	Test Sample Number 2
Element Stores No:	TRA-032056-S2
Date Received:	21st June 2016

Part Name	TRNC(G) Series Train Antenna
Part No:	TRNCG-7-60
Serial No:	Test Sample Number 2
Element Stores No:	TRA-032056-S4
Date Received:	21st June 2016

The specimens detailed above were subjected to the climatic tests defined in Section 3.

3. SPECIFICATION

Tested in accordance with Element quotation TRA-032056-00, dated 26th May 2016 referencing BS EN 50155:2007 and BS EN 61373:2010.

3.1. VIBRATION AND SHOCK TESTS – BS EN 61373:2010 – CATEGORY 1 – CLASS B

Functional Test

Frequency range:	5 Hz to 150 Hz	
Acceleration:	Vertical:	0.0301 $(m/s^2)^2$/Hz from 5 Hz to 20 Hz
	Transverse:	0.0060 $(m/s^2)^2$/Hz from 5 Hz to 20 Hz
	Longitudinal:	0.0144 $(m/s^2)^2$/Hz from 5 Hz to 20 Hz
		Each level then falling at -6 dB/octave to 150 Hz
Duration:	10 minutes per axis	
UUT Status:	Non-operational	

Simulated Long Life Test;

Frequency range:	5 Hz to 150 Hz	
Acceleration:	Vertical:	0.964 $(m/s^2)^2$/Hz from 5 Hz to 20 Hz
	Transverse:	0.192 $(m/s^2)^2$/Hz from 5 Hz to 20 Hz
	Longitudinal:	0.461 $(m/s^2)^2$/Hz from 5 Hz to 20 Hz
		Each level then falling at -6 dB/octave to 150 Hz
Duration:	5 hours per axis	
UUT Status:	Non-operational	

Shock Test

Pulse:	Half Sine
Axis:	Vertical and Transverse
Acceleration:	30m/s^2
Axis:	Longitudinal
Acceleration:	50m/s^2
Duration:	30ms
Number of shocks:	3 positive, 3 negative per direction (18 Total)
UUT Status:	Non-operational

3.2. CLIMATIC TESTS

3.2.1. COOLING TEST – BS EN 50155:2007, CLAUSE 12.2.3

Tests Temperature:	-40°C
Duration:	Sufficient to ensure thermal stabilisation, minimum 2 hours.
Ramp Rate:	Not greater than 1°C per minute
Performance Checks:	1 at the end of the thermal stabilisation period, whilst maintaining the specified test temperature

3.2.2. DRY HEAT TEST – BS EN 50155:2007, CLAUSE 12.2.4

Test Temperature:	+70°C
Over-temperature:	+85°C
Duration:	6 hours at +70°C followed by 10 minutes at +85°C
Ramp Rate:	Not greater than 1°C per minute
Performance Checks:	1 at the end of the temperature dwell at +70°C and 1 at the end of the temperature dwell at +85°C

4. PROCEDURE

4.1. VIBRATION AND SHOCK TESTS

The specimens were attached to an aluminium fixture plate using M12 cap-head bolts torque tightened to 6Nm. This plate was then attached to an electrodynamic vibration system employing a head expander for the vertical axis, Figure 1, and a hydrostatic slip table for the transverse and longitudinal axes, Figures 2 and 3. Two control accelerometers were attached adjacent to the specimens' mounting points, and an average of their signals were used to ensure compliance with the specified input levels. Each test specimen was then fitted with a single measurement accelerometer to record their dynamic response during the tests. The specimens were tested in accordance with the test specification, and on completion of each axis an external visual inspection was carried out.

4.2. CLIMATIC TESTS

The specimens were placed into a climatic test chamber as shown in Figure 4. A representative of the customer then fitted cable sets to the specimens, which were routed outside of the test chamber to allow the specimens to be performance checked without disturbing the test conditions. A single platinum resistance thermometer was positioned adjacent to the test specimens to ensure compliance with the specified test conditions, and a further two platinum resistance thermometers were fitted to the test specimens to monitor thermal stabilisation. The specimens were then tested in accordance with the test specification, and on completion of each test an external visual inspection was carried out. It should be noted that wherever the test specification called for a 'Performance Check' the following sequence was followed:

1. Connect TRNCG communication and GPS cables to the spectrum analyser and multi-meter respectively.
2. Photograph readings.
3. Connect, in turn, the TRNMG front and back communication cables to the spectrum analyser and photograph readings.
4. Connect TRNMG GPS cable to the multi-meter and photograph reading.

5. RESULTS

5.1. VIBRATION AND SHOCK TESTS

The specimens completed the vibration and shock testing with no conspicuous signs of external damage or degradation, and on completion of the tests the specimens were returned to the customer for further inspection and performance checks.

The vibration response spectra, and shock time histories for these tests are presented in Figures 5 to 16 of this report.

5.2. CLIMATIC TESTS

The specimens completed the Cooling and Dry Heat tests with no conspicuous signs of external damage or degradation, and on completion of the tests the specimens were returned to the customer for further inspection and performance checks.

The digital chart recording and performance check results for the Cooling test are presented in Figures 17 to 20 of this report.

The digital chart recording and performance check results for the Dry Heat test are presented in Figures 21 to 27 of this report.

Please note that the performance checks were conducted using test equipment and instrumentation supplied by the customer, and therefore the results are not covered by Element's UKAS accreditation, and are included in this report for information purposes only.

6. QUALITY ASSURANCE

Our technical competence and quality control arrangements are in accordance with the conditions of our UKAS accreditation. The quality management system for the Test Laboratory is accredited by the United Kingdom Accreditation Service, designated as UKAS Testing Laboratory No 0026.

The quality assurance system has been approved against the international quality standard ISO 9001 by Lloyd's Register Quality Assurance under their Certificate No LRQ 4007187.

Tests marked 'Not UKAS Accredited' in this document are not included in the UKAS accreditation schedule for Element Materials Technology Warwick Ltd. Opinions and interpretations expressed in this document are outside the scope of UKAS accreditation.

7. EQUIPMENT AND INSTRUMENTATION

7.1. TRACEABILITY

All equipment has been calibrated as required using standards traceable to National or International standards, in accordance with the requirements of BS EN ISO 17025. Traceability is established through UKAS accredited calibration laboratories.

The test equipment and instrumentation used for each test are detailed in Table 1.

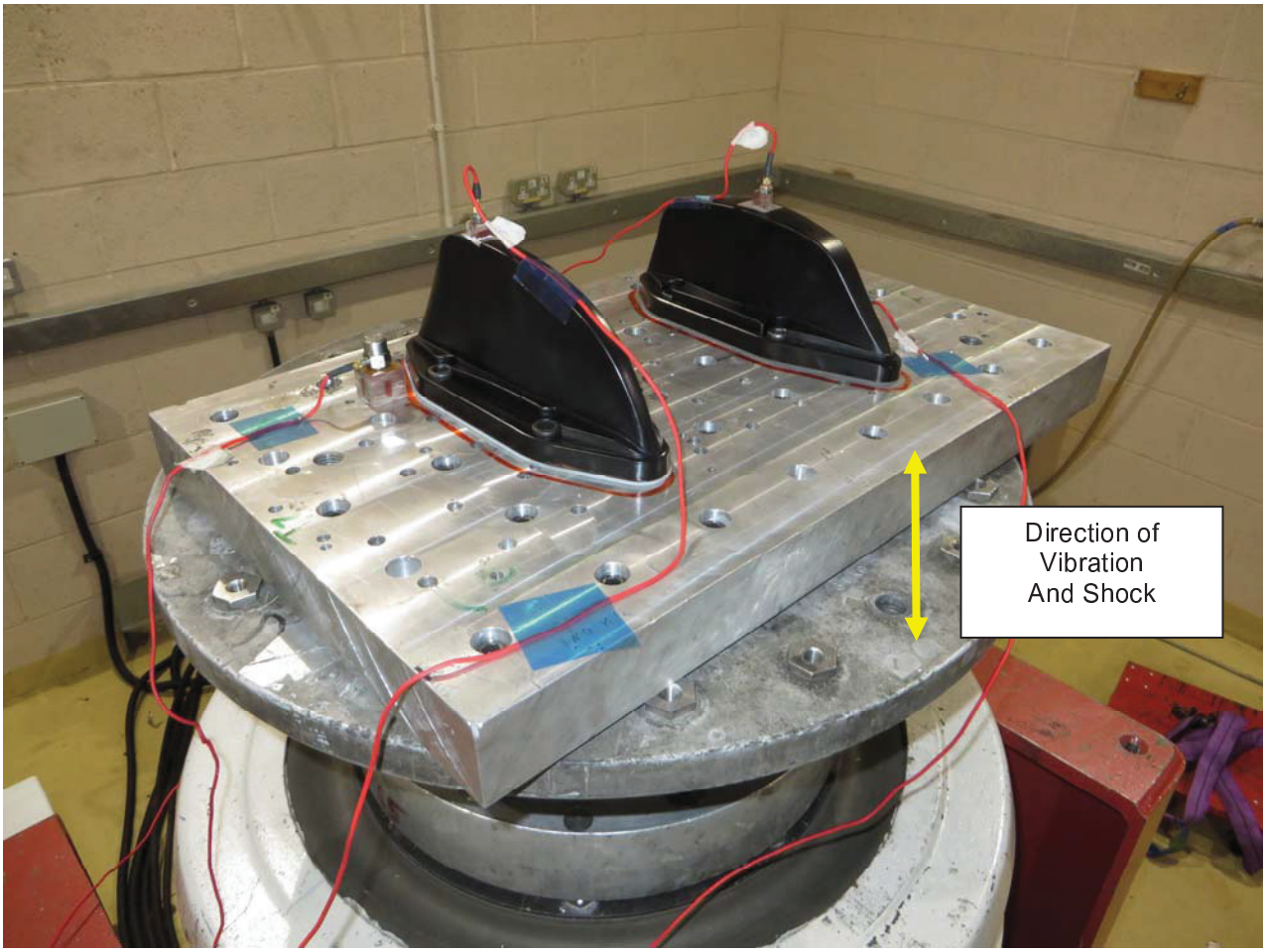
Each item of calibrated equipment and instrumentation was used within its valid calibration period.

7.2. TEST EQUIPMENT AND INSTRUMENTATION

Description	QA Number	Calibration Due Date
Vibration and Shock Tests		
Vibration System	2602	NA
Signal Conditioner	6611	03-04-17
Signal Conditioner	6613	03-04-17
Accelerometer – Control 1	2076	18-07-16
Accelerometer – Control 2	6406	21-03-17
Accelerometer – Monitor 1	6773	14-11-16
Accelerometer – Monitor 2	6702	25-04-17
Vibration Control System	6591	06-01-17
Climatic Tests		
Climatic Chamber	6884	09-06-17
Platinum Resistance Thermometer	6344	24-01-17
Platinum Resistance Thermometer	6376	24-01-17
Platinum Resistance Thermometer	6371	17-01-17
Digital Chart Recorder	2635	18-08-16

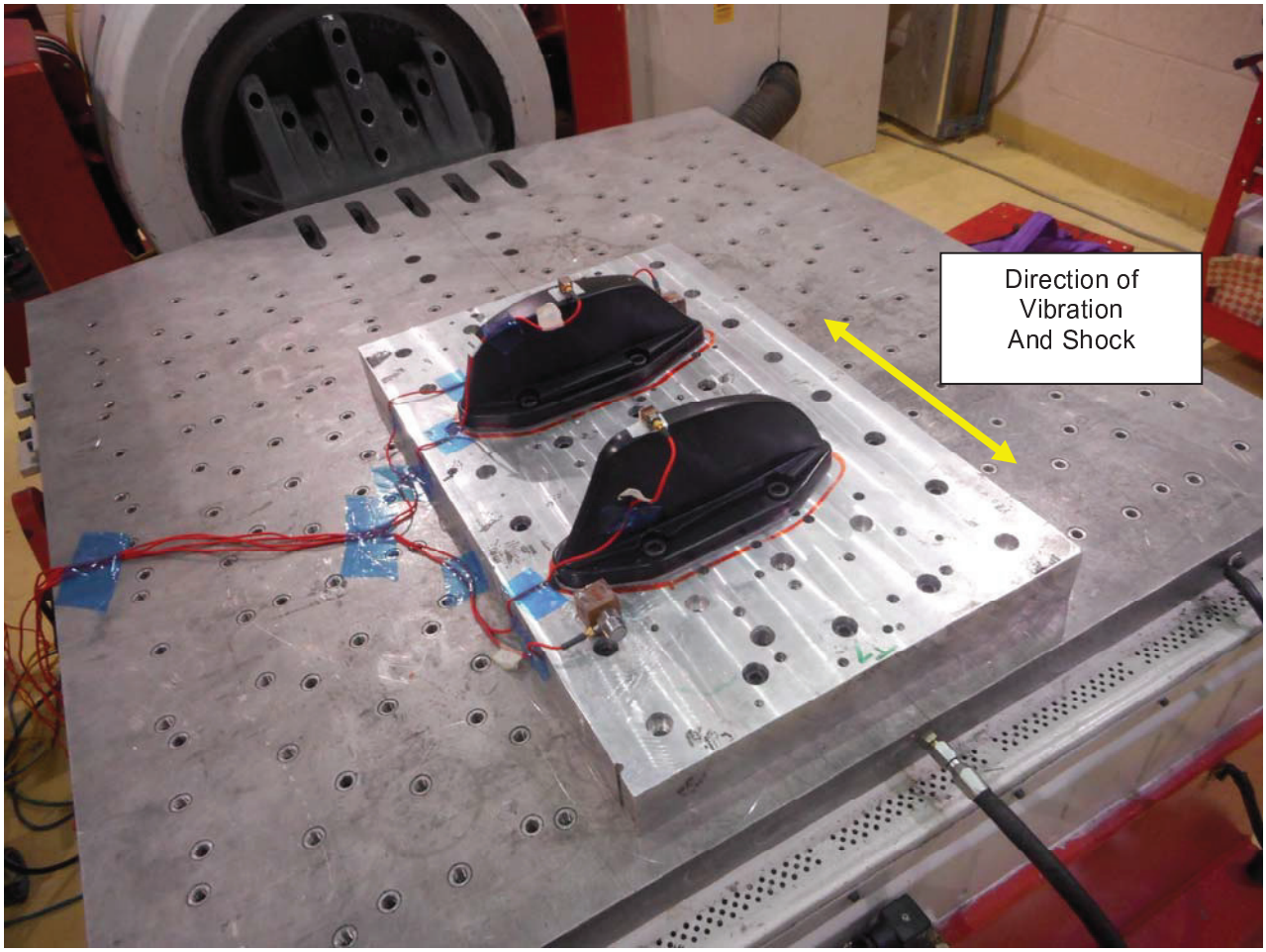
Test Equipment and Instrumentation

Table 1



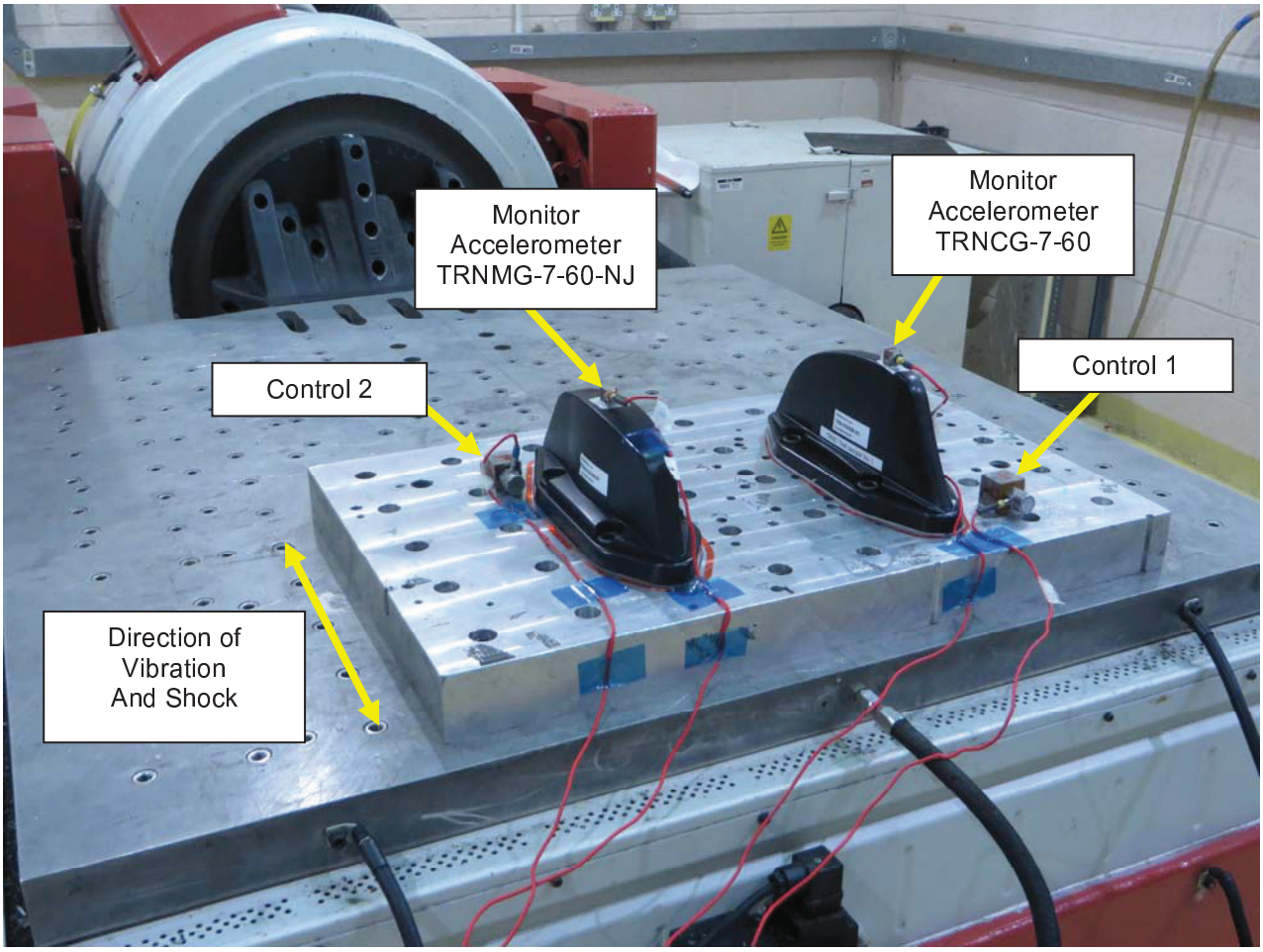
Vibration and Shock Tests
Vertical Axis Test Configuration

Figure 1



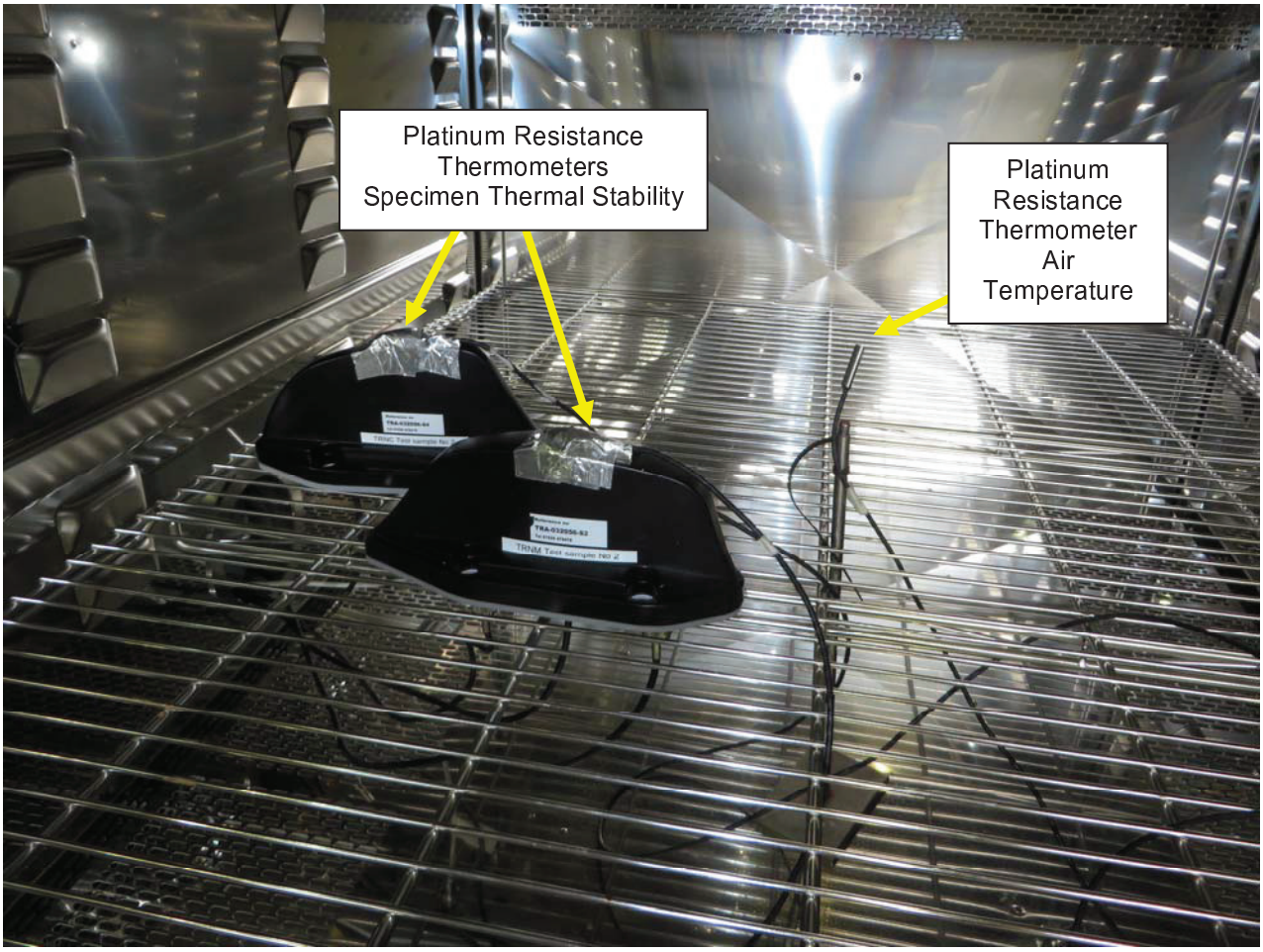
Vibration and Shock Tests
Transverse Axis Configuration

