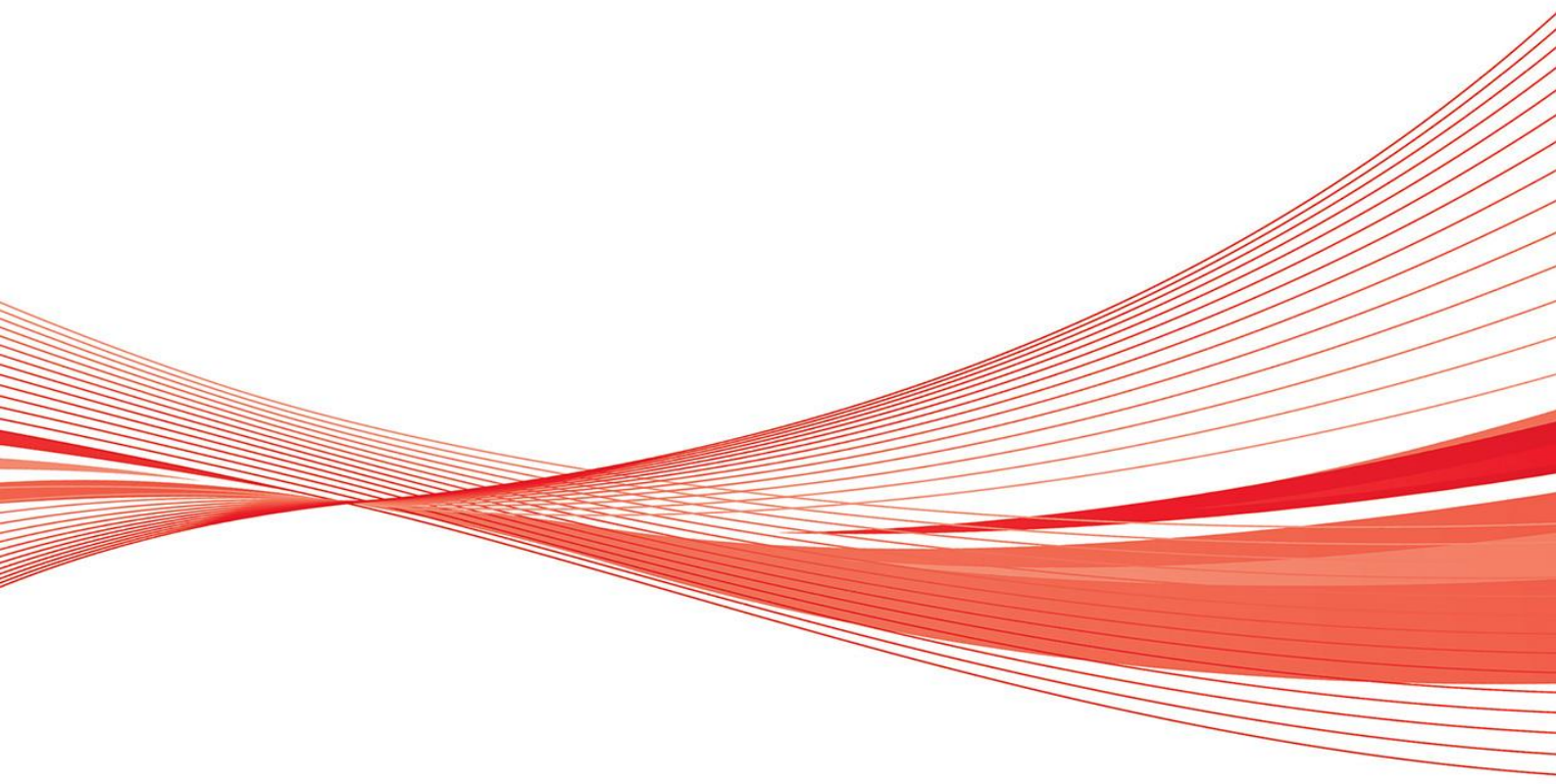
# Harwin Test Report Summary

## HT07901

### Datamate Backshell & Shielded Cables
### Attenuation Testing



harwin.com

# 1. Introduction

## 1.1. Description and Purpose

The purpose of this testing is to determine the RF Attenuation provided on Datamate Cable Assemblies, with both vertical and horizontal metal Backshells and full cable braiding.

## 1.2. Conclusion

This report has established the attenuation rates over a specified frequency range of 0.01 MHz to 400.00 MHz for the Datamate Shielded Cables and Backshells range. The full external report has been attached as the last section of this document.

For further information please contact one of our Experts at www.harwin.com/contact.

# 2. Test Method and Requirements

## 2.1. Specification Parameters

Tests were carried out in general accordance with MIL-STD 1377 (1971).

## 2.2. List of Connectors & Assemblies

The following female-to-female 1m cable assemblies were used for the test programme:

- M80-FC31005F1-1000F1 – 10 contact unshielded cable assembly
- M80-FC31005F1-1000F1 – 10 contact shielded cable assembly
- M80-FC32005F1-1000F1 – 20 contact unshielded cable assembly
- M80-FC32005F1-1000F1 – 20 contact shielded cable assembly
- M80-FC35005F1-1000F1 – 50 contact unshielded cable assembly
- M80-FC35005F1-1000F1 – 50 contact shielded cable assembly
- M80-FC35005F1-1000F1 – 50 contact Kevlar shielded cable assembly

The cables were mated to the following board-mounted connectors and backshells:

- M80-5101005 & M80-9061002 – 10 contact throughboard male vertical connector and backshell
- M80-5002005 & M80-9062002 – 20 contact throughboard male vertical connector and backshell
- M80-5105005 & M80-9065002 – 50 contact throughboard male vertical connector and backshell
- M80-5401005 & M80-9041002 – 10 contact throughboard male horizontal connector and backshell
- M80-5412005 & M80-9042002 – 20 contact throughboard male horizontal connector and backshell
- M80-5405005 & M80-9045002 – 50 contact throughboard male horizontal connector and backshell

## 3. Summary Test Results

All attenuation measurements are rounded to the nearest 2dB (see Appendix, Figures 2.1.8, 2.2.8, and 2.3.10).

| Vertical Board Connection | Attenuation (dB) | | | | | |
|---|---|---|---|---|---|---|
| | Frequency 0.10MHz – 1.00MHz | | Frequency 1.00MHz – 100.00MHz | | Frequency 100.00MHz – 400.00MHz | |
| | Min | Max | Min | Max | Min* | Max |
| 10 contact Shielded cable | 10 | 42 | 38 | 62 | 22 | 66 |
| 20 contact Shielded cable | 20 | 42 | 40 | 50 | 16 | 62 |
| 50 contact Shielded cable | 14 | 38 | 36 | 56 | 10 | 48 |
| 50 contact Kevlar Shielded cable | 10 | 36 | 34 | 54 | 10 | 48 |

| Horizontal Board Connection | Attenuation (dB) | | | | | |
|---|---|---|---|---|---|---|
| | Frequency 0.10MHz – 1.00MHz | | Frequency 1.00MHz – 100.00MHz | | Frequency 100.00MHz – 400.00MHz | |
| | Min | Max | Min | Max | Min* | Max |
| 10 contact Shielded cable | 24 | 46 | 44 | 52 | 22 | 56 |
| 20 contact Shielded cable | 26 | 60 | 46 | 68 | 38 | 72 |
| 50 contact Shielded cable | 16 | 52 | 42 | 60 | 38 | 64 |
| 50 contact Kevlar Shielded cable | 14 | 48 | 38 | 72 | 28 | 54 |

*As cable length approaches wavelength, shielding effectiveness is reduced.

## 4. Appendix – Complete 3rd Party Test Report

See following attached pages.


# Report On

Shielding Effectiveness Testing of the
Harwin PLC
Metal Back-shells Cable Assembly

**Commercial-In-Confidence**

**Document 75952012 Report 01 Issue 1** **July 2021**

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**REPORT ON**

Shielding Effectiveness Testing of the
Harwin PLC
Metal Back-shells Cable Assembly

Document 75952012 Report 01 Issue 1

July 2021

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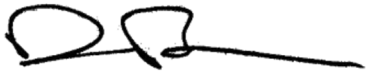

**D Binns**
Authorised Signatory

**DATED** 5 July 2021

## CONTENTS

**SECTION 1**

**REPORT SUMMARY**

Shielding Effectiveness Testing of the
Harwin PLC
Datamate Metal Back-shells Cable Assembly

## 1.1 INTRODUCTION

The information contained in this report is intended to show the RF attenuation provided by the Harwin PLC metal back-shells the braided screened cables with reference to MIL-STD 1377 (1971), for the tests listed in Section 1.2.

| | |
|---|---|
| Objective | Testing to determine the RF Attenuation provided by the metal back-shells and the braided screened cable with the MIL-STD 1377 (1971), for the series of tests carried out. |
| Manufacturer | Harwin PLC |
| Model Number(s) | 10-way cable unshielded – 1m Long 26 AGW wire<br>10-way cable shielded – 1m Long 26 AGW wire<br>20-way cable unshielded – 1m Long 26 AGW wire<br>20-way cable shielded– 1m Long 26 AGW wire<br>50-way cable unshielded – 1m Long 26 AGW wire<br>50-way cable shielded – 1m Long 26 AGW wire<br>50-way cable Kevlar shielded – 1m Long 26 AGW wire |
| Serial Number(s) | 10-way cable unshielded – M80-FC31005F1-1000F1<br>10-way cable shielded – M80C151039C<br>20-way cable unshielded – M80-FC32005F1-1000F1<br>20-way cable shielded– M80C151040C<br>50-way cable unshielded – M80-FC35005F1-1000F1<br>50-way cable shielded – M80C151041C<br>50-way cable Kevlar shielded – M80C151062C |
| Software Version | N/A |
| Hardware Version | N/A |
| Number of Samples Tested | 7 |
| Test Specification/Issue/Date | MIL-STD 1377, 1971 |
| Test Plan/Issue/Date | N/A |
| Incoming Release<br>Date | 26 April 2021 |
| Disposal<br>Reference Number<br>Date | Pending collection |
| Order Number<br>Date | P815128<br>21 April 2021 |
| Start of Test | 01 June 2021 |
| Finish of Test | 04 June 2021 |
| Related Documents | None |

## 1.2 BRIEF SUMMARY OF RESULTS

| Section | Accreditation | Test Description | Result |
|---|---|---|---|
| 2.1 | NUA | Shielding Effectiveness Test – 10 Way Cable Assembly | N/A |
| 2.2 | NUA | Shielding Effectiveness Test – 20 Way Cable Assembly | N/A |
| 2.3 | NUA | Shielding Effectiveness Test – 50 Way Cable Assembly | N/A |

**Table 1**

## 1.3 PRODUCT INFORMATION

### 1.3.1 Technical Description

The Equipment Under Test (EUT) was a Harwin PLC Cable Assembly with the cable types shown from figure 1.3.1 to 1.3.7 below.

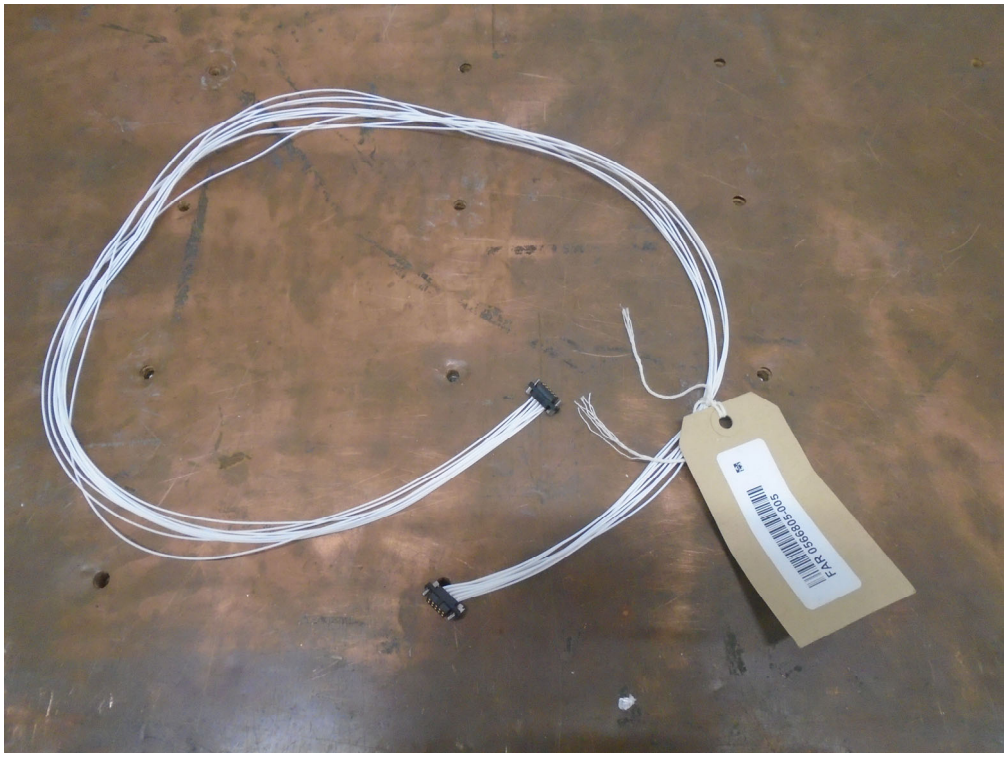

Figure 1.3.1 Equipment Under Test - 10-way cable unshielded


Figure 1.3.2 Equipment Under Test - 10-way cable shielded


Figure 1.3.3 Equipment Under Test - 20-way cable unshielded

Figure 1.3.4 Equipment Under Test - 20-way cable shielded

Figure 1.3.5 Equipment Under Test - 50-way cable unshielded


Figure 1.3.6 Equipment Under Test - 50-way cable shielded


Figure 1.3.7 Equipment Under Test - 50-way cable Kevlar shielded

### 1.3.2 Test Configuration

The tests were carried out in two general configurations with 1 m cables of varying connecter sizes with the connector PCB in two orientations:

Configuration 1: Unshielded

| Cable (1 m ) | Horizontal Connectors | Vertical Connectors | Test Section |
|---|---|---|---|
| 10 way | ✓ | ✓ | 2.1 |
| 20 way | ✓ | ✓ | 2.2 |
| 50 way | ✓ | ✓ | 2.3 |

**Table 2**

Configuration 2: Shielded

| Cable (1 m ) | Horizontal Connectors | Vertical Connectors | Test Section |
|---|---|---|---|
| 10 way | ✓ | ✓ | 2.1 |
| 20 way | ✓ | ✓ | 2.2 |
| 50 way | ✓ * | ✓ * | 2.3 |

**Table 3**

✓ * : An additional Kevlar shielded cable was included in the test.

