Test Report for the Testing of a Rio Pro 360 to the FCC Rules For Magicard Ltd

Test Report number 12814TR1

Project number C3939

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Issue	Description						Issue by	Date
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Test Report Change History

Issue	Date	Modification Details
1	18th May 2018	Original issue of test report
2	12th June 2018	Replaced 20dB bandwidth and band edge measurements following comments from the TCB (Sections 8 and 9). Added statement regarding correlation of chamber (Laboratory 1) measurements and a site with no ground plane (Section 6.3.5)
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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	Magicard Ltd
Address	Hampshire Road
	Weymouth
	Dorset
	DT4 9XD
Tel:	+44 (0) 1305 470 000
Contact	Tim Last
Email	info@magicard.com
Customer Representative(s) present during testing	Tim Last

Section 3 Equipment Details

3.1 Equipment Under Test (EUT)

Date received:	19th April 2018
EUT name:	Rio Pro 360
Type/Part no:	3652-3001
Serial no/s:	SAMPLE_A
EUT description:	The Rio Pro 360 is an ID and smart card printer

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:	60cm		W:	42cm		H:	43cm	
Tested as	Table top								
Mode/s of operation	Transmitting modulated 13.56MHz near field communication signal								
Hardware Version	Issue 1								
Software Version	4.17								
Client modification statement:	Not applicable								
Modifications incorporated during testing:	No modifications were applied to the EUT								

3.2 EUT Photos

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

3.3 Configuration of EUT

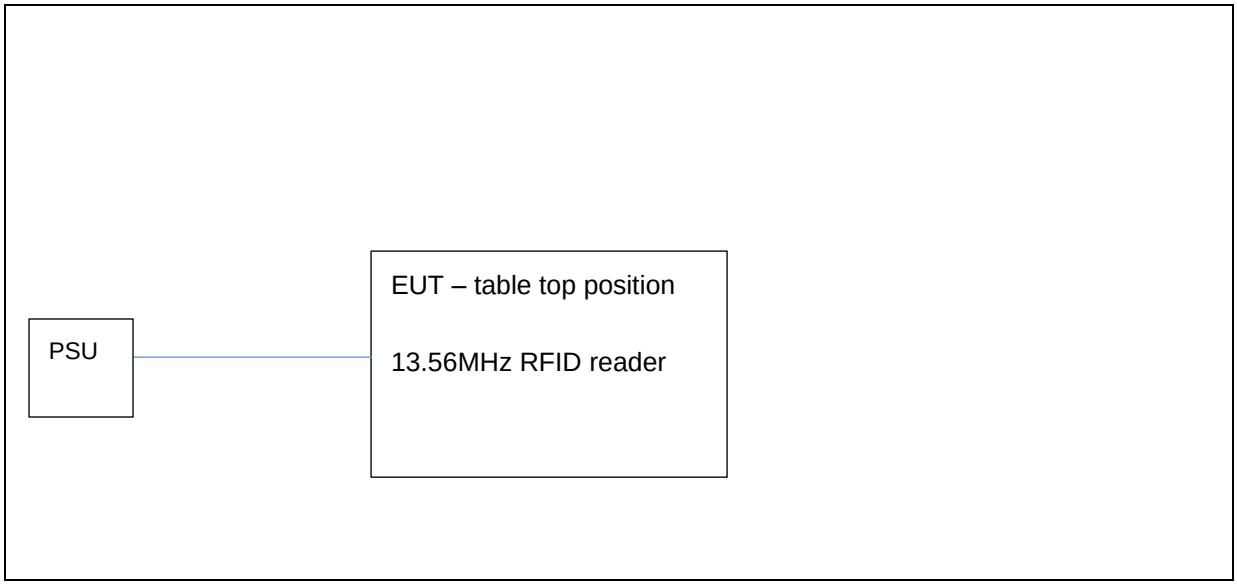

Figure 1: Diagram of EUT.

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)	6	Pass
	Authorised band edge measurements	As specified in Section 15.205	9	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 of the Rio Pro 360.

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
414788	Test sites for radiated emission measurements	04/18/2017

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 Rio Pro 360, 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

Eurofins York test procedure	CEP19 Issue 2
Test software	RadiMation Version 2016.1.6

5.4.1 Date of Test

19th 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).

