# AN RADIO TEST REPORT

# FOR

# Paxton Access Ltd

# ON

# Net10 Dual Mode RFID Desktop Reader

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

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UKAS TESTING
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|---|---|
| **TRaC Wireless Test Report** | **:** TRA-024435-00-47-00B |
| **Applicant** | **:** Paxton Access Ltd |
| **Apparatus** | **:** Net10 Dual Mode RFID Desk Top Reader |
| **Specification(s)** | **:** CFR47 Part 15, RSS-GEN & RSS-210 |
| **Purpose of Test** | **:** Certification |
| **FCCID** | **:** USE010387 |
| **Certification Number** | **:** 10217A-010387 |
| **Authorised by** | **:** John Charters<br>Digitally signed by John Charters<br>DN: cn=John Charters, o=TRAC Global Ltd, ou=Radio Product Manager, email=john.charters@tracglobal.com, c=GB<br>Date: 2015.04.23 12:18:03 +01'00'<br>: Radio Product Manager |
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**Contents**

## 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

This testing in this report was requested by :

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### 1.3 Manufacturer

As Above

### 1.4 Apparatus Assessed

The following apparatus was assessed between 22nd – 28th January 2015

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

Model: 010-387

## 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 | S02,S38, S07,S08,S09 |
| Modification state | 0 |
| SE in test environment | None |
| 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 | 76.10 | 86.28 | 0.310 |
| 125.00 | 10 | 48.90 | 59.08 | 0.310 |
| Limit value @ fc | | 19.20µV/m@ 300meters | | |
| | | | | |
| Band occupancy @ -20 dBc | | f lower | | f higher |
| 13.14kHz | | 118.429487kHz | | 131.570512kHz |
| Band occupancy @ 99% | | f lower | | f higher |
| 33.49kHz | | 114.583333kHz | | 148.076923kHz |

**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), RSS-210 A2.6 |
| Measurement standard | ANSI C63.10:2009 |
| EUT sample number | S01,S37,S07,S08,S09 |
| Modification state | 0 |
| SE in test environment | None |
| 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 | 73.00 | 35.98 | 70.918 |
| 13.56 | 10 | 56.10 | 19.08 | 70.918 |
| Limit value @ fc | | 15848 µV/m @ 30metres | | |
| Band occupancy @ -20 dBc | | f lower | | f higher |
| 350kHz | | 13.432115MHz | | 13.782115MHz |
| Band occupancy @ 99% | | f lower | | f higher |
| 1.738MHz | | 12.686602MHz | | 14.425384MHz |

| FREQ. (MHz) | Limit @30m (µV/m) | Result |
|---|---|---|
| 13.410-13553<br>13.567-13710 | 334 | Compliant<br>Note 8 |
| 13.110-13.410<br>13.710-14.010 | 106 | Compliant<br>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 | S02,S38, S07,S08,S09 |
| Modification state | 0 |
| SE in test environment | None |
| 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. | 30.10 | 4.0 | 0.8 | 17.8 | - | 22.6 | - | 13.41 | 100 |
| 2. | 33.40 | 8.0 | 0.8 | 16.0 | - | 24.8 | - | 17.38 | 100 |
| 3. | 33.90 | 8.7 | 0.8 | 15.8 | - | 25.3 | - | 18.30 | 100 |
| 4. | 34.55 | 6.9 | 0.8 | 15.4 | - | 23.1 | - | 14.24 | 100 |
| 5. | 36.00 | 13.7 | 0.8 | 14.6 | - | 29.1 | - | 28.64 | 100 |
| 6. | 45.15 | 9.4 | 1.0 | 9.8 | - | 20.2 | - | 10.27 | 100 |
| 7. | 46.05 | 12.8 | 1.0 | 9.4 | - | 23.2 | - | 14.42 | 100 |
| 8. | 46.25 | 15.6 | 1.0 | 9.3 | - | 25.9 | - | 19.68 | 100 |
| 9. | 156.00 | 13.3 | 1.8 | 9.6 | - | 24.7 | - | 17.18 | 150 |
| 10. | 164.00 | 21.4 | 1.9 | 9.3 | - | 32.6 | - | 42.66 | 150 |
| 11. | 196.00 | 13.4 | 2.0 | 8.7 | - | 24.1 | - | 16.00 | 150 |
| 12. | 204.00 | 22.4 | 1.9 | 8.8 |  | 33.1 |  | 45.19 | 150 |
| 13. | 212.00 | 25.7 | 2.0 | 8.4 | - | 36.1 | - | 63.68 | 150 |
| 14. | 220.00 | 21.5 | 2.1 | 8.5 | - | 32.1 | - | 40.04 | 200 |
| 15. | 715.00 | 13.1 | 3.8 | 19.4 | - | 36.3 | - | 65.09 | 200 |
| 16. | 780.00 | 10.9 | 4.0 | 20.0 | - | 34.9 | - | 55.27 | 200 |

| 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 | S01,S37, S07,S08,S09 |
| Modification state | 0 |
| SE in test environment | None |
| 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. | 30.50 | 3.8 | 0.8 | 17.6 | - | 22.2 | - | 12.81 | 100 |
| 2. | 36.15 | 15.7 | 0.9 | 14.5 | - | 31.1 | - | 35.81 | 100 |
| 3. | 39.60 | 11.0 | 0.9 | 12.6 | - | 24.5 | - | 16.87 | 100 |
| 4. | 40.35 | 13.3 | 1.0 | 12.2 | - | 26.5 | - | 21.16 | 100 |
| 5. | 43.85 | 16.6 | 1.0 | 10.5 | - | 28.1 | - | 25.35 | 100 |
| 6. | 51.85 | 15.3 | 1.0 | 7.1 | - | 23.4 | - | 14.71 | 100 |
| 7. | 60.15 | 14.9 | 1.1 | 5.2 | - | 21.2 | - | 11.48 | 100 |
| 8. | 75.90 | 12.8 | 1.3 | 6.0 | - | 20.1 | - | 10.08 | 100 |
| 9. | 83.85 | 13.4 | 1.3 | 7.5 | - | 22.2 | - | 12.84 | 100 |
| 10. | 123.85 | 11.8 | 1.6 | 11.6 | - | 25.0 | - | 17.78 | 150 |
| 11. | 139.90 | 16.1 | 1.6 | 11.0 | - | 28.7 | - | 27.23 | 150 |
| 12. | 148.15 | 19.1 | 1.7 | 10.2 | - | 31.0 | - | 35.40 | 150 |
| 13. | 156.15 | 22.8 | 1.8 | 9.6 | - | 34.2 | - | 51.29 | 150 |
| 14. | 163.85 | 28.0 | 1.9 | 9.3 | - | 39.2 | - | 91.20 | 150 |
| 15. | 179.85 | 13.8 | 2.0 | 8.3 | - | 24.1 | - | 15.96 | 150 |
| 16. | 195.85 | 28.5 | 2.0 | 8.7 | - | 39.2 | - | 90.99 | 150 |
| 17. | 203.90 | 28.9 | 1.9 | 8.8 | - | 39.6 | - | 95.50 | 150 |
| 18. | 212.00 | 29.2 | 2.0 | 8.4 | - | 39.6 | - | 95.28 | 150 |
| 19. | 220.00 | 21.8 | 2.1 | 8.5 | - | 32.4 | - | 41.45 | 200 |
| 20. | 715.00 | 8.8 | 3.8 | 19.4 | - | 32.0 | | 39.67 | 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) |
|---|---|---|---|---|---|---|---|---|---|
| 21. | 780.00 | 4.6 | 4.0 | 20.0 | - | 28.6 | - | 26.76 | 200 |
| 22. | 845.00 | 5.8 | 4.0 | 20.3 | - | 30.1 | - | 32.10 | 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).