Two sets of interface boxes were used, each pair configured with the vertical connectors and horizontal connectors.

The vertical interface box contained 6 connecters each. 3 connector boards without the back shells used for configuration 1 (unshielded) and 3 connector boards with shielding back shells used for configuration 2 (shielded) as shown in the figures 1.3.8 to 1.3.10.

The horizontal interface box contained 3 connectors each. In order to test the in configuration 1 (unshielded), the back shells on the connectors had to be removed. To test in configuration 2 (shielded), the back shells were left on the connectors as shown in the figures 1.3.11 to 1.3.14

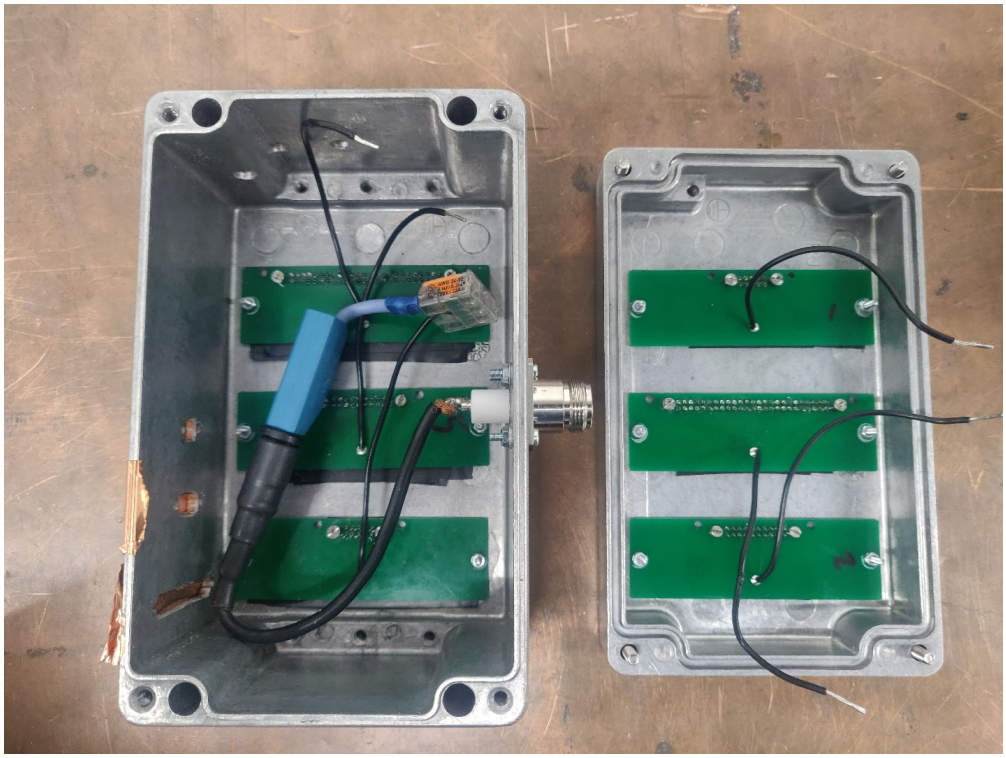

Figure 1.3.8 Interface box used to test the vertical connectors.

Figure 1.3.9 Interface box: side with the shielded vertical connectors.

Figure 1.3.10 Interface box: side with the unshielded vertical connectors

Figure 1.3.11 Interface box – horizontal connectors

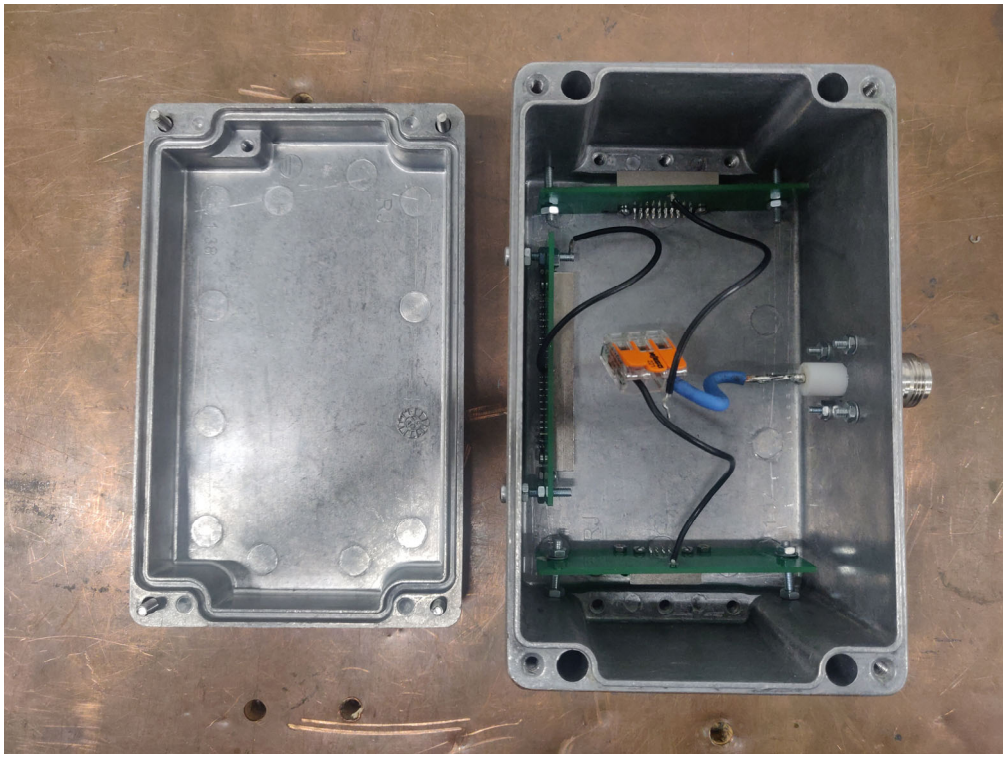

Figure 1.3.12 Horizontal interface box – horizontal connector with the back shells can be seen on the top and bottom connectors.

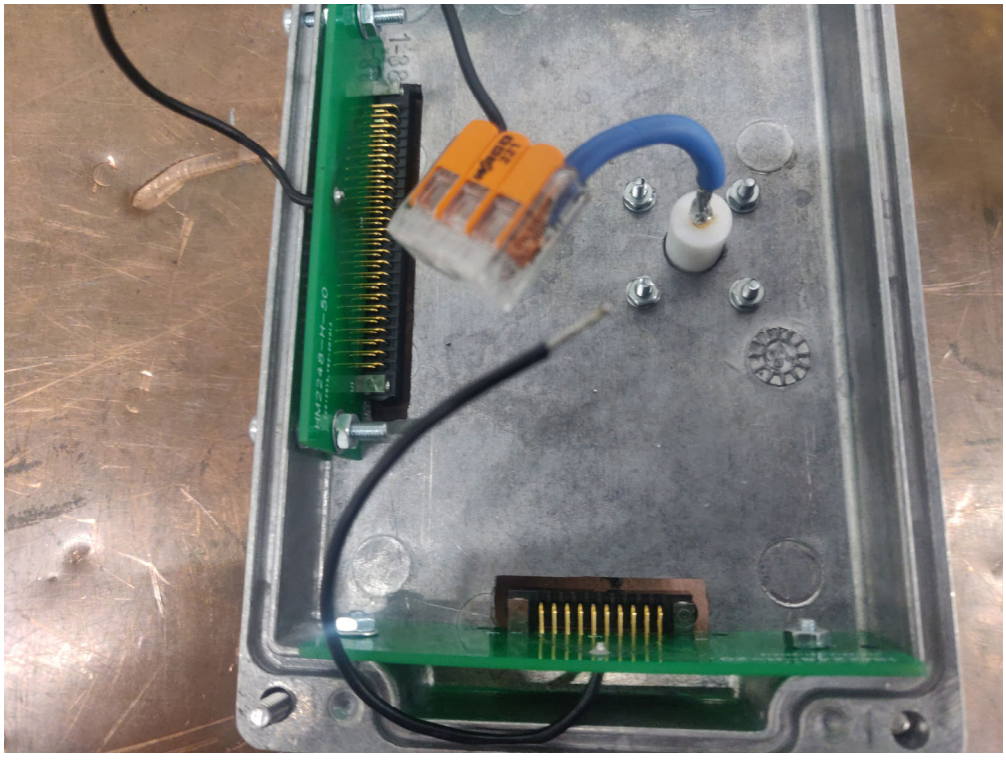

Figure 1.3.13 Horizontal interface box – horizontal connectors with backshell removed.

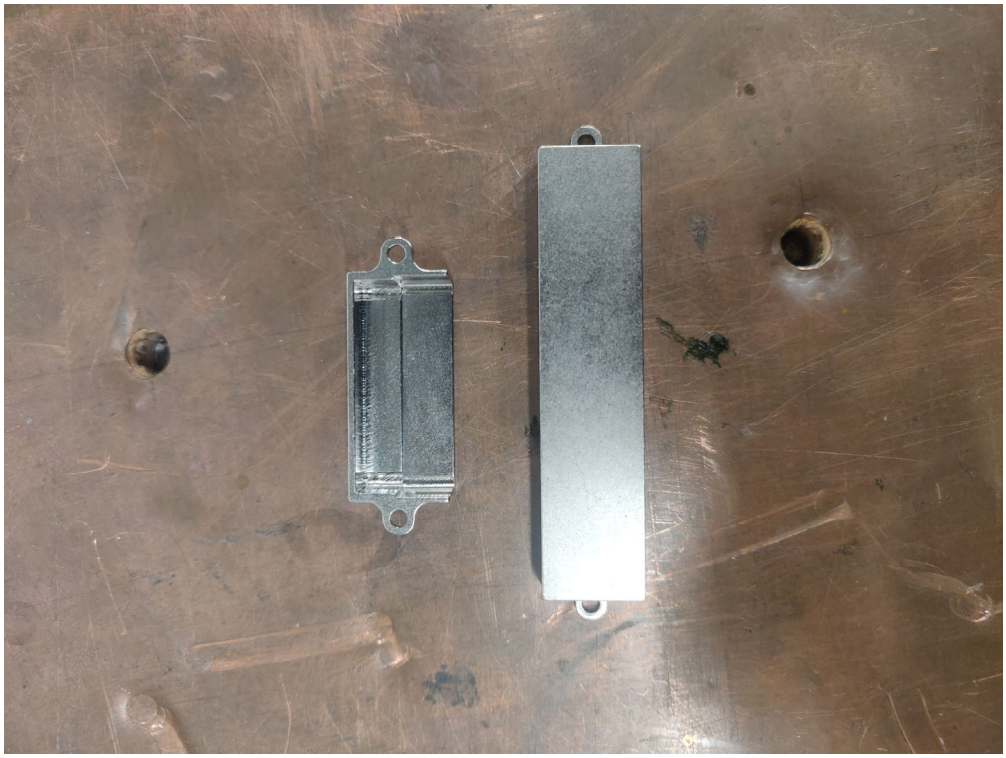

Figure 1.3.14 Removable back shells from the horizontal connectors.

The cable assembly under test was set up on a non-conductive PVC platform and interconnected between two interface boxes.

The interface boxes were bonded to a ground plane.

