



FCC/IC Test Report

FOR:

Digi International Inc.

Model: WDNu

Description: Wireless Data Networking Unit Tracker installed in airplane

FCC ID: MCQ-WDNu

IC ID: 1846A-WDNu

47 CFR Part 15.247 for DTS Systems

IC RSS-210 Issue 8

TEST REPORT #: EMC_SPECT_008_11001_DTS_Rev3

DATE: 2012-07-24



**FCC listed
A2LA Accredited**

**IC recognized #
3462B**

CETECOM Inc.

411 Dixon Landing Road ♦ Milpitas, CA 95035 ♦ U.S.A.

Phone: + 1 (408) 586 6200 ♦ Fax: + 1 (408) 586 6299 ♦ E-mail: info@cetekomusa.com ♦ <http://www.cetekom.com>

CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

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1 Assessment

The following equipment (and as identified in Ch.3 of this test report) was evaluated against the applicable criteria specified in

- FCC CFR47 Parts 15.247, 15.209
- Industry Canada Radio Standard Specifications RSS-210 Issue 8

and no deviations were ascertained during the course of the tests performed.

Company	Description	Model Name
Digi International Inc.	Wireless Data Networking Unit installed in airplane	WDNU

Responsible for Testing Laboratory:

2012-07-24	Compliance	Sajay Jose (Test Lab Manager)	
Date	Section	Name	Signature

Responsible for the Report:

2012-07-24	Compliance	David Lang (EMC Engineer)	
Date	Section	Name	Signature

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.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Test Lab Manager:	Sajay Jose
Test Engineer	David Lang

2.2 Identification of the Client

Client:	Digi International Inc.
Street Address:	11001 Bren Road East
City/Zip Code	Minneapolis, MN 55343
Country	USA
Contact Person:	Frank Artner
Phone No.	952-912-3200
e-mail:	frank.artner@digi.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as client
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Model:	WDNU
Product Description:	Wireless Data Networking Unit installed in airplane
HW / SW Revision :	HW: 50001466-01 Rev A SW: 82002543
Integrated Module information:	Cinterion HC25 HW Ver: B2.12.1 SW Ver: 02.050
FCC ID:	MCQ-WDNU
IC ID:	1846A-WDNU
Radios supported:	GSM/GPRS/EDGE 850/900/1800/1900 UMTS FDD Bands 1/2/5 WLAN 802.11b/g 2.4GHz
Frequency and Channel Range and mode of test for this report:	WLAN 802.11b/g 2.4GHz 2412-2462 MHz / Ch: 1 – 11
Type(s) of Modulation:	802.11b: DSSS / 802.11g:OFDM
Antenna Type and Gain Information:	WLAN: 2.4-2.5GHz External 2.4GHz swivel blade (SMA male): Manufacturer stated Antenna Gain = -1dBi Cellular: Manufacturer stated antenna gain: 850 band= 2dBi, 1900 band= 3dBi.
Nominal Operating Voltage:	28 VDC
Rated Operating Voltage Range:	22V- 30V DC
Rated Operating Temperature Range:	-40°C to 70°C
Prototype / Production unit	Prototype

3.2 Identification of the Equipment Under Test (EUT)

EUT #	ID (IMEI #)	HW Version	SW Version
1	354114011031011	HW: 50001466-01 Rev A	SW: 82002543

3.3 Test modes of operation:

Worst case test modes of operation, as described below, is based on the max output power for different data rates and modulations, as stated by the manufacturer.

Mode	Data rate (Mbps)	Modulation scheme
802.11b	1.0	BPSK
802.11g	6.0	BPSK

During testing, the EUT was programmed to transmit in different modes and data rates using a test SW provided by the manufacturer. Output power was set to 25dBm.

3.4 Dates of testing:

Aug 2, 2011- Sep 7, 2011.

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 against the applicable criteria specified in

- 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.

This test report is to support a request for new equipment authorization under the FCC ID: **MCQ-WDNU** and IC ID: **1846A-WDNU**.

During the testing process the EUT was tested on low, mid and high channels in 802.11b and 802.11g modes.

For radiated measurements, all data in this report shows the worst case emissions data between H/V antenna polarizations and for all 3 orthogonal orientations of the EUT.

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	802.11b 802.11g	■	□	□	□	Complies
§15.247(e) RSS210 A8.2(b)	Power Spectral Density	Nominal	802.11b 802.11g	■	□	□	□	Complies
§15.247(a)(1) RSS210 A8.1(b)	Carrier Frequency Separation	Nominal		□	□	■	□	-
§15.247(a)(1) RSS210 A8.1(d)	Number of Hopping Channels	Nominal		□	□	■	□	-
§15.247(a)(1)(iii) RSS210 A8.3(1)	Time of occupancy	Nominal		□	□	■	□	-
§15.247(a)(1) RSS210 A8.2(a)	Spectrum Bandwidth	Nominal	802.11b 802.11g	■	□	□	□	Complies
§15.247(b)(1) RSS210 A8.4(2)	Maximum Output Power	Nominal	802.11b 802.11g	■	□	□	□	Complies
§15.247(d) RSS210 A8.5	Band edge compliance-Conducted	Nominal		□	□	□	■	-
§15.247(d) RSS210 A8.5	Band edge compliance-Radiated	Nominal	802.11b 802.11g	■	□	□	□	Complies
§15.247(d) RSS210 A8.5	TX Spurious emissions-Conducted	Nominal	802.11b 802.11g	■	□	□	□	Complies
§15.247(d) RSS210 A8.5	TX Spurious emissions-Radiated	Nominal	802.11g	■	□	□	□	Complies
§15.209(a) RSS Gen	TX Spurious Emissions Radiated<30MHz	Nominal	802.11g	■	□	□	□	Complies

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

1. Band Edge compliance-conducted is NOT PERFORMED as the device passes radiated measurement.
2. Hopping test cases NA for WLAN.

6 Measurements

6.1 Measurement Methode

All radiated and conducted testing is performed according to guidelines in FCC publication KDB558074: Measurement of Digital Transmission systems operating under Section 15.247, March 23, 2005.

6.2 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.

6.3 Sample Calculations for Radiated Measurements

6.3.1 Field Strength Measurements:

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

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

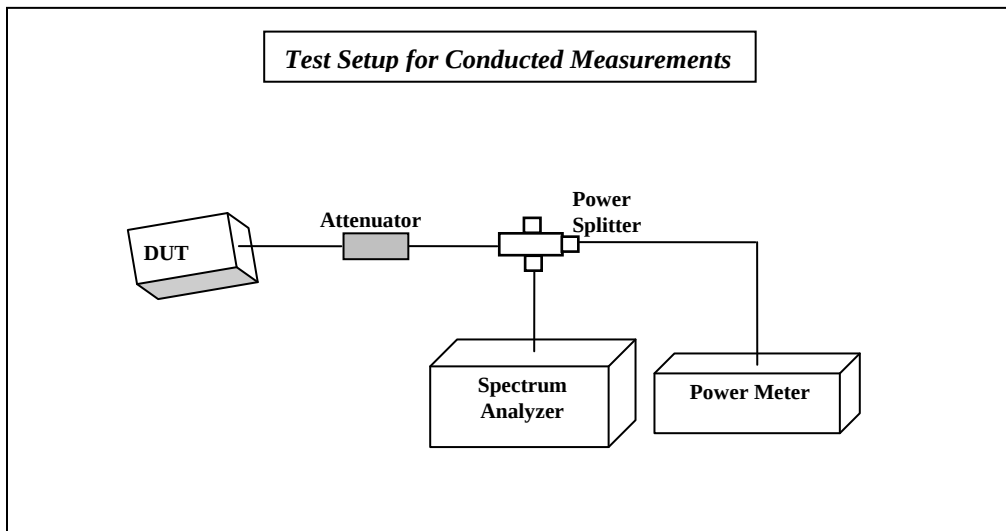
FS (dB μ V/m)= Measured Value on SA (dB μ V)+ Cable Loss (dB)+ Antenna Factor (dB/m)

Eg:

Frequency (MHz)	Measured SA (dB μ V)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dB μ 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.

6.4 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. Adjust the settings of the EUT to set to transmit at a specific mode and with the desired power levels.
3. Measurements are to be performed with the EUT set to the low, middle and high channels.

6.5 Fundamental Emission Output Power

6.5.1 Limits:

6.5.1.1 §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.

6.5.1.2 RSS 210- A8.4(2)

Nominal Peak Output Power < 30 dBm (1W)

EIRP < 36dBm

6.5.2 Test Conditions:

Tnom: 25°C; Vnom: 28V

Spectrum Analyzer settings:

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

Sweep Time: Auto

Span=40MHz

Reported Antenna Gain (dBi): -1dBi for all channels.

6.5.3 Test Result:

Measured Maximum Peak Conducted Output Power (dBm)			
Mode	Frequency (MHz)		
	2412 Channel 1	2437 Channel 6	2462 Channel 11
802.11b	18.09	18.45	17.87
802.11g	20.43	20.56	20.20
Measurement Uncertainty: ± 0.5 dB			

Calculated Maximum Peak Radiated Output Power (dBm)			
Mode	Frequency (MHz)		
	2412 Channel 1	2437 Channel 6	2462 Channel 11
802.11b	17.09	17.45	16.97
802.11g	19.43	19.56	19.20
Measurement Uncertainty: ± 3 dB			

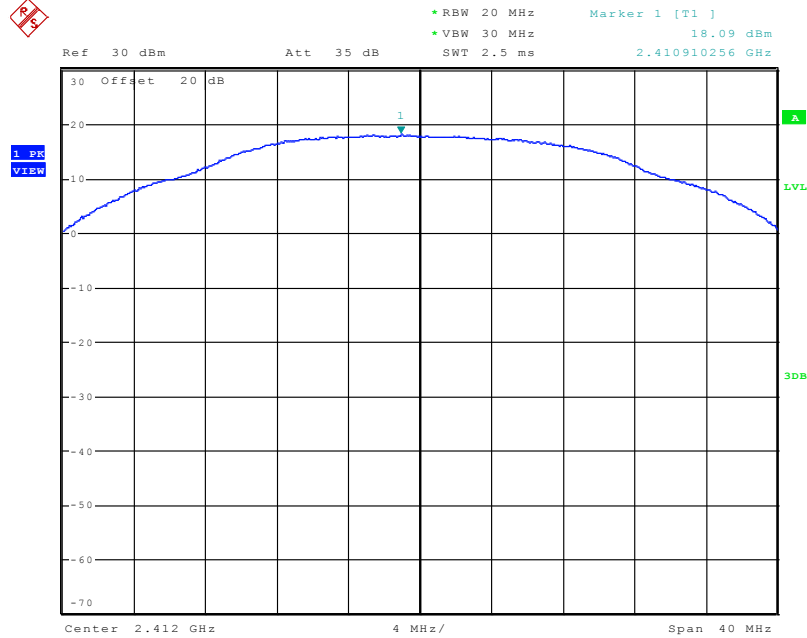
Note: Radiated EIRP is calculated as
Conducted Measurement + Antenna Gain

6.5.3.1 Measurement Result

Pass.

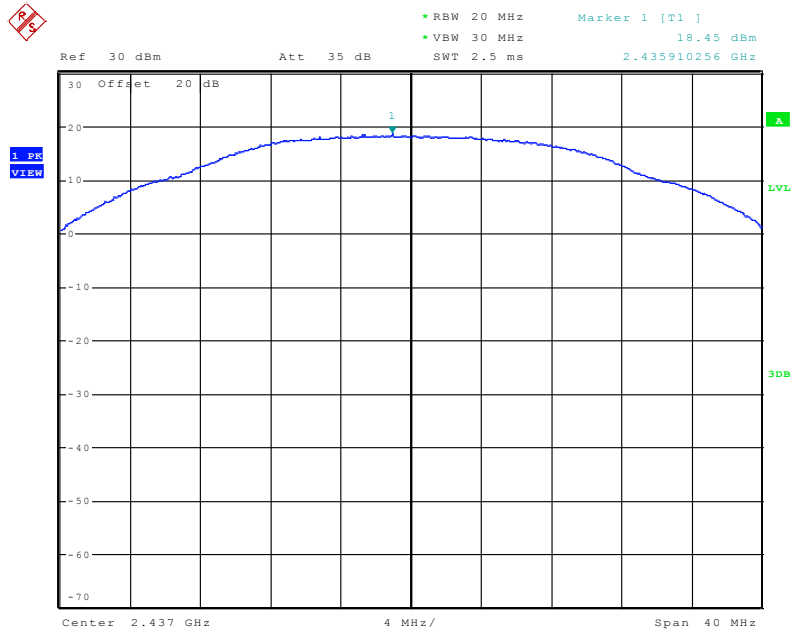
6.5.4 Test Data/plots:

Conducted Peak Power 802.11b 2412 MHz



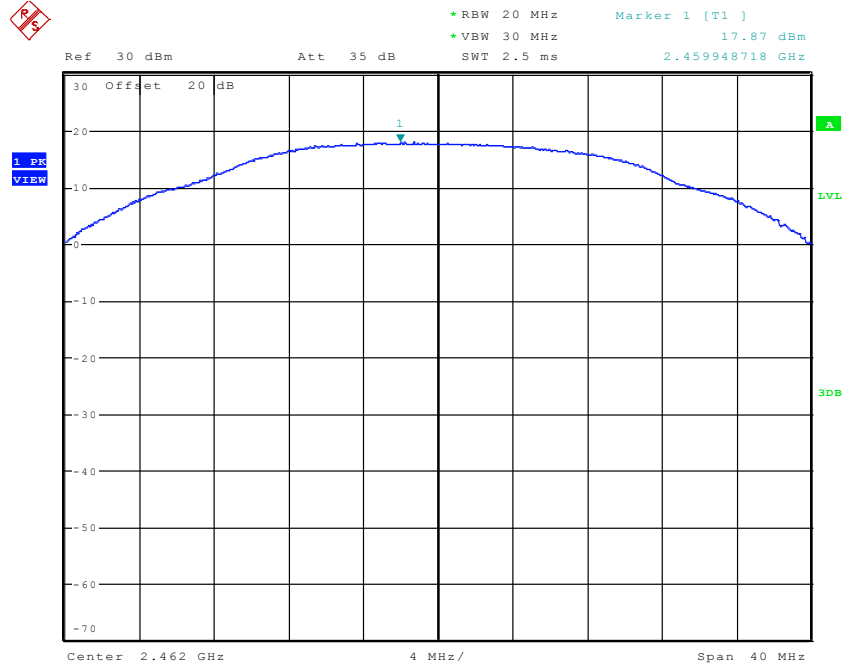
Date: 31.JUL.2011 10:47:05

Conducted Peak Power 802.11b 2437 MHz



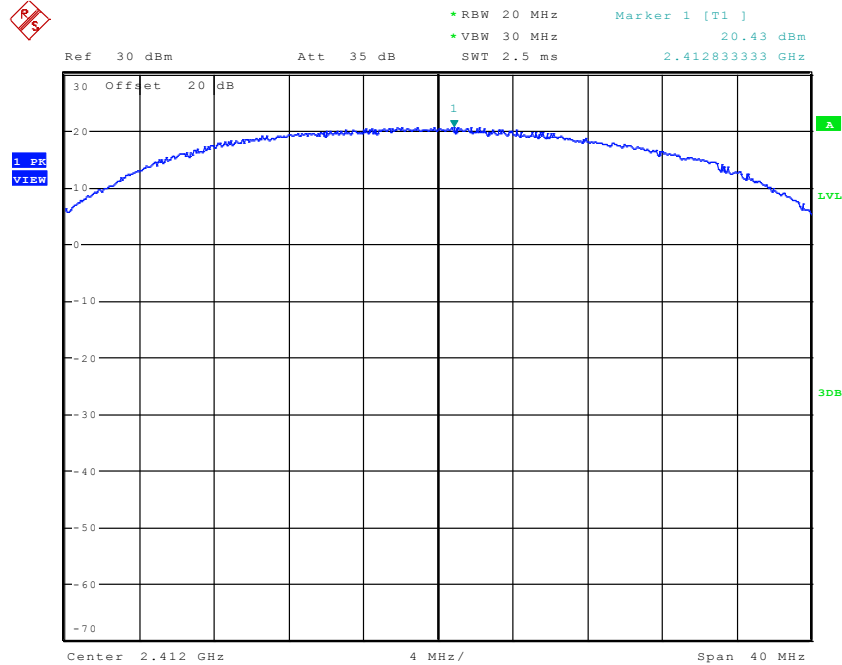
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Conducted Peak Power 802.11b 2462 MHz



