A RADIO TEST REPORT

FOR

AGD SYSTEMS Ltd

ON

350-101-000

DOCUMENT NO. TRA-016047-47-US-1C

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TRaC Wireless Test Report	**:** TRA-016047-47-US-1C
Applicant	**:** AGD Systems Ltd
Apparatus	**:** 350-101-000
Specification(s)	**:** CFR47 Part 15.245
Purpose of Test	**:** Certification
FCCID	**:** WH3350101
Authorised by	**:** John Charters Digitally signed by John Charters DN: cn=John Charters, o=Element Materials Technology, ou, email=john.charters@element.com, c=GB Date: 2016.03.03 14:41:36 Z
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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 :

AGD Systems Ltd
White Lion House
Gloucester Road
Staverton
Cheltenham
Gloucestershire

1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between 20th - 24th April 2015

350-101-000

The 350-101-000 is a Traffic Management Radar.

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
Spurious Emissions Radiated <1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.209 & 15.245	ANSI C63.10:2009	Pass
Spurious Emissions Radiated >1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.209 & 15.245	ANSI C63.10:2009	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	ANSI C63.10:2009	Pass
Intentional Emission Frequency	Title 47 of the CFR: Part 15 Subpart (c) 15.245(b)	ANSI C63.10:2009	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15.245(b)	ANSI C63.10:2009	Pass
Intentional Emission Band Occupancy	Title 47 of the CFR: Part 15 Subpart (c) 15.215(c)	ANSI C63.10:2009	Pass
Intentional Emission ERP (mW)	Title 47 of the CFR: Part 15 Subpart (c)	ANSI C63.10:2009	N/A
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10:2009	N/A*
Antenna Arrangements Integral:	Title 47 of the CFR: Part 15 Subpart (c) 15.203	-	-
Antenna Arrangements External Connector	Title 47 of the CFR: Part 15 Subpart (c) 15.204	-	-
Restricted Bands	Title 47 of the CFR: Part 15 Subpart (c) 15.205	-	-
Maximum Frequency of Search	Title 47 of the CFR: Part 15 Subpart (c) 15.33	-	-
Extrapolation Factor	Title 47 of the CFR: Part 15 Subpart (c) 15.31(f)	-	-

*The AGD342 is a permanently transmitting device; emissions are covered under the transmitter spurious measurements.

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 (Power Meter) = **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
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

Carrier power was verified with the EUT transmitting Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.245(b)
Measurement standard	ANSI C63.10:2009
EUT sample number	S11
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	23°C
Humidity	33%
Photographs (Appendix F)	1&2

FREQ. (MHz)	MEASUREMENT Rx. READING (dBµV)	CABLE LOSS (dB)	ANT FACTOR (dB/m)	PRE AMP (dB)	FIELD STRENGTH (dBµV/m)	FIELD STRENGTH (mV/m)
24102.00	74.09	1.74	37.6	N/A	113.43	469.35
Limit value @ fc			**2500 (mV/m)**			
Band occupancy @ -20 dBc			f lower		f higher	
			24080.648MHz		24124.583MHz	
			43.935MHz			

Notes:
1 Results quoted are extrapolated as indicated
2 Receiver detector @ fc = Peak 1MHz 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 orthagonal planes.
Maximum results recorded

Carrier power was verified with the EUT transmitting **Test Details:**	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.245(b)
Measurement standard	ANSI C63.10:2009
EUT sample number	S11
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	23°C
Humidity	33%
Photographs (Appendix F)	1&2

FREQ. (MHz)	**MEASUREMENT Rx. READING (dBµV)**	**CABLE LOSS (dB)**	**ANT FACTOR (dB/m)**	**PRE AMP (dB)**	**FIELD STRENGTH (dBµV/m)**	**FIELD STRENGTH (mV/m)**
24148.00	74.15	1.74	37.7	N/A	113.59	478.08
Limit value @ fc			**2500 (mV/m)**			
Band occupancy @ -20 dBc			f lower		f higher	
			24126.488MHz		24170.393MHz	
			43.905MHz			

Notes:
1 Results quoted are extrapolated as indicated
2 Receiver detector @ fc = Peak
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 orthagonal planes.
Maximum results recorded

A2 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric filed emission test applies to all spurious emissions and harmonics emissions. The maximum permitted field strength is listed in Section 15.209 and 15.245. 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]

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

Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.209
Measurement standard	ANSI C63.10:2009
Frequency range	S11
EUT sample number	0
Modification state	30MHz-100GHz
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 are listed overleaf:

No further significant emissions other than those reported, were found up to 100 GHz

Note: During the emissions testing the EUT Detection threshold setting was set to 60.
(= 938 off 02 messages per second) which is worse case.

