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EMC Test Report

Application for FCC Grant of Equipment Authorization
Canada Certification

Innovation, Science and Economic Development Canada
RSS-Gen Issue 4 / RSS 247 Issue 1
FCC Part 15 Subpart C

Model: Botvac D3 Connected and Botvac D5 Connected

IC CERTIFICATION #:	12757A-JLTCJ
FCC ID:	2ABSSJLTCJ
APPLICANT:	Neato Robotics 8100 Jarvis Avenue, Suite 100 Newark, CA 94560
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-3; 2845B-4, 2845B-5, 2845B-7
REPORT DATE:	July 27, 2016
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PROGRAM MGR /
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ACCREDITED
Testing Cert #0214.26

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	July 27, 2016	First release	
1	August 31, 2016	Model name is revised.	Deniz Demirci
2	September 8, 2016	Revised Model Name	David Guidotti

TABLE OF CONTENTS

SCOPE

An electromagnetic emissions test has been performed on the Neato Robotics model Botvac D5 Connected, pursuant to the following rules:

RSS-Gen Issue 4 "General Requirements for Compliance of Radio Apparatus"
RSS 247 Issue 1 "Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices"
FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in National Technical Systems - Silicon Valley test procedures:

ANSI C63.10-2013
FCC DTS Measurement Guidance KDB558074

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification

Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Neato Robotics model Botvac D5 Connected complied with the requirements of the following regulations:

RSS-Gen Issue 4 " General Requirements for Compliance of Radio Apparatus"
RSS 247 Issue 1 "Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices"
FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of Neato Robotics model Botvac D5 Connected and therefore apply only to the tested sample. The sample was selected and prepared by Matt Tenuta of Neato Robotics.

Testing performed on model Botvac D5 Connected is considered representative of the model Botvac D3 Connected. The two models are considered electrically identical. The similarities and the differences between models are described in a separate exhibit provided by the manufacturer.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHz)

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)	RSS 247 5.2	Digital Modulation	Systems uses OFDM / DSSS techniques	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	RSS 247 5.2 (1)	6dB Bandwidth	9.6 MHz	>500 kHz	Complies
15.247 (b) (3)	RSS 247 5.4 (4)	Output Power (multipoint systems)	Conducted: 16.8 dBm EIRP = 0.026 W Note 1	1Watt, EIRP limited to 4 Watts.	Complies
15.247(e)	RSS 247 5.2 (2)	Power Spectral Density	-1.3 dBm/ 10 kHz	8 dBm/3 kHz	Complies
15.247(d)	RSS 247 5.5	Antenna Port Spurious Emissions 30 MHz – 25 GHz	> -20 dBc	< -20 dBc	Complies
15.247(d) / 15.209	RSS 247 5.5	Radiated Spurious Emissions 30 MHz – 25 GHz	73.1 dBµV/m @ 2388.9 MHz (-0.9 dB)	Refer to the limits section (p20) for restricted bands, all others < -20 dBc	Complies
Note 1: EIRP calculated using antenna gain of -2.7 dBi for the highest EIRP system.					

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	-	Unique or integral antenna required	Complies
15.407 (b) (6)	RSS-Gen Table 3	AC Conducted Emissions	52.5 dBµV @ 0.178 MHz (-12.1 dB)	Refer to page 19	Complies
15.109	RSS GEN Table 2	Receiver spurious emissions	N/A	N/A	N/A
15.247 (i) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to MPE calculations in separate exhibit, RSS 102 declaration and User Manual statements.	Refer to OET 65, FCC Part 1 and RSS 102	Complies
-	RSS-Gen 8.3 and 8.4	User Manual		See user manual as a separate exhibit.	Complies
-	RSP-100 RSS-Gen 6.6	Occupied Bandwidth	802.11b: 14.9 MHz 802.11g: 17.7 MHz 802.11n: 18.3 MHz	Information only	N/A

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (Power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (Substitution method)	dBm	25 to 26500 MHz	± 2.5 dB
Radiated emission (Field strength)	dBµV/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB
Conducted Emissions (AC Power)	dBµV	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Neato Robotics model Botvac D5 Connected is a Robotic Vacuum cleaner. It is a floor standing equipment. The EUT is positioned on the table, above the ground plane in order to get accurate measurement results and in conformance with ANSI C63.10-2013 requirement. The electrical rating of the EUT is 100-240 Volts, 50/60 Hz, 0.5 Amps.