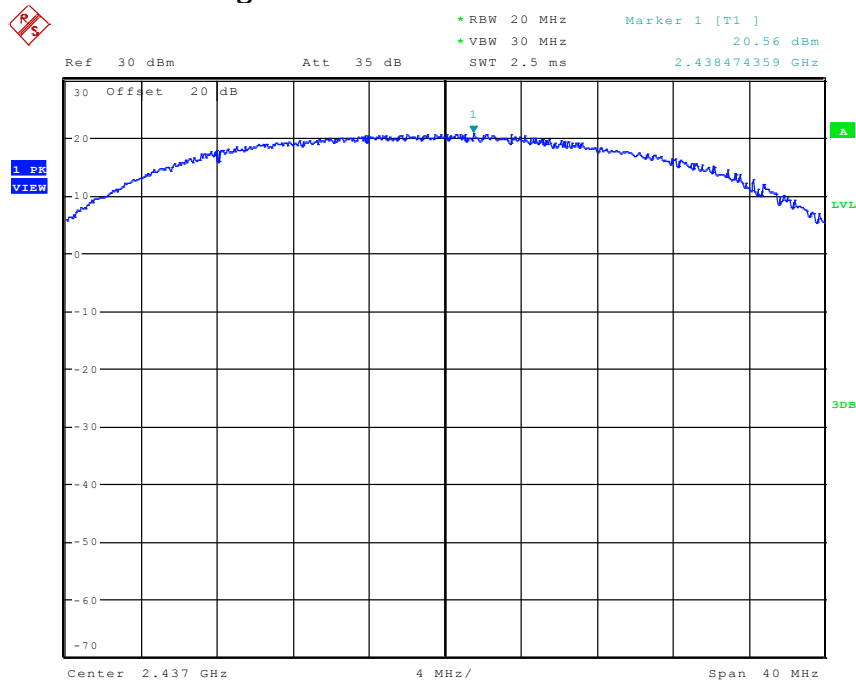
Date: 31.JUL.2011 10:48:56

Conducted Peak Power 802.11g 2412 MHz



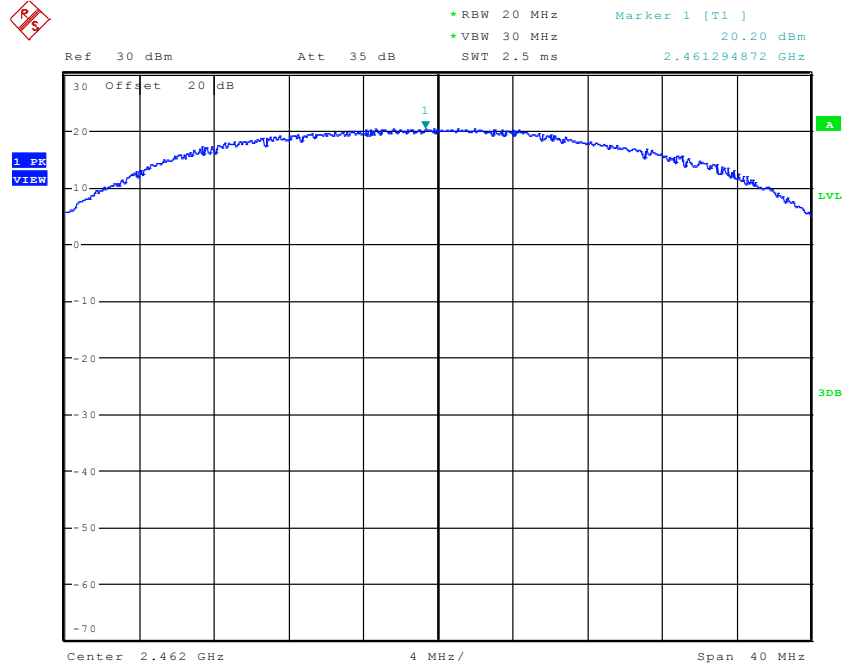
Date: 31.JUL.2011 10:51:15

Conducted Peak Power 802.11g 2437 MHz



Date: 31.JUL.2011 10:55:03

Conducted Peak Power 802.11g 2462 MHz



Date: 31.JUL.2011 10:56:47

6.6 Emission 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: 28V

Spectrum Analyzer settings:

RBW=200kHz, VBW=1MHz, Detector: Peak- Max hold;

Sweep Time: Auto

Span=50MHz

6.6.3 Test Result:

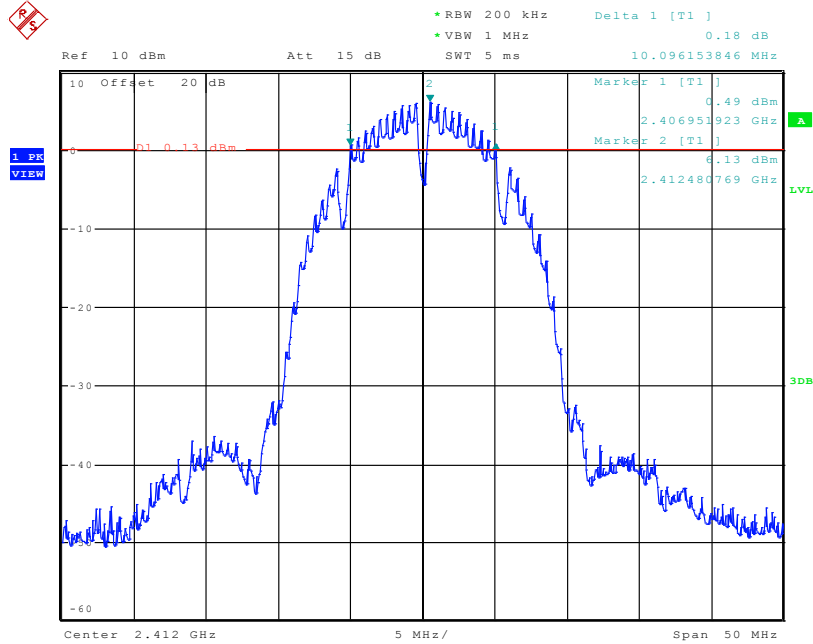
Occupied Bandwidth (MHz)						
Mode	Frequency (MHz)					
	2412 Channel 1		2437 Channel 6		2462 Channel 11	
	6dB	20dB/ 99%	6dB	20dB/ 99%	6dB	20dB/ 99%
802.11b	10.09	16.35	10.18	16.35	10.09	16.35
802.11g	16.43	17.87	16.35	17.95	16.43	17.95
Measurement Uncertainty: ±100 kHz						

6.6.3.1 Measurement Result

Pass.

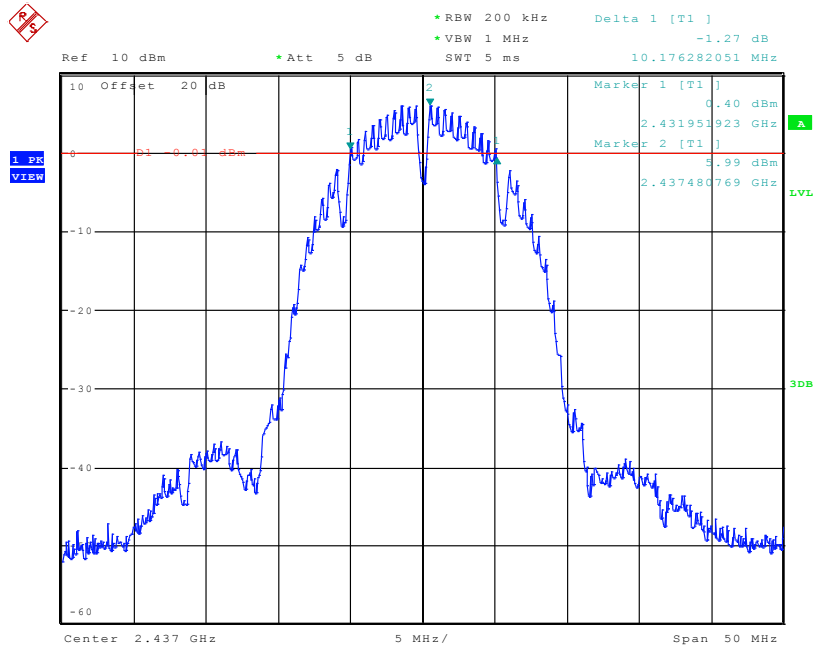
6.6.4 Test Data/plots:

6dB Bandwidth 802.11b 2412 MHz



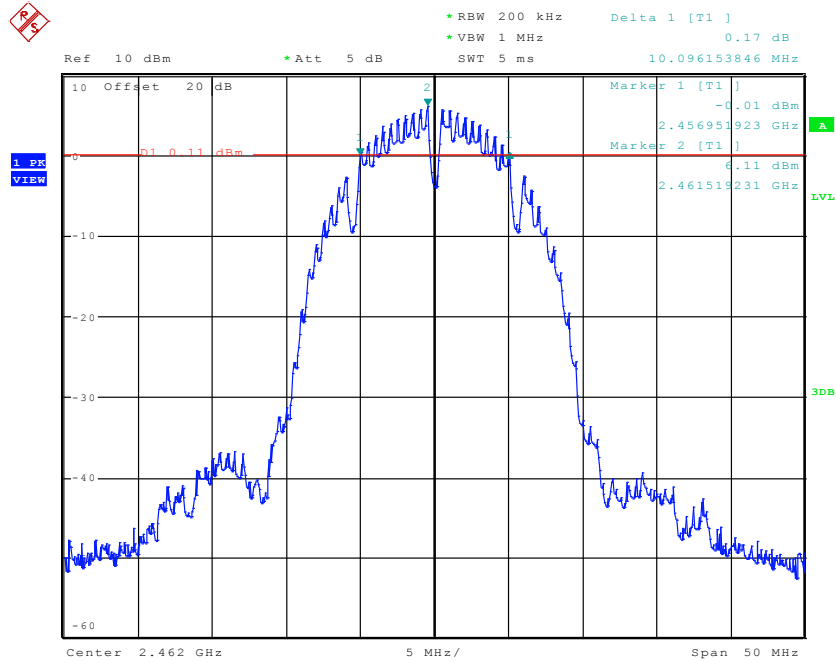
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6dB Bandwidth 802.11b 2437 MHz



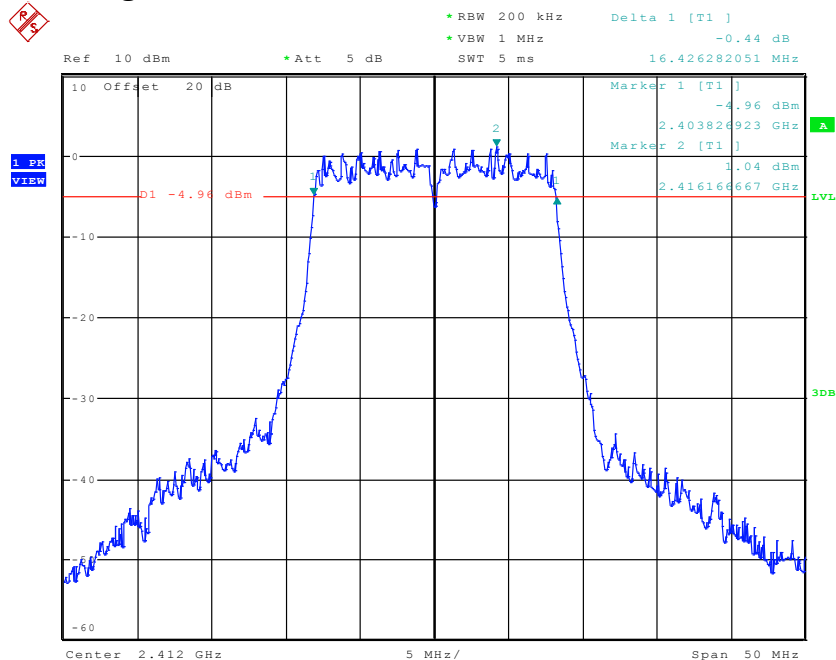
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6dB Bandwidth 802.11b 2462 MHz



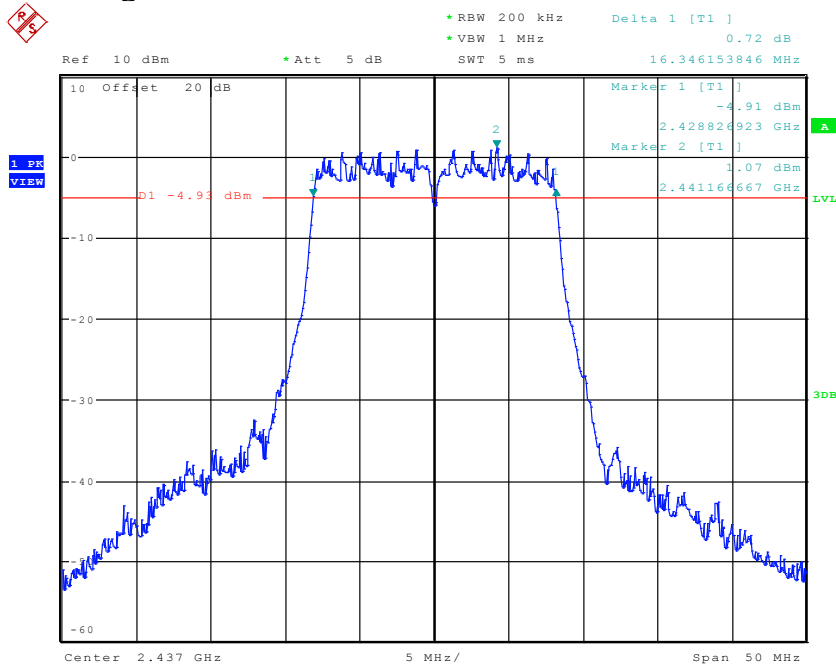
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6dB Bandwidth 802.11g 2412 MHz



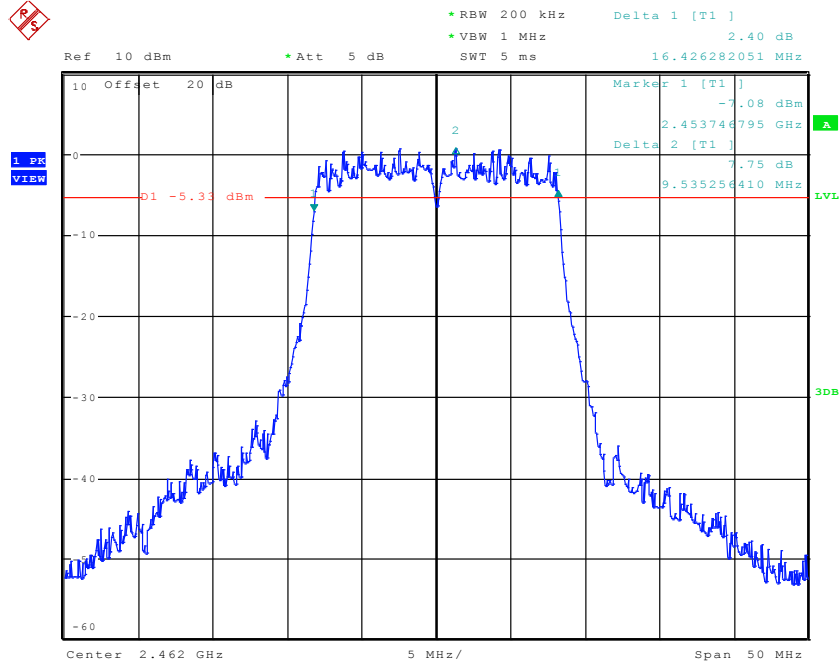
Date: 31.JUL.2011 11:51:51

6dB Bandwidth 802.11g 2437 MHz



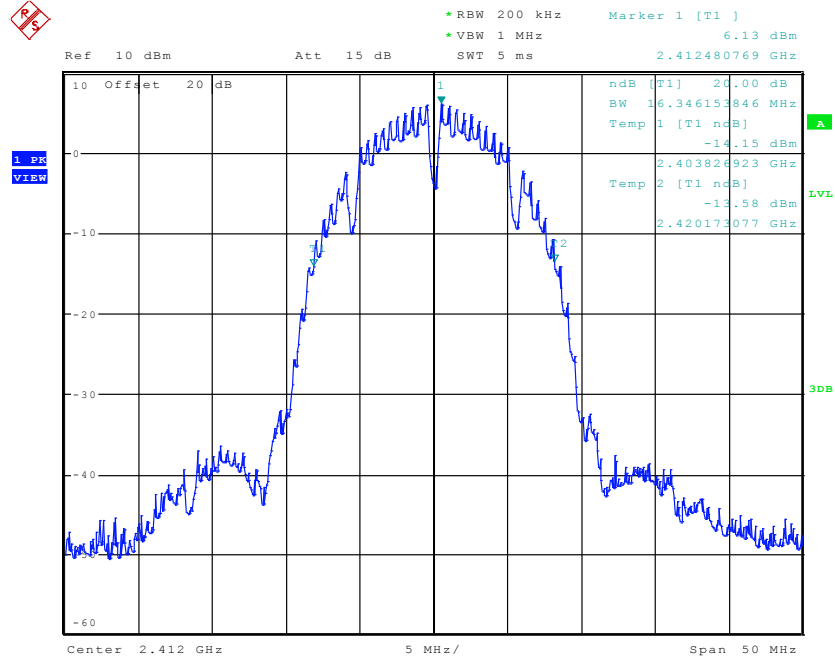
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6dB Bandwidth 802.11g 2462 MHz



