Test Report for the Testing of a Qubi 3 Model H to the FCC Rules For QED Advanced Systems Ltd

Test Report number 12774TR1

Project number C3936

Author: ....
M Render BSc, PhD, MIET
Senior Engineer

Checked: .....
C Greenfield BEng (Hons), Laboratory Business Manager

Approved: .....
Dr. D. Bozec, BSc(Hons), PhD, MBA, CEng, MIET
Laboratories Director

Issue	Description						Issue by	Date
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Issue	Date	Modification Details
1	3rd May 2018	Original issue of test report
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Section 1 Test Location

All testing was performed at;

Eurofins York Ltd	Unit 5
	Speedwell Road
	Castleford
	WF10 5PY
Tel:	01977 731173
Tests performed by	Mark Render, Senior Engineer
Website	http://www.yorkemc.co.uk
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 latest accreditation schedule can be found at:

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

Eurofins York Castleford Laboratory (formerly York EMC Services), is an Accredited facility recognised by the Federal Communications Commission (FCC) for certification testing. The appropriate FCC Designation Number is number is UK0022, dated 5th September 2017.

Section 2 Customer Information

Company name	QED Advanced Systems Ltd
Address	The Hive
	Beaufighter Road
	Weston-super-Mare
	Somerset
	BS24 8EE
Tel:	44 (0)1934 836960
Contact	Ian Fisher
Email	andy.fisher@qedas.com
Customer Representative(s) present during testing	Ian Fisher

Section 3 Equipment Details

3.1 Equipment Under Test (EUT)

Date received:	5th April 2018
EUT name:	Qubi 3 Model H
Type/Part no:	Qubi 3 Model H
Serial no/s:	Q3H100001
EUT description:	Device Overview The device is a microprocessor based unit with a compiled 'C' based operating system for indicating the status of bookable workspaces as well as providing an interactive capability to book the space, check-in to a pre-booked space, extend a booking in progress and check-out of the session early. The device connects via WiFi to either an on-premise or cloud based server using HTTP or HTTPS commands for status updates every 60 seconds or on-demand in the event of an interactive action from the touch pads or RFID reader(s). Power is supplied via a standard Micro USB port and this port can also be used to initially configure the settings in terms of WiFi parameters and host server. There are 2 options for RFID frequency depending on the end users' existing RFID standard in use i.e. LF 125 kHz and HF 13.56 MHz. These are only selectable individually through the device setup process. Other circuit functions are; LEDS - these indicate the workspace status with Red (Busy), Green (Free), Amber (Check-In) and Blue (start-up or connecting to server for interactive access) OLED display - this is a black and white pixel based OLED technology module for communicating workspace session details, name of workspace, WiFi signal, time and options for interactive access. Speaker - Used to confirm card and touch pad actions Touch Pads - Consist of 3 capacitive touch pads for initiating interactive actions Other devices not in current use include - Microphone, Wireless Receiver, PIR and 3-axis motion sensor. Antenna's There are 2 PCB tracked antenna's for the WiFi module and 13.56 MHz. The LF RFID module uses the manufacturers on-board antenna. See separate antenna document for full details. Ground System The PCB tracking includes a variety of ground planes as required.

No of units tested:	One										
EUT power:	120	V	60	Hz					Single phase		
Highest internal frequency:	40MHz										
Cables:	Cable 1		3	m		Unscreened			USB to mains adapter		
Size of EUT (m)	L:	12cm		W:	11cm		H:	1cm			
Tested as	Table top										
Mode/s of operation	Transmitting modulated 13.56MHz near field communication signal.										
	Transmitting unmodulated 13.56MHz near field communication signal										
Hardware Version	Issue 5										
Software Version	V1.11.00										
Client modification statement:	Not applicable										
Modifications incorporated during testing:	No modifications were applied										

Radio Module(s)

Module	**Frequency Range (MHz)**	**FCC Status**	**FCC ID**
Mifare/NFC 13.56 MHz RFID	13.56	Not certified	TBC
Elatec low power communications device	0.125	Single modular authorisation	WP5TWN4F4
Silicon Laboratories Pty Ltd, Digital transmission system	2412.0-2462.0	Limited single modular	2ABPY-5B9198

3.2 EUT Photos

Photographs are not included in this test report and are supplied separately.

3.3 Configuration of EUT

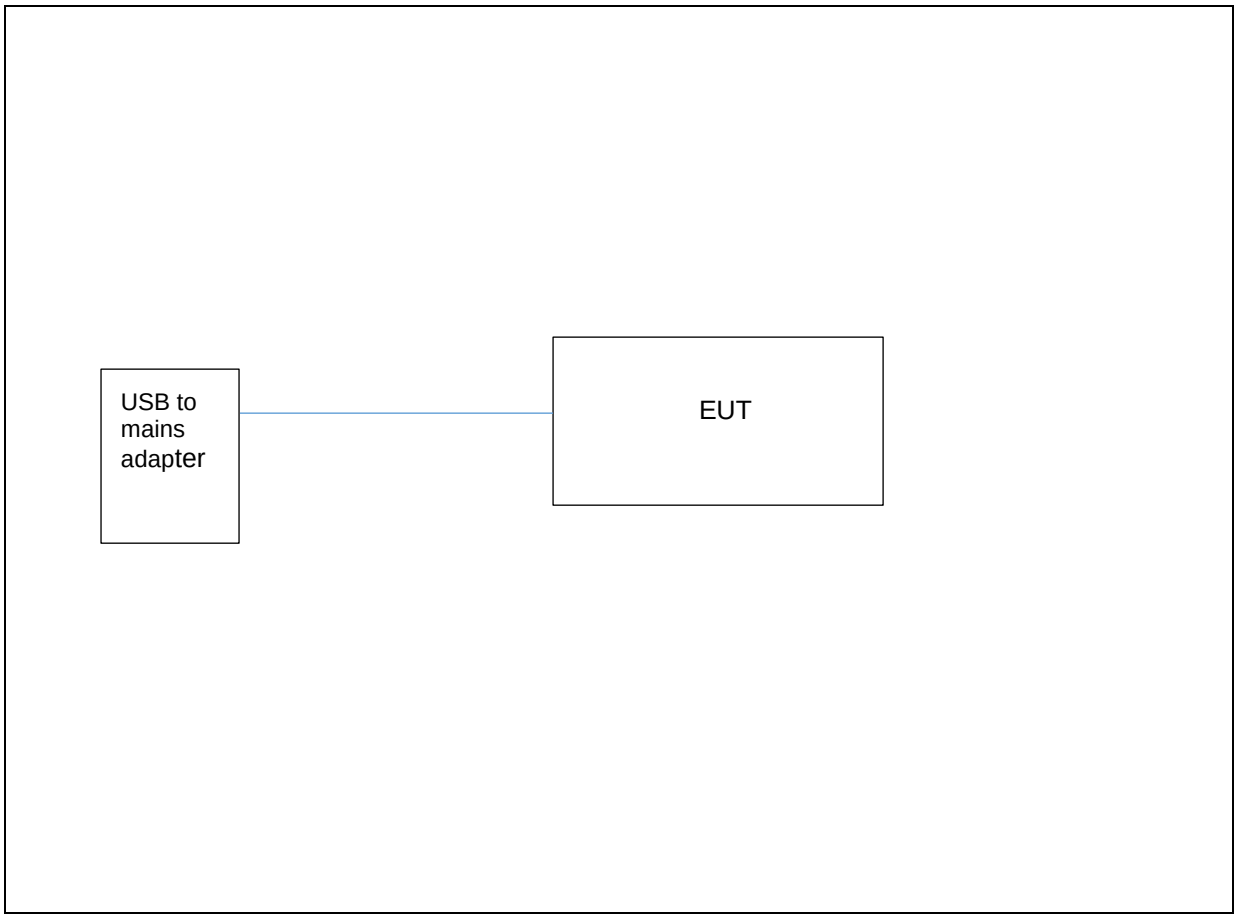


Figure 1: Diagram of EUT.

The apparatus contains the radio modules listed in table above in Section 3.1.

3.4 EUT Monitoring/Auxiliary Equipment

None.

Section 4 Test Summary

The tests were performed in accordance with Eurofins York Quotation QuC3936.

