AN RADIO TEST REPORT

FOR

Paxton Access Ltd

ON

Net10 Dual Mode RFID Reader

DOCUMENT NO.TRA-024435-00-47-01B

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UKAS TESTING
0026

TRaC Wireless Test Report	**:** TRA-024435-00-47-01B
Applicant	**:** Paxton Access Ltd
Apparatus	**:** Net10 Dual Mode RFID Reader
Specification(s)	**:** CFR47 Part 15, RSS-GEN & RSS-210
Purpose of Test	**:** Certification
FCCID	**:** USE010818
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Authorised by	**:** John Charters Digitally signed by John Charters DN: cn=John Charters, o=TRAC Global Ltd, ou=Radio Product Manager, email=john.charters@tracglobal.com, c=GB Date: 2015.04.09 11:06:09 +01'00' : Radio Product Manager
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Section 1: Introduction

1.1 General

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on samples submitted to the Laboratory.

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1.2 Tests Requested By

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1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between 22nd January – 9th February 2015

The Net10 Dual mode RFID reader which operates on 125kHz and 13.56MHz.

Model: 010-818

1.5 Test Result Summary

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

Test Type	Title 47 of the CFR: Part 15 Subpart (c)	RSS-210	Measurement standard	Result
Spurious Emissions Radiated <1000MHz	15.209	RSS-Gen Issue 4 6.13	ANSI C63.10:2009	Pass
Spurious Emissions Radiated >1000MHz	15.209	RSS-Gen Issue 4 6.13	ANSI C63.10:2009	N/A
Emissions Below 30MHz	15.209	RSS-Gen Issue 4 6.13	ANSI C63.10:2009	Pass
AC Power conducted emissions	15.207	RSS-Gen Issue 4 8.8	ANSI C63.10:2009	Pass
Intentional Emission Frequency	15.209 & 15.225(a)	A2.6 & RSS-Gen Issue 4 6.13	ANSI C63.10:2009	Pass
Intentional Emission Field Strength	15.209 & 15.225(a)	A2.6 & RSS-Gen Issue 4 6.12	ANSI C63.10:2009	Pass
Intentional Emission Band Occupancy	15.215 (c)	RSS-Gen Issue 4 6.6	ANSI C63.10:2009	Pass
Frequency Stability	15.225	RSS-Gen 4.7	ANSI C63.10:2009	Pass
Unintentional Radiated Spurious Emissions	Subpart (b) 15.109	RSS-Gen Issue 4 6.11	ANSI C63.10:2009	Pass
Antenna Arrangements Integral:	15.203	RSS-Gen Issue 4 6.7	-	Pass
Antenna Arrangements External Connector	15.204	RSS-Gen Issue 4 6.7	-	N/A
Restricted Bands	15.205	RSS-Gen Issue 4 8.10	-	Pass
Maximum Frequency of Search	15.33	RSS-Gen Issue 4 6.13	-	Pass
Extrapolation Factor	15.31(f)	RSS-Gen Issue 4 6.5	-	Pass

Abbreviations used in the above table:

CFR : Code of Federal Regulations
REFE : Radiated Electric Field Emissions
ANSI : American National Standards Institution
PLCE : Power Line Conducted Emissions

1.6 Notes Relating To The Assessment

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, “Pass” indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

Temperature	: 17 to 23 °C
Humidity	: 45 to 75 %
Barometric Pressure	: 86 to 106 kPa

All dates used in this report are in the format dd/mm/yy.

This assessment has been performed in accordance with the requirements of ISO/IEC 17025.

1.7 Deviations from Test Standards

All test result at 3 meters are recorded at IC Site 39030-B4 additional measurements were performed on an open sites with no ground plane.

Section 2: Measurement Uncertainty

2.1 Measurement Uncertainty Values

For the test data recorded the following measurement uncertainty was calculated:

Radio Testing – General Uncertainty Schedule

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

Uncertainty in test result (Power Meter) = **1.08dB**
Uncertainty in test result (Spectrum Analyser) = **2.48dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

Uncertainty in test result (Frequency Counter) = **0.113ppm**
Uncertainty in test result (Spectrum Analyser) = **0.265ppm**

[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**,
Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,
Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

Uncertainty in test result – Up to 8.1GHz = **3.31dB**
Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**
Uncertainty in test result – 15.3GHz – 21GHz = **5.34dB**
Uncertainty in test result – Up to 26GHz = **3.14dB**

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

Uncertainty in overall test level = **2.1dB**,
Uncertainty in time measurement = **0.59%,**
Uncertainty in Amplitude measurement = **0.82%**

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

Uncertainty in test result = **2.59% (frequency)**
Uncertainty in test result = **1.32dB (amplitude)**

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3: Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Section 4 **General Test Procedures**

4.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst case determined for function, operation, orientation etc for both vertical and horizontal polarisations

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10:2009 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

For devices with intentional emissions below 30 MHz, a shielded loop antenna is used as the test antenna. It is placed at a 1 meter receive height and appropriate low frequency magnetic field extrapolation to the regulatory limit distance is employed. The EUT is rotated through 360˚in the azimuth.

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360˚ in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Where regulations allow for direct measurement of field strength, power values measured on the test receiver / analyzer are converted to dBuV/m at the regulatory distance, using:

$$FS = PR + AF + CL - PA + KG + DC - CF \text{ (dBuV/m)}$$

Where:

PR is the power recorded on receiver / spectrum analyzer (dBuV),
AF is the test antenna factor in dB/m,
CL is the cable loss in dB,
PA is the pre-amplifier gain dB (when applicable),
DC is duty correction factor (when applicable) in dB, and
CF is a distance correction (employed only for measurements at alternate distance to limit) in dB.

This field strength value is then compared with the regulatory limit.

If effective radiated power (ERP) or effective isotropic radiated power (EIRP) is required, it is computed as per ANSI C63.10:2009

$$P = \frac{(Ed)^2}{30G}$$

Where

P is the power, in W
E is the measured peak field strength, in V/m
d is the distance at which the measurement was made, in m
G is the numeric gain of the radiating element

If the gain of the radiating element is not known, then either the effective radiated power (ERP) or the effective isotropic radiated power (EIRP) may be calculated from the measured peak field strength, by using either G = 1.64 or G = 1, respectively.

4.2 AC Powerline Conducted Emissions Test Setup and Procedures

AC Powerline Conducted Emissions from the EUT are checked first by preview scans with Peak and average detectors covering both live and neutral lines. A spectrum analyser is used to determine if any periodic emissions are present. Preview scans are performed in standby or receive mode if the device is subject to these requirements. For transmit mode of operation the device is set to one of the following modes.

- Transmitting operating at full power (single mode device)
- Transmitting at freq / modulation that gives highest output power (multi mode device)
- Transmitter operating in normal TX mode (e.g. FHSS, TDMA etc)

Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans.

Battery Power devices are not subject to power line conducted emissions measurements when it is powered solely by its internal battery.

4.3 Antenna Port Conducted Emissions

Antenna port conducted emissions can include, but are not limited to, Carrier power, Power Spectral Density, Occupied bandwidth and spurious emission.

Spurious Emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked to identify frequencies to perform formal measurements on.

Formal measurements are made on frequencies identified from the preview scans and fundamental emission(s). Measurements are made using the correct instrumentation (inc. power meter, receiver, spectrum analyser) that operate with the required detector(s) and bandwidth.

Care is taken to ensure the measurement instrument is not overloaded by the presence of the transmitted signal by use of external attenuation and filtering where required.

Measured levels are corrected for cables, attenuators, and filters. If applicable, for the specific measurement, antenna gain is also taken into account.

4.4 Power Supply Variation

Tests at extreme supply voltages are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report.

In the case the EUT is designed for operation from a lead-acid battery power source, the extreme test voltages are evaluated between 90% and 130% of the nominal battery voltage declared by the manufacturer.

For float charge applications using gel-cell type batteries, extreme test voltages are evaluated between 85% and 115% of the nominal battery voltage declared.

For all battery operated equipment, worst case intentional and spurious emissions are re-checked employing a new (fully charged) battery.

4.5 Thermal Variation

Tests at extreme temperatures are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report.

Tests are performed at the upper and lower extremes as required and typically at 10˚ steps between.

Before any temperature measurements are made, the equipment is allowed to reach a thermal balance in the test chamber.

