Advanced Compliance Laboratory

210 Cougar Court
Hillsborough, NJ 08844
Tel: (908) 927 9288
Fax: (908) 927 0728

FCC CFR47 PART 15 SUBPART C & IC RSS-247

TEST REPORT

For

Centrak, Inc.

Ambient Cyro Temperature Sensor
Model Number: ITD-736TH, ITD-736TO, ITD-736LT

FCC ID: ST2-ITD736
IC: 6012A-ITD736

Report Number: 0048-170307-01A-FCC-IC

Prepared for
Centrak, Inc.
125 Pheasant Run
Newtown, PA 18940, USA

Prepared by
Advanced Compliance Laboratory, Inc.
210 Cougar Court
Hillsborough, NJ 08844
Tel: (908) 927 9288
Fax: (908) 927 0728

Date: 03/14/2017

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1. TEST RESULT CERTIFICATION

COMPANY NAME: **Centrak, Inc.**
125 Pheasant Run
Newtown, PA 18940, USA

EUT DESCRIPTION: **2.4GHz Band Sensor**

MODEL: **ITD-736TH, ITD-736TO, ITD-736LT**

DATE TESTED: 03/07/2017to 03/14/2017

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC Part 15.247 & IC RSS-247:Issue 1 & RSS-GEN: Issue 4	NO NON-COMPLIANCE NOTED

Test Summary

Testing Items Per FCC Part 2/ Part 15.247 & IC RSS-247 /RSS-Gen Standard Requirements for DTS Modulation	Section	Limit	Result
DTS Bandwidth	15.247(a) (2) RSS-247, 5.2(1)	>=500KHz	Complies
Peak Power Limit	15.247(b) (3) RSS-247, 5.4(4)	Conducted: 1W (30dBm) e.i.r.p. 4W(36dBm)	Complies
Peak Power Spectral Density	15.247(e) RSS-247, 5.2(2)	8dBm/3KHz	Complies
Emissions (Conducted)	15.247(d) RSS-247, 5.5	-20dB/-30dB	Complies
Spurious (Radiated)	15.205(a) RSS-247, 5.5	15.209/RSS-Gen	Complies
RF Safety*	1.1310/RSS-102	1.0/5.0 mW/cm^2	Complies

NOTE: * For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

Advanced Compliance Laboratory, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: This document reports conditions under which testing was conducted and results of tests performed. This document may not be altered or revised in any way unless done so by Advanced Compliance Laboratory, Inc. (ACL) and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by ACL, Advanced Compliance Laboratory, Inc. will

constitute fraud and shall nullify the document.

Approved & Released For ACL By:

Wei Li

Manager
Advanced Compliance Laboratory, Inc.

Tested By:

David Tu

EMC Engineer

2. EUT DESCRIPTION

The EUT for this certification is a low power transmitter, using digital modulation & operating in the 2400-2483.5 MHz band.

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Rated Power	Measured Max. Conducted Output Power (dBm/W)	
2400-2483.5	8dBm	7.3dBm/ 0.005	

The EUT can use a surface mount antenna:. Johanson Technology, Inc., P/N 2450AT42A100, 2.4GHz Band, 0 dBi, typ. (XZ-Vertical Polarization)

Max. e.i.r.p is 7.3dBm, i.e. 0.005W with 0dBi gain antenna. With this antenna, both conducted output power and e.r.i.p are under FCC & IC limit.

EUT Specification:

Operation Frequency & Channel Number	2412MHz~2462MHz(802.11b), 11 channels
Channel Separation	5MHz
Modulation (IEEE 802.11b)	Direct Sequence Spread Spectrum (DSSS)
Data Speed (IEEE 802.11b)	1/2/5.5/11Mbps
Antennal Type and Gain	Dipole , 0dBi max.
Power Supply	3.3 Vdc

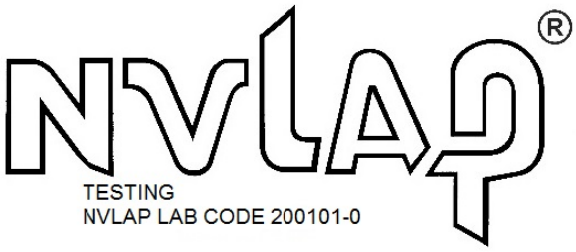
3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4(2014)/C63.10(2013), FCC CFR 47 Part 2 & 15 and IC RSS-247(Issue 1) & RSS-GEN (Issue 4). Test procedure described in FCC "KDB 558074 D01 DTS Measurement Guidance c03r05 (2016)" is used in this report.

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at Hillsborough, New Jersey, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication. All receiving equipment conforms to CISPR Publication 16-1,
"Radio Interference Measuring Apparatus and Measurement Methods"

ACL is accredited by NVLAP, Laboratory Code 200101-0. The full accreditation can be viewed at http://www.ac-lab.com



No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.

5. CALIBRATION AND UNCERTAINTY

5.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

5.2. MEASUREMENT UNCERTAINTY

The estimated uncertainty of the test result is given as following. The method of uncertainty calculation is provided in Advanced Compliance Lab. Doc. No. 0048-01-01.

	Prob. Dist.	Uncertainty(dB)	Uncertainty(dB)	Uncertainty(dB)
		30-1000MHz	1-6.5GHz	Conducted
Combined Std. Uncertainty u_c	norm.	±2.36	±2.99	±1.83

5.3. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Manufacturer	Model	Serial No.	Description	Cal Due mm/dd/ yy
Agilent	E4440A	US40420700	3Hz-26.5GHz Spec. Analyzer	6/17/17
R &S	ESPI	100018	9KHz-7GHz EMI Receiver	8/25/17
HP	HP8546A	3448A00290	9kHz to 6.5GHz EMI Receiver	9/25/17
EMCO	3104C	9307-4396	20-300MHz Biconical Antenna	11/12/17
EMCO	3146	9008-2860	200-1000MHz Log-Periodic Antenna	11/13/17
Electro-Meterics	ALR-25M/30	289	10KHz-30MHz Active Loop Antenna	5/28/17
EMCO	3115	4945	Double Ridge Guide Horn Antenna	11/28/17
ARA	MWH-1826/ B	1013	18-26GHZ Horn Antena	10/2/17
R&S	SMH	8942280/010	Signal Generator	
RES-NET	RFA500NFF 30	0108	30dB in-line Power Attenuator	
Lorch Microwave	5NF-800/10 00-S	AC3	Notch Filter	
Lorch Microwave	5NF-1800/2 200-S	AE10	Notch Filter	
Narda	3022	80986	Directional Coupler	
Lorch Microwave	5NF-800/10 00-S	AC3	Notch Filter	

All Test Equipment Used is Calibrated, Traceable to NIST Standards. Calibration interval: 2 years

6. SETUP OF EQUIPMENT UNDER TEST

SUPPORT EQUIPMENT

None.

TEST SETUP

Testing Frequency/Channel/Port Selection:

- Conducted measurement performed at EUT's antenna connector.
- Using internal continuous testing signal source.
- Modulation: DSSS
- Signal OBW: 15.973MHz. Emission Designator: 16M0G1D
- L(owest), M(iddle), H(ighest) Channels of 2.4G Band were selected:
- L=2412MHz, M=2438MHz, H=2462MHz
- A laptop was used for changing EUT transmitting channels and providing 3.3V DC power for testing purpose.
- USB ports are for Probe connection only. Not USB protocol port. No Data transfer.

Frequency settings:

Modulation	802.11b	
Lowest Channel (L)	2412MHz	
Middle Channel (M)	2437MHz	
Highest Channel (H)	2462MHz	

Worst case Scenario:

Via pre-scan, the following modes were found representing the " worst case" data. Duty cycle was set for 100% with max. power setting for all modulations.

Mode No.	Mode Modulation & Data Rate
1	802.11b, 1Mbps

7. APPLICABLE LIMITS AND TEST RESULTS

7.1 6dB &99% BANDWIDTH

LIMIT

§15.247 (a) (2) & RSS-247 Sec. 5.2(1): Min. 6dB DTS bandwidth should be no less than 500KHz.

TEST PROCEDURE *per FCC KDB 558074D01v03r05*

Measurement Procedure for Emission Bandwidth (DTS Bandwidth)	Applicable to this EUT
8.1 DTS BW Measurement Procedure: Option 1 (manual)	☐
8.2 DTS BW Measurement Procedure: Option 2 (automatic)	☒

RESULTS

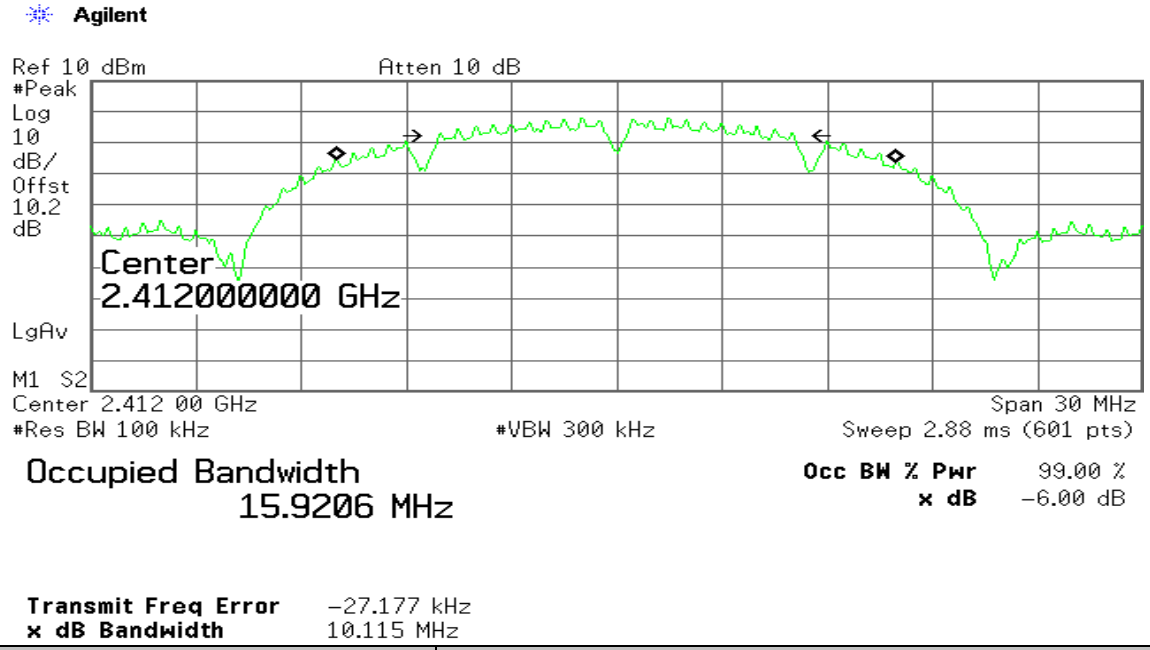
No non-compliance noted.

