

**Radio Test Report  
FOR  
Light Blue Optics  
ON  
Light Touch LT1021 and Light Touch LT1221  
Document Number TTR-001930WUS2**

**TRaC Wireless Test Report** : TTR-001930WUS2

**Applicant** : Light Blue Optics

**Apparatus** : Light Touch LT1021 and Light Touch LT1221

**Specification(s)** : CFR47 Part 15.247 July 2008  
Radiated spurious emissions and power line conducted emission only.

**FCCID** : YVE-LM

**Purpose of Test** : Certification

Authorised by



: Radio Product Manager

**Issue Date** : 6<sup>th</sup> June 2011

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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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TRaC Telecoms & Radio.**

## **1.2 Tests Requested By**

This testing in this report was requested by:

Light Blue Optics  
4775 Centennial Blvd, Suit103  
Colorado Springs  
CO  
80919  
USA

## **1.3 Manufacturer**

As above.

## **1.4 Apparatus Assessed**

The following apparatus was assessed between 27/04/11 and 12/05/11:

Light Touch LT1021 and Light Touch LT1221

The above equipment was a WIFI IEEE802.11b/g enabled interactive projector operating in the 2400MHz to 2483.5MHz band enclosed within a moulded plastic case.

For the conducted RF parameter see TRaC test report TTR-001930WUS1.

## 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
Radiated spurious emissions (Restricted bands)	Title 47 of the CFR: Part 15 Subpart (c) 15.247	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10	Pass

Abbreviations used in the above table:

Mod : Modification  
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

TRaC Telecoms & Radio Ltd did not perform all the applicable tests at the request of the manufacturer. This report only covers the radiated assessment of Title 47 of the CFR: Part 15 Subpart (c) 15.247, Radiated spurious emissions (Restricted bands) and Title 47 of the CFR: Part 15 Subpart (b) 15.109, Unintentional Radiated Spurious Emissions.

For the conducted RF parameter see TRaC test report TTR-001930WUS1.

**Section 2:**

**Measurement Uncertainty**

**2.1 Application of Measurement Uncertainty**

The following table contains the measurement uncertainties for measurements

- The measured value related to the corresponding limit is used to decide whether equipment meets the requirements of the standard.
- The measurement uncertainty value for the measurement of each parameter is recorded in section 2.3 of this report.
- All values of measurement uncertainty are equal to or lower than the values in the table (section 2.2) below as required by the standard

## 2.2 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 = **0.9 dB**

#### [3] Effective Radiated Power

Uncertainty in test result = **4.1 dB**

#### [4] Spurious Emissions

Uncertainty in test result = **4.1dB**

#### [5] Maximum frequency error

Uncertainty in test result = **3.6kHz**

#### [6] Frequency deviation

Uncertainty in test result = **3.6 kHz**

#### [7] Magnetic Field Emissions

Uncertainty in test result = **2.1 dB**

#### [8] Conducted Spurious

Uncertainty in test result = **0.9 dB**

#### [9] Channel Bandwidth

Uncertainty in test result = **3.6 kHz**

#### [10] Power Line Conduction

Uncertainty in test result = **3.5 dB**

#### [11] Spectrum Mask Measurements

Uncertainty in test result = **3.6 kHz (frequency)**  
Uncertainty in test result = **0.9 dB (amplitude)**

#### [12] Transmission Time Measurement

Uncertainty in test result = **5.8% ± 10ns**

**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
		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	Mbps	: Mega Bits Per Second

## A1 Radiated Electric Field Emissions Within The Restricted Bands of 15.205

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to spurious emissions and harmonics that fall within the restricted bands listed in Section 15.205. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit on its lowest, centre and highest carrier frequency and operating at data rates of 11Mbps & 54Mbps at each frequency. Plots were taken of all data rates and frequencies. Only plots of top middle and bottom frequencies for the data rate producing highest output power are contained in appendix B.

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: 11Mbps	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S13, S14 and S15
Modification state	0
SE in test environment	S18 and S19
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	Photograph 1 and 2

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

2412 MHz – 11Mbps											
Ref No.	FREQ. (MHz)	Det.	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)	Margin (dB)
1	37.936	Pk	50.3	0.6	11.6	30.8	31.7	0.0	31.7	60.0	-28.3
2	37.936	QP	44.6	0.6	11.6	30.8	26.0	0.0	26.0	40.0	-14.0
3	180.577	Pk	58.2	1.5	12.4	31.0	41.1	0.0	41.1	89.7	-48.6
4	180.577	QP	46.7	1.5	12.4	31.0	29.6	0.0	29.6	69.7	-40.1
5	279.981	Pk	46.3	2.1	13.0	31.0	30.4	0.0	30.4	66.0	-35.6
6	279.981	QP	43.6	2.1	13.0	31.0	27.7	0.0	27.7	46.0	-18.3
7	419.974	Pk	51.1	2.4	15.6	31.2	37.9	0.0	37.9	89.7	-51.8
8	419.974	QP	49.7	2.4	15.6	31.2	36.5	0.0	36.5	69.7	-33.2
9	559.965	Pk	26.2	2.6	18.5	0.0	47.3	0.0	47.3	89.7	-42.4
10	559.965	QP	24.4	2.6	18.5	0.0	45.5	0.0	45.5	69.7	-24.2
11	599.963	Pk	47.6	2.9	18.6	30.9	38.2	0.0	38.2	89.7	-51.5
12	599.963	QP	45.9	2.9	18.6	30.9	36.5	0.0	36.5	69.7	-33.2
13	699.957	Pk	53.3	3.0	20.7	30.9	46.1	0.0	46.1	89.7	-43.6
14	699.957	QP	52.4	3.0	20.7	30.9	45.2	0.0	45.2	69.7	-24.5
15	839.947	Pk	51.4	3.2	21.9	30.6	45.9	0.0	45.9	89.7	-43.8
16	839.947	QP	50.4	3.2	21.9	30.6	44.9	0.0	44.9	69.7	-24.8
17	979.938	Pk	43.8	3.6	23.4	29.7	41.1	0.0	41.1	74.0	-32.9
18	979.938	AV	42.6	3.6	23.4	29.7	39.9	0.0	39.9	54.0	-14.1
19	1000.000	Pk	58.2	3.5	22.1	34.6	49.2	0.0	49.2	74.0	-24.8
20	1000.000	AV	41.1	3.5	22.1	34.6	32.1	0.0	32.1	54.0	-21.9
21	1399.915	Pk	48.2	4.5	25.0	33.9	43.8	0.0	43.8	74.0	-30.2
22	1399.915	AV	35.8	4.5	25.0	33.9	31.4	0.0	31.4	54.0	-22.6
23	1539.935	Pk	48.6	5.0	25.9	33.7	45.8	0.0	45.8	74.0	-28.2
24	1539.935	AV	40.0	5.0	25.9	33.7	37.2	0.0	37.2	54.0	-16.8
25	2386.350	Pk	64.3	4.7	29.5	33.8	64.8	0.0	64.8	74.0	-9.2
26	2386.350	AV	40.9	4.7	29.5	33.8	41.4	0.0	41.4	54.0	-12.6
27	2390.000	Pk	66.6	4.5	29.5	33.8	66.9	0.0	66.9	74.0	-7.1
28	2390.000	AV	41.0	4.5	29.5	33.8	41.3	0.0	41.3	54.0	-12.7
29	2412.577	Pk	76.1	4.1	29.5	N/A	109.7	0.0	109.7	137.0	-27.3
30	4823.963	Pk	45.6	8.2	36.0	34.0	55.8	0.0	55.8	74.0	-18.2
31	4823.963	AV	32.2	8.2	36.0	34.0	42.4	0.0	42.4	54.0	-11.6

2437 MHz – 11Mbps											
Ref No.	FREQ. (MHz)	Det.	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)	Margin (dB)
1	37.936	Pk	50.3	0.6	11.6	30.8	31.7	0.0	31.7	60.0	-28.3
2	37.936	QP	44.6	0.6	11.6	30.8	26.0	0.0	26.0	40.0	-14.0
3	180.577	Pk	58.2	1.5	12.4	31.0	41.1	0.0	41.1	90.7	-49.6
4	180.577	QP	46.7	1.5	12.4	31.0	29.6	0.0	29.6	70.7	-41.1
5	279.981	Pk	46.3	2.1	13.0	31.0	30.4	0.0	30.4	66.0	-35.6
6	279.981	QP	43.6	2.1	13.0	31.0	27.7	0.0	27.7	46.0	-18.3
7	419.974	Pk	51.1	2.4	15.6	31.2	37.9	0.0	37.9	90.7	-52.8
8	419.974	QP	49.7	2.4	15.6	31.2	36.5	0.0	36.5	70.7	-34.2
9	559.965	Pk	26.2	2.6	18.5	0.0	47.3	0.0	47.3	90.7	-43.4
10	559.965	QP	24.4	2.6	18.5	0.0	45.5	0.0	45.5	70.7	-25.2
11	599.963	Pk	47.6	2.9	18.6	30.9	38.2	0.0	38.2	90.7	-52.5
12	599.963	QP	45.9	2.9	18.6	30.9	36.5	0.0	36.5	70.7	-34.2
13	699.957	Pk	53.3	3.0	20.7	30.9	46.1	0.0	46.1	90.7	-44.6
14	699.957	QP	52.4	3.0	20.7	30.9	45.2	0.0	45.2	70.7	-25.5
15	839.947	Pk	51.4	3.2	21.9	30.6	45.9	0.0	45.9	90.7	-44.8
16	839.947	QP	50.4	3.2	21.9	30.6	44.9	0.0	44.9	70.7	-25.8
17	979.938	Pk	43.8	3.6	23.4	29.7	41.1	0.0	41.1	74.0	-32.9
18	979.938	AV	42.6	3.6	23.4	29.7	39.9	0.0	39.9	54.0	-14.1
19	1000.000	Pk	58.0	3.5	22.1	34.6	49.0	0.0	49.0	74.0	-25.0
20	1000.000	AV	41.4	3.5	22.1	34.6	32.4	0.0	32.4	54.0	-21.6
21	1399.914	Pk	48.9	4.5	25.0	33.9	44.5	0.0	44.5	74.0	-29.5
22	1399.914	AV	36.0	4.5	25.0	33.9	31.6	0.0	31.6	54.0	-22.4
23	1539.906	Pk	49.0	5.0	25.9	33.7	46.2	0.0	46.2	74.0	-27.8
24	1539.906	AV	40.5	5.0	25.9	33.7	37.7	0.0	37.7	54.0	-16.3
25	2437.641	Pk	77.1	4.0	29.6	N/A	110.7	0.0	110.7	137.0	-26.3
26	4873.960	Pk	48.0	8.3	36.1	34.1	58.3	0.0	58.3	74.0	-15.7
27	4873.960	AV	34.1	8.3	36.1	34.1	44.4	0.0	44.4	54.0	-9.6

2462 MHz – 11Mbps											
Ref No.	FREQ. (MHz)	Det.	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)	Margin (dB)
1	37.936	Pk	50.3	0.6	11.6	30.8	31.7	0.0	31.7	60.0	-28.3
2	37.936	QP	44.6	0.6	11.6	30.8	26.0	0.0	26.0	40.0	-14.0
3	180.577	Pk	58.2	1.5	12.4	31.0	41.1	0.0	41.1	89.5	-48.4
4	180.577	QP	46.7	1.5	12.4	31.0	29.6	0.0	29.6	69.5	-39.9
5	279.981	Pk	46.3	2.1	13.0	31.0	30.4	0.0	30.4	66.0	-35.6
6	279.981	QP	43.6	2.1	13.0	31.0	27.7	0.0	27.7	46.0	-18.3
7	419.974	Pk	51.1	2.4	15.6	31.2	37.9	0.0	37.9	89.5	-51.6
8	419.974	QP	49.7	2.4	15.6	31.2	36.5	0.0	36.5	69.5	-33.0
9	559.965	Pk	26.2	2.6	18.5	0.0	47.3	0.0	47.3	89.5	-42.2
10	559.965	QP	24.4	2.6	18.5	0.0	45.5	0.0	45.5	69.5	-24.0
11	599.963	Pk	47.6	2.9	18.6	30.9	38.2	0.0	38.2	89.5	-51.3
12	599.963	QP	45.9	2.9	18.6	30.9	36.5	0.0	36.5	69.5	-33.0
13	699.957	Pk	53.3	3.0	20.7	30.9	46.1	0.0	46.1	89.5	-43.4
14	699.957	QP	52.4	3.0	20.7	30.9	45.2	0.0	45.2	69.5	-24.3
15	839.947	Pk	51.4	3.2	21.9	30.6	45.9	0.0	45.9	89.5	-43.6
16	839.947	QP	50.4	3.2	21.9	30.6	44.9	0.0	44.9	69.5	-24.6
17	979.938	Pk	43.8	3.6	23.4	29.7	41.1	0.0	41.1	74.0	-32.9
18	979.938	AV	42.6	3.6	23.4	29.7	39.9	0.0	39.9	54.0	-14.1
19	1000.000	Pk	56.2	3.5	22.1	34.6	47.2	0.0	47.2	74.0	-26.8
20	1000.000	AV	42.4	3.5	22.1	34.6	33.4	0.0	33.4	54.0	-20.6
21	1539.905	Pk	47.9	5.0	25.9	33.7	45.1	0.0	45.1	74.0	-28.9
22	1539.905	AV	39.5	5.0	25.9	33.7	36.7	0.0	36.7	54.0	-17.3
23	1799.891	Pk	46.5	5.3	27.1	33.7	45.2	0.0	45.2	89.5	-44.3
24	1799.891	AV	33.2	5.3	27.1	33.7	31.9	0.0	31.9	69.5	-37.6
25	2462.686	Pk	75.5	4.3	29.7	N/A	109.5	0.0	109.5	137.0	-27.5
26	2483.500	Pk	65.1	4.4	29.8	33.8	65.5	0.0	65.5	74.0	-8.5
27	2483.500	AV	39.4	4.4	29.8	33.8	39.8	0.0	39.8	54.0	-14.2
28	4923.958	Pk	47.1	8.8	36.2	34.1	58.0	0.0	58.0	74.0	-16.0
29	4923.958	AV	32.8	8.8	36.2	34.1	43.7	0.0	43.7	54.0	-10.3

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

<b>Test Details: 54Mbps</b>	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S13, S14 and S15
Modification state	0
SE in test environment	S18 and S19
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	Photograph 1 and 2

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

2412 MHz – 54Mbps											
Ref No.	FREQ. (MHz)	Det.	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)	Margin (dB)
1	37.936	Pk	50.3	0.6	11.6	30.8	31.7	0.0	31.7	60.0	-28.3
2	37.936	QP	44.6	0.6	11.6	30.8	26.0	0.0	26.0	40.0	-14.0
3	180.577	Pk	58.2	1.5	12.4	31.0	41.1	0.0	41.1	90.3	-49.2
4	180.577	QP	46.7	1.5	12.4	31.0	29.6	0.0	29.6	70.3	-40.7
5	279.981	Pk	46.3	2.1	13.0	31.0	30.4	0.0	30.4	66.0	-35.6
6	279.981	QP	43.6	2.1	13.0	31.0	27.7	0.0	27.7	46.0	-18.3
7	419.974	Pk	51.1	2.4	15.6	31.2	37.9	0.0	37.9	90.3	-52.4
8	419.974	QP	49.7	2.4	15.6	31.2	36.5	0.0	36.5	70.3	-33.8
9	559.965	Pk	26.2	2.6	18.5	0.0	47.3	0.0	47.3	90.3	-43.0
10	559.965	QP	24.4	2.6	18.5	0.0	45.5	0.0	45.5	70.3	-24.8
11	599.963	Pk	47.6	2.9	18.6	30.9	38.2	0.0	38.2	90.3	-52.1
12	599.963	QP	45.9	2.9	18.6	30.9	36.5	0.0	36.5	70.3	-33.8
13	699.957	Pk	53.3	3.0	20.7	30.9	46.1	0.0	46.1	90.3	-44.2
14	699.957	QP	52.4	3.0	20.7	30.9	45.2	0.0	45.2	70.3	-25.1
15	839.947	Pk	51.4	3.2	21.9	30.6	45.9	0.0	45.9	90.3	-44.4
16	839.947	QP	50.4	3.2	21.9	30.6	44.9	0.0	44.9	70.3	-25.4
17	979.938	Pk	43.8	3.6	23.4	29.7	41.1	0.0	41.1	74.0	-32.9
18	979.938	AV	42.6	3.6	23.4	29.7	39.9	0.0	39.9	54.0	-14.1
19	1000.000	Pk	53.9	3.5	22.1	34.6	44.9	0.0	44.9	74.0	-29.1
20	1000.000	AV	41.2	3.5	22.1	34.6	32.2	0.0	32.2	54.0	-21.8
21	1399.913	Pk	48.2	4.5	25.0	33.9	43.8	0.0	43.8	74.0	-30.2
22	1399.913	AV	36.1	4.5	25.0	33.9	31.7	0.0	31.7	54.0	-22.3
23	1539.903	Pk	46.8	5.0	25.9	33.7	44.0	0.0	44.0	74.0	-30.0
24	1539.903	AV	36.5	5.0	25.9	33.7	33.7	0.0	33.7	54.0	-20.3
25	2387.821	Pk	62.4	4.5	29.5	33.8	62.7	0.0	62.7	74.0	-11.3
26	2387.821	AV	42.8	4.5	29.5	33.8	43.1	0.0	43.1	54.0	-10.9
27	2390.000	Pk	67.8	4.5	29.5	33.8	68.1	0.0	68.1	74.0	-5.9
28	2390.000	AV	47.0	4.5	29.5	33.8	47.3	0.0	47.3	54.0	-6.7
29	2417.160	Pk	76.4	4.3	29.6	N/A	110.3	0.0	110.3	137.0	-26.7

2437 MHz – 54Mbps											
Ref No.	FREQ. (MHz)	Det.	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)	Margin (dB)
1	37.936	Pk	50.3	0.6	11.6	30.8	31.7	0.0	31.7	60.0	-28.3
2	37.936	QP	44.6	0.6	11.6	30.8	26.0	0.0	26.0	40.0	-14.0
3	180.577	Pk	58.2	1.5	12.4	31.0	41.1	0.0	41.1	89.7	-48.6
4	180.577	QP	46.7	1.5	12.4	31.0	29.6	0.0	29.6	69.7	-40.1
5	279.981	Pk	46.3	2.1	13.0	31.0	30.4	0.0	30.4	66.0	-35.6
6	279.981	QP	43.6	2.1	13.0	31.0	27.7	0.0	27.7	46.0	-18.3
7	419.974	Pk	51.1	2.4	15.6	31.2	37.9	0.0	37.9	89.7	-51.8
8	419.974	QP	49.7	2.4	15.6	31.2	36.5	0.0	36.5	69.7	-33.2
9	559.965	Pk	26.2	2.6	18.5	0.0	47.3	0.0	47.3	89.7	-42.4
10	559.965	QP	24.4	2.6	18.5	0.0	45.5	0.0	45.5	69.7	-24.2
11	599.963	Pk	47.6	2.9	18.6	30.9	38.2	0.0	38.2	89.7	-51.5
12	599.963	QP	45.9	2.9	18.6	30.9	36.5	0.0	36.5	69.7	-33.2
13	699.957	Pk	53.3	3.0	20.7	30.9	46.1	0.0	46.1	89.7	-43.6
14	699.957	QP	52.4	3.0	20.7	30.9	45.2	0.0	45.2	69.7	-24.5
15	839.947	Pk	51.4	3.2	21.9	30.6	45.9	0.0	45.9	89.7	-43.8
16	839.947	QP	50.4	3.2	21.9	30.6	44.9	0.0	44.9	69.7	-24.8
17	979.938	Pk	43.8	3.6	23.4	29.7	41.1	0.0	41.1	74.0	-32.9
18	979.938	AV	42.6	3.6	23.4	29.7	39.9	0.0	39.9	54.0	-14.1
19	1000.000	Pk	56.2	3.5	22.1	34.6	47.2	0.0	47.2	74.0	-26.8
20	1000.000	AV	43.0	3.5	22.1	34.6	34.0	0.0	34.0	54.0	-20.0
21	1399.911	Pk	48.7	4.5	25.0	33.9	44.3	0.0	44.3	74.0	-29.7
22	1399.911	AV	37.1	4.5	25.0	33.9	32.7	0.0	32.7	54.0	-21.3
23	1539.904	Pk	46.6	5.0	25.9	33.7	43.8	0.0	43.8	74.0	-30.2
24	1539.904	AV	36.7	5.0	25.9	33.7	33.9	0.0	33.9	54.0	-20.1
25	1819.886	Pk	45.9	5.3	27.2	33.7	44.7	0.0	44.7	89.7	-45.0
26	1819.886	AV	36.1	5.3	27.2	33.7	34.9	0.0	34.9	69.7	-34.8
27	2439.885	Pk	76.1	4.0	29.6	N/A	109.7	0.0	109.7	137.0	-27.3

2462 MHz – 54Mbps											
Ref No.	FREQ. (MHz)	Det.	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)	Margin (dB)
1	37.936	Pk	50.3	0.6	11.6	30.8	31.7	0.0	31.7	60.0	-28.3
2	37.936	QP	44.6	0.6	11.6	30.8	26.0	0.0	26.0	40.0	-14.0
3	180.577	Pk	58.2	1.5	12.4	31.0	41.1	0.0	41.1	88.1	-47.0
4	180.577	QP	46.7	1.5	12.4	31.0	29.6	0.0	29.6	68.1	-38.5
5	279.981	Pk	46.3	2.1	13.0	31.0	30.4	0.0	30.4	66.0	-35.6
6	279.981	QP	43.6	2.1	13.0	31.0	27.7	0.0	27.7	46.0	-18.3
7	419.974	Pk	51.1	2.4	15.6	31.2	37.9	0.0	37.9	88.1	-50.2
8	419.974	QP	49.7	2.4	15.6	31.2	36.5	0.0	36.5	68.1	-31.6
9	559.965	Pk	26.2	2.6	18.5	0.0	47.3	0.0	47.3	88.1	-40.8
10	559.965	QP	24.4	2.6	18.5	0.0	45.5	0.0	45.5	68.1	-22.6
11	599.963	Pk	47.6	2.9	18.6	30.9	38.2	0.0	38.2	88.1	-49.9
12	599.963	QP	45.9	2.9	18.6	30.9	36.5	0.0	36.5	68.1	-31.6
13	699.957	Pk	53.3	3.0	20.7	30.9	46.1	0.0	46.1	88.1	-42.0
14	699.957	QP	52.4	3.0	20.7	30.9	45.2	0.0	45.2	68.1	-22.9
15	839.947	Pk	51.4	3.2	21.9	30.6	45.9	0.0	45.9	88.1	-42.2
16	839.947	QP	50.4	3.2	21.9	30.6	44.9	0.0	44.9	68.1	-23.2
17	979.938	Pk	43.8	3.6	23.4	29.7	41.1	0.0	41.1	74.0	-32.9
18	979.938	AV	42.6	3.6	23.4	29.7	39.9	0.0	39.9	54.0	-14.1
19	1539.904	Pk	48.9	5.0	25.9	33.7	46.1	0.0	46.1	74.0	-27.9
20	1539.904	AV	41.4	5.0	25.9	33.7	38.6	0.0	38.6	54.0	-15.4
21	2464.853	Pk	74.2	4.2	29.7	N/A	108.1	0.0	108.1	137.0	-28.9
22	2483.500	Pk	66.0	4.4	29.8	33.8	66.4	0.0	66.4	74.0	-7.6
23	2483.500	AV	46.4	4.4	29.8	33.8	46.8	0.0	46.8	54.0	-7.2
24	2487.017	Pk	62.7	4.6	29.8	33.8	63.3	0.0	63.3	74.0	-10.7
25	2487.017	AV	42.0	4.6	29.8	33.8	42.6	0.0	42.6	54.0	-11.4

**Notes:**

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1
- 2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector do not exceed a level 20 dB above the average limit.
- 3 Measurements at 2400 & 2483.5 MHz were made to ensure band edge compliance.
- 4 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.
- 5 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= 1MHz, VBW > RBW
Average	RBW= 1MHz, VBW > RBW

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

- 6 In accordance with DA 00-705, the average level of the spurious radiated emission may be reduced by the duty cycle correction factor. If the dwell time per channel (refer to the measured channel occupancy time, section A7 of this test report) of the hopping signal is less than 100ms then the average measurement may be further adjusted by the duty cycle correction factor which is derived from

$$20\log_{10}\left(\frac{\text{dwell time}}{100ms}\right)$$

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15:2008 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits (47 CFR Part15: Clause 15.209) for emissions falling within the restricted bands defined in 15.205(a):

Frequency of emission (MHz)	Field strength $\text{mV/m}$	Measurement Distance m	Field strength $\text{dBmV/m}$
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

**Notes:**

(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:

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

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

(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				

**A2 Unintentional Radiated Electric Field Emissions - 15.109**

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The maximum permitted field strength is listed in Section 15.109. The EUT was set to receive mode only.