General test setup photos are shown at Figures 1.3.15 and 1.3.17

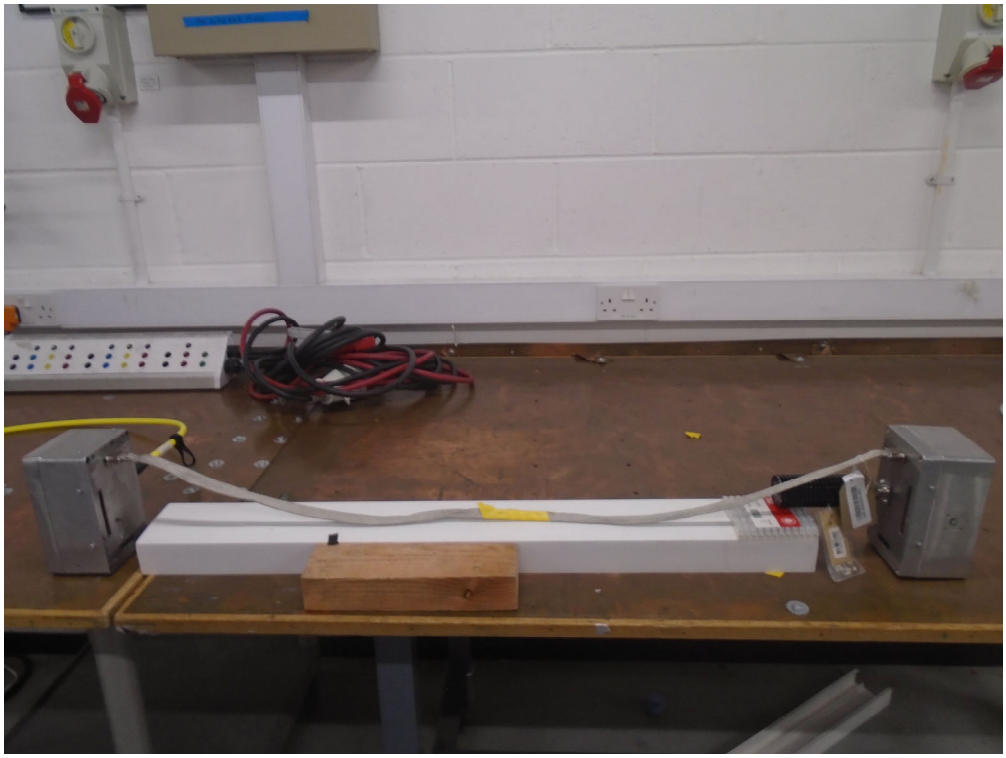

Figure 1.3.15 General test setup – horizontal PCB

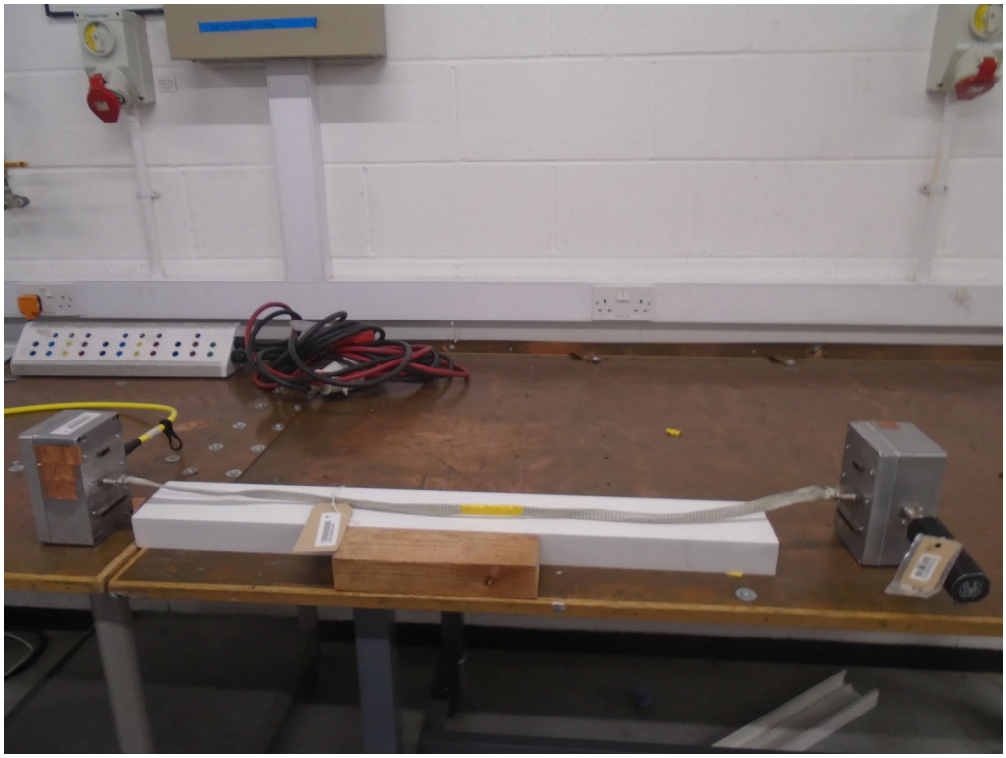

Figure 1.3.16 General test setup – vertical PCB

The cable assembly was set up in between two interface boxes with its corresponding cable adapters/connectors.

One interface box was configured with a 50-ohm Termination. The second interface box supplied 10 Watts to the cable assembly.

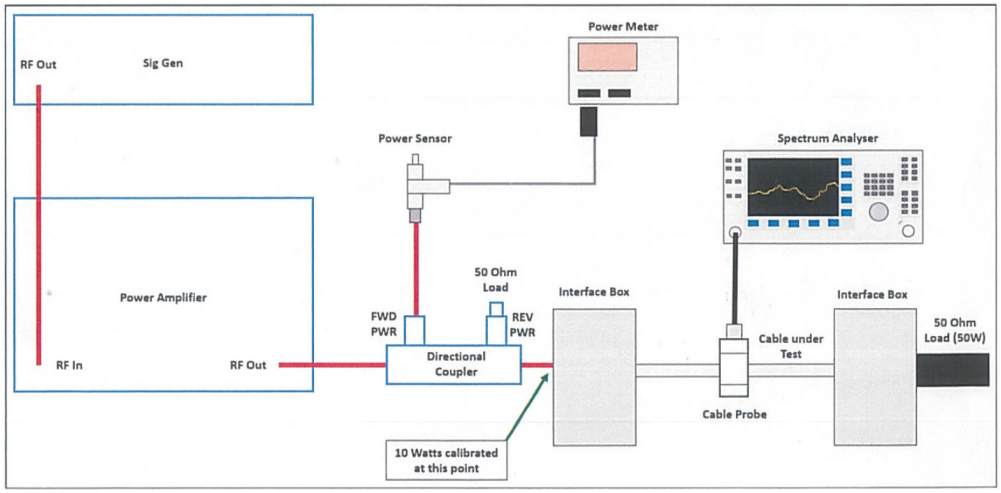


Figure 1.3.17 General test setup

## 1.4 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing covered by this test report.

## 1.5 MODIFICATION RECORD

The table below details modifications made to the EUT during the test programme. The modifications incorporated during each test are recorded on the appropriate test pages.

| Modification State | Description of Modification still fitted to EUT | Modification Fitted By | Date Modification Fitted |
|---|---|---|---|
| 0 | As supplied by the customer | N/A | N/A |

**Table 4**

## SECTION 2

## TEST DETAILS

Shielding Effectiveness Testing of the
Harwin PLC
Metal Back-shells and Braided Screened Cable

## 2.1 SHIELDING EFFECTIVENESS TEST – 10 WAY CABLE ASSEMBLY

### 2.1.1 Specification Reference

MIL-STD 1377 (1971)
Scope of Work – TUV SUD

### 2.1.2 Equipment Under Test

10-way cable unshielded – M80-FC31005F1-1000F1
10-way cable shielded – M80C151039C

### 2.1.3 Date of Test and Modification State

01 June 2021, Modification State 0

### 2.1.4 Test Location and Test Equipment Used

This test was carried out in Test Laboratory 4 and Shielded Enclosure 7. The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.1.5 Test Procedure

The cable assembly was set up between two interface boxes with a 50-ohm termination at one end. A signal of 10 watts was applied at the other end over the frequency range of 10 kHz to 400 MHz.

The Current was measured at the mid-point of the cable using 2 current Probes (1 for 10 kHz to 1 MHz, and 1 for 1 MHz to 400 MHz)

The signal was swept at a rate of 100 steps/decade with a dwell time of 20 ms.

