Environmental Qualification Test Report

for the

Spidertracks Spider 7

Document No: 38-0037
Revision: A

FDS Job No. 29615

Paul Hirons, Engineering Project Manager — Date (DD/MM/YY) 18-12-15

Adrian Spiteri, Senior Technician — Date (DD/MM/YY) 18/12/15

DOCUMENT CONTROL

Document: 38-0037 **Revision** A	
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REVISION LIST

Revision N°.	**Revision Date**	**Revised By**	**Revision Description**

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1.0 INTRODUCTION

1.1 Purpose

This document discusses the performance results obtained by carrying out environmental testing on the Spidertracks Spider 7 hardware in accordance with RTCA/DO-160G Environmental Conditions and Test Procedures for Airborne Equipment.

1.2 Scope

This document shall be presented by the manufacturer to detail compliance and non-compliance with the RTCA/DO-160G standard.

1.3 Acronyms and Abbreviations

ATP	Acceptance Test
EUT	Equipment under test

1.4 Applicable Documents

The following documents are listed for reference only. Each document is applicable to this report only to the extent specified herein.

1.4.1 External Documents

Document	***Description***
RTCA/DO-160G	Environmental Conditions and Test Procedures for Airborne Equipment

1.4.2 Internal Documents

Document	***Description***
36-0104 Issue C	DO-160G: Operational Shock
36-0105 Issue A	DO-160G: Impulse Shock Crash Safety
36-0106 Issue C	DO-160G: Sustained Shock Crash Safety

2.0 TESTING

Testing was carried out on the Spider 7 as described below.

2.1 Customer Requirements

DO-160G Section	***Description***	***Category***	***Notes***
7.2.1	Operational Shock	E	
7.3.1	Impulse Shock	E	
7.3.3	Sustained Shock	E	
8.8.1	Vibration	R – Helicopter; Known Frequency	4 main rotor blades, Main rotor RPM: 395

3.0 EQUIPMENT TRACEABILITY

NOTE: In this document the EUT is referred to as Spider 7; the provided unit was a Spider S7. There is no difference in form, fit and function; it is purely a name change. The Spider 7 as stated by the customer, may be supplied as part number 6000S7int. There is no form, fit or function change for this part number compared to Spider 7.

3.1 Part N°;

Spider 7

3.2 Product;

Spidertracks Spider 7 with internal antenna

3.3 Serial N°'s used;

2015BETA34

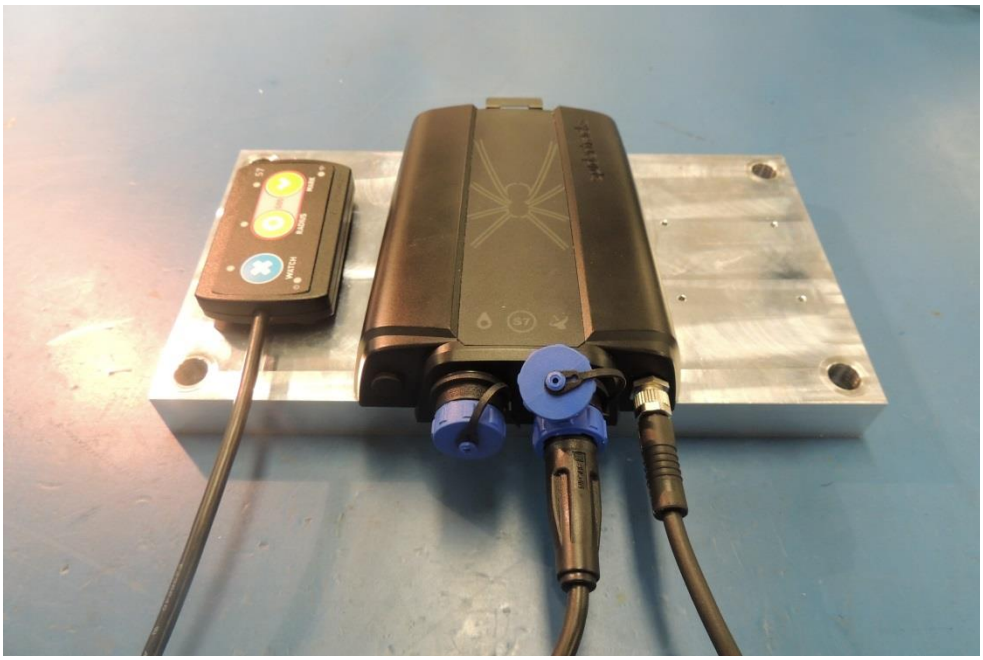


Figure 1: EUT

4.0 TEST HOUSES

4.1 Flight Data Systems PTY. LTD

31 McGregors Drive,
Keilor Park, Victoria 3042 Australia

5.0 RESOURCES

5.1 Equipment

Part Number	***Description***
Spider 7	Spider 7 (EUT)
7251A-100	Endevco single axis piezoelectric accelerometer
DSX6650/16-930/2-HV	Thermotron Electrodynamic Vibration System
79-1000-00	FDS Sustained Shock Testing System (Centrifuge)
Fluke 115C	Digital multimeter
LA20	GPS Repeater

5.2 Personnel

Name	***Job Description***
Adrian Spiteri	Senior Technician

5.3 Facilities

Part Number	***Description***
79-1000-00	FDS Sustained Shock Testing System (Centrifuge)
DSX6650/16-930/2-HV	Thermotron Electrodynamic Vibration System

Table 1: Environmental Testing Chambers / Labs

6.0 BRIEF SUMMARY OF RESULTS

DO-160G Section	***Description***	***Category***	***Test Procedure***	***Result***
7.2.1	Operational Shock	E	36-0104 Issue C	Pass
7.3.1	Impulse Shock	E	36-0105 Issue A	Pass
8.8.1	Vibration	R – Helicopter; Known Frequency	DO160G Section 8.8.1	Pass
7.3.3	Sustained Shock	E	36-0106 Issue C	Pass

7.0 ENVIRONMENTAL TEST RESULTS

7.1 Operational Shock

The test was carried out to RTCA/DO-160G 7.2.1 Category E, in accordance with Test Procedure 36-0104 Issue C.

Test Results and setup are recorded in Appendix A.

7.2 Impulse Shock

The test was carried out to RTCA/DO-160G 7.3.1 Category E, in accordance with Test Procedure 36-0105 Issue A.

Test Results and setup are recorded in Appendix B.

7.3 Vibration

The test was carried out to RTCA/DO-160G 8.0 Category R[G] in accordance with DO160G section 8.8.1.

Test Results and setup are recorded in Appendix C.

7.4 Sustained Shock

The test was carried out to RTCA/DO-160G 7.3.3 Category E, in accordance with Test Procedure 36-0106 Issue C.

Test Results and setup are recorded in Appendix D.

8.0 CONCLUSION

The Spider 7 has met the test requirements as set out in Section 2.0.

Appendix A **OPERATIONAL SHOCK**

A 1. **Equipment Under Test (EUT)**

Part Number: Spider 7
Serial Number used: 2015BETA34

A 2. **Test House**

Flight Data Systems Pty Ltd

A 3. **Equipment Used**

See Qualification Test Report Form below.

A 4. **Test Method**

1.0 Review test cover sheet and ensure test type, test category and test level are specified before proceeding.

2.0 Begin filling out Qualification Test Report From 21-0274

3.0 Complete a visual inspection of the Test Item; record overall physical state of Test Item and any notable flaws/damage visible on the unit. Take profile pictures of unit as a visual record.

4.0 Ensure calibrated transducer is installed on Shaker prior to installation of Test Item.

5.0 Mount Test Item on test mount, then mount assembly to shaker via FDAIU shaker adaptor mounts as required. Ensure Test Item is placed securely on test mount before attaching to FDAIU mount and vibration tester to apply force in the 'fore' orientation as per cover sheet if defined there, otherwise base orientation on Figure 1 below. Take note of centre of gravity as per interface drawing for Test Item.

6.0 Setup the Test Item in its normal operational configuration with power and minimum required inputs.

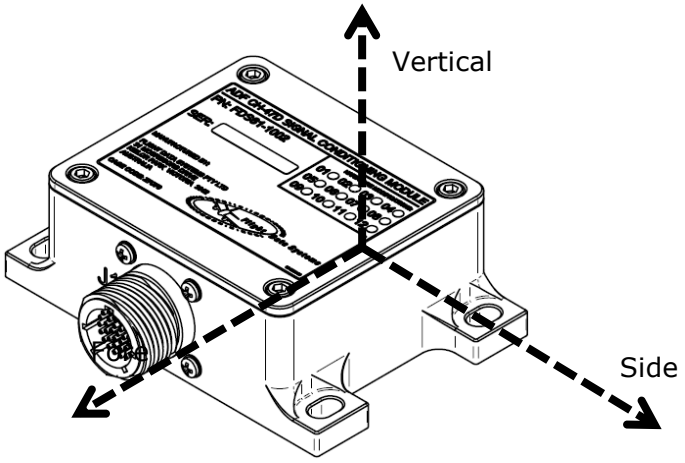


Figure 1 - Example of unit mounting

7.0 Configure the shaker to apply a shock with the profile below in Figure 22; configure the shock strength at 6gs with 11 ms pulse duration for Category A or B, 20 ms for low frequency testing Category D or E.

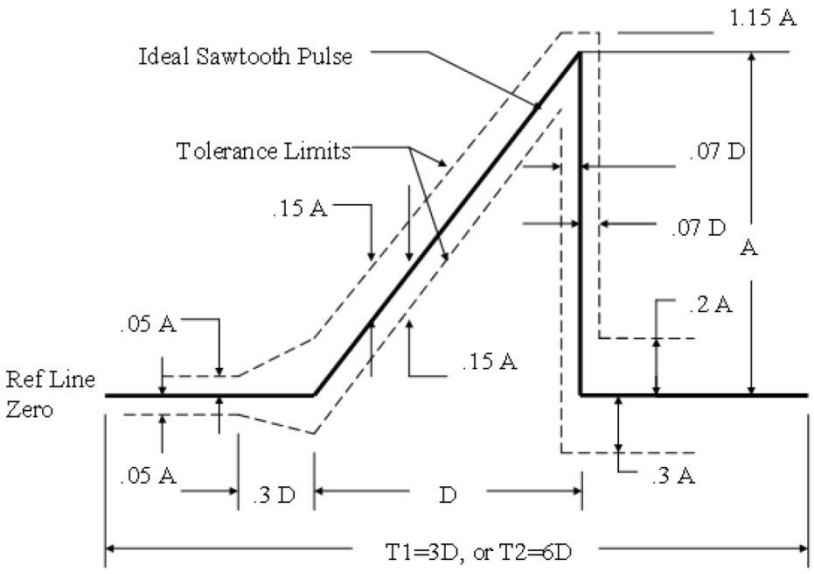


Figure 2 - Ideal Sawtooth Pulse; extracted from DO-160G document; Figure 7-2

D = Duration of Pulse (as per test cover sheet)

A = Peak Acceleration of nominal Pulse (6g)

T1 = Minimum time during which the pulse shall be monitored for shocks produced using a conventional shock testing machine, this is three times the duration of the pulse

T2 = Minimum time during which the pulse shall be monitored for shocks produced using a vibration generator, this is six times the duration of the pulse

8.0 Apply at least three shocks confirmed to fit the above profile; take a record via the shakers control window.

9.0 Visually inspect the test item for evidence of physical damage. Ensure records (photos) of the entire device are taken.

10.0 Repeat steps 5.0 through 9.0 for all 6 orientations (up, down, fore, aft, left and right), applying a positive and negative shock is acceptable as long as the shaker can achieve shocks within the profile in both directions.

11.0 Complete a full inspection of test item, take pictures of the unit for comparison to pre-test pictures; any failure of Test Item mounting is considered a failure.

12.0 Complete acceptance test on test item; attach completed acceptance test to test report.

13.0 If Test Item performs within applicable performance specifications as per relevant test documents where required above, and there is no evidence of fatigue or failure in test item mounting then the test is passed and this should be recorded on the test report.

A 5. **Qualification Test Cover Sheet**

Qualification Test Cover Sheet

Part Number: Spidertracks S7 **Job Number:** 29615

Product name: Spidertracks S7

S/N of provided units: 2015BETA34

Test Required: DO160G - Section 7.2.1 Operational Shock **Operational Test:** (if required) Attached printout (read notes)

Test Plan: 36-0104 Issue C **Acceptance Test:** Attached printout (read notes)

Test Limits:

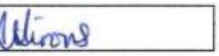
Category E (low frequency shocks) as per test plan 36-0104.

Notes:

Operational and acceptance test instructions attached to document - from customer's email.

After completing form sign below; create a copy for R&D record keeping; attach original with test report and other test documents. **Do not modify after document signed.**

Authorized by: Paul Hirons

Signed:  Date: 17-11-15.

Operator: A. SPITERI Date: 17-11-2015

Document No: 21-0296
Issue: A

Pre and Post tests

1. Position the Spider with an unobstructed and full view of the sky (horizon to horizon)

2. Power the Spider using the auxiliary lead provided - ensure power supply is stable in the range of 10-28VDC and able to deliver 1.5A

3. After initial start-up sequence, which consists of the Spider's LED flashing several times and the keypad LEDs flashing 10sec. Afterwards, you should see a solid power LED on the unit (middle LED and bottom left on the keypad)

4. Within a 2-4 minute period the green GPS LED (left LED) on the unit should turn on and the satellite LED (right LED) should turn on shortly after. The bottom right LED on the Keypad should turn orange and then green shortly after. The GPS LED and the orange LED on the keypad indicate GPS lock has been achieved. The satellite LED on the unit and green LED on the keypad indicate that the first position report has been sent through Iridium.

5. Please run through these steps before and after testing.

Performance (during) Tests

1. Power the Spider using the auxiliary lead provided - ensure power supply is stable in the range of 10-28VDC and able to deliver 1.5A, ensure power supply is not interrupted during test.

2. After initial start-up sequence, which consists of the Spider's LED flashing several times and the keypad LEDs flashing 10sec. Afterwards, you should see a solid power LED on the unit (middle LED and bottom left on the keypad)

3. Within a 2-4 minute period the green GPS LED (left LED) on the unit should turn on, the bottom right LED on the Keypad should turn orange. The GPS LED and the orange LED on the keypad indicate GPS lock has been achieved.

4. Run during environmental test.

A 6. **Setup**

EUT was powered with an input voltage of 15V and GPS locked as per operational test in Appendix E.

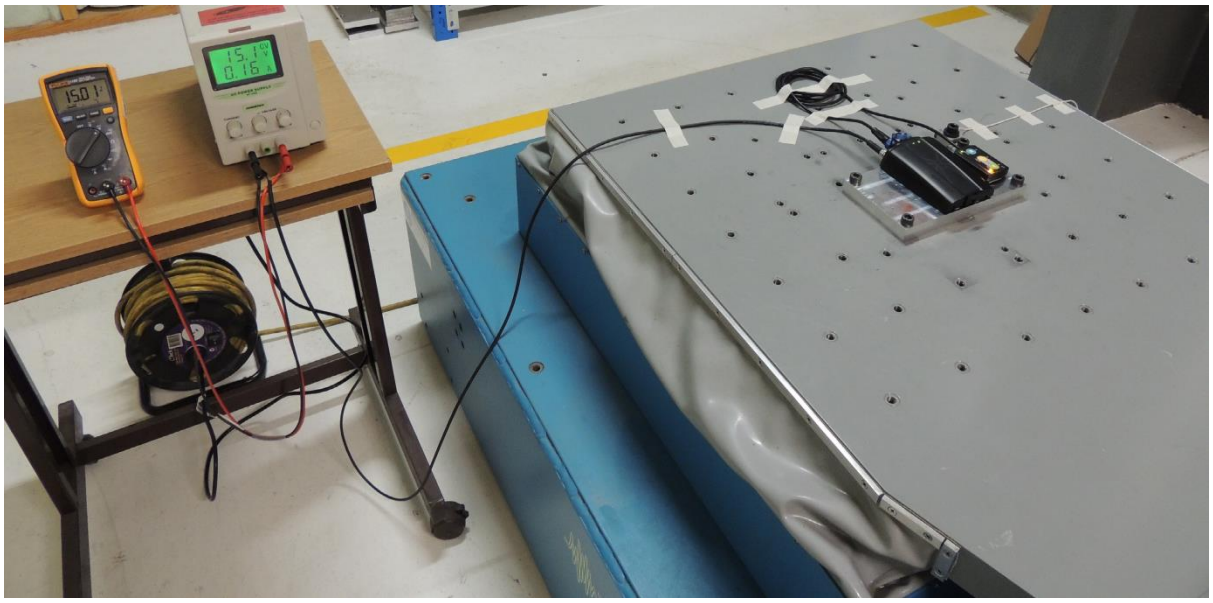


Figure 2: Operational Shock Test Setup

A 7. **Fore**

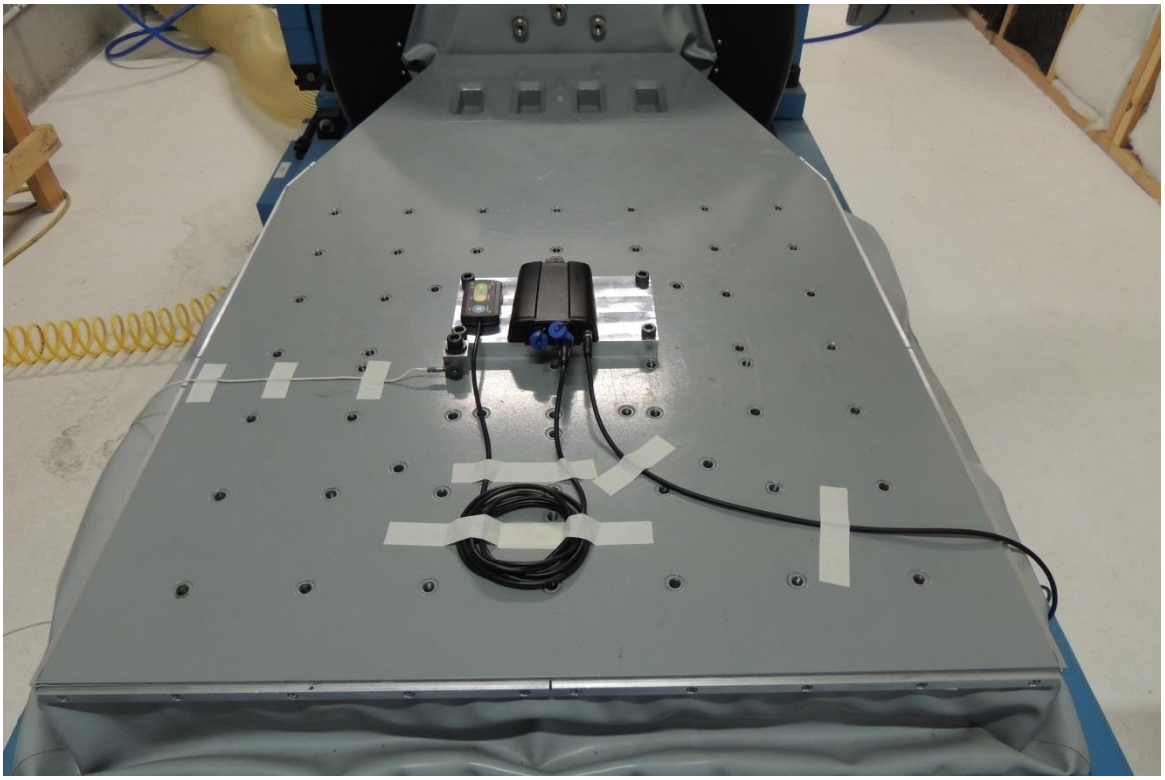


Figure 3: Unit mounting (Fore)

Figure 4: Fore pre test

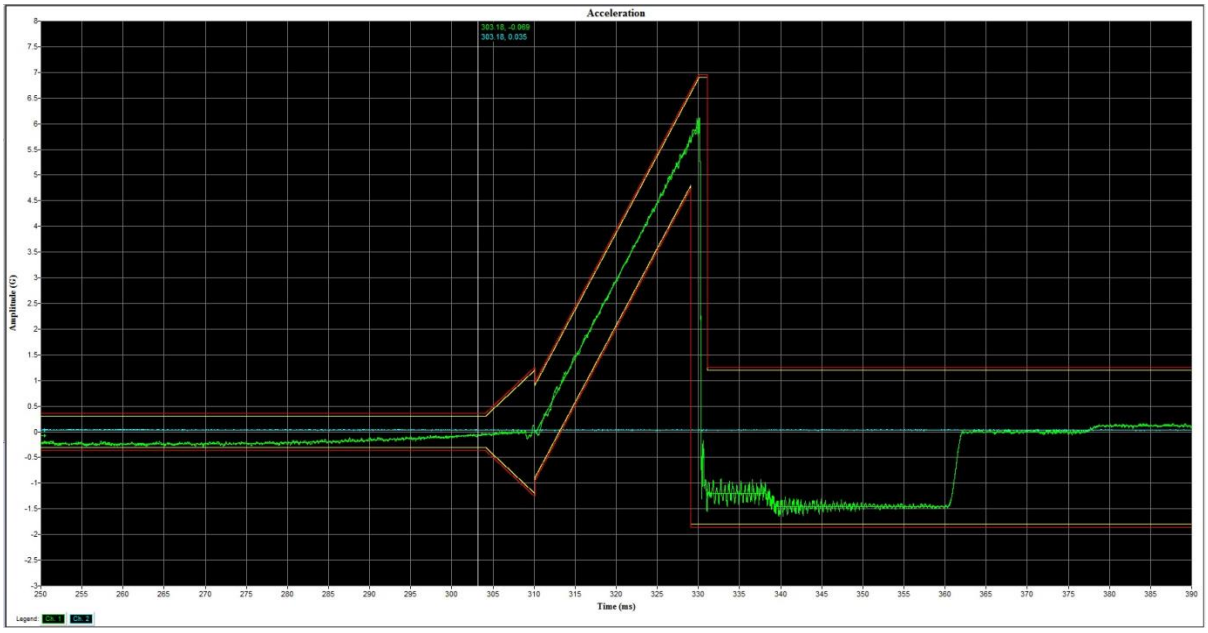


Figure 5: Fore positive shock

Figure 6: Fore negative shock

Figure 7: Fore post test

A 8. **Side**

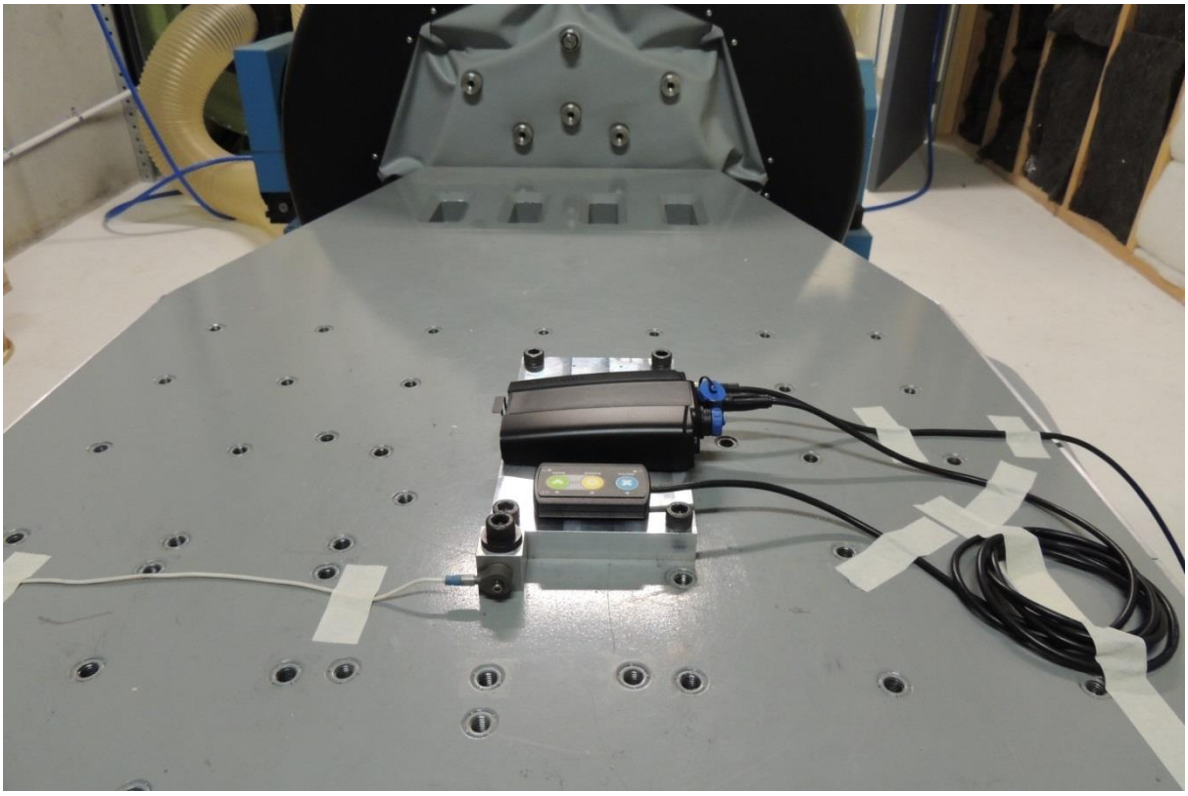


Figure 8: Unit mounting (side)

Figure 9: Side pre test

Figure 10: Side negative shock

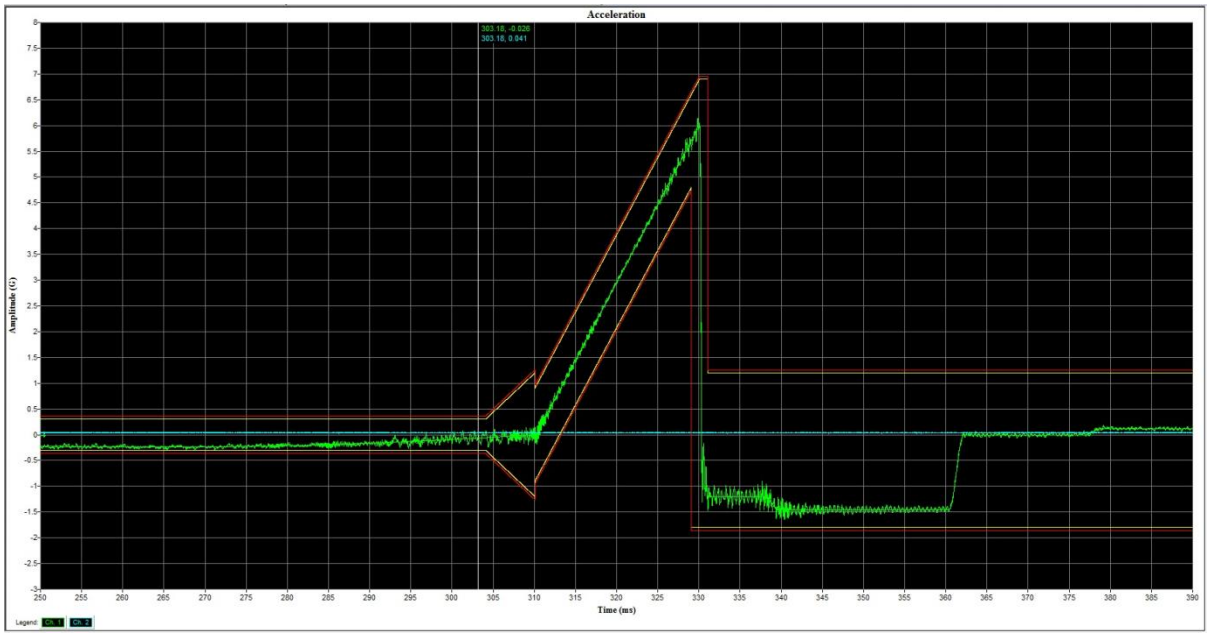


Figure 11: Side positive shock

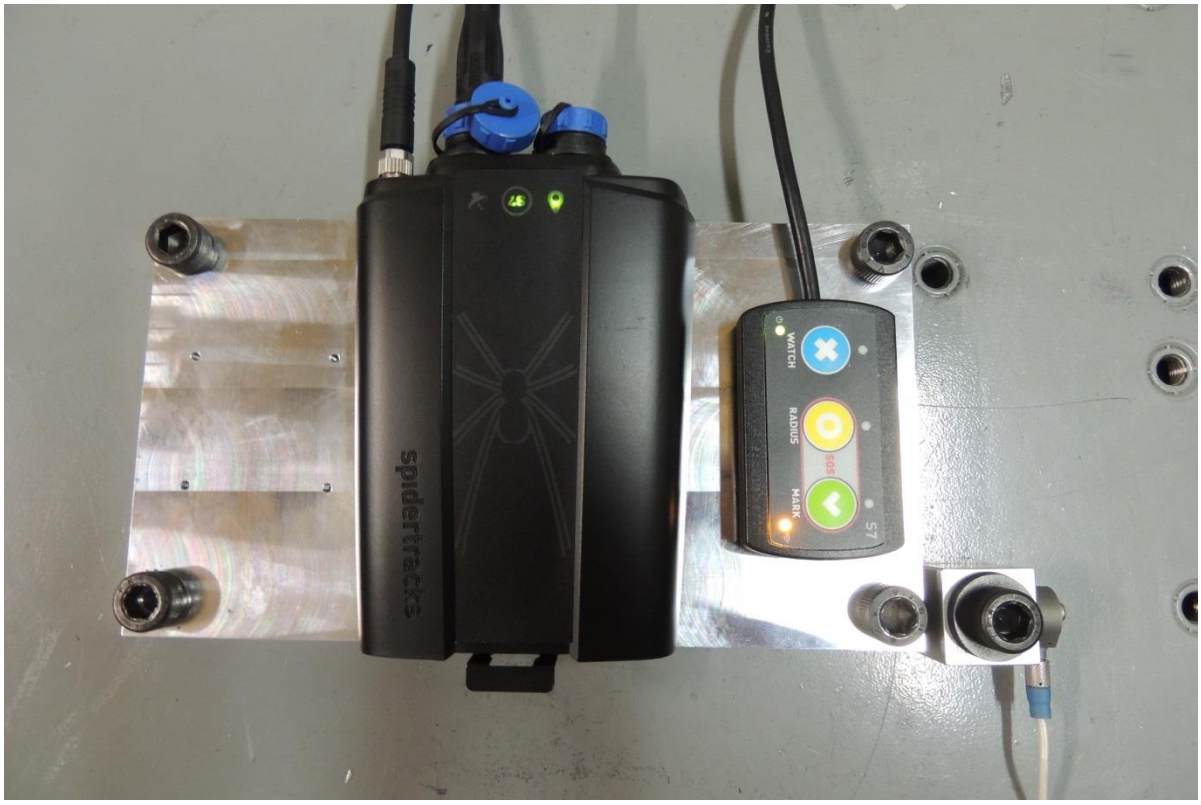


Figure 12: Side post test

A 9. **Vertical**

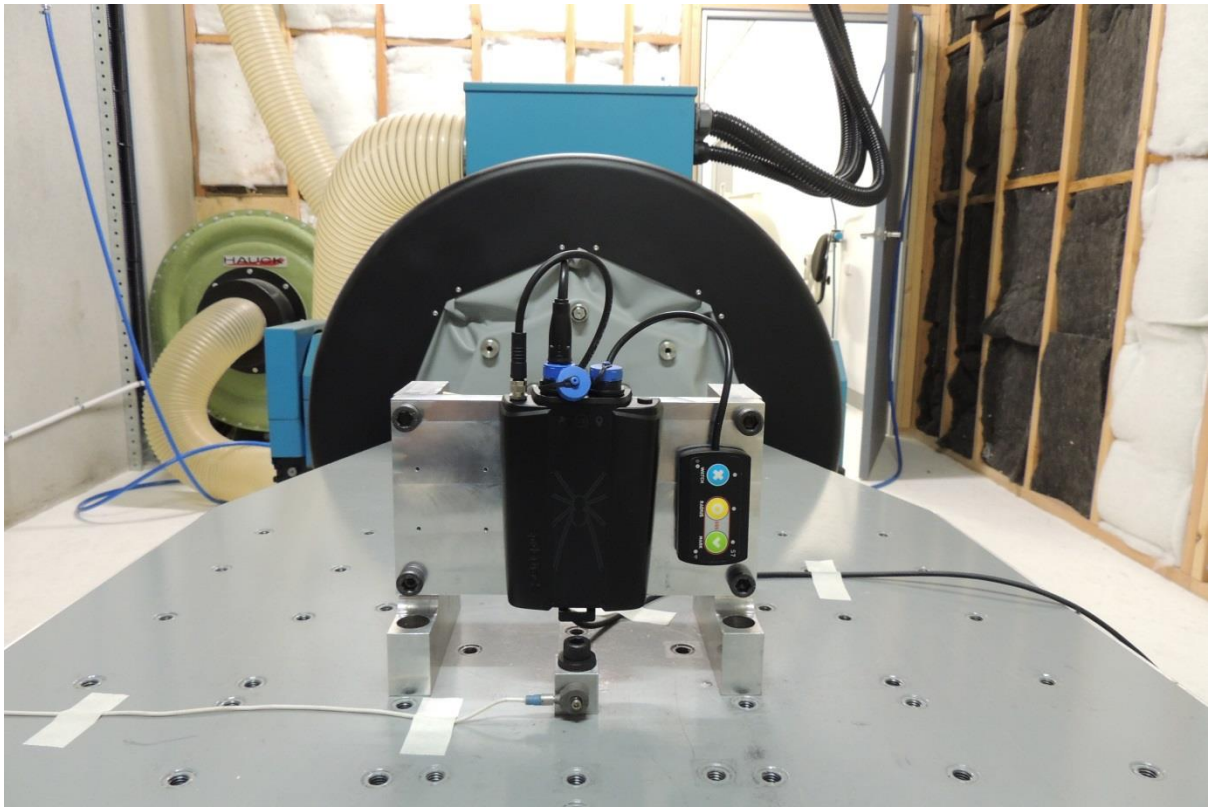


Figure 13: Unit mounting (vertical)

