

Nemko-CCL, Inc.
1940 West Alexander Street
Salt Lake City, UT 84119
801-972-6146

Test Report

Certification

Test Of: 67Tb

FCC ID: 2AA6Z67TB

Test Specifications:

FCC PART 15, Subpart C

Test Report Serial No: 293209-5.1

Applicant:
CaptionCall, LLC
4215 South Riverboat Road
Salt Lake City, UT 84123
U.S.A

Date of Test: August 27, 2015

Report Issue Date: October 2, 2015

Accredited Testing Laboratory By:



NVLAP Lab Code 100272-0

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Nemko-CCL, Inc. to document compliance of the device described below with the requirements of Federal Communications Commission (FCC) Part 15, Subpart C. This report may be reproduced in full, partial reproduction may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

- Applicant: CaptionCall, LLC
- Manufacturer: CaptionCall, LLC
- Brand Name: CaptionCall
- Model Number: 67Tb
- FCC ID: 2AA6Z67TB

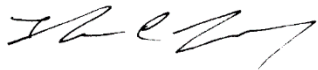
On this 2nd day of October 2015, I, individually and for Nemko-CCL, Inc., certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has recognized that the Nemko-CCL, Inc. EMC testing facilities are in good standing, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

Nemko-CCL, Inc.



Tested by: Norman P. Hansen
Test Technician



Reviewed by: Thomas C. Jackson
Certification Manager

Revision History		
Revision	Description	Date
0	Original Report Release for the CaptionCall 67T (FCC ID 2AA6Z67T) as Nemko-CCL report #251965-3	May 29, 2014
1	The Applicant has activated the Bluetooth capabilities of the transceiver chip. No hardware changes have been implemented. Section 7 has been added to show the Bluetooth test data.	October 2, 2015

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SECTION 1.0 CLIENT INFORMATION

1.1 Applicant:

Company Name: CaptionCall, LLC
4215 South Riverboat Road
Salt Lake City, UT 84123
U.S.A.

Contact Name: Jasper Pan
Title: Hardware Engineering Manager

1.2 Manufacturer:

Company Name: CaptionCall, LLC
4215 South Riverboat Road
Salt Lake City, UT 84123
U.S.A.

Contact Name: Jasper Pan
Title: Hardware Engineering Manager

SECTION 2.0 EQUIPMENT UNDER TEST (EUT)**2.1 Identification of EUT:**

Brand Name: CaptionCall
 Model Number: 67Tb
 Serial Number: None
 Dimensions: 25 cm x 22 cm x 5 cm

2.2 Description of EUT:

The CaptionCall 67Tb is a single-line telephone that incorporates a 7" easy to read touch screen to quickly provide written captioning services (similar to captioned television) for anyone who has trouble hearing on the phone. It works like a regular telephone with dial keypad, handset, and speakerphone. Audio and frequency settings can be customized to each person's hearing loss. The 67Tb has a phone port, Ethernet port, and neckloop port. Power is provided by a Kwong Yuen DR12015U311 power supply. The 67Tb has a transceiver module for 802.11bgn and Bluetooth. The antenna is an inverted F, trace antenna on a separate PCB connected to the Main PCB by a 25 cm coaxial cable with FLP-40 connectors. The table below shows the 802.11bgn channels, frequencies, and maximum power settings incorporated in the production firmware. The Bluetooth transceiver uses 79 channels, spaced 1 MHz apart, from 2402 MHz to 2480 MHz. The power setting for Bluetooth operation was +10.

Channel Number	Frequency	Maximum Power Setting		
		802.11b	802.11g	802.11n (Note 1)
1	2412	+16	+13	+13
2	2417	+16	+16	+16
3	2422	+16	+17	+17
4	2427	+16	+17	+17
5	2432	+16	+17	+17
6	2437	+16	+17	+17
7	2442	+16	+17	+17
8	2447	+16	+17	+17
9	2452	+16	+17	+17
10	2457	+16	+16	+16
11	2462	+16	+14	+14
Note 1: When operating in 802.11n, only the 20 MHz bandwidth is supported.				

The 802.11bgn transceiver was tested and certified under FCC ID 2AA6Z67T. The Bluetooth operation of the transceiver chip was enabled for Bluetooth operation. The data in this test report for the 802.11bgn transceiver is placed in this report from Nemko-CCL report 251965-3. The Bluetooth data was taken August 27, 2015.

This report covers the circuitry of the devices subject to FCC Part 15, Subpart C. The circuitry of the device subject to FCC Subpart B was found to be compliant and is covered in Nemko-CCL, Inc. report 251965-2.

2.3 EUT and Support Equipment:

The FCC ID numbers for all the EUT and support equipment used during the test are listed below:

Brand Name Model Number Serial No.	FCC ID Number	Description	Name of Interface Ports / Interface Cables
BN: CaptionCall MN: 67Tb (Note 1) SN: None	2AA6Z67TB	Telephone with captioning	See Section 2.4
BN: ClearSounds MN: CLA7 v2 SN:None	None	Neckloop	Audio/Cable with 2.5mm audio jack (Note 2)
BN: CaptionCall MN: CR1 SN: 69213110300199	2AA6ZCR1	802.11bgn Router	Ethernet/Cat5e cables
BN: Lenovo MN: T60 SN: 063291	DoC	Laptop Computer	Ethernet/Cat5e cable
BN: Trendnet MN: TE100-S8P SN: 0243C3A16540	DoC	Network Switch	LAN/Cat 5e cables (Note 2)
BN: Toshiba MN: 2020 SN: None	None	PBX	Phone/Modular phone cord (Note 2)
BN: Comdial MN: 201 SN: None	None	Telephone	Phone/Modular phone cord

Note: (1) EUT

(2) Interface port connected to EUT (See Section 2.4)

The support equipment listed above was not modified in order to achieve compliance with this standard.

2.4 Interface Ports on EUT:

Name of Ports	No. of Ports Fitted to EUT	Cable Descriptions/Length
Ethernet	1	Cat5e cable/7 meters
Phone	1	Modular phone cord/3 meters
Neckloop	1	Cable with 2.5 mm jack/1 meter

2.5 Modification Incorporated/Special Accessories on EUT:

The following modifications were made to the EUT by the Client during testing to comply with the specification. This report is not complete without an accompanying signed attestation, that the product will have all of the documented modifications incorporated into the product when manufactured and placed on the market.

1. The power settings for 802.11bgn channels were changed to the settings found in the table of paragraph 2.2.

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES**3.1 Test Specification:**

Title: FCC PART 15, Subpart C (47 CFR 15)
15.203, 15.207, and 15.247

Limits and methods of measurement of radio interference
characteristics of radio frequency devices.

Purpose of Test: The tests were performed to demonstrate initial compliance.

3.2 Methods & Procedures:**3.2.1 §15.203 Antenna Requirement**

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. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

3.2.2 §15.207 Conducted Limits

(a) Except for Class A digital devices, for equipment 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 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.5*	66 to 56*	56 to 46*
0.5 – 5	56	46
5 - 30	60	50

*Decreases with the logarithm of the frequency.

3.2.3 §15.247 Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, and 5725 – 5850 MHz

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400 – 2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 non-overlapping channels are used.

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

(b) The maximum peak output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

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

(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 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.

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (b)(4)(i) and (b)(4)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna /antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of $10 \log$ (number of array elements or staves) plus the directional gain of the element or staff having the highest gain.

(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.

(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

(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)).

(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.

(f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

(i) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.

Note: Spread spectrum systems are sharing these bands on a noninterference basis with systems supporting critical Government requirements that have been allocated the usage of these bands, secondary only to ISM equipment operated under the provisions of Part 18 of this Chapter. Many of these Government systems are airborne radiolocation systems that emit a high EIRP which

can cause interference to other users. Also, investigations of the effect of spread spectrum interference to U. S. Government operations in the 902-928 MHz band may require a future decrease in the power limits allowed for spread spectrum operation.

3.3 Test Procedure

The testing was performed according to the procedures in ANSI C63.4: 2003 and 47 CFR Part 15. Testing was performed at the Nemko-CCL, Inc. Wanship open area test site #2, located at 29145 Old Lincoln Highway, Wanship, UT. This site has been registered with the FCC, and was renewed January 22, 2015 (90504). This registration is valid for three years.

Nemko-CCL, Inc. is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Lab Code: 100272-0, which is effective until September 30, 2015.

SECTION 4.0 OPERATION OF EUT DURING TESTING**4.1 Operating Environment:**

Power Supply: 120 VAC
AC Mains Frequency: 60 Hz

4.2 Operating Modes:

The transmitter was tested while in a constant transmit mode at the upper, middle, and lower channels while in Bluetooth SDR, Bluetooth EDR, 802.11b, 802.11g, and 802.11n(20 MHz) modes of operation. The transmitter was tested in each mode using each of the available data rates and modulation types to find the worst-case emissions. The AC mains voltage to the AC adapter was varied as required by §15.31(e) with no change seen in the voltage supplied to the transmitter or in transmitter characteristics. The configuration with the EUT placed as vertical as the incorporated stand allowed exhibited the worst-case emissions.

4.3 EUT Exercise Software:

CaptionCall test software was used to exercise and control the transmitters.

SECTION 5.0 SUMMARY OF TEST RESULTS**5.1 FCC Part 15, Subpart C**

The 67Tb transceiver was subjected to each of the tests shown in the summary table below.

5.1.1 Summary of 802.11bgn Tests:

Section	Environmental Phenomena	Frequency Range (MHz)	Result
15.203	Antenna Requirements	Structural requirement	Complied
15.207	Conducted Disturbance at Mains Ports	0.15 to 30	Complied
15.247(a)	Bandwidth Requirement	2400 – 2483.5	Complied
15.247(b)	Peak Output Power	2400 – 2483.5	Complied
15.247(d)	Antenna Conducted Spurious Emissions	0.009 - 25000	Complied
15.247(d)	Radiated Spurious Emissions	0.009 - 25000	Complied
15.247(e)	Peak Power Spectral Density	2400 – 2483.5	Complied
15.247(i)	RF Exposure	2400 – 2483.5	Complied (Note 1)
Note 1: Compliance with these requirements is shown in documents filed with the FCC at the time of Certification.			

5.1.2 Summary of Bluetooth Tests

Section	Environmental Phenomena	Frequency Range (MHz)	Result
15.203	Antenna Requirements	Structural requirement	Complied
15.207	Conducted Disturbance at Mains Ports	0.15 to 30	Complied
15.247(a)	Channel Separation	2400 to 2483.5	Complied
15.247(a)	20 dB Bandwidth	2400 to 2483.5	Complied
15.247(a)	Time of Occupancy	2400 to 2483.5	Complied
15.247(b)	Peak Output Power	2400 to 2483.5	Complied
15.247(d)	Antenna Conducted Spurious Emissions	0.009 - 25000	Complied
15.247(d)	Radiated Spurious Emissions	0.009 - 25000	Complied

Section	Environmental Phenomena	Frequency Range (MHz)	Result
15.247(g)	Channel Usage	2400 to 2483.5	Complied (Note 1)
15.247(h)	Channel Intelligence/Avoidance	2400 to 2483.5	Complied (Note 1)
15.247(i)	RF Exposure	2400 to 2483.5	Complied (Note 1)
Note 1: Compliance with these requirements is shown in documents filed with the FCC at the time of Certification.			

5.2 Result

In the configuration tested, the transceiver(s) complied with the requirements of the specification.

SECTION 6.0 MEASUREMENTS AND RESULTS – 802.11bgn Transceiver**6.1 General Comments:**

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Appendix 1 of this report.

6.2 802.11bgn Test Results:**6.2.1 §15.203 Antenna Requirements**

The EUT uses an inverted F, trace antenna on a PCB separate from the Main PCB that contains the transmitter circuitry. The transceiver is connected to the antenna PCB via a 25 cm coaxial cable with FLP-40 connectors.

RESULT

The EUT complied with the specification.

6.2.2 §15.207 Conducted Disturbance at the AC Mains Ports

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.17	Hot Lead	Peak (Note 1)	46.0	55.0	-9.0
0.50	Hot Lead	Peak (Note 1)	38.6	46.0	-7.4
0.60	Hot Lead	Peak (Note 1)	42.0	46.0	-4.0
18.90	Hot Lead	Quasi-Peak (Note 1)	42.8	50.0	-7.2
19.55	Hot Lead	Quasi-Peak (Note 1)	44.1	50.0	-5.9
20.30	Hot Lead	Quasi-Peak (Note 1)	43.3	50.0	-6.7
0.50	Neutral Lead	Peak (Note 1)	35.8	46.0	-10.2
18.88	Neutral Lead	Peak (Note 1)	46.3	50.0	-3.7
19.33	Neutral Lead	Quasi-Peak (Note 1)	44.5	50.0	-5.5
19.93	Neutral Lead	Quasi-Peak (Note 1)	44.0	50.0	-6.0
20.30	Neutral Lead	Quasi-Peak (Note 1)	41.3	50.0	-8.7
27.25	Neutral Lead	Peak (Note 1)	40.0	50.0	-10.0
Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.					

RESULT

In the configuration tested, the EUT complied with the specification by 3.7 dB.

6.2.3 §15.247(a)(2) Emission Bandwidth

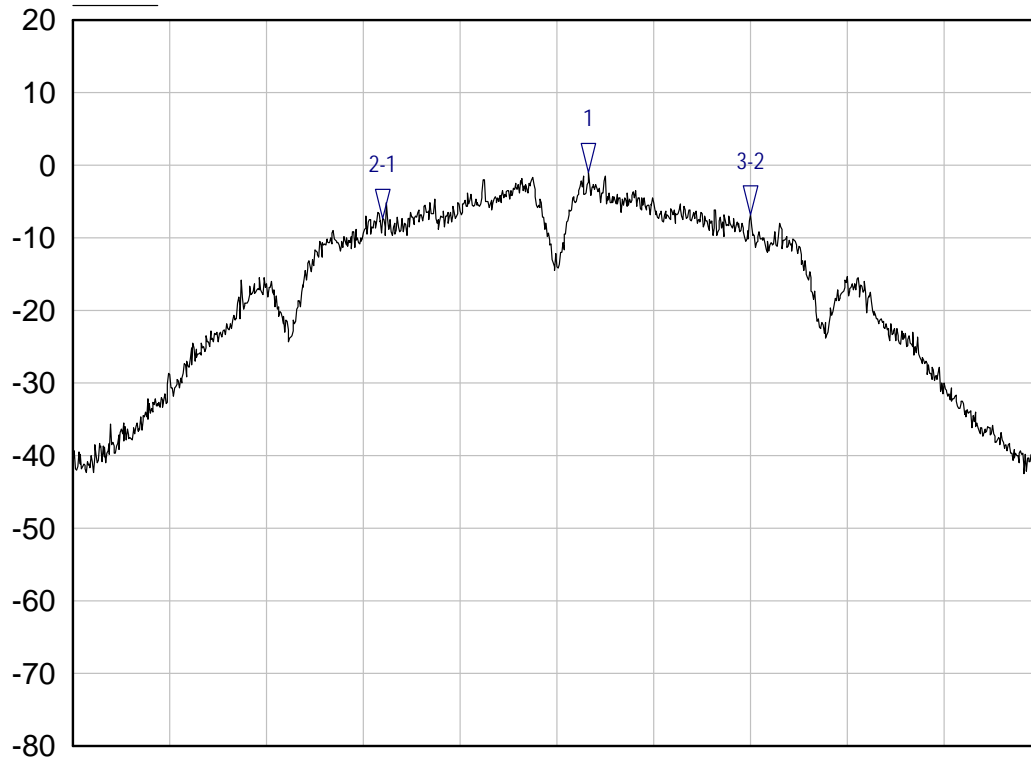
Frequency (MHz)	Emission 6 dB bandwidth (MHz)		
	802.11b	802.11g	802.11n
2412	7.60	15.14	15.02
2437	7.58	15.14	15.14
2462	7.50	15.16	15.14

RESULT

In the configuration tested, the 6 dB bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

Lowest Channel (802.11b)

dBm Trace A



Start: 2.4020 GHz

Stop: 2.4220 GHz

Res BW: 100 kHz

Vid BW: 300 kHz

Sweep: 200.00 ms

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Atten: 55 dB

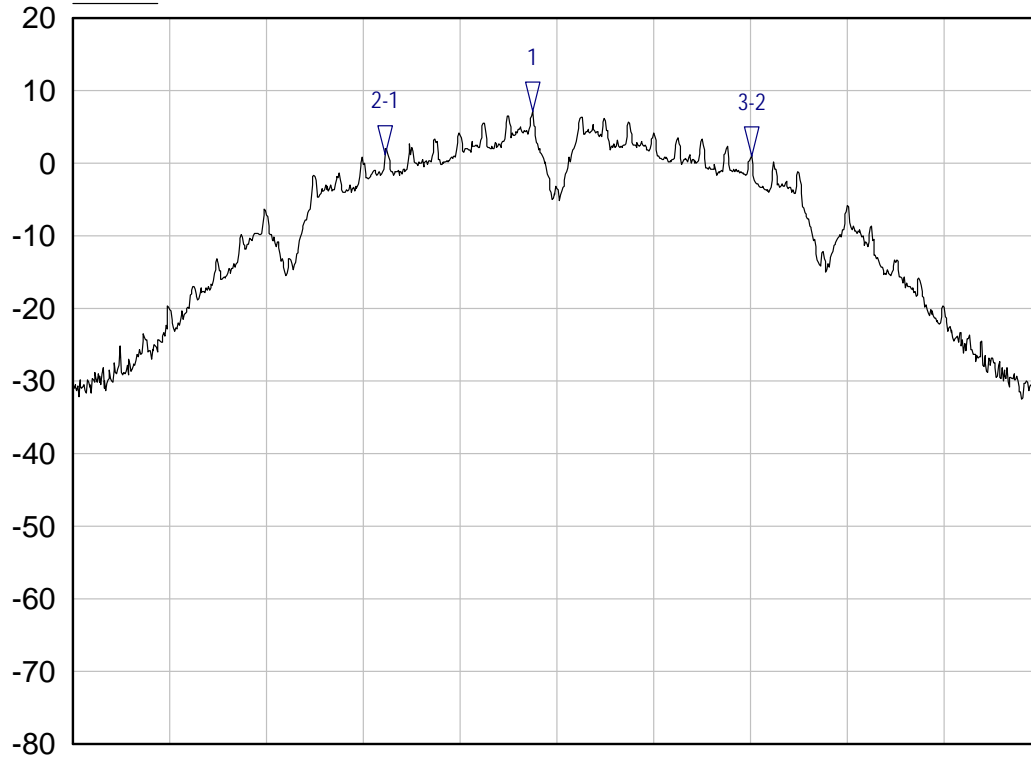
ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4127 GHz	-1.07 dBm	
2-1 ▽	Trace A	-4.2600 MHz	-6.21 dB	
3-2 ▽	Trace A	7.6000 MHz	0.48 dB	

Trace A +16 power setting

Middle Channel (802.11b)

dBm Trace A



Start: 2.4270 GHz

Stop: 2.4470 GHz

Res BW: 100 kHz

Vid BW: 300 kHz

Sweep: 10.00 ms

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Atten: 55 dB

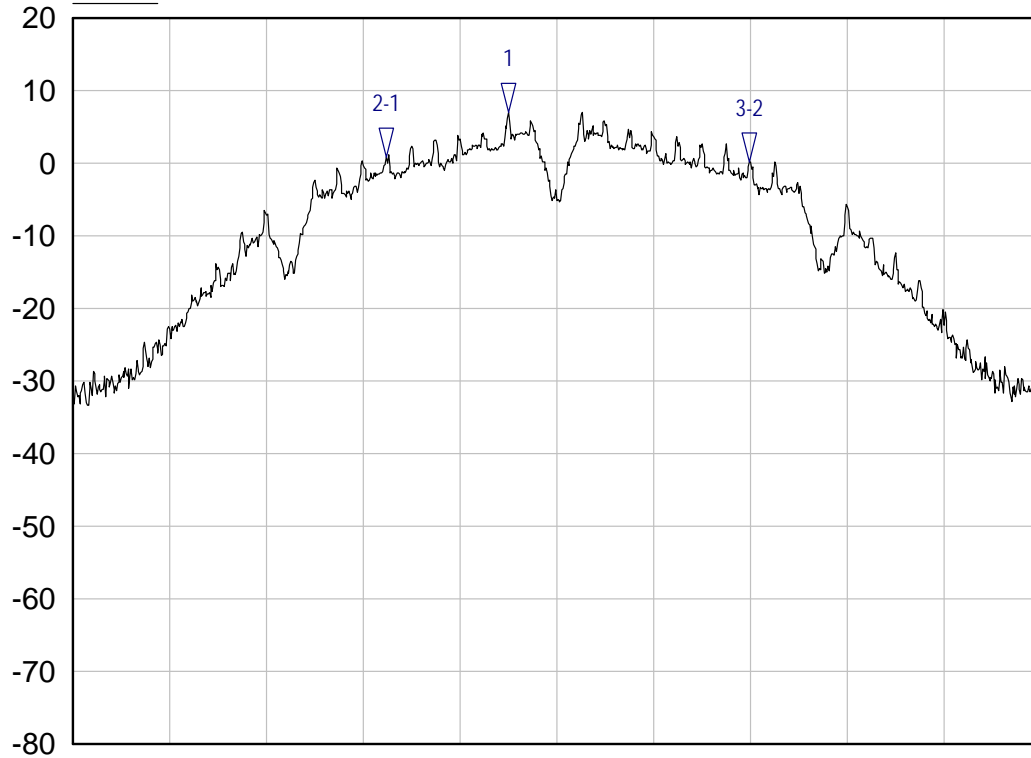
ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4365 GHz	7.10 dBm	
2-1 ▽	Trace A	-3.0600 MHz	-6.02 dB	
3-2 ▽	Trace A	7.5800 MHz	-0.16 dB	

Trace A +16 power setting

Highest Channel (802.11b)

dBm Trace A



Start: 2.4520 GHz

Stop: 2.4720 GHz

Res BW: 100 kHz

Vid BW: 300 kHz

Sweep: 10.00 ms

5/21/2014 12:50:54 PM

Atten: 55 dB

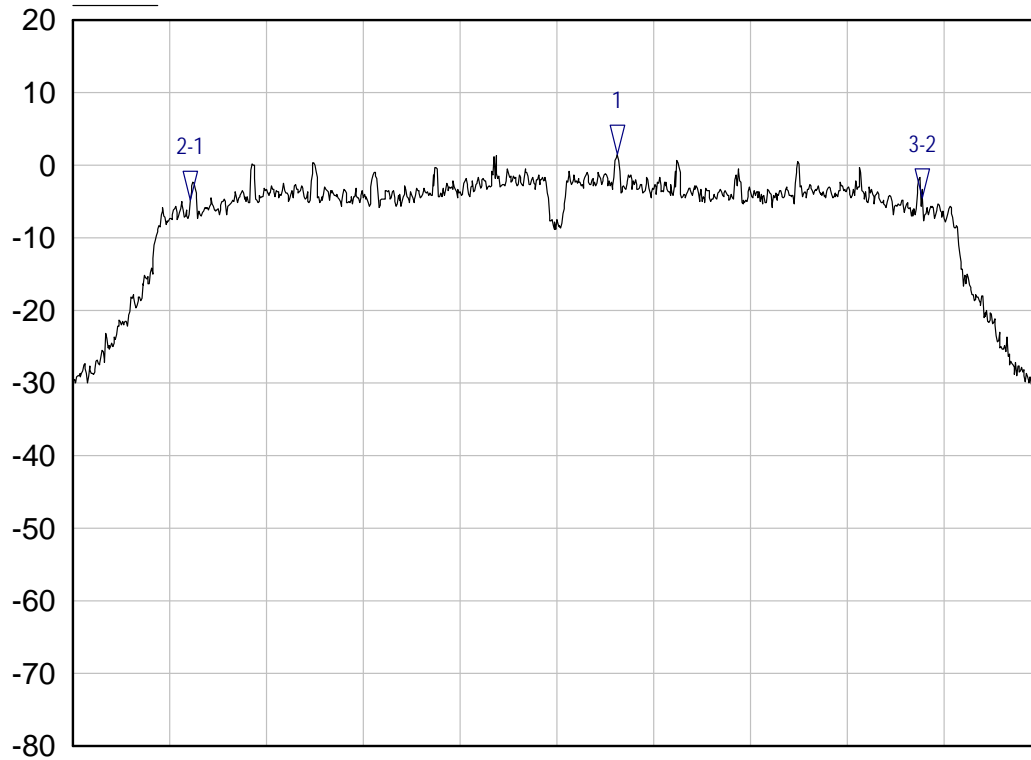
ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4610 GHz	7.01 dBm	
2-1 ▽	Trace A	-2.5200 MHz	-6.19 dB	
3-2 ▽	Trace A	7.5000 MHz	-0.57 dB	

Trace A +16 power setting

Lowest Channel (802.11g)

dBm Trace A



Start: 2.4020 GHz

Stop: 2.4220 GHz

Res BW: 100 kHz

Vid BW: 300 kHz

Sweep: 10.00 ms

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Atten: 55 dB

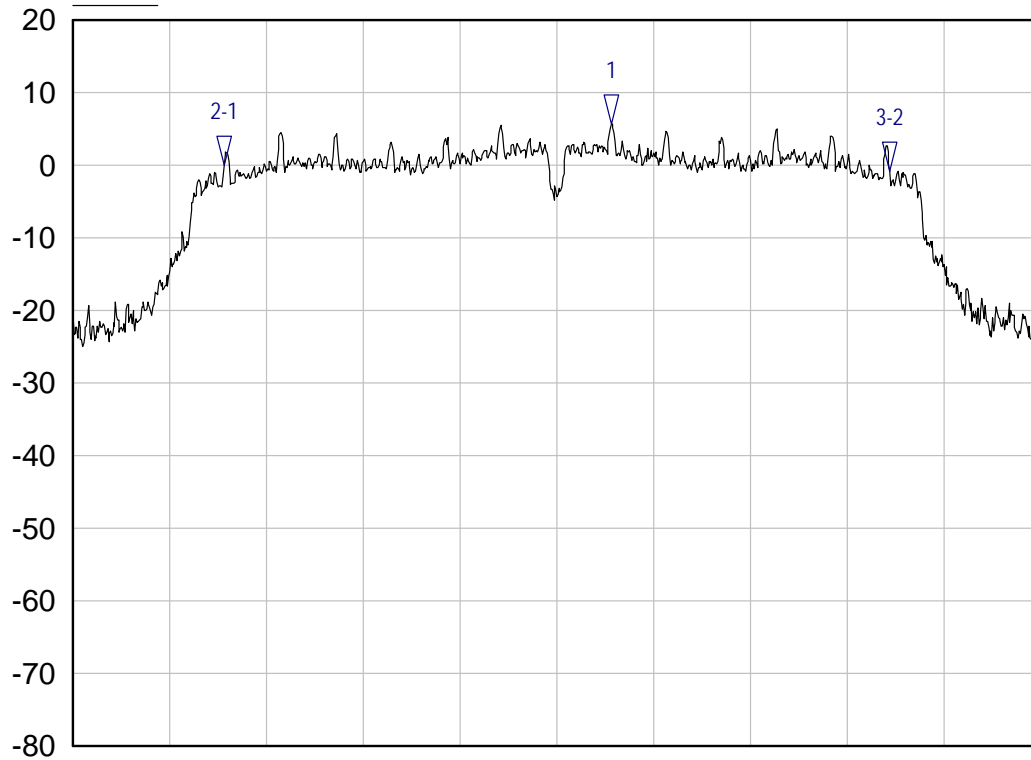
ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4132 GHz	1.54 dBm	
2-1 ▽	Trace A	-8.8200 MHz	-6.30 dB	
3-2 ▽	Trace A	15.1400 MHz	0.24 dB	

Trace A 802.11g +13 power setting

Middle Channel (802.11g)

dBm Trace A



Start: 2.4260 GHz

Stop: 2.4480 GHz

Res BW: 100 kHz

Vid BW: 300 kHz

Sweep: 10.00 ms

5/21/2014 1:40:31 PM

Atten: 55 dB

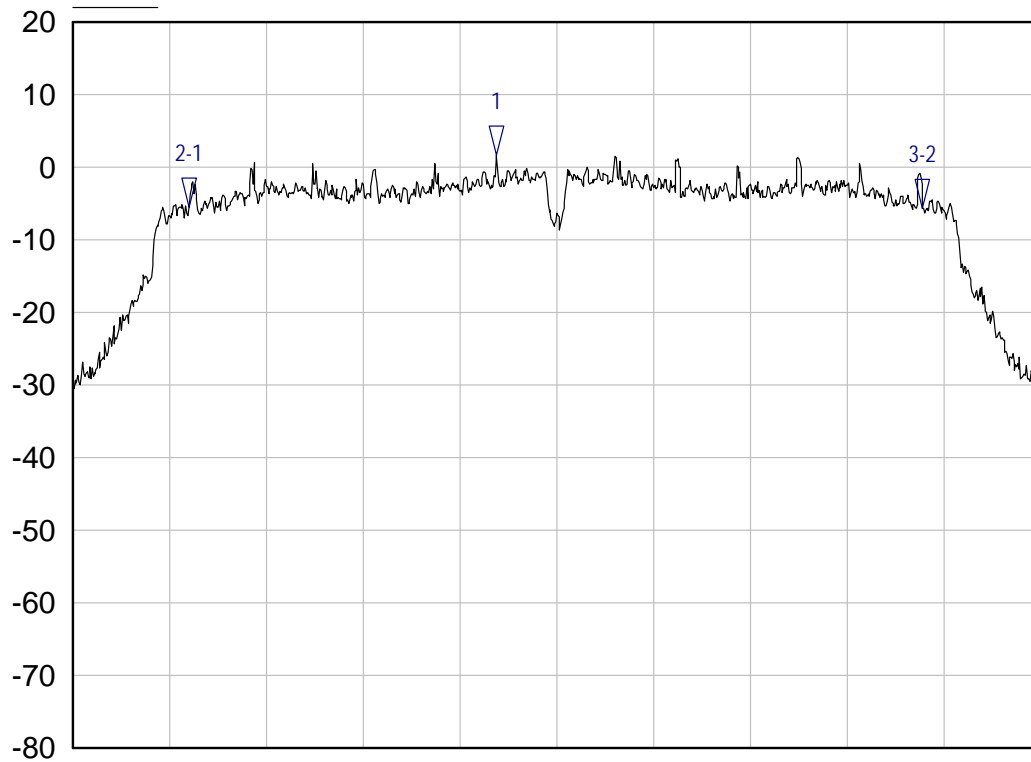
ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4382 GHz	5.73 dBm	
2-1 ▽	Trace A	-8.8000 MHz	-5.74 dB	
3-2 ▽	Trace A	15.1360 MHz	-0.78 dB	

Trace A 802.11g +17 power setting

Highest Channel (802.11g)

dBm Trace A



Start: 2.4520 GHz

Stop: 2.4720 GHz

Res BW: 100 kHz

Vid BW: 300 kHz

Sweep: 10.00 ms

5/21/2014 1:25:28 PM

Atten: 55 dB

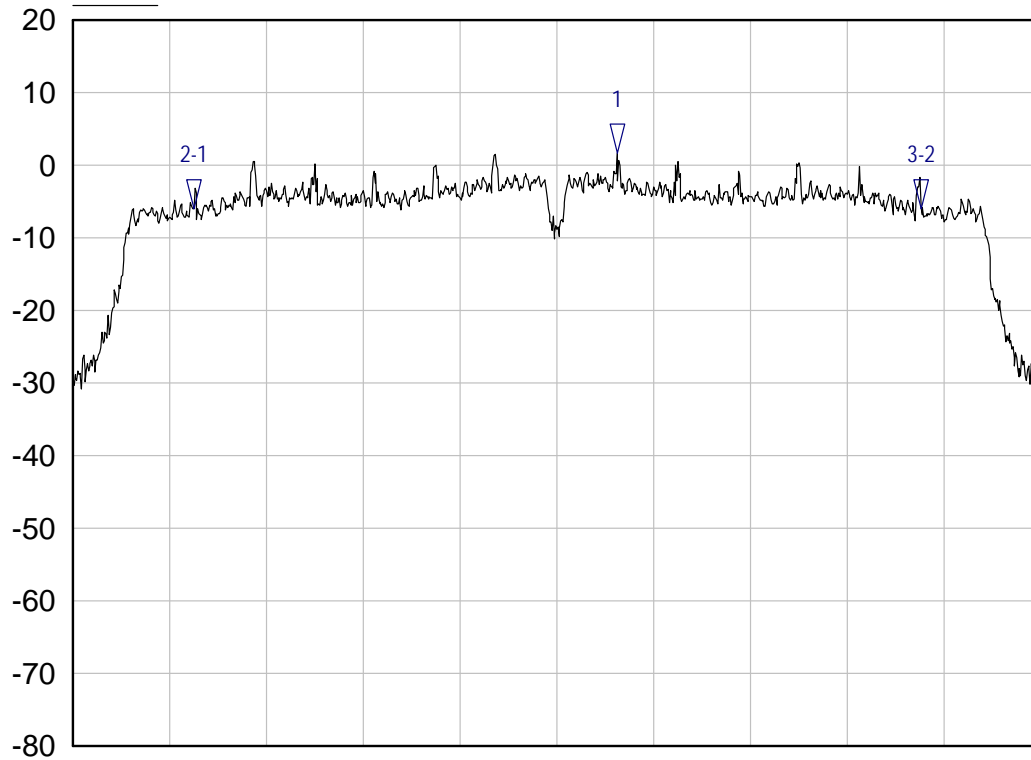
ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4607 GHz	1.60 dBm	
2-1 ▽	Trace A	-6.3400 MHz	-7.03 dB	
3-2 ▽	Trace A	15.1600 MHz	-0.23 dB	

Trace A 802.11g +14 power setting

Lowest Channel (802.11n)

dBm Trace A



Start: 2.4020 GHz

Stop: 2.4220 GHz

Res BW: 100 kHz

Vid BW: 300 kHz

Sweep: 10.00 ms

5/21/2014 2:38:37 PM

Atten: 55 dB

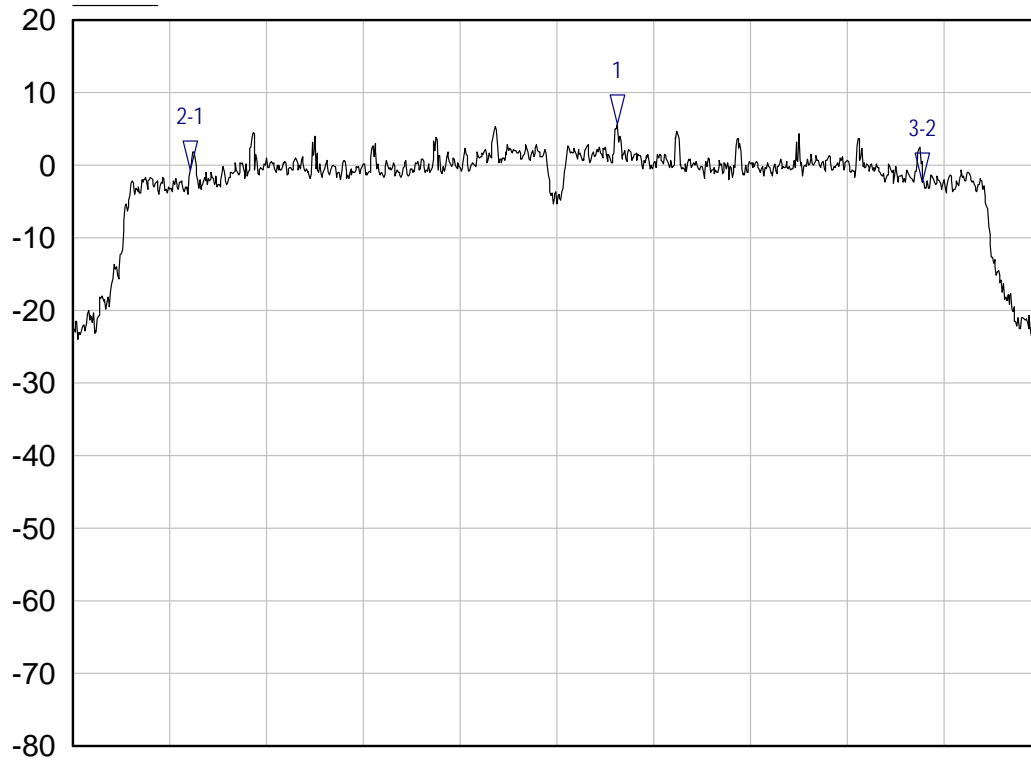
ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4132 GHz	1.66 dBm	
2-1 ▽	Trace A	-8.7400 MHz	-7.67 dB	
3-2 ▽	Trace A	15.0200 MHz	0.03 dB	

Trace A 802.11n +13 power setting

Middle Channel (802.11n)

dBm Trace A



Start: 2.4270 GHz

Stop: 2.4470 GHz

Res BW: 100 kHz

Vid BW: 300 kHz

Sweep: 10.00 ms

5/21/2014 1:52:18 PM

Atten: 55 dB

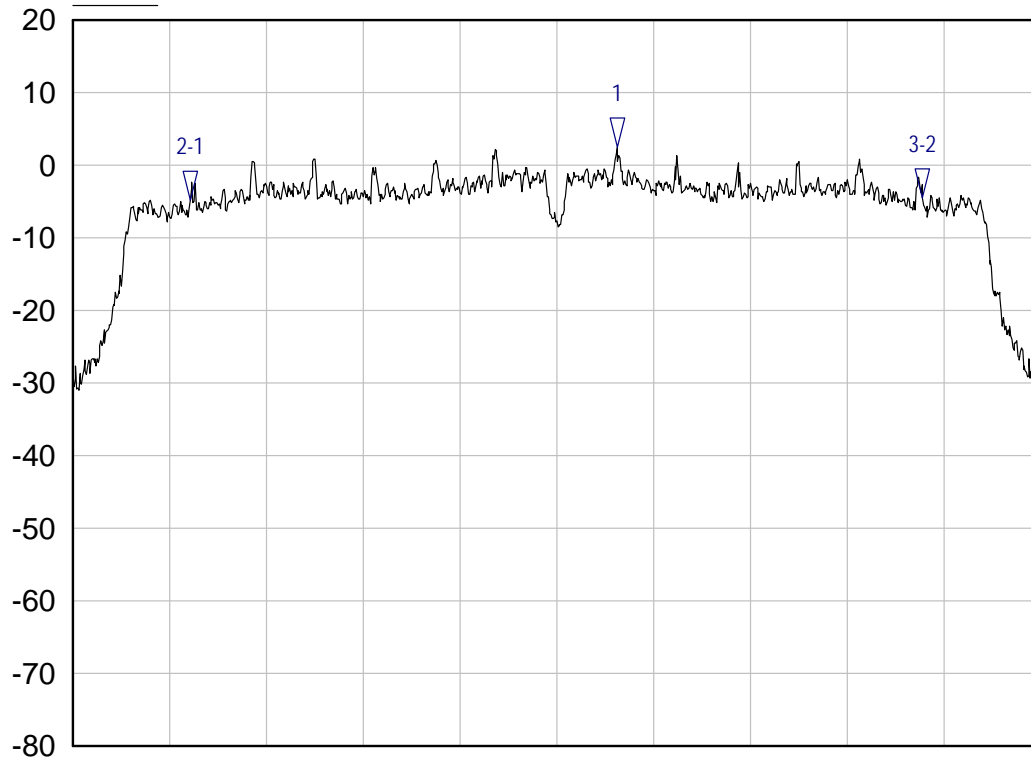
ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4382 GHz	5.73 dBm	
2-1 ▽	Trace A	-8.8200 MHz	-6.35 dB	
3-2 ▽	Trace A	15.1400 MHz	-1.67 dB	

Trace A 802.11n +17 power setting

Highest Channel (802.11n)

dBm Trace A



Start: 2.4520 GHz

Stop: 2.4720 GHz

Res BW: 100 kHz

Vid BW: 300 kHz

Sweep: 10.00 ms

5/21/2014 2:04:03 PM

Atten: 55 dB

ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4632 GHz	2.44 dBm	
2-1 ▽	Trace A	-8.8200 MHz	-7.25 dB	
3-2 ▽	Trace A	15.1400 MHz	0.26 dB	

Trace A 802.11n +14 power setting

6.2.4 §15.247(b)(3) Peak Output Power

The maximum peak RF Conducted output power measured for this device was 23.91 dBm or 246 mW. The limit is 30 dBm or 1 Watt when using antennas with 6 dBi or less gain. The antenna has a maximum calculated gain of 5.4 dBi. Radiated and conducted measurements of the fundamental emission were made in each mode, power setting, and modulation type at the upper, lower, and middle channels and the antenna gain was calculated using the equation $P = (FS \times d)^2 / 30 \times G$ where P is power in Watts, FS is field strength in dBμV/m, d is the measurement distance in meters, and G is the numeric gain of the antenna. The gain of 5.4 dBi was calculated using $P = 112.2 \text{ mW}$ (20.5 dBm), $FS = 121.12 \text{ dBμV/m}$, and $d = 3 \text{ meters}$.

