

**AN RADIO TEST REPORT**  
**FOR**  
**THIRD MILLENNIUM SYSTEMS Ltd**  
**ON**  
**RX60**  
**DOCUMENT NO.TRA-012604-47-00-C**

**HULL**

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**TRaC Wireless Test Report** : TRA-020447-00-47-01-C

**Applicant** : Third Millennium Systems Ltd

**Apparatus** : RX60

**Specification(s)** : CFR47 Part 15 & RSS-210

**Purpose of Test** : Class II Permissive Change

**FCCID** : UTJ-RX60

**Authorised by**

: 

: Radio Product Manager

**Issue Date** : 20<sup>th</sup> November 2014

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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**

This testing in this report was requested by :

Third Millennium Systems Ltd  
18/19 Torfaen Business Centre  
Panteg Way  
New Inn  
Pontypool  
NP4 0LS

## **1.3 Manufacturer**

As Above

## **1.4 Apparatus Assessed**

The following apparatus was assessed between 12<sup>th</sup> April 2014 – 7<sup>th</sup> July 2014:

RX60 RFID contactless proximity reader PCB assembly

The RX60 RFID contactless proximity readers PCB assembly is contained in the following model variants; RX360, RX3K60 and RX1K60.

All the referenced variants incorporate identical hardware. The RX3K60 and RX1K60 use identical hardware with the variation in housing size only.

## 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 7.2.5	ANSI C63.10:2009	Pass
Spurious Emissions Radiated >1000MHz	15.209	RSS-Gen 7.2.5	ANSI C63.10:2009	N/A
AC Power conducted emissions	15.207	RSS-Gen 7.2.4	ANSI C63.10:2009	Pass
Intentional Emission Frequency	15.209 & 15.225(a)	A2.6 & RSS-Gen 7.2.5	ANSI C63.10:2009	Pass
Intentional Emission Field Strength	15.209 & 15.225(a)	A2.6 & RSS-Gen 7.2.5	ANSI C63.10:2009	Pass
Intentional Emission Band Occupancy	15.215 (c)	RSS-Gen 4.6	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 6.1	ANSI C63.10:2009	Pass
Antenna Arrangements Integral:	15.203	RSS-Gen 7.1.2	-	Pass
Antenna Arrangements External Connector	15.204	RSS-Gen 7.1.2	-	N/A
Restricted Bands	15.205	RSS-Gen 7.2.2	-	Pass
Maximum Frequency of Search	15.33	RSS-Gen 4.9	-	Pass
Extrapolation Factor	15.31(f)	RSS-Gen 7.2.7	-	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**

There were no deviations from the standards tested to.

**Section 2:****Measurement Uncertainty****2.1 Measurement Uncertainty Values**

For the test data recorded in accordance with note (iii) of Section 2.1 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 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

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

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	ALSR	: Absorber Lined Screened Room
Mod	: Modification	OATS	: Open Area Test Site
		ATS	: Alternative Test Site
EUT	: Equipment Under Test		
SE	: Support Equipment	Ref	: Reference
		Freq	: Frequency
L	: Live Power Line		
N	: Neutral Power Line	MD	: Measurement Distance
E	: Earth Power Line	SD	: Spec Distance
Pk	: Peak Detector	Pol	: Polarisation
QP	: Quasi-Peak Detector	H	: Horizontal Polarisation
Av	: Average Detector	V	: Vertical Polarisation
CDN	: Coupling & decoupling network		

**A1 Transmitter Intentional Emission Radiated – 15.209**

Carrier power was verified with the EUT transmitting Test Details:	
Regulation	Part15 Subpart (c) 15.209 & RSS-Gen, RSS-Gen 7.2.5
Measurement standard	ANSI C63.10:2009
EUT sample number	S02, S03
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

RX360				
FREQ. (kHz)	MEASUREMENT DISTANCE Meters	MEASUREMENT Rx. READING (dBµV/m)	EXTRAP. FACTOR (dB)	FIELD STRENGTH (µV/m)
125.85	1	91.40	101.60	0.309
125.85	3	69.80	80.00	0.309
Limit value @ fc		19.21 µV/m @ 300meters		
RX3K60				
FREQ. (kHz)	MEASUREMENT DISTANCE Meters	MEASUREMENT Rx. READING (dBµV/m)	EXTRAP. FACTOR (dB)	FIELD STRENGTH (µV/m)
125.85	1	91.80	104.00	0.245
125.85	3	67.80	80.00	0.245
Limit value @ fc		19.21 µV/m @ 300meters		