Test Standard	Relevant Section	Class/limit	Test Order	
CFR 47 Part 15C & ANSI C63.10-2013	Section 15.225(a) Field strength within the band 13.553MHz-13.567MHz	As specified in Section 15.225(a)	1	Pass
	Section 15.225(a) Field strength within the bands 13.410MHz-13.552MHz and 13.567MHz to 13.710MHz	As specified in Section 15.225(b)	2	Pass
	15.225(b) Field strength within the bands 13.110MHz-13.410MHz and 13.710MHz to 14.010MHz	As specified in Section 15.225(c)	3	Pass
	Section 15.225(d) Field Strength outside the band 13.110MHz-14.010MHz	As specified in Section 15.209	4	Pass
	Section 15.225(e) Frequency tolerance of the carrier signal	As specified in Section 15.225(e)	5	Pass
	Section 15.31(e) Field strength variation with operating voltage	As specified in Section 15.31(e)	7	Pass
	15.215 (c) 20dB bandwidth	As specified in Section 15.215 (c)	8	Pass
	Section 15.207 Mains conducted emissions	As specified in Section 15.207(a) Test not applicable	6	Pass

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

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

4.1 Knowledge Database References

The following KDBs were referenced during the testing of the: Qubi 3 Model H

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 (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)

913591	Measurement of radiated emissions at the band-edge for a Part 15 RF Device	04/05/2017

4.2 Compliance Statement

The Qubi 3 Model H as tested, was shown to meet requirements of the tests 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 +/- 3.31dB

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

EurofinsYork test procedure	CEP19 Issue 2
Test software	RadiMation Version 2016.1.6

5.4.1 Date of Test

5th April 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 a known impedance was presented to the EUT

