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Test Report for the FCC and ISED Radio Testing of a Qubi 3C RFID v2 for QED Advanced Systems

Test Report number: C14977TR1
Project number: C7405

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Issue	Description						Issue by	Date
1	*Copy 1*		*Copy 2*		*PDF*	*X*	MR	*17/02/2023*

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i54 Business Park, Valiant Way
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Registered in England and Wales
Company Reg. No. 6048589
VAT Reg. No. GB 887 1276 83

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Test Report Change History

Issue	Date	Modification Details
1	17th February 2023	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 Ltd	Unit 5
	Speedwell Road
	Castleford
	WF10 5PY
Tel:	01977 731173
Website	https://www.yorkemc.com
UKAS Testing No.	1574

1.1 UKAS Accreditation

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

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

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

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

Eurofins York 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					
EUT name:	Qubi 3C RFID v2					
FCC ID	2AB38QUBI3CA					
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					
Details of radio technology (type, frequency, RF Module)	125kHz 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.					
Client modification statement:	None					
Modifications incorporated during testing:	None					

3.2 EUT Photographs

Photographs are supplied separately.

3.3 Configuration of EUT

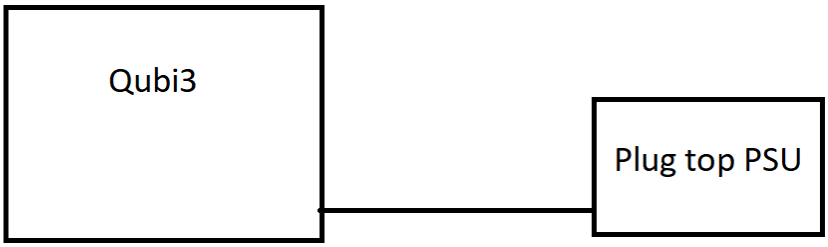


Figure 1: Diagram of EUT set-up

Section 4 Test Specifications

The tests were performed in accordance with Eurofins York Ltd Quotation C7405.

Based on 47CFR Part 15, Sub Part C Intentional Radiators			
Which references the following specification: -			
ANSI C63-10: 2013			
Test	**Method**	**Levels**	**Result**
Radiated Emissions 47 CFR Part 15.C Section 15.209 (9kHz to 1GHz) See Note 1	ANSI C63.10: 2013	47CFR Part 15 Clause 15.209 47CFR Part 15 Clause 15.205 (Restricted bands)	Pass
AC power line conducted emissions	ANSI C63.10: 2013	47CFR Part 15 Clause 15.207	Pass

Note 1: The spectrum was investigated up to 10 times the highest frequency in accordance with FCC rule part 15.33(b).

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 Qubi3 Version A:

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

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

4.2 Compliance Statement

The Qubi 3C RFID v2, 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

Regulation (USA)	47CFR15.209
Standard	ANSI C63.10:2013 General radiated emission limits in Section 15.209, 9kHz to 1GHz
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

5.2 Procedure and Test Software Version

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

The limits for field strength in 47CFR15.209 are:

Frequency	Limits (µV/m)	Limits (µA/m)	Specified distance
9kHz to 490kHz	2400/F(kHz)	6.37/F (kHz)	300m
490kHz to 1.705MHz	24000/F(kHz) a	63.7/F (kHz)	30m
1.705MHz to 30MHz	30	0.08	30m

Notes:

1. The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
2. The magnetic field and electric field limits are related via:

$$\frac{E}{H} = 377 \text{ Ohms}$$

Where,
E is the electric field in V/m
H is the magnetic field strength in A/m

3. The limit decreases linearly with the logarithm of the frequency in the range 9kHz to 490kHz

5.3.2 Receiver Settings

Receiver Parameters	Setting
Detector Function	Peak – for chamber pre-scans
Start Frequency	9kHz
Stop Frequency	150kHz
Resolution Bandwidth	200Hz
Video Bandwidth	Auto

Receiver Parameters	Setting
Detector Function	Peak – for chamber pre-scans
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 5 – Fully anechoic chamber

