

**Radio Test Report  
FOR  
Light Blue Optics  
ON  
Light Touch 1020 and Light Touch 1220  
Document Number TTR-001930WUS1**

**HULL**

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**TRaC Radio Test Report** : TTR-001930WUS1

**Applicant** : Light Blue Optics

**Apparatus** : Light Touch 1020 and Light Touch 1220

**Specification(s)** : CFR47 Part 15.247 July 2008

**FCCID** : YVE-LT

**Purpose of Test** : Certification

Authorised by

A handwritten signature in black ink, appearing to read "John Charles".

:

: Radio Product Manager

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## Contents

Section 1: Introduction	4
1.1 General	4
1.2 Tests Requested By	5
1.3 Manufacturer	5
1.4 Apparatus Assessed	5
1.5 Test Result Summary	6
1.6 Notes Relating To The Assessment	7
1.7 Deviations from Test Standards	7
Section 2: Measurement Uncertainty	8
2.1 Application of Measurement Uncertainty	8
2.2 Measurement Uncertainty Values	9
Section 3: Modifications	10
3.1 Modifications Performed During Assessment	10
Appendix A: Formal Emission Test Results	11
A1 Transmitter Peak Output Power	12
A2 Transmitter Power Spectral Density	13
A3 RF Antenna Conducted Spurious Emissions	14
A4 Radiated Electric Field Emissions Within The Restricted Bands of 15.205	16
A5 6 dB Bandwidth	26
A6 Antenna Gain	27
A7 Unintentional Radiated Electric Field Emissions - 15.109	28
A8 Power Line Conducted Emissions	32
Appendix B: Supporting Graphical Data	36
Appendix C: Additional Test and Sample Details	107
C1 Test samples	108
C2 EUT Operating Mode During Testing.	109
C3 EUT Configuration Information.	110
C4 List of EUT Ports	111
C5 Details of Equipment Used	112
Appendix D: Additional Information	114
Appendix E: Photographs and Figures	117
Appendix F: MPE Calculation	121

**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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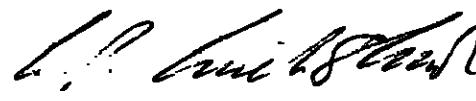
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## **1.2 Tests Requested By**

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 03/03/11 and 18/05/11:

Light Touch 1020 and Light Touch 1220

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

## 1.5 Test Result Summary

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

Test Type	Regulation	Measurement standard	Result
Radiated spurious emissions (Restricted bands)	Title 47 of the CFR: Part 15 Subpart (c) 15.247	ANSI C63.10	Pass
Conducted spurious emissions (Non-restricted bands)	Title 47 of the CFR: Part 15 Subpart (c) 15.247	ANSI C63.10	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	ANSI C63.10	Pass
6dB Bandwidth	Title 47 of the CFR : Part 15 Subpart (c) 15.247(a)(2)	ANSI C63.10	Pass
Conducted Carrier Power	Title 47 of the CFR : Part 15 Subpart (c) 15.247(b)(3)	ANSI C63.10	Pass
Power Spectral Density	Title 47 of the CFR : Part 15 Subpart (c); 15.247(d)	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	ANSI	: American National Standards Institution
REFE	: Radiated Electric Field Emissions	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 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 Transmitter Peak Output Power

Carrier power was verified with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.247(b)(1)
Measurement standard	ANSI C63.10:2003
EUT sample number	S05 and S06
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	20°C

Data Rate = 11Mbps			
Channel Frequency (MHz)	Peak Carrier Power (W)	Limit (W)	Result
2412.0	0.020	1	Pass
2437.0	0.022		Pass
2462.0	0.027		Pass
Data Rate = 54Mbps			
Channel Frequency (MHz)	Peak Carrier Power (W)	Limit (W)	Result
2412.0	0.029	1	Pass
2437.0	0.029		Pass
2462.0	0.035		Pass

Notes:

Conducted Measurement

Measured Peak Carrier power includes highest gain of any antenna to be used.  
Highest Gain of any antenna to be used = 1.8 dBi

Conducted measurements were performed with a temporary antenna connector provided by the client.

## A2 Transmitter Power Spectral Density

Transmitter Power Spectral Density was verified with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.247(b)(3)
Measurement standard	ANSI C63.10:2003
EUT sample number	S05 and S06
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	20°C

Channel Frequency (MHz)	Peak Power Spectral Density (dBm)	Limit (dBm)	Result
2412.0	4.3	8.0	Pass
2437.0	4.2	8.0	Pass
2462.0	4.2	8.0	Pass

Notes:

Conducted Measurement

Measured Power Spectral Density includes highest gain of any antenna to be used.

Highest Gain of any antenna to be used = 1.8 dBi

Conducted measurements were performed with a temporary antenna connector provided by the client.

The resolution bandwidth on the analyser was set to 3kHz and trace set to max hold.

The span is set to 3MHz

The sweep time is 1000 seconds (Span/3kHz).

### A3 RF Antenna Conducted Spurious Emissions

Measurement of conducted spurious emissions at the antenna port was performed using a peak detector with the RBW set to 100kHz and the VBW>RBW. Frequencies were scanned up through to the 10th harmonic with the EUT transmitting on its lowest, centre and highest carrier frequency in turn 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.

Test Details	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d)
Measurement standard	ANSI C63.10:2003
Frequency range	9 kHz to 25 GHz
EUT sample number	S05 and S06
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Temperature	20°C

The worst case conducted emission measurements at the antenna port are listed below:

Test Details : 11Mbps, 2412MHz, 2437MHz & 2462MHz						
Ref No.	Measured Freq (MHz)	Det.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
No significant emissions within 20 dB of the limit						

Test Details : 54Mbps, 2412MHz, 2437MHz & 2462MHz						
Ref No.	Measured Freq (MHz)	Det.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
No significant emissions within 20 dB of the limit						

**Notes:**

1. The conducted emission limit for all emissions are based on a transmitted carrier level in a 100kHz RBW. With the EUT transmitting on its lowest, centre and highest carrier frequencies in turn, emissions from the EUT are required to be 20 dB below the level of the highest fundamental as measured within a 100 kHz RBW in accordance with 15.247(d) using a peak detector.
2. The RBW = 100 kHz, Video bandwidth (VBW) > RBW and the radio spectrum was investigated up to the 10th harmonic in accordance 15.33 (a)(1).
3. The measurements at 2400 MHz and 2483.5 MHz were made to ensure band edge compliance.
4. The carrier level was measured whilst varying the supply voltage between 85% and 105% of the nominal supply voltage as required by 15.31(e). No variation in carrier level was observed. All other emissions were at least 20dB below the test limit

The limit outside the restricted band in 100 kHz RBW is defined using the following formula in accordance with 15.247(d):

The limit in 100 kHz RBW = (Maximum Peak Conducted Carrier/100kHz) - 20dB

#### A4 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	S07 and S16
Modification state	0
SE in test environment	S17, S18, S19 and S20
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	35.008	Pk	58.1	0.6	12.2	30.8	40.1	0	40.1	88.4	-48.3
2	35.008	QP	51.4	0.6	12.2	30.8	33.4	0	33.4	68.4	-35.0
3	144.006	Pk	50.7	1.3	12.4	31	33.4	0	33.4	88.4	-55.0
4	144.006	QP	46.9	1.3	12.4	31	29.6	0	29.6	68.4	-38.8
5	240.014	Pk	54.5	1.8	11.1	31.1	36.3	0	36.3	66.0	-29.7
6	240.014	QP	53.4	1.8	11.1	31.1	35.2	0	35.2	46.0	-10.8
7	559.966	Pk	54.8	2.8	18.5	30.9	45.2	0	45.2	88.4	-43.2
8	559.966	QP	54.3	2.8	18.5	30.9	44.7	0	44.7	68.4	-23.7
9	599.963	Pk	50.5	2.9	18.6	30.9	41.1	0	41.1	88.4	-47.3
10	599.963	QP	48.8	2.9	18.6	30.9	39.4	0	39.4	68.4	-29.0
11	699.957	Pk	45.7	3.0	20.7	30.9	38.5	0	38.5	88.4	-49.9
12	699.957	QP	44.4	3.0	20.7	30.9	37.2	0	37.2	68.4	-31.2
13	839.949	Pk	51.6	3.2	21.9	30.6	46.1	0	46.1	88.4	-42.3
14	839.949	QP	50.6	3.2	21.9	30.6	45.1	0	45.1	68.4	-23.3
15	979.941	Pk	50.7	3.6	23.4	29.7	48.0	0	48.0	74.0	-26.0
16	979.941	QP	49.9	3.6	23.4	29.7	47.2	0	47.2	54.0	-6.8
17	1000.000	Pk	55.6	3.5	22.1	34.6	46.6	0	46.6	74.0	-27.4
18	1000.000	AV	42.1	3.5	22.1	34.6	33.1	0	33.1	54.0	-20.9
19	1399.915	Pk	52.5	4.5	25.0	33.9	48.1	0	48.1	74.0	-25.9
20	1399.915	AV	43.6	4.5	25.0	33.9	39.2	0	39.2	54.0	-14.8
21	1539.905	Pk	48.1	5.0	25.9	33.7	45.3	0	45.3	74.0	-28.7
22	1539.905	AV	41.2	5.0	25.9	33.7	38.4	0	38.4	54.0	-15.6
23	2412.523	Pk	74.8	4.1	29.5	N/A	108.4	0	108.4	137.0	-28.6
24	2385.269	Pk	64.8	4.7	29.4	33.8	65.2	0	65.2	74.0	-8.8
25	2385.269	AV	41.6	4.7	29.4	33.8	42.0	0	42.0	54.0	-12.0
26	2390.000	Pk	67.5	4.5	29.5	33.8	67.8	0	67.8	74.0	-6.2
27	2390.000	AV	41.4	4.5	29.5	33.8	41.7	0	41.7	54.0	-12.3
28	4823.966	Pk	45.0	8.2	36.0	34.0	55.2	0	55.2	74.0	-18.8
29	4823.966	AV	31.8	8.2	36.0	34.0	42.0	0	42.0	54.0	-12.0

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	35.008	Pk	58.1	0.6	12.2	30.8	40.1	0	40.1	89.1	-49.0
2	35.008	QP	51.4	0.6	12.2	30.8	33.4	0	33.4	69.1	-35.7
3	144.006	Pk	50.7	1.3	12.4	31	33.4	0	33.4	89.1	-55.7
4	144.006	QP	46.9	1.3	12.4	31	29.6	0	29.6	69.1	-39.5
5	240.014	Pk	54.5	1.8	11.1	31.1	36.3	0	36.3	66.0	-29.7
6	240.014	QP	53.4	1.8	11.1	31.1	35.2	0	35.2	46.0	-10.8
7	559.966	Pk	54.8	2.8	18.5	30.9	45.2	0	45.2	89.1	-43.9
8	559.966	QP	54.3	2.8	18.5	30.9	44.7	0	44.7	69.1	-24.4
9	599.963	Pk	50.5	2.9	18.6	30.9	41.1	0	41.1	89.1	-48.0
10	599.963	QP	48.8	2.9	18.6	30.9	39.4	0	39.4	69.1	-29.7
11	699.957	Pk	45.7	3.0	20.7	30.9	38.5	0	38.5	89.1	-50.6
12	699.957	QP	44.4	3.0	20.7	30.9	37.2	0	37.2	69.1	-31.9
13	839.949	Pk	51.6	3.2	21.9	30.6	46.1	0	46.1	89.1	-43.0
14	839.949	QP	50.6	3.2	21.9	30.6	45.1	0	45.1	69.1	-24.0
15	979.941	Pk	50.7	3.6	23.4	29.7	48.0	0	48.0	74.0	-26.0
16	979.941	QP	49.9	3.6	23.4	29.7	47.2	0	47.2	54.0	-6.8
17	1000.000	Pk	61.4	3.5	22.1	34.6	52.4	0	52.4	74.0	-21.6
18	1000.000	AV	48.0	3.5	22.1	34.6	39.0	0	39.0	54.0	-15.0
19	1399.913	Pk	52.1	4.5	25.0	33.9	47.7	0	47.7	74.0	-26.3
20	1399.913	AV	43.8	4.5	25.0	33.9	39.4	0	39.4	54.0	-14.6
21	1539.905	Pk	48.6	5.0	25.9	33.7	45.8	0	45.8	74.0	-28.2
22	1539.905	AV	41.5	5.0	25.9	33.7	38.7	0	38.7	54.0	-15.3
23	2437.564	Pk	75.5	4.0	29.6	N/A	109.1	0	109.1	137.0	-27.9
24	4873.968	Pk	46.5	8.3	36.1	34.1	56.8	0	56.8	74.0	-17.2
25	4873.968	AV	32.9	8.3	36.1	34.1	43.2	0	43.2	54.0	-10.8

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	35.008	Pk	58.1	0.6	12.2	30.8	40.1	0	40.1	88.5	-48.4
2	35.008	QP	51.4	0.6	12.2	30.8	33.4	0	33.4	68.5	-35.1
3	144.006	Pk	50.7	1.3	12.4	31	33.4	0	33.4	88.5	-55.1
4	144.006	QP	46.9	1.3	12.4	31	29.6	0	29.6	68.5	-38.9
5	240.014	Pk	54.5	1.8	11.1	31.1	36.3	0	36.3	66.0	-29.7
6	240.014	QP	53.4	1.8	11.1	31.1	35.2	0	35.2	46.0	-10.8
7	559.966	Pk	54.8	2.8	18.5	30.9	45.2	0	45.2	88.5	-43.3
8	559.966	QP	54.3	2.8	18.5	30.9	44.7	0	44.7	68.5	-23.8
9	599.963	Pk	50.5	2.9	18.6	30.9	41.1	0	41.1	88.5	-47.4
10	599.963	QP	48.8	2.9	18.6	30.9	39.4	0	39.4	68.5	-29.1
11	699.957	Pk	45.7	3.0	20.7	30.9	38.5	0	38.5	88.5	-50.0
12	699.957	QP	44.4	3.0	20.7	30.9	37.2	0	37.2	68.5	-31.3
13	839.949	Pk	51.6	3.2	21.9	30.6	46.1	0	46.1	88.5	-42.4
14	839.949	QP	50.6	3.2	21.9	30.6	45.1	0	45.1	68.5	-23.4
15	979.941	Pk	50.7	3.6	23.4	29.7	48.0	0	48.0	74.0	-26.0
16	979.941	QP	49.9	3.6	23.4	29.7	47.2	0	47.2	54.0	-6.8
17	1000.000	Pk	60.9	3.5	22.1	34.6	51.9	0	51.9	74.0	-22.1
18	1000.000	AV	47.8	3.5	22.1	34.6	38.8	0	38.8	54.0	-15.2
19	1399.913	Pk	51.1	4.5	25.0	33.9	46.7	0	46.7	74.0	-27.3
20	1399.913	AV	42.6	4.5	25.0	33.9	38.2	0	38.2	54.0	-15.8
21	1539.907	Pk	47.6	5.0	25.9	33.7	44.8	0	44.8	74.0	-29.2
22	1539.907	AV	39.5	5.0	25.9	33.7	36.7	0	36.7	54.0	-17.3
23	2460.577	Pk	74.6	4.2	29.7	N/A	108.5	0	108.5	137.0	-28.5
24	2483.500	Pk	62.6	4.4	29.8	33.8	63.0	0	63.0	74.0	-11.0
25	2483.500	AV	41.4	4.4	29.8	33.8	41.8	0	41.8	54.0	-12.2
26	2486.269	Pk	64.5	4.5	29.8	33.8	65.0	0	65.0	74.0	-9.0
27	2486.269	AV	42.8	4.5	29.8	33.8	43.3	0	43.3	54.0	-10.7
28	4923.958	Pk	48.5	8.8	36.2	34.1	59.4	0	59.4	74.0	-14.6
29	4923.958	AV	33.5	8.8	36.2	34.1	44.4	0	44.4	54.0	-9.6

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	S07 and S16
Modification state	0
SE in test environment	S17, S18, S19 and S20
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	35.008	Pk	58.1	0.6	12.2	30.8	40.1	0	40.1	87.1	-47.0
2	35.008	QP	51.4	0.6	12.2	30.8	33.4	0	33.4	67.1	-33.7
3	144.006	Pk	50.7	1.3	12.4	31	33.4	0	33.4	87.1	-53.7
4	144.006	QP	46.9	1.3	12.4	31	29.6	0	29.6	67.1	-37.5
5	240.014	Pk	54.5	1.8	11.1	31.1	36.3	0	36.3	66.0	-29.7
6	240.014	QP	53.4	1.8	11.1	31.1	35.2	0	35.2	46.0	-10.8
7	559.966	Pk	54.8	2.8	18.5	30.9	45.2	0	45.2	87.1	-41.9
8	559.966	QP	54.3	2.8	18.5	30.9	44.7	0	44.7	67.1	-22.4
9	599.963	Pk	50.5	2.9	18.6	30.9	41.1	0	41.1	87.1	-46.0
10	599.963	QP	48.8	2.9	18.6	30.9	39.4	0	39.4	67.1	-27.7
11	699.957	Pk	45.7	3.0	20.7	30.9	38.5	0	38.5	87.1	-48.6
12	699.957	QP	44.4	3.0	20.7	30.9	37.2	0	37.2	67.1	-29.9
13	839.949	Pk	51.6	3.2	21.9	30.6	46.1	0	46.1	87.1	-41.0
14	839.949	QP	50.6	3.2	21.9	30.6	45.1	0	45.1	67.1	-22.0
15	979.941	Pk	50.7	3.6	23.4	29.7	48.0	0	48.0	74.0	-26.0
16	979.941	QP	49.9	3.6	23.4	29.7	47.2	0	47.2	54.0	-6.8
17	1000.000	Pk	57.5	3.5	22.1	34.6	48.5	0	48.5	74.0	-25.5
18	1000.000	AV	44.7	3.5	22.1	34.6	35.7	0	35.7	54.0	-18.3
19	1399.913	Pk	51.9	4.5	25.0	33.9	47.5	0	47.5	74.0	-26.5
20	1399.913	AV	43.8	4.5	25.0	33.9	39.4	0	39.4	54.0	-14.6
21	1539.904	Pk	48.3	5.0	25.9	33.7	45.5	0	45.5	74.0	-28.5
22	1539.904	AV	41.2	5.0	25.9	33.7	38.4	0	38.4	54.0	-15.6
23	2390.000	Pk	68.6	4.5	29.5	33.8	68.9	0	68.9	74.0	-5.1
24	2390.000	AV	48.7	4.5	29.5	33.8	49.0	0	49.0	54.0	-5.0
25	2414.880	Pk	73.4	4.1	29.6	N/A	107.1	0	107.1	137.0	-29.9

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	35.008	Pk	58.1	0.6	12.2	30.8	40.1	0	40.1	89.2	-49.1
2	35.008	QP	51.4	0.6	12.2	30.8	33.4	0	33.4	69.2	-35.8
3	144.006	Pk	50.7	1.3	12.4	31	33.4	0	33.4	89.2	-55.8
4	144.006	QP	46.9	1.3	12.4	31	29.6	0	29.6	69.2	-39.6
5	240.014	Pk	54.5	1.8	11.1	31.1	36.3	0	36.3	66.0	-29.7
6	240.014	QP	53.4	1.8	11.1	31.1	35.2	0	35.2	46.0	-10.8
7	559.966	Pk	54.8	2.8	18.5	30.9	45.2	0	45.2	89.2	-44.0
8	559.966	QP	54.3	2.8	18.5	30.9	44.7	0	44.7	69.2	-24.5
9	599.963	Pk	50.5	2.9	18.6	30.9	41.1	0	41.1	89.2	-48.1
10	599.963	QP	48.8	2.9	18.6	30.9	39.4	0	39.4	69.2	-29.8
11	699.957	Pk	45.7	3.0	20.7	30.9	38.5	0	38.5	89.2	-50.7
12	699.957	QP	44.4	3.0	20.7	30.9	37.2	0	37.2	69.2	-32.0
13	839.949	Pk	51.6	3.2	21.9	30.6	46.1	0	46.1	89.2	-43.1
14	839.949	QP	50.6	3.2	21.9	30.6	45.1	0	45.1	69.2	-24.1
15	979.941	Pk	50.7	3.6	23.4	29.7	48.0	0	48.0	74.0	-26.0
16	979.941	QP	49.9	3.6	23.4	29.7	47.2	0	47.2	54.0	-6.8
17	1000.000	Pk	57.4	3.5	22.1	34.6	48.4	0	48.4	74.0	-25.6
18	1000.000	AV	44.7	3.5	22.1	34.6	35.7	0	35.7	54.0	-18.3
19	1399.917	Pk	52.8	4.5	25.0	33.9	48.4	0	48.4	74.0	-25.6
20	1399.917	AV	44.4	4.5	25.0	33.9	40.0	0	40.0	54.0	-14.0
21	1539.904	Pk	49.2	5.0	25.9	33.7	46.4	0	46.4	74.0	-27.6
22	1539.904	AV	42.9	5.0	25.9	33.7	40.1	0	40.1	54.0	-13.9
23	2431.199	Pk	75.5	4.1	29.6	N/A	109.2	0	109.2	137.0	-27.8

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	35.008	Pk	58.1	0.6	12.2	30.8	40.1	0	40.1	86.7	-46.6
2	35.008	QP	51.4	0.6	12.2	30.8	33.4	0	33.4	66.7	-33.3
3	144.006	Pk	50.7	1.3	12.4	31	33.4	0	33.4	86.7	-53.3
4	144.006	QP	46.9	1.3	12.4	31	29.6	0	29.6	66.7	-37.1
5	240.014	Pk	54.5	1.8	11.1	31.1	36.3	0	36.3	66.0	-29.7
6	240.014	QP	53.4	1.8	11.1	31.1	35.2	0	35.2	46.0	-10.8
7	559.966	Pk	54.8	2.8	18.5	30.9	45.2	0	45.2	86.7	-41.5
8	559.966	QP	54.3	2.8	18.5	30.9	44.7	0	44.7	66.7	-22.0
9	599.963	Pk	50.5	2.9	18.6	30.9	41.1	0	41.1	86.7	-45.6
10	599.963	QP	48.8	2.9	18.6	30.9	39.4	0	39.4	66.7	-27.3
11	699.957	Pk	45.7	3.0	20.7	30.9	38.5	0	38.5	86.7	-48.2
12	699.957	QP	44.4	3.0	20.7	30.9	37.2	0	37.2	66.7	-29.5
13	839.949	Pk	51.6	3.2	21.9	30.6	46.1	0	46.1	86.7	-40.6
14	839.949	QP	50.6	3.2	21.9	30.6	45.1	0	45.1	66.7	-21.6
15	979.941	Pk	50.7	3.6	23.4	29.7	48.0	0	48.0	74.0	-26.0
16	979.941	QP	49.9	3.6	23.4	29.7	47.2	0	47.2	54.0	-6.8
17	1000.000	Pk	62.7	3.5	22.1	34.6	53.7	0	53.7	74.0	-20.3
18	1000.000	AV	49.9	3.5	22.1	34.6	40.9	0	40.9	54.0	-13.1
19	1399.915	Pk	52.1	4.5	25.0	33.9	47.7	0	47.7	74.0	-26.3
20	1399.915	AV	44.1	4.5	25.0	33.9	39.7	0	39.7	54.0	-14.3
21	1539.907	Pk	49.0	5.0	25.9	33.7	46.2	0	46.2	74.0	-27.8
22	1539.907	AV	41.6	5.0	25.9	33.7	38.8	0	38.8	54.0	-15.2
23	2464.923	Pk	72.8	4.2	29.7	N/A	106.7	0	106.7	137.0	-30.3
24	2483.500	Pk	69.2	4.4	29.8	33.8	69.6	0	69.6	74.0	-4.4
25	2483.500	AV	49.1	4.4	29.8	33.8	49.5	0	49.5	54.0	-4.5

**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 Part15:2008 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits (47 CFR Part 15: Clause 15.209) for emissions falling within the restricted bands defined in 15.205(a):

Frequency of emission (MHz)	Field strength uV/m	Measurement Distance m	Field strength dBuV/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				

## A5 6 dB Bandwidth

Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(2) requires the measurement of the bandwidth of the transmission between the -6 dB points on the transmitted spectrum. The results of this test determine the limits for channel spacing.

Test Details:	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(2)
EUT sample number	S05 and S06
Modification state	0
SE in test environment	None
SE isolated from EUT	None
Temperature	20°C
EUT set up	Refer to Appendix C

11Mbps	
Channel Frequency (MHz)	Measured 6 dB Bandwidth (kHz)
2412	7930
2437	7481
2462	7481

54Mbps	
Channel Frequency (MHz)	Measured 6 dB Bandwidth (kHz)
2412	16275
2437	16425
2462	16425

Plots of the 6 dB bandwidth are contained in Appendix B of this test report.

## A6 Antenna Gain

The maximum antenna gain for the antenna types to be used with the EUT, as declared by the client, is 1.8dBi. The data sheet for the antenna is contained within Appendix D

**A7 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	S07 and S16
Modification state	0
SE in test environment	S17, S18, S19 and S20
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	35.008	Pk	58.1	0.6	12.2	30.8	40.1	0	40.1	60.0	-19.9
2	35.008	QP	51.4	0.6	12.2	30.8	33.4	0	33.4	40.0	-6.6
3	144.006	Pk	50.7	1.3	12.4	31	33.4	0	33.4	63.5	-30.1
4	144.006	QP	46.9	1.3	12.4	31	29.6	0	29.6	43.5	-13.9
5	240.014	Pk	54.5	1.8	11.1	31.1	36.3	0	36.3	66.0	-29.7
6	240.014	QP	53.4	1.8	11.1	31.1	35.2	0	35.2	46.0	-10.8
7	559.966	Pk	54.8	2.8	18.5	30.9	45.2	0	45.2	66.0	-20.8
8	559.966	QP	54.3	2.8	18.5	30.9	44.7	0	44.7	46.0	-1.3
9	599.963	Pk	50.5	2.9	18.6	30.9	41.1	0	41.1	66.0	-24.9
10	599.963	QP	48.8	2.9	18.6	30.9	39.4	0	39.4	46.0	-6.6
11	699.957	Pk	45.7	3.0	20.7	30.9	38.5	0	38.5	66.0	-27.5
12	699.957	QP	44.4	3.0	20.7	30.9	37.2	0	37.2	46.0	-8.8
13	839.949	Pk	51.6	3.2	21.9	30.6	46.1	0	46.1	66.0	-19.9
14	839.949	QP	50.6	3.2	21.9	30.6	45.1	0	45.1	46.0	-0.9
15	979.941	Pk	50.7	3.6	23.4	29.7	48.0	0	48.0	74.0	-26.0
16	979.941	QP	49.9	3.6	23.4	29.7	47.2	0	47.2	54.0	-6.8
17	1331.957	Pk	48.5	4.2	24.5	34.0	43.2	0	43.2	74.0	-30.8
18	1331.957	AV	39.5	4.2	24.5	34.0	34.2	0	34.2	54.0	-19.8
19	1539.905	Pk	48.9	5.0	25.9	33.7	46.1	0	46.1	74.0	-27.9
20	1539.905	AV	41.3	5.0	25.9	33.7	38.5	0	38.5	54.0	-15.5
21	1819.889	Pk	46.7	5.3	27.2	33.7	45.5	0	45.5	74.0	-28.5
22	1819.889	AV	37.7	5.3	27.2	33.7	36.5	0	36.5	54.0	-17.5

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	35.008	Pk	58.1	0.6	12.2	30.8	40.1	0	40.1	60.0	-19.9
2	35.008	QP	51.4	0.6	12.2	30.8	33.4	0	33.4	40.0	-6.6
3	144.006	Pk	50.7	1.3	12.4	31	33.4	0	33.4	63.5	-30.1
4	144.006	QP	46.9	1.3	12.4	31	29.6	0	29.6	43.5	-13.9
5	240.014	Pk	54.5	1.8	11.1	31.1	36.3	0	36.3	66.0	-29.7
6	240.014	QP	53.4	1.8	11.1	31.1	35.2	0	35.2	46.0	-10.8
7	559.966	Pk	54.8	2.8	18.5	30.9	45.2	0	45.2	66.0	-20.8
8	559.966	QP	54.3	2.8	18.5	30.9	44.7	0	44.7	46.0	-1.3
9	599.963	Pk	50.5	2.9	18.6	30.9	41.1	0	41.1	66.0	-24.9
10	599.963	QP	48.8	2.9	18.6	30.9	39.4	0	39.4	46.0	-6.6
11	699.957	Pk	45.7	3.0	20.7	30.9	38.5	0	38.5	66.0	-27.5
12	699.957	QP	44.4	3.0	20.7	30.9	37.2	0	37.2	46.0	-8.8
13	839.949	Pk	51.6	3.2	21.9	30.6	46.1	0	46.1	66.0	-19.9
14	839.949	QP	50.6	3.2	21.9	30.6	45.1	0	45.1	46.0	-0.9
15	979.941	Pk	50.7	3.6	23.4	29.7	48.0	0	48.0	74.0	-26.0
16	979.941	QP	49.9	3.6	23.4	29.7	47.2	0	47.2	54.0	-6.8
17	1331.957	Pk	48.5	4.2	24.5	34.0	43.2	0	43.2	74.0	-30.8
18	1331.957	AV	39.5	4.2	24.5	34.0	34.2	0	34.2	54.0	-19.8
19	1539.905	Pk	48.9	5.0	25.9	33.7	46.1	0	46.1	74.0	-27.9
20	1539.905	AV	41.3	5.0	25.9	33.7	38.5	0	38.5	54.0	-15.5
21	1819.889	Pk	46.7	5.3	27.2	33.7	45.5	0	45.5	74.0	-28.5
22	1819.889	AV	37.7	5.3	27.2	33.7	36.5	0	36.5	54.0	-17.5

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	35.008	Pk	58.1	0.6	12.2	30.8	40.1	0	40.1	60.0	-19.9
2	35.008	QP	51.4	0.6	12.2	30.8	33.4	0	33.4	40.0	-6.6
3	144.006	Pk	50.7	1.3	12.4	31	33.4	0	33.4	63.5	-30.1
4	144.006	QP	46.9	1.3	12.4	31	29.6	0	29.6	43.5	-13.9
5	240.014	Pk	54.5	1.8	11.1	31.1	36.3	0	36.3	66.0	-29.7
6	240.014	QP	53.4	1.8	11.1	31.1	35.2	0	35.2	46.0	-10.8
7	559.966	Pk	54.8	2.8	18.5	30.9	45.2	0	45.2	66.0	-20.8
8	559.966	QP	54.3	2.8	18.5	30.9	44.7	0	44.7	46.0	-1.3
9	599.963	Pk	50.5	2.9	18.6	30.9	41.1	0	41.1	66.0	-24.9
10	599.963	QP	48.8	2.9	18.6	30.9	39.4	0	39.4	46.0	-6.6
11	699.957	Pk	45.7	3.0	20.7	30.9	38.5	0	38.5	66.0	-27.5
12	699.957	QP	44.4	3.0	20.7	30.9	37.2	0	37.2	46.0	-8.8
13	839.949	Pk	51.6	3.2	21.9	30.6	46.1	0	46.1	66.0	-19.9
14	839.949	QP	50.6	3.2	21.9	30.6	45.1	0	45.1	46.0	-0.9
15	979.941	Pk	50.7	3.6	23.4	29.7	48.0	0	48.0	74.0	-26.0
16	979.941	QP	49.9	3.6	23.4	29.7	47.2	0	47.2	54.0	-6.8
17	1331.957	Pk	48.5	4.2	24.5	34.0	43.2	0	43.2	74.0	-30.8
18	1331.957	AV	39.5	4.2	24.5	34.0	34.2	0	34.2	54.0	-19.8
19	1539.905	Pk	48.9	5.0	25.9	33.7	46.1	0	46.1	74.0	-27.9
20	1539.905	AV	41.3	5.0	25.9	33.7	38.5	0	38.5	54.0	-15.5
21	1819.889	Pk	46.7	5.3	27.2	33.7	45.5	0	45.5	74.0	-28.5
22	1819.889	AV	37.7	5.3	27.2	33.7	36.5	0	36.5	54.0	-17.5

## A8 Power Line Conducted Emissions

Previous power line conducted emission measurements were performed with a peak detector in a screened room. The effect of the EUT set-up on the measurements is summarised in note (b). Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn. The formal measurements are detailed below:

Test Details: Transmit Mode 11b	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.10
Frequency range	150kHz to 30MHz
EUT sample number	S01 and S06
Modification state	0
SE in test environment	S17, S18, S19 and S20
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 3

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

### Results measured using the peak detector compared to the average limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.150	L1	29.5	56.0	-26.5	Pass
2	0.190	L1	49.7	54.0	-4.3	Pass
3	0.380	L1	38.0	48.3	-10.3	Pass
4	1.230	L1	36.7	46.0	-9.3	Pass
5	1.520	L1	38.2	46.0	-7.8	Pass
6	4.600	L1	38.1	46.0	-7.9	Pass
7	0.150	N	29.8	56.0	-26.2	Pass
8	0.190	N	49.9	54.0	-4.1	Pass
9	0.380	N	38.0	48.3	-10.3	Pass
10	1.230	N	36.2	46.0	-9.8	Pass
11	1.520	N	37.8	46.0	-8.2	Pass
12	4.600	N	37.6	46.0	-8.4	Pass

Previous power line conducted emission measurements were performed with a peak detector in a screened room. The effect of the EUT set-up on the measurements is summarised in note (b). Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn. The formal measurements are detailed below:

Test Details: Transmit Mode 11g	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.10
Frequency range	150kHz to 30MHz
EUT sample number	S01 and S06
Modification state	0
SE in test environment	S17, S18, S19 and S20
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 3

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

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

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.150	L1	29.9	56.0	-26.1	Pass
2	0.190	L1	50.0	54.0	-4.0	Pass
3	0.380	L1	37.7	48.3	-10.6	Pass
4	1.230	L1	36.5	46.0	-9.5	Pass
5	1.520	L1	37.9	46.0	-8.1	Pass
6	4.600	L1	37.8	46.0	-8.2	Pass
7	0.150	N	29.4	56.0	-26.6	Pass
8	0.190	N	49.4	54.0	-4.6	Pass
9	0.380	N	37.4	48.3	-10.9	Pass
10	1.230	N	35.0	46.0	-11.0	Pass
11	1.520	N	37.6	46.0	-8.4	Pass
12	4.600	N	36.6	46.0	-9.4	Pass

Previous power line conducted emission measurements were performed with a peak detector in a screened room. The effect of the EUT set-up on the measurements is summarised in note (b). Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The EUT was set to not transmit. The formal measurements are detailed below:

Test Details: Receive Mode	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.107
Measurement standard	ANSI C63.10
Frequency range	150kHz to 30MHz
EUT sample number	S01 and S06
Modification state	0
SE in test environment	S17, S18, S19 and S20
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 3

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

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

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.150	L1	30.0	56.0	-26.0	Pass
2	0.190	L1	49.5	54.0	-4.5	Pass
3	0.380	L1	37.5	48.3	-10.8	Pass
4	1.230	L1	36.1	46.0	-9.9	Pass
5	1.520	L1	37.7	46.0	-8.3	Pass
6	4.600	L1	37.4	46.0	-8.6	Pass
7	0.150	N	29.3	56.0	-26.7	Pass
8	0.190	N	49.0	54.0	-5.0	Pass
9	0.380	N	37.5	48.3	-10.8	Pass
10	1.230	N	34.5	46.0	-11.5	Pass
11	1.520	N	37.3	46.0	-8.7	Pass
12	4.600	N	36.7	46.0	-9.3	Pass

**Specification limits :**

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

Conducted disturbance at the mains ports.

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

Notes:

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				

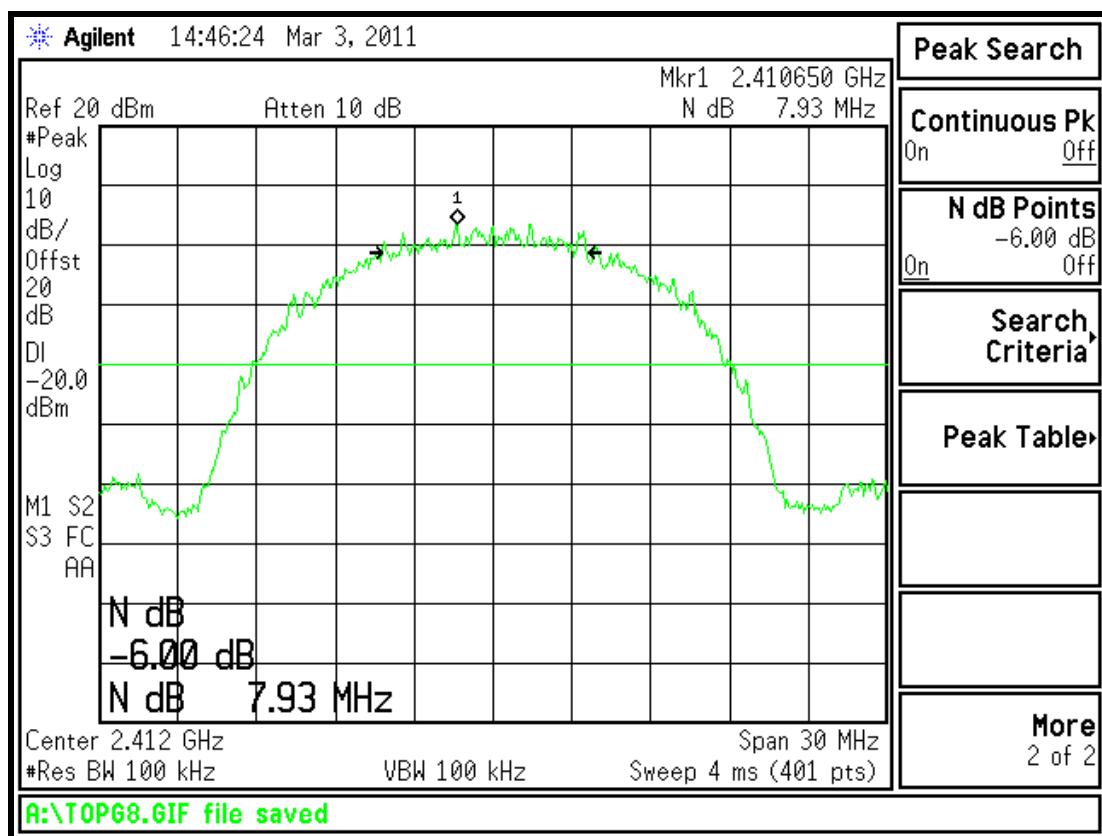
**Appendix B:**

**Supporting Graphical Data**

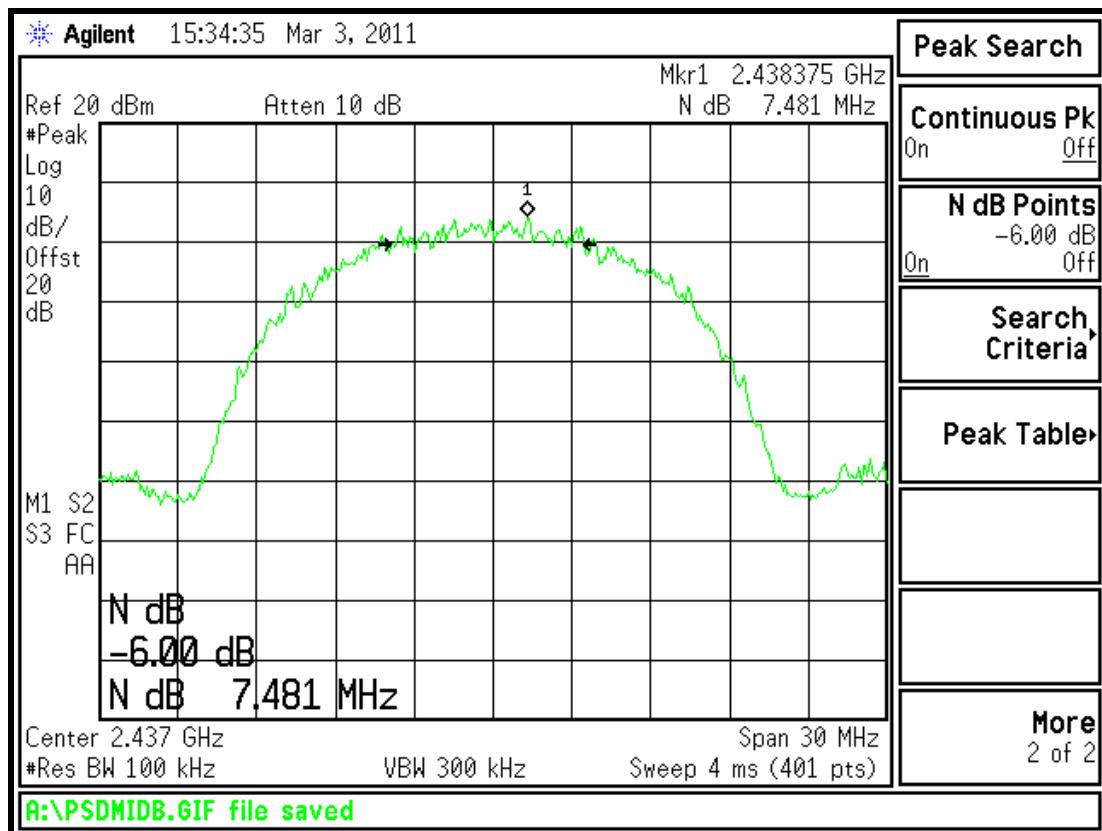
This appendix contains graphical data obtained during testing.

Notes:

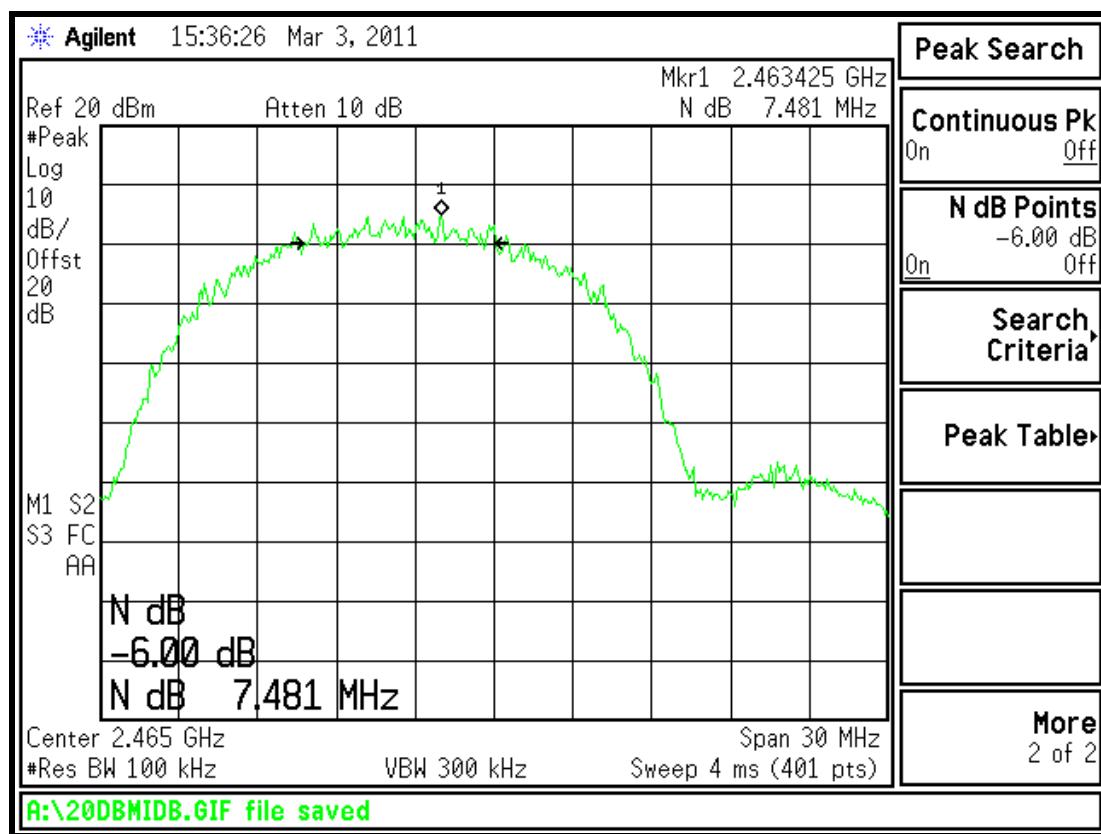
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power 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.



