Eurofins York Castleford
Unit 5, Speedwell Road
Castleford, WF10 5PY
United Kingdom
+44 (0) 1977 731173
enquiryyork@eurofins.com
eurofins.co.uk/york

Test Report for the FCC Testing of a Qubi 3C RFID v4 to FCC Rules 47CFR 15.225 and 47CFR 15.209 for QED Advanced Systems

Test Report number: C14978TR1
Project number: C7350

Author: .....
M Render BSc(Hons), PhD, MIET
Senior Test Engineer

Checked: .....
J Beevers MPhys(Hons), PhD
Radio Testing Team Lead

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

Issue	Description						Issue by	Date
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Registered Address:
Eurofins York Ltd
i54 Business Park, Valiant Way
Wolverhampton, WV9 5GB, UK

Registered in England and Wales
Company Reg. No. 6048589
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1	23rd February 2023	First Issue
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Section 1 Test Location

All testing was performed at;

Eurofins York	Unit 5
	Speedwell Road
	Castleford
	WF10 5PY
Tel:	01977 731173
Website	http://www.yorkemc.co.uk
UKAS Testing No.	1574

1.1 UKAS Accreditation

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, 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	QED Advanced Systems
Address	22 Bridgwater Court
	Oldmixon Crescent
	Weston-super-Mare
	BS24 9AY
	United Kingdom
Tel:	+44 (0)1934 836 960
Contact	Ian Fisher
Email	ian.fisher@qedas.com
Customer Representative(s) present during testing	None

Section 3 Equipment Details

3.1 Equipment Under Test (EUT)

Date received:	24th October 2022					
FCC ID	2AB38QUBI3CA					
EUT name:	Qubi 3C RFID v4					
Firmware version	V1.50.1r					
EUT description:	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. Power is supplied via a standard Micro USB port. The unit contains the following radio technologies: RFID 125kHz and 13.56MHz					
Details of radio technology (type, frequency, RF Module)	125kHz RFID and 13.56MHz RFID					
Modulation	Amplitude shift keying					
RF module used	Elatec TWN4 MT3 RFID reader module FCCI D: WPSTWN4F4					
No of units tested:	One					
EUT power:	120	V	60Hz. Tested in combination with a plug-top power supply. Providing power via USB port			
Highest internal frequency:	40MHz					
Cables: **(see section 3.3 for configuration)**	USB (power cable)	2	m	Unscreened	Terminated	
Tested as	Table top					
Mode/s of operation	Continuous transmission of modulated signal at 125kHz and 13.56MHz.					
Client modification statement:	None					
Modifications incorporated during testing:	None					

3.2 EUT Photographs

Photographs are supplied separately.

3.3 Configuration of EUT

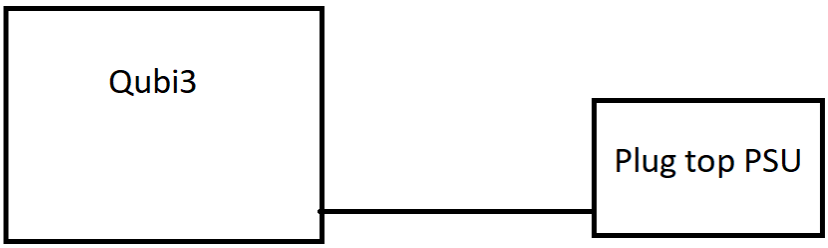

Figure 1 Diagram of EUT.

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

3.4 EUT Monitoring/Auxiliary Equipment

None.

3.5 Monitoring Software

None. The channel required was selected via software prior to the testing.

Section 4Test Specifications

The tests were performed in accordance with Eurofins York Quotation QuC7350

For USA:

Relevant Section	Class/limit	Status
Section 15.225(a) Field strength within the band 13.553MHz-13.567MHz	As specified in Section 15.225(a)	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)	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)	Pass
Section 15.225(d) Field Strength outside the band 13.110MHz-14.010MHz	As specified in Section 15.209	Pass
Section 15.225(d) Field Strength outside the band 13.110MHz-14.010MHz	As specified in Section 15.209	Pass

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

4.1 Knowledge Database References

The following KDBs were referenced during the testing.
The latest knowledge database references are available via the FCC KDB website at:

https://apps.fcc.gov/kdb

4.1.1 Modular Trenamitter Integration Guide Guidance For Host Product Manufacturers

Publication Number	Keyword	Publication Date
996369	Integration of certified modules into a host unit. Section 3.1 states: "Testing of the host product with all the transmitters installed – referred to as the composite investigation test- is recommended, to verify that the host product meets all the applicable FCC rules. The radio spectrum is to be investigated with all the transmitters in the final host product functioning to determine that no emissions exceed the highest limit permitted for any one individual transmitter as required by Section 2.947(f). A formal application for certification submission containing the results of this investigation is not required. The host manufacturer is responsible to ensure that when their product operates as intended it does not have any emissions present that are out of compliance that were not present when the transmitters were tested individually".	13th October 2020

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

4.2 Compliance Statement

The Qubi 3C RFID v4, as tested, was shown to meet requirements of the standards listed in Section 4 of this report.

