



# FCC/IC Test Report

FOR

**Multi-Tech Systems, Inc.**

**MultiModem rCell<sup>®</sup> 100 Series Router**

**FCC ID: AU792U13A16854**

**IC ID: 125A-0049**

**Model Numbers: MTR-H5-B10, MTR-H5-B09**

**47 CFR Part 15.247, Digital Transmission Systems (DTS), 2.4 GHz  
IC RSS-210 Issue 8, Annex 8**

**TEST REPORT #: EMC\_MULTI\_053\_MTR\_H5-V-BW\_DTS**

**DATE: 2014-01-15**



FCC :  
Accredited

IC recognized #  
3462B-1

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**9 Revision History ..... 44**

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## 1 Assessment

The below given equipment (as further detailed in ch.3 of this test report) was evaluated against the applicable criteria specified in FCC CFR47 Part 15.247, 15.207, 15.205, 15.209 and Industry Canada Standards RSS-210 Issue 8, Annex 8.

No deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Multi-Tech Systems, Inc	MultiModem rCell@100 Series Router	MTR-H5-B09, MTR-H5-B10

### Responsible for Testing Laboratory:

Tunji Yusuf

2014-01-15

Compliance

(Test Lab Manager)

Date	Section	Name	Signature
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### Responsible for the Report:

Danh Le

2014-01-15

Compliance

(EMC Test Engineer)

Date	Section	Name	Signature
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The test results of this test report relate exclusively to the test item specified in Section3.

CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

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## 2 Administrative Data

### 2.1 Identification of the Testing Laboratory Issuing the Test Report

<b>Company Name:</b>	CETECOM Inc.
<b>Department:</b>	Compliance
<b>Address:</b>	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
<b>Telephone:</b>	+1 (408) 586 6200
<b>Fax:</b>	+1 (408) 586 6299
<b>Test Lab Manager:</b>	Tunji Yusuf
<b>Responsible Project Leader:</b>	Danh Le

### 2.2 Identification of the Client

<b>Client:</b>	MultiTech Systems, Inc.
<b>Street Address:</b>	2205 Woodale Drive
<b>City/Zip Code</b>	Mounds View, MN 55112
<b>Country</b>	United States
<b>Contact Person:</b>	Jody Lanes
<b>Phone No.</b>	+1 (763) 785 3500
<b>E-mail:</b>	jlanes@multitech.com

### 2.3 Identification of the Manufacturer

<b>Manufacturer's Name:</b>	Same as client.
<b>Manufacturers Address:</b>	
<b>City/Zip Code</b>	
<b>Country</b>	

### 3 Equipment under Test (EUT)

#### 3.1 Specification of the Equipment under Test

<b>Marketing Name / Description:</b>	<b>MultiModem rCell<sup>®</sup> 100 Series Router</b>
<b>FCC-ID:</b>	<b>AU792U13A16854</b>
<b>IC certification no.:</b>	<b>125A-0049</b>
<b>Model Numbers (IC model numbers):</b>	<b>MTR-H5-B10</b> (tested model), <b>MTR-H5-B09</b> (non-tested model variant without GPS; declared to be identical otherwise)
<b>Product Description:</b>	WLAN router incorporating a pre-certified IEEE 802.11bgn / Bluetooth combo module and a 3G module. (details see under “Other Radios” below)
<b>Technology/ Type(s) of Modulation:</b>	2.4 GHz 802.11 b/g/n: CCK, BPSK, QPSK, 16QAM, 64QAM
<b>Modes of Operation</b>	IEEE 802.11bgn client and master
<b>Channel Bandwidths</b>	20 MHz (HT20)
<b>Operating Frequency Ranges (MHz)/ Channels:</b>	Nominal band: 2400 – 2483.5 MHz; Center to center with HT20: 2412(ch 1) – 2462(ch 11), 11 channels
<b>Antenna info:</b>	2.4GHz 2.3dBi Screw mount Dipole Antenna with RP-SMA(M) Connector (Taoglas GW.11.A153); 2.3dBi peak gain;
<b>Max. Output Powers:</b>	Conducted: 22.35dBm (0.172 W) EIRP (conducted result + documented antenna gain): 24.65dBm (0.292W)
<b>Rated Operating Voltage:</b>	Vmin: 7.0V/ Vnom: 9.0V/ Vmax: 32V through bundled AC/DC power supply, see accessories below;
<b>Rated Operating temperature range:</b>	Tmin: -40°C / Tmax: 80°C
<b>Other Radios included:</b>	1.Telit HE910-D 3G module, FCC ID: RI7HE910; IC ID: 5131A-HE910 <ul style="list-style-type: none"> <li>• GSM 850 / 900 / 1800 / 1900</li> <li>• UMTS FDD: BandI/BandII/Band/IV/BandV/BandVIII</li> </ul> 2.Murata LBEE5ZSTNC, 802.11bgn 2.4 GHz / Bluetooth 4.0 combo module, FCC-ID: VPYLBTN, IC: 772C-LBTN; 3.GPS 1575.42 MHz (model MTR-H5-B09 only)
<b>Test sample status:</b>	Prototype

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### **3.2 Identification of the Equipment Under Test (EUT)**

EUT #	Serial Number	HW Version	SW Version	Model	Notes/Comments
1	16597279	B10	12.00.023	MTR-H5-B10	Radiated Sample

### **3.3 Identification of Accessory Equipment**

AE #	Type	Manufacturer	Model	Serial Number
1	AC Power Adapter 100-240VAC / 9VDC, 1.7A	GlobTek, Inc	GT-41052-1509	GS-1370

### **3.4 Environmental conditions during Test:**

Ambient Temperature: 20-25°C

Relative humidity: 40-60%

### **3.5 Dates of Testing:**

08/27/2013

### 3.6 Other Testing Notes:

The device was configured with a manufacturer provided test SW, capable of setting the unit in different supported modulation schemes, data rates and channels of operation.

All testing has been applied to the EUT with DC (9V nominal) power supplied from it's bundled AC/DC power supply as listed under accessories above.

The Device was set to continuous framed Tx (burst) mode per test SW and could thus be operated with 100% duty cycle during testing.

The EUT was tested on the low, mid and high channel of each of the supported 2.4GHz IEEE 802.11b, 802.11g, and 802.11n (HT20) modes.

The below listed worst case test modes of operation have been established from the output power measurement and evaluation of long term test data available to the lab for the different data rates and modulations which are supported by the equipment.

Mode		Data rate (Mbps)	Modulation scheme
2.4 GHz	802.11b	1.0	CCK
	802.11g	6.0	OFDM
	802.11n (HT20)	6.5	OFDM

Testing has been applied to model number MTR-H5-B10 only based on the manufacturer's declaration and documentation claiming that model number MTR-H5-B09 is identical except from having the GPS HW depopulated.

Taking into account guidance from FCC KDB 996369 (modular approval) and where relevant test procedures did not change most conducted test results are leveraged from the related test report #31KE0354-HO-01-A issued on July 26, 2011 by UL Japan, Inc. of the certification of the integrated Bluetooth/WLAN combo module (see section 3.1).



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#### **4 Subject of Investigation**

The objective of the measurements applied by CETECOM Inc. was to establish compliance of the EUT as described under Ch. 3 of this Test Report, with the applicable criteria specified in

- FCC CFR47 Parts 15.247, 15.207, 15.205/15.209
- IC RSS-210 Issue 8

This test report is to support a request for new equipment authorization under the

**FCC ID: AU792U13A16854**

and the

**IC ID: 125A-0049**

for both

**Model Numbers, MTR-H5-B10 and MTR-H5-B09**

### 5 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(e) RSS-210 A8.2(b)	Power Spectral Density	Nominal	802.11 b/g/n	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	See Note 1
§15.247(a)(1) RSS-210 A8.1(b)	Carrier Frequency Separation	Nominal	-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	See Note 2
§15.247(a)(1) RSS-210 A8.1(d)	Number of Hopping Channels	Nominal	-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	See Note 2
§15.247(a)(1)(iii) RSS-210 A8.3(1)	Time of occupancy	Nominal	-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	See Note 2
§15.247(a)(2) RSS-210 A8.2(a)	Spectrum Bandwidth	Nominal	802.11 b/g/n	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	See Note 1
§15.247(b)(3) RSS-210 A8.4(4)	Maximum Peak Conducted Output Power and EIRP	Nominal	802.11 b/g/n	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.247(d) RSS-210 A8.5	Unwanted Emissions into non-Restricted Frequency Bands band edge-Conducted	Nominal	802.11 b/g/n	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	See Note 1
§15.209(a) RSS-GEN 7.2	Unwanted Emissions into Restricted Frequency Bands, Band edge-Radiated	Nominal	802.11 b/g/n	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.247(d) RSS-210 A8.5	Unwanted Emissions into Non-Restricted Frequency Bands-Conducted	Nominal	802.11 b/g/n	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	See Note 1
§15.209(a) RSS-GEN 7.2	Unwanted Emissions into Restricted Frequency Bands - Radiated	Nominal	802.11 b/g/n	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.207(a) RSS-GEN 7.2	AC Line Conducted Emissions<30MHz	Nominal	802.11 g	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies

Note: NA= Not Applicable; NP= Not Performed.

1. Testing leveraged from test report of incorporated radio module.
2. Test only applicable to frequency hopping systems.

## **6 Measurements**

### **6.1 Measurement Method**

Testing is performed according to the guidelines provided in *FCC publication (KDB) 558074 D01 DTS Meas Guidance v03r01: Measurement Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) operating under 15.247, April 2013* and according to relevant parts of ANSI C63.4 (2009) as detailed below.

#### **6.1.1 Radiated Measurement Procedure**

##### **6.1.1.1 ANSI C63.4 (2009) Section 8.3.1.1: Exploratory radiated emission measurements**

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. A shielded room may be used for exploratory testing, but may have anomalies that can lead to significant errors in amplitude measurements.

Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of testing. It is recommended that either a headset or loudspeaker be connected as an aid in detecting ambient signals and finding frequencies of significant emission from the EUT when the exploratory and final testing is performed in an OATS with strong ambient signals. Caution should be taken if either antenna height between 1 and 4 meters or EUT azimuth is not fully explored. Not fully exploring these parameters during exploratory testing may require complete testing at the OATS or semi-anechoic chamber when the final full spectrum testing is conducted.

The EUT should be set up in its typical configuration and arrangement, and operated in its various modes. For tabletop systems, cables or wires should be manipulated within the range of likely arrangements. For floor-standing equipment, the cables or wires should be located in the same manner as the user would install them and no further manipulation is made. For combination EUTs, the tabletop and floor-standing portions of the EUT shall follow the procedures for their respective setups and cable manipulation. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce the maximum level of emissions.

For each mode of operation required to be tested, the frequency spectrum shall be monitored. Variations in antenna height between 1 and 4 m, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) shall be explored to produce the emission that has the highest amplitude relative to the limit. A step-by-step technique for determining this emission can be found in Annex C.

When measuring emissions above 1 GHz, the frequencies of maximum emission shall be determined by manually positioning the antenna close to the EUT and by moving the antenna over all sides of the EUT while observing a spectral display. It will be advantageous to have prior knowledge of the frequencies of emissions above 1 GHz. If the EUT is a device with dimensions approximately equal to that of the measurement antenna beam width, the measurement antenna shall be aligned with the EUT.

##### **6.1.1.2 ANSI C63.4 (2009) Section 8.3.1.2: Final radiated emission measurements**

Based on the measurement results in 8.3.1.1, the one EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. The final measurement is then performed on a site meeting the requirements of 5.3, 5.4, or 5.5 as appropriate without variation of the EUT arrangement or EUT mode of operation. If the EUT is relocated from an exploratory test site to a final test site, the highest emission shall be re-maximized at the final test location before final radiated emissions measurements are performed. However, antenna height and polarity and EUT azimuth are to be varied. In addition, the full frequency spectrum (for the range to be checked for meeting compliance) shall be investigated.

This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency spectrum investigation, particular focus should be made on those frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement (associated with achieving the least margin with respect to the limit). This full spectrum test constitutes the compliance measurement.

For measurements above 1 GHz, use the cable, EUT arrangement, and mode of operation determined in the exploratory testing to produce the emission that has the highest amplitude relative to the limit. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the antenna in the “cone of radiation” from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response. The antenna may have to be higher or lower than the EUT, depending on the EUT’s size and mounting height, but the antenna should be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. If the transmission line for the measurement antenna restricts its range of height and polarization, the steps needed to ensure the correct measurement of the maximum emissions, shall be described in detail in the report of measurements. Data collected shall satisfy the report requirements of Clause 10.

#### NOTES

- 1— Where limits are specified by agencies for both average and peak (or quasi-peak) detection, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.
- 2—Use of waveguide and flexible waveguide may be necessary at frequencies above 10 GHz to achieve usable signal-to noise ratios at required measurement distances. If so, it may be necessary to restrict the height search of the antenna, and special care should be taken to ensure that maximum emissions are correctly measured.
- 3—All presently known devices causing emissions above 10 GHz are physically small compared with the beam-widths of typical horn antennas used for EMC measurements. For such EUTs and frequencies, it may be preferable to vary the height and polarization of the EUT instead of the receiving antenna to maximize the measured emissions.