- 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 7.2.7
  - 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 orthogonal planes.  
Maximum results recorded

**A2 Transmitter Intentional Emission Radiated – 15.225(a)**

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	S02, S03, S05
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

RX360				
FREQ. (MHz)	MEASUREMENT DISTANCE Metres	MEASUREMENT Rx. READING (dBµV/m)	EXTRAP. FACTOR (dB)	FIELD STRENGTH (µV/m)
13.56	1	91.30	62.40	27.861
13.56	3	68.90	40.00	27.861
Limit value @ fc		15848 µV/m @ 30metres		
RX3K60				
FREQ. (MHz)	MEASUREMENT DISTANCE Metres	MEASUREMENT Rx. READING (dBµV/m)	EXTRAP. FACTOR (dB)	FIELD STRENGTH (µV/m)
13.56	1	92.00	62.50	29.854
13.56	3	69.50	40.00	29.854
Limit value @ fc		15848 µV/m @ 30metres		



- Notes:**
- 1 Results quoted are extrapolated as indicated
  - 2 Receiver detector @  $f_c$  = Quasi Peak 10
  - 4 Extrapolation <30 MHz 40dB/decade as per 15.31(f)(2) & RSS Gen 7.2.7
  - 5 3 – 300 metre extrapolation 80 dB (40dB/decade) as per 15.31(f)(2)
  - 6 1 – 3 metre extrapolation as measured
  - 7 1 – 300 metre extrapolation 104.7 dB (80dB + 24.7dB)

- 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 orthogonal 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 :

☒

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details	
Regulation	Part 15 Subpart (c) Clause 15.209, RSS-Gen 7.2.5
Measurement standard	ANSI C63.10:2009
Frequency range	9kHz – 1GHz
EUT sample number	S02, S03, S05
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:

RX360									
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.	40.70	10.6	1.0	12.1	-	23.6	-	15.14	100
2.	420.35	8.3	2.4	16.7	-	27.4	-	23.44	200
3.	433.90	8.4	2.5	16.4	-	27.3	-	23.17	200
4.	447.50	12.2	2.5	16.3	-	31.0	-	35.48	200
5.	461.05	10.6	2.5	16.7	-	29.8	-	30.90	200
6.	528.85	10.3	2.6	17.7	-	30.6	-	33.88	200
7.	542.40	11.1	2.6	18.5	-	32.2	-	40.74	200
8.	555.95	16.2	2.7	18.7	-	37.6	-	75.86	200
9.	569.55	13.8	2.8	18.8	-	35.4	-	58.88	200
10.	583.10	9.9	2.8	18.8	-	31.5	-	37.58	200
11.	596.65	4.9	2.9	18.7	-	26.5	-	21.13	200
12.	610.20	9.4	3.0	18.6		31.0		35.48	200
13.	637.35	8.6	3.1	19.0	-	30.6	-	33.88	200
14.	650.90	8.9	3.1	19.1	-	31.0	-	35.48	200
15.	691.55	6.5	3.2	19.0	-	28.7	-	27.23	200
16.	705.15	7.3	3.3	19.4	-	29.9	-	31.26	200
17.	800.05	5.9	3.4	20.3	-	29.6	-	30.20	200
18.	827.15	6.0	3.4	20.3	-	29.7	-	30.55	200
19.	952.50	1.3	3.7	21.2	-	26.2	-	20.42	200

