TEST REPORT

Part 15 Subpart C 15.212

1. Applicant
   - Name : MTTKorea Co., Ltd..
   - Address : 3F, 272-15, Dodang-dong, Wonmi-gu, Bucheon-si, Gyeonggi-do, Korea(#420-808)
   - FCC ID : N34MK-815WM

2. Products
   - Name : WiFi Module
   - Model/Type : MK-815WM/ DSSS, OFDM
   - Manufacturer : MTTKorea Co., Ltd..

3. Test Standard : 47 CFR FCC Part 15 Subpart C

4. Test Method : ANSI C63.4-2009
5. Test Result : Positive
6. Dates of Test : May 04, 2012 to May 18, 2012
7. Date of Issue : May 23, 2012
8. Test Laboratory : Korea Standard Quality Laboratories
   FCC Designation Number : KR0024
   IC OATS Number : 9053A

Tested by	Approved by
SoonHo, Kim	SungBum, Hong
Test Engineer:	Compliance Engineer:

Korea Standard Quality Laboratories
Testing Laboratories for EMC and Safety Compliance
www.ksqlab.com
#102, Jangduk-Dong, Hwasung-City, Kyunggi-Do, KOREA

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1. GENERAL

These tests were performed using the test procedure outlined in ANSI C63.4, 2009 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.247
The EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards.

We attest to the accuracy of data. All measurements reported herein were performed by Korea Standard Quality Laboratories and were made under Chief Engineer''s supervision.
We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

2. TEST SITE

Korea Standard Quality Laboratories

2.1 Location

#102, Jangduk Dong, Hwasung City, Kyunggi Do, South Korea
(FCC Designation Number : KR0024)

This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.

2.2 Test Date

Date of Test: May04, 2012 to May 18, 2012

2.3 Test Environment

See each test item''s description.

3. DESCRIPTION OF THE EQUIPMENT UNDER TEST

The product specification described herein was obtained from the product data sheet or user''s manual.

3.1 Rating and Physical Characteristics

Product Name	WiFi Module
Model Number	MK-815WM
Frequency Range	IEEE 802.11b/g : 2412MHz 2472MHz IEEE 802.11n : 2422MHz 2462MHz
Transmit Power	IEEE 802.11b/g : 21.42dBm IEEE 802.11g: 26.17dBm IEEE 802.11n : 8.40dBm
Channel Number	IEEE 802.11b/g : 13 Channels IEEE 802.11n : 9 Channels
Transmit Data Rate	IEEE 802.11b : 11, 5.5, 2, 1Mbps IEEE 802.11g : 54, 48 ,36, 24, 18, 12, 11, 9, 6Mbps IEEE 802.11n(20MHz) : 144.4, 130, 115.6, 86.7, 57.3, 43.3, 28.9, 14.4Mbps IEEE 802.11n(40MHz) : 300, 270, 240, 180, 120, 90, 60, 30Mbps
Type of Modulation	IEEE 802.11b : DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g : OFDM (64QAM, 16QAM, QPSK, BPSK)
Frequency Selection	by software / firmware
Antenna Type	Chip Antenna Gain : 1.8dBi.
Power Source	3.3VDC

Remark: for more details, please refer to the User''s manual of the EUT.

3.2 Equipment Modifications

None.

4. EQUIPMENT UNDER TEST

4.1. DESCRIPTION OF EUT

The EUT is an 802.11b/g/n WLAN transceiver module in a PCI form factor, for 2.4 AP/Router

4.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (W)
2.4 GHz BAND			
2412 ~2472	802.11b	21.42	0.138
2412 ~2472	802.11g	26.17	0.413
2412 ~2472	802.11n HT20	21.47	0.140
2422 ~2462	802.11n HT40	8.40	0.007

4.3. DESCRIPTION OF AVAILABLE ANTENNAS

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.
And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Result : PASS
The transmitter has an chip Antenna. The directional gain of the antenna is 1.8 dBi.

4.4. SOFTWARE AND FIRMWARE

The test utility software used during emissions testing was RT3352QA

4.5. WORST-CASE CONFIGURATION AND MODE

The EUT was tested as an external module installed in a test jig board connected to a host Laptop PC.

Worst-Case data rates were utilized from preliminary testing of the Chipset, worst-case data rates used during the testing are as follows:
IEEE 802.11b : 11Mbps
IEEE 802.11g : 54Mbps
IEEE 802.11n(20MHz) : 130 Mbps
IEEE 802.11n(40MHz) : 130 Mbps

4.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	IBM	T43 ThinkPad	L3-XDLXW06/02	DoC
AC Adapter	IBM	08K8204	11S08K8204Z1Z9	DoC
DC Power Supply	Tektronic	PS2521G	N/A	N/A
DC Power Supply	HP	336108	KR24104150	N/A
Extender PCI	ALLION	V1 EC-PEM V1.0	A073	N/A

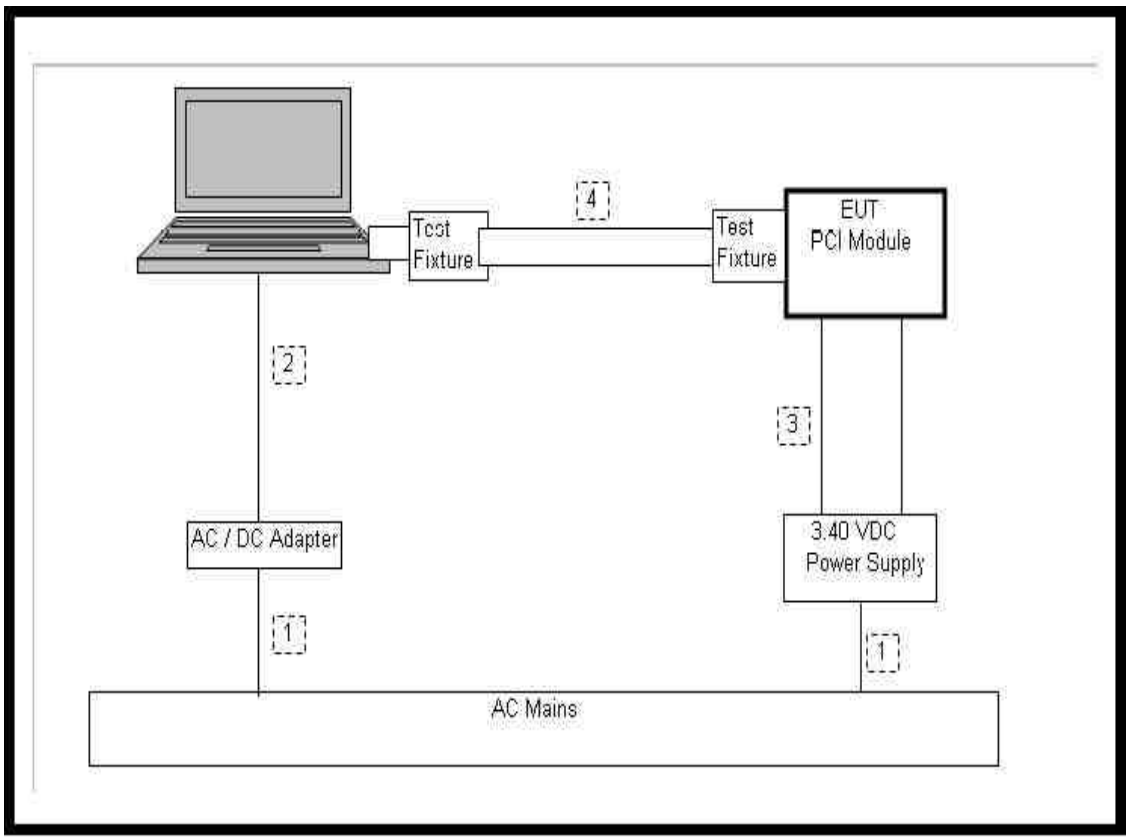
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connecto Type	Cable Type	Cable Length	Remarks
1	AC	2	US115	Un-shielded	1.5 m	For laptop
2	DC	1	DC	Un-shielded	1.5 m	For laptop
3	DC	1	Cable	Un-shielded	1.0 m	For EUT
4	Ribbon	1	Ribbon	Un-shielded	.4 m	Test Fixture

TEST SETUP

The EUT is connected to a host laptop computer via a test fixture during the tests. Test software exercised the radio card.

SETUP DIAGRAM FOR TESTS



5. ANTENNA PORT TEST RESULTS

5.1. 2.4 GHz BAND CHANNEL TESTS FOR 802.11b MODE

5.1.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

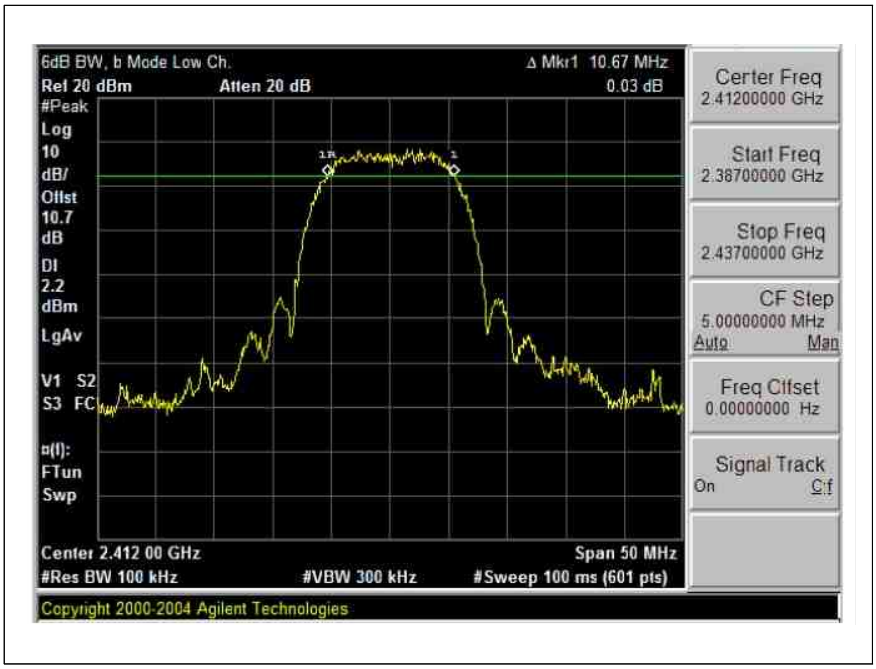
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

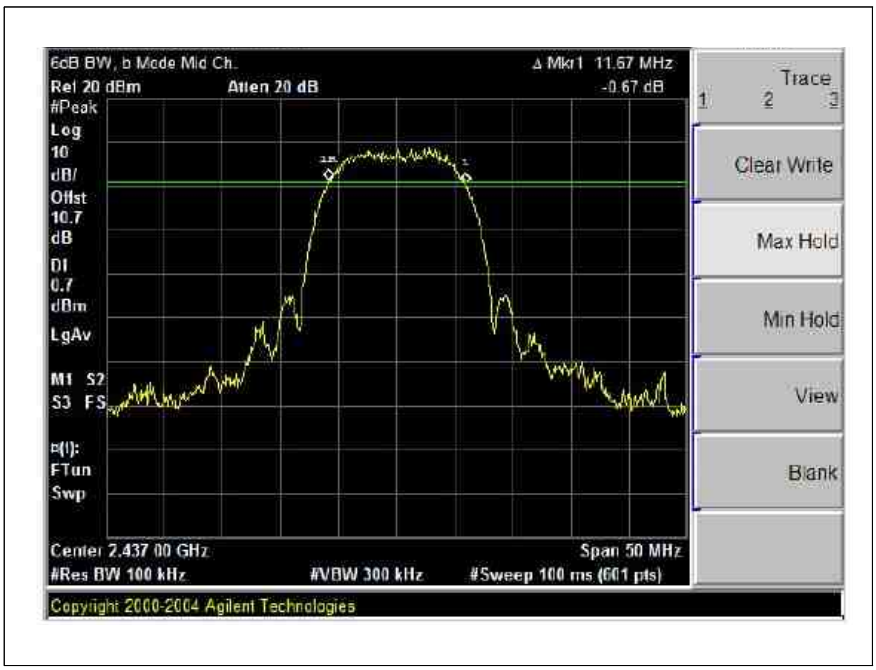
Channel	Frequency (MHz)	6 dB BW(MHz)	Verdict
Low	2412	10.67	Pass
Middle	2437	11.57	Pass
High	2472	10.83	Pass

Plot of the 6dB Channel Bandwidth

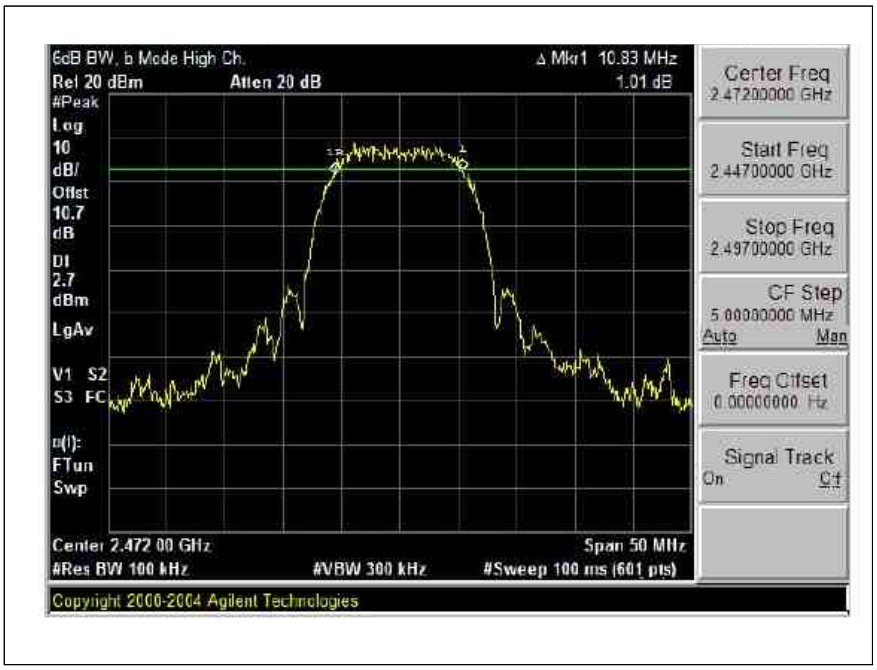
Low Channel (2412MHz)



Middle Channel (2437 MHz)



Highest Channel (2472 MHz)



5.1.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

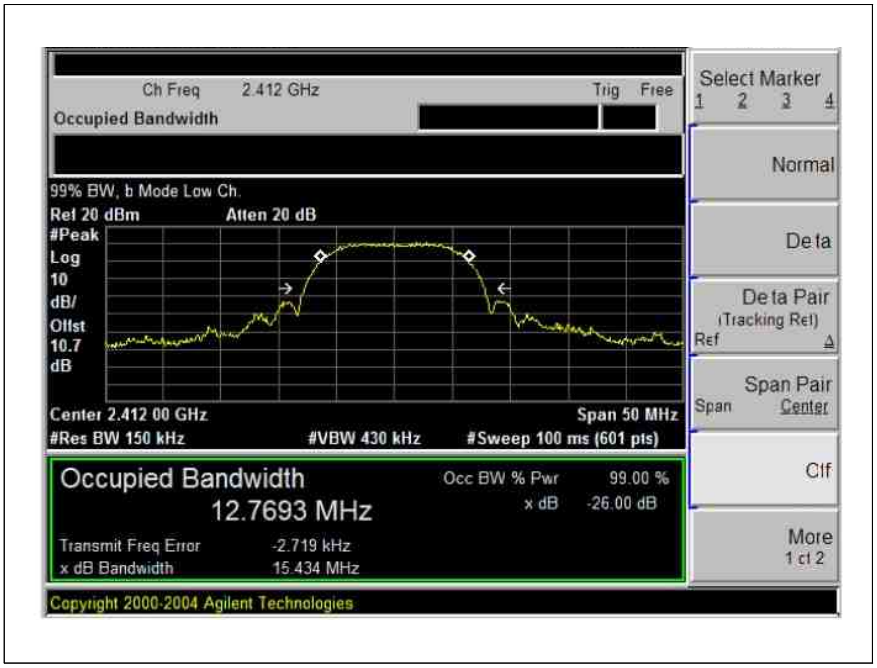
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth measurement function is utilized.

RESULTS

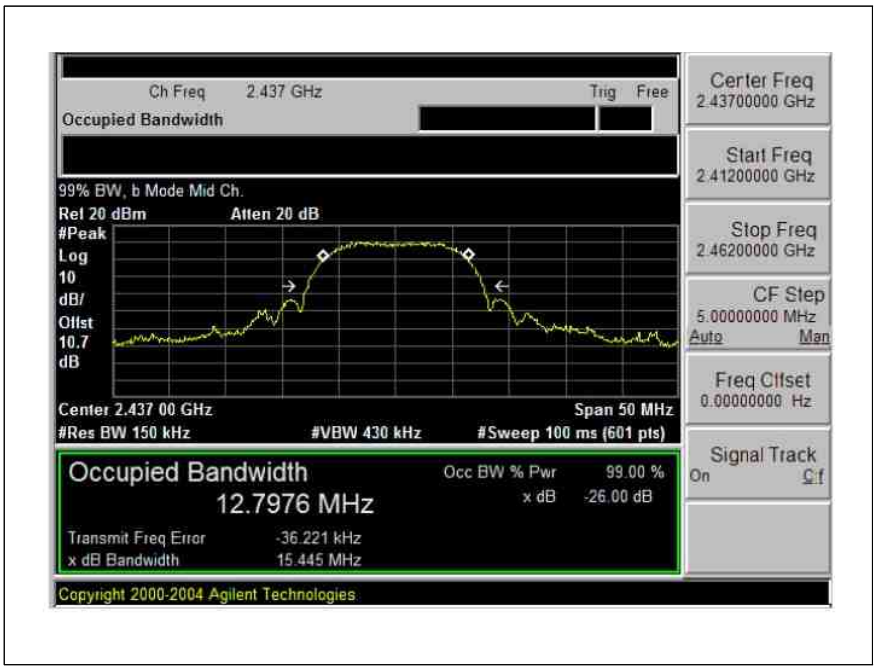
Channel	Frequency (MHz)	99% OBW (MHz)
Low	2412	12.769
Middle	2437	12.797
High	2472	12.799

Plot of the 99% Channel Bandwidth

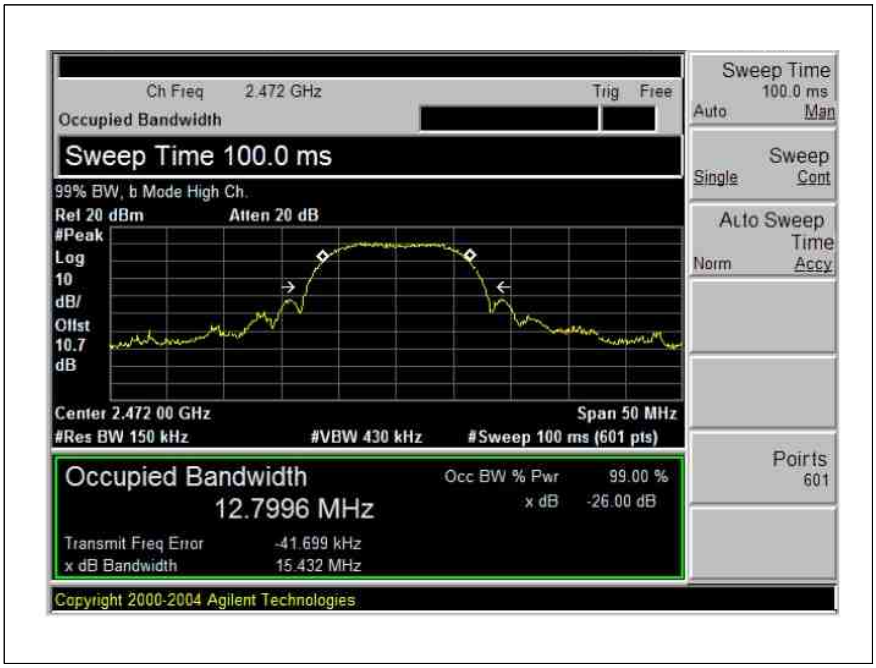
Low Channel (2412MHz)



Middle Channel (2437 MHz)



Highest Channel (2472 MHz)



5.1.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

TEST PROCEDURE

Output power was measured based on the use of RMS averaging over a time interval in accordance with FCC document ☐Measurement of Digital Transmission Systems Operating under Section 15.247☐, March 23, 2005.

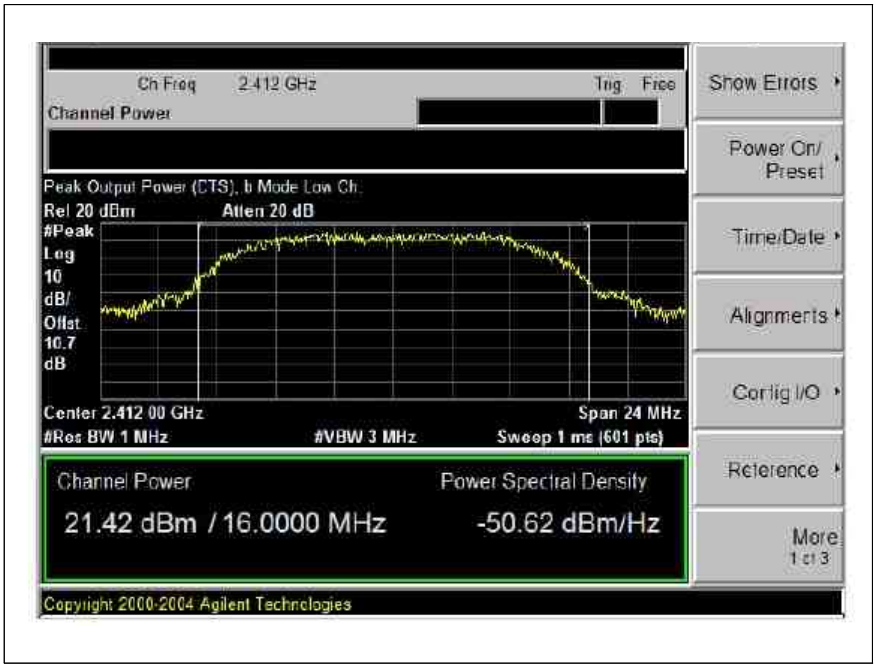
RESULTS : PASS

Table 2 : Measured values of the Maximum Peak Output Power(Conducted)

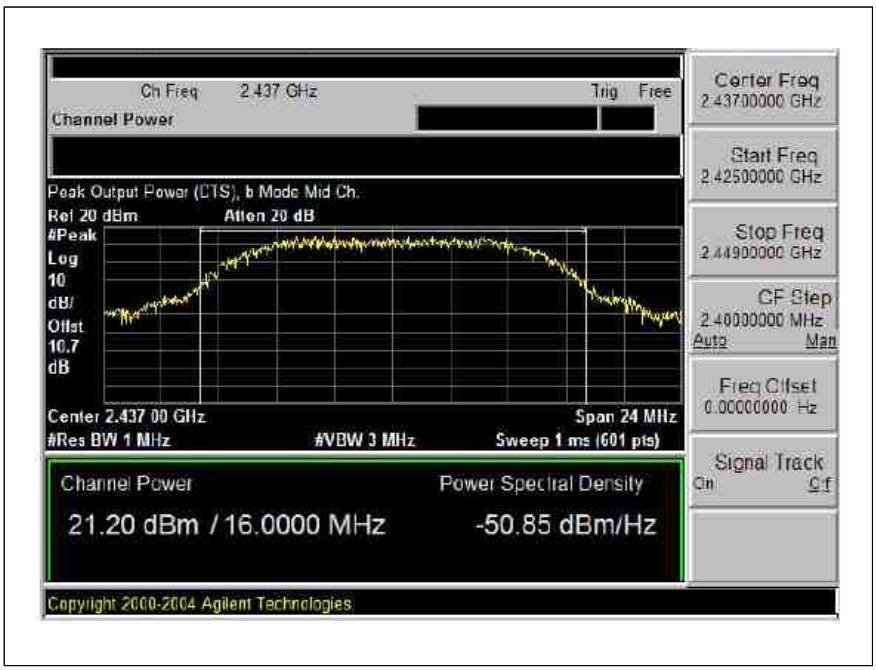
Mode	Frequency (MHz)	Reading Power (dBm)	Output Power (W)	Limit (W)	Verdict
802.11b	2412	21.42	0.138	1	Pass
	2437	21.20	0.131	1	Pass
	2472	14.75	0.03	1	Pass

Plot of the Maximum Peak Output Power

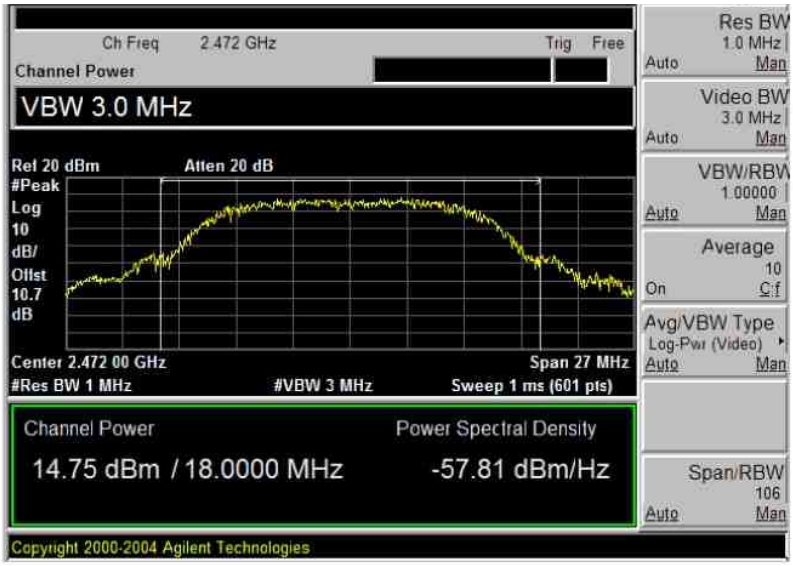
Low Channel (2412 MHz) Average Power = 19dBm