Radiated Measurement Uncertainty:  $\pm 3\text{dB}$

### 6.1.1.3 Sample Calculations for Radiated Measurements

#### Field Strength Measurements:

Measurements from the Spectrum Analyzer/ Receiver are used to calculate the Field Strength, taking into account the following parameters:

1. Measured reading in dB $\mu$ V
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

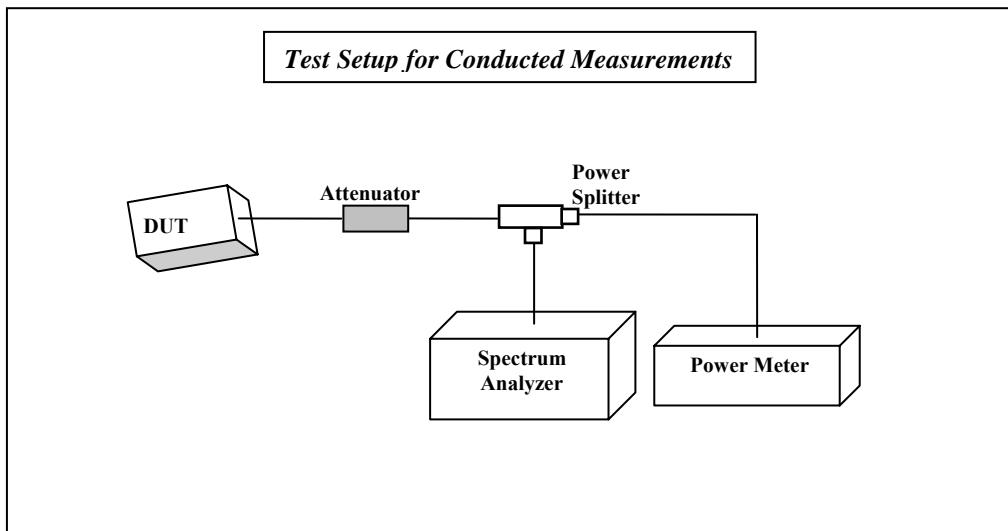
$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Eg:

Frequency (MHz)	Measured SA (dB $\mu$ V)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dB $\mu$ V/m)
1000	80.5	3.5	14	98.0

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the above equation.

### 6.1.2 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. A test SW provided by the manufacturer is used to control the different modulations, data rates and max output power configurations.
3. Measurements are to be performed on the low, middle and high channel for all supported 802.11 modes and for all supported bandwidths.

Measurement uncertainty for all conducted measurements:  $\pm 0.5\text{dB}$

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## **6.2 Maximum Peak Conducted Output Power and EIRP**

### **6.2.1 Limits:**

§15.247(b)(3)

Maximum peak conducted output power for DTS with antenna gain  $\leq 6$  dBi: 1 W;

RSS-210- A8.4(4)

Maximum peak conducted output power for DTS: 1 W,

E.I.R.P  $\leq 4$  W;

### **6.2.2 Test Conditions:**

Tnom: 20°C; Vnom: 120V

### **6.2.3 Test Procedure:**

Measurement according to FCC KDB 558074 D01 DTS Meas Guidance v03r01,  
section 9.1.2 - Integrated Band Power Method

#### **Spectrum Analyzer settings:**

RBW=1MHz, VBW=3MHz, Detector: Peak- Max Hold.

Sweep Time: Auto

Span= 20 MHz / 25 MHz (to fully encompass DTS Bandwidth for 802.11 a/b/g & n modes)

**Rated max. Antenna Gain: 2.3 dBi**



**6.2.4 Test Results:**

<b>Measured Maximum Peak Conducted Output Power (dBm)</b>			
<b>Mode</b>	<b>Frequency (MHz)</b>		
	<b>2412 Channel 1</b>	<b>2437 Channel 6</b>	<b>2462 Channel 11</b>
<b>802.11b</b>	15.87	16.26	16.40
<b>802.11g</b>	21.54	22.35	21.34
<b>802.11n (HT20)</b>	21.44	21.61	21.76

<b>Calculated Maximum Peak Radiated Output Power (dBm)</b>			
<b>Mode</b>	<b>Frequency (MHz)</b>		
	<b>2412 Channel 1</b>	<b>2437 Channel 6</b>	<b>2462 Channel 11</b>
<b>802.11b</b>	18.17	18.56	18.70
<b>802.11g</b>	23.84	24.65	23.64
<b>802.11n (HT20)</b>	23.74	23.91	24.06

**Note:** Radiated EIRP is calculated as  
*Conducted Measurement + Antenna Gain*

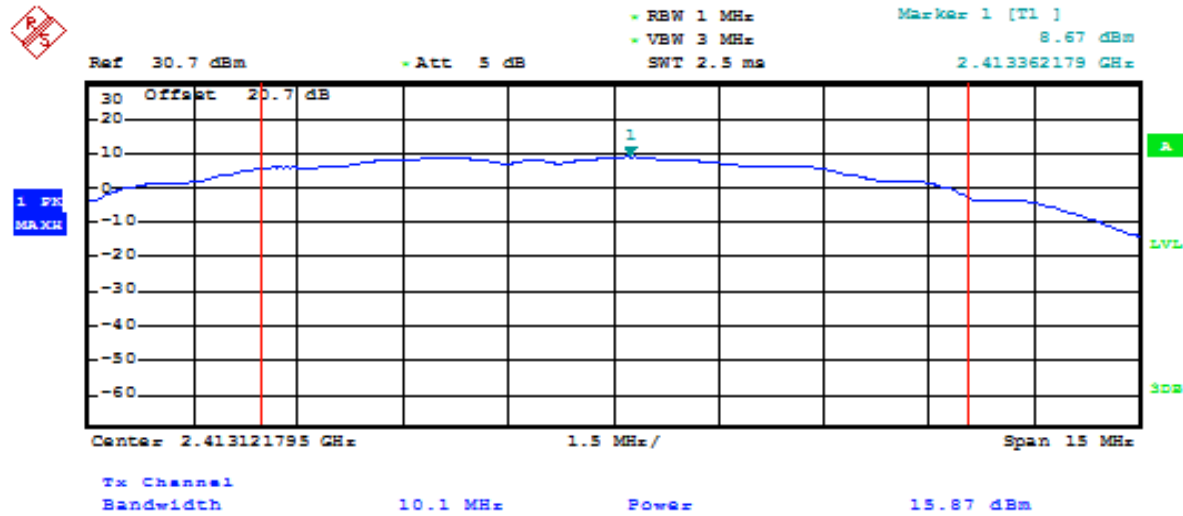
**6.2.5 Measurement Verdict – Peak Conducted Output Power and EIRP**

Pass.

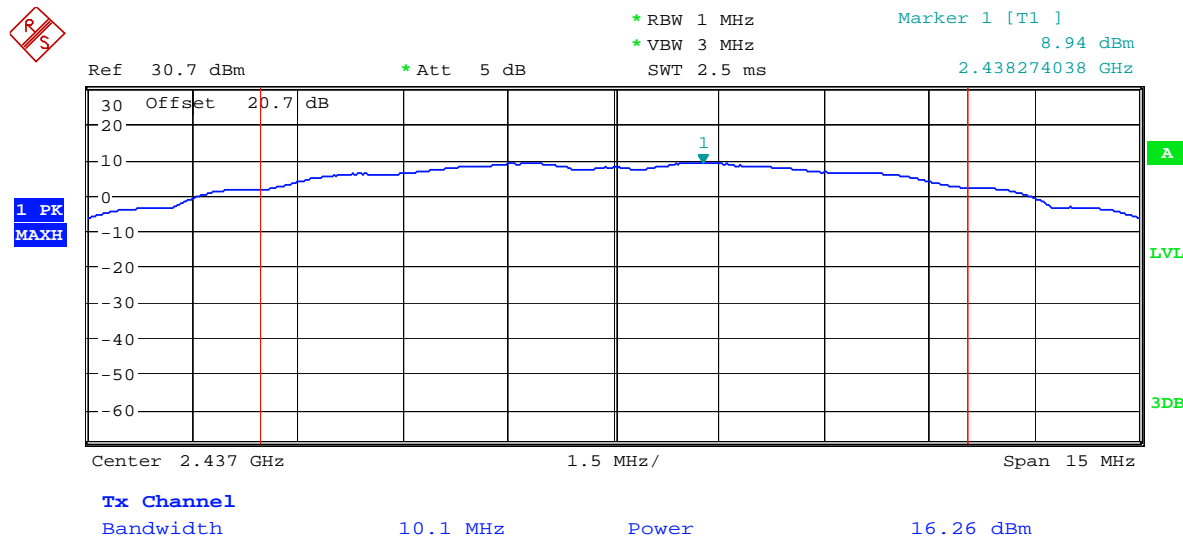


### 6.2.6 Test Data/plots:

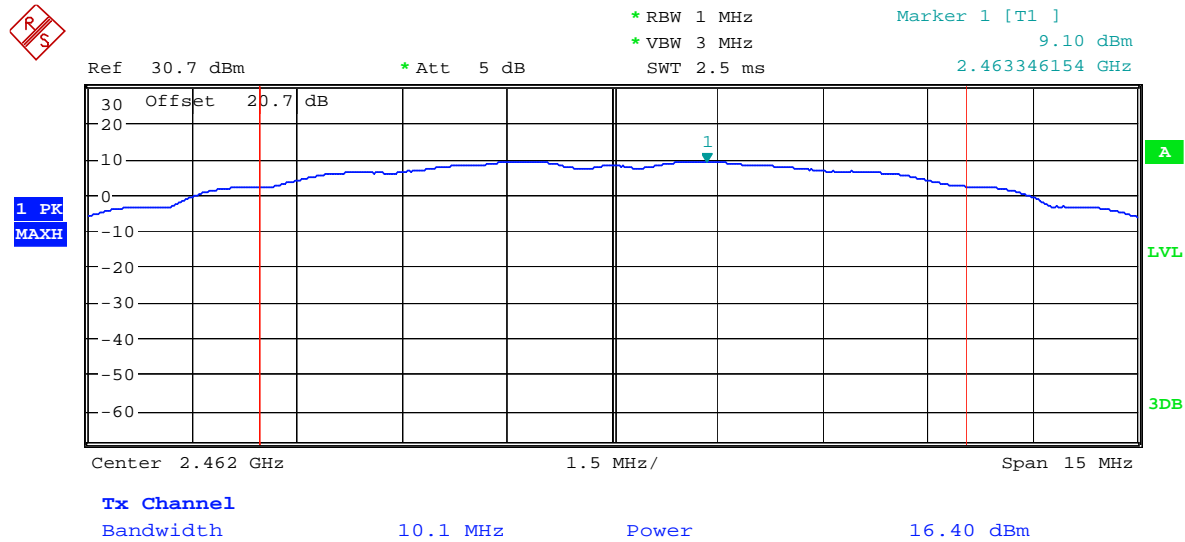
#### Conducted Peak Power 802.11b 2412 MHz



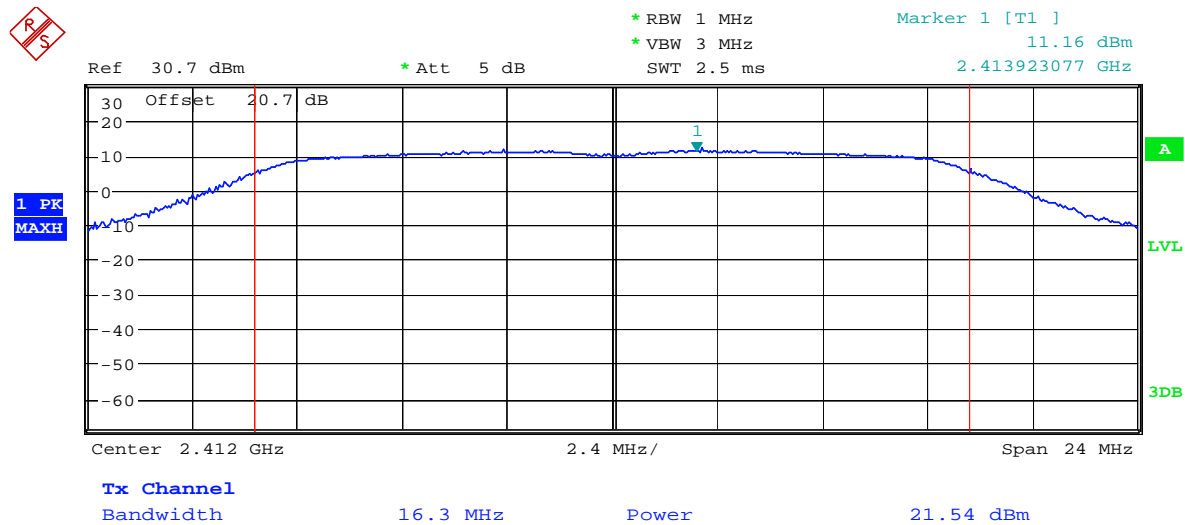
#### Conducted Peak Power 802.11b 2437 MHz



