



# FCC/IC Test Report

**FOR:**

**Model Name: A1427**  
**Apple TV**  
**FCC ID: BCGA1427**  
**IC ID: 579C-A1427**

**47 CFR Part 15.247 for DSSS Systems**  
**IC RSS-210 Issue 8**

**TEST REPORT #: EMC\_APPLE\_089\_11001\_DSSS\_Rev1**  
**DATE: 2012-02-10**



**Bluetooth Qualification Test  
Facility  
(BQTF)**



**FCC listed**  
**A2LA Accredited**  
**IC recognized #**  
**3462B**

**CETECOM Inc.**

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**TABLE OF CONTENTS**

**1 Assessment ..... 4**

**2 Administrative Data..... 5**

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report.....5

2.2 Identification of the Client.....5

2.3 Identification of the Manufacturer.....5

**3 Equipment under Test (EUT) ..... 6**

3.1 Specification of the Equipment under Test .....6

3.2 Identification of the Equipment under Test (EUT).....7

3.3 Identification of Accessory equipment .....7

**4 Subject Of Investigation ..... 8**

**5 Summary of Measurement Results..... 9**

**6 Measurements..... 10**

6.1 Radiated Measurement Procedure .....10

6.2 Conducted Measurement Procedure .....12

6.3 Sample Calculations for Radiated Measurements .....13

6.3.1 *Field Strength Measurements:* .....13

6.3.2 *Power Measurements using Substitution Procedure:* .....13

6.4 Maximum Peak Output Power.....14

6.4.1 *Limits:*.....14

6.4.2 *Test Conditions:*.....14

6.4.3 *Test Result: 2.4 GHz Band* .....15

6.4.4 *Test Result: 5 GHz Band* .....16

6.4.5 *Test Data/plots: 2.4GHz Band* .....17

6.4.6 *Test Data/plots: 5 GHz Band* .....22

6.5 Restricted Band Edge Compliance .....25

6.5.1 *Limits: §15.247/15.205*.....25

6.5.2 *Measurement Procedure:* .....25

6.5.3 *Test Data/plots: 2.4 GHz Band* .....26

6.6 Occupied Bandwidth/ 20dB Bandwidth .....32

6.6.1 *Limits:*.....32

6.6.2 *Test Conditions:*.....32

6.6.3 *Test Result: 2.4 GHz Band* .....33

6.6.4 *Test Result: 5 GHz Band* .....33

6.6.5 *Test Data/plots: 2.4 GHz Band* .....34

6.6.6 *Test Data/plots: 5 GHz Band* .....44

6.7 Power Spectral Density.....50

6.7.1 *Limits:*.....50

6.7.2 *Measurement procedure:*.....50

6.7.3 *Test results: 2.4 GHz*.....50

6.7.4 *Test results: 5 GHz*.....51

6.7.5 *Test Data/plots: 2.4 GHz Band* .....52

6.7.6 *Test Data/plots: 5 GHz Band* .....57

6.8 Transmitter Spurious Emissions- Conducted § 15.247 (c).....60

6.8.1 *Reference and Limits:*.....60

6.8.2 *Test Conditions:*.....60

6.8.3 *Test data/ plots: 2.4 GHz Band* .....60

6.8.4 *Test data/ plots: 5 GHz Band* .....61

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6.8.5	Test data/ plots: 2.4 GHz Band .....	62
6.8.6	Test data/ plots: 5 GHz Band .....	67
6.9	Transmitter Spurious Emissions- Radiated.....	73
6.9.1	Limits: .....	73
6.9.2	Test Result: .....	74
6.9.3	Test data/ plots: 2.4 GHz Band .....	75
6.10	AC Power Line Conducted Emissions.....	99
6.10.1	References: .....	99
6.10.2	Limits: .....	99
6.10.3	Test Conditions: .....	99
6.10.4	Results .....	99
6.10.5	Test Results: 2.4GHz / 5 GHz Band .....	100
<b>7</b>	<b>Test Equipment and Ancillaries used for tests.....</b>	<b>102</b>
<b>8</b>	<b>Block Diagrams .....</b>	<b>103</b>
<b>9</b>	<b>Revision History .....</b>	<b>104</b>

**1 Assessment**

**The following device was tested against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and Industry Canada Standards RSS 210 Issue 8 and no deviations were ascertained during the course of the tests performed.**

Company	Description	Model #
Apple Inc.	The device is a digital media receiver designed to play internet content onto a TV through an HDMI port. It incorporates WiFi and Bluetooth radios.	A1427

**Responsible for Testing Laboratory:**

		Sajay Jose	
2012-02-10	Compliance	(Test Lab Manager)	
Date	Section	Name	Signature

**Responsible for the Report:**

		Calvin Lee	
2012-02-10	Compliance	(EMC Engineer)	
Date	Section	Name	Signature

The test results of this test report relate exclusively to the test item specified in Section 3. 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.

## 2 Administrative Data

### 2.1 Identification of the Testing Laboratory Issuing the EMC 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.
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<b>Test Lab Director:</b>	Heiko Strehlow
<b>Responsible Project Leader:</b>	Calvin Lee

### 2.2 Identification of the Client

<b>Applicant's Name:</b>	Apple Inc.
<b>Street Address:</b>	1 Infinite Loop Mail Stop26A
<b>City/Zip Code</b>	Cupertino, California 95014
<b>Country</b>	USA
<b>Contact Person:</b>	Marc Douat
<b>Phone No.</b>	1-408-862-2927
<b>e-mail:</b>	mdouat@apple.com

### 2.3 Identification of the Manufacturer

<b>Manufacturer's Name:</b>	Same as above.
<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 / Model No:</b>	Apple TV/A1427
<b>HW / SW Revision :</b>	EVT/9B123
<b>FCC-ID / IC-ID:</b>	BCGA1427 / 579C-A1427
<b>Product Description:</b>	The device is a digital media receiver designed to play internet content onto a TV through an HDMI port. It incorporates WiFi and Bluetooth radios.
<b>Frequency Bands supported:</b>	BT2.1+ EDR: ISM Band 2400-2483.5 MHz BT 4.0: ISM Band 2400-2483.5 MHz WLAN 802.11 a/b/g/n: 5150 MHz-5350 MHz and 5470 MHz-5725 MHz
<b>Type(s) of Modulation:</b>	Bluetooth: GFSK, $\pi/4$ DQPSK, 8DPSK; WLAN: CCK, OFDM
<b>Power Supply:</b>	100-240V/50-60Hz 6 Watts
<b>Prototype / Production unit:</b>	Prototype
<b>EUT Specifications for mode of test: WLAN 802.11 a/b/g/n</b>	
<b>Frequency Range / number of channels:</b>	WiFi: 2412MHz – 2462MHz / 13 WiFi: 5180MHz – 5825MHz / 18
<b>Modes of Operation:</b>	WLAN - development firmware used to force transmitter and achieve 98% duty cycle
<b>Antenna Type / gain / position / min. distance to other antenna (if appl):</b>	Integrated Antenna: PIFA Antenna Gain: (the values below represent the max. antenna gain in the given bands and have been provided by the manufacturer)

<b>Antenna Type / gain / position / min. distance to other antenna (if appl):</b>	<b>Max Gains (dBi)</b>		
	<b>Band</b>	<b>Ant1 PIFA</b>	<b>Ant0 PIFA</b>
	2400-2483.5	<b>3.7</b>	-
	5150-5250	4.5	2.4
	5250-5350	4.1	-
	5470-5725	4.5	-
	5745-5850	<b>4.6</b>	-
Note: Antenna 0 will only be used at one frequency, 5200MHz.			

**3.2 Identification of the Equipment under Test (EUT)**

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
<b>1</b>	PT662763	EVT	9B123	Conducted sample
<b>2</b>	PT677761	EVT	9B123	Radiated Sample

**3.3 Identification of Accessory equipment**

AE #	Type	Manufacturer	Model	Serial Number
<b>1</b>	Mac Book Pro	Apple	A1150	YD6124XQVJ1
<b>2</b>	AC Power Cord	Apple	N/A	N/A

#### **4 Subject Of Investigation**

The objective of the measurements done by Cetecom Inc. was to measure the performance of the EUT as specified by requirements listed in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Industry Canada rules RSS-210 Issue 8.

This test report is to support a request for new equipment authorization under the FCC ID **BCGA1427** and IC ID **579C-A1427**.

All testing was performed on the product referred to in Section 3 as EUT.

This test report contains full radiated and conducted testing results as per

- 47 CFR Part 15: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communications Commission subchapter A- General, Part 15- Radio Frequency Devices.
- RSS-210 Issue 8: Spectrum Management and Telecommunications- Radio Standards Specification. Low-power Licence-exempt radio communication devices (All frequency bands): Category 1 equipment.

During the testing process the EUT was tested on low, mid and high channels for all the supported modes of operation. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

This device contains two integral PIFA antennas. Ant1 is the primary antenna, and used for Bluetooth, and all WiFi channels, except channel 40. Ant 0 is the secondary antenna and used for WiFi channel 40.



## 5 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(b)(4) RSS210 A8.4(2)	Antenna Gain	Nominal	-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Complies
§15.247(e) RSS210 A8.2(b)	Power Spectral Density	Nominal	802.11b 802.11g 802.11n 802.11a	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.247(a)(1) RSS210 A8.1(b)	Carrier Frequency Separation	Nominal	-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-
§15.247(a)(1) RSS210 A8.1(d)	Number of Hopping Channels	Nominal	-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-
§15.247(a)(1)(iii) RSS210 A8.3(1)	Time of occupancy	Nominal	-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-
§15.247(a)(1) RSS210 A8.2(a)	Spectrum Bandwidth	Nominal	802.11b 802.11g 802.11n 802.11a	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.247(b)(1) RSS210 A8.4(2)	Maximum Output Power	Nominal	802.11b 802.11g 802.11n 802.11a	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.247(d) RSS210 A8.5	Band edge compliance- Conducted	Nominal	802.11b 802.11g 802.11n	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Note 1
§15.247(d) RSS210 A8.5	Band edge compliance- Radiated	Nominal	802.11b 802.11g 802.11n	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.247(d) RSS210 A8.5	TX Spurious emissions- Conducted	Nominal	802.11b 802.11g 802.11n 802.11a	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.247(d) RSS210 A8.5	TX Spurious emissions- Radiated	Nominal	802.11b 802.11g 802.11n 802.11a	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.209(a) RSS Gen	TX Spurious Emissions Radiated<30MHz	Nominal	802.11b 802.11n 802.11a	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.207(a)	Conducted Emissions <30MHz	Nominal	802.11b 802.11n	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies

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

1. Band Edge compliance-conducted is NOT PERFORMED as the device passes radiated measurement.

## **6 Measurements**

### **6.1 Radiated Measurement Procedure**

#### **ANSI C63.4:2003 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 beamwidth, the measurement antenna shall be aligned with the EUT.

### ANSI C63.4:2003 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 remaximized 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

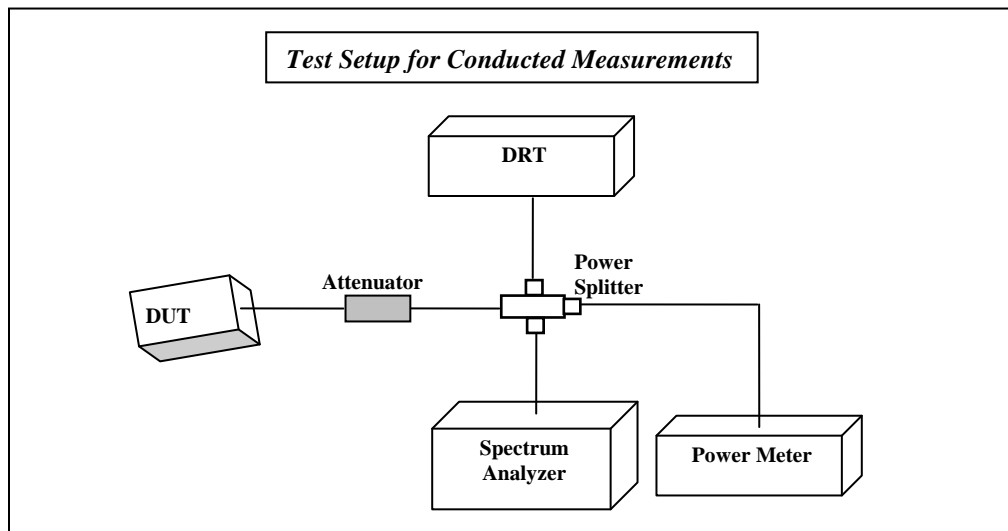
1— Where limits are specified by agencies for both average and peak (or quasi-peak) detection, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

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.

**Note: Measurement uncertainty for all radiated measurements= +/- 3dB**

## 6.2 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. Adjust the settings of the Digital Radio Communication Tester (DRT) to connect the EUT at the required channel (OR) alternatively use the EUT to set to transmit at a specific mode.
3. Measurements are to be performed with the EUT set to the low, middle and high channels.

**Note: Measurement uncertainty for all conducted measurements= +/- 0.5dB**

### 6.3 Sample Calculations for Radiated Measurements

#### 6.3.1 Field Strength Measurements:

Field Strength measurements are directly taken from the Spectrum Analyzer/ Receiver, taking into account the cable loss between the Receiving Antenna and the Spectrum Analyzer/ Receiver. Antenna Factor is accounted for by the test SW.

FS (dB $\mu$ V/m)= Measured Value on SA (dB $\mu$ V)+ Cable Loss (dB)

Eg:

Frequency (MHz)	Measured SA (dB $\mu$ V)	Cable Loss (dB)	Field Strength Result (dB $\mu$ V/m)
1000	95.5	3.5	99.0

#### 6.3.2 Power Measurements using Substitution Procedure:

The measurement on the Spectrum Analyzer is used as a basis for the Substitution procedure.

The EUT is replaced with a Signal Generator and an antenna. The setting on the Signal Generator is varied until the Spectrum Analyzer displays the original reading. EIRP is calculated as-

EIRP (dBm)= Signal Generator setting (dBm)- Cable Loss (dB)+ Antenna Gain (dBi)

Eg:

Frequency (MHz)	Measured SA (dB $\mu$ V)	Signal Generator setting (dBm)	Antenna Gain (dBi)	Dipole Gain (dBd)	Cable Loss (dB)	EIRP (dBm)
1000	95.5	24.5	6.5	0	3.5	27.5

## 6.4 Maximum Peak Output Power

### 6.4.1 Limits:

#### 6.4.1.1 §15.247 (b)(3)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

#### 6.4.1.2 RSS 210- A8.4(2)

Nominal Peak Output Power < 30 dBm (1W)

EIRP < 36dBm

### 6.4.2 Test Conditions:

Tnom: 20.5°C; Vnom: 120V

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

RBW=20MHz, VBW=30MHz, Detector: Peak- Max Hold.

Sweep Time: Auto

Span=40MHz

#### **Max. Antenna Gain (dBi):**

2.4 GHz Band: 3.7 dBi

5 GHz Band: 4.6 dBi

### 6.4.3 Test Result: 2.4 GHz Band

Measured Peak Output Power- Conducted (dBm)			
Mode	Frequency (MHz)		
	2412 Channel 1	2437 Channel 6	2462 Channel 11
802.11b	23.37	23.76	22.09
802.11g	24.99	25.95	24.56
802.11n/HT20	24.39	26.10	24.26

Calculated Peak Output Power- Radiated (dBm)			
Mode	Frequency (MHz)		
	2412 Channel 1	2437 Channel 6	2462 Channel 11
802.11b	27.07	27.46	25.79
802.11g	28.69	29.65	28.26
802.11n/HT20	28.09	29.8	27.69

**Note: Radiated EIRP is calculated as  
Conducted Measurement + max. Antenna Gain (3.7dBi)**

#### 6.4.3.1 Measurement result:

Pass.

**6.4.4 Test Result: 5 GHz Band**

Measured Peak Output Power- Conducted (dBm)						
Mode	Frequency (MHz)					
	5745 Channel 149		5785 Channel 157		5825 Channel 165	
	Peak	Average	Peak	Average	Peak	Average
<b>802.11a</b>	26.07	19.27	26.13	19.37	26.31	19.20
<b>802.11n/HT20</b>	26.47	19.29	26.33	19.43	26.46	19.23

Calculated Peak Output Power- Radiated (dBm)			
Mode	Frequency (MHz)		
	5745 Channel 149	5785 Channel 157	5825 Channel 165
<b>802.11a</b>	31.07	30.73	30.91
<b>802.11n/HT20</b>	30.67	30.93	31.06

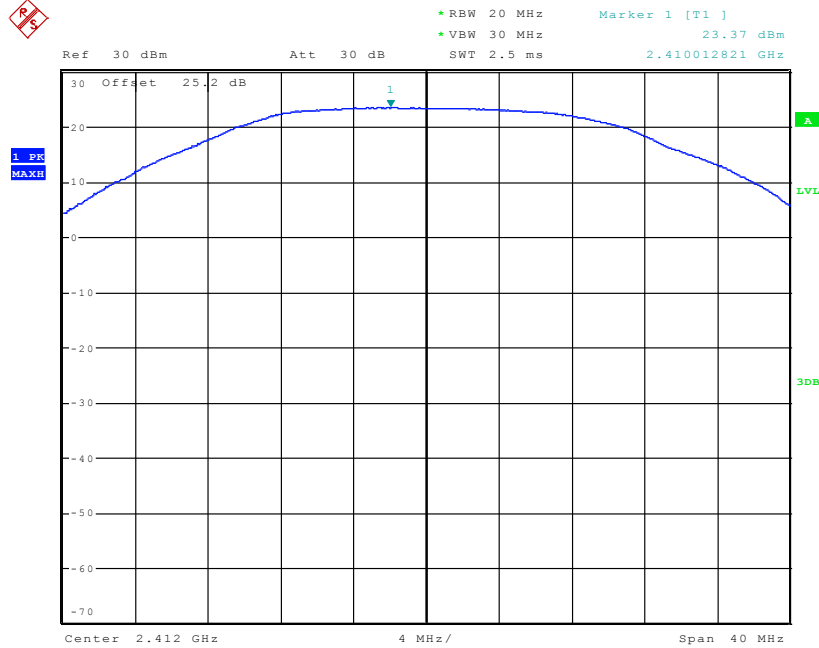
**Note: Radiated EIRP is calculated as  
 Conducted Measurement + max. Antenna Gain (4.6dBi)**

6.4.4.1 Measurement result:  
 Pass.



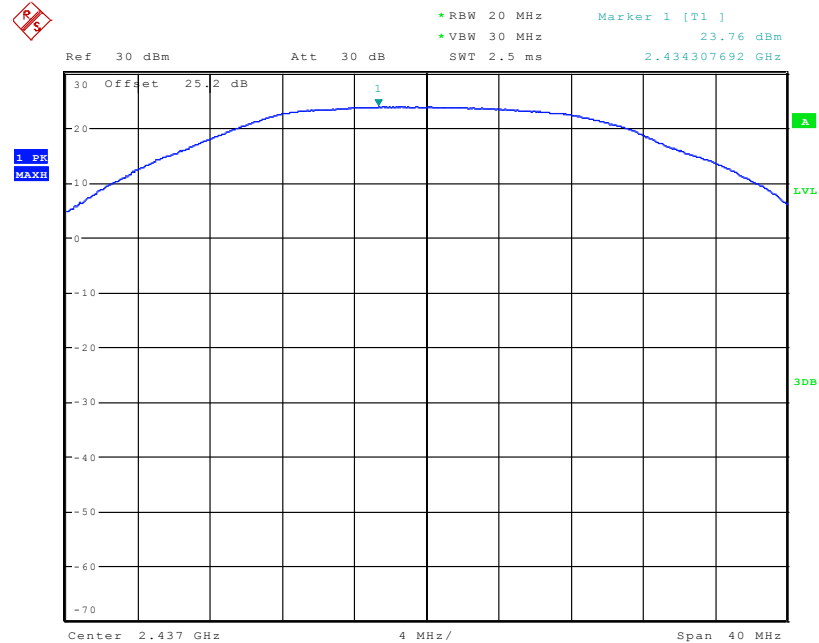
### 6.4.5 Test Data/plots: 2.4GHz Band

#### Conducted Peak Power 802.11b 2412 MHz



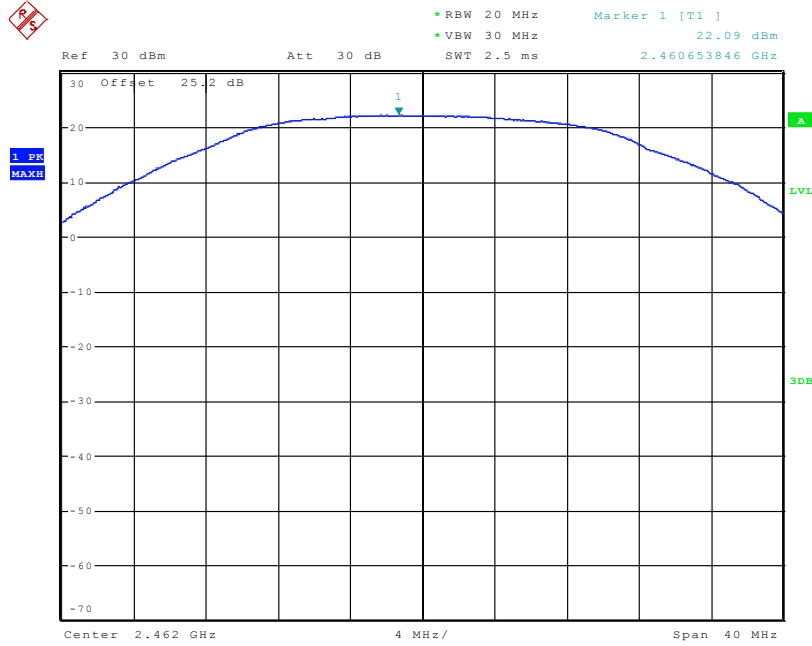
Date: 5.DEC.2011 09:49:26

#### Conducted Peak Power 802.11b 2437 MHz



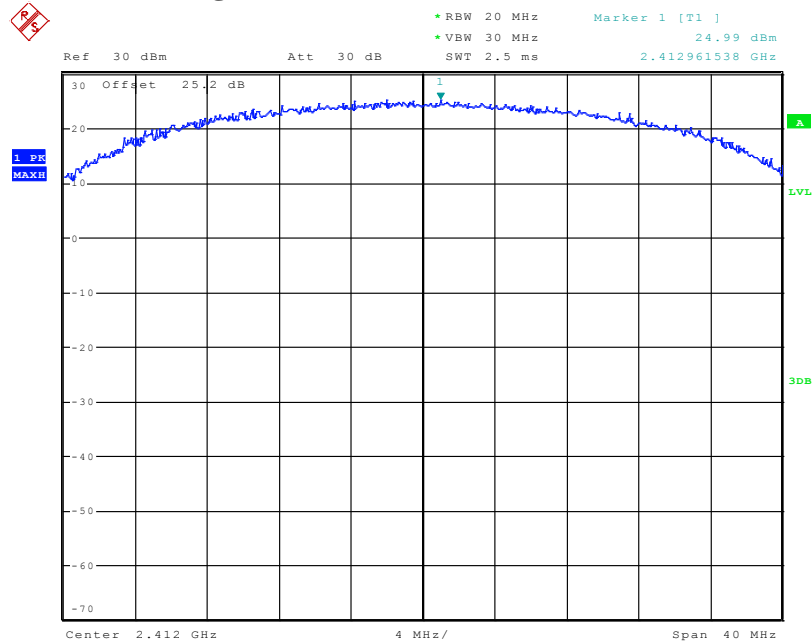
Date: 5.DEC.2011 09:56:01

### Conducted Peak Power 802.11b 2462 MHz



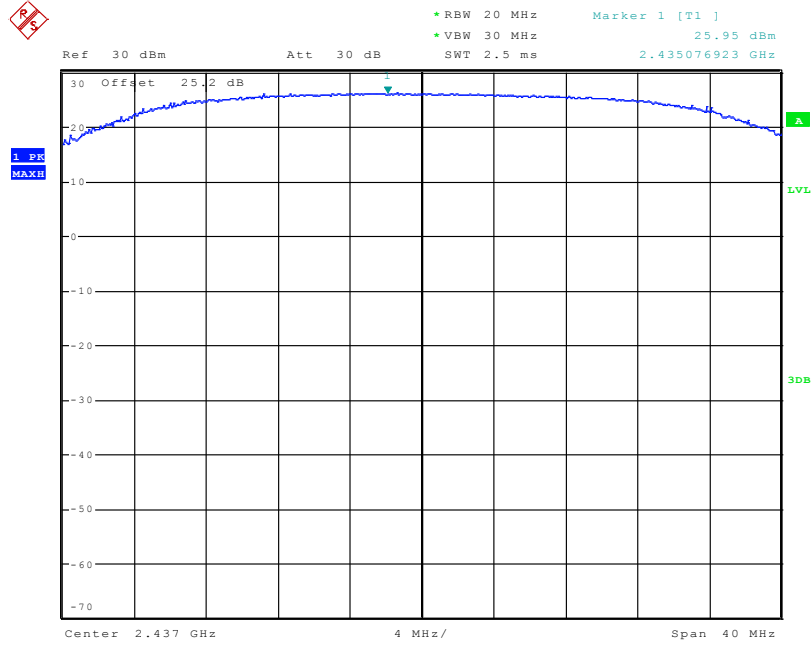
Date: 5.DEC.2011 09:56:44

### Conducted Peak Power 802.11g 2412 MHz



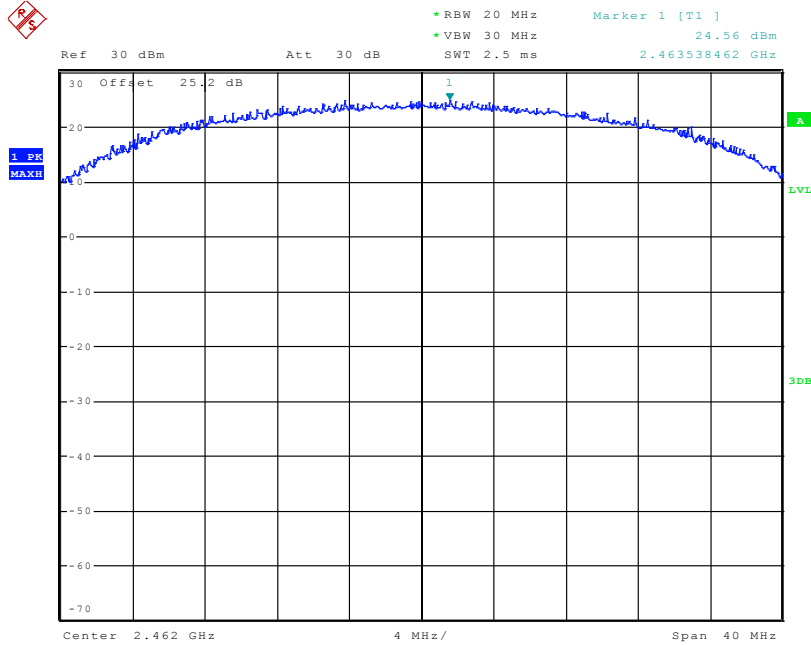
Date: 5.DEC.2011 09:57:50

### Conducted Peak Power 802.11g 2437 MHz



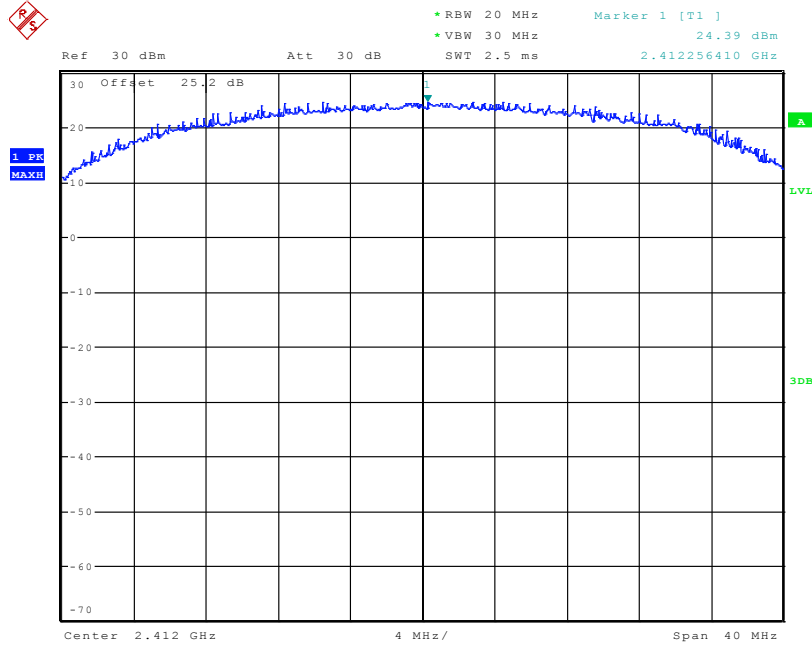
Date: 5.DEC.2011 09:58:51

### Conducted Peak Power 802.11g 2462 MHz



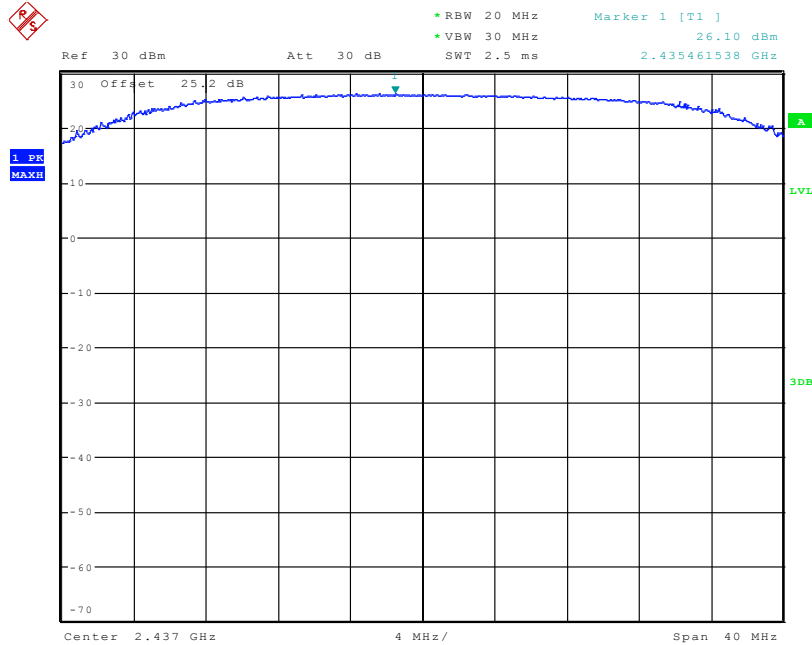
Date: 5.DEC.2011 09:59:33

### Conducted Peak Power 802.11n/HT20 2412 MHz



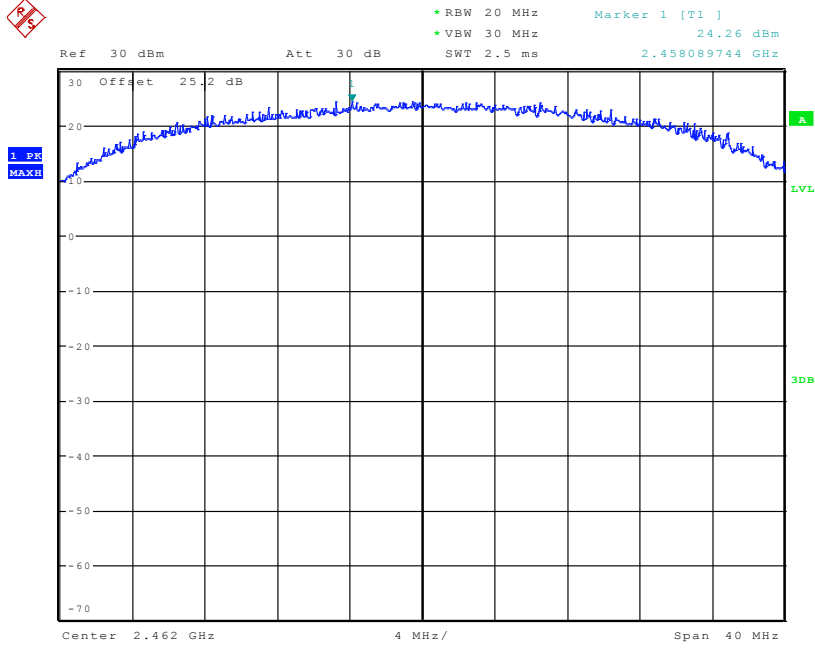
Date: 5.DEC.2011 10:00:30

### Conducted Peak Power 802.11n/HT20 2437 MHz



Date: 5.DEC.2011 10:01:40

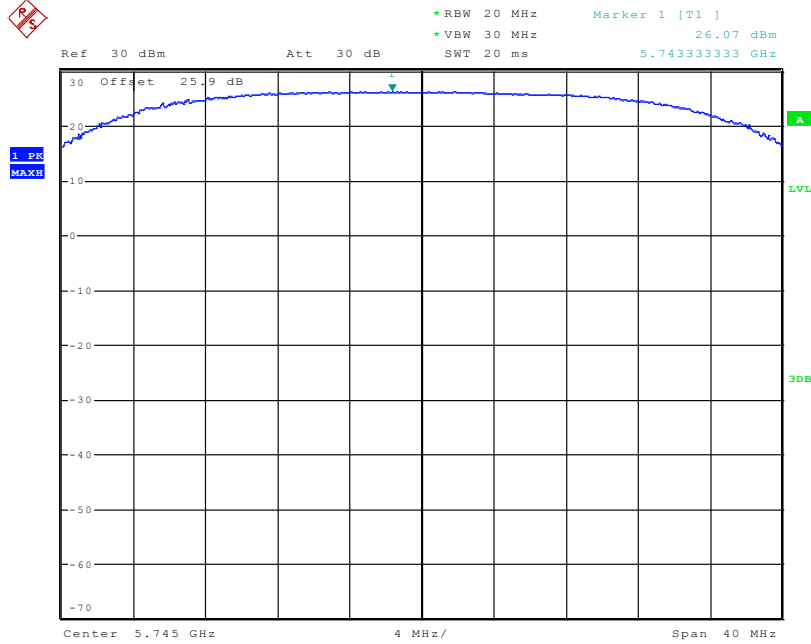
### Conducted Peak Power 802.11n/HT20 2462 MHz



