York EMC Services

Test Report for the EMC Testing of Inductosense Wand 2.0 for Spark Product Innovation

Test Report number B2379TR1

Project number B3833

Author: S. Pandey
Samiksha Pandey
Test Engineer

Checked: .....
Mr David Feasey, Technical Manager

Approved: .....
Mr David Feasey, Technical Manager

Issue	Description						Issue by	Date
1	*Copy 1*		*Copy 2*		*PDF*		*DF*	*17th July 2018*

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The results contained in this report are only applicable to the apparatus tested.

CONTENTS

Test Report Change History **4**

Section 1 Test Location **5**
1.1 UKAS Accreditation 5

Section 2 Customer Information **6**

Section 3 Equipment Details **7**
3.1 Equipment Under Test (EUT) 7
3.2 EUT Photos 8
3.3 Configuration of EUT 10
3.4 EUT Monitoring/Auxiliary Equipment 10
3.5 Monitoring Software 11

Section 4 Test Specifications **12**
4.1 Knowledge Database References 14
4.1.1 Conducted Emissions 14
4.1.2 Radiated Emissions (30MHz to 1000MHz) 14
4.1.3 Radiated Emissions (1GHz to 18/40GHz) 14
4.2 Compliance Statement 14
4.3 Test Sequence 15

Section 5 Conducted Emission Results **16**
5.1 Test Specification 16
5.2 Power Line Emission Limits 16
5.3 Receiver Settings 16
5.4 Procedure and Test Software Version 16
5.4.1 Date of Test 16
5.4.2 Test Area 17
5.4.3 Test Setup 17
5.4.4 Plots 19

Section 6 Radiated Emission Results **21**
6.1 Test Specification 21
6.2 Procedure and Test Software Version 21
6.3 Radiated Emissions (30MHz to 1GHz) 22
6.3.1 Limits at 3m 22
6.3.2 Receiver Settings 22
6.3.3 Emissions measurements 22
6.3.4 Date of Test 22
6.3.5 Test Area 22
6.3.6 Test Setup 23
6.3.7 Electric field emissions, 30MHz to 1GHz 25
6.4 Radiated Emissions (1GHz to 6GHz) 27
6.4.1 Limits 27
6.4.2 Receiver Settings 27
6.4.3 Emissions measurements 27
6.4.4 Date of Test 27
6.4.5 Test Area 27
6.4.6 Test Setup 28
6.4.7 Electric field emissions, 1GHz to 6GHz 30

Appendix A Test Equipment List **34**

List of Figures

Figure 1: Diagram of EUT 10

Figure 2: Screenshot – Monitoring Software 11
Figure 3: Test setup for Conducted Emissions on the AC power port 18
Figure 4: Conducted Emissions Plot - Input Power 120V 60Hz Live (Charging mode) 19
Figure 5: Conducted Emissions Plot - Input Power 120V 60Hz Neutral (Charging mode) 20
Figure 6: Test Setup for E-Field Measurements from 30MHz to 1GHz 24
Figure 7: Electric field emissions Plot, 30MHz to 1GHz (Charging mode) 25
Figure 8 : Electric field emissions Plot, 30MHz to 1GHz (Trans receive mode) 26
Figure 9: Test Setup for Final E-Field Measurements from 1GHz to 6GHz 28
Figure 10: Electric field emissions Plot, 1GHz to 6GHz (Trans receive mode) 30
Figure 11 : Electric field emissions Plot, 1GHz to 6GHz (Charging mode) 31

List of Tables

Table 1: Test Sequence 15
Table 2: Input Power 120V 60Hz Live Conducted Emissions Peaks (Charging mode) 19
Table 3: Input Power 120V 60Hz Neutral Conducted Emissions Peaks (Charging mode) 20
Table 4: Electric Field Emissions Peaks, 30MHz to 1GHz (Charging mode) 25
Table 5 : Electric Field Emissions Peaks, 30MHz to 1GHz (Trans receive mode) 26
Table 6: Electric Field Emissions Peaks, 1GHz to 6GHz (Trans receive mode) 30
Table 7: Electric Field Emissions Peaks, 1GHz to 6GHz (Charging mode) 31

Test Report Change History

Issue	Date	Modification Details
1		Original issue of test report
2		
3		
4		
5		
6		
7		
8		
9		
10		

Section 1 Test Location

All testing was performed at;

Eurofins York	46 Waverley Road
	Beeches Industrial Estate
	Yate
	Bristol
	BS37 5QT
Tel:	+44 (0) 1454 326998
Website	http://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.

York EMC Services latest accreditation schedule can be found at:

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

Section 2 Customer Information

Company name	Spark Product Innovation Ltd.
Address	Bristol and Bath Science Park
	Dirac Cresent , Emerson green
	Bristol
	BS16 7FR
Tel:	0117 244 1915
Contact	Stephen Causier
Email	stephen.causier@sparkpi.co.uk
Customer Representative(s) present during testing	Testing was witnessed by the customer

Section 3 Equipment Details

3.1 Equipment Under Test (EUT)

Date received:	15.05.2018						
EUT name:	Inductosense Wand 2.0						
Type/Part no:	Wand 2.0						
Serial no/s:	Unknown						
EUT description:	The EUT is a battery powered device that uses ultrasonic sound to measure and monitor the thickness and possible corrosion/erosion levels of pipework and structures. The EUT is primarily for use in industrial environments.						
No of units tested:	One						
EUT power:	120	V	60	Hz	Single phase		
	8.4	V	Battery operation				
Highest internal frequency:	916MHz						
Cables:	USB		1.2	m	Unscreened		
	DC		1.2	m	Unscreened		
Size of EUT (mm)	L: -	0.29	W: -		0.12	H: -	0.035
Tested as	Table top						
Mode/s of operation 1	Charging						
2	Trans receive mode						
3	Standby						
Firmware Version	Nano M6E						
Software Version	Unknown						
Client modification statement:	None						
Modifications incorporated during testing:	None						

Radio Module(s)	Thing Magic Non M6E FCC ID- QV5MERCURY6EN

3.2 EUT Photos

Front view

Back view

L.H.S view

R.H.S view

3.3 Configuration of EUT

EUT was configured for Transmitting, Standby and Charging mode through Software.

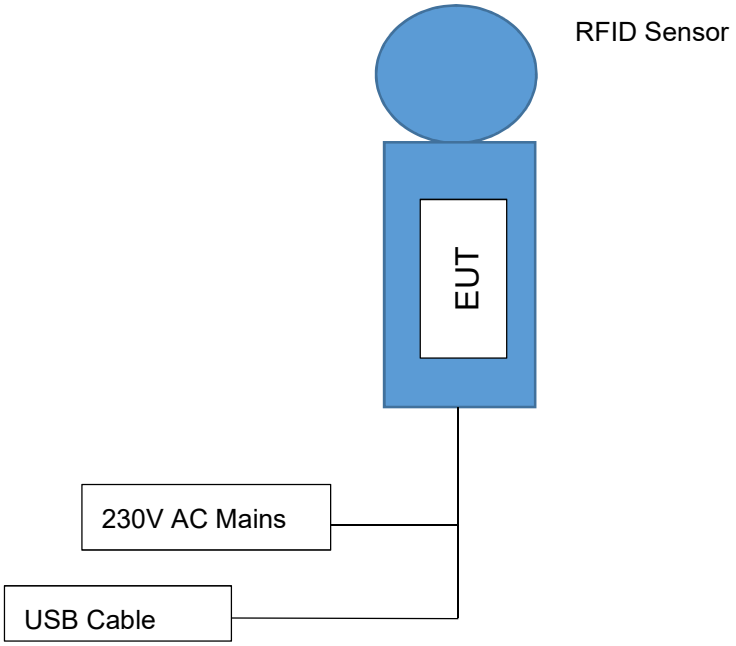


Figure 1: Diagram of EUT

3.4 EUT Monitoring/Auxiliary Equipment

Equipment Name	Type No.	Serial No.
None	None	None

3.5 Monitoring Software

None

Figure 2: Screenshot – Monitoring Software

Section 4 Test Specifications

The tests were performed in accordance with Eurofins York Quotation B3833.

47CFR Part 15, Sub Part B Unintentional Radiators			
Which references the following specification: -			
ANSI C63-4: 2014 Methods of Measurements of Radio Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range 9kHz to 40GHz.			
Test	**Method**	**Levels**	**Result**
Conducted Emissions (0.15 – 30MHz)	ANSI C63.4: 2014 Section 7	Part 15 Clause 15.107 Part 18 Clause 18.307 Class A/B	Pass
Radiated Emissions Magnetic Field Measurements (9kHz to 30MHz)	ANSI C63.4: 2014 Section 8	Part 15 Clause 15.109(e) Part 15 Clause 15.209	Not Applicable
Radiated Emissions Electric Field Measurements (30MHz – 6000MHz)	ANSI C63.4: 2014 Section 8	Part 15 Clause 15.109 Part 18 Clause 18.305 Class A/B	Pass See Note 1

Note 1 :All testing was carried out at a test distance of 3m and the limits adjusted accordingly. This is a deviation from the standard as Class A limits are specified at 10m test distance.

