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Test Report for the FCC and ISED Intermodulation Radio Testing of a Wireless Gateway for Building Automated Products, Inc

Test Report number: C15282TR4
Project number: C8034

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Issue	Description						Issue by	Date
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Test Report Change History

Issue	Date	Modification Details
1	27th October 2023	Original issue of test report
2	4th December 2023	Customer address amended
3	4th December 2023	FCC ID updated
4	22nd February 2024	Output power verification statement added
5		
6		
7		
8		
9		
10		

Section 1 Test Location

All testing was performed at;

Eurofins E&E UK 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 E&E UK, Castleford latest accreditation schedule can be found at:

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

Eurofins E&E UK Castleford Laboratory, is an Accredited facility recognised by the Federal Communications Commission (FCC) for certification testing. The appropriate FCC Designation Number is UK2013, dated 1st March 2021.

Section 2 Customer Information

Company name	Building Automated Products, Inc
Address	750 North Royal Avenue
	Gays Mills
	Wisconsin
	54631
	US
Contact	Mr Gavin Moizer-Peace
Email	Gavin@bapihvac.co.uk
Customer Representative(s) present during testing	None

Section 3 Equipment Details

3.1 Equipment Under Test (EUT)

Date received:	9th October 2023					
EUT name:	Wireless Gateway					
Serial no/s:	Wireless Gateway. Serial number: 8c4995840d04					
FCC ID:	T4FSM211221					
ISED number:	9067A-SM211221					
HVIN:	REV B					
FVIN:	V02.23.00					
PMN:	Wireless Gateway					
EUT description:	The Wireless Gateway receives data from one or more sensors via Bluetooth Low Energy (BLE) and provides data to the cloud using the 2.4GHz Wi-Fi connection.					
Details of radio technology (type, frequency, RF Module, FCC ID)	WiFi: – WFM200 FCC ID: QOQWFM200 Bluetooth: – Untested BLE chipset					
No of units tested:	One					
EUT power:	5	V	DC. Tested with a representative plug top PSU & micro USB cable			
Highest internal frequency:	2.48 GHz					
Cables: (see section 3.3 for config)	Micro-USB to USB power cable	0.8	m	screened	Terminated	
Tested as	Table top					
Mode/s of operation	**Mode 1**: Simultaneous transmission of the BLE & 2.4GHz WiFi outputs: BLE: Advertising mode. 2.402GHz CH37, 2.426GHz CH38, 2.480GHz CH39 WiFi: Normal operation at 2.412GHz CH1. Communications established with a router					
	Mode 2: Simultaneous transmission of the BLE & 2.4GHz WiFi outputs: BLE: Advertising mode. 2.402GHz CH37, 2.426GHz CH38, 2.480GHz CH39 WiFi: Normal operation at 2.437GHz CH6. Communications established with a router					
	Mode 3: Simultaneous transmission of the BLE & 2.4GHz WiFi outputs: BLE: Advertising mode. 2.402GHz CH37, 2.426GHz CH38, 2.480GHz CH39 WiFi: Normal operation at 2.462GHz CH11. Communications established with a router					
Test mode setup and control software:	The EUT was connected to a Eurofins E&E supplied DrayTek Vigor AP 902 wireless access point, placed in a quiet corner of the measurement chamber, which allowed testing on the lowest, middle and highest Wi-Fi channels (Ch1, 6 & 11). The EUT was set to BLE advertising mode, which gave a BLE output on channels 37,38 & 39.					

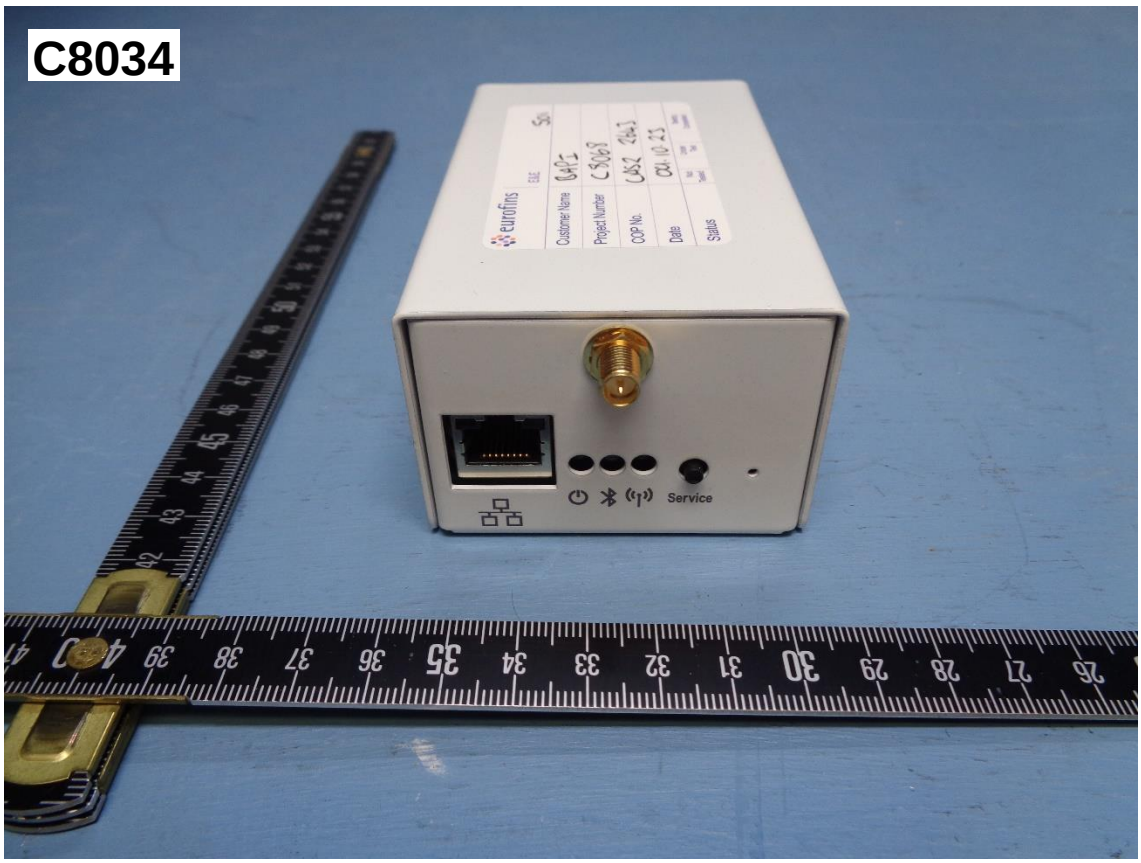
	This method of BLE testing was agreed with the customer as a dedicated BLE test mode was unavailable. Changes to the EUT settings were performed via a laptop and USB serial cable prior to the tests being carried out. The laptop was then removed from the test chamber.
Client modification statement:	None
Modifications incorporated during testing:	None

EUT Monitoring/Auxiliary Equipment

Equipment name	**Type no.**	**Serial no**
DrayTek Wi-Fi router	VigorAP 902	166670600003
HP Laptop	14-ce1507sa	5CD9115SNKV
USB – Serial Cable	FTDI TTL-234X-3V3	-
Sony 5VDC adaptor	AC-UUD12	22021HR3012628

3.2 EUT Photos

EUT Overhead view



EUT Front view

3.3 Configuration of EUT

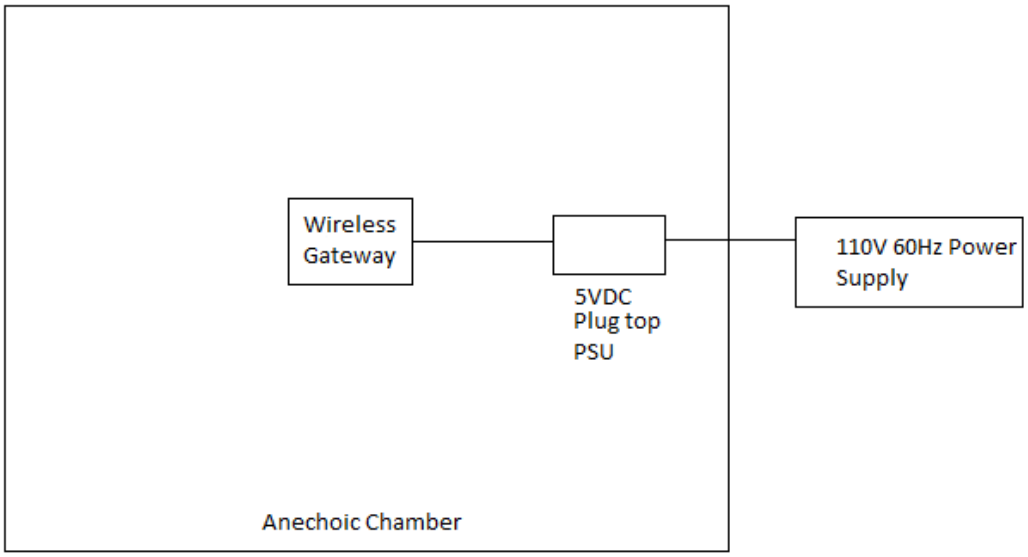


Figure 1: Diagram of EUT set-up

Section 4 Test Specifications

The tests were performed in accordance with Eurofins E&E UK Ltd Quotation B5380.

Based on 47CFR Part 15, Sub Part C Intentional Radiators referencing KDB 996369 D04 Module Integration Guide **And:** **RSS-247 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices March 24, 2017** **RSS-GEN General Requirements for Compliance of Radio Apparatus Issue 5 April 2018**			
Which references the following specification: -			
ANSI C63-10: 2013			
Test	**Method**	**Levels**	**Result**
Radiated Emissions Electric Field Measurements (30MHz to 12.5GHz) See Note 1	ANSI C63.10: 2013	47CFR Part 15 Clause 15.209 47CFR Part 15 Clause 15.205 (Restricted bands) 47CFR Part 15 Clause 15.247(d) (Radiated Tests) RSS-247 Section 5.5 (Radiated tests) RSS-GEN Issue 5 Clause 8.9 RSS-GEN Issue 5 Clause 8.10 (Restricted bands)	Pass
AC power line conducted emissions	ANSI C63.10: 2013	47CFR Part 15 Clause 15.207 RSS-247 Section 3.1	Pass

Note 1: The spectrum was investigated up to 5 times the highest frequency in accordance with FCC rule part 15.33(b).

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 Class B	Pass
Radiated Emissions Electric Field Measurements (30MHz – 12.5GHz)	ANSI C63.4: 2014 Section 8	Part 15 Clause 15.109 Part 15 Class 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.

The Decision Rule is applied on the basis of the following:

Wireless testing - ETSI TR 102 273 and ETSI TR 100 028

These standards provide guidance on how to calculate and apply measurement uncertainty whilst providing maximum uncertainties allowance. In all cases due consideration will be given to JCGM 106:2012, ILAC-G8:09/2019 and LAB 48.

This laboratory has demonstrated by calibrating its equipment and facilities, and calculating its own uncertainties, that it complies with the above requirements and therefore no allowance of uncertainties has been given to the tolerances.

