



2.4 & 5.0 GHz WLAN (DTS Systems) FCC/IC Test Report

FOR:

Intel Corporation

Model Name: DZ110

**Product Description: Smartphone with GSM/GPRS/EDGE, UMTS/HSPA+, LTE,
Wi-Fi, BT, NFC and GPS Radios**

FCC ID: O2Z-DZ110
C ID: 1000W – DZ110

47 CFR Part 15.247

RSS-210 Issue 8 & RSS-Gen Issue 3

TEST REPORT #: EMC_EMG_INTEL_039_14001_15.247_DTS_WLAN_Rev1
DATE: 2014-06-26



FCC listed
A2LA Accredited
IC recognized #
3462B

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1 Assessment


The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant IC standard RSS-210 issue 8, Annex 8. No deviations were ascertained.

Company	Description	Model #
Intel Corporation	Smartphone with GSM/GPRS/EDGE, UMTS/HSPA+, LTE, Wi-Fi, BT, NFC and GPS Radios	DZ110

Responsible for Testing Laboratory:

2014-06-12	Compliance	Josie Sabado (Test Lab Manager)	 Signing on behalf of Franz Engert (Compliance Manager)
Date	Section	Name	Signature

Responsible for the Report:

2014-06-12	Compliance	Danh Le (EMC Engineer)	 Digitally signed by Danh Le DN: cn=Danh Le, o=Cetecom, ou=Compliance, email=danh.le@cetecom.com, c=US Date: 2014.07.07 22:53:06 -0700
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 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
Compliance Manager:	Franz Engert
Responsible Project Leader:	Danh Le

2.2 Identification of the Client

Applicant's Name:	Intel Corporation
Street Address:	2200 Mission College Blvd
City/Zip Code	Santa Clara / 95054
Country	USA
Contact Person:	Christine Ryan
Phone No.	408 300 2167
Fax:	408-765-2336
e-mail:	Christine.m.ryan@intel.com

2.3 Identification of the Manufacturer

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

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name / Model No:	Intel 4.5-inch Premium LTE Smartphone / DZ110
HW Version :	PR2D.2
FCC-ID:	O2Z-DZ110
IC-ID:	1000W- DZ110
Product Description:	Smartphone with GSM/GPRS/EDGE, UMTS/HSPA+, LTE, Wi-Fi, BT, NFC and GPS Radios
Technology/ Type(s) of Modulation:	2.4 GHz 802.11 b/g/n: CCK, BPSK, QPSK, 16QAM, 64QAM 5 GHz 802.11 a/n: BPSK, QPSK, 16QAM, 64QAM
Modes of Operation	In both bands: client, active scan, P2P, and hot spot supported
Channel Bandwidths	HT20
Operating Frequency Ranges (MHz)/ Channels:	Nominal band: 2400 – 2483.5 MHz; Center to center with HT20: 2412(ch 1) – 2462(ch 11), 11 channels Nominal band: 5725 – 5850 MHz Center to center with HT20: 5745(ch 149) – 5825(ch 165), 5 channels
Antenna info:	Internal Monopole (PCB) 2.4 GHz: -5.5 dBi 5 GHz: 0 dBi
Max. Output Powers:	2.4 GHz: 802.11b:22.63dBm(183.2 mW); 802.11g: 26.72dBm(469.9 mW); 802.11n:25.1dBm(323.6 mW) Radiated-EIRP (Calculated): 5 GHz: 802.11a:25.5dBm (354.8 mW); 802.11n: 25.45dBm(350.7mW) Radiated-EIRP (Calculated):
Rated Operating Voltage / Power Supply:	3.6 Vmin/3.8 Vnom/4.35 Vmax; AA lithium battery pack (dedicated);
Rated Operating temperature range:	-10°C - 55°C
Test Sample:	Prototype
Other Radios included in the device:	<ol style="list-style-type: none"> Intel XMM 7160 Radio Module GSM 850/900/1800/1900MHz GPRS / EDGE Multi-slot class 33 operation WCDMA / HSPA+ 850/900/1700/1900/2100 MHz LTE 700/800/850/900/1700/1800/1900/2100/2600 BT Basic/EDR, BT LE (BCM4339) NFC GPS

3.2 Identification of the Equipment under Test (EUT)

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	INV133601723	PR2D.2	SB SB JB r43-main-weekly-973 (WW46)	Radiated and Conducted RF Sample
2	INV133600961	PR2D.2	SB SB JB r43-main-weekly-973 (WW46)	AC Conducted Sample

3.3 Environmental conditions during Test:

The following environmental conditions were maintained during the course of testing:

Ambient Temperature: 20-25°C

Relative humidity: 40-60%

3.4 Dates of Testing:

02/11/2013 – 04/05/2014

3.5 Test modes of operation:

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

Modes of Operation		Data rate (Mbps)	Modulation Scheme
2.4 GHz	802.11b	1.0	BPSK
	802.11g	6.0	BPSK
	802.11n (20 MHz)	MCS0: 6.5	BPSK
5 GHz	802.11a	6	BPSK
	802.11n (HT20)	6.5	BPSK

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

The Device was set to continuous framed Tx (burst) mode per test SW and could thus be operated with > 98% duty cycle during testing.

The EUT was tested on low, mid and high channels (2.4GHz and 5GHz) in 802.11a, 802.11b, 802.11g, and 802.11n (HT20) modes (n-mode is used with 20 MHz channel bandwidth (HT20) only).

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 Radio Standard Specification RSS-210 Issue 8 of Industry Canada.

This test report is to support a request for new equipment authorization under the FCC ID **O2Z-DZ110**. 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-Gen Issue 3: General Requirements and Information for the Certification of Radio Apparatus.

5 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(e) RSS210 A8.2(b)	Power Spectral Density	Nominal	802.11a 802.11b 802.11g 802.11n	■	□	□	□	Complies
§15.247(a)(1) RSS210 A8.2(a)	Emission Bandwidth	Nominal	802.11b 802.11g 802.11n	■	□	□	□	Complies
§15.247(b)(3) RSS210 A8.4(4)	Maximum Peak Conducted Output Power	Nominal	802.11a 802.11b 802.11g 802.11n	■	□	□	□	Complies
§15.247(d) RSS210 A8.5	Band edge compliance	Nominal	802.11a 802.11b 802.11g 802.11n	■	□	□	□	Complies
§15.247(d) RSS210 A8.5	TX Spurious emissions-Conducted	Nominal	802.11a 802.11b 802.11g 802.11n	□	□	□	■	See Note
§15.247(d) §15.209(a) RSS210 A8.5 RSS Gen 7.2.2	TX Spurious emissions-Radiated	Nominal	802.11a 802.11b 802.11g 802.11n	■	□	□	□	Complies
§15.207(a) RSS Gen 7.2.4	AC Conducted Emissions <30MHz	Nominal	802.11a 802.11g 802.11n	■	□	□	□	Complies

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

Conducted spurious emissions test against non-restricted band limits is NOT PERFORMED since radiated spurious emissions against more stringent restricted band limits over the complete measurement range (9kHz to 26GHz) is passed.

6 Measurements

6.1 Radiated Measurement Procedure

ANSI C63.10 (2009) Section 8.3.1.1: Exploratory radiated emission measurements

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

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

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

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

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

ANSI C63.10 (2009) Section 8.3.1.2: Final radiated emission measurements

Based on the measurement results in 8.3.1.1, the one EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. The final measurement is then performed on a site meeting the requirements of 5.3, 5.4, or 5.5 as appropriate without variation of the EUT arrangement or EUT mode of operation. If the EUT is relocated from an exploratory test site to a final test site, the highest emission shall be 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.

Radiated Measurement Uncertainty: ±3dB

6.1.1 Sample Calculations for Radiated Measurements

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

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

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

Eg:

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

6.2 Conducted Emissions Procedure

ANSI C63.10 (2009) Section 6.2.5: Final AC Power-Line Conducted Emission Measurements

Based on the exploratory tests of the EUT performed in 6.2.4, the one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation. If the EUT is comprised of equipment units that have their own separate ac power connections, e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network, each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be separately measured. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

If the EUT uses a detachable antenna, these measurements shall be made with a suitable dummy load connected to the antenna output terminals; otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended. When measuring the ac conducted emissions from a device that operates between 150 kHz and 30 MHz a non-detachable antenna may be replaced with a dummy load for the measurements within the fundamental emission band of the transmitter, but only for those measurements.

Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency. Diagram or photograph the test setup that was used. See Clause 8 for full reporting requirements.

Section 6.2.5: Measurement requirements

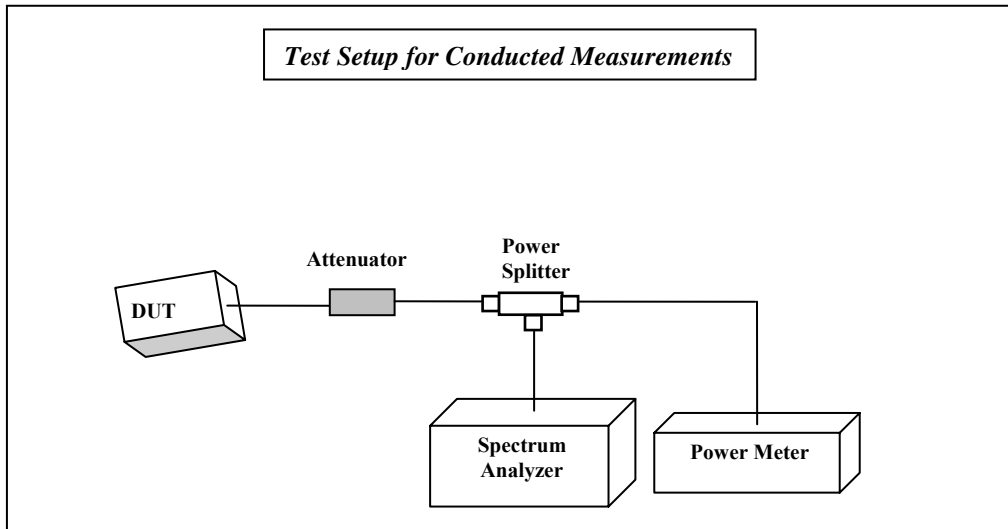
The LISN housing, measuring instrument case, reference ground plane, vertical conducting plane, if used, shall be bonded together.

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument, or where permitted or required, the emission currents on the power line sensed by a current probe. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer, and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements, using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having a 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

Measurement Uncertainty: ± 3.0 dB

6.3 RF Conducted Measurement Procedure

Measurement according to KDB 558074 D01 DTS: 2013 (Guidance for Performing Compliance Measurements on Digital Transmission System (DTS) Operating Under §15.247)



1. Connect the equipment as shown in the above diagram.
2. Adjust the settings by entering test commands for TX/RX mode on/off, changing channels, modulations and data rates.
3. Measurements are to be performed with the EUT set to the low, middle and high channels.

6.4 Maximum Peak Conducted Output Power

6.4.1 Limits:

Maximum Peak Output Power:

FCC §15.247 (b)(3): 1W

IC RSS-210 Issue 8, annex 8.4(2): 1W

EIRP:

IC RSS-210 Issue 8, annex 8.4(2): 4W

6.4.2 Test Conditions:

Tnom: 21°C; Vnom: 3.8V

6.4.3 Test Procedure

Measurement according to FCC KDB 558074 D01 DTS v03r01 section 9.1.2

Spectrum Analyzer settings:

Peak Output Power

Span = wide enough to capture the entire emission being measured

RBW = 1 MHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Use integrated band power method. Set channel bandwidth \geq 6 dB bandwidth of the emission being measured

6.4.4 Test Result: 2.4 GHz Band

Measured Maximum Peak Conducted Output Power (dBm)			
Mode	Frequency (MHz)		
	2412 Channel 1	2437 Channel 6	2462 Channel 11
802.11b	21.15	21.64	22.63
802.11g	25.90	26.72	26.65
802.11n /MCS0 (20 MHz)	24.28	25.07	25.01

Calculated Radiated Output Power EIRP (dBm) Antenna Gain = -5.5 dBi			
Mode	Frequency (MHz)		
	2412 Channel 1	2437 Channel 6	2462 Channel 11
802.11b	15.65	16.14	17.13
802.11g	20.4	21.22	21.15
802.11n /MCS0 (20 MHz)	18.78	19.57	19.51

6.4.5 Test Result: 5 GHz Band

Measured Maximum Peak Conducted Output Power (dBm)			
Mode	Frequency (MHz)		
	5745 Channel 149	5785 Channel 157	5825 Channel 165
802.11a	25.49	25.30	25.36
802.11n /MCS0 (20 MHz)	25.45	25.24	25.33

Calculated Radiated Output Power EIRP (dBm) Antenna Gain = 0 dBi			
Mode	Frequency (MHz)		
	5745 Channel 149	5785 Channel 157	5825 Channel 165
802.11a	25.49	25.30	25.36
802.11n /MCS0 (20 MHz)	25.45	25.24	25.33

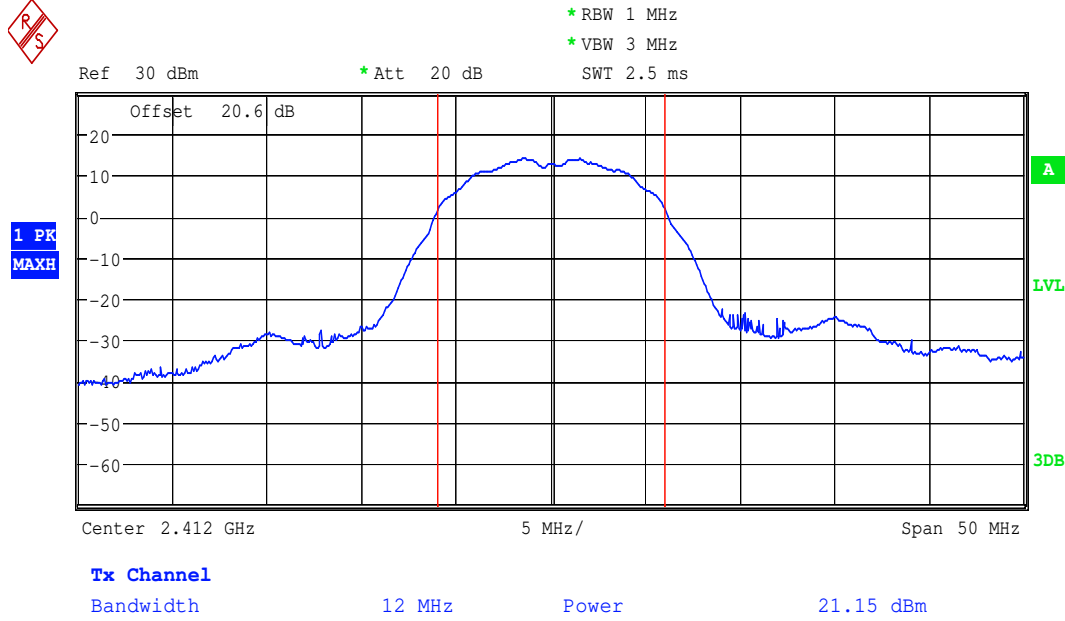
Note: Radiated EIRP is calculated as
Conducted Measurement + Antenna Gain

6.4.5.1 Measurement Result

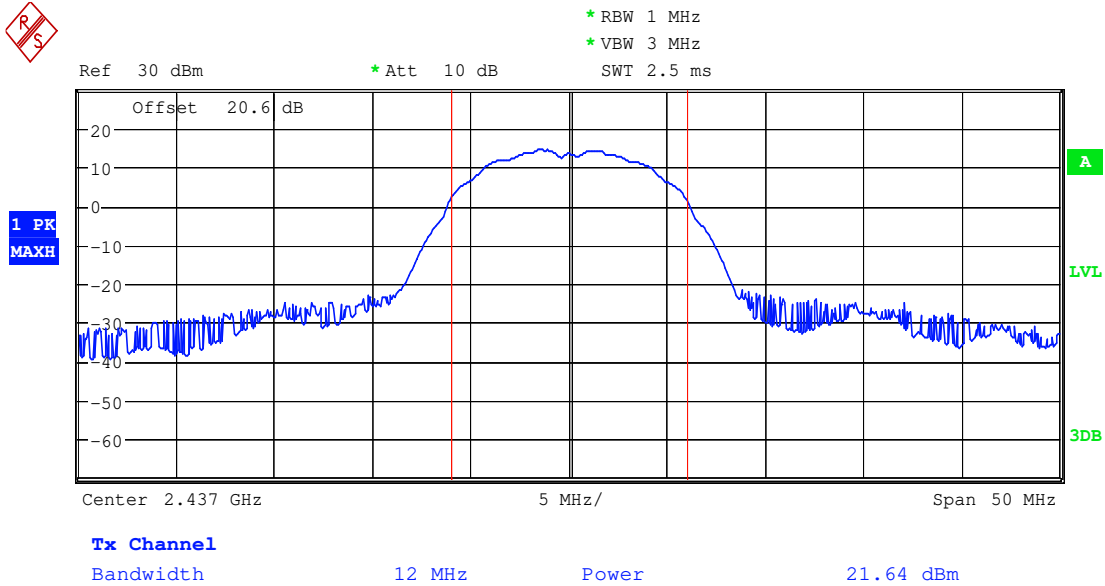
Pass.