### Conducted Peak Power 802.11b 2462 MHz



### Conducted Peak Power 802.11g 2412 MHz



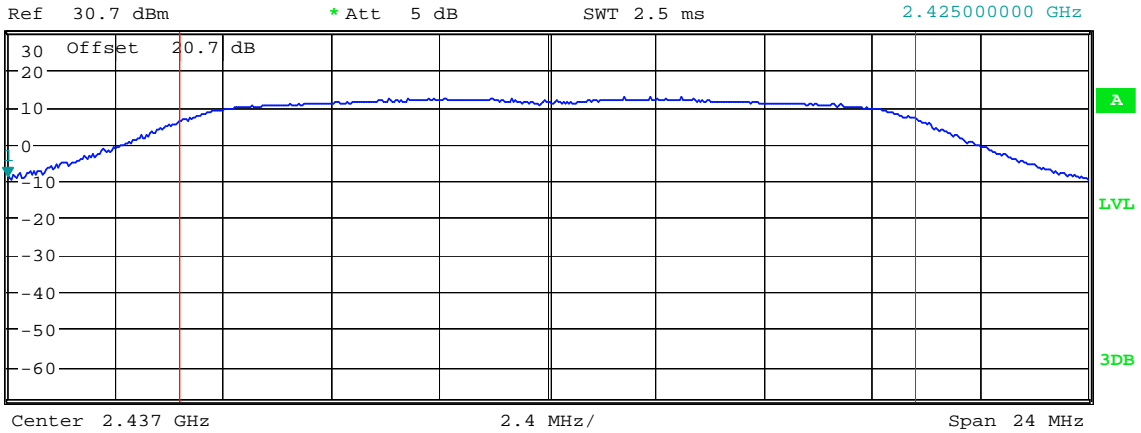


### Conducted Peak Power 802.11g 2437 MHz



\* RBW 1 MHz  
\* VBW 3 MHz  
SWT 2.5 ms

Marker 1 [T1 ]  
-9.14 dBm  
2.425000000 GHz



Center 2.437 GHz 2.4 MHz/ Span 24 MHz

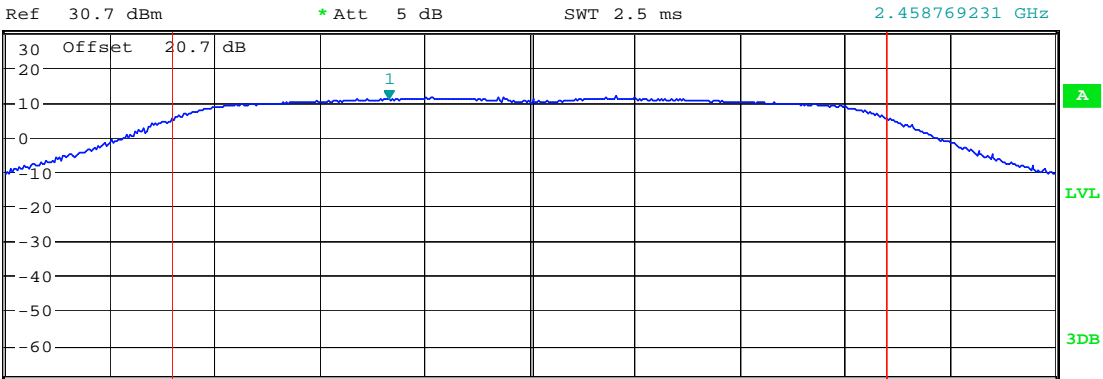
Tx Channel  
Bandwidth 16.3 MHz Power 22.35 dBm

### Conducted Peak Power 802.11g 2462 MHz



\* RBW 1 MHz  
\* VBW 3 MHz  
SWT 2.5 ms

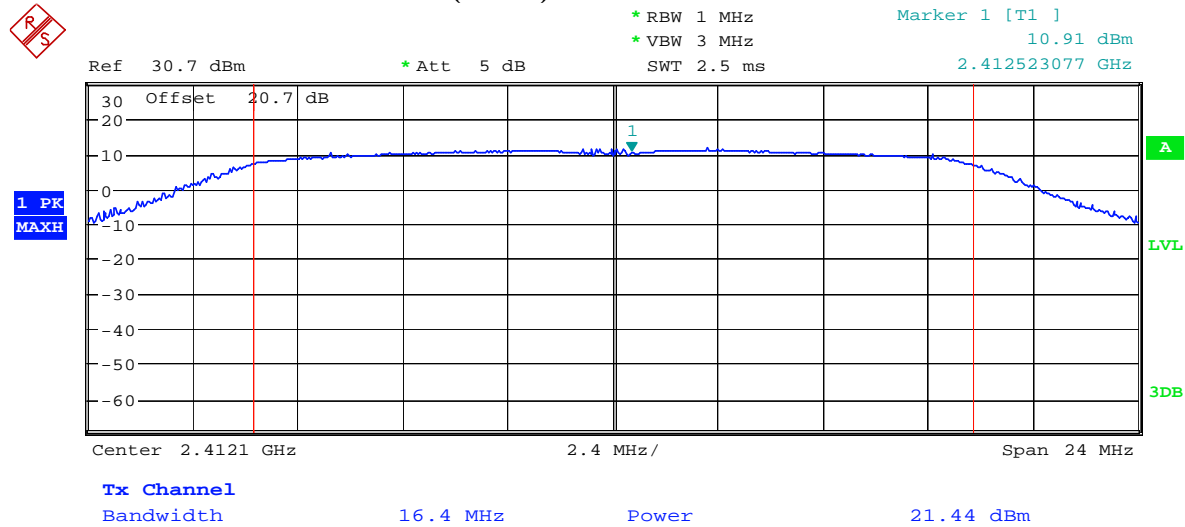
Marker 1 [T1 ]  
10.63 dBm  
2.458769231 GHz



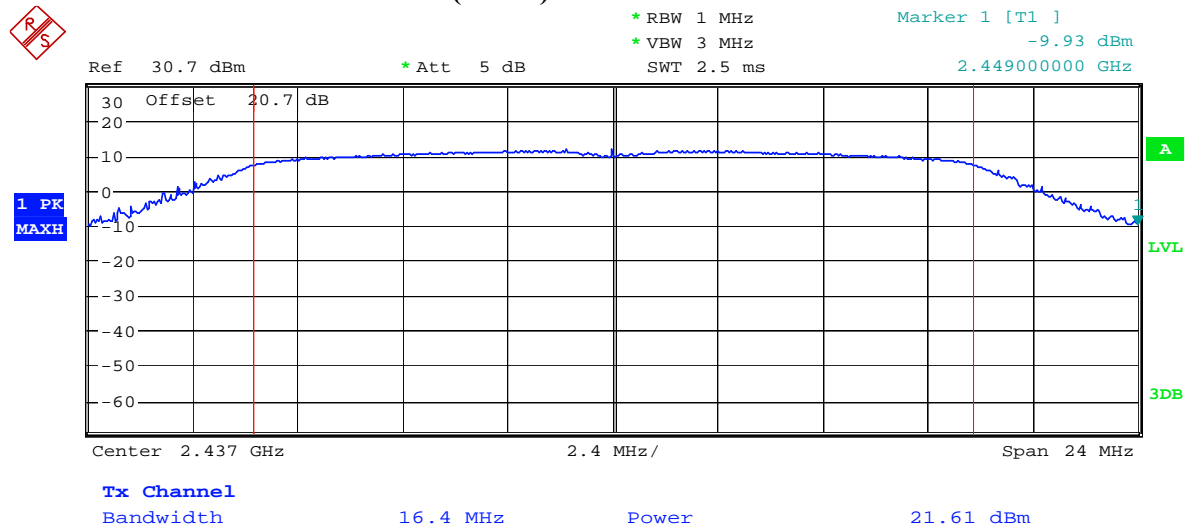
Center 2.462 GHz 2.4 MHz/ Span 24 MHz

Tx Channel  
Bandwidth 16.3 MHz Power 21.34 dBm

### Conducted Peak Power 802.11n (HT20) 2412 MHz



### Conducted Peak Power 802.11n (HT20) 2437 MHz



### Conducted Peak Power 802.11n (HT20) 2462 MHz

Test Report #: EMC\_MULTI\_053\_MTR\_H5-V-BW\_DTS

FCC ID: AU792U13A16854

Date of Report : 2014-01-15

IC ID: 125A-0049



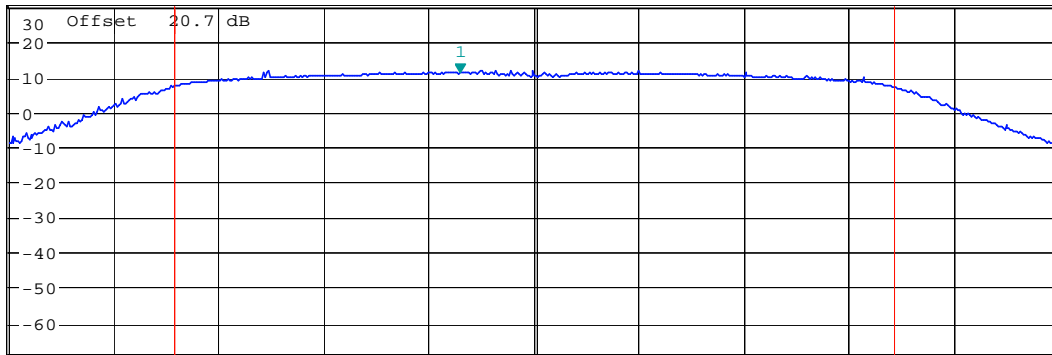
\* RBW 1 MHz  
\* VBW 3 MHz  
SWT 2.5 ms

Marker 1 [T1 ]  
11.02 dBm  
2.460317308 GHz

Ref 30.7 dBm

\* Att 5 dB

1 PK  
MAXH



Center 2.462 GHz

2.4 MHz/

Span 24 MHz

Tx Channel

Bandwidth

16.4 MHz

Power

21.76 dBm



**6.3 Unwanted Emissions into Restricted Frequency Bands – band edge – radiated**

**6.3.1 Reference and Limits:**

§15.247/15.205/15.209; RSS-GEN 7.2;

15.247 (d) Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

§15.205 Restricted bands of operation.

(a) Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	( <sup>2</sup> )
13.36 - 13.41			

**§15.209 Radiated emission limits; general requirements.**

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (m)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	100 (40dBμV/m)	30
30–88	150 (43.5 dBμV/m)	3
88–216	200 (46 dBμV/m)	3
216–960	500 (54 dBμV/m)	3
Above 960	100 (40dBμV/m)	3

**RSS-GEN, issue 3, section 7.2.2 Emissions falling within restricted frequency bands**

Restricted bands, identified in Table 3, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

- (a) fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of Table 3;
- (b) unwanted emissions falling into restricted bands of Table 3 shall comply with the limits specified in RSS-Gen;
- (c) unwanted emissions not falling within restricted frequency bands shall either comply with the limits specified in the applicable RSS, or with those specified in RSS-Gen.



**Table 3: Restricted Frequency Bands**

MHz	MHz	GHz
0.090-0.110	240-285	9.0-9.2
2.1735-2.1905	322-335.4	9.3-9.5
3.020-3.026	399.9-410	10.6-12.7
4.125-4.128	608-614	13.25-13.4
4.17725-4.17775	960-1427	14.47-14.5
4.20725-4.20775	1435-1626.5	15.35-16.2
5.677-5.683	1645.5-1646.5	17.7-21.4
6.215-6.218	1660-1710	22.01-23.12
6.26775-6.26825	1718.8-1722.2	23.6-24.0
6.31175-6.31225	2200-2300	31.2-31.8
8.291-8.294	2310-2390	36.43-36.5
8.362-8.366	2655-2900	Above 38.6
8.37625-8.38675	3260-3267	
8.41425-8.41475	3332-3339	
12.29-12.293	3345.8-3358	
12.51975-12.52025	3500-4400	
12.57675-12.57725	4500-5150	
13.36-13.41	5350-5460	
16.42-16.423	7250-7750	
16.69475-16.69525	8025-8500	
16.80425-16.80475		
25.5-25.67		
37.5-38.25		
73-74.6		
74.8-75.2		
108-138		
156.52475-156.52525		
156.7-156.9		

Note: Certain frequency bands listed in Table 1 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in the 200- and 300- series RSSs, such as RSS-210 and RSS-310, which contain the requirements that apply to licence-exempt radio apparatus.



**RSS-GEN, issue 3, section 7.2.2 Transmitter Spurious Emission Limits**

Spurious emissions from licence-exempt transmitters shall comply with the field strength limits shown below. Additionally, the level of any transmitter spurious emission shall not exceed the level of the transmitter’s fundamental emission.

**Table 5: General Field Strength Limits for Transmitters at Frequencies Above 30 MHz**

Frequency (MHz)	Field Strength (microvolt/m)	Distance (m)
30-88	100 (40dBµV/m)	3
88-216	150 (43.5 dBµV/m)	3
216-960	200 (46 dBµV/m)	3
Above 960	500 (54 dBµV/m)	3

Note: Transmitting devices are not permitted in Table 1 bands or, unless stated otherwise, in TV bands (54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz).

**Table 6: General Field Strength Limits for Transmitters at Frequencies Below 30 MHz (Transmit)**

Frequency	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement distance
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1.705-30 MHz	30 (29.5 dBµV/m)	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing an average detector

**6.3.2 Test Conditions:**

Tnom: 20°C; Vnom: 9.0 VDC

**6.3.3 Test Procedure:**

Marker delta method according to ANSI C63.10

Peak measurements are made using a peak detector and RBW=1MHz.

\*PEAK LIMIT= 74dBµV/m

Average measurements performed using a peak detector and according to video averaging procedure with RBW=1MHz and VBW=10Hz.