Where a result is considered marginal in respect of its proximity to the limit line, for example, the customer would be made aware of situation so that they can make an informed decision on how to proceed.

4.1 Knowledge Database References

The following KDBs were referenced during the testing of the Shogun Connect:

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

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

4.1.1 Radiated Emissions (1GHz to 40GHz)

Publication Number	Keyword	Publication Date
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

4.2 Compliance Statement

The Wireless Gateway, as tested, was shown to meet requirements of the standards listed in Section 4 of this report.

Note: The conducted RF output power of both Wi-Fi and BLE were measured and found not to exceed the module's certified power value.

Section 5 Radiated 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 +/- 6.26dB for the frequency range 30MHz to 1GHz +/- 5.14dB for the frequency range from 1GHz to 6GHz +/- 5.45dB for the frequency range from 6GHz to 18GHz

Note: during exploratory measurements the worst case EUT orientation was investigated and determined to be with the EUT positioned horizontally in the desktop position.

5.2 Procedure and Test Software Version

Eurofins E&E UK test procedure (30MHz to 1GHz)	CEP23 Issue 9
Eurofins E&E UK test procedure (1GHz to 40GHz)	CEP64 Issue 10
Test software	RadiMation Version 2016.2.8

5.3 Radiated Emissions (30MHz to 1GHz)

5.3.1 Limits at 3m

Frequency (MHz)	Electric Field Strength Limit Limit (dBµV/m) Class B at 3m
	Quasi Peak
30 - 88	40.0
88 -216	43.5
216 - 960	46.0
960- 1000	54.0

5.3.2 Receiver Settings

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

5.3.3 Emissions measurements

5.3.4 Date of Test

17th October 2023

5.3.5 Test Area

LAB 1 (Semi Anechoic Chamber)

5.3.6 Tested by

L Trickett

5.3.7 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.

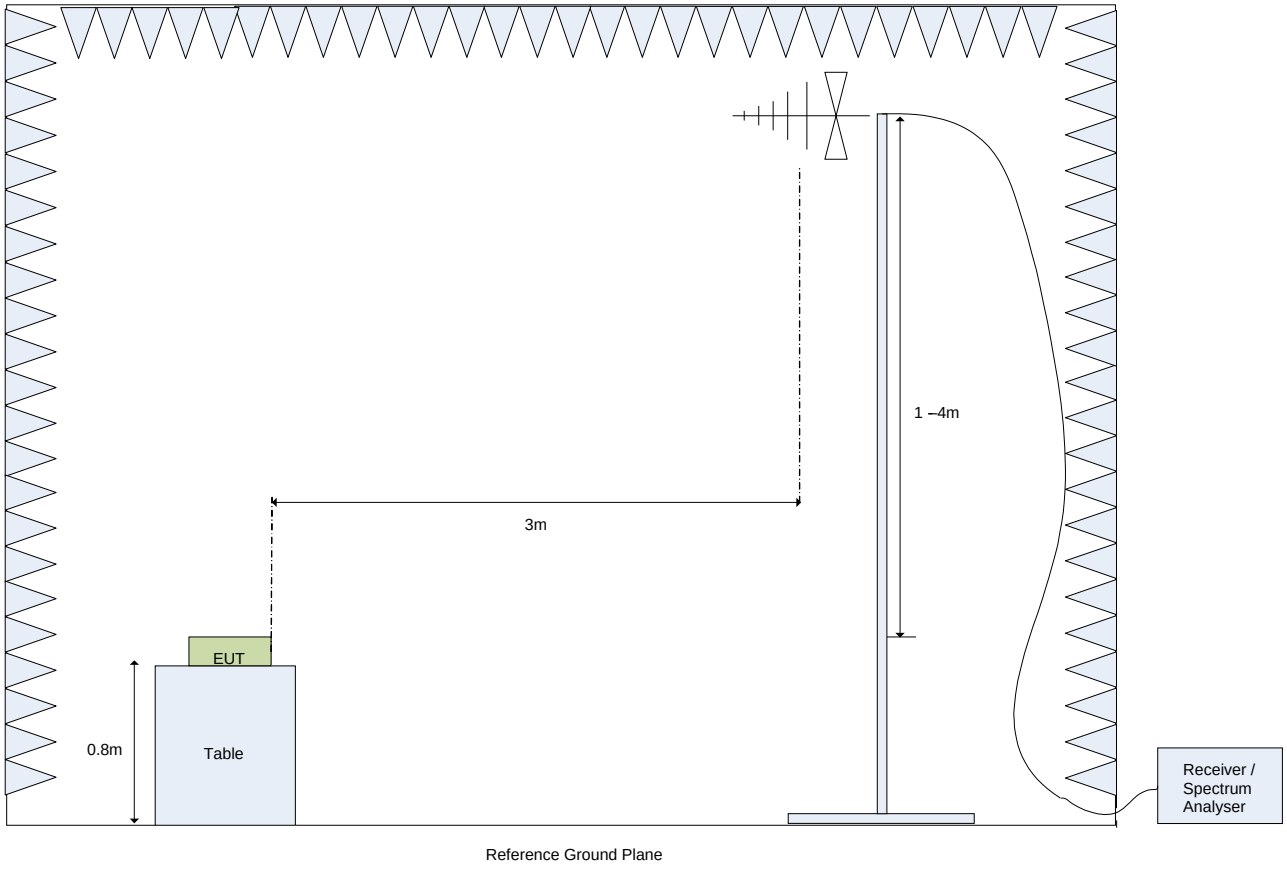


Figure 2: Test Setup for E-Field Measurements from 30MHz to 1GHz

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.

Operating Mode During testing

During spurious emission testing the equipment under test was set to transmit on the following Wi-Fi channels: 2412MHz, 2437MHz and 2462MHz in turn.

The equipment under test was pre-scanned using peak detection when operating on all three channels. Final measurements were performed with the equipment under test operating on 2462MHz.

5.3.8 Electric field emissions, 30MHz to 1GHz

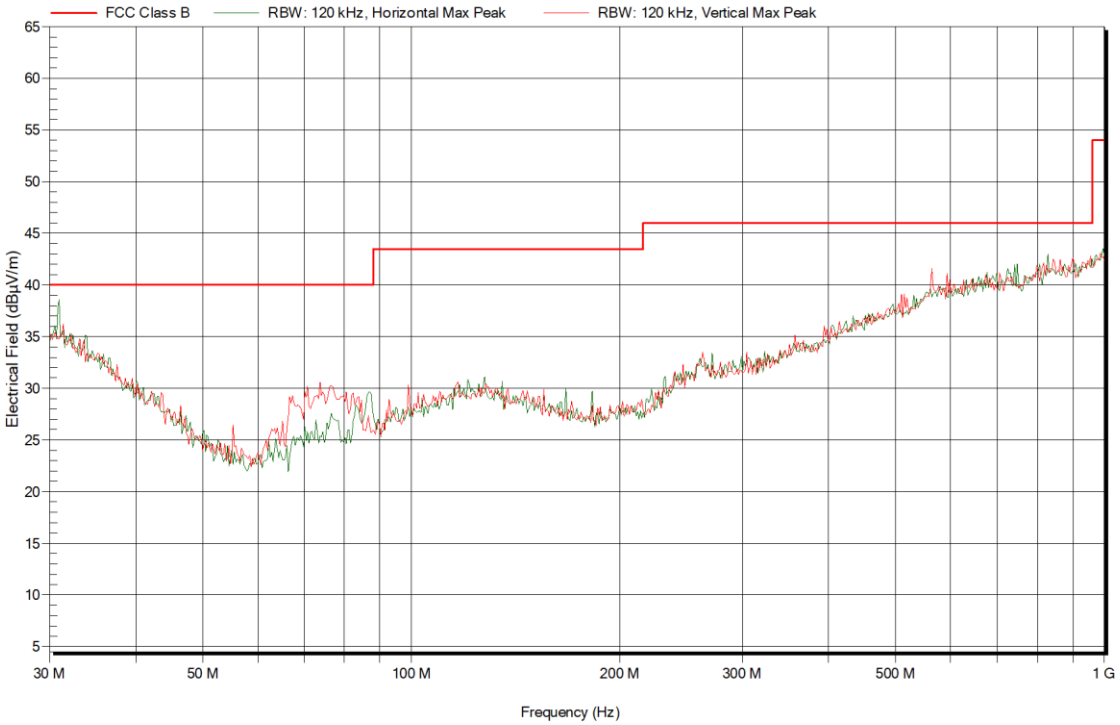


Figure 3: Electric field emissions Plot, 30MHz to 1GHz – Mode 1 – Peak detector scan

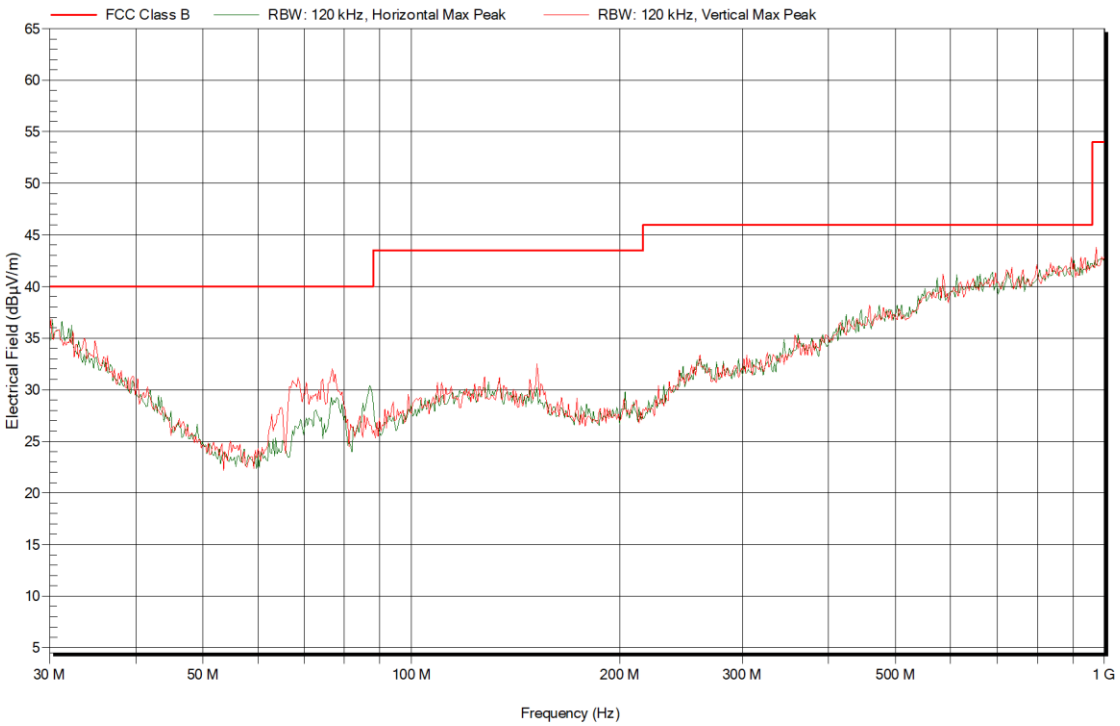


Figure 4: Electric field emissions Plot, 30MHz to 1GHz – Mode 2 – Peak detector scan