Middle Channel (2437 MHz) Average Power = 19dBm



Highest Channel (2472 MHz) Average Power = 12dBm



5.1.4. POWER SPECTRAL DENSITY

LIMITS

According to §15.247(e), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

TEST PROCEDURE

- Set Spectrum analyzer as RBW = 3 kHz, VBW = 10kHz,
- Record the max. reading

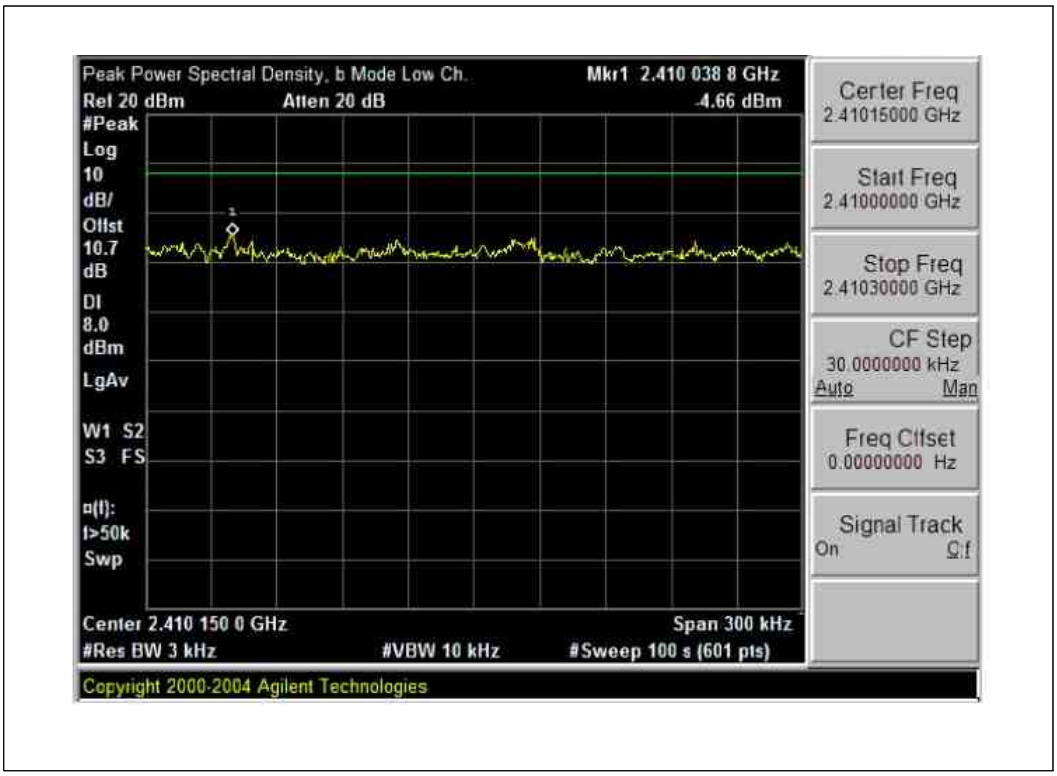
RESULTS : PASS

Table 3 : Measured values of the Power Spectral Density

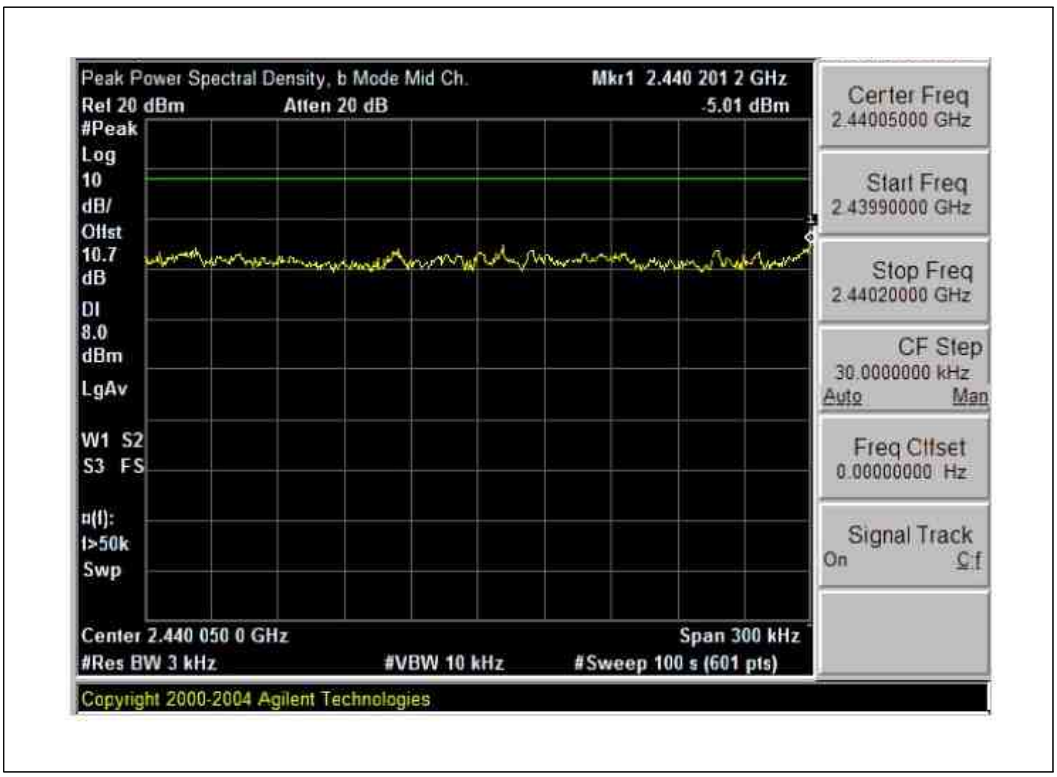
Mode	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Verdict
802.11b	2412	-4.66	8	Pass
	2437	-5.01	8	Pass
	2472	-4.60	8	Pass

Plot of the Power Spectral Density

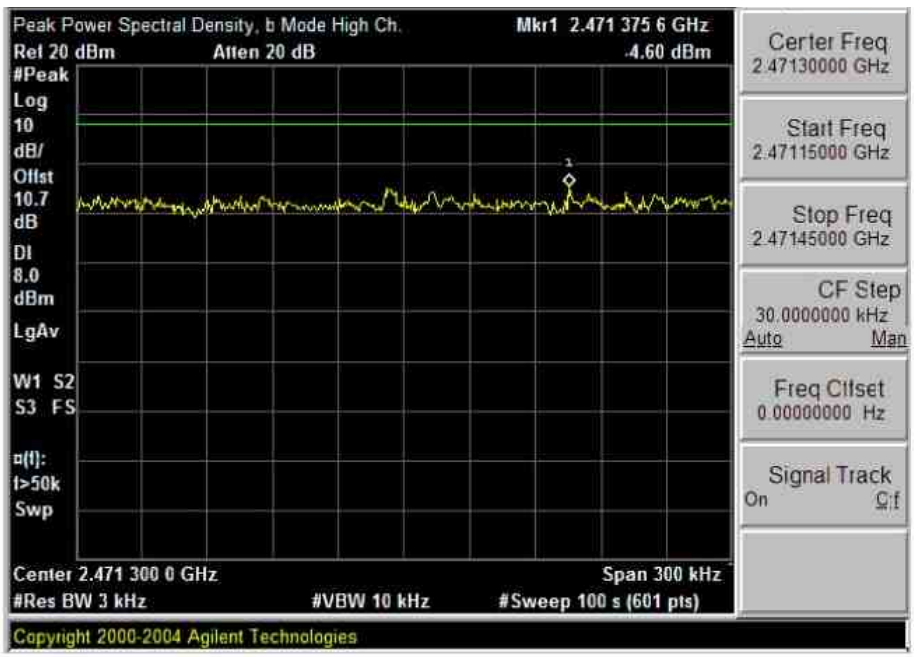
Low Channel (2412 MHz)



Middle Channel (2437 MHz)



Highest Channel (2472 MHz)



5.1.5. SPURIOUS EMISSIONS, BAND EDGE, AND RESTRICTED BANDS

Regulation

According to §15.247(d), 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

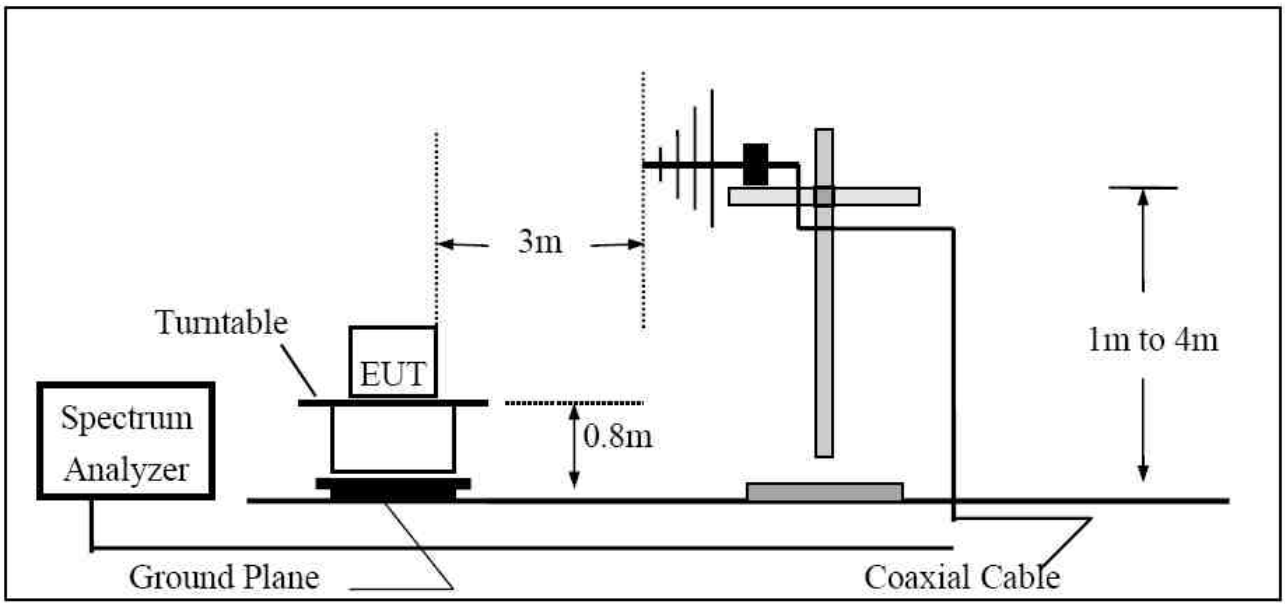
Frequency (MHz)	Field strength (μV/m @ 3m)	Field strength (dBμV/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

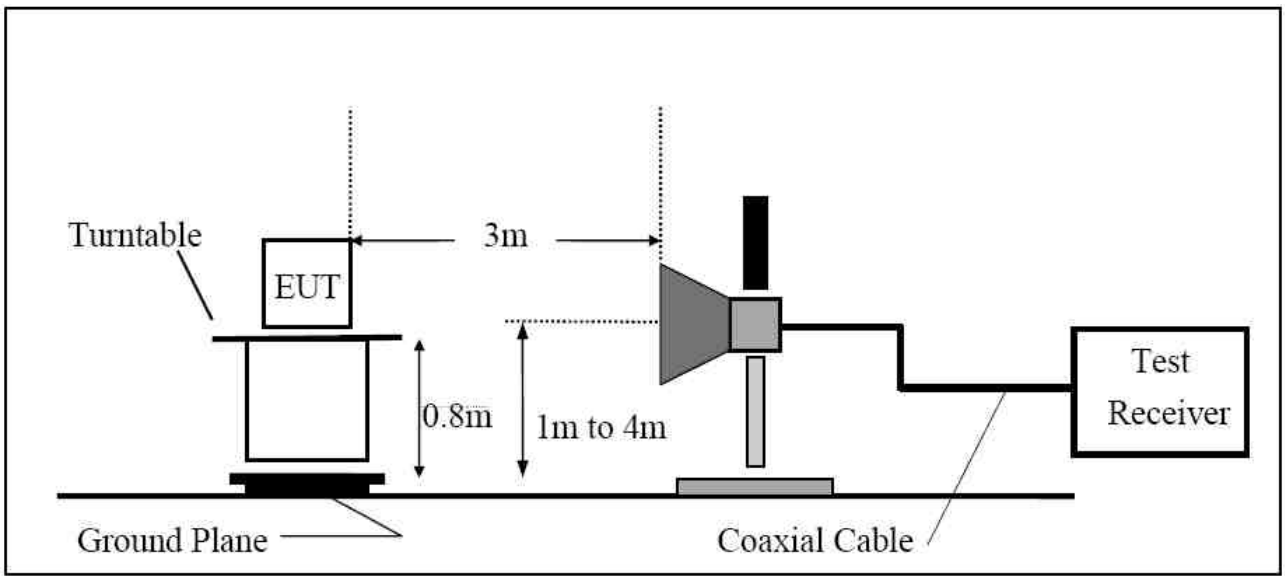
** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

Test Setup Layout

5.1.5.1 Radiated Emission Test Set-Up, Frequency Below 1000MHz



5.1.5.2 Radiated Emission Test Set-UP Frequency Over 1000MHz



Test Procedure

1) Band-edge Compliance of RF Conducted Emissions

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Spurious RF Conducted Emissions:

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters for above 30 MHz, and at 1 meter distance for below 30 MHz.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.

3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, from 30 to 1000 MHz using the Trilog broadband antenna, and from 1 GHz to tenth harmonic of the highest fundamental frequency using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The EUT is situated in three orthogonal planes (if appropriate)
7. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
8. If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative “marker-delta” method may be employed.

4) Marker-Delta Method at the edge of the authorized band of operation:

1. Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function as the above Spurious Radiated Emissions test procedure.
2. Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.
3. Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.
4. The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two “standard” bandwidths must be measured as the above Spurious Radiated Emissions test procedure.

Test Results: **PASS**

Band-edge compliance of RF conducted/radiated emissions was shown in the Figure 7 and Figure 8

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

Spurious RF conducted emissions were shown in the Figure 9

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

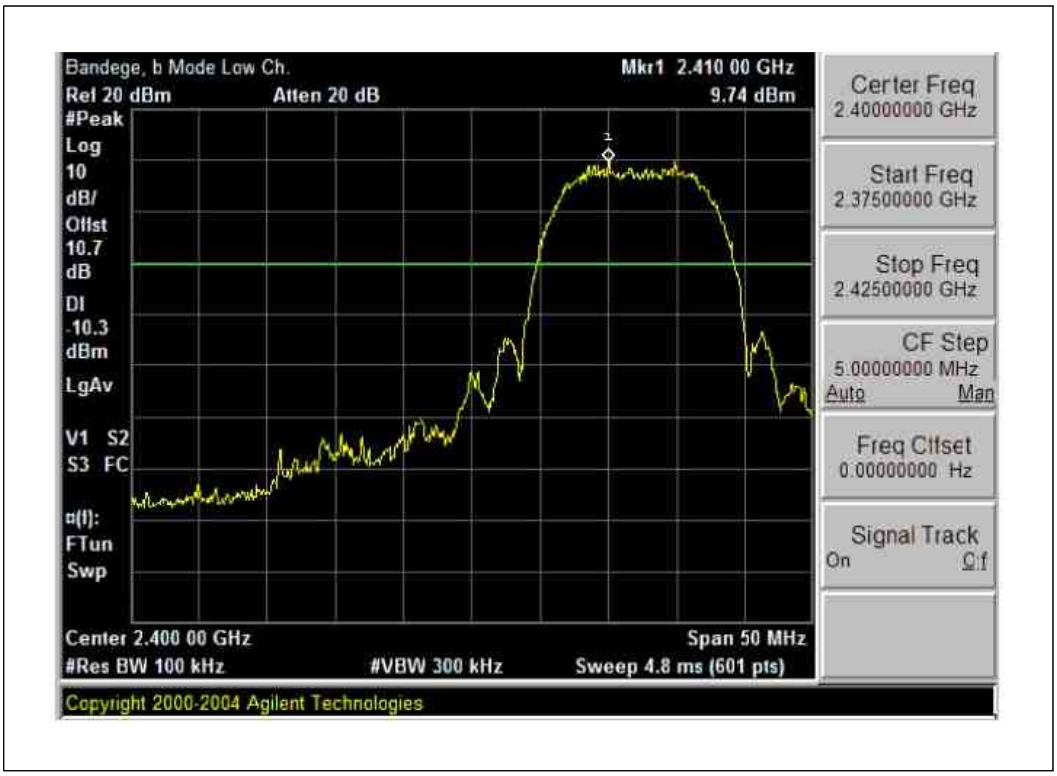
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
LOW CH=2412 MHz															
4.824	3.0	54.5	49.0	33.6	3.1	-37.9	0.0	0.6	53.9	48.4	74	54	-20.1	-5.6	H
12.060	3.0	45.0	33.0	38.4	5.6	-37.6	0.0	0.9	52.3	40.3	74	54	-21.7	-13.7	H, NOISE FLOOR
4.824	3.0	55.3	50.1	33.6	3.1	-37.9	0.0	0.6	54.7	50.1	74	54	-19.3	-3.9	V
12.060	3.0	45.9	34.0	38.4	5.6	-37.6	0.0	0.9	53.2	41.3	74	54	-20.8	-12.7	V, NOISE FLOOR
MID CH=2437MHz															
4.874	3.0	53.2	49.8	33.7	3.1	-37.9	0.0	0.6	52.7	49.3	74	54	-21.3	-4.7	H
7.311	3.0	47.0	38.0	36.2	3.7	-36.9	0.0	0.6	50.6	41.6	74	54	-23.4	-12.4	H
12.185	3.0	45.0	33.9	38.4	5.6	-37.7	0.0	0.9	52.2	41.1	74	54	-21.8	-12.9	H, NOISE FLOOR
4.874	3.0	54.9	51.1	33.7	3.1	-37.9	0.0	0.6	54.4	50.6	74	54	-19.6	-3.4	V
7.311	3.0	47.6	37.0	36.2	3.7	-36.9	0.0	0.6	51.2	40.6	74	54	-22.8	-13.4	V
12.185	3.0	46.0	34.5	38.4	5.6	-37.7	0.0	0.9	53.2	41.7	74	54	-20.8	-12.3	V, NOISE FLOOR
HI CH=2472MHz															
4.944	3.0	52.2	47.0	33.7	3.1	-37.9	0.0	0.6	51.8	46.6	74	54	-22.2	-7.4	H
7.416	3.0	46.0	37.0	36.3	3.8	-36.8	0.0	0.6	49.8	40.8	74	54	-24.2	-13.2	H
12.360	3.0	46.0	33.0	38.4	5.6	-37.8	0.0	0.9	53.1	40.1	74	54	-20.9	-13.9	H, NOISE FLOOR
4.944	3.0	54.0	49.9	33.7	3.1	-37.9	0.0	0.6	53.6	49.5	74	54	-20.4	-4.5	V
7.416	3.0	47.0	38.0	36.3	3.8	-36.8	0.0	0.6	50.8	41.8	74	54	-23.2	-12.2	V
12.360	3.0	44.6	34.0	38.4	5.6	-37.8	0.0	0.9	51.7	41.1	74	54	-22.3	-12.9	V, NOISE FLOOR
NO OTHER EMISSIONS WERE DETECTED AFTER 5TH HARMONIC															

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

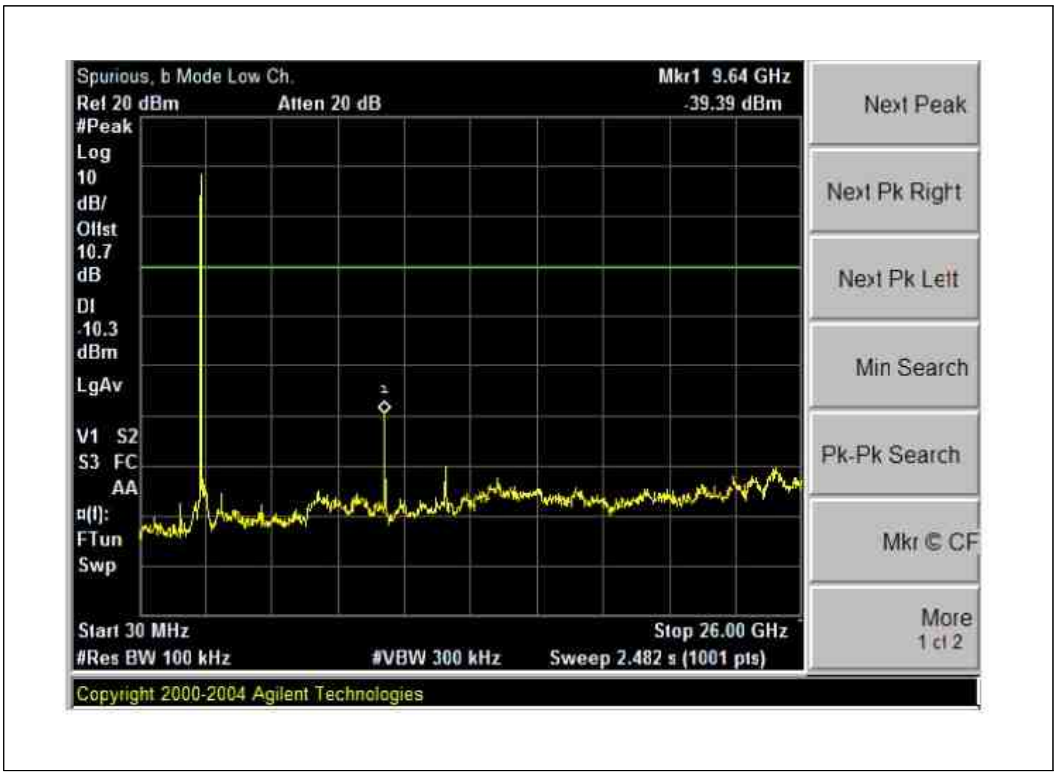
1. Margin (dB) = Limit − Emission Level
2. H = Horizontal, V = Vertical Polarization

Plot of the Band Edge

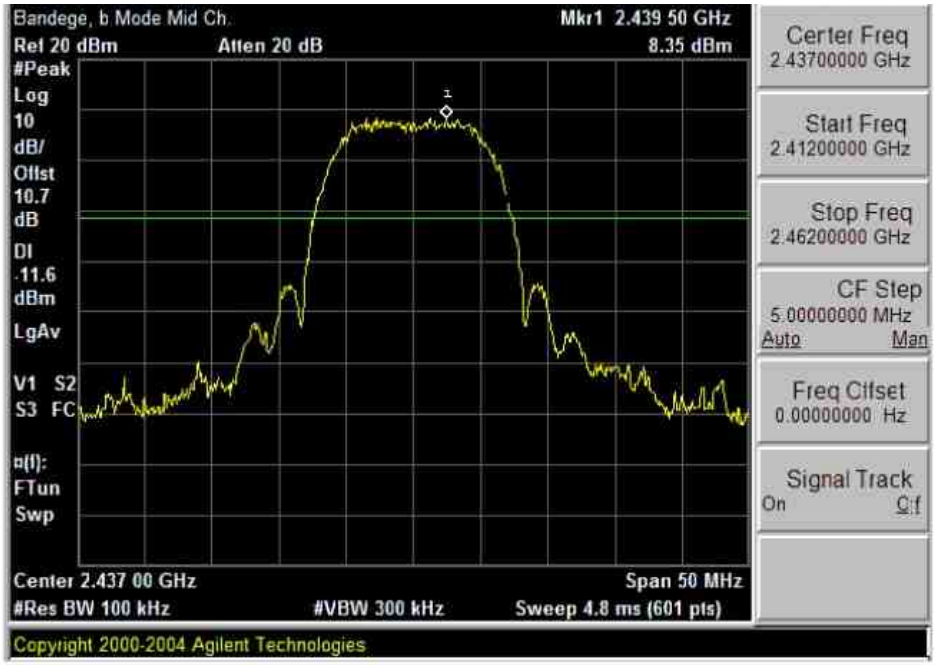
Low Channel (2412 MHz)



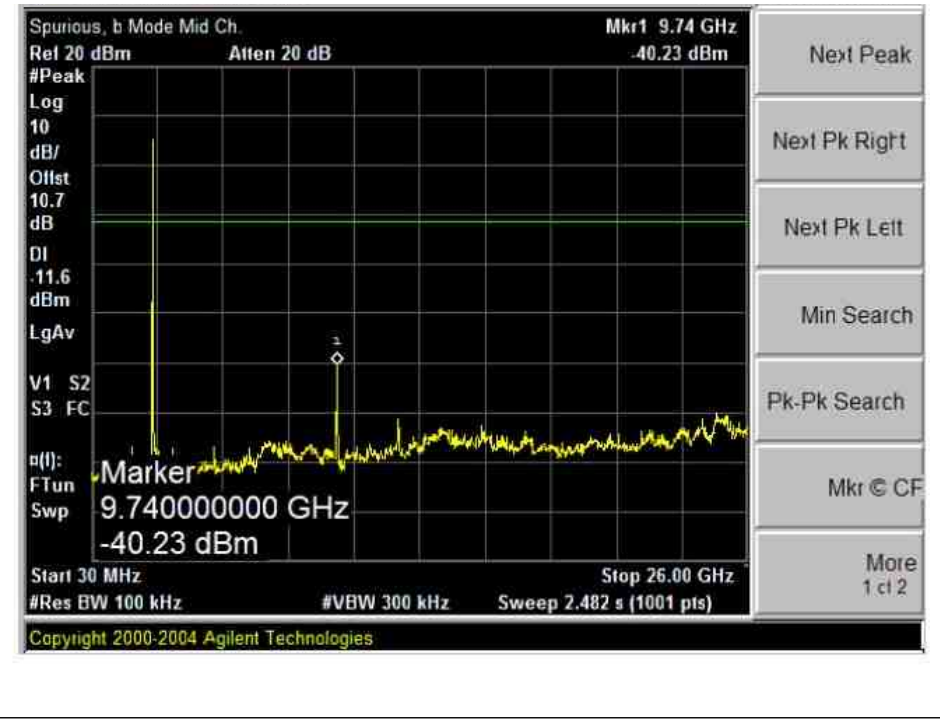
Low Channel (2412 MHz)



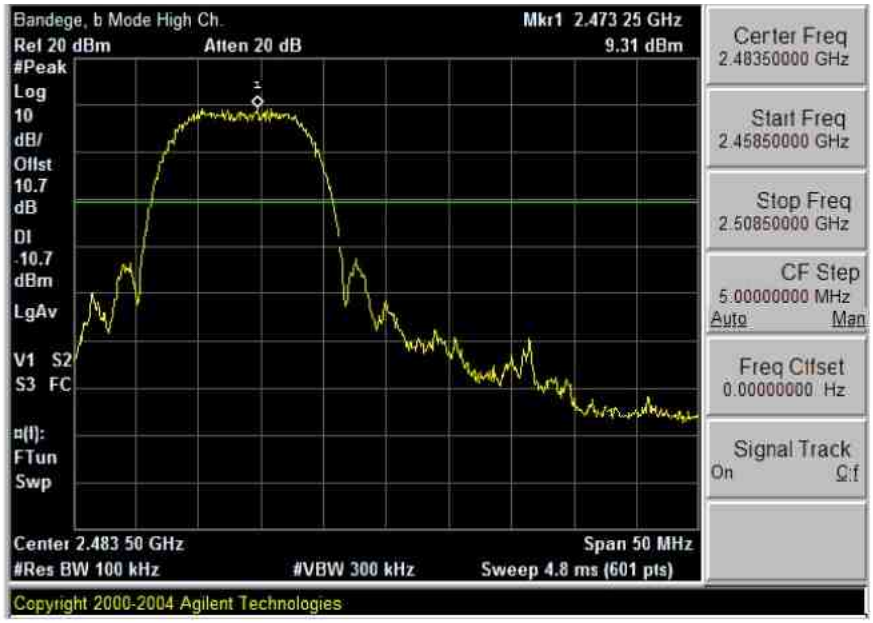
Middle Channel (2437 MHz)



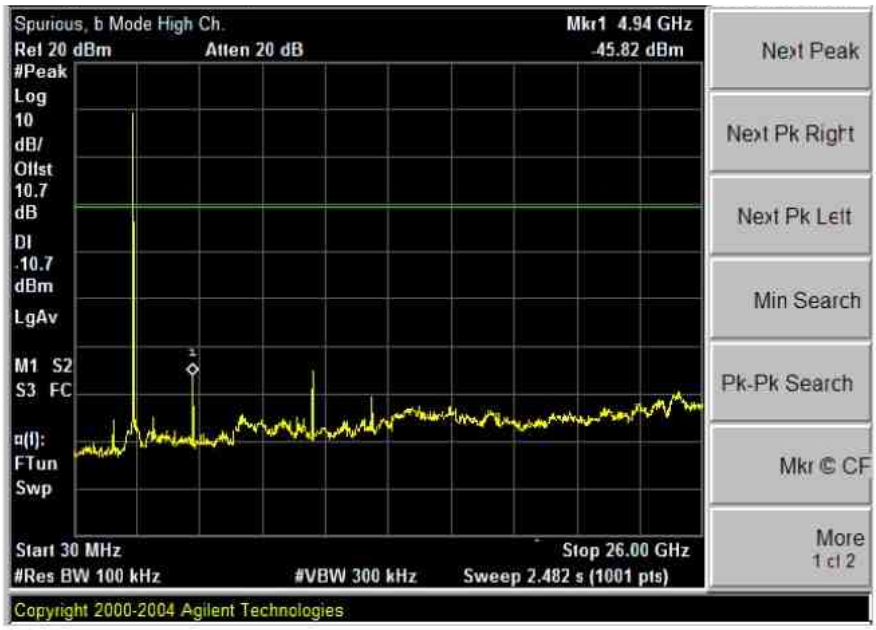
Middle Channel (2437 MHz)



High Channel (2472MHz)



High Channel (2472MHz)