RX3K60									
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)
20.	40.70	11.6	1.0	12.1	-	24.6	-	16.98	100
21.	420.35	7.8	2.4	16.7	-	26.9	-	22.13	200
22.	433.95	11.1	2.5	16.4	-	30.0	-	31.62	200
23.	461.05	11.2	2.5	16.7	-	30.4	-	33.11	200
24.	528.85	9.5	2.6	17.7	-	29.8	-	30.90	200
25.	542.45	7.4	2.6	18.5	-	28.5	-	26.61	200
26.	556.00	12.2	2.7	18.7	-	33.6	-	47.86	200
27.	569.55	13.6	2.8	18.8	-	35.2	-	57.54	200
28.	583.10	10.5	2.8	18.8	-	32.1	-	40.27	200
29.	596.65	11.1	2.9	18.7	-	32.7	-	43.15	200
30.	610.20	10.4	3.0	18.6	-	32.0	-	39.81	200
31.	623.80	7.0	3.0	19.0		29.0		28.18	200
32.	637.35	10.7	3.1	19.0	-	32.7	-	43.15	200
33.	650.90	5.8	3.1	19.1	-	27.9	-	24.83	200
34.	664.45	11.2	3.1	19.0	-	33.3	-	46.24	200
35.	691.55	11.7	3.2	19.0	-	33.9	-	49.55	200
36.	718.70	15.0	3.3	19.3	-	37.6	-	75.86	200
37.	732.25	5.4	3.3	19.5	-	28.2	-	25.70	200
38.	745.80	12.9	3.3	19.8	-	36.0	-	63.10	200
39.	772.95	9.9	3.4	20.0	-	33.3	-	46.24	200
40.	800.05	8.1	3.4	20.3	-	31.8	-	38.90	200
41.	827.20	8.3	3.4	20.3	-	32.0	-	39.81	200
42.	935.65	3.5	3.6	21.0	-	28.1	-	25.41	200

**Notes:**

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10:2009: section 4.5, Table 1 For emissions below 30MHz the cable losses are assumed to be negligible.
- 2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
- 3 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.
- 4 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 47 CFR Part 15: Clause 15.209 for all emissions:

Frequency of emission (MHz)	Field strength $\mu\text{V/m}$	Measurement Distance m	Field strength $\text{dB}\mu\text{V/m}$
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:

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

- (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 7.2.4
Measurement standard	ANSI C63.10:2009
Frequency range	150kHz to 30MHz
EUT sample number	S02, S03, S05
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 average detector compared to the average limit

RX360						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	13.558	Neutral	50.0	50	0.0	Pass
Antenna Replaced by dummy load						
2	13.558	Neutral	20.9	50	-29.1	Pass

##### Results measured using the quasi-peak detector compared to the quasi-peak limit

RX360						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	13.562	Live	58.7	60	-1.3	Pass
Antenna Replaced by dummy load						
2	13.562	Live	30.3	60	-29.7	Pass

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

<b>RX3K60</b>						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	13.558	Neutral	38.4	50	-11.6	Pass
<b>Antenna Replaced by dummy load</b>						
Not Applicable						

**Results measured using the quasi-peak detector compared to the quasi-peak limit**

<b>RX3K60</b>						
Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	13.558	Neutral	47.8	60	-12.2	Pass
<b>Antenna Replaced by dummy load</b>						
Not Applicable						

Specification limits :

Conducted emission limits (47 CFR Part 15: Clause 15.207 & RSS-Gen 7.2.4):

Conducted disturbance at the mains ports.

Frequency range MHz	Limits dB $\mu$ V	
	Quasi-peak	Average
0.15 to 0.5	66 to 56 <sup>2</sup>	56 to 46 <sup>2</sup>
0.5 to 5	56	46
5 to 30	60	50

Notes:

- The lower limit shall apply at the transition frequency.
- 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