Note 2: Applies to carrier current systems see reference 47CFR Part 15Clause 15.109(e).

Industry Canada ICES-003:2016 – Information and Technology Equipment (ITE) – Limits and Methods of Measurement. **Conducted (clause 6.1) and Radiated (clause 6.2) Emission Limits**		
Which references the following specification:		
ANSI C63-4: 2014 Methods of Measurements of Radio Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range 9kHz to 40GHz		
Test	**Class/Limits**	**Result (Pass/Fail)**
Conducted Emissions (0.15 – 30MHz)	Class A	Pass
Radiated Emissions, Note 1, Note 2 (30MHz – 6GHz)	Class A	Pass

Note 1 : Below 1GHz compliance can be demonstrated in 3 ways:

(i) By complying with CAN/CSA-CISPR 22-10, Information and technology equipment - Radio disturbance characteristics – Limits and methods of measurements

(ii) By complying with the limits shown in Section 6 using methods of measurement described in ANSI C63.4.

(iii) By complying with limits referenced in Section 3a of CAN/CSA-CISPR 22-10, whilst using methods of measurement described in ANSI C63.4.

Method (ii) will be applied in this report.

Note 2 : To determine the conditional radiated disturbance testing procedure the highest frequency generated or used within the EUT has been advised by the customer as 800MHz.

Note 3 : Tests above 40GHz are not offered.

Note 4 : Class A limits are for non-residential operation and Class B limits (more stringent) are for residential.

Note 5 : All testing was carried out at a test distance of 3m and the limits adjusted accordingly. This is a deviation from the standard as Class A limits are specified at 10m test distance.

4.1 Knowledge Database References

The following KDBs were referenced during the testing of the Inductosense wand 2.0

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

4.1.2 Radiated Emissions (30MHz to 1000MHz)

None

4.1.3 Radiated Emissions (1GHz to 18/40GHz)

Publication Number	Keyword	Publication Date
714737	15B, Average Detector for Unintentional Radiator	30/11/2010
414788	Radiated Emissions Test Site	04/18/2017

4.2 Compliance Statement

The **Inductosense wand 2.0** as tested was shown to meet requirements of the standards listed in Section 4 of this report.

4.3 Test Sequence

Test Description	Test Order	Test Repeated	Comment
Radiated Emissions			
30MHz to 1GHz	3	No	None
1GHz to 6GHz	1	No	None
Conducted Emissions			
AC Power Ports	2	No	None

Table 1: Test Sequence

Section 5 Conducted Emission Results

5.1 Test Specification

Standard	ANSI C63.4:2014
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 ±3.35dB (EN55016-4-2:2011 +A1:2014) ESHS10 ±3.34dB (EN55016-4-2:2011 +A1:2014) ESHS30 ±3.31dB (EN55016-4-2:2011 +A1:2014) ESU40

5.2 Power Line Emission Limits

Frequency (MHz)	Class A (dBµV)		Class B (dBµV)	
	Quasi Peak	Average	Quasi Peak	Average
0.15 – 0.5	79.0	66.0	66 – 56*	56 – 46*
0.5 – 5.0	73.0	60.0	56.0	46.0
5.0 - 30	73.0	60.0	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	BEP19 Issue 8 20 Nov 2014
Test software	RadiMation Version 2016.1.6

5.4.1 Date of Test

18th May 2018 to 21st May 2018

5.4.2 Test Area

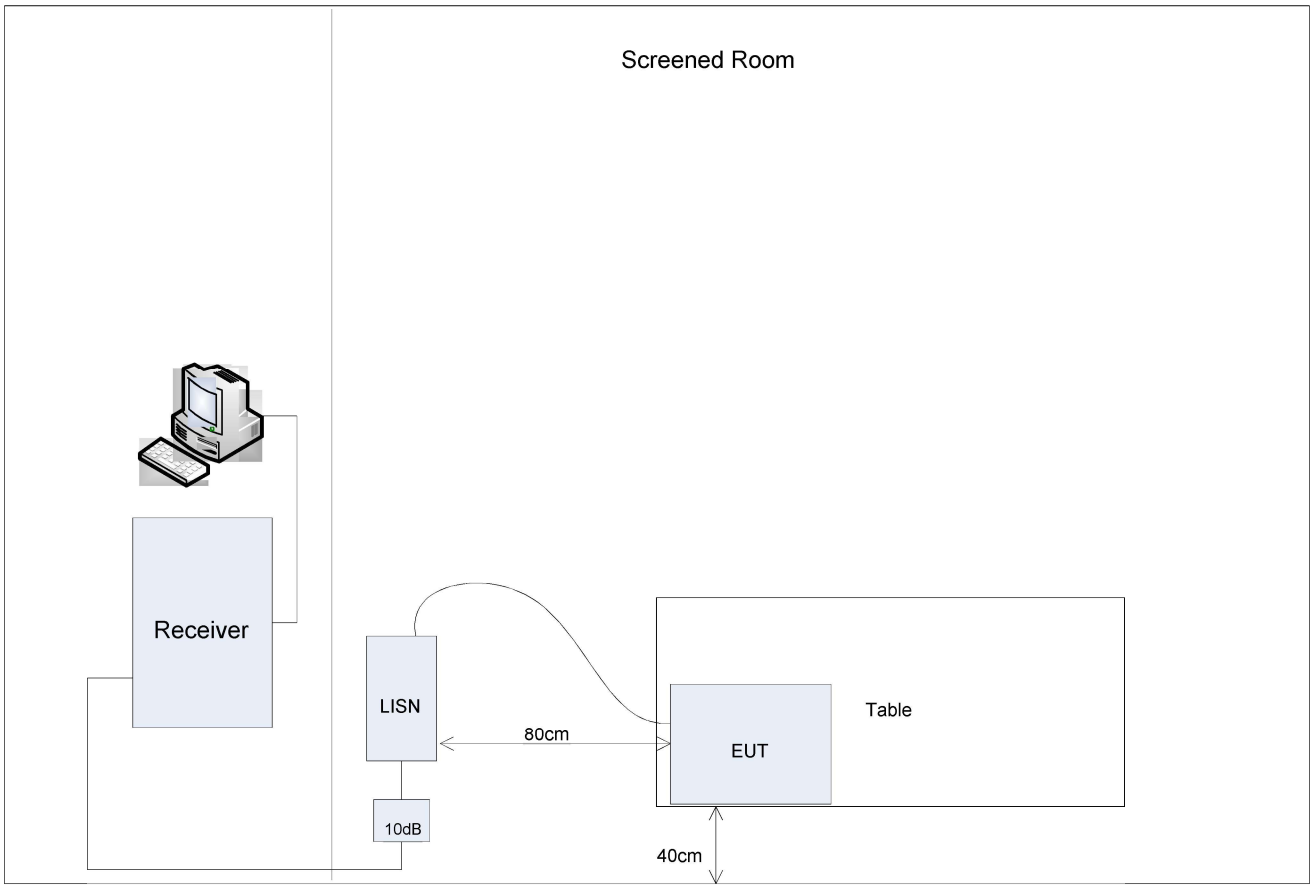
LAB 2

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 known impedance was presented to the EUT