5.2. 2.4 GHz BAND CHANNEL TESTS FOR 802.11g MODE

5.2.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

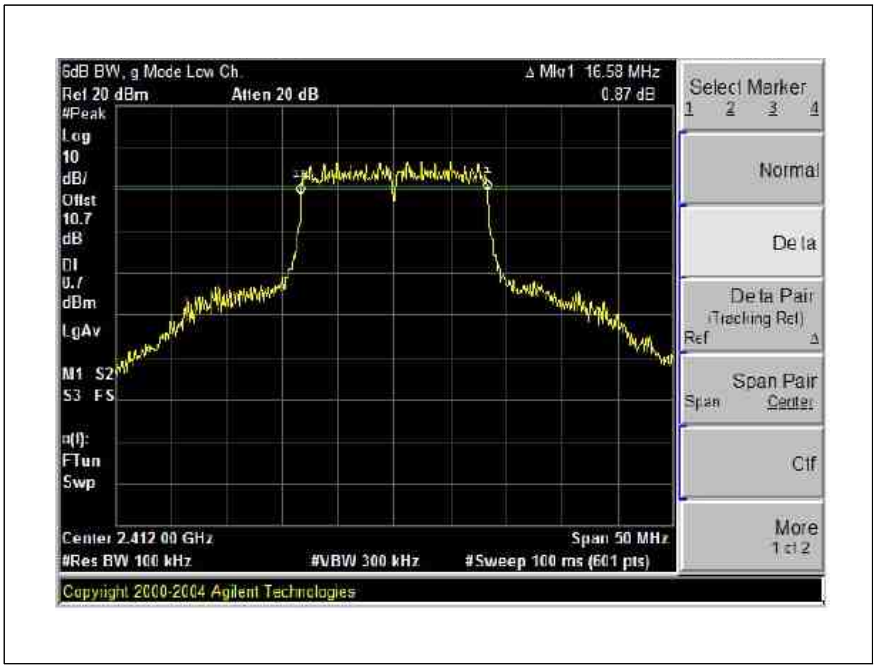
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

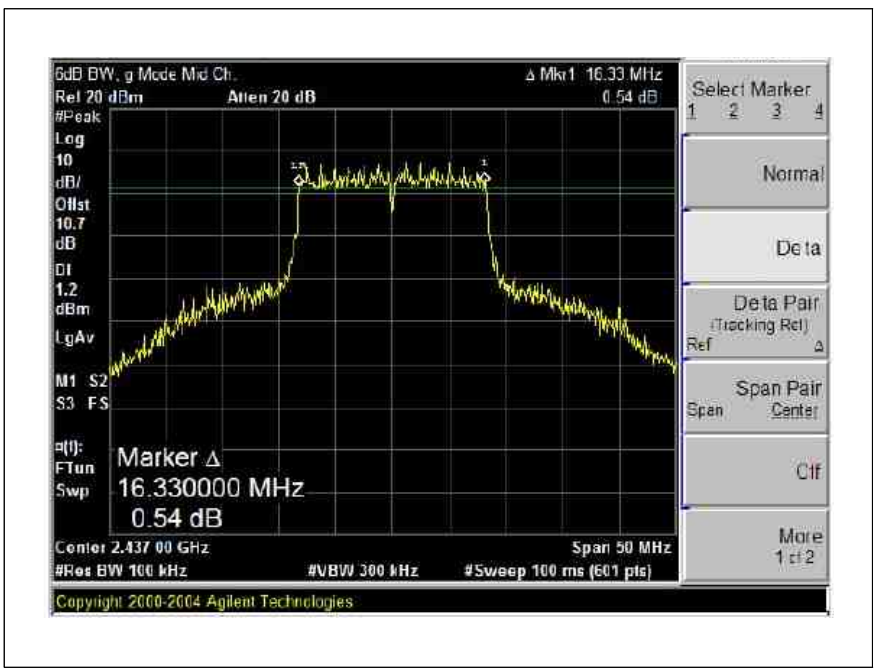
Channel	Frequency (MHz)	6 dB BW(MHz)	Verdict
Low	2412	16.58	Pass
Middle	2437	16.33	Pass
High	2472	16.50	Pass

Plot of the 6dB Channel Bandwidth

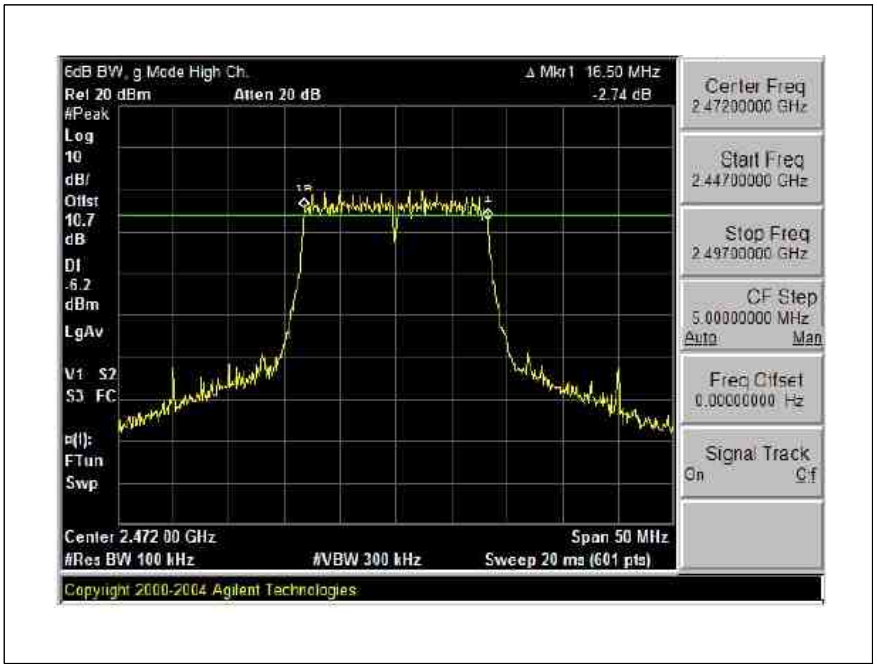
Low Channel (2412 MHz)



Middle Channel (2437 MHz)



Highest Channel (2472 MHz)



5.2.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

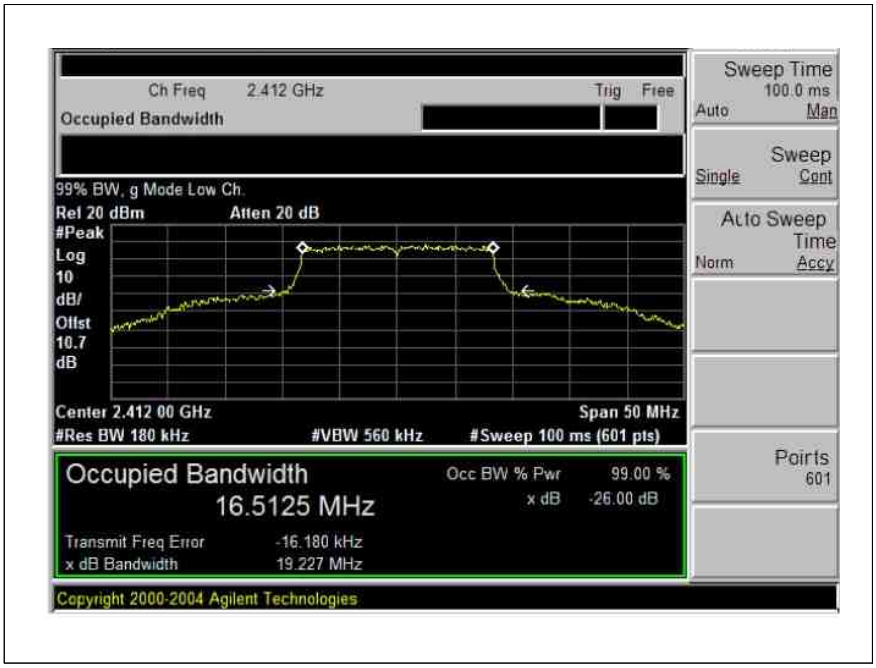
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth measurement function is utilized.

RESULTS

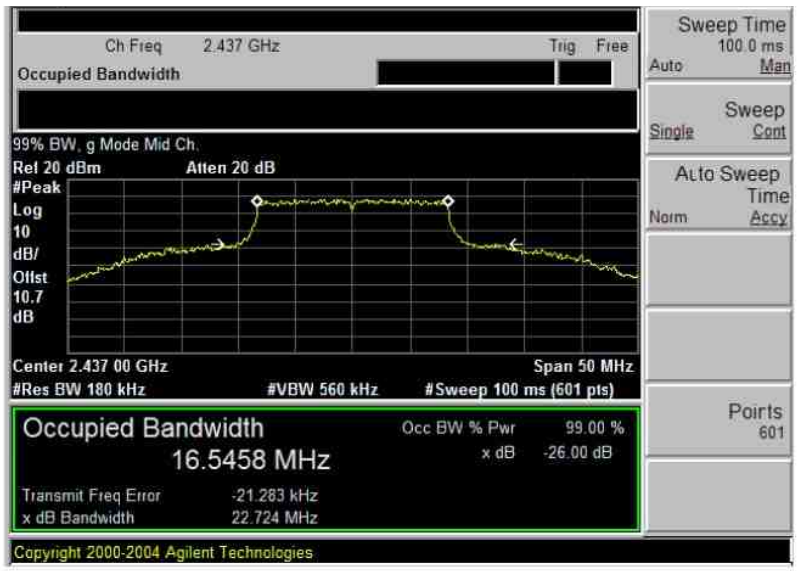
Channel	Frequency (MHz)	99% OBW (MHz)
Low	2412	16.512
Middle	2437	16.545
High	2472	16.427

Plot of the 99% Channel Bandwidth

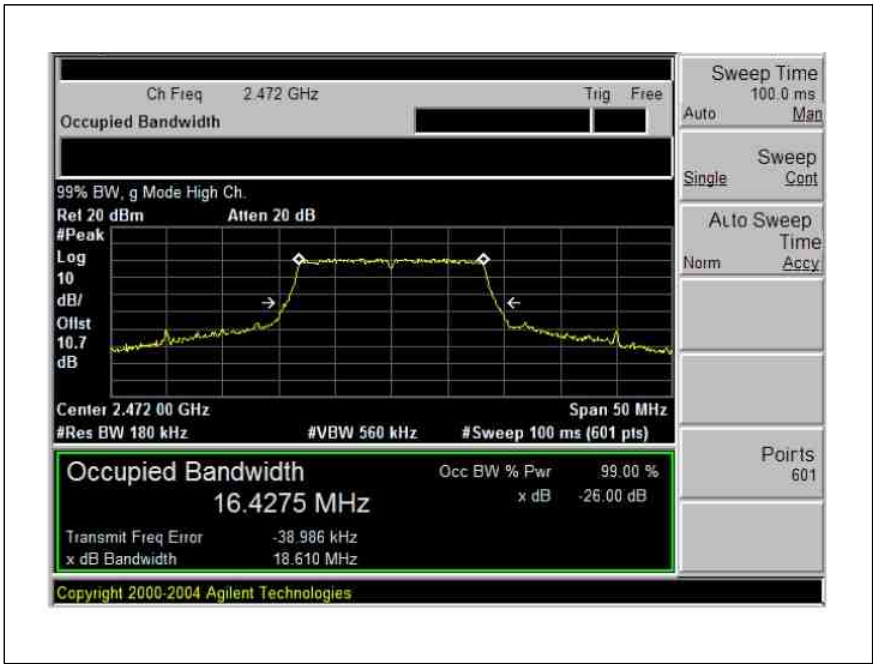
Low Channel (2412MHz)



Middle Channel (2437 MHz)



Highest Channel (2472 MHz)



5.2.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

TEST PROCEDURE

Output power was measured based on the use of RMS averaging over a time interval in accordance with FCC document ☐Measurement of Digital Transmission Systems Operating under Section 15.247☐, March 23, 2005.

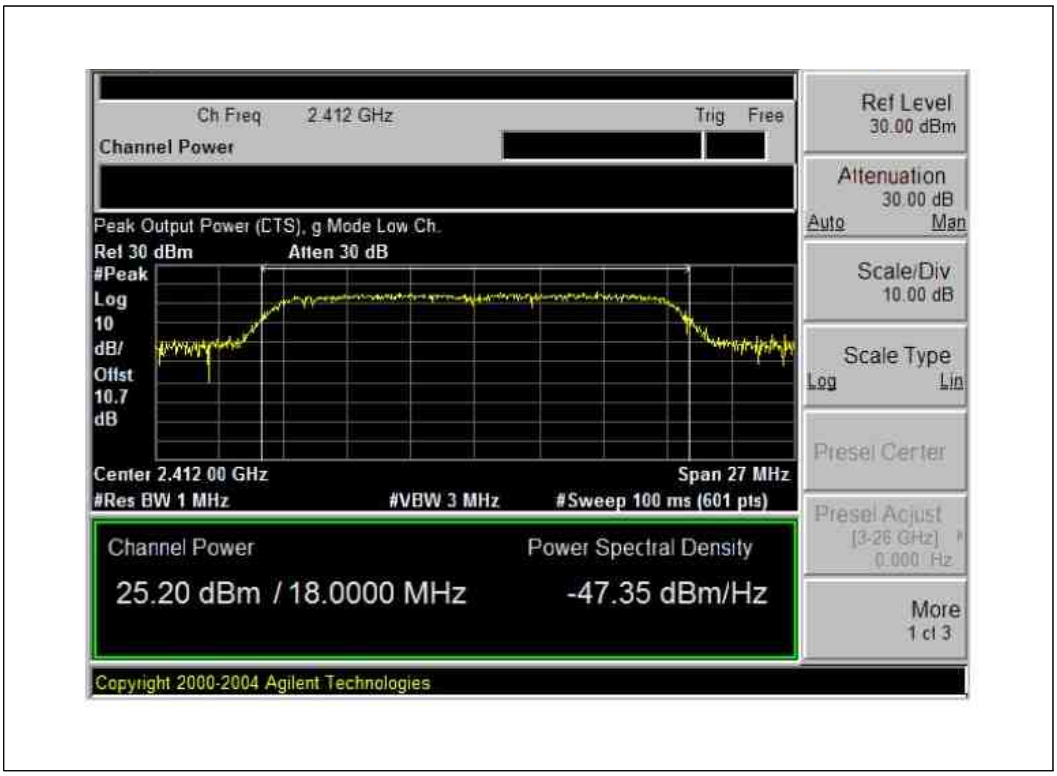
RESULTS : PASS

Table 2 : Measured values of the Maximum Peak Output Power(Conducted)

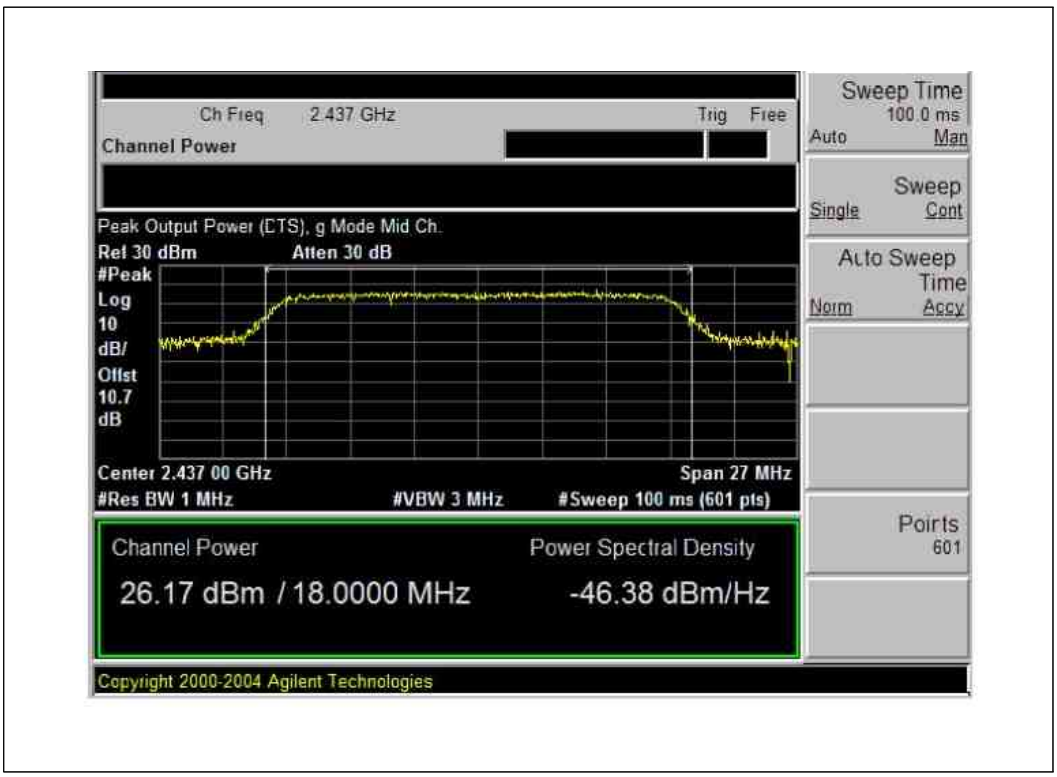
Mode	Frequency (MHz)	Reading Power (dBm)	Output Power (W)	Limit (W)	Verdict
802.11g	2412	25.20	0.331	1	Pass
	2437	26.17	0.413	1	Pass
	2472	19.55	0.090	1	Pass

Plot of the Maximum Peak Output Power

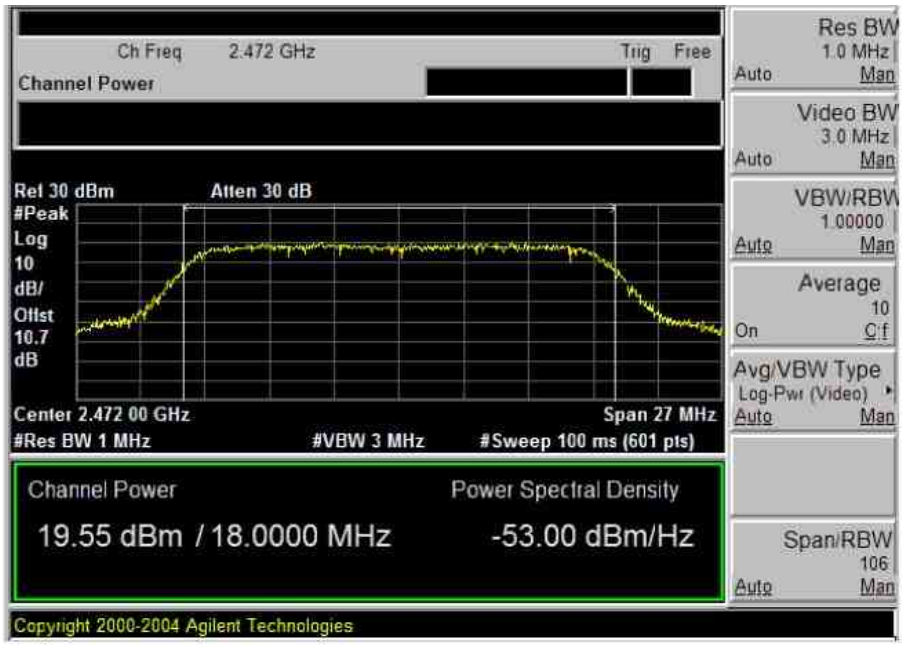
Low Channel (2412 MHz) Average Power = 18dBm



Middle Channel (2437 MHz) Average Power = 19dBm



Highest Channel (2472 MHz) Average Power = 12dBm



5.2.4. POWER SPECTRAL DENSITY

LIMITS

According to §15.247(e), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

TEST PROCEDURE

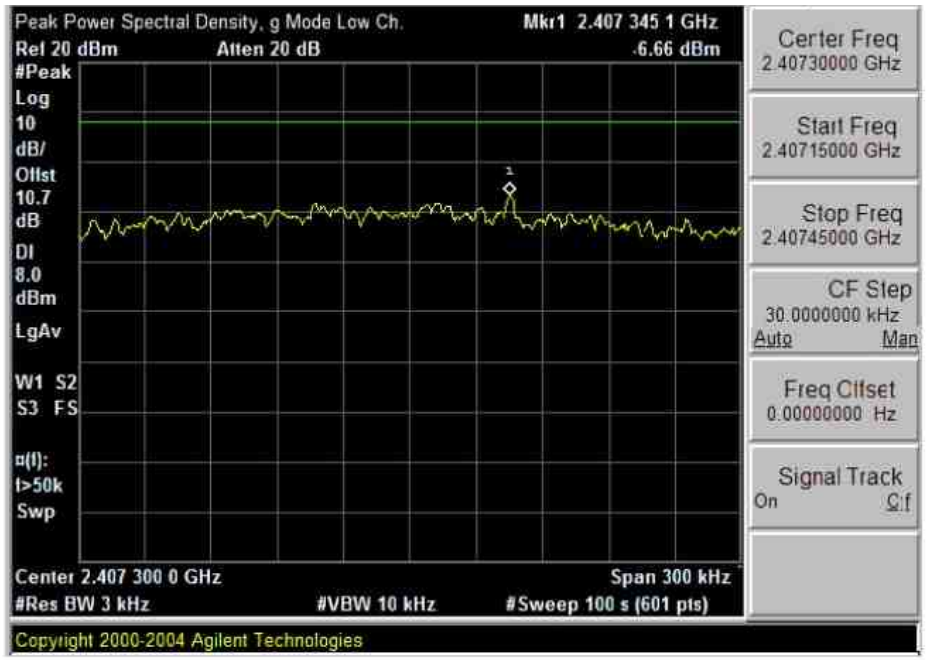
- Set Spectrum analyzer as RBW = 3 kHz, VBW = 10kHz,
- Record the max. reading

RESULTS : PASS

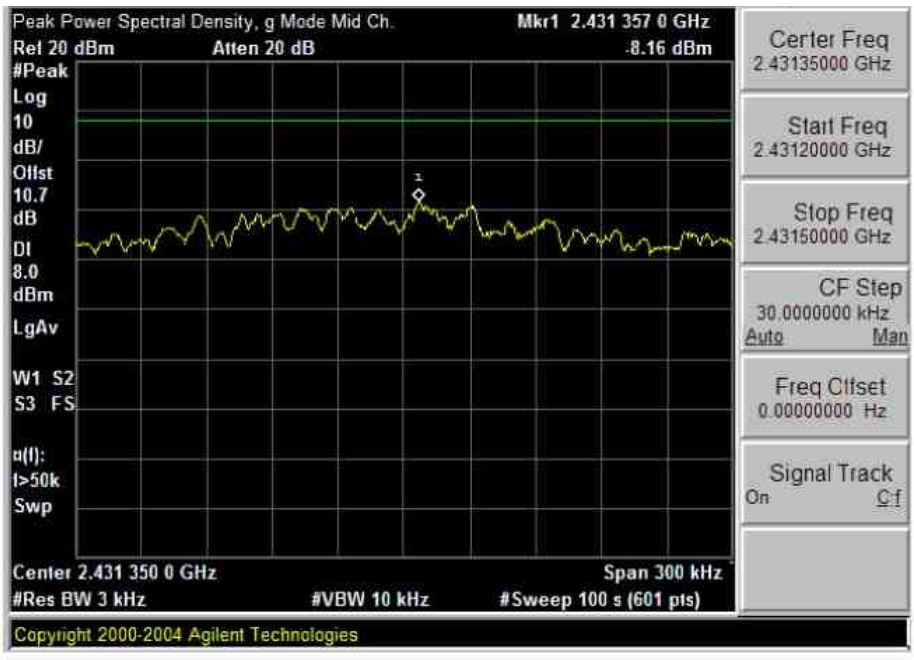
Table 3 : Measured values of the Power Spectral Density

Mode	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Verdict
802.11g	2412	-6.66	8	Pass
	2437	-8.16	8	Pass
	2472	-12.98	8	Pass

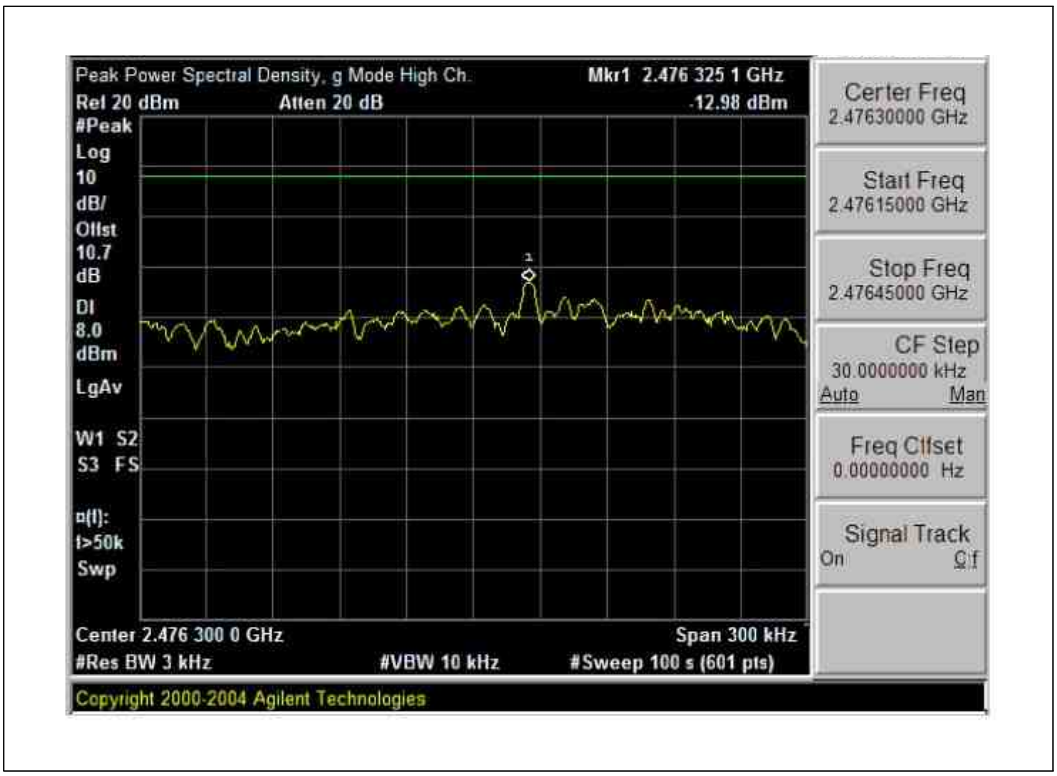
Low Channel (2412MHz)



Middle Channel (2437 MHz)



Highest Channel (2472MHz)



5.2.5. SPURIOUS EMISSIONS, BAND EDGE, AND RESTRICTED BANDS

Regulation

According to §15.247(d), 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

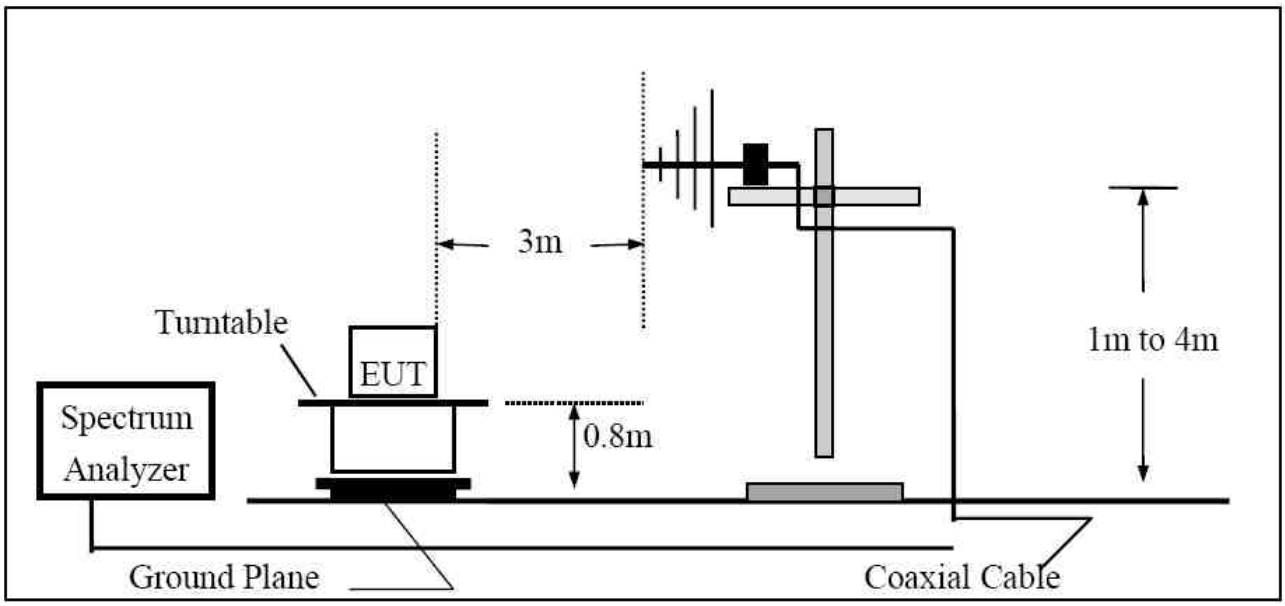
Frequency (MHz)	Field strength (μV/m @ 3m)	Field strength (dBμV/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

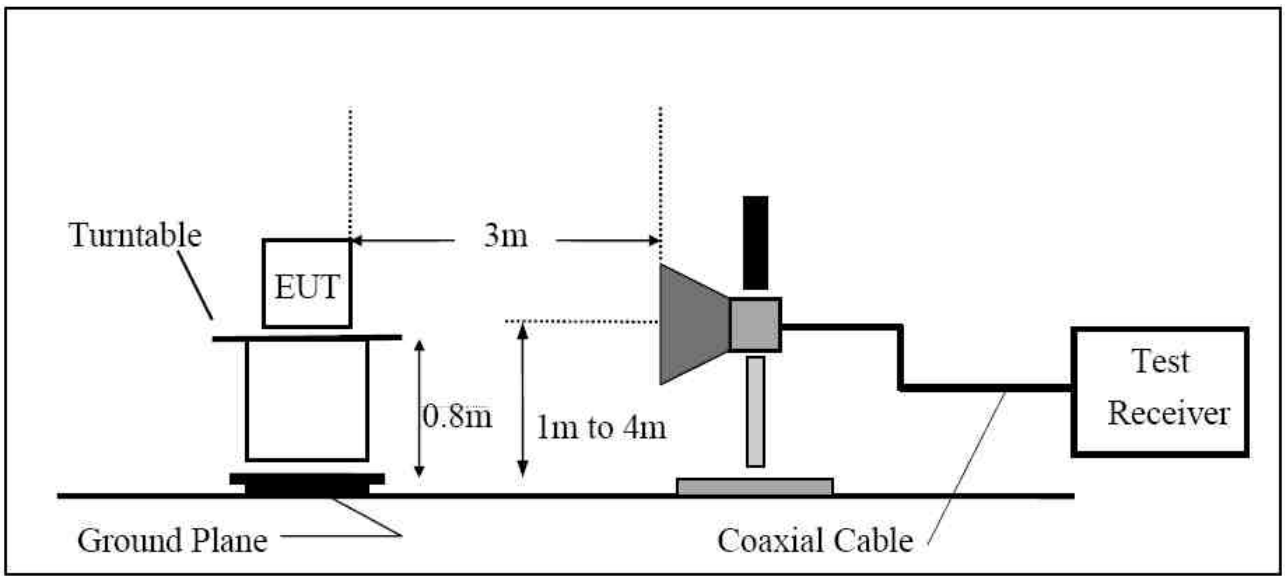
** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

Test Setup Layout

5.1.5.1 Radiated Emission Test Set-Up, Frequency Below 1000MHz



5.2.5.2 Radiated Emission Test Set-UP Frequency Over 1000MHz



Test Procedure

1) Band-edge Compliance of RF Conducted Emissions

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Spurious RF Conducted Emissions:

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters for above 30 MHz, and at 1 meter distance for below 30 MHz.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.