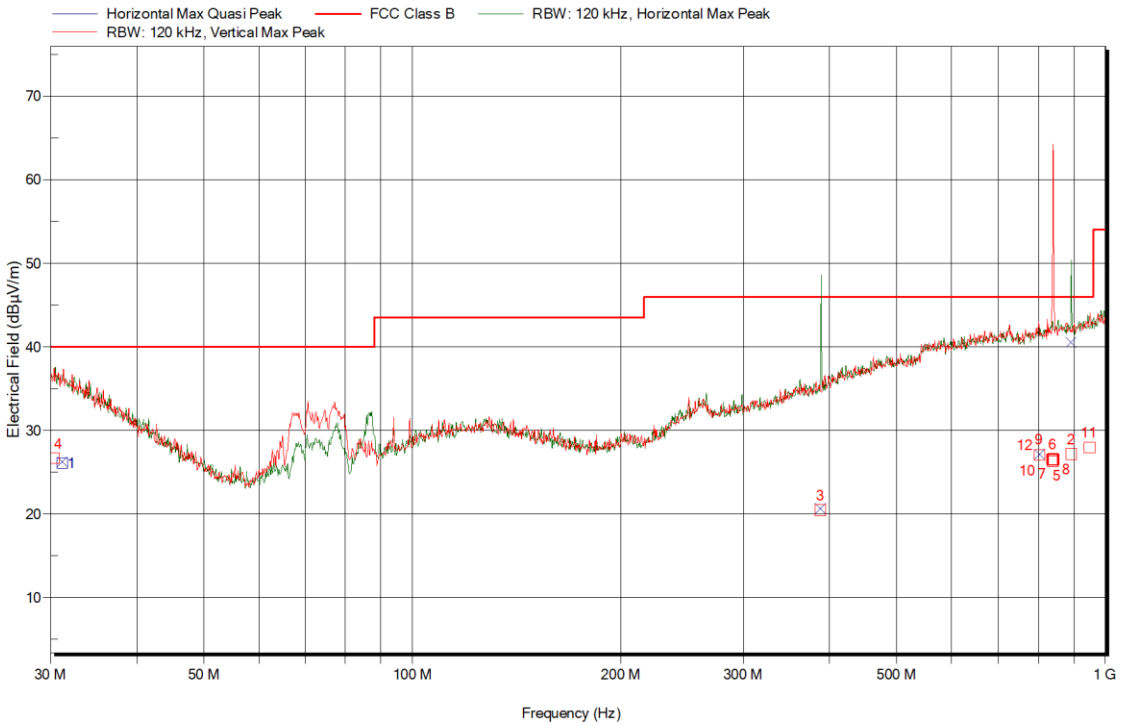


Figure 5: Electric field emissions Plot, 30MHz to 1GHz – Mode 3

Frequency	Quasi-Peak	Quasi Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height	Polarization
MHz	dBµV/m	dBµV/m	dB		degrees	m	
31.20	26.1	40	-13.9	Pass	240	1.0	Horizontal
891.72	27.2	46	-18.8	Pass	85	3.3	Horizontal
387.78	20.5	46	-25.5	Pass	265	3.5	Horizontal
30.36	26.7	40	-13.3	Pass	275	1.5	Vertical
839.88	26.3	46	-19.7	Pass	230	2.3	Vertical
839.16	26.6	46	-19.4	Pass	155	1.5	Vertical
837.30	26.5	46	-19.5	Pass	245	3.3	Vertical
838.8	26.5	46	-19.5	Pass	185	2.0	Vertical
841.74	26.5	46	-19.5	Pass	225	3.7	Vertical
840.54	26.5	46	-19.5	Pass	260	3.5	Vertical
948.66	28.0	46	-18.0	Pass	280	1.5	Vertical
803.64	27.1	46	-18.9	Pass	190	2.8	Horizontal

Table 1: Electric Field Emissions Peaks, 30MHz to 1GHz – Mode 3

5.3.9 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)

5.3.10 Sample Data

The Quasi-Peak level at 803.64MHz

FS (dBµV/m) = 27.1dB = -1.2dBµV + 25.8dB + 2.5dB

5.4 Radiated Emissions (1GHz to 12.5GHz)

5.4.1 Limits

Frequency (GHz)	Electric Field Strength Limit (dBµV/m)
	Average
1-18	54.0

5.4.2 Receiver Settings

Receiver Parameters	Setting
Detector Function	Average
Start Frequency	1GHz
Stop Frequency	12.5GHz
Resolution Bandwidth	1MHz
Video Bandwidth	Auto

5.4.3 Emissions measurements

5.4.4 Date of Test

17th October 2023

5.4.5 Test Area

LAB 1 (SAC)

5.4.6 Tested by

L Trickett

5.4.7 Test Setup

The EUT was configured in the SAC on an 1.5m high table.

Exploratory measurements on the EUT were carried out to identify suspect frequencies and worst case orientations, see Section 5.4.8.

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.

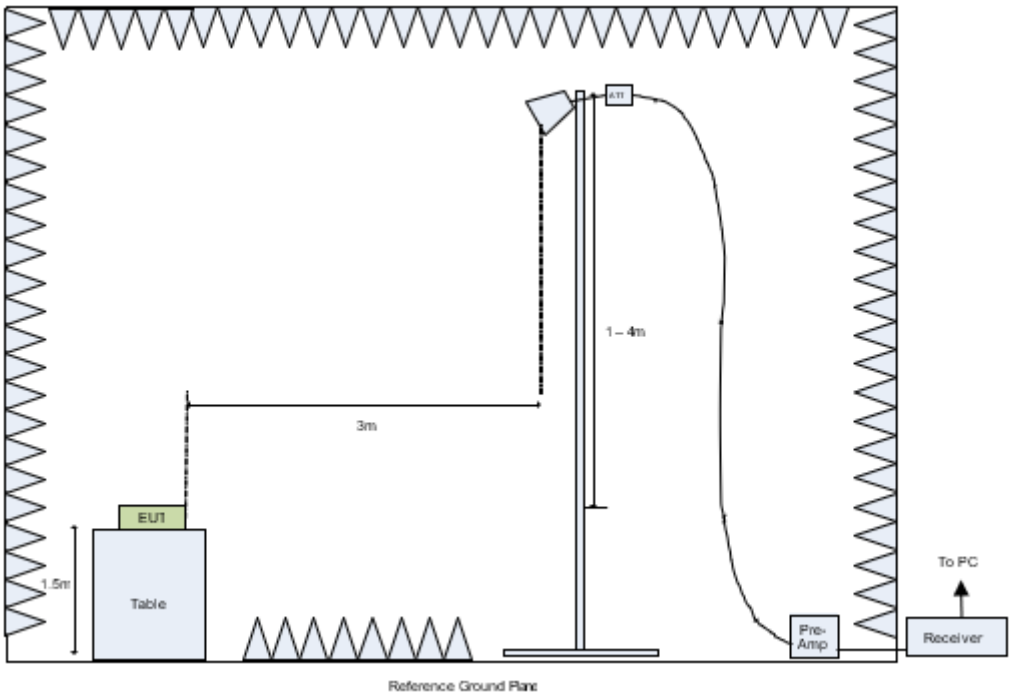


Figure 6: Test Setup for Final E-Field Measurements from 1GHz to 12.5GHz

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.

Note 3: On all swept and final measurements made between 1GHz and 112.5GHz a 2.4GHz Microtronics BRM50702 notch filter was placed in the measurement chain between the antenna and pre-amplifier in order to prevent the artificial generation of harmonics within the pre-amplifier.

5.4.8 Exploratory Radiated Emission Maximization

During exploratory testing, suspect emissions from the EUT were identified both in terms of the frequency and directionality. This was achieved by manually positioning the antenna close to the EUT and also by scanning it over all sides of the EUT whilst observing a spectral display. The typical distance between the surface of the EUT and the scanning antenna was circa 30cm.

Frequency (GHz)	Mode of operation	EUT face	Emissions Angle (w.r.t. turntable)	Height (m)	Polarization
1.158	Mode 1, 2 and 3	USB end	90	1.0	Horizontal
1.724	Mode 1, 2 and 3	USB end	90	1.0	Horizontal
2.673	Mode 1, 2 and 3	USB end	90	1.0	Vertical
3.288	Mode 1, 2 and 3	USB end	90	1.0	Vertical
7.283	Mode 1, 2 and 3	USB end	90	1.0	Vertical
7.432	Mode 1, 2 and 3	USB end	90	1.0	Vertical

Table 2: Frequencies identified during Exploratory Radiated Emission maximization

Note 1 : The front face of the EUT is deemed to be 0°, which is then turned in a clockwise direction through 360°.

Note 2 : The method for the exploratory radiated emission maximisation is as detailed in Annex E of ANSI C63.4-2014 and ANSI C63.10: 2013.

5.4.9 Electric field emissions, 1GHz to 12.5GHz

The equipment under test was pre-scanned using peak detection when operating on all three channels. Final measurements were performed with the equipment under test operating on 2412MHz

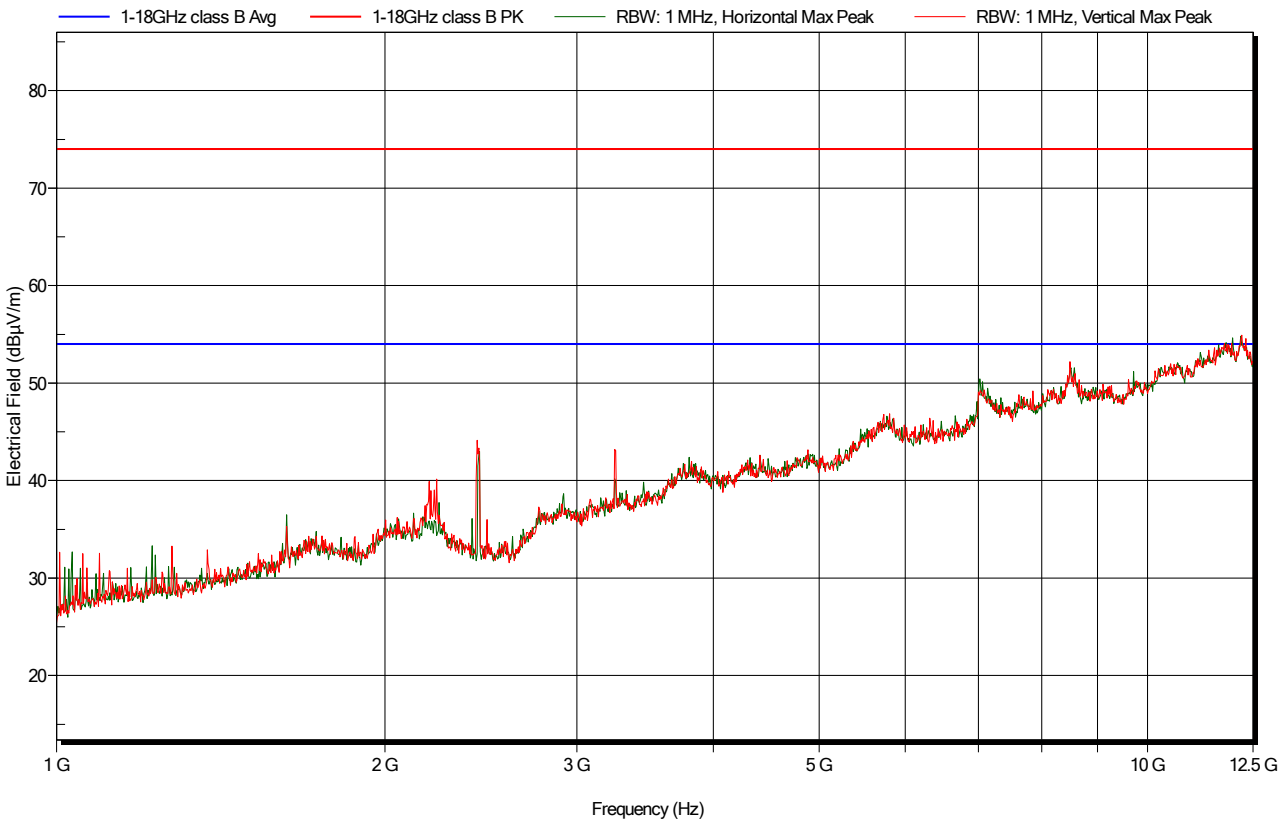


Figure 7: Electric field emissions Plot, 1GHz to 12.5GHz – Mode 2 – Peak detector scan