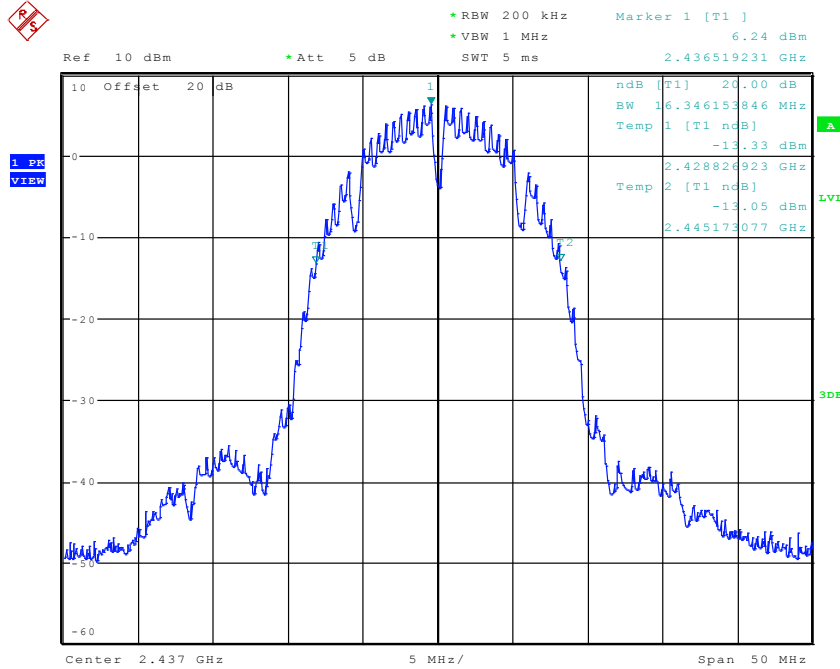
Date: 31.JUL.2011 12:01:20

20dB Bandwidth 802.11b 2412 MHz



Date: 31.JUL.2011 11:28:26

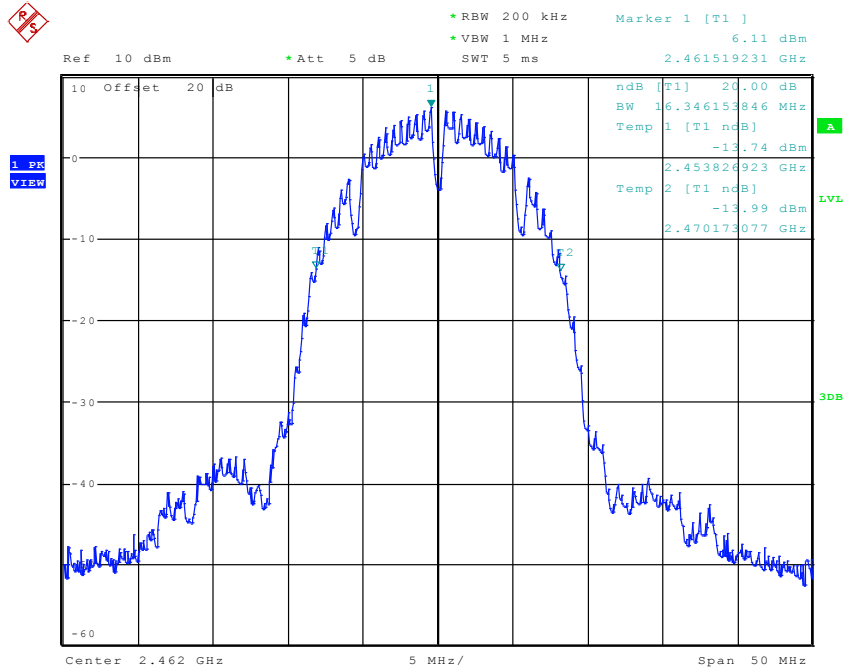
20dB Bandwidth 802.11b 2437 MHz



Date: 31.JUL.2011 11:45:09

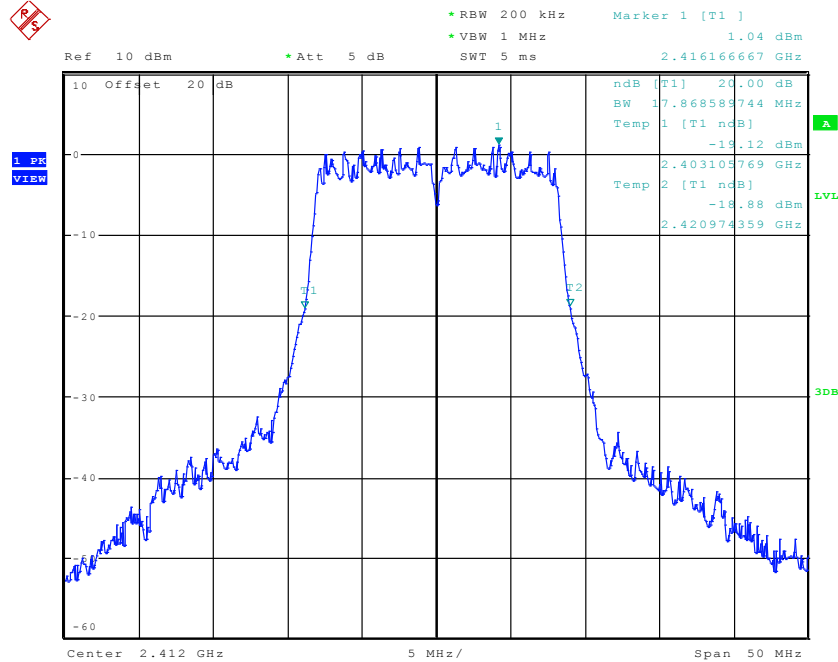


20dB Bandwidth 802.11b 2462 MHz



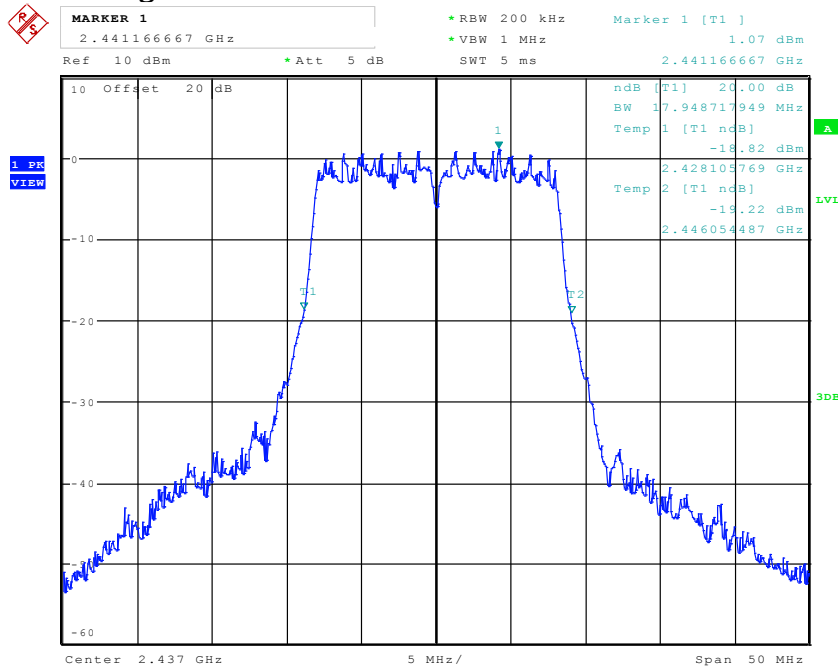
Date: 31.JUL.2011 11:40:00

20dB Bandwidth 802.11g 2412 MHz



Date: 31.JUL.2011 11:47:15

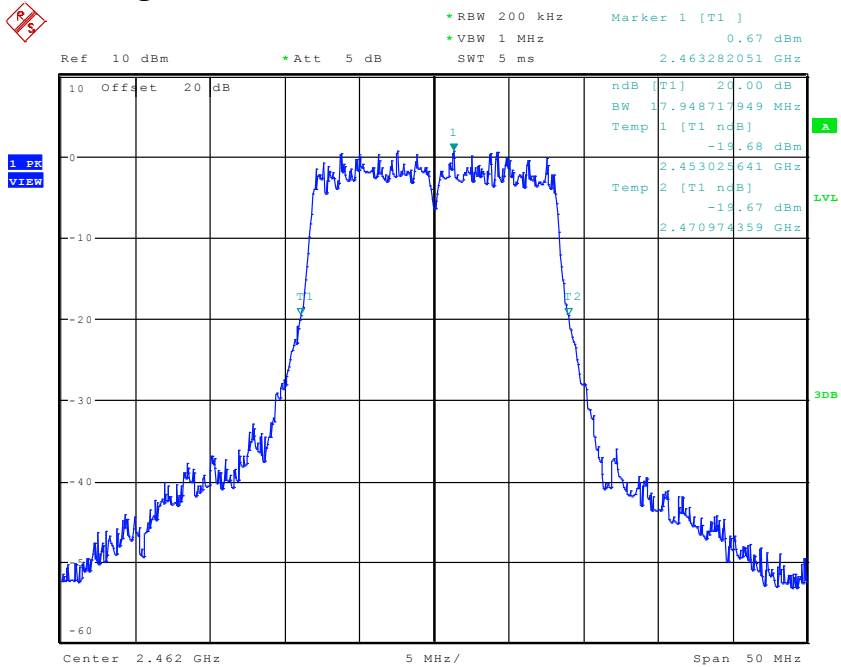
20dB Bandwidth 802.11g 2437 MHz



Date: 31.JUL.2011 11:57:25



20dB Bandwidth 802.11g 2462 MHz



Date: 31.JUL.2011 11:59:22

6.7 Maximum Power Spectral Density Level in the Fundamental Emission**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:

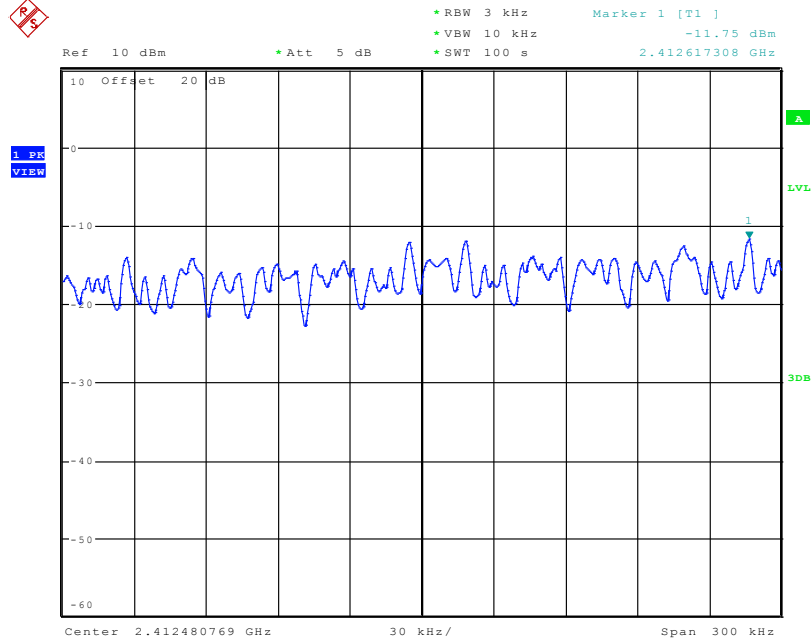
Measured Conducted Power Spectral Density (dBm)			
Mode	Frequency (MHz)		
	2412 Channel 1	2437 Channel 6	2462 Channel 11
802.11b	-11.75	-11.22	-11.43
802.11g	-18.16	-17.02	-17.27
Measurement Uncertainty: ±0.5dB			

6.7.3.1 Measurement Result

Pass.

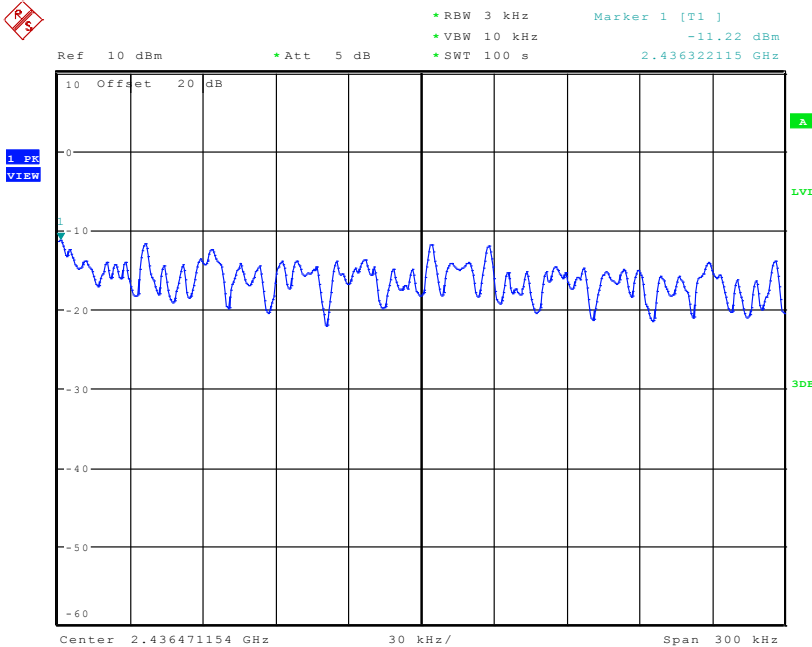
6.7.4 Test Data/plots:

Power Spectral Density 802.11b 2412 MHz



Date: 31.JUL.2011 12:24:44

Power Spectral Density 802.11b 2437 MHz



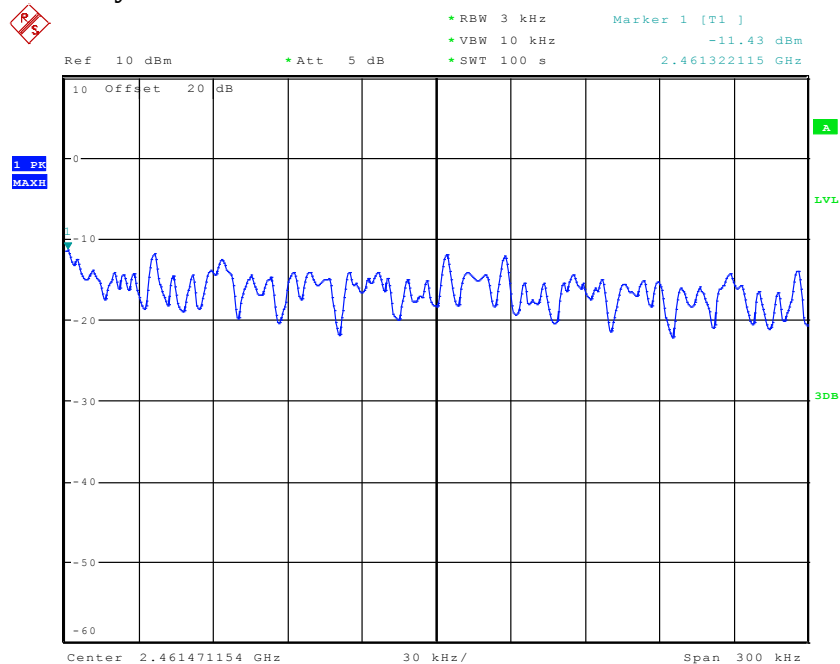
Date: 31.JUL.2011 12:28:41

Test Report #: EMC_SPECT_008_11001_DTS_Rev3
Date of Report : 2012-07-24

FCC ID: MCQ-WDNU
IC ID: 1846A-WDNU



Power Spectral Density 802.11b 2462 MHz



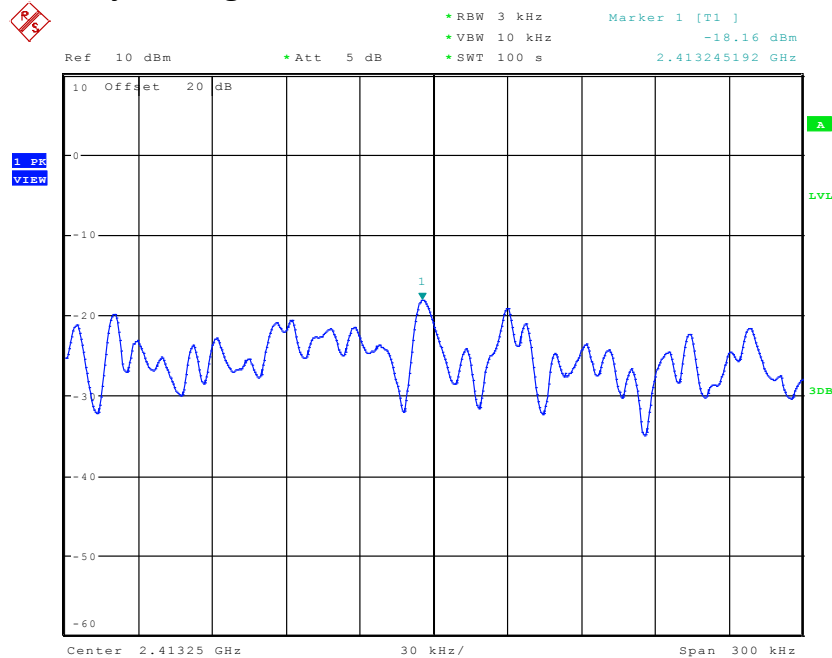
Date: 31.JUL.2011 12:39:31

Test Report #: EMC_SPECT_008_11001_DTS_Rev3
Date of Report : 2012-07-24

FCC ID: MCQ-WDNU
IC ID: 1846A-WDNU

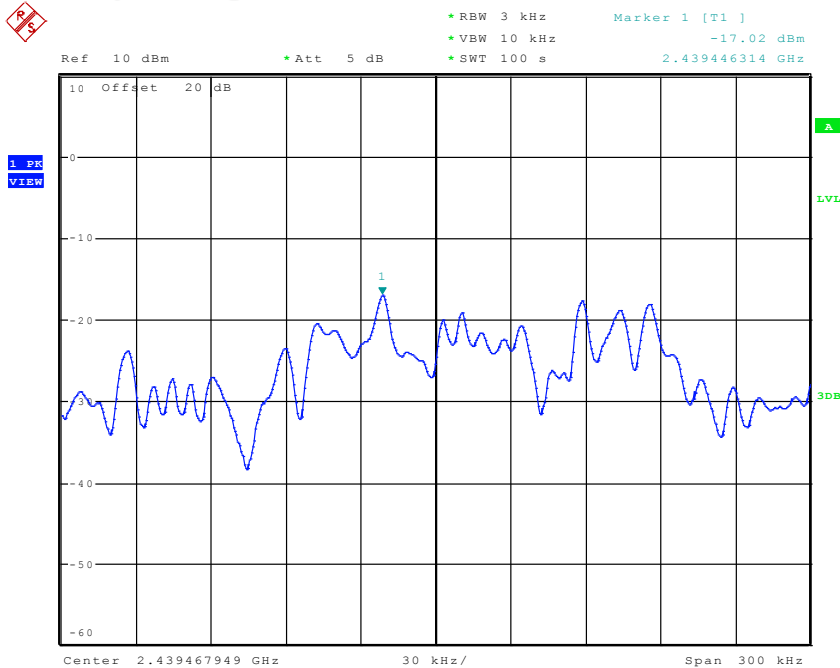


Power Spectral Density 802.11g 2412 MHz



Date: 31.JUL.2011 12:16:11

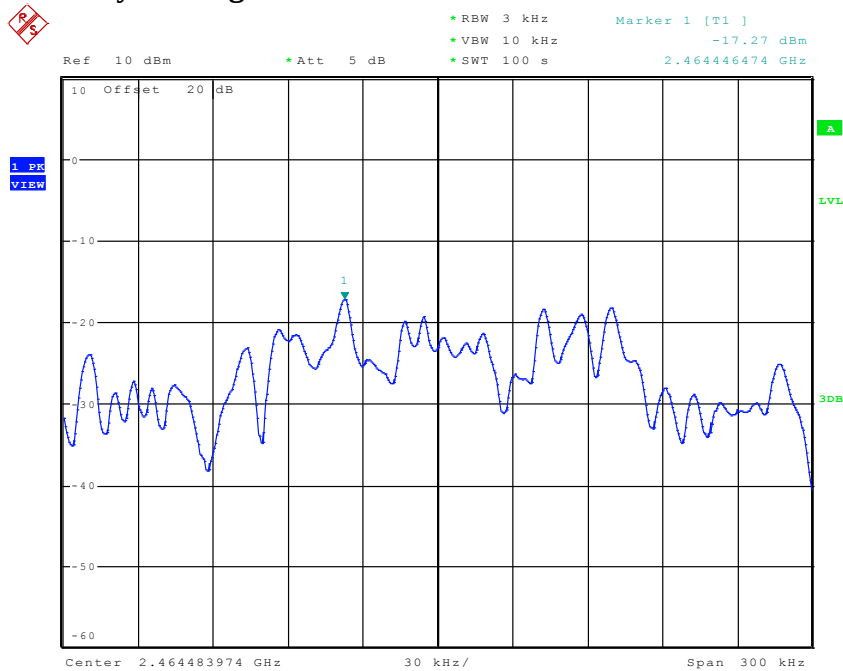
Power Spectral Density 802.11g 2437 MHz



Date: 31.JUL.2011 12:20:45



Power Spectral Density 802.11g 2462 MHz



Date: 31.JUL.2011 12:12:05

6.8 Unwanted Emissions into Non-Restricted Frequency Bands- Conducted**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:

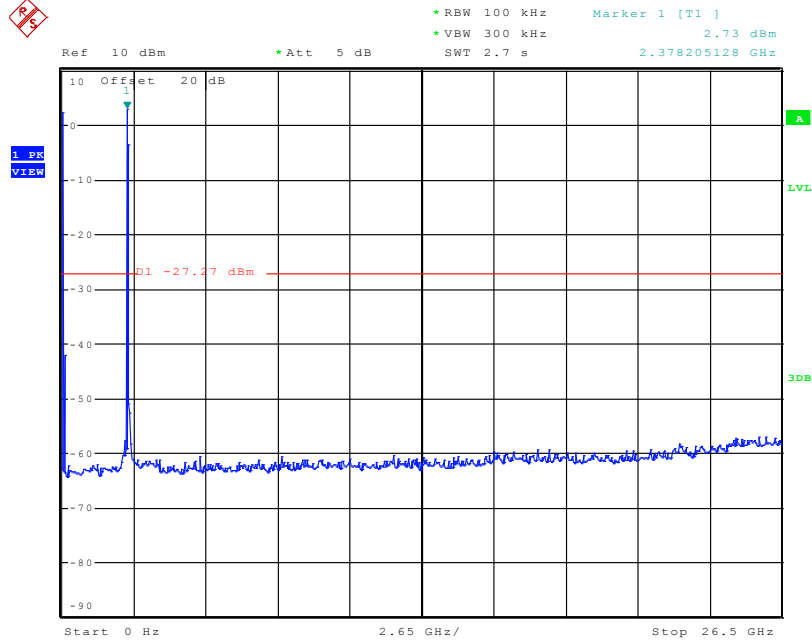
Conducted Spurious Emissions				
Channel	Frequency (MHz)	Amplitude (dBm)		Limits
		802.11b	802.11g	
Low	2412	2.73	-4.57	30dBm
	Spurious	All other peaks >20dB below limit		-20dBc
Mid	2437	1.86	-6.2	30 dBm
	Spurious	All other peaks >20dB below limit		-20dBc
High	2462	1.99	-6.45	30 dBm
	Spurious	All other peaks >20dB below limit		-20dBc
Measurement Uncertainty: ±1.0 dB				

6.8.3.1 Measurement Result

Pass.

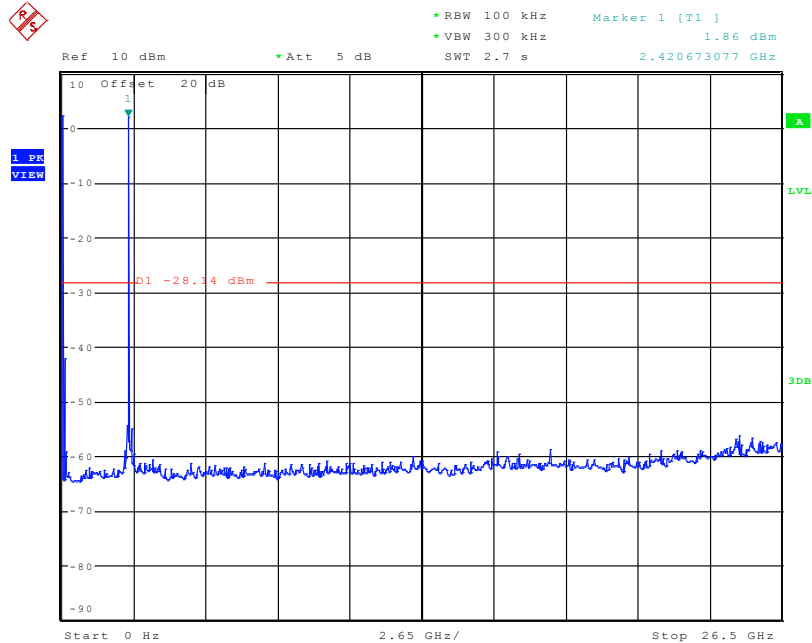
6.8.4 Test data/ plots:

Conducted Spurious Emission 802.11b 2412 MHz



Date: 31.JUL.2011 12:46:59

Conducted Spurious Emission 802.11b 2437 MHz



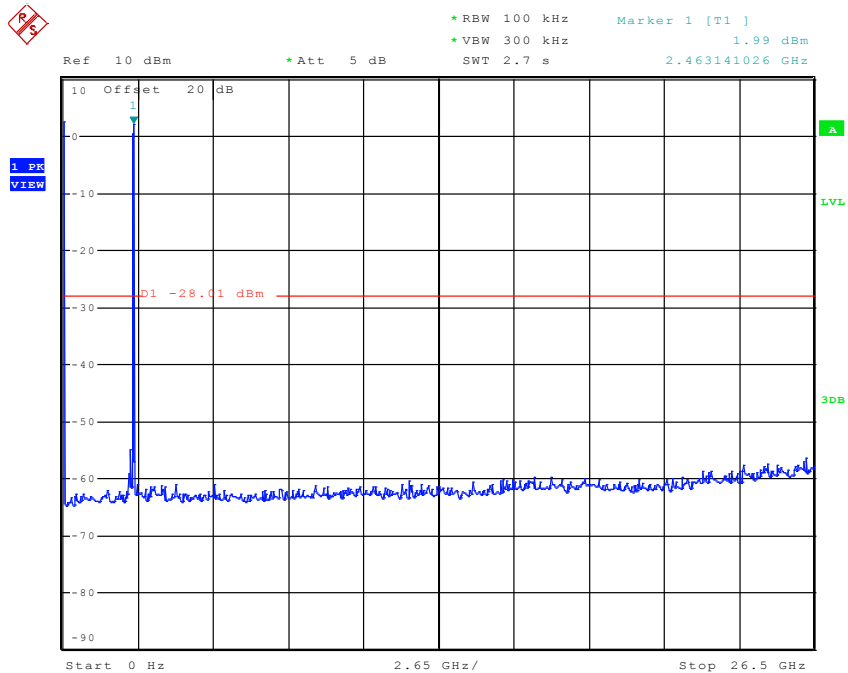
Date: 31.JUL.2011 12:49:44

Test Report #: EMC_SPECT_008_11001_DTS_Rev3
Date of Report : 2012-07-24

FCC ID: MCQ-WDNU
IC ID: 1846A-WDNU

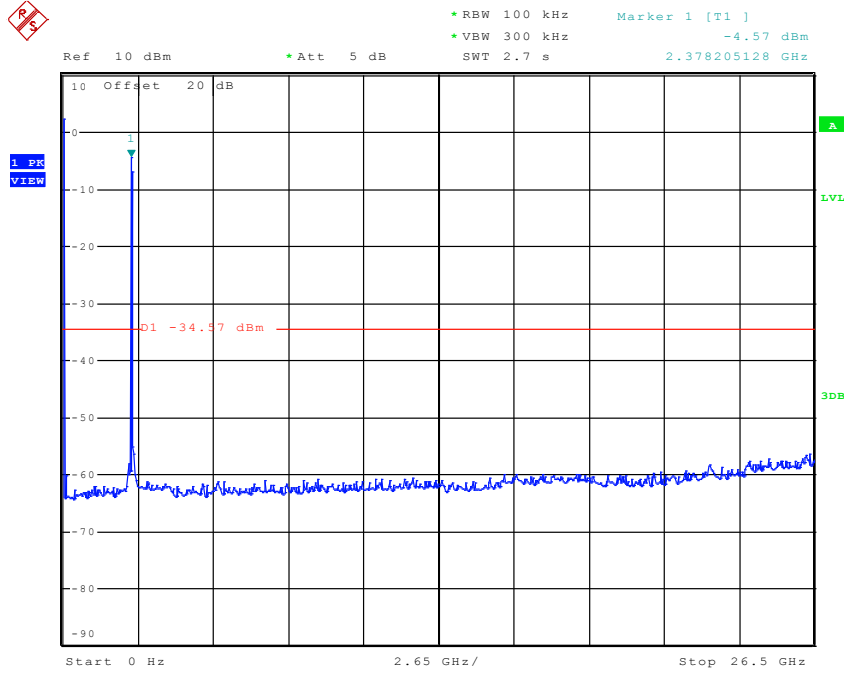


Conducted Spurious Emission 802.11b 2462 MHz



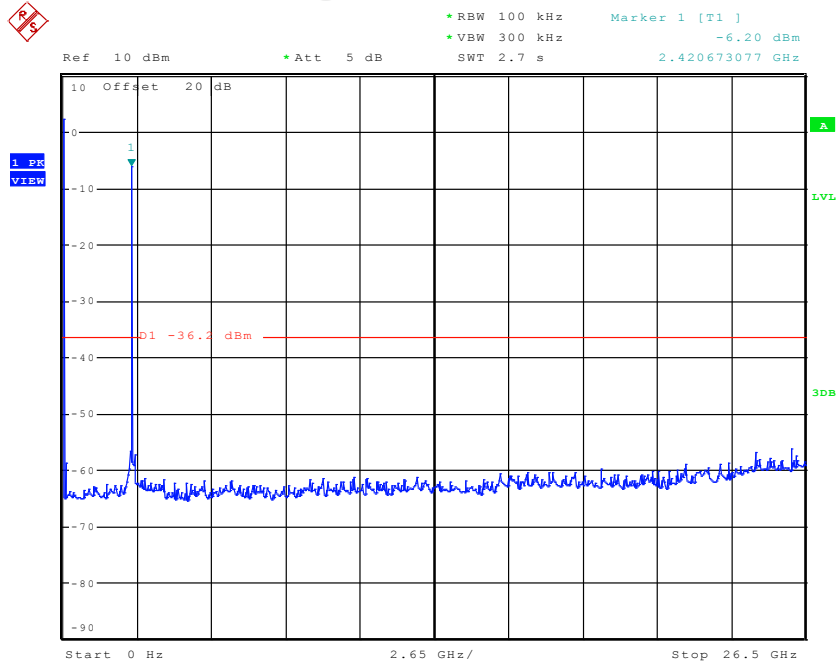
Date: 31.JUL.2011 12:54:10

Conducted Spurious Emission 802.11g 2412 MHz



Date: 31.JUL.2011 12:51:43

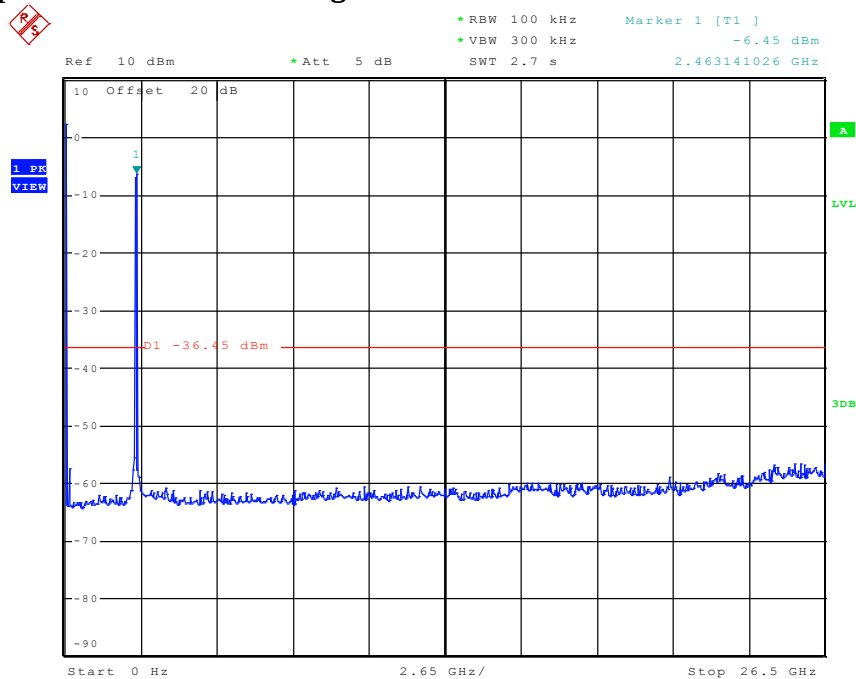
Conducted Spurious Emission 802.11g 2437 MHz