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



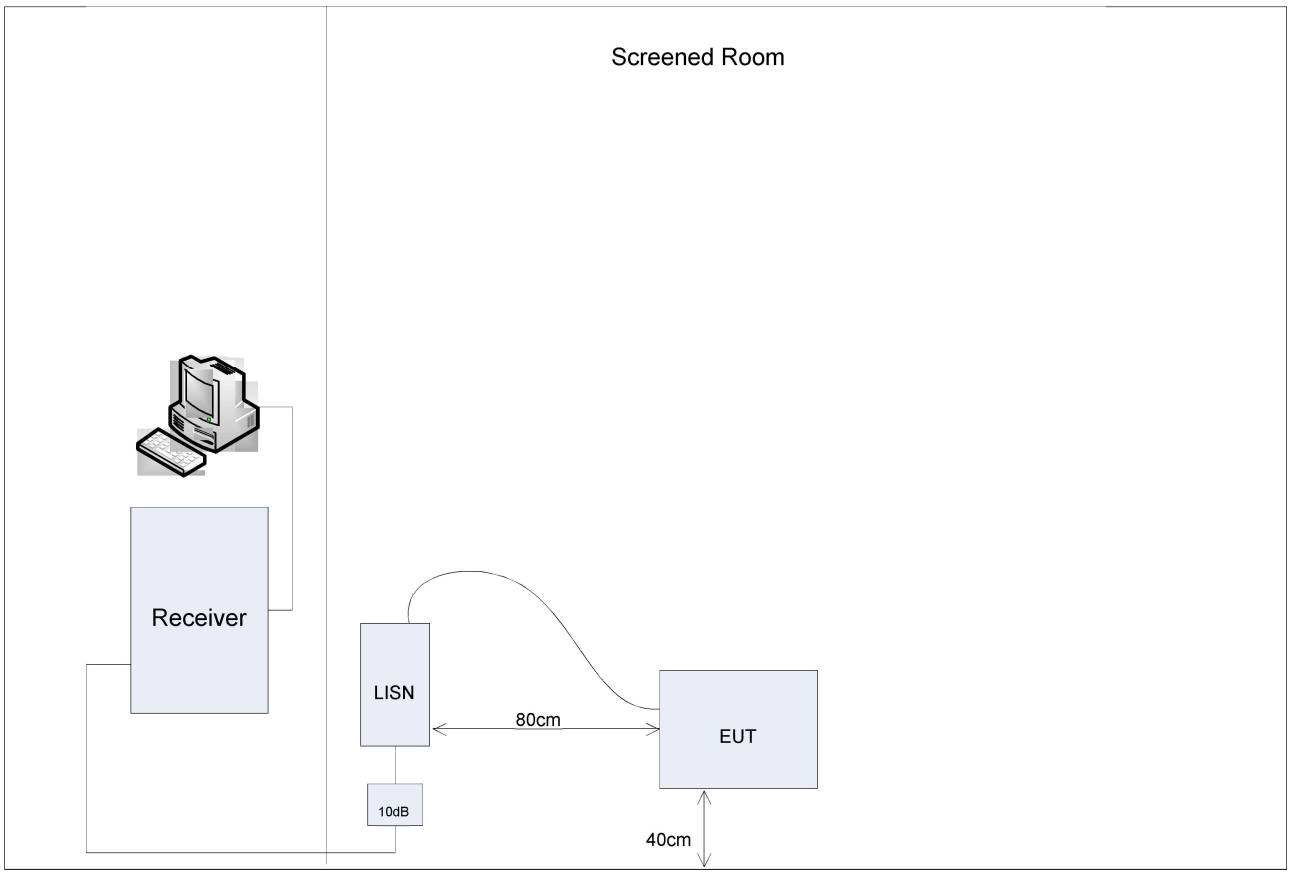


Figure 3: Test setup for Conducted Emissions on the AC power port

The screened room provides an environment that ensures valid, repeatable measurement results that meet the requirements of Clause 5.2 of ANSI C63.4-2014.

5.4.4 Plots

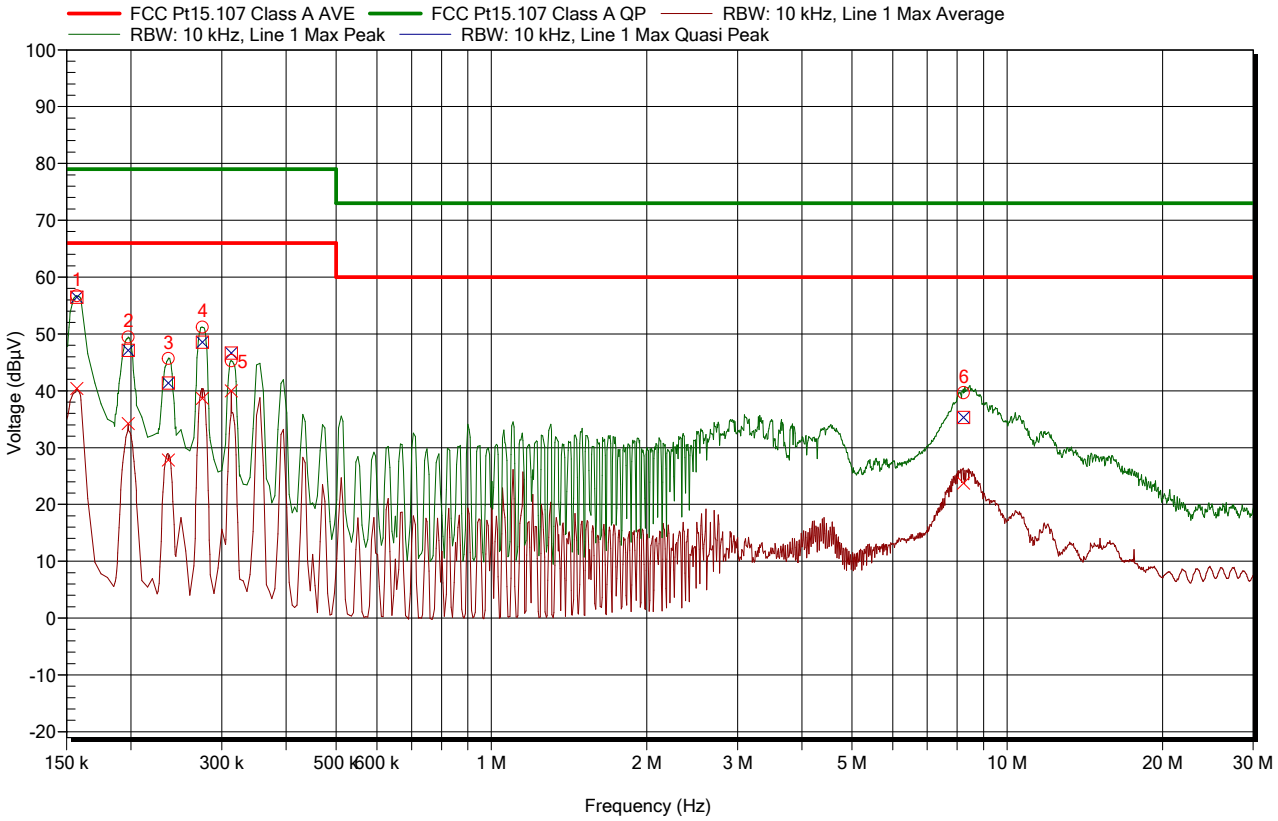


Figure 4: Conducted Emissions Plot - Input Power 120V 60Hz Live (Charging mode)

Frequency	Peak	Average	Average Difference	Average Correction	Average Status	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Correction	Quasi-Peak Status
157 kHz	56.68 dBµV	40.38 dBµV	-25.62 dB	14.3 dB	Pass	56.48 dBµV	79 dBµV	-22.52 dB	14.3 dB	Pass
197.5 kHz	49.44 dBµV	34.23 dBµV	-31.77 dB	14.3 dB	Pass	47.13 dBµV	79 dBµV	-31.87 dB	14.3 dB	Pass
236.5 kHz	45.66 dBµV	27.84 dBµV	-38.16 dB	14.3 dB	Pass	41.35 dBµV	79 dBµV	-37.65 dB	14.3 dB	Pass
275 kHz	51.16 dBµV	38.69 dBµV	-27.31 dB	14.3 dB	Pass	48.55 dBµV	79 dBµV	-30.45 dB	14.3 dB	Pass
313 kHz	45.22 dBµV	40 dBµV	-26 dB	14.3 dB	Pass	46.63 dBµV	79 dBµV	-32.37 dB	14.3 dB	Pass
8.23 MHz	39.63 dBµV	23.74 dBµV	-36.26 dB	13.8 dB	Pass	35.29 dBµV	73 dBµV	-37.71 dB	13.8 dB	Pass

Table 2: Input Power 120V 60Hz Live Conducted Emissions Peaks (Charging mode)

