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# Test Report for the FCC Testing of a 15 Bay Docking Station To 47CFR 15.225 For Reactec Ltd

Test Report number: 14161TR1
Project number: C5667

Author: ..... .....
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Laboratory Business Manager

| Issue | Description | | | | | | Issue by | Date |
|---|---|---|---|---|---|---|---|---|
| 1 | Copy 1 | | Copy 2 | | PDF | X | CWG | 26th May 2021 |

## CONTENTS

# Test Report Change History

| Issue | Date | Modification Details |
|---|---|---|
| 1 | 26th May 2021 | Original issue of test report |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

# Section 1Test Location

All testing was performed at;

| | |
|---|---|
| **Eurofins York Ltd** | Unit 5 |
| | Speedwell Road |
| | Castleford |
| | WF10 5PY |
| | |
| **Tel:** | 01977 731173 |
| | |
| **Website** | https://www.yorkemc.com |
| **UKAS Testing No.** | 1574 |

## 1.1 UKAS Accreditation

Tests marked "Not UKAS Accredited" in this report are not included in the UKAS Accreditation Schedule for our laboratory.

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Eurofins York, Castleford latest accreditation schedule can be found at:

http://www.ukas.org/testing/lab_detail.asp?lab_id=989&location_id=&vMenuOption=3

Eurofins York, is a recognised test facility with the Federal Communications Commission (FCC). The appropriate FCC recognition number is UK2013, recognition date 1st March 2021.

## Section 2 Customer Information

| | |
|---|---|
| **Company name** | Reactec Ltd |
| **Address** | Vantage Point |
| | 3 Cultins Road |
| | Edinburgh |
| | EH11 4DF |
| | |
| | |
| **Tel:** | 44 (0)131 221 0930 |
| **Contact** | Mr P Gillespie |
| **Email** | PeterGillespie@reactec.com |
| **Customer Representative(s) present during testing** | Testing was not witnessed |

# Section 3Equipment Details

## 3.1 Equipment Under Test (EUT)

| | | | | | | |
|---|---|---|---|---|---|---|
| **Date received:** | 7th December 2020 | | | | | |
| **EUT name:** | HAVwear Docking Station (no GPRS) | | | | | |
| **Type/Part no:** | DST-E001 | | | | | |
| **FCC ID** | 2AYGFHVWDST001 | | | | | |
| **EUT description:** | Docking station for charging internal battery of HAVwear modules, and for transferring customer data from HAVwear module to Reactec Analytics cloud server using Ethernet local area network connection. | | | | | |
| **No of units tested:** | One | | | | | |
| **EUT power:** | 120V AC single phase | | | | | |
| **Cables:** | AC Mains | | | | | |
| **Size of EUT (mm)** | L: - | 340 | W: - | 180 | H: - | 60 |
| **Tested as** | Table top mounted | | | | | |
| **Mode/s of operation** | RFID active operating at 13.56MHz | | | | | |
| **Client modification statement:** | Not applicable | | | | | |
| **Modifications incorporated during testing:** | None. | | | | | |

### 3.2 EUT Photos

Photographs are supplied separately.

### 3.3 Configuration of EUT

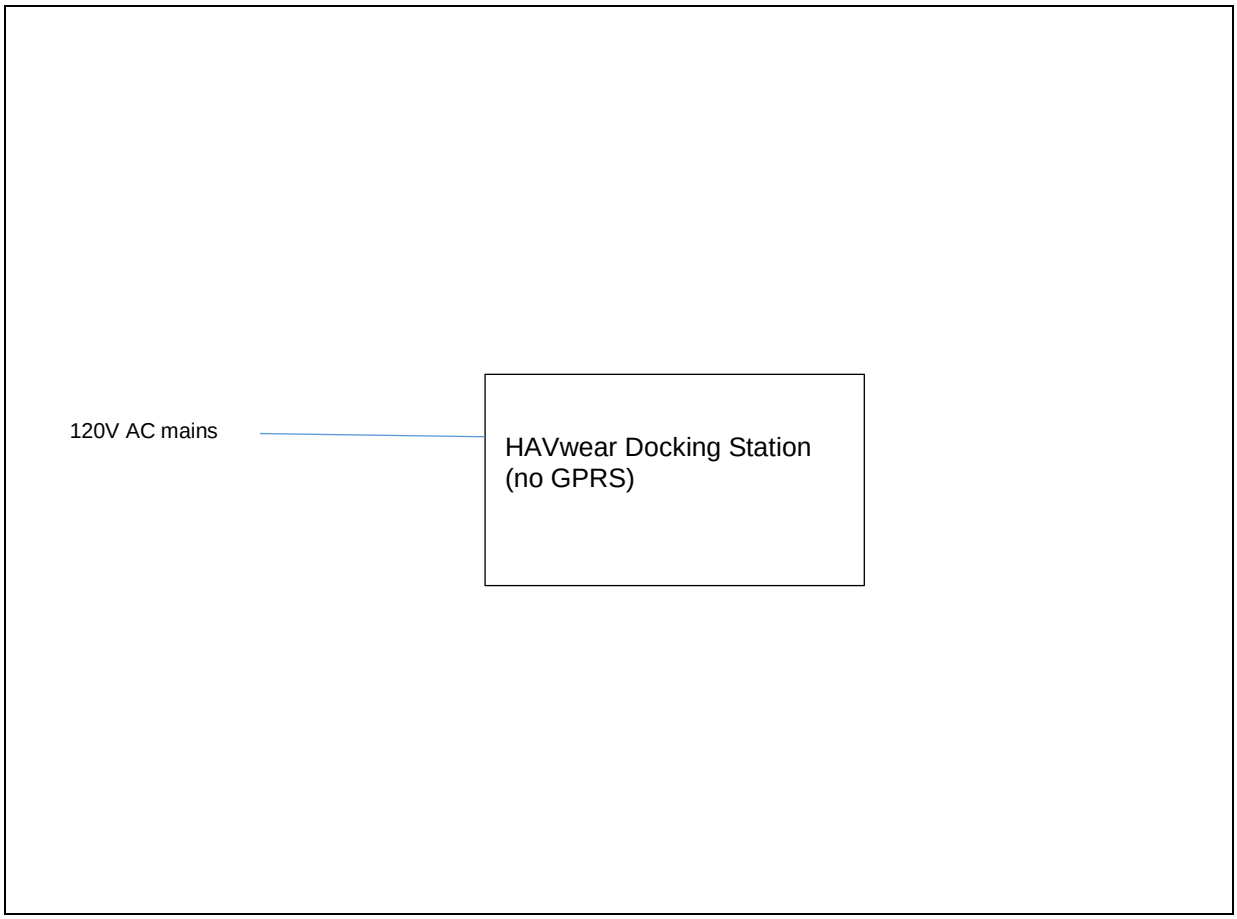



**Figure 1: Diagram of EUT**

### 3.4 EUT Monitoring/Auxiliary Equipment

None.

### 3.5 Monitoring Software

Monitoring software was not used.

## Section 4Test Specifications

The tests were performed in accordance with Eurofins York Ltd Quotation QuC5667.

| | | | |
|---|---|---|---|
| **47CFR Part 15, Sub Part C Intentional Radiators**<br>**Section 15.225 Operation within the band 13.110-14.010MHz.**<br>**Section 15.215 Additional provisions to the general radiated emission limitations. Section (C) 20dB bandwidth.** | | | |
| **Which references the following test standard 47CFR 15.38 (G) (3): -** | | | |
| **ANSI C63-10: 2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.** | | | |
| **Test** | **Method** | **Levels** | **Result** |
| Conducted Emissions<br>(0.15 – 30MHz) | ANSI C63.10: 2013 | 47CFR15.207 | Pass |
| Radiated Emissions<br>Magnetic Field Measurements<br>(Expressed as electric field)<br>(9kHz to 30MHz)<br>And<br>Electric Field Measurements<br>(30MHz – 1000MHz) | ANSI C63.10: 2013 | (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.<br><br>(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.<br><br>(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.<br><br>(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209. | Pass |
| Section 15.225 (e) – Frequency tolerance of the carrier signal | ANSI C63.10: 2013 | The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to + 50 degrees C at normal supply voltage | Pass |
| Section 15.215(C)<br>20dB bandwidth | ANSI C63.10:2013 | 20dB bandwidth must remain within assigned frequency band | Pass |

Note 1 :All testing was carried out at a test distance of 3m and the data adjusted accordingly.

### 4.1 Knowledge Database References

The following KDBs were referenced during the testing of the HAVwear Module

The latest knowledge database references are available via the FCC KDB website at:

https://apps.**fcc**.gov/kdb

#### 4.1.1 Conducted Emissions

| Publication Number | Keyword | Publication Date |
|---|---|---|
| 174176 | Section 15.107, 15.207,18.307, C63.4, C63.10, Suitable Dummy Load, AC Power Line Conducted Measurement | 03/06/2015 |
| 640677 | Radio Frequency LED Lighting | 17/06/2016 |
| 892282 | Exclusions, Transportation, Electric Vehicle Battery Charge | 21/01/2012 |
| 657217 | Test procedures for Notebook Computers | 01/10/2008 |

#### 4.1.2 Radiated Emissions (9kHz to 30MHz)

| Publication Number | Keyword | Publication Date |
|---|---|---|
| 937606 | Test Site Requirements for Part 15 and 18 Devices Operating Below 30 MHz | 10/10/2014 |
| 460108 | Radiated emission measurements below 30 MHz | 06/15/2015 |

#### 4.1.3 Radiated Emissions (30MHz to 1000MHz)

| Publication Number | Keyword | Publication Date |
|---|---|---|
| 746324 | CE Mark and use of CISPR 22 limits | 06/12/2015 |
| 640677 | Radio Frequency LED Lighting | 17/06/2016 |
| 657217 | Test procedures for Notebook Computers | 01/10/2008 |
| 913591 | Measurement of radiated emissions at the band-edge for a Part 15 RF Device | 04/05/2017 |

#### 4.1.4 Radiated Emissions (1GHz to 40GHz)

| Publication Number | Keyword | Publication Date |
|---|---|---|
| 746324 | CE Mark and use of CISPR 22 limits | 12/06/2015 |
| 714737 | 15B, Average Detector for Unintentional Radiator | 30/11/2010 |
| 704992 | Test Site Validation Requirements above 1 GHZ. | 12/06/2015 |
| 149045 | Comparison Noise Emitter (CNE), reference noise source, .pdf | 05/04/2007 |
| 913591 | Measurement of radiated emissions at the band-edge for a Part 15 RF Device | 04/05/2017 |
| 934285 | Comparison Noise Emitters (CNE), test equipment, Broadband.pdf | 05/04/2007 |

### 4.1.5 Radiated Emissions - Apparatus Containing a Modular Transmitter

| Publication Number | Keyword | Publication Date |
|---|---|---|
| 996369 | Modular Transmitter Integration Guide – Guidance for Host Product Manufacturers, Frequency Spectrum to be Investigated | 01/02/2019 |

### 4.2 Compliance Statement

The HAVwear Docking Station (no GPRS), was shown to meet requirements of the standards listed in Section 4 of this report.