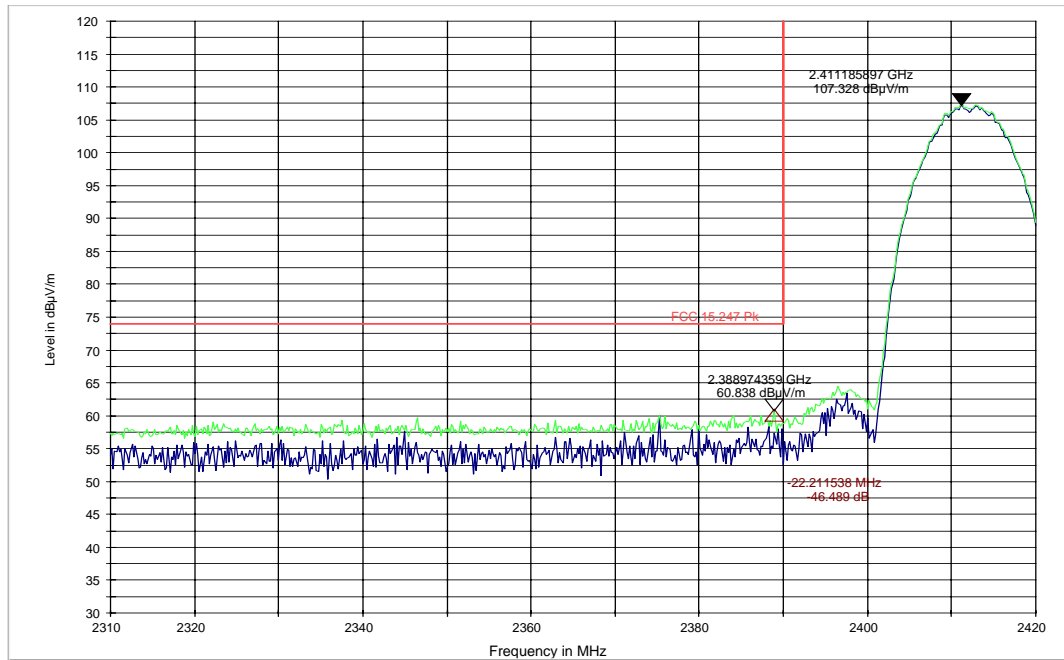
\*AVG. LIMIT= 54dBµV/m

Measurement Uncertainty: ±3.0dB

**6.3.4 Measurement Verdict – Unwanted Emissions into Restricted Frequency Bands – bandedge - radiated**

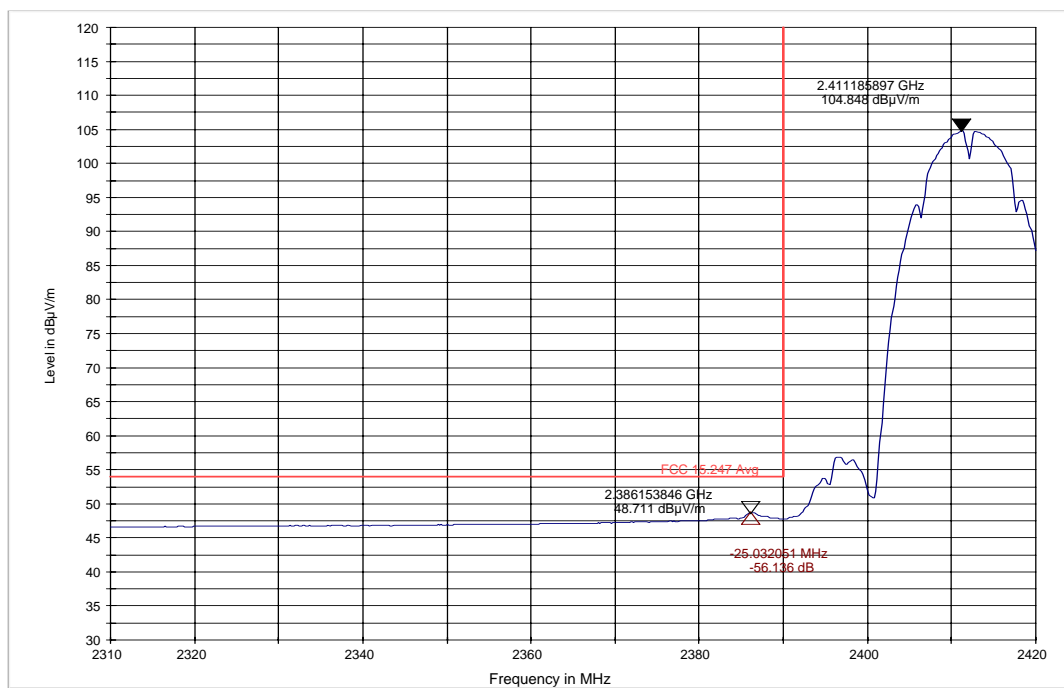
Pass.

### 6.3.5 Test Data/plots: Lower band edge peak -802.11b mode



MaxPeak-ClearWrite-PK+      MaxPeak-MaxHold-PK+      FCC 15.247 Pk

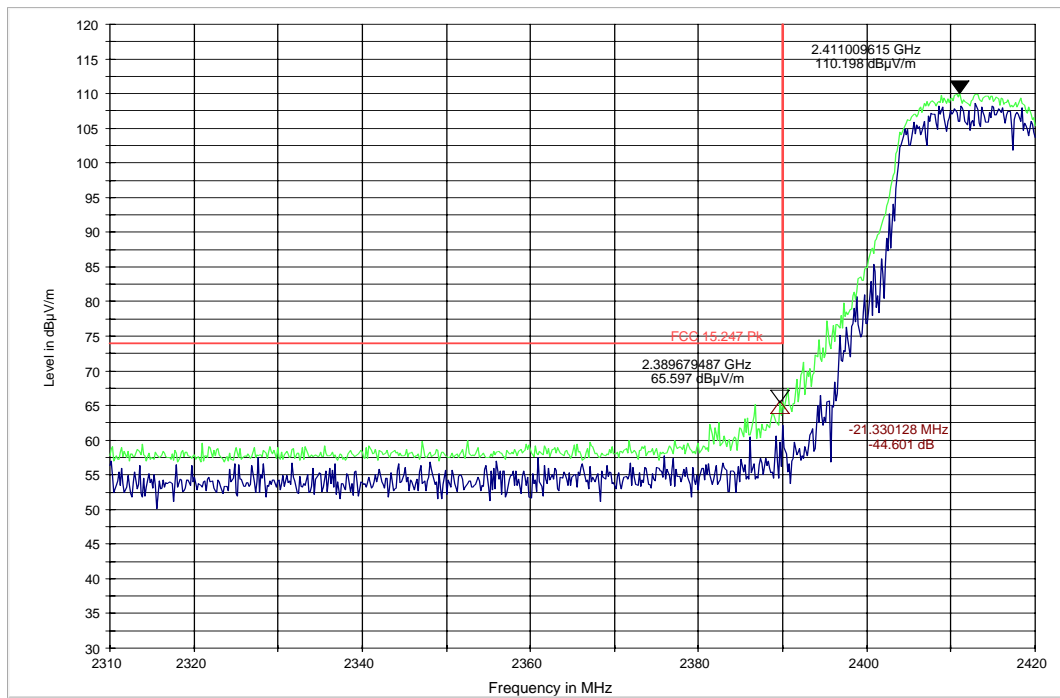
### Lower band edge average -802.11b mode



MaxPeak-MaxHold-PK+      Average-MaxHold-AVG      FCC 15.247 Avg

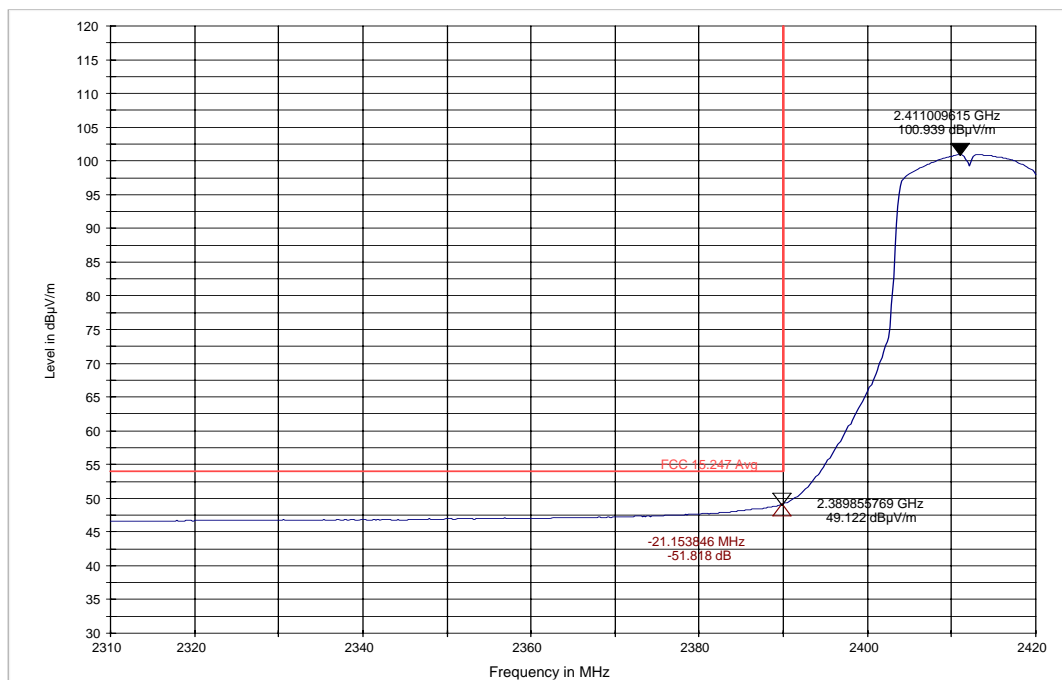


### Lower band edge peak – 802.11g mode



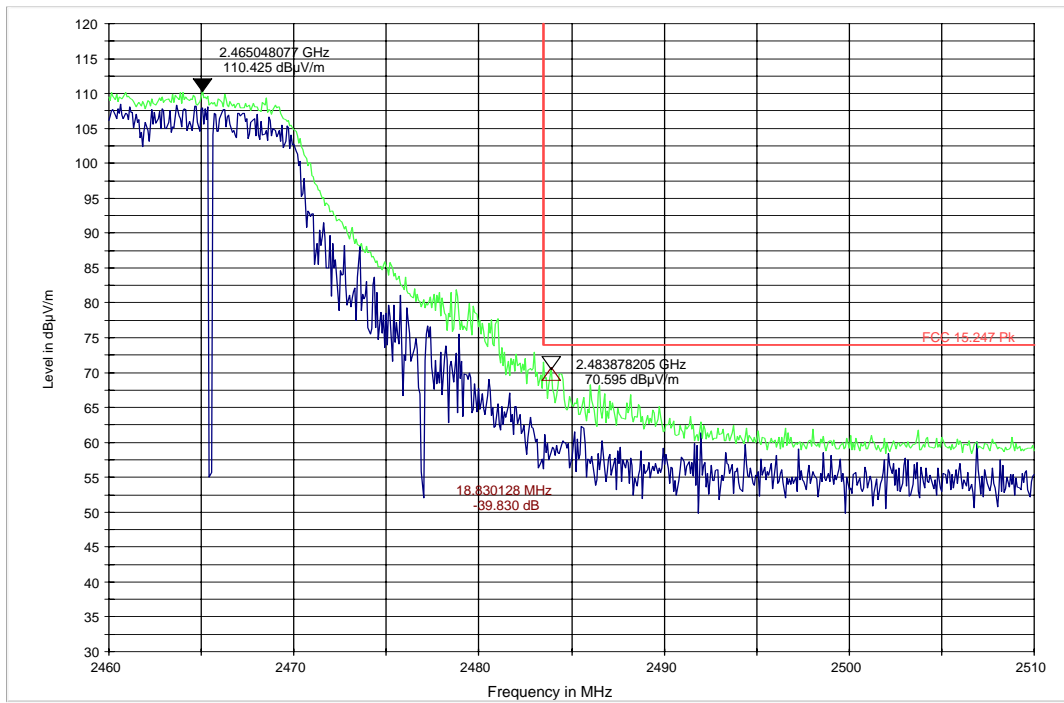
MaxPeak-ClearWrite-PK+      MaxPeak-MaxHold-PK+      FCC 15.247 Pk

### Lower band edge average -802.11g mode



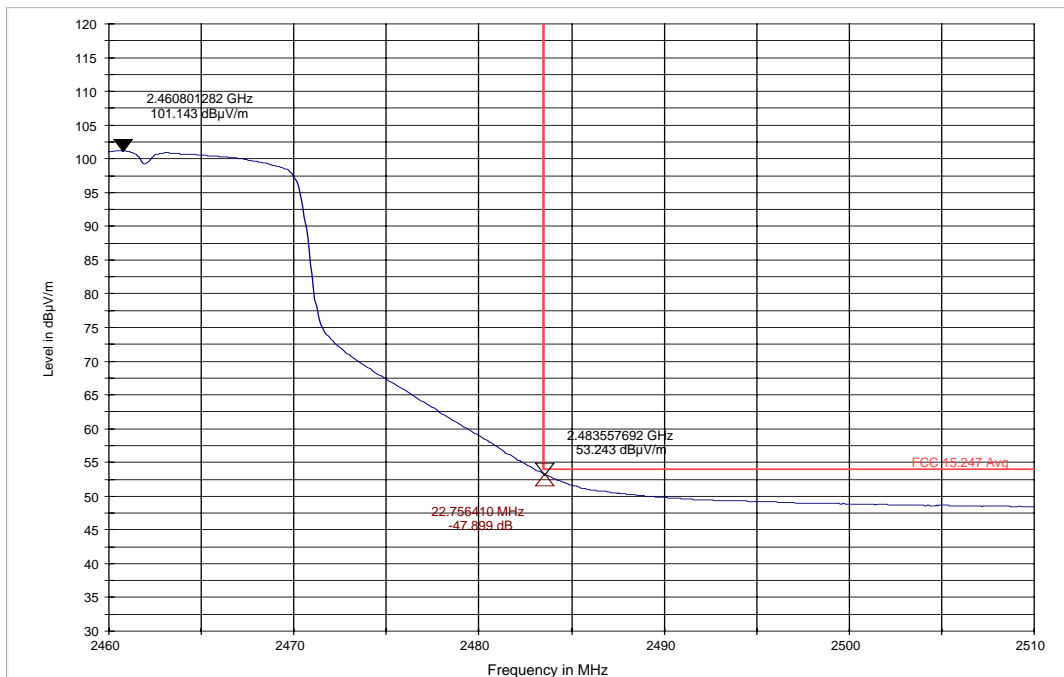
MaxPeak-MaxHold-PK+      Average-MaxHold-AVG      FCC 15.247 Avg