Mode No.1: 802.11b

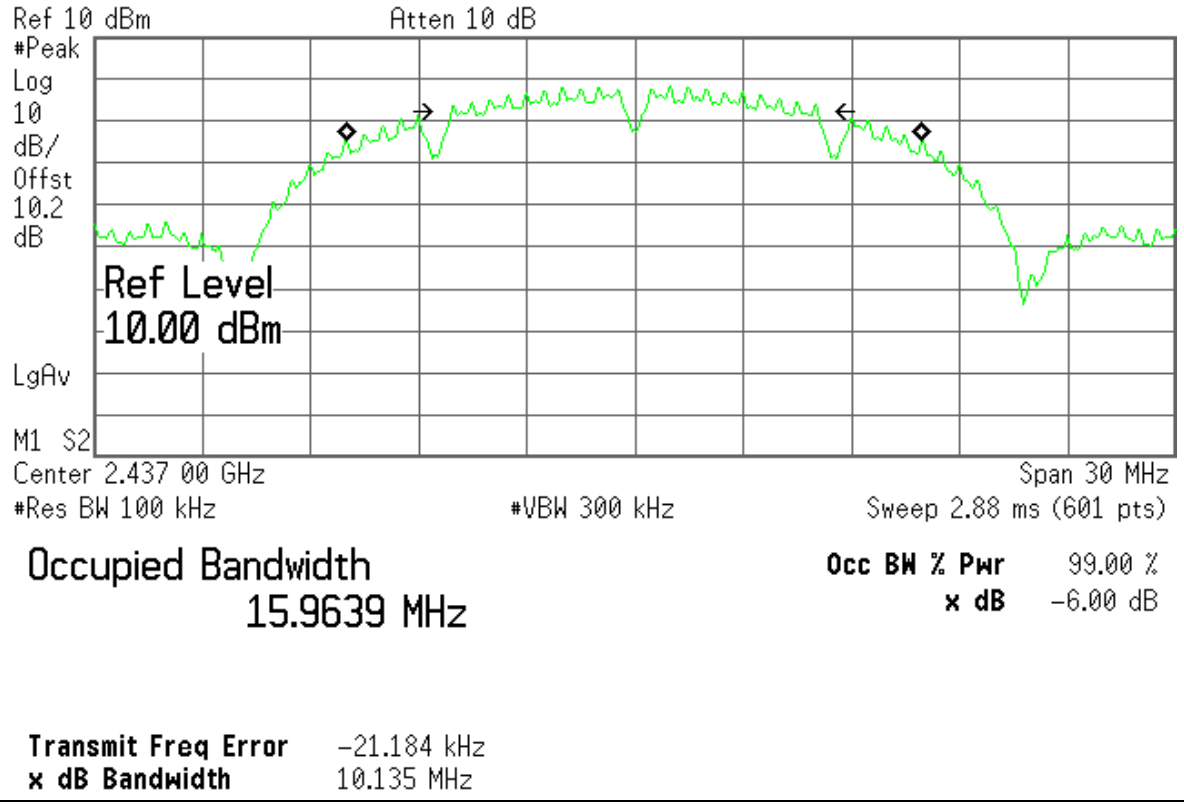
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2412	10.115	15.921
Middle	2437	10.135	15.964
High	2462	10.136	15.973

6dB & 99% BANDWIDTH

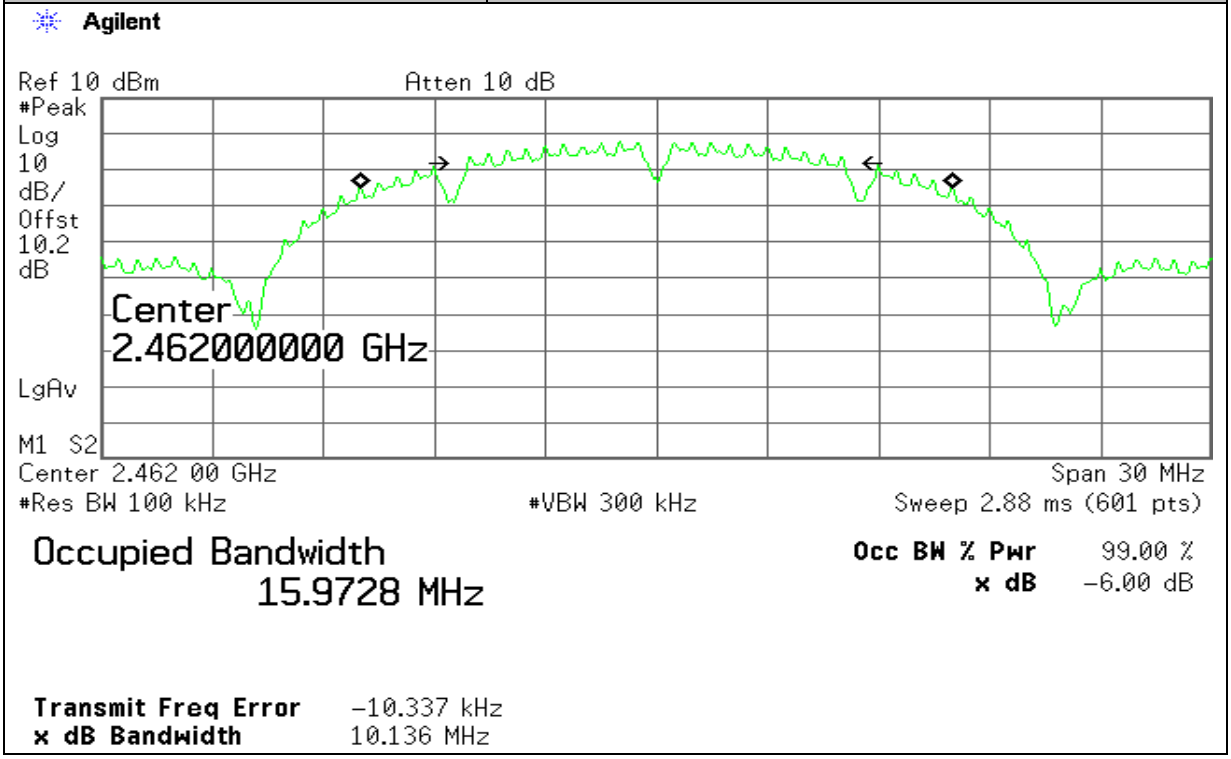
Plot Name:	6dB &99% Bandwidth, Mode No 1. 802.11b, Low CH



Plot Name:	6dB &99% Bandwidth, Mode No 1. 802.11b, Mid CH



Plot Name:	6dB & 99% Bandwidth, Mode No 1. 802.11b, High CH



7.2 MAXIMUM OUTPUT POWER

PEAK POWER LIMIT

§15.247 (b)(3) & RSS-247 Sec. 5.4.(4)

The maximum peak conducted output power of the intentional radiator shall not exceed the following: For systems using digital modulation in the 2400-2483.5 MHz band: 1 Watt.

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.

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.

Therefore, the applicable output power limit shall be calculated as follows:

Pout = 30 -(Gtx-6) for antenna gain ≤6dBi or
Pout = 30 -Floor[(Gtx-6)/3]
G_{Tx} = the maximum transmitting antenna directional gain in dBi.

TEST PROCEDURE ***per FCC KDB 558074D01v03r05***

Measurement Procedure for Fundamental Emission Output Power	**Applicable to this EUT**
9.1.1 Maximum Peak Conducted Output Power Level Measurement Procedure Option 1 (RBW≥DTS BW) using SA	☐
9.1.2 Maximum Peak Conducted Output Power Level Measurement Procedure Option 2 (RBW<DTS BW) using Broadband Peak RF power meter)---**PKPM1**	☐
9.2.2.2 Maximum Average Conducted Output Power Level Measurement Procedure using SA: Method **AVGSA-1** (trace averaging with the EUT transmitting at full power throughout each sweep)	☒ **preferred**
9.2.2.3 Maximum Average Conducted Output Power Level Measurement Procedure using SA: Method **AVGSA-1 Alternative** (RMS detection with slow sweep and EUT transmitting continuously at full power)	☐
9.2.2.4 Maximum Average Conducted Output Power Level Measurement Procedure using SA: Method **AVGSA-2** (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction)	☐
9.2.2.5 Maximum Average Conducted Output Power Level Measurement Procedure using SA: Method **AVGSA-2 Alternative** (RMS detection with slow sweep with spectrum bin averaging across on and off times of the EUT transmissions, followed by duty cycle correction)	☐
9.2.2.6 Maximum Average Conducted Output Power Level Measurement Procedure using SA: Method **AVGSA-3** (RMS detection across on and off times of the EUT with max hold)	☐
9.2.2.7 Maximum Average Conducted Output Power Level Measurement	☐

Procedure using SA: Method **AVGSA-3 Alternative** (reduced VBW averaging across on and off times of the EUT with max hold)	
9.2.3.1 Maximum Average Conducted Output Power Level Measurement Procedure using PM: Method **AVGPM** (Measurement using an RF average power meter)	☐
9.2.3.2 Maximum Average Conducted Output Power Level Measurement Procedure using PM: Method **AVGPM-G** (Measurement using a gated RF average power meter)	☐

* SA=Spectrum Analyser, PM= Powe Meter

ALTERNATIVE METHOD
(Ref: FCC KDB 558074D01v03r05)

The measurement procedures described herein are based on the use of an antenna-port conducted test configuration. However, if antenna-port conducted tests cannot be performed on an EUT (*e.g.*, portable or handheld devices with integral antenna), then radiated tests are acceptable for demonstrating compliance to the conducted emission requirements. The guidance provided herein is applicable to either antenna-port conducted or radiated compliance measurements.