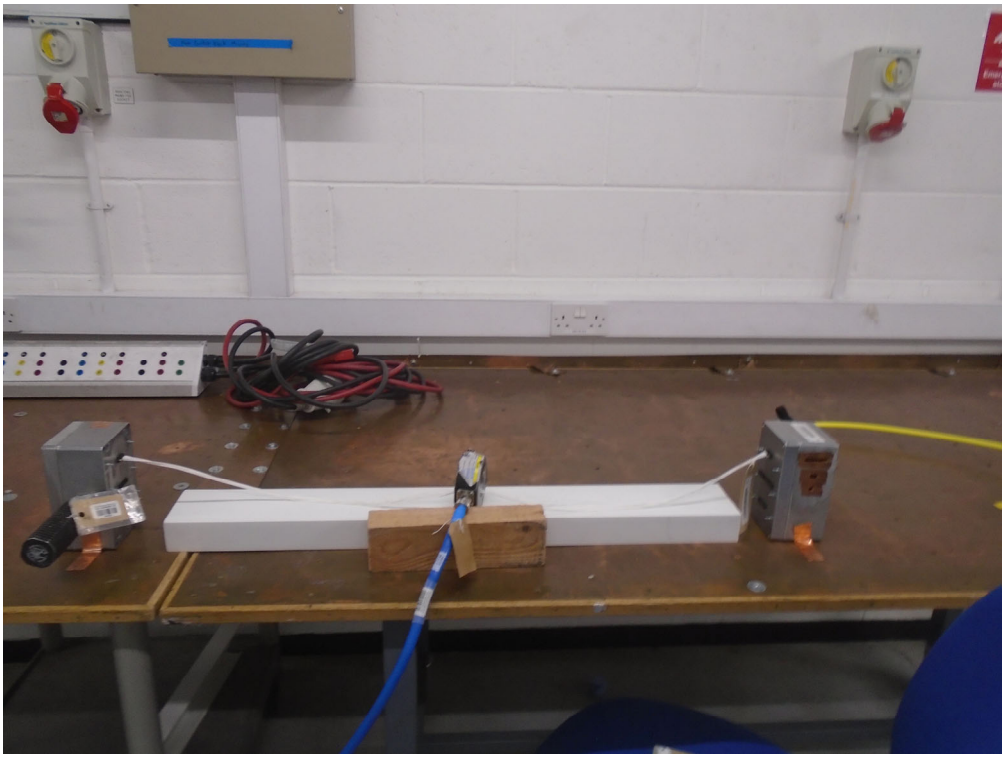

Figure 2.1.1 Test setup – 10-way, unshielded cable, vertical PCB

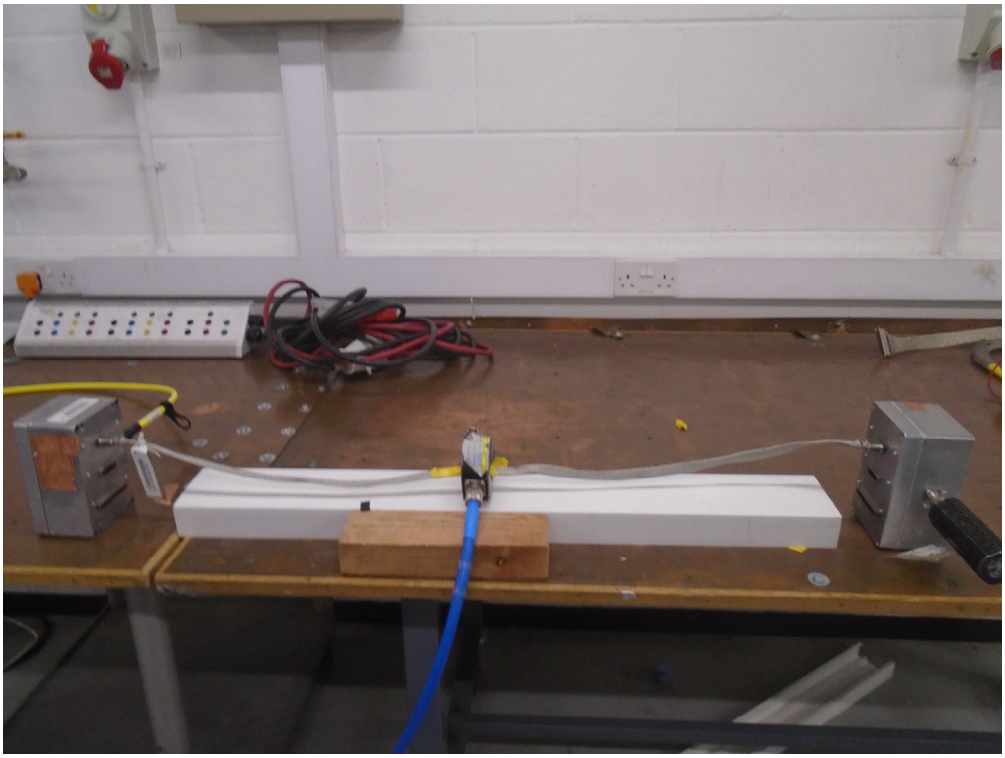

Figure 2.1.2 Test setup – 10-way, shielded cable, vertical PCB

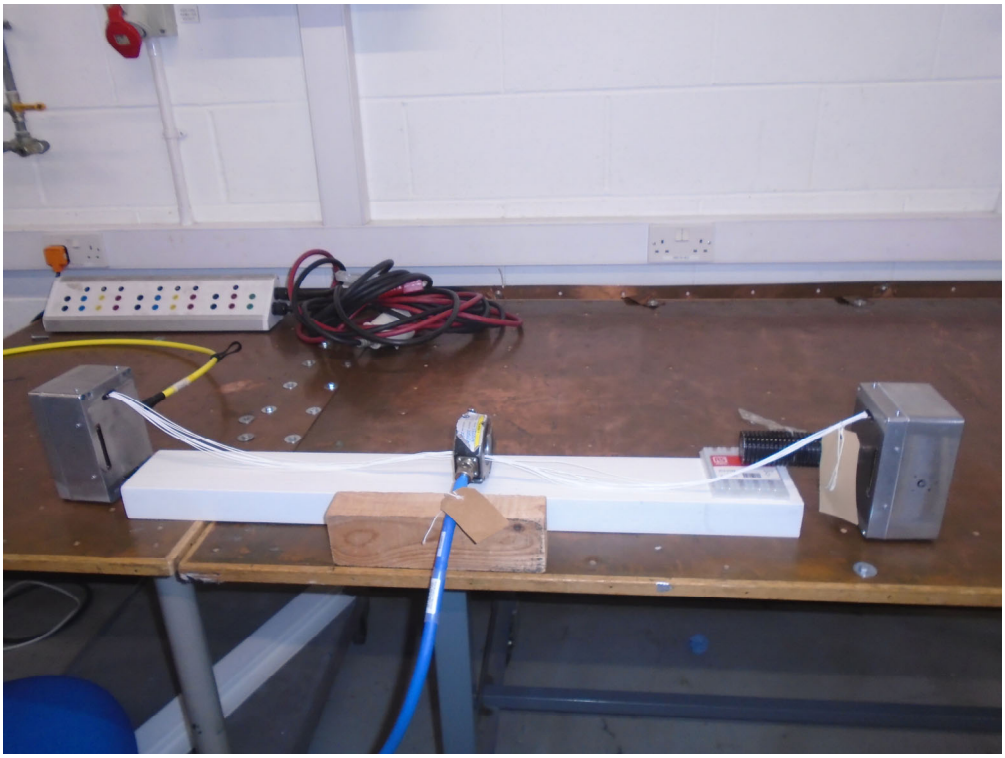

Figure 2.1.3 Test setup – 10-way, unshielded cable, horizontal PCB

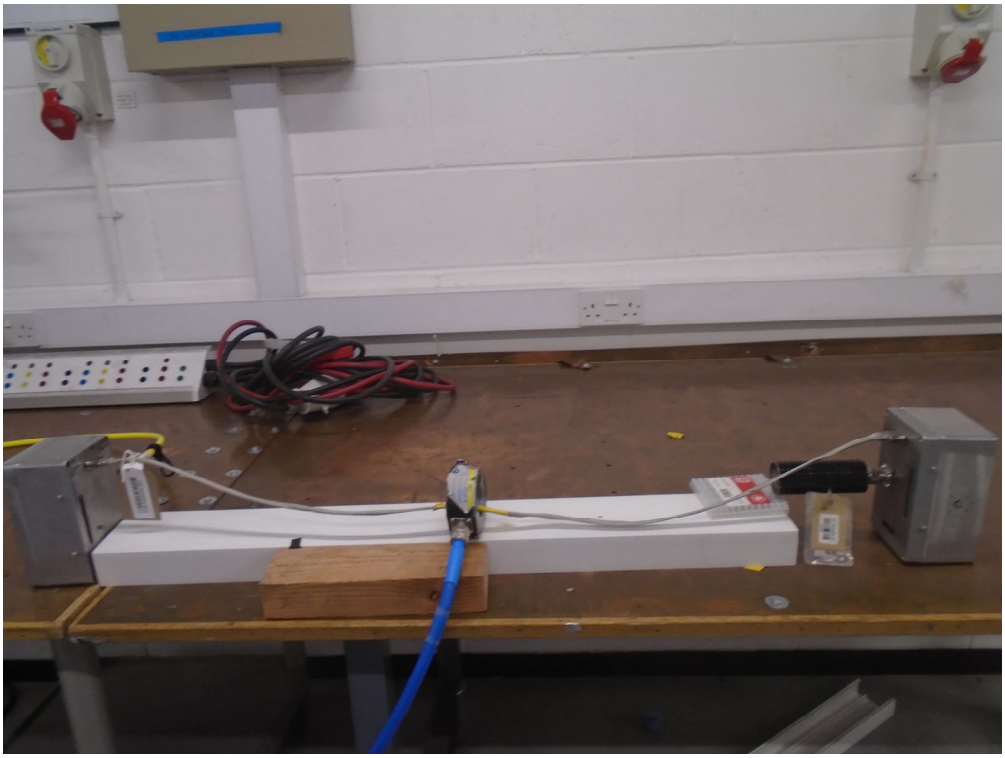

Figure 2.1.4 Test setup – 10-way, shielded cable, horizontal PCB

### 2.1.6 Test Results

The measurements of the shielding effectiveness are as follows:

Configuration 1: Unshielded cables and unshielded connectors
Configuration 2: Shielded cables and shielded connectors

| Connector PCB orientation | Description | Figure |
|---|---|---|
| Vertical | Induced current comparison of config 1 v config 2 | 2.1.5 |
| Horizontal | Induced current comparison of config 1 v config 2 | 2.1.6 |
| Vertical and Horizontal | current comparison of config 1 v config 2 | 2.1.7 |
| Vertical and Horizontal | Attenuation Comparison of config 1 v config 2 | 2.1.8 |