3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, from 30 to 1000 MHz using the Trilog broadband antenna, and from 1 GHz to tenth harmonic of the highest fundamental frequency using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The EUT is situated in three orthogonal planes (if appropriate)
7. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
8. If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative “marker-delta” method may be employed.

4) Marker-Delta Method at the edge of the authorized band of operation:

1. Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function as the above Spurious Radiated Emissions test procedure.
2. Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.
3. Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.
4. The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two “standard” bandwidths must be measured as the above Spurious Radiated Emissions test procedure.

Test Results: **PASS**

Band-edge compliance of RF conducted/radiated emissions was shown in the Figure 7 and Figure 8

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

Spurious RF conducted emissions were shown in the Figure 9

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

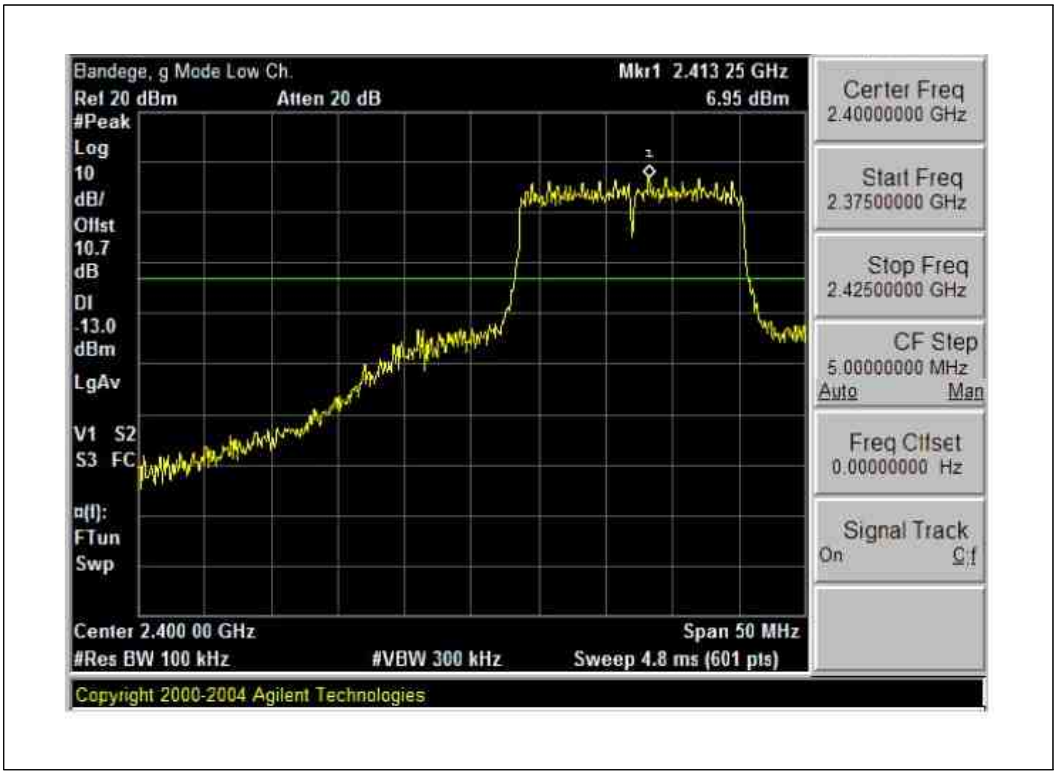
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
LOW CH=2412 MHz															
4.824	3.0	55.0	41.0	33.7	3.1	-37.9	0.0	0.6	54.5	40.5	74	54	-19.5	-13.5	H
7.236	3.0	55.8	42.4	35.4	3.7	-37.0	0.0	0.6	58.5	45.2	74	54	-15.5	-8.8	H
9.648	3.0	51.5	36.4	37.5	4.4	-36.2	0.0	0.8	58.0	42.9	74	54	-16.0	-11.1	H
12.060	3.0	44.0	34.1	38.5	5.6	-37.6	0.0	0.9	51.4	41.5	74	54	-22.6	-12.5	H, NOISE FLOOR
4.824	3.0	56.8	43.1	33.7	3.1	-37.9	0.0	0.6	56.3	42.6	74	54	-17.7	-11.4	V
7.236	3.0	55.0	41.8	35.4	3.7	-37.0	0.0	0.6	57.8	44.6	74	54	-16.2	-9.4	V
9.648	3.0	57.1	38.5	37.5	4.4	-36.2	0.0	0.8	63.6	45.0	74	54	-10.4	-9.0	V
12.060	3.0	44.8	34.5	38.5	5.6	-37.6	0.0	0.9	52.2	41.9	74	54	-21.8	-12.1	V, NOISE FLOOR
MID CH=2437MHz															
4.874	3.0	58.9	45.8	33.8	3.1	-37.9	0.0	0.6	58.5	45.4	74	54	-15.5	-8.6	H
7.311	3.0	56.2	43.3	35.5	3.7	-36.9	0.0	0.6	59.1	46.2	74	54	-14.9	-7.8	H
9.748	3.0	53.4	41.4	37.5	4.4	-36.1	0.0	0.8	60.0	48.0	74	54	-14.0	-6.0	H
12.185	3.0	44.4	34.6	38.5	5.6	-37.7	0.0	0.9	51.7	41.9	74	54	-22.3	-12.1	H, NOISE FLOOR
4.874	3.0	59.1	47.0	33.8	3.1	-37.9	0.0	0.6	58.7	46.6	74	54	-15.3	-7.4	V
7.311	3.0	57.8	46.0	35.5	3.7	-36.9	0.0	0.6	60.7	48.9	74	54	-13.3	-5.1	V
9.748	3.0	56.4	41.1	37.5	4.4	-36.1	0.0	0.8	63.0	47.7	74	54	-11.0	-6.3	V
12.185	3.0	45.8	34.3	38.5	5.6	-37.7	0.0	0.9	53.1	41.6	74	54	-20.9	-12.4	V, NOISE FLOOR
HI CH=2472MHz															
4.944	3.0	57.6	45.0	33.8	3.1	-37.9	0.0	0.6	57.3	44.7	74	54	-16.7	-9.3	H
7.416	3.0	56.4	44.4	35.6	3.8	-36.8	0.0	0.6	59.6	47.6	74	54	-14.4	-6.4	H
9.888	3.0	53.0	41.5	37.6	4.5	-36.1	0.0	0.8	59.9	48.4	74	54	-14.1	-5.6	H
12.360	3.0	48.0	35.7	38.5	5.6	-37.8	0.0	0.9	55.2	42.9	74	54	-18.8	-11.1	H, NOISE FLOOR
4.944	3.0	56.9	45.5	33.9	3.1	-37.9	0.0	0.6	56.6	45.2	74	54	-17.4	-8.8	V
7.416	3.0	59.7	47.2	35.6	3.8	-36.8	0.0	0.6	62.9	50.4	74	54	-11.1	-3.6	V
9.888	3.0	50.0	38.1	37.6	4.5	-36.1	0.0	0.8	56.9	45.0	74	54	-17.1	-9.0	V
12.360	3.0	48.5	37.0	38.5	5.6	-37.8	0.0	0.9	55.7	44.2	74	54	-18.3	-9.8	V, NOISE FLOOR
NO OTHER EMISSIONS WERE DETECTED AFTER 5TH HARMONIC															

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

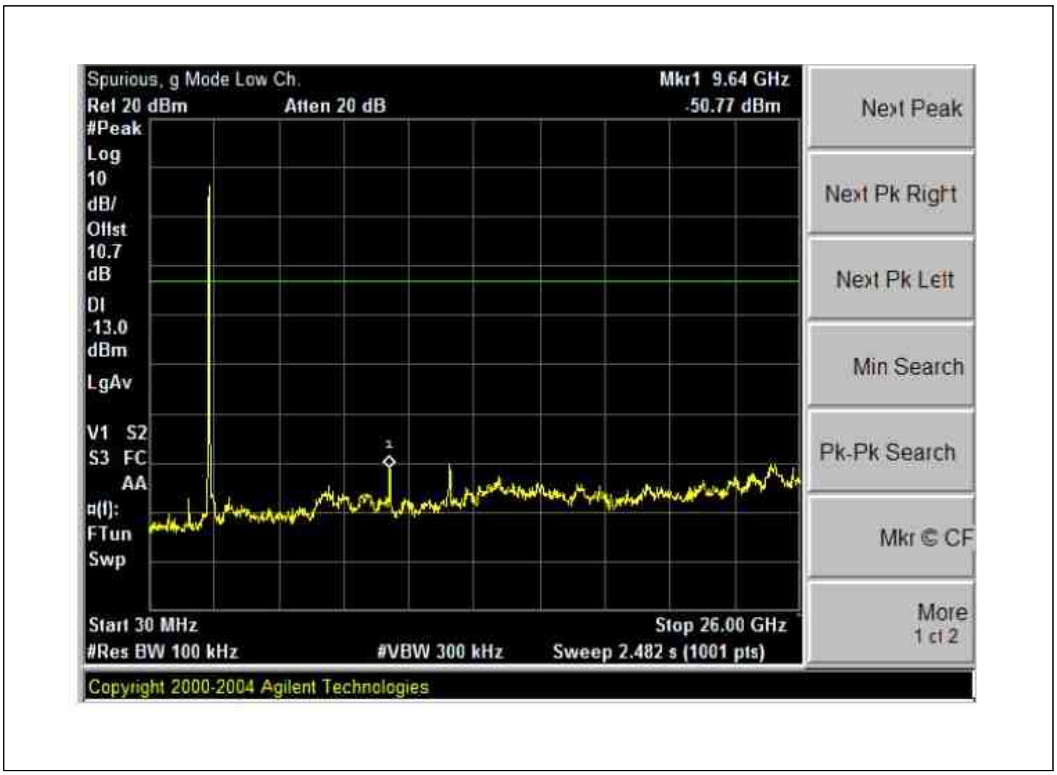
1. Margin (dB) = Limit − Emission Level
2. H = Horizontal, V = Vertical Polarization

Plot of the Band Edge

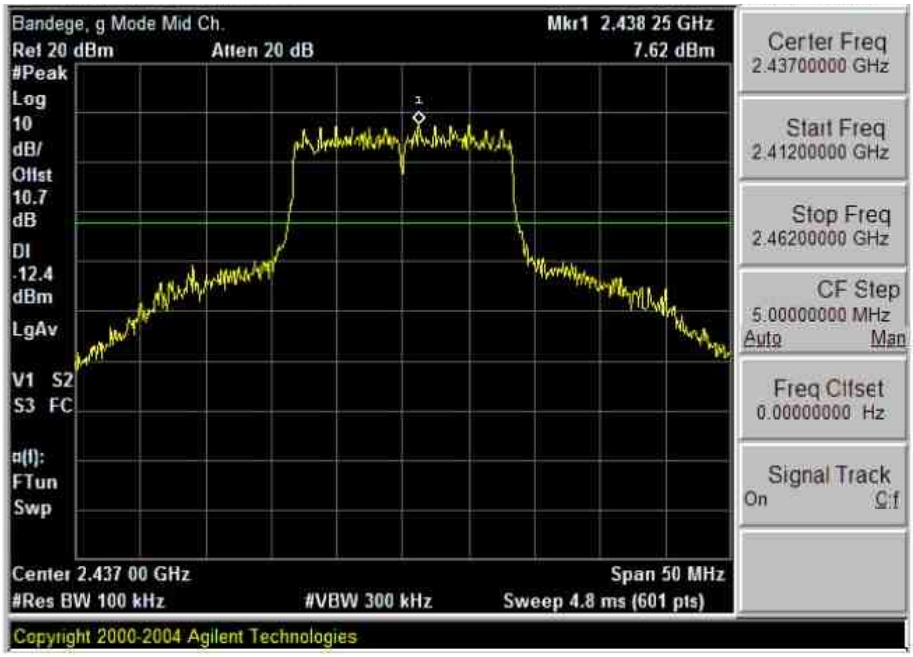
Low Channel (2412MHz)



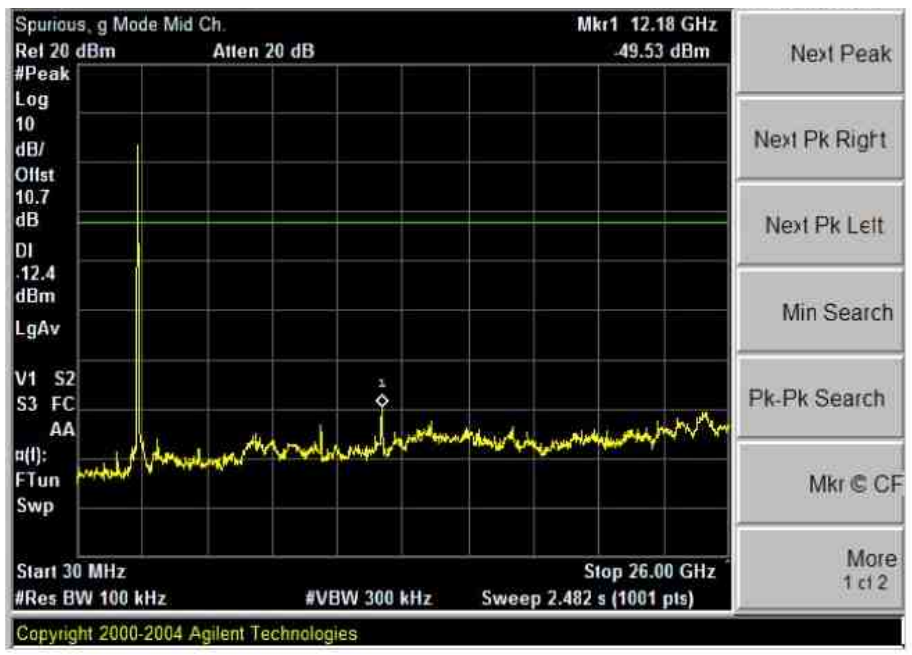
Low Channel (2412MHz)



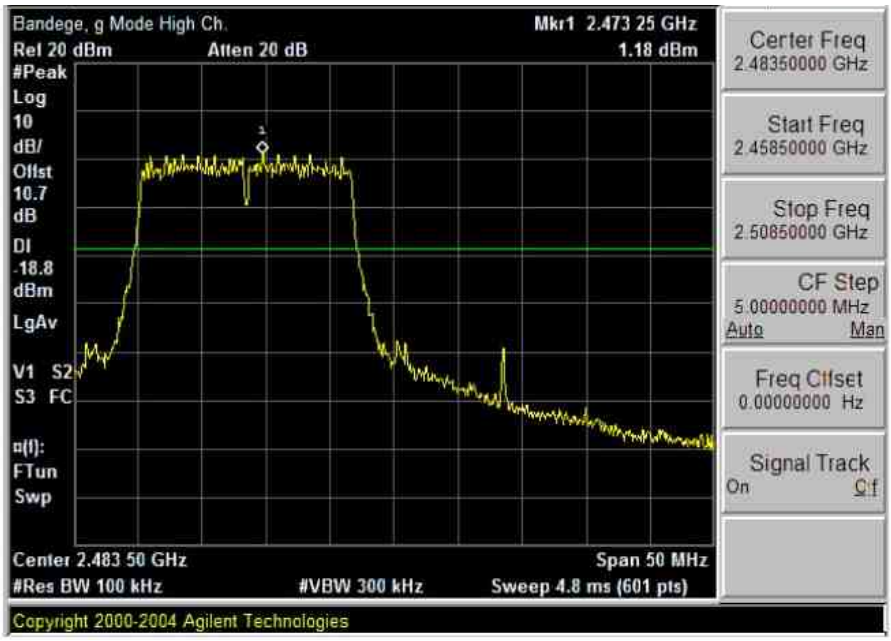
Middle Channel (2437 MHz)



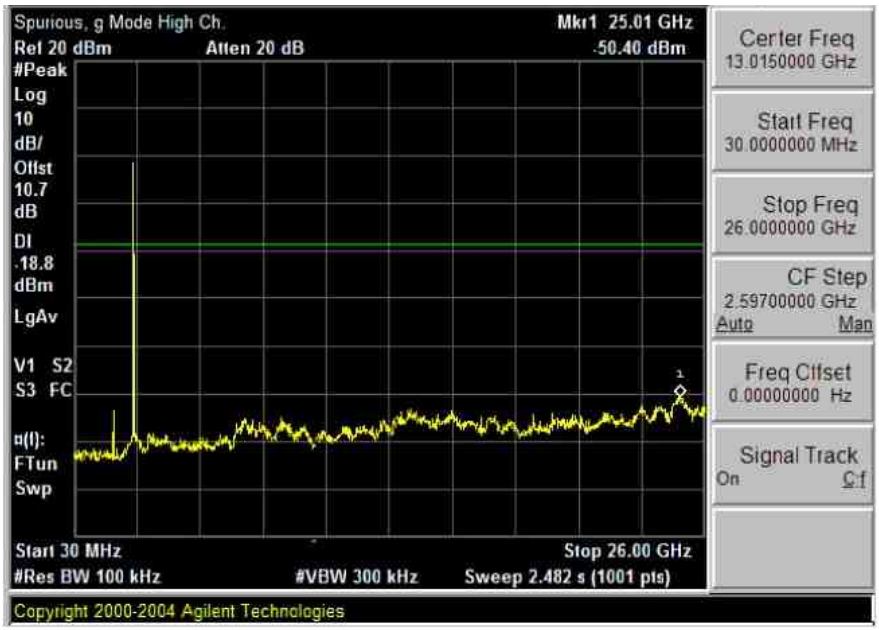
Middle Channel (2437 MHz)



High Channel (2472MHz)



High Channel (2472MHz)



5.3. 2.4 GHz BAND CHANNEL TESTS FOR 802.11n HT20 MODE

5.3.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

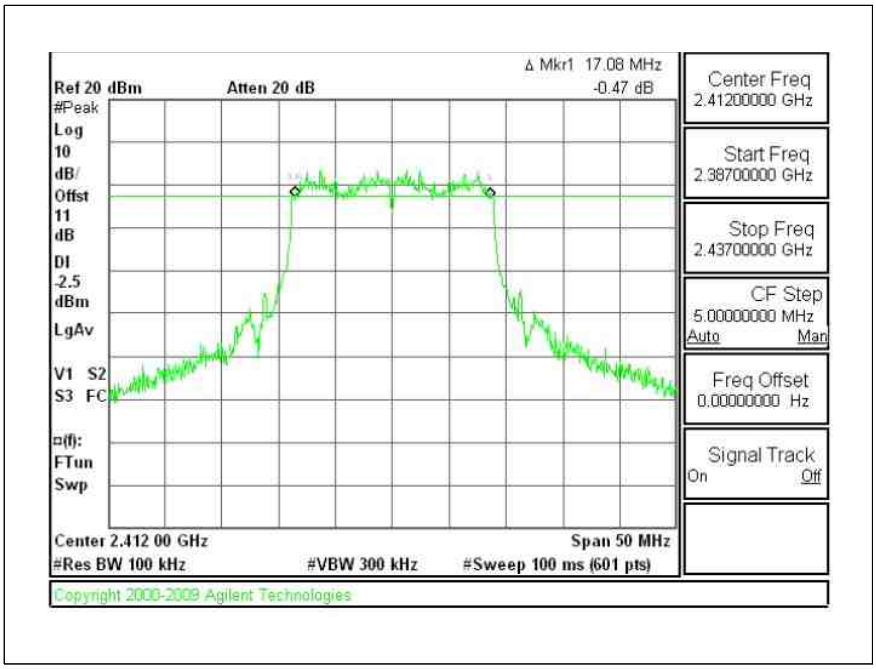
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

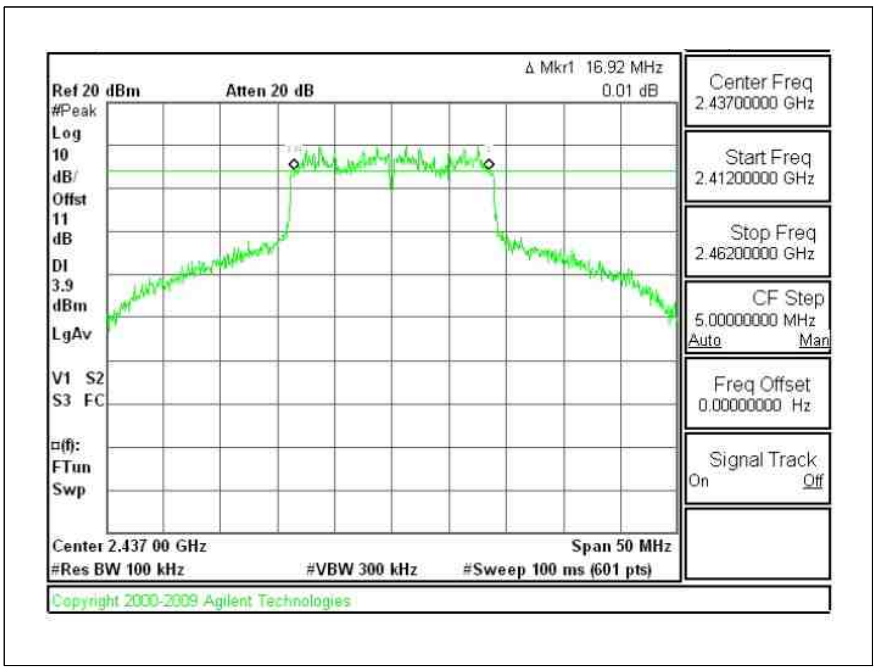
Channel	Frequency (MHz)	6 dB BW(MHz)	Verdict
Low	2412	17.08	Pass
Middle	2437	16.92	Pass
High	2472	17.25	Pass

Plot of the 6dB Channel Bandwidth

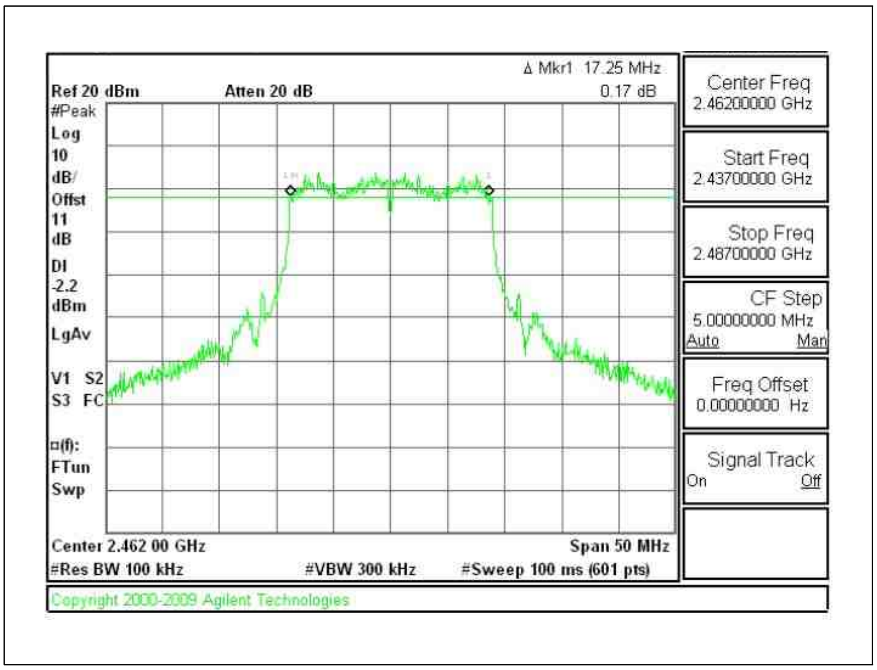
Low Channel (2412MHz)



Middle Channel (2437 MHz)



Highest Channel (2472MHz)



5.3.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

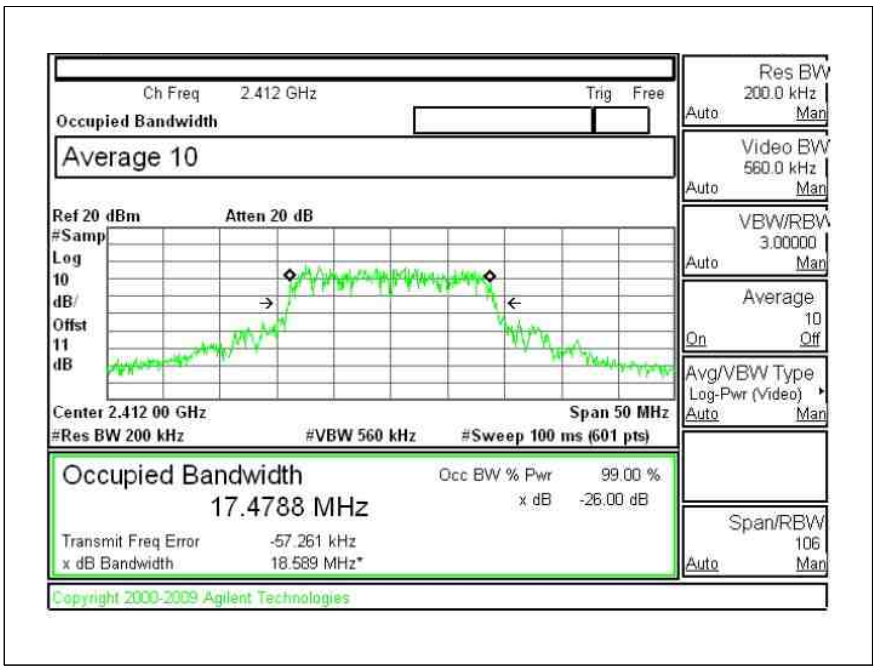
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth measurement function is utilized.