The sample was received on May 4, 2016 and tested on May 4, 9, 10, 11 and 18, 2016. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Neato Robotics	Botvac D5 Connected	Robotic Vacuum cleaner	-	2ABSSJLTCJ
Neato Robotics	DELTA Power Charger	Battery Charger	-	-

OTHER EUT DETAILS

The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes. In some cases, the highest internal source determines the frequency range of test for radiated emissions. The highest internal source of the EUT was declared as 500 MHz.

ANTENNA SYSTEM

Internal antenna, -2.7 dBi.

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 34 cm wide by 32 cm deep by 8 cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Silicon Valley.

SUPPORT EQUIPMENT

No local support equipment was used during testing.

The following equipment was used as remote support equipment for emissions testing:

Company	Model	Description	Serial Number	FCC ID
HP	Pavilion DV6000	Laptop	-	-

Note: Laptop was used to configure the EUT. It was not connected to the EUT during the tests

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
None	-	-	--	

EUT OPERATION

During emissions testing the EUT was transmitting in a rated power and modulation specified in the test cases.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Designation / Registration Numbers		Location
	FCC	Canada	
Chamber 3	US0027	2845B-3	41039 Boyce Road Fremont, CA 94538-2435
Chamber 5	US0027	2845B-5	

ANSI C63.4 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.10. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

Radiated measurements are performed in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20 Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000 MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

Software is used to view and convert receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers. The software used for radiated and conducted emissions measurements is NTS EMI Test Software (rev 2.10)

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a 50 µH Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 µH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. .

ANSI C63.10 specifies that the test height above ground for transmit antenna shall be 0.80 m for below 1 GHz measurements and 1.5 m for above 1 GHz measurements. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

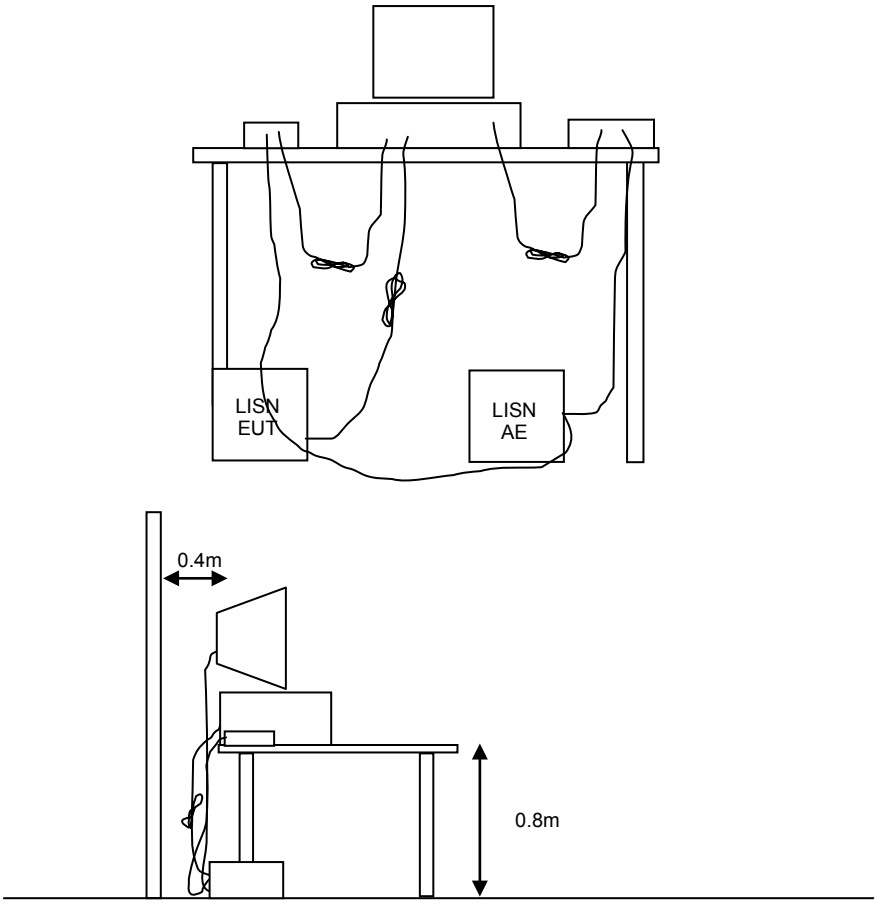
TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.10, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak and Average mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