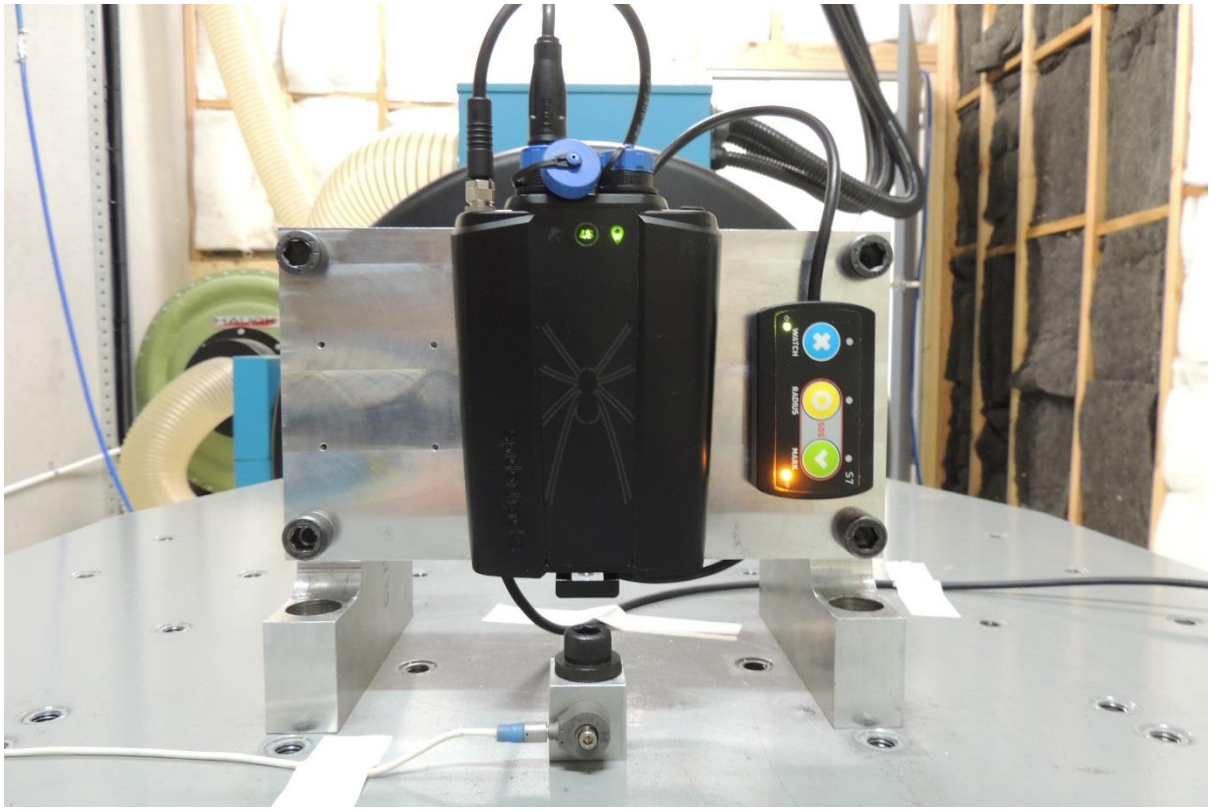


Figure 14: Vertical pre test

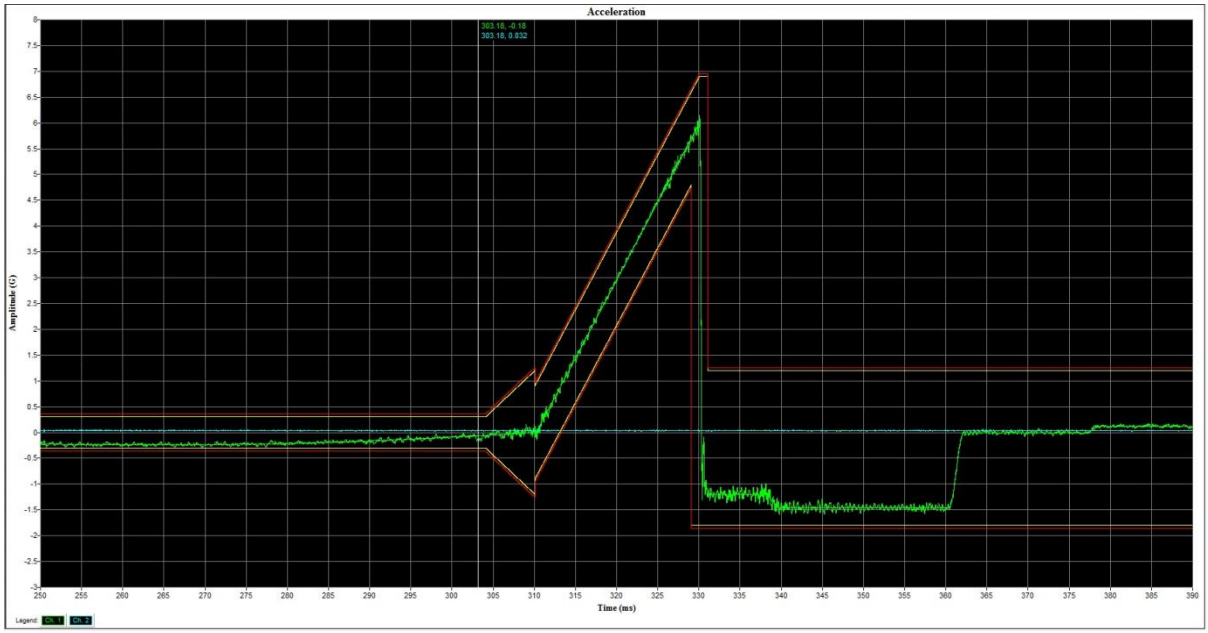


Figure 15: Vertical positive shock

Figure 16: Vertical negative shock

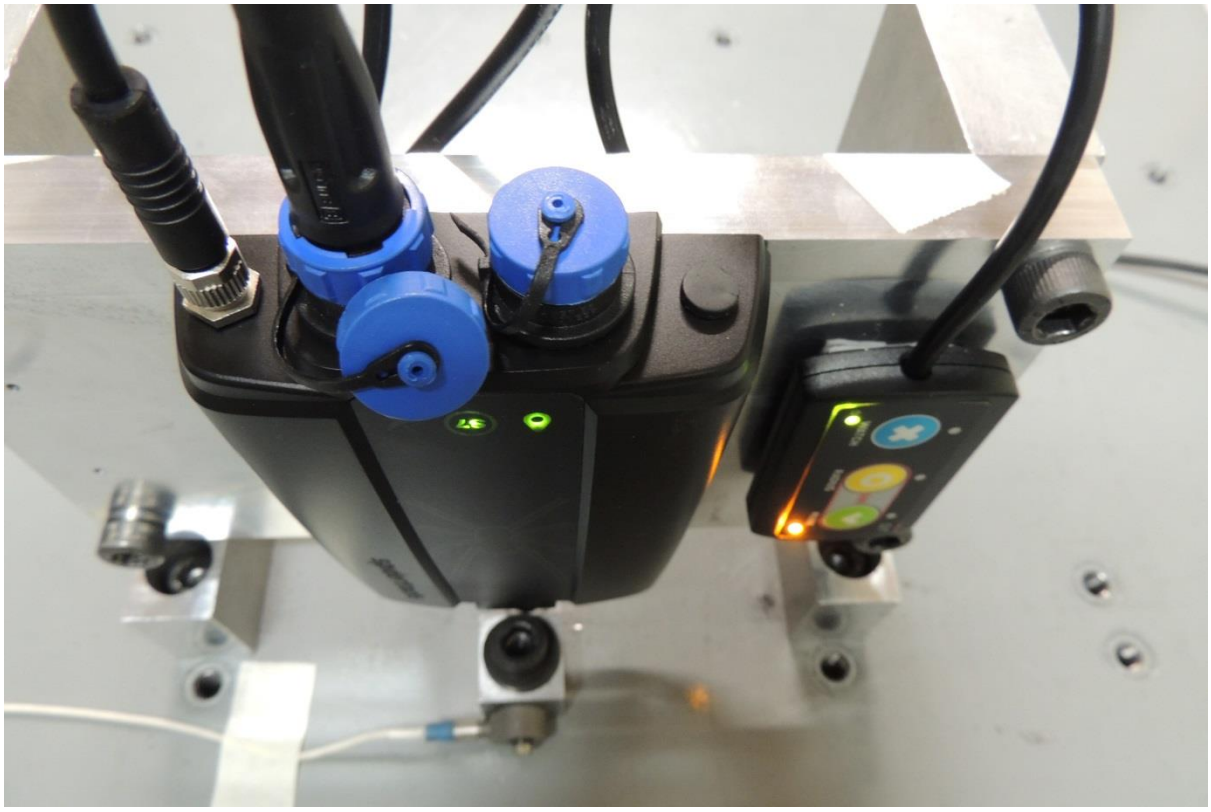


Figure 17: Vertical post test

The unit functioned as per specifications during the shocks.
The unit was visually inspected after the test. No defects were found.
The unit was then subjected to an ATP in accordance with Appendix E.

Figure 18: Acceptance test

A 10. **Qualification Test Report Form**

Qualification Test Report Form

1.0 Test Information

Test Performed:	36-0104 Issue C
Operational Test (circle):	Yes / No
Date (DD/MM/YYYY):	17/11/2015
Location:	FDS
Outside Contractor (if required):	SPIDERTRACKS
Test Supervisor:	ADRIAN SPITERI
Present Personnel:	
Ambient Temperature:	23 °C

2.0 Equipment Information

Test Item

P/N: SPIDERTRACKS S7 S/N: 2015BETA34

Golden Unit (if applicable)

P/N: N/A S/N: N/A

Equipment:

Name	Serial Number	Cal Date (DD/MM/YYYY)	Cal Expiry Date (DD/MM/YYYY)
Thermotron EDV Shaker	42586	12/02/2015	12/02/2016
Endevco Accelerometer	14578	08/12/2014	08/12/2015
Fluke 115C DMM	25601084	04/06/2015	04/06/2016

Form No: 21-0274
Issue:D

Qualification Test Report Form

3.0 Start Time

Date (DD/MM/YYYY):	17 / 11 /2015	Local Time:	13:50

4.0 Finish Time

Date (DD/MM/YYYY):	17 / 11 /2015	Local Time:	14:53

5.0 Notes

Fore positive	Start	13:50
	Finish	13:51
Fore negative	Start	13:59
	Finish	14:00
Side negative	Start	14:12
	Finish	14:13
Side positive	Start	14:16
	Finish	14:17
Vertical positive	Start	14:47
	Finish	14:48
Vertical negative	Start	14:50
	Finish	14:52

6.0 Signatures

Confirm that the Test Item passed as per test plan referenced above (Para 1.0), and that the appropriate test procedure was completed in full.

Test Result: FAIL/(PASS)

Test Engineer: A. SPITERI
Print/Sign

Signed:
Print/Sign

Date (DD/MM/YYYY): 17 / 11 /2015

Form No: 21-0274
Issue: D

Appendix B **IMPULSE SHOCK**

B 1. **Equipment Under Test (EUT)**

Part Number: Spider 7
Serial Number used: 2015BETA34

B 2. **Test House**

Flight Data Systems Pty Ltd

B 3. **Equipment Used**

See Qualification Test Report Form below.

B 4. **Test Method**

1.0 Review test cover sheet and ensure test type, test category and test level are specified before proceeding.

2.0 Begin filling out Qualification Test Report From 21-0274

3.0 Complete a visual inspection of the Test Item; record overall physical state of Test Item and any notable flaws/damage visible on the unit. Take profile pictures of unit as a visual record.

4.0 Ensure calibrated transducer is installed on Shaker prior to installation of Test Item.

5.0 Mount Test Item on test mount, then mount assembly to shaker via FDAIU shaker adaptor mounts as required. Ensure Test Item is placed securely on test mount before attaching to FDAIU mount and vibration tester to apply force in the 'fore' orientation as per cover sheet if defined there, otherwise base orientation on Figure 1 below. Take note of centre of gravity as per interface drawing for Test Item.

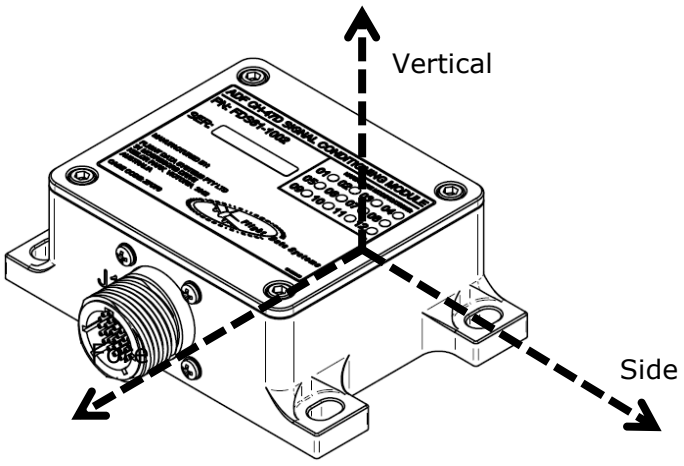


Figure 1 - Example of unit mounting

6.0 Configure the shaker to apply a shock with the profile below in Figure 2; configure the shock strength at 20gs with pulse duration as per test cover sheet.

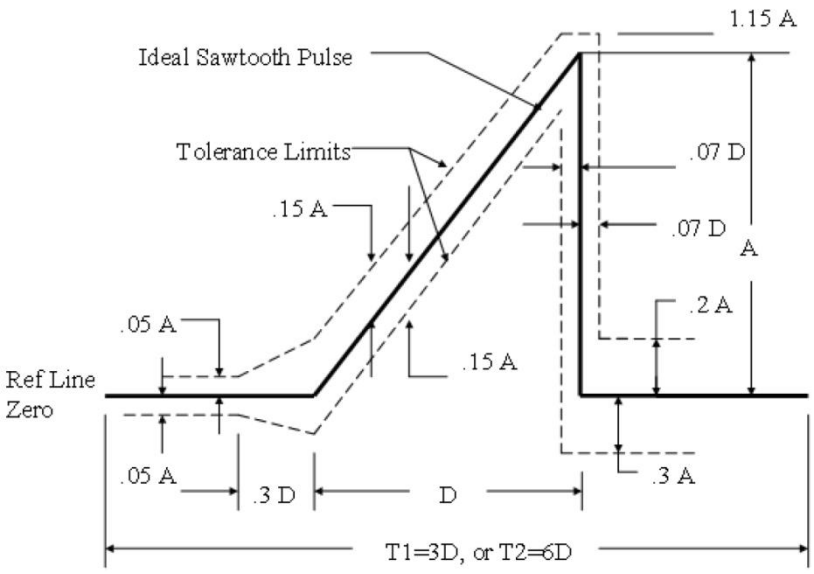


Figure 2 - Ideal Sawtooth Pulse; extracted from DO-160G document; Figure 7-2

D = Duration of Pulse

A = Peak Acceleration of nominal Pulse (20 gs)

T1 = Minimum time during which the pulse shall be monitored for shocks produced using a conventional shock testing machine

T2 = Minimum time during which the pulse shall be monitored for shocks produced using a vibration generator

7.0 Apply at least one shock confirmed to fit the above profile; take a record via the shakers control window.

8.0 Visually inspect the test item for evidence of physical damage. Ensure records (photos) of the entire device are taken.

9.0 Repeat steps 5.0 through 9.0 for all 6 orientations (up, down, fore, aft, left and right), applying a positive and negative shock is acceptable as long as the shaker can achieve shocks within the profile in both directions.

10.0 Ensure Test Item demonstrates no failure of the mounting attachment and not eject any components or dummy load (if applicable). Bending and distortion of the Test Item is acceptable.

B 5. **Qualification Test Cover Sheet**

Qualification Test Cover Sheet

Part Number:	Spidertracks S7	**Job Number:**	29615
Product name:	Spidertracks S7		
S/N of provided units:	2015BETA34		
Test Required:	DO160G - Section 7.3.1 Impulse Shock	**Operational Test:** (if required)	N/A
Test Plan:	36-0105 Issue A	**Acceptance Test:**	Attached printout (read notes)

Test Limits:

Category E (low frequency shocks) as per test plan 36-0105.

Notes:

Acceptance test instructions attached to document - from customer's email.

After completing form sign below; create a copy for R&D record keeping; attach original with test report and other test documents. **Do not modify after document signed.**

Authorized by: PAUL HIRONS

Signed: PHillirons Date: 18-11-2015

Operator: A.SPITERI Date: 18-11-2015

Document No: 21-0296
Issue: A

Pre and Post tests

1. Position the Spider with an unobstructed and full view of the sky (horizon to horizon)

2. Power the Spider using the auxiliary lead provided - ensure power supply is stable in the range of 10-28VDC and able to deliver 1.5A

3. After initial start-up sequence, which consists of the Spider's LED flashing several times and the keypad LEDs flashing 10sec. Afterwards, you should see a solid power LED on the unit (middle LED and bottom left on the keypad)

4. Within a 2-4 minute period the green GPS LED (left LED) on the unit should turn on and the satellite LED (right LED) should turn on shortly after. The bottom right LED on the Keypad should turn orange and then green shortly after. The GPS LED and the orange LED on the keypad indicate GPS lock has been achieved. The satellite LED on the unit and green LED on the keypad indicate that the first position report has been sent through Iridium.

5. Please run through these steps before and after testing.

Performance (during) Tests

1. Power the Spider using the auxiliary lead provided - ensure power supply is stable in the range of 10-28VDC and able to deliver 1.5A, ensure power supply is not interrupted during test.

2. After initial start-up sequence, which consists of the Spider's LED flashing several times and the keypad LEDs flashing 10sec. Afterwards, you should see a solid power LED on the unit (middle LED and bottom left on the keypad)

3. Within a 2-4 minute period the green GPS LED (left LED) on the unit should turn on, the bottom right LED on the Keypad should turn orange. The GPS LED and the orange LED on the keypad indicate GPS lock has been achieved.

4. Run during environmental test.

B 6. **Setup**

Cables were connected to the unit but no power applied.

B 7. **Vertical**

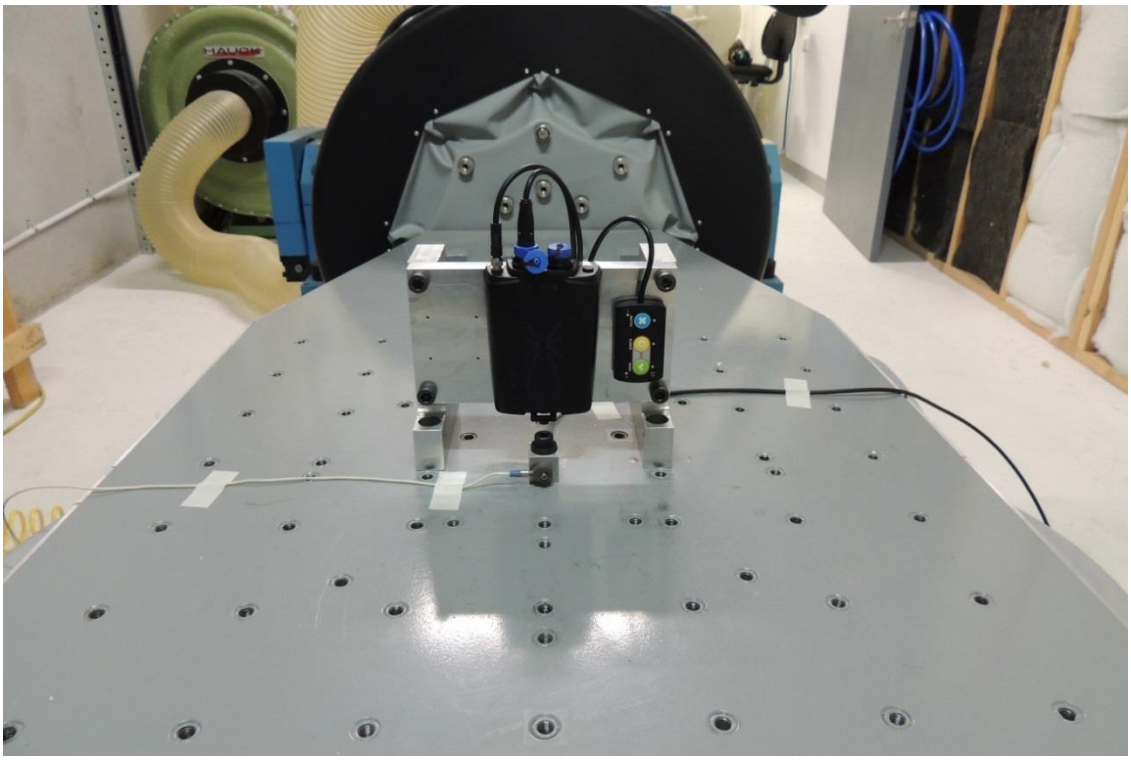


Figure 19: Unit mounting (Vertical)

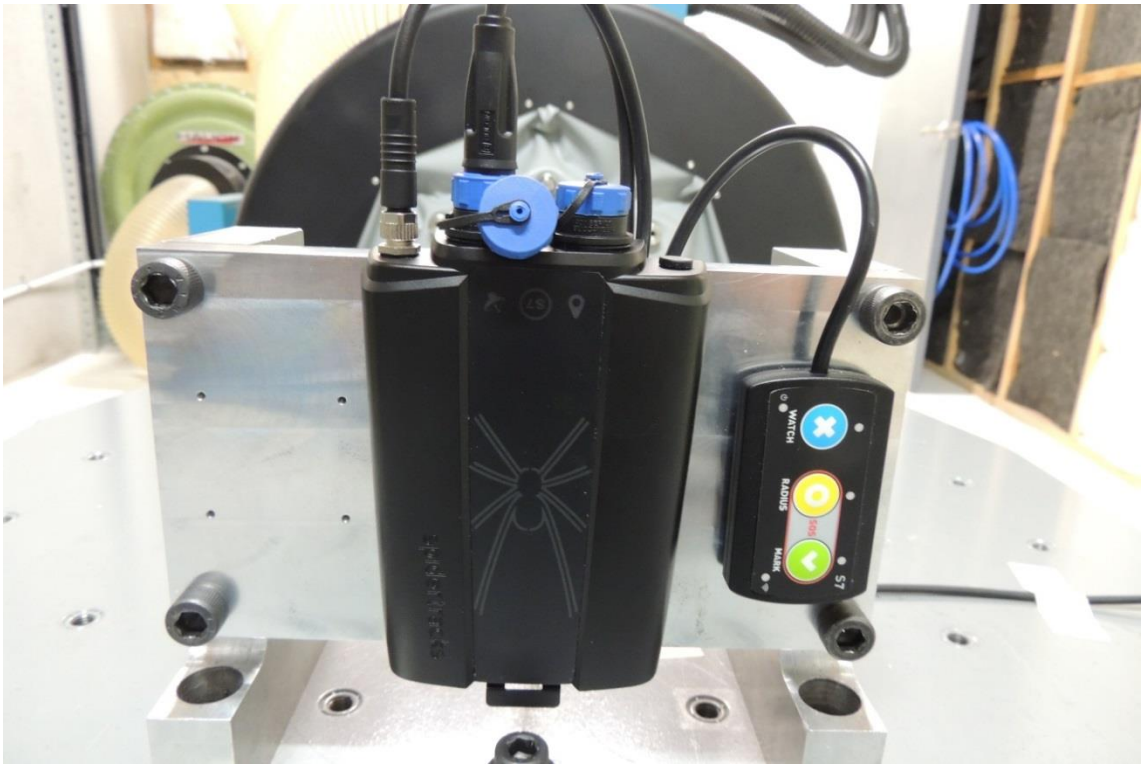


Figure 20: Vertical pre test

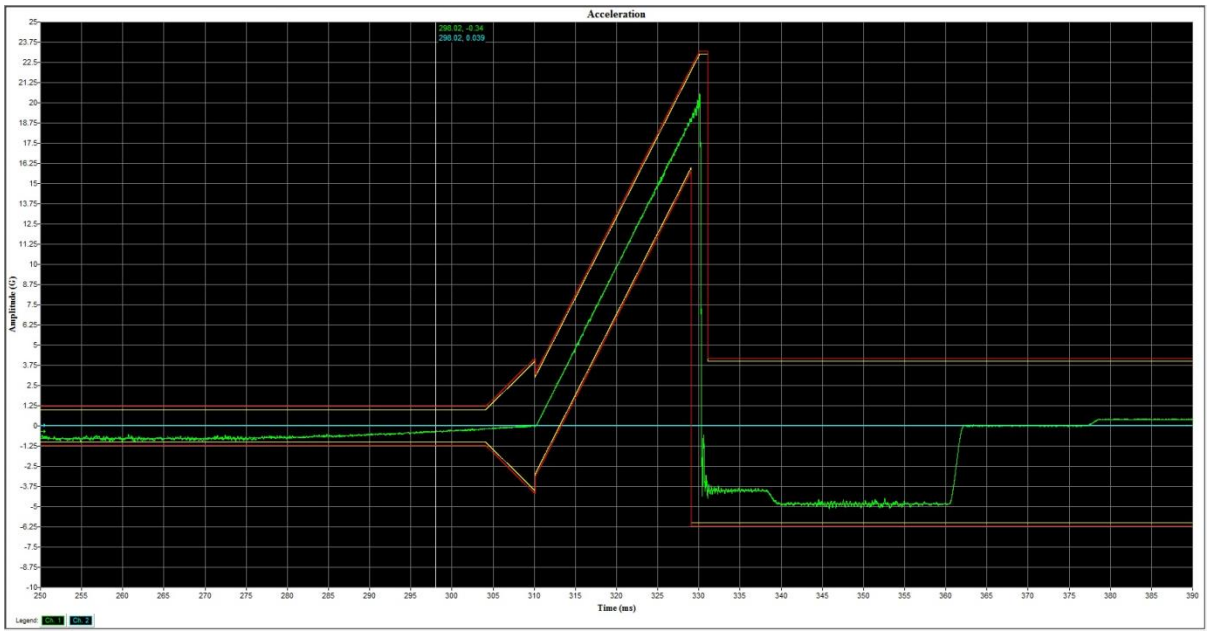


Figure 21: Vertical positive shock

Figure 22: Vertical negative shock

Figure 23: Vertical post test

B 8. **Fore**

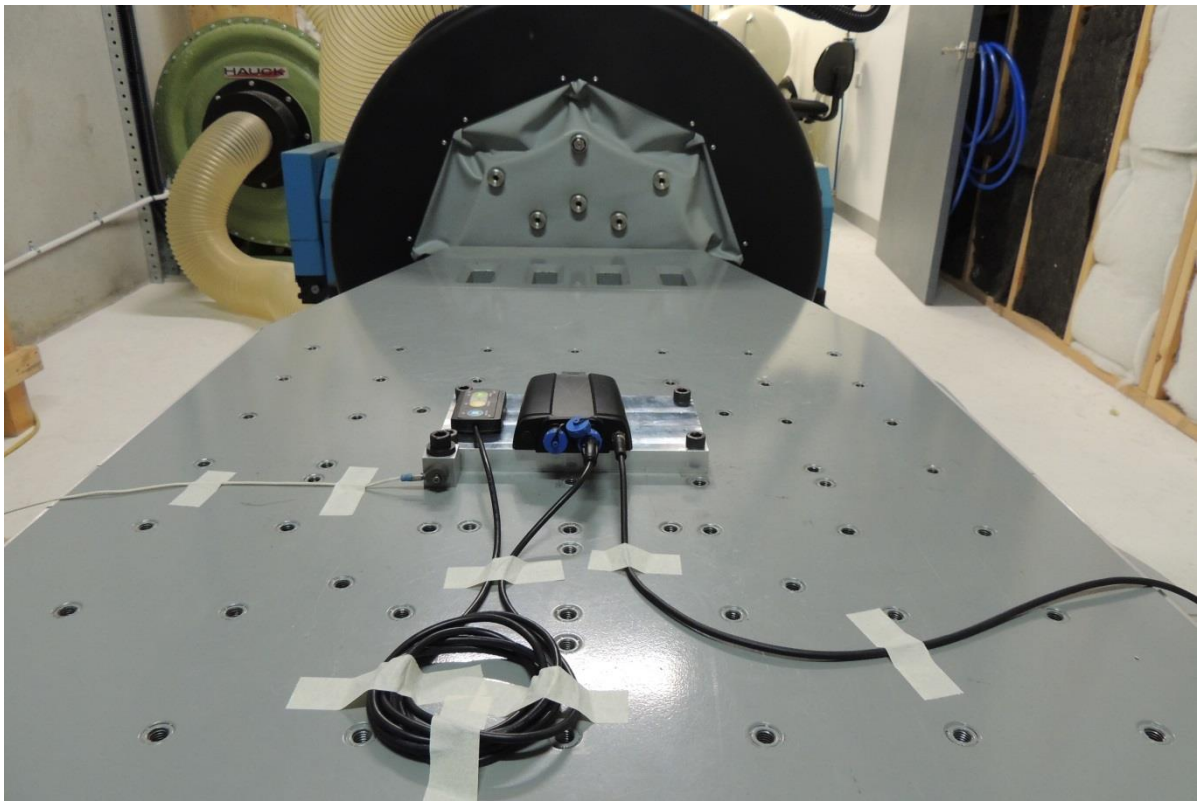


Figure 24: Unit mounting (Fore)