Date: 5.DEC.2011 10:02:25

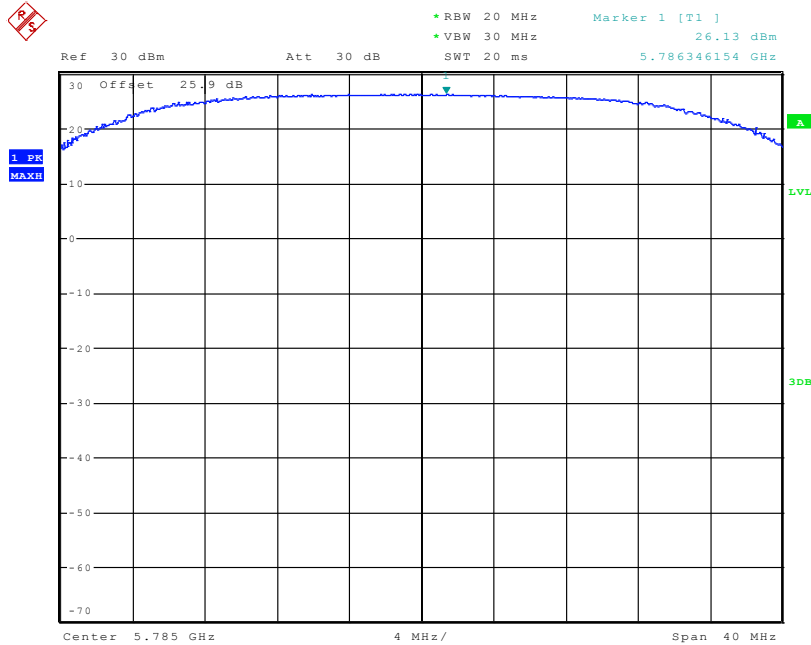
### 6.4.6 Test Data/plots: 5 GHz Band

#### Conducted Peak Power 802.11a 5745 MHz



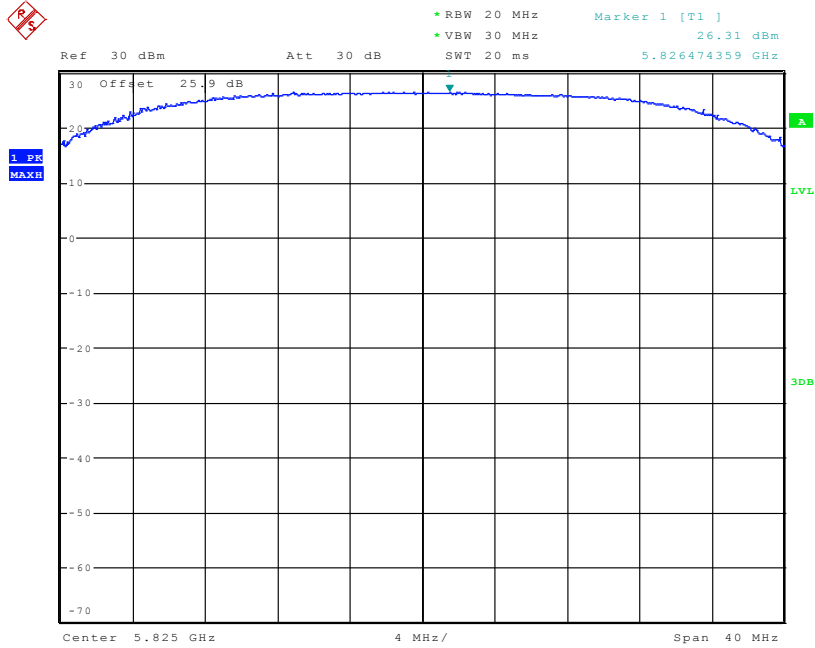
Date: 6.DEC.2011 09:19:06

#### Conducted Peak Power 802.11a 5785 MHz



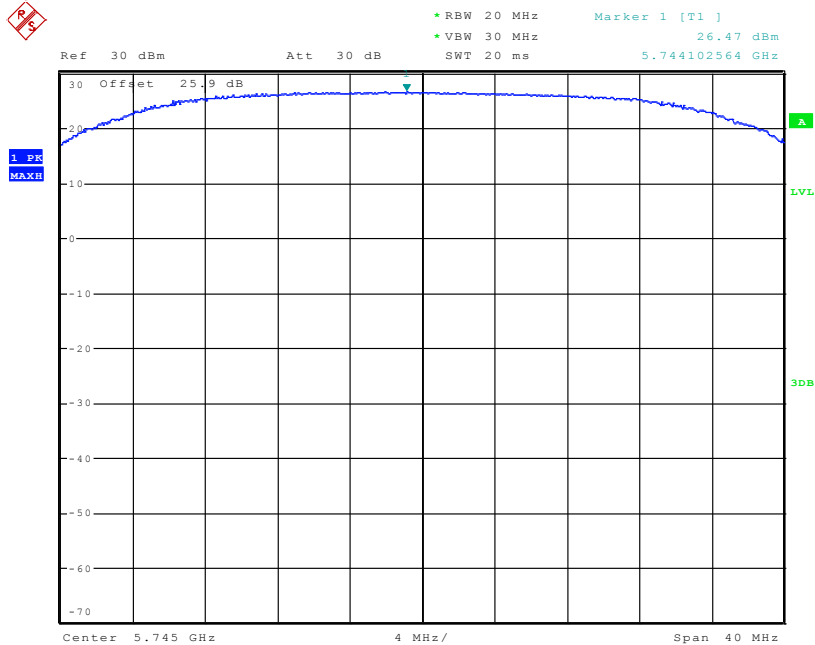
Date: 6.DEC.2011 09:47:18

### Conducted Peak Power 802.11a 5825 MHz



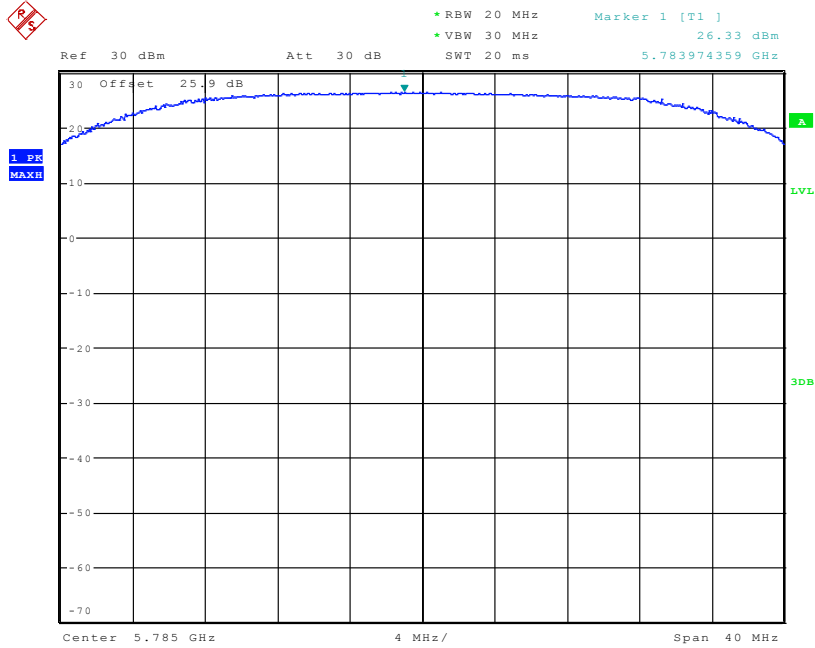
Date: 6.DEC.2011 10:09:48

### Conducted Peak Power 802.11n/HT20 5745 MHz



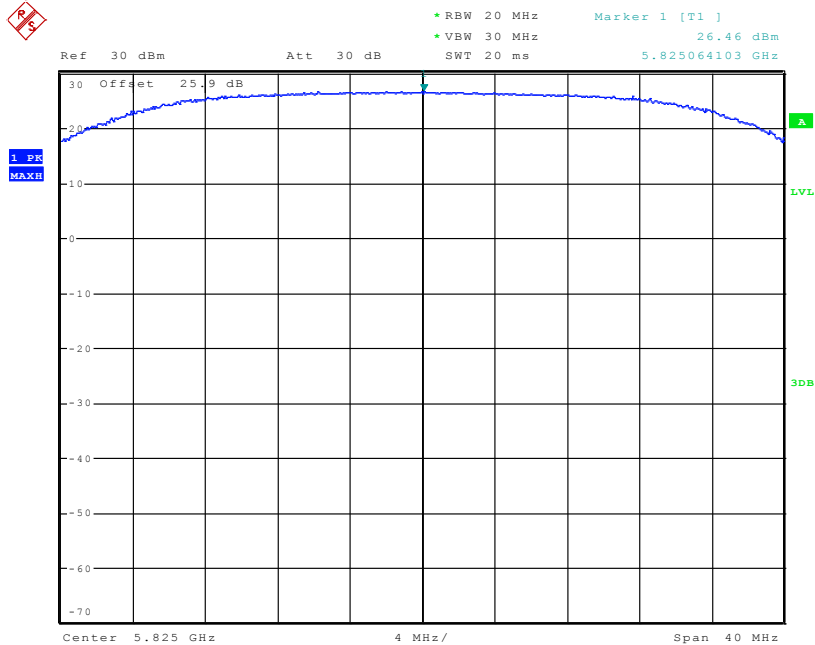
Date: 6.DEC.2011 10:29:36

### Conducted Peak Power 802.11n/HT20 5785 MHz



Date: 6.DEC.2011 10:44:36

### Conducted Peak Power 802.11n/HT20 5825 MHz



Date: 6.DEC.2011 10:58:11



**6.5 Restricted Band Edge Compliance**

**6.5.1 Limits: §15.247/15.205**

(a) Except as shown in paragraph (d) of this section, 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
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			

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

**6.5.2 Measurement Procedure:**

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

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

\*PEAK LIMIT= 74dBμV/m

\*AVG. LIMIT= 54dBμV/m

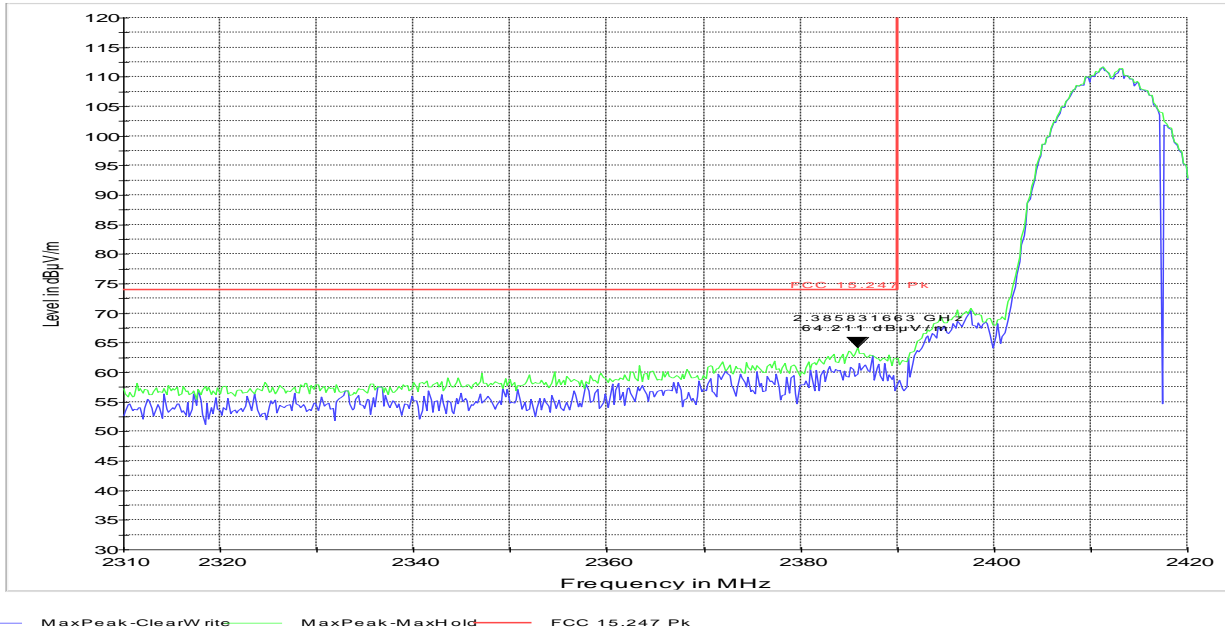
Measurement Uncertainty: ±3.0dB

**6.5.2.1 Measurement Result**

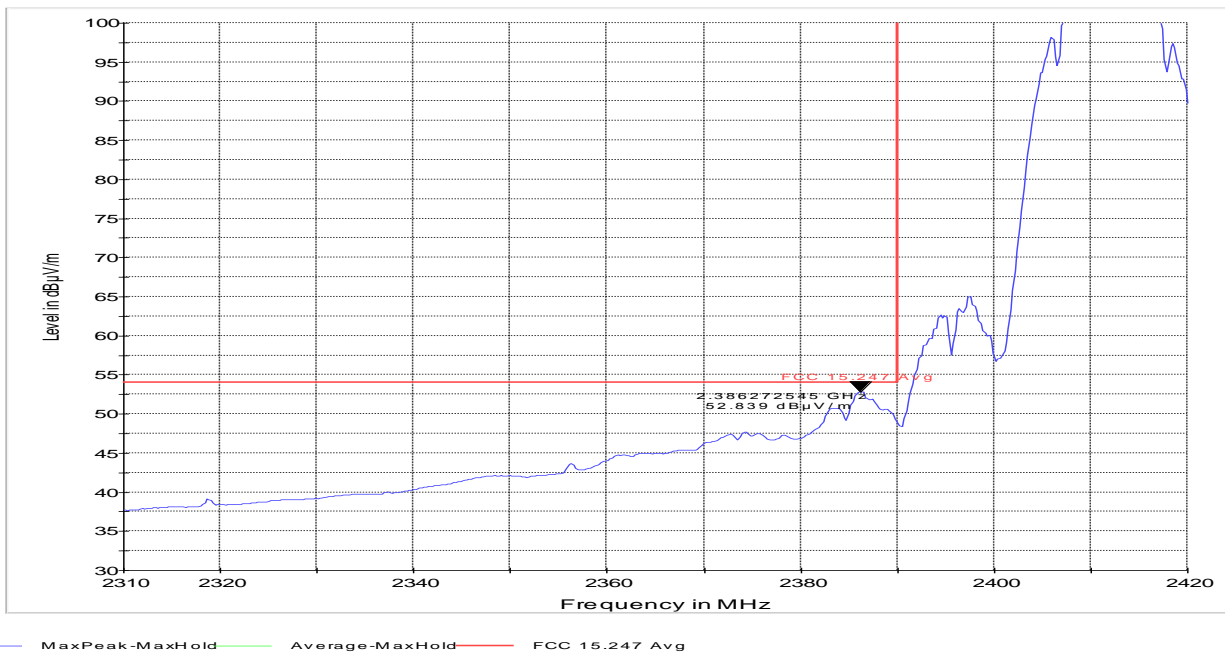
Pass.

### 6.5.3 Test Data/plots: 2.4 GHz Band

#### Lower band edge peak -802.11b mode

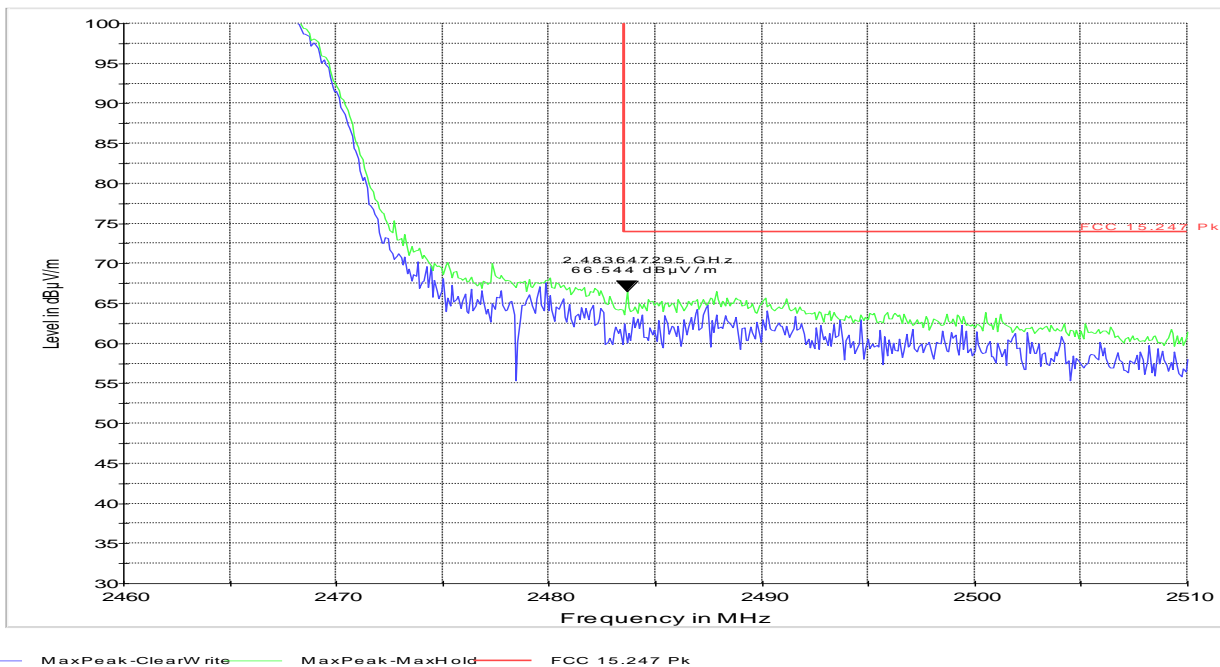


#### Lower band edge average -802.11b mode

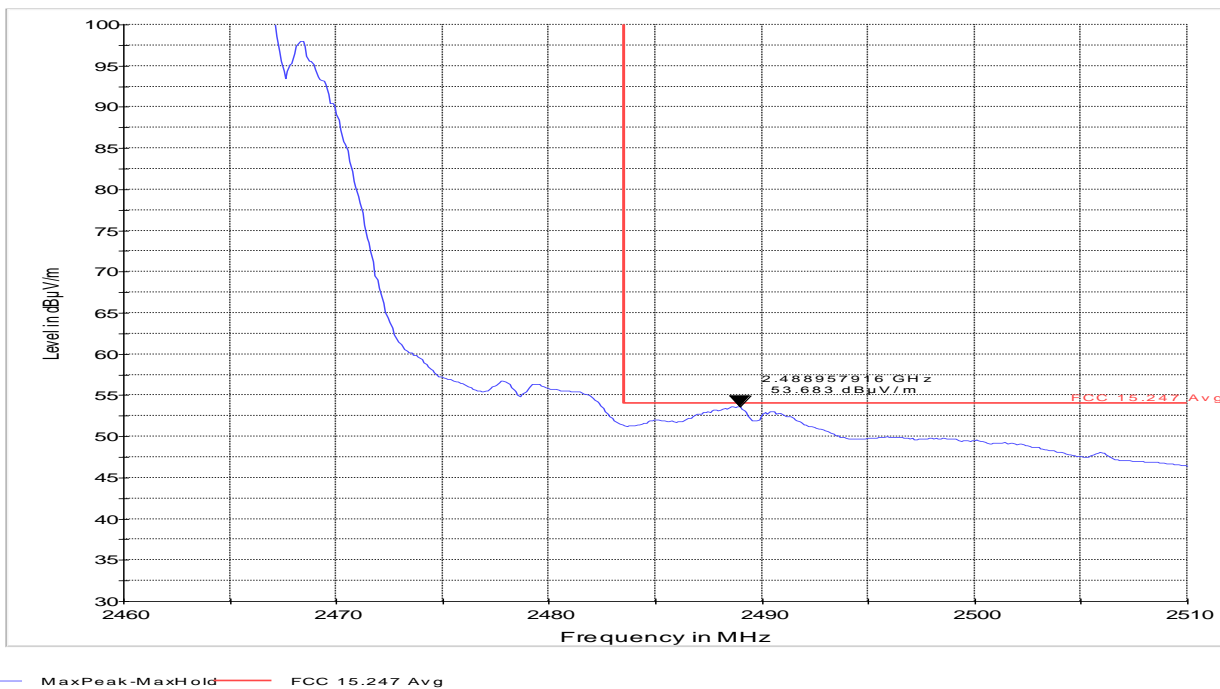


Note: Marker at 2.380 GHz – 52.83 dBµV/m

### Higher band edge peak -802.11b mode

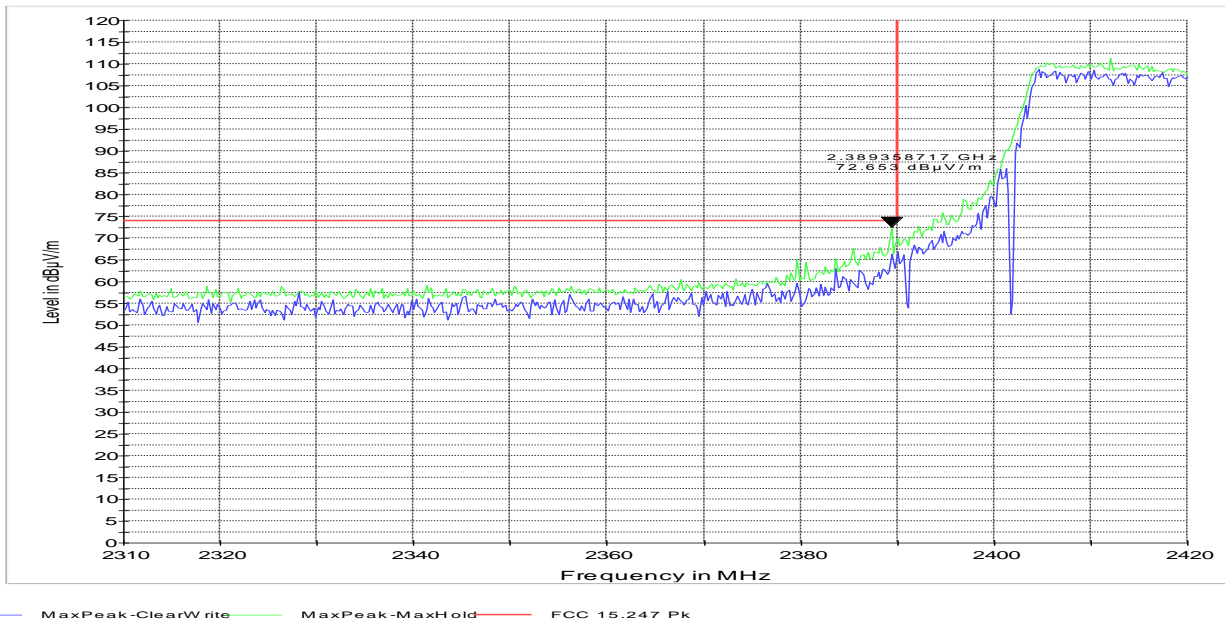


### Higher band edge average-802.11b mode



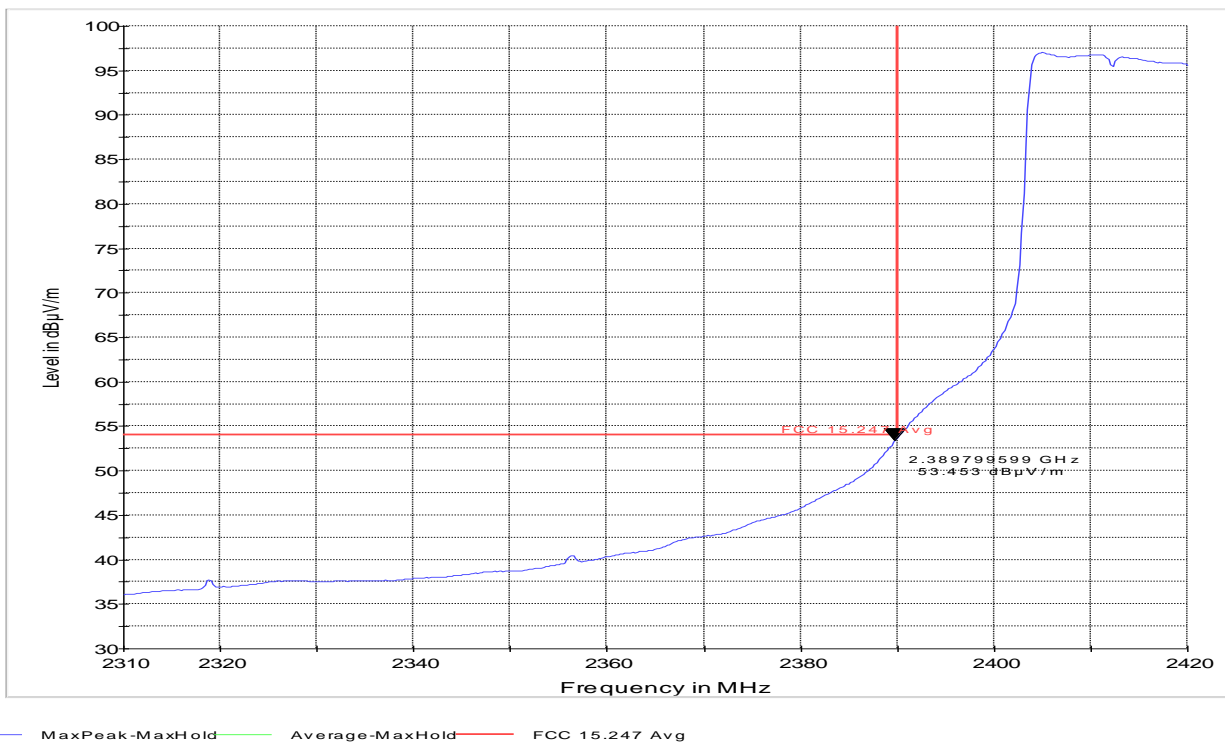
Note: Marker at 2.488 GHz – 53.68 dBµV/m

### Lower band edge peak – 802.11g mode



Note: Marker at 2.389 GHz – 72.65 dBµV/m

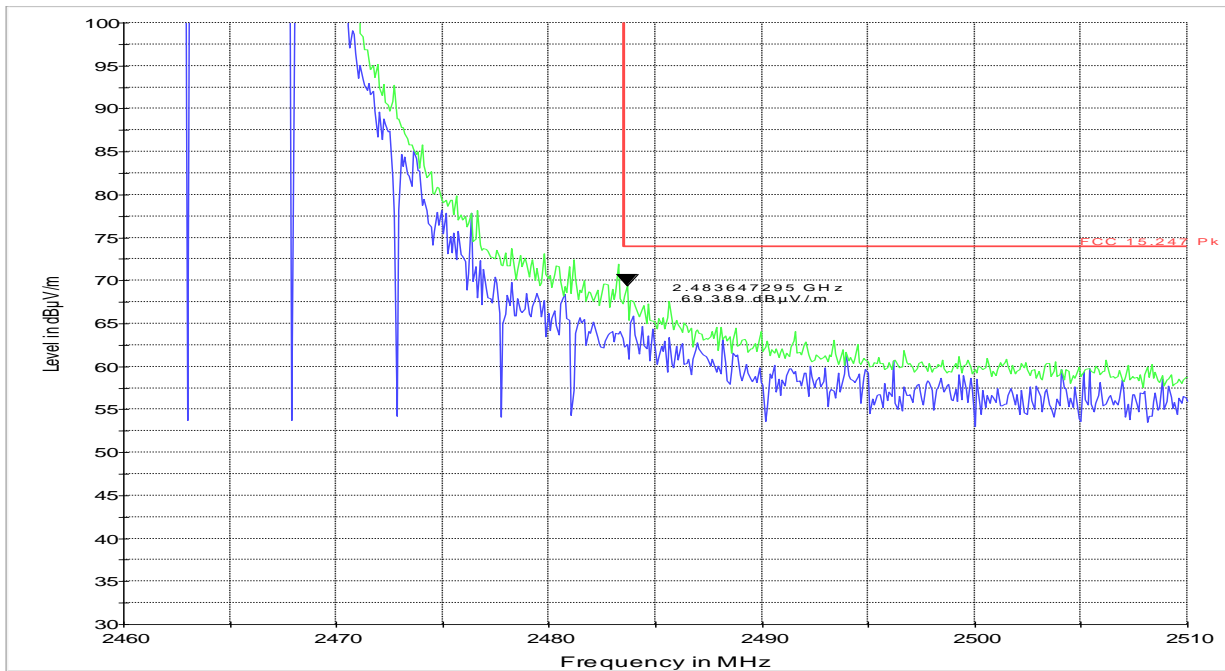
### Lower band edge average -802.11g mode



Note: Marker at 2.389 GHz – 53.45 dBµV/m

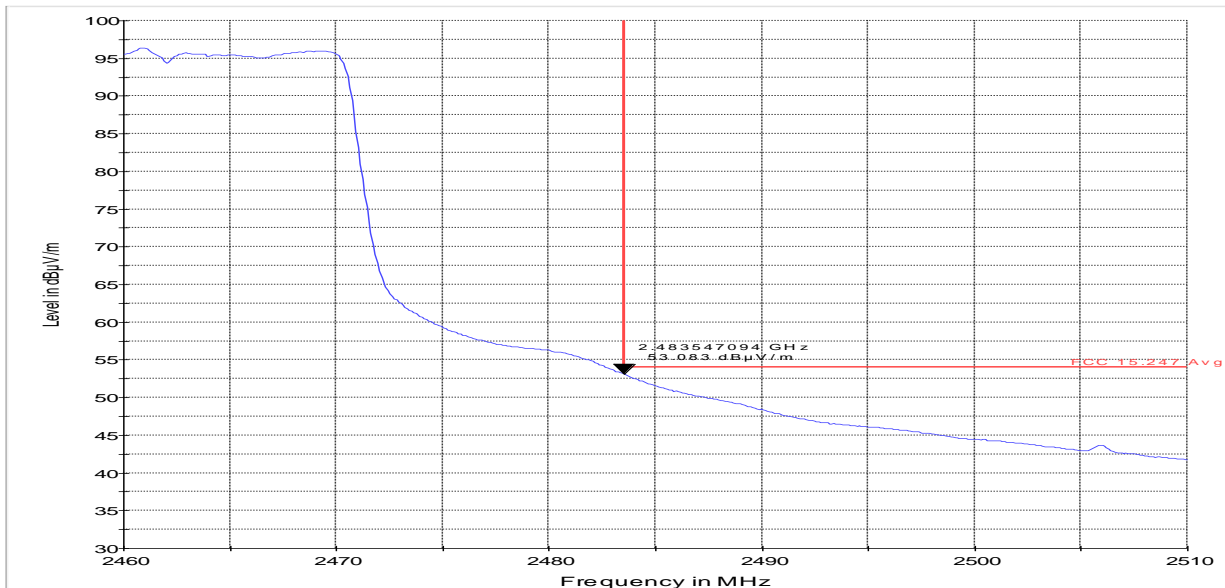


### Higher band edge peak -802.11g mode



MaxPeak-ClearWrite MaxPeak-MaxHold FCC 15.247 Pk

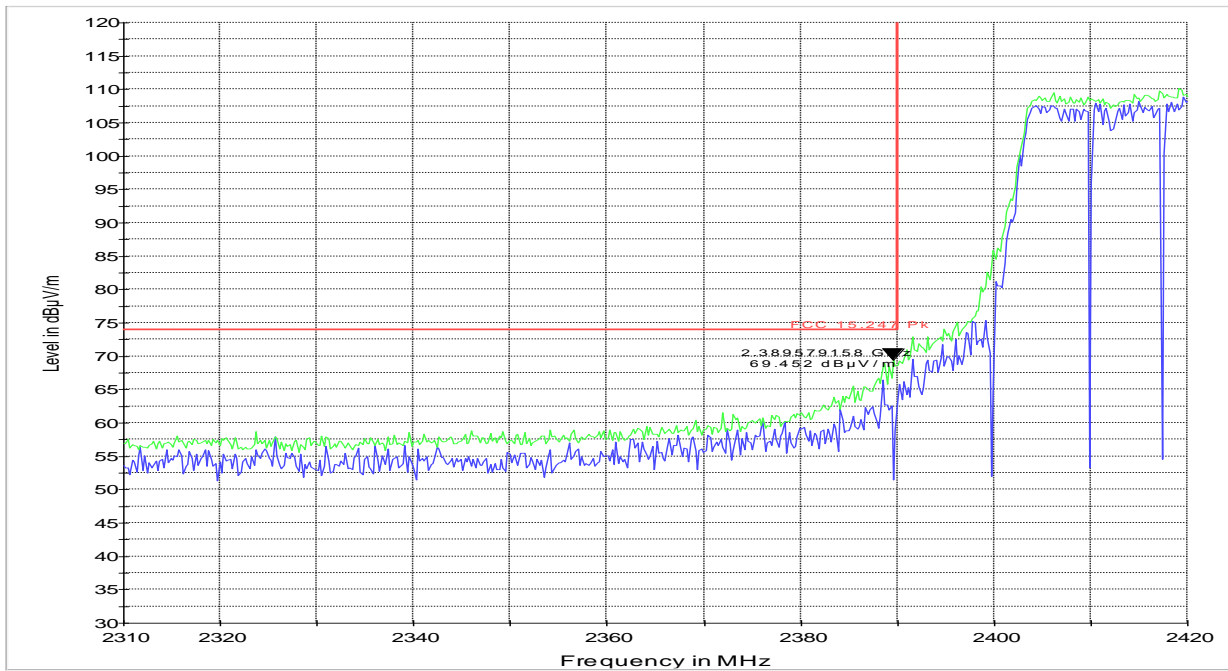
### Higher band edge average- 802.11g mode



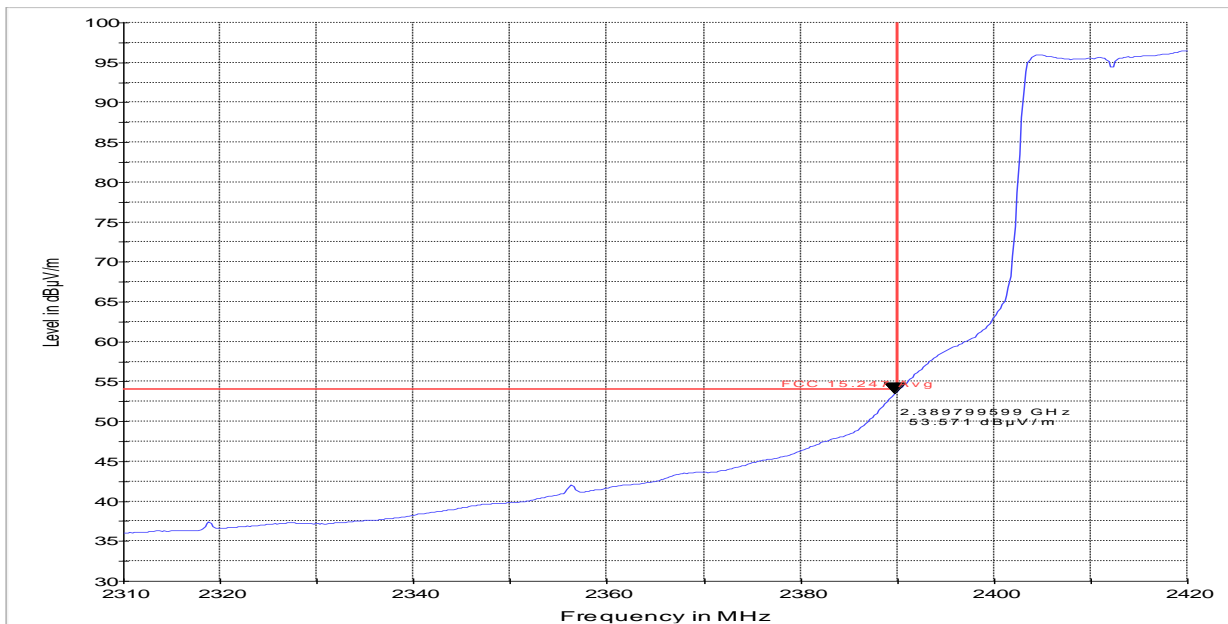
MaxPeak-MaxHold FCC 15.247 Avg

Note: Marker at 2.483 GHz – 53.08 dBµV/m

### Lower band edge peak – 802.11n/HT20 mode

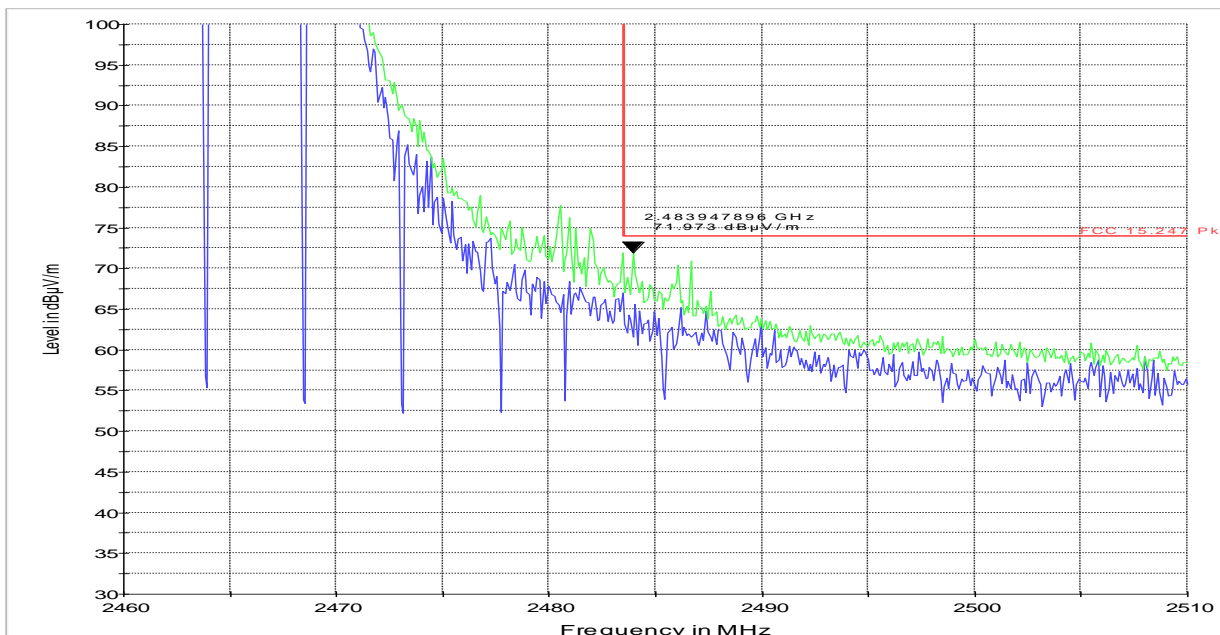


### Lower band edge average -802.11n/HT20 mode



Note: Marker at 2.389 GHz – 53.57 dBµV/m

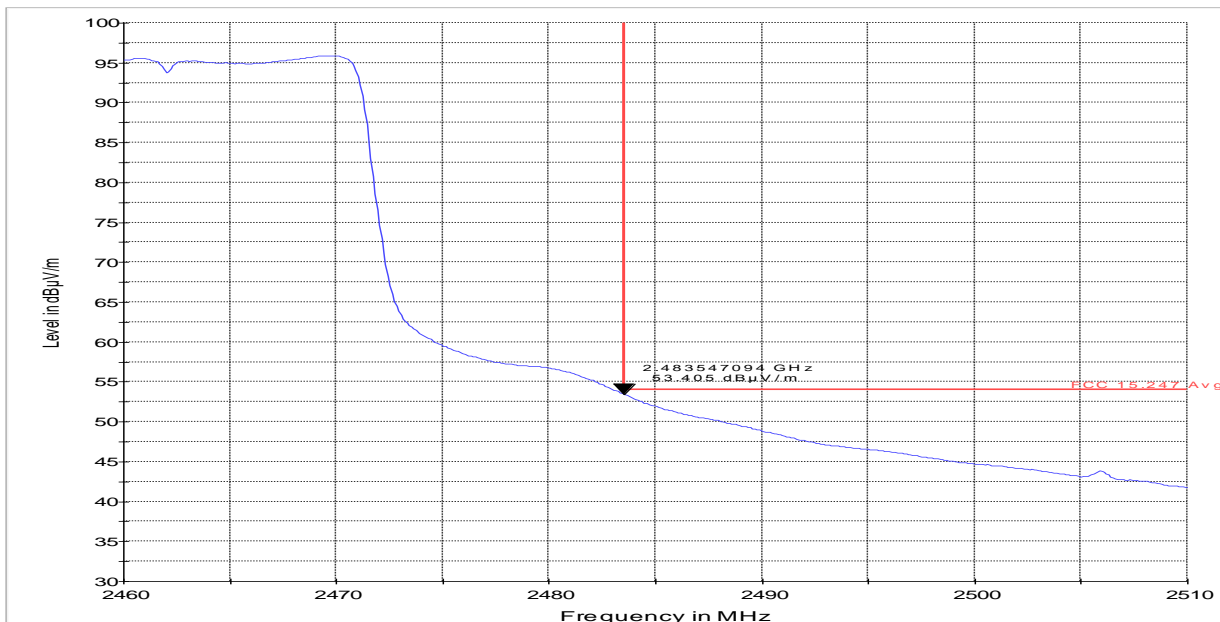
### Higher band edge peak - 802.11n/HT20 mode



MaxPeak-ClearWrite    MaxPeak-MaxHold    FCC 15.247 Pk

Note: Marker at 2.483 GHz – 71.97 dBµV/m

### Higher band edge average-802.11n/HT20 mode



MaxPeak-MaxHold    FCC 15.247 Avg

Note: Marker at 2.483 GHz – 53.40 dBµV/m

## **6.6 Occupied Bandwidth/ 20dB Bandwidth**

### **6.6.1 Limits:**

6.6.1.1 §15.247 (a)(2)

6.6.1.2 RSS 210- A8.2(a)

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### **6.6.2 Test Conditions:**

Tnom: 25°C; Vnom: 120 V

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

RBW=300kHz, VBW=300kHz, Detector: Peak- Max hold;

Sweep Time: Auto

Span=20MHz



**6.6.3 Test Result: 2.4 GHz Band**

Occupied Bandwidth (MHz)						
Mode	Frequency (MHz)					
	2412 Channel 1		2437 Channel 6		2462 Channel 11	
	6dB	20dB/ 99%	6dB	20dB/ 99%	6dB	20dB/ 99%
802.11b	9.535	14.022	9.535	14.262	9.054	13.862
802.11g	16.506	16.586	16.506	20.993	16.586	16.586
802.11n/HT20	17.708	17.788	17.708	22.275	17.788	17.708
Measurement Uncertainty: ±100 kHz						

6.6.3.1 Measurement Result

Pass.

**6.6.4 Test Result: 5 GHz Band**

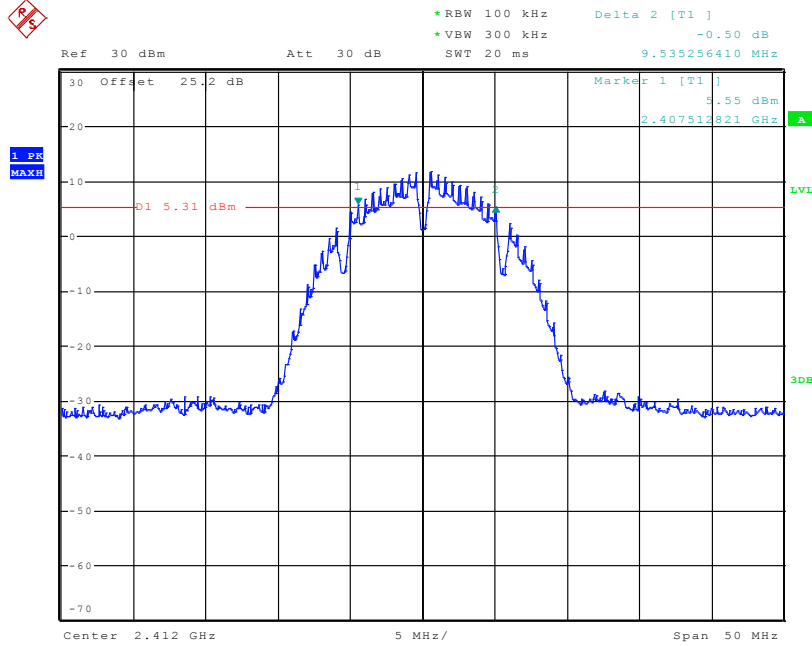
Occupied Bandwidth (MHz)						
Mode	Frequency (MHz)					
	5745 Channel 149		5785 Channel 157		5825 Channel 165	
	6dB	20dB/ 99%	6dB	20dB/ 99%	6dB	20dB/ 99%
802.11a	16.27	17.63	16.19	17.39	16.35	17.55
802.11n/HT20	17.63	18.11	17.47	18.11	17.55	18.27
Measurement Uncertainty: ±100 kHz						

6.6.4.1 Measurement Result

Pass.