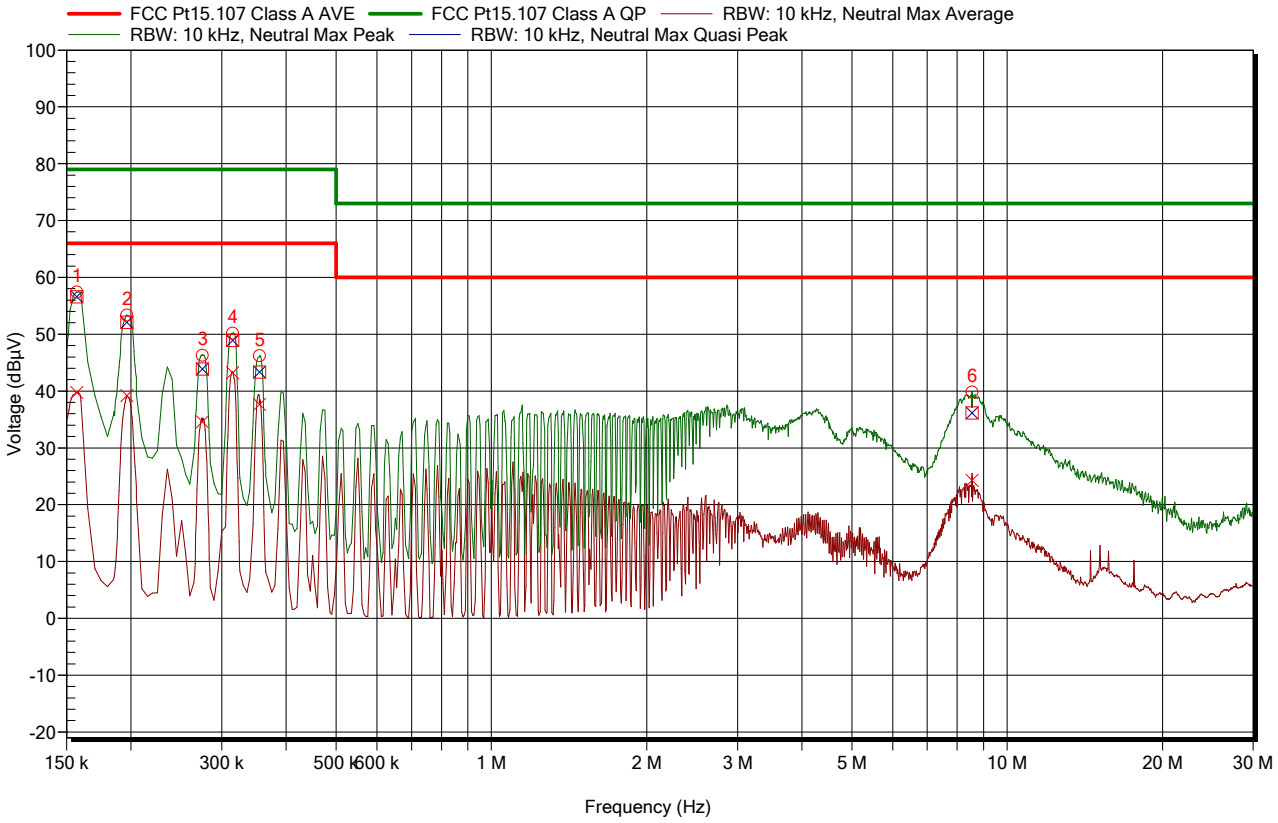


Figure 5: Conducted Emissions Plot - Input Power 120V 60Hz Neutral (Charging mode)

Frequency	Peak	Average	Average Difference	Average Correction	Average Status	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Correction	Quasi-Peak Status
157 kHz	57.41 dBµV	39.76 dBµV	-26.24 dB	14.3 dB	Pass	56.61 dBµV	79 dBµV	-22.39 dB	14.3 dB	Pass
196.5 kHz	53.35 dBµV	39.23 dBµV	-26.77 dB	14.3 dB	Pass	52.07 dBµV	79 dBµV	-26.93 dB	14.3 dB	Pass
275 kHz	46.27 dBµV	34.59 dBµV	-31.41 dB	14.3 dB	Pass	43.86 dBµV	79 dBµV	-35.14 dB	14.3 dB	Pass
315 kHz	50.2 dBµV	43.21 dBµV	-22.79 dB	14.3 dB	Pass	48.89 dBµV	79 dBµV	-30.11 dB	14.3 dB	Pass
355 kHz	46.19 dBµV	37.66 dBµV	-28.34 dB	14.2 dB	Pass	43.33 dBµV	79 dBµV	-35.67 dB	14.2 dB	Pass
8.553 MHz	39.8 dBµV	24.28 dBµV	-35.72 dB	13.8 dB	Pass	36.17 dBµV	73 dBµV	-36.83 dB	13.8 dB	Pass

Table 3: Input Power 120V 60Hz Neutral Conducted Emissions Peaks (Charging mode)

Section 6 Radiated Emission Results

6.1 Test Specification

Standard	ANSI C63.4:2014
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 5.16dB (EN55016-4-2:2011 +A1:2014 (<1GHz)) ESU40 4.66dB (EN55016-4-2:2011 +A1:2014 (1-6GHz)) ESU40/HL050 4.96dB (EN55016-4-2:2011 +A1:2014 (6-18GHz)) ESU40/HL050 4.92dB (EN55016-4-2:2011 +A1:2014 (18-40GHz)) ESU40/HL050

6.2 Procedure and Test Software Version

Eurofins York test procedure (30MHz to 1GHz)	BEP23 Issue 10 Oct 2016
Eurofins York test procedure (1GHz to 40GHz)	BEP27 Issue 7 7 Oct 2016
Test software	RadiMation Version 2016.1.6

6.3 Radiated Emissions (30MHz to 1GHz)

6.3.1 Limits at 3m

Frequency (MHz)	Class A (dBµV/m)	Class B (dBµV/m)
	Quasi Peak	Quasi Peak
30 - 88	49.5	40.0
88 -216	53.5	43.5
216 - 960	56.4	46.0
960- 1000	59.5	54.0

Note: FCC 47 CFR Part 15 Section 15.109 specifies test limits at 10m for Class A and 3m for Class B.
Please note that for Class A, limits have adjusted by 10dB to correct for the measurement distance of 3m.

6.3.2 Receiver Settings

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

6.3.3 Emissions measurements

6.3.4 Date of Test

22nd May 2018

6.3.5 Test Area

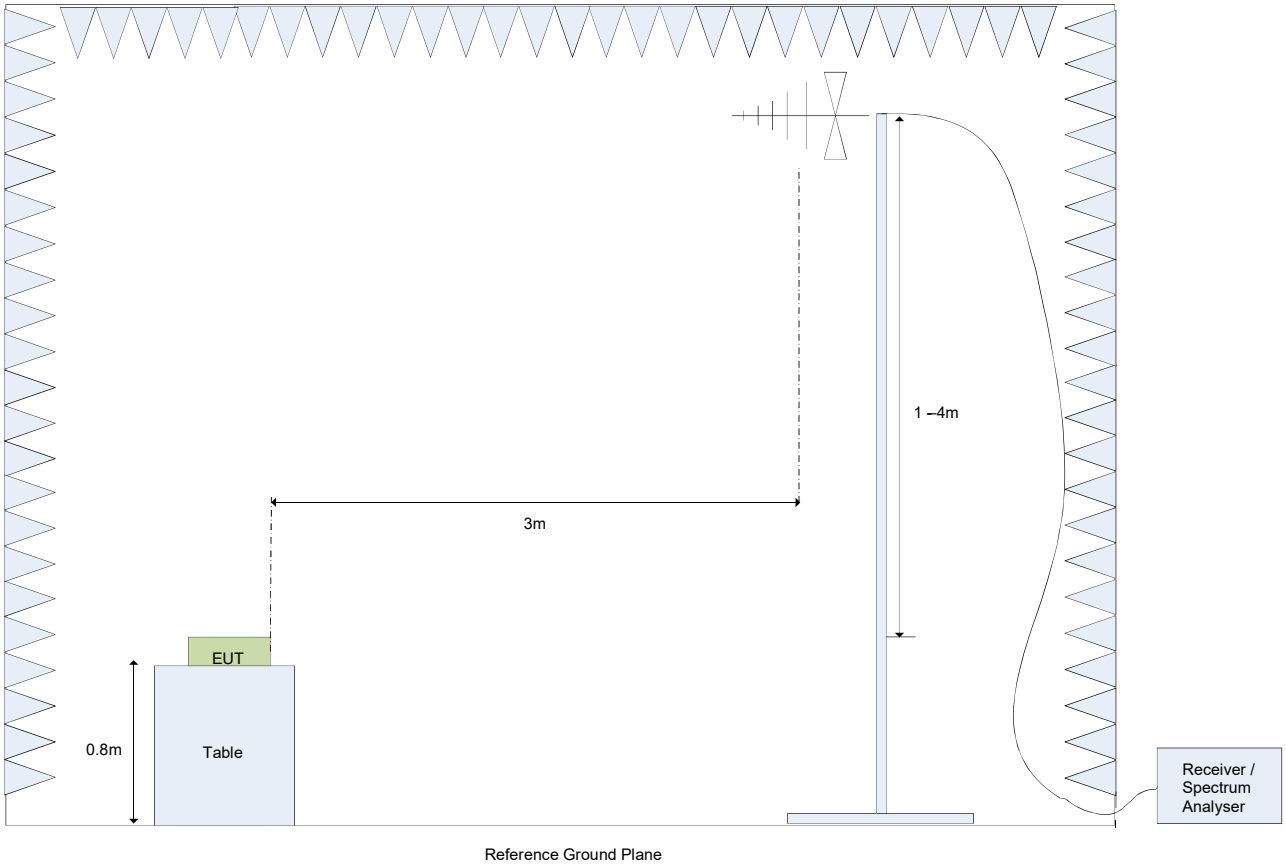
LAB 1 (SAC)

6.3.6 Test Setup

The EUT was configured in the SAC on an 80cm high table.

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.