5.3.6 Tested by

M Render

5.3.7 Chamber 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.

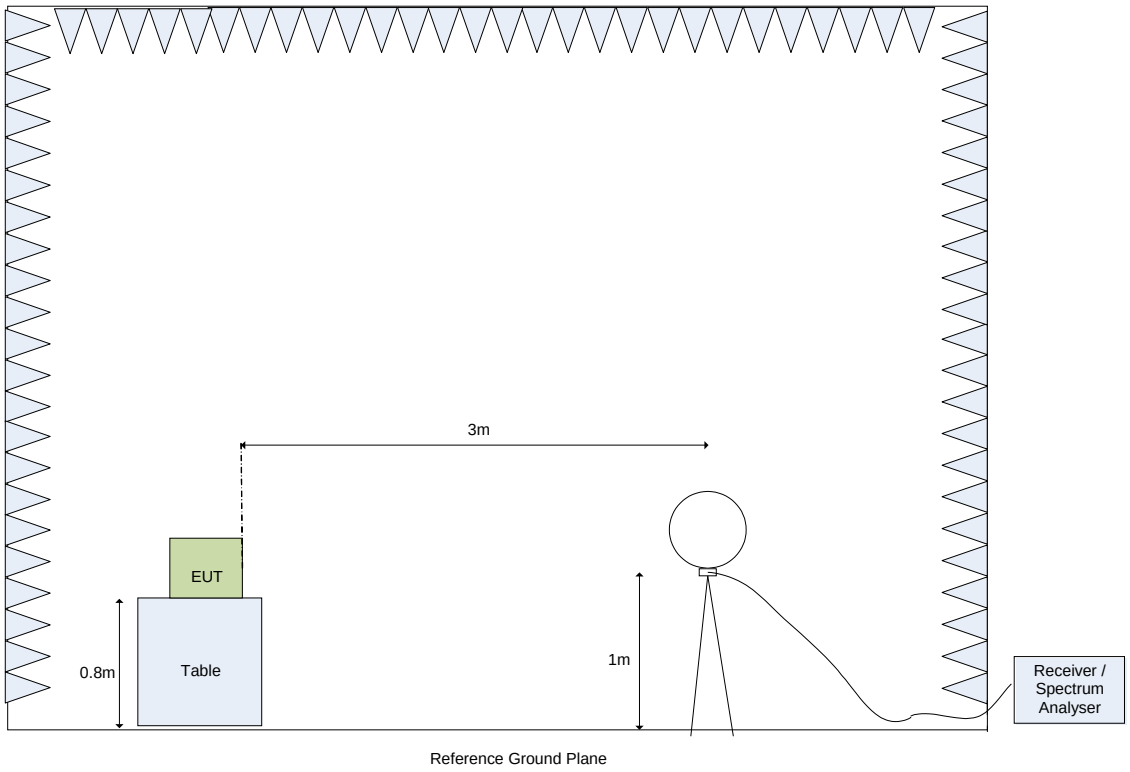


Figure 2 Test Setup for H-Field Measurements from 9kHz to 30MHz

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

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.

5.3.8 Magnetic field emissions, 9kHz to 30MHz – Chamber Measurements

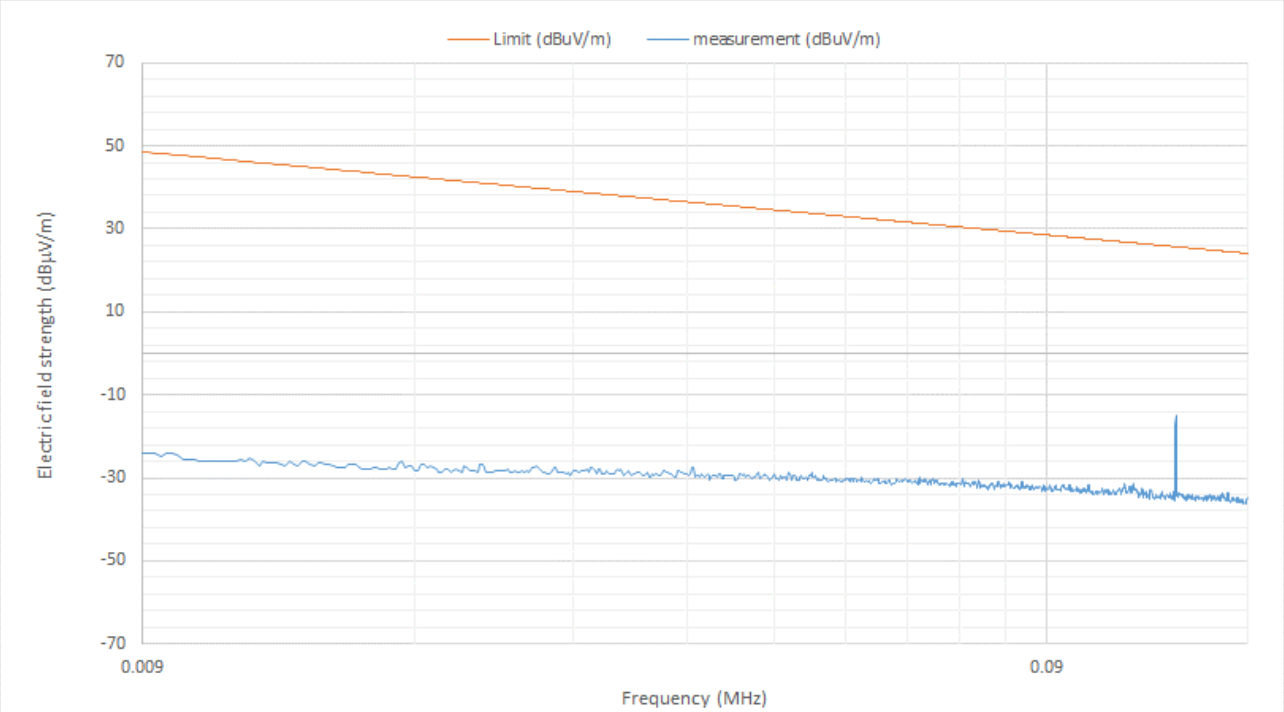


Figure 3 Magnetic field emissions Plot, 9kHz to 150kHz Parallel orientation

All measurements apart from the wanted signal were greater than 10dB from the specification limit. Further measurements were not necessary to determine compliance with the specification limit.