Section 5 Radiated Emission Results

5.1 Test Specification

FCC Rule Part	47CFR 15.225 Operation in the band 13.110-14.010MHz
Standard	ANSI C63.10:2013
Measurement Uncertainty Radiated tests	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 +/- 5.01dB for the frequency range from 9kHz to 30MHz +/- 6.26dB for the frequency range 30MHz to 1GHz

5.2 Procedure and Test Software Version

Radiated tests:- 47CFR15.205 and 47CFR15.209

Eurofins York Test procedure (9kHz to 30MHz)	CEP22 Issue 8
Eurofins York test procedure (30MHz to 1GHz)	CEP23 Issue 9
Test software	RadiMation Version 2016.2.8

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

5.3.1 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).

5.3.2 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

5.3.3 Emissions measurements

5.3.4 Date of Test

2nd February 2023

5.3.5 Test Area

LAB 1 (SAC)

5.3.6 Tested by

M Render

5.3.7 SAC Test Setup

The EUT was configured in the anechoic chamber AC 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.

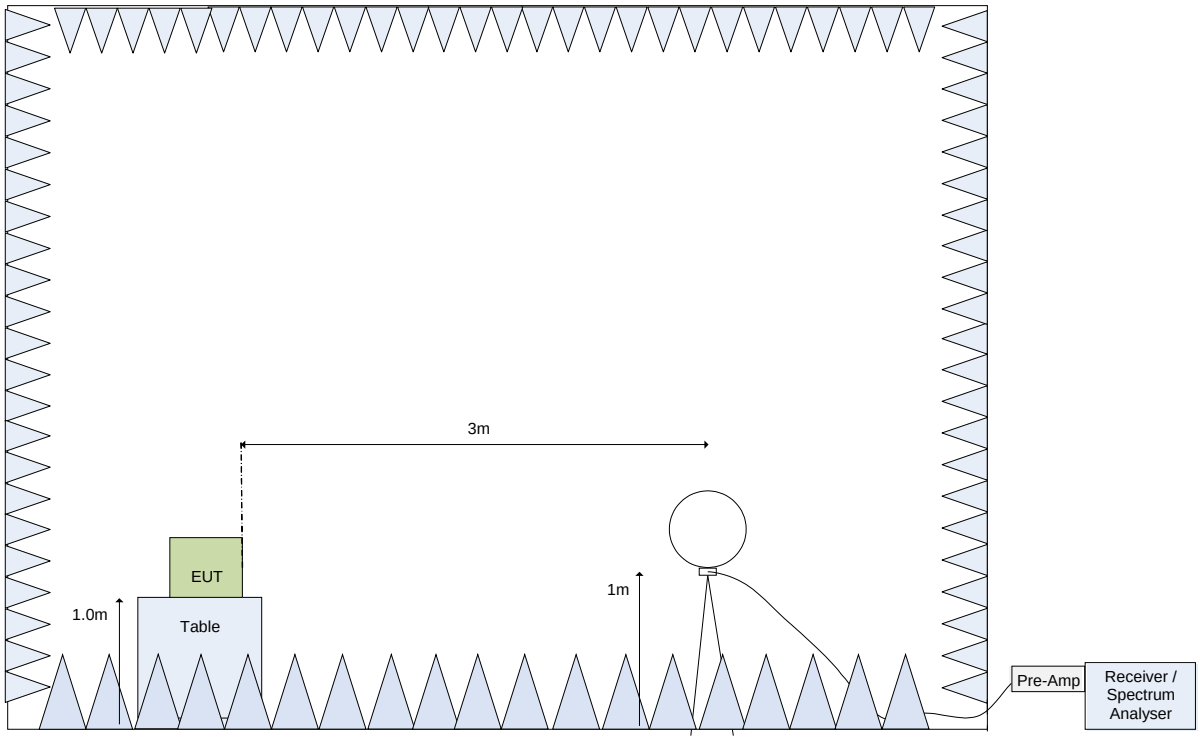

Figure 2: Test Setup for H-Field Measurements from 9kHz to 30MHz

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

5.3.8 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.