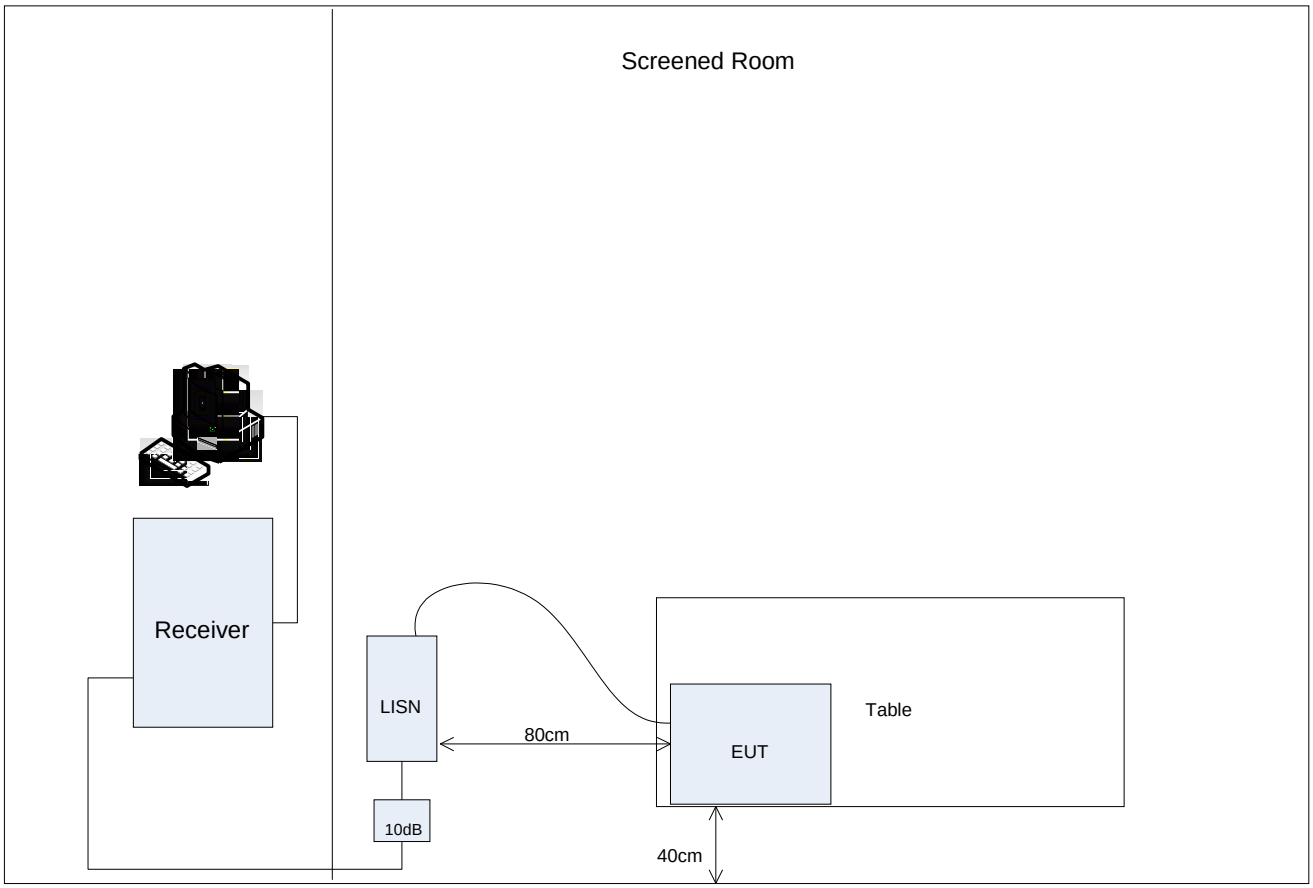

Figure 2: Test setup for Conducted Emissions on the AC power port

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

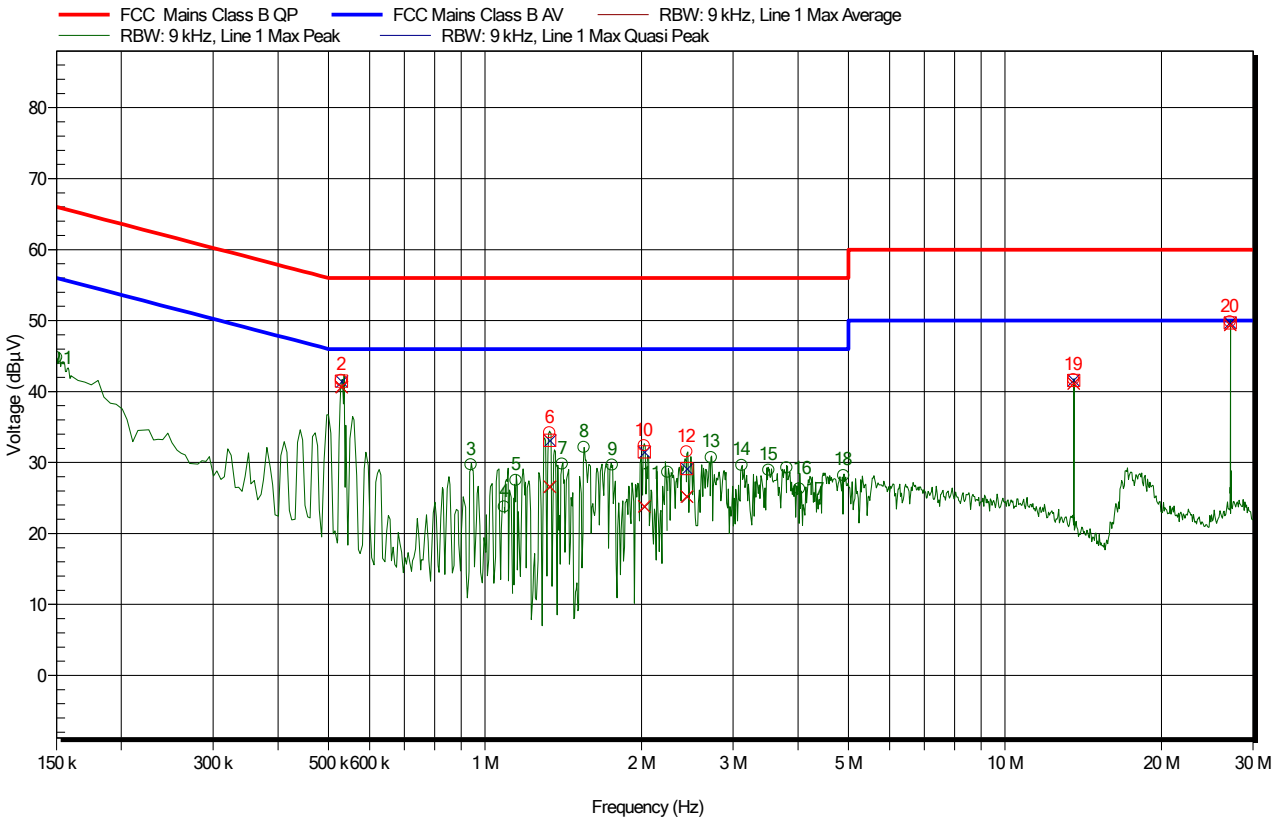

Figure 3: Conducted Emissions Plot - Input Power 120V 60Hz Live

Frequency MHz	Average dBµV	Average Limit dBµV	Average Difference dB	Average Correction dB	Average Status dB
0.529	40.6	46	-5.36	10.1	Pass
1.332	26.6	46	-19.39	10	Pass
2.024	23.8	46	-22.16	10.1	Pass
2.444	25.2	46	-20.76	10.1	Pass
13.56	41.1	50	-8.86	11	Pass
27.119	49.4	50	-0.64	11.6	Pass

Table 1: Live Conducted Emissions Peaks – Average detector

Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Correction	Quasi-Peak Status
MHz	dBµV	dBµV	dB	dB	dBµV
0.529	41.5	56	-14.54	10.1	Pass
1.332	33.1	56	-22.89	10	Pass
2.024	31.5	56	-24.52	10.1	Pass
2.444	29.2	56	-26.84	10.1	Pass
13.56	41.6	60	-18.42	11	Pass
27.119	49.7	60	-10.31	11.6	Pass