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 : 

Test Details:	
Regulation	Title 47 of the CFR: Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S13, S14 and S15
Modification state	0
SE in test environment	S18 and S19
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	19°C
Photographs (Appendix F)	Photograph 1 and 2

The worst case radiated emission measurements for spurious emissions:

2412 MHz – Rx mode											
Ref No.	FREQ. (MHz)	Det.	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)	Margin (dB)
1	38.108	Pk	49.7	0.6	11.6	30.8	31.1	0.0	31.1	60.0	-28.9
2	38.108	QP	45.6	0.6	11.6	30.8	27.0	0.0	27.0	40.0	-13.0
3	180.598	Pk	53.6	1.5	12.4	31.0	36.5	0.0	36.5	63.5	-27.0
4	180.598	QP	49.0	1.5	12.4	31.0	31.9	0.0	31.9	43.5	-11.6
5	559.966	Pk	25.6	2.6	18.5	0.0	46.7	0.0	46.7	66.0	-19.3
6	559.966	QP	23.8	2.6	18.5	0.0	44.9	0.0	44.9	46.0	-1.1
7	599.963	Pk	44.8	2.9	18.6	30.9	35.4	0.0	35.4	66.0	-30.6
8	599.963	QP	42.1	2.9	18.6	30.9	32.7	0.0	32.7	46.0	-13.3
9	699.957	Pk	52.4	3.0	20.7	30.9	45.2	0.0	45.2	66.0	-20.8
10	699.957	QP	51.3	3.0	20.7	30.9	44.1	0.0	44.1	46.0	-1.9
11	839.947	Pk	50.8	3.2	21.9	30.6	45.3	0.0	45.3	66.0	-20.7
12	839.947	QP	49.8	3.2	21.9	30.6	44.3	0.0	44.3	46.0	-1.7
13	979.938	Pk	44.7	3.6	23.4	29.7	42.0	0.0	42.0	74.0	-32.0
14	979.938	QP	43.3	3.6	23.4	29.7	40.6	0.0	40.6	54.0	-13.4
15	1000.000	Pk	51.9	3.5	22.1	34.6	42.9	0.0	42.9	74.0	-31.1
16	1000.000	AV	39.7	3.5	22.1	34.6	30.7	0.0	30.7	54.0	-23.3
17	1399.914	Pk	49.7	4.5	25.0	33.9	45.3	0.0	45.3	74.0	-28.7
18	1399.914	AV	39.1	4.5	25.0	33.9	34.7	0.0	34.7	54.0	-19.3
19	1539.905	Pk	48.2	5.0	25.9	33.7	45.4	0.0	45.4	74.0	-28.6
20	1539.905	AV	40.2	5.0	25.9	33.7	37.4	0.0	37.4	54.0	-16.6

2437 MHz – Rx mode											
Ref No.	FREQ. (MHz)	Det.	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)	Margin (dB)
1	38.108	Pk	49.7	0.6	11.6	30.8	31.1	0.0	31.1	60.0	-28.9
2	38.108	QP	45.6	0.6	11.6	30.8	27.0	0.0	27.0	40.0	-13.0
3	180.598	Pk	53.6	1.5	12.4	31.0	36.5	0.0	36.5	63.5	-27.0
4	180.598	QP	49.0	1.5	12.4	31.0	31.9	0.0	31.9	43.5	-11.6
5	559.966	Pk	25.6	2.6	18.5	0.0	46.7	0.0	46.7	66.0	-19.3
6	559.966	QP	23.8	2.6	18.5	0.0	44.9	0.0	44.9	46.0	-1.1
7	599.963	Pk	44.8	2.9	18.6	30.9	35.4	0.0	35.4	66.0	-30.6
8	599.963	QP	42.1	2.9	18.6	30.9	32.7	0.0	32.7	46.0	-13.3
9	699.957	Pk	52.4	3.0	20.7	30.9	45.2	0.0	45.2	66.0	-20.8
10	699.957	QP	51.3	3.0	20.7	30.9	44.1	0.0	44.1	46.0	-1.9
11	839.947	Pk	50.8	3.2	21.9	30.6	45.3	0.0	45.3	66.0	-20.7
12	839.947	QP	49.8	3.2	21.9	30.6	44.3	0.0	44.3	46.0	-1.7
13	979.938	Pk	44.7	3.6	23.4	29.7	42.0	0.0	42.0	74.0	-32.0
14	979.938	QP	43.3	3.6	23.4	29.7	40.6	0.0	40.6	54.0	-13.4
15	1000.000	Pk	51.9	3.5	22.1	34.6	42.9	0.0	42.9	74.0	-31.1
16	1000.000	AV	39.7	3.5	22.1	34.6	30.7	0.0	30.7	54.0	-23.3
17	1399.914	Pk	49.7	4.5	25.0	33.9	45.3	0.0	45.3	74.0	-28.7
18	1399.914	AV	39.1	4.5	25.0	33.9	34.7	0.0	34.7	54.0	-19.3
19	1539.905	Pk	48.2	5.0	25.9	33.7	45.4	0.0	45.4	74.0	-28.6
20	1539.905	AV	40.2	5.0	25.9	33.7	37.4	0.0	37.4	54.0	-16.6

2462 MHz – Rx mode											
Ref No.	FREQ. (MHz)	Det.	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)	Margin (dB)
1	1	38.108	Pk	49.7	0.6	11.6	30.8	31.1	0.0	31.1	60.0
2	2	38.108	QP	45.6	0.6	11.6	30.8	27.0	0.0	27.0	40.0
3	3	180.598	Pk	53.6	1.5	12.4	31.0	36.5	0.0	36.5	63.5
4	4	180.598	QP	49.0	1.5	12.4	31.0	31.9	0.0	31.9	43.5
5	5	559.966	Pk	25.6	2.6	18.5	0.0	46.7	0.0	46.7	66.0
6	6	559.966	QP	23.8	2.6	18.5	0.0	44.9	0.0	44.9	46.0
7	7	599.963	Pk	44.8	2.9	18.6	30.9	35.4	0.0	35.4	66.0
8	8	599.963	QP	42.1	2.9	18.6	30.9	32.7	0.0	32.7	46.0
9	9	699.957	Pk	52.4	3.0	20.7	30.9	45.2	0.0	45.2	66.0
10	10	699.957	QP	51.3	3.0	20.7	30.9	44.1	0.0	44.1	46.0
11	11	839.947	Pk	50.8	3.2	21.9	30.6	45.3	0.0	45.3	66.0
12	12	839.947	QP	49.8	3.2	21.9	30.6	44.3	0.0	44.3	46.0
13	13	979.938	Pk	44.7	3.6	23.4	29.7	42.0	0.0	42.0	74.0
14	14	979.938	QP	43.3	3.6	23.4	29.7	40.6	0.0	40.6	54.0
15	15	1000.000	Pk	51.9	3.5	22.1	34.6	42.9	0.0	42.9	74.0
16	16	1000.000	AV	39.7	3.5	22.1	34.6	30.7	0.0	30.7	54.0
17	17	1399.914	Pk	49.7	4.5	25.0	33.9	45.3	0.0	45.3	74.0
18	18	1399.914	AV	39.1	4.5	25.0	33.9	34.7	0.0	34.7	54.0
19	19	1539.905	Pk	48.2	5.0	25.9	33.7	45.4	0.0	45.4	74.0
20	20	1539.905	AV	40.2	5.0	25.9	33.7	37.4	0.0	37.4	54.0

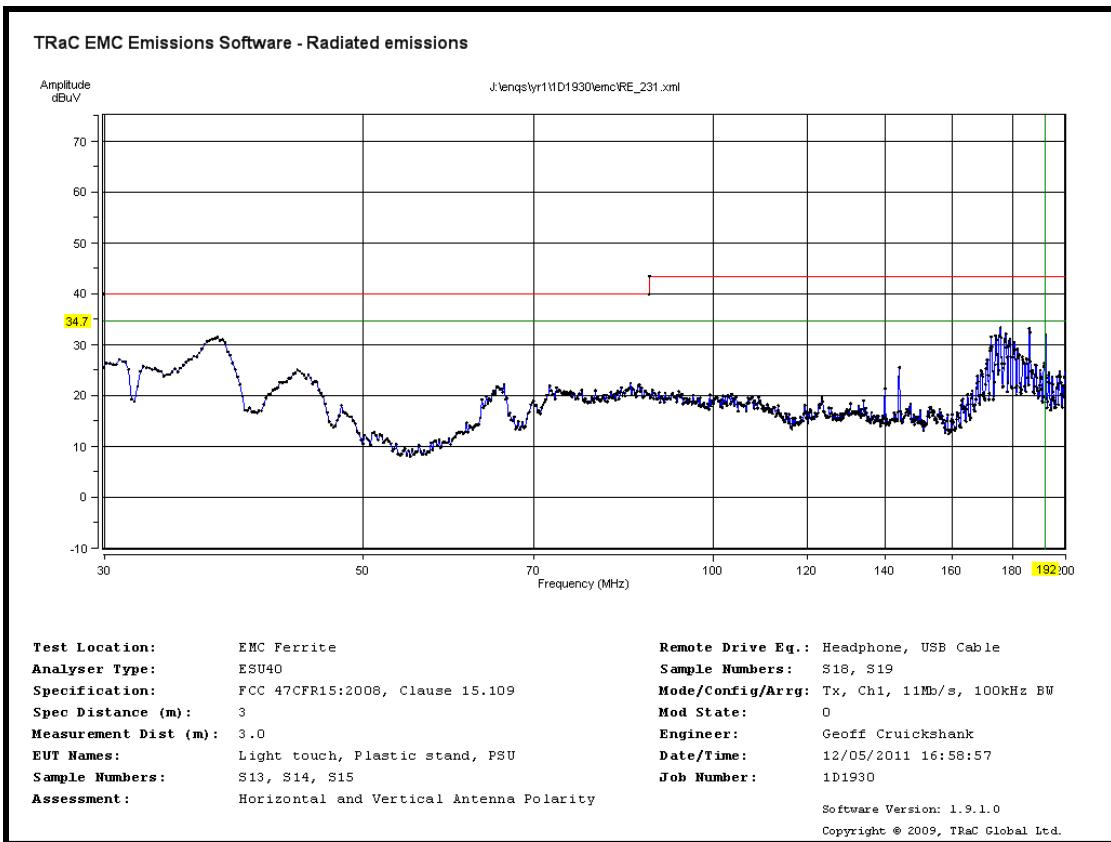
**Appendix B:**

**Supporting Graphical Data**

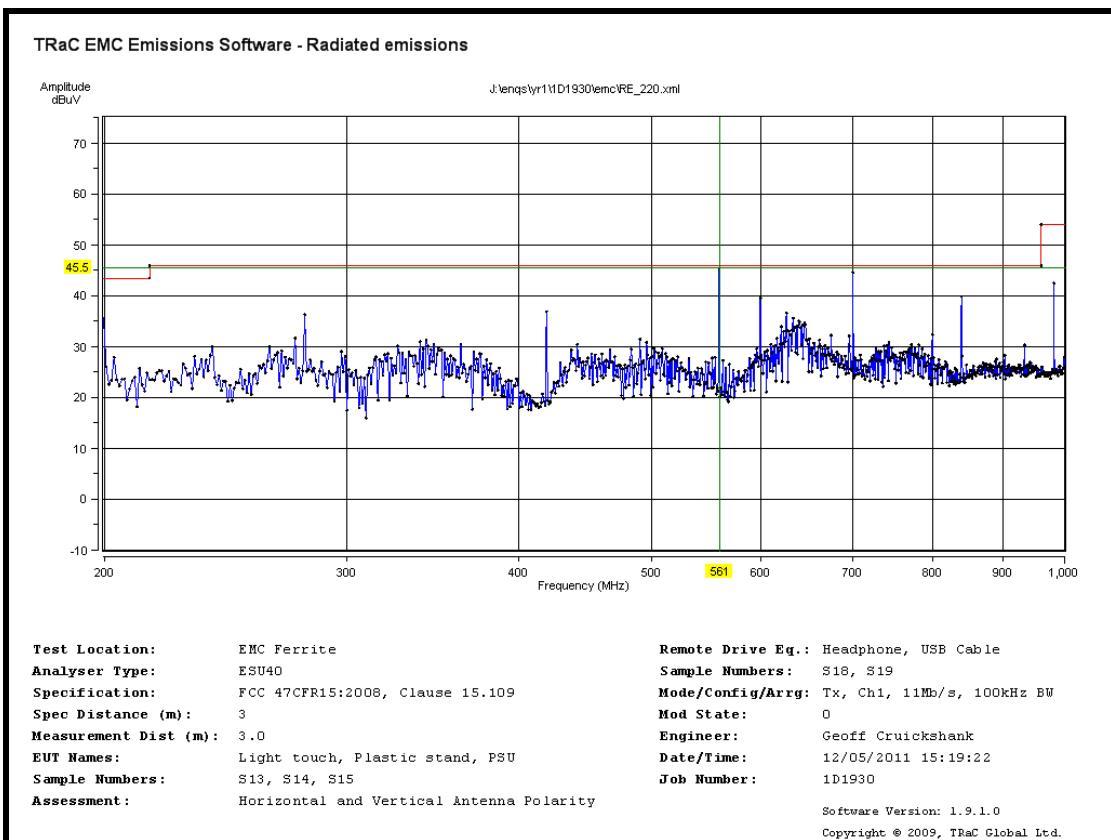
This appendix contains graphical data obtained during testing.

**Notes:**

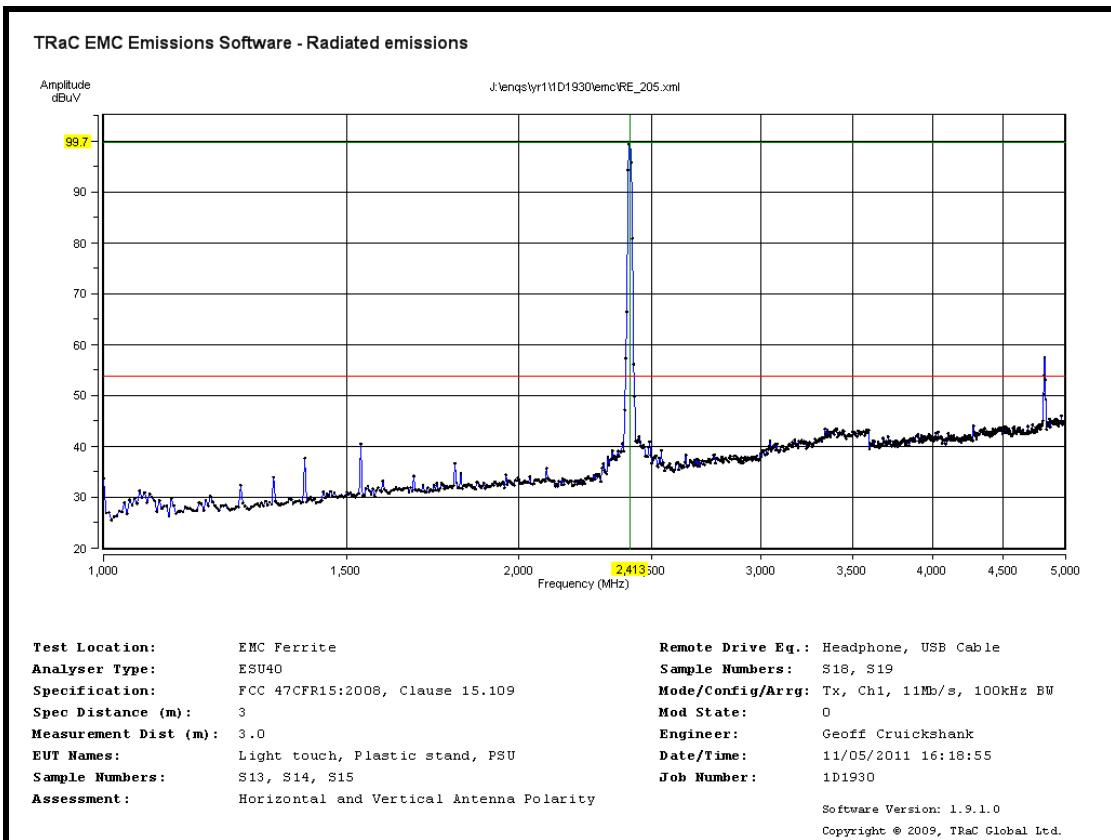
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.
- (d) Appendix C details the numbering system used to identify the sample and its modification state.
- (e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.



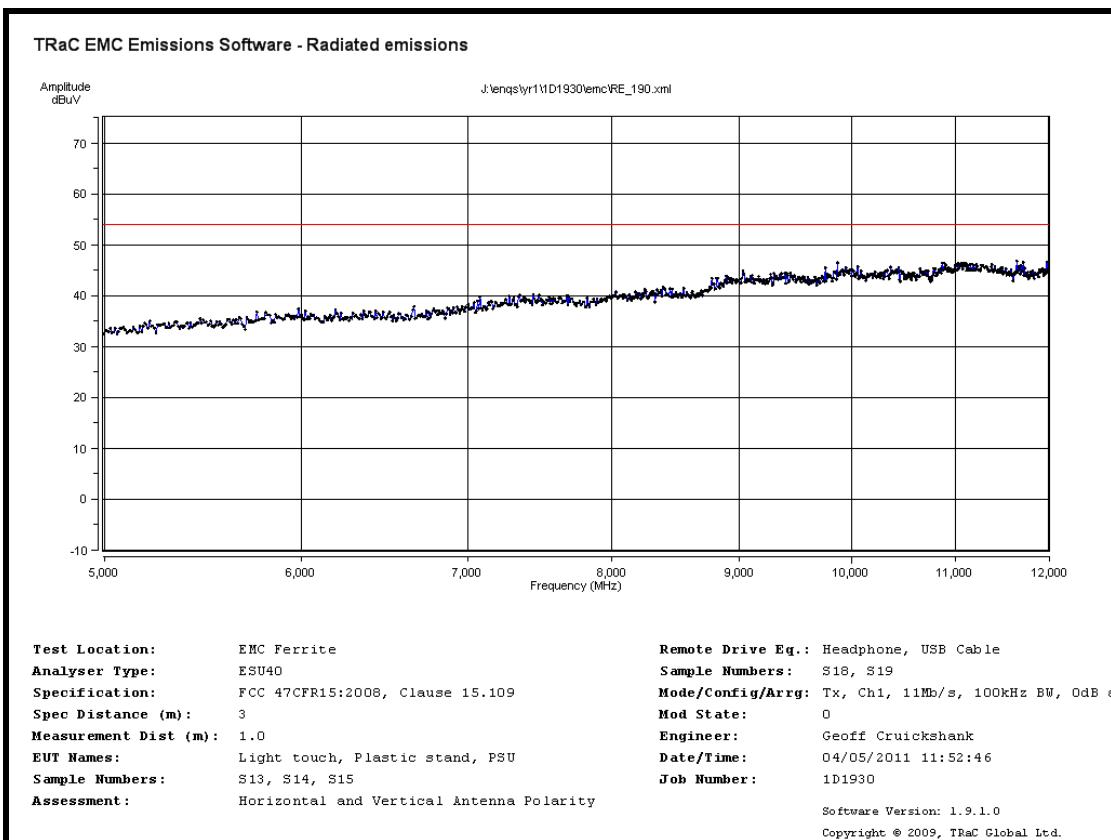
Radiated Spurious emissions 30 MHz to 200 MHz – 2412MHz – 11Mbps



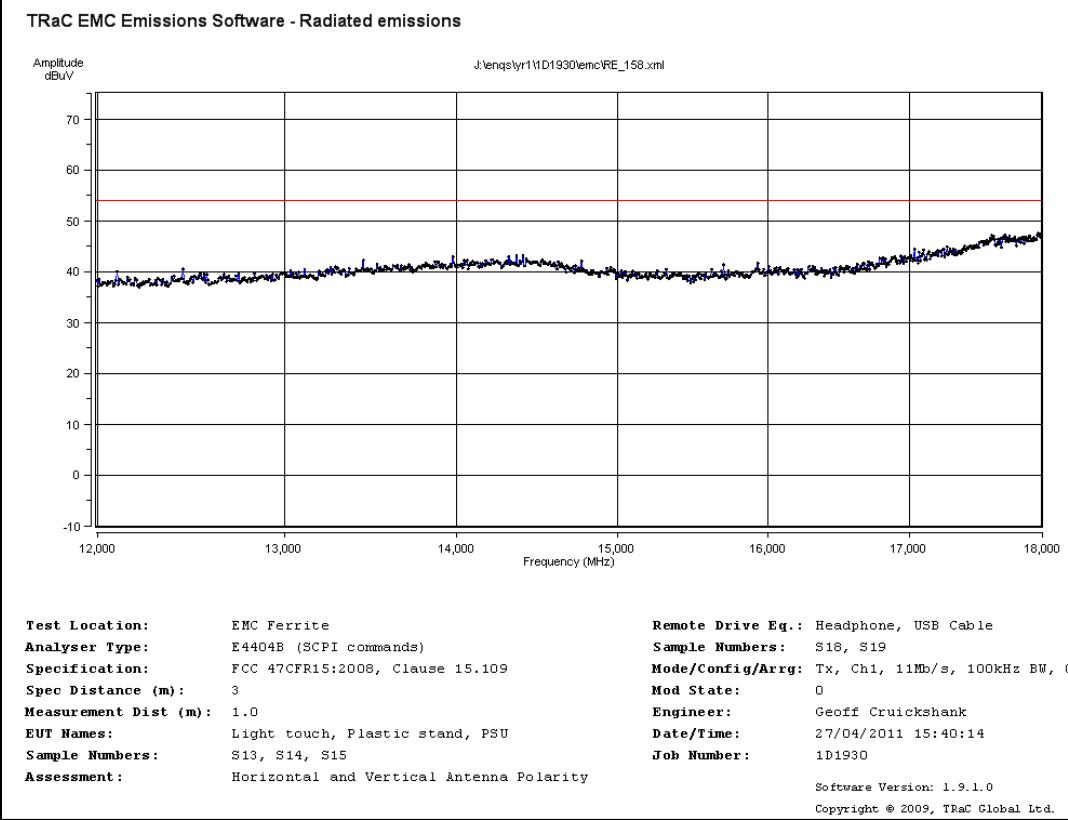
Radiated Spurious emissions 200 MHz to 1 GHz – 2412MHz – 11Mbps



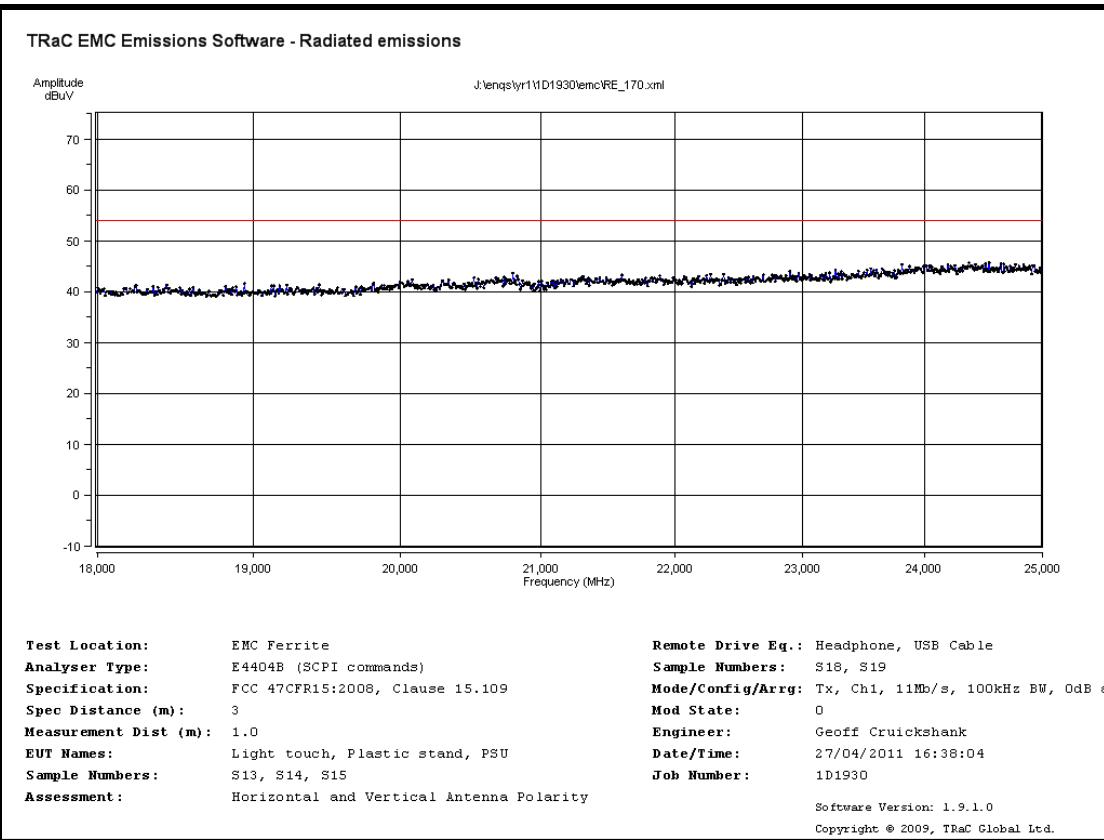
### Radiated Spurious emissions 1 GHz to 5 GHz – 2412MHz – 11Mbps



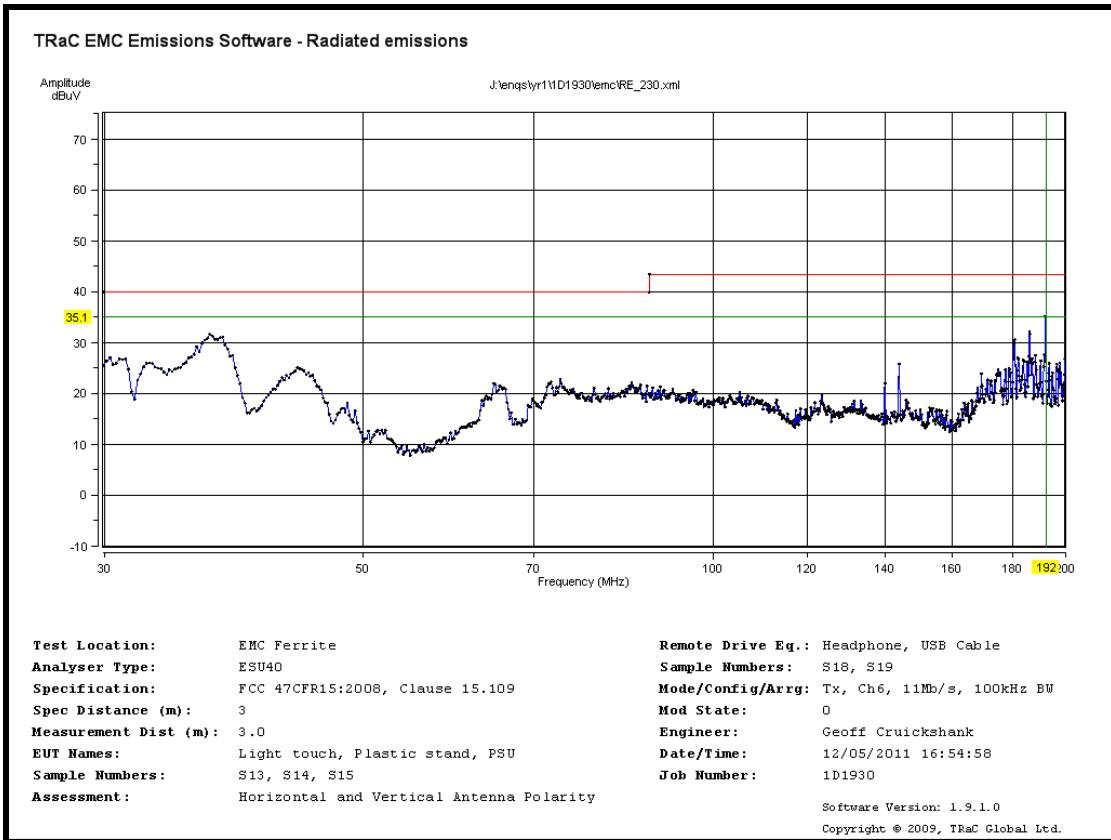
### Radiated Spurious emissions 5 GHz to 12 GHz – 2412MHz – 11Mbps