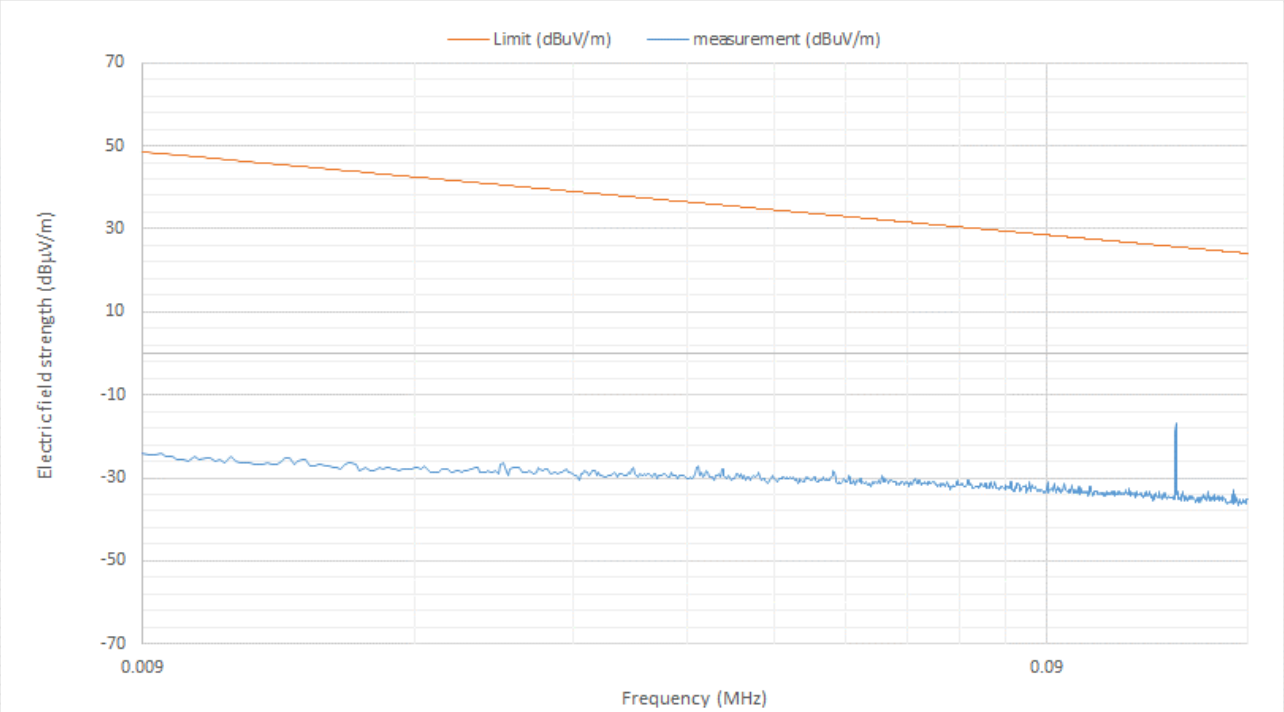


Figure 4 Magnetic field emissions Plot, 9kHz to 150kHz Perpendicular

All measurements apart from the wanted signal were greater than 10dB from the specification limit. Further measurements were not necessary to determine compliance with the specification limit.