If a radiated test configuration is used, then the measured power or field strength levels shall be converted to equivalent conducted power levels for comparison to the applicable output power limit. This may be accomplished by first measuring the radiated field strength or power levels using a methodology for maximum peak conducted power or maximum conducted (average) power as applicable and peak or average power spectral density as applicable. The radiated field strength or power level can then be converted to EIRP (see ANSI C63.10 for guidance). Therefore, the applicable output power limit shall be calculated as follows:

EIRP (dBm) = E (dBuV/m) – 95.2

TEST RESULT

No non-compliance noted.

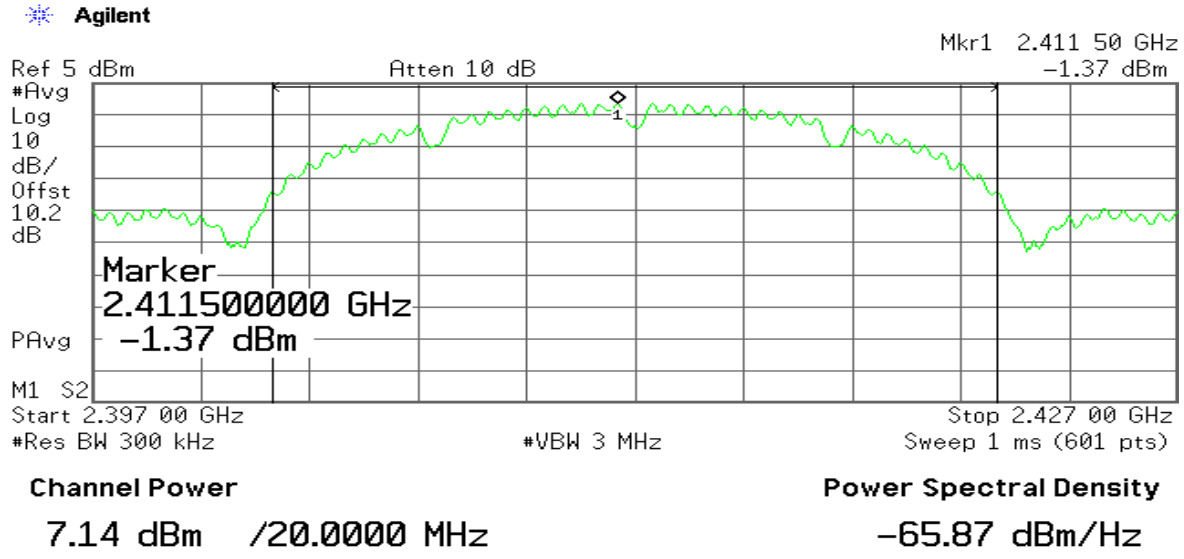
Summary of Max. Conducted (average) Output Power Testing Data:

Max. Conducted output power is 7.30dBm/ 0.005W.
Max. e.i.r.p is 7.30dBm/ 0.005W with 0 dBi gain antenna.
Both conducted output power and e.r.i.p are under FCC & IC limit.

Mode No.1 802.11 b

Channel	Frequency (MHz)	Output Power* (dBm)	Limit (dBm)	Margin (dB)
Low	2412	7.14	30	-13.86
Middle	2437	7.30	30	-14.70
High	2462	7.02	30	-14.98

Plot Name:	Conducted Output Power Mode No 1. 802.11b, Low CH



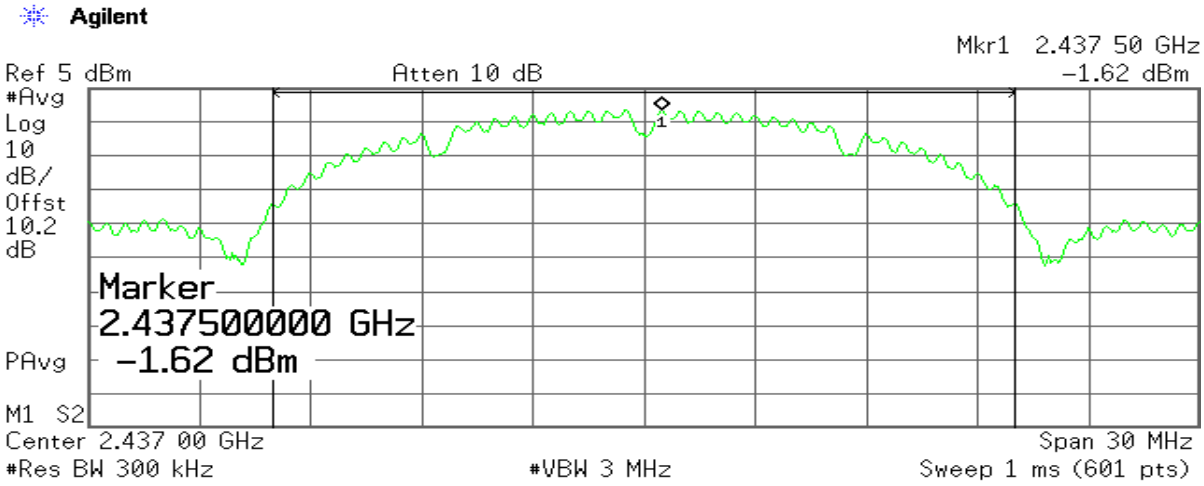
Channel Power

7.14 dBm /20.0000 MHz

Power Spectral Density

-65.87 dBm/Hz

Plot Name:	Conducted Output Power Mode No 1. 802.11b, Mid CH



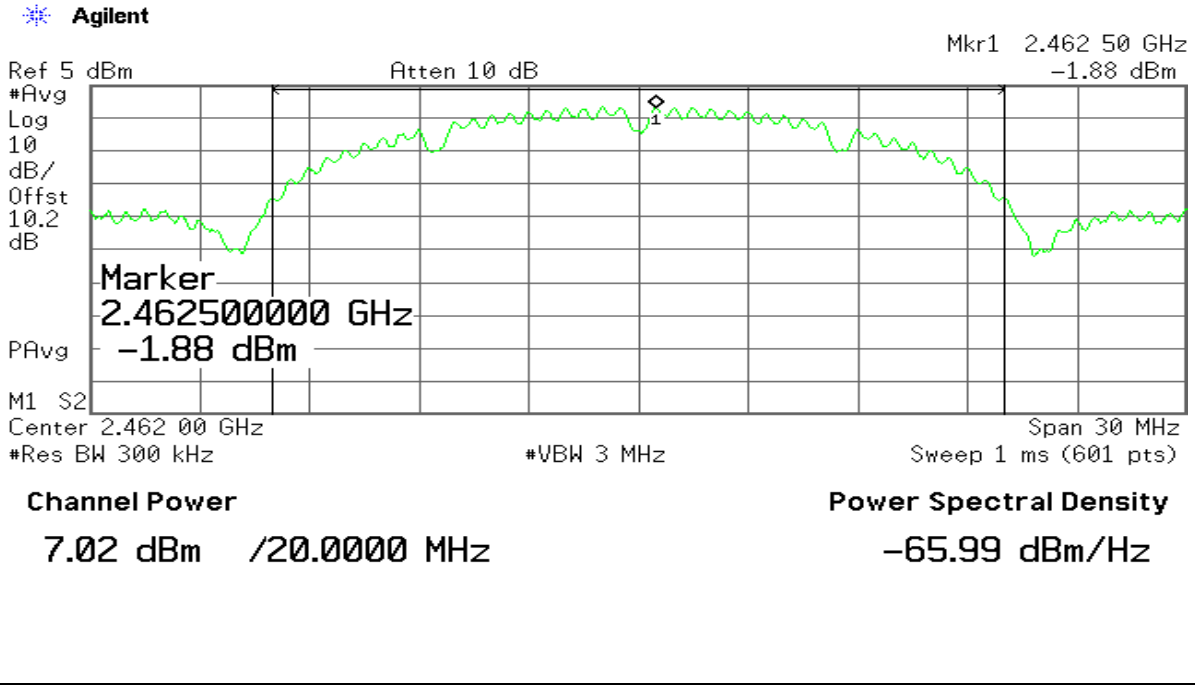
Channel Power

7.30 dBm /20.0000 MHz

Power Spectral Density

-65.71 dBm/Hz

Plot Name:	Conducted Output Power Mode No 1. 802.11b, High CH



7.3 MAXIMUM PERMISSIBLE EXPOSURE

LIMITS & RSS-102

§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.