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.	33.30	11.40	0.8	17.3	-	29.50	N/A	29.79	100
2.	34.20	13.80	0.8	16.9	-	31.50	N/A	37.50	100
3.	35.15	14.20	0.8	16.3	-	31.30	N/A	36.86	100
4.	36.10	18.00	0.9	15.8	-	34.70	N/A	54.26	100
5.	37.00	19.20	0.9	15.3	-	35.40	N/A	58.88	100
6.	37.05	20.00	0.9	15.3	-	36.20	N/A	64.34	100
7.	37.95	19.70	0.9	14.7	-	35.30	N/A	58.41	100
8.	41.25	25.00	1.0	13.0	-	39.00	N/A	88.61	100
9.	41.70	22.20	1.0	12.7	-	35.90	N/A	62.23	100
10.	42.20	21.00	1.0	12.4	-	34.40	N/A	52.48	100
11.	42.65	17.50	1.0	12.2	-	30.70	N/A	34.20	100
12.	43.15	16.60	1.0	11.9	-	29.50	N/A	29.89	100
13.	45.00	13.20	1.0	10.9	-	25.10	N/A	17.99	100
14.	45.95	17.00	1.0	10.3	-	28.30	N/A	26.09	100
15.	46.40	17.80	1.0	10.1	-	28.90	N/A	27.99	100
16.	46.90	24.90	1.0	9.9	-	35.80	N/A	61.94	100
17.	47.35	21.20	1.0	9.7	-	31.90	N/A	39.31	100
18.	48.30	19.80	1.0	9.2	-	30.00	N/A	31.44	100

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)
19.	49.20	17.40	1.0	8.7	-	27.10	N/A	22.65	100
20.	50.15	13.40	1.0	8.2	-	23.40	N/A	13.55	100
21.	50.65	14.90	1.0	8.0	-	24.10	N/A	15.74	100
22.	52.50	22.20	1.0	7.3	-	30.50	N/A	33.50	100
23.	53.45	25.60	1.0	7.0	-	33.60	N/A	47.97	100
24.	54.40	25.70	1.0	6.8	-	33.50	N/A	47.10	100
25.	55.30	23.9	1.0	6.6	-	31.50	N/A	37.63	100
26.	56.25	22.20	1.0	6.4	-	29.60	N/A	30.13	100
27.	58.15	21.95	1.0	6.2	-	29.15	N/A	28.67	100
28.	61.90	18.90	1.1	6.0	-	26.00	N/A	19.93	100
29.	65.65	21.00	1.2	6.1	-	28.30	N/A	25.85	100
30.	68.45	17.90	1.2	6.3	-	25.40	N/A	18.62	100
31.	69.35	22.50	1.2	6.3	-	30.00	N/A	31.62	100
32.	71.25	19.30	1.2	6.4	-	26.90	N/A	22.21	100
33.	93.75	12.90	1.4	9.7	-	24.00	N/A	15.78	150
34.	95.65	16.50	1.5	9.9	-	27.90	N/A	24.60	150
35.	97.50	12.30	1.5	10.0	-	23.80	N/A	15.47	150
36.	108.75	11.20	1.5	11.2	-	23.90	N/A	15.65	150
37.	114.40	11.80	1.6	11.7	-	25.10	N/A	17.95	150
38.	125.65	13.30	1.6	12.5	-	27.40	N/A	23.52	150
39.	129.40	13.40	1.5	12.5	-	27.40	N/A	23.52	150
40.	136.90	13.10	1.6	12.1	-	26.80	N/A	21.88	150
41.	144.40	10.30	1.6	11.8	-	23.70	N/A	15.35	150
42.	153.75	14.30	1.8	11.2	-	27.30	N/A	23.17	150
43.	155.65	19.20	1.8	11.0	-	32.00	N/A	39.99	150
44.	157.50	16.60	1.8	11.0	-	29.40	N/A	29.51	150
45.	159.40	18.60	1.8	10.9	-	31.30	N/A	36.56	150
46.	161.25	13.00	1.8	10.7	-	25.50	N/A	18.88	150
47.	166.90	12.30	2.0	10.0	-	24.30	N/A	16.39	150
48.	168.75	12.40	2.0	9.8	-	24.20	N/A	16.27	150
49.	170.60	15.00	2.0	9.5	-	26.50	N/A	21.23	150
50.	250.00	22.10	1.8	11.0	-	34.90	N/A	67.45	200
51.	270.00	12.20	2.4	12.1	-	26.70	N/A	22.72	200
52.	275.00	15.70	2.2	12.7	-	30.60	N/A	33.54	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)
53.	325.00	12.50	2.5	13.6	-	28.60	N/A	26.92	200
54.	329.95	16.20	2.5	13.8	-	32.50	N/A	42.17	200
55.	330.00	20.60	2.5	13.8	-	36.90	N/A	69.98	200
56.	375.00	17.70	2.8	14.7	-	35.20	N/A	57.15	200
57.	570.0	6.60	3.4	19.1	-	29.10	N/A	28.54	200
58.	625.00	11.40	3.7	19.5	-	34.60	N/A	53.64	200
59.	690.0	9.20	3.7	20.0	-	32.90	N/A	44.11	200
60.	750.00	7.80	3.9	21.9	-	33.60	N/A	47.70	200
61.	1000.00	11.30	4.4	23.9	-	39.60	N/A	95.61	500

1 All further Peak values of any radiated emissions recorded ≥1GHz are less than the Average limit, and therefore pass by default.