6.4.6 Test Data/plots: 2.4 GHz Band

Peak Conducted Power 802.11b 2412 MHz



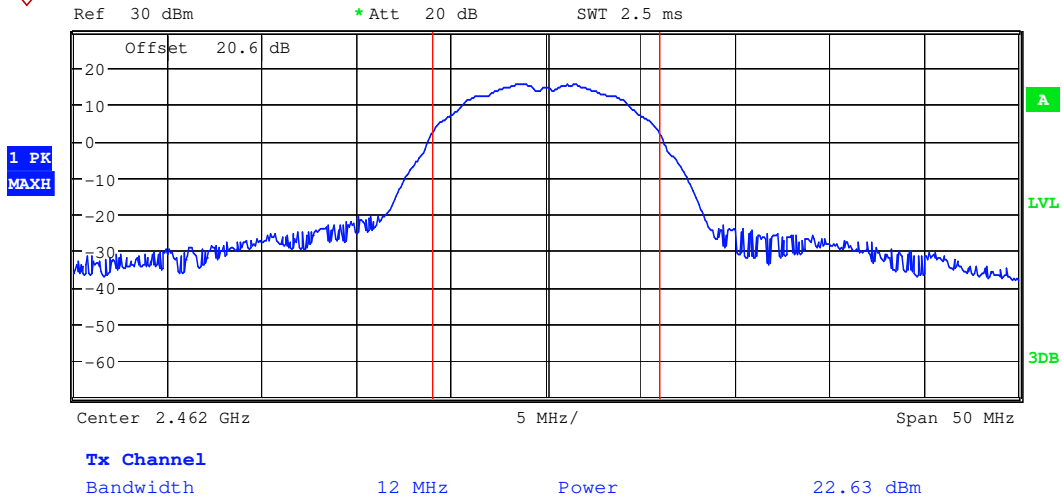
Peak Conducted Power 802.11b 2437 MHz



Peak Conducted Power 802.11b 2462 MHz



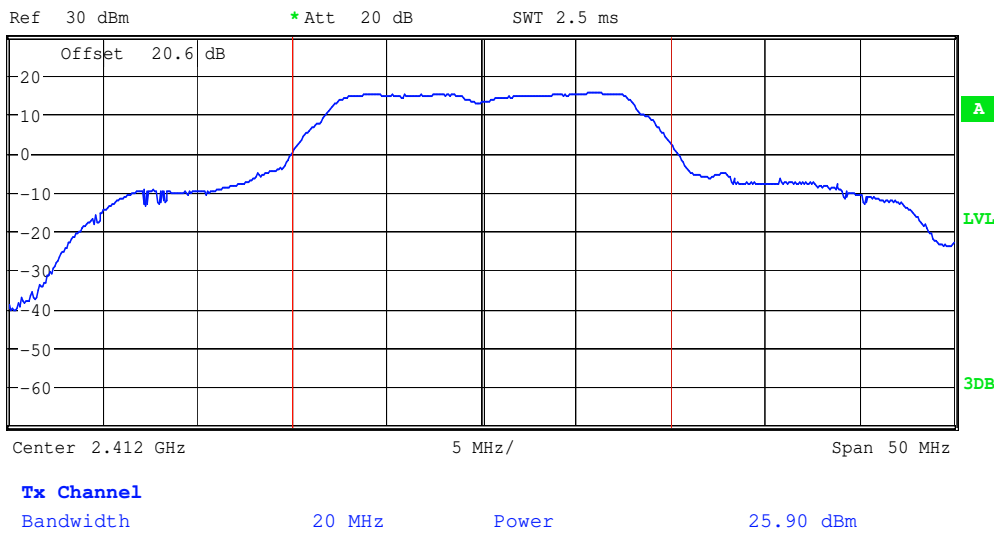
* RBW 1 MHz
* VBW 3 MHz
SWT 2.5 ms



Peak Conducted Power 802.11g 2412 MHz



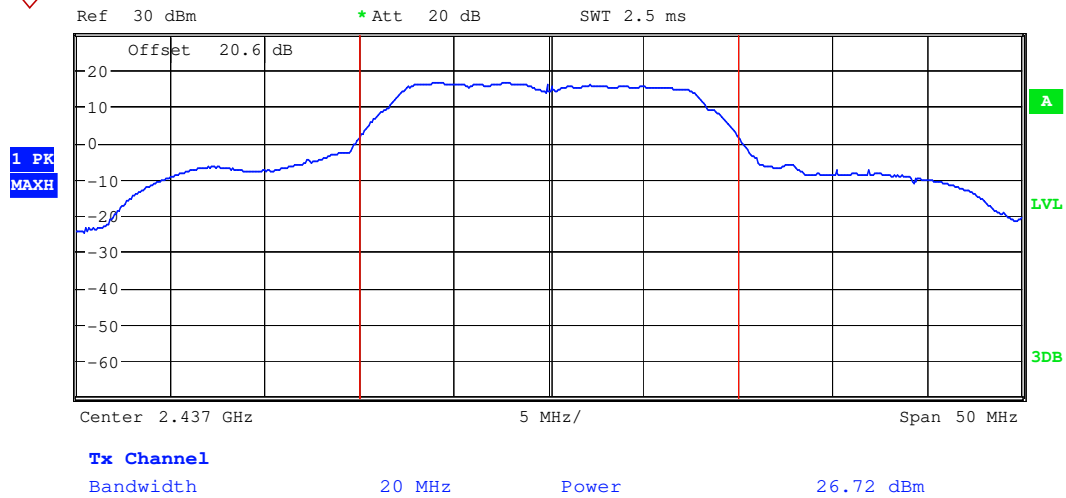
* RBW 1 MHz
* VBW 3 MHz



Peak Conducted Power 802.11g 2437 MHz



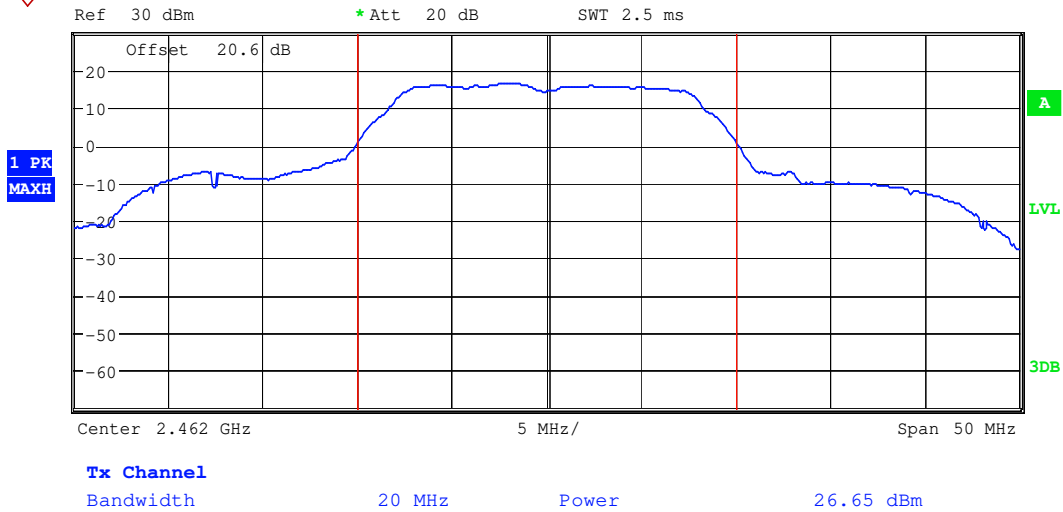
* RBW 1 MHz
* VBW 3 MHz
SWT 2.5 ms



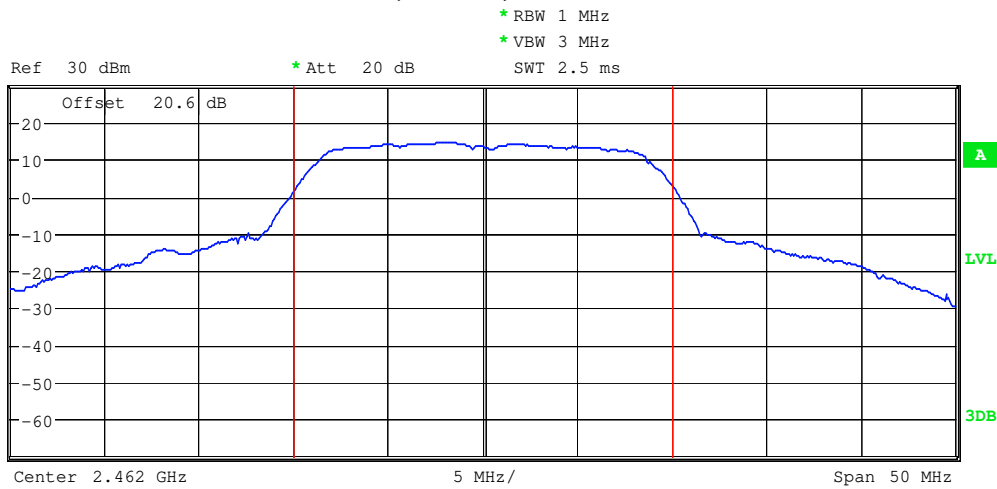
Peak Conducted Power 802.11g 2462 MHz



* RBW 1 MHz
* VBW 3 MHz
SWT 2.5 ms

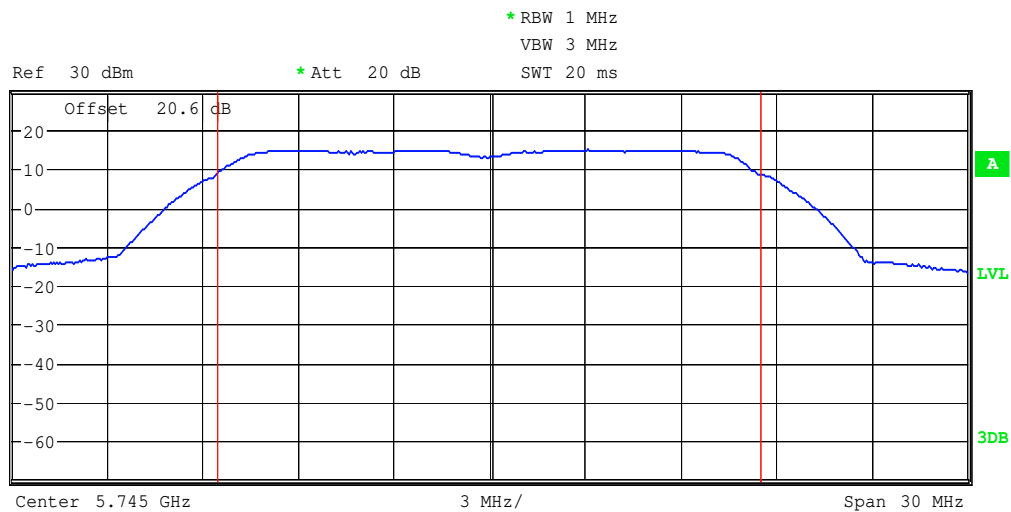


Peak Conducted Power 802.11n-MCSO (20MHz) 2462 MHz



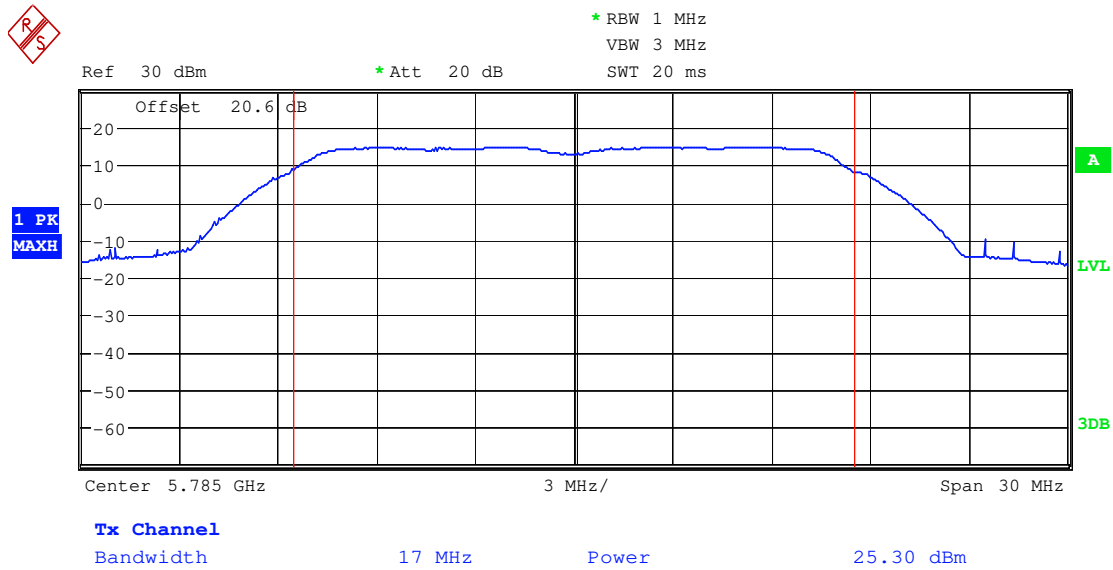
Tx Channel
Bandwidth 20 MHz Power 25.01 dBm

Peak Conducted Power 802.11a 5745 MHz

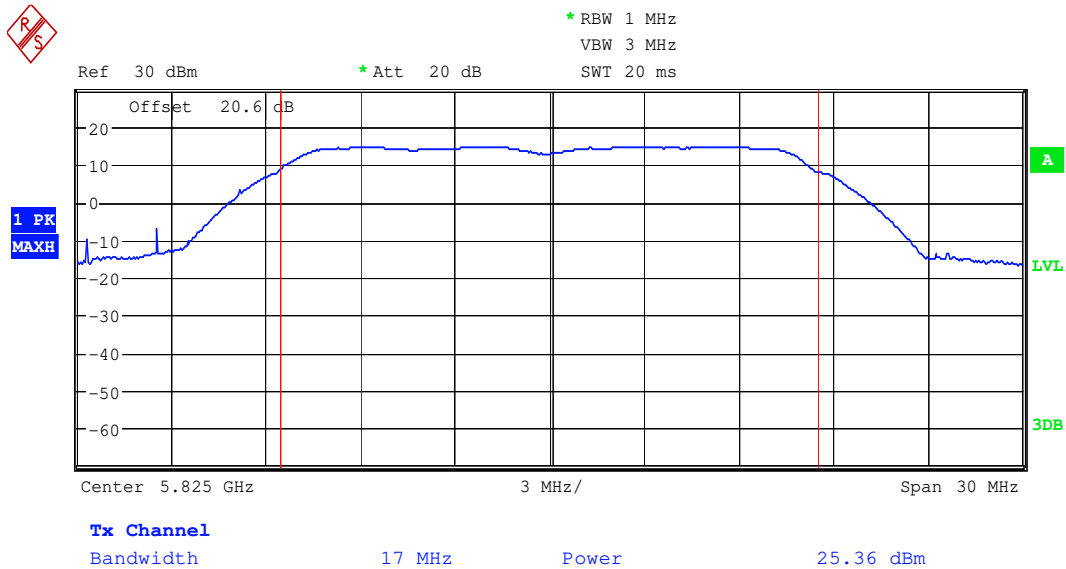


Tx Channel
Bandwidth 17 MHz Power 25.49 dBm

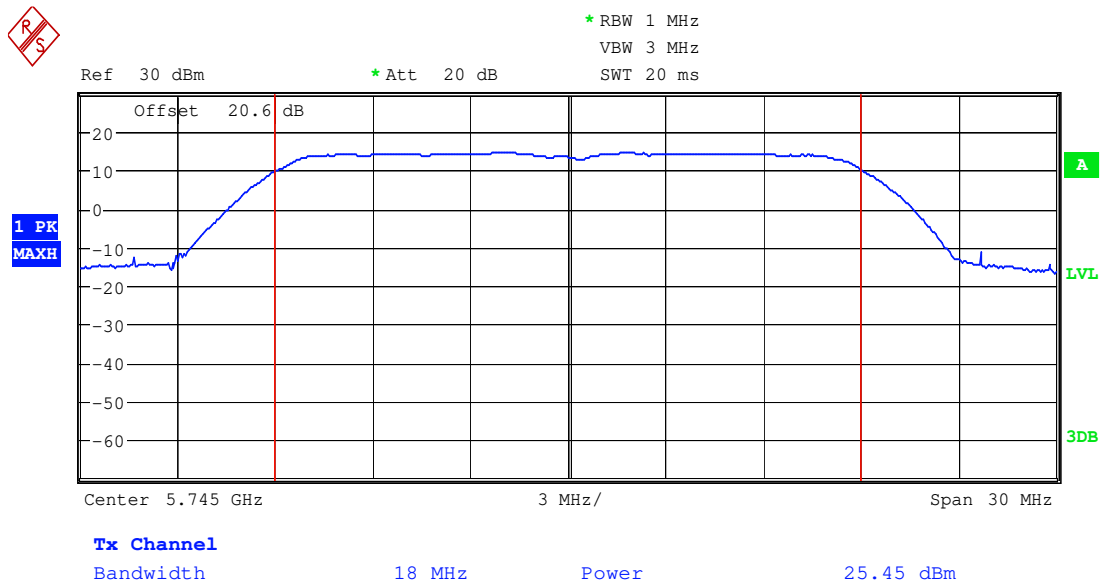
Peak Conducted Power 802.11a 5785 MHz



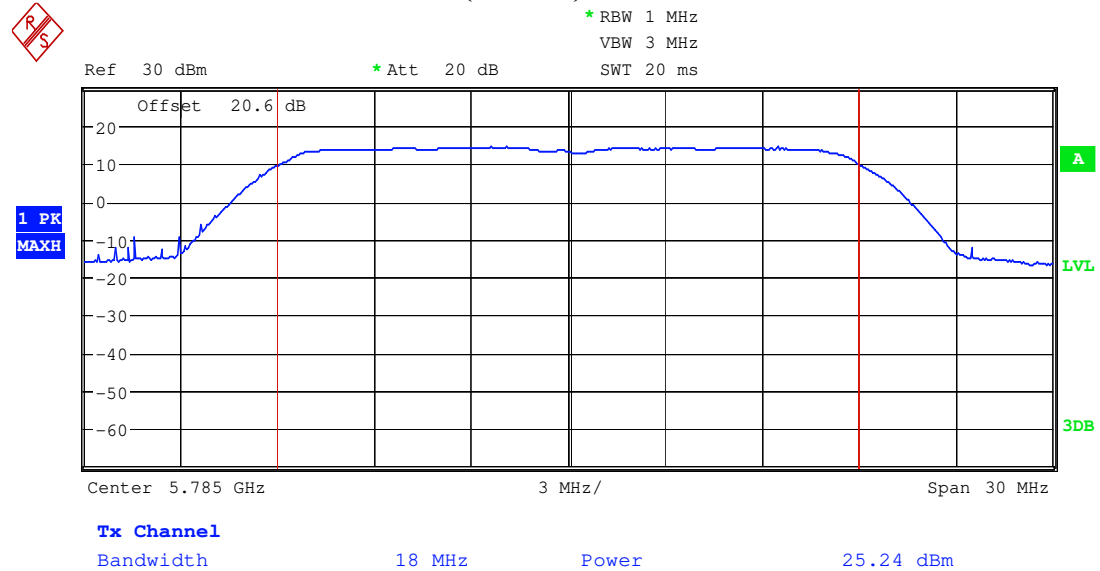
Peak Conducted Power 802.11a 5825 MHz



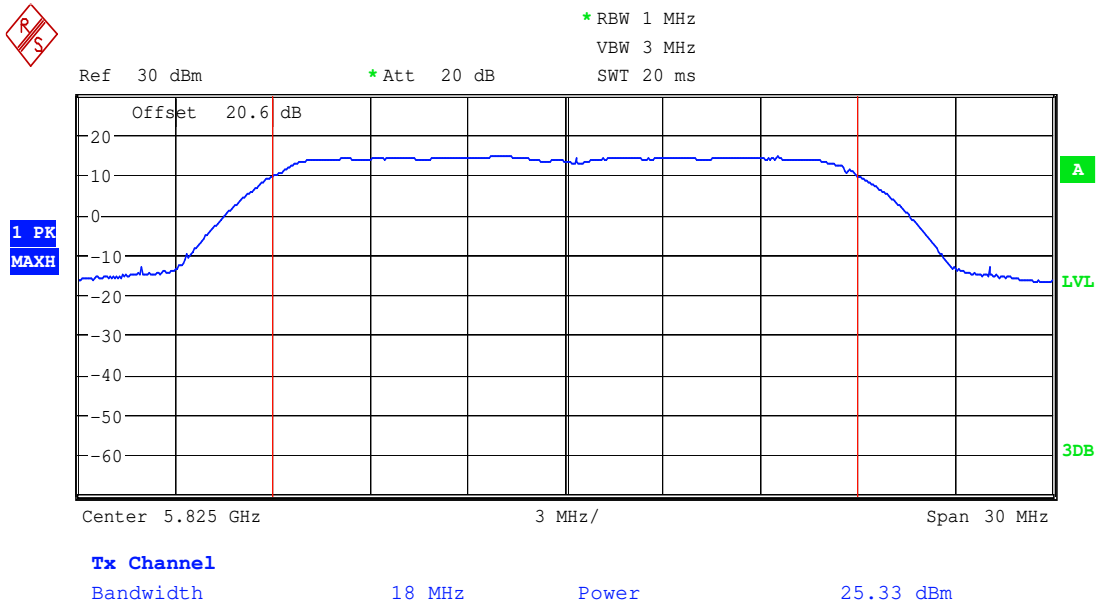
Peak Conducted Power 802.11n-MCSO (20MHz) 5745 MHz



Peak Conducted Power 802.11n-MCSO (20MHz) 5785 MHz



Peak Conducted Power 802.11n-MCSO (20MHz) 5825 MHz



6.5 Band Edge Compliance & Restricted and Non-restricted Band Edges

6.5.1 Limits: §15.247/15.205 & RSS-Gen 7.2.2/ 7.2.5, RSS-210 A8.5

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			

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:

Measurement according to ANSI C63.10:2009 section 6.9.2.4

For Band Edge measurement

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= 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

*AVG. LIMIT= 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

For Restricted Band measurement

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

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

Start frequency is the beginning of the restricted band

Stop frequency is at the end of the restricted band

*PEAK LIMIT= 74dB μ V/m (-21.2 dBm)

*AVG. LIMIT= 54dB μ V/m (-41.2 dBm)

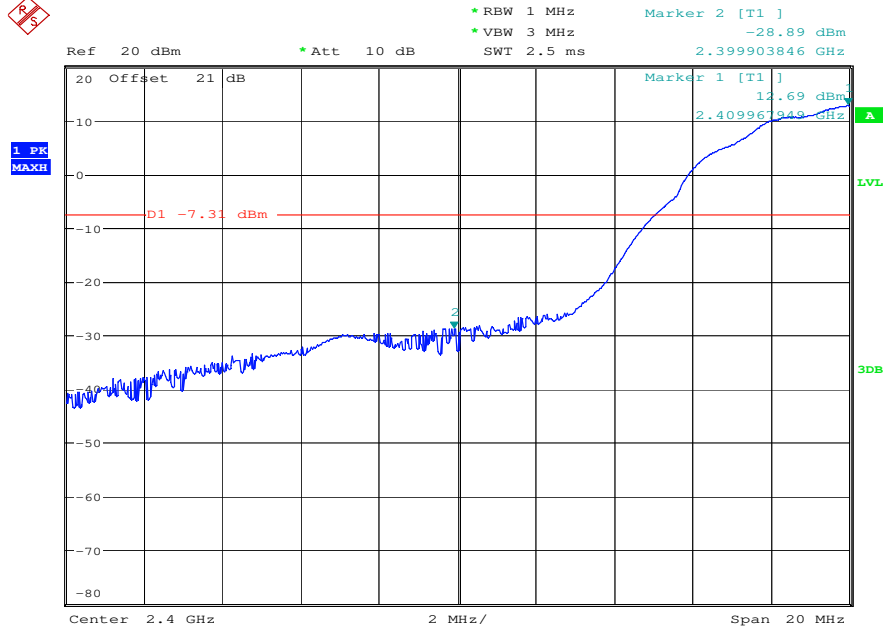
6.5.2.1 Measurement Result

Pass.

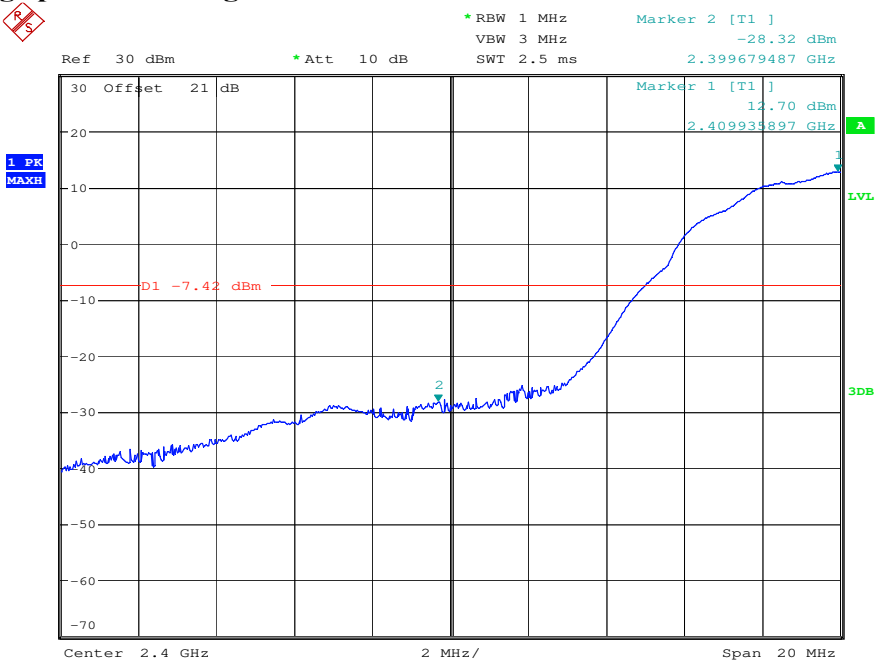
6.5.3 Band Edge and Restricted band plots:

2.4 GHz Band Edge

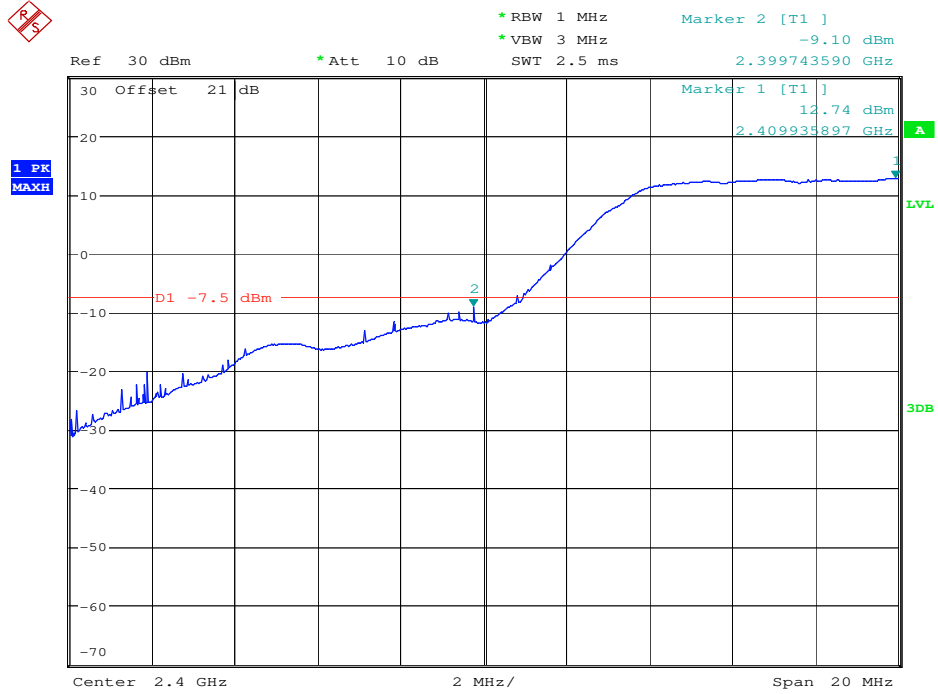
Lower band edge peak -802.11b mode -Ch1



Lower band edge peak - 802.11g mode -Ch 1

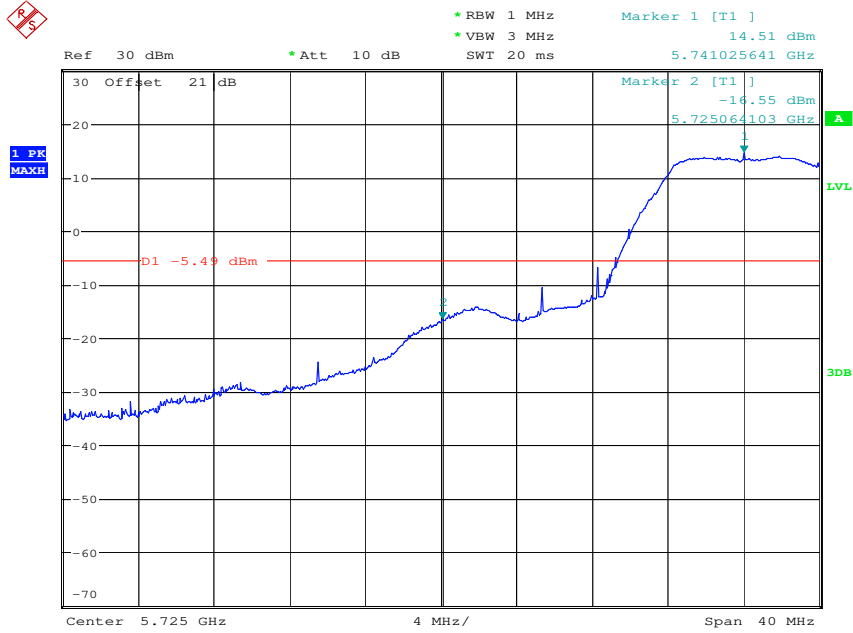


Lower band edge peak – 802.11n (HT20) mode MCS0 – Ch 1

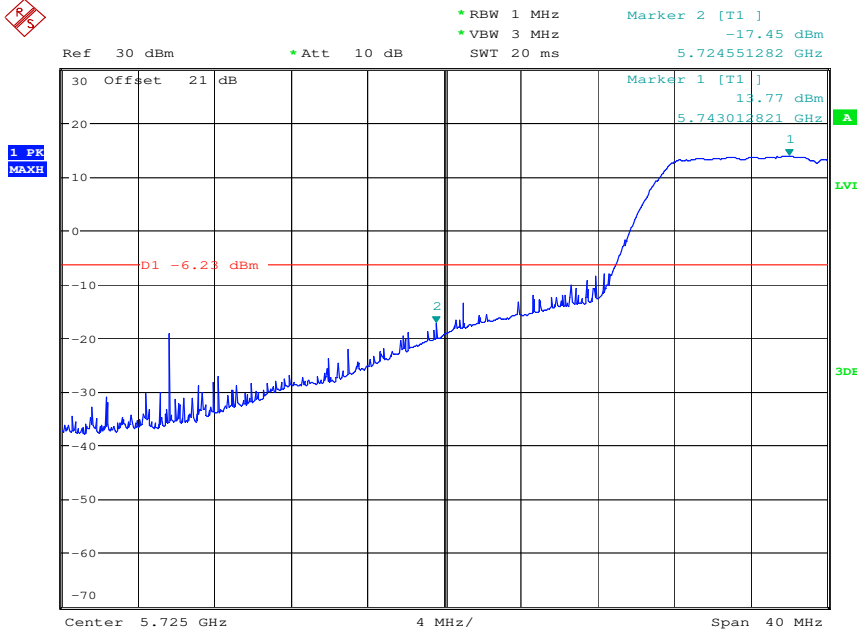


5.0 GHz Band Edge

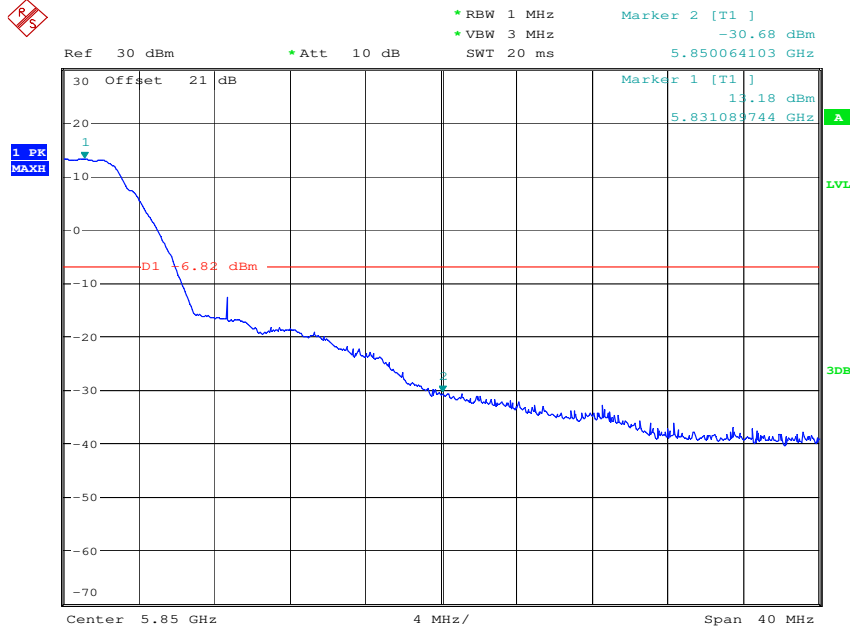
Lower band edge peak -802.11b mode -Ch 149