Figure 2



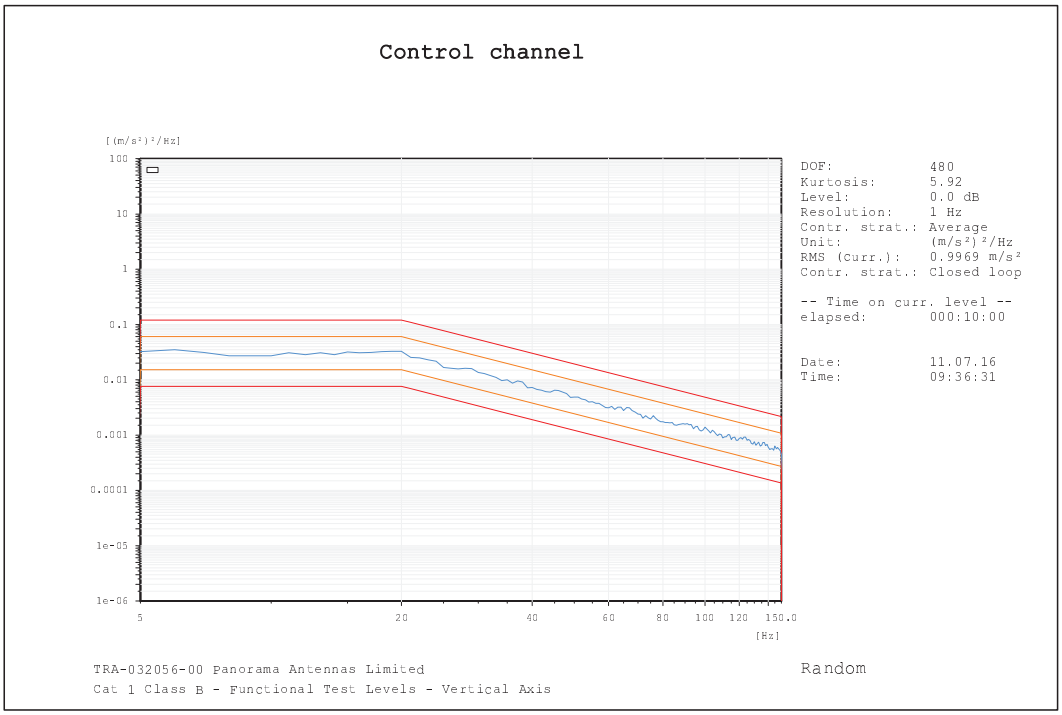
Vibration and Shock Tests
Longitudinal Test Configuration

Figure 3



Climatic Tests
Test Configuration

Figure 4



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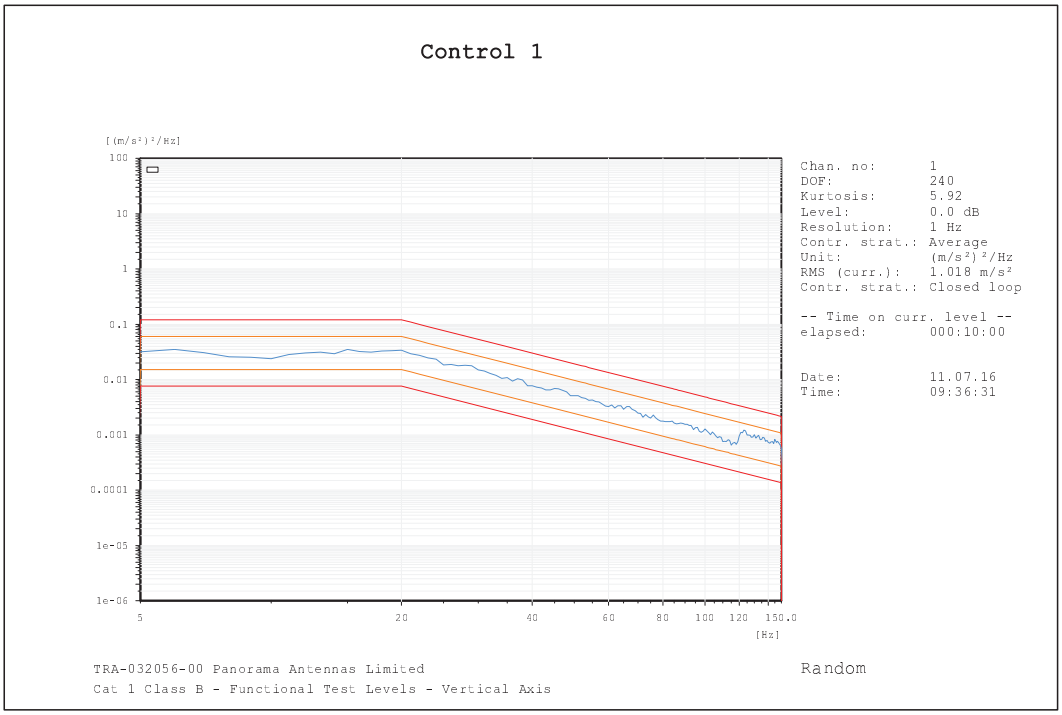
Test 1 - Functional Vibration Test Vertical Axis
Vibration and Shock Tests **Figure 5.1**



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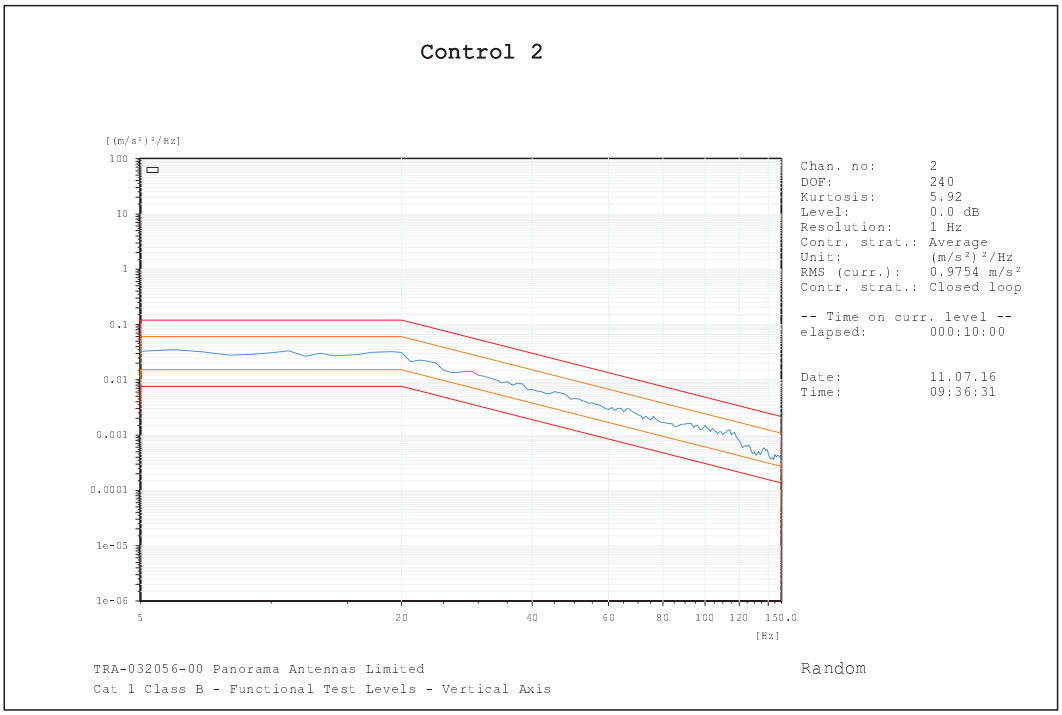
Test 1 - Functional Vibration Test Vertical Axis
Vibration and Shock Tests **Figure 5.2**



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Test 1 - Functional Vibration Test Vertical Axis
Vibration and Shock Tests **Figure 5.3**

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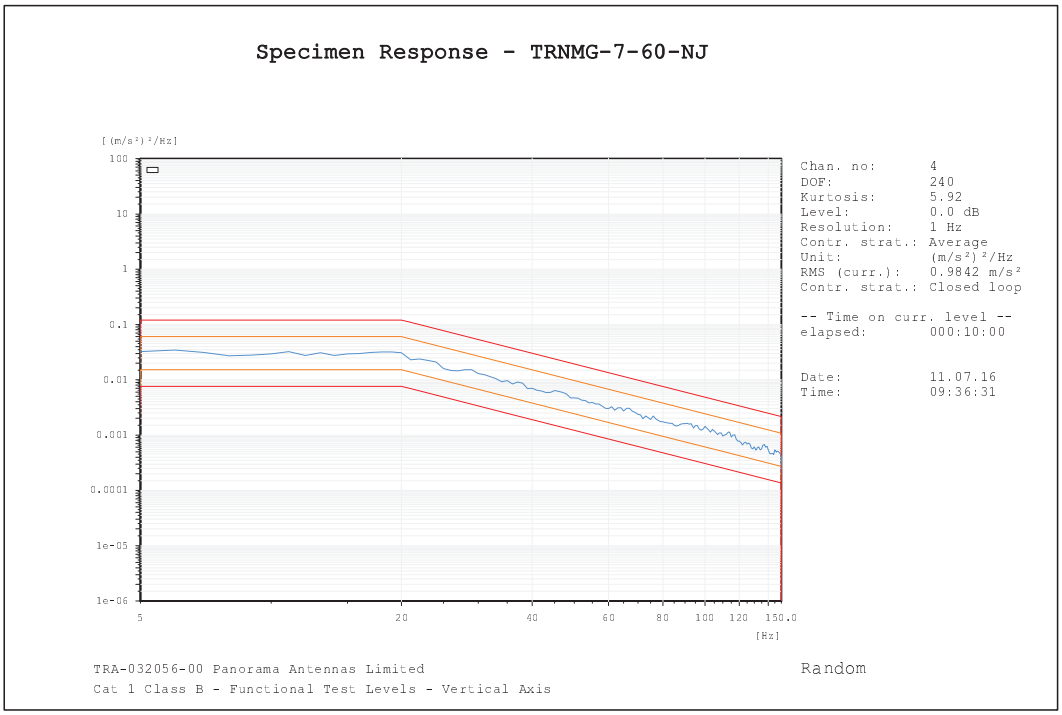
Test 1 - Functional Vibration Test Vertical Axis
Vibration and Shock Tests **Figure 5.4**



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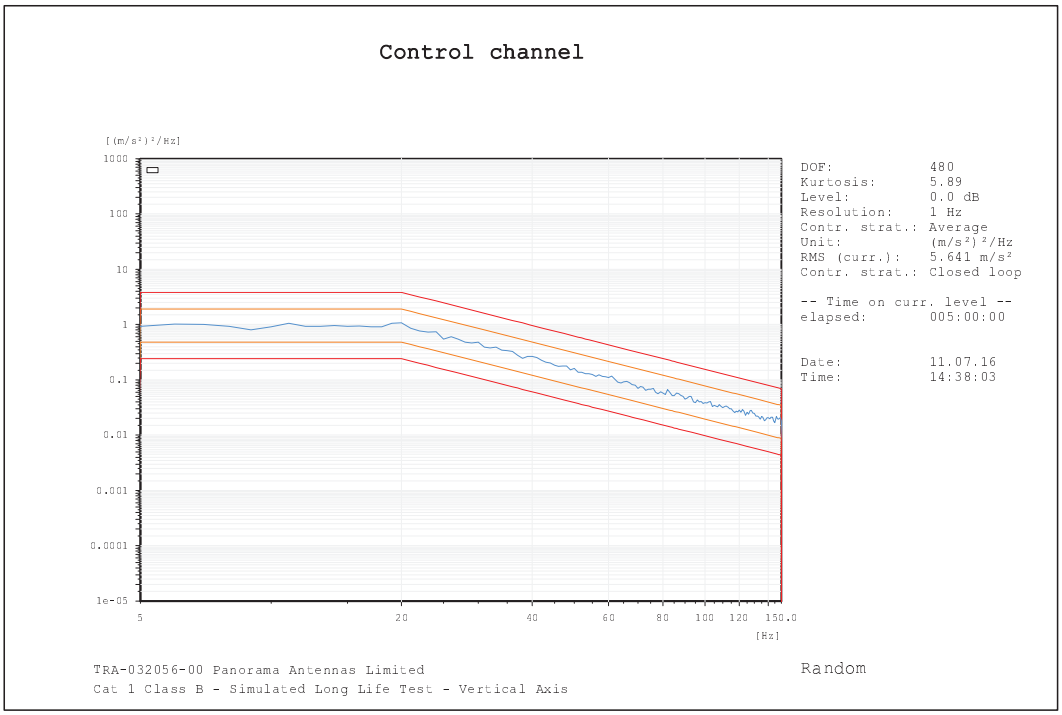
Test 1 - Functional Vibration Test Vertical Axis
Vibration and Shock Tests **Figure 5.5**



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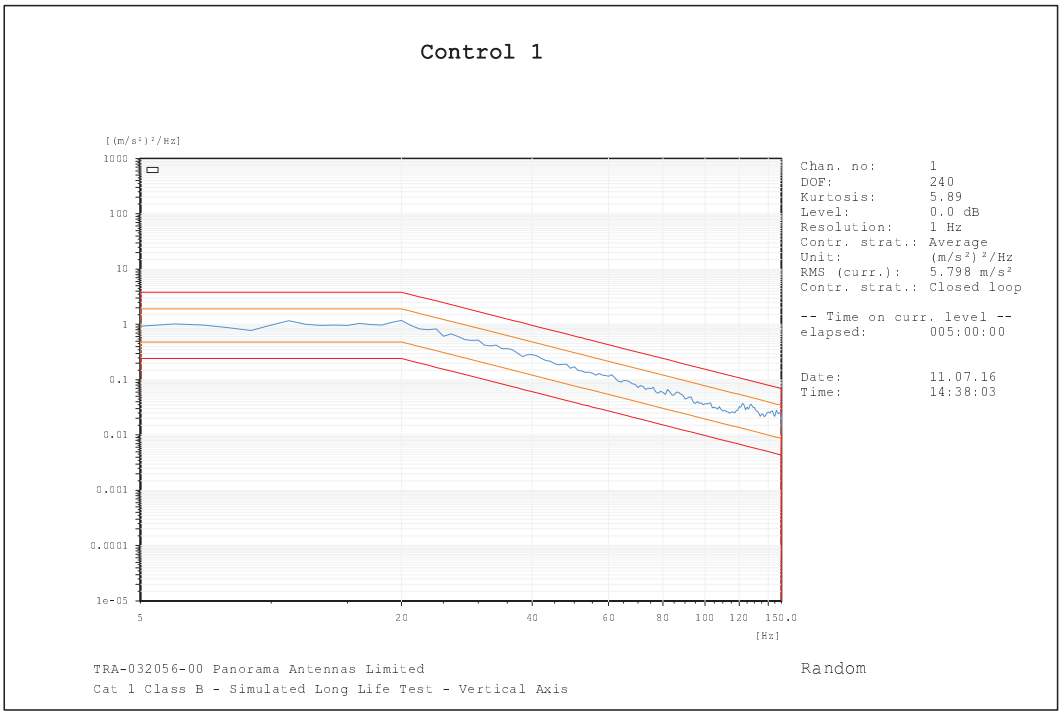
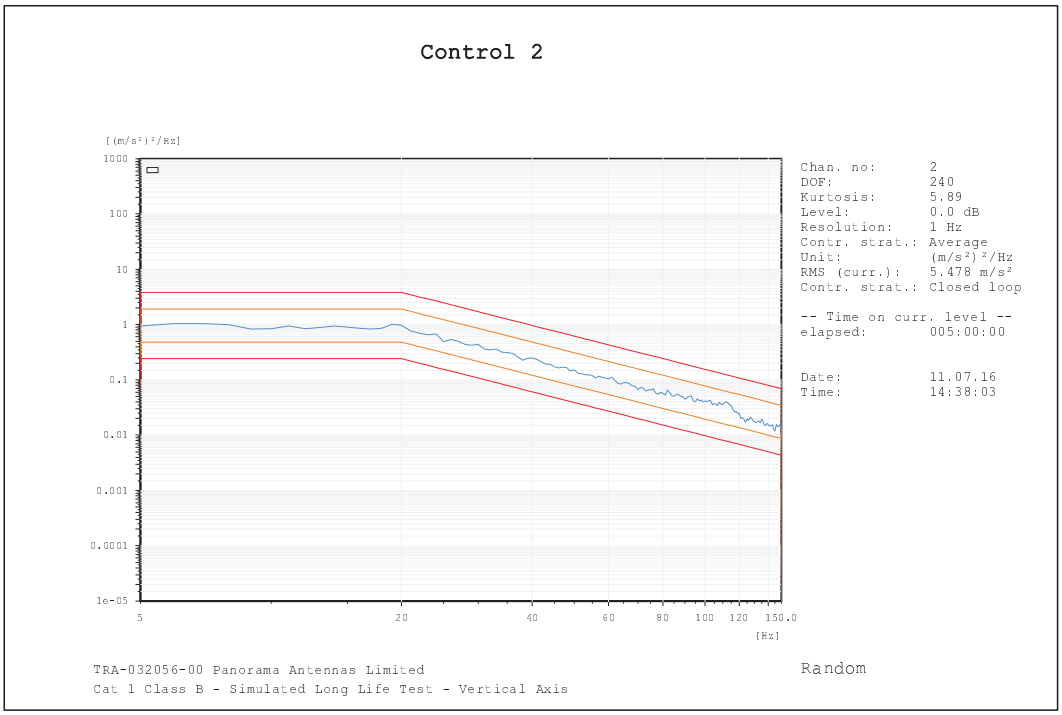
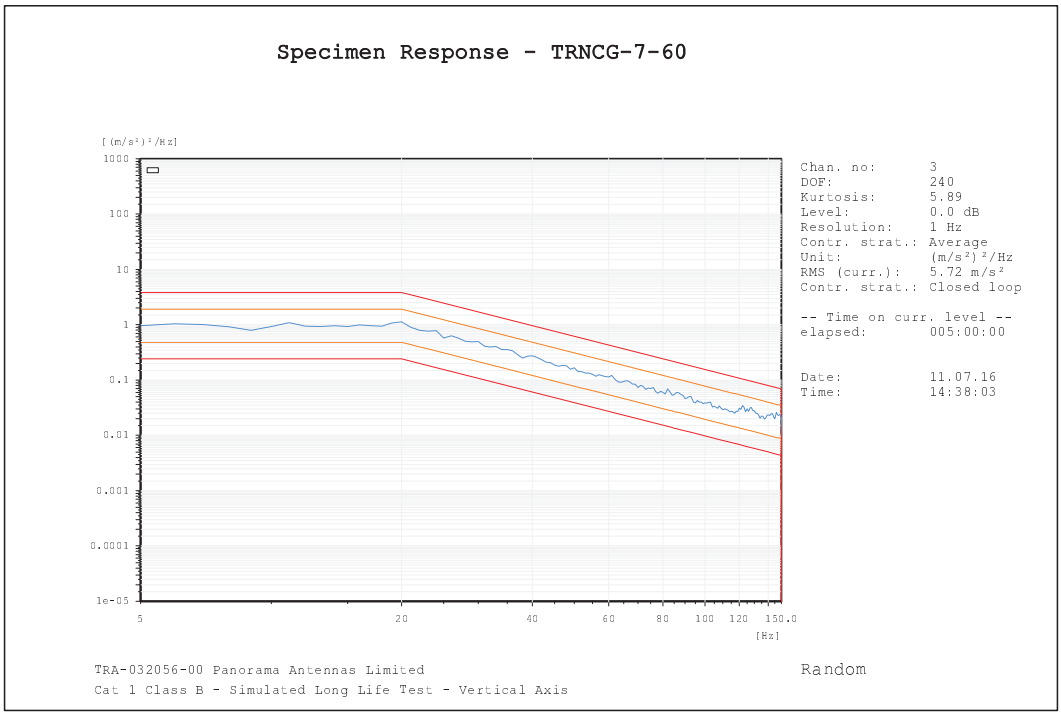
Test 2 - Simulated Long Life Vertical Axis
Vibration and Shock Tests **Figure 6.1**



Test 2 - Simulated Long Life Vertical Axis Vibration and Shock Tests **Figure 6.2**



Test 2 - Simulated Long Life Vertical Axis Vibration and Shock Tests **Figure 6.3**



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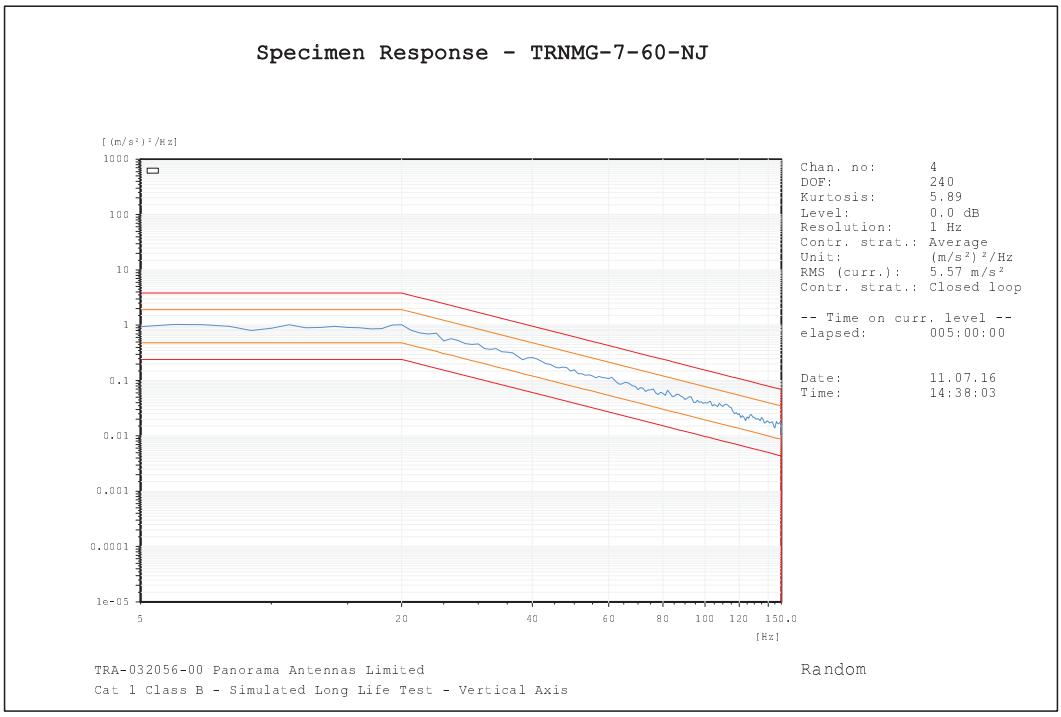
Test 2 - Simulated Long Life Vertical Axis Vibration and Shock Tests **Figure 6.4**



