

A RADIO TEST REPORT

FOR

HWM-WATER Ltd

ON

PR4US

DOCUMENT NO. TRA-012696-47-00-A

HULL

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TRaC Wireless Test Report : TRA-012696-47-00-A

Applicant : HWM-Water Ltd

Apparatus : PR4US

Specification(s) : CFR47 Part 15.249 & RSS-210 Annex 2 A2.9

Purpose of Test : Certification

FCCID : RUZ-031

Certification Number : 10962A-031

Authorised by :



: Radio Product Manager

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Contents

Section 1:	Introduction	4
1.1	General	4
1.2	Tests Requested By	5
1.3	Manufacturer	5
1.4	Apparatus Assessed	5
1.5	Test Result Summary	6
1.6	Notes Relating To The Assessment	7
1.7	Deviations from Test Standards	7
Section 2:	Measurement Uncertainty	8
2.1	Measurement Uncertainty Values	8
Section 3:	Modifications	10
3.1	Modifications Performed During Assessment	10
Appendix A:	Formal Emission Test Results	11
A1	Transmitter Intentional Emission Radiated	12
A2	Radiated Electric Field Emissions	13
Appendix B:	Supporting Graphical Data	15
Appendix C:	Additional Test and Sample Details	19
Appendix D:	Additional Information	25
Appendix E:	Calculation of the duty cycle correction factor	26
Appendix F:	Photographs and Figures	27
Appendix G:	MPE Calculation	30

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 :

HWM-Water Ltd
Ty Coch House
Llantarnam Industrial Park
Cwmbran
NP44 3AW

1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between 27th – 28th February 2013

PR4US

The PR4US is a transmitter operating at 914.5 MHz

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	Regulation		Measurement standard	Result
	Title 47 of the CFR: Part 15 Subpart (c)	RSS-210 Issue 8 RSS-Gen Issue 3		
Spurious Emissions Radiated <1000MHz	15.209 & 15.249 (a) (d)	Annex 2 A2.9(a) RSS-Gen 4.9	ANSI C63.10:2009	Pass
Spurious Emissions Radiated >1000MHz	15.209 & 15.249 (a) (d)	Annex 2 A2.9(a) RSS-Gen 4.9	ANSI C63.10:2009	Pass
AC Power conducted emissions	15.207	RSS-Gen 7.2.4	ANSI C63.10:2009	N/A
Intentional Emission Frequency	15.249 (a)	Annex 2 A2.9(a)	ANSI C63.10:2009	Pass
Intentional Emission Field Strength	15.249 (a)	RSS-Gen 4.8	ANSI C63.10:2009	Pass
Intentional Emission Band Occupancy	15.215 (c)	RSS-Gen 4.6	ANSI C63.10:2009	Pass
Intentional Emission ERP (mW)	-	RSS-Gen 4.8	ANSI C63.10:2009	N/A
Unintentional Radiated Spurious Emissions	15.109	RSS-Gen 4.10	ANSI C63.10:2009	N/A
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	-	-
Maximum Frequency of Search	15.33	RSS-Gen 4.9	-	-
Extrapolation Factor	15.31(f)	RSS-Gen 7.2.7	-	-

Abbreviations used in the above table:

ANSI C 63.10:2009 is outside the scope of the laboratories UKAS accreditation.

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 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

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
EUT	: Equipment Under Test	ATS	: Alternative Test Site
SE	: Support Equipment	Ref	: Reference
L	: Live Power Line	Freq	: Frequency
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

Carrier power was verified with the EUT transmitting Test Details:	
Regulation	Part 15.249 (a) & RSS-210 Annex 2 A2.9(a)
Measurement standard	ANSI C63.10:2009
EUT sample number	S05
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18
Photographs (Appendix F)	1 & 2

FREQ. (MHz)	MEASUREMENT Rx. READING (dB μ V)	CABLE LOSS (dB)	ANT FACTOR (dB/m)	PRE AMP (dB)	FIELD STRENGTH (dB μ V/m)	FIELD STRENGTH (mV/m)
914.47	66.0	3.6	24.2	-	93.8	48.97
Limit value @ fc			50 mV/m @ 3m			
Band occupancy @ -20 dBc			f lower		f higher	
			914.419986 MHz		914.545709 MHz	
			125.723 kHz			
Band occupancy @ 99%			f lower		f higher	
			914.372596 MHz		914.592147 MHz	
			219.551 kHz			