### Higher band edge peak -802.11g mode



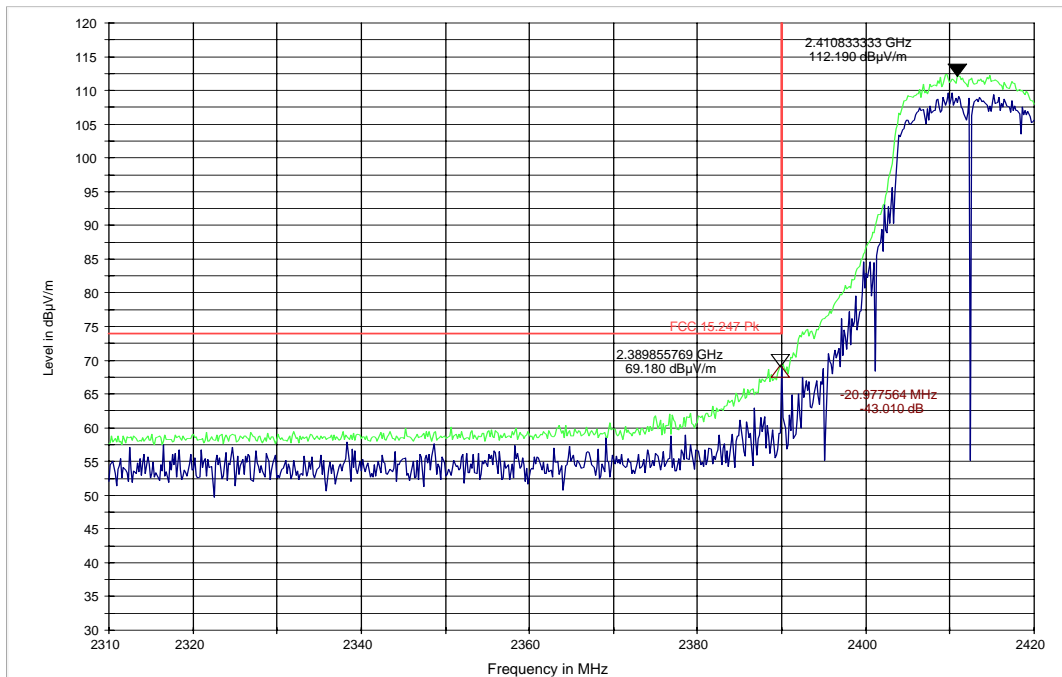
MaxPeak-ClearWrite-PK+      MaxPeak-MaxHold-PK+      FCC 15.247 Pk

### Higher band edge average- 802.11g mode



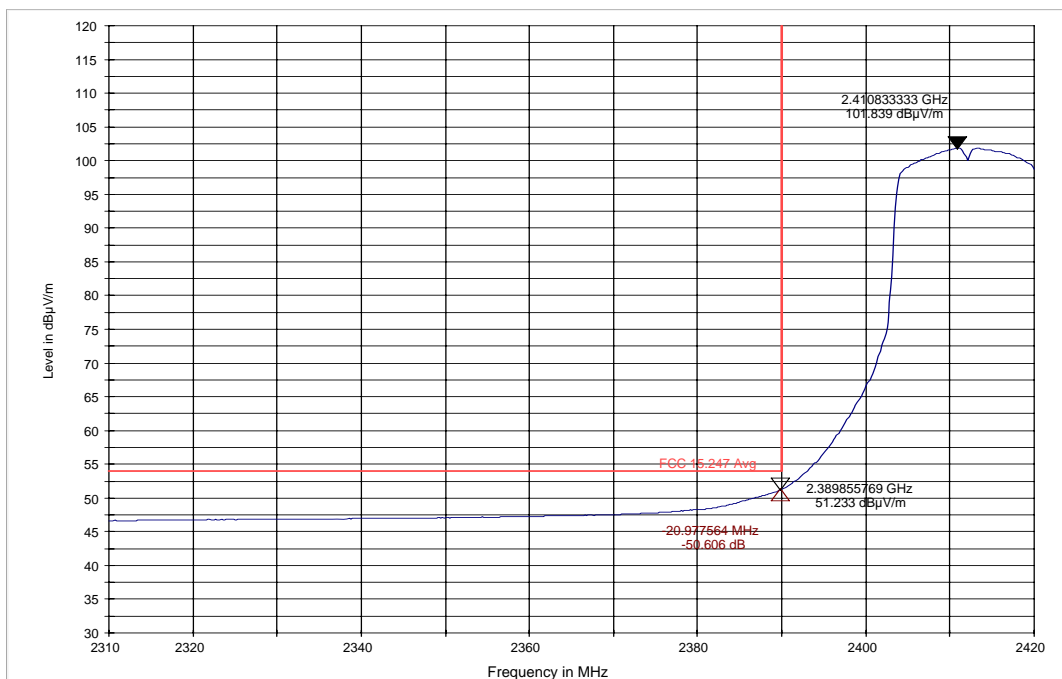
MaxPeak-MaxHold-PK+      FCC 15.247 Avg

### Lower band edge peak – 802.11n (HT20) mode



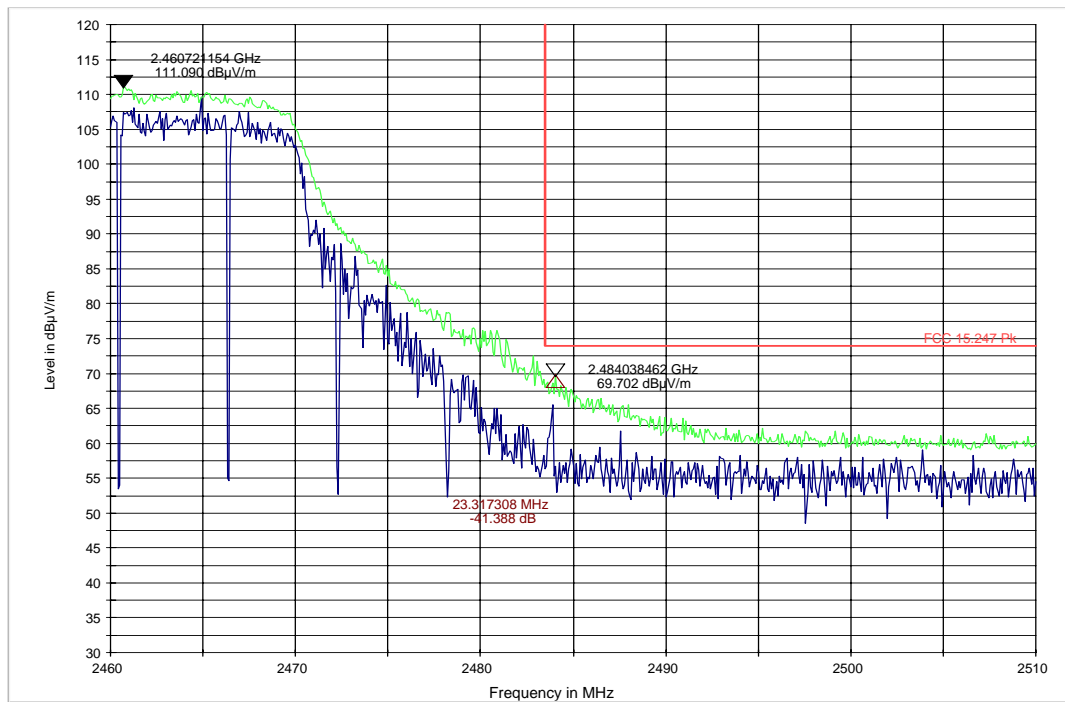
MaxPeak-ClearWrite-PK+      MaxPeak-MaxHold-PK+      FCC 15.247 Pk

### Lower band edge average -802.11n (HT20) mode



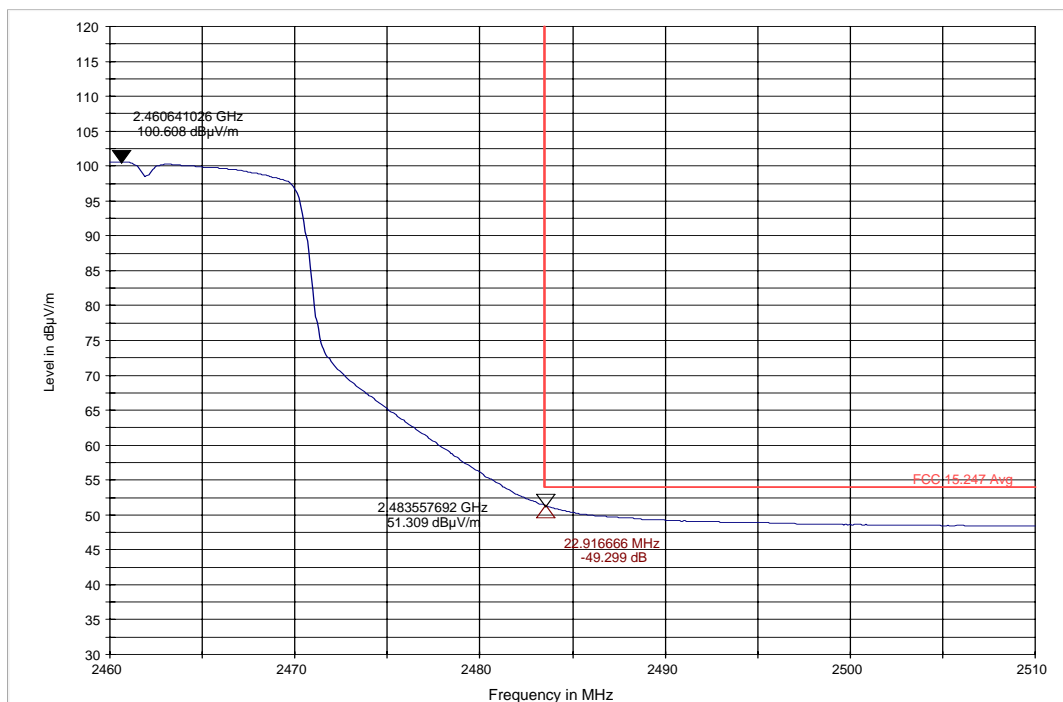
MaxPeak-MaxHold-PK+      Average-MaxHold-AVG      FCC 15.247 Avg

### Higher band edge peak -802.11n (HT20) mode



MaxPeak-ClearWrite-PK+      MaxPeak-MaxHold-PK+      FCC 15.247 Pk

### Higher band edge average- 802.11n (HT20) mode



MaxPeak-MaxHold-PK+      FCC 15.247 Avg

## **6.4 Unwanted Emissions into Restricted Frequency Bands - radiated**

### **6.4.1 Reference and Limits:**

§15.247/15.205/15.209; RSS-GEN 7.2;

Details given under band edge radiated test description above.

### **6.4.2 Test Conditions:**

Tnom: 20°C; Vnom: 9.0 VDC

### **6.4.3 Test Result:**

All inadvertent emissions are below the applicable limits.

### **6.4.4 Testing Notes**

The following plots show the worst case per frequency range out of all tested modes of operation.

For the measurement range up to 30 MHz in the following plots the field strength results from 3m distance measurement are extrapolated to 300m and 30m distance respectively, by 40dB/decade, according to part 15.31(f)(2), per antenna factor scaling.

The red limit line shows the 300 m limit up to 490 kHz, the 30m limit up to 30 MHz and 3m limit above 30MHz.

Unless mentioned otherwise, the emissions outside the limit lines in the plots are from the transmit signal.

Measurement distance: 3m.