CALCULATIONS

Given

$E = \sqrt{(30 * P * G)} / d$

and

$S = E \wedge 2 / 3770$

where

E = Field Strength in Volts/meter
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power Density in milliwatts/square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$d = \sqrt{((30 * P * G) / (3770 * S))}$

Changing to units of Power to mW and Distance to cm, using:

P(mW) = P (W) / 1000 and
d (cm) =100 * d (m)

yields

$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$
$d = 0.282 * \sqrt{(P * G / S)}$

where

d = distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using: P (mW) = 10 ^ (P (dBm) / 10) and
G (numeric) = 10 ^ (G (dBi) / 10)

yields

$d = 0.282 * 10 \wedge ((P + G) / 20) / \sqrt{S}$ Equation (1)
$S = 0.0795 * 10 \wedge ((P + G)/10)/ d\wedge 2$ Equation (2)

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

Equation (1) and the measured Output power is used to calculate the MPE distance.
Equation (2) and the measured Output power is used to calculate the Power density.

LIMITS

From §1.1310 Table 1 (B),
for Public S = 1.0 mW/cm^2
for Professional, S = 5.0 mW/cm^2

RESULTS

No non-compliance noted:

For this EUT, P+G=7.30+0=7.30 dBm, and d=20cm

Plug all three items into equation (2), yielding,

Power Density Limit (mV/cm^2)	Output Power (dBm)	Antenna] Gain (dBi)	Power Density ($mW/ cm^{2)}$
1.0/5.0	7.30	0	0.001

NOTE: For mobile or fixed location transmitters, the minimum separation distance between the antenna & radiating structures of the device and nearby persons is 20 cm, even if calculations indicate that the MPE distance would be less.

7.4 MAXIMUM POWER SPECTRAL DENSITY

LIMIT

§15.247 (e) & RSS-247 Sec. 5.2(2)
For direct sequence systems, the peak 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.

TEST PROCEDURE ***per FCC KDB 558074D01v03r05***

Measurement Procedure for Maximum Power Spectral Density in the Fundamental Emission*	**Applicable to this EUT**
10.2 Measurement Procedure for Peak PSD--- Method **PKPSD(peak PSD)**	☐
10.3 Measurement Procedure for Average PSD--- Method **AVGPSD-1** (trace averaging with EUT transmitting at full power throughout each sweep)	☒**preferred**
10.4 Measurement Procedure for Average PSD---Method **AVGPSD-1 Alternative** (RMS detection with slow sweep speed and EUT transmitting continuously at full power)	☐
10.5 Measurement Procedure for Average PSD---Method **AVGPSD-2** (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction)	☐
10.6 Measurement Procedure for Average PSD---Method **AVGPSD-2 Alternative** (RMS detection with slow sweep speed with spectrum bin averaging across on and off times of the EUT transmissions, followed by duty cycle correction)	☐
10.7 Measurement Procedure for Average PSD---Method **AVGPSD-3** (RMS detection across on and off times of the EUT with max hold)	☐
10.8 Measurement Procedure for Average PSD---Method **AVGPSD-3 Alternative** (reduced VBW averaging across on and off times of the EUT with max hold)	☐

* Same measurement method as used to determine the maximum fundamental power.
** EUT shall be configured to transmit continuously (min. 98% duty cycle at full power) or use video trigging/signal gating. The spectrum analyzer shall be set for bin-to-bin spacing ≤RBW/2.

RESULTS

No non-compliance noted:

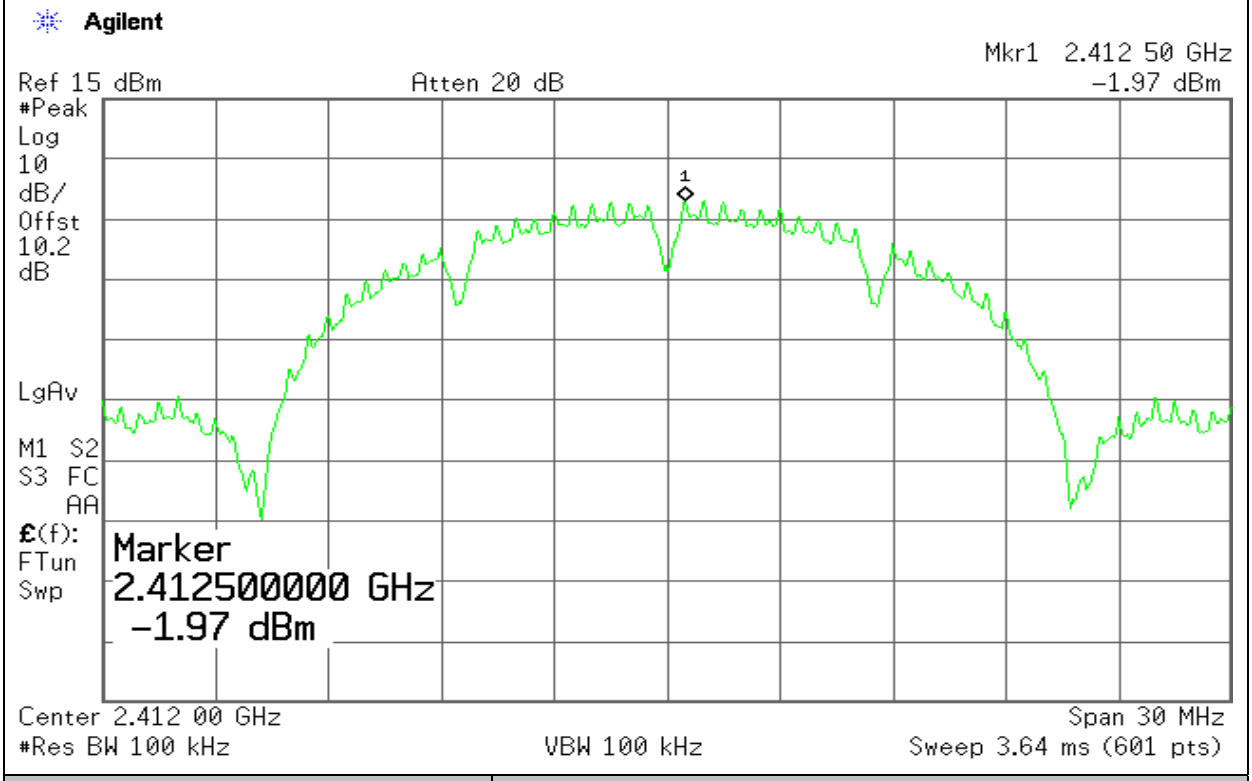
Summary of PPSD Testing Data:

Mode No.1 802.11b

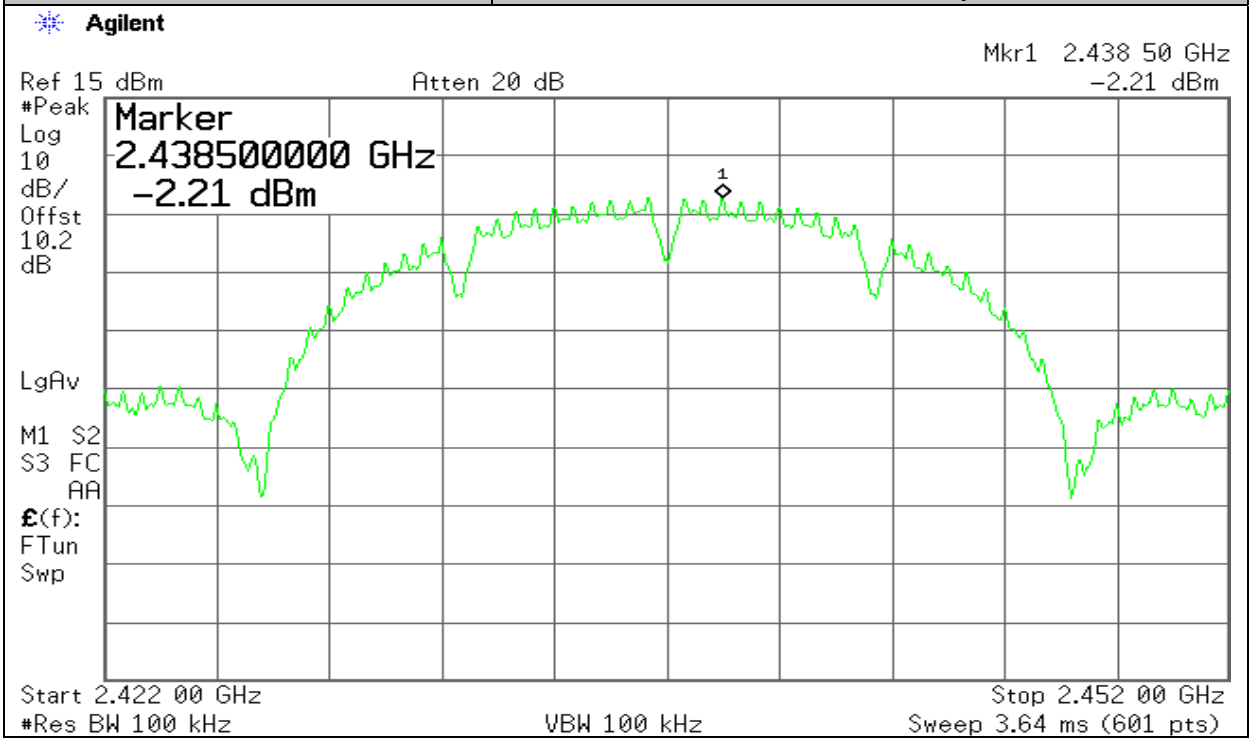
Channel	**Frequency (MHz)**	**PPSD (dBm/30KHz)**	**Limit (dBm/3KHz)**	**Margin (dB)**
Low	2412	-1.97	8	-9.97
Middle	2437	-2.21	8	-10.21
High	2462	-1.89	8	-9.89