The maximum RBW of the spectrum analyzer was not larger than the bandwidth of the signal to be measured; therefore, the method described in section 9.1.2 of FCC document, KDB 558074 v01r03, Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, dated 04/09/2013 was used to measure the output power.

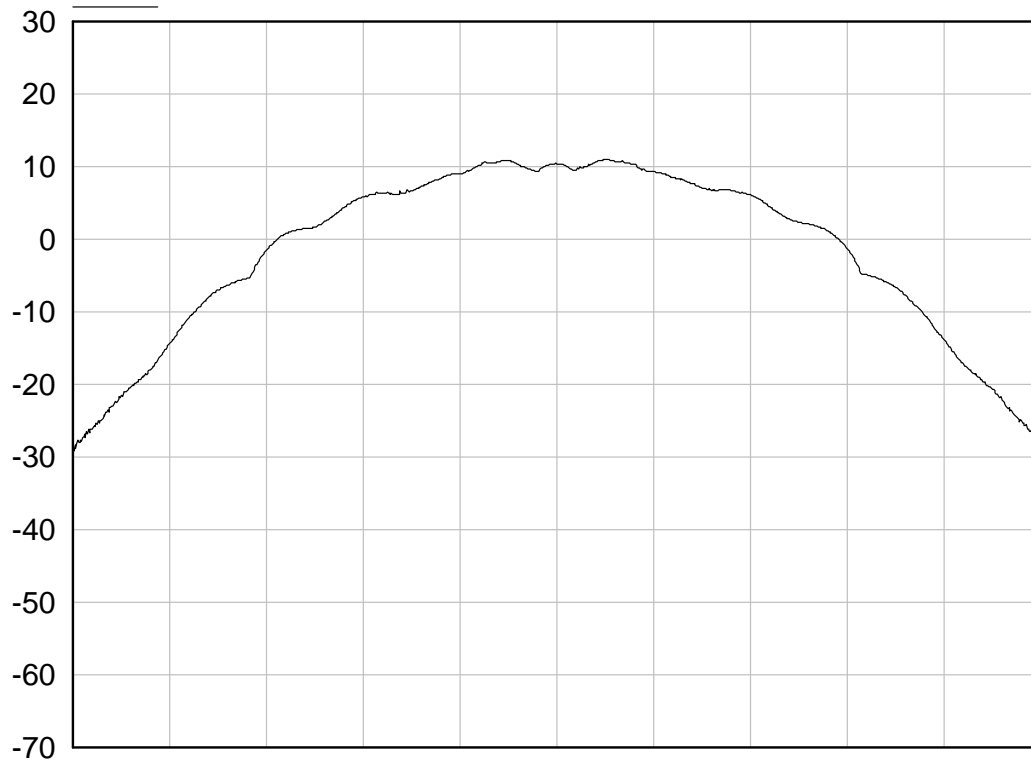
Frequency (MHz)	Measured Output Power (dBm)					
	802.11b		802.11g		802.11n	
	dBm	mW	dBm	mW	dBm	mW
2412	17.33	54.1	20.04	100.9	19.73	94.0
2437	17.22	52.7	23.91	246.0	23.72	235.2
2462	17.23	52.8	20.73	118.3	20.50	112.2

RESULT

In the configuration tested, the RF peak output power was less than 1.0 Watt; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

Lowest Channel (802.11b)

dBm Trace A



Start: 2.4020 GHz

Stop: 2.4220 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

5/21/2014 11:57:16 AM

Atten: 55 dB

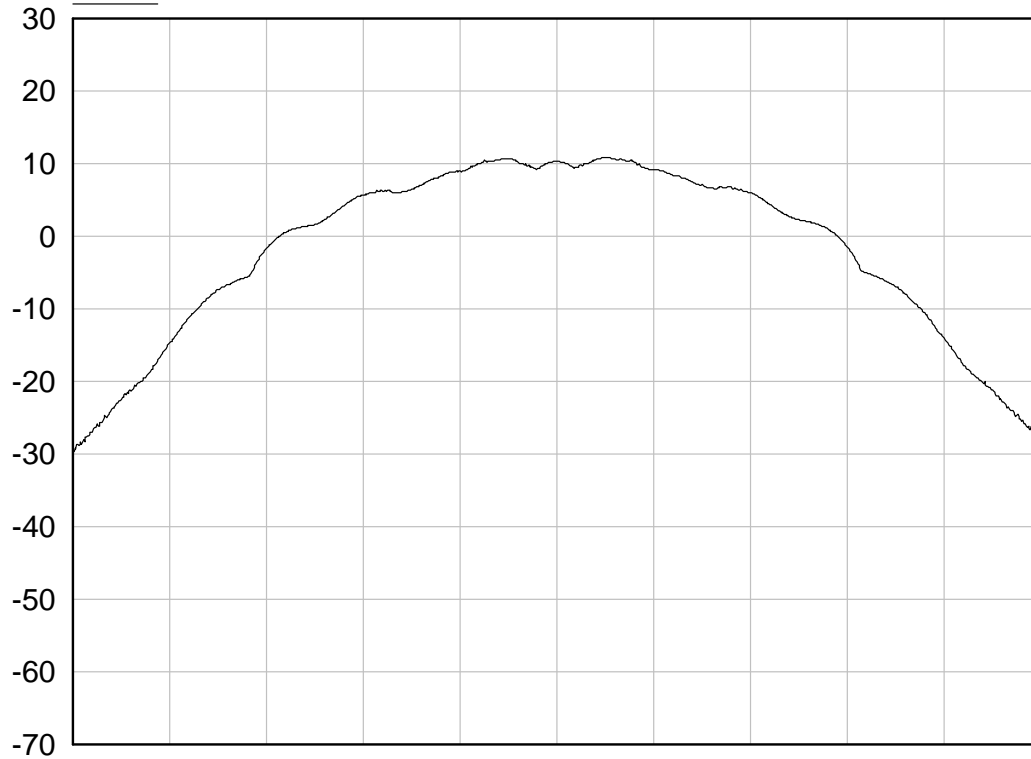
ESU-40

Trace A +16 power setting

Measurement Parameter	Value
Channel power	17.33 dBm

Middle Channel (802.11b)

dBm Trace A



Start: 2.4270 GHz

Stop: 2.4470 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

5/21/2014 12:19:57 PM

Atten: 55 dB

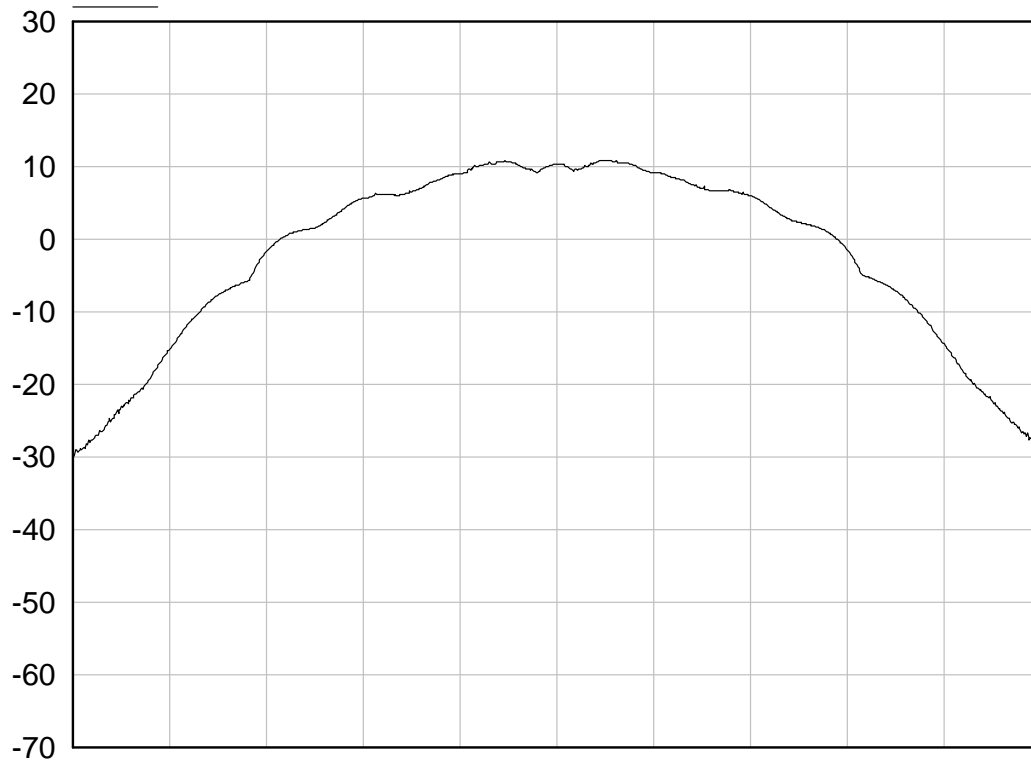
ESU-40

Trace A +16 power setting

Measurement Parameter	Value
Channel power	17.22 dBm

Highest Channel (802.11b)

dBm Trace A



Start: 2.4520 GHz

Stop: 2.4720 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

5/21/2014 12:52:44 PM

Atten: 55 dB

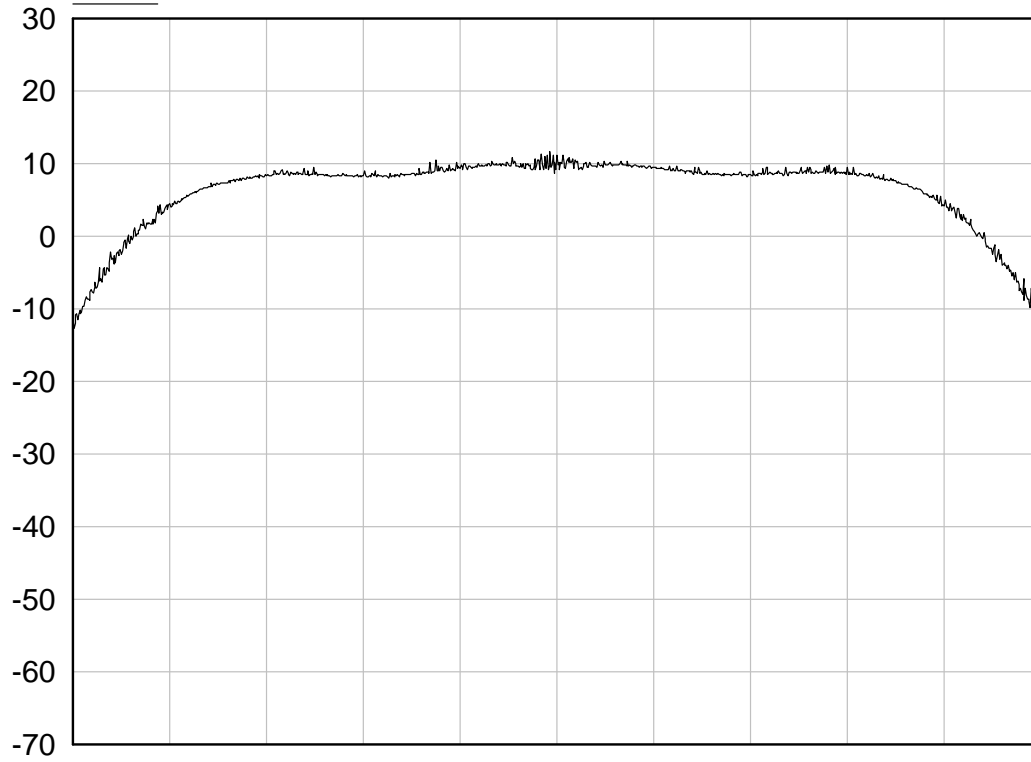
ESU-40

Trace A +16 power setting

Measurement Parameter	Value
Channel power	17.23 dBm

Lowest Channel (802.11g)

dBm Trace A



Start: 2.4020 GHz

Stop: 2.4220 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

5/21/2014 1:07:19 PM

Atten: 55 dB

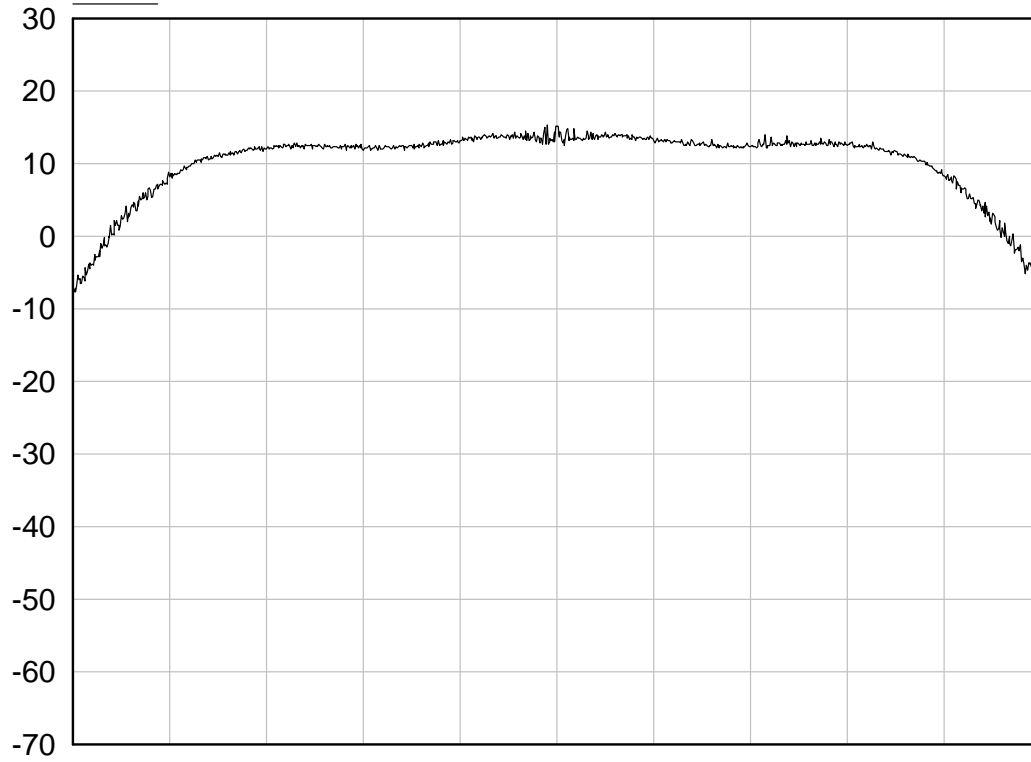
ESU-40

Trace A 802.11g +13 power setting

Measurement Parameter	Value
Channel power	20.04 dBm

Middle Channel (802.11g)

dBm Trace A



Start: 2.4270 GHz

Stop: 2.4470 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

5/21/2014 1:42:50 PM

Atten: 55 dB

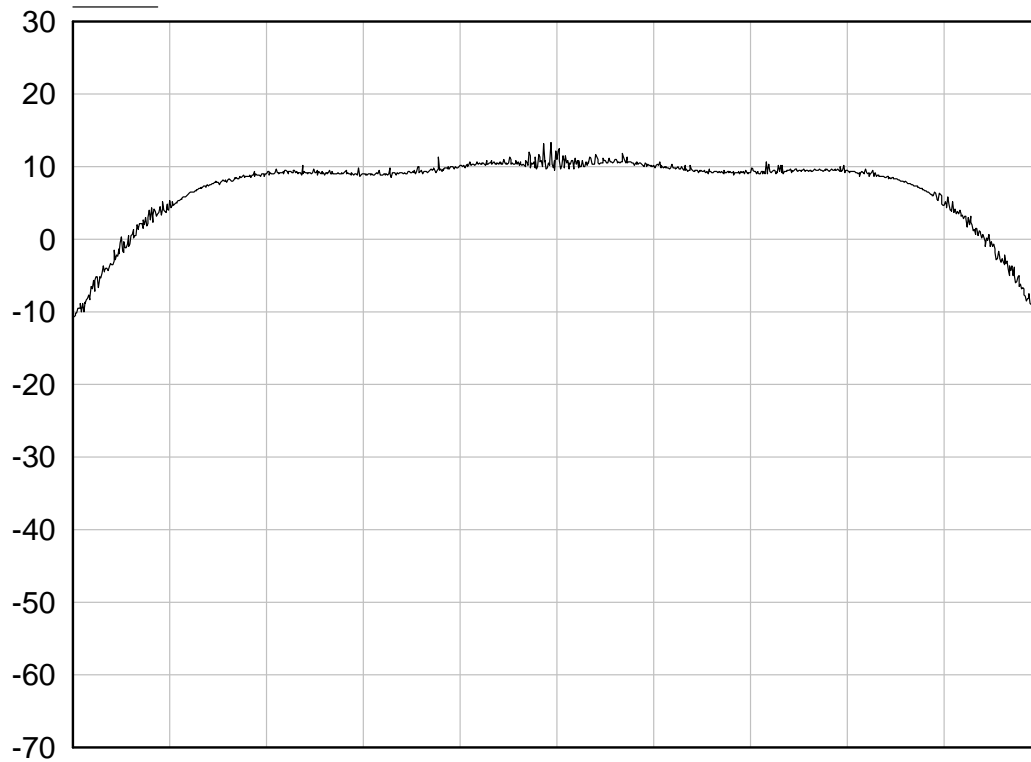
ESU-40

Trace A 802.11g +17 power setting

Measurement Parameter	Value
Channel power	23.91 dBm

Highest Channel (802.11g)

dBm Trace A



Start: 2.4520 GHz

Stop: 2.4720 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

5/21/2014 1:28:27 PM

Atten: 55 dB

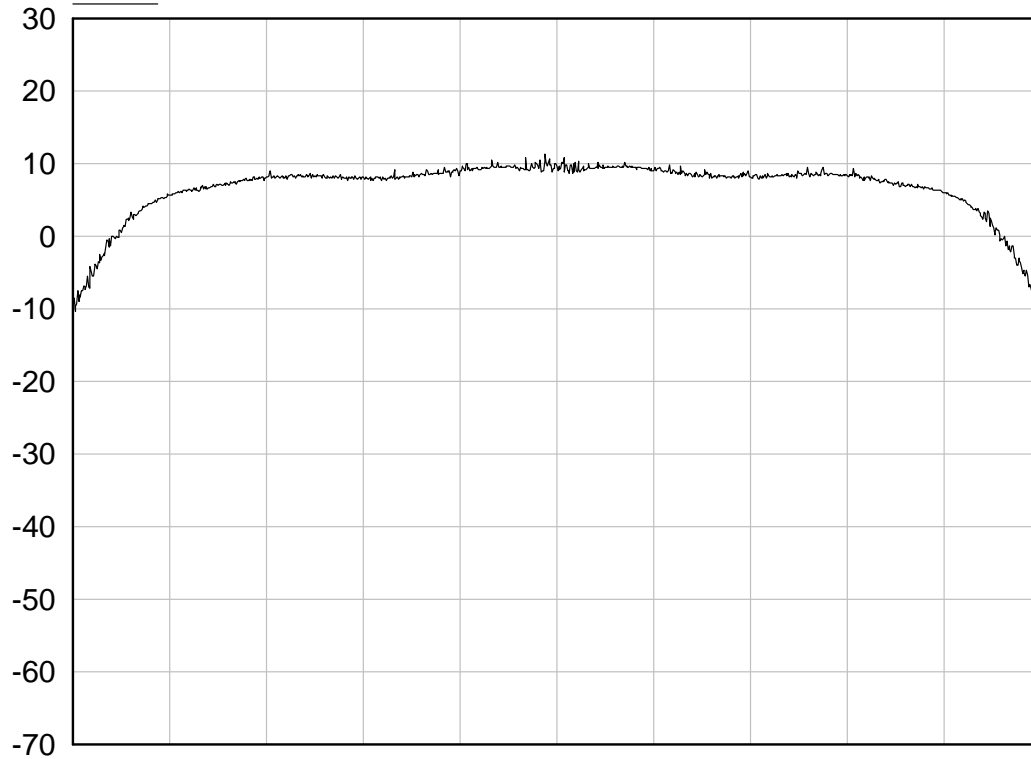
ESU-40

Trace A 802.11g +14 power setting

Measurement Parameter	Value
Channel power	20.73 dBm

Lowest Channel (802.11n)

dBm Trace A



Start: 2.4020 GHz

Stop: 2.4220 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

5/21/2014 2:40:52 PM

Atten: 55 dB

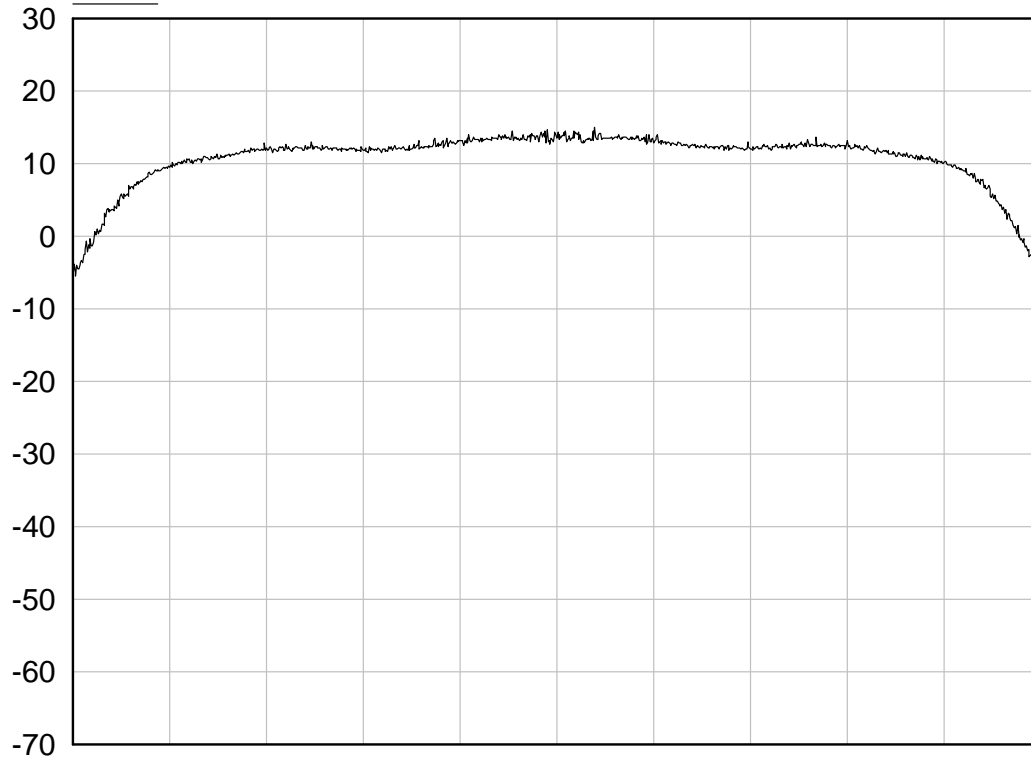
ESU-40

Trace A 802.11n +13 power setting

Measurement Parameter	Value
Channel power	19.73 dBm

Middle Channel (802.11n)

dBm Trace A



Start: 2.4270 GHz

Stop: 2.4470 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

5/21/2014 1:55:24 PM

Atten: 55 dB

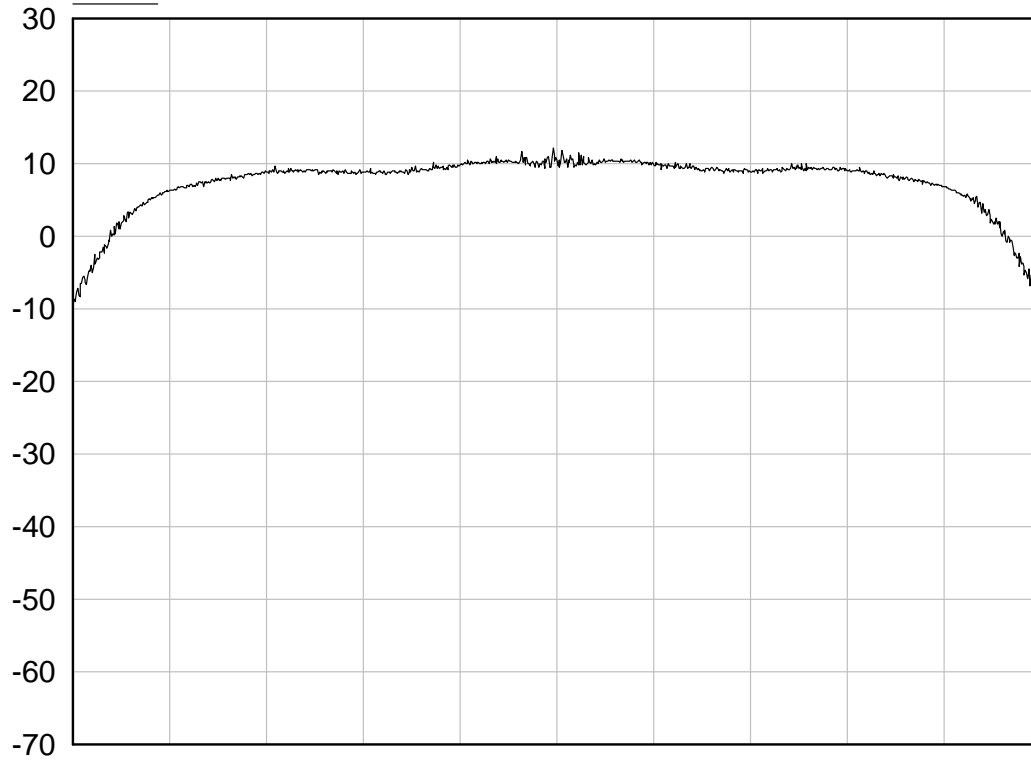
ESU-40

Trace A 802.11n +17 power setting

Measurement Parameter	Value
Channel power	23.72 dBm

Highest Channel (802.11n)

dBm Trace A



Start: 2.4520 GHz

Stop: 2.4720 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

Sweep: 5.00 ms

5/21/2014 2:06:44 PM

Atten: 55 dB

ESU-40

Trace A 802.11n +14 power setting

Measurement Parameter	Value
Channel power	20.50 dBm

6.2.5 §15.247(d) Spurious Emissions**6.2.5.1 Conducted Spurious Emissions**

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. The tables show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency, and upper frequency. Shown below are plots with the EUT tuned to the upper and lower channels. These demonstrate compliance with the provisions of this section at the band edges.

The emissions must be attenuated 20 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW. The table below shows the limits applied in testing. Since when operating in 802.11g and 802.11n modes the device uses different power settings for different channels, band edge plots are shown for those channels.

Frequency (MHz)	802.11b		802.11g		802.11n	
	Fundamental (dBm)	Spurious Limit (dBm)	Fundamental (dBm)	Spurious Limit (dBm)	Fundamental (dBm)	Spurious Limit (dBm)
2412	7.63	-12.37	1.48	-18.52	1.74	-18.26
2437	7.41	--	5.61	-14.39	5.65	-14.35
2462	6.93	--	2.08	-17.92	2.15	-17.85

RESULT

Conducted spurious emissions were attenuated 20 dB or more from the fundamental; therefore, the EUT complies with the specification.

Lowest Channel (802.11b)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4824	-42.5	-12.37	-30.1
7236	-58.9	-12.37	-46.5
9648	-62.3	-12.37	-49.9
12060	-63.0	-12.37	-50.6
14472	-63.1	-12.37	-50.7
16884	-63.4	-12.37	-51.0
19296	-62.8	-12.37	-50.4
21708	-62.5	-12.37	-50.1
24120	-63.4	-12.37	-51.0

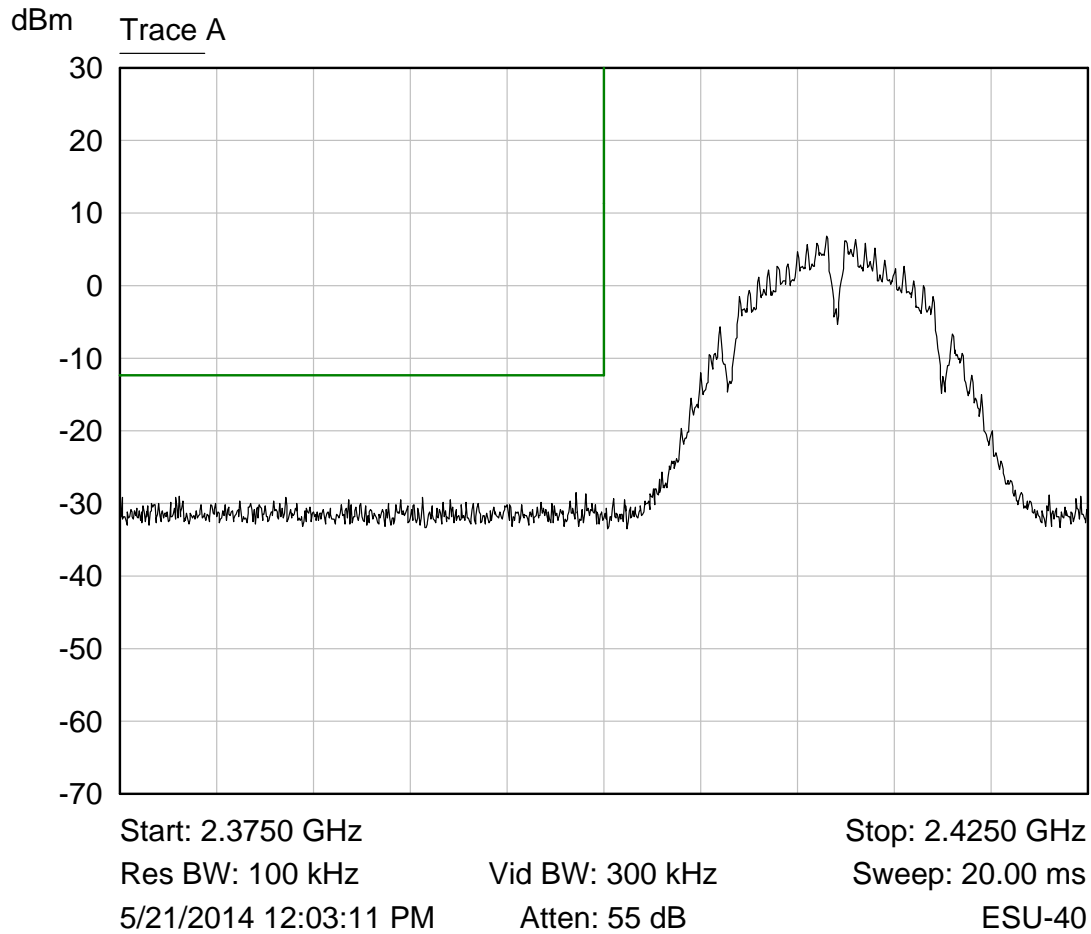
Middle Channel (802.11b)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4874	-45.0	-12.37	-32.6
7311	-59.1	-12.37	-46.7
9748	-62.5	-12.37	-50.1
12185	-62.8	-12.37	-50.4
14622	-62.2	-12.37	-49.8
17059	-62.2	-12.37	-49.8
19496	-63.9	-12.37	-51.5
21933	-63.0	-12.37	-50.6
24370	-63.6	-12.37	-51.2

Highest Channel (802.11b)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4924	-47.0	-12.37	-34.6
7386	-57.5	-12.37	-45.1
9848	-62.5	-12.37	-50.1
12310	-63.1	-12.37	-50.7
14772	-62.8	-12.37	-50.4
17234	-62.8	-12.37	-50.4
19696	-62.8	-12.37	-50.4
22158	-63.0	-12.37	-50.6
24620	-62.1	-12.37	-49.7

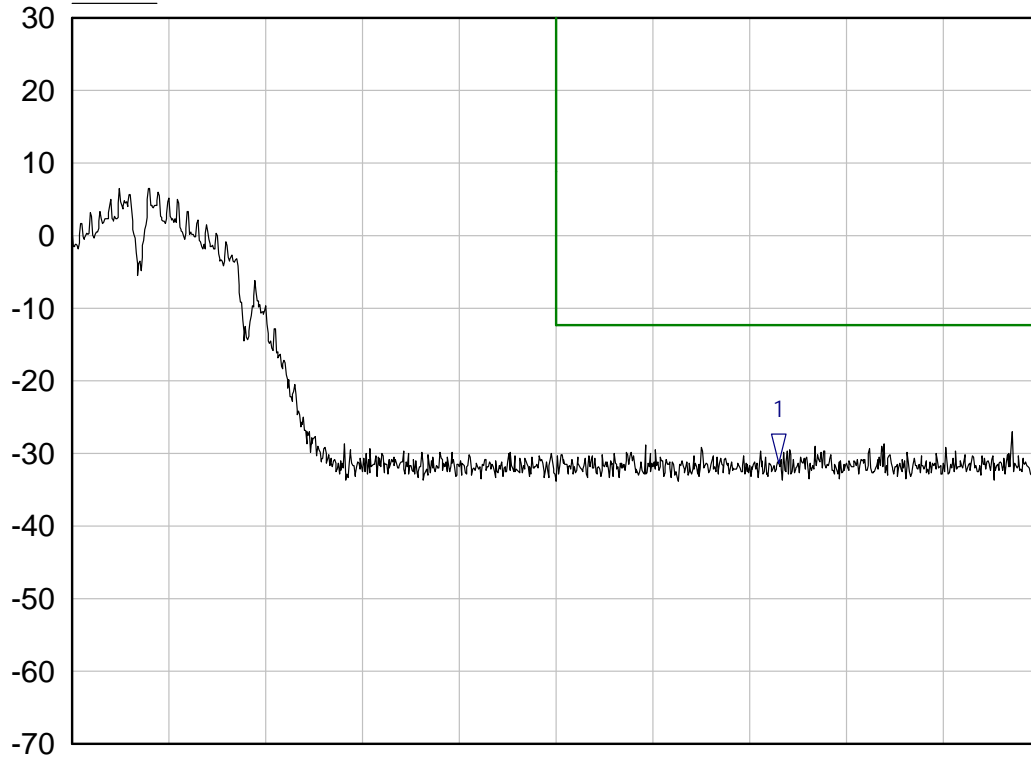
Lower Band Edge Plot (802.11b)



Trace A 802.11b +16 power setting

Upper Band Edge Plot (802.11b)

dBm Trace A



Start: 2.4585 GHz

Stop: 2.5085 GHz

Res BW: 100 kHz

Vid BW: 300 kHz

Sweep: 20.00 ms

5/21/2014 12:54:30 PM

Atten: 55 dB

ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4950 GHz	-31.36 dBm	

Trace A 802.11b +16 setting

Lowest Channel (802.11g)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4824	-59.6	-18.52	-41.1
7236	-63.6	-18.52	-45.1
9648	-63.8	-18.52	-45.3
12060	-63.2	-18.52	-44.7
14472	-64.1	-18.52	-45.6
16884	-63.9	-18.52	-45.4
19296	-62.8	-18.52	-44.3
21708	-64.3	-18.52	-45.8
24120	-63.5	-18.52	-45.0

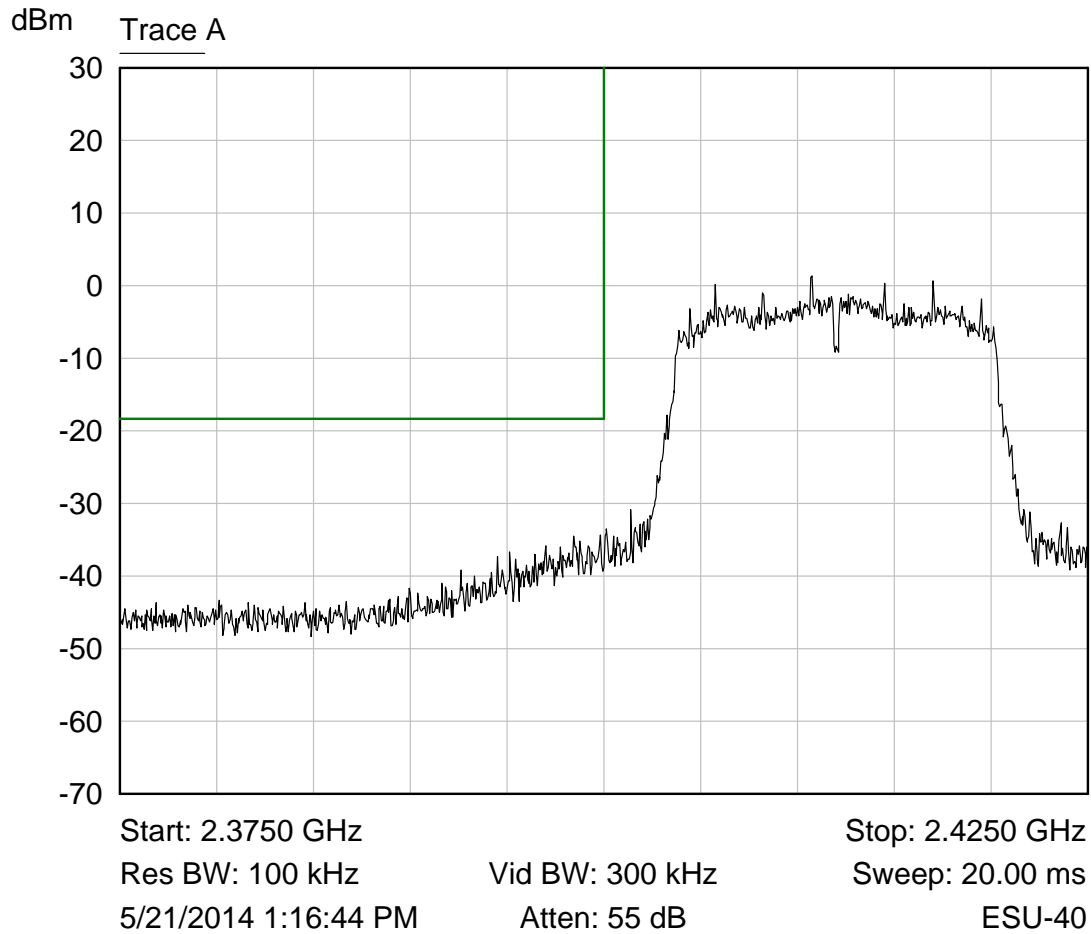
Middle Channel (802.11g)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4874	-51.3	-14.39	-36.9
7311	-59.0	-14.39	-44.6
9748	-63.6	-14.39	-49.2
12185	-62.7	-14.39	-48.3
14622	-62.1	-14.39	-47.7
17059	-63.1	-14.39	-48.7
19496	-64.1	-14.39	-49.7
21933	-63.9	-14.39	-49.5
24370	-63.9	-14.39	-49.5

Highest Channel (802.11g)