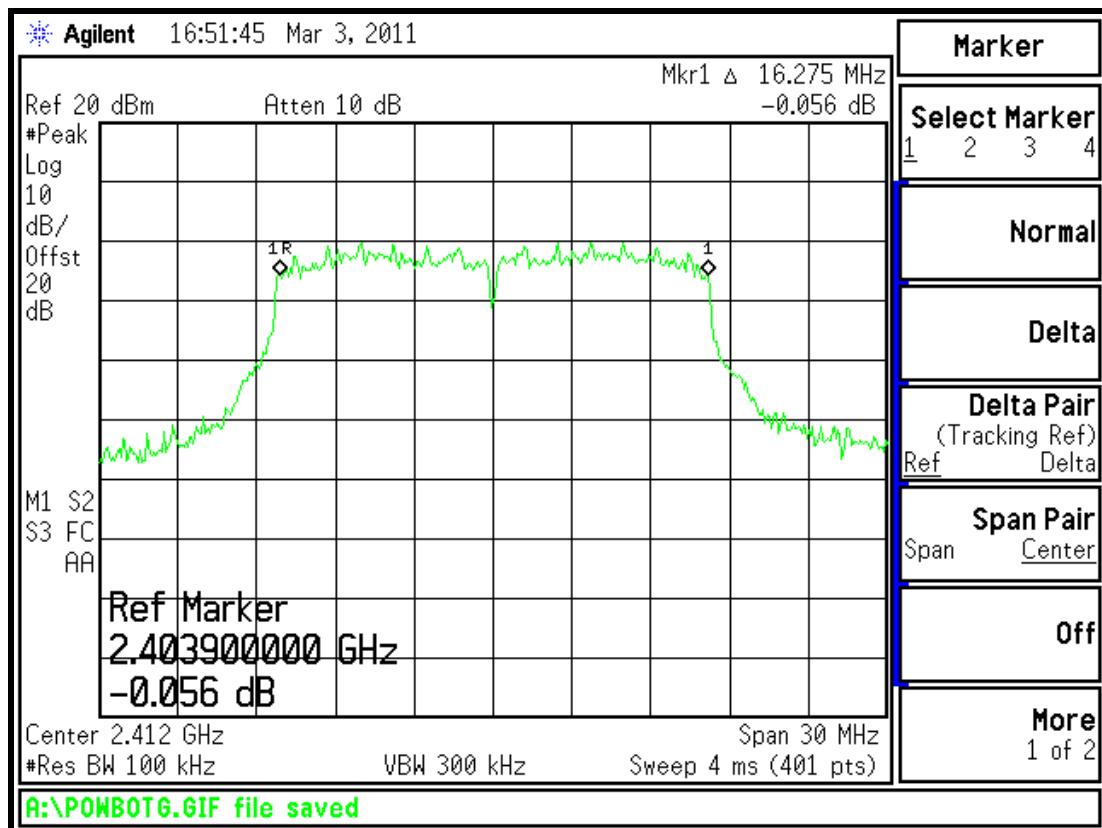
6dB Bandwidth – 11Mbps – 2412MHz



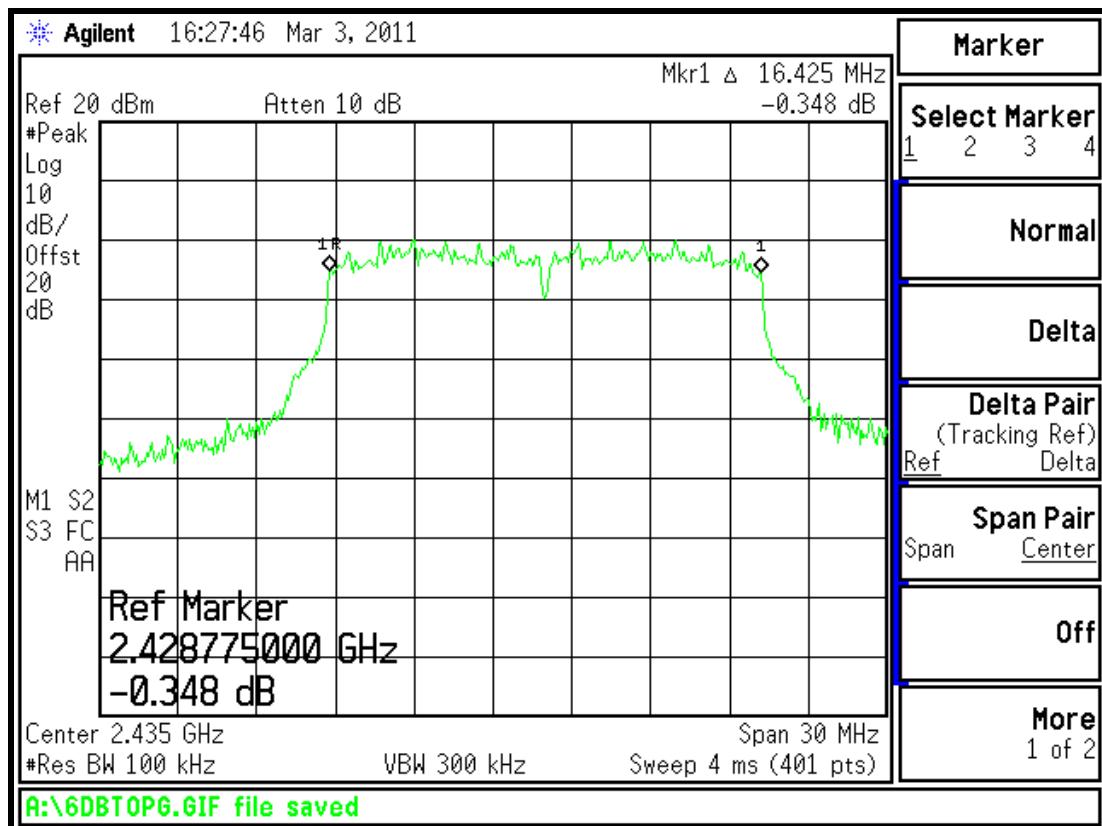
6 dB Bandwidth – 11Mbps – 2437MHz



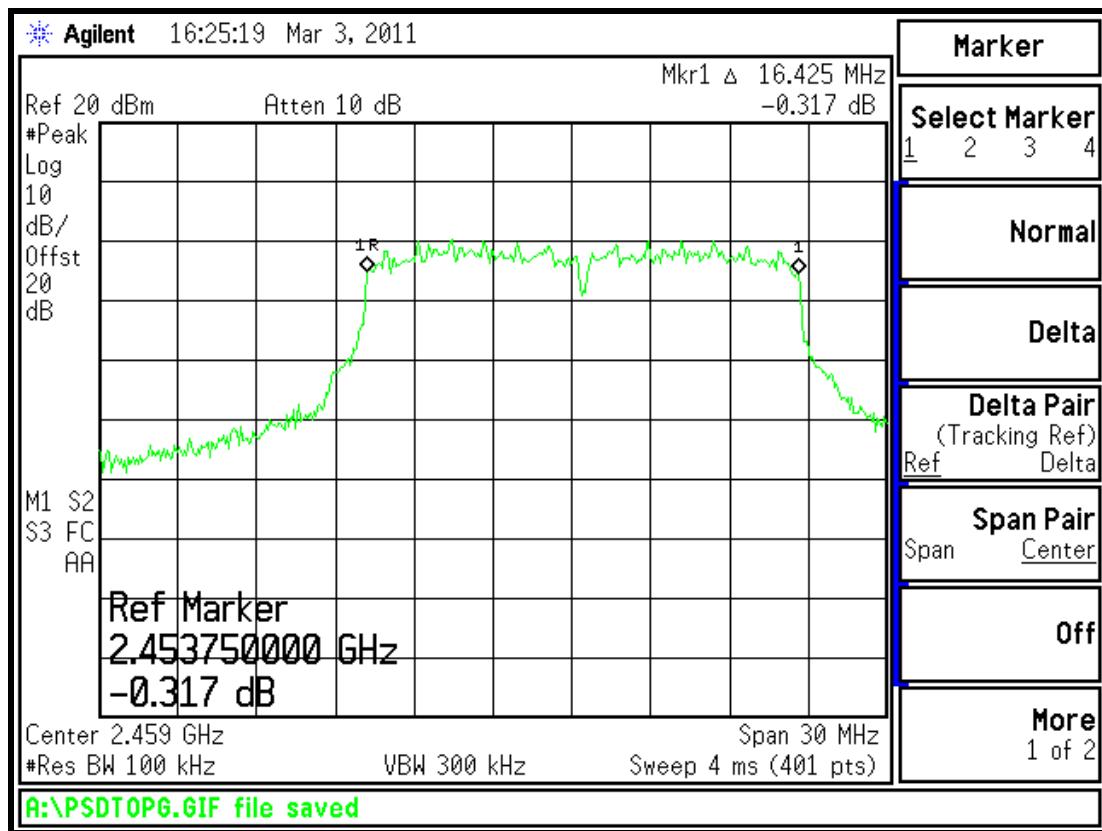
6dB Bandwidth – 11Mbps – 2462MHz



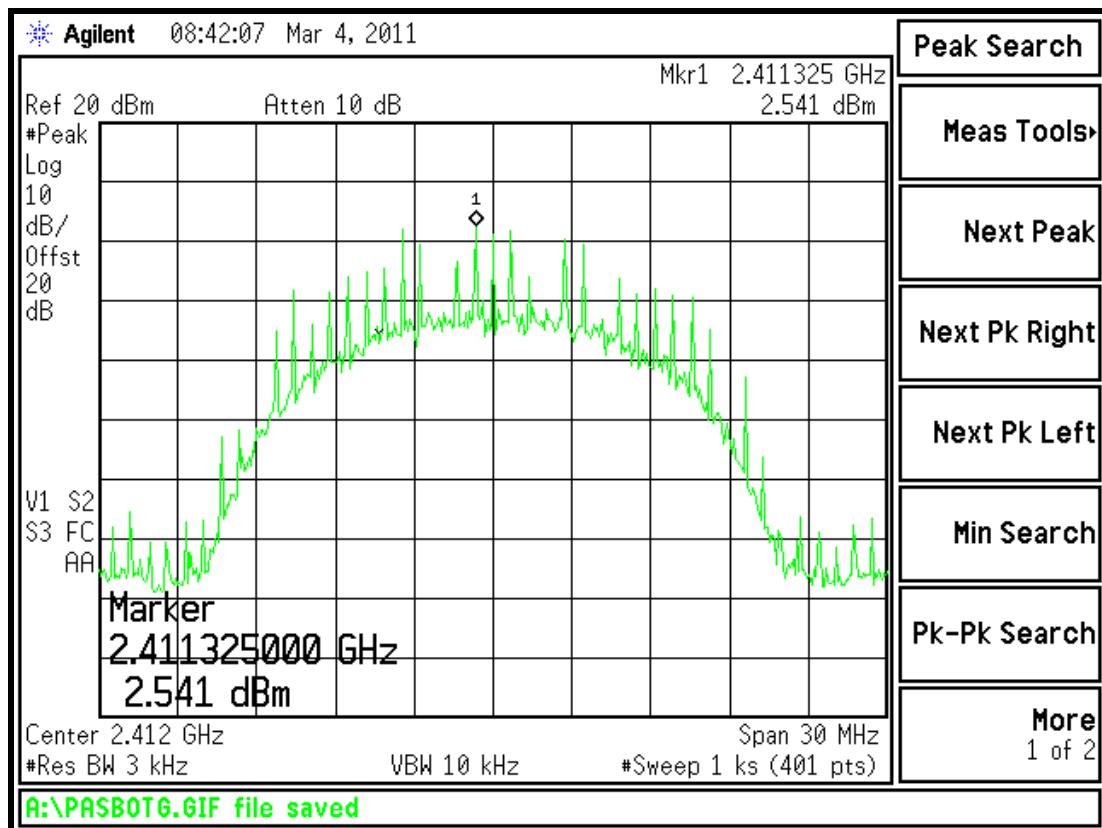
6dB Bandwidth – 54Mbps – 2412MHz



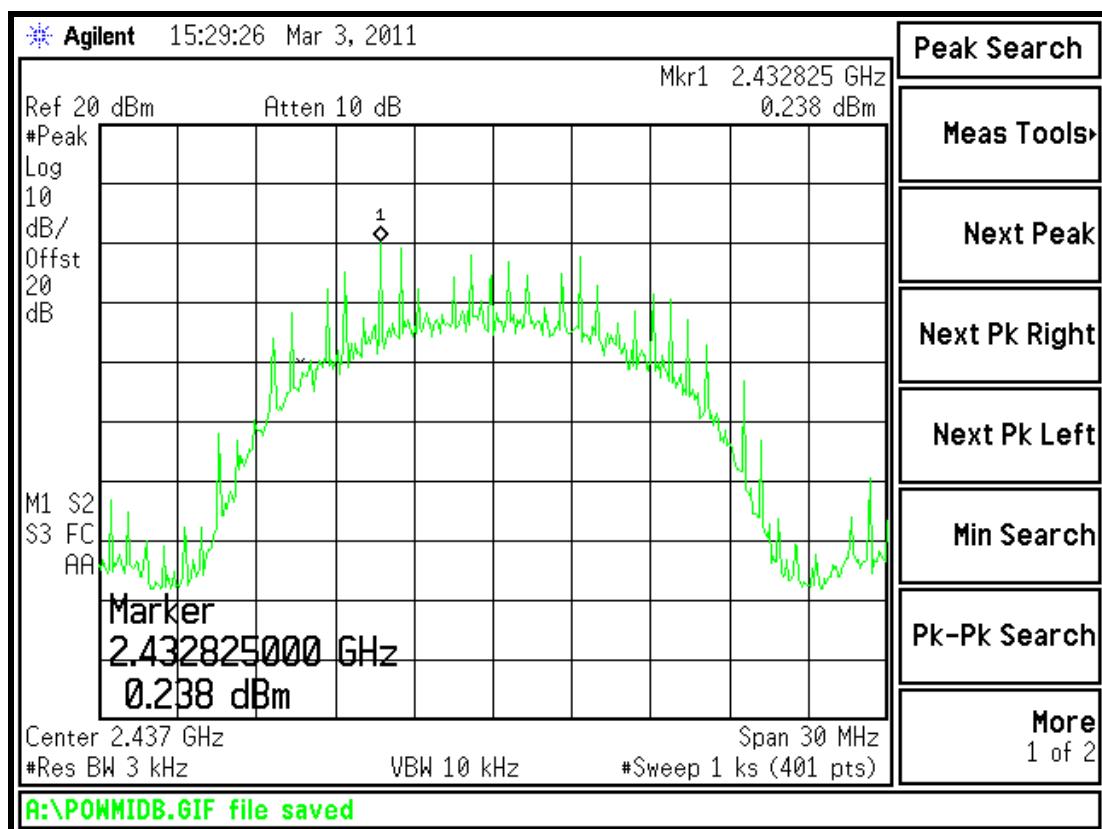
6dB Bandwidth – 54Mbps – 2437MHz



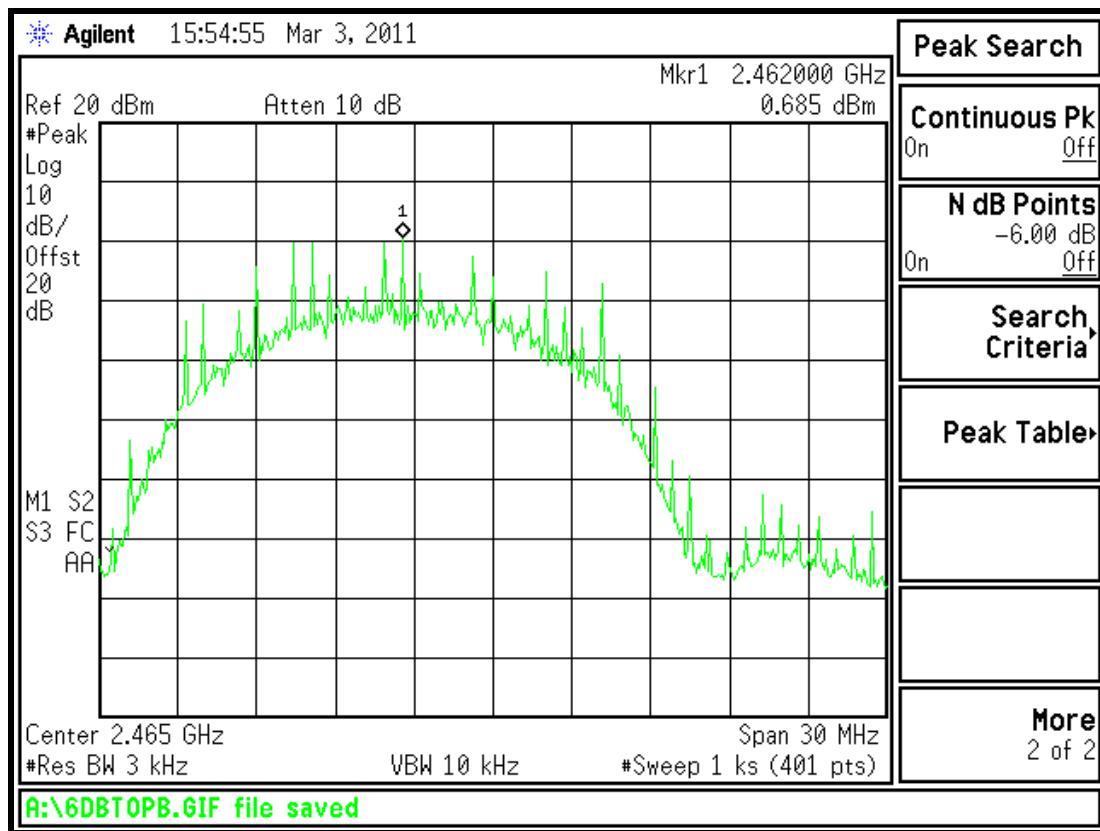
6dB Bandwidth – 54Mbps – 2462MHz



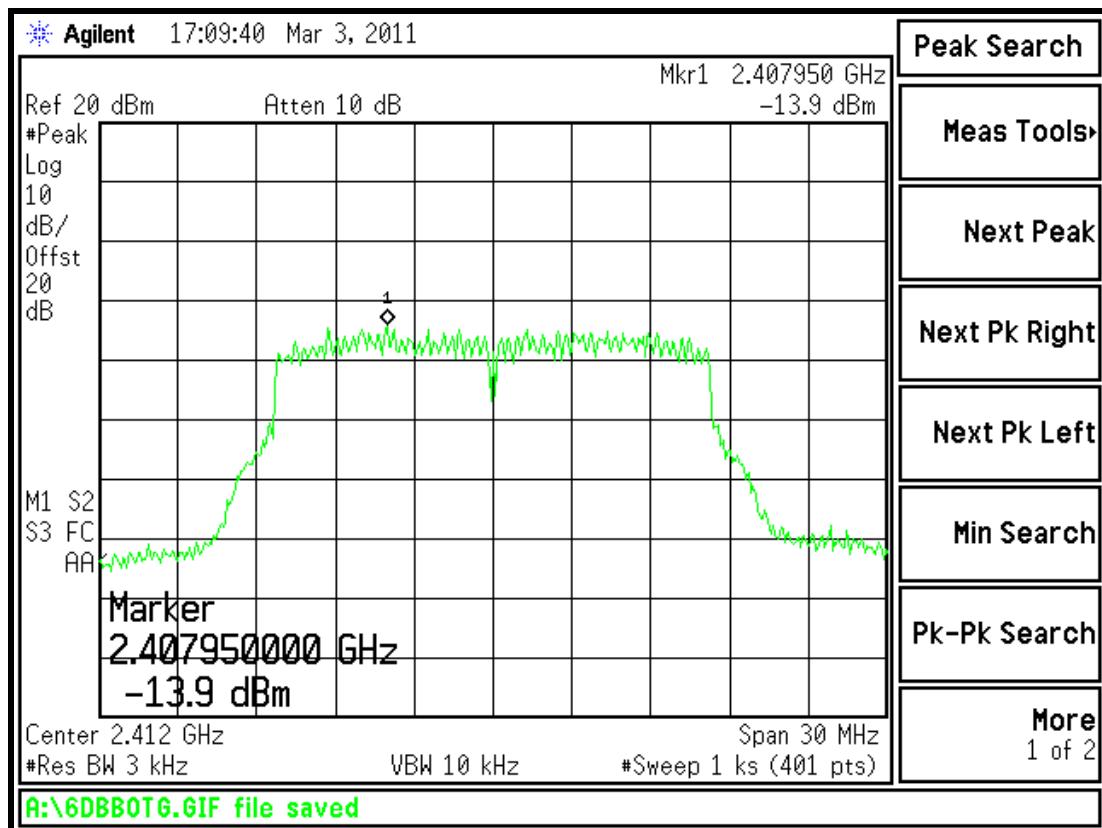
Power spectral density – 11Mbps – 2412MHz



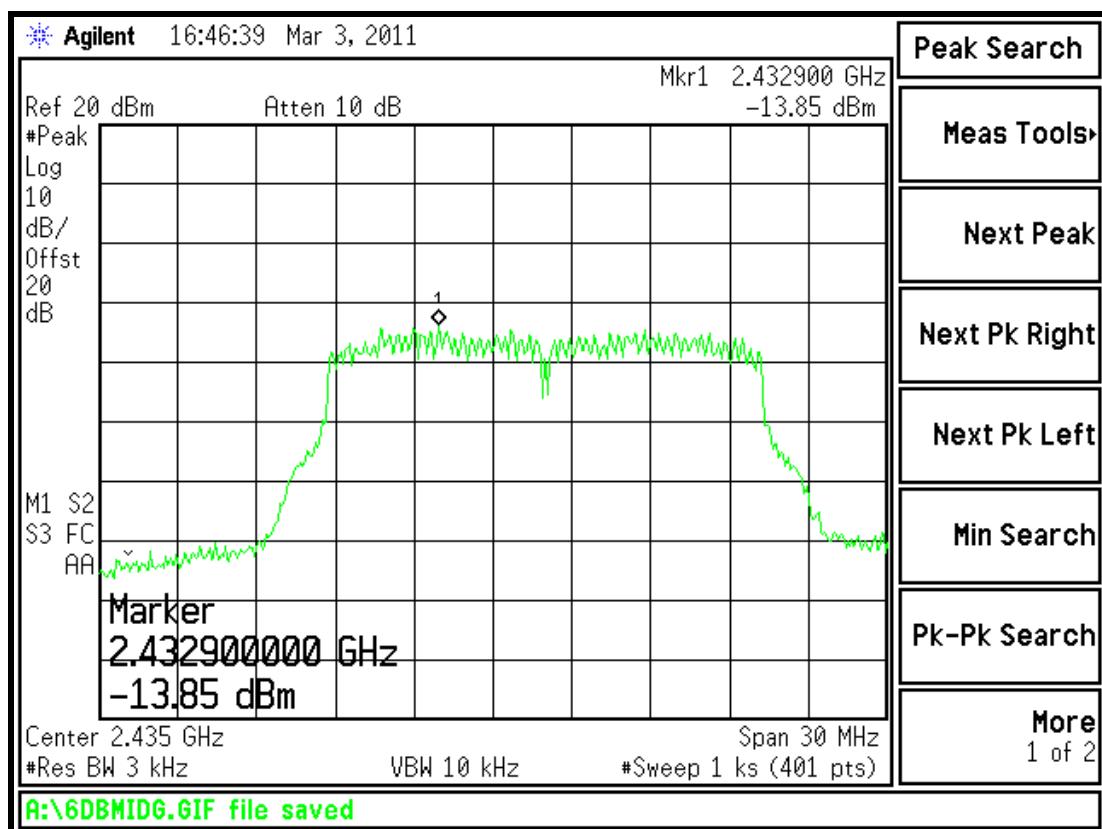
Power spectral density – 11Mbps – 2437MHz



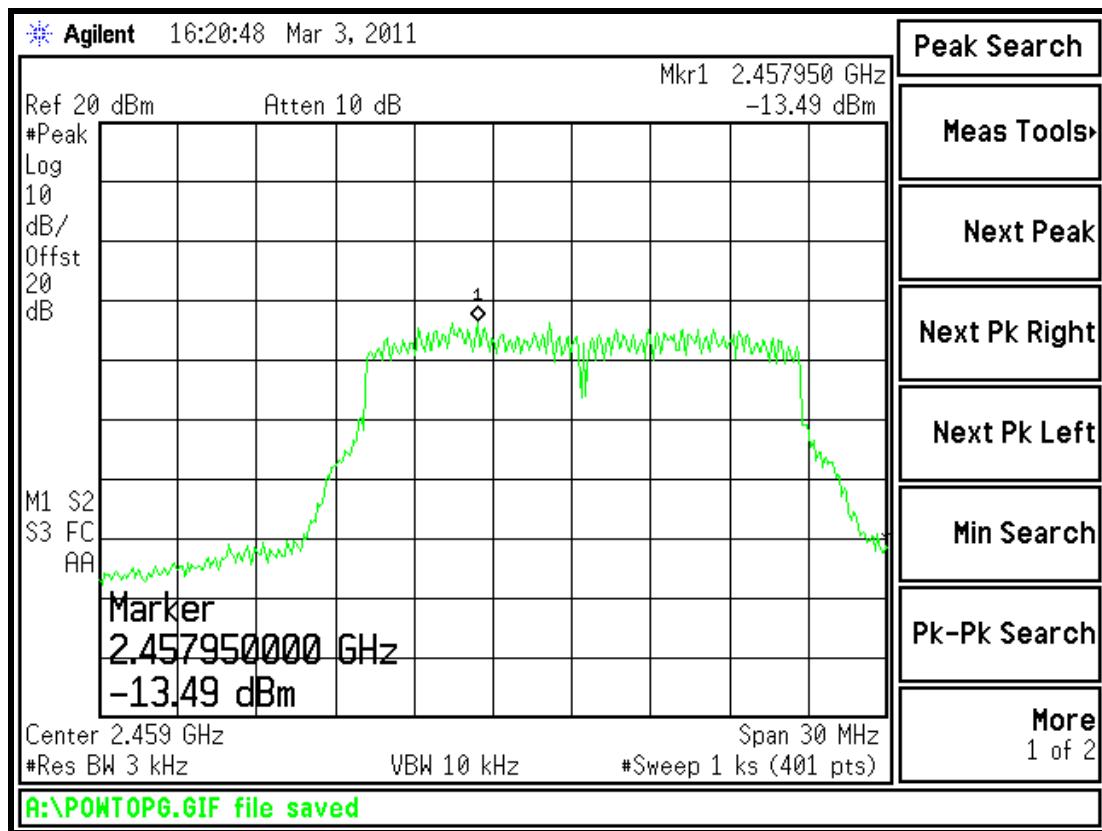
Power spectral density – 11Mbps – 2462MHz



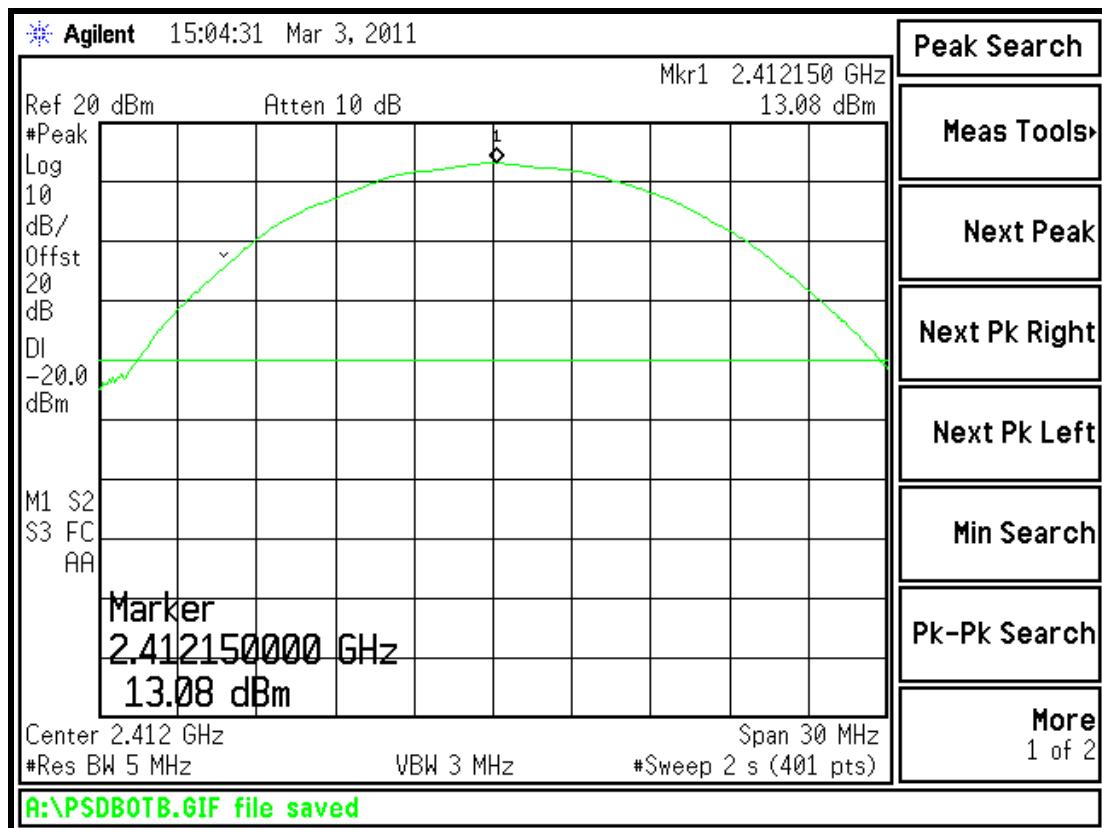
Power spectral density – 54Mbps – 2412MHz



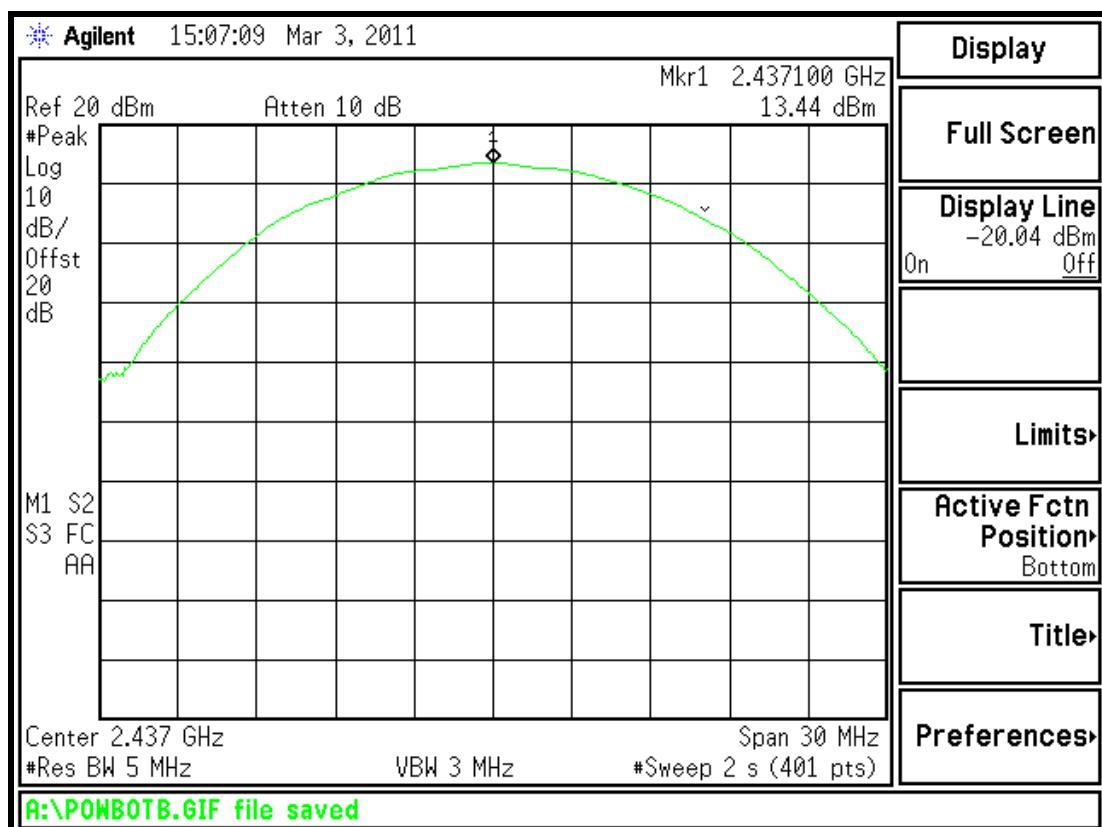
Power spectral density – 54Mbps – 2437MHz



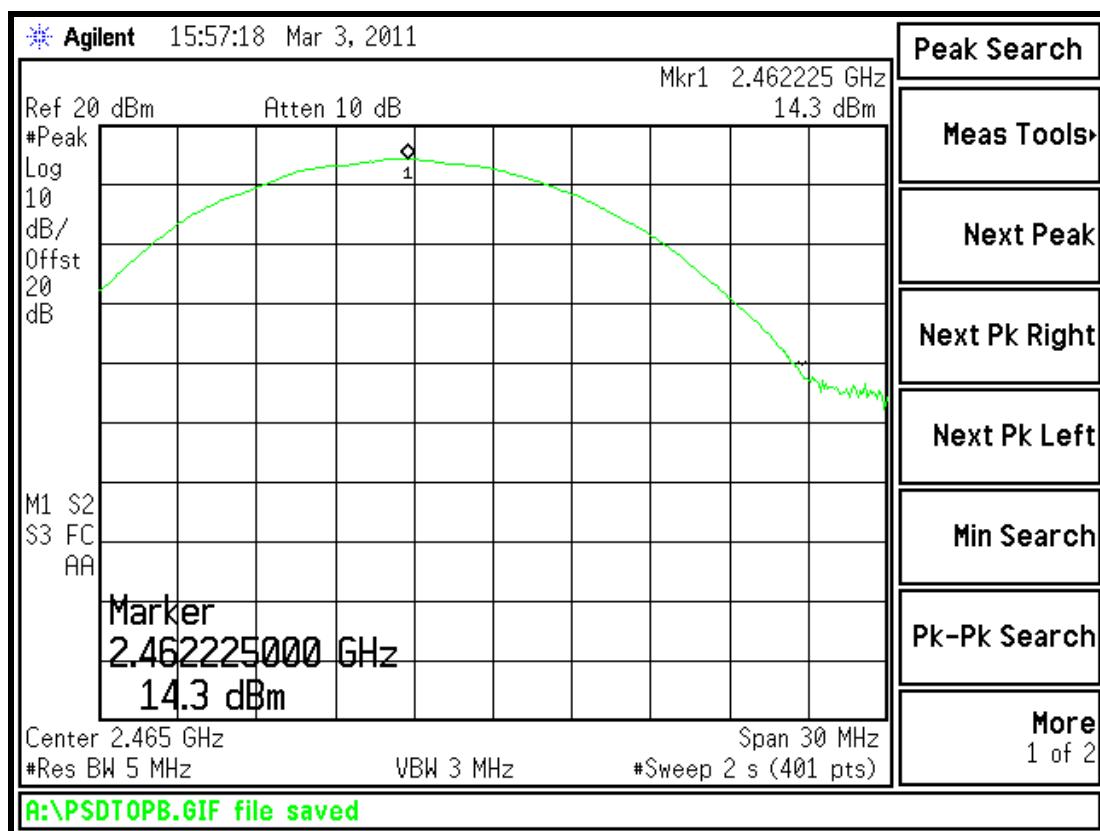
Power spectral density – 54Mbps – 2462MHz



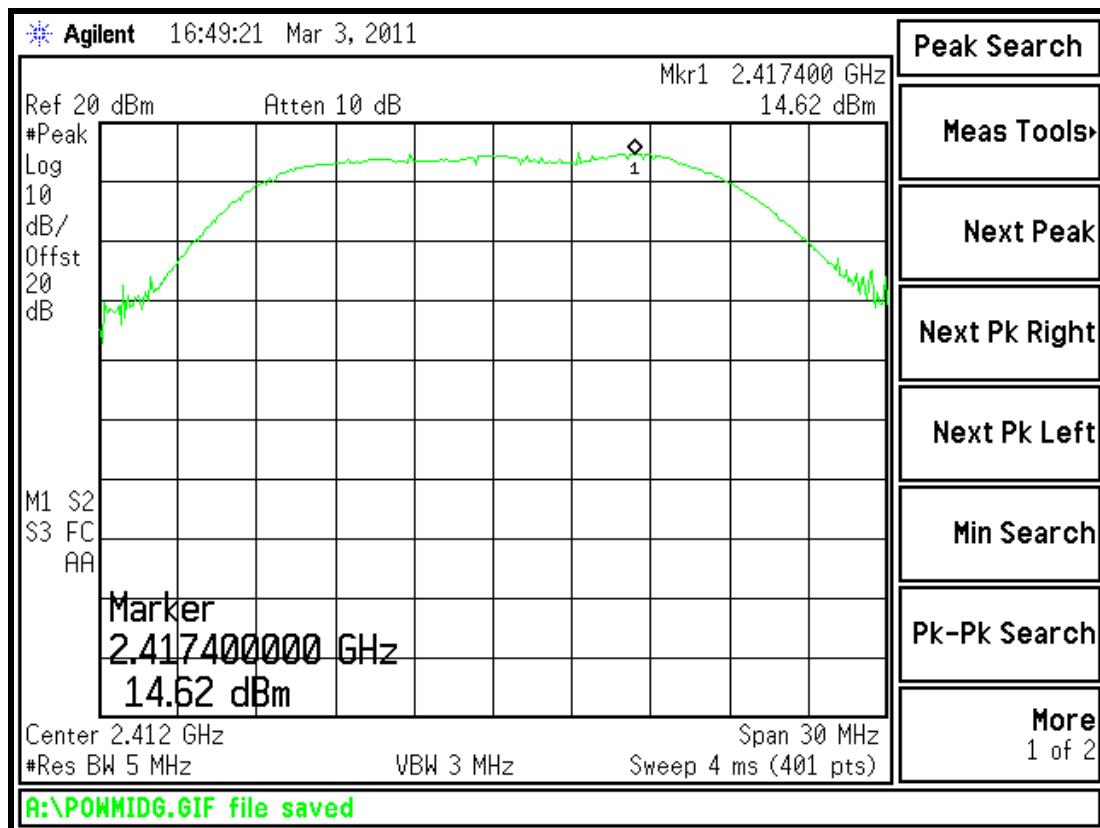
Conducted carrier power 2412MHz – 11Mbps



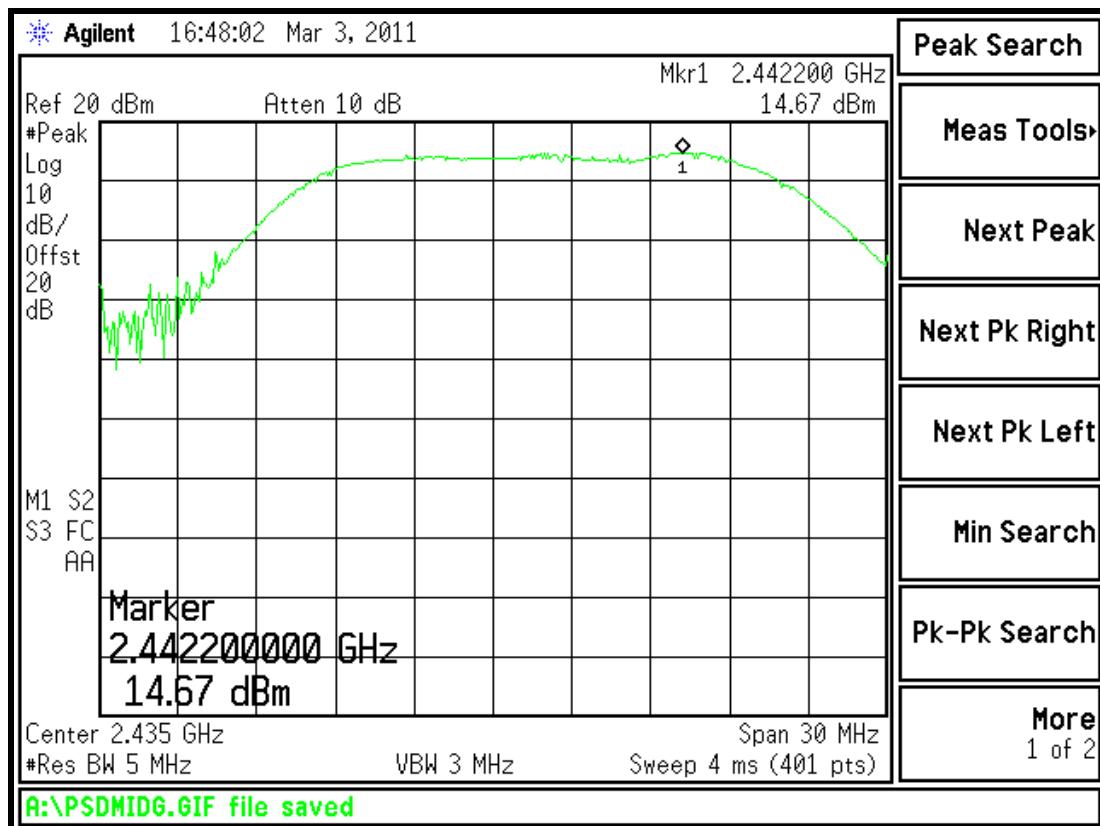
Conducted carrier power 2437MHz – 11Mbps



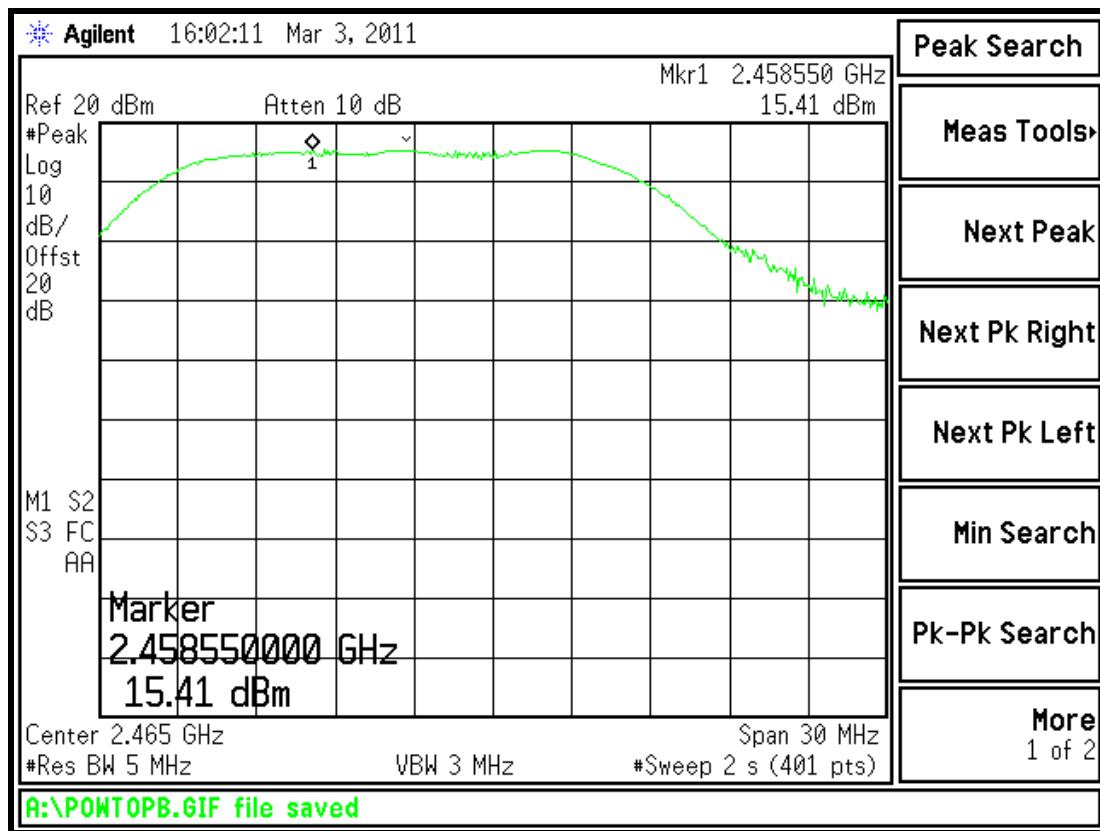
Conducted carrier power 2462MHz – 11Mbps



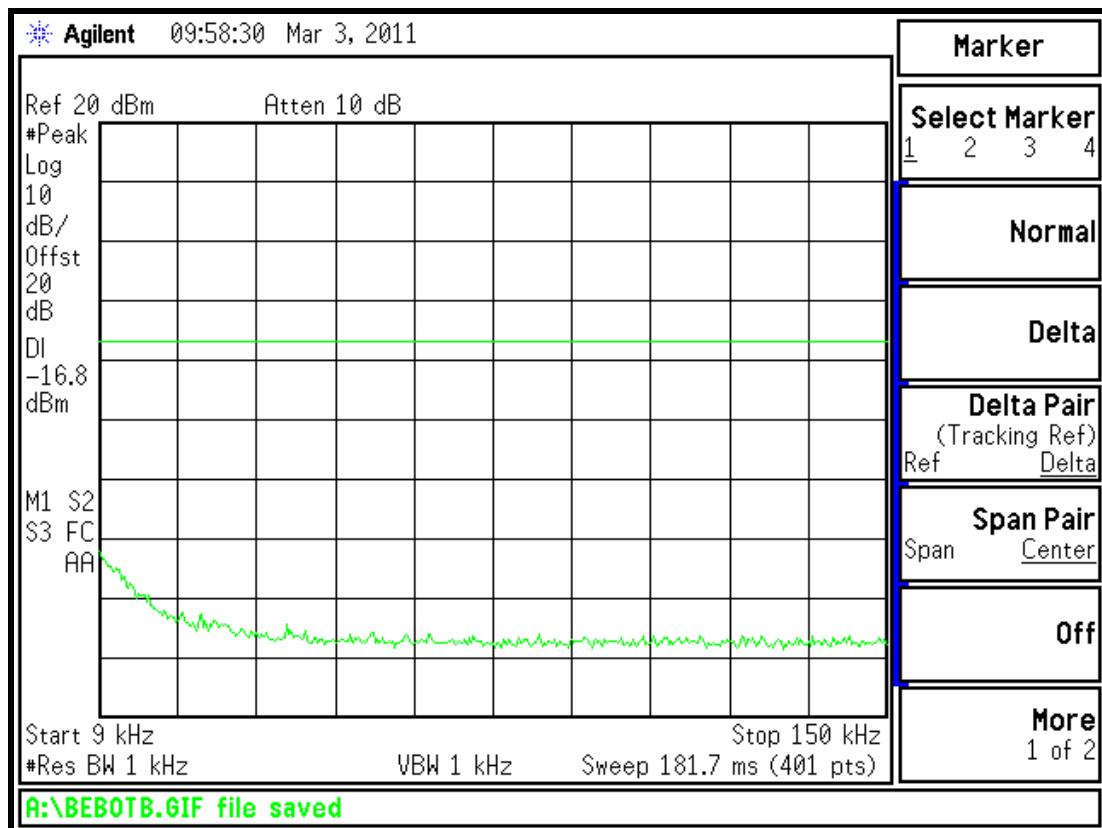
Conducted carrier power 2412MHz – 54Mbps



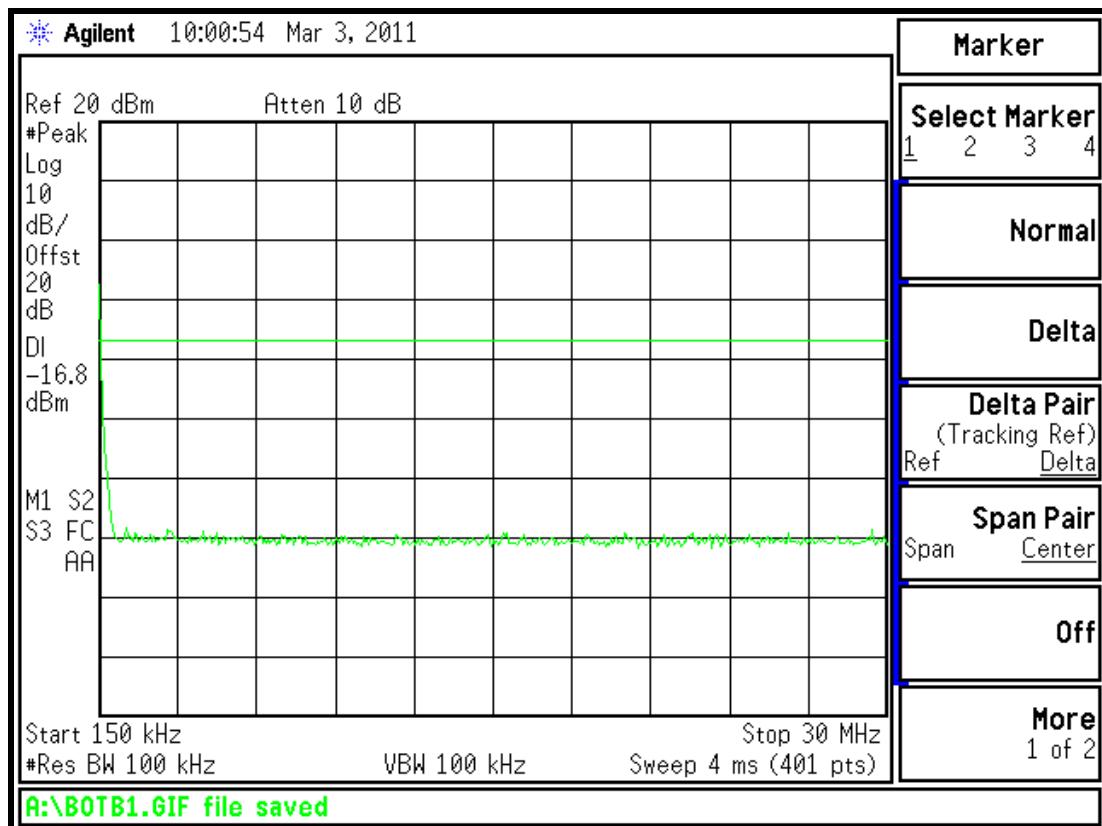
Conducted carrier power 2437MHz – 54Mbps



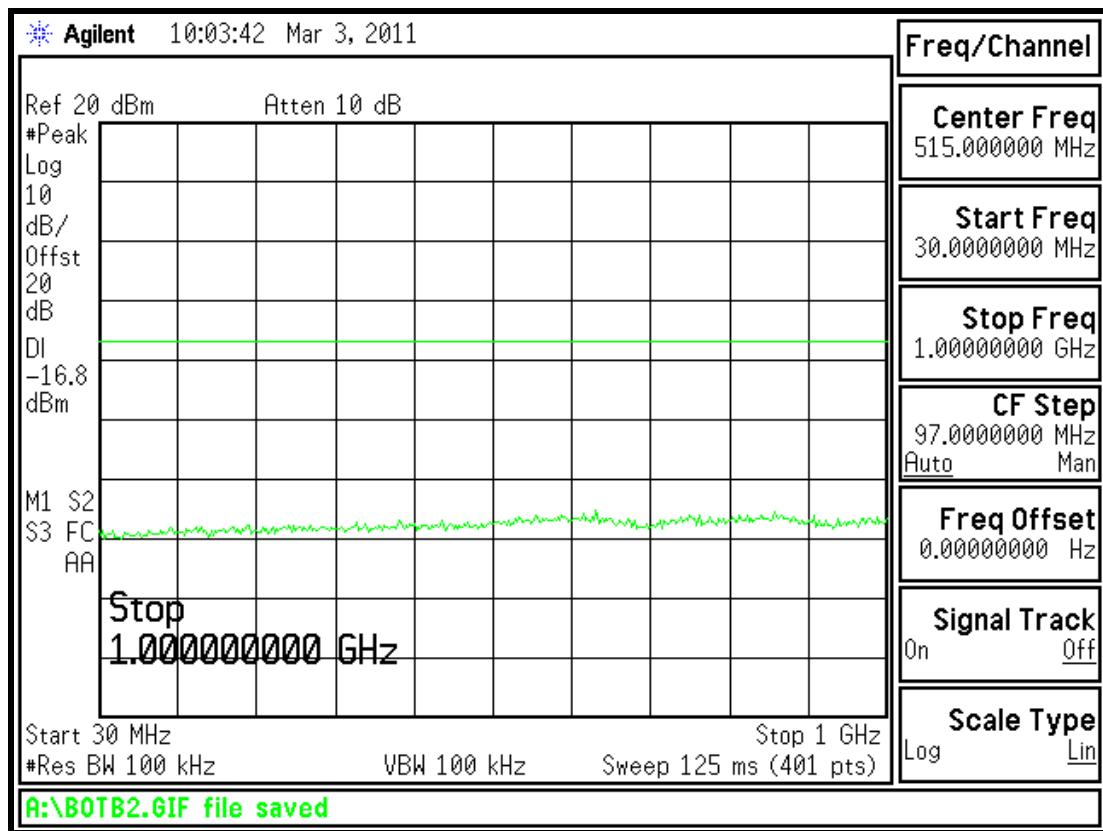
Conducted carrier power 2462MHz – 54Mbps



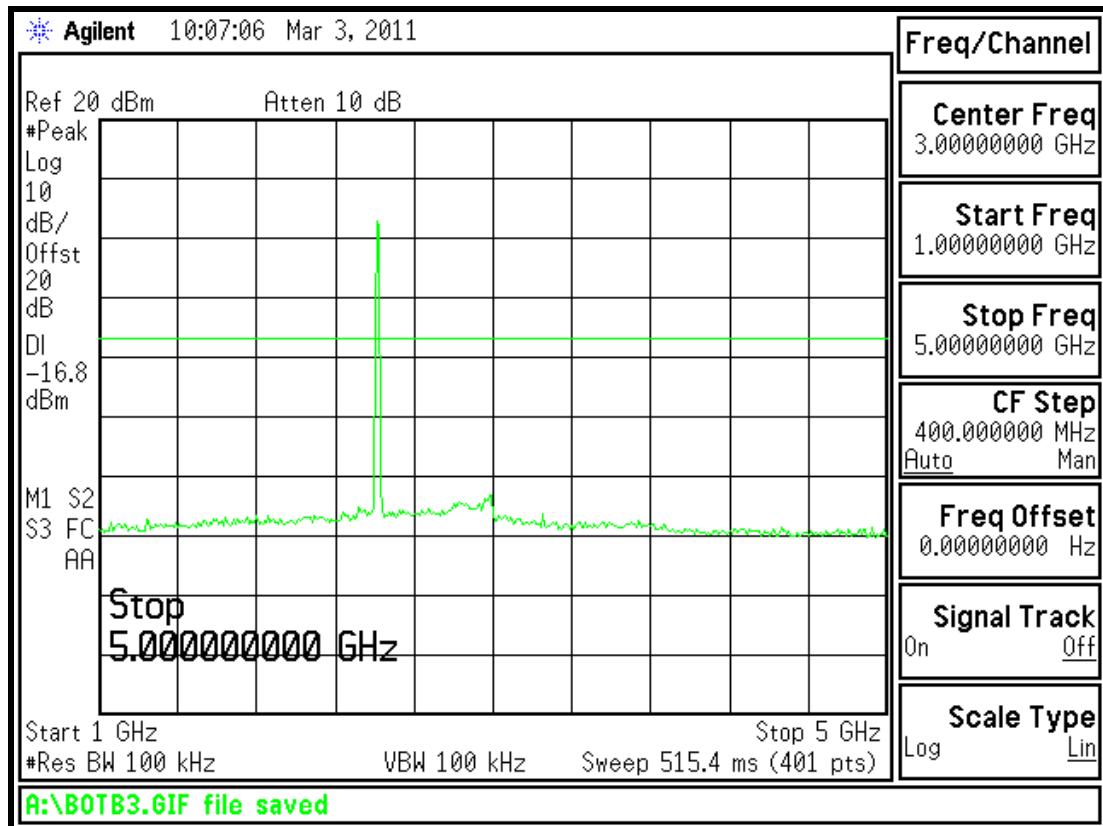
Conducted spurious emissions 9 kHz to 150 kHz – 2412MHz – 11Mbps



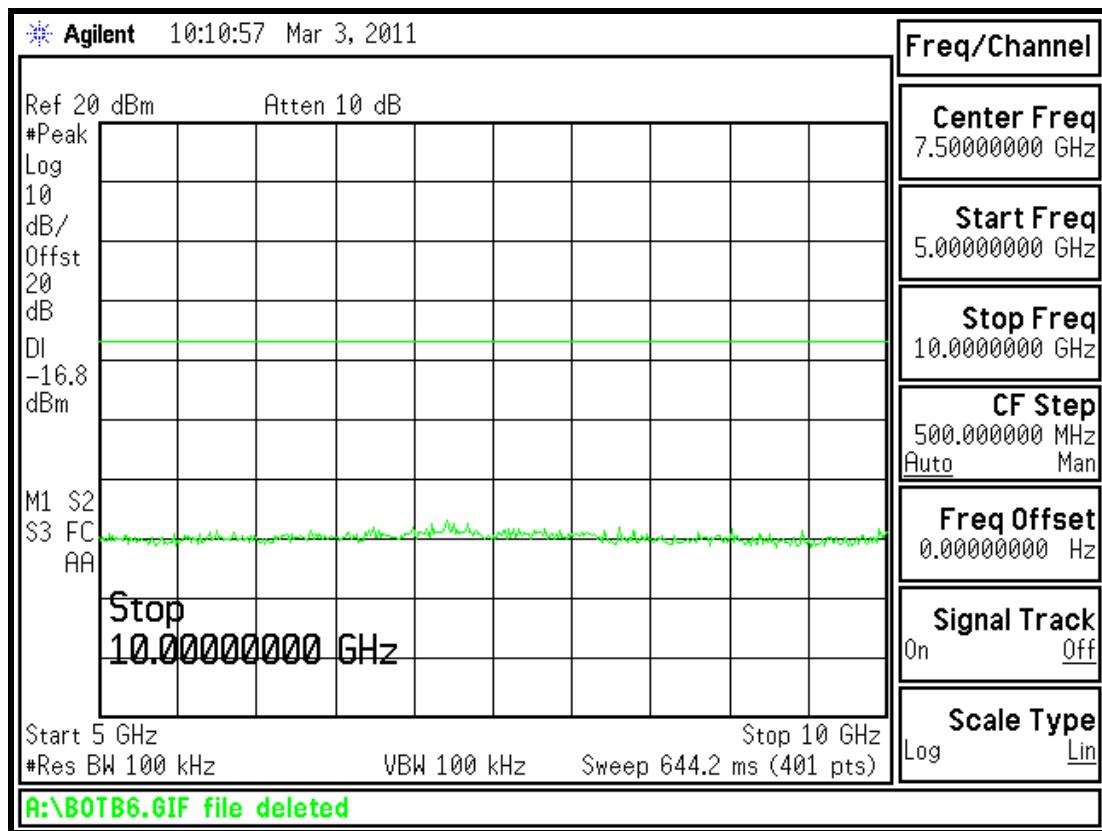
Conducted spurious emissions 150 kHz to 30 MHz – 2412MHz – 11Mbps



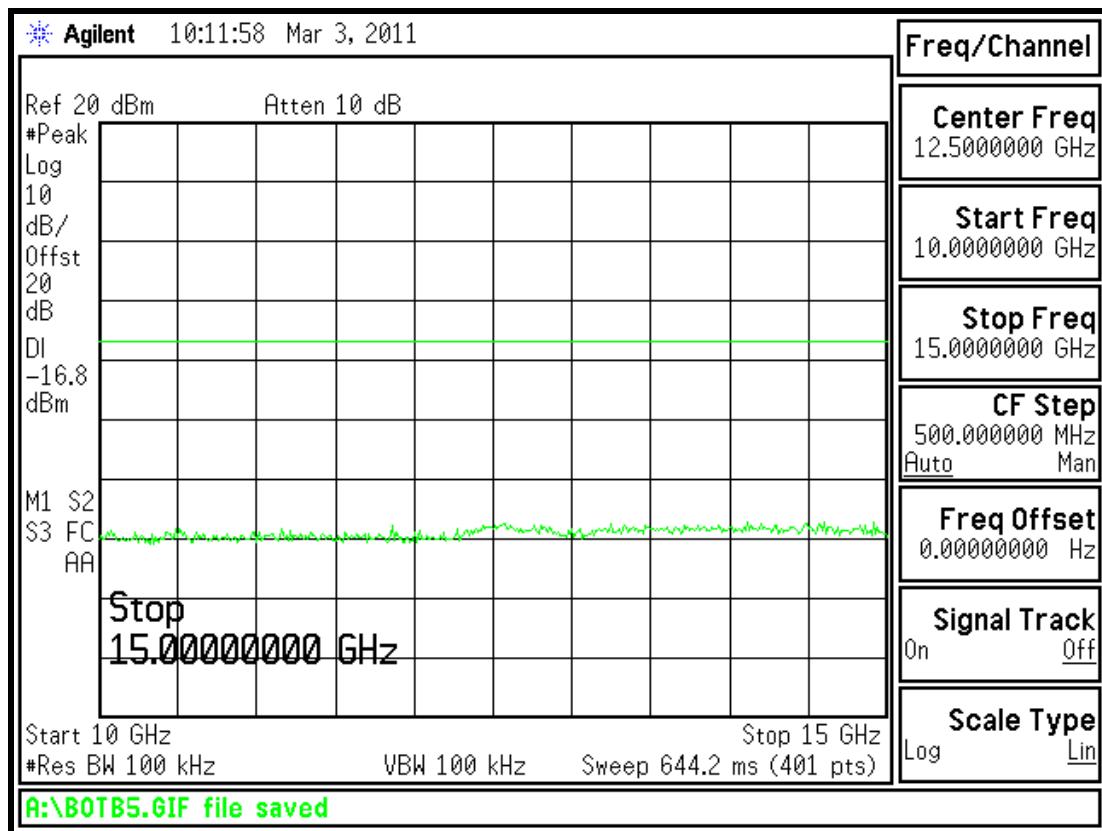
Conducted spurious emissions 30 MHz to 1 GHz – 2412MHz – 11Mbps