4.6 Time Domain Measurements

Time domain measurements are made for (but not limited to) use in duty cycle correction, to ensure compliance with time restrictions on certain types of devices.

If measurements of a transmitter's on time are required these are performed with a spectrum analyser in the time domain or with an oscilloscope and RF detector. If time on a specific frequency is required (e.g. FHSS timing) the measurement can only be made with a spectrum analyser.

The triggering, timescale and amplitude settings are adjusted according to the signal to be measured on a case by case basis.

For devices with sharp rise/fall times measurements are made between RF reaching full power (T_{on}) and RF dropping to the measurement instrument noise floor (T_{off}). For longer rise times measurements are made for T_{on} and T_{off} at the RF level required by the occupied bandwidth measurement (e.g. 6 dB, 20 dB etc).

Appendix A: Formal Emission Test Results

Abbreviations used in the tables in this appendix:

Spec	: Specification
Mod	: Modification
EUT	: Equipment Under Test
SE	: Support Equipment
L	: Live Power Line
N	: Neutral Power Line
E	: Earth Power Line
Pk	: Peak Detector
QP	: Quasi-Peak Detector
Av	: Average Detector
CDN	: Coupling & decoupling network

ALSR	: Absorber Lined Screened Room
OATS	: Open Area Test Site
ATS	: Alternative Test Site
Ref	: Reference
Freq	: Frequency
MD	: Measurement Distance
SD	: Spec Distance
Pol	: Polarisation
H	: Horizontal Polarisation
V	: Vertical Polarisation

A1 Transmitter Intentional Emission Radiated - 125.0 kHz

Carrier power was verified with the EUT transmitting Test Details:	
Regulation	Part15 Subpart (c) 15.209 & RSS-Gen 6.13
Measurement standard	ANSI C63.10:2009
EUT sample number	S12,
Modification state	0
SE in test environment	S39, S16, S17, S38.
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	19˚C
Photographs (Appendix F)	1

FREQ. (kHz)	MEASUREMENT DISTANCE Meters	MEASUREMENT Rx. READING (dBµV/m)	EXTRAP. FACTOR (dB)	FIELD STRENGTH (µV/m)
125.00	3	76.20	88.08	0.255
125.00	10	47.20	59.08	0.255
Limit value @ fc		19.20µV/m@ 300meters		

Band occupancy @ -20 dBc	f lower	f higher
15.54kHz	118.108974kHz	133.653846kHz
Band occupancy @ 99%	f lower	f higher
36.37kHz	113.141025kHz	149.519230kHz

Notes:
1 Results quoted are extrapolated as indicated
2 Receiver detector @ fc = Average 200Hz bandwidth
3 When battery powered the EUT was powered with new batteries
4 Extrapolation <30 MHz 40dB/decade as per 15.31(f)(2) & RSS Gen 6.4
5 3 – 300 metre extrapolation 80 dB
6 1 – 3 metre extrapolation measured
7 1 – 300 metre extrapolation = measured 1m-3m + calculated 3m - 300m

Test Method:
1 As per Radio – Noise Emissions, ANSI C63.10:2009
2 Measuring distances 1m & 3m
3 EUT 0.8 metre above ground plane
4 Emissions maximised by rotation of EUT, on an automatic turntable.
Raising and lowering the receiver antenna between 1m & 4m.
Horizontal and vertical polarisations, of the receive antenna.
EUT orientation in three orthagonal planes.
Maximum results recorded

A2 Transmitter Intentional Emission Radiated – 13.56MHz

Carrier power was verified with the EUT transmitting Test Details:	
Regulation	Part15 Subpart (c) 15.225(a)(b)(c), RSS-210 A2.6
Measurement standard	ANSI C63.10:2009
EUT sample number	S15,
Modification state	0
SE in test environment	S39, S16, S17, S37.
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	19˚C
Photographs (Appendix F)	1

FREQ. (MHz)	MEASUREMENT DISTANCE Metres	MEASUREMENT Rx. READING (dBµV/m)	EXTRAP. FACTOR (dB)	FIELD STRENGTH (µV/m)
13.56	3	76.90	33.58	146.473
13.56	10	62.40	19.08	146.473
Limit value @ fc		15848 µV/m @ 30metres		
Band occupancy @ -20 dBc		f lower		f higher
363.46kHz		13.415288MHz		13.778750MHz
Band occupancy @ 99%		f lower		f higher
430.77kHz		13.347980MHz		13.778750MHz

FREQ. (MHz)	Limit @30m (µV/m)	Result
13.410-13553 13.567-13710	334	Compliant Note 8
13.110-13.410 13.710-14.010	106	Compliant Note 8

Notes:
1 Results quoted are extrapolated as indicated
2 Receiver detector @ fc = Quasi Peak 10
4 Extrapolation <30 MHz 40dB/decade as per 15.31(f)(2) & RSS Gen 6.4
5 3 – 300 metre extrapolation 80 dB (40dB/decabe) as per 15.31(f)(2)
6 1 – 3 metre extrapolation as measured
7 1 – 300 metre extrapolation 104.7 dB (80dB + 24.7dB)
8 For compliance with emission mask rule part 15.225(b) and (c) see graphical data

Test Method:

1 As per Radio – Noise Emissions, ANSI C63.10:2009
2 Measuring distances 1m & 3m
3 EUT 0.8 metre above ground plane
4 Emissions maximised by rotation of EUT, on an automatic turntable.
Raising and lowering the receiver antenna between 1m & 4m.
Horizontal and vertical polarisations, of the receive antenna.
EUT orientation in three orthagonal planes.
Maximum results recorded

A3 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to all spurious emissions and harmonics emissions. The EUT was set to transmit as required.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : [ ] 3m alternative test site : [X]

Test Details 125.0kHz	
Regulation	Part 15 Subpart (c) Clause 15.209, RSS-Gen 6.13
Measurement standard	ANSI C63.10:2009
Frequency range	9kHz – 1GHz
EUT sample number	S12,
Modification state	0
SE in test environment	S39, S16, S17, S38.
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	19˚C
Photographs (Appendix F)	1

The worst case radiated emission measurements for spurious emissions and harmonics are listed overleaf:
Note only emission within 20 dB of limit are recorded. See scan data in appendix B.

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	30.35	5.30	0.8	17.6	-	23.70	-	15.36	100
2.	34.25	7.40	0.8	15.6	-	23.80	-	15.40	100
3.	35.95	14.10	0.8	14.6	-	29.50	-	30.10	100
4.	37.05	15.06	0.9	14.1	-	30.06	-	31.73	100
5.	41.75	9.50	1.0	11.5	-	22.00	-	12.63	100
6.	52.50	18.10	1.0	6.8	-	25.90	-	19.72	100
7.	53.75	21.70	1.0	6.5	-	29.20	-	28.67	100
8.	54.75	21.50	1.0	6.2	-	28.70	-	27.16	100
9.	55.70	20.90	1.0	5.9	-	27.80	-	24.52	100
10.	56.85	18.90	1.0	5.7	-	25.60	-	19.10	100
11.	64.20	24.80	1.1	5.0	-	30.90	-	35.28	100
12.	64.80	24.90	1.2	5.1	-	31.20	-	36.02	100
13.	65.45	21.70	1.2	5.1	-	28.00	-	25.03	100
14.	70.90	16.70	1.2	5.4	-	23.30	-	14.60	100
15.	80.00	21.10	1.3	6.7	-	29.10	-	28.51	100
16.	81.45	18.70	1.3	7.0	-	27.00	-	22.36	100
17.	81.80	21.30	1.3	7.1	-	29.70	-	30.41	100
18.	86.35	10.80	1.3	8.0	-	20.10	-	10.13	100
19.	100.00	13.00	1.5	10.3	-	24.80	-	17.38	150

Test Details 13.56MHz	
Regulation	Part 15 Subpart (c) Clause 15.209, RSS-Gen 6.13
Measurement standard	ANSI C63.10:2009
Frequency range	9kHz – 1GHz
EUT sample number	S15,
Modification state	0
SE in test environment	S39, S16, S17, S37.
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	19˚C
Photographs (Appendix F)	1

The worst case radiated emission measurements for spurious emissions and harmonics are listed below.
Note only emission within 20 dB of limit are recorded. See scan data in appendix B.