# Section 5 Conducted Emission Results

## 5.1 Test Specification

| | |
|---|---|
| Standard | ANSI C63.10-2013 |
| Measurement Uncertainty | The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 % is<br>+/- 3.45dB |

## 5.2 Power Line Emission Limits

| **Frequency (MHz)** | **47CFR 15.207 (dBµV)** | |
|---|---|---|
| | **Quasi Peak** | **Average** |
| 0.15 – 0.5 | 66 – 56* | 56 – 46* |
| 0.5 – 5.0 | 56.0 | 46.0 |
| 5.0 - 30 | 60.0 | 50.0 |

Note: * The limit decreases linearly with the logarithm of the frequency in the range

## 5.3 Receiver Settings

| **Receiver Parameters** | **Setting** |
|---|---|
| Detector Function | Quasi Peak and Average |
| Start Frequency | 150kHz |
| Stop Frequency | 30MHz |
| Resolution Bandwidth | 10kHz |
| Video Bandwidth | Auto |

## 5.4 Procedure and Test Software Version

| | |
|---|---|
| Eurofins York test procedure | CEP19 Issue 5 |
| Test software | RadiMation Version 2016.1.6 |

### 5.4.1 Date of Test

27th January 2021

### 5.4.2 Test Area

Laboratory 2

### 5.4.3 Test Setup

This test was applied to the EUT's Live and Neutral lines. The EUT was configured in the screened room on an 80cm high table and was positioned 40cm from the room wall.

A calibrated mains extension lead was used to ensure a known impedance was presented to the EUT

The EUT was then powered from the mains supply via a Line Impedance Stabilisation Network (LISN).

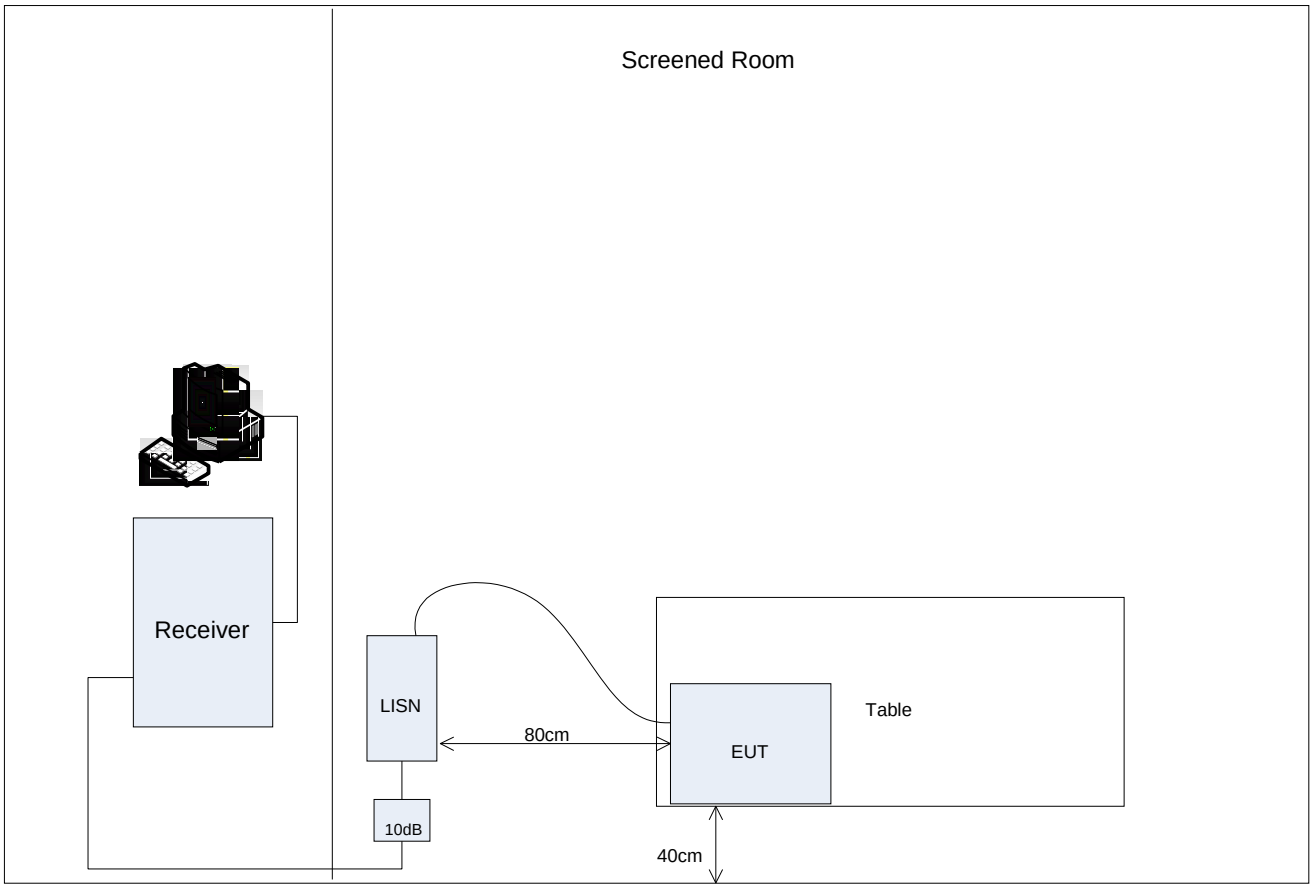
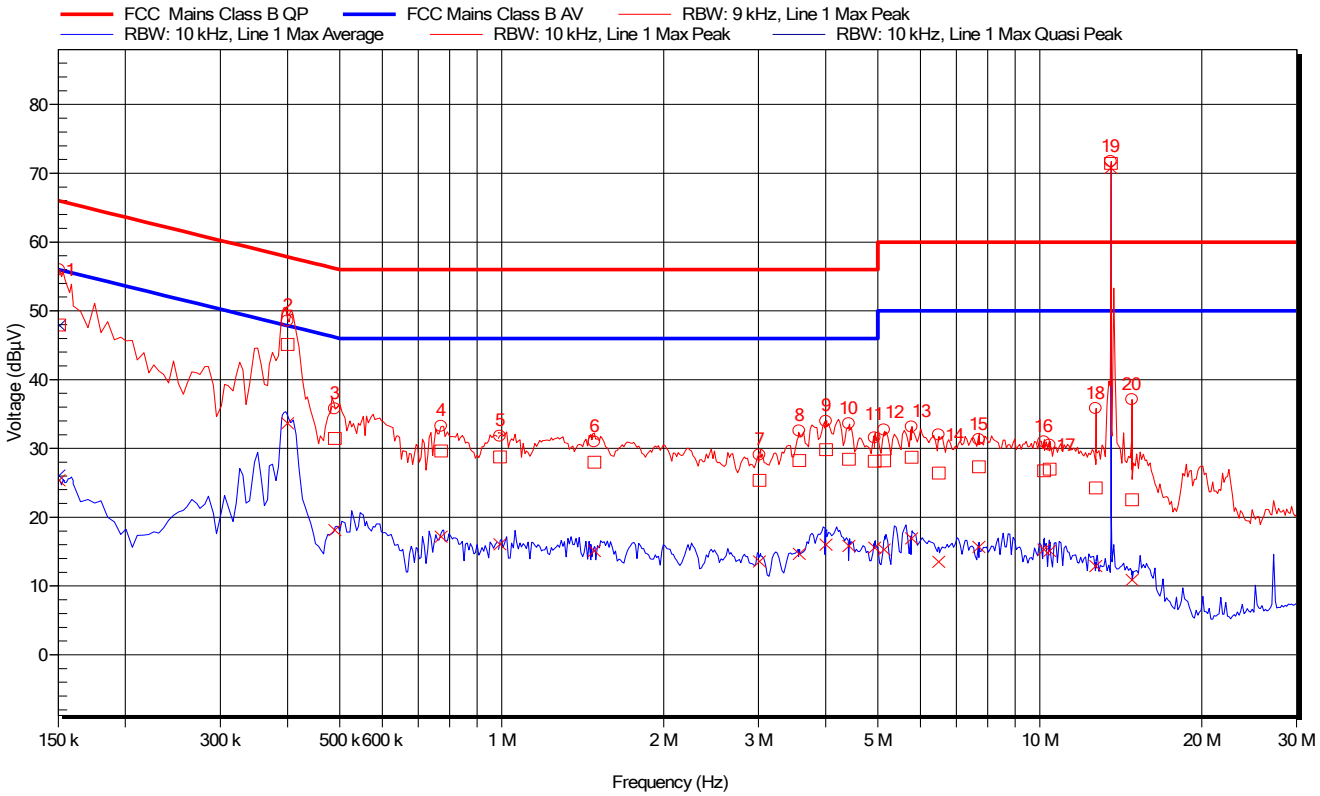