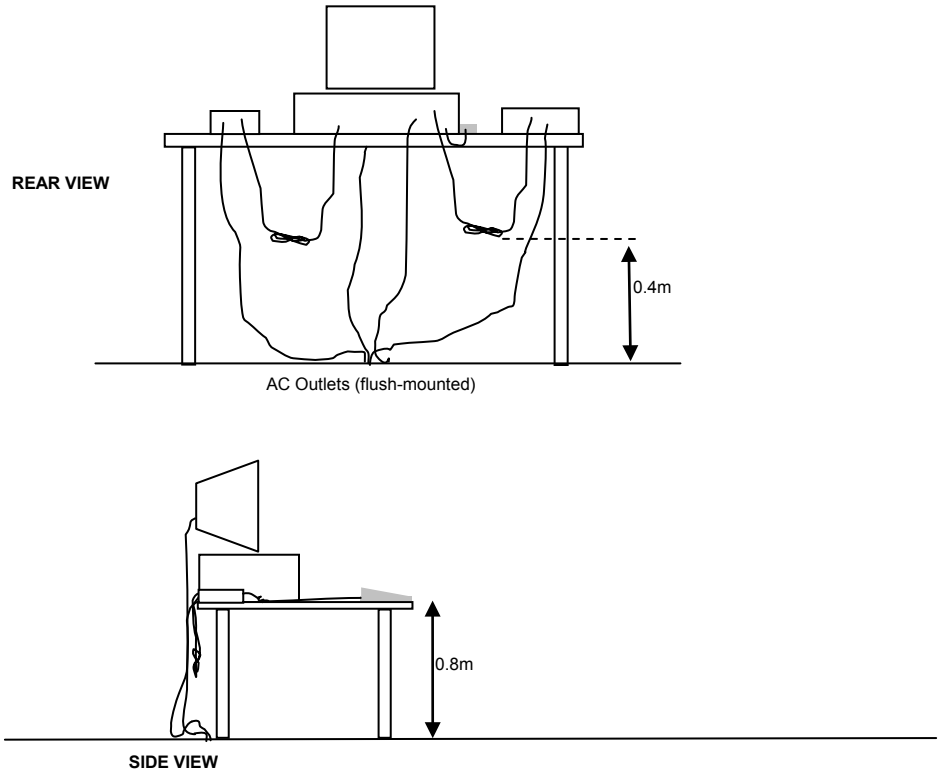


Typical Conducted Emissions Test Configuration

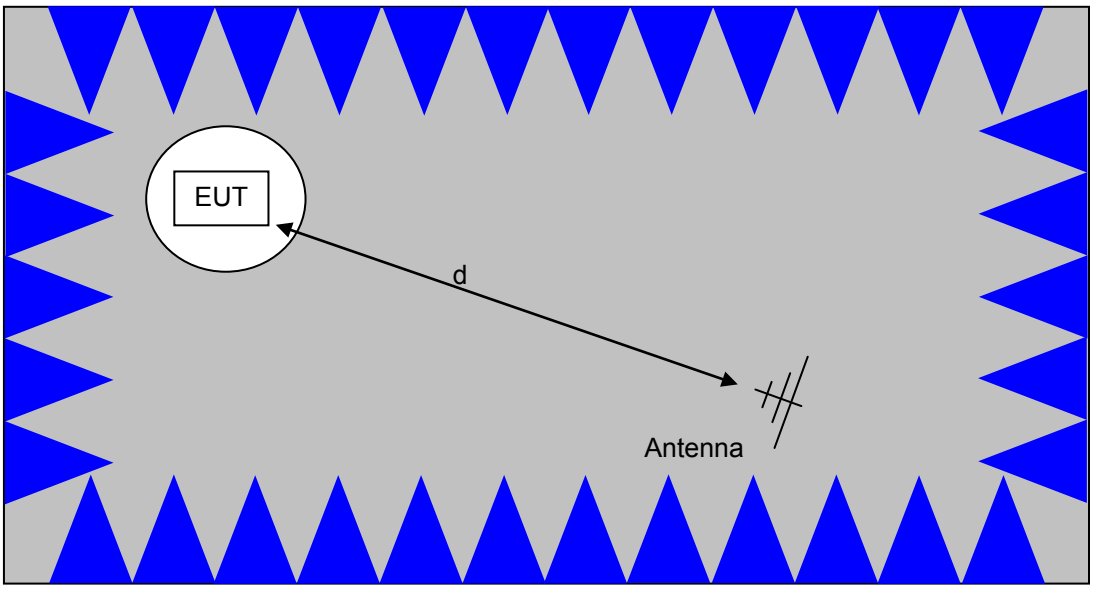
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical to the EUT). During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