RESULTS

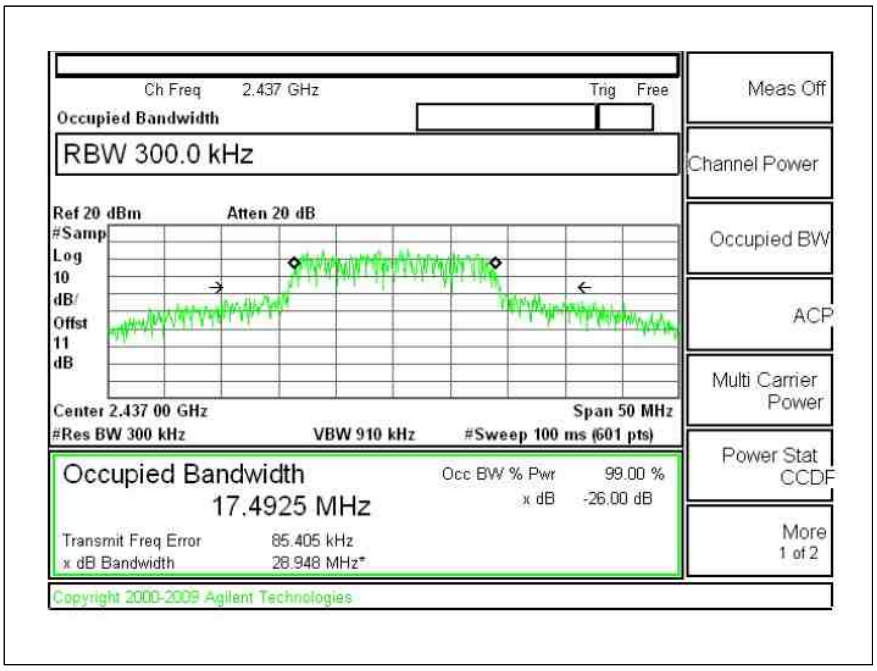
Channel	Frequency (MHz)	99% OBW (MHz)
Low	2412	17.48
Middle	2437	17.49
High	2472	17.43

Plot of the 99% Channel Bandwidth

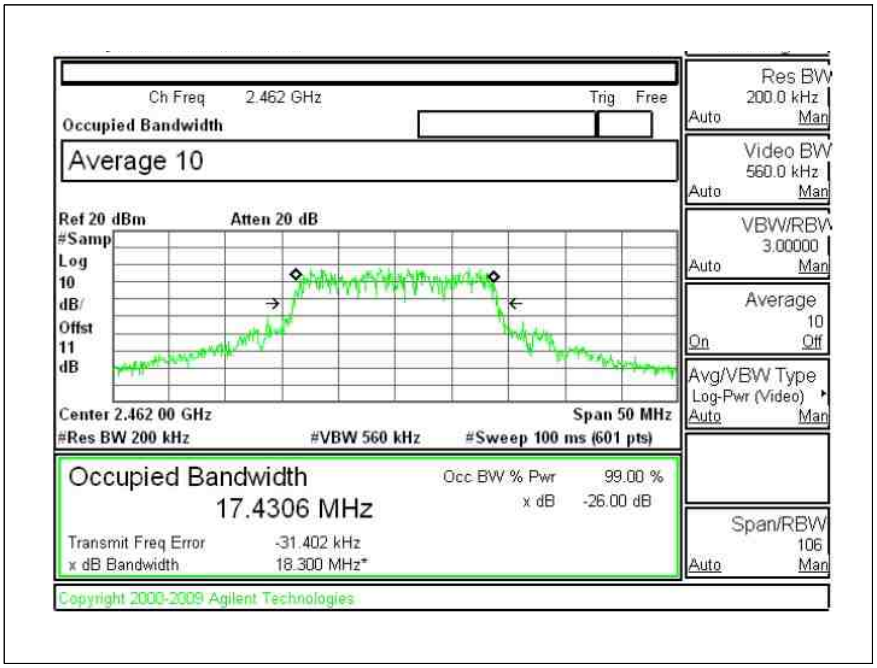
Low Channel (2412MHz)



Middle Channel (2437 MHz)



Highest Channel (2472 MHz)



5.3.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

TEST PROCEDURE

Output power was measured based on the use of RMS averaging over a time interval in accordance with FCC document ☐Measurement of Digital Transmission Systems Operating under Section 15.247☐, March 23, 2005.

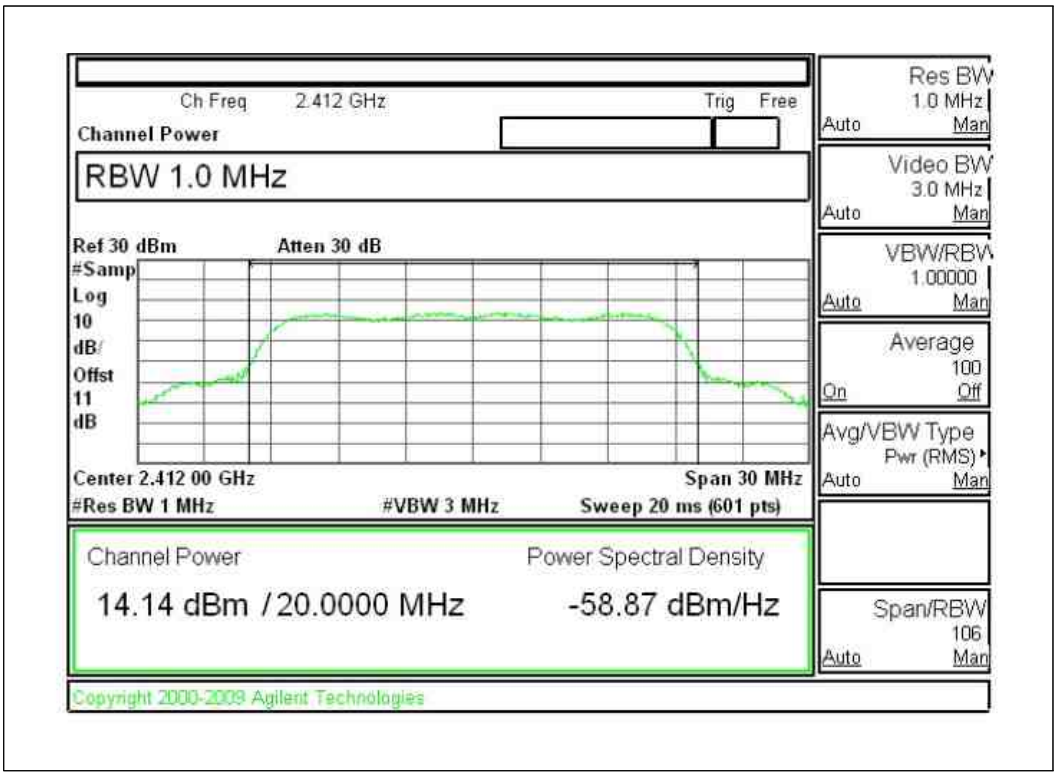
RESULTS : PASS

Table 2 : Measured values of the Maximum Peak Output Power(Conducted)

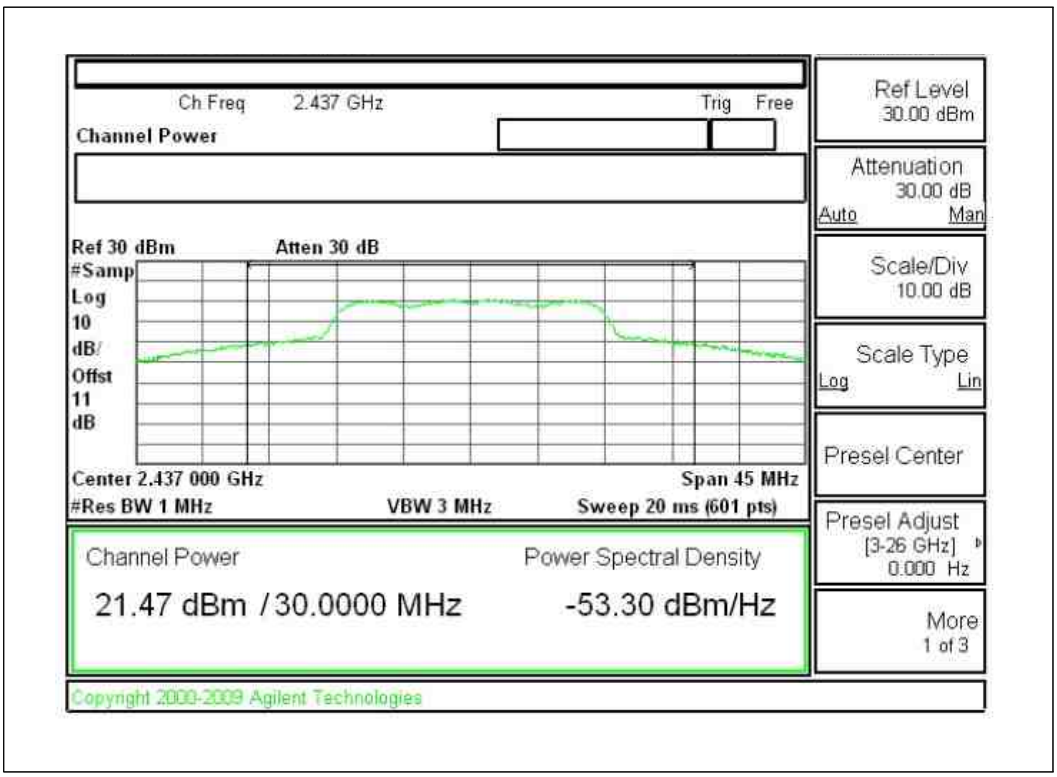
Mode	Frequency (MHz)	Reading Power (dBm)	Output Power (W)	Limit (W)	Verdict
802.11n HT20	2412	14.14	0.025	1	Pass
	2437	21.47	0.140	1	Pass
	2472	13.90	0.024	1	Pass

Plot of the Maximum Peak Output Power

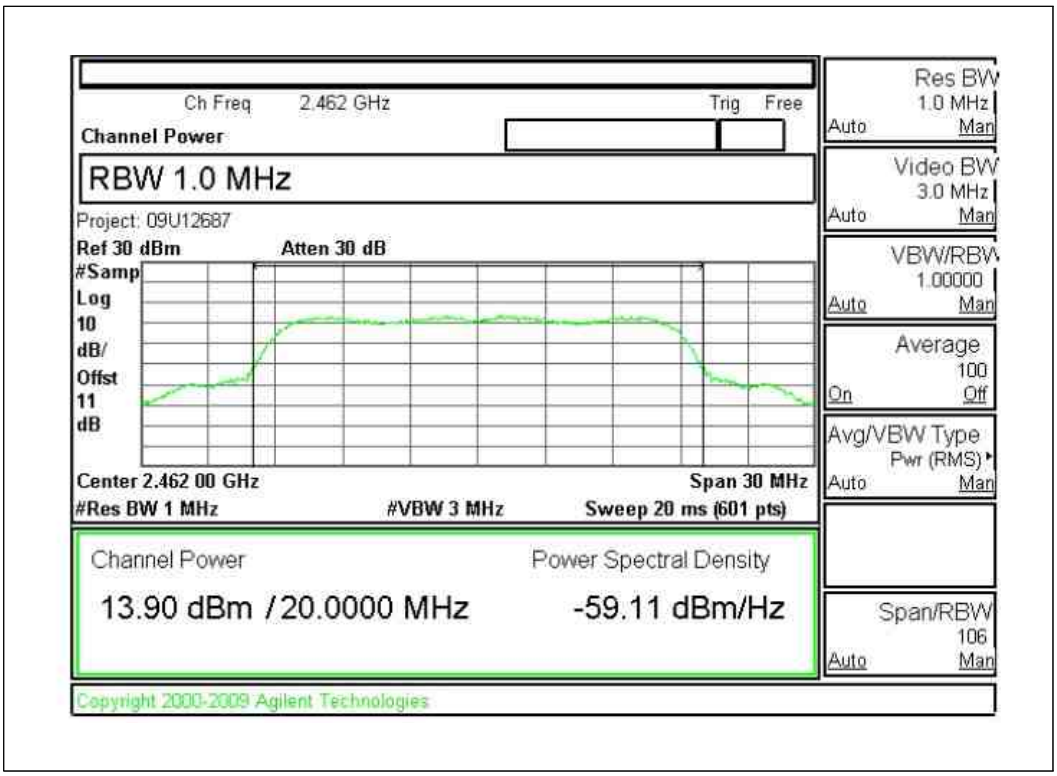
Low Channel (2412 MHz)



Middle Channel (2437 MHz)



Highest Channel (2472 MHz)



5.3.4. POWER SPECTRAL DENSITY

LIMITS

According to §15.247(e), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

TEST PROCEDURE

- Set Spectrum analyzer as RBW = 3 kHz, VBW = 9kHz,
- Record the max. reading

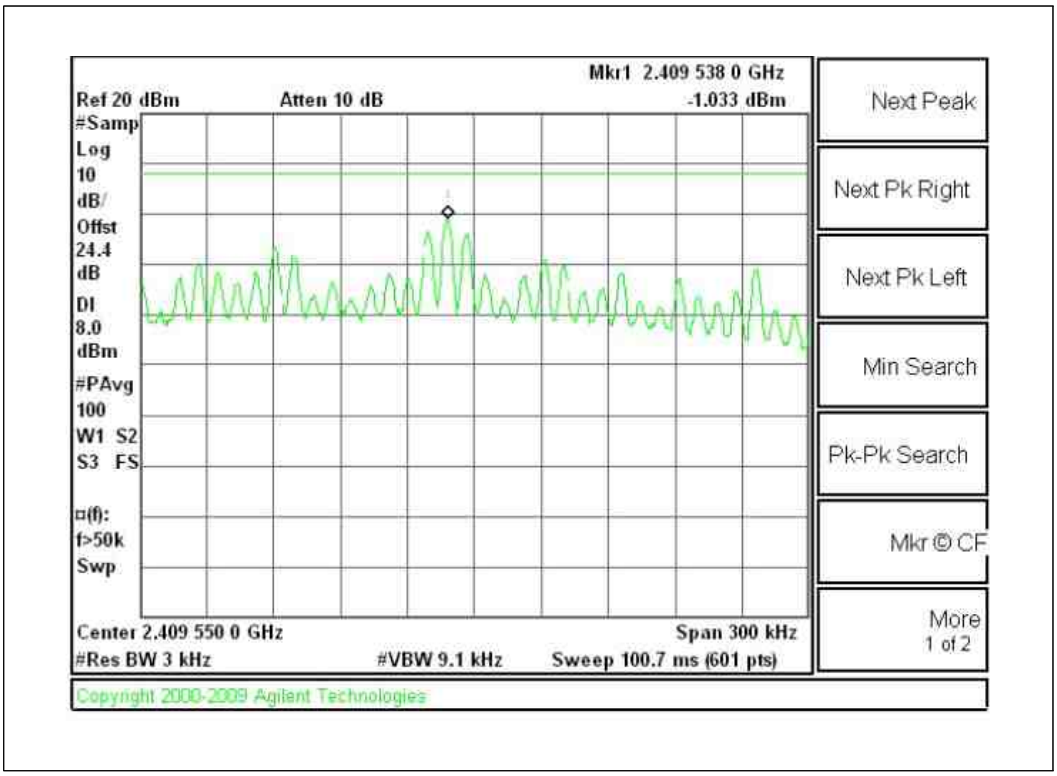
RESULTS : PASS

Table 3 : Measured values of the Power Spectral Density

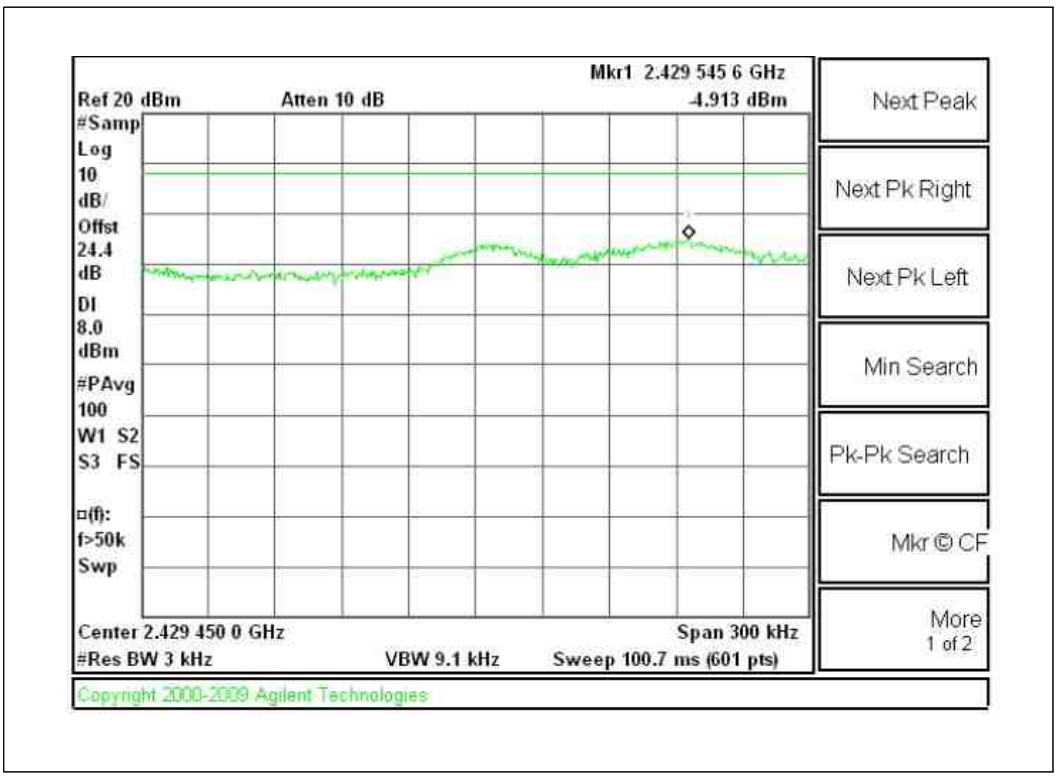
Mode	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Verdict
802.11n HT20	2412	-1.033	8	Pass
	2442	-4.913	8	Pass
	2472	-11.317	8	Pass

Plot of the Power Spectral Density

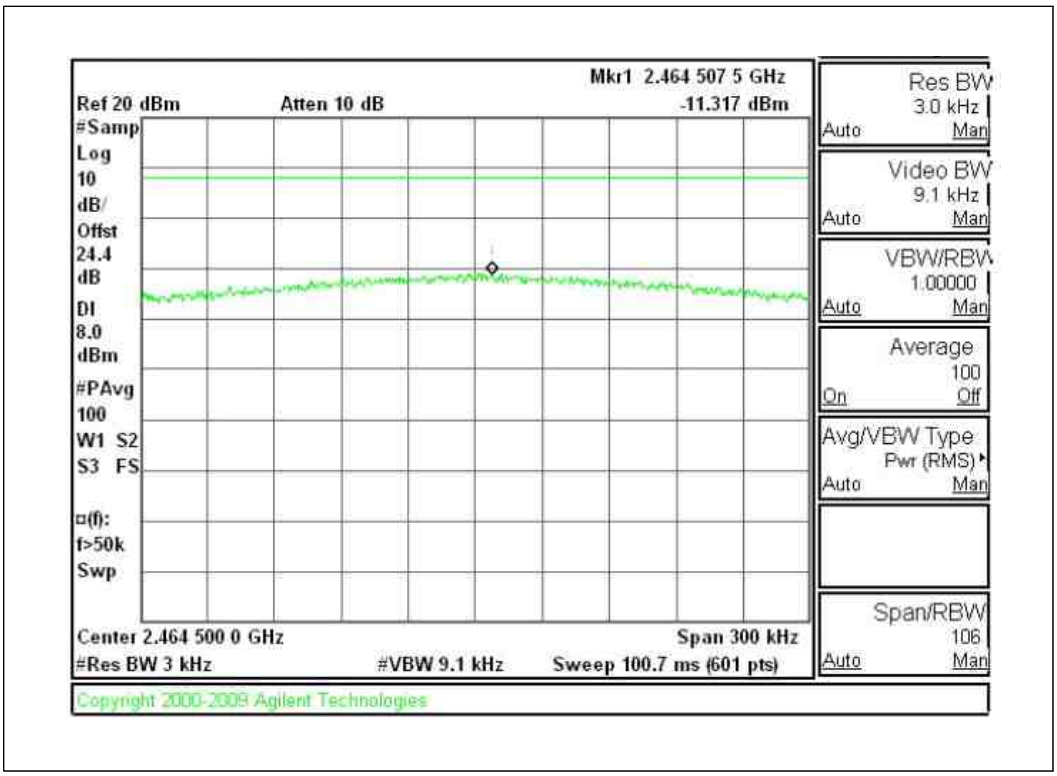
Low Channel (2412MHz)



Middle Channel (2437 MHz)



Highest Channel (2472 MHz)



5.3.5. SPURIOUS EMISSIONS, BAND EDGE, AND RESTRICTED BANDS

Regulation

According to §15.247(d), 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

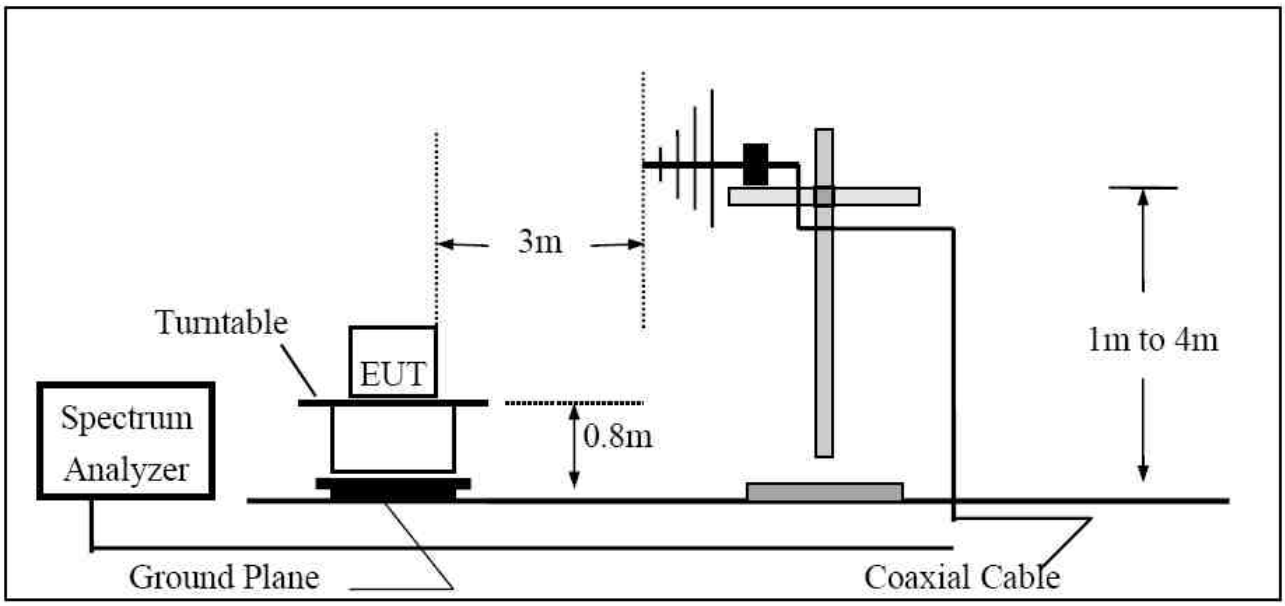
Frequency (MHz)	Field strength (μV/m @ 3m)	Field strength (dBμV/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

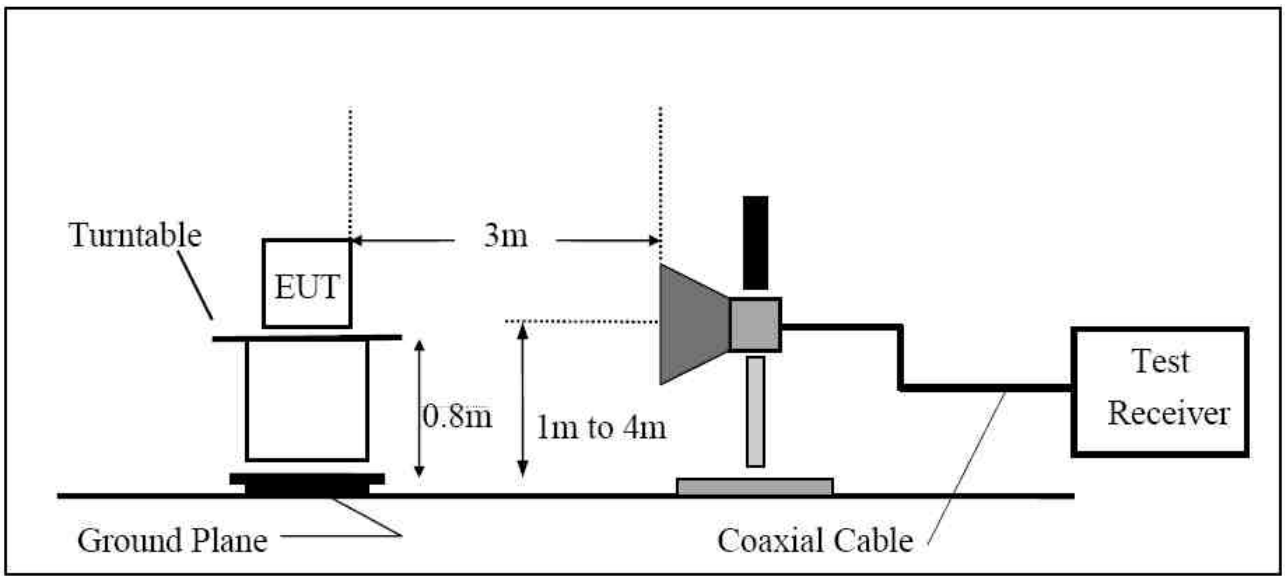
** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

Test Setup Layout

5.3.5.1 Radiated Emission Test Set-Up, Frequency Below 1000MHz



5.3.5.2 Radiated Emission Test Set-UP Frequency Over 1000MHz



Test Procedure

1) Band-edge Compliance of RF Conducted Emissions

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Spurious RF Conducted Emissions:

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters for above 30 MHz, and at 1 meter distance for below 30 MHz.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.

3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, from 30 to 1000 MHz using the Trilog broadband antenna, and from 1 GHz to tenth harmonic of the highest fundamental frequency using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The EUT is situated in three orthogonal planes (if appropriate)
7. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
8. If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative “marker-delta” method may be employed.

4) Marker-Delta Method at the edge of the authorized band of operation:

1. Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function as the above Spurious Radiated Emissions test procedure.
2. Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.
3. Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.
4. The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two “standard” bandwidths must be measured as the above Spurious Radiated Emissions test procedure.