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
1.	30.00	5.6	0.8	17.8	-	24.20	-	16.22	100
2.	34.20	6.2	0.8	15.6	-	22.00	-	13.46	100
3.	35.85	17.7	0.8	14.7	-	33.20	-	45.81	100
4.	36.10	16.1	0.9	14.6	-	31.60	-	37.58	100
5.	37.20	13.7	0.9	14.0	-	28.60	-	26.85	100
6.	40.70	16.3	1.0	12.1	-	29.40	-	29.34	100
7.	51.75	18.6	1.0	7.1	-	26.70	-	21.58	100
8.	53.55	20.3	1.0	6.5	-	27.80	-	24.52	100
9.	54.75	21.1	1.0	6.2	-	28.30	-	25.94	100
10.	56.60	20.5	1.0	5.7	-	27.20	-	23.01	100
11.	64.50	24.3	1.1	5.1	-	30.50	-	33.46	100
12.	67.80	27.2	1.2	5.1	-	33.50	-	47.32	100
13.	70.20	14.8	1.2	5.3	-	21.30	-	11.64	100
14.	79.35	17.3	1.3	6.6	-	25.20	-	18.13	100
15.	81.40	26.7	1.3	7.0	-	35.00	-	56.10	100
16.	83.75	19.4	1.3	7.5	-	28.20	-	25.56	100
17.	99.75	13.3	1.5	10.3	-	25.10	-	17.95	150
18.	139.65	12.1	1.6	11.0	-	24.70	-	17.18	150
19.	162.70	19.1	1.9	9.3	-	30.30	-	32.62	150
20.	189.85	22.2	2.0	8.4	-	32.60	-	42.41	150
21.	203.40	14.1	1.9	8.8	-	24.80	-	17.40	150
22.	216.95	21.1	2.0	8.3	-	31.40	-	37.28	200

Ref No.	FREQ. (MHz)	MEAS Rx (dBµV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBµV/m)	EXTRAP FACT (dB)	FIELD ST'GH (µV/m)	LIMIT (µV/m)
23.	230.55	14.2	2.2	9.9	-	26.30	-	20.44	200
24.	325.45	13.4	2.5	13.8	-	29.70	-	30.55	200
25.	352.55	13.6	2.5	14.4	-	30.50	-	33.77	200
26.	379.70	14.5	2.9	15.1	-	32.50	-	41.78	200
27.	406.80	7.6	2.7	16.2	-	26.50	-	21.26	200
28.	461.05	7.0	3.1	16.7	-	26.80	-	21.93	200

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10:2009. For emissions below 30MHz the cable losses are assumed to be negligible.

2 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.

3 For Frequencies below 1 GHz, RBW= 120 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak	RBW= 1MHz, VBW ≥ RBW
Average	RBW= 1MHz, VBW ≥ RBW

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15 Clause 15.33(a) and 15.33(a)(1) & RSS-GEN 6.13

Radiated emission limits:

Frequency of emission (MHz)	Field strength µV/m	Measurement Distance m	Field strength dBµV/m
0.009-0.490	2400/F(kHz)	300	67.6/F (kHz)
0.490-1.705	24000/F(kHz)	30	87.6/F (kHz
1.705-30	30	30	29.5
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

(a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

$$\text{Extrapolation}\,(\text{dB}) = 20\log_{10}\left(\frac{\text{measurement distance}}{\text{specification distance}}\right)$$

(b) The levels may have been rounded for display purposes.

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels	✓			
Effect of Position of EUT cables & samples on emission levels	✓			

(i) Parameter defined by standard and / or single possible, refer to Appendix D
(ii) Parameter defined by client and / or single possible, refer to Appendix D
(iii) Parameter had a negligible effect on emission levels, refer to Appendix D
(iv) Worst case determined by initial measurement, refer to Appendix D

A4 Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak detector in a screened room. The effect of the EUT set-up on the measurements is summarised in note (b). Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector.

Test Details: 13.56MHz	
Regulation	Part 15 Subpart (c) Clause 15.207, RSS-Gen 8.8
Measurement standard	ANSI C63.10:2009
Frequency range	150kHz to 30MHz
EUT sample number	S15, S13,
Modification state	0
SE in test environment	S39, S16, S17, S37.
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	2

The worst-case power line conducted emission measurements are listed below:

Results measured using the Quasi Peak detector compared to the Quasi Peak limit
13.56MHz

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.174000	48.7	2000.0	10.000	L1	9.5	16.1	64.8
0.198000	46.3	2000.0	10.000	L1	9.5	17.4	63.7
0.266000	36.0	2000.0	10.000	L1	9.5	25.3	61.2
0.386000	39.7	2000.0	10.000	N	9.5	18.4	58.1
0.486000	39.0	2000.0	10.000	N	9.5	17.2	56.2
0.642000	37.0	2000.0	10.000	N	9.5	19.0	56.0
0.738000	32.6	2000.0	10.000	N	9.5	23.4	56.0
1.238000	34.0	2000.0	10.000	L1	9.5	22.0	56.0
1.282000	35.9	2000.0	10.000	N	9.5	20.1	56.0
13.346000	40.3	2000.0	10.000	N	9.7	19.7	60.0
13.426000	38.1	2000.0	10.000	N	9.7	21.9	60.0
13.550000	49.1	2000.0	10.000	N	9.7	10.9	60.0
13.558000	69.0	2000.0	10.000	N	9.7	-9.0	60.0
13.694000	38.9	2000.0	10.000	N	9.7	21.1	60.0
13.770000	41.1	2000.0	10.000	N	9.7	18.9	60.0

Results measured using the Average detector compared to the Average limit
13.56MHz

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.626000	27.4	2000.0	10.000	L1	9.5	18.6	46.0
0.738000	15.0	2000.0	10.000	L1	9.5	31.0	46.0
3.230000	29.9	2000.0	10.000	N	9.6	16.1	46.0
4.170000	30.0	2000.0	10.000	N	9.6	16.0	46.0
4.710000	31.9	2000.0	10.000	N	9.6	14.1	46.0
7.402000	36.0	2000.0	10.000	N	9.6	14.0	50.0
7.806000	37.0	2000.0	10.000	N	9.6	13.0	50.0
7.934000	21.0	2000.0	10.000	L1	9.6	29.0	50.0
8.346000	38.0	2000.0	10.000	N	9.6	12.0	50.0
8.750000	36.4	2000.0	10.000	N	9.6	13.6	50.0
8.882000	35.7	2000.0	10.000	N	9.6	14.3	50.0
9.286000	35.3	2000.0	10.000	N	9.6	14.7	50.0
13.550000	37.0	2000.0	10.000	N	9.7	13.0	50.0
13.558000	64.7	2000.0	10.000	N	9.7	-14.7	50.0
18.026000	20.6	2000.0	10.000	L1	9.7	29.4	50.0

13.56MHz Dummy Load fitted

Results measured using the Quasi Peak detector compared to the Quasi Peak limit

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.174000	48.5	2000.0	10.000	L1	9.5	16.2	64.8
0.198000	46.3	2000.0	10.000	L1	9.5	17.4	63.7
0.266000	36.0	2000.0	10.000	L1	9.5	25.3	61.2
0.366000	40.4	2000.0	10.000	N	9.5	18.2	58.6
0.478000	39.1	2000.0	10.000	N	9.5	17.3	56.4
0.642000	35.3	2000.0	10.000	N	9.5	20.7	56.0
0.770000	33.1	2000.0	10.000	N	9.5	22.9	56.0
1.242000	32.7	2000.0	10.000	L1	9.5	23.3	56.0
1.254000	31.4	2000.0	10.000	L1	9.5	24.6	56.0
1.878000	31.4	2000.0	10.000	L1	9.6	24.6	56.0
2.690000	32.3	2000.0	10.000	L1	9.6	23.7	56.0
3.090000	28.1	2000.0	10.000	L1	9.6	27.9	56.0
4.034000	29.5	2000.0	10.000	L1	9.6	26.5	56.0
4.706000	30.3	2000.0	10.000	L1	9.6	25.7	56.0
7.934000	27.0	2000.0	10.000	L1	9.6	33.0	60.0

13.56MHz Results measured using the Average detector compared to the Average limit