PEAK POWER SPECTRAL DENSITY

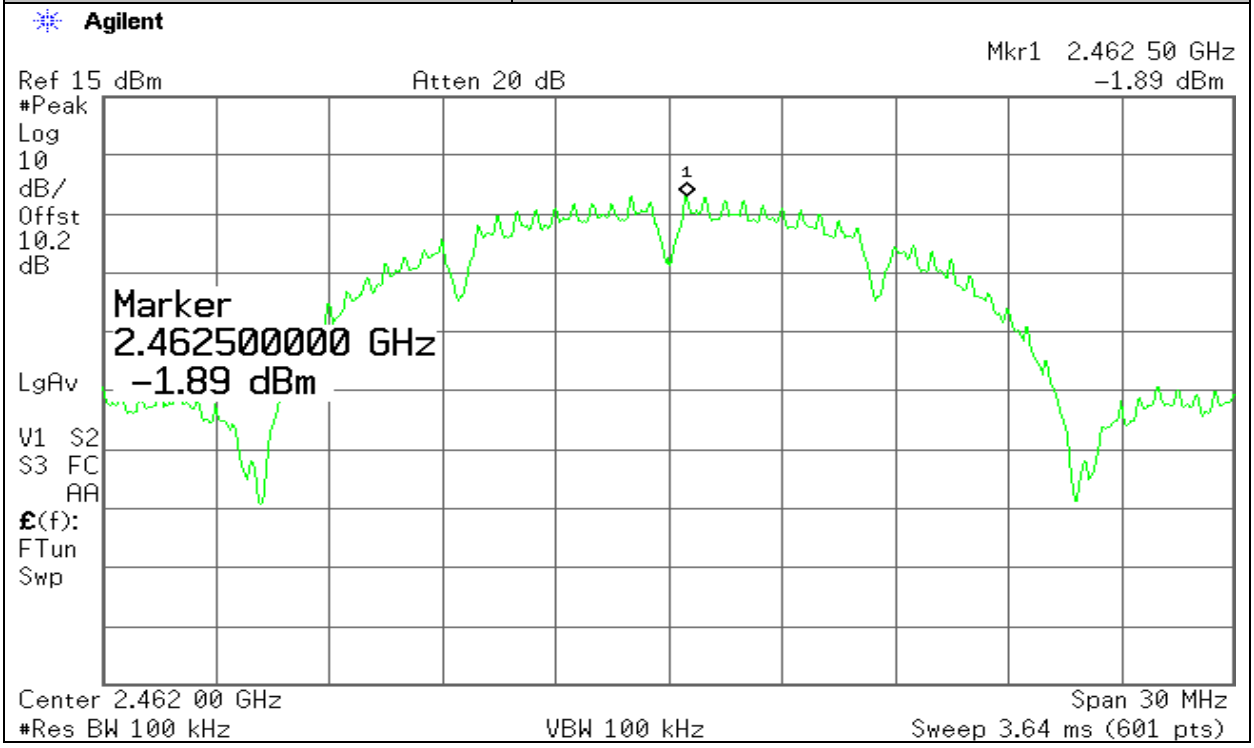
Plot Name:	POWER SPECTRAL DENSITY Mode No 1. 802.11b, Low CH



Plot Name:	POWER SPECTRAL DENSITY Mode No 1. 802.11b, Mid CH



Plot Name:	POWER SPECTRAL DENSITY Mode No 1. 802.11b, High CH



7.6 CONDUCTED SPURIOUS EMISSIONS

LIMITS

§15.247 (d) & RSS- 247 Sec. 5.5
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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205 (a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST PROCEDURE ***per FCC KDB 558074D01v03r05***

(Report the three highest emissions relative to the limit)

Conducted Measurement Procedure for Maximum Unwanted Emissions into Non-Restricted Frequency Bands	**Applicable to this EUT**	
	Peak Power limit: (-20dB)	**Average Power Limit: (-30dB)**
11.1-11.2 Measurement Procedure-Reference Level (RBW=100KHz, VBW=300KHz)	☐	☒**preferred**
11.3 Measurement Procedure-Unwanted Emission Level*	☐	☒**preferred**

* Different attenuation limit shall be used based on the measurement method of fundamental emission power and PSD.

Antenna-Port Conducted Measurement Procedure for Maximum Unwanted Emissions into Restricted Frequency Bands**	**Applicable to this EUT**
12.2.3 CISPR Quasi-Peak Measurement (CISPR 16)	☐
12.2.4 Peak Power Measurement (Table 1 for RBW setting)	☐
12.2.5 Average Power Measurement (three options)***	☐
13.2 Band-Edge Marker-Delta Method (ANSI C63.10) (within 2MHz)	☐
13.3 Band-Edge Integration Method (peak / average) (within 2MHz)	☐

** To use this conducted testing method, per 12.2.2-12.2.6, the followings shall be taken as consideration:

1. Proper RBW and detector, per 15.35 a/b, shall be chosen in different frequency ranges;
2. **Maximum transmitter antenna gain (no less than 2dBi), G, shall be added to the measured power level to determine the EIRP;**
3. **Appropriate factor, A, shall be added to model worst case ground reflections: 6.0dB (f≤30MHz) and 4.7dB (f≤30 to 1000MHz)**
4. **Electric field strength can be obtained from the equation: E= EIRP-20log(d)+104.8+G (or 2.0) +A; Then compare to applicable limit;**
5. Unwanted emissions from EUT cabinet or casing shall be measured via radiated emission test method per C63.10 (in this case, the antenna port may be terminated properly).
6. Absolute peak power limit of -21.2dBm within the unwanted emission bandwidth shall be used for meeting 15.35(b) requirement;
7. Per 15.35(c), for pulse operation, Duty Cycle factor reduction can be applied for unwanted emissions that have the same pulse characteristics as does the fundamental emissions (such as harmonics) pulse operation

*** EUT shall be configured to transmit continuously (min. 98% duty cycle at full power). The spectrum analyzer shall be set for bin-to-bin spacing ≤RBW/2.

RESULTS

Complied with 30dBc attenuation requirement.

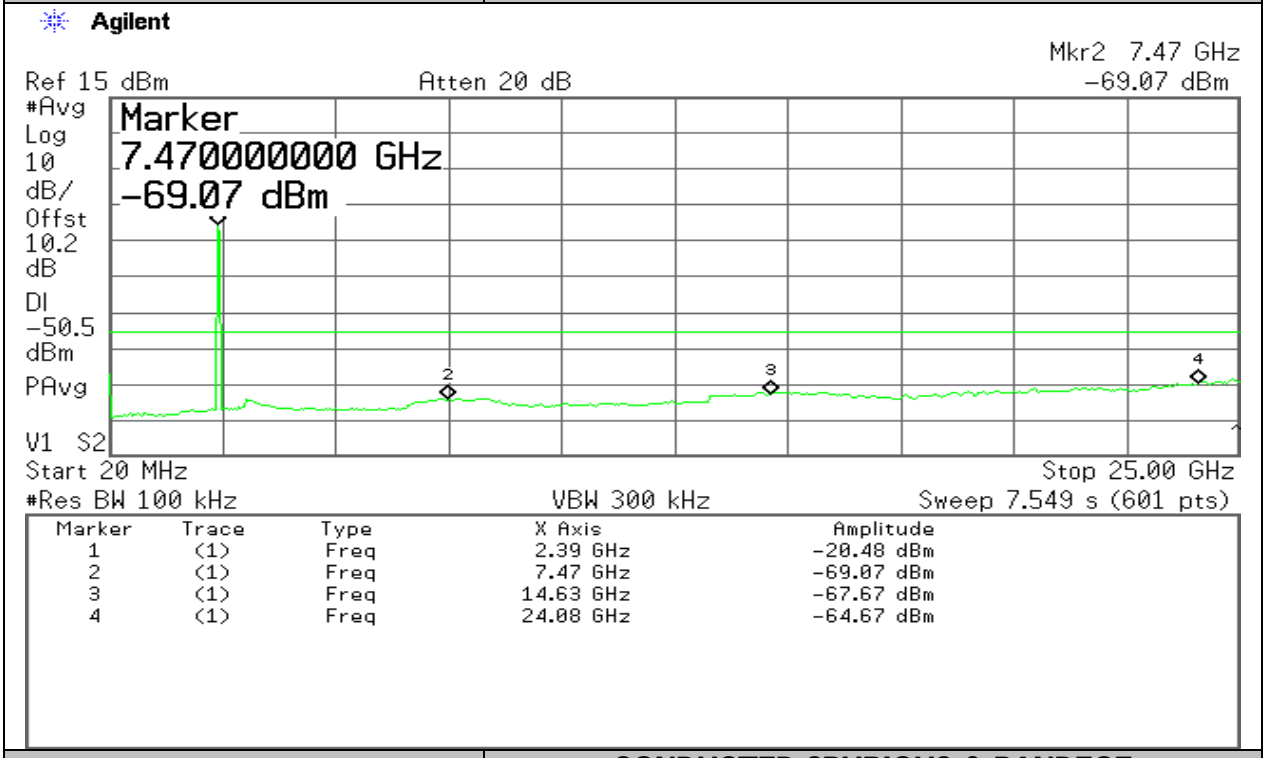
Data Summary:

Mode No.1 802.11 b

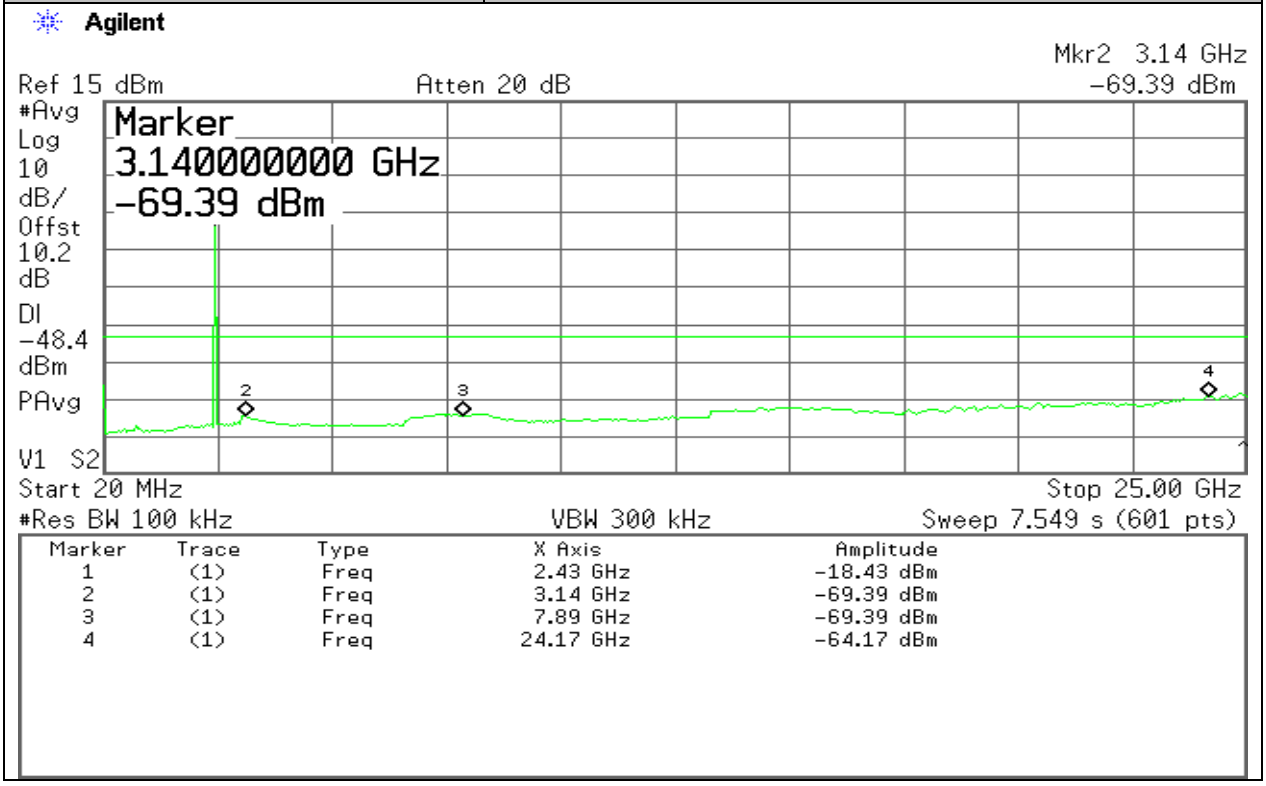
Channel	Frequency (MHz)	PSD Reference Level (dBm)	Max. Emission Level (dBm)	Attenuation (dBc)
Low	2412	-20.48	-69.07	-48.59
Middle	2437	-18.43	-69.39	-50.96
High	2462	-18.58	-69.34	-50.76

Unwanted Out-of-band Spurious via Conducted Measurement:

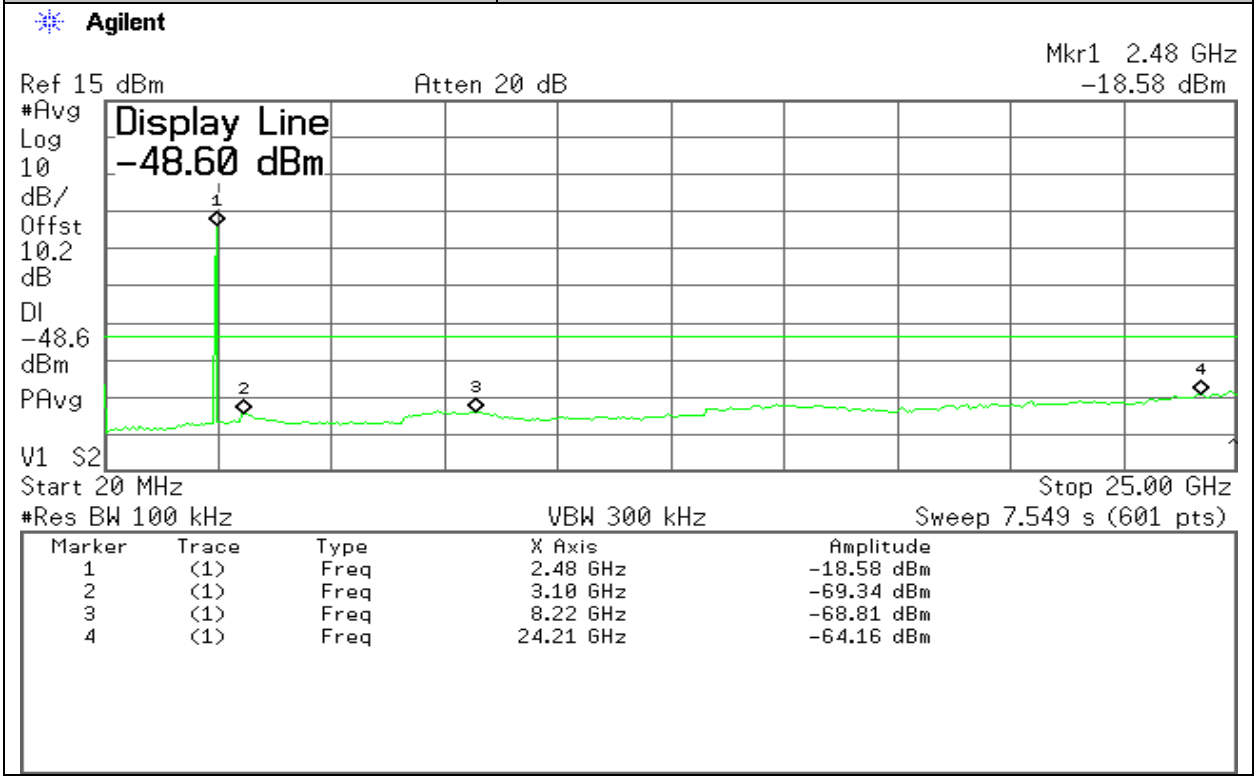
Plot Name:	CONDUCTED SPURIOUS & BANDEGE Mode No 1. 802.11b, Low CH