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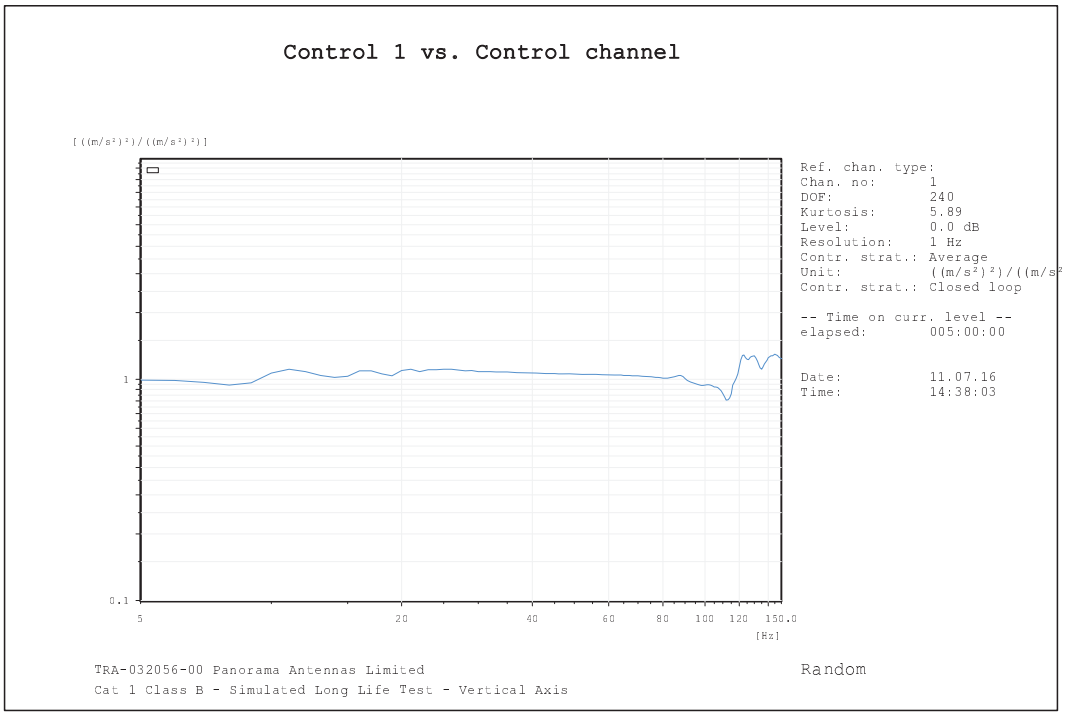
Test 2 - Simulated Long Life Vertical Axis Vibration and Shock Tests **Figure 6.5**



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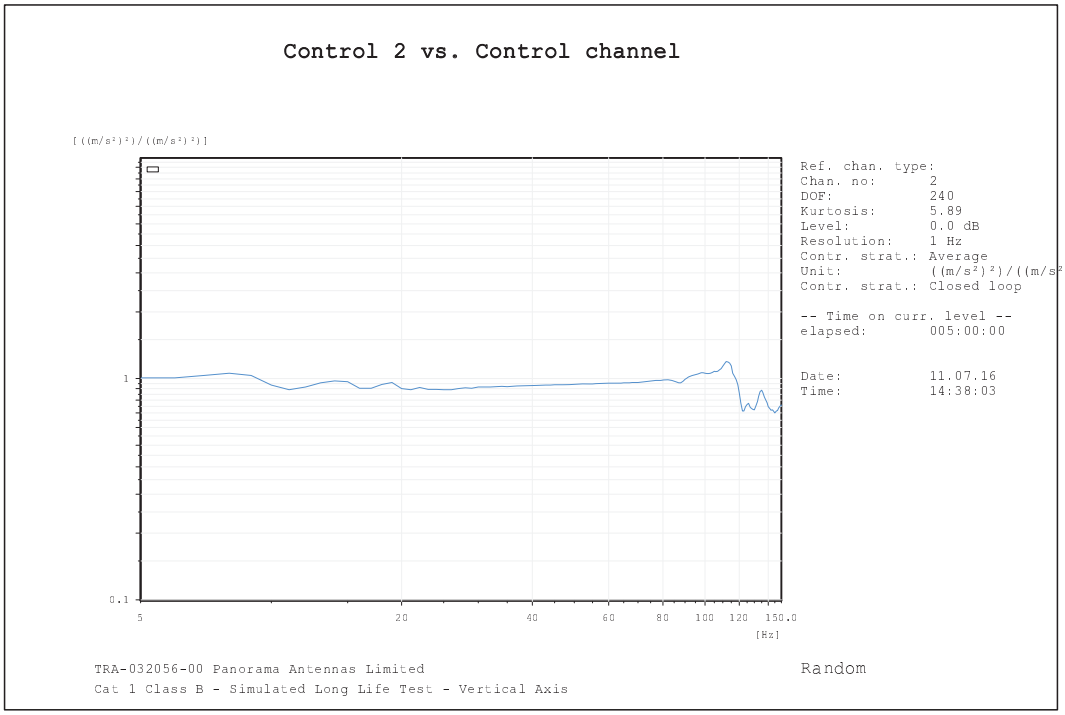
Test 2 - Transfer Function Simulated Long Life Vertical Axis
Vibration and Shock Tests **Figure 7.1**



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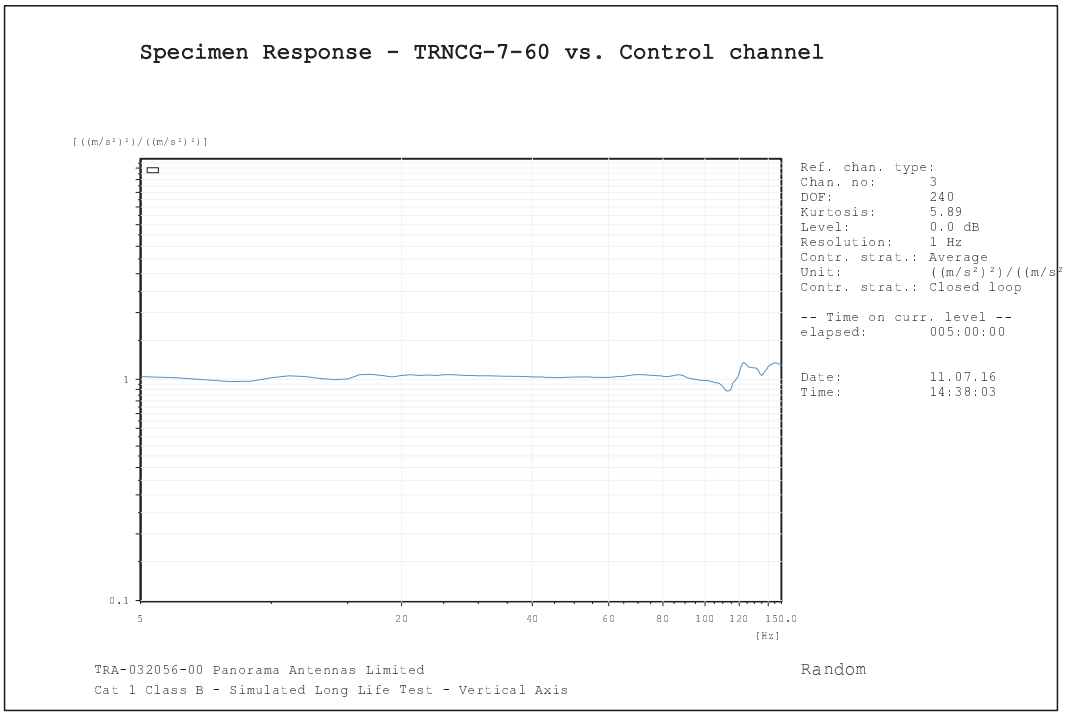
Test 2 - Transfer Function Simulated Long Life Vertical Axis
Vibration and Shock Tests **Figure 7.2**



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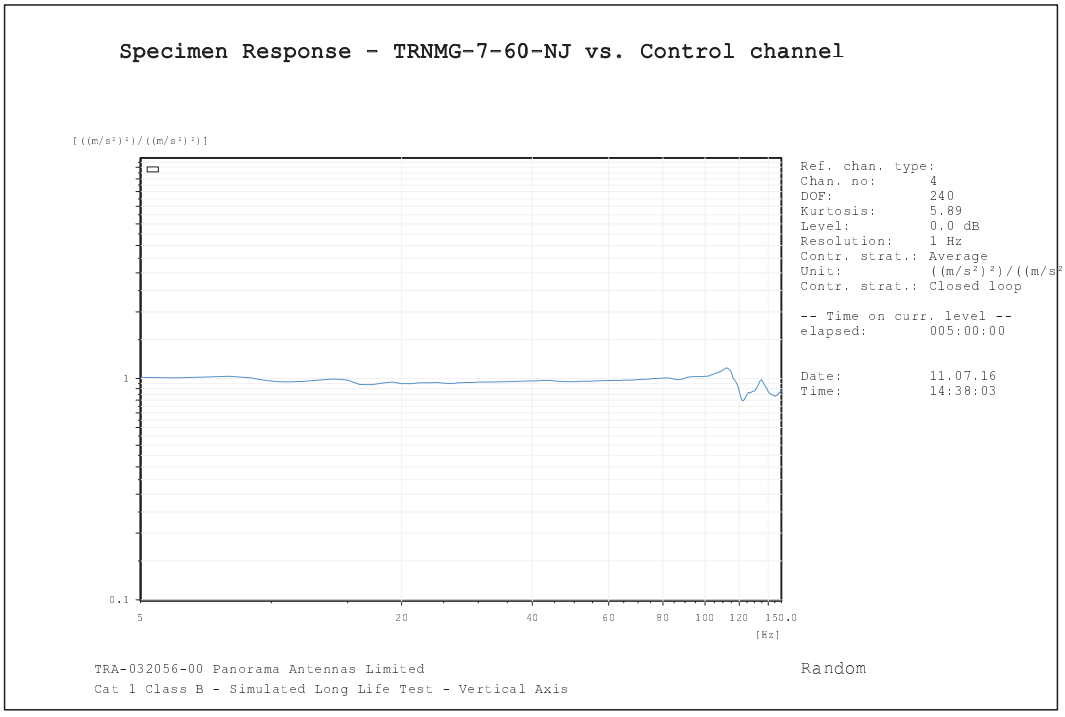
Test 2 - Transfer Function Simulated Long Life Vertical Axis
Vibration and Shock Tests **Figure 7.3**



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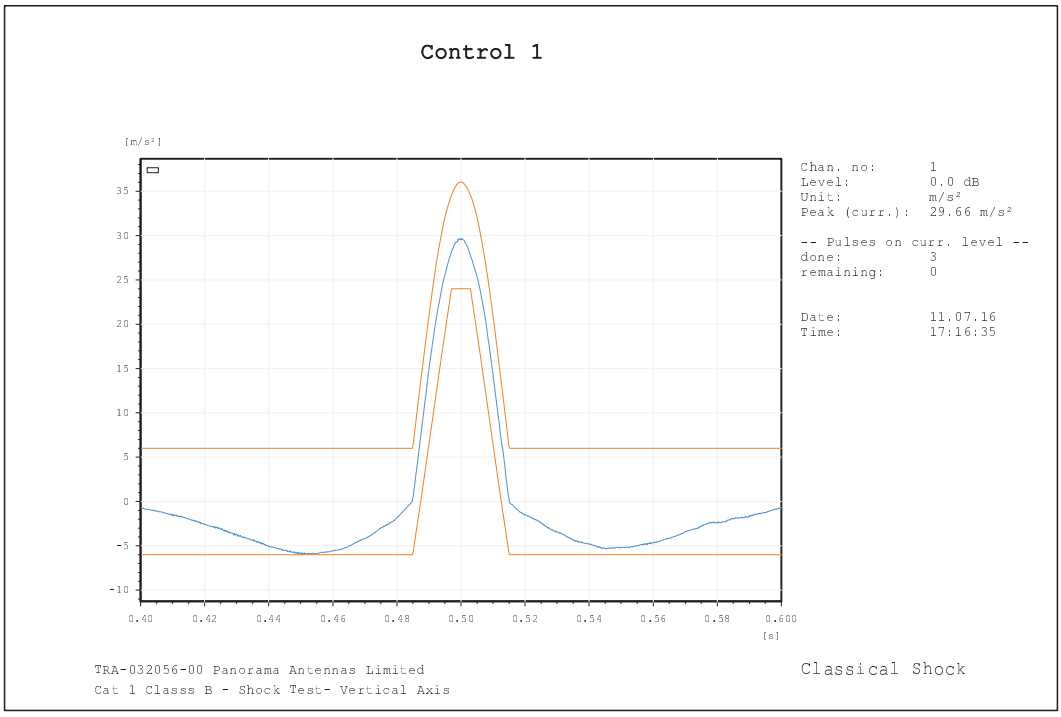
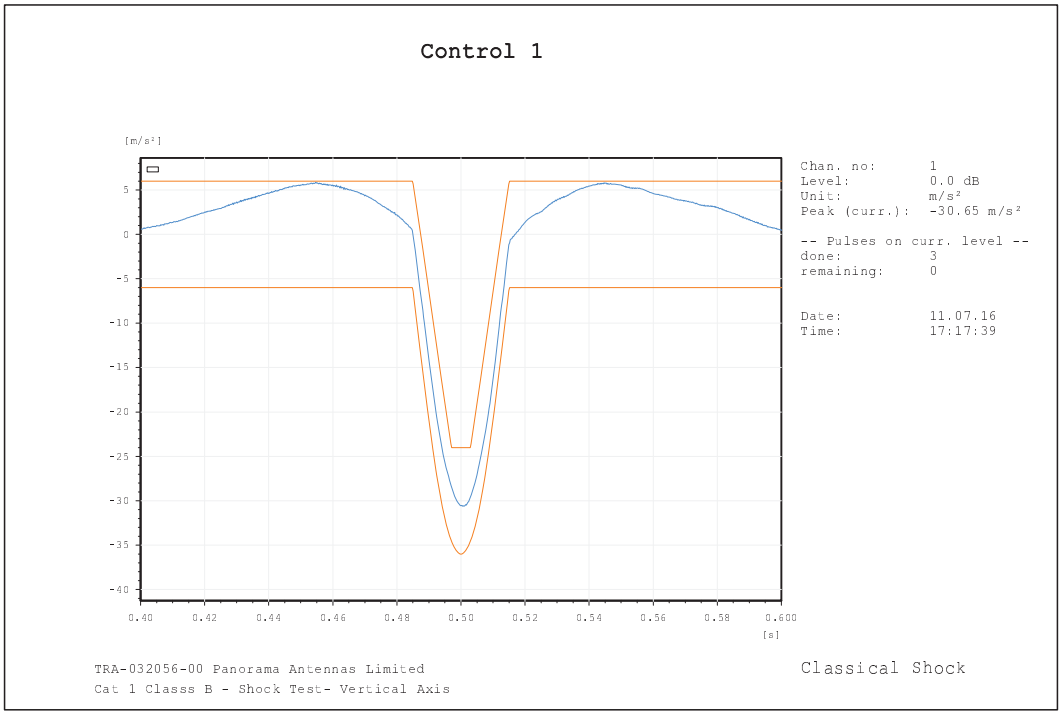
Test 2 - Transfer Function Simulated Long Life Vertical Axis
Vibration and Shock Tests **Figure 7.4**



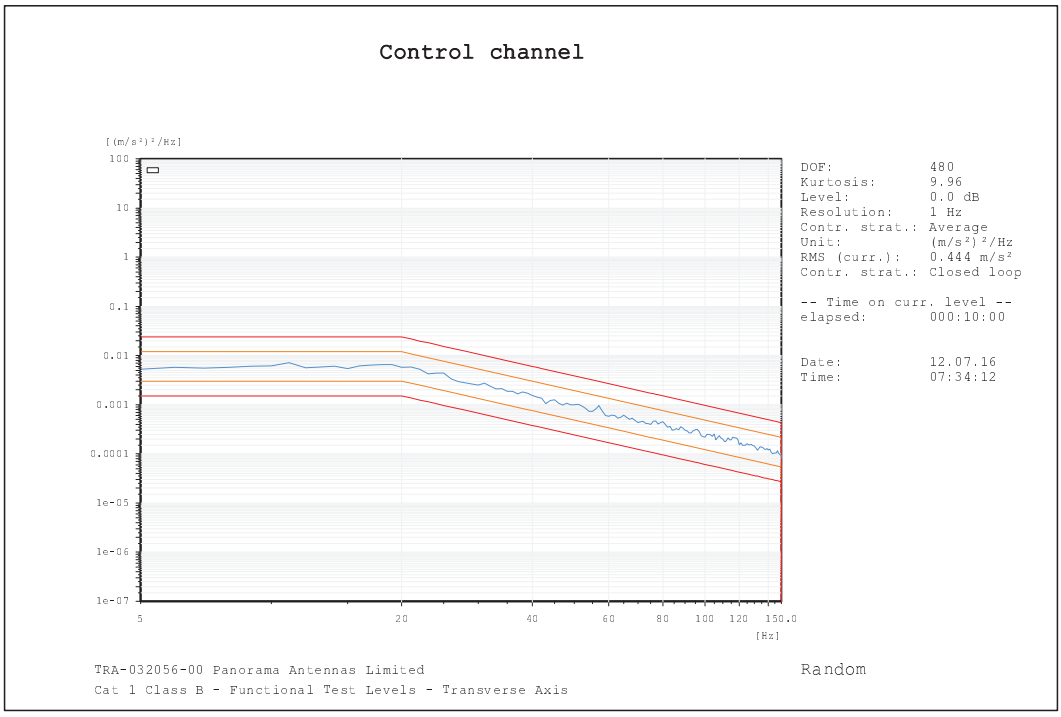
C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Vertical Axis\Test 3 - Shock Test_001.rcs

Test 3 - Shock Test Vertical Axis
Vibration and Shock Tests **Figure 8.1**



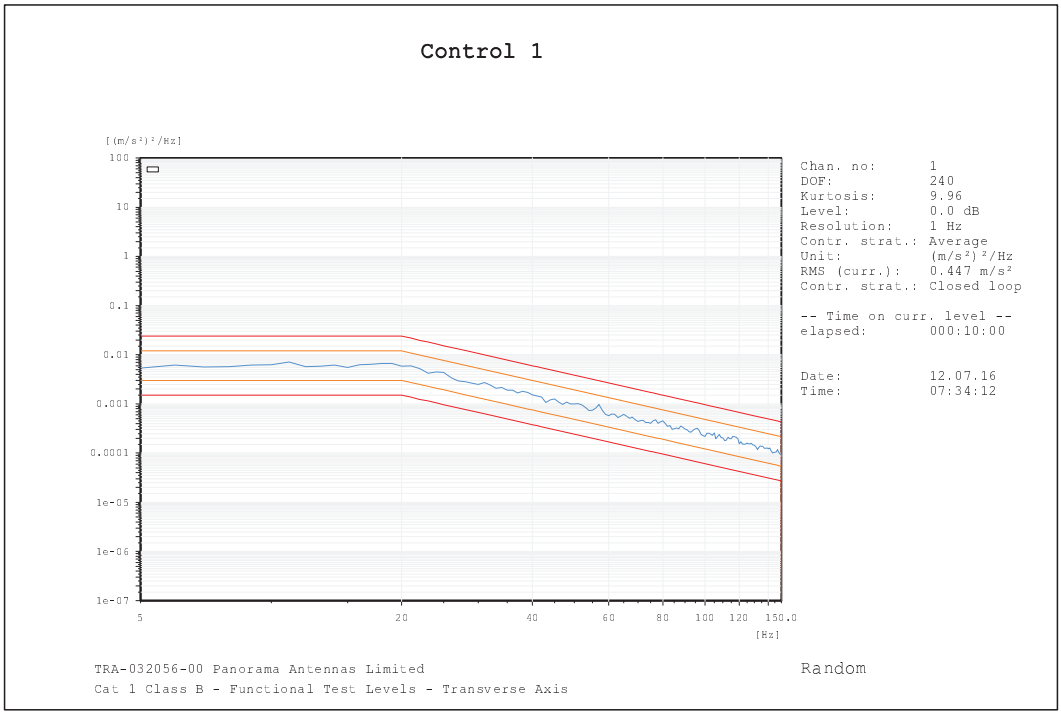
C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Vertical Axis\Test 3 - Shock Test_001.rcs

Test 3 - Shock Test Vertical Axis
Vibration and Shock Tests **Figure 8.2**



C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Transverse Axis\Test 4 - Functional Vibration_001.rrn

Test 4 - Functional Vibration Test Transverse Axis
Vibration and Shock Tests **Figure 9.1**



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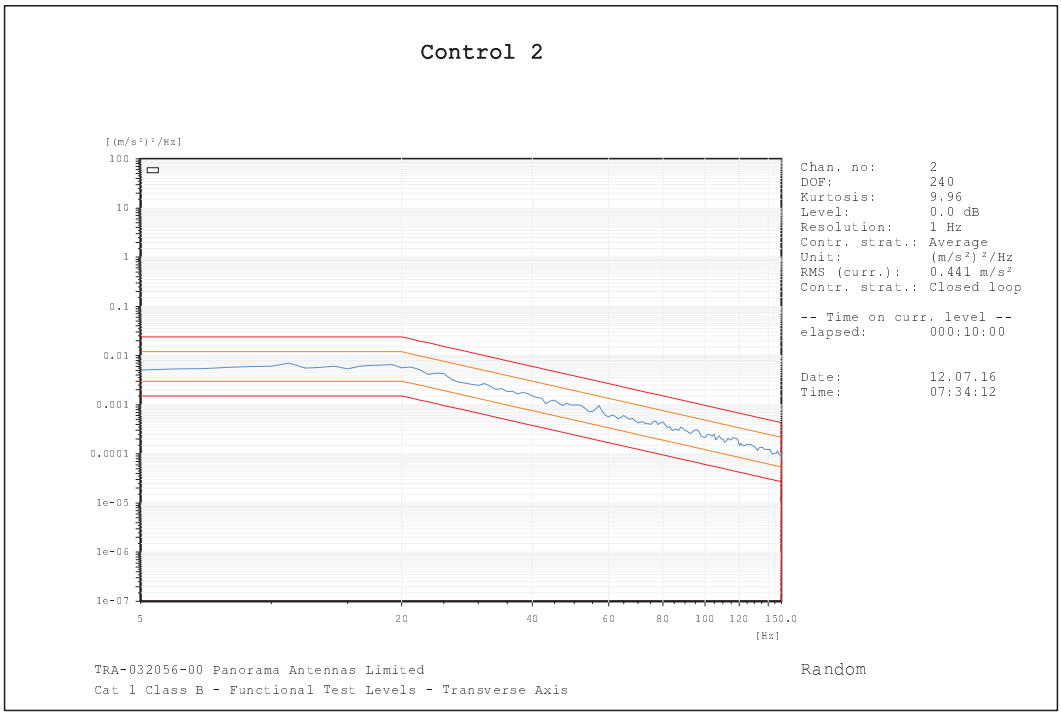
Test 4 - Functional Vibration Test Transverse Axis
Vibration and Shock Tests **Figure 9.2**