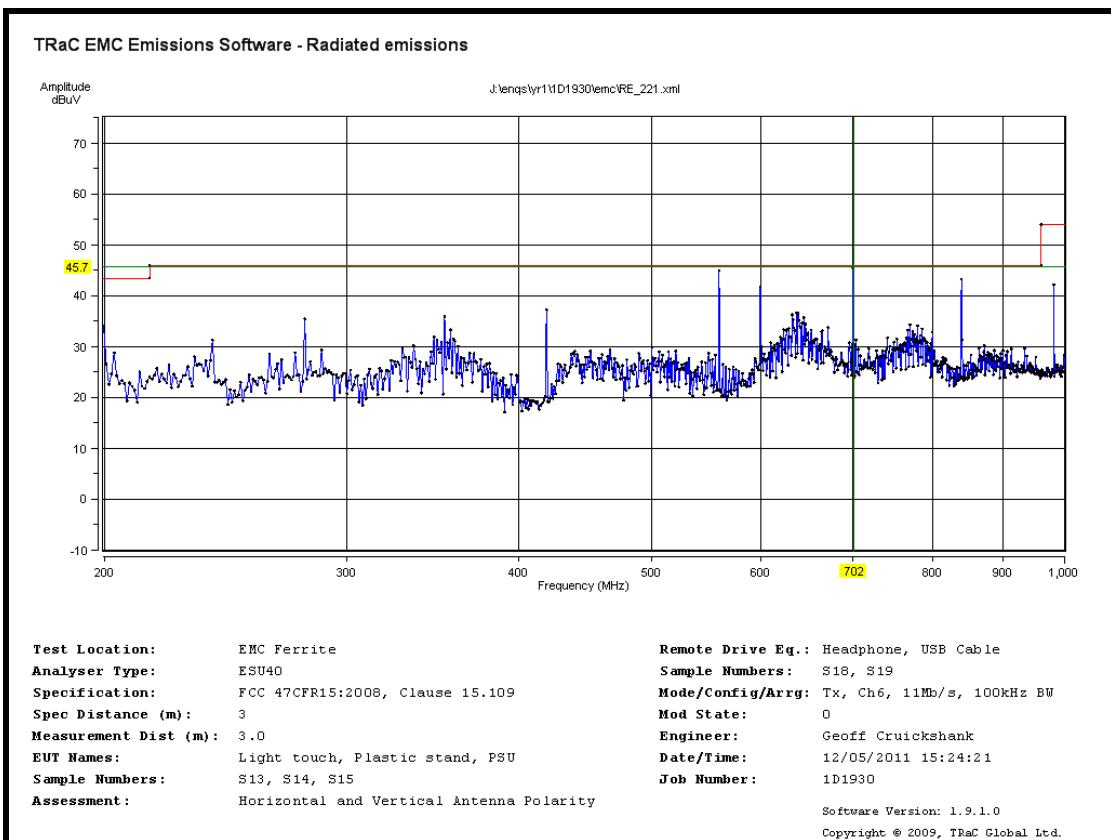
### Radiated Spurious emissions 12 GHz to 18 GHz – 2412MHz – 11Mbps



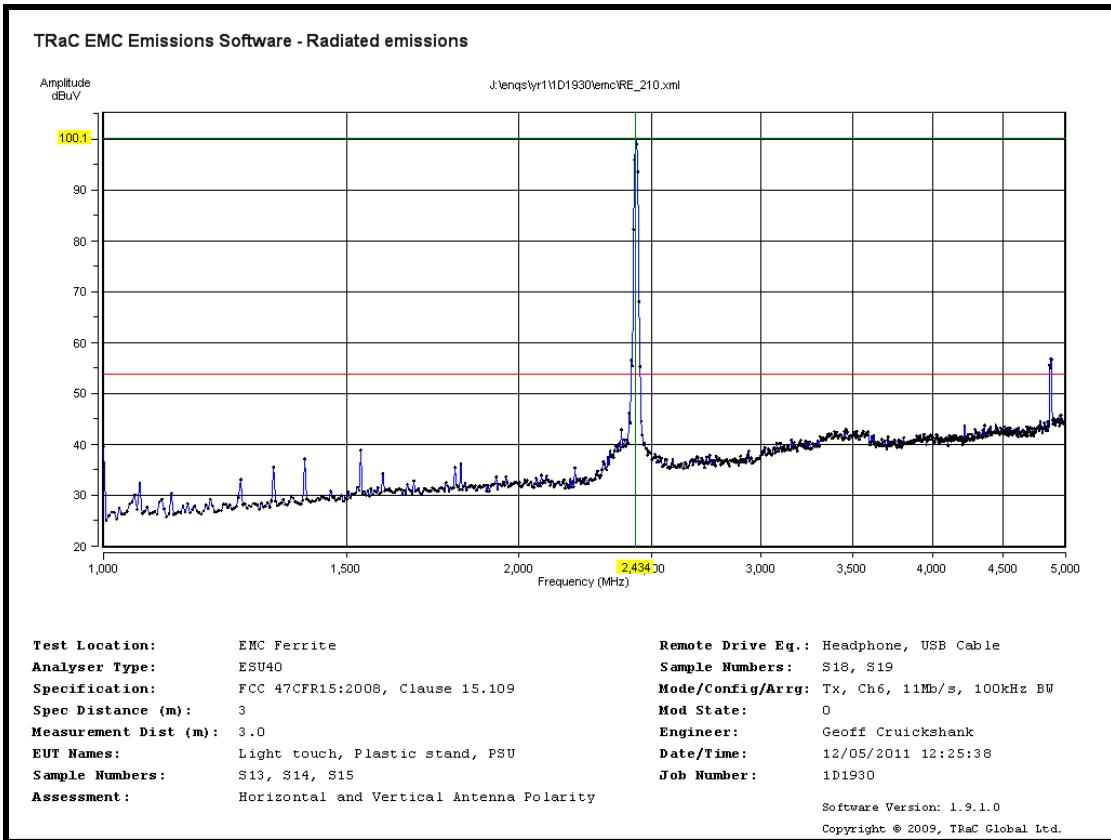
### Radiated Spurious emissions 18 GHz to 25 GHz – 2412MHz – 11Mbps



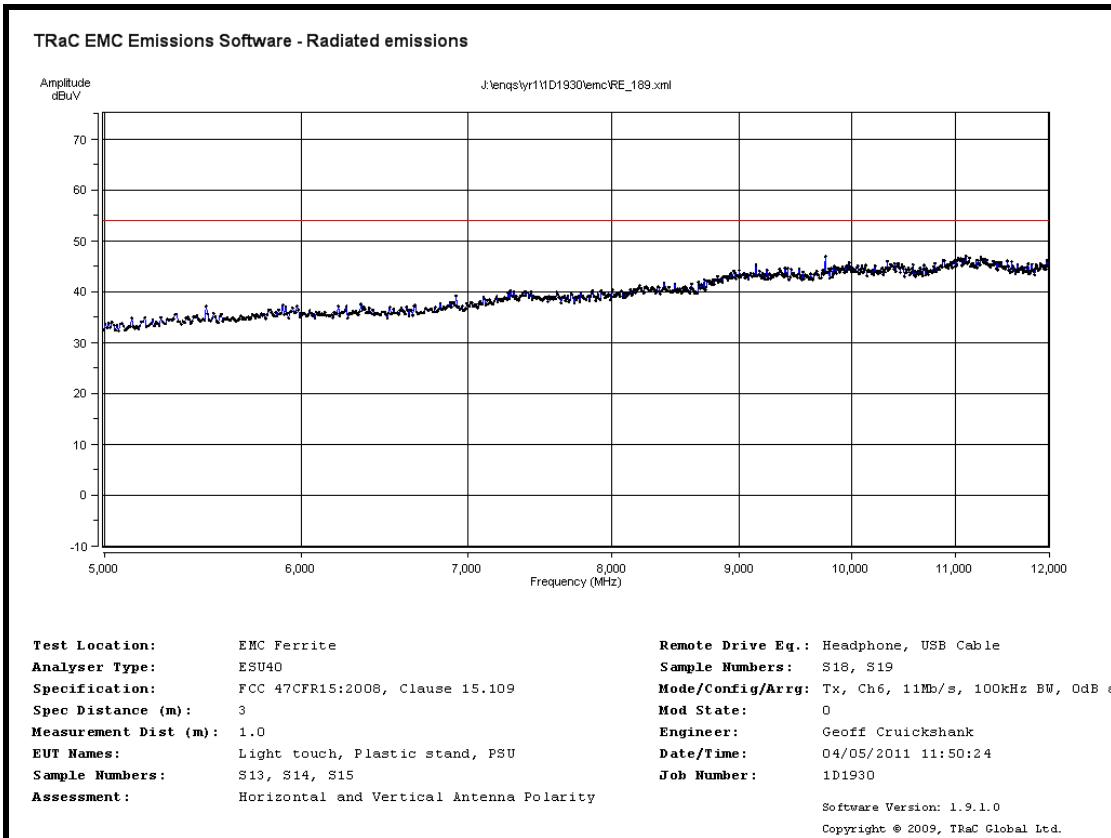
Radiated Spurious emissions 30 MHz to 200 MHz – 2437MHz – 11Mbps



Radiated Spurious emissions 200 MHz to 1 GHz – 2437MHz – 11Mbps

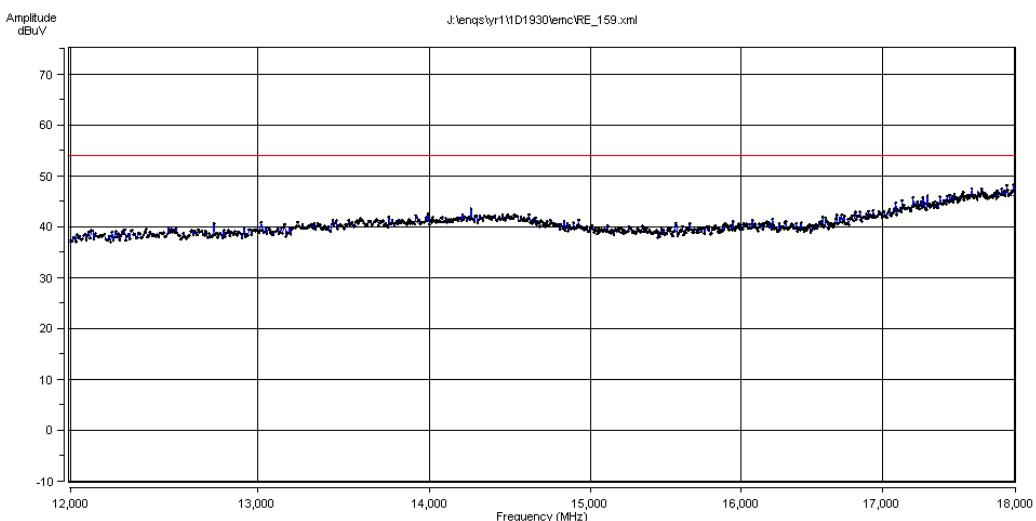


Radiated Spurious emissions 1 GHz to 5 GHz – 2437MHz – 11Mbps



Radiated Spurious emissions 5 GHz to 12 GHz – 2437MHz – 11Mbps

## TRaC EMC Emissions Software - Radiated emissions

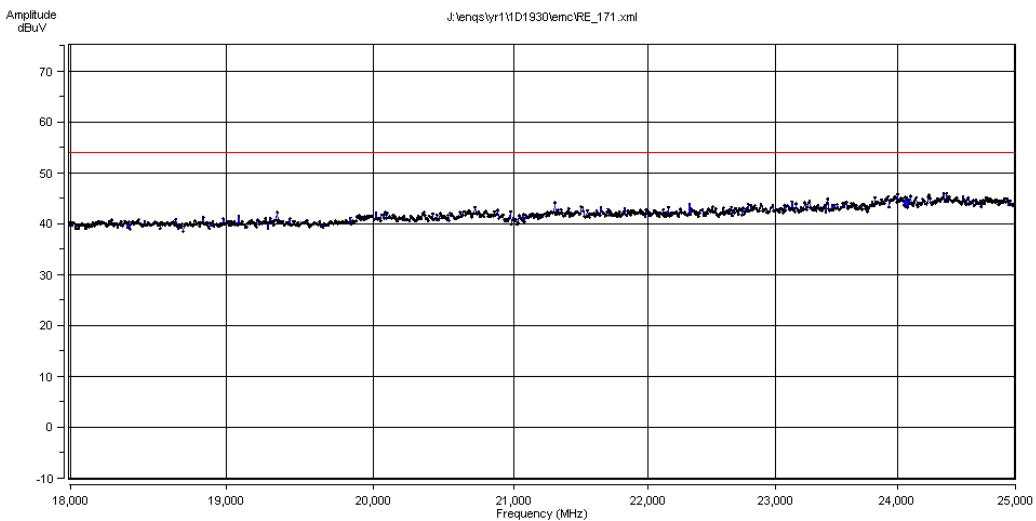


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, Plastic stand, PSU  
**Sample Numbers:** S13, S14, S15  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphone, USB Cable  
**Sample Numbers:** S18, S19  
**Mode/Config/Arrg:** Tx, Ch6, 11Mb/s, 100kHz BW, 0dB a  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 15:42:24  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

## Radiated Spurious emissions 12 GHz to 18 GHz – 2437MHz – 11Mbps

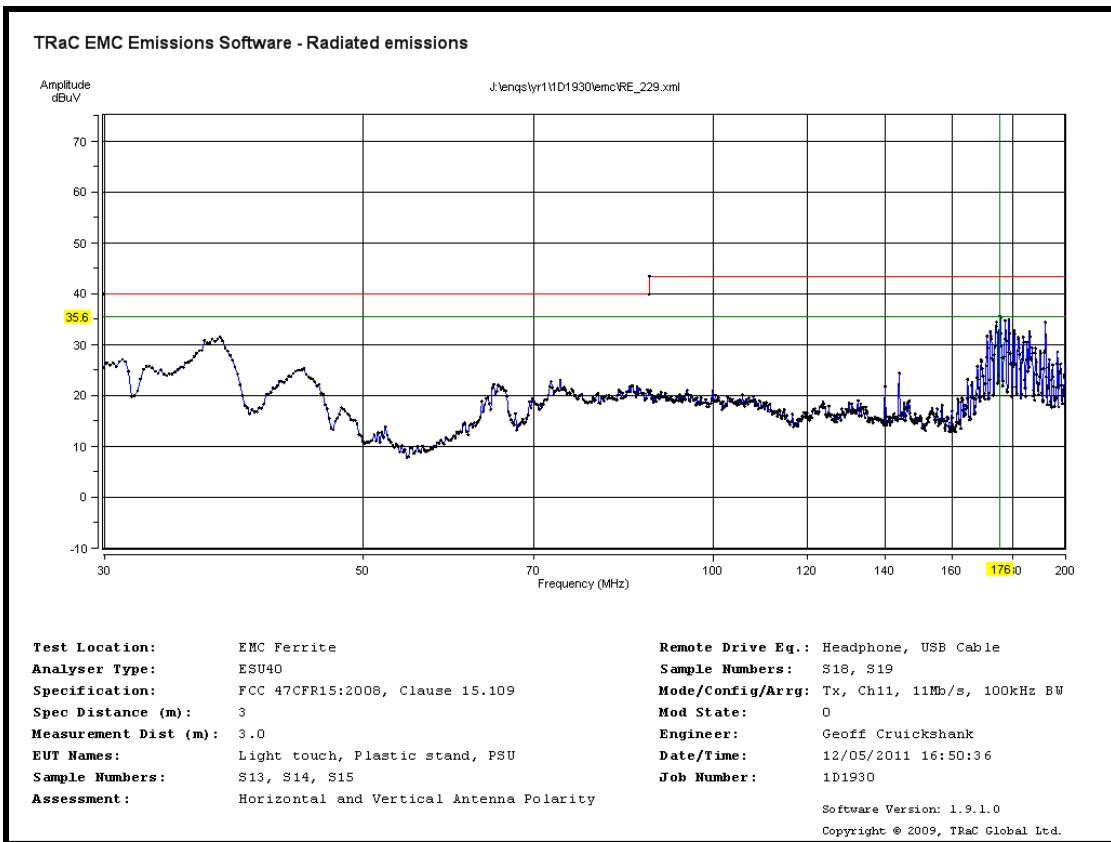
## TRaC EMC Emissions Software - Radiated emissions



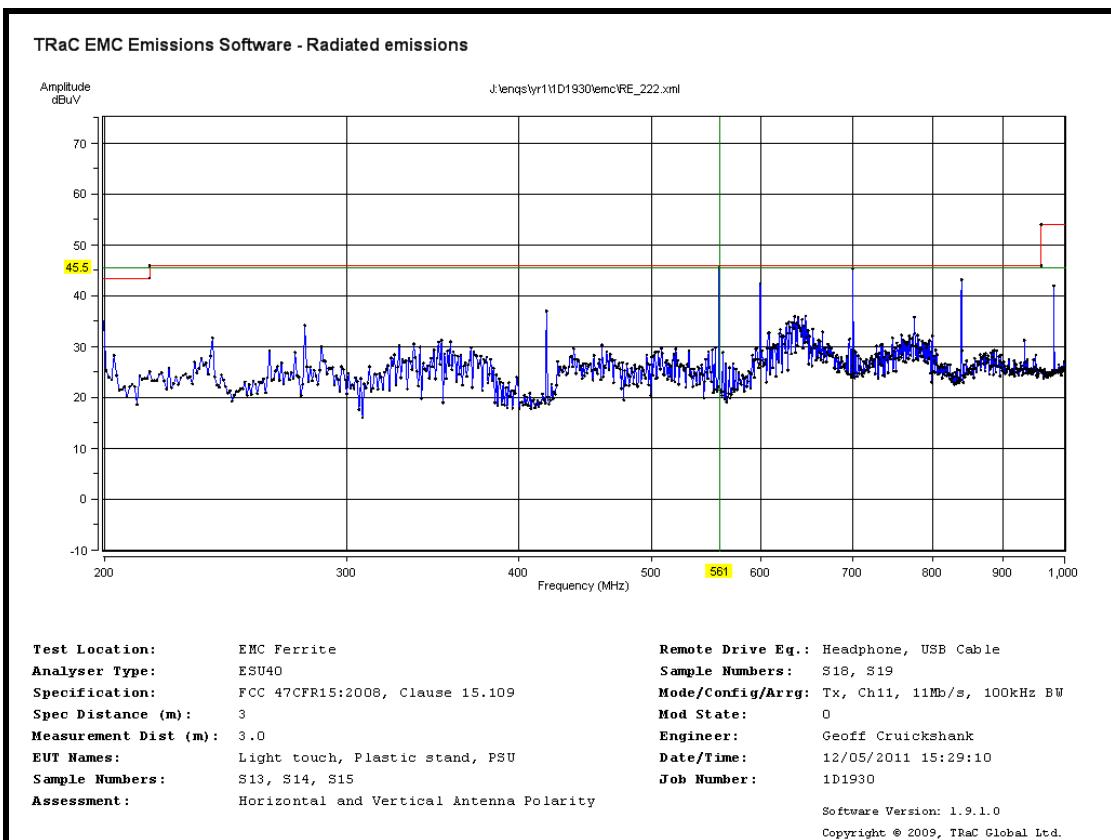
**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, Plastic stand, PSU  
**Sample Numbers:** S13, S14, S15  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphone, USB Cable  
**Sample Numbers:** S18, S19  
**Mode/Config/Arrg:** Tx, Ch6, 11Mb/s, 100kHz BW, 0dB a  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 16:40:17  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

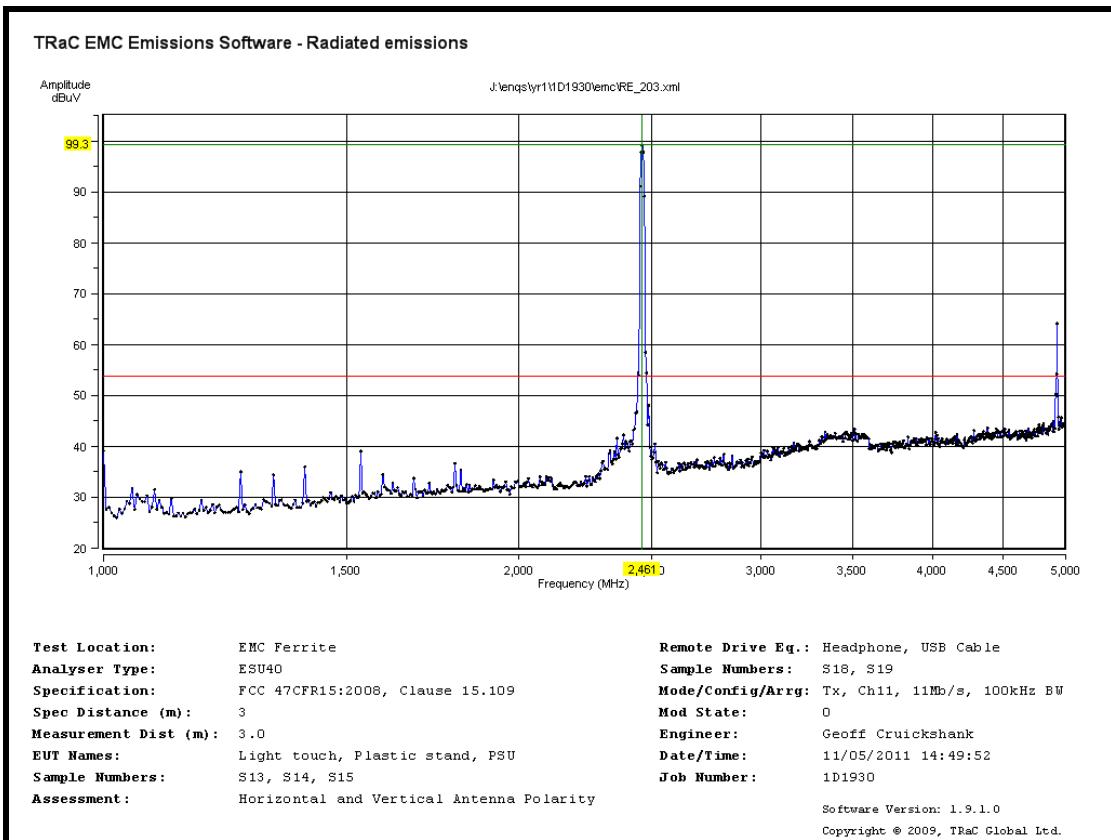
## Radiated Spurious emissions 18 GHz to 25 GHz – 2437MHz – 11Mbps



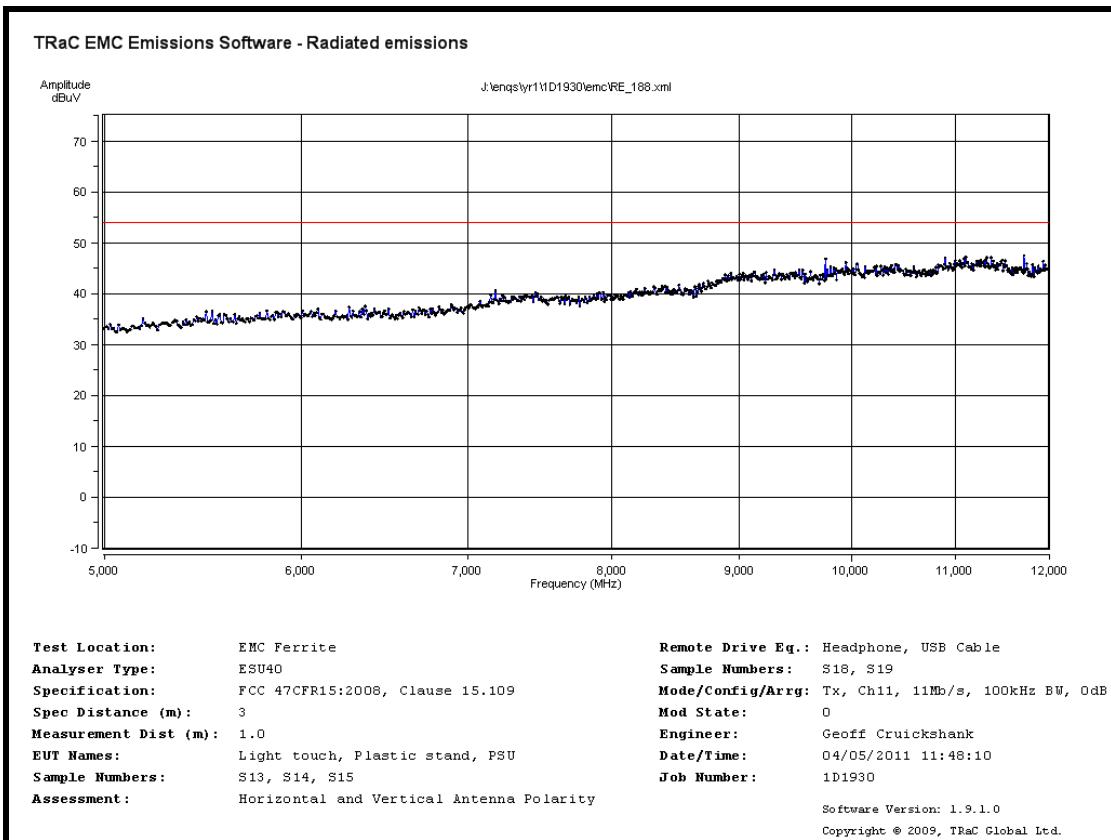
Radiated Spurious emissions 30 MHz to 200 MHz – 2462MHz – 11Mbps