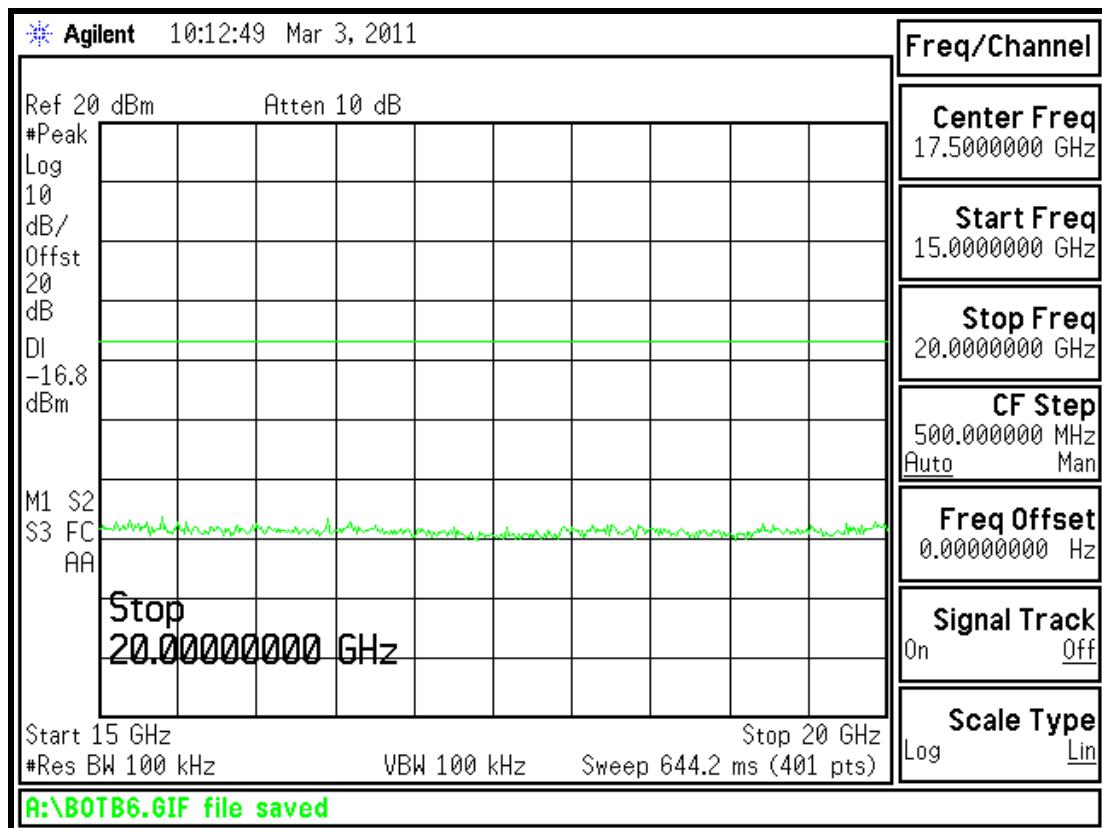
Conducted spurious emissions 1 GHz to 5 GHz – 2412MHz – 11Mbps



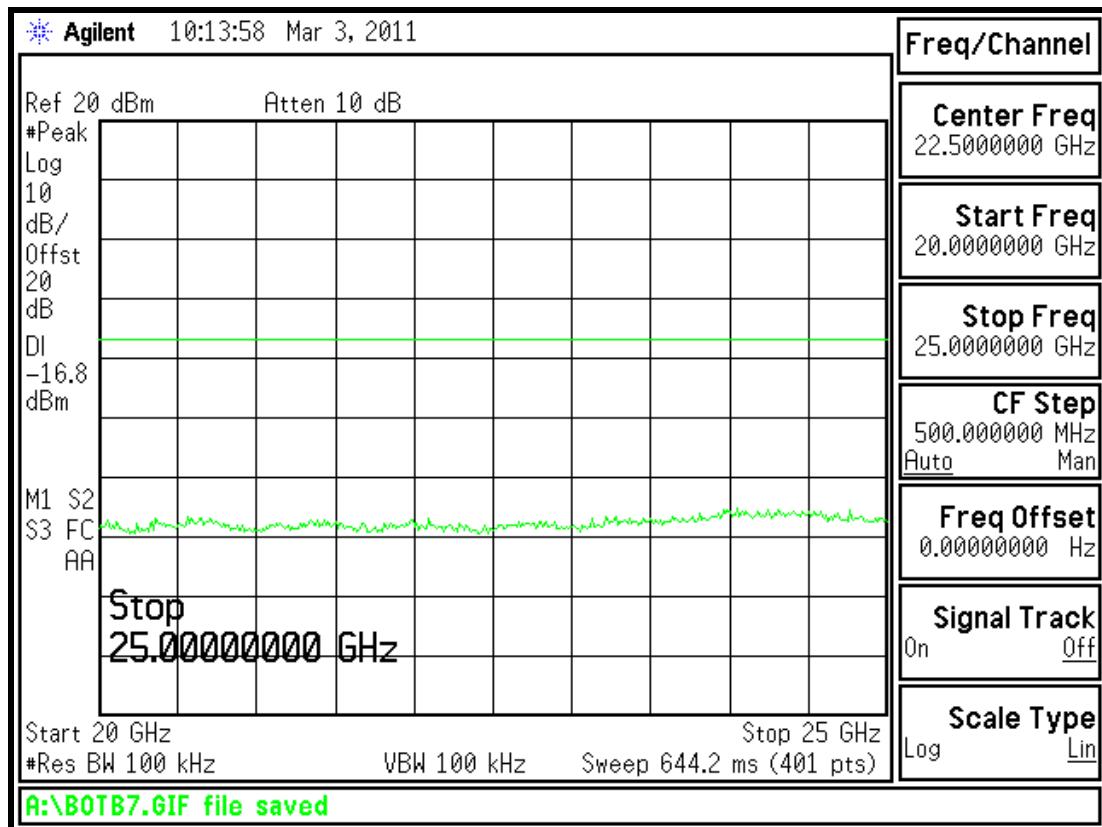
Conducted spurious emissions 5 GHz to 10 GHz – 2412MHz – 11Mbps



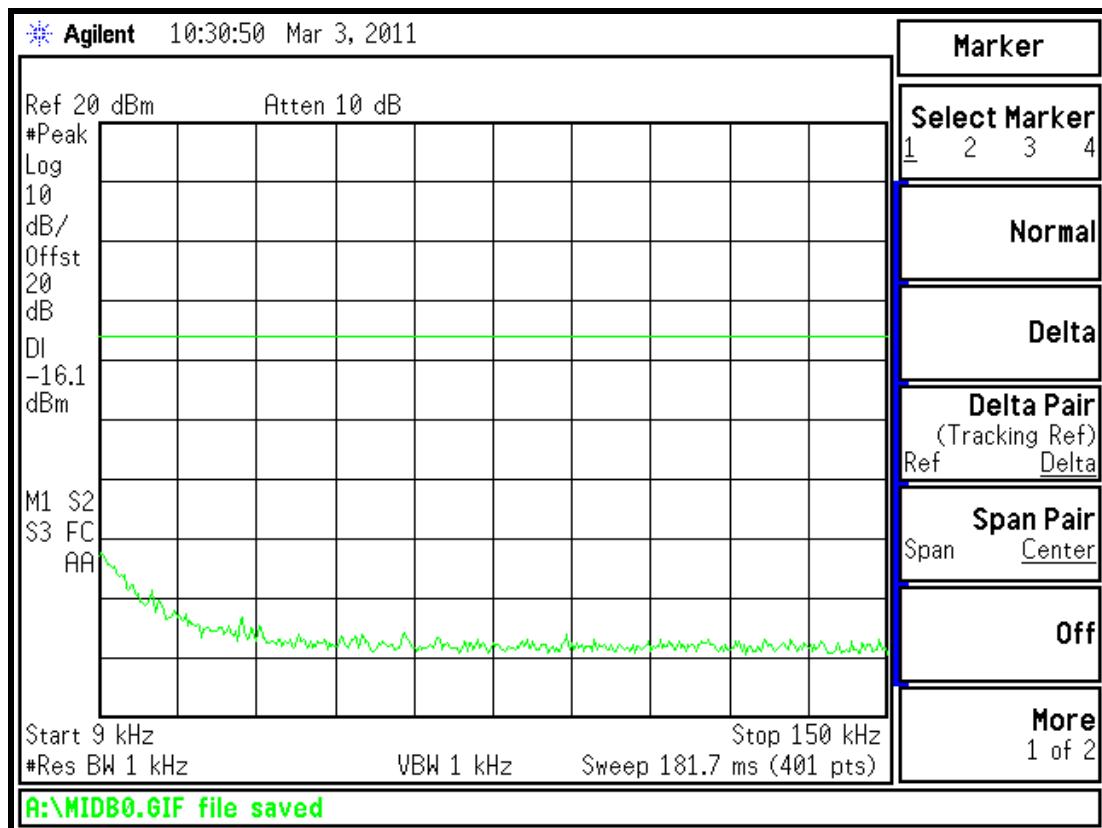
Conducted spurious emissions 10 GHz to 15 GHz – 2412MHz – 11Mbps



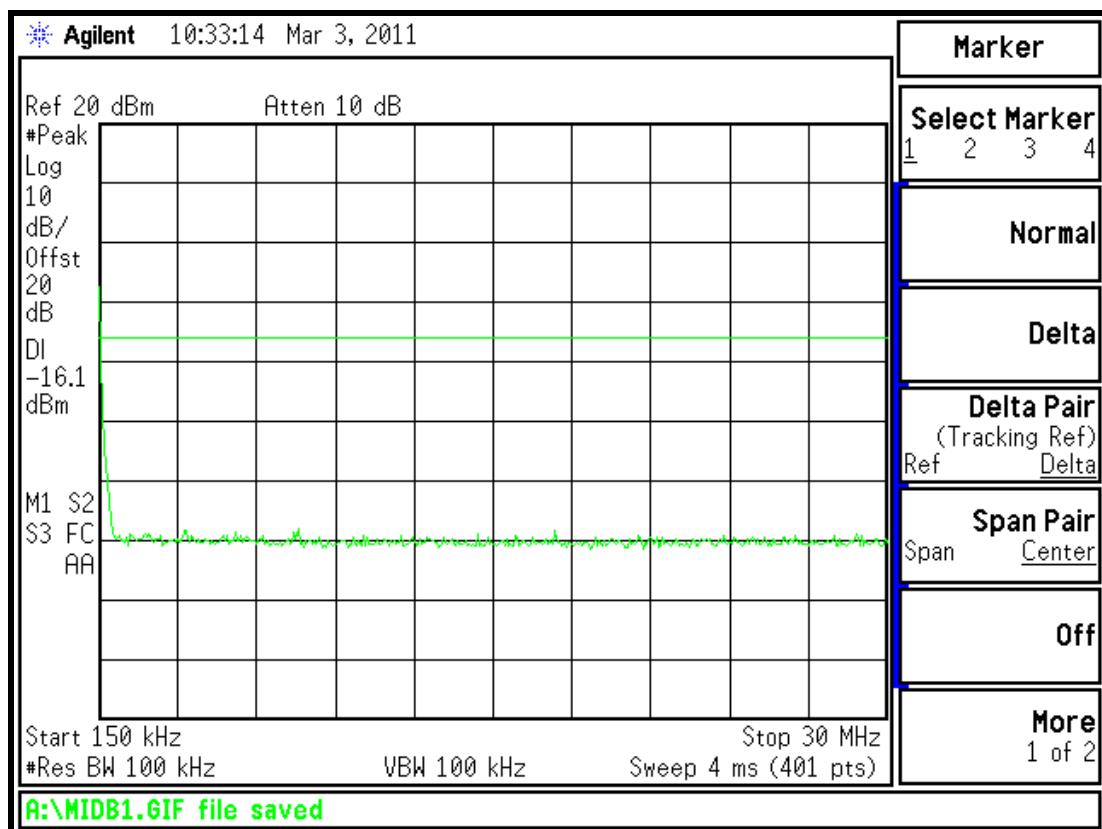
Conducted spurious emissions 15 GHz to 20 GHz – 2412MHz – 11Mbps



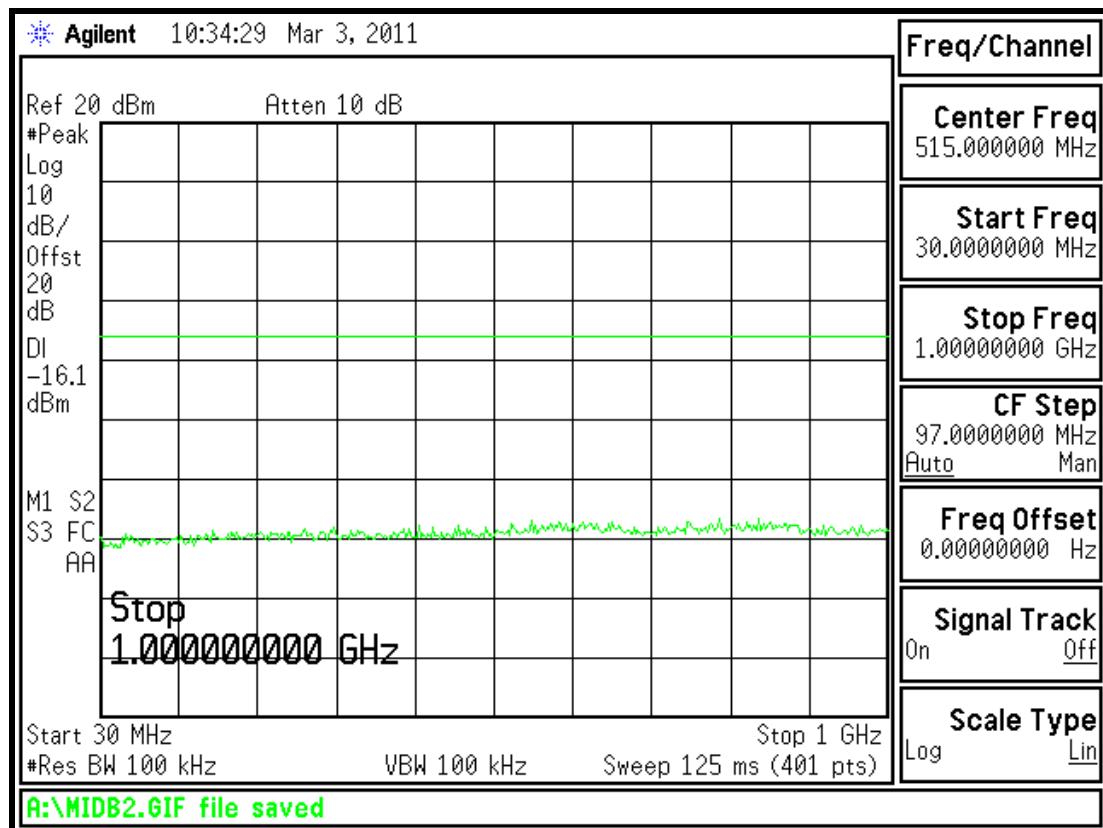
Conducted spurious emissions 20 GHz to 25 GHz – 2412MHz 11Mbps



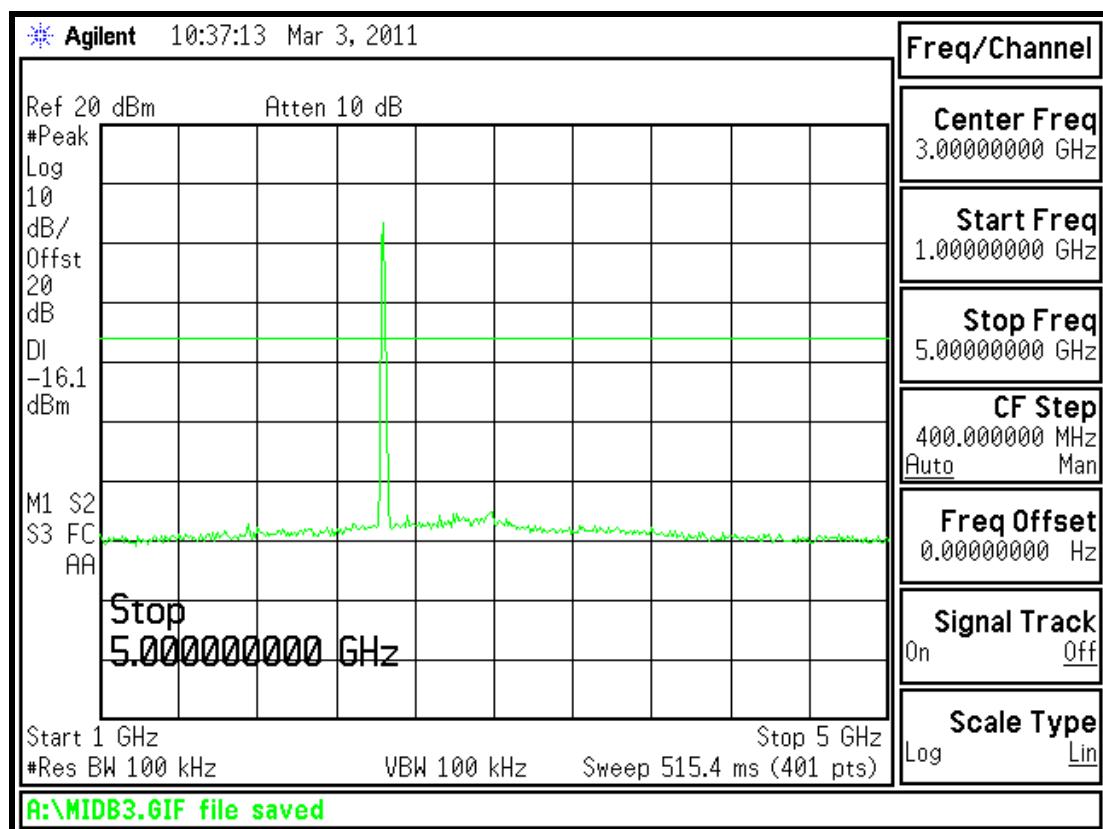
Conducted spurious emissions 9 kHz to 150 kHz – 2437MHz – 11Mbps



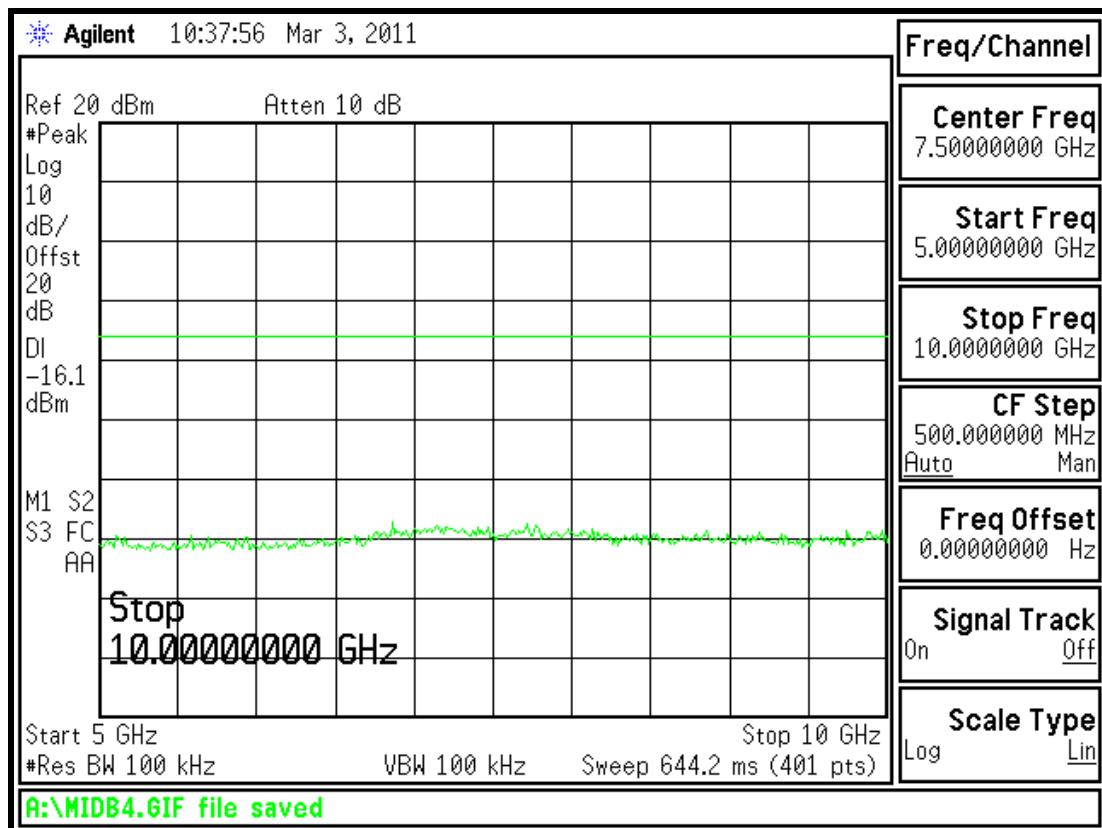
Conducted spurious emissions 150 kHz to 30 MHz – 2437MHz – 11Mbps



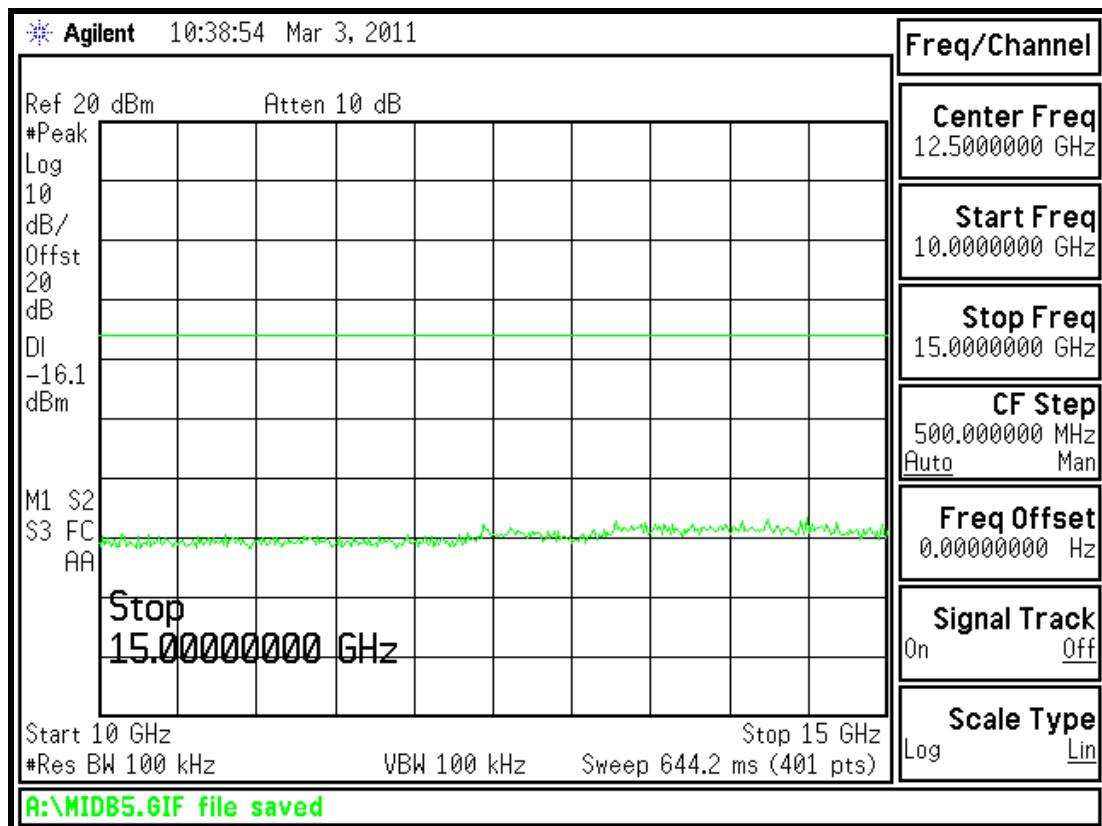
Conducted Spurious emissions 30 MHz to 1 GHz – 2437MHz – 11Mbps



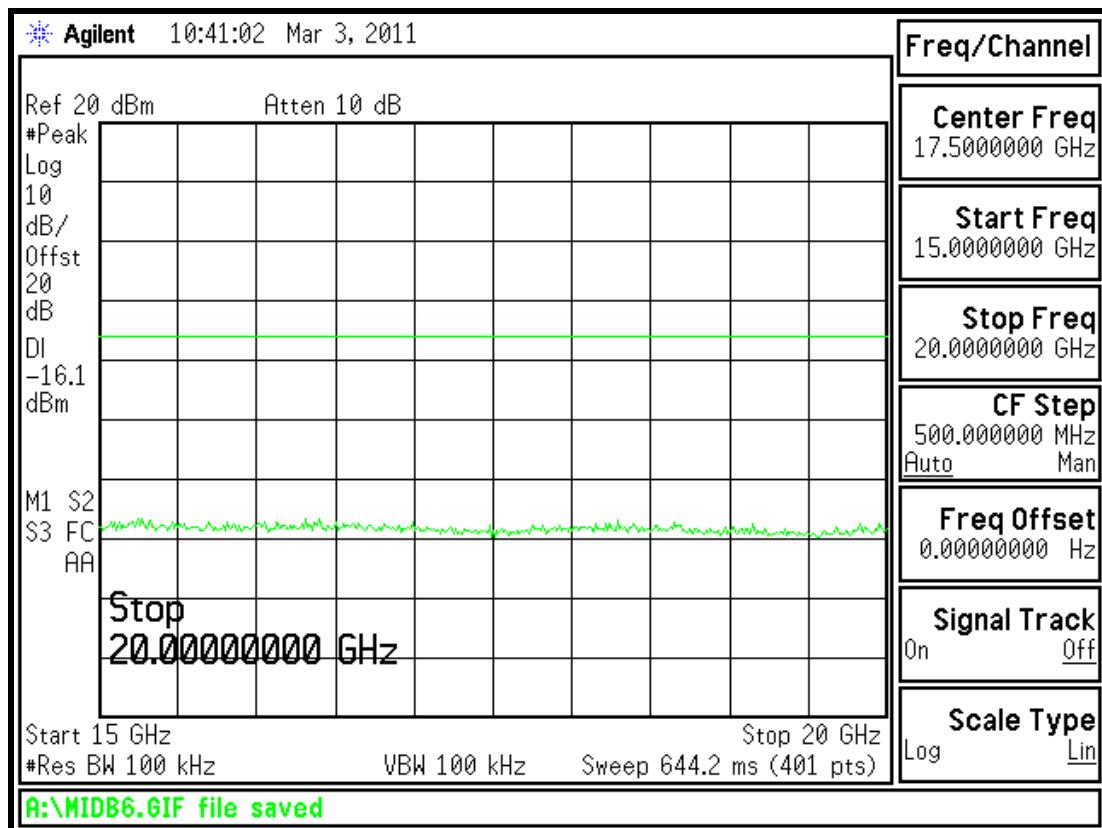
Conducted Spurious emissions 1 GHz to 5 GHz – 2437MHz – 11Mbps



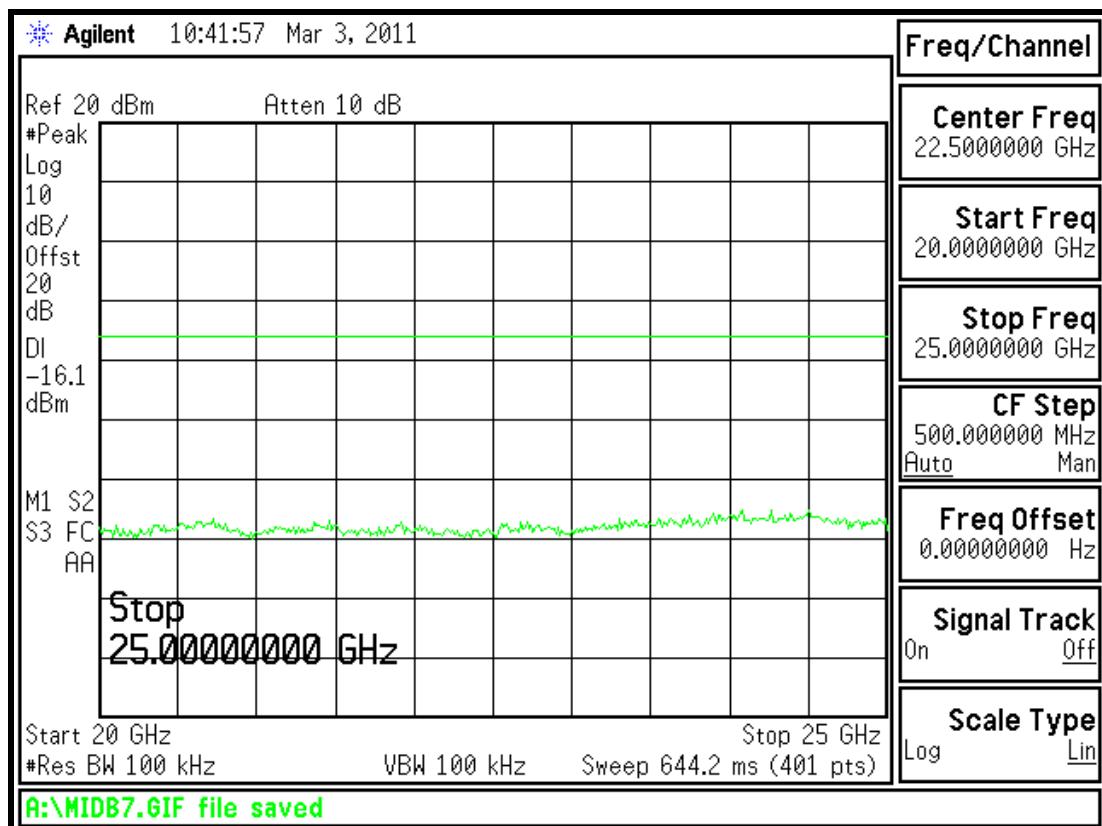
Conducted Spurious emissions 5 GHz to 10 GHz – 2437MHz – 11Mbps



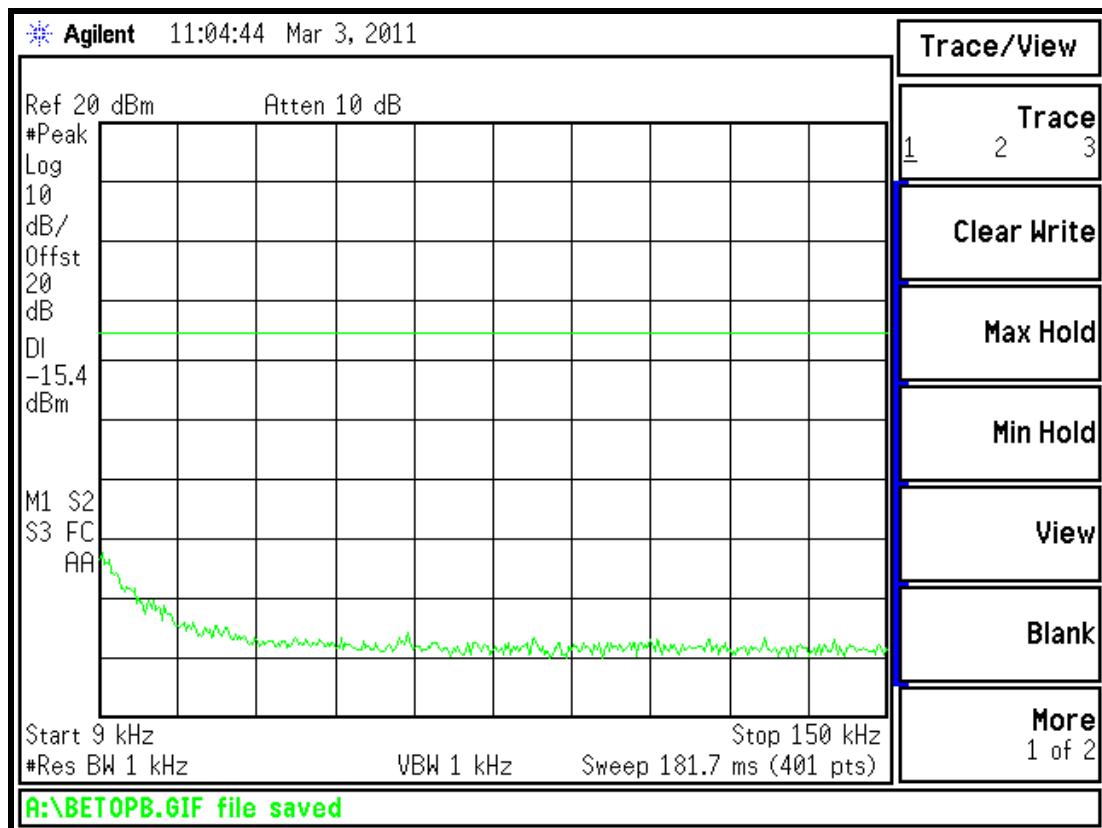
Conducted Spurious emissions 10 GHz to 15GHz – 2437MHz – 11Mbps



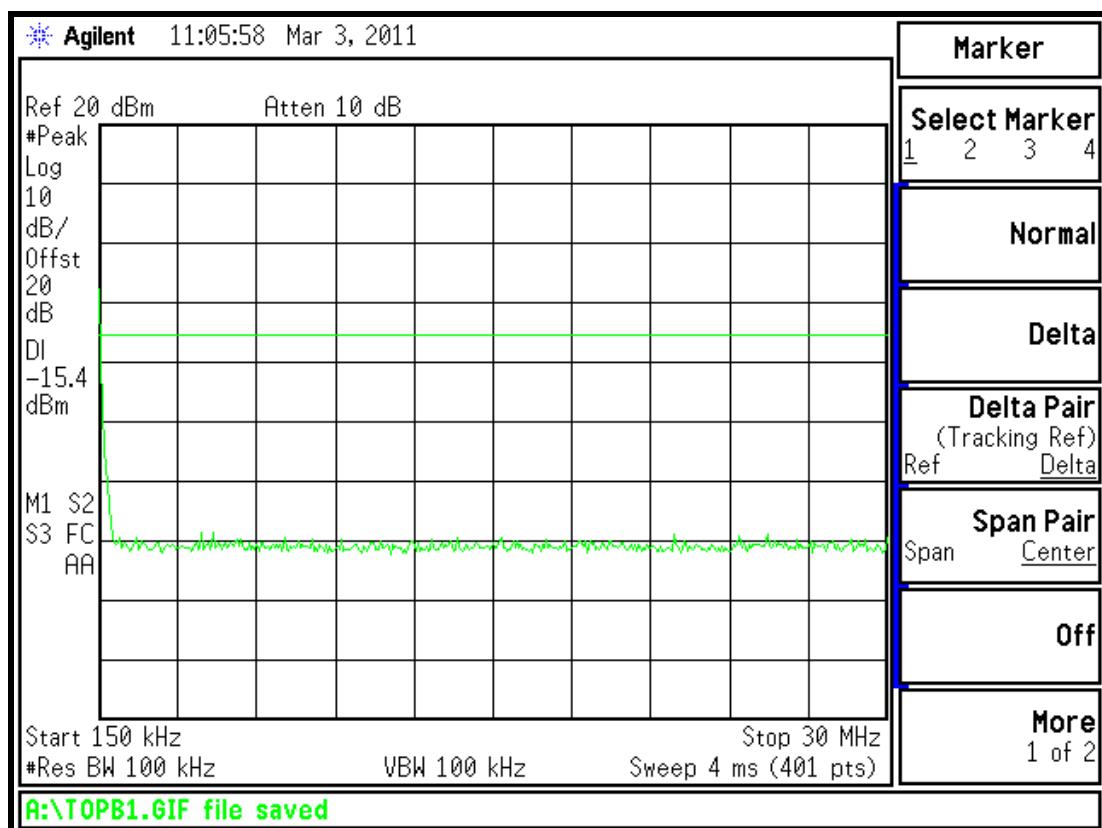
Conducted Spurious emissions 15 GHz to 20GHz – 2437MHz – 11Mbps



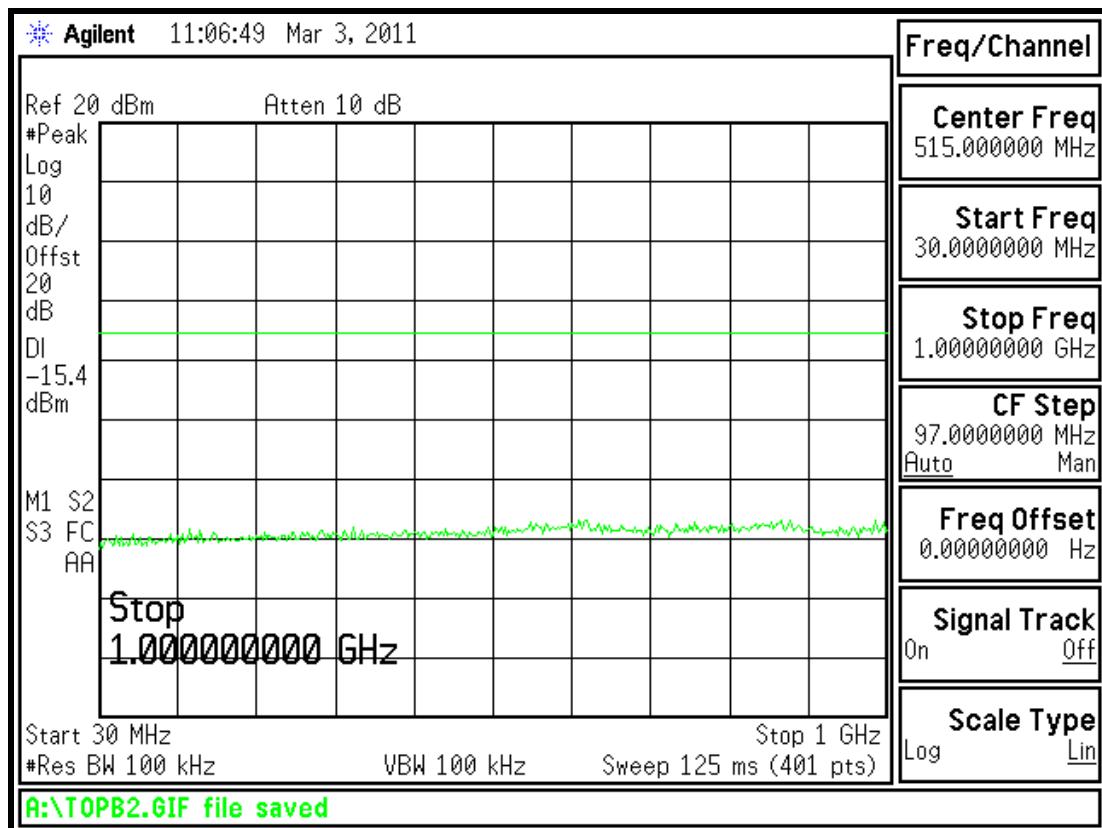
Conducted Spurious emissions 20 GHz to 25GHz – 2437MHz – 11Mbps



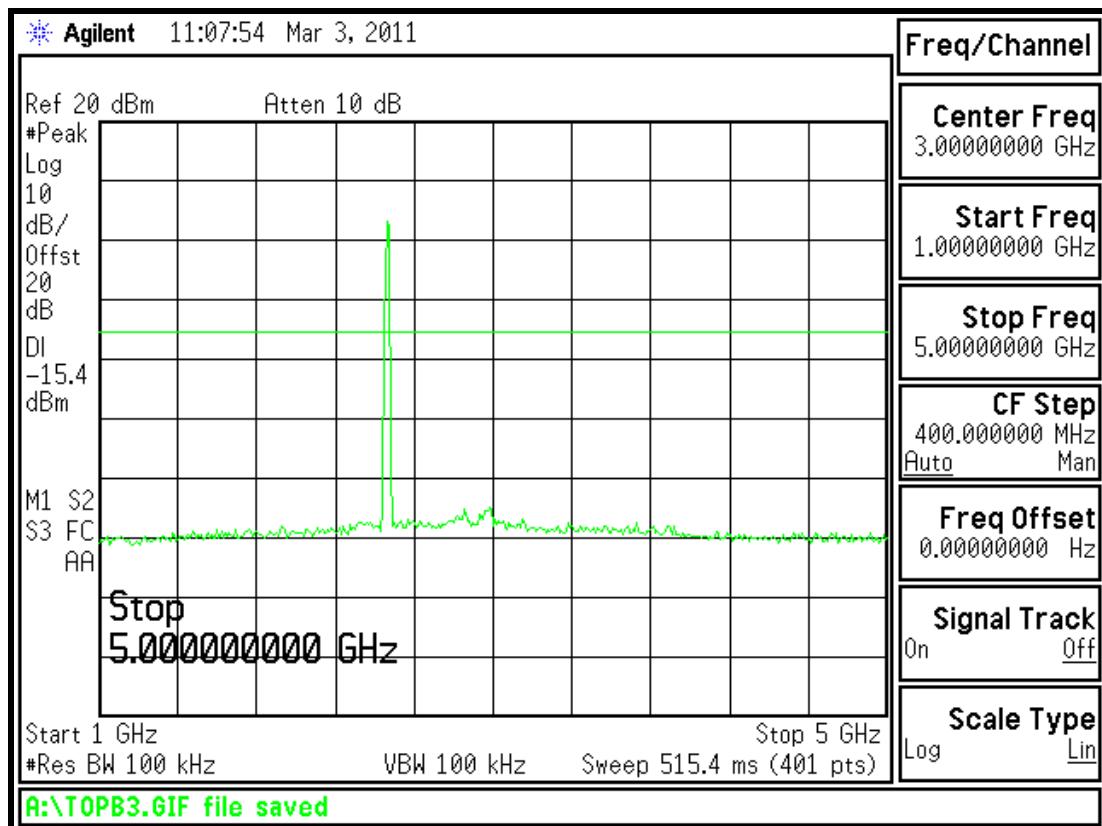
Conducted spurious emissions 9 kHz to 150 kHz – 2462MHz – 11Mbps



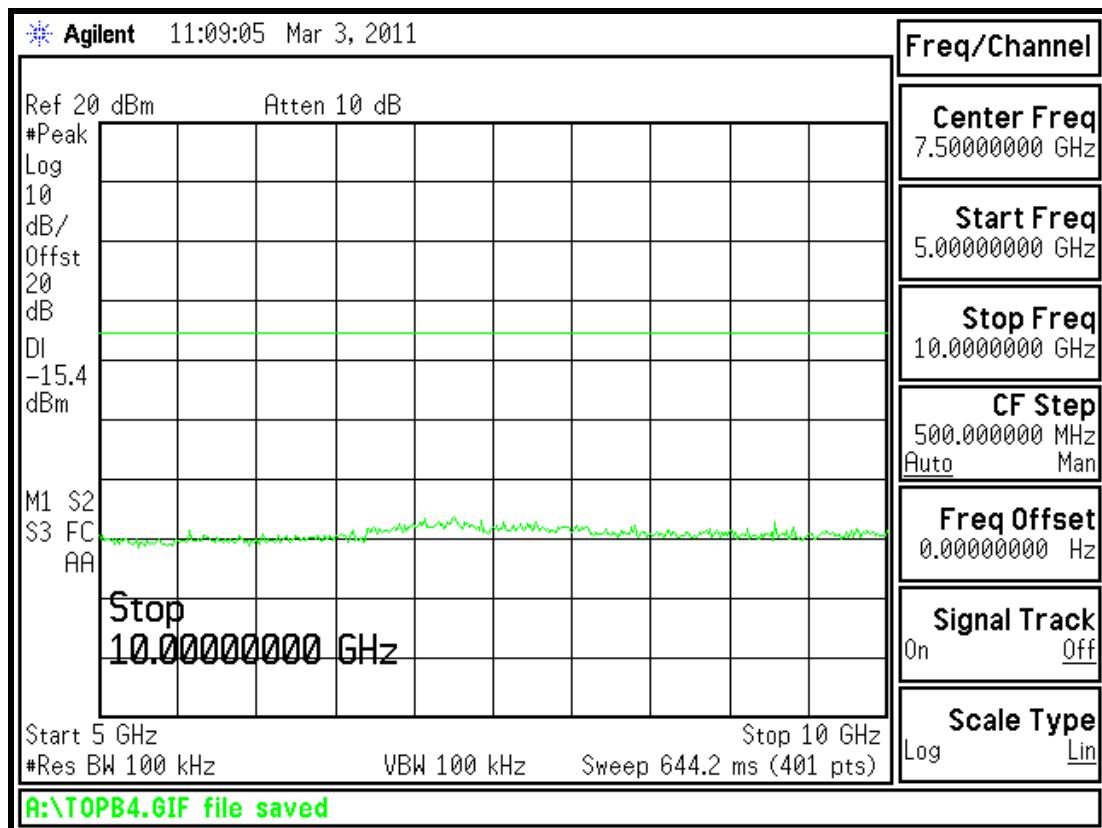
Conducted spurious emissions 150 kHz to 30 MHz – 2462MHz – 11Mbps



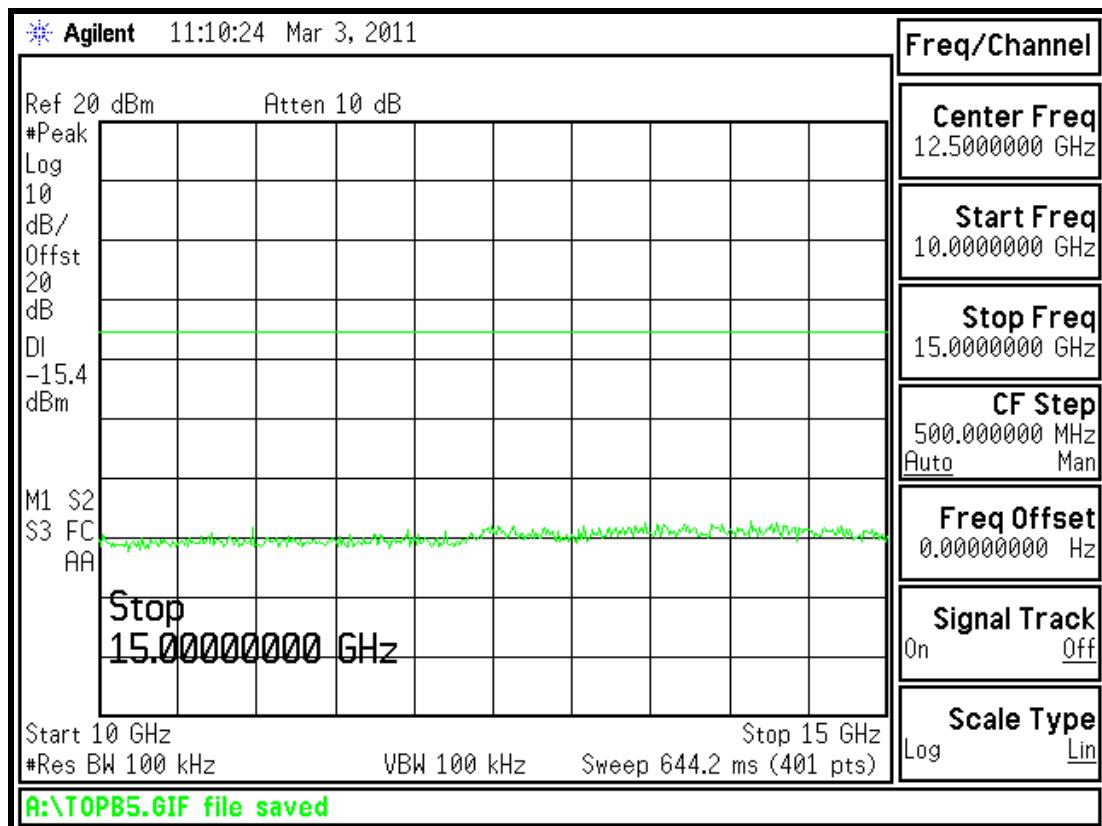
Conducted Spurious emissions 30 MHz to 1 GHz – 2462MHz – 11Mbps



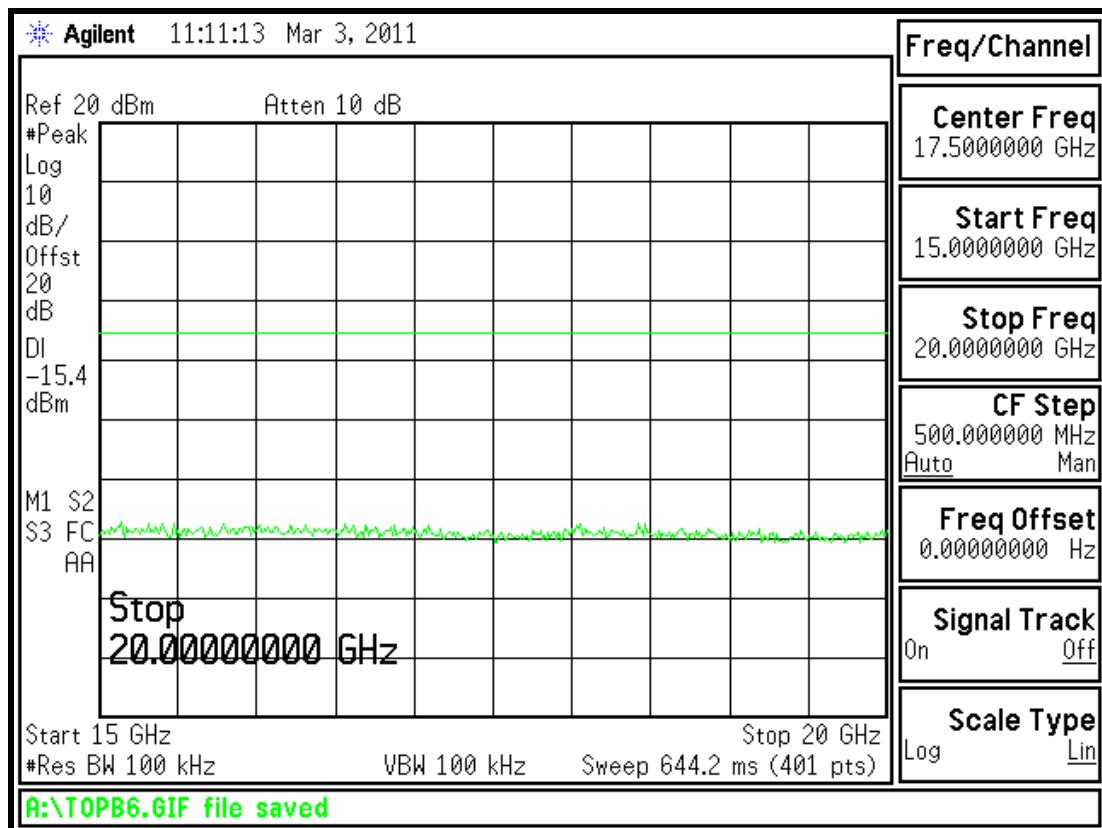
Conducted Spurious emissions 1 GHz to 5 GHz – 2462MHz – 11Mbps



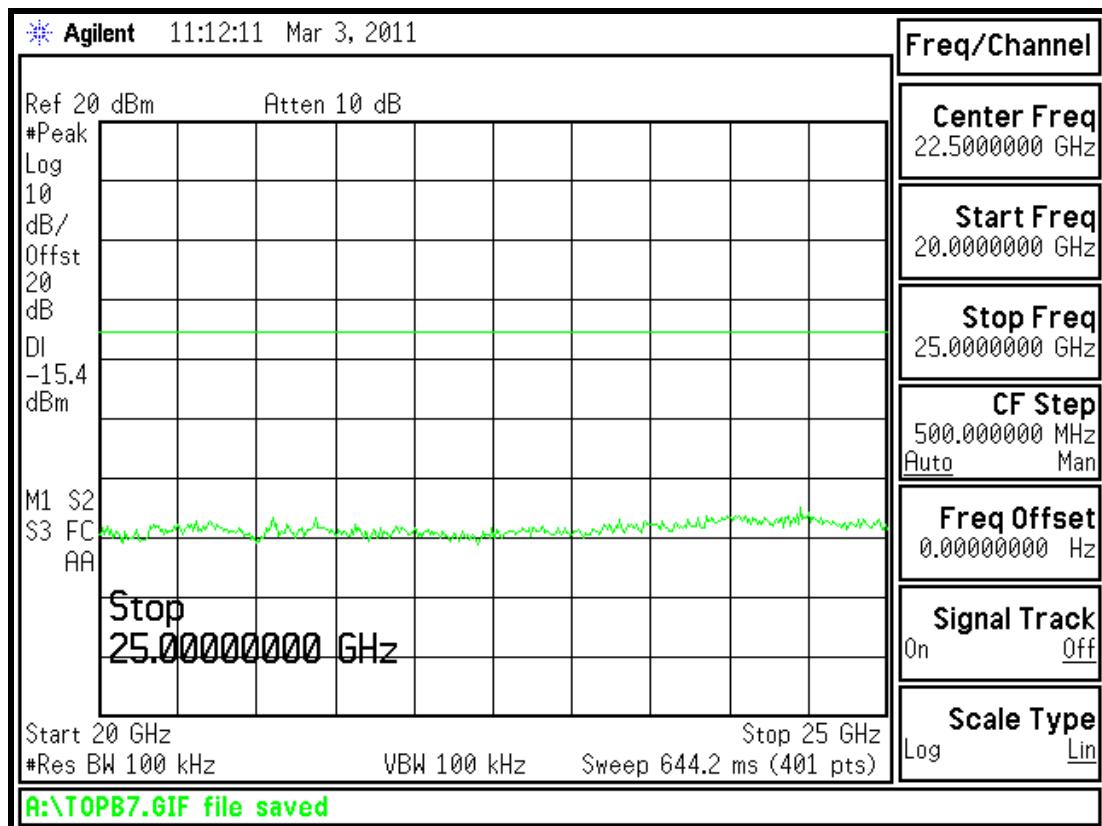
Conducted Spurious emissions 5 GHz to 10 GHz– 2462MHz – 11Mbps