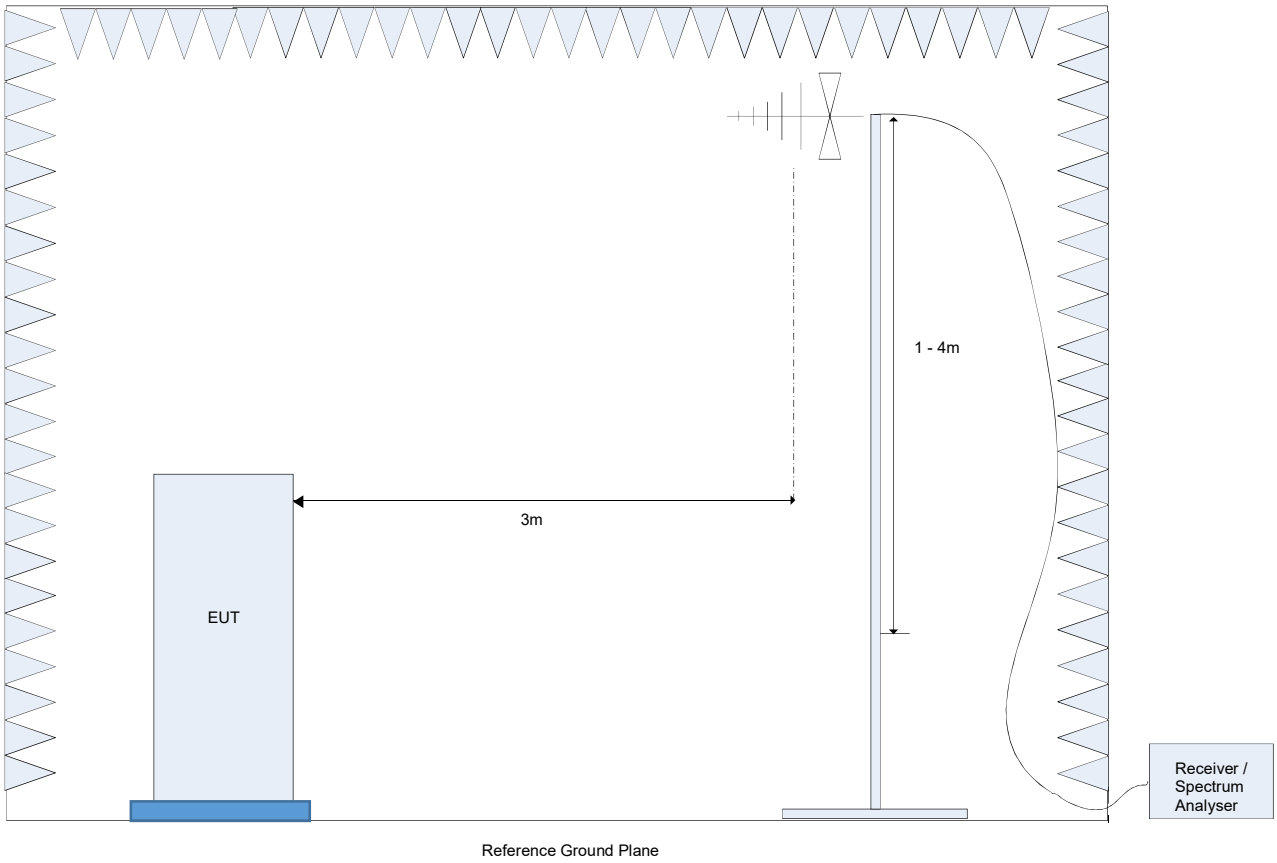


Figure 6: Test Setup for E-Field Measurements from 30MHz to 1GHz

Note 1 : With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement of ANSI C63.4-2014 Clause 5.1.3.

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.

6.3.7 Electric field emissions, 30MHz to 1GHz

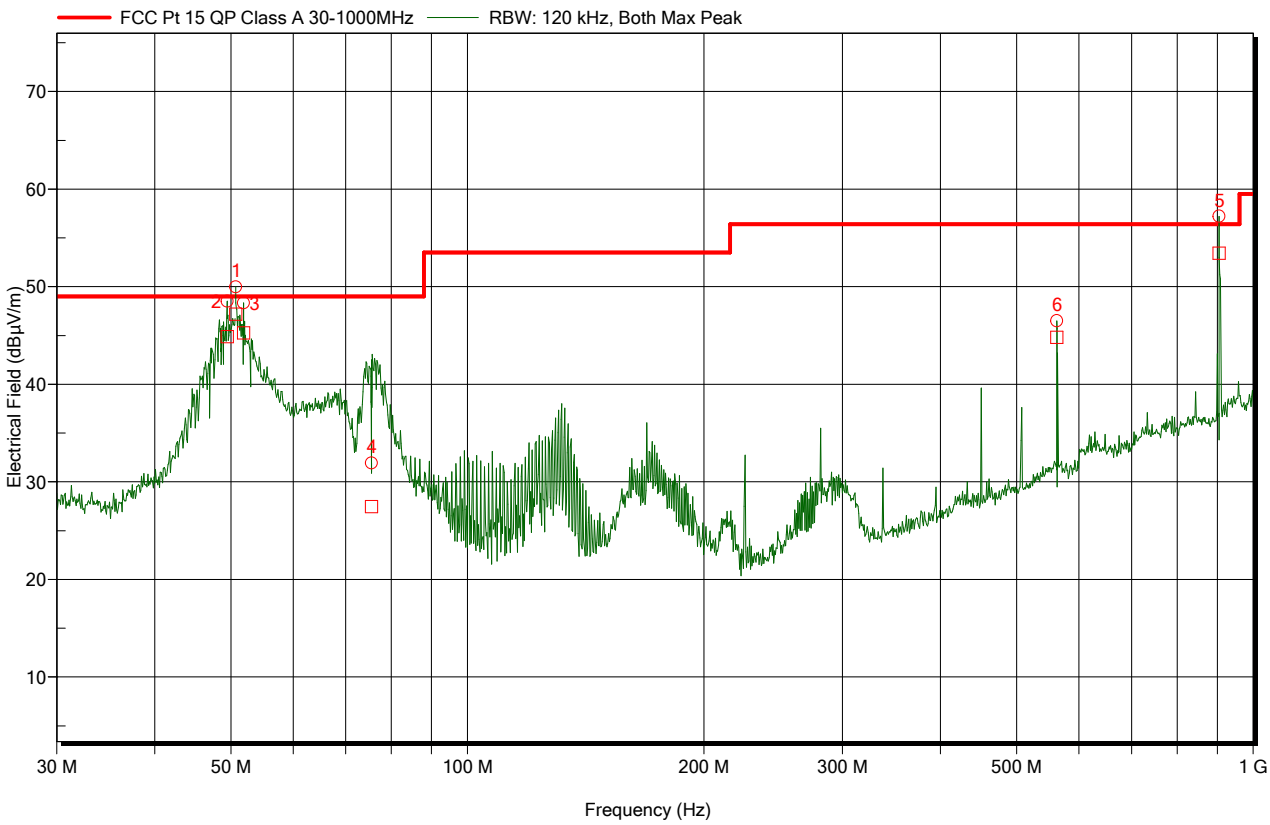


Figure 7: Electric field emissions Plot, 30MHz to 1GHz (Charging mode)

Detected Peaks:

Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Quasi-Peak Correction	Quasi-Peak Status	Angle	Height	Polarization
50.706 MHz	49.98 dBµV/m	47.17 dBµV/m	-1.83 dB	16.7 dB	Pass	164 Degree	1 m	Vertical
49.44 MHz	48.52 dBµV/m	44.9 dBµV/m	-4.1 dB	17.3 dB	Pass	105 Degree	1 m	Vertical
51.9 MHz	48.34 dBµV/m	45.27 dBµV/m	-3.73 dB	16.3 dB	Pass	29 Degree	1 m	Vertical
75.48 MHz	31.93 dBµV/m	27.47 dBµV/m	-21.53 dB	14.6 dB	Pass	4 Degree	1.1 m	Vertical
904.668 MHz	57.2 dBµV/m	53.45 dBµV/m	-2.95 dB	32 dB	Pass	332 Degree	3.5 m	Horizontal
562.53 MHz	46.5 dBµV/m	44.8 dBµV/m	-11.6 dB	28.1 dB	Pass	106 Degree	1.5 m	Horizontal

Table 4: Electric Field Emissions Peaks, 30MHz to 1GHz (Charging mode)