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: | |
|---|---|
| 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 | S01,S02,S03, S07,S08,S09 |
| Modification state | 0 |
| SE in test environment | None |
| 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) | PE | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|---|
| 0.167910 | 41.8 | 2000.0 | 9.000 | GND | N | 0.1 | 23.4 | 65.2 |
| 2.663370 | 28.3 | 2000.0 | 9.000 | GND | N | 0.3 | 27.7 | 56 |
| 2.812620 | 32.0 | 2000.0 | 9.000 | GND | N | 0.3 | 24 | 56 |
| 13.558620 | 53.2 | 2000.0 | 9.000 | GND | N | 1.0 | 2.8 | 56 |
| 20.000250 | 37.4 | 2000.0 | 9.000 | GND | L1 | 1.3 | 22.6 | 60 |
| 26.480685 | 33.6 | 2000.0 | 9.000 | GND | L1 | 1.5 | 26.4 | 60 |
| 26.844855 | 26.7 | 2000.0 | 9.000 | GND | L1 | 1.6 | 33.3 | 60 |
| 26.895600 | 31.0 | 2000.0 | 9.000 | GND | N | 1.5 | 29 | 60 |
| 26.907540 | 43.3 | 2000.0 | 9.000 | GND | N | 1.5 | 16.7 | 60 |
| 26.922465 | 29.7 | 2000.0 | 9.000 | GND | L1 | 1.6 | 30.3 | 60 |
| 26.973210 | 31.9 | 2000.0 | 9.000 | GND | L1 | 1.6 | 28.1 | 60 |
| 27.068730 | 32.4 | 2000.0 | 9.000 | GND | N | 1.5 | 27.6 | 60 |
| 27.107535 | 37.4 | 2000.0 | 9.000 | GND | N | 1.5 | 22.6 | 60 |
| 27.125445 | 45.6 | 2000.0 | 9.000 | GND | L1 | 1.6 | 14.4 | 60 |
| 27.143355 | 33.4 | 2000.0 | 9.000 | GND | N | 1.5 | 26.6 | 60 |
| 27.170220 | 31.4 | 2000.0 | 9.000 | GND | L1 | 1.6 | 28.6 | 60 |
| 27.265740 | 31.3 | 2000.0 | 9.000 | GND | N | 1.5 | 28.7 | 60 |
| 27.313500 | 30.5 | 2000.0 | 9.000 | GND | N | 1.5 | 29.5 | 60 |
| 27.334395 | 39.3 | 2000.0 | 9.000 | GND | L1 | 1.6 | 20.7 | 60 |
| 28.119450 | 40.8 | 2000.0 | 9.000 | GND | N | 1.5 | 19.2 | 60 |

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

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | PE | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|---|
| 0.164925 | 38.4 | 2000.0 | 9.000 | GND | N | 0.1 | 16.7 | 55.1 |
| 2.803665 | 29.5 | 2000.0 | 9.000 | GND | N | 0.3 | 16.5 | 46 |
| 2.848440 | 28.5 | 2000.0 | 9.000 | GND | L1 | 0.3 | 17.5 | 46 |
| 3.018585 | 29.6 | 2000.0 | 9.000 | GND | N | 0.3 | 20.4 | 50 |
| 13.558620 | 53.5 | 2000.0 | 9.000 | GND | N | 1.0 | -3.5 | 50 |
| 20.003235 | 33.8 | 2000.0 | 9.000 | GND | L1 | 1.3 | 16.2 | 50 |
| 26.895600 | 26.2 | 2000.0 | 9.000 | GND | N | 1.5 | 23.8 | 50 |
| 26.907540 | 34.7 | 2000.0 | 9.000 | GND | N | 1.5 | 15.3 | 50 |
| 27.068730 | 27.1 | 2000.0 | 9.000 | GND | N | 1.5 | 22.9 | 50 |
| 27.095595 | 28.3 | 2000.0 | 9.000 | GND | L1 | 1.6 | 21.7 | 50 |
| 27.101565 | 30.5 | 2000.0 | 9.000 | GND | N | 1.5 | 19.5 | 50 |
| 27.119475 | 46.5 | 2000.0 | 9.000 | GND | L1 | 1.6 | 3.5 | 50 |
| 27.128430 | 36.5 | 2000.0 | 9.000 | GND | N | 1.5 | 13.5 | 50 |
| 27.334395 | 32.4 | 2000.0 | 9.000 | GND | L1 | 1.6 | 17.6 | 50 |
| 27.835875 | 40.3 | 2000.0 | 9.000 | GND | N | 1.5 | 9.7 | 50 |
| 27.907515 | 38.9 | 2000.0 | 9.000 | GND | N | 1.5 | 11.1 | 50 |
| 28.000050 | 38.1 | 2000.0 | 9.000 | GND | N | 1.5 | 11.9 | 50 |
| 28.047810 | 36.1 | 2000.0 | 9.000 | GND | N | 1.5 | 13.9 | 50 |
| 28.119450 | 40.9 | 2000.0 | 9.000 | GND | N | 1.5 | 9.1 | 50 |
| 28.191090 | 38.9 | 2000.0 | 9.000 | GND | N | 1.5 | 11.1 | 50 |