Conducted Spurious emissions 10 GHz to 15 GHz– 2462MHz – 11Mbps

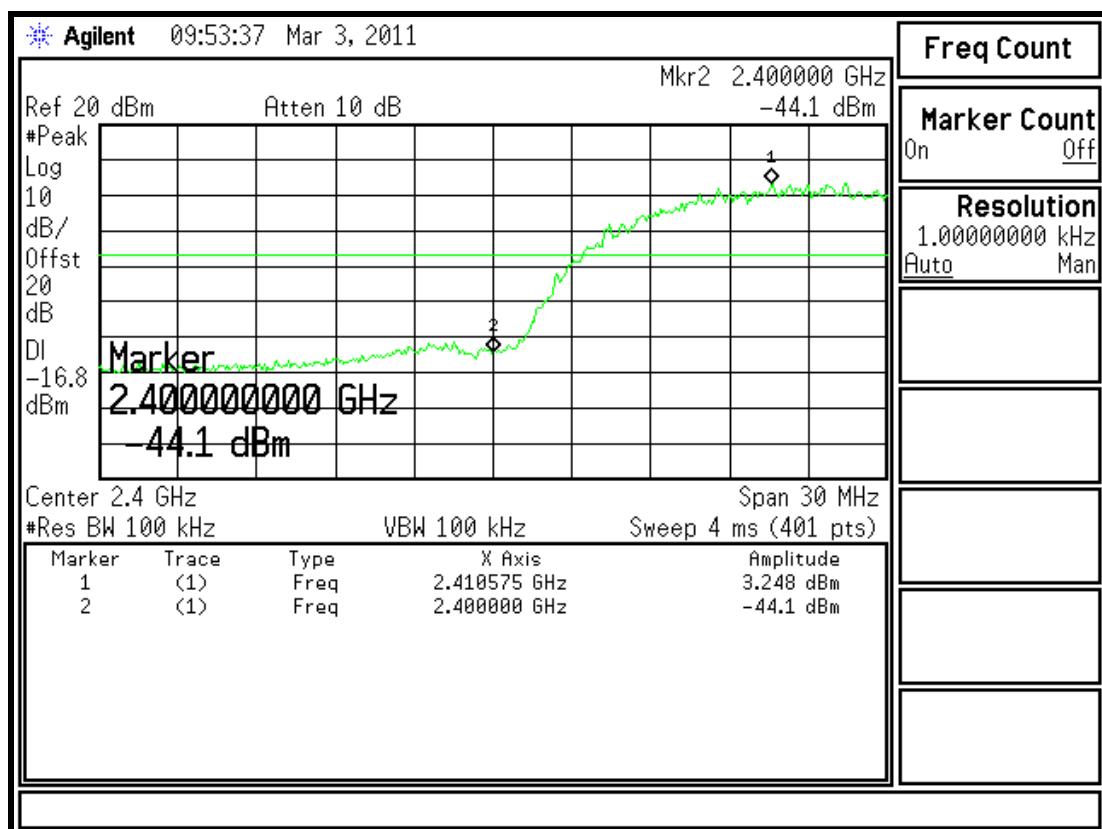


Conducted Spurious emissions 15 GHz to 20 GHz– 2462MHz – 11Mbps

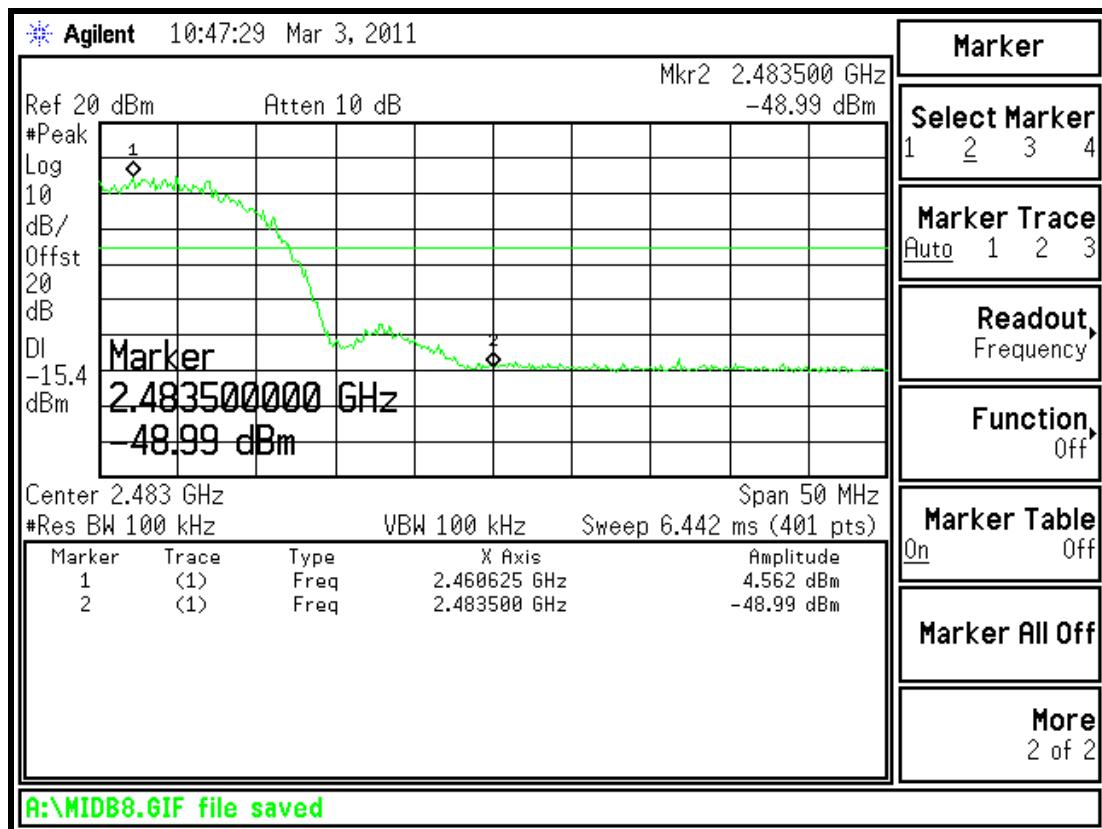


Conducted Spurious emissions 20 GHz to 25 GHz– 2462MHz – 11Mbps

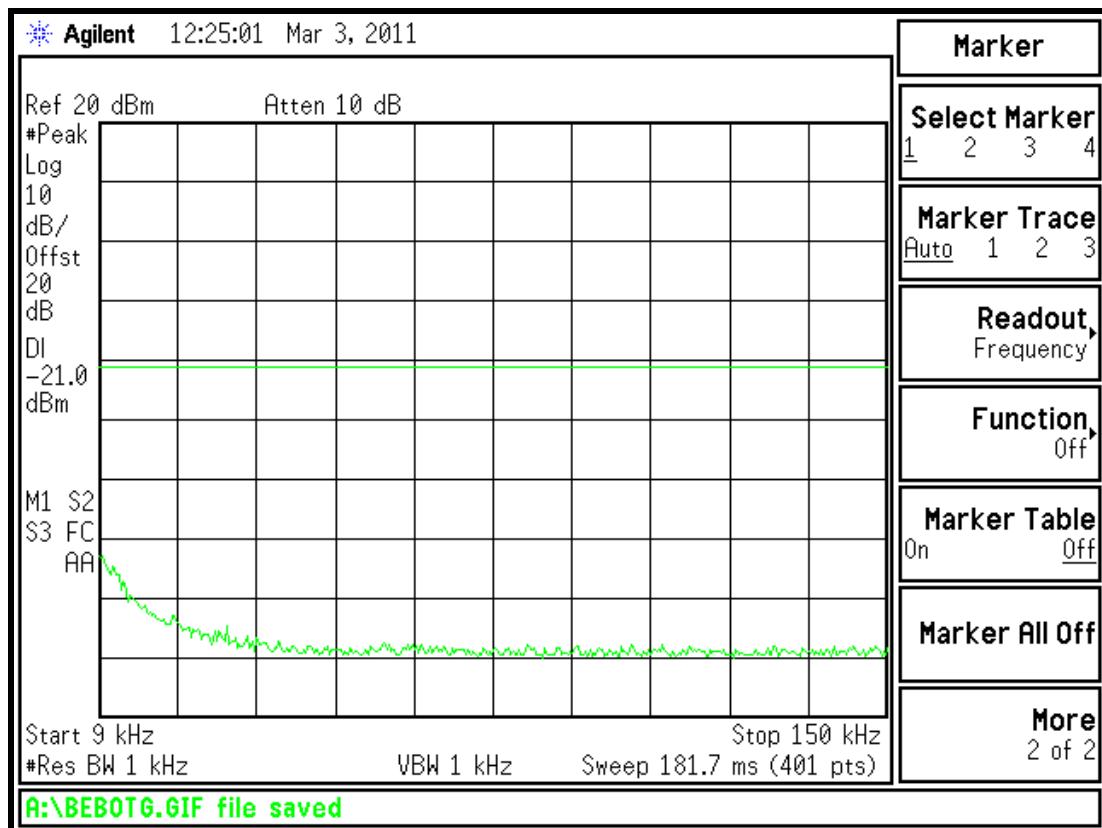
## Conducted Bandedge Compliance



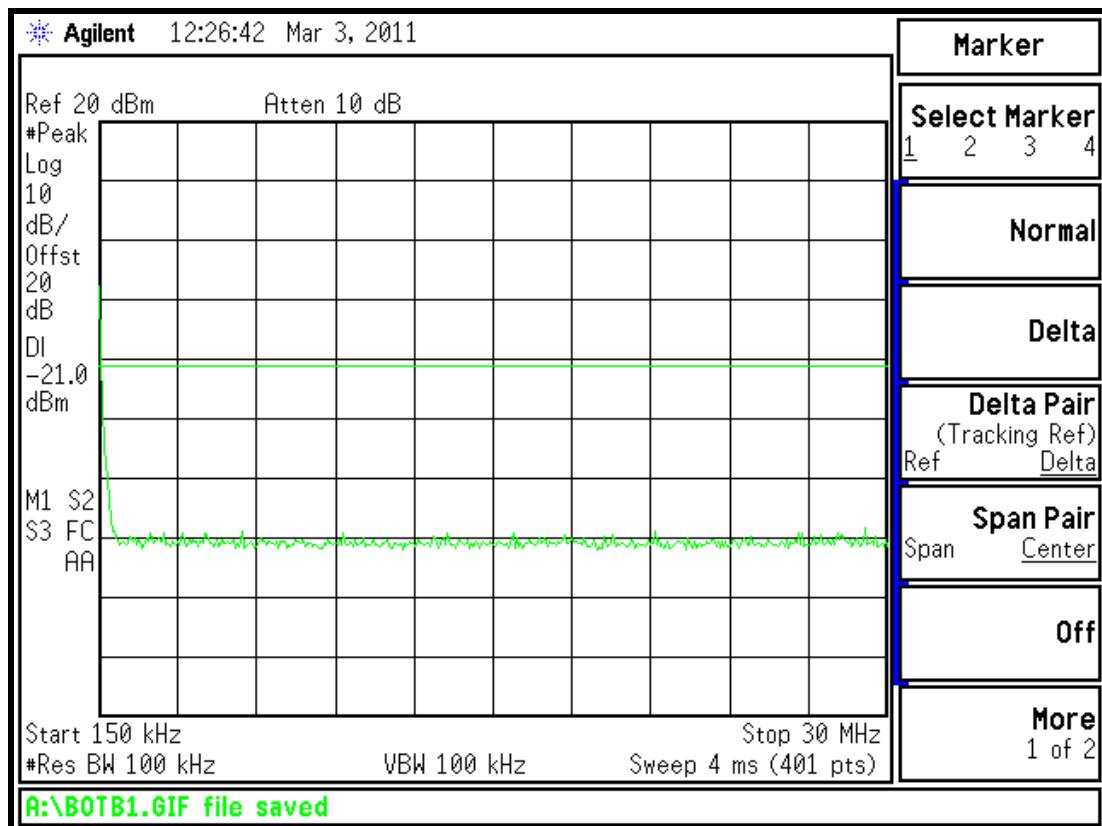
Lower Bandedge – 11Mbps



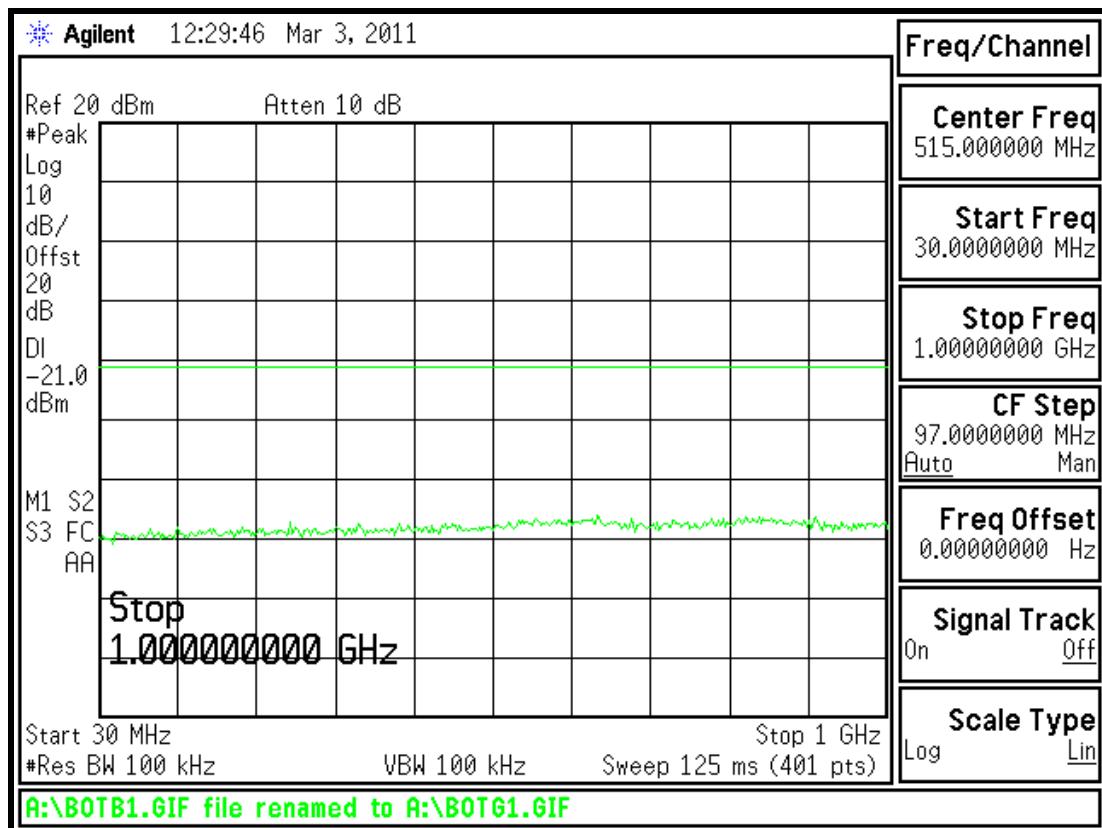
Upper Bandedge – 11Mbps



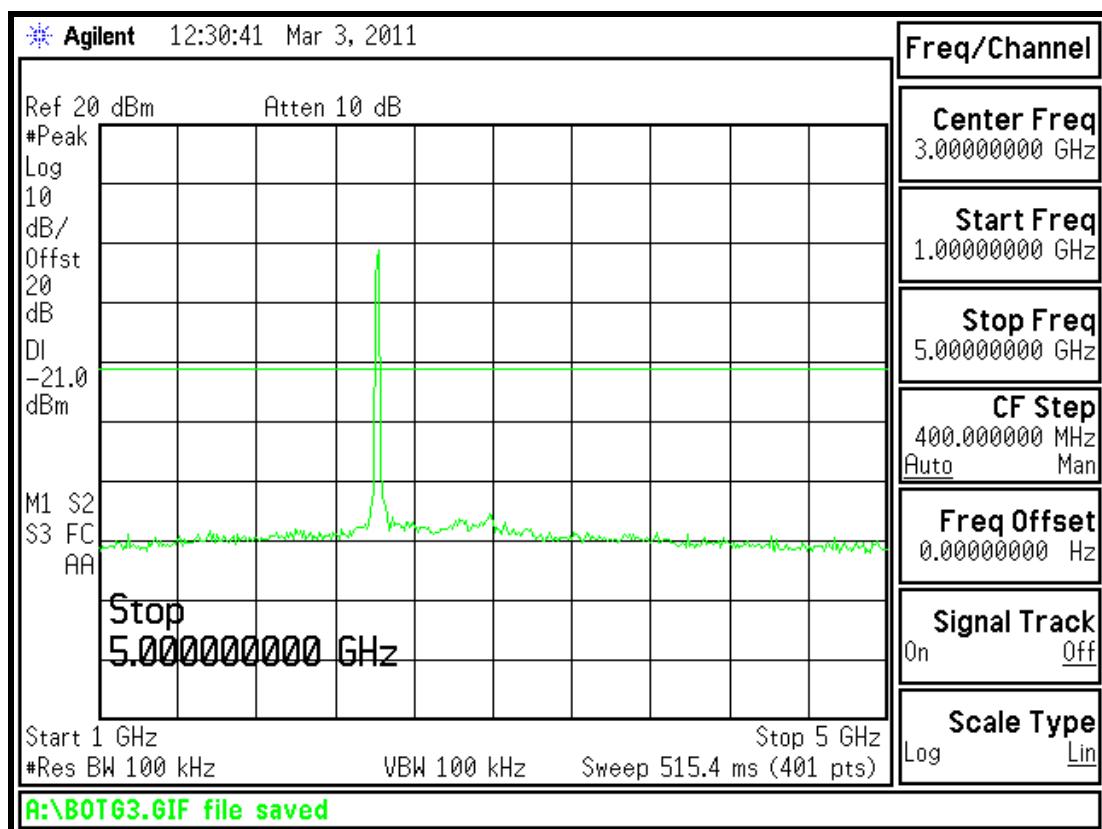
Conducted spurious emissions 9 kHz to 150 kHz – 2412MHz – 54Mbps



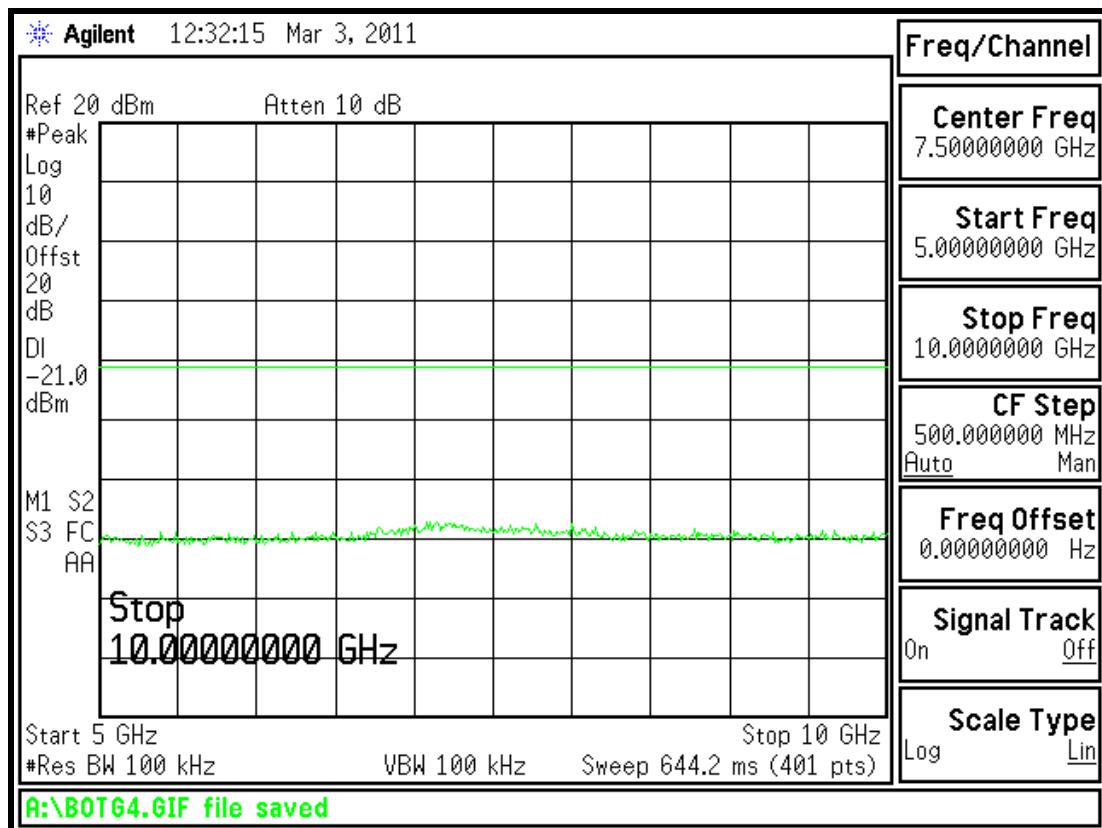
Conducted spurious emissions 150 kHz to 30 MHz – 2412MHz – 54Mbps



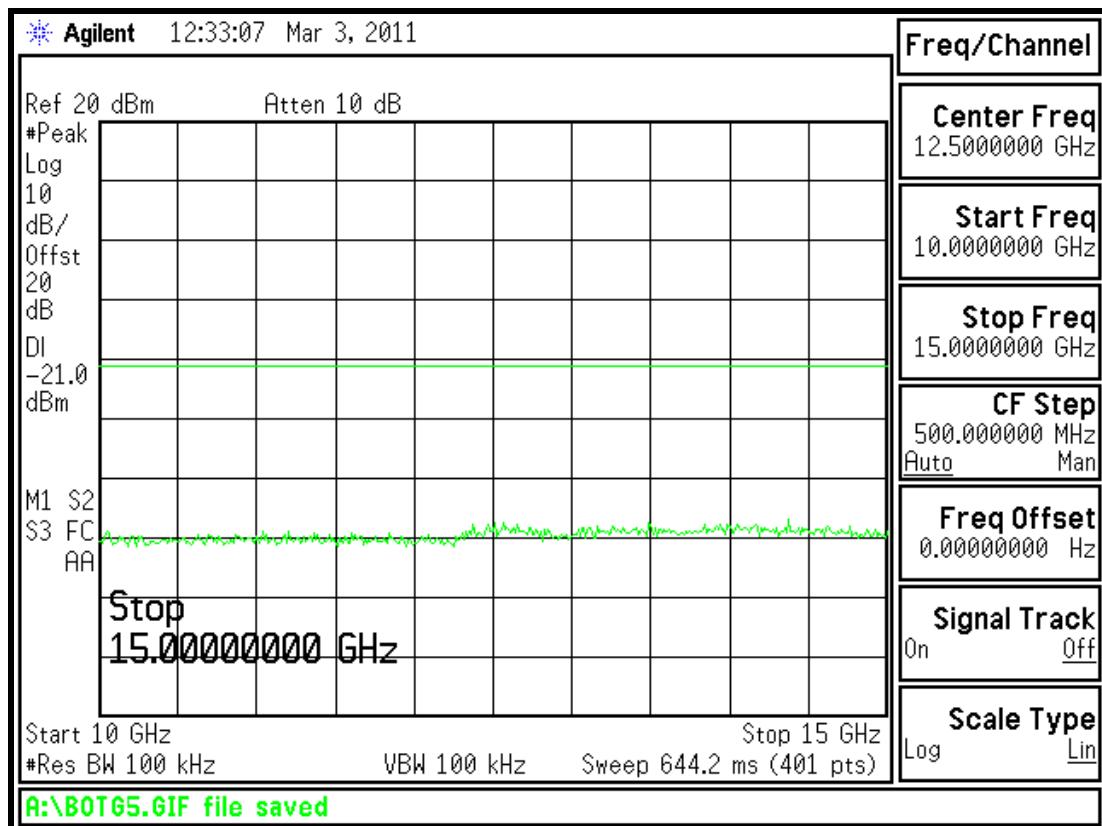
Conducted spurious emissions 30 MHz to 1 GHz – 2412MHz – 54Mbps



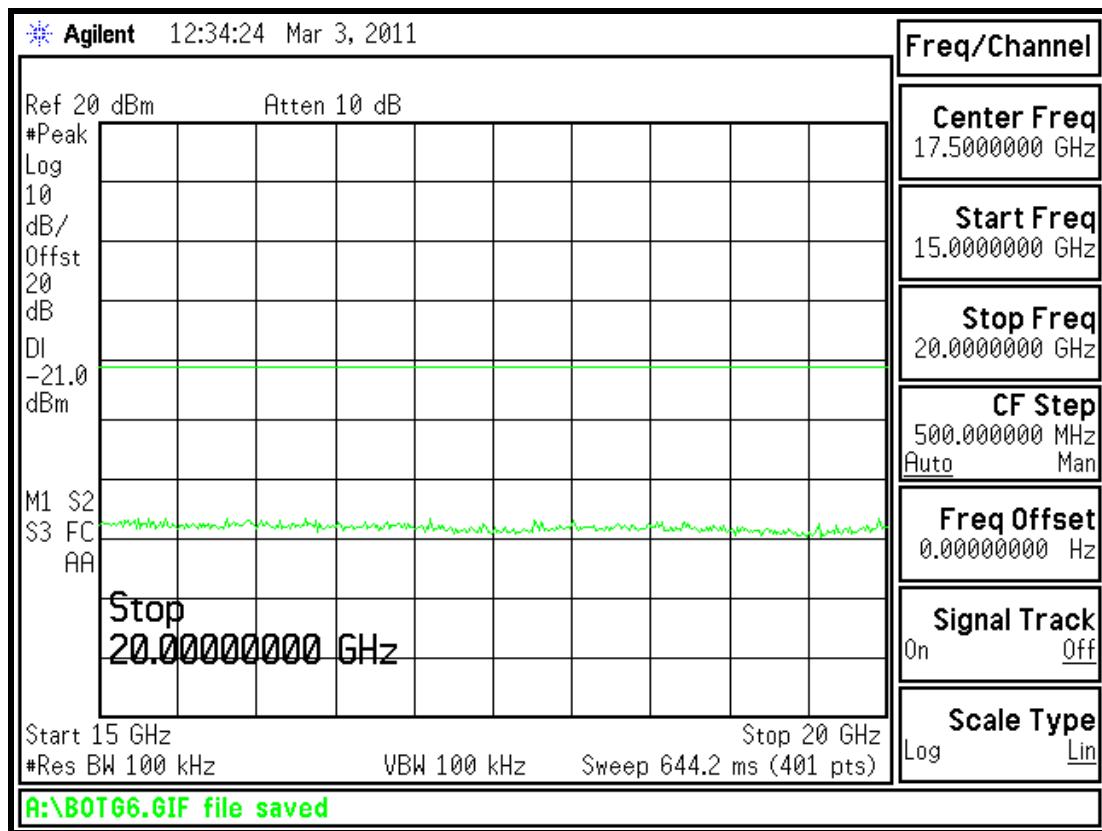
Conducted spurious emissions 1 GHz to 5 GHz – 2412MHz – 54Mbps



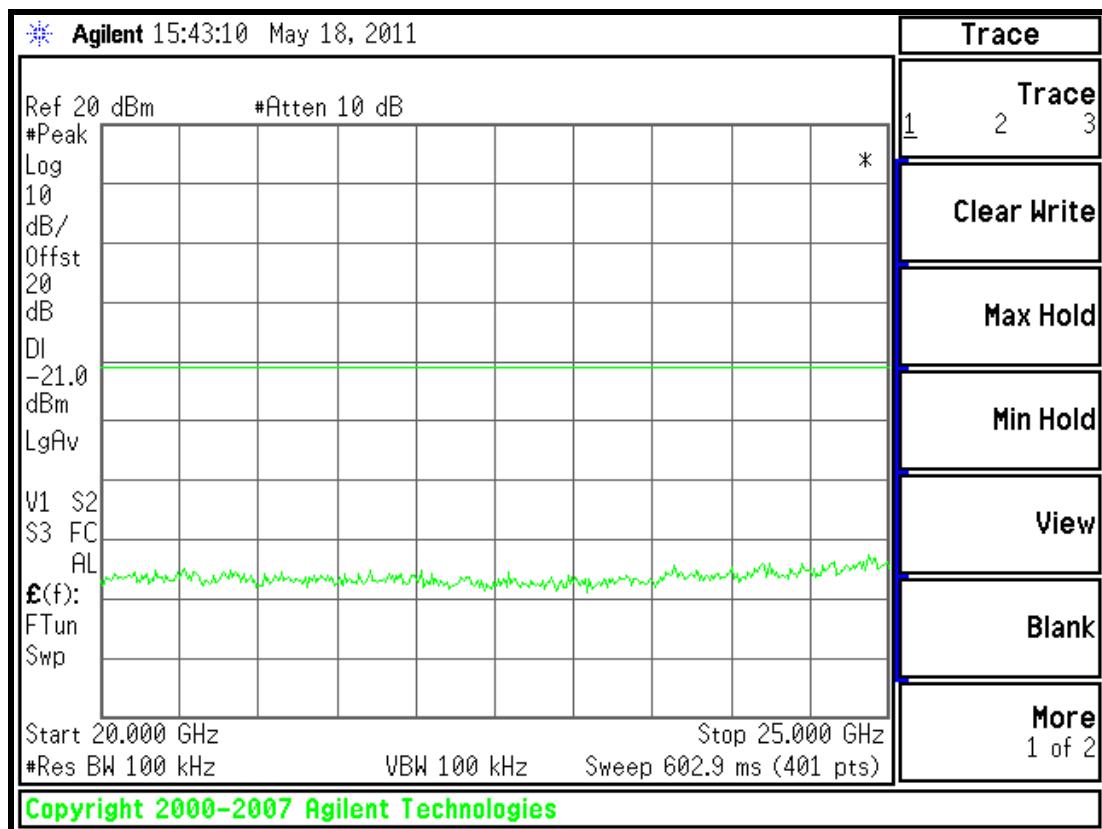
Conducted spurious emissions 5 GHz to 10 GHz – 2412MHz – 54Mbps



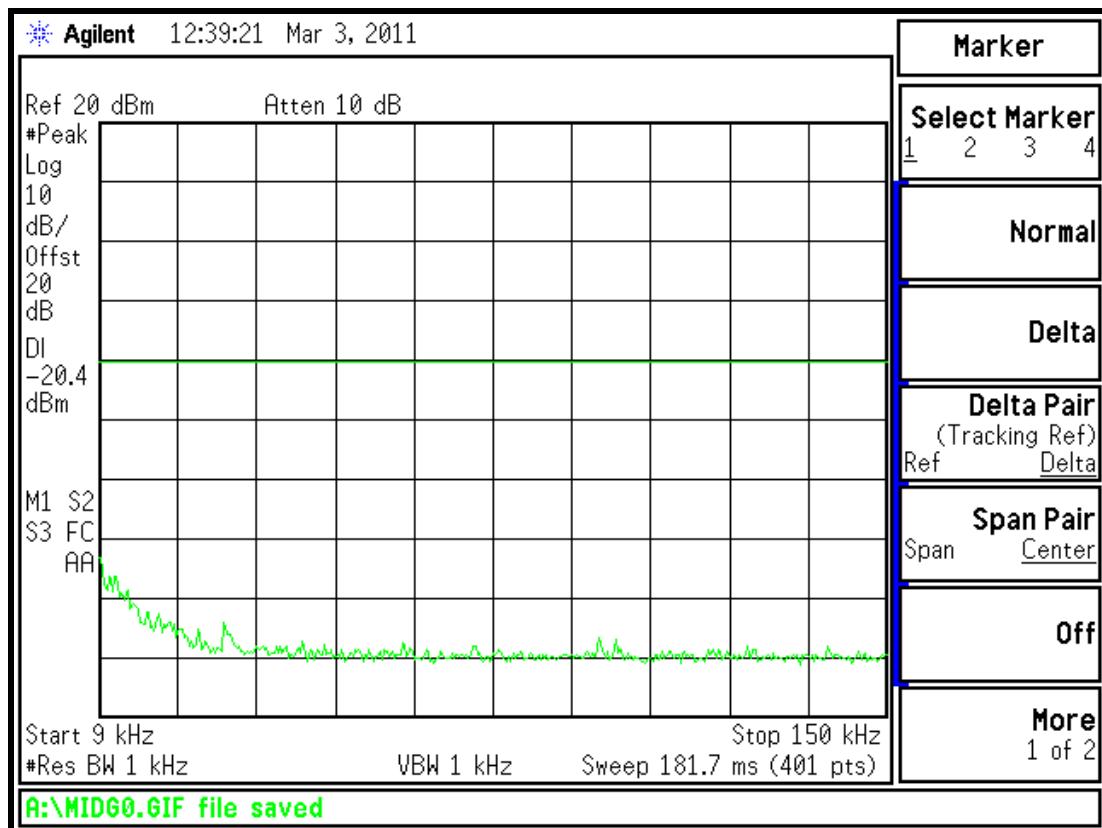
Conducted spurious emissions 10 GHz to 15 GHz – 2412MHz – 54Mbps



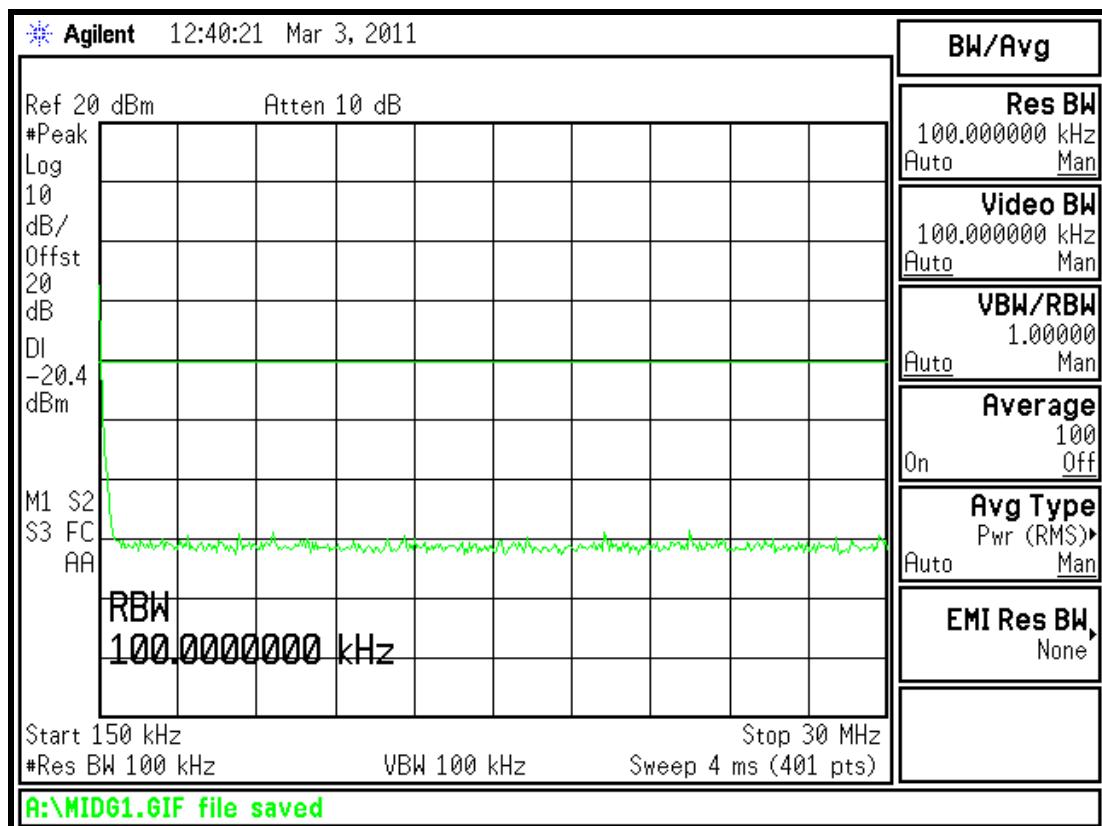
Conducted spurious emissions 15 GHz to 20 GHz – 2412MHz – 54Mbps



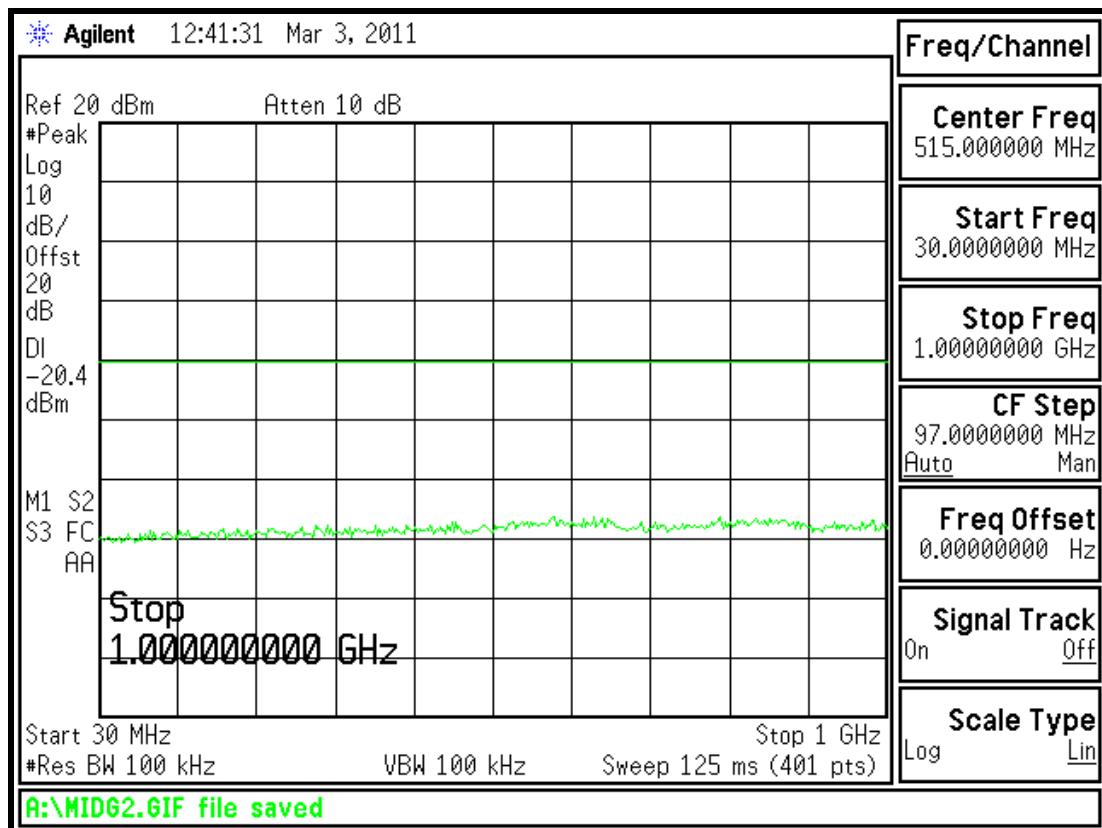
Conducted spurious emissions 20 GHz to 25 GHz – 2412MHz 54Mbps



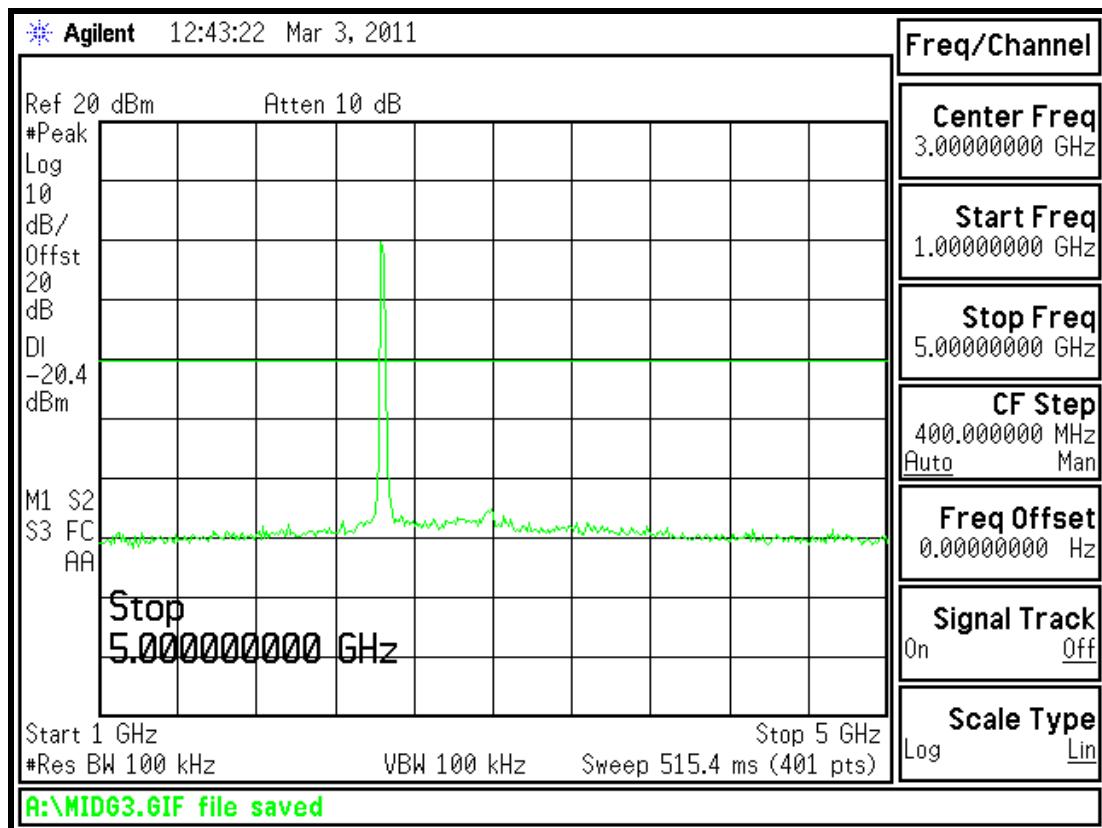
Conducted spurious emissions 9 kHz to 150 kHz – 2437MHz – 54Mbps



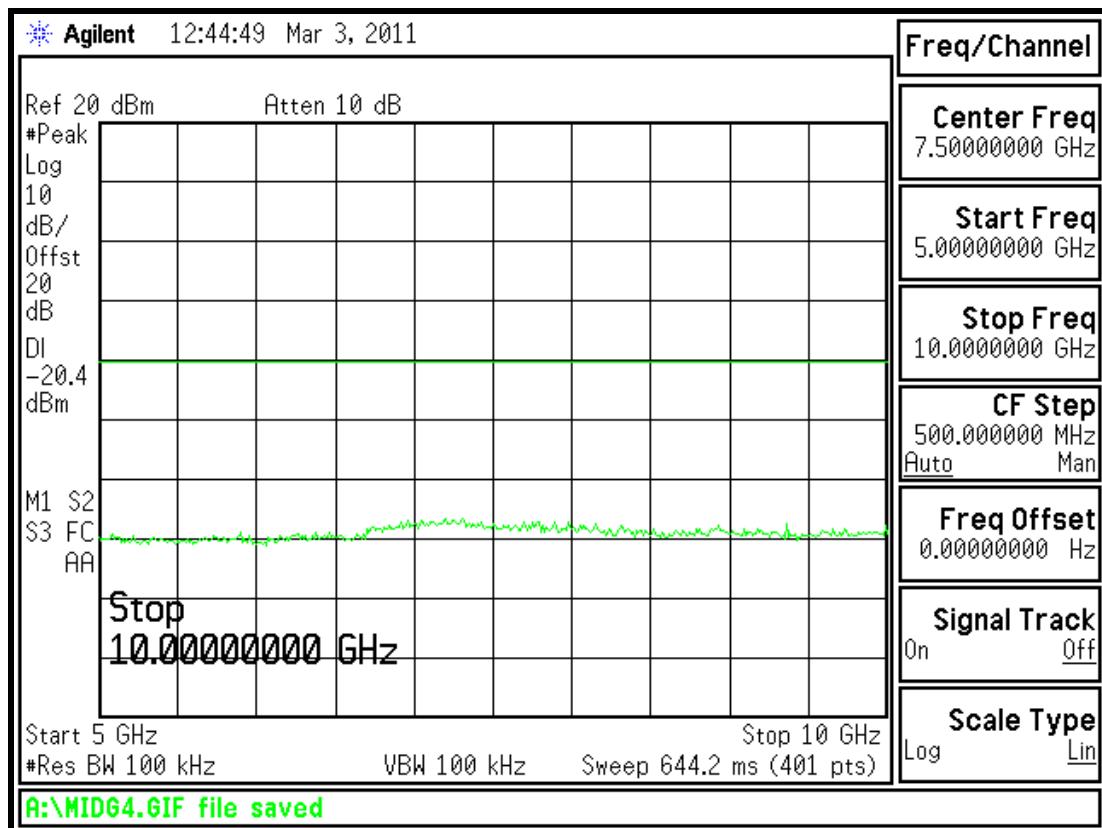
Conducted spurious emissions 150 kHz to 30 MHz – 2437MHz – 54Mbps



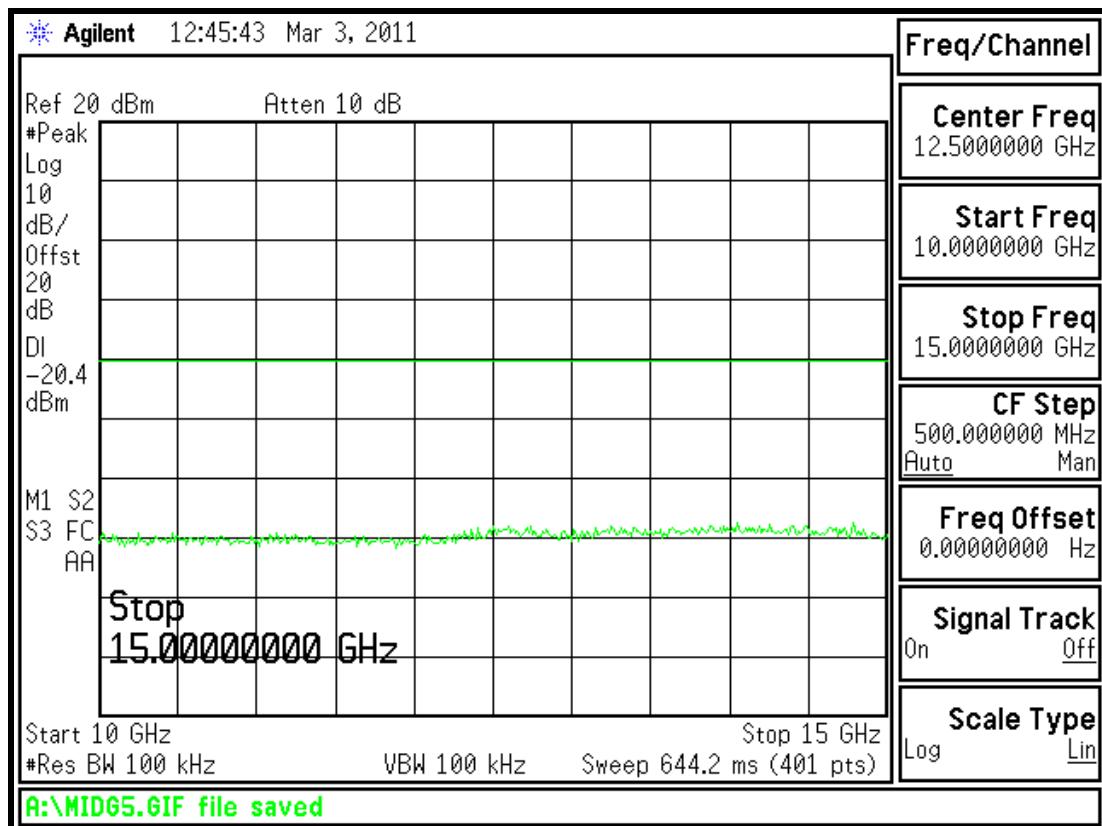
Conducted Spurious emissions 30 MHz to 1 GHz – 2437MHz – 54Mbps



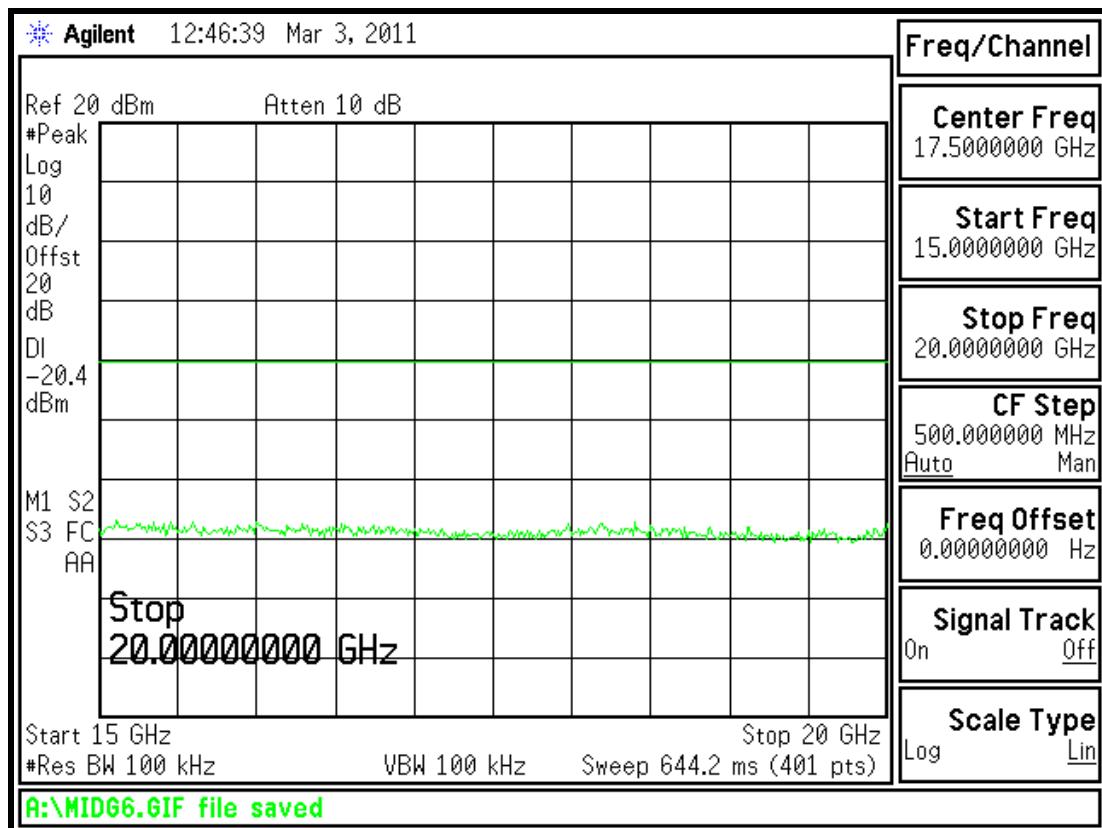
Conducted Spurious emissions 1 GHz to 5 GHz – 2437MHz – 54Mbps



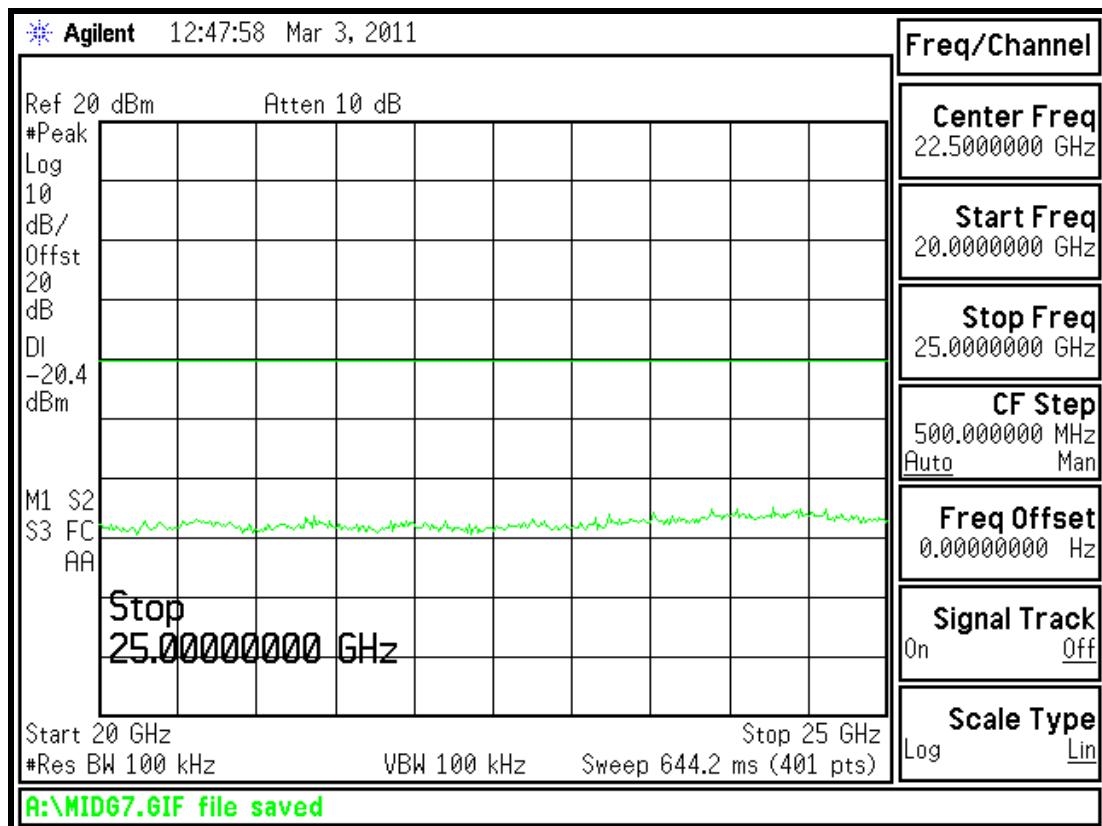
Conducted Spurious emissions 5 GHz to 10 GHz – 2437MHz – 54Mbps