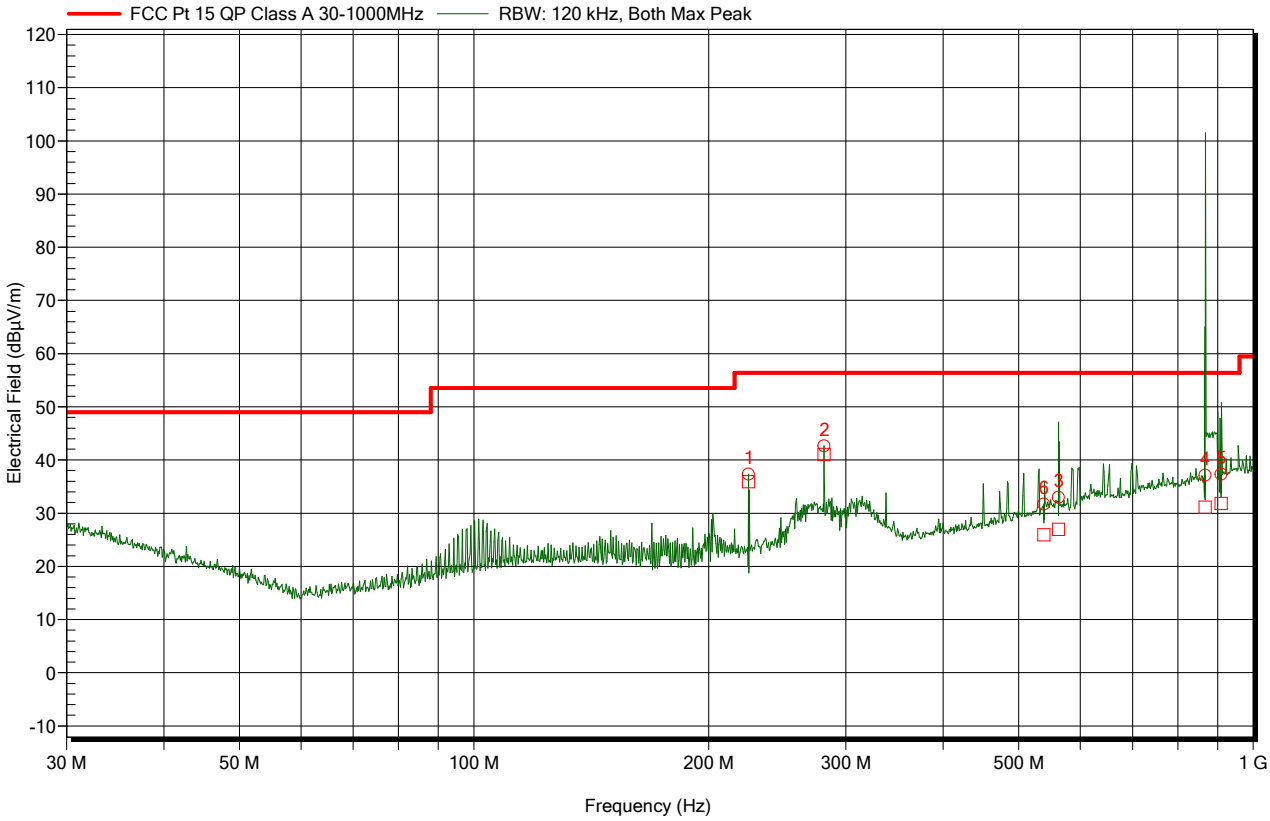


Figure 8 : Electric field emissions Plot, 30MHz to 1GHz (Trans receive mode)

Detected Peaks:

Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height	Polarization
225.006 MHz	37.32 dBµV/m	35.94 dBµV/m	-20.46 dB	Pass	96 Degree	1.2 m	Horizontal
281.268 MHz	42.65 dBµV/m	41.03 dBµV/m	-15.37 dB	Pass	268 Degree	1.1 m	Horizontal
562.53 MHz	32.96 dBµV/m	26.99 dBµV/m	-29.41 dB	Pass	91 Degree	1.5 m	Horizontal
916.28 MHz	37.15 dBµV/m	31.13 dBµV/m	-25.27 dB	Pass	288 Degree	3.9 m	Horizontal
919.59 MHz	32.93 dBµV/m	32.83 dBµV/m	-24.54 dB	Pass	44 Degree	1.9 m	Horizontal
538.8 MHz	31.68 dBµV/m	25.97 dBµV/m	-30.43 dB	Pass	52 Degree	1.8 m	Horizontal
225.006 MHz	37.32 dBµV/m	35.94 dBµV/m	-20.46 dB		96 Degree	1.2 m	Horizontal

Table 5 : Electric Field Emissions Peaks, 30MHz to 1GHz (Trans receive mode)

6.4 Radiated Emissions (1GHz to 6GHz)

6.4.1 Limits

Frequency (GHz)	Class A (dBµV/m)	Class B (dBµV/m)
	Average	Average
1-6	59.5	54.0

6.4.2 Receiver Settings

Receiver Parameters	Setting
Detector Function	Average
Start Frequency	1GHz
Stop Frequency	6GHz
Resolution Bandwidth	1MHz
Video Bandwidth	Auto

6.4.3 Emissions measurements

6.4.4 Date of Test

18th May 2018

6.4.5 Test Area

LAB 1 (SAC)

6.4.6 Test Setup

The EUT was configured in the SAC on an 80cm high table.

Exploratory measurements on the EUT were carried out to identify suspect frequencies and worst case orientations, see Section **Error! Reference source not found.**.

The measurement was then performed with an antenna to EUT separation distance of 3m.

The antenna was kept in the "cone of radiation" from the EUT and pointed at the area both in azimuth and elevation using the tilt mechanism on the antenna mast.

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

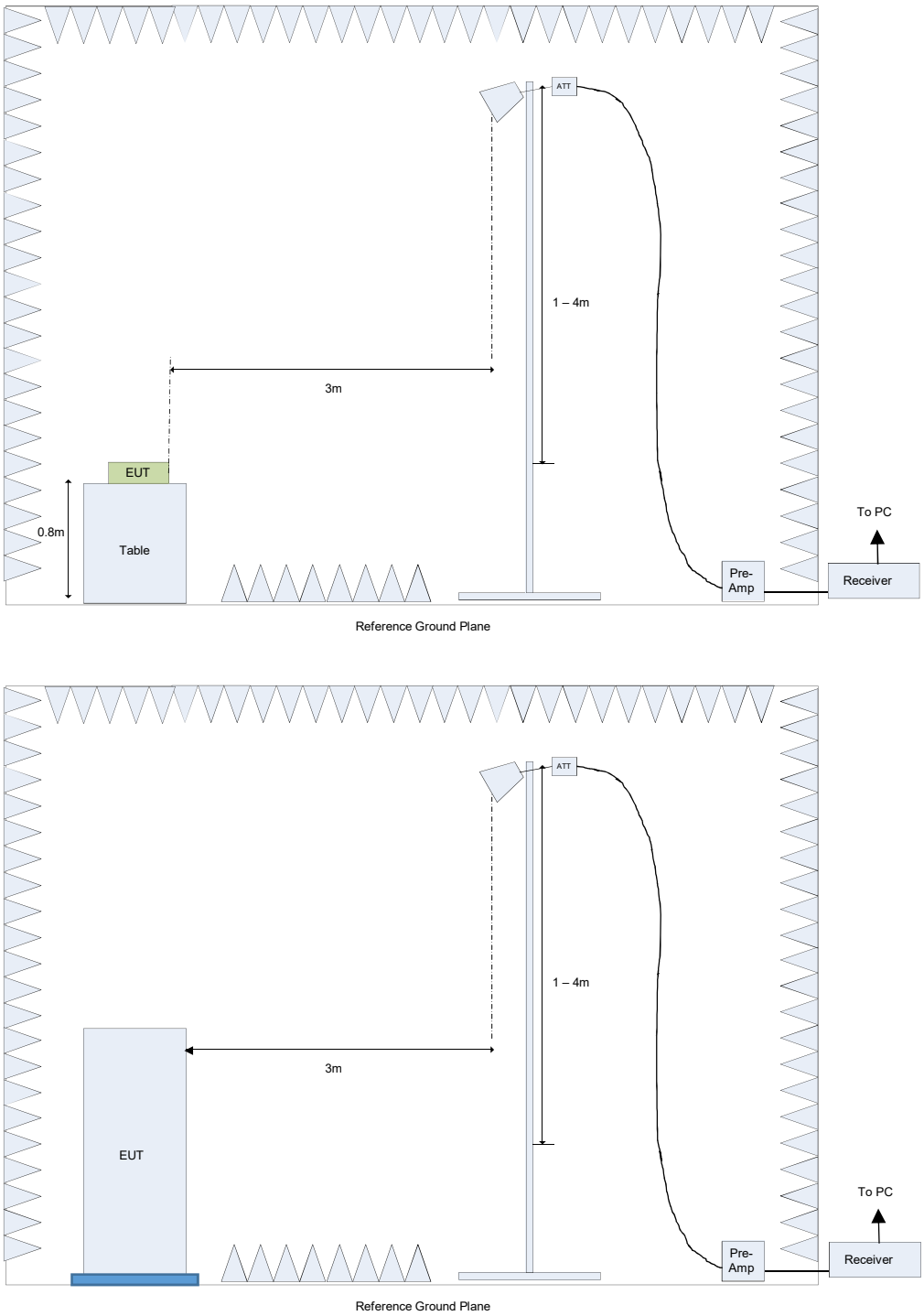


Figure 9: Test Setup for Final E-Field Measurements from 1GHz to 6GHz

Note 1 : With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement of ANSI C63.4-2014 Clause 5.1.3.