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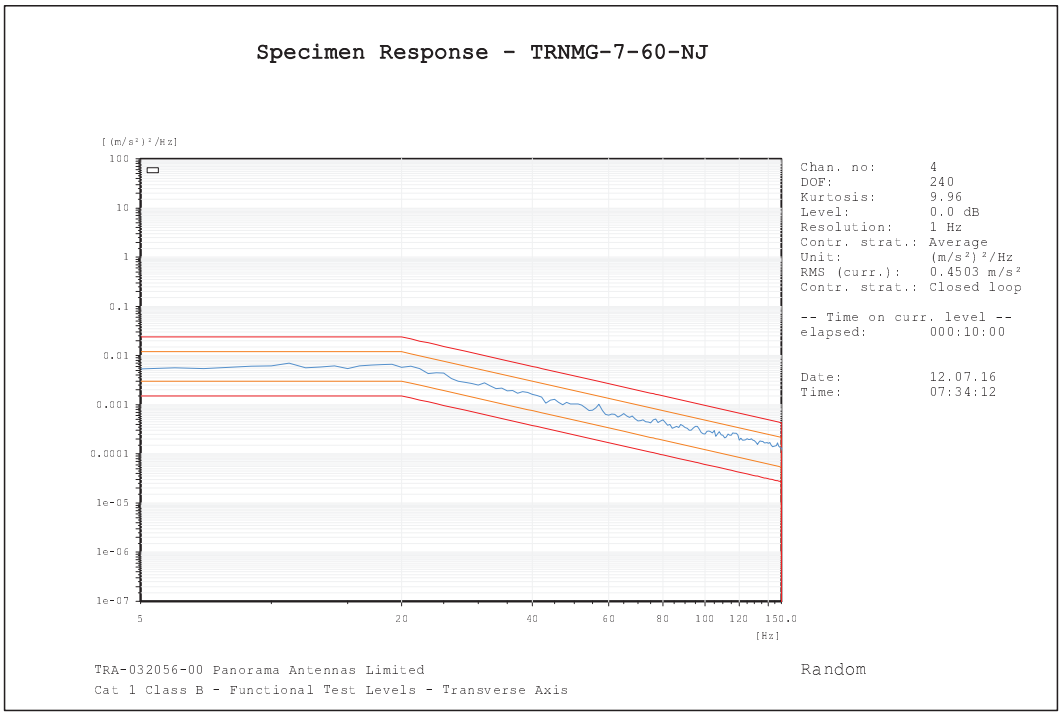
Test 4 - Functional Vibration Test Transverse Axis
Vibration and Shock Tests **Figure 9.3**

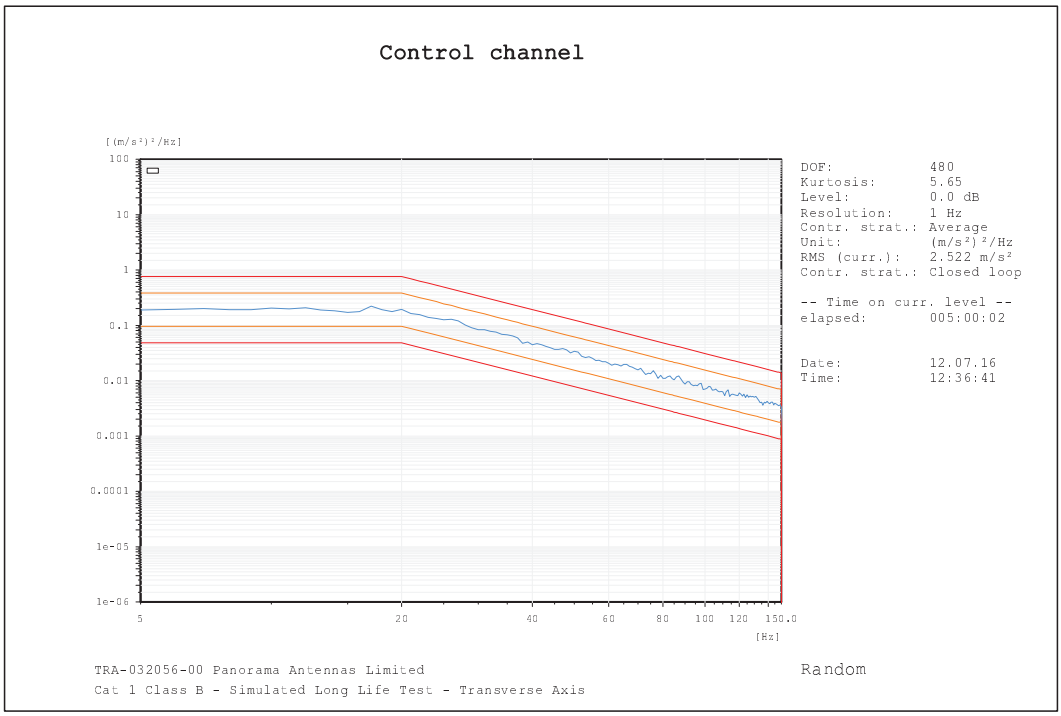
C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Transverse Axis\Test 4 - Functional Vibration_001.rrn

Test 4 - Functional Vibration Test Transverse Axis
Vibration and Shock Tests **Figure 9.4**



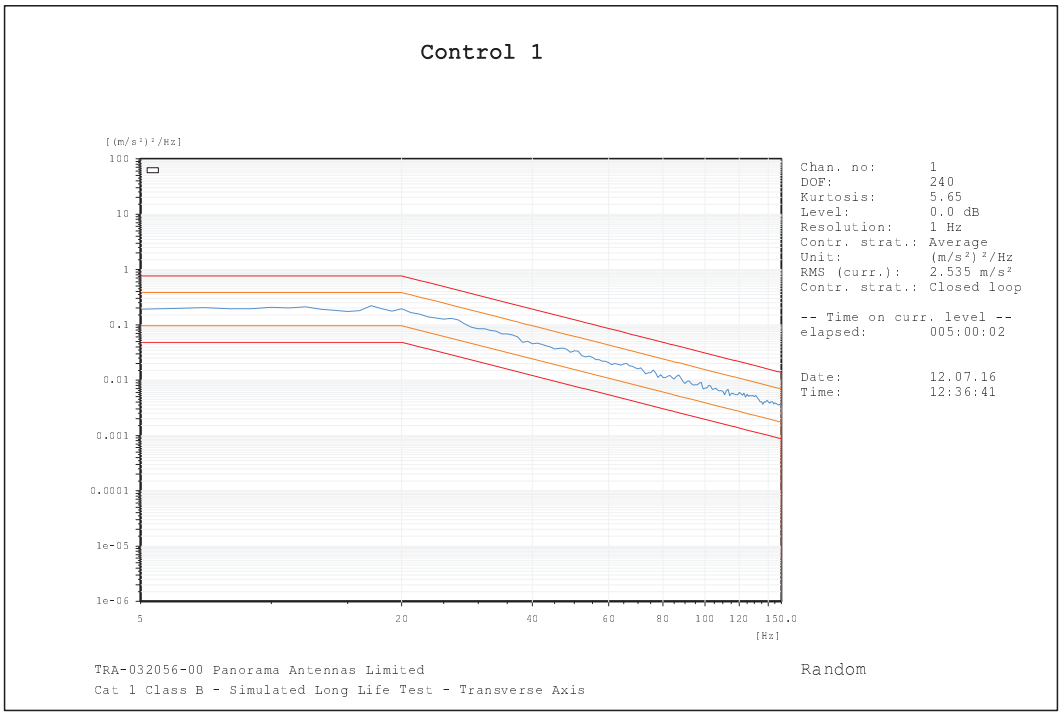
C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Transverse Axis\Test 4 - Functional Vibration_001.rrn

Test 4 - Functional Vibration Test Transverse Axis
Vibration and Shock Tests **Figure 9.5**



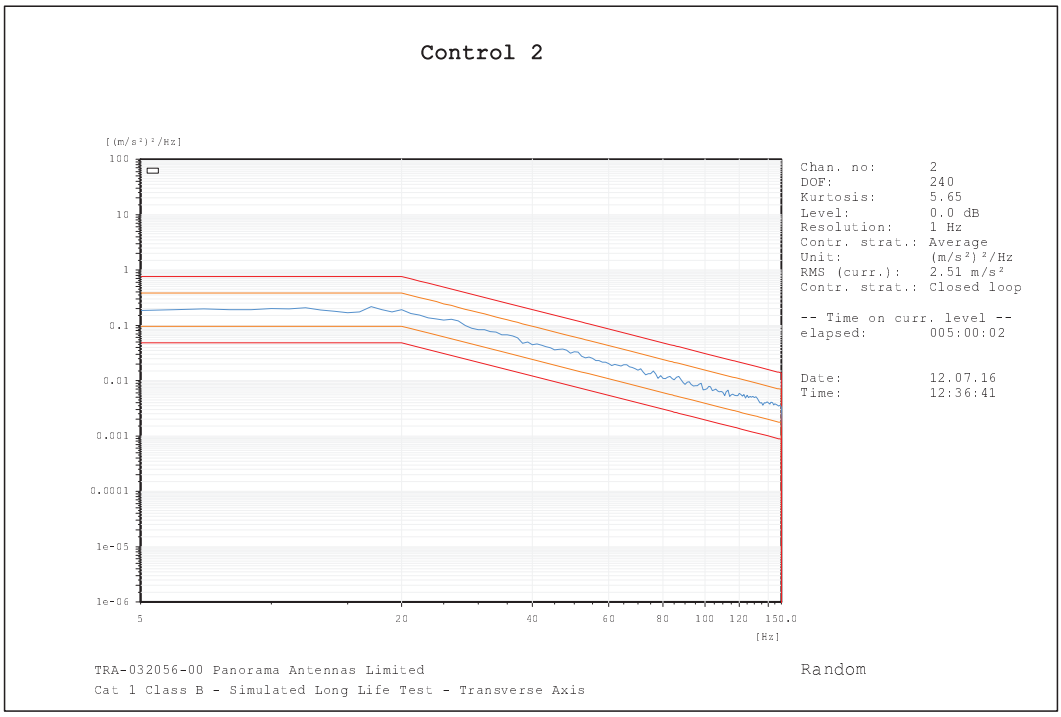
C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Transverse Axis\Test 5 - Simulated Long Life_001.rrn

Test 5 - Simulated Long Life Transverse Axis
Vibration and Shock Tests **Figure 10.1**



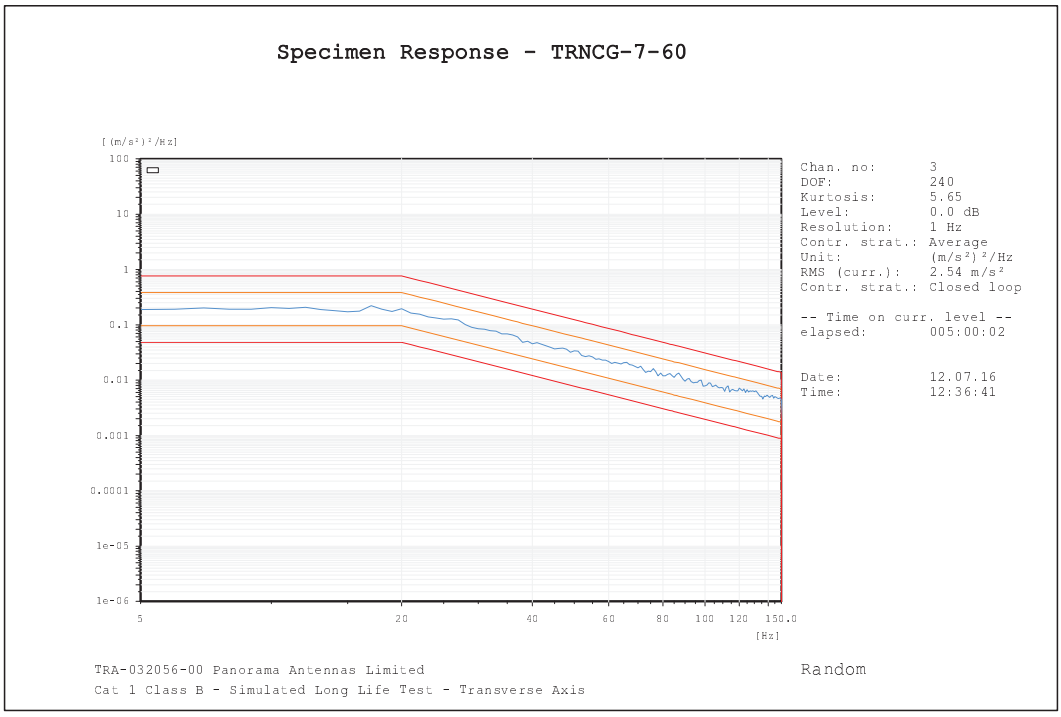
C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Transverse Axis\Test 5 - Simulated Long Life_001.rrn

Test 5 - Simulated Long Life Transverse Axis
Vibration and Shock Tests **Figure 10.2**



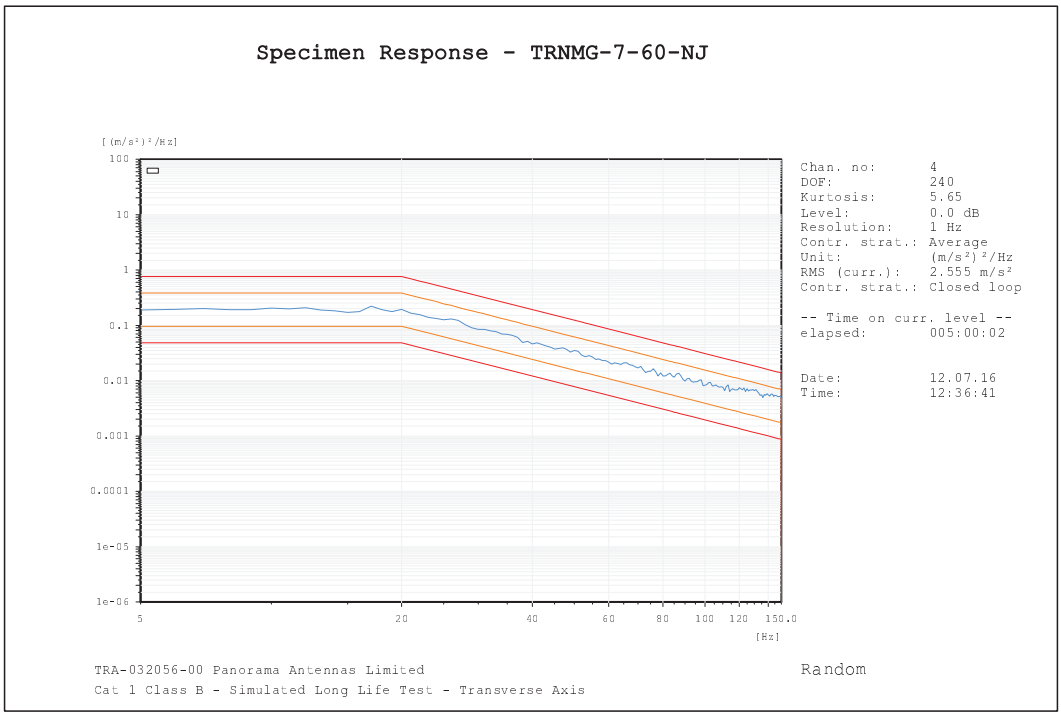
C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Transverse Axis\Test 5 - Simulated Long Life_001.rrn

Test 5 - Simulated Long Life Transverse Axis
Vibration and Shock Tests **Figure 10.3**



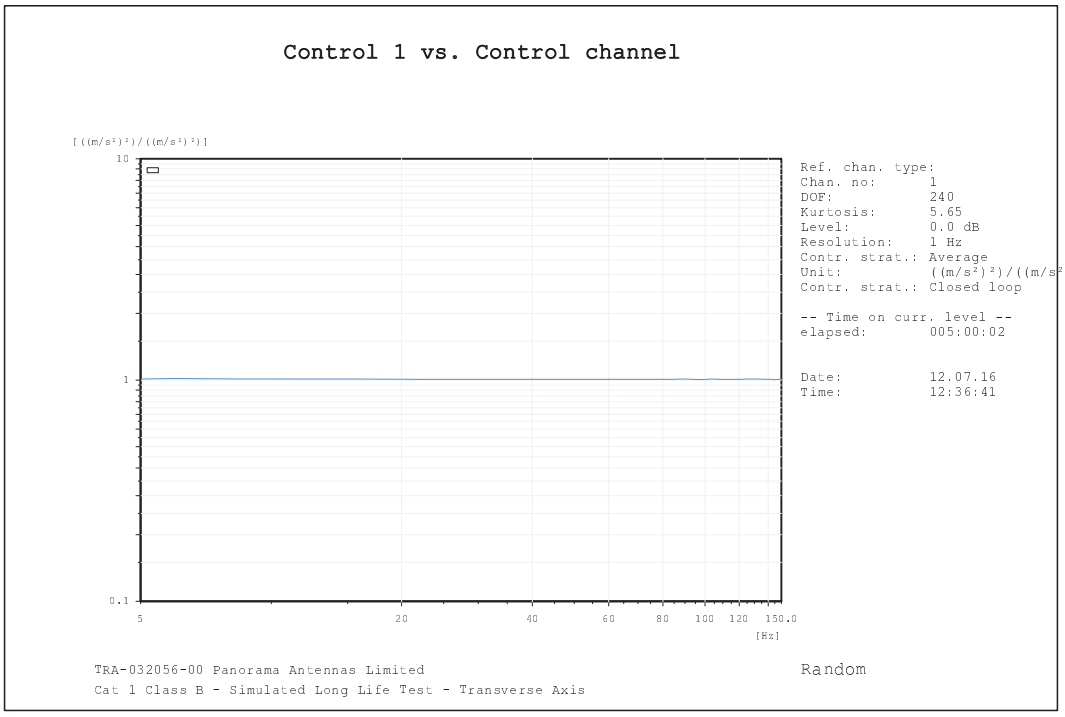
C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Transverse Axis\Test 5 - Simulated Long Life_001.rrn

Test 5 - Simulated Long Life Transverse Axis
Vibration and Shock Tests **Figure 10.4**



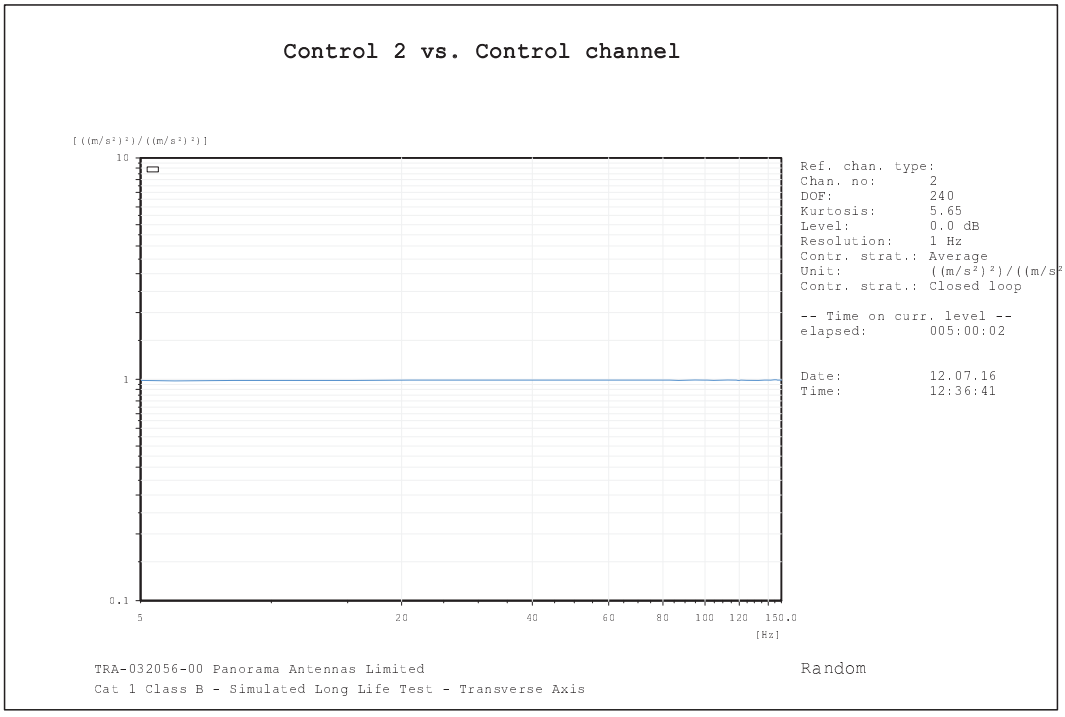
C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Transverse Axis\Test 5 - Simulated Long Life_001.rrn

Test 5 - Simulated Long Life Transverse Axis
Vibration and Shock Tests **Figure 10.5**



C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Transverse Axis\Test 5 - Simulated Long Life_001.rrn

Test 5 - Transfer Function Simulated Long Life Transverse Axis
Vibration and Shock Tests **Figure 11.1**



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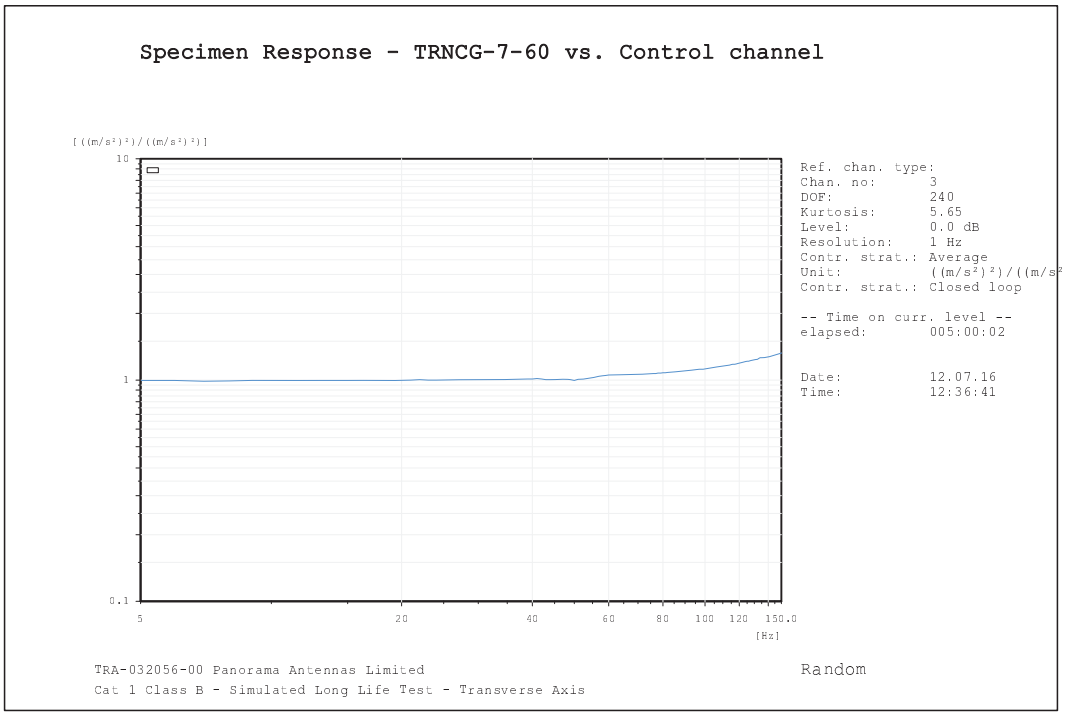
Test 5 - Transfer Function Simulated Long Life Transverse Axis
Vibration and Shock Tests **Figure 11.2**