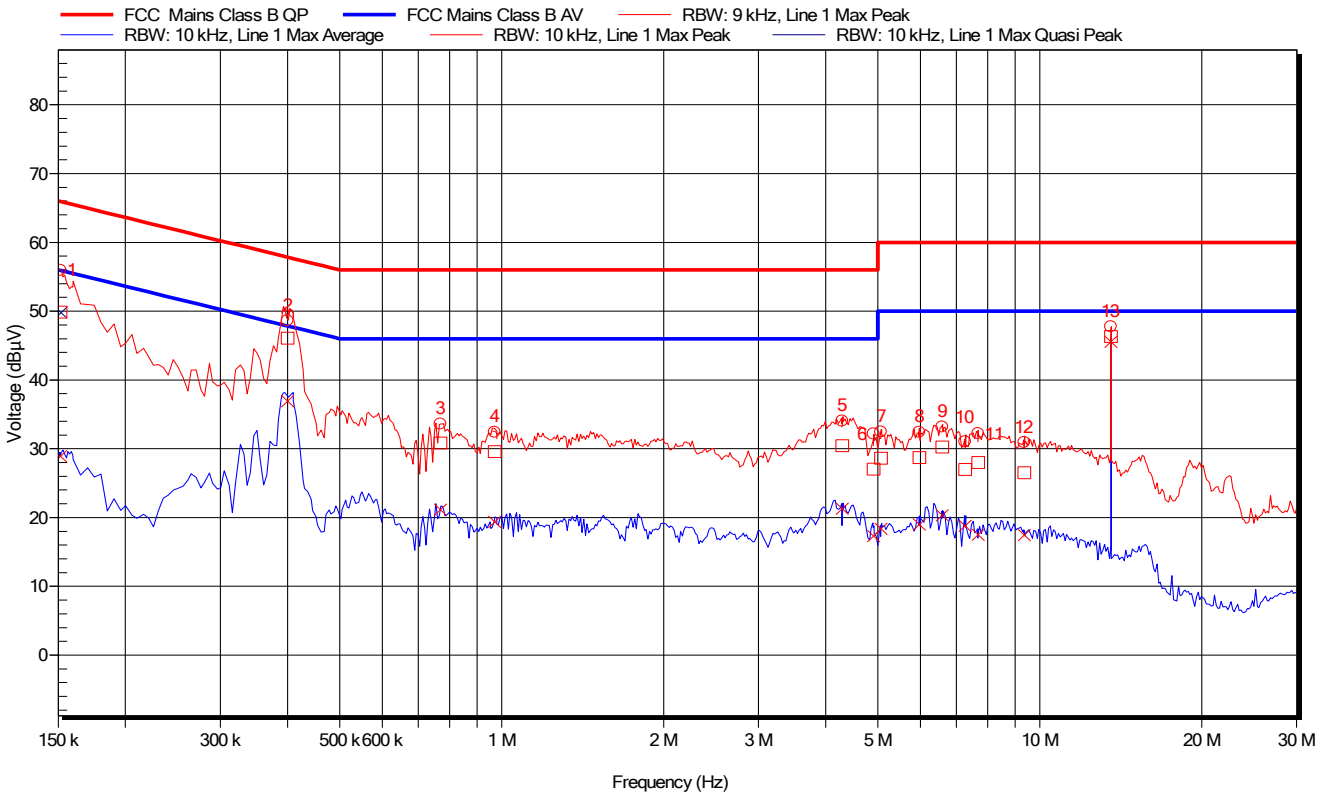

**Figure 2: Test setup for Conducted Emissions on the AC power port**

### 5.4.4 Plots



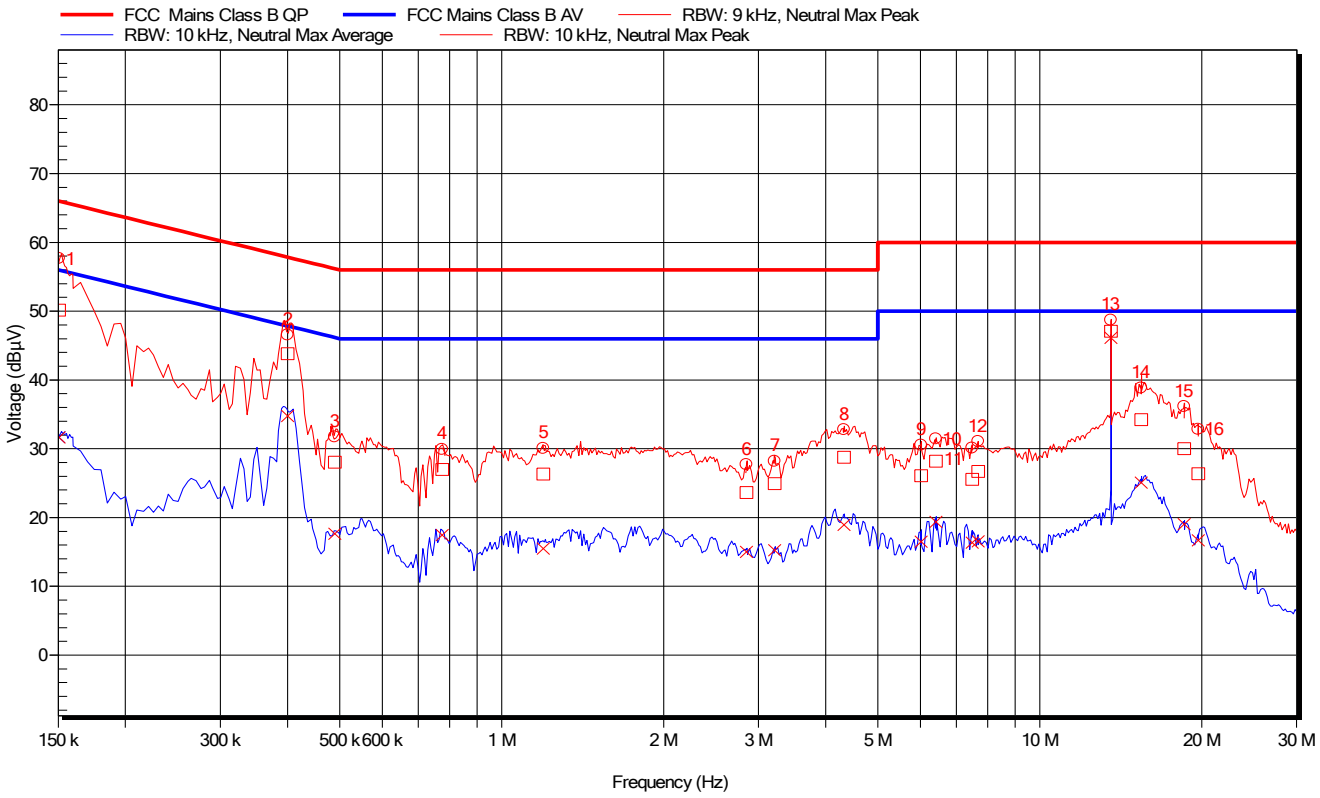

| Frequency MHz | Average dBµV | Average Limit dBµV | Average Difference dB | Average Status dB | Quasi-Peak dBµV | Quasi-Peak Limit dBµV | Quasi-Peak Difference dB | Quasi-Peak Status | Overall Status |
|---|---|---|---|---|---|---|---|---|---|
| 0.150 | 25.4 | 56 | -30.59 | Pass | 48.0 | 66.0 | -18.01 | Pass | Pass |
| 0.400 | 33.6 | 47.9 | -14.21 | Pass | 45.1 | 57.9 | -12.76 | Pass | Pass |
| 0.490 | 18.1 | 46.2 | -28.03 | Pass | 31.5 | 56.2 | -24.71 | Pass | Pass |
| 0.772 | 17.2 | 46.0 | -28.82 | Pass | 29.6 | 56.0 | -26.35 | Pass | Pass |
| 0.994 | 16.0 | 46.0 | -29.96 | Pass | 28.8 | 56.0 | -27.24 | Pass | Pass |
| 1.486 | 15.1 | 46.0 | -30.92 | Pass | 28.0 | 56.0 | -28.03 | Pass | Pass |
| 3.015 | 13.5 | 46.0 | -32.45 | Pass | 25.3 | 56 | -30.66 | Pass | Pass |
| 3.570 | 14.7 | 46.0 | -31.33 | Pass | 28.2 | 56 | -27.75 | Pass | Pass |
| 4.005 | 16.0 | 46.0 | -29.97 | Pass | 29.8 | 56 | -26.2 | Pass | Pass |
| 4.420 | 25.4 | 56.0 | -30.59 | Pass | 28.4 | 56 | -27.56 | Pass | Pass |

Emissions with normal antenna




| Frequency MHz | Average dBµV | Average Limit dBµV | Average Difference dB | Average Status dB | Quasi-Peak dBµV | Quasi-Peak Limit dBµV | Quasi-Peak Difference dB | Quasi-Peak Status | Overall Status |
|---|---|---|---|---|---|---|---|---|---|
| 0.152 | 28.9 | 55.9 | -26.99 | Pass | 49.9 | 65.9 | -16.06 | Pass | Pass |
| 0.400 | 36.9 | 47.9 | -10.96 | Pass | 46.1 | 57.9 | -11.80 | Pass | Pass |
| 0.769 | 21.1 | 46.0 | -24.87 | Pass | 30.8 | 56.0 | -25.17 | Pass | Pass |
| 0.970 | 19.4 | 46.0 | -26.64 | Pass | 29.6 | 56.0 | -26.43 | Pass | Pass |
| 4.295 | 21.3 | 46.0 | -24.72 | Pass | 30.4 | 56.0 | -25.55 | Pass | Pass |
| 4.910 | 17.3 | 46.0 | -28.69 | Pass | 27.1 | 56.0 | -28.94 | Pass | Pass |
| 5.070 | 18.4 | 50.0 | -31.65 | Pass | 28.6 | 60.0 | -31.40 | Pass | Pass |
| 5.975 | 19 | 50.0 | -30.99 | Pass | 28.7 | 60.0 | -31.29 | Pass | Pass |
| 6.590 | 20.3 | 50.0 | -29.70 | Pass | 30.3 | 60.0 | -29.74 | Pass | Pass |
| 7.265 | 18.8 | 50.0 | -31.21 | Pass | 27 | 60.0 | -33.03 | Pass | Pass |
| 13.560 | 45.5 | 50.0 | -4.46 | Pass | 46.3 | 60.0 | -13.69 | Pass | Pass |

Live data with antenna replaced by 50Ω Load




| Frequency MHz | Average dBµV | Average Limit dBµV | Average Difference dB | Average Status dB | Quasi-Peak dBµV | Quasi-Peak Limit dBµV | Quasi-Peak Difference dB | Quasi-Peak Status | Overall Status |
|---|---|---|---|---|---|---|---|---|---|
| 0.150 | 31.6 | 56 | -24.34 | Pass | 50.1 | 66.0 | -15.85 | Pass | Pass |
| 0.400 | 34.8 | 47.9 | -13.09 | Pass | 43.8 | 57.9 | -14.04 | Pass | Pass |
| 0.490 | 17.6 | 46.2 | -28.52 | Pass | 28.1 | 56.2 | -28.11 | Pass | Pass |
| 0.775 | 17.4 | 46 | -28.57 | Pass | 27.0 | 56.0 | -28.99 | Pass | Pass |
| 1.195 | 15.5 | 46 | -30.52 | Pass | 26.3 | 56.0 | -29.67 | Pass | Pass |
| 2.850 | 15 | 46 | -30.97 | Pass | 23.6 | 56.0 | -32.36 | Pass | Pass |
| 3.215 | 15.2 | 46 | -30.77 | Pass | 24.9 | 56.0 | -31.07 | Pass | Pass |
| 4.325 | 19 | 46 | -27.05 | Pass | 28.8 | 56.0 | -27.24 | Pass | Pass |
| 6.015 | 16.5 | 50 | -33.52 | Pass | 26.1 | 60.0 | -33.93 | Pass | Pass |
| 6.411 | 19.3 | 50 | -30.65 | Pass | 28.2 | 60.0 | -31.79 | Pass | Pass |
| 13.561 | 46.1 | 50 | -3.90 | Pass | 47.1 | 60.0 | -12.93 | Pass | Pass |

Neutral data with antenna replaced by 50Ω Load

### 5.4.5 Correction factors

The quasi-peak correction and average correction are shown in the above table. This correction figure consists of LISN Insertion loss (IL), Cable loss (CL) and Transient Limiter Loss (TL)

The Actual Signal Level (ASL) is calculated as follows:

ASL (dBµV) = Indicated Signal Level (dBµV) + IL (dB) + CL (dB) + TL (dB)

### 5.4.6 Sample Data

The Quasi-Peak level at 13.561MHz

ASL (dBµV) =47.1dBµV = 35.09dBµV + 1.63dB + 0.27dB + 10.1dB

# Section 6 Radiated Emission Results

## 6.1 Test Specification

| | |
|---|---|
| Standard | ANSI C63.10-2013 |
| Measurement Uncertainty | The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95% is<br>+/- 5.01dB for the frequency range from 9kHz to 30MHz<br>+/- 6.23dB for the frequency range 30MHz to 1GHz<br>+/- 5.04dB for the frequency range from 1GHz to 6GHz<br>+/- 5.35dB for the frequency range from 6GHz to 18GHz<br>+/- 4.81dB for the frequency range from 18GHz to 40GHz |

## 6.2 Procedure and Test Software Version

| | |
|---|---|
| Eurofins York test procedure (9kHz to 30MHz) | CEP22 Issue 5 |
| Eurofins York test procedure (30MHz to 1GHz) | CEP23 Issue 5 |
| Eurofins York test procedure (1GHz to 40GHz) | CEP64 Issue 6 |
| Test software | Keysight Connect |

## 6.3 Magnetic Field Radiated Emissions (9kHz to 30MHz)

### 6.3.1 Limits

| Frequency | Limits (µV/m) |
|---|---|
| 9kHz to 490kHz | 2400/F(kHz) at 300m |
| 490kHz to 1.705MHz | 24000/F(kHz) at 30m |
| 1,705MHz to 30MHz | 30 at 30m |

Note 1: * The limit decreases linearly with the logarithm of the frequency in the range

Note 2: FCC 47 CFR Part 15 Section 15.209 has different test limits from 300m to 30m depending upon the measurement frequency range. The limits have been adjusted for a measurement distance of 3m.