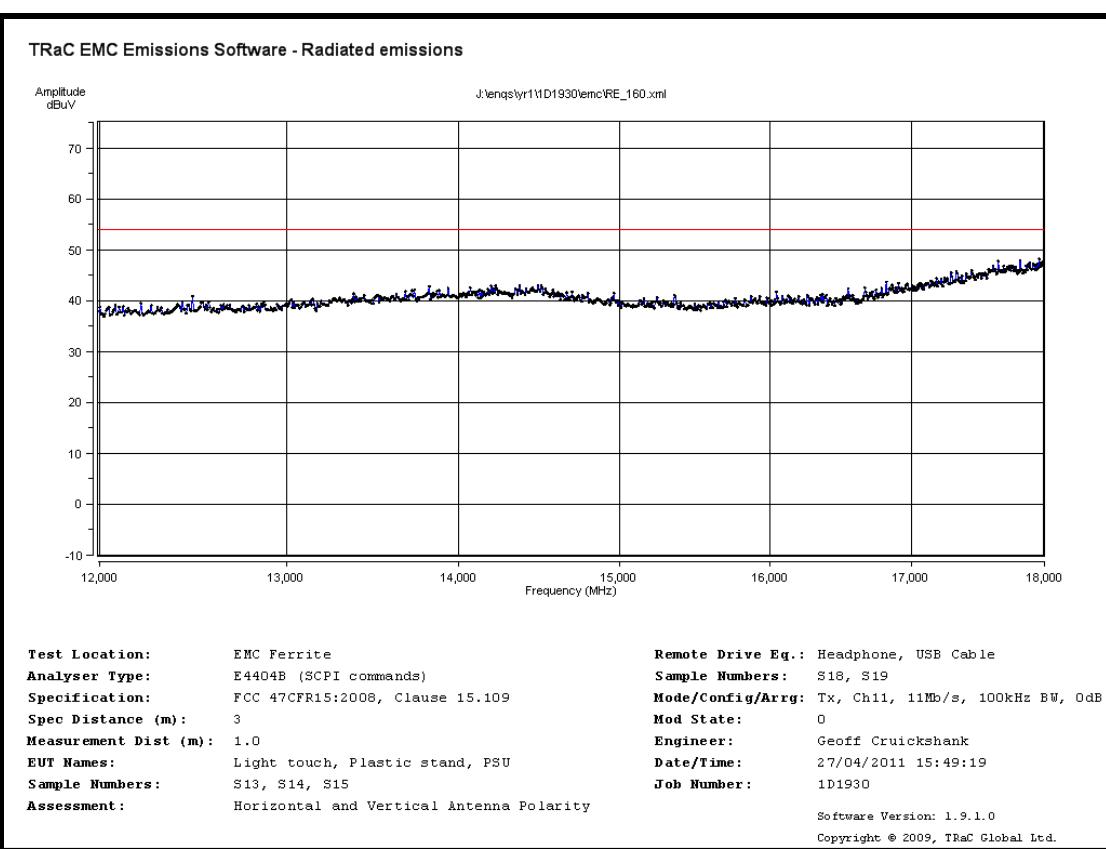
Radiated Spurious emissions 200 MHz to 1 GHz – 2462MHz – 11Mbps



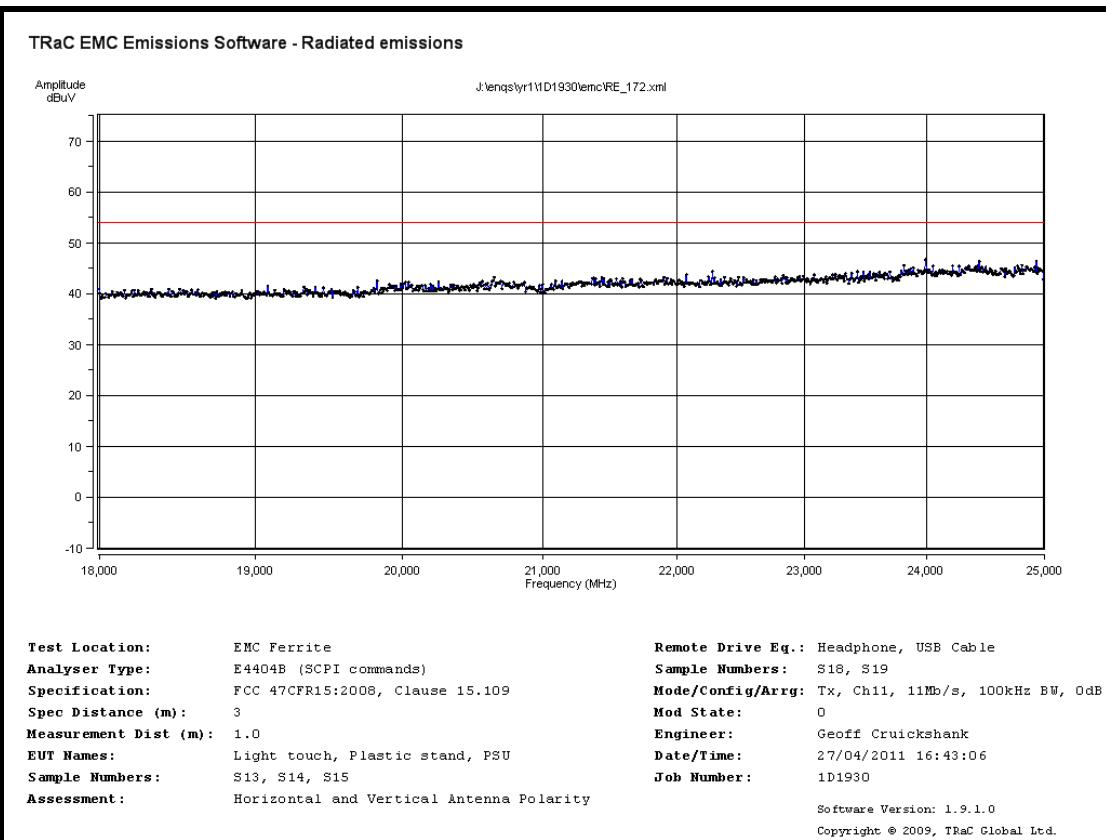
### Radiated Spurious emissions 1 GHz to 5 GHz – 2462MHz – 11Mbps



### Radiated Spurious emissions 5 GHz to 12 GHz – 2462MHz – 11Mbps

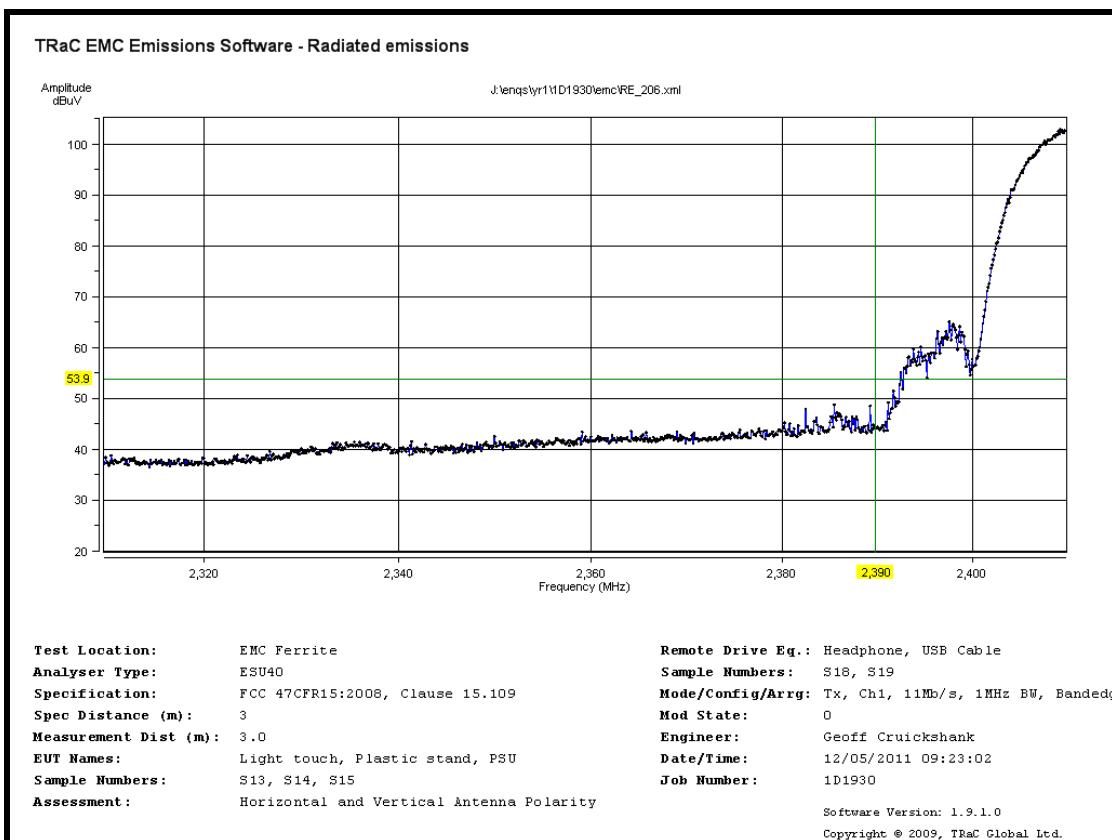


### Radiated Spurious emissions 12 GHz to 18 GHz – 2462MHz – 11Mbps

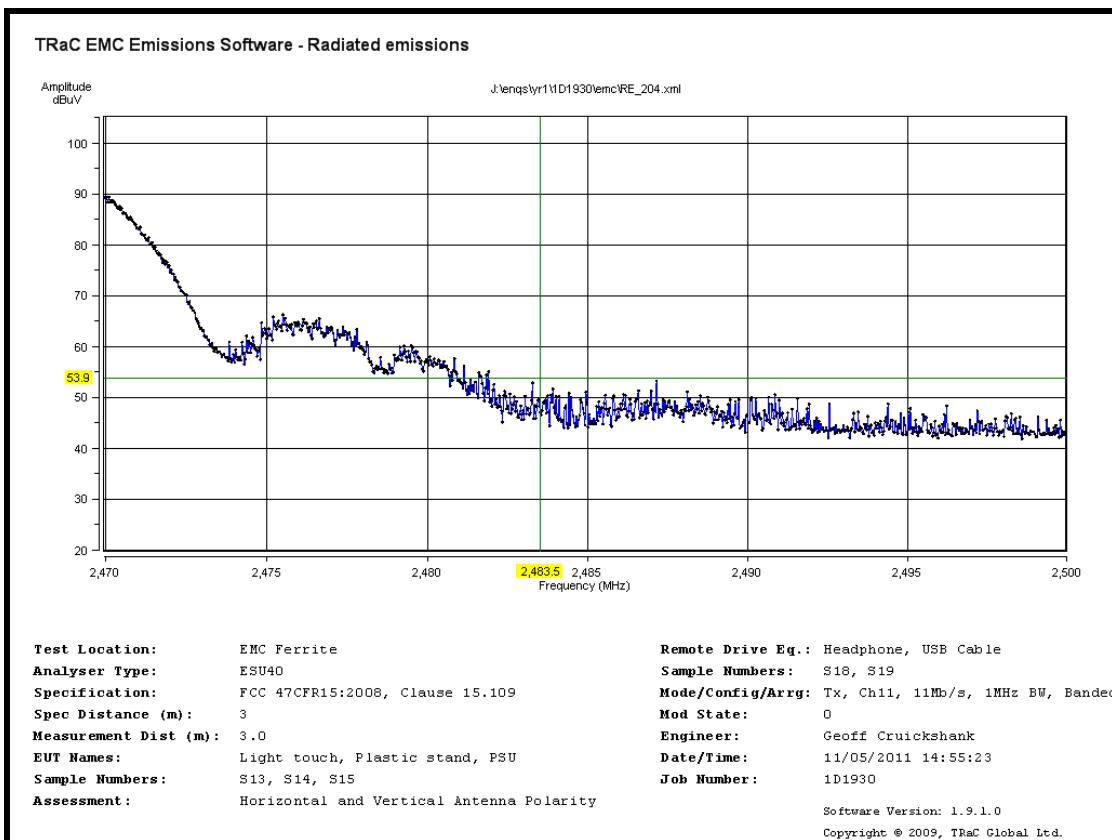


### Radiated Spurious emissions 18 GHz to 25 GHz – 2462MHz – 11Mbps

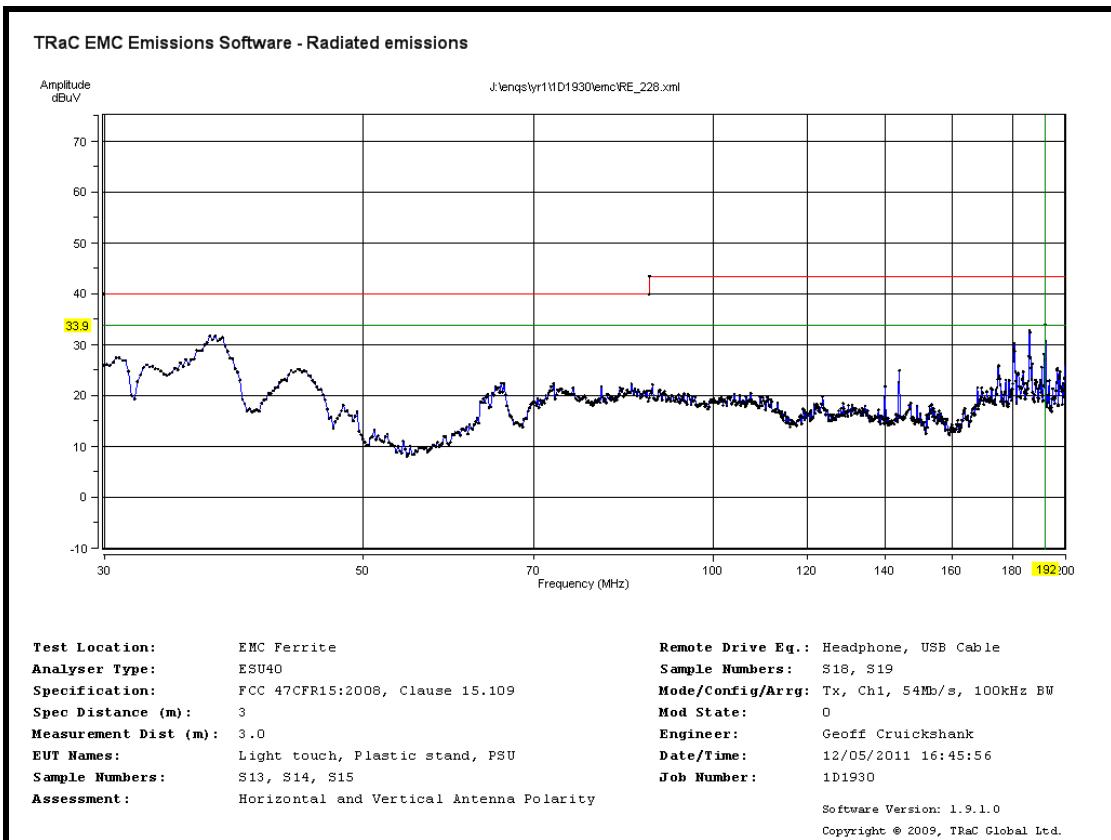
## Radiated Bandedge Compliance – Average plot to average limit in a 1MHz BW



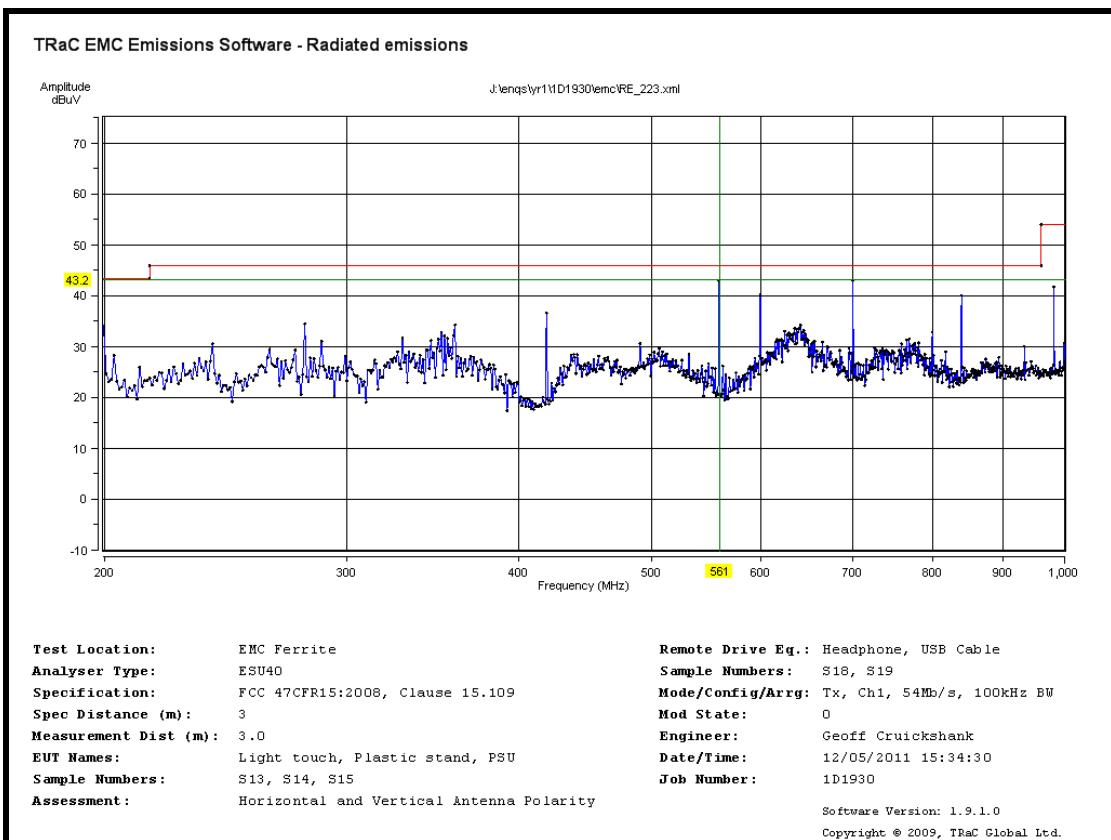
## Lower Bandedge



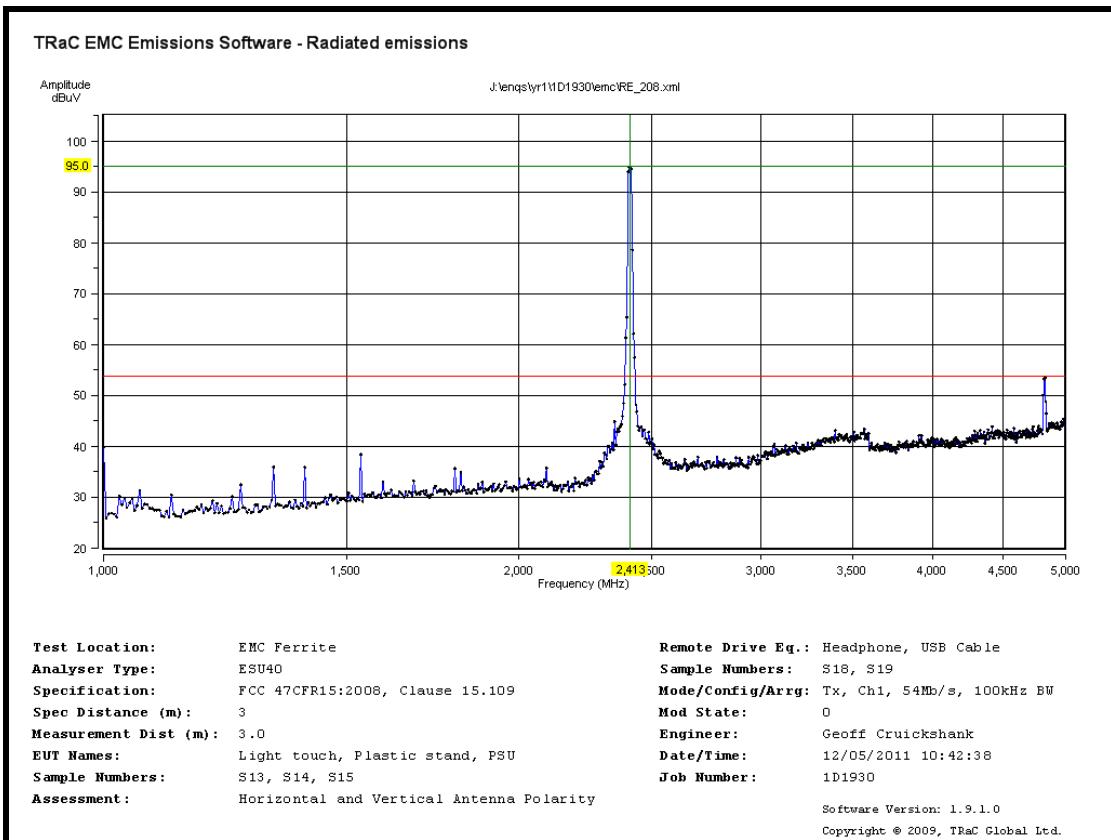
## Upper Bandedge



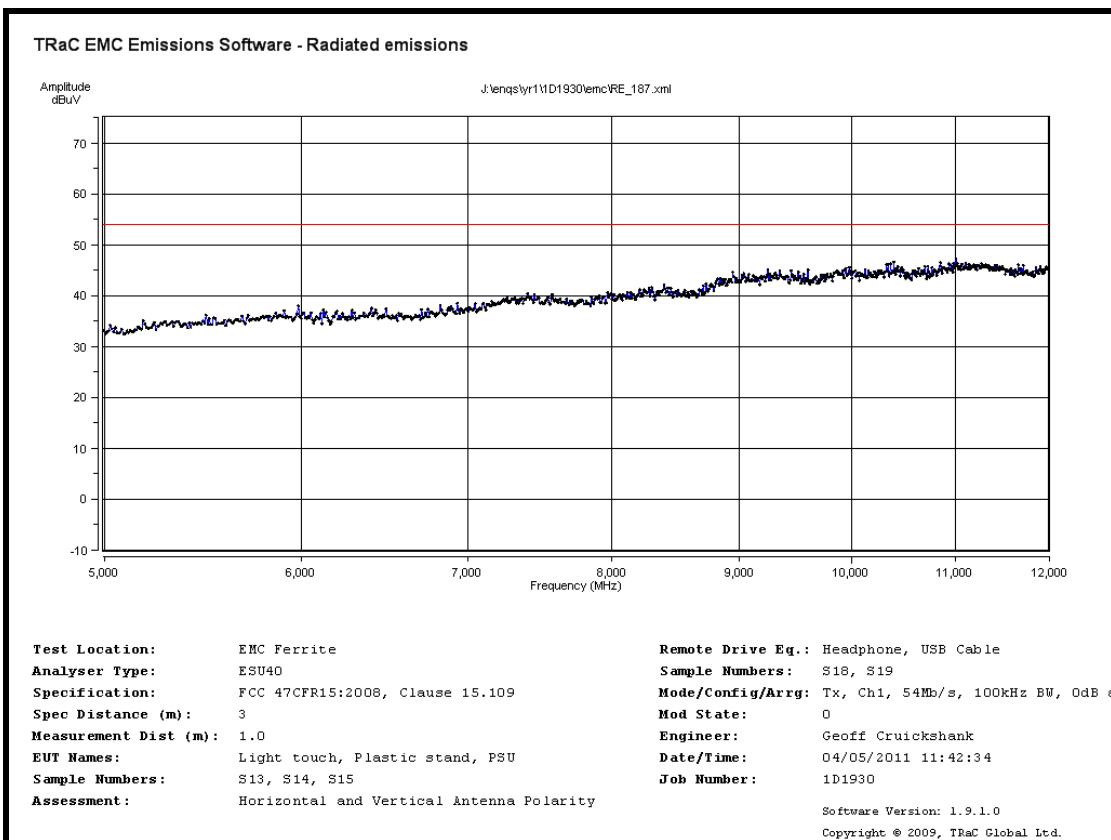
Radiated Spurious emissions 30 MHz to 200 MHz – 2412MHz – 54Mbps