- Notes:**
- 1 Results quoted are extrapolated as indicated
 - 2 Receiver detector @ fc = Quasi Peak 120kHz bandwidth
 - 3 When battery powered the EUT was powered with new batteries

- Test Method:**
- 1 As per Radio – Noise Emissions, ANSI C63.10:2009
 - 2 Measuring distances 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 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 15.209, 15.249 (a) & (d), Annex 2 A2.9(a), RSS-Gen 4.9
Measurement standard	ANSI C63.10:2009
Frequency range	30 MHz – 10 GHz
EUT sample number	S05
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	18
Photographs (Appendix F)	1 & 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below:

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.	364	10.4	2.4	14.5	N/A	27.3	-	23.17	200
2.	416	8.1	2.6	16.5	N/A	27.2	-	22.91	200
3.	468	17.5	2.8	17.3	N/A	37.6	-	75.86	200
4.	520	9.3	2.9	18.6	N/A	30.8	-	34.67	200
5.	572	4.4	3.0	20.0	N/A	27.4	-	23.44	200
6.	1828.9 _{Av}	59.2	2.6	27.2	36.3	52.7	-	431.52	500
7.	1828.9 _{Pk}	56.8	2.6	27.2	36.3	50.3	-	327.34	5000
8.	5486.8 _{Av}	50.8	4.1	33.8	35.8	52.9	-	441.57	500
9.	5486.8 _{Pk}	45.1	4.1	33.8	35.8	47.2	-	229.09	5000

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), 15.33(a)(1) and RSS-Gen 4.9 .

Radiated emission limits 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 :

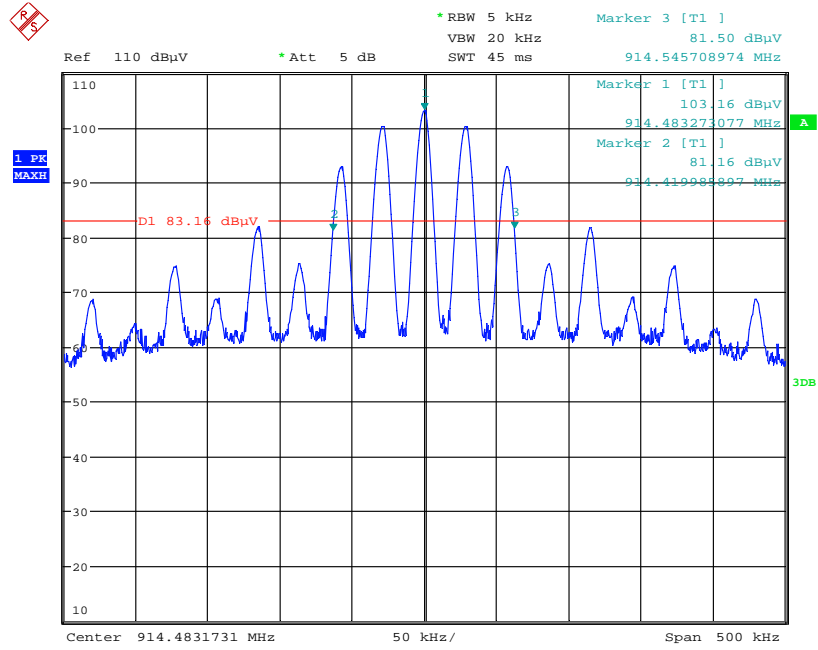
	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels	✓			
Effect of Position of EUT cables & samples on emission levels	✓			
(i) Parameter defined by standard and / or single possible, refer to Appendix D (ii) 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				

Appendix B:**Supporting Graphical Data**

This appendix contains graphical data obtained during testing.