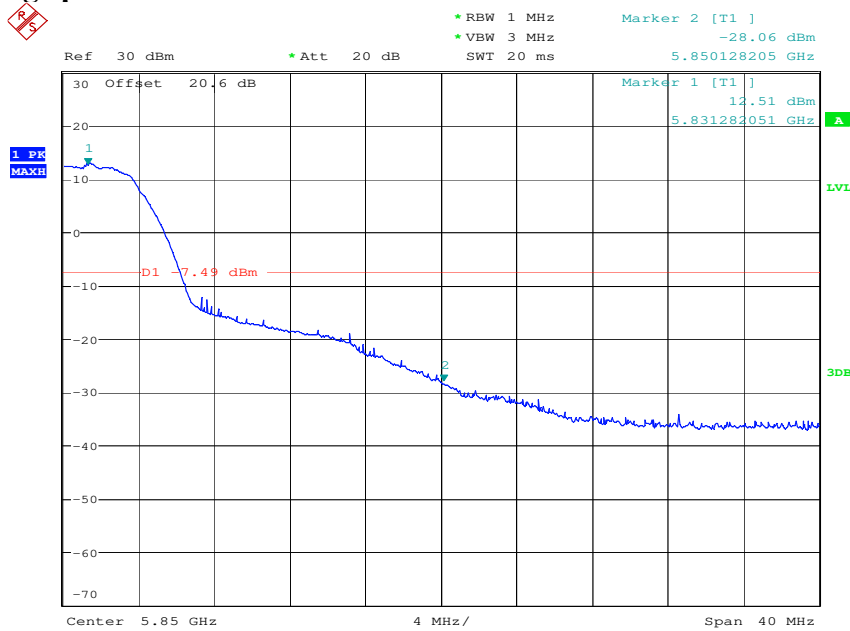
Lower band edge peak -802.11n (HT20) mode -Ch 149



Upper band edge peak -802.11a mode (Ch 165)



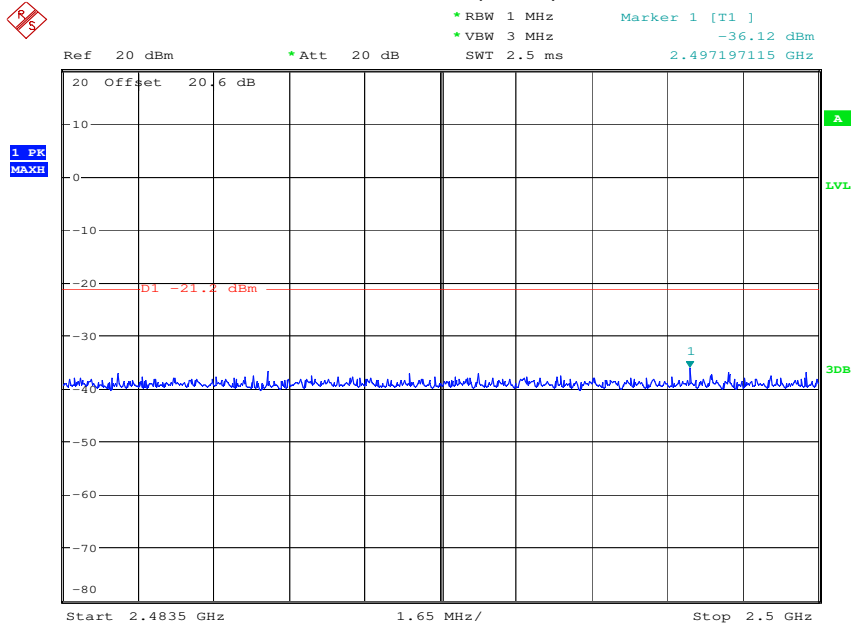
Upper band edge peak -802.11n20 mode Ch.165



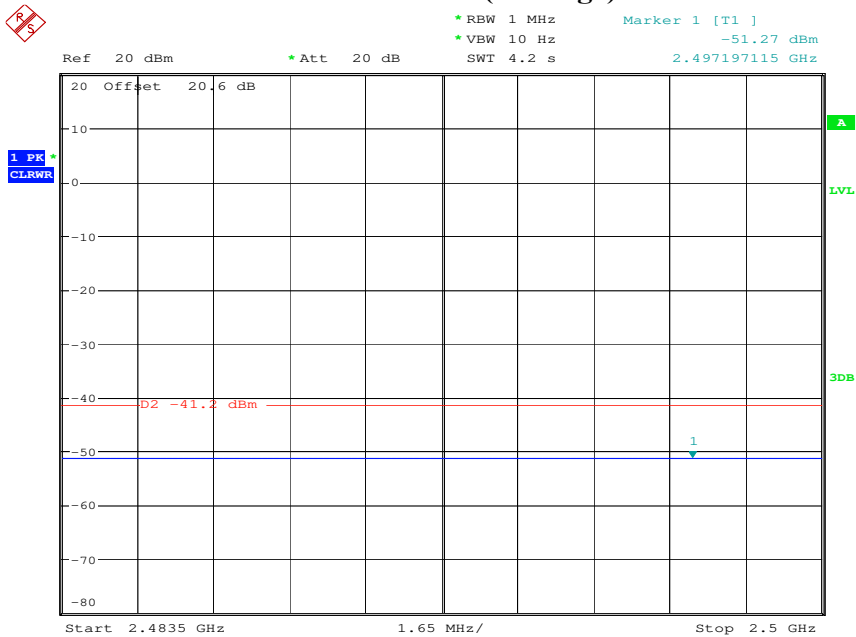
Restricted Band Edges (Conducted)

2.4 GHz Band

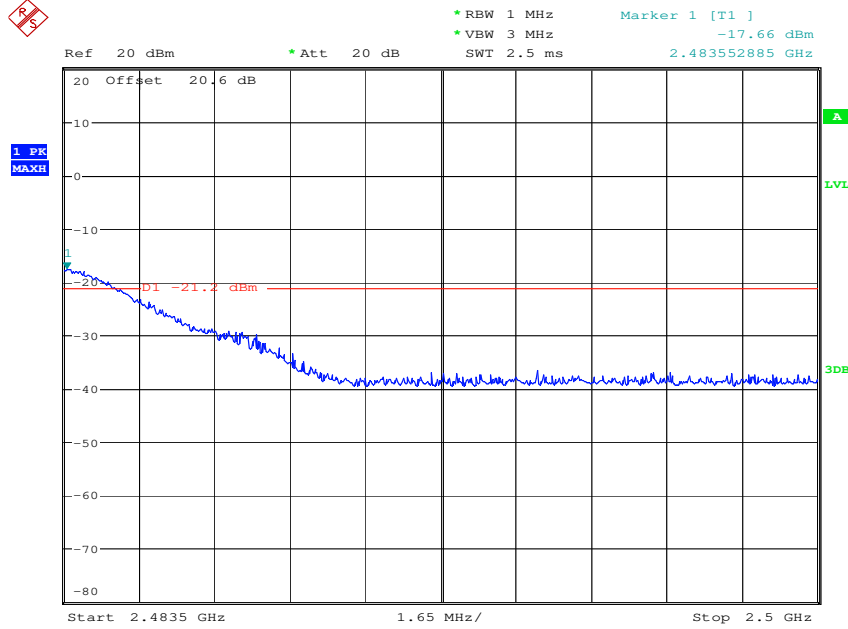
Upper restricted band – 802.11b mode – Ch 11 (Peak)



Upper restricted band – 802.11b mode – Ch 11 (Average)

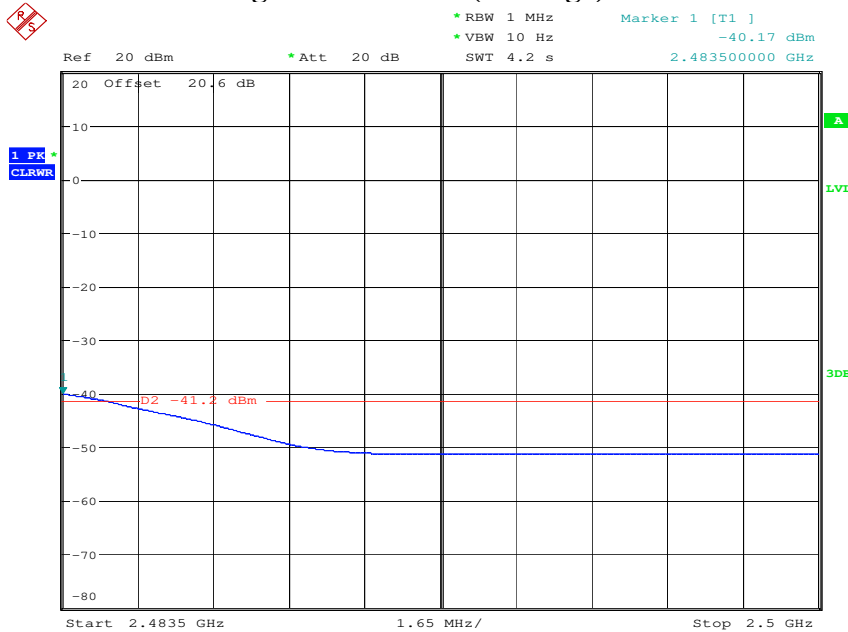


Upper restricted band – 802.11g mode – Ch 11 (Peak)



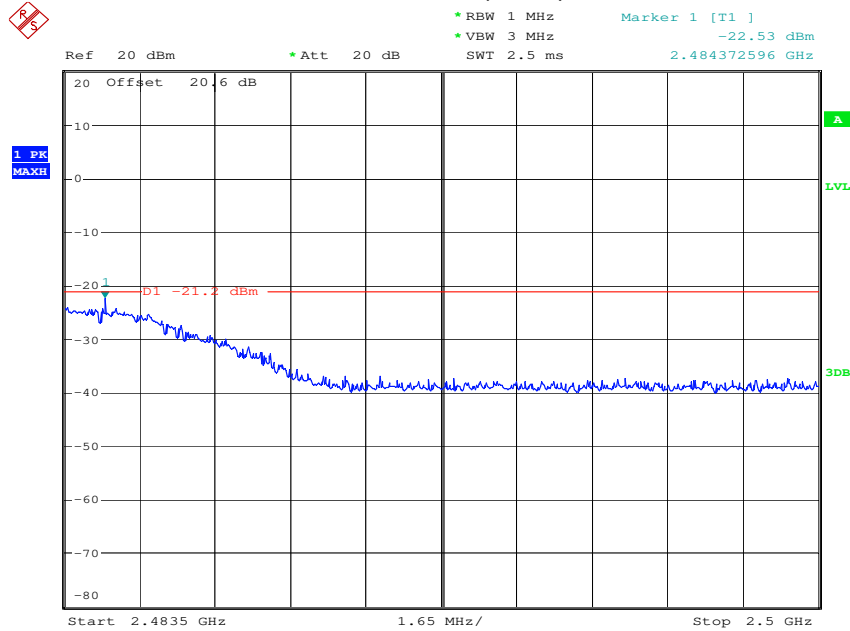
Note: Antenna gain @ 2.4GHz = -5.5dBi, EIRP @2.4835 GHz = -17.66dBm – 5.5dB = **-23.16 dBm** (Pass)

Upper restricted band – 802.11g mode – Ch 11 (Average)

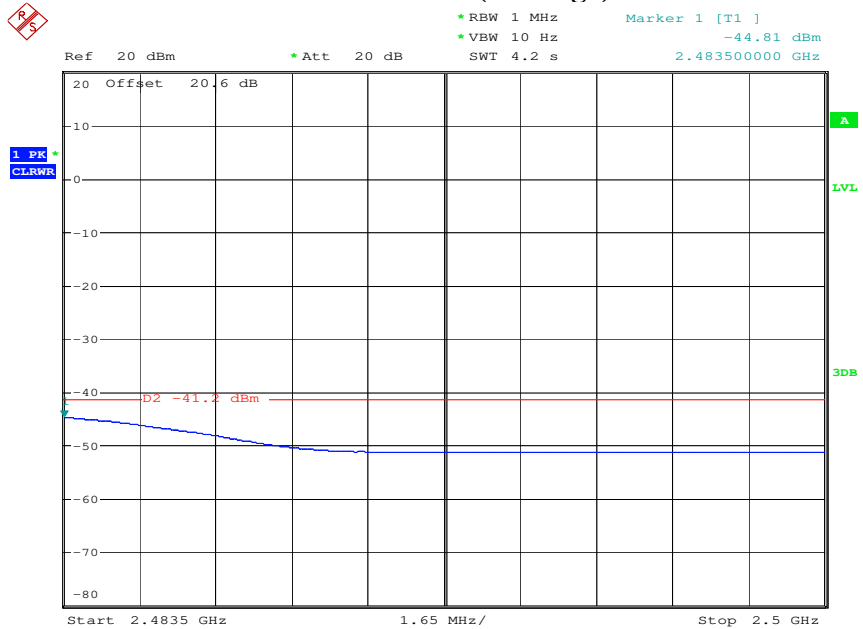


Note: Antenna gain @ 2.4GHz = -5.5dBi, EIRP @2.4843 GHz = -40.17dBm – 5.5dB = **-45.67 dBm** (Pass)

Upper restricted band – 802.11n mode – Ch 11 (Peak)



Upper restricted band – 802.11n mode – Ch 11 (Average)



6.6 Occupied Bandwidth (20dB & 99%)

6.6.1 Limits:

§15.247 (a)(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: 22 °C; Vnom: 3.8V

6.6.3 Measurement procedure:

Measurement according to ANSI C63.10: 2009 section 6.9.1 & RSS-Gen 4.6 Issue 3

Spectrum Analyzer settings:

Span= 2 to 5 x the occupied BW

RBW= 1% to 5 % of the occupied BW, unless otherwise specified

VBW≥ RBW, Detector: Peak- Max hold;

Sweep Time: Auto

Allow the trace to stabilize

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the peak level measured in the fundamental emission.

6.6.4 Test Result: 2.4 GHz Band

Occupied Bandwidth (MHz)						
Mode	Frequency (MHz)					
	2412 Channel 1		2437 Channel 6		2462 Channel 11	
	6dB	99%	6dB	99%	6dB	99%
802.11b	8.89	11.78	8.73	11.54	8.65	11.38
802.11g	16.99	18.75	16.59	18.51	16.51	18.11
802.11n (20 MHz)	18.18	19.07	18.26	18.99	18.03	18.83
Measurement Uncertainty: ±100 kHz						

6.6.5 Test Result: 5 GHz Band

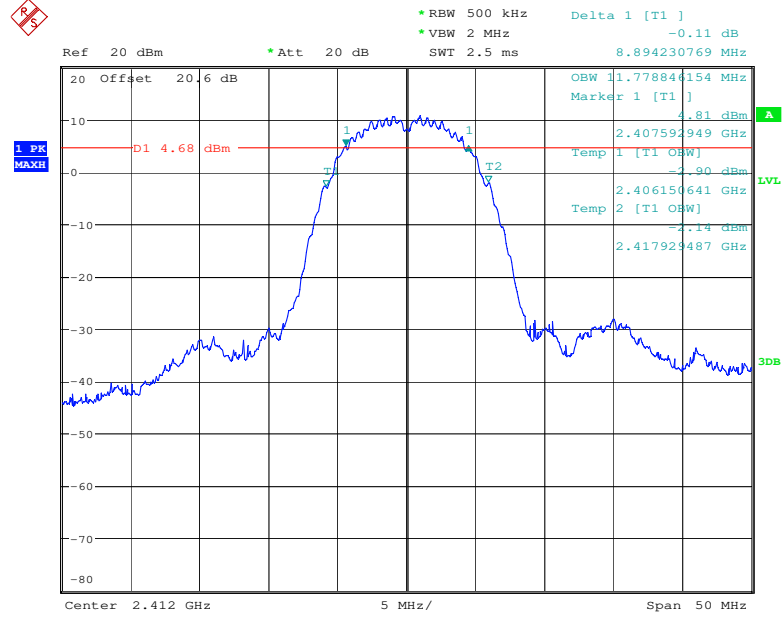
Occupied Bandwidth (MHz)						
Mode	Frequency (MHz)					
	5745 Channel 149		5785 Channel 157		5825 Channel 165	
	6dB	99%	6dB	99%	6dB	99%
802.11a	16.44	16.56	16.38	16.56	16.39	16.56
802.11n (20MHz)	17.69	17.79	17.69	17.74	17.64	17.74
Measurement Uncertainty: ±100 kHz						

6.6.6 Measurement Result

Pass.