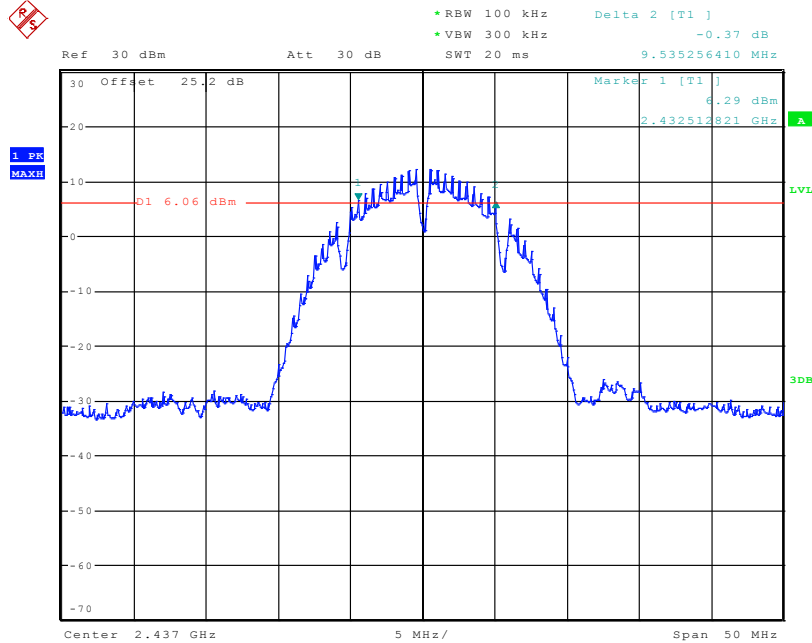
### 6.6.5 Test Data/plots: 2.4 GHz Band

#### 6dB Bandwidth 802.11b 2412 MHz



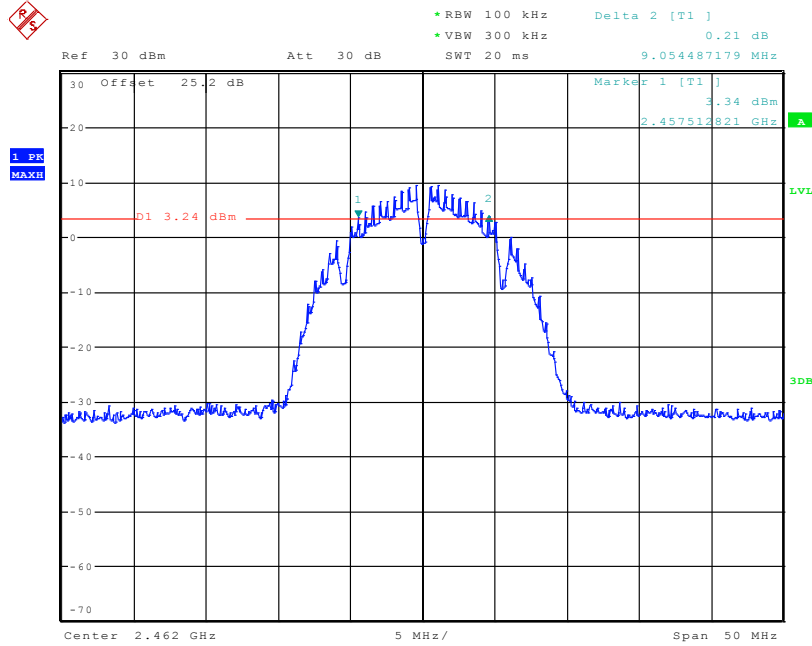
Date: 5.DEC.2011 10:55:17

#### 6dB Bandwidth 802.11b 2437 MHz



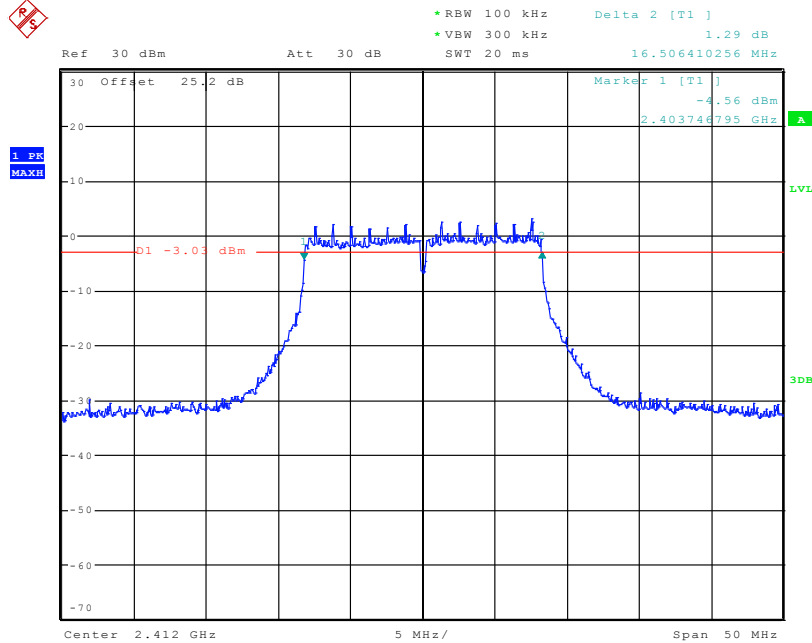
Date: 5.DEC.2011 10:59:37

### 6dB Bandwidth 802.11b 2462 MHz



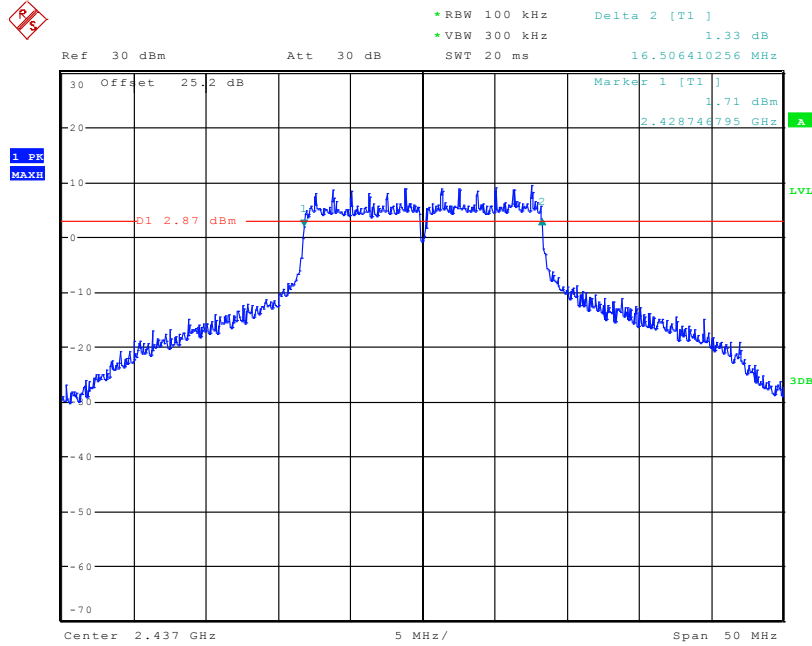
Date: 5.DEC.2011 11:01:08

### 6dB Bandwidth 802.11g 2412 MHz



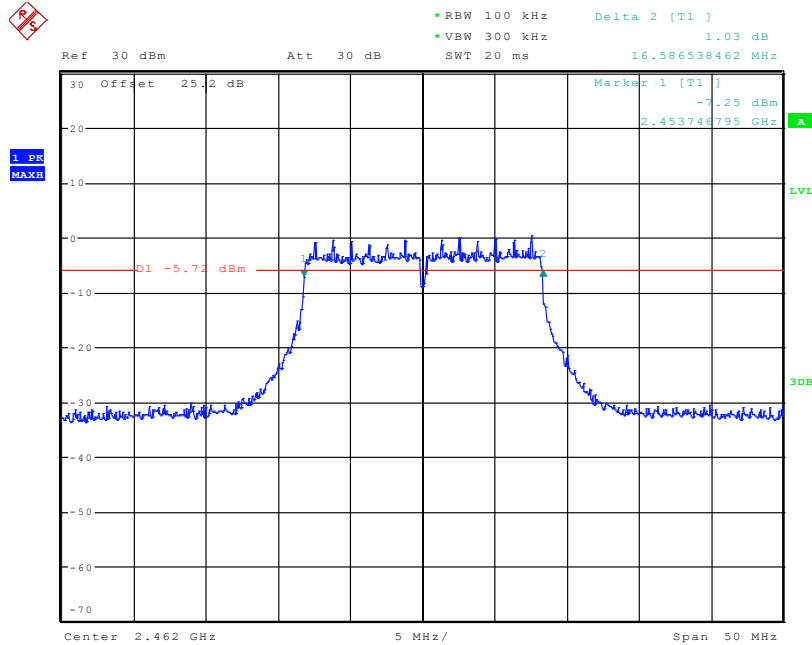
Date: 5.DEC.2011 11:03:58

### 6dB Bandwidth 802.11g 2437 MHz



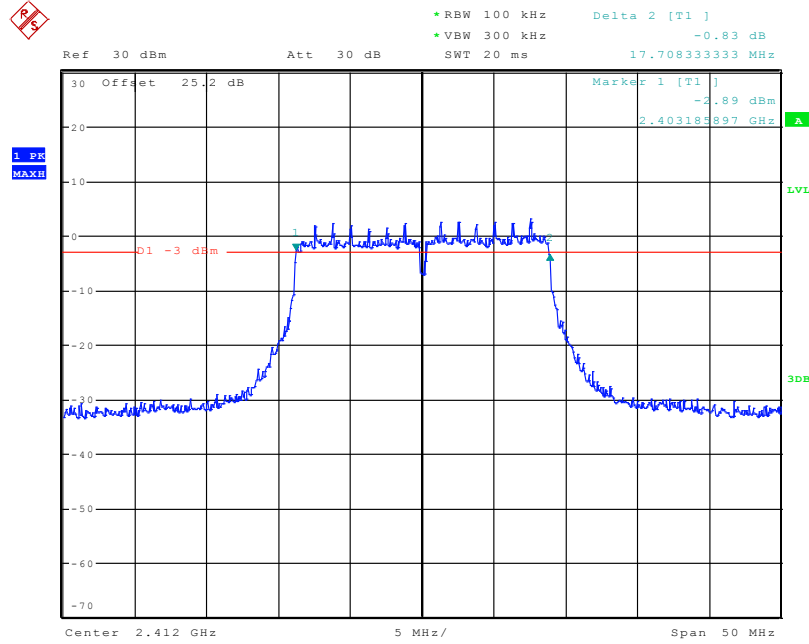
Date: 5.DEC.2011 11:07:48

### 6dB Bandwidth 802.11g 2462 MHz



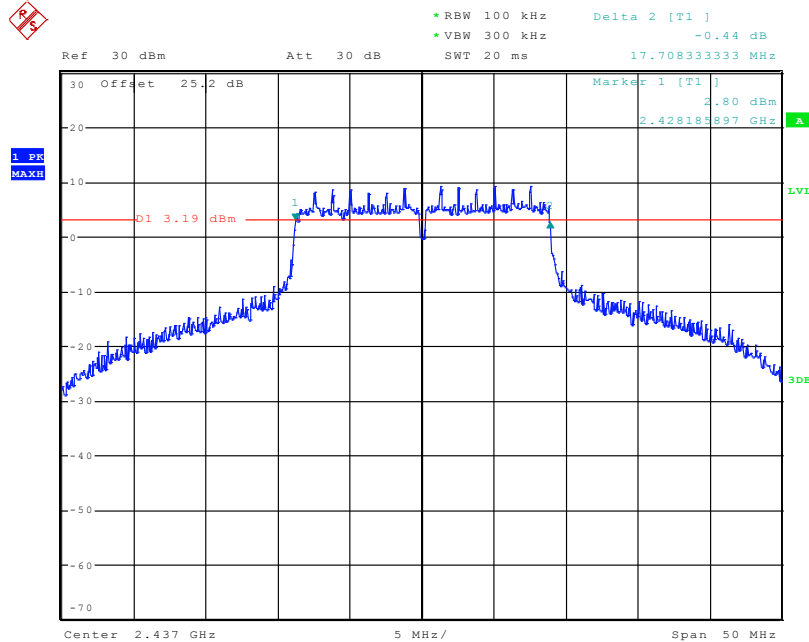
Date: 5.DEC.2011 11:09:26

### 6dB Bandwidth 802.11n/HT20 2412 MHz



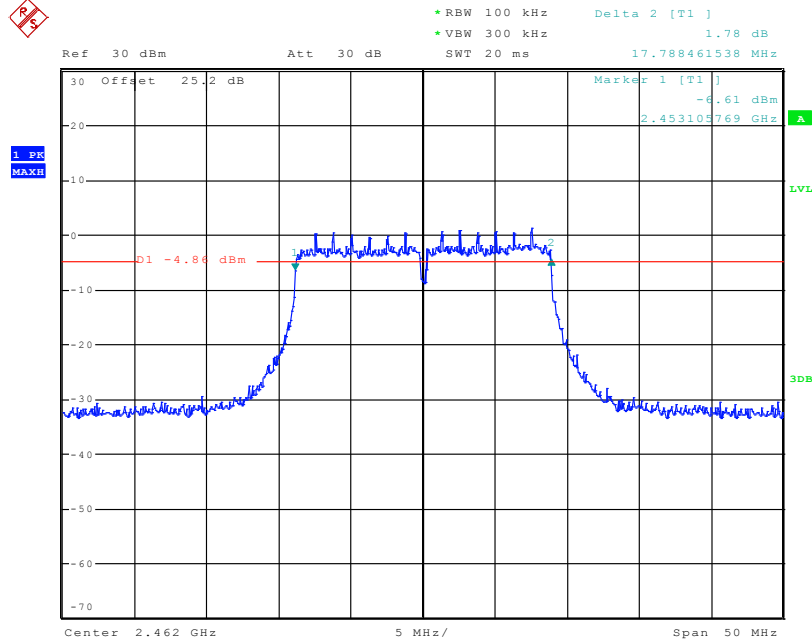
Date: 5.DEC.2011 11:13:34

### 6dB Bandwidth 802.11n/HT20 2437 MHz



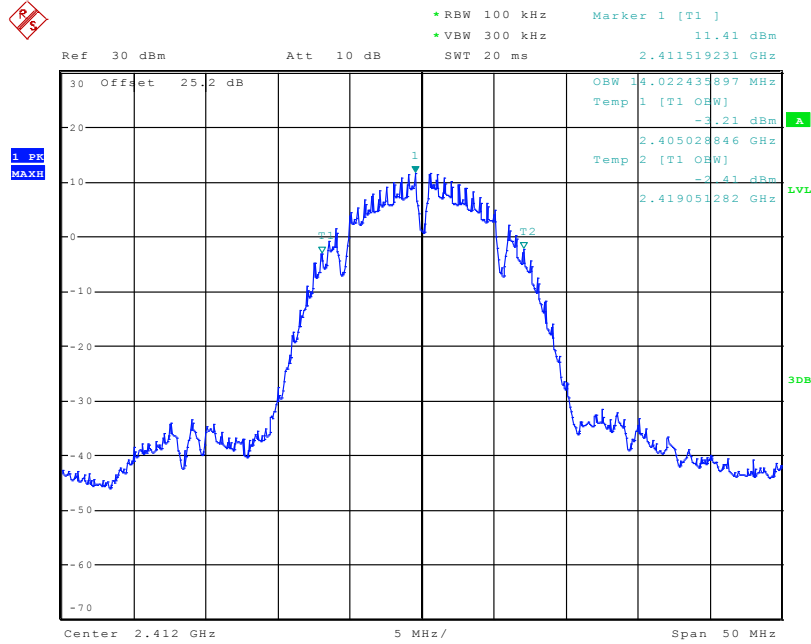
Date: 5.DEC.2011 11:14:57

### 6dB Bandwidth 802.11n/HT20 2462 MHz



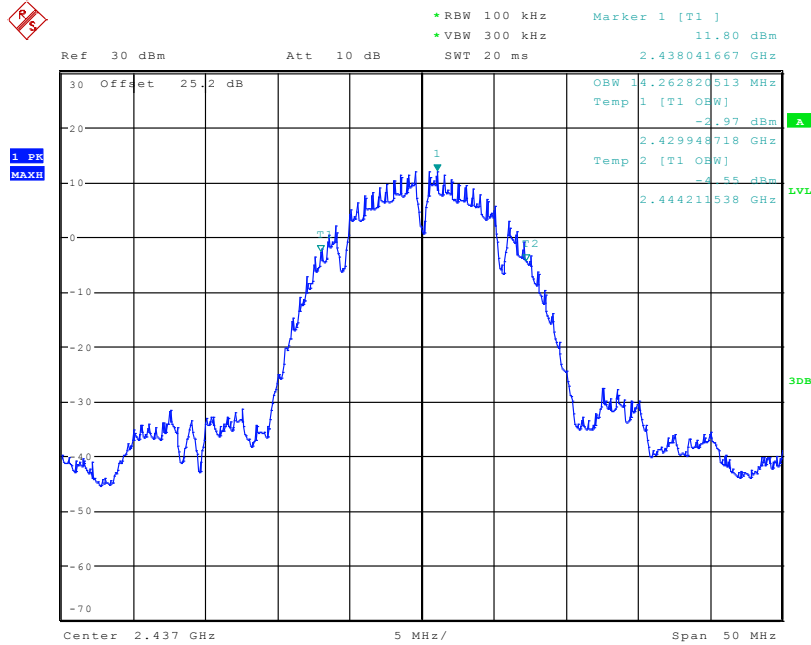
Date: 5.DEC.2011 11:18:18

### 20dB Bandwidth 802.11b 2412 MHz



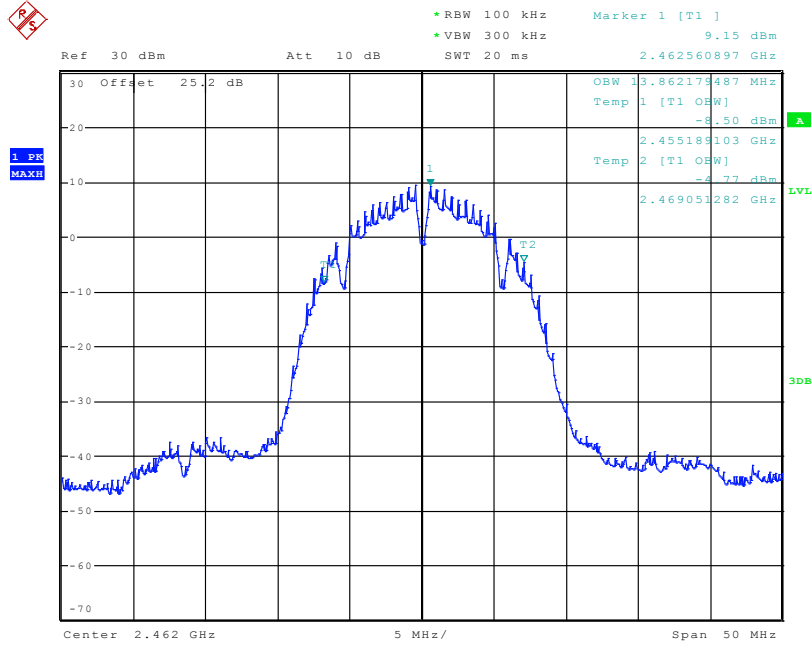
Date: 5.DEC.2011 10:57:15

### 20dB Bandwidth 802.11b 2437 MHz



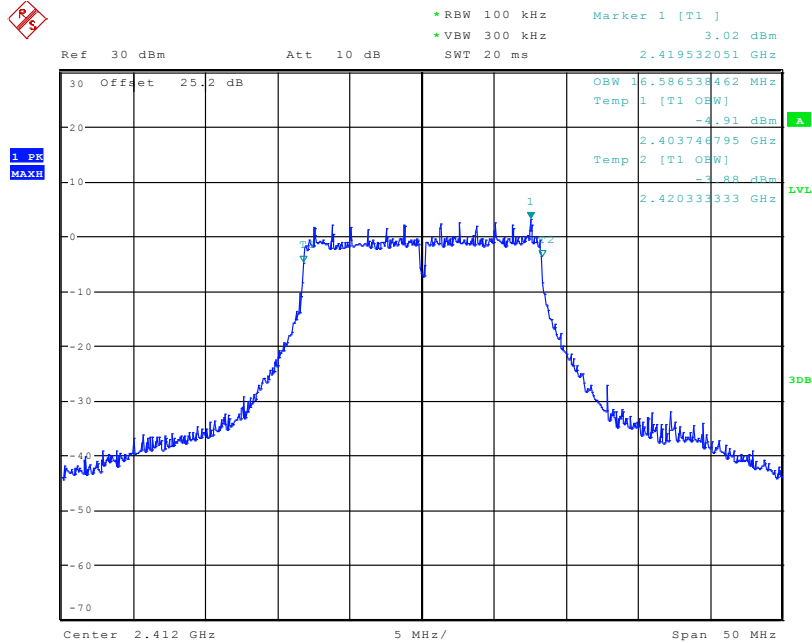
Date: 5.DEC.2011 10:58:08

### 20dB Bandwidth 802.11b 2462 MHz



Date: 5.DEC.2011 11:02:08

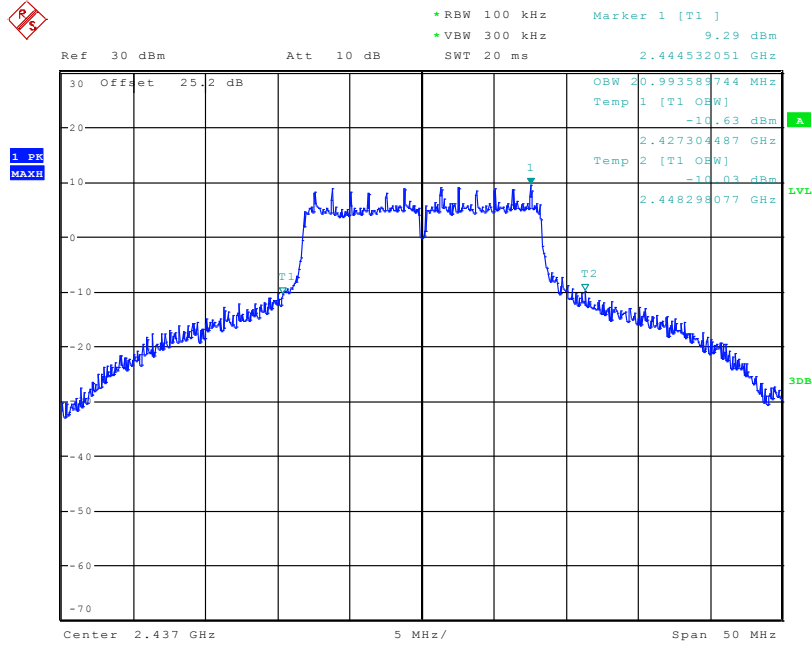
### 20dB Bandwidth 802.11g 2412 MHz



Date: 5.DEC.2011 11:04:58

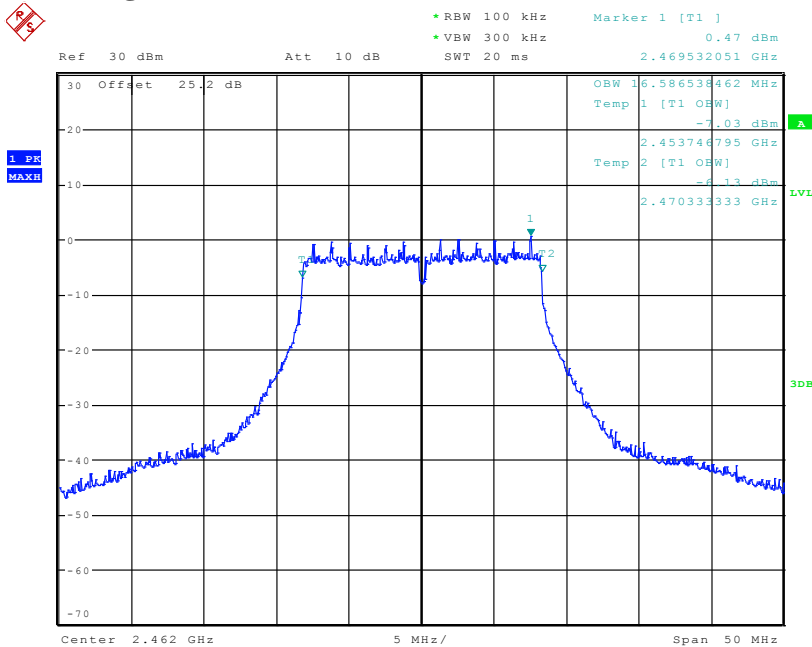


### 20dB Bandwidth 802.11g 2437 MHz



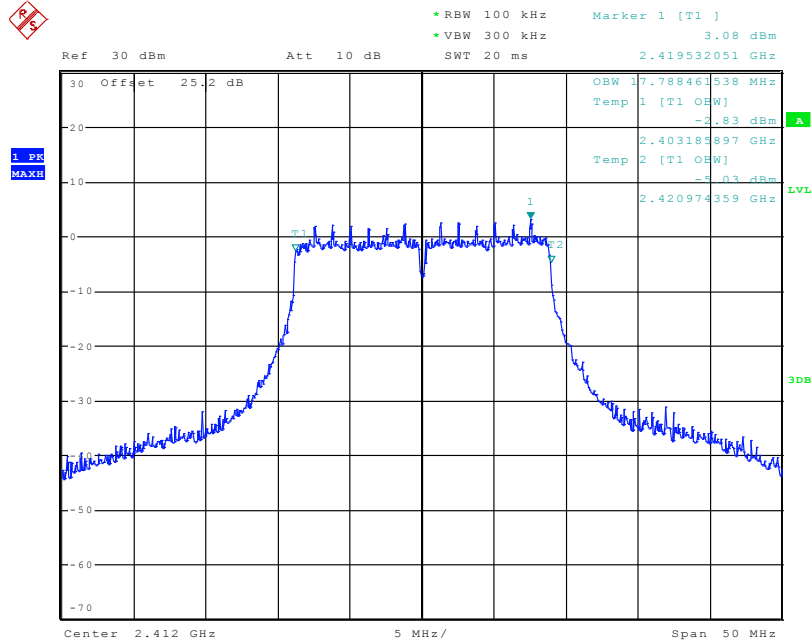
Date: 5.DEC.2011 11:06:10

### 20dB Bandwidth 802.11g 2462 MHz



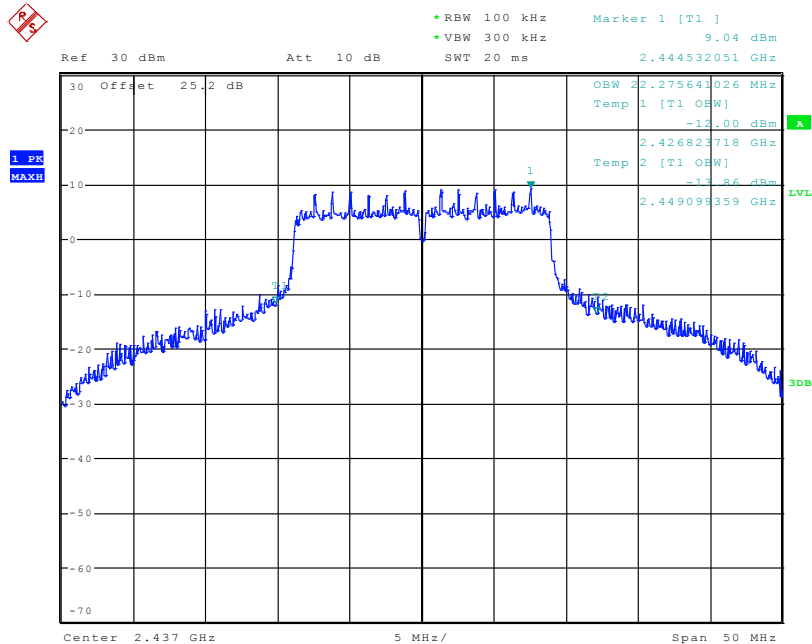
Date: 5.DEC.2011 11:10:35

### 20dB Bandwidth 802.11n/HT20 2412 MHz



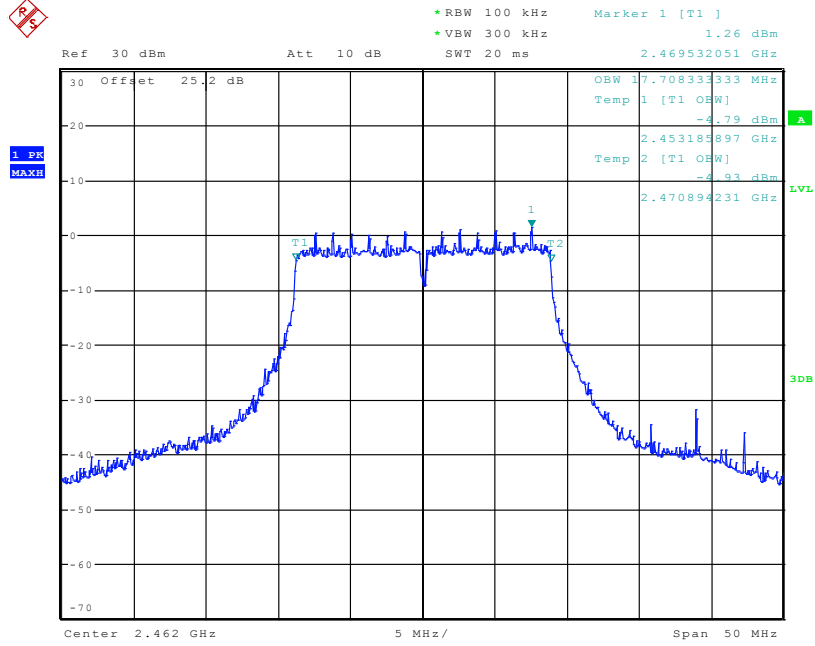
Date: 5.DEC.2011 11:12:22

### 20dB Bandwidth 802.11n/HT20 2437 MHz



Date: 5.DEC.2011 11:15:47

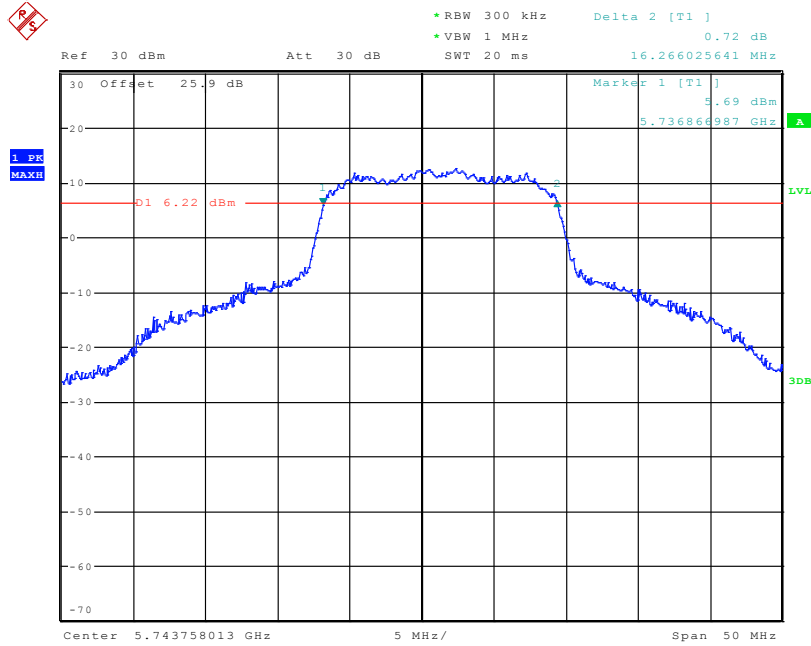
### 20dB Bandwidth 802.11n/HT20 2462 MHz