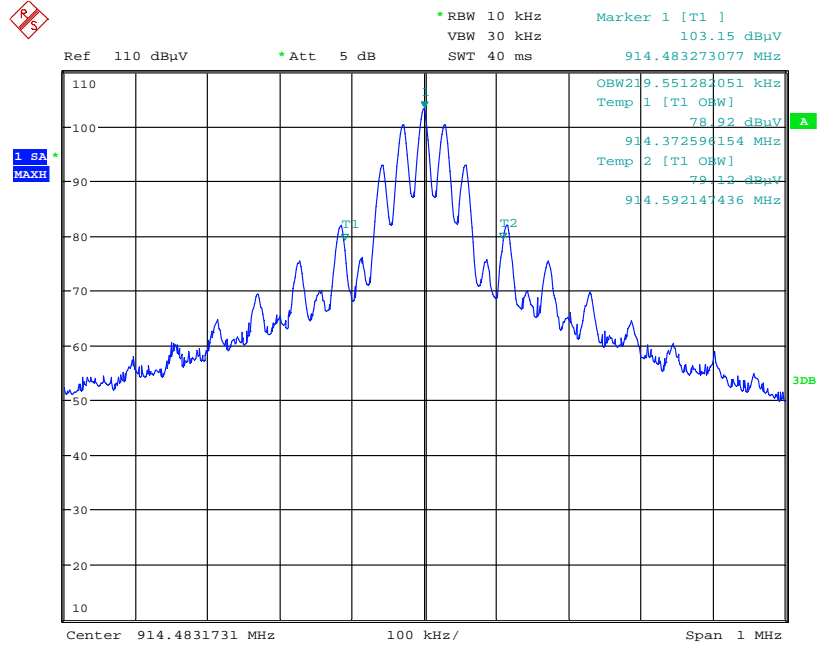
Notes:

- (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.