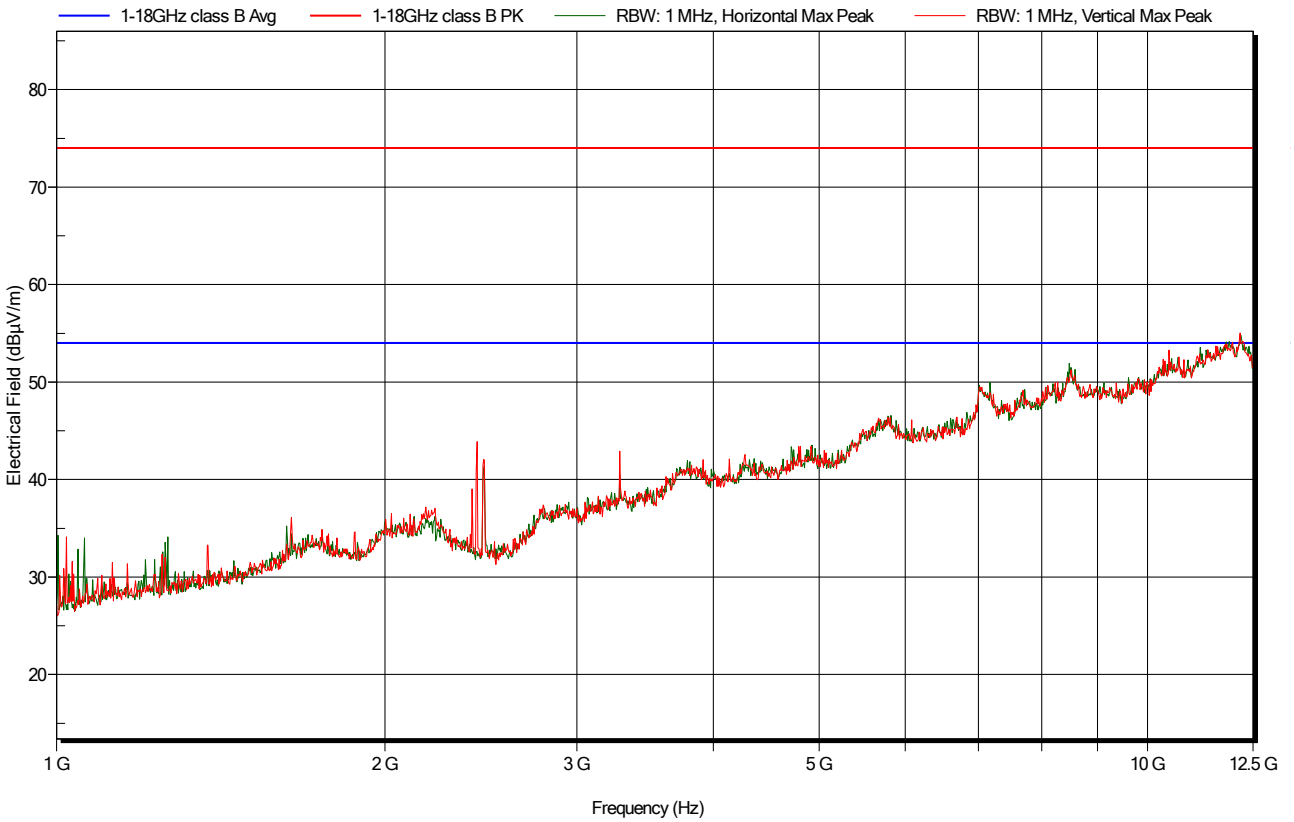


Figure 8: Electric field emissions Plot, 1GHz to 12.5GHz – Mode 3 – Peak detector scan

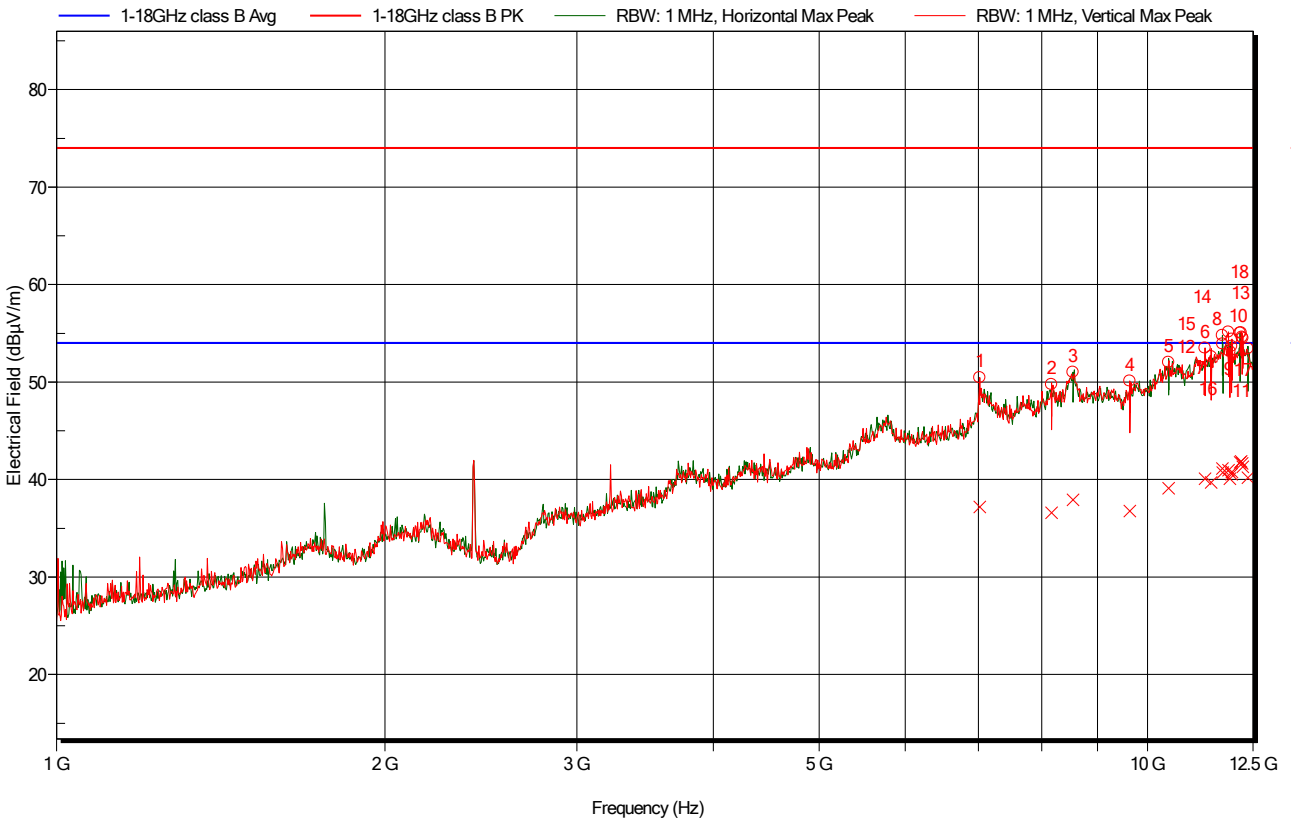


Figure 9: Electric field emissions Plot, 1GHz to 12.5GHz – Mode 1

Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height	Polarization
GHz	dBµV/m	dBµV/m	dB		degrees	m	
7.022	37.18	54	-16.82	Pass	325	2.3	Vertical
8.166	36.61	54	-17.39	Pass	5	1.8	Vertical
8.548	37.92	54	-16.08	Pass	145	3.9	Horizontal
9.634	36.77	54	-17.23	Pass	165	2.3	Vertical
10.458	39.09	54	-14.91	Pass	205	2.7	Horizontal
11.292	40.08	54	-13.92	Pass	300	2.8	Vertical
11.44	39.69	54	-14.31	Pass	75	1.8	Vertical
11.712	41.14	54	-12.86	Pass	225	1.4	Horizontal
11.726	40.73	54	-13.27	Pass	210	2	Horizontal
11.864	40.95	54	-13.05	Pass	65	2	Vertical
11.902	40.08	54	-13.92	Pass	150	3.3	Vertical
11.94	40.55	54	-13.45	Pass	205	3.8	Vertical
12.182	41.87	54	-12.13	Pass	220	1.5	Vertical
12.208	41.65	54	-12.35	Pass	225	2.2	Vertical
12.233	41.32	54	-12.68	Pass	35	2.7	Vertical
12.365	40.2	54	-13.8	Pass	280	2.5	Horizontal
11.951	40.78	54	-13.22	Pass	270	1.2	Vertical
12.162	41.77	54	-12.23	Pass	310	3.7	Horizontal

Table 3: Electric Field Emissions Peaks, 1GHz to 12.5GHz – Mode 1

5.4.10 Average correction factors

The total average corrections are shown in the above table. This correction figure consists of Preamplifier gain (PG), Antenna factor (AF); Attenuator loss (AL) and Cable loss (CL).