Table 2: Live Conducted Emissions Peaks – Quasi Peak detector

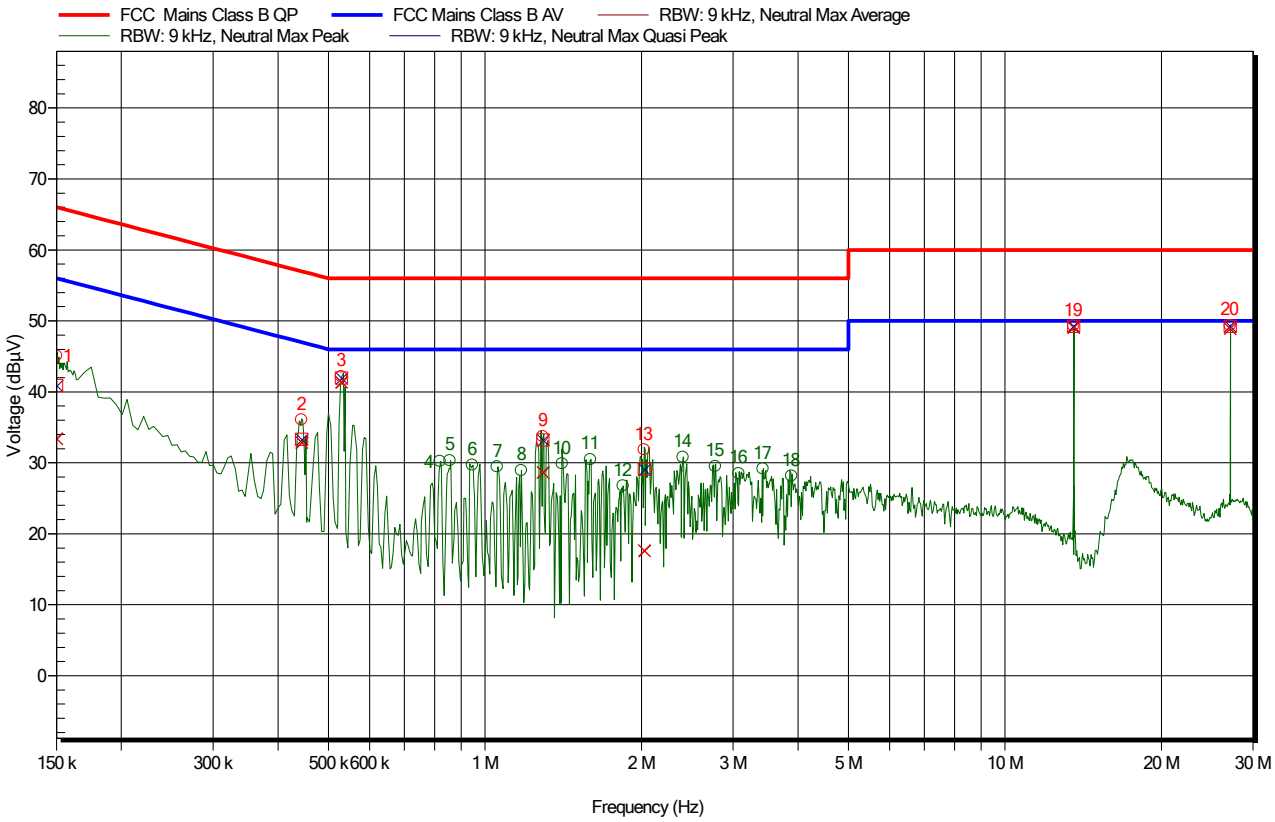

Figure 4: Conducted Emissions Plot - Input Power 120V 60Hz Neutral

Frequency MHz	Average dBµV	Average Limit dBµV	Average Difference dB	Average Correction dB	Average Status dB
0.150	33.4	56	-22.58	10	Pass
0.444	32.9	47	-14.07	10.1	Pass
0.529	41.4	46	-4.64	10.1	Pass
1.293	28.7	46	-17.33	10	Pass
2.026	17.6	46	-28.36	10.1	Pass
13.56	49	50	-0.95	11	Pass
27.119	48.9	50	-1.12	11.6	Pass

Table 3: Neutral Conducted Emissions Peaks, Average Detector

Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Correction	Quasi-Peak Status
MHz	dBµV	dBµV	dB	dB	dBµV
0.150	40.9	66	-25.11	10	Pass
0.444	33.3	57	-23.66	10.1	Pass
0.5295	41.9	56	-14.05	10.1	Pass
1.293	33.2	56	-22.76	10	Pass
2.026	29.1	56	-26.9	10.1	Pass
13.56	49.2	60	-10.78	11	Pass
27.119	49.2	60	-10.78	11.6	Pass

Table 4: Neutral Conducted Emissions Peaks, Quasi Peak Detector

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 linear average level at 27.119MHz MHz

ASL (dBµV) = 37.8dBµV+0.96(dB) + 0.3(dB) + 10.34(dB) = 49.4(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

19th April 2018

6.3.5 Test Area

Laboratory 1 semi-anechoic chamber

The 3m semi-anechoic chamber has been calibrated against open area test site (OATS) data as per KDB414788 D01. This data is available on request from Eurofins York.

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.