Distance Correction Factor = 40log(test distance /specific distance).

### 6.3.2 Analyser Settings Outside of the 13.110-14.010 MHz band

| Receiver Parameters | Setting |
|---|---|
| Detector Function | Peak – for initial investigation |
| Start Frequency | 9kHz |
| Stop Frequency | 150kHz |
| Resolution Bandwidth | 200Hz |
| Video Bandwidth | 620Hz |

| Receiver Parameters | Setting |
|---|---|
| Detector Function | Peak – for initial investigation |
| Start Frequency | 150kHz |
| Stop Frequency | 30MHz |
| Resolution Bandwidth | 10kHz |
| Video Bandwidth | 30kHz |

Spectrum Mask: Analyser Settings within the bands,

13.553-13.567 MHz, 13.410-13.553 MHz, 13.567-13.710 MHz, 13.110-13.410 MHz and 13.710-14.010 MHz

| Receiver Parameters | Setting |
|---|---|
| Detector Function | Peak – for initial investigation |
| Start Frequency | 13.110MHz |
| Stop Frequency | 14.010MHz |
| Resolution Bandwidth | 10kHz |
| Video Bandwidth | 30kHz |

### 6.3.3 Emissions measurements

### 6.3.4 Date of Test

18th January 2021

### 6.3.5 Test Area

LAB 5
(Anechoic chamber)

### 6.3.6 Tested by

M Render

### 6.3.7 Anechoic Test Setup

The EUT was configured in the chamber on an 80cm high table (polystyrene block)

The measurement was then performed with an antenna to EUT separation distance of 3m within the anechoic chamber based upon the highest emissions results recorded on the outside test site.

The centre of the loop antenna was 1m above the ground and results were obtained with it parallel to the EUT and then perpendicular to the EUT.

The results are maximised in orientation 0-360 degrees.

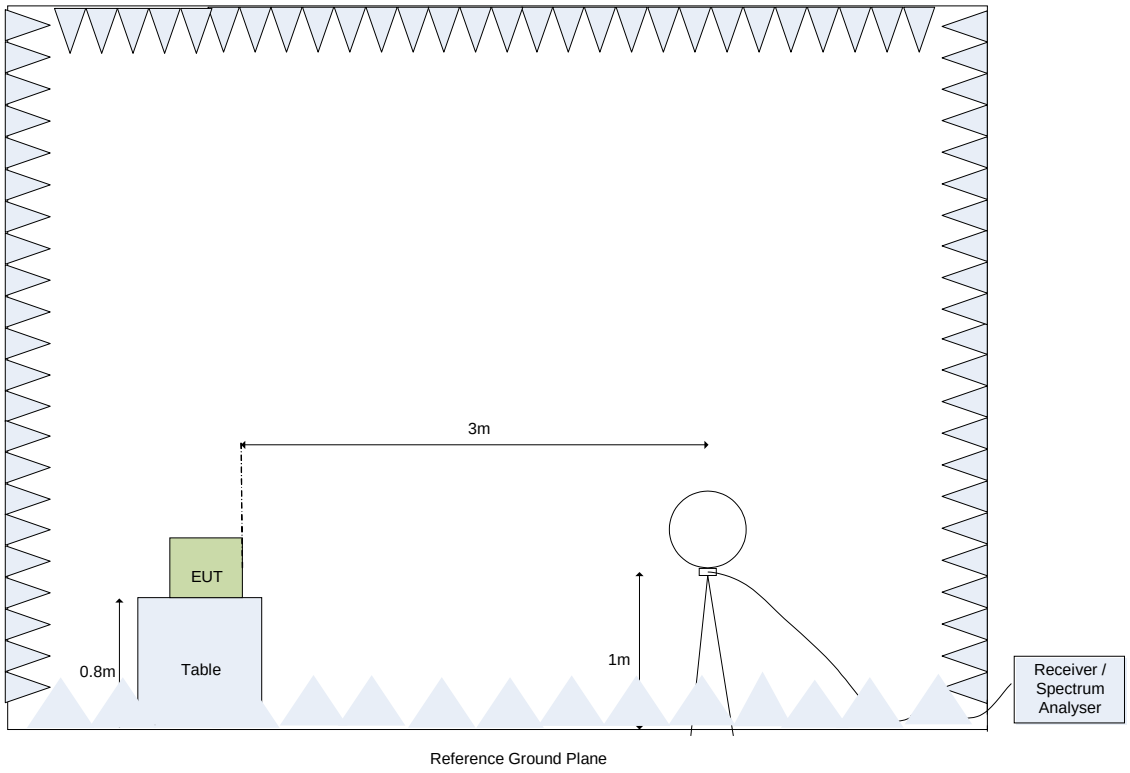



**Figure 2: Test Setup for H-Field Measurements from 9kHz to 30MHz**

Note 1 : With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement

Note 2 : There were no significant environmental temperature changes during the test duration and hence it was not considered necessary to consider any variation in cable loss.

### 6.3.8 Magnetic Field Emissions Results, 9kHz to 30MHz

Measurements were made in an anechoic chamber at a 3m measurement distance. There were no reflective surfaces, since the wall, floor and ceiling were lined with radio absorbent material.

The results present data measured with a PEAK detector.