Field strength (FS) is calculated as follows:

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

5.4.11 Sample Data

The Average level at 12.162GHz

FS (dBµV/m) = 41.77dBµV/m = 40.23dBµV – 52.69dB + 43.26dB + 10.97dB

Section 6 AC Mains Conducted Emissions

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 +/- 3.44dB

6.2 Power Line Emission Limits

Frequency (MHz)	Class B (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

6.3 Receiver Settings

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

6.4 Procedure and Test Software Version

Eurofins E&E UK test procedure	CEP19 Issue 9
Test software	RadiMation Version 2016.1.6

6.4.1 Date of Test

16th October 2023

6.4.2 Test Area

LAB 2

6.4.3 Tested by

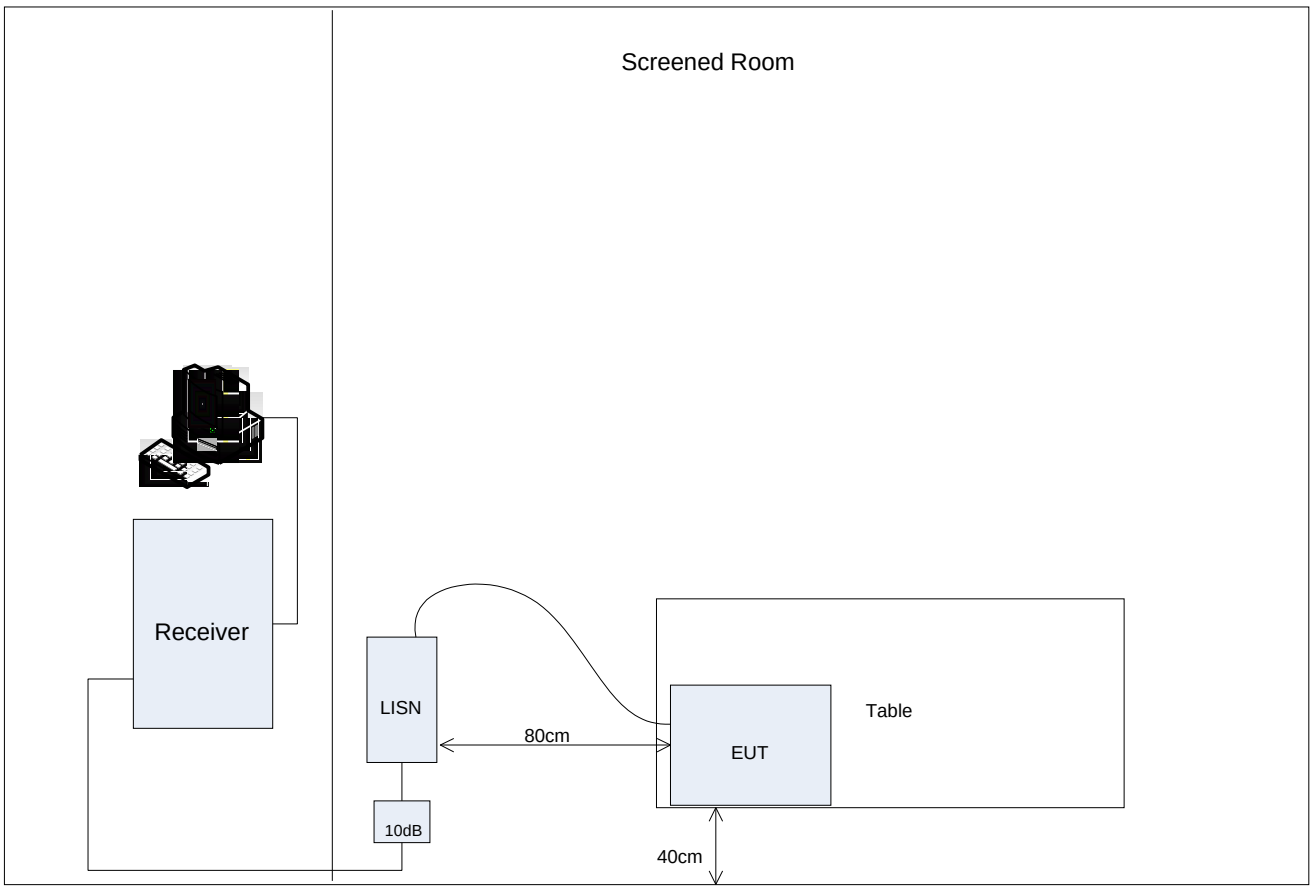
L Trickett

6.4.4 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 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).



6.5 Test Results

This section contains graphical and tabulated data. The following data is presented

Mode of Operation	Conductor	Result summary
1	Live	Pass
1	Neutral	Pass
2	Live	Pass
2	Neutral	Pass
3	Live	Pass
3	Neutral	Pass

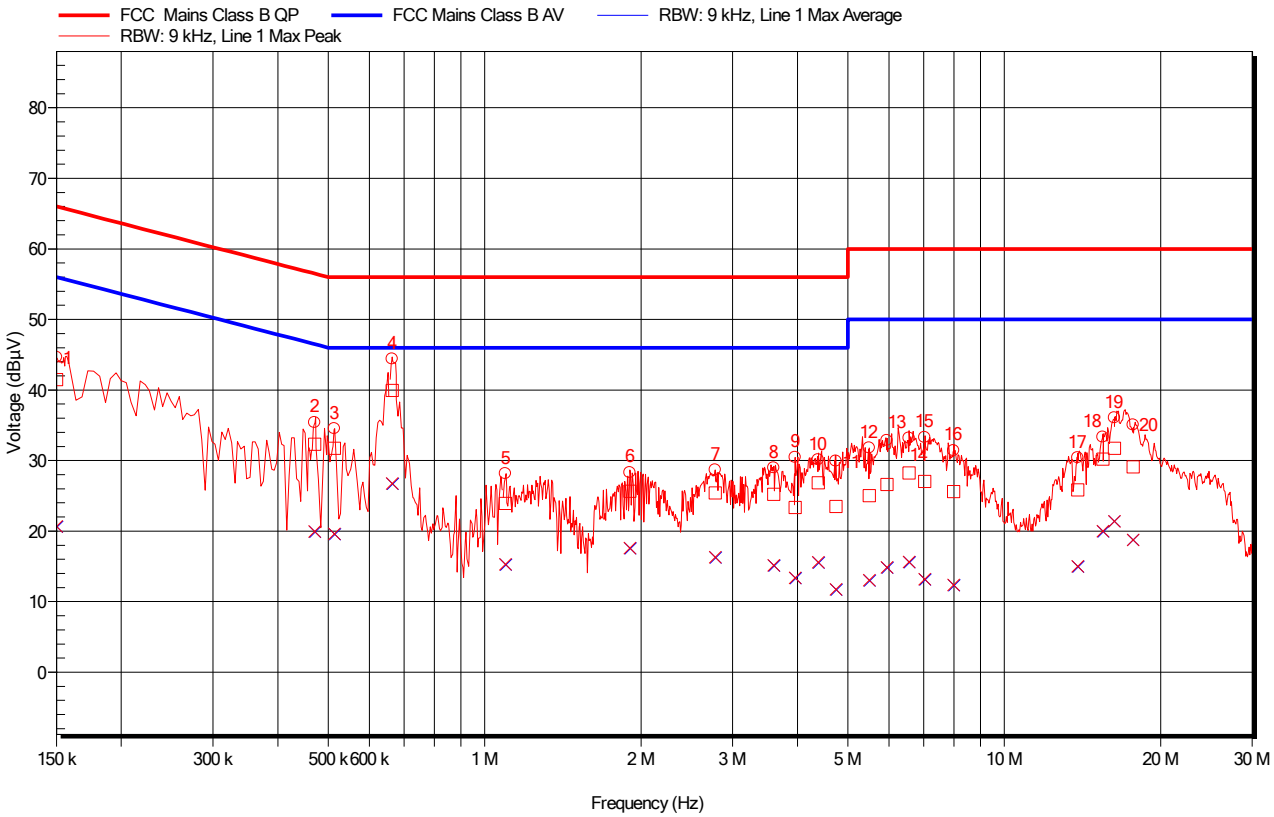


Figure 10: AC mains conducted emissions. Mode 1 – Live

Frequency (MHz)	Average (dBµV)	Average Limit (dBµV)	Average Difference (dB)	Average Status	Quasi-Peak (dBµV)	Quasi-Peak Limit (dBµV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.150	20.7	56	-35.3	Pass	41.5	66	-24.5	Pass
0.471	20.0	46.5	-26.5	Pass	32.3	56.5	-24.2	Pass
0.514	19.6	46	-26.4	Pass	31.8	56	-24.2	Pass
0.664	26.8	46	-19.2	Pass	39.9	56	-16.1	Pass
1.096	15.3	46	-30.7	Pass	23.9	56	-32.1	Pass
1.902	17.6	46	-28.4	Pass	25.6	56	-30.4	Pass
2.778	16.3	46	-29.7	Pass	25.4	56	-30.6	Pass
3.598	15.1	46	-30.9	Pass	25.2	56	-30.8	Pass
3.957	13.4	46	-32.6	Pass	23.4	56	-32.6	Pass
4.385	15.6	46	-30.4	Pass	26.9	56	-29.1	Pass
4.739	11.7	46	-34.3	Pass	23.5	56	-32.5	Pass
5.494	13.0	50	-37.0	Pass	25.0	60	-35.0	Pass
5.946	14.9	50	-35.1	Pass	26.6	60	-33.4	Pass
6.558	15.6	50	-34.4	Pass	28.2	60	-31.8	Pass
7.025	13.2	50	-36.8	Pass	27.0	60	-33.0	Pass
7.985	12.4	50	-37.6	Pass	25.6	60	-34.4	Pass
13.848	15.0	50	-35.0	Pass	25.9	60	-34.1	Pass
15.481	20.0	50	-30.0	Pass	30.2	60	-29.8	Pass
16.296	21.4	50	-28.6	Pass	31.7	60	-28.3	Pass
17.700	18.7	50	-31.3	Pass	29.1	60	-30.9	Pass