Test Results: **PASS**

Band-edge compliance of RF conducted/radiated emissions was shown in the Figure 7 and Figure 8

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

Spurious RF conducted emissions were shown in the Figure 9

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

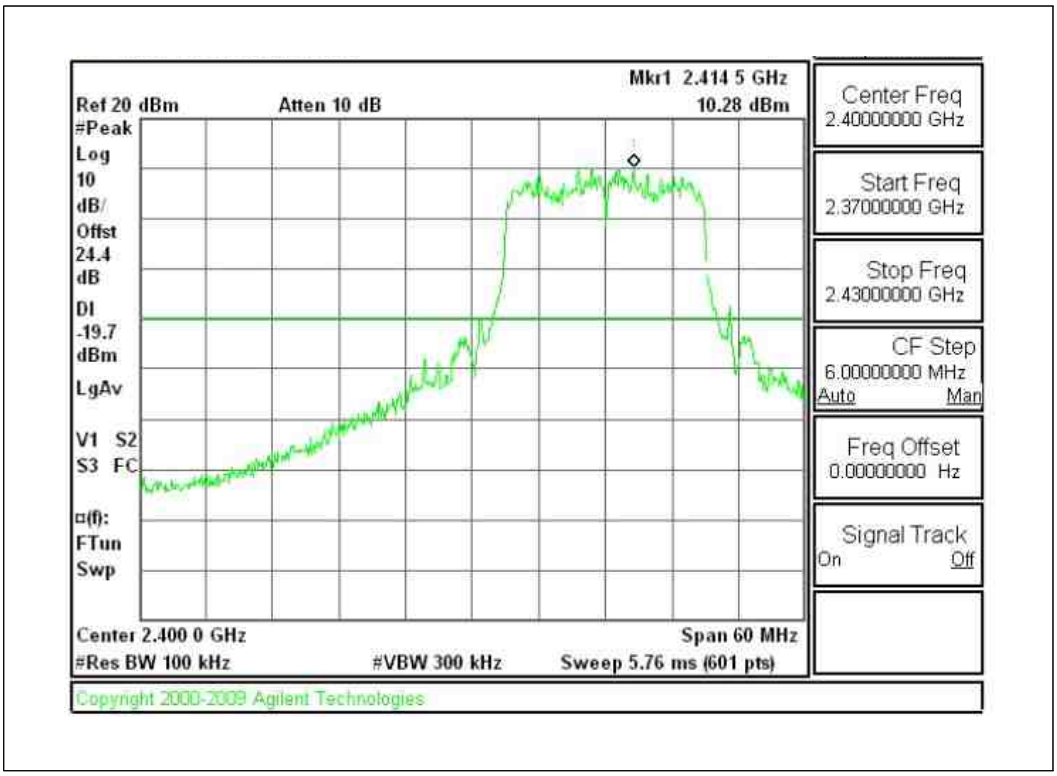
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
Low Ch. 2412 MHz															
4.824	3.0	39.9	33.0	5.8	-36.5	0.0	0.0	42.2	74.0	-31.8	V	P	110.6	315.3	
4.824	3.0	28.0	33.0	5.8	-36.5	0.0	0.0	30.3	54.0	-23.7	V	A	110.6	315.3	
4.824	3.0	38.5	33.0	5.8	-36.5	0.0	0.0	40.9	74.0	-33.1	H	P	156.0	158.7	
4.824	3.0	26.4	33.0	5.8	-36.5	0.0	0.0	28.8	54.0	-25.2	H	A	156.0	158.7	
Mid Ch. 2437 MHz															
4.874	3.0	51.4	33.1	5.8	-36.5	0.0	0.0	53.9	74.0	-20.1	V	P	103.7	170.9	
4.874	3.0	36.9	33.1	5.8	-36.5	0.0	0.0	39.3	54.0	-14.7	V	A	103.7	170.9	
4.874	3.0	40.6	33.1	5.8	-36.5	0.0	0.0	43.0	74.0	-31.0	H	P	102.4	48.0	
4.874	3.0	28.3	33.1	5.8	-36.5	0.0	0.0	30.8	54.0	-23.2	H	A	102.4	48.0	
7.311	3.0	48.6	35.3	7.3	-36.2	0.0	0.0	55.0	74.0	-19.0	V	P	122.2	351.5	
7.311	3.0	35.0	35.3	7.3	-36.2	0.0	0.0	41.3	54.0	-12.7	V	A	122.2	351.5	
7.311	3.0	43.9	35.3	7.3	-36.2	0.0	0.0	50.2	74.0	-23.8	H	P	109.1	49.5	
7.311	3.0	28.7	35.3	7.3	-36.2	0.0	0.0	35.0	54.0	-19.0	H	A	109.1	49.5	
High Ch. 2462 MHz															
4.924	3.0	42.4	33.1	5.9	-36.5	0.0	0.0	44.9	74.0	-29.1	V	P	124.3	121.9	
4.924	3.0	29.9	33.1	5.9	-36.5	0.0	0.0	32.5	54.0	-21.5	V	A	124.3	121.9	
4.924	3.0	38.6	33.1	5.9	-36.5	0.0	0.0	41.1	74.0	-32.9	H	P	109.9	88.6	
4.924	3.0	26.3	33.1	5.9	-36.5	0.0	0.0	28.9	54.0	-25.1	H	A	109.9	88.6	
7.386	3.0	39.5	35.4	7.3	-36.2	0.0	0.0	46.0	74.0	-28.0	V	P	102.3	232.9	
7.386	3.0	27.5	35.4	7.3	-36.2	0.0	0.0	34.0	54.0	-20.0	V	A	102.3	232.9	
7.386	3.0	37.4	35.4	7.3	-36.2	0.0	0.0	43.9	74.0	-30.1	H	P	187.9	175.7	
7.386	3.0	25.1	35.4	7.3	-36.2	0.0	0.0	31.6	54.0	-22.4	H	A	187.9	175.7	

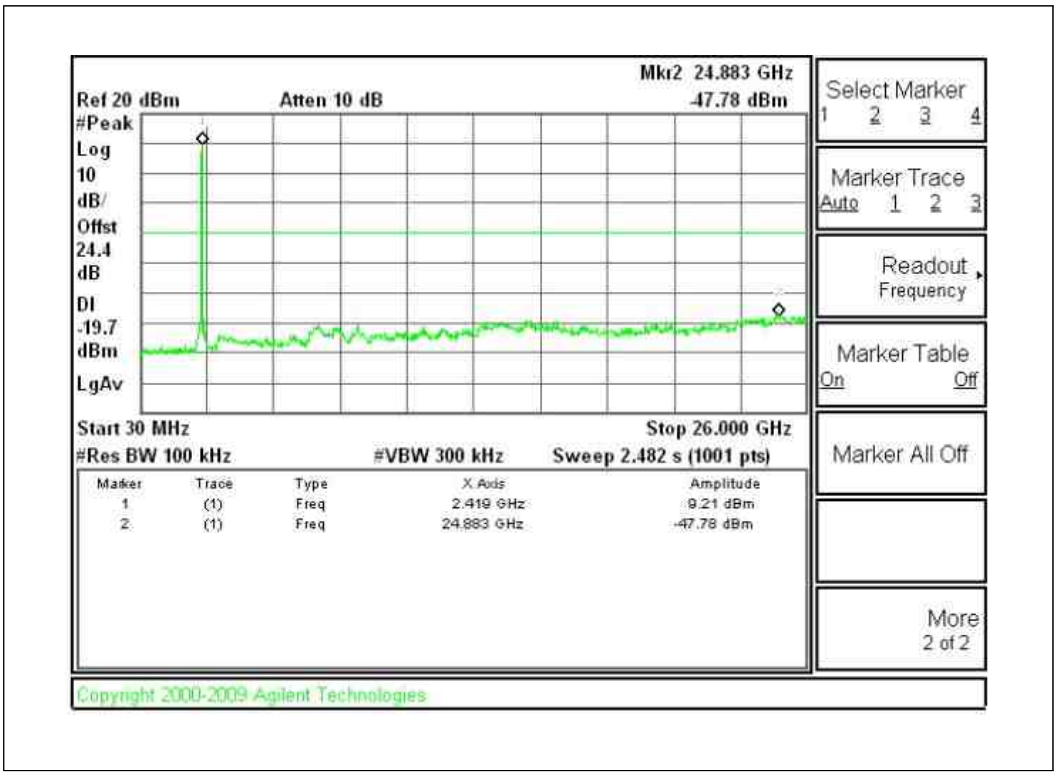
1. Margin (dB) = Limit − Emission Level
2. H = Horizontal, V = Vertical Polarization

Plot of the Band Edge

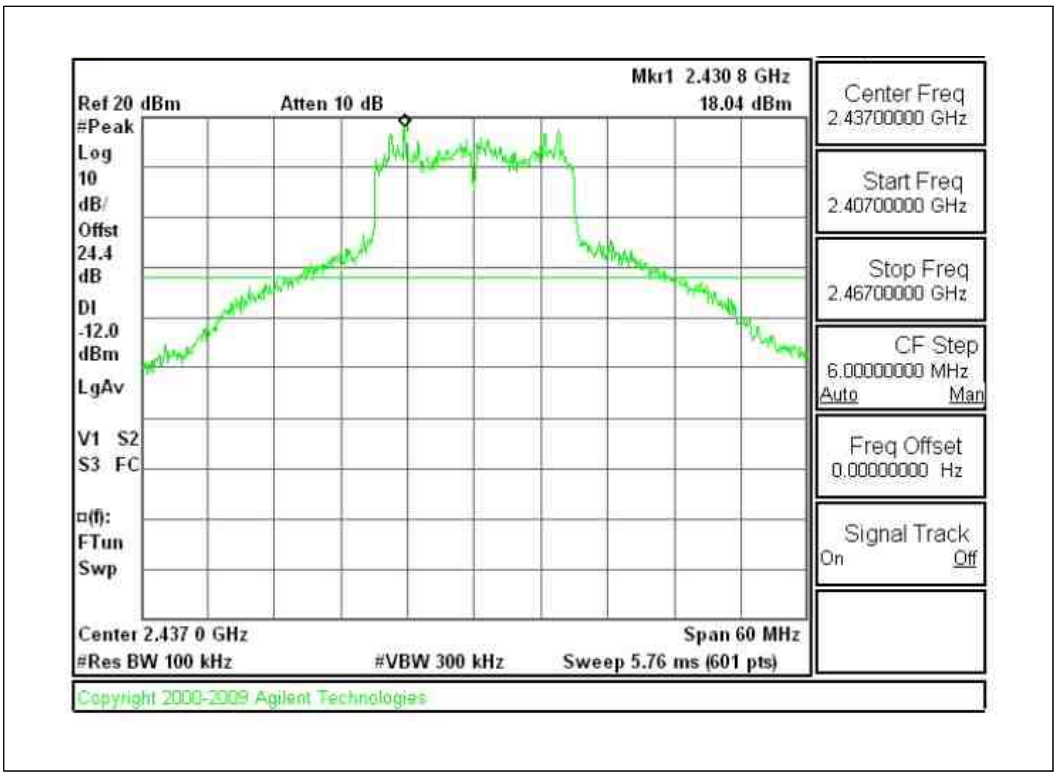
Low Channel (2412MHz)



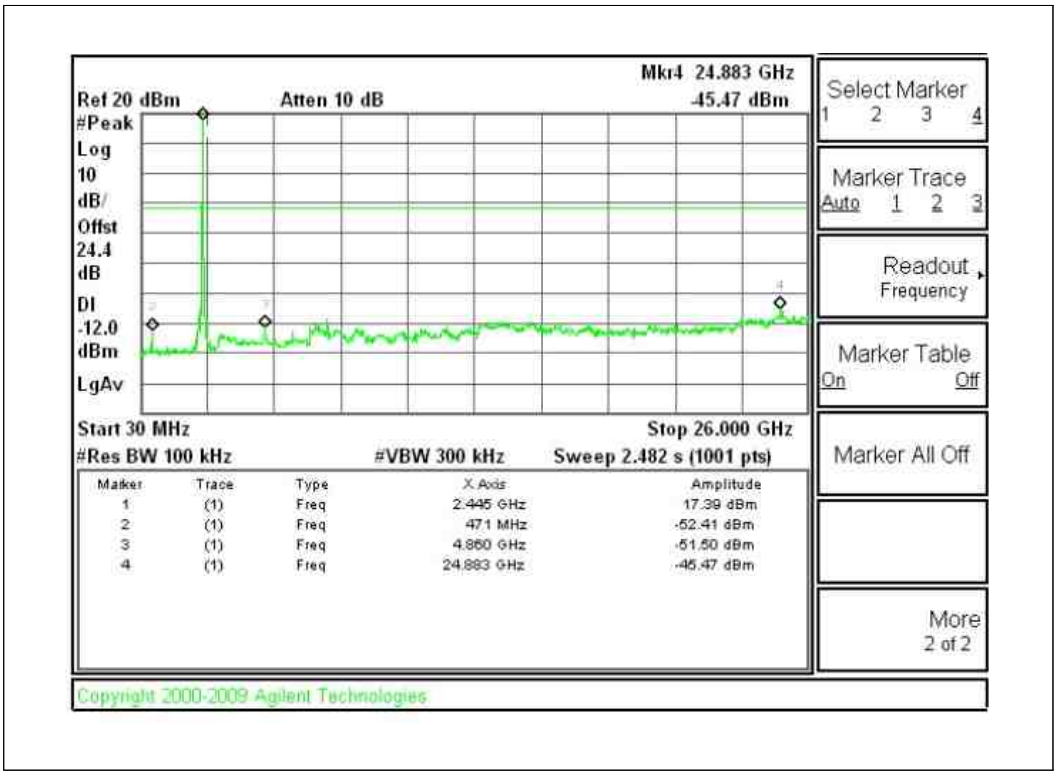
Low Channel (2412MHz)



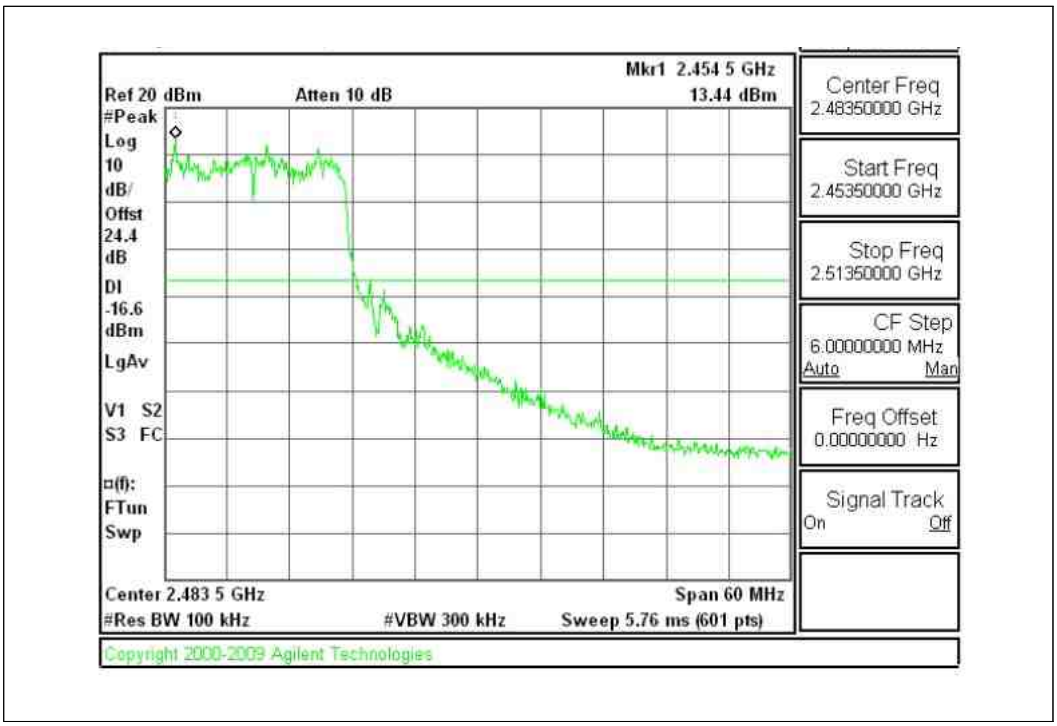
Middle Channel (2437 MHz)



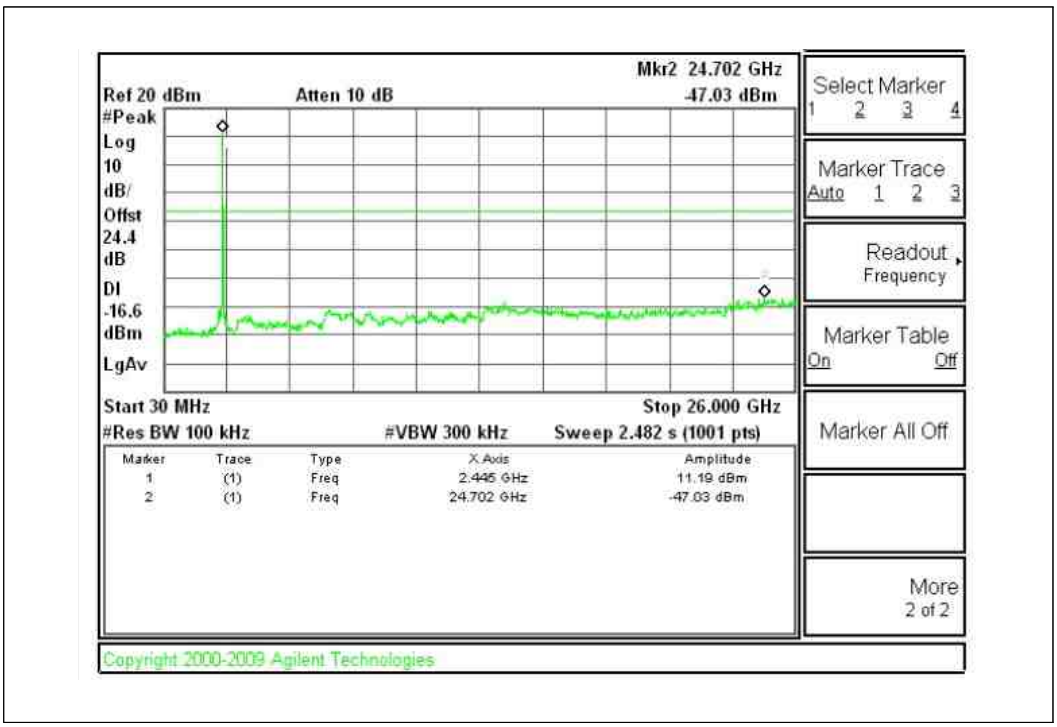
Middle Channel (2437 MHz)



High Channel (2472MHz)



High Channel (2472MHz)



5.4. 2.4 GHz BAND CHANNEL TESTS FOR 802.11n HT40 MODE

5.4.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

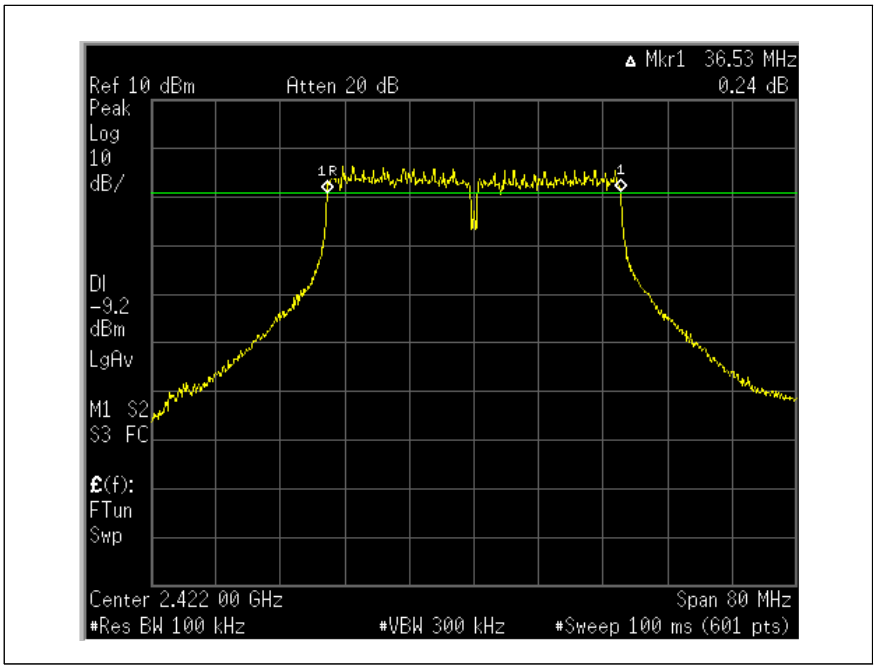
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

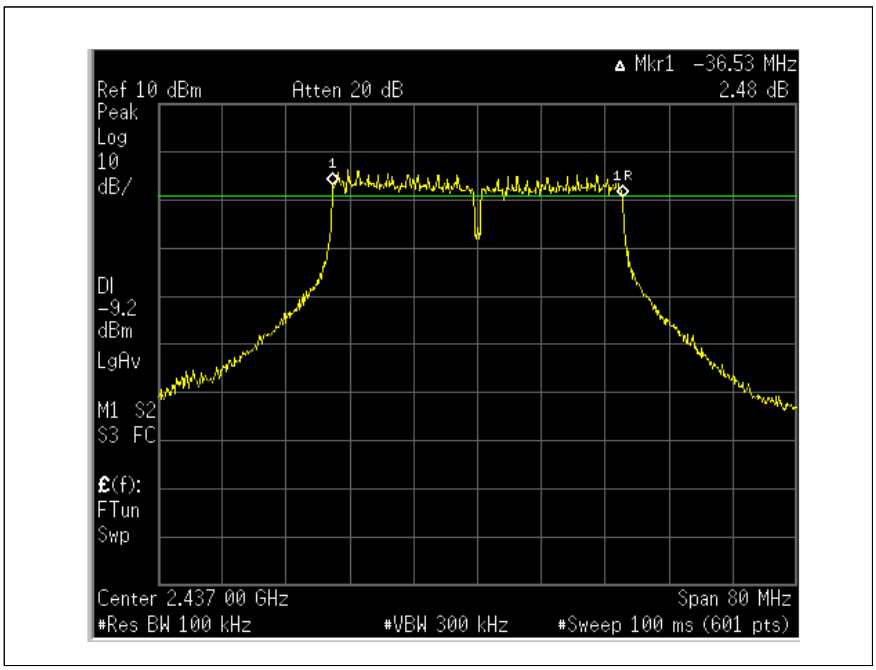
Channel	Frequency (MHz)	6 dB BW(MHz)	Verdict
Low	2422	36.53	Pass
Middle	2437	36.53	Pass
High	2462	36.40	Pass

Plot of the 6dB Channel Bandwidth

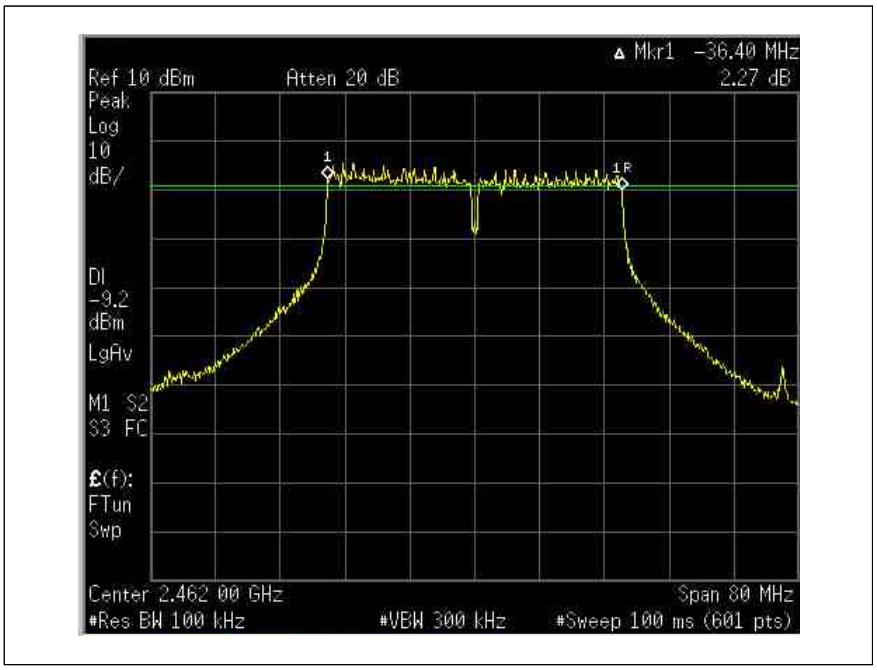
Low Channel (2422 MHz)



Middle Channel (24437MHz)



Highest Channel (2462MHz)



5.4.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

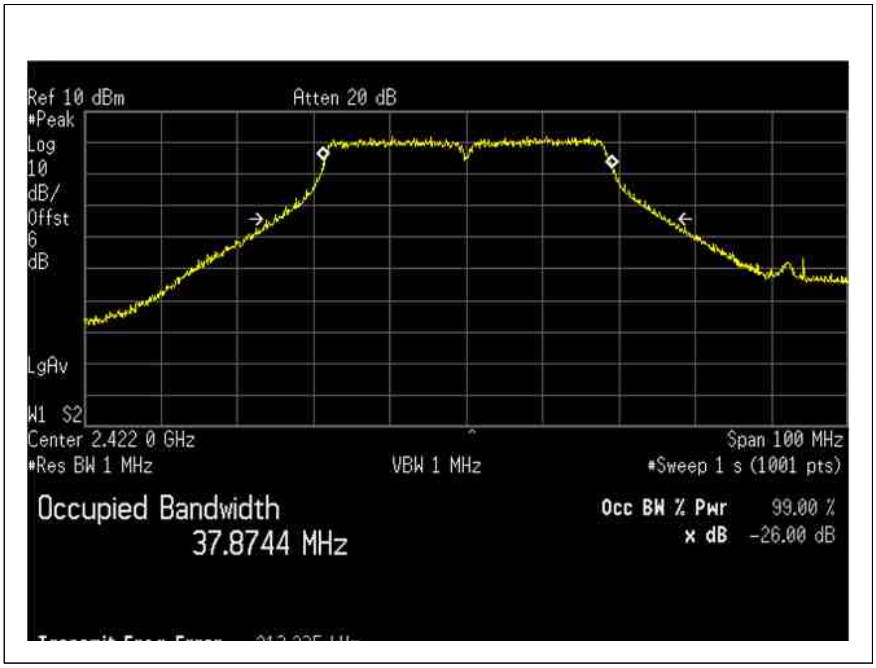
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth measurement function is utilized.

RESULTS

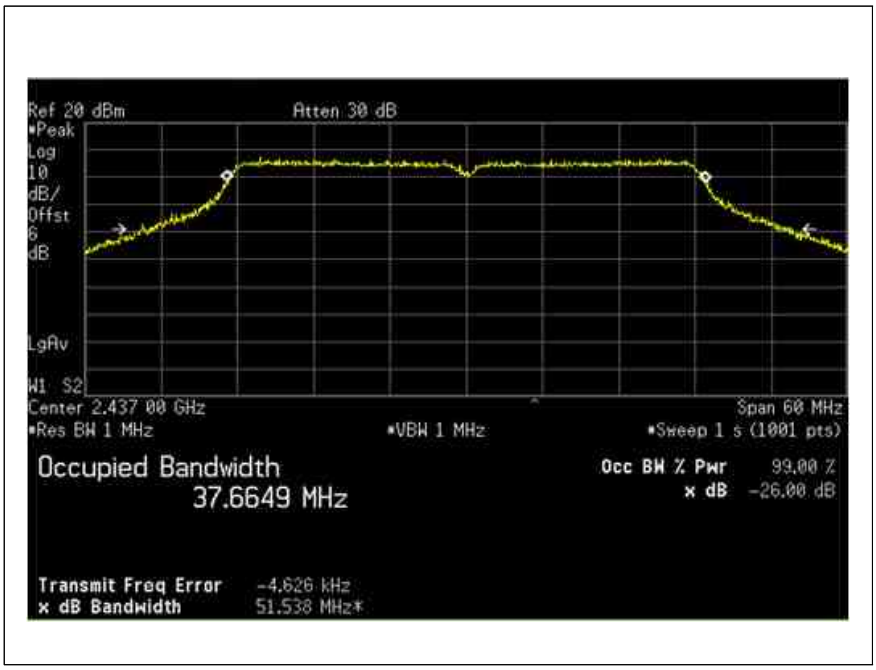
Channel	Frequency (MHz)	99% OBW (MHz)
Low	2422	37.87
Middle	2437	37.66
High	2462	37.67

Plot of the 99% Channel Bandwidth

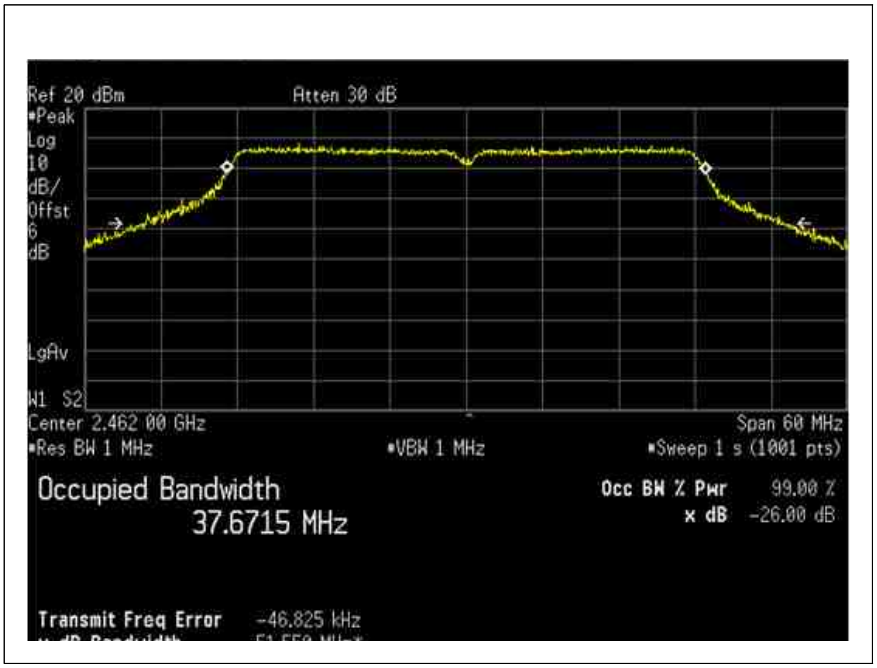
Low Channel (2422MHz)



Middle Channel (2437 MHz)



Highest Channel (2462 MHz)



5.4.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

TEST PROCEDURE

Output power was measured based on the use of RMS averaging over a time interval in accordance with FCC document ☐Measurement of Digital Transmission Systems Operating under Section 15.247☐, March 23, 2005.