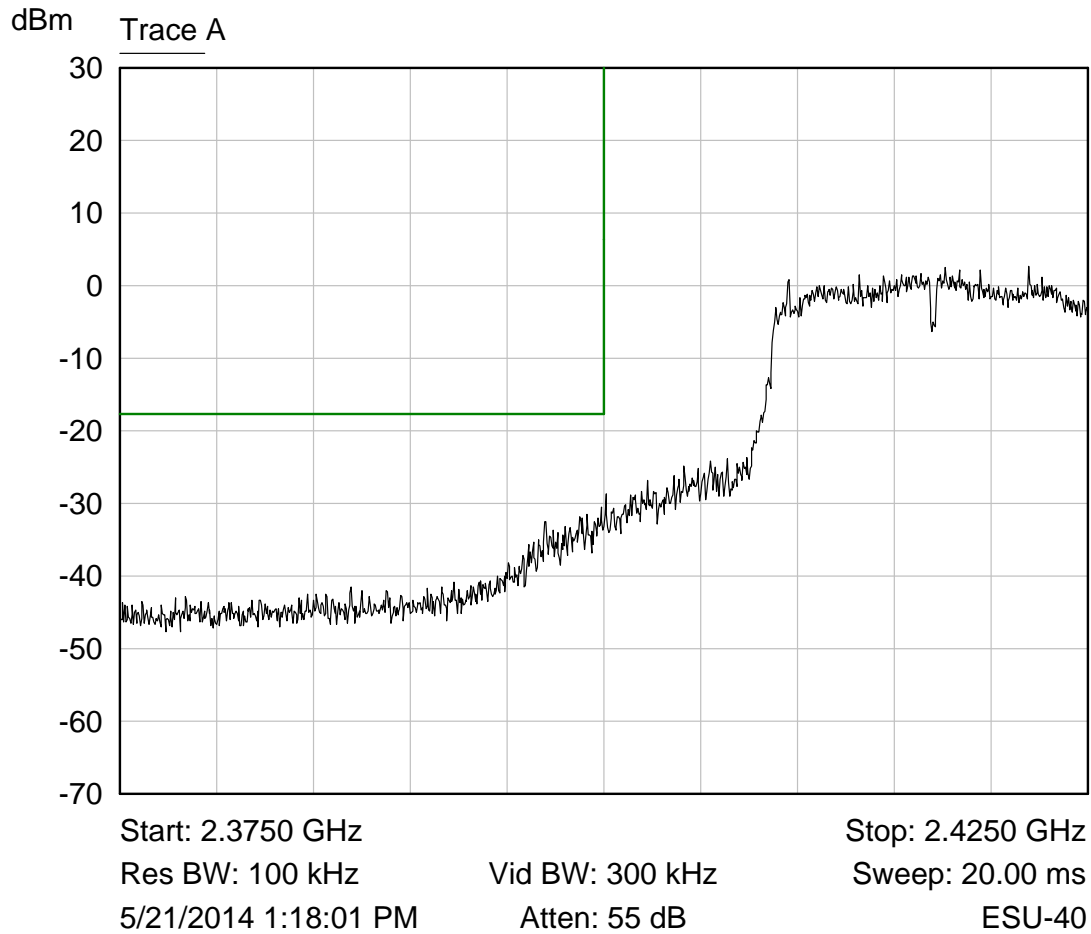
Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4924	-58.6	-17.92	-40.7
7386	-62.7	-17.92	-44.8
9848	-60.2	-17.92	-42.3
12310	-63.4	-17.92	-45.5
14772	-63.7	-17.92	-45.8
17234	-62.0	-17.92	-44.1
19696	-63.9	-17.92	-46.0
22158	-63.2	-17.92	-45.3
24620	-63.1	-17.92	-45.2

Channel 1 Band Edge Plot (802.11g)



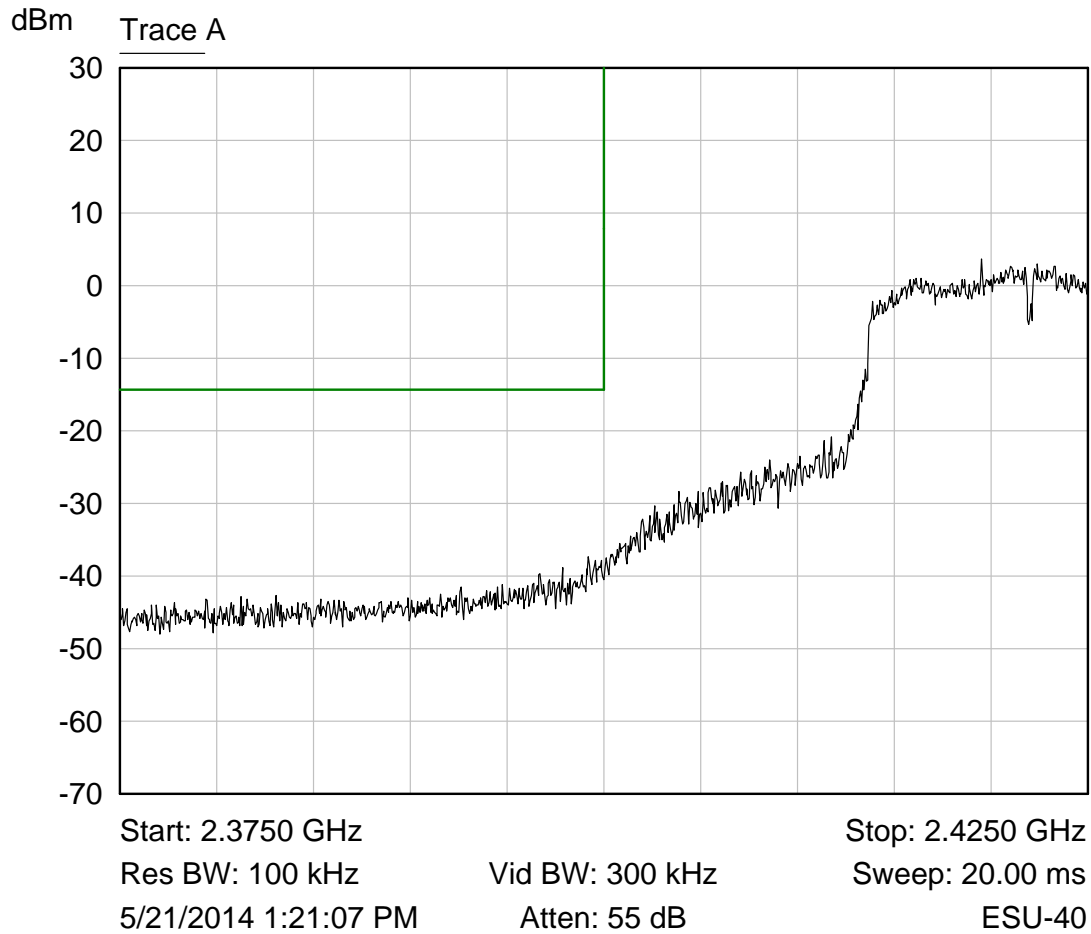
Trace A 802.11g +13 power setting

Channel 2 Band Edge Plot (802.11g)



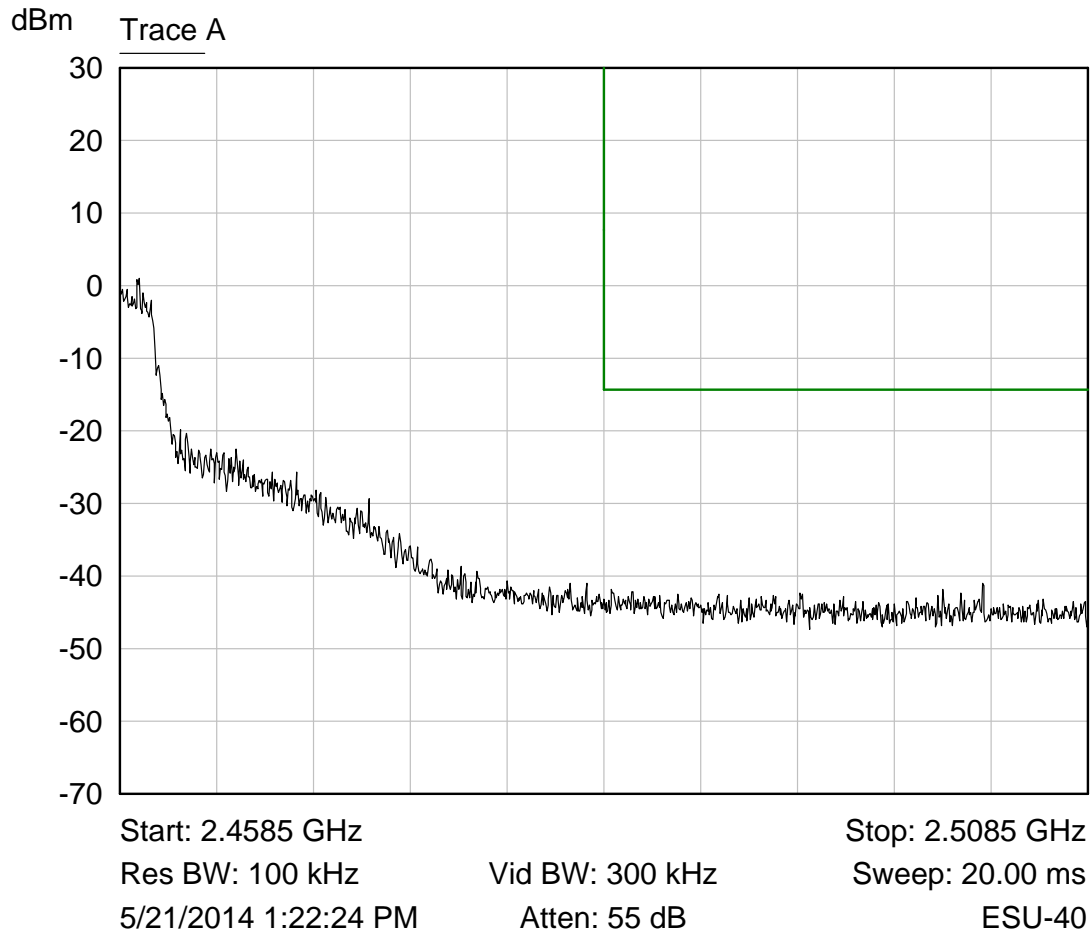
Trace A 802.11g +16 power setting

Channel 3 Band Edge Plot (802.11g)



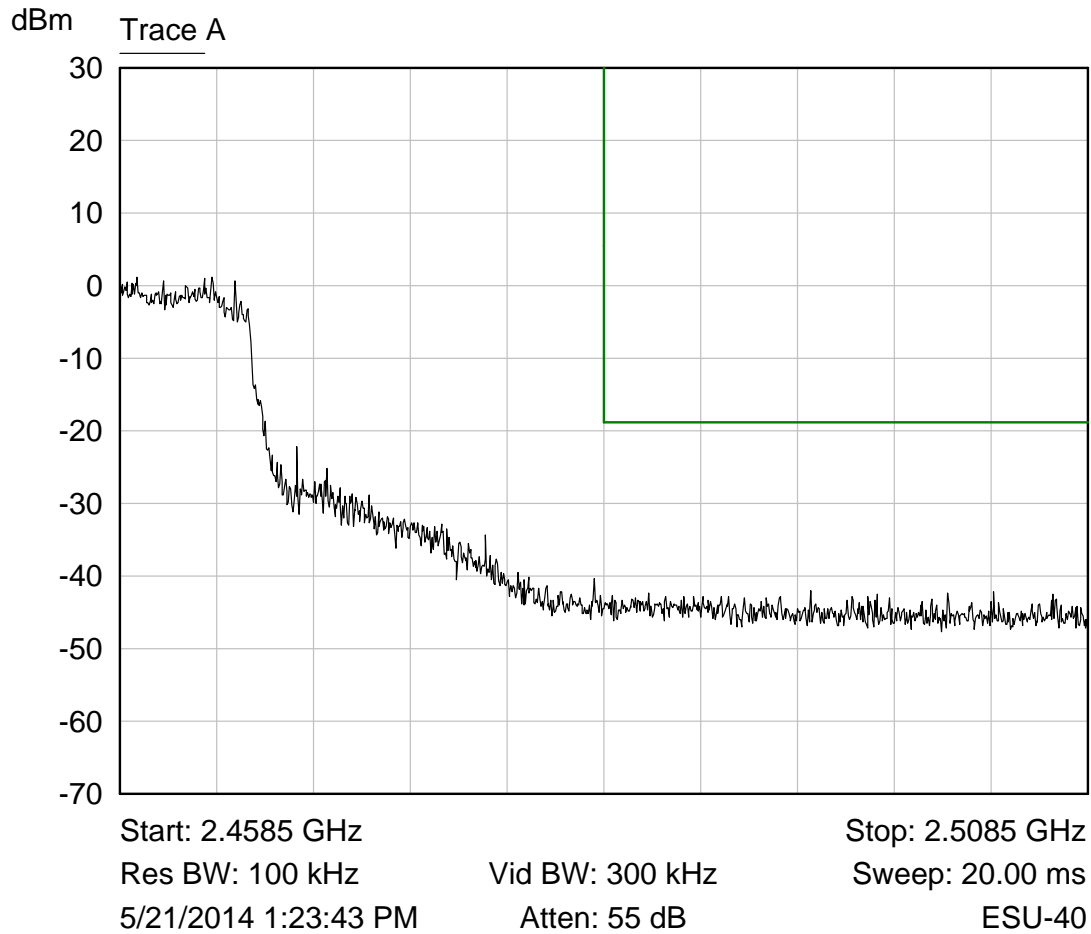
Trace A 802.11g +17 power setting

Channel 9 Band Edge Plot (802.11g)



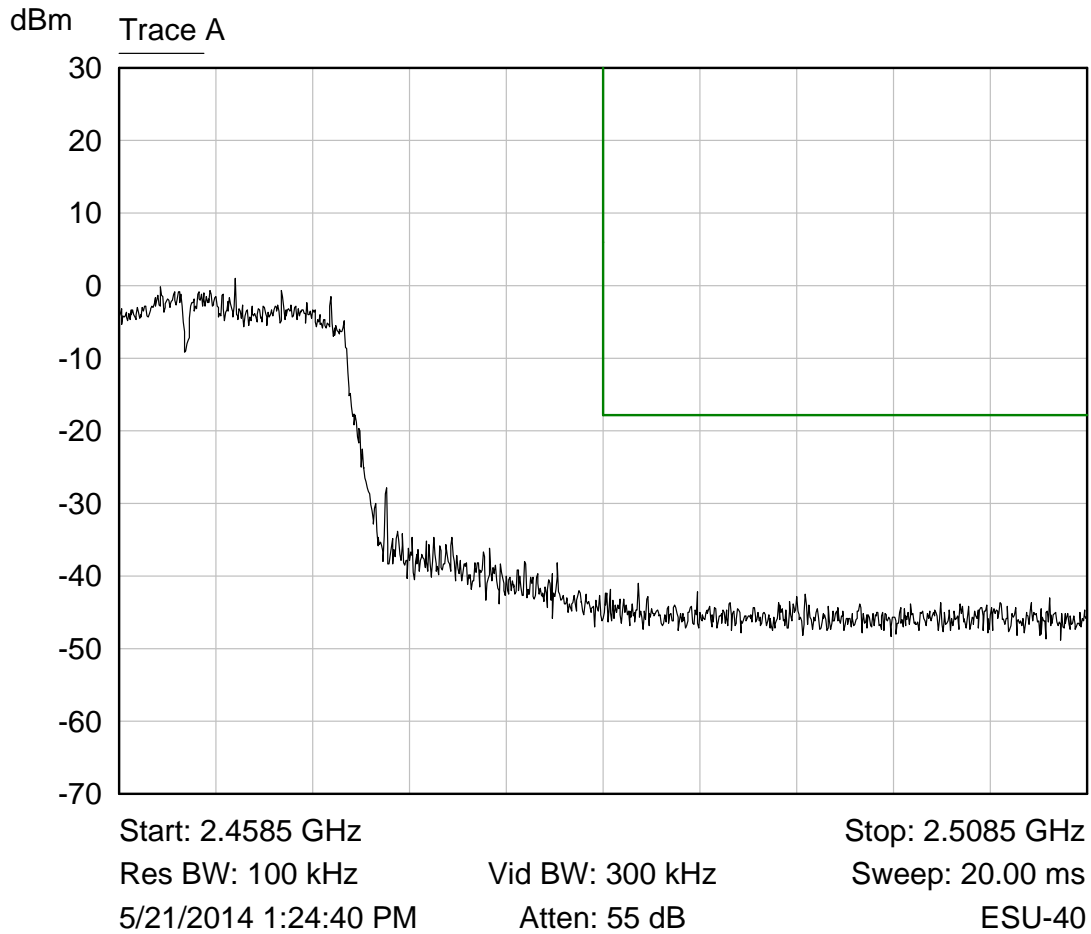
Trace A 802.11g +17 power setting

Channel 10 Band Edge Plot (802.11g)



Trace A 802.11g +16 power setting

Channel 11 Band Edge Plot (802.11g)



Trace A 802.11g +14 power setting

Lowest Channel (802.11n)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4824	-59.5	-18.26	-41.2
7236	-61.4	-18.26	-43.1
9648	-63.0	-18.26	-44.7
12060	-63.3	-18.26	-45.0
14472	-63.0	-18.26	-44.7
16884	-63.3	-18.26	-45.0
19296	-63.0	-18.26	-44.7
21708	-62.6	-18.26	-44.3
24120	-62.9	-18.26	-44.6

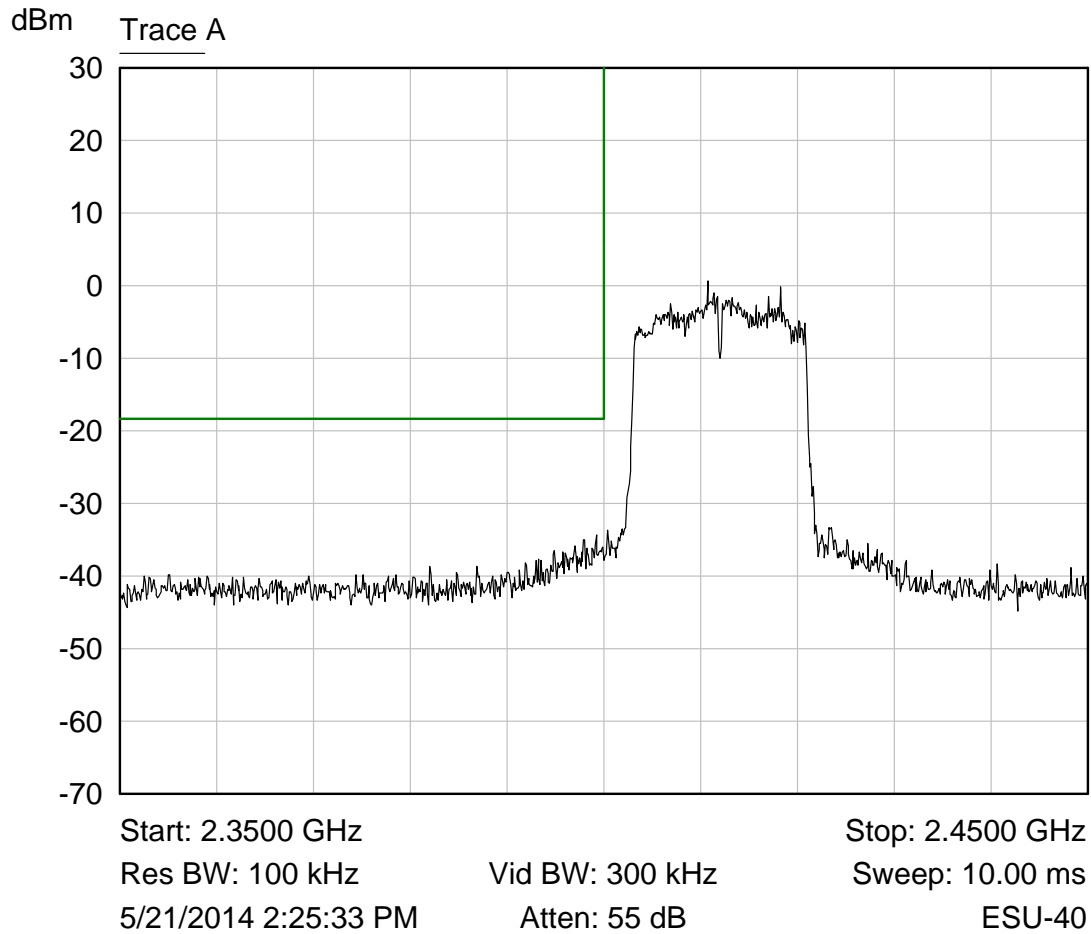
Middle Channel (802.11n)

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4874	-50.9	-14.35	-36.6
7311	-58.9	-14.35	-44.6
9748	-63.2	-14.35	-48.9
12185	-62.5	-14.35	-48.2
14622	-63.1	-14.35	-48.8
17059	-63.4	-14.35	-49.1
19496	-64.0	-14.35	-49.7
21933	-63.2	-14.35	-48.9
24370	-63.1	-14.35	-48.8

Highest Channel (802.11n)

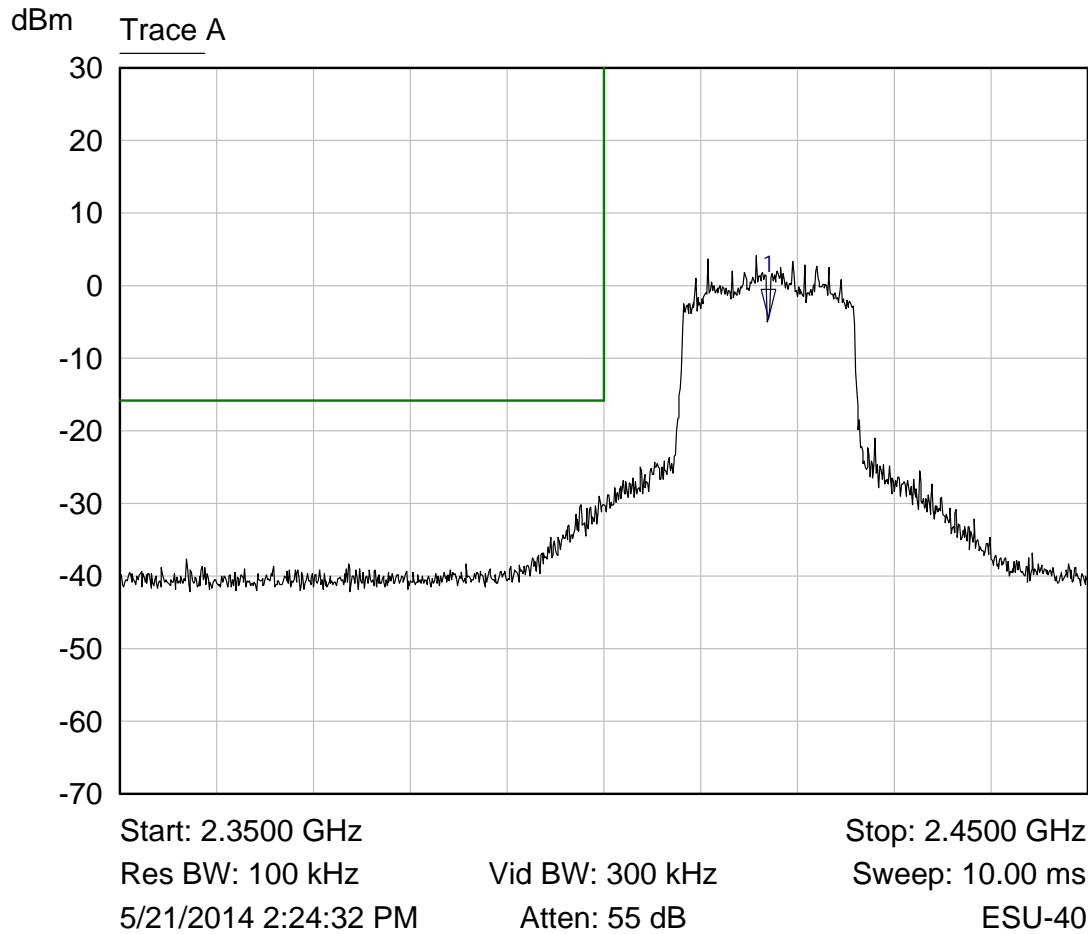
Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4924	-57.9	-17.85	-40.1
7386	-60.2	-17.85	-42.4
9848	-62.8	-17.85	-45.0
12310	-63.2	-17.85	-45.4
14772	-63.1	-17.85	-45.3
17234	-62.5	-17.85	-44.7
19696	-62.1	-17.85	-44.3
22158	-62.7	-17.85	-44.9
24620	-63.0	-17.85	-45.2

Channel 1 Band Edge Plot (802.11n)



Trace A 802.11n +13 power setting

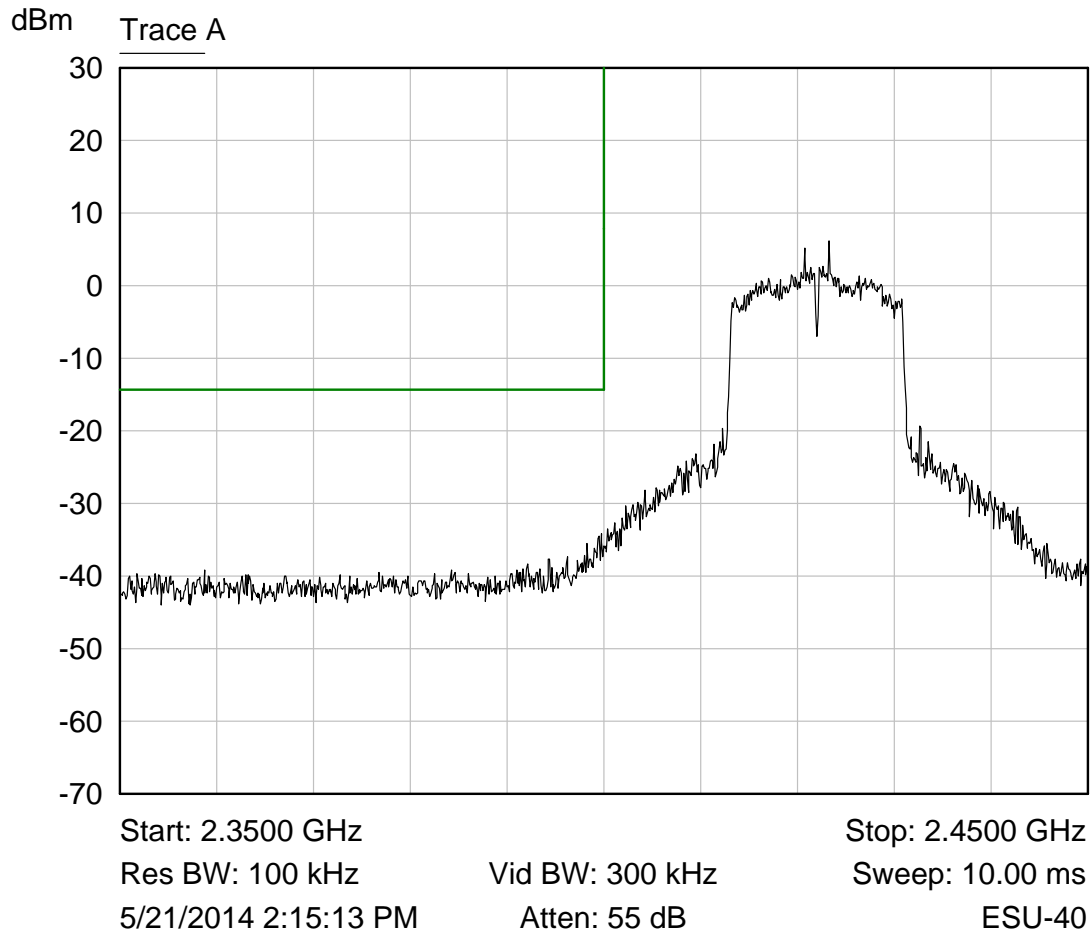
Channel 2 Band Edge Plot (802.11n)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4170 GHz	-4.48 dBm	

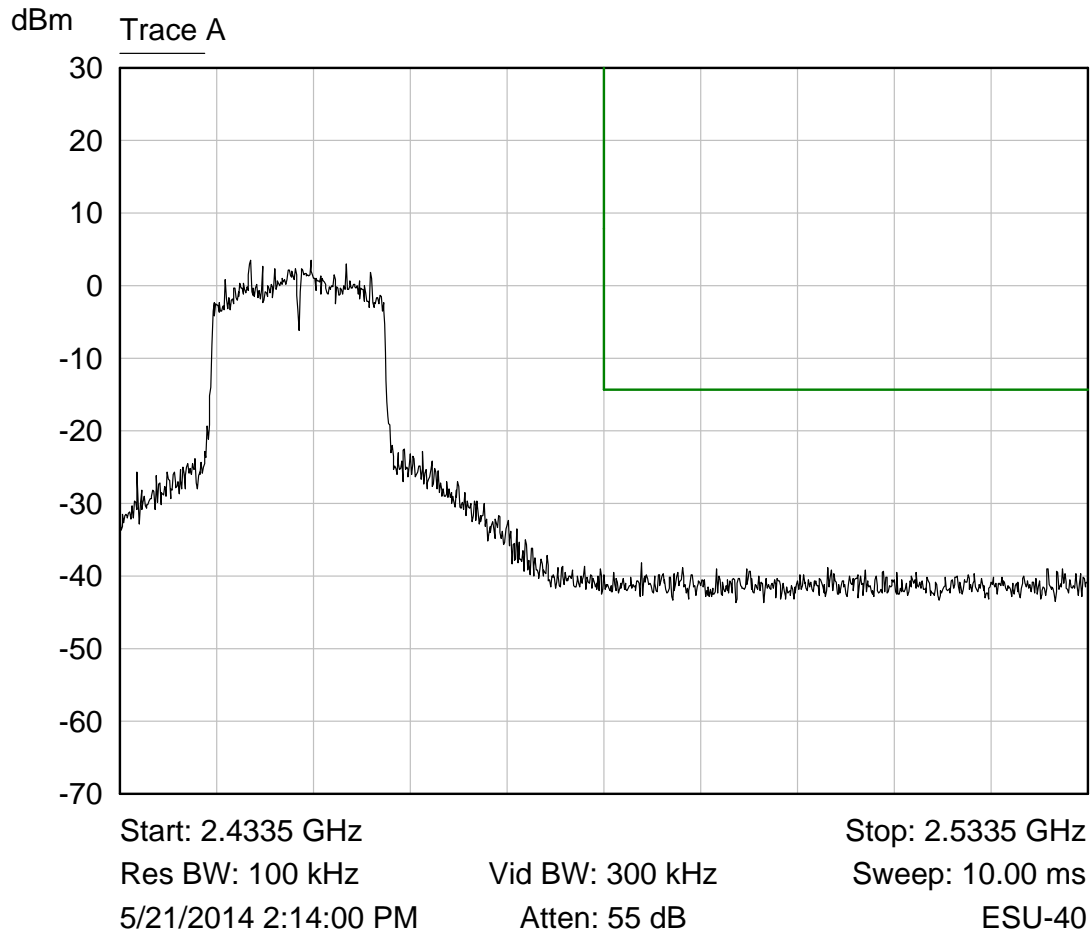
Trace A 802.11n +16 power setting

Channel 3 Band Edge Plot (802.11n)



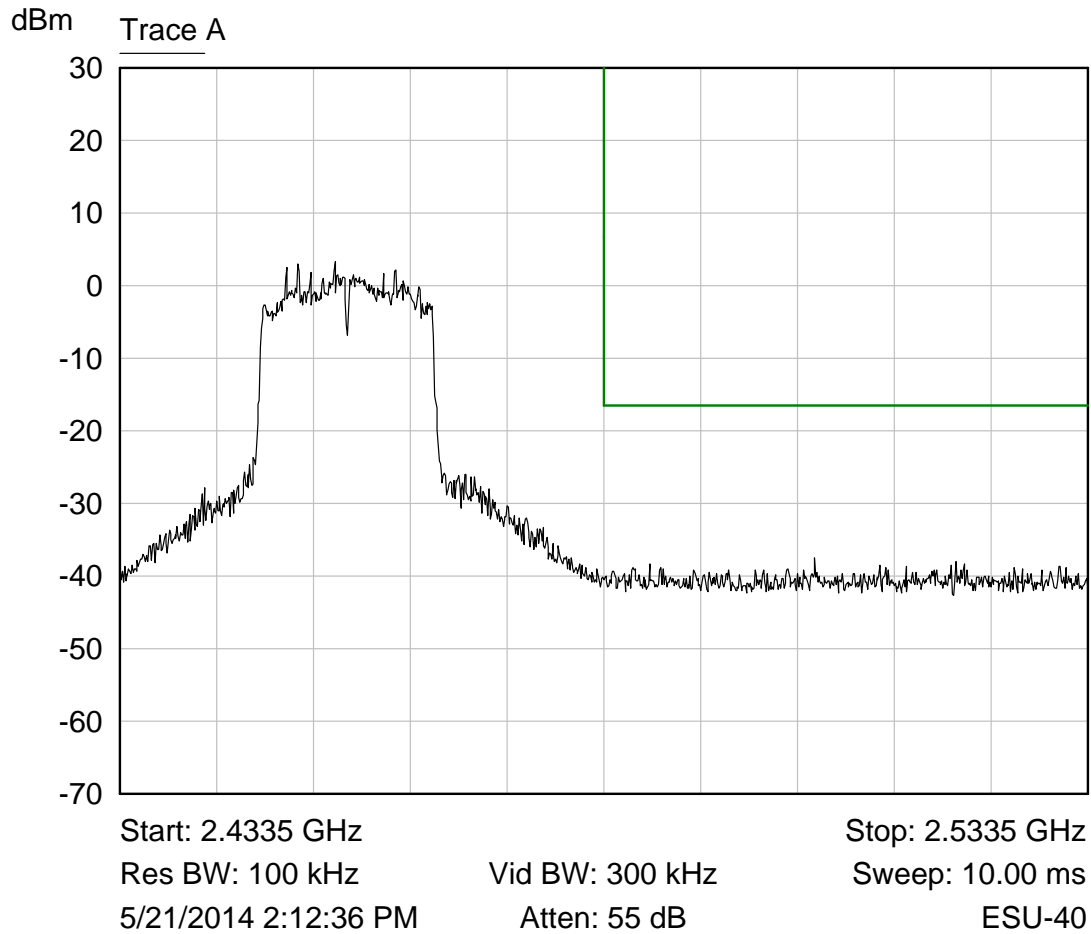
Trace A 802.11n +17 power setting

Channel 9 Band Edge Plot (802.11n)



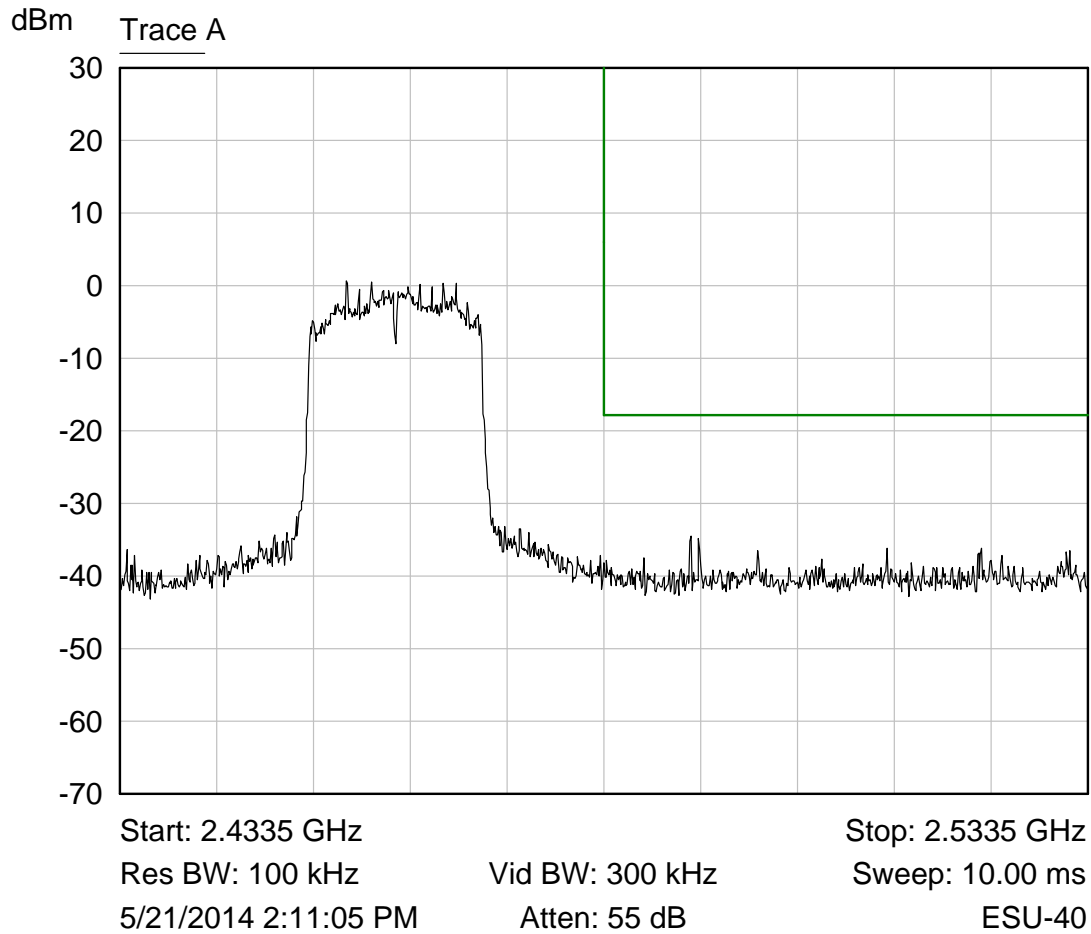
Trace A 802.11n +17 power setting

Channel 10 Band Edge Plot (802.11n)



Trace A 802.11n +16 power setting

Channel 11 Band Edge Plot (802.11n)



Trace A 802.11n +14 power setting

6.2.5.2 Radiated Emissions in the Restricted Bands of §15.205

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental emission was investigated to measure any radiated emissions in the restricted bands. The following tables show measurements of any emission that fell into the restricted bands of §15.205. The tables show the worst-case emission measured from the EUT. For frequencies above 12.5 GHz, a measurement distance of 1 meter was used. The noise floor was a minimum of 6 dB below the limit. The emissions in the restricted bands must meet the limits specified in §15.209. Tabular data for each of the spurious emissions is shown below for each of the units. The measurements were taken of emissions in the restricted bands were taken at the upper, middle, and lower channels with the power set to +16 in 802.11b and +17 for 802.11g and 802.11n. Plots of the band edges are also shown for each channel at the maximum power setting for that channel until the maximum power for any channel in the band for that mode of operation was reached. The power settings are noted in the plots.

AVERAGE FACTOR

There was no average factor applied.

RESULT

All emissions in the restricted bands of §15.205 met the limits specified in §15.209; therefore, the EUT complies with the specification.