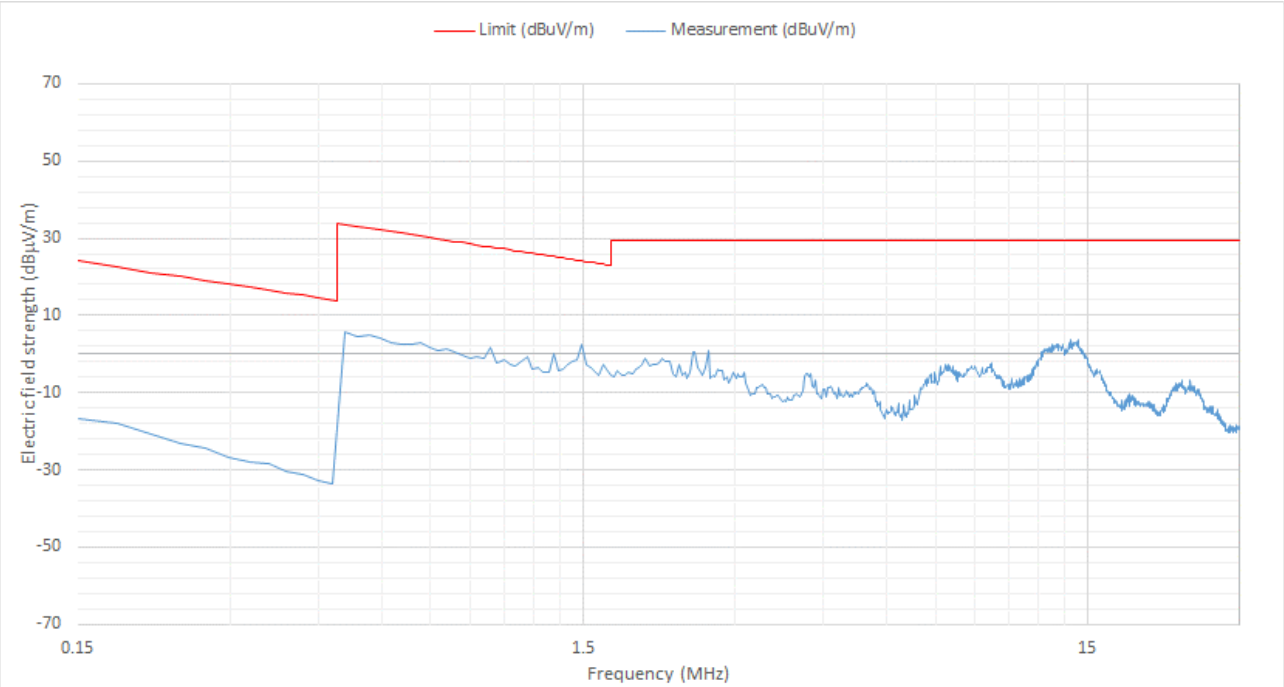


Figure 5 Magnetic field emissions Plot,150kHz to 30MHz Parallel orientation

All measurements apart from the wanted signal were greater than 10dB from the specification limit. Further measurements were not necessary to determine compliance with the specification limit.

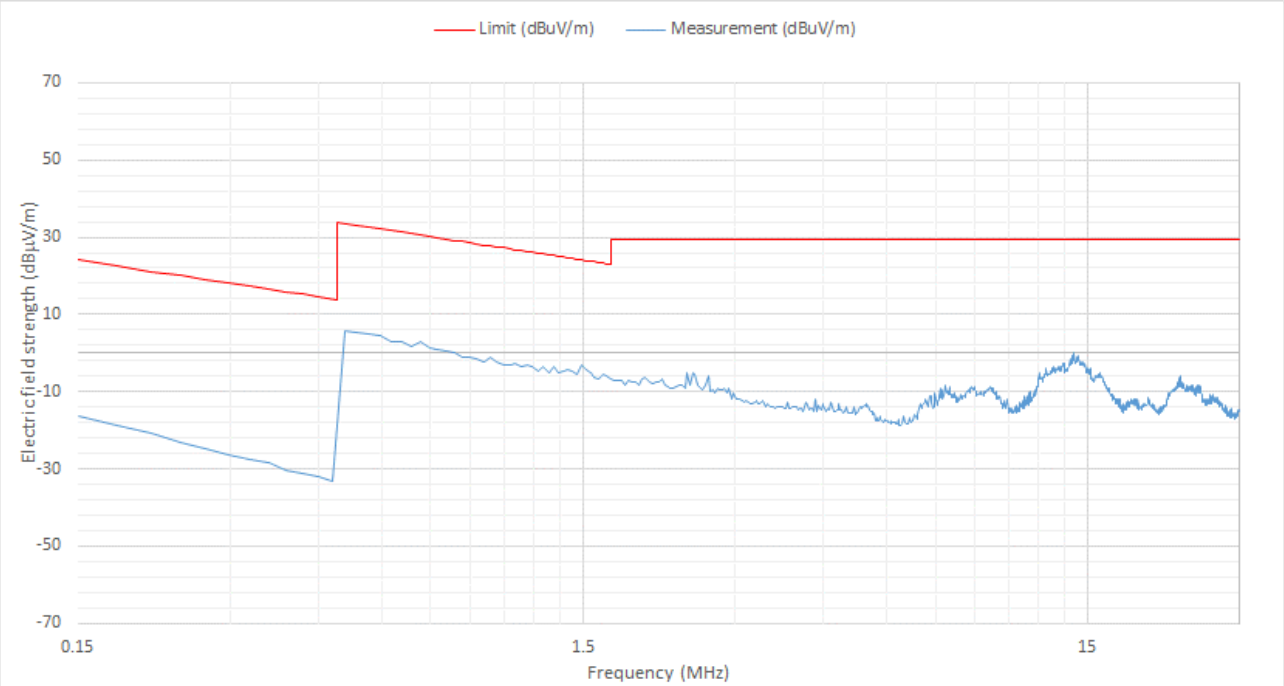


Figure 6 Magnetic field emissions Plot,150kHz to 30MHz Perpendicular orientation

All measurements apart from the wanted signal were greater than 10dB from the specification limit. Further measurements were not necessary to determine compliance with the specification limit.