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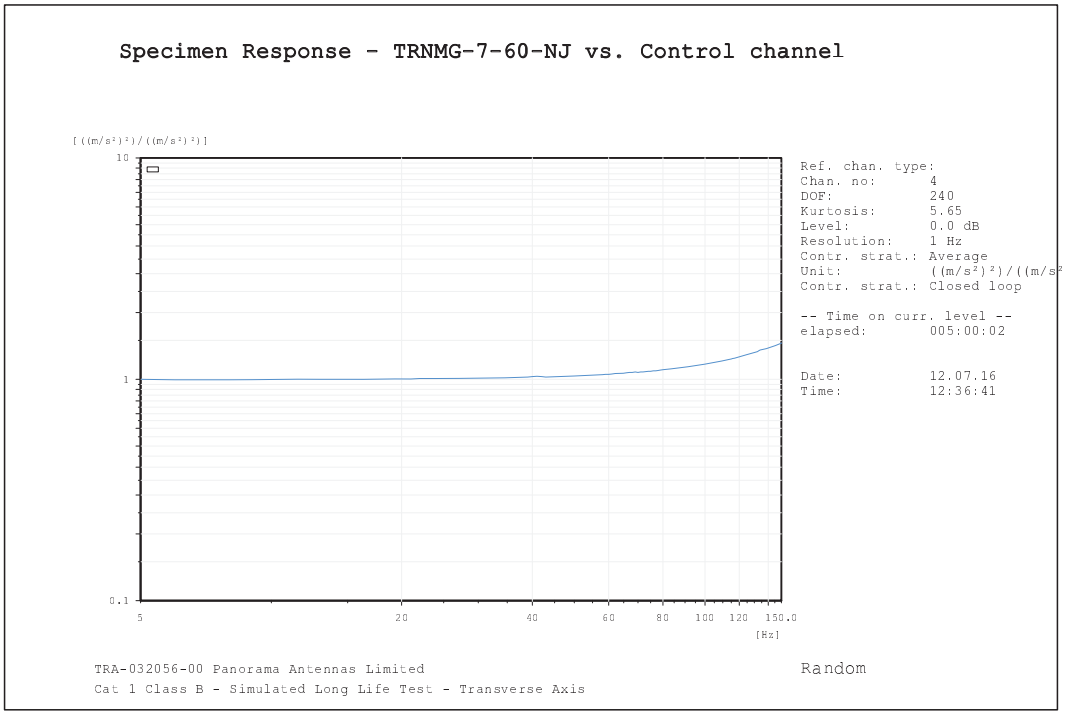
Test 5 - Transfer Function Simulated Long Life Transverse Axis
Vibration and Shock Tests **Figure 11.3**



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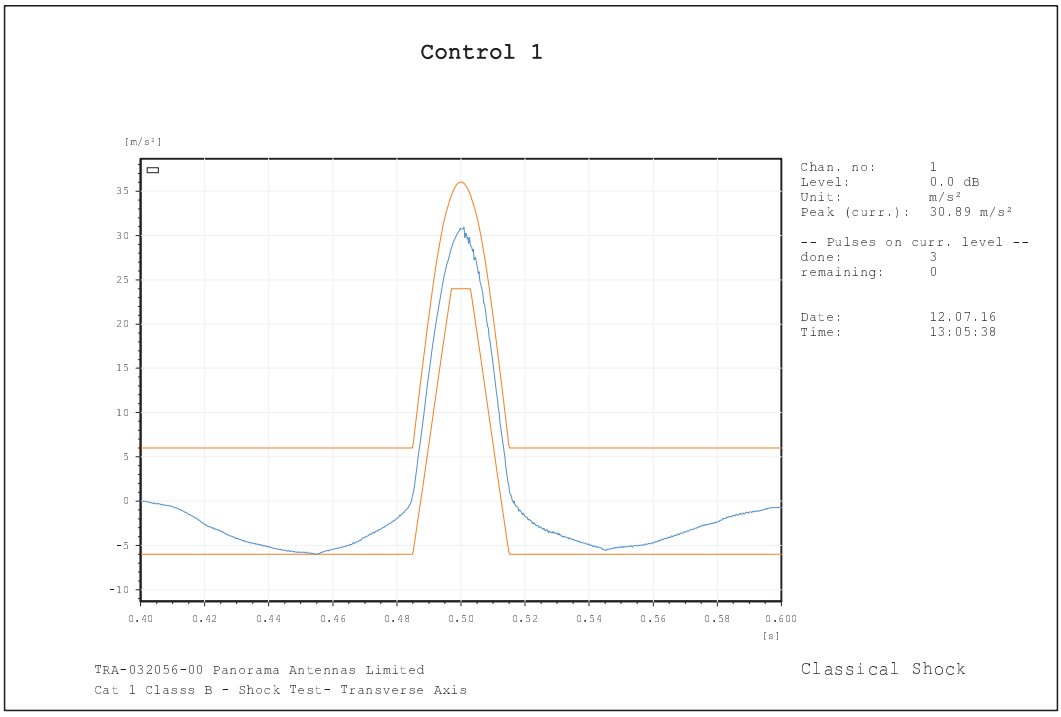
Test 5 - Transfer Function Simulated Long Life Transverse Axis
Vibration and Shock Tests **Figure 11.4**



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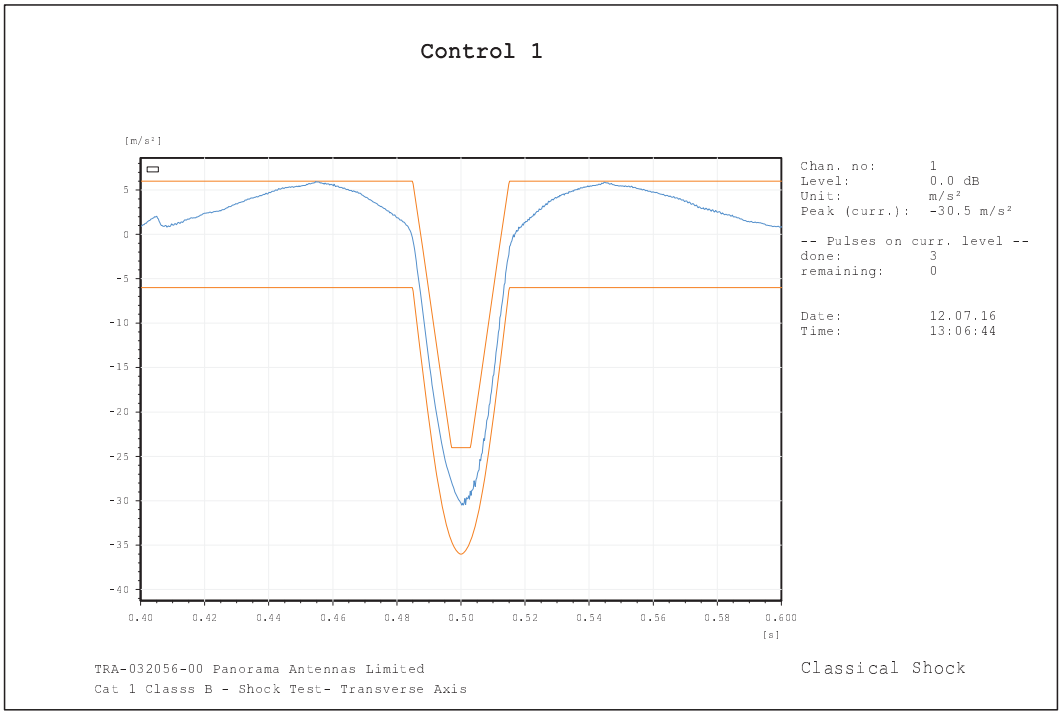
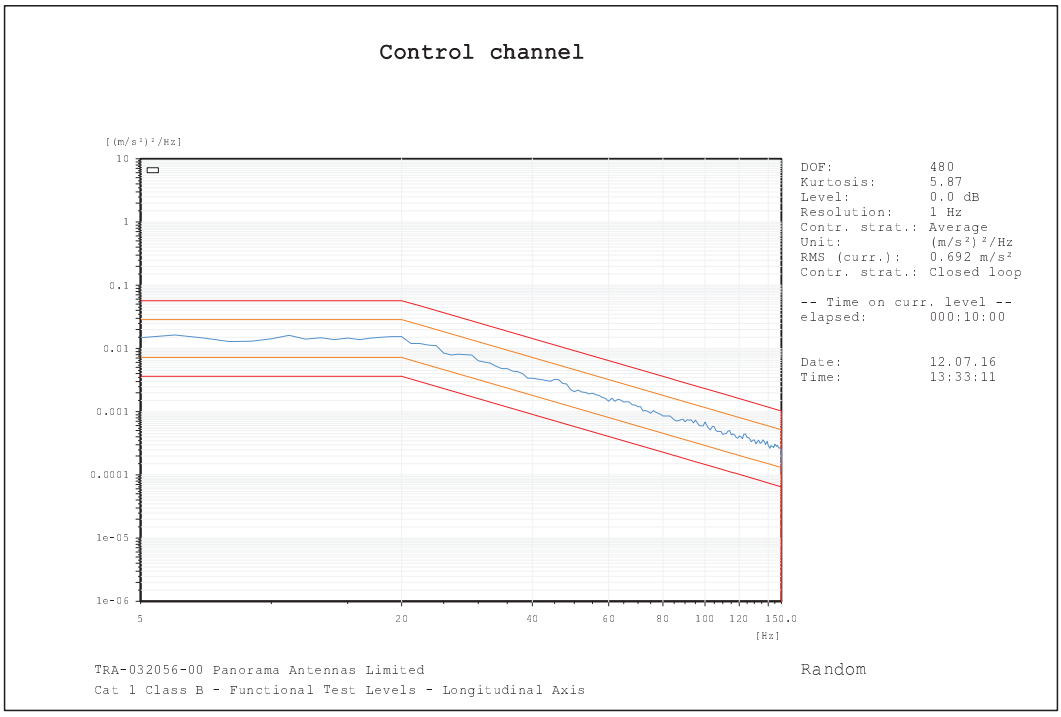
Test 6 - Shock Test Transverse Axis
Vibration and Shock Tests **Figure 12.1**

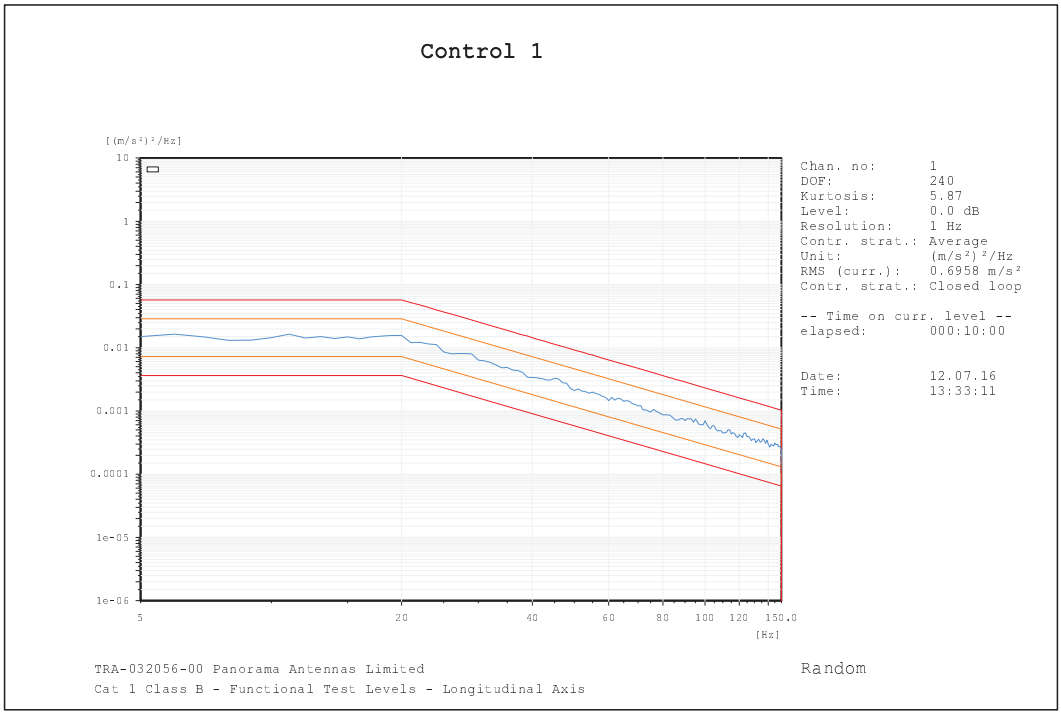


C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Transverse Axis\Test 6 - Shock Test_001.rcs

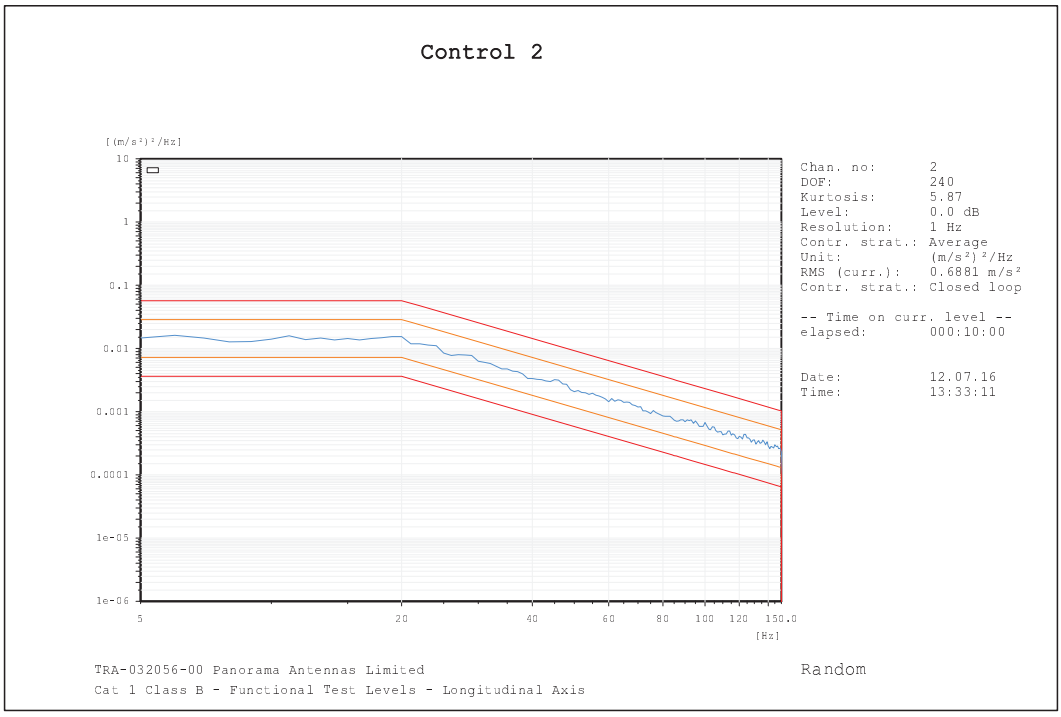
Test 6 - Shock Test Transverse Axis
Vibration and Shock Tests **Figure 12.2**



Test 7 - Functional Vibration Test Longitudinal Axis
Vibration and Shock Tests **Figure 13.1**



Test 7 - Functional Vibration Test Longitudinal Axis
Vibration and Shock Tests **Figure 13.2**



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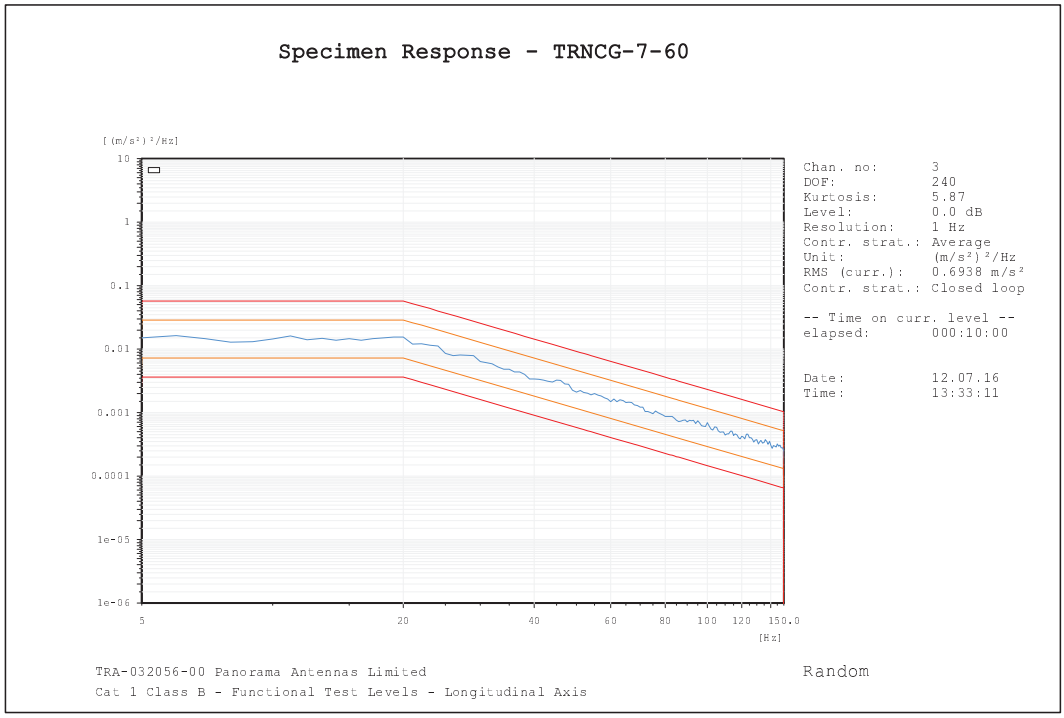
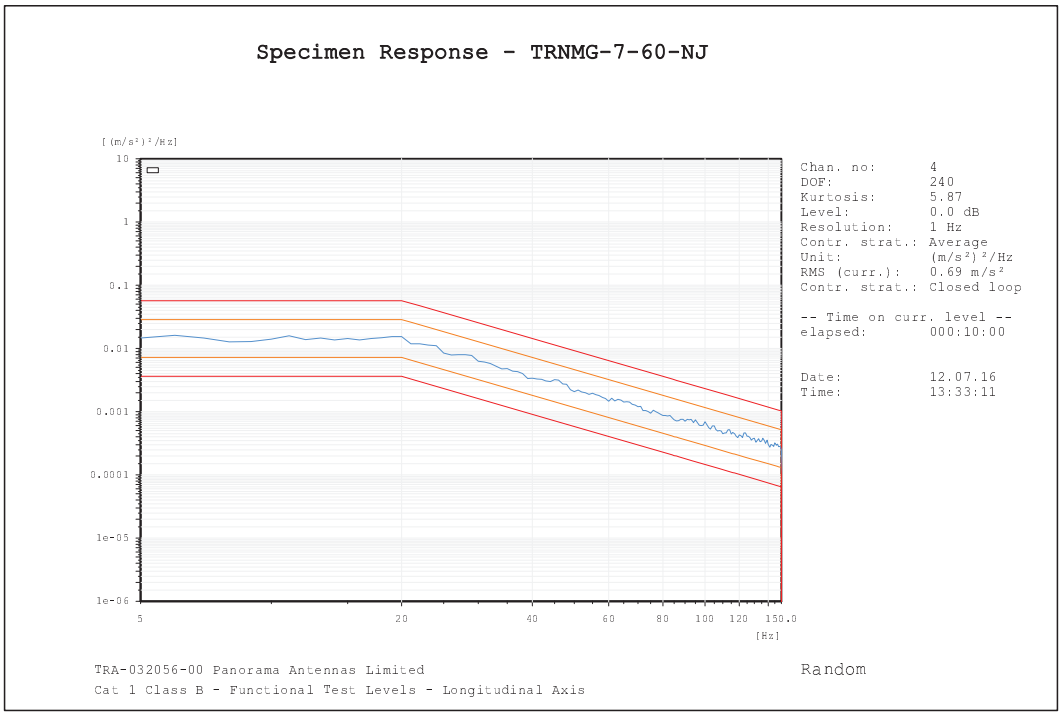
Test 7 - Functional Vibration Test Longitudinal Axis
Vibration and Shock Tests **Figure 13.3**



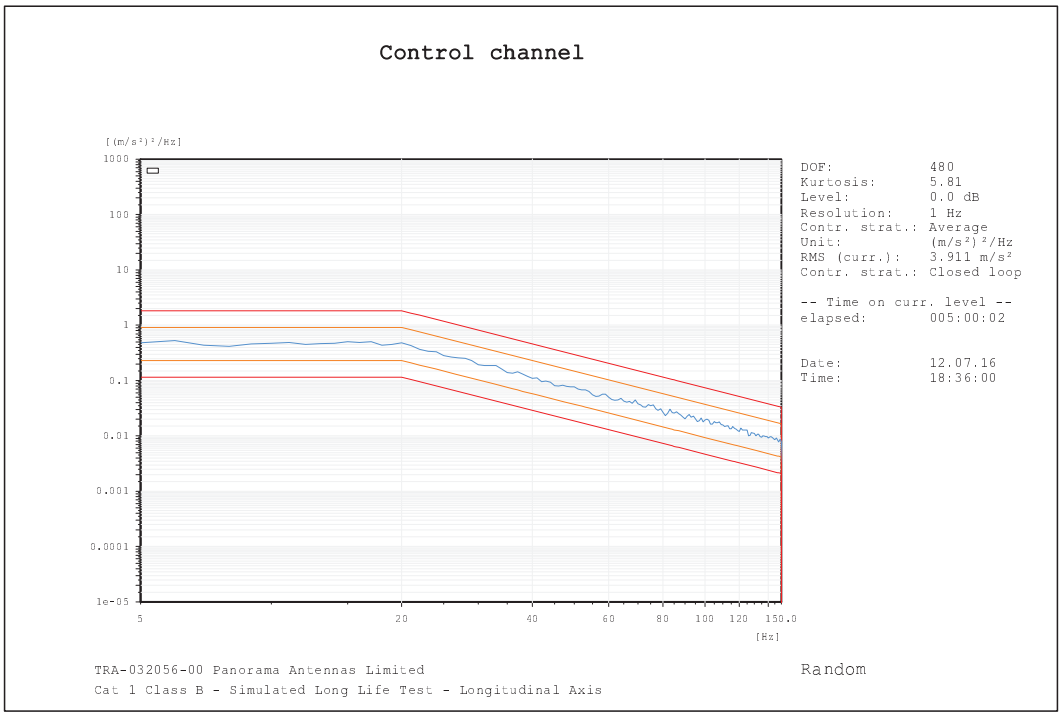
C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Longitudinal Axis\Test 7 - Functional Vibration_001.rrn