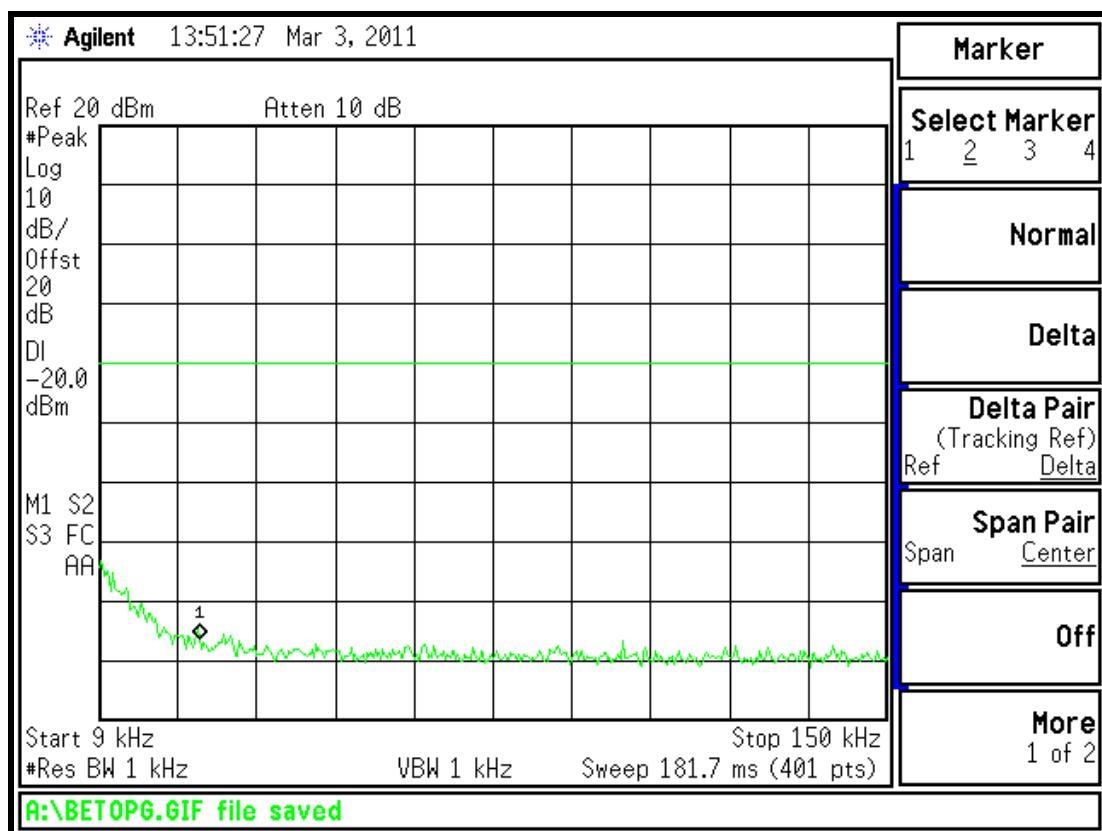
Conducted Spurious emissions 10 GHz to 15GHz – 2437MHz – 54Mbps



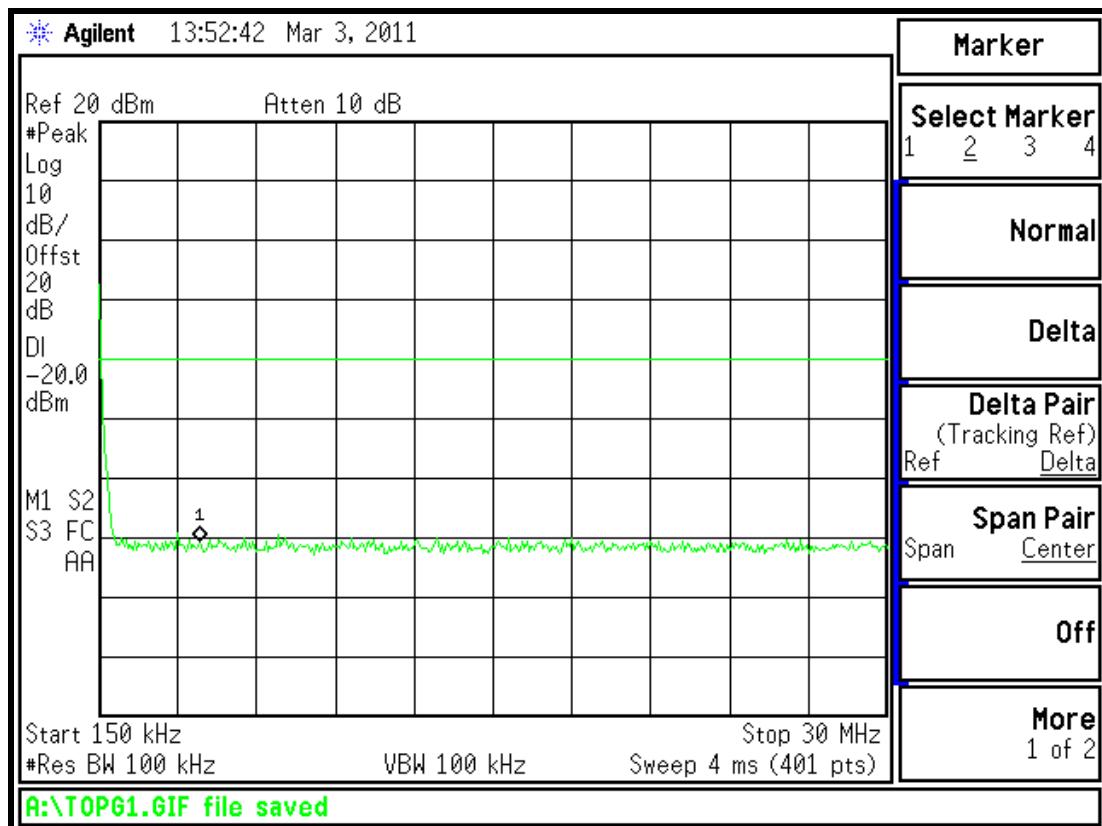
Conducted Spurious emissions 15 GHz to 20GHz – 2437MHz – 54Mbps



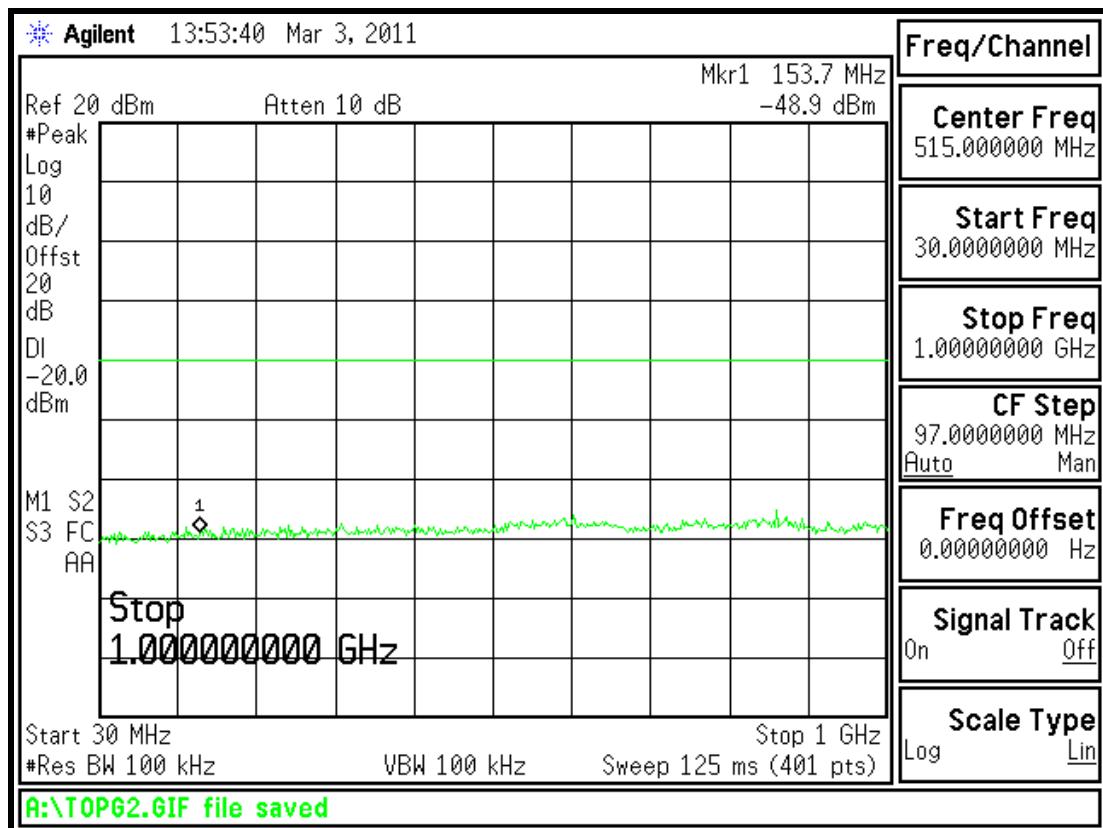
Conducted Spurious emissions 20 GHz to 25GHz – 2437MHz – 54Mbps



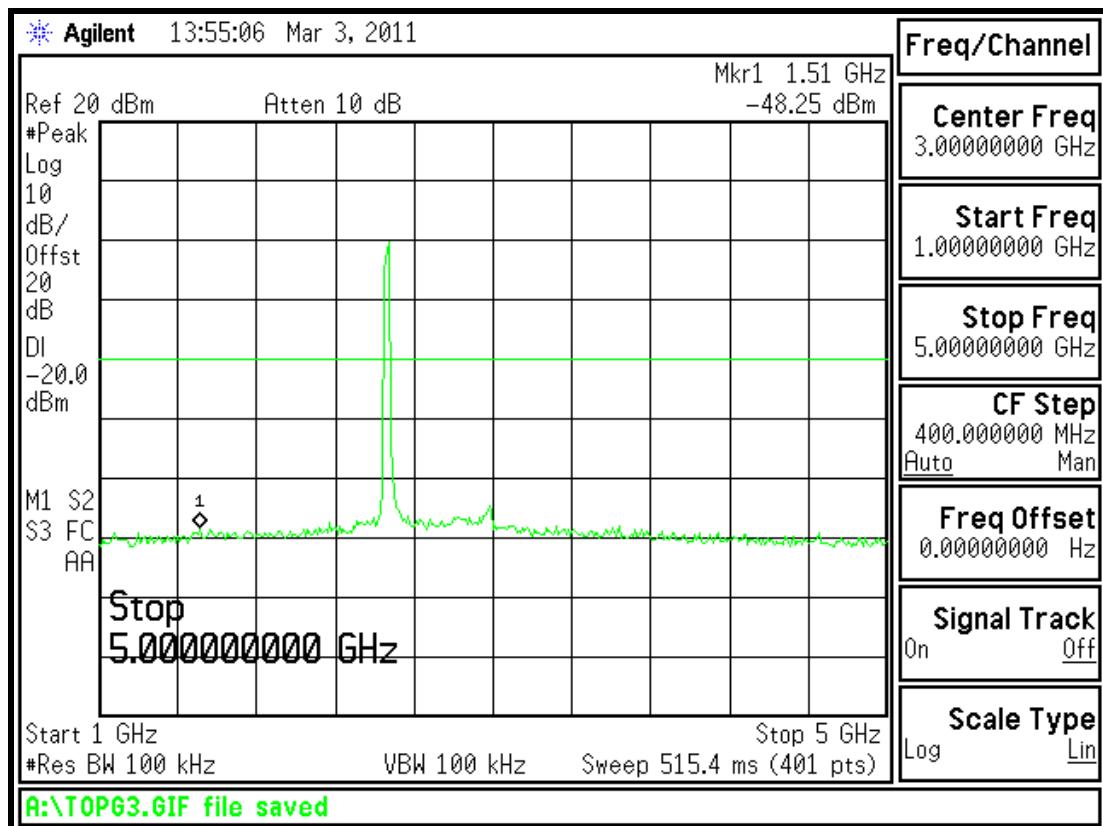
Conducted spurious emissions 9 kHz to 150 kHz – 2462MHz – 54Mbps



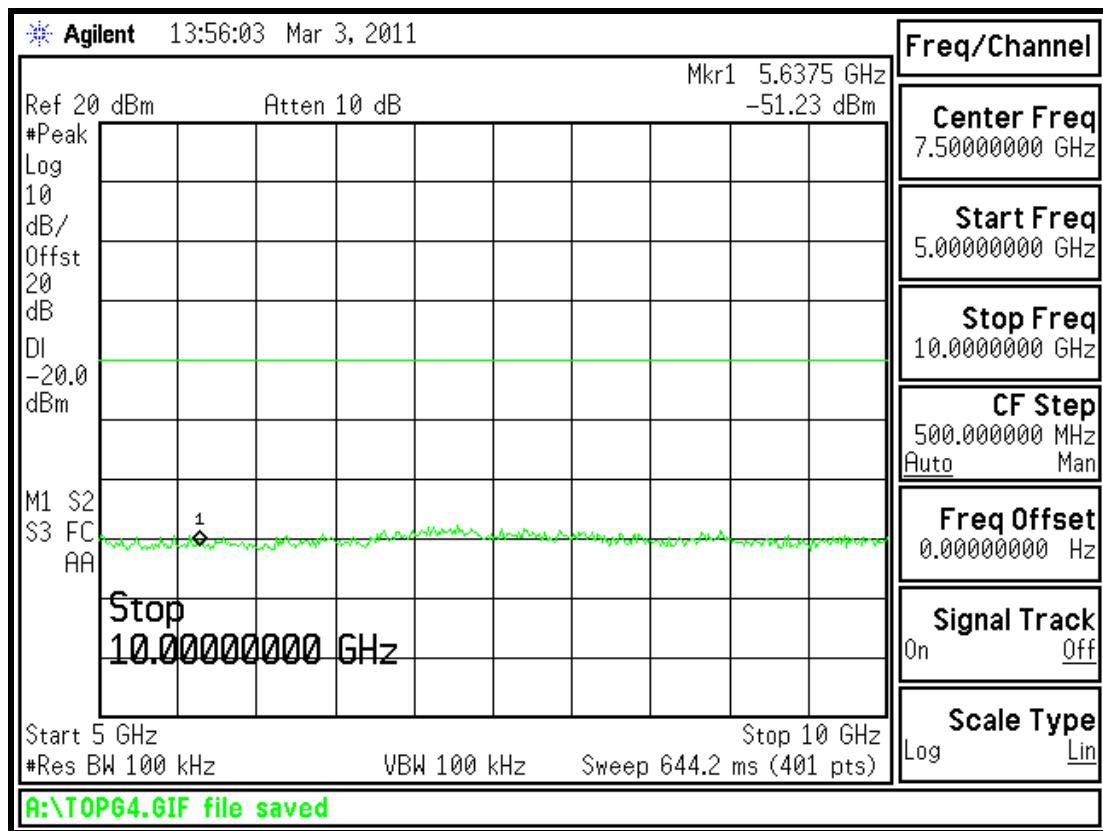
Conducted spurious emissions 150 kHz to 30 MHz – 2462MHz – 54Mbps



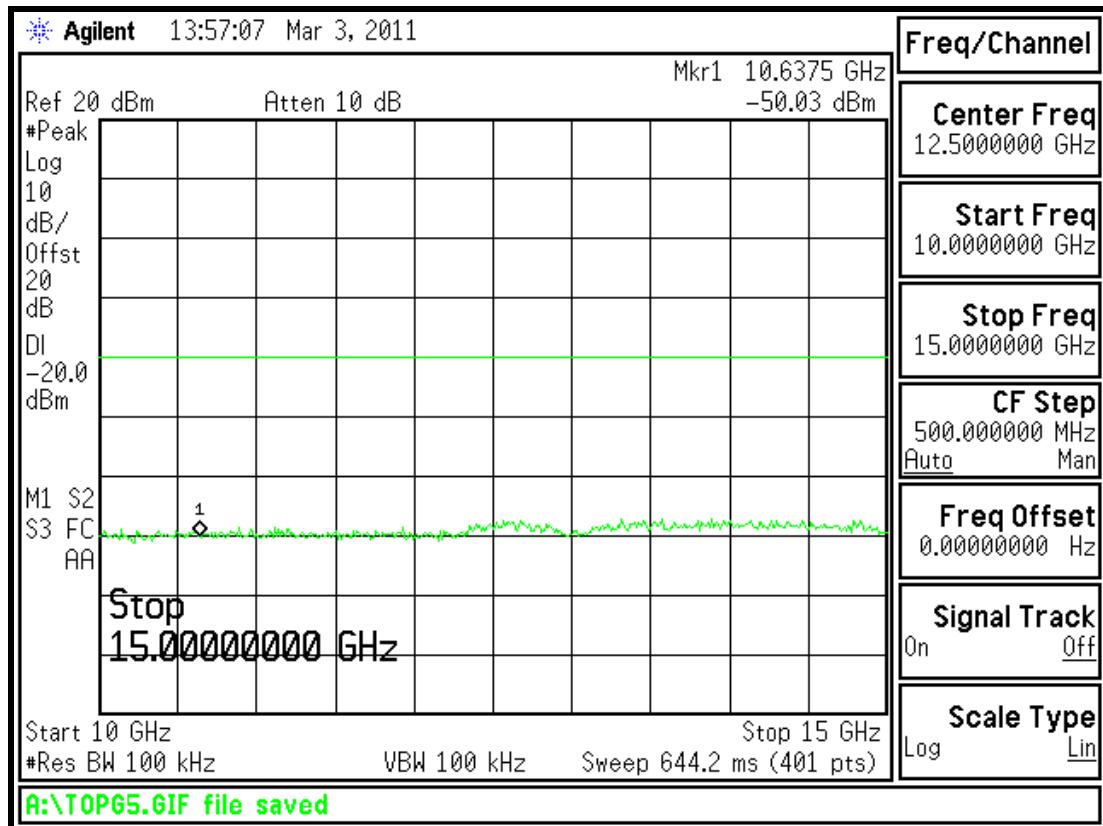
Conducted Spurious emissions 30 MHz to 1 GHz – 2462MHz – 54Mbps



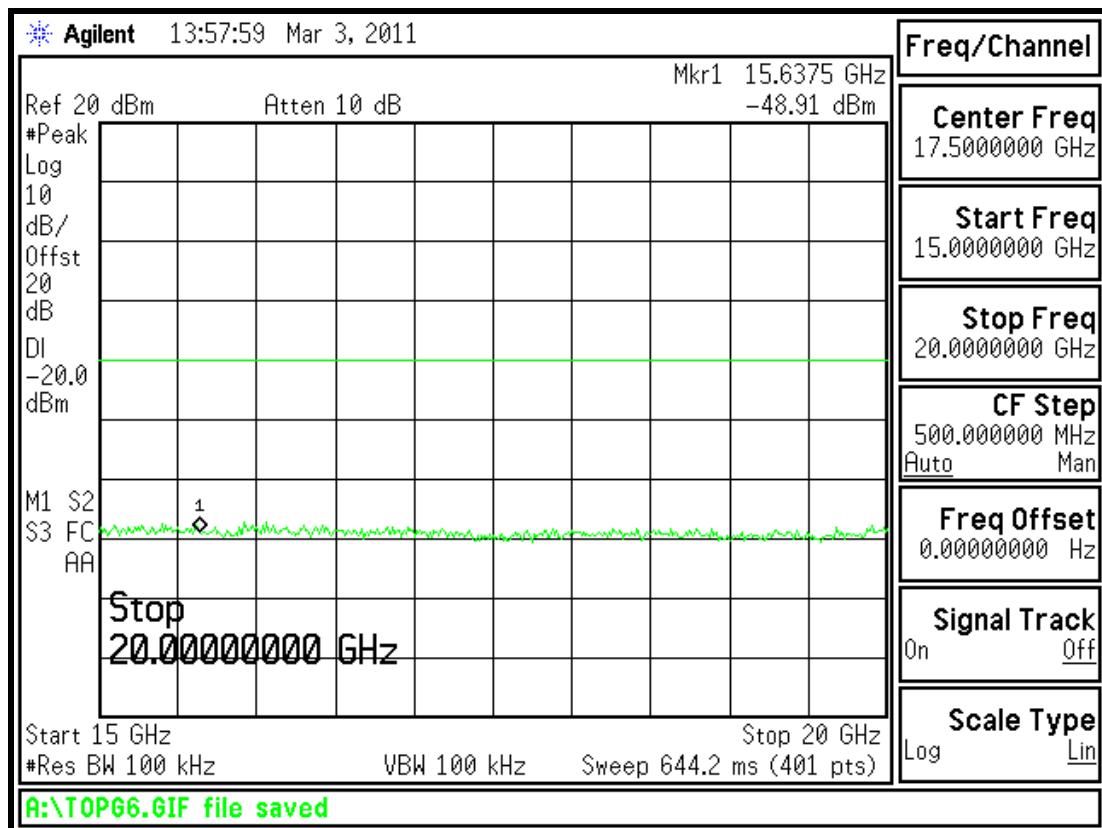
Conducted Spurious emissions 1 GHz to 5 GHz – 2462MHz – 54Mbps



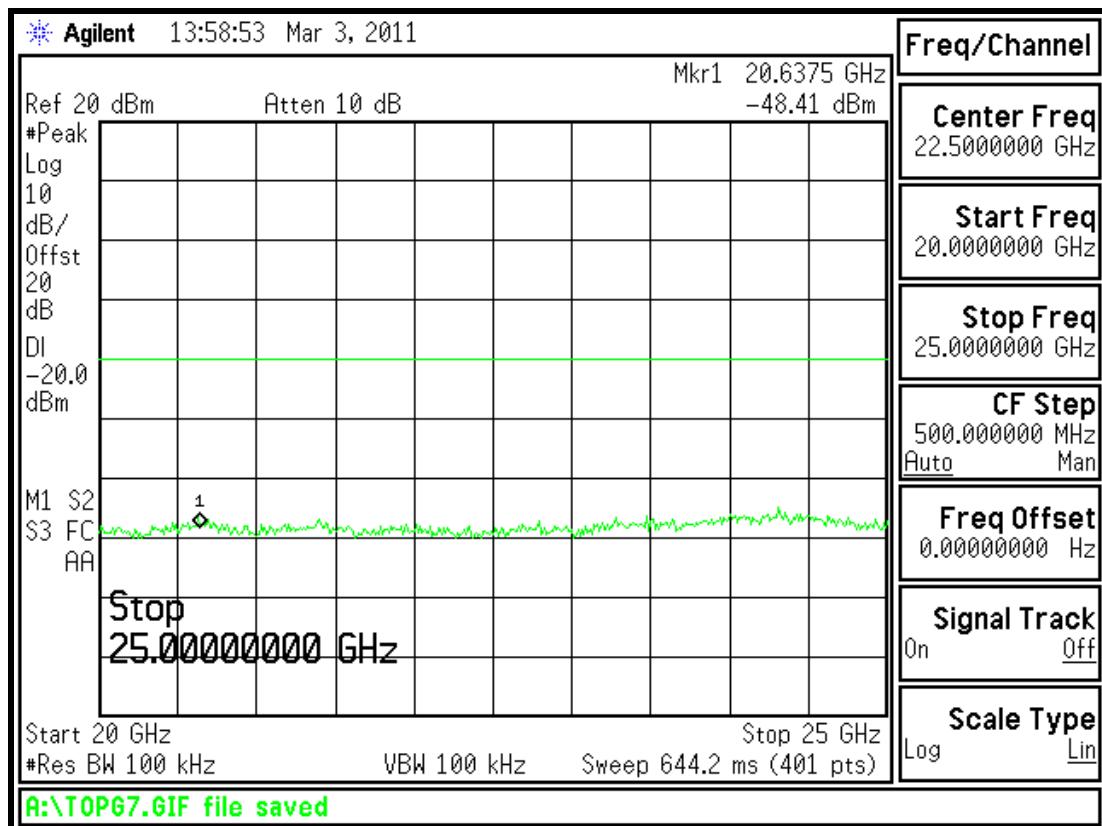
Conducted Spurious emissions 5 GHz to 10 GHz– 2462MHz – 54Mbps



Conducted Spurious emissions 10 GHz to 15 GHz– 2462MHz – 54Mbps

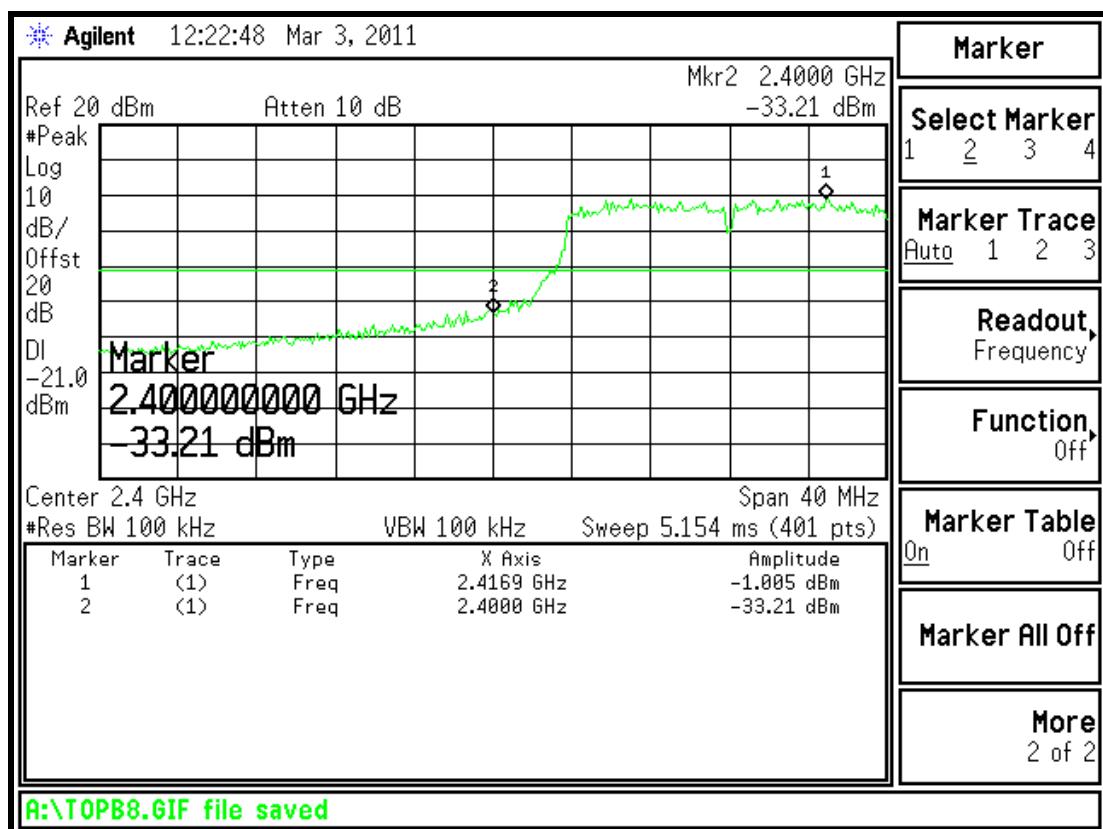


Conducted Spurious emissions 15 GHz to 20 GHz– 2462MHz – 54Mbps

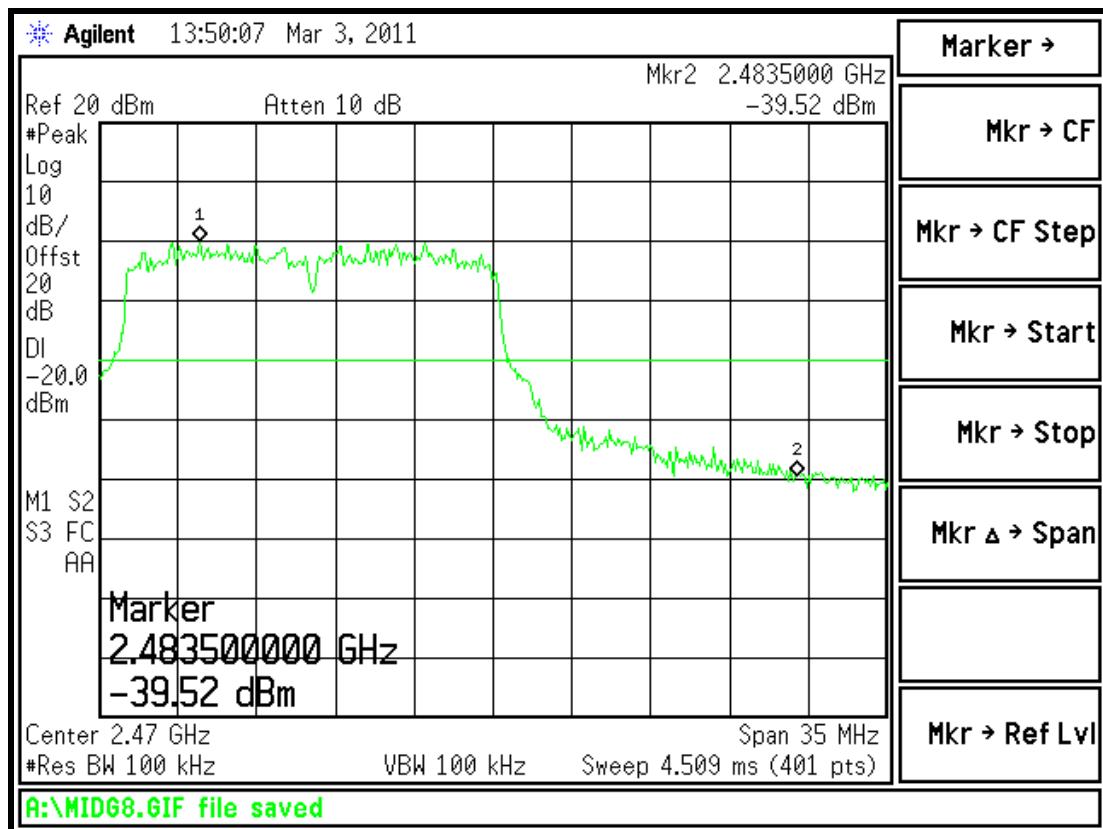


Conducted Spurious emissions 20 GHz to 25 GHz– 2462MHz – 54Mbps

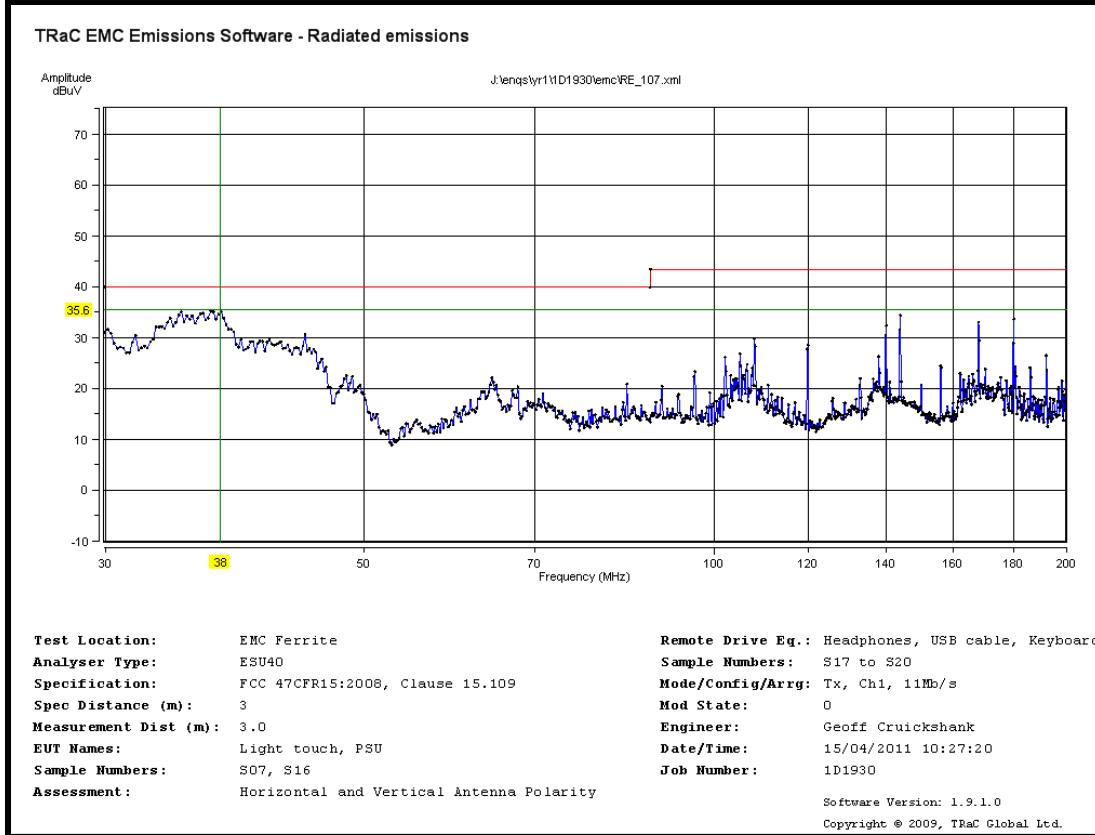
## Conducted Bandedge Compliance



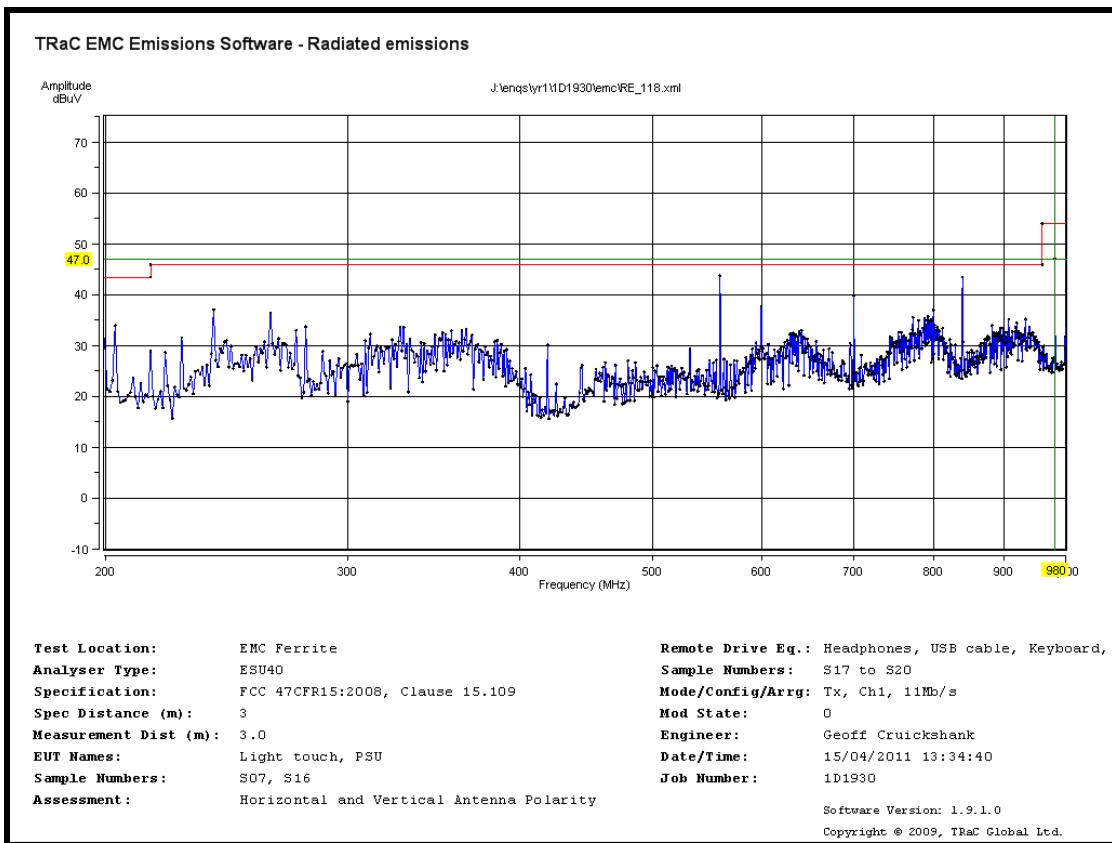
Lower Bandedge – 54Mbps



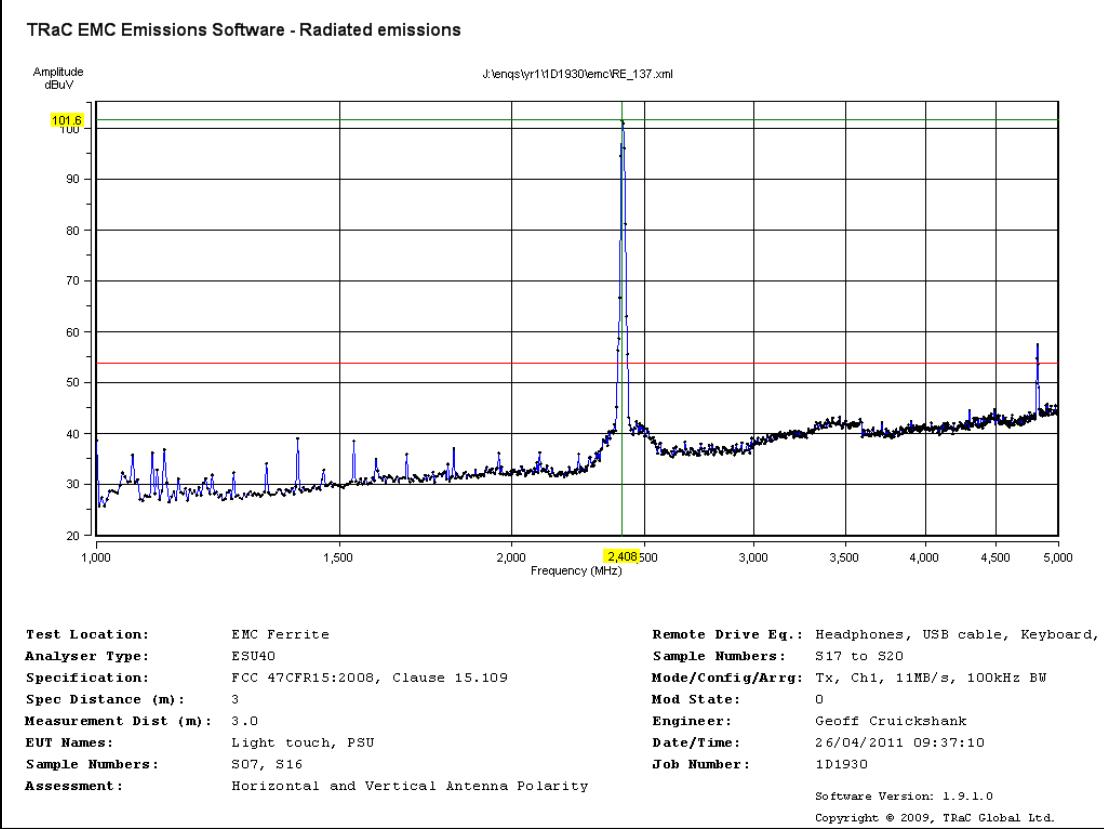
Upper Bandedge – 54Mbps



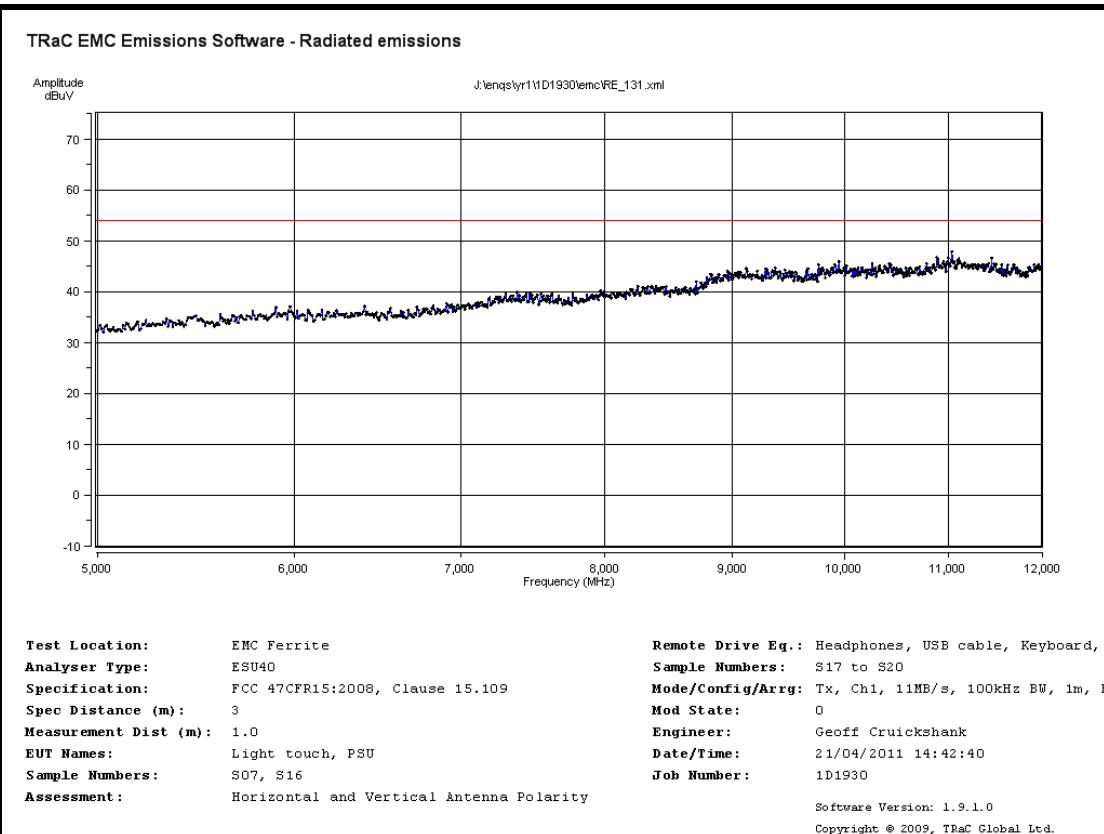
Radiated Spurious emissions 30 MHz to 200 MHz – 2412MHz – 11Mbps



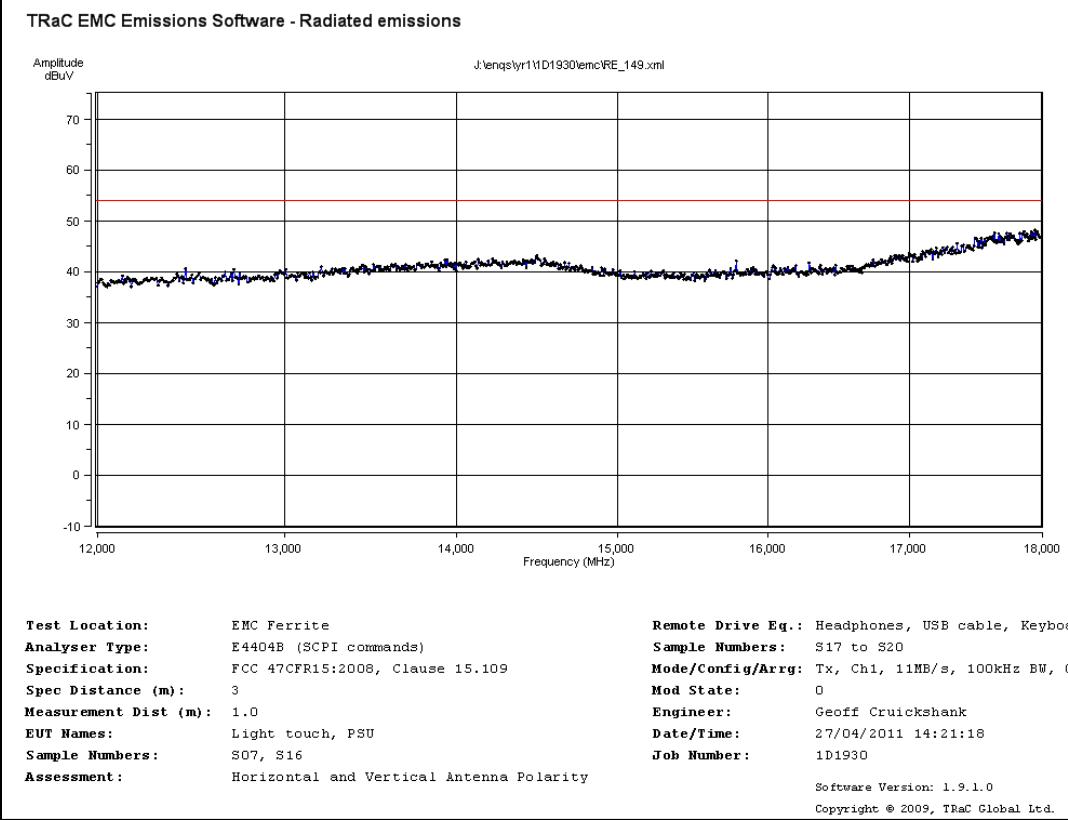
Radiated Spurious emissions 200 MHz to 1 GHz – 2412MHz – 11Mbps



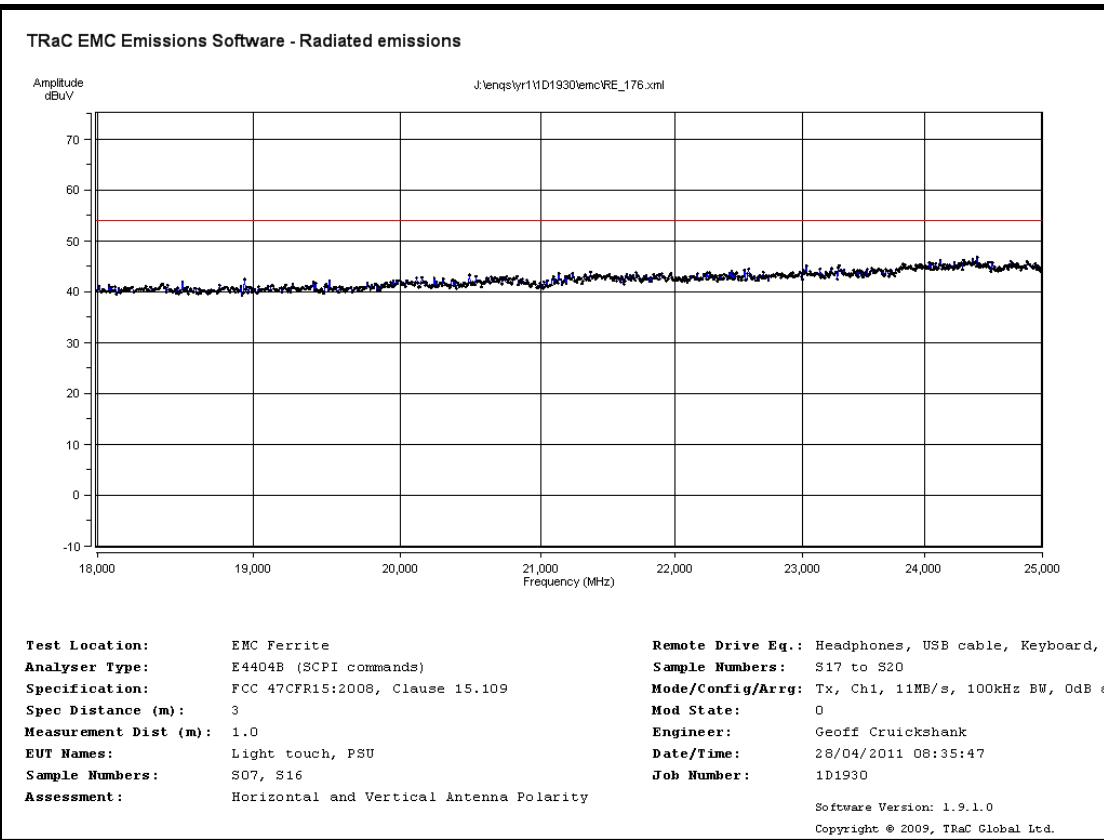
### Radiated Spurious emissions 1 GHz to 5 GHz – 2412MHz – 11Mbps



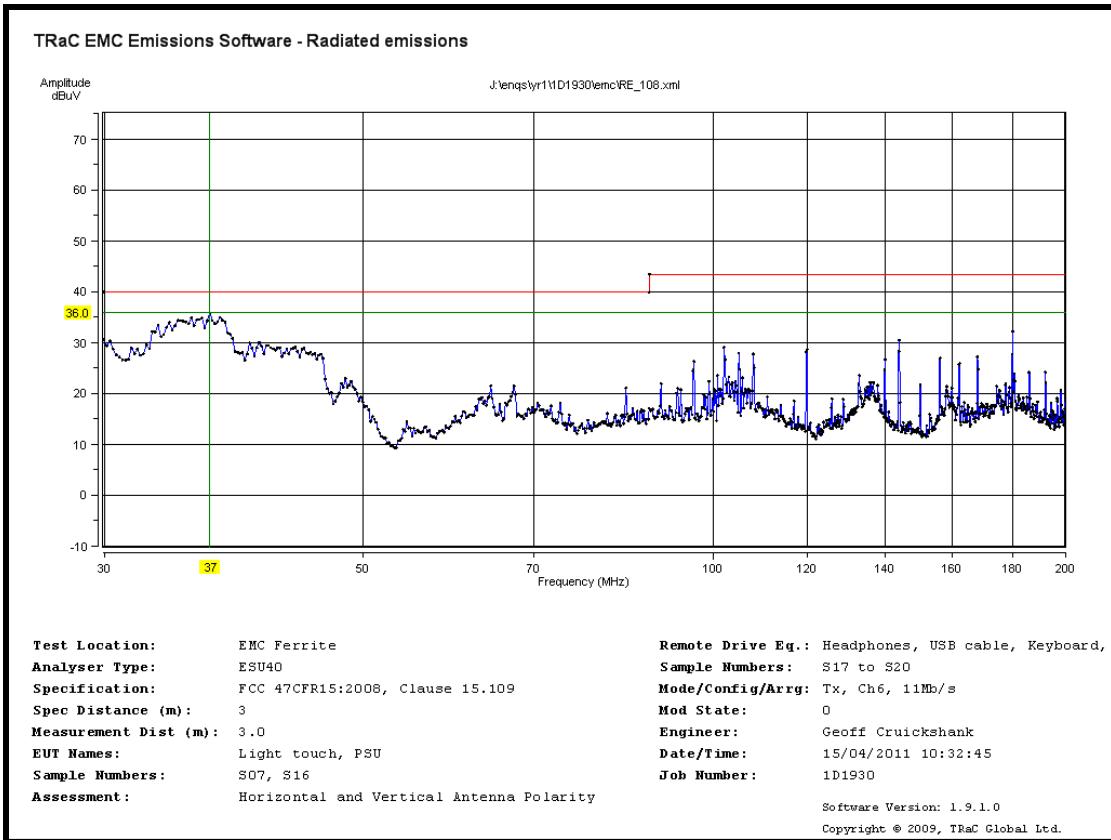
### Radiated Spurious emissions 5 GHz to 12 GHz – 2412MHz – 11Mbps



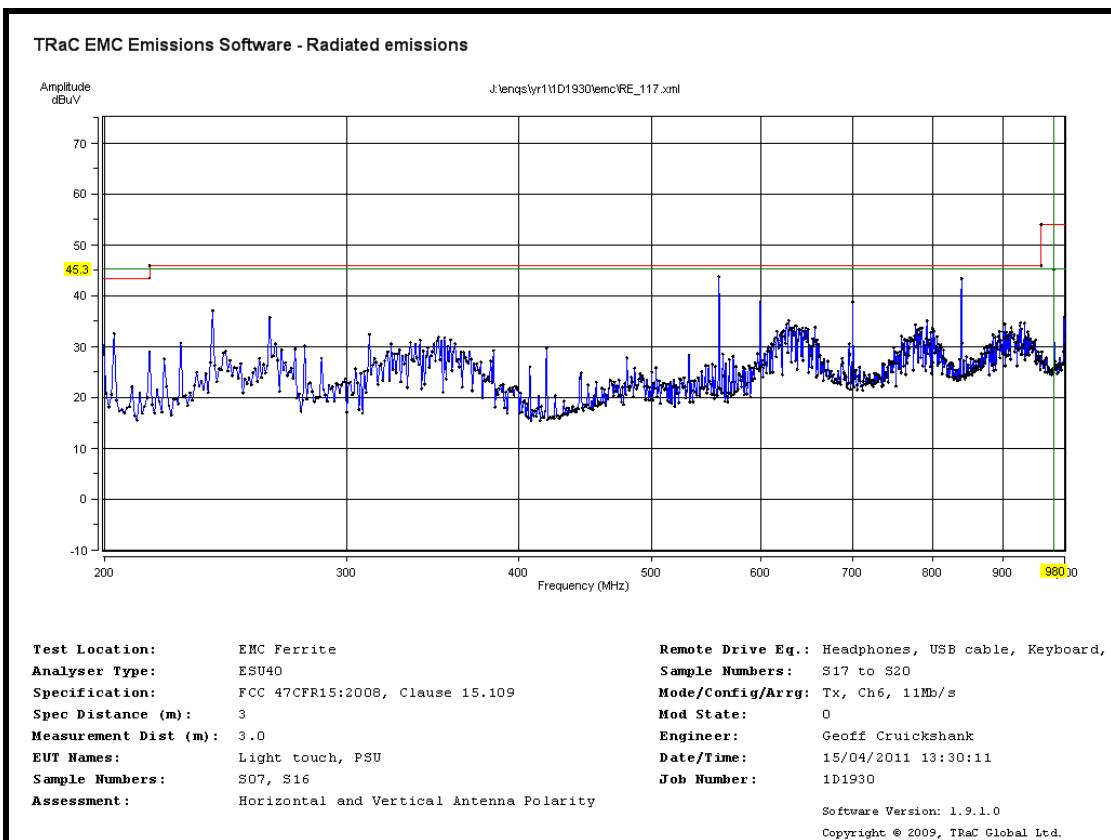
### Radiated Spurious emissions 12 GHz to 18 GHz – 2412MHz – 11Mbps