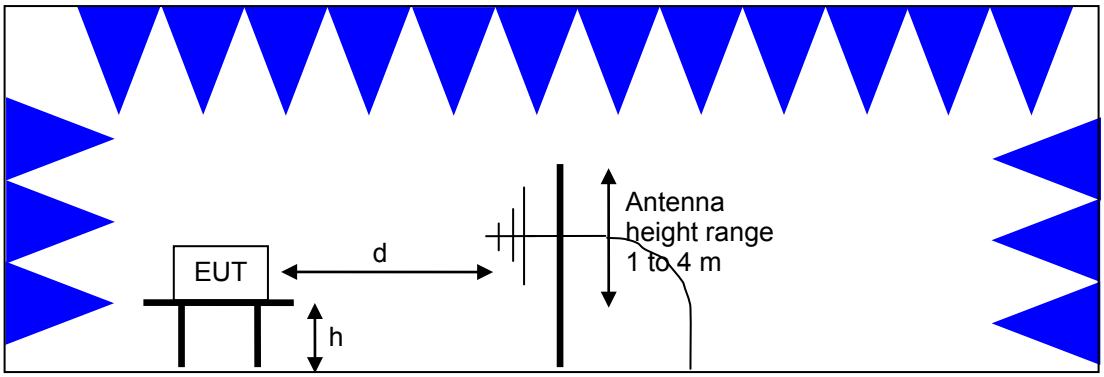
Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.



Typical Test Configuration for Radiated Field Strength Measurements



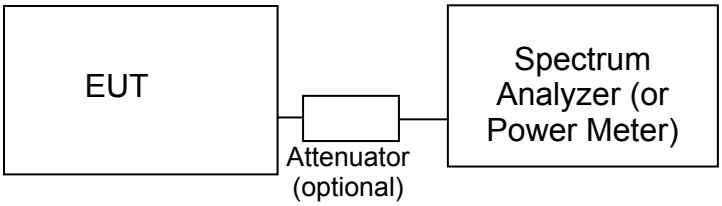
The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements of power, bandwidth and power spectral density are performed, where possible, with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.



Test Configuration for Antenna Port Measurements

Measurement bandwidths (video and resolution) are set in accordance with the relevant standards and NTS Silicon Valley's test procedures for the type of radio being tested. When power measurements are made using a resolution bandwidth less than the signal bandwidth the power is calculated by summing the power across the signal bandwidth using either the analyzer channel power function or by capturing the trace data and calculating the power using software. In both cases the summed power is corrected to account for the equivalent noise bandwidth (ENBW) of the resolution bandwidth used.

If power averaging is used (typically for certain digital modulation techniques), the EUT is configured to transmit continuously. Power averaging is performed using either the built-in function of the analyzer or, if the analyzer does not feature power averaging, using external software. In both cases the average power is calculated over a number of sweeps (typically 100). When the EUT cannot be configured to continuously transmit then either the analyzer is configured to perform a gated sweep to ensure that the power is averaged over periods that the device is transmitting or power averaging is disabled and a max-hold feature is used.

If a power meter is used to make output power measurements the sensor head type (peak or average) is stated in the test data table.

BANDWIDTH MEASUREMENTS

The 6 dB, 20 dB, 26 dB and/or 99% signal bandwidth are measured using the bandwidths recommended by ANSI C63.10 and RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBµV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBµV/m). The results are then converted to the linear forms of µV and µV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS: FCC 15.207; FCC 15.107(a), RSS GEN

The table below shows the limits for the emissions on the AC power line from an intentional radiator and a receiver.