5.3.9 Example Calculation

This correction figure consists of indicated signal level (SL) Antenna factor (AF) pre-amplifier gain (PAG) and extrapolation factor (Ext)

Note: Cable loss was not considered to contribute significantly to the measurement.

Field strength (FS) is calculated as follows:

FS (dBµV/m) = Indicated Signal Level (dBµV) – (PAG) +AF(dB/m) – EXT(dB)

The extrapolation factor used was in accordance with ANSI C63.10-2013

$$E_{300m}(dB\mu V/m) = 40\log_{10}(3/SD) + E_{3m}(dB\mu V/m)$$

Where,

E_{3m}(dBµV/m) is the field strength measured at 3m

E_{300m}(dBµV/m) is the required field strength at 300m

SD is the specified distance (m).

Indicated signal level = SL(dBµV) = 27.99 dBµV

-PAG(dB) =29.40 dB

+AF(dB/m) = 64.30dB/m

-EXT(dB) = 80.00 dB

= -17.11dBµV/m

5.4 Radiated Emissions (30MHz to 1GHz)

5.4.1 Limits at 3m

Frequency (MHz)	Electric Field Strength Limit Limit (dBµV/m) Class B at 3m	Electric Field Strength Limit Limit (dBµV/m) Class A at 3m
	Quasi Peak	Quasi Peak
30 - 88	40.0	49.0
88 -216	43.5	53.5
216 - 960	46.0	56.0
960- 1000	54.0	59.5

5.4.2 Receiver Settings

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

5.4.3 Emissions measurements

5.4.4 Date of Test

3rd February 2023

5.4.5 Test Area

LAB 1 (Semi Anechoic Chamber)

5.4.6 Tested by

M Render

5.4.7 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.