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

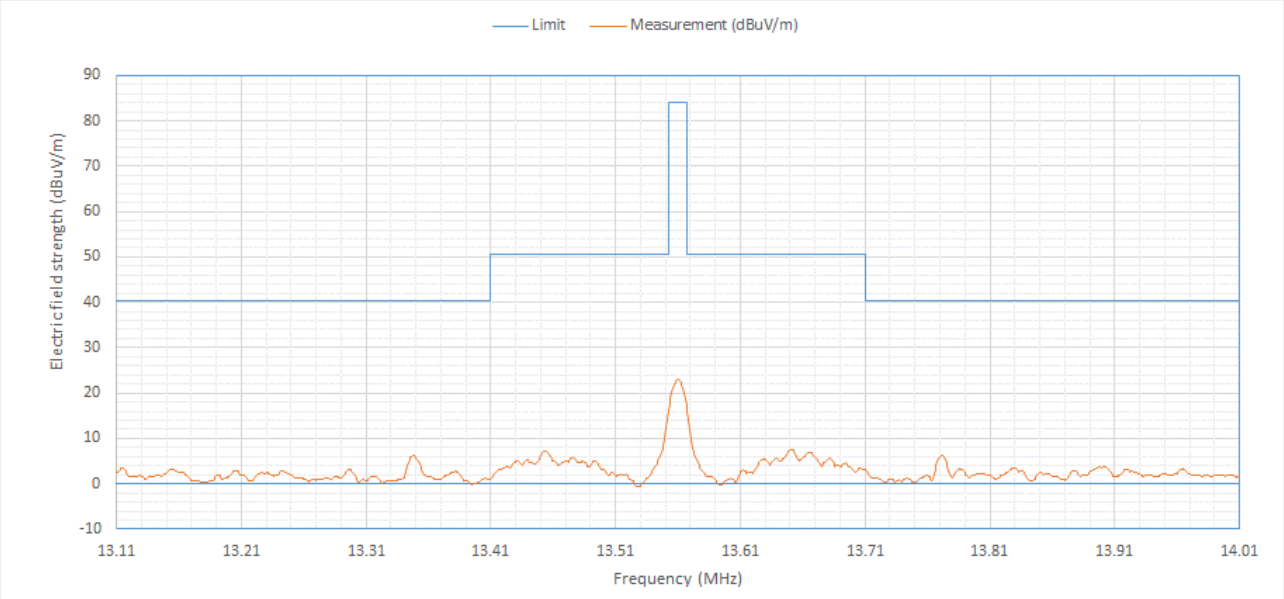

Figure 3 Magnetic field emissions Plot, Parallel

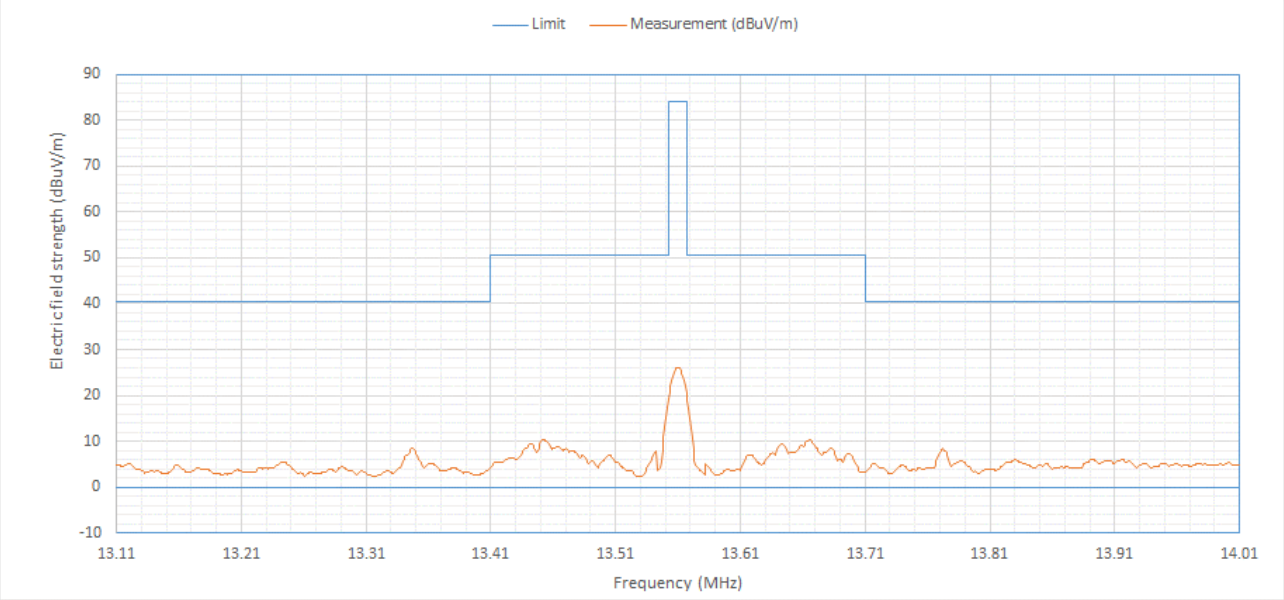

Figure 4 Magnetic field emissions Plot, Perpendicular

5.3.9 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.