Test 7 - Functional Vibration Test Longitudinal Axis
Vibration and Shock Tests **Figure 13.4**



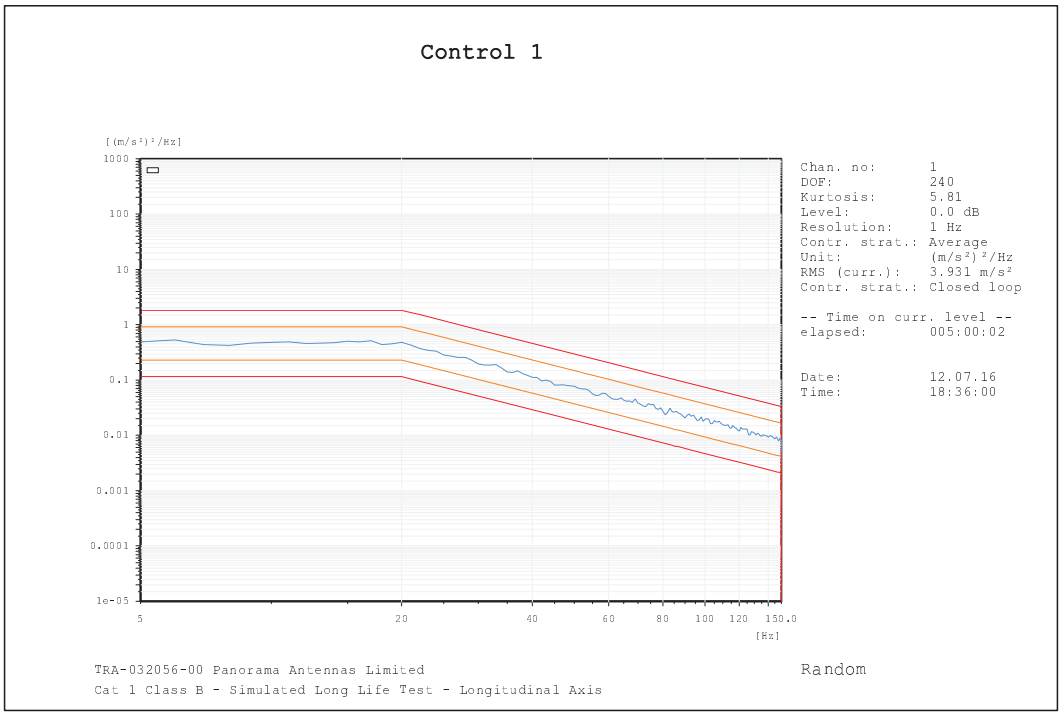
C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Longitudinal Axis\Test 7 - Functional Vibration_001.rrn

Test 7 - Functional Vibration Test Longitudinal Axis
Vibration and Shock Tests **Figure 13.5**

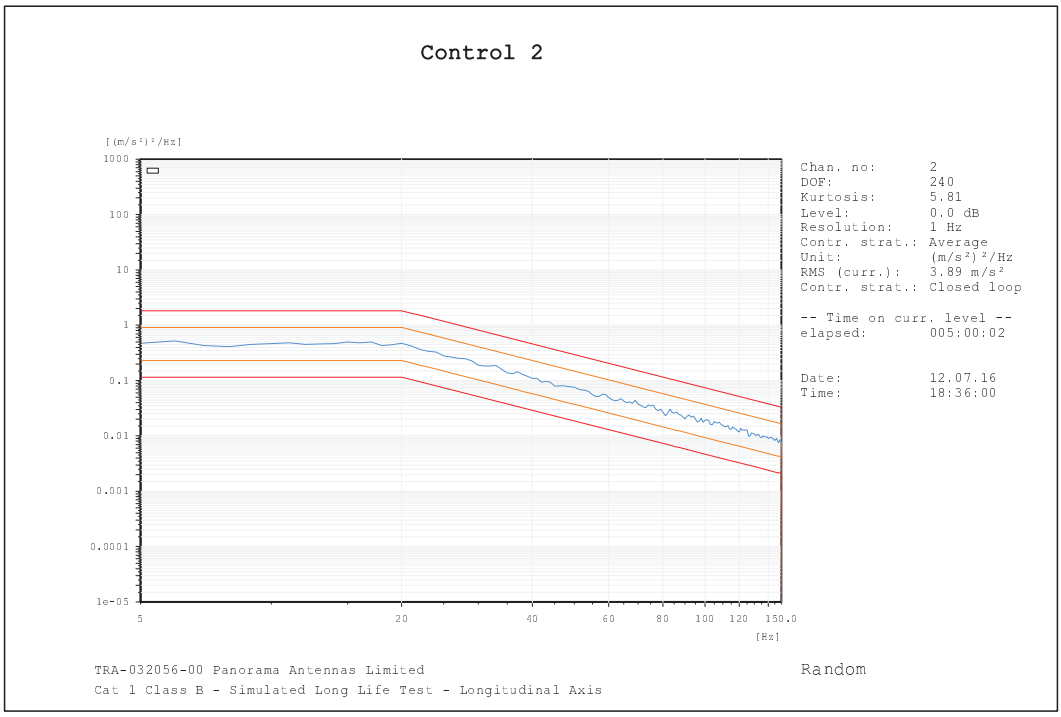


C:\Users\vcpc\Desktop\Tests\TRA-032056-00 Panorama Antennas Limited\Longitudinal Axis\Test 8 - Simulated Long Life_001.rrn

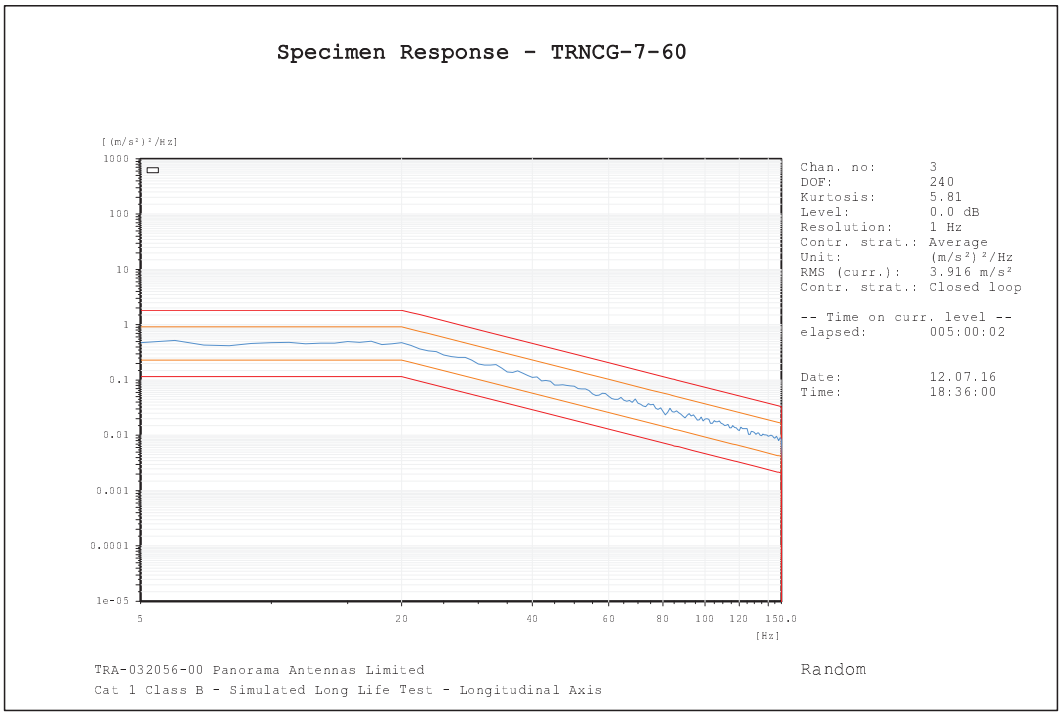
Test 8 - Simulated Long Life Longitudinal Axis
Vibration and Shock Tests **Figure 14.1**



Test 8 - Simulated Long Life Longitudinal Axis
Vibration and Shock Tests **Figure 14.2**



Test 8 - Simulated Long Life Longitudinal Axis
Vibration and Shock Tests **Figure 14.3**



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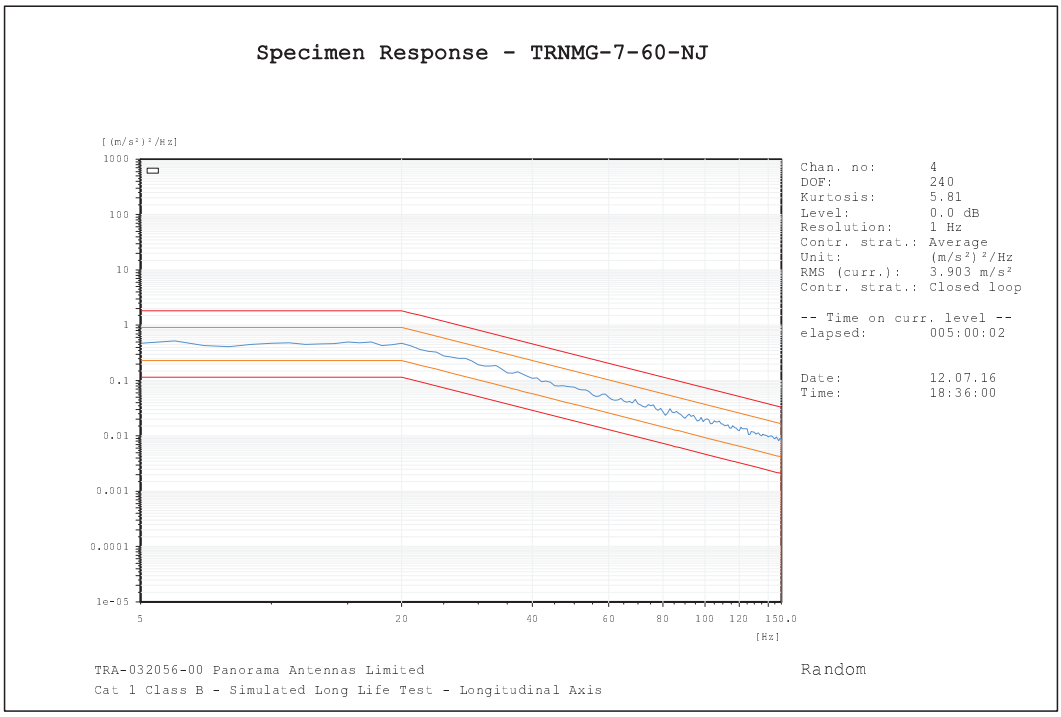
Test 8 - Simulated Long Life Longitudinal Axis
Vibration and Shock Tests **Figure 14.4**



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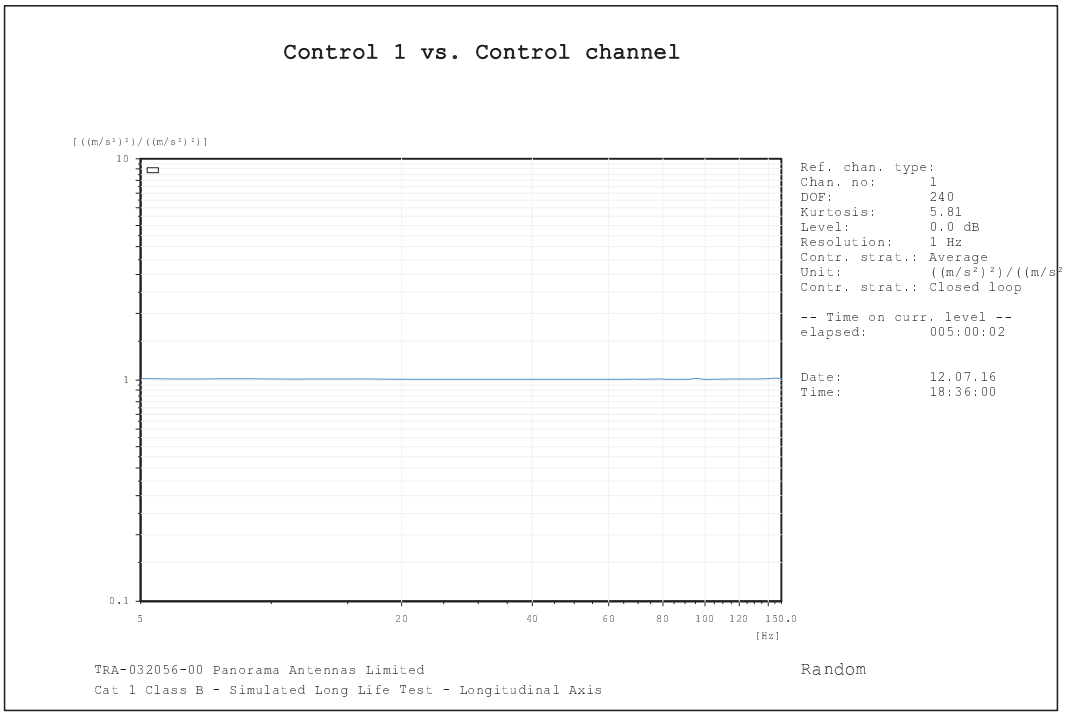
Test 8 - Simulated Long Life Longitudinal Axis
Vibration and Shock Tests **Figure 14.5**



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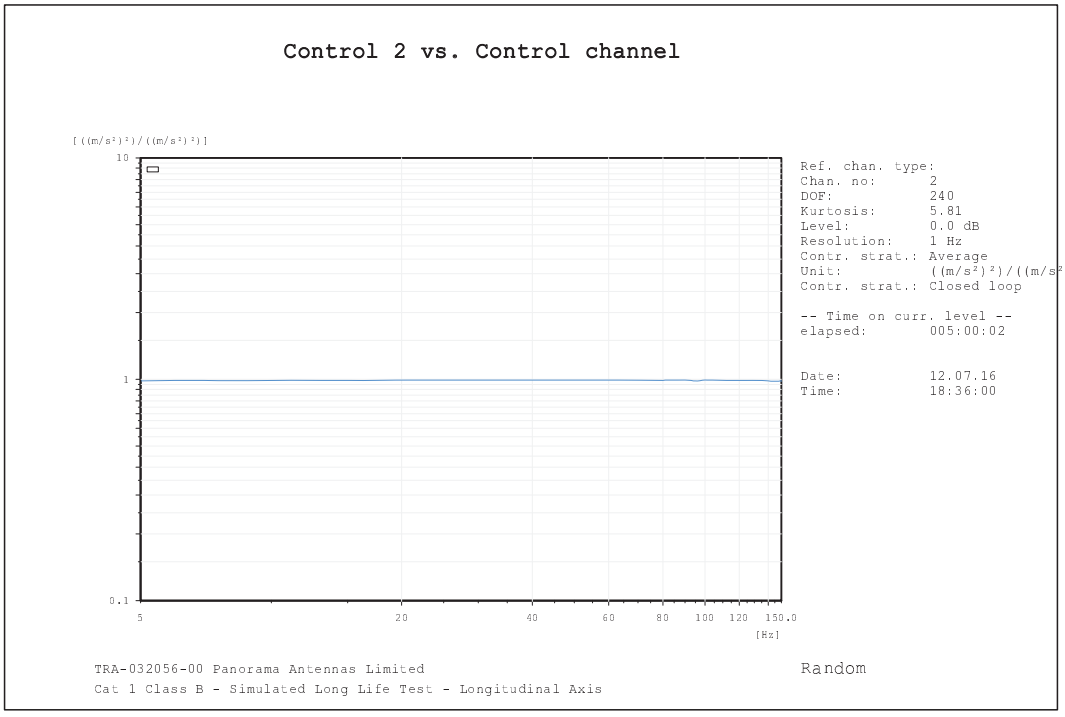
Test 8 - Transfer Function Simulated Long Life Longitudinal Axis
Vibration and Shock Tests **Figure 15.1**



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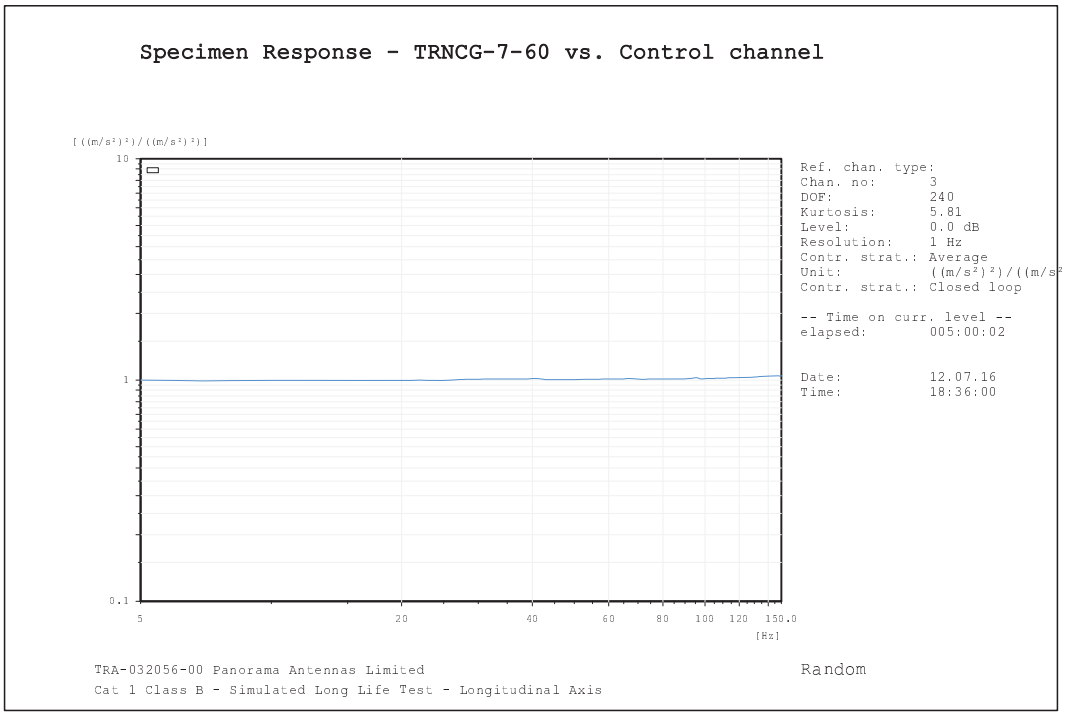
Test 8 - Transfer Function Simulated Long Life Longitudinal Axis
Vibration and Shock Tests **Figure 15.2**



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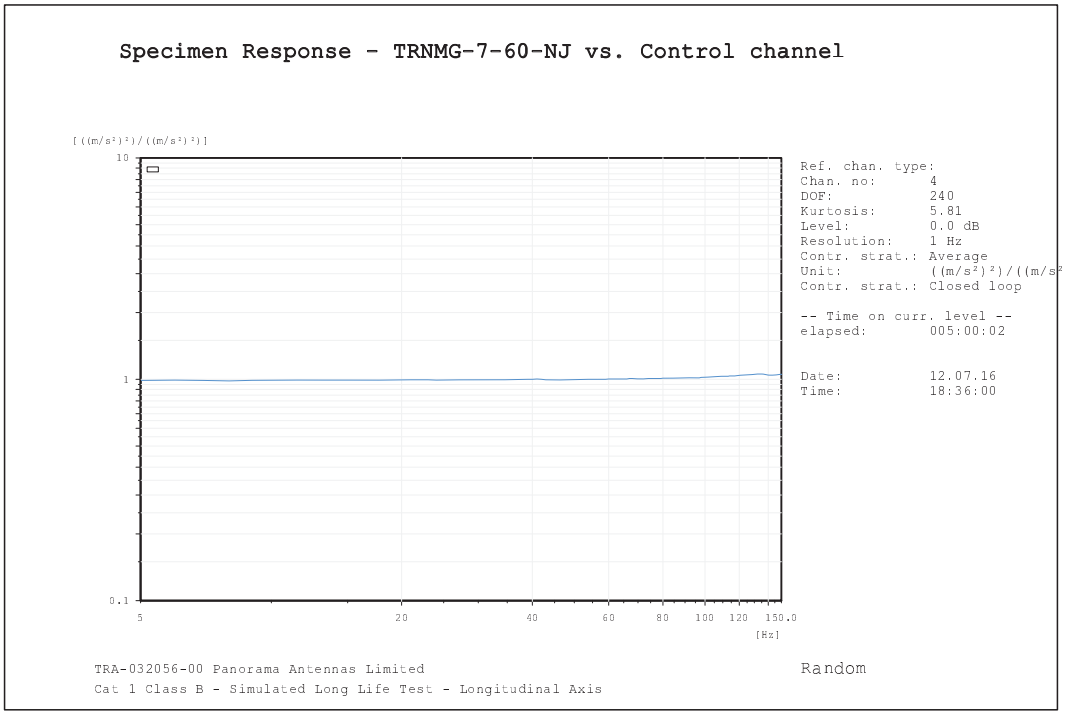
Test 8 - Transfer Function Simulated Long Life Longitudinal Axis
Vibration and Shock Tests **Figure 15.3**



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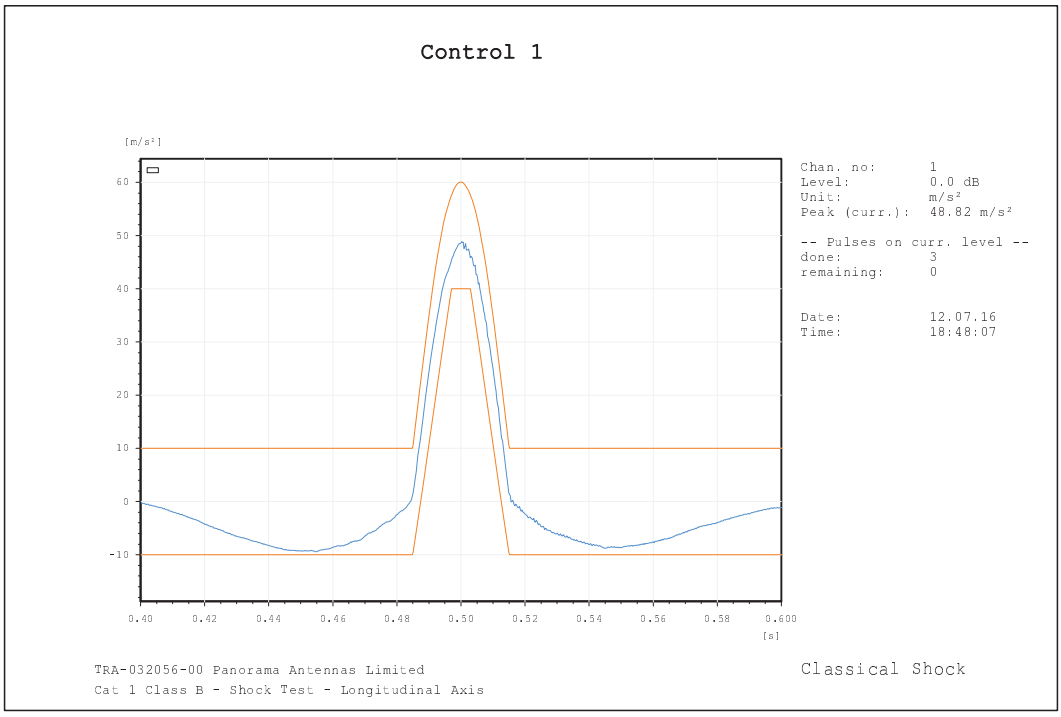
Test 8 - Transfer Function Simulated Long Life Longitudinal Axis
Vibration and Shock Tests **Figure 15.4**