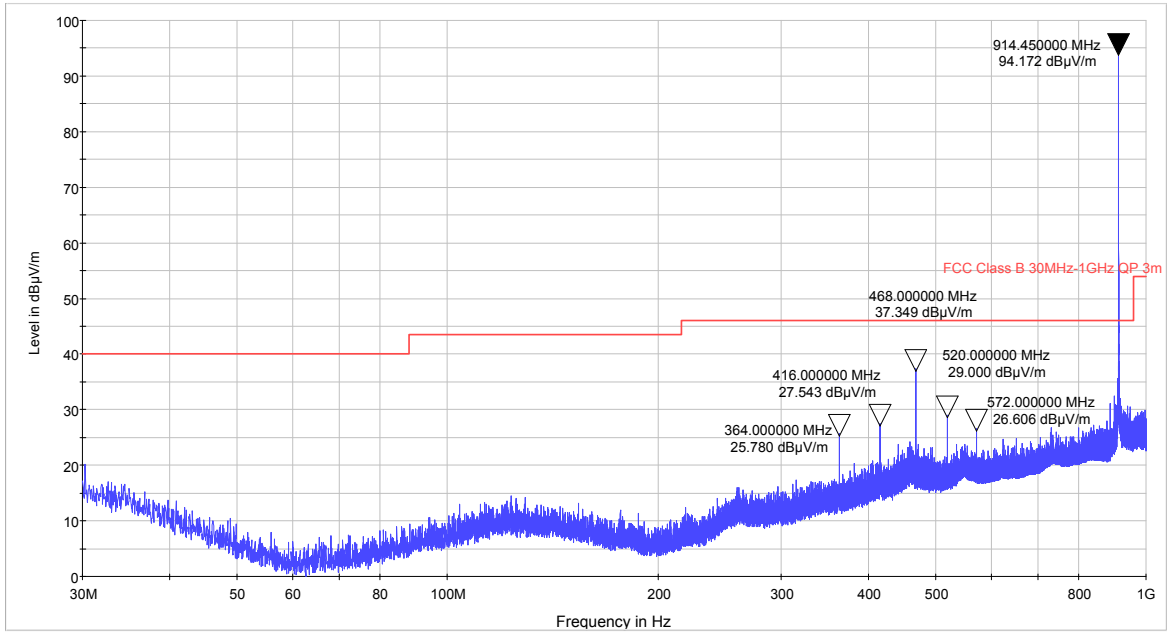
Date: 28.FEB.2013 11:18:03

20dB Bandwidth

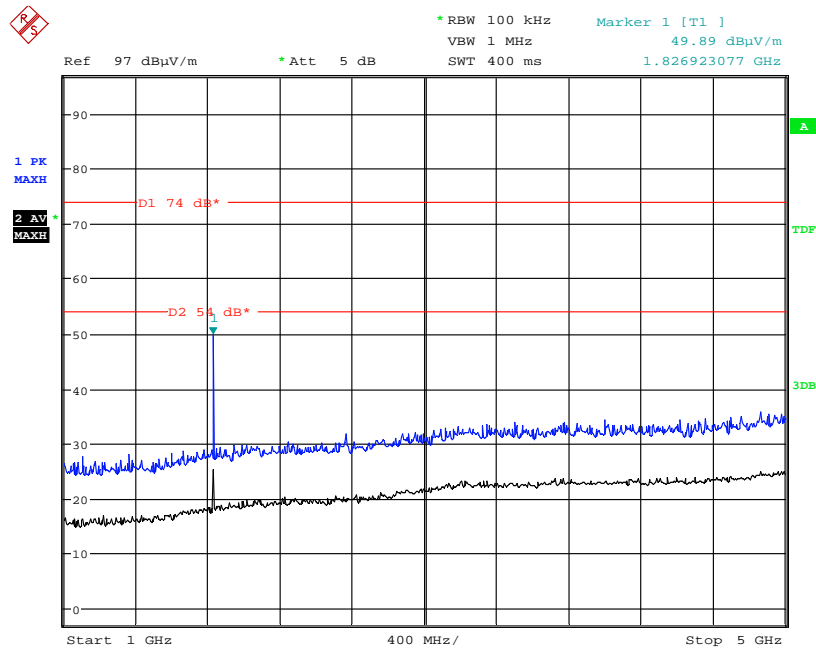


Date: 28.FEB.2013 11:22:17

99% Bandwidth



Radiated spurious emissions 30 MHz to 1 GHz



Date: 28.FEB.2013 10:51:07

Radiated spurious emissions 1 GHz to 5 GHz

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. S05
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
S05	PR4US	P4-1290002

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

Sample No.	Description	Identification

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

Identification	Description

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 transmitting a permanently modulated carrier

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:

The PR4US has no External Ports

Sample :
 Tests : Conducted

Port	Description of Cable Attached	Cable length	Equipment Connected

Sample :
 Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected

* Only connected during setup.

C5 Details of Equipment Used

TRaC No	Equipment Type	Equipment Description	Manufacturer	Last Cal Calibration	Calibration Period	Due For Calibration
UH191	CBL611/A	Bilog	Chase	13/12/2012	24	13/12/2014
REF909	FSU26	Spectrum Analyser	R&S	04/02/2013	12	04/02/2014
L138	3115	1-18GHz Horn	EMCO	08/11/2011	24	08/11/2013
L139	3115	1-18GHz Horn	EMCO	14/09/2011	24	14/09/2013
L317	ESVS10	Receiver	R&S	09/01/2013	12	09/01/2014
L572	8449B	Pre Amp	Agilent	12/12/2012	24	12/12/2014
REF940	ATS	Radio Chamber - PP	Rainford EMC	26/06/2012	12	26/06/2013

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 / required by the device covered in this report. The correction factor above is for example of how the correction is calculated. Any applicable duty cycle used will be recorded in the relevant results sections of this report.

Appendix F:

Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: Over view.
2. Radiated electric field emissions arrangement: Close up.



Photograph 1



Photograph 2

Appendix G:

MPE Calculation

OET Bulletin No. 65, Supplement C 01-01 & RSS-102

47 CFR §§1.1307 and 2.1091

2.1091 Radio frequency radiation exposure evaluation: mobile devices.

For purposes of these requirements mobile devices are defined by the FCC and 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 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 and 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 power density limit, as required under rules.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

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

where:

S = power density

R = distance to the centre of radiation of the antenna

EIRP = EUT Maximum power

Note:

The EIRP measurement was performed using a signal substitution method.

Result

Prediction Frequency (MHz)	Maximum EIRP	Power density limit (S) (mW/cm ²)	Distance (R) cm required to be less than 0.61mW/cm ²
914.47	0.44 mW	0.61	0.24 cm

FCC defines limits in mW/cm²

Industry Canada defines limits in W/m²

$$\text{mW/cm}^2 \equiv \text{W/m}^2$$