### 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) | PE | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|---|
| 0.158000 | 37.0 | 2000.0 | 10.000 | GND | L1 | 0.1 | 28.6 | 65.6 |
| 2.178000 | 34.3 | 2000.0 | 10.000 | GND | N | 0.3 | 21.7 | 56.0 |
| 2.258000 | 34.3 | 2000.0 | 10.000 | GND | L1 | 0.3 | 21.7 | 56.0 |
| 2.314000 | 34.3 | 2000.0 | 10.000 | GND | L1 | 0.3 | 21.7 | 56.0 |
| 2.810000 | 34.3 | 2000.0 | 10.000 | GND | N | 0.3 | 21.7 | 56.0 |
| 17.938000 | 35.2 | 2000.0 | 10.000 | GND | N | 1.2 | 24.8 | 60.0 |
| 18.098000 | 35.2 | 2000.0 | 10.000 | GND | N | 1.2 | 24.8 | 60.0 |
| 18.650000 | 35.3 | 2000.0 | 10.000 | GND | N | 1.3 | 24.7 | 60.0 |
| 19.998000 | 42.2 | 2000.0 | 10.000 | GND | L1 | 1.3 | 17.8 | 60.0 |
| 20.446000 | 35.4 | 2000.0 | 10.000 | GND | L1 | 1.4 | 24.6 | 60.0 |
| 20.746000 | 35.4 | 2000.0 | 10.000 | GND | L1 | 1.4 | 24.6 | 60.0 |
| 23.998000 | 35.9 | 2000.0 | 10.000 | GND | N | 1.4 | 24.1 | 60.0 |
| 24.010000 | 35.5 | 2000.0 | 10.000 | GND | L1 | 1.5 | 24.5 | 60.0 |
| 27.118000 | 35.5 | 2000.0 | 10.000 | GND | N | 1.5 | 24.5 | 60.0 |
| 27.330000 | 35.5 | 2000.0 | 10.000 | GND | N | 1.5 | 24.5 | 60.0 |
| 27.834000 | 35.9 | 2000.0 | 10.000 | GND | L1 | 1.6 | 24.1 | 60.0 |
| 27.906000 | 35.6 | 2000.0 | 10.000 | GND | N | 1.5 | 24.4 | 60.0 |
| 27.998000 | 44.6 | 2000.0 | 10.000 | GND | L1 | 1.6 | 15.4 | 60.0 |
| 28.118000 | 36.2 | 2000.0 | 10.000 | GND | N | 1.5 | 23.8 | 60.0 |
| 28.190000 | 35.7 | 2000.0 | 10.000 | GND | N | 1.5 | 24.3 | 60.0 |

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

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | PE | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|---|
| 0.158000 | 36.2 | 2000.0 | 10.000 | GN | L1 | 0.1 | 19.4 | 55.6 |
| 0.482000 | 34.1 | 2000.0 | 10.000 | GN | L1 | 0.1 | 12.2 | 46.3 |
| 0.758000 | 34.2 | 2000.0 | 10.000 | GN | N | 0.2 | 11.8 | 46.0 |
| 2.986000 | 34.3 | 2000.0 | 10.000 | GN | L1 | 0.3 | 11.7 | 46.0 |
| 19.998000 | 42.6 | 2000.0 | 10.000 | GN | N | 1.3 | 7.4 | 50.0 |
| 23.998000 | 35.7 | 2000.0 | 10.000 | GN | N | 1.4 | 14.3 | 50.0 |
| 27.762000 | 35.5 | 2000.0 | 10.000 | GN | N | 1.5 | 14.5 | 50.0 |
| 27.830000 | 35.5 | 2000.0 | 10.000 | GN | N | 1.5 | 14.5 | 50.0 |
| 27.906000 | 35.6 | 2000.0 | 10.000 | GN | N | 1.5 | 14.4 | 50.0 |
| 27.998000 | 44.7 | 2000.0 | 10.000 | GN | N | 1.5 | 5.3 | 50.0 |
| 28.046000 | 35.5 | 2000.0 | 10.000 | GN | N | 1.5 | 14.5 | 50.0 |
| 28.118000 | 35.8 | 2000.0 | 10.000 | GN | L1 | 1.6 | 14.2 | 50.0 |
| 28.190000 | 35.6 | 2000.0 | 10.000 | GN | N | 1.5 | 14.4 | 50.0 |
| 28.686000 | 35.5 | 2000.0 | 10.000 | GN | N | 1.5 | 14.5 | 50.0 |
| 29.610000 | 35.6 | 2000.0 | 10.000 | GN | L1 | 1.6 | 14.4 | 50.0 |
| 29.678000 | 35.5 | 2000.0 | 10.000 | GN | N | 1.5 | 14.5 | 50.0 |

| Test Details: | |
|---|---|
| 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 | S02,S38, S07,S08,S09 |
| Modification state | 0 |
| SE in test environment | None |
| 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) | PE | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|---|
| 0.161940 | 44.0 | 2000.0 | 9.000 | GN | N | 0.1 | 21.4 | 65.4 |
| 2.176815 | 20.3 | 2000.0 | 9.000 | GN | N | 0.3 | 35.7 | 56.0 |
| 2.260395 | 21.0 | 2000.0 | 9.000 | GN | N | 0.3 | 35.0 | 56.0 |
| 2.430540 | 24.6 | 2000.0 | 9.000 | GN | L1 | 0.3 | 31.4 | 56.0 |
| 2.624565 | 26.8 | 2000.0 | 9.000 | GN | N | 0.3 | 29.2 | 56.0 |
| 2.905155 | 32.0 | 2000.0 | 9.000 | GN | L1 | 0.3 | 24.0 | 56.0 |
| 19.755480 | 30.9 | 2000.0 | 9.000 | GN | L1 | 1.3 | 29.1 | 60.0 |
| 20.003235 | 33.8 | 2000.0 | 9.000 | GN | L1 | 1.3 | 26.2 | 60.0 |
| 20.068905 | 31.4 | 2000.0 | 9.000 | GN | L1 | 1.3 | 28.6 | 60.0 |
| 20.125620 | 31.5 | 2000.0 | 9.000 | GN | L1 | 1.3 | 28.5 | 60.0 |
| 20.224125 | 31.3 | 2000.0 | 9.000 | GN | L1 | 1.4 | 28.7 | 60.0 |
| 20.268900 | 31.1 | 2000.0 | 9.000 | GN | L1 | 1.4 | 28.9 | 60.0 |
| 20.355465 | 30.8 | 2000.0 | 9.000 | GN | L1 | 1.4 | 29.2 | 60.0 |
| 20.373375 | 30.7 | 2000.0 | 9.000 | GN | L1 | 1.4 | 29.3 | 60.0 |
| 20.424120 | 30.3 | 2000.0 | 9.000 | GN | L1 | 1.4 | 29.7 | 60.0 |
| 20.471880 | 30.3 | 2000.0 | 9.000 | GN | L1 | 1.4 | 29.7 | 60.0 |
| 20.534565 | 29.8 | 2000.0 | 9.000 | GN | L1 | 1.4 | 30.2 | 60.0 |
| 20.647995 | 29.6 | 2000.0 | 9.000 | GN | L1 | 1.4 | 30.4 | 60.0 |
| 23.498670 | 34.4 | 2000.0 | 9.000 | GN | N | 1.4 | 25.6 | 60.0 |
| 28.000050 | 40.4 | 2000.0 | 9.000 | GN | N | 1.5 | 19.6 | 60.0 |