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.622000	25.5	2000.0	10.000	N	9.5	20.5	46.0
3.230000	28.4	2000.0	10.000	N	9.6	17.6	46.0
4.166000	21.4	2000.0	10.000	L1	9.6	24.6	46.0
4.710000	29.5	2000.0	10.000	N	9.6	16.5	46.0
7.402000	35.2	2000.0	10.000	N	9.6	14.8	50.0
7.806000	35.4	2000.0	10.000	N	9.6	14.6	50.0
7.934000	21.8	2000.0	10.000	L1	9.6	28.2	50.0
8.342000	34.3	2000.0	10.000	N	9.6	15.7	50.0
8.746000	33.8	2000.0	10.000	N	9.6	16.2	50.0
8.882000	35.4	2000.0	10.000	N	9.6	14.6	50.0
9.286000	35.1	2000.0	10.000	N	9.6	14.9	50.0
11.978000	33.2	2000.0	10.000	N	9.7	16.8	50.0
13.998000	35.3	2000.0	10.000	N	9.7	14.7	50.0
14.402000	36.7	2000.0	10.000	N	9.7	13.3	50.0
18.034000	33.7	2000.0	10.000	N	9.7	16.3	50.0

Test Details: 125.0kHz	
Regulation	Part 15 Subpart (c) Clause 15.207, RSS-Gen 8.8
Measurement standard	ANSI C63.10:2009
Frequency range	150kHz to 30MHz
EUT sample number	S12,
Modification state	0
SE in test environment	S39, S16, S17, S38.
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	2

Results measured using the Quasi Peak detector compared to the Quasi Peak limit
125.0kHz

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.174000	47.8	2000.0	10.000	L1	9.5	17.0	64.8
0.202000	45.1	2000.0	10.000	N	9.5	18.4	63.5
0.278000	37.0	2000.0	10.000	N	9.5	23.9	60.9
0.370000	40.3	2000.0	10.000	N	9.5	18.2	58.5
0.478000	39.1	2000.0	10.000	N	9.5	17.3	56.4
0.642000	35.2	2000.0	10.000	N	9.5	20.8	56.0
0.762000	32.9	2000.0	10.000	N	9.5	23.1	56.0
1.242000	32.5	2000.0	10.000	N	9.5	23.5	56.0
1.250000	31.6	2000.0	10.000	N	9.5	24.4	56.0
1.878000	31.7	2000.0	10.000	L1	9.6	24.3	56.0
2.690000	32.2	2000.0	10.000	L1	9.6	23.8	56.0
3.074000	27.5	2000.0	10.000	L1	9.6	28.5	56.0
3.766000	31.5	2000.0	10.000	L1	9.6	24.5	56.0
4.714000	32.2	2000.0	10.000	L1	9.6	23.8	56.0
7.402000	36.4	2000.0	10.000	L1	9.6	23.6	60.0

Results measured using the Average detector compared to the Average limit
125.0kHz

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.626000	25.1	2000.0	10.000	N	9.5	20.9	46.0
3.230000	28.3	2000.0	10.000	N	9.6	17.7	46.0
4.174000	29.6	2000.0	10.000	N	9.6	16.4	46.0
4.710000	29.0	2000.0	10.000	L1	9.6	17.0	46.0
7.402000	34.3	2000.0	10.000	L1	9.6	15.7	50.0
7.806000	34.3	2000.0	10.000	L1	9.6	15.7	50.0
7.942000	35.6	2000.0	10.000	N	9.6	14.4	50.0
8.346000	36.8	2000.0	10.000	N	9.6	13.2	50.0
8.750000	35.5	2000.0	10.000	N	9.6	14.5	50.0
8.882000	33.3	2000.0	10.000	L1	9.6	16.7	50.0
9.286000	33.0	2000.0	10.000	L1	9.6	17.0	50.0
11.574000	29.7	2000.0	10.000	L1	9.6	20.3	50.0
13.866000	34.5	2000.0	10.000	N	9.7	15.5	50.0
14.402000	33.5	2000.0	10.000	N	9.7	16.5	50.0
18.038000	33.3	2000.0	10.000	N	9.7	16.7	50.0

Test Details: Idle Mode	
Regulation	Part 15 Subpart (c) Clause 15.207, RSS-Gen 8.8
Measurement standard	ANSI C63.10:2009
Frequency range	150kHz to 30MHz
EUT sample number	S14,
Modification state	0
SE in test environment	S39, S16, S17, S38.
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	2

Results measured using the Quasi Peak detector compared to the Quasi Peak limit

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.170000	47.4	2000.0	10.000	N	9.5	17.6	65.0
0.210000	45.0	2000.0	10.000	N	9.5	18.2	63.2
0.310000	34.0	2000.0	10.000	L1	9.5	26.0	60.0
0.362000	40.2	2000.0	10.000	N	9.5	18.4	58.7
0.482000	39.1	2000.0	10.000	N	9.5	17.2	56.3
0.642000	35.2	2000.0	10.000	N	9.5	20.8	56.0
0.746000	32.7	2000.0	10.000	N	9.5	23.3	56.0
1.242000	32.0	2000.0	10.000	L1	9.5	24.0	56.0
1.286000	30.8	2000.0	10.000	L1	9.5	25.2	56.0
1.926000	31.8	2000.0	10.000	L1	9.6	24.2	56.0
2.486000	31.8	2000.0	10.000	L1	9.6	24.2	56.0
3.094000	29.1	2000.0	10.000	L1	9.6	26.9	56.0
3.770000	33.4	2000.0	10.000	L1	9.6	22.6	56.0
4.710000	31.8	2000.0	10.000	L1	9.6	24.2	56.0
7.406000	37.0	2000.0	10.000	L1	9.6	23.0	60.0

Results measured using the Average detector compared to the Average limit

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
3.230000	28.4	2000.0	10.000	L1	9.6	17.6	46.0
4.174000	29.8	2000.0	10.000	L1	9.6	16.2	46.0
4.714000	29.8	2000.0	10.000	N	9.6	16.2	46.0
7.406000	35.5	2000.0	10.000	N	9.6	14.5	50.0
7.810000	35.4	2000.0	10.000	N	9.6	14.6	50.0
7.946000	36.1	2000.0	10.000	N	9.6	13.9	50.0
8.350000	36.9	2000.0	10.000	N	9.6	13.1	50.0
8.754000	35.3	2000.0	10.000	N	9.6	14.7	50.0
8.886000	35.6	2000.0	10.000	N	9.6	14.4	50.0
9.290000	34.7	2000.0	10.000	N	9.6	15.3	50.0
11.986000	33.4	2000.0	10.000	N	9.7	16.6	50.0
13.870000	34.8	2000.0	10.000	N	9.7	15.2	50.0
14.002000	34.2	2000.0	10.000	N	9.7	15.8	50.0
14.410000	36.3	2000.0	10.000	N	9.7	13.7	50.0
18.986000	34.6	2000.0	10.000	N	9.7	15.4	50.0

Specification limits :

Conducted emission limits (47 CFR Part 15: Clause 15.207 & RSS-Gen 8.8):

Conducted disturbance at the mains ports.

Frequency range MHz	Limits dBμV	
	Quasi-peak	Average
0.15 to 0.5	66 to 56[2]	56 to 46[2]
0.5 to 5	56	46
5 to 30	60	50
Notes: 1. The lower limit shall apply at the transition frequency. 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.		

Notes:

(a) The levels may have been rounded for display purposes.

(b) The following table summarises the effect of the EUT operating mode and internal configuration on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels		✓		
Effect of EUT internal configuration on emission levels		✓		

(i) Parameter defined by standard and / or single possible, refer to Appendix C
(ii) Parameter defined by client and / or single possible, refer to Appendix C
(iii) Parameter had a negligible effect on emission levels, refer to Appendix C
(iv) Worst case determined by initial measurement, refer to Appendix C

A5 Frequency Tolerance 13.56MHz

Test Details	
Regulation	Part 15.225(e) / RSS – 210 Issue 8 (A2.6)
Measurement standard	ANSI C63.10:2009:2009
EUT sample number	S15
Modification state	0
SE in test environment	S39,S16,S17,S37
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	19˚C

Test Conditions		Measured Frequency (MHz)	Drift (kHz)
$T_{nom\ (+20^{\circ}C)}$	V_{nom}	13.55983974	N/A
$T_{nom\ (+20^{\circ}C)}$	V_{min}	13.55983974	0.0000
$T_{nom\ (+20^{\circ}C)}$	V_{max}	13.55983974	0.0000
$T_{max\ (+50^{\circ}C)}$	V_{nom}	13.55979006	-0.0497
$T_{min\ (-20^{\circ}C)}$	V_{nom}	13.55986859	0.0289
Limit		± 1.356 kHz (± 0.01% of the operating frequency)	
Verdict		Pass	

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.