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

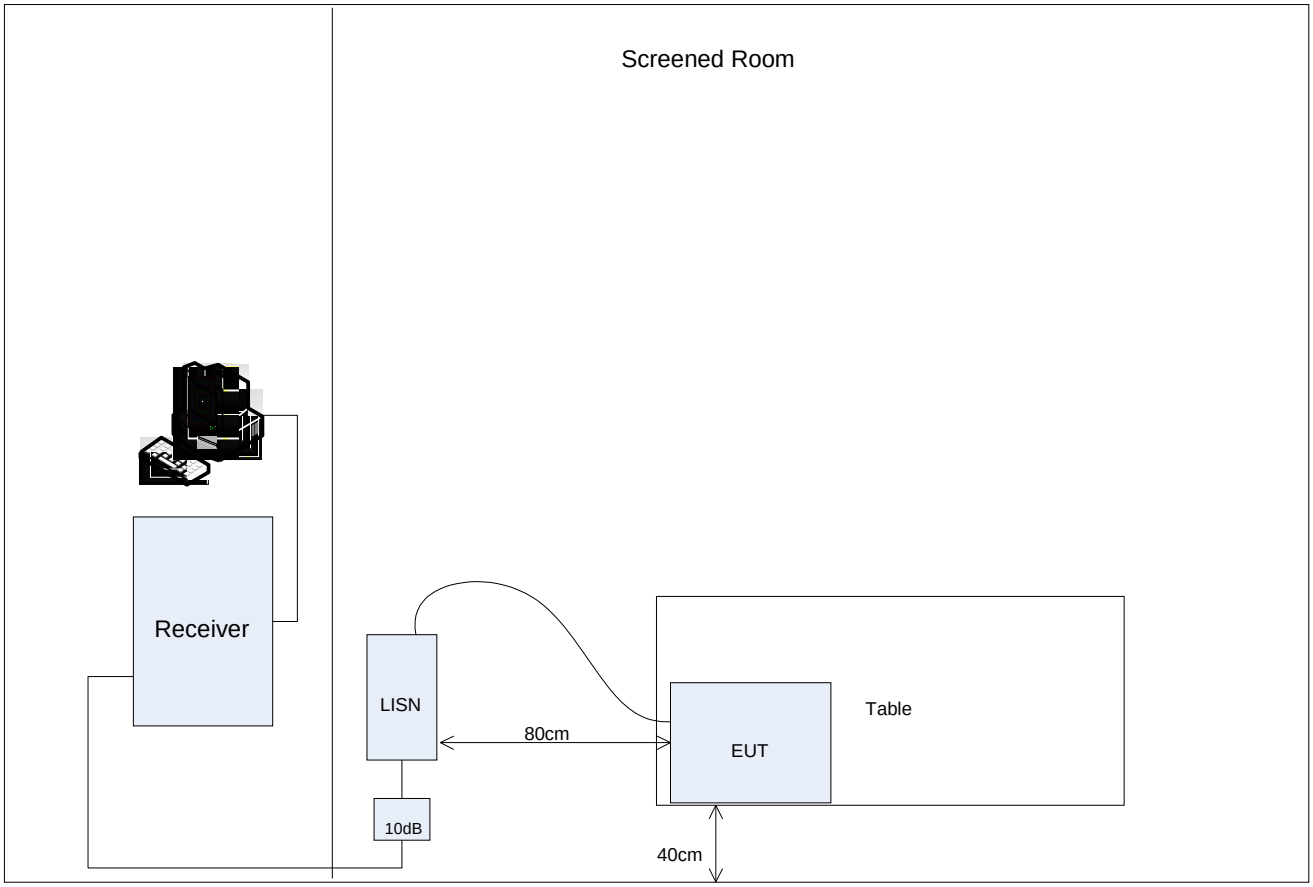


Figure 2: Test setup for Conducted Emissions on the AC power port

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

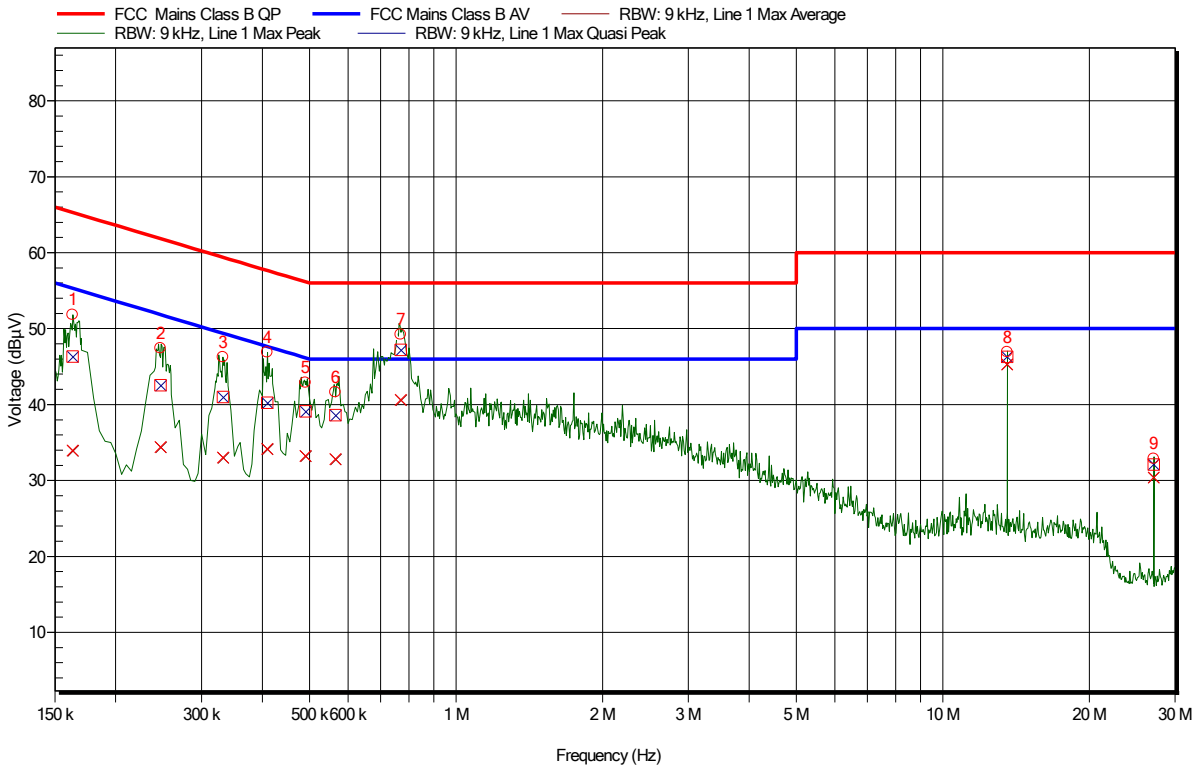


Figure 3: Conducted Emissions Plot - Input Power 120V 60Hz Live

Frequency MHz	Average dBµV	Average Limit dBµV	Average Difference dB	Average Correction dB	Average Status dB	Quasi-Peak dBµV	Quasi-Peak Limit dBµV	Quasi-Peak Difference dB	Quasi-Peak Correction dB	Quasi-Peak Status	Overall Status
0.163	34 0	55.3	-21.34	10 0	Pass	46.3	65.3	-19 0	10 0	Pass	Pass
0.247	34.4	51.9	-17.46	10 0	Pass	42.6	61.9	-19.29	10 0	Pass	Pass
0.332	33 0	49.4	-16.38	10 0	Pass	41 0	59.4	-18.41	10 0	Pass	Pass
0.770	40.6	46 0	-5.38	10 0	Pass	47.2	56 0	-8.8 dB	10 0	Pass	Pass
0.409	34.2	47.7	-13.48	10 0	Pass	40.3	57.7	-17.39	10 0	Pass	Pass
0.565	32.8	46 0	-13.2	10.1	Pass	38.6	56 .0	-17.4	10.1	Pass	Pass
0.490	33.2	46.2	-12.93	10.1	Pass	39.1	56.2	-17.04	10.1	Pass	Pass
13.560	45.3	50 0	-4.72	11.0	Pass	46.3	60 0	-13.7	11 0	Pass	Pass
27.119	30.4	50 0	-19.62	11.6	Pass	32.1	60 0	-27.9	11.6	Pass	Pass

Table 1: Input Power Live Conducted Emissions Peaks

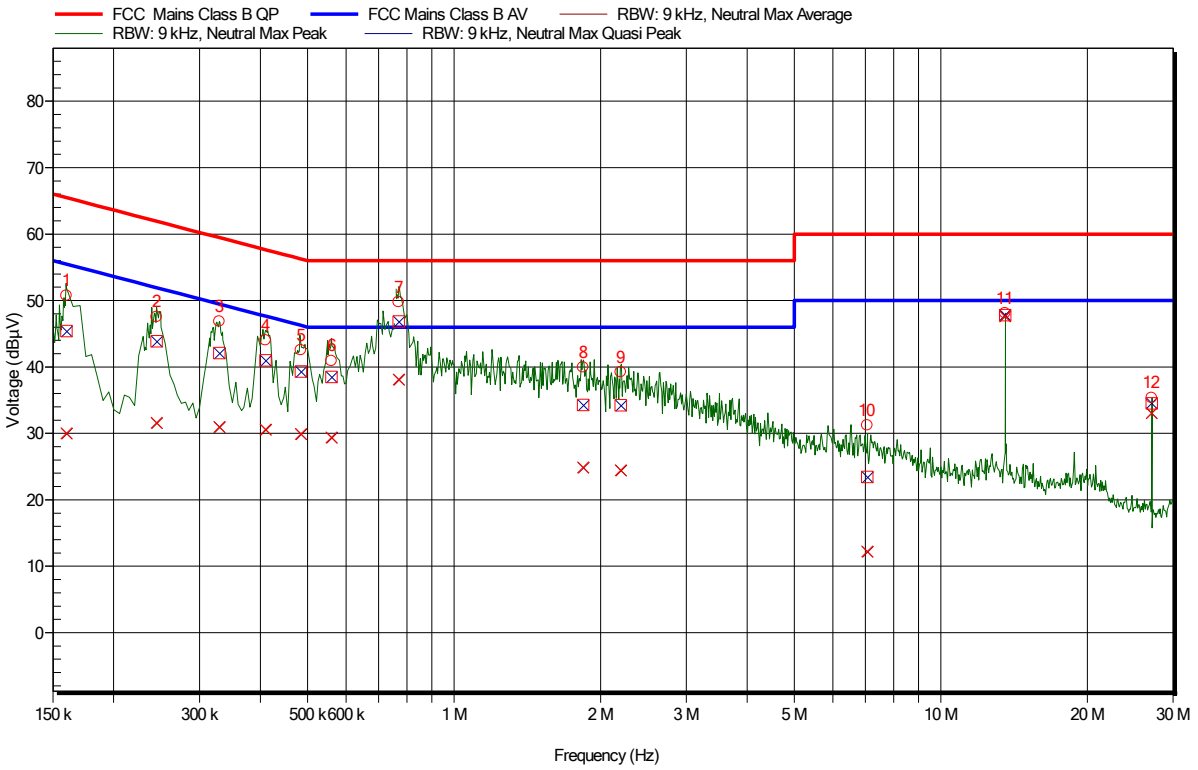


Figure 4: Conducted Emissions Plot - Input Power 120V 60Hz Neutral

Frequency MHz	Average dBµV	Average Limit dBµV	Average Difference dB	Average Correction dB	Average Status dB	Quasi-Peak dBµV	Quasi-Peak Limit dBµV	Quasi-Peak Difference dB	Quasi-Peak Correction dB	Quasi-Peak Status	Overall Status
0.160	30 0	55.5	-25.45	10 0	Pass	45.4	65.5	-20.07	10 0	Pass	Pass
0.245z	31.6	51.9	-20.3	10.0	Pass	43.9	61.9	-18.07	10.0	Pass	Pass
0.3295	30.9	49.5	-18.51	10 .0	Pass	42.1	59.5	-17.39	10 .0	Pass	Pass
0.770	38.1	46 0	-7.9	10.0	Pass	46.9	56.0	-9.14	10.0	Pass	Pass
0.410z	30.6	47.6	-17.08	10 .0	Pass	41.0	57.6	-16.65	10 .0	Pass	Pass
0.560	29.4	46 0	-16.6	10.1	Pass	38.5	56.0	-17.51	10.1	Pass	Pass
0.485z	29.9	46.3	-16.34	10.1	Pass	39.3	56.3	-16.94	10.1	Pass	Pass
7.055	12.2	50 0	-37.79	10.5	Pass	23.4	60.0	-36.58	10.5	Pass	Pass
13.56	47.6	50 0	-2.38	11 .0	Pass	47.8 d	60.0	-12.2	11 .0	Pass	Pass
27.119	33 0	50 0	-16.96	11.6	Pass	34.5	60.0	-25.5	11.6	Pass	Pass

Table 2: Input Power 120V 60Hz Neutral Conducted Emissions Peaks

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 Live conductor Quasi-Peak level at 13.56MHz MHz

ASL (dBµV) = 35.3dBµV + 0.56dB + 0.3dB + 10.17(dB) = 46.3 (dBµV)

Section 6 Radiated Emission Results

6.1 Test Specification

FCC Rule	47CFR 15.225 Operation in the band 13.110-14.010MHz
Test 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 +/- 4.27dB for the frequency range from 9kHz to 30MHz +/- 5.81dB for the frequency range 30MHz to 1GHz +/- 4.64dB for the frequency range from 1GHz to 6GHz +/- 4.96dB for the frequency range from 6GHz to 18GHz +/- 4.77dB for the frequency range from 18GHz to 40GHz

6.2 Procedure and Test Software Version

Eurofins York Test procedure (9kHz to 30MHz)	CEP22 Issue 2
Eurofins York test procedure (30MHz to 1GHz)	CEP23b Issue 2
Eurofins York test procedure (1GHz to 40GHz)	CEP64b Issue 2
Test software	RadiMation Version 2016.2.8 Keysight Connection Expert software Excel

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

6.3.1 Limits

Frequency	Limits (dBµV/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: FCC 47 CFR Part 15 Section 15.209 has different test limits from 300m to 30m depending upon the measurement frequency range. The measured was adjusted for a measurement distance of 3m.
Distance Correction Factor = 40log(test distance /specific distance).