Frequency (MHz)	Average Limit (dBµV)	Quasi Peak Limit (dBµV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1].

Frequency Range (MHz)	Limit (μV/m)	Limit (dBμV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300 m	$67.6-20*\log_{10}(F_{KHz})$ @ 300 m
0.490-1.705	$24000/F_{KHz}$ @ 30 m	$87.6-20*\log_{10}(F_{KHz})$ @ 30 m
1.705 to 30	30 @ 30 m	29.5 @ 30 m
30 to 88	100 @ 3 m	40.0 @ 3 m
88 to 216	150 @ 3 m	43.5 @ 3 m
216 to 960	200 @ 3 m	46.0 @ 3 m
Above 960	500 @ 3 m	54.0 @ 3 m

[1] The restricted bands are detailed in FCC 15.205 and RSS-Gen Table 6

OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Output Power	Power Spectral Density
902 – 928	1 Watt (30 dBm)	8 dBm/3 kHz
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3 kHz
5725 – 5850	1 Watt (30 dBm)	8 dBm/3 kHz

The maximum permitted output power is reduced by 1 dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS 210. All other unwanted (spurious) emissions shall be at least 20 dB below the level of the highest in-band signal level (30 dB if the power is measured using the sample detector/power averaging method).

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:
R_r = Receiver Reading in dBµV
S = Specification Limit in dBµV
M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:
F_d = Distance Factor in dB
D_m = Measurement Distance in meters
D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:
R_r = Receiver Reading in dBµV/m
F_d = Distance Factor in dB
R_c = Corrected Reading in dBµV/m
L_s = Specification Limit in dBµV/m
M = Margin in dB Relative to Spec

Appendix A Test Equipment Calibration Data

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Antenna port measurements, 04-May-16					
NTS	NTS Capture Analyzer Software (rev 3.8)	N/A	0		N/A
Fluke	Multimeter, True RMS	111	1480	3/28/2016	3/28/2017
Rohde & Schwarz	Power Meter, Dual Channel	NRVD	1539	9/24/2015	9/24/2016
Agilent Technologies	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	6/22/2015	6/22/2016
Agilent Technologies	USB Average Power Sensor	U2001A	2442	1/6/2016	1/6/2017
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts use with 20dB attenuator sn:1031.6959.00 only	NRV-Z32	3225	9/24/2015	9/24/2016
Radiated Emissions, 1,000 - 18,000 MHz, 09-May-16					
NTS	NTS EMI Software (rev 2.10)	N/A	0		N/A
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	10/12/2015	10/12/2016
Hewlett Packard	Spectrum Analyzer (SA40) Blue 9 kHz - 40 GHz	8564E (84125C)	1393	3/28/2016	3/28/2017
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	6/27/2014	6/27/2016
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2238	9/16/2015	9/16/2016
Radiated Emissions, 1,000 - 25,000 MHz, 09-May-16					
NTS	NTS EMI Software (rev 2.10)	N/A	0		N/A
Hewlett Packard	High Pass filter, 8.2 GHz	P/N 84300-80039	1152	7/10/2015	7/10/2016
HP / Miteq	SA40 Head (Blue)	TTA1840-45-5P-HG-S	1620	3/8/2016	3/8/2017
A. H. Systems	Red System Horn, 18-40GHz	SAS-574, p/n: 2581	2161	7/16/2015	7/16/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	10/12/2015	10/12/2016
Hewlett Packard	Spectrum Analyzer (SA40) Blue 9 kHz - 40 GHz	8564E (84125C)	1393	3/28/2016	3/28/2017
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	6/27/2014	6/27/2016
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2238	9/16/2015	9/16/2016
Radiated Emissions, 30 - 1,000 MHz, 10-May-16					
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1548	9/17/2014	9/17/2016
Com-Power	Preamplifier, 30-1000 MHz	PA-103	1632	6/17/2015	6/17/2016
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	6/20/2015	6/20/2016
Antenna port measurements, 11-May-16					
Rohde & Schwarz	Power Meter, Dual Channel	NRVD	1539	9/24/2015	9/24/2016
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/6/2016	5/6/2017