Table 4: Electric Field Emissions Peaks, 150kHz to 30MHz – Mode 1 - Live

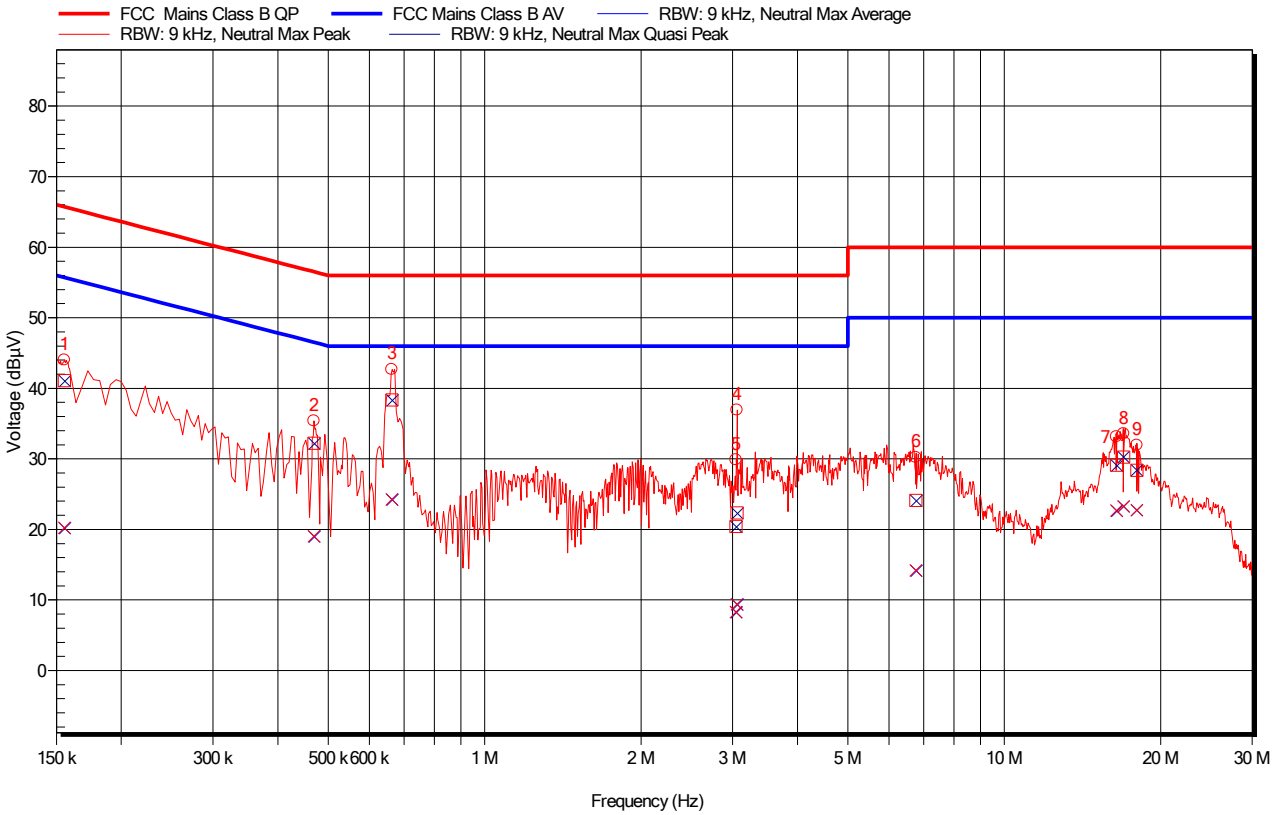


Figure 11: AC mains conducted emissions. Mode 1 – Neutral

Frequency (MHz)	Average (dBµV)	Average Limit (dBµV)	Average Difference (dB)	Average Status	Quasi-Peak (dBµV)	Quasi-Peak Limit (dBµV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.155	20.2	55.7	-35.5	Pass	41.1	65.7	-24.6	Pass
0.470	19.0	46.5	-27.5	Pass	32.2	56.5	-24.3	Pass
0.663	24.2	46	-21.8	Pass	38.3	56	-17.7	Pass
3.061	9.4	46	-36.6	Pass	22.3	56	-33.7	Pass
3.045	8.3	46	-37.7	Pass	20.4	56	-35.6	Pass
6.756	14.2	50	-35.8	Pass	24.1	60	-35.9	Pass
16.423	22.7	50	-27.3	Pass	29.1	60	-30.9	Pass
16.960	23.3	50	-26.7	Pass	30.3	60	-29.7	Pass
17.986	22.7	50	-27.3	Pass	28.4	60	-31.6	Pass

Table 5: Electric Field Emissions Peaks, 150kHz to 30MHz – Mode 1 - Neutral

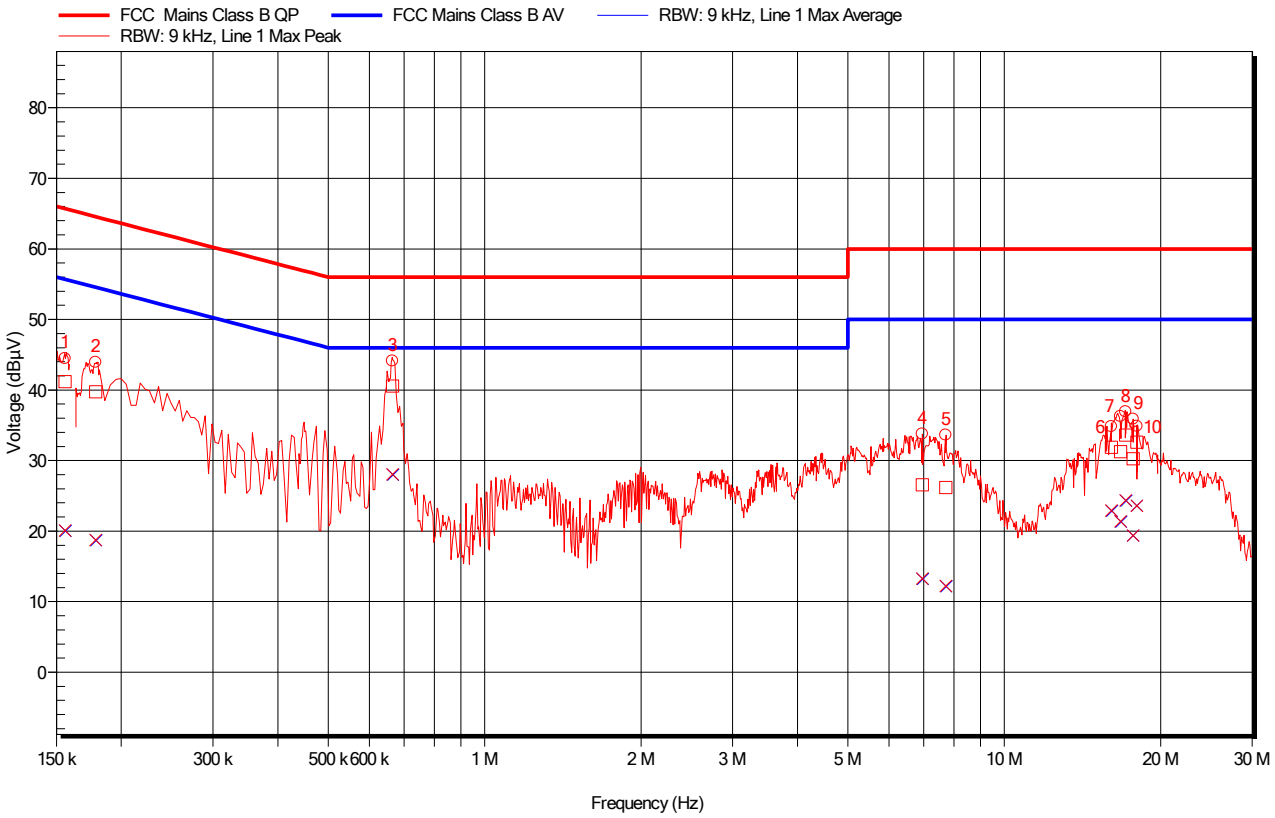


Figure 12: AC mains conducted emissions. Mode 2 – Live

Frequency (MHz)	Average (dBµV)	Average Limit (dBµV)	Average Difference (dB)	Average Status	Quasi-Peak (dBµV)	Quasi-Peak Limit (dBµV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.156	20.1	55.7	-35.6	Pass	41.2	65.7	-24.5	Pass
0.178	18.8	54.6	-35.8	Pass	39.7	64.6	-24.8	Pass
0.665	28.1	46	-17.9	Pass	40.6	56	-15.4	Pass
6.950	13.3	50	-36.7	Pass	26.6	60	-33.4	Pass
7.719	12.2	50	-37.8	Pass	26.2	60	-33.8	Pass
16.064	22.9	50	-27.1	Pass	31.9	60	-28.1	Pass
16.737	21.4	50	-28.6	Pass	31.3	60	-28.7	Pass
17.118	24.3	50	-25.7	Pass	33.6	60	-26.4	Pass
17.698	19.4	50	-30.6	Pass	30.3	60	-29.7	Pass
17.990	23.6	50	-26.4	Pass	32.6	60	-27.4	Pass

Table 6: Electric Field Emissions Peaks, 150kHz to 30MHz – Mode 2 - Live

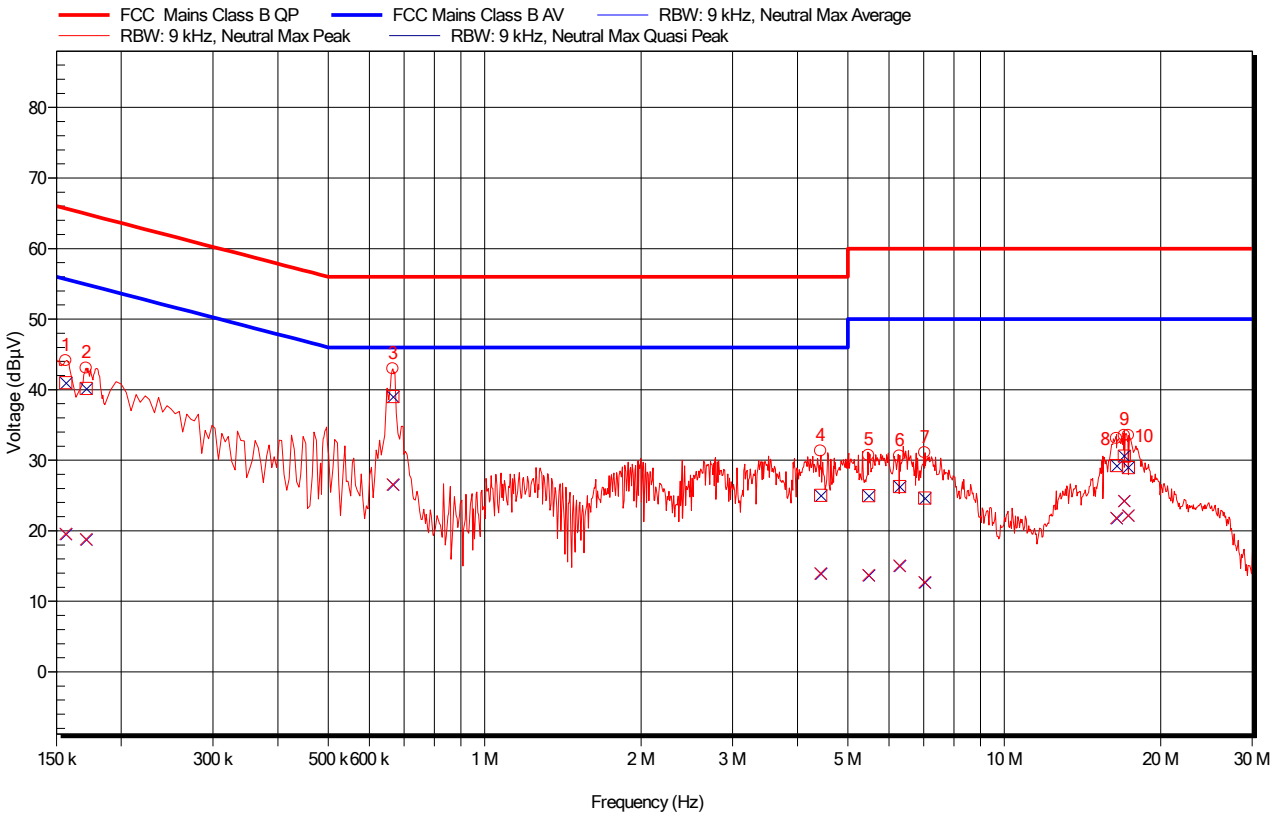


Figure 13: AC mains conducted emissions. Mode 2 – Neutral

Frequency (MHz)	Average (dBµV)	Average Limit (dBµV)	Average Difference (dB)	Average Status	Quasi-Peak (dBµV)	Quasi-Peak Limit (dBµV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.156	19.5	55.7	-36.1	Pass	41.0	65.7	-24.7	Pass
0.171	18.8	54.9	-36.1	Pass	40.2	64.9	-24.8	Pass
0.666	26.5	46	-19.5	Pass	39.0	56	-17.0	Pass
4.430	13.9	46	-32.1	Pass	25.0	56	-31.0	Pass
5.479	13.7	50	-36.3	Pass	25.0	60	-35.0	Pass
6.287	15	50	-35.0	Pass	26.3	60	-33.8	Pass
7.027	12.7	50	-37.3	Pass	24.7	60	-35.3	Pass
16.429	21.8	50	-28.2	Pass	29.2	60	-30.8	Pass
17.006	24.2	50	-25.8	Pass	30.6	60	-29.4	Pass
17.323	22.1	50	-27.9	Pass	29.0	60	-31.0	Pass

