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# Test Report Summary

## HT06603

Environmental & Mechanical Testing of
Shield Clips S0911-46R and S0921-46R

# 1. Introduction

## 1.1. Description and Purpose

The purpose of this test program is to confirm the environmental, mechanical, and electrical performance of Shield Clips S0911-46R and S0921-46R.

## 1.2. Conclusion

This report is a summary of the testing documented in Test Reports 1710, 1761, 1852, 1855 and 1857.

S0911-46R: Under the specified conditions the requirements for environmental, mechanical and electrical testing were met. Following results from the exploratory sweep, vibration tests were scaled back to 15G instead of 40G. It is recommended that if the clip is being used in harsh environments where there is likely to be high shock, vibration and bump requirements, 6 or more clips are used (although Harwin recommend independent testing is carried out as each application can vary).

S0921-46R: Under the specified conditions the requirements for environmental, mechanical and electrical testing were met. It is possible that this clip is suitable for use in environments where harsh vibration, shock and bump requirements would be experienced (although Harwin recommend independent testing is carried out as each application can vary).

# 2. Test Method and Requirements

## 2.1. Specification Parameters

| Testing Standard | Description of Test | Section | Page No. |
|---|---|---|---|
| **EIA-364-06C: 2006** | Contact Resistance | 3.1 | 3 |
| **EIA-364-09C: 1999** | Durability | 3.2 | 4-5 |
| **N/A** | SMT Retention to Board | 3.3 | 5 |
| **N/A** | Force vs Deflection | 3.4 | 6-7 |
| **EIA-364-17B: 1999** | Temperature Life (without loading) | 3.5 | 7 |
| **EIA-364-32C: 2000 (BS EN 60068-2-14:2009)** | Thermal Shock (Temperature Cycling) | 3.6 | 8 |
| **EIA-364-31B: 1999 (BS EN 60068-2-78:2013)** | Humidity | 3.7 | 8 |
| **EIA-364-26B: 1999 (BS EN 60068-2-11:1999)** | Salt Spray | 3.8 | 9 |
| **EIA-364-28D: 1999 (BS EN 60068-2-6:2008)** | Vibration | 3.9 | 10-12 |
| **EIA-364-27B: 1996 (BS EN 60068-2-27:2009)** | Mechanical Shock | 3.10 | 13 |
| **MIL STD 285** | RF Attenuation | 3.11 | 14-15 |

## 2.2. List of Test Samples.

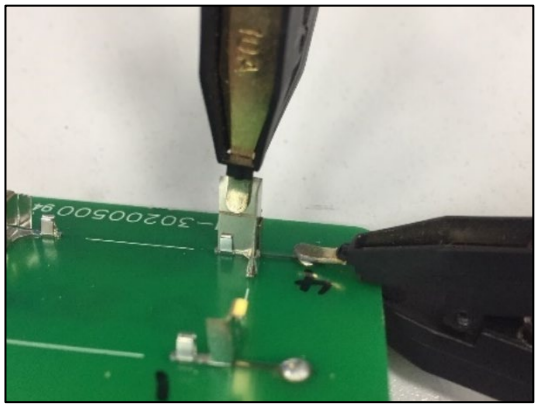
The two clips under test were S0911-46R Compact Shield Clip and S0921-46R Corner Shield Clip. For all these tests the clips were SMT soldered to test boards, in the following configurations:

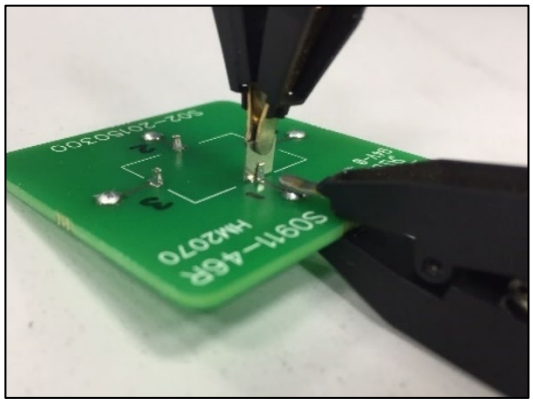
- Test board A: 4 x S0911-46R Shield Clips, with Shield Can S02-30200250 assembled
- Test board B: 4 x S0911-46R Shield Clips, with Shield Can S02-20150300 assembled
- Test board C: 6 x S0911-46R Shield Clips, with Shield Can S02-20150300 assembled
- Test board D: 6 x S0911-46R Shield Clips, with Shield Can S02-30200250 assembled
- Test board E: 4 x S0921-46R Shield Clips, with Shield Can S01-30300500 assembled
- Test board F: 4 x S0921-46R Shield Clips, with Shield Can S01-50250500 assembled

## 3. Test Results

### 3.1. Contact Resistance: EIA-364-06C: 1999

Methodology: The cans from test boards containing S0911-46R & S0921-46R were removed. The clips were mated to a cutting of blank shield can from S01-806005KIT (1x1 & 2x2 size cuttings used, respectively). The contact resistance of the clip mated with the shield can was measured prior to any electrical, mechanical or environmental testing (listed as INITIAL in the table). Samples were also tested post-conditioning (after tests 3.2, 3.6, 3.7, 3.8).



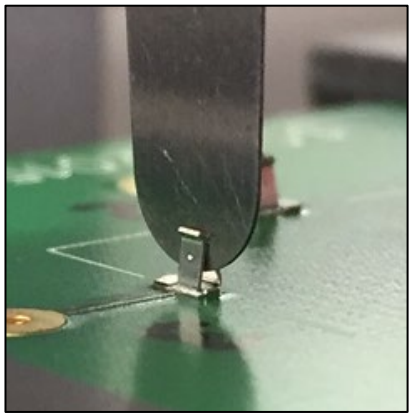


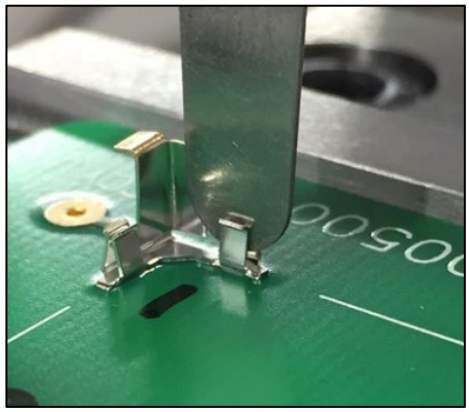
Results:

| Component | Test | | Contact Resistance (mΩ) | | |
|---|---|---|---|---|---|
| | | | Maximum | Minimum | Average |
| S0911-46R | Initial | | 5.00 | 4.30 | **4.60** |
| | Durability | | 5.70 | 4.50 | **5.10** |
| | Humidity | | 5.50 | 4.70 | **5.20** |
| | Thermal Shock | | 5.40 | 4.80 | **5.20** |
| | Salt Spray | | 19.70 | 13.90 | **15.70** |
| | Temperature Life | 96hrs | 6.30 | 3.90 | **4.90** |
| | | 250 hrs | 5.80 | 3.80 | **4.80** |
| | | 1,000 hrs | 5.80 | 4.80 | **5.10** |
| S0921-46R | Initial | | 2.85 | 2.31 | **2.67** |
| | Durability | | 2.86 | 2.48 | **2.71** |
| | Humidity | | 2.87 | 2.73 | **2.81** |
| | Thermal Shock | | 2.89 | 2.73 | **2.81** |
| | Salt Spray | | 6.03 | 4.22 | **5.27** |
| | Temperature Life | 96hrs | 3.51 | 2.79 | **3.05** |
| | | 250 hrs | 3.22 | 2.77 | **3.01** |
| | | 1,000 hrs | 3.11 | 2.85 | **2.99** |