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 For Frequencies below 1 GHz, RBW= 100 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=VBW= 1MHz
Average RBW=VBW= 1MHz

These settings as per ANSI C63.10:2009 and DA 00-705.

Radiated emission limits for emissions falling within the restricted bands.

Frequency of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)	Field strength (dBµV/m)
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:

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

The results displayed take into account applicable antenna factors and cable losses.

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

Radiated emission limits 47 CFR Part 15: Clause 15.209 & 15.245 for all emissions:

Frequency of emission (MHz)	Field strength μV/m	Measurement Distance m
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3
Un-restricted Bands & Harmonics		
Frequency of emission (MHz)	Field strength mV/m	Measurement Distance m
Harmonics <17.7 GHz Un-restricted Bands	25.0	3
Harmonics in restricted bands >17.7 GHz	25.0*	3
Harmonics in restricted bands >17.7 GHz	7.5#	3
All other Emissions	-50dBc	3

* For the second and third harmonics of field disturbance sensors operating in the 24075–24175 MHz band and for other field disturbance sensors designed for use only within a building or to open building doors

\# For all other field disturbance sensors

(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

A3 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	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.10:2009
Frequency range	150kHz to 30MHz
EUT sample number	S11
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	45.0	2000.0	10.000	N	9.5	21.0	66.0
0.245000	43.7	2000.0	10.000	N	9.5	18.3	61.9
0.320000	40.6	2000.0	10.000	N	9.5	19.1	59.7
0.420000	41.5	2000.0	10.000	L1	9.5	16.0	57.4
0.465000	36.6	2000.0	10.000	L1	9.5	20.0	56.6
0.570000	34.3	2000.0	10.000	N	9.6	21.7	56.0
0.755000	32.2	2000.0	10.000	N	9.6	23.8	56.0
0.965000	26.2	2000.0	10.000	N	9.6	29.8	56.0
15.155000	15.6	2000.0	10.000	N	9.8	44.4	60.0
16.875000	43.1	2000.0	10.000	N	9.9	16.9	60.0
19.705000	28.6	2000.0	10.000	N	9.9	31.4	60.0
21.560000	8.7	2000.0	10.000	L1	9.9	51.3	60.0
24.375000	47.7	2000.0	10.000	L1	9.8	12.3	60.0
25.310000	34.4	2000.0	10.000	N	9.9	25.6	60.0
28.125000	47.6	2000.0	10.000	L1	9.8	12.4	60.0

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
13.125000	26.0	2000.0	10.000	N	9.8	24.0	50.0
16.875000	9.6	2000.0	10.000	N	9.9	40.4	50.0
18.265000	5.9	2000.0	10.000	N	9.9	44.1	50.0
18.915000	26.4	2000.0	10.000	L1	9.8	23.6	50.0
21.565000	4.2	2000.0	10.000	L1	9.9	45.8	50.0
23.130000	29.2	2000.0	10.000	N	10.0	20.8	50.0
24.375000	43.7	2000.0	10.000	L1	9.8	6.3	50.0
26.490000	30.3	2000.0	10.000	N	9.9	19.7	50.0
26.550000	30.6	2000.0	10.000	N	9.9	19.4	50.0
26.610000	31.2	2000.0	10.000	N	9.9	18.8	50.0
27.160000	32.9	2000.0	10.000	N	9.9	17.1	50.0
28.125000	43.6	2000.0	10.000	L1	9.8	6.4	50.0
28.685000	30.7	2000.0	10.000	N	9.9	19.3	50.0
29.115000	27.2	2000.0	10.000	N	9.9	22.8	50.0
29.235000	29.9	2000.0	10.000	N	9.9	20.1	50.0

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. The EUT was set to transmit frequency. The formal measurements are detailed above:

Note: The EUT operates at 12Vdc, but as the origin of the dc supply voltage used at the location where the radar would be installed is undetermined, it was decided to make use of an unfiltered 110Vac to 12Vdc convertor.

Specification limits:

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

Conducted disturbance at the mains ports.

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

Notes:

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

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

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

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.