Date: 5.DEC.2011 11:17:01

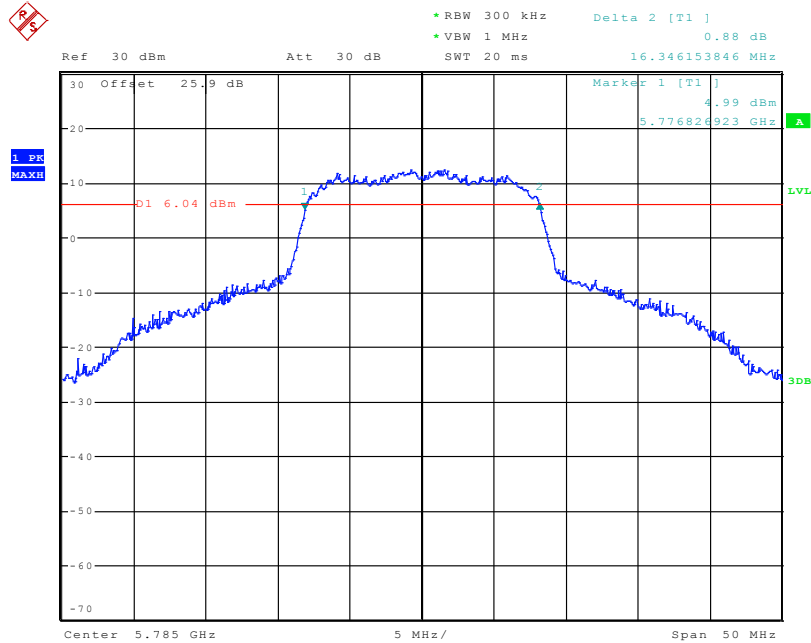
### 6.6.6 Test Data/plots: 5 GHz Band

#### 6dB Bandwidth 802.11a 5745 MHz



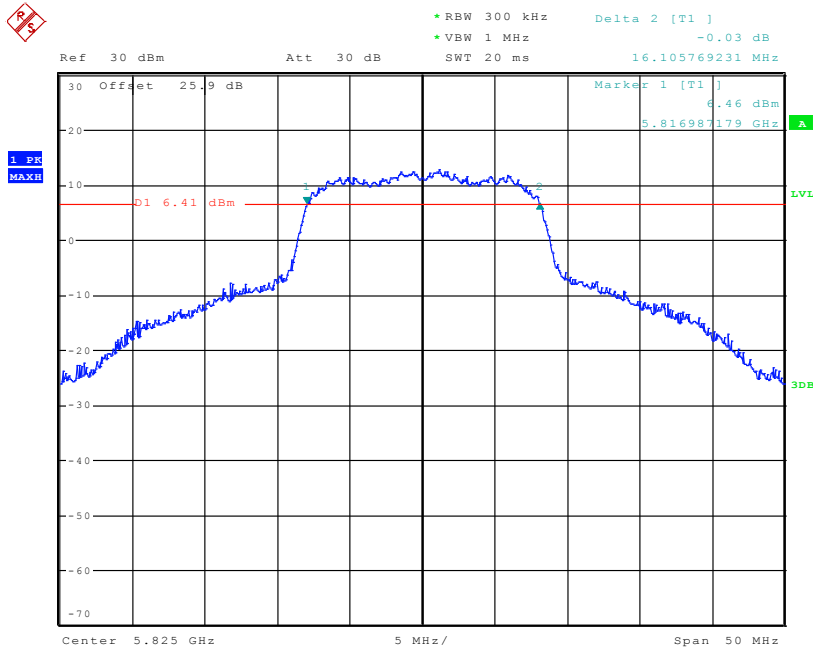
Date: 5.DEC.2011 14:57:40

#### 6dB Bandwidth 802.11a 5785 MHz



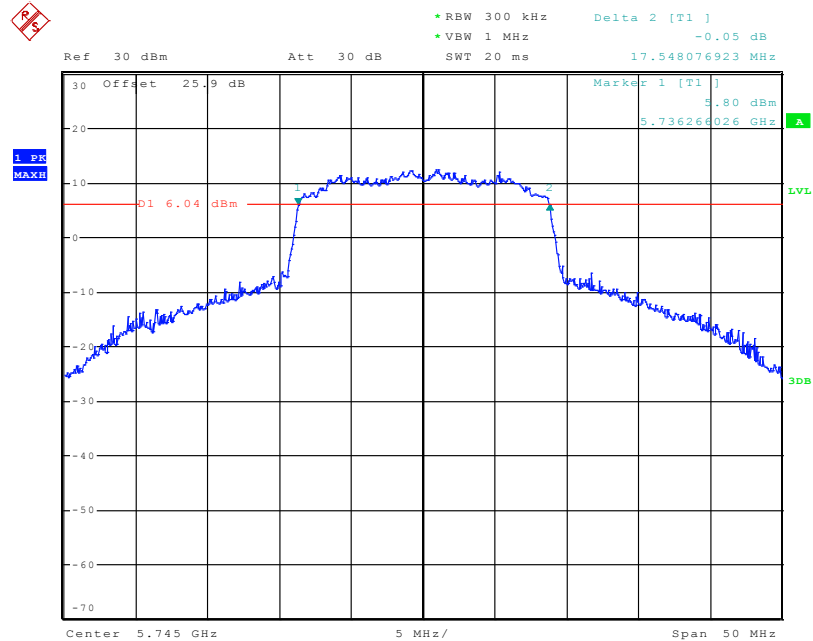
Date: 5.DEC.2011 15:51:31

### 6dB Bandwidth 802.11a 5825 MHz



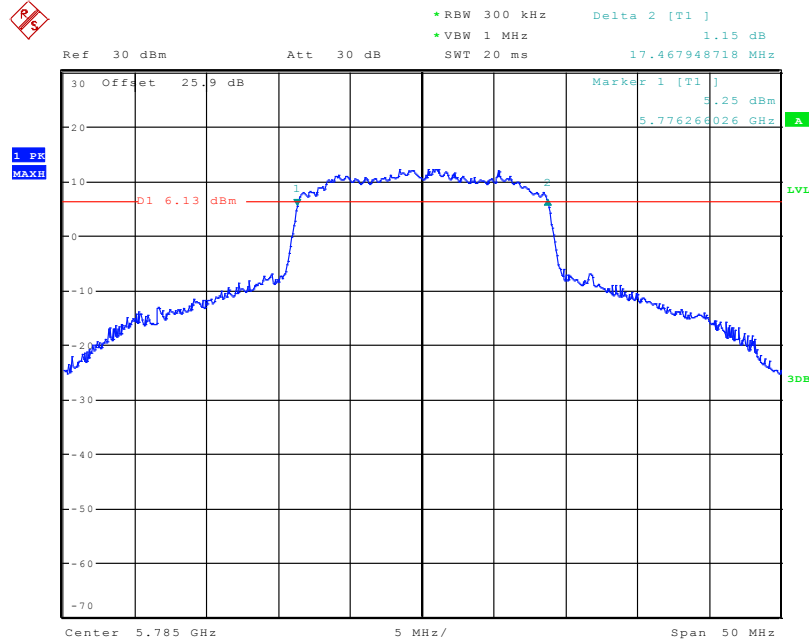
Date: 5.DEC.2011 16:03:25

### 6dB Bandwidth 802.11n/HT20 5745 MHz



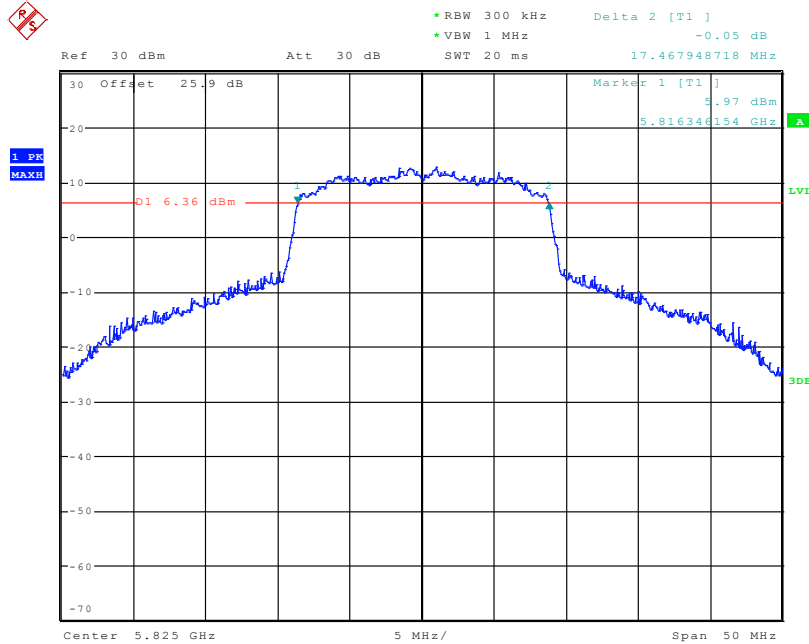
Date: 5.DEC.2011 16:15:10

### 6dB Bandwidth 802.11n/HT20 5785 MHz



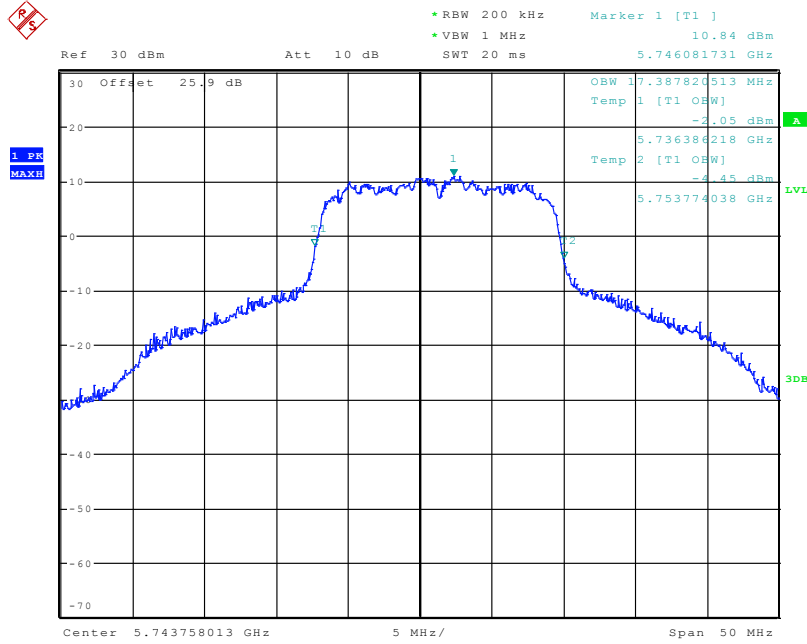
Date: 5.DEC.2011 16:27:09

### 6dB Bandwidth 802.11n/HT20 5825 MHz



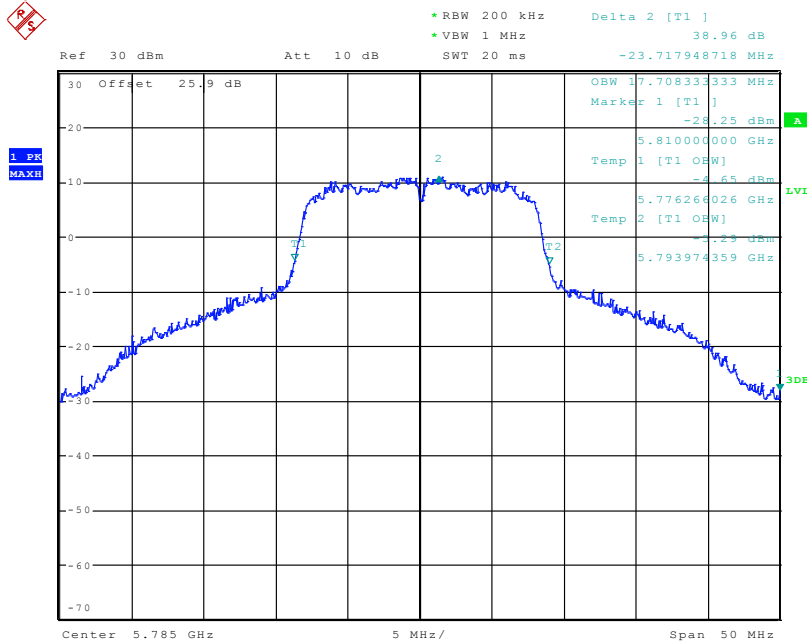
Date: 5.DEC.2011 16:36:59

### 20dB Bandwidth 802.11a 5745 MHz



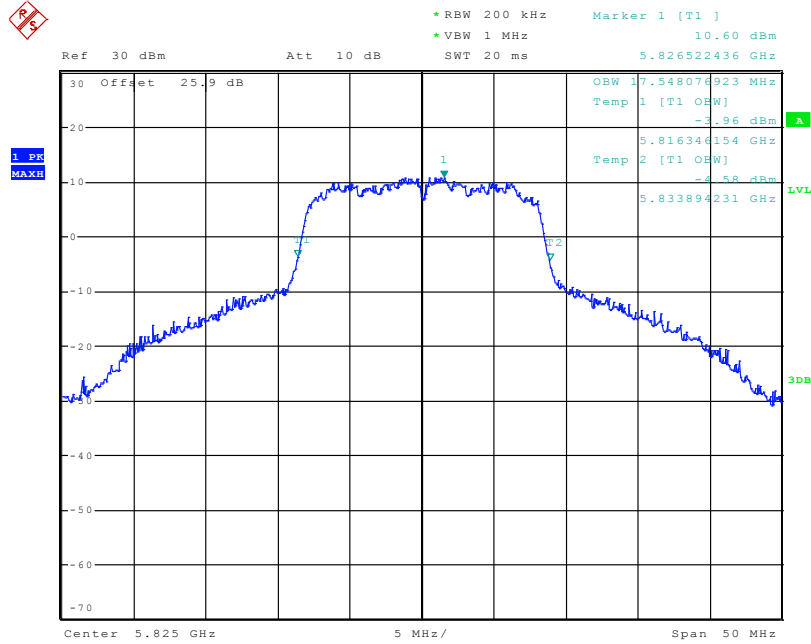
Date: 5.DEC.2011 15:01:46

### 20dB Bandwidth 802.11a 5785 MHz



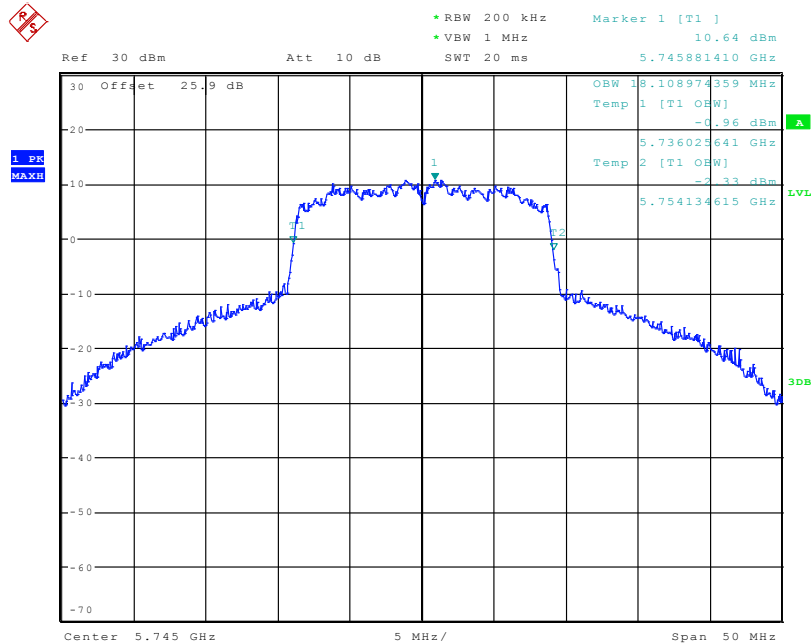
Date: 6.DEC.2011 11:14:54

### 20dB Bandwidth 802.11a 5825 MHz



Date: 5.DEC.2011 16:04:48

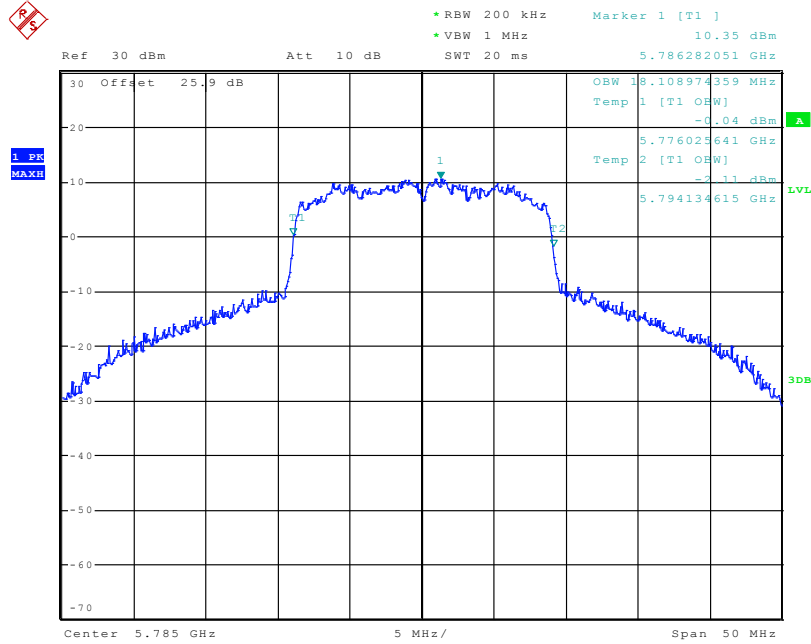
### 20dB Bandwidth 802.11n/HT20 5745 MHz



Date: 5.DEC.2011 16:16:23

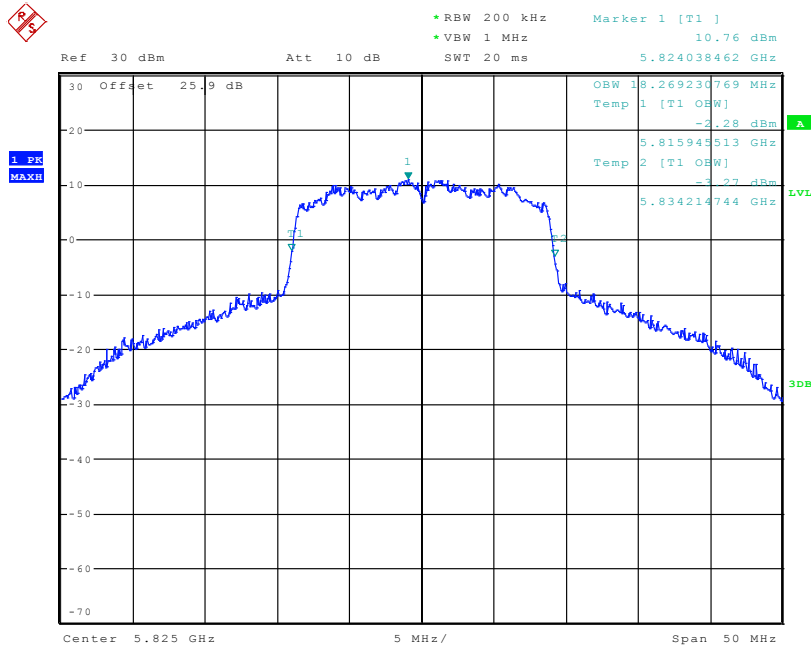


### 20dB Bandwidth 802.11n/HT20 5785 MHz



Date: 5.DEC.2011 16:28:20

### 20dB Bandwidth 802.11n/HT20 5825 MHz



Date: 5.DEC.2011 16:38:39

## 6.7 Power Spectral Density

### 6.7.1 Limits:

6.7.1.1 § 15.247 (e)

6.7.1.2 RSS 210- A8.2(b)

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

### 6.7.2 Measurement procedure:

1. Determine the highest peak level for a sweep with RBW=VBW=100kHz and span =10MHz.
2. Set the peak level at the center of the screen and sweep again for a span of 5MHz.
3. Repeat step 2 with a span of 1MHz.
4. Set the peak level at the center of the screen and sweep with RBW=3kHz, VBW=10kHz, Span=300kHz and sweep time of 100sec.
5. Allow two sweeps to complete to determine the highest level as the PSD.

### 6.7.3 Test results: 2.4 GHz

Conducted Power Spectral Density (dBm)			
Mode	Frequency (MHz)		
	2412 Channel 1	2437 Channel 6	2462 Channel 11
802.11b	-1.77	-1.37	-3.45
802.11g	-10.10	-4.46	-12.56
802.11n	-9.35	-4.25	-12.60

#### 6.7.3.1 Measurement Result

Pass.

**6.7.4 Test results: 5 GHz**

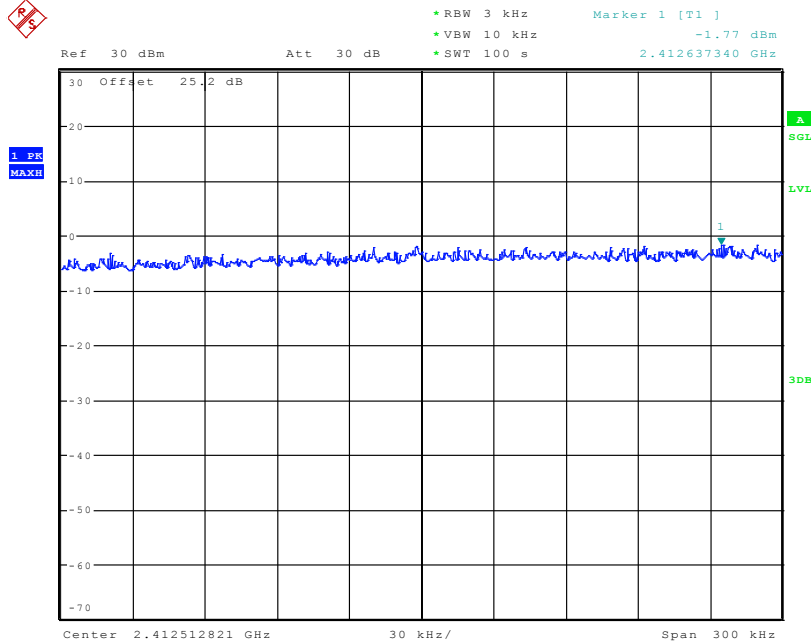
<b>Conducted Power Spectral Density (dBm)</b>			
<b>Mode</b>	<b>Frequency (MHz)</b>		
	<b>5745 Channel 149</b>	<b>5785 Channel 157</b>	<b>5825 Channel 165</b>
<b>802.11a</b>	-3.73	-4.65	-3.83
<b>802.11n</b>	-2.80	-4.24	-2.76

**6.7.4.1 Measurement Result**

Pass.

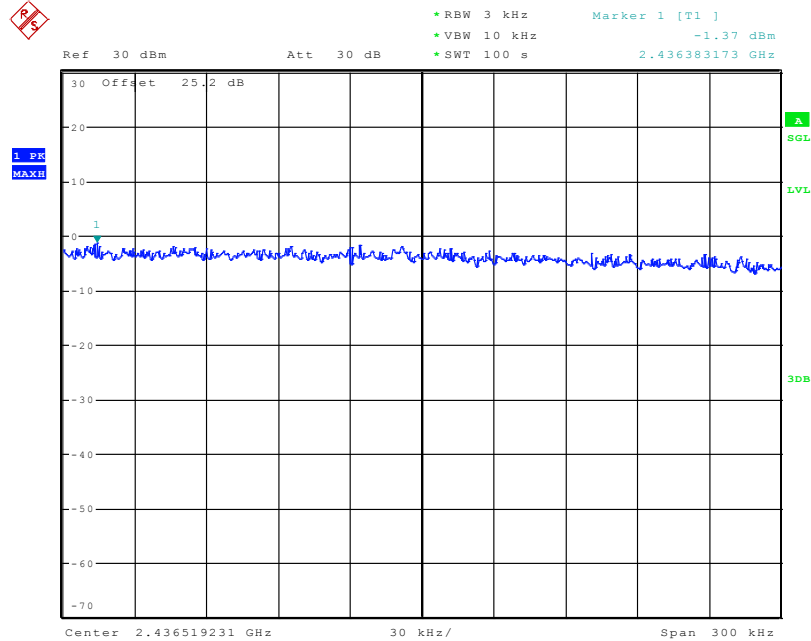
### 6.7.5 Test Data/plots: 2.4 GHz Band

#### Power Spectral Density 802.11b 2412 MHz



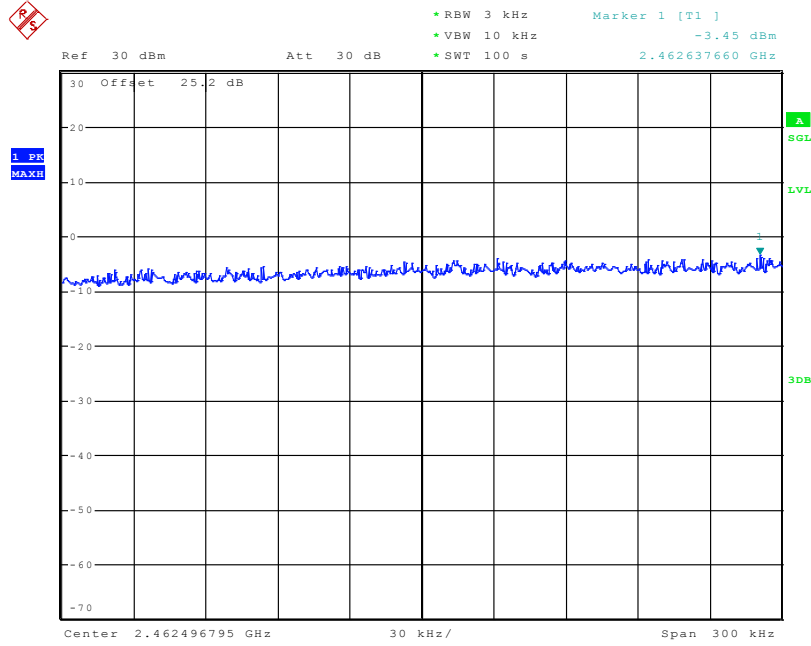
Date: 5.DEC.2011 10:14:41

#### Power Spectral Density 802.11b 2437 MHz



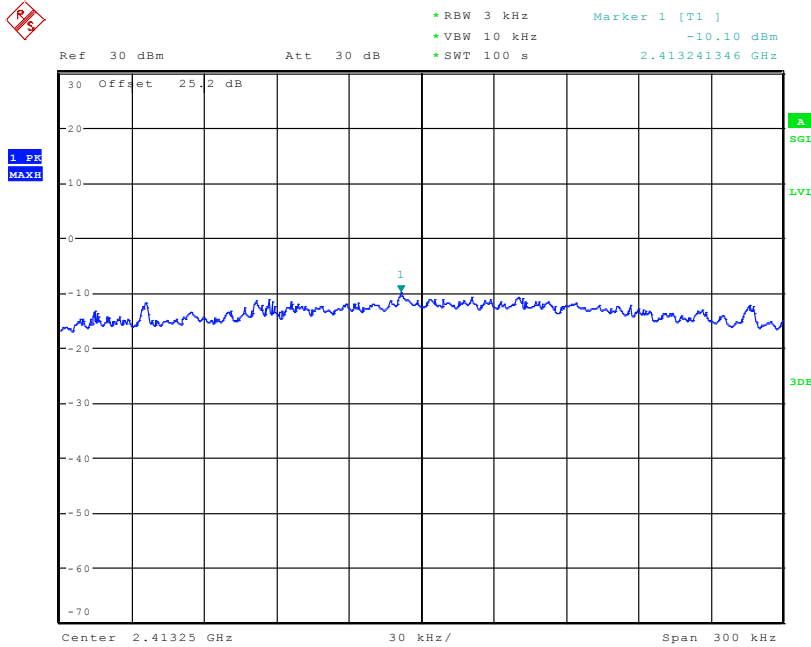
Date: 5.DEC.2011 10:21:20

### Power Spectral Density 802.11b 2462 MHz



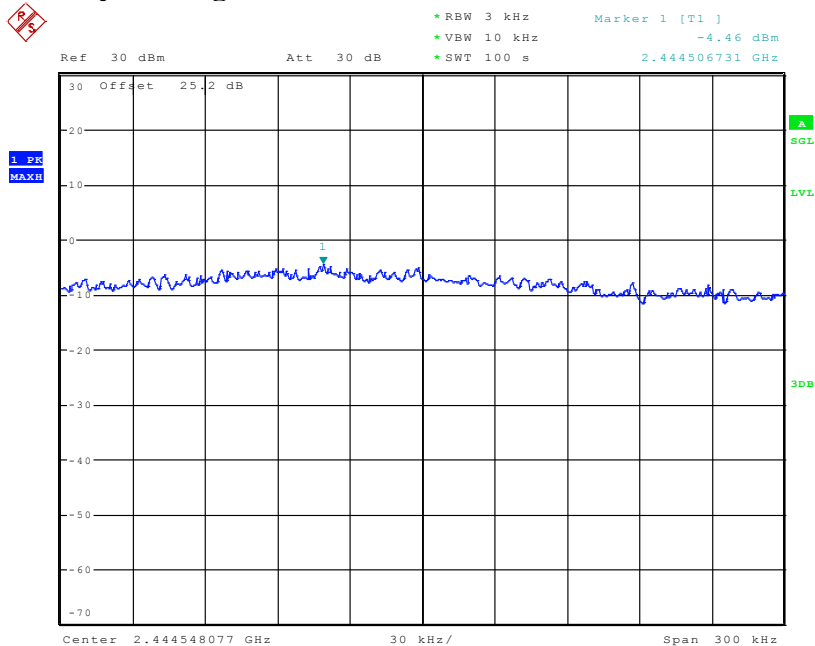
Date: 5.DEC.2011 10:25:49

### Power Spectral Density 802.11g 2412 MHz



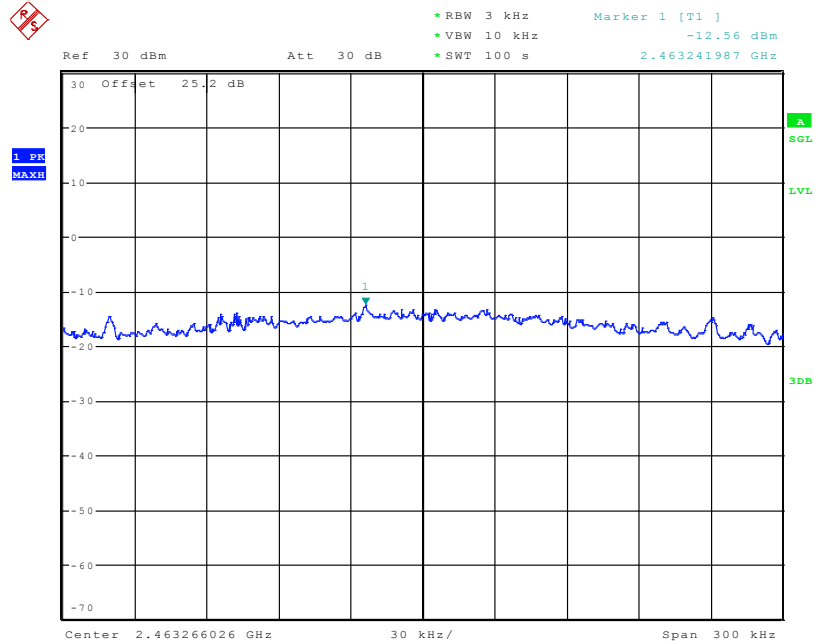
Date: 5.DEC.2011 10:32:04

### Power Spectral Density 802.11g 2437 MHz



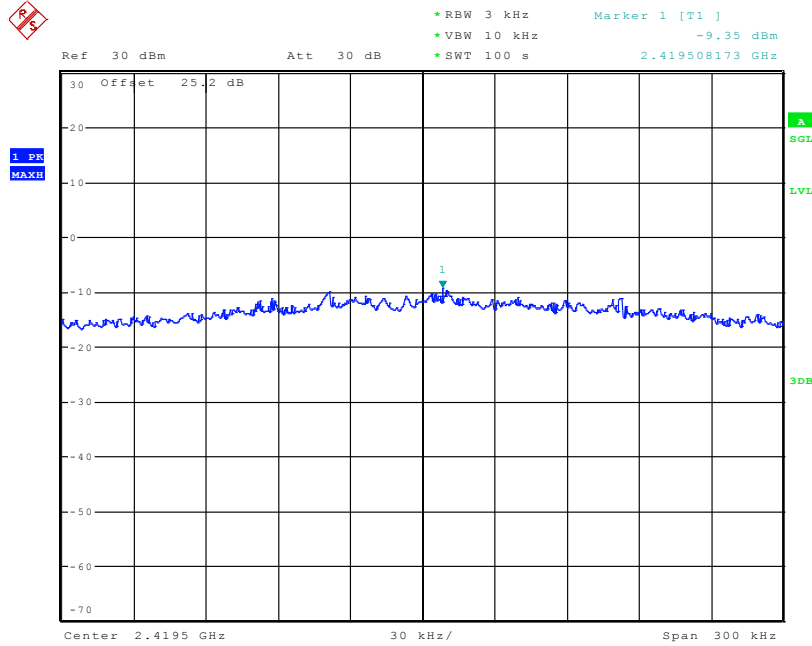
Date: 5.DEC.2011 10:38:32

### Power Spectral Density 802.11g 2462 MHz



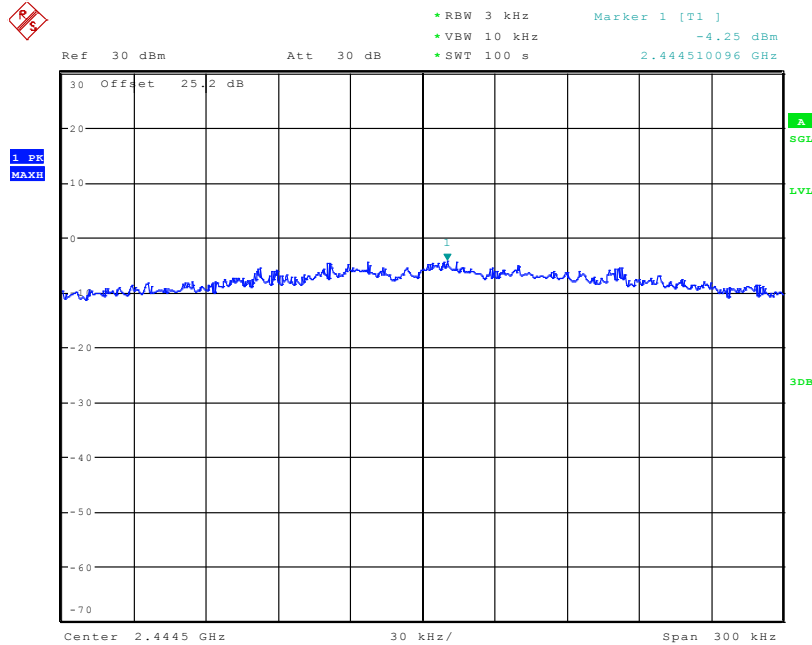
Date: 5.DEC.2011 10:42:22

### Power Spectral Density 802.11n/HT20 2412 MHz



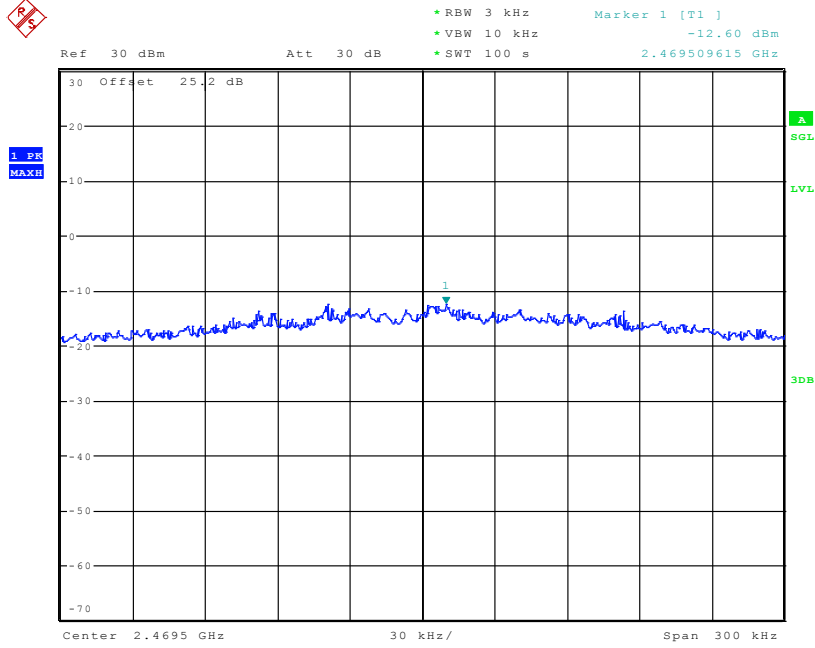
Date: 5.DEC.2011 10:45:52

### Power Spectral Density 802.11n/HT20 2437 MHz



Date: 5.DEC.2011 10:49:04

### Power Spectral Density 802.11n/HT20 2462 MHz

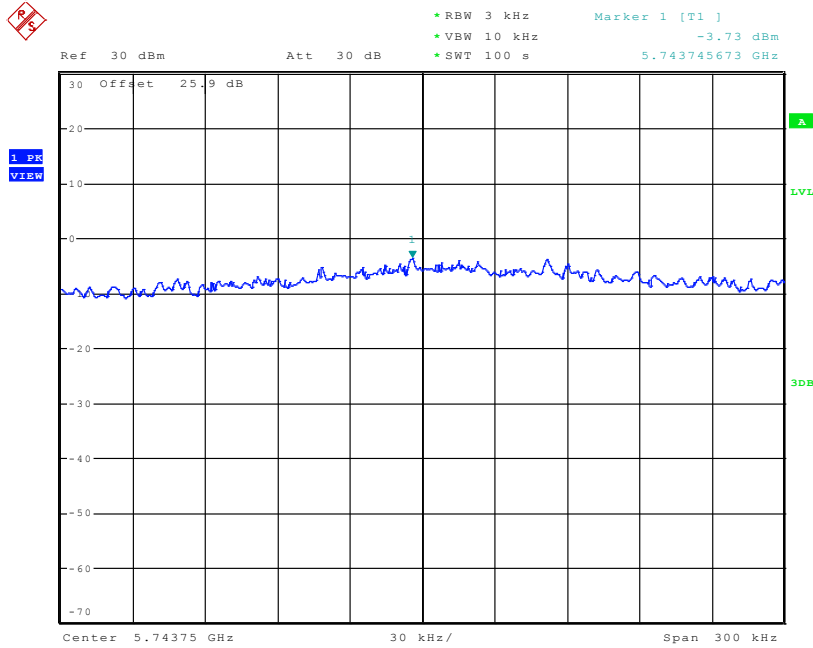


Date: 5.DEC.2011 10:52:10



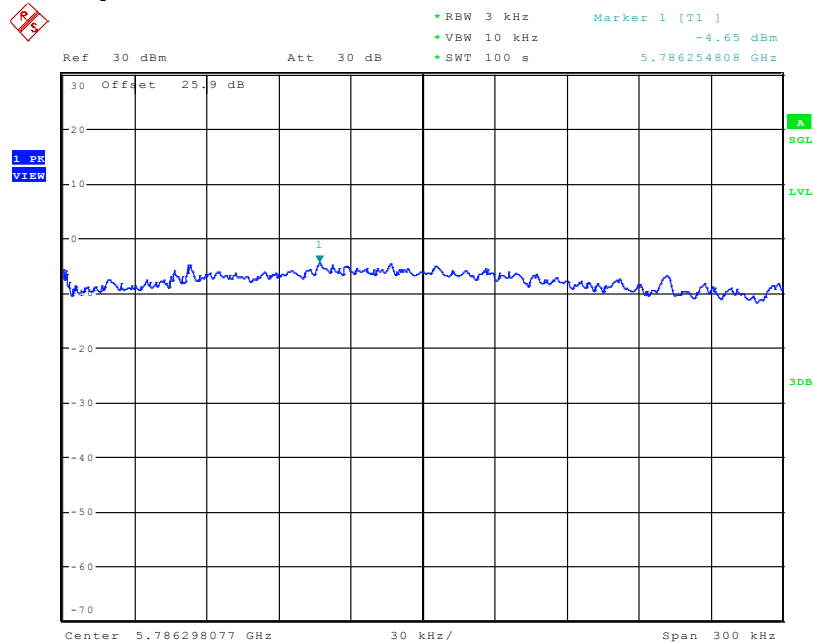
### 6.7.6 Test Data/plots: 5 GHz Band

#### Power Spectral Density 802.11a 5745 MHz



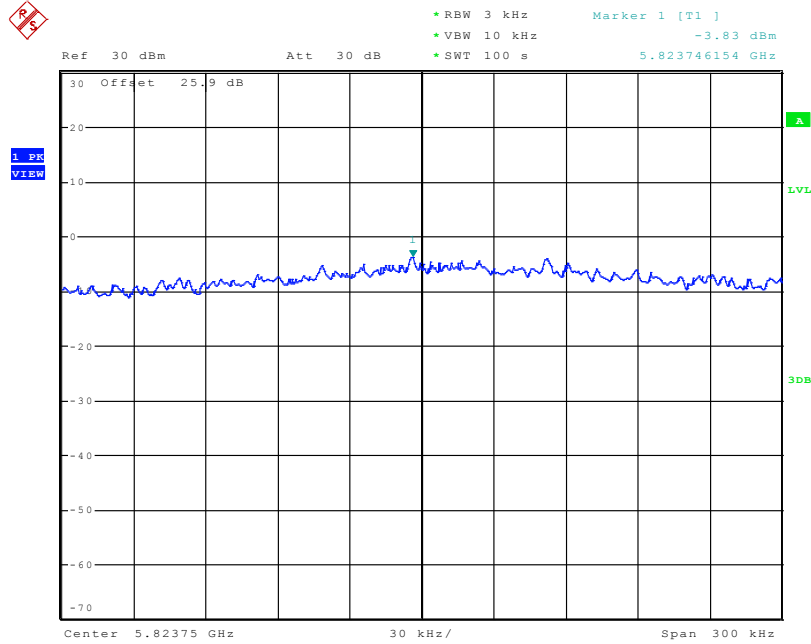
Date: 6.DEC.2011 10:06:38

#### Power Spectral Density 802.11a 5785 MHz



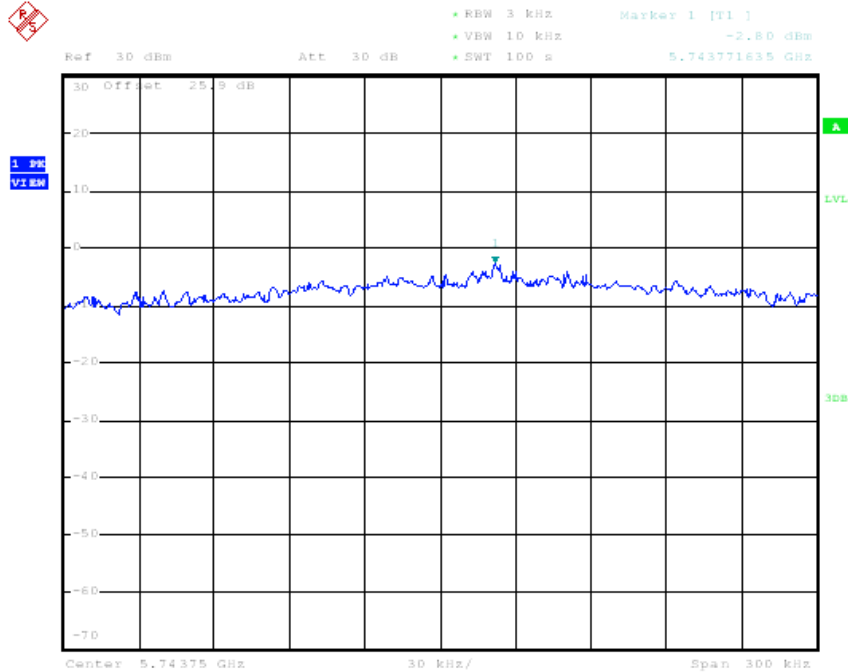
Date: 6.DEC.2011 09:58:12

### Power Spectral Density 802.11a 5825 MHz



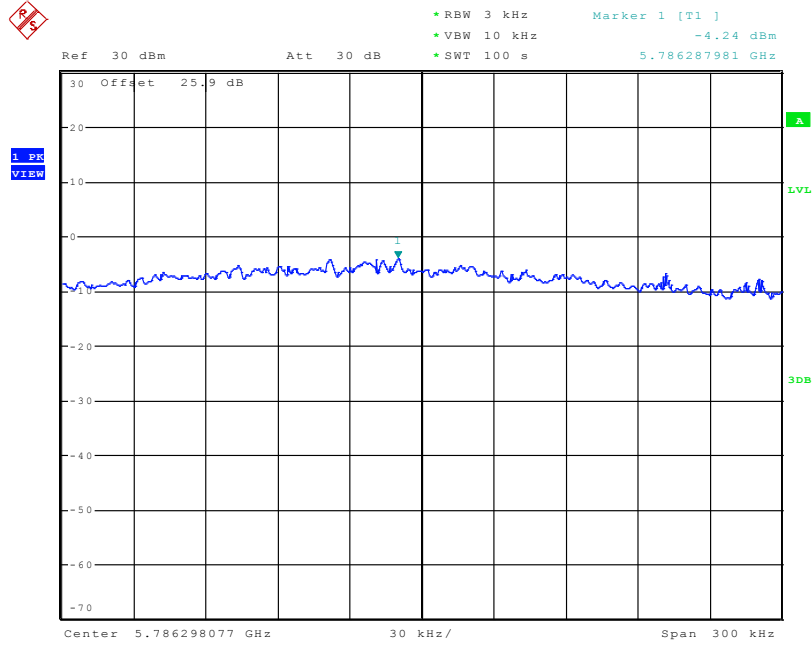
Date: 6.DEC.2011 10:16:28

### Power Spectral Density 802.11n/HT20 5745 MHz



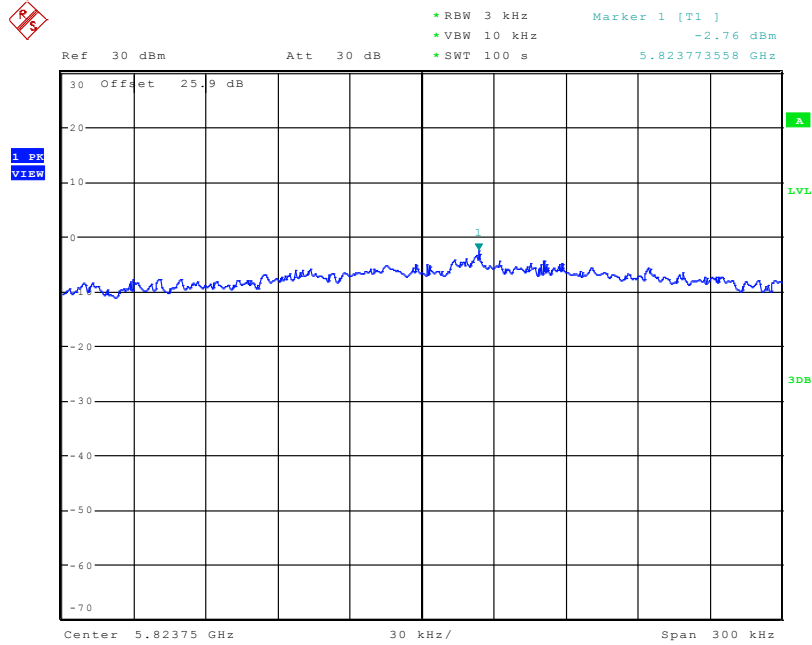
Date: 6.DEC.2011 10:39:08

### Power Spectral Density 802.11n/HT20 5785 MHz



Date: 6.DEC.2011 10:56:14

### Power Spectral Density 802.11n/HT20 5825 MHz



Date: 6.DEC.2011 11:10:57

**6.8 Transmitter Spurious Emissions- Conducted § 15.247 (c)**

**6.8.1 Reference and Limits:**

6.8.1.1 § 15.247 (d)

6.8.1.2 RSS 210-A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

30dBm for the transmitter.