## 3.2. Durability: EIA-364-09C: 1999

Methodology: S0911-46R clips assembled to test boards were mated with 0.15 & 0.20mm thickness gauges. S0921-46R clips assembled to test boards were mated with 0.30 & 0.40mm thickness gauges. The test was performed at a speed of 25mm/min for 30 cycles. Insertion and withdrawal forces were measured. Samples were also tested post-conditioning (after tests 3.5, 3.6, 3.7, 3.8).





Results: Insertion Forces and post-conditioning results after Durability test.

| Part Number | Gauge (mm) | Condition | Maximum (N) | Minimum (N) | Average (N) | Calculated Average Force: Shield Can to 4 Clips (N) |
|---|---|---|---|---|---|---|
| **S0911-46R** | 0.15 | Initial Force | 1.552 | 1.030 | 1.246 | 4.807 |
| | | Cycling Force | 1.552 | 1.030 | 1.262 | |
| | | Final Force | 1.369 | 0.843 | 1.097 | |
| **S0911-46R** | 0.20 | Initial Force | 2.086 | 1.358 | 1.705 | 6.360 |
| | | Cycling Force | 2.086 | 1.358 | 1.711 | |
| | | Final Force | 1.597 | 1.116 | 1.354 | |
| **S0921-46R** | 0.30 | Initial Force | 6.219 | 4.104 | 4.958 | 28.792 |
| | | Cycling Force | 6.219 | 4.104 | 4.958 | |
| | | Final Force | 3.018 | 2.201 | 2.717 | |
| **S0921-46R** | 0.40 | Initial Force | 7.040 | 4.100 | 5.789 | 42.037 |
| | | Cycling Force | 7.040 | 4.708 | 5.850 | |
| | | Final Force | 5.555 | 3.194 | 4.125 | |

| Part Number | Gauge (mm) | Test | | Maximum (N) | Minimum (N) | Average (N) |
|---|---|---|---|---|---|---|
| **S0911-46R** | 0.20 | Initial | | 2.086 | 1.116 | **1.590** |
| | | Salt Spray | | 1.962 | 0.705 | **1.499** |
| | | Humidity | | 1.593 | 0.179 | **0.836** |
| | | Thermal Shock | | 2.022 | 0.623 | **1.189** |
| | | Temperature | 96 hrs | 1.933 | 0.168 | **0.691** |
| | | | 250 hrs | 1.365 | 0.369 | **0.862** |
| | | | 1,000 hrs | 1.839 | 0.716 | **1.046** |
| **S0921-46R** | 0.30 | Initial | | 6.219 | 2.201 | **4.211** |
| | | Salt Spray | | 6.704 | 2.929 | **5.121** |
| | | Humidity | | 3.936 | 1.227 | **2.559** |
| | | Thermal Shock | | 3.582 | 0.948 | **2.807** |
| | | Temperature | 96 hrs | 4.380 | 0.705 | **2.905** |
| | | | 250 hrs | 4.719 | 1.533 | **3.379** |
| | | | 1,000 hrs | 3.149 | 1.399 | **2.224** |

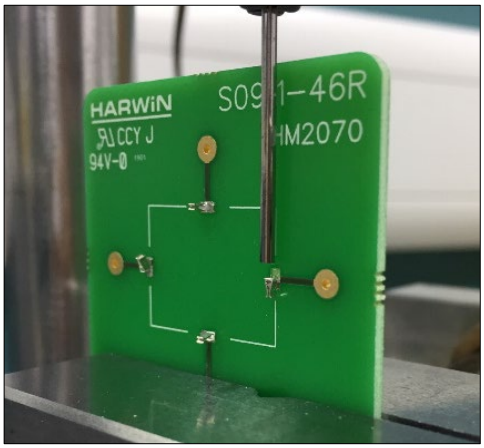
Results: Withdrawal Forces and post-conditioning results after Durability test.

| Part Number | Gauge (mm) | Condition | Maximum (N) | Minimum (N) | Average (N) | Calculated Average Force: Shield Can from 4 Clips (N) |
|---|---|---|---|---|---|---|
| **S0911-46R** | 0.15 | Initial Force | 0.772 | 0.534 | 0.677 | 3.027 |
| | | Cycling Force | 1.138 | 0.704 | 0.876 | |
| | | Final Force | 0.862 | 0.582 | 0.717 | |
| **S0911-46R** | 0.20 | Initial Force | 0.821 | 0.575 | 0.685 | 2.861 |
| | | Cycling Force | 0.895 | 0.705 | 0.792 | |
| | | Final Force | 0.750 | 0.589 | 0.669 | |
| **S0921-46R** | 0.30 | Initial Force | 6.316 | 1.545 | 3.429 | 9.544 |
| | | Cycling Force | 6.316 | 1.776 | 3.536 | |
| | | Final Force | 2.641 | 1.496 | 1.919 | |
| **S0921-46R** | 0.40 | Initial Force | 1.813 | 1.541 | 1.684 | 15.651 |
| | | Cycling Force | 4.731 | 1.776 | 2.266 | |
| | | Final Force | 2.641 | 1.496 | 1.919 | |

| Part Number | Gauge (mm) | Test | | Maximum (N) | Minimum (N) | Average (N) |
|---|---|---|---|---|---|---|
| **S0911-46R** | 0.20 | Initial | | 0.895 | 0.575 | **0.715** |
| | | Salt Spray | | 1.474 | 0.425 | **0.969** |
| | | Humidity | | 0.877 | 0.164 | **0.482** |
| | | Thermal Shock | | 1.571 | 0.317 | **0.702** |
| | | Temperature | 96 hrs | 0.966 | 0.175 | **0.413** |
| | | | 250 hrs | 1.056 | 0.358 | **0.630** |
| | | | 1,000 hrs | 1.074 | 0.347 | **0.650** |
| **S0921-46R** | 0.30 | Initial | | 1.705 | 1.007 | **1.327** |
| | | Salt Spray | | 2.119 | 1.149 | **1.775** |
| | | Humidity | | 1.634 | 0.515 | **0.949** |
| | | Thermal Shock | | 1.369 | 0.429 | **0.828** |
| | | Temperature | 96 hrs | 1.194 | 0.399 | **0.770** |
| | | | 250 hrs | 2.100 | 0.631 | **1.378** |
| | | | 1,000 hrs | 1.977 | 0.418 | **1.181** |

## 3.3. SMT Retention to Board

Methodology: Components S0911-46R & S0921-46R were assembled on to test boards. A lateral force was applied to the wings of the components until they broke or peeled away from the board.



