

**A RADIO TEST REPORT
FOR
GUIDANCE NAVIGATION LIMITED
ON
RANGEGUARD SYSTEM
DOCUMENT NO. TRA-025840-47-00A**

HULL

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TRaC Wireless Test Report : TRA-025840-47-00A

Applicant : Guidance Navigation Limited

Apparatus : RangeGuard System

Specification(s) : CFR47 Part 15

Purpose of Test : Certification

FCCID : VYMRANGEGUARD

Authorised by :

: Radio Product Manager

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Section 1:

Introduction

1.1 General

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

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1.2 Tests Requested By

This testing in this report was requested by :

Guidance Navigation Limited
4 Dominus Way
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Leicester
LE19 1RP
United Kingdom

1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between 26th – 27th March 2015:

Rangeguard System

The Above device is a FMCW radar operating in the 24.00 – 24.25 GHz band

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)	Measurement standard	Result
Spurious Emissions Radiated <1000MHz	15.249 (a), (d) 15.209	ANSI C63.10:2009	Pass
Spurious Emissions Radiated >1000MHz	15.249 (a), (d) 15.209	ANSI C63.10:2009	Pass
AC Power conducted emissions	15.207	ANSI C63.10:2009	Pass
Intentional Emission Frequency	15.249(a)	ANSI C63.10:2009	Pass
Intentional Emission Field Strength	15.249 (a)	ANSI C63.10:2009	Pass
Intentional Emission Band Occupancy	15.215C	ANSI C63.10:2009	Pass
Intentional Emission ERP (mW)	-	ANSI C63.10:2009	N/A
Unintentional Radiated Spurious Emissions	15.109	ANSI C63.10:2009	N/A
Extrapolation Factor:	15.31(f)	-	-
Maximum Frequency of Search:	15.33	-	-
Antenna Arrangements Integral:	15.203	-	-
Antenna Arrangements External Connector:	15.204	-	-
Restricted Bands:	15.205	-	-

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

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
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	15.249(a)
Measurement standard	ANSI C63.10:2013
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	23

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)
24150	69.24	N/A	37.4	N/A	106.64	214.78
Limit value @ fc			250 mV/m @ 3m			
Band occupancy @ -20 dBc			f lower		f higher	
			24050.75256 MHz		24249.35256 MHz	
			198.6 MHz			

Notes:

- 1 Results quoted are extrapolated as indicated
- 2 Receiver detector @ fc = Average Wideband Power Meter
- 3 When battery powered the EUT was powered with new batteries

Test Method:

- 1 As per Radio – Noise Emissions, ANSI C63.10:2013
- 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	15.209, 15.249 (a)
Measurement standard	ANSI C63.10:2013
Frequency range	30 MHz – 100 GHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	23
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 (dB μ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB μ V/m)	EXTRAP FACT (dB)	FIELD ST'GH (μ V/m)	LIMIT (μ V/m)
QP	35.93	13.5	0.8	15.9	N/A	30.3	-	32.66	100
QP	48.54	7.6	1.0	9.0	N/A	17.6	-	7.61	100
QP	51.97	10.4	1.0	7.4	N/A	18.8	-	8.73	100
QP	66.70	5.9	1.2	6.2	N/A	13.3	-	4.61	100
QP	96.78	-0.7	1.5	10.0	N/A	10.8	-	3.45	150
QP	431.25	2.3	2.9	16.0	N/A	21.2	-	11.44	200
Pk	1510.0	53.9	2.1	25.8	36.6	45.2	-	182.39	5012
Av	1510.0	42.3	2.1	25.8	36.6	33.6	-	47.97	500
Pk	1900.0	54.6	2.7	27.5	36.2	48.6	-	270.40	5012
Av	1900.0	49.5	2.7	27.5	36.2	43.5	-	150.31	500
Pk	12080.0	62.6	6.5	39.1	36.3	71.9	-	3940.03	5012
Av	12080.0	37.2	6.5	39.1	36.3	46.5	-	210.86	500
Pk	48300	43.1	N/A	42.8	N/A	85.9	-29.54	56.36	2500

Notes:

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10:2013: 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 \geq RBW
Average	RBW= 1MHz, VBW \geq 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:

Frequency of emission (MHz)	Field Strength (μ V/m)	Measurement Distance (m)	Field Strength (dB μ 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
Harmonic Emissions			
Harmonic	2500	3	68.0

(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				

A3 Power Line Conducted Emissions

Previous 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	15.207
Measurement standard	ANSI C63.10:2013
Frequency range	150kHz to 30MHz
EUT sample number	S01
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	3

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

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.215000	50.4	2000.0	10.000	On	N	9.5	12.6	63.0
0.425000	37.1	2000.0	10.000	On	N	9.5	20.2	57.3
0.530000	31.3	2000.0	10.000	On	L1	9.6	24.7	56.0
0.640000	35.6	2000.0	10.000	On	N	9.6	20.4	56.0
1.065000	33.7	2000.0	10.000	On	N	9.6	22.3	56.0
1.920000	33.6	2000.0	10.000	On	N	9.6	22.4	56.0
3.945000	16.3	2000.0	10.000	On	N	9.7	39.7	56.0

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.210000	45.6	2000.0	10.000	On	L1	9.5	7.6	53.2
0.425000	34.3	2000.0	10.000	On	L1	9.5	13.0	47.3
0.530000	29.9	2000.0	10.000	On	L1	9.6	16.1	46.0
0.640000	32.9	2000.0	10.000	On	N	9.6	13.1	46.0
1.065000	29.6	2000.0	10.000	On	N	9.6	16.4	46.0
1.920000	28.7	2000.0	10.000	On	N	9.6	17.3	46.0

Specification limits :

Conducted emission limits (47 CFR Part 15: Clause 15.207):

Conducted disturbance at the mains ports.

Frequency range MHz	Limits dB μ V	
	Quasi-peak	Average
0.15 to 0.5	66 to 56 ²	56 to 46 ²
0.5 to 5	56	46
5 to 30	60	50

Notes:

1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

Notes:

- (a) The levels may have been rounded for display purposes.
- (b) The following table summarises the effect of the EUT operating mode and internal configuration on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels		✓		
Effect of EUT internal configuration on emission levels		✓		
(i) Parameter defined by standard and / or single possible, refer to Appendix C				
(ii) Parameter defined by client and / or single possible, refer to Appendix C				
(iii) Parameter had a negligible effect on emission levels, refer to Appendix C				
(iv) Worst case determined by initial measurement, refer to Appendix C				

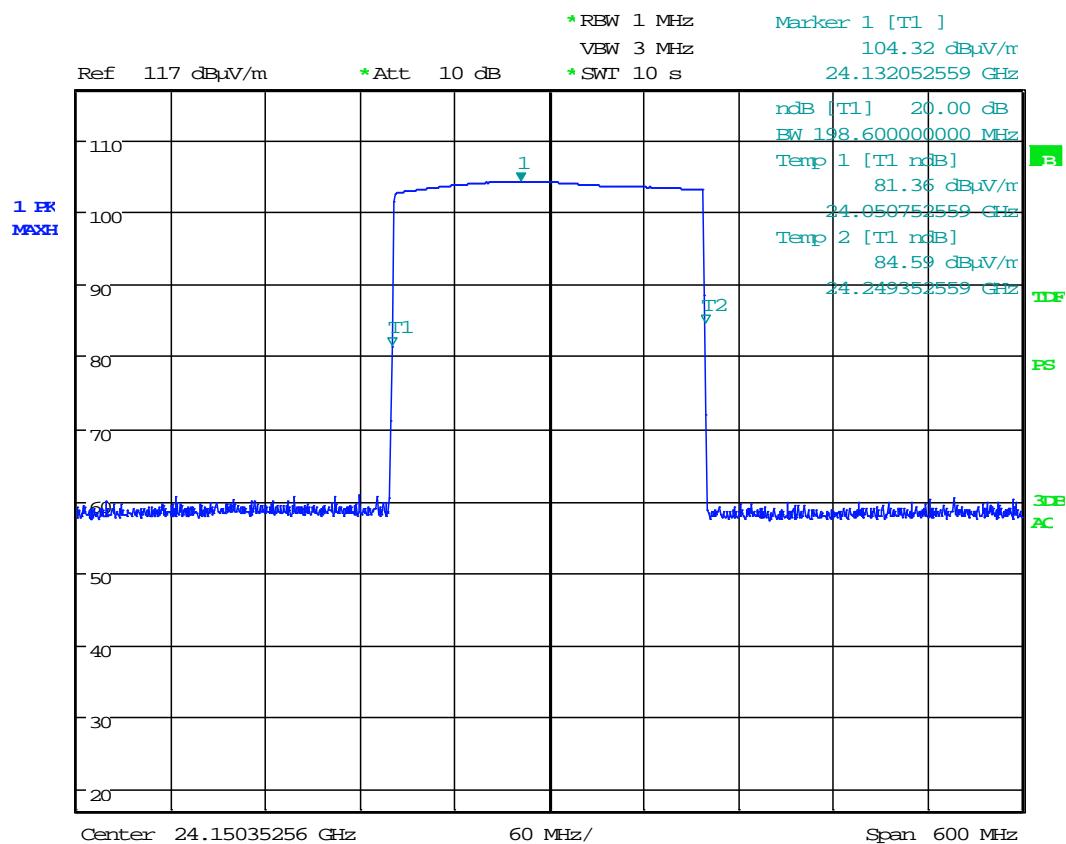
Appendix B:

Supporting Graphical Data

This appendix contains graphical data obtained during testing.

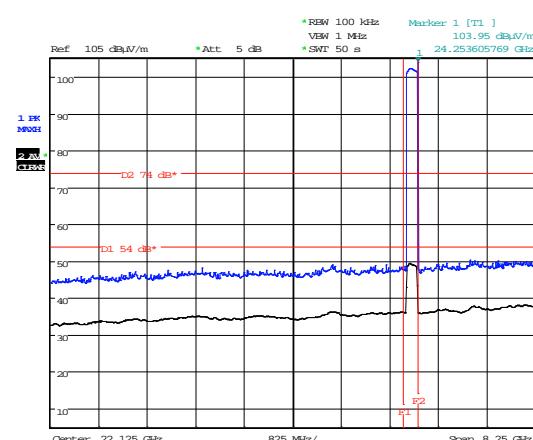
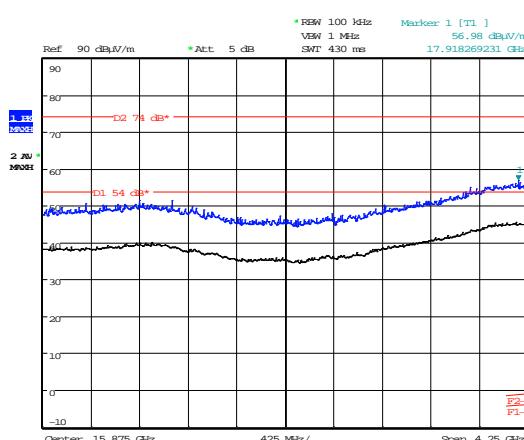
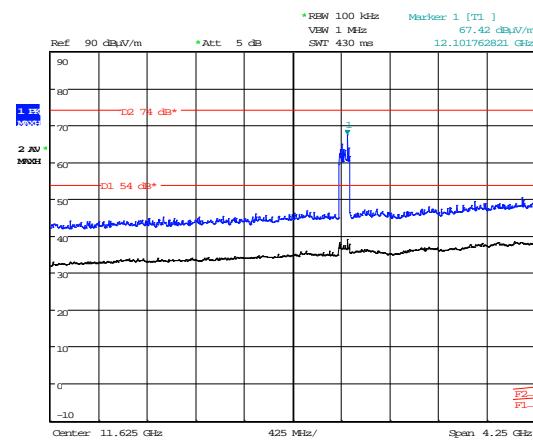
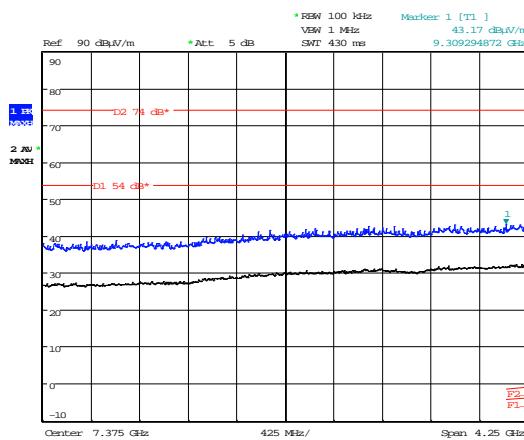
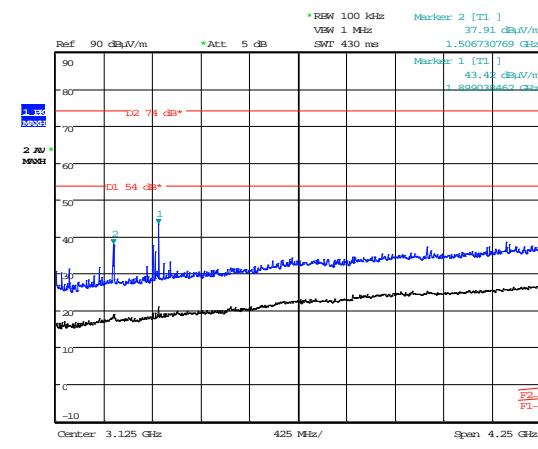
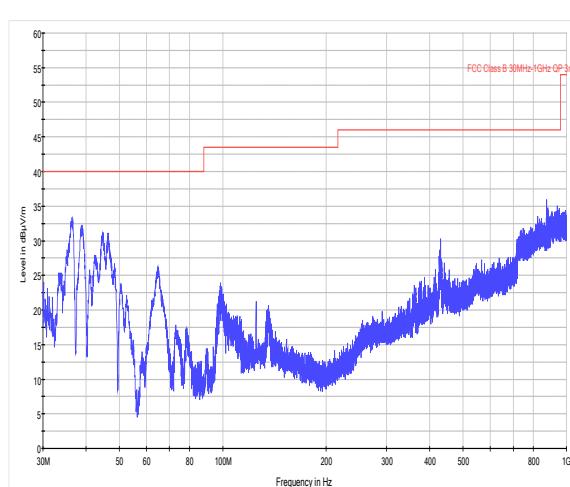
Notes:

- (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.

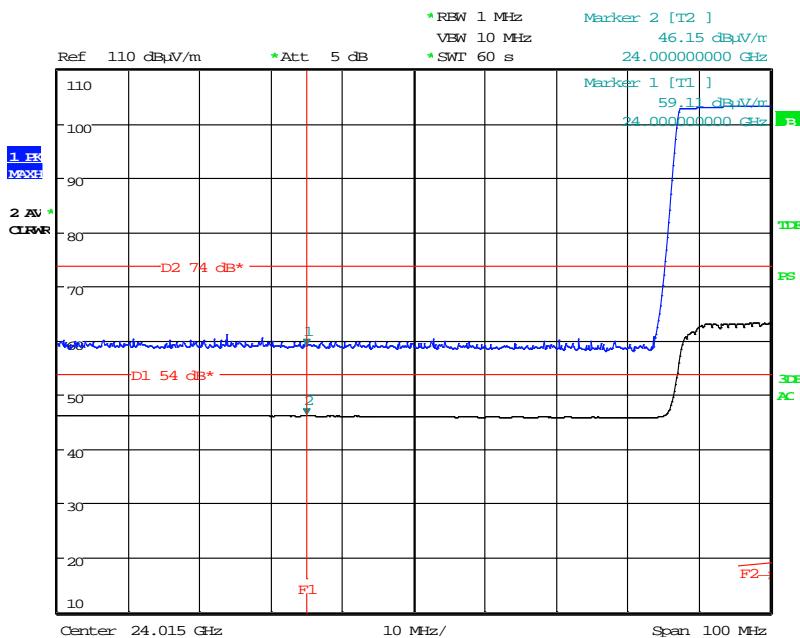


20dB Bandwidth

Radiated spurious emissions

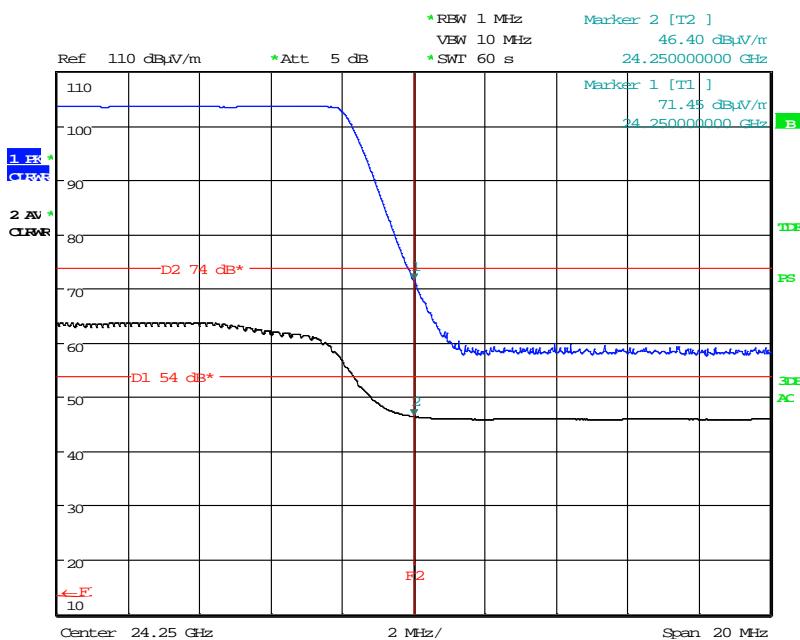


Radiated Bandedge Compliance



Date: 26.MAR.2015 13:29:35

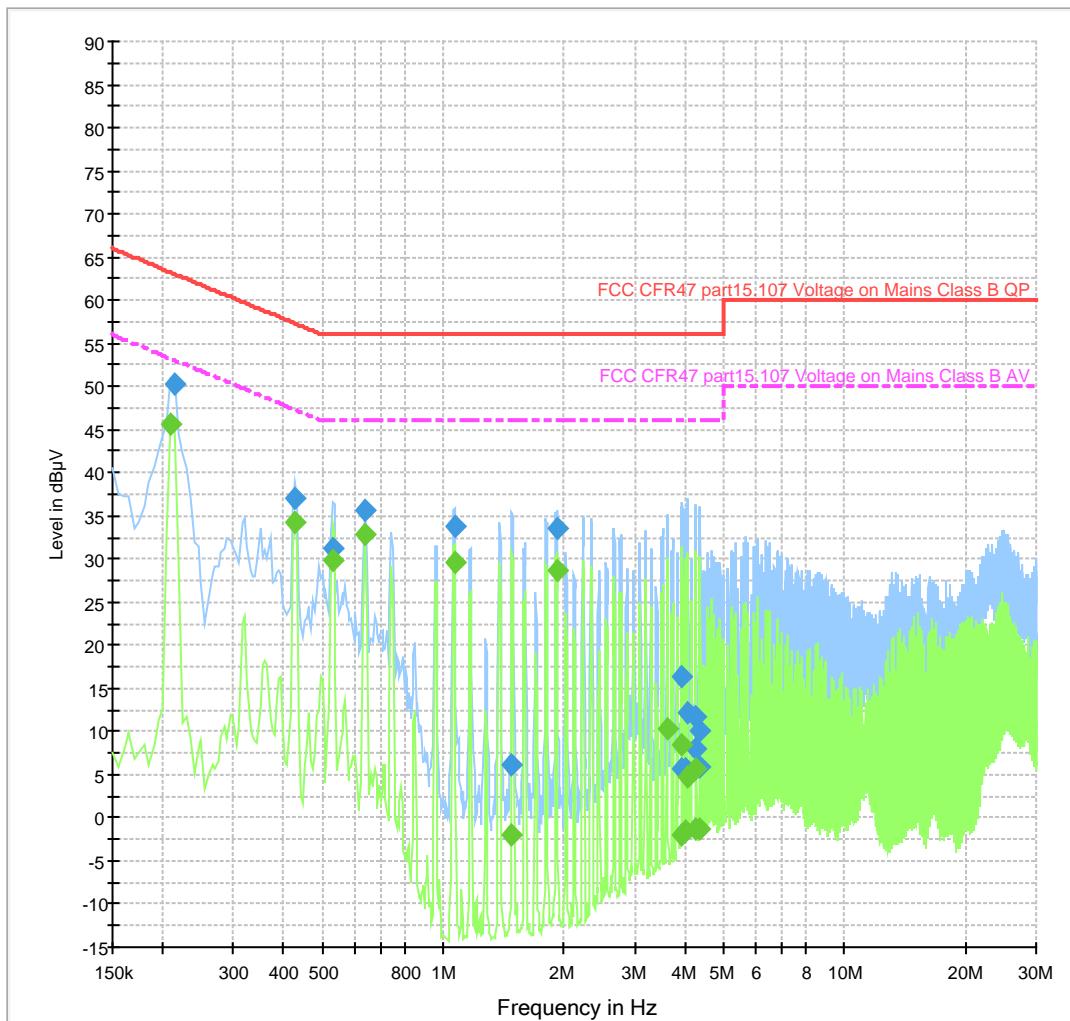
Lower Bandedge



Date: 26.MAR.2015 13:22:54

Upper Bandedge

Conducted emissions on Mains 9kHz-30MHz ESHS10 + UH396



AC Powerline Conducted Emissions

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 its 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	RangeGuard Radar	

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

Sample No.	Description	Identification
None		

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	EUT transmitting FMCW signal

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
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Multiport	Multicore signal / power cable	>10m	S02

* Only connected during setup.