Date: 31.JUL.2011 12:55:23



Conducted Spurious Emission 802.11g 2462 MHz



Date: 31.JUL.2011 12:43:42

6.9 Unwanted Emissions into Restricted Frequency Bands- Radiated

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

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 (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
¹ 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	(²)
13.36 - 13.41			

15.209 (a) Emission Limits:

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	30	30
30–88	100**	3
88–216	150**	3
216–960	200**	3
Above 960	500	3

6.9.2 Measurement Procedure:

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

*PEAK LIMIT= 74dB μ V/m

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

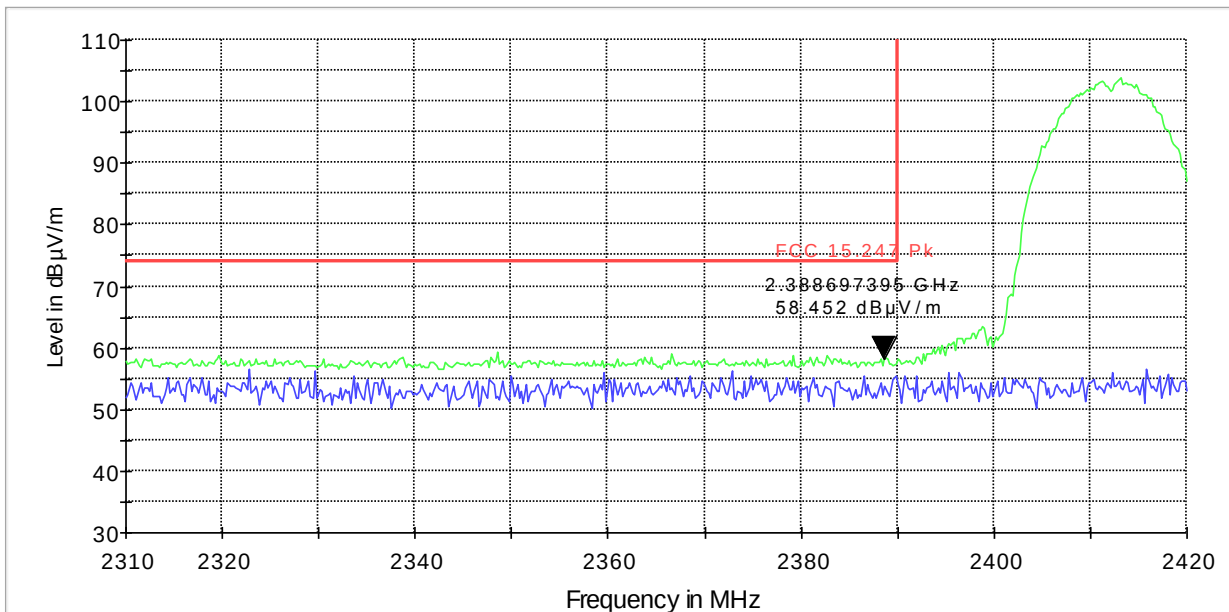
*AVG. LIMIT= 54dB μ V/m

Measurement Uncertainty: ± 3.0 dB

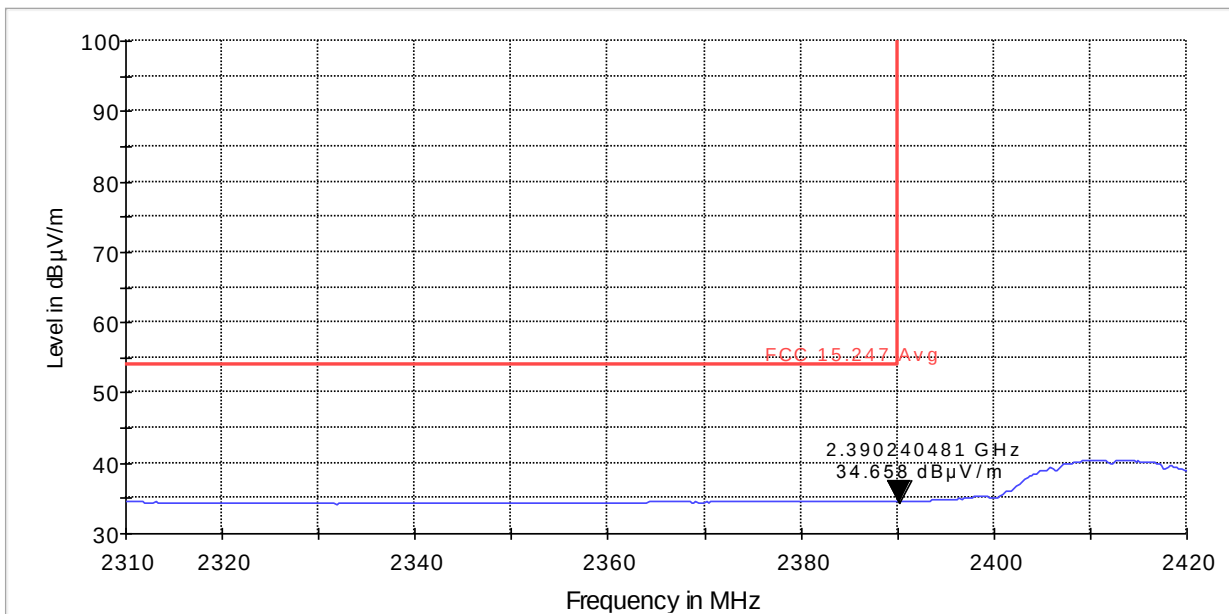
6.9.2.1 Measurement Result

Pass.

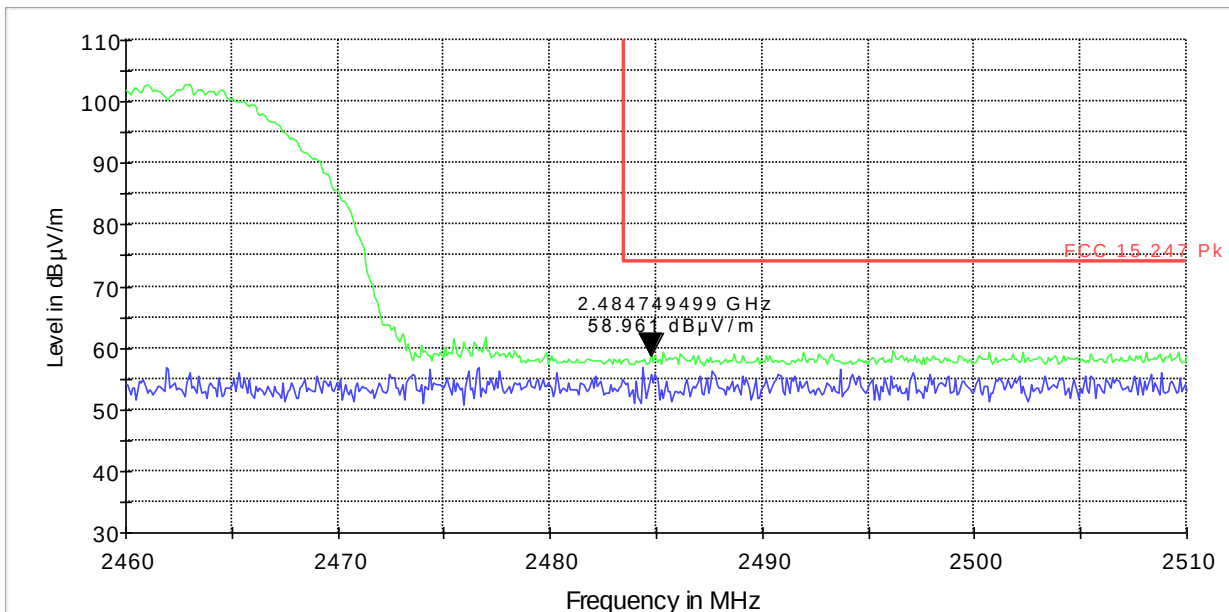
6.9.3 Test Data/plots: Lower band edge peak -802.11b mode



Lower band edge average -802.11b mode

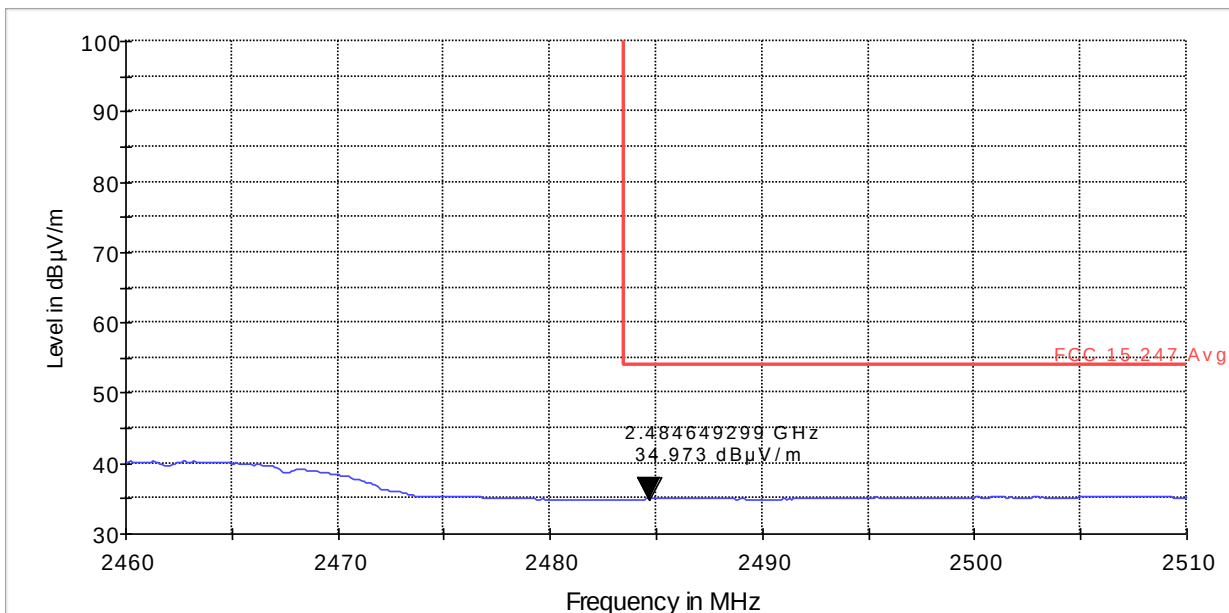


Higher band edge peak -802.11b mode



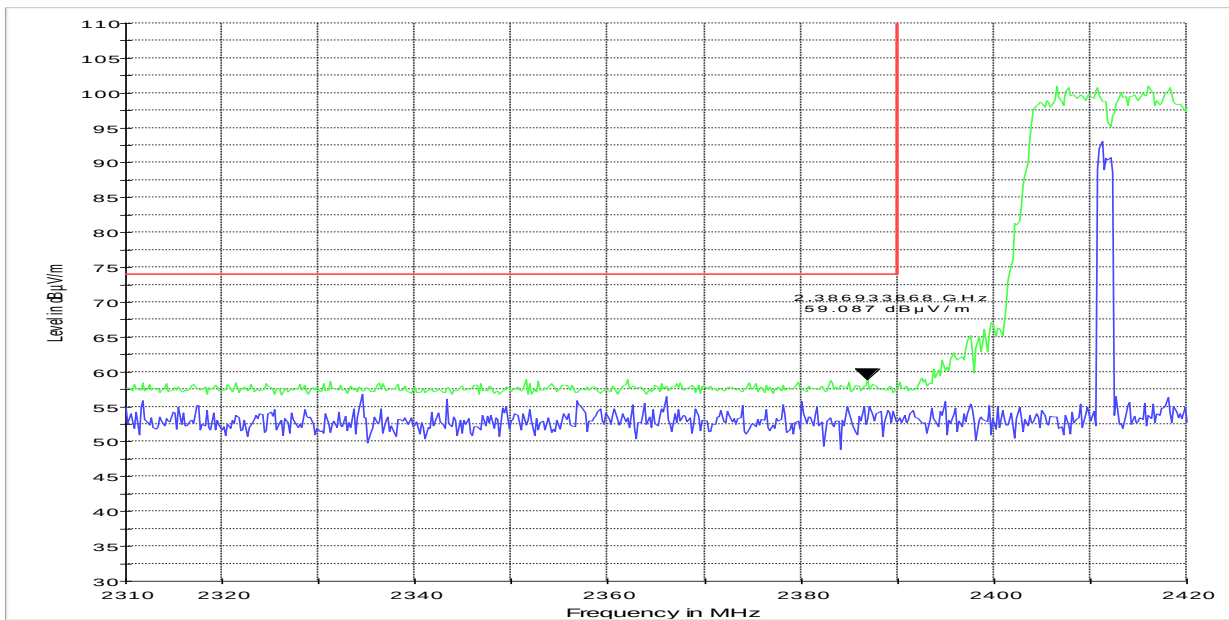
MaxPeak-ClearWrite MaxPeak-MaxHold FCC 15.247 Pk