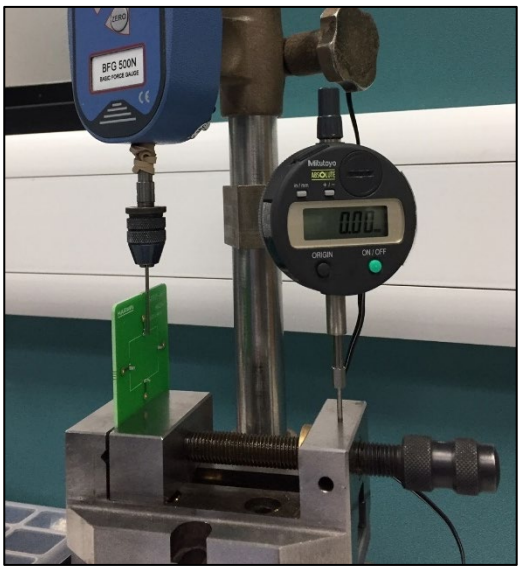


Results:

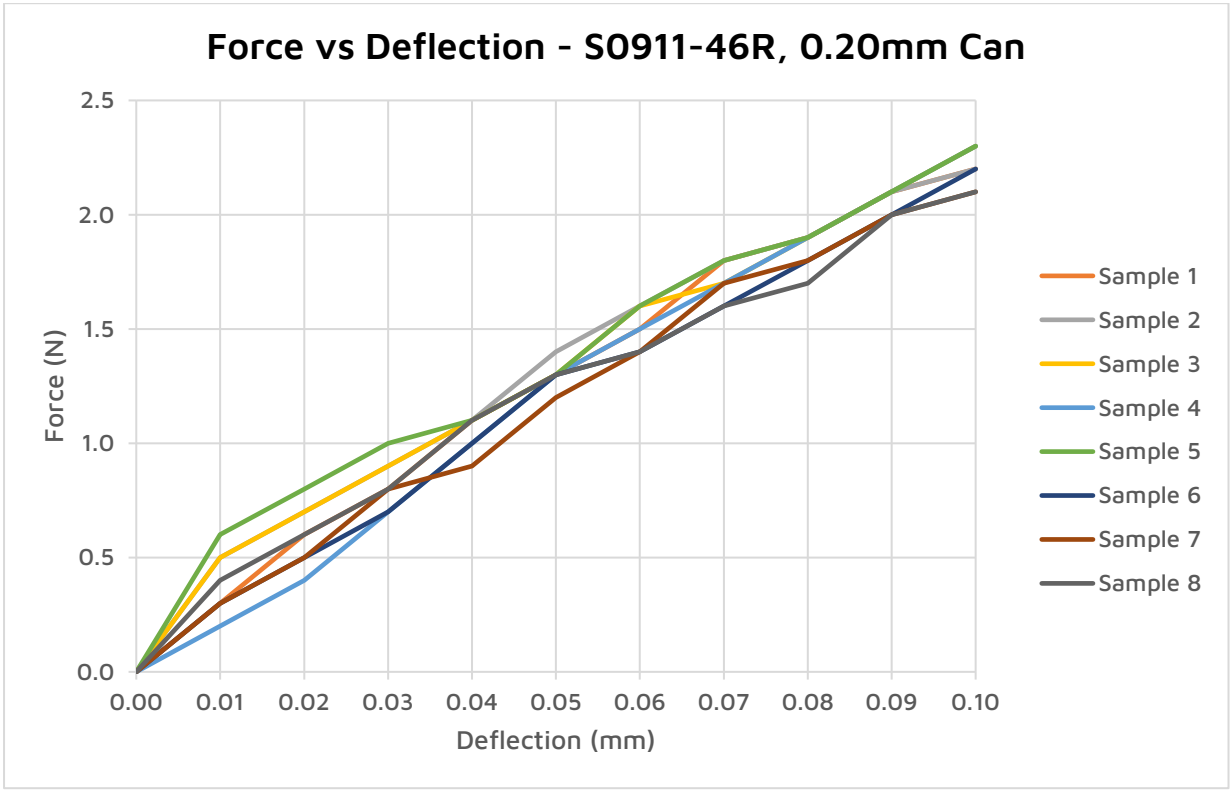
| Part Number | Maximum (N) | Minimum (N) | Average (N) |
|---|---|---|---|
| **S0911-46R** | 81.7 | 47.8 | **58.3** |
| **S0921-46R** | 62.0 | 48.9 | **58.2** |