Figure 25: Fore pre test

Figure 26: Fore negative shock

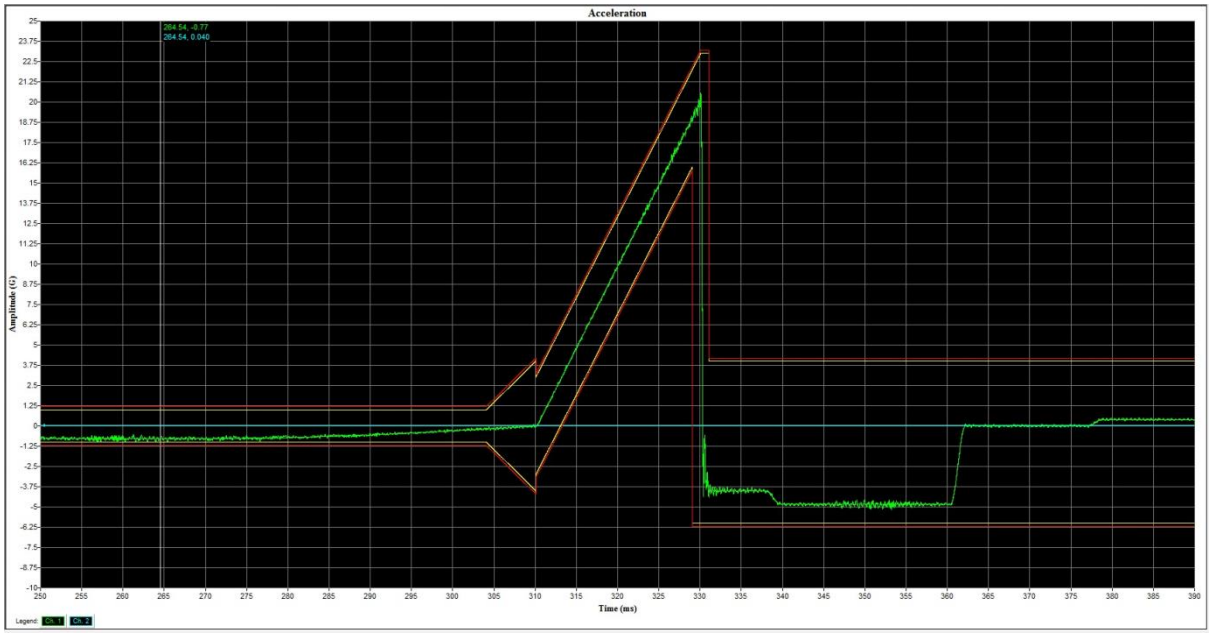


Figure 27: Fore positive shock

Figure 28: Fore post test

B 9. **Side**

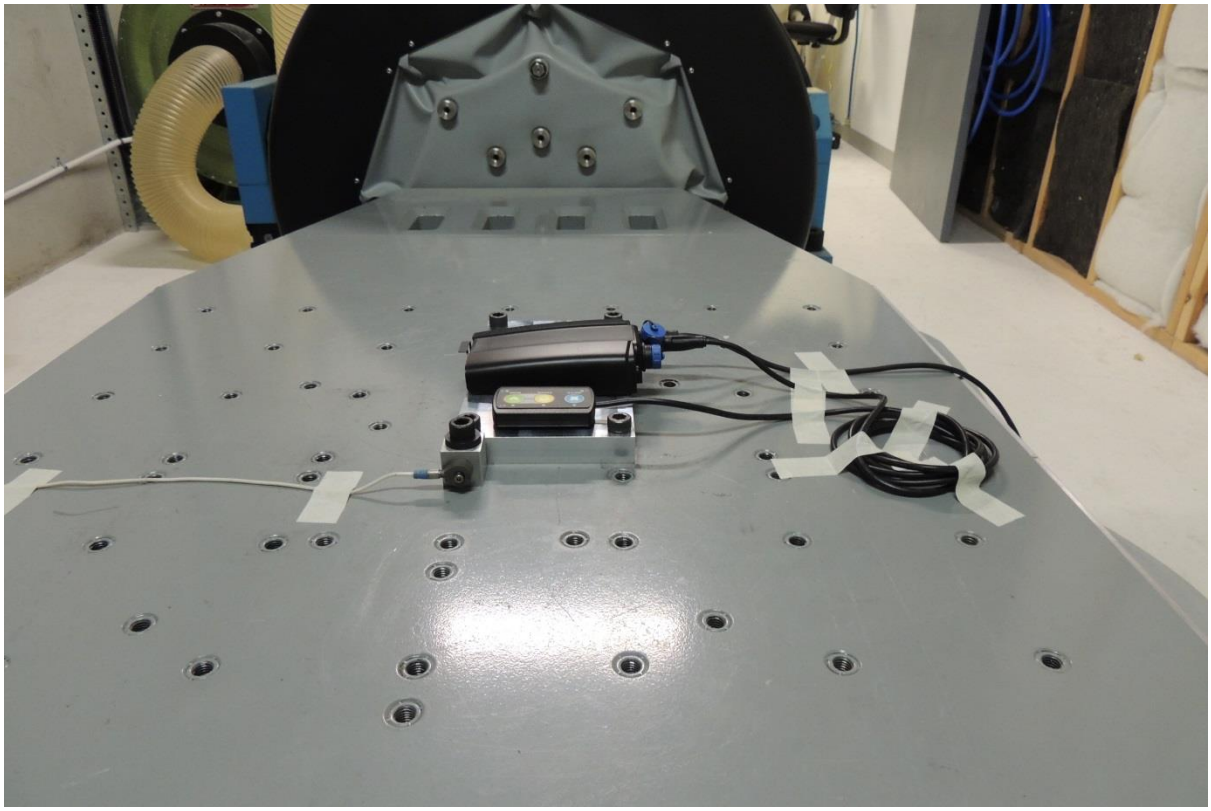


Figure 29: Unit mounting (side)

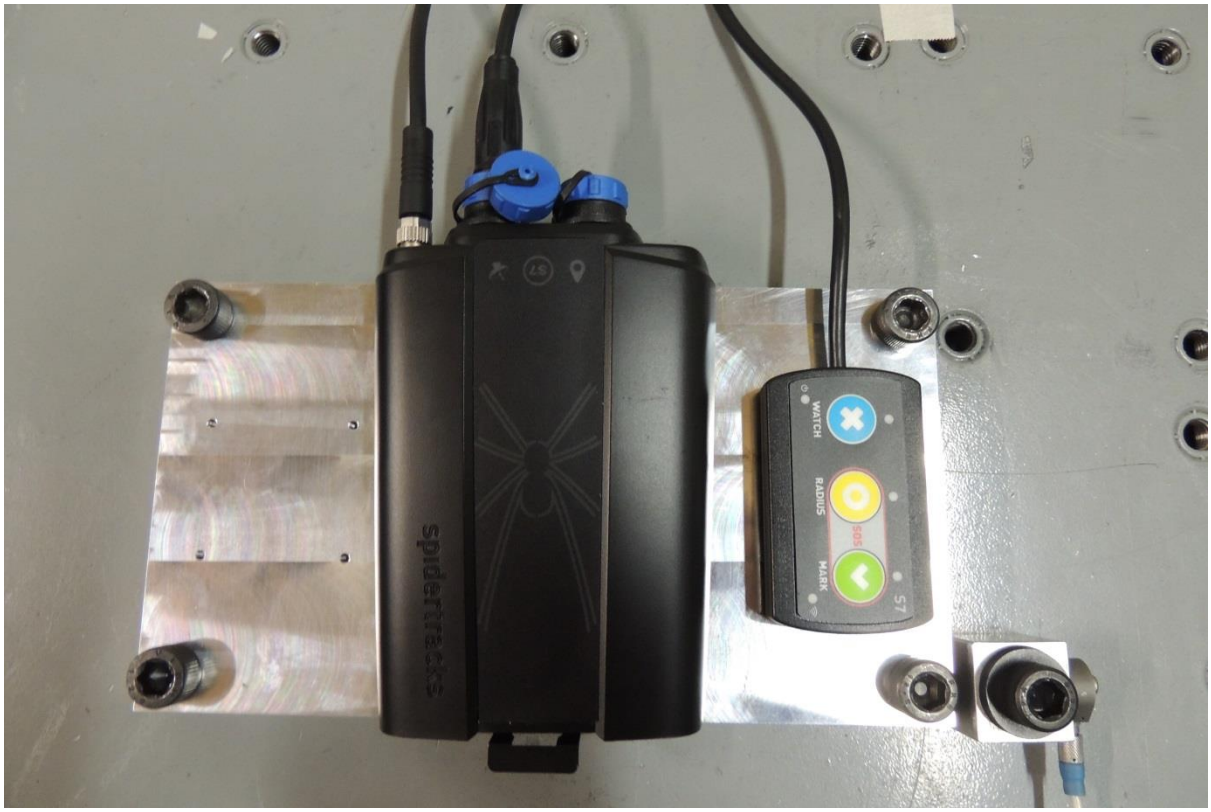


Figure 30: Side pre test

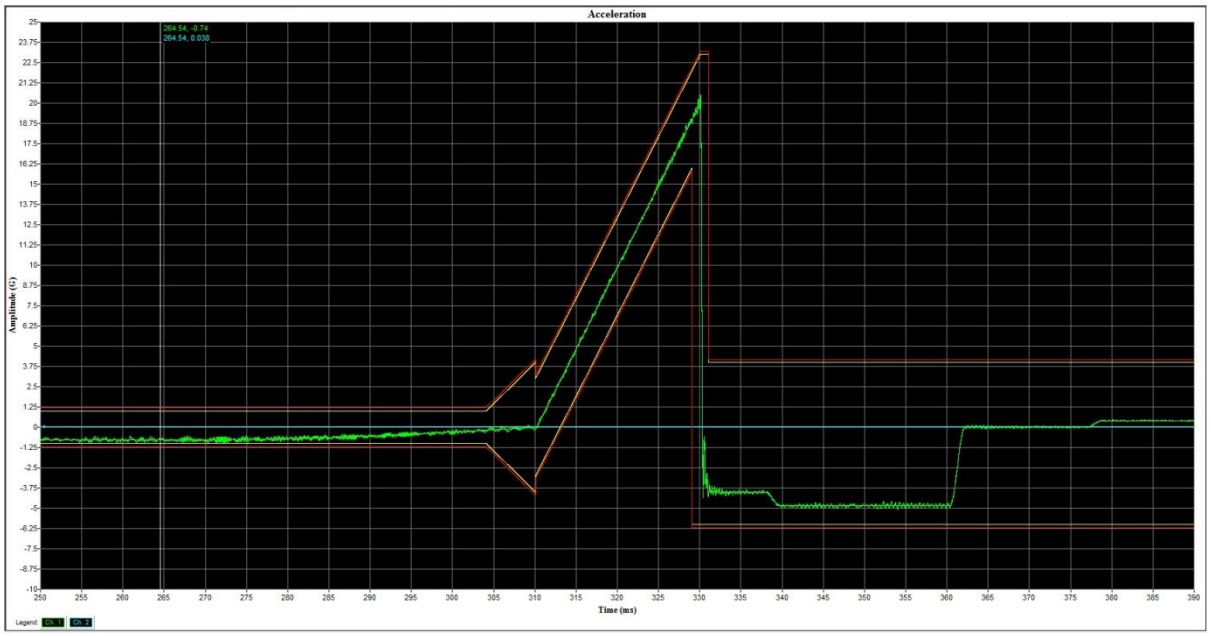


Figure 31: Side positive shock

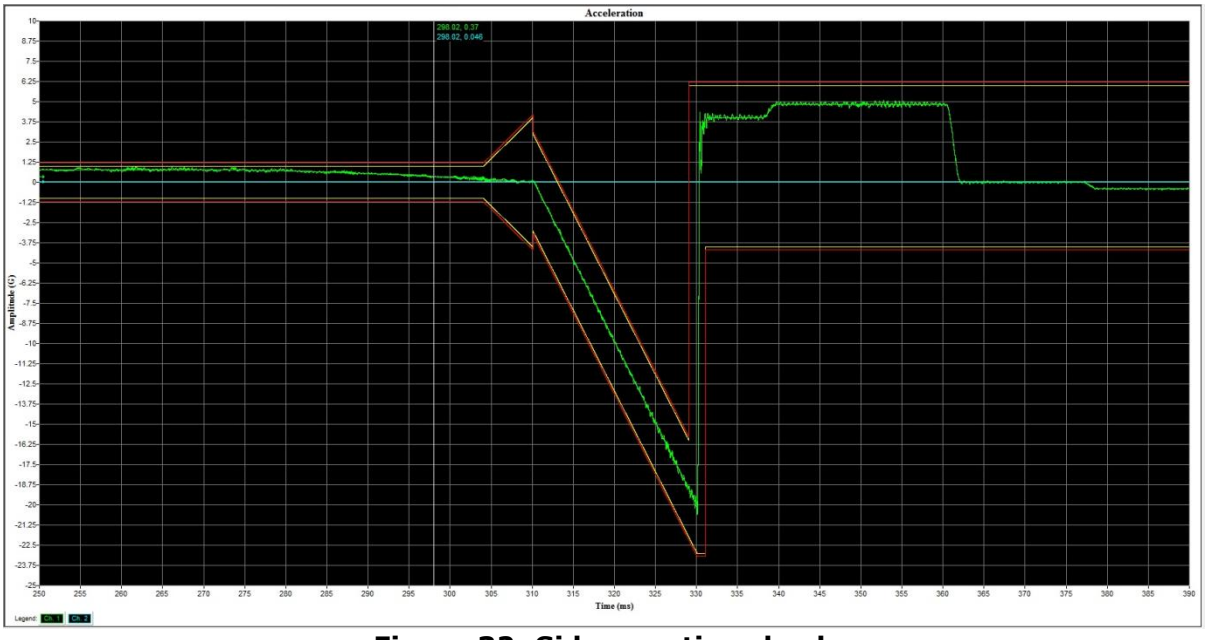


Figure 32: Side negative shock

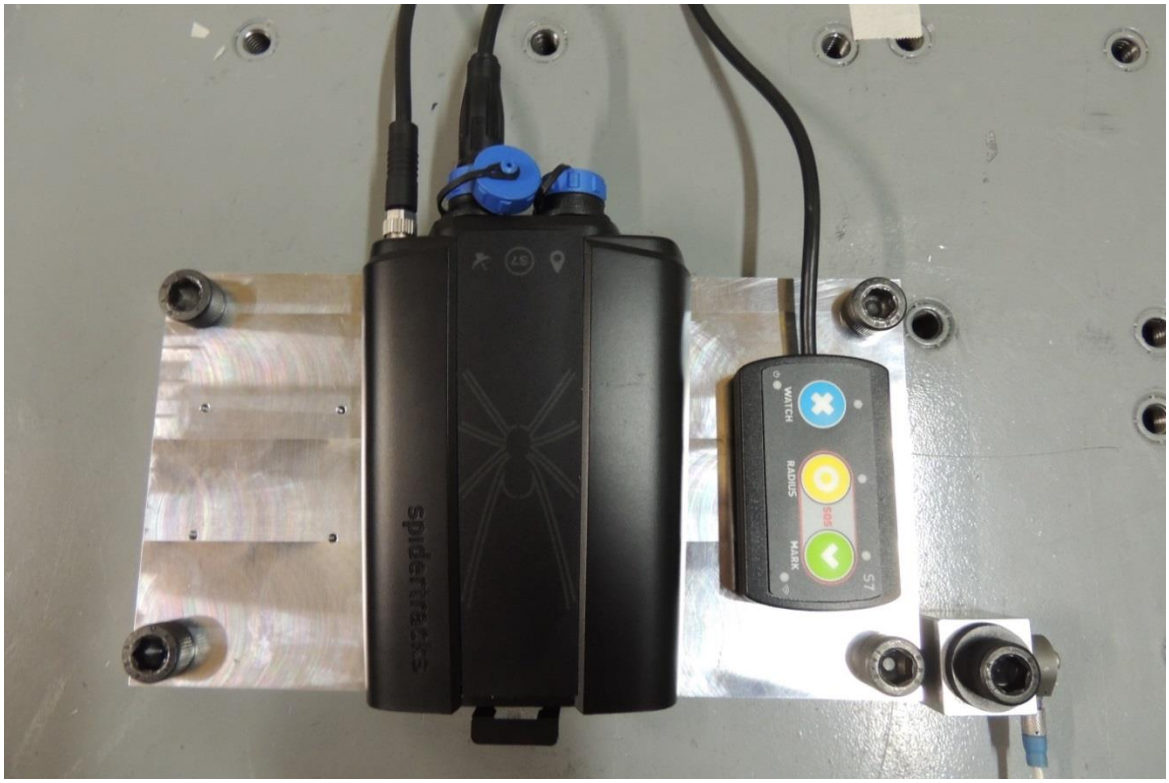


Figure 33: Side post test

The unit was visually inspected after the test. No defects were found.
The unit was then subjected to an ATP in accordance with Appendix E.

Figure 34: Acceptance test

B 10. **Qualification Test Report Form**

Qualification Test Report Form

1.0 Test Information

Test Performed:	36-0105 Issue A
Operational Test (circle):	Yes / (No)
Date (DD/MM/YYYY):	18/11/2015
Location:	FDS
Outside Contractor (if required):	SPIDERTRACKS
Test Supervisor:	ADRIAN SPITERI
Present Personnel:	
Ambient Temperature:	22.1 °C

2.0 Equipment Information

Test Item

P/N: SPIDERTRACKS S7 S/N: 2015BETA34

Golden Unit (if applicable)

P/N: N/A S/N: N/A

Equipment:

Name	Serial Number	Cal Date (DD/MM/YYYY)	Cal Expiry Date (DD/MM/YYYY)
Thermotron EDV Shaker	42586	12/02/2015	12/02/2016
Endevco Accelerometer	14578	08/12/2014	08/12/2015

Form No: 21-0274
Issue:D

Qualification Test Report Form

3.0 Start Time

Date (DD/MM/YYYY):	18 / 11 /2015	Local Time:	08:51

4.0 Finish Time

Date (DD/MM/YYYY):	18 / 11 /2015	Local Time:	10:35

5.0 Notes

Vertical positive	Start	08:51
	Finish	08:53
Vertical negative	Start	09:01
	Finish	09:02
Side negative	Start	09:11
	Finish	09:12
Side positive	Start	10:21
	Finish	10:22
Fore positive	Start	10:30
	Finish	10:32
Fore negative	Start	10:34
	Finish	10:35

6.0 Signatures

Confirm that the Test Item passed as per test plan referenced above (Para 1.0), and that the appropriate test procedure was completed in full.

Test Result: FAIL/PASS

Test Engineer: A. SPITZER
Print/Sign

Signed:
Print/Sign

Date (DD/MM/YYYY): 18 / 11 /2015

Form No: 21-0274
Issue: D

Appendix C **VIBRATION**

C 1. **Equipment Under Test (EUT)**

Part Number: Spider 7

Serial Number used: 2015BETA34

C 2. **Test House**

Flight Data Systems Pty Ltd

C 3. **Equipment Used**

See Qualification Test Report Form below.

C 4. **Test Method**

The sinusoidal frequencies shall be varied at a logarithmic sweep rate not exceeding 1 Oct/min from fn*(0.9) to fn*(1.1) (where fn are the sinusoidal frequencies of the test spectrum).

a. With the equipment not operating, perform a 0.5 g-PK sinusoidal scan from 10 Hz to 2000Hz at a sweep rate not exceeding 1.0 octave/minute. Record plots of response accelerometers to determine resonant frequencies and amplification factors. Resonant frequencies are defined as response peaks that are greater than twice the input acceleration amplitude.

b. With the equipment operating, apply the appropriate performance test level curve for a minimum of 10 minutes and monitor the operation of the test item during vibration.

c. With the equipment operating, apply the appropriate endurance test level curve for a minimum of 2 hours.

d. After completion of step c, reapply the appropriate performance test level curve for a minimum of 10 minutes and monitor the operation of the test item during vibration.

e. Power down the test item and repeat the sinusoidal scan from step a. Any changes in vibration resonant frequencies shall be noted.

f. At the completion of the tests, the equipment shall be inspected and shall show no evidence of structural failure.

g. Perform an ATP on the test item.

h. Repeat steps a to g in each of the equipment's three orthogonal axes.

C 5. **Calculating test levels**

Based on information provided by the customer:

- Helicopter with known rotor frequencies
- EUT would be installed on the instrument panel, console or equipment rack

We can determine that robust vibration Category R (known rotor frequencies) and Zone/Test Curve G (instrument panel, console and equipment rack) is the most appropriate approach as per the standard.

Customer information:
Main rotor (NM) is 395 RPM and number of blades on main rotor (FM) is 4.

From the above, we can determine the test frequencies and test levels as per Table 8-2a & Table 8-2b from the standard.

The calculated test frequencies for test curve G are shown below:

$F_1 = (in\ Hz) \times FM = (395 \div 60) \times 4 = 26.33\ Hz$
$F_2 = 2 \times NM \times FM = F1 \times 2 = 52.66\ Hz$

The calculated test levels for test curve G are shown below:

	Test levels g-PK	
Test Frequency	**Performance**	**Endurance**
26.33Hz (F_1)	1.0532	2.5
52.66Hz (F_2)	1.6	2.5
PSD	**Random curve level g²/Hz**	
W_0	0.01	0.02

Table 2: Test frequencies and levels

For test profile, refer to figure 8-6 from the standard.
The test profile programmed on the Thermotron shaker control unit is set to 'sine on random' and the test frequencies F_1 and F_2 are programmed to vary, as per the standard, from Fn × 0.9 to Fn × 1.1.

C 6. **Qualification Test Cover Sheet**

Qualification Test Cover Sheet

Part Number: Spidertracks S7 **Job Number:** 29615

Product name: Spidertracks S7

S/N of provided units: 2015BETA34

Test Required: DO160G - Section 8.8.1 Operational Vibration - Helicopters; Known Frequencies **Operational Test:** (if required) Attached printout (read notes)

Test Plan: As per DO160G standard **Acceptance Test:** Attached printout (read notes)

Test Limits:

Calculated test levels based on the following customer information:
Robust test for Helicopters; known frequencies.
Main Rotor Frequency: 395 RPM.
Number of blades on main rotor: 4.
Installation area: Instrument panel => Test Category G.

Levels described below:
Performance test levels;
F1 = 26.33Hz; 1.053G
F2 = 52.67Hz; 1.600G
Random vibration level: 0.01 g²/Hz (2.75 Grms)

Endurance test levels;
F1 = 26.33Hz; 2.500G
F2 = 52.67Hz; 2.500G
Random vibration level: 0.02 g²/Hz (3.89 Grms)

Notes:

Operational and acceptance test instructions attached to document - from customer's email.

After completing form sign below; create a copy for R&D record keeping; attach original with test report and other test documents. **Do not modify after document signed.**

Authorized by: PAUL HIRONS

Signed: PHirons Date: 18-11-2015.

Operator: A.SATERI Date: 18-11-2015

Document No: 21-0296
Issue: A

Pre and Post tests

1. Position the Spider with an unobstructed and full view of the sky (horizon to horizon)

2. Power the Spider using the auxiliary lead provided - ensure power supply is stable in the range of 10-28VDC and able to deliver 1.5A

3. After initial start-up sequence, which consists of the Spider's LED flashing several times and the keypad LEDs flashing 10sec. Afterwards, you should see a solid power LED on the unit (middle LED and bottom left on the keypad)

4. Within a 2-4 minute period the green GPS LED (left LED) on the unit should turn on and the satellite LED (right LED) should turn on shortly after. The bottom right LED on the Keypad should turn orange and then green shortly after. The GPS LED and the orange LED on the keypad indicate GPS lock has been achieved. The satellite LED on the unit and green LED on the keypad indicate that the first position report has been sent through Iridium.

5. Please run through these steps before and after testing.

Performance (during) Tests

1. Power the Spider using the auxiliary lead provided - ensure power supply is stable in the range of 10-28VDC and able to deliver 1.5A, ensure power supply is not interrupted during test.

2. After initial start-up sequence, which consists of the Spider's LED flashing several times and the keypad LEDs flashing 10sec. Afterwards, you should see a solid power LED on the unit (middle LED and bottom left on the keypad)

3. Within a 2-4 minute period the green GPS LED (left LED) on the unit should turn on, the bottom right LED on the Keypad should turn orange. The GPS LED and the orange LED on the keypad indicate GPS lock has been achieved.

4. Run during environmental test.

C 7. **Setup**

EUT was powered with an input voltage of 15V and GPS locked during the performance and the endurance tests as per operational test in Appendix E.