Lowest Frequency (802.11b)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4824.0	Peak	Vertical	16.3	39.0	55.3	74.0	-18.7
4824.0	Average	Vertical	13.9	39.0	52.9	54.0	-1.1
4824.0	Peak	Horizontal	14.0	39.0	53.0	74.0	-21.0
4824.0	Average	Horizontal	11.2	39.0	50.2	54.0	-3.8
7236.0	Peak	Vertical	3.3	43.5	46.8	74.0	-27.2
7236.0	Average	Vertical	-4.9	43.5	38.6	54.0	-15.4
7236.0	Peak	Horizontal	2.5	43.5	46.0	74.0	-28.0
7236.0	Average	Horizontal	-5.2	43.5	38.3	54.0	-15.7



Middle Frequency (802.11b)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4874.0	Peak	Vertical	13.0	39.1	52.1	74.0	-21.9
4874.0	Average	Vertical	9.9	39.1	49.0	54.0	-5.0
4874.0	Peak	Horizontal	11.7	39.1	50.8	74.0	-23.2
4874.0	Average	Horizontal	8.7	39.1	47.8	54.0	-6.2
7311.0	Peak	Vertical	3.5	43.7	47.2	74.0	-26.8
7311.0	Average	Vertical	-4.7	43.7	39.0	54.0	-15.0
7311.0	Peak	Horizontal	2.7	43.7	46.4	74.0	-27.6
7311.0	Average	Horizontal	-5.4	43.7	38.3	54.0	-15.7

Highest Frequency (802.11b)

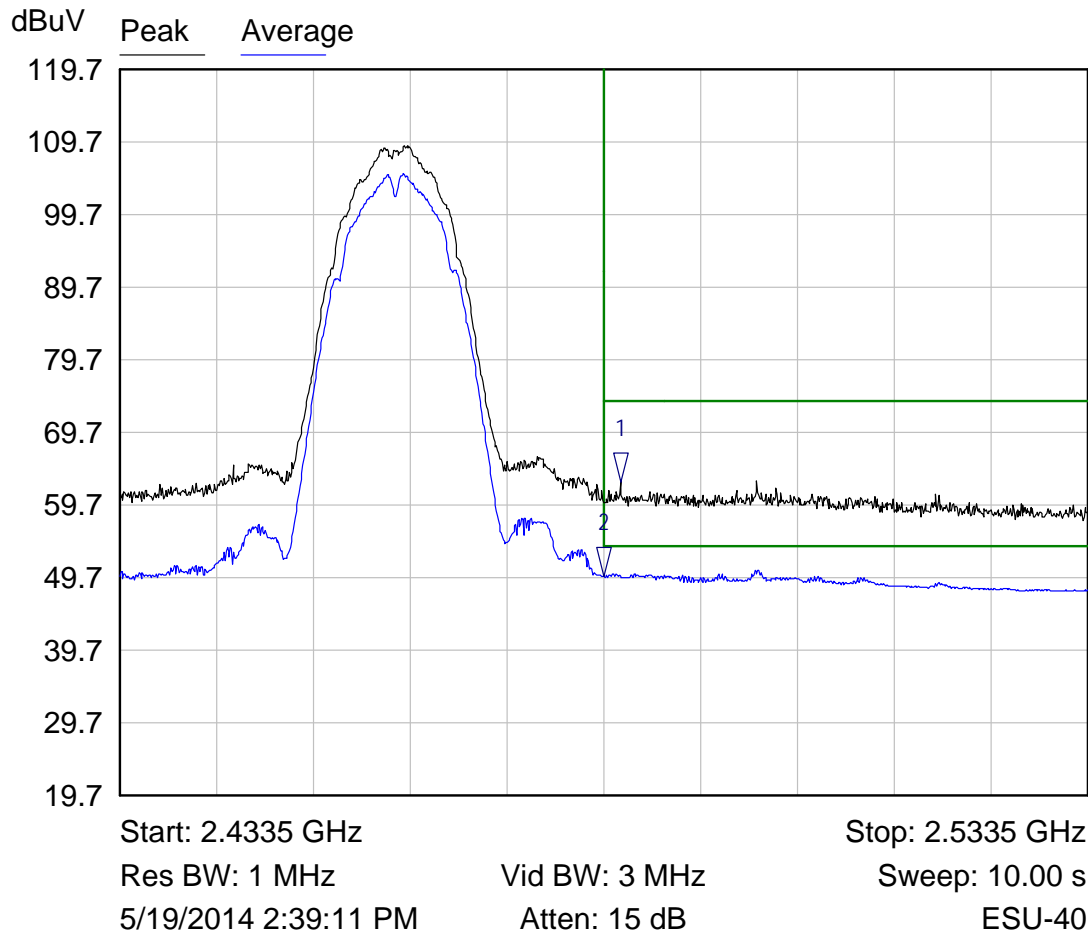
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4924.0	Peak	Vertical	10.9	39.2	50.1	74.0	-23.9
4924.0	Average	Vertical	7.4	39.2	46.6	54.0	-7.4
4924.0	Peak	Horizontal	9.5	39.2	48.7	74.0	-25.3
4924.0	Average	Horizontal	5.6	39.2	44.8	54.0	-9.2
7386.0	Peak	Vertical	4.1	44.0	48.1	74.0	-25.9
7386.0	Average	Vertical	-3.8	44.0	40.2	54.0	-13.8
7386.0	Peak	Horizontal	2.6	44.0	46.6	74.0	-27.4
7386.0	Average	Horizontal	-4.6	44.0	39.4	54.0	-14.6

No other emissions were seen in the restricted bands.

Mkr	Trace	X-Axis	Value	Notes
1 	Peak	2.3898 GHz	61.58 dBuV	
2 	Average	2.3886 GHz	51.01 dBuV	

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Upper Band Edge Plot (802.11b)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4852 GHz	62.87 dBuV	
2 ▽	Average	2.4835 GHz	49.83 dBuV	

power = +16

Lowest Frequency (802.11g)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4824.0	Peak	Vertical	14.5	39.0	53.5	74.0	-20.5
4824.0	Average	Vertical	2.9	39.0	41.9	54.0	-12.1
4824.0	Peak	Horizontal	16.5	39.0	55.5	74.0	-18.5
4824.0	Average	Horizontal	4.7	39.0	43.7	54.0	-10.3
7236.0	Peak	Vertical	5.0	43.5	48.5	74.0	-25.5
7236.0	Average	Vertical	-6.8	43.5	36.7	54.0	-17.3
7236.0	Peak	Horizontal	4.4	43.5	47.9	74.0	-26.1
7236.0	Average	Horizontal	-6.6	43.5	36.9	54.0	-17.1

Middle Frequency (802.11g)

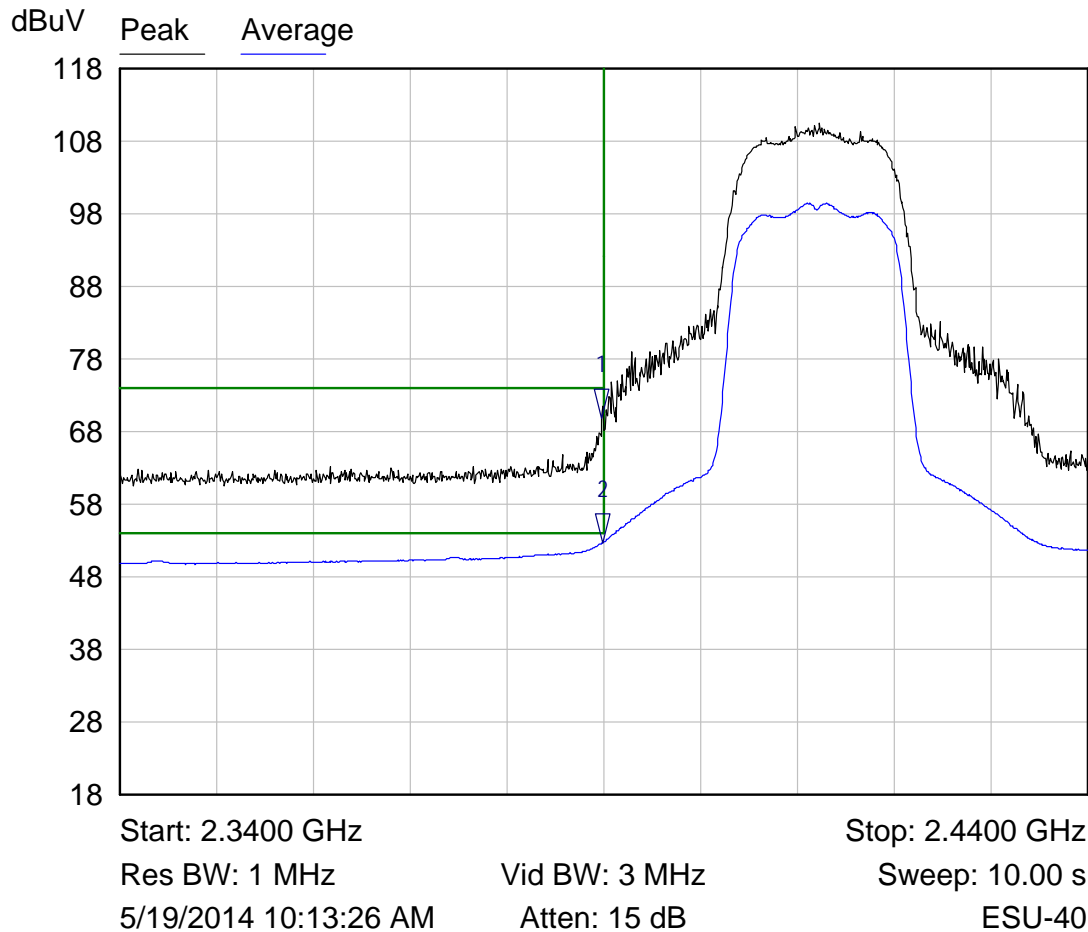
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4874.0	Peak	Vertical	14.7	39.1	53.8	74.0	-20.2
4874.0	Average	Vertical	0.2	39.1	39.3	54.0	-14.7
4874.0	Peak	Horizontal	16.1	39.1	55.2	74.0	-18.8
4874.0	Average	Horizontal	1.2	39.1	40.3	54.0	-13.7
7311.0	Peak	Vertical	5.6	43.7	49.3	74.0	-24.7
7311.0	Average	Vertical	-8.9	43.7	34.8	54.0	-19.2
7311.0	Peak	Horizontal	6.9	43.7	50.6	74.0	-23.4
7311.0	Average	Horizontal	-6.8	43.7	36.9	54.0	-17.1

Highest Frequency (802.11g)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4924.0	Peak	Vertical	13.1	39.2	52.3	74.0	-21.7
4924.0	Average	Vertical	1.5	39.2	40.7	54.0	-13.3
4924.0	Peak	Horizontal	15.5	39.2	54.7	74.0	-19.3
4924.0	Average	Horizontal	4.0	39.2	43.2	54.0	-10.8
7386.0	Peak	Vertical	7.0	44.0	51.0	74.0	-23.0
7386.0	Average	Vertical	-4.6	44.0	39.4	54.0	-14.6
7386.0	Peak	Horizontal	7.0	44.0	51.0	74.0	-23.0
7386.0	Average	Horizontal	-5.7	44.0	38.3	54.0	-15.7

No other emissions were seen in the restricted bands.

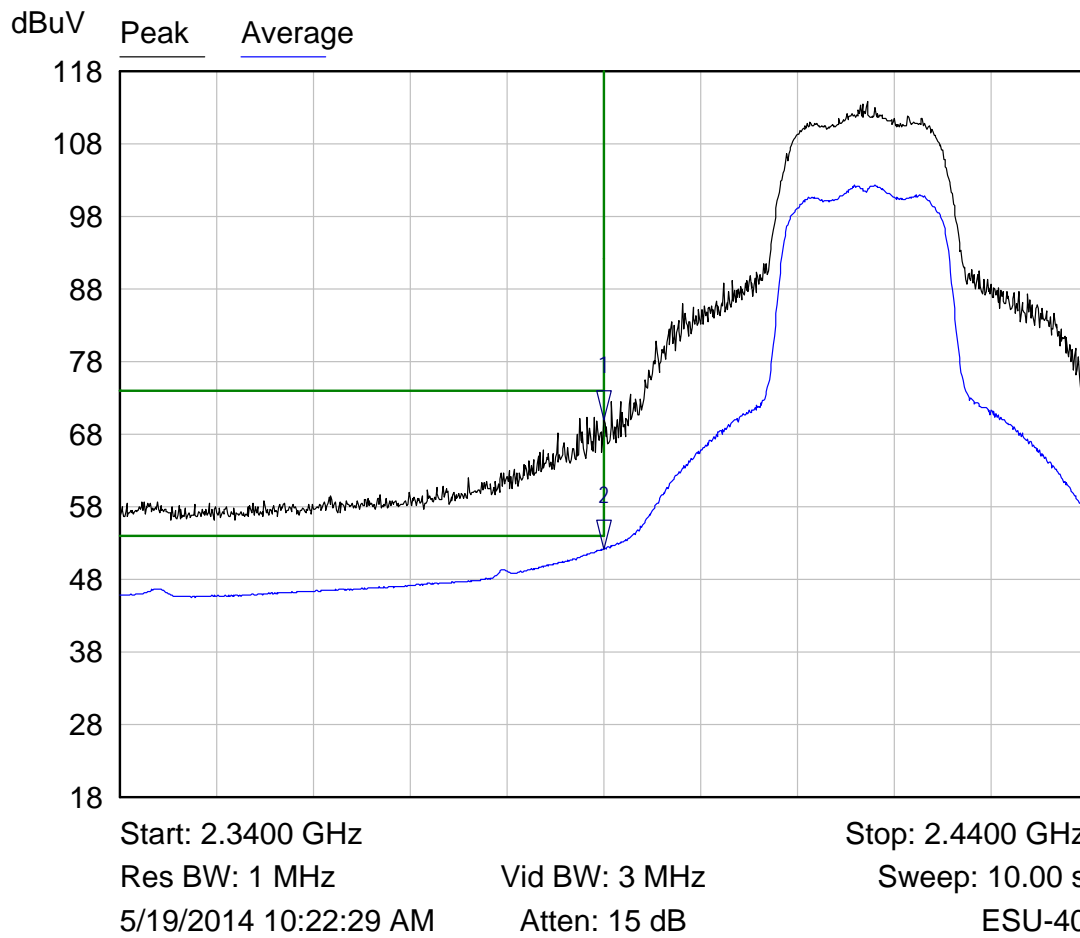
Channel 1 Band Edge Plot (802.11g)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.3898 GHz	69.90 dBuV	
2 ▽	Average	2.3899 GHz	52.67 dBuV	

power = +13

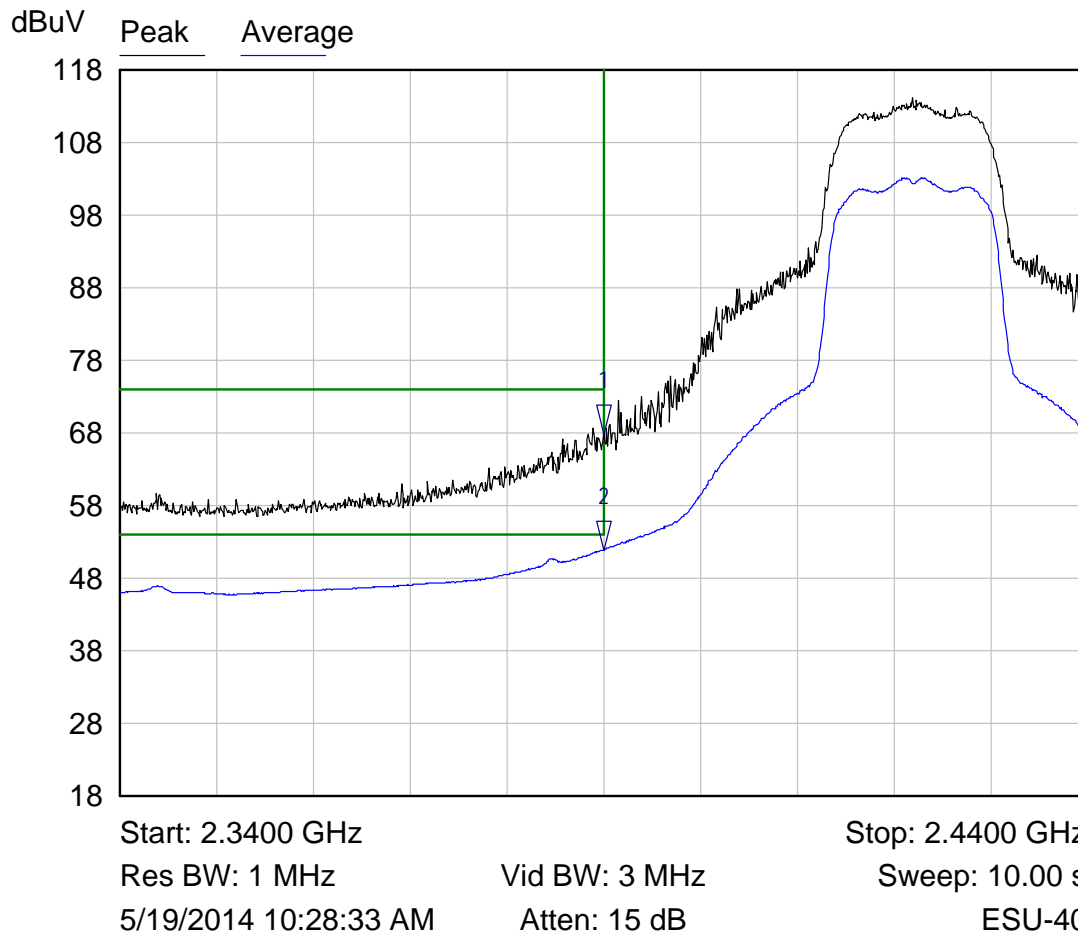
Channel 2 Band Edge Plot (802.11g)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.3900 GHz	69.92 dBuV	
2 ▽	Average	2.3900 GHz	52.17 dBuV	

power = +16

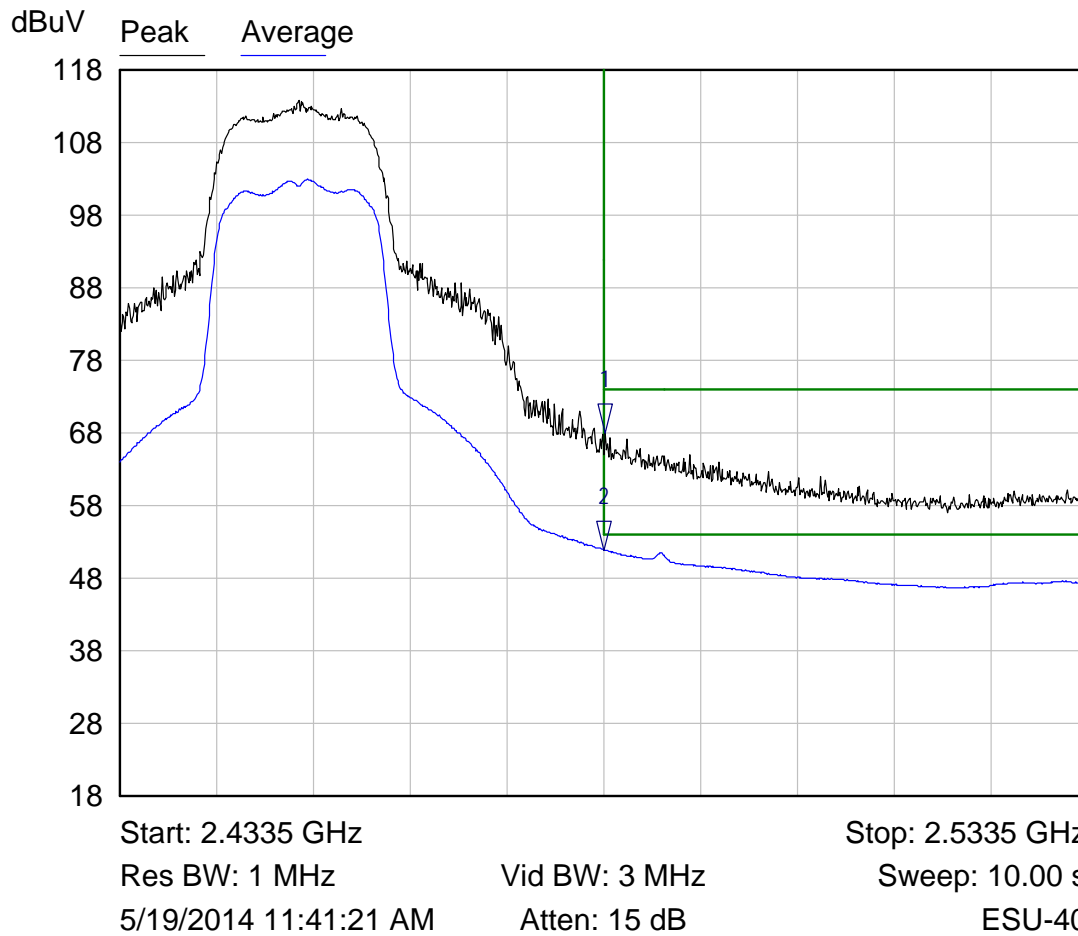
Channel 3 Band Edge Plot (802.11g)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.3900 GHz	67.77 dBuV	
2 ▽	Average	2.3900 GHz	51.87 dBuV	

power = +17

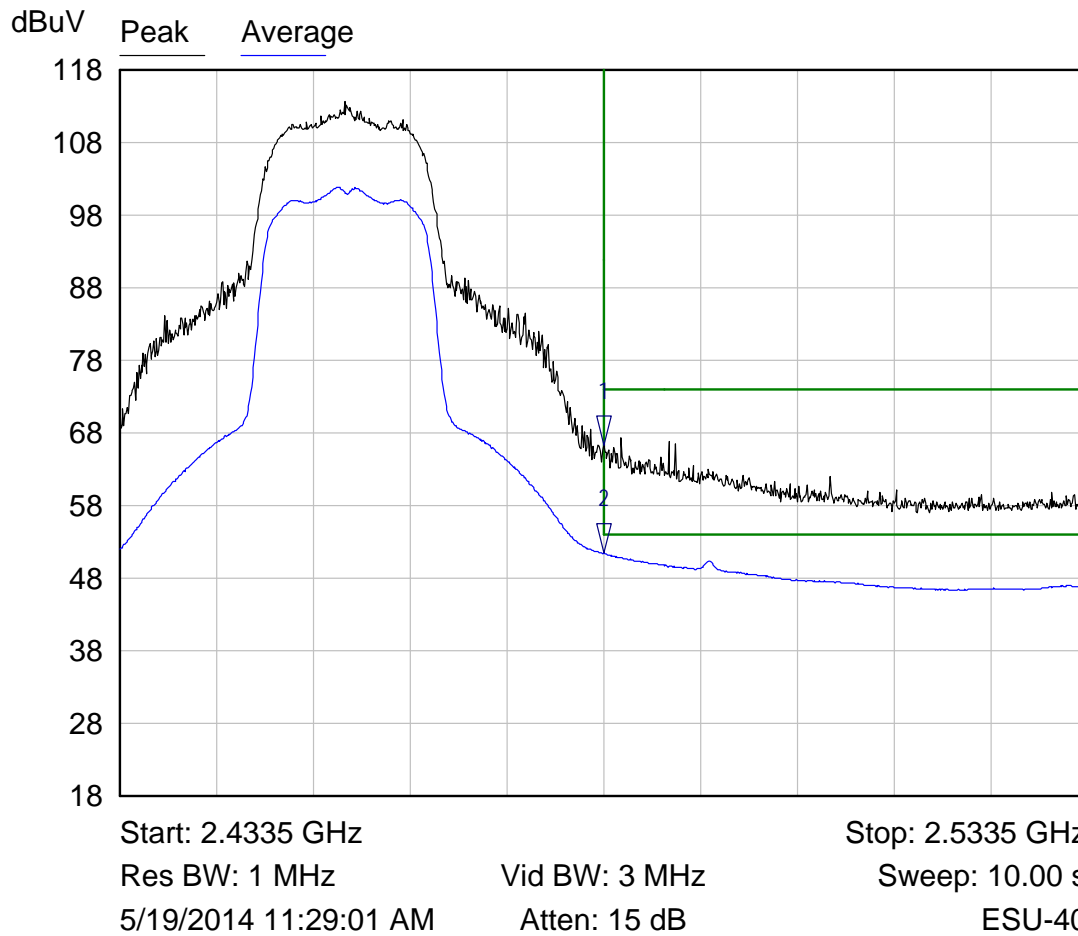
Channel 9 Band Edge Plot (802.11g)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4836 GHz	67.93 dBuV	
2 ▽	Average	2.4835 GHz	51.91 dBuV	

power = +17

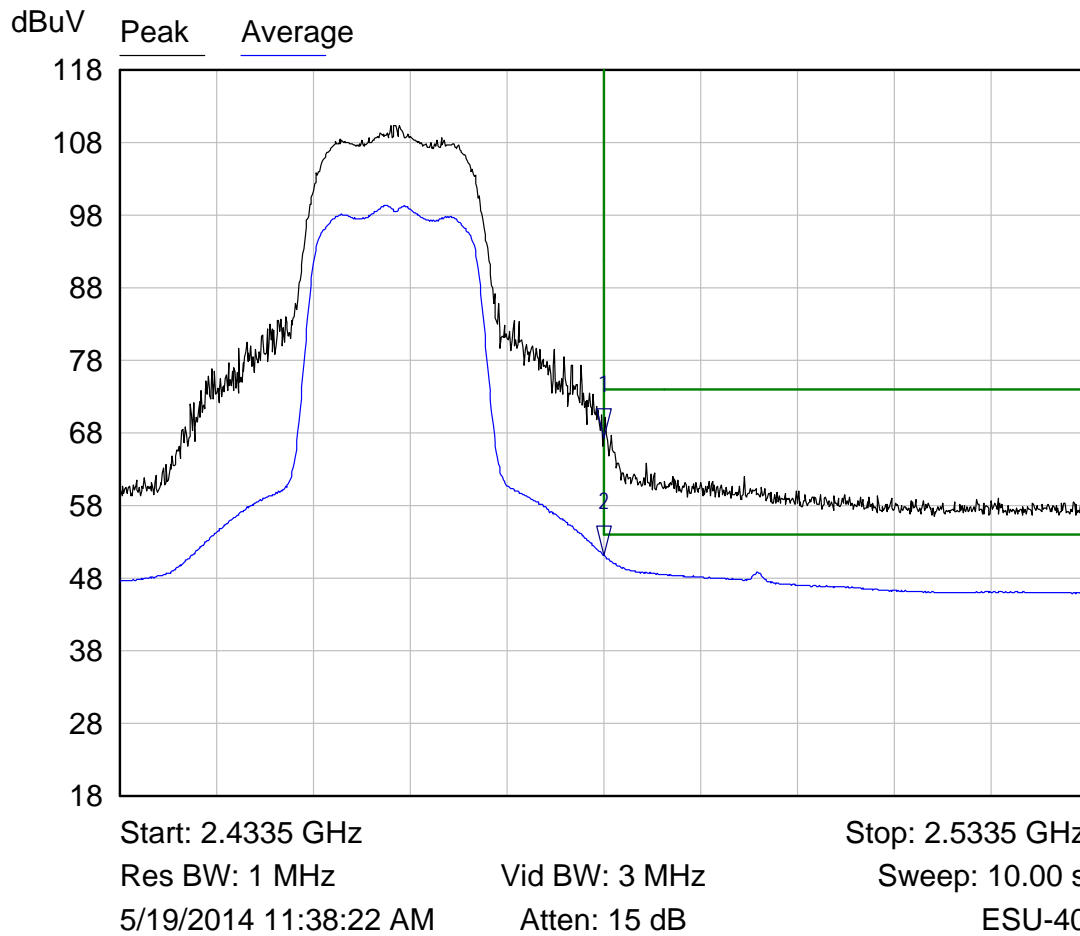
Channel 10 Band Edge Plot (802.11g)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4835 GHz	66.27 dBuV	
2 ▽	Average	2.4835 GHz	51.52 dBuV	

power = +16

Channel 11 Band Edge Plot (802.11g)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4835 GHz	67.33 dBuV	
2 ▽	Average	2.4835 GHz	51.11 dBuV	

power = +14

Lowest Frequency (802.11n)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4824.0	Peak	Vertical	17.4	39.0	56.4	74.0	-17.6
4824.0	Average	Vertical	3.6	39.0	42.6	54.0	-11.4
4824.0	Peak	Horizontal	16.0	39.0	55.0	74.0	-19.0
4824.0	Average	Horizontal	2.5	39.0	41.5	54.0	-12.5
7236.0	Peak	Vertical	0.7	43.5	44.2	74.0	-29.8
7236.0	Average	Vertical	-10.9	43.5	32.6	54.0	-21.4
7236.0	Peak	Horizontal	5.1	43.5	48.6	74.0	-25.4
7236.0	Average	Horizontal	-7.6	43.5	35.9	54.0	-18.1

Middle Frequency (802.11n)

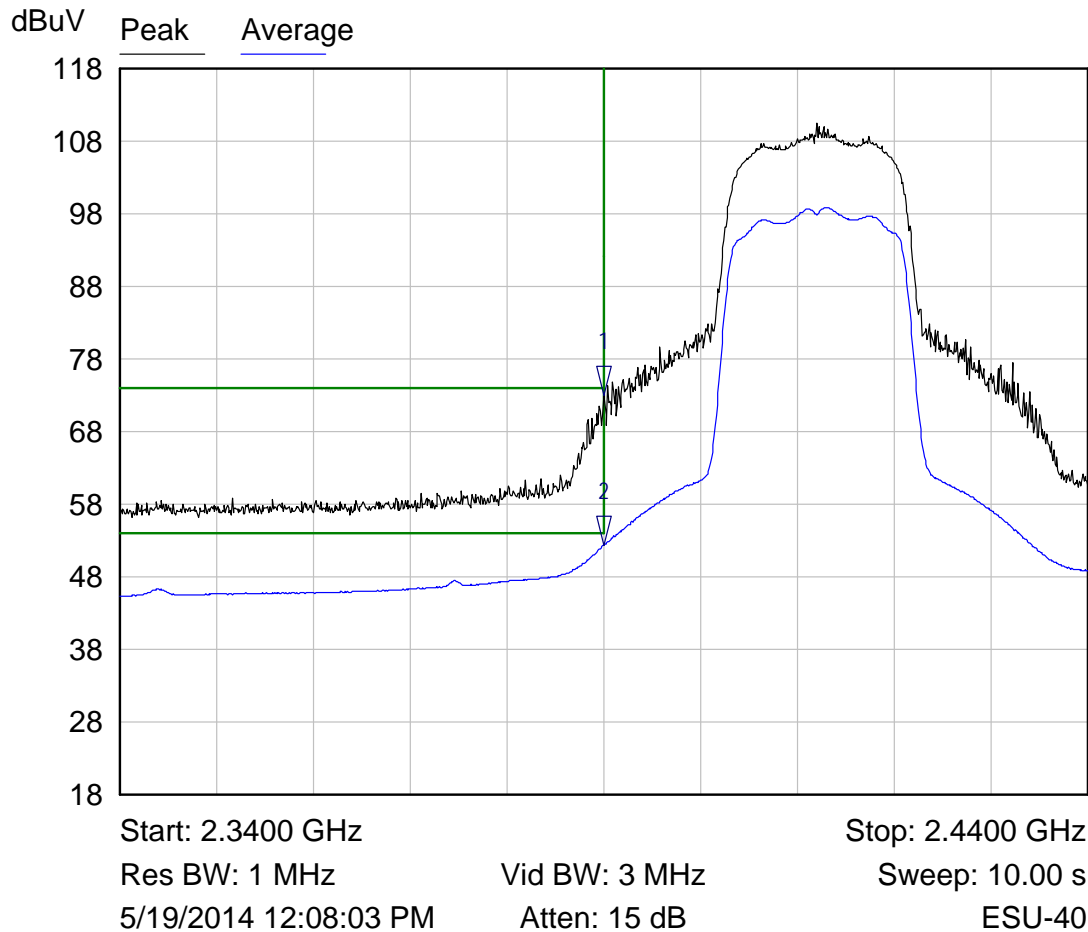
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4874.0	Peak	Vertical	13.2	39.1	52.3	74.0	-21.7
4874.0	Average	Vertical	3.5	39.1	42.6	54.0	-11.4
4874.0	Peak	Horizontal	15.4	39.1	54.5	74.0	-19.5
4874.0	Average	Horizontal	2.6	39.1	41.7	54.0	-12.3
7311.0	Peak	Vertical	5.2	43.7	48.9	74.0	-25.1
7311.0	Average	Vertical	-6.6	43.7	37.1	54.0	-16.9
7311.0	Peak	Horizontal	5.3	43.7	49.0	74.0	-25.0
7311.0	Average	Horizontal	-6.8	43.7	36.9	54.0	-17.1

Highest Frequency (802.11n)

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4924.0	Peak	Vertical	11.1	39.2	50.3	74.0	-23.7
4924.0	Average	Vertical	-0.3	39.2	38.9	54.0	-15.1
4924.0	Peak	Horizontal	13.5	39.2	52.7	74.0	-21.3
4924.0	Average	Horizontal	0.9	39.2	40.1	54.0	-13.9
7386.0	Peak	Vertical	7.7	44.0	51.7	74.0	-22.3
7386.0	Average	Vertical	-5.7	44.0	38.3	54.0	-15.7
7386.0	Peak	Horizontal	5.7	44.0	49.7	74.0	-24.3
7386.0	Average	Horizontal	-6.3	44.0	37.7	54.0	-16.3

No other emissions were seen in the restricted bands.

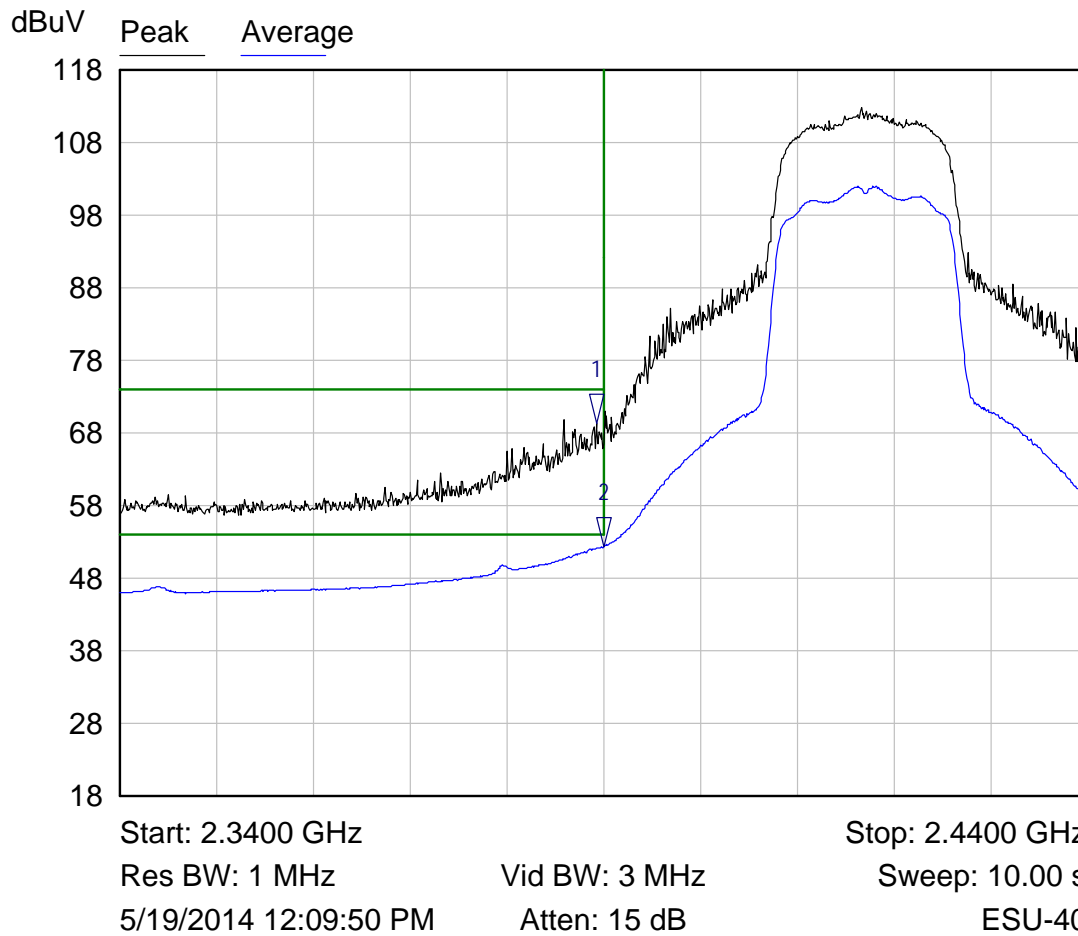
Channel 1 Band Edge Plot (802.11n)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.3900 GHz	73.04 dBuV	
2 ▽	Average	2.3900 GHz	52.28 dBuV	

power = +13

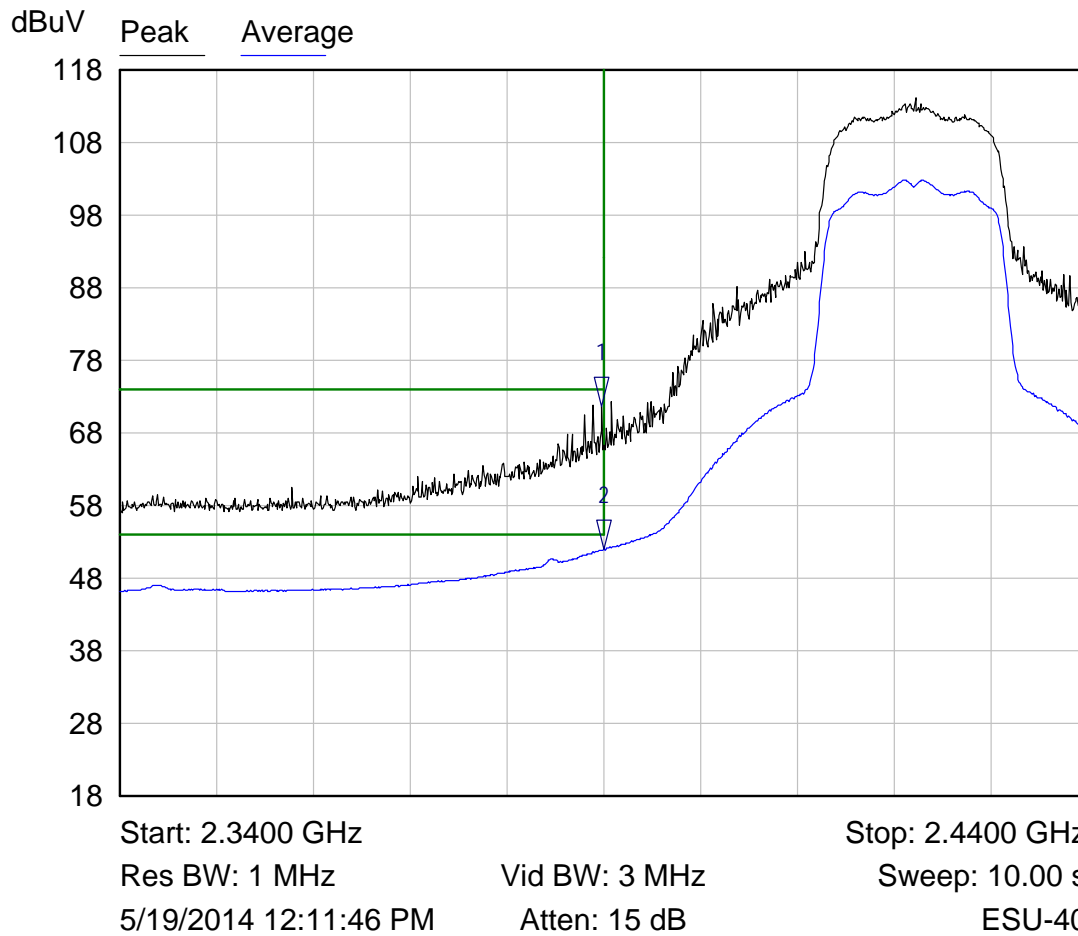
Channel 2 Band Edge Plot (802.11n)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.3892 GHz	69.38 dBuV	
2 ▽	Average	2.3900 GHz	52.40 dBuV	

power = +16

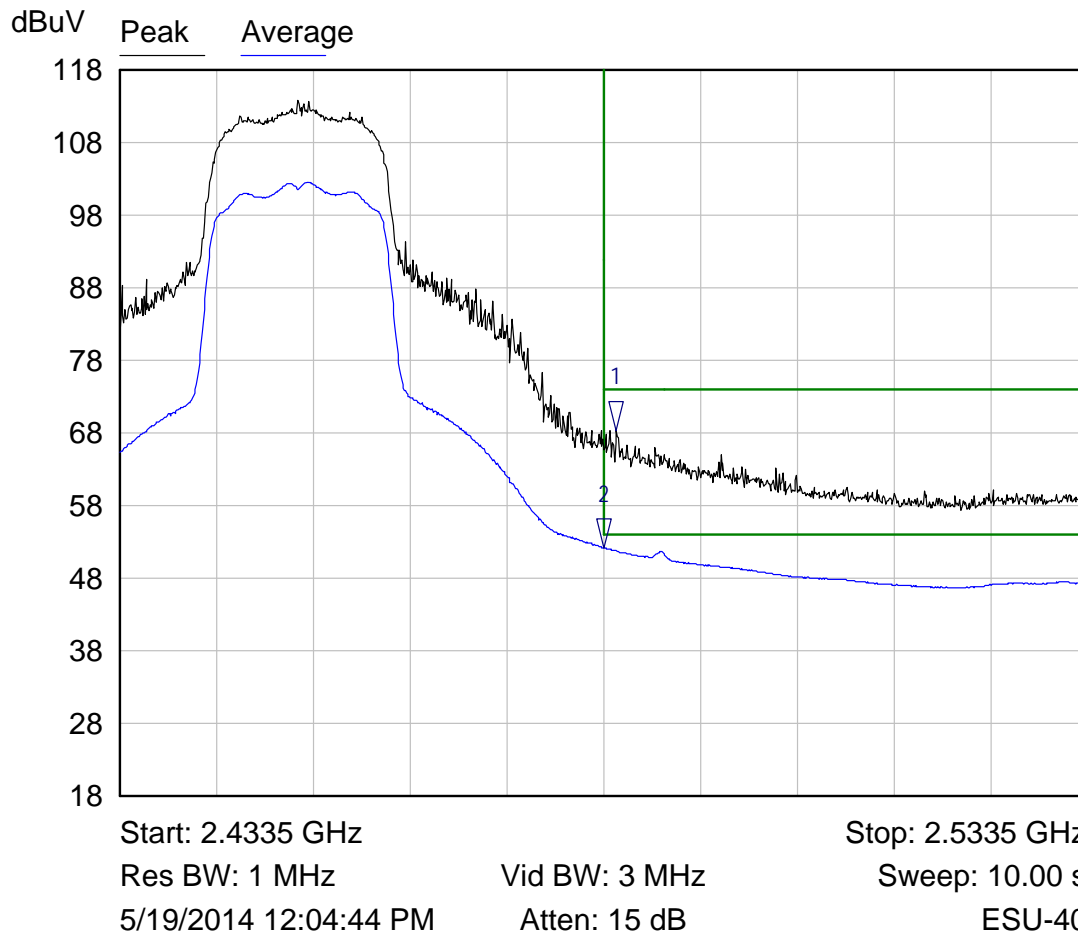
Channel 3 Band Edge Plot (802.11n)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.3898 GHz	71.73 dBuV	
2 ▽	Average	2.3900 GHz	51.99 dBuV	

power = +17

Channel 9 Band Edge Plot (802.11n)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4848 GHz	68.31 dBuV	
2 ▽	Average	2.4835 GHz	52.15 dBuV	