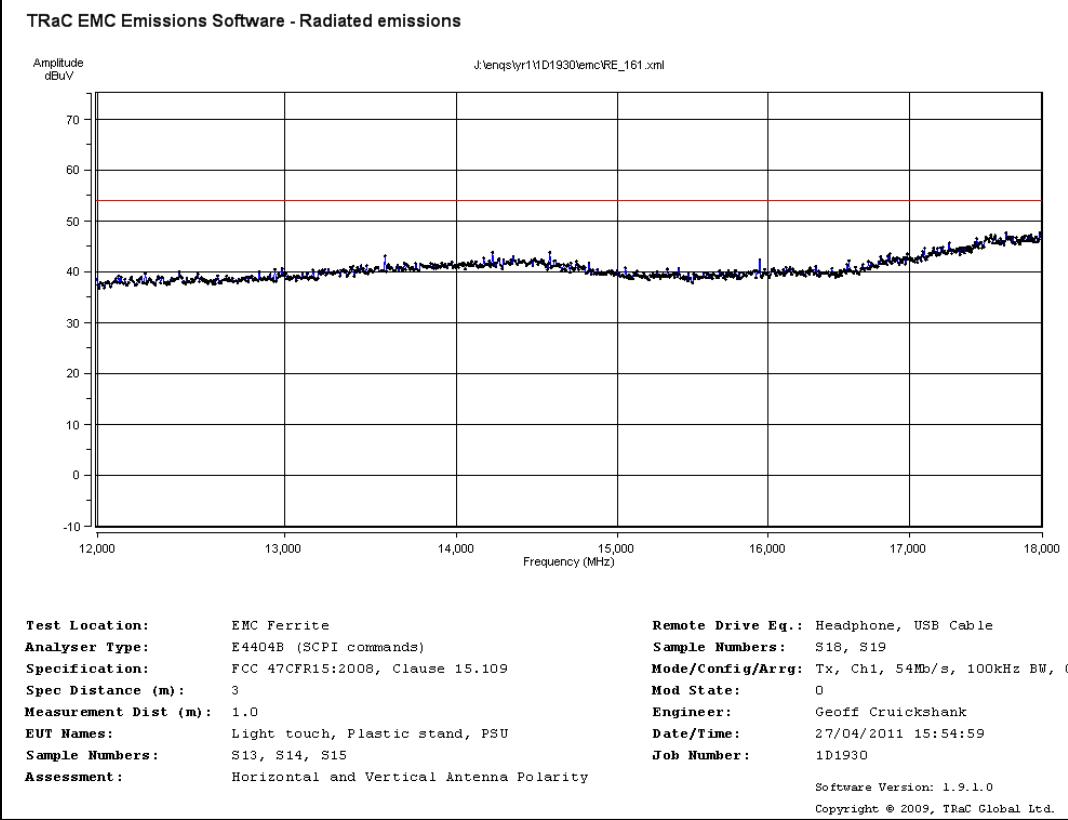
Radiated Spurious emissions 200 MHz to 1 GHz – 2412MHz – 54Mbps



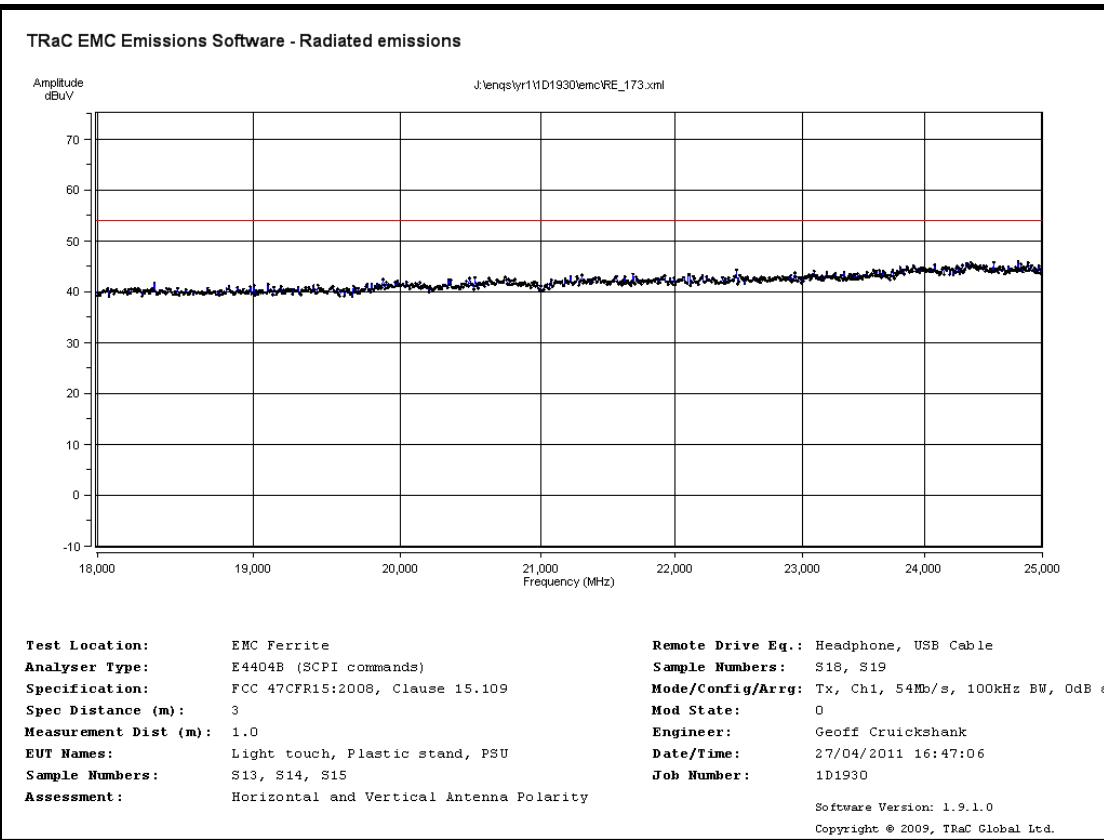
Radiated Spurious emissions 1 GHz to 5 GHz – 2412MHz – 54Mbps



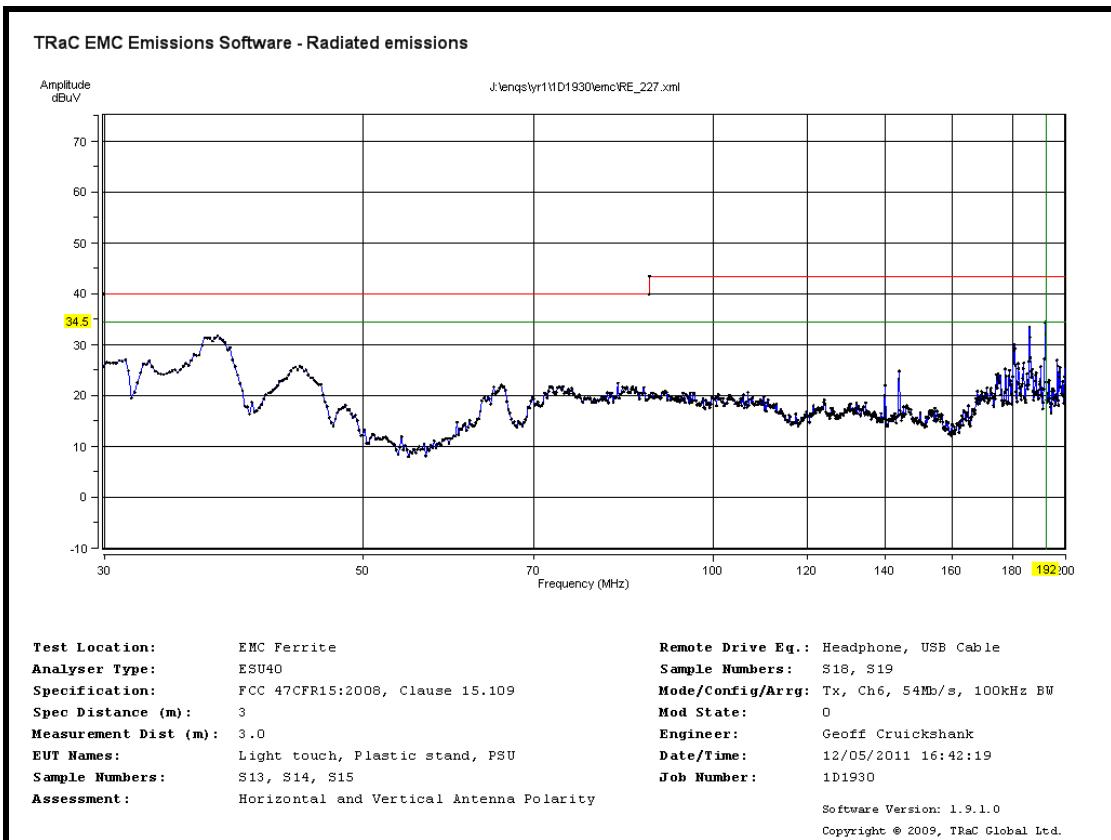
Radiated Spurious emissions 5 GHz to 12 GHz – 2412MHz – 54Mbps



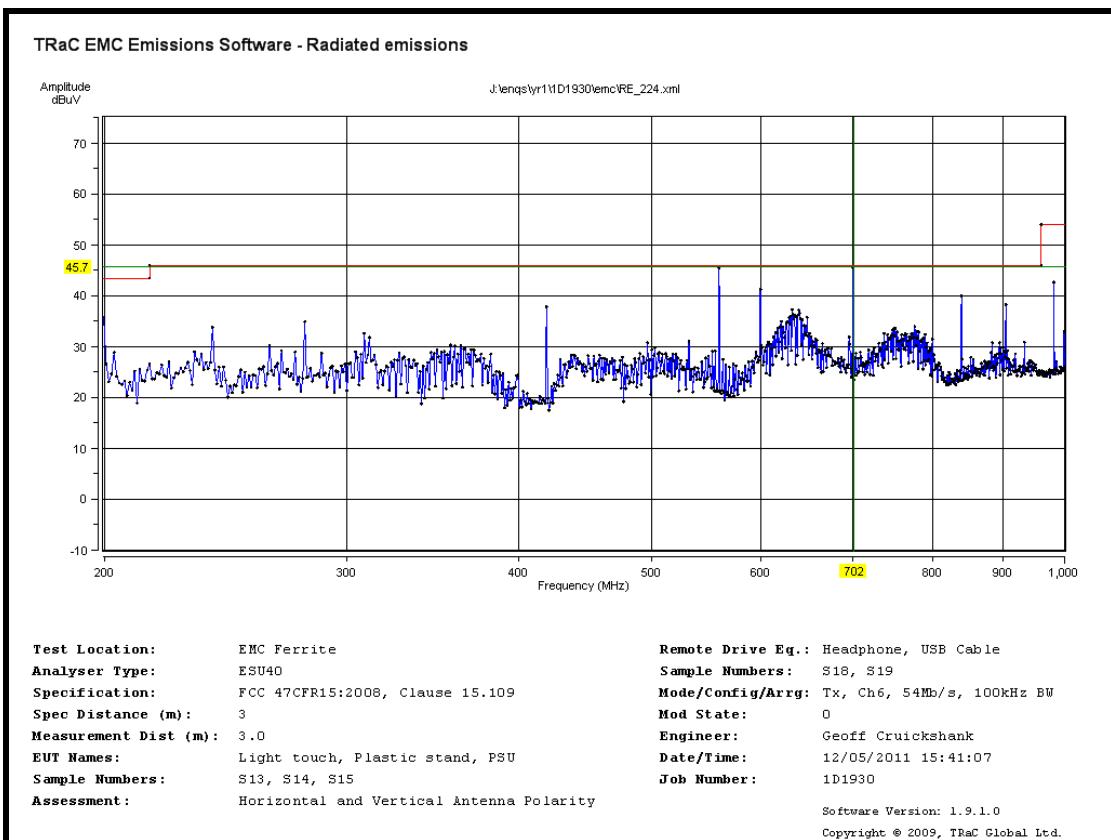
### Radiated Spurious emissions 12 GHz to 18 GHz – 2412MHz – 54Mbps



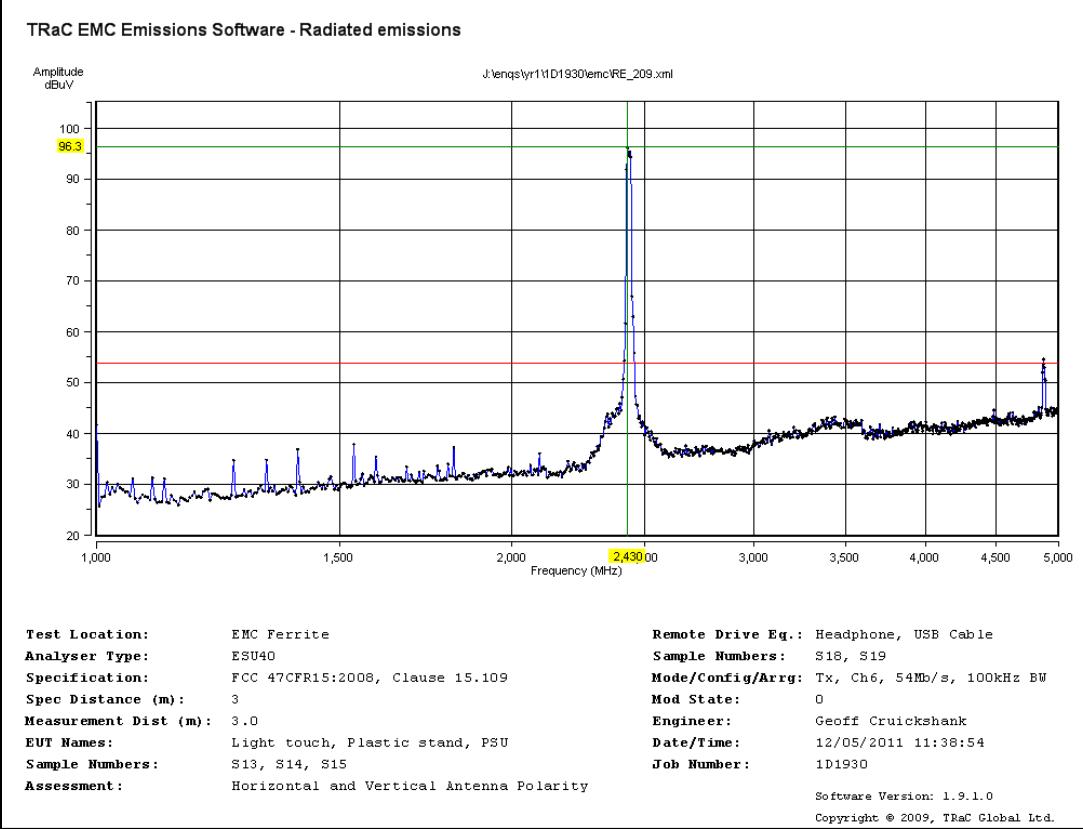
### Radiated Spurious emissions 18 GHz to 25 GHz – 2412MHz – 54Mbps



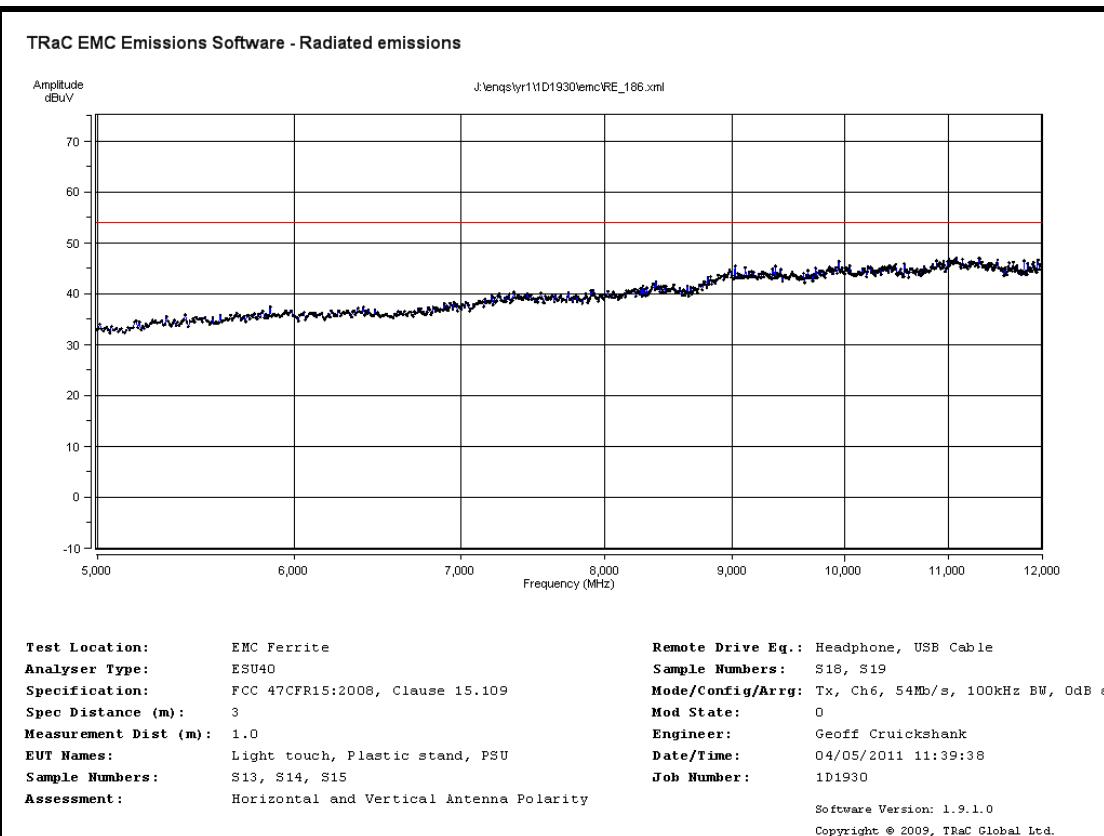
Radiated Spurious emissions 30 MHz to 200 MHz – 2437MHz – 54Mbps



Radiated Spurious emissions 200 MHz to 1 GHz – 2437MHz – 54Mbps

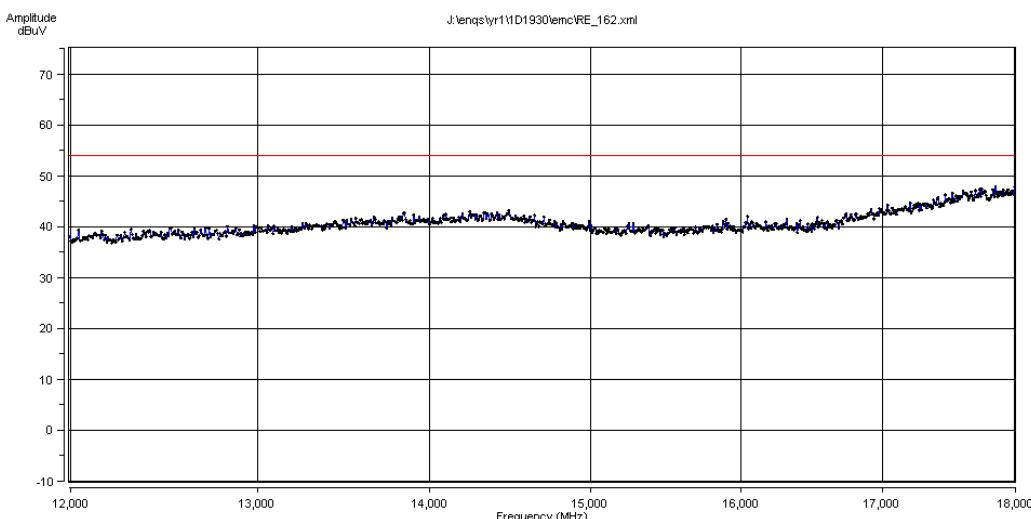


Radiated Spurious emissions 1 GHz to 5 GHz – 2437MHz – 54Mbps



Radiated Spurious emissions 5 GHz to 12 GHz – 2437MHz – 54Mbps

## TRaC EMC Emissions Software - Radiated emissions

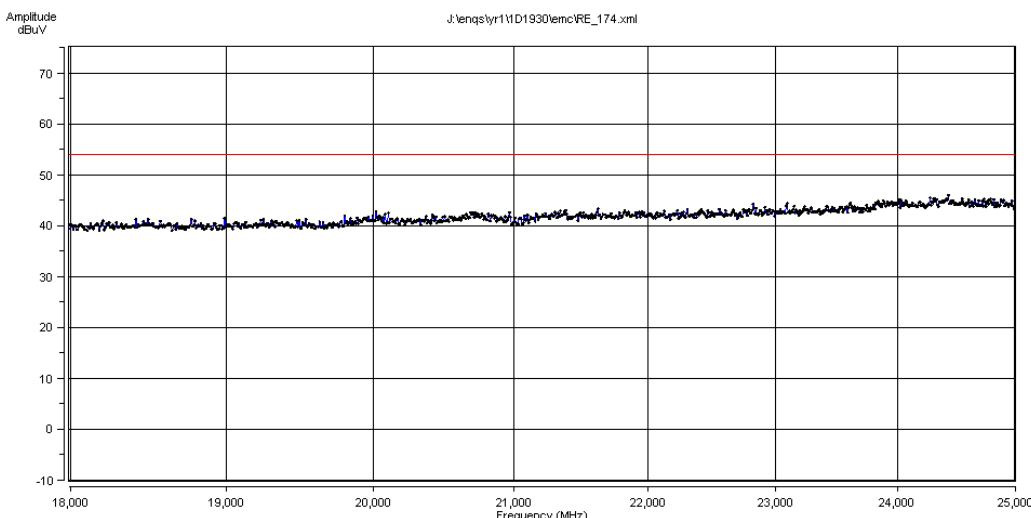


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, Plastic stand, PSU  
**Sample Numbers:** S13, S14, S15  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphone, USB Cable  
**Sample Numbers:** S18, S19  
**Mode/Config/Arrg:** Tx, Ch6, 54Mb/s, 100kHz BW, 0dB a  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 15:57:16  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

## Radiated Spurious emissions 12 GHz to 18 GHz – 2437MHz – 54Mbps

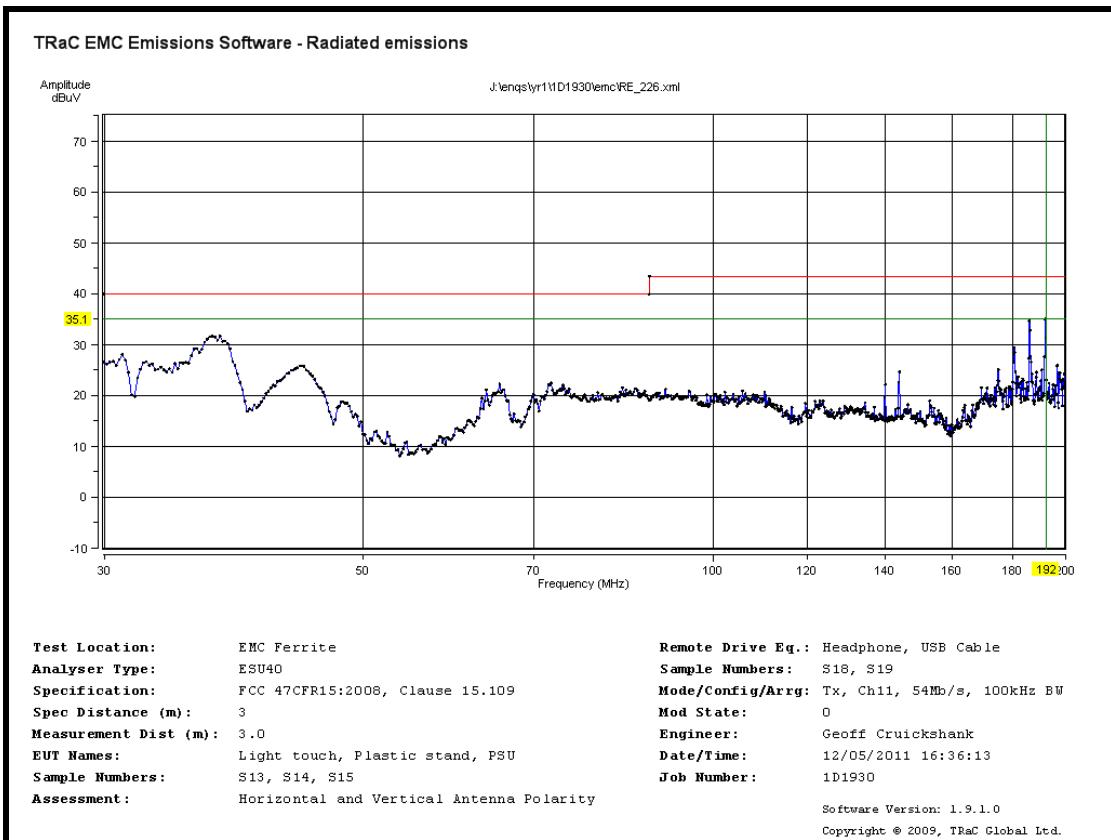
## TRaC EMC Emissions Software - Radiated emissions



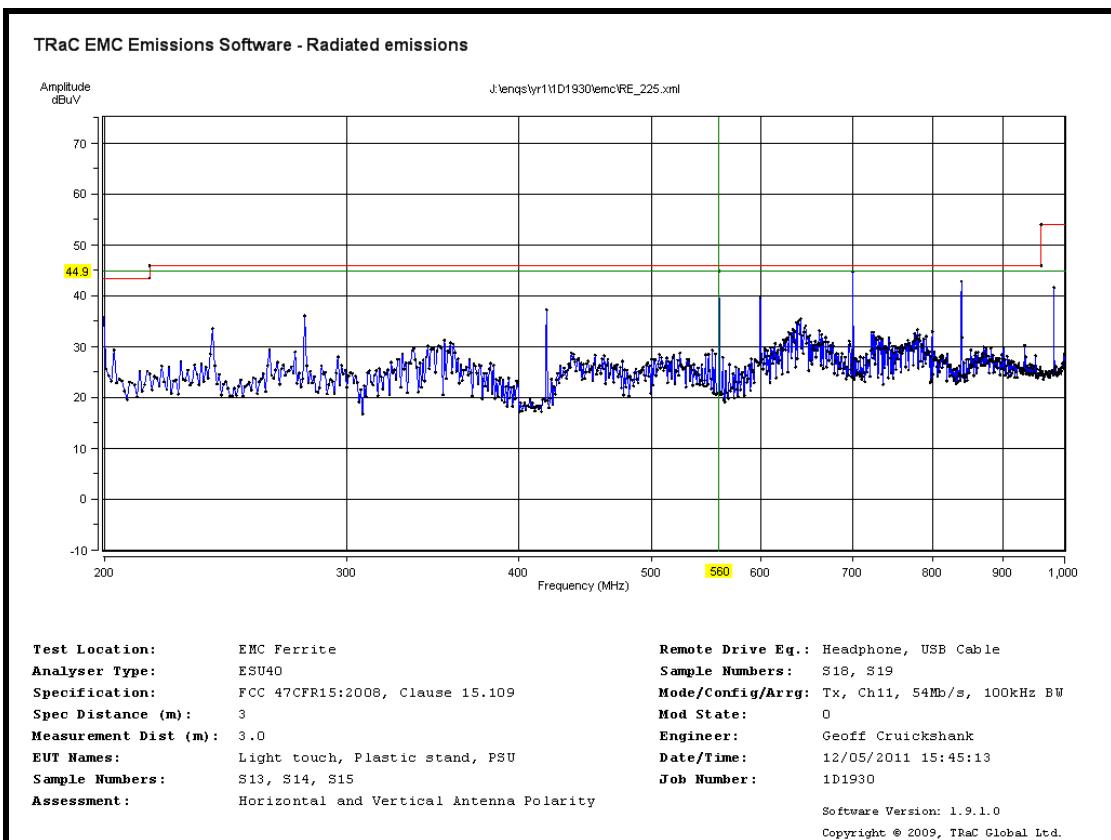
**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, Plastic stand, PSU  
**Sample Numbers:** S13, S14, S15  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphone, USB Cable  
**Sample Numbers:** S18, S19  
**Mode/Config/Arrg:** Tx, Ch6, 54Mb/s, 100kHz BW, 0dB a  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 16:49:12  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