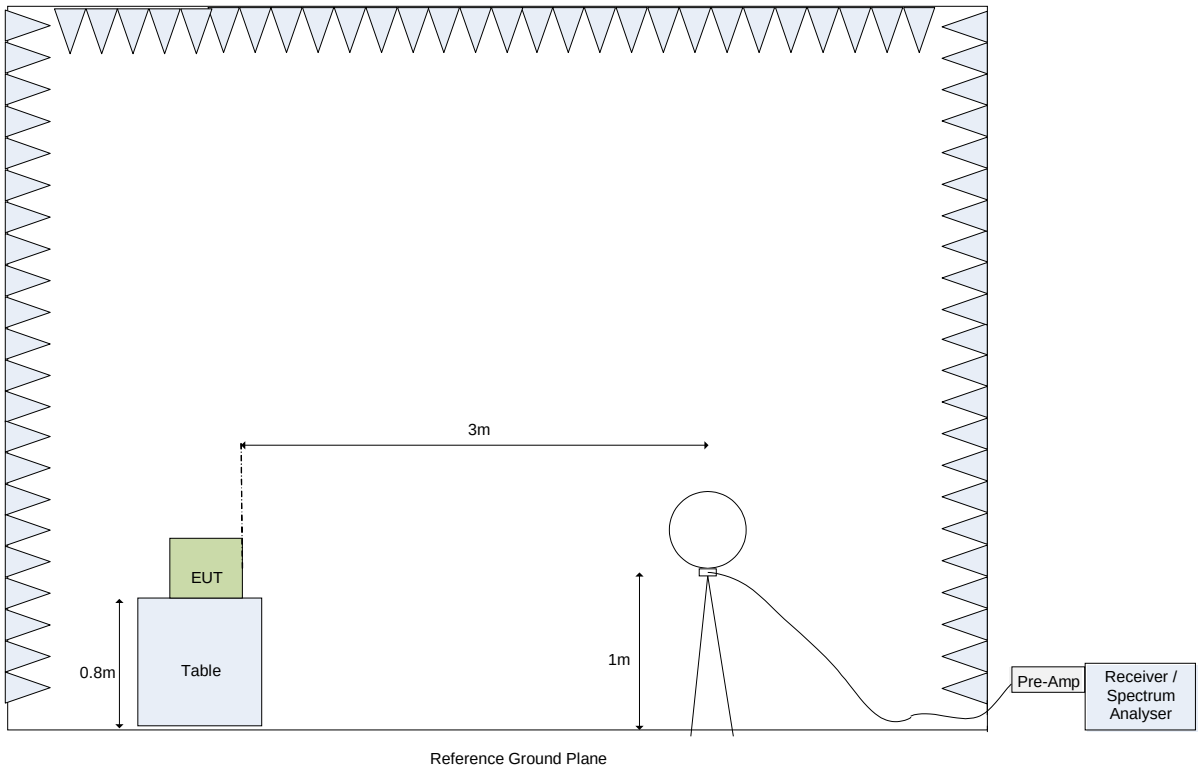

Figure 5: Test Setup for H-Field Measurements from 9kHz to 30MHz

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

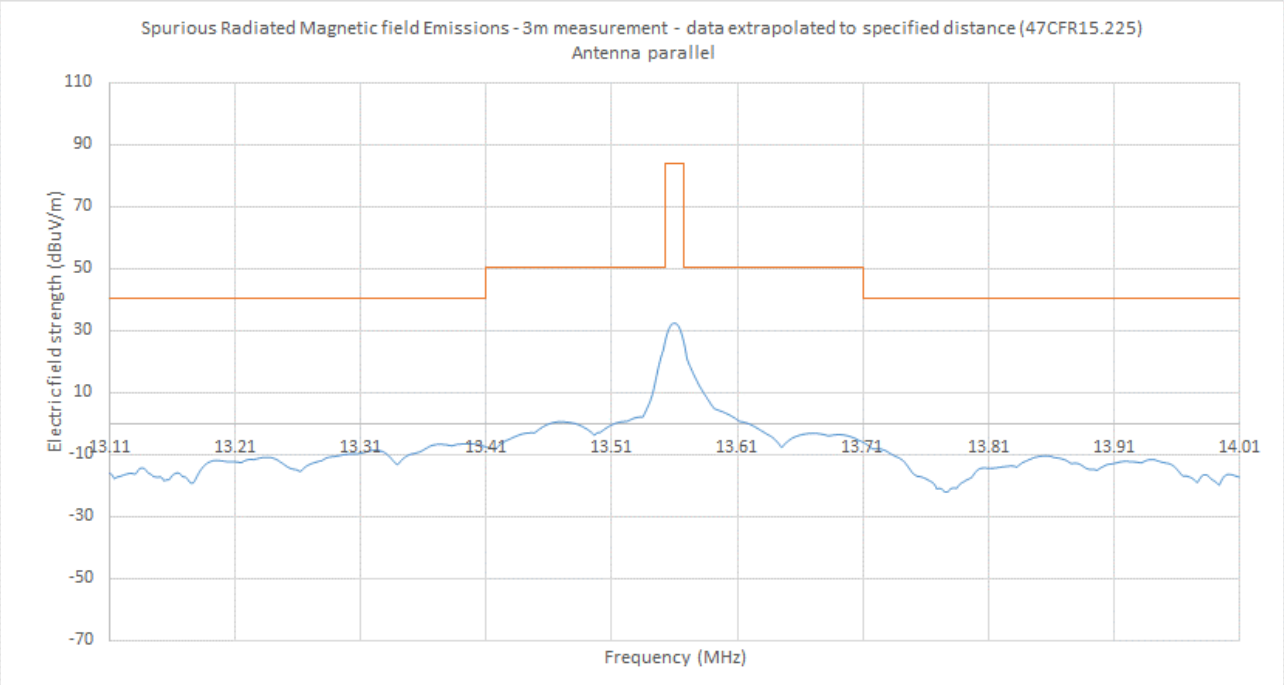

Figure 6: Magnetic field emissions Plot, 13.110MHz to 14.010MHz, Parallel

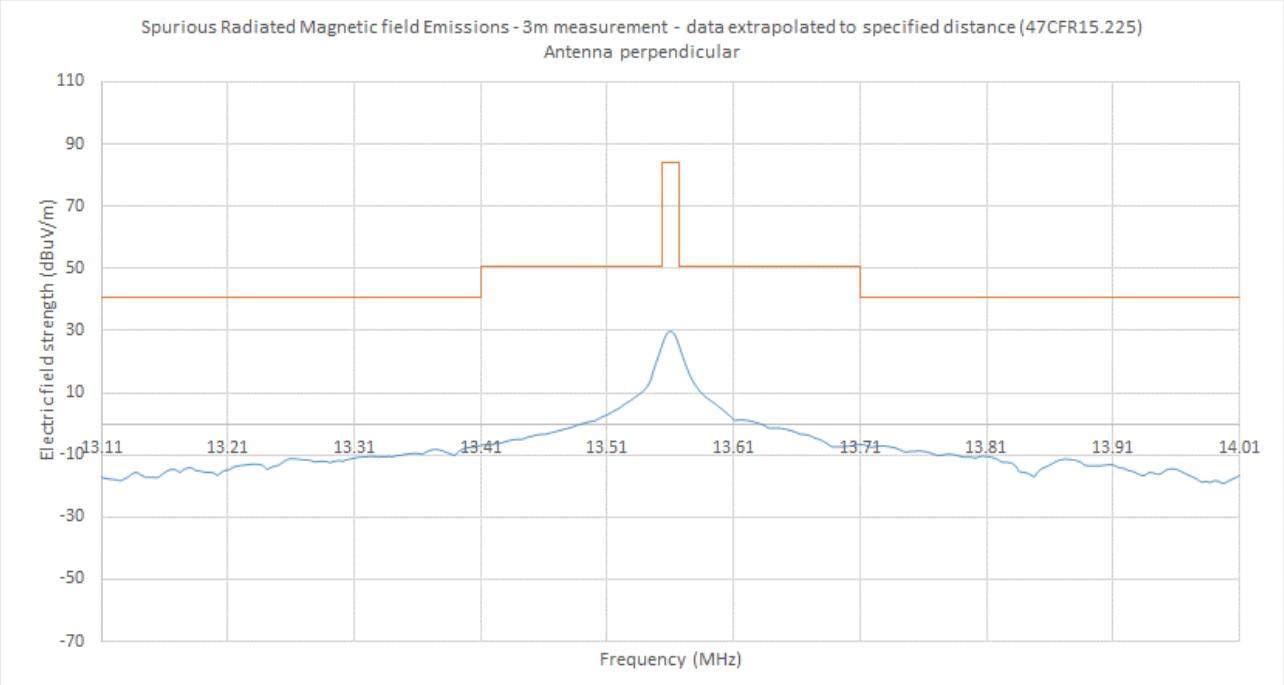

Figure 7: Magnetic field emissions Plot, 13.110MHz to 14.010MHz, Perpendicular

Freq (MHz)	Rx (dBμV)	Distance correction factor (40dB/ decade)	Preamp gain (dB)	Antenna factor dB/m	Result at 30m (dBμV/m)	Limit At 30m (dBμV/m)	Margin (dB)	Result
13.110	19.6	-40	-29.6	34.1	-15.9	40.5	-56.4	Below limit
13.410	28.1	-40	-29.6	34.1	-7.4	40.5	-47.9	Below limit
13.553	62.8	-40	-29.6	34.1	27.3	50.5	-23.2	Below limit
13.560	68.1	-40	-29.6	34.1	32.6	84	-51.4	Below limit
13.567	62.2	-40	-29.6	34.1	26.7	50.5	-23.8	Below limit
13.710	29.7	-40	-29.6	34.1	-5.8	40.5	-46.3	Below limit
14.010	18.5	-40	-29.6	34.1	-17.0	40.5	-57.5	Below limit

Table 5: Receiving antenna at 1m measurement height – Parallel orientation

Freq (MHz)	Rx (dBμV)	Distance correction factor (40dB/ decade)	Preamp gain (dB)	Antenna factor dB/m	Result at 30m (dBμV/m)	Limit At 30m (dBμV/m)	Margin (dB)	Result
13.56	65.8	-40	-29.6	34.1	30.3	84	-53.7	Below limit
13.41	28.9	-40	-29.6	34.1	-6.6	40.5	-47.1	Below limit
13.553	60.5	-40	-29.6	34.1	25	50.5	-25.5	Below limit
13.567	60	-40	-29.6	34.1	24.5	50.5	-26.0	Below limit
13.71	29	-40	-29.6	34.1	-6.5	40.5	-47.0	Below limit
13.11	18.5	-40	-29.6	34.1	-17	40.5	-57.5	Below limit
14.01	19.2	-40	-29.6	34.1	-16.3	40.5	-56.8	Below limit

Table 6: Receiving antenna at 1m measurement height – Perpendicular orientation

Rx = Test peak detector receiver reading (voltage dBμV) before the addition of antenna factor.

Result at 3m = Field strength (dBμV/m) at a measurement distance of 3m, 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.