**Results measured using the Average detector compared to the Average limit**

**125.0kHz**

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | PE | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|---|
| 0.150000 | 39.1 | 2000.0 | 9.000 | GN | N | 0.1 | 16.9 | 56.0 |
| 0.194775 | 31.3 | 2000.0 | 9.000 | GN | N | 0.1 | 22.5 | 53.8 |
| 0.239550 | 29.5 | 2000.0 | 9.000 | GN | L1 | 0.1 | 22.6 | 52.1 |
| 2.633520 | 24.7 | 2000.0 | 9.000 | GN | N | 0.3 | 21.3 | 46.0 |
| 2.905155 | 29.2 | 2000.0 | 9.000 | GN | L1 | 0.3 | 16.8 | 46.0 |
| 19.621155 | 27.4 | 2000.0 | 9.000 | GN | L1 | 1.3 | 22.6 | 50.0 |
| 19.770405 | 27.6 | 2000.0 | 9.000 | GN | L1 | 1.3 | 22.4 | 50.0 |
| 19.868910 | 27.2 | 2000.0 | 9.000 | GN | L1 | 1.3 | 22.8 | 50.0 |
| 19.919655 | 27.4 | 2000.0 | 9.000 | GN | L1 | 1.3 | 22.6 | 50.0 |
| 20.000250 | 35.8 | 2000.0 | 9.000 | GN | N | 1.3 | 14.2 | 50.0 |
| 20.137560 | 28.0 | 2000.0 | 9.000 | GN | L1 | 1.3 | 22.0 | 50.0 |
| 20.170395 | 26.9 | 2000.0 | 9.000 | GN | L1 | 1.3 | 23.1 | 50.0 |
| 20.331585 | 26.9 | 2000.0 | 9.000 | GN | L1 | 1.4 | 23.1 | 50.0 |
| 20.370390 | 27.0 | 2000.0 | 9.000 | GN | L1 | 1.4 | 23.0 | 50.0 |
| 20.406210 | 27.2 | 2000.0 | 9.000 | GN | L1 | 1.4 | 22.8 | 50.0 |
| 20.421135 | 27.3 | 2000.0 | 9.000 | GN | L1 | 1.4 | 22.7 | 50.0 |
| 20.471880 | 27.1 | 2000.0 | 9.000 | GN | L1 | 1.4 | 22.9 | 50.0 |
| 20.645010 | 26.2 | 2000.0 | 9.000 | GN | L1 | 1.4 | 23.8 | 50.0 |
| 24.000150 | 33.5 | 2000.0 | 9.000 | GN | N | 1.4 | 16.5 | 50.0 |
| 28.000050 | 40.6 | 2000.0 | 9.000 | GN | N | 1.5 | 9.4 | 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:<br>1. The lower limit shall apply at the transition frequency.<br>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<br>(ii) Parameter defined by client and / or single possible, refer to Appendix C<br>(iii) Parameter had a negligible effect on emission levels, refer to Appendix C<br>(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) |
|---|---|---|---|
| $T_{nom\ (+20^{\circ}C)}$ | $V_{nom}$ | 13.5600000 | N/A |
| $T_{nom\ (+20^{\circ}C)}$ | $V_{min}$ | 13.5600000 | 0.0000 |
| $T_{nom\ (+20^{\circ}C)}$ | $V_{max}$ | 13.5600000 | 0.0000 |
| $T_{max\ (+50^{\circ}C)}$ | $V_{nom}$ | 13.5600000 | 0.0000 |
| $T_{min\ (-20^{\circ}C)}$ | $V_{nom}$ | 13.5600000 | 0.0000 |
| 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.

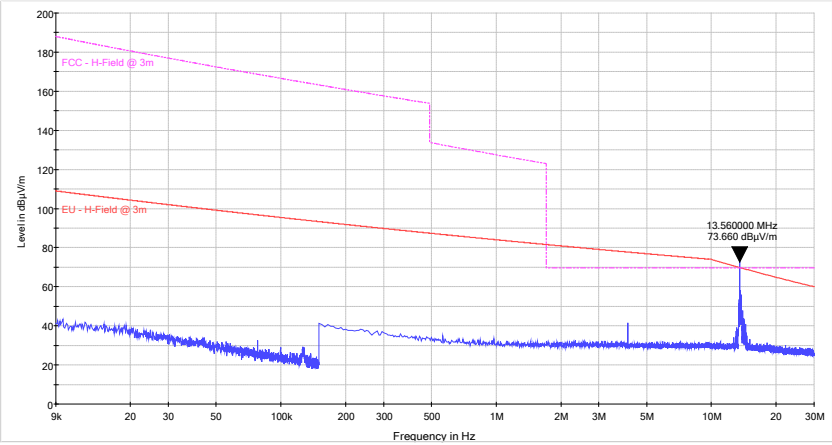
(c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.

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

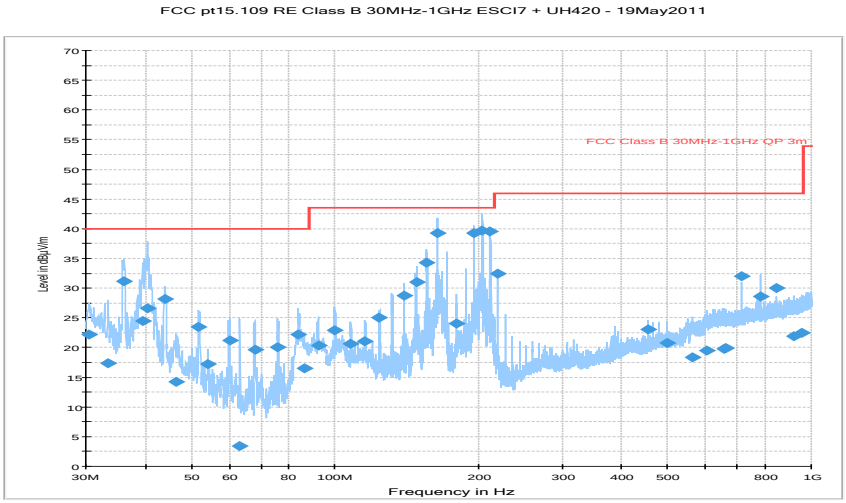
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