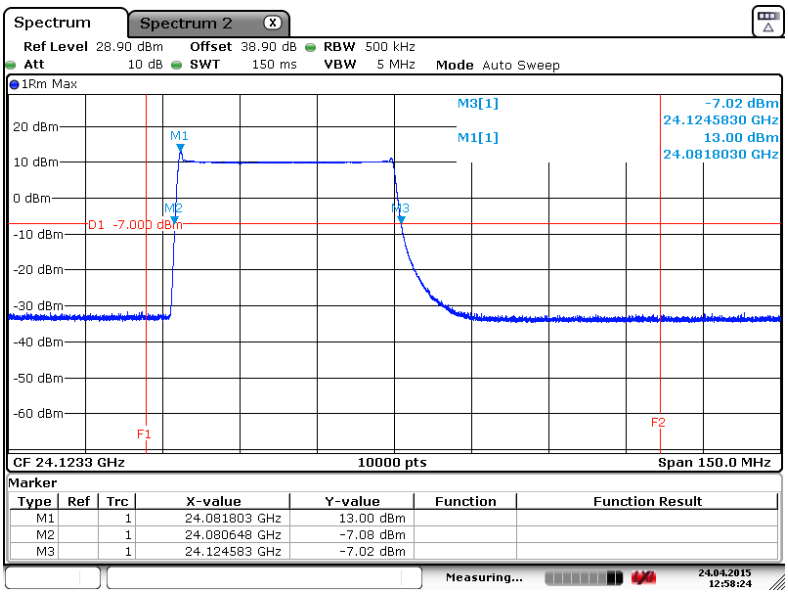
(b) The time and date on the plots do not necessarily equate to the time of the test.

(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.

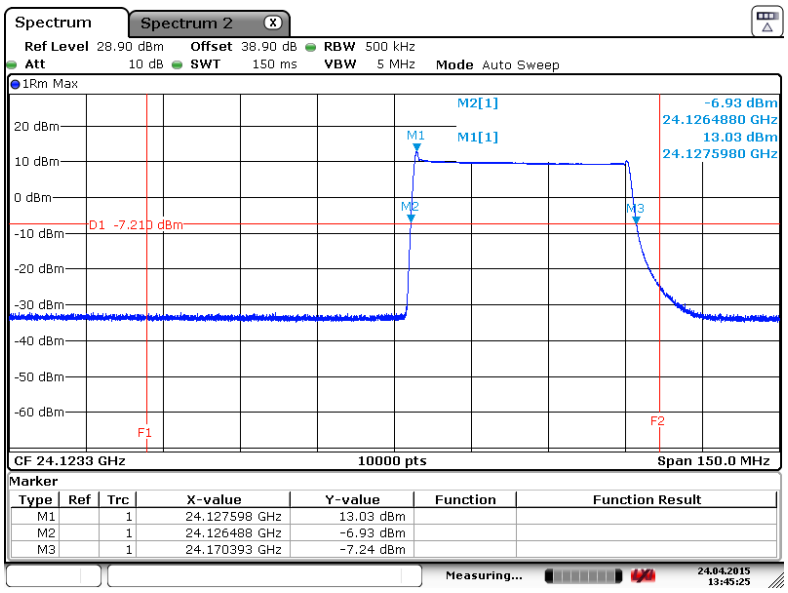
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