**Appendix B:****Supporting Graphical Data**

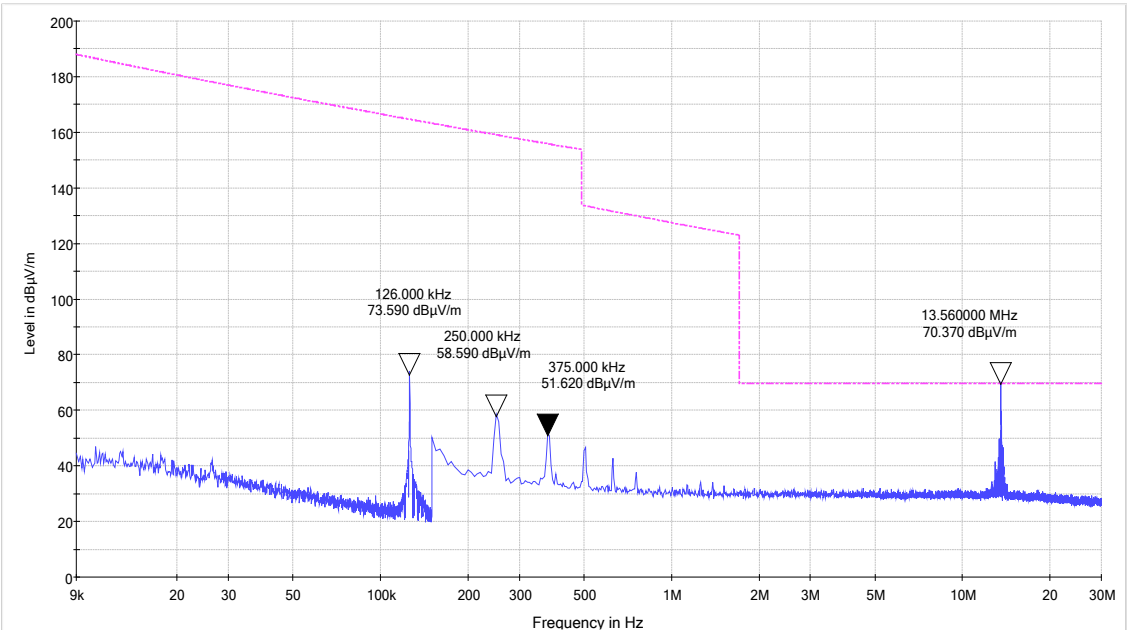
This appendix contains graphical data obtained during testing.

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.