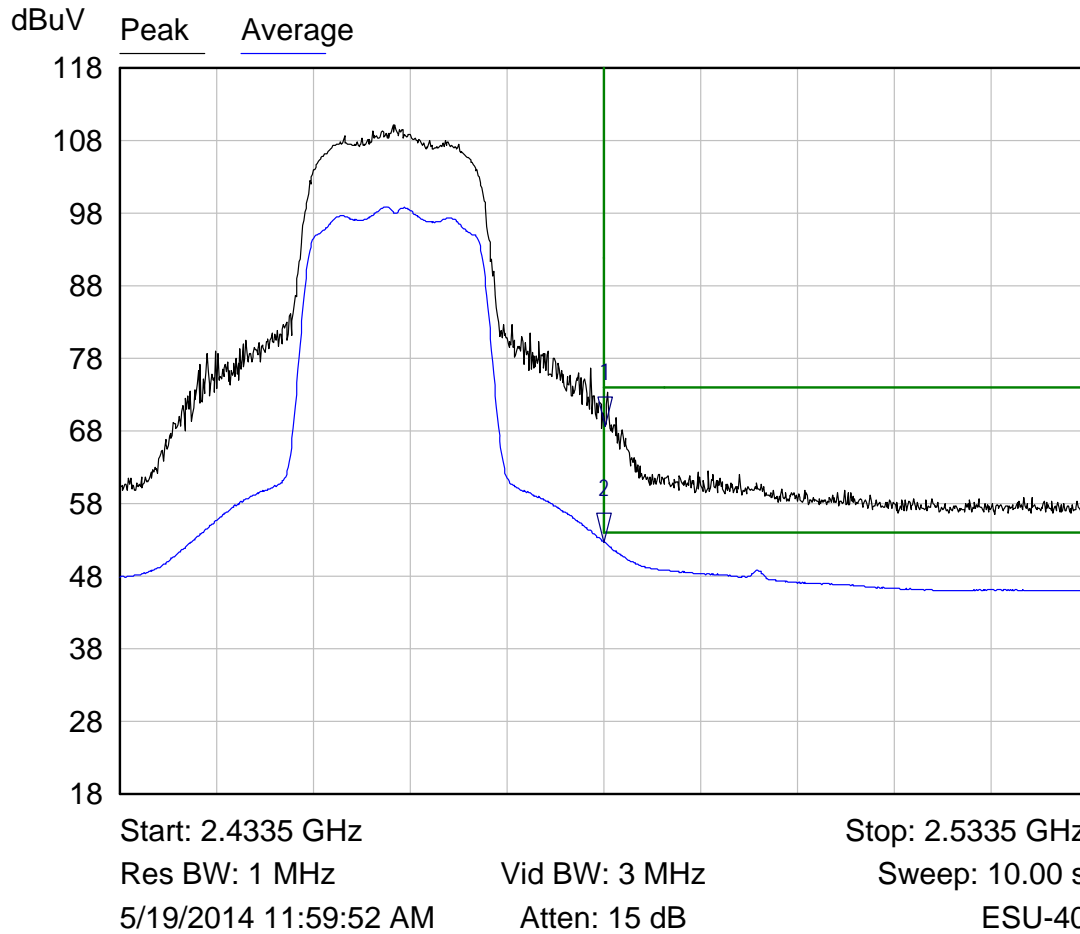
power = +17

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Mkr	Trace	X-Axis	Value	Notes
1 ▾	Peak	2.4837 GHz	66.41 dBuV	
2 ▾	Average	2.4835 GHz	51.91 dBuV	

power = +16

Channel 11 Band Edge Plot (802.11n)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4836 GHz	68.72 dBuV	
2 ▽	Average	2.4835 GHz	52.71 dBuV	

power = +14

6.2.6 §15.247(e) Peak Power Spectral Density

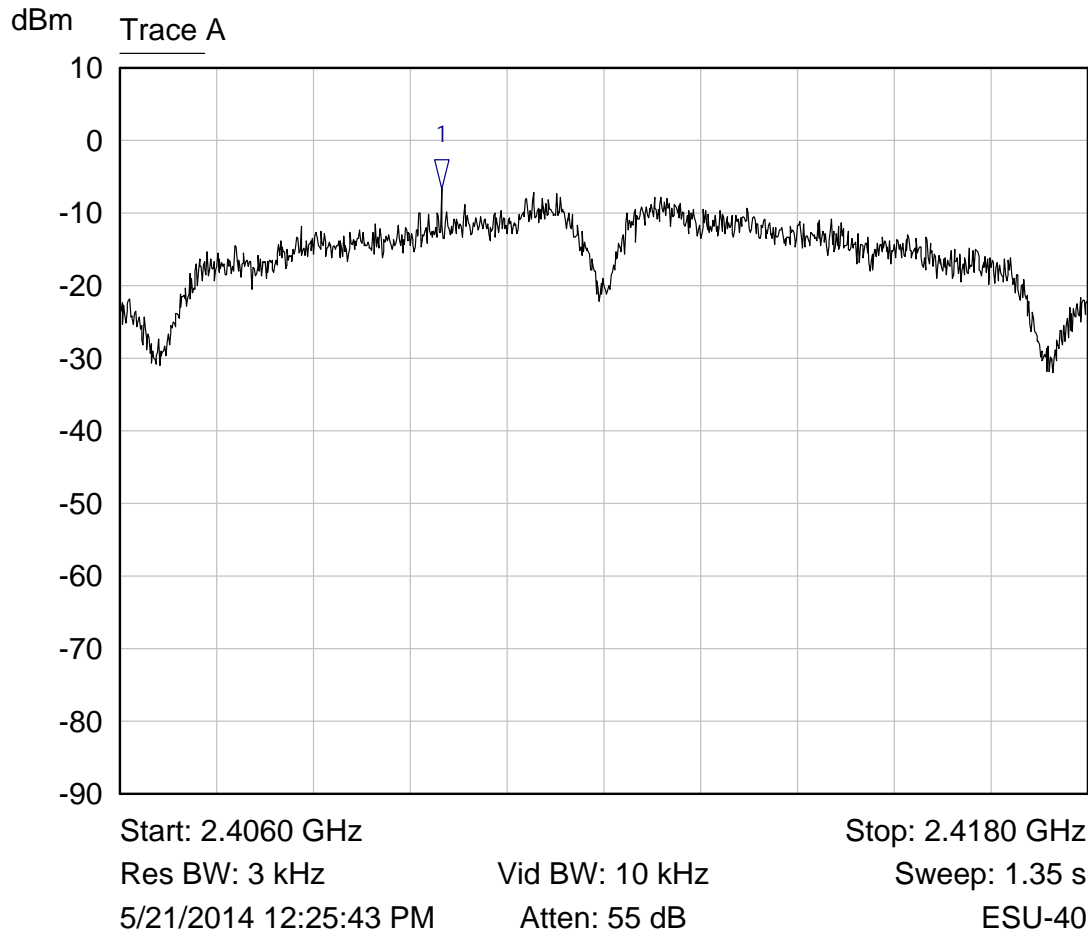
The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. The method described in section 10.2 of FCC document, KDB 558074 v01r03, Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, dated 04/09/2013 was used to measure the 3 kHz power spectral density of the emission. The result of this testing is summarized in the table below.

Frequency (MHz)	Measurement (dBm)			Criteria (dBm)
	802.11b	802.11g	802.11n	
2412	-6.71	-12.18	-12.95	8.0
2437	-6.69	-8.86	-8.49	8.0
2462	-6.38	-12.22	-11.96	8.0

RESULT

The maximum peak power spectral density was -6.38 dBm, less than the limit of 8 dBm; therefore, the EUT complies with the specification.

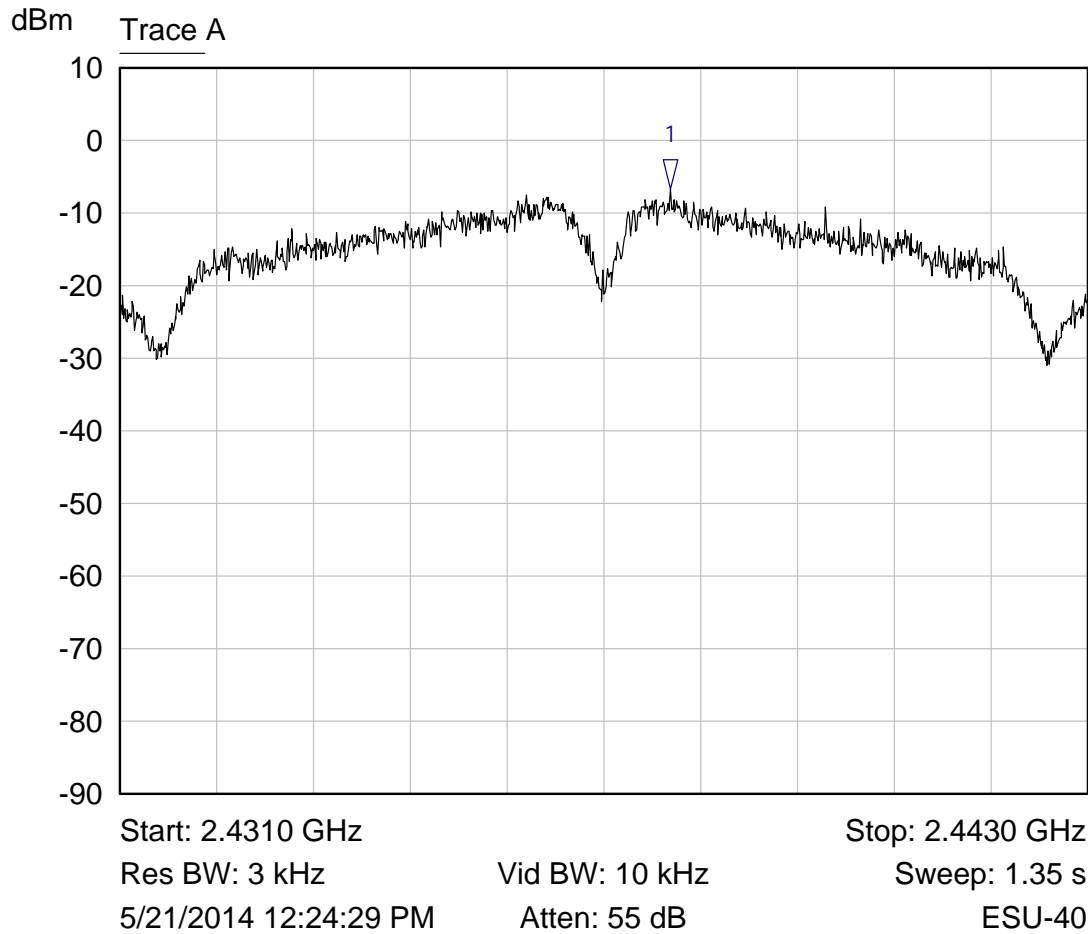
Lowest Channel 3 kHz PSD Plot (802.11b)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4100 GHz	-6.71 dBm	

Trace A 802.11b +16 power setting

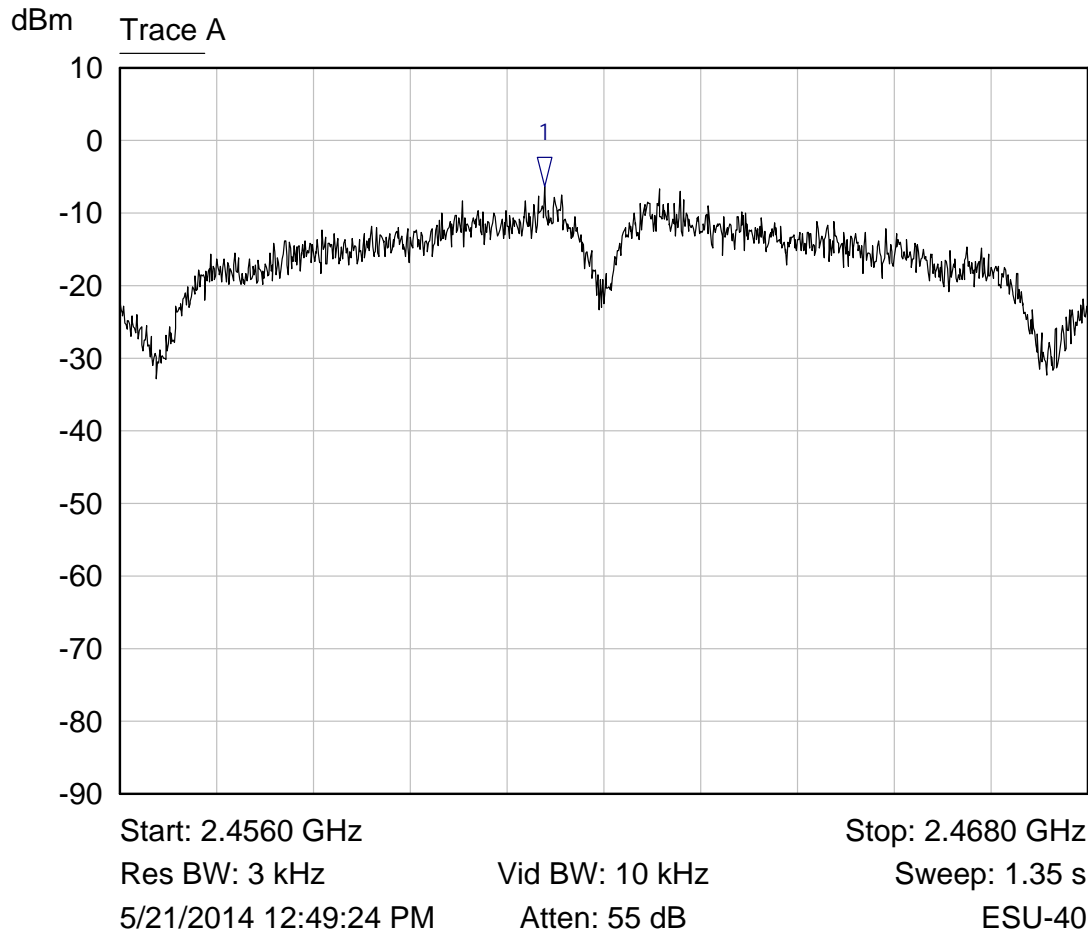
Middle Channel 3 kHz PSD Plot (802.11b)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4378 GHz	-6.69 dBm	

Trace A 802.11b +16 power setting

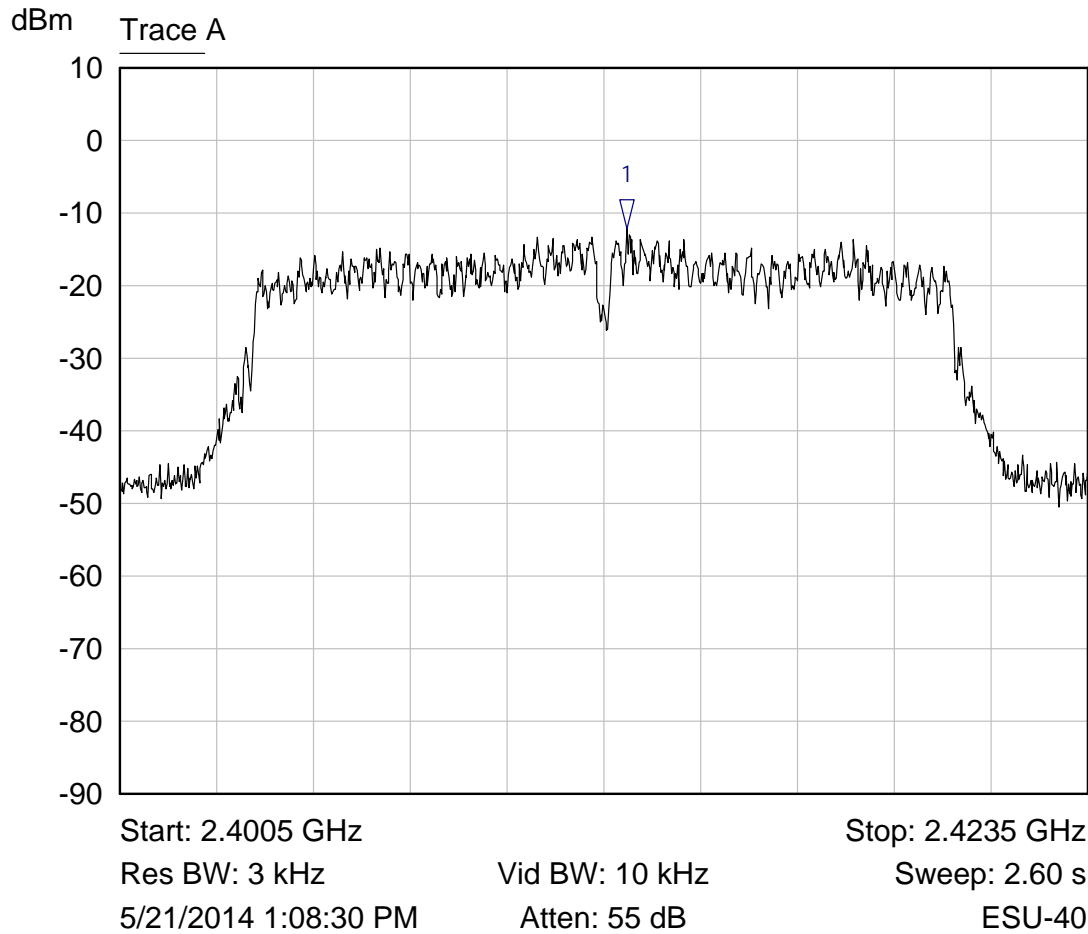
Highest Channel 3 kHz PSD Plot (802.11b)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4613 GHz	-6.38 dBm	

Trace A 802.11b +16 power setting

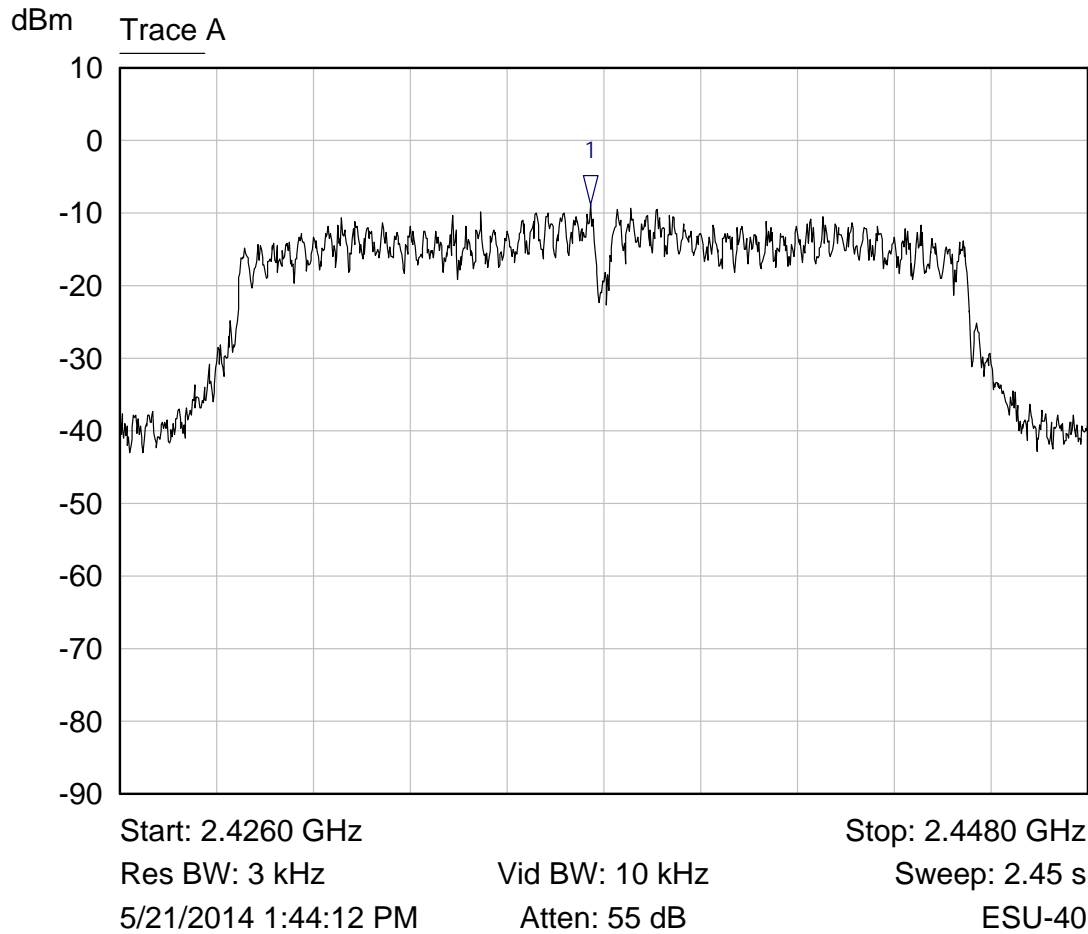
Lowest Channel 3 kHz PSD Plot (802.11g)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4126 GHz	-12.18 dBm	

Trace A 802.11g +13 power setting

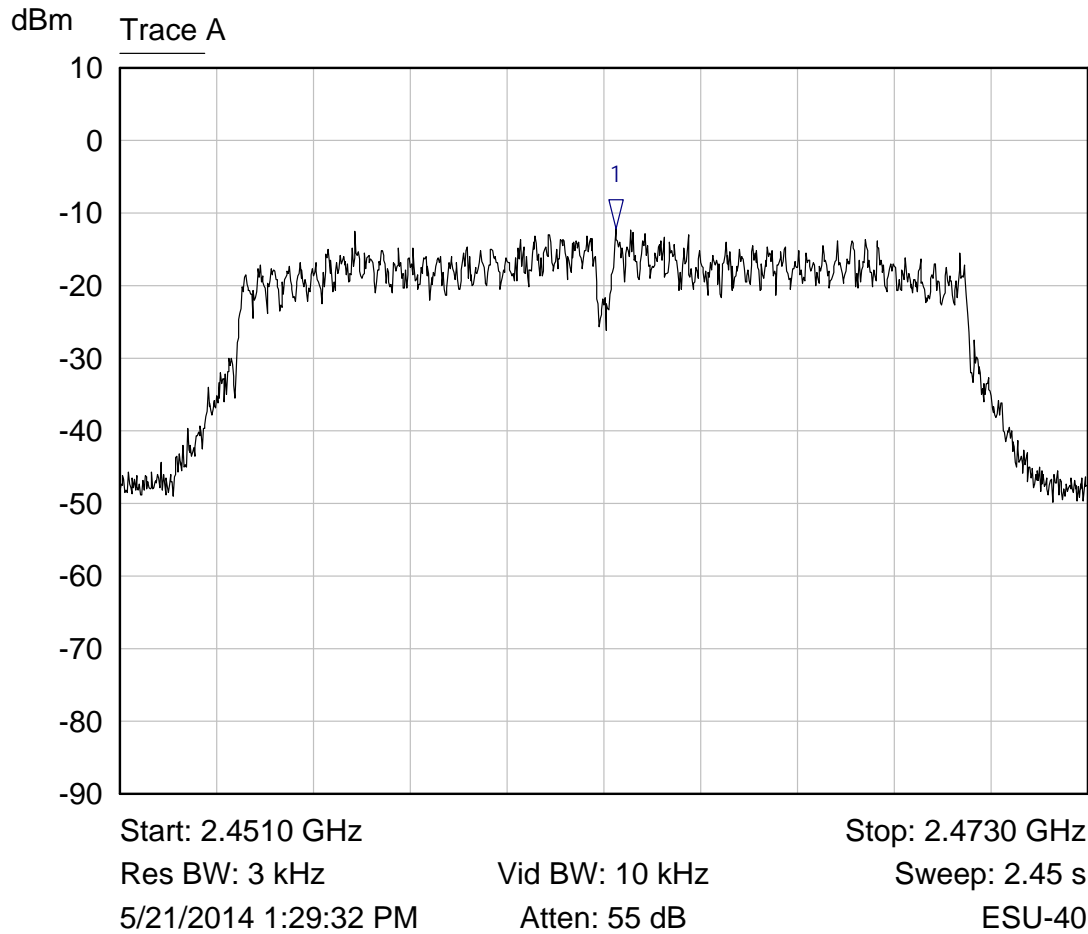
Middle Channel 3 kHz PSD Plot (802.11g)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4367 GHz	-8.86 dBm	

Trace A 802.11g +17 power setting

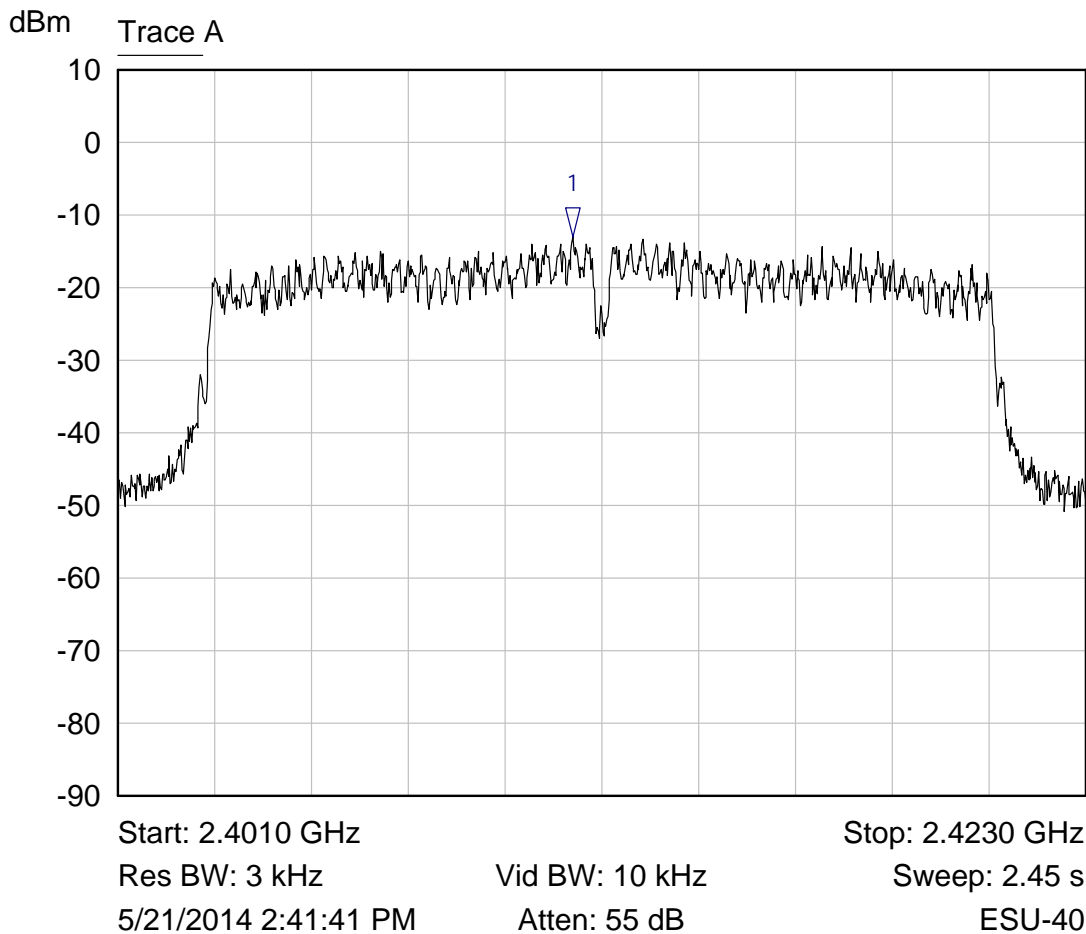
Highest Channel 3 kHz PSD Plot (802.11g)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4623 GHz	-12.22 dBm	

Trace A 802.11g +14 power setting

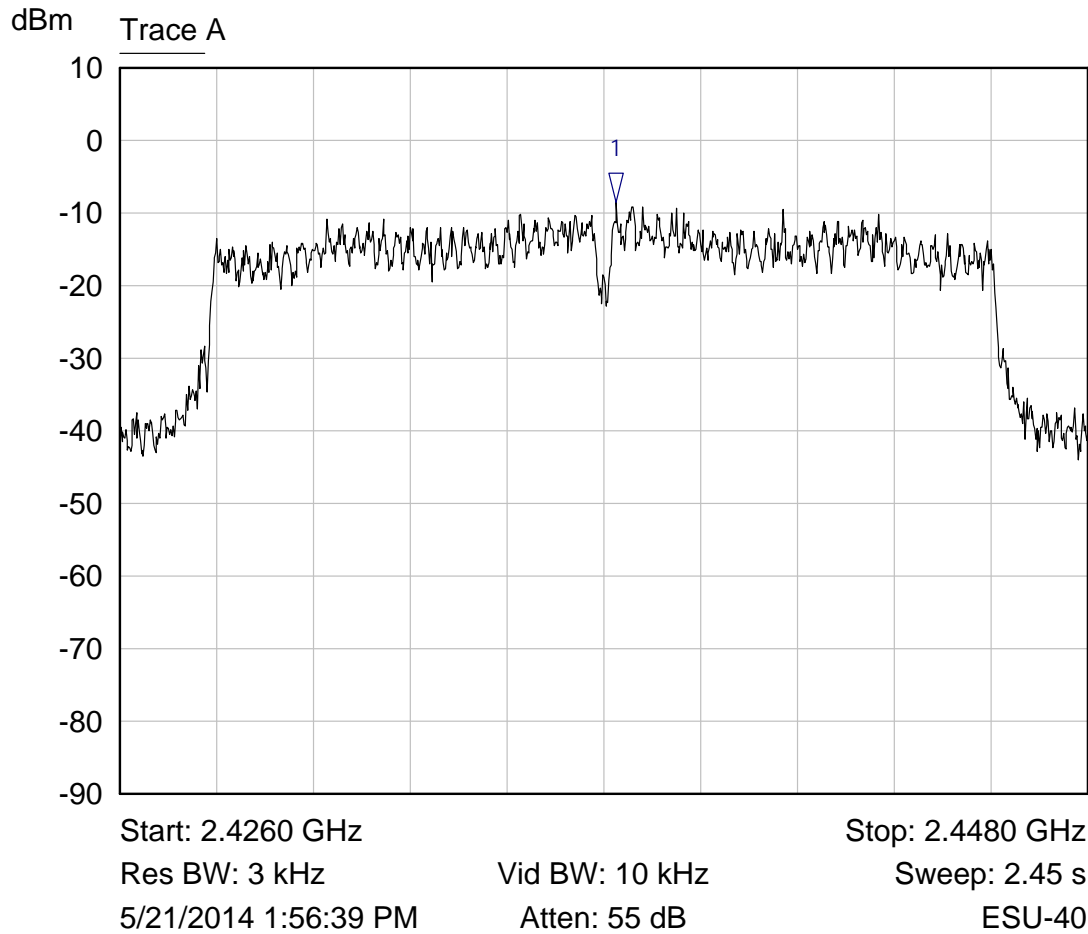
Lowest Channel 3 kHz PSD Plot (802.11n)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4113 GHz	-12.95 dBm	

Trace A 802.11n +13 power setting

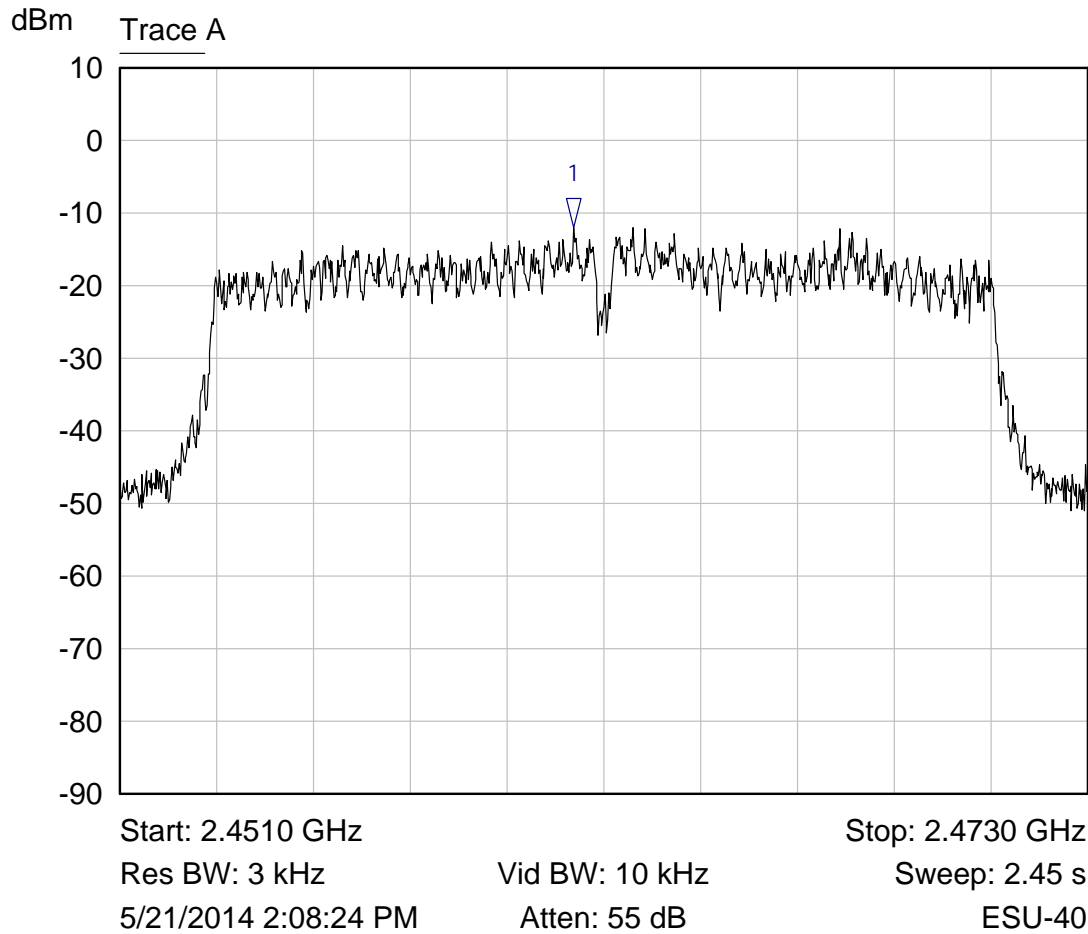
Middle Channel 3 kHz PSD Plot (802.11n)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4373 GHz	-8.49 dBm	

Trace A 802.11n +17 power setting

Highest Channel 3 kHz PSD Plot (802.11n)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4613 GHz	-11.96 dBm	

Trace A 802.11n +14 power setting

SECTION 7.0 MEASUREMENTS AND RESULTS – Bluetooth Transceiver**7.1 General Comments:**

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Appendix 1 of this report.

7.2 Bluetooth Test Results:**7.2.1 §15.203 Antenna Requirements**

The EUT uses an inverted F, trace antenna on a PCB separate from the Main PCB that contains the transmitter circuitry. The transceiver is connected to the antenna PCB via a 25 cm coaxial cable with FLP-40 connectors.

RESULT

The EUT complied with the specification.

7.2.2 §15.207 Conducted Disturbance at the AC Mains Ports

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.17	Hot Lead	Peak (Note 1)	46.0	55.0	-9.0
0.50	Hot Lead	Peak (Note 1)	38.6	46.0	-7.4
0.60	Hot Lead	Peak (Note 1)	42.0	46.0	-4.0
18.90	Hot Lead	Quasi-Peak (Note 1)	42.8	50.0	-7.2
19.55	Hot Lead	Quasi-Peak (Note 1)	44.1	50.0	-5.9
20.30	Hot Lead	Quasi-Peak (Note 1)	43.3	50.0	-6.7
0.50	Neutral Lead	Peak (Note 1)	35.8	46.0	-10.2
18.88	Neutral Lead	Peak (Note 1)	46.3	50.0	-3.7
19.33	Neutral Lead	Quasi-Peak (Note 1)	44.5	50.0	-5.5
19.93	Neutral Lead	Quasi-Peak (Note 1)	44.0	50.0	-6.0
20.30	Neutral Lead	Quasi-Peak (Note 1)	41.3	50.0	-8.7
27.25	Neutral Lead	Peak (Note 1)	40.0	50.0	-10.0
Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.					

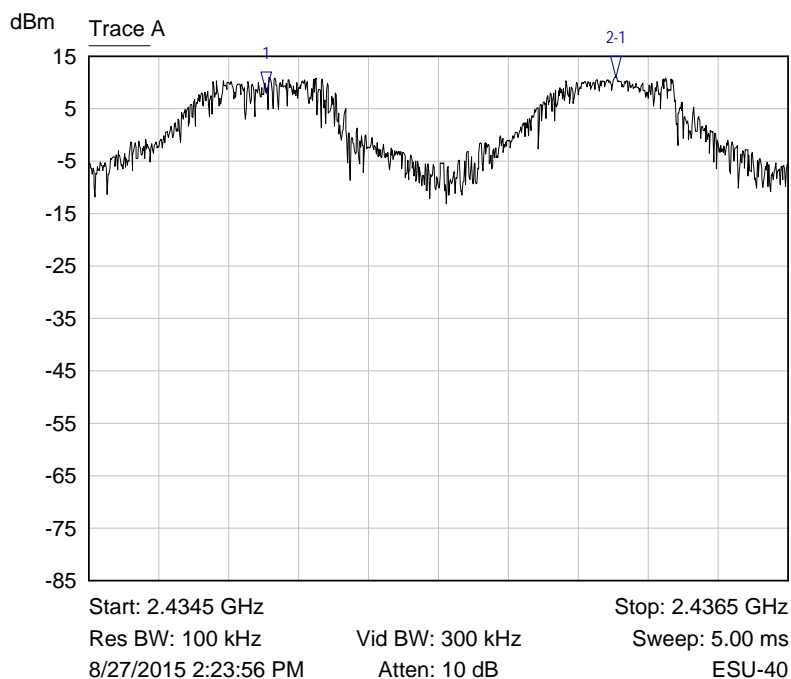
RESULT

In the configuration tested, the EUT complied with the specification by 3.7 dB.

7.2.3 §15.247(a) Channel Separation

The EUT must have the hopping channel carrier frequencies separated by 25 kHz or the 20 dB bandwidth, whichever is greater. Alternately, FHSS systems operating in the 2400 – 2483.5 MHz band may have channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. A plot showing a 1 MHz channel separation is shown below. The SDR 20 dB bandwidth is 962 kHz. The EDR 20 dB bandwidth is 1341 kHz. The channel bandwidths are shown in section 7.2.4.