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts use with 20dB attenuator sn:1031.6959.00 only	NRV-Z32	3225	9/24/2015	9/24/2016
Conducted Emissions - AC Power Ports, 18-May-16					
EMCO	LISN, 10 kHz-100 MHz	3825/2	1293	6/2/2015	6/2/2016
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1401	4/26/2016	4/26/2017
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	6/20/2015	6/20/2016

Appendix B Test Data

T101649 Pages 26 – 90

Client:	Neato Robotics	Job Number:	JD101609
Product	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	
Emissions Standard(s):	FCC 15.247, RSS 247	Class:	B
Immunity Standard(s):	-	Environment:	

EMC Test Data

For The

Neato Robotics

Product

Botvac D3/D5 Connected

Date of Last Test: 5/18/2016

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Power vs. Data Rate

In normal operating modes the card uses power settings stored on EEPROM to set the output power. For a given nominal output power the actual transmit power normally is reduced as the data rate increases, therefore testing was performed at the data rate in the mode with highest power to determine compliance with the requirements.
The following power measurements were made using an average/peak power meter and with the device configured in a continuous transmit mode on Chain 1 at the various data rates in each mode to verify the highest power mode:

Sample Notes

Sample S/N:
WLAN Driver: MCP-8.0.1.47_Rel
WLAN Firmware: PLT 8.9.0.1.38
Date of Test: 5/4/2016
Test Engineer: Deniz Demirci
Test Location: FT Lab #4b

Mode	Data Rate	Peak Power (dBm)	Average Power (dBm)	Power setting
802.11b	1	18.4	17.9	Max
	2	18.2	17.8	
	5.5	18.5	18.3	
	11	18.3	18.0	
802.11g	6	16.6	16.0	Max
	9	16.7	16.0	
	12	16.6	16.0	
	18	16.6	16.0	
	24	16.0	15.2	
	36	16.6	15.8	
	48	16.6	15.8	
	54	16.0	14.2	
802.11n 20 MHz	6.5	16.7	16.1	Max
	13	16.6	16.0	
	19.5	16.6	16.0	
	26	16.7	16.0	
	39	16.6	15.8	
	52	16.7	15.8	
	58.5	16.1	15.0	
	65	16.1	15.0	

Note : Power setting - the maximum software power setting used for reference only.

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Duty Cycle

Date of Test: 5/4/2016
Test Engineer: Deniz Demirci
Test Location: FT Lab #4b

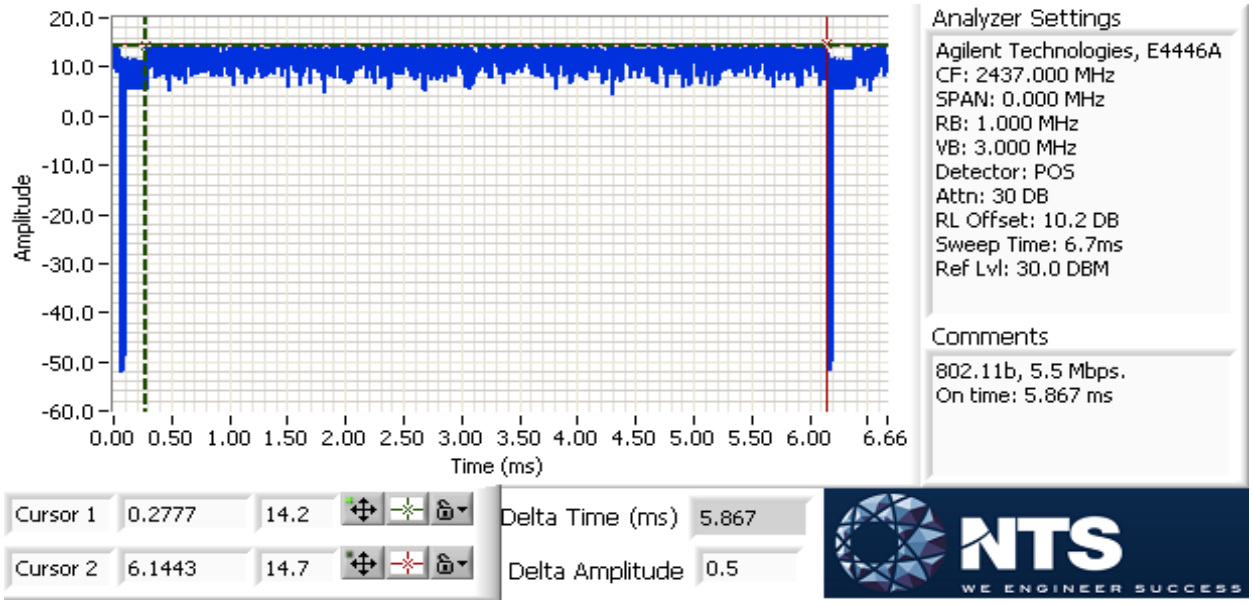
Duty cycle measurements performed on the worse case data rate for power.