Radiated spurious emissions

13.56MHz 9 kHz to 30 MHz

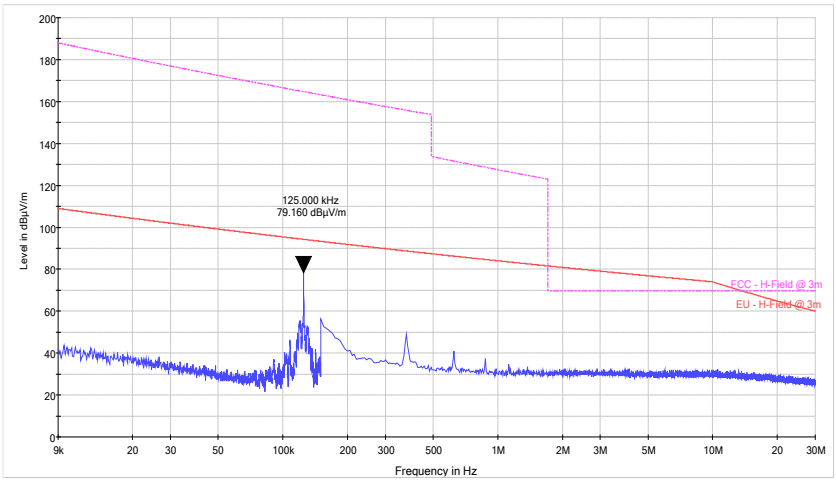



13.56MHz 30 MHz to 1 GHz

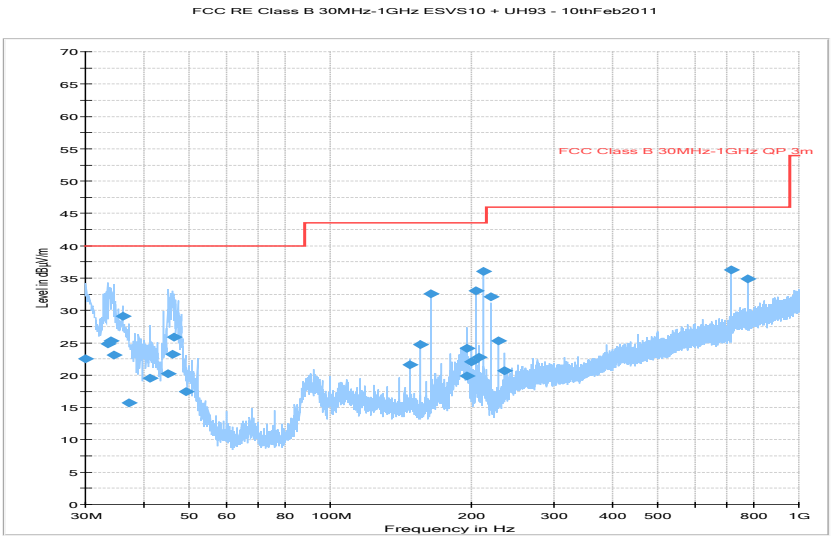


Radiated spurious emissions

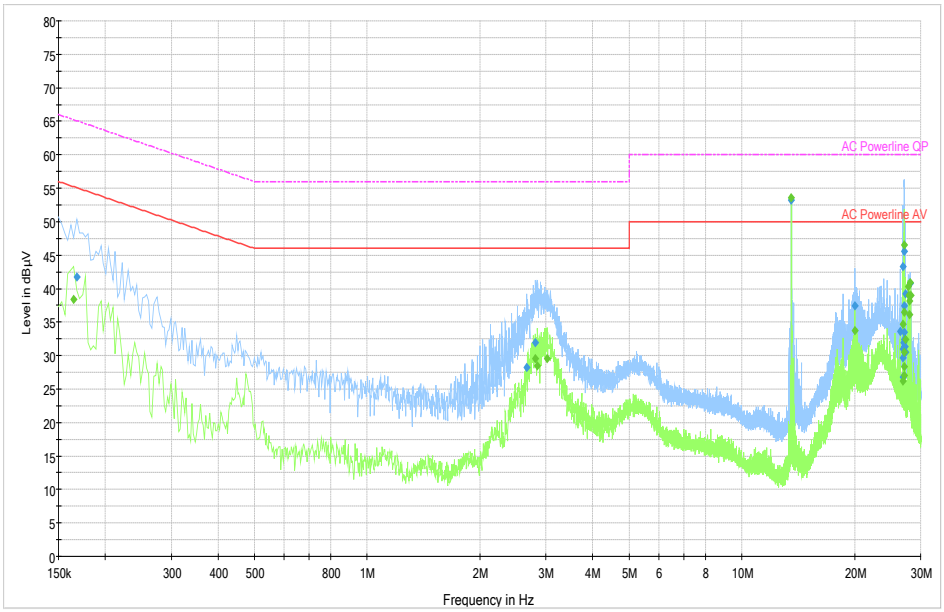
125.0kHz 9 kHz to 30 MHz



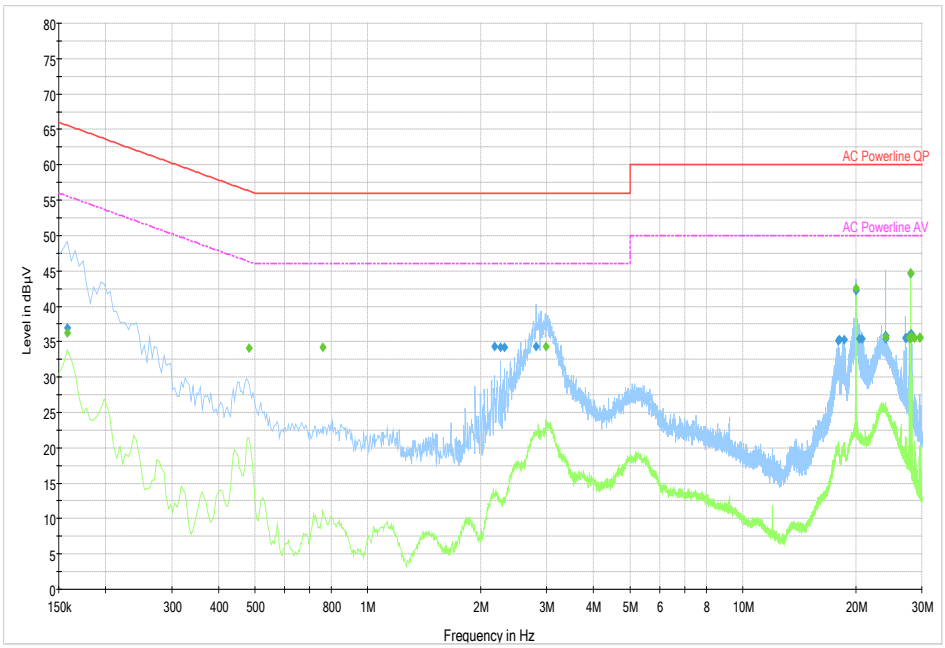