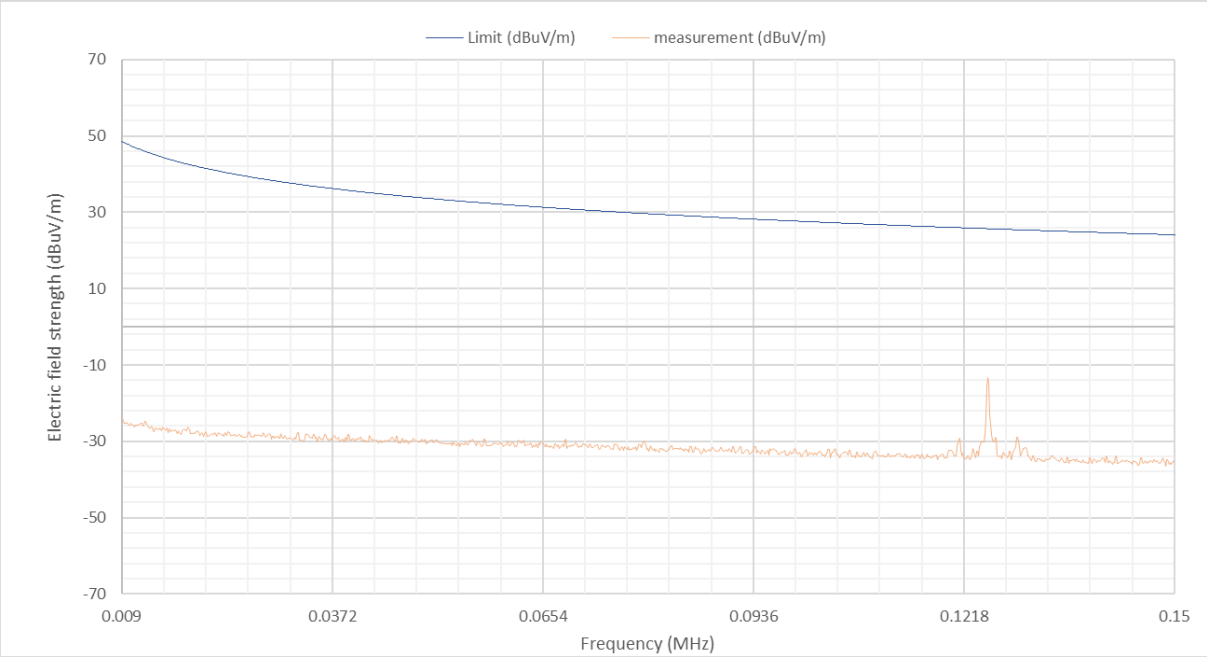

Figure 5 Magnetic field emissions Plot, 9kHz to 150kHz. Parallel

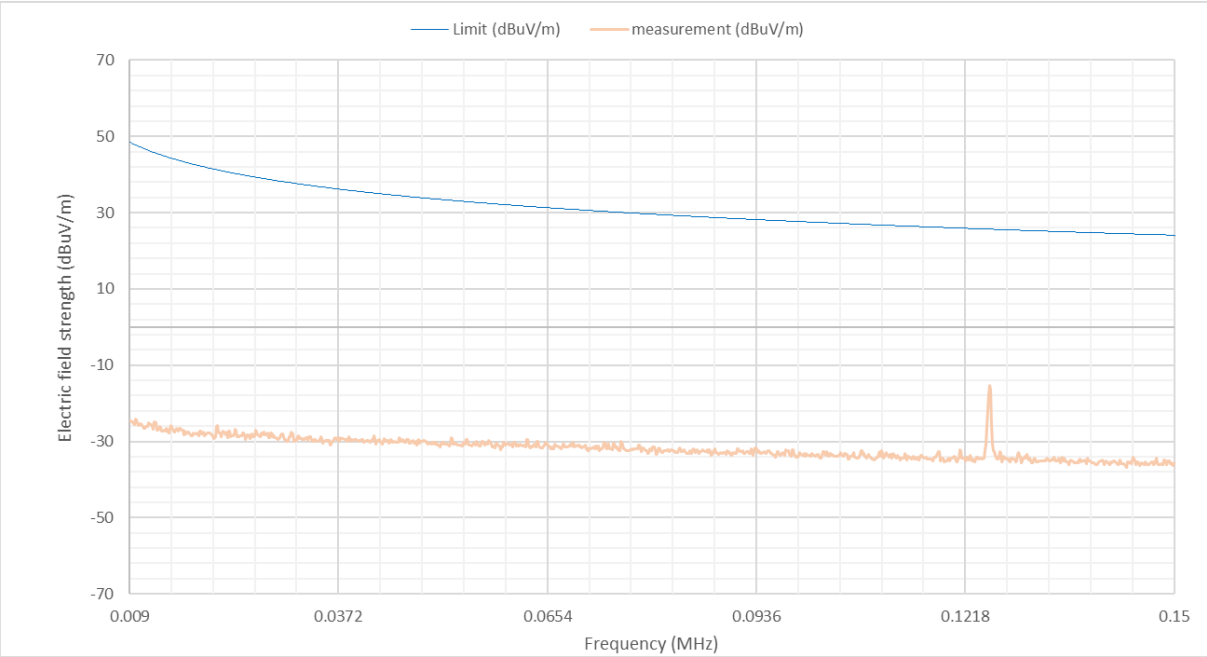

Figure 6 Magnetic field emissions Plot, 9kHz to 150Hz. Perpendicular

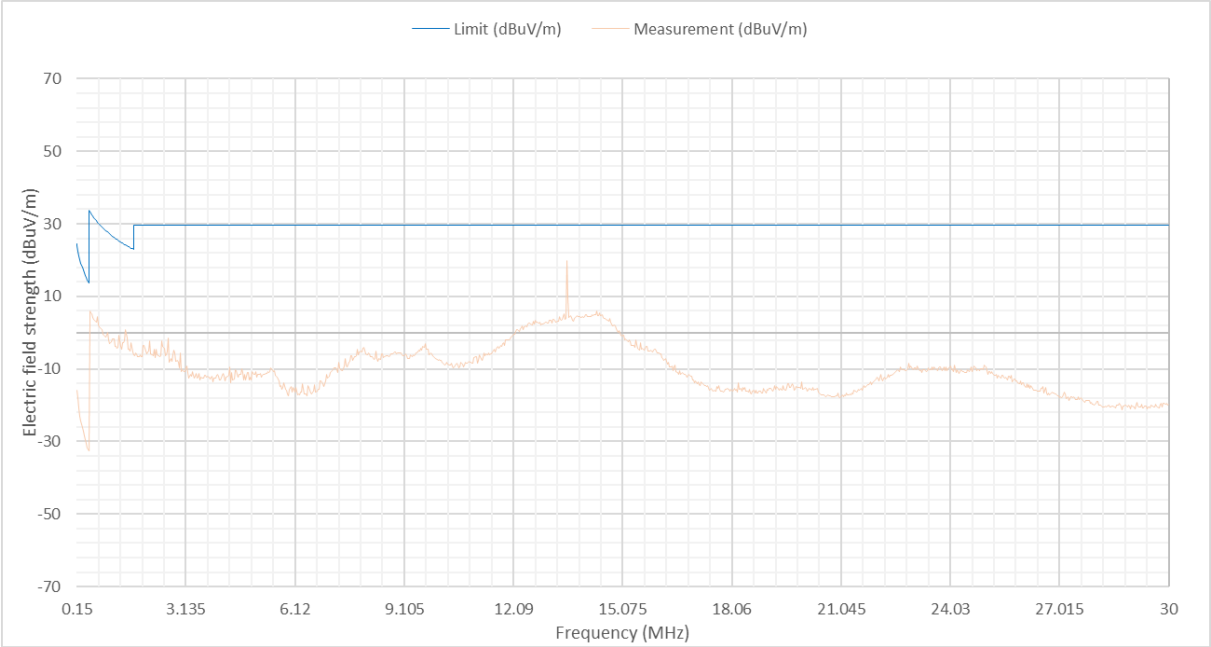

Figure 7 Magnetic field emissions Plot, 150kHz to 30MHz. Parallel

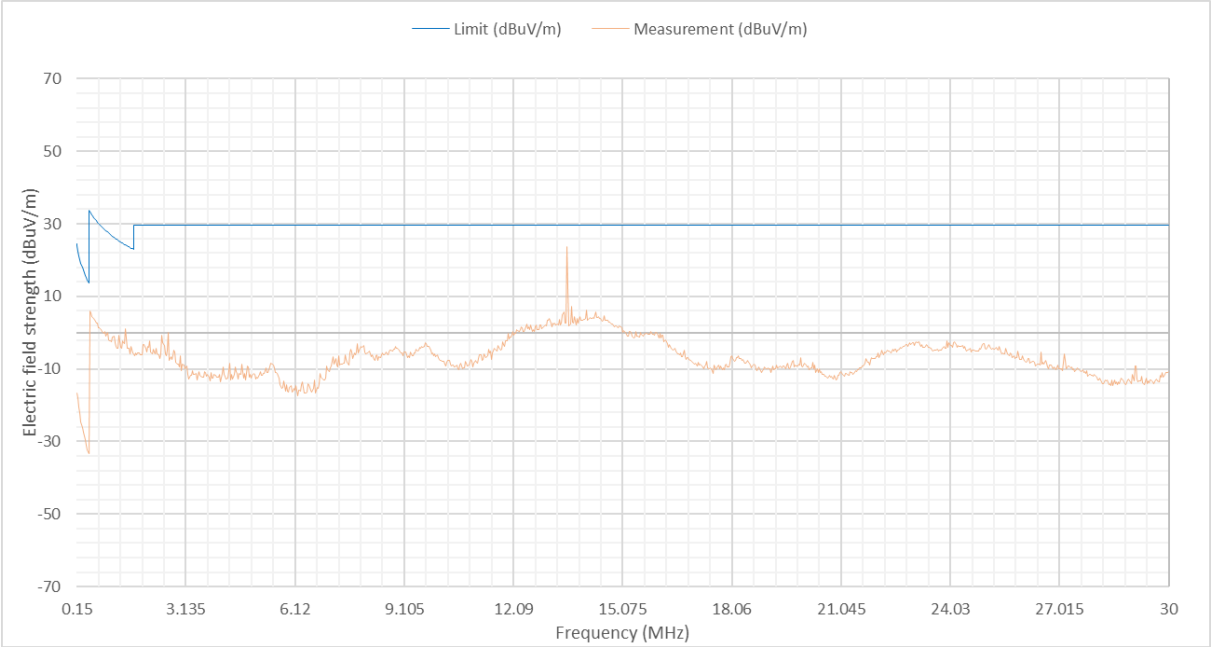

Figure 8 Magnetic field emissions Plot, 150kHz to 30MHz. Perpendicular

No radiated spurious emissions were detected from the product closer than 20dB to the limit other than the carrier at 13.56MHz and 125kHz.

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)