Measurement Uncertainty:  $\pm 3.0\text{dB}$

### **6.4.5 Measurement Verdict – Unwanted Emissions into Restricted Frequency Bands-radiated** Pass.



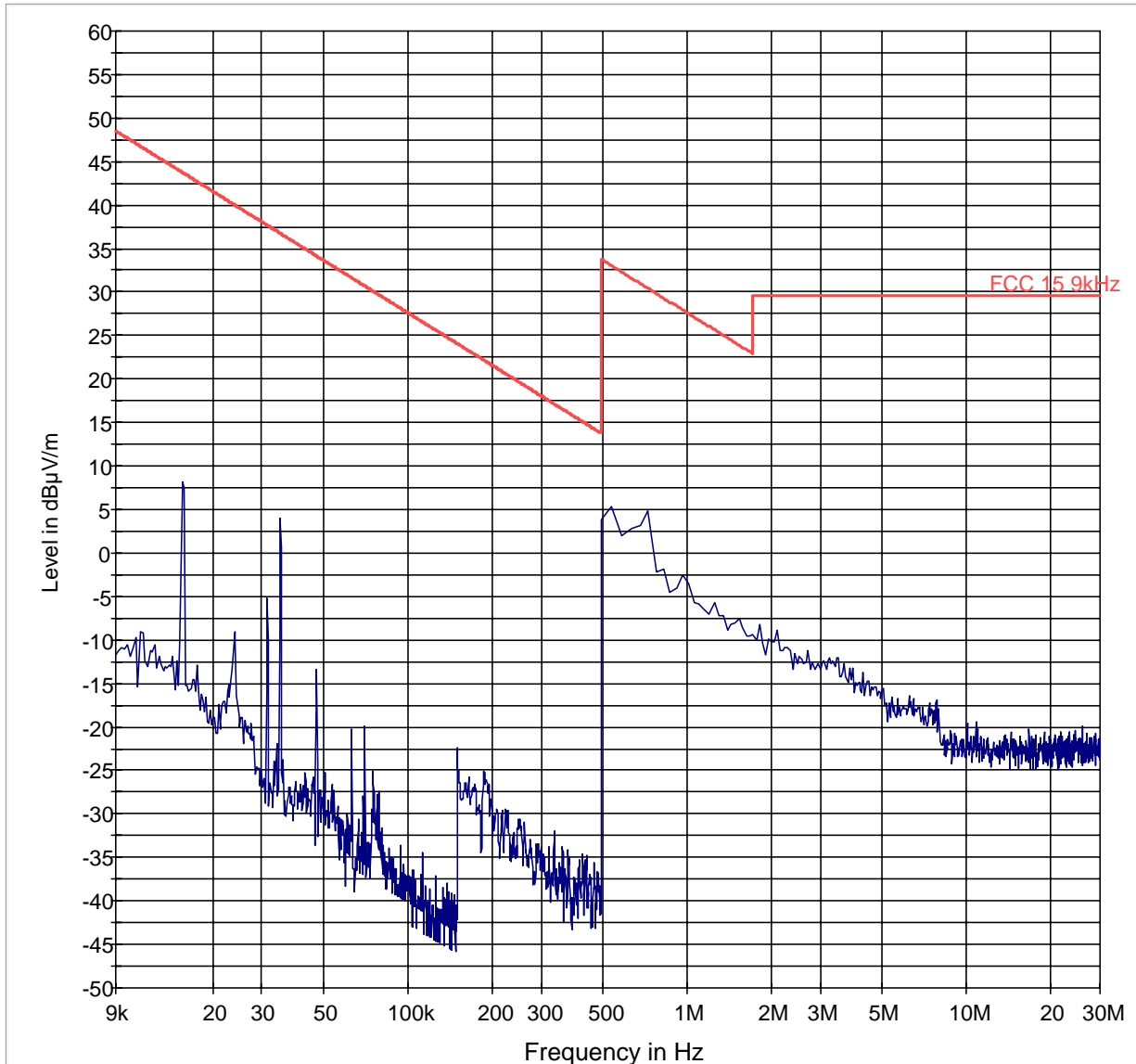
### 6.4.6 Test data/plots

#### 6.4.6.1 Wi-Fi 2.4GHz (802.11g Ch.6)

##### Unwanted Emissions into Restricted Frequency Bands, Radiated - 802.11b: <30MHz

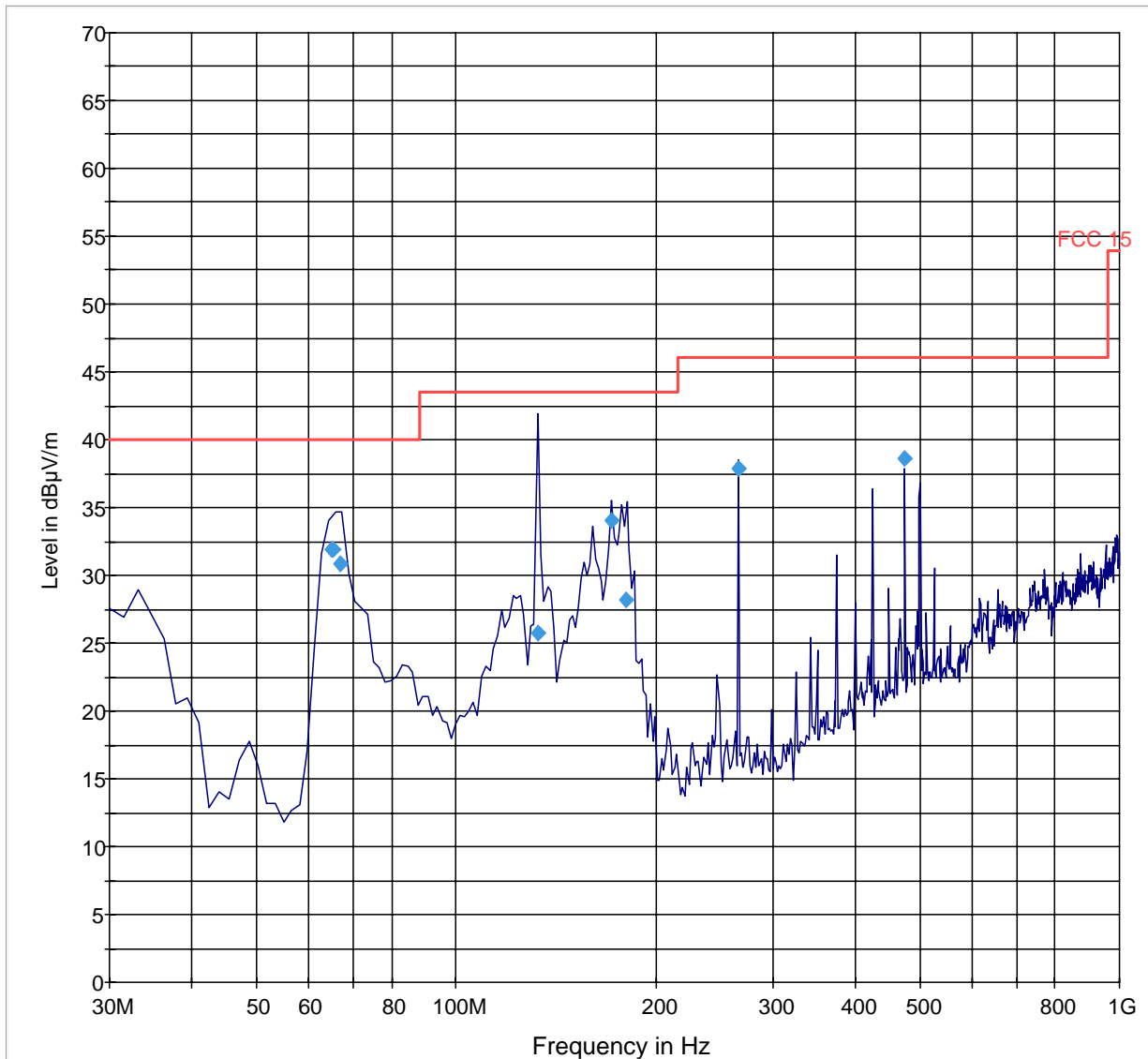
Note: Worst case representation for all modes of operation in this frequency range-

Limits adjusted for 3m measurement.



— FCC 15.9kHz — Preview Result 1-PK+

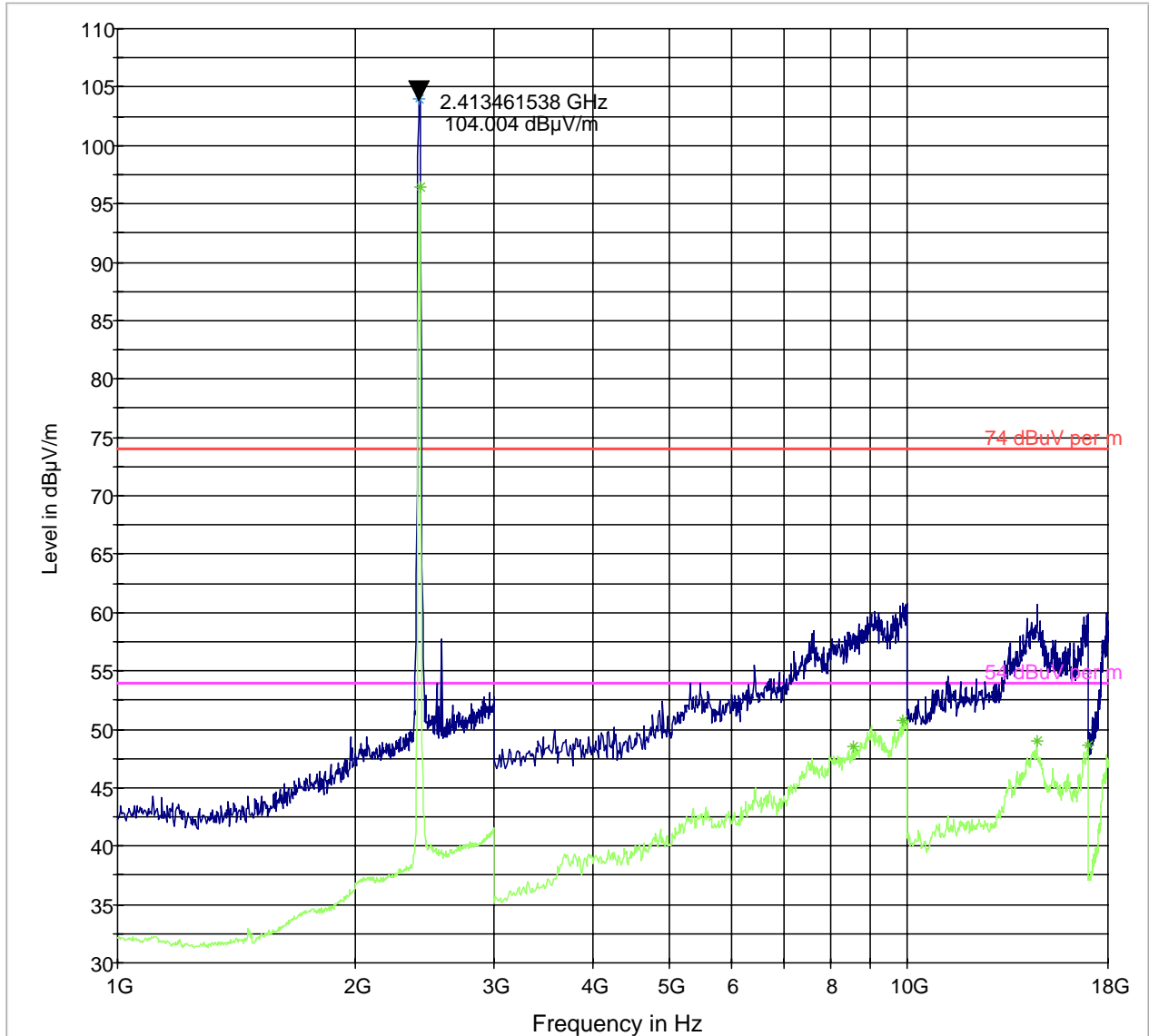
### Unwanted Emissions into Restricted Frequency Bands, Radiated - 802.11g Ch1- 30M-1GHz



— FCC 15    — Preview Result 1-PK+    ◆ Final Result 1-QPK

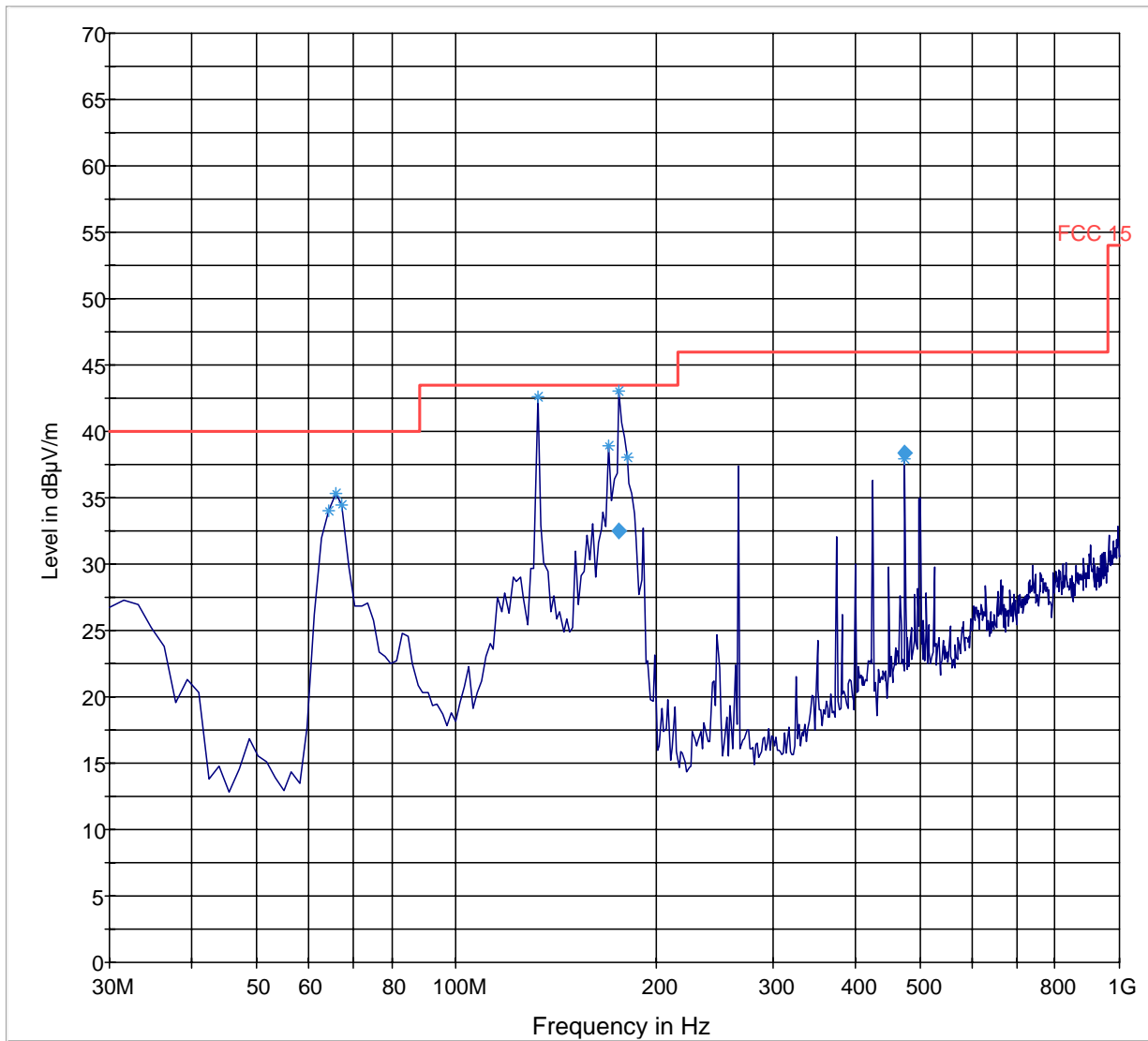
### Unwanted Emissions into Restricted Frequency Bands, Radiated - 802.11g: Ch1- 1G-18GHz