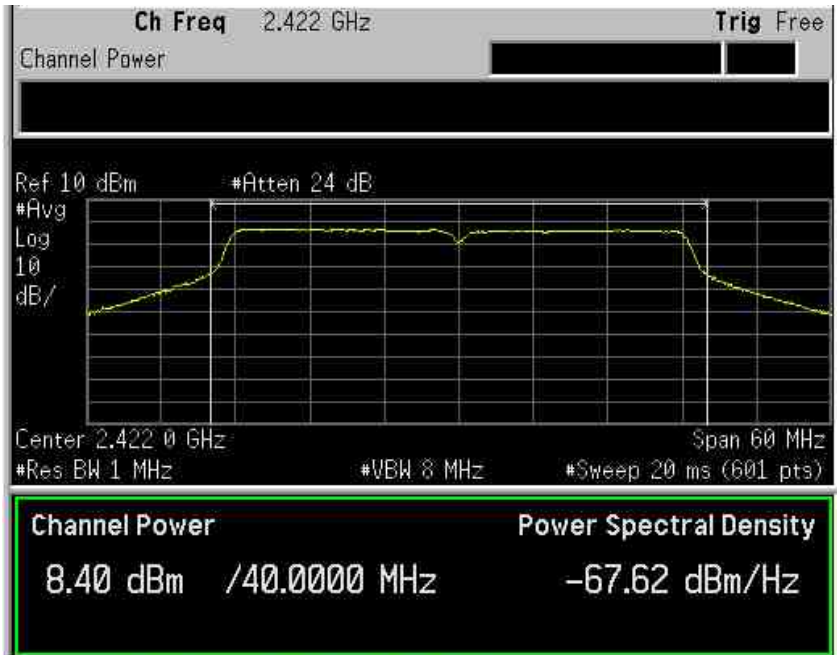
RESULTS : PASS

Table 2 : Measured values of the Maximum Peak Output Power(Conducted)

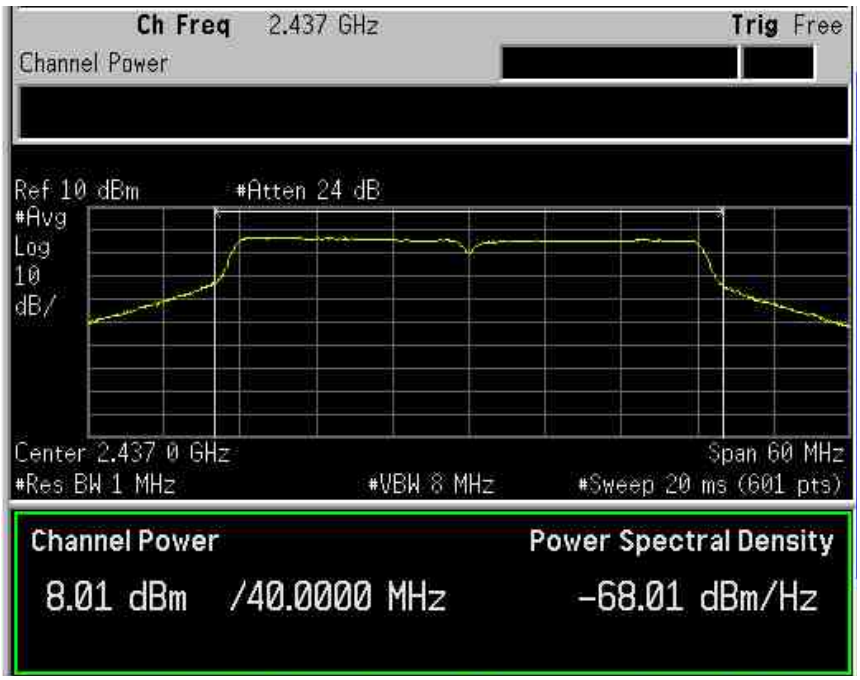
Mode	Frequency (MHz)	Reading Power (dBm)	Output Power (W)	Limit (W)	Verdict
802.11n HT40	2422	8.40	0.007	1	Pass
	2437	8.01	0.006	1	Pass
	2462	7.03	0.005	1	Pass

Plot of the Maximum Peak Output Power

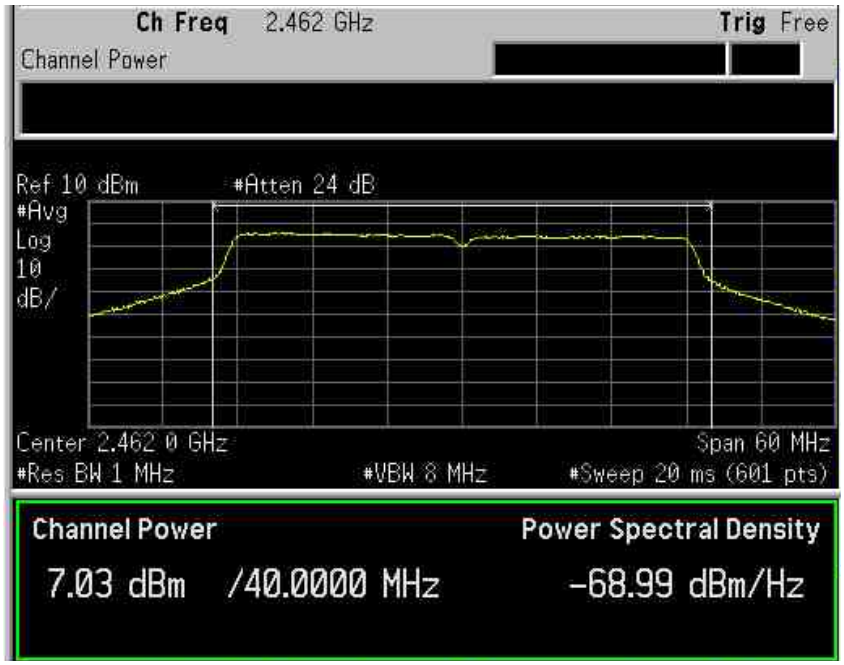
Low Channel (2422 MHz)



Middle Channel (2437 MHz)



Highest Channel (2462MHz)



5.4.4. POWER SPECTRAL DENSITY

LIMITS

According to §15.247(e), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

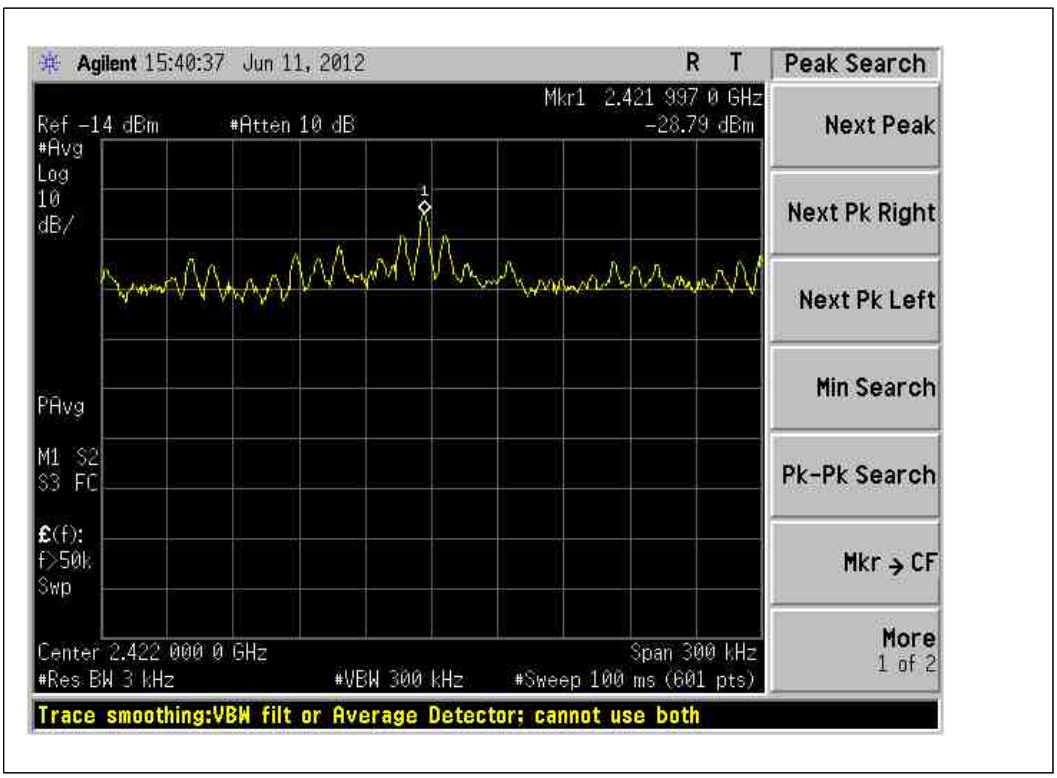
TEST PROCEDURE

- Set Spectrum analyzer as RBW = 3 kHz, VBW = 300kHz,
- Record the max. reading

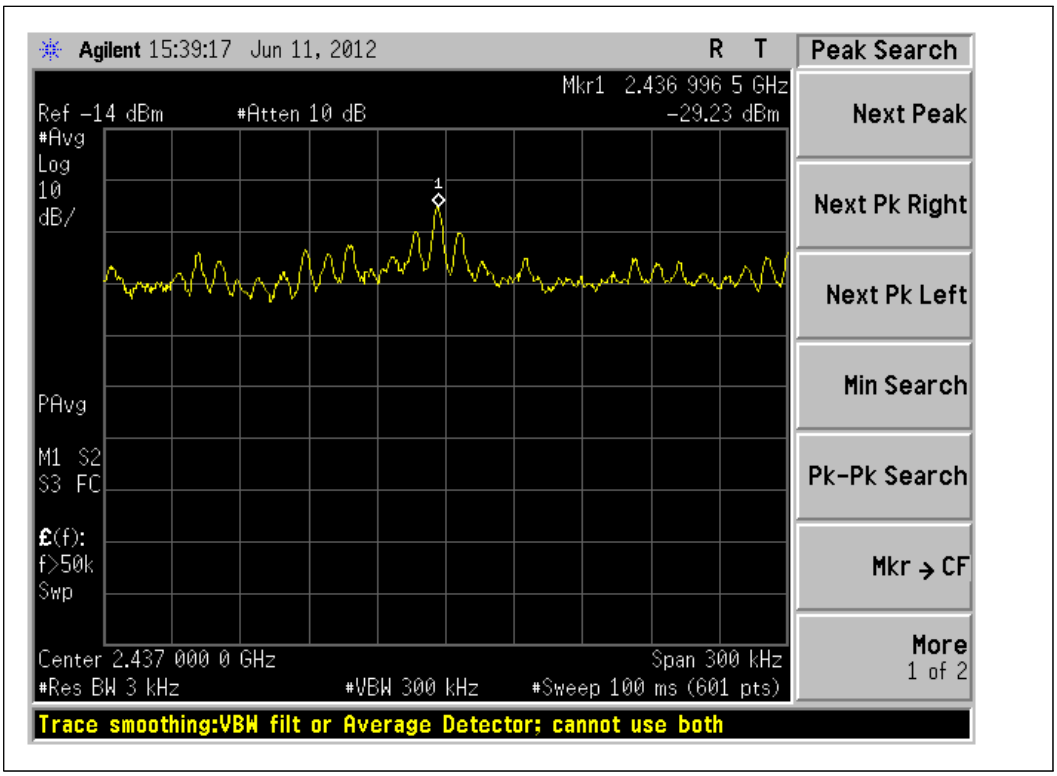
RESULTS : PASS

Table 3 : Measured values of the Power Spectral Density				
Mode	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Verdict
802.11n HT40	2422	-28.79	8	Pass
	2437	-29.23	8	Pass
	2462	-23.31	8	Pass

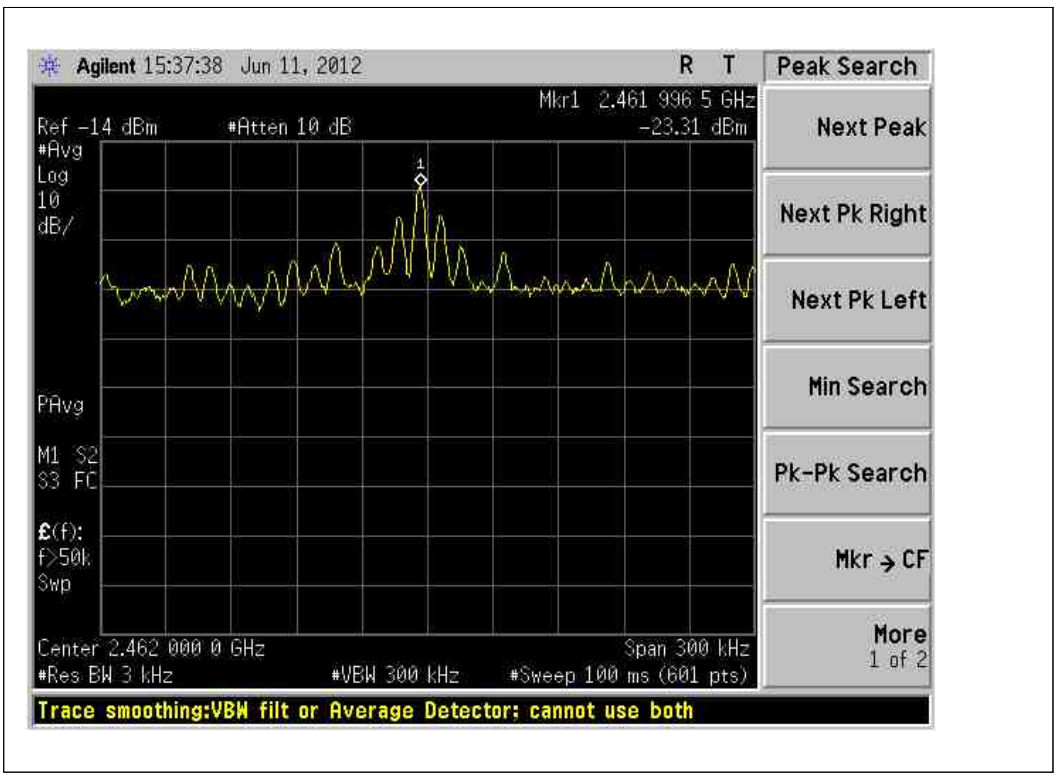
Low Channel (2422 MHz)



Middle Channel (2437MHz)



Highest Channel (2462 MHz)



5.4.5. SPURIOUS EMISSIONS, BAND EDGE, AND RESTRICTED BANDS

Regulation

According to §15.247(d), 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

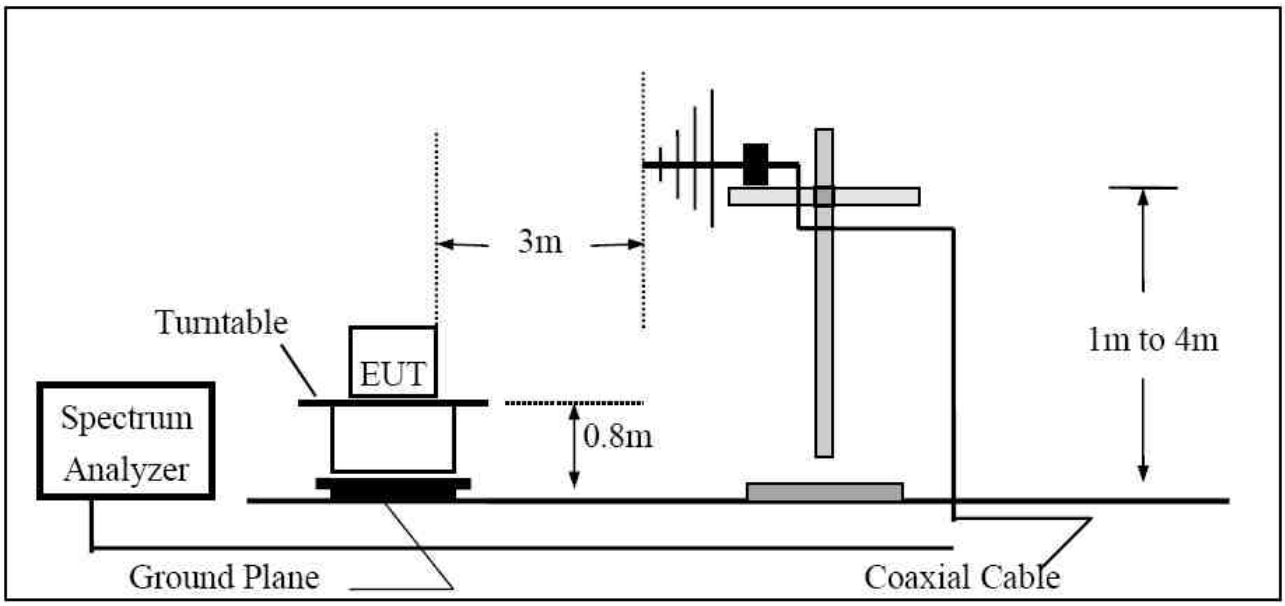
Frequency (MHz)	Field strength (μV/m @ 3m)	Field strength (dBμV/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

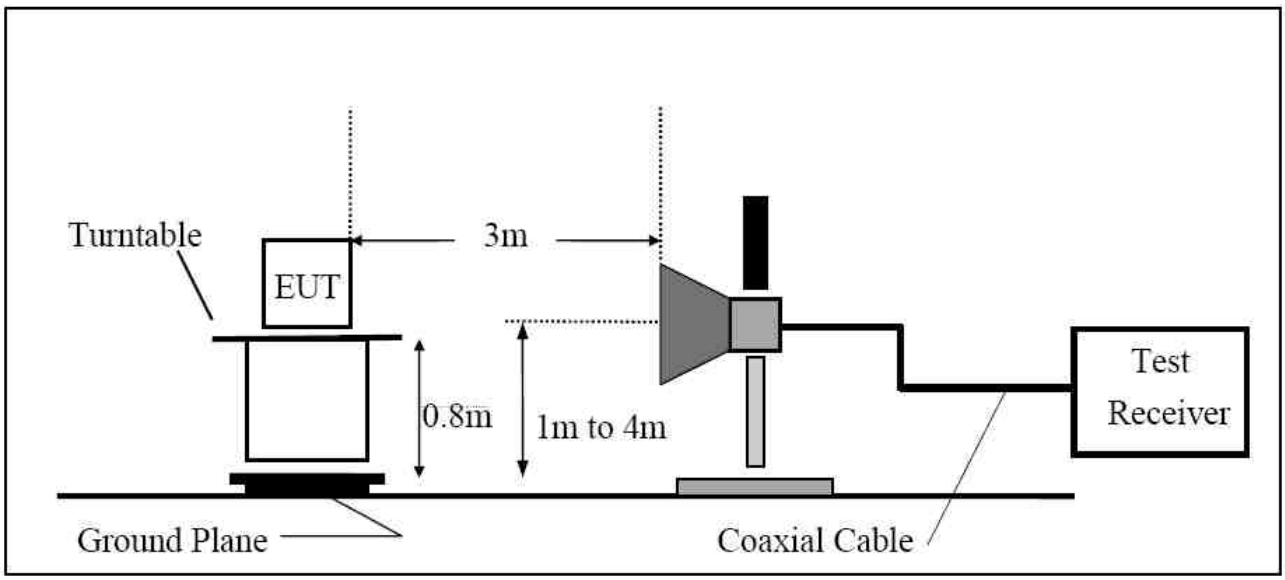
** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

Test Setup Layout

5.3.5.1 Radiated Emission Test Set-Up, Frequency Below 1000MHz



5.4.5.2 Radiated Emission Test Set-UP Frequency Over 1000MHz



Test Procedure

1) Band-edge Compliance of RF Conducted Emissions

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Spurious RF Conducted Emissions:

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters for above 30 MHz, and at 1 meter distance for below 30 MHz.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.

3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, from 30 to 1000 MHz using the Trilog broadband antenna, and from 1 GHz to tenth harmonic of the highest fundamental frequency using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The EUT is situated in three orthogonal planes (if appropriate)
7. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
8. If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative “marker-delta” method may be employed.

4) Marker-Delta Method at the edge of the authorized band of operation:

1. Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function as the above Spurious Radiated Emissions test procedure.
2. Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.
3. Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.
4. The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two “standard” bandwidths must be measured as the above Spurious Radiated Emissions test procedure.

Test Results: **PASS**

Band-edge compliance of RF conducted/radiated emissions was shown in the Figure 7 and Figure 8

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

Spurious RF conducted emissions were shown in the Figure 9

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

f	Measurement Frequency	Amp	Preamp Gain
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m
AF	Antenna Factor	Peak	Calculated Peak Field Strength
CL	Cable Loss	HPF	High Pass Filter

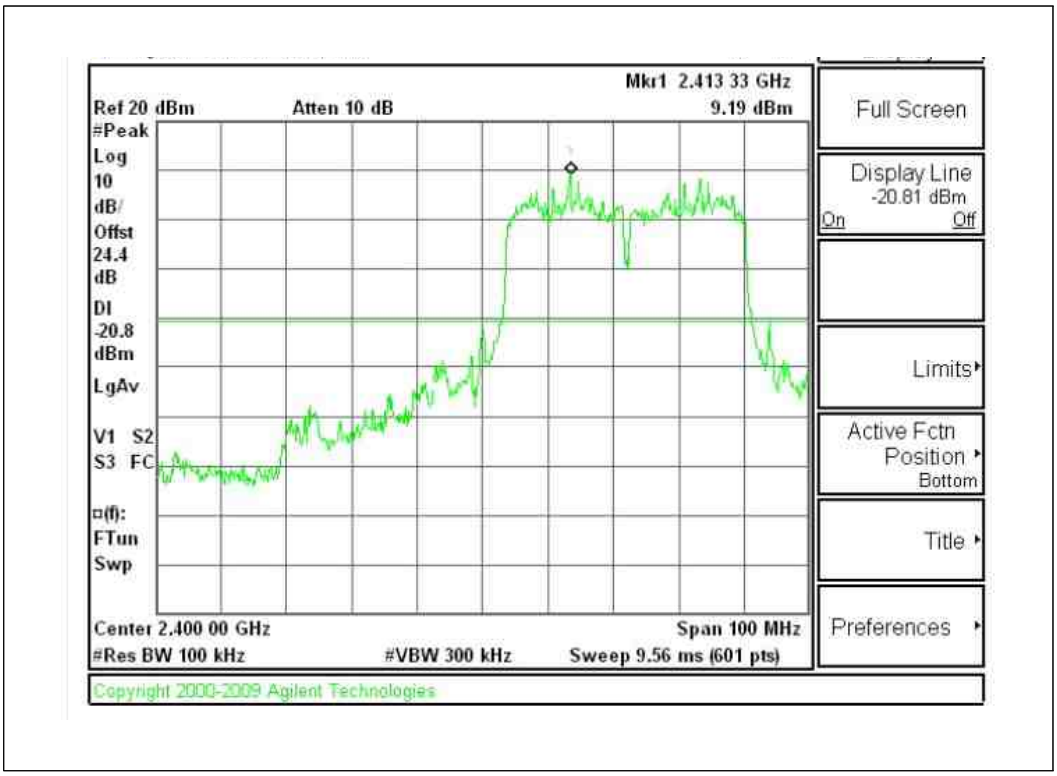
Average Field Strength Limit
Peak Field Strength Limit
Margin vs. Average Limit
Margin vs. Peak Limit

f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
Low Ch. 2422 MHz															
4.844	3.0	41.3	33.1	5.8	36.5	0.0	0.0	43.8	74.0	30.2	V	P	102.4	34.0	
4.844	3.0	27.3	33.1	5.8	-36.5	0.0	0.0	29.7	54.0	-24.3	V	A	102.4	34.0	
4.844	3.0	38.6	33.1	5.8	-36.5	0.0	0.0	41.0	74.0	-33.0	H	P	123.5	253.4	
4.844	3.0	26.3	33.1	5.8	-36.5	0.0	0.0	28.7	54.0	-25.3	H	A	123.5	253.4	
7.266	3.0	37.5	35.2	7.2	-36.2	0.0	0.0	43.8	74.0	30.2	V	P	127.9	250.3	
7.266	3.0	25.7	35.2	7.2	-36.2	0.0	0.0	32.0	54.0	-22.0	V	A	127.9	250.3	
7.266	3.0	37.2	35.2	7.2	-36.2	0.0	0.0	43.5	74.0	-30.5	H	P	118.1	81.3	
7.266	3.0	25.1	35.2	7.2	-36.2	0.0	0.0	31.4	54.0	-22.6	H	A	118.1	81.3	
Mid Ch. 2437 MHz															
4.874	3.0	48.8	33.1	5.8	-36.5	0.0	0.0	51.2	74.0	-22.8	V	P	103.4	32.6	
4.874	3.0	34.5	33.1	5.8	-36.5	0.0	0.0	37.0	54.0	-17.0	V	A	103.4	32.6	
4.874	3.0	41.2	33.1	5.8	-36.5	0.0	0.0	43.7	74.0	-30.3	H	P	103.1	48.1	
4.874	3.0	27.2	33.1	5.8	-36.5	0.0	0.0	29.7	54.0	24.3	H	A	103.1	48.1	
7.311	3.0	49.4	35.3	7.3	-36.2	0.0	0.0	55.7	74.0	-18.3	V	P	130.6	269.6	
7.311	3.0	34.7	35.3	7.3	-36.2	0.0	0.0	41.0	54.0	-13.0	V	A	130.6	269.6	
7.311	3.0	41.5	35.3	7.3	-36.2	0.0	0.0	47.8	74.0	-26.2	H	P	121.1	35.5	
7.311	3.0	27.6	35.3	7.3	-36.2	0.0	0.0	34.0	54.0	-20.0	H	A	121.1	35.5	
High Ch. 2452 MHz															
4.904	3.0	40.5	33.1	5.9	-36.5	0.0	0.0	43.1	74.0	-30.9	V	P	103.9	40.5	
4.904	3.0	27.5	33.1	5.9	-36.5	0.0	0.0	30.0	54.0	-24.0	V	A	103.9	40.5	
4.904	3.0	38.7	33.1	5.9	-36.5	0.0	0.0	41.2	74.0	-32.8	H	P	199.2	71.8	
4.904	3.0	26.3	33.1	5.9	-36.5	0.0	0.0	28.8	54.0	-25.2	H	A	199.2	71.8	
7.356	3.0	38.5	35.4	7.3	-36.2	0.0	0.0	44.9	74.0	-29.1	V	P	101.1	235.3	
7.356	3.0	26.0	35.4	7.3	-36.2	0.0	0.0	32.5	54.0	-21.5	V	A	101.1	235.3	
7.356	3.0	37.6	35.4	7.3	-36.2	0.0	0.0	44.1	74.0	-29.9	H	P	102.2	76.5	
7.356	3.0	25.1	35.4	7.3	-36.2	0.0	0.0	31.5	54.0	-22.5	H	A	102.2	76.5	