Table 7: Electric Field Emissions Peaks, 150kHz to 30MHz – Mode 2 - Neutral

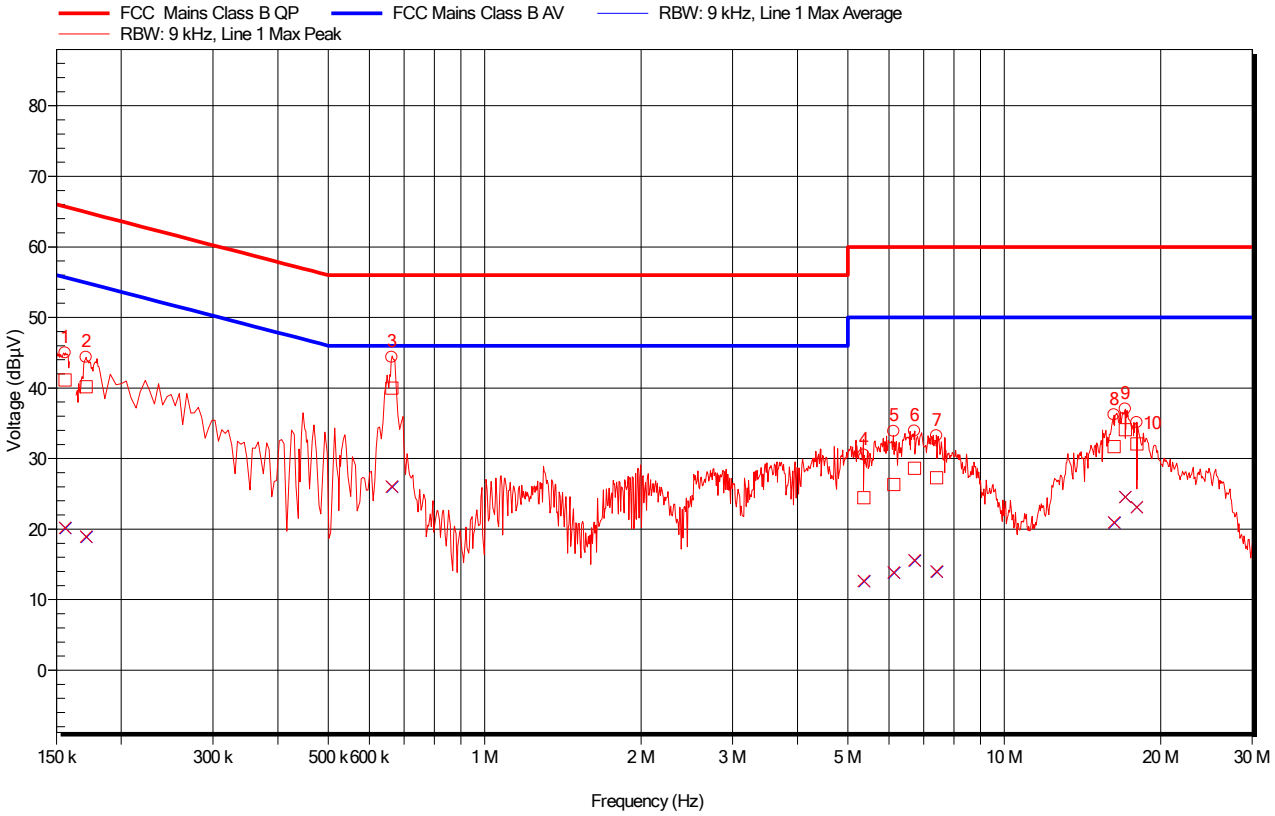


Figure 14: AC mains conducted emissions. Mode 3 – Live

Frequency (MHz)	Average (dBµV)	Average Limit (dBµV)	Average Difference (dB)	Average Status	Quasi-Peak (dBµV)	Quasi-Peak Limit (dBµV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.156	20.2	55.7	-35.5	Pass	41.1	65.7	-24.6	Pass
0.171	18.9	54.9	-36.0	Pass	40.2	64.9	-24.7	Pass
0.663	26.0	46	-20.0	Pass	40.0	56	-16.0	Pass
5.363	12.7	50	-37.3	Pass	24.4	60	-35.6	Pass
6.131	13.8	50	-36.2	Pass	26.3	60	-33.7	Pass
6.716	15.6	50	-34.4	Pass	28.6	60	-31.4	Pass
7.404	14.0	50	-36.0	Pass	27.3	60	-32.7	Pass
16.265	21.0	50	-29.0	Pass	31.7	60	-28.3	Pass
17.090	24.5	50	-25.5	Pass	34.1	60	-25.9	Pass
17.989	23.1	50	-26.9	Pass	32.1	60	-27.9	Pass

Table 8: Electric Field Emissions Peaks, 150kHz to 30MHz – Mode 3 - Live

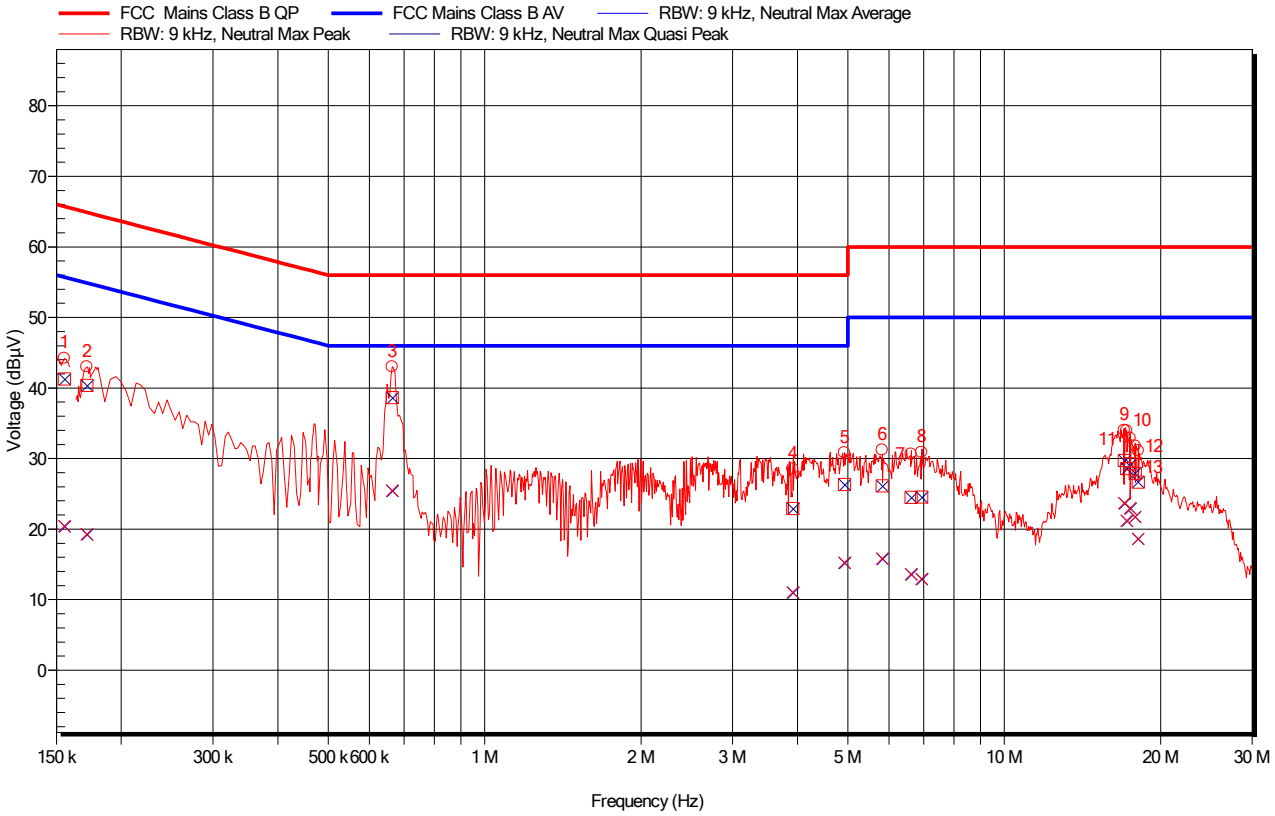


Figure 15: AC mains conducted emissions. Mode 3 – Neutral

Frequency (MHz)	Average (dBµV)	Average Limit (dBµV)	Average Difference (dB)	Average Status	Quasi-Peak (dBµV)	Quasi-Peak Limit (dBµV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.155	20.4	55.7	-35.3	Pass	41.3	65.7	-24.4	Pass
0.172	19.3	54.9	-35.6	Pass	40.4	64.9	-24.5	Pass
0.664	25.4	46	-20.6	Pass	38.6	56	-17.4	Pass
3.919	11.0	46	-35.0	Pass	22.9	56	-33.1	Pass
4.923	15.2	46	-30.8	Pass	26.3	56	-29.7	Pass
5.820	15.8	50	-34.2	Pass	26.1	60	-33.9	Pass
6.619	13.6	50	-36.4	Pass	24.5	60	-35.5	Pass
6.929	13.0	50	-37.1	Pass	24.5	60	-35.5	Pass
17.008	23.7	50	-26.3	Pass	29.7	60	-30.3	Pass
17.203	21.2	50	-28.8	Pass	28.6	60	-31.4	Pass
17.455	23.0	50	-27.0	Pass	29.3	60	-30.8	Pass
17.858	21.7	50	-28.3	Pass	27.9	60	-32.1	Pass
18.095	18.6	50	-31.4	Pass	26.6	60	-33.4	Pass

Table 9: Electric Field Emissions Peaks, 150kHz to 30MHz – Mode 3 - Neutral

6.5.1 Example calculation

This correction factors required 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)