-20dBc in the frequency range 30MHz- 25GHz.

**6.8.2 Test Conditions:**

**Spectrum Analyzer settings:**

RBW=100kHz, VBW=300kHz, Detector: Peak- Max hold;

Sweep Time: Auto

Span=Full range

**6.8.3 Test data/ plots: 2.4 GHz Band**

Conducted Spurious Emissions					
Channel	Frequency (MHz)	Amplitude (dBm)			Limits
		802.11b	802.11g	HT20	
Low	2412	10.50	10.46	8.56	30dBm
	Spurious	All other peaks >20dB below limit			-20dBc
Mid	2437	0.10	4.02	-2.30	30 dBm
	Spurious	All other peaks >20dB below limit			-20dBc
High	2462	-0.58	7.16	-3.74	30 dBm
	Spurious	All other peaks >20dB below limit			-20dBc

6.8.3.1 Measurement Result

Pass.

**6.8.4 Test data/ plots: 5 GHz Band**

Conducted Spurious Emissions				
Channel	Frequency (MHz)	Amplitude (dBm)		Limits
		802.11a	HT20	
Low	5745	4.86	7.39	30dBm
	Spurious	All other peaks >20dB below limit		-20dBc
Mid	5785	5.13	5.33	30 dBm
	Spurious	All other peaks >20dB below limit		-20dBc
High	5825	7.53	6.87	30 dBm
	Spurious	All other peaks >20dB below limit		-20dBc

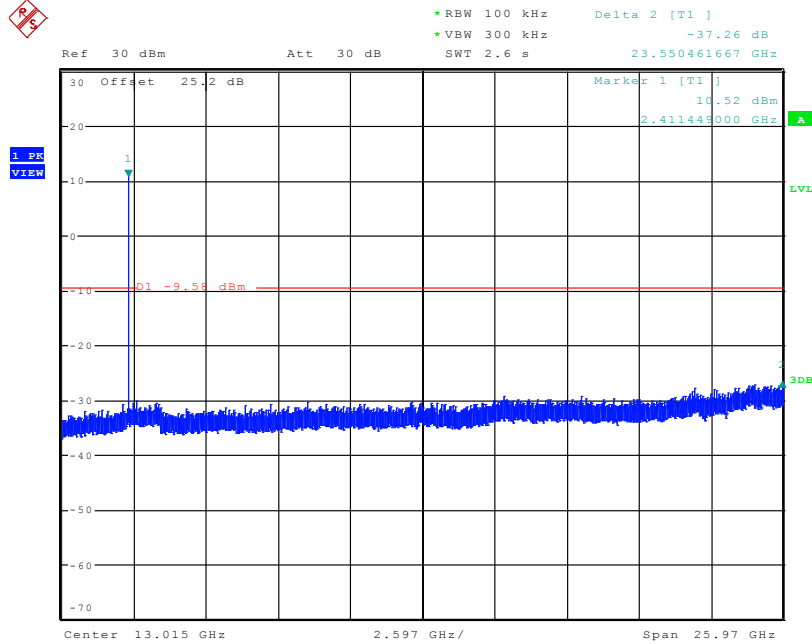
6.8.4.1 Measurement Result

Pass.



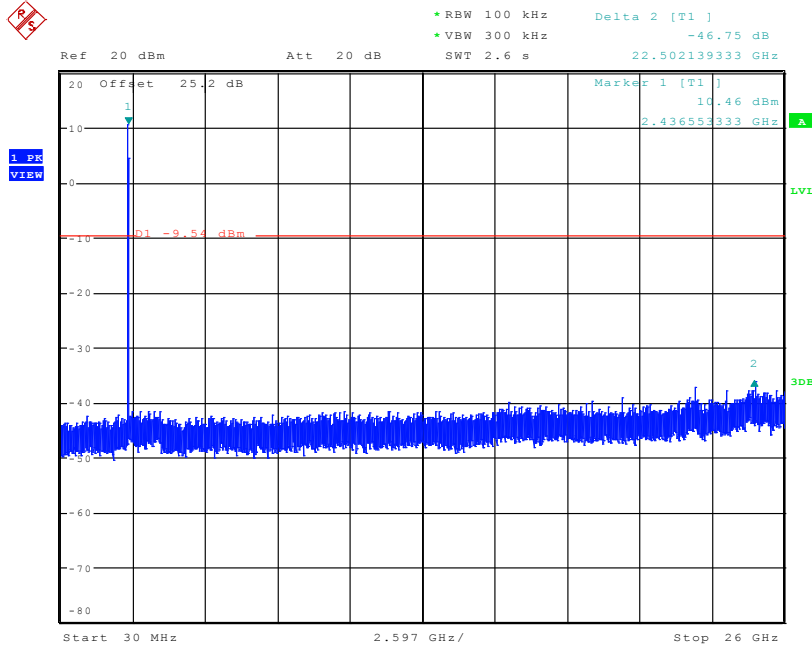
### 6.8.5 Test data/ plots: 2.4 GHz Band

#### Conducted Spurious Emission 802.11b 2412 MHz



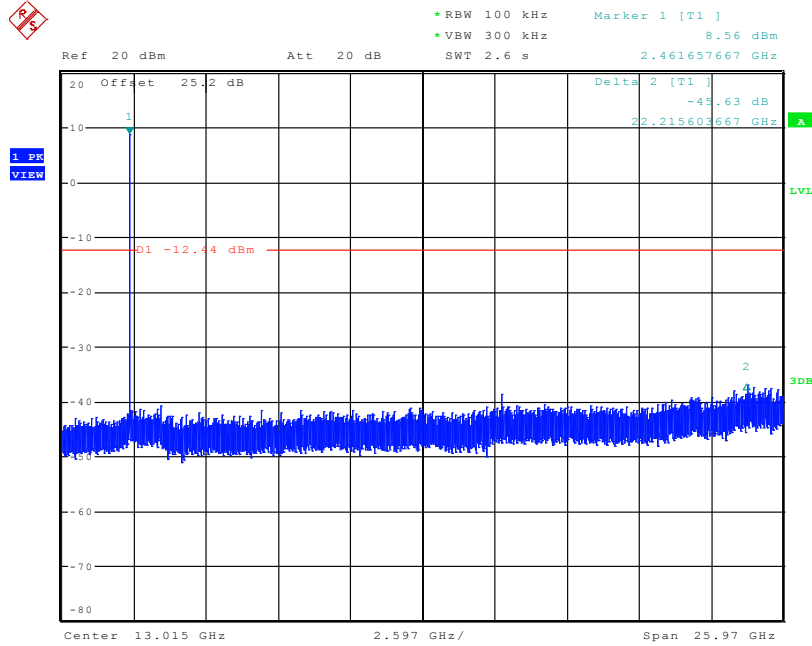
Date: 5.DEC.2011 11:28:32

#### Conducted Spurious Emission 802.11b 2437 MHz



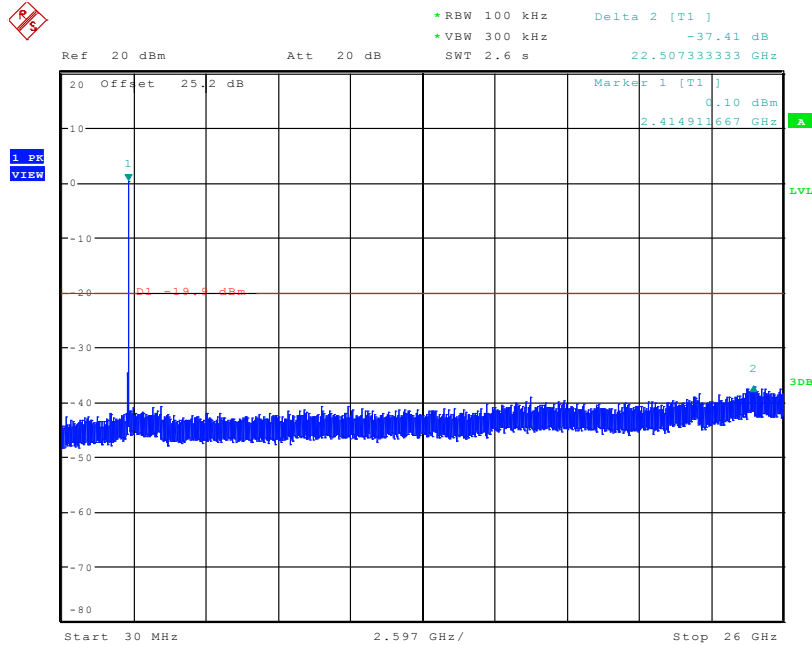
Date: 5.DEC.2011 11:38:28

### Conducted Spurious Emission 802.11b 2462 MHz



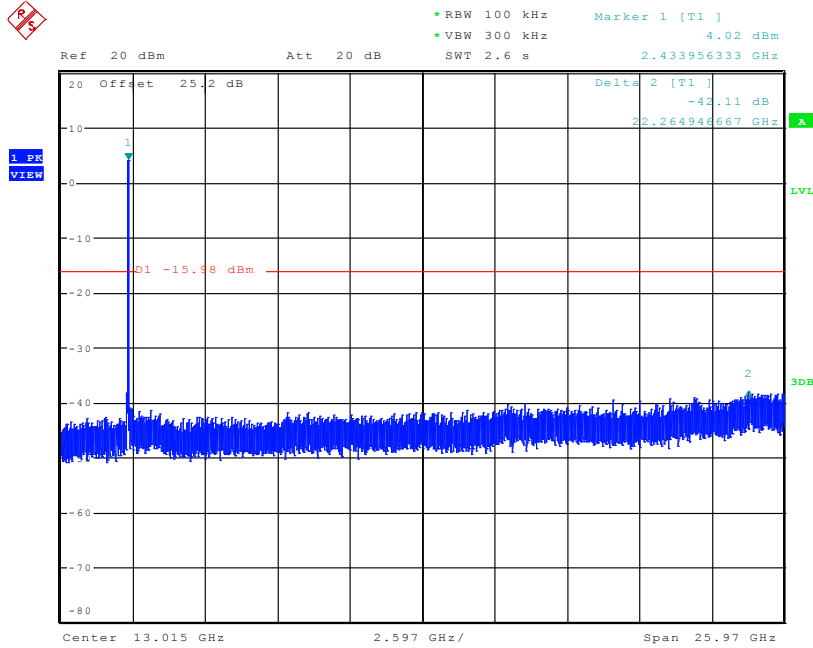
Date: 5.DEC.2011 11:40:16

### Conducted Spurious Emission 802.11g 2412 MHz



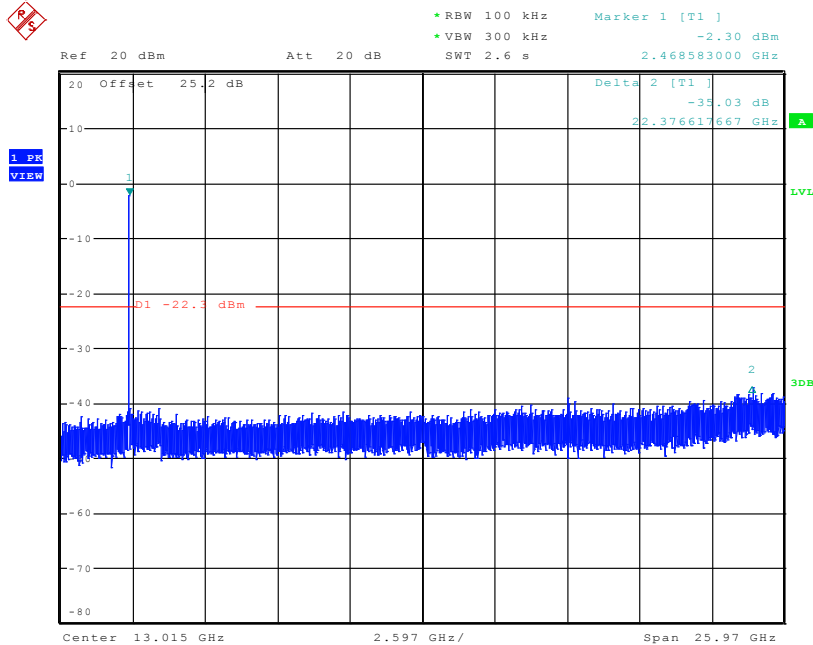
Date: 5.DEC.2011 11:36:38

### Conducted Spurious Emission 802.11g 2437 MHz



Date: 5.DEC.2011 11:43:01

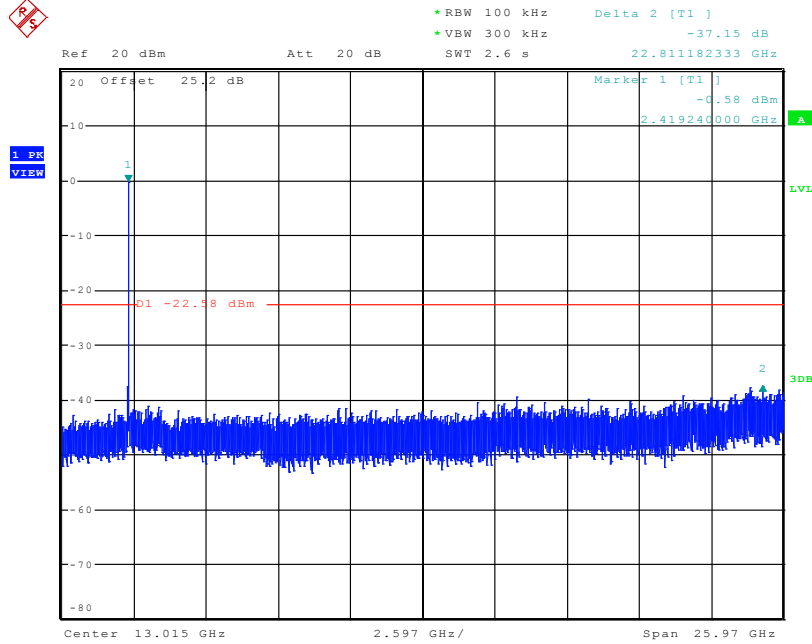
### Conducted Spurious Emission 802.11g 2462 MHz



Date: 5.DEC.2011 11:44:25

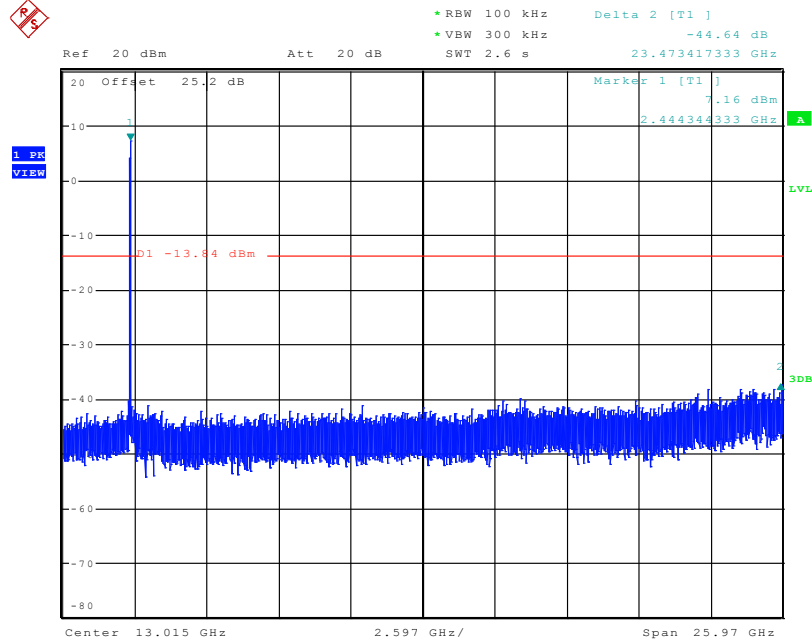


### Conducted Spurious Emission 802.11n/HT20 2412 MHz



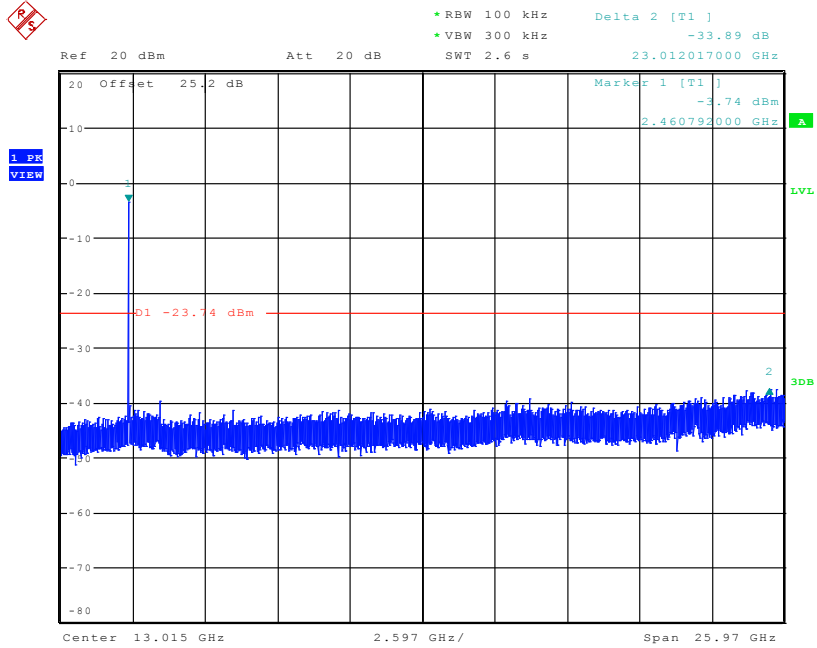
Date: 5.DEC.2011 11:46:01

### Conducted Spurious Emission 802.11n/HT20 2437 MHz



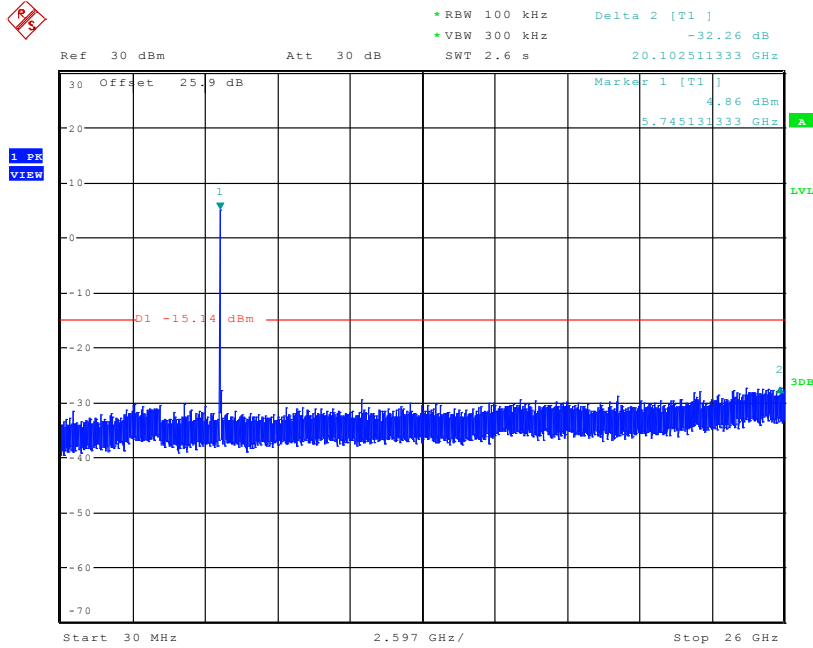
Date: 5.DEC.2011 11:47:25

### Conducted Spurious Emission 802.11n/HT20 2462 MHz

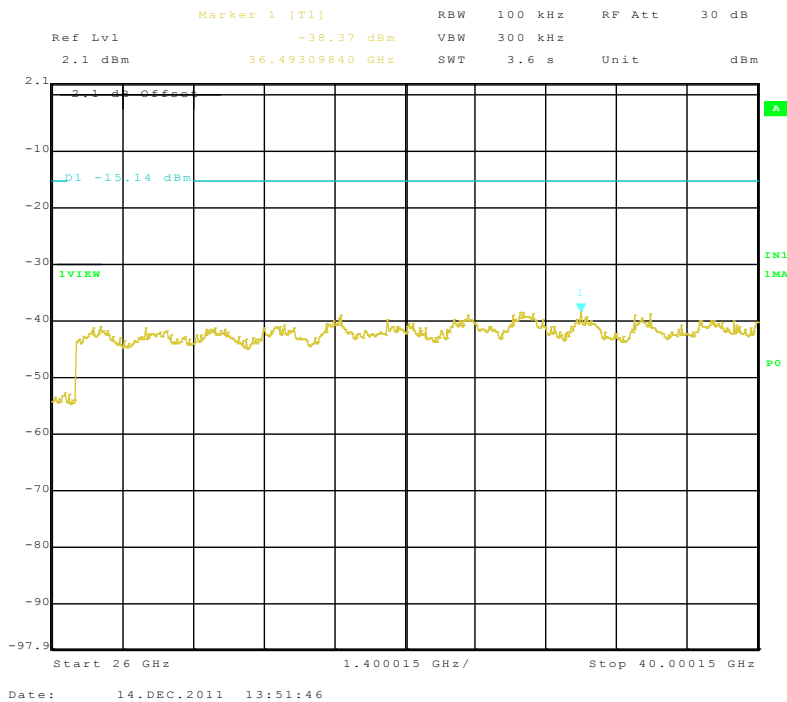


Date: 5.DEC.2011 11:48:37

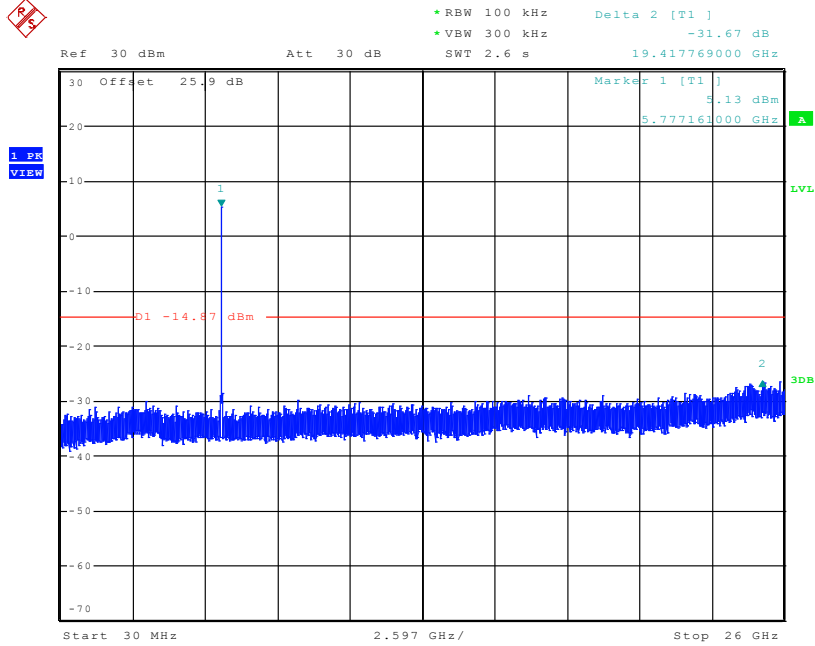
### 6.8.6 Test data/ plots: 5 GHz Band Conducted Spurious Emission 802.11a 5745 MHz



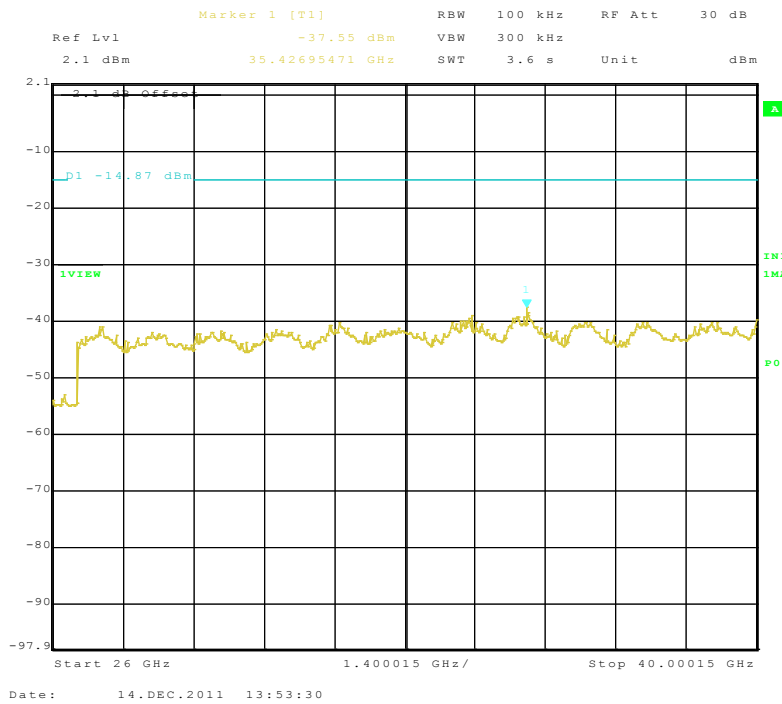
Date: 6.DEC.2011 09:33:06



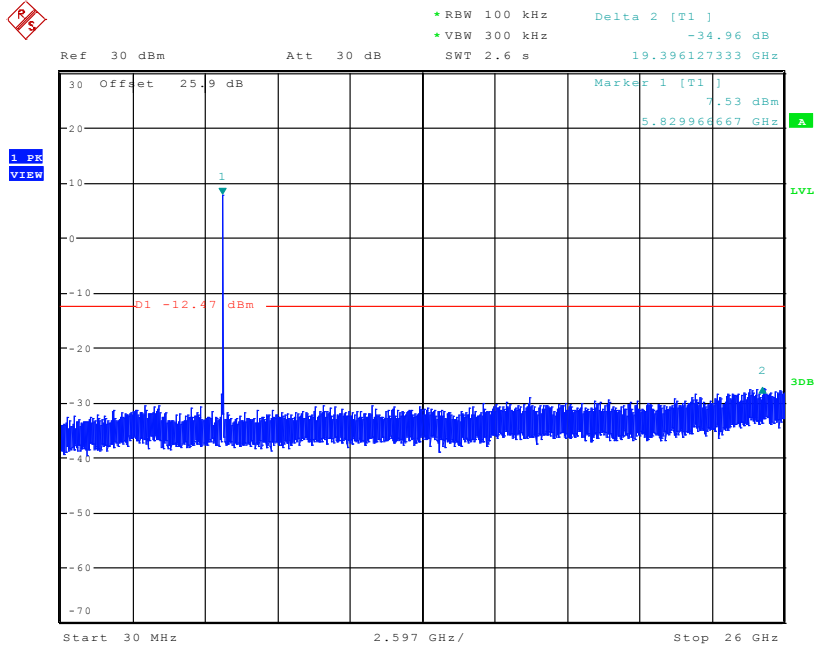
### Conducted Spurious Emission 802.11a 5785 MHz



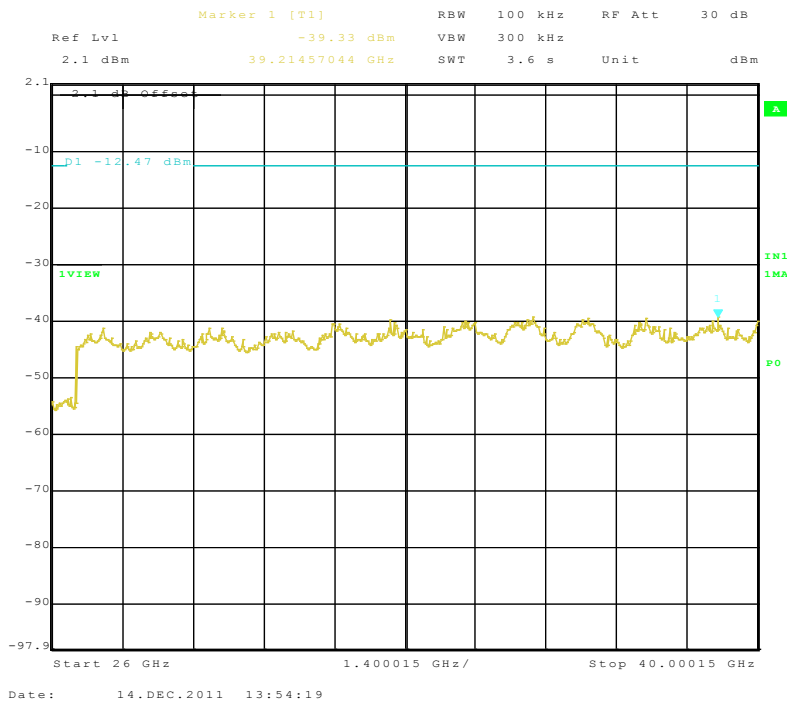
Date: 6.DEC.2011 09:45:19



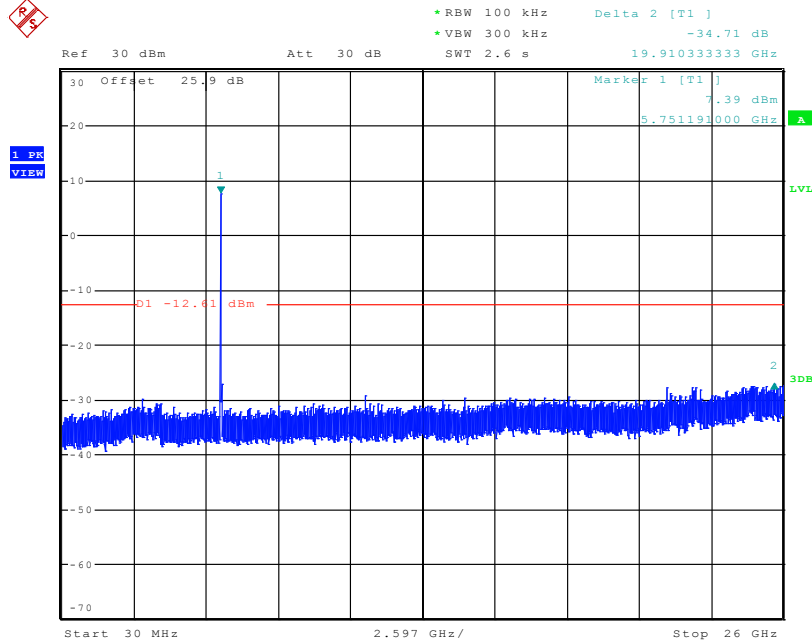
### Conducted Spurious Emission 802.11a 5825 MHz



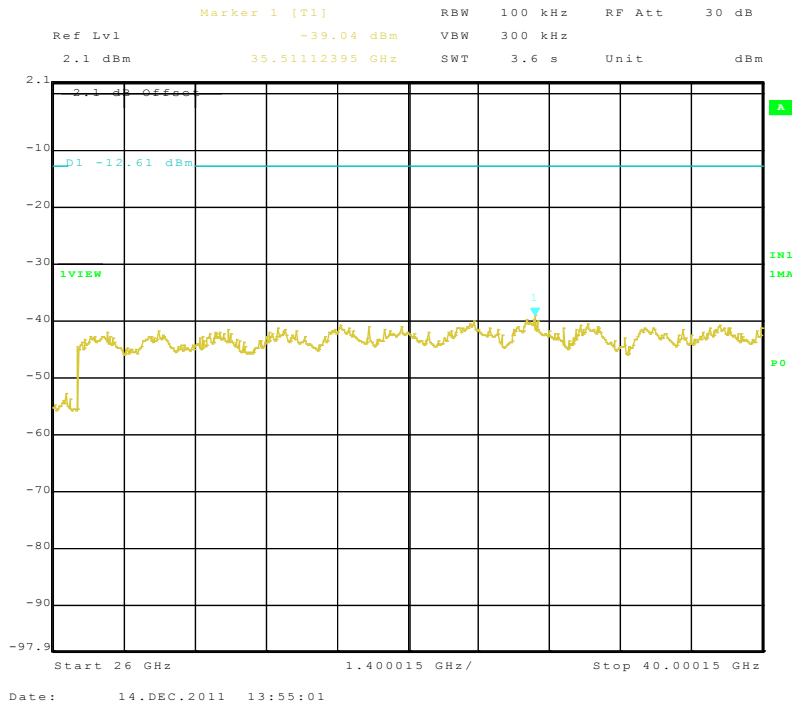
Date: 6.DEC.2011 10:24:46



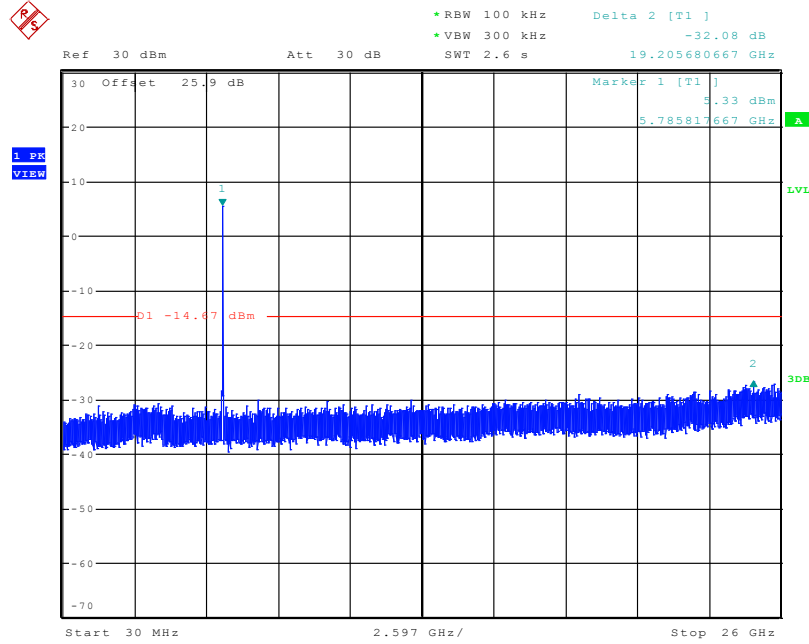
### Conducted Spurious Emission 802.11n/HT20 5745 MHz



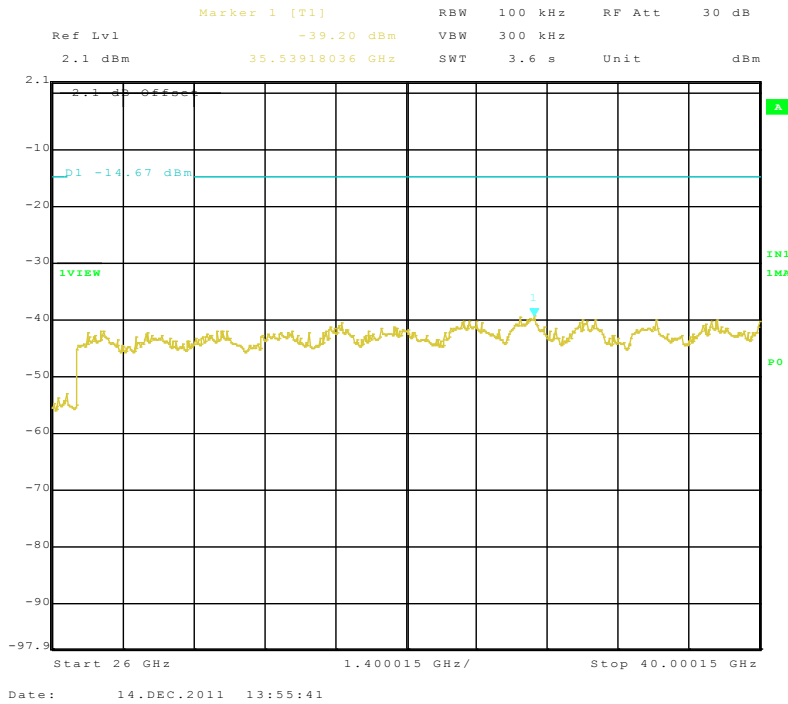
Date: 6.DEC.2011 10:27:53



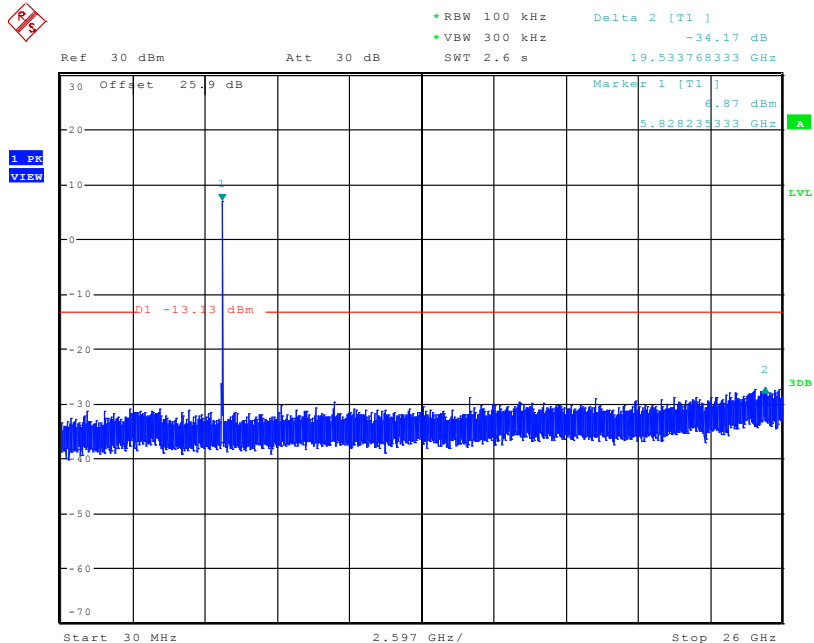
### Conducted Spurious Emission 802.11n/HT20 5785 MHz



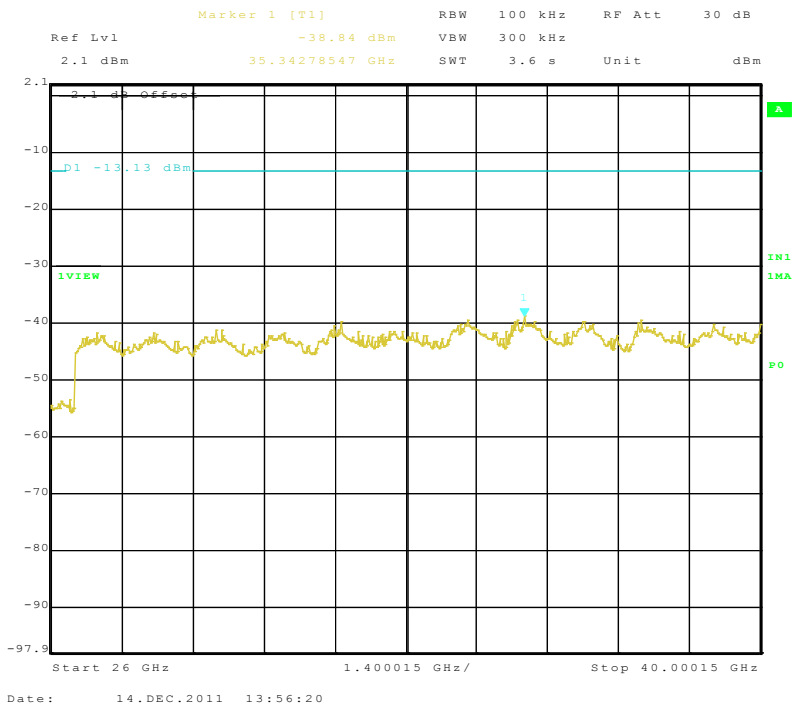
Date: 6.DEC.2011 10:42:51



### Conducted Spurious Emission 802.11n/HT20 5825 MHz



Date: 6.DEC.2011 11:12:39





**6.9 Transmitter Spurious Emissions- Radiated**

**6.9.1 Limits:  
§15.247/15.205  
RSS 210-A8.5**

(a) Except as shown in paragraph (d) of this section, 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			

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB.