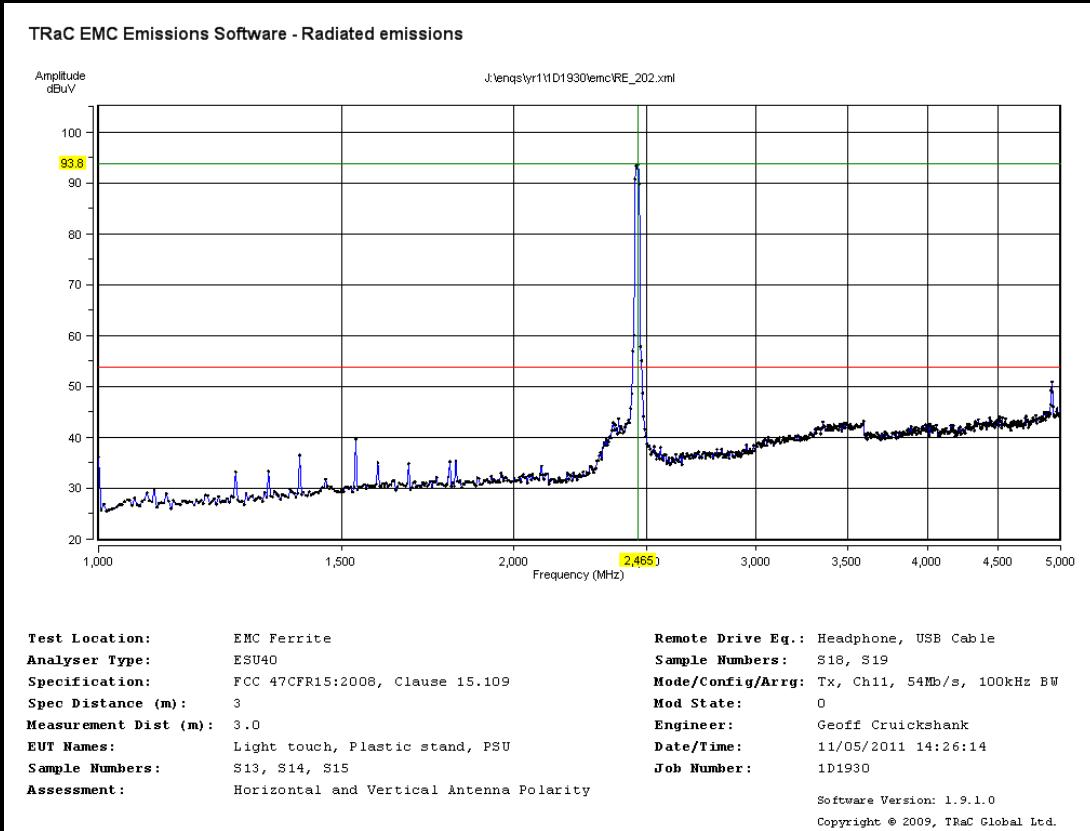
## Radiated Spurious emissions 18 GHz to 25 GHz – 2437MHz – 54Mbps



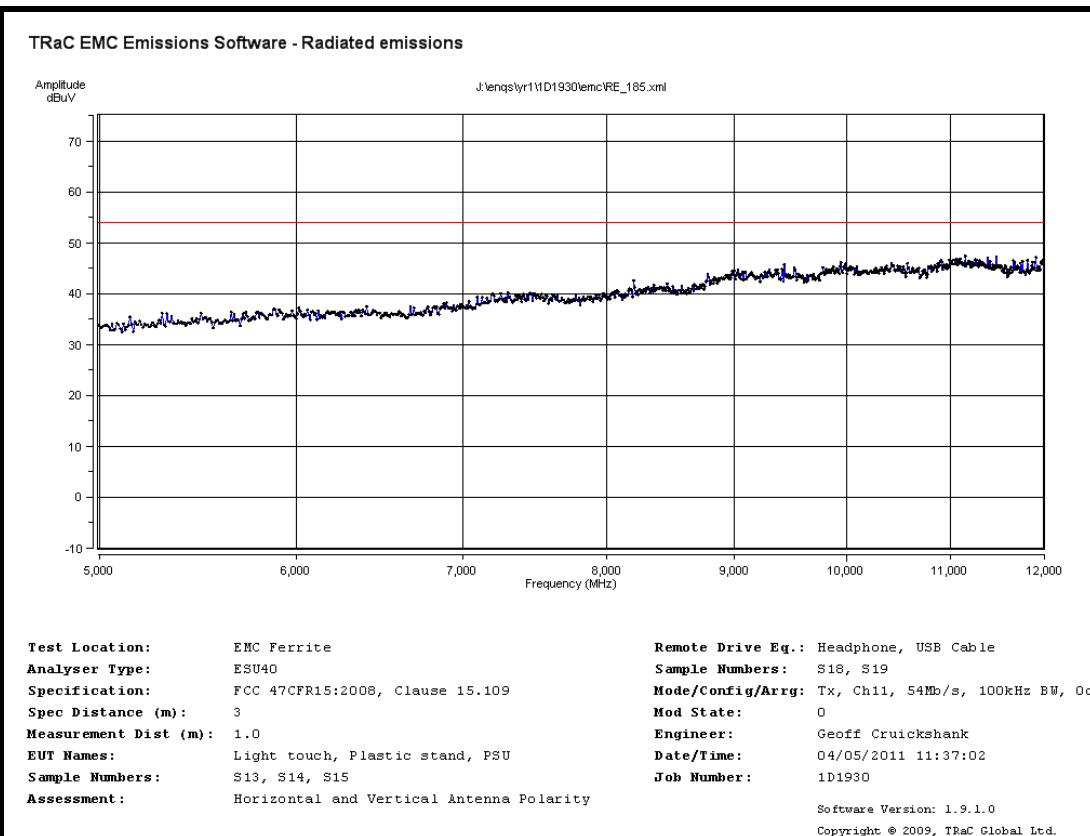
Radiated Spurious emissions 30 MHz to 200 MHz – 2462MHz – 54Mbps



Radiated Spurious emissions 200 MHz to 1 GHz – 2462MHz – 54Mbps

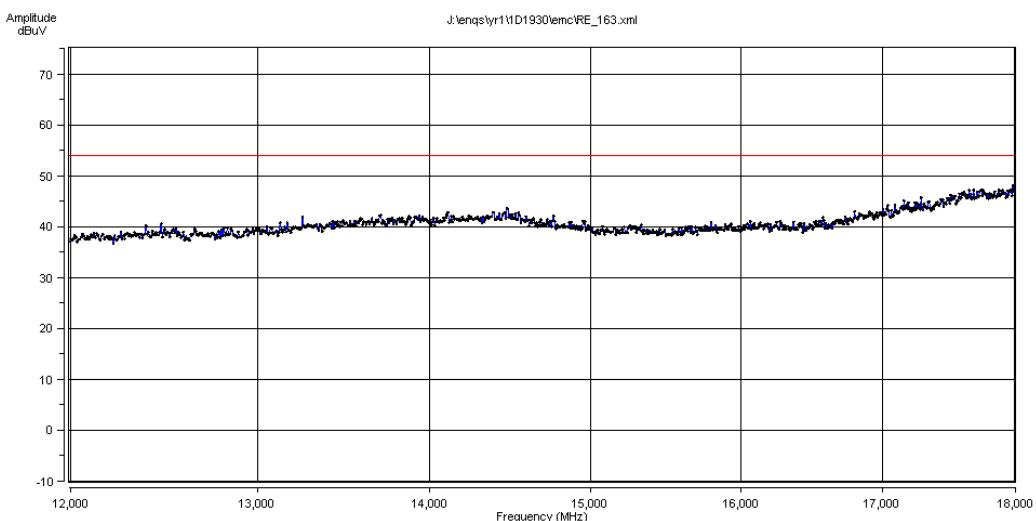


Radiated Spurious emissions 1 GHz to 5 GHz – 2462MHz – 54Mbps



Radiated Spurious emissions 5 GHz to 12 GHz – 2462MHz – 54Mbps

## TRaC EMC Emissions Software - Radiated emissions

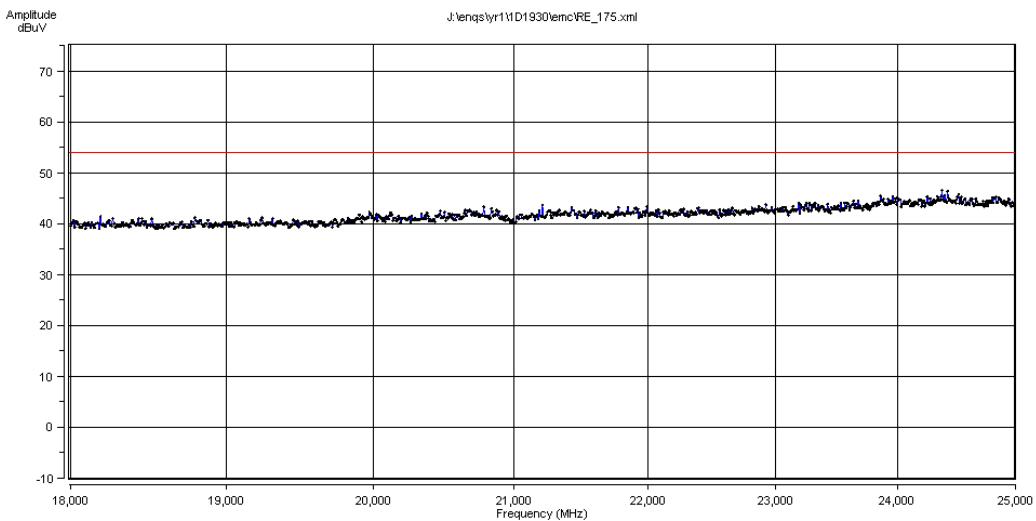


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, Plastic stand, PSU  
**Sample Numbers:** S13, S14, S15  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphone, USB Cable  
**Sample Numbers:** S18, S19  
**Mode/Config/Arrg:** Tx, Ch11, 54Mb/s, 100kHz BW, 0dB  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 15:59:47  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

## Radiated Spurious emissions 12 GHz to 18 GHz – 2462MHz – 54Mbps

## TRaC EMC Emissions Software - Radiated emissions

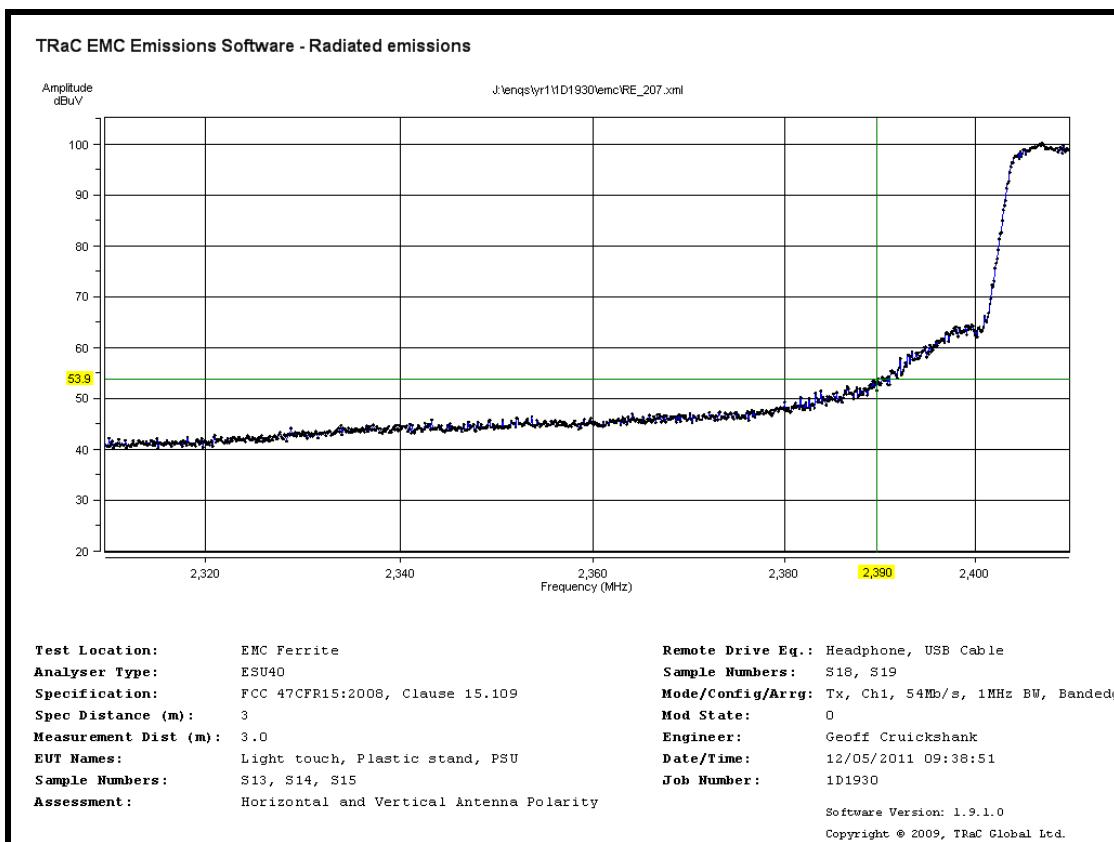


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, Plastic stand, PSU  
**Sample Numbers:** S13, S14, S15  
**Assessment:** Horizontal and Vertical Antenna Polarity

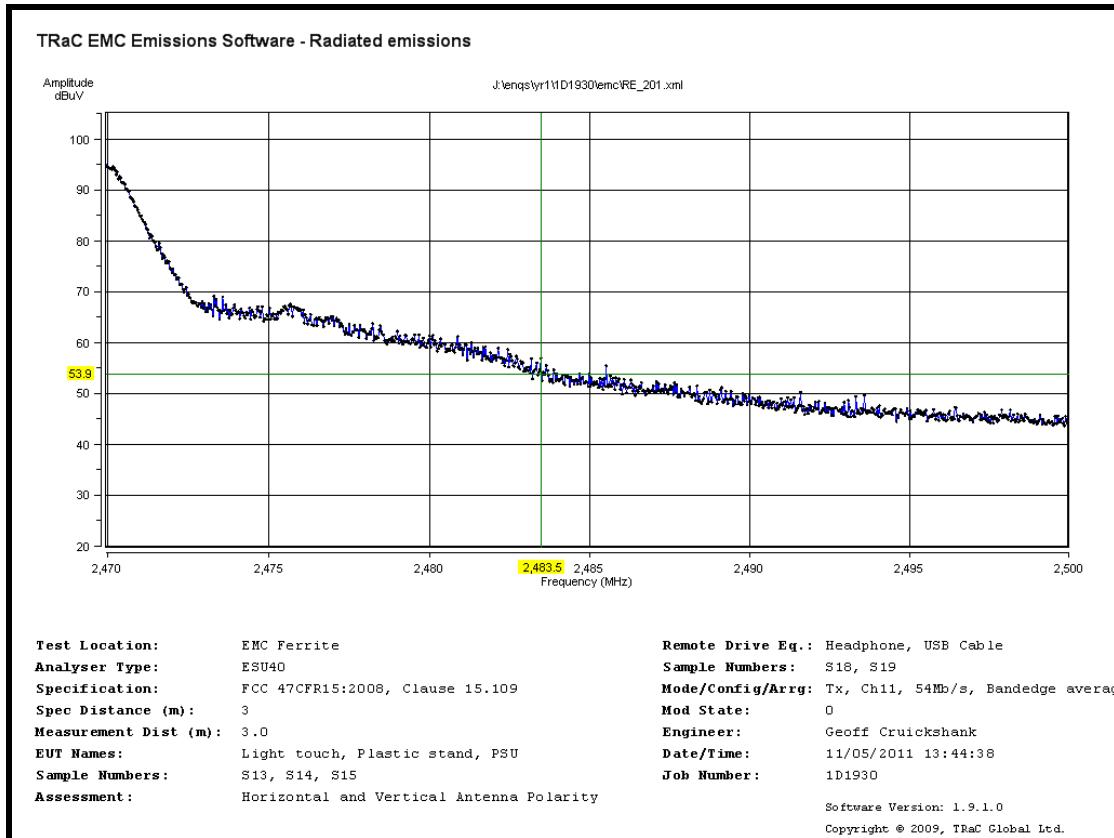
**Remote Drive Eg.:** Headphone, USB Cable  
**Sample Numbers:** S18, S19  
**Mode/Config/Arrg:** Tx, Ch11, 54Mb/s, 100kHz BW, 0dB  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 16:51:21  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

## Radiated Spurious emissions 18 GHz to 25 GHz – 2462MHz – 54Mbps

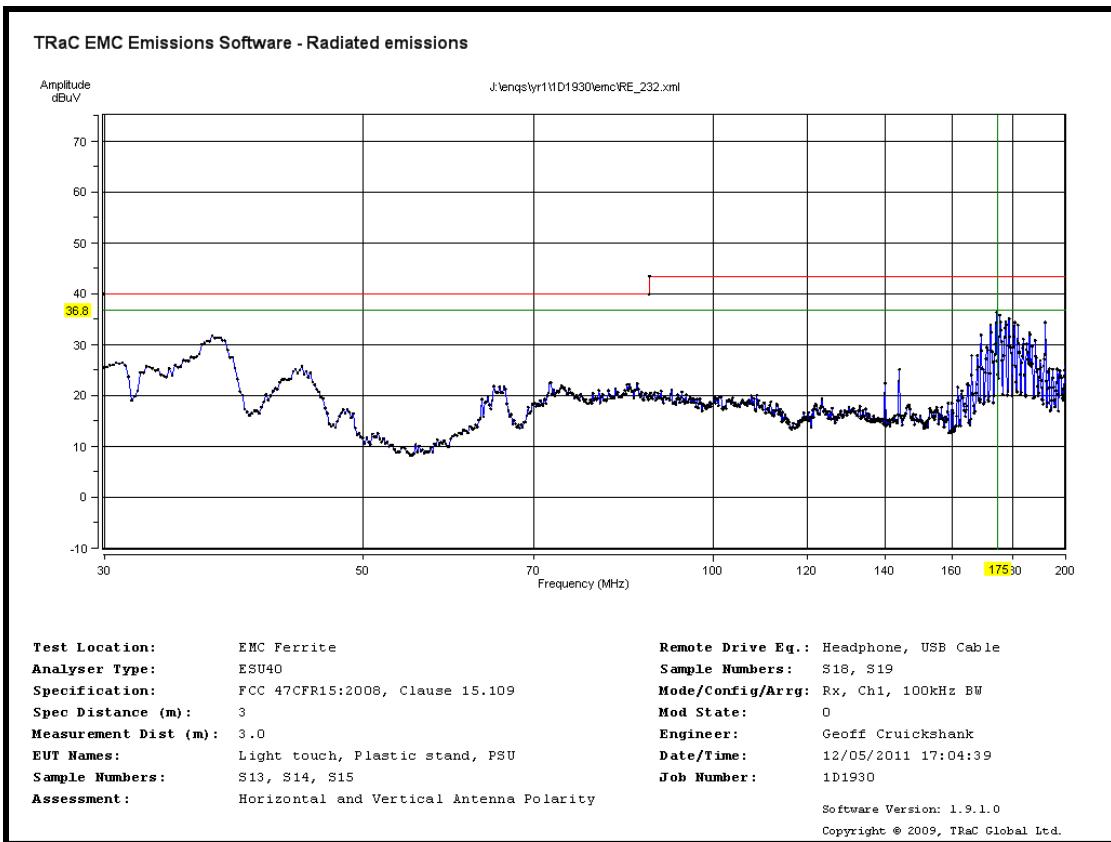
## Radiated Bandedge Compliance – Average plot to average limit



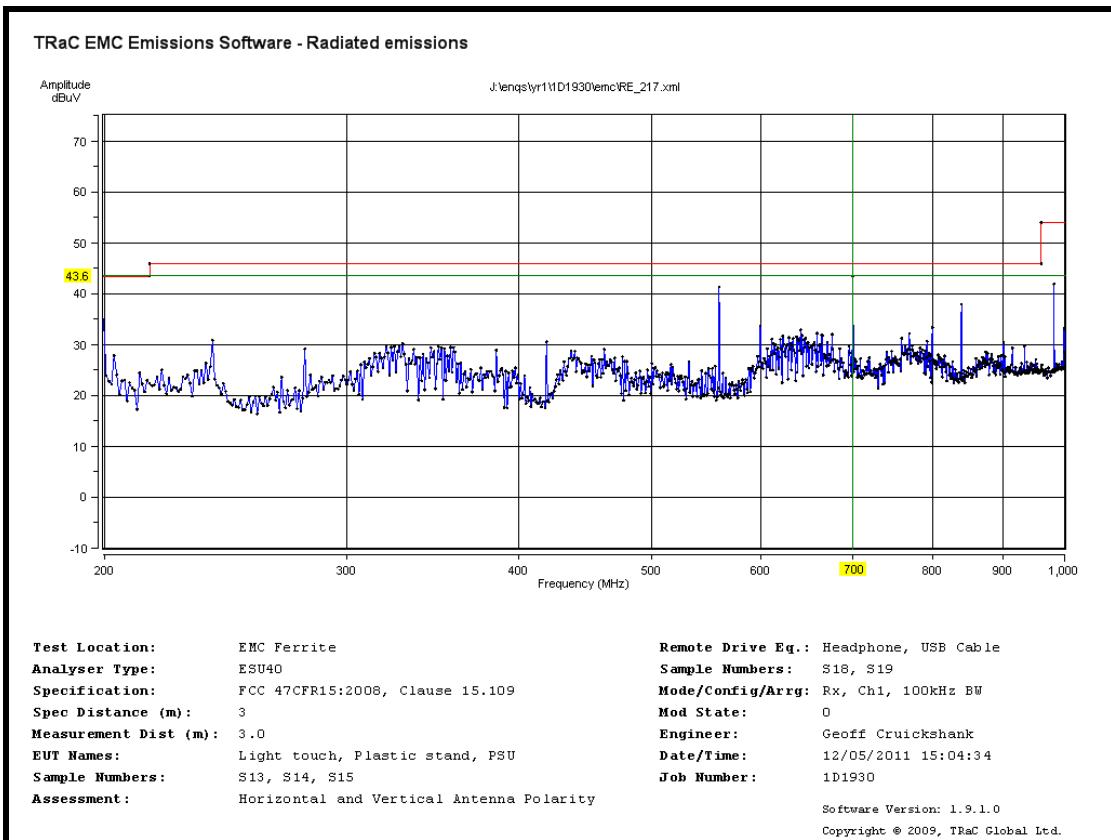
## Lower Bandedge



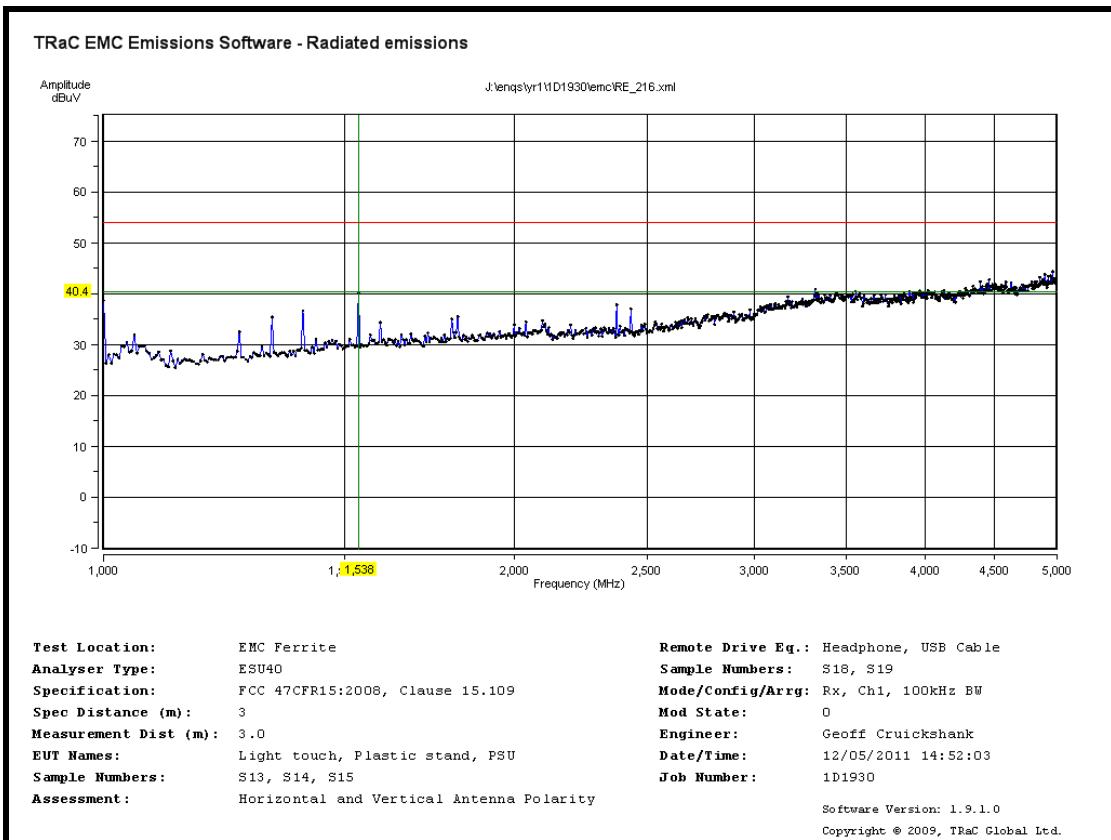
## Upper Bandedge



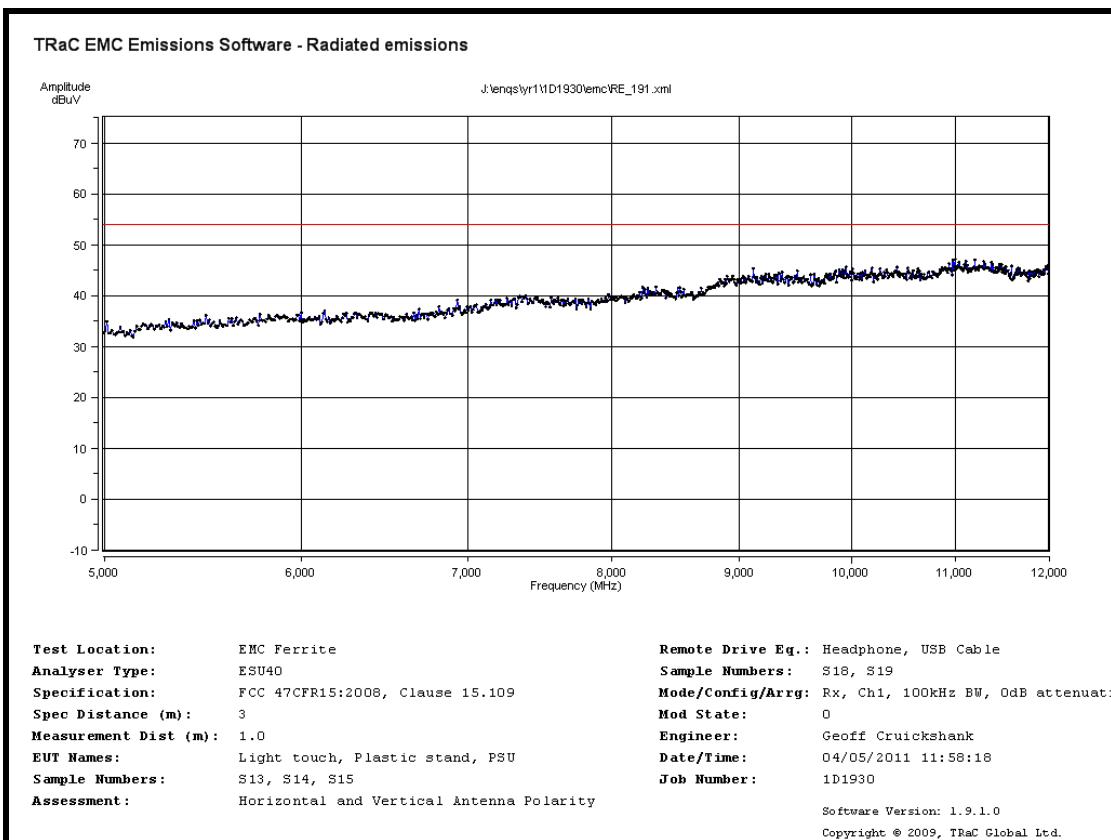
### Unintentional Radiated Spurious emissions 30 MHz to 200 MHz – 2412MHz