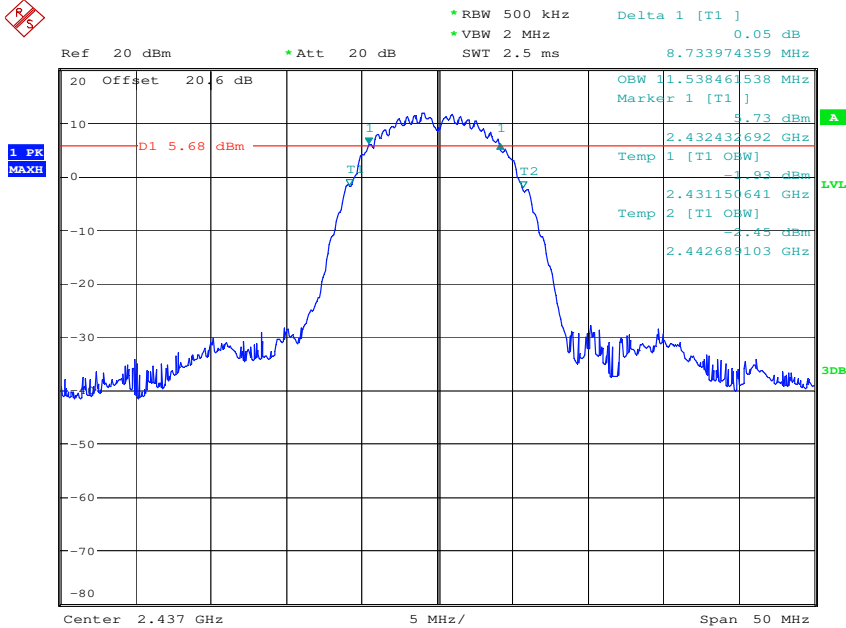
6.6.7 Test Data/plots: 2.4 GHz Band

6dB & 99% Bandwidth 802.11b 2412 MHz



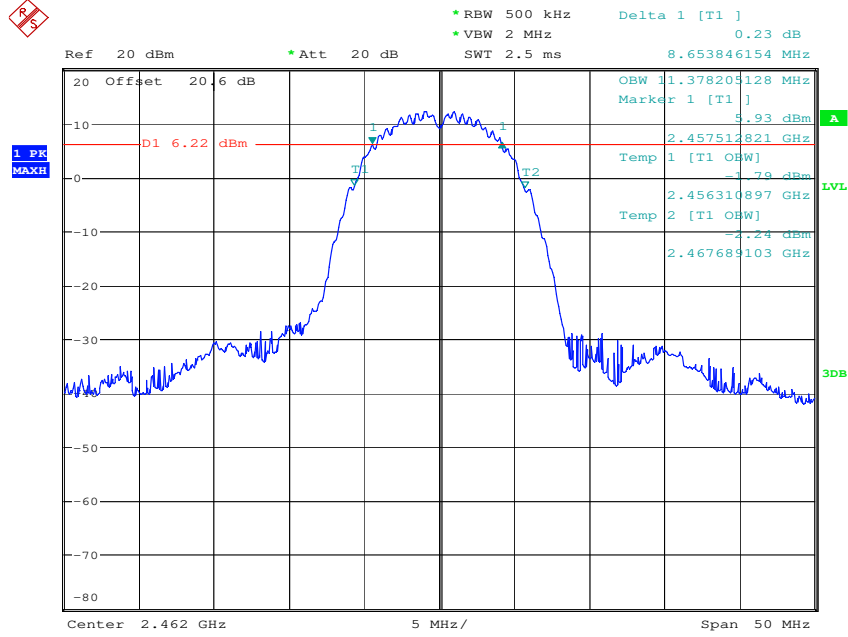
Date: 3.MAR.2014 22:01:48

6dB & 99% Bandwidth 802.11b 2437 MHz



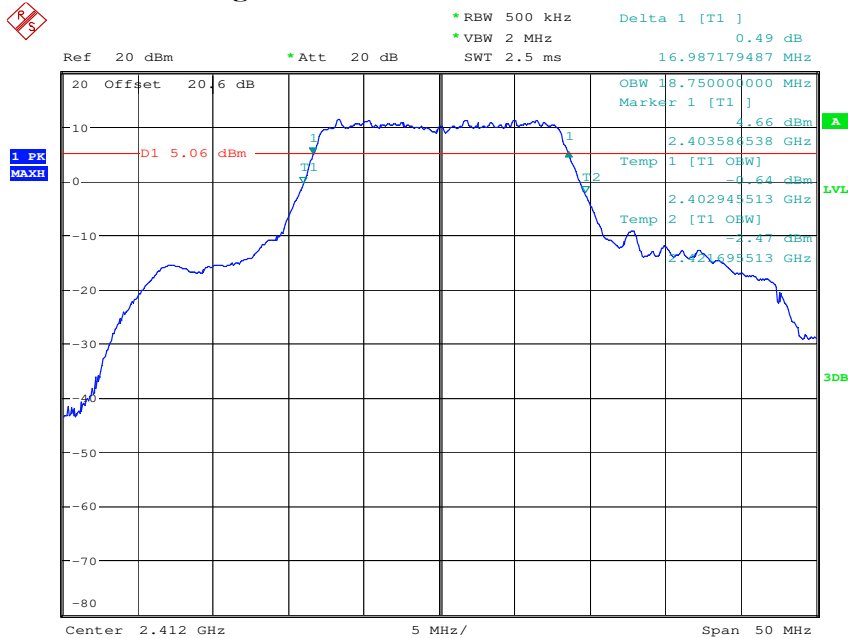
Date: 3.MAR.2014 22:03:41

6dB & 99% Bandwidth 802.11b 2462 MHz



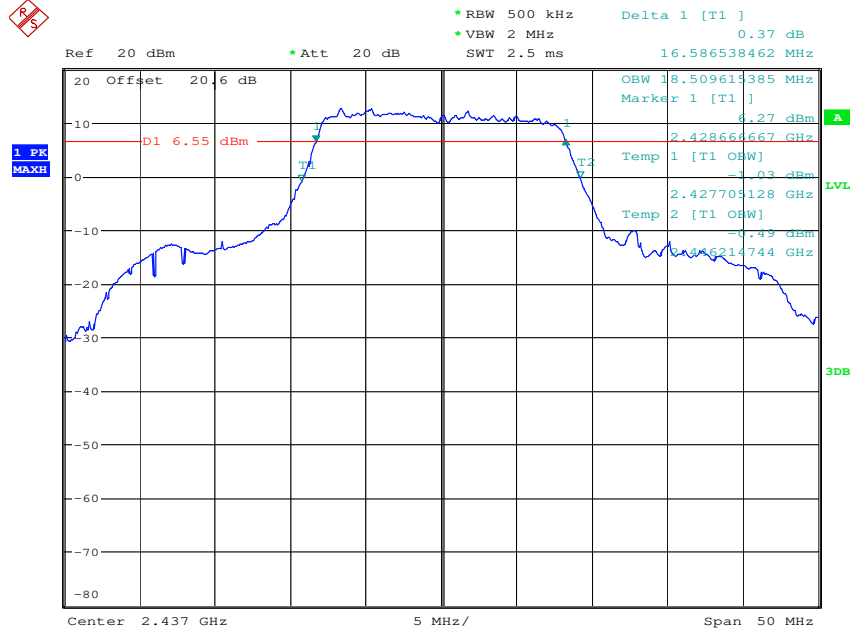
Date: 3.MAR.2014 22:05:16

6dB & 99% Bandwidth 802.11g 2412 MHz



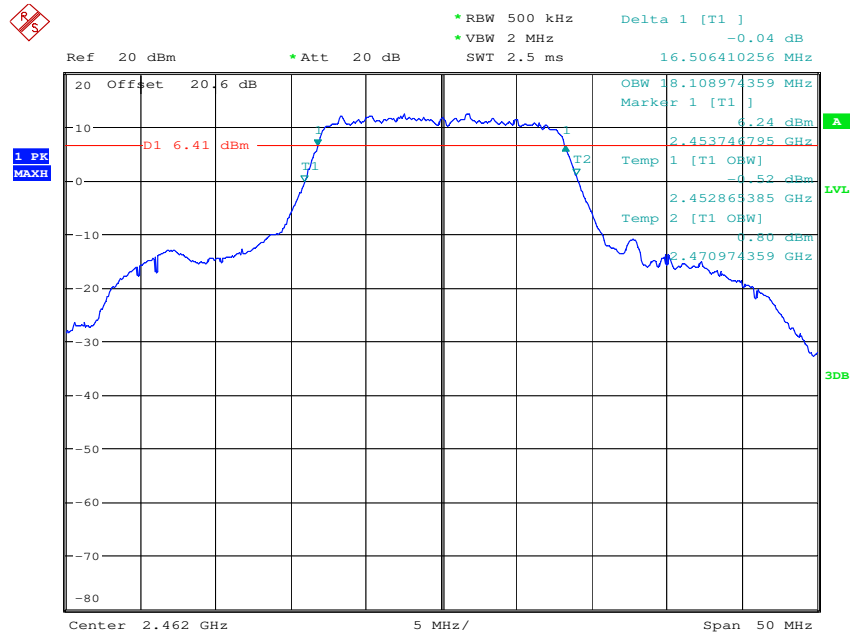
Date: 3.MAR.2014 21:55:27

6dB & 99% Bandwidth 802.11g 2437 MHz



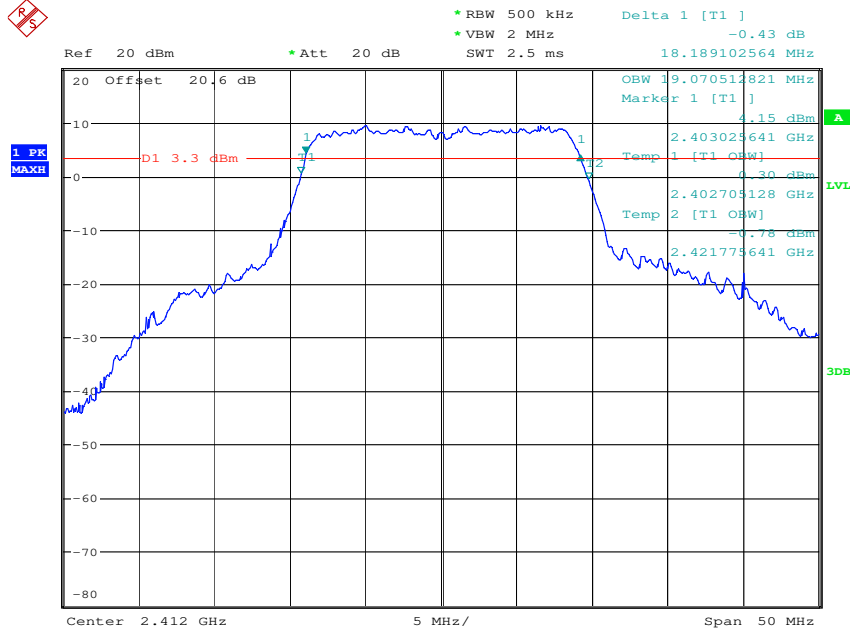
Date: 3.MAR.2014 21:57:53

6dB & 99% Bandwidth 802.11g 2462 MHz



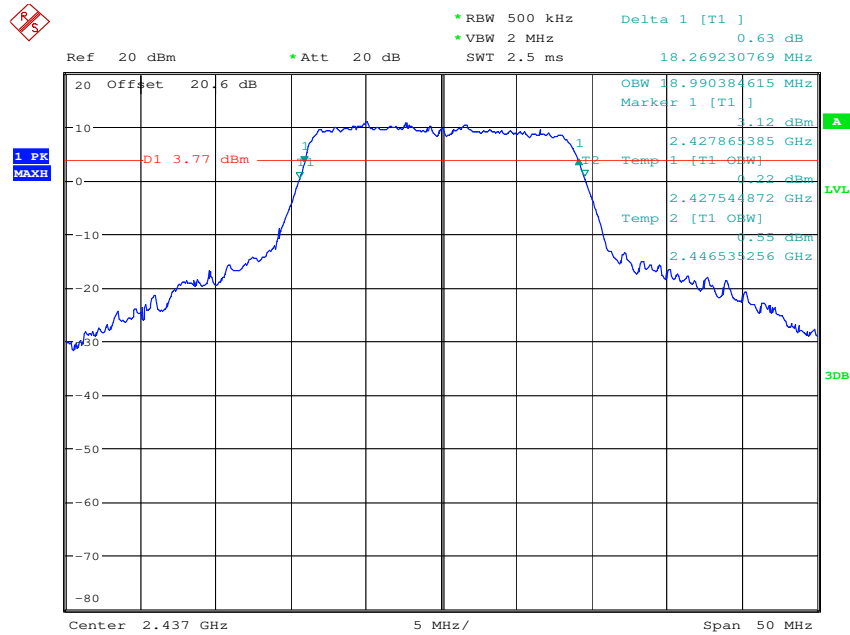
Date: 3.MAR.2014 21:59:52

6dB & 99% Bandwidth 802.11n -MCS0 (20 MHz) 2412 MHz



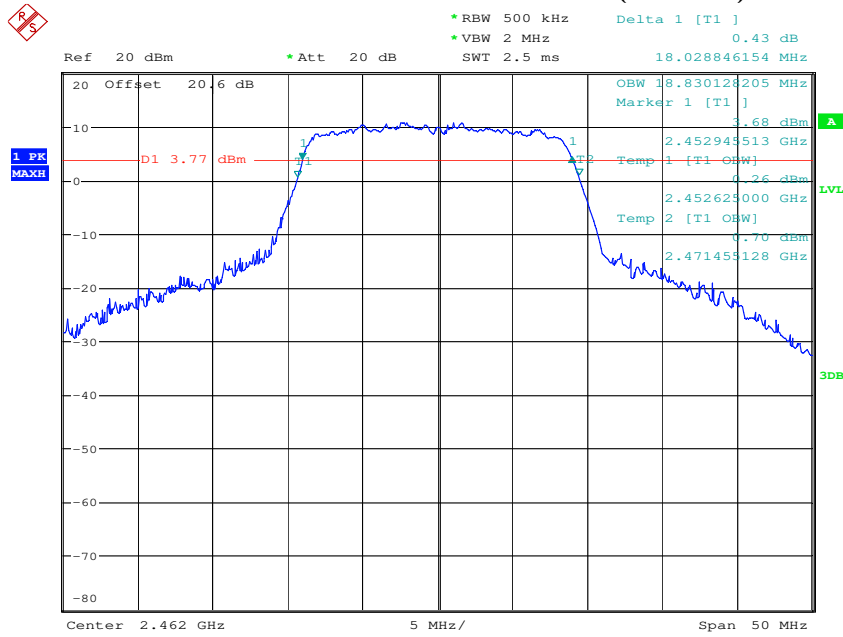
Date: 3.MAR.2014 22:10:57

6dB & 99% Bandwidth 802.11n -MCS0 (20 MHz) 2437 MHz



Date: 3.MAR.2014 22:12:55

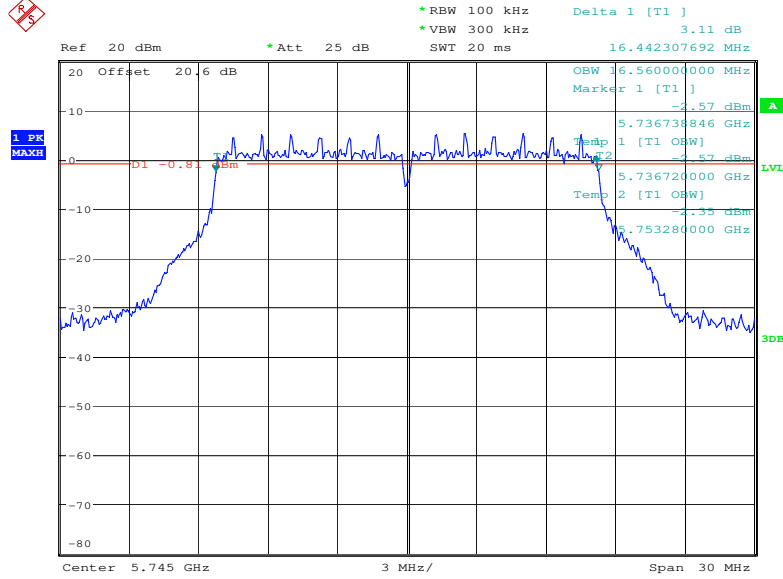
6dB & 99% Bandwidth 802.11n -MCS0 (20 MHz) 2462 MHz



Date: 3.MAR.2014 22:30:08

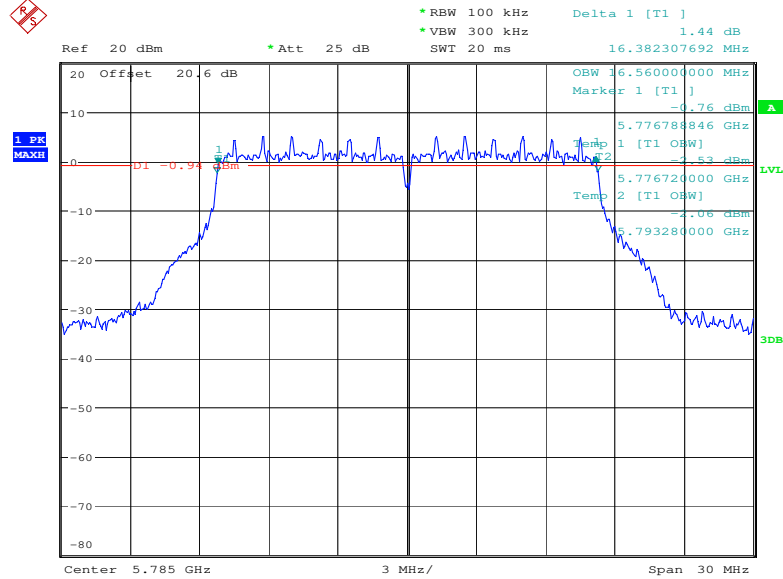
6.6.8 Test Data/plots: 5 GHz Band

6dB & 99% Bandwidth 802.11a 5745 MHz



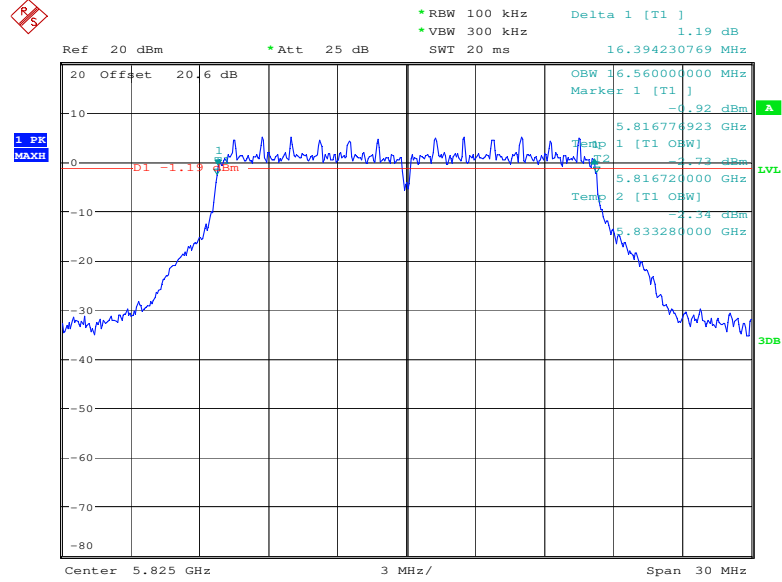
low
Date: 6.MAR.2014 22:18:46

6dB & 99% Bandwidth 802.11a 5785 MHz



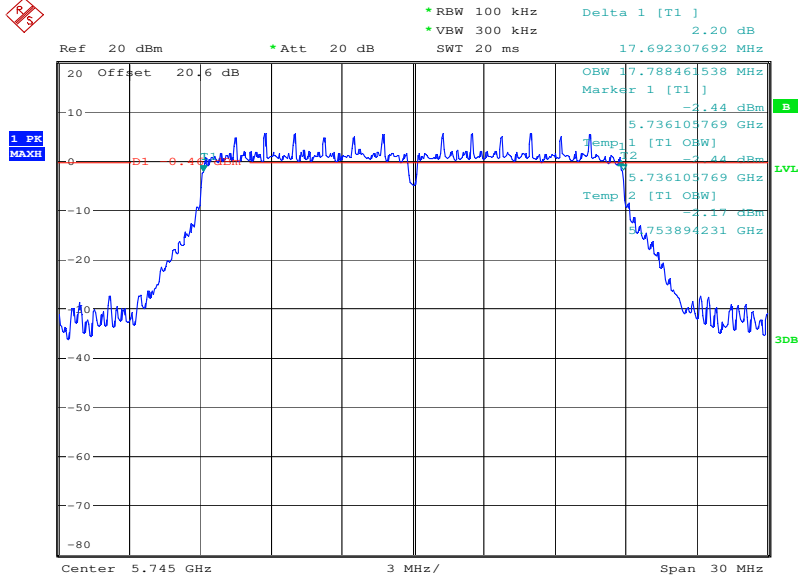
low
Date: 6.MAR.2014 22:23:04

6dB & 99% Bandwidth 802.11a 5825 MHz



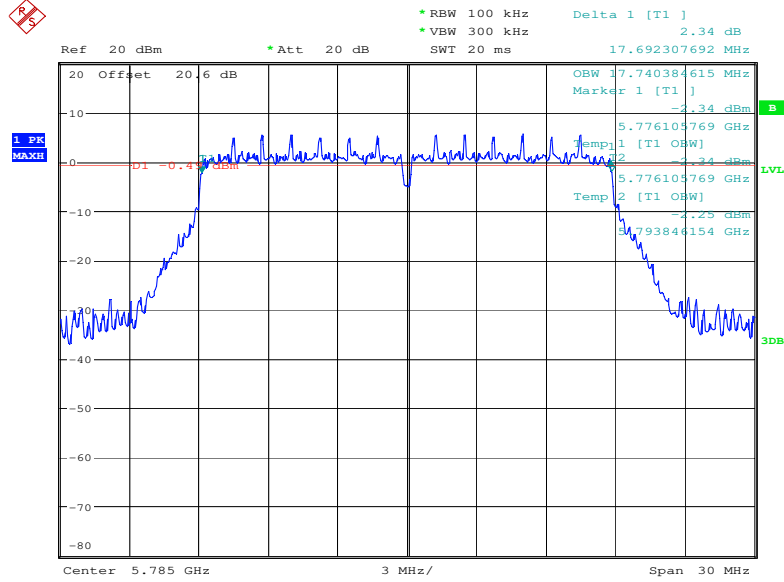
low
Date: 6.MAR.2014 22:32:13

6dB & 99% Bandwidth 802.11n -MCS0 (20 MHz) 5745 MHz



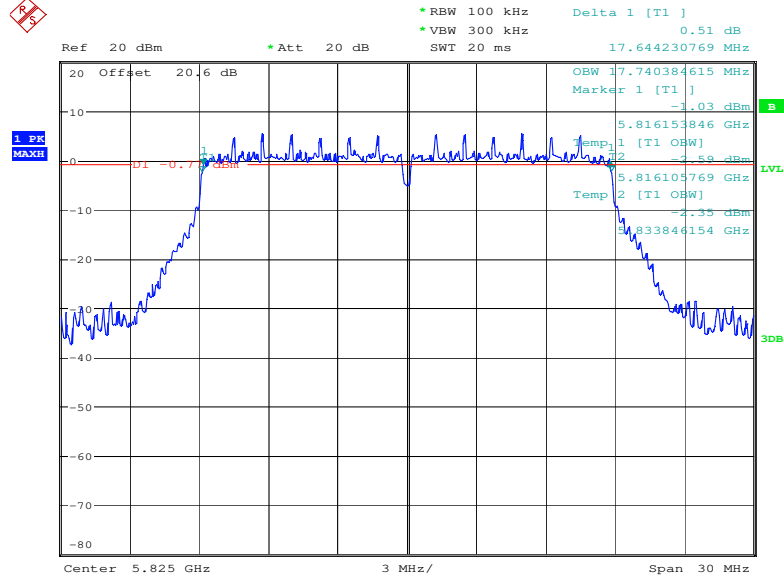
low
Date: 18.APR.2014 22:11:06

6dB & 99% Bandwidth 802.11n -MCS0 (20 MHz) 5785 MHz



low
Date: 18.APR.2014 22:08:53

6dB & 99% Bandwidth 802.11n -MCS0 (20 MHz) 5825 MHz



low
Date: 18.APR.2014 22:06:28

6.7 Power Spectral Density

6.7.1 Limits:

§ 15.247 (e) & 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 Test Conditions:

Tnom: 22 °C; Vnom: 3.8V

6.7.3 Measurement procedure:

Measurement according to FCC KDB 558074 D01 DTS v03r1 section 10.2

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 x the DTS BW
3. Set the RBW=3 kHz, VBW \geq 3 x RBW and sweep time = auto.
4. Trace mode = max hold
5. Detector = Peak
6. Allow trace to fully stabilize and use peak marker function to determine the highest level as the PSD.

6.7.4 Test Data: 2.4 / 5 GHz Band

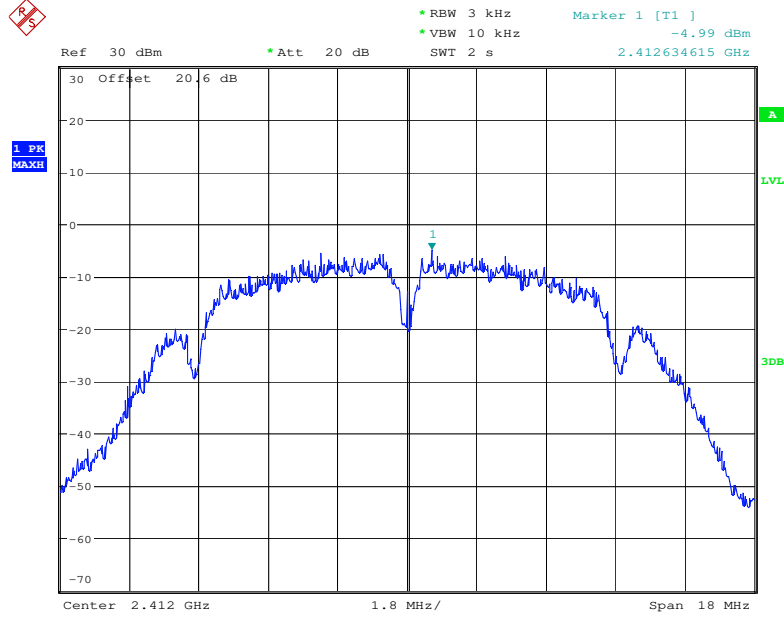
Power Spectral Density (dBm)			
Mode	Frequency (MHz)		
	2412 Channel 1	2437 Channel 6	2462 Channel 11
802.11b	-4.99	-4.12	-2.40
802.11g	-8.40	-9.19	-8.34
802.11n	-10.40	-9.67	-8.20
Power Spectral Density (dBm)			
Mode	Frequency (MHz)		
	5745 Channel 149	5785 Channel 157	5825 Channel 165
802.11a	-9.40	-9.86	-9.41
802.11n	-7.60	-9.35	-8.36
Measurement Uncertainty: ±0.5dB			

6.7.4.1 Measurement Result

Pass.