Channel Separation Plot



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4350 GHz	7.92 dBm	
2-1 ▽	Trace A	1.0000 MHz	3.06 dB	

RESULT

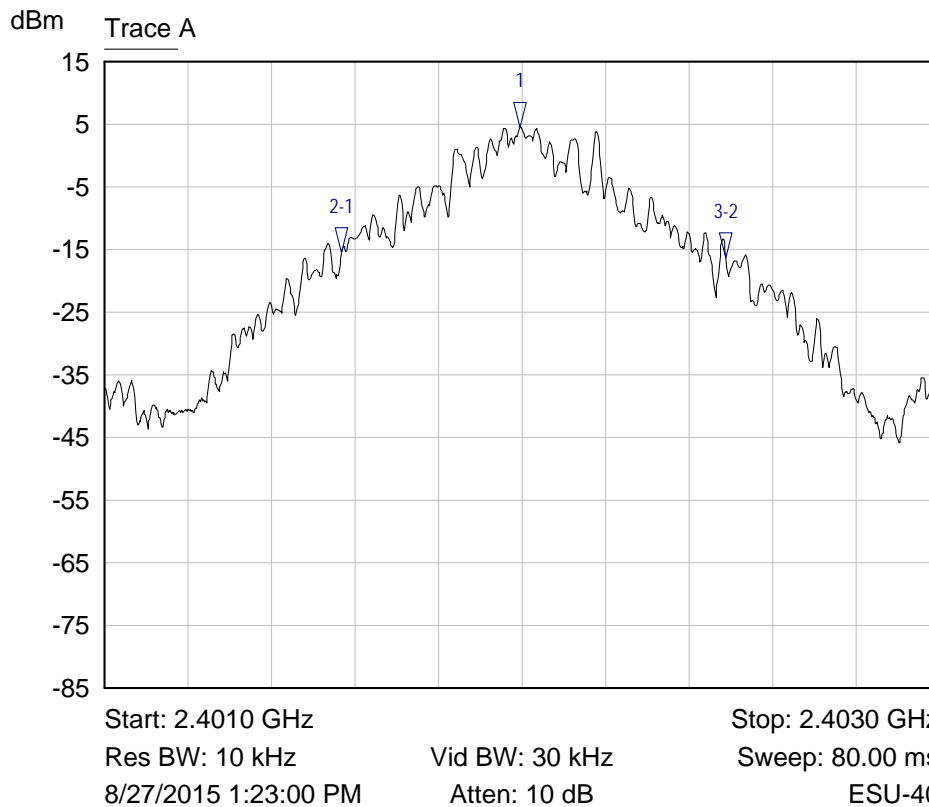
The channel carrier frequency separation is 1000 kHz, which is greater than two-thirds of the 20 dB bandwidth; therefore, the EUT complies with the specification.

7.2.4 §15.247(a) Channel Bandwidth

The 20 dB bandwidth of the hopping channels is shown in the table and plots below.

Frequency (MHz)	Emission 20 dB bandwidth (kHz)	
	SDR	EDR
2402	920	1320
2440	960	1329
2480	962	1341

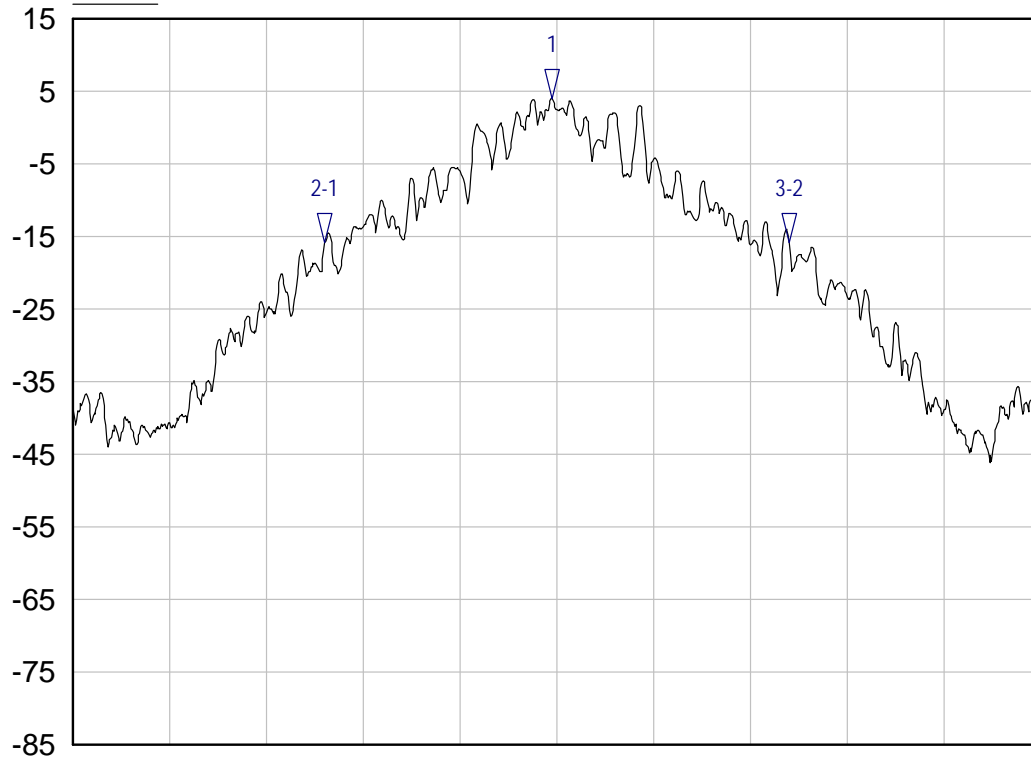
Lowest Channel 20 dB Bandwidth – SDR



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4020 GHz	4.54 dBm	
2-1 ▽	Trace A	-428.0000 kHz	-20.02 dB	
3-2 ▽	Trace A	920.0000 kHz	-0.85 dB	

Middle Channel 20 dB Bandwidth – SDR

dBm Trace A



Start: 2.4390 GHz

Stop: 2.4410 GHz

Res BW: 10 kHz

Vid BW: 30 kHz

Sweep: 80.00 ms

8/27/2015 1:34:46 PM

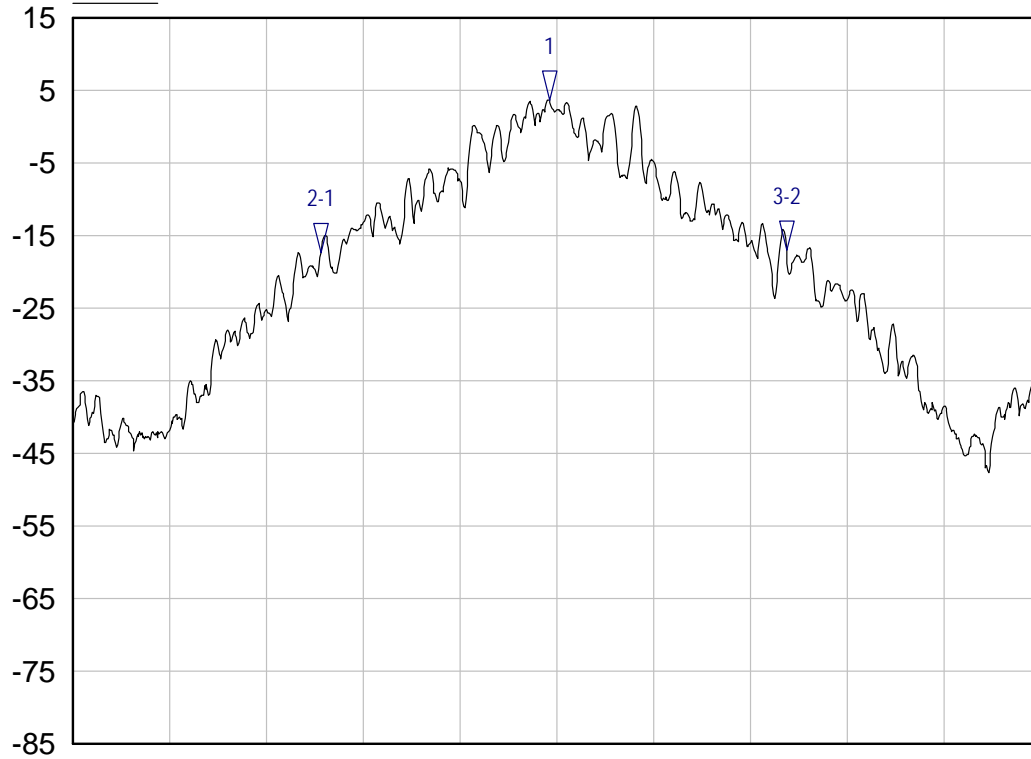
Atten: 10 dB

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Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4400 GHz	3.96 dBm	
2-1 ▽	Trace A	-470.0000 kHz	-19.83 dB	
3-2 ▽	Trace A	960.0000 kHz	0.01 dB	

Highest Channel 20 dB Bandwidth – SDR

dBm Trace A



Start: 2.4790 GHz

Stop: 2.4810 GHz

Res BW: 10 kHz

Vid BW: 30 kHz

Sweep: 80.00 ms

8/27/2015 1:37:57 PM

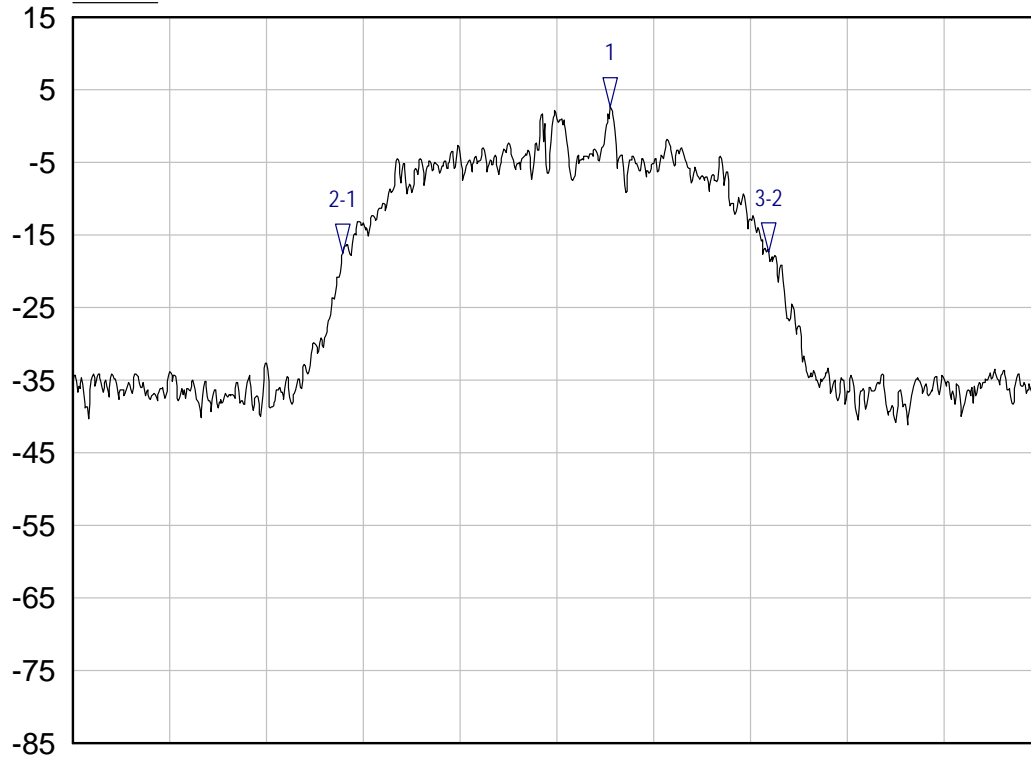
Atten: 10 dB

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Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4800 GHz	3.65 dBm	
2-1 ▽	Trace A	-472.0000 kHz	-20.95 dB	
3-2 ▽	Trace A	962.0000 kHz	0.25 dB	

Lowest Channel 20 dB Bandwidth – EDR

dBm Trace A



Start: 2.4005 GHz

Stop: 2.4035 GHz

Res BW: 10 kHz

Vid BW: 30 kHz

Sweep: 80.00 ms

8/27/2015 2:11:58 PM

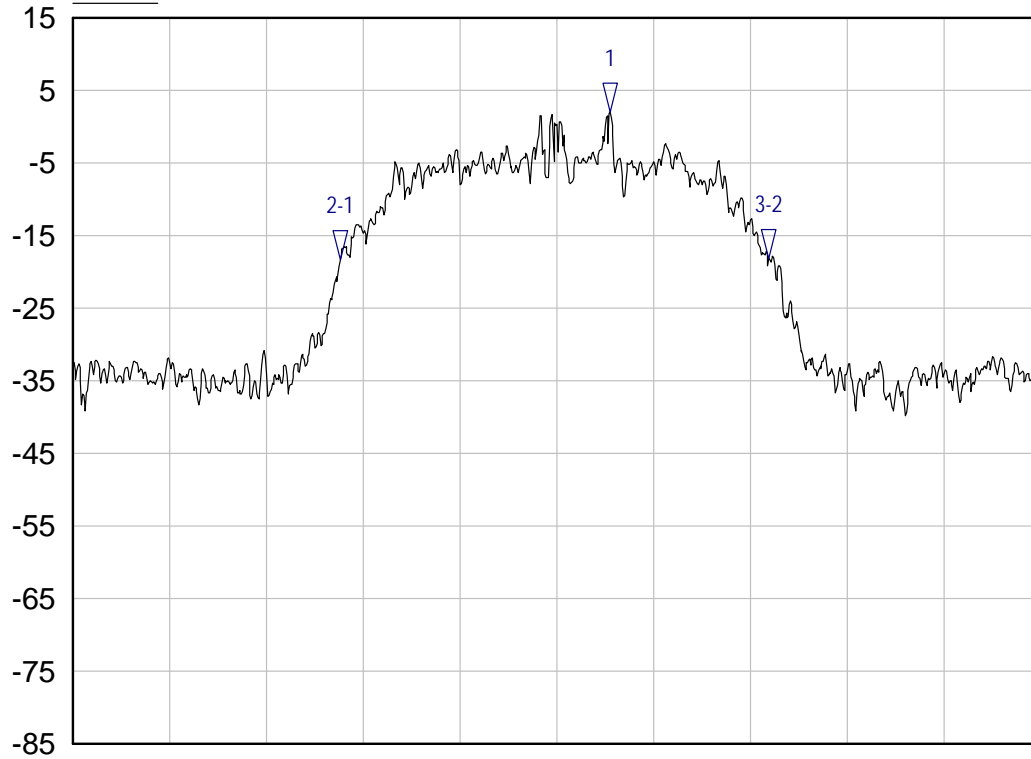
Atten: 10 dB

ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4022 GHz	2.62 dBm	
2-1 ▽	Trace A	-828.0000 kHz	-20.10 dB	
3-2 ▽	Trace A	1.3200 MHz	0.14 dB	

Middle Channel 20 dB Bandwidth – EDR

dBm Trace A



Start: 2.4385 GHz

Stop: 2.4415 GHz

Res BW: 10 kHz

Vid BW: 30 kHz

Sweep: 80.00 ms

8/27/2015 2:08:31 PM

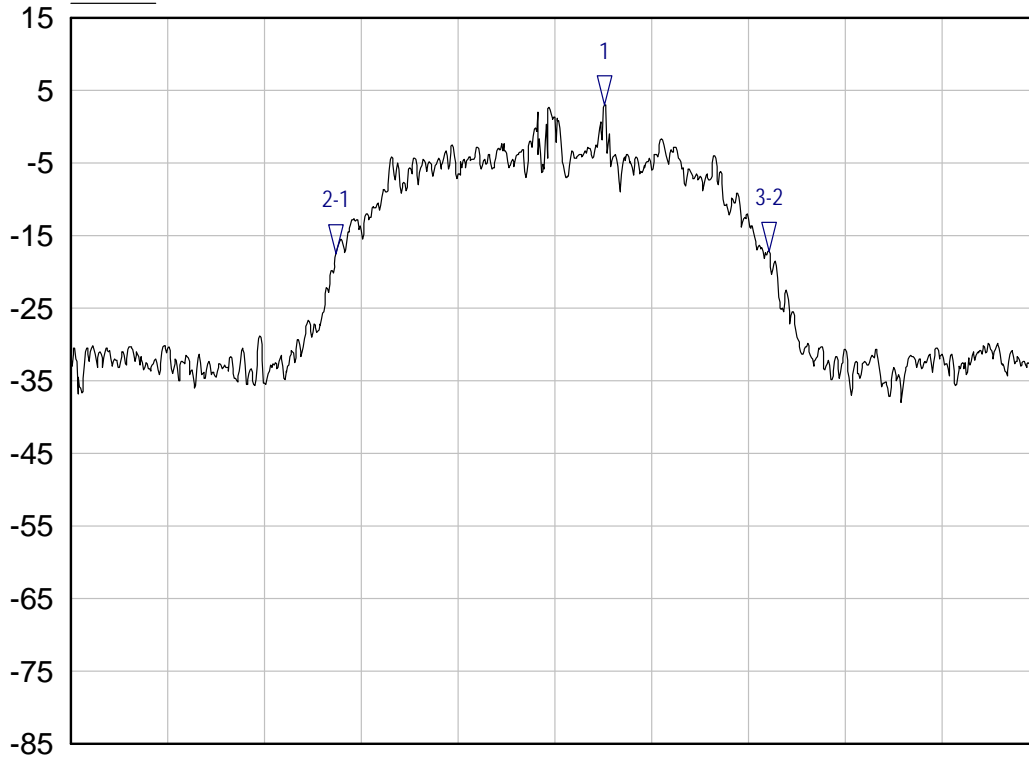
Atten: 10 dB

ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4402 GHz	2.00 dBm	
2-1 ▽	Trace A	-837.0000 kHz	-20.30 dB	
3-2 ▽	Trace A	1.3290 MHz	0.07 dB	

Highest Channel 20 dB Bandwidth – EDR

dBm Trace A



Start: 2.4785 GHz

Stop: 2.4815 GHz

Res BW: 10 kHz

Vid BW: 30 kHz

Sweep: 80.00 ms

8/27/2015 1:56:00 PM

Atten: 10 dB

ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4802 GHz	2.99 dBm	
2-1 ▽	Trace A	-831.0000 kHz	-20.49 dB	
3-2 ▽	Trace A	1.3410 MHz	0.38 dB	

RESULT

In the configuration tested, the channel bandwidth allows the channel separation of 1 MHz to be compliant; therefore, the EUT complied with the requirements of the specification.

The EUT uses 79 channels that have a bandwidth greater than 250 kHz; therefore, the EUT must have an average time of occupancy on any frequency that is no greater than 0.4 seconds in a period of 31.6 seconds (0.4 seconds x 79 channels). See the plots and calculations below.

Trace A

1 2 3 4 5 6 7 8 9 10

dBm

15

5

-5

-15

-25

-35

-45

-55

-65

-75

-85

Start: 0 s

Stop: 1.0000 s

Res BW: 100 kHz

Vid BW: 300 kHz

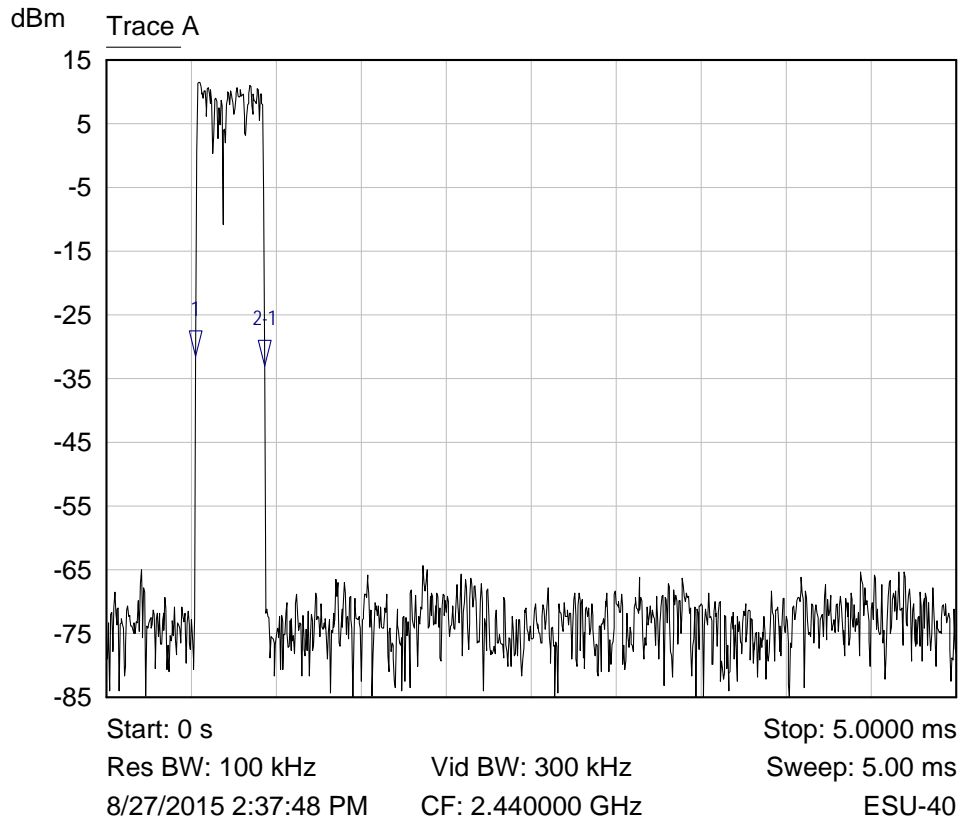
Sweep: 1.00 s

8/27/2015 2:40:46 PM

CF: 2.440000 GHz

ESU-40

Mkr	Trace	X-Axis	Value	Notes
1 ▾	Trace A	133.0000 ms	10.81 dBm	
2 ▾	Trace A	185.0000 ms	10.79 dBm	
3 ▾	Trace A	313.0000 ms	10.81 dBm	
4 ▾	Trace A	379.0000 ms	10.80 dBm	
5 ▾	Trace A	534.0000 ms	10.78 dBm	
6 ▾	Trace A	569.0000 ms	10.78 dBm	
7 ▾	Trace A	733.0000 ms	10.79 dBm	
8 ▾	Trace A	782.0000 ms	10.78 dBm	
9 ▾	Trace A	916.0000 ms	10.79 dBm	
10 ▾	Trace A	982.0000 ms	10.80 dBm	

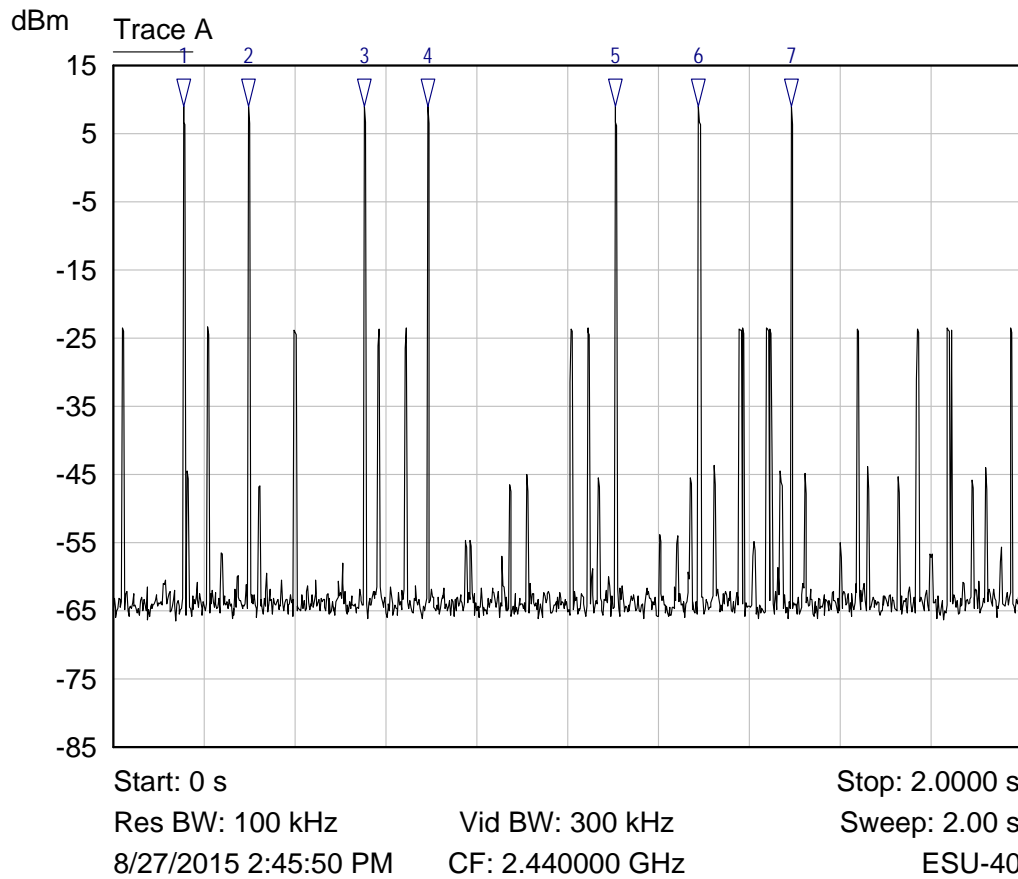


Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	525.0000 us	-31.53 dBm	
2-1 ▽	Trace A	405.0000 us	-1.43 dB	

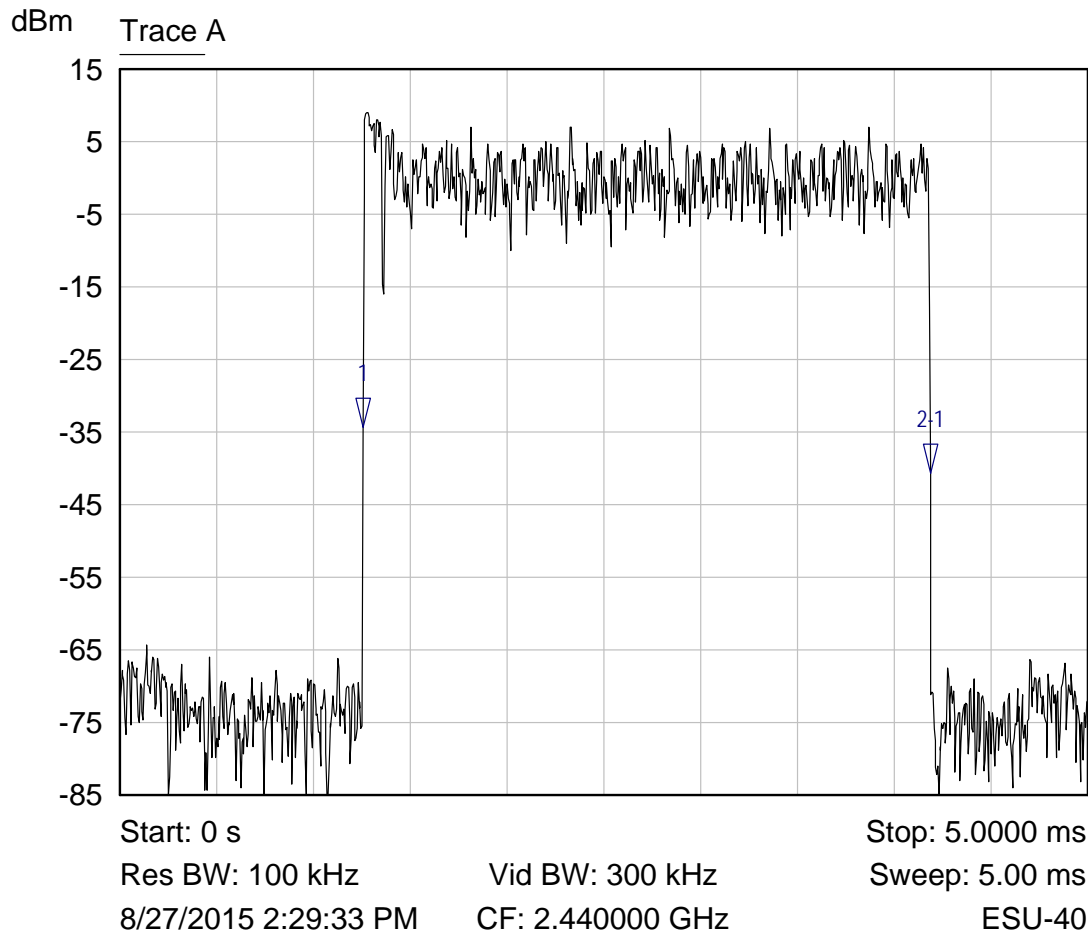
From the plots, the EUT transmits up to 10 times per second for 0.4 ms at each transmission.

Dwell time = 31.6 seconds x 10 hits/second x 0.405 ms = 127.98 ms/31.6 second interval

EDR Operation



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	154.0000 ms	8.97 dBm	
2 ▽	Trace A	298.0000 ms	8.96 dBm	
3 ▽	Trace A	552.0000 ms	8.96 dBm	
4 ▽	Trace A	692.0000 ms	8.97 dBm	
5 ▽	Trace A	1.1040 s	8.95 dBm	
6 ▽	Trace A	1.2880 s	8.96 dBm	
7 ▽	Trace A	1.4920 s	8.95 dBm	



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	1.2550 ms	-34.28 dBm	
2-1 ▽	Trace A	2.9300 ms	-6.31 dB	

From the plots, the EUT transmits up to 3.5 (7 hits per 2 seconds/2) times per second for 2.93 ms at each transmission.

$$\text{Dwell time} = 31.6 \text{ seconds} \times 3.5 \text{ hits/second} \times 2.93 \text{ ms} = 324.058 \text{ ms/31.6 second interval}$$

RESULT

The EUT complies with the specification as the EUT transmits on an individual channel for a maximum of 324.058 milliseconds in 31.6 seconds, less than the 0.4 seconds allowed by the specification.

7.2.6 §15.247(b) Peak Output Power

The maximum peak RF Conducted output power measured for this device was 13.37 dBm or 21.73 mW. The limit is 0.125 Watt when using antennas with 6 dBi or less gain. The antenna has a maximum calculated gain of 5.4 dBi. Radiated and conducted measurements of the fundamental emission were made in each mode, power setting, and modulation type at the upper, lower, and middle channels and the antenna gain was calculated using the equation $P = (FS \times d)^2 / 30 \times G$ where P is power in Watts, FS is field strength in dBμV/m, d is the measurement distance in meters, and G is the numeric gain of the antenna. The gain of 5.4 dBi was calculated using P = 112.2 mW (20.5 dBm), FS = 121.12 dBμV/m, and d = 3 meters. Plots are shown below of the operating band and the results of this testing are summarized in the table.

Frequency (MHz)	Measurement (dBm)		Peak Output Power (mW)	
	SDR	EDR	SDR	EDR
2402	13.37	12.81	21.73	19.10
2440	11.80	11.25	15.14	13.34
2480	11.55	10.95	14.29	12.45

RESULT

In the configuration tested, the RF peak output power was less than 0.125 Watt; therefore, the EUT complied with the requirements of the specification.

7.2.7 §15.247(c) Spurious Emissions**7.2.7.1 Conducted Spurious Emissions**

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. The tables show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency, and upper frequency. Shown below are plots with the EUT tuned to the upper and lower channels. These demonstrate compliance with the provisions of this section at the band edges.

The emissions must be attenuated 20 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW. The highest power using SDR measured in was 11.6 dBm; therefore, the criteria is 11.6 – 20 = -8.4 dBm. For EDR, the highest power measured was 9.8 dBm; therefore the criteria is 9.8 – 20 = -10.2 dBm.

Lowest Channel – SDR

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4804	-54.3	-8.4	-45.9
7206	-63.3	-8.4	-54.9
9208	-63.7	-8.4	-55.3
12010	-63.6	-8.4	-55.2
14412	-63.0	-8.4	-54.6
16814	-63.2	-8.4	-54.8
19216	-64.4	-8.4	-56.0
21618	-63.6	-8.4	-55.2
24020	-63.1	-8.4	-54.7

Middle Channel – SDR

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4880	-55.0	-8.4	-46.6
7320	-63.6	-8.4	-55.2
9760	-63.8	-8.4	-55.4
12200	-64.0	-8.4	-55.6
14640	-64.0	-8.4	-55.6
17080	-63.6	-8.4	-55.2
19520	-63.8	-8.4	-55.4
21960	-63.7	-8.4	-55.3
24400	-63.9	-8.4	-55.5

Highest Channel – SDR

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4960	-55.7	-8.4	-47.3
7440	-61.7	-8.4	-53.3
9920	-63.8	-8.4	-55.4
12400	-64.0	-8.4	-55.6
14880	-64.2	-8.4	-55.8
17360	-63.8	-8.4	-55.4
19840	-63.7	-8.4	-55.3
22230	-63.2	-8.4	-54.8
24800	-63.9	-8.4	-55.5

Lowest Channel – EDR

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4804	-60.0	-10.2	-49.8
7206	-63.2	-10.2	-53.0
9208	-63.6	-10.2	-53.4
12010	-64.4	-10.2	-54.2
14412	-64.0	-10.2	-53.8
16814	-64.4	-10.2	-54.2
19216	-64.3	-10.2	-54.1
21618	-63.6	-10.2	-53.4
24020	-64.4	-10.2	-54.2

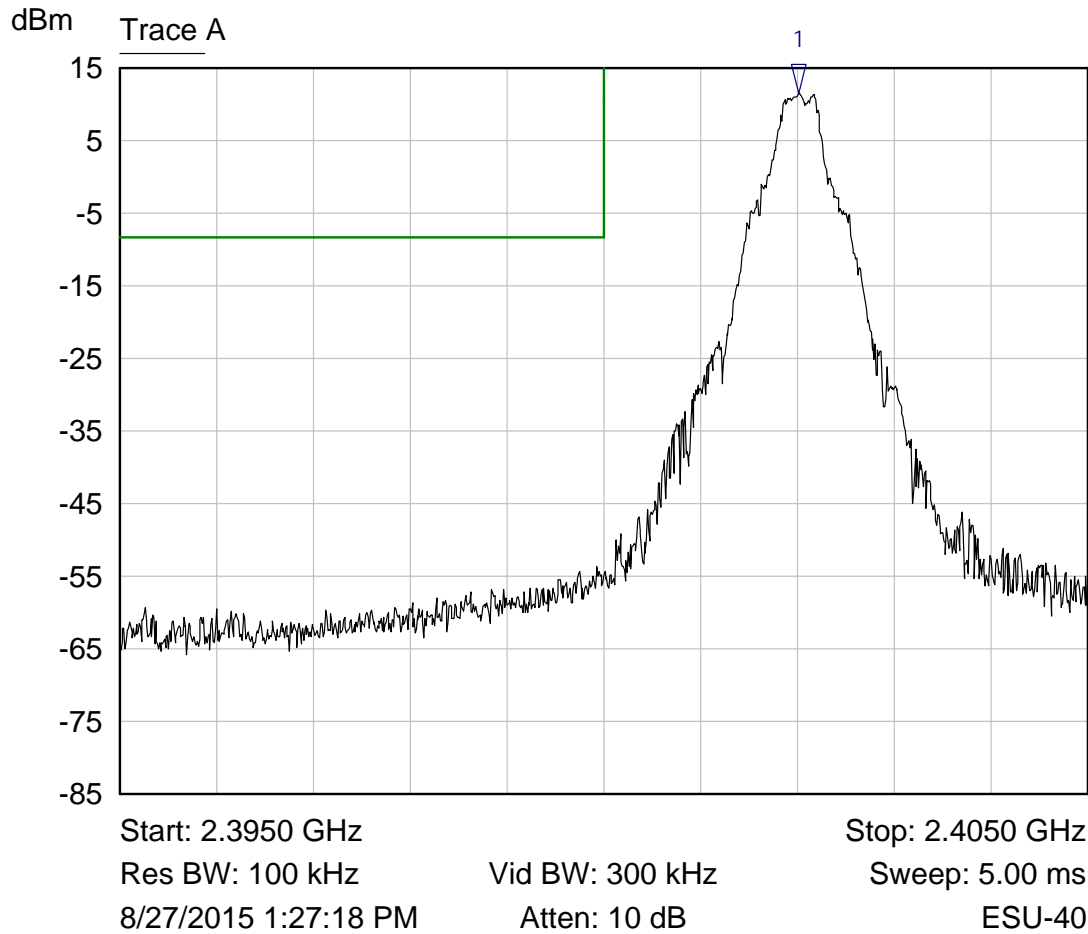
Middle Channel – EDR

Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4880	-59.8	-10.2	-49.6
7320	-63.1	-10.2	-52.9
9760	-64.0	-10.2	-53.8
12200	-63.5	-10.2	-53.3
14640	-65.2	-10.2	-55.0
17080	-63.9	-10.2	-53.7
19520	-64.4	-10.2	-54.2
21960	-64.8	-10.2	-54.6
24400	-64.4	-10.2	-54.2

Highest Channel – EDR

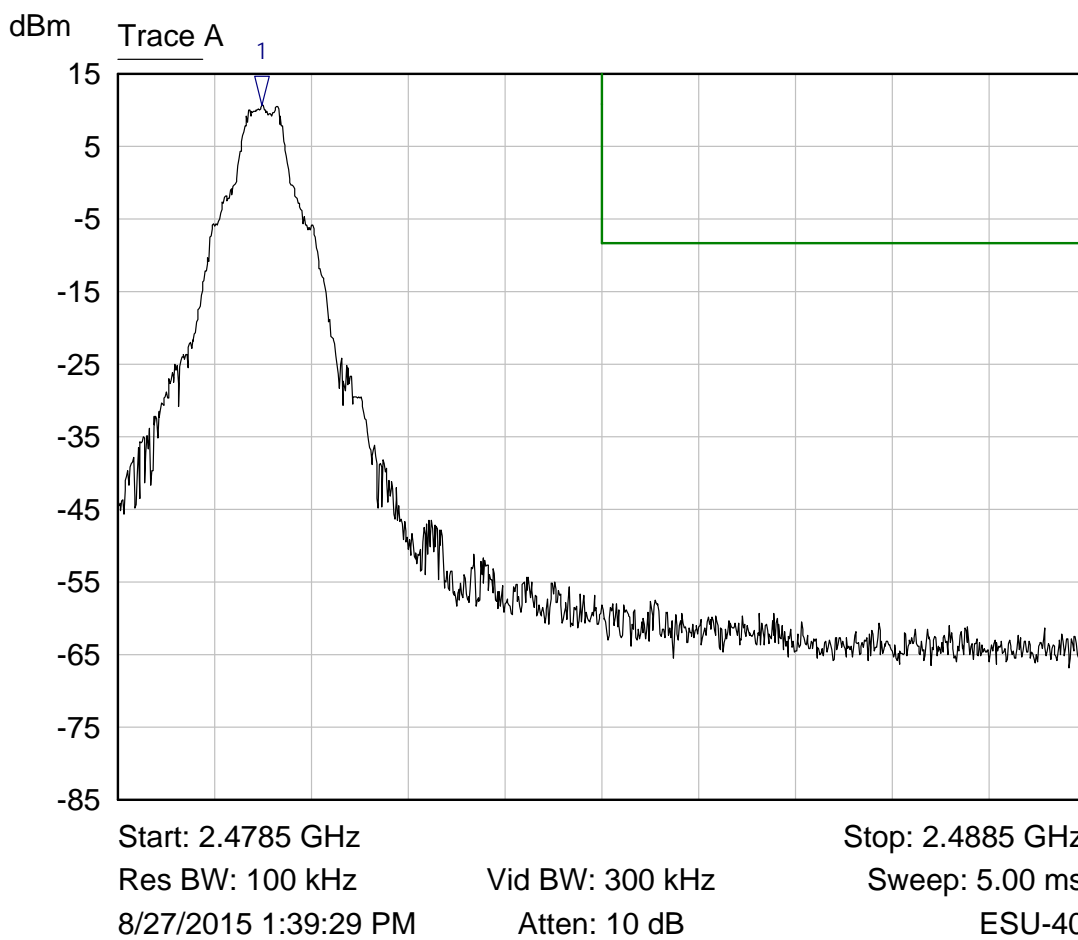
Frequency (MHz)	Corrected Level (dBm)	Criteria (dBm)	Margin (dB)
4960	-59.8	-10.2	-49.6
7440	-63.7	-10.2	-53.5
9920	-64.5	-10.2	-54.3
12400	-65.2	-10.2	-55.0
14880	-63.0	-10.2	-52.8
17360	-64.4	-10.2	-54.2
19840	-64.0	-10.2	-53.8
22230	-63.4	-10.2	-53.2
24800	-64.1	-10.2	-53.9