### Unintentional Radiated Spurious emissions 200 MHz to 1 GHz – 2412MHz

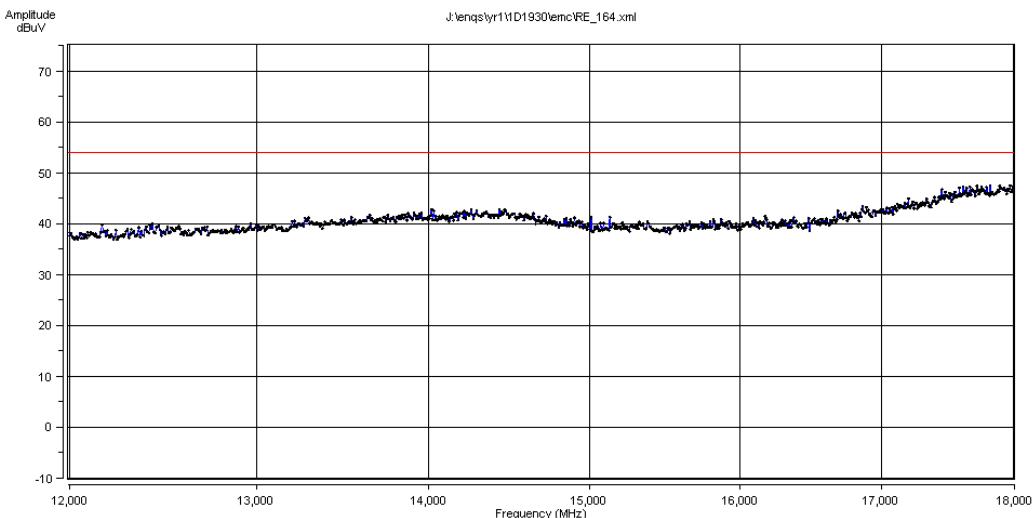


### Unintentional Radiated Spurious emissions 1 GHz to 5 GHz – 2412MHz



### Unintentional Radiated Spurious emissions 5 GHz to 12 GHz – 2412MHz

## TRaC EMC Emissions Software - Radiated emissions

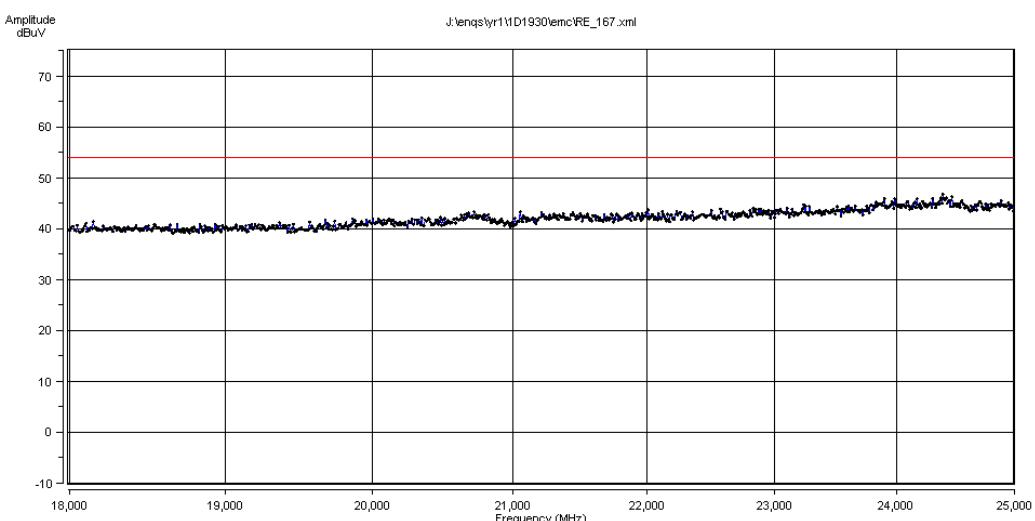


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, Plastic stand, PSU  
**Sample Numbers:** S13, S14, S15  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphone, USB Cable  
**Sample Numbers:** S18, S19  
**Mode/Config/Arrg:** Rx, Ch1, 100kHz BW, 0dB attenuati  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 16:04:17  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

## Unintentional Radiated Spurious emissions 12 GHz to 18 GHz – 2412MHz

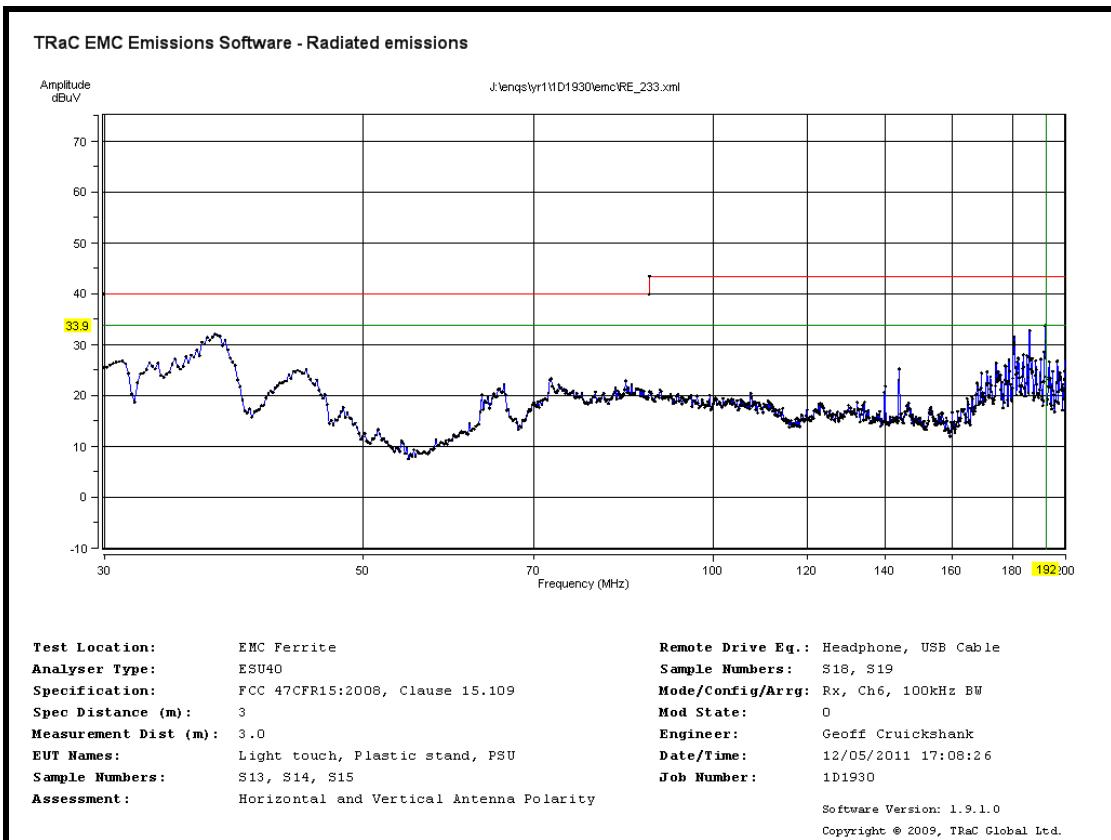
## TRaC EMC Emissions Software - Radiated emissions



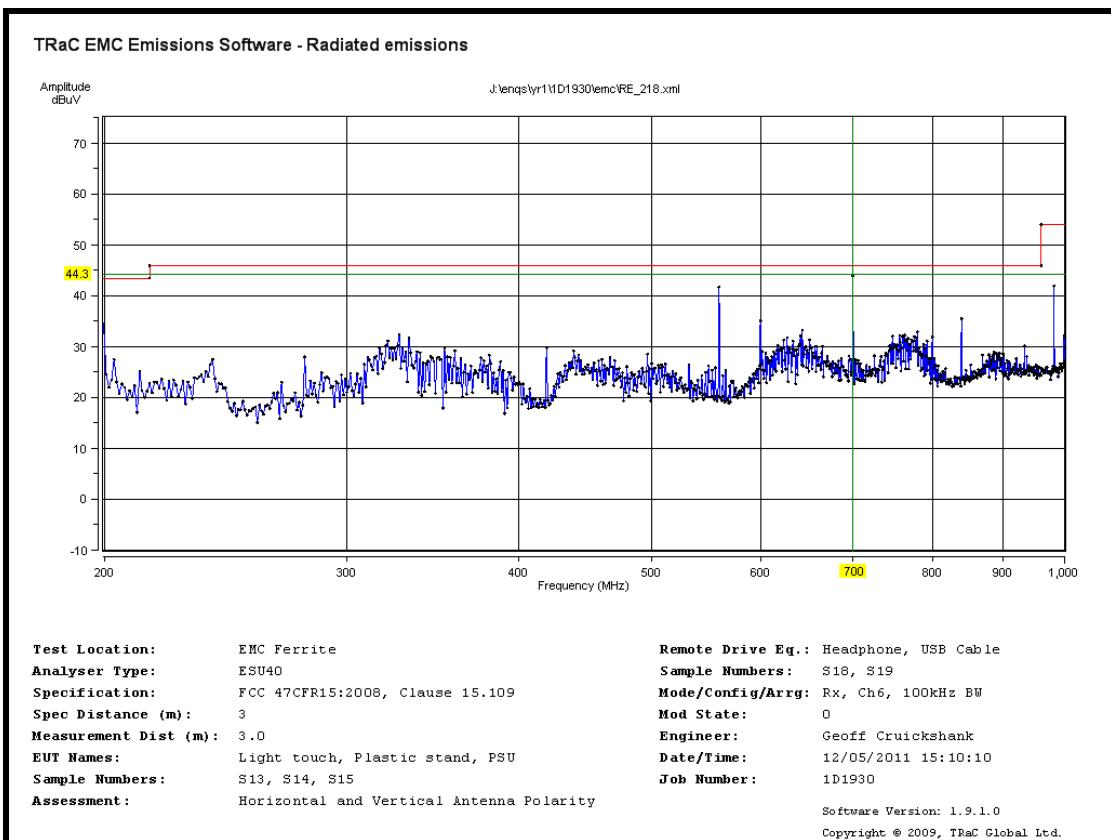
**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, Plastic stand, PSU  
**Sample Numbers:** S13, S14, S15  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphone, USB Cable  
**Sample Numbers:** S18, S19  
**Mode/Config/Arrg:** Rx, Ch1, 100kHz BW, 0dB attenuati  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 16:30:01  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

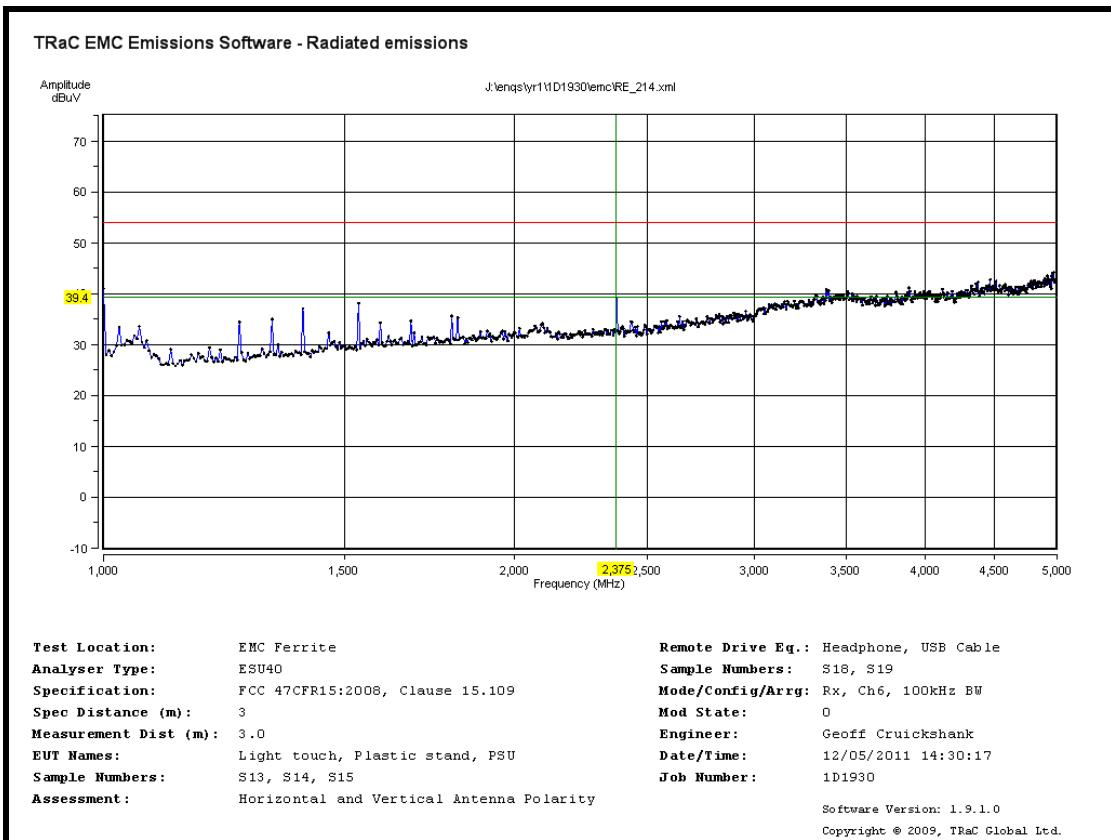
## Unintentional Radiated Spurious emissions 18 GHz to 25 GHz – 2412MHz



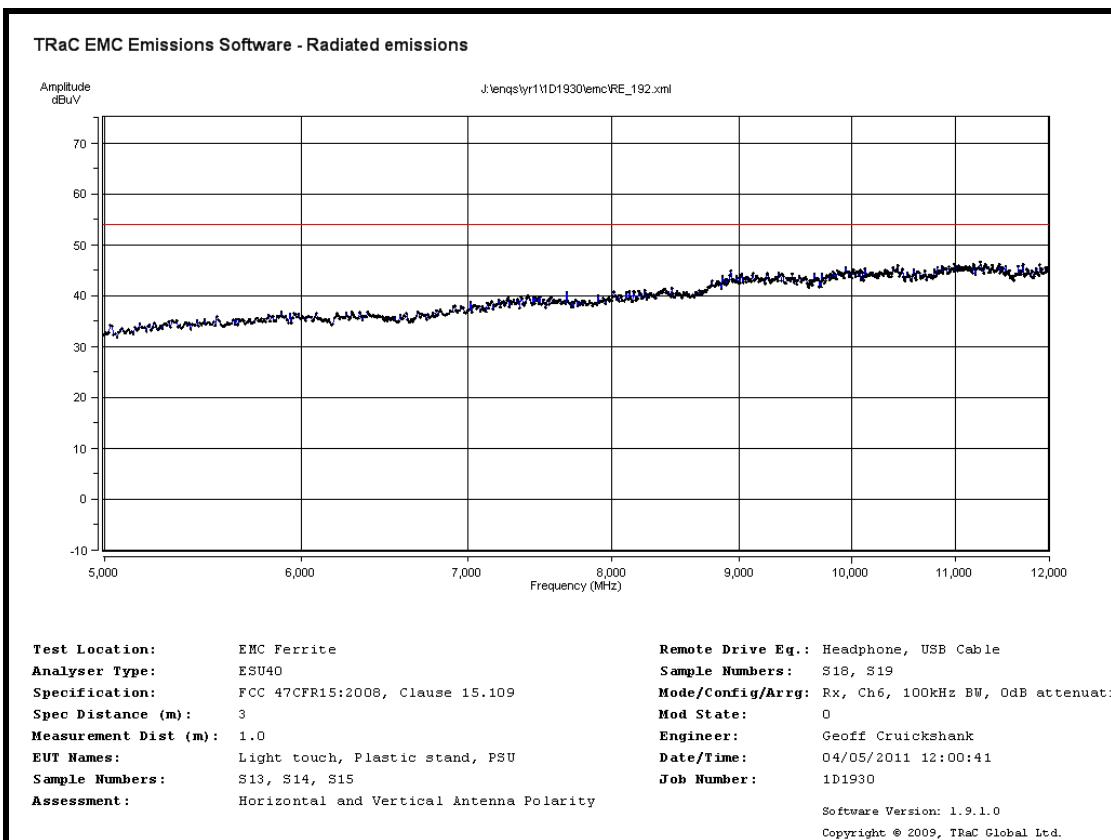
### Unintentional Radiated Spurious emissions 30 MHz to 200 MHz – 2437MHz



### Unintentional Radiated Spurious emissions 200 MHz to 1 GHz – 2437MHz

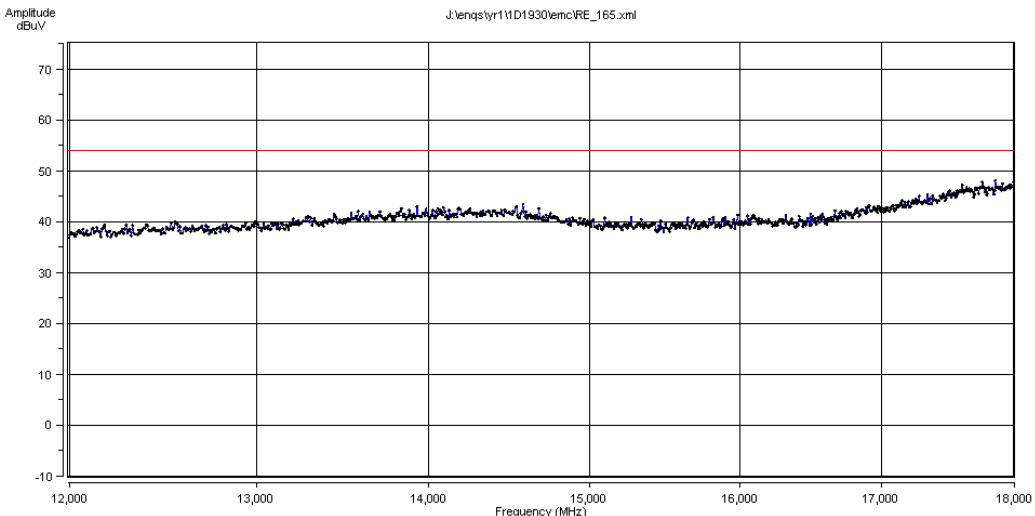


### Unintentional Radiated Spurious emissions 1 GHz to 5 GHz – 2437MHz



### Unintentional Radiated Spurious emissions 5 GHz to 12 GHz – 2437MHz

## TRaC EMC Emissions Software - Radiated emissions

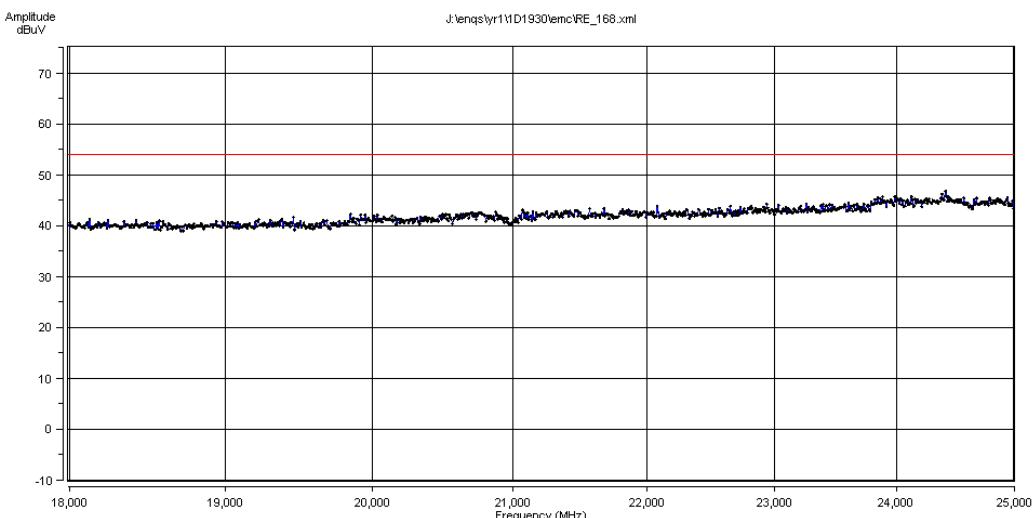


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, Plastic stand, PSU  
**Sample Numbers:** S13, S14, S15  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphone, USB Cable  
**Sample Numbers:** S18, S19  
**Mode/Config/Arrg:** Rx, Ch6, 100kHz BW, 0dB attenuati  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 16:07:02  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

## Unintentional Radiated Spurious emissions 12 GHz to 18 GHz – 2437MHz

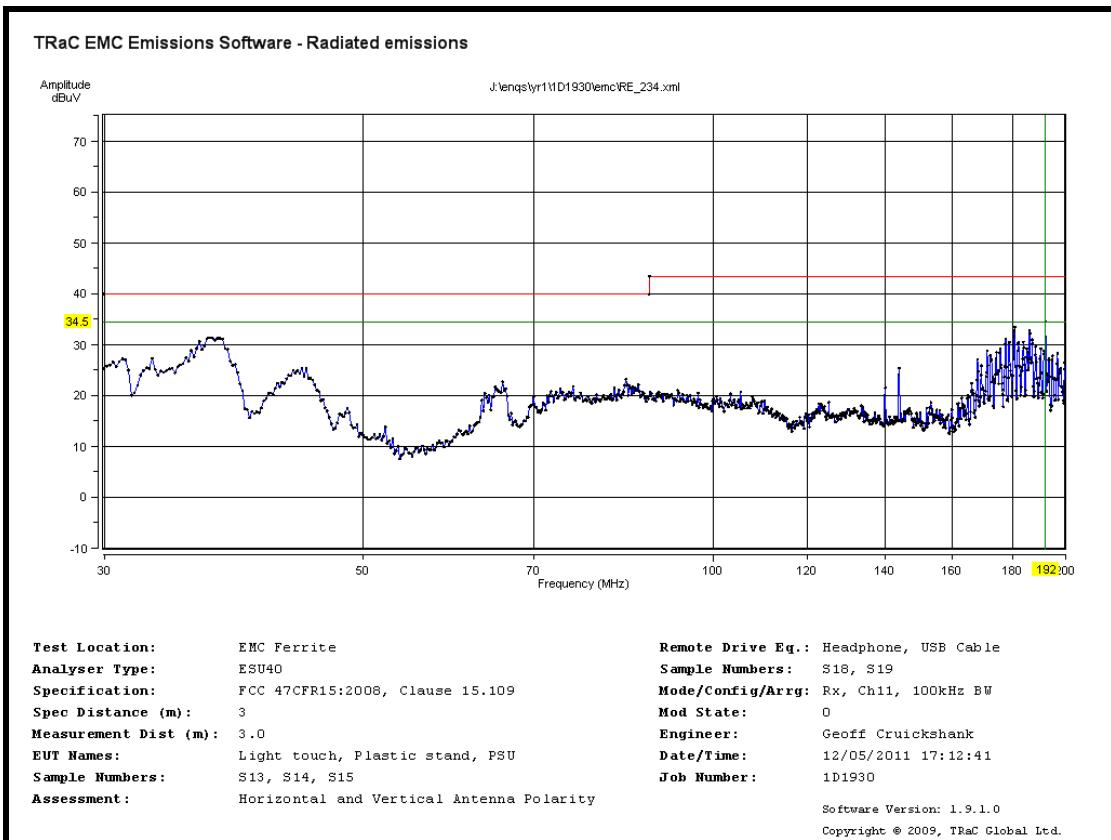
## TRaC EMC Emissions Software - Radiated emissions