(b) The time and date on the plots do not necessarily equate to the time of the test.

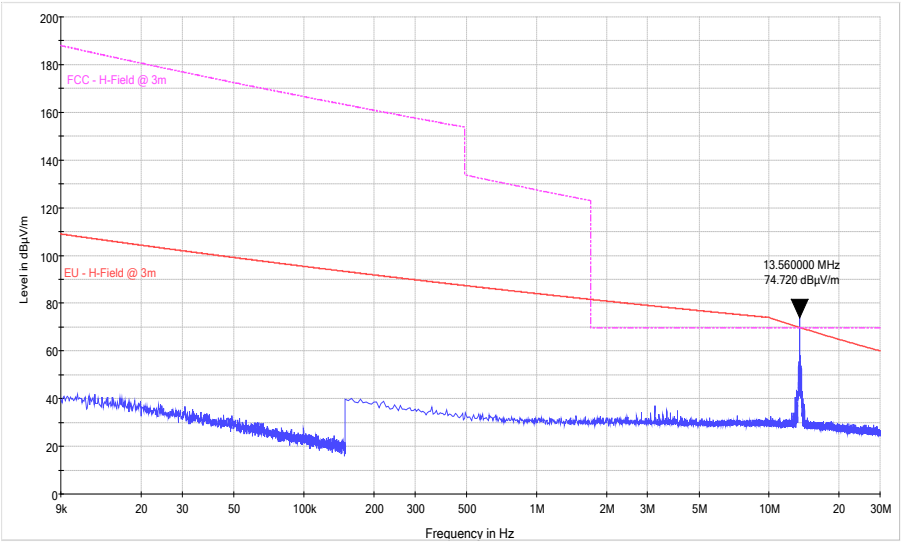
(c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.

(d) Appendix C details the numbering system used to identify the sample and its modification state.

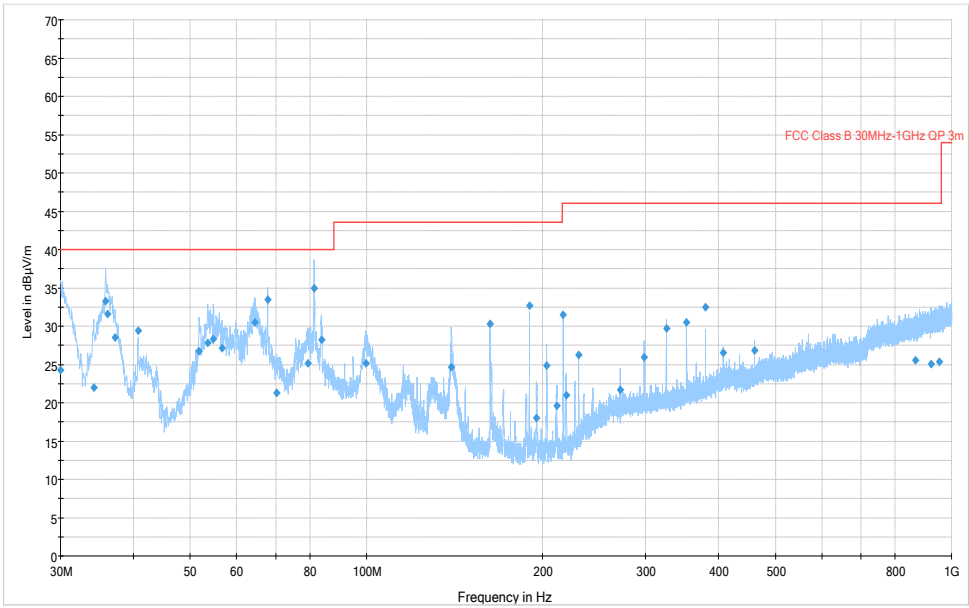
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