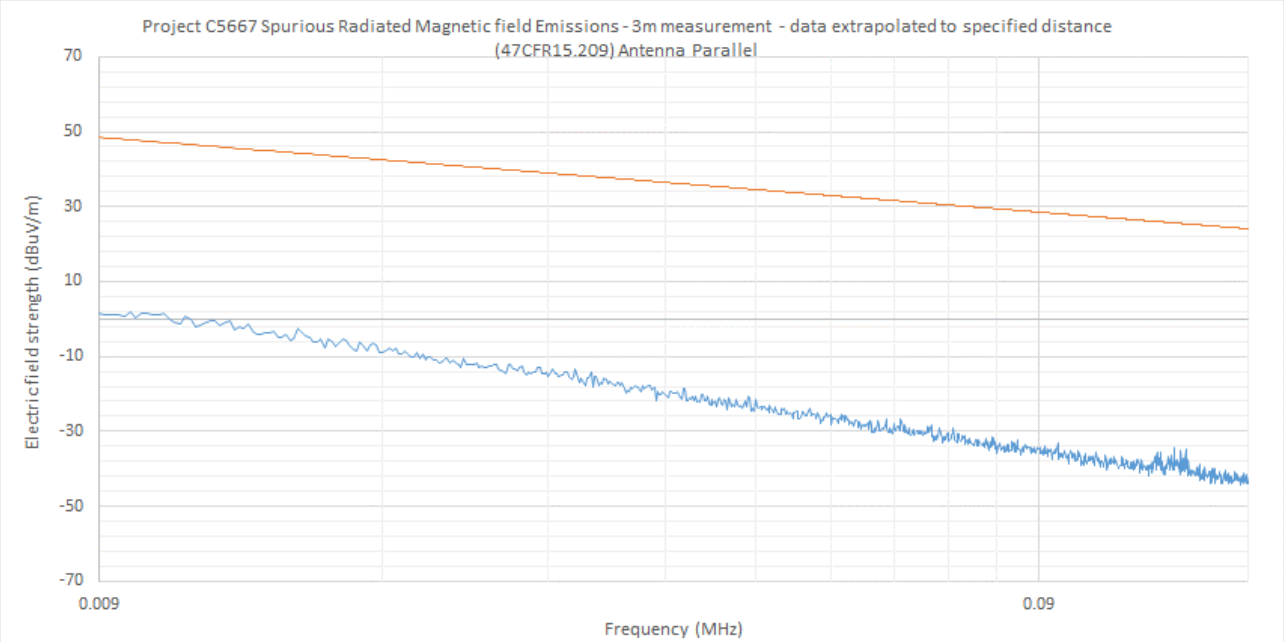



**Figure 3: Magnetic field emissions Plot, 9kHz to 150kHz Parallel**

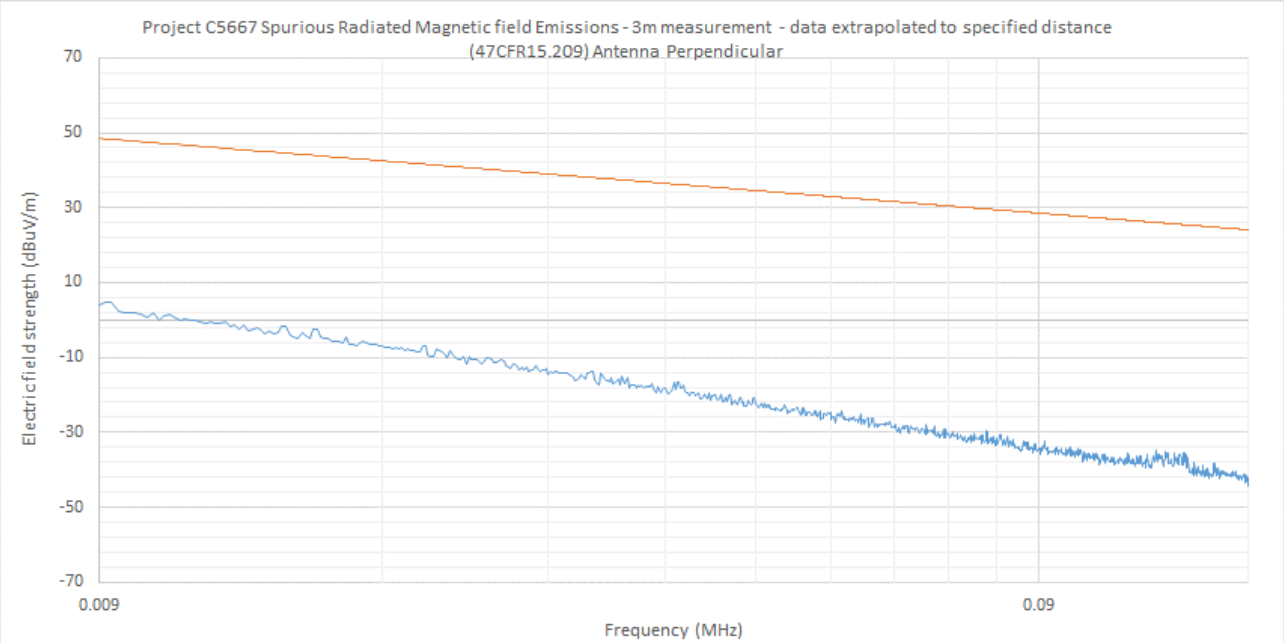



**Figure 4: Magnetic field emissions Plot, 9kHz to 150kHz Perpendicular**

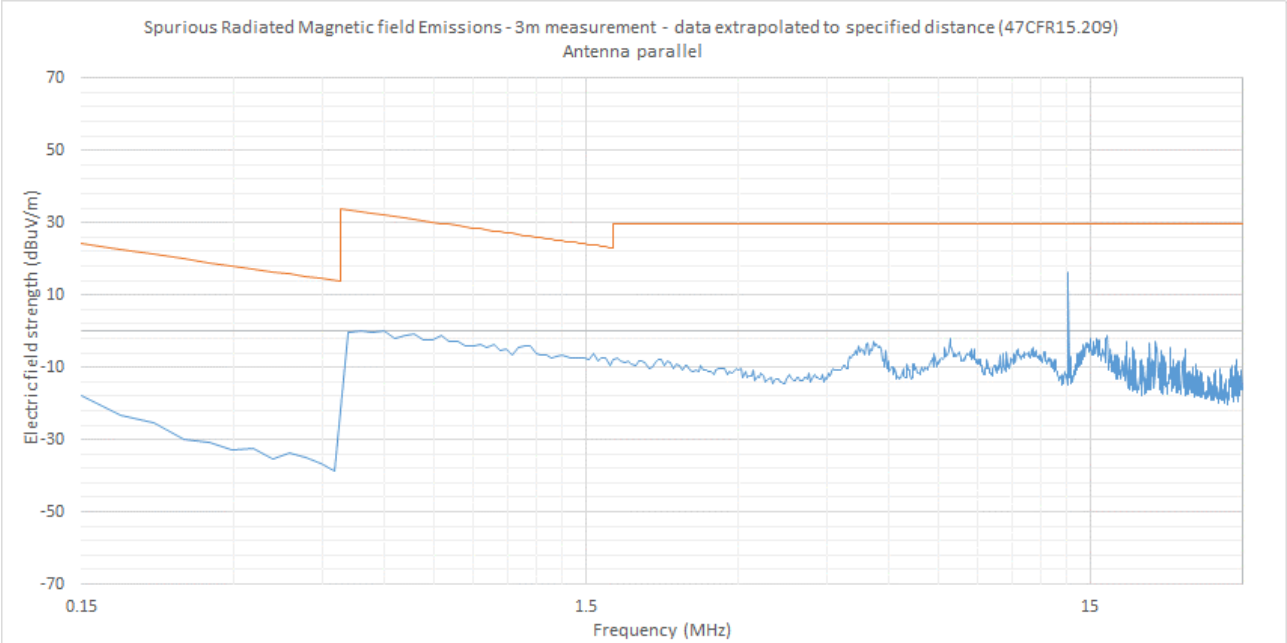



**Figure 5: Magnetic field emissions Plot, 150kHz to 30MHz Parallel**

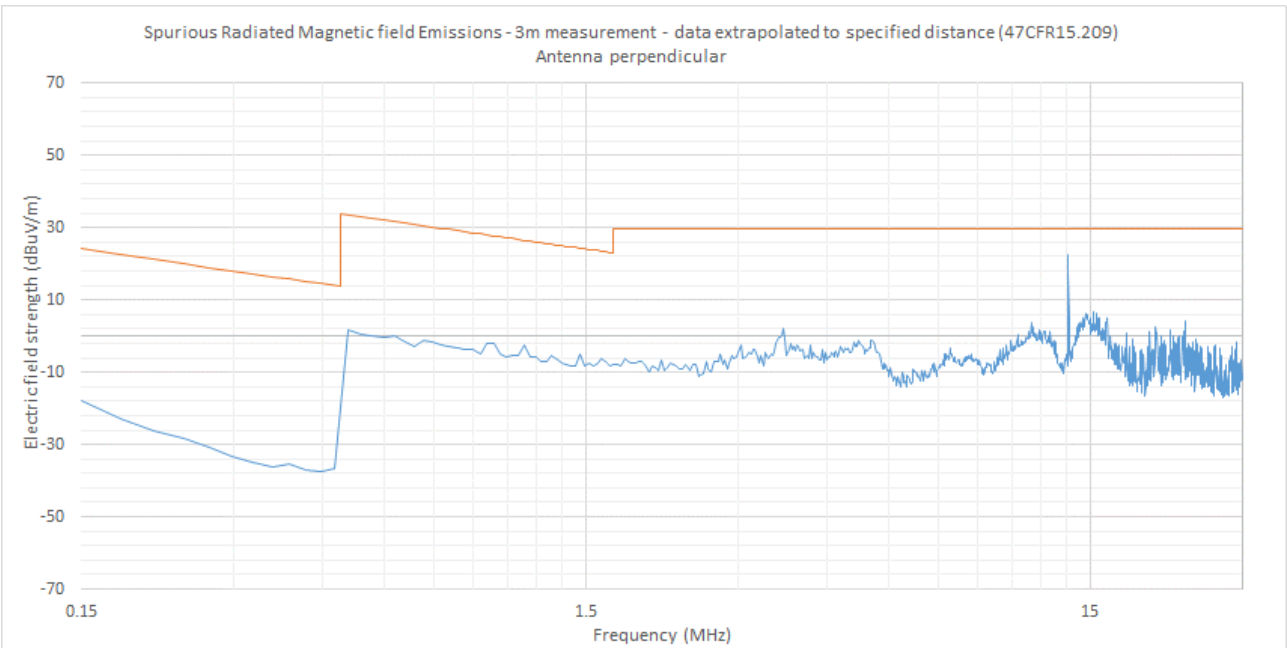



**Figure 6: Magnetic field emissions Plot, 150kHz to 30MHz Perpendicular**

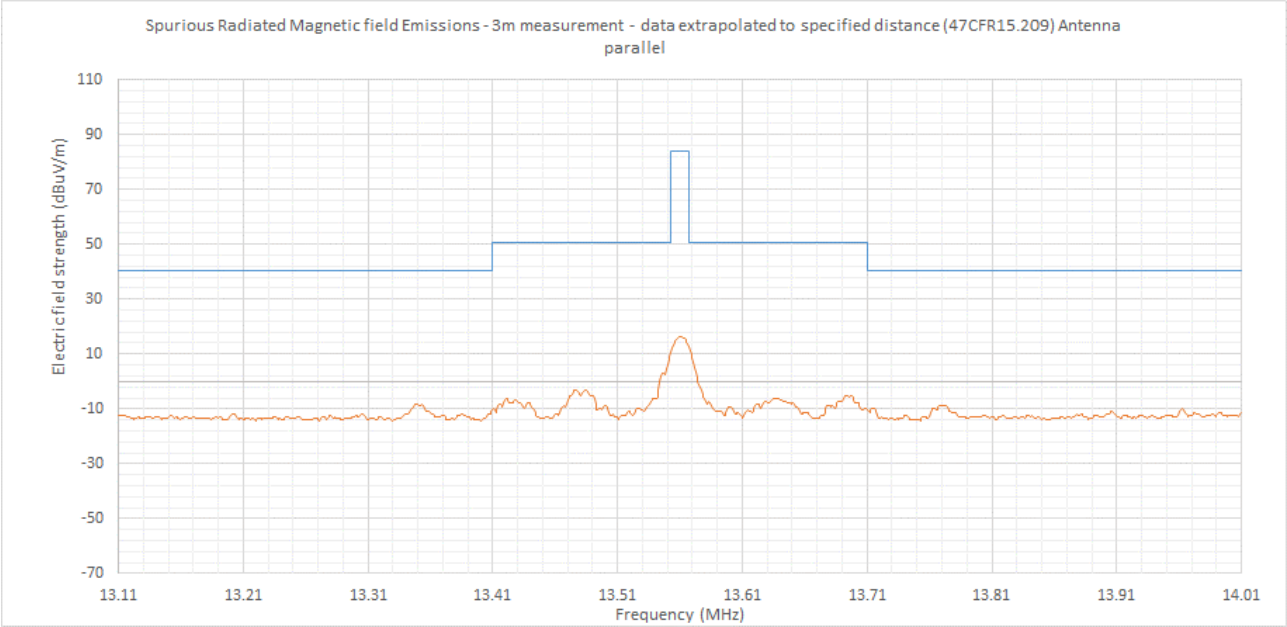



**Figure 7: Magnetic field emissions Plot, 13.11MHz to 14.01MHz – Spectrum Mask – antenna Parallel**

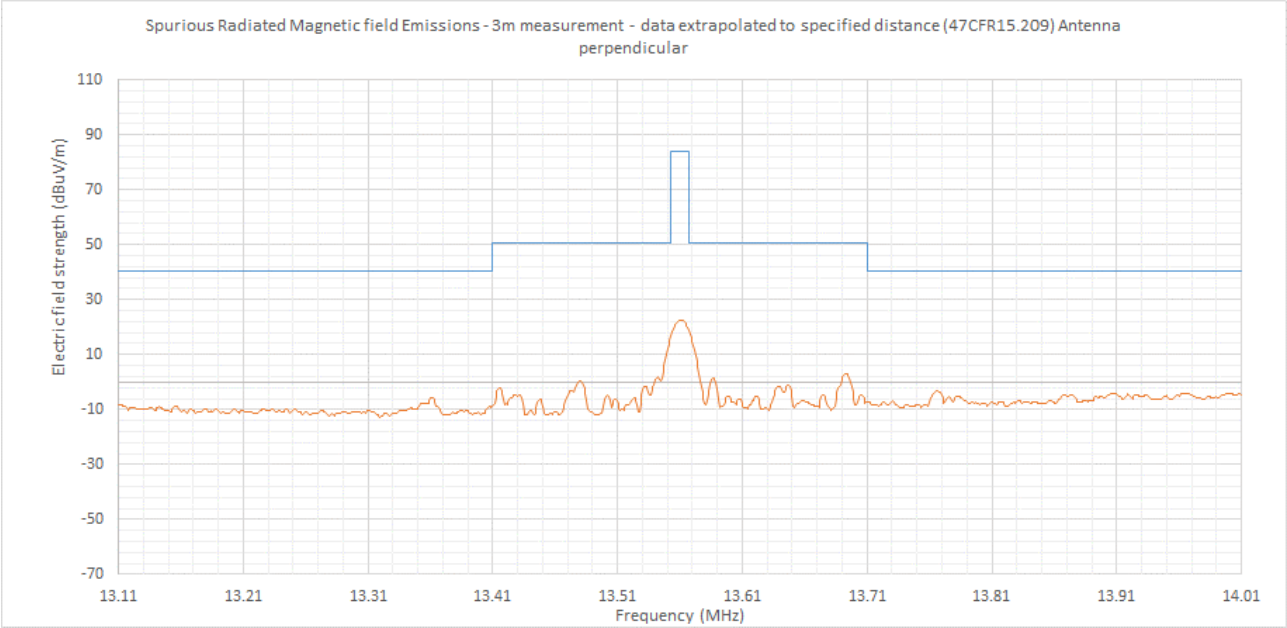



**Figure 8: Magnetic field emissions Plot, 13.11MHz to 14.01MHz – Spectrum Mask – antenna Perpendicular**

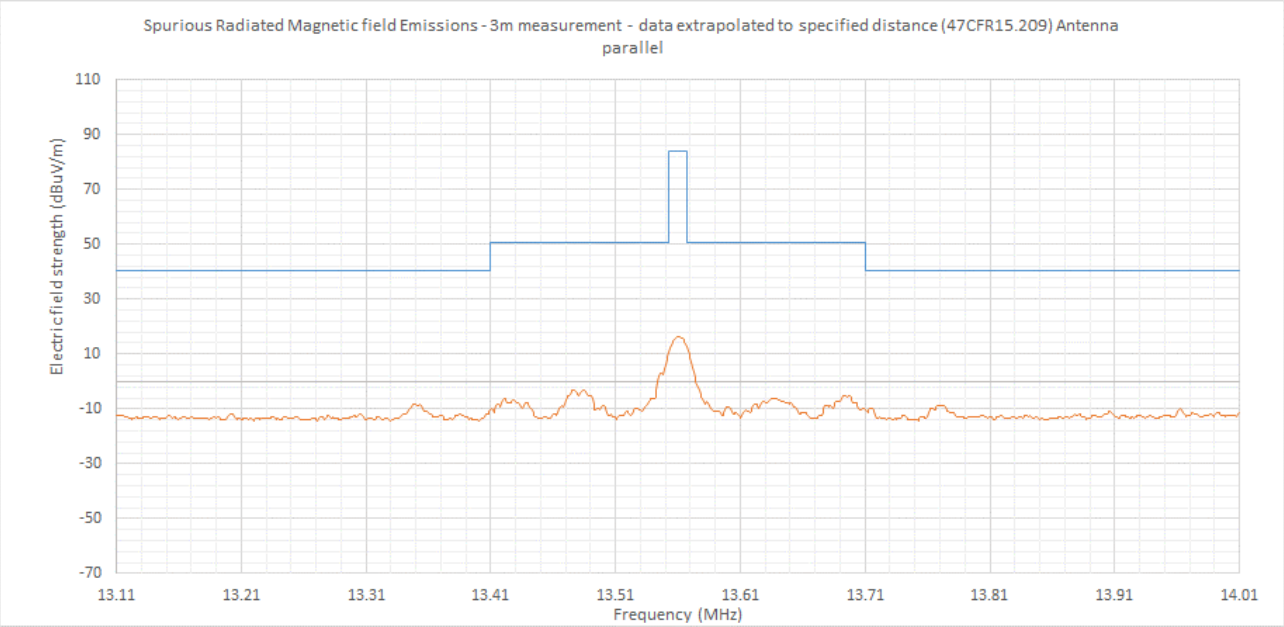



**Figure 9: Magnetic field emissions Plot, 13.11MHz to 14.01MHz – Spectrum Mask – antenna Parallel. Supply voltage set to 85%, 102V**