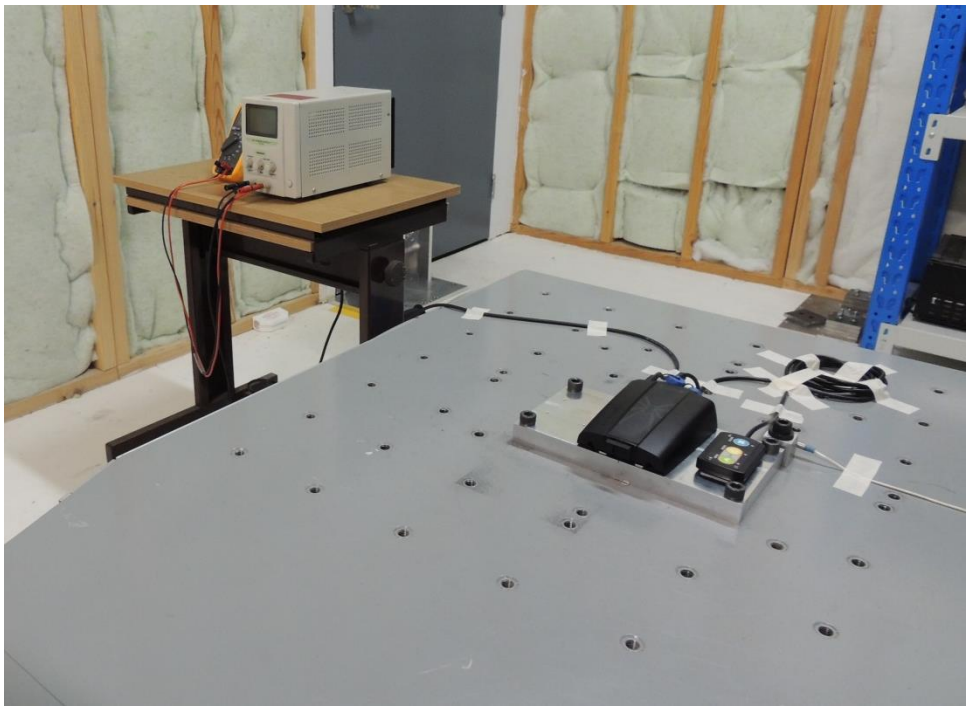


Figure 35: Vibration test setup

C 8. **Fore**

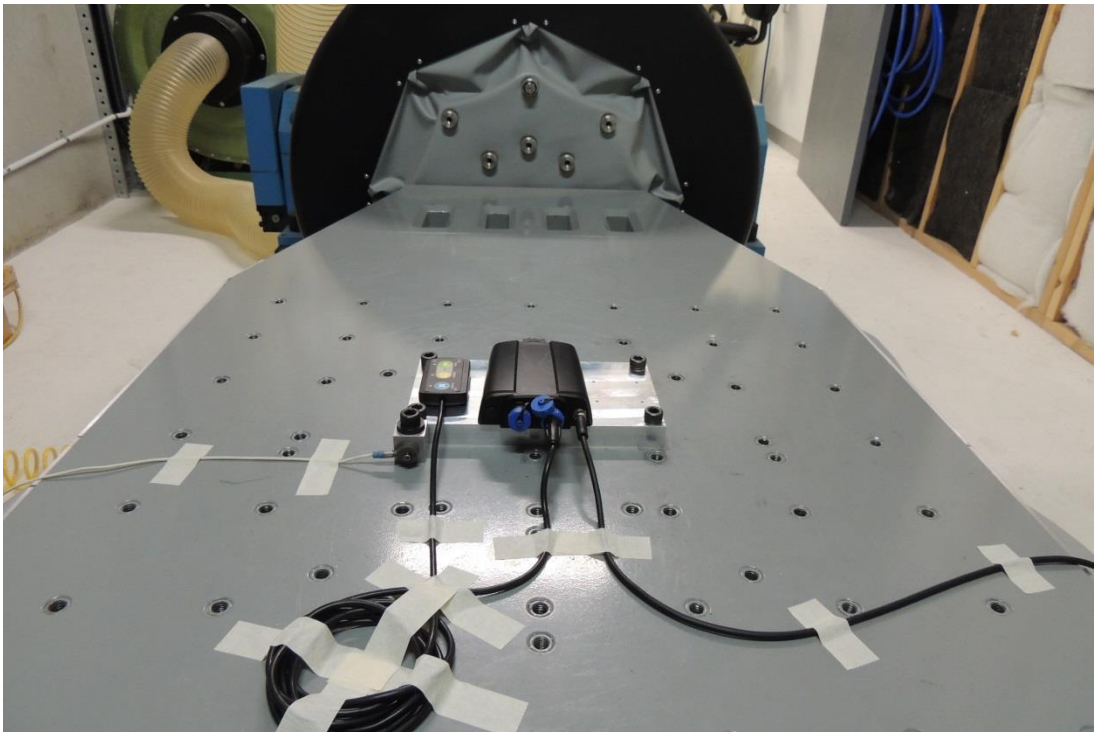


Figure 36: Unit mounting (Fore)

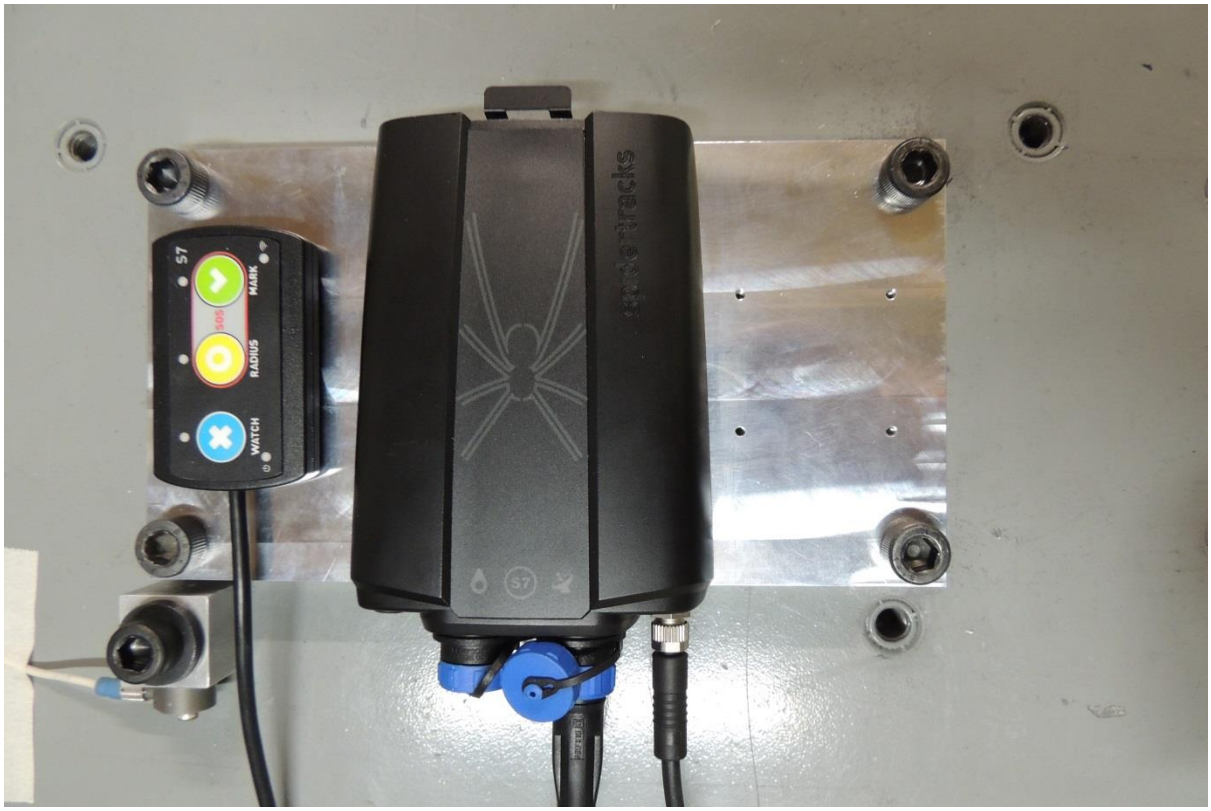


Figure 37: Fore vibration pre test

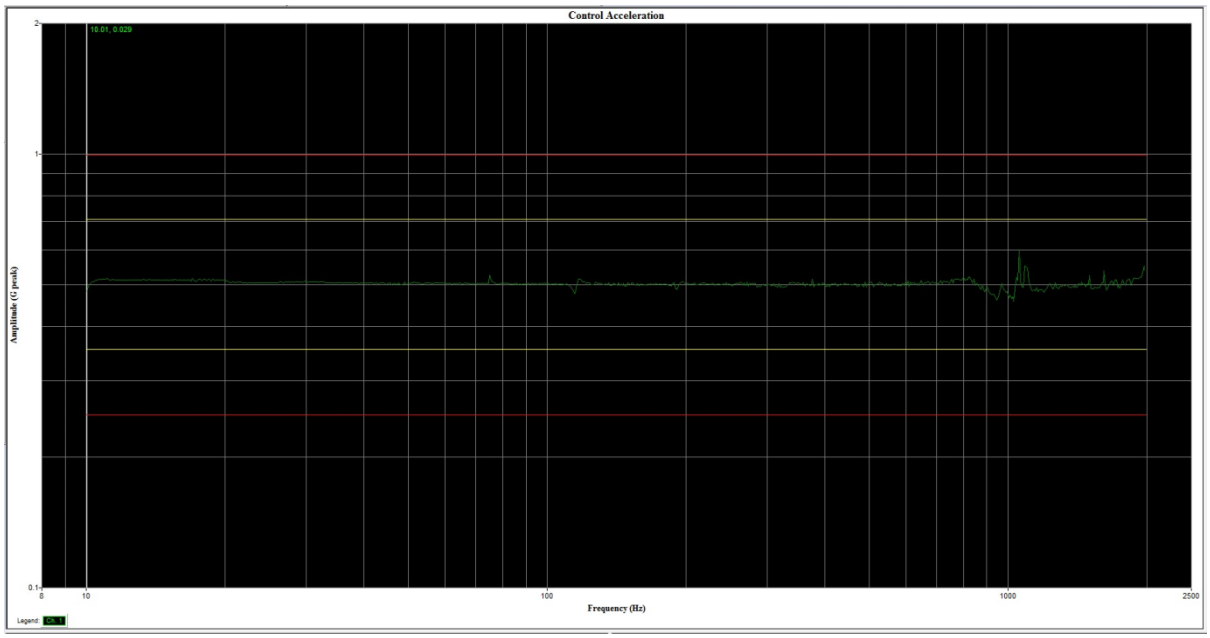


Figure 38: Fore sweep 1

Figure 39: Fore pre vibration test curves

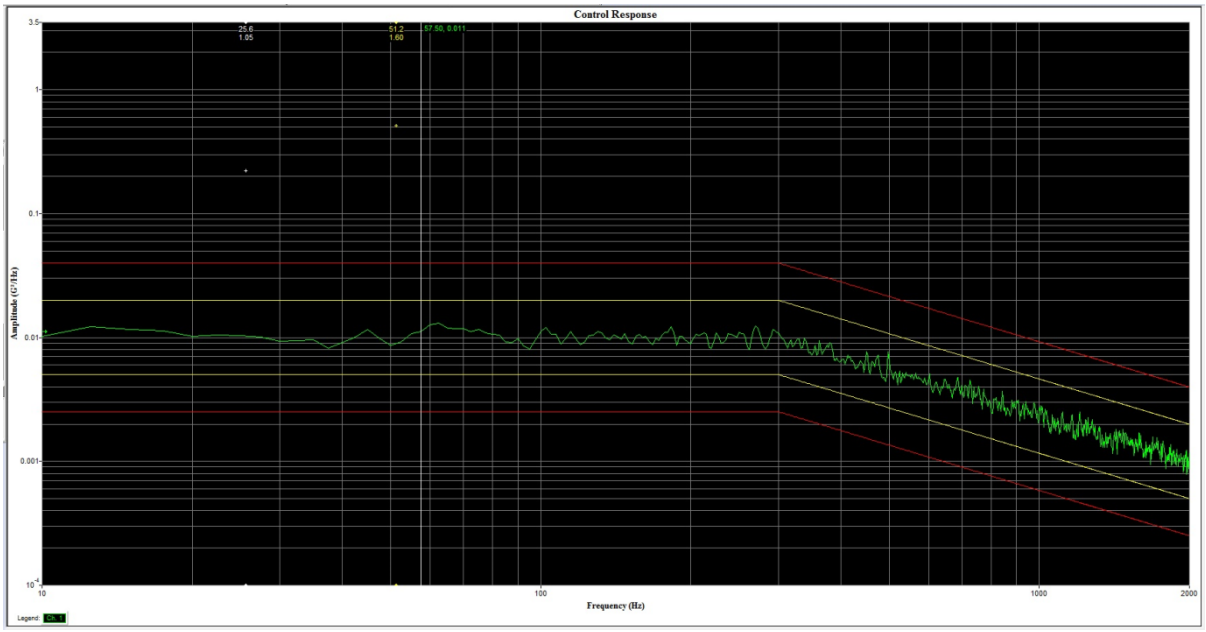


Figure 40: Fore performance 1 control

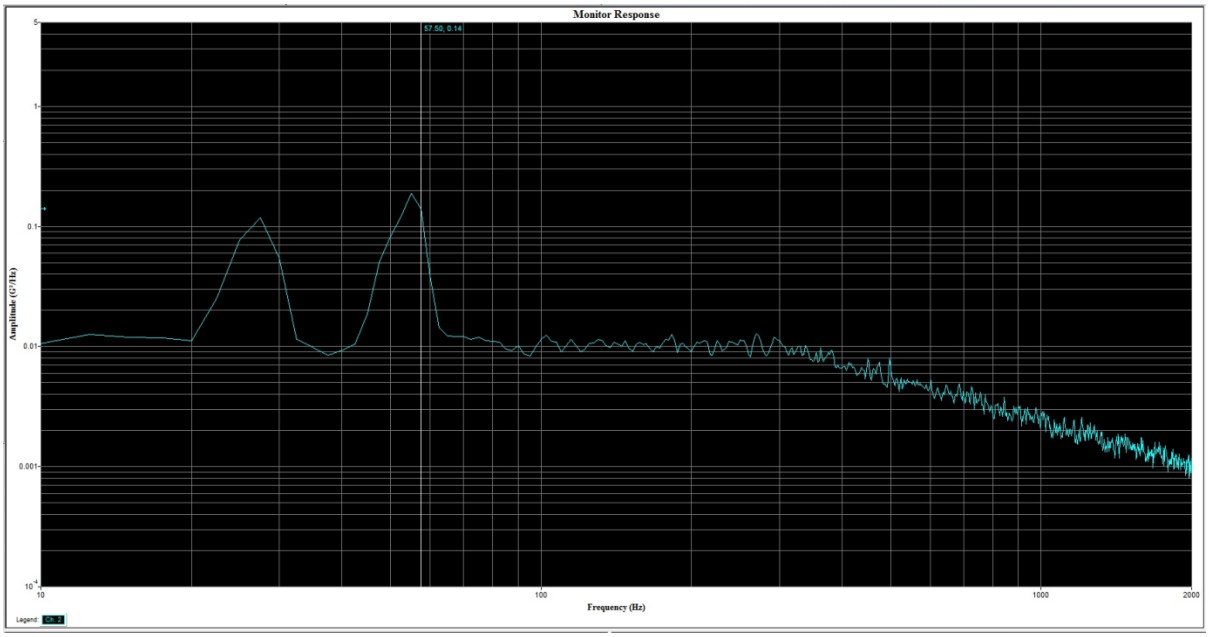


Figure 41: Fore performance 1 monitor

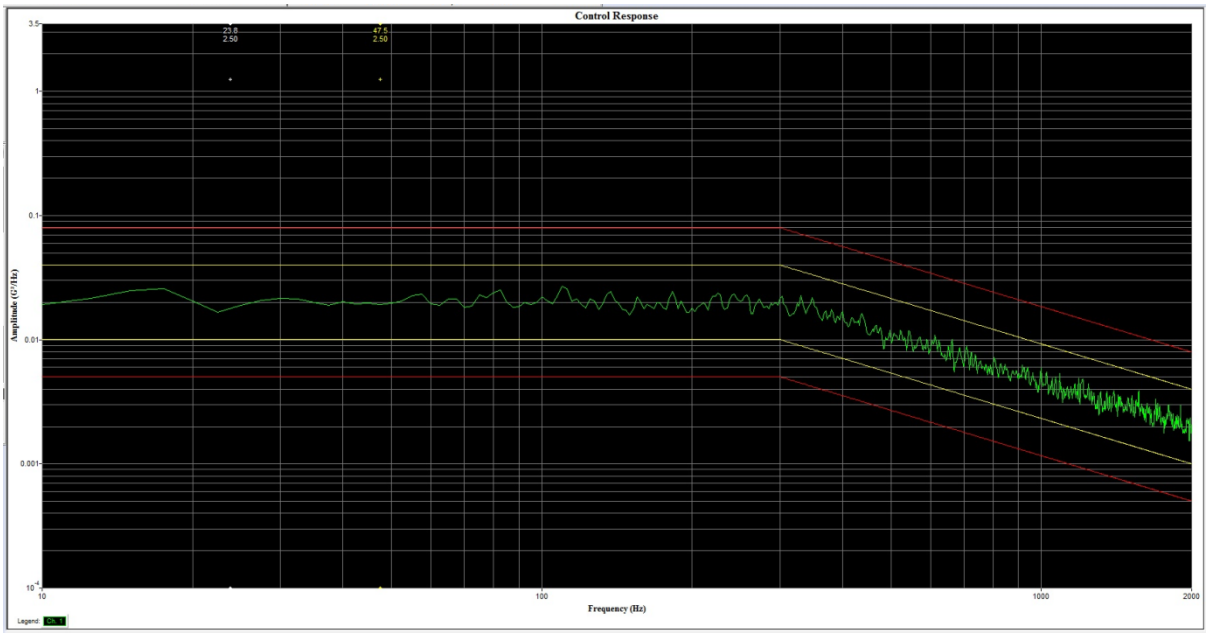


Figure 42: Fore endurance control

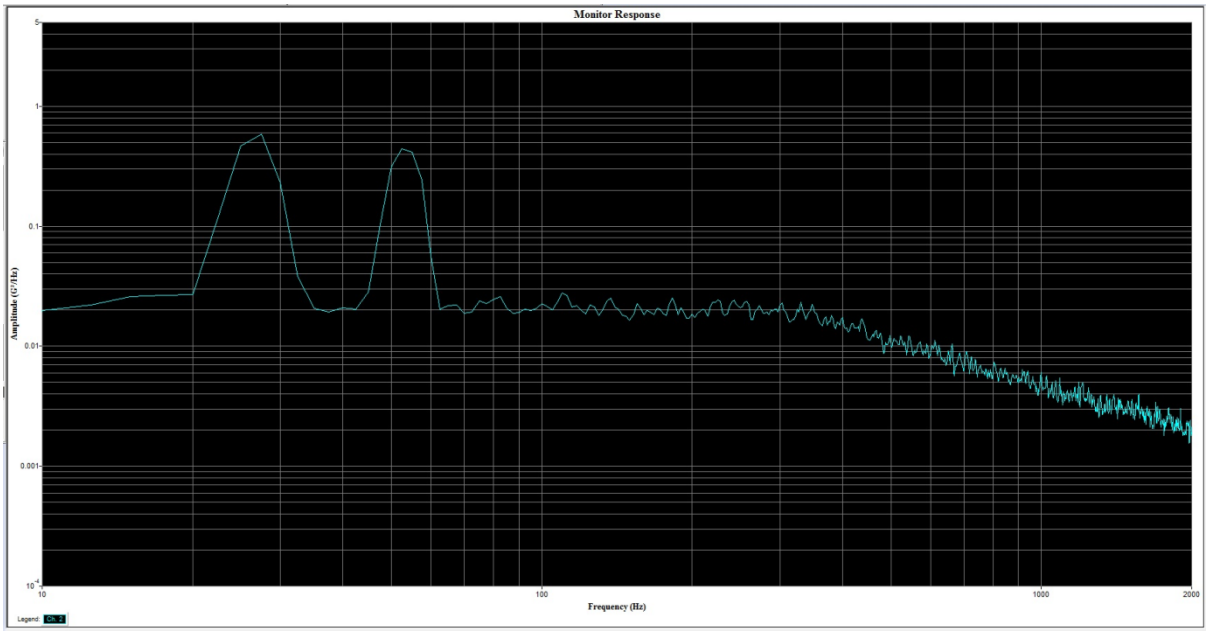


Figure 43: Fore endurance monitor

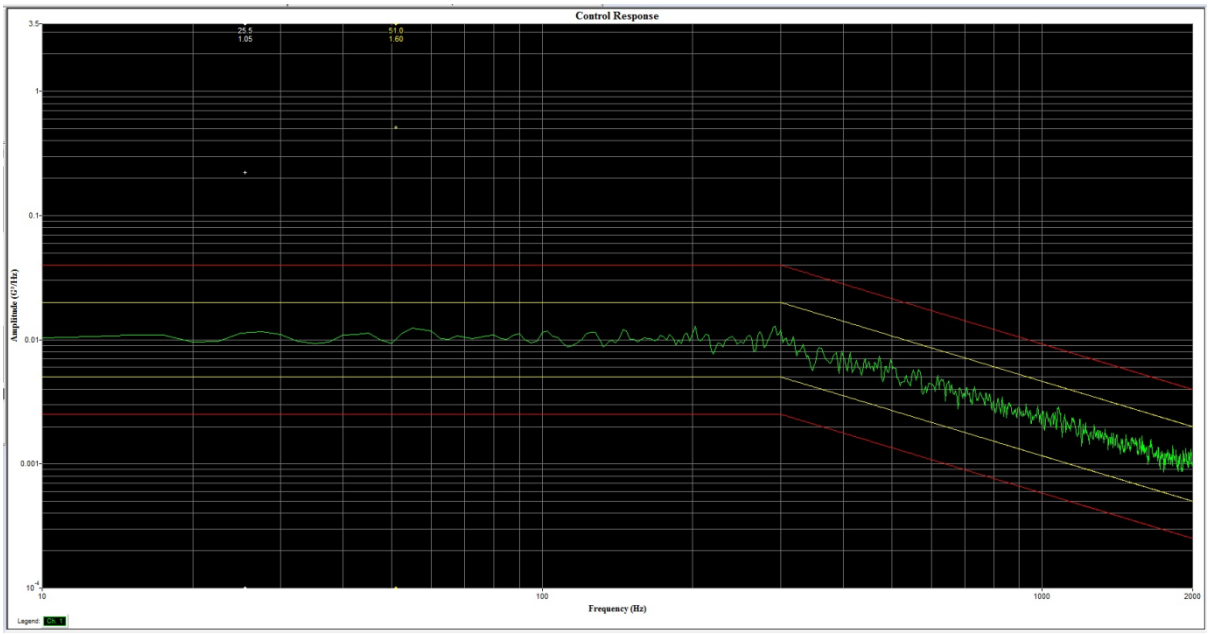


Figure 44: Fore performance 2 control

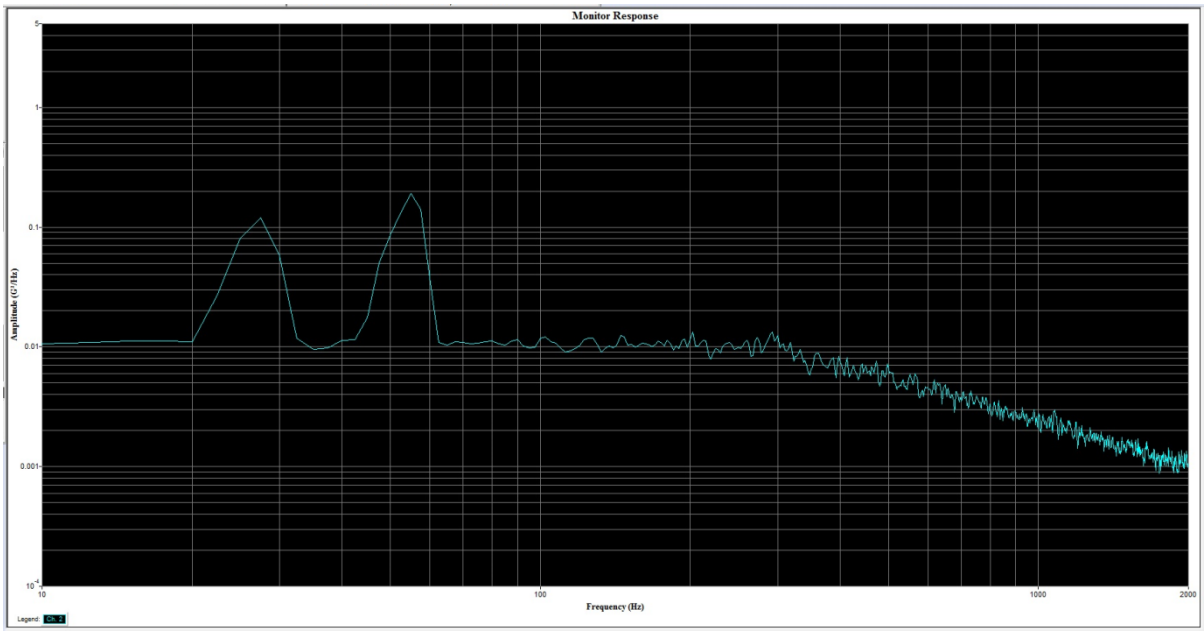


Figure 45: Fore performance 2 monitor

Figure 46: Fore post vibration test curves

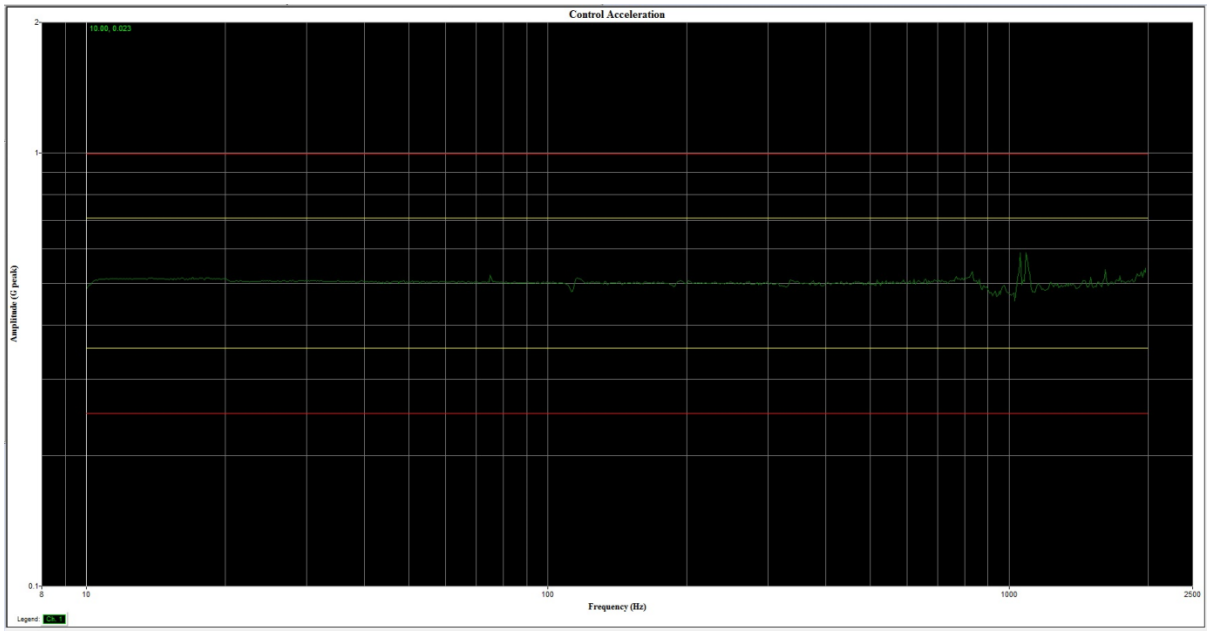


Figure 47: Fore sweep 2

Figure 48: Fore post test

The unit functioned as per specifications during the tests.
The unit was visually inspected after the test. No defects were found.
The unit was then subjected to an ATP in accordance with Appendix E.