Radiated spurious emissions

13.56MHz 9 kHz to 30 MHz

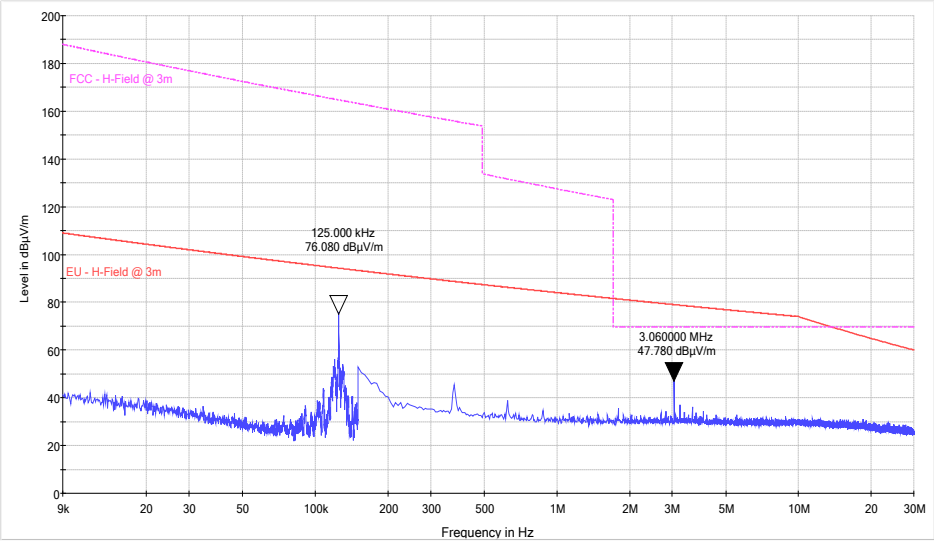


13.56MHz 30 MHz to 1 GHz

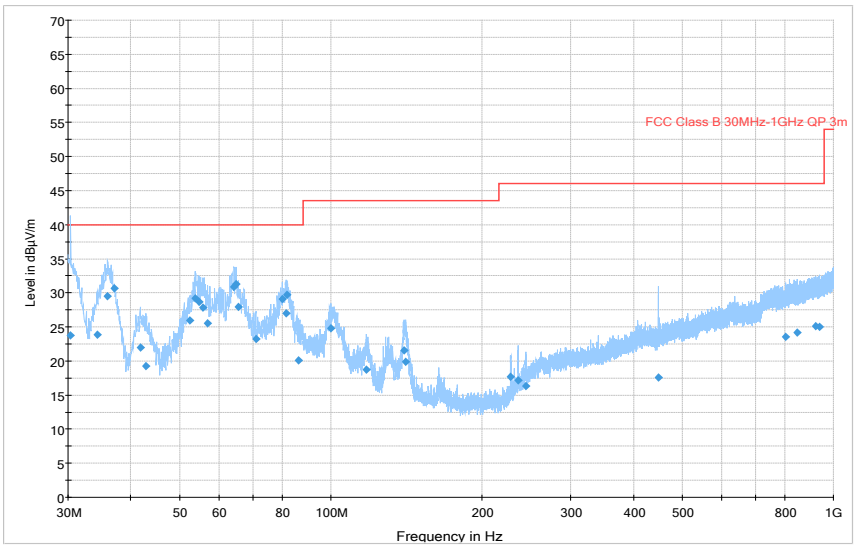


Radiated spurious emissions

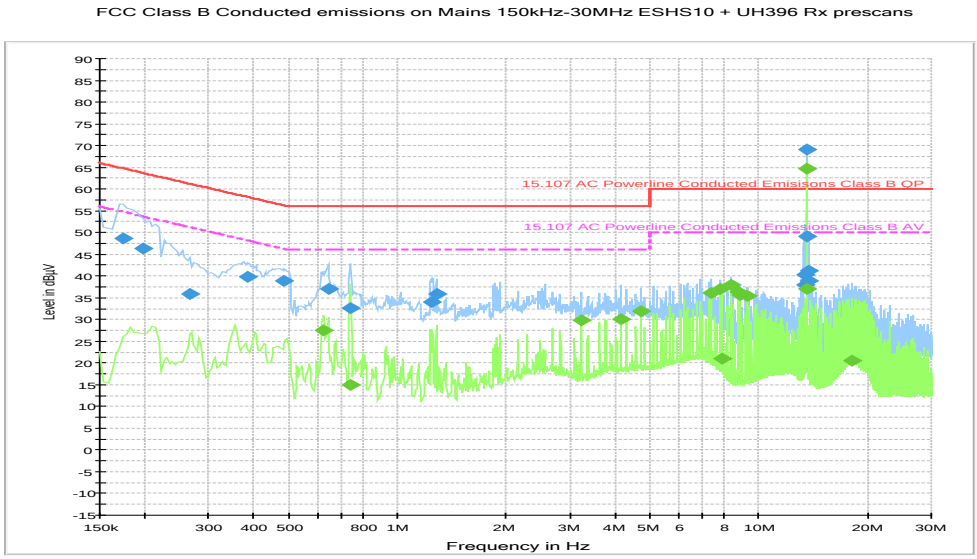
125.0kHz 9 kHz to 30 MHz



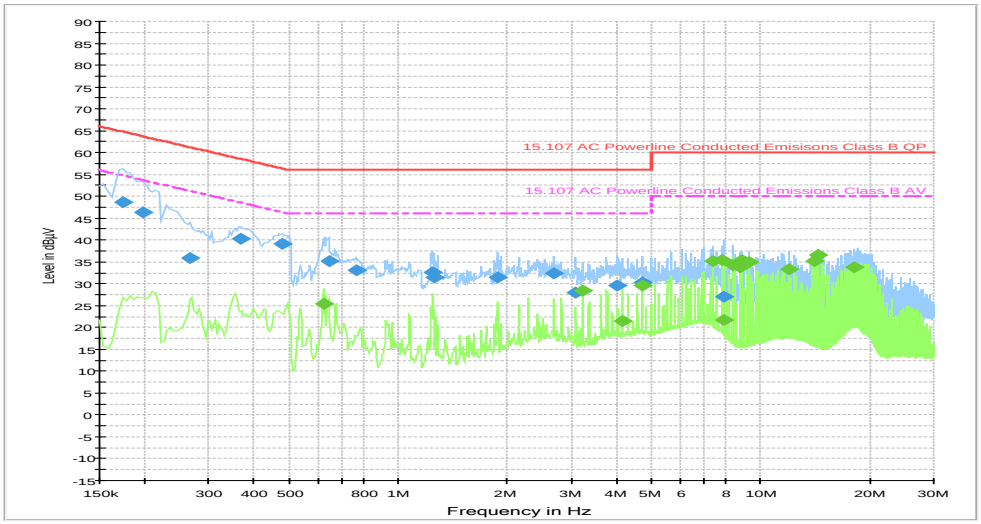
125.0kHz 30 MHz to 1 GHz



AC Powerline Conducted Emissions
13.56MHz

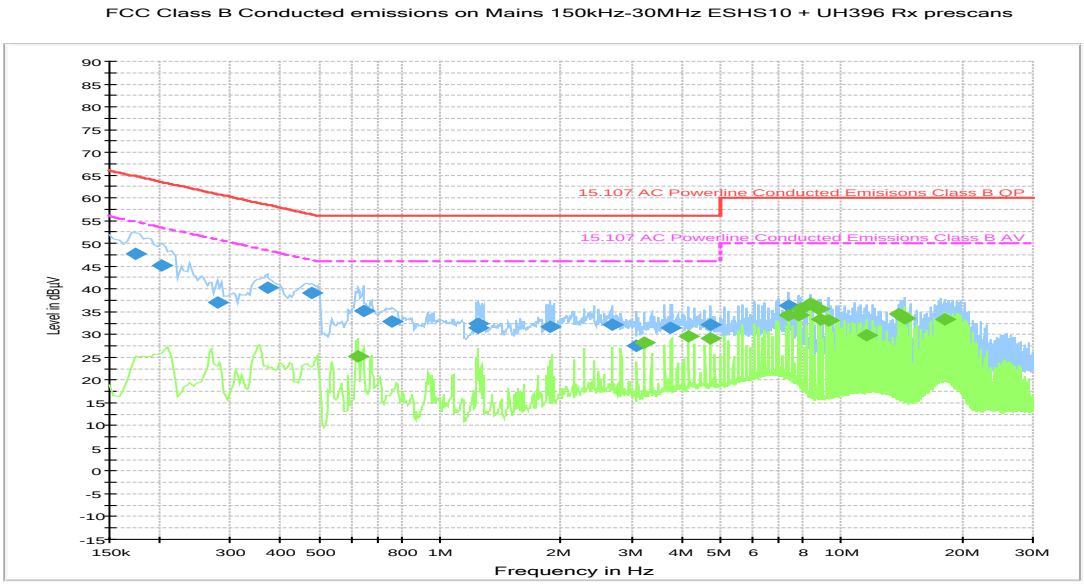


13.56MHz Dummy load

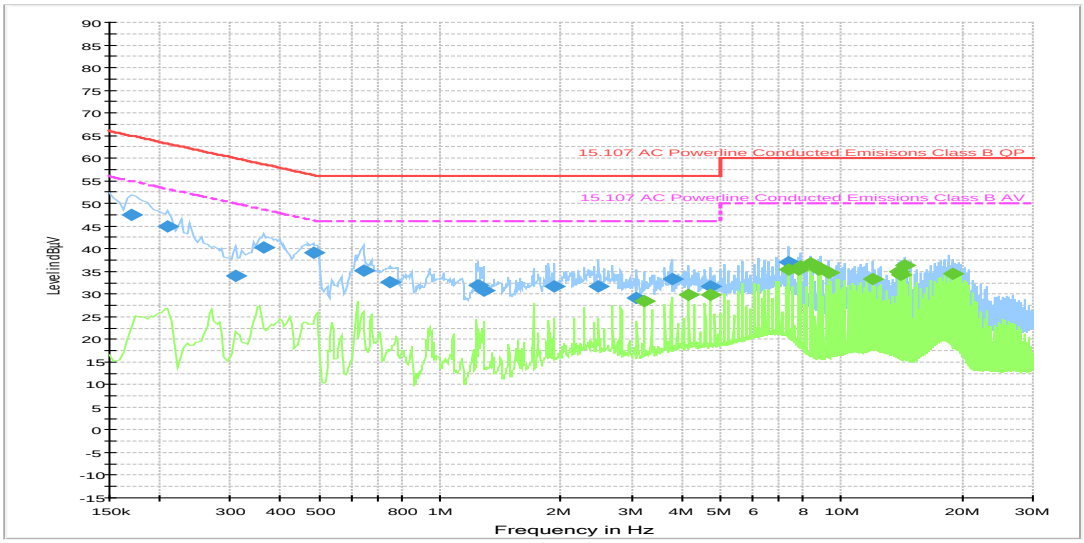


AC Powerline Conducted Emissions

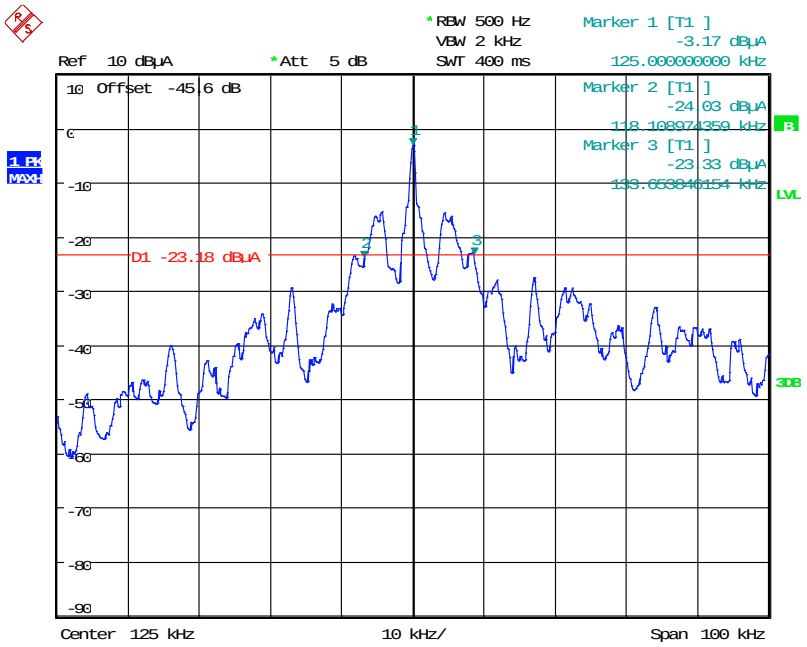
125.0kHz



Idle Mode

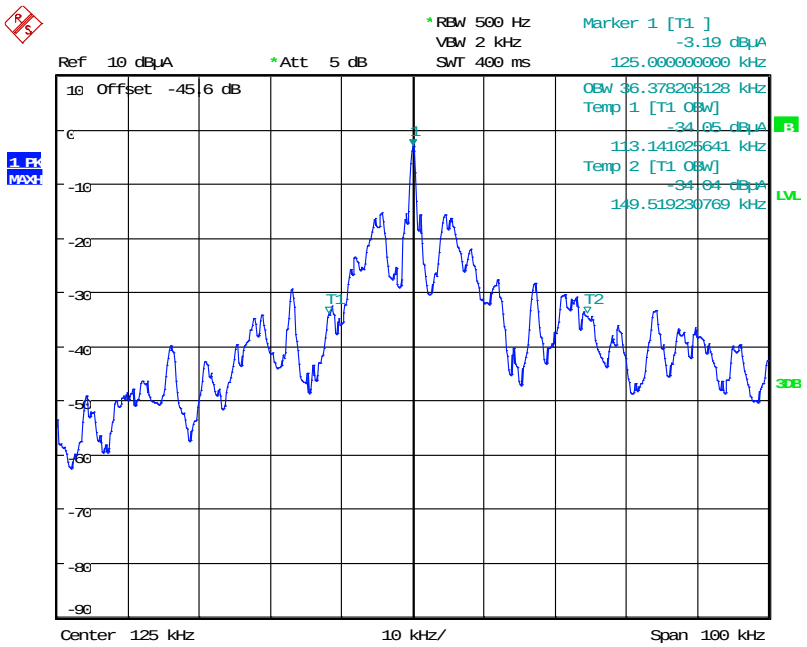


125.0kHz 20dB bandwidth



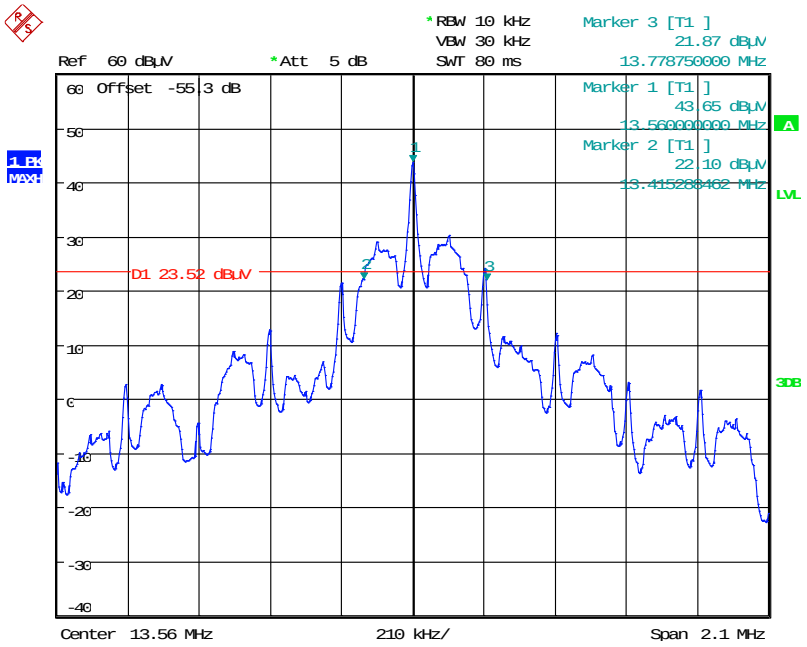
Date: 26.JAN.2015 13:59:07

125.0kHz 99% bandwidth



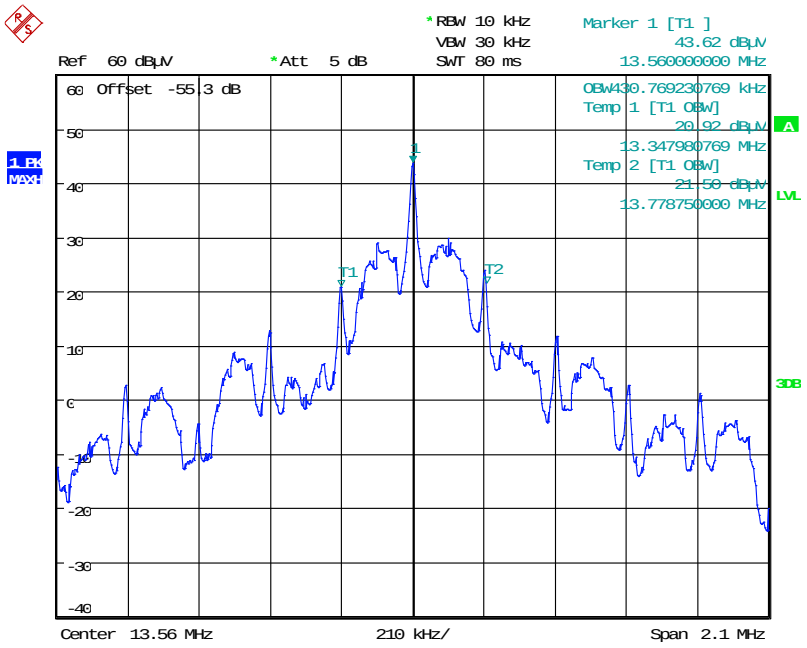
Date: 26.JAN.2015 13:48:29

13.56MHz 20dB bandwidth



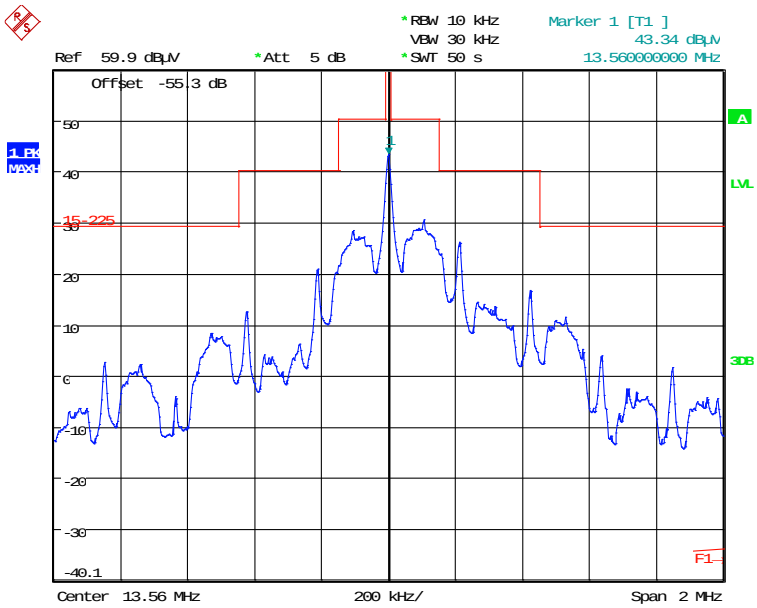
Date: 26.JAN.2015 13:54:19

13.56MHz 99% bandwidth



Date: 26.JAN.2015 13:49:41

13.56MHz Mask



Date: 26.JAN.2015 09:34:56

Appendix C: **Additional Test and Sample Details**

This appendix contains details of:

1. The samples submitted for testing.
2. Details of EUT operating mode(s)
3. Details of EUT configuration(s) (see below).
4. EUT arrangement (see below).

Throughout testing, the following numbering system is used to identify the sample and it's modification state:

Sample No: Sxx Mod w

where:

xx = sample number eg. S01
w = modification number eg. Mod 2

The following terminology is used throughout the test report:

Support Equipment (SE) is any additional equipment required to exercise the EUT in the applicable operating mode. Where relevant SE is divided into two categories:

SE in test environment: The SE is positioned in the test environment and is not isolated from the EUT (e.g. on the table top during REFE testing).