5.3.10 Sample Data

Example:

At 13.56MHz
Parallel orientation, Figure 7

At 3m field strength = receiver reading 56.20(dBuV)

-pre amplifier gain (29.17)

+ Antenna factor 32.74(dB/m)+ extrapolation (-40dB)

= 19.77 dBμV/m

At 125kHz
Parallel orientation, Figure 5

At 3m field strength = receiver reading 31.77(dBn/μV)

-pre amplifier gain (29.4-)

+ Antenna factor 64.28(dB/m)+ extrapolation (-80dB)

= -13.35 dBμV/m

5.4 Radiated Emissions (30MHz to 1GHz)

Radiated electric field emission measurements are applied as defined in 47CFR15.205 and 47CFR15.209.

5.4.1 Limits at 3m

Frequency (MHz)	Electric Field Strength Limit (dBµV/m) at 3m measurement distance
	Quasi Peak
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 and 15.205 specifies test limits at 3m

Receiver Settings

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

5.4.2 Emissions measurements

5.4.3 Date of Test

1st February 2023

5.4.4 Test Area

LAB 1 (SAC)

5.4.5 Tested by

M Render

5.4.6 Test Setup

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

The measurement was performed with an antenna to EUT separation distance of 3m. The results were maximised in orientation 0-360 degrees and height 1-4m.