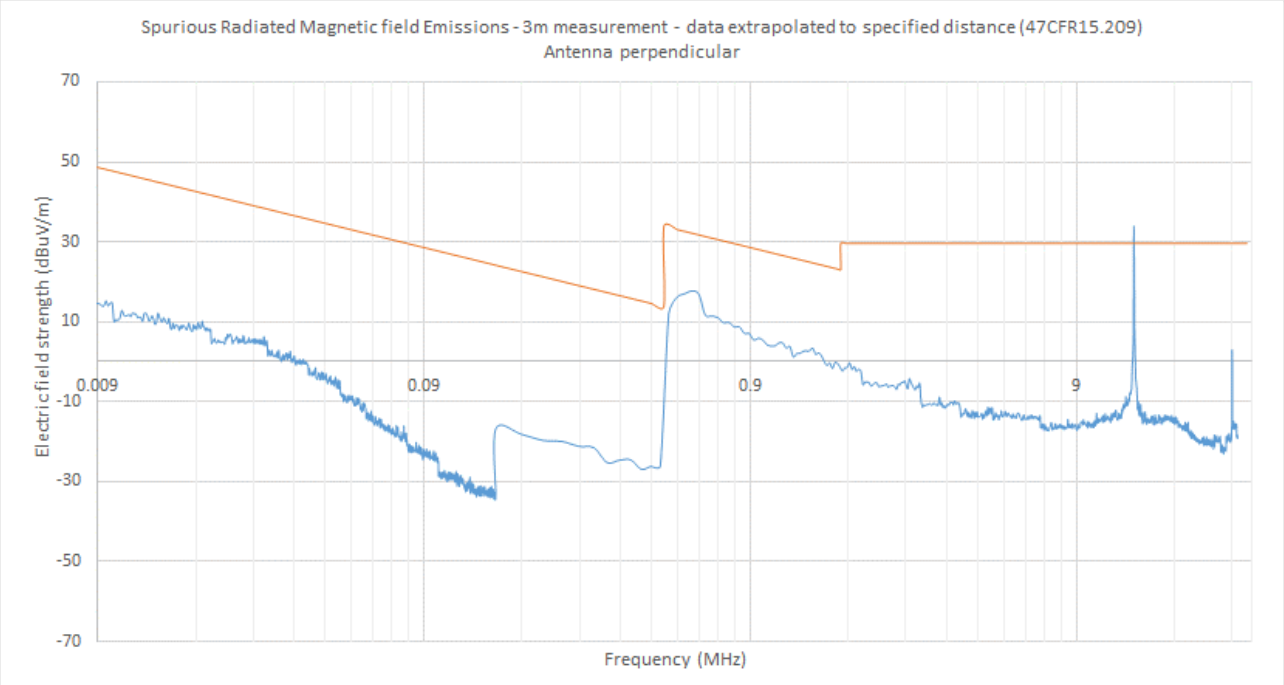

Figure 8: Magnetic field emissions Plot, 9kHz to 30MHz, antenna perpendicular

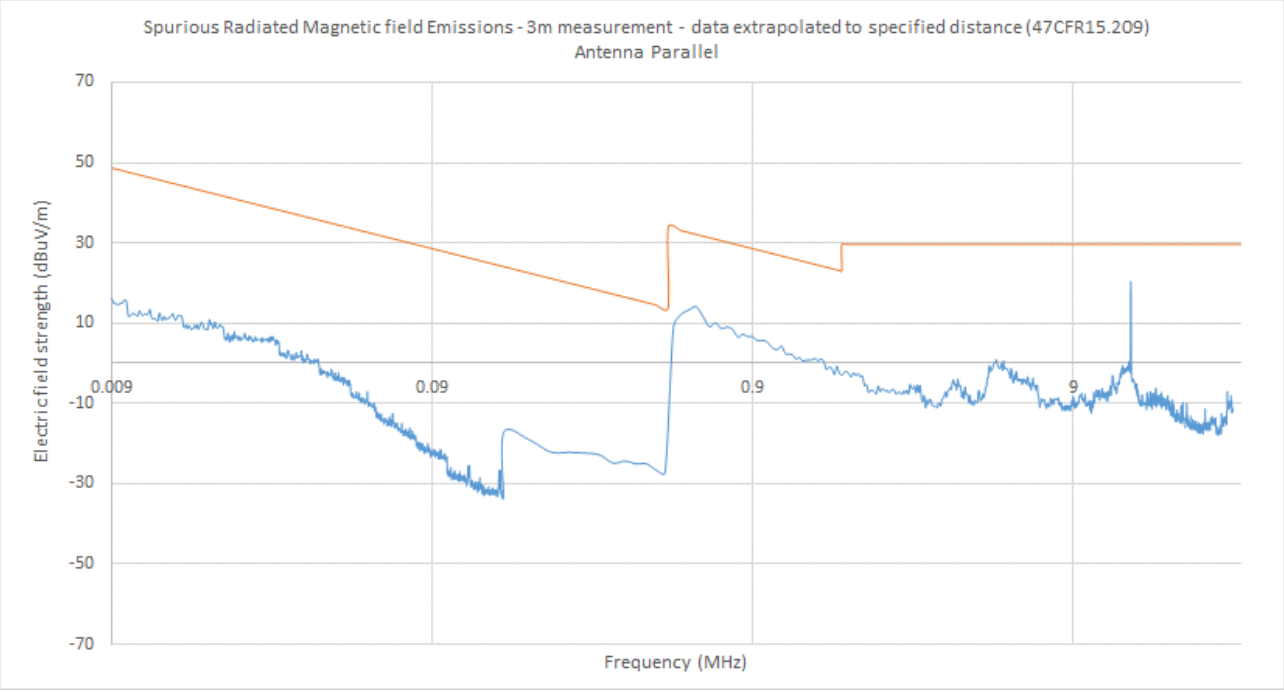

Figure 9: Magnetic field emissions Plot, 9kHz to 30MHz, antenna parallel

Freq (MHz)	Rx (dBμV)	Distance correction factor (40dB/ decade)	Preamp gain (dB)	Antenna factor dB/m	Result at 30m (dBμV/m)	Limit At 30m (dBμV/m)	Margin (dB)	Result
0.02	28.1	-80	29.7	87.5	5.9	41.6	-35.7	Below limit
0.15	22	-80	29.7	70.5	-17.2	44.1	-61.3	Below limit
0.497	19.9	-80	29.7	62.6	-27.2	33.7	-60.9	Below limit
0.5977	24.2	-40	29.7	59.6	14.1	32.1	-18	Below limit
0.9261	19.6	-40	29.7	55.8	5.7	28.3	-22.6	Below limit
27.1344	25.2	-40	29.7	37.1	-7.4	29.5	-36.9	Below limit

Table 7: Receiving antenna at 1m measurement height. Antenna parallel

Freq (MHz)	Rx (dBμV)	Distance correction factor (40dB/ decade)	Preamp gain (dB)	Antenna factor dB/m	Result at 30m (dBμV/m)	Limit At 30m (dBμV/m)	Margin (dB)	Result
0.020	27.1	-80	29.7	87.5	4.9	41.6	-36.7	Below limit
0.150	22.4	-80	29.7	70.5	-16.8	44.1	-60.9	Below limit
0.497	20.8	-80	29.7	62.6	-26.3	33.7	-60.0	Below limit
0.5977	27.8	-40	29.7	59.6	17.7	32.1	-14.4	Below limit
0.9261	19.32	-40	29.7	55.8	5.42	28.3	-22.88	Below limit
27.1344	35.4	-40	29.7	37.1	2.8	29.5	-26.7	Below limit

Table 8: 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 27.1344MHz, antenna parallel,

At 3m field strength = receiver reading 35.4dBuV

-pre amplifier gain (29.7)

+ Antenna factor (37.1dB/m)+ extrapolation (-40dB)

= 2.8dBuV/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

23rd April 2018

6.4.5 Test Area

LAB 1 Semi Anechoic Chamber

6.4.6 Test Setup

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

The measurement was performed with an antenna to EUT separation distance of 3m. The Quasi peak limits are therefore increased by 10dB (from the 10m values), to allow for the reduction in the measurement distance.