\*PEAK LIMIT= 74dBμV/m

\*AVG. LIMIT= 54dBμV/m

**Table 1:**

Frequency of emission (MHz)	Field strength (μV/m)
30–88	100 (40dBμV/m)
88–216	150 (43.5 dBμV/m)
216–960	200 (46 dBμV/m)
Above 960	500 (54 dBμV/m)

**Table 2:**

Frequency of emission (MHz)	Field strength ( $\mu\text{V/m}$ )	Measurement Distance (m)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30

**6.9.2 Test Result:**

**Test mode:** *Modulation:* 802.11n- since highest conducted power and additionally 802.11b.

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

Plots reported here represent the worse case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT.

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

**6.9.2.1 Measurement Result**

Pass.

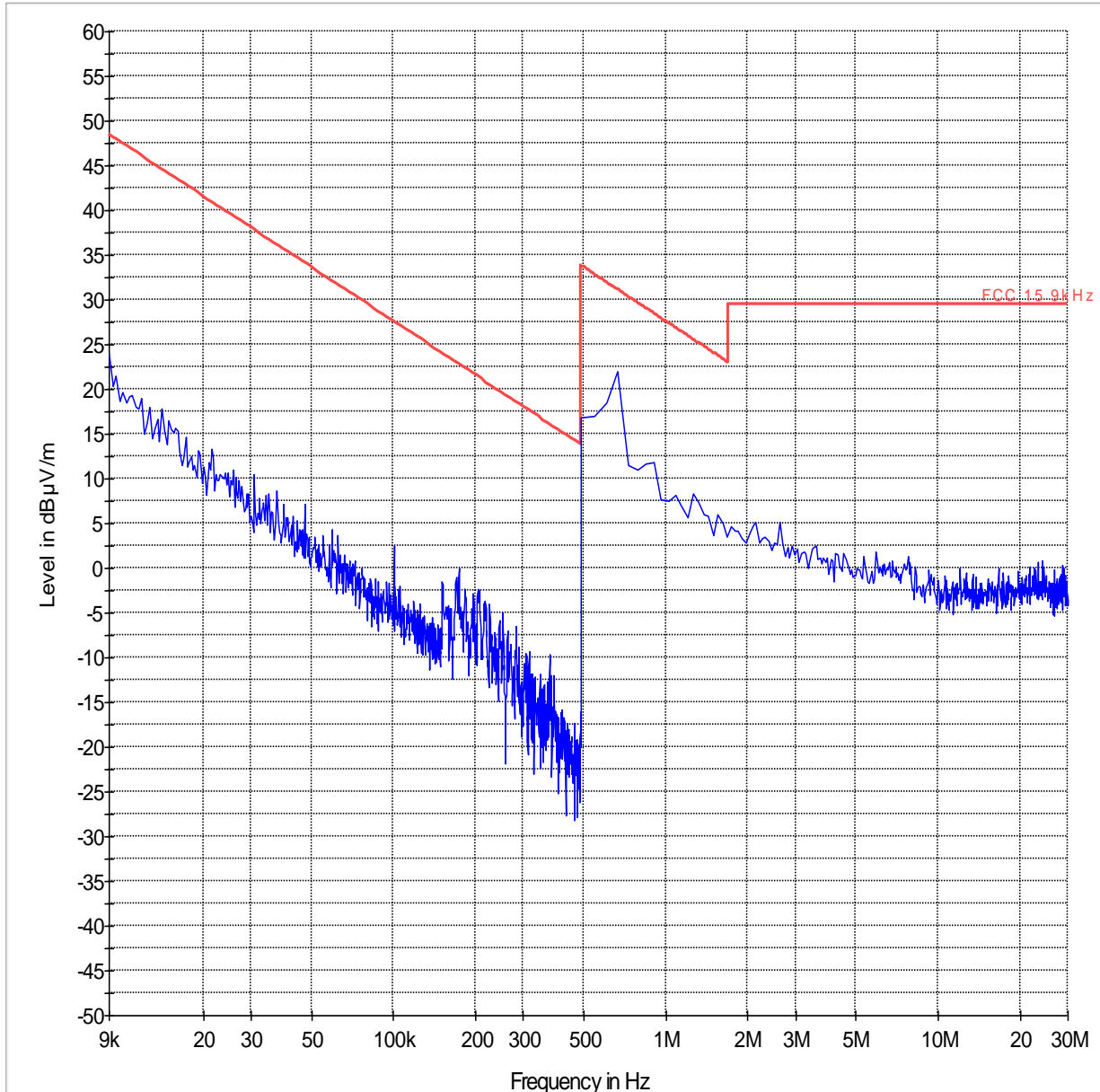
### 6.9.3 Test data/ plots: 2.4 GHz Band

#### Transmitter Radiated Spurious Emission:<30MHz

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

Limits adjusted for 3m measurement.

#### Transmitter Spurious Emission – 9k-30MHz - 802.11b - 2437MHz

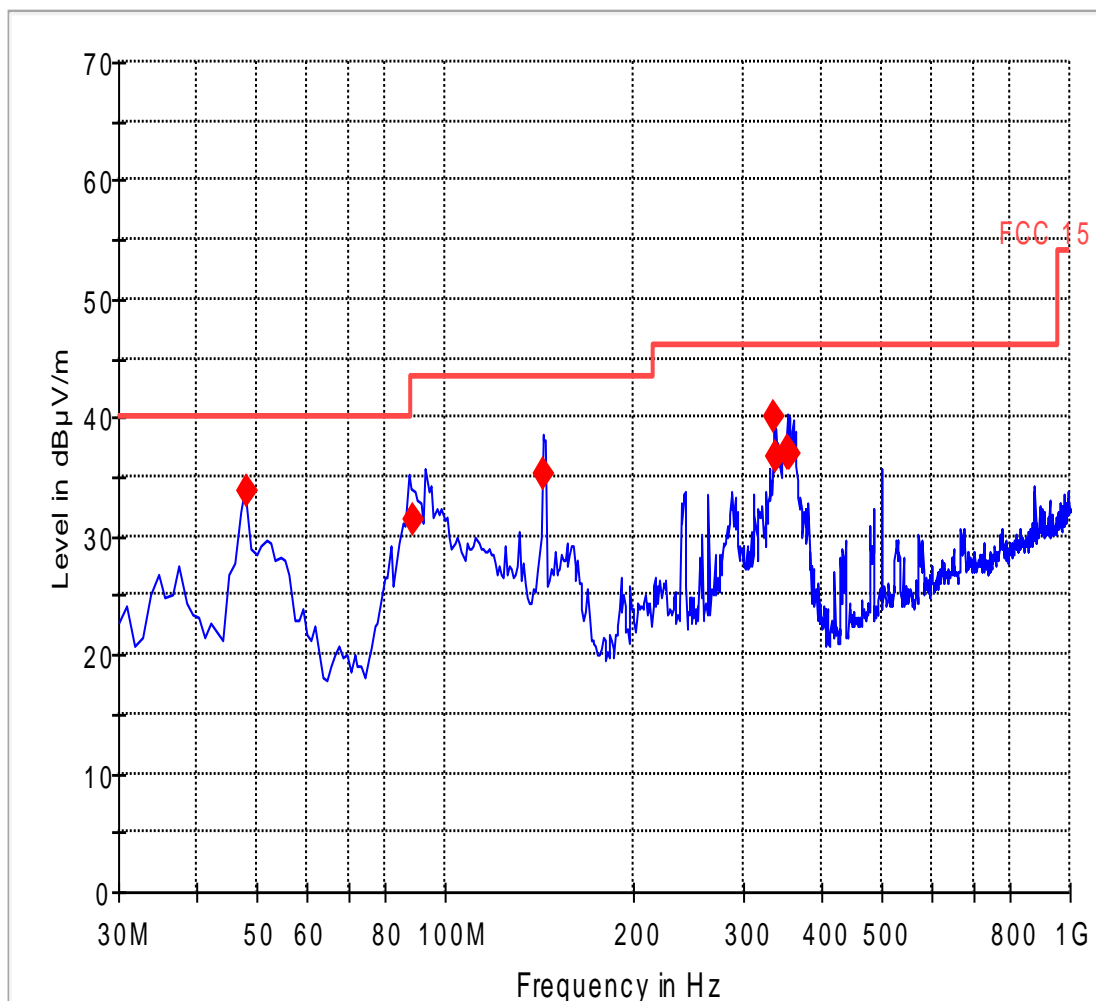


— FCC 15.9kHz.LimitLine — Preview Result 1

**Transmitter Radiated Spurious Emission - 30M-1GHz - 802.11b - 2412MHz**

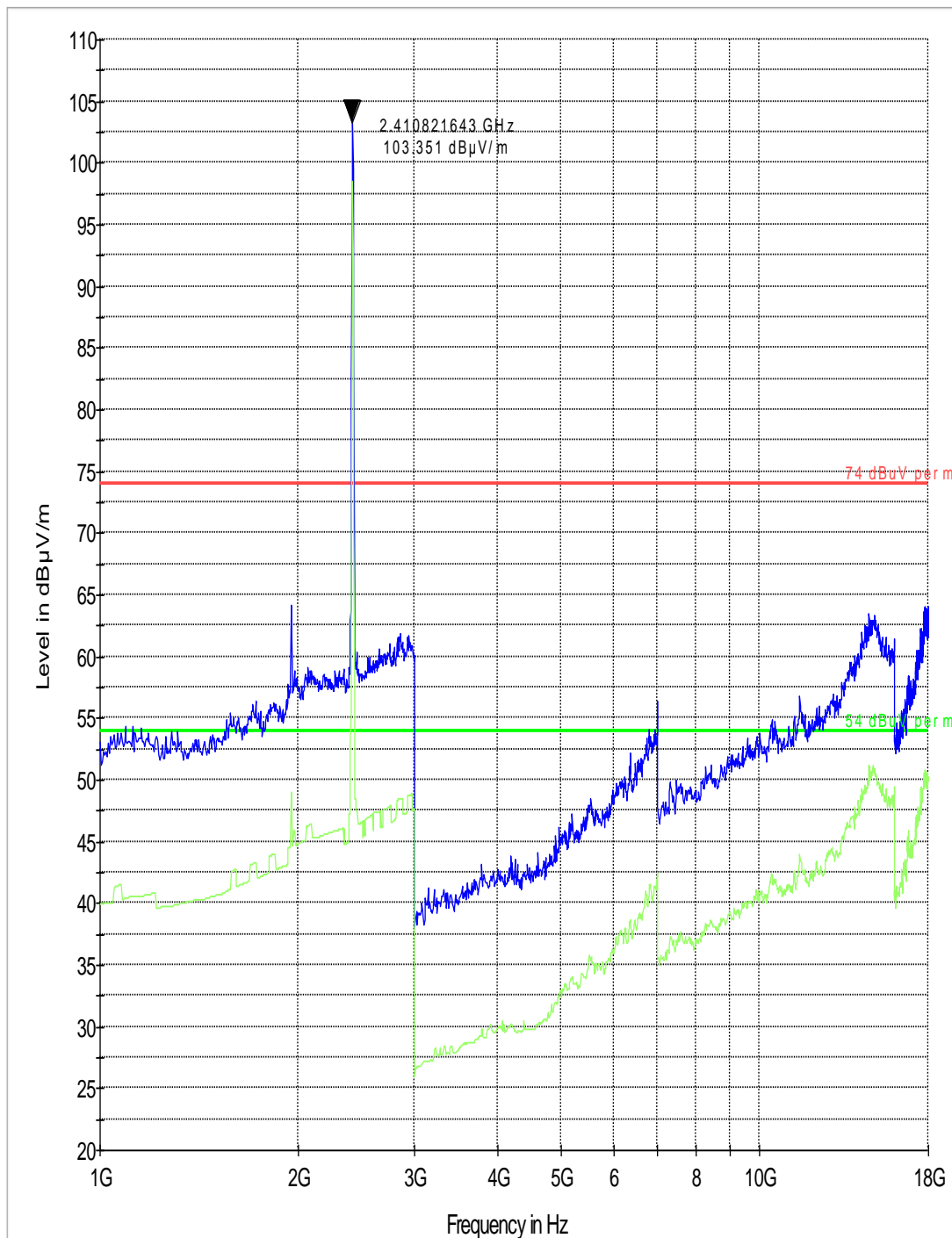
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
48.037380	33.7	20.0	120.000	120.0	V	237.0	6.6	6.3	40.0
88.581023	31.5	20.0	120.000	120.0	V	196.0	10.3	12.0	43.5
143.162193	35.2	20.0	120.000	120.0	V	0.0	9.6	8.3	43.5
336.000170	40.1	20.0	120.000	120.0	V	180.0	16.6	5.9	46.0
338.655016	36.7	20.0	120.000	120.0	V	0.0	16.7	9.3	46.0
351.844224	36.9	20.0	120.000	120.0	V	159.0	17.0	9.1	46.0
352.995360	37.1	20.0	120.000	120.0	V	170.0	17.1	8.9	46.0
355.737077	37.0	20.0	120.000	120.0	V	167.0	17.1	9.0	46.0

FCC 15 30-1000MHz



— FCC 15 Limit Line — Preview Result 1 ◆ Final Result 1

### Transmitter Radiated Spurious Emission - 1G-18GHz - 802.11b - 2412MHz

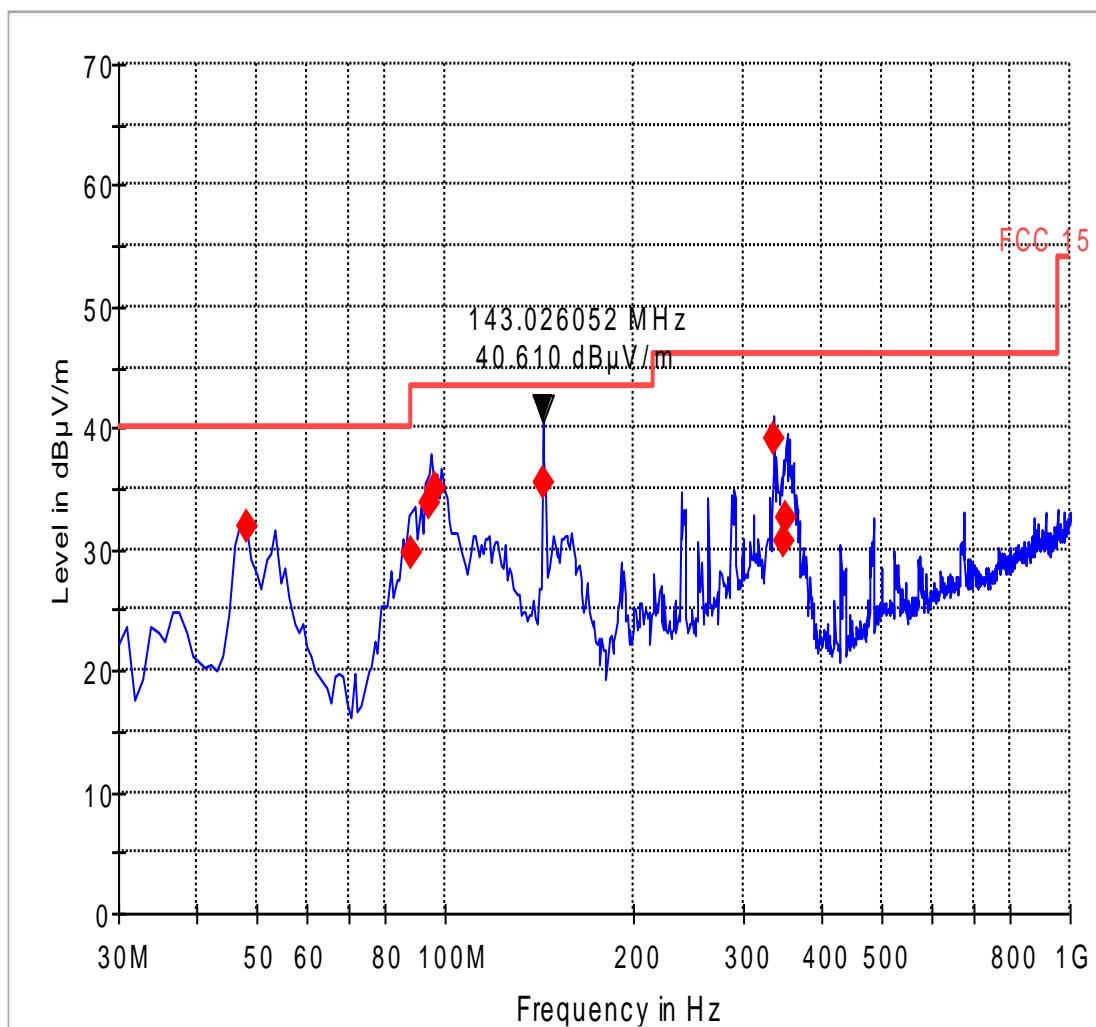


74 dBuV per m.LimitLine 54 dBuV per m.LimitLine Preview Result 1 Preview Result 2

**Transmitter Radiated Spurious Emission - 30M-1GHz - 802.11b - 2437MHz**

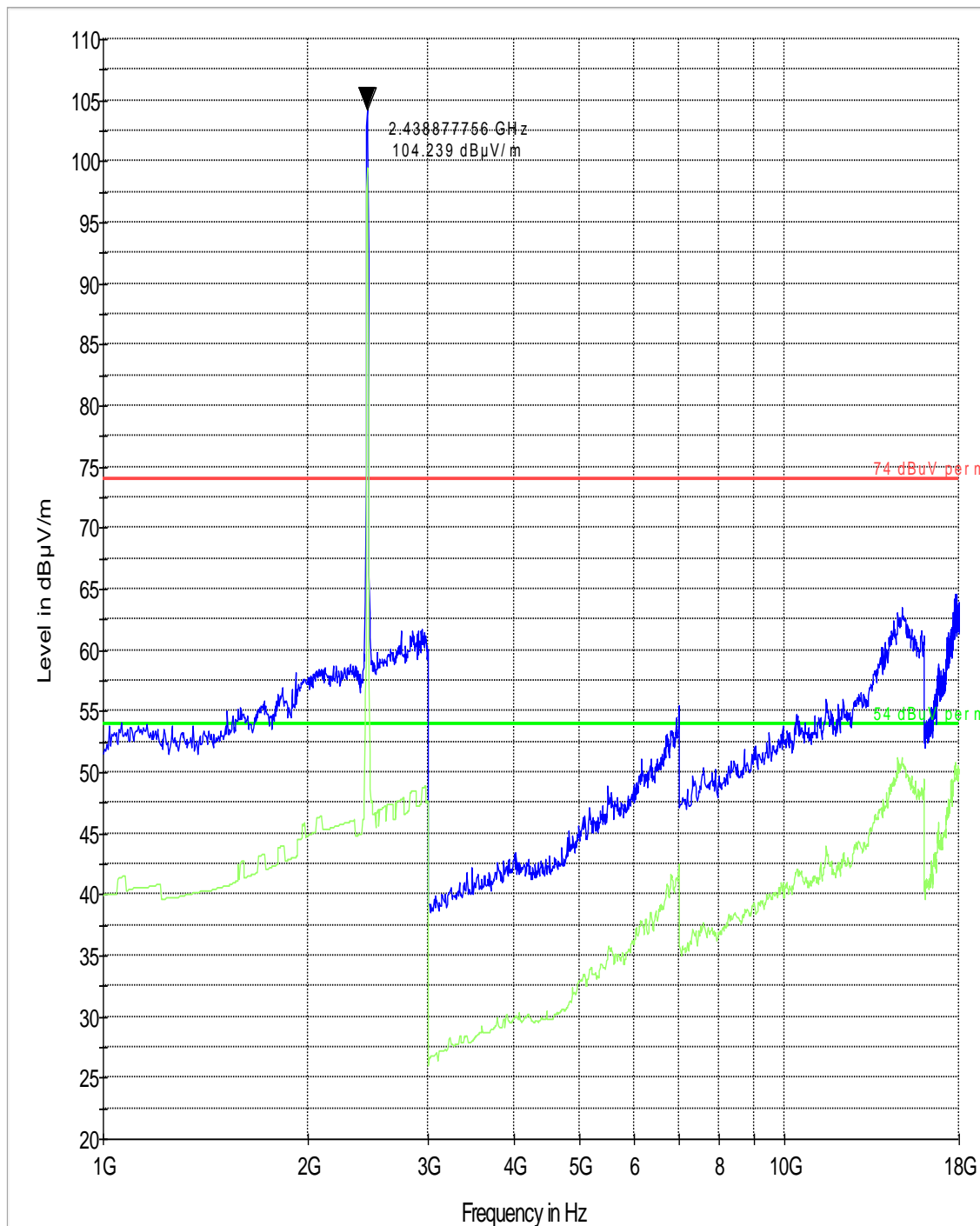
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
48.133372	31.8	20.0	120.000	120.0	V	170.0	6.6	8.2	40.0
88.318117	29.7	20.0	120.000	120.0	V	188.0	10.3	13.8	43.5
94.195308	33.7	20.0	120.000	120.0	V	205.0	10.2	9.8	43.5
96.407264	35.0	20.0	120.000	120.0	V	204.0	10.1	8.5	43.5
143.133532	35.6	20.0	120.000	120.0	V	0.0	9.6	7.9	43.5
335.994346	39.1	20.0	120.000	120.0	V	0.0	16.6	6.9	46.0
347.731569	30.8	20.0	120.000	152.0	V	279.0	17.0	15.2	46.0
351.660125	32.7	20.0	120.000	153.0	V	277.0	17.0	13.3	46.0

FCC 15 30-1000MHz



— FCC 15 Limit Line — Preview Result 1 ◆ Final Result 1

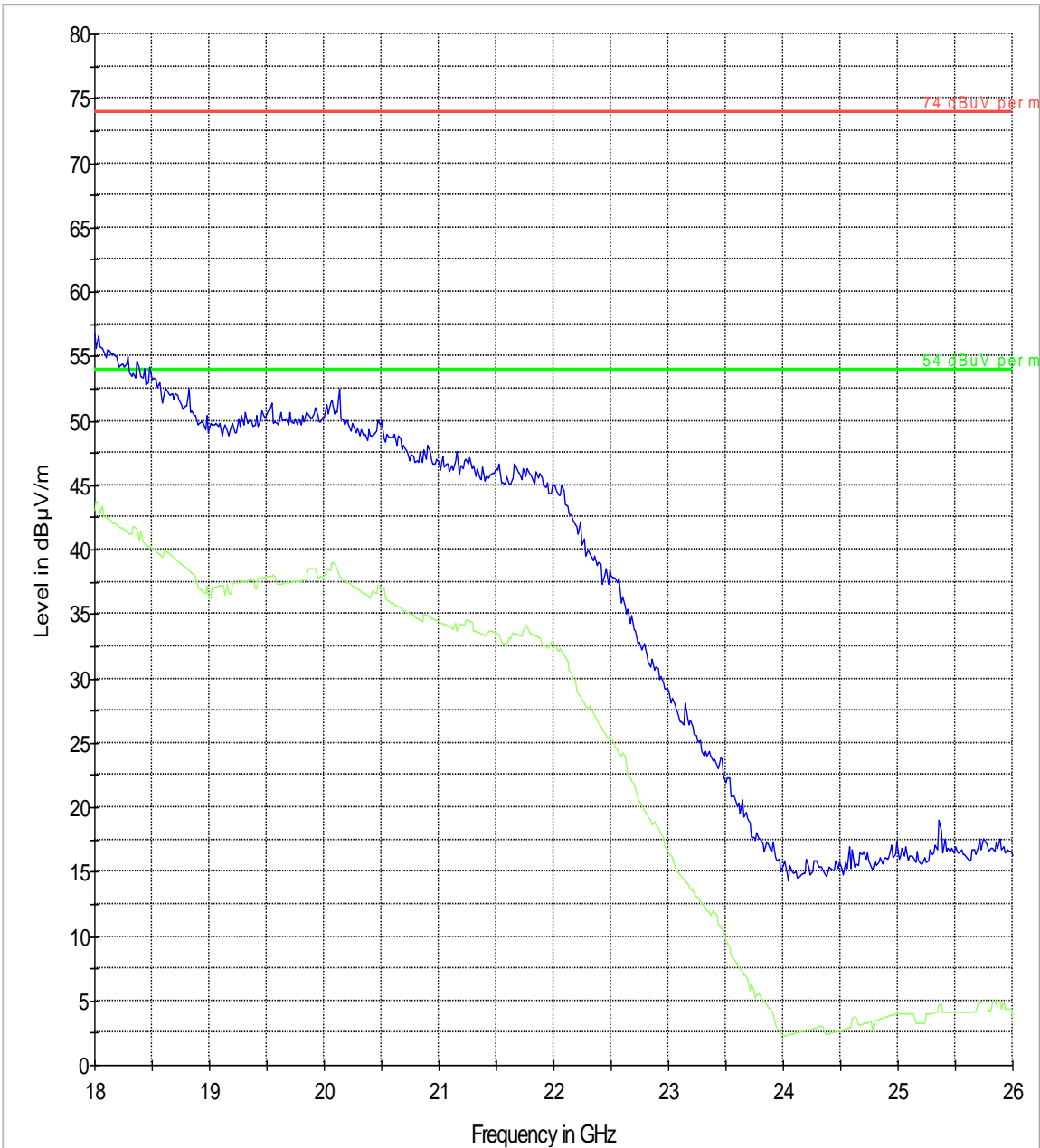
### Transmitter Radiated Spurious Emission - 1G-18GHz - 802.11b - 2437MHz



74 dBµV per m.LimitLine 54 dBµV per m.LimitLine Preview Result 1 Preview Result 2

### Transmitter Radiated Spurious Emission - 18G-26GHz - 802.11b - 2437MHz

Worst case representation in this frequency range for all modes.

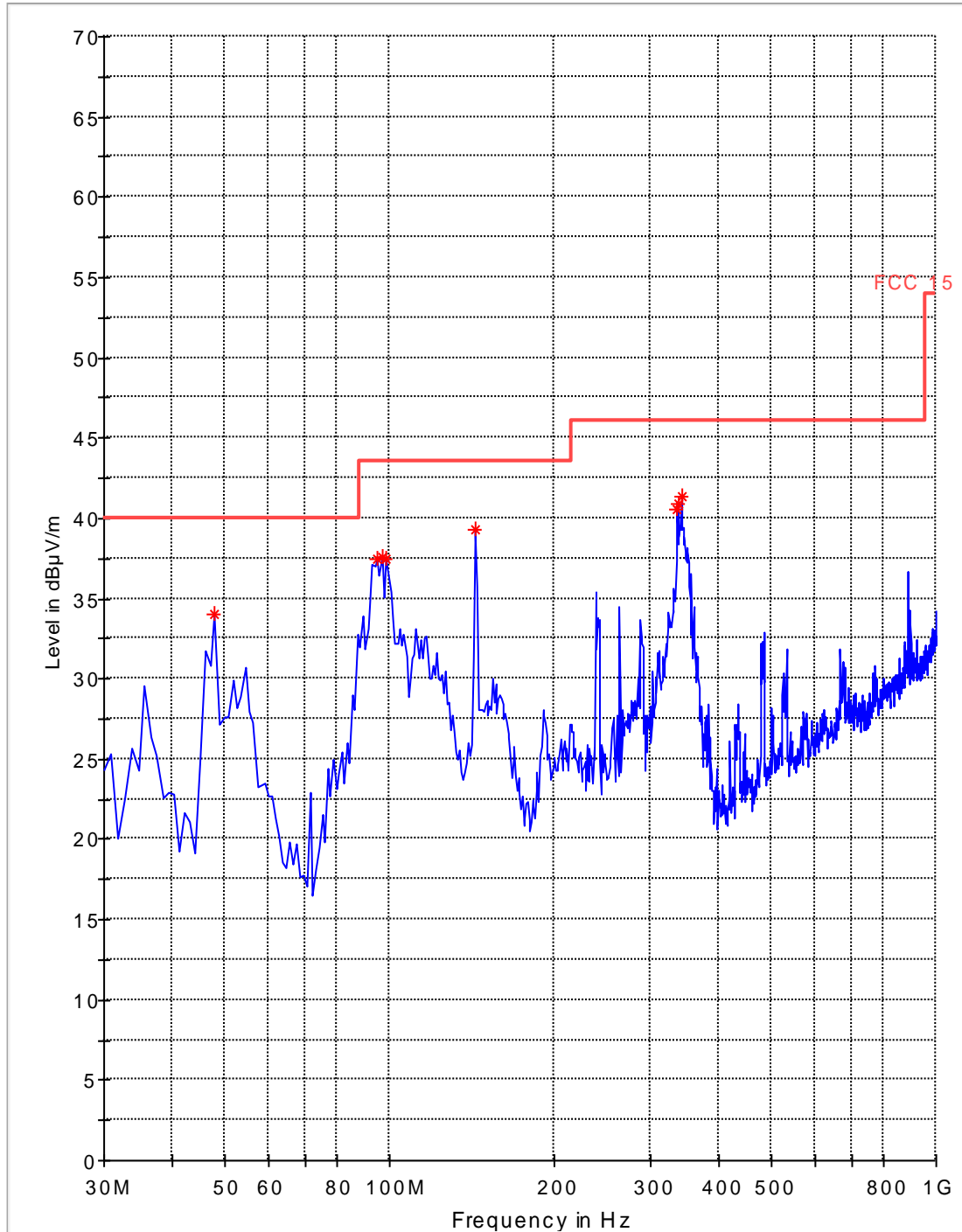


— 74 dBuV per m.LimitLine — 54 dBuV per m.LimitLine — Preview Result 1 — Preview Result 2



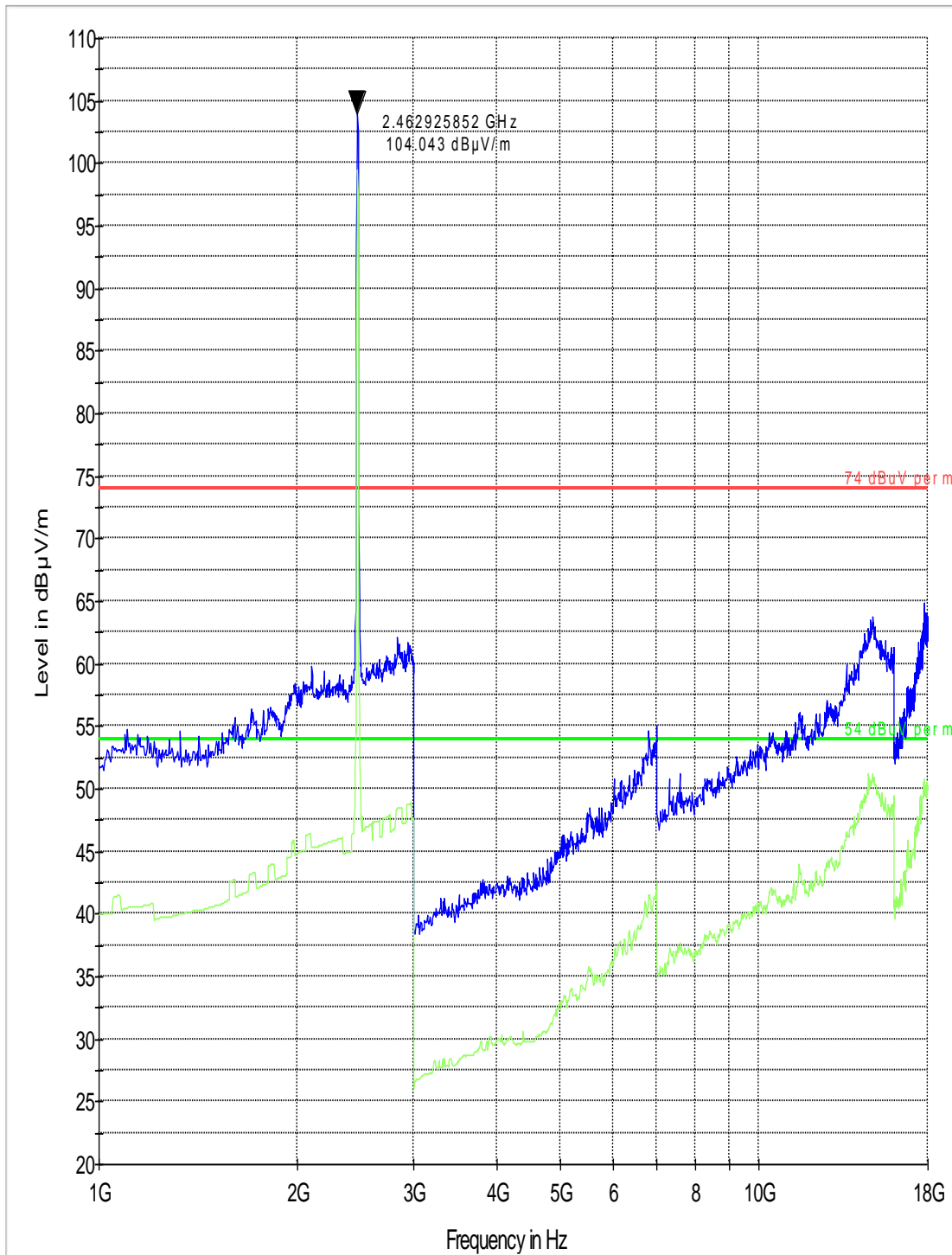
### Transmitter Radiated Spurious Emission - 30M-1GHz - 802.11b - 2462MHz

FCC 15 30-1000MHz



— FCC 15 Limit Line — Preview Result 1 \* Data Reduction Result 1 [3]

### Transmitter Radiated Spurious Emission - 1G-18GHz - 802.11b - 2462MHz



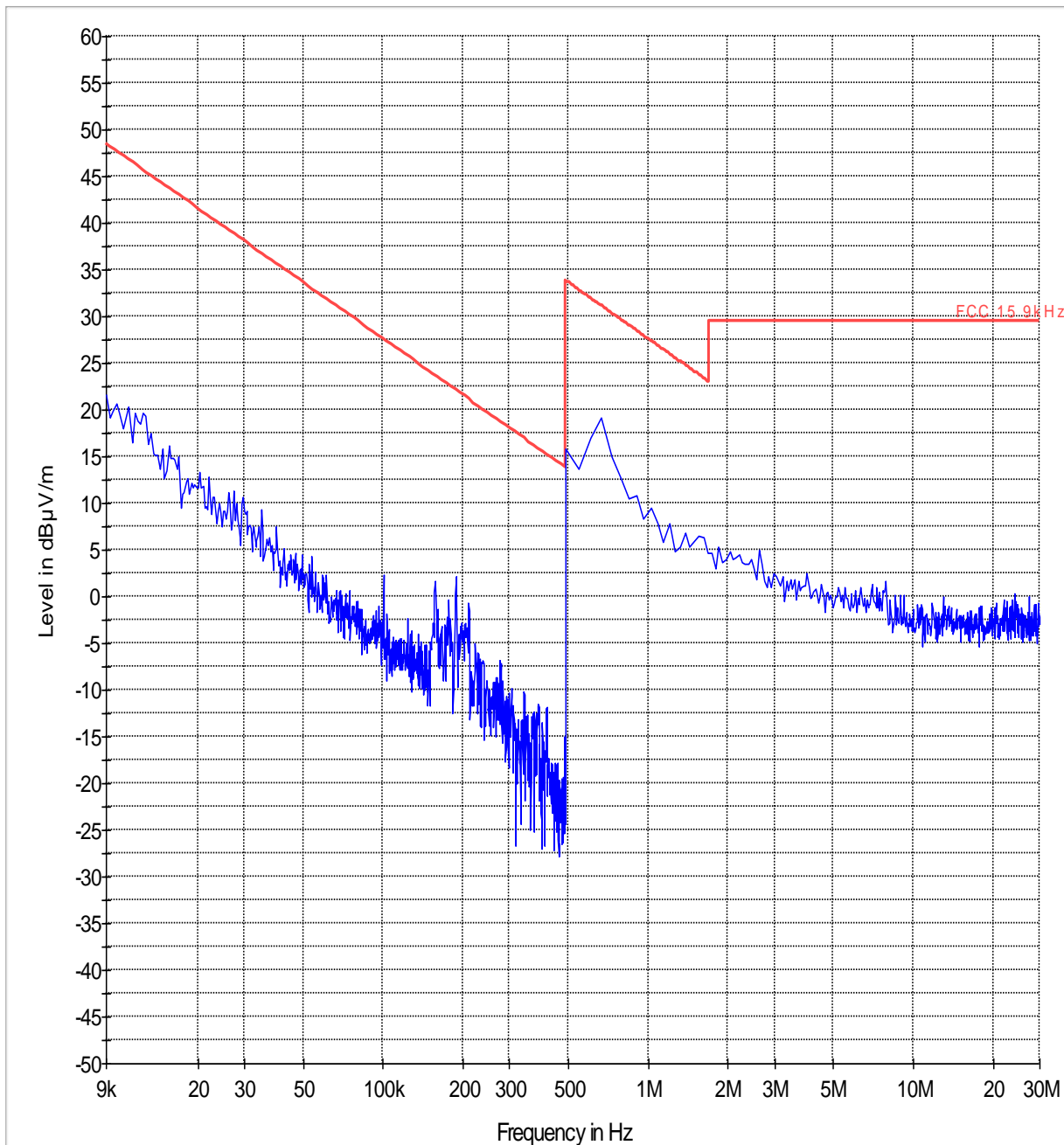
74 dBuV per m.LimitLine 54 dBuV per m.LimitLine Preview Result 1 Preview Result 2