Note: Signal over the limit is the carrier frequency



- 74 dBuV per m
- 54 dBuV per m
- Preview Result 1-PK+
- Preview Result 2-AVG
- Data Reduction Result 1 [4]-PK+
- Data Reduction Result 2 [4]-AVG

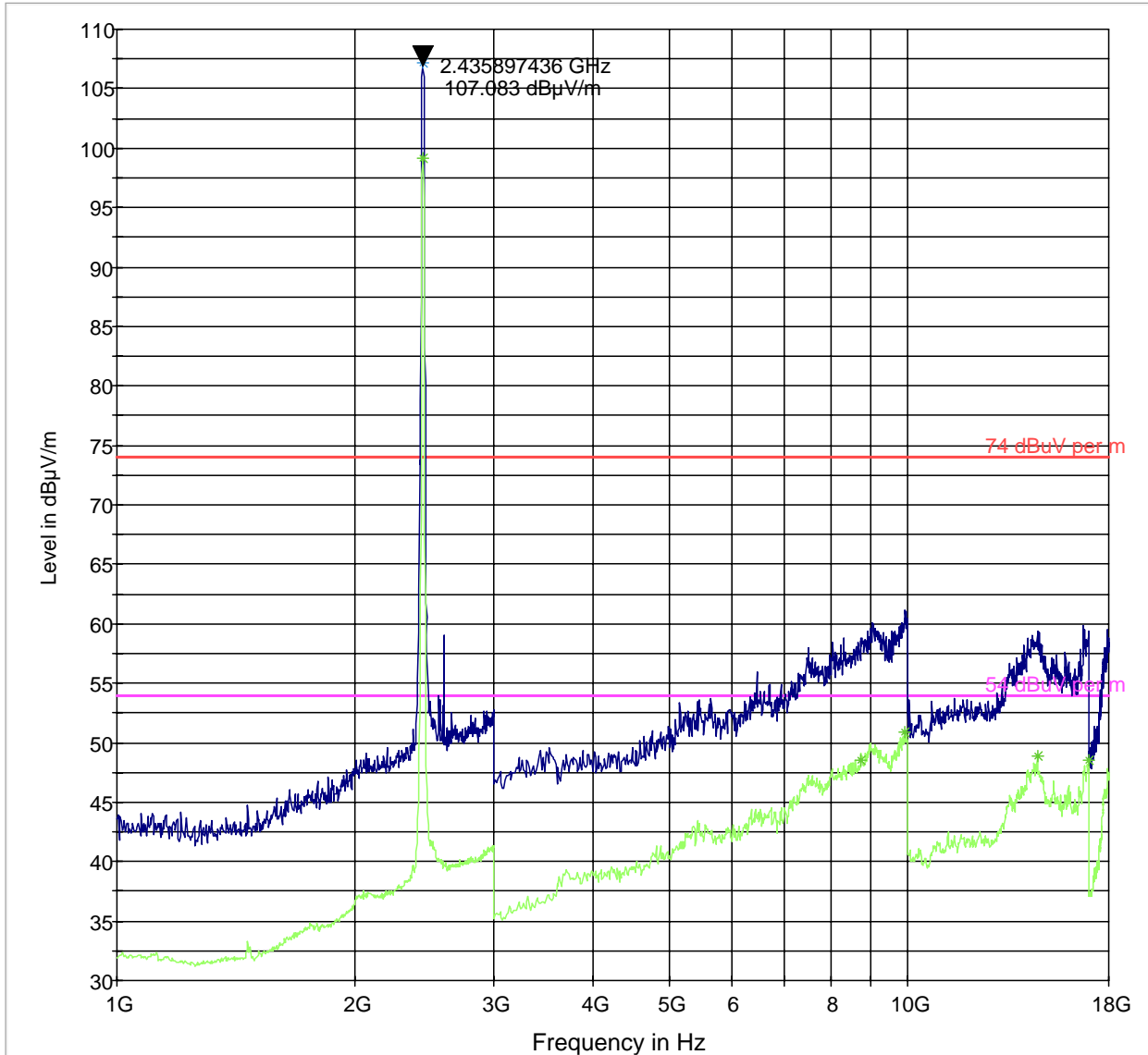
### Unwanted Emissions into Restricted Frequency Bands, Radiated - 802.11g: Ch6 - 1- 30M-1GHz



- FCC 15
- \* Data Reduction Result 1 [3]-PK+
- Preview Result 1-PK+
- ◆ Final Measurement Result 1-QPK

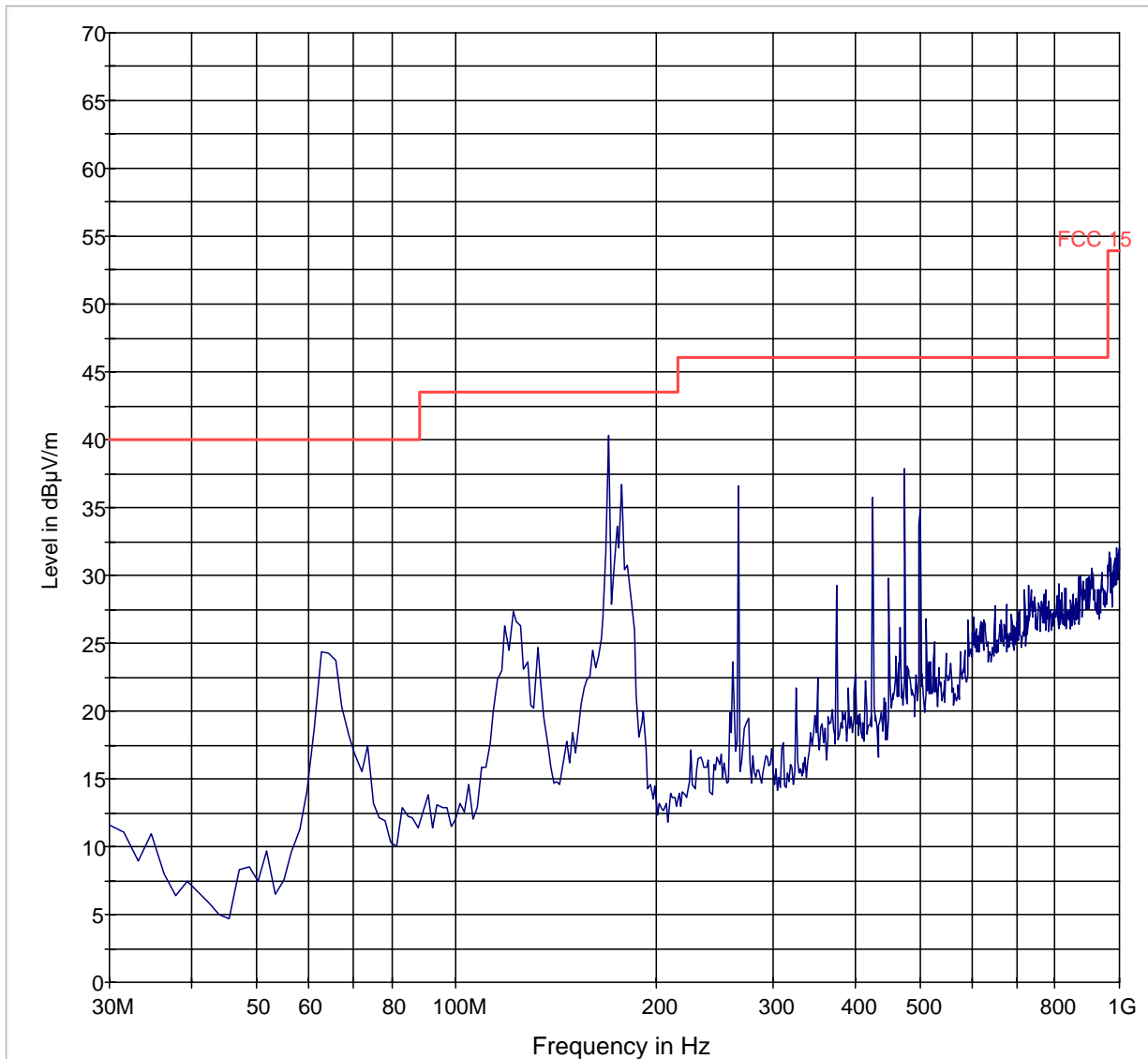
### Unwanted Emissions into Restricted Frequency Bands, Radiated - 802.11b: Ch6- 1G-18GHz

Note: Signal over the limit is the carrier frequency



- 74 dBuV per m
- 54 dBuV per m
- Preview Result 1-PK+ Data Reduction Result 1 [4]-PK+ \*
- Preview Result 2-AVG
- Data Reduction Result 2 [4]-AVG \*

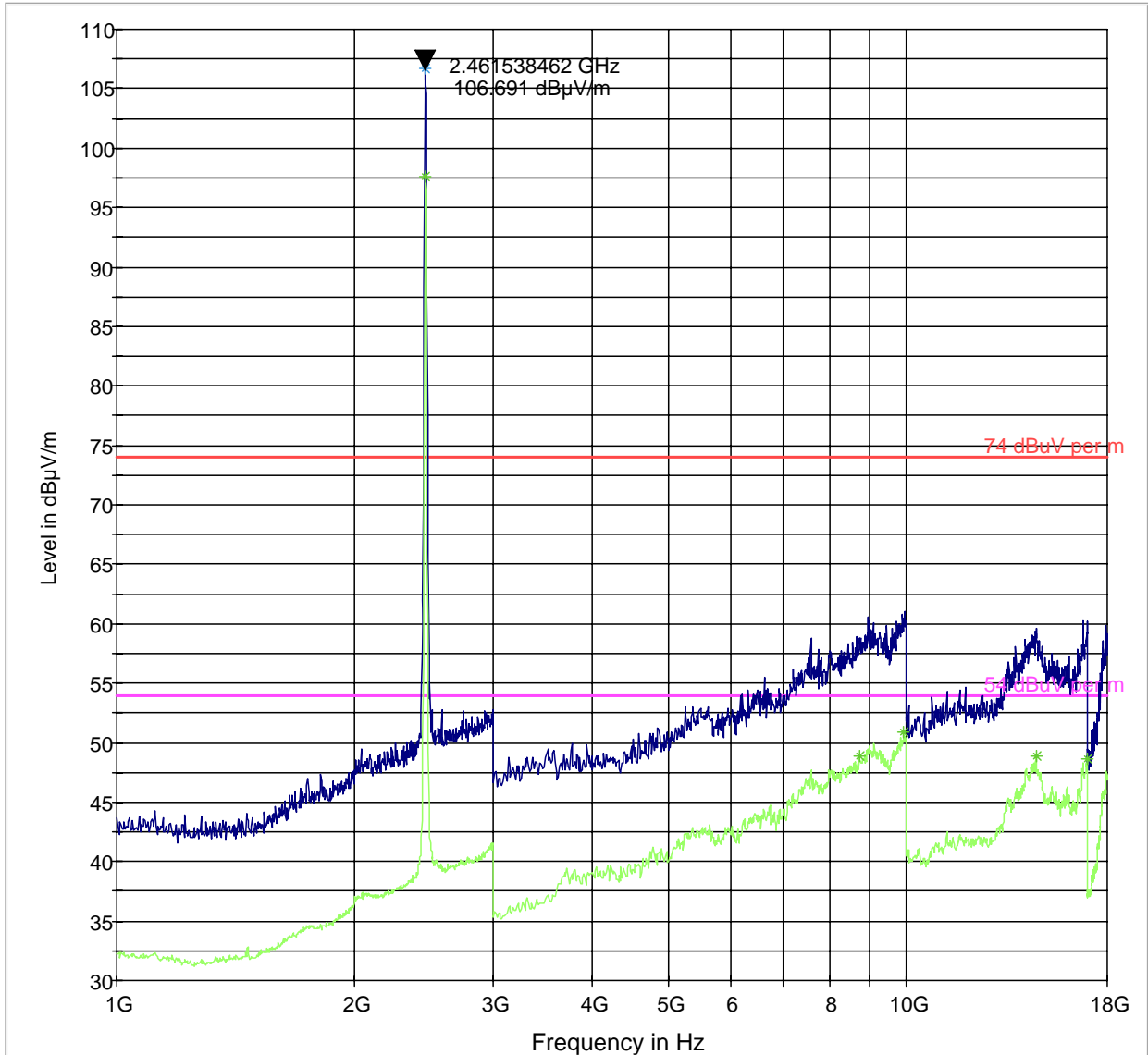
Unwanted Emissions into Restricted Frequency Bands, Radiated - 802.11g: Ch11- 30M-1GHz



— FCC 15    — Preview Result 1-PK+

### Unwanted Emissions into Restricted Frequency Bands, Radiated - 802.11g: Ch11- 1G-18GHz

Note: Signal over the limit is the carrier frequency



- 74 dBµV per m
- 54 dBµV per m
- Preview Result 1-PK+ Data Reduction Result 1 [4]-PK+ \*
- Preview Result 2-AVG
- Data Reduction Result 2 [4]-AVG \*

## 6.5 AC Power Line Conducted Emissions

### 6.5.1 References:

FCC: CFR Part 15.207

The purpose of this test is to measure unwanted radio frequency currents induced in any AC conductor external to the equipment which could conduct interference to other equipment via the AC electrical network.