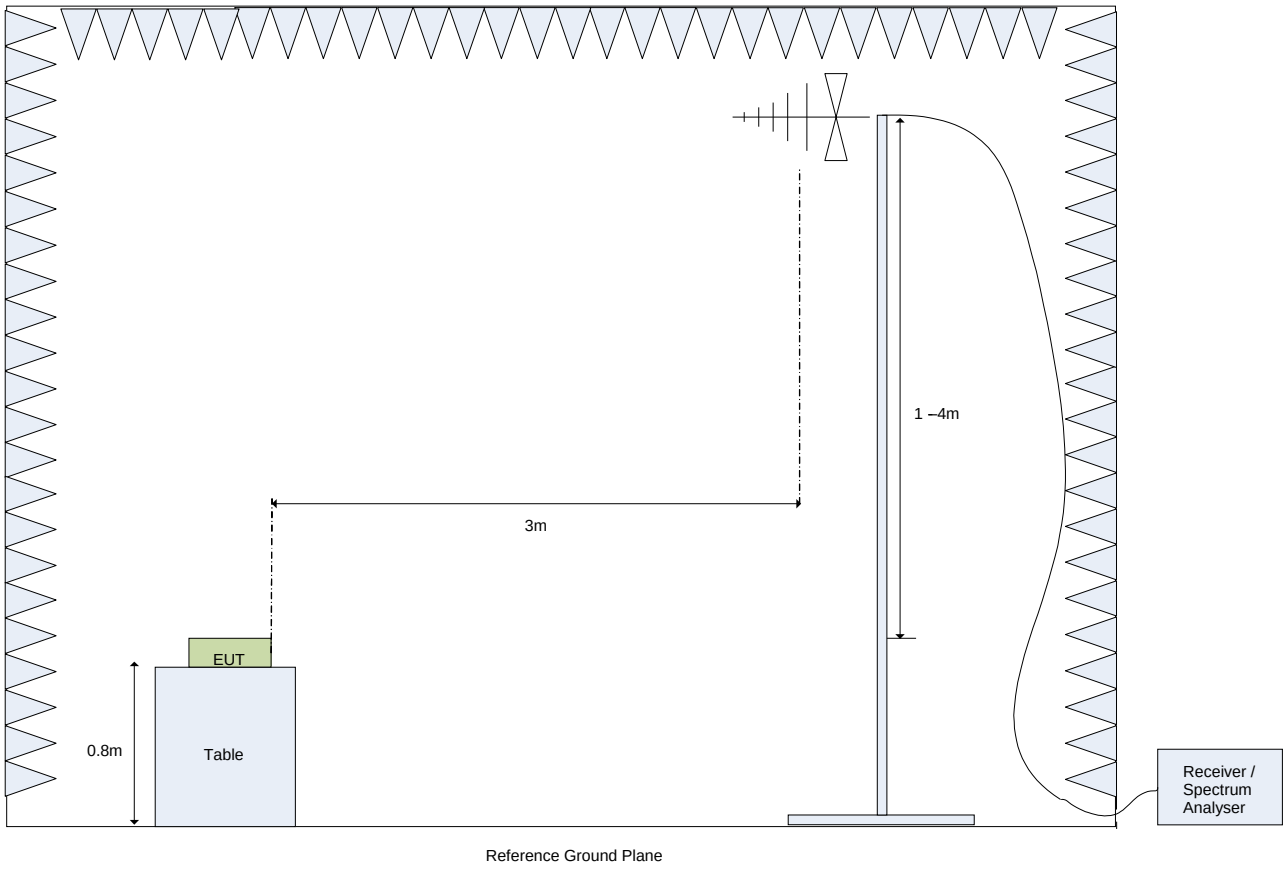


Figure 7: Test Setup for E-Field Measurements from 30MHz to 1GHz

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.

5.4.8 Electric field emissions, 30MHz to 1GHz

Figure 8: 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	
36.180	29.40	40	-10.60	Pass	180	1.0	Vertical
44.460	27.90	40	-12.10	Pass	95	1.0	Vertical
48.120	34.80	40	-5.20	Pass	255	1.0	Vertical
60.660	27.20	40	-12.80	Pass	285	1.0	Vertical
61.080	27.80	40	-12.20	Pass	125	1.0	Vertical
67.500	29.50	40	-10.50	Pass	185	1.5	Vertical

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

5.4.9 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)

5.4.10 Sample Data

The Quasi-Peak level at 48.120MHz

FS (dBµV/m) = 34.80dBµV = 19.20dBµV + 14.75dB + 0.90

Section 6 AC Mains Conducted Emissions

6.1 Test Specification

Regulation (USA)	47CFR15.207
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 +/- 3.45dB

6.2 Power Line Emission Limits

Frequency (MHz)	Limit (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 York test procedure	CEP19 Issue 5
Test software	RadiMation Version 2016.1.6