125.0kHz 30 MHz to 1 GHz



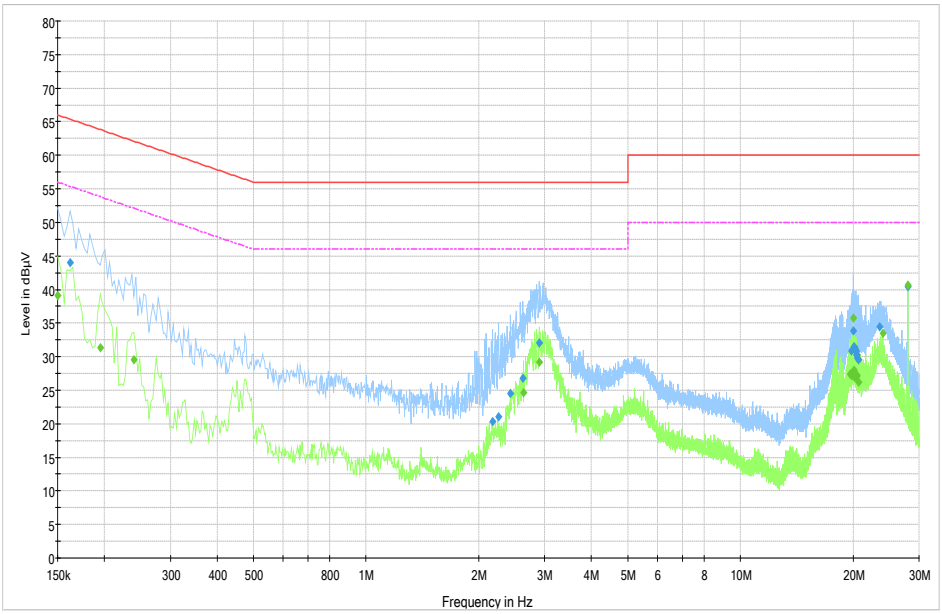
AC Powerline Conducted Emissions
13.56MHz

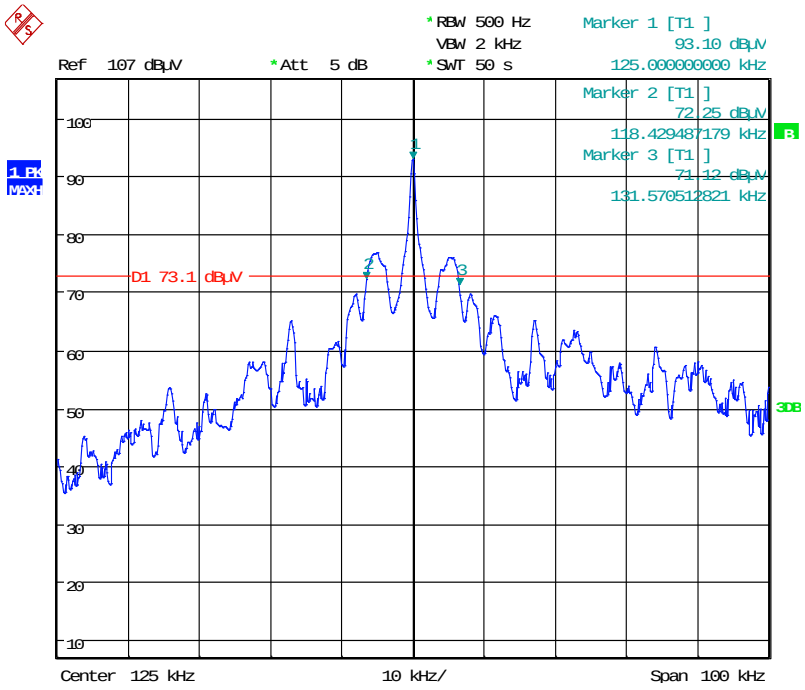



13.56MHz Dummy load



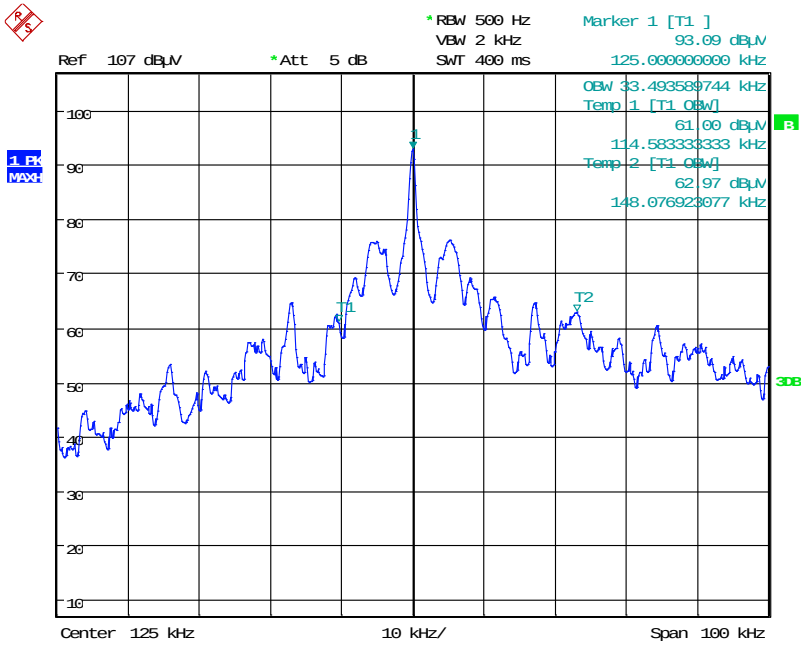
AC Powerline Conducted Emissions
125.0kHz