20dB Bandwidth lower test frequency



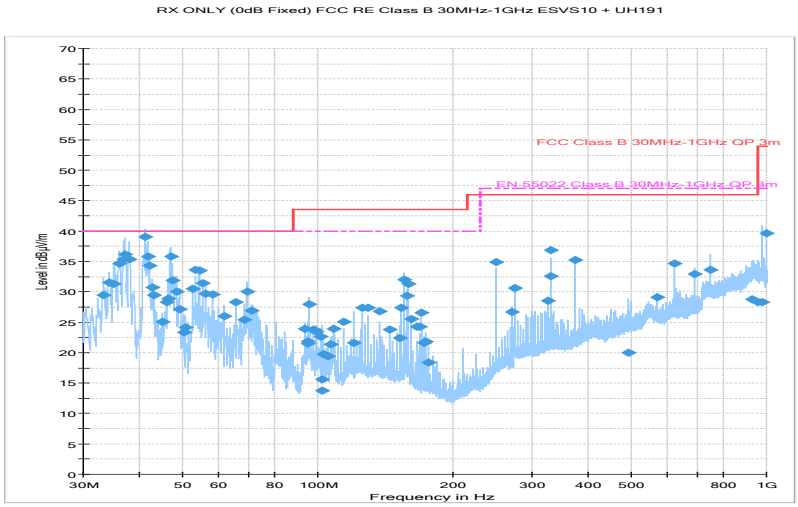
Date: 24.APR.2015 12:58:25

20dB Bandwidth Higher test frequency

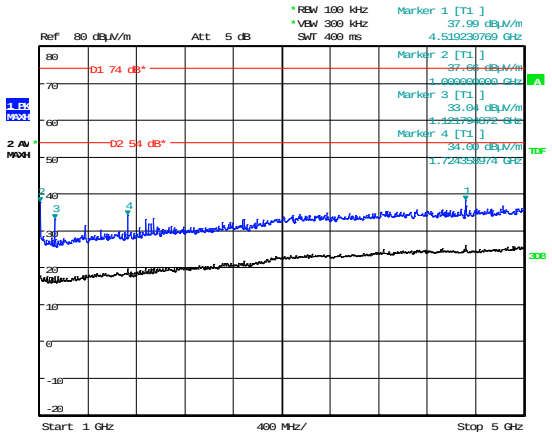


Date: 24.APR.2015 13:45:26

24.102GHz Radiated spurious emissions 30 MHz to 1 GHz

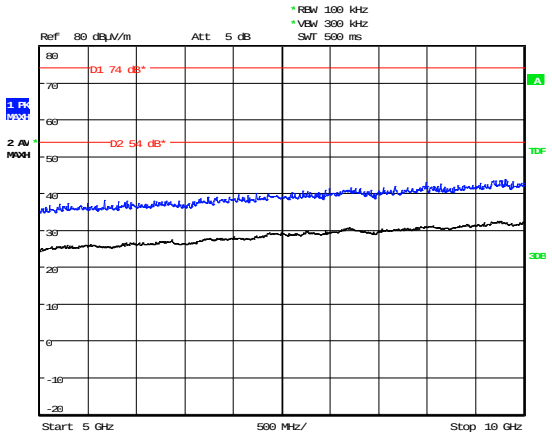


24.102GHz Radiated spurious emissions 1 GHz to 5 GHz



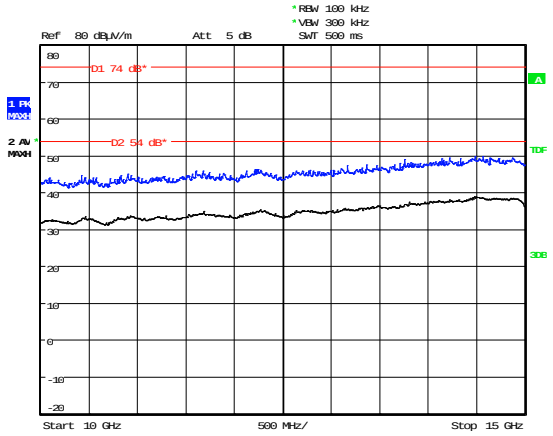
Date: 21.APR.2015 13:25:53

24.102GHz Radiated spurious emissions 5 GHz to 10 GHz

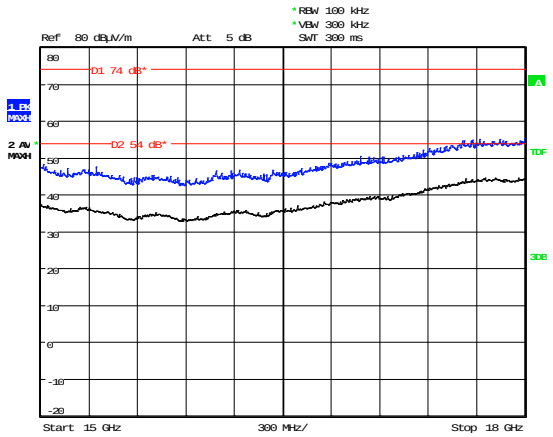


Date: 21.APR.2015 13:27:31

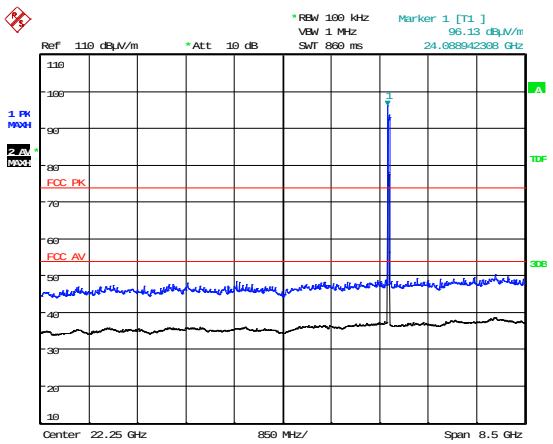
24.102GHz Radiated spurious emissions 10 GHz to 15 GHz