Higher band edge average-802.11b mode



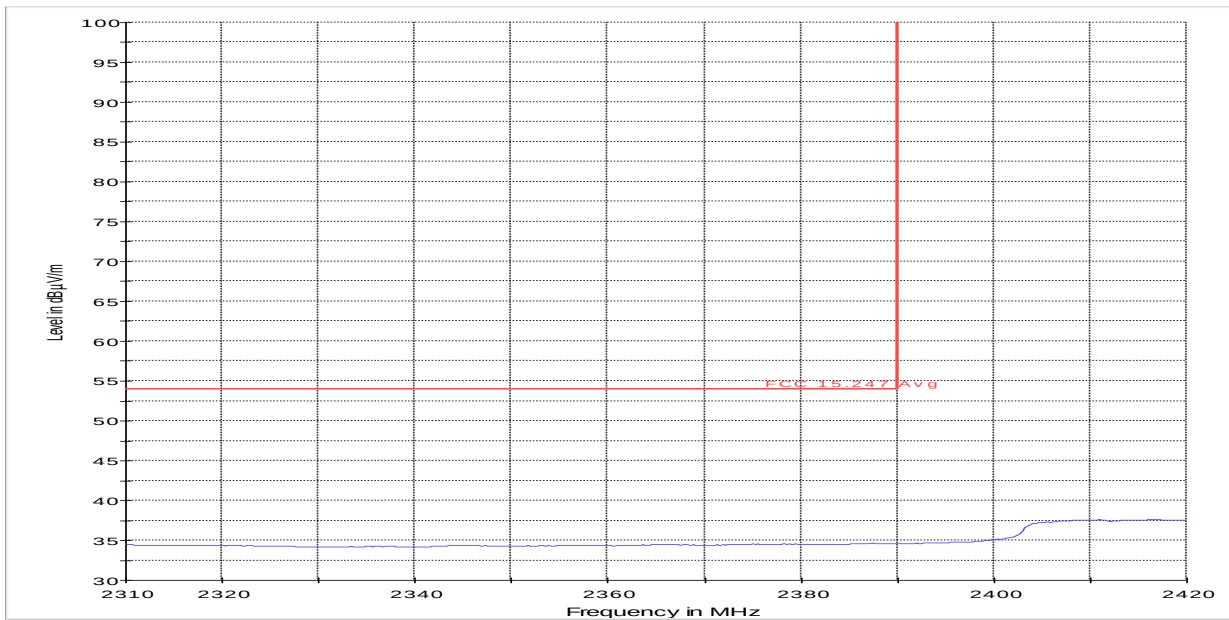
MaxPeak-MaxHold FCC 15.247 Avg

Lower band edge peak – 802.11g mode



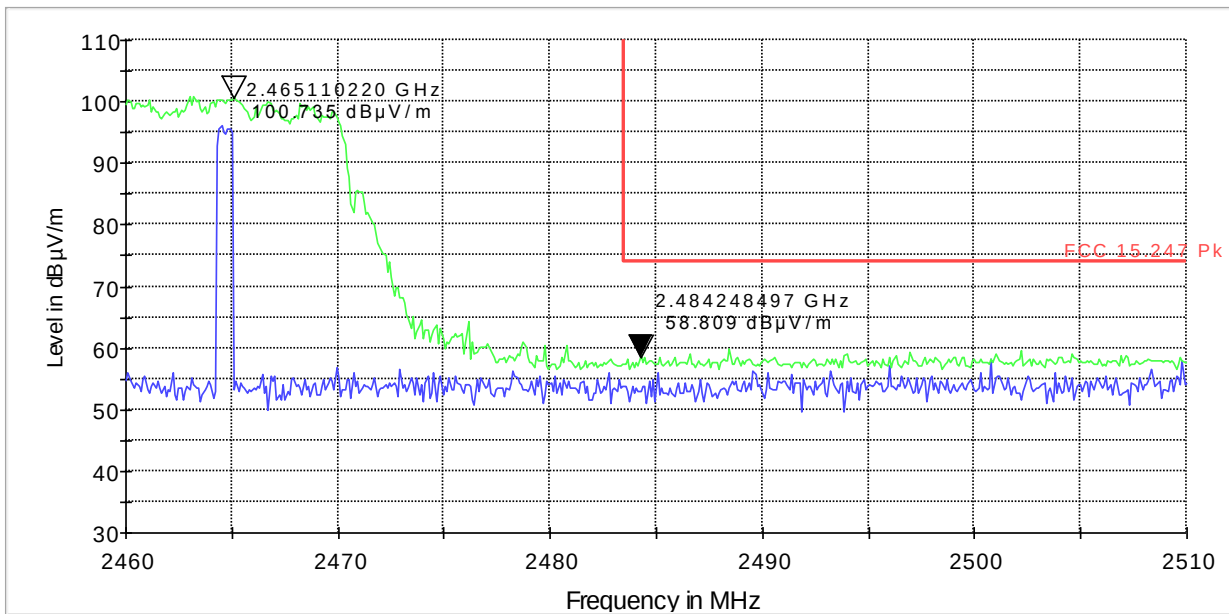
MaxPeak-ClearWrite MaxPeak-MaxHold FCC 15.247 Pk

Lower band edge average -802.11g mode



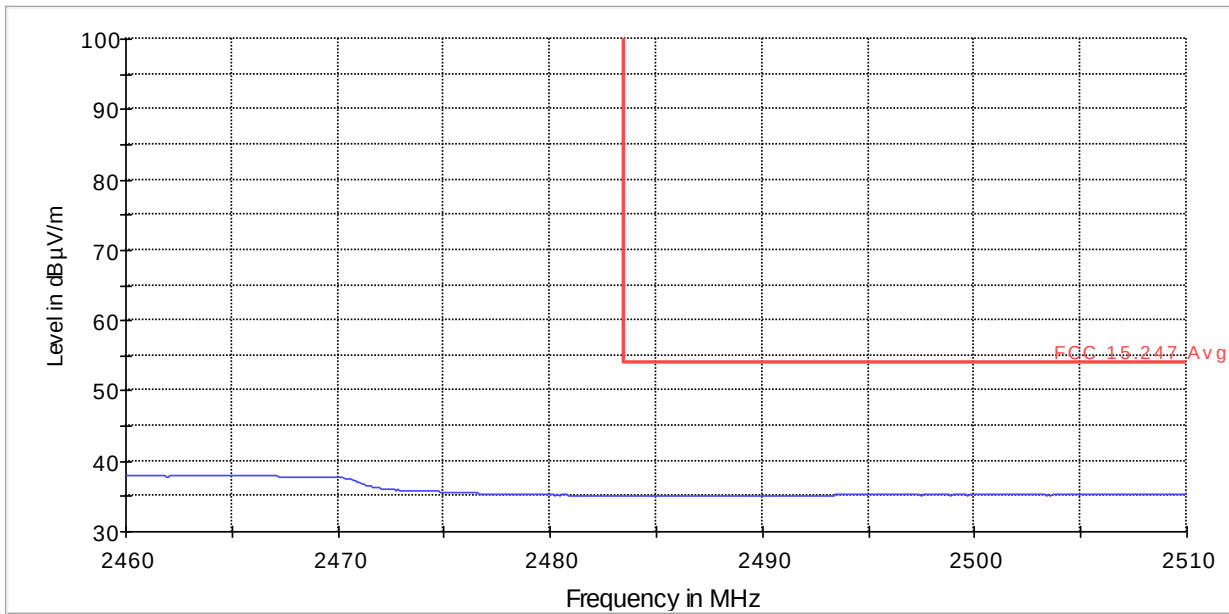
MaxPeak-MaxHold FCC 15.247 Avg

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

6.10 Transmitter Spurious Emissions- Radiated

6.10.1 Limits:

§15.247/15.205

RSS 210-A8.5

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)

Frequency of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30

6.10.2 Test Result:

802.11g mode was used for testing spurious emissions as it represents the worst case scenario with the highest conducted output power.

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 all three orthogonal orientations of the EUT.

6.10.2.1 Measurement Result

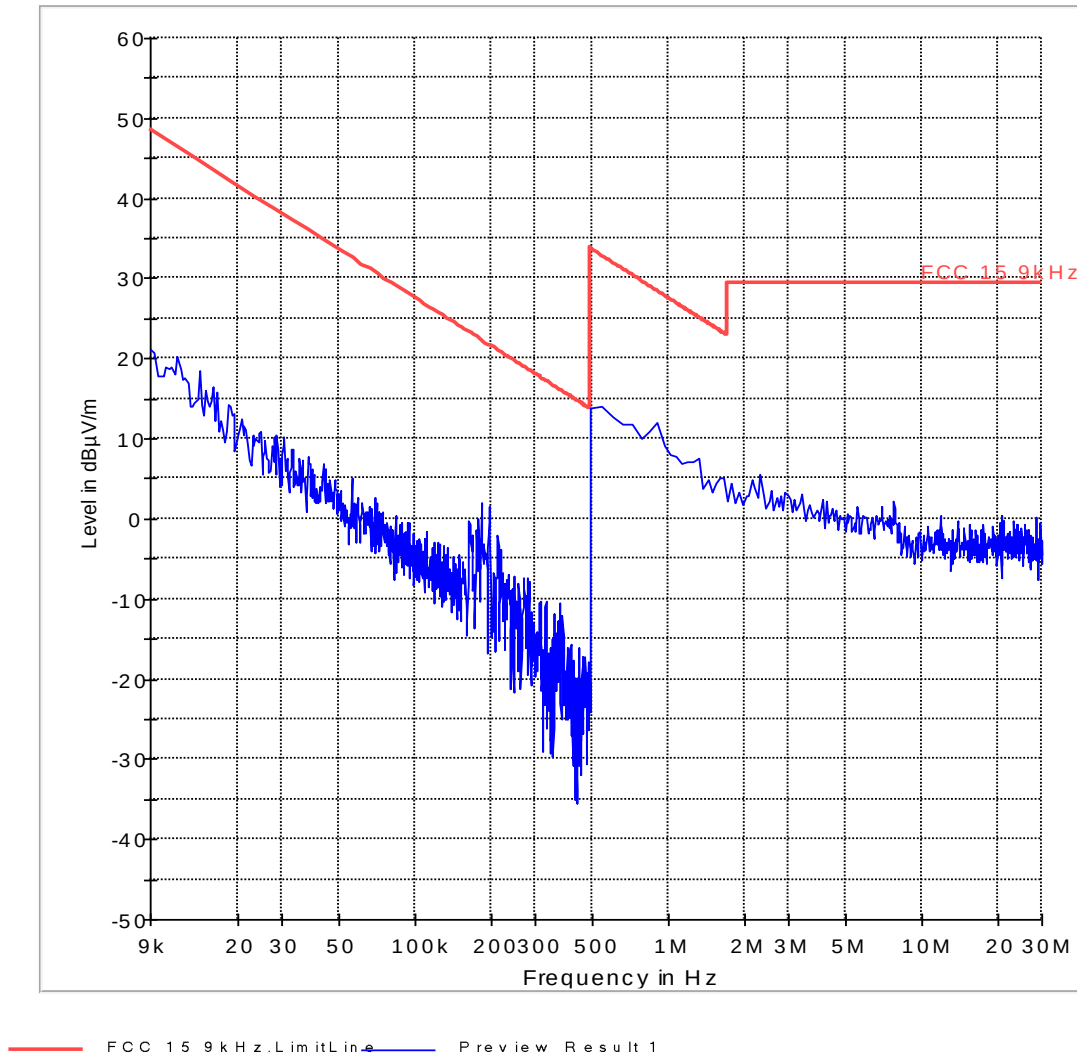
Pass

6.10.3 Test data/ plots:

Transmitter Radiated Spurious Emission:<30MHz

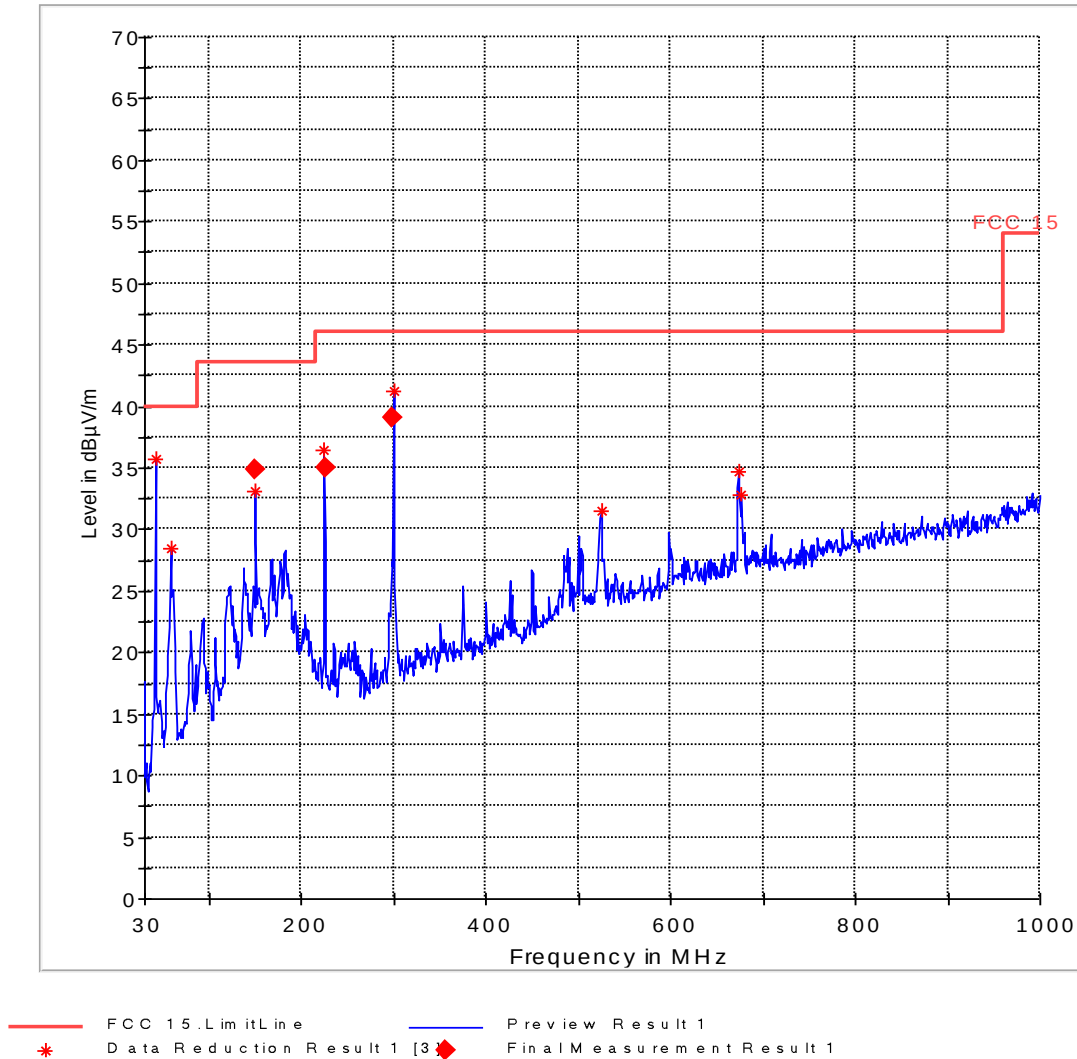
Note: Worst case representation for all modes of operation in this frequency range-
Limits adjusted for 3m measurement.