Plot Name:	CONDUCTED SPURIOUS & BANDEGE Mode No 1. 802.11b, Mid CH

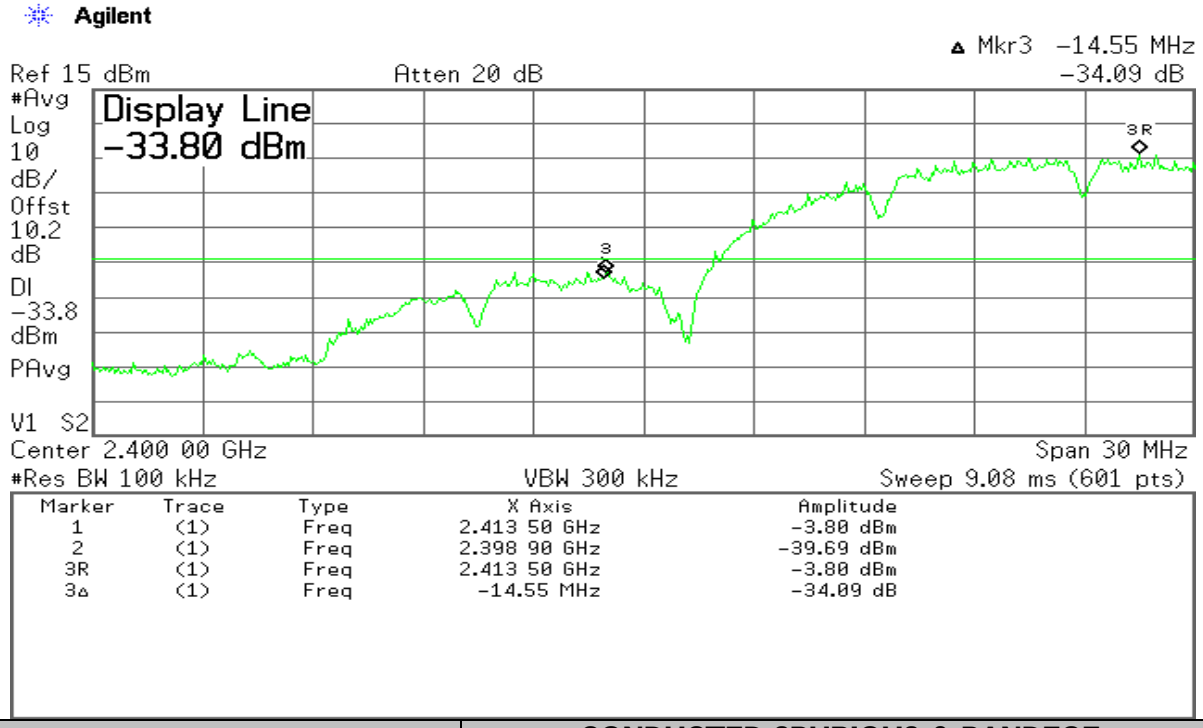


Plot Name:	CONDUCTED SPURIOUS & BANDEGE Mode No 1. 802.11b, High CH

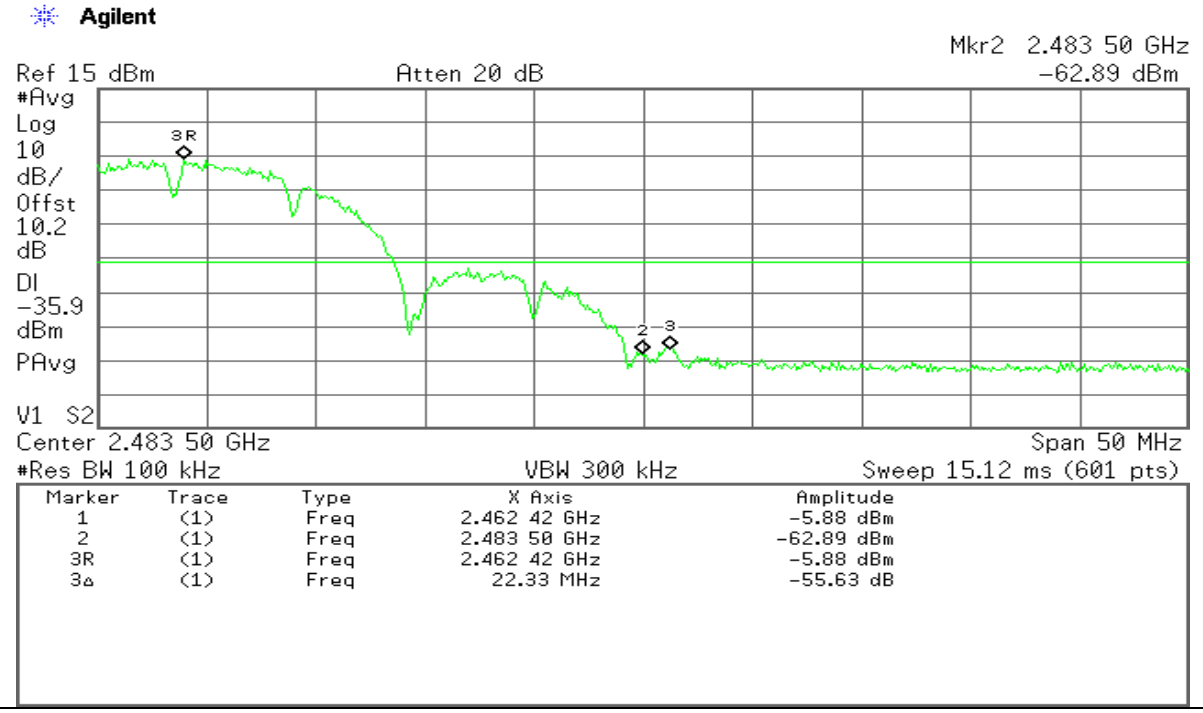


Bandedge Spurious via Conducted Measurement:

Plot Name:	CONDUCTED SPURIOUS & BANDEGE Mode No 1. 802.11b, Low Bandedge



Plot Name:	CONDUCTED SPURIOUS & BANDEGE Mode No 1. 802.11b, High Bandedge



7.7 RADIATED EMISSIONS

7.7.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

LIMITS

§15.205 (a) RSS-102 Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHZ	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[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			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2] Above 38.6

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

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

Frequency (MHz)	Field Strength (microvolts /meter	Measurement Distance (meters)
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode. Established procedures in C63.10 for performing radiated measurements shall be used. For cabinet emission measurements, the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. EUT was tested with applicable orientations.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak. For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

The radio spectrum was investigated from the lowest frequency generated within the device (without going below 9 kHz) up to the 10^{th} harmonic of the rated transmitted emission. The emissions are investigated with the transmitter set to the lowest, middle, and highest channels.

The emissions are investigated with the transmitter set to the lowest, middle, and highest channels, if applicable. The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

RESULTS

No non-compliance noted.

7.7.2. TRANSMITTER RADIATED EMISSIONS DATA

(HARMONICS & SPURIOUS falling in restricted bands listed in Sec.15.205 and non-restricted bands *)

Operation Mode: 802.11b

Low Channel(2412MHz) Harmonics/Spurious

Freq. (MHz)	Worst H/V	Dist. (m)	D Corr (dB)	Peak@3m (dBuV/m)	QP/Avg @3m (dBuV/m)	PK Lim (dBuV/m)	QP /Avg. Lim (dBuV/m)	PK Mar (dBuV/m)	QP /Avg.Mar. (dBuV/m)
4824	Z/H/up	3	-	50.2	41.9	74	54	-23.8	-12.1
4824	Z/V/up	3	-	50.6	40.8	74	54	-23.4	-13.2
7236	Z/H/up	3	-	52.7	42.1	74	54	-21.3	-11.9
7236	Z/V/up	3	-	51.2	41.2	74	54	-22.8	-12.8
4824	Z/H/down	3	-	51.8	43.9	74	54	-22.2	-10.1
4824	Z/V/down	3	-	50.4	41.7	74	54	-23.6	-12.3
7236	Z/H/down	3	-	53.1	44.2	74	54	-20.9	-9.8
7236	Z/V/down	3	-	51.0	41.3	74	54	-23.0	-12.7

Middle Channel(2437MHz) Harmonics/Spurious

Freq. (MHz)	Worst H/V	Dist. (m)	D Corr (dB)	Peak@3m (dBuV/m)	QP/Avg @3m (dBuV/m)	PK Lim (dBuV/m)	QP /Avg. Lim (dBuV/m)	PK Mar (dBuV/m)	QP /Avg.Mar. (dBuV/m)
4874	Z/H/up	3	-	51.7	41.6	74	54	-22.3	-12.4
4874	Z/V/up	3	-	48.5	39.3	74	54	-25.5	-14.7
7311	Z/H/up	3	-	52.1	41.3	74	54	-21.9	-12.7
7311	Z/V/up	3	-	51.6	41.6	74	54	-22.4	-12.4
4874	Z/H/down	3	-	51.8	43.9	74	54	-22.2	-10.1
4874	Z/V/down	3	-	49.9	40.6	74	54	-24.1	-13.4
7311	Z/H/down	3	-	53.5	44.7	74	54	-20.5	-9.3
7311	Z/V/down	3	-	50.4	41.1	74	54	-23.6	-12.9

High Channel(2462MHz) Harmonics/Spurious

Freq. (MHz)	Worst H/V	Dist. (m)	D Corr (dB)	Peak@3m (dBuV/m)	QP/Avg @3m (dBuV/m)	PK Lim (dBuV/m)	QP /Avg. Lim (dBuV/m)	PK Mar (dBuV/m)	QP /Avg.Mar. (dBuV/m)
4924	Z/H/up	3	-	50.7	40.8	74	54	-23.3	-13.2
4924	Z/V/up	3	-	48.5	39.4	74	54	-25.5	-14.6
7386	Z/H/up	3	-	51.3	41.4	74	54	-22.7	-12.6
7386	Z/V/up	3	-	52.0	41.6	74	54	-22.0	-12.4
4924	Z/H/down	3	-	51.1	43.2	74	54	-22.9	-10.8
4924	Z/V/down	3	-	49.8	40.6	74	54	-24.2	-13.4
7386	Z/H/down	3	-	53.5	44.2	74	54	-20.5	-9.8
7386	Z/V/down	3	-	50.7	41.0	74	54	-23.3	-13.0

* Data shown above represents the worst case in all applicable EUT orientations. No other significant emissions were found in the rest frequency range. For spurious in restricted band, the limit is per 15.209.

Band Edge Data for EUT

In addition, the band-edge requirements are also verified.

Testing procedure per KDB 558074D01:

The measurement of unwanted emissions at the edge of the authorized frequency bands can be complicated by the capture of RF energy from the fundamental emission within the RBW passband. The following techniques are permitted for use in performing a measurement of the unwanted emission level at the band edges.

10.2.5.1 Marker-Delta Method

The marker-delta method, as described in KDB 913591 and in C63.10, can be used to perform measurements of the unwanted emissions level at the band-edges.

10.2.5.2 Integrated Power Measurement

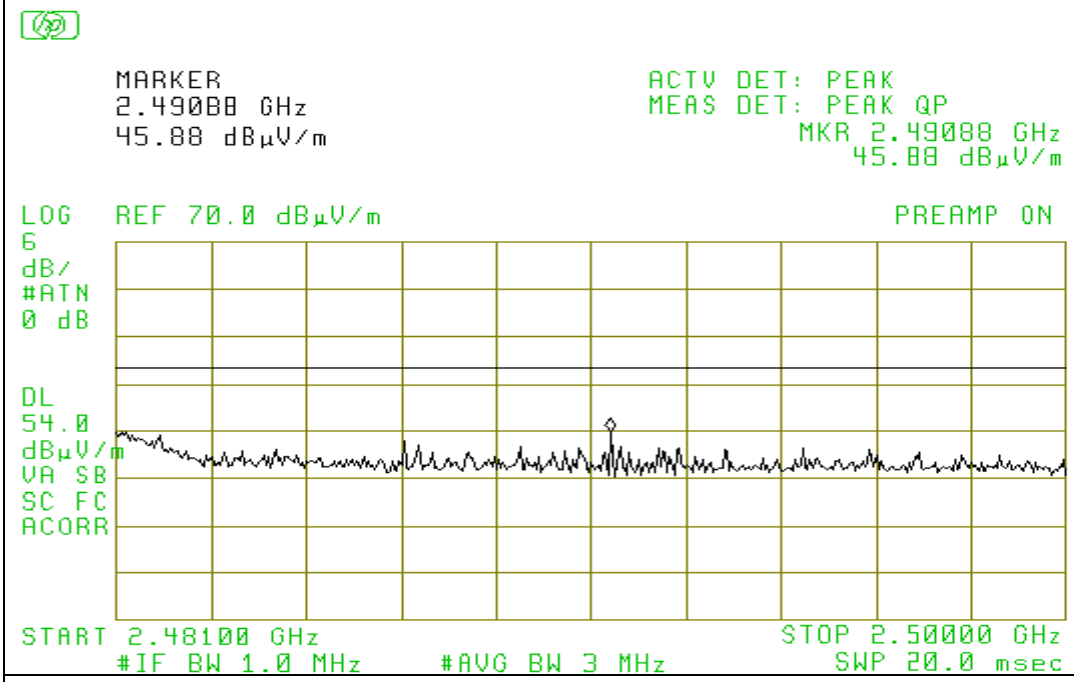
A narrower resolution bandwidth can be used at the band edge to improve the measurement accuracy provided that the measurement is subsequently integrated to the relevant bandwidth specification (e.g., 100 kHz within non-restricted bands and 1 MHz within restricted frequency bands).