6.3.2 Receiver Settings

Receiver Parameters	Setting
Detector Function	Peak
Start Frequency	9kHz
Stop Frequency	150Hz
Resolution Bandwidth	200Hz
Video Bandwidth	Auto

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

6.3.3 Emissions measurements

6.3.4 Date of Test

5th April 2018

6.3.5 Test Area

LAB 1 (SAC)

6.3.6 SAC Test Setup

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

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

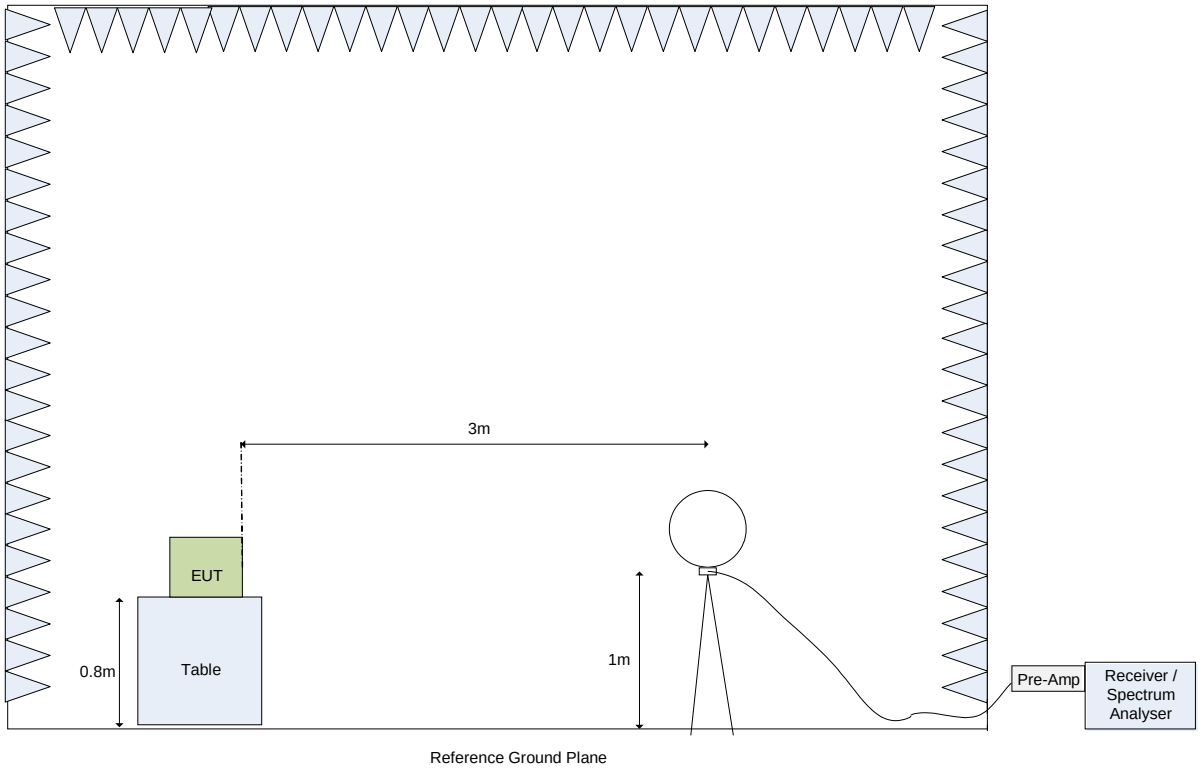


Figure 5: Test Setup for H-Field Measurements from 9kHz to 30MHz

Note 1 : With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement 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 Magnetic field emissions,13.110MHz to 14.010MHz

The field strength is split into sub-bands as defined below in Section 47CFR 15.225:

a) Section 15.225(a) Field strength within the band 13.553MHz-13.567MHz

Limit: 15848μV/m at 30m = 84dBμV/m at 30m

b) Section 15.225(b) Field strength within the bands 13.410MHz-13.552MHz and 13.567MHz to 13.710MHz

Limit: 3348μV/m at 30m = 50.5dBμV/m at 3m

c) Section 15.225(c) Field strength within the bands 13.110MHz-13.410MHz and 13.710MHz to 14.010MHz

Limit: 106μV/m at 30m = 40.5dBμV/m at 3m

The results of peak detector max-hold emission measurements are presented below. The measurements were taken using an SAC as initial measurements.

Measurements were performed at a 3m measurement distance.
The detector used was a peak detector.

For measurements in the band 0.009MHz to 0.490MHz the specified measurement distance is 300m. The distance correction will be:

Correction = 40*log (3/300) = -80dB

For measurements in the band 0.490MHz to 30MHz the specified measurement distance is 30m. The distance correction will be:

Correction = 40*log (3/30) = -40dB

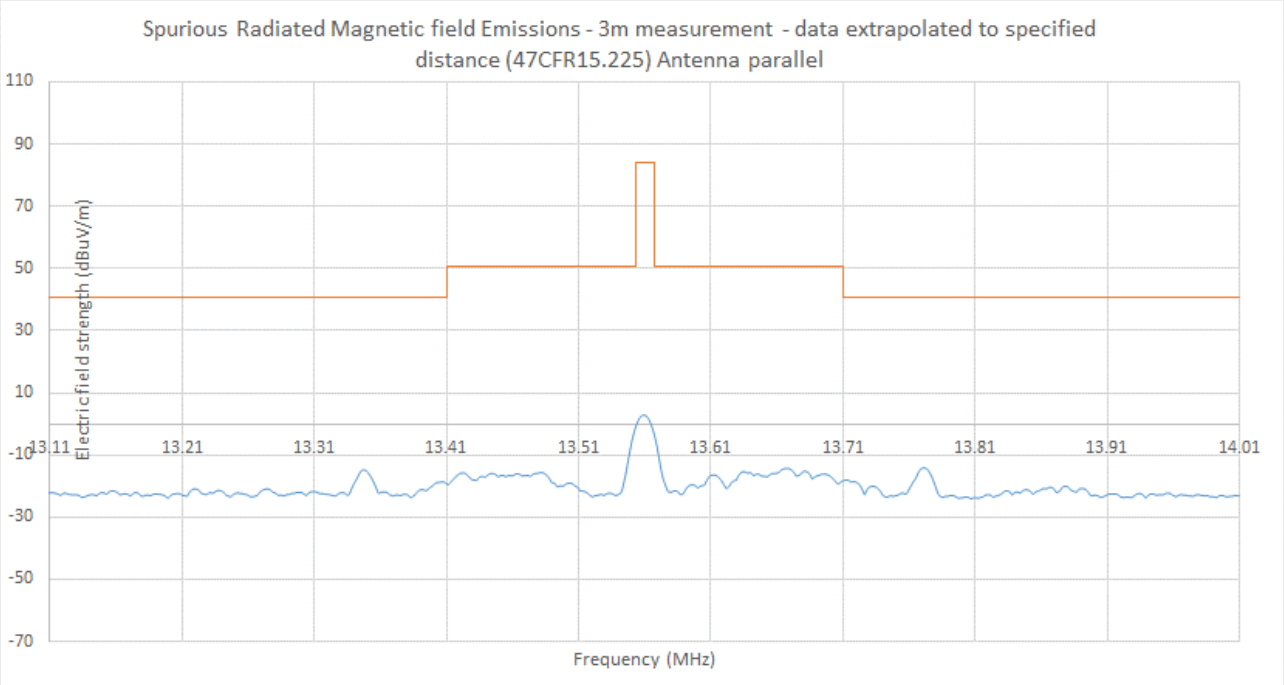


Figure 6: Magnetic field emissions Plot, Parallel

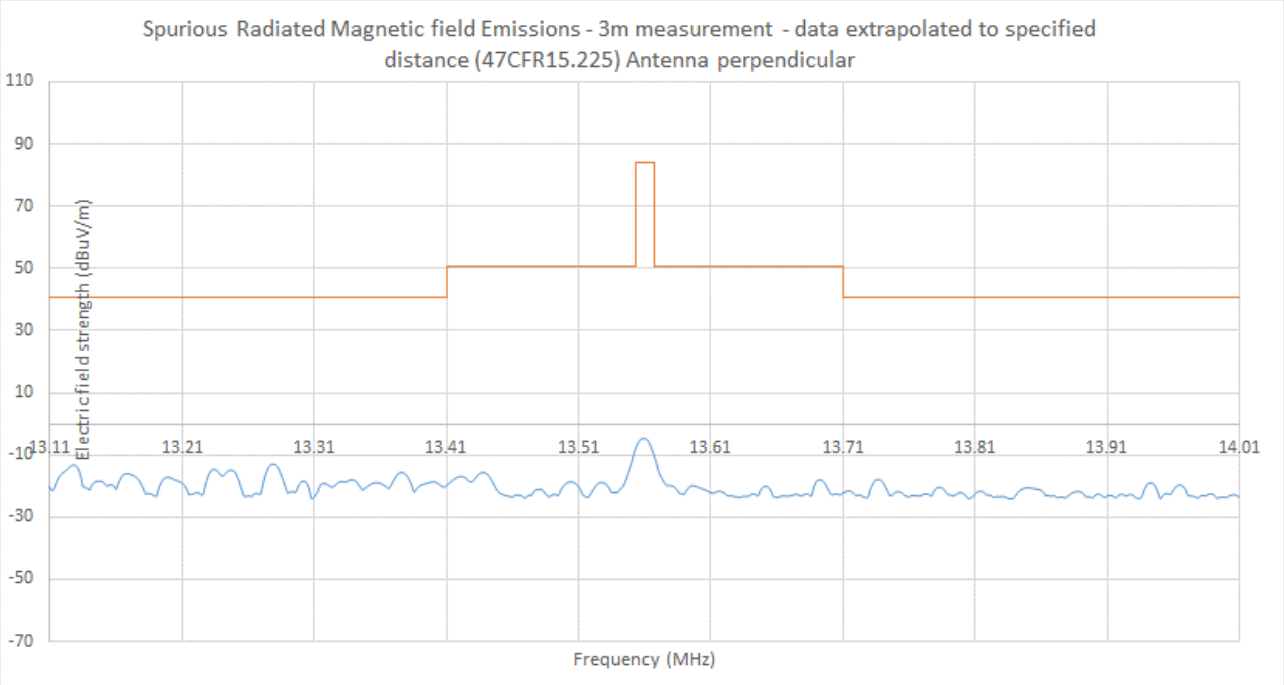


Figure 7: Magnetic field emissions Plot, 9kHz to 30MHz Perpendicular

Freq (MHz)	Rx (dBμV)	Pre-amp (dB)	Antenna factor dB/m	Distance correction factor (40dB/decade)	Result at 30m (dBμV/m)	Limit At 30m (dBμV/m)	Margin (dB)	Result
13.11	14.9	-29.6	32.7	-40	-22.0	40.5	-62.5	Below limit
13.41	17.4	-29.6	32.7	-40	-19.5	40.5	-60.0	Below limit
13.56	36.9	-29.6	32.7	-40	2.8	84.0	-81.2	Below limit
13.71	19.0	-29.6	32.7	-40	-17.9	40.5	-58.4	Below limit
13.89	14.1	-29.6	32.7	-40	-22.8	40.5	-17.7	Below limit
14.01	13.9	-29.6	32.7	-40	-23.0	40.5	-63.5	Below limit

Table 3.2.2 Receiving antenna at 1m measurement height – Parallel orientation

Freq (MHz)	Rx (dBμV)	Pre-amp (dB)	Antenna factor dB/m	Distance correction factor (40dB/decade)	Result at 30m (dBμV/m)	Limit At 30m (dBμV/m)	Margin (dB)	Result
13.11	16.6	-29.6	32.7	-40	-20.3	40.5.	-60.8	Below limit
13.41	17.5	-29.6	32.7	-40	-19.2	40.5	-59.7	Below limit
13.56	32.3	-29.6	32.7	-40	-4.6	84.0	-79.4	Below limit
13.71	14.8	-29.6	32.7	-40	-22.1	40.5	-62.6	Below limit
13.89	13.9	-29.6	32.7	-40	-23.0	40.5	-61.5	Below limit
14.01	13.41	-29.6	32.7	-40	-23.49	40.5	-64.0	Below limit

Table 3.2.2 Receiving antenna at 1m measurement height – Perpendicular orientation

Rx = Test receiver reading (voltage dBμV) before the addition of cable loss and antenna factor.

CL = total cable loss between antenna and test receiver (dB)

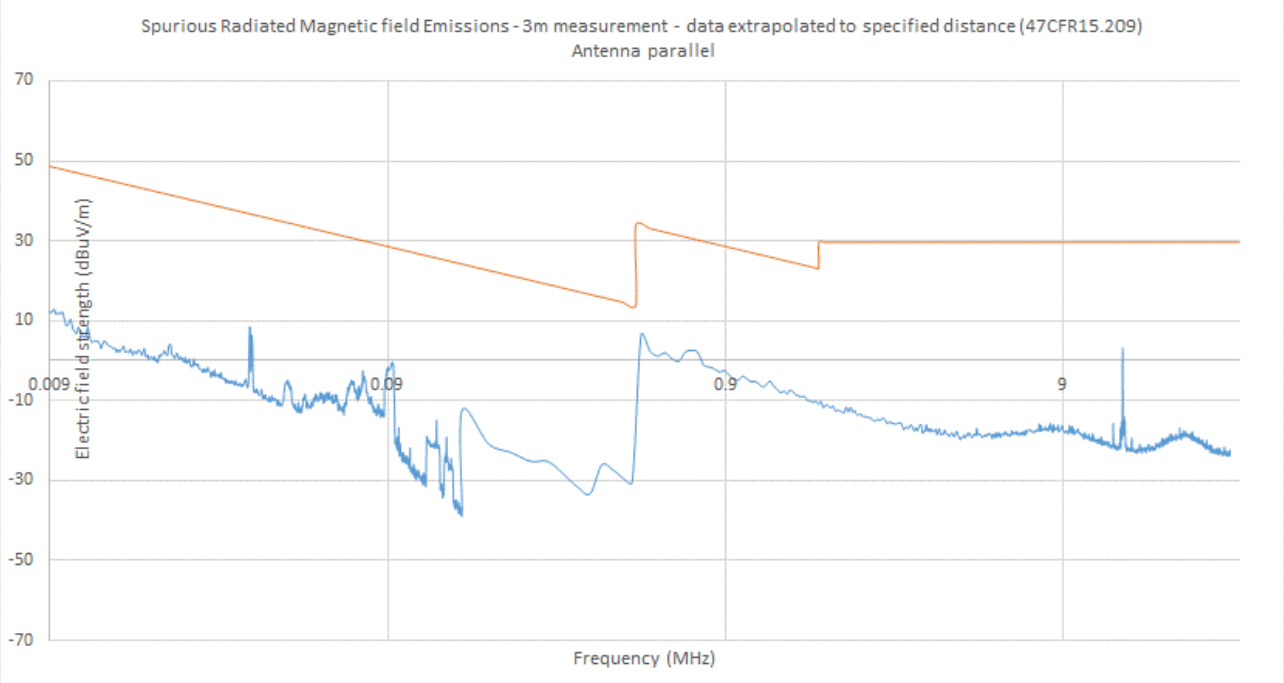
Result at 10m = Field strength (dBμV/m) at a measurement distance of 10m, calculated as follows:

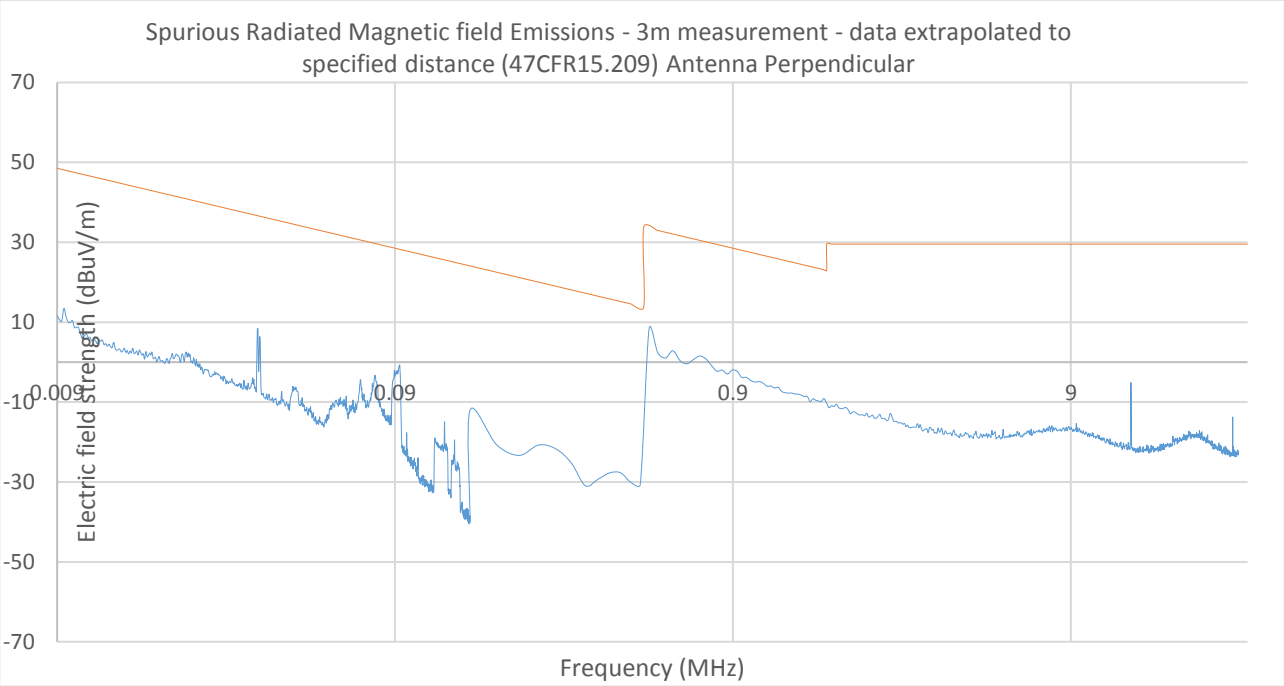
Field strength (dBμV/m) = Rx (dBmV) + Antenna factor (dB/m)

No radiated spurious emissions were detected from the product other than the carrier (13.56MHz). The above representative noise floor emissions were taken.

6.3.8 Magnetic field emissions,9kHz to 30MHz and outside the band 13.110MHz to 14.010MHz

The results of peak detector max-hold emission measurements are presented below. The measurements were taken using an SAC as initial measurements.





Freq (MHz)	Rx (dBμV)	Pre-amp (dB)	Antenna factor dB/m	Distance correction factor (40dB/decade)	Result at 30m (dBμV/m)	Limit At 30m (dBμV/m)	Margin (dB)	Result
0.090	39.8	29.8	67.6	-80	-2.4	28.5	-30.9	Below limit
0.150	9.6	29.7	63	-80	-37.1	24.1	-61.2	Below limit
0.508	23.5	29.7	52.5	-40	6.3	33.5	-27.2	Below limit
1.016	19.1	29.7	46.7	-40	-3.9	27.5	-31.4	Below limit
10.836	17.2	29.6	33.1	-40	-19.3	29.5	-48.8	Below limit
20.000	20.7	29.6	32.1	-40	-16.8	29.5	-46.3	Below limit

Table 3.2.2 Receiving antenna at 1m measurement height, Antenna parallel

Freq (MHz)	Rx (dBμV)	Pre-amp (dB)	Antenna factor dB/m	Distance correction factor (40dB/decade)	Result at 30m (dBμV/m)	Limit At 30m (dBμV/m)	Margin (dB)	Result
0.09	39.7	29.8	67.6	-80	-2.5	28.5	-31	Below limit
0.15	8.4	29.7	63	-80	-38.3	24.1	-62.4	Below limit
0.5082	25.5	29.7	52.5	-40	8.3	33.5	-25.2	Below limit
1.01565	18.4	29.7	46.7	-40	-4.6	27.5	-32.1	Below limit
10.8363	18.2	29.6	33.1	-40	-18.3	29.5	-47.8	Below limit
20.0002	19	29.6	32.1	-40	-18.5	29.5	-48	Below limit

Table 3.2.2 Receiving antenna at 1m measurement height. Antenna perpendicular

No radiated spurious emissions were detected from the product other than the carrier (13.56MHz). The above representative noise floor emissions were taken.

Rx = Test receiver reading (voltage dBμV) before the addition of cable loss and antenna factor.

Result at 30m is calculated form a field strength (dBμV/m) at a measurement distance of 3m, as follows:

Field strength (dBμV/m) = Rx (dBμV) – pre amplifier gain (dB) + Extrapolation (dB) + Antenna factor (dB/m)

6.3.9 Sample Data

Example:

At 20MHz

At 3m field strength = receiver reading (20.7dBuV)

-pre amplifier gain (29.6)

+ Antenna factor (32.1dB/m)+ extrapolation (-40dB)

= -16.8dBuV/m

The limit was calculated according to 47CFR15.209 table:

Between 0.009MHz and 0.490MHz

Limit (dBuV/m) at 300m = $20\log_{10}(2400/F)$

Between 0.490MHz and 30MHz

Limit (dBuV/m) at 300m = $20\log_{10}(24000/F)$

Where F is frequency in kHz.

6.4 Radiated Emissions (30MHz to 1GHz)

6.4.1 Limits at 3m

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

Note: FCC 47 CFR Part 15 Section 15.209 specifies test limits at 3m.

6.4.2 Receiver Settings

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

6.4.3 Emissions measurements

6.4.4 Date of Test

5th April 2018

6.4.5 Test Area

LAB 1 (SAC)

6.4.6 Test Setup

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

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.

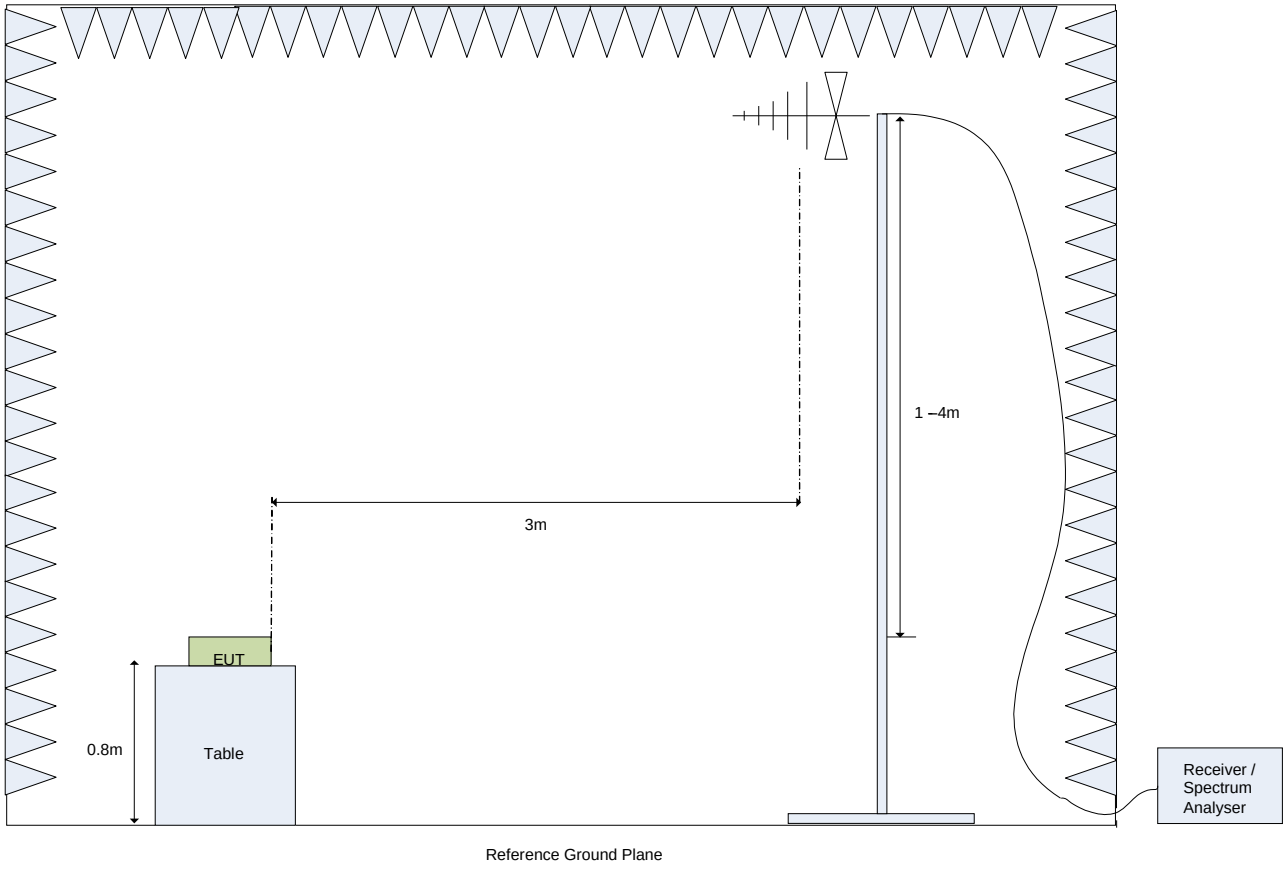


Figure 8: Test Setup for E-Field Measurements from 30MHz to 1GHz

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.