Figure 49: Fore vibration acceptance test

C 9. **Side**

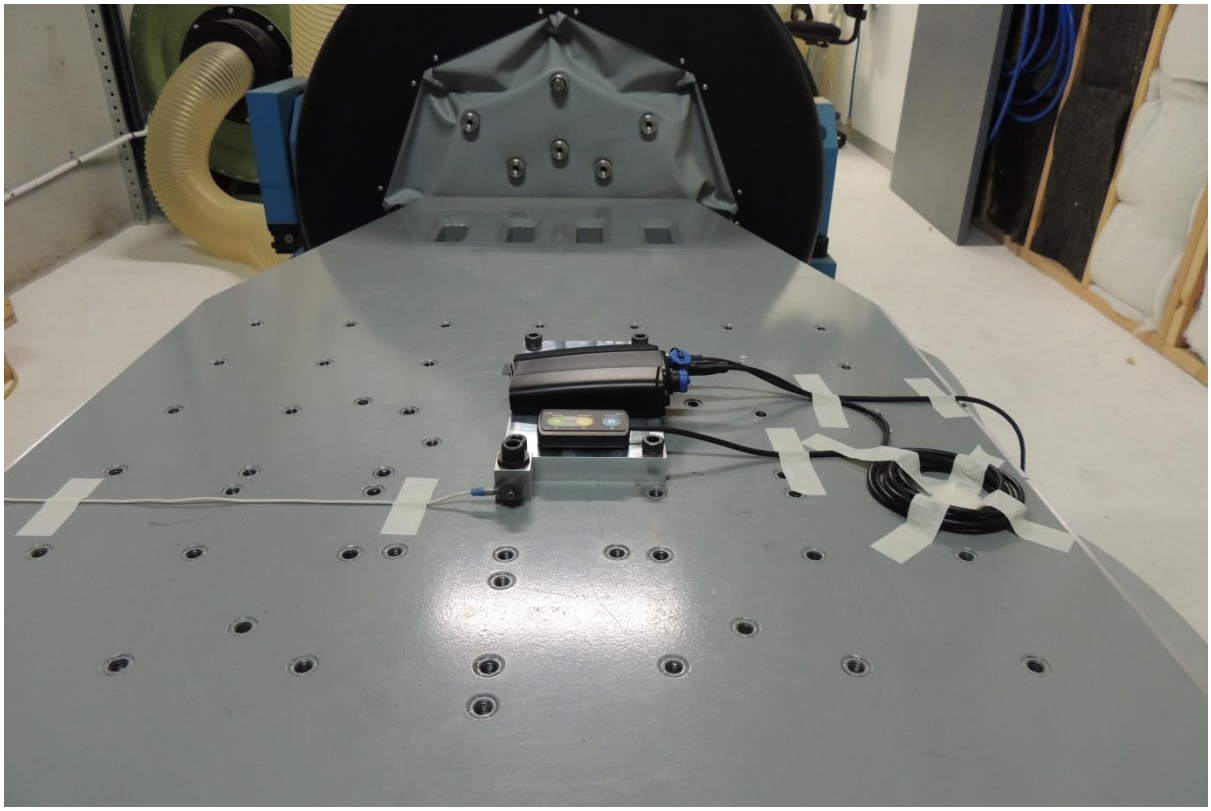


Figure 50: Unit mounting (Side)

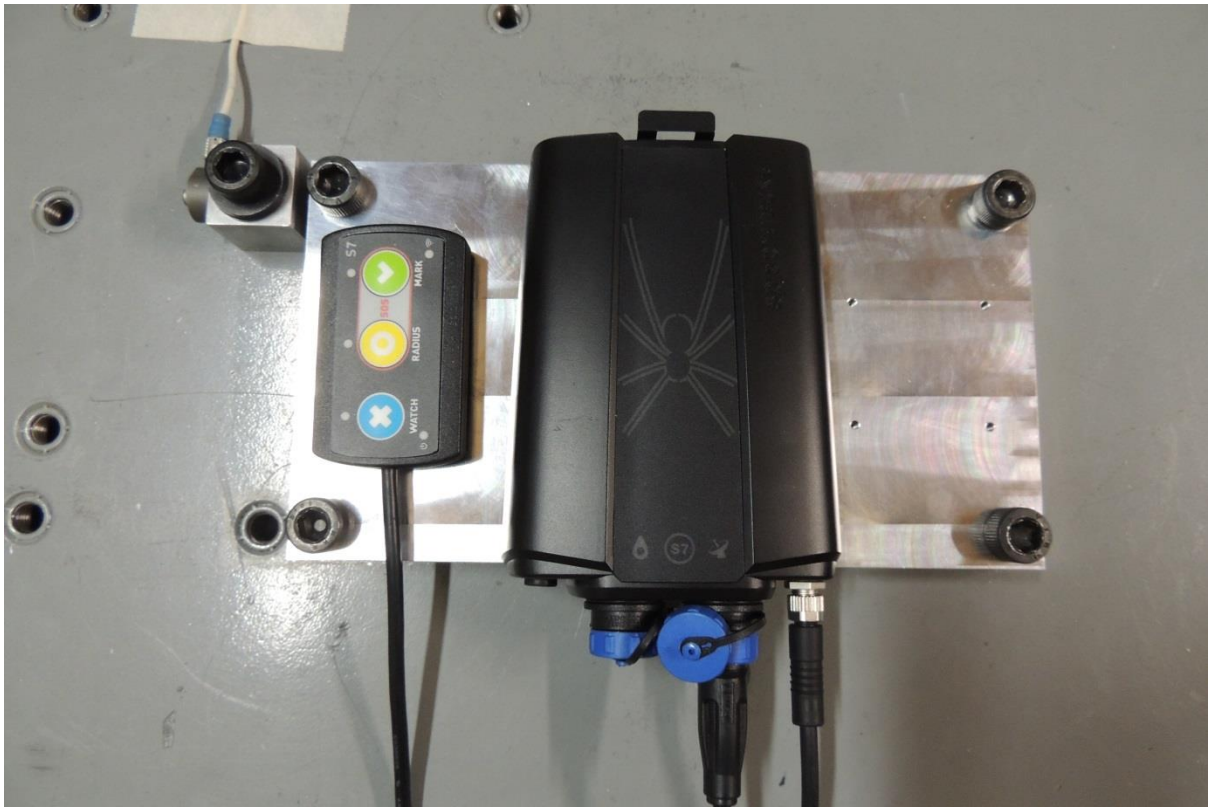


Figure 51: Side vibration pre test

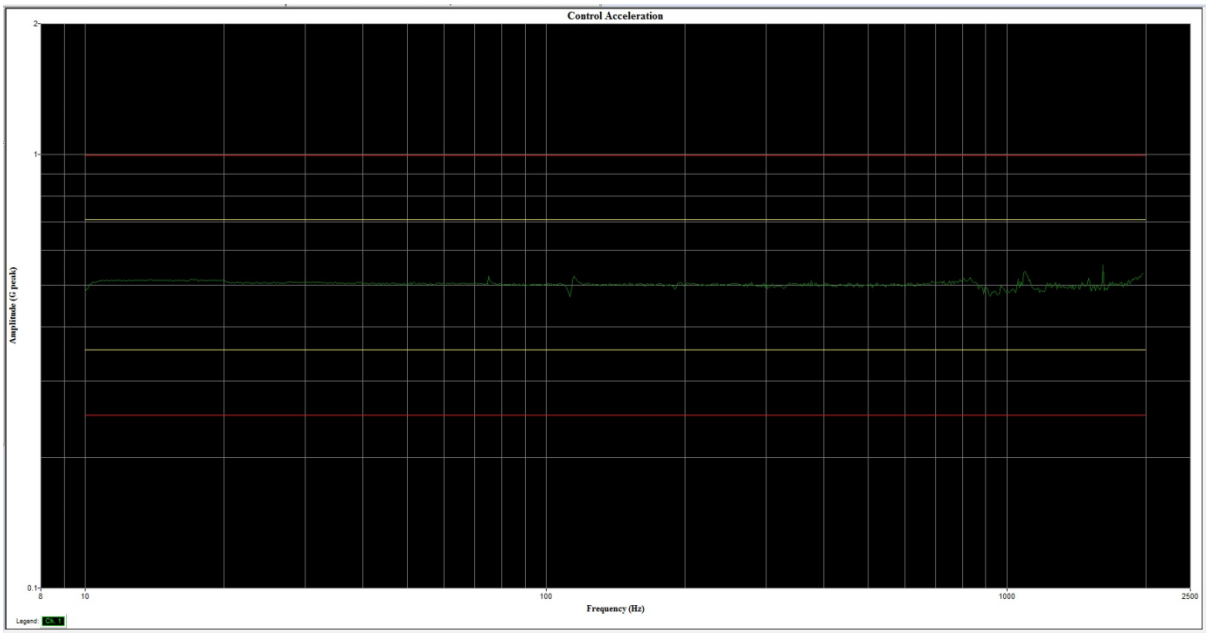


Figure 52: Side sweep 1

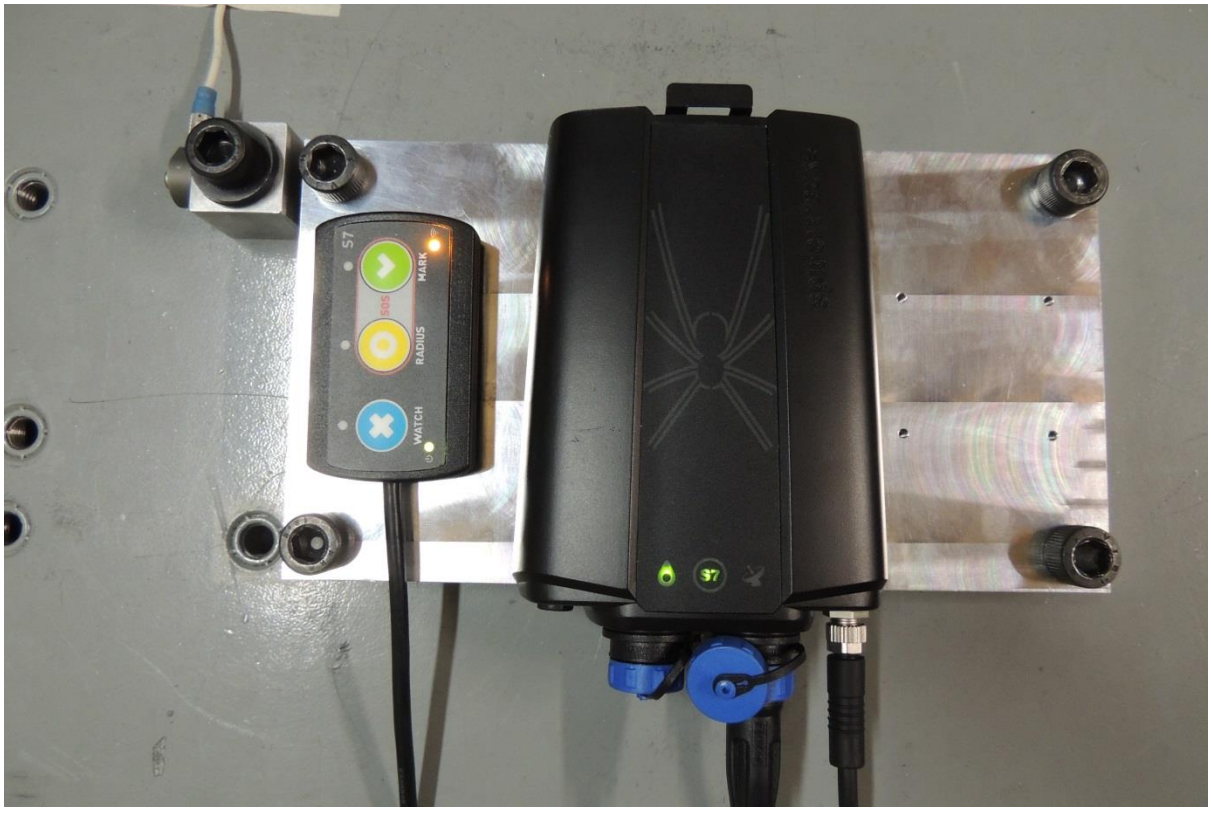


Figure 53: Side pre vibration test curves

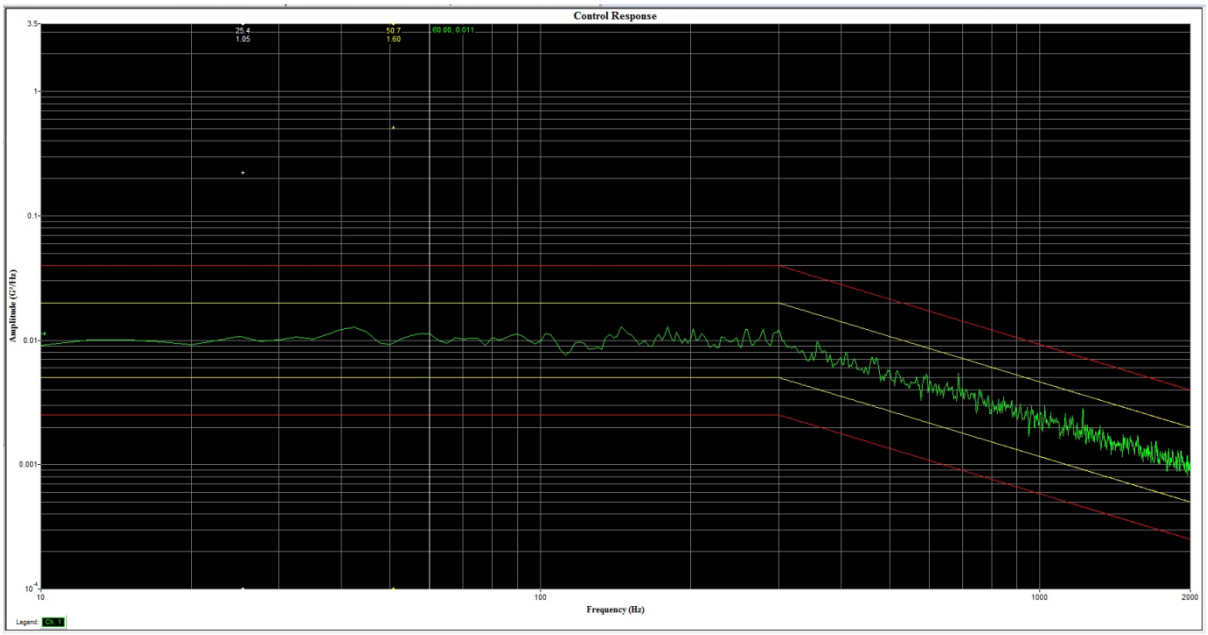


Figure 54: Side performance 1 control

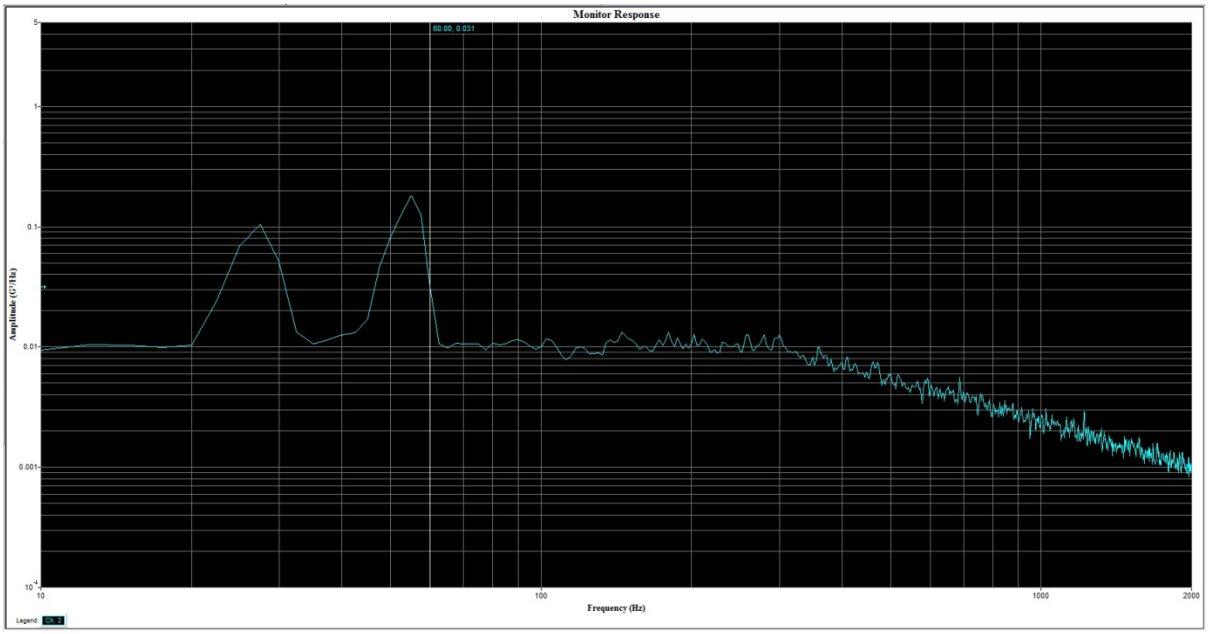


Figure 55: Side performance 1 monitor

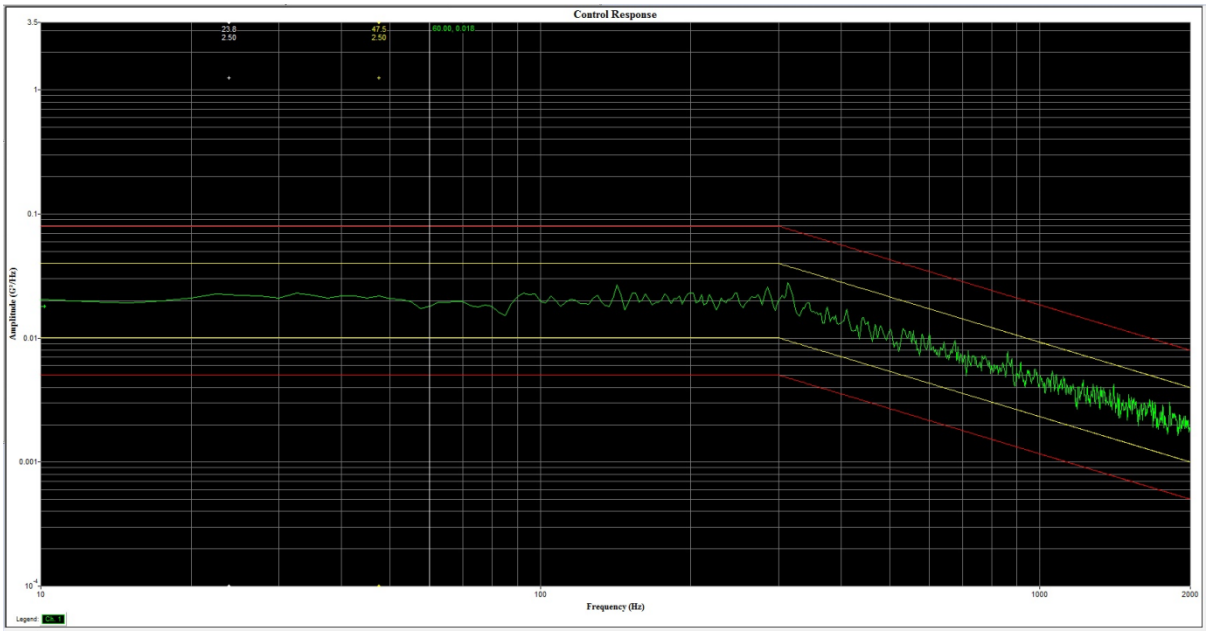


Figure 56: Side endurance control

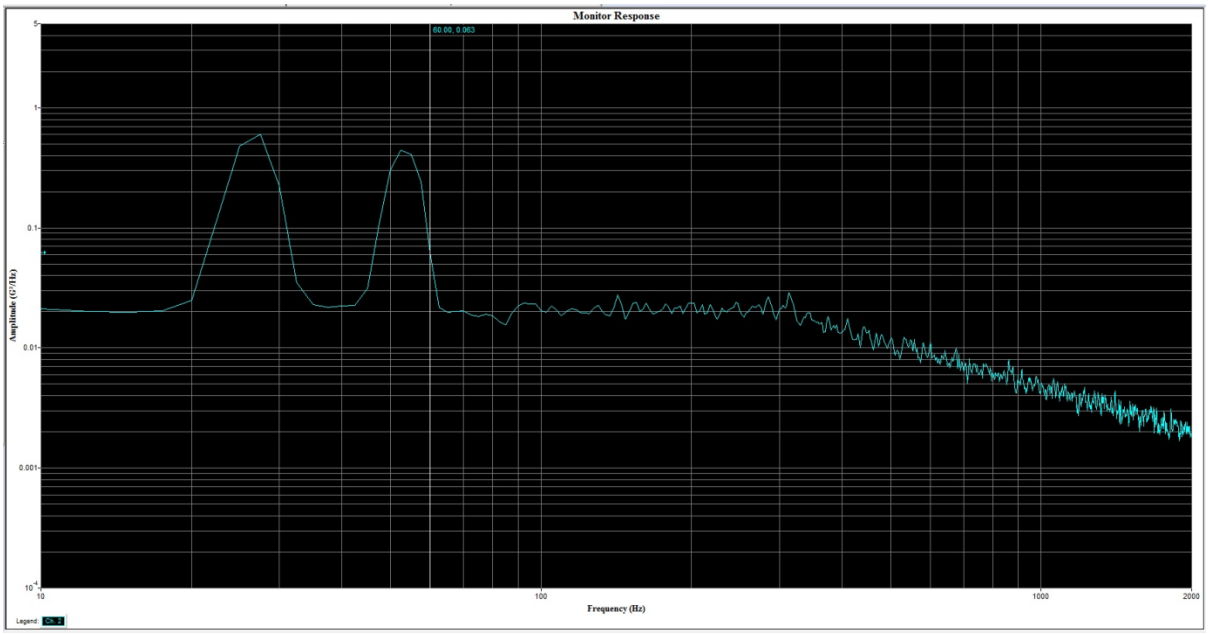


Figure 57: Side endurance monitor

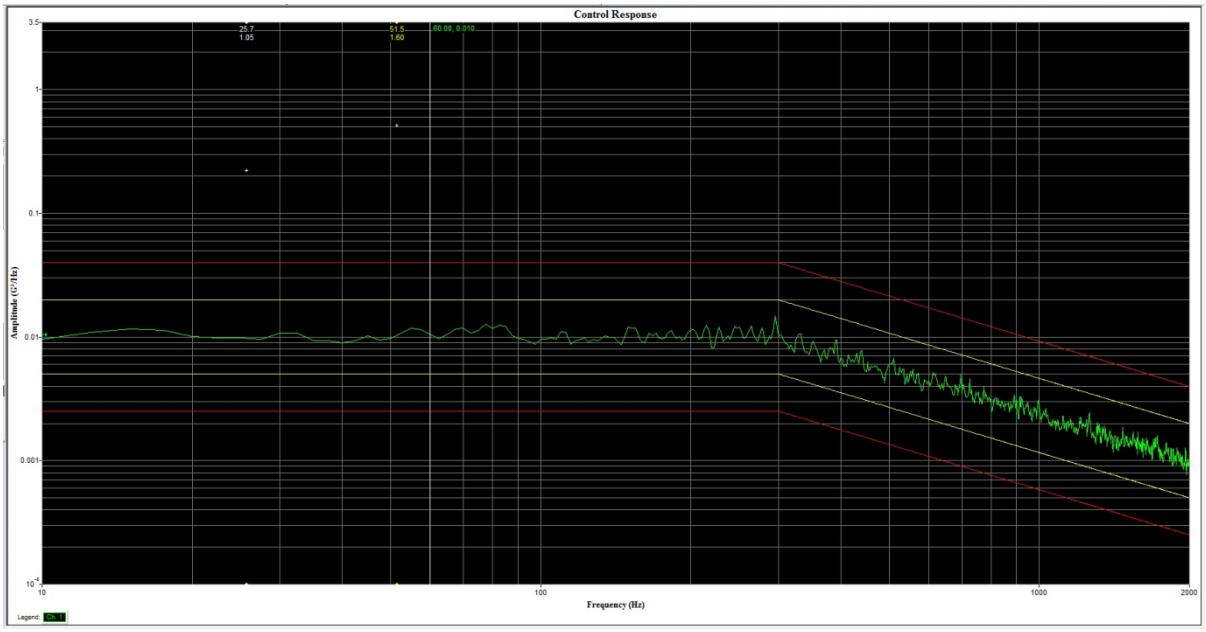


Figure 58: Side performance 2 control

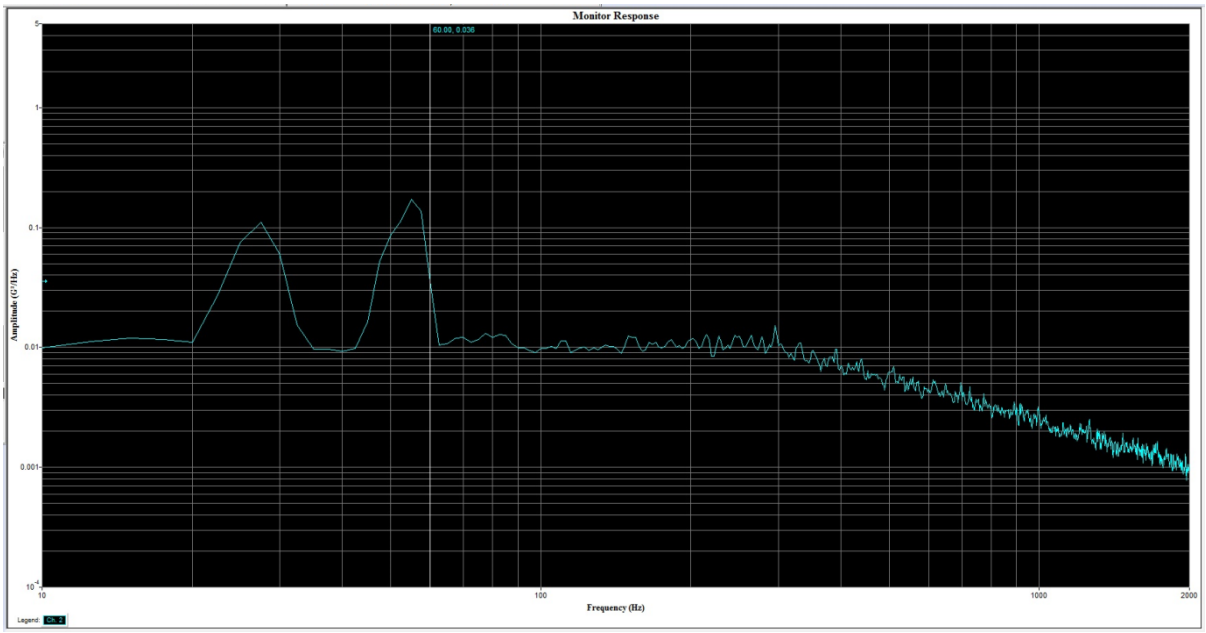


Figure 59: Side performance 2 monitor

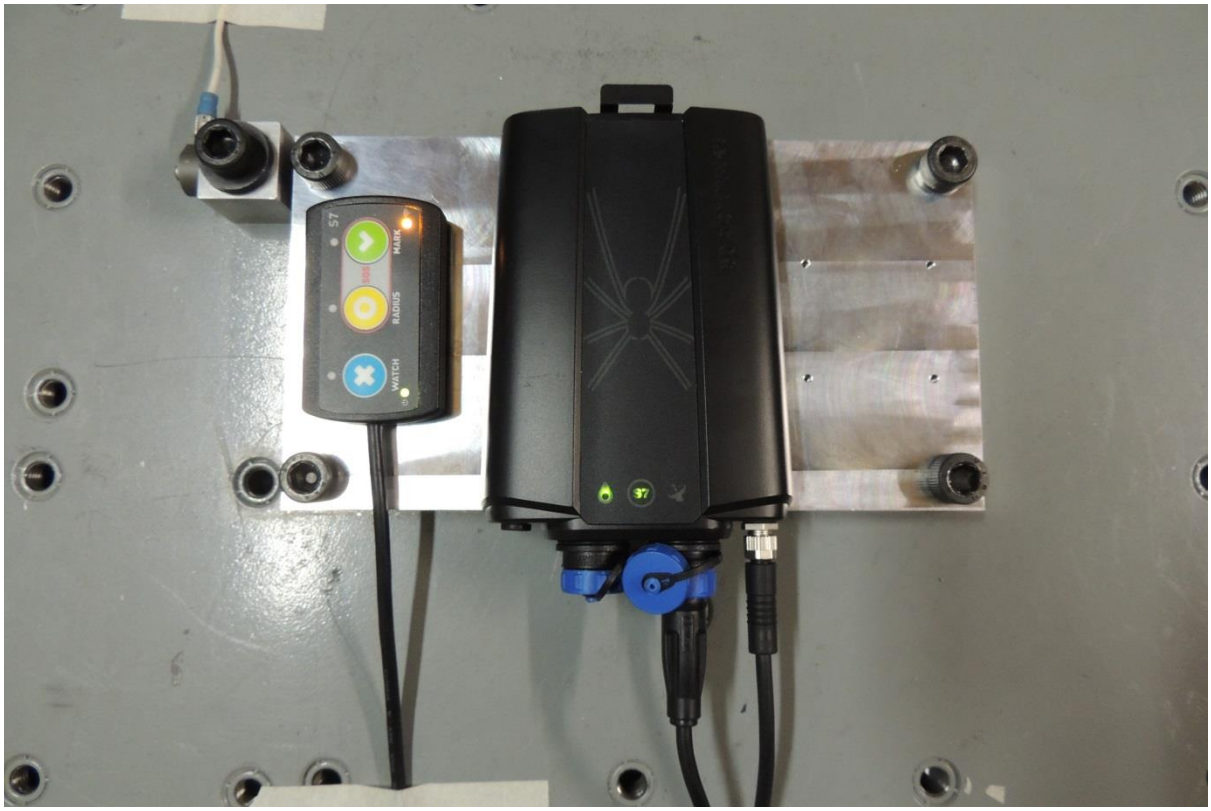


Figure 60: Side post vibration test curves

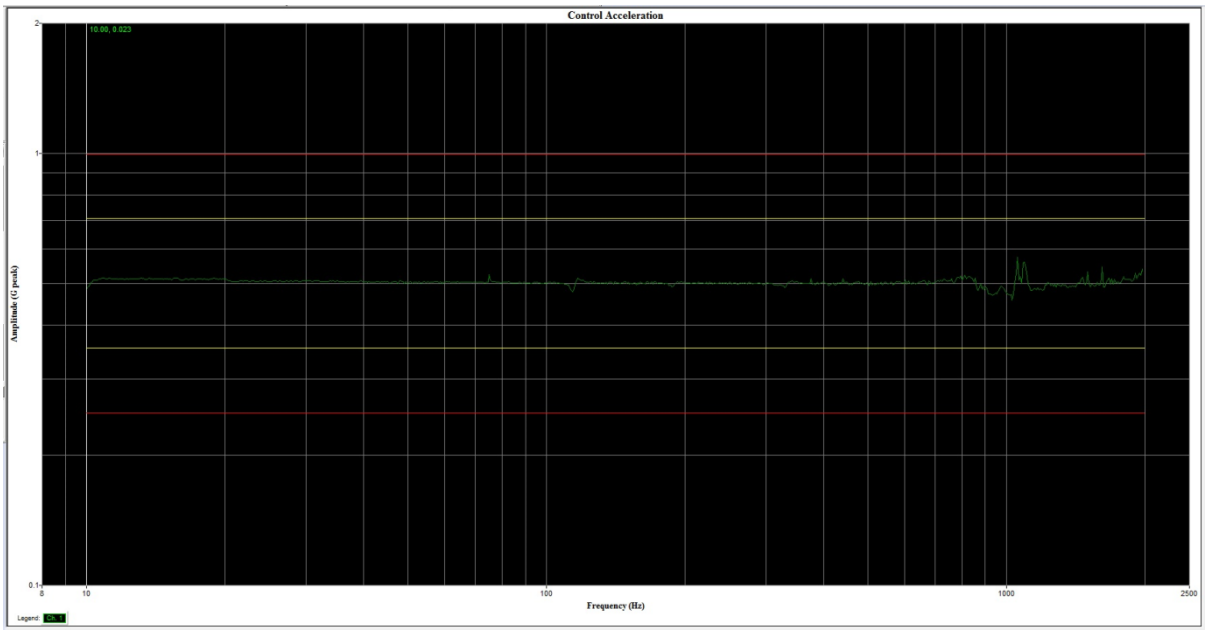


Figure 61: Side sweep 2

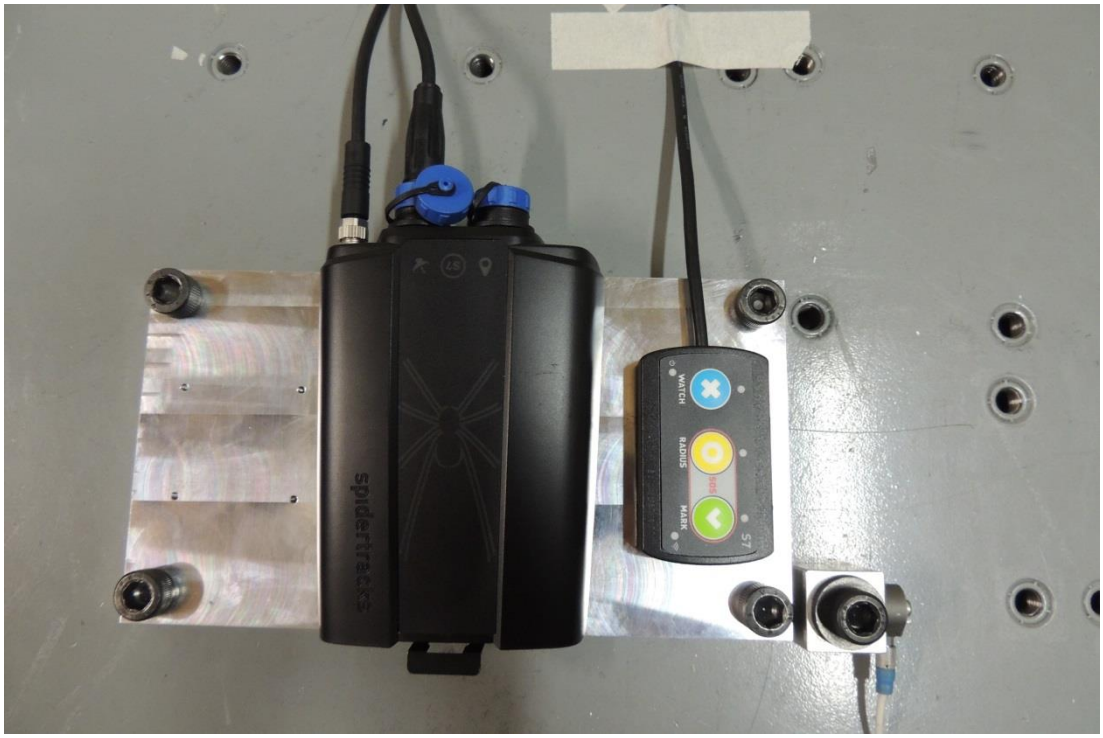


Figure 62: Side post test

The unit functioned as per specifications during the tests.
The unit was visually inspected after the test. No defects were found.
The unit was then subjected to an ATP in accordance with Appendix E.