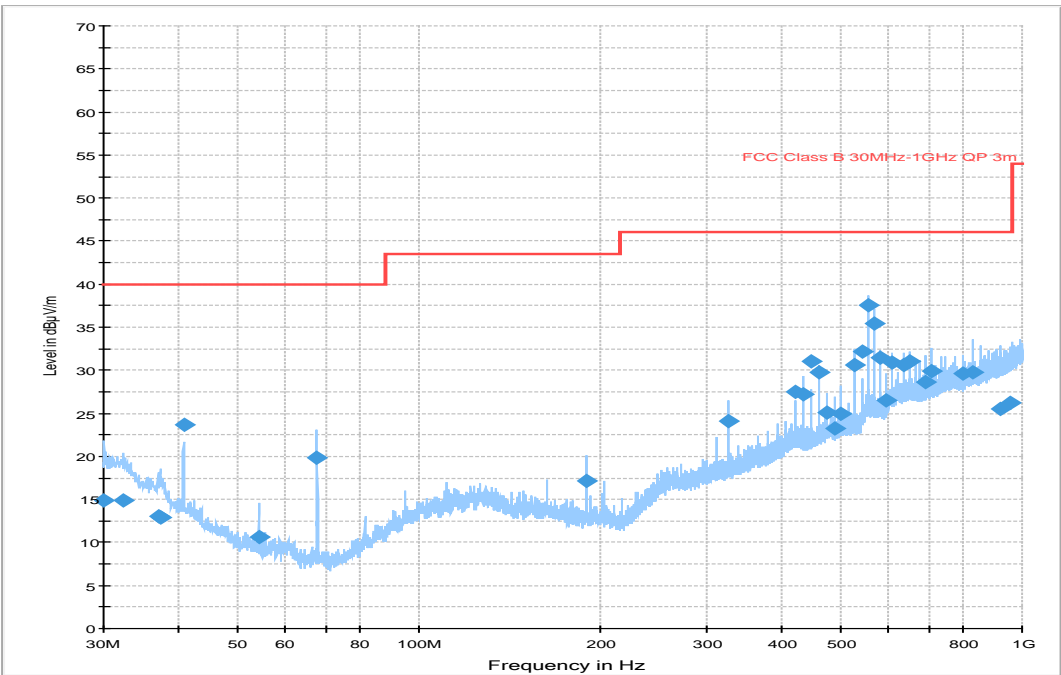
RX360

Radiated spurious emissions



9 kHz to 30 MHz

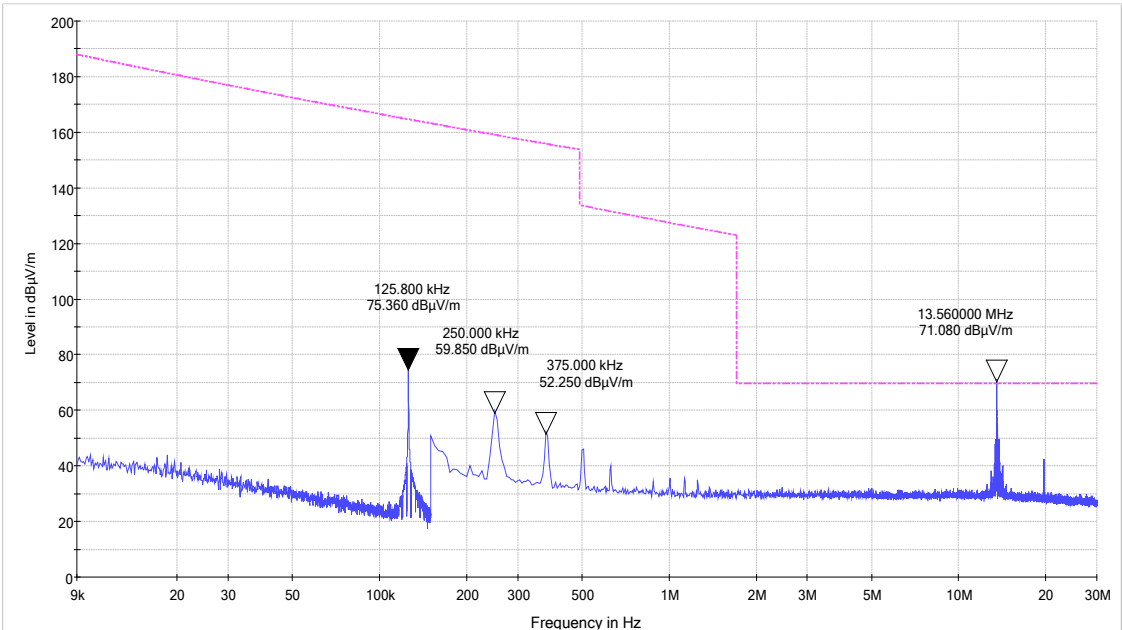
FCC pt15.109 RE Class B 30MHz-1GHz ESCI7 + UH420 - 19May2011