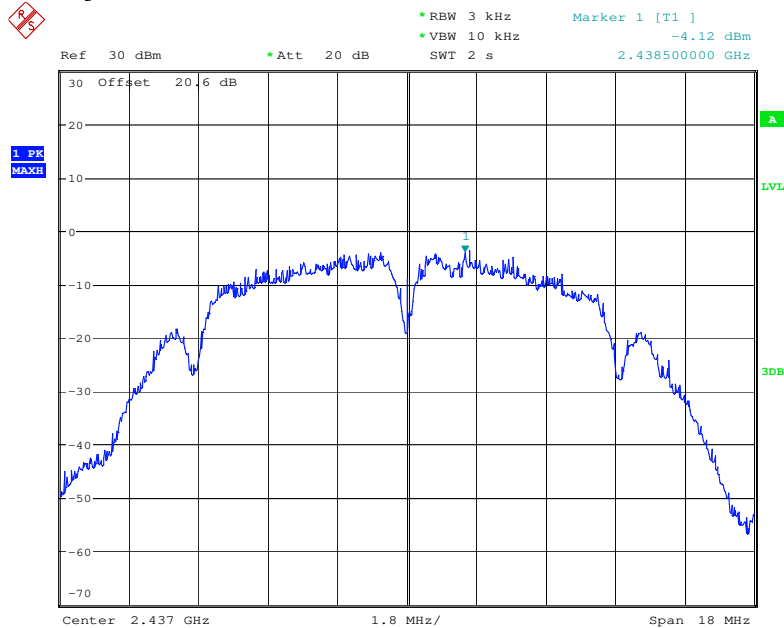
6.7.5 Measurement Plots: 2.4 GHz Band

Power Spectral Density 802.11b 2412 MHz



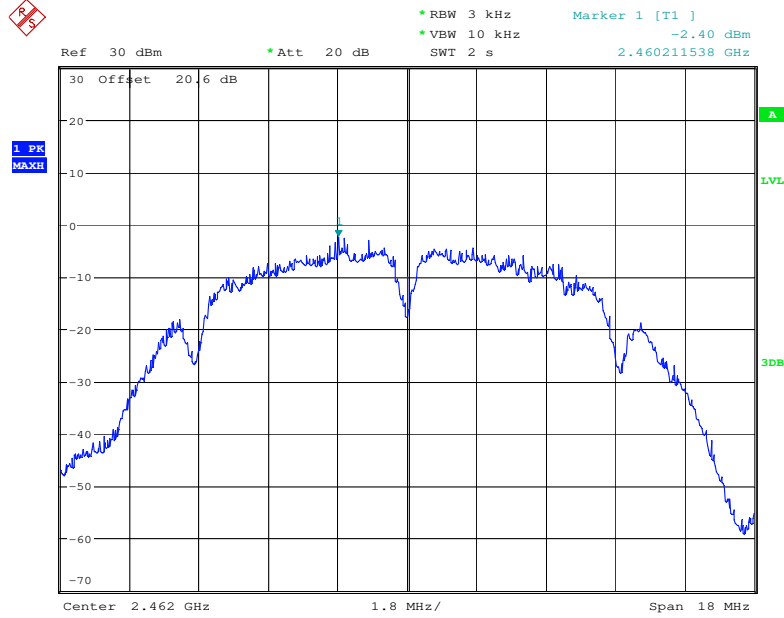
Date: 3.MAR.2014 23:29:22

Power Spectral Density 802.11b 2437 MHz



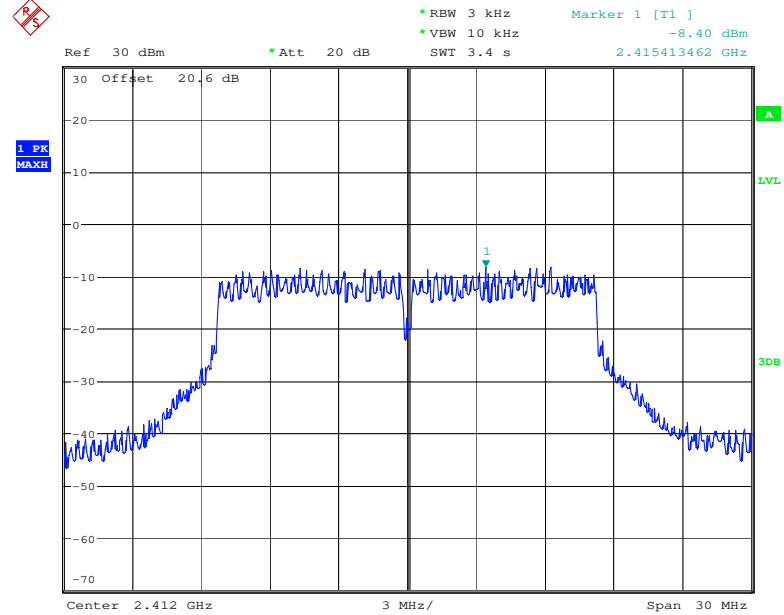
Date: 3.MAR.2014 23:16:01

Power Spectral Density 802.11b 2462 MHz



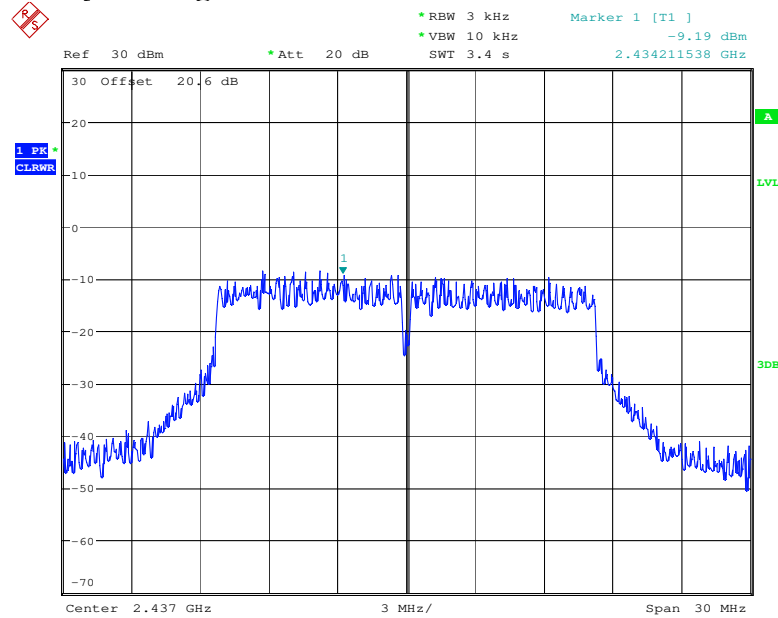
Date: 3.MAR.2014 23:26:53

Power Spectral Density 802.11g 2412 MHz



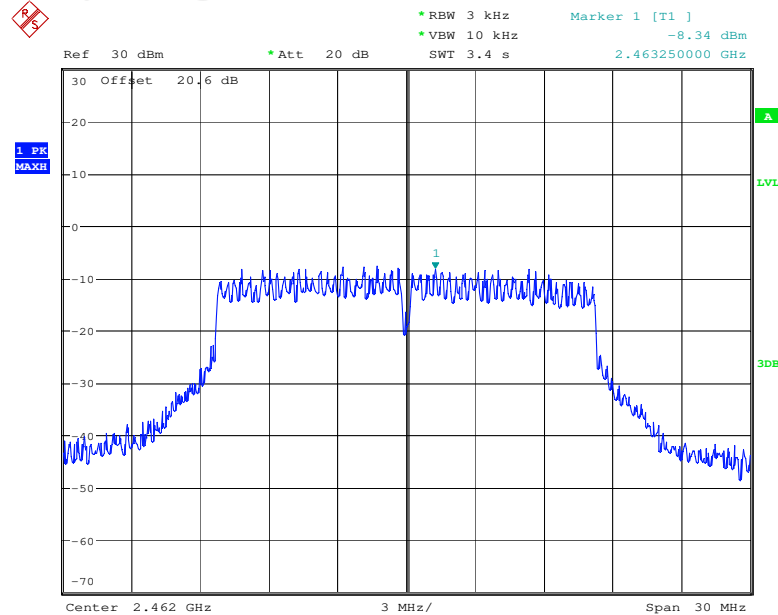
Date: 3.MAR.2014 23:34:03

Power Spectral Density 802.11g 2437 MHz



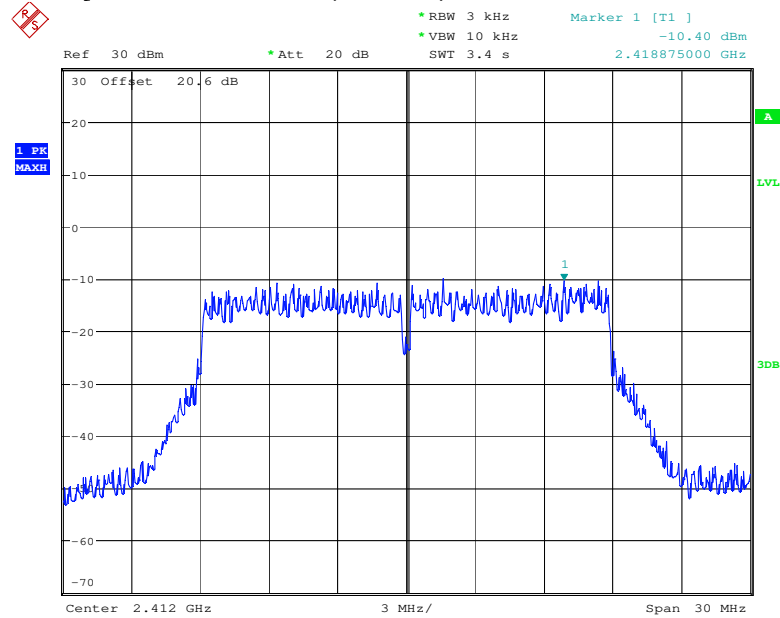
Date: 3.MAR.2014 23:37:21

Power Spectral Density 802.11g 2462 MHz



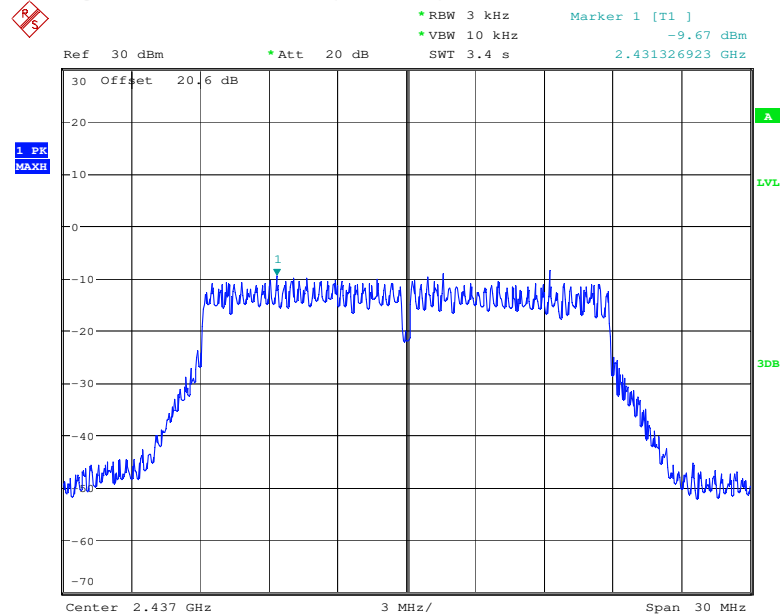
Date: 3.MAR.2014 23:38:12

Power Spectral Density 802.11n -MCS0 (20MHz) 2412 MHz



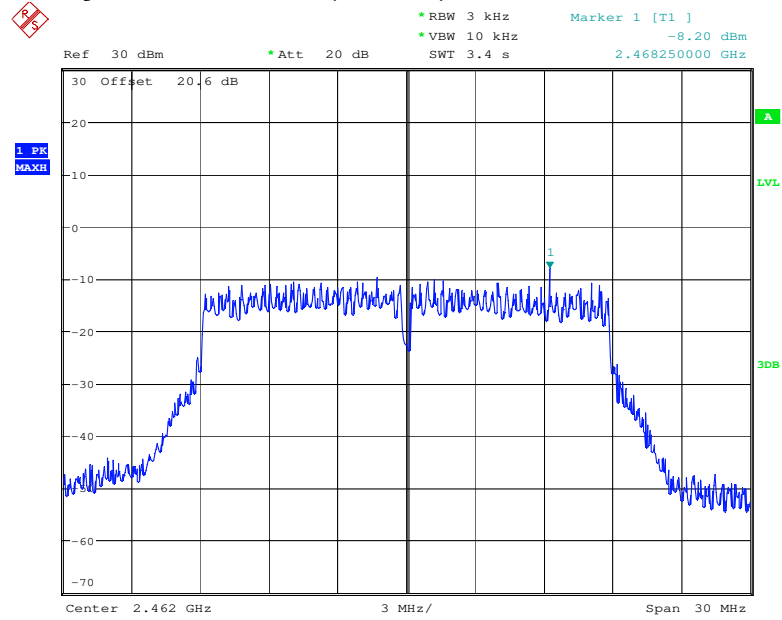
Date: 3.MAR.2014 23:39:18

Power Spectral Density 802.11n -MCS0 (20MHz) 2437 MHz



Date: 3.MAR.2014 23:40:48

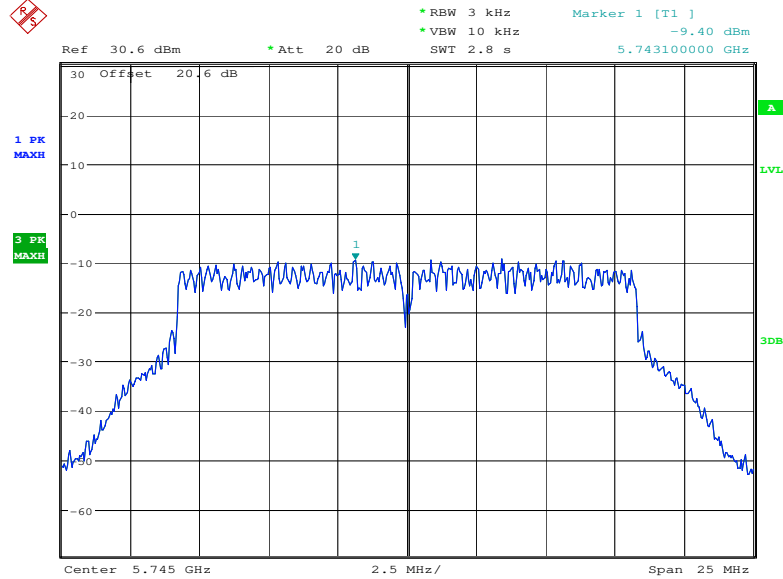
Power Spectral Density 802.11n -MCS0 (20MHz) 2462 MHz



Date: 3.MAR.2014 23:41:50

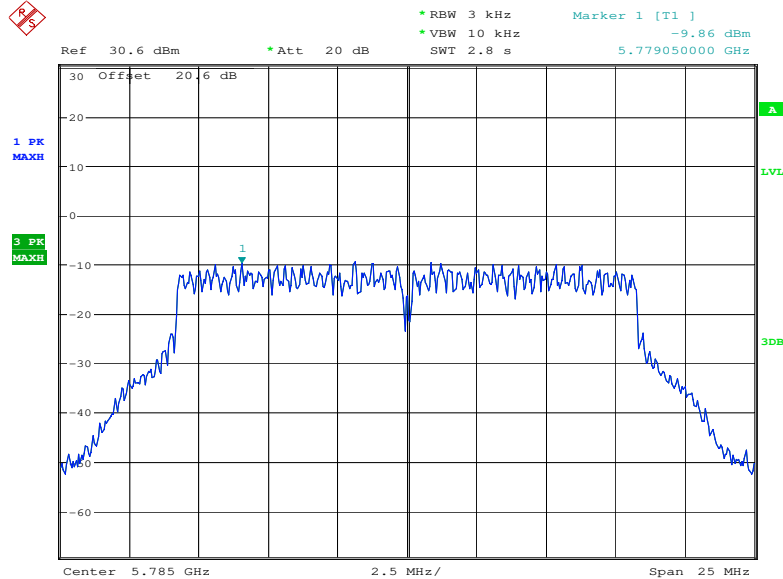
6.7.6 Test Data/plots: 5 GHz Band

Power Spectral Density 802.11a 5745 MHz



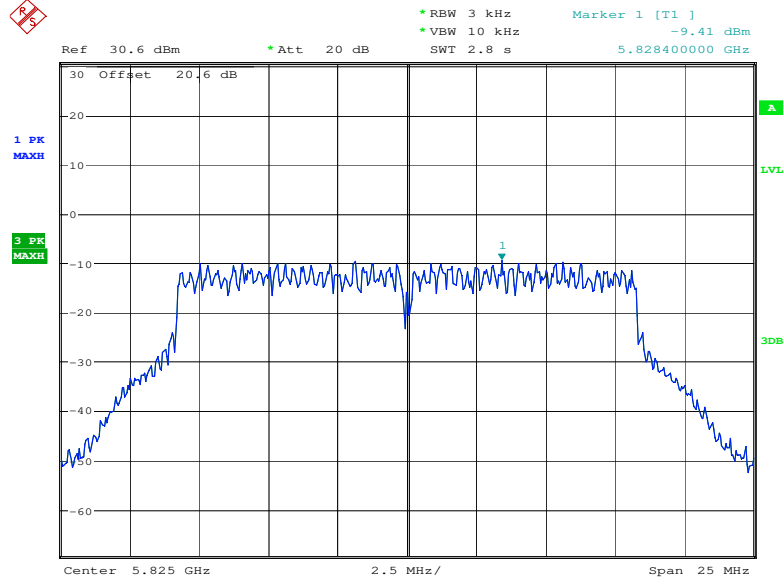
low
Date: 6.MAR.2014 23:14:00

Power Spectral Density 802.11a 5785 MHz



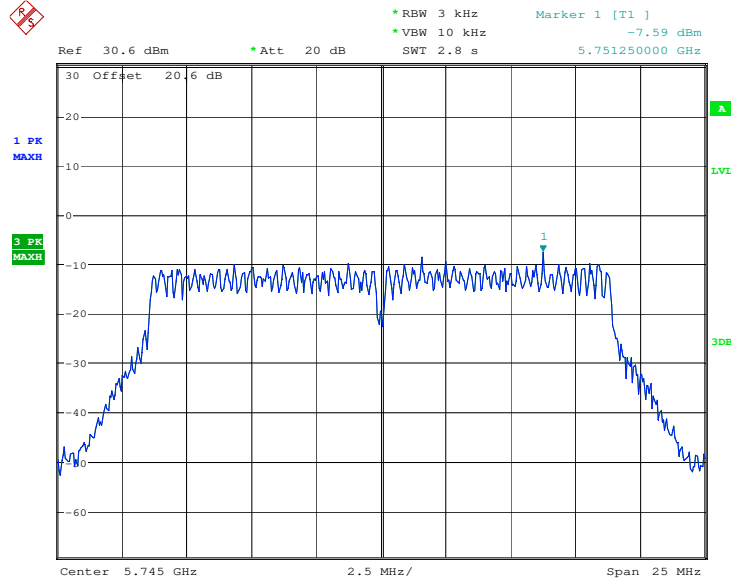
low
Date: 6.MAR.2014 23:17:30

Power Spectral Density 802.11a 5825 MHz



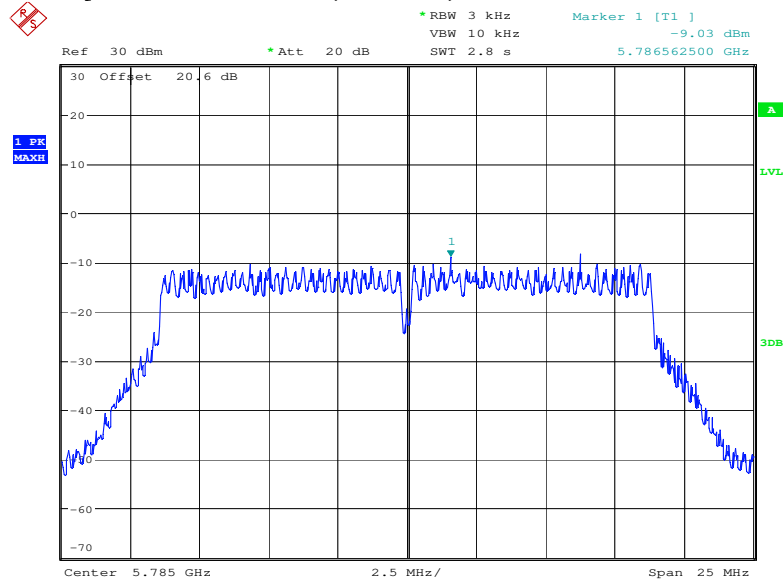
low
Date: 6.MAR.2014 23:23:22

Power Spectral Density 802.11n -MCS0 (20 MHz) 5745 MHz



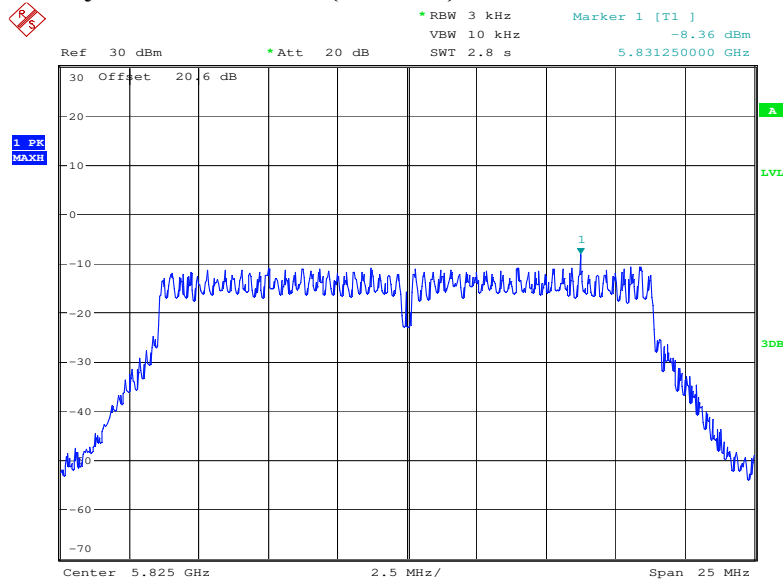
low
Date: 6.MAR.2014 23:21:17

Power Spectral Density 802.11n -MCS0 (20 MHz) 5785 MHz



low
Date: 6.MAR.2014 23:48:51

Power Spectral Density 802.11n -MCS0 (20 MHz) 5825 MHz



low
Date: 6.MAR.2014 23:52:39

6.8 Radiated Transmitter Spurious Emissions & Restricted Band Limits

6.8.1 Limits:

§15.247/15.205/15.209 & RSS-210 A8.5 / RSS-Gen 7.2.2/ 7.2.5,

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	(²)
13.36 - 13.41			

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, average) (Peak limit: 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

6.8.2 Test Conditions:

Tnom: 23 °C; Vnom: 3.8V

6.8.3 Measurement procedure:

Measurement according to ANSI C63.10:2009 (also refer to section 6.1 in this test report)

6.8.4 Test Result:

Test mode: *Modulation:* 802.11a, b, g & n- according to the table in section 3 of this test report.

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

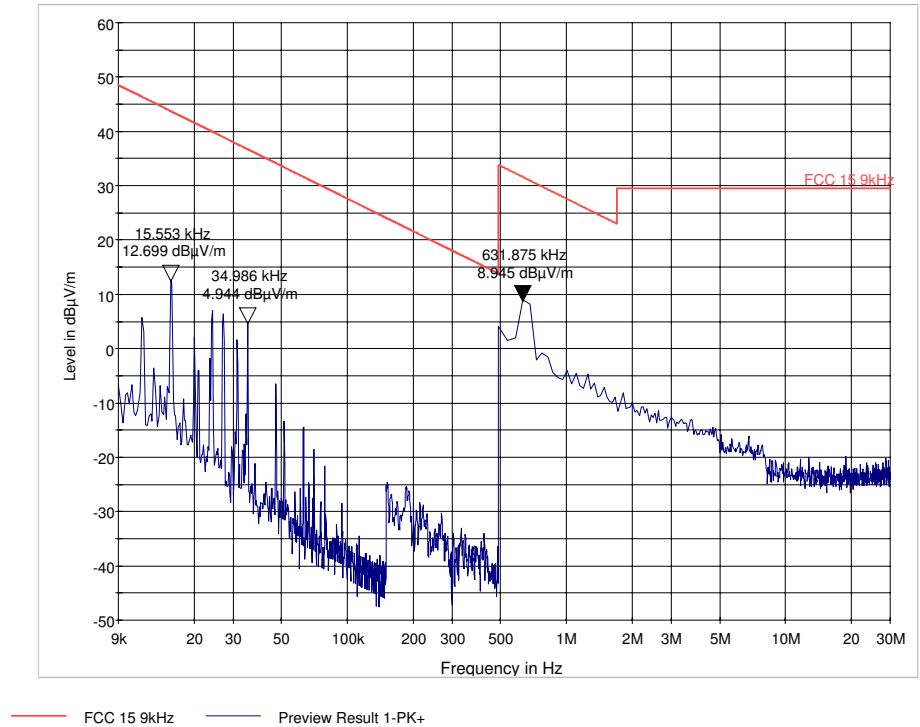
Plots reported here represent the worst case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT.

6.8.4.1 Measurement Result

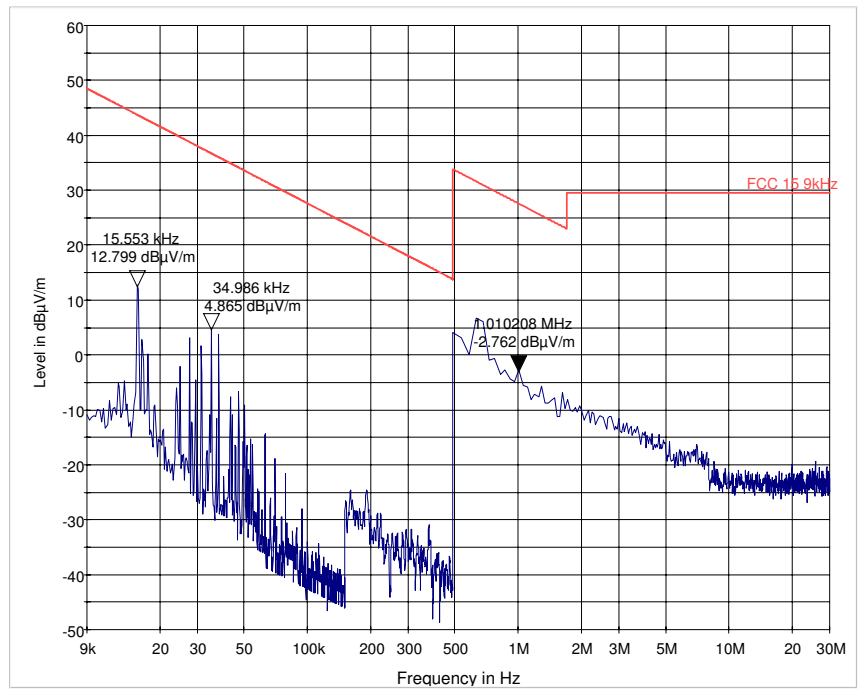
Pass.

6.8.5 Test data/ plots: 2.4 GHz Band

Transmitter Radiated Spurious Emission: Ch Mid- 9kHz – 30MHz- 802.11b-mode

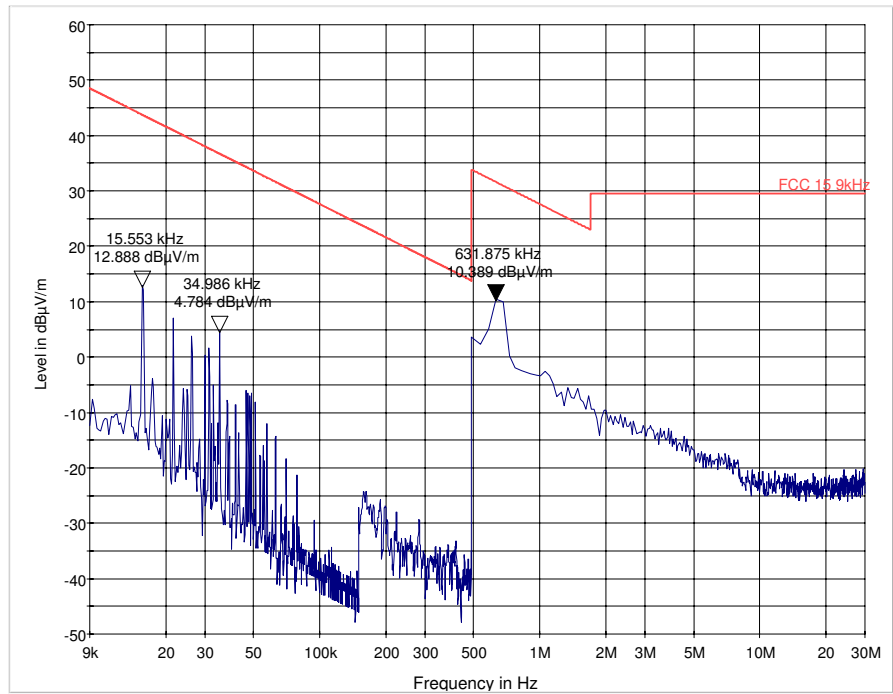


Transmitter Radiated Spurious Emission: Ch Mid- 9kHz – 30MHz- 802.11g-mode



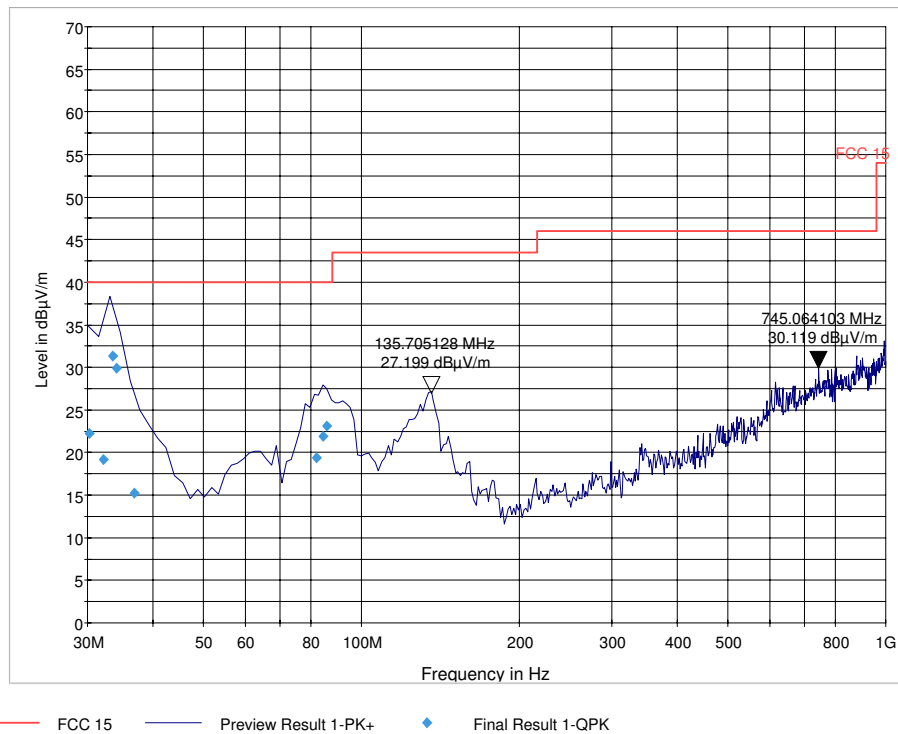
— FCC 15.9kHz — Preview Result 1-PK+

Transmitter Radiated Spurious Emission: Ch Mid- 9kHz – 30MHz- 802.11n-mode

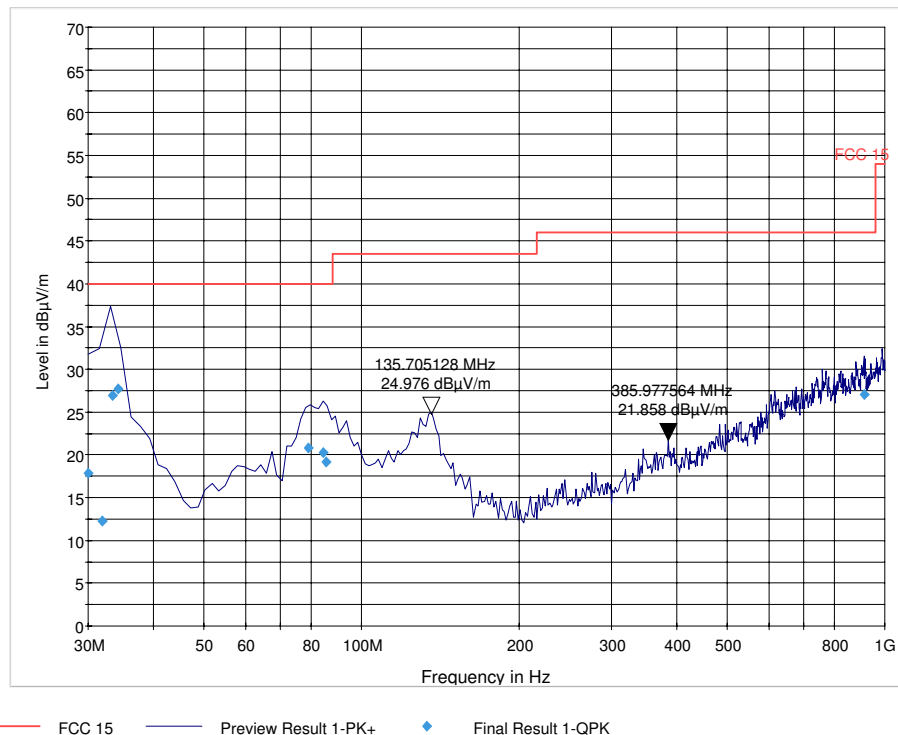


— FCC 15.9kHz — Preview Result 1-PK+

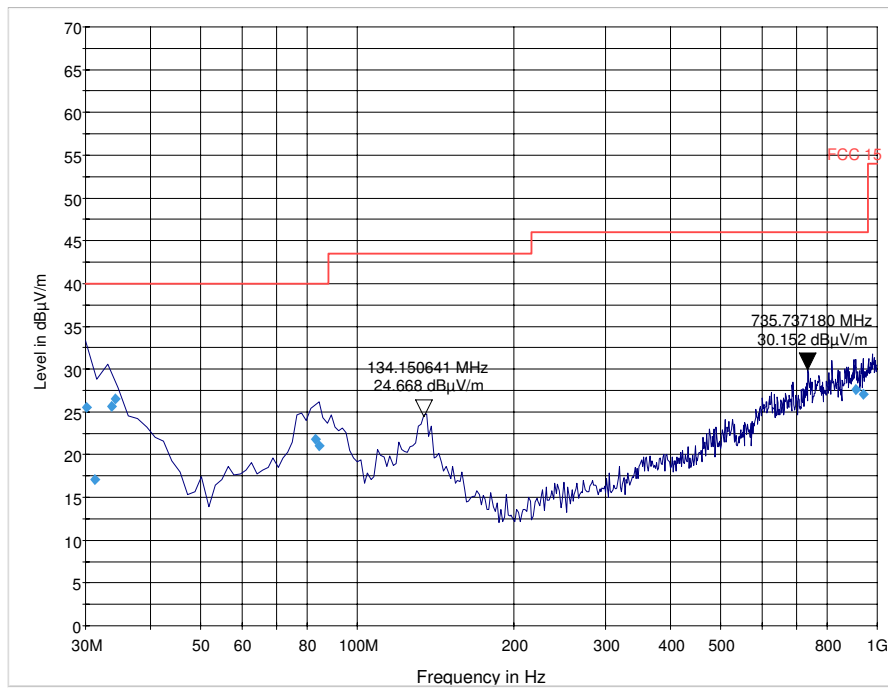
Transmitter Radiated Spurious Emission: Ch Low- 30 MHz – 1GHz- 802.11b-mode