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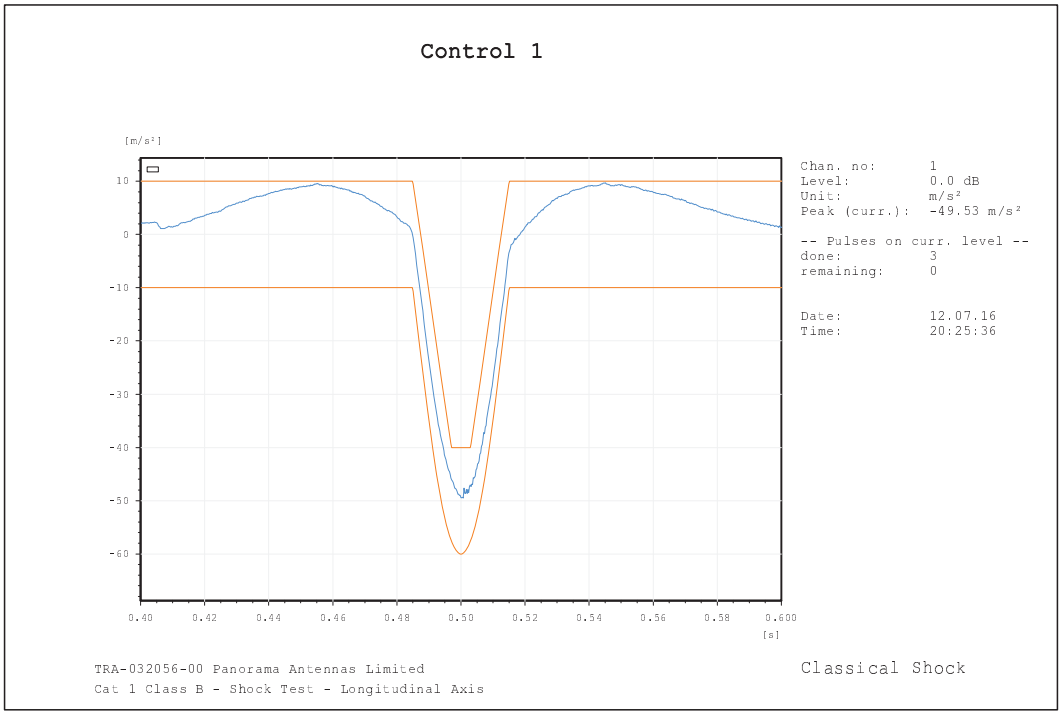
Test 9 - Shock Test Longitudinal Axis
Vibration and Shock Tests **Figure 16.1**



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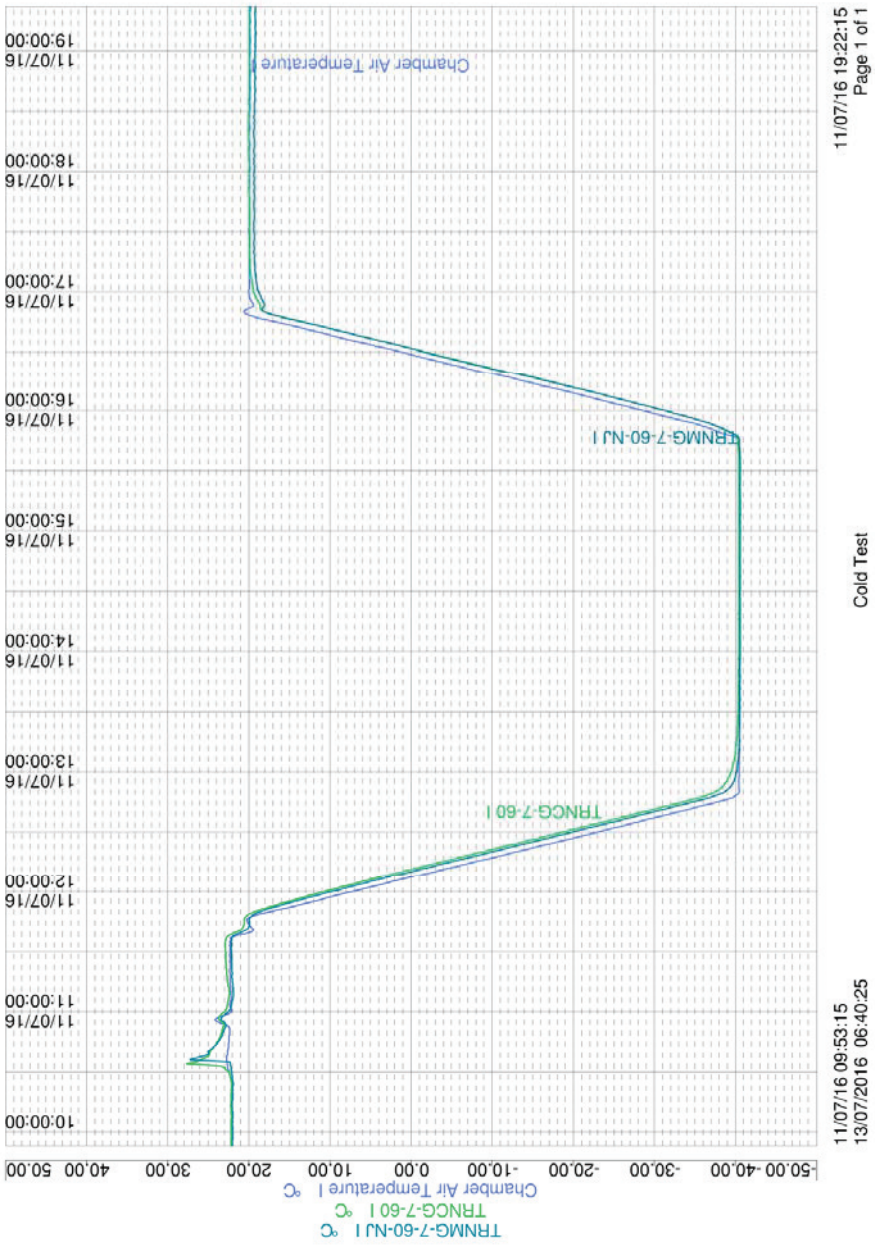
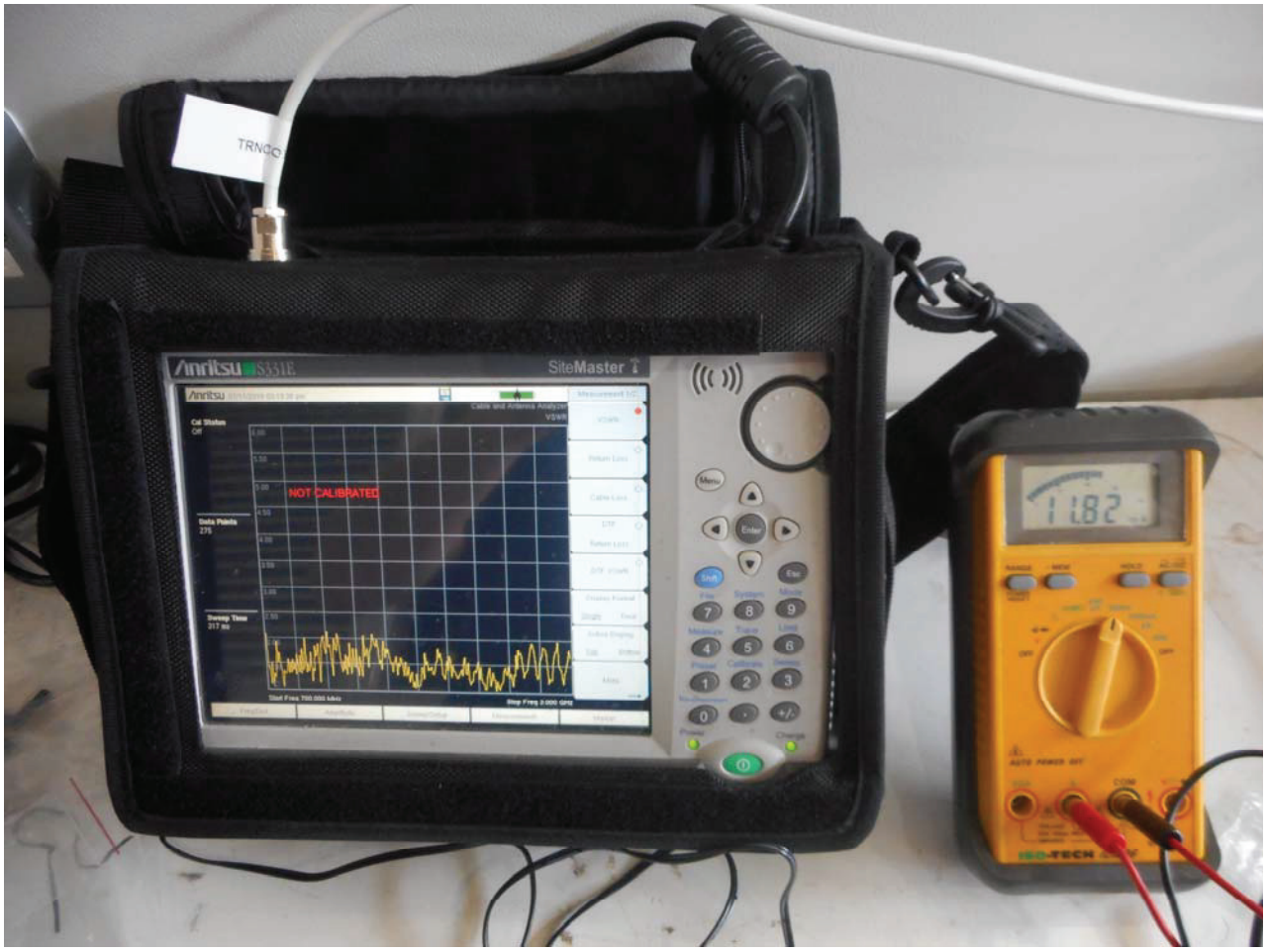
Test 9 - Shock Test Longitudinal Axis
Vibration and Shock Tests **Figure 16.2**



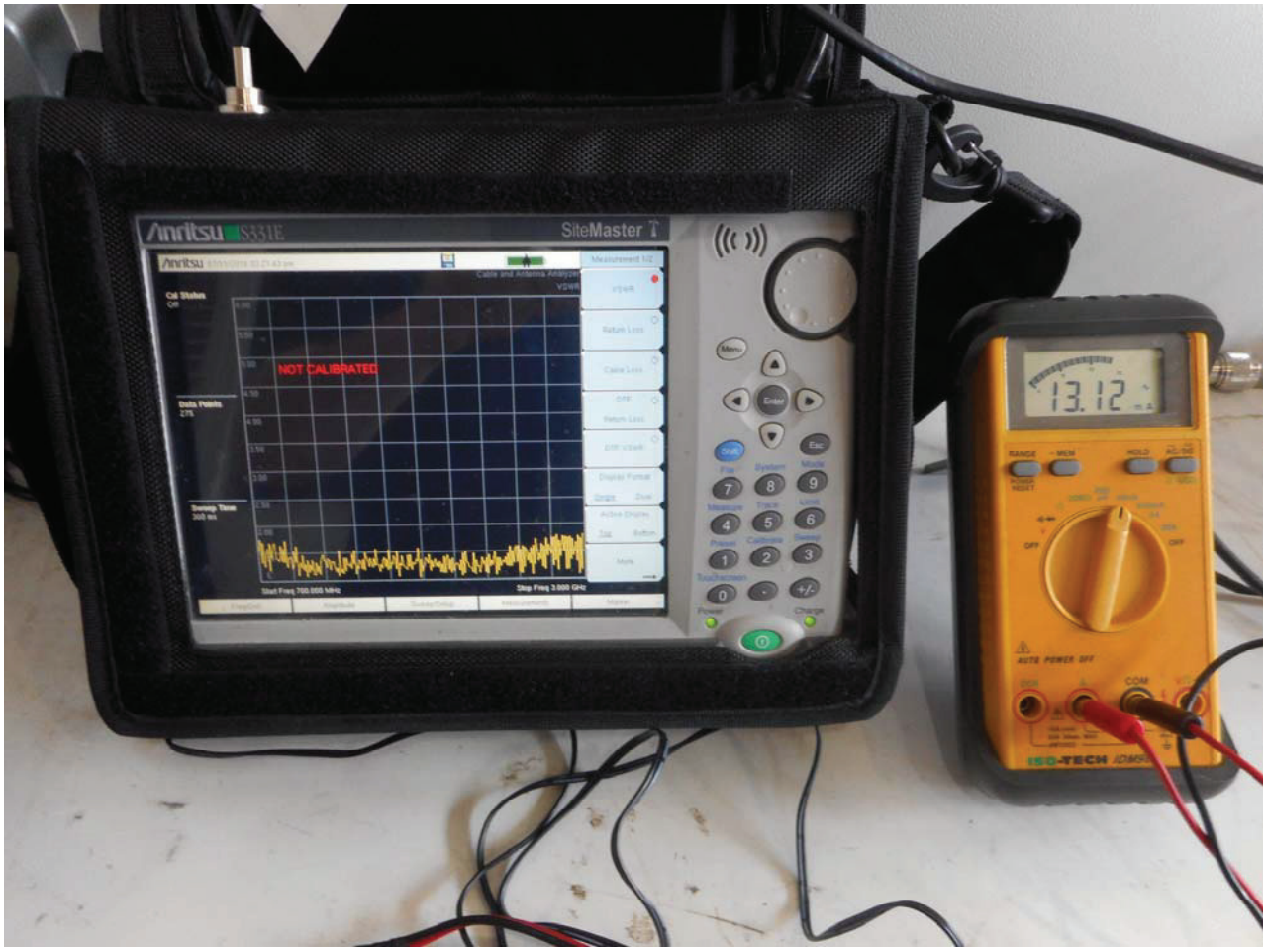
Climatic Tests
Cooling Test Digital Chart Record

Figure 17



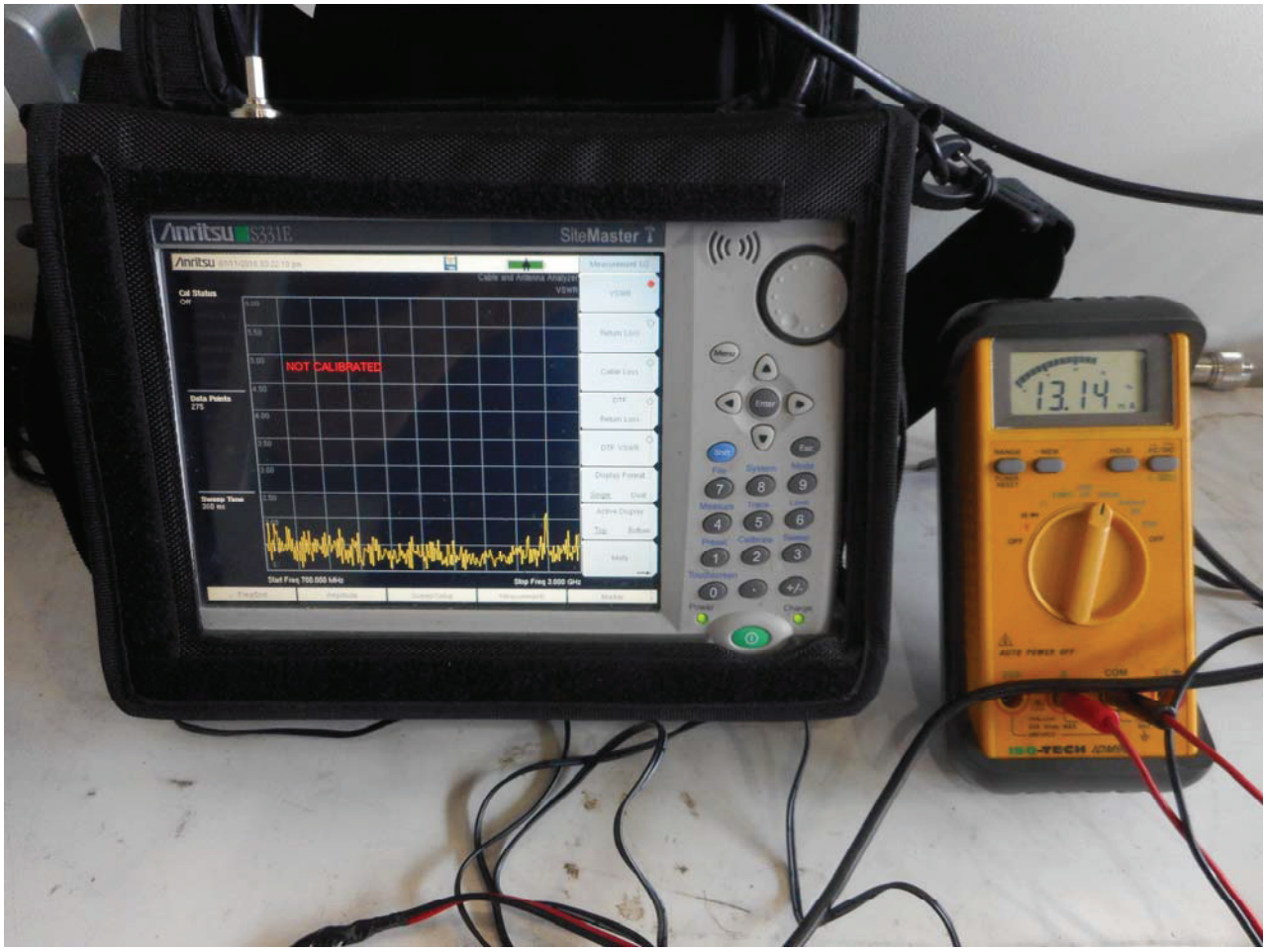
Cooling Test Performance Check at -40°C
TRNCG Communications and GPS Readings

Figure 18



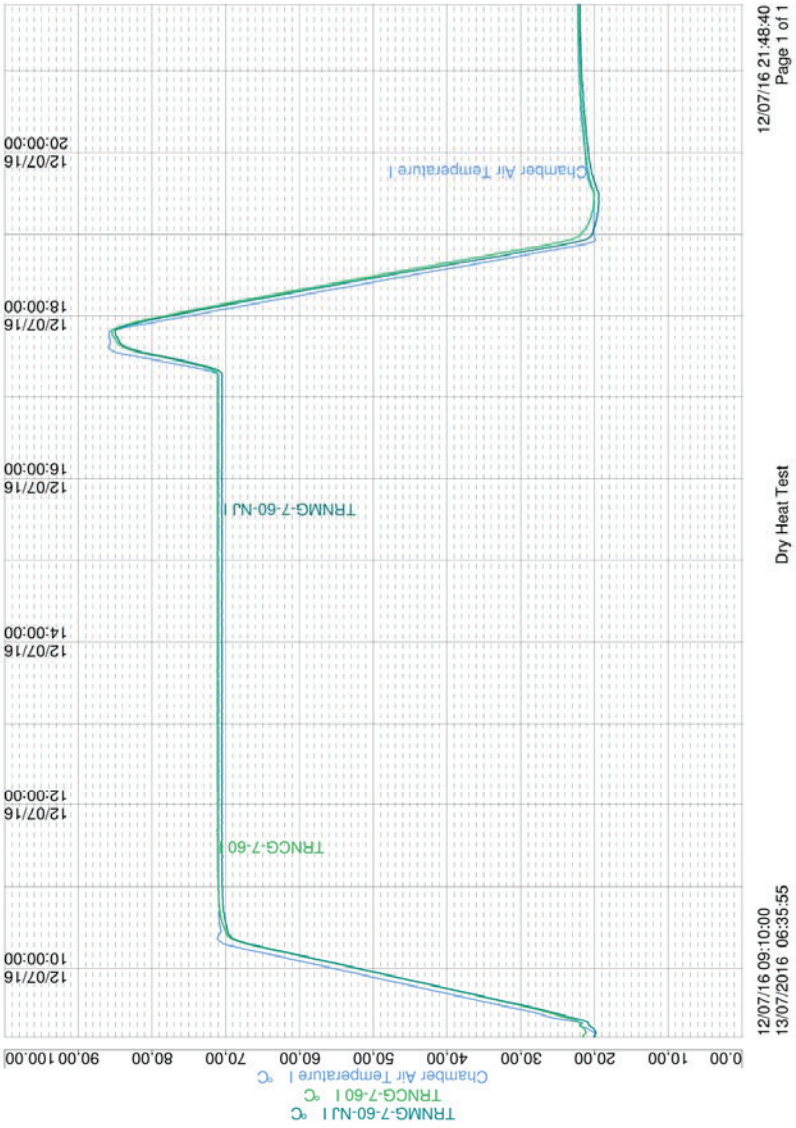
Cooling Test Performance Check at -40°C
TRNMG Front Communications and GPS Readings