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, 1GHz to 6GHz

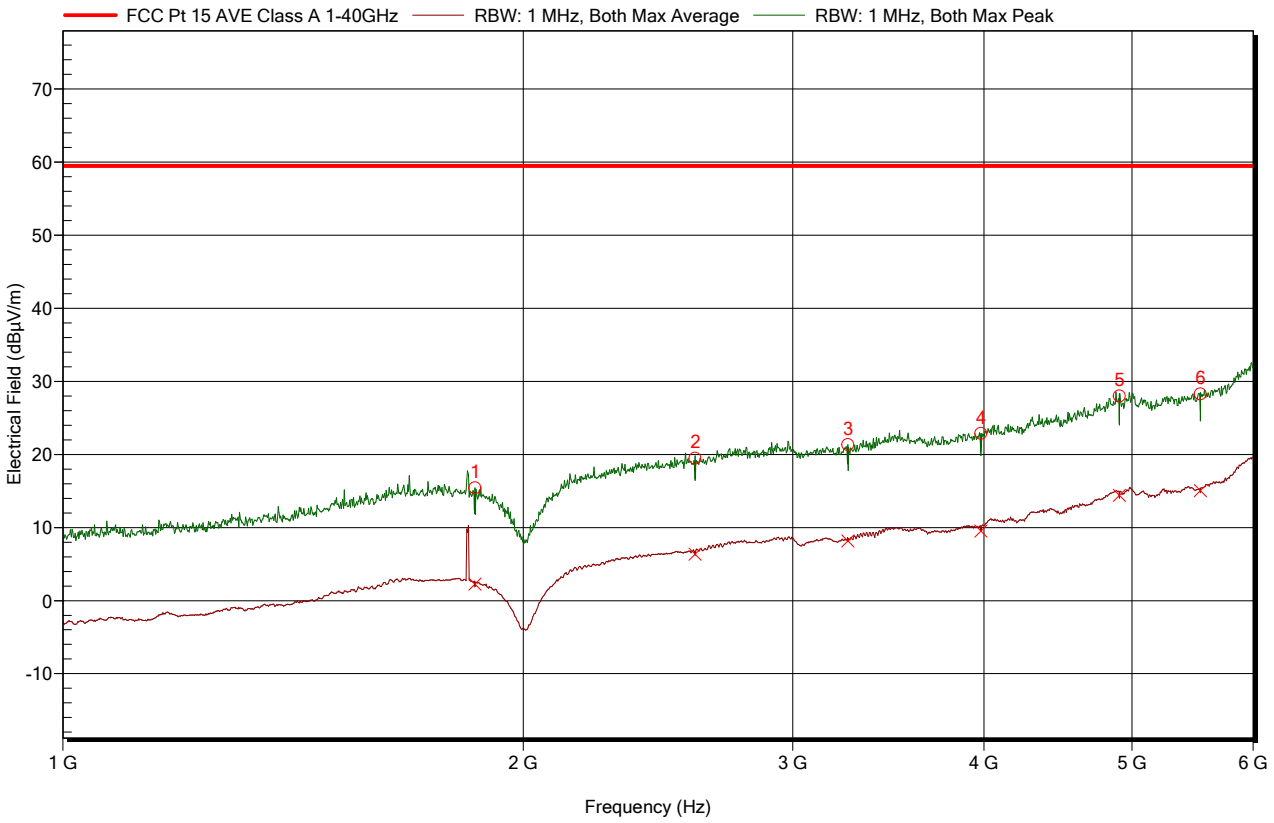


Figure 10: Electric field emissions Plot, 1GHz to 6GHz (Trans receive mode)

Frequency	Peak	Average	Average Difference	Average Correction	Average Status	Angle	Height	Polarization
1.86 GHz	15.43 dBµV/m	2.27 dBµV/m	-53.73 dB	-42.6 dB	Pass	133 Degree	3.1 m	Vertical
2.591 GHz	19.49 dBµV/m	6.38 dBµV/m	-49.62 dB	-37.8 dB	Pass	344 Degree	1.5 m	Vertical
3.259 GHz	21.33 dBµV/m	8.16 dBµV/m	-51.84 dB	-35.1 dB	Pass	333 Degree	1.8 m	Vertical
3.983 GHz	22.89 dBµV/m	9.53 dBµV/m	-50.47 dB	-32.1 dB	Pass	43 Degree	2.8 m	Vertical
4.905 GHz	27.98 dBµV/m	14.4 dBµV/m	-45.6 dB	-27.3 dB	Pass	58 Degree	2.5 m	Vertical
5.541 GHz	28.27 dBµV/m	15.05 dBµV/m	-44.95 dB	-24.9 dB	Pass	328 Degree	2.5 m	Vertical

Table 6: Electric Field Emissions Peaks, 1GHz to 6GHz (Trans receive mode)

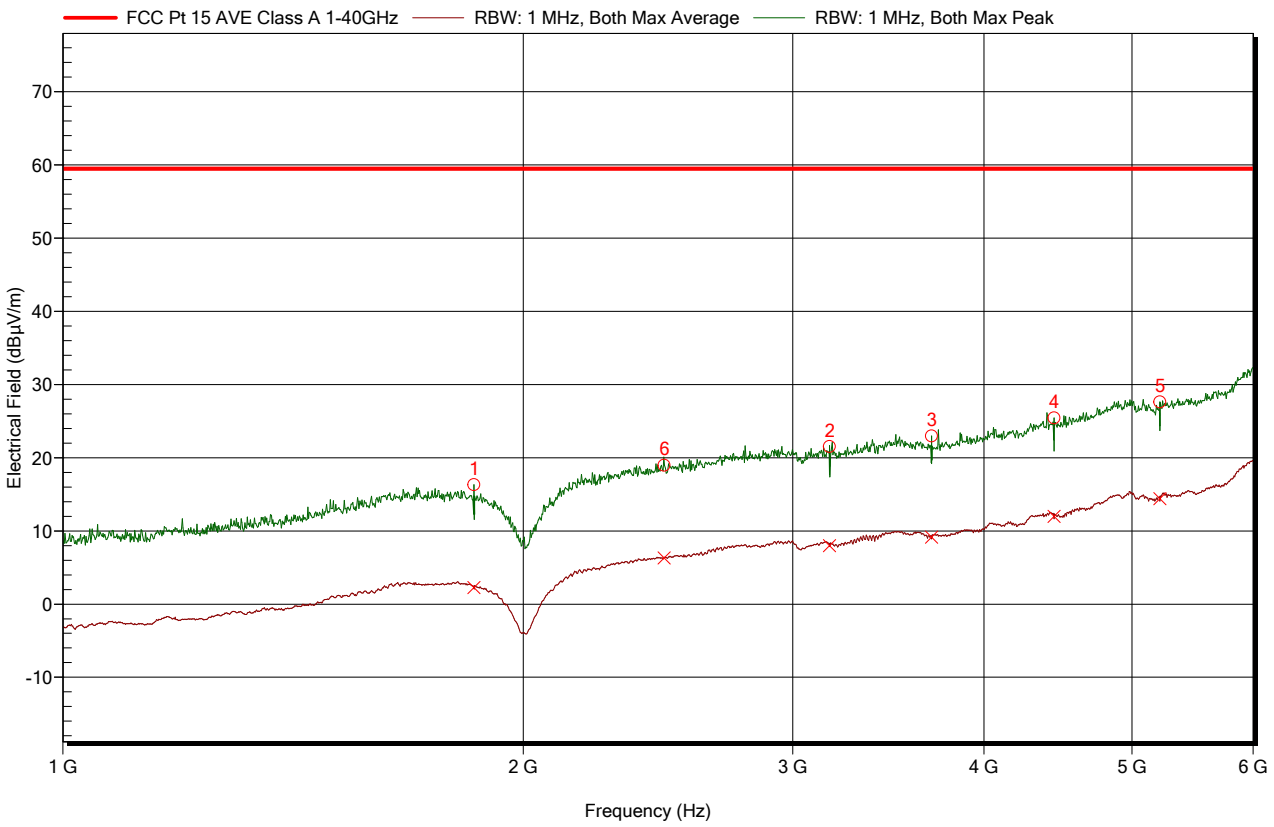


Figure 11 : Electric field emissions Plot, 1GHz to 6GHz (Charging mode)

Detected Peaks:

Frequency	Peak	Peak Difference	Peak Correction	Average	Average Differenc e	Average Correction	Average Status	Angle	Height	Polarization
1.857 GHz	16.31 dBµV/m	-57.69 dB	-42.6 dB	2.28 dBµV/m	-51.72 dB	-42.6 dB	Pass	287 Degree	3.8 m	Vertical
3.172 GHz	21.53 dBµV/m	-52.47 dB	-35.3 dB	7.99 dBµV/m	-46.01 dB	-35.3 dB	Pass	223 Degree	2.5 m	Vertical
3.697 GHz	22.98 dBµV/m	-51.02 dB	-33.7 dB	9.16 dBµV/m	-44.84 dB	-33.7 dB	Pass	87 Degree	4 m	Vertical
4.445 GHz	25.44 dBµV/m	-48.56 dB	-29.4 dB	12.01 dBµV/m	-41.99 dB	-29.4 dB	Pass	207 Degree	3.1 m	Vertical
5.213 GHz	27.61 dBµV/m	-46.39 dB	-26.1 dB	14.4 dBµV/m	-39.6 dB	-26.1 dB	Pass	357 Degree	3.2 m	Vertical
2.472 GHz	18.97 dBµV/m	-55.03 dB	-38.4 dB	6.29 dBµV/m	-47.71 dB	-38.4 dB	Pass	194 Degree	1 m	Vertical

Table 7: Electric Field Emissions Peaks, 1GHz to 6GHz (Charging mode)