Figure 63: Side vibration acceptance test

C 10. **Vertical**

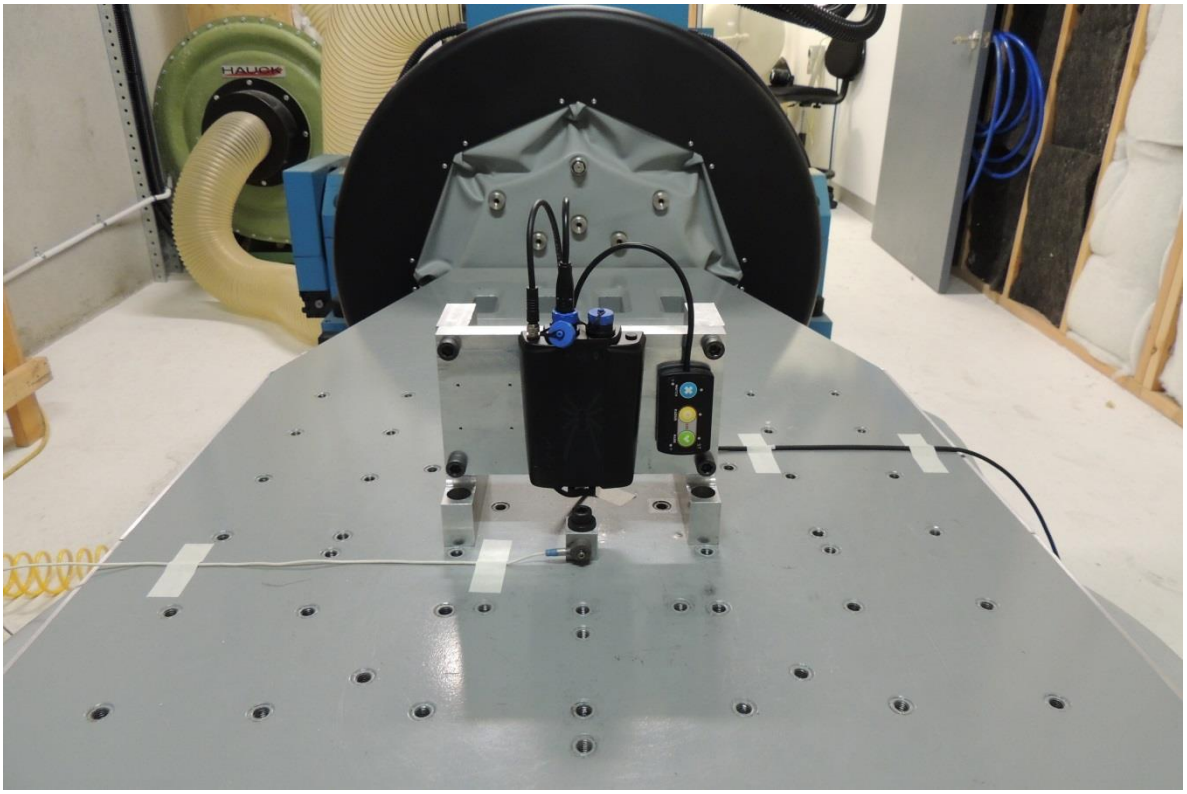


Figure 64: Unit mounting (Vertical)

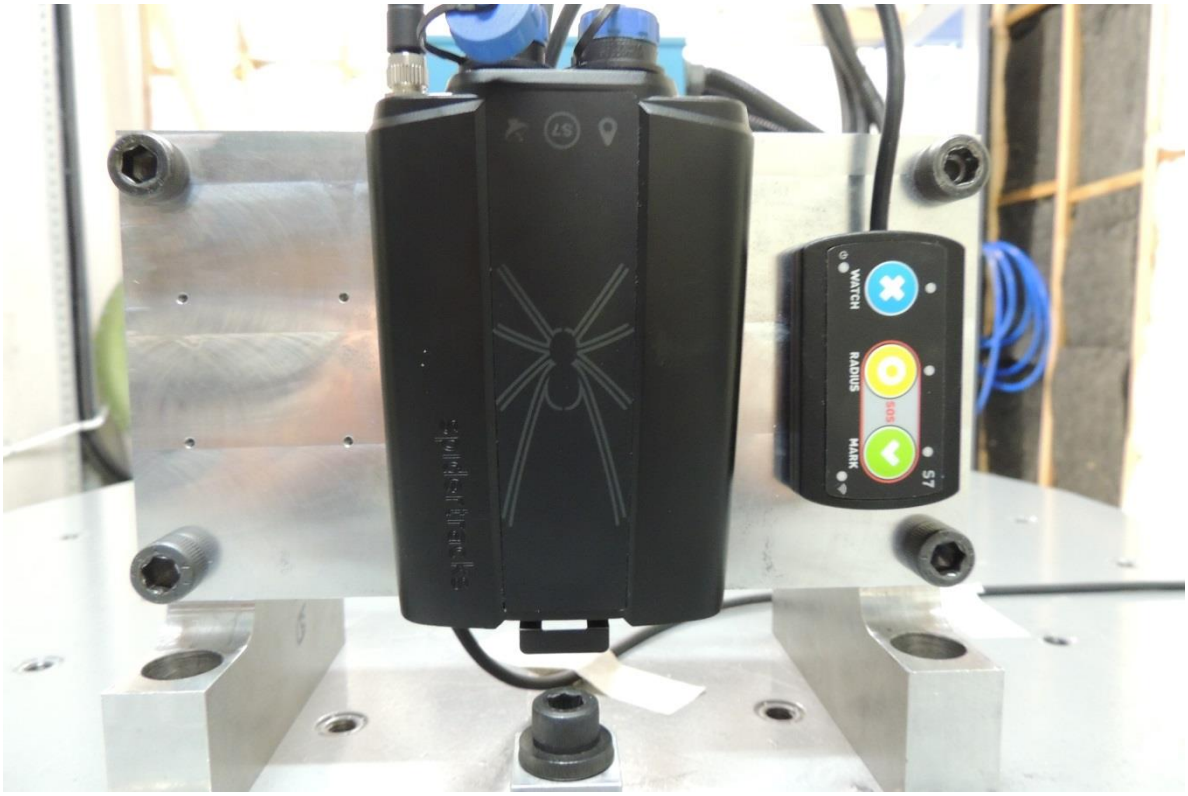


Figure 65: Vertical vibration pre test

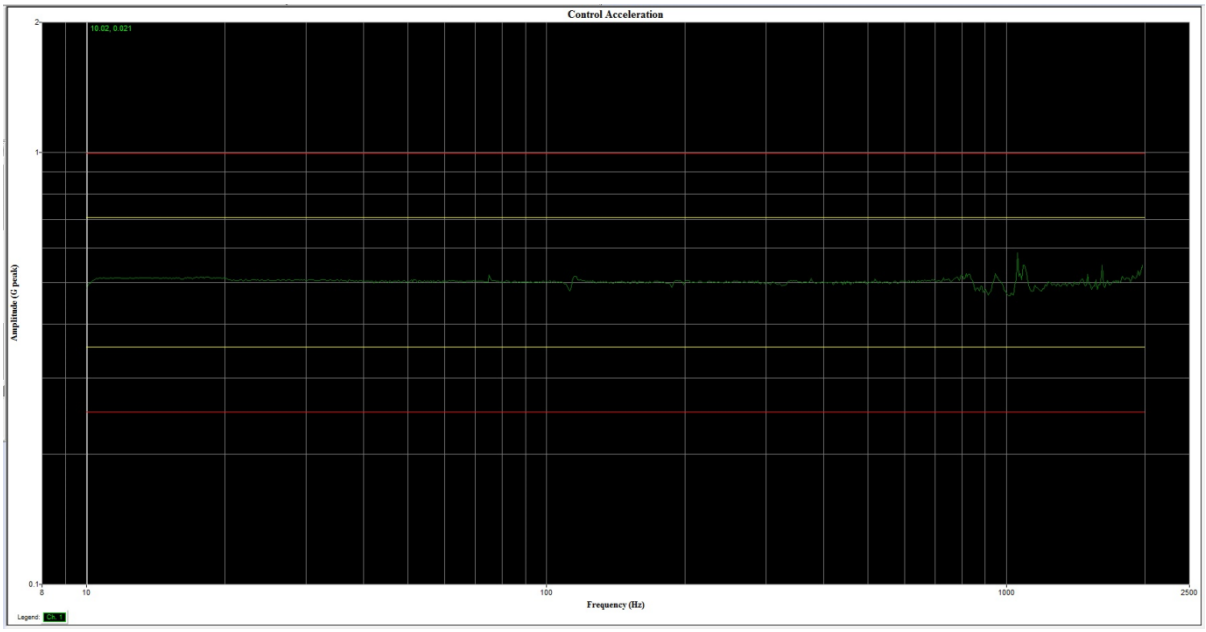


Figure 66: Vertical sweep 1

Figure 67: Vertical pre vibration test curves

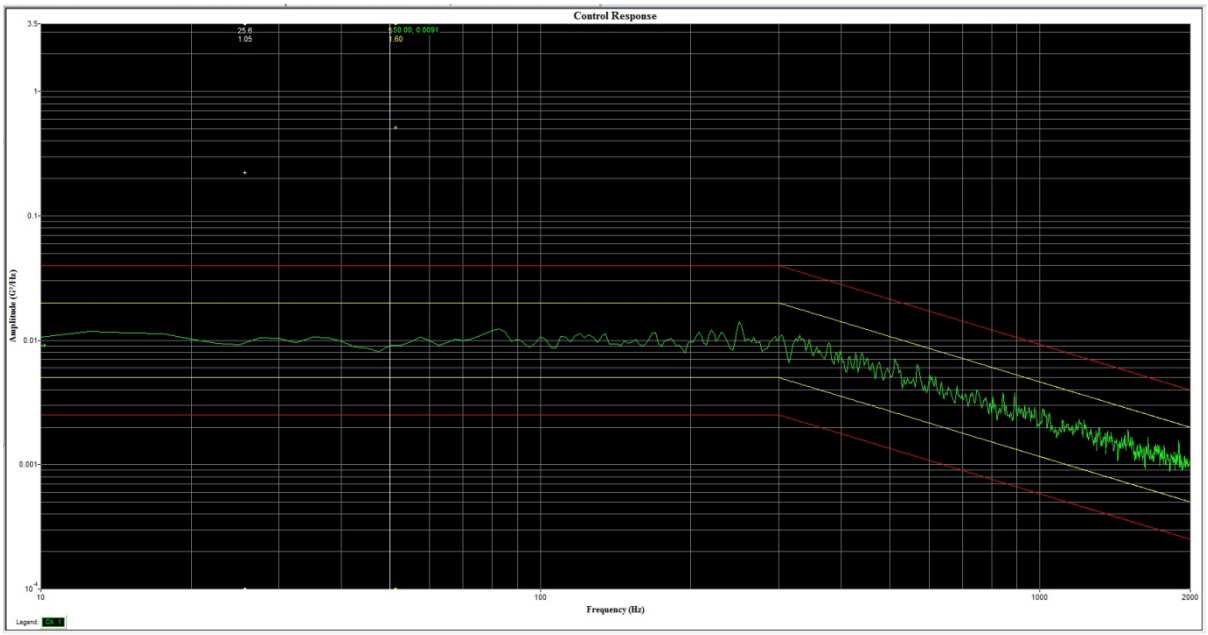


Figure 68: Vertical performance 1 control

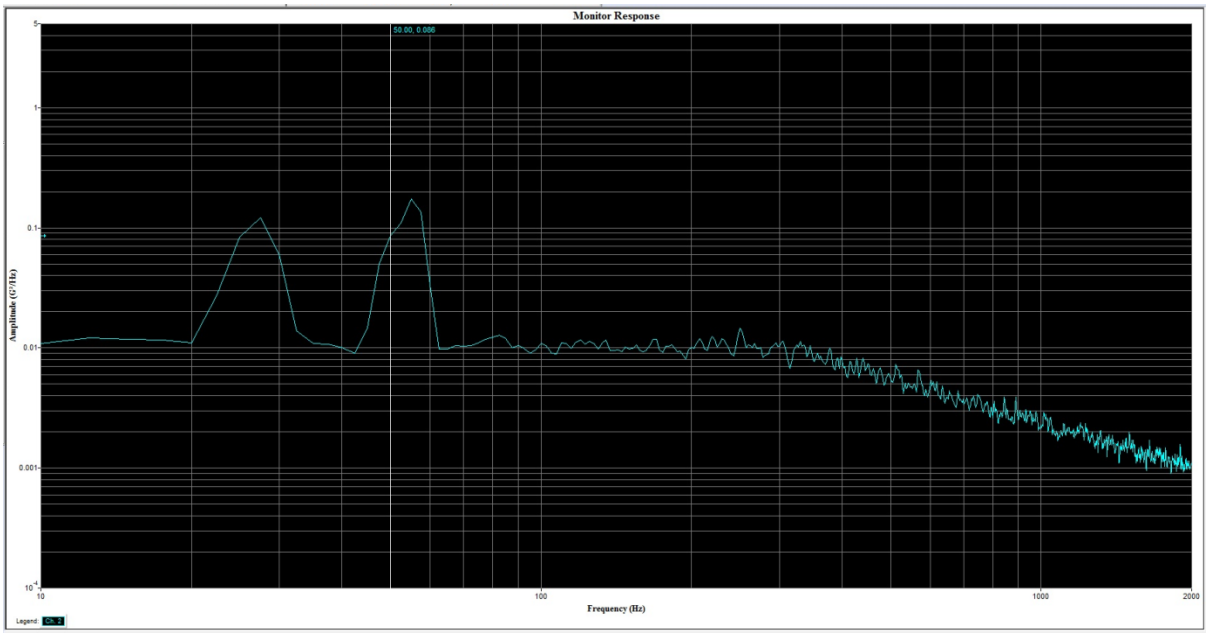


Figure 69: Vertical performance 1 monitor

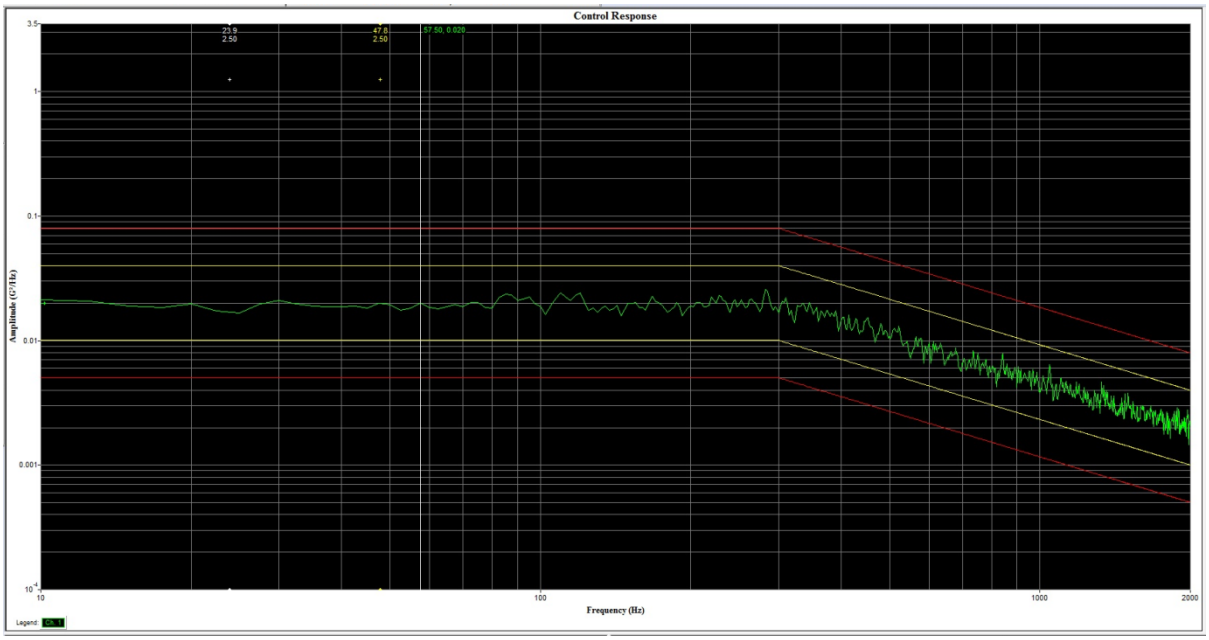


Figure 70: Vertical endurance control

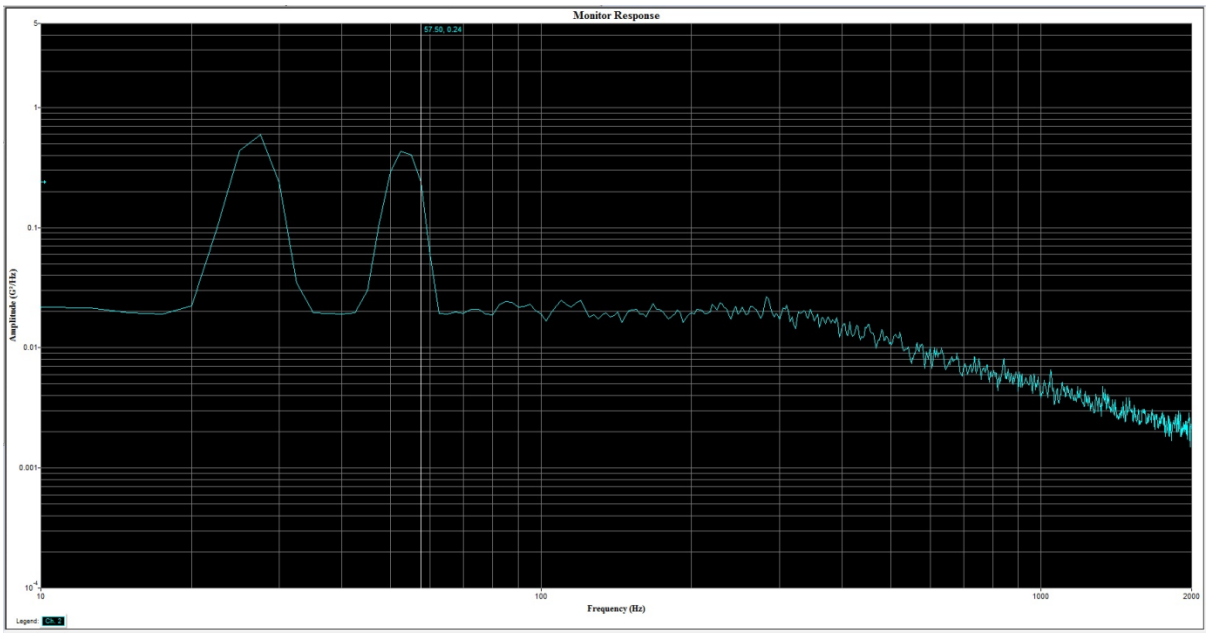


Figure 71: Vertical endurance monitor

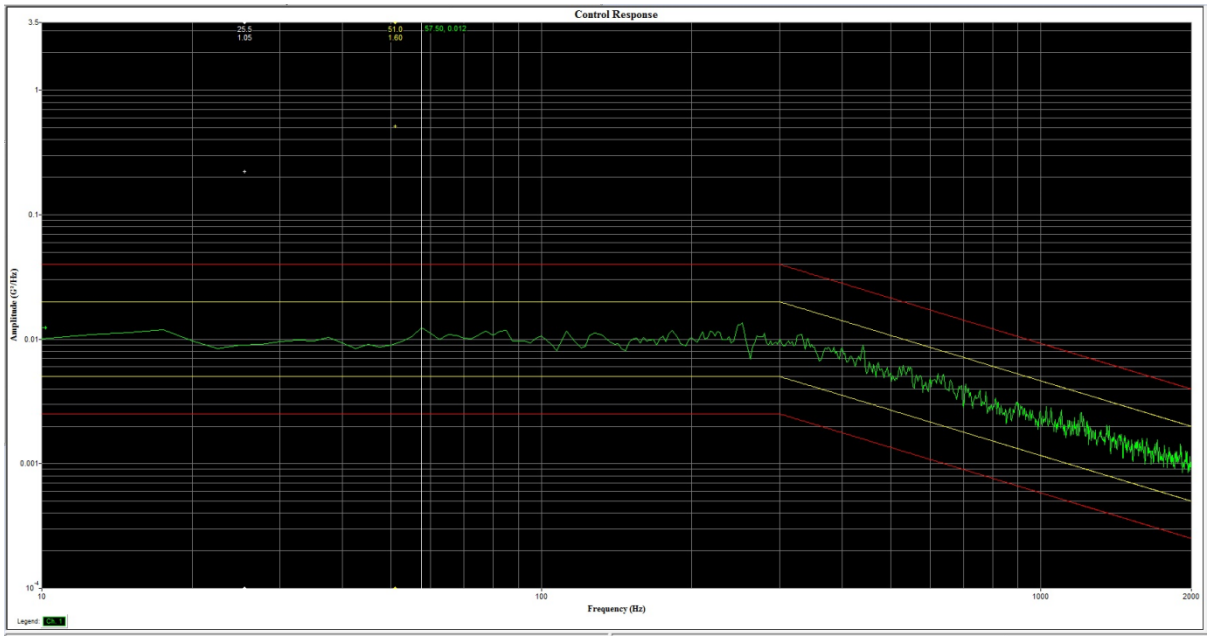


Figure 72: Vertical performance 2 control

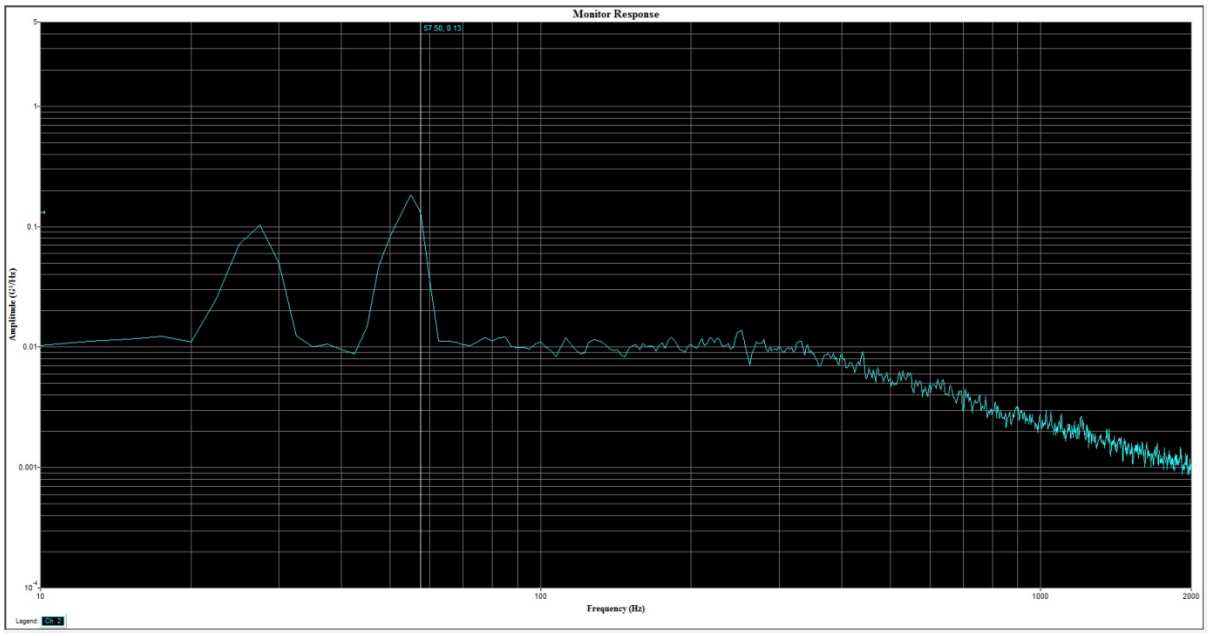


Figure 73: Vertical performance 2 monitor

Figure 74: Vertical post vibration test curves

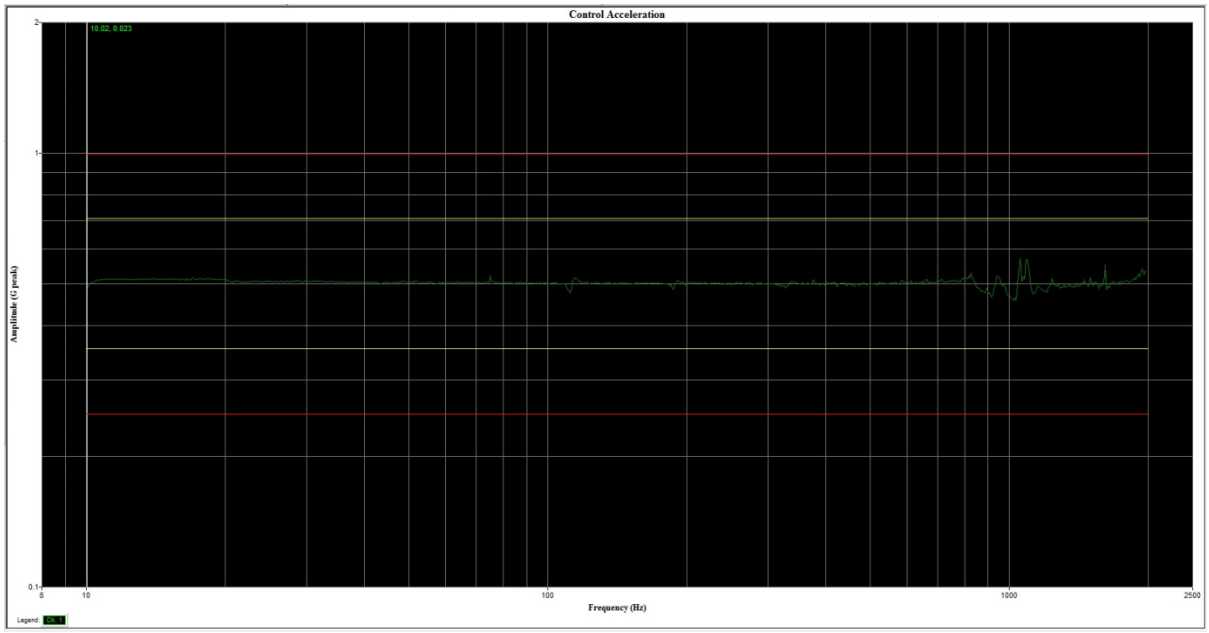


Figure 75: Vertical sweep 2

Figure 76: Vertical post test

The unit functioned as per specifications during the tests.
The unit was visually inspected after the test. No defects were found.
The unit was then subjected to an ATP in accordance with Appendix E.