Figure 19



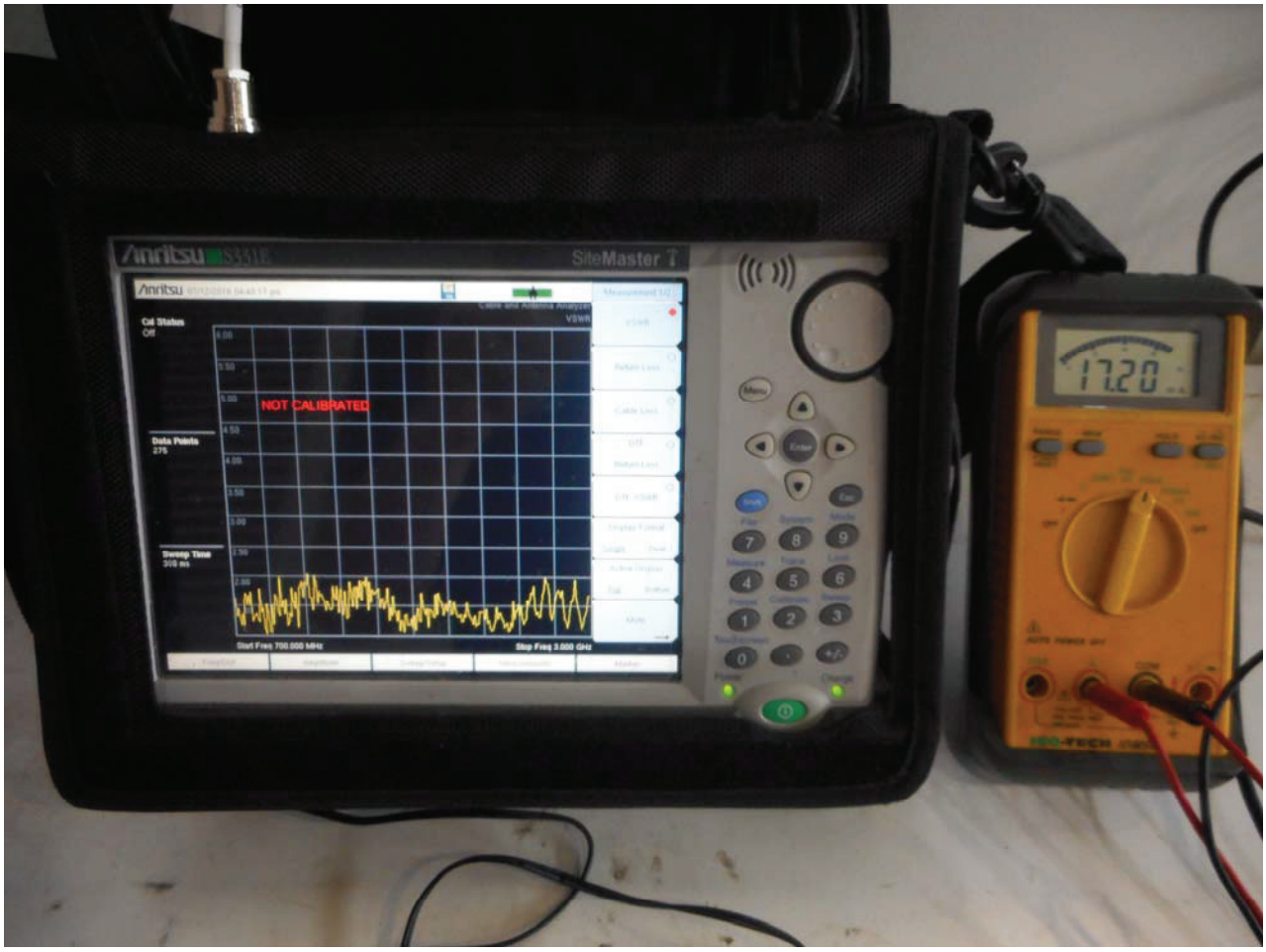
Cooling Test Performance Check at -40°C
TRNMG Back Communications and GPS Readings

Figure 20



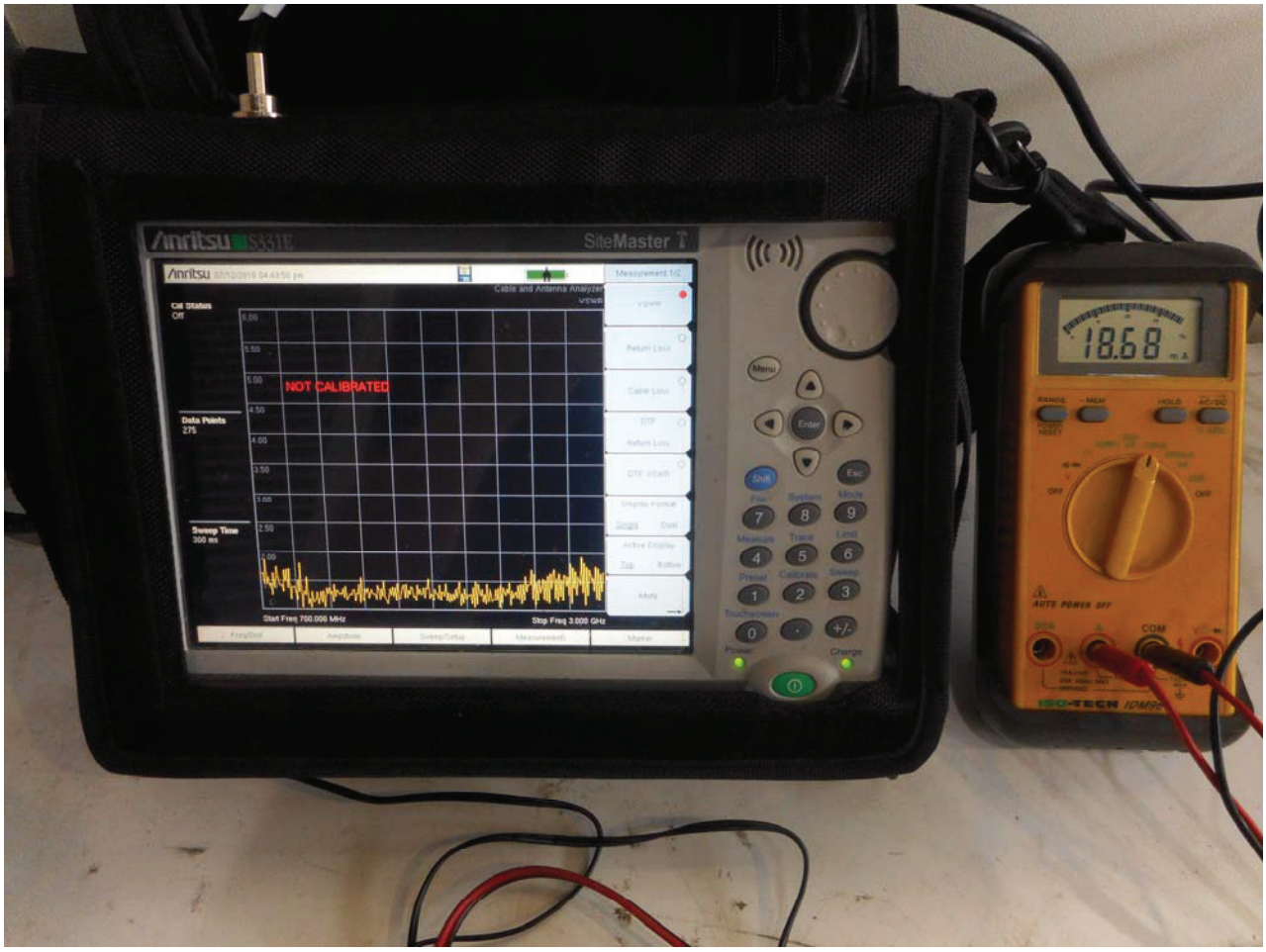
Climatic Tests
Dry Heat Test Digital Chart Record

Figure 21



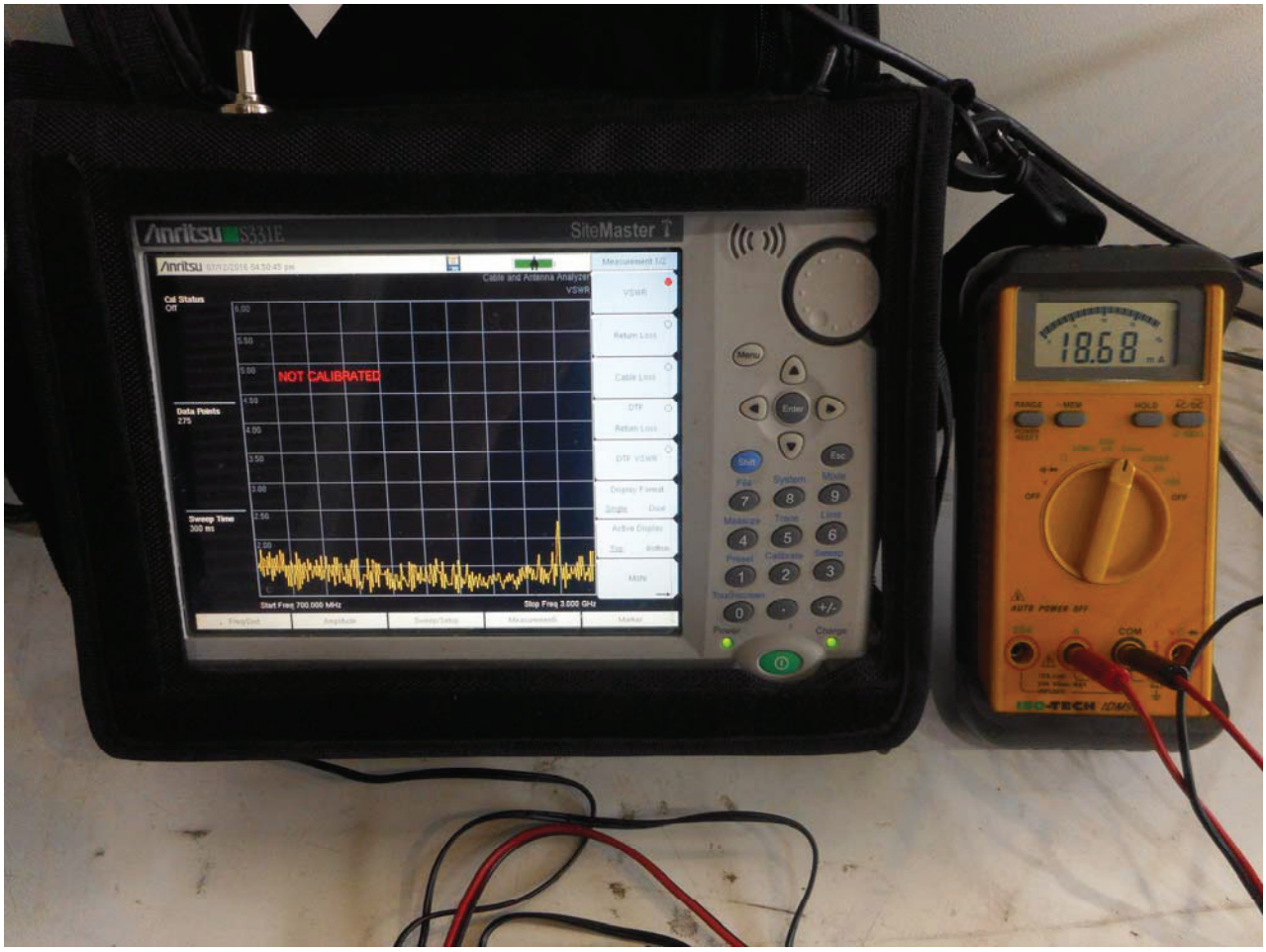
Dry Heat Test Performance Check at +70°C
TRNCG Communications and GPS Readings

Figure 22



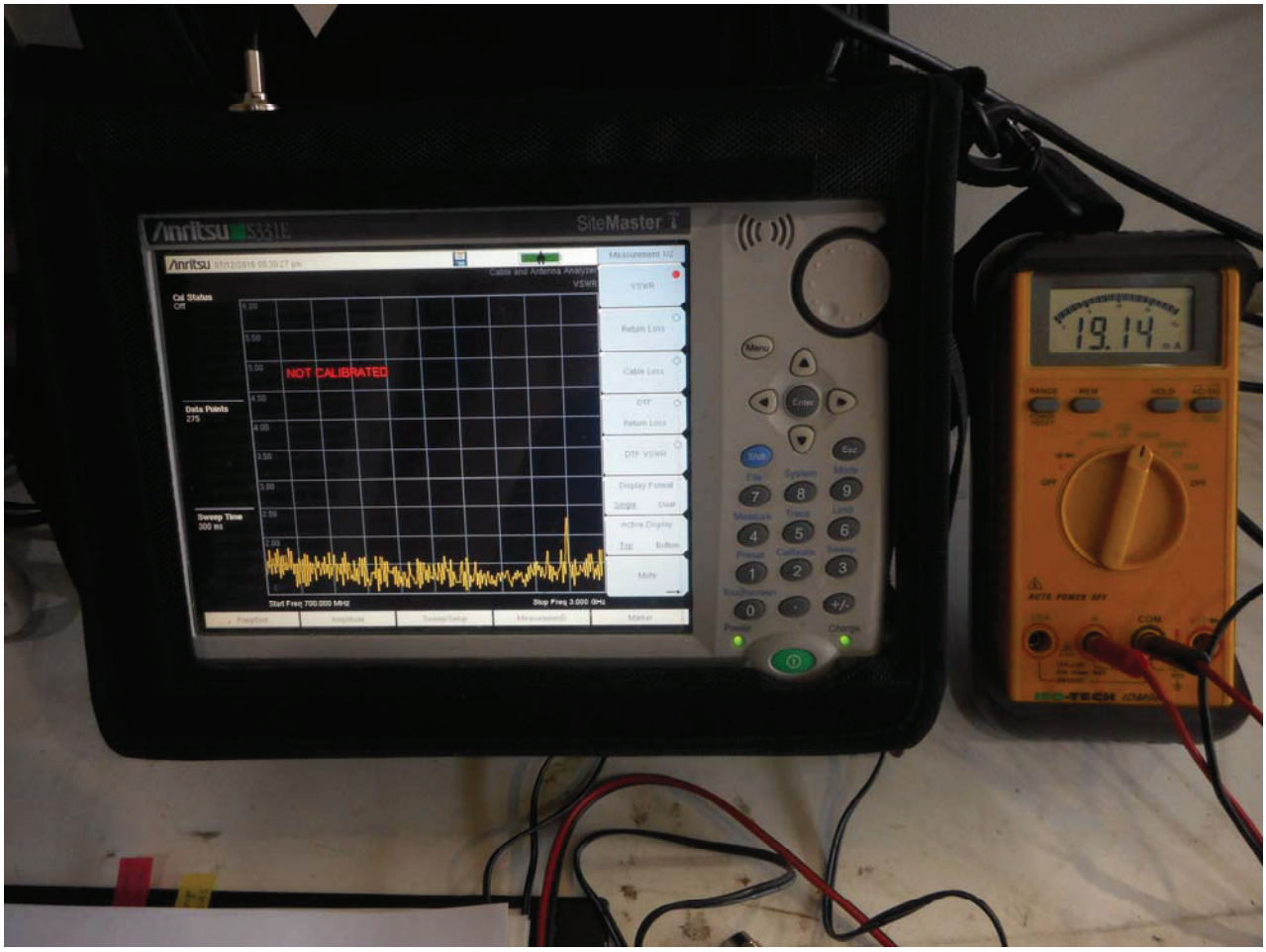
Dry Heat Test Performance Check at +70°C
TRNMG Front Communications and GPS Readings

Figure 23



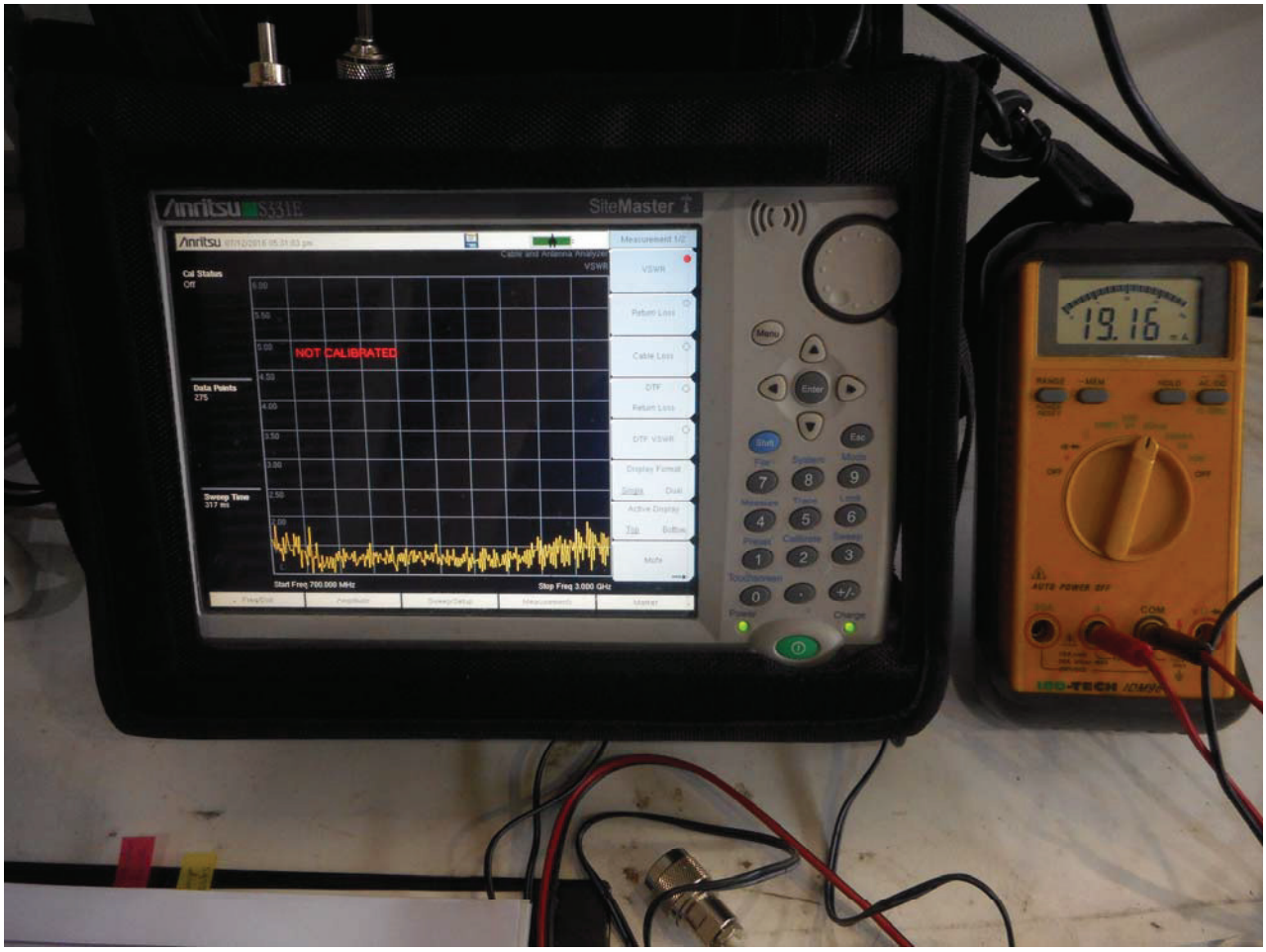
Dry Heat Test Performance Check at +70°C
TRNMG Back Communications and GPS Readings

Figure 24



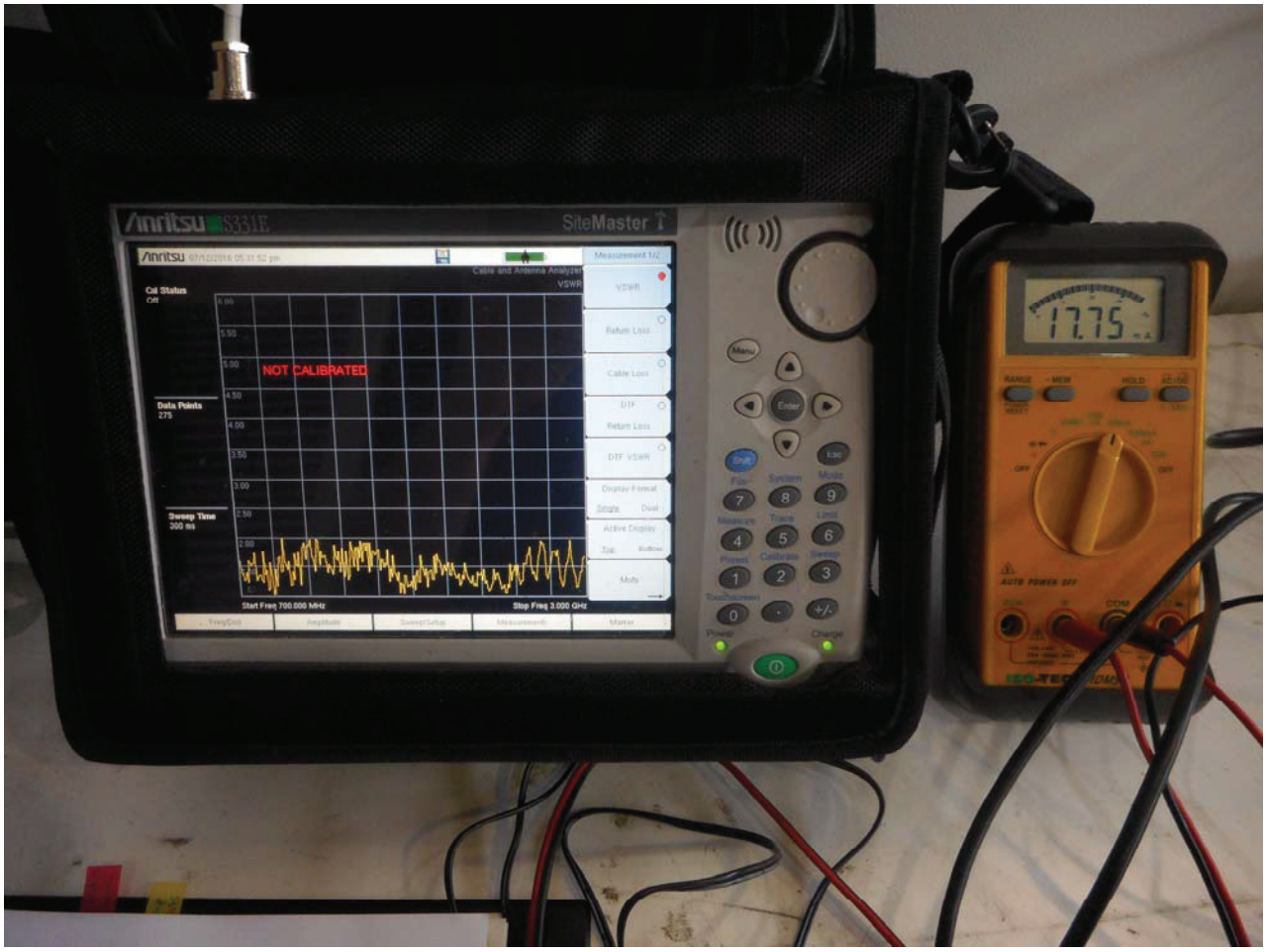
Dry Heat Test Performance Check at +85°C
TRNCG Communications and GPS Readings

Figure 25



Dry Heat Test Performance Check at +85°C
TRNMG Front Communications and GPS Readings

Figure 26



Dry Heat Test Performance Check at +85°C
TRNMG Back Communications and GPS Readings

Figure 27