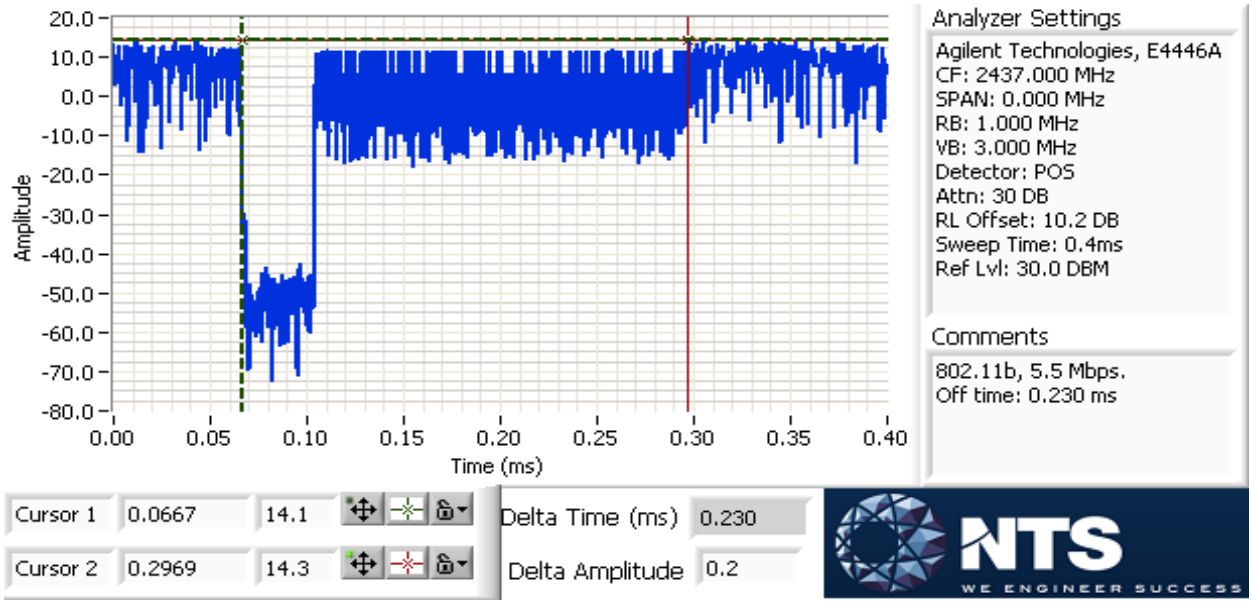
Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	5.5	0.96	Yes	5.867	0.2	0.3	170
11g	6	0.99	Yes	5.361	0.0	0.0	10
n20	6.5	0.99	Yes	4.476	0.0	0.0	10

* Correction factor when using RMS/Power averaging - 10*log(1/x)
** Correction factor when using linear voltage average - 20*log(1/x)
T = Minimum transmission duration