30 MHz to 1 GHz

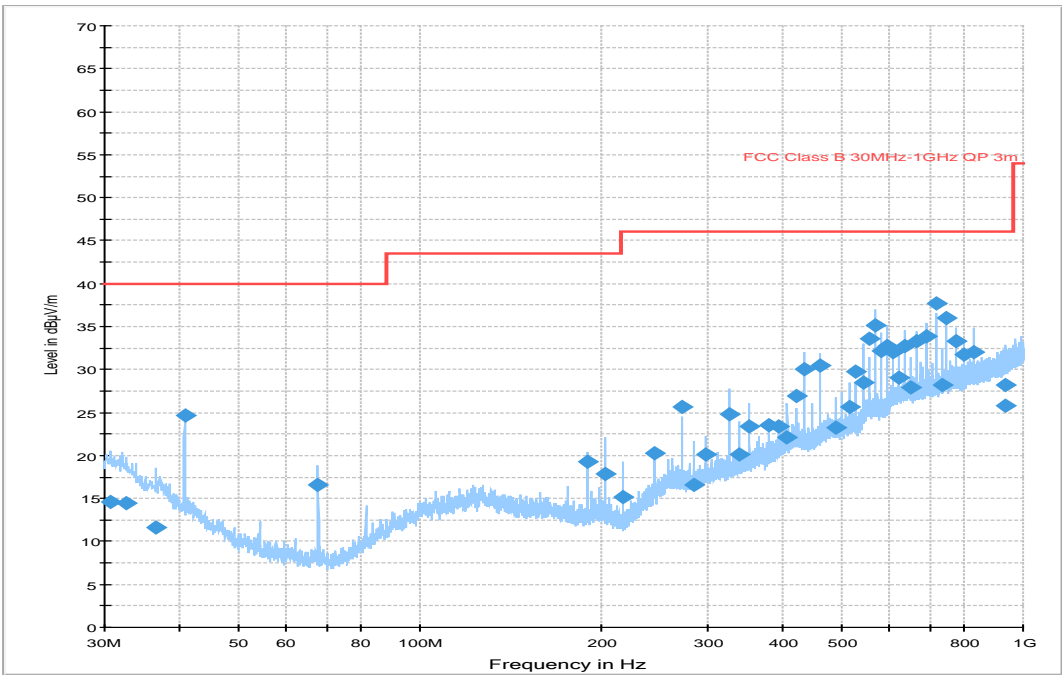
RX3K60

Radiated spurious emissions



9 kHz to 30 MHz

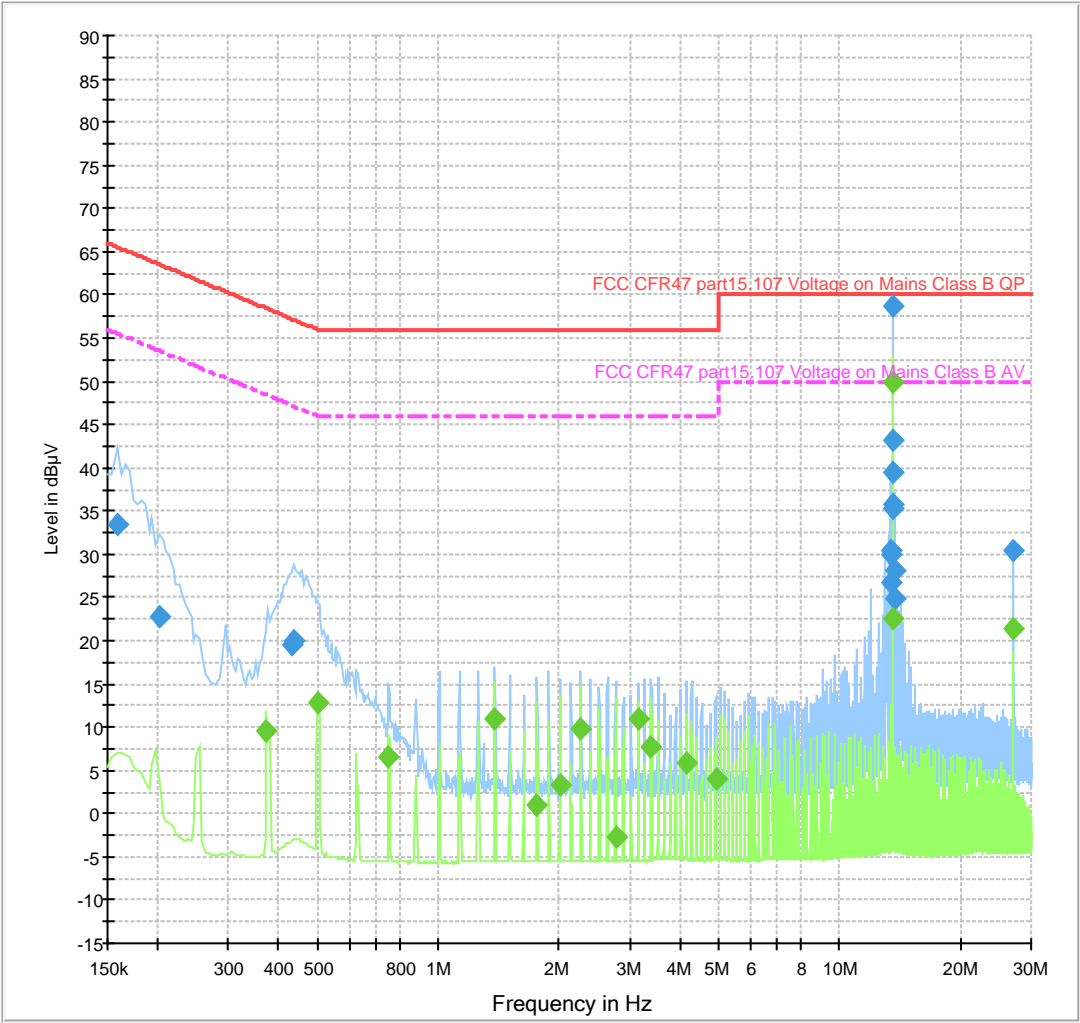
FCC pt15.109 RE Class B 30MHz-1GHz ESCI7 + UH420 - 19May2011