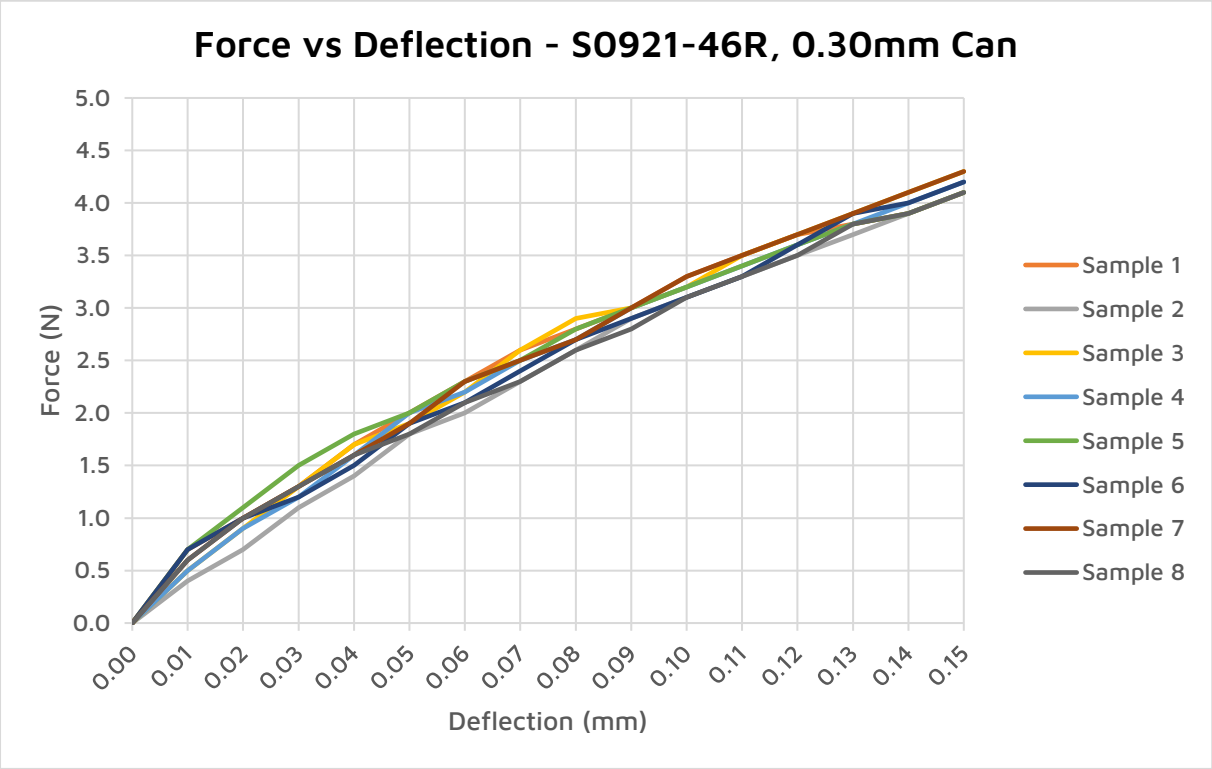
### 3.4. Force vs Deflection

Methodology: Components S0911-46R & S0921-46R were assembled on to test boards. A lateral force was applied to one contact side (wing) at deflection increments of 0.01mm – the force at each step was noted. Deflection was continued up to 0.10mm deflection for S0911-46R, and 0.15mm deflection for S0921-46R. The distance of permanent set after maximum deflection was measured.




Results:






| Part Number | Permanent Set – After Deflection (mm) | | |
|---|---|---|---|
| | Maximum | Minimum | Average |
| **S0911-46R** | 0.02 | 0.01 | **0.02** |
| **S0921-46R** | 0.04 | 0.03 | **0.03** |

### 3.5. Temperature life (Without Load): EIA-364-17B:1999

Methodology: Testing was performed to EIA-364-17B, condition 5, method A. Clips assembled to test boards were subjected to 96 hours, 250 hours and 1,000 hours at 105±2°C. The samples were measured for contact resistance and durability, as well as a visual inspection after testing.
Results: No obvious visual changes were noted. See also results table in section 3.1.

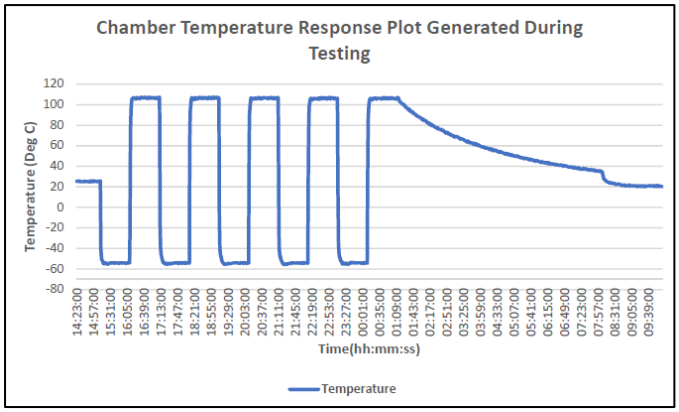
| Part Number | Duration in Temperature Testing Oven | | |
|---|---|---|---|
| | 96 hours | 250 hours | 1,000 hours |
| **S0911-46R** | Pass | Pass | Pass |
| **S0921-46R** | Pass | Pass | Pass |

## 3.6. Thermal Shock: EIA-364-32C: 2000

Methodology: Thermal Shock Testing was performed to the shield clips assembled to the test boards in accordance with BS EN 60068-2-14:2009 Test Na and EIA364-32C Test Condition 7, using the following conditions:

- Temperature Extremes = -55°C and +105°C
- Dwell times 1 hr at each temperature extreme
- 5 cycles

The samples were measured for contact resistance and durability, as well as a visual inspection after testing.





*Samples in Thermal Shock Chamber*

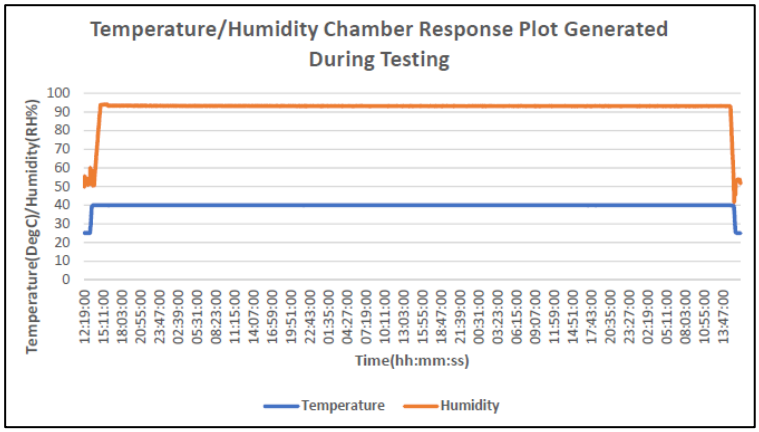
Results: No obvious visual changes were noted. See also results table in section 3.1.

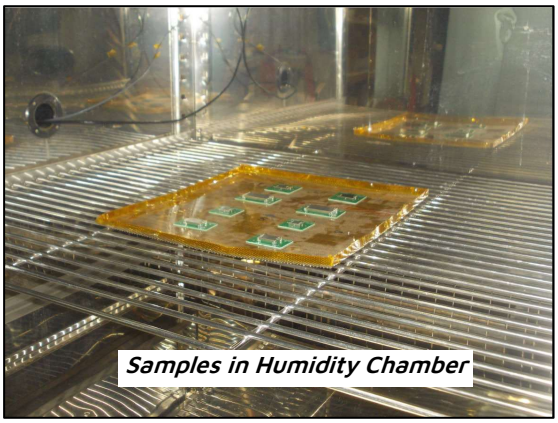
## 3.7. Humidity (Steady State): EIA-364-31B: 1999

Methodology: A Steady State Humidity test was performed on the two clips assembled to test boards, in accordance with BS EN 60068-2-78-2013 Test Cab and EIA-364-31B Method 2 Test Condition A, using the following conditions:

- Ambient Temperature = +40°C
- Steady state humidity = 90% to 95% Rh
- Duration = 96hrs

The samples were measured for contact resistance and durability, as well as a visual inspection after testing.





*Samples in Humidity Chamber*

Results: No obvious visual changes were noted. See also results table in section 3.1.