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

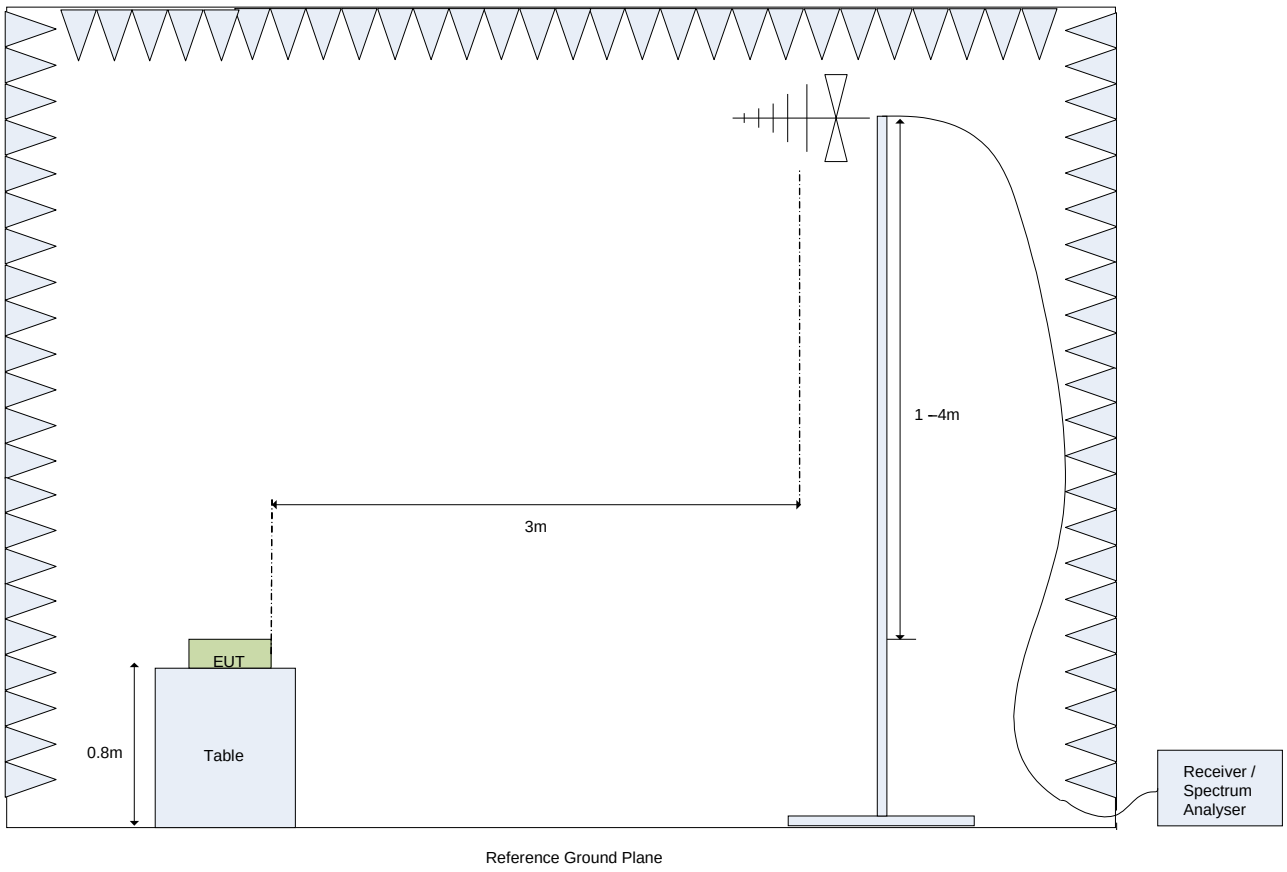

Figure 10: Test Setup for E-Field Measurements from 30MHz to 1GHz

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

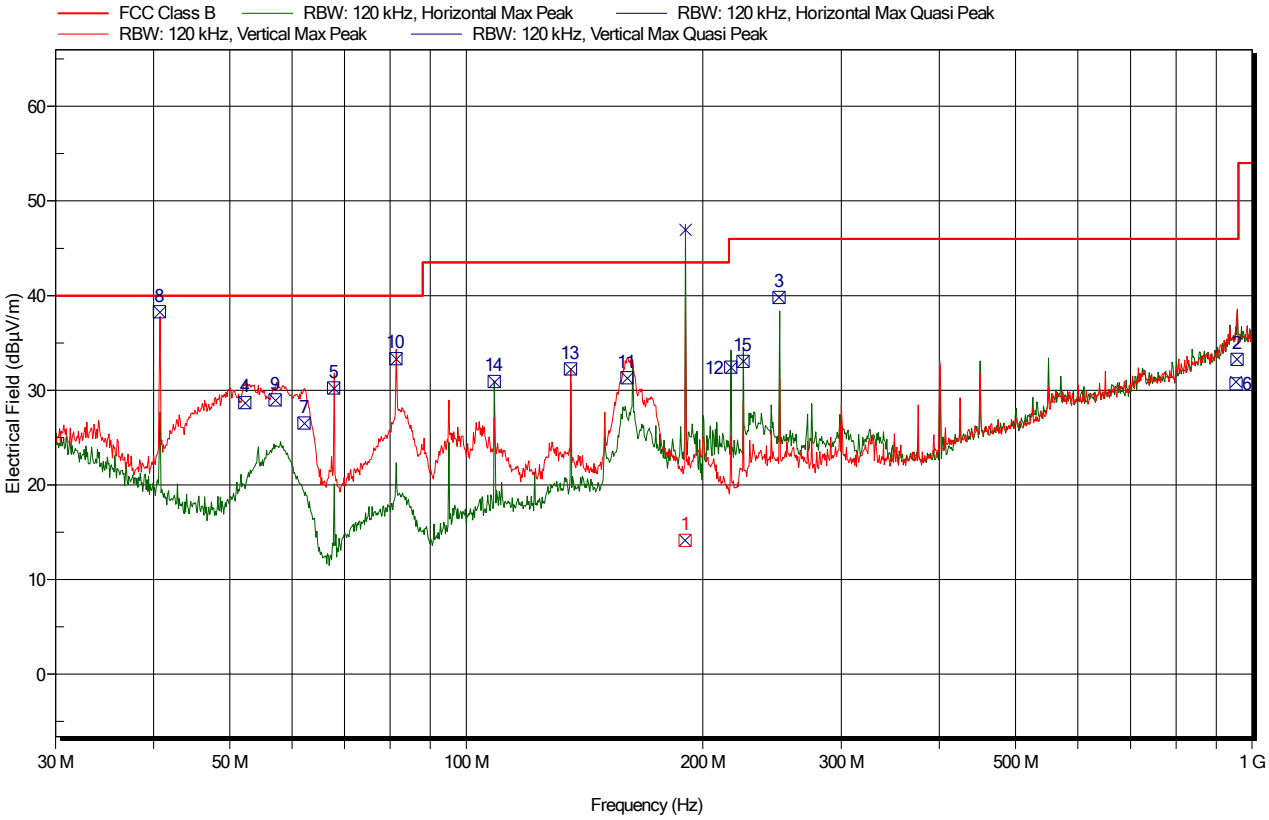

Figure 11: Electric field emissions Plot, 30MHz to 1GHz. Combined horizontal (green) and vertical (red) antenna polarisations