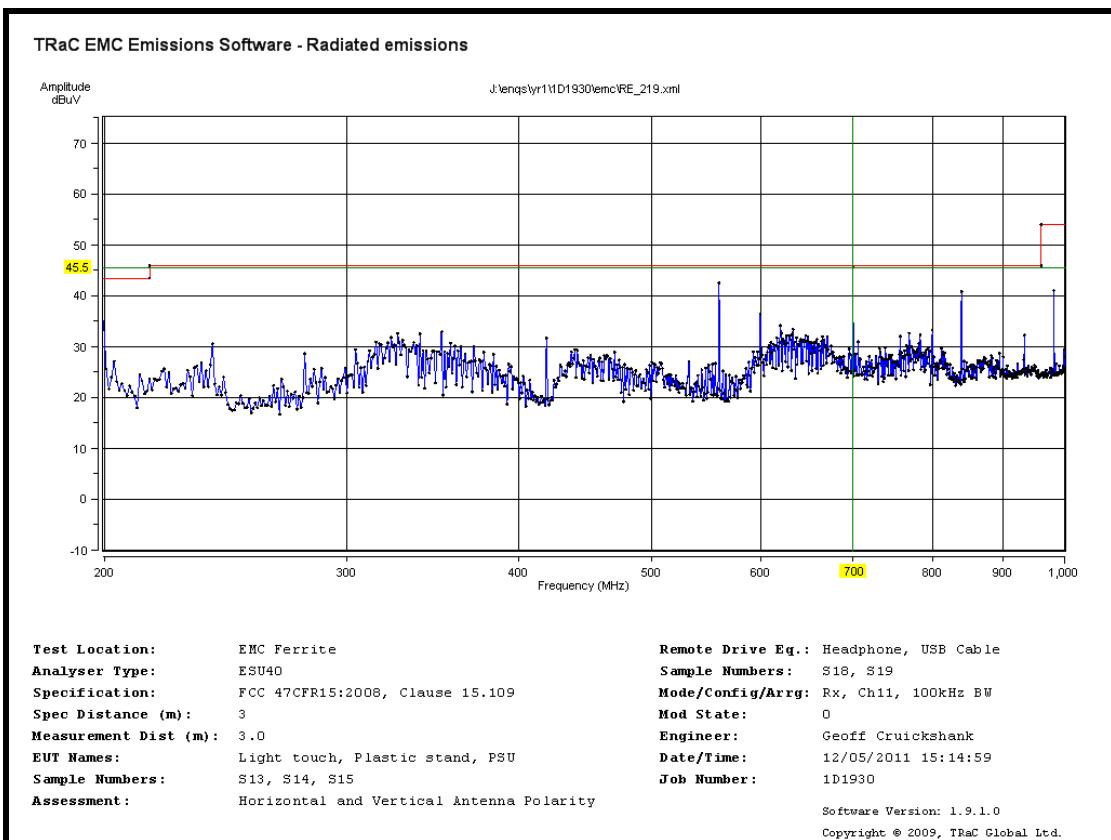
**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, Plastic stand, PSU  
**Sample Numbers:** S13, S14, S15  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphone, USB Cable  
**Sample Numbers:** S18, S19  
**Mode/Config/Arrg:** Rx, Ch6, 100kHz BW, 0dB attenuati  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 16:32:04  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

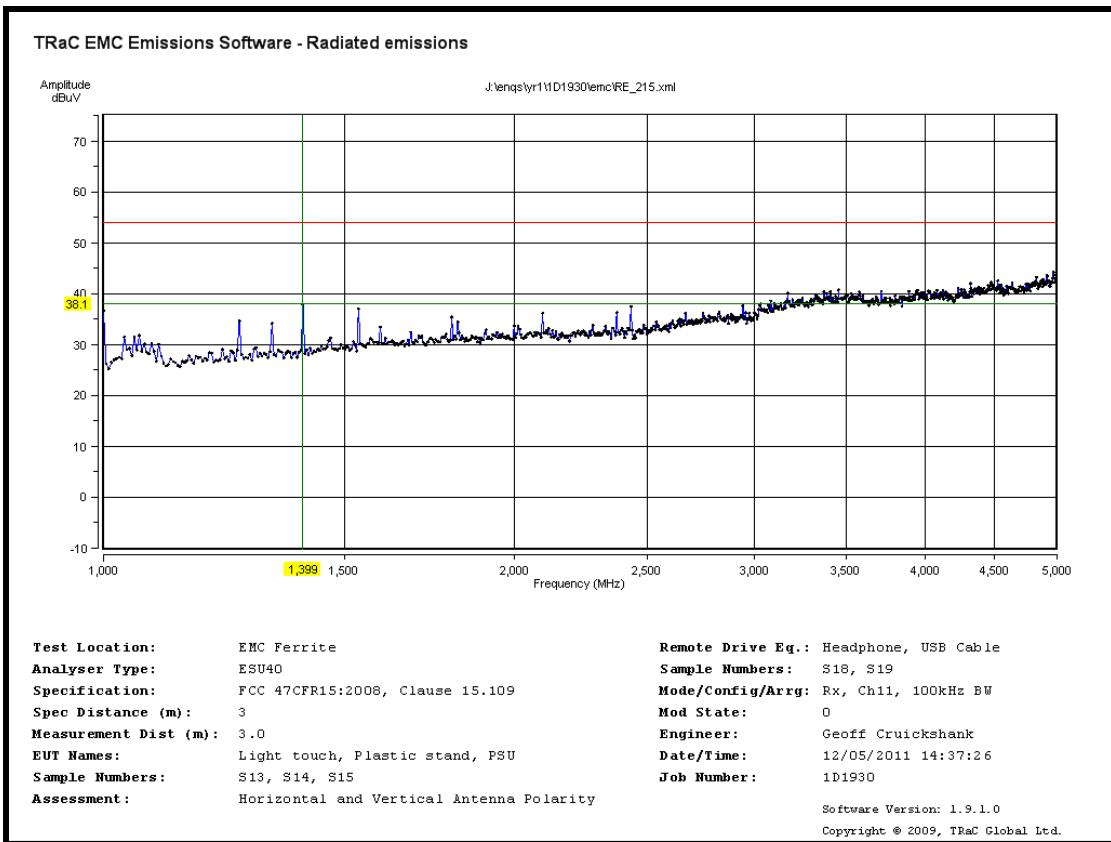
## Unintentional Radiated Spurious emissions 18 GHz to 25 GHz – 2437MHz



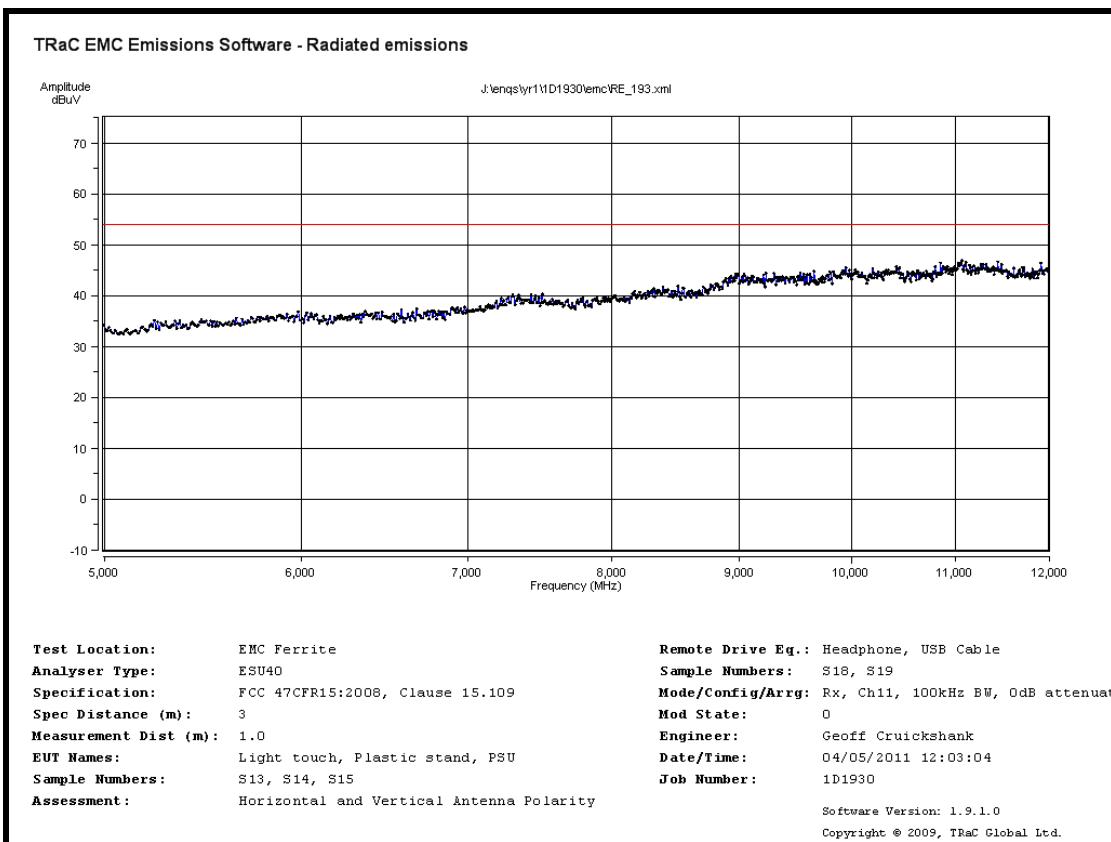
### Unintentional Radiated Spurious emissions 30 MHz to 200 MHz – 2462MHz



### Unintentional Radiated Spurious emissions 200 MHz to 1 GHz – 2462MHz

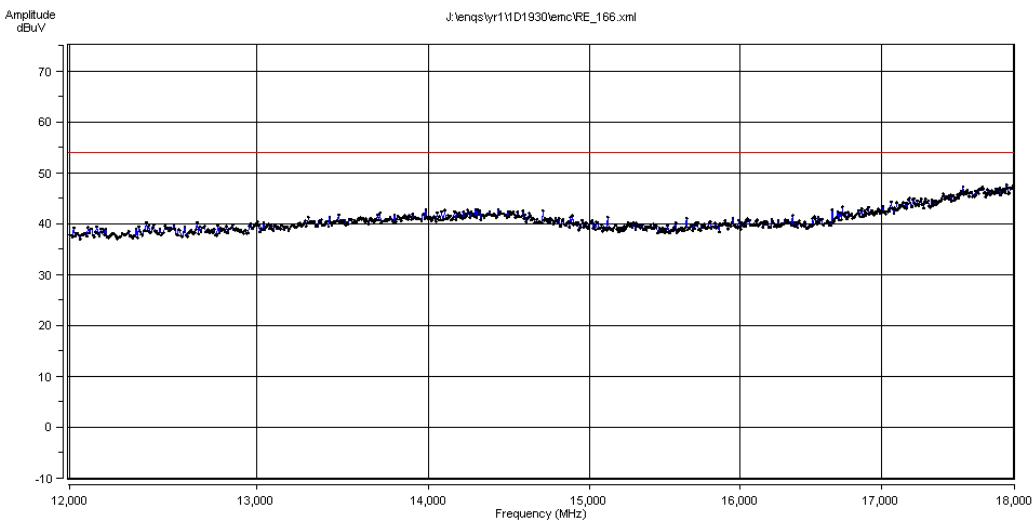


### Unintentional Radiated Spurious emissions 1 GHz to 5 GHz – 2462MHz



### Unintentional Radiated Spurious emissions 5 GHz to 12 GHz – 2462MHz

## TRaC EMC Emissions Software - Radiated emissions

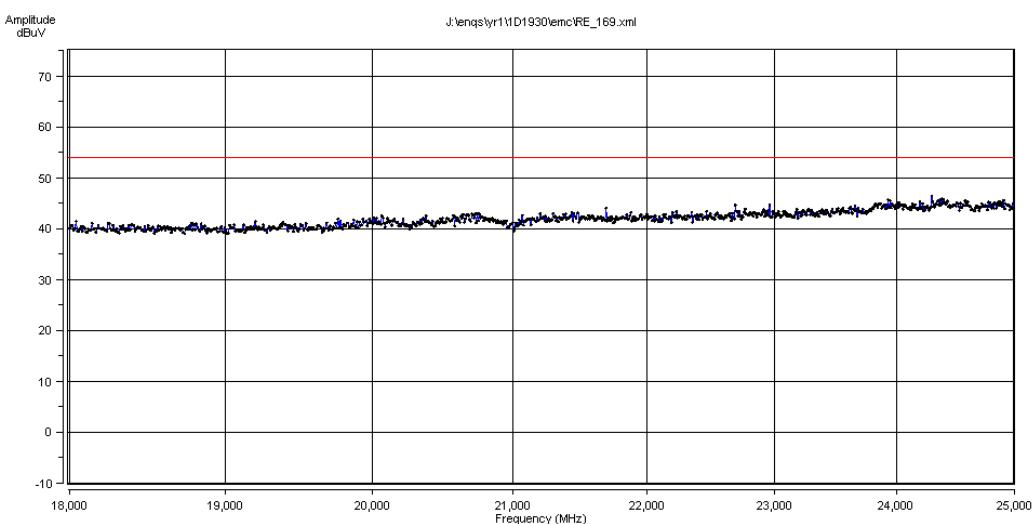


Test Location: EMC Ferrite  
 Analyser Type: E4404B (SCPI commands)  
 Specification: FCC 47CFR15:2008, Clause 15.109  
 Spec Distance (m): 3  
 Measurement Dist (m): 1.0  
 EUT Names: Light touch, Plastic stand, PSU  
 Sample Numbers: S13, S14, S15  
 Assessment: Horizontal and Vertical Antenna Polarity

Remote Drive Eg.: Headphone, USB Cable  
 Sample Numbers: S18, S19  
 Mode/Config/Arrg: Rx, Ch11, 100kHz BW, 0dB attenuat  
 Mod State: 0  
 Engineer: Geoff Cruickshank  
 Date/Time: 27/04/2011 16:09:15  
 Job Number: 1D1930  
 Software Version: 1.9.1.0  
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## Unintentional Radiated Spurious emissions 12 GHz to 18 GHz – 2462MHz

## TRaC EMC Emissions Software - Radiated emissions



Test Location: EMC Ferrite  
 Analyser Type: E4404B (SCPI commands)  
 Specification: FCC 47CFR15:2008, Clause 15.109  
 Spec Distance (m): 3  
 Measurement Dist (m): 1.0  
 EUT Names: Light touch, Plastic stand, PSU  
 Sample Numbers: S13, S14, S15  
 Assessment: Horizontal and Vertical Antenna Polarity

Remote Drive Eg.: Headphone, USB Cable  
 Sample Numbers: S18, S19  
 Mode/Config/Arrg: Rx, Ch11, 100kHz BW, 0dB attenuat  
 Mod State: 0  
 Engineer: Geoff Cruickshank  
 Date/Time: 27/04/2011 16:34:11  
 Job Number: 1D1930  
 Software Version: 1.9.1.0  
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## Unintentional Radiated Spurious emissions 18 GHz to 25 GHz – 2462MHz

**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 Telecoms & Radio upon request.

## C1 Test samples

The following samples of the apparatus were submitted by the client for testing :

Sample No.	Description	Identification
S13	LT1221 Light Touch Mini Projector	None
S14	Base unit	None
S15	V-Infinity Switch Mode Power Supply	P/N: EMSA050300-P42P-SZ-C1

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

Sample No.	Description	Identification
S18	Sony Headset	None
S19	USB Lead	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 Transmitter tests detailed in this report	EUT active transmitting, operating at 11Mbps and 54Mbps data rates on the highest middle and lowest operating frequencies at each data rate.

Test	Description of Operating Mode:
Receiver conducted and radiated spurious emissions	EUT active but non-transmitting.

### **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 : S13  
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power Port	2 core unscreened	1m	S15
Micro USB Port	Micro USB Cable	2m	S19 - Unterminated
Headphone Port	Phono Cable	1m	S18
dc Power Contacts	None	N/A	S14

Sample : S14  
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power Contacts	None	N/A	S13
dc Power Port	None	N/A	None

Sample : S15  
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power Port	2 core unscreened	1m	S13
ac Power Port	None	N/A	ac Mains

## C5 Details of Equipment Used

For Radiated Measurements:

For Radiated TX and Standby/RX spurious emissions 30MHz to 1GHz

RFG No	Type	Description	Manufacturer	Date Calibrated.
REF886	Lab 16	Large Anechoic Chamber	TRaC	10/06/10
095	96002	Bicon Antena (30-200MHz)	Eaton	12/05/10
191	3146	Log Periodic Antenna (200-1000MHz)	EMCO	12/05/10
673	310	Pre-Amp (9kHz-1GHz)	Sonoma	14/09/10
REF847	ESU	Spectrum Analyser	R&S	14/06/10
454		HF RF coaxial cable	Teledyne Reynolds	04/05/10
REF881		HF RF coaxial cable	Teledyne Reynolds	10/06/10
REF882		HF RF coaxial cable	Teledyne Reynolds	10/06/10
REF884		HF RF coaxial cable	Teledyne Reynolds	10/06/10
464	6220B	dc Power Supply	HP	N/A
REF883		HF RF coaxial cable		10/06/10
REF829	N4010A	Wireless connectivity Test Set	Agilent	02/03/11

Radiated TX and Standby/RX spurious emissions 1GHz to 12.75GHz

RFG No	Type	Description	Manufacturer	Date Calibrated
REF886	Lab 16	Large Anechoic Chamber	TRaC	10/06/10
REF880	HL050	Log Perodic Antenna (1-26.5GHz)	R&S	14/05/10
307	HP8449B	Microwave Pre-Amp (1-26.5GHz)	HP	01/03/10
REF847	ESU	Spectrum Analyser	R&S	14/06/10
454		HF RF coaxial cable	Teledyne Reynolds	04/05/10
REF881		HF RF coaxial cable	Teledyne Reynolds	10/06/10
REF882		HF RF coaxial cable	Teledyne Reynolds	10/06/10
REF884		HF RF coaxial cable	Teledyne Reynolds	10/06/10
464	6220B	dc Power Supply	HP	N/A
REF883		HF RF coaxial cable		10/06/10
REF829	N4010A	Wireless connectivity Test Set	Agilent	02/03/11

**Appendix D:**

**Additional Information**

Manufactures declaration of the model number differences.



Declaration of Model Number Differences – Molded Skin

The Light Touch Product models (LT1021 & LT1221) utilize the same APM6658 module for WiFi.

The only difference in the two models is the Laser Classification. The LT1221 is a Class 2 device and the LT1021 is a Class 1 device.

Regards,

A handwritten signature in black ink that reads "Patrick W. Lafferty".

Patrick W. Lafferty  
Light Blue Optics  
Sustaining Engineering Manager  
4775 Centennial Blvd, Suite 103  
Colorado Springs, CO 80919

Manufactures data sheet detailing the maximum gain used by the EUT.

**antenova®**

## Mixtus Dual-band Wi-Fi SMD Antenna

Part No. A10194      Product Specification

### 1 Features

- Designed for 2.4 – 2.5 GHz and 4.9 – 5.0 GHz applications: 802.11a/b/g/j/n, Wi-Fi®
- Easy to integrate
- High efficiency
- Light weight
- Intended for SMD mounting
- Supplied in tape on reel

### 2 Description

Mixtus is intended for use with all dual-band Wi-Fi applications, including 802.11n MIMO. The antenna requires a ground plane, i.e. your device acts as an active part of the antenna and thus demands careful consideration concerning its placement.

### 3 Applications

- Mobile phones
- PDAs
- Portable Media Players (PMPs)
- Headsets
- PC-Cards
- Game Consoles
- Access Points
- Set-top-box
- Networked Digital TVs



**Integrated Antenna and RF Solutions**

1  
Product Specification 06MD-0010-3-PS

Manufactures data sheet detailing the maximum gain used by the EUT continued:

Mixtus Dual-band Wi-Fi SMD Antenna  
Part No. A10194

#### 4 Part No.

**Mixtus: A10194**



#### 5 General data

Product name	Mixtus Wi-Fi
Part No.	A10194
Frequency	2.4 – 2.5 GHz and 4.9 – 5.9 GHz
Polarization	Linear
Operating temperature	-40 °C to +85 °C
Impedance with matching	50 Ω
Weight	0.2 g
Antenna type	SMD
Dimensions	10 x 10 x 0.9 [mm]

#### 6 Electrical characteristics

	Typical performance	Conditions
Peak gain	1.8 dBi	Data given for the 2.4 – 2.5 GHz frequency range All data measured on Antenova's reference board part number A10194-U1
Average gain	-0.5 dBi	
Average efficiency	>75%	
Maximum Return Loss	-15 dB	
Maximum VSWR	1.4:1	
Peak gain	4.1 dBi	Data given for the 4.9 – 5.9 GHz frequency range All data measured on Antenova's reference board part number A10194-U1
Average gain	-2.3 dBi	
Average efficiency	>60%	
Maximum Return Loss	-11 dB	
Maximum VSWR	1.8:1	

Integrated Antenna and RF Solutions

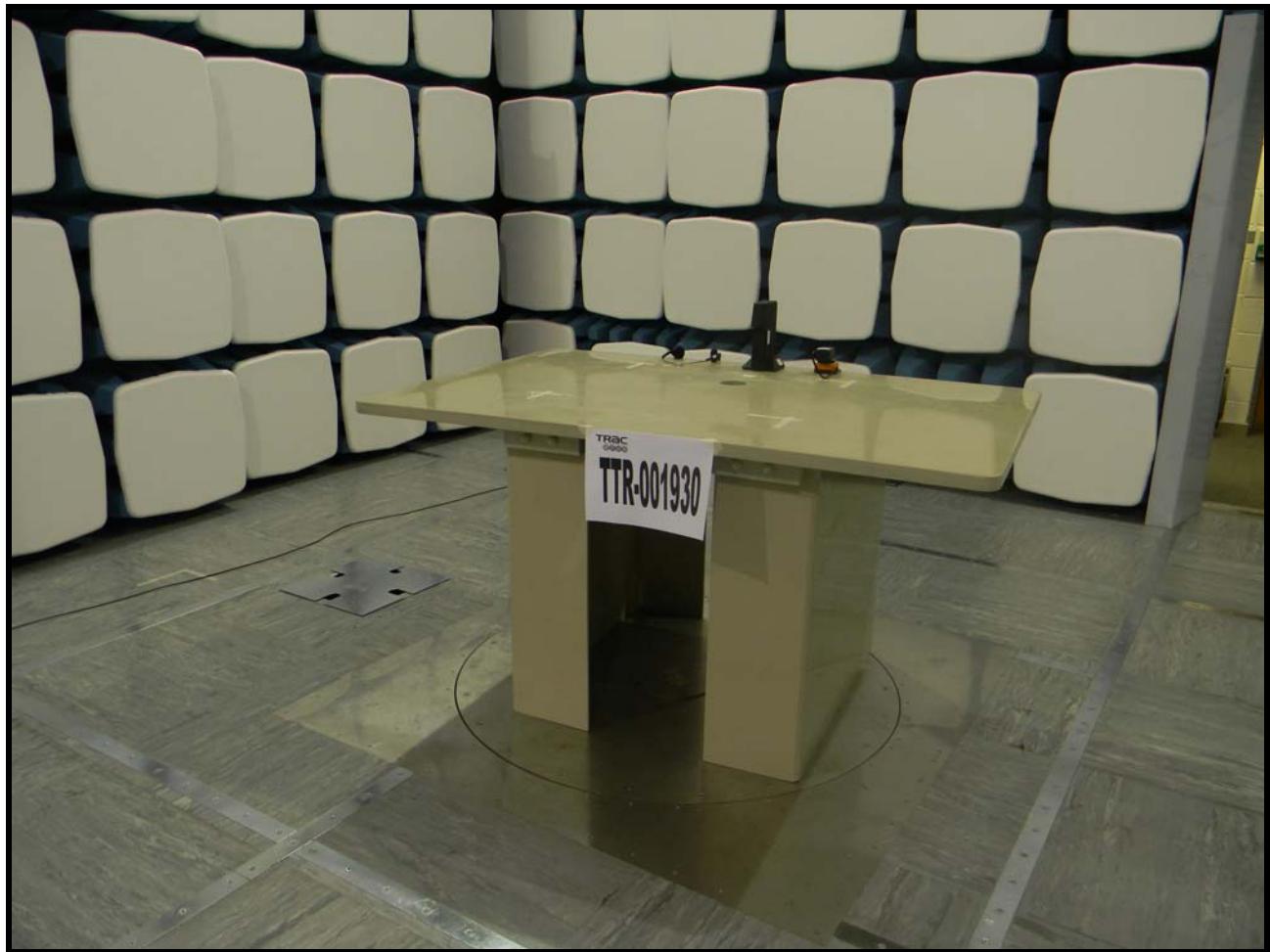
2  
Product Specification 06MD-0010-3-PS

**Appendix E:**

**Photographs and Figures**

The following photographs were taken of the test samples:

1. Radiated emissions overview: Front view
2. Radiated emissions overview: Back view



Photograph 1



Photograph 2