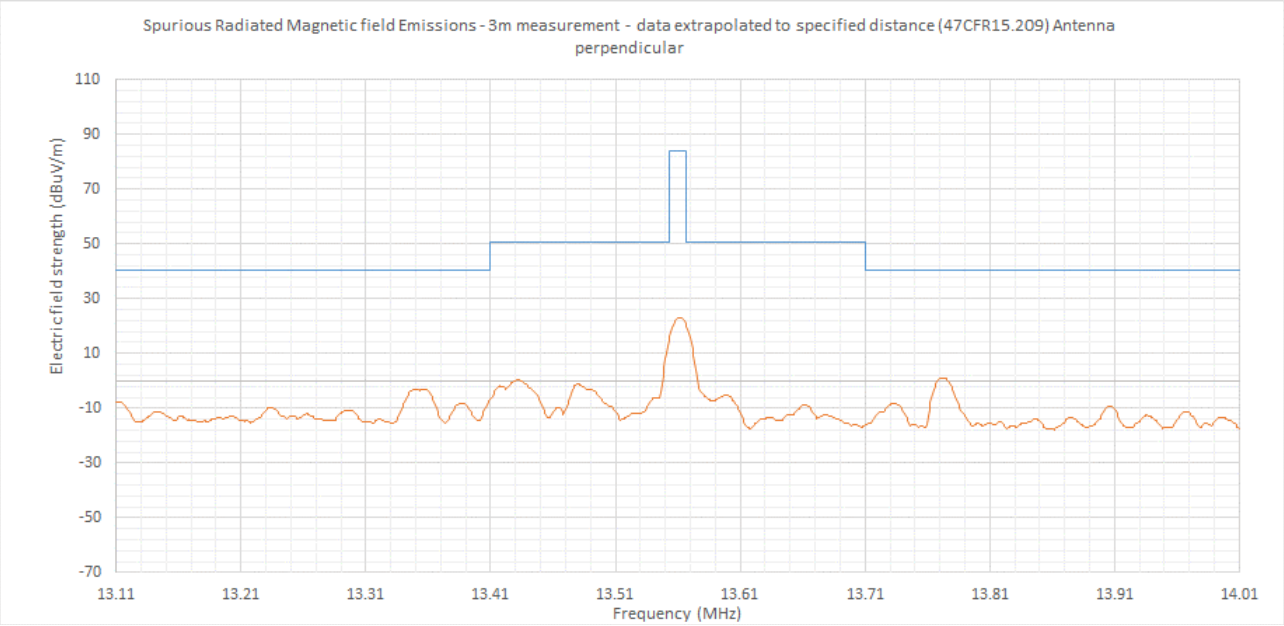



**Figure 10: Magnetic field emissions Plot, 13.11MHz to 14.01MHz – Spectrum Mask – antenna Perpendicular. Supply voltage set to 85%, 102V**

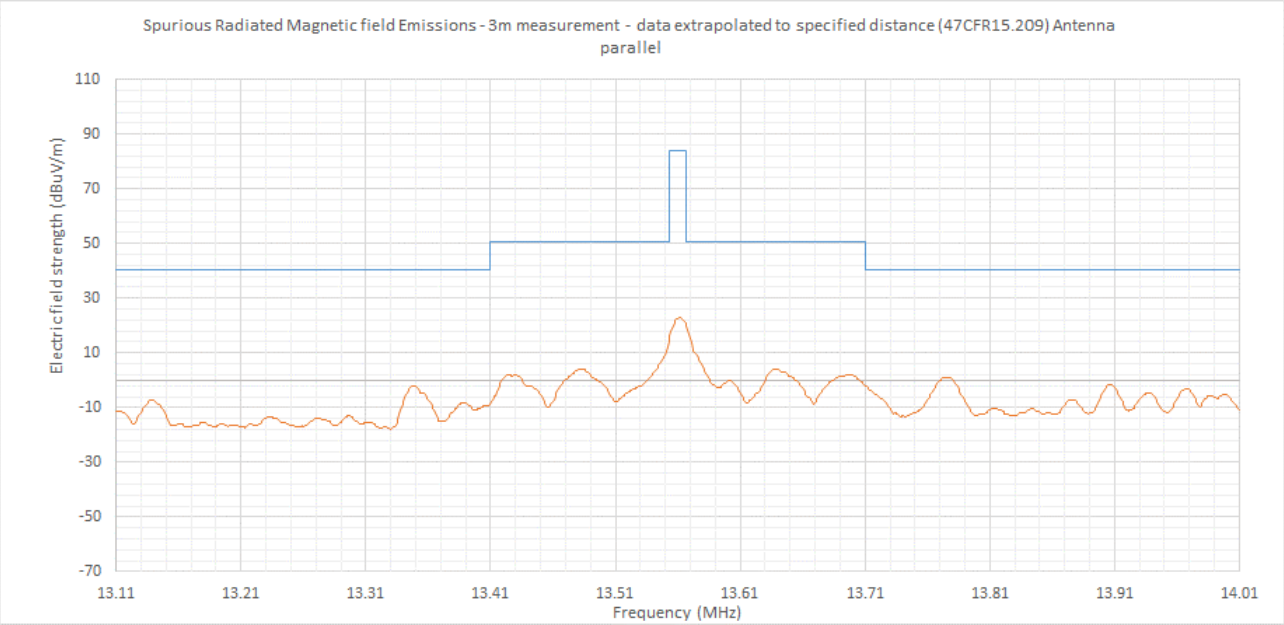



**Figure 11: Magnetic field emissions Plot, 13.11MHz to 14.01MHz – Spectrum Mask – antenna Parallel. Supply voltage set to 115%, 138V**

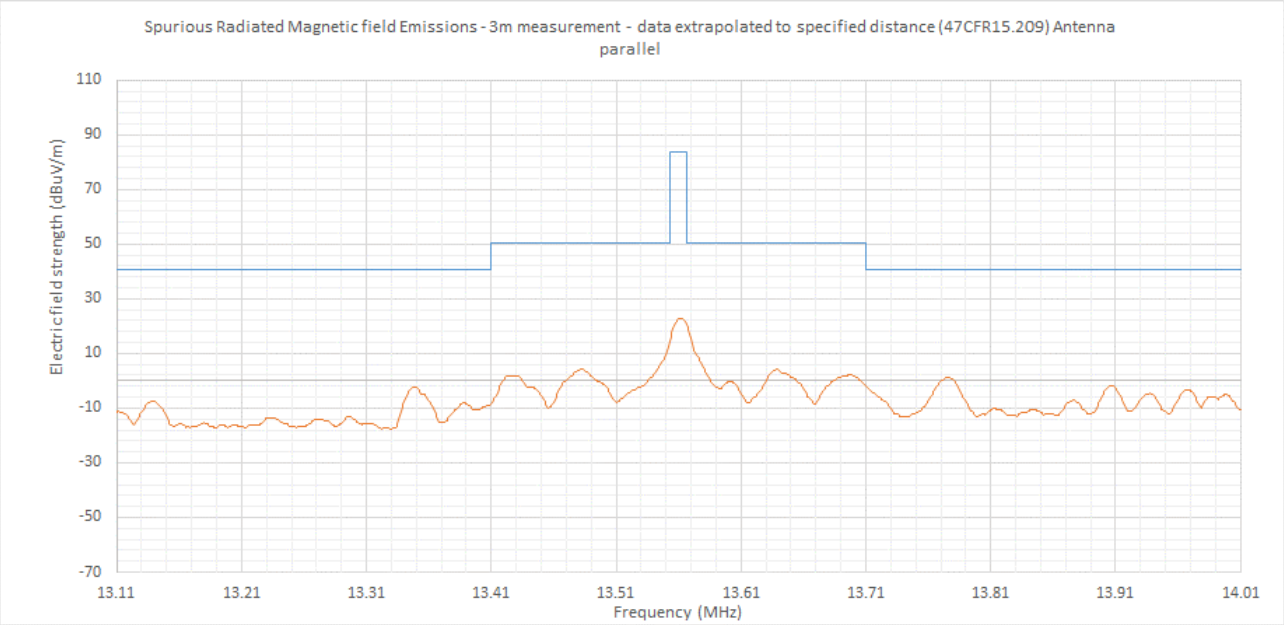



**Figure 12: Magnetic field emissions Plot, 13.11MHz to 14.01MHz – Spectrum Mask – antenna Perpendicular. Supply voltage set to 115%, 138V**

### 6.3.9 Calculation of result

Field strength (FS) is calculated as follows from the receiver reading, Antenna factor (AF) in dB/m; Cable loss (CL) and pre-amplifier gain (G).

FS (dBµV/m) = Indicated Signal Level (dBµV)+ AF(dB/m) –G(dB)+ CL (dB)

Cable loss was considered to have no influence on the measurement result in this case.

| Freq (MHz) | Rx (dBµV) | Preamp gain G (dB) | Antenna factor (dB/m) | Result at 3m (dBµV/m) | Distance correction factor (40dB/decade) | Result at 30m (dBµV/m) | Limit At 30m (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|---|---|---|---|
| 13.56 | 56.1 | 26.3 | 32.7 | 62.5 | -40 | 22.5 | 85 | -62.5 | Below limit |

**13.56MHz result calculation – measurement antenna perpendicular**

| Freq (MHz) | Rx (dBµV) | Preamp gain G (dB) | Antenna factor (dB/m) | Result at 3m (dBµV/m) | Distance correction factor (40dB/decade) | Result at 30m (dBµV/m) | Limit At 30m (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|---|---|---|---|
| 13.56 | 49.79 | 26.3 | 32.7 | 56.19 | -40 | 16.19 | 84 | -67.81 | Below limit |

**13.56MHz result calculation – measurement antenna parallel**

### 6.3.10 Data Extrapolation

Measurements were made at a 3m measurement distance since the NFC 13.56MHz signal was not detected at 10m. The data was extrapolated to the required specified distance as follows:

Between 9kHz and 490kHz the measurement distance according to 47CFR15.209 (a) is 300m:

$$\text{measurement at } 300\text{m} = \text{measurement at } 3\text{m} + 40\log\left(\frac{3}{300}\right)$$

$$\text{measurement at } 300\text{m} = \text{measurement at } 3\text{m} - 80$$

Between 490kHzand 30MHz the measurement distance according to 47CFR15.209 (a) is 30m:

$$\text{measurement at } 30\text{m} = \text{measurement at } 3\text{m} + 40\log\left(\frac{3}{30}\right)$$

$$\text{measurement at } 30\text{m} = \text{measurement at } 3\text{m} - 40\text{dB}$$

### 6.3.11 Measurement Summary

No further emissions were identified as being within 20dB of the specification limit using a peak detector. No further measurements were taken.