EUT Test Photos

Conducted Emissions

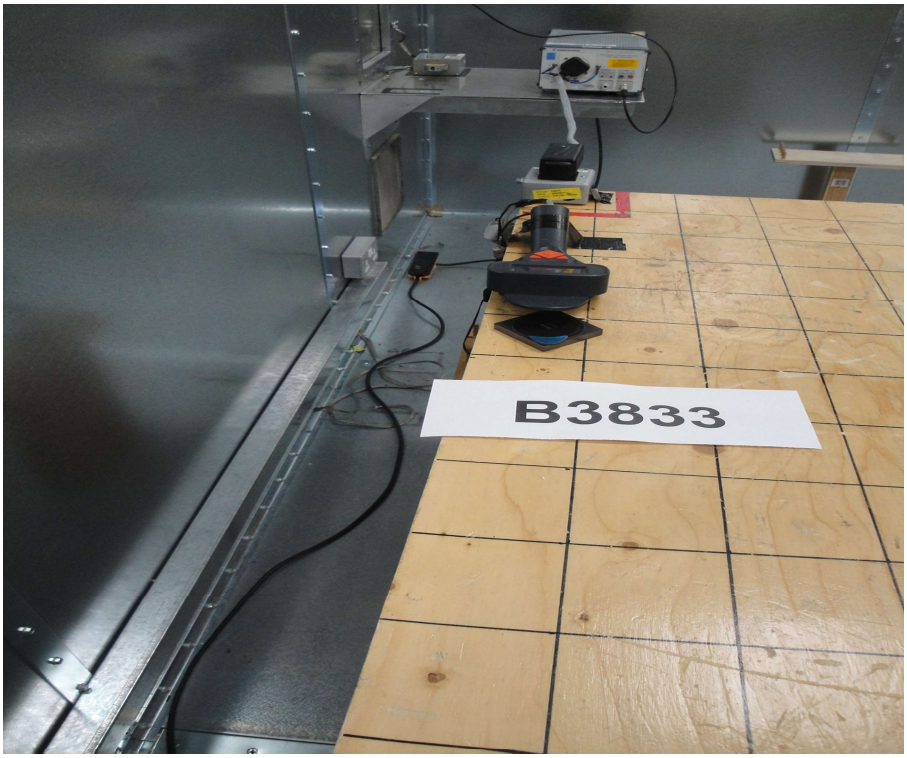


Photo 1: Conducted Emissions, Power Line

Radiated Emissions

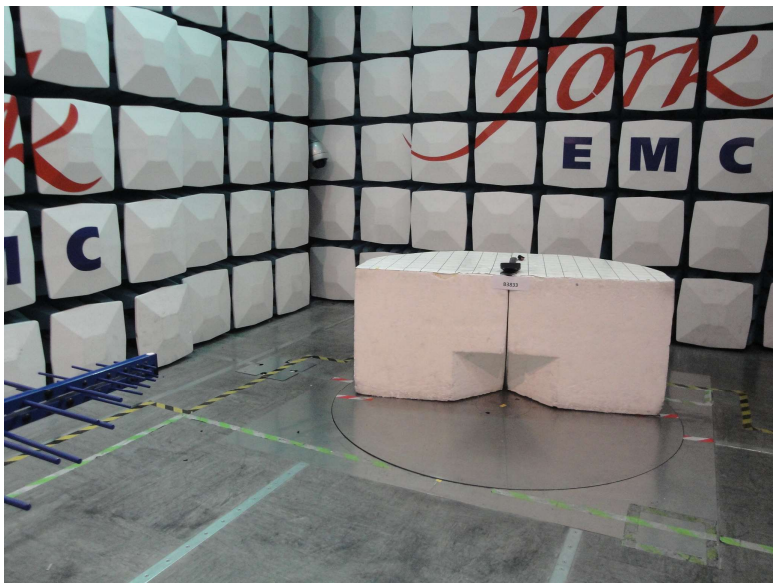


Photo 2: Radiated Emissions, close-up shot

The cable/wire placement on the test site was setup to produce the highest radiated emissions. The above photograph(s) illustrates the setup tested.

Photo 3: Radiated Emissions, 30MHz to 1GHz

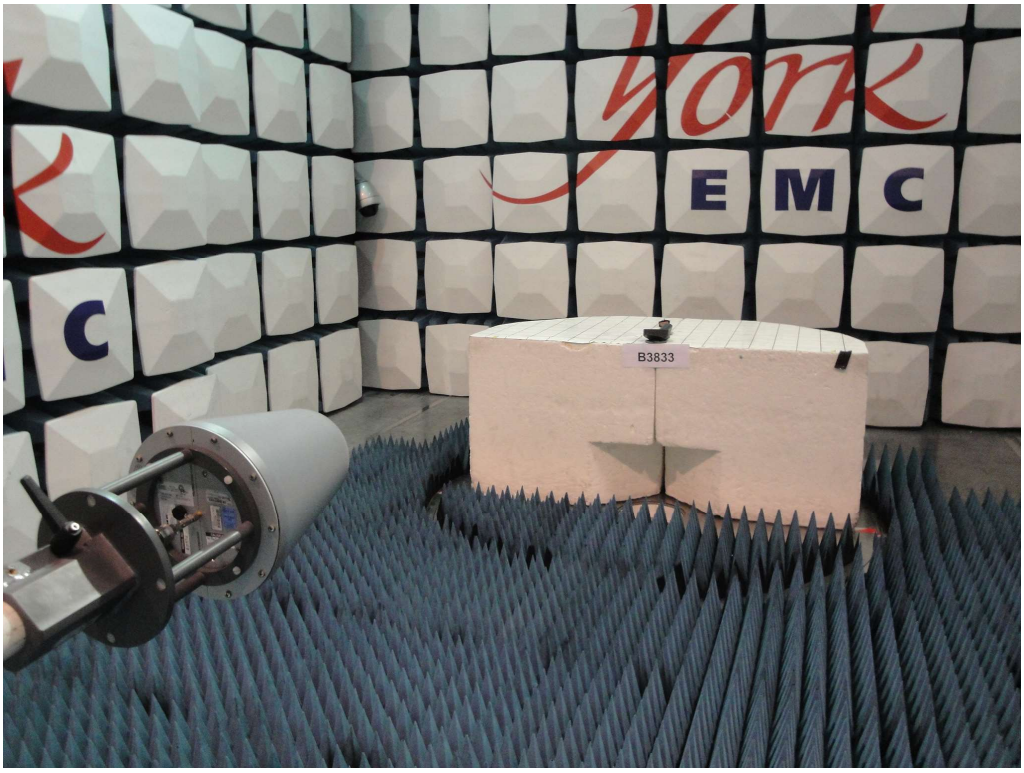


Photo 4: Radiated Emission, 1GHz to 6GHz

Appendix A Test Equipment List

Conducted Emissions

Item	Serial No.	Last Calibration Date	Calibration Interval
Rainford Screened Room 7.0m x 4.0m x 3.0m	Lab2	N/A	N/A
Rohde & Schwarz ESHS30 Measuring Receiver	B1401	27/02/2018	12 Months
Rohde & Schwarz ESH3-Z5	B0816	11/05/2017	12 Months
10dB Attenuator / Limiter	B0539	11/10/2017	12 Months
6dB Attenuator	B0949	09/10/2017	12 Months
CNE V Emission Source	B0855	N/A	N/A
LISN Adapter LSA02	B0914	N/A	N/A
BNC type Test cable	C07	11/10/2017	12 Months
N-type Test cable	B03	09/10/2017	12 Months
Mains cable M04	IEC Lead 1.0m	N/A	N/A
Vaisala HM 34 Humidity and temperature meter	B1332	17/05/2017	36 Months

Radiated Emissions Equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Rainford Shielded Room Ferrite/hybrid lined semi/anechoic chamber 8.9m x 4.8m x 5.4m	LAB1	17/05/2018	36 Months
60A Mains Filter DS23335C	(Fixed)	N/A	N/A
R&S ESU40 Measuring Receiver	B0984	26/01/2018	1 year
Chase Bilog Antenna, 30MHz - 1GHz CBL6111A	B0544	15/04/2016	36 Months
6dB Attenuator (3GHz)	B1444	15/04/2016	36 Months
CNE V Emission Source	B0855	N/A	N/A
R&S HL050 Log Periodic Antenna	B0936	10/11/2016	36 Months
3dB Attenuator (18GHz)	B1327	04/10/2017	12 Months
18GHz Bonn Preamplifier BLM0118-5A	B1333	05/02/2018	12 Months
YES emission reference source CGE01C	B0996	N/A	N/A
3dB Attenuator (40GHz)	B1395	06/09/2016	36 Months
0.5m 40GHz IW microwave cable	B1370	06/09/2016	36 Months
5m 40GHz IW microwave cable	B1449	06/09/2016	36 Months
Maturo Antenna Mast	B1405	N/A	N/A
Clark Compressor (Mast)	B0953	N/A	N/A
Vaisala HM 34 Humidity and temperature meter	B1332	17/05/2017	36 Months
2m 26GHz Gigalink test cable	B0957	02/10/2017	12 Months
5m 26GHz Gigalink test cable	B0959	02/10/2017	12 Months
9m N Type Cable PL800-NMNM-9M	B1591	02/10/2017	12 Months