Figure 77: Vertical vibration acceptance test

C 11. **Qualification test Report Form**

Qualification Test Report Form

1.0 Test Information

Test Performed:	DO160G - Section 8.8.1 Vibration
Operational Test (circle):	(Yes) / No
Date (DD/MM/YYYY):	18/11/2015
Location:	FDS
Outside Contractor (if required):	SPIDERTRACKS
Test Supervisor:	ADRIAN SPITERI
Present Personnel:	
Ambient Temperature:	21.8 °C

2.0 Equipment Information

Test Item

P/N: SPIDERTRACKS S7 S/N: 2015BETA34

Golden Unit (if applicable)

P/N: N/A S/N: N/A

Equipment:

Name	Serial Number	Cal Date (DD/MM/YYYY)	Cal Expiry Date (DD/MM/YYYY)
Thermotron EDV Shaker	42586	12/02/2015	12/02/2016
Endevco Accelerometer	14578	08/12/2014	08/12/2015
Fluke 115C DMM	25601084	04/06/2015	04/06/2016

Form No: 21-0274
Issue:D

Qualification Test Report Form

3.0 Start Time

Date (DD/MM/YYYY):	18 / 11 /2015	Local Time:	13:16

4.0 Finish Time

Date (DD/MM/YYYY):	19 / 11 /2015	Local Time:	15:49

5.0 Notes

Fore	Start	18/11/15	13:16
	Finish	18/11/15	16:33
Side	Start	19/11/15	08:09
	Finish	19/11/15	11:14
Vertical	Start	19/11/15	11:43
	Finish	19/11/15	15:49

6.0 Signatures

Confirm that the Test Item passed as per test plan referenced above (Para 1.0), and that the appropriate test procedure was completed in full.

Test Result: FAIL/PASS

Test Engineer: A. SPITERI
Print/Sign

Signed:
Print/Sign

Date (DD/MM/YYYY): 19 / 11 /2015

Form No: 21-0274
Issue: D

Appendix D **SUSTAINED SHOCK**

D 1. **Equipment Under Test (EUT)**

Part Number: Spider 7
Serial Number used: 2015BETA34

D 2. **Test House**

Flight Data Systems Pty Ltd

D 3. **Equipment Used**

See Qualification Test Report Form below.

D 4. **Test Method**

1.0 Review test cover sheet and ensure test type, test category and test level are specified before proceeding.

2.0 Begin filling out Qualification Test Report From 21-0274

3.0 Complete a visual inspection of the Test Item; record overall physical state of Test Item and any notable flaws/damage visible on the unit. Take profile pictures of unit as a visual record.

4.0 Mount Test Item on test mount, then mount assembly to centrifuge via adaptor mounts as required. Ensure Test Item is placed securely on test mount before attaching to mount and vibration tester to apply force in the 'fore' orientation as per cover sheet if defined there, otherwise base orientation on Figure 1 below. Take note of centre of gravity as per interface drawing for Test Item.

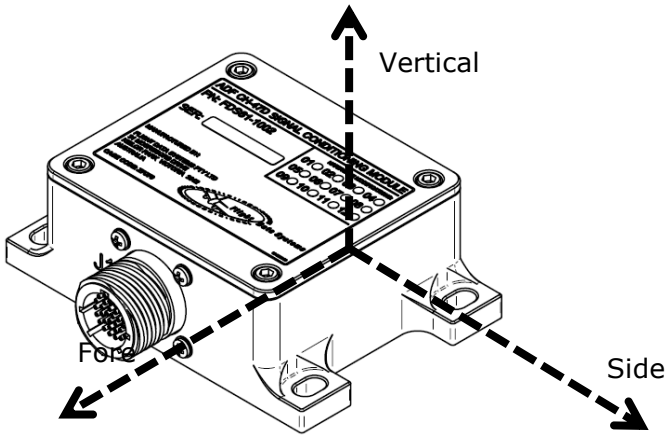


Figure 1 - Example of unit mounting

5.0 Use the following formula to determine the RPM for the motor;

Accel (g's) = R (ω)² / 9.81 = 0.001118 x R x (RPM)²

Where: **R** = Radius in meters, centrifuge to Centre of Gravity (CoG) of Test Item

ω = Angular rotation, radians/second

RPM = Revolutions Per Minute

6.0 Ensure the centre of gravity of the unit is exposed to the Gs required as per provided test level. The centre of gravity is shown on the Test Item interface drawing. Bring the centrifuge RPM to speed as displayed on the RPM meter.

7.0 Ensure motion stabilizes and maintain this force/centrifuge speed for at least three seconds.

8.0 Stop the Centrifuge

9.0 Visually inspect the test item for evidence of physical damage. Ensure records (photos) of the entire device are taken

10.0 Repeat steps 4.0 through 8.0 for all 6 orientations (up, down, fore, aft, left and right)

11.0 Ensure Test Item demonstrates no failure of the mounting attachment and not eject any components or dummy load (if applicable). Bending and distortion of the Test Item is acceptable.

D 5. **Qualification Test Cover Sheet**

Qualification Test Cover Sheet

Part Number:	Spidertracks S7	**Job Number:**	29615
Product name:	Spidertracks S7		
S/N of provided units:	2015BETA34		
Test Required:	DO160G - Section 7.3.3 Sustained Shock	**Operational Test:** (if required)	N/A
Test Plan:	36-0106 Issue C	**Acceptance Test:**	Attached printout (read notes)

Test Limits:

As per test plan 36-0106.
20G for 3 seconds.

Notes:

Acceptance test instructions attached to document - from customer's email.
Centre of gravity not available - worst case scenario used.

After completing form sign below; create a copy for R&D record keeping; attach original with test report and other test documents. **Do not modify after document signed.**

Authorized by: PAUL HIRONS

Signed: P Hirons Date: 20-11-2015

Operator: A.SATERI Date: 20-11-2015

Document No: 21-0296
Issue: A

Pre and Post tests

1. Position the Spider with an unobstructed and full view of the sky (horizon to horizon)

2. Power the Spider using the auxiliary lead provided - ensure power supply is stable in the range of 10-28VDC and able to deliver 1.5A

3. After initial start-up sequence, which consists of the Spider's LED flashing several times and the keypad LEDs flashing 10sec. Afterwards, you should see a solid power LED on the unit (middle LED and bottom left on the keypad)

4. Within a 2-4 minute period the green GPS LED (left LED) on the unit should turn on and the satellite LED (right LED) should turn on shortly after. The bottom right LED on the Keypad should turn orange and then green shortly after. The GPS LED and the orange LED on the keypad indicate GPS lock has been achieved. The satellite LED on the unit and green LED on the keypad indicate that the first position report has been sent through Iridium.

5. Please run through these steps before and after testing.

Performance (during) Tests

1. Power the Spider using the auxiliary lead provided - ensure power supply is stable in the range of 10-28VDC and able to deliver 1.5A, ensure power supply is not interrupted during test.

2. After initial start-up sequence, which consists of the Spider's LED flashing several times and the keypad LEDs flashing 10sec. Afterwards, you should see a solid power LED on the unit (middle LED and bottom left on the keypad)

3. Within a 2-4 minute period the green GPS LED (left LED) on the unit should turn on, the bottom right LED on the Keypad should turn orange. The GPS LED and the orange LED on the keypad indicate GPS lock has been achieved.

4. Run during environmental test.

D 6. **Setup**

Cables were connected to the unit but no power applied.