Transmitter Radiated Spurious Emission: Ch Low- 30 MHz – 1GHz- 802.11g-mode

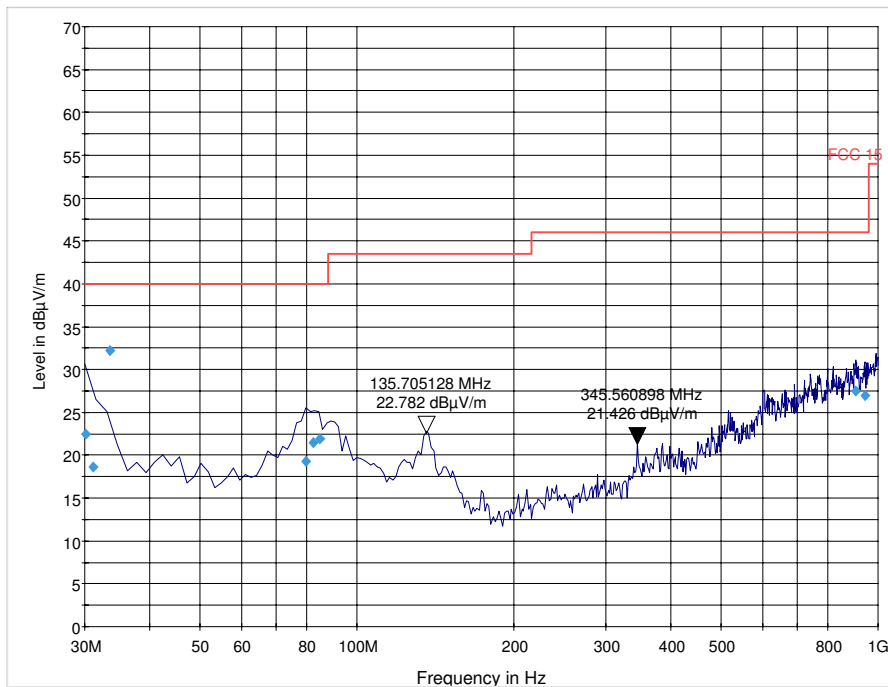


Transmitter Radiated Spurious Emission: Ch Low- 30 MHz – 1GHz- 802.11n-mode



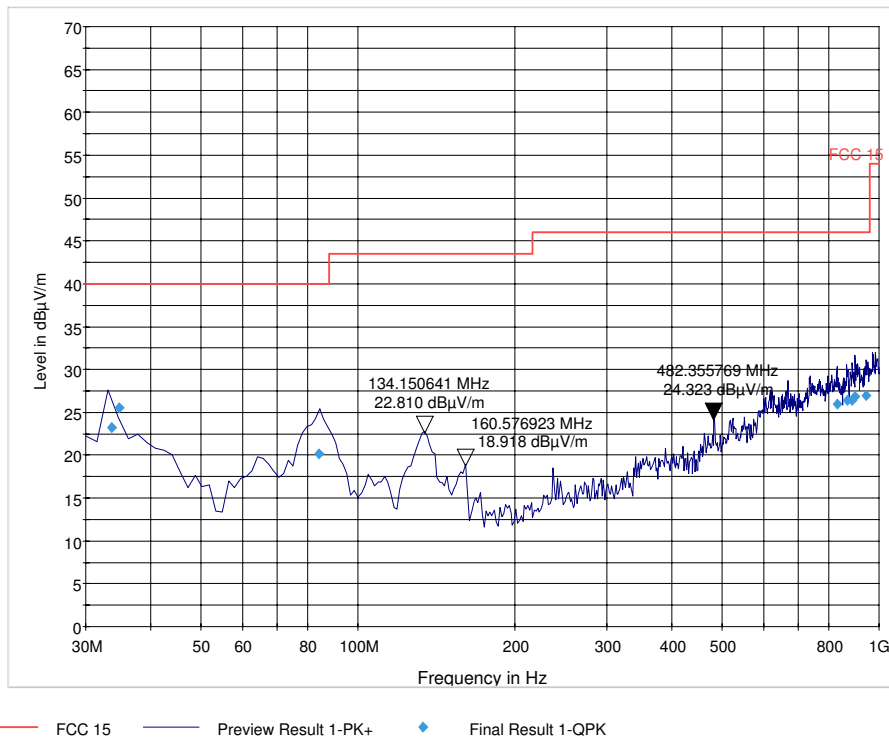
— FCC 15 — Preview Result 1-PK+ ◆ Final Result 1-QPK

Transmitter Radiated Spurious Emission: Ch Mid- 30 MHz – 1GHz- 802.11b-mode

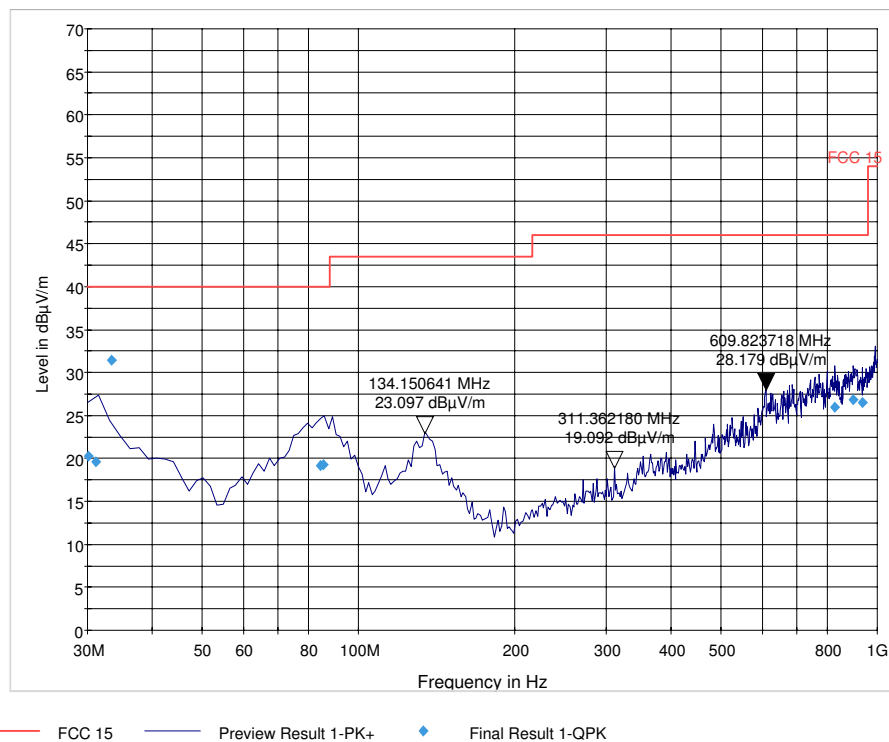


— FCC 15 — Preview Result 1-PK+ ◆ Final Result 1-QPK

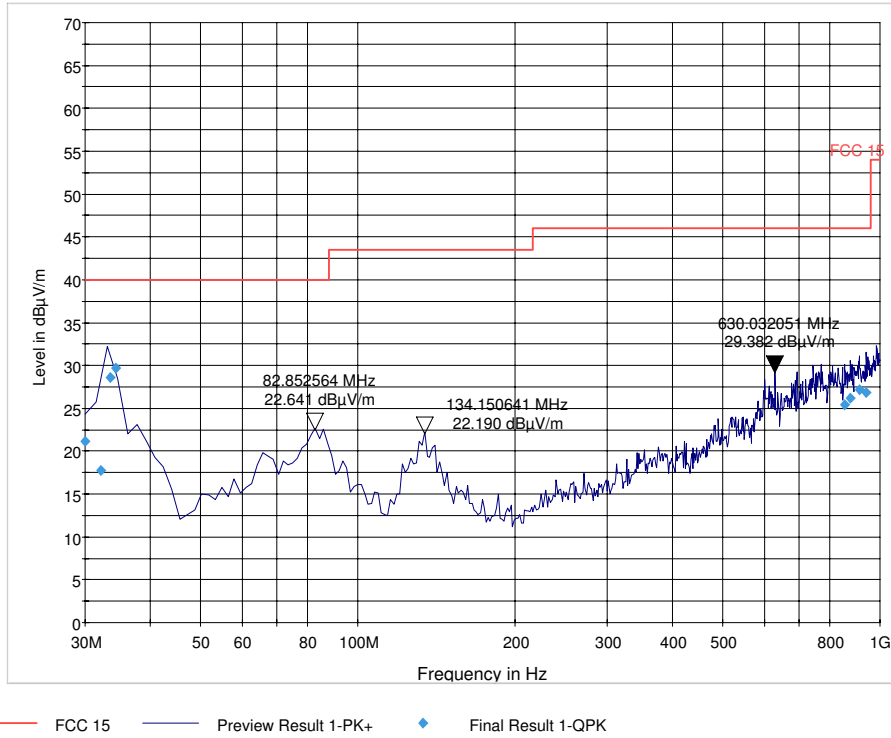
Transmitter Radiated Spurious Emission: Ch Mid- 30 MHz – 1GHz- 802.11g-mode



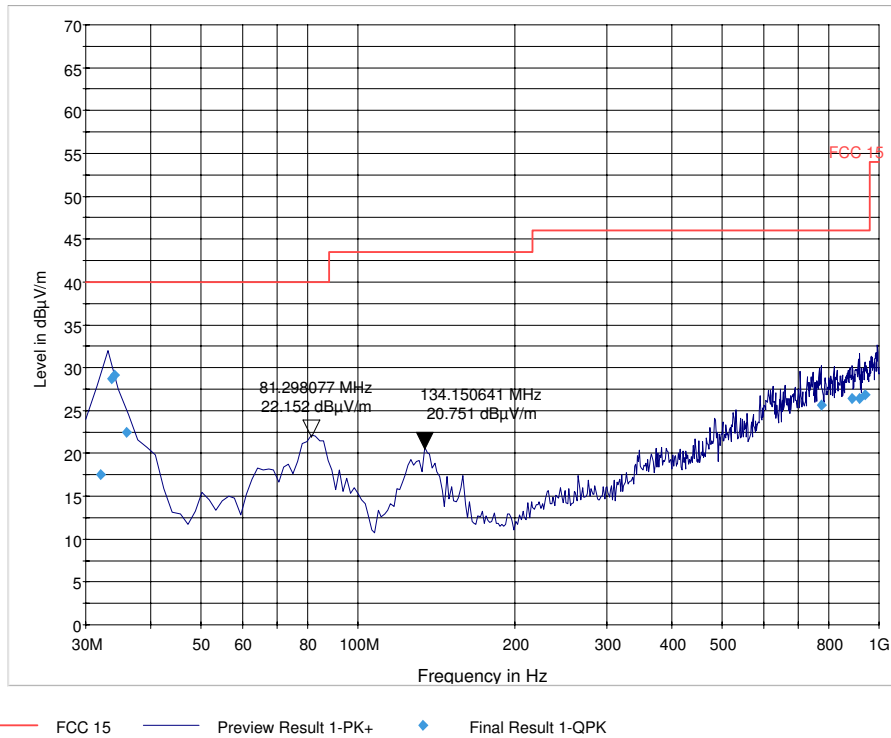
Transmitter Radiated Spurious Emission: Ch Mid- 30 MHz – 1GHz- 802.11n-mode



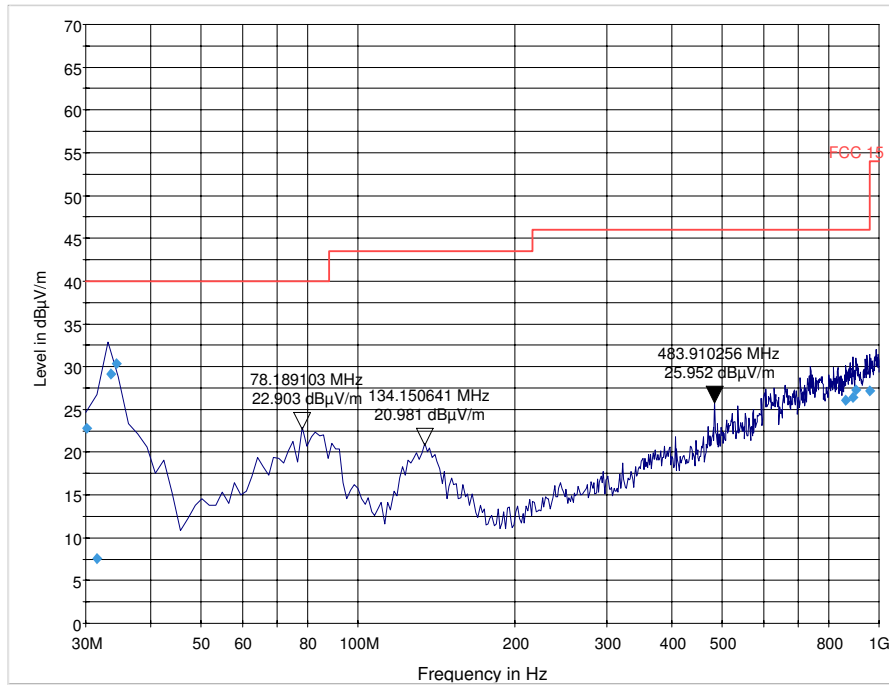
Transmitter Radiated Spurious Emission: Ch High- 30 MHz – 1GHz- 802.11b-mode



Transmitter Radiated Spurious Emission: Ch High- 30 MHz – 1GHz- 802.11g-mode

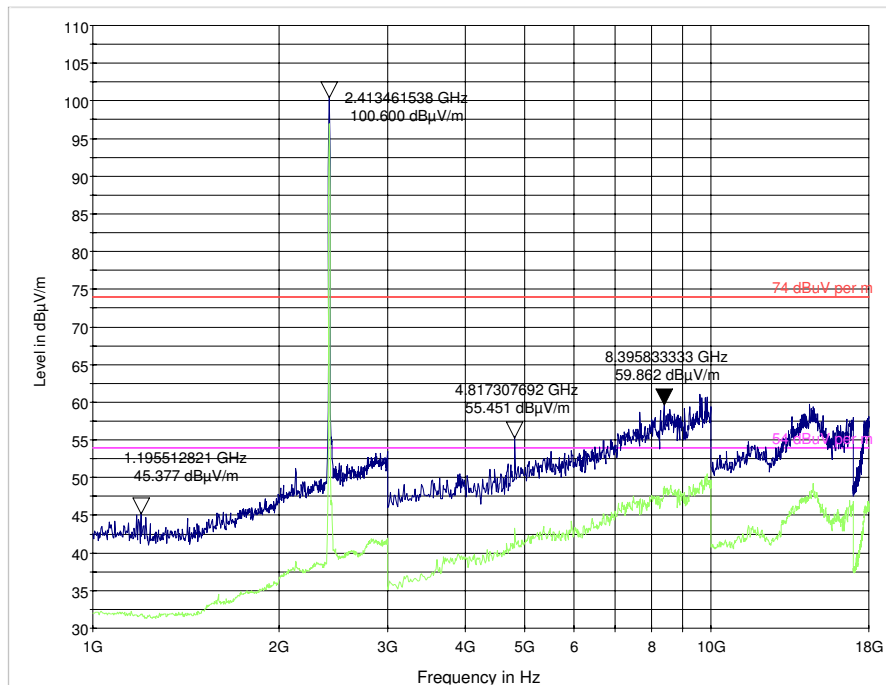


Transmitter Radiated Spurious Emission: Ch High- 30 MHz – 1GHz- 802.11n-mode



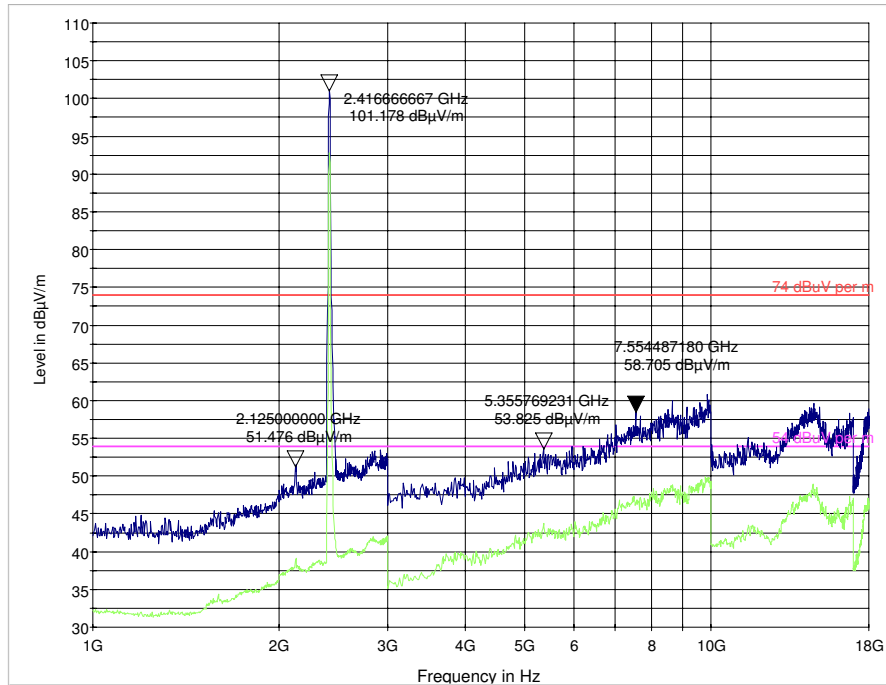
— FCC 15 — Preview Result 1-PK+ ◆ Final Result 1-QPK

Transmitter Radiated Spurious Emission: Ch Low- 1 GHz – 18GHz- 802.11b-mode



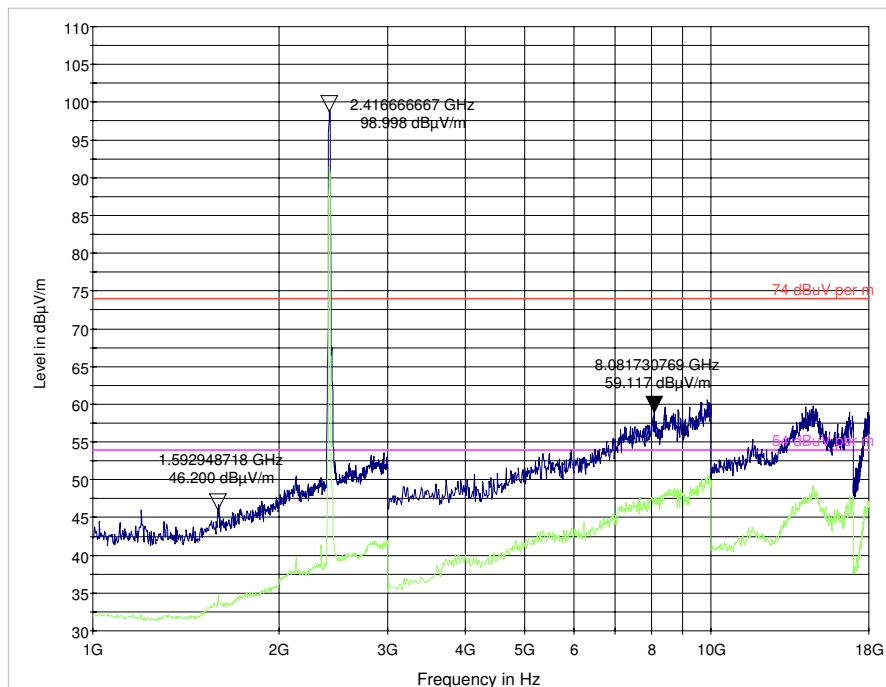
— 74 dBµV per m — 54 dBµV per m — Preview Result 1-PK+ — Preview Result 2-AVG

Transmitter Radiated Spurious Emission: Ch Low- 1 GHz – 18GHz- 802.11g-mode



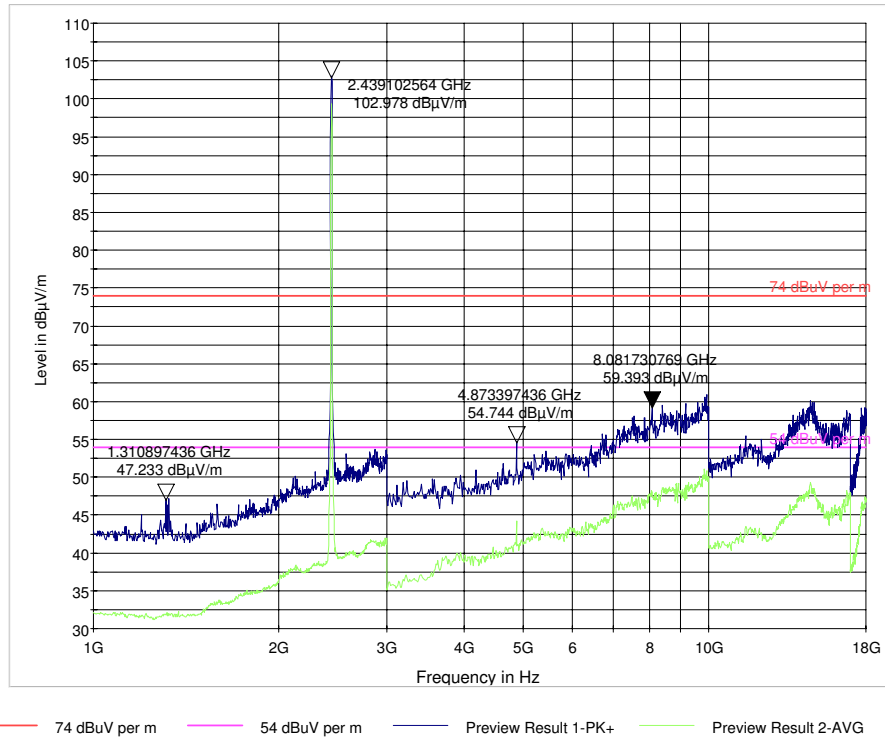
74 dBuV per m 54 dBuV per m Preview Result 1-PK+ Preview Result 2-AVG

Transmitter Radiated Spurious Emission: Ch Low- 1 GHz – 18GHz- 802.11n-mode

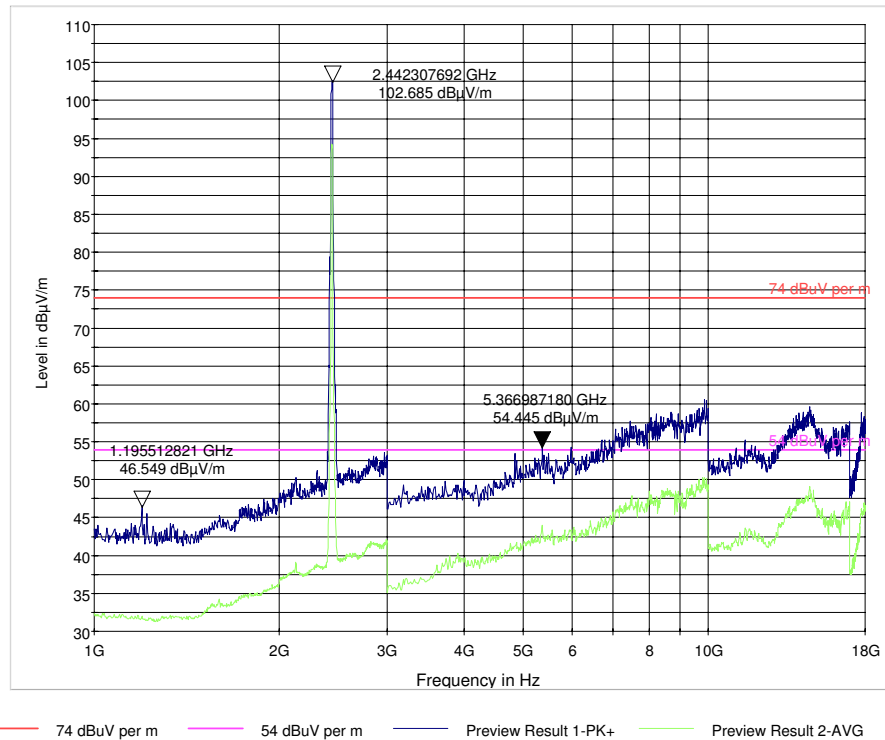


74 dBuV per m 54 dBuV per m Preview Result 1-PK+ Preview Result 2-AVG

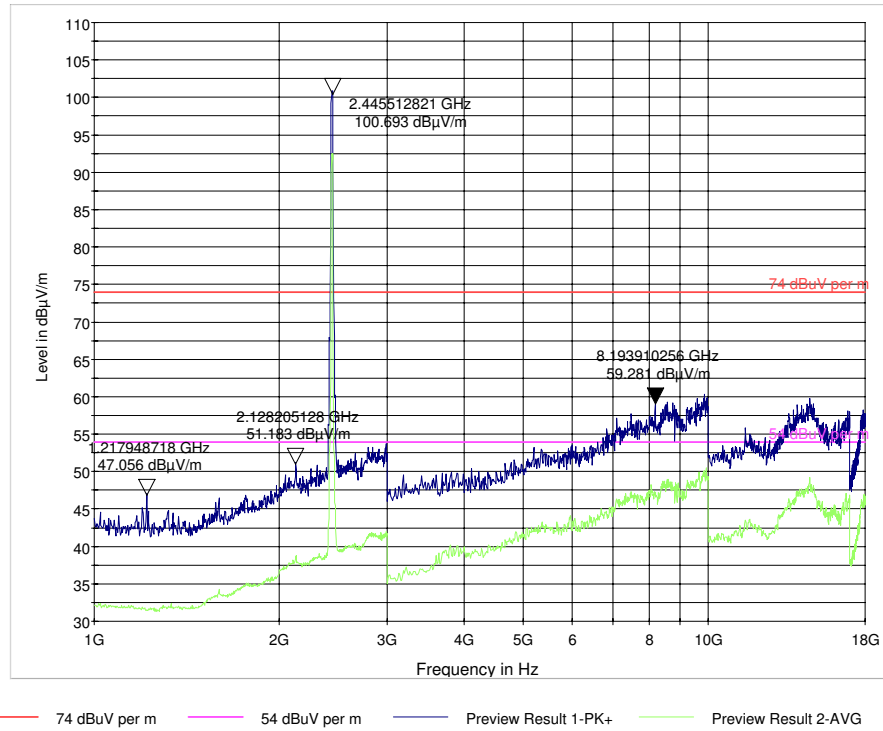
Transmitter Radiated Spurious Emission: Ch Mid- 1 GHz – 18GHz- 802.11b-mode