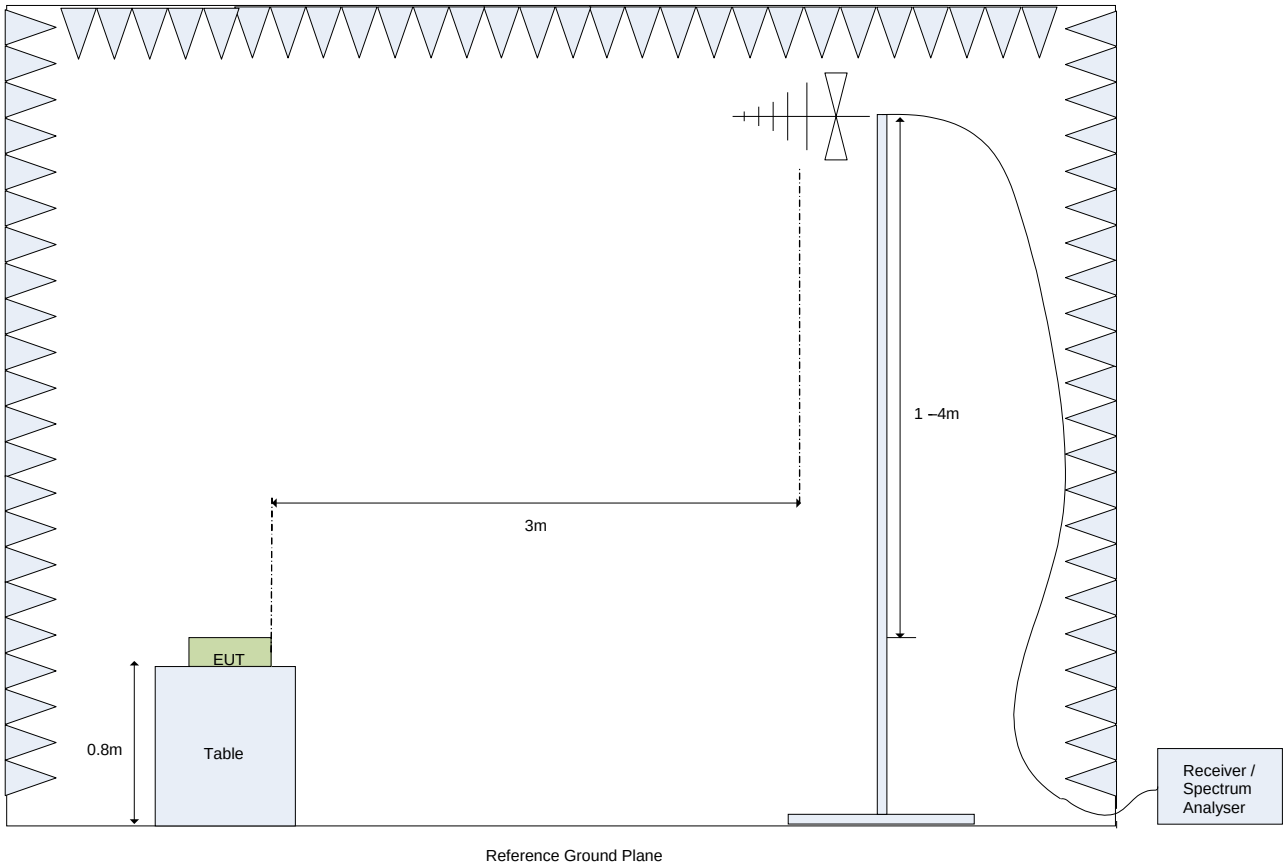

Figure 9 Test Setup for E-Field Measurements from 30MHz to 1GHz

Note 1 : With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement of ANSI C63.10-2013.

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.