6.4.1 Date of Test

3rd February 2023

6.4.2 Test Area

LAB 2

6.4.3 Tested by

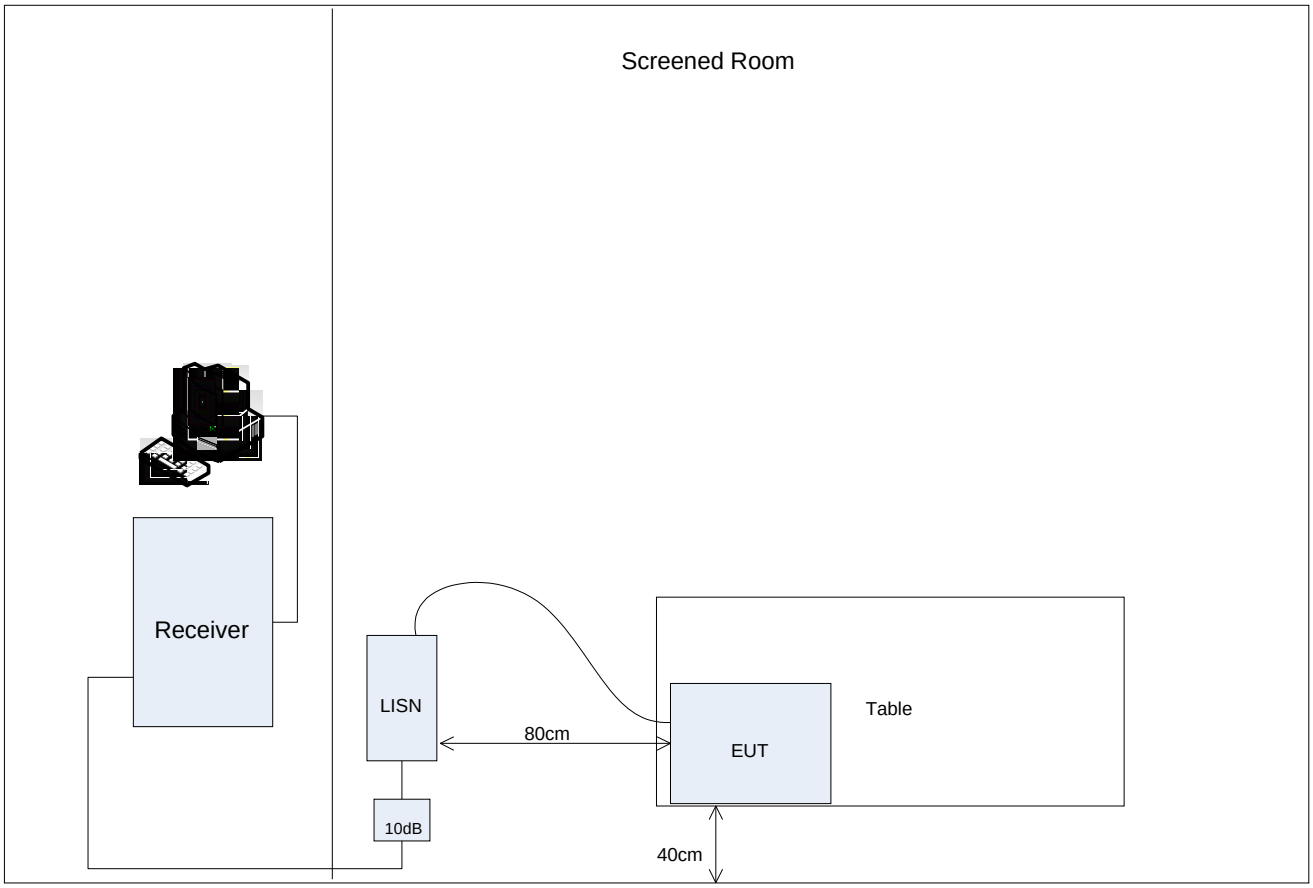
M Render

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
125kHz	Live	Pass
125kHz	Neutral	Pass

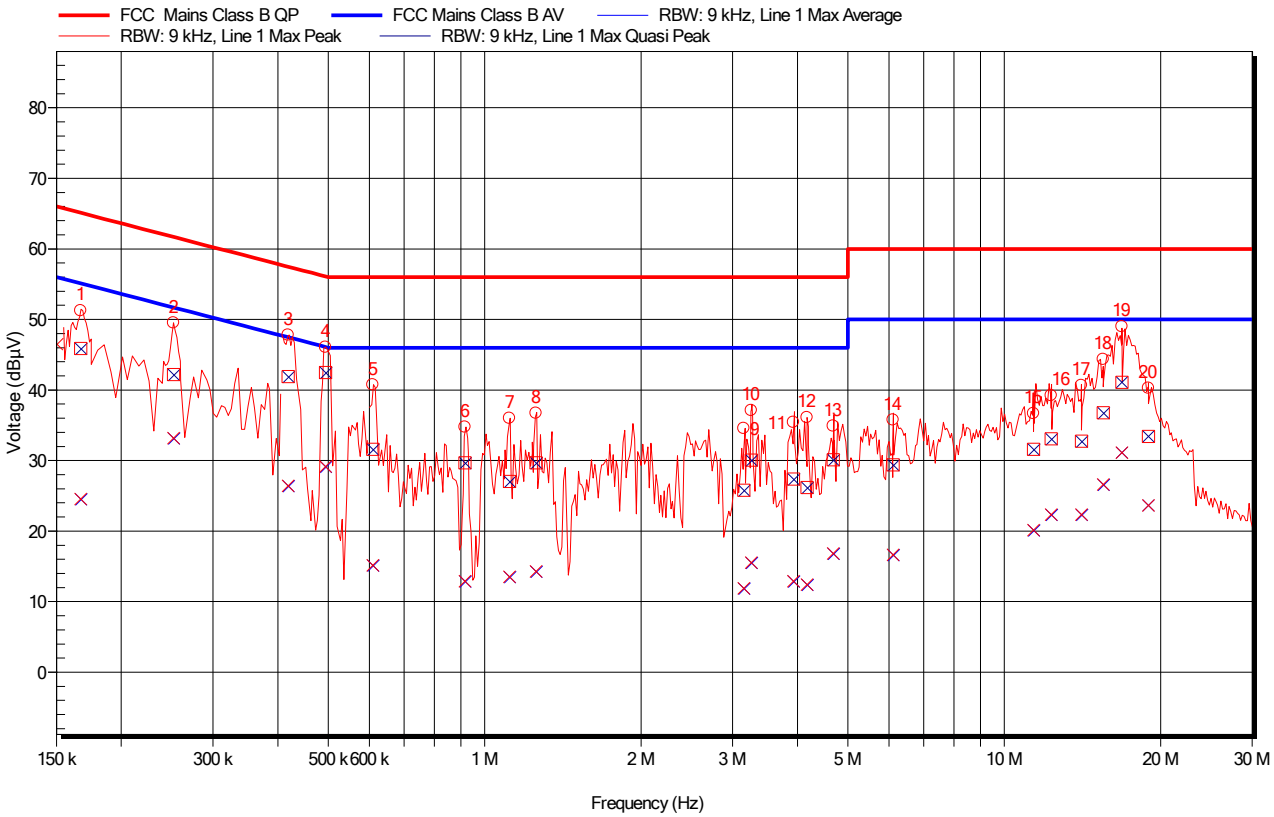


Figure 9: AC mains conducted emissions – Live

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
0.1670	24.50	55.10	-30.60	Pass	45.90	65.10	-19.20	Pass
0.2520	33.20	51.70	-18.50	Pass	42.20	61.70	-19.50	Pass
0.4190	26.40	47.50	-21.10	Pass	41.90	57.50	-15.60	Pass
0.4940	29.10	46.10	-17.00	Pass	42.50	56.10	-13.60	Pass
0.6090	15.10	46.00	-30.90	Pass	31.60	56.00	-24.40	Pass
0.9165	12.90	46.00	-33.10	Pass	29.70	56.00	-26.30	Pass
18.920	23.60	50.00	-26.40	Pass	33.40	60.00	-26.60	Pass