**Test data/ plots: 5 GHz Band**

**Transmitter Radiated Spurious Emission:<30MHz**

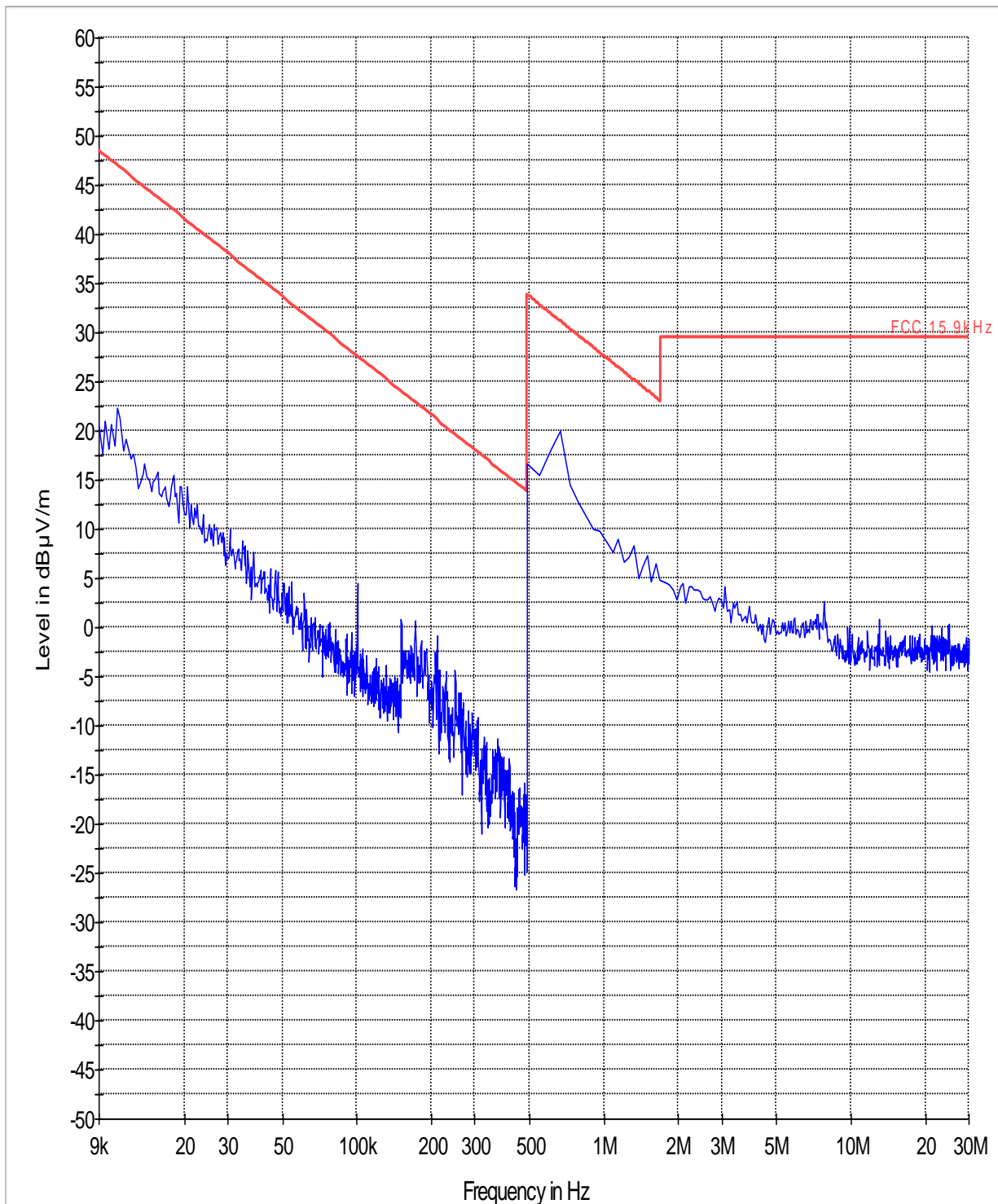
**Note: Worst case representation for all modes of operation in this frequency range- Limits adjusted for 3m measurement.**

**Transmitter Spurious Emission – 9k-30MHz - 802.11a - 5785MHz**



— FCC 15.9kHz.LimitLine — Preview Result 1

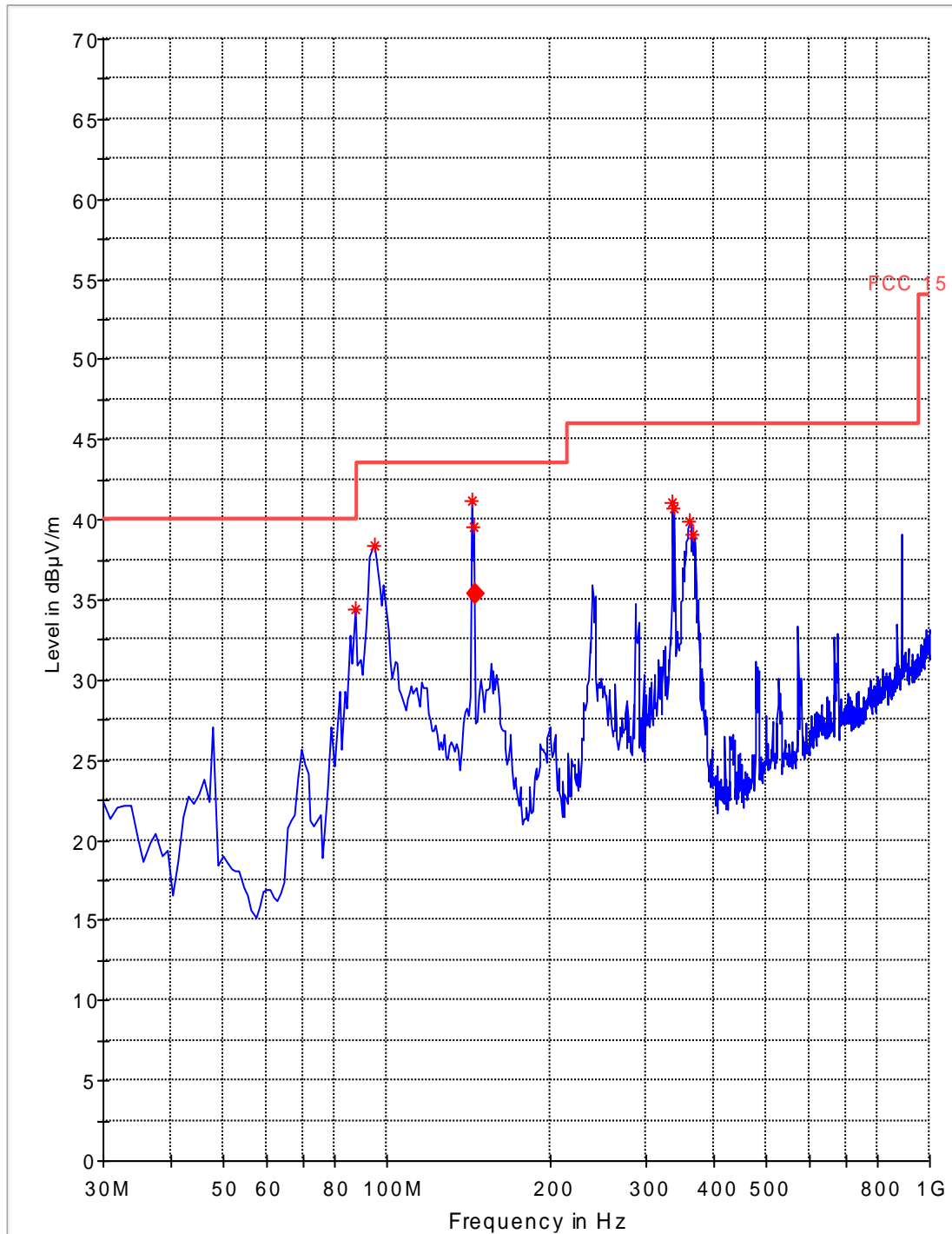
### Transmitter Spurious Emission - 9k-30MHz - 802.11n/HT20 - 5785MHz



— FCC 15.9kHz.LimitLine — Preview Result 1

### Transmitter Radiated Spurious Emission - 30M-1GHz - 802.11a - 5745MHz

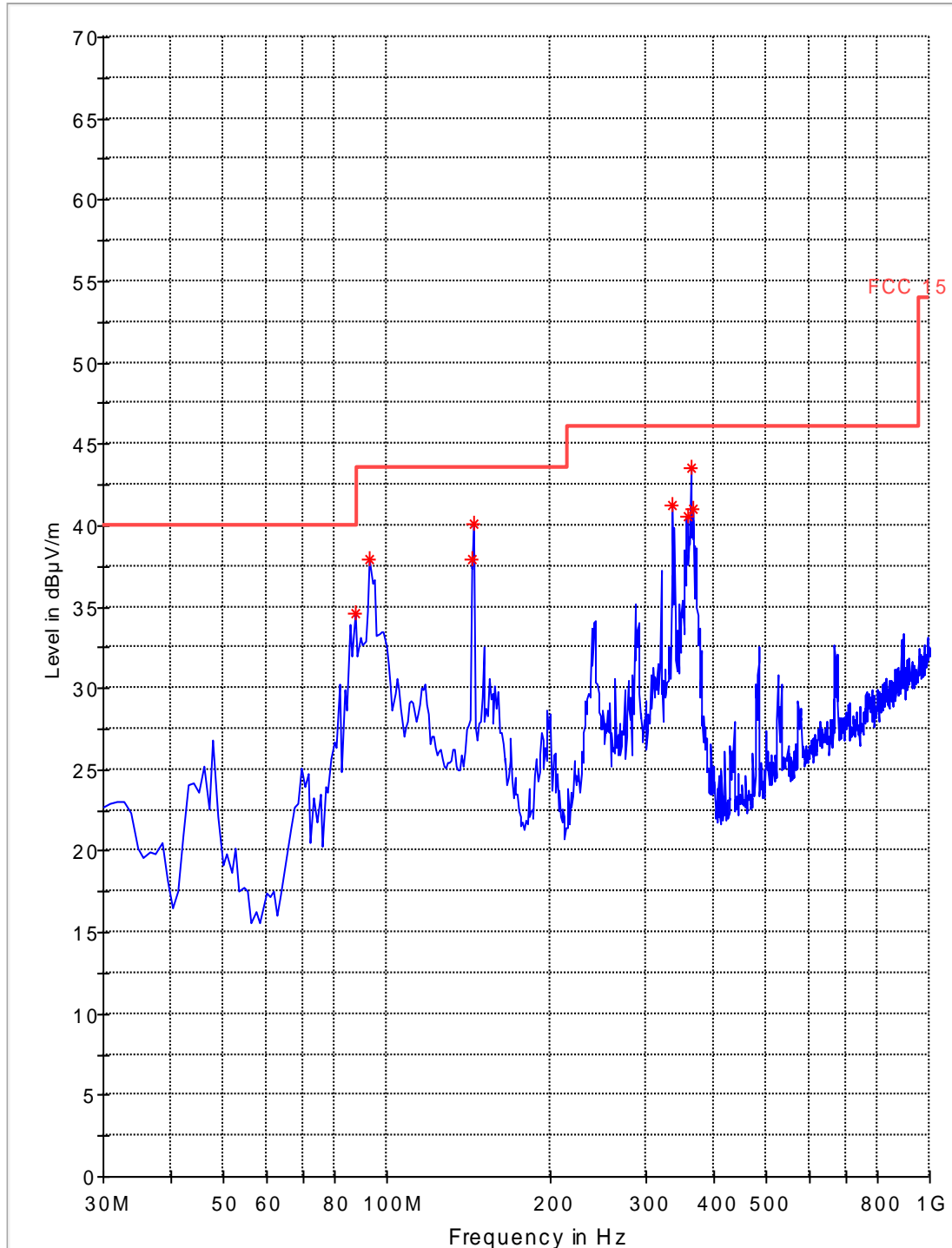
FCC 15 30-1000MHz



— FCC 15 Limit Line      — Preview Result 1  
\* Data Reduction Result 1 [3] ◆ Final Measurement Result 1

### Transmitter Radiated Spurious Emission - 30M-1GHz - 802.11n/HT20 - 5745MHz

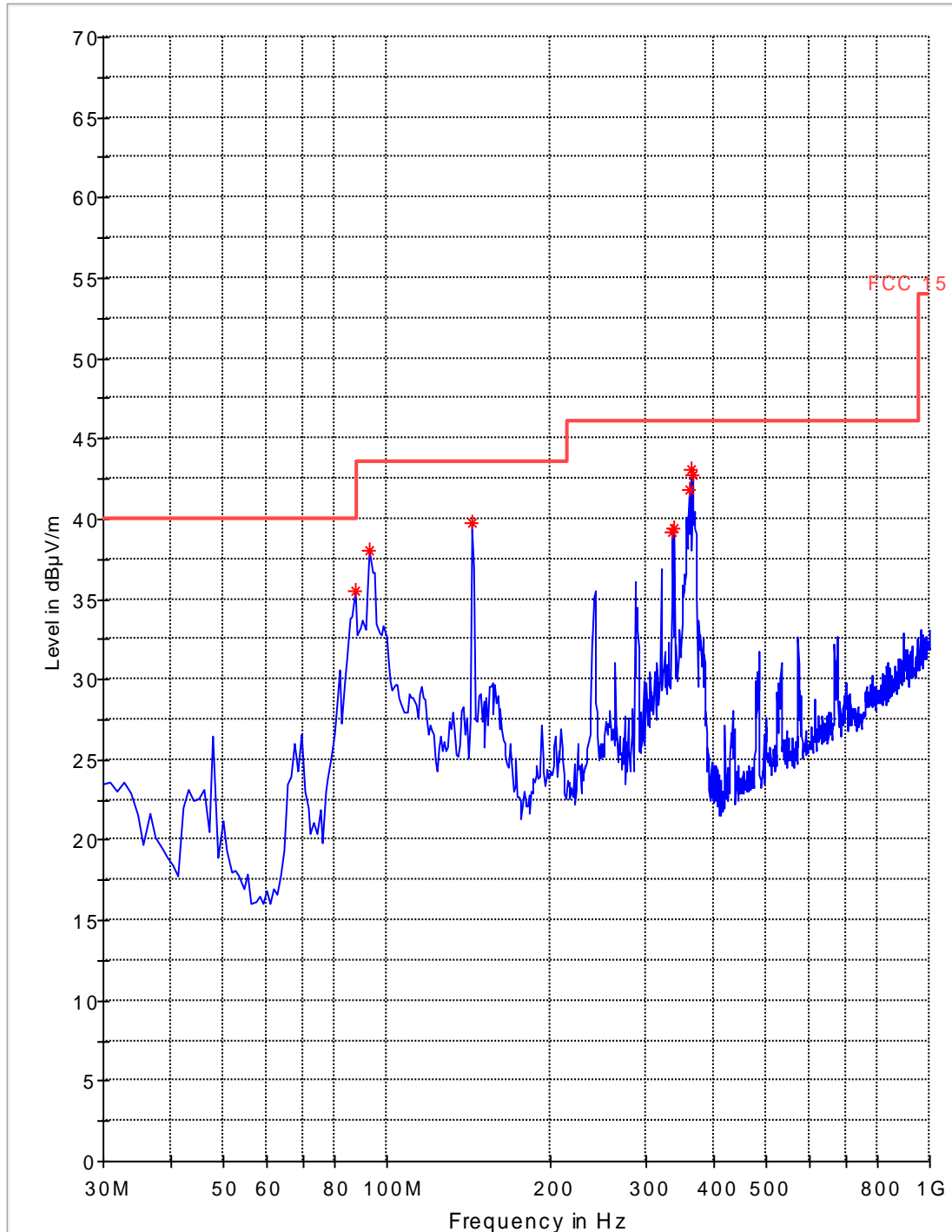
FCC 15 30-1000MHz



— FCC 15 Limit Line — Preview Result 1 \* Data Reduction Result 1 [3]

### Transmitter Radiated Spurious Emission - 30M-1GHz - 802.11a - 5785MHz

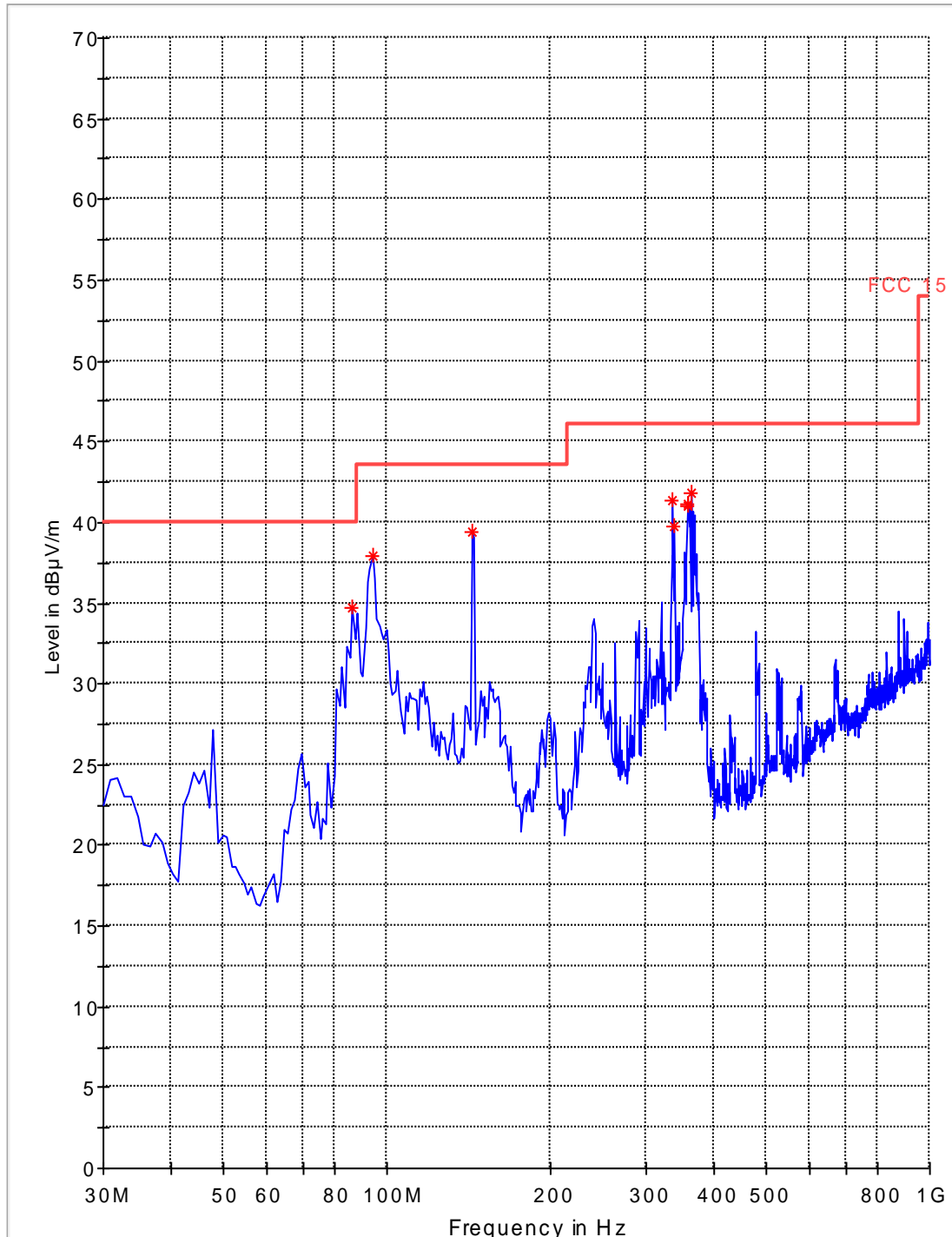
FCC 15 30-1000MHz



— FCC 15 Limit Line — Preview Result 1 \* Data Reduction Result 1 [3]

### Transmitter Radiated Spurious Emission - 30M-1GHz - 802.11n/HT20 - 5785MHz

FCC 15 30-1000MHz

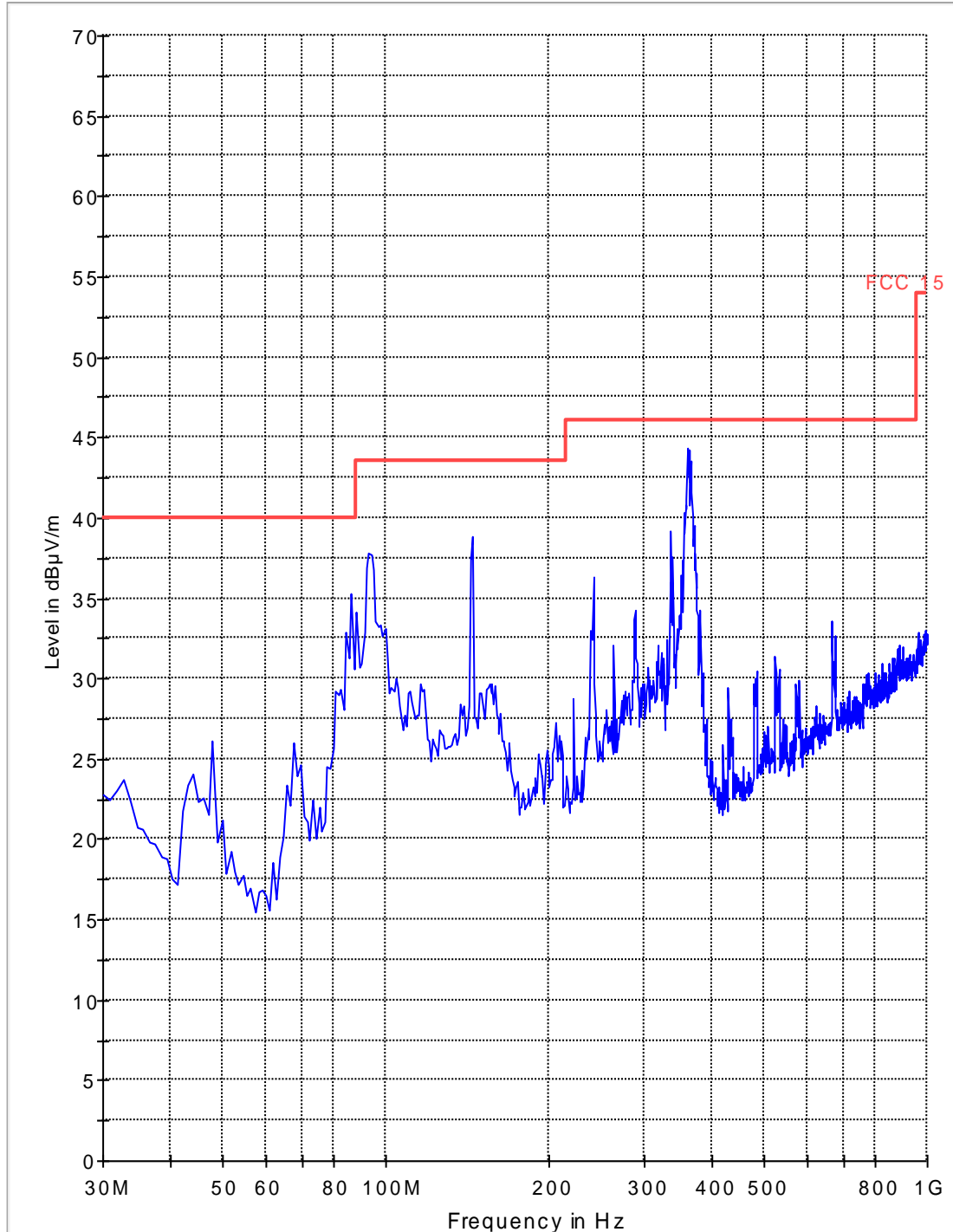


— FCC 15 Limit Line — Preview Result 1 \* Data Reduction Result 1 [3]



### Transmitter Radiated Spurious Emission - 30M-1GHz - 802.11a - 5825MHz

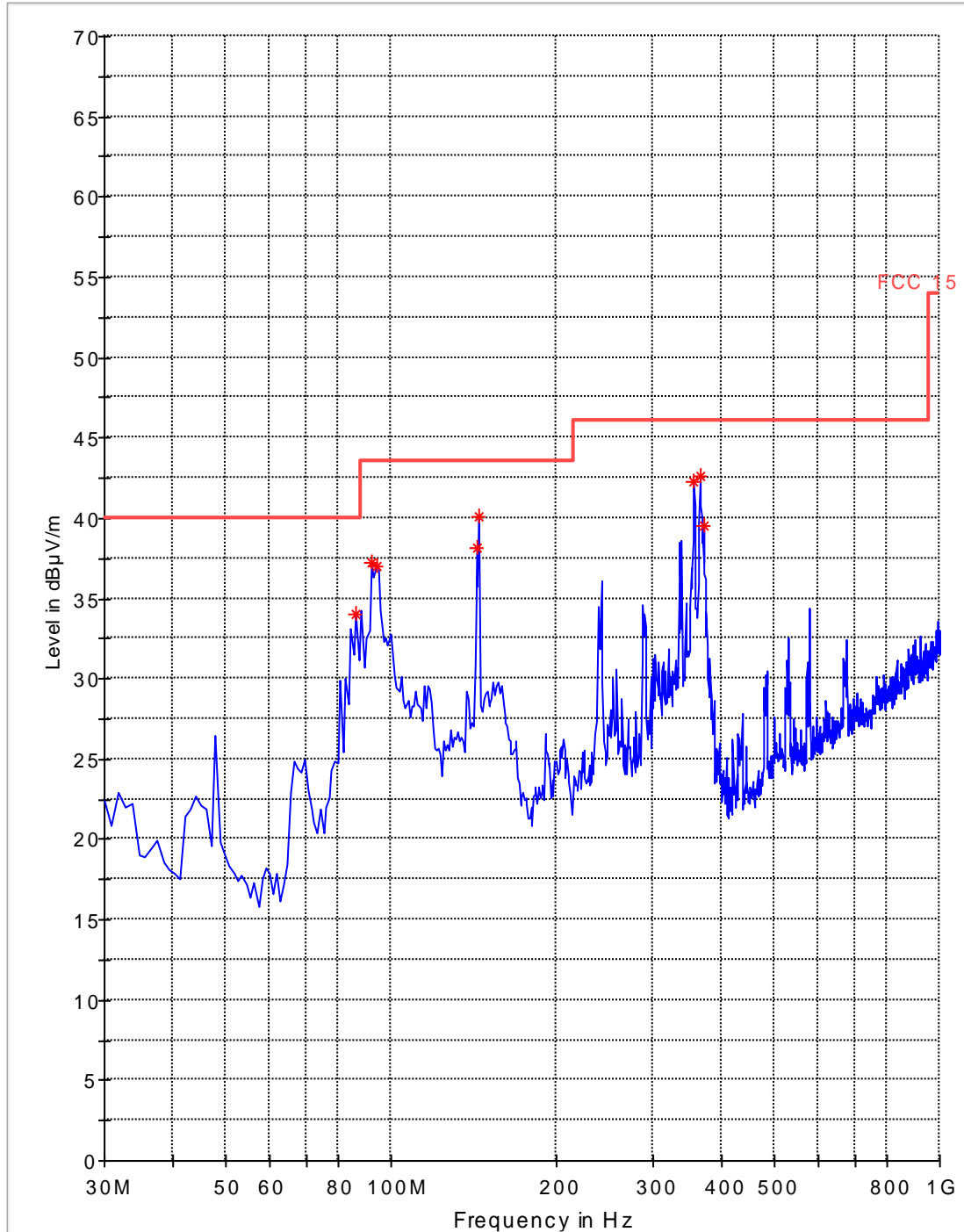
FCC 15 30-1000MHz



— FCC 15 Limit Line — Preview Result 1

### Transmitter Radiated Spurious Emission - 30M-1GHz - 802.11n/HT20 - 5825MHz

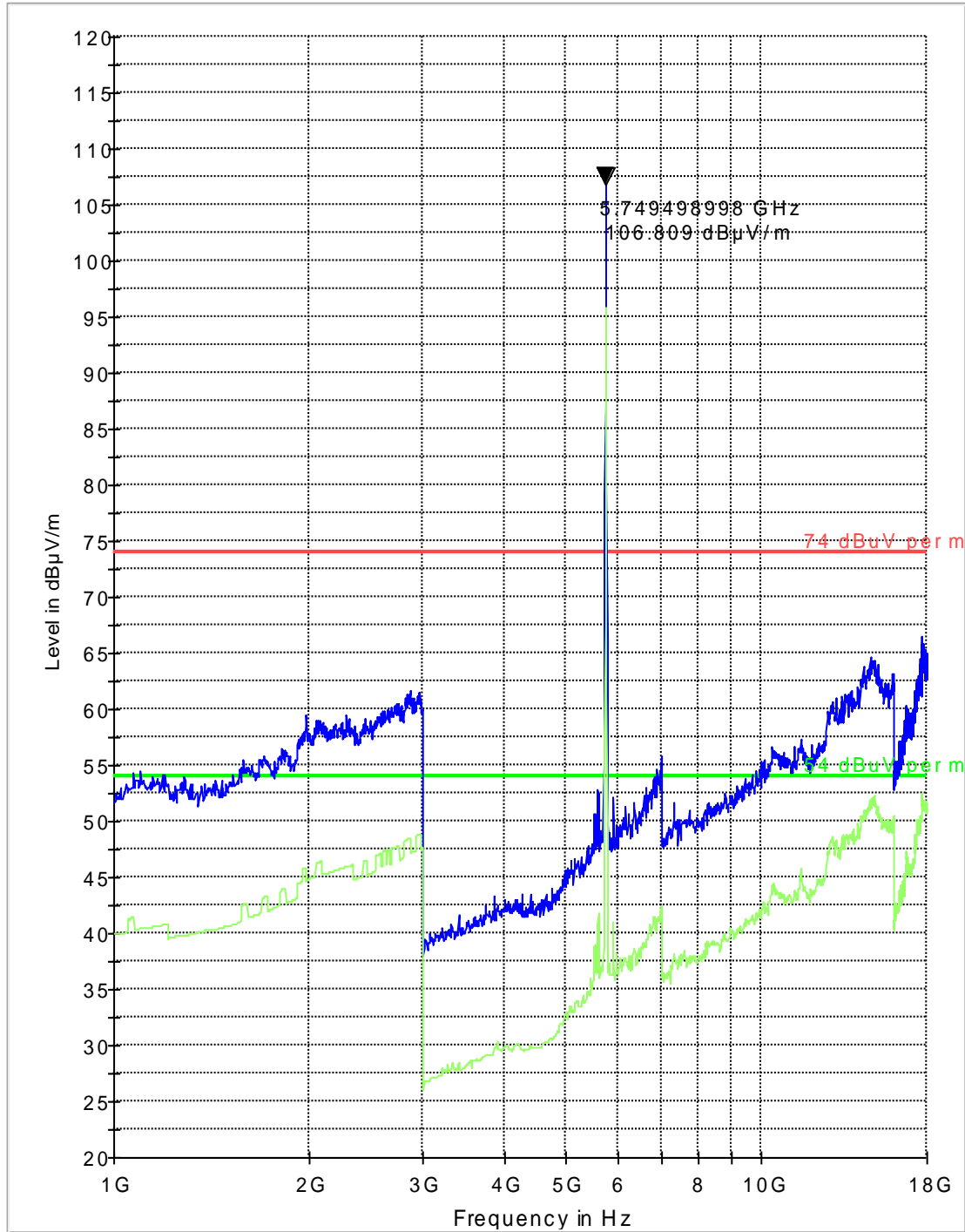
FCC 15 30-1000MHz



— FCC 15 Limit Line — Preview Result 1 \* Data Reduction Result 1 [3]

### Transmitter Radiated Spurious Emission - 1G-18GHz - 802.11a - 5745MHz

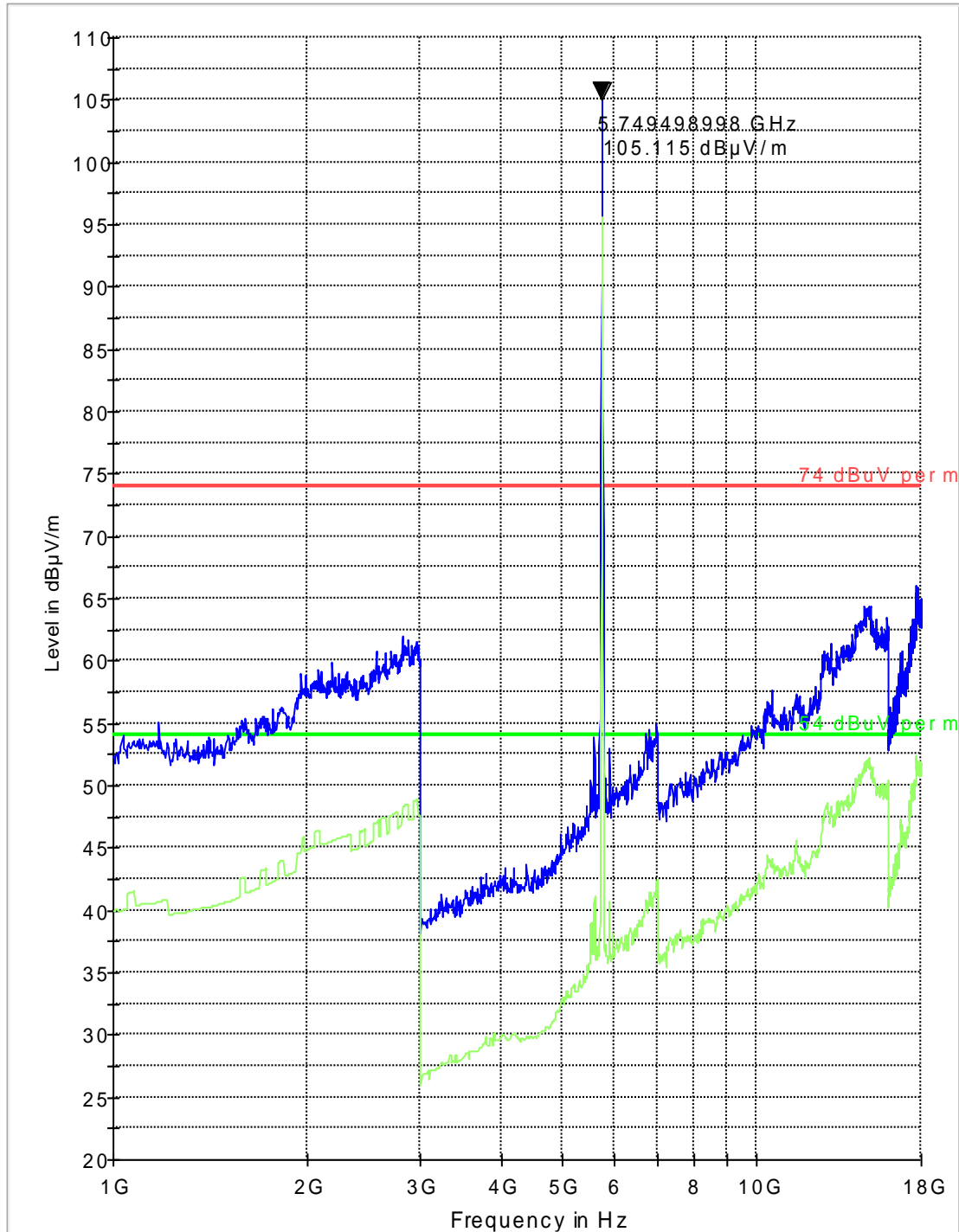
FCC 15 1-18GHz\_6GHz\_HPF



— 74 dBuV per m. Limit Line — 54 dBuV per m. Limit Line  
— Preview Result 1 — Preview Result 2