5.4.7 Electric field emissions, 30MHz to 1GHz

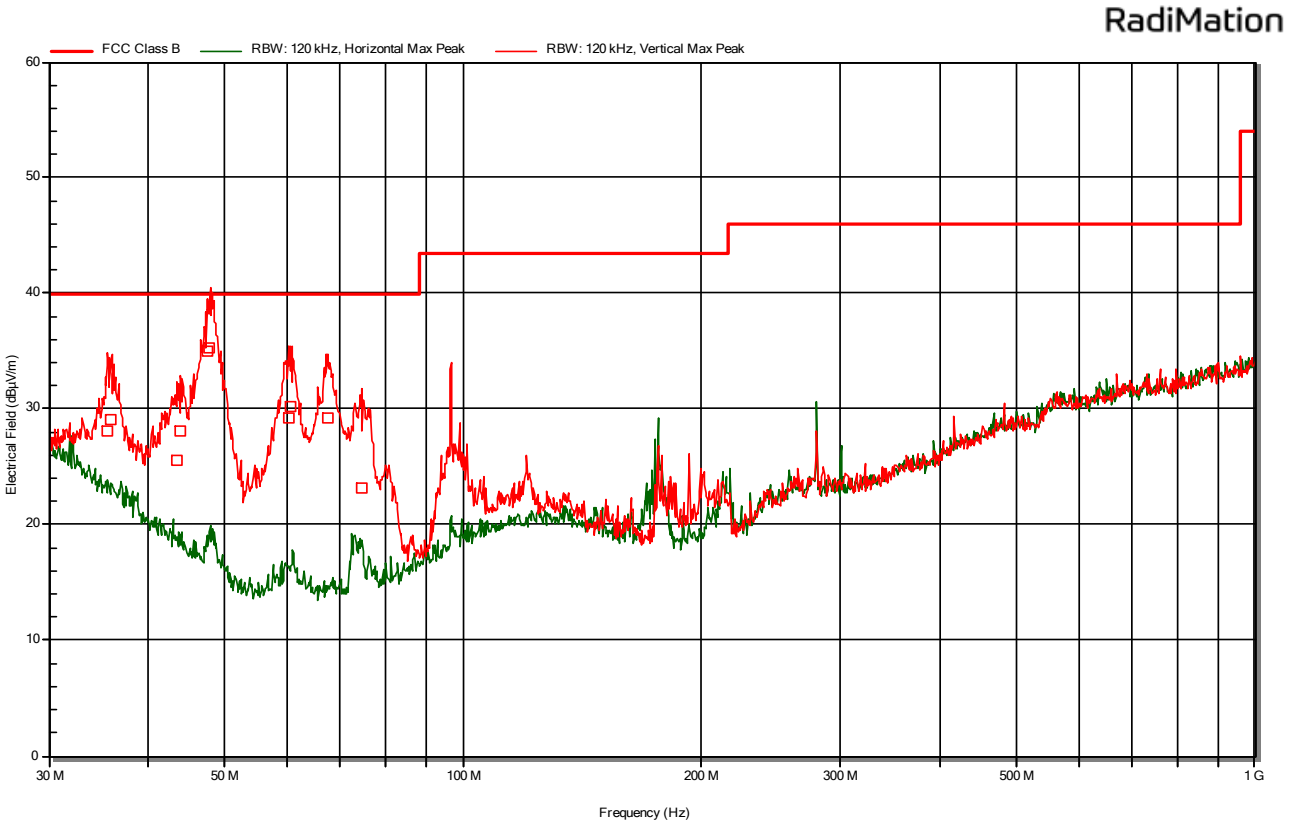

Figure 10 Electric field emissions Plot, 30MHz to 1GHz

Frequency	Quasi-Peak	Quasi Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height	Polarization
MHz	dBµV/m	dBµV/m	dB		degrees	m	
35.580	28.10	40	-11.90	Pass	120	1.0	Vertical
35.940	29.10	40	-10.90	Pass	95	1.0	Vertical
43.560	25.60	40	-14.40	Pass	230	1.0	Vertical
47.520	34.90	40	-5.10	Pass	170	1.0	Vertical
47.880	35.30	40	-4.70	Pass	44	1.0	Vertical
60.240	29.20	40	-10.80	Pass	150	1.0	Vertical
60.660	30.20	40	-9.80	Pass	70	1.0	Vertical
67.440	29.20	40	-10.80	Pass	175	1.8	Vertical
74.520	23.20	40	-16.80	Pass	185	1.5	Vertical

Table 1 Electric Field Emissions Peaks, 30MHz to 1GHz.

5.4.8 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)

5.4.9 Sample Data

The Quasi-Peak level at 47.880 MHz

FS (dBµV/m) = 19.6(dBµV) + 14.9(dB/m) + 0.8(dB) = 35.3 (dBµV/m)

Appendix A EUT Test Photographs

Test set up photographs are supplied separately.

Appendix B Test Equipment List

Radiated Emissions 30MHz to 1GHz Equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Laboratory 1 Semi-Anechoic Chamber	Lab 1	20th January 2020	3 years
ETS Lindgren 2017B Mast (1 – 4m) with tilting mechanism	--	-	-
R & S ESR26	C0502	3rd May 2022	12 months
6dB Attenuator (For use with Bilog Antenna)	C0506B	15th July 2021	36 months
Teseq CBL6112D Bilog Antenna	C0506	12th January 2022	12 months
HF26 Cable	HF26	1st December 2022	12 months
HF35 Cable	HF35	30th November 2022	12 months
HF27 Cable	HF27	30th November 2022	12 months

Radiated Emissions 9kHz to 30MHz Equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Laboratory 5 Fully-Anechoic Chamber	Lab 5	Not required	N/A
Schwarzbeck BBV 9745 preamplifier 9kHz – 2GHz	C0632	9th February 2022	24 months
ETS Lindgren 6512 loop antenna	B0921	21st February 2020	36 months
RF cables	Cable 11	30th November 2022	12 months
	HF10	12th December 2022	12 months
Rohde & Schwarz ESW Test Receiver	C0658	8th November 2022	12 months