30 MHz to 1 GHz

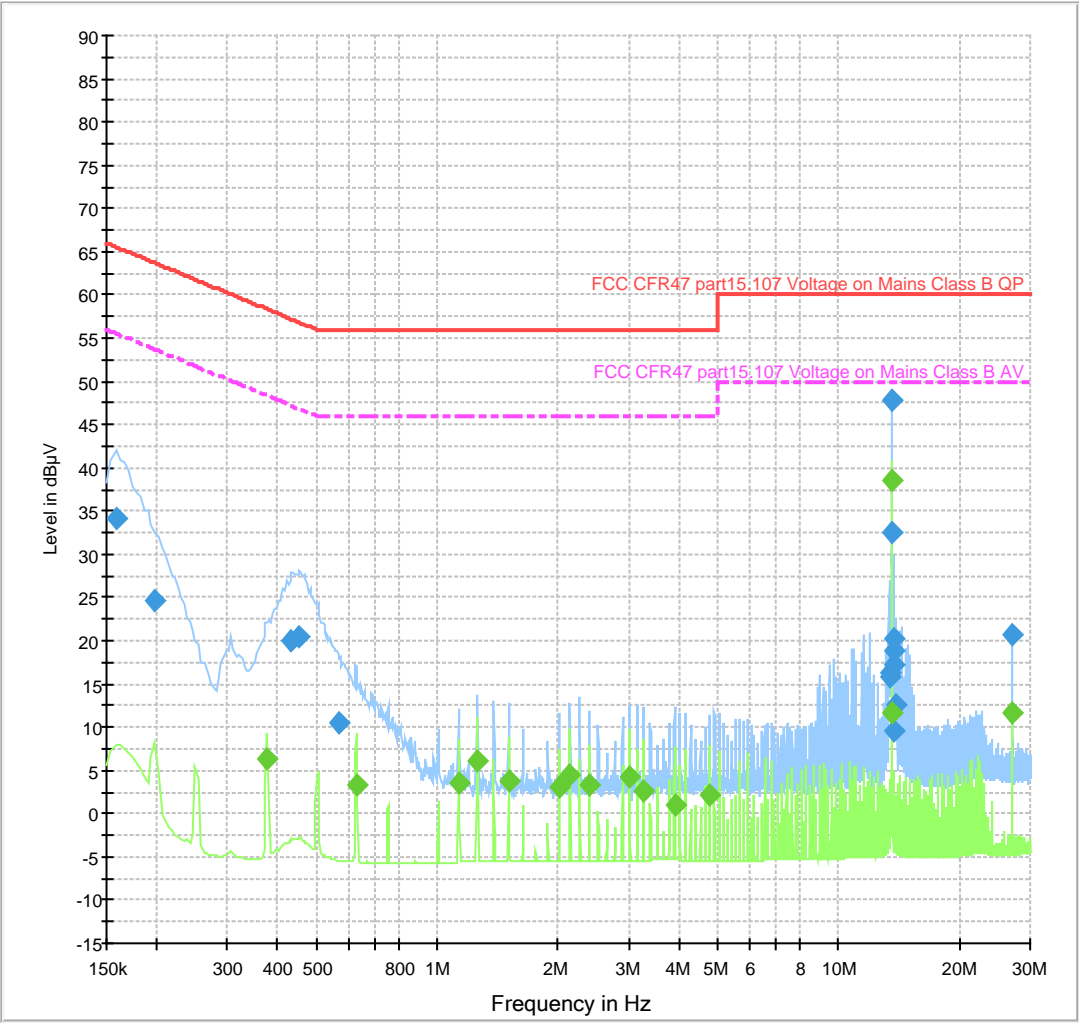
RX360 AC Powerline Conducted Emissions

Fcc Class B Conducted emissions on Mains 150kHz-30MHz ESHS10 + UH195 Rx prescans



RX3K60 AC Powerline Conducted Emissions

Fcc Class B Conducted emissions on Mains 150kHz-30MHz ESHS10 + UH195 Rx prescans



**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
S02	RX360	None
S03	RX3K60	None

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

Sample No.	Description	Identification
S08	Test Card	None
S09	MEC MARCOM Ferrite	TRCN-20-10-10

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 : S02, S03  
Tests : All Tests