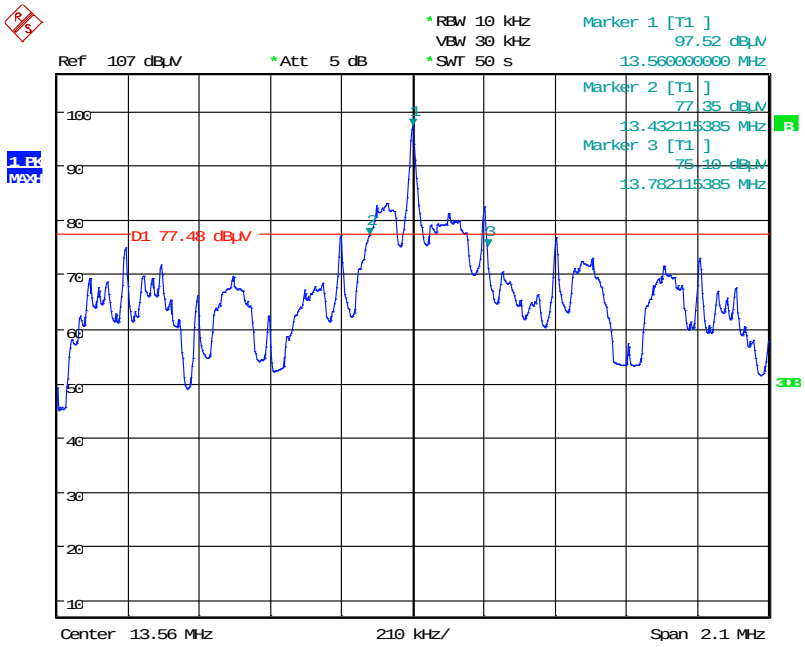

Date: 28.JAN.2015 16:03:55

125.0kHz 20dB bandwidth



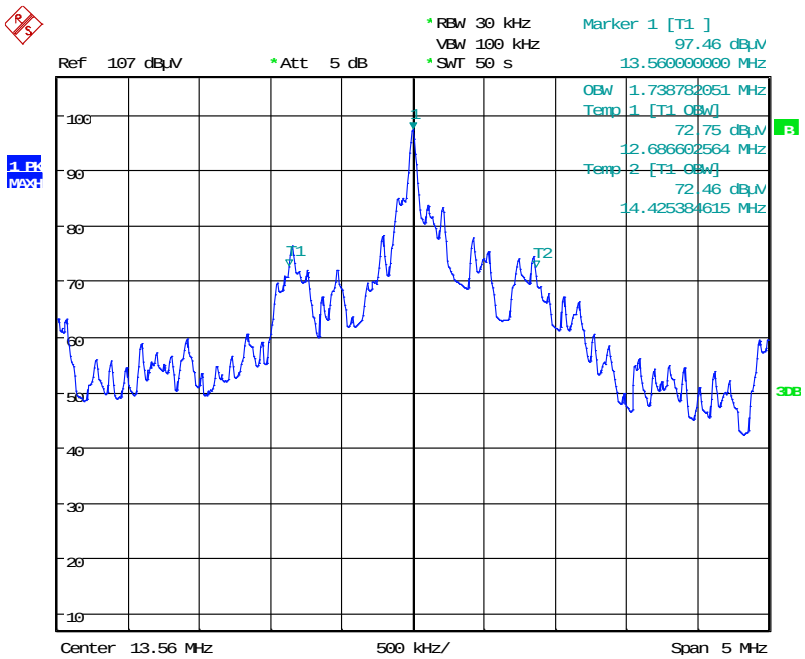

Date: 28.JAN.2015 16:02:01

125.0kHz 99% bandwidth



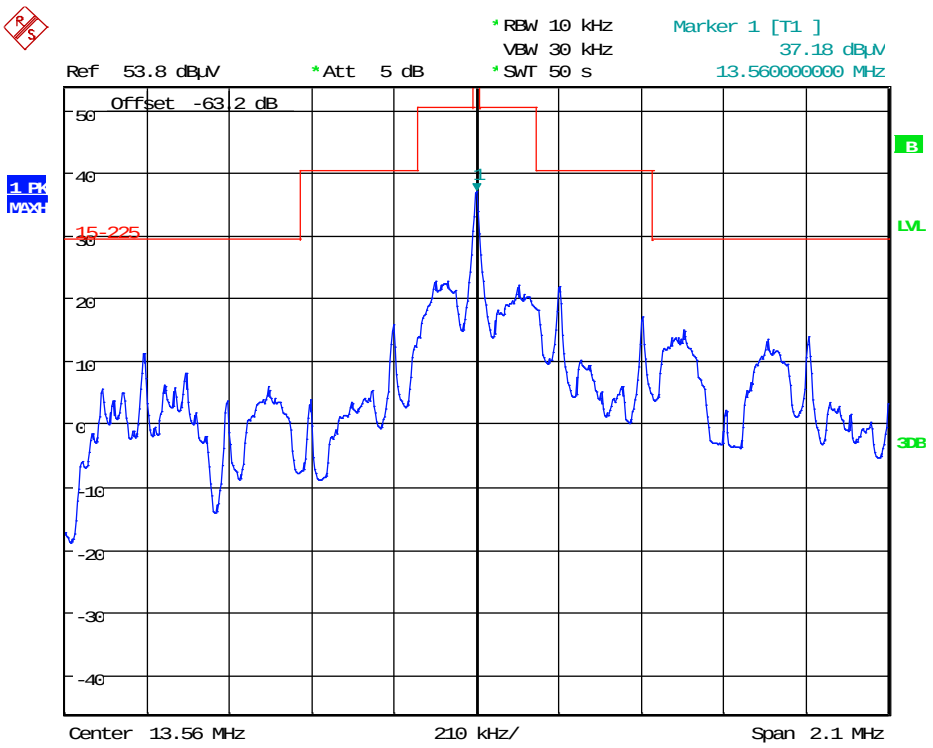

Date: 28.JAN.2015 15:54:42

13.56MHz 20dB bandwidth




Date: 28.JAN.2015 15:59:48

13.56MHz 99% bandwidth




Date: 27.JAN.2015 11:12:48

13.56MHz Mask

**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 |
|---|---|---|
| S01 | 13.56MHz unit | 2839144 |
| S02 | 125.0kHz unit | 2839142 |
| S03 | 13.56MHz unit (Dummy Antenna) | 2988553 |

| 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 |
|---|---|---|
| S07 | 1.8mtr USB cable | None |
| S08 | USB power Source third party device | None |
| S09 | Dc Power supply for the above equipment | P/NA0652101 |

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

| Identification | Description |
|---|---|
| | None |

**C2) EUT Operating Mode During Testing**.

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

| Test | Description of Operating Mode: |
|---|---|
| All tests detailed in this report | EUT is actively transmitting either waiting for a tag to be presented or reading a tag as required. |

**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:

Sample : S01,S02, S03
Tests : All Tests

| Port | Description of Cable Attached | Cable length | Equipment Connected |
|---|---|---|---|
| Power | USB cable | 1.8mtr | USB power source |

## C5 Details of Equipment Used

| TRaC No | Type | Description | Manufacturer | Last Cal | Period | Cal Due |
|---|---|---|---|---|---|---|
| UH403 | ESCI 7 | Recevier | R&S | 20/08/2014 | 12 | 20/08/2015 |
| 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.