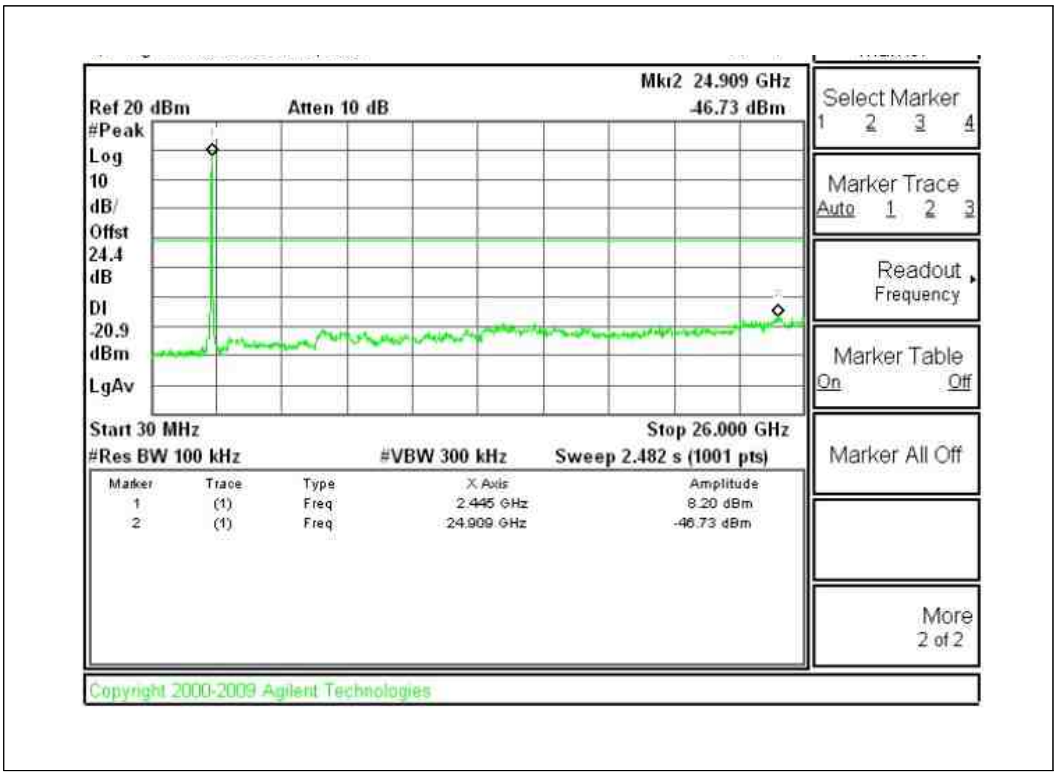
1. Margin (dB) = Limit − Emission Level
2. H = Horizontal, V = Vertical Polarization

Plot of the Band Edge

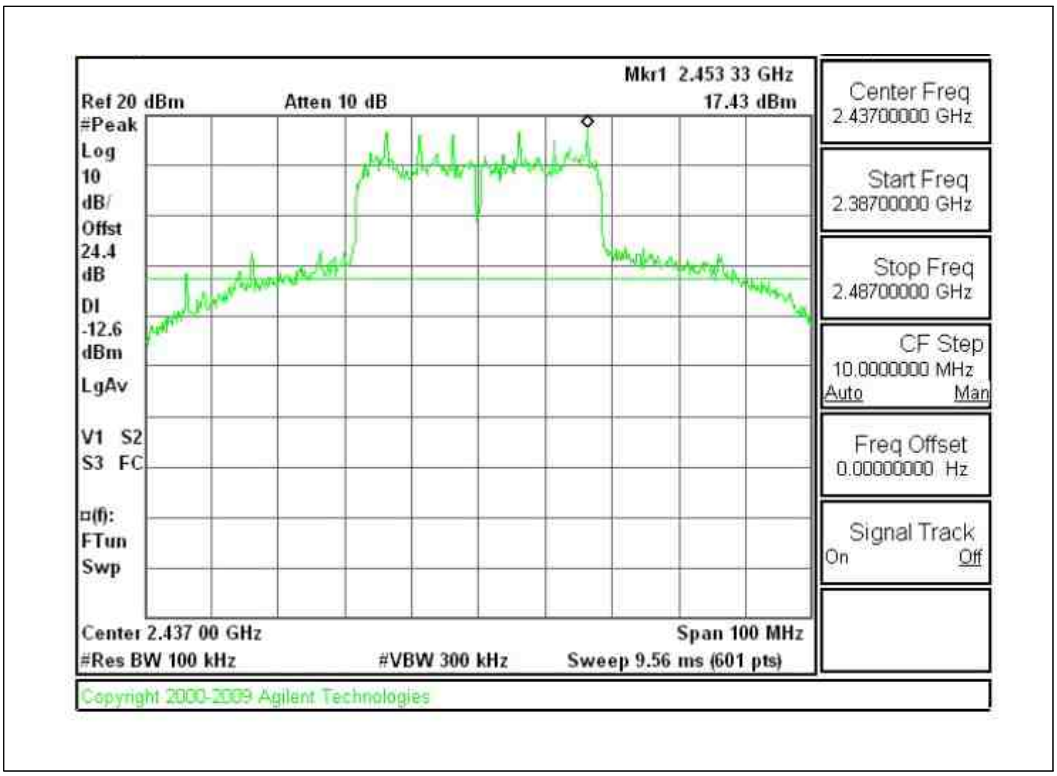
Low Channel (2422 MHz)



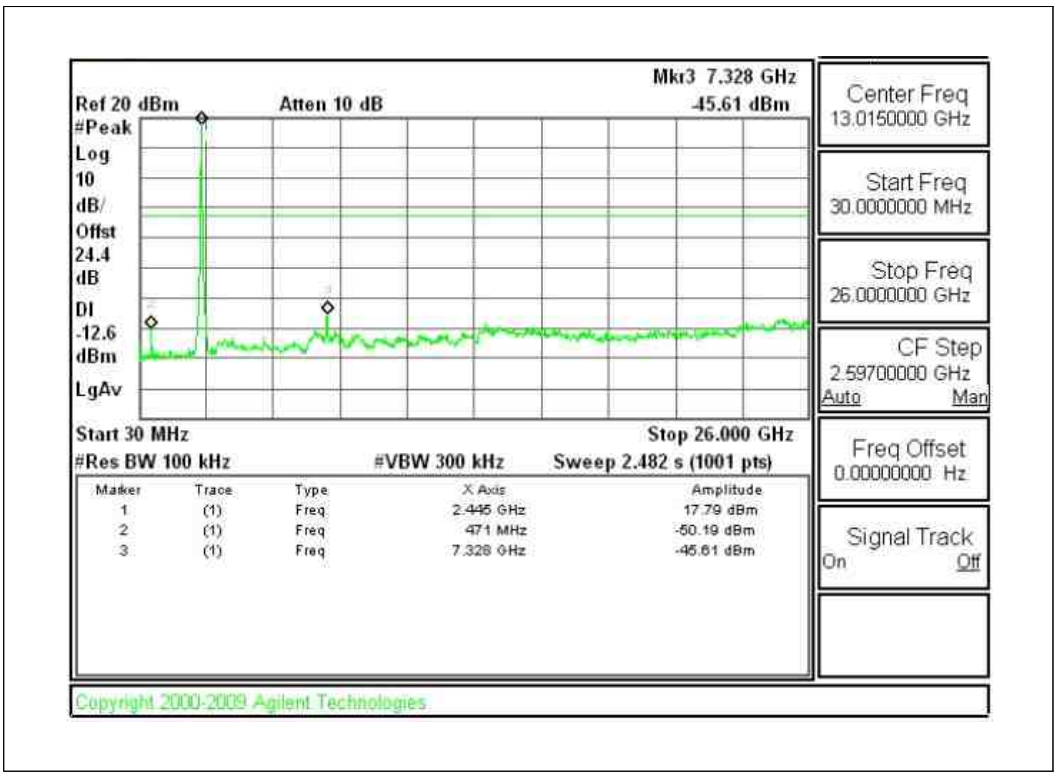
Low Channel (2422 MHz)



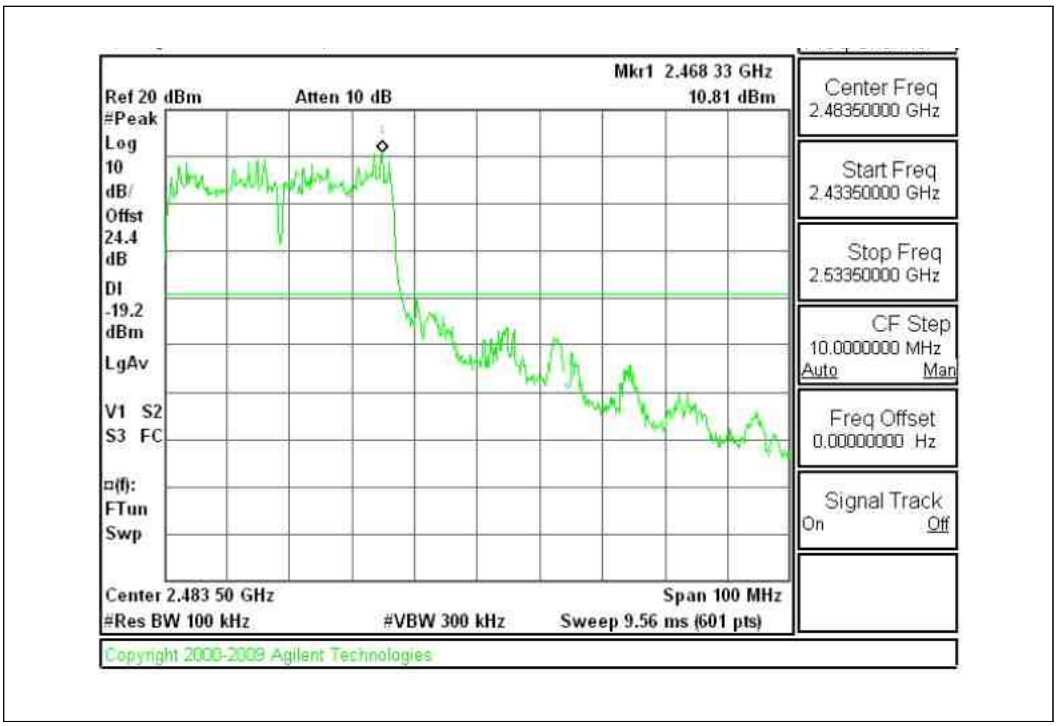
Middle Channel (2442MHz)



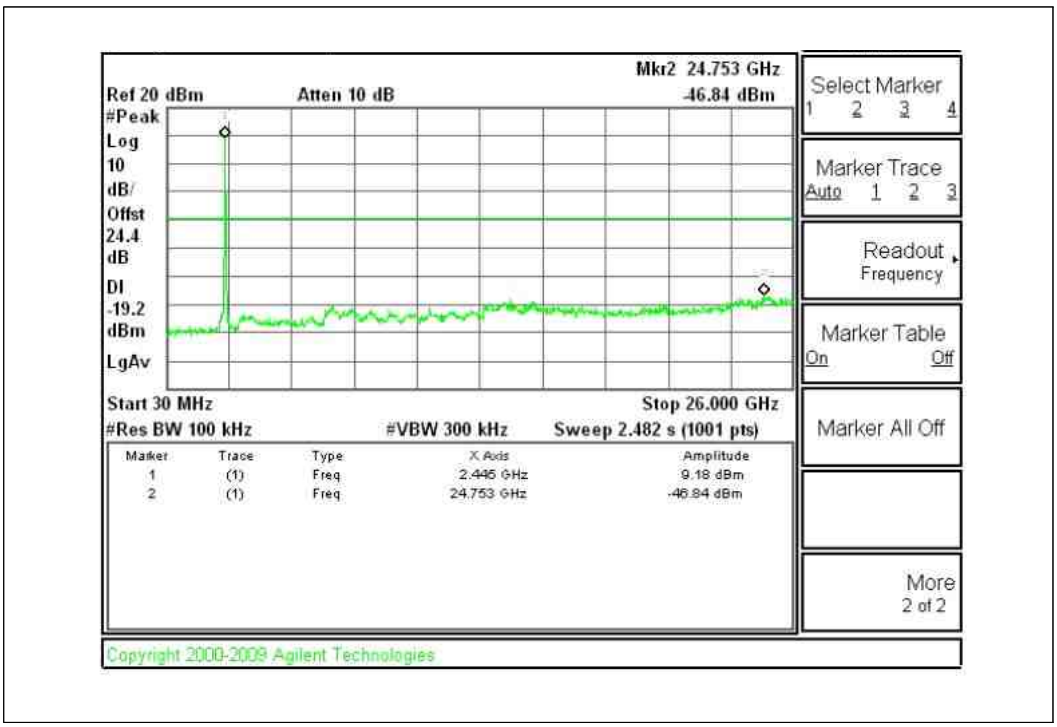
Middle Channel (2442MHz)



High Channel (2462 MHz)



High Channel (2462 MHz)



5.5 RECEIVER SPURIOUS EMISSIONS

5.5.1 Regulation

According to RSS-Gen 7.2.3, the following receiver spurious emission limits shall be complied with:

(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 1. The resolution bandwidth of the spectrum analyzer shall be 100 kHz for spurious emission measurements below 1.0 GHz, and 1.0 MHz for measurements above 1.0 GHz.

Spurious Emission Limit for Receivers

Frequency (MHz)	Field strength (μV/m @ 3m)	Field strength (dBμV/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

* Use quasi-peak below 1000 MHz and averaging meter above 1000 MHz.

5.5.2 Test Results:

f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter	

f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
Low Ch. 2412 MHz															
4.824	3.0	46.7	33.0	5.8	-36.5	0.0	0.6	49.6	74.0	-24.4	V	P	101.7	263.2	
4.824	3.0	44.1	33.0	5.8	-36.5	0.0	0.6	47.0	54.0	-7.0	V	A	101.7	263.2	
4.824	3.0	40.9	33.0	5.8	-36.5	0.0	0.6	43.9	74.0	-30.1	H	P	100.0	315.5	
4.824	3.0	32.9	33.0	5.8	-36.5	0.0	0.6	35.9	54.0	-18.2	H	A	100.0	315.5	
Mid Ch. 2437 MHz															
4.874	3.0	50.8	33.1	5.8	-36.5	0.0	0.6	53.9	74.0	-20.1	V	P	101.0	148.4	
4.874	3.0	49.2	33.1	5.8	-36.5	0.0	0.6	52.3	54.0	-1.7	V	A	101.0	148.4	
4.874	3.0	42.6	33.1	5.8	-36.5	0.0	0.6	45.7	74.0	-28.3	H	P	100.0	260.4	
4.874	3.0	37.8	33.1	5.8	-36.5	0.0	0.6	40.9	54.0	-13.1	H	A	100.0	260.4	
7.311	3.0	51.8	35.3	7.3	-36.2	0.0	0.6	58.8	74.0	-15.2	V	P	131.7	97.7	
7.311	3.0	44.7	35.3	7.3	-36.2	0.0	0.6	51.7	54.0	-2.3	V	A	131.7	97.7	
7.311	3.0	45.6	35.3	7.3	-36.2	0.0	0.6	52.6	74.0	-21.4	H	P	100.2	65.9	
7.311	3.0	35.2	35.3	7.3	-36.2	0.0	0.6	42.2	54.0	-11.8	H	A	100.2	65.9	
High Ch. 2462 MHz															
4.924	3.0	50.4	33.1	5.9	-36.5	0.0	0.6	53.6	74.0	-20.4	V	P	102.0	234.8	
4.924	3.0	48.2	33.1	5.9	-36.5	0.0	0.6	51.3	54.0	-2.7	V	A	102.0	234.8	
4.924	3.0	41.4	33.1	5.9	-36.5	0.0	0.6	44.6	74.0	-29.4	H	P	101.0	177.9	
4.924	3.0	34.9	33.1	5.9	-36.5	0.0	0.6	38.1	54.0	-15.9	H	A	101.0	177.9	
7.386	3.0	45.0	35.4	7.3	-36.2	0.0	0.6	52.2	74.0	-21.8	V	P	156.6	136.6	
7.386	3.0	38.5	35.4	7.3	-36.2	0.0	0.6	45.6	54.0	-8.4	V	A	156.6	136.6	
7.386	3.0	39.9	35.4	7.3	-36.2	0.0	0.6	47.1	74.0	-26.9	H	P	108.3	74.5	
7.386	3.0	30.4	35.4	7.3	-36.2	0.0	0.6	37.5	54.0	-16.5	H	A	108.3	74.5	

1. Margin (dB) = Limit − Emission Level
2. H = Horizontal, V = Vertical Polarization

6. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

According to §15.207(a), 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, as measured using a 50μH/50Ω 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.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Qausi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

TEST PROCEDURE

ANSI C63.4

RESULTS

6 WORST EMISSIONS

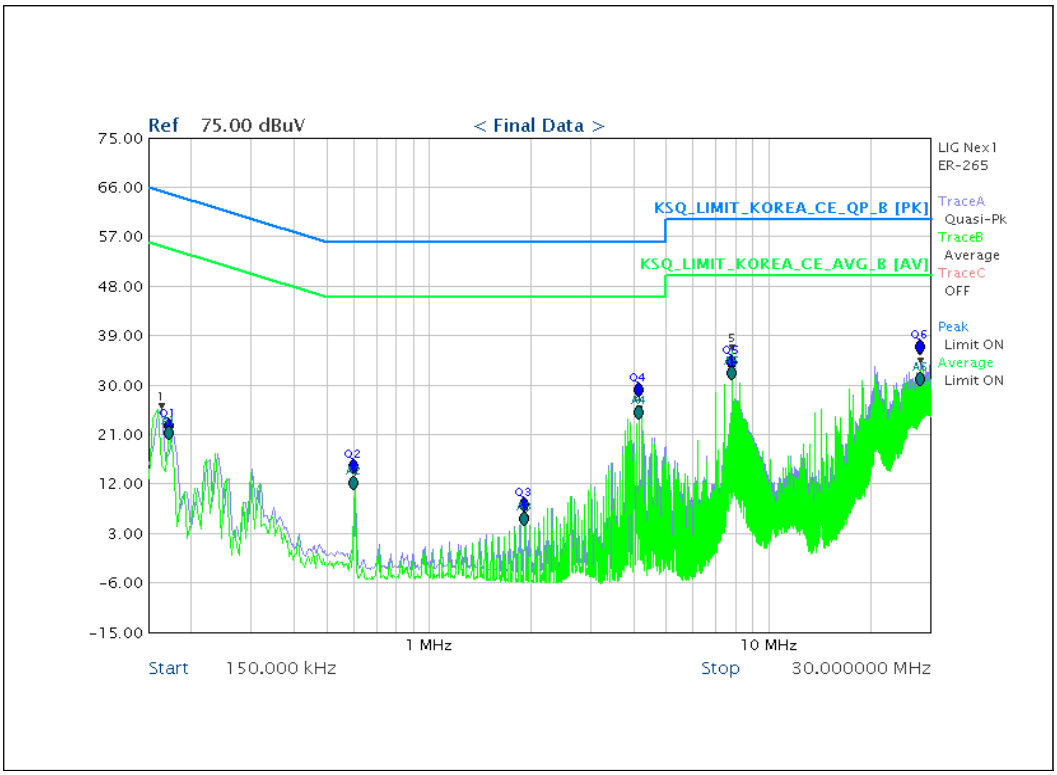
Table 7 : Measured values of the Conducted Emissions

Frequency (MHz)	Line/Neutral (L/N)	Measured Value (dBμV)	Correction Factor (dB)	Cable Loss (dB)	Emission Level (dBμV)	Limit (dBμV)	Margin (dB)
QUASI-PEAK DATA							
0.163500	L	25.47	0.18	0.08	25.73	66	40.27
0.163500	N	14.89	0.07	0.08	15.04	56	40.96
0.609000	L	11.26	0.14	0.05	11.45	56	44.55
0.604500	N	0.95	0.11	0.05	1.11	46	44.89
1.923000	L	5.13	0.12	0.11	5.36	56	50.64
1.860000	N	2.25	0.03	0.11	2.39	46	43.61
4.159500	L	25.05	0.11	0.22	25.38	56	30.62
4.096500	N	20.72	0.02	0.22	20.96	46	25.04
7.827000	L	36.10	0.16	0.23	36.49	60	23.51
7.827000	N	29.72	0.06	0.23	30.01	50	19.99
27.928499	L	33.78	0.28	0.47	34.53	60	25.47
29.219999	N	29.34	0.23	0.50	30.07	50	19.93

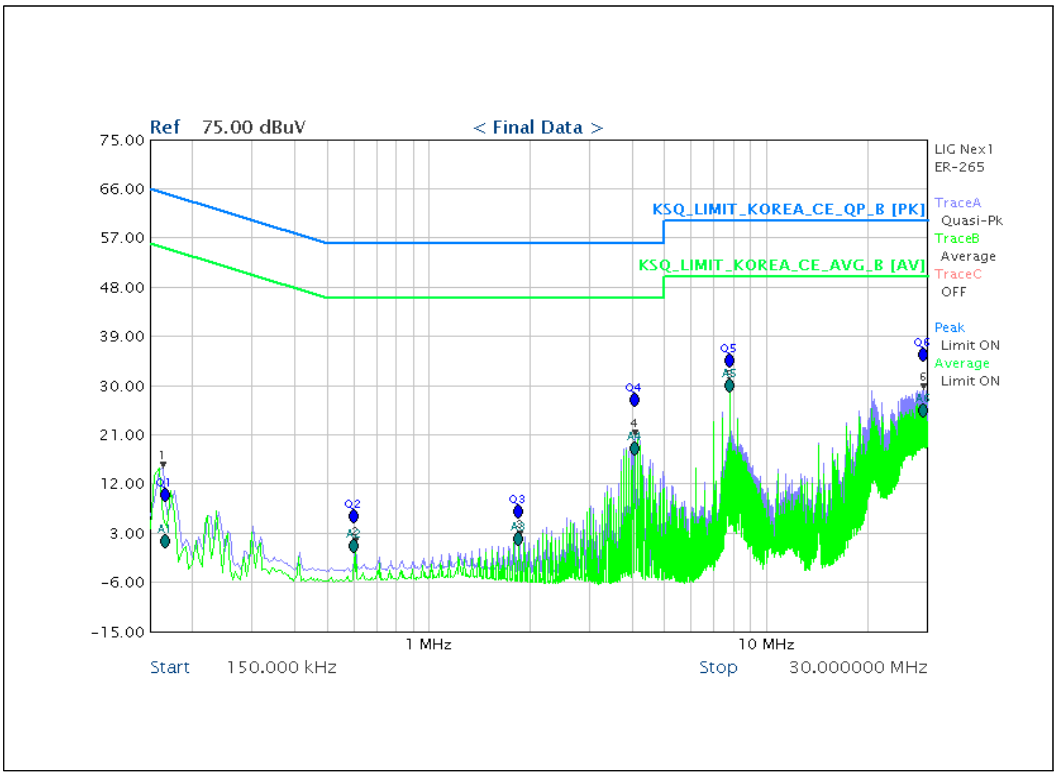
Margin (dB) = Limit − Emission Level

[Emission Level = Measured Value + CF + CL]

LINE 1 RESULTS: Transmit 2.4GHz



LINE 2 RESULTS



7. MAXIMUM PERMISSIBLE EXPOSURE

FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

EQUATIONS

Power density is given by:

S = EIRP / (4 * Pi * D^2)

where

S = Power density in W/m^2
EIRP = Equivalent Isotropic Radiated Power in W
D = Separation distance in m

Power density in units of W/m^2 is converted to units of mWc/m^2 by dividing by 10.

Distance is given by:

D = SQRT (EIRP / (4 * Pi * S))

where

D = Separation distance in m
EIRP = Equivalent Isotropic Radiated Power in W
S = Power density in W/m^2

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2 From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

RESULTS
(MPE distance equals 20 cm)

Band	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm^2)
2.4 GHz	0.20	27.26	1.8	0.174

8. TEST EQUIPMENT USED FOR TESTS

No.	Description	Manufacturer	Model No.	Specifications	Next Cal. Data	Used equipment
1	EMI Test Receiver	LIG Nex1	LSA-265	3Hz~26.5GHz	12.12.18	■
2	Dipole ANT	ElectroMetrics	TDA-30/1-4	30~1GHz	13.03.23	□
3	Biconical ANT	ElectroMetrics	BIA-30S	30~300MHz	13.03.23	■
4	Log periodic ANT	ElectroMetrics	LPA-30	0.2~1GHz	13.03.23	■
5	Bilog Antenna	Schaffner-Chase EMC Ltd.	CBL6140A	50V, 5A	13.05.07	■
6	Turn Table	KEI	KEI-TURN	1500×1000×800	N/A	□
7	Turn Table	KEI	KEI-TURN	1500×1000×800	N/A	■
8	Loop ANT.	Com-Power	AL-130	9kHz~30MHz	13.04.21	□
9	Spectrum Analyzer	Agilent	E4440A	1kHz~26.5GHz	13.05.20	■
10	Function Generator	Agilent	33120A	15MHz sine&square	12.06.08	□
11	Frequency Counter	HP	5350B	10Hz~20GHz	12.06.08	□
12	Modulation Analyzer	Agilent	8901B	10MHz~1.3GHz	12.06.08	□
13	Audio Analyaer	Agilent	8903B	20Hz~100kHz	12.06.08	□
14	Attenuator	Agilent	8494B	0~11dB, 18GHz	12.06.08	□
15	Attenuator	Agilent	8496B	0~110dB, 18GHz	12.06.08	□
16	Attenuator	Agilent	8495B	0~70dB, 18GHz	12.06.08	□
17	Attenuator	TAE SUNG	SMA-1	6dB	12.09.02	□
18	Attenuator	TAE SUNG	SMA-2	6dB	12.09.02	□
19	Power Meter	Agilent	E4418B	100kHz~110GHz, 0.0001uW~25100mW	12.06.08	■
20	Power Sensor	HP	8485A	50MHz~26.5GHz	12.06.08	■
21	Vibration Tester	Gana	GNV-400	10~60Hz, 0~4mm	12.06.08	□
22	RF Cable	Gigalane	SMS-LL280-SMS -1.5M	1.5m	N/A	■
23	Temp & Humidity Chamber	Seoksan Tech	SE-CT-02	-40~150℃, 30~98%	12.06.08	■
24	Signal Generator	Leader Electronics	3220	100kHz~1.3GHz	12.06.08	■
25	Oscilloscope	Tektronix	TDS-350	200MHz	12.09.02	□
26	Drop Tester	Self-made	KSQ-01	150cm	N/A	□
27	Pre Amplifier	GTC	GA-1825A	0.1~18GHz	12.06.08	■
28	Continuous operation tester	GTC	CT-100	Local Control	N/A	□
29	CW Generator	HP	83711B	1~20GHz	12.06.08	■
30	POWER DIVIDER	Agilent	11636B	26.5GHz	12.06.08	□
31	Power Sensor	Agilent	8482B	100kHz ~ 4.2GHz	12.06.08	□
32	Attenuator	Winswell	53-30-33	dc-2.5GHz, 500W	12.06.08	□
33	DC Power Supply	Hanil	HPS-505A	50V, 5A	12.09.02	□
34	Slidacs	Hanchang	5KV	5kW, 300V	12.09.02	□
35	Termination	Kwang Yeok	KYTE-NJ-150W	150W	12.09.02	□
36	Band-limited filter	MITECH	KSQ-02	600Ω	12.09.02	□
37	Signal Generator	WILTRON	6759B	10MHz ~ 26.5GHz	12.09.02	□
38	Digital Multimeter	DONG HWA	DM-300A	AC/DC 500V Max,320mA Max	12.09.02	■
39	Horn ANT.	SCHWARZBECK	BBHA 9120D	700MHz ~ 18GHz	12.09.23	■
40	DC Power Supply	ALINCO	DM-340MW	15V, 30A	12.09.02	■

9. APPENDIX

1. EUT photo