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
40.680	38.3	40	-1.7	20.9	Pass	5	1	Vertical
62.160	26.5	40	-13.5	12.6	Pass	90	1	Vertical
67.800	30.2	40	-9.8	13.2	Pass	165	1.2	Vertical
81.360	33.3	40	-6.7	14.5	Pass	360	1.1	Vertical
108.480	30.9	43.5	-12.6	17.7	Pass	50	2.9	Horizontal
135.600	32.3	43.5	-11.2	19.1	Pass	115	1	Vertical
160.140	31.3	43.5	-12.2	17.6	Pass	220	1	Vertical
216.960	32.4	46	-13.6	17.2	Pass	75	1.4	Horizontal
225.000	33.1	46	-12.9	17.7	Pass	105	1.4	Horizontal
250.020	39.8	46	-6.2	20.5	Pass	250	1	Horizontal
956.460	33.2	46	-12.8	34.9	Pass	200	1	Horizontal

Table 9: 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) + CL (dB)

6.4.9 Sample Data

The Quasi-Peak level at 40.680MHz

FS (dBµV/m) = 17.6(dBµV) + 20.3 (dB/m) +0.4 (dB) = 38.3 (dBµV/m)

Section 7 Frequency Stability

FCC Rule	47CFR 15.225 (e) – Frequency tolerance with temperature variation and supply voltage
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 $\pm 1 \times 10^{-8}$

7.1.1 Date of Test

24th 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 - Frequency stability and supply voltage:

Nominal voltage: 120V, 60Hz

85% of supply voltage: 102V

115% of supply voltage: 138V

Supply voltage (V ac)	Frequency (MHz)	Nominal	Deviation	Limit	Result
102	13.55982432	13.56	0.001295575	0.01	Within limit
138	13.55982452	13.56	0.0012941	0.01	Within limit

Table 10 Frequency stability with supply voltage

7.1.5 Test Results - Frequency stability and temperature

Temperature C	Time	Frequency (MH)	Nominal	Deviation %	Limit 47CFR15.225 %	Result
50	Start up	13.559809	13.56	0.001408555	0.01	Within Limit
	2min	13.559808	13.56	0.001415929	0.01	Within Limit
	5min	13.559826	13.56	0.001283186	0.01	Within Limit
	10min	13.559805	13.56	0.001438053	0.01	Within Limit
40	Start up	13.559804	13.56	0.001445428	0.01	Within Limit
	2min	13.559804	13.56	0.001445428	0.01	Within Limit
	5min	13.559814	13.56	0.001371681	0.01	Within Limit
	10min	13.559804	13.56	0.001445428	0.01	Within Limit
30	Start up	13.559814	13.56	0.001371681	0.01	Within Limit
	2min	13.559805	13.56	0.001438053	0.01	Within Limit
	5min	13.559806	13.56	0.001430678	0.01	Within Limit
	10min	13.559808	13.56	0.001415929	0.01	Within Limit
20	Start up	13.559817	13.56	0.001349558	0.01	Within Limit
	2min	13.559817	13.56	0.001349558	0.01	Within Limit
	5min	13.559822	13.56	0.001312684	0.01	Within Limit
	10min	13.559816	13.56	0.001356932	0.01	Within Limit
10	Start up	13.55983	13.56	0.001253687	0.01	Within Limit
	2min	13.559841	13.56	0.001172566	0.01	Within Limit
	5min	13.559838	13.56	0.00119469	0.01	Within Limit
	10min	13.55985	13.56	0.001106195	0.01	Within Limit
0	Start up	13.559846	13.56	0.001135693	0.01	Within Limit
	2min	13.559846	13.56	0.001135693	0.01	Within Limit
	5min	13.559853	13.56	0.001084071	0.01	Within Limit
	10min	13.559863	13.56	0.001010324	0.01	Within Limit
-10	Start up	13.559873	13.56	0.000936578	0.01	Within Limit
	2min	13.559873	13.56	0.000936578	0.01	Within Limit
	5min	13.559895	13.56	0.000774336	0.01	Within Limit
	10min	13.559875	13.56	0.000921829	0.01	Within Limit
-20	Start up	13.559873	13.56	0.000936578	0.01	Within Limit
	2min	13.559873	13.56	0.000936578	0.01	Within Limit
	5min	13.559888	13.56	0.000825959	0.01	Within Limit
	10min	13.559867	13.56	0.000980826	0.01	Within Limit

Table 11: Frequency stability with temperature

Section 8 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 $\pm 1 \times 10^{-8}$

8.1.1 Date of Test

5th June 2018

8.1.2 Test Area

LAB 1 Semi anechoic Chamber

8.1.3 Procedure

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

8.1.4 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 1.383kHz which was contained within the operating band 13.110 to 14.01MHz.

Note: The analyser settings were as close as possible to the requirements of ANSI C63.10-2013 Clause 6.9.2.

The radiated measurements in Section 6 show all emissions within the band 13.110MHz to 14.010MHz at least 20dB below the specification limit.