6.4.7 Electric field emissions, 30MHz to 1GHz

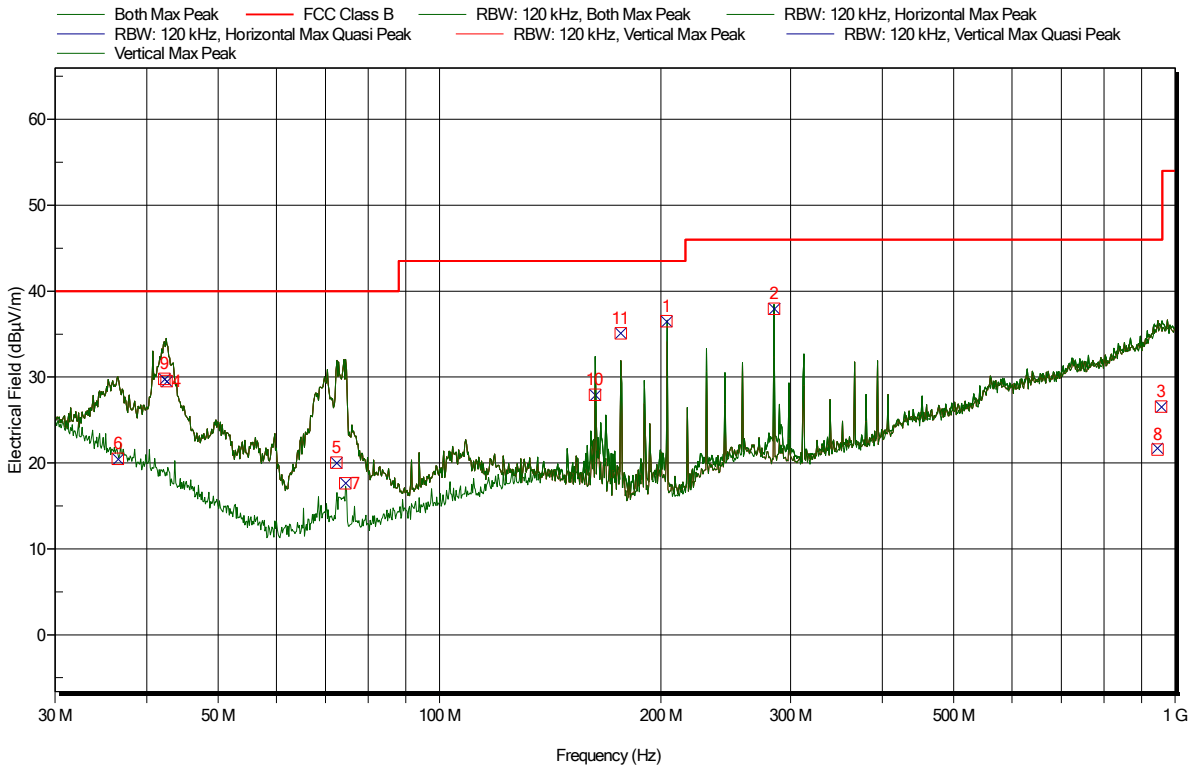


Figure 9: Electric field emissions Plot, 30MHz to 1GHz. Combined horizontal and vertical antenna polarisations

Frequency MHz	Quasi-Peak dBµV/m	Quasi Peak Limit dBµV/m	Quasi-Peak Difference dB	Quasi-Peak Correction dB	Quasi-Peak Status	Angle degrees	Height m	Polarization
36.540	20.5	40	-19.5	22.8	Pass	115	1	Vertical
42.240	29.8	40	-10.2	20.1	Pass	35	1	Vertical
42.540	29.5	40	-10.5	19.9	Pass	310	1	Vertical
72.420	20.0	40	-20	13.6	Pass	195	1.4	Vertical
74.460	17.6	40	-22.4	13.8	Pass	135	1.7	Vertical
162.720	27.9	43.5	-15.6	17.4	Pass	145	1.9	Horizontal
176.280	35.1	43.5	-8.4	16.7	Pass	65	1	Vertical
203.400	36.5	43.5	-7	16.6	Pass	310	1.6	Horizontal
284.760	38.0	46	-8	20.6	Pass	330	1	Horizontal
946.260	21.6	46	-24.4	34.8	Pass	85	3.3	Vertical
956.400	26.6	46	-19.4	34.9	Pass	295	1.4	Horizontal

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

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); Attenuator loss (AL) and Cable loss (CL).

Field strength (FS) is calculated as follows:

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

6.4.9 Sample Data

The Quasi-Peak level at 203.4MHz

FS (dBµV/m) = 19.9(dBmV) + 15.6 (dB/m) +1.0(dB) = 36.5 (dBµV/m)

Section 7 Frequency Stability

FCC Rule	47CFR 15.225 (e) – Frequency tolerance with temperature variation
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 ±1x10^{-8}

±1x10^{-8}

7.1.1 Date of Test

5th April 2018

7.1.2 Test Area

Environmental chamber Asset number: C0412.

7.1.3 Procedure

For frequency stability with respect to supply voltage the procedures of ANSIC63.10 Section 6.8.2 were followed. The measurements were performed at ambient room temperature.

For frequency stability with respect to ambient temperature the procedure of ANSI C63.10 Section 6.8.1 was followed.

7.1.4 Test Results

Supply voltage (V ac)		Frequency (MHz)	Nominal	Deviation	Limit	Result
115% of Nom	138	13.559497	13.56	0.00370944	0.01	Within limit
85% of Nom	102	13.559497	13.56	0.00370944	0.01	Within limit

Frequency stability with supply voltage

Temperature C	Time	Frequency (MH)	Nominal	Deviation %	Limit 47CFR15.225 %	Result
50	Startup	13.559434	13.56	0.004174041	0.01	Within Limit
	2min	13.559432	13.56	0.004188791	0.01	Within Limit
	5min	13.559427	13.56	0.004225664	0.01	Within Limit
	10min	13.559422	13.56	0.004262537	0.01	Within Limit
40	Startup	13.55943	13.56	0.00420354	0.01	Within Limit
	2min	13.559424	13.56	0.004247788	0.01	Within Limit
	5min	13.559423	13.56	0.004255162	0.01	Within Limit
	10min	13.559425	13.56	0.004240413	0.01	Within Limit
30	Startup	13.559428	13.56	0.004218289	0.01	Within Limit
	2min	13.559431	13.56	0.004196165	0.01	Within Limit
	5min	13.559434	13.56	0.004174041	0.01	Within Limit
	10min	13.55944	13.56	0.004129794	0.01	Within Limit
20	Startup	13.559486	13.56	0.00379056	0.01	Within Limit
	2min	13.559482	13.56	0.003820059	0.01	Within Limit
	5min	13.559481	13.56	0.003827434	0.01	Within Limit
	10min	13.559483	13.56	0.003812684	0.01	Within Limit
10	Startup	13.559525	13.56	0.00350295	0.01	Within Limit
	2min	13.559518	13.56	0.003554572	0.01	Within Limit
	5min	13.559517	13.56	0.003561947	0.01	Within Limit
	10min	13.559518	13.56	0.003554572	0.01	Within Limit
0	Startup	13.559523	13.56	0.003517699	0.01	Within Limit
	2min	13.559525	13.56	0.00350295	0.01	Within Limit
	5min	13.55953	13.56	0.003466077	0.01	Within Limit
	10min	13.559539	13.56	0.003399705	0.01	Within Limit
-10	Startup	13.559552	13.56	0.003303835	0.01	Within Limit
	2min	13.559566	13.56	0.00320059	0.01	Within Limit
	5min	13.559569	13.56	0.003178466	0.01	Within Limit
	10min	13.559571	13.56	0.003163717	0.01	Within Limit
-20	Startup	13.55955	13.56	0.003318584	0.01	Within Limit
	2min	13.559661	13.56	0.0025	0.01	Within Limit
	5min	13.559566	13.56	0.00320059	0.01	Within Limit
	10min	13.559567	13.56	0.003193215	0.01	Within Limit

Frequency stability with temperature

Section 8 Variation of field strength with operating voltage

FCC Rule	47CFR 15.31 (e) – Frequency tolerance with temperature variation
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 +/- 4.2dB

8.1.1 Date of Test

11th April 2018

8.1.2 Test Area

Lab 1

8.1.3 Procedure

For field strength respect to supply voltage the procedures of ANSIC63.10 Section 5.13 were followed.