**Table 5**

**Job Number: 75952012 Test Applied: Date of Test: 01 June 2021**

EUT: 10 Way Cable;- Mid Point of Loom

Plot Description: Shield Comparison - Vertical PCB;- 10 kHz to 400 MHz

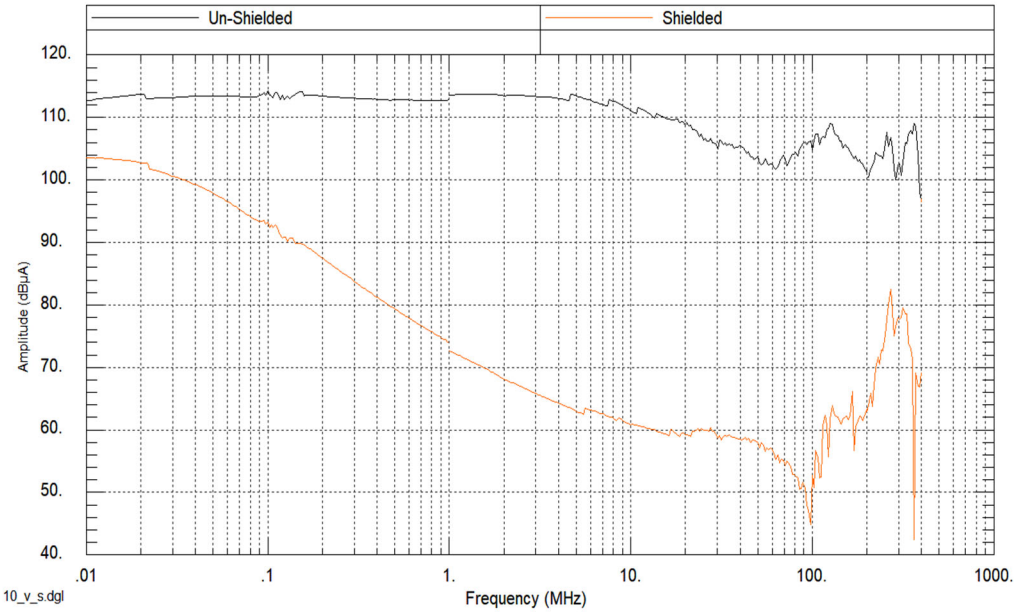


Figure 2.1.5

**Job Number: 75952012 Test Applied: Date of Test: 01 June 2021**

EUT: 10 Way Cable;- Mid Point of Loom

Plot Description: Shield Comparison - Horizontal PCB;- 10 kHz to 400 MHz

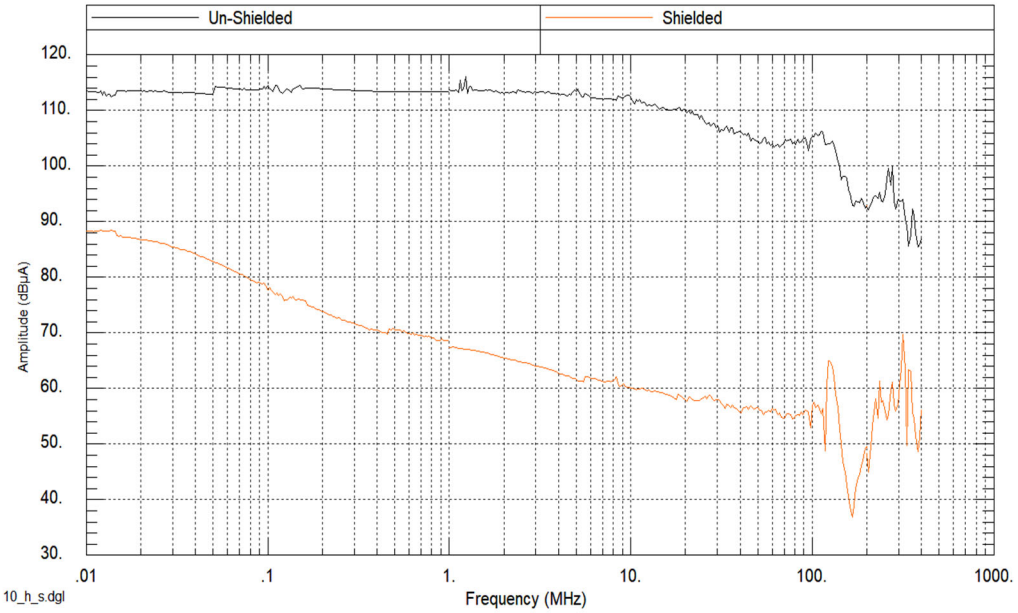


Figure 2.1.6

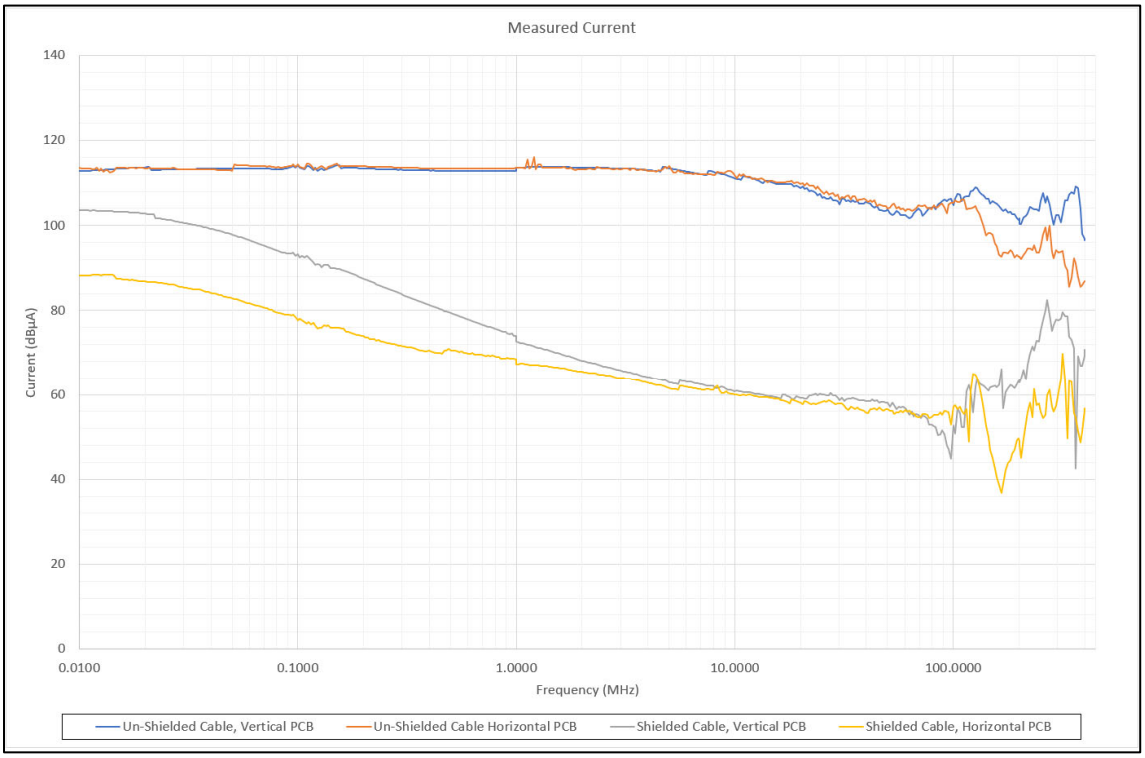


Figure 2.1.7

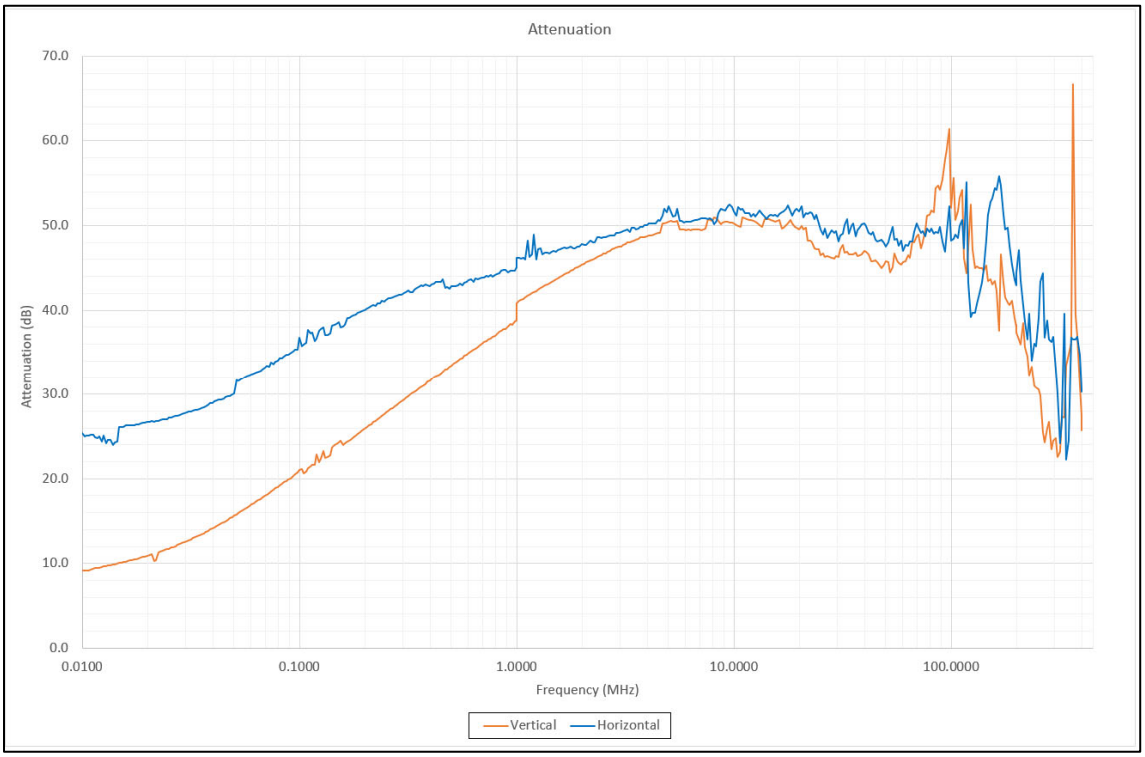


Figure 2.1.8

## 2.2 SHIELDING EFFECTIVENESS TEST – 20 WAY CABLE ASSEMBLY

### 2.2.1 Specification Reference

MIL-STD 1377 (1971)
Scope of Work – TUV SUD

### 2.2.2 Equipment Under Test

20-way cable unshielded – M80-FC32005F1-1000F1
20-way cable shielded– M80C151040C

### 2.2.3 Date of Test and Modification State

02 June 2021, Modification State 1, Modification State 0

### 2.2.4 Test Location and Test Equipment Used

This test was carried out in Shielded Enclosure 7. The major items of test equipment used for the above tests are identified in Section 3.1. effectiveness

### 2.2.5 Test Procedure

The cable assembly was set up between two interface boxes with a 50 ohm termination at one end. A signal of 10 watts was applied at the other end over the frequency range of 10 kHz to 400 MHz.

The Current was measured at the mid-point of the cable using 2 current Probes (1 for 10 kHz to 1 MHz, and 1 for 1 MHz to 400 MHz)

The signal was swept at a rate of 100 steps/decade with a dwell time of 20 ms.

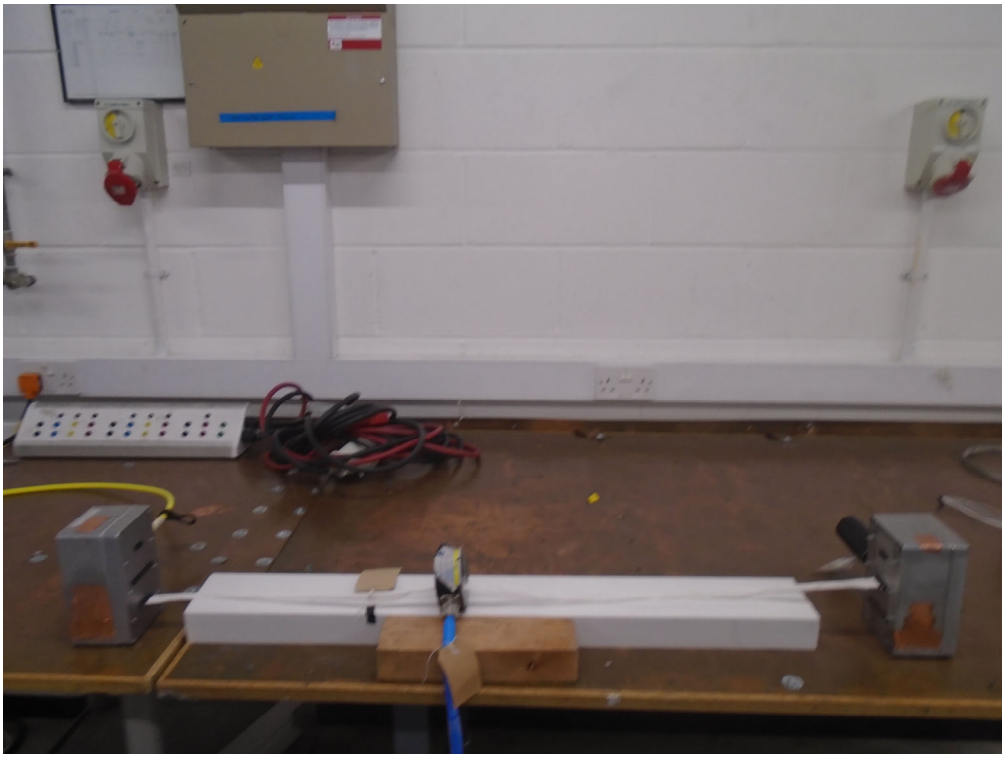

Figure 2.2.1 Test setup – 20-way, unshielded cable, vertical PCB

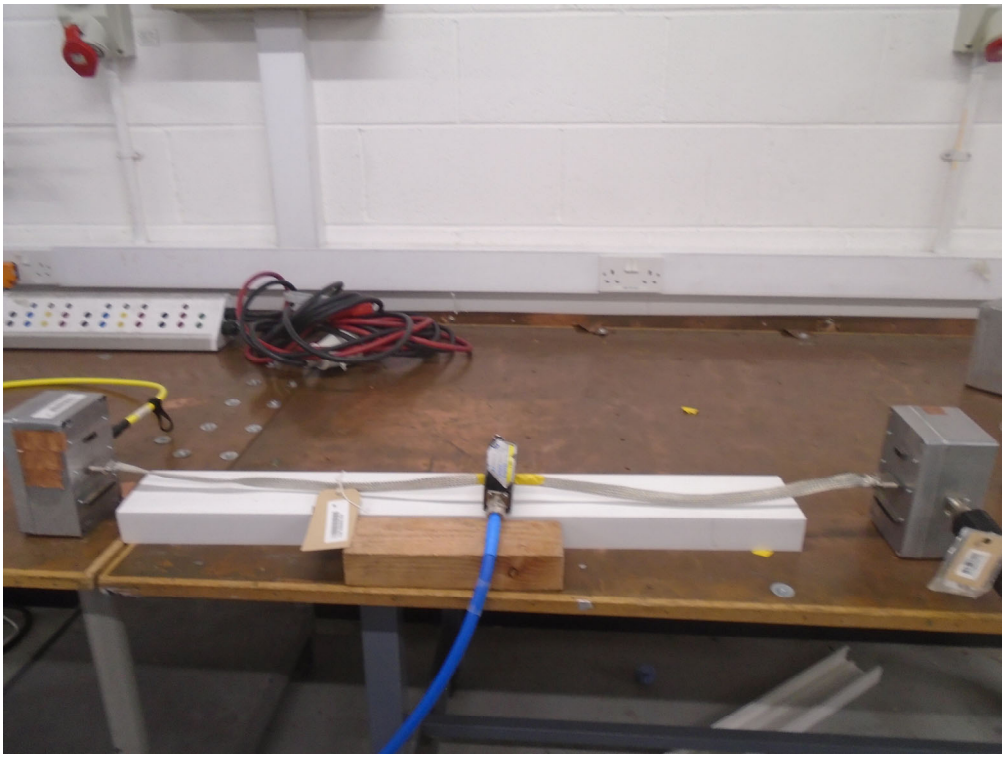

Figure 2.2.2 Test setup – 20-way, shielded cable, vertical PCB

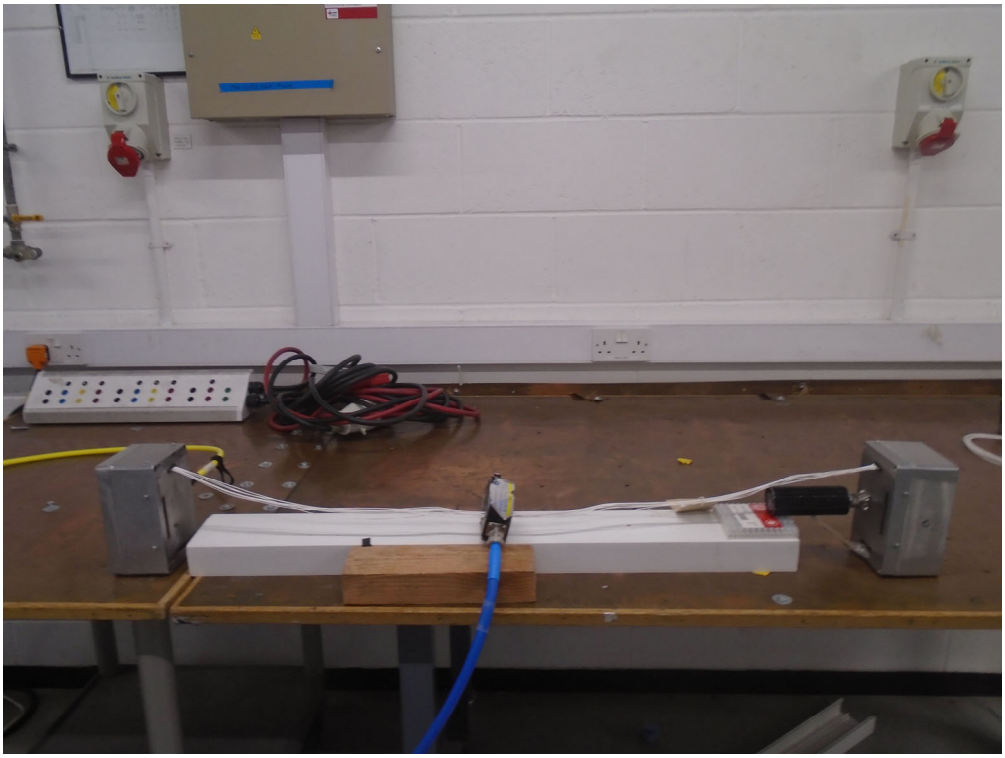

Figure 2.2.3 Test setup – 20-way, unshielded cable, horizontal PCB

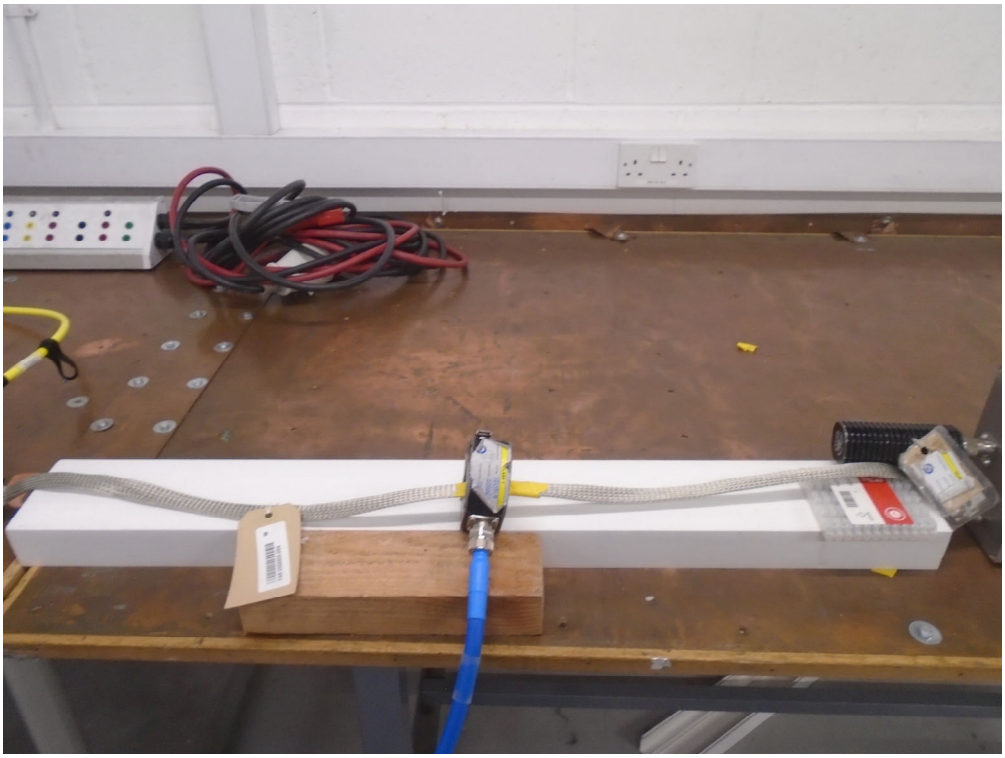

Figure 2.2.4 Test setup – 20-way, shielded cable, horizontal PCB

### 2.2.6 Test Results

The measurements of the shielding effectiveness are as follows:

Configuration 1: Unshielded cables and unshielded connectors
Configuration 2: Shielded cables and shielded connectors

| Connector PCB orientation | Description | Figure |
|---|---|---|
| Vertical | Induced current comparison of config 1 v config 2 | 2.2.5 |
| Horizontal | Induced current comparison of config 1 v config 2 | 2.2.6 |
| Vertical and Horizontal | current comparison of config 1 v config 2 | 2.2.7 |
| Vertical and Horizontal | Attenuation Comparison of config 1 v config 2 | 2.2.8 |

**Table 6**

**Job Number: 75952012 Test Applied: Date of Test: 02 June 2021**

EUT: 20 Way Cable;- Mid Point of Loom

Plot Description: Shield Comparison - Vertical PCB;- 10 kHz to 400 MHz

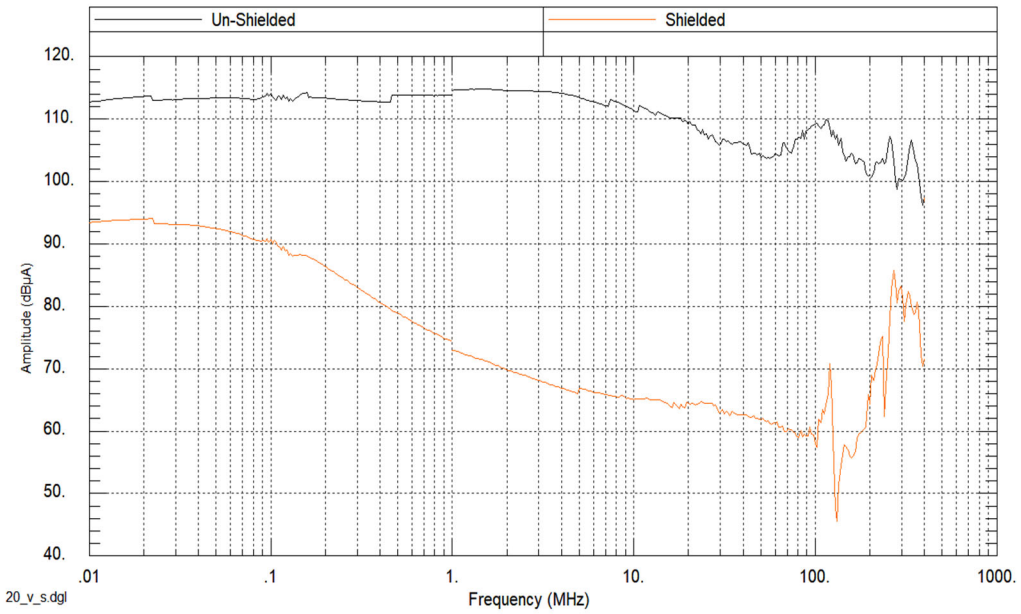


Figure 2.2.5

**Job Number: 75952012 Test Applied: Date of Test: 02 June 2021**

EUT: 20 Way Cable;- Mid Point of Loom

Plot Description: Shield Comparison - Horizontal PCB;- 10 kHz to 400 MHz

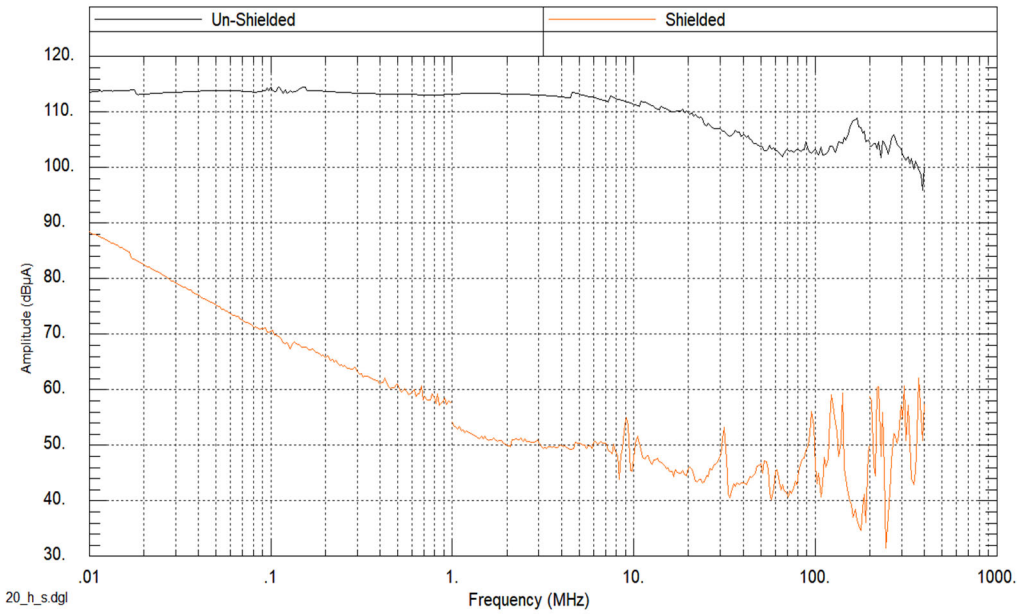


Figure 2.2.6

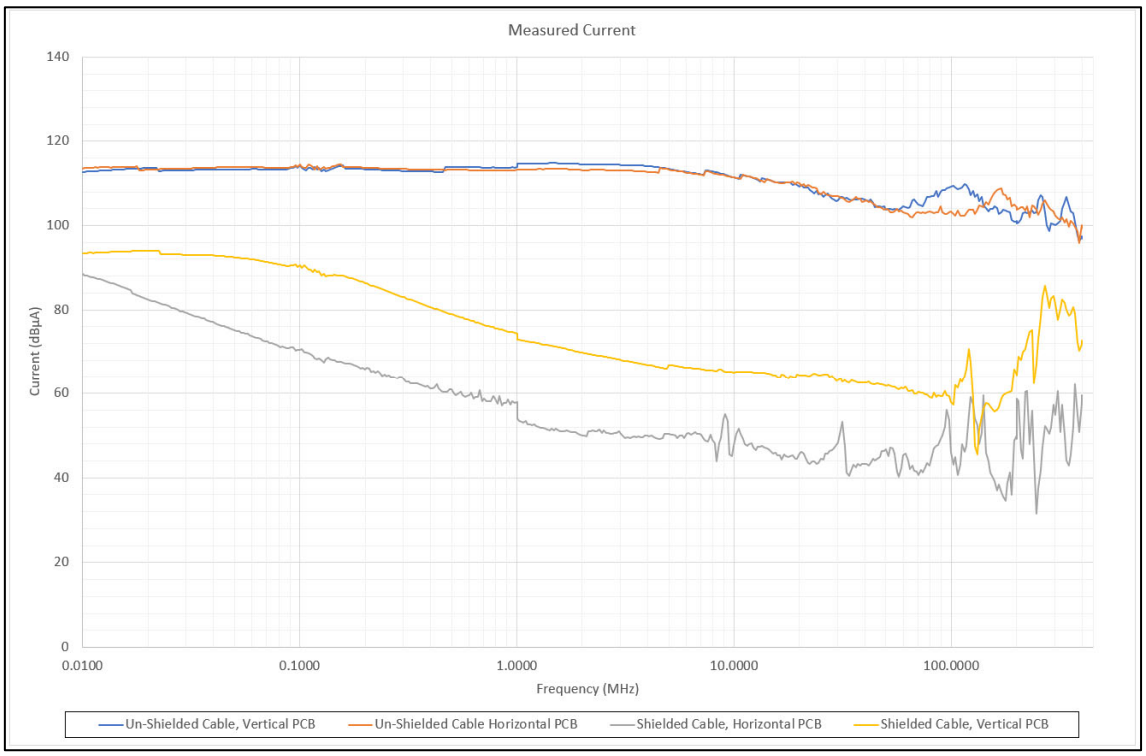


Figure 2.2.7

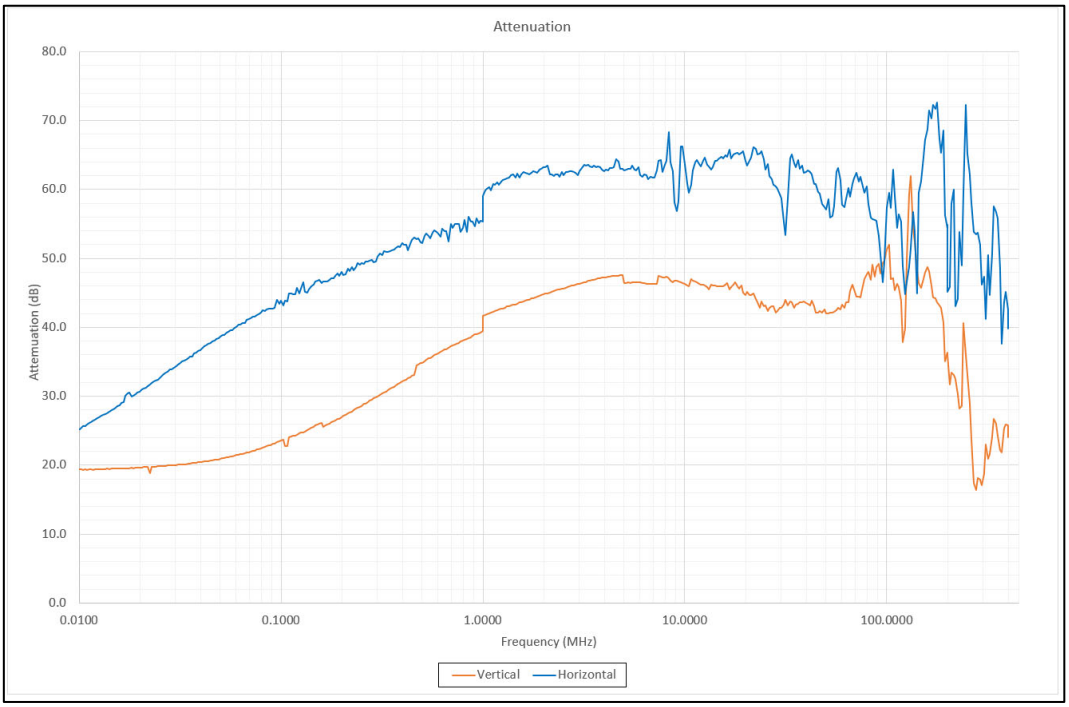


Figure 2.2.8

## 2.3 SHIELDING EFFECTIVENESS TEST – 50 WAY CABLE ASSEMBLY

### 2.3.1 Specification Reference

MIL-STD 1377 (1971)
Scope of Work – TUV SUD

### 2.3.2 Equipment Under Test

50-way cable unshielded – M80-FC35005F1-1000F1
50-way cable shielded – M80C151041C
50-way cable Kevlar shielded – M80C151062C

### 2.3.3 Date of Test and Modification State

03 June 2021, Modification State 0

### 2.3.4 Test Location and Test Equipment Used

This test was carried out in Shielded Enclosure 7. The major items of test equipment used for the above tests are identified in Section 3.1. effectiveness

### 2.3.5 Test Procedure

The cable assembly was set up between two interface boxes with a 50 ohm termination at one end. A signal of 10 watts was applied at the other end over the frequency range of 10 kHz to 400 MHz.

The Current was measured at the mid-point of the cable using 2 current Probes (1 for 10 kHz to 1 MHz, and 1 for 1 MHz to 400 MHz)

The signal was swept at a rate of 100 steps/decade with a dwell time of 20 ms.