Port	Description of Cable Attached	Cable length	Equipment Connected
Power	2 wire	1m	PSU

Sample : S05  
Tests : All Tests

Port	Description of Cable Attached	Cable length	Equipment Connected
Power	2 wire cable with 3 turns on ferrite S09	1m	PSU

**C5 Details of Equipment Used**

TRaC No	Type	Description	Manufacturer	Last Cal	Period	Cal Due
UH420	CBL6112B	Bilog	Chase	06/07/2012	24	06/07/2014
UH403	ESCI7	Receiver	R&S	12/08/2013	12	12/08/2014
UH195	ESH3-Z5.831.5	Lisn	R&S	03/07/2013	12	03/07/2014
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

**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 =  $20 \times (\text{Log}_{10} \text{ Calculated Duty Cycle})$

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

e.g

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

0.07459 or 7.459%

Correction factor (dB) =  $20 \times (\text{Log}_{10} 0.07459) = -22.54\text{dB}$

**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 Overview – RX360
2. Radiated emissions arrangement Close up – RX360
3. Radiated emissions arrangement Overview – RX3K60
4. Radiated emissions arrangement Close up – RX3K60

Photograph 1



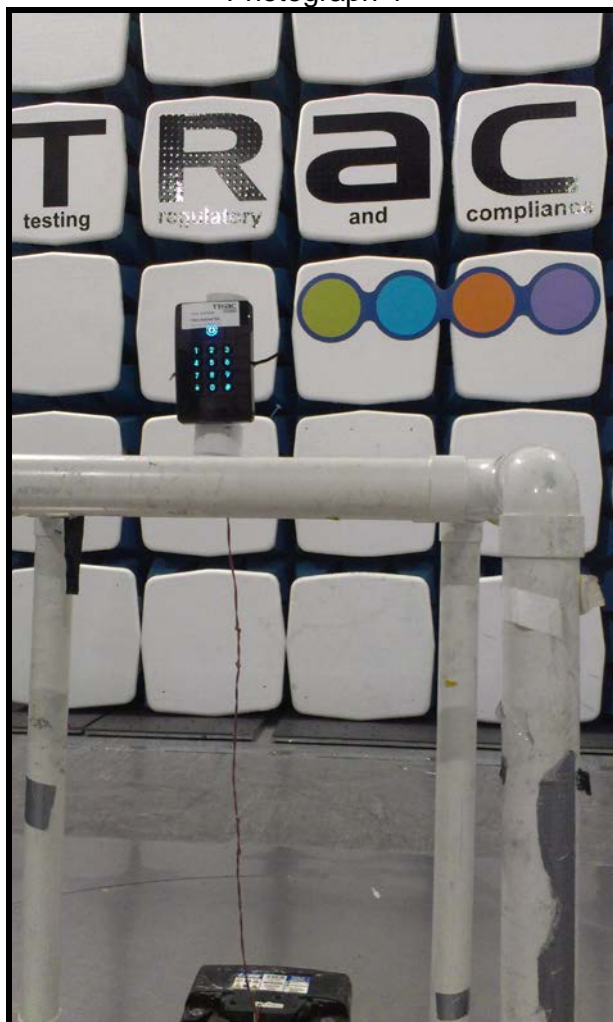
Photograph 2



Photograph 3



Photograph 4





**Appendix G:****MPE calculation****As per KDB 447498****47 CFR §§1.1307 and 2.1091**

2.1091 Radio frequency radiation exposure evaluation: Portable devices.

For purposes of these requirements mobile devices are defined by the FCC 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 centimetres 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 FCC 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 0.6mW/cm<sup>2</sup> power density limit, as required under FCC rules

**Prediction of MPE limit at a given distance**

Equation from KDB 447498 D01

$$S = \frac{1.64ERP}{4\pi R^2} \text{ re - arranged } R = \sqrt{\frac{1.64ERP}{S4\pi}}$$

where:

S = power density

R = distance to the centre of radiation of the antenna

ERP = EUT Maximum power

Result:

Prediction Frequency (MHz)	Maximum ERP (mW)	Power density limit (S) (mW/cm <sup>2</sup> )	Distance (R) cm required to be less than 0.6mW/cm <sup>2</sup> (cm)
0.12585	0.0017	0.6	0.019