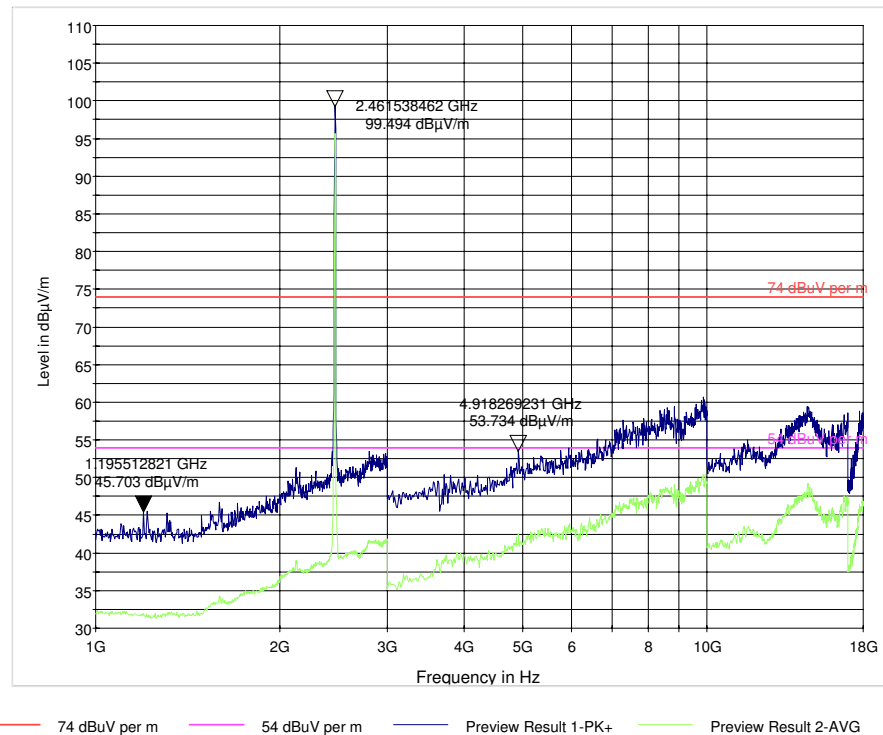
Transmitter Radiated Spurious Emission: Ch Mid- 1 GHz – 18GHz- 802.11g-mode



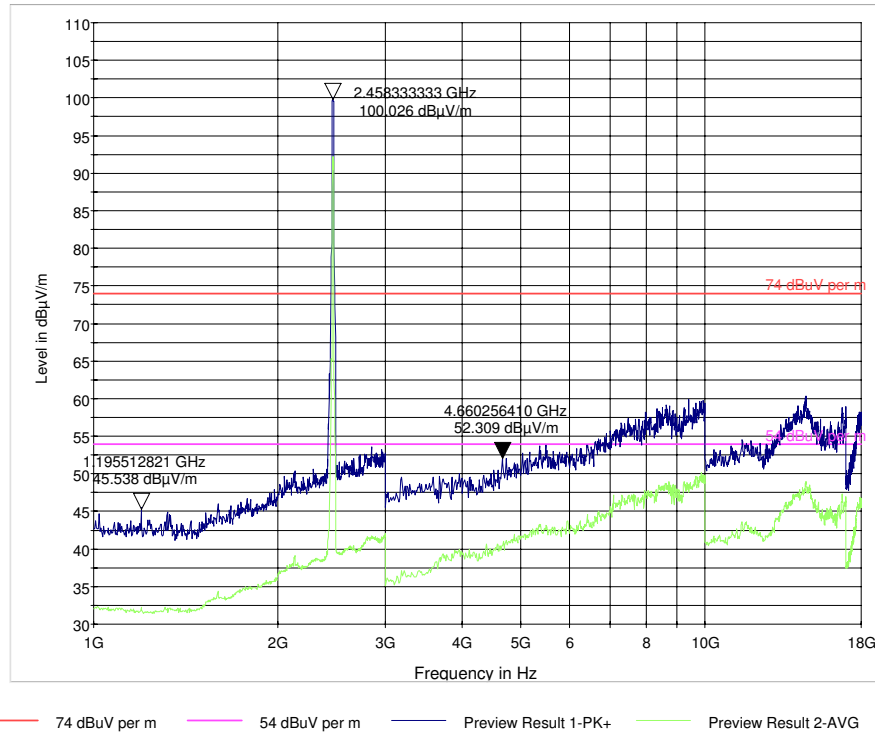
Transmitter Radiated Spurious Emission: Ch Mid- 1 GHz – 18GHz- 802.11n-mode



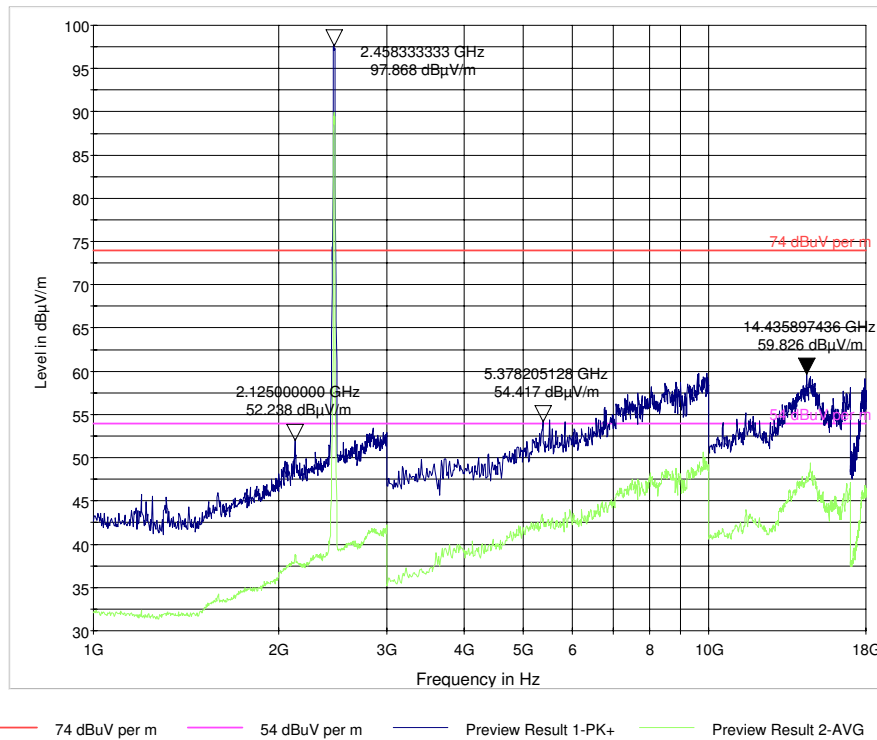
Transmitter Radiated Spurious Emission: Ch High- 1 GHz – 18GHz- 802.11b-mode



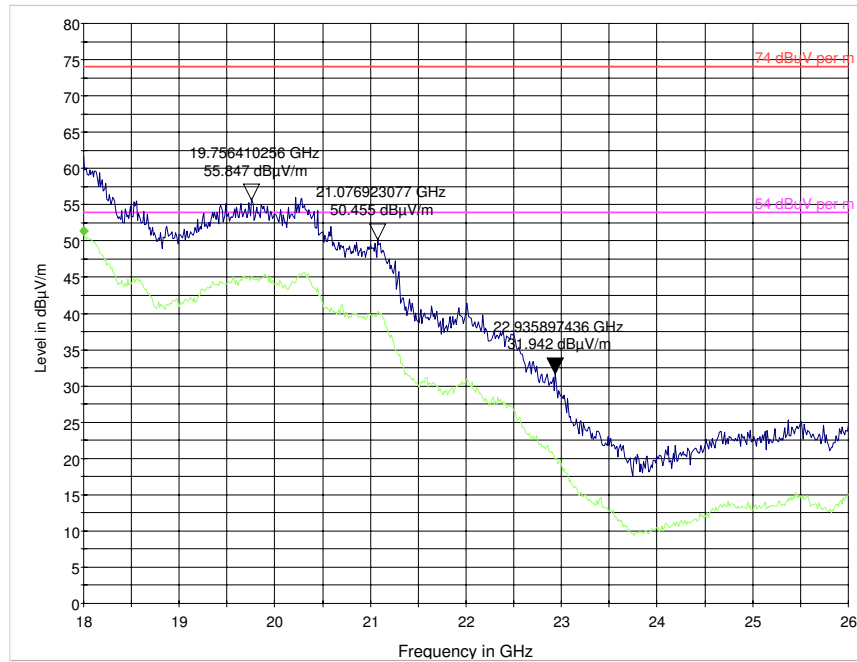
Transmitter Radiated Spurious Emission: Ch High- 1 GHz – 18GHz- 802.11g-mode



Transmitter Radiated Spurious Emission: Ch High- 1 GHz – 18GHz- 802.11n-mode

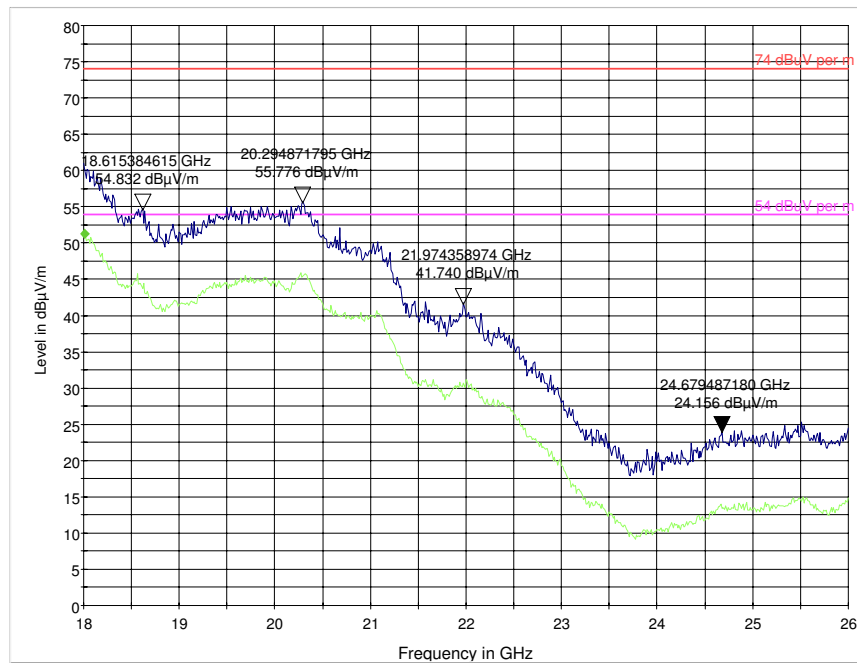


Transmitter Radiated Spurious Emission: Ch Mid- 18 GHz – 26 GHz- 802.11b-mode



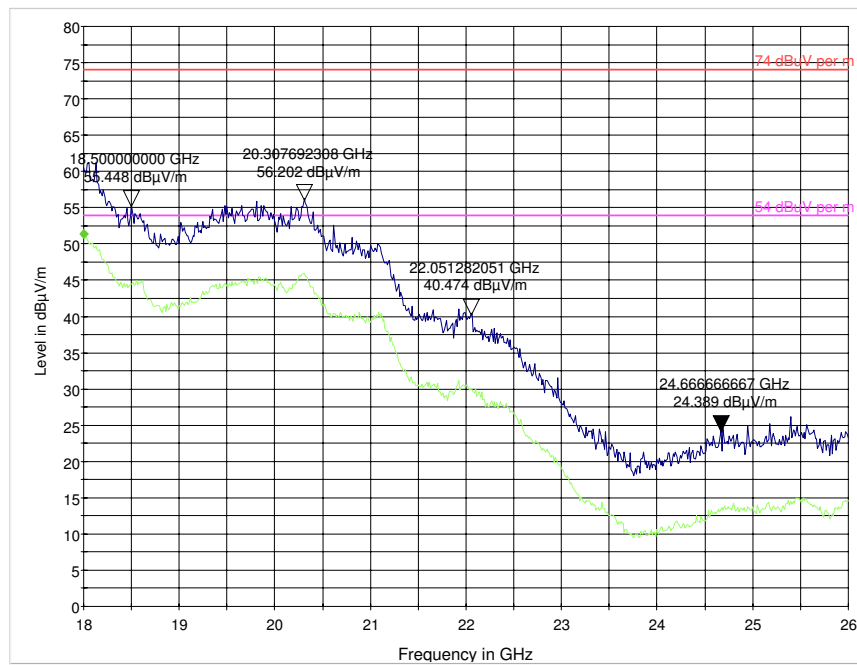
74 dBuV per m 54 dBuV per m Preview Result 1-PK+
 Preview Result 2-AVG Final Result 2-AVG

Transmitter Radiated Spurious Emission: Ch Mid- 18 GHz – 26 GHz- 802.11g-mode



74 dBuV per m 54 dBuV per m Preview Result 1-PK+
 Preview Result 2-AVG Final Result 2-AVG

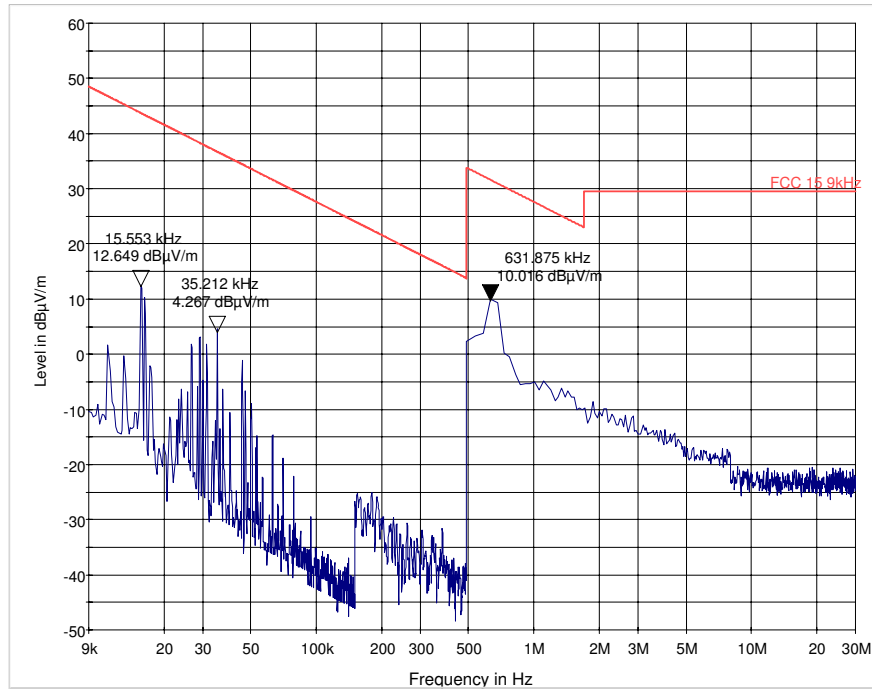
Transmitter Radiated Spurious Emission: Ch Mid- 18 GHz – 26 GHz- 802.11n-mode



— 74 dBµV per m
 — 54 dBµV per m
 — Preview Result 1-PK+
— Preview Result 2-AVG
 ◆ Final Result 2-AVG

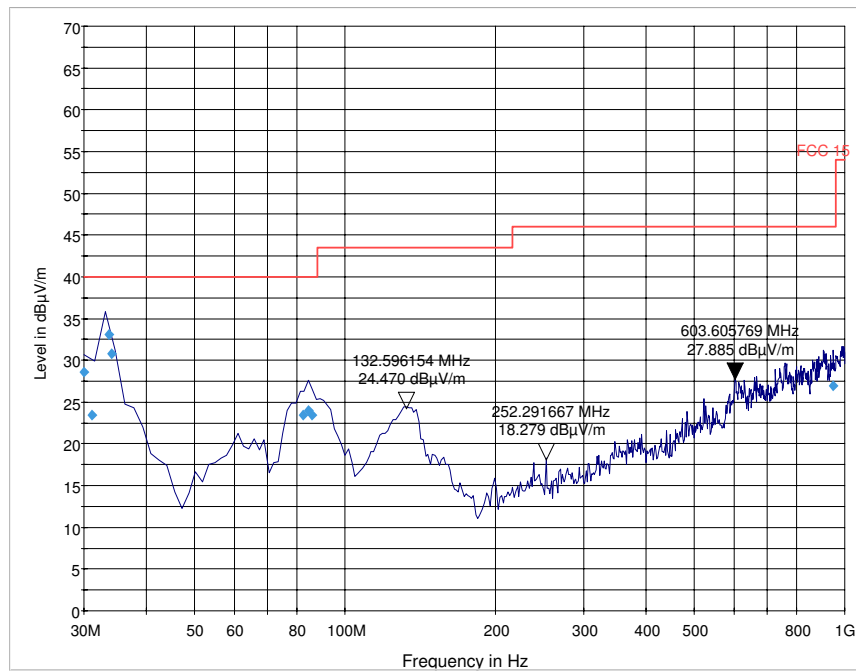
6.8.6 Measurement Plots: 5 GHz Band

Transmitter Radiated Spurious Emission: Ch Mid (147) 9 kHz – 30 MHz- 802.11a-mode



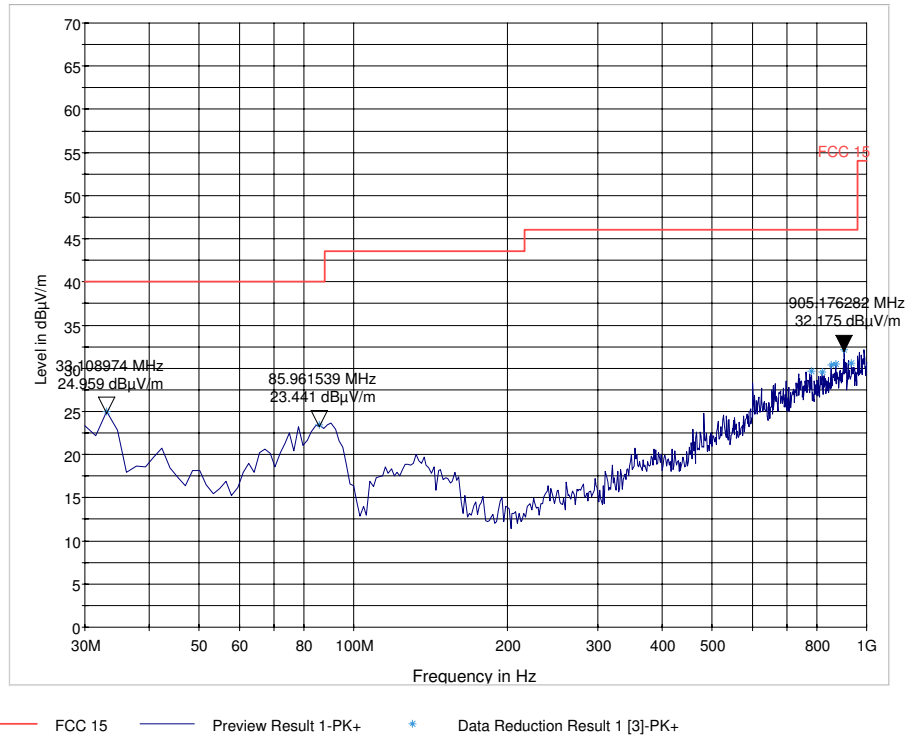
— FCC 15.9kHz — Preview Result 1-PK+

Transmitter Radiated Spurious Emission- Ch Low (149) 30MHz - 1GHz- 802.11a-mode

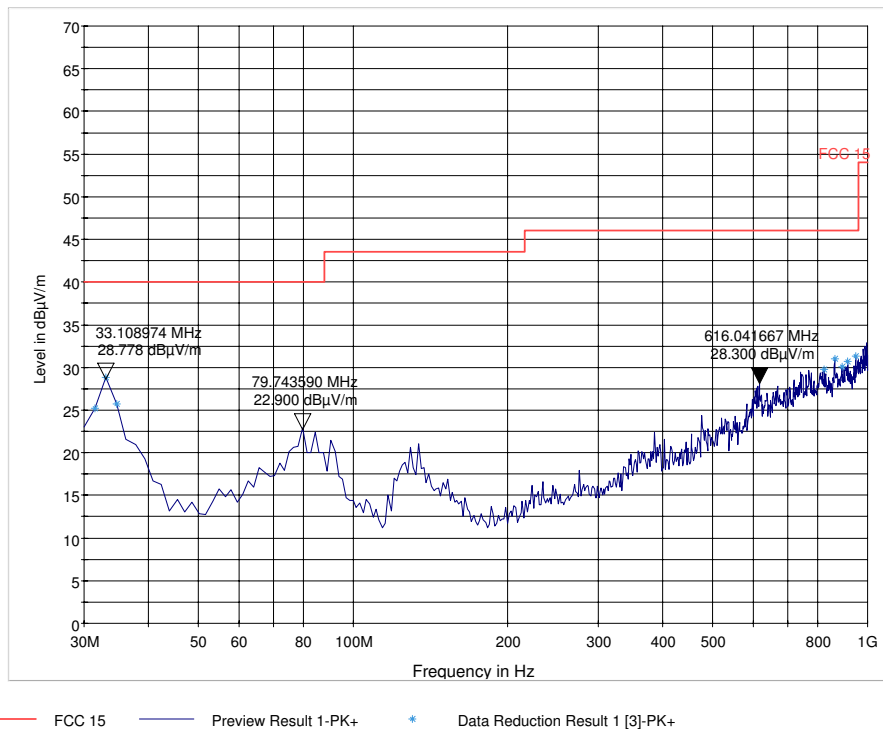


— FCC 15 — Preview Result 1-PK+ ◆ Final Result 1-QPK

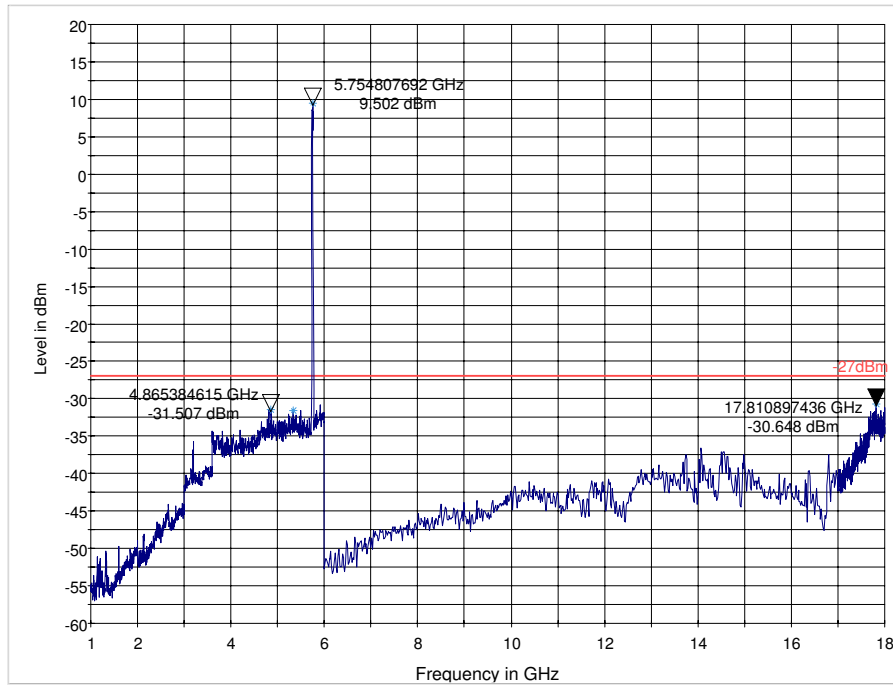
Transmitter Radiated Spurious Emission- Ch Mid (157) 30 MHz – 1 GHz- 802.11a-mode