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

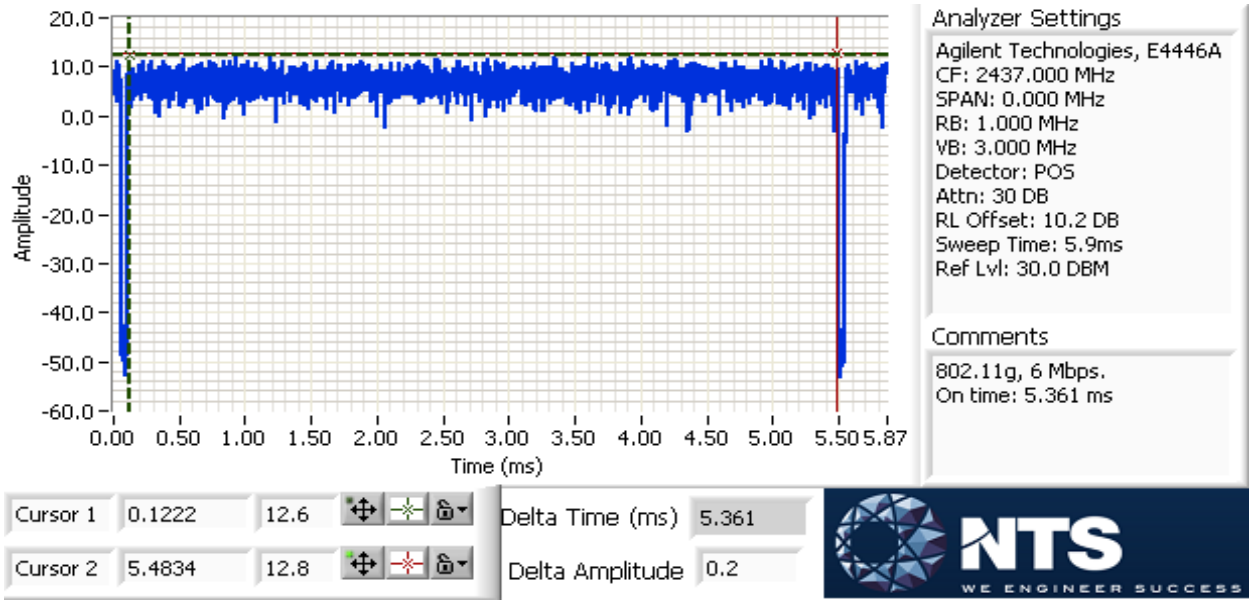
802.11b

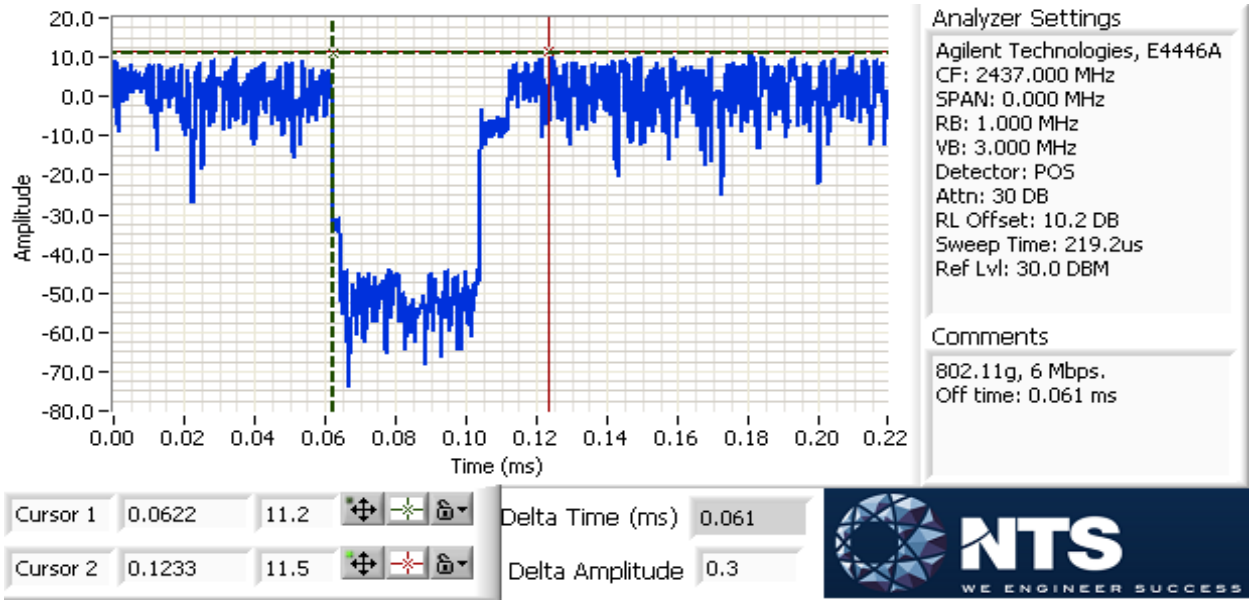




Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