8.1.4 Test Results

Supply voltage (V ac)	Orientation	Freq (MHz)	Rx (dBμV)	Pre-amp (dB)	Antenna factor dB/m	Distance correction factor (40dB/decade)	Result at 30m (dBμV/m)	Limit At 30m (dBμV/m)	Margin (dB)	Result
102	Perp.	13.56	37.0	29.6	32.7	-40	0.1	84.0	-83.9	Below limit
138	Perp.	13.56	35.5	29.6	32.7	-40	-1.4	84.0	-85.4	Below limit
102	Parallel	13.56	37.3	29.6	32.7	-40	0.4	84.0	-83.6	Below limit
138	Parallel	13.56	37.3	29.6	32.7	-40	0.4	84.0	-83.6	Below limit

Rx = Test receiver reading (voltage dBμV) before the addition of cable loss and antenna factor.

Result at 30m is calculated form a field strength (dBμV/m) at a measurement distance of 3m, as follows:

Field strength (dBμV/m) = Rx (dBμV) – pre amplifier gain (dB)+ Extrapolation (dB) + Antenna factor (dB/m)

Section 9 20dB bandwidth

FCC Rule	47CFR 15.215 (c) – 20dB Bandwidth
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 $\pm 1x10^{-8}$

9.1.1 Date of Test

5th April 2018

9.1.2 Test Area

Lab 1

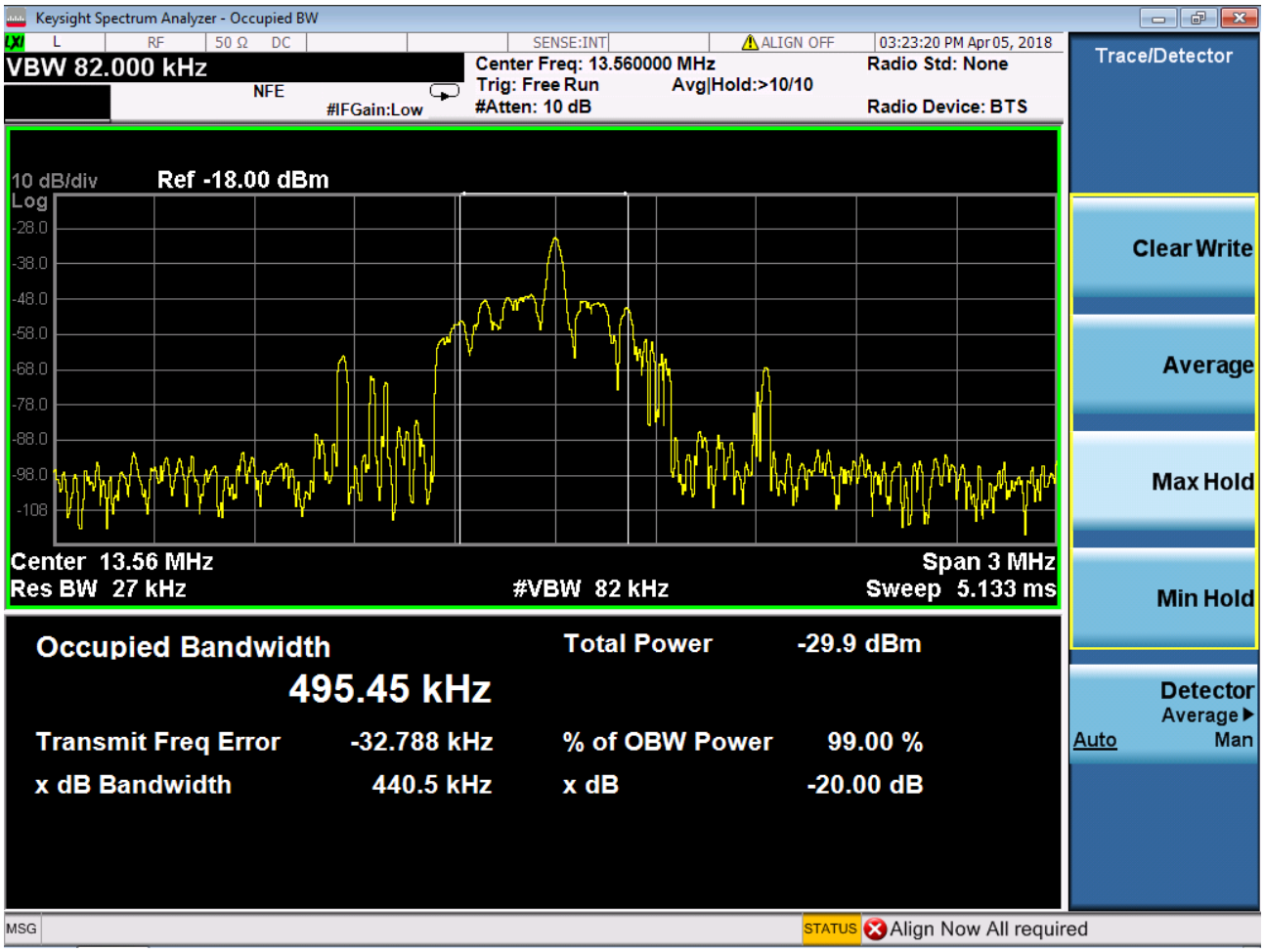
9.1.3 Procedure

For 20dB bandwidth the procedures of ANSIC63.10 Section 6.9.2 were followed.

9.1.4 Test Results

The 20dB bandwidth was measured using the bandwidth function of the signal analyser and the procedures of Clause 6.9.2 of ANSI C63.10-2013.

The measured 20dB bandwidth was 440.5kHz which was contained within the operating band 13.110 to 14.01MHz.



20dB Bandwidth measurement

Appendix A Test Equipment List

Conducted Emissions

Item	Serial No.	Last Calibration Date	Calibration Interval
Keysight MXE EMI Receiver	MY51210185	15/03/2017	15 Months
Rohde & Schwarz ESH3-Z5 plus calibrated mains lead (C0448)	831767/010	26/01/18	12 Months
Cable	LF3	15/052017	12 Months
Cable	J7	15/05/2017/2017	12 Months
Cable	J9	15/05/2017/2017	12 Months
Teseq 10dB Transient limiter	34718	10/05/2017	12 Months

Radiated Emissions Equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Laboratory 1 Semi-Anechoic Chamber	Lab 1	07/12/2016	24 Months
ETS Lindgren 2017B Mast (1 – 4m)	--	N/A	N/A
EMCO Loop antenna 6512	00148043	20/04/2016	24 Months
Chase CPA9231 Pre amplifier	1434	14/02/2017	12 Months
HF18 Cable (For use from 9kHz to 18GHz)	167004-001	15/05/2017	12 Months
Keysight MXE EMI Receiver	MY51210185	15/03/2017	15 Months
Chase CBL6112B Bilog Antenna 78167		16/11/2016	18 Months
HF14 Cable (For use from 9kHz to 18GHz)	167003-001	15/05/2017	12 Months
HF17 Cable (For use from 9kHz to 18GHz)	167002-001	15/05/2017	12 Months