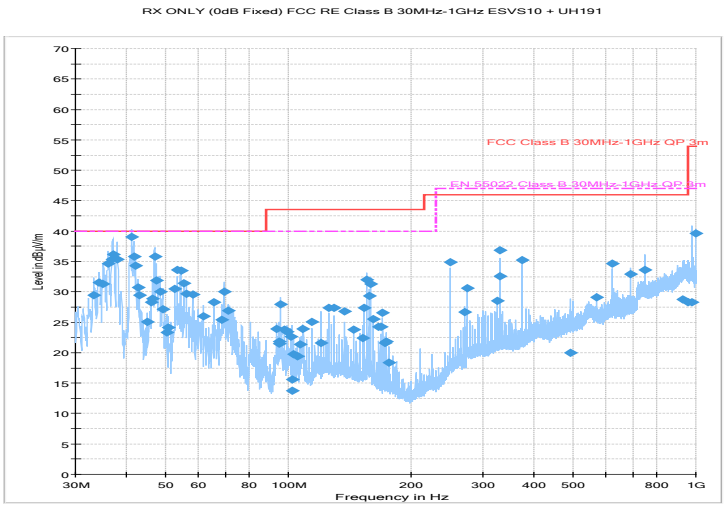
24.102GHz Radiated spurious emissions 15 GHz to 18GHz



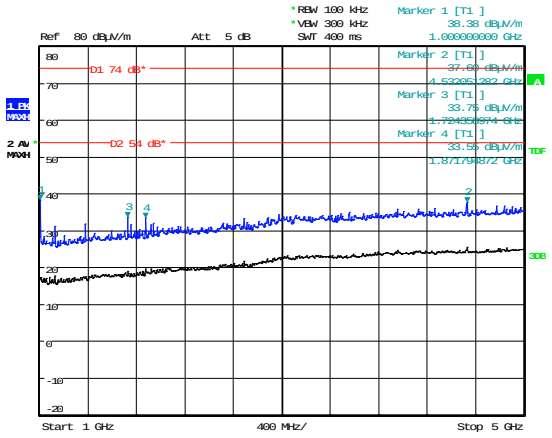
24.102GHz Radiated spurious emissions 18 GHz to 26 GHz