## 3.8. Salt Spray: EIA-364-26B: 1999

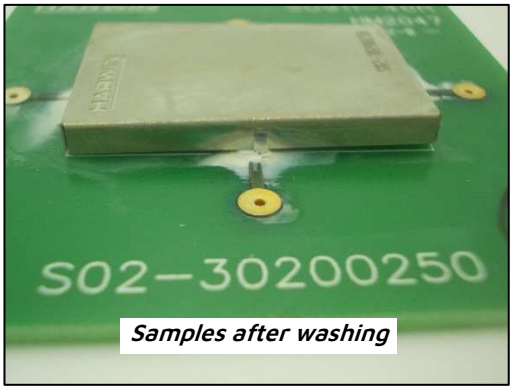
Methodology: A salt mist test was performed on test boards including the two clips, in accordance with BS EN 60068-2-11:1999 Test Ka, using the following conditions:

- Salt solution = 5% NaCl
- Salt Mist chamber temperature = +35°C
- 96hrs continuous salt spray
- Fallout rates = 0.5-3ml per hr
- pH level = 6.5 to 7.2

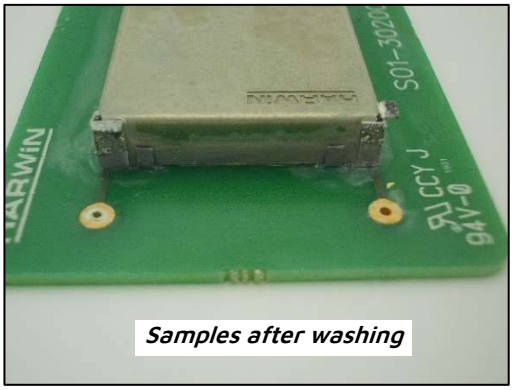
On completion of the salt mist duration, the samples were dipped in running water and placed into a temperature chamber at +38°C for 16hrs. The samples were measured for contact resistance and durability, as well as a visual inspection after testing.


*Samples in Salt Mist Chamber*

*Samples being washed*



*Samples after washing*



*Samples after washing*

Results: No obvious visual changes were noted. See also results table in section 3.1.

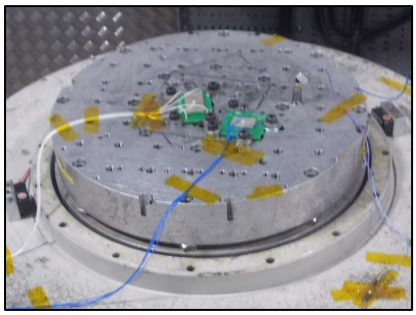
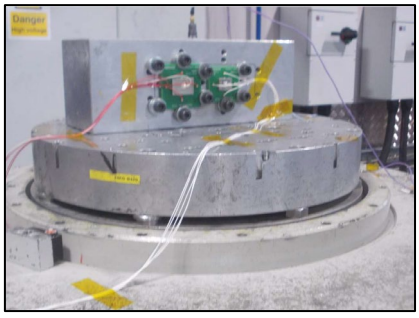
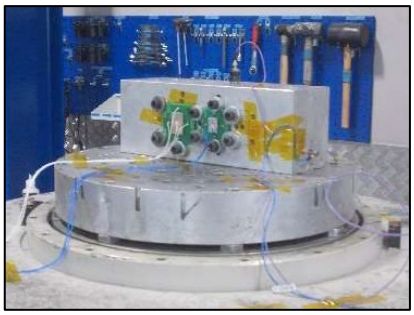
## 3.9. Vibration: EIA-364-28D: 1999

Methodology: One of each assembled test board were placed onto a shaker table and subjected to a sine vibration test, performed in accordance with BS EN 60068-2-6:2008 Test Fc and EIA-364-28D Test Condition 4, using the following conditions:

- Vertical sine sweep investigation only: 10Hz to 2,000Hz with increasing incremental acceleration steps of: 10G, 15G, 20G, 23G, 26G, 29G, 32G, 35G, 38G and 40G.
- If discontinuity was noted at any particular acceleration, a dwell of 4 hours at -5G of that set-point was performed.
- If at 40G no discontinuity was noted, a sine sweep at 40G for a duration of 4 hours per axis was performed.

The following profiles were then applied for the sine endurance vibration on all samples, on completion of the investigational sweeps:

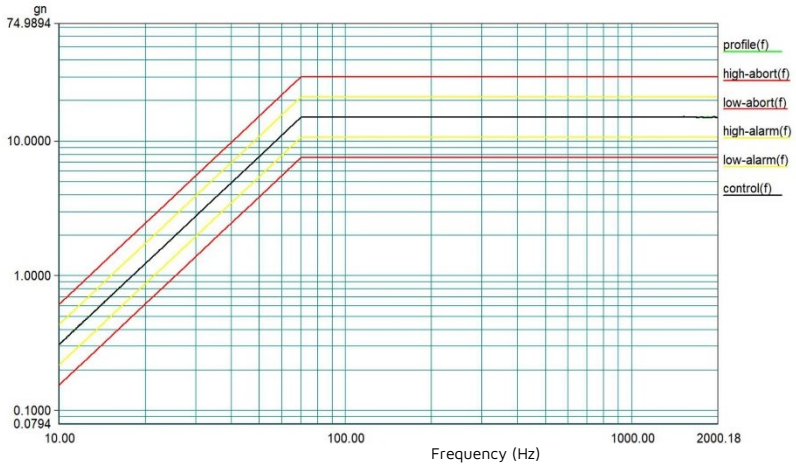
- 10Hz to 2,000Hz and return to 10Hz, traversed in 20 minutes.
- This cycle performed 12 times in each of three mutually perpendicular directions (total of 36 times).

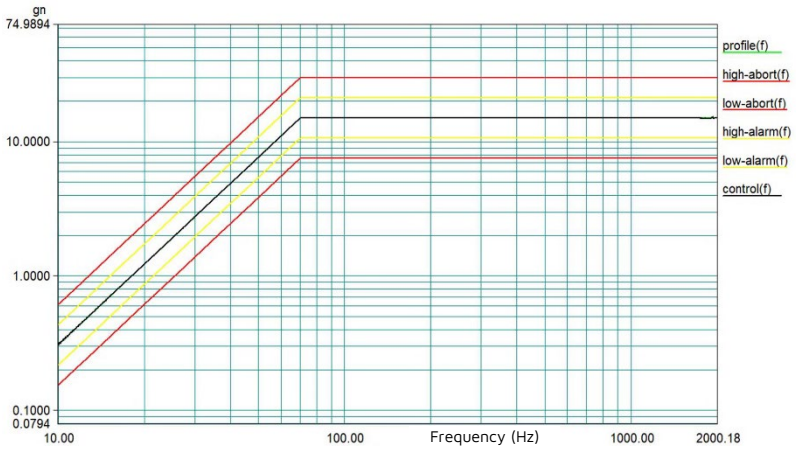
Results:

- **S9011-46R with 4 clips, test boards A and B (can S02-30200250, can S02-20150300)** Following the exploratory sweep at an endurance level of 15G (10-70Hz at 1.52mm amplitude followed by 70-2,000Hz at 15G), test samples triggered multiple times during the 4 hour endurance tests in each axis. In some cases, the corner of the shield can lifted slightly from the clips, but never fully removed from the board.
- **S9021-46R with 4 clips, test boards E and F (can S01-30300500, can S01-50250500)** Following the exploratory sweep at an endurance level of 40G (10-114.3Hz at 1.52mm amplitude followed by 114.3-2,000Hz at 40G), no discontinuities were noted during the 4 hour endurance tests, in each axis.