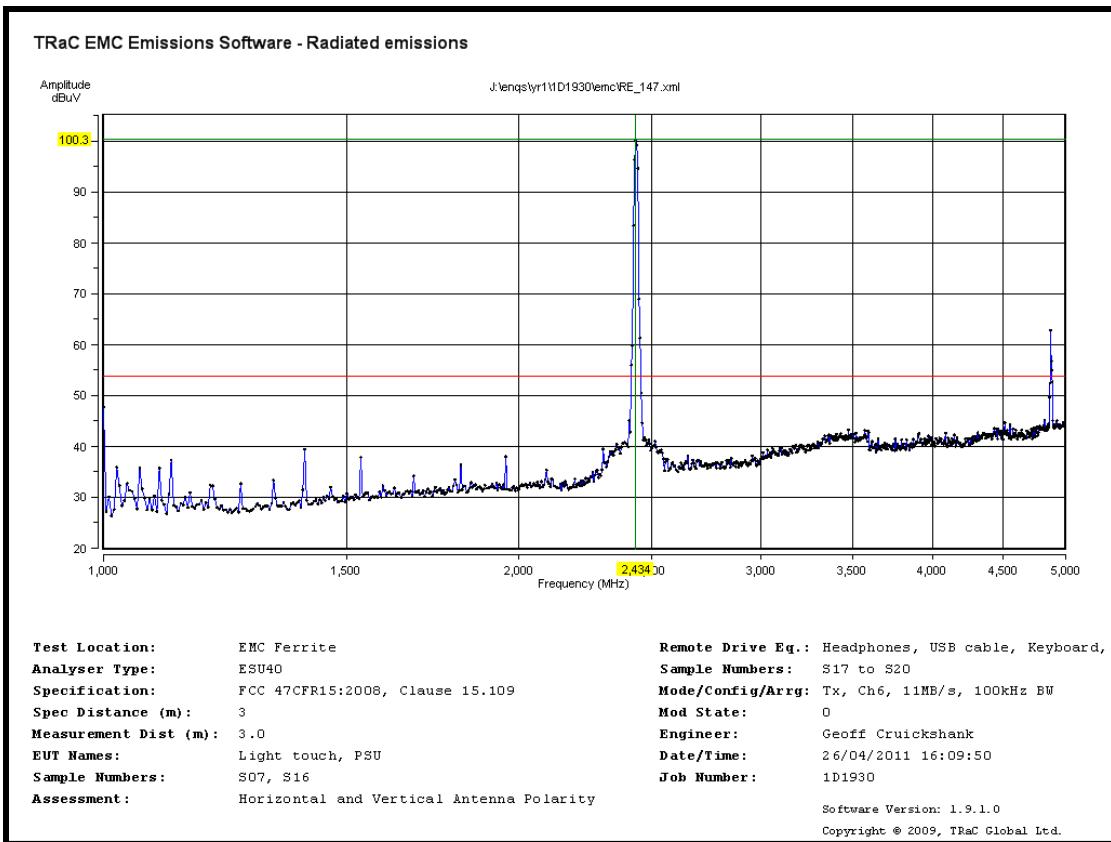
### Radiated Spurious emissions 18 GHz to 25 GHz – 2412MHz – 11Mbps



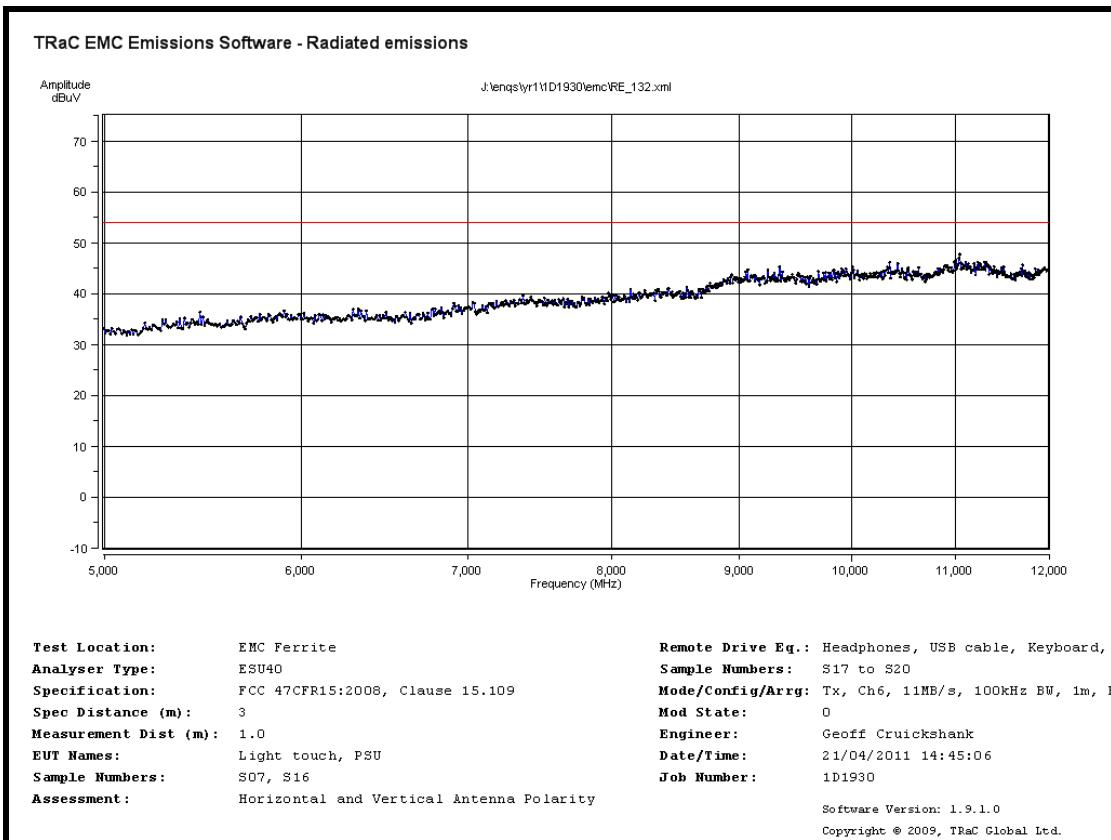
Radiated Spurious emissions 30 MHz to 200 MHz – 2437MHz – 11Mbps



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

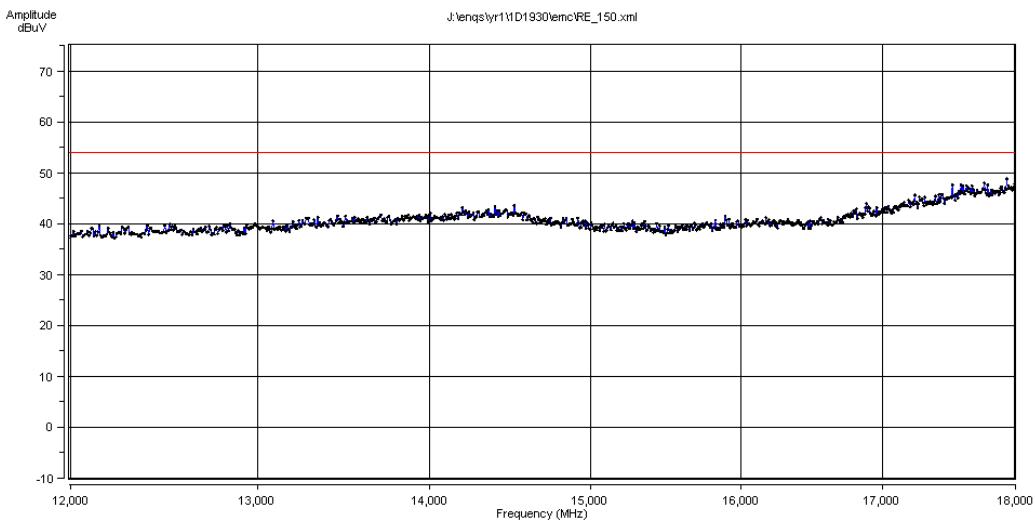


Radiated Spurious emissions 1 GHz to 5 GHz – 2437MHz – 11Mbps



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

## TRaC EMC Emissions Software - Radiated emissions

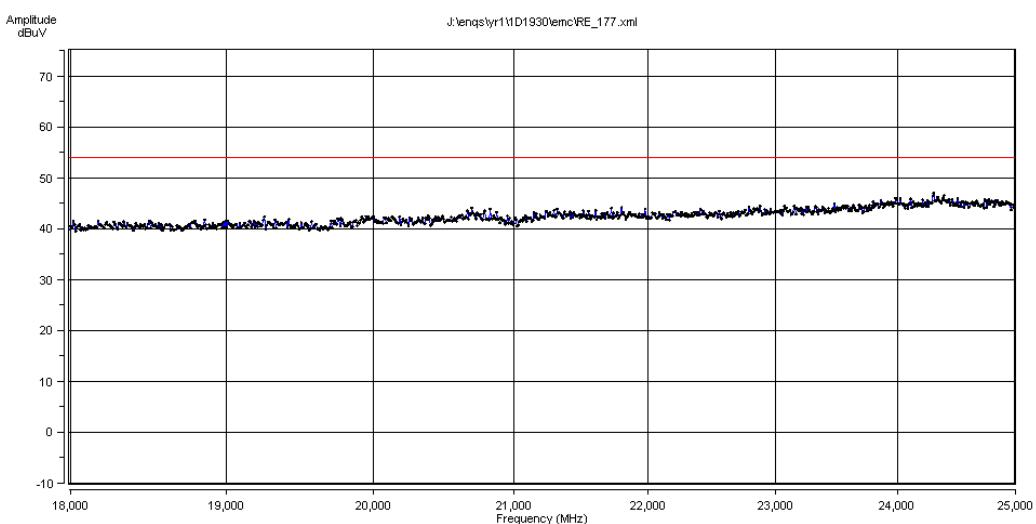


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Tx, Ch6, 11MB/s, 100kHz BW, 0dB a  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 14:24:36  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

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

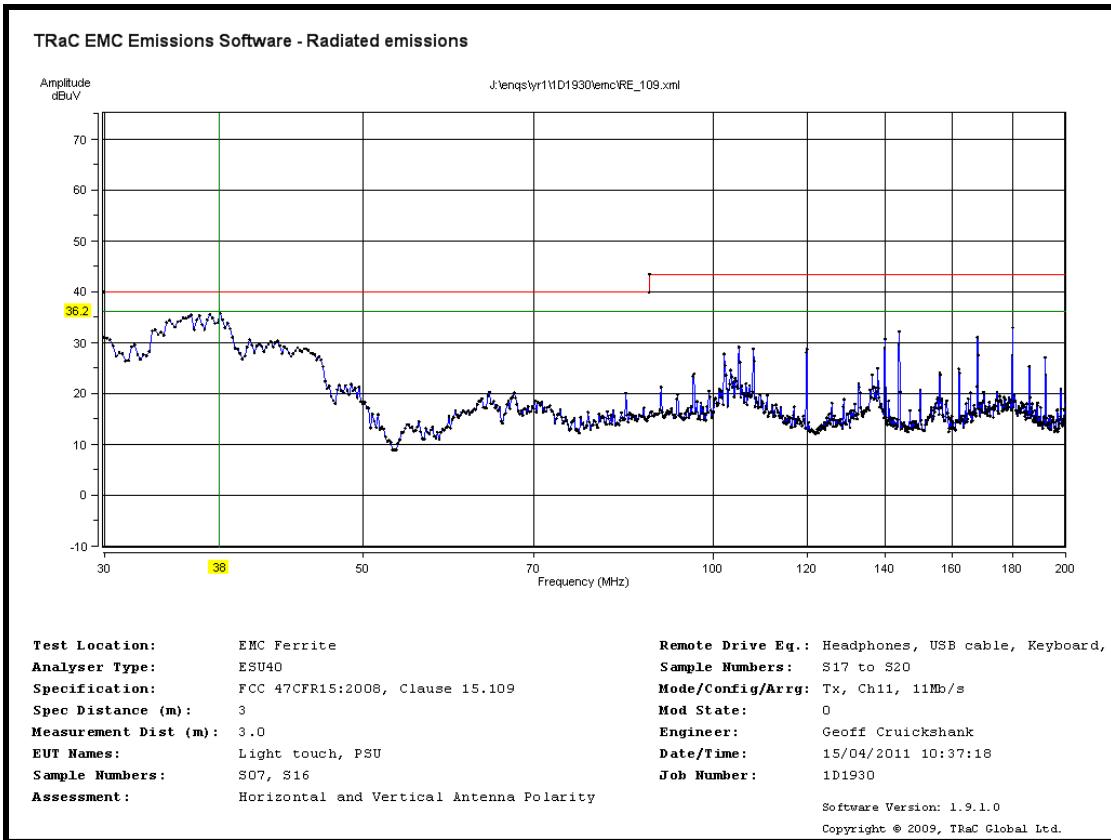
## TRaC EMC Emissions Software - Radiated emissions



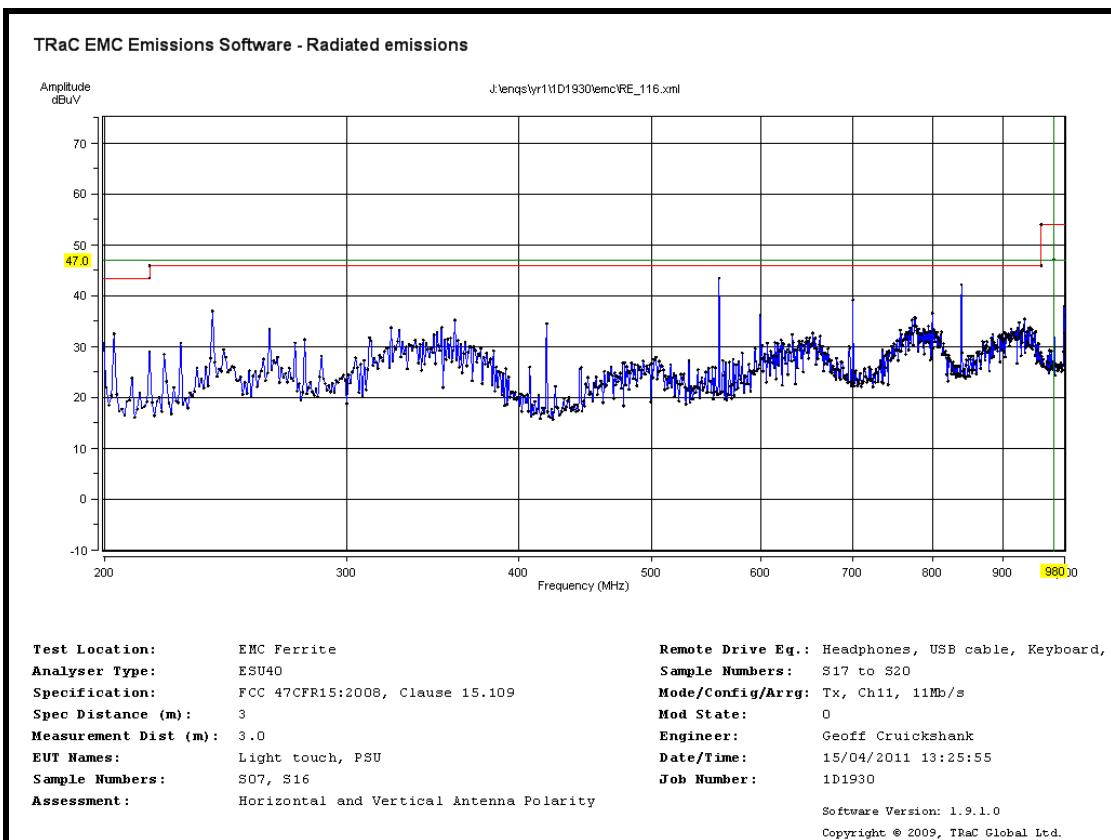
**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Tx, Ch6, 11MB/s, 100kHz BW, 0dB a  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 28/04/2011 08:39:22  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
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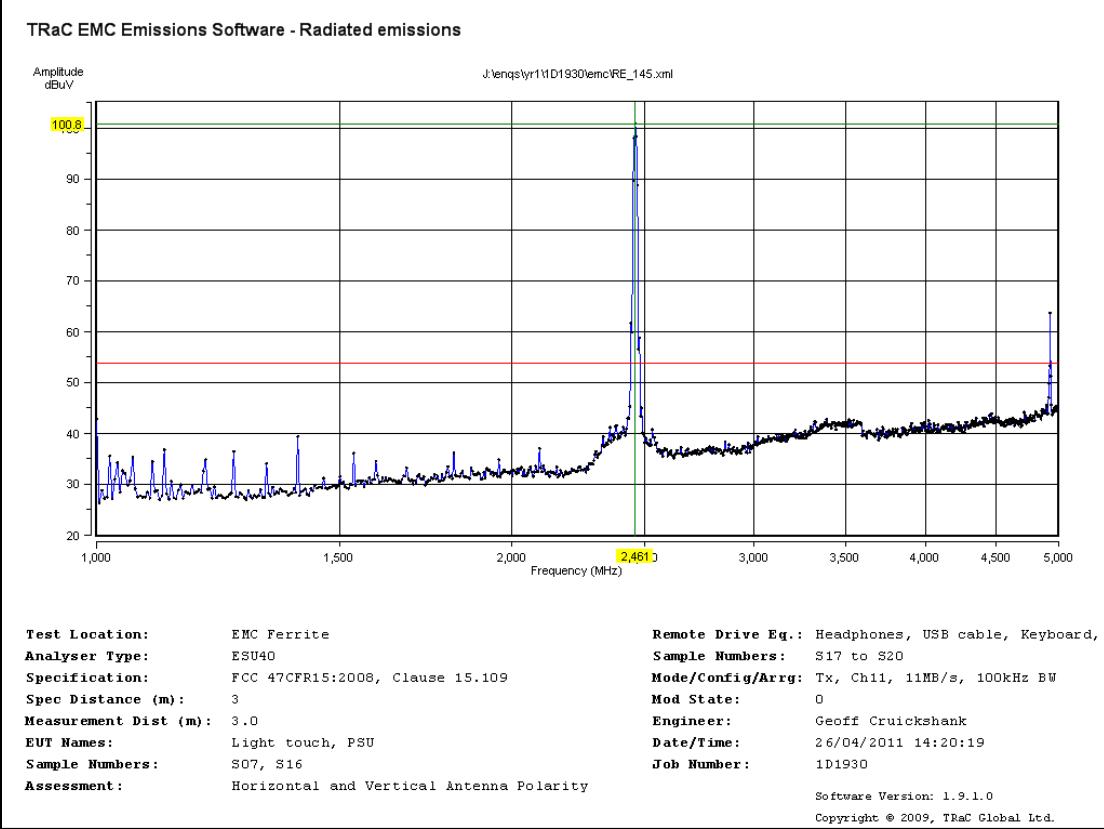
## Radiated Spurious emissions 18 GHz to 25 GHz – 2437MHz – 11Mbps



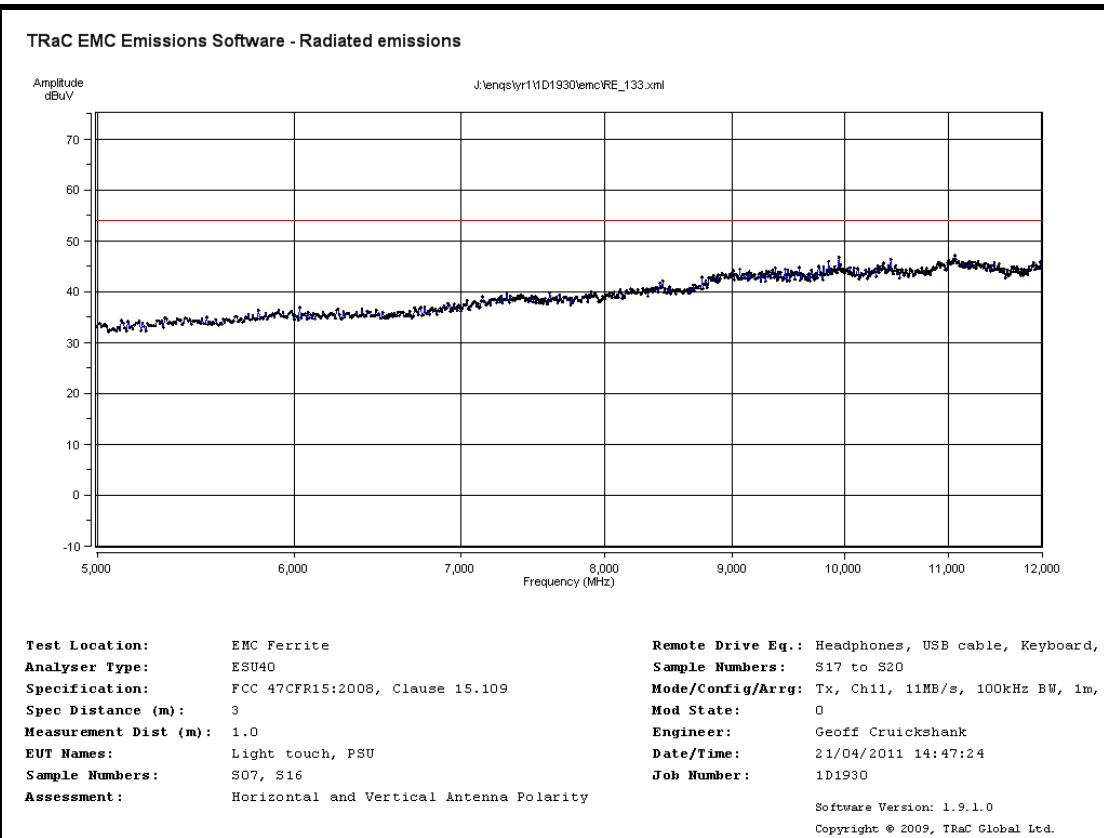
Radiated Spurious emissions 30 MHz to 200 MHz – 2462MHz – 11Mbps



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

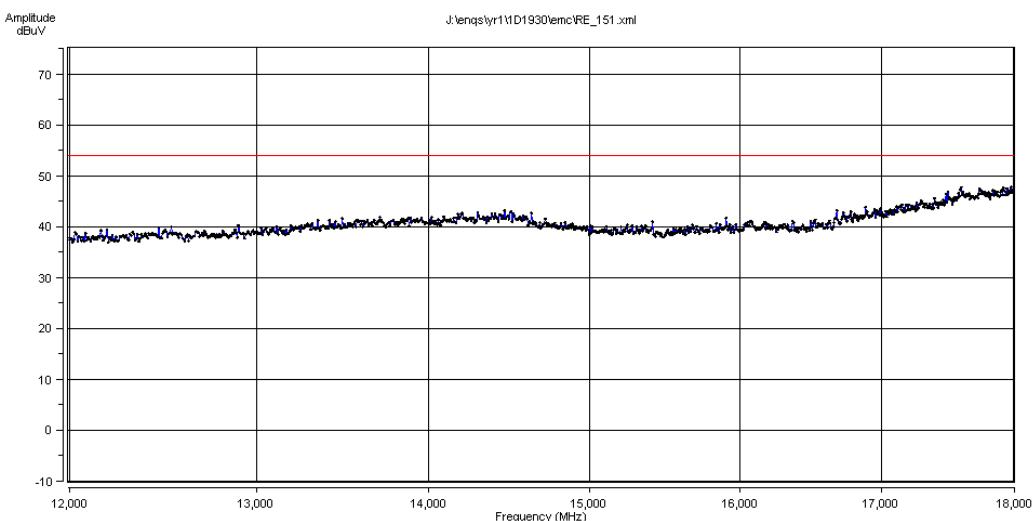


### Radiated Spurious emissions 1 GHz to 5 GHz – 2462MHz – 11Mbps



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

## TRaC EMC Emissions Software - Radiated emissions

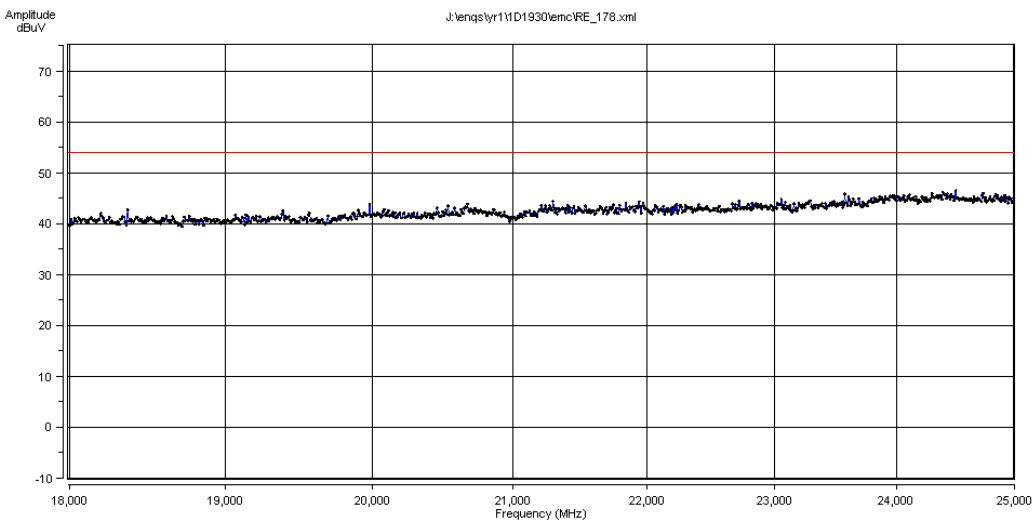


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Tx, Ch11, 11MB/s, 100kHz BW, 0dB  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 14:34:13  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

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

## TRaC EMC Emissions Software - Radiated emissions

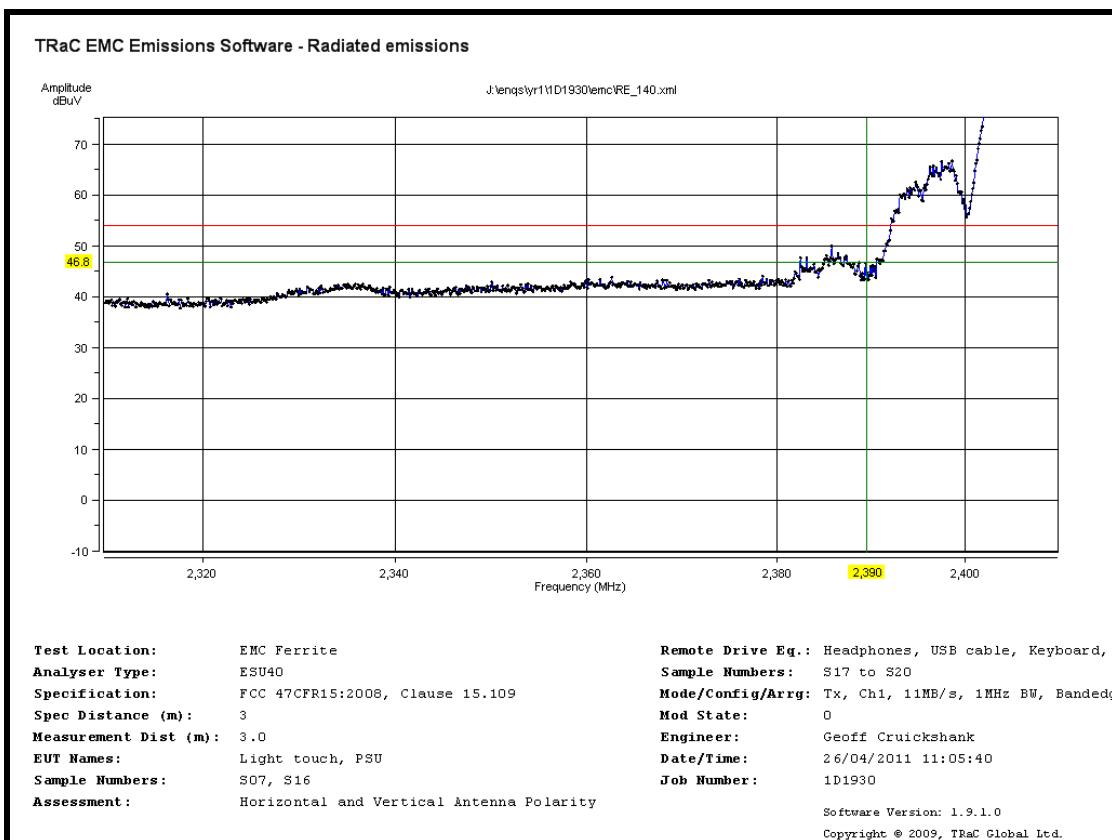


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

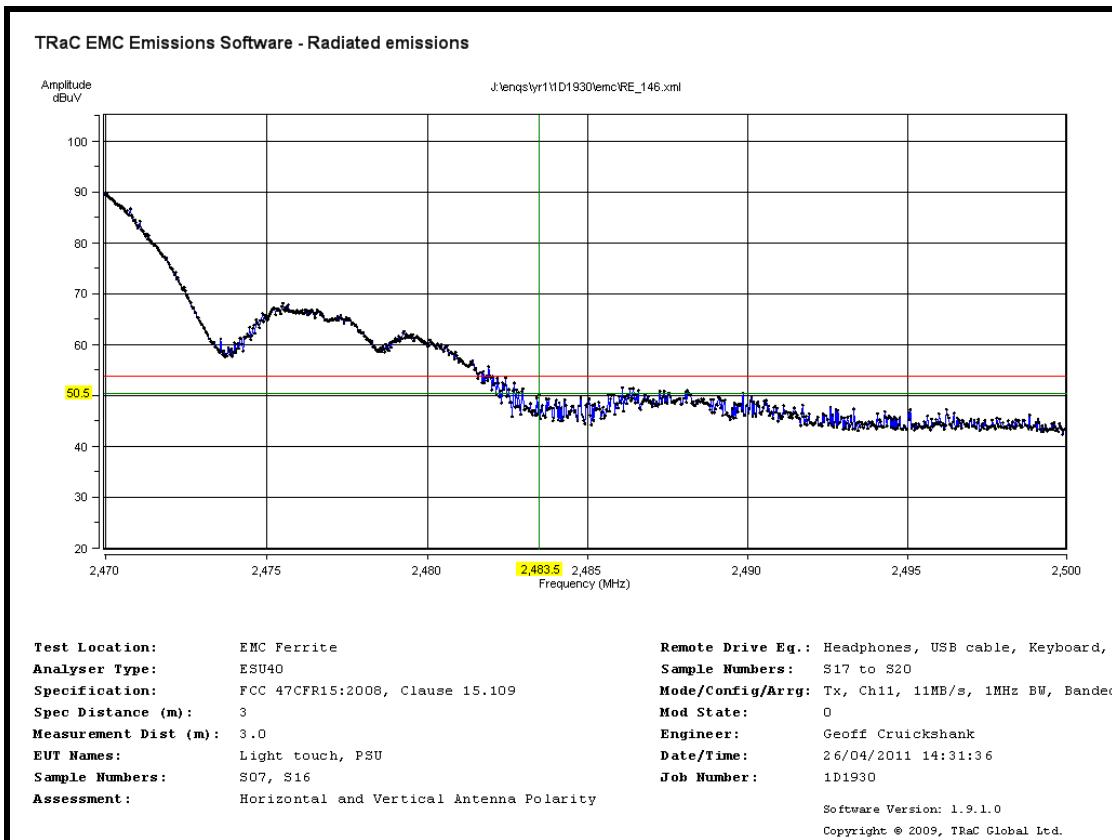
**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Tx, Ch11, 11MB/s, 100kHz BW, 0dB  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 28/04/2011 08:41:28  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

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

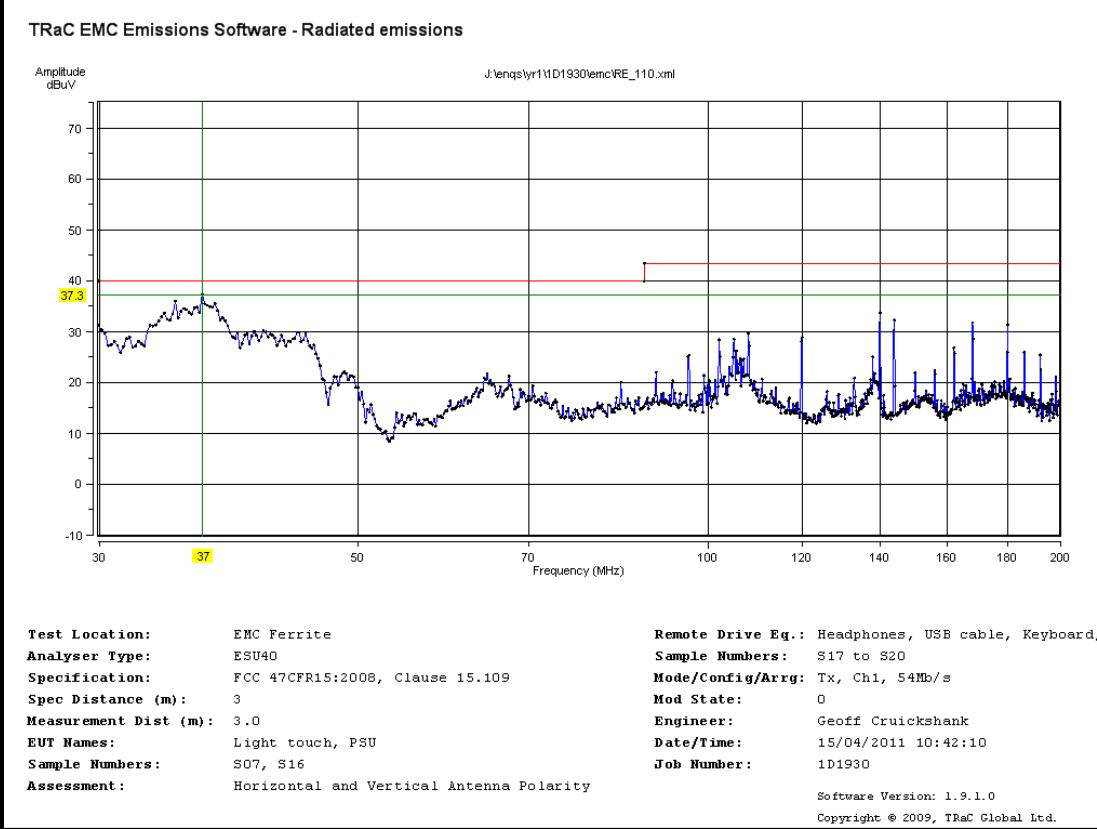
## Radiated Bandedge Compliance – Average plot to average limit



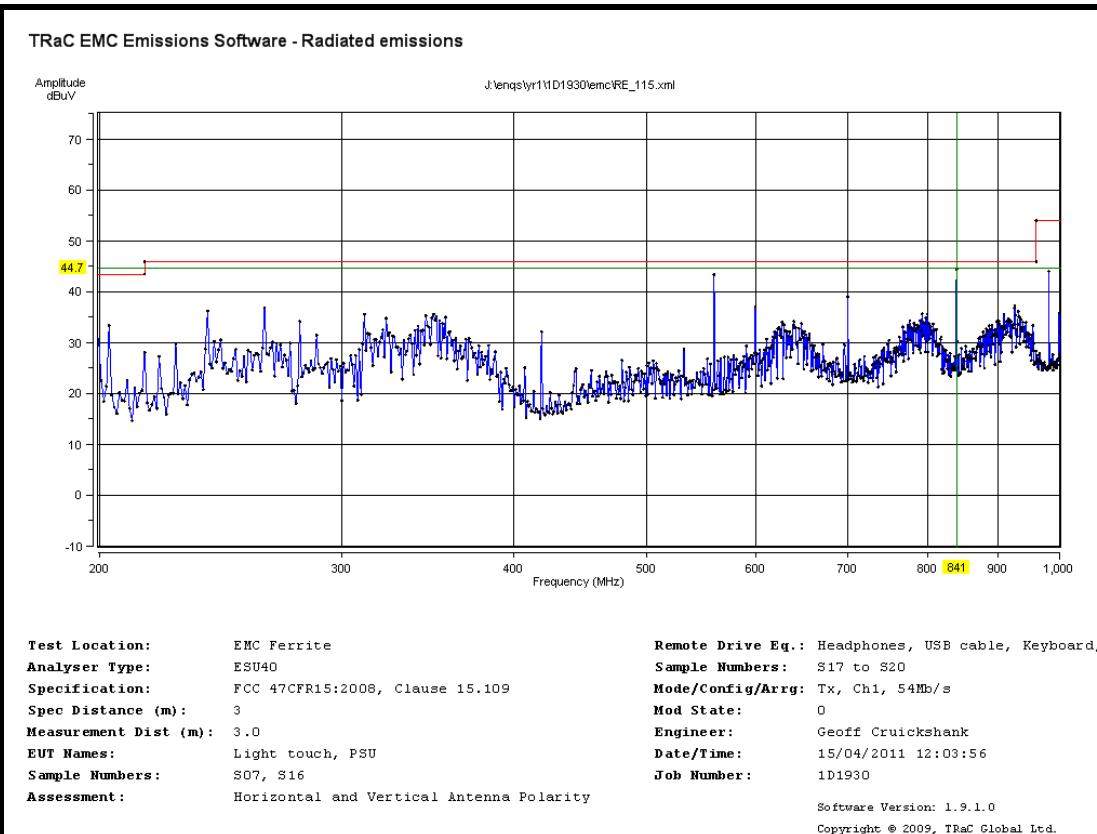
## Lower Bandedge



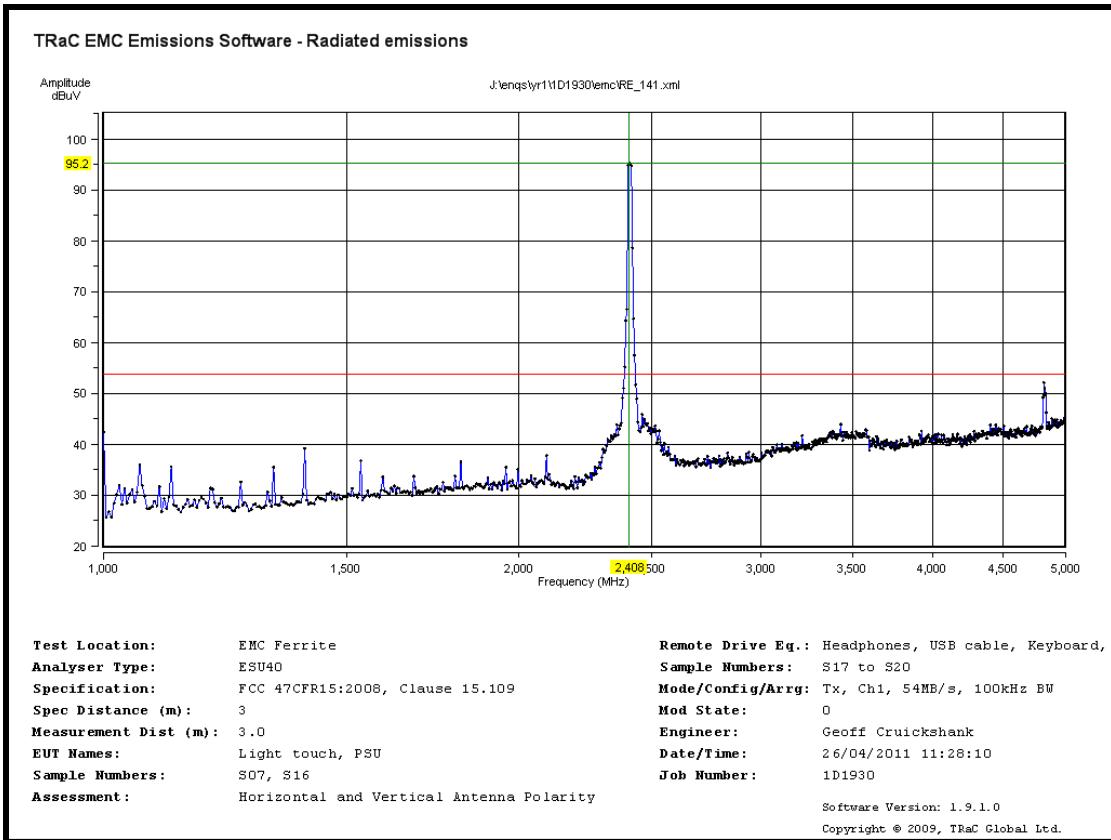
## Upper Bandedge



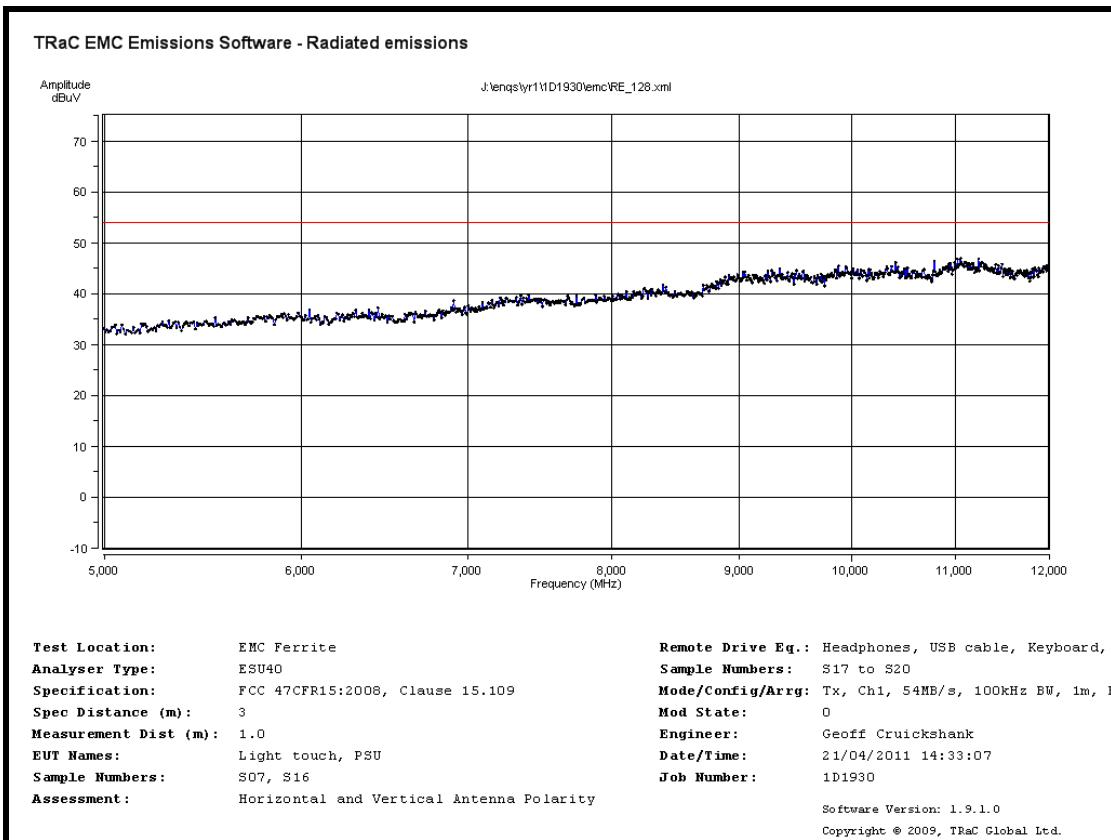
Radiated Spurious emissions 30 MHz to 200 MHz – 2412MHz – 54Mbps



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

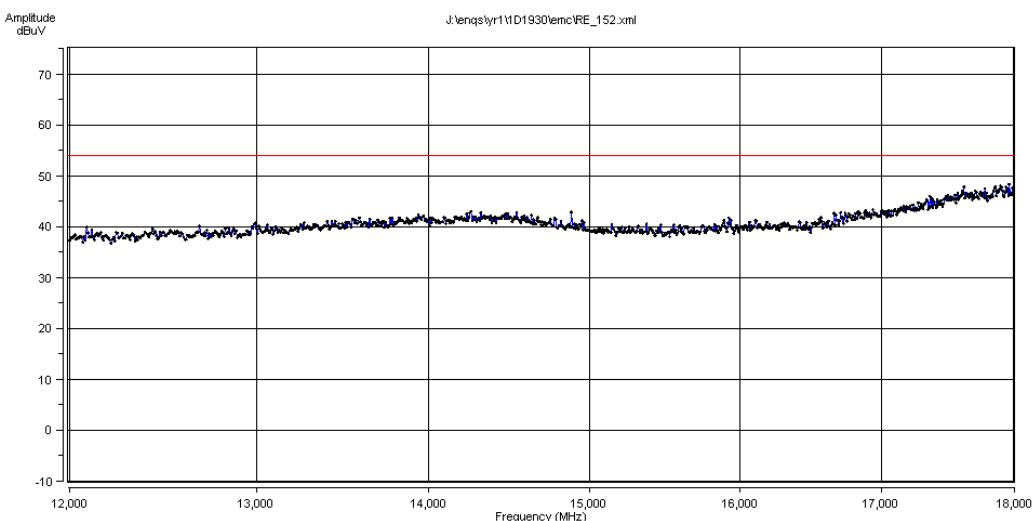


Radiated Spurious emissions 1 GHz to 5 GHz – 2412MHz – 54Mbps



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

## TRaC EMC Emissions Software - Radiated emissions

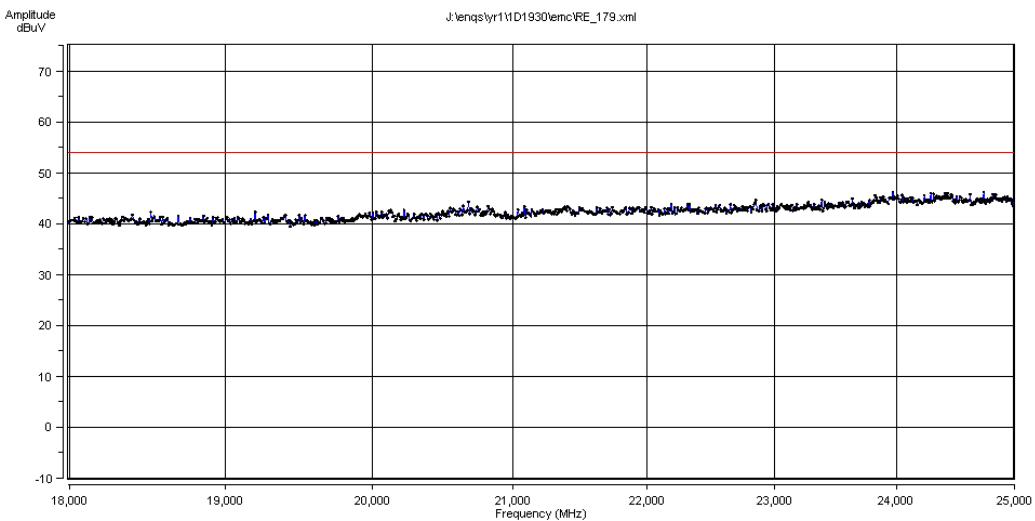


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Tx, Ch1, 54MB/s, 100kHz BW, 0dB a  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 14:40:11  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

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

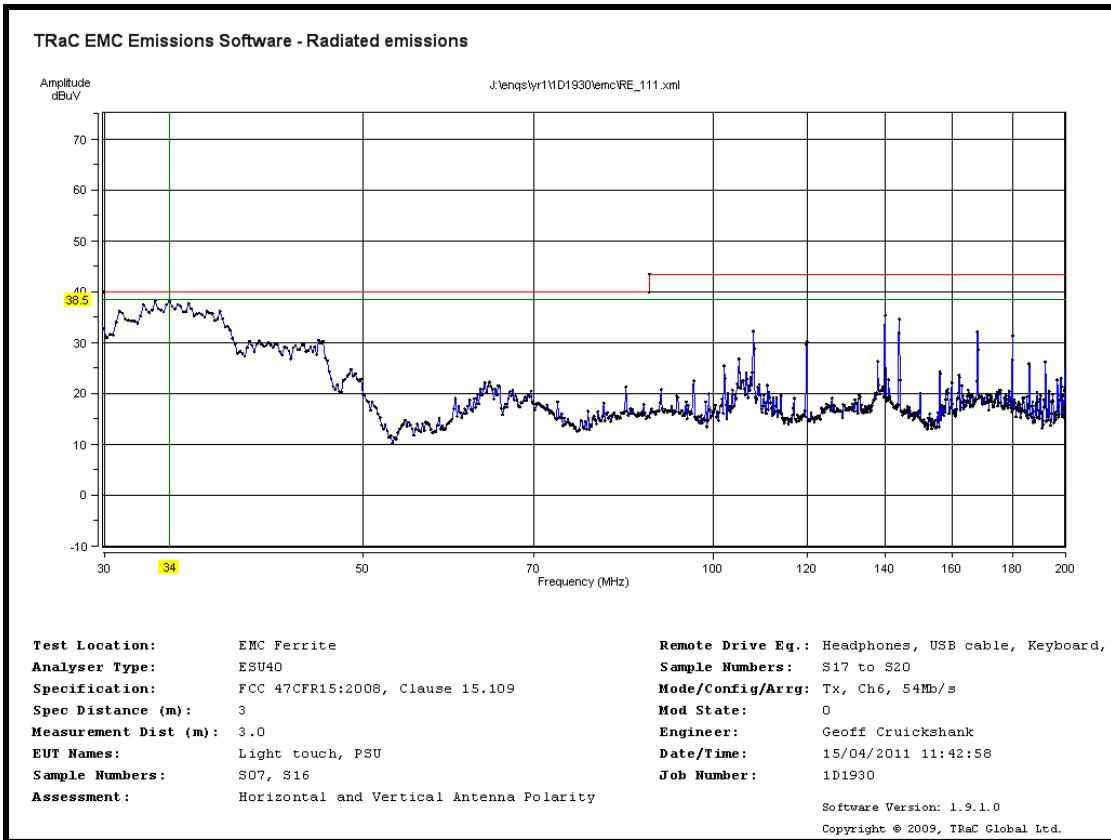
## TRaC EMC Emissions Software - Radiated emissions



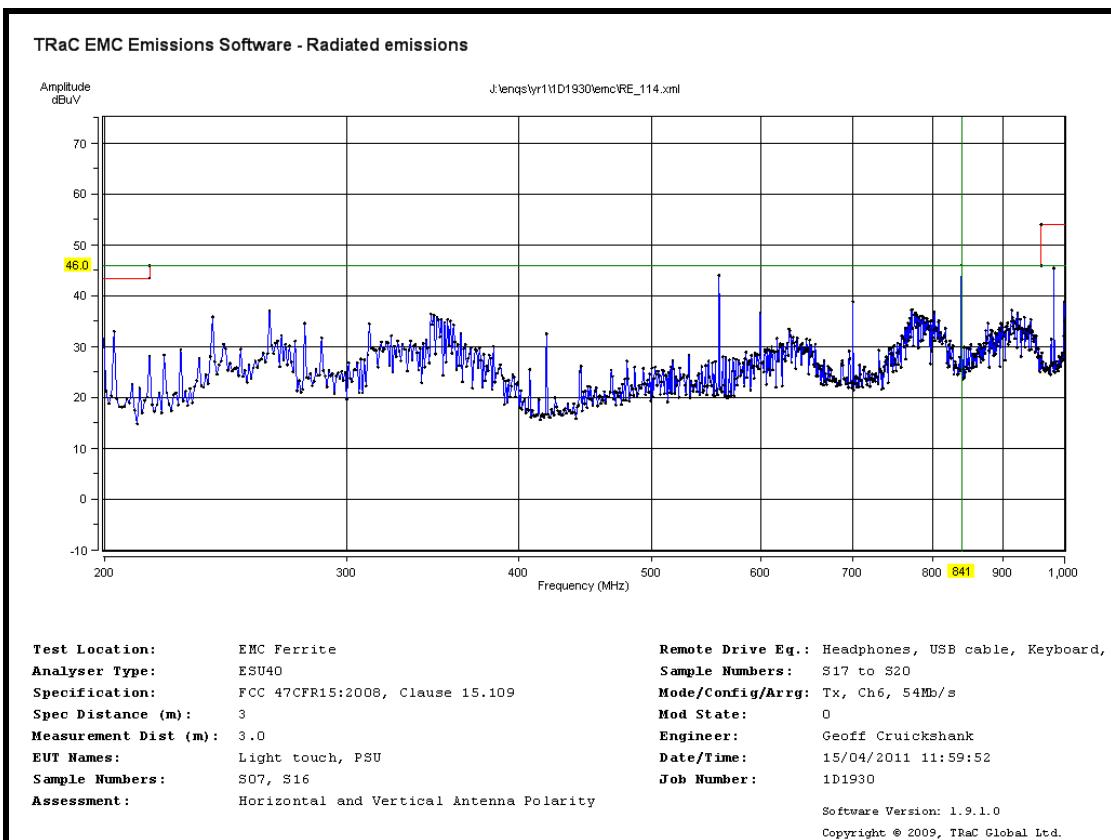
**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Tx, Ch1, 54MB/s, 100kHz BW, 0dB a  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 28/04/2011 08:45:53  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
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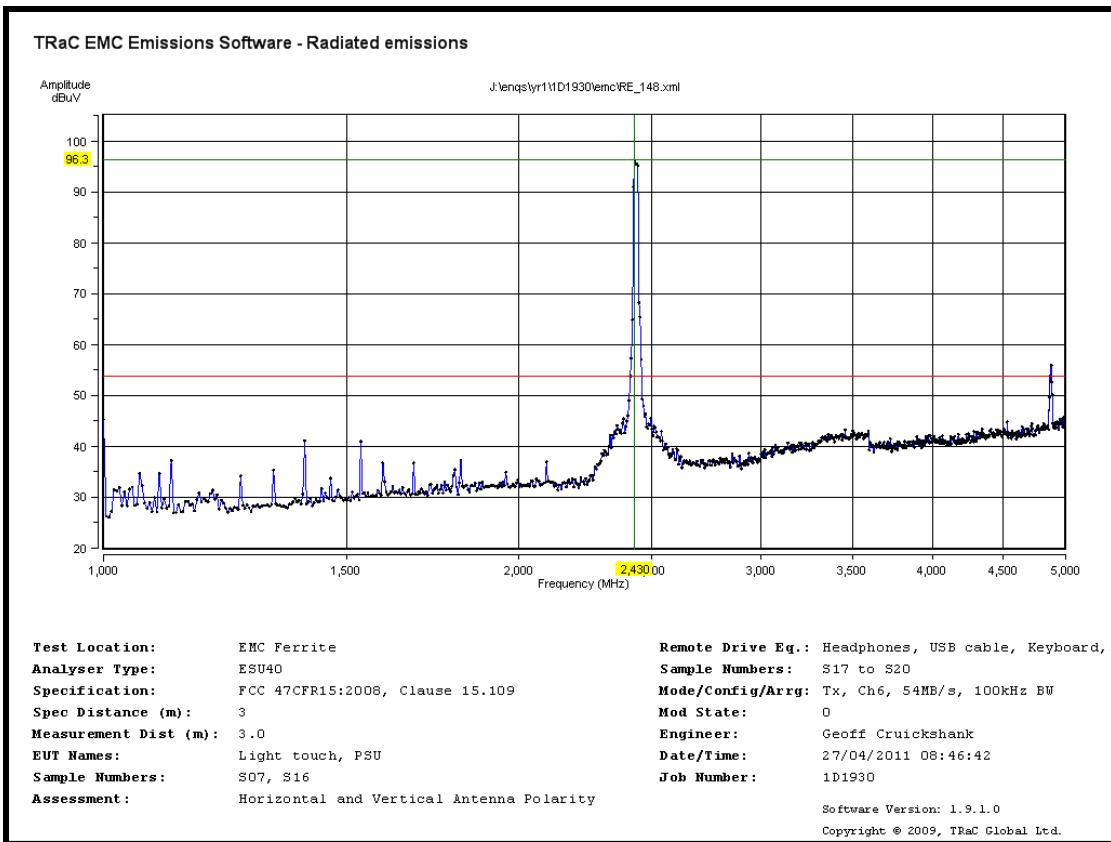
## Radiated Spurious emissions 18 GHz to 25 GHz – 2412MHz – 54Mbps