FCC 15 9kHz - 30 MHz



Transmitter Radiated Spurious Emission- Ch1- 30M-1GHz

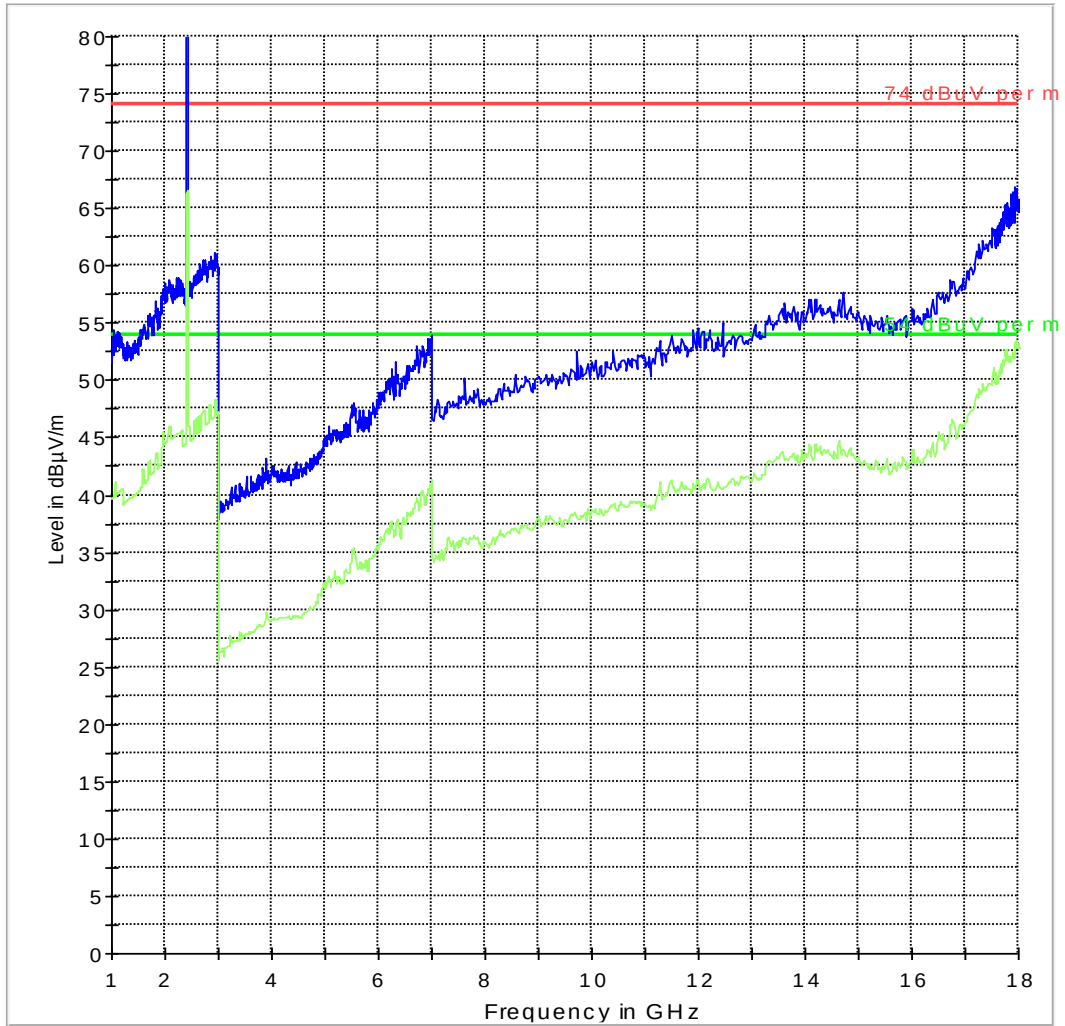
FCC 15 30-1000MHz



Transmitter Radiated Spurious Emission- Ch1- 1G-18GHz

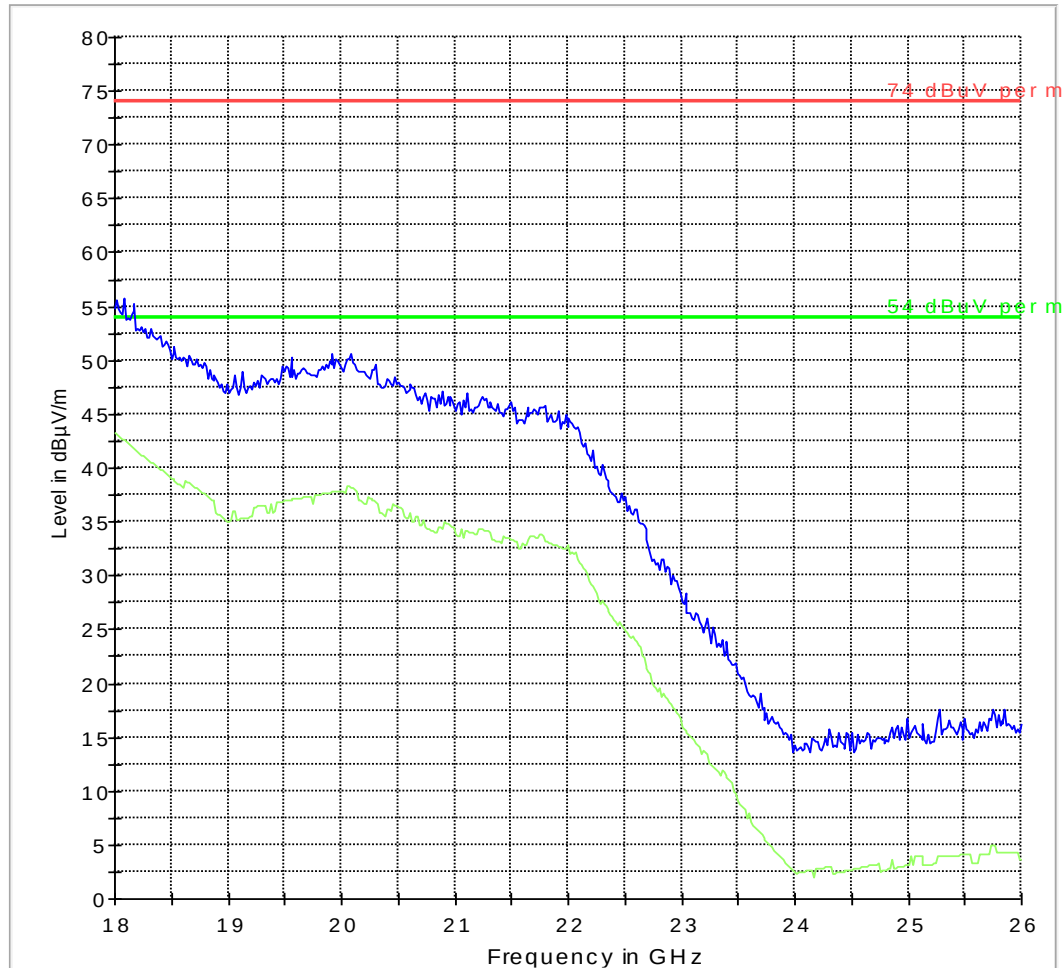
Emissions exceeding the limit lines are from the TX signal.

FCC 15 1-18GHz



Transmitter Radiated Spurious Emission- Ch1- 18G-26GHz

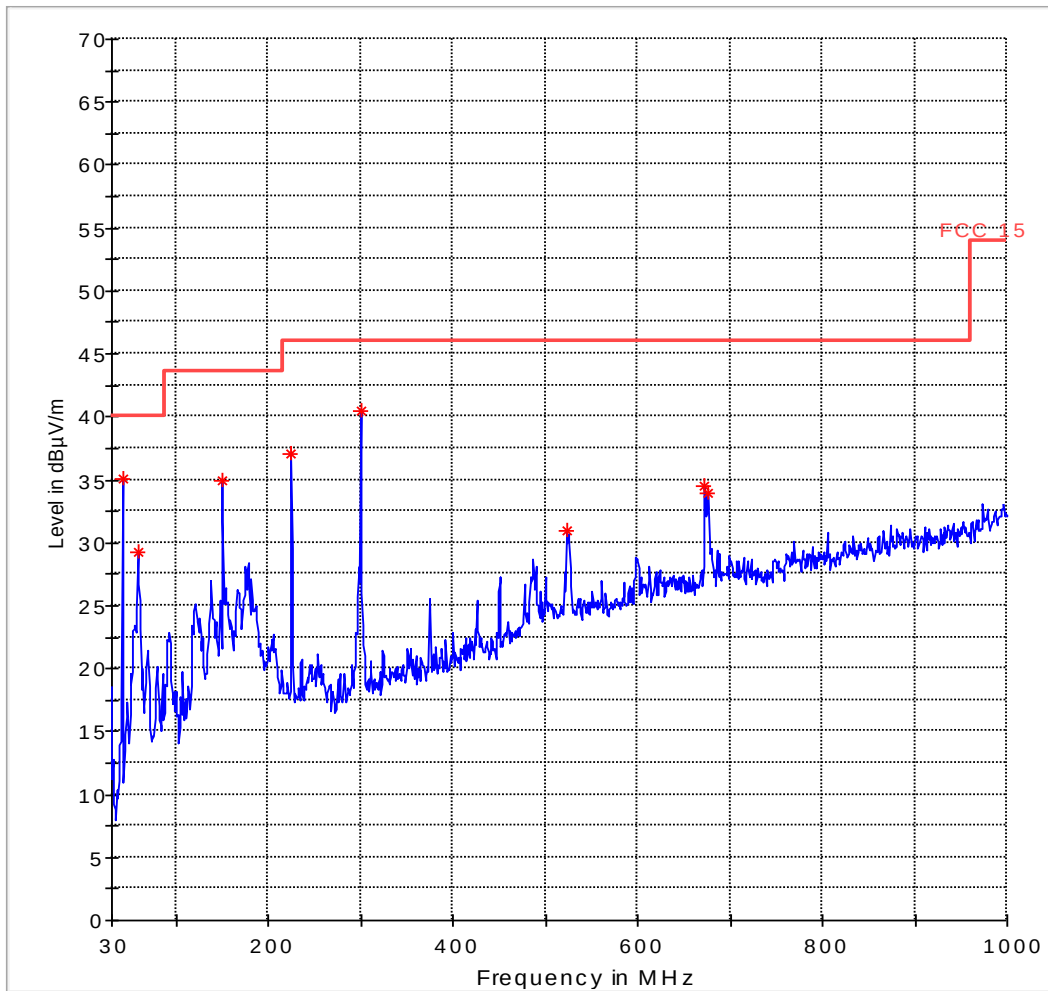
FCC 15 18-26GHz



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

Transmitter Radiated Spurious Emission- Ch6- 30M-1GHz

FCC 15 30-1000MHz

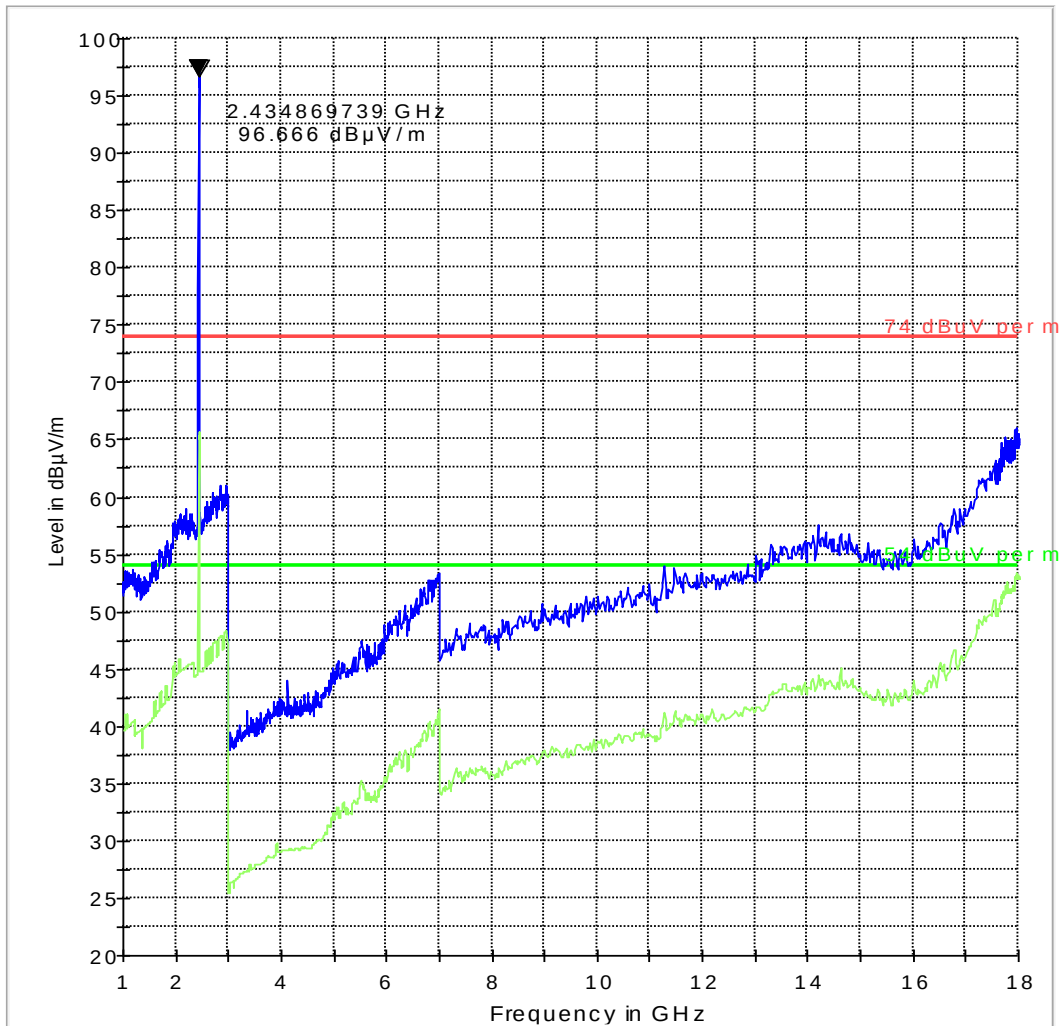


— FCC 15 Limit Line — Preview Result 1 * Data Reduction Result 1 [3]

Transmitter Radiated Spurious Emission- Ch6- 1G-18GHz

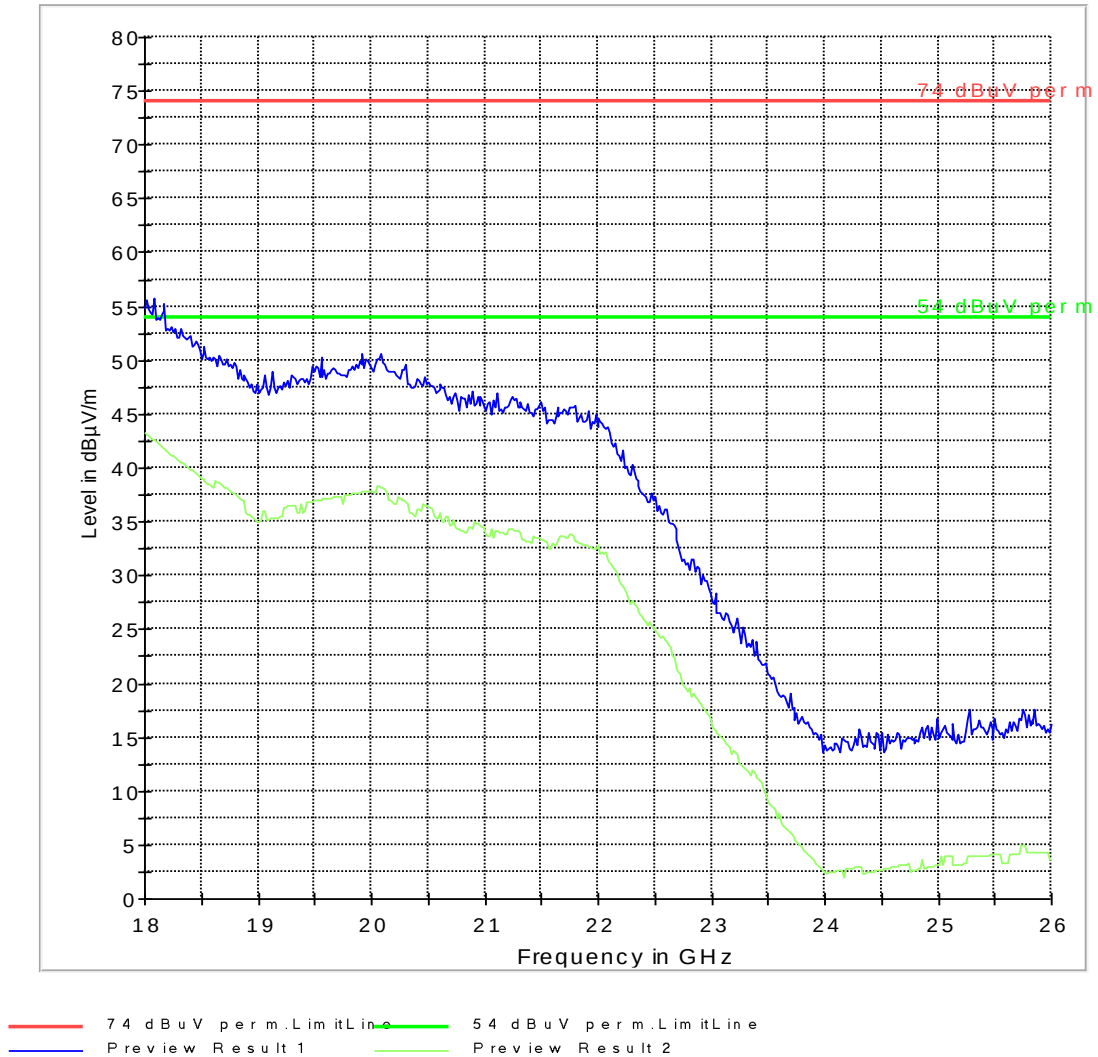
Emissions exceeding the limit lines are from the TX signal.