### Transmitter Radiated Spurious Emission - 1G-18GHz - 802.11n/HT20 - 5745MHz

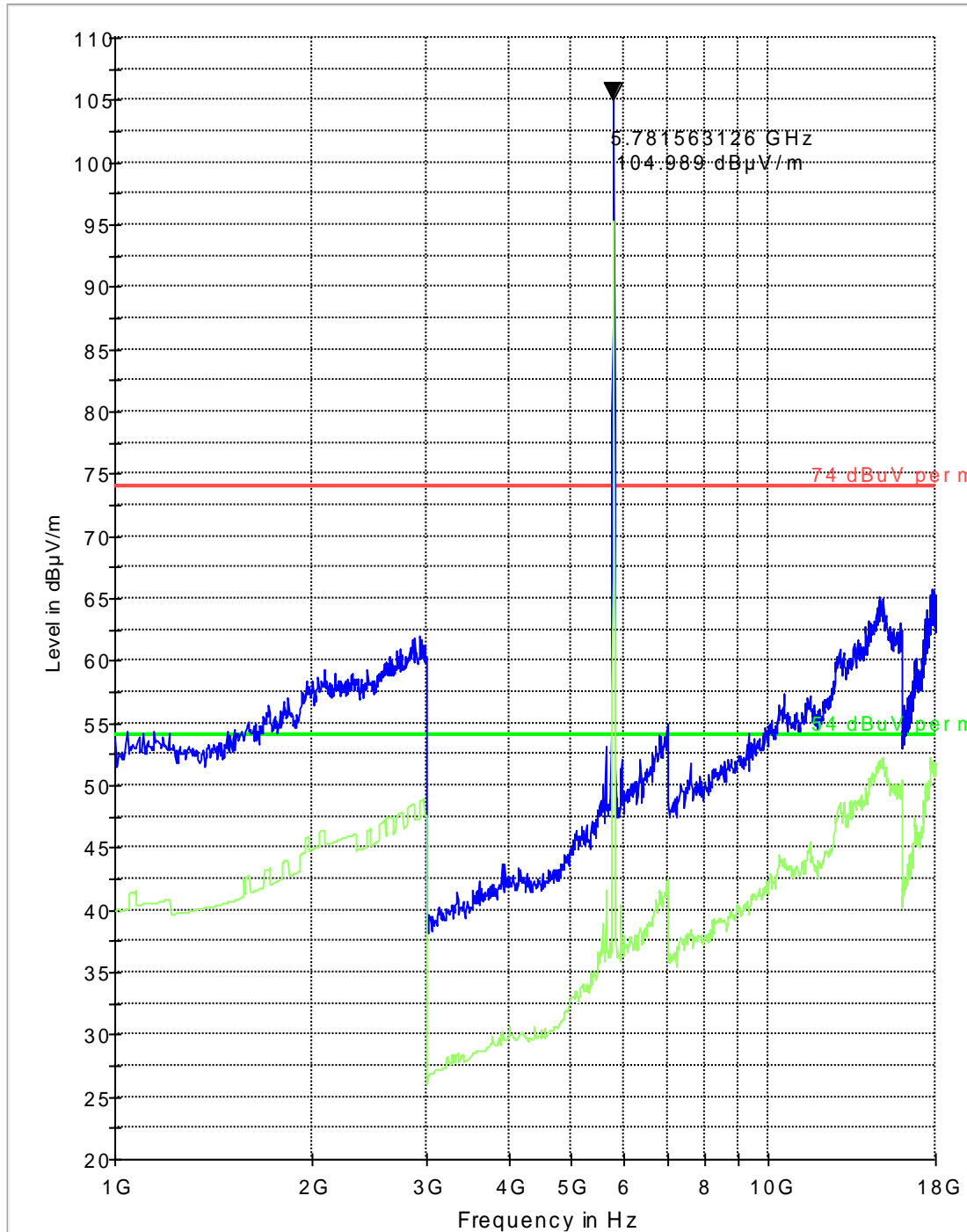
FCC 15 1-18GHz\_6GHz\_HPF



74 dBµV per m. Limit Line      54 dBµV per m. Limit Line  
Preview Result 1      Preview Result 2

### Transmitter Radiated Spurious Emission - 1G-18GHz - 802.11a - 5785MHz

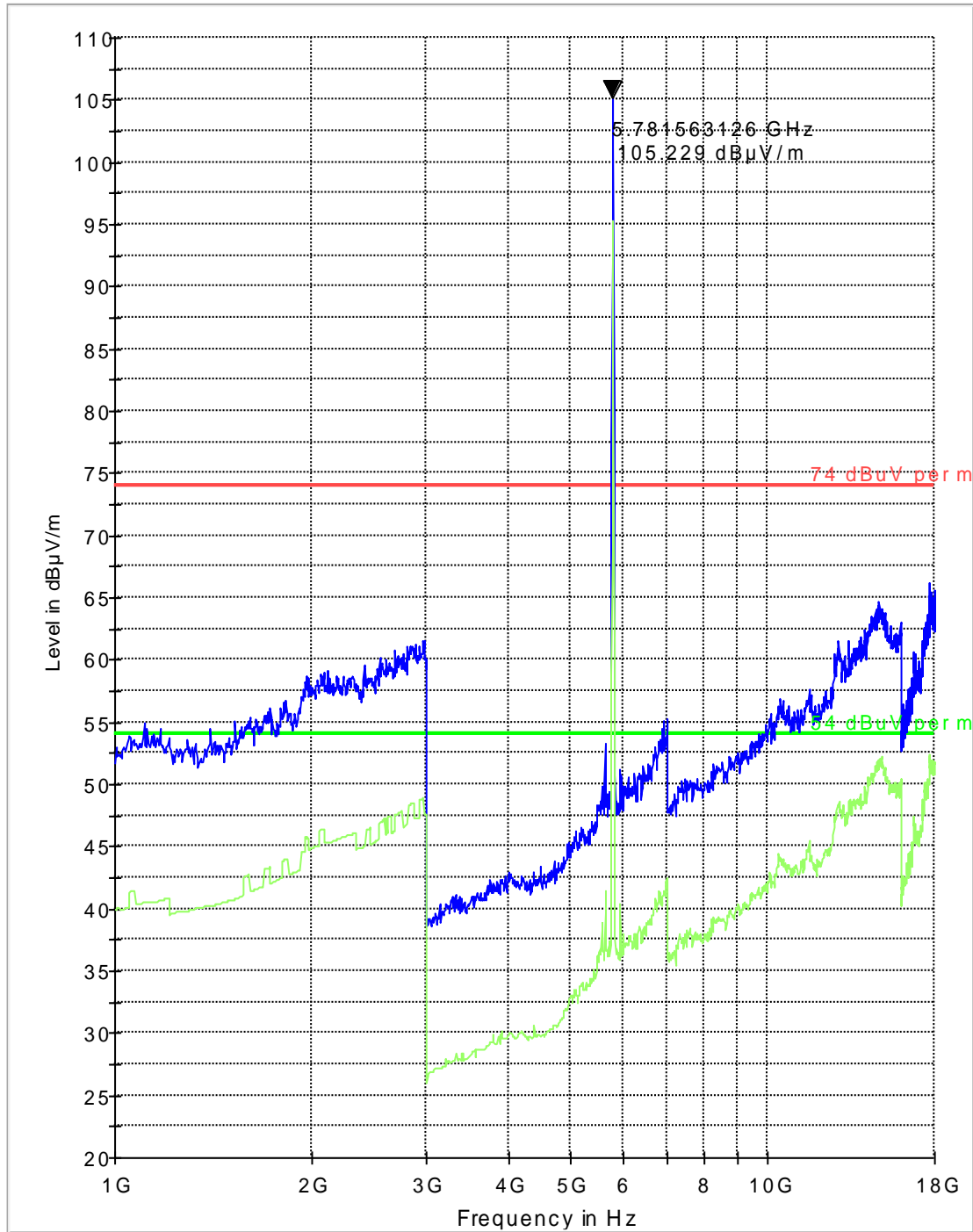
FCC 15 1-18GHz\_6GHz\_HPF



74 dBuV per m. Limit Line      54 dBuV per m. Limit Line  
Preview Result 1                  Preview Result 2

### Transmitter Radiated Spurious Emission - 1G-18GHz - 802.11n/HT20 - 5785MHz

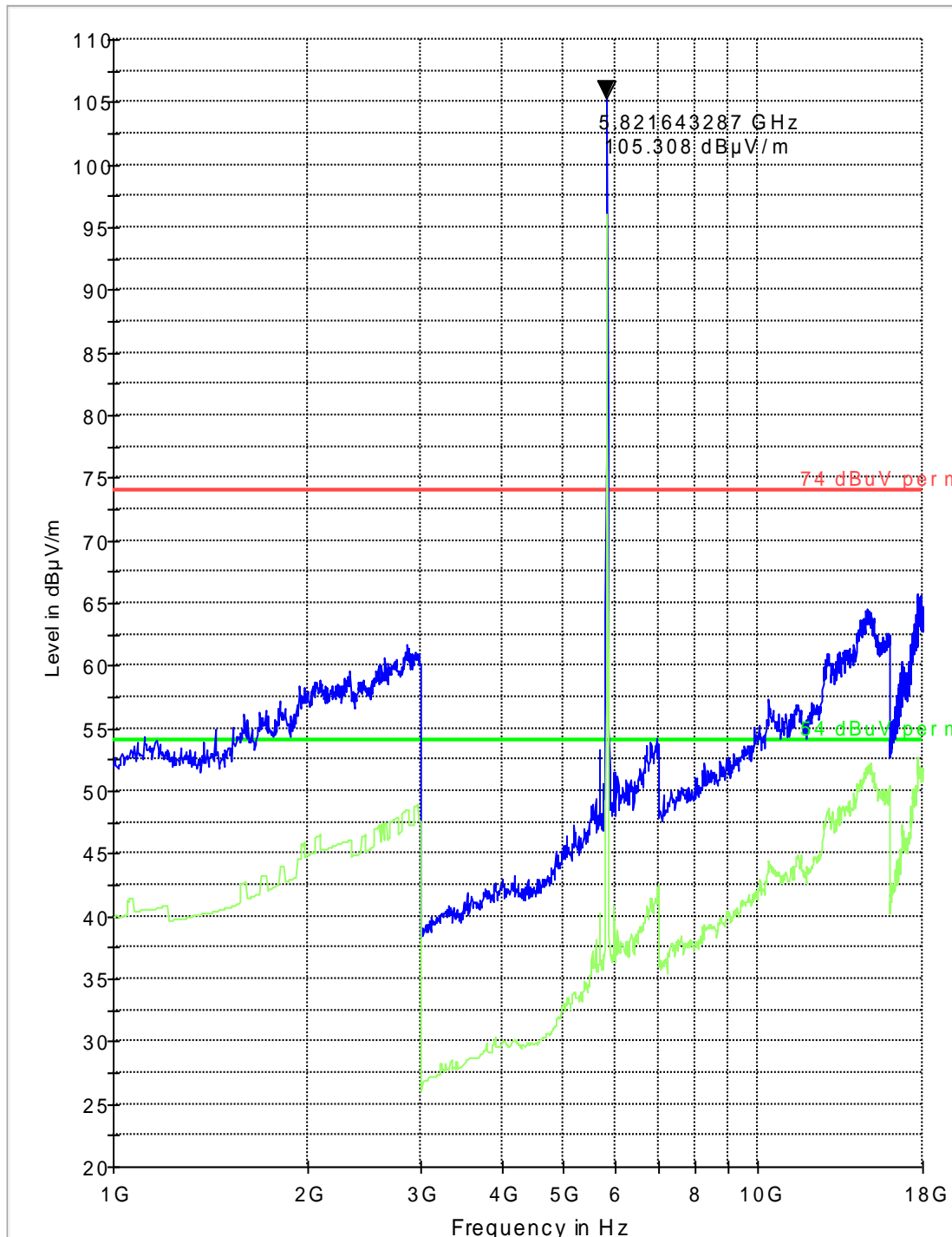
FCC 15 1-18GHz\_6GHz\_HPF



74 dBuV per m. Limit Line      54 dBuV per m. Limit Line  
Preview Result 1                  Preview Result 2

### Transmitter Radiated Spurious Emission - 1G-18GHz - 802.11a - 5825MHz

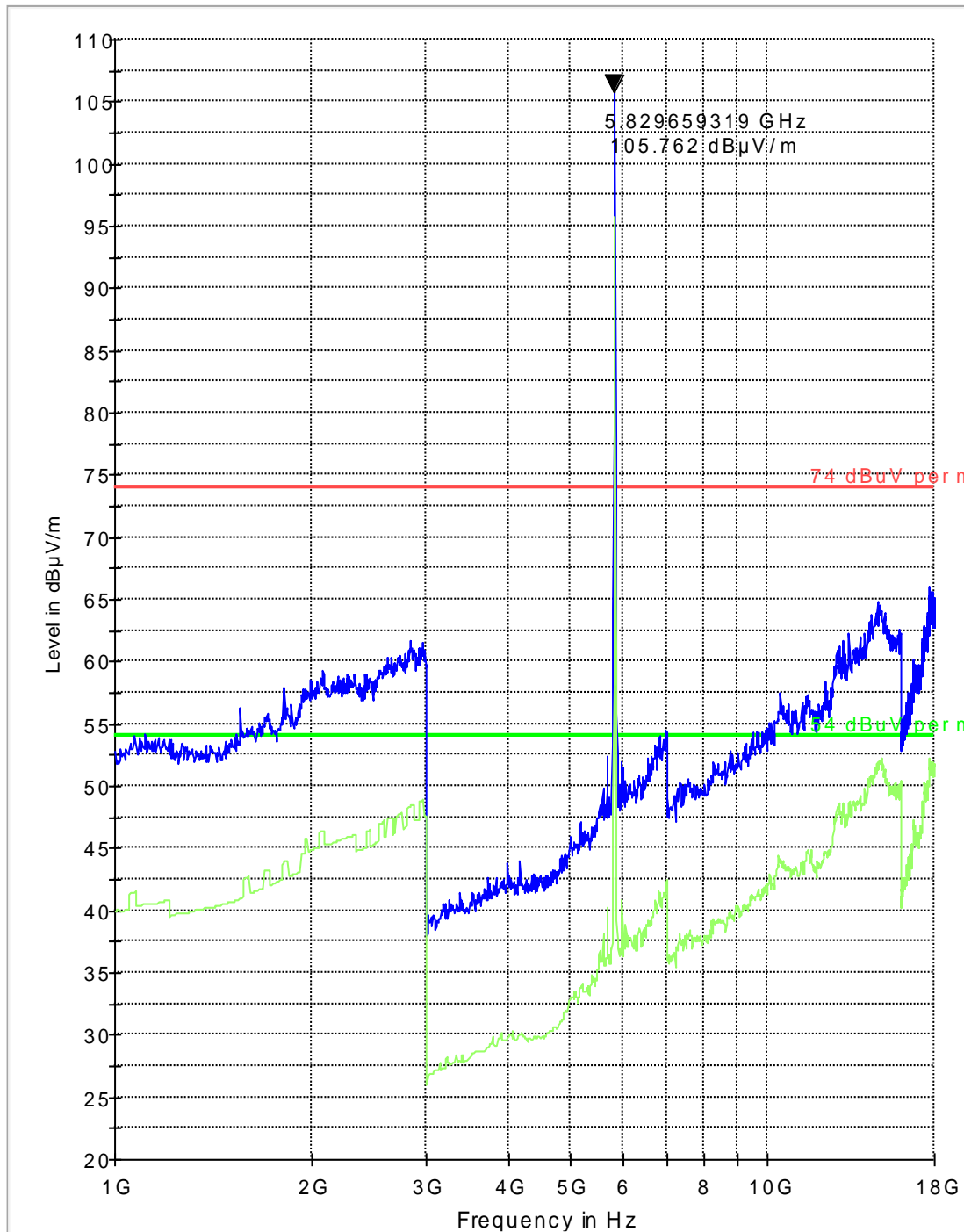
FCC 15 1-18GHz\_6GHz\_HPF



74 dBuV per m. Limit Line      54 dBuV per m. Limit Line  
Preview Result 1      Preview Result 2

### Transmitter Radiated Spurious Emission - 1G-18GHz - 802.11n/HT20 - 5825MHz

FCC 15 1-18GHz\_6GHz\_HPF



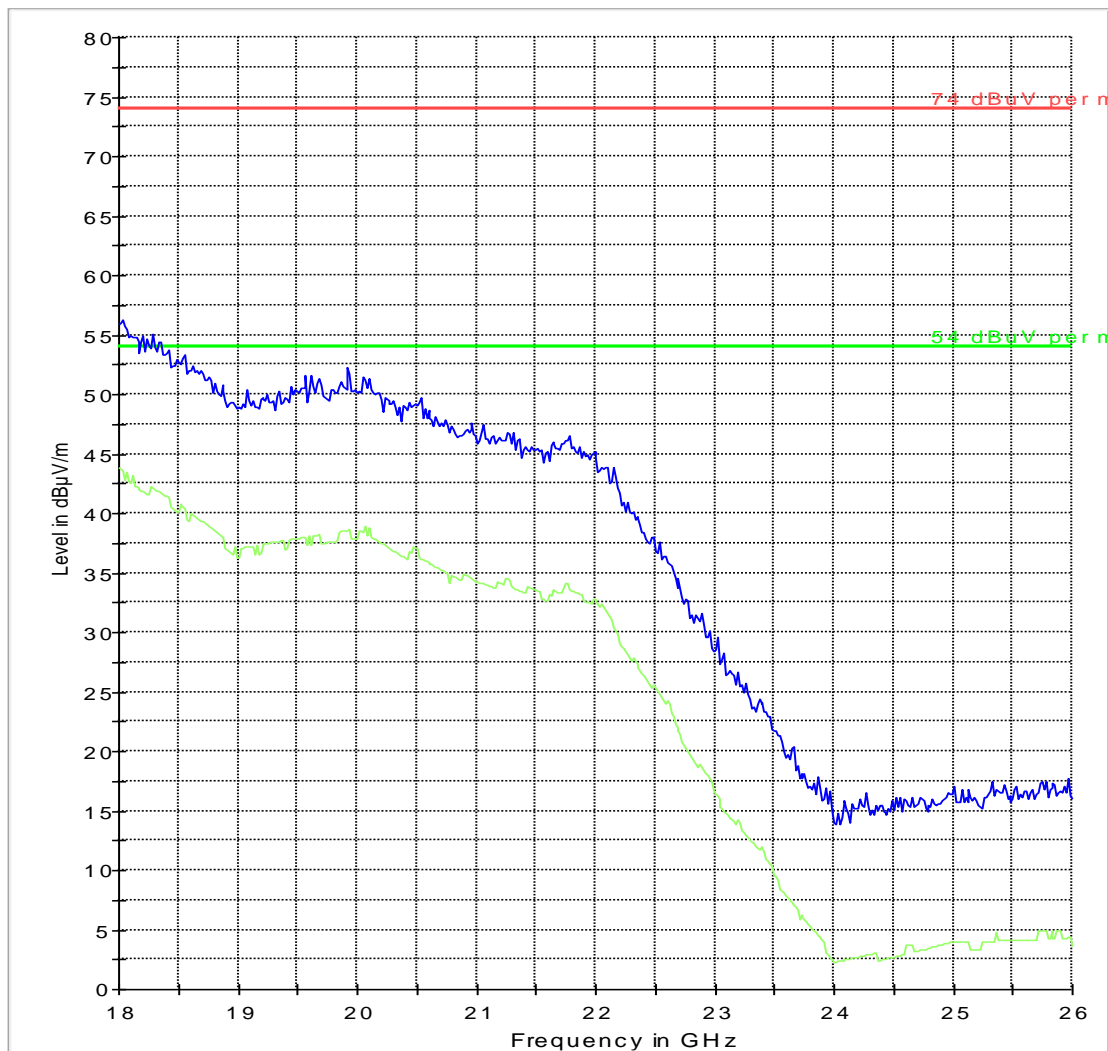
74 dBµV per m Limit Line      54 dBµV per m Limit Line  
Preview Result 1                  Preview Result 2



### Transmitter Radiated Spurious Emission - 18G-26GHz - 802.11a - 5785MHz

Worst case representation in this frequency range for all modes.

FCC 15 18-26GHz

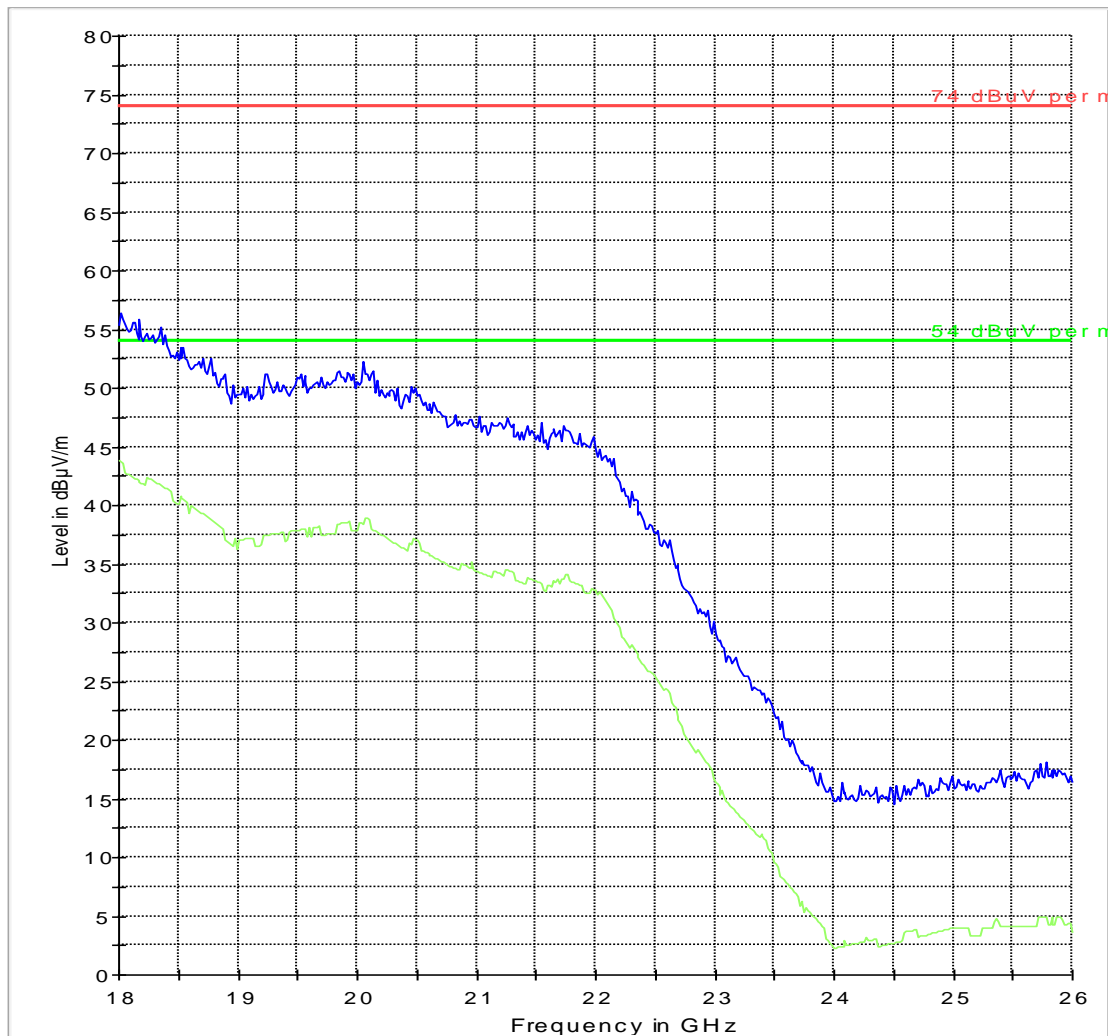


74 dBuV per m. Limit Line      54 dBuV per m. Limit Line  
Preview Result 1                  Preview Result 2

### Transmitter Radiated Spurious Emission - 18G-26GHz - 802.11n/HT20 - 5785MHz

Worst case representation in this frequency range for all modes.

FCC 15 18-26GHz



74 dBµV per m. Limit Line      54 dBµV per m. Limit Line  
Preview Result 1      Preview Result 2

## 6.10 AC Power Line Conducted Emissions

### 6.10.1 References:

FCC: CFR Part 15.207

IC: RSS-Gen Section 7.2.2

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.

### 6.10.2 Limits:

#### 6.10.2.1 §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.

#### 6.10.2.2 RSS-Gen 7.2.2

Except when the requirements applicable to a given device state otherwise, for any licence-exempt radiocommunication device equipped to operate from the public utility AC power supply, either directly or indirectly, the radio frequency voltage that is conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown below. The tighter limit applies at the frequency range boundaries.

**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- 9KHz.**

### 6.10.3 Test Conditions:

Modulation: 802.11b- Transmit mode of operation

Measurement Uncertainty:  $\pm$ 3.0dB

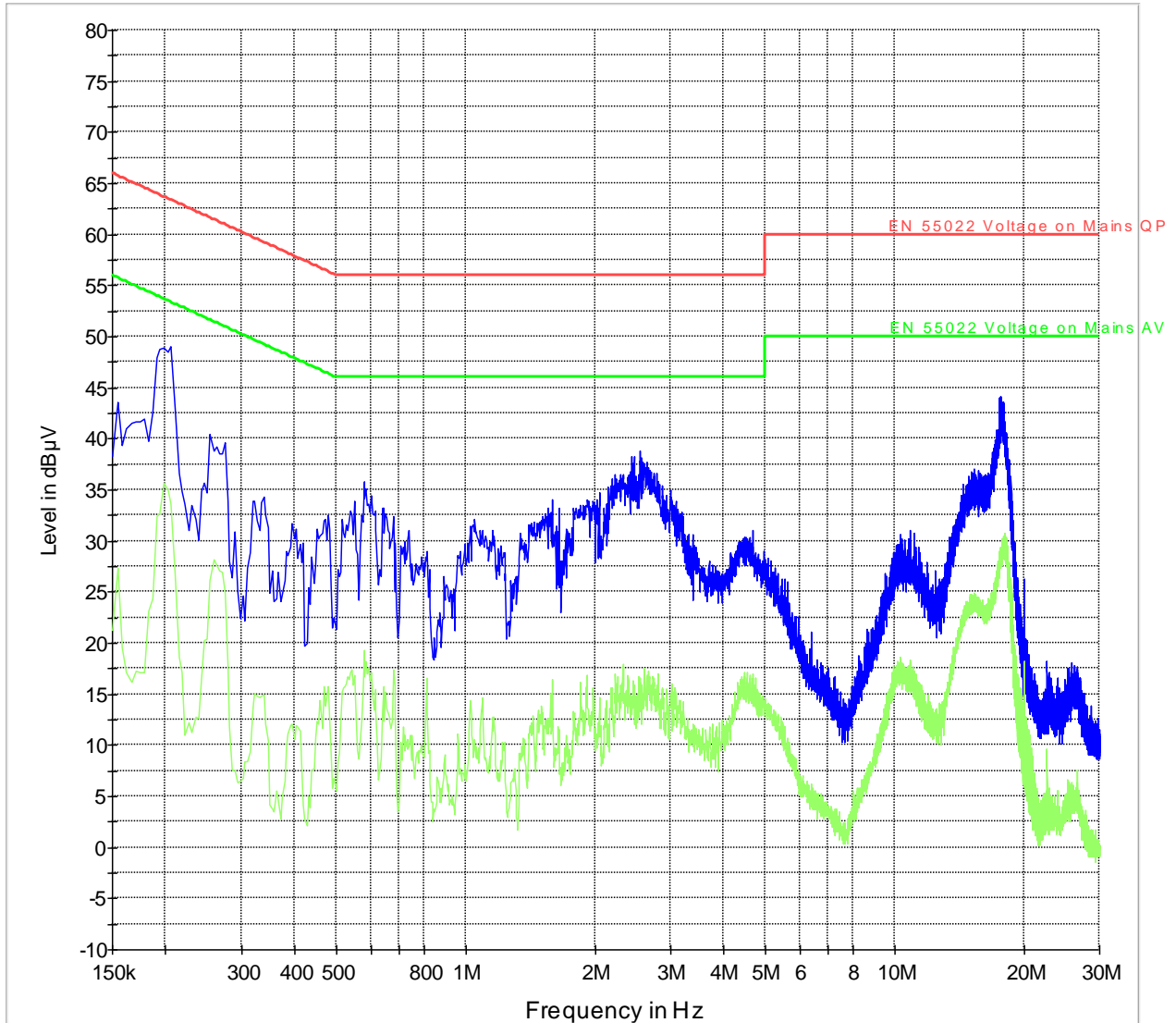
### 6.10.4 Results

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

#### 6.10.4.1 Measurement Result

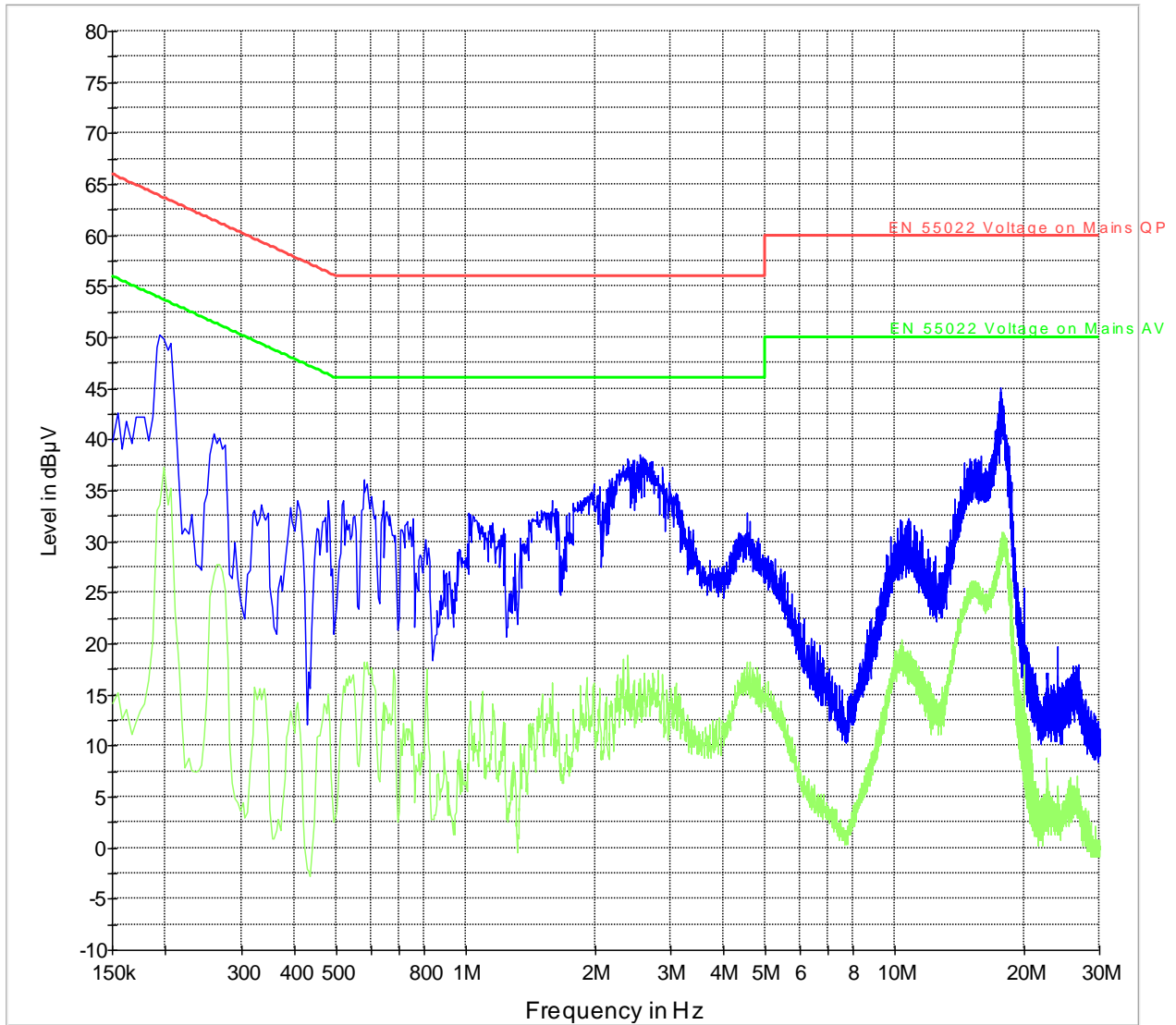
Pass.

### 6.10.5 Test Results: 2.4GHz / 5 GHz Band WLAN TX Mode – 2.4GHz Band – 2437MHz



EN 55022 Voltage on Mains QP.Limit Line EN 55022 Voltage on Mains AV.Limit Line Preview Result 1 Preview Result 2

**WLAN TX Mode – 5GHz Band – 5785MHz**



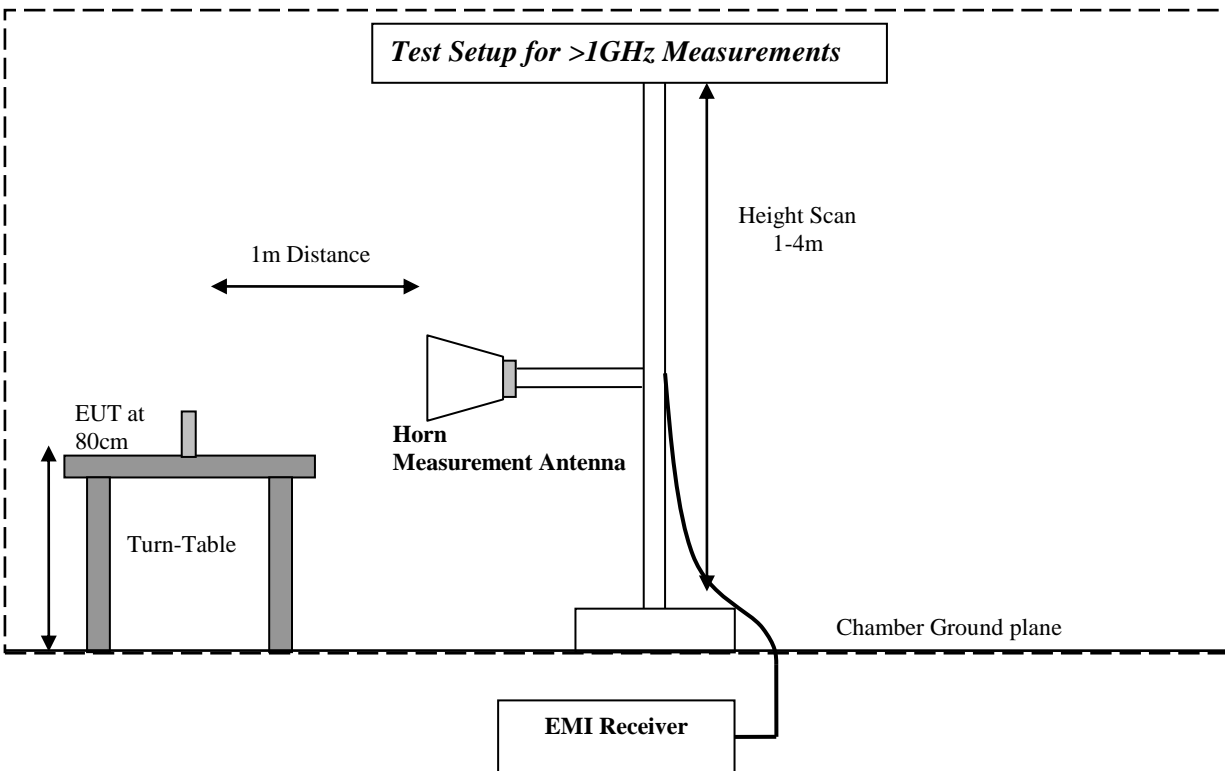
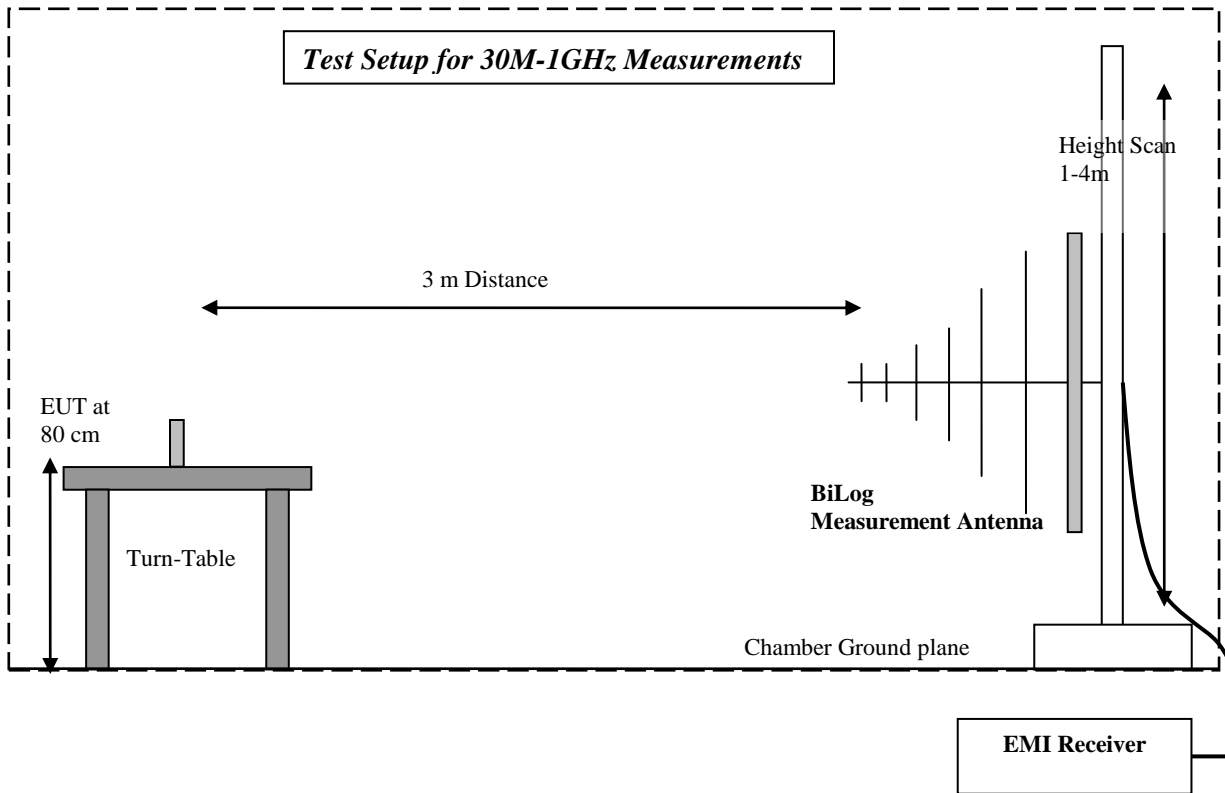
EN 55022 Voltage on Mains QP.LimitLine EN 55022 Voltage on Mains AV.LimitLine Preview Result 1 Preview Result 2

## 7 Test Equipment and Ancillaries used for tests

Instrument/Ancillary	Model	Manufacturer	Serial No.	Cal Date	Cal Interval
EMI Receiver/Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2011	1 year
Spectrum Analyzer	FSU	Rohde & Schwarz	200302	May 2011	1 year
Loop Antenna	6512	EMCO	00049838	Oct 2011	3 years
Biconilog Antenna	3141	EMCO	0005-1186	June 2009	3 years
Horn Antenna (1-18GHz)	3115	ETS	00035111	Jan 2009	3 years
Horn Antenna (18-40GHz)	3116	ETS	00070497	Oct 2011	3 years
High Pass Filter	5HC2700	Trilithic Inc.	9926013	Part of system calibration	
High Pass Filter	4HC1600	Trilithic Inc.	9922307	Part of system calibration	
6GHz High Pass Filter	HPM50106	Microtronics	001	Part of system calibration	
Pre-Amplifier	JS4-00102600	Miteq	00616	Part of system calibration	
LISN	50-25-2-08	FCC	08014	June 2011	1 year
Power Smart Sensor	R&S	NRP-Z81	100161	May 2011	1 Year
DC Power Supply	E3610A	Hewlett Packard	KR83021224	n/a	n/a
Multimeter	MM200	Klein	N/A	Apr 2011	1 Year
Temp Hum Logger	TM320	Dickson	03280063	Feb 2011	1 Year

Note: Testing on this EUT performed while the equipment calibration status was still valid.

8 **Block Diagrams**



**9 Revision History**

<b>Date</b>	<b>Report Name</b>	<b>Changes to report</b>	<b>Report prepared by</b>
2012-02-01	EMC_APPLE_089_11001_15.247WLAN	First Version	C Lee
2012-02-10	EMC_APPLE_089_11001_15.247WLAN_Rev1	Removed Receiver test data from Pg 99-104	C Lee