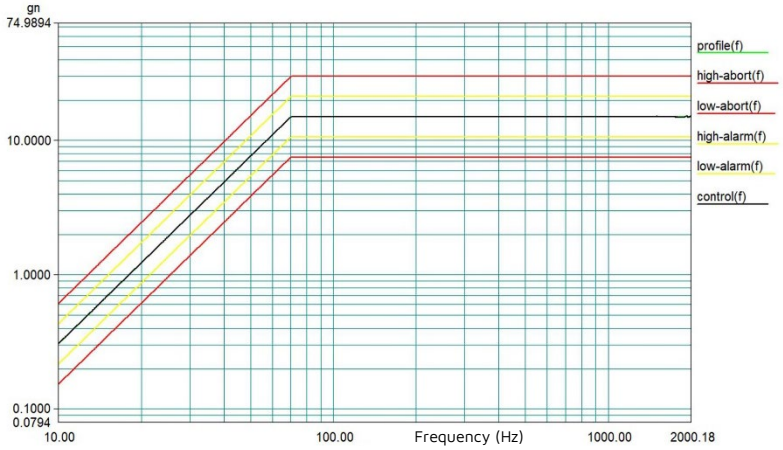
### 3.9.1. Vertical Axis – S0911-46R, 4 clip configuration



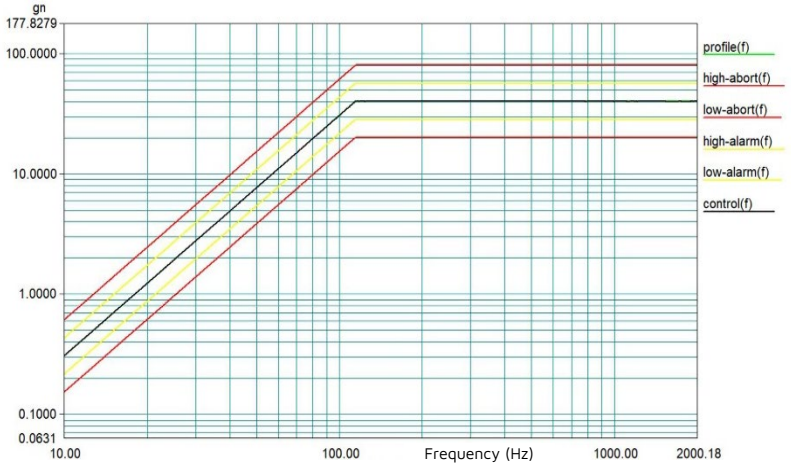
### 3.9.2. Transverse Axis – S0911-46R, 4 clip configuration