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

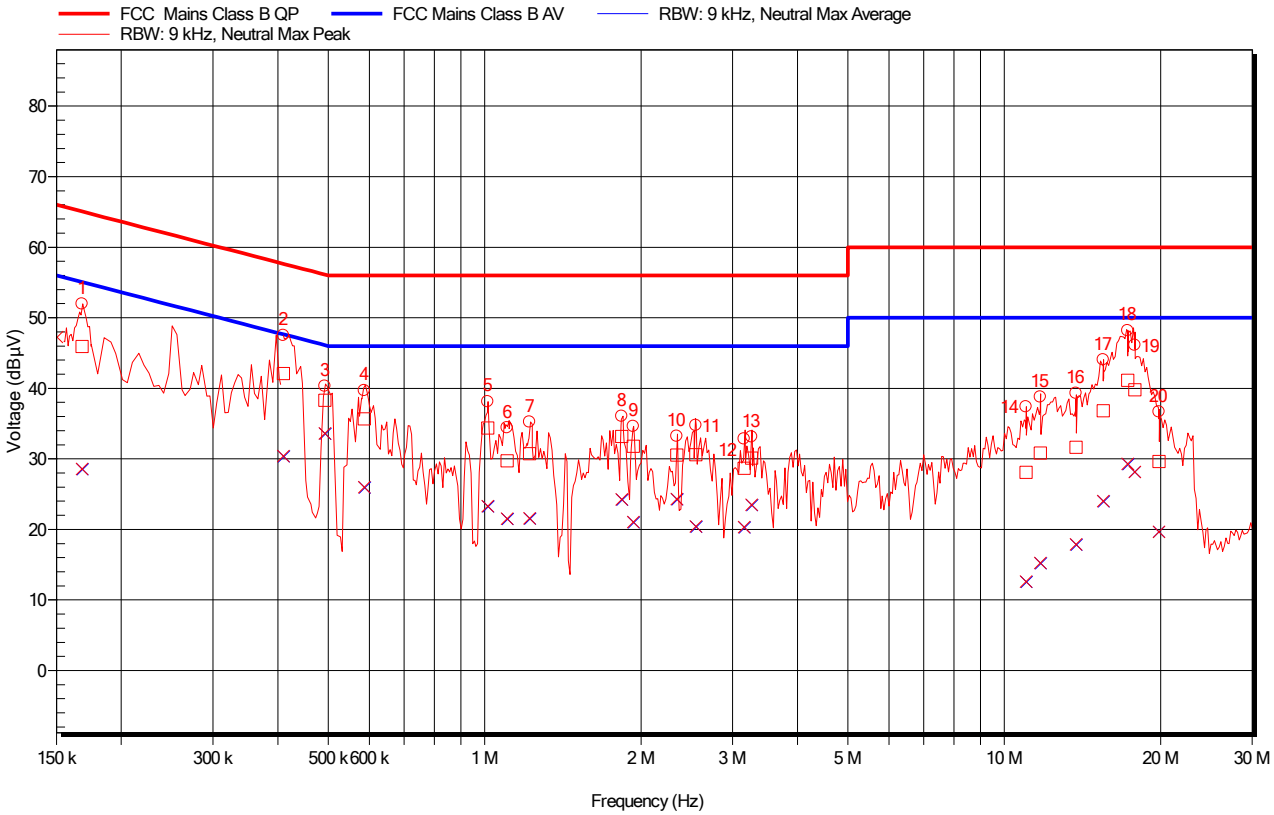


Figure 10: AC mains conducted emissions – Neutral

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
0.168	28.60	55.10	-26.50	Pass	46.00	65.10	-19.10	Pass
0.492	33.60	46.10	-12.50	Pass	38.30	56.10	-17.80	Pass
0.587	26.00	46.00	-20.00	Pass	35.70	56.00	-20.30	Pass
1.014	23.30	46.00	-22.70	Pass	34.40	56.00	-21.60	Pass
1.105	21.50	46.00	-24.50	Pass	29.70	56.00	-26.30	Pass
0.410	30.40	47.60	-17.20	Pass	42.10	57.60	-15.50	Pass
17.296	29.30	50.00	-20.70	Pass	41.10	60.00	-18.90	Pass

Table 3: Electric Field Emissions Peaks, 150kHz to 30MHz – 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 0.494MHz

ASL (dBµV) = 42.50dBµV = 32.63dBµV + 0.17dB + (-1.19)dB + 9.90dB

Appendix A EUT Test Photographs

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	15th July 2021	36 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	36 Months

AC Mains conducted emissions equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Rohde & Schwarz ESR7 Test receiver	C0449	3rd February 2022	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	11th January 2022	24 Months
Kikusui PCR2000M power supply	-	-	-