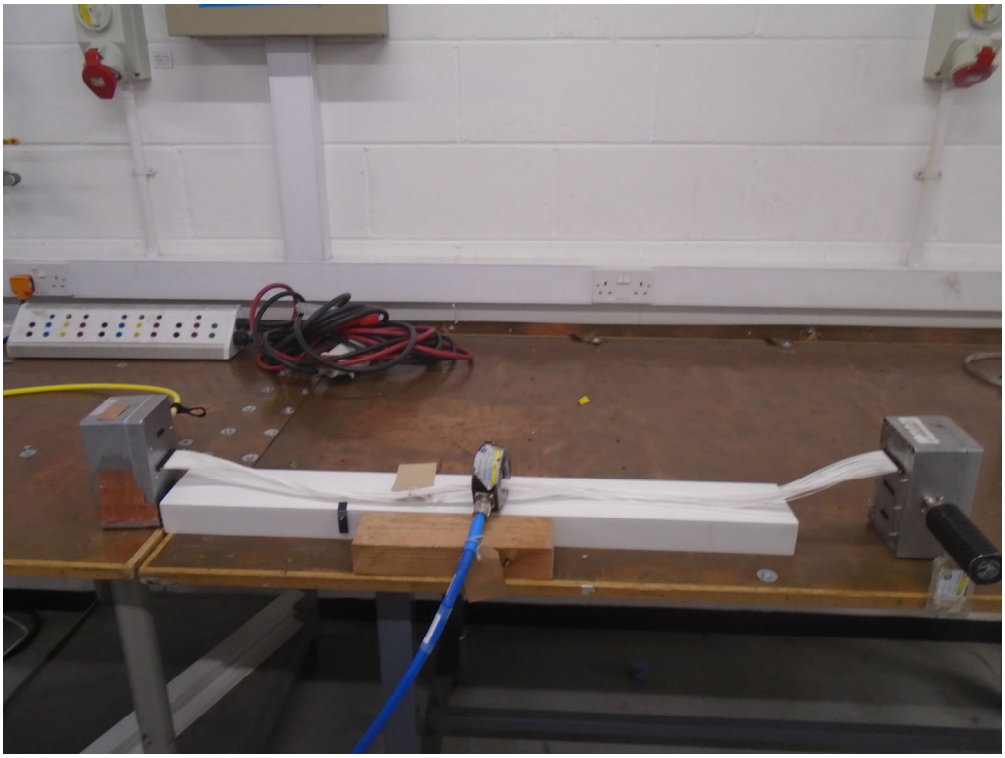

Figure 2.1.1 Test setup – 50-way, unshielded cable, vertical PCB

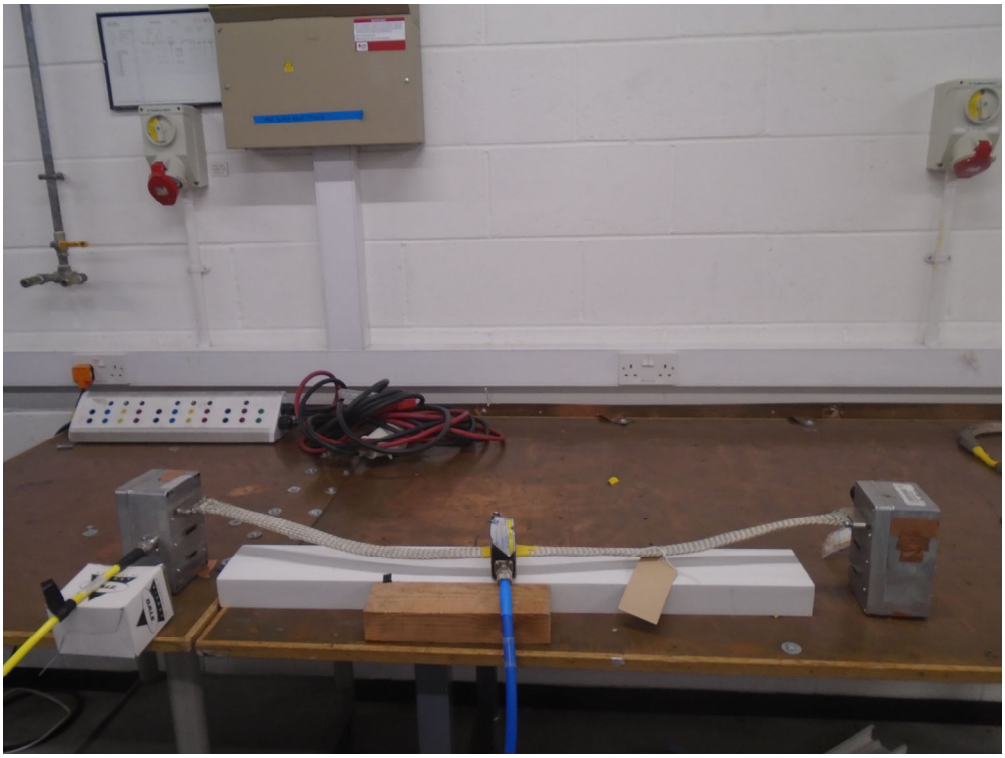

Figure 2.1.2 Test setup – 50-way, shielded cable, vertical PCB

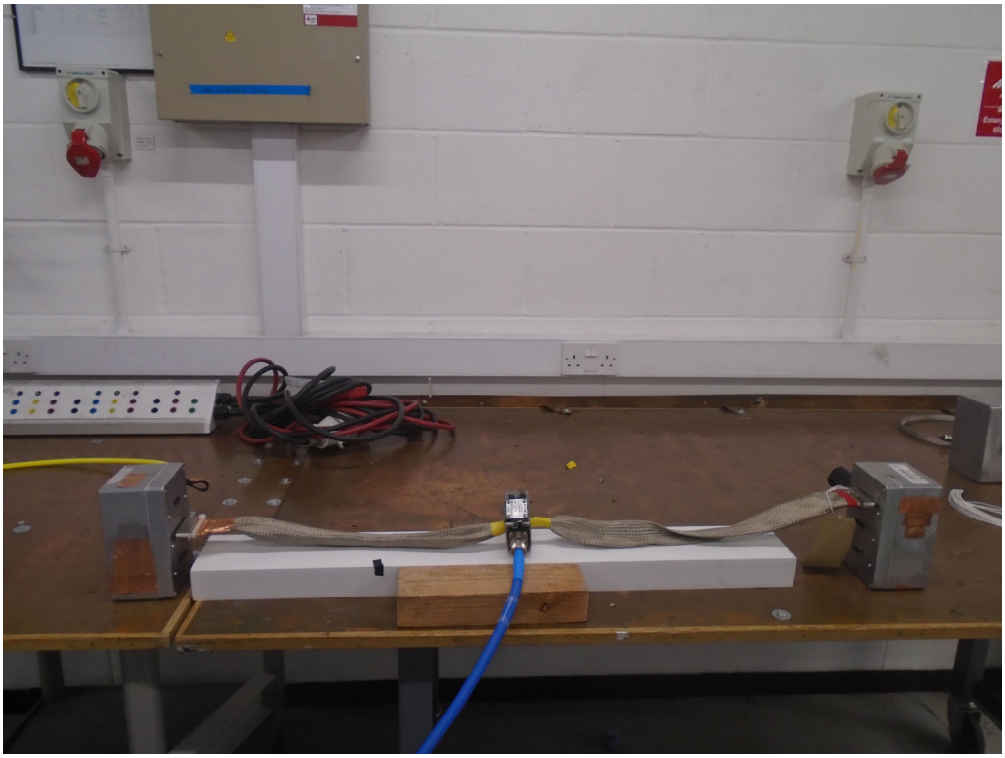

Figure 2.1.3 Test setup – 50-way, Kevlar shielded cable, vertical PCB

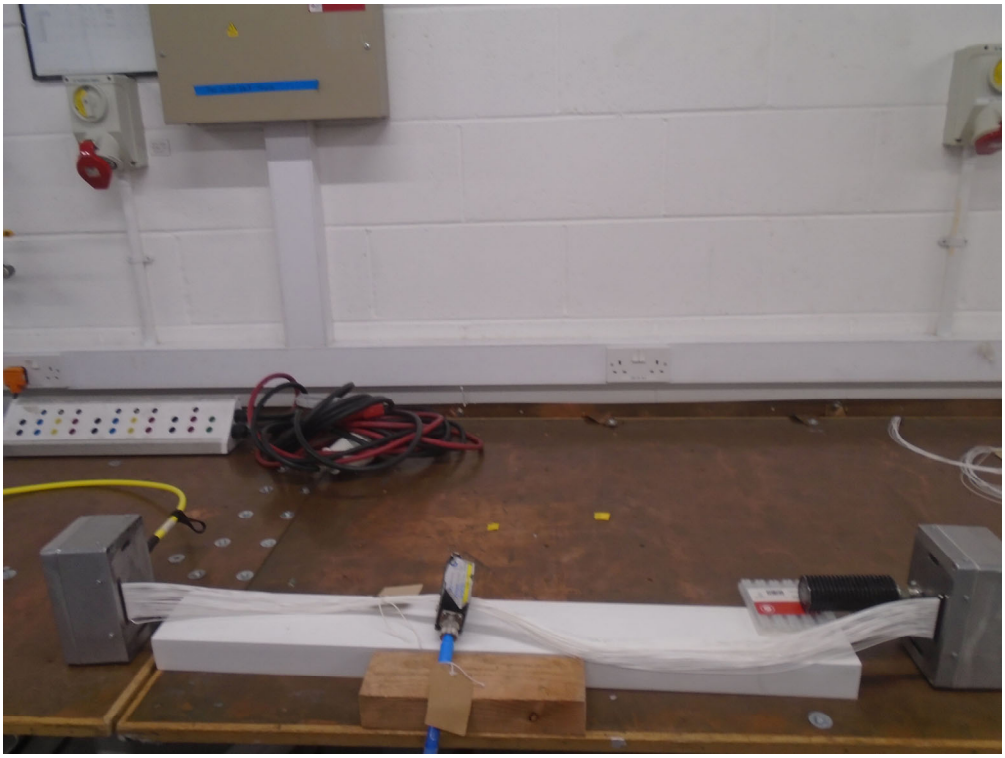

Figure 2.1.4 Test setup – 50-way, unshielded cable, horizontal PCB

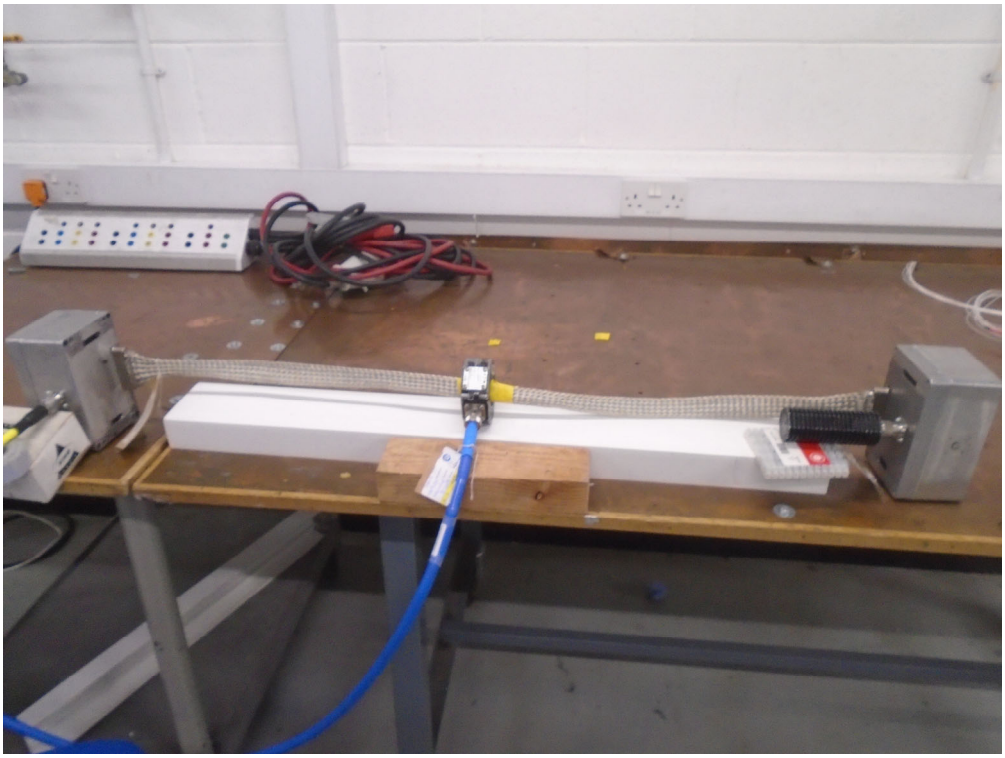

Figure 2.1.5 Test setup – 50-way, shielded cable, horizontal PCB

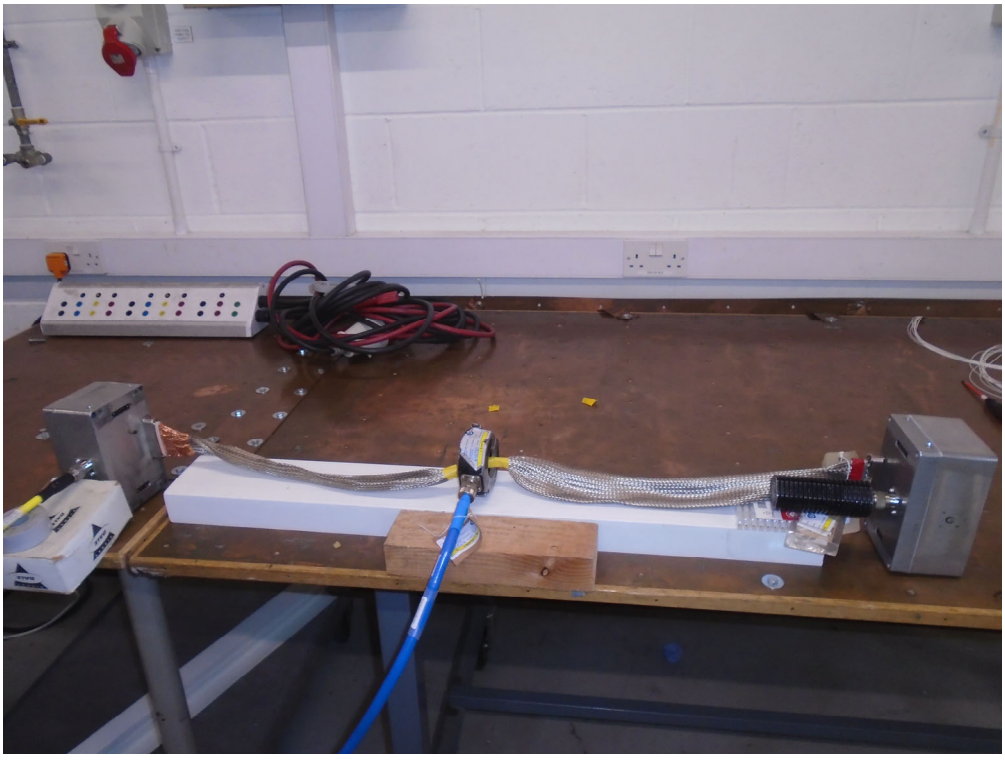

Figure 2.1.6 Test setup – 50-way, Kevlar shielded cable, horizontal PCB

**2.3.6**

### 2.3.6 Test Results

The measurements of the shielding effectiveness are as follows:

Configuration 1: Unshielded cables and unshielded connectors
Configuration 2a: Shielded cables and shielded connectors
Configuration 2b: Kevlar shielded cables shielded connectors

| Connector PCB orientation | Description | Figure |
|---|---|---|
| Vertical | Induced current comparison of config 1 v config 2a v config 2b | 2.3.7 |
| Horizontal | Induced current comparison of config 1 v config 2a v config 2b | 2.3.8 |
| Vertical and Horizontal | current comparison of config 1 v config 2a v config 2b | 2.3.9 |
| Vertical and Horizontal | Attenuation Comparison of config 1 v config 2a v config 2b | 2.3.10 |

**Table 7**

**Job Number: 75952012 Test Applied: Date of Test: 03 June 2021**

EUT: 50 Way Cable;- Mid Point of Loom

Plot Description: Shield Comparison - Vertical PCB;- 10 kHz to 400 MHz

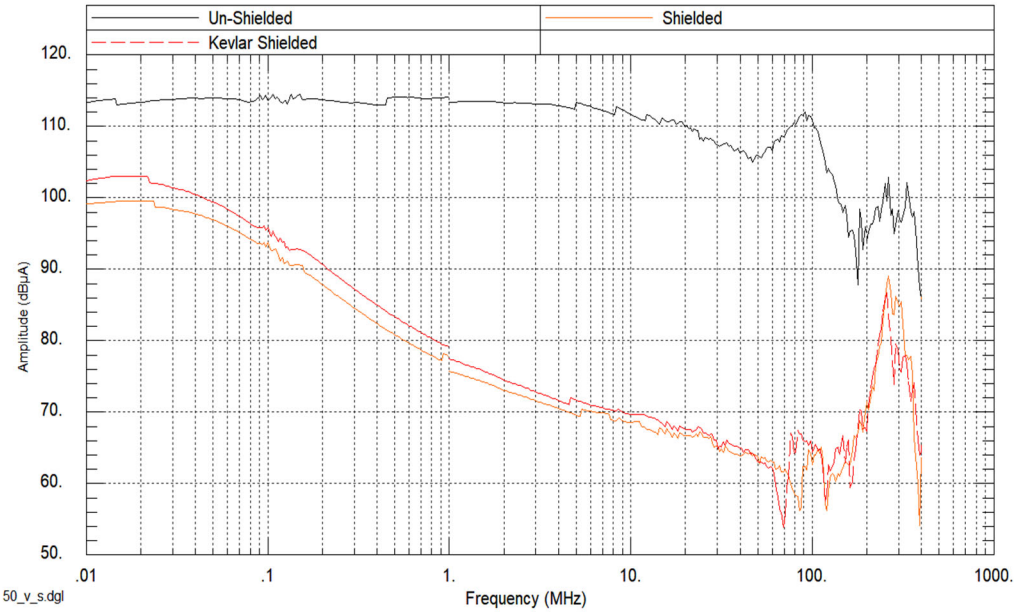


Figure 2.3.7

**Job Number: 75952012 Test Applied: Date of Test: 03 June 2021**

EUT: 50 Way Cable;- Mid Point of Loom

Plot Description: Shield Comparison - Horizontal PCB;- 10 kHz to 400 MHz

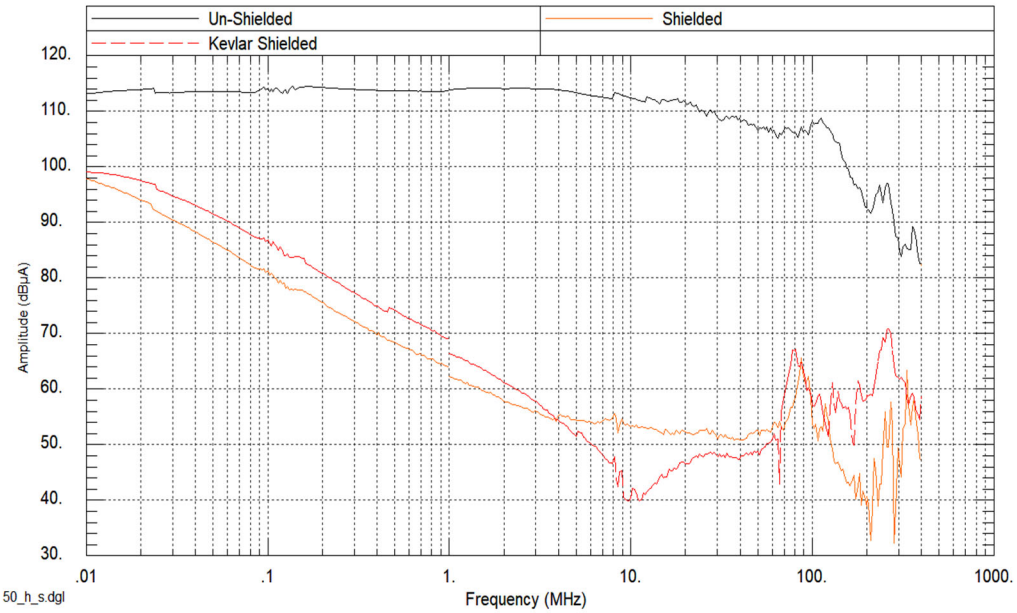


Figure 2.3.8

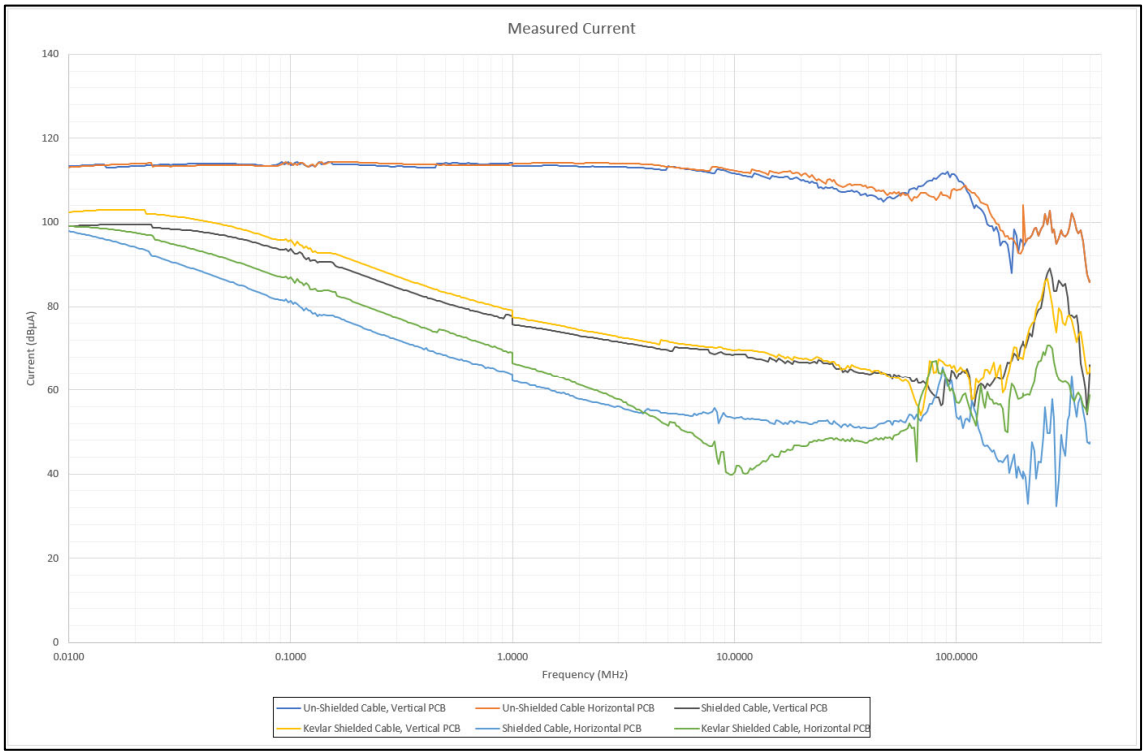


Figure 2.3.9

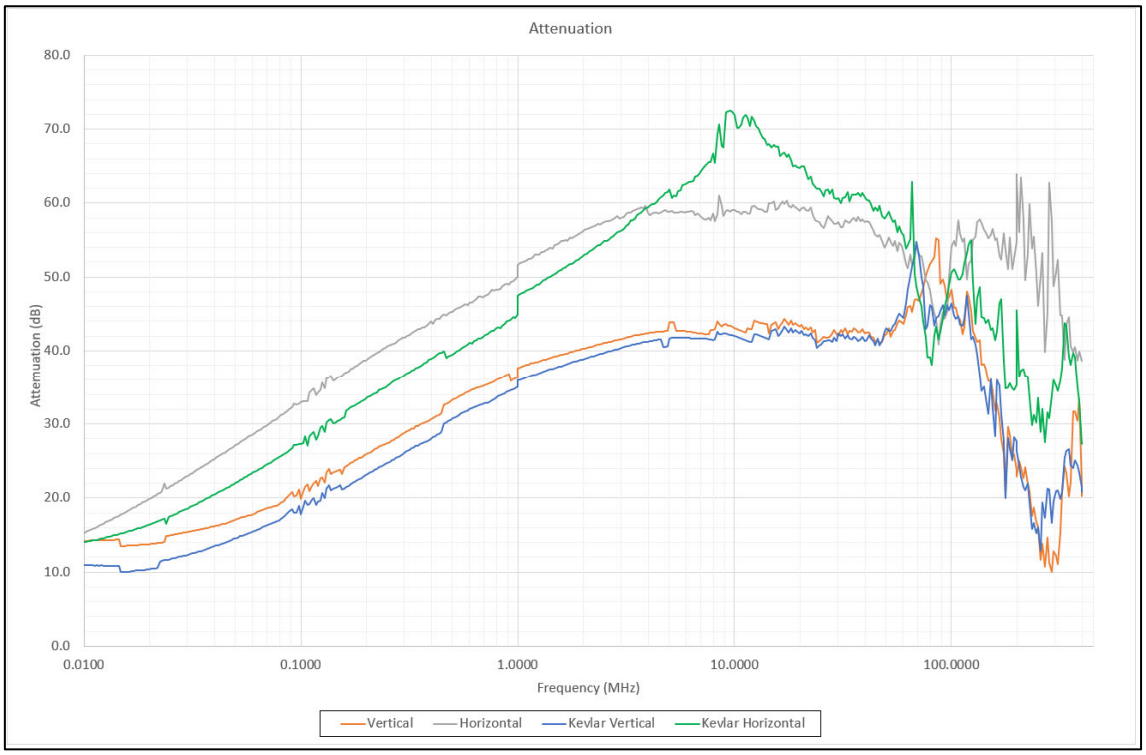


Figure 2.3.10

# SECTION 3

# TEST EQUIPMENT USED

## 3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

| Instrument | Manufacturer | Type No. | TE No. | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| **Section 2.1 to 2.3 – Shielding Effectiveness Test (10 kHz to 400 MHz)** | | | | | |
| RF Power Amplifier | Amp Research | 100W1000M1A | 278 | - | TU |
| Termination (50ohm) | Radio Spares | 613-690 | 353 | 12 | 22-Jun-2021 |
| Directional Coupler | Amp Research | DC2500 | 501 | 12 | 22-Oct-2021 |
| Current Probe | Eaton | 94111-1 | 519 | 12 | 22-Oct-2021 |
| Current Probe | Solar | 9205-1 | 527 | 12 | 8-Apr-2022 |
| Signal Generator | Rohde & Schwarz | SML01 | 1590 | 12 | 25-Jun-2021 |
| RF Power Amplifier | Amp Research | 150L | 2054 | - | TU |
| Termination | Tyco Electronics | 1329823-1 | 3249 | 12 | 16-Dec-2021 |
| Termination | Diamond Antenna | DL-30N | 3400 | 12 | 15-Nov-2020 |
| Spectrum Analyser | Rohde & Schwarz | FSP3 | 3486 | 12 | 20-Oct-2021 |
| Spectrum Analyser | Rohde & Schwarz | FSP3 | 3487 | 12 | 20-Oct-2021 |
| Cable Assembly - 18GHz 2m | Aaren | AT38P-10-10-2803-2M | 5717 | 6 | 5-Aug-2021 |
| Cable Assembly - 18GHz 2m | Junkosha | MWX221-02000AMSAMS | 5724 | 6 | 5-Aug-2021 |
| Die Cast Aluminium Enclosure | RS PRO | 760-8939 | TU | TU | TU |
| 50Ω Straight Flange Mount, N Connector | RS PRO | 170-6989 | TU | TU | TU |

**Table 8**

TU – Traceability Unscheduled

## 3.2 TEST EQUIPMENT DATA

Not Applicable

## 3.3 SOFTWARE DATA

The following TÜV SÜD software was used for data presentation of results obtained during Emissions testing.

1. Waveform Reporting, Version 2.1
2. Automated Bulk Current Injection, Version 2.0.1

## 3.4 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

| Test Discipline | Frequency / Parameter | MU |
|---|---|---|
| Conducted Emissions Current | 10Hz - 150MHz | 4.20dB |

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2007, clause 4.4.3 and 4.5.1.

# SECTION 4

# INCIDENT REPORTS

## 4.1 INCIDENT REPORTS ISSUED

No incident reports were issued for the tests referenced in this report.

## SECTION 5

## ACCREDITATION, DISCLAIMERS AND COPYRIGHT

## 5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

Our report does not cover opinions and interpretations

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).