Lower Band Edge – SDR



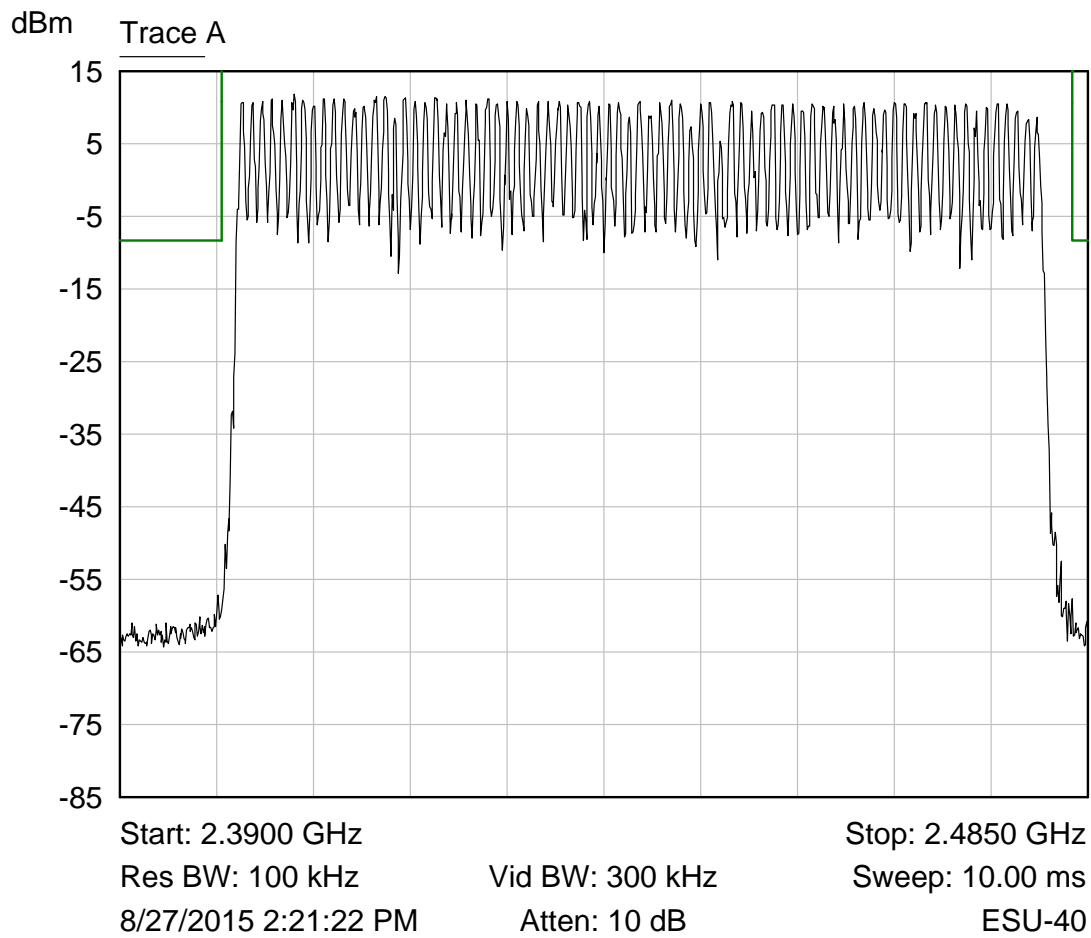
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4020 GHz	11.46 dBm	

Upper Band Edge – EDR

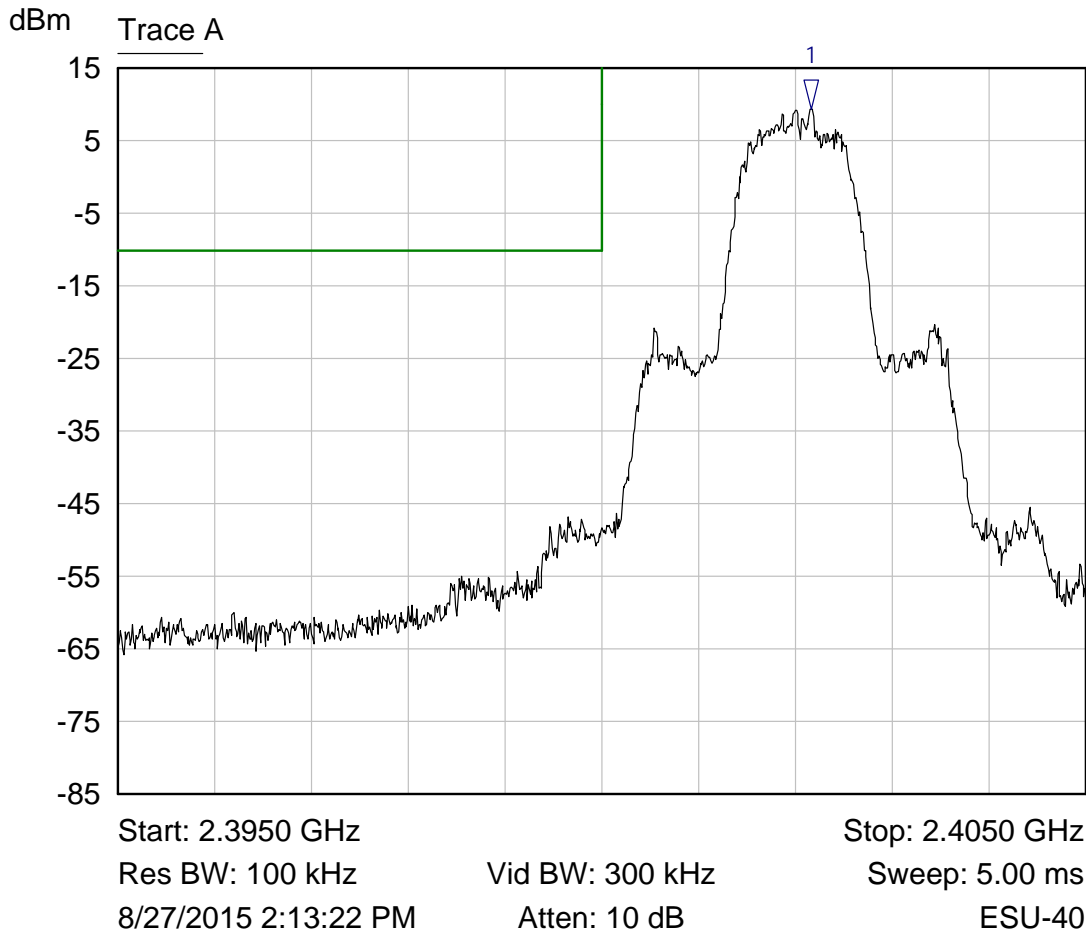


Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4800 GHz	10.61 dBm	

Operating Band when Hopping – SDR

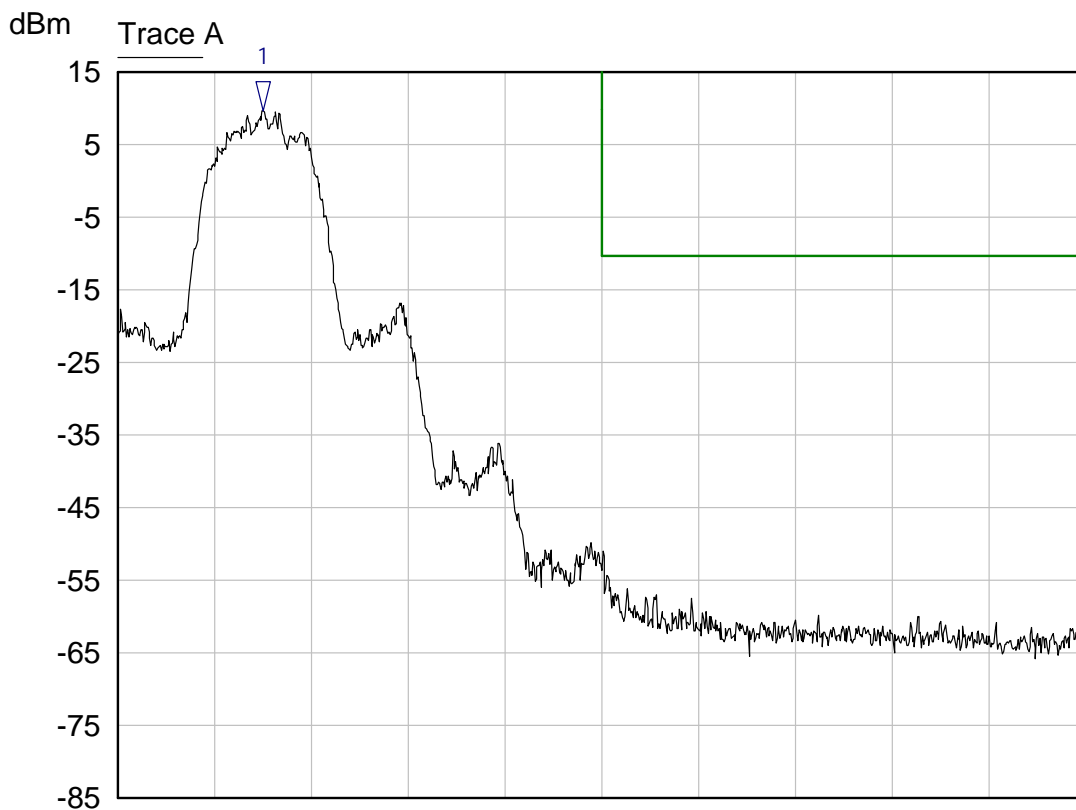


Lower Band Edge – EDR



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4022 GHz	9.39 dBm	

Upper Band Edge – EDR



Start: 2.4785 GHz

Stop: 2.4885 GHz

Res BW: 100 kHz

Vid BW: 300 kHz

Sweep: 5.00 ms

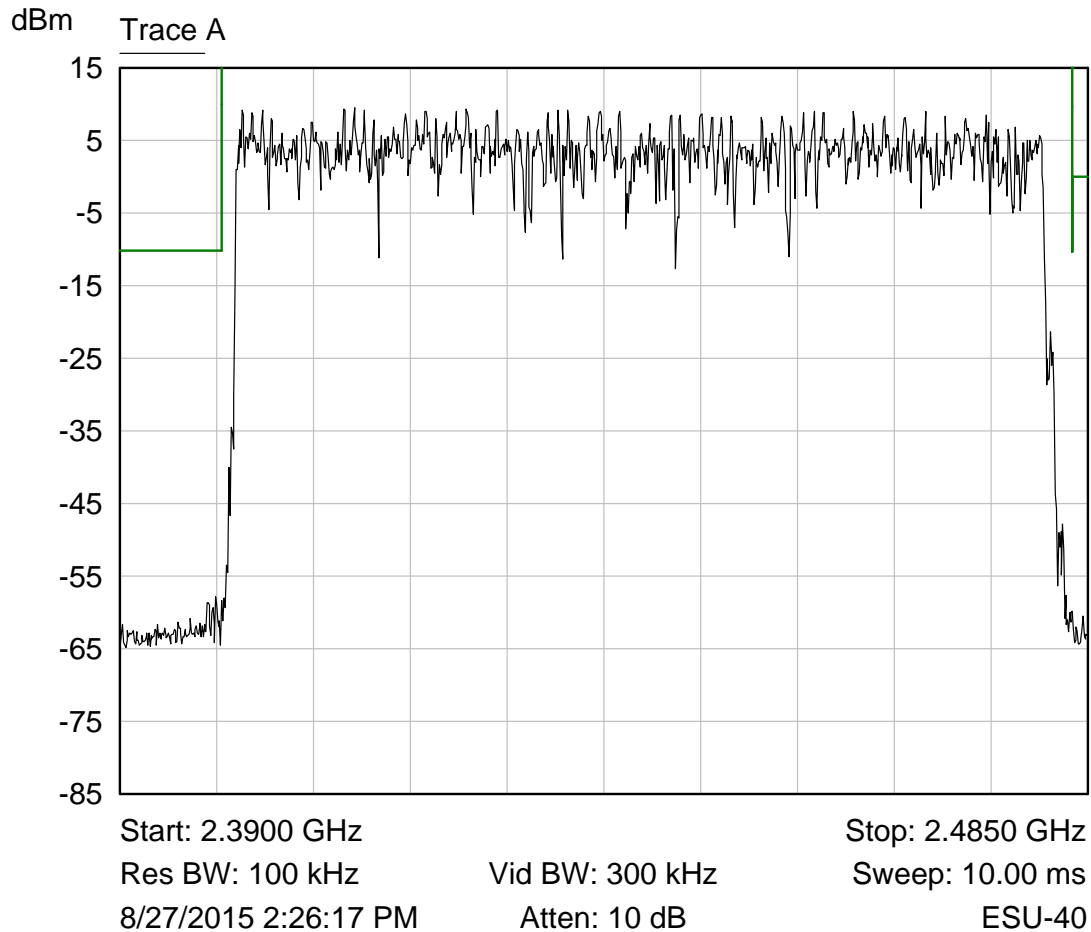
8/27/2015 2:03:01 PM

Atten: 10 dB

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Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4800 GHz	9.71 dBm	

Operating Band when Hopping – EDR

**RESULT**

Conducted spurious emissions were attenuated 20 dB or more from the fundamental and the EUT operates fully within the authorized frequency band; therefore, the EUT complies with the specification.

7.2.7.2 Radiated Spurious Emissions in the Restricted Bands

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental emission was investigated to measure any radiated emissions in the restricted bands. The following tables show measurements of any emission that fell into the restricted bands of §15.205. The tables show the worst-case emission measured from the EUT. For frequencies above 12.5 GHz, a measurement distance of 1 meter was used. The noise floor was a minimum of 6 dB below the limit. The emissions in the restricted bands must meet the limits specified in §15.209. Tabular data for each of the spurious emissions is shown below for each of the units. Plots of the band edges are also shown.

AVERAGE FACTOR

There was no average factor applied.

Transmitting at the Lowest Frequency – SDR

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Duty Cycle Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4804	Peak	Vertical	4.7	39.0	0.0	43.7	74.0	-30.3
4804	Average	Vertical	-6.1	39.0	0.0	32.9	54.0	-21.1
4804	Peak	Horizontal	3.1	39.0	0.0	42.1	74.0	-31.9
4804	Average	Horizontal	-7.9	39.0	0.0	31.1	54.0	-22.9
7206	Peak	Vertical	2.6	43.4	0.0	46.0	74.0	-28.0
7206	Average	Vertical	-7.4	43.4	0.0	36.0	54.0	-18.0
7206	Peak	Horizontal	2.2	43.4	0.0	45.6	74.0	-28.4
7206	Average	Horizontal	-6.1	43.4	0.0	37.3	54.0	-16.7

Transmitting at the Middle Frequency – SDR

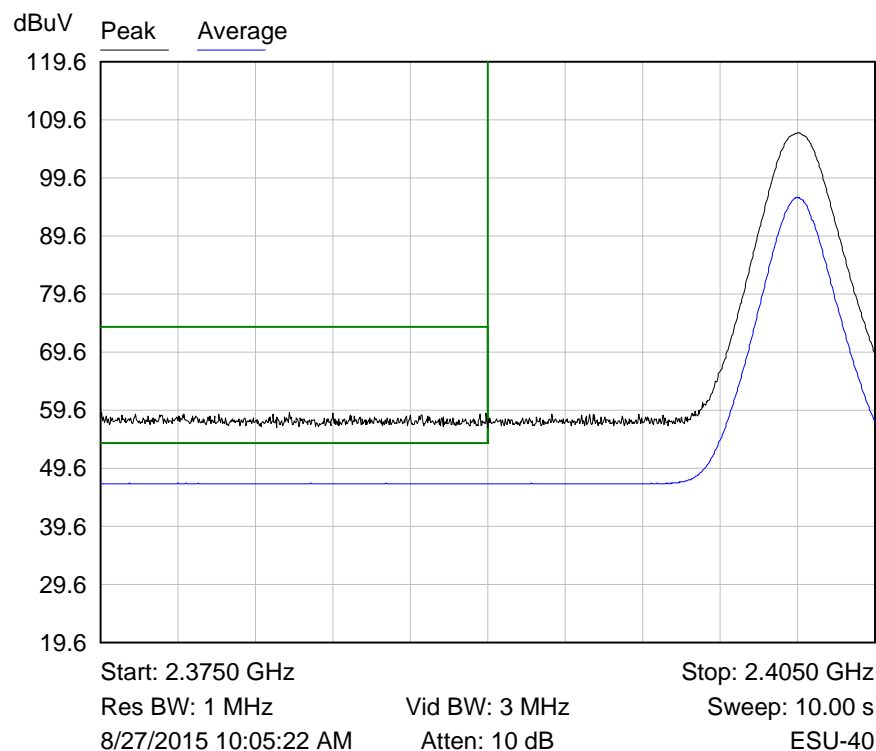
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Duty Cycle Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4880	Peak	Vertical	3.2	39.2	0.0	42.4	74.0	-31.6
4880	Average	Vertical	-7.3	39.2	0.0	31.9	54.0	-22.1
4880	Peak	Horizontal	2.8	39.2	0.0	42.0	74.0	-32.0
4880	Average	Horizontal	-8.2	39.2	0.0	31.0	54.0	-23.0
7320	Peak	Vertical	2.2	43.7	0.0	45.9	74.0	-28.1
7320	Average	Vertical	-8.1	43.7	0.0	35.6	54.0	-18.4
7320	Peak	Horizontal	3.2	43.7	0.0	46.9	74.0	-27.1
7320	Average	Horizontal	-6.9	43.7	0.0	36.8	54.0	-17.2

Transmitting at the Highest Frequency – SDR

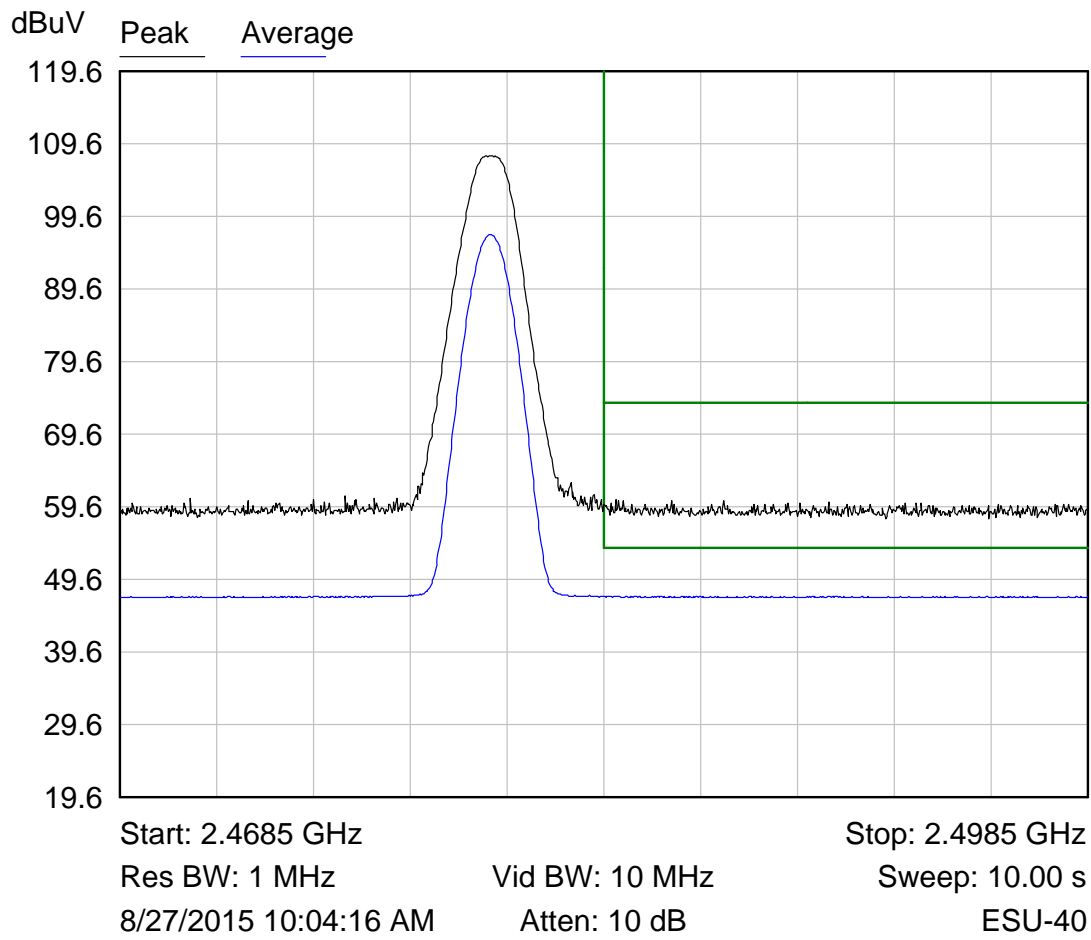
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Duty Cycle Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4960	Peak	Vertical	5.8	39.4	0.0	45.2	74.0	-28.8
4960	Average	Vertical	-1.9	39.4	0.0	37.5	54.0	-16.5
4960	Peak	Horizontal	3.0	39.4	0.0	42.4	74.0	-31.6
4960	Average	Horizontal	-6.7	39.4	0.0	32.7	54.0	-21.3
7440	Peak	Vertical	3.1	44.1	0.0	47.2	74.0	-26.8
7440	Average	Vertical	-5.5	44.1	0.0	38.6	54.0	-15.4
7440	Peak	Horizontal	3.5	44.1	0.0	47.6	74.0	-26.4
7440	Average	Horizontal	-6.1	44.1	0.0	38.0	54.0	-16.0

No other emissions were seen in the restricted bands.

Lower Band Edge Plot



Upper Band Edge Plot



Transmitting at the Lowest Frequency – EDR

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Duty Cycle Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4804	Peak	Vertical	3.9	39.0	0.0	42.9	74.0	-31.1
4804	Average	Vertical	-4.0	39.0	0.0	35.0	54.0	-19.0
4804	Peak	Horizontal	5.0	39.0	0.0	44.0	74.0	-30.0
4804	Average	Horizontal	-2.5	39.0	0.0	36.5	54.0	-17.5
7206	Peak	Vertical	1.8	43.4	0.0	45.2	74.0	-28.8
7206	Average	Vertical	-9.1	43.4	0.0	34.3	54.0	-19.7
7206	Peak	Horizontal	2.2	43.4	0.0	45.6	74.0	-28.4
7206	Average	Horizontal	-7.9	43.4	0.0	35.5	54.0	-18.5

Transmitting at the Middle Frequency – EDR

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Duty Cycle Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4880	Peak	Vertical	3.0	39.2	0.0	42.2	74.0	-31.8
4880	Average	Vertical	-8.6	39.2	0.0	30.6	54.0	-23.4
4880	Peak	Horizontal	1.2	39.2	0.0	40.4	74.0	-33.6
4880	Average	Horizontal	-8.9	39.2	0.0	30.3	54.0	-23.7
7320	Peak	Vertical	2.3	43.7	0.0	46.0	74.0	-28.0
7320	Average	Vertical	-9.7	43.7	0.0	34.0	54.0	-20.0
7320	Peak	Horizontal	2.0	43.7	0.0	45.7	74.0	-28.3
7320	Average	Horizontal	-9.6	43.7	0.0	34.1	54.0	-19.9

Transmitting at the Highest Frequency – EDR

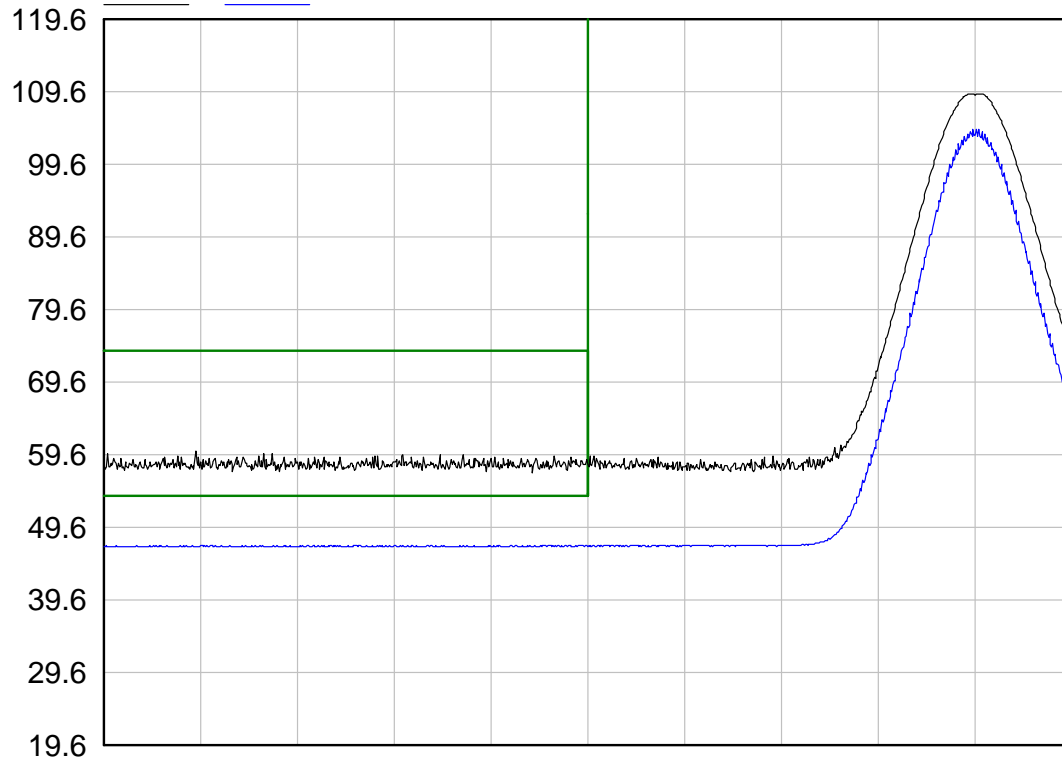
Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Duty Cycle Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4960	Peak	Vertical	3.0	39.4	0.0	42.4	74.0	-31.6
4960	Average	Vertical	-6.5	39.4	0.0	32.9	54.0	-21.1
4960	Peak	Horizontal	2.9	39.4	0.0	42.3	74.0	-31.7
4960	Average	Horizontal	-7.4	39.4	0.0	32.0	54.0	-22.0
7440	Peak	Vertical	2.7	44.1	0.0	46.8	74.0	-27.2
7440	Average	Vertical	-7.3	44.1	0.0	36.8	54.0	-17.2

Frequency (MHz)	Detection Mode	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Duty Cycle Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
7440	Peak	Horizontal	1-9	44.1	0.0	36.1	74.0	-37.9
7440	Average	Horizontal	-6.6	44.1	0.0	37.5	54.0	-16.5

No other emissions were seen in the restricted bands.

Lower Band Edge Plot – EDR

dBuV Peak Average



Start: 2.3750 GHz

Stop: 2.4050 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

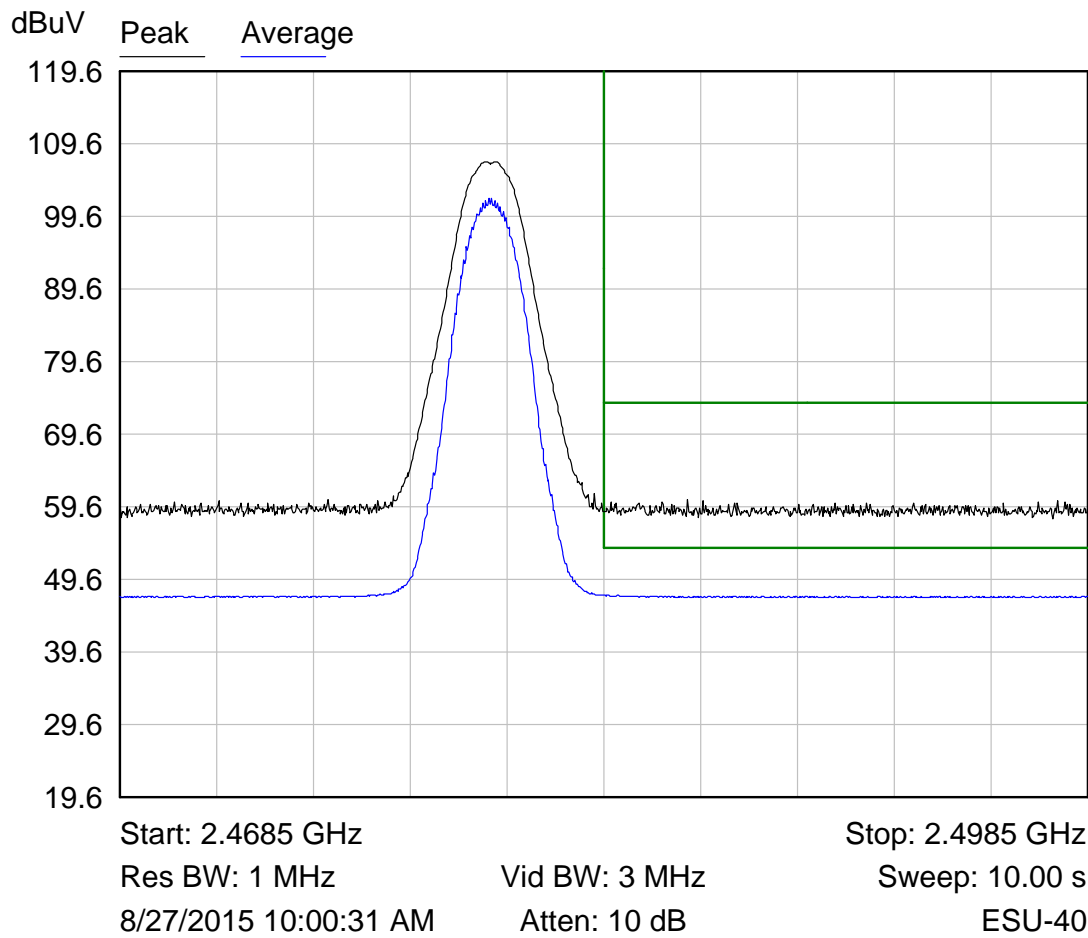
Sweep: 10.00 s

8/27/2015 9:53:51 AM

Atten: 10 dB

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Upper Band Edge Plot – EDR

**RESULT**

The radiated spurious emissions in the restricted bands met the limits specified in §15.209; therefore, the EUT complies with the specification

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT**A1.1 Conducted Disturbance at the AC Mains**

The conducted disturbance at mains ports from the EUT was measured using a spectrum analyzer with a quasi-peak adapter for peak, quasi-peak and average readings. The quasi-peak adapter uses a bandwidth of 9 kHz, with the spectrum analyzer's resolution bandwidth set at 100 kHz, for readings in the 150 kHz to 30 MHz frequency ranges.

The conducted disturbance at mains ports measurements are performed in a screen room using a (50 Ω /50 μ H) Line Impedance Stabilization Network (LISN).

Where mains flexible power cords are longer than 1 m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4 m in length.

Where the EUT is a collection of equipment with each device having its own power cord, the point of connection for the LISN is determined from the following rules:

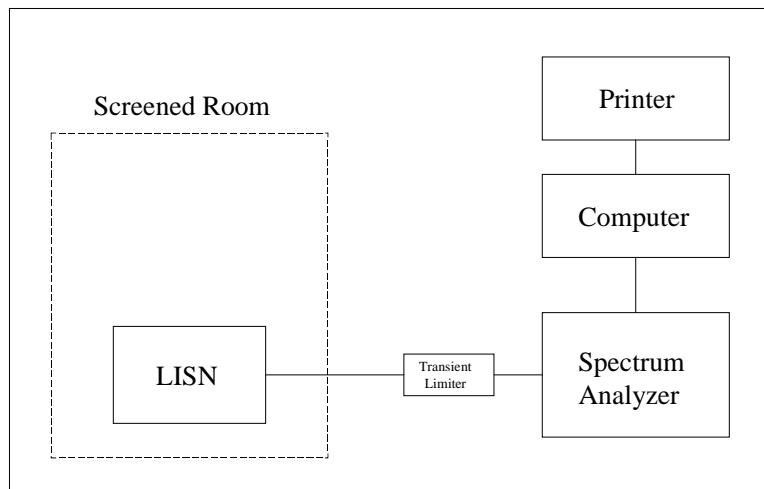
- (a) Each power cord, which is terminated in a mains supply plug, shall be tested separately.
- (b) Power cords, which are not specified by the manufacturer to be connected via a host unit, shall be tested separately.
- (c) Power cords which are specified by the manufacturer to be connected via a host unit or other power supplying equipment shall be connected to that host unit and the power cords of that host unit connected to the LISN and tested.
- (d) Where a special connection is specified, the necessary hardware to effect the connection is supplied by the manufacturer for the testing purpose.
- (e) When testing equipment with multiple mains cords, those cords not under test are connected to an artificial mains network (AMN) different than the AMN used for the mains cord under test.

For AC mains port testing, desktop EUT are placed on a non-conducting table at least 0.8 meters from the metallic floor and placed 40 cm from the vertical coupling plane (copper plating in the wall behind EUT table). Floor standing equipment is placed directly on the earth grounded floor.

Type of Equipment	Manufacturer	Model Number	Barcode Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer	Hewlett Packard	8566B	644	03/23/2015	03/23/2016
Quasi-Peak Detector	Hewlett Packard	85650A	1130	03/16/2015	03/16/2016
LISN	Nemko	LISN-COMM-50	1424	02/25/2015	02/25/2016
Conductance Cable Wanship Site #2	Nemko	Cable J	840	12/23/2014	12/23/2015
Transient Limiter	Hewlett Packard	11947A	768	12/23/2014	12/23/2015

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

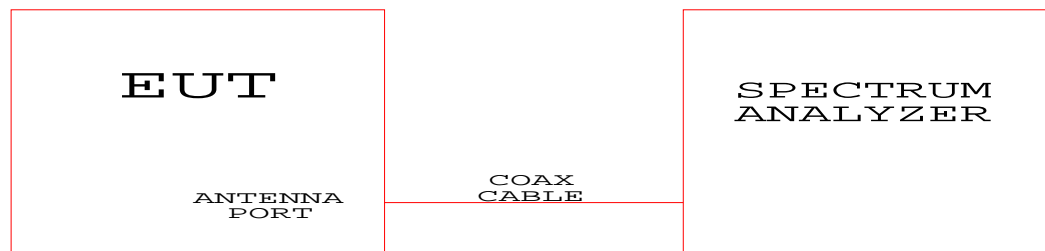
Conducted Emissions Test Setup



A1.2 Direct Connection at the Antenna Port Tests

Type of Equipment	Manufacturer	Model Number	Barcode Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer	Hewlett Packard	8566B	644	03/23/2015	03/23/2016
Quasi-Peak Detector	Hewlett Packard	85650A	1130	03/16/2015	03/16/2016
Spectrum Analyzer/Receiver	Rohde & Schwarz	ESU40	1229	04/07/2015	04/07/2016
6 dB Attenuator	Hewlett Packard	8491A	1103	12/23/2014	12/23/2015
Low Loss Cable (1 dB)	N/A	N/A	N/A	12/23/2014	12/23/2015

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Test Configuration Block Diagram

A1.3 Radiated Emissions

The radiated emissions from the intentional radiator were measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings.

A loop antenna was used to measure emissions below 30 MHz. Emission readings more than 20 dB below the limit at any frequency may not be listed in the reported data. For frequencies between 9 kHz and 30 MHz, or the lowest frequency generated or used in the device greater than 9 kHz, and less than 30 MHz, the spectrum analyzer resolution bandwidth was set to 9 kHz and the video bandwidth was set to 30 kHz. For average measurements, the spectrum analyzer average detector was used.

For frequencies above 30 MHz, an amplifier and preamplifier were used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 120 kHz, with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequency ranges. For peak emissions above 1000 MHz the spectrum analyzer's resolution bandwidth was set to 1 MHz and the video bandwidth was set to 3 MHz. For average measurements above 1000 MHz the spectrum analyzer's resolution bandwidth was set to 1 MHz and the average detector of the analyzer was used.