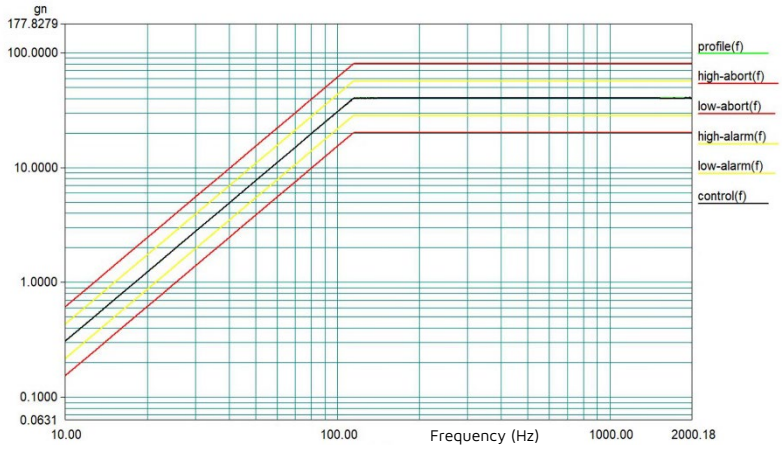

### 3.9.3. Longitudinal Axis – S0911-46R, 4 clip configuration



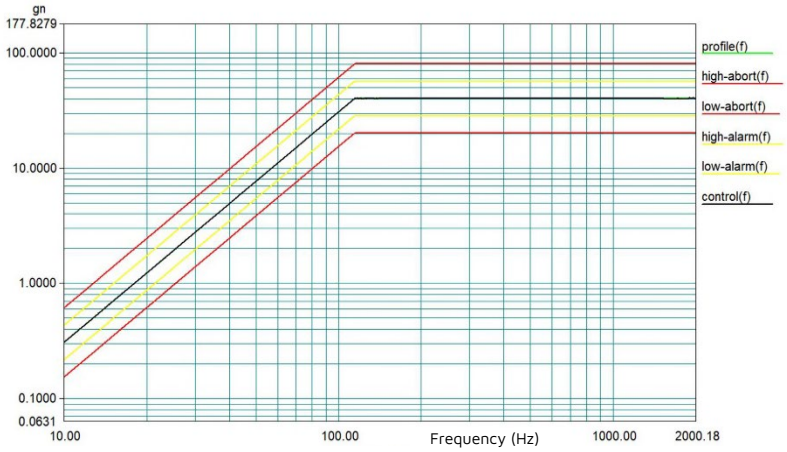

### 3.9.4. Vertical Axis – S0921-46R, 4 clip configuration

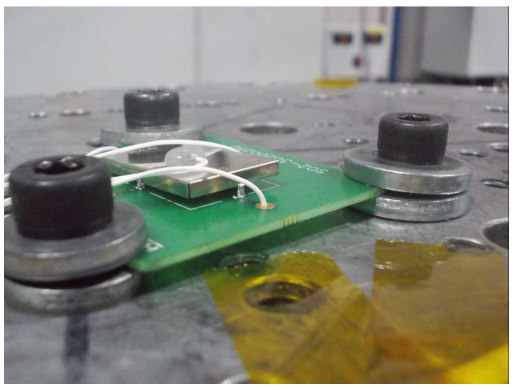


### 3.9.5. Transverse Axis – S0921-46R, 4 clip configuration




### 3.9.6. Longitudinal Axis – S0921-46R, 4 clip configuration



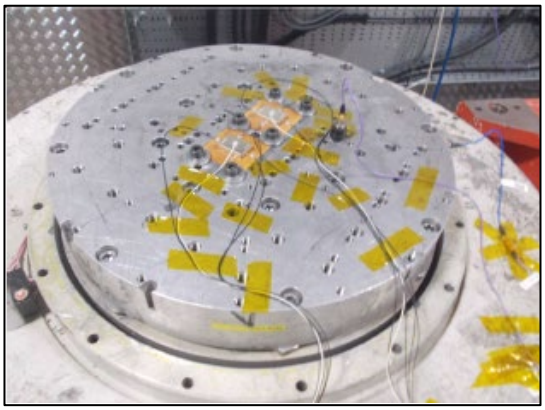



***Example of lifted shield can post vibration testing***

## 3.10. Shock: EIA-364-27B:1996

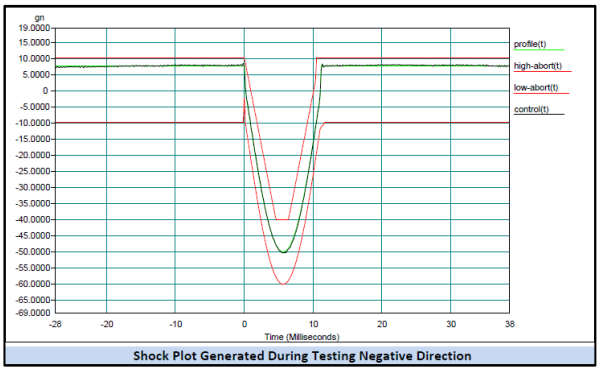
Methodology: The samples were placed onto the shaker and subjected to a Shock Test performed in accordance with BS EN 60068-2-27:2009 Test Ea and EIA-364-27B test conditions A & C, using the following conditions:

- Acceleration 50G, Shock duration 11ms, Shock shape Half sine pulse, 3 shocks in each case, vertical axis only, monitor for discontinuity throughout testing to 1 microsecond.
- Acceleration 100G, Shock duration 3ms, Shock shape half sine pulse, 3 shocks in each case, vertical axis only, monitor for discontinuity throughout testing to 1 microsecond.

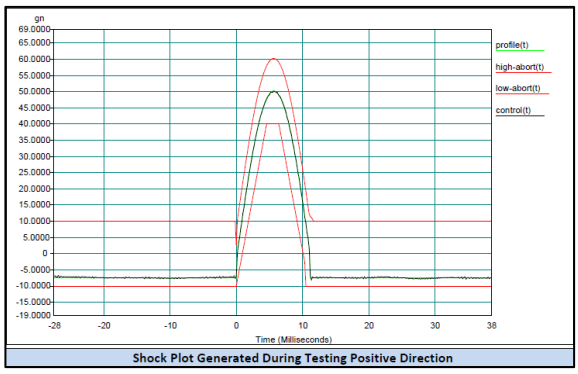


Results:

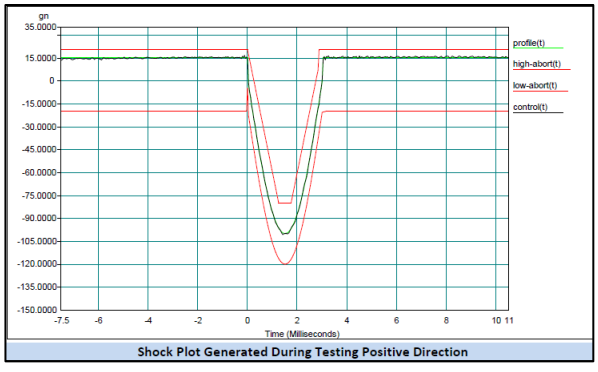
- **S9011-46R with 4 / 6 clips, test boards B and C (small can S02-20150300).**
  No discontinuities were noted during the 50G and 100G tests.
- **S9021-46R with 4 clips, test boards E and F (can S01-30300500, can S01-50250500).**
  No discontinuities were noted during the 50G and 100G tests.
- **S9011-46R with 4 / 6 clips, test boards A and D (larger can S02-30200250).**
  No discontinuities were noted during the 50G test. Discontinuities were noted during the 100G tests. Shield cans had lifted slightly, but never fully removed from clips.



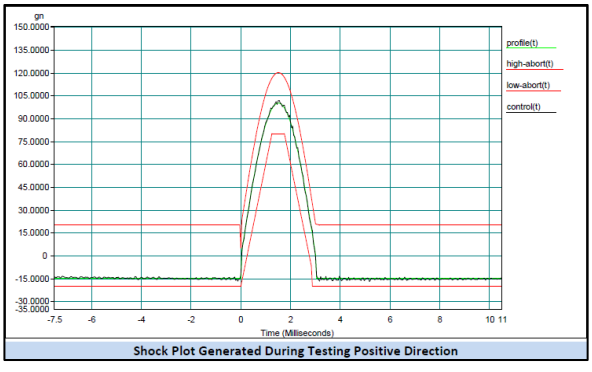
Shock Plot Generated During Testing Negative Direction



Shock Plot Generated During Testing Positive Direction



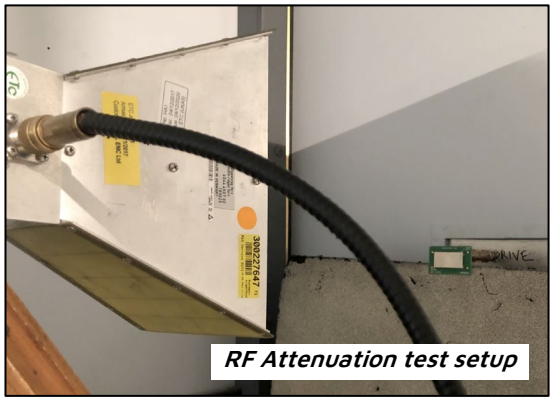
Shock Plot Generated During Testing Positive Direction



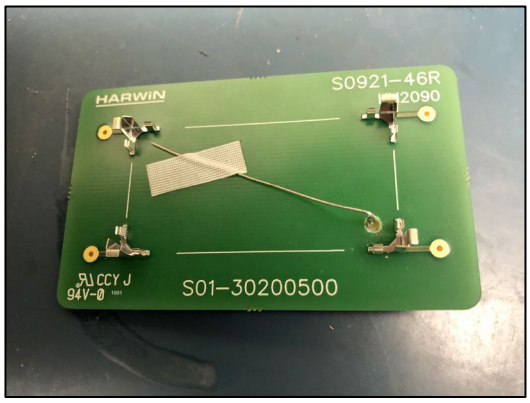
Shock Plot Generated During Testing Positive Direction

### 3.11. RF Attenuation: MIL STD 285

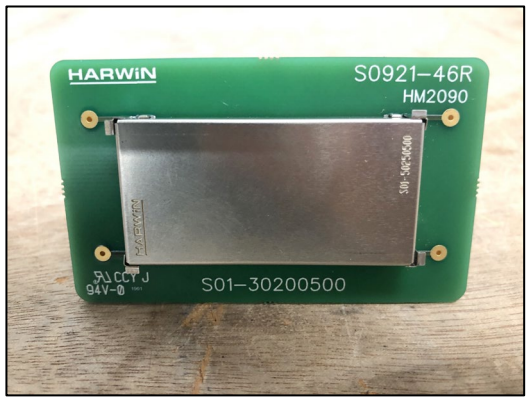
Methodology: Measurements were made in general accordance with MIL STD 285. Each test sample was mounted (without the shield can fitted) on a fixed jig within a screened test chamber and a stepped measurement made between 1GHz and 18GHz. This test was subsequently repeated with the shield can fitted (without any other changes in the test system). The difference in levels recorded between the two runs is the RF Attenuation offered by the shield can, expressed in dBs.