C5 Details of Equipment Used

TRaC No	Equipment Type	Equipment Description	Manufacturer	Last Cal Calibration	Calibration Period	Due For Calibration
UH003	ESHS10	Receiver	R&S	03/07/2014	12	03/07/2015
UH191	CBL611/A	Bilog	Chase	26/02/2015	24	26/02/2017
UH195	ESH3-Z5.831.5	Lisn	R&S	21/07/2014	12	21/07/2015
UH396	ENV216	Lisn	R&S	22/05/2014	12	22/05/2015
UH405	FSU26	Spectrum Analyser	R&S	16/04/2014	12	16/04/2015
L138	3115	1-18GHz Horn	EMCO	17/10/2013	24	17/10/2015
L139	3115	1-18GHz Horn	EMCO	20/09/2013	24	20/09/2015
L300	20240-20	Horn 18-26GHz (&UH330)	Flann	10/02/2014	24	10/02/2016
L317	ESVS10	Receiver	R&S	26/02/2015	12	26/02/2016
L572	8449B	Pre Amp	Agilent	10/02/2015	12	10/02/2016
L654	8563A	Spectrum Analyser	HP	11/12/2014	12	11/12/2015
REF909	FSU26	Spectrum Analyser	R&S	13/02/2015	12	13/02/2016
REF936	0.6m 3.5mm	Cable	Rosenberger	28/11/2014	12	28/11/2015
REF938	5m 3.5mm	Cable	Rosenberger	28/11/2014	12	28/11/2015
REF831	5m 2.92mm	Cable	Teledyne	03/09/2014	12	03/09/2015
UH365	11970Q	Harmonic Mixer (33-50)	Agilent	16/07/2008	24	16/07/2010
UH366	11970V	Harmonic Mixer (50-75)	Agilent	21/07/2008	24	21/07/2010
UH367	11970W	Harmonic Mixer (75-110)	Agilent	02/07/2008	24	02/07/2010
UH368	25240-20	Standard Gain Horn (50-75)	Flann	ANSI C63.10 - 4.6.2 Antenna calibration Note 1		
UH369	27240-20	Standard Gain Horn (75-110)	Flann			
L264/A	2324-20	Standard Gain Horn 33-50	Flann			
L301	22240-20	Standard Gain Horn 26-40	Flann			
L309	20094-SF40	SMA Transition	N/A			
L263/A	20240-20	Horn 18-26GHz	Flann			

Note 1:

Standard gain horn antennas have gain characteristics that are established by the physical dimensions and dimensional tolerances. Consequently, standard-gain horn antennas need not be calibrated beyond the dimensional characteristics that are provided by the manufacturer, unless damage or deterioration is suspected, or if used at distances closer than $2D2/\lambda$.

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 pulsedwidths 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 pulsedwidths over one complete pulse train. However if the pulse train exceeds 100ms then the duty cycle was calculated by averaging the sum of the pulsedwidths 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 = the sum of the highest average value pulsedwidths over 100ms
100ms

e.g

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

0.07459 or 7.459%

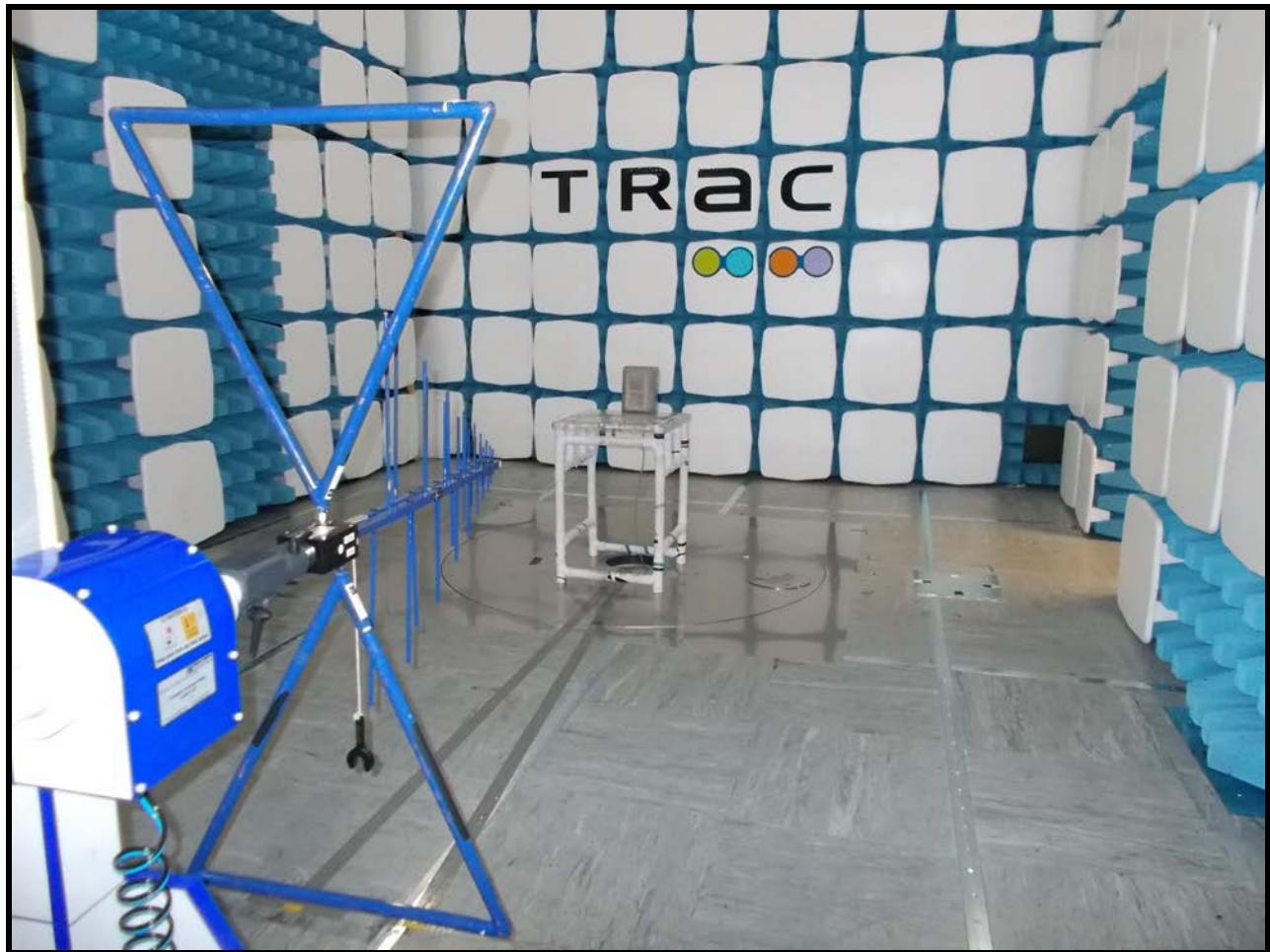
Correction factor (dB) = $20 \times (\text{Log}_{10} 0.07459) = -22.54\text{dB}$

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.
3. AC powerline electric field emissions arrangement: Over view.



Photograph 1



Photograph 2



Photograph 3