A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz and a Double Ridge Guide Horn antenna was used to measure the frequency range of 1 GHz to 18 GHz, and a Pyramidal Horn antenna was used to measure the frequency range of 18 GHz to 25 GHz, at a distance of 3 meters and/or 1 meter from the EUT. The readings obtained by the antenna are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

The configuration of the EUT was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.3 via the interconnecting cables listed in Section 2.4. A technician manually manipulated these interconnecting cables to obtain worst-case radiated disturbance. The EUT was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there were multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

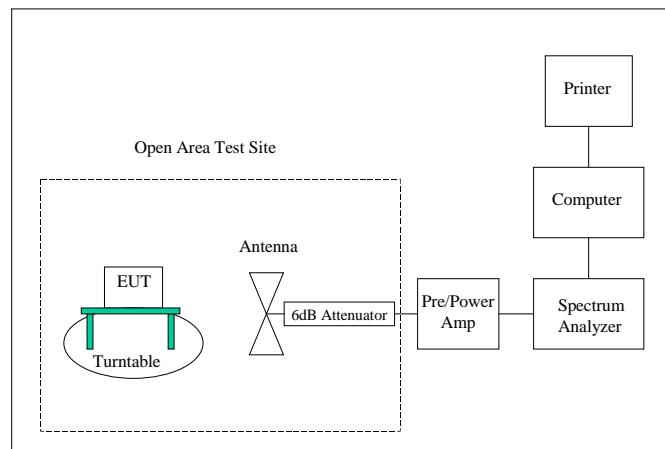
Desktop EUT are measured on a non-conducting table 0.8 meters above the ground plane. The table is placed on a turntable, which is level with the ground plane. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

For radiated emission testing at 30 MHz or above that is performed at distances closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

Type of Equipment	Manufacturer	Model Number	Barcode Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer/Receiver	Rohde & Schwarz	ESU40	1229	04/07/2015	04/07/2016
Spectrum Analyzer	Hewlett Packard	8566B	644	03/23/2015	03/23/2016
Quasi-Peak Detector	Hewlett Packard	85650A	1130	03/16/2015	03/16/2016
Loop Antenna	EMCO	6502	176	03/17/2015	03/17/2017
Biconilog Antenna	EMCO	3142	713	10/22/2014	10/22/2016
Double Ridged Guide Antenna	EMCO	3115	735	03/17/2015	03/17/2017
Pyramidal Standard Gain Horn	EMC Test System	3160-09	1052	04/10/2009	ICO
High Frequency Amplifier	Miteq	AFS4-00102650-35-10P-4	1299	12/23/2014	12/23/2015
20' High Frequency Cable	Microcoax	UFB197C-1-3120-000000	1297	12/23/2014	12/23/2015
3 Meter Radiated Emissions Cable Wanship Site #2	Microcoax	UFB205A-0-4700-000000	1295	12/23/2014	12/23/2015
Pre/Power-Amplifier	Hewlett Packard	8447F	762	09/05/2014	09/05/2015
6 dB Attenuator	Hewlett Packard	8491A	1103	12/23/2014	12/23/2015

An independent calibration laboratory or Nemko-CCL, Inc. personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Radiated Emissions Test Setup

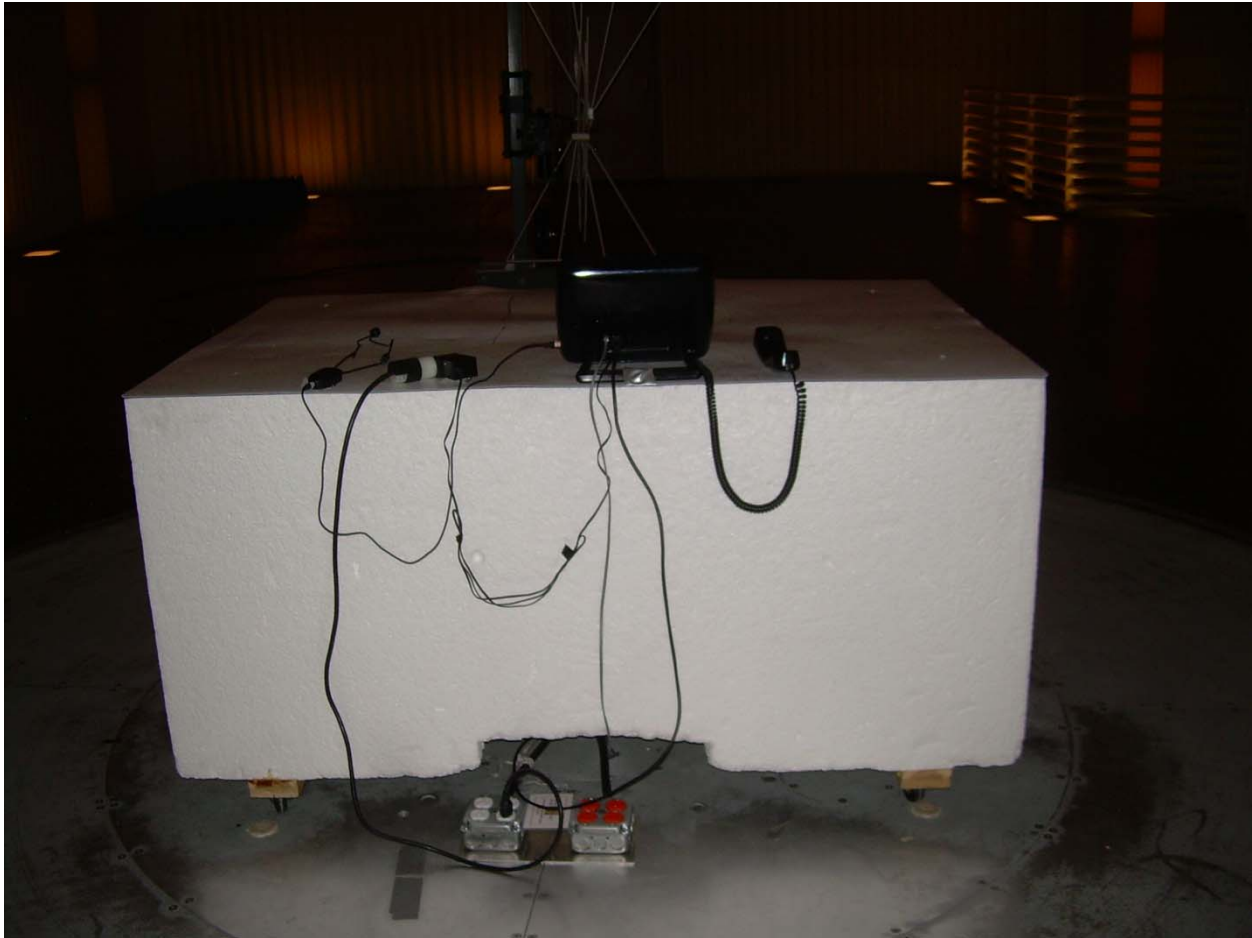


APPENDIX 2 PHOTOGRAPHS

Photograph 1 – Front View Radiated Disturbance Worst Case Configuration



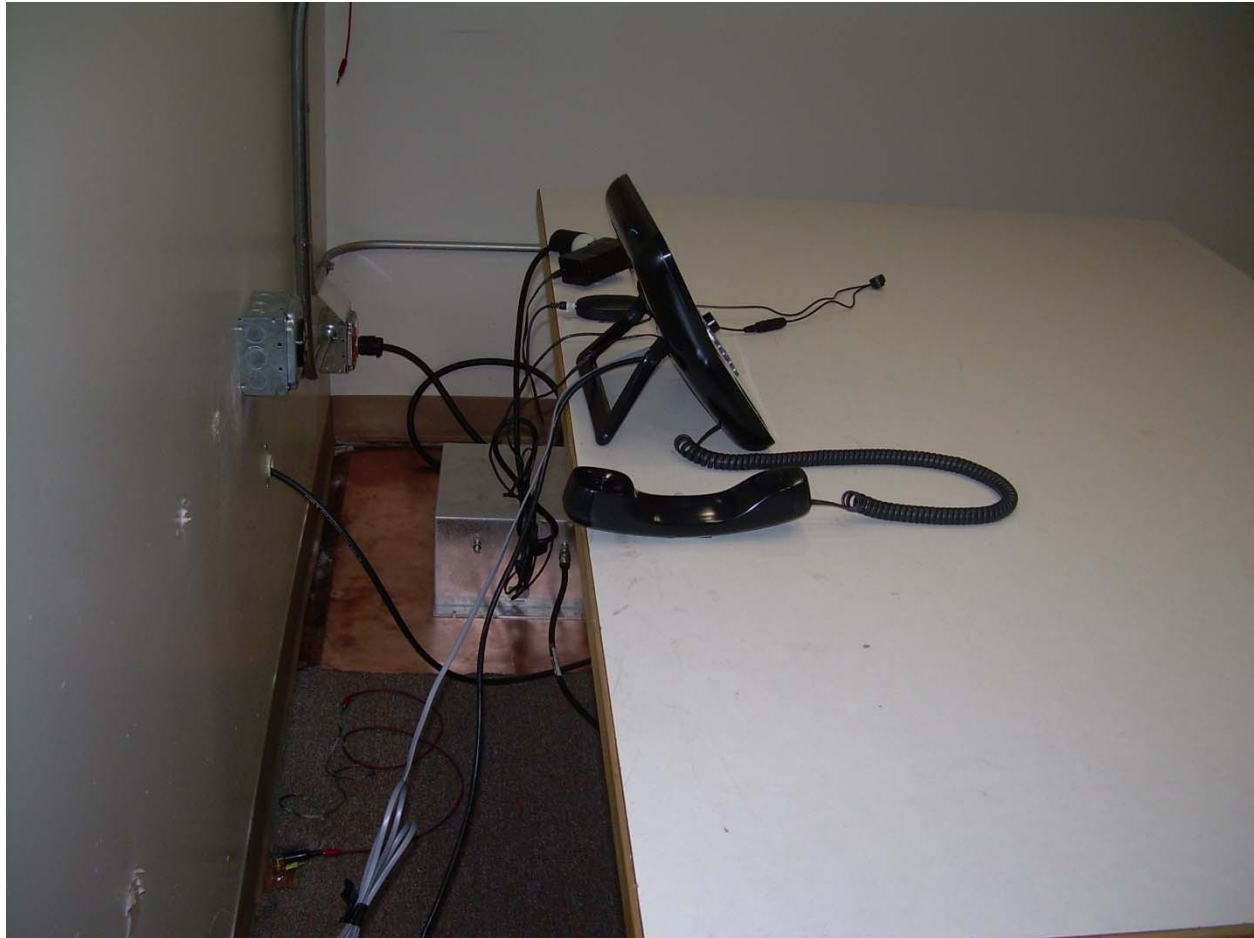
Photograph 2 – Back View Radiated Disturbance Worst Case Configuration



Photograph 3 – Front View Conducted Disturbance Worst Case Configuration



Photograph 4 – Back View Conducted Disturbance Worst Case Configuration



Photograph 5 – Front View of the EUT



Photograph 6 – Back View of the EUT



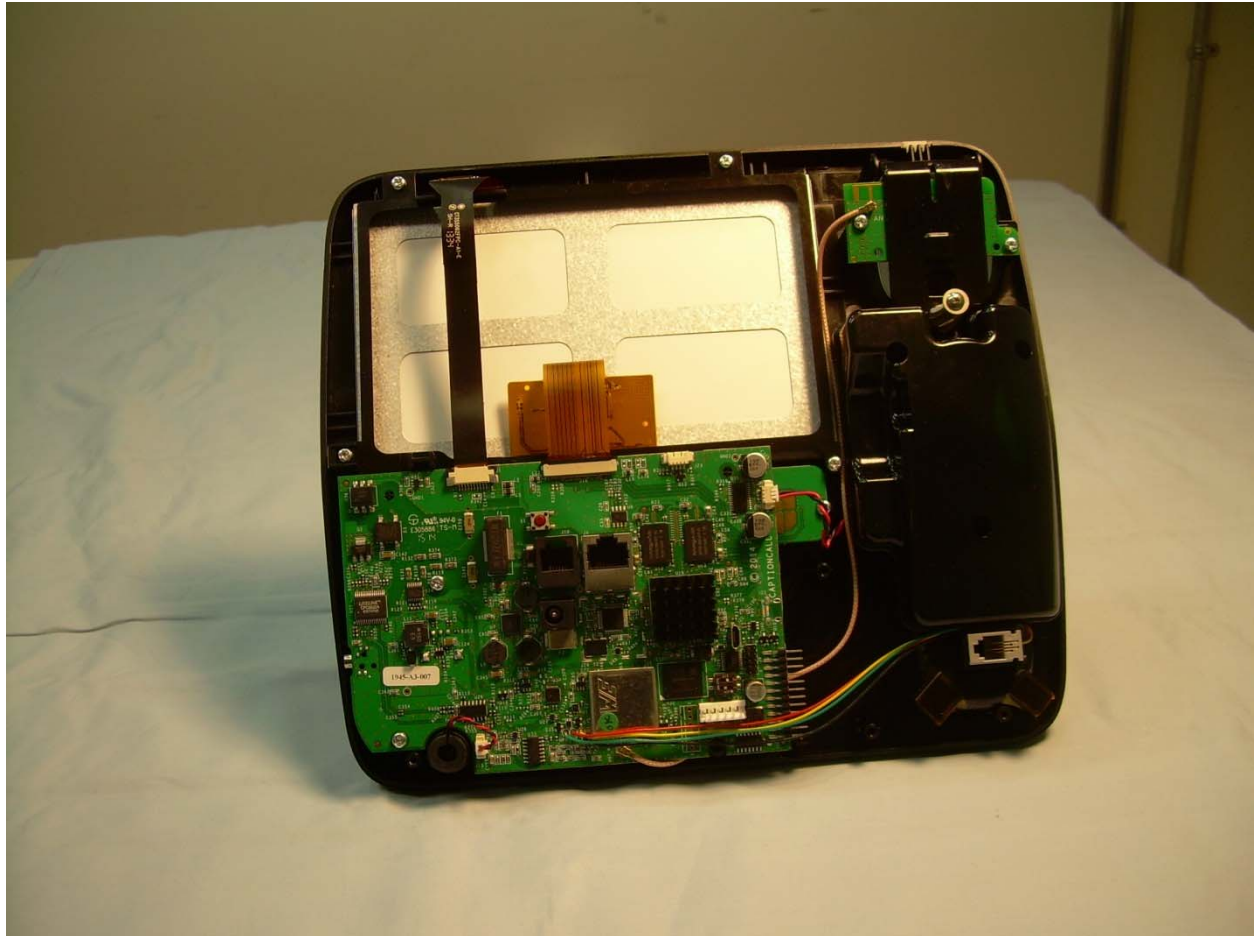
Photograph 7 – View of the Interface Ports on the Back of the EUT



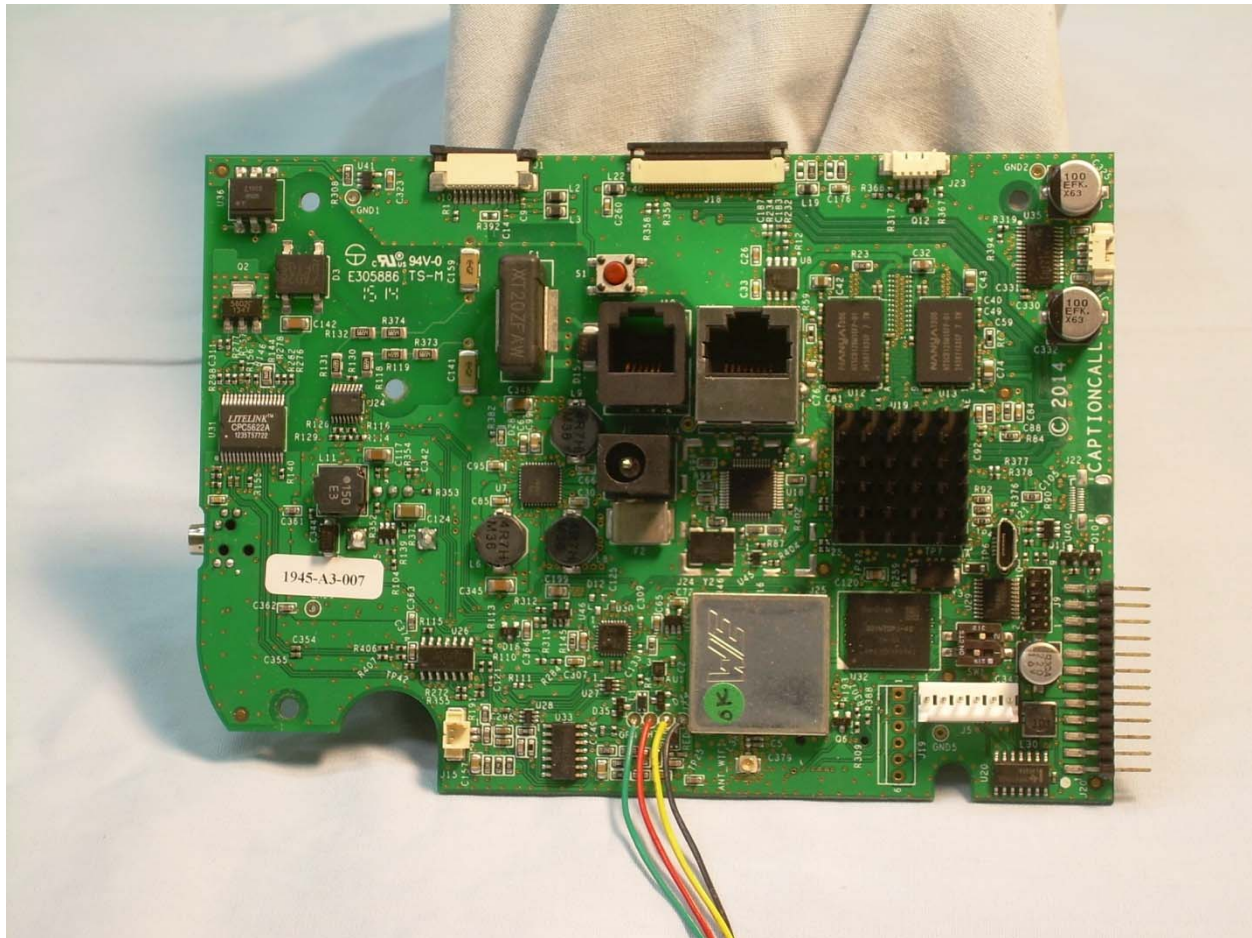
Photograph 8 – Front View of the EUT with Handset Removed



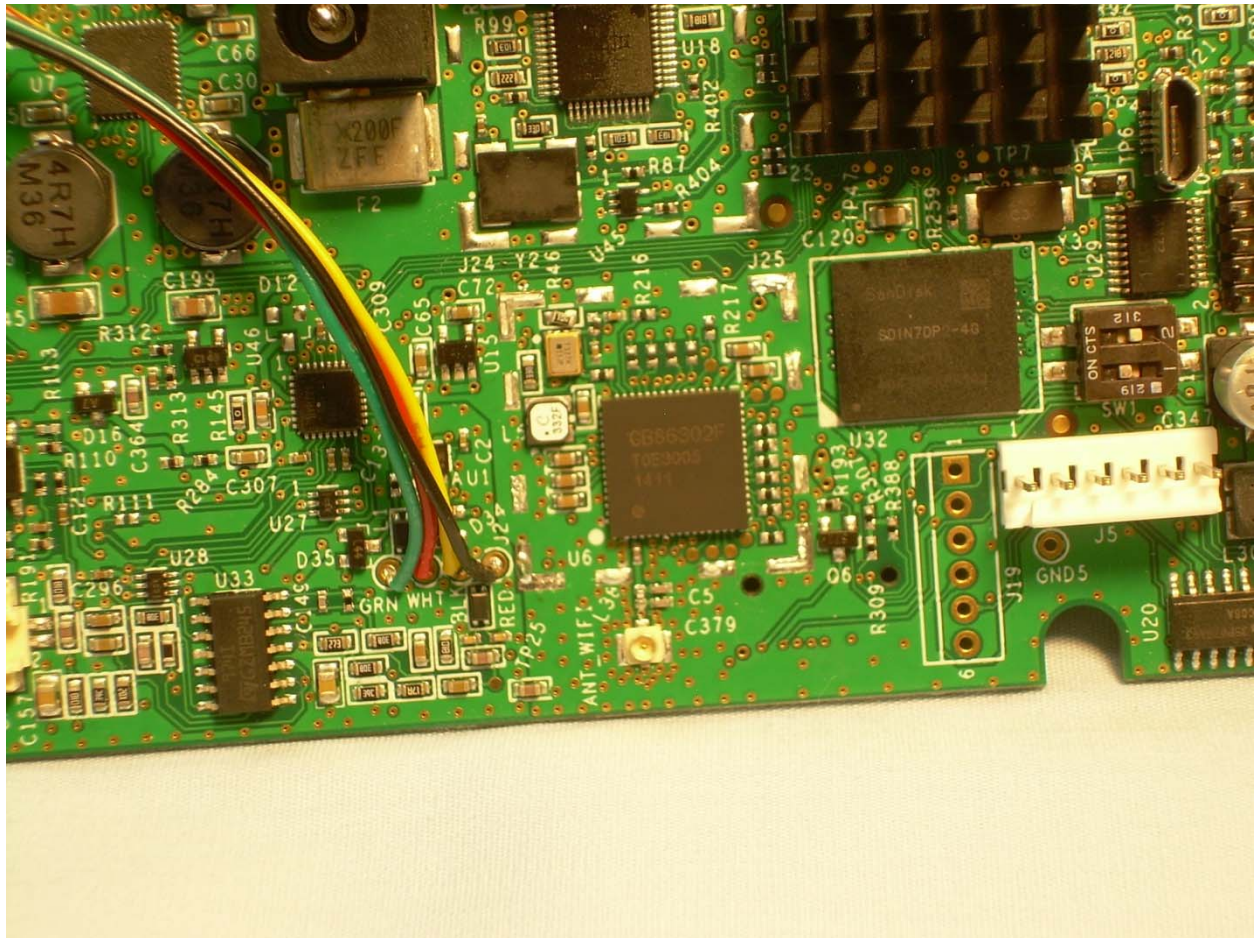
Photograph 9 – View of the EUT with the Back Cover Removed



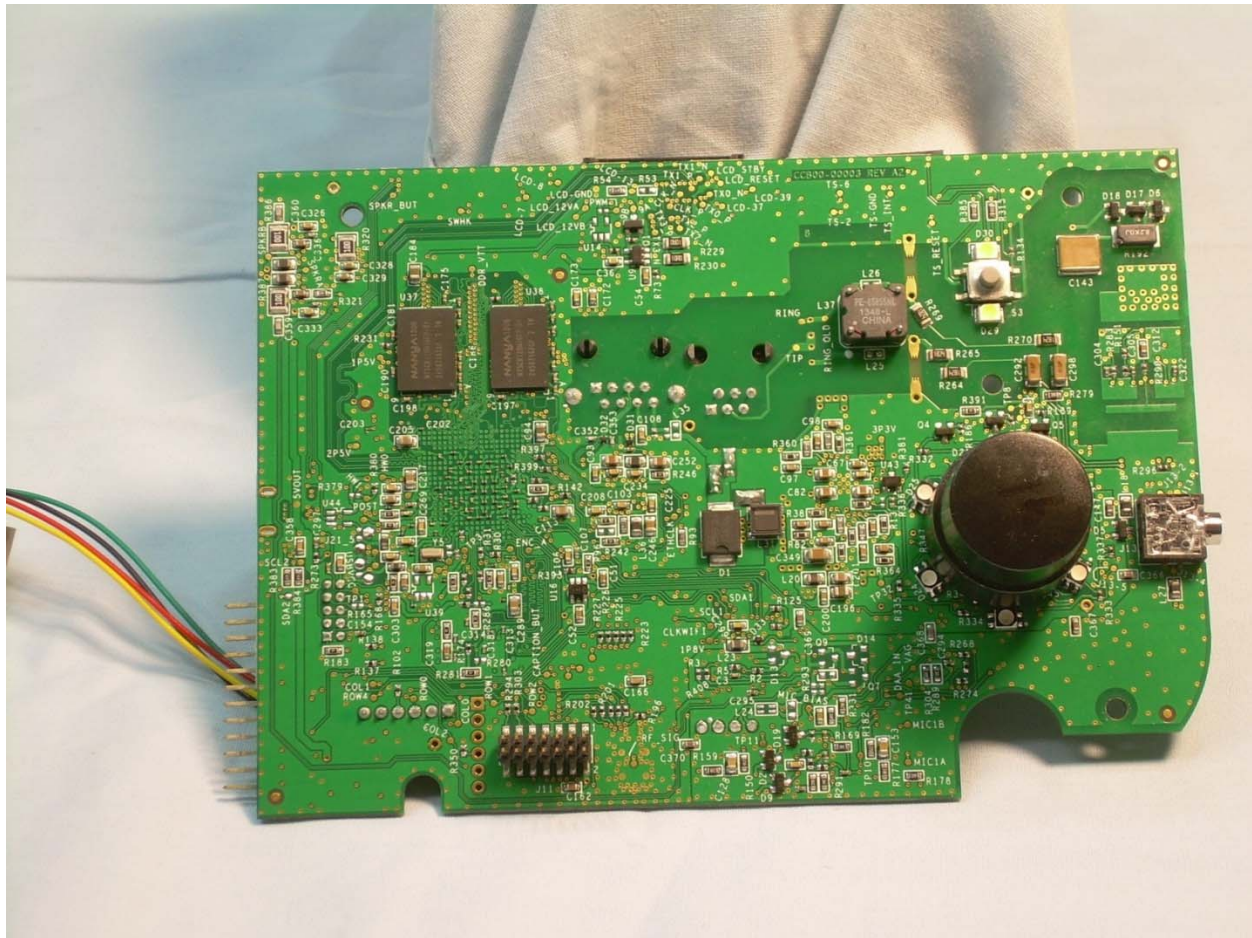
Photograph 10 – View of the Back Side of the Main PCB



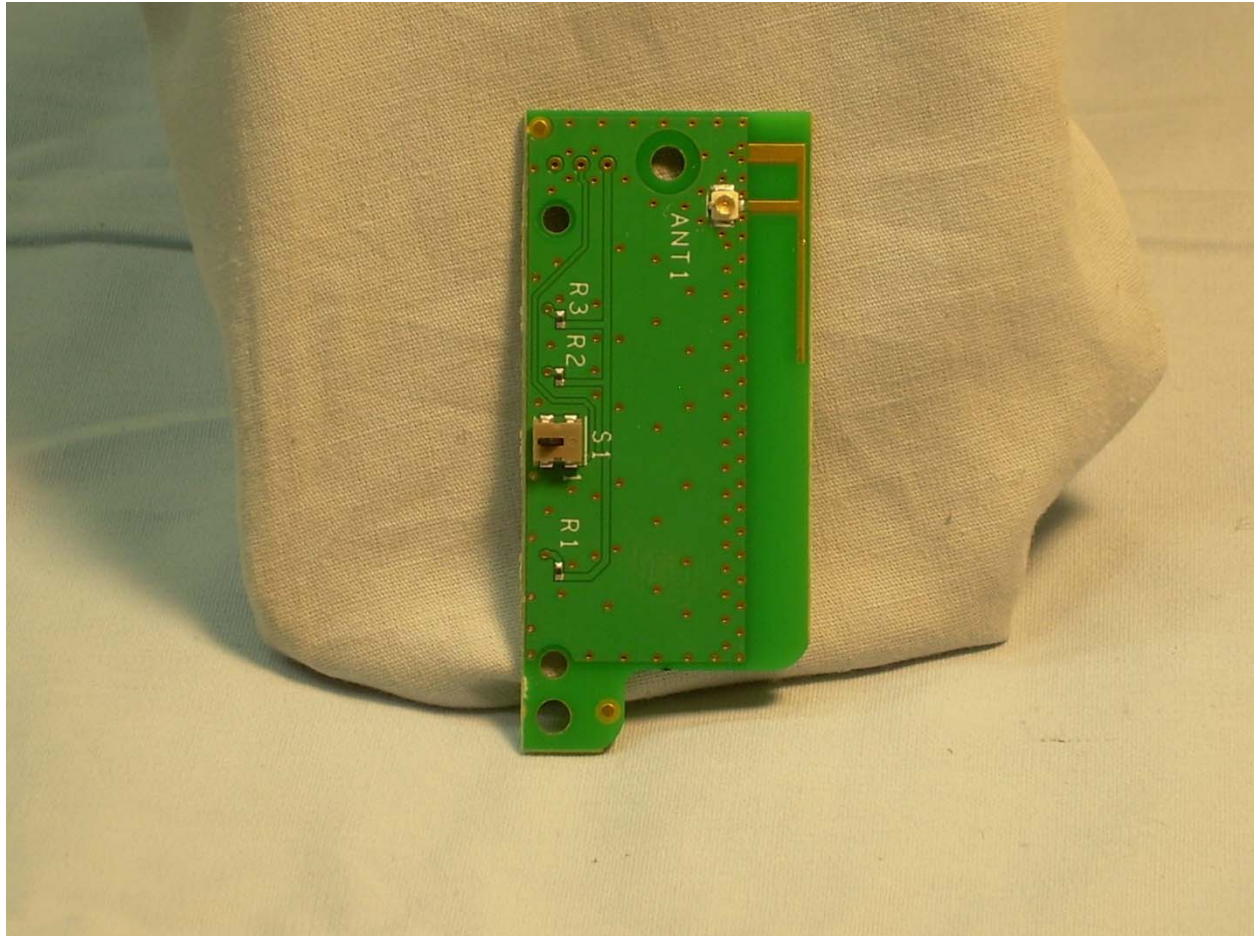
Photograph 11 – View of the Back Side of the Main PCB Circuitry with RF Shield Removed



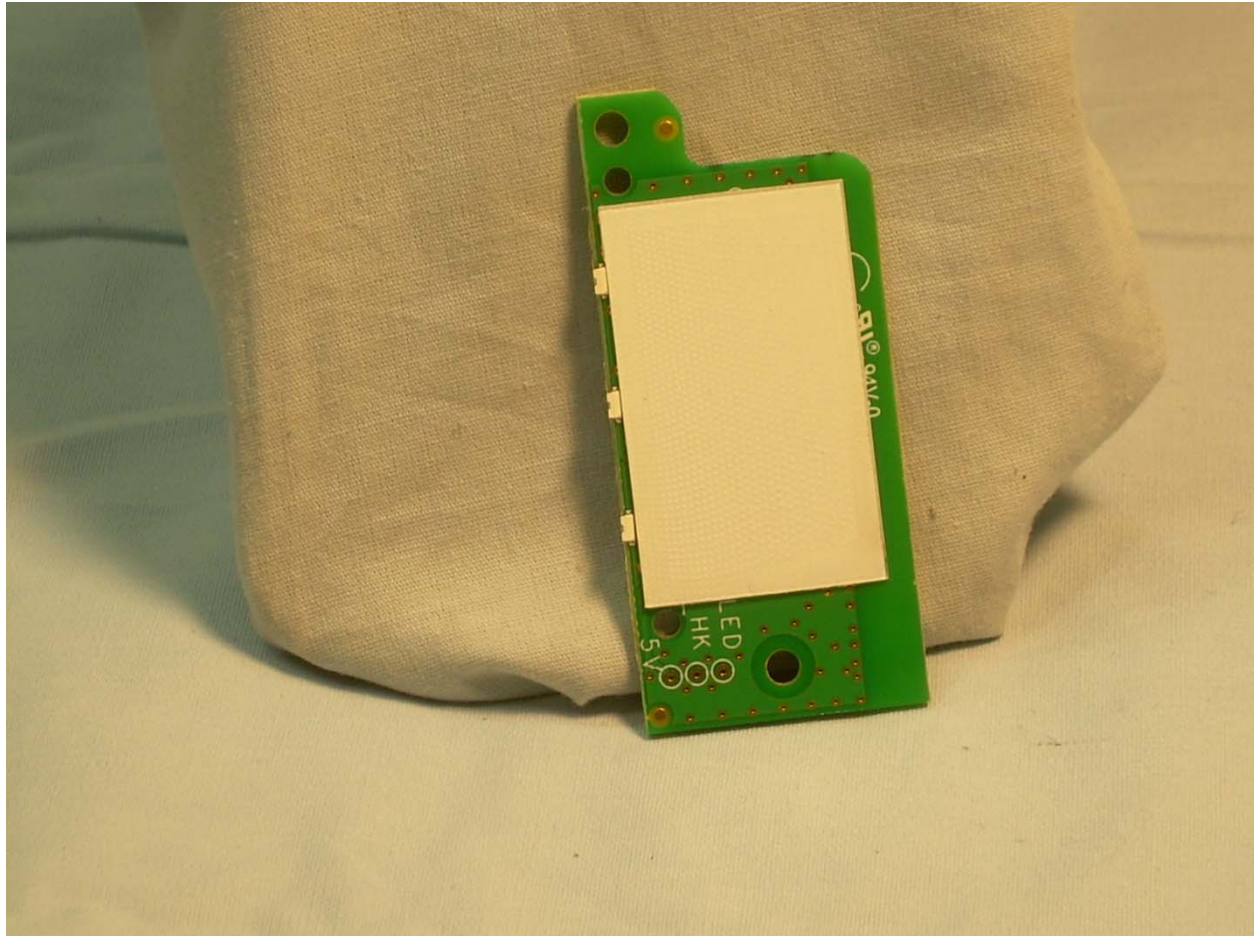
Photograph 12 – View of the Front Side of the Main PCB



Photograph 13 – View of the Back Side of the Antenna PCB



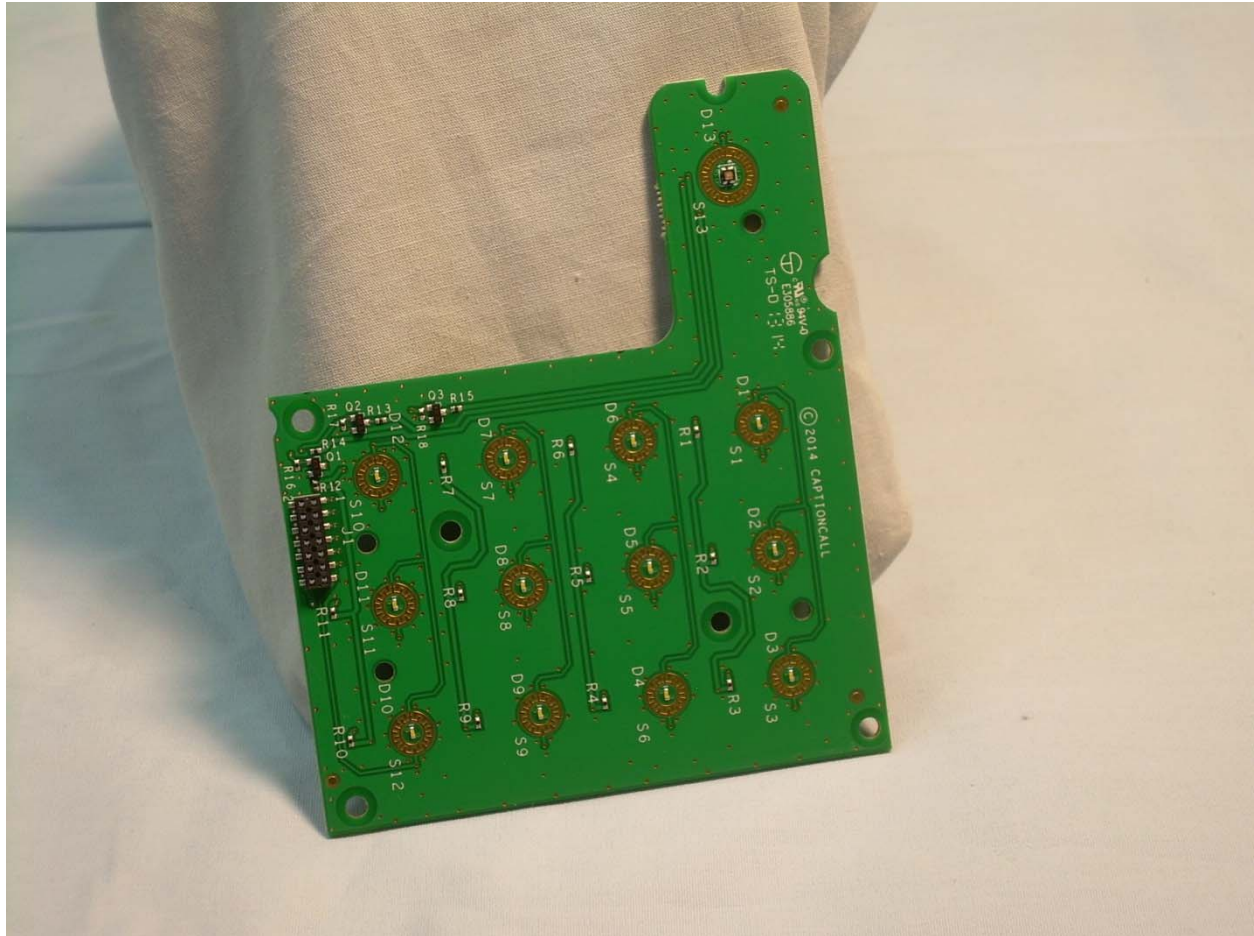
Photograph 14 – View of the Front Side of the Antenna PCB



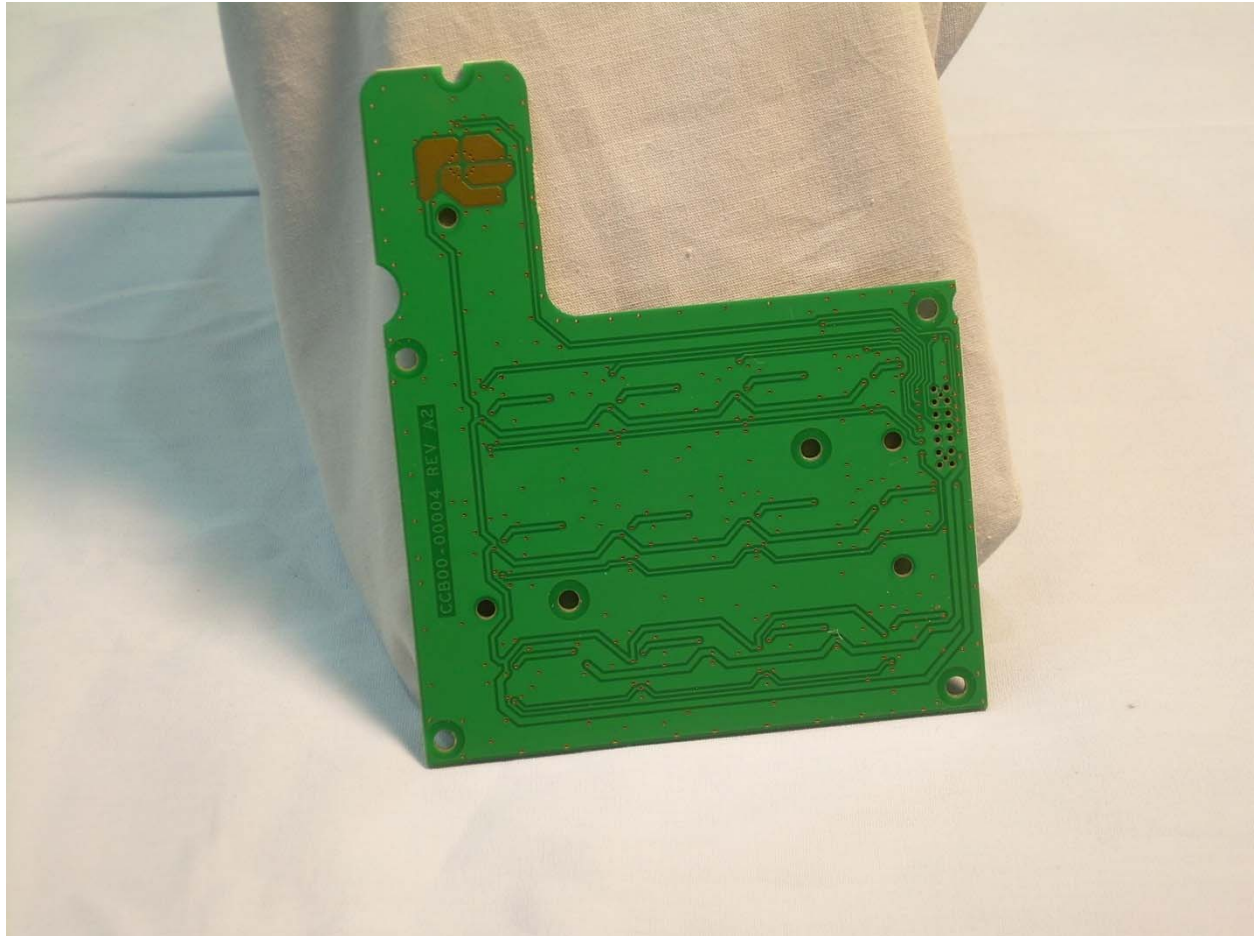
Photograph 15 – View of the Coax Cable that Connects the Main PCB to the Antenna PCB



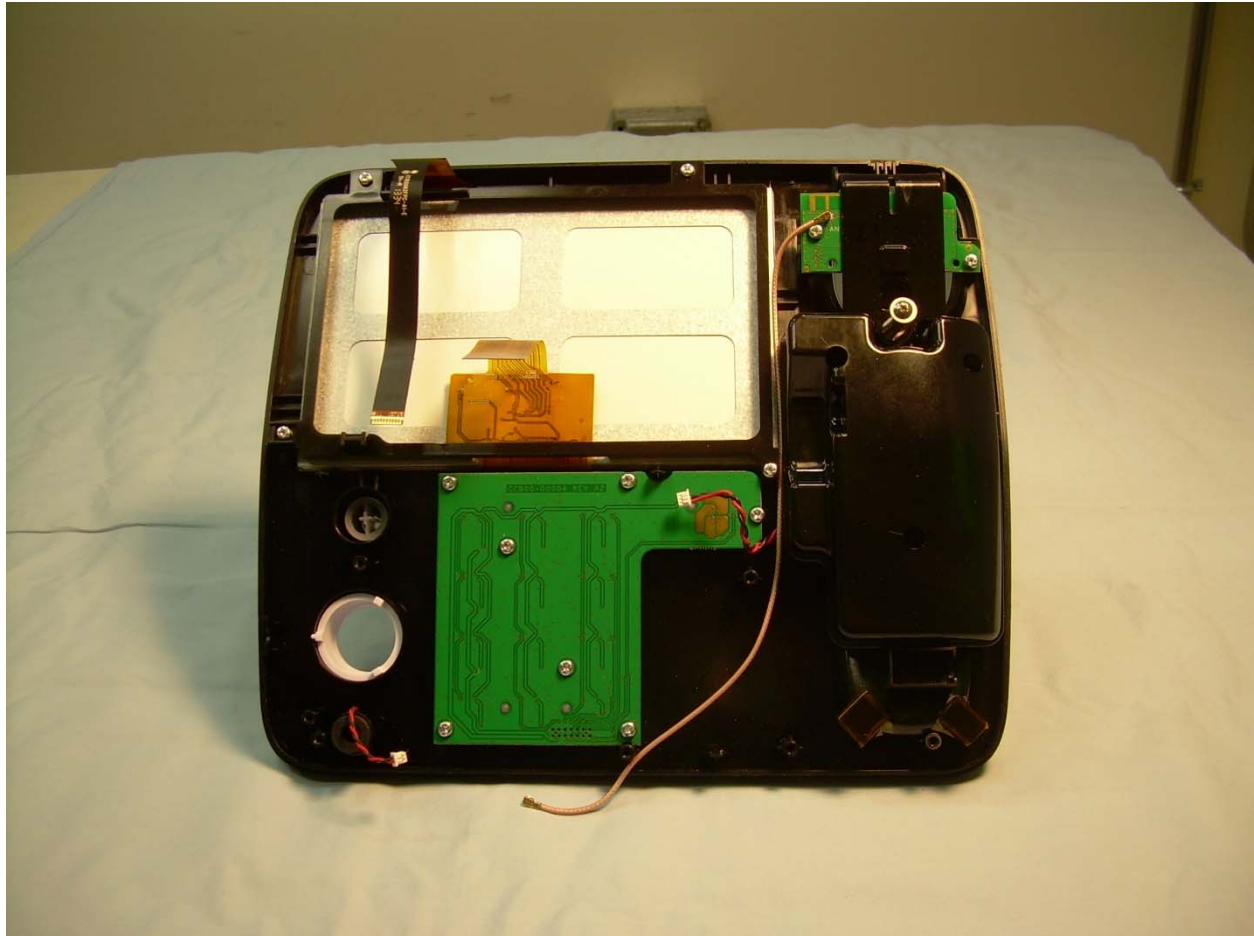
Photograph 16 – View of the Front Side of the Button Interface PCB



Photograph 17 – View of the Back Side of the Button Interface PCB



Photograph 18 – Internal View of the EUT with the Main PCB Removed



Photograph 19 – Internal View of the EUT with PCBs Removed



Photograph 20 – View of the Power Supply