SE isolated from the EUT: The SE is isolated via filtering from the EUT. (e.g. equipment placed externally to the ALSR during REFE testing).

EUT configuration refers to the internal set-up of the EUT. It may include for example:

Positioning of cards in a chassis.
Setting of any internal switches.
Circuit board jumper settings.
Alternative internal power supplies.

Where no change in EUT configuration is **possible**, the configuration is described as “single possible configuration”.

EUT arrangement refers to the termination of EUT ports / connection of support equipment, and where relevant, the relative positioning of samples (EUT and SE) in the test environment.

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by TRaC Global upon request.

C1) Test samples

The following samples of the apparatus were submitted by the client for testing :

Sample No.	Description	Identification
S15	13.56MHz unit	2839130
S12	125.0kHz unit	2839129
S13	13.56MHz unit (Dummy Antenna)	2919721
S14	Idle Mode	2839132

Description	
Software version	V1.00.5470.31123
Hardware version	Final production

The following samples of apparatus were submitted by the client as host, support or drive equipment (auxiliary equipment):

Sample No.	Description	Identification
S41	1mtr Ethernet cable	None
S40	0.5mtr Ethernet cable	None
S42	5.0 mtr Ethernet cable	None
S39	P.O.E	P122307810A1
S16	Net10 Controller	2865868
S17	Net10 Door Connector	2865917
S37	13.56MHz RFID Card	None
S38	125.0kHz RFID Card	None

The following samples of apparatus were supplied by TRaC Global as support or drive equipment (auxiliary equipment):

Identification	Description
HP Compaq	Test Laptop/to provide load to 2nd POE port

C2) EUT Operating Mode During Testing.

During testing, the EUT was exercised as described in the following tables :

Test	Description of Operating Mode:
Transmit mode tests detailed in this report	EUT is actively transmitting either waiting for a tag to be presented or reading a tag as required.
Idle Mode	The system is in Idle mode, and waiting for the movement detector to detect the presence on somebody near the RFID tag reader before enabling the RFID.

C3) EUT Configuration Information.

The EUT was submitted for testing in one single possible configuration.

C4) List of EUT Ports

The tables below describe the termination of EUT ports:

Tests : All Tests

Port	Description of Cable Attached	Cable length	Equipment Connected
POE	Ethernet cable	0.5 mtr	Net10 Controller
POE	Ethernet cable	1.0 mtr	Net10 Door Connector
POE	Ethernet cable	5.0 mtr	Test Laptop/Load

C5 Details of Equipment Used

TRaC No	Type	Description	Manufacturer	Last Cal	Period	Cal Due
UH93	CBL6112B	Bilog	Chase	08/07/2013	24	08/07/2015
L007	hfh2	Loop Antenna	R&S	17/10/2013	24	17/10/2015
UH187	ESHS10	Receiver	R&S	19/02/2014	12	19/02/2015
L317	ESVS10	Receiver	R&S	12/02/2014	12	12/02/2015
REF940	ATS	Radio Chamber - PP	Rainford EMC	09/07/2013	24	09/07/2015
UH396	ENV216	Lisn	R&S	22/05/2014	12	22/05/2015
UH909	FSU26	Spectrum Analyser	R&S	12/02/2014	12	12/02/2015

Appendix D: Additional Information

No additional information is included within this test report.

Appendix E: Calculation of the duty cycle correction factor

Using a spectrum analyser in zero span mode, centred on the fundamental carrier frequency with a RBW of 1MHz and a video Bandwidth of 1MHz the sweep time was set accordingly to capture the pulse train. The transmit pulsewidths and period was measured. A plots of the pulse train is contained in Appendix B of this test report.

If the pulse train was less than 100 ms, including blanking intervals, the duty cycle was calculated by averaging the sum of the pulsewidths over one complete pulse train. However if the pulse train exceeds 100ms then the duty cycle was calculated by averaging the sum of the pulsewidths over the 100ms width with the highest average value. (The duty cycle is the value of the sum of the pulse widths in one period (or 100ms), divided by the length of the period (or 100ms). The duty cycle correction factor was then expressed in dB and the peak emissions adjusted accordingly to give an average value of the emission.

Correction factor dB = 20 x (Log_{10} Calculated Duty Cycle)

Therefore the calculated duty cycle was determined:

The pulse train period was greater than >100ms and in as shown from the plots in contained in appendix B of this test report.

Duty cycle = $\frac{\text{the sum of the highest average value pulsewidths over 100ms}}{\text{100ms}}$

e.g

$$= \frac{7.459ms}{100ms} = 0.07459$$

0.07459 or 7.459%

Correction factor (dB) = 20 x (Log_{10} 0.07459) = -22.54dB

Duty cycle correction may not be applicable.
Unless duty cycle correction is utilised in the results section of this report this section is included for information only

Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated emissions arrangement
2. Radiated emissions arrangement
3. AC Powerline emissions arrangement

Photograph 1

Photograph 2

Photograph 3

Appendix G: General SAR test reduction and exclusion guidance

KDB 447498 & RSS-102

Section 4.3 General SAR test reduction and exclusion guidance

For Standalone SAR exclusion consideration, when the considering SAR exclusion Threshold requirement in KDB 447498 is satisfied standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

In the frequency range below 100 MHz and test separation distance ≤ 50mm, the SAR Test Exclusion Threshold will be determined as follows

SAR Exclusion Threshold (SARET)

SAR Exclusion Threshold = ([Step 1 + Step2] * Step 3a) * Step 3b

Step 1

$$NT = [(MP/TSD^{A}) * \sqrt{f_{GHz}}]$$

NT	=	Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)
MP	=	Max Power of channel (mW) (inc tune up)
TSD^{A}	=	Min Test separation Distance or 50mm (whichever is lower) = 50
f_{GHz}	=	Transmit frequency (or 100MHz if lower)

We can transpose this formula to allow us to find the maximum power of a channel allowed and compare this to the measured maximum power.

$$MP = [(NT \times TSD^{A}) / \sqrt{f_{GHz}}]$$

For Distances Greater than 50 mm Step 2 applies

Step 2

$$(TSD^{B} - 50mm) * f_{(MHz)}/150$$

Where:

f_{MHz}	=	Transmit frequency
TSD^{B}	=	Min Test separation Distance (mm) = 50

Step 3

3a) The power threshold at the corresponding test separation distance at 100 MHz in step 2) is multiplied by [1 + log(100/$f_{(MHz)}$)] for *test separation distances* > 50 mm and < 200 mm

3b) The power threshold determined by the equation in steps 1 and 2 for 50 mm and 100 MHz is multiplied by ½ for *test separation distances* ≤ 50 mm

$$SARET = (\{ [(NT \times TSD^{A}) / \sqrt{f_{GHz}}] + (TSD^{B} - 50) * [100/150] \} * (1 + Log [100 / F_{MHz}])) * {}^{1}/_{2}$$
$$SARET = (\{ [(3.0 \times 50) / \sqrt{0.1}] + (50 - 50) * [100/150] \} * (1 + Log [100 / F_{MHz}]) * {}^{1}/_{2}$$
$$SARET = (474 * (1 + Log [100 / 13.56)) * {}^{1}/_{2}$$
$$SARET = 442.65 \text{ mW}$$

The calculated output power is 0.00364 mW (eirp) which is less than the SAR Exclusion Threshold of 468mW, at 5mm test separation distance, for general population and uncontrolled exposure.

Therefore standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

Prediction of MPE limit at a given distance

For purposes of these requirements mobile devices are defined by the Industry Canada as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20cm separation specified under Industry Canada rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than 1.67W/m^2 power density limit, as required under Industry Canada rules.

Equation from IEEE C95.1

$$S = \frac{EIRP}{4\pi R^2} \quad \text{re-arranged } R = \sqrt{\frac{EIRP}{S4\pi}}$$

Where:

S = power density
R = distance to the centre of radiation of the antenna
EIRP = EUT Maximum power

Note:

The EIRP value was calculated using the peak E Field measurement.

Result

Prediction Frequency (MHz)	Maximum EIRP (mW)	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 0.98 mW/cm^2
13.56	0.00364	0.9789	0.027

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