## 6.4 Radiated Emissions (30MHz to 1GHz)

### 6.4.1 Limits at 3m

| Frequency (MHz) | 47CFR15.209 (a) (dBµV/m) |
|---|---|
| | Quasi Peak |
| 30 - 88 | 40.0 |
| 88 -216 | 43.5 |
| 216 - 960 | 46.0 |
| 960- 1000 | 54.0 |

47CFR 15.209 specifies limits at a 3m measurement distance.

| Receiver Parameters | Setting |
|---|---|
| Detector Function | Quasi Peak |
| Start Frequency | 30MHz |
| Stop Frequency | 1000MHz |
| Resolution Bandwidth | 120kHz |
| Video Bandwidth | Auto |

### 6.4.2 Emissions measurements

### 6.4.3 Date of Test

19th January 2021

### 6.4.4 Test Area

LAB 1 (SAC)

### 6.4.5 Tested by

M Render

### 6.4.6 Test Setup

The EUT was configured in the SAC on an 80cm high table (polystyrene block).

The measurement was performed with an antenna to EUT separation distance of 3m. The Quasi peak limits are therefore increased by 10dB (from the 10m values), to allow for the reduction in the measurement distance.

The results were maximised in orientation 0-360 degrees and height 1-4m.

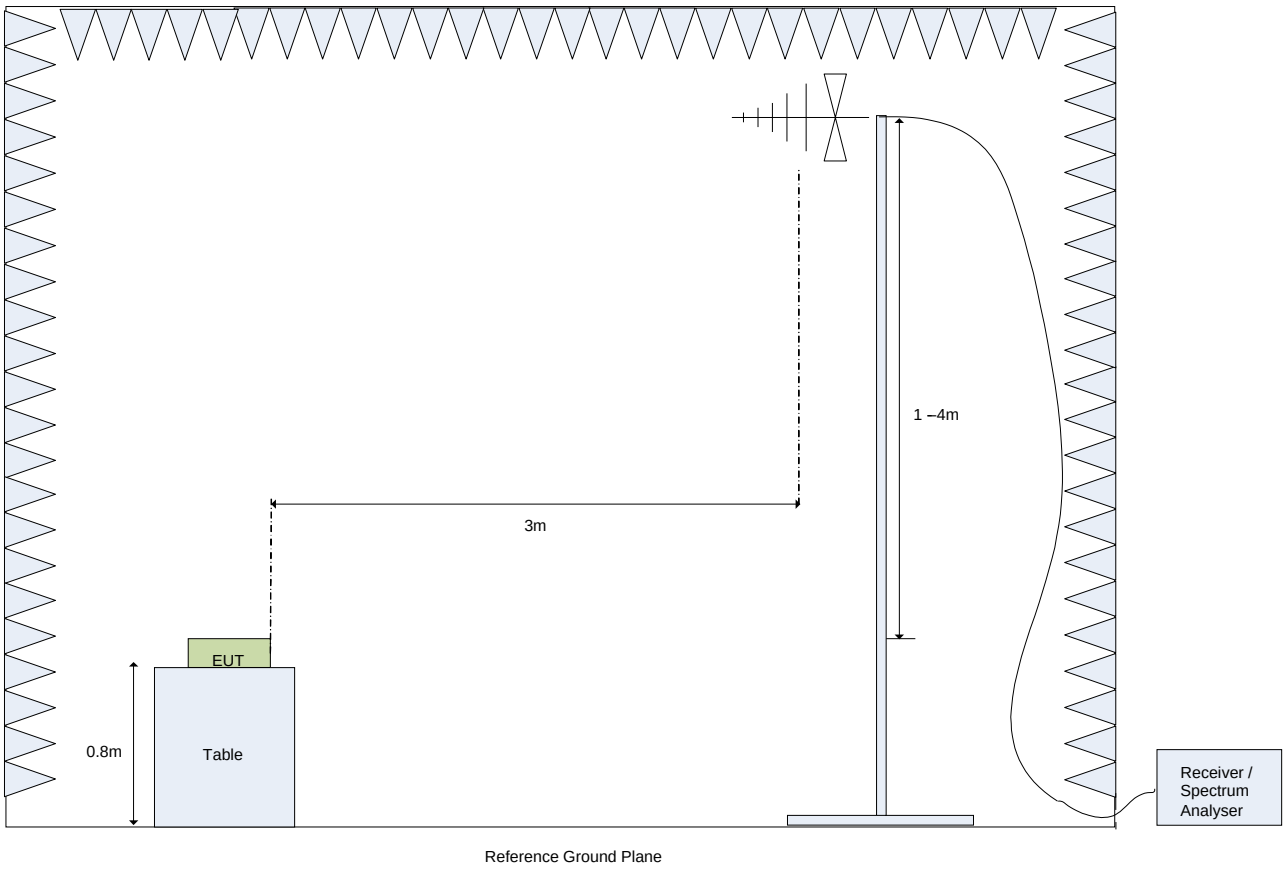



**Figure 13: Test Setup for E-Field Measurements from 30MHz to 1GHz**

Note 1 : With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement.

Note 2 : There were no significant environmental temperature changes during the test duration and hence it was not considered necessary to consider any variation in cable loss.

### 6.4.7 Electric field emissions, 30MHz to 1GHz

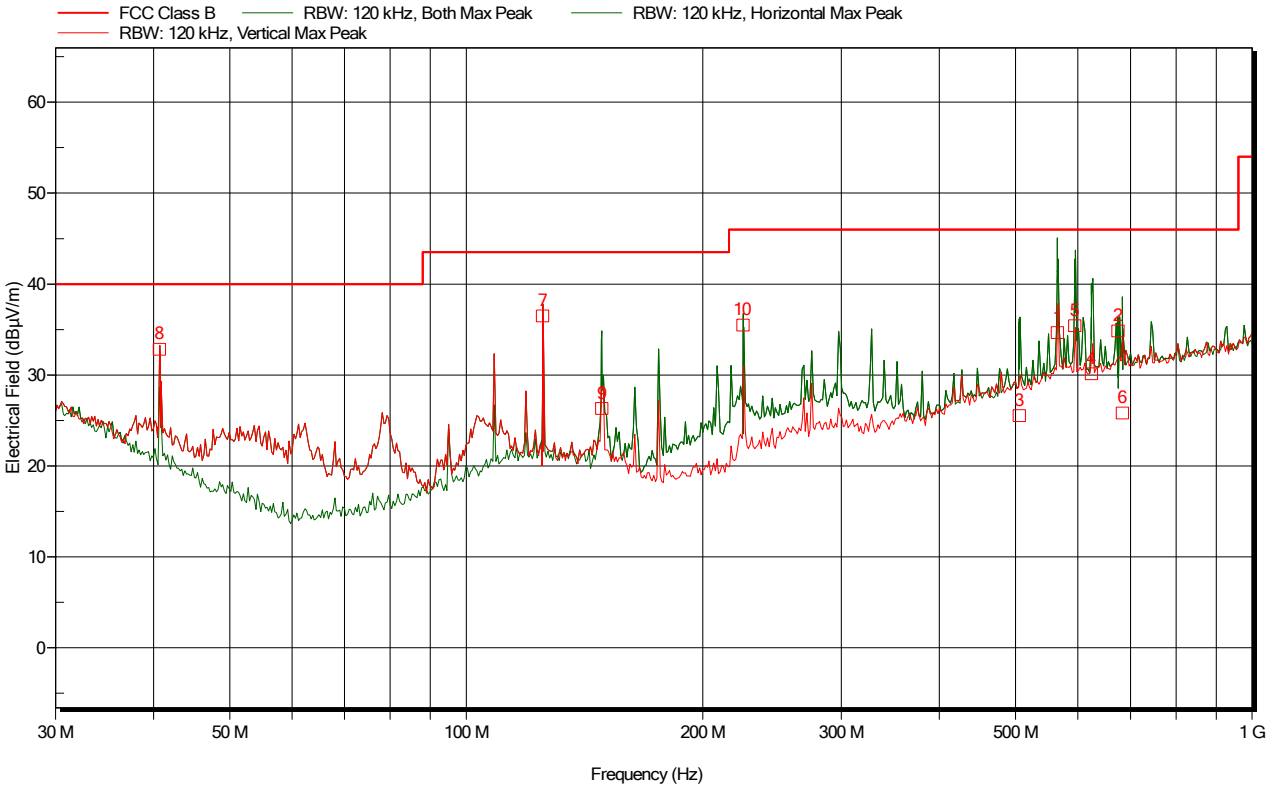



**Figure 14: Electric field emissions Plot, 30MHz to 1GHz.**

| Frequency MHz | Measured QP dBµV/m | Limit dBµV/m | Margin dB | Polarity | Height m | Comment |
|---|---|---|---|---|---|---|
| 40.680 | 32.8 | 40 | -7.2 | Vertical | 1 | Pass |
| 125.004 | 36.5 | 43.5 | -7.0 | Vertical | 1 | Pass |
| 148.668 | 26.3 | 43.5 | -17.2 | Horizontal | 1.7 | Pass |
| 225.012 | 35.5 | 46 | -10.5 | Horizontal | 1.3 | Pass |
| 505.350 | 25.5 | 46 | -20.5 | Horizontal | 1.7 | Pass |
| 565.002 | 34.7 | 46 | -11.3 | Horizontal | 1.4 | Pass |
| 594.780 | 35.4 | 46 | -10.6 | Horizontal | 1.6 | Pass |
| 624.420 | 30.1 | 46 | -15.9 | Horizontal | 1.3 | Pass |
| 675.012 | 34.8 | 46 | -11.2 | Horizontal | 1.2 | Pass |
| 683.700 | 25.8 | 46 | -20.2 | Horizontal | 1.4 | Pass |

**Final quasi-peak detector measurements**

### 6.4.8 Quasi Peak correction factors

The quasi peak correction is shown in the above table. This correction figure consists of Antenna factor (AF); and Cable loss (CL).