D 7. **Back to Centre of Centrifuge**

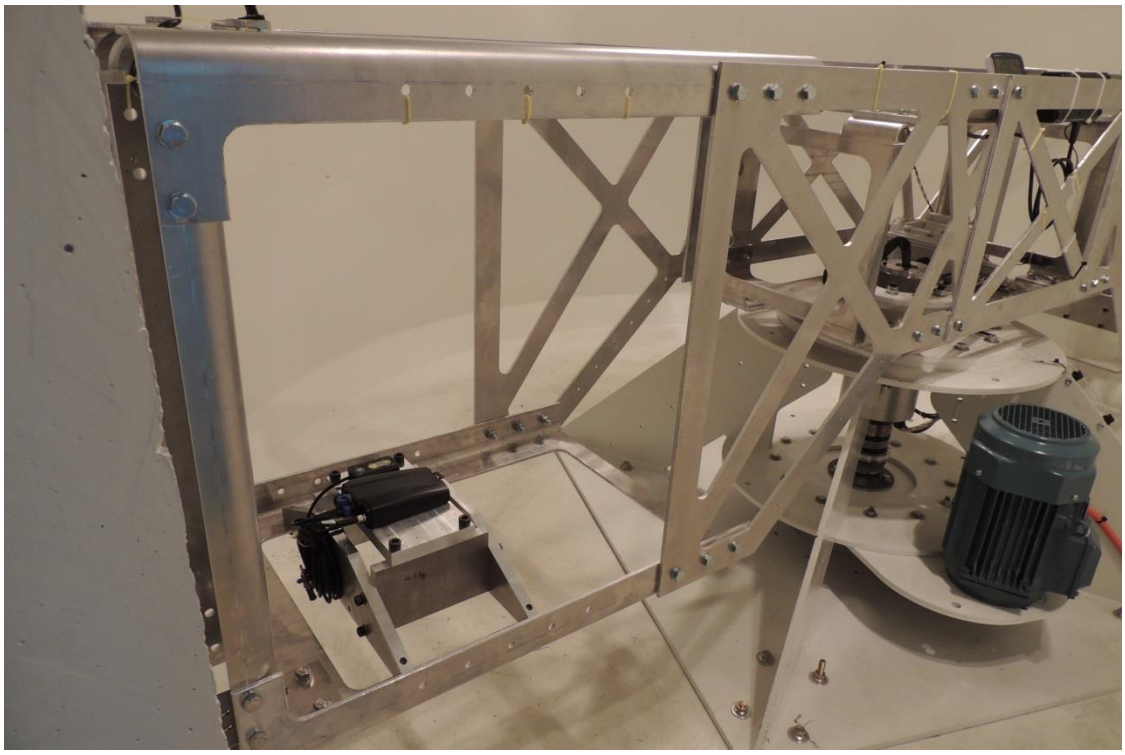


Figure 78: Unit mounting Back to centre of centrifuge

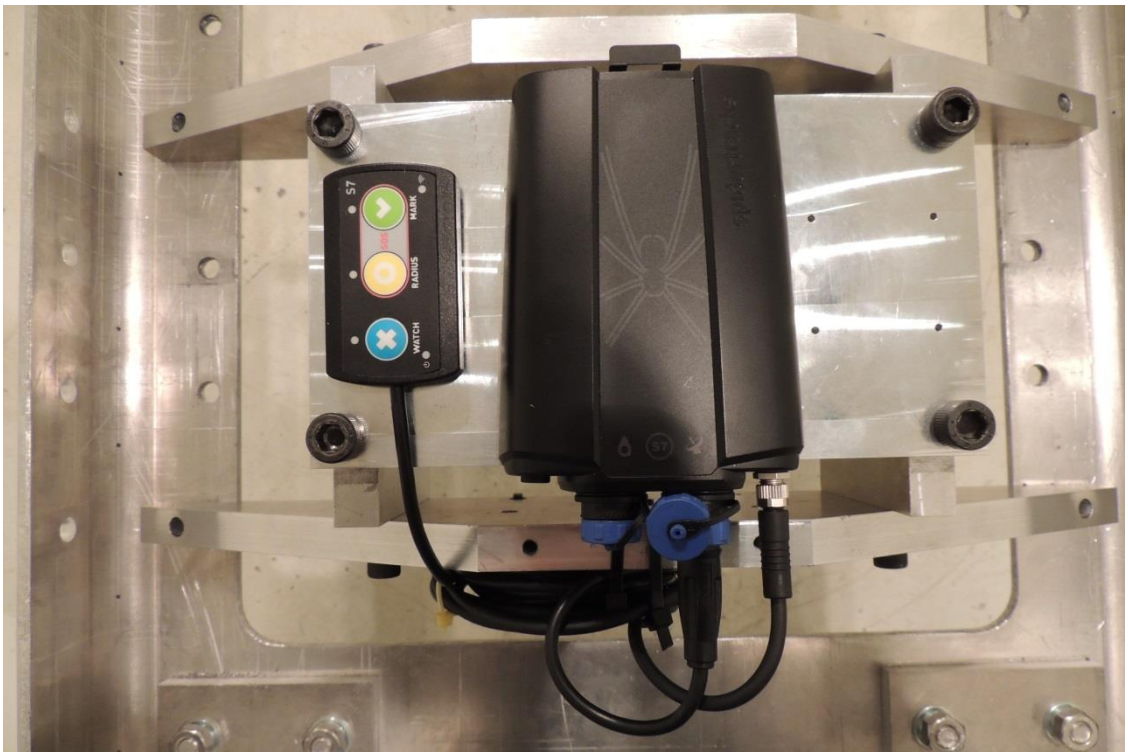


Figure 79: Back to centre of centrifuge pre test

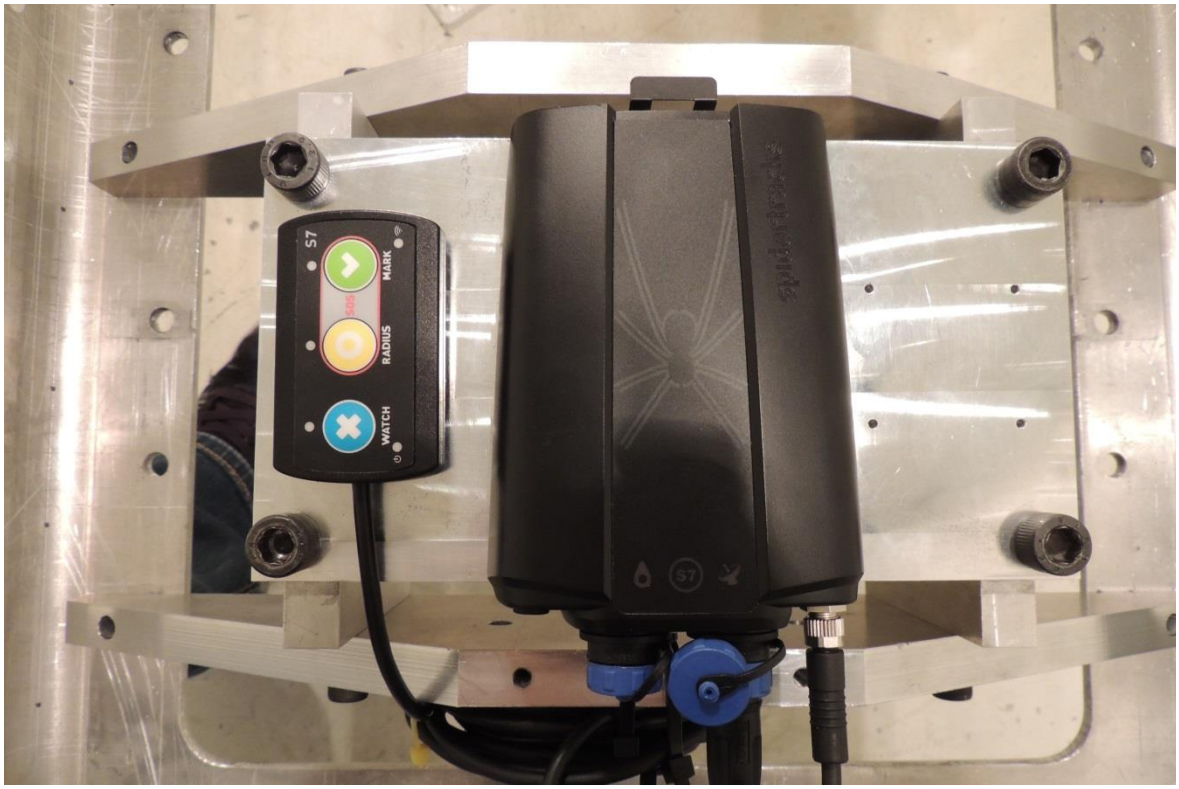


Figure 80: Back to centre of centrifuge post test

D 8. **Front to Centre of Centrifuge**

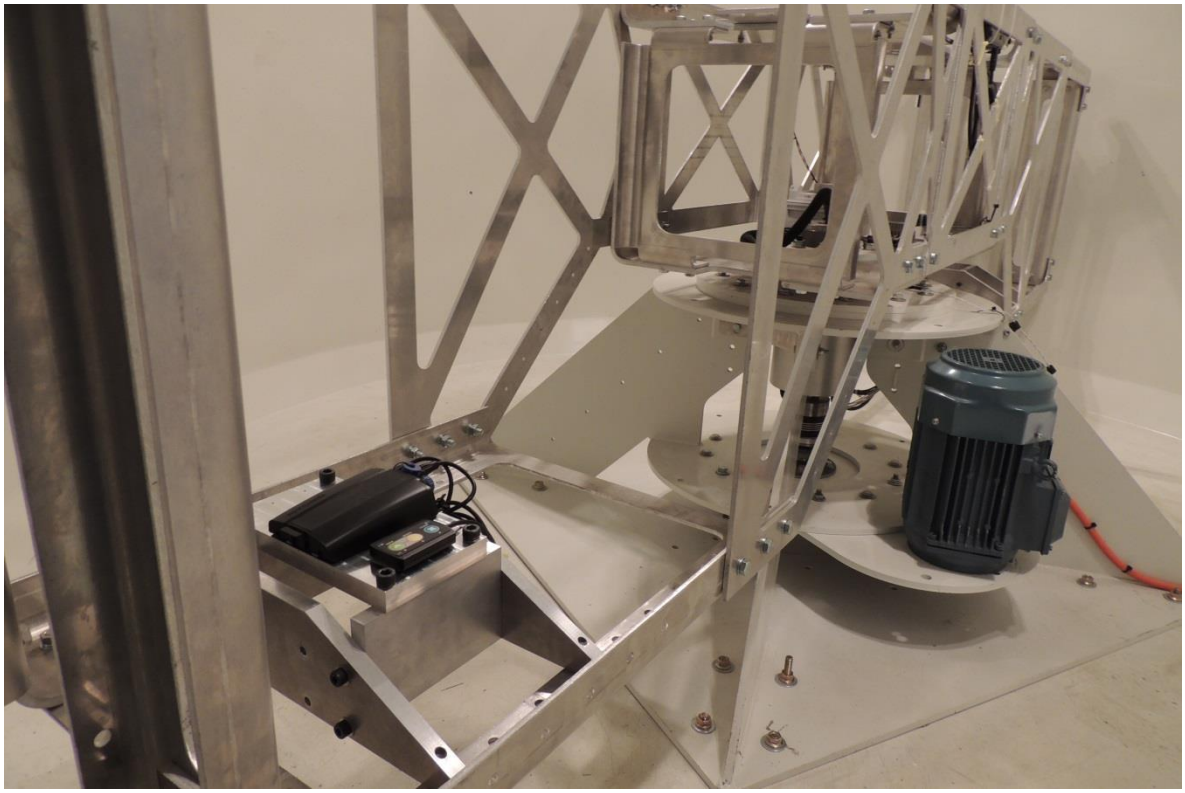


Figure 81: Unit mounting Front to centre of centrifuge

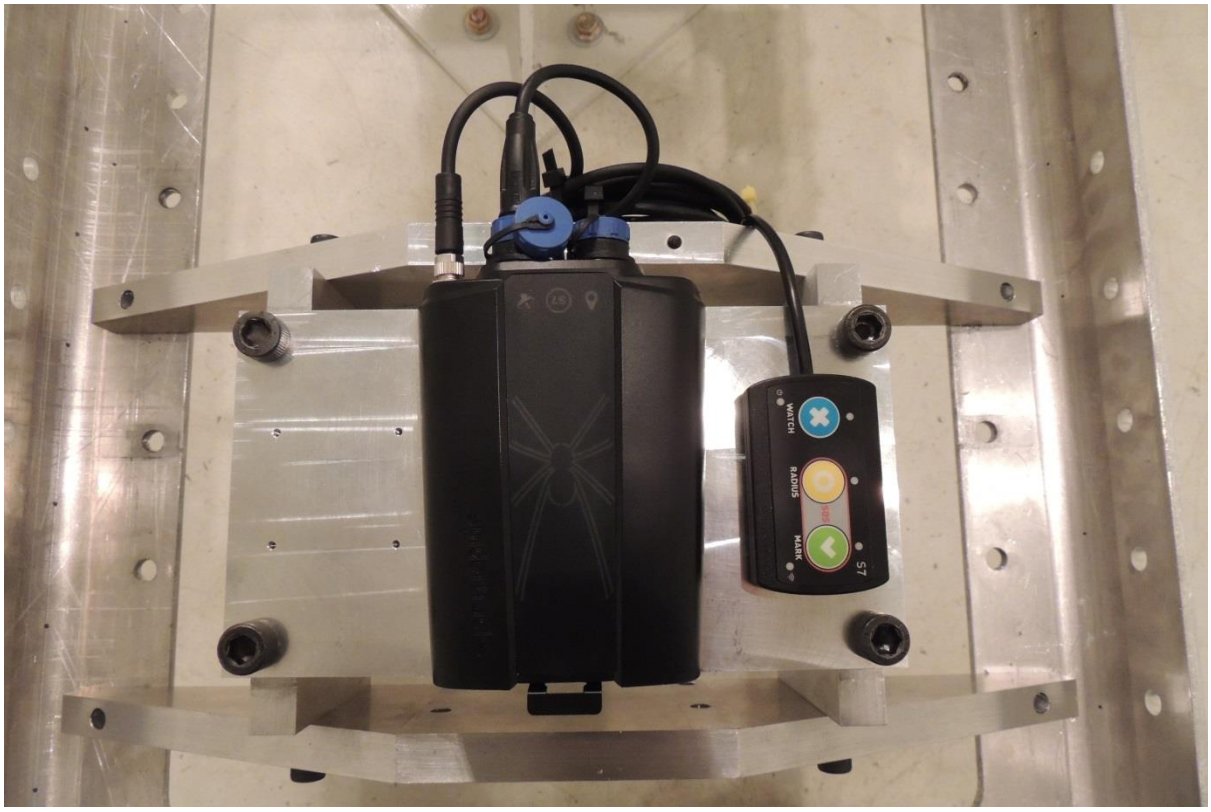


Figure 82: Front to centre of centrifuge pre test

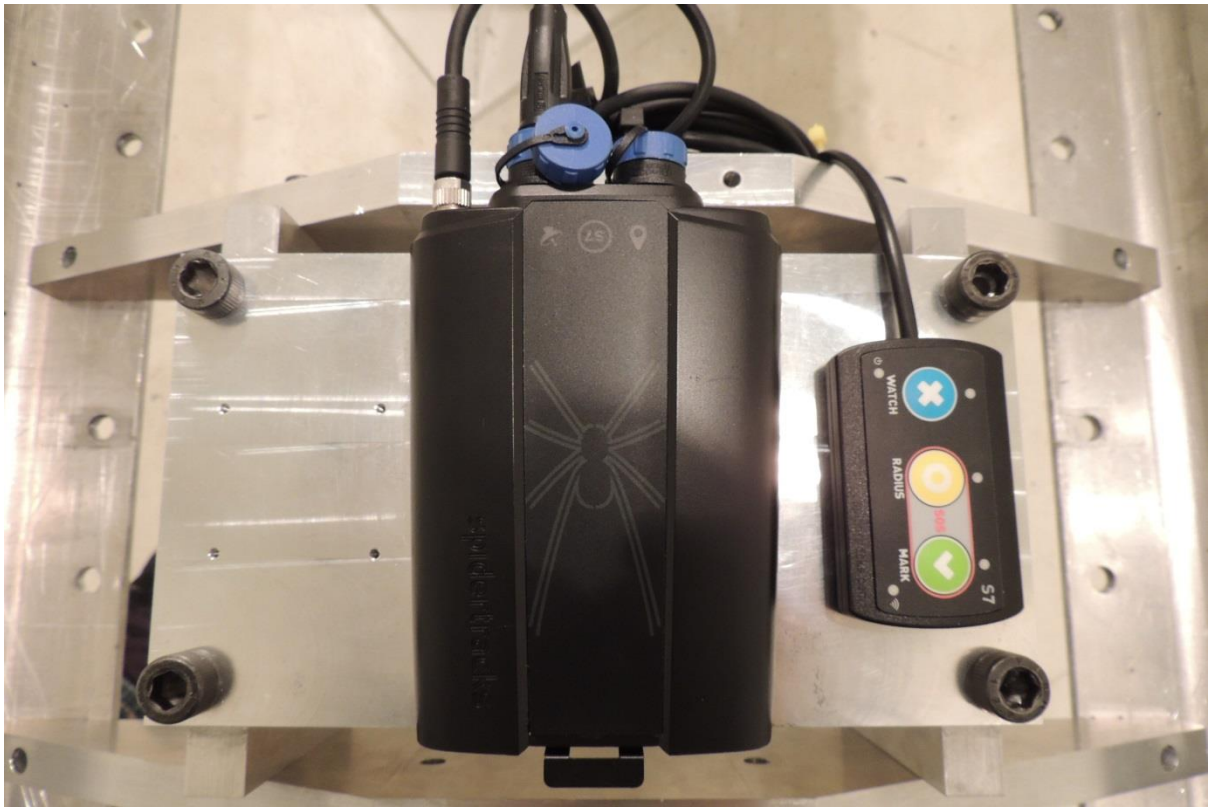


Figure 83: Front to centre of centrifuge post test

D 9. Top to Centre of Centrifuge

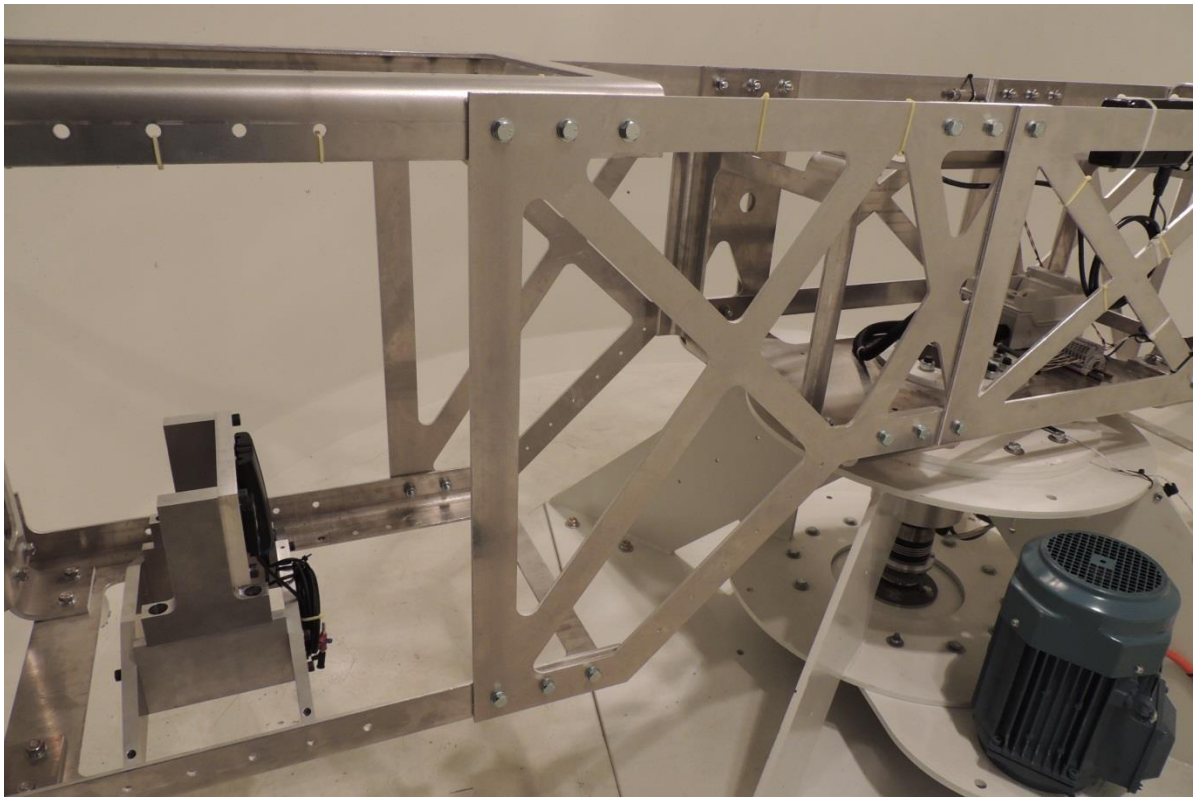


Figure 84: Unit mounting Top to centre of centrifuge

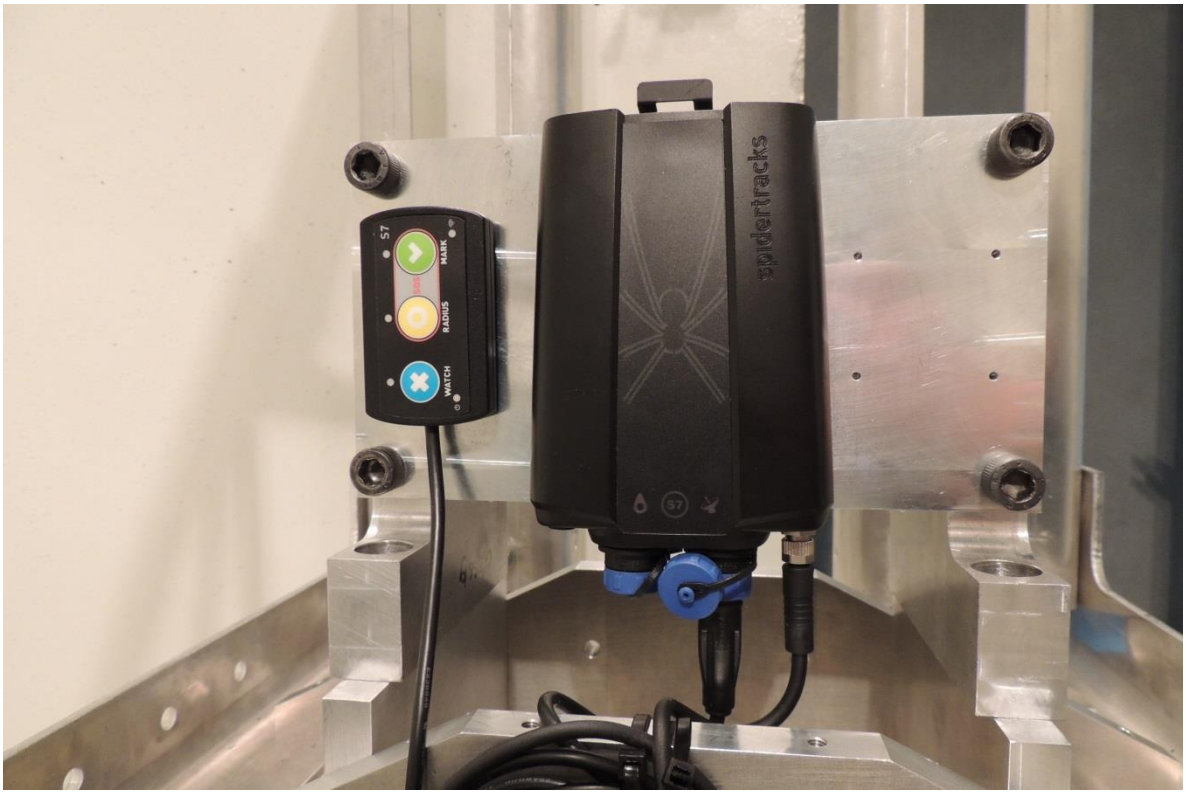


Figure 85: Top to centre of centrifuge pre test

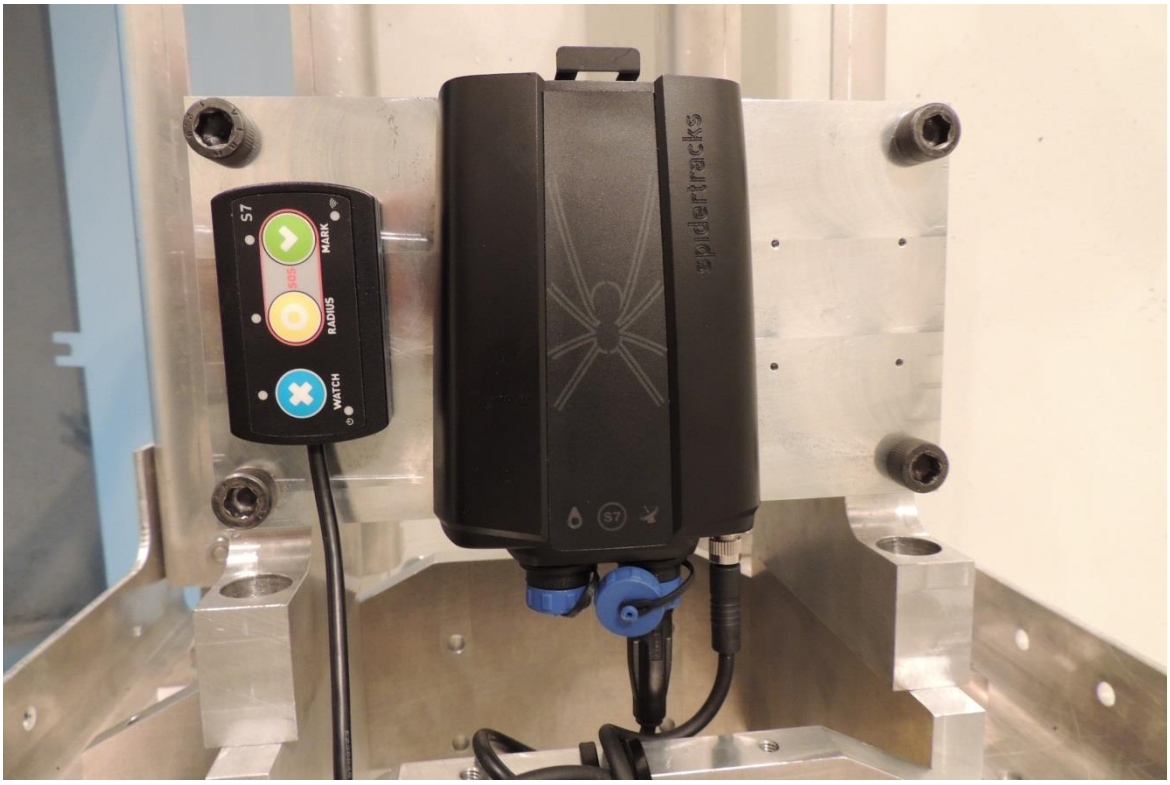


Figure 86: Top to centre of centrifuge post test

D 10. **Bottom to Centre of Centrifuge**

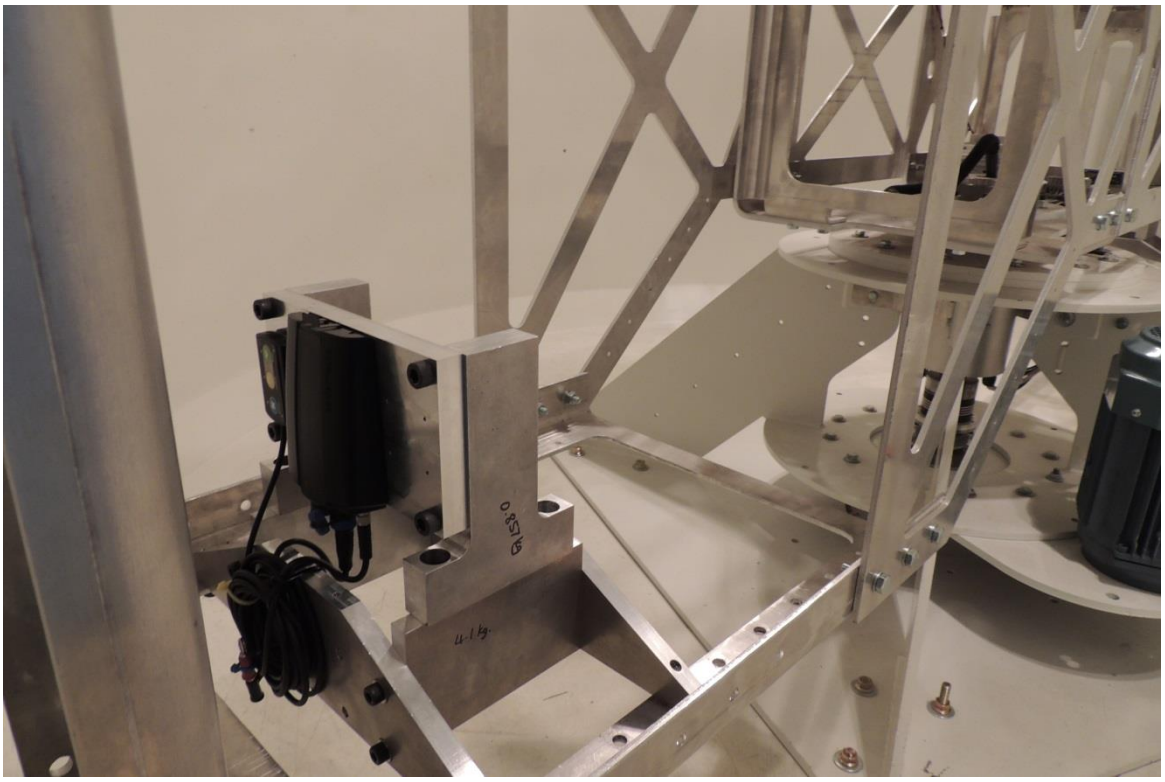


Figure 87: Unit mounting Bottom to centre of centrifuge

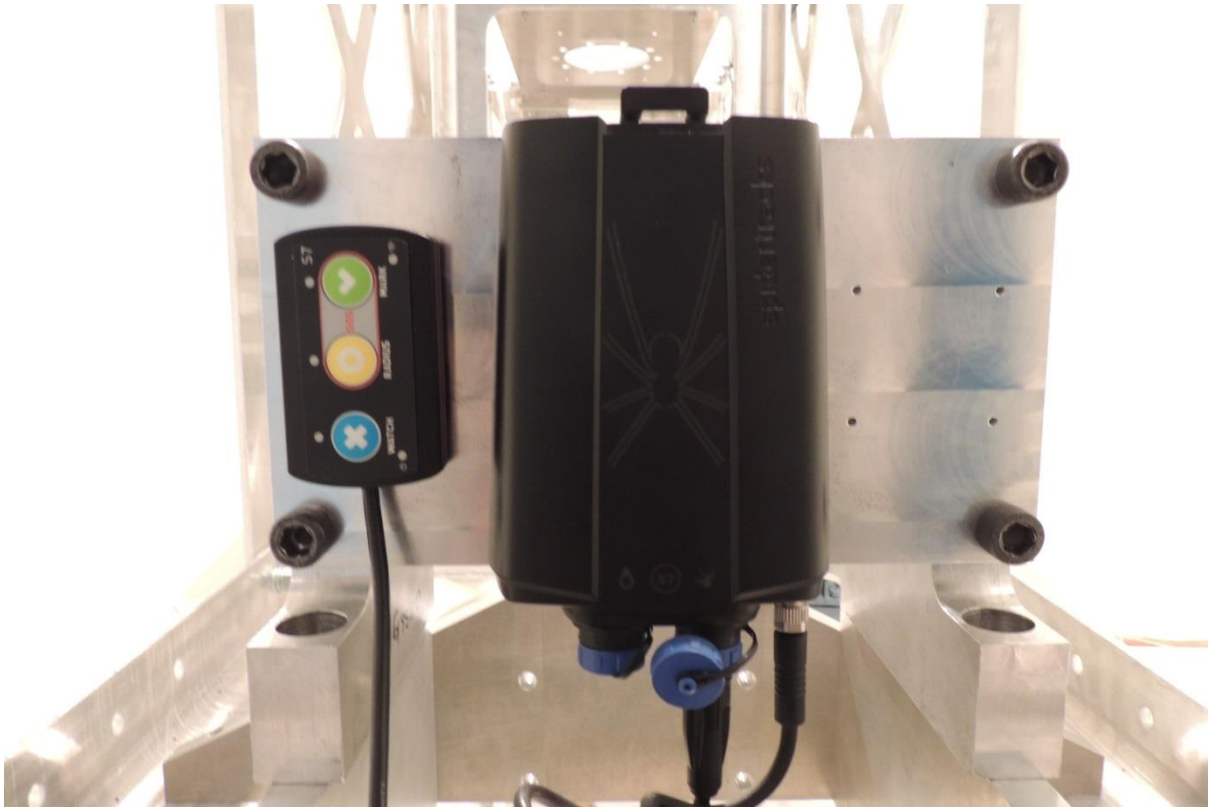


Figure 88: Bottom to centre of centrifuge pre test

Figure 89: Bottom to centre of centrifuge post test

D 11. **Left to Centre of Centrifuge**

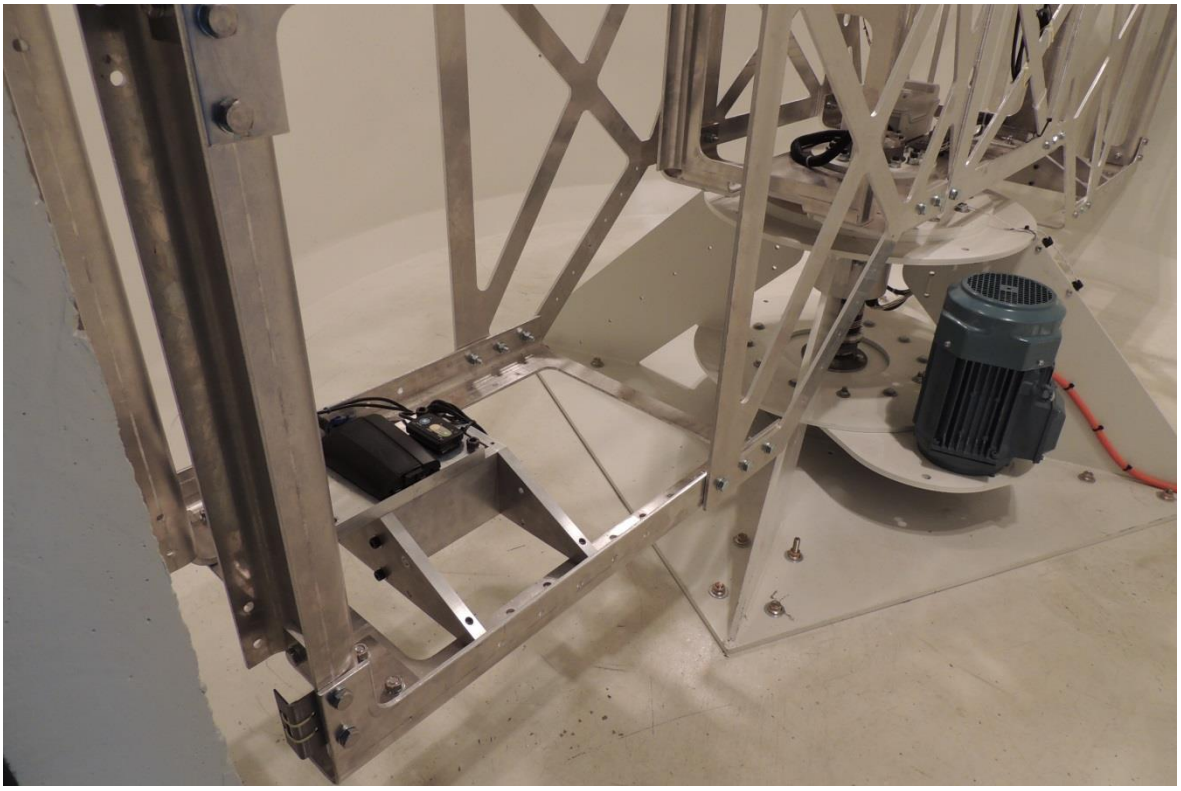


Figure 90: Unit mounting Left to centre of centrifuge

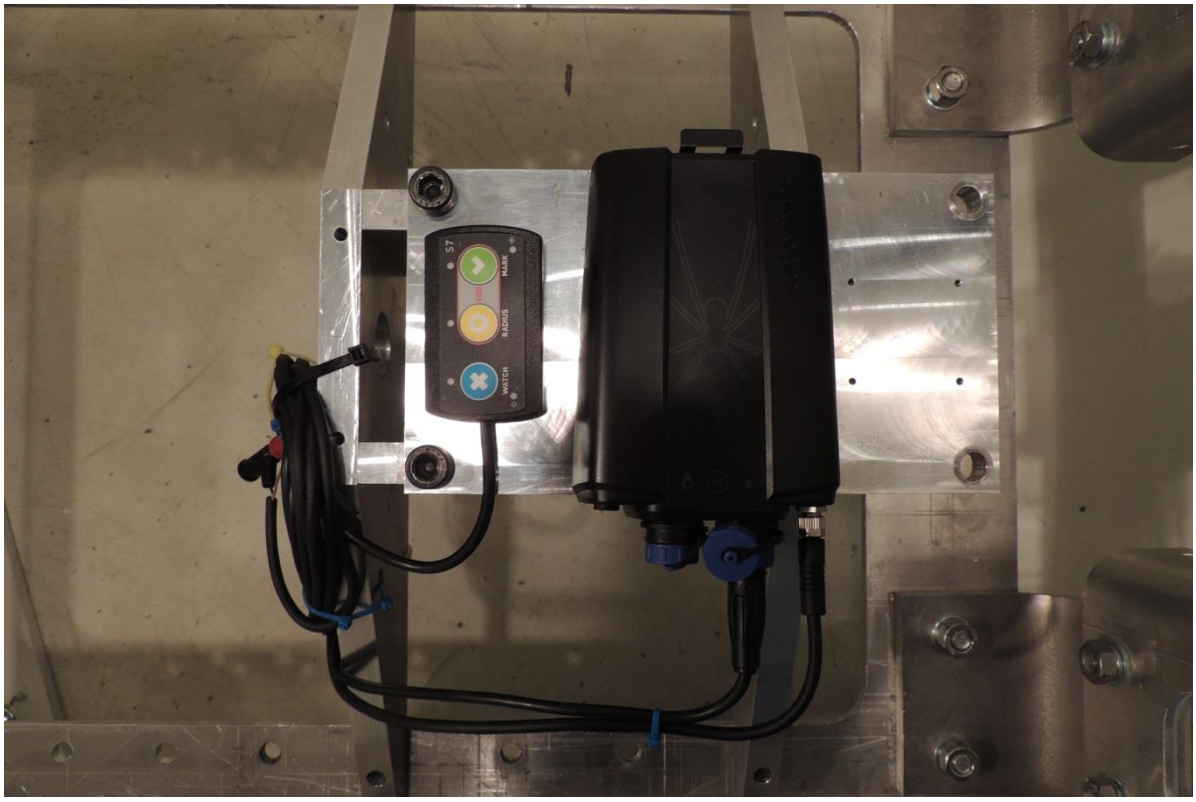


Figure 91: Left to centre of centrifuge pre test

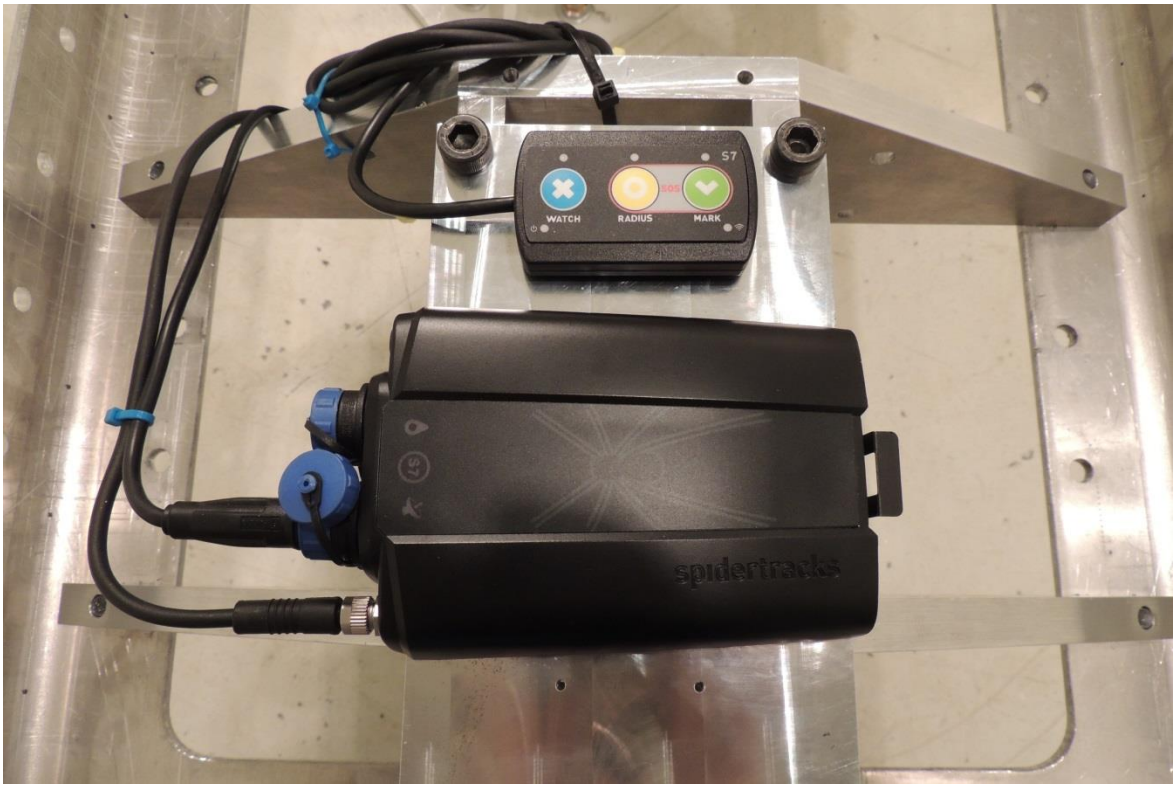


Figure 92: Left to centre of centrifuge post test

D 12. **Right to Centre of Centrifuge**

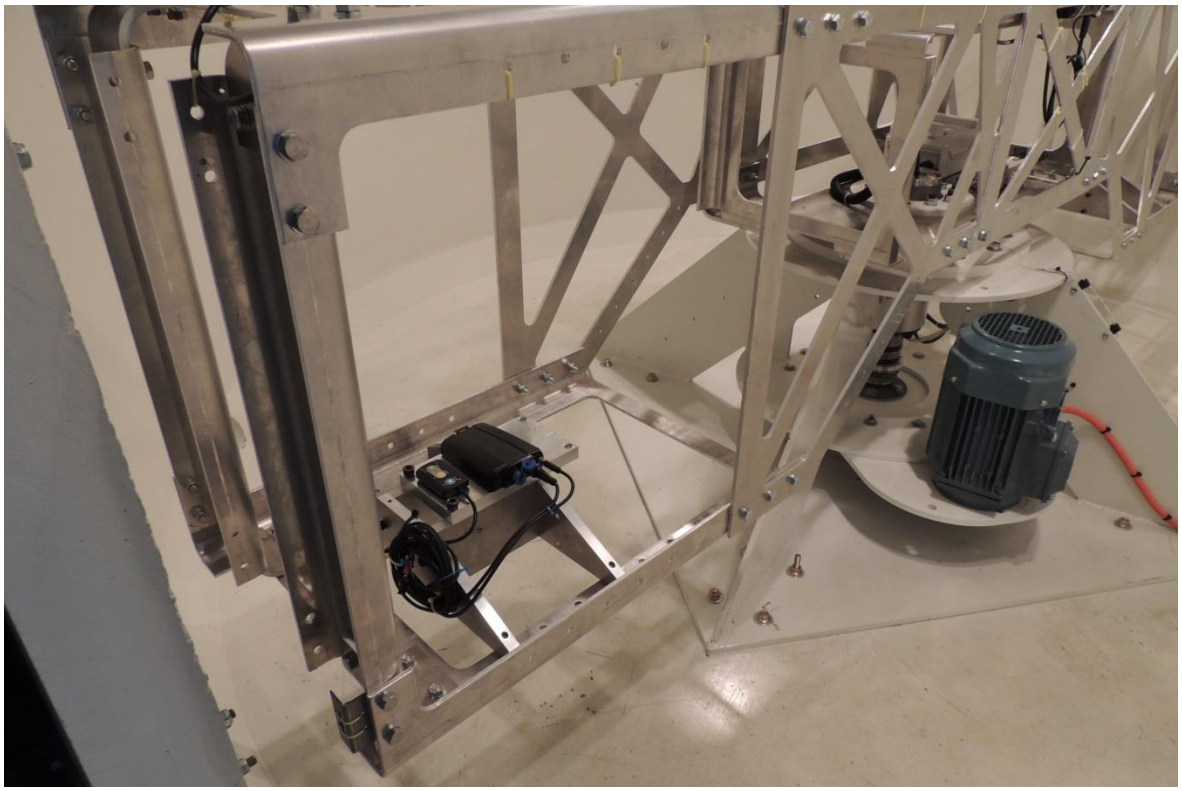


Figure 93: Unit mounting Right to centre of centrifuge

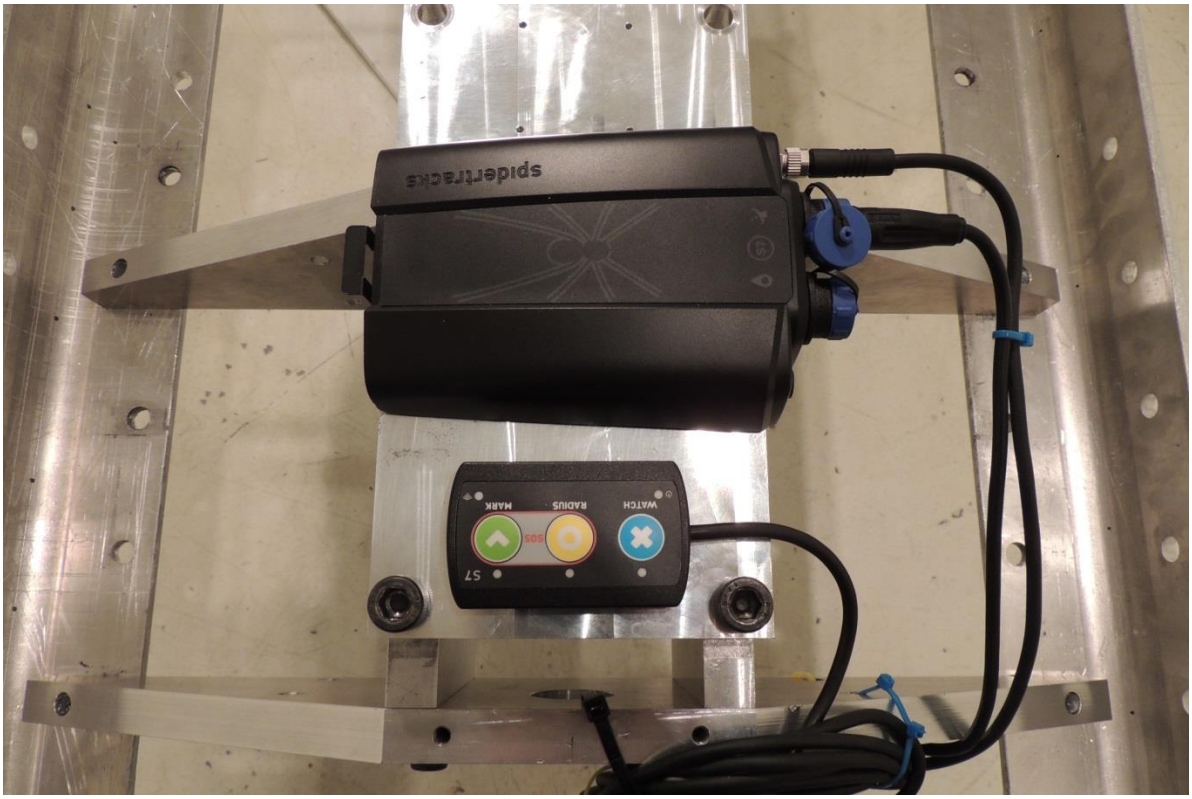


Figure 94: Right to centre of centrifuge pre test

Figure 95: Right to centre of centrifuge post test

The unit was visually inspected after the test. No defects were found.
The unit was then subjected to an ATP in accordance with Appendix E.

Figure 96: Acceptance test

D 13. **Qualification Test Report Form**

Qualification Test Report Form

1.0 Test Information

Test Performed:	36-0106 Issue C
Operational Test (circle):	Yes / (No)
Date (DD/MM/YYYY):	20/11/2015
Location:	FDS
Outside Contractor (if required):	SPIDERTRACKS
Test Supervisor:	ADRIAN SPITERI
Present Personnel:	
Ambient Temperature:	28.3 °C

2.0 Equipment Information

Test Item

P/N: SPIDERTRACKS S7 S/N: 2015BETA34

Golden Unit (if applicable)

P/N: N/A S/N: N/A

Equipment:

Name	Serial Number	Cal Date (DD/MM/YYYY)	Cal Expiry Date (DD/MM/YYYY)
Centrifuge P/N 79-1000-00	N/A	28/10/2015	28/10/2016

Form No: 21-0274
Issue:D

Qualification Test Report Form

3.0 Start Time

Date (DD/MM/YYYY):	20 / 11 /2015	Local Time:	09:31

4.0 Finish Time

Date (DD/MM/YYYY):	20 / 11 /2015	Local Time:	14:00

5.0 Notes

Back to centre	Start	09:31
	Finish	09:34
Front to centre	Start	09:52
	Finish	09:55
Top to centre	Start	10:56
	Finish	10:59
Bottom to centre	Start	11:15
	Finish	11:13
Left to centre	Start	13:36
	Finish	13:39
Right to centre	Start	13:57
	Finish	14:00

6.0 Signatures

Confirm that the Test Item passed as per test plan referenced above (Para 1.0), and that the appropriate test procedure was completed in full.

Test Result: FAIL/PASS

Test Engineer: A. SPITERI
Print/Sign

Signed:
Print/Sign

Date (DD/MM/YYYY): 20 / 11 /2015

Form No: 21-0274
Issue: D

Appendix E **OPERATIONAL AND ACCEPTANCE TESTS**

The following tests were supplied by the customer:

E 1. **Operational test (During environment test)**

1. Power the Spider using the auxiliary lead provided - ensure power supply is stable in the range of 10-28VDC and able to deliver 1.5A, ensure power supply is not interrupted during test.

2. After initial start-up sequence, which consists of the Spider's LED flashing several times and the keypad LEDs flashing 10sec. Afterwards, you should see a solid power LED on the unit (middle LED and bottom left on the keypad)

3. Within a 2-4 minute period the green GPS LED (left LED) on the unit should turn on, the bottom right LED on the Keypad should turn orange. The GPS LED and the orange LED on the keypad indicate GPS lock has been achieved.

4. Run during environmental test.

E 2. **Acceptance Test (Pre and Post environmental test)**

1. Position the Spider with an unobstructed and full view of the sky (horizon to horizon).

2. Power the Spider using the auxiliary lead provided - ensure power supply is stable in the range of 10-28VDC and able to deliver 1.5A

3. After initial start-up sequence, which consists of the Spider's LED flashing several times and the keypad LEDs flashing 10sec. Afterwards, you should see a solid power LED on the unit (middle LED and bottom left on the keypad)

4. Within a 2-4 minute period the green GPS LED (left LED) on the unit should turn on and the satellite LED (right LED) should turn on shortly after. The bottom right LED on the Keypad should turn orange and then green shortly after. The GPS LED and the orange LED on the keypad indicate GPS lock has been achieved. The satellite LED on the unit and green LED on the keypad indicate that the first position report has been sent through Iridium.

5. Please run through these steps before and after testing.

Appendix F **EQUIPMENT**

F 1. **FDS Calibrated Equipment**

Number	***Description***	***S/N***	***Calibration Expiry***
7251A-100	Accelerometer (Endevco)	14578	08/12/2016
DSX6650/16-930/2-HV	Electrodynamic Vibration System (Thermotron)	42586	12/02/2016
115C	Digital Multimeter (Fluke)	25601084	04/06/2016
79-1000-00	FDS Sustained Shock System (Centrifuge)	N/A	28/10/2016