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

e.g

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

0.07459 or 7.459%

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

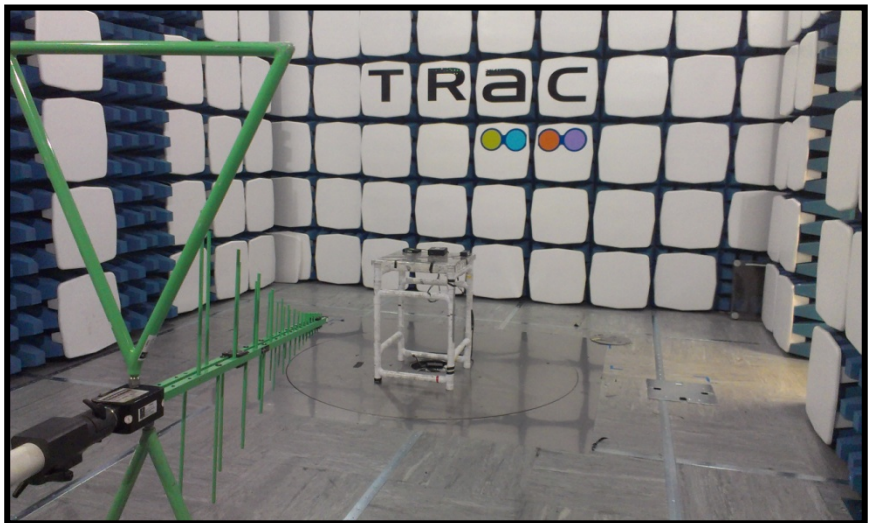
**Duty cycle correction may not be applicable.**
**Unless duty cycle correction is utilised in the results section of this report this section is included for information only**

## Appendix F: Photographs and Figures

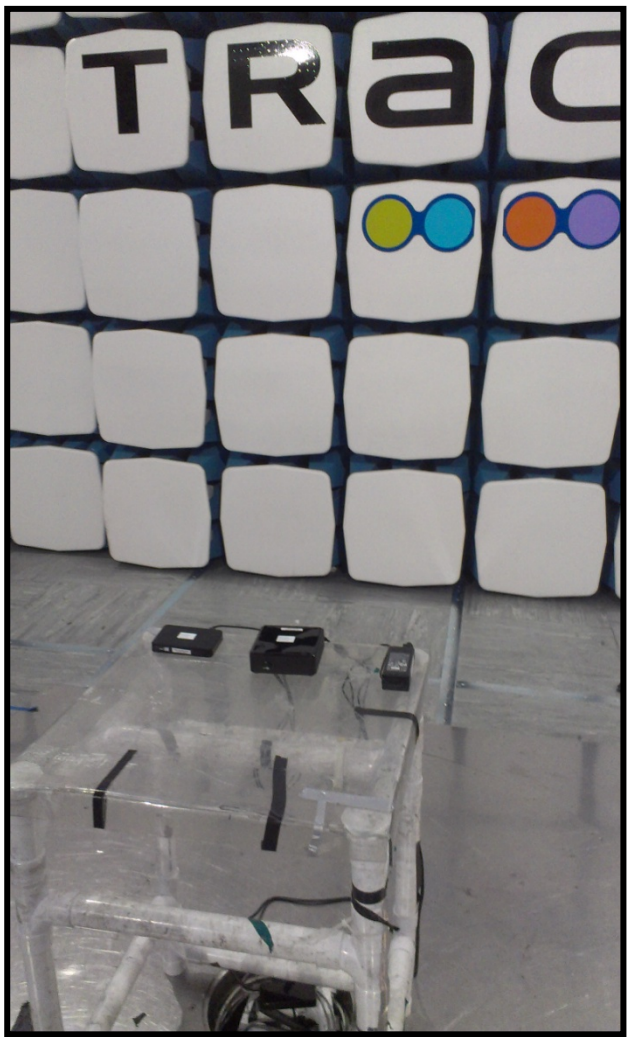
The following photographs were taken of the test samples:

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

Photograph 1

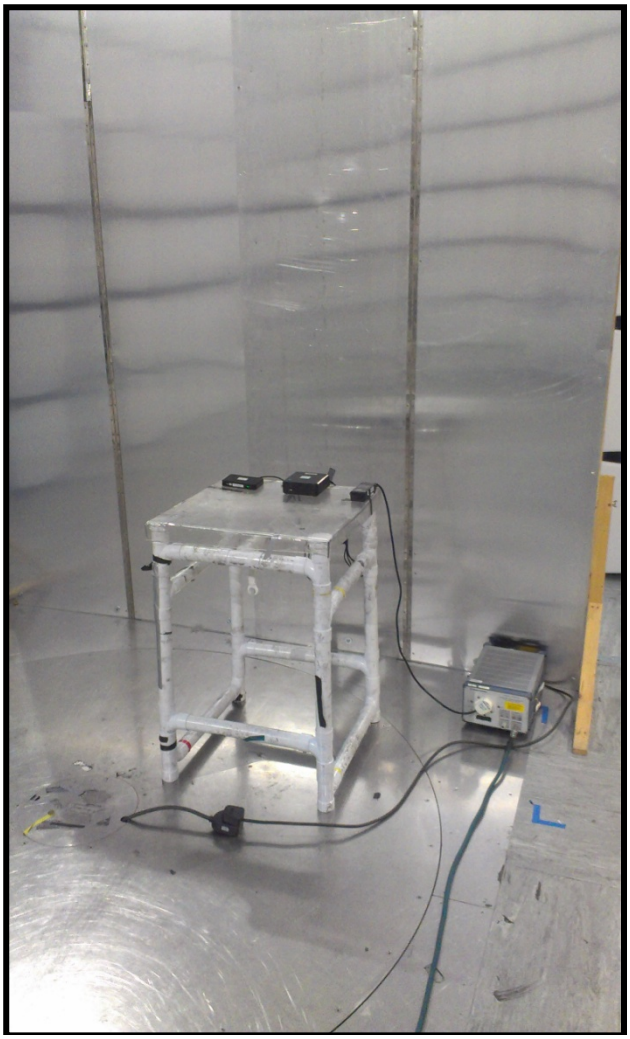



Photograph 2



Photograph 3

Photograph 4



**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 | 0.0173 |

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