6.5.2 Sample Data

The Quasi-Peak level at 18.095 MHz

ASL (dBµV) = 18.6dBµV = 7.4dBµV + 1.3dB - 0.2dB + 10.1dB

Appendix A EUT Test Photos

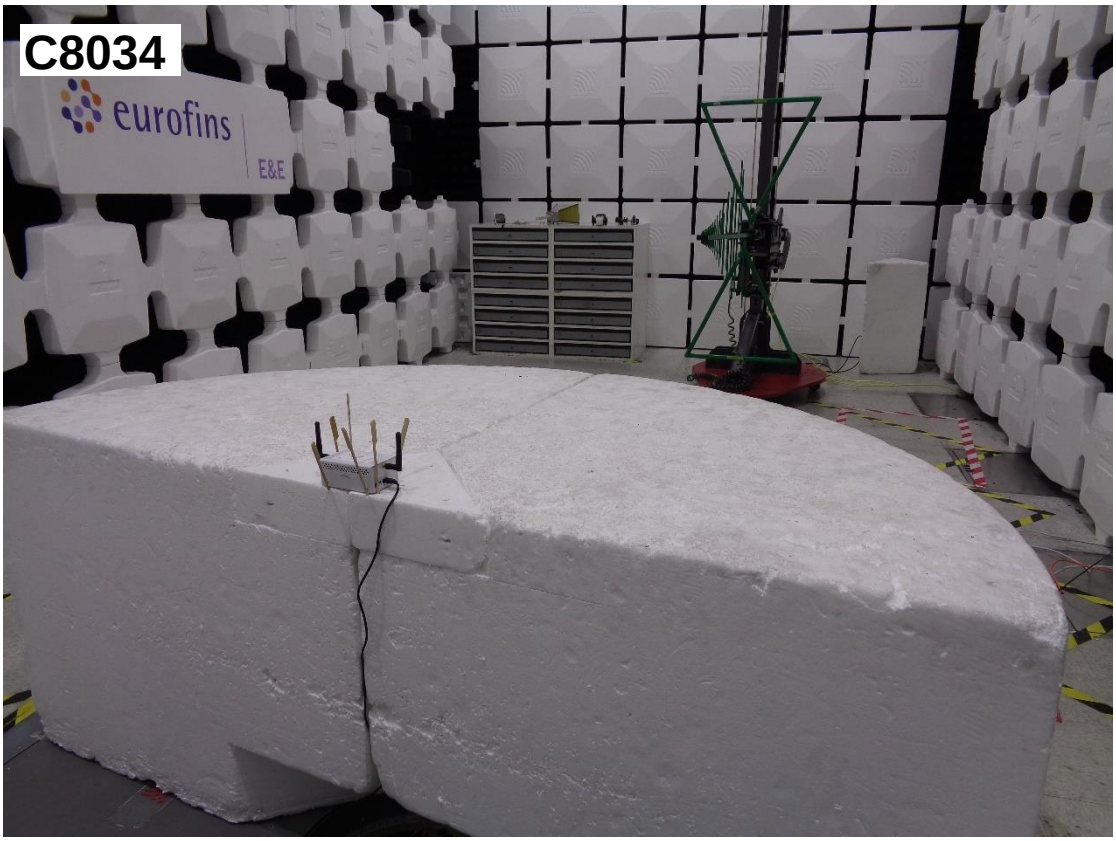


Photo 1: Radiated Emissions, 30MHz to 1GHz

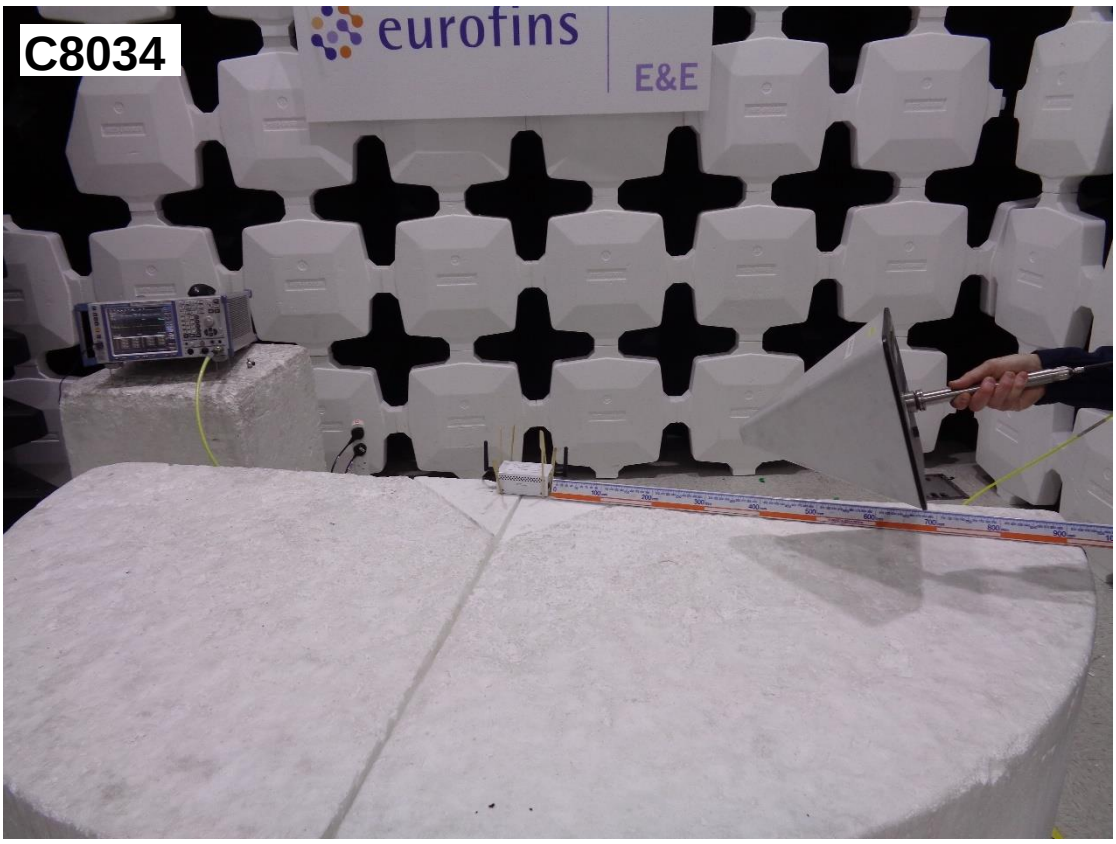


Photo 2: Exploratory Radiated Emissions Maximization, 1GHz to 12.5GHz

Photo 3: Radiated Emissions, 1GHz to 12.5GHz

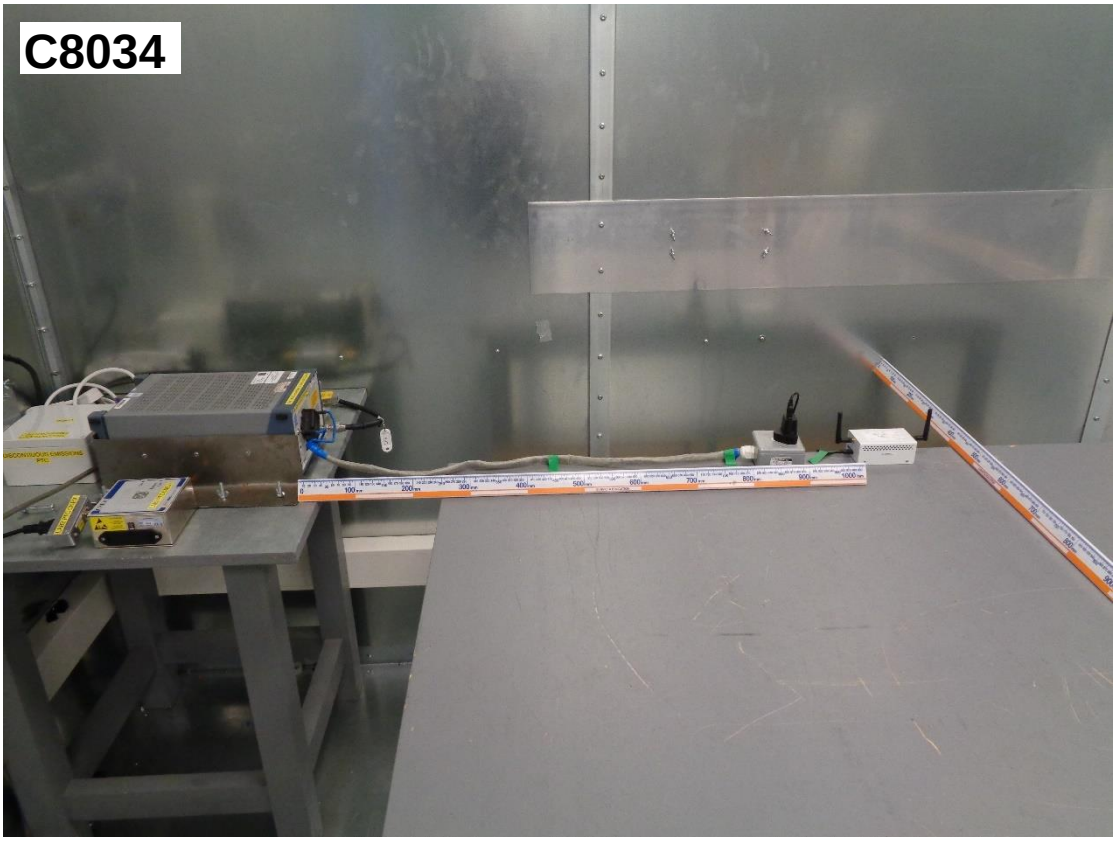


Photo 4: AC Mains Conducted Emissions, 150kHz to 30MHz

Appendix B Test Equipment List

Radiated Emissions Equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Laboratory 1 Semi-Anechoic Chamber	Lab 1	06/12/2022 (NSA) (Svswr)	36 Months
ETS Lindgren 2017B Mast (1 – 4m) with tilting mechanism	--	N/A	N/A
Rohde & Schwarz ESR 26	101464	8th August 2023	12 Months
Schwarzbeck STLP9148 Stacked log periodic Antenna	179	12th April 2022	36 Months
Teseq CBL6112D Bilog Antenna	49040	15th July 2021	36 Months
HF 31 Cable	19148_06_13_002	30th November 2022	12 Months
HF 27 Cable	19149.03.13.004	30th November 2022	12 Months
HF35 Cable	19149.02.13.003	30th November 2022	12 Months
Schwarzbeck STLP9148 Stacked log periodic Antenna	179	12th April 2022	36 Months
BONN BLMA 0118-M Preamplifier (C0702)	2213986	7th July 2023	12 Months
Micro-Tronics 2.4GHz band reject filter	C0473	17th January 2022	12 Months
Kikusui PCR2000M power supply	--	N/A	N/A

AC Mains conducted emissions equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Rohde & Schwarz ESR7 Test receiver	C0449	6th April 2023	12 Months
Cables J7, J9 and LF3	-	1st December 2022	12 Months
Rohde & Schwarz ESH3-Z5 LISN 78119	78119	17th January 2022	24 Months
Teseq CFL 9206A transient limiter 10dB 9kHz - 30MHz	C0282	1st December 2022	12 Months
FCC Mains extension	C0448	17th January 2022	24 Months
Kikusui PCR2000M power supply	-	-	-

----------END OF REPORT----------