### 6.5.2 Limits:

§15.207 Conducted limits- Intentional Radiators:

(a) Except as shown in paragraphs (b) and (c) of this section of the CFR, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table (1), as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

**Table 1:**

Frequency of emission (MHz)	Conducted limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

\*Decreases with the logarithm of the frequency.

**Analyzer Settings: CISPR Bandwidth- 9 KHz.**

### 6.5.3 Test Conditions:

Modulation: 802.11g mode.

Measurement Uncertainty:  $\pm$ 3.0dB

### 6.5.4 Results

All emissions are below applicable limits.

Plots shown here represent the combined worse case emissions for power lines, phases and neutral line.

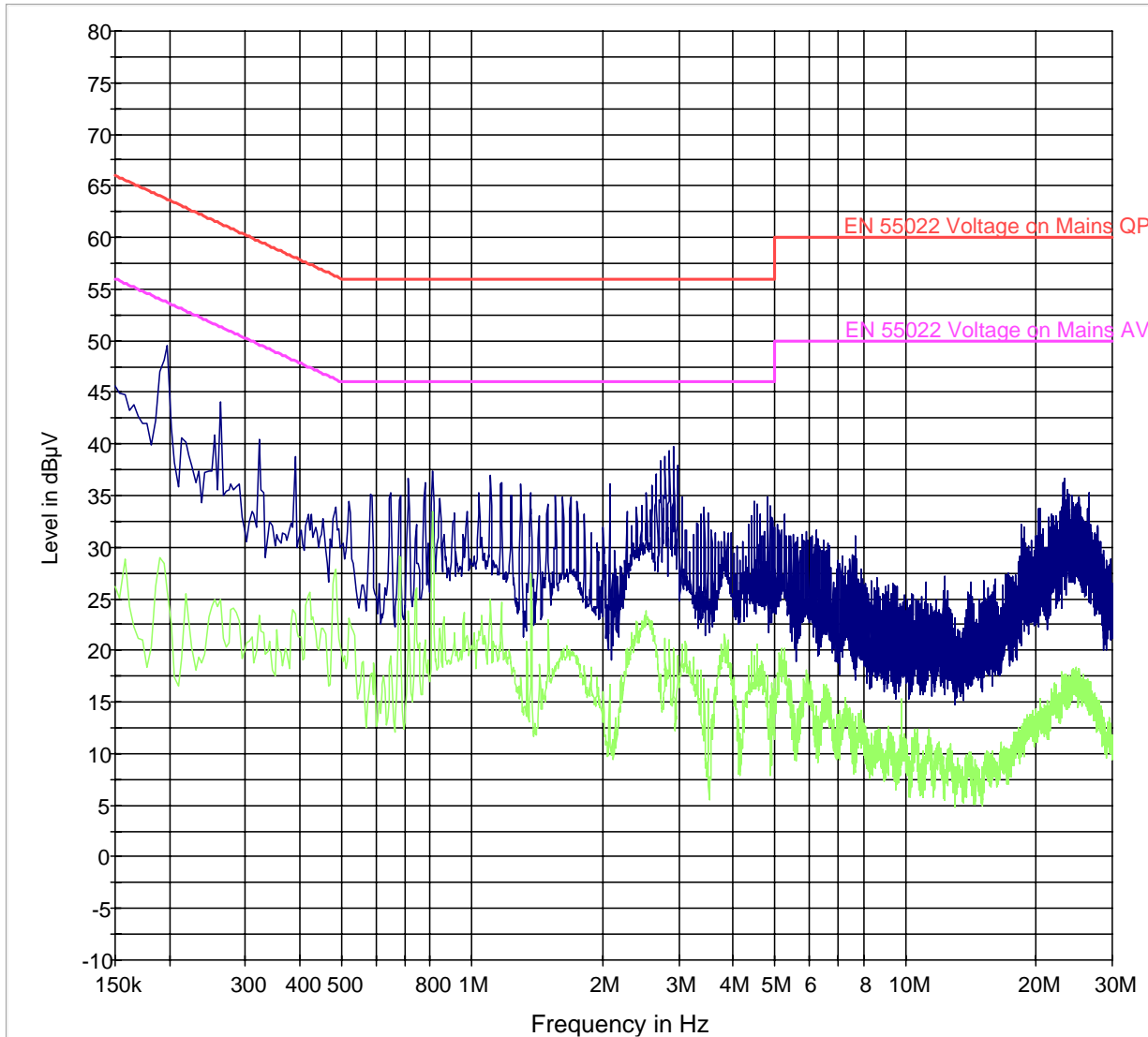
### 6.5.5 Measurement Verdict – AC Power Line Conducted Emissions

Pass.



### 6.5.6 Test data/plots:

#### 6.5.6.1 2.4GHz WLAN TX Mode:



- EN 55022 Voltage on Mains QP
- EN 55022 Voltage on Mains AV
- Preview Result 1-PK+
- Preview Result 2-AVG



**7 Test Equipment and Ancillaries used for tests**

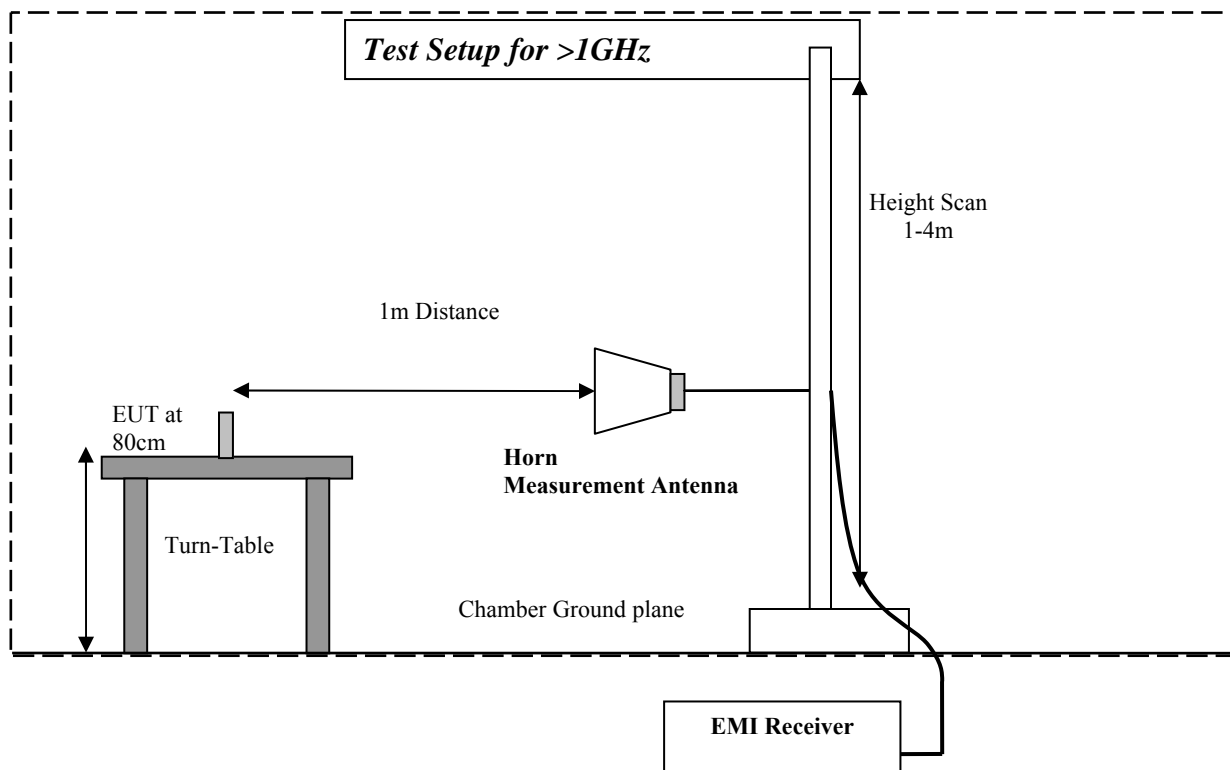
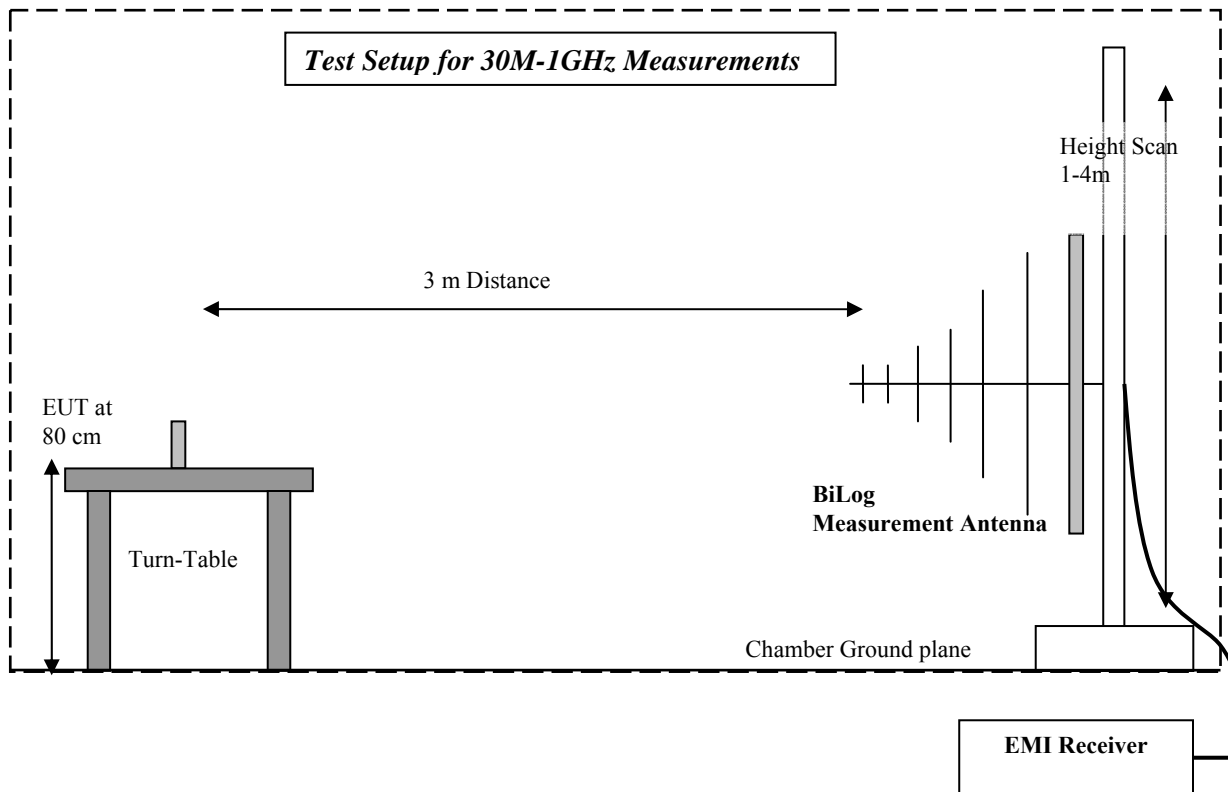
No.	Equipment Name	Manufacturer	Type/model	Serial No.	Cal Date	Cal Interval
<b>3m Semi- Anechoic Chamber:</b>						
	Turn table	EMCO	2075	N/A	N/A	N/A
	MAPS Position Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
	Antenna Mast	EMCO	2075	N/A	N/A	N/A
	Relay Switch Unit	Rohde&Schwarz	RSU	338964/001	N/A	N/A
	EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	May 2012	1 Year
	Spectrum Analyzer	Rohde&Schwarz	FSU	200302	Jun 2013	2 Years
	1500MHz HP Filter	Filtek	HP12/1700	14c48	N/A	N/A
	2800 MHz HP Filter	Filtek	HP12/2800	14C47	N/A	N/A
	Pre-Amplifier	Miteq	JS40010260	340125	N/A	N/A
	Binconilog Antenna	EMCO	3141	0005-1186	Apr 2012	3 Years
	Binconilog Antenna	ETS	3149	J000123908	Feb 2012	3 years
	Horn Antenna	EMCO	3115	35114	Mar 2012	3 Years
	LISN	FCC	50-25-2-08	08014	Jul 2012	1 Year
<b>Ancillary equipment</b>						
	Multimeter	Klein Tools	MM200	001	Apr 2011	2 Years
	Humidity Temperature Logger	Dickson	TM320	03280063	Mar 2012	1 Year
	Digital Barometer	VWR	35519-055	91119547	Nov 2011	2 Years
	DC Power Supply	HP	E3610A	KR83023316	N/A	N/A
	DC Power Supply	Protek	3003B	H012771	N/A	N/A
	Communication Antenna	IBP5-900/1940	Kathrein	N/A	N/A	N/A

Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.

Calibration due dates, unless defined specifically, falls on the last day of the month.

Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

### 8 Test Setup Diagrams



**Test Report #:** EMC\_MULTI\_053\_MTR\_H5-V-BW\_DTS    FCC ID: AU792U13A16854

**Date of Report :** 2014-01-15

IC ID: 125A-0049



## 9 Revision History

Date	Report Name	Changes to report	Report prepared by
2014-01-15	EMC_MULTI_053_MTR_H5-V-BW_DTS	Original Version	Tunji Yusuf