Field strength (FS) is calculated as follows:

FS (dBµV/m) = Indicated Signal Level (dBµV) + AF (dB) + CL (dB)

### 6.4.9 Sample Data

The Quasi-Peak level at 125.004MHz

FS (dBµV/m) =36.5 dBµV/m = 17.4dBµV + 17.97dB + 1.2dB

# Section 7 Frequency Stability

### 7.1.1 Limits

| FCC Rule Part | Test Standard | Requirement |
|---|---|---|
| Section 15.225 (e) – Frequency tolerance of the carrier signal | ANSI C63.10: 2013 | The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to + 50 degrees C at normal supply voltage |

### 7.1.2 Receiver Settings

| Receiver Parameters | Setting |
|---|---|
| Detector Function | Average |
| Centre frequency | 13.56MHzz |
| Span | 500kHz |
| Resolution Bandwidth | 10kHz |
| Video Bandwidth | 30kHz |

### 7.1.3 Frequency stability measurements

### 7.1.4 Date of Test

21st January 2021

### 7.1.5 Test Area

LAB 7
(temperature chambers)

### 7.1.6 Tested by

M Render

### 7.1.7 Test Setup

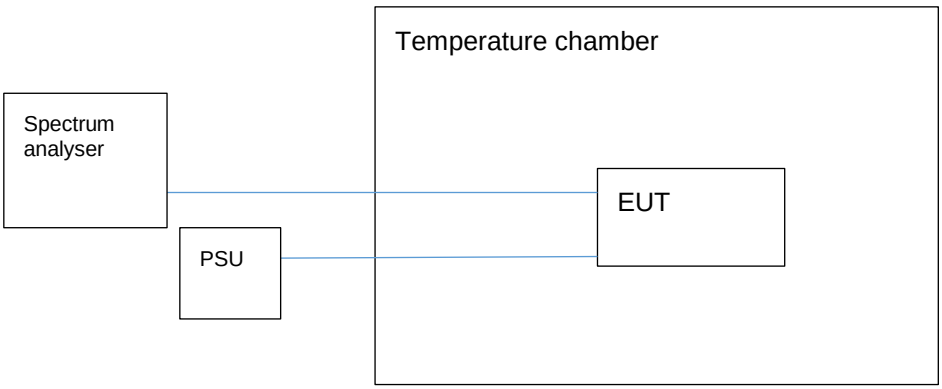



**Figure 13: Test arrangement for frequency stability testing.**

For this test, a temporary SMA antenna connector was fitted for direct connection to the spectrum analyser.

### 7.1.8 Frequency stability test results

| Temp. C | | Frequency (MH) | Nominal (MHz) | Deviation % | Limit 47CFR15.225 (e) % | Result |
|---|---|---|---|---|---|---|
| 50 | Startup | 13.56049766 | 13.56 | 0.00366994 | 0.01 | Within limit |
| | 2min | 13.56048226 | 13.56 | 0.00355636 | 0.01 | Within limit |
| | 5min | 13.5604521 | 13.56 | 0.00333398 | 0.01 | Within limit |
| | 10min | 13.5604501 | 13.56 | 0.00331922 | 0.01 | Within limit |
| 40 | Startup | 13.56043201 | 13.56 | 0.00318581 | 0.01 | Within limit |
| | 2min | 13.56045022 | 13.56 | 0.00332007 | 0.01 | Within limit |
| | 5min | 13.56045079 | 13.56 | 0.00332426 | 0.01 | Within limit |
| | 10min | 13.56045027 | 13.56 | 0.00332048 | 0.01 | Within limit |
| 30 | Startup | 13.56045729 | 13.56 | 0.00337225 | 0.01 | Within limit |
| | 2min | 13.56045752 | 13.56 | 0.00337392 | 0.01 | Within limit |
| | 5min | 13.56060933 | 13.56 | 0.00449336 | 0.01 | Within limit |
| | 10min | 13.5606697 | 13.56 | 0.00493855 | 0.01 | Within limit |
| 20 | Startup | 13.5604989 | 13.56 | 0.00367908 | 0.01 | Within limit |
| | 2min | 13.56046995 | 13.56 | 0.0034656 | 0.01 | Within limit |
| | 5min | 13.56059531 | 13.56 | 0.00439001 | 0.01 | Within limit |
| | 10min | 13.56049777 | 13.56 | 0.00367074 | 0.01 | Within limit |
| 10 | Startup | 13.56059394 | 13.56 | 0.00437993 | 0.01 | Within limit |
| | 2min | 13.56051818 | 13.56 | 0.00382124 | 0.01 | Within limit |
| | 5min | 13.56053132 | 13.56 | 0.00391815 | 0.01 | Within limit |
| | 10min | 13.56052464 | 13.56 | 0.00386888 | 0.01 | Within limit |
| 0 | Startup | 13.5605431 | 13.56 | 0.004005 | 0.01 | Within limit |
| | 2min | 13.56054538 | 13.56 | 0.00402184 | 0.01 | Within limit |
| | 5min | 13.56081469 | 13.56 | 0.00600765 | 0.01 | Within limit |
| | 10min | 13.56055238 | 13.56 | 0.00407345 | 0.01 | Within limit |
| -10 | Startup | 13.56083116 | 13.56 | 0.00612909 | 0.01 | Within limit |
| | 2min | 13.56056814 | 13.56 | 0.00418965 | 0.01 | Within limit |
| | 5min | 13.56067495 | 13.56 | 0.00497726 | 0.01 | Within limit |
| | 10min | 13.56057625 | 13.56 | 0.00424942 | 0.01 | Within limit |
| -20 | Startup | 13.56057407 | 13.56 | 0.00423337 | 0.01 | Within limit |
| | 2min | 13.56088346 | 13.56 | 0.00651477 | 0.01 | Within limit |
| | 5min | 13.56057116 | 13.56 | 0.00421192 | 0.01 | Within limit |
| | 10min | 13.56056818 | 13.56 | 0.00418991 | 0.01 | Within limit |

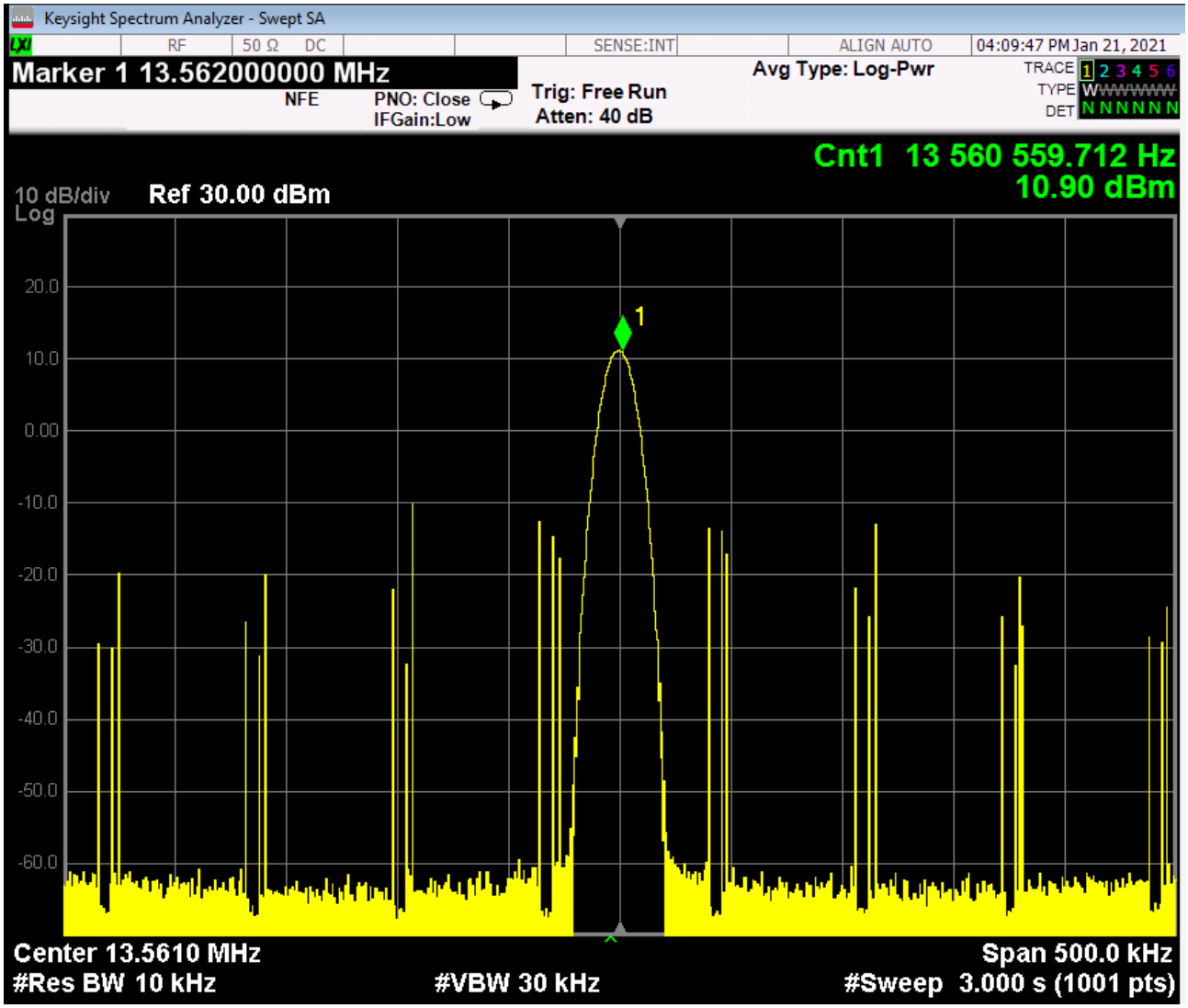



**Figure 14: Example measurement of frequency stability**

# Section 8 20dB Bandwidth

### 8.1.1 Limits

| FCC Rule Part | Test Standard | Requirement |
|---|---|---|
| Section 15.215(C) | ANSI C63.10:2013 | 20dB bandwidth must remain within assigned frequency band |

### 8.1.2 Receiver Settings

| Receiver Parameters | Setting |
|---|---|
| Detector Function | Average |
| Centre Frequency | 13.56MHz |
| Stop Frequency | 4MHz |
| Resolution Bandwidth | 24kHz |
| Video Bandwidth | 75KHz |

### 8.1.3 20dB Bandwidth

### 8.1.4 Date of Test

19th January 2021

### 8.1.5 Test Area

LAB 5

### 8.1.6 Tested by

M Render

### 8.1.7 20dB Bandwidth Results

The whole of the emission is below the limit for general radiated emissions of 47CFR15.209 as shown by figures 7 and 8 and contained within the band 13.110-14.010 MHz.

# Appendix A EUT Test Photos

Photographs are supplied separately.

# Appendix B Test Equipment List

## Radiated Emissions Equipment

| Item | Serial No. | Last Calibration Date | Calibration Interval |
|---|---|---|---|
| Laboratory 1 Semi-Anechoic Chamber | Lab 1 | 04/11/2019 (NSA)<br>28/01/2020 (Svswr) | 36 Months |
| ETS Lindgren 2017B Mast (1 – 4m) with tilting mechanism | -- | N/A | N/A |
| Laboratory 5 fully anechoic chamber for 9kHz to 30MHz | - | N/A | N/A |
| EMCO Loop antenna 6512 | 00148043 | 02/06/20 | 24 Months |
| Rohde & Schwarz ESR 26 | 101464 | 10/11/20 | 12 Months |
| Rohde & Schwarz ESR 7 | 101930 | 26/01/2021 | 12 Months |
| Teseq CBL6112D Bilog Antenna | 49040 | 15/08/2018 | 36 Months |
| 6dB Attenuator (For use with Bilog Antenna) | C0506B | 15/08/2018 | 36 Months |
| HF 26 Cable | 19148_06_13_001 | 5/01/2021 | 12 Months |
| HF 27 Cable | 19149.03.13.004 | 5/01/2021 | 12 Months |
| HF17 Cable | 167002-001 | 5/01/2021 | 12 Months |
| Keysight PXA EMI Receiver | MY54170531 | 03/04/20 | 20 Months |