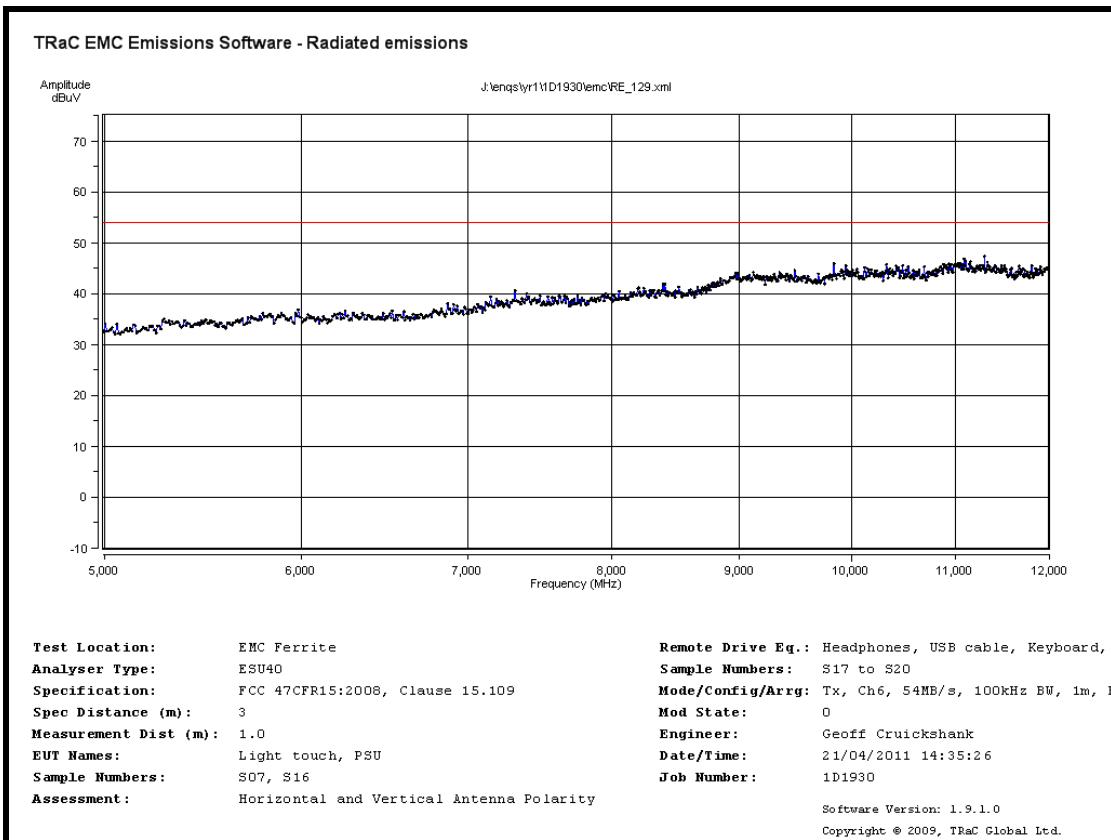
Radiated Spurious emissions 30 MHz to 200 MHz – 2437MHz – 54Mbps



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

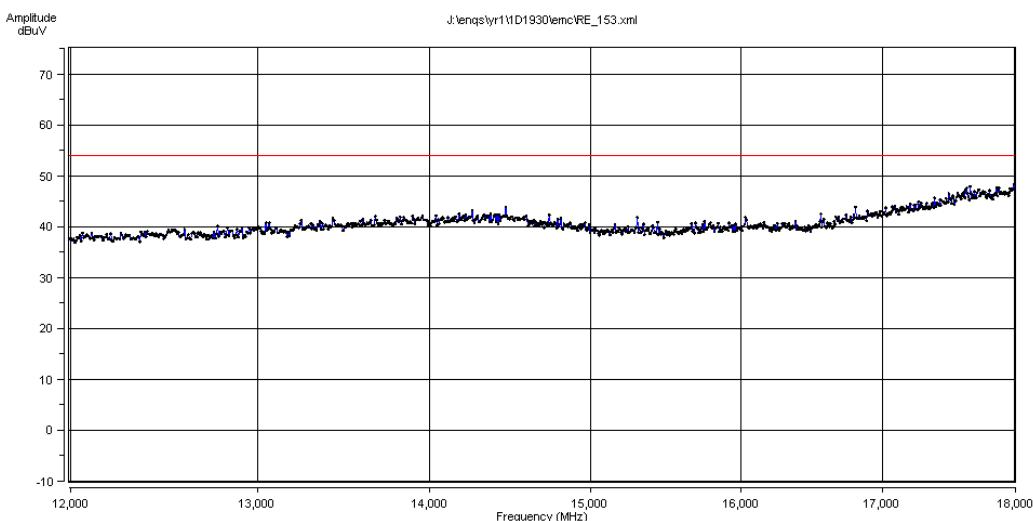


Radiated Spurious emissions 1 GHz to 5 GHz – 2437MHz – 54Mbps



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

## TRaC EMC Emissions Software - Radiated emissions

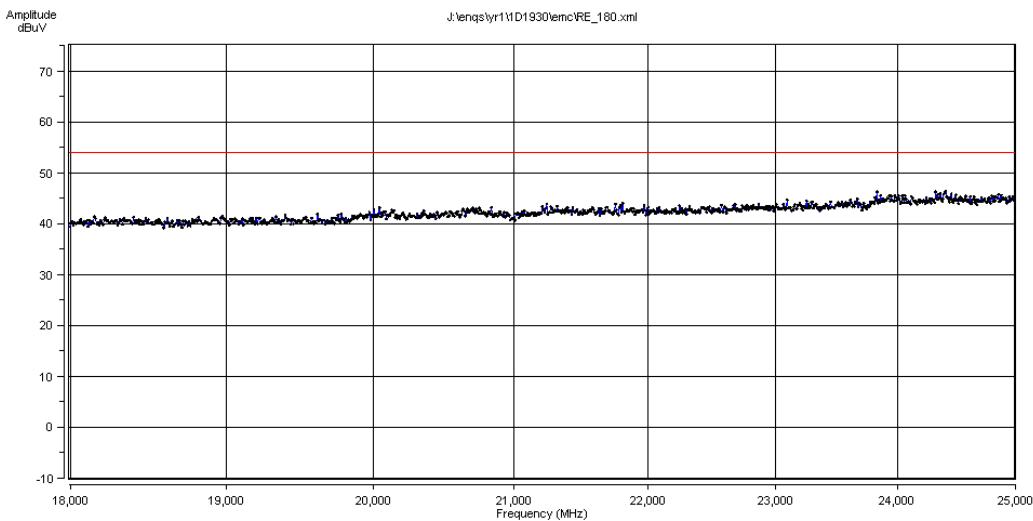


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Tx, Ch6, 54MB/s, 100kHz BW, 0dB a  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 14:42:36  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

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

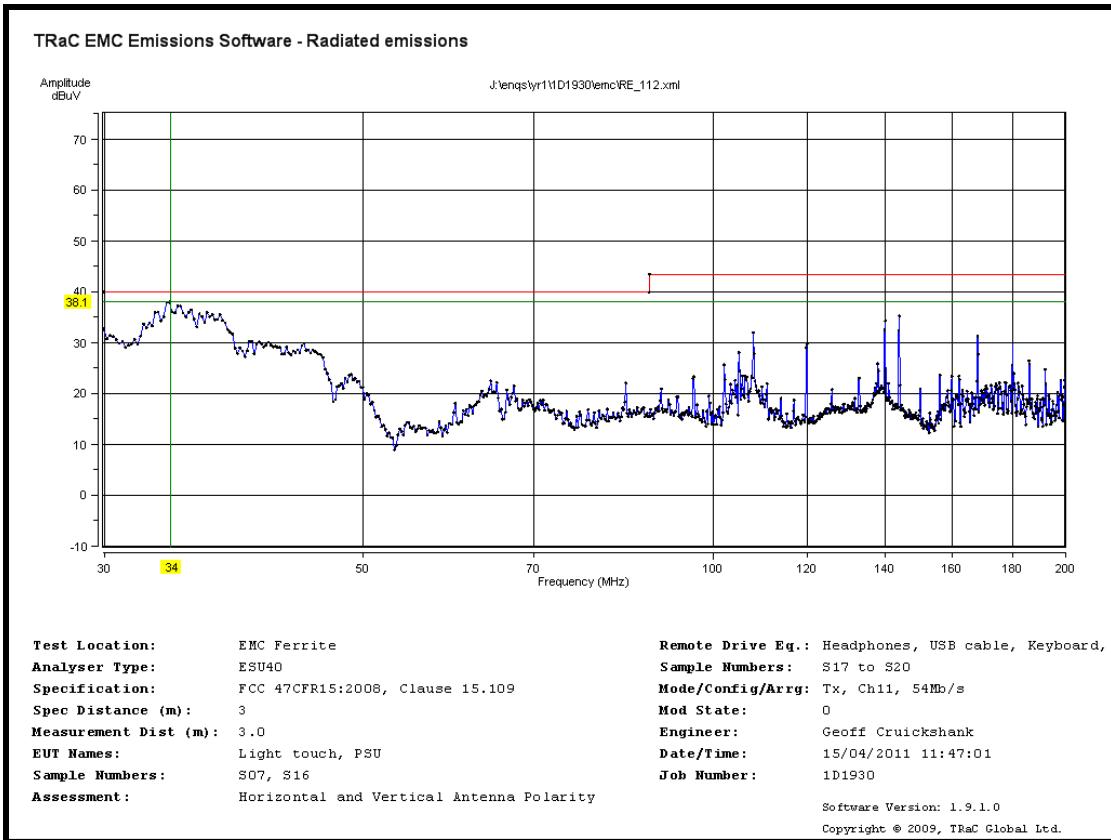
## TRaC EMC Emissions Software - Radiated emissions



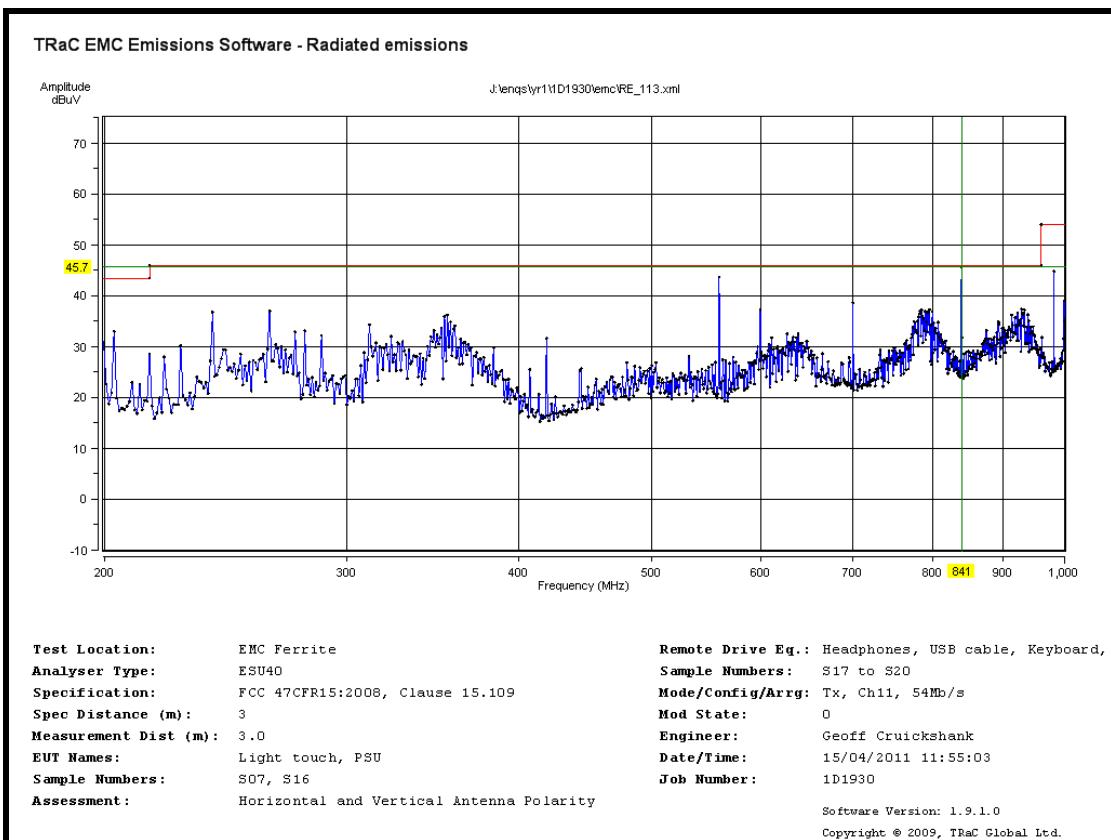
**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Tx, Ch6, 54MB/s, 100kHz BW, 0dB a  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 28/04/2011 08:47:56  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
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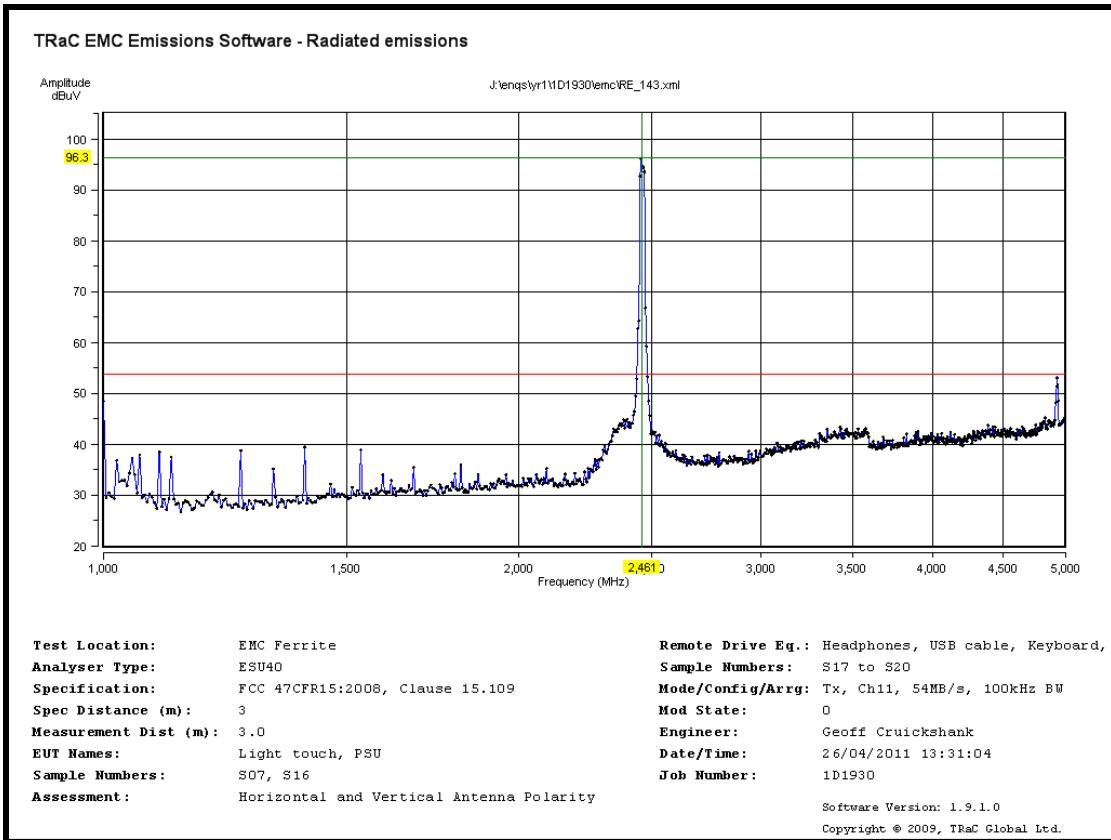
## Radiated Spurious emissions 18 GHz to 25 GHz – 2437MHz – 54Mbps



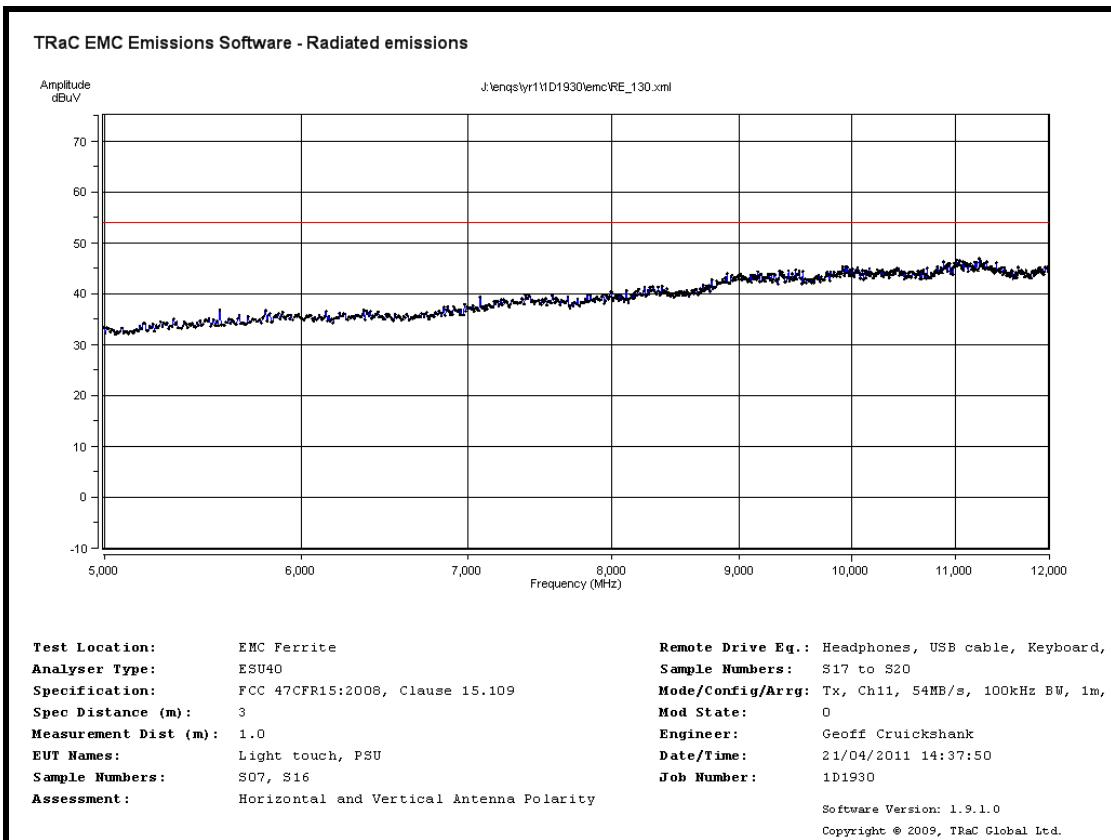
Radiated Spurious emissions 30 MHz to 200 MHz – 2462MHz – 54Mbps



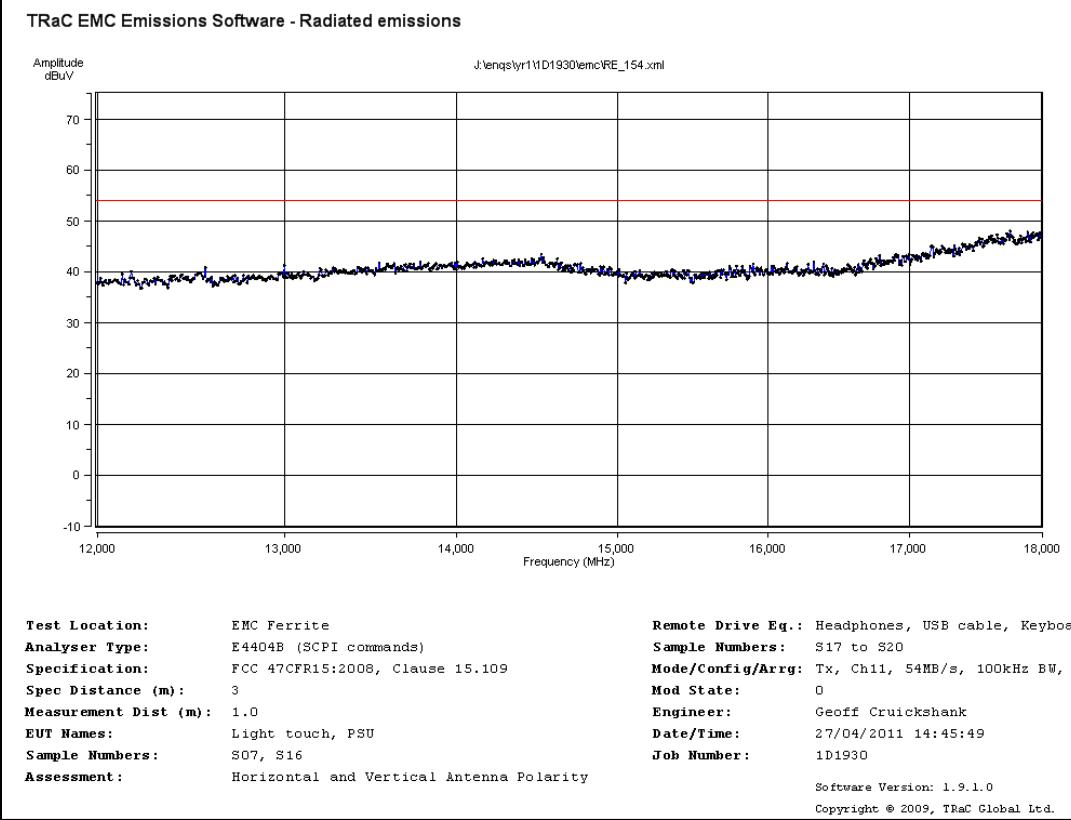
Radiated Spurious emissions 200 MHz to 1 GHz – 2462MHz – 54Mbps



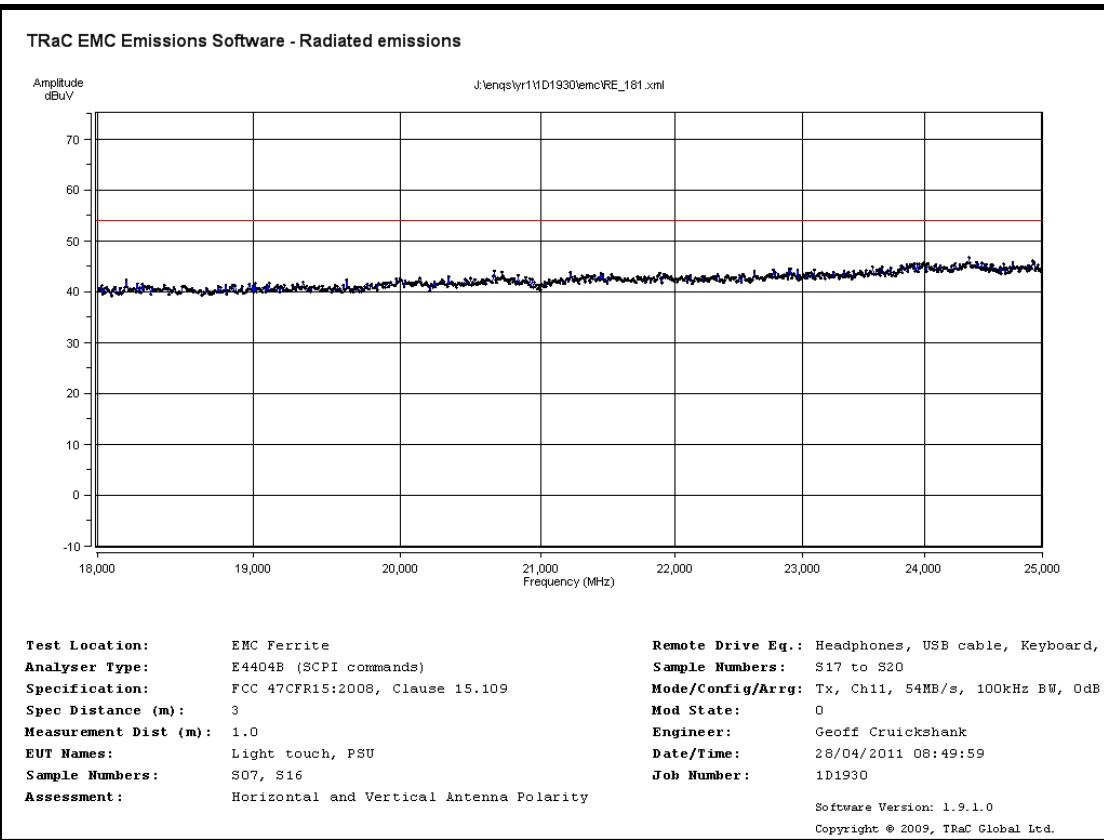
Radiated Spurious emissions 1 GHz to 5 GHz – 2462MHz – 54Mbps



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

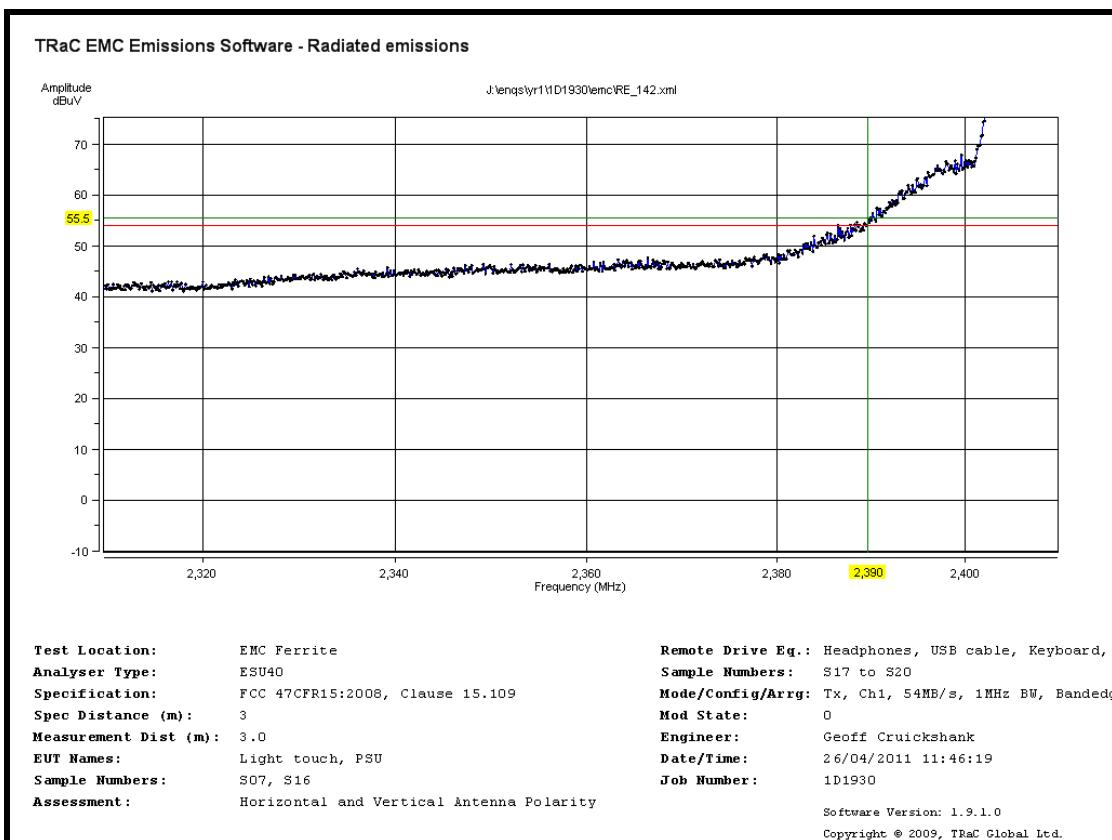


### Radiated Spurious emissions 12 GHz to 18 GHz – 2462MHz – 54Mbps

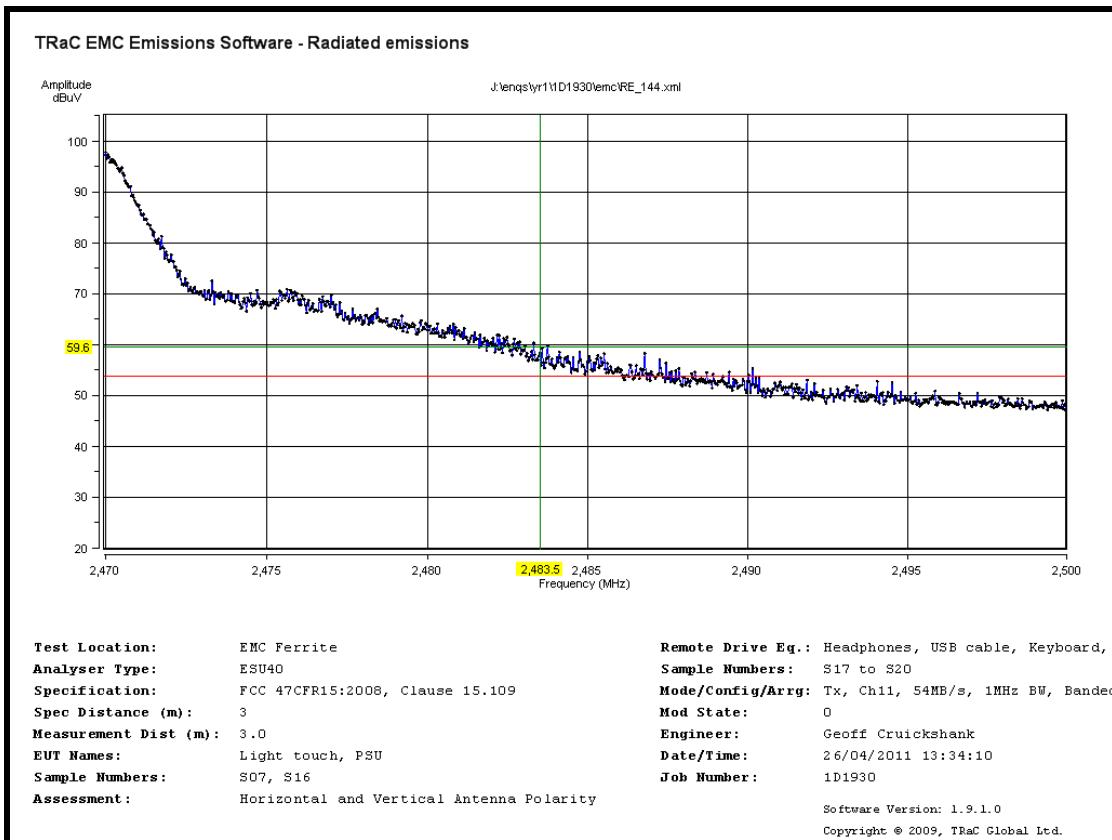


### Radiated Spurious emissions 18 GHz to 25 GHz – 2462MHz – 54Mbps

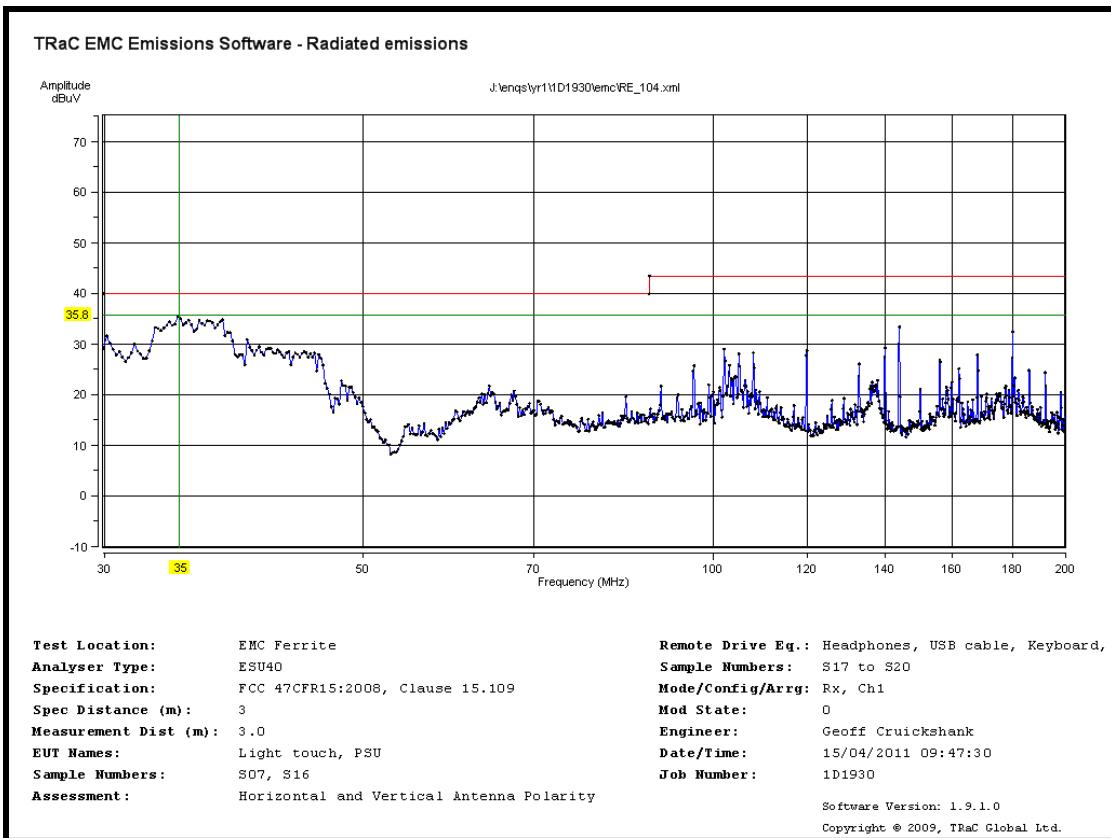
## Radiated Bandedge Compliance – Average plot to average limit



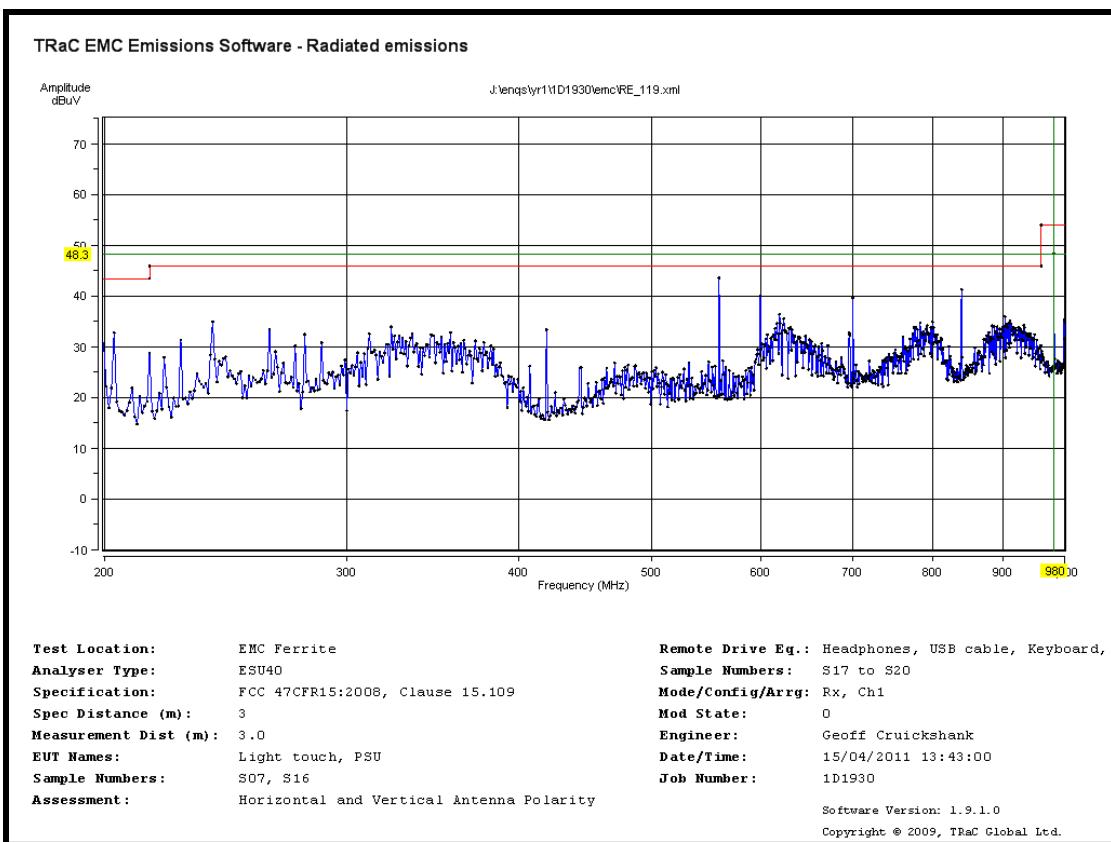
## Lower Bandedge



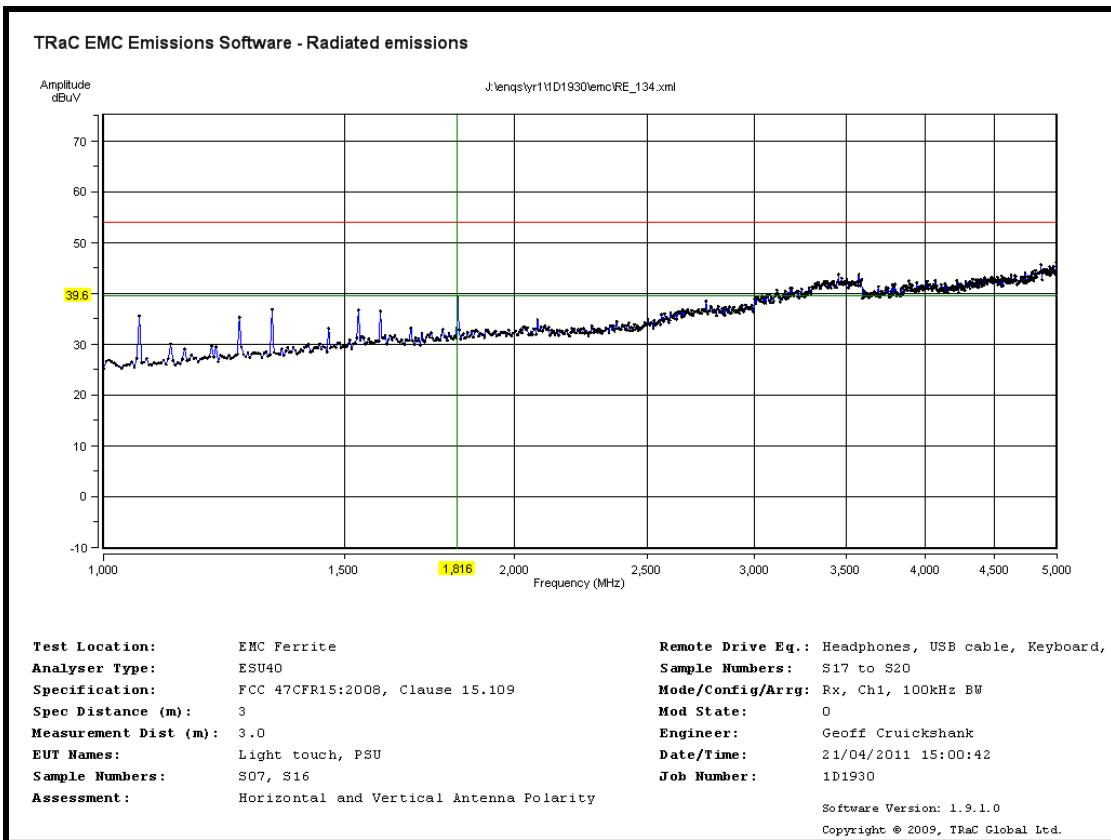
## Upper Bandedge



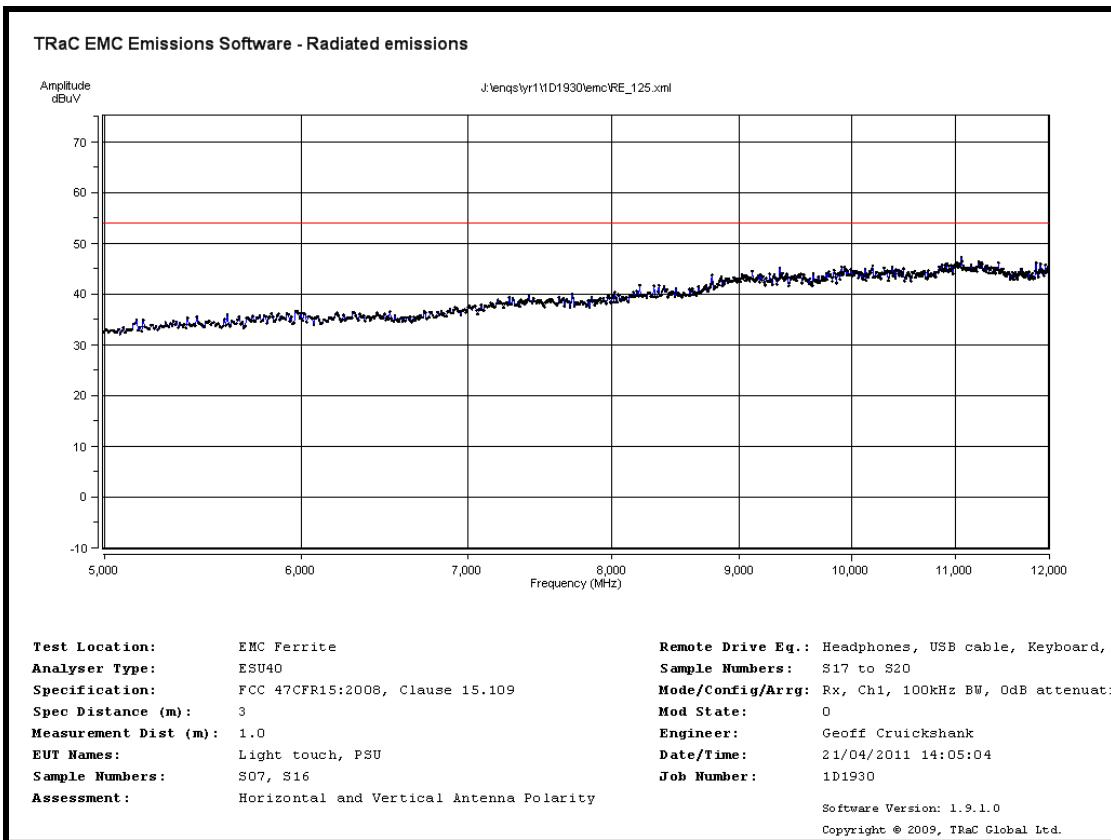
### Unintentional Radiated Spurious emissions 30 MHz to 200 MHz – 2412MHz



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

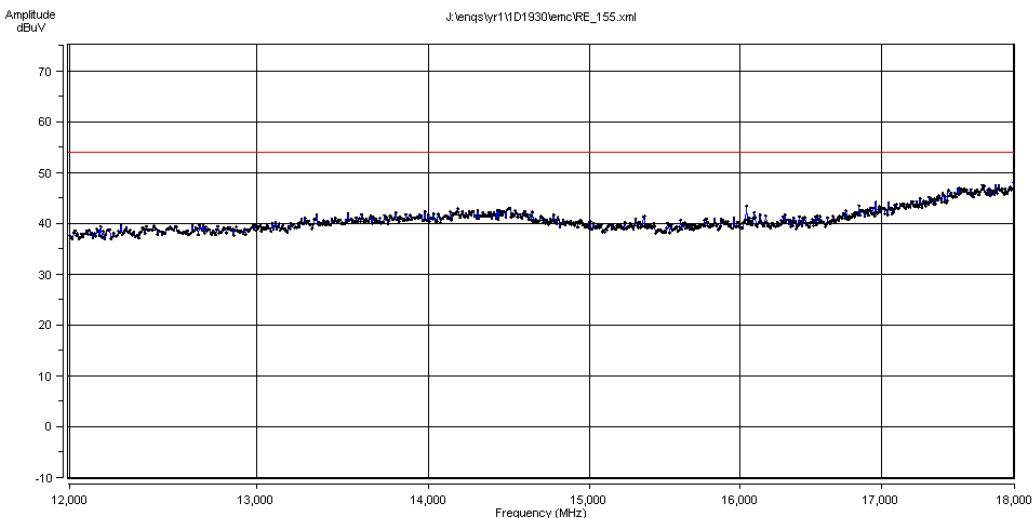


### Unintentional Radiated Spurious emissions 1 GHz to 5 GHz – 2412MHz



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

## TRaC EMC Emissions Software - Radiated emissions

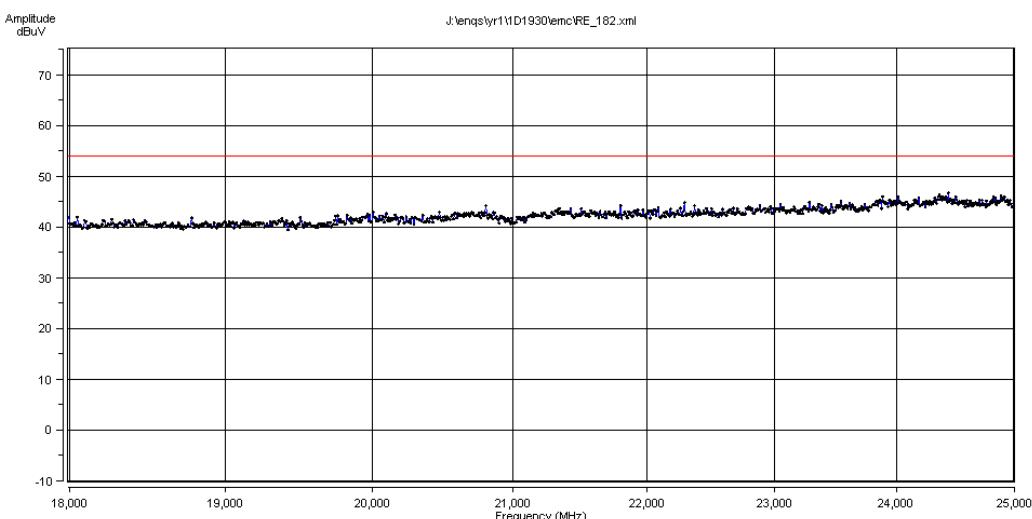


**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Rx, Ch1, 100kHz BW, 0dB attenuati  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 14:51:00  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

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

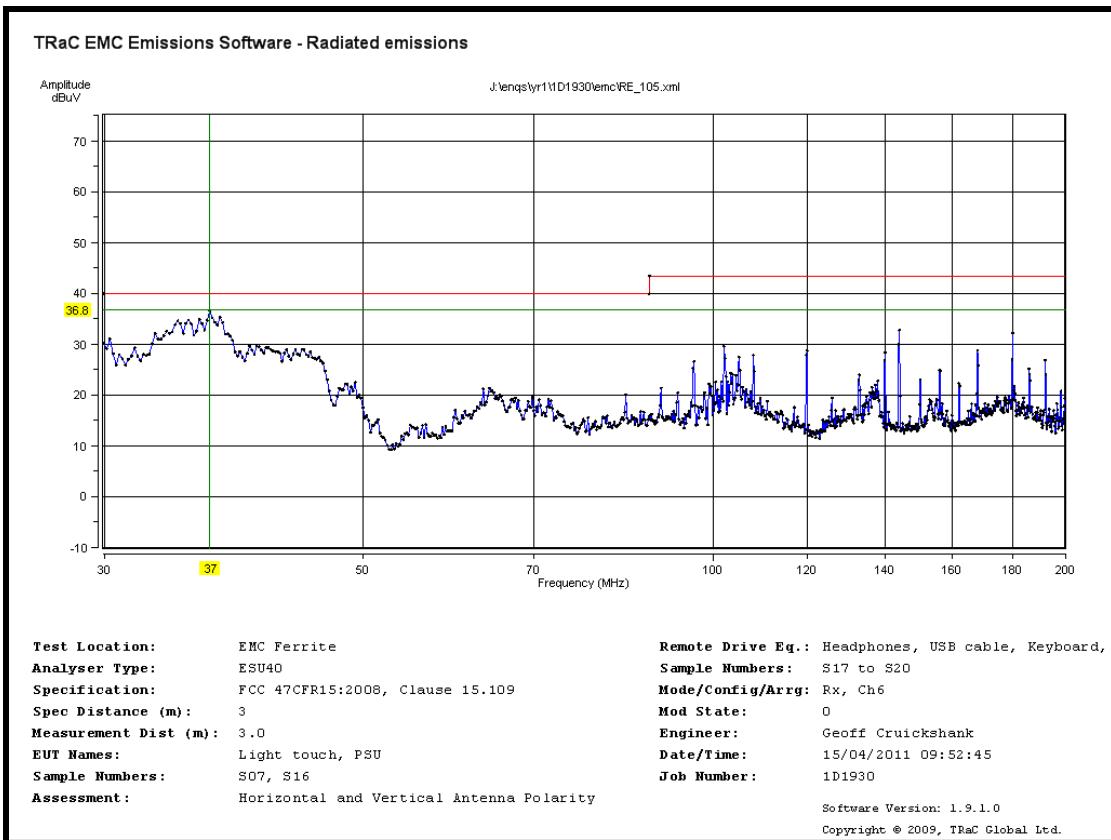
## TRaC EMC Emissions Software - Radiated emissions



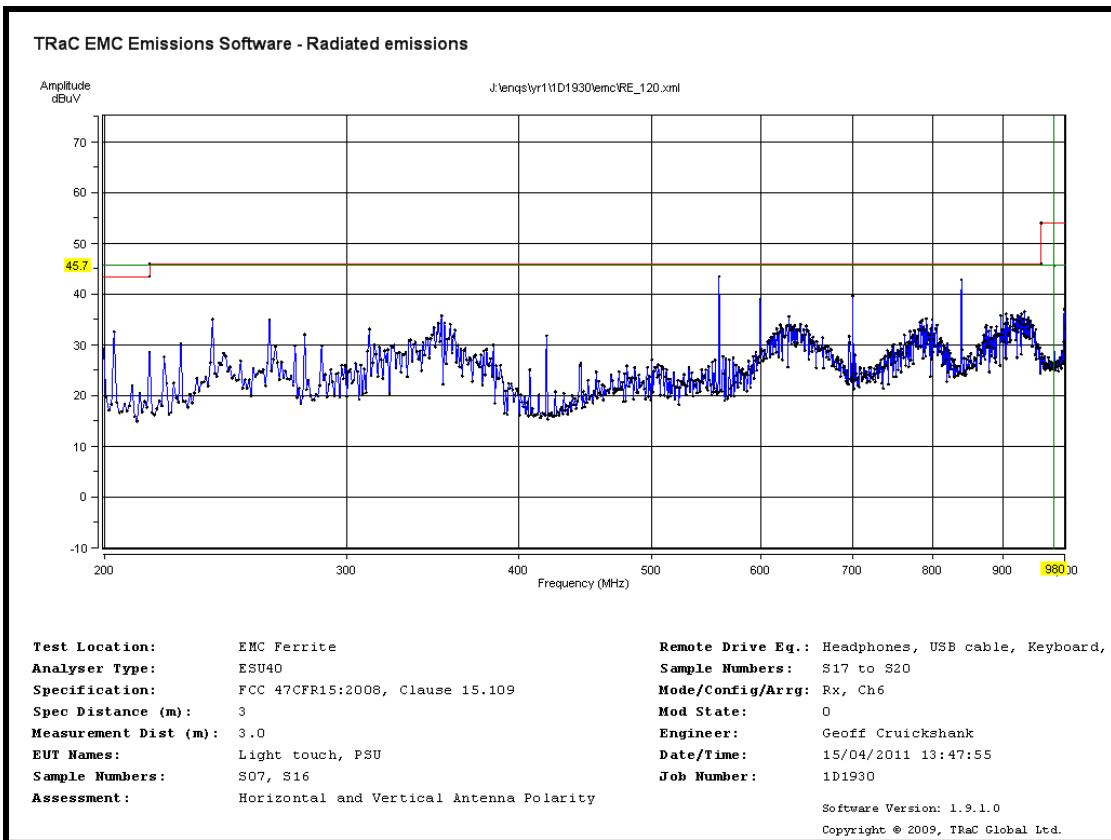
**Test Location:** EMC Ferrite  
**Analyser Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Rx, Ch1, 100kHz BW, 0dB attenuati  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 28/04/2011 08:53:55  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