Transmitter Radiated Spurious Emission- Ch High (165) 30 MHz – 1 GHz- 802.11a-mode

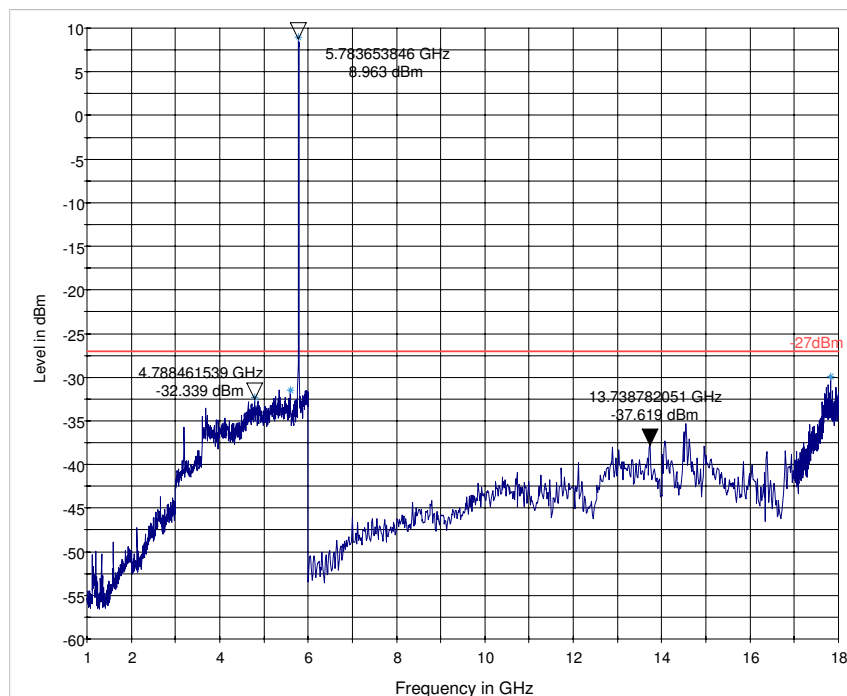


Transmitter Radiated Spurious Emission- Ch Low (149) 1 GHz – 18 GHz- 802.11a-mode



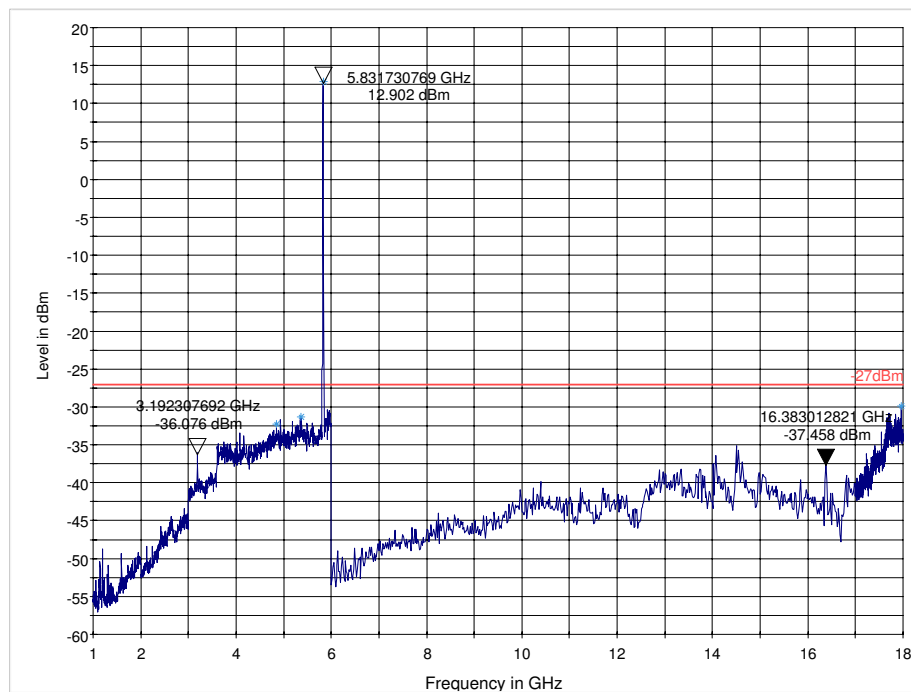
— -27dBm — Preview Result 1-PK+ * Data Reduction Result 1 [2]-PK+

Transmitter Radiated Spurious Emission- Ch Mid (157) 1 GHz – 18 GHz- 802.11a-mode



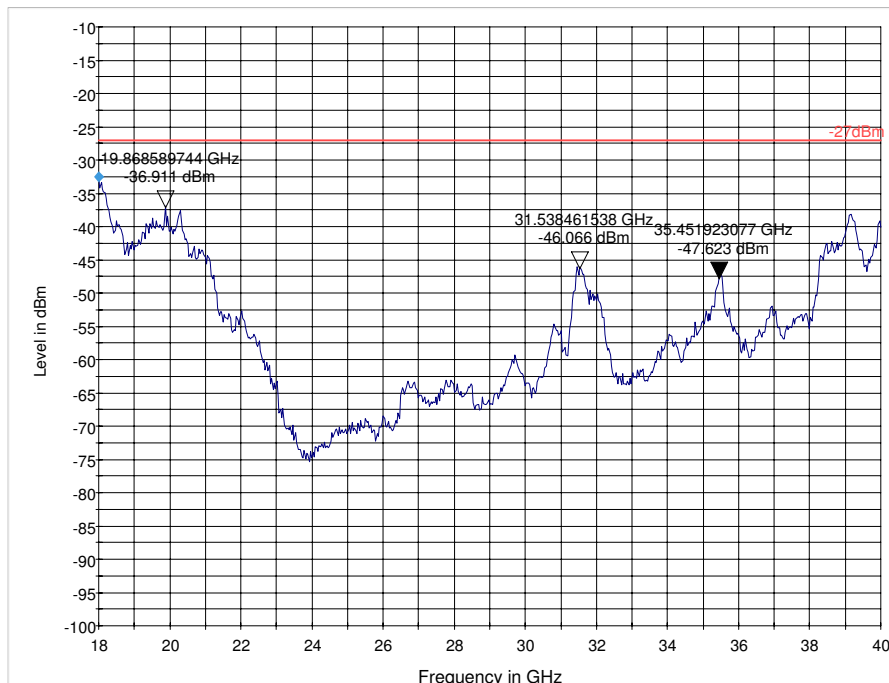
— -27dBm — Preview Result 1-PK+ * Data Reduction Result 1 [2]-PK+

Transmitter Radiated Spurious Emission- Ch High (165) 1 GHz – 18 GHz- 802.11a-mode



— -27dBm — Preview Result 1-PK+ * Data Reduction Result 1 [2]-PK+

Transmitter Radiated Spurious Emission- Ch Mid (157) 18 GHz – 40 GHz- 802.11a-mode



— -27dBm — Preview Result 1-PK+ ♦ Final Result 1-PK+

6.9 AC Power Line Conducted Emissions

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.

6.9.1 Limits:

§15.207 & RSS-Gen 7.2.4

(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 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Table 1:

Frequency of emission (MHz)	Conducted limit (dB μ 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.

6.9.2 Test Conditions:

Tnom: 23 °C; Vnom: 3.8V

Modulation: 2.4GHz: 802.11g- Transmit and Receive modes of operation, 5GHz: 802.11a- Transmit mode of operation

6.9.3 Measurement procedure:

Measurement according to ANSI C63.10:2009 section 6.2 (also refer to section 6, 6.2 in this test report)

Analyzer Settings:

CISPR Bandwidth- 9KHz.

Detector = Qusi-peak / Average

6.9.4 Results

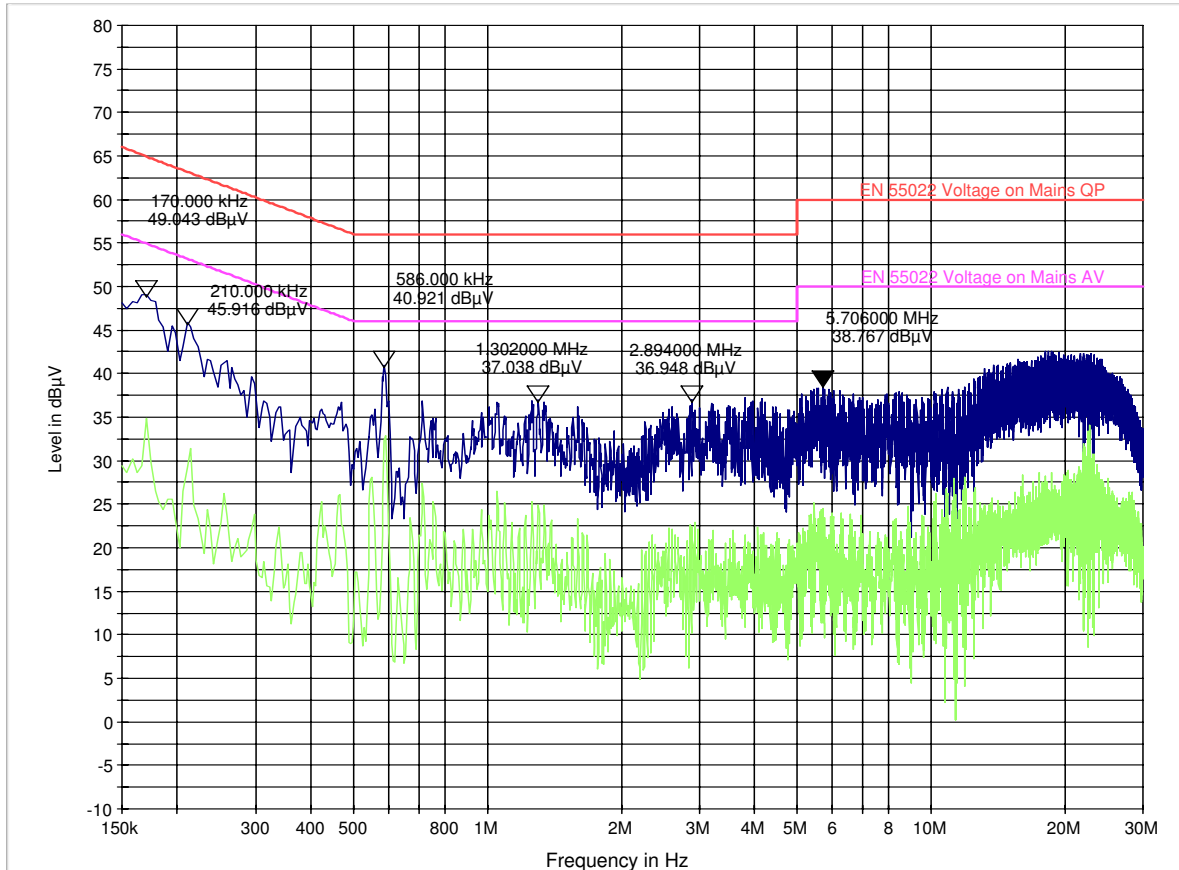
Plots shown here represent the combined worse case emissions for phases and neutral line.

6.9.4.1 Measurement Result

Pass.

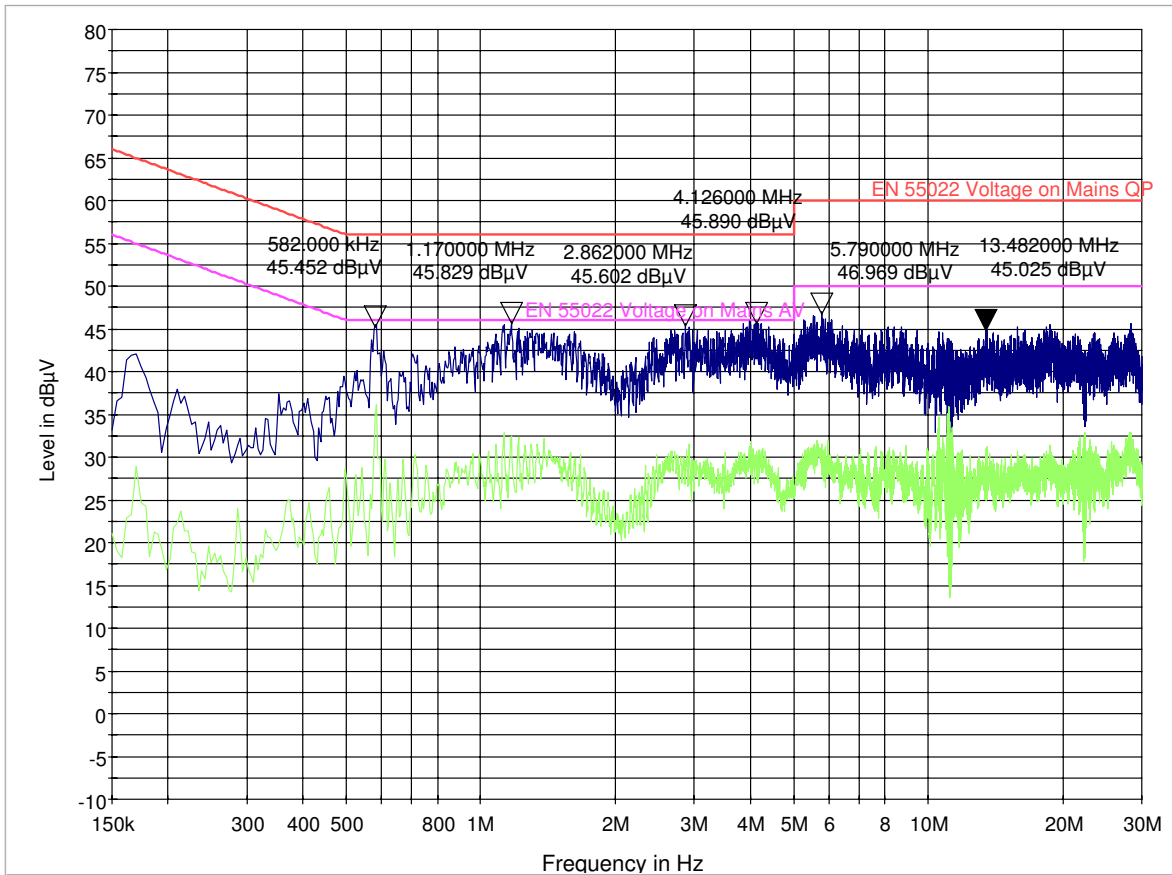
6.9.5 Test Results:

WLAN 2.4 GHz TX mode (802.11g):



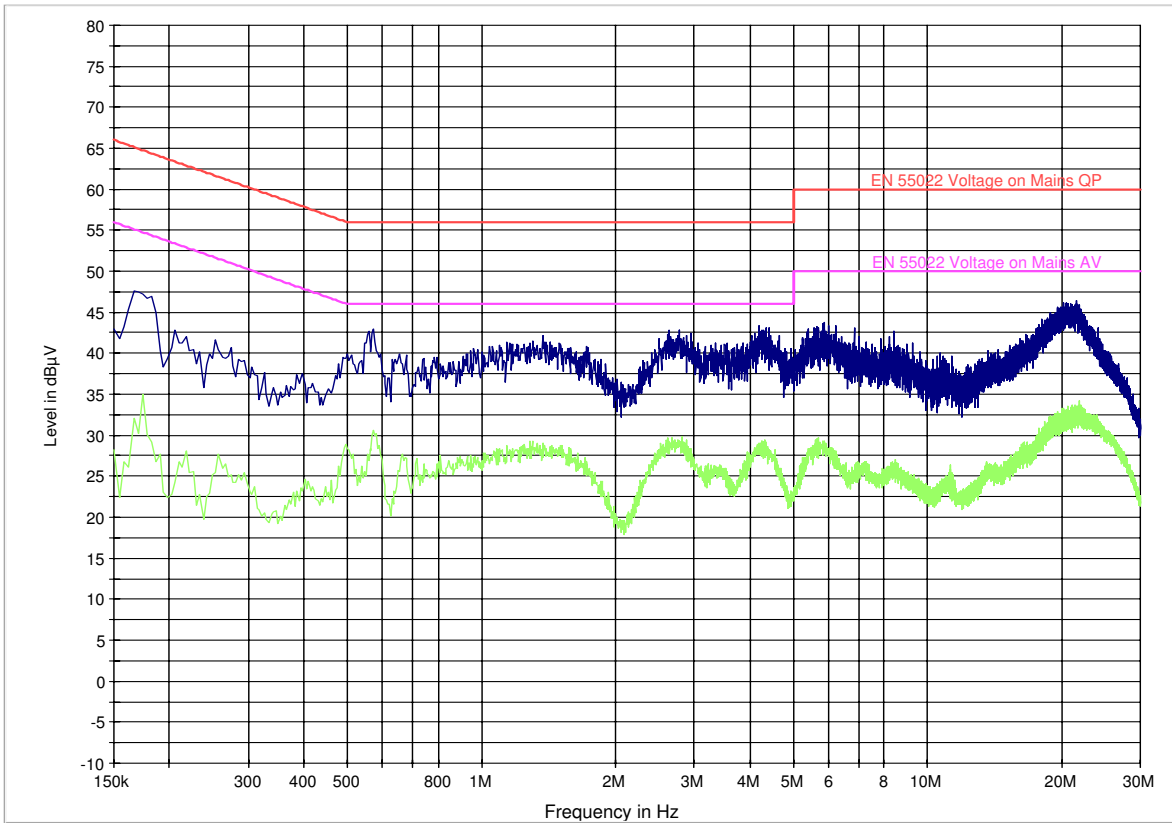
— MaxPeak-ClearWrite
 — Average-ClearWrite
 — Voltage on Mains QP
 — Voltage on Mains AV

WLAN 5GHz TX Mode (802.11a):



— MaxPeak-ClearWrite
 — Average-ClearWrite
 — Voltage on Mains QP
 — Voltage on Mains AV

RX/Idle mode:

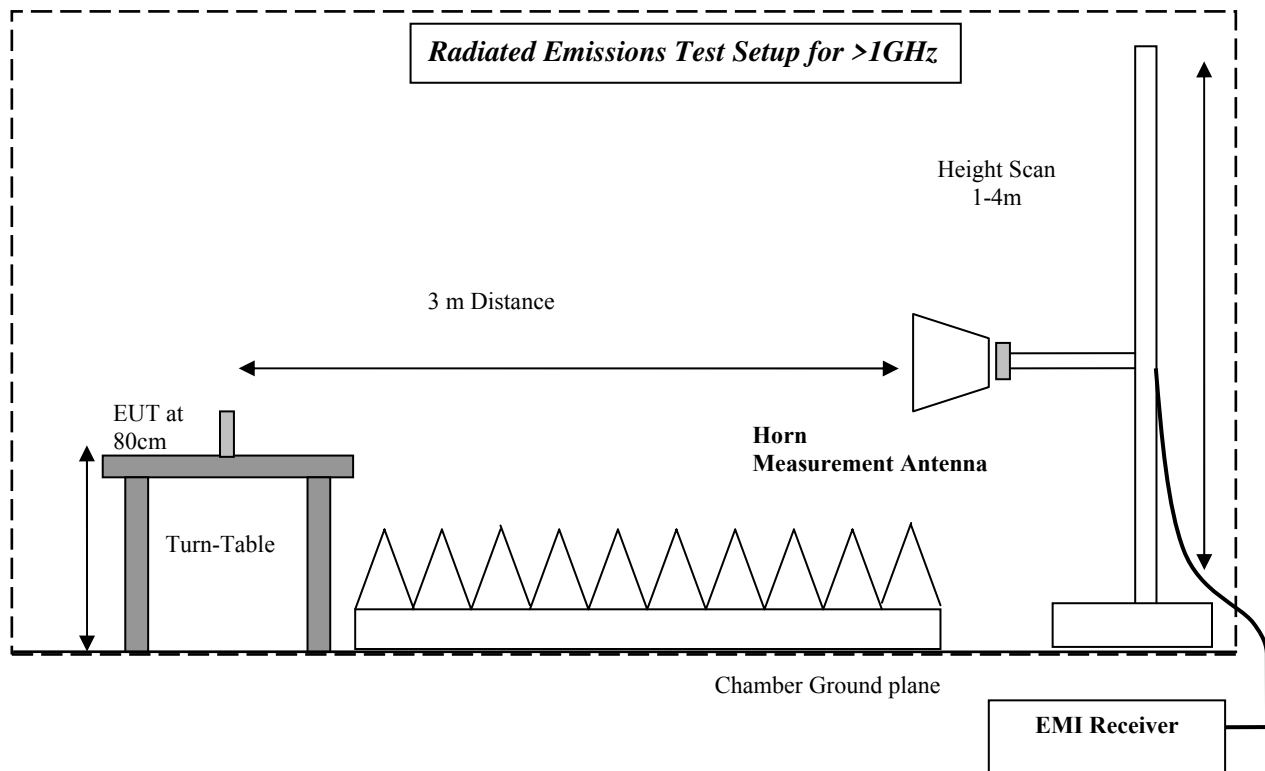
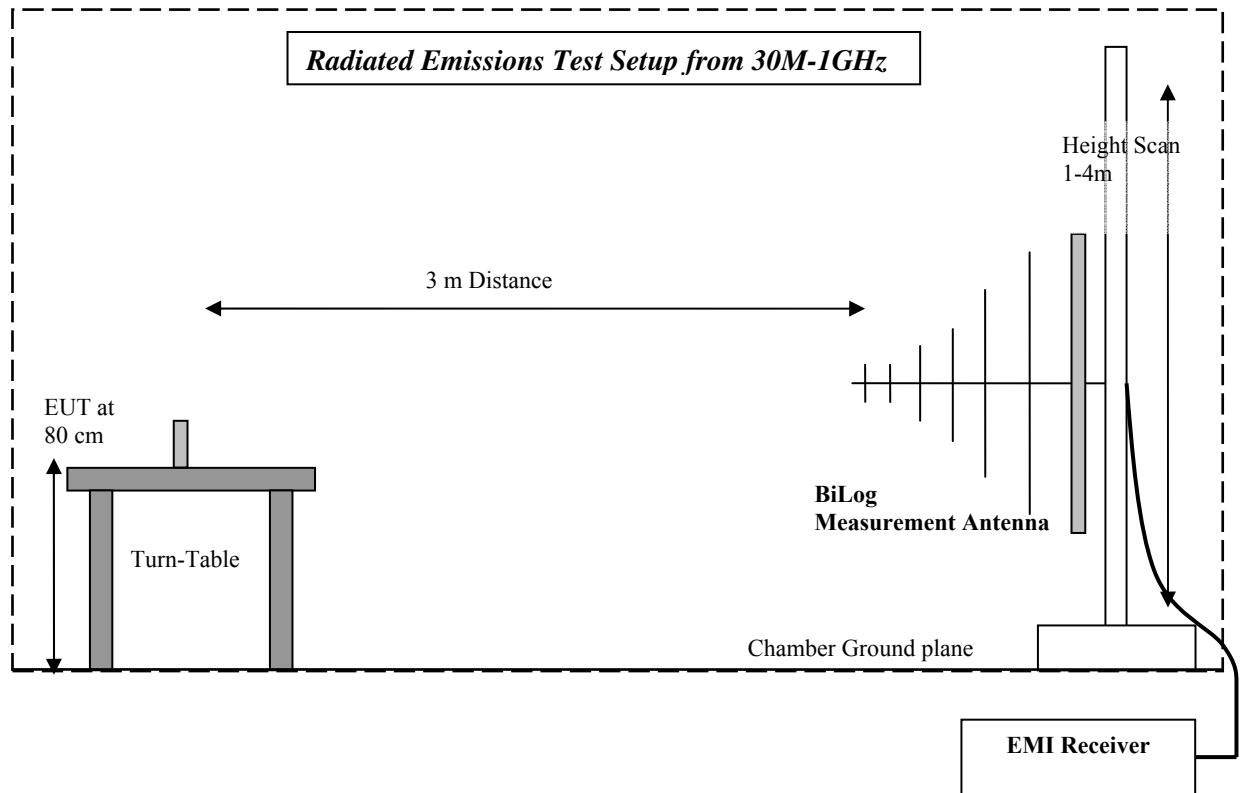


— MaxPeak-ClearWrite — Average-ClearWrite — Voltage on Mains QP — Voltage on Mains AV

7 Test Equipment and Ancillaries used for tests

No.	Equipment Name	Manufacturer	Type/model	Serial No.	Cal Date	Cal Interval
	Turn table	EMCO	2075	N/A	N/A	N/A
	MAPS Position Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
	Antenna Mast	EMCO	2075	N/A	N/A	N/A
	Relay Switch Unit	Rohde&Schwarz	RSU	338964/001	N/A	N/A
	EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	Sept 2013	2 Year
	Spectrum Analyzer	Rohde&Schwarz	FSU	200302	Jun 2013	2 Years
	1500MHz HP Filter	Filtek	HP12/1700	14c48	N/A	N/A
	2800 MHZ HP Filter	Filtek	HP12/2800	14C47	N/A	N/A
	Pre-Amplifier	Miteq	JS40010260	340125	N/A	N/A
	Binconilog Antenna	EMCO	3141	0005-1186	Apr 2012	3 Years
	Binconilog Antenna	ETS	3149	J000123908	Feb 2012	3 years
	Horn Antenna	EMCO	3115	35114	Mar 2012	3 Years
	LISN	Rohde and Schwarz	ESV 216	101129	Mar 2013	2 years
	Spectrum Analyzer	Rohde&Schwarz	FSU	200302	Jun 2013	2 Years
	Power Splitter	Agilent	11667B	52565	N/A	N/A

8 Test Setup Diagram:



9 Revision History

Date	Report Name	Changes to report	Report prepared by
2014-06-11	EMC_INTEL_039_14001_15.247_DTS_WLAN	First official version	Danh Le
2014-06-26	EMC_INTEL_039_14001_15.247_DTS_WLAN_Rev1	Section 6.4.5 updated; replaces previous test report #.	Danh Le