24.148GHz Radiated spurious emissions 30 MHz to 1 GHz

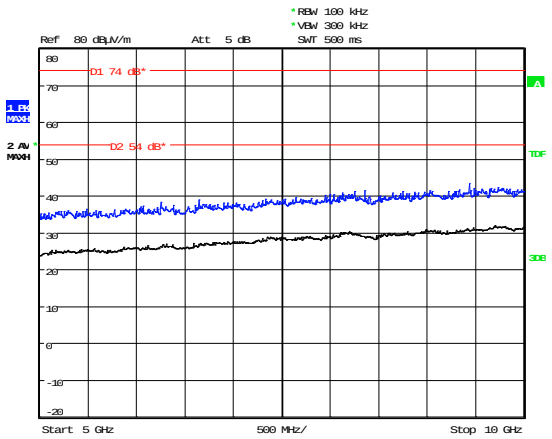


24.148GHz Radiated spurious emissions 1 GHz to 5 GHz



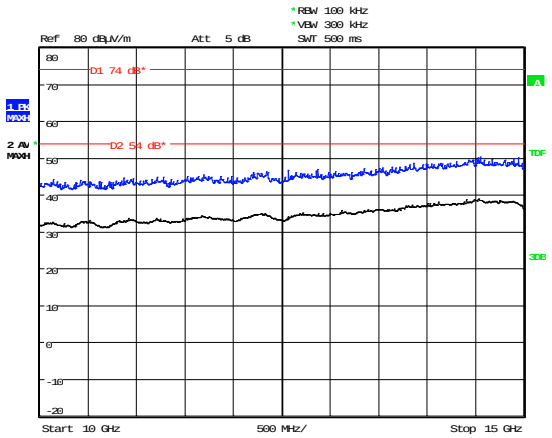
Date: 21.APR.2015 14:37:59

24.148GHz Radiated spurious emissions 5 GHz to 10 GHz



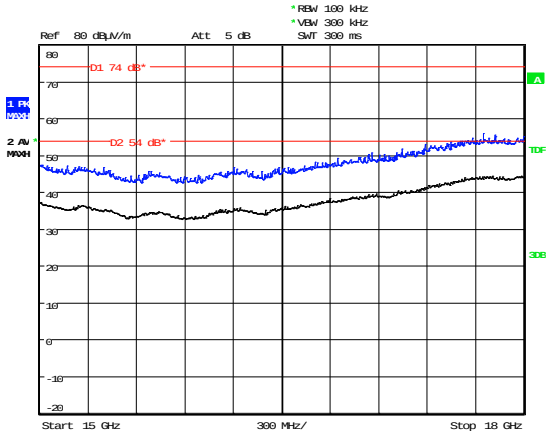
Date: 21.APR.2015 14:38:39

24.148GHz Radiated spurious emissions 10 GHz to 15 GHz



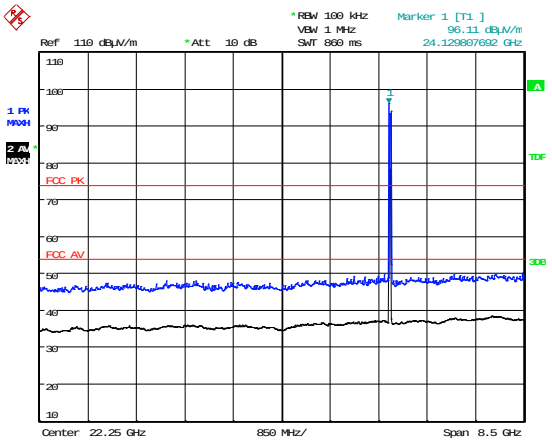
Date: 21.APR.2015 14:40:23

24.148GHz Radiated spurious emissions 15 GHz to 18 GHz

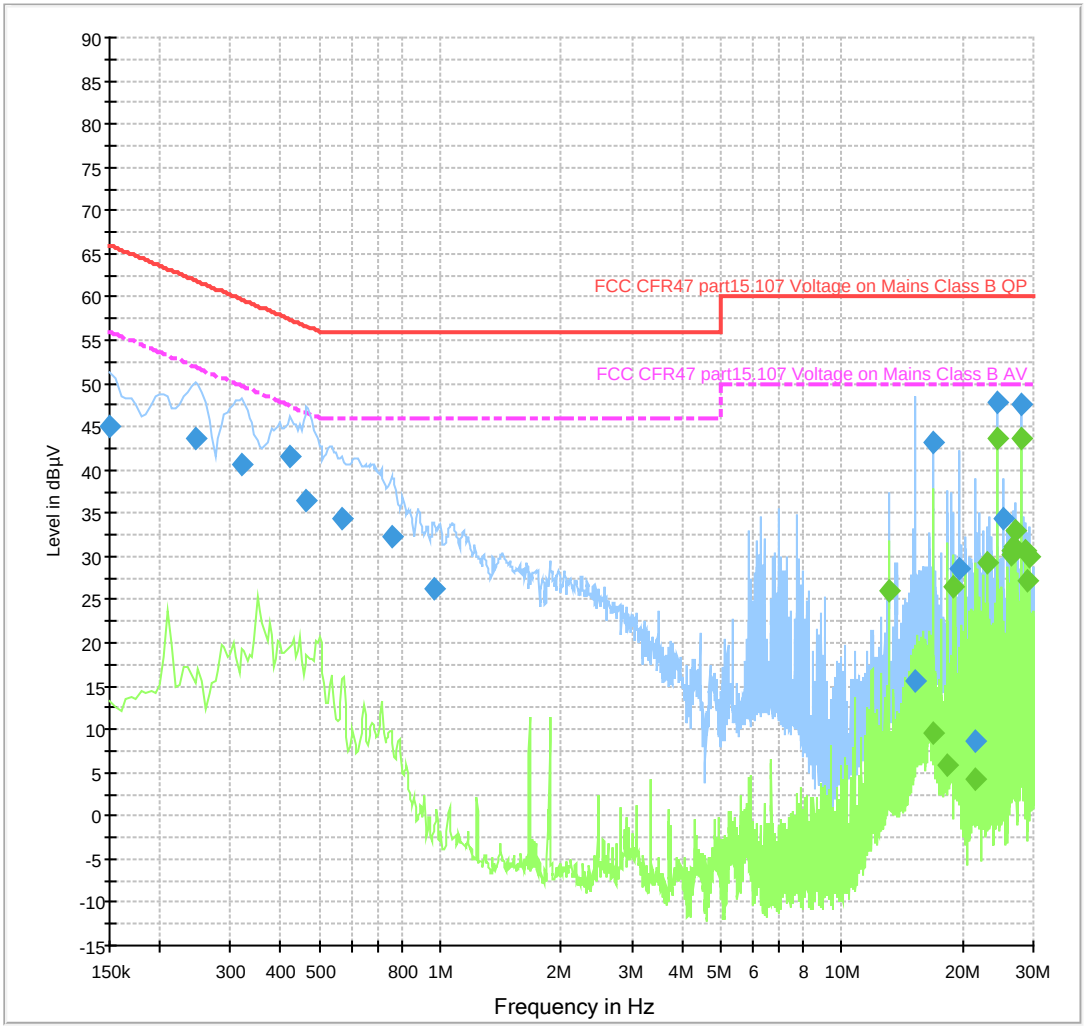


Date: 21.APR.2015 14:42:05

24.148GHz Radiated spurious emissions 18 GHz to 26 GHz



AC Powerline Conducted Emissions



Note: The EUT is dc powered, but will be provided with AC from the roadside cabinet
The AC voltage was applied to an AC-DC power supply.
The AC supply voltage was 110vdc

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
S11	AGD350-101-000	999999-1235

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

Sample No.	Description	Identification
S12	Client Laptop	N/A
S13	Laptop Power supply	N/A
S14	TP Link	N/A
S15	10mtr Ethernet cable	N/A
S16	Power Cable	N/A
S17	Dc power supply	N/A

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 active and transmitting at full power During the emissions testing the EUT Detection threshold setting was set to 60 (= 938 off 02 messages per second) which is worse case.