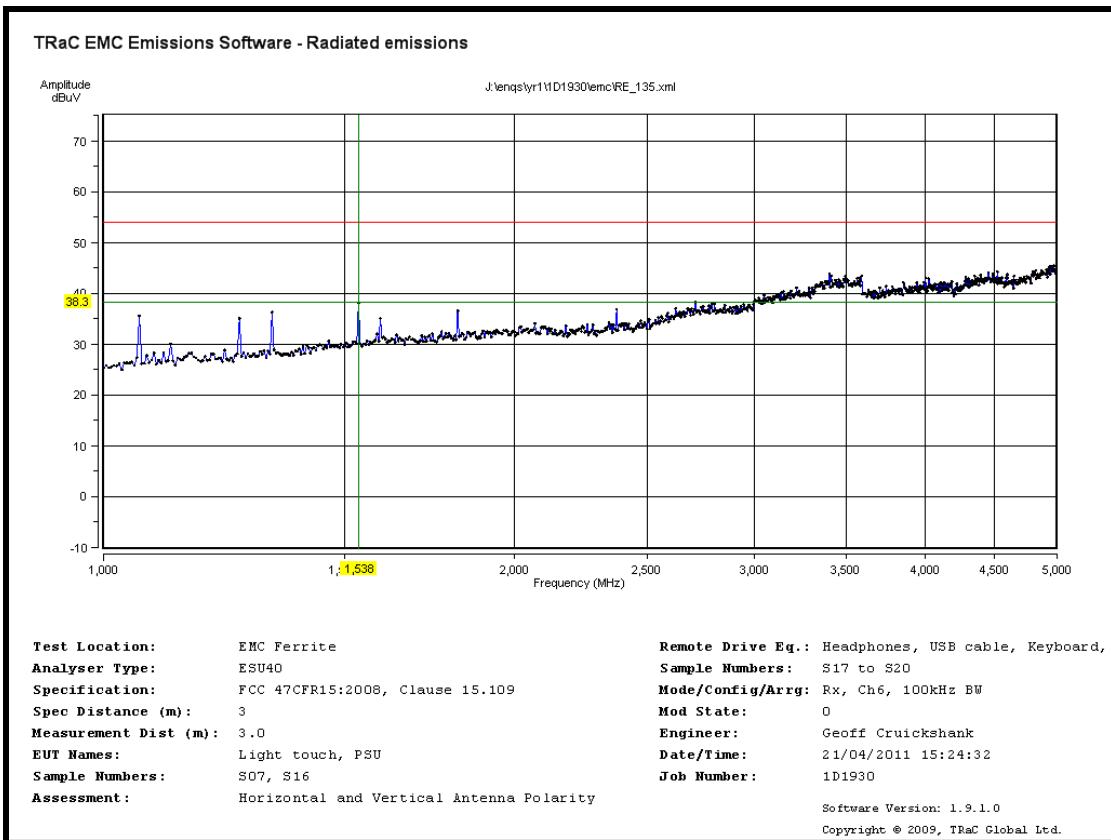
## Unintentional Radiated Spurious emissions 18 GHz to 25 GHz – 2412MHz



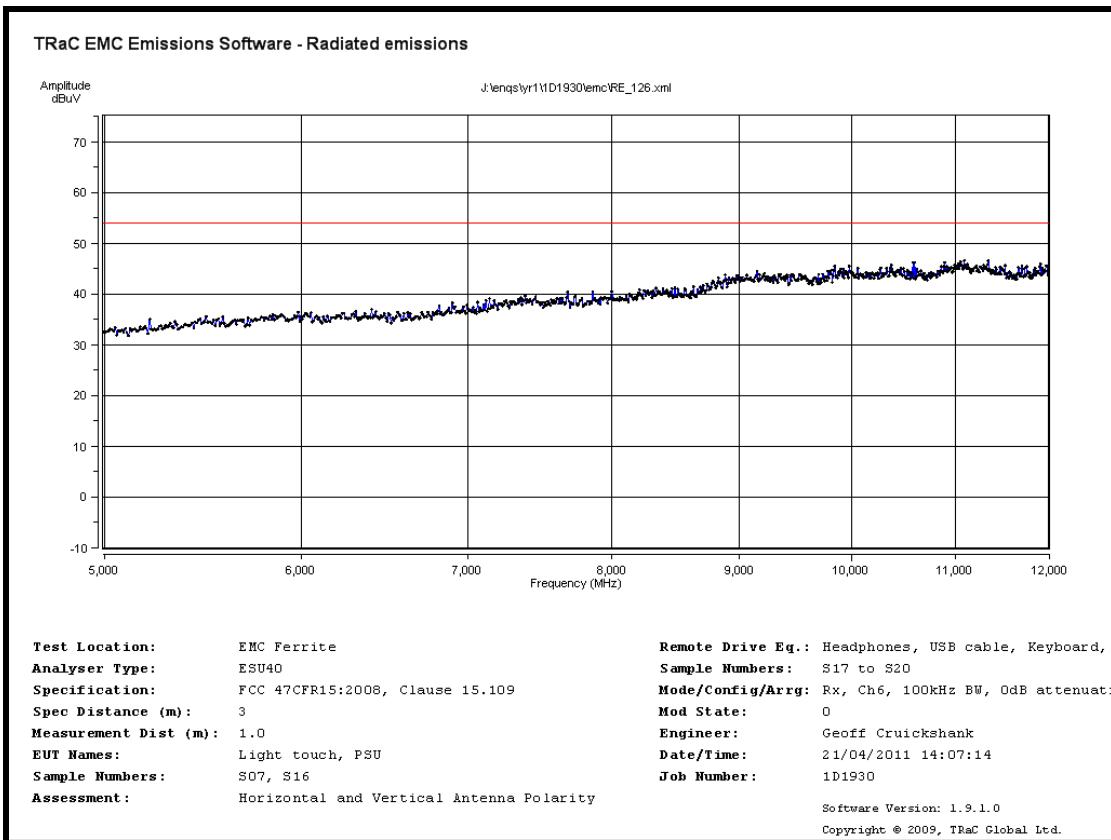
### Unintentional Radiated Spurious emissions 30 MHz to 200 MHz – 2437MHz



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

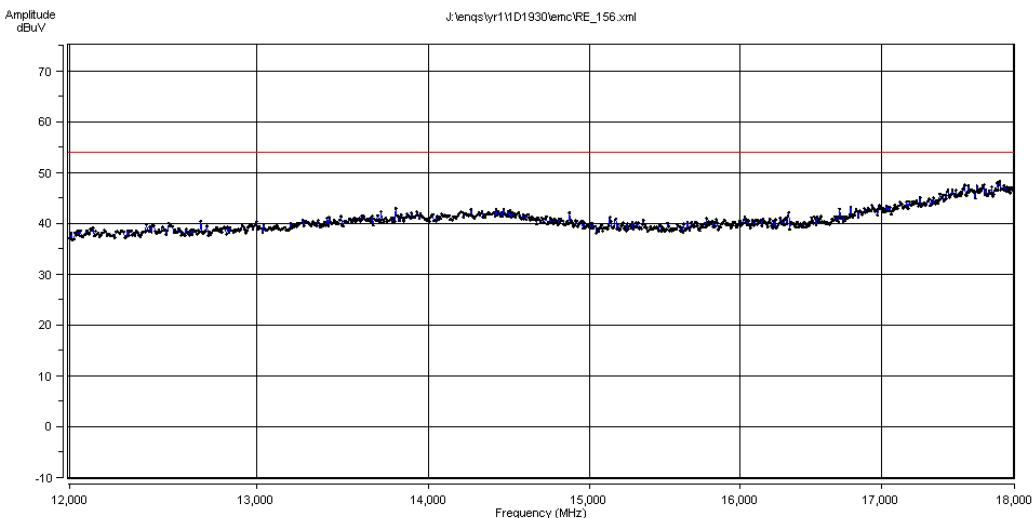


### Unintentional Radiated Spurious emissions 1 GHz to 5 GHz – 2437MHz



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

## TRaC EMC Emissions Software - Radiated emissions

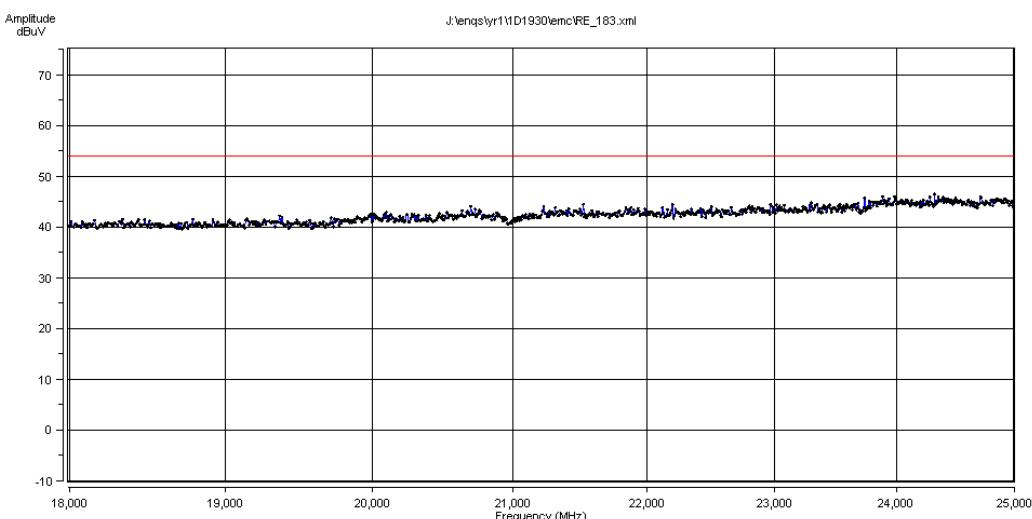


**Test Location:** EMC Ferrite  
**Analysyer Type:** E4404B (SCPI commands)  
**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Rx, Ch6, 100kHz BW, 0dB attenuati  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 27/04/2011 14:53:02  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

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

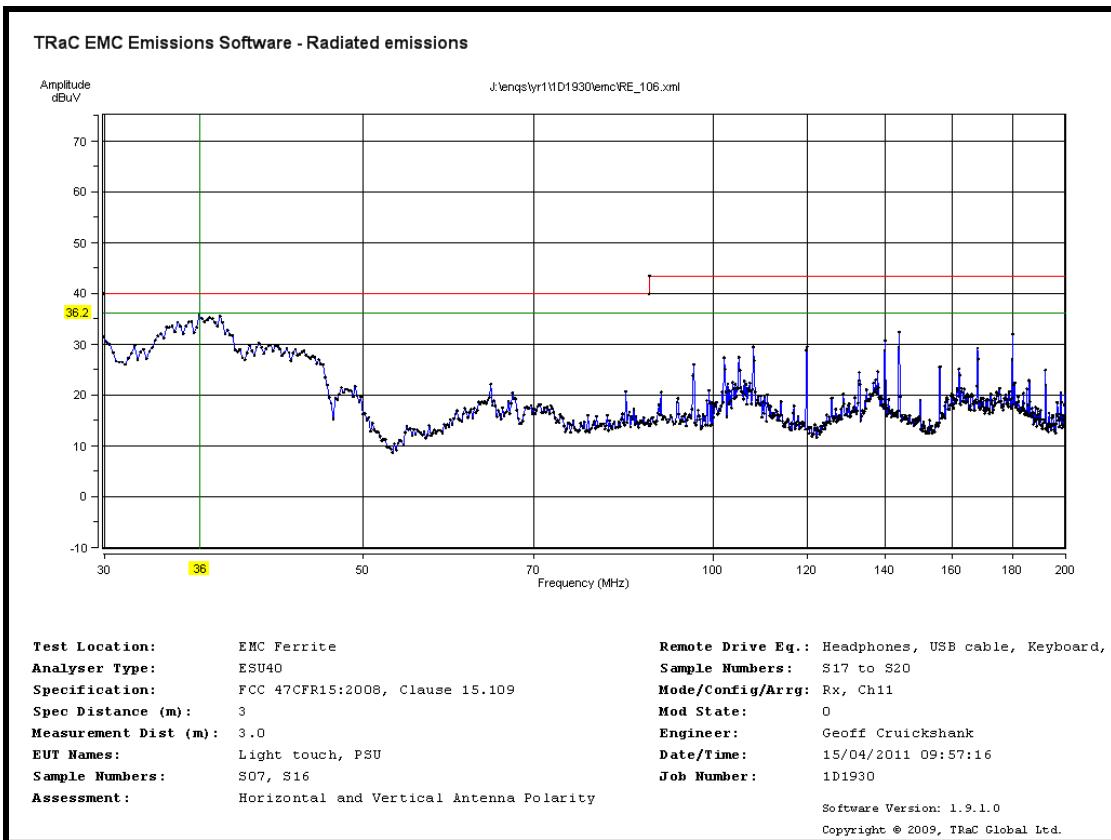
## TRaC EMC Emissions Software - Radiated emissions



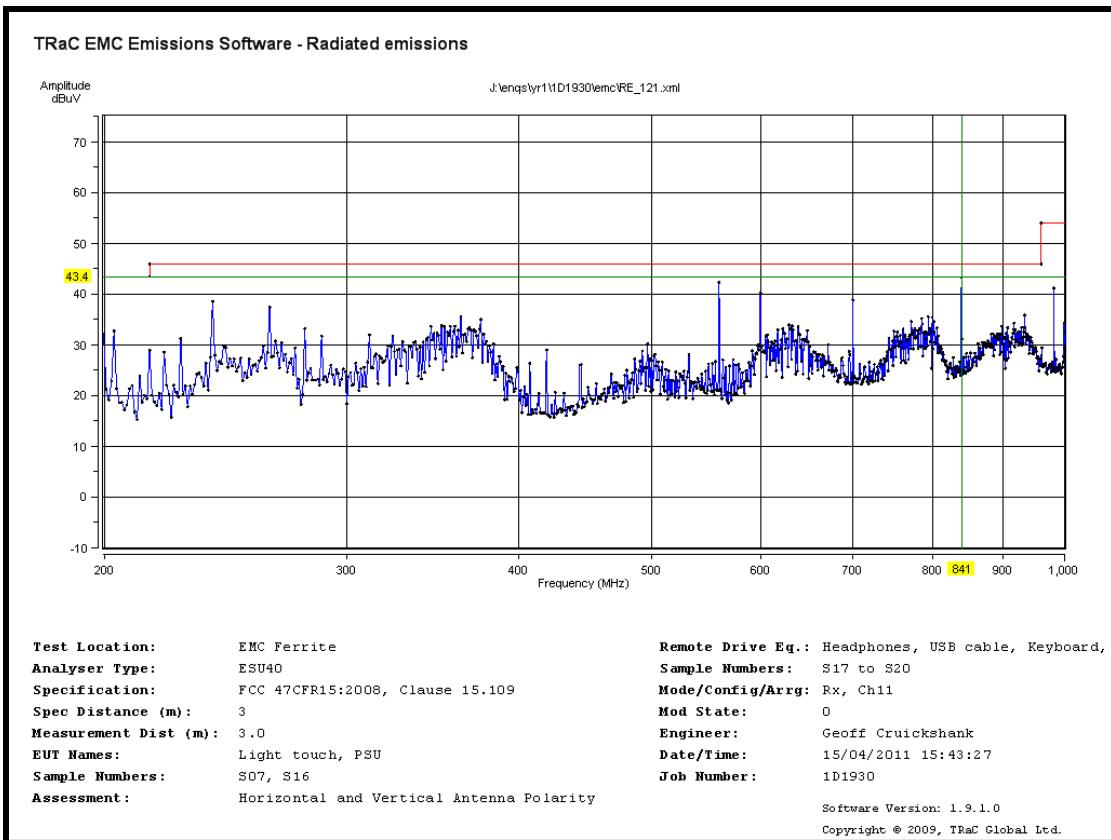
**Test Location:** EMC Ferrite  
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**Specification:** FCC 47CFR15:2008, Clause 15.109  
**Spec Distance (m):** 3  
**Measurement Dist (m):** 1.0  
**EUT Names:** Light touch, PSU  
**Sample Numbers:** S07, S16  
**Assessment:** Horizontal and Vertical Antenna Polarity

**Remote Drive Eg.:** Headphones, USB cable, Keyboard,  
**Sample Numbers:** S17 to S20  
**Mode/Config/Arrg:** Rx, Ch6, 100kHz BW, 0dB attenuati  
**Mod State:** 0  
**Engineer:** Geoff Cruickshank  
**Date/Time:** 28/04/2011 08:56:15  
**Job Number:** 1D1930  
**Software Version:** 1.9.1.0  
**Copyright © 2009, TRaC Global Ltd.**

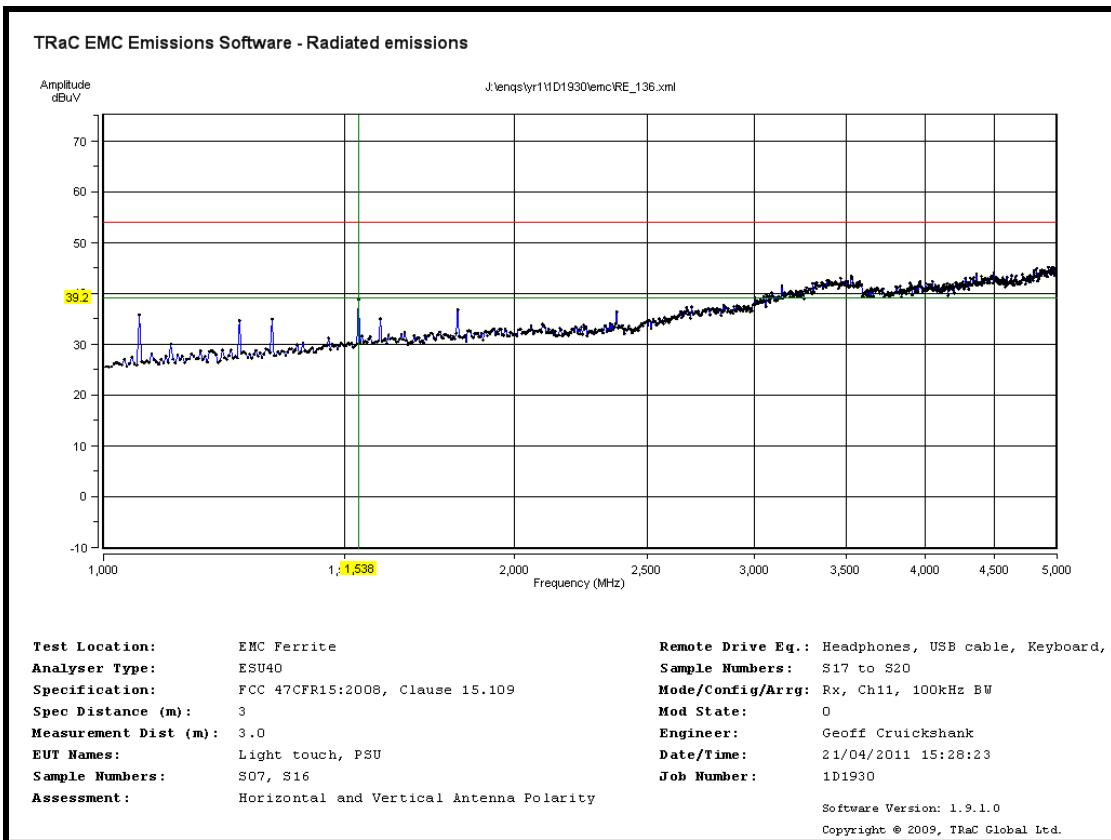
## Unintentional Radiated Spurious emissions 18 GHz to 25 GHz – 2437MHz



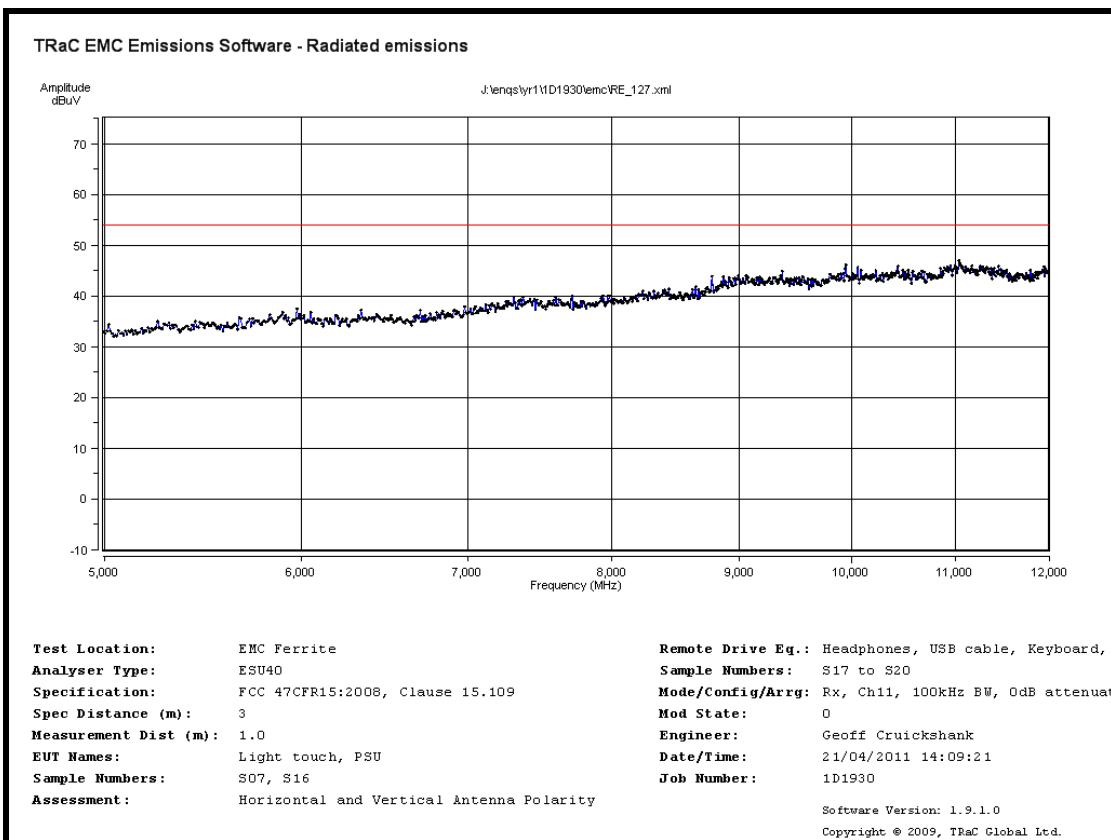
### Unintentional Radiated Spurious emissions 30 MHz to 200 MHz – 2462MHz



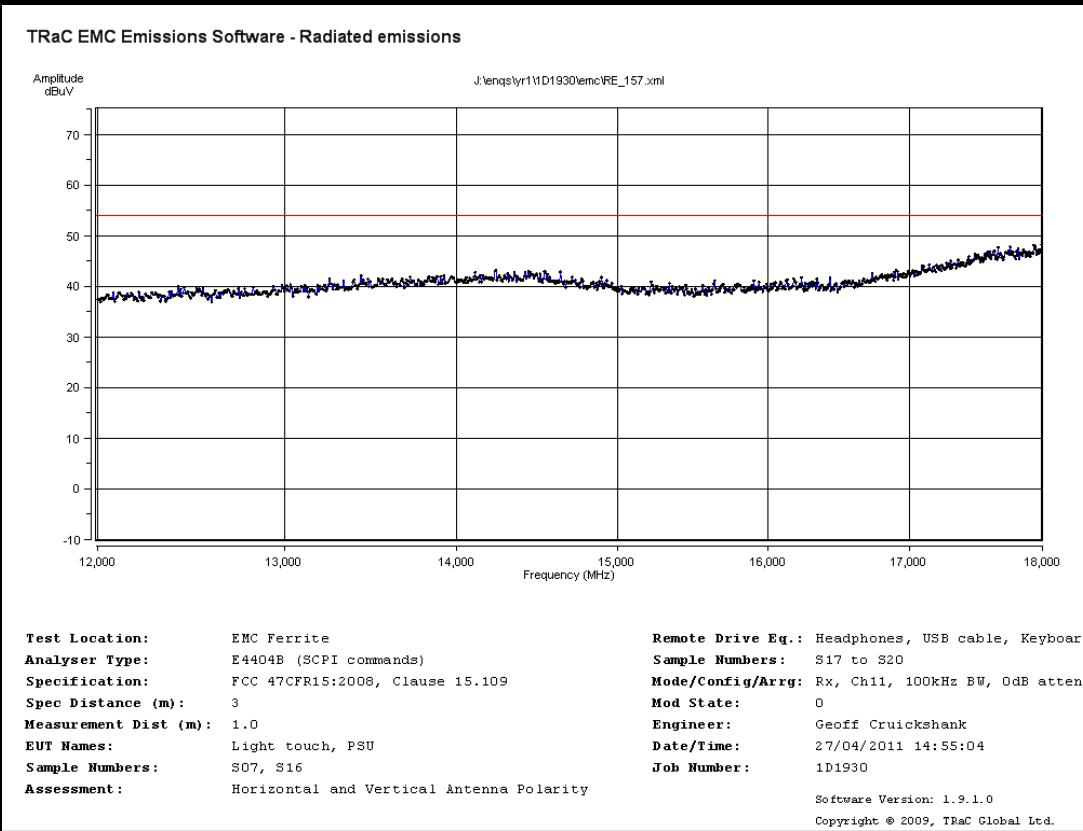
### Unintentional Radiated Spurious emissions 200 MHz to 1 GHz – 2462MHz



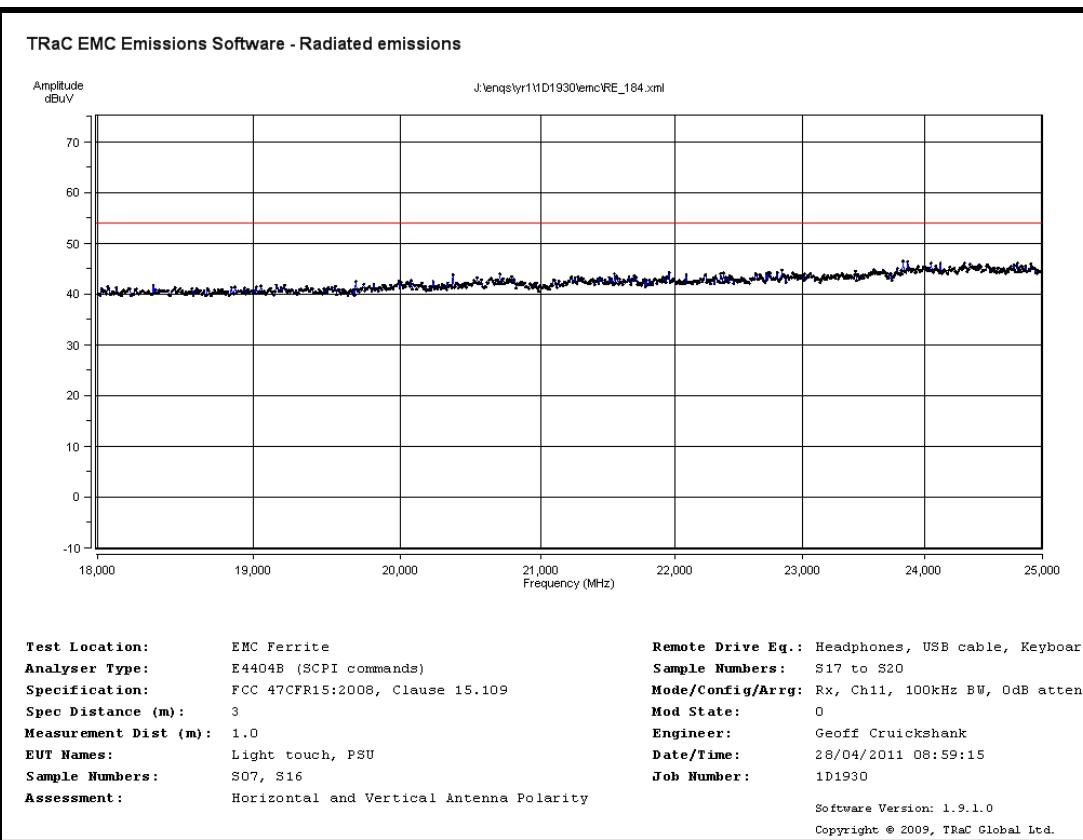
### Unintentional Radiated Spurious emissions 1 GHz to 5 GHz – 2462MHz



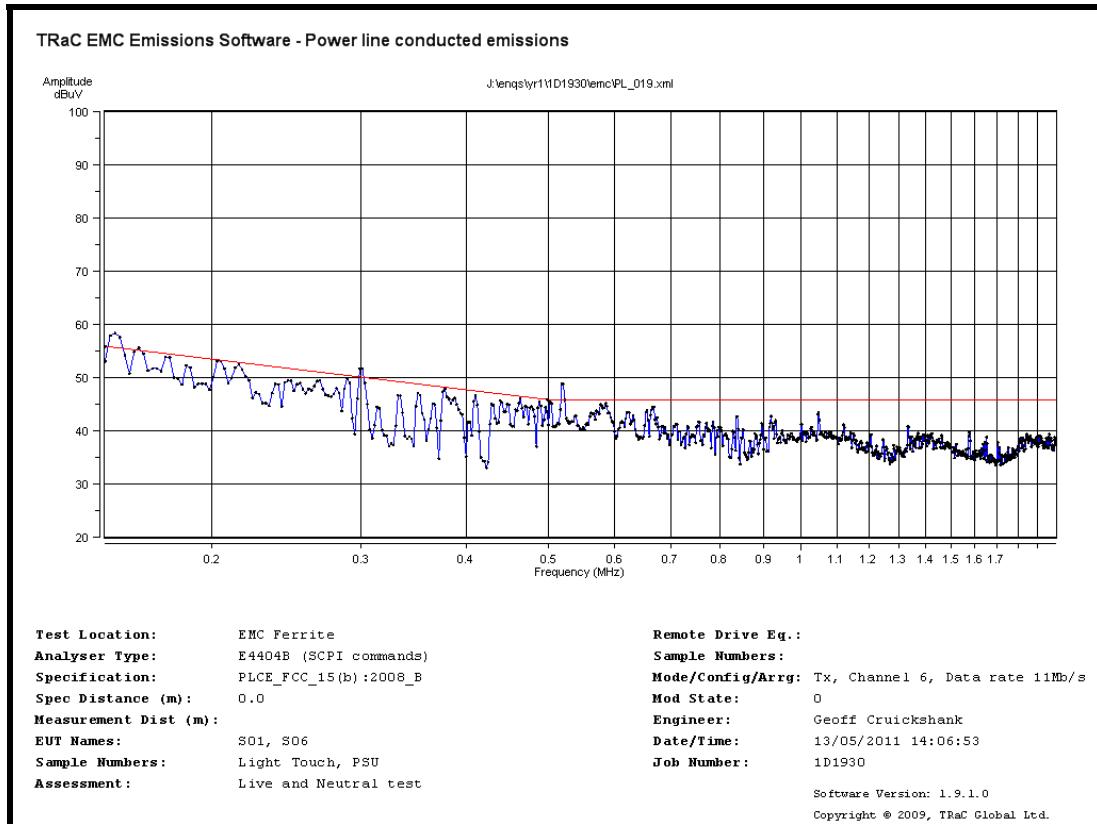
### Unintentional Radiated Spurious emissions 5 GHz to 12 GHz – 2462MHz



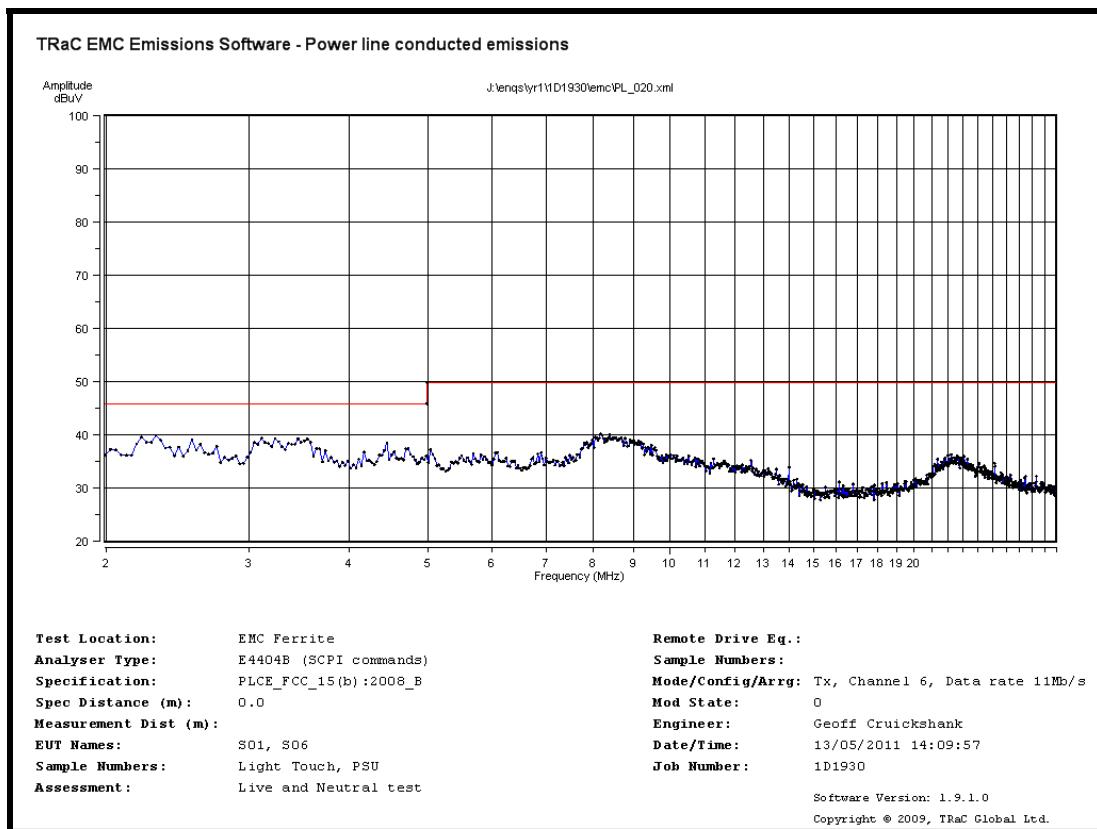
### Unintentional Radiated Spurious emissions 12 GHz to 18 GHz – 2462MHz



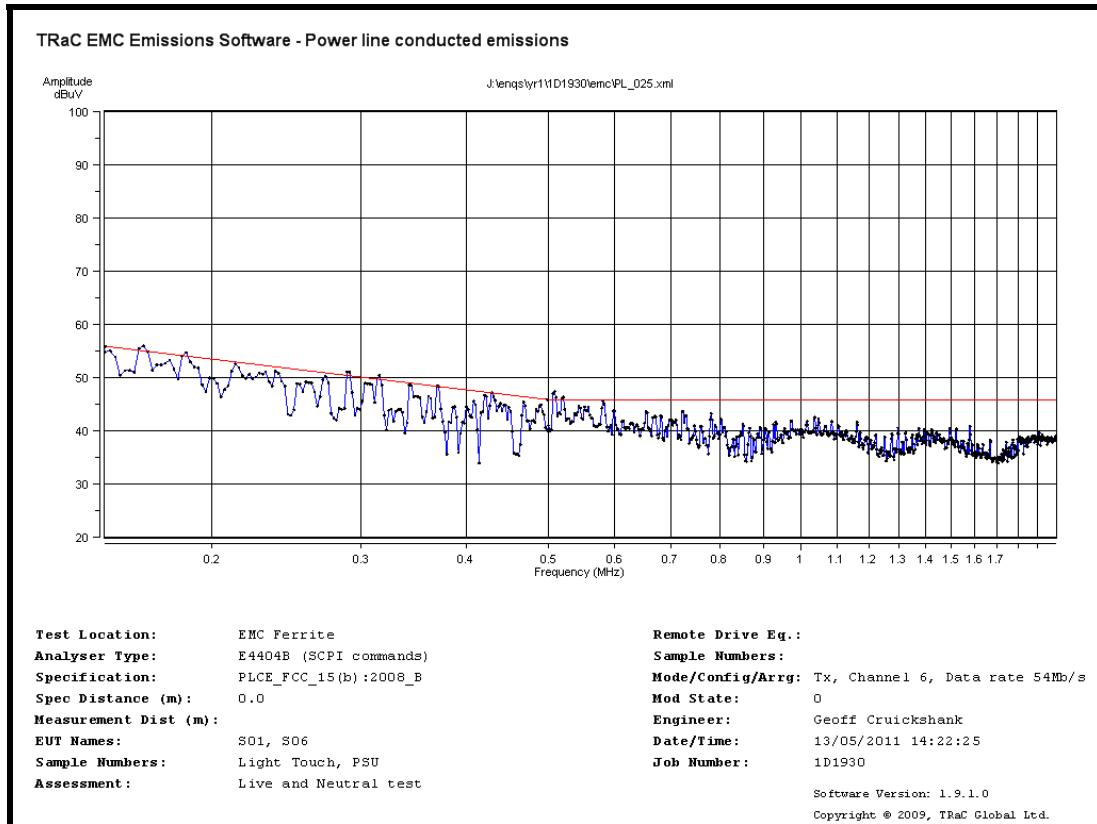
### Unintentional Radiated Spurious emissions 18 GHz to 25 GHz – 2462MHz



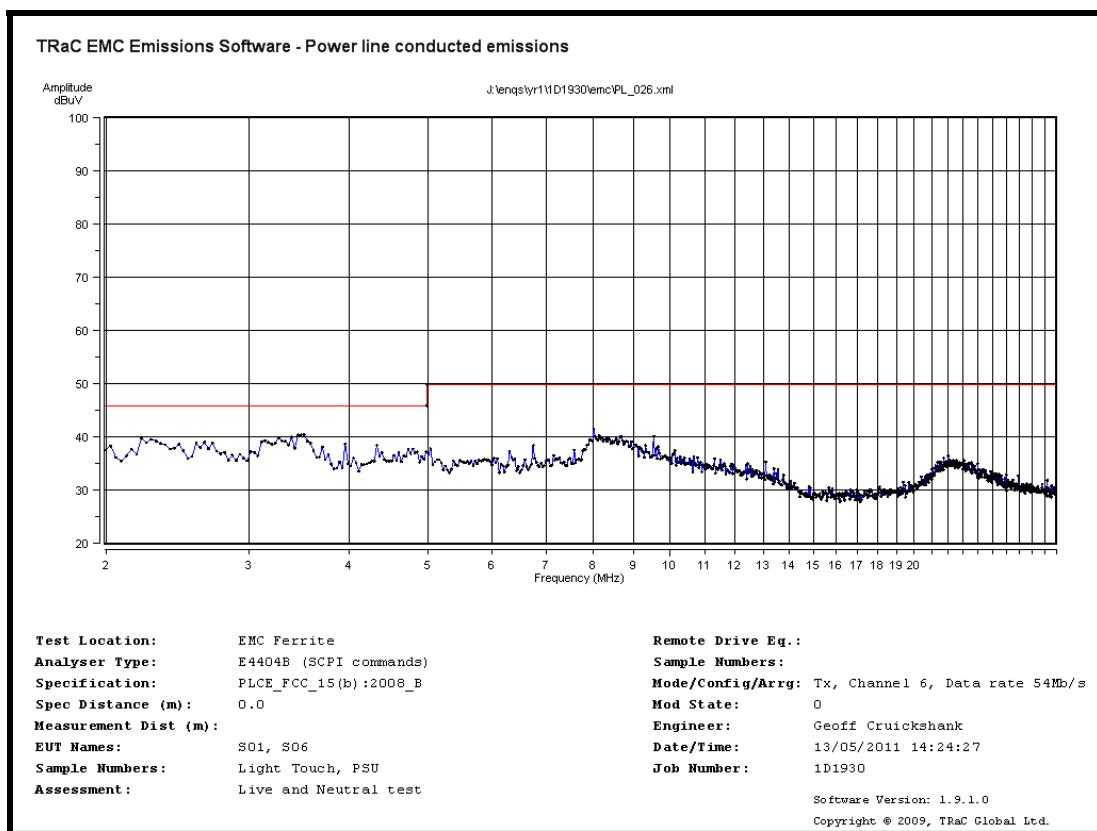
### Power line conducted emissions Transmit Mode 0.15 MHz to 2 MHz - 11Mbps



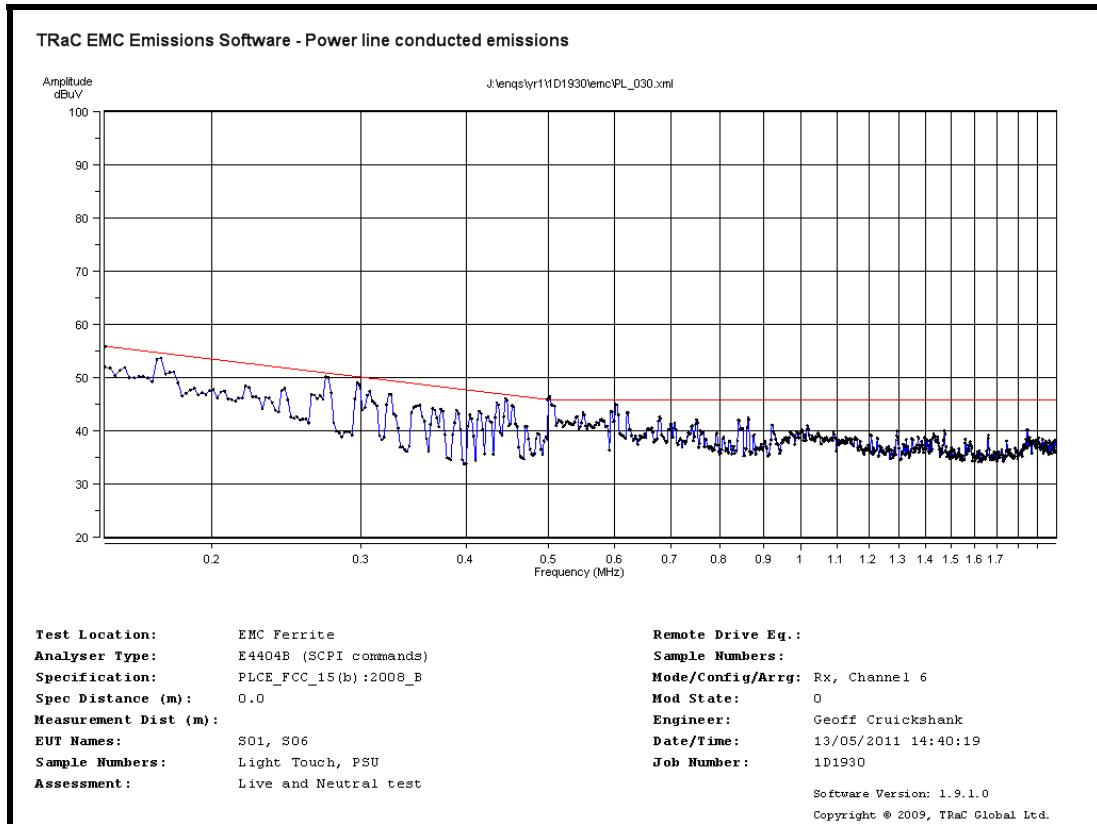
### Power line conducted emissions Transmit Mode 2 MHz to 30 MHz - 11Mbps



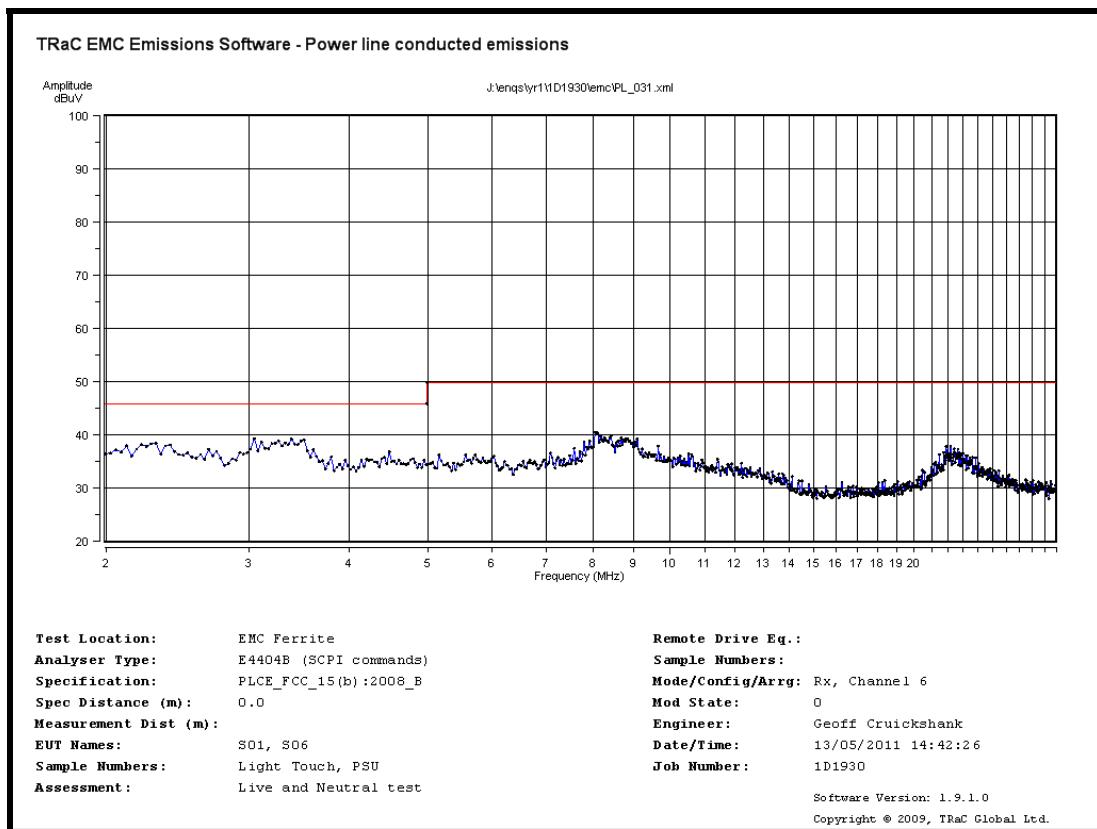
### Power line conducted emissions Transmit Mode 0.15 MHz to 2 MHz - 54Mbps



### Power line conducted emissions Transmit Mode 2 MHz to 30 MHz - 54Mbps



### Power line conducted emissions Receive Mode 0.15 MHz to 2 MHz



### Power line conducted emissions Receive Mode 2 MHz to 30 MHz

**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
S01	LT1020FC 4 Light Touch Mini Projector	S/N: BG001354
S05	Light Touch 1020FC (Conducted Sample)	S/N: BG002152
S06	V-Infinity PSU 3A-181WP05	P/N EMS050320-P5P-SZ
S07	LT1020FC 4 Light Touch Mini Projector	S/N: BG002088
S16	V-Infinity Switch Mode Power Supply	None

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

Sample No.	Description	Identification
S17	KB-558 Keyboard	None
S18	Sony Headset	None
S19	USB Lead	None
S20	Serial Cable	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 : S01  
 Tests : All Power Line Conducted emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power Port	2 core unscreened	1m	S06
Micro SD Port	None	N/A	None
USB Port	USB Cable	1.5m	S17
Micro USB Port	Micro USB Cable	2m	S19 - Unterminated
Headphone Port	Phono Cable	1m	S18
Customer Port	18 pin D-Type serial cable	1m	S20 - Unterminated

Sample : S05  
 Tests : All radiated testing

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power Port	2 core unscreened	1m	S06
ac Power Port	None	N/A	ac Mains

Sample : S07  
 Tests : All radiated testing

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power Port	2 core unscreened	1m	S16
Micro SD Port	None	N/A	None
USB Port	USB Cable	1.5m	S17
Micro USB Port	Micro USB Cable	2m	S19 - Unterminated
Headphone Port	Phono Cable	1m	S18
Customer Port	18 pin D-Type serial cable	1m	S20 - Unterminated

Sample : S16  
 Tests : All radiated testing

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power Port	2 core unscreened	1m	S07
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

For Conducted Measurements

RFG No	Type	Description	Manufacturer	Date Calibrated
REF909	FSU	Spectrum Analyser	R&S	14/06/10
REF053	6634A	dc Power Supply	HP	Cal before Use
REF887	34405A	DMM	Agilent	25/08/10

## For Power Line Conducted Measurements

RFG No	Type	Description	Manufacturer	Date Calibrated
404	E4407B	Spectrum Analyser	Agilent	10/05/10
125	ESHS10	Test receiver	R&S	23/11/10
232	ESH2-Z5	LISN	R&S	22/05/10
674	0357.8810.54	Pulse Limiter	R&S	08/07/11
296	BNC	Cable	TRaC	17/09/10
298	BNC	Cable	TRaC	17/09/10

**Appendix D:**

**Additional Information**

Manufactures declaration of the model number differences.



Declaration of Model Number Differences – Metal Skin

The Light Touch Product models (LT1020 & LT1220) utilize the same APM6658 module for WiFi.

The only difference in the two models is the Laser Classification. The LT1220 is a Class 2 device and the LT1020 is a Class 1 device.

Regards,



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

Integrated Antenna and RF Solutions

2

Product Specification 06MD-0010-3-PS

**Appendix E:**

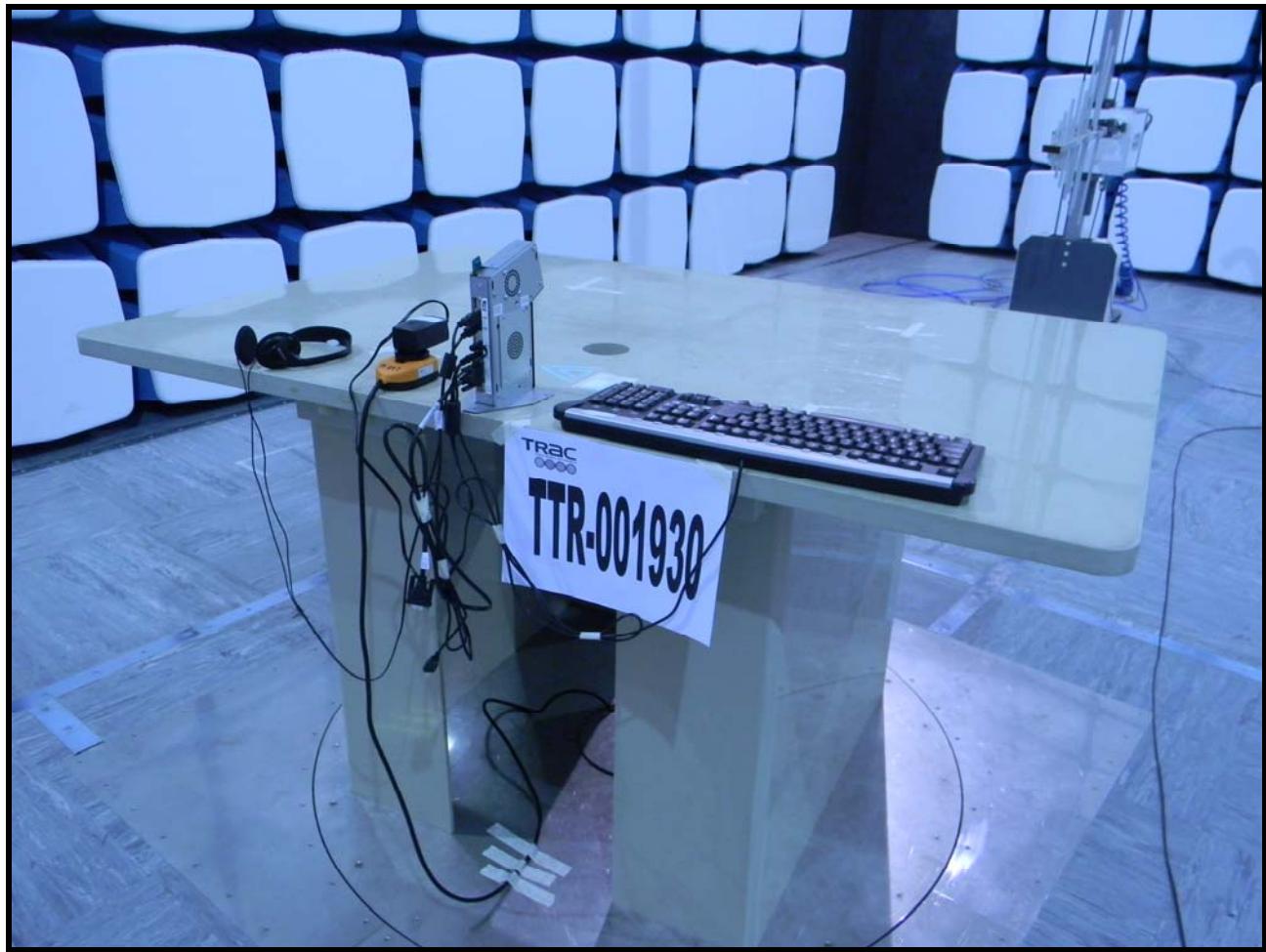
**Photographs and Figures**

The following photographs were taken of the test samples:

1. Radiated emissions overview: Front view
2. Radiated emissions overview: Back view
3. Power line conducted emissions overview



Photograph 1



Photograph 2



Photograph 3

**Appendix F:****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  $1\text{mW/cm}^2$  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

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

where:

S = power density

R = distance to the centre of radiation of the antenna

EIRP = EUT Maximum power

Note:

The EIRP value was determined using the peak conducted power measurement in conjunction with the declared antenna gain (1.8dBi).

Result

Prediction Frequency (MHz)	Maximum EIRP (mW)	Power density limit (S) ( $\text{mW/cm}^2$ )	Distance (R) cm required to be less than $1\text{mW/cm}^2$
2462	53	1	2.1