Results:

The testing results for worst case based on pretesting results are shown as following and comply with the band-edge requirements for 2400-2483.5MHz DTS per FCC Part 15.247. EUT antenna with max gain was used for this testing.

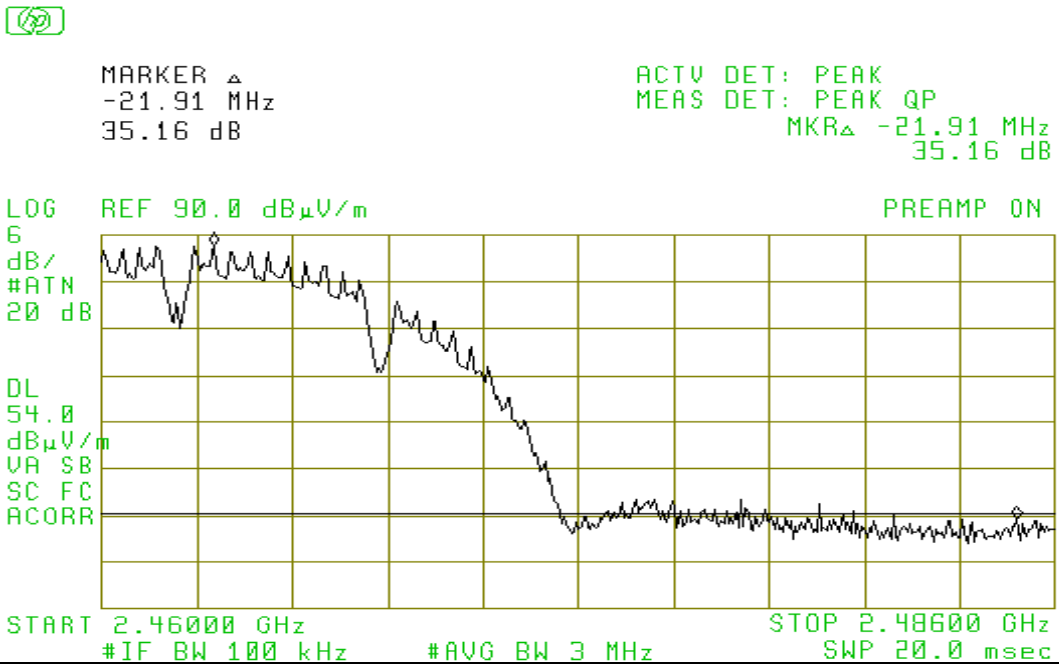
- H=Measurement antenna horizontal position
- V= Measurement antenna vertical position
- Using conventional manner for measuring the radiated emissions that are removed by more than two measurement bandwidths from band-edge, such as the emissions in the restricted band 2310-2390MHz & 2483.5-2500MHz, etc.
- Using conventional manner or if needed, using “delta” measurement technique for measuring the radiated emissions that are up to two measurement bandwidths removed from band-edge, such as the restricted band that begins at 2483.5MHz.
- The worst case for different EUT orientations was chosen for final data collection based on pre-scan testing results.

Plot Name:	Band-Edge Radiated Emissions for Mode 1: 802.11 b @ High End, worst

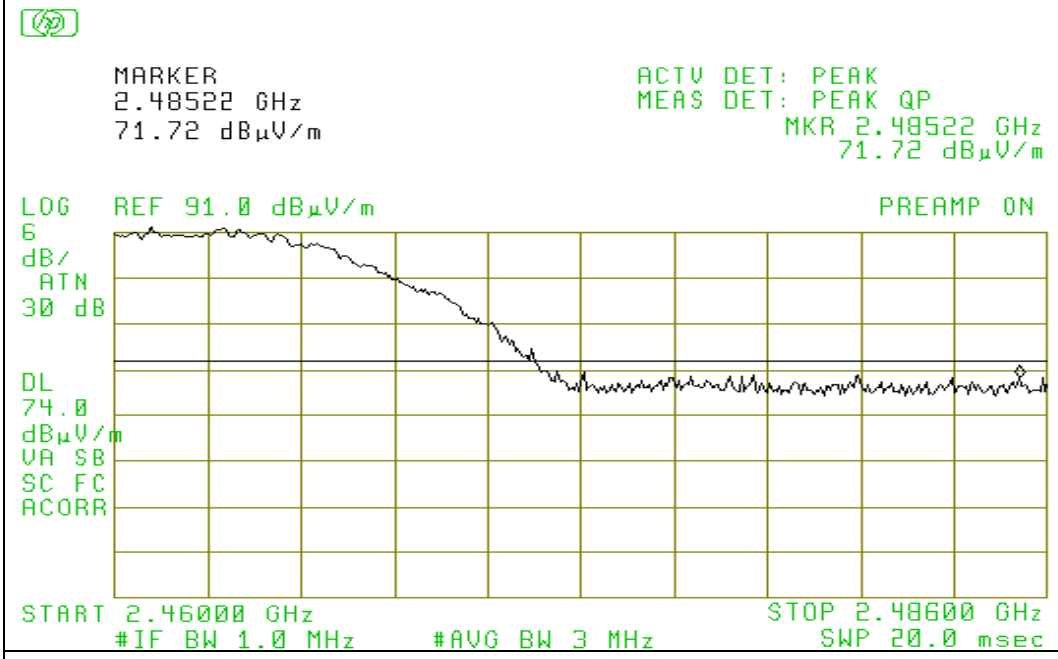


Average reading @ 2.49088GHz: 41.6dBuV/m

Plot Name:	Band-Edge Radiated Emissions for Mode 1: 802.11 b @ High End, V

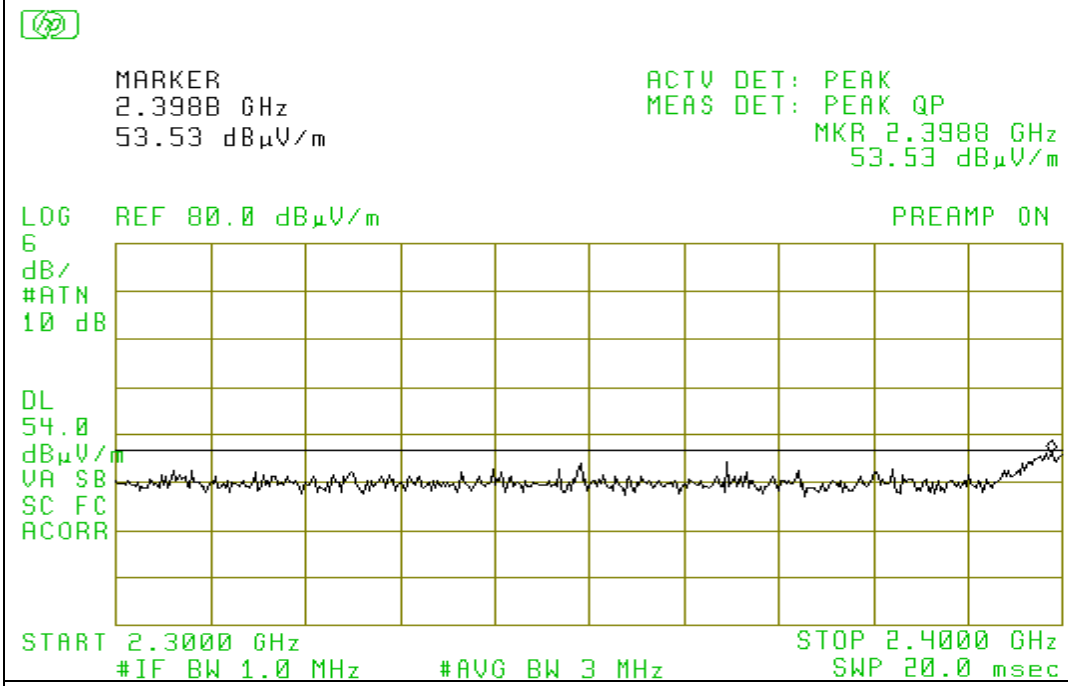


Plot Name:	Band-Edge Radiated Emissions for Mode 1: 802.11 b @ High End, V



Worst Peak Reading in restricted band <74dBuV/m

Plot Name:	Band-Edge Radiated Emissions for Mode 1: 802.11 b @ Low End, worst



Average reading @ 2.3988GHz: 48.2dBuV/m

7.8 CONDUCTED EMISSION *

7.8.1 Test Methods and Conditions

The EUT was under normal operational mode during the conducted emission test. EMI Receiver was scanned from 150KHz to 30MHz with maximum hold mode for maximum emission. Recorded data was sent to the plotter to generate output in linear format. At the input of the spectrum analyzer, a HP transient limiter is inserted for protective purpose. This limiter has a 10 dB attenuation in the range of 150KHZ to 30MHZ. That factor was automatically compensated by the receiver, so the readings are the corrected readings. The reference of the plot is the CISPR 22 Class B limit in following plots.

Conducted Emission Technical Requirements				
	Class A		**Class B**	
Frequency Range	**Quasi-Peak dBuV**	**Average dBuV**	**Quasi-Peak DBuV**	**Average dBuV**
150kHz –0.5MHz	79 (8912uV)	66 (1995uV)	66-56	56-46
0.5MHz-30MHz	73 (4467uV)	60 (1000uV)	---	---
0.5MHz- 5MHz	---	---	56	46 (250uV)
5MHz-30MHz	---	---	60	50

Emissions that have peak values close to the specification limit (if any) are also measured in the quasi-peak/average mode to determine compliance.

7.8.2 Test Data

The following plots show the neutral and line conducted emissions for the standard operation.

Highest Data for AC Line Conducted Emissions						
Frequency (MHz)						
Peak Reading (dBuV)						
Average Reading (dBuV*)						

* no need to show the average reading if the peak value is under average limit.

Test Personnel:

Tester Signature: _____

Typed/Printed Name: _____ Date: _____

Not Applicable