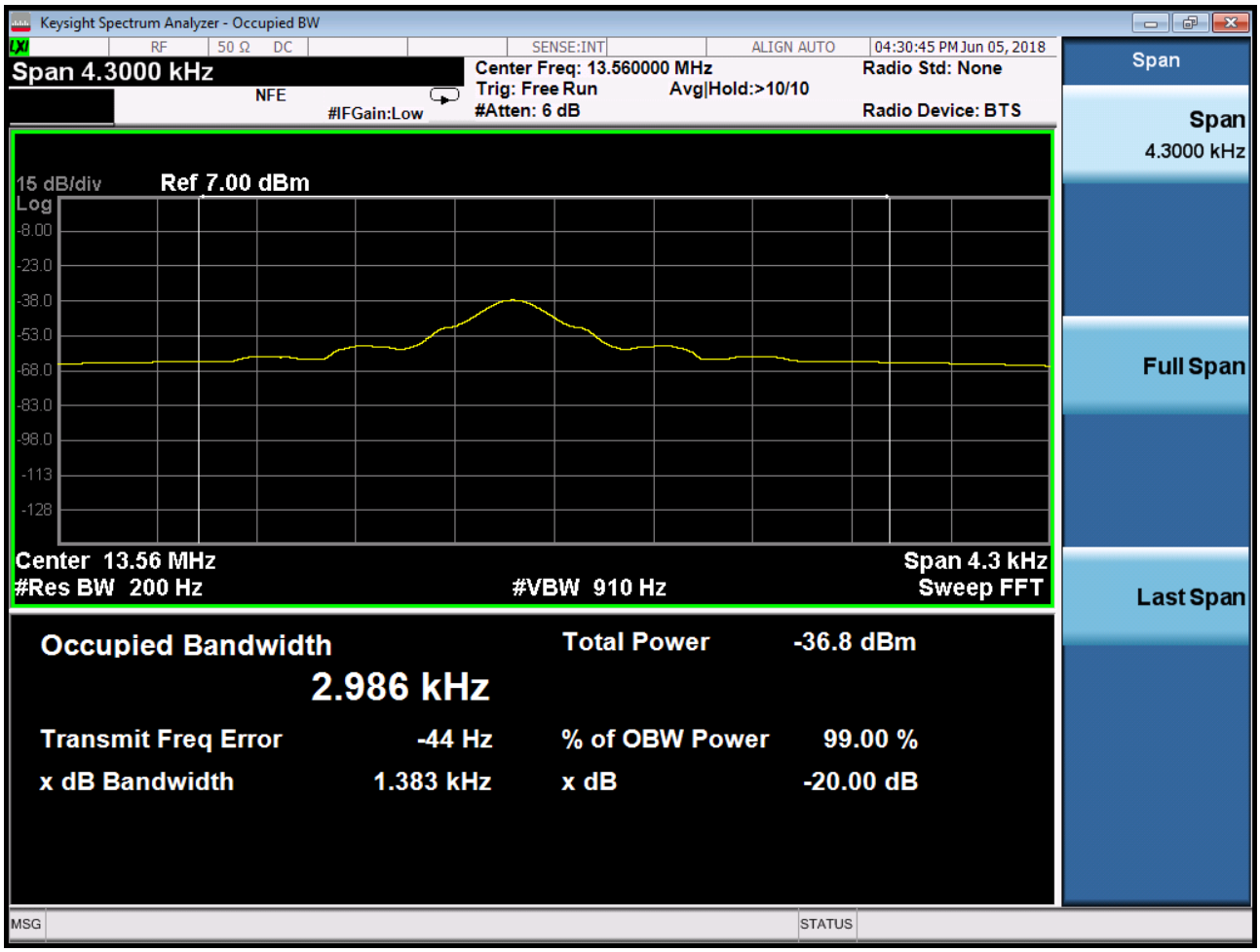

Figure 12: 20dB Bandwidth measurement

Section 9 Authorised Band Edge Measurements

FCC Rule Part	47CFR15.205
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 Frequency: $\pm 10^{-8}$

9.1.1 Date of Test

5th June 2018

9.1.2 Test Area

Laboratory 5 bench area.

9.1.3 Test Setup

This test was performed as a conducted measurement according to the procedures of ANSI C63.10-2013 Clause 6.10.4.

Spectrum analyser settings were according to ANSI C63.4-2013Clause 6.10.4 e) 1) to 6):

Attenuation	Auto
RBW	100kHz
Detector	Peak
Sweep time	Coupled
VBW	300kHz
Trace	Max hold

9.1.4 Requirement 47CFR15.

The authorised band-edge measurements according to the procedures of ANSI C63.10-2013 Clause 6.10.4 were performed.

9.1.5 Procedure

The procedure described in ANSI C63.10-2013 Clause 6.10.4

9.1.6 Results

Band edge frequency (MHz)	Figure	dBc band edge value	Summary
13.110	13	26.6	Pass
14.010	13	24.9	Pass

Table 12: Band Edge Measurements

Based on the carrier was measured as >50dB below the specification limit (Tables 5 and 6) and the radiated measurements (Figures 5 and 6) the apparatus meets the band edge requirements.

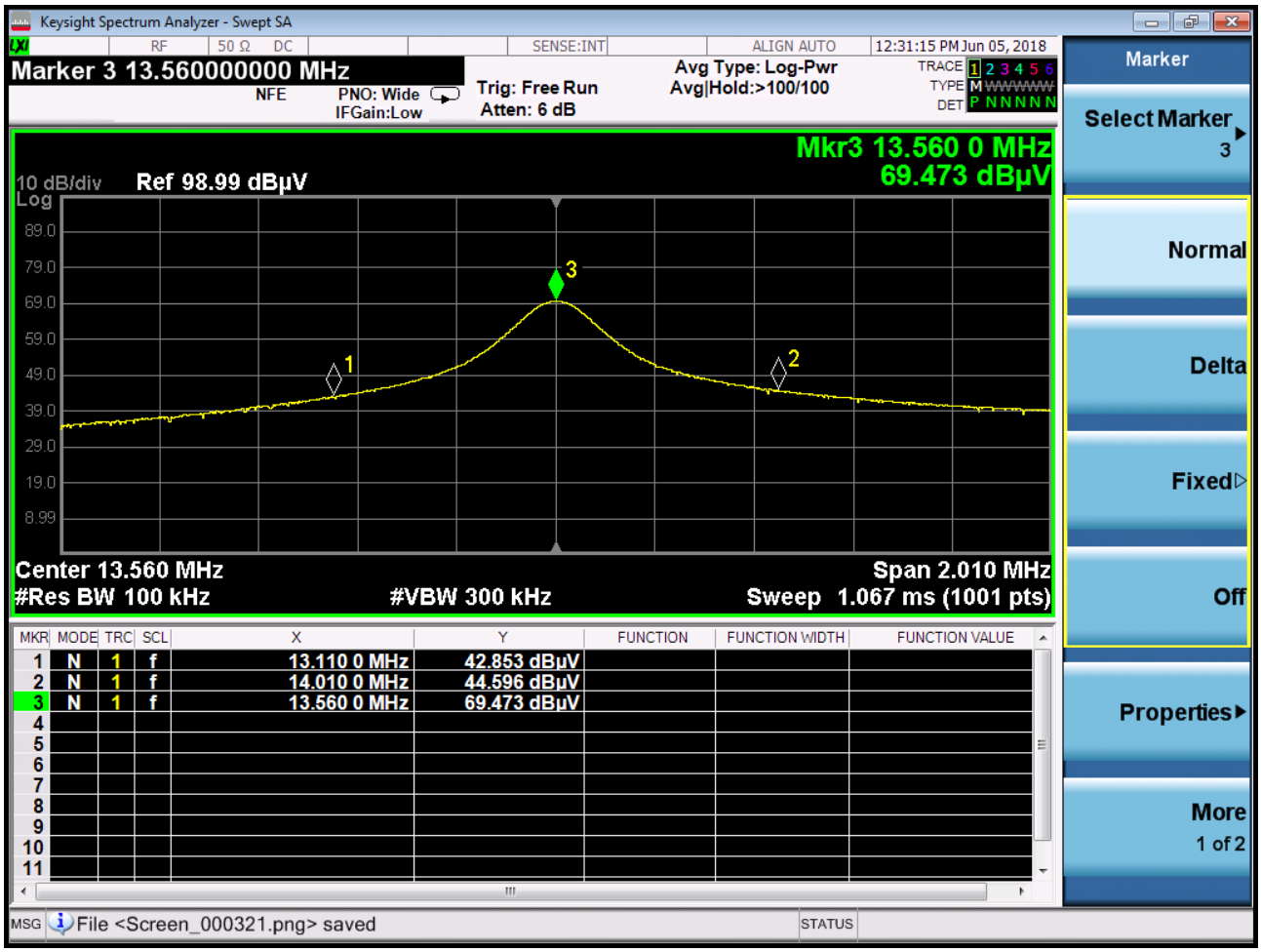

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Figure 13: Band Edge Measurement – conducted test

Appendix A Test Equipment List

Conducted Emissionst

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	15/05/2017	12 Months
Cable	J7	15/05/2017	12 Months
Cable	J9	15/05/2017	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	09/02/2018	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	1503	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