*RF Attenuation test setup*

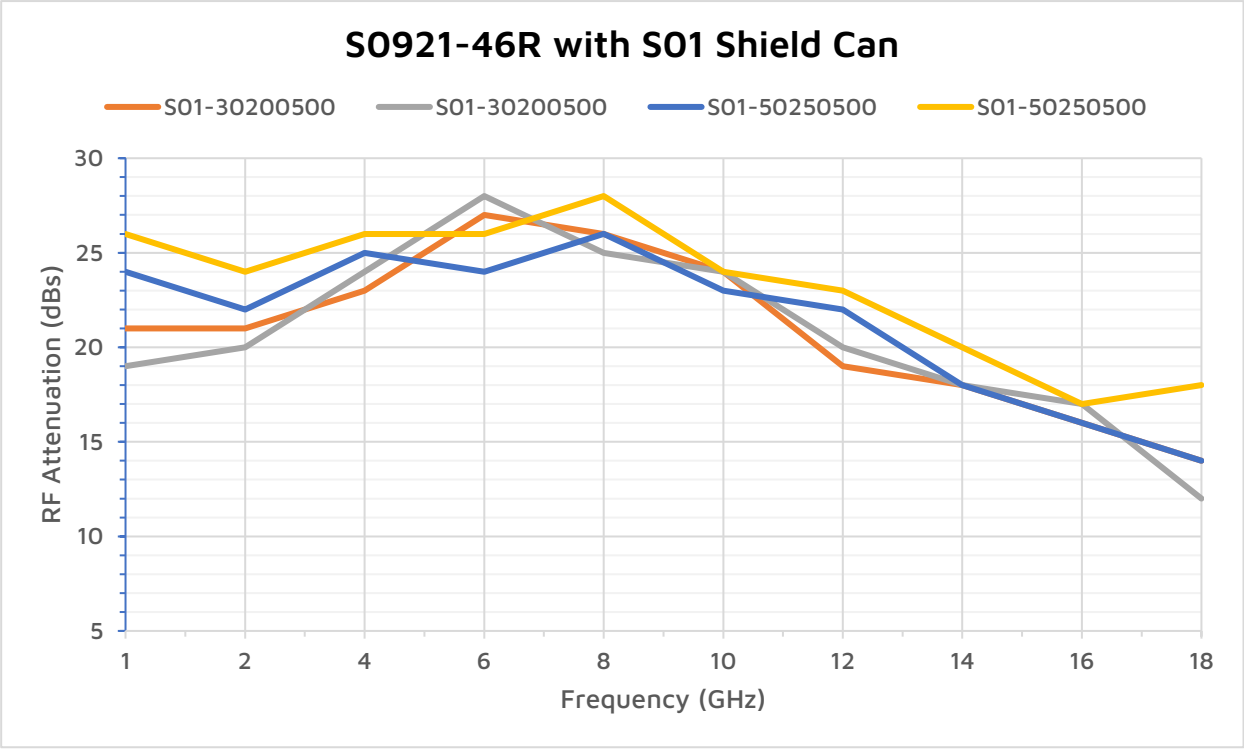


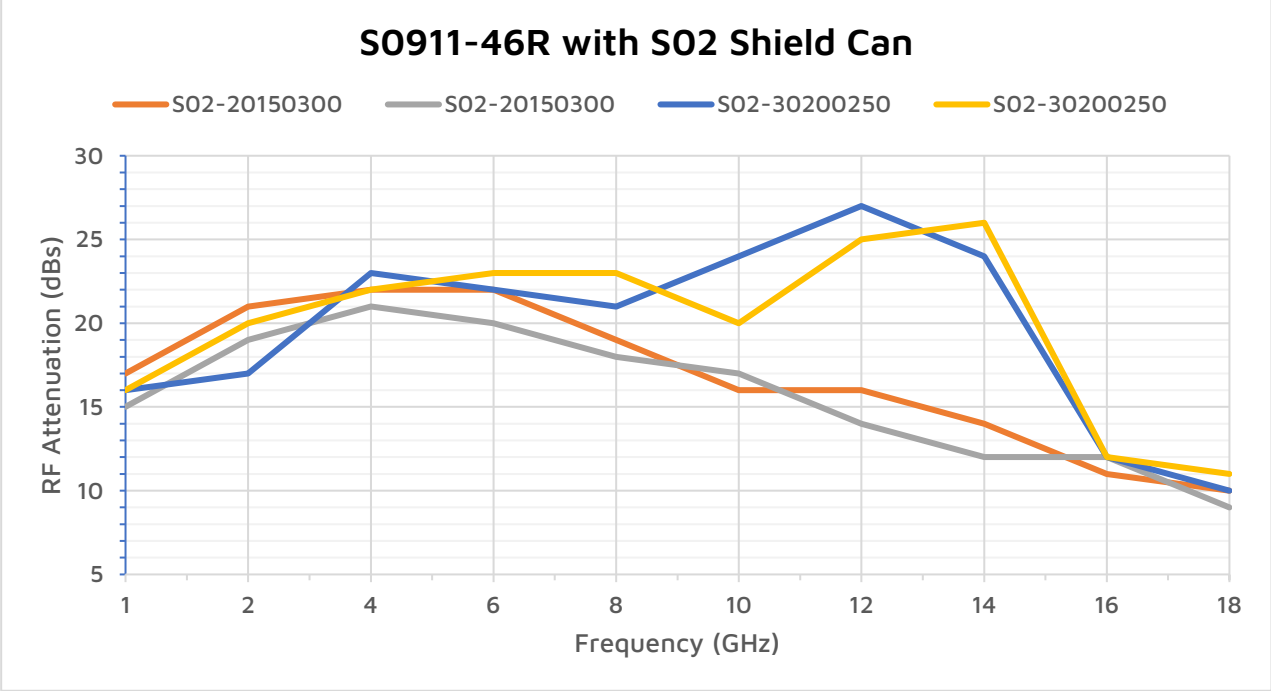

*Test board (calibration configuration)*




*Test board (measurement configuration)*

Results:


S0921-46R with S01 Shield Can
S01-30200500
S01-30200500
S01-50250500
S01-50250500
RF Attenuation (dBs)
30
25
20
15
10
5
1
2
4
6
8
10
12
14
16
18
Frequency (GHz)


S0911-46R with S02 Shield Can
S02-20150300
S02-20150300
S02-30200250
S02-30200250
RF Attenuation (dBs)
30
25
20
15
10
5
1
2
4
6
8
10
12
14
16
18
Frequency (GHz)