FCC 15 1-18GHz



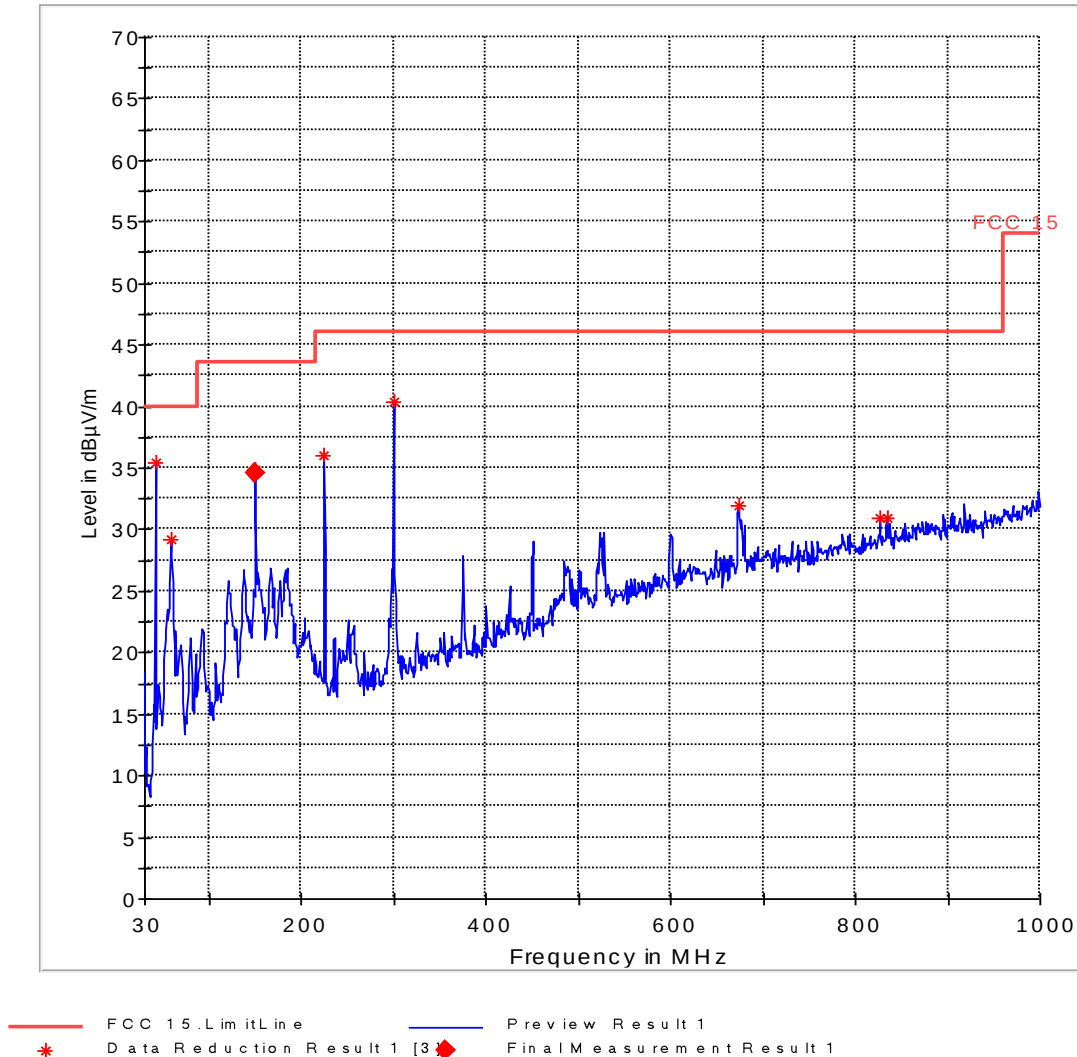
Transmitter Radiated Spurious Emission- Ch6- 18G-26GHz

FCC 15 18-26GHz



Transmitter Radiated Spurious Emission- Ch11- 30M-1GHz

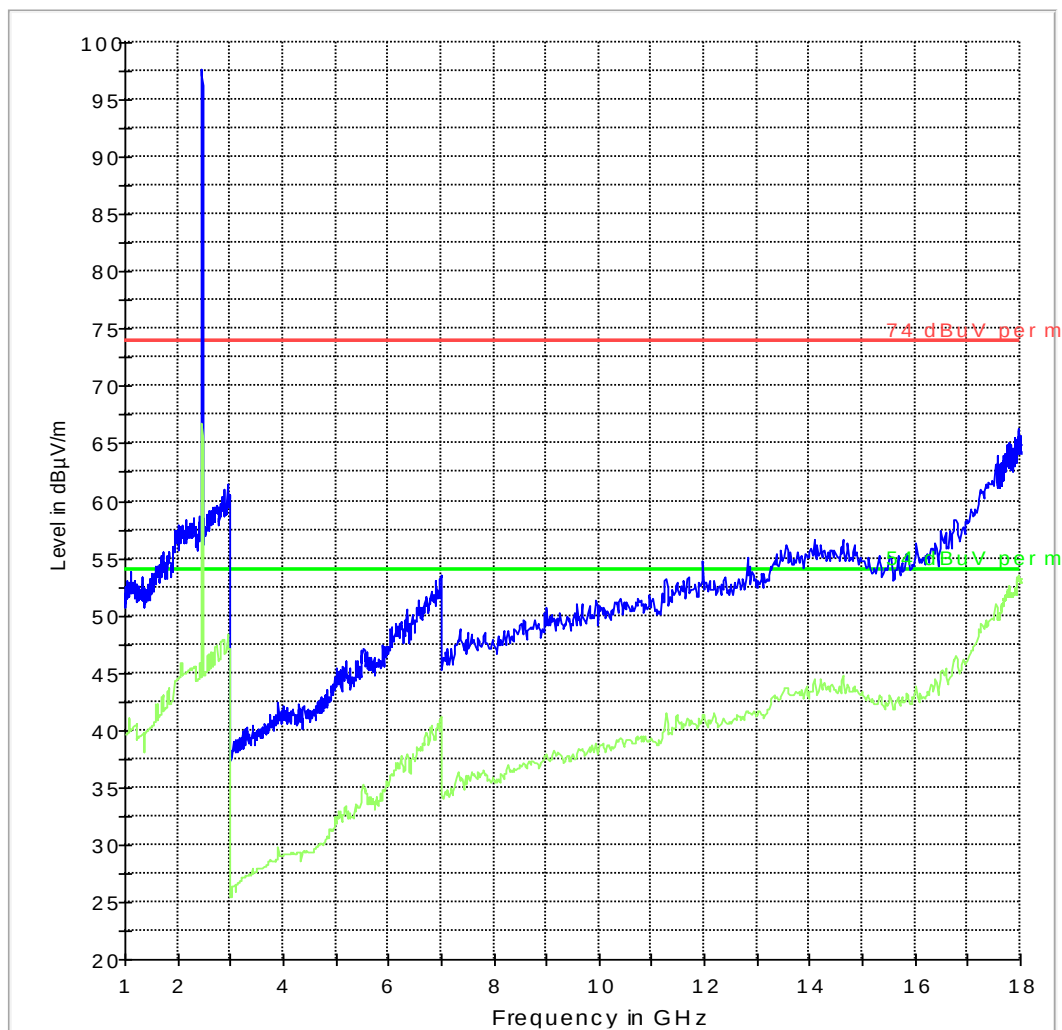
FCC 15 30-1000MHz



Transmitter Radiated Spurious Emission- Ch11- 1G-18GHz

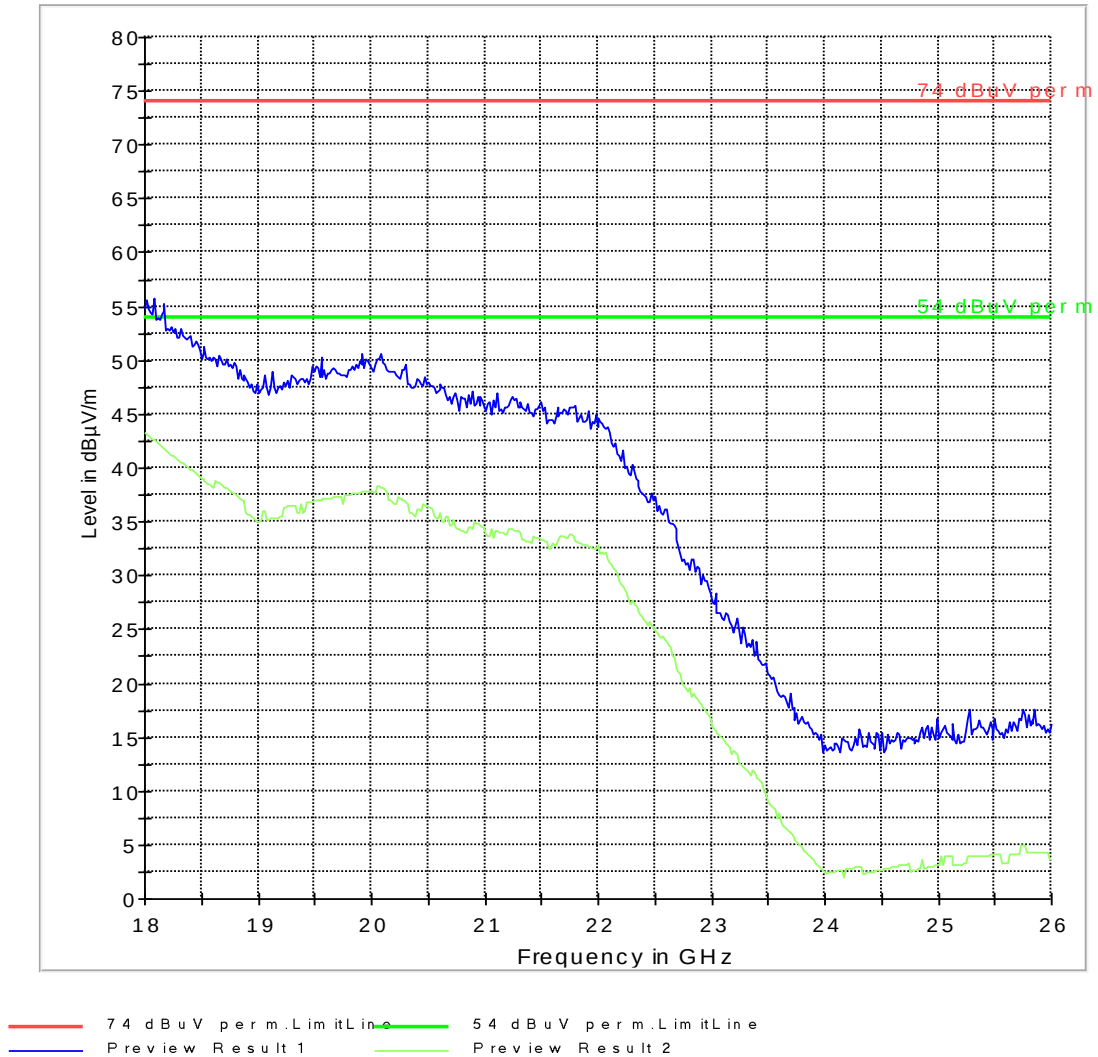
Emissions exceeding the limit lines are from the TX signal.

FCC 15 1-18GHz



Transmitter Radiated Spurious Emission- Ch11- 18G-26GHz

FCC 15 18-26GHz

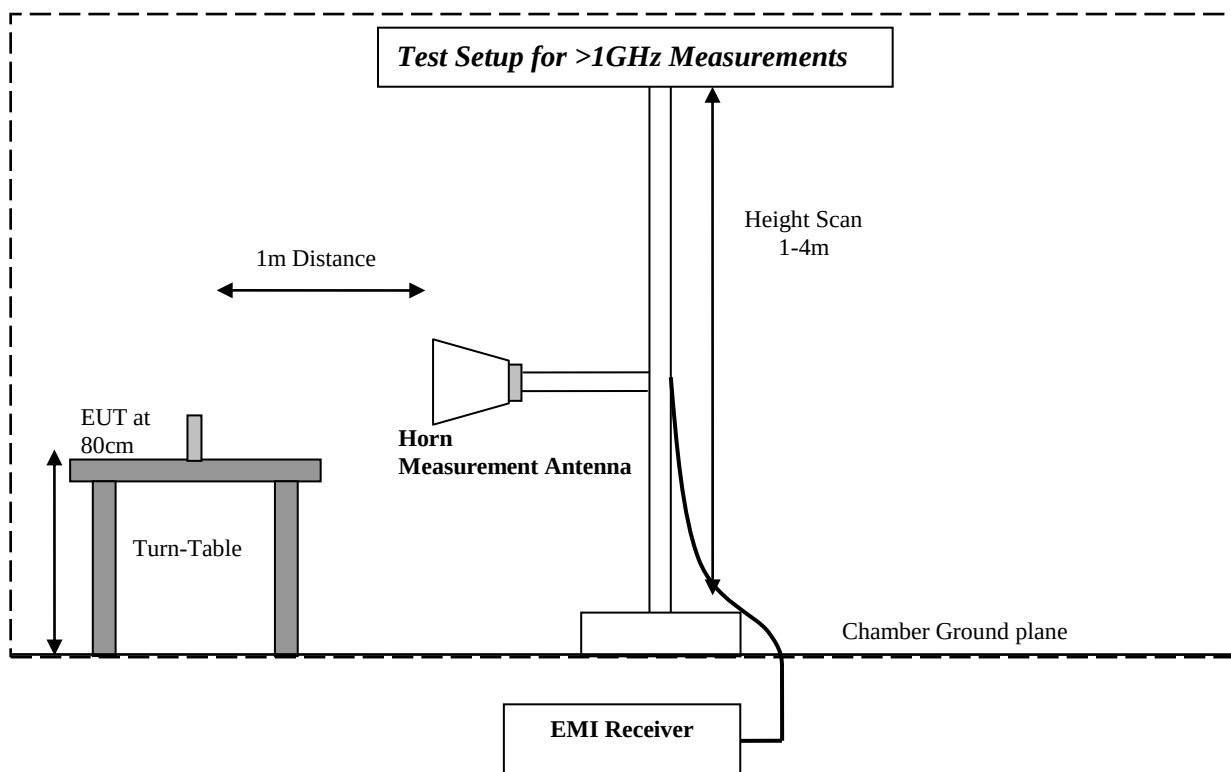
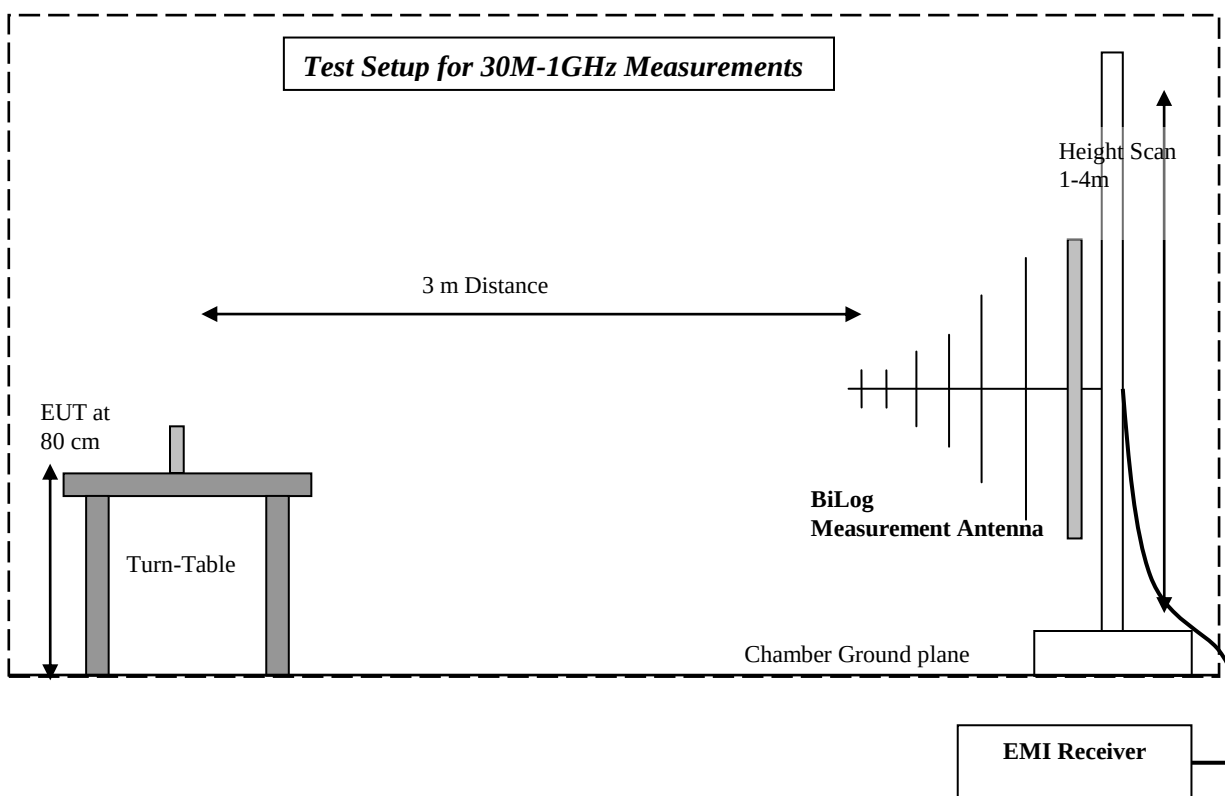


7 Test Equipment and Ancillaries used for tests

Instrument/Ancillary	Model	Manufacturer	Serial No.	Cal Date	Cal Interval
EMI Receiver/Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2010	1 year
Spectrum Analyzer	FSU	Rohde & Schwarz	200302	Jul 2010	1 year
Loop Antenna	6512	EMCO	00049838	April 2009	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	Jan 2009	3 years
Communication Antenna	IBP5-900/1940	Kathrein	n/a	n/a	n/a
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	
Power Smart Sensor	R&S	NRP-Z81	100161	June 2010	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
Temp Hum Logger	TM325	Dickson	5285354	Feb 2011	1 Year

Note: Equipment calibration status was valid at the time of testing, as identified in Ch. 3.4

8 Test Setup Diagrams



9 Revision History

Date	Report Name	Changes to report	Report prepared by
2011-09-14	EMC_ SPECT_008_11001_DTS	First Version	C. Torio
2012-03-06	EMC_ SPECT_008_11001_DTS_Rev1	IC information added. EUT information with antenna gain updated.	D.Lang
2012-06-21	EMC_ SPECT_008_11001_DTS_Rev2	Section 2.2: Applicant's Name and Contact information corrected; Section 3.1: Antenna Information updated; Section 6.1: Measurement Method added; Section 6.3: Sample Calculation updated;	D.Lang
2012-07-24	EMC_ SPECT_008_11001_DTS_Rev3	Section 3.1: Wifi Channel Range added; Antenna Information updated	D.Lang