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 : S11
Tests : Radiated Emissions & powerline Conduction

Port	Description of Cable Attached	Cable length	Equipment Connected
Power	10mtr	<10m	+12Vdc
Data	10mtr Ethernet screened cable	≤10m	TPlink switch

* Only connected during setup.

C5 Details of Equipment Used

TRaC No	Equipment Type	Equipment Description	Manufacturer	Last Cal	Cal Period	Cal Due
UH004	ESVS10	Receiver	R&S	24/03/2015	12	24/03/2016
UH191	CBL611/A	Bilog	Chase	26/02/2015	24	26/02/2017
UH096	6960B	Power meter	Marconi	13/01/2015	12	13/01/2016
UH129	6924	Power Sensor	Marconi	12/01/2015	12	12/01/2016
UH396	ENV216	Lisn	R&S	22/05/2014	12	22/05/2015
REF909	FSU26	Spectrum Analyser	R&S	13/02/2015	12	13/02/2016
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
L263/A	20240-20	Horn 18-26GHz	Flann	See Note Below		
UH03	ESHS10	Receiver	R&S	03/07/2014	12	03/07/2015
L572	8449B	Pre Amp	Agilent	10/02/2015	24	10/02/2016
L654	8563A	Spectrum Analyser	HP	11/12/2014	12	11/12/2015
REF940	ATS	Radio Chamber - PP	Rainford EMC	08/09/2014	12	08/09/2015
UH330	N/A	K type transition	Maury M'wave	Connected & Calibrated with TRL300		
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	See Note Below		
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			

Note: ANSI C63.10 - 4.6.2 Antenna calibration
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/λ.

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 / 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.

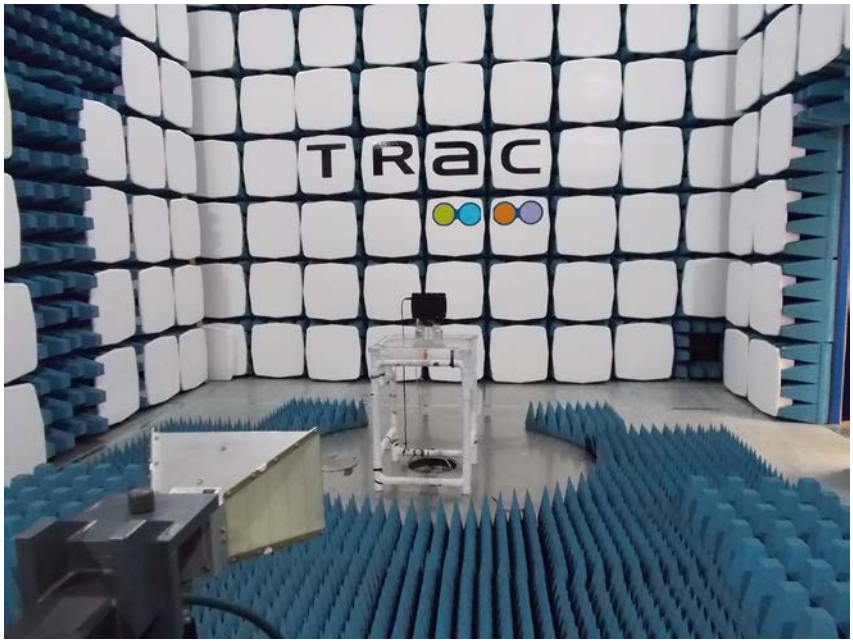
Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: Overview.
2. Radiated electric field emissions arrangement: Overview.
3. AC powerline conducted emissions arrangement: Overview.

Photograph 1

Photograph 2



Photograph 3

Appendix G: **MPE Calculation**

OET Bulletin No. 65, Supplement C 01-01

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 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 1mW/cm^2 power density limit, as required under FCC rules.

Prediction of MPE limit at a given distance

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

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

where:

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

Note:

The EIRP measurement was performed using a signal substitution method.

Result

Prediction Frequency (MHz)	Maximum EIRP (mW)	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 1mW/cm^2
24102	66.13	1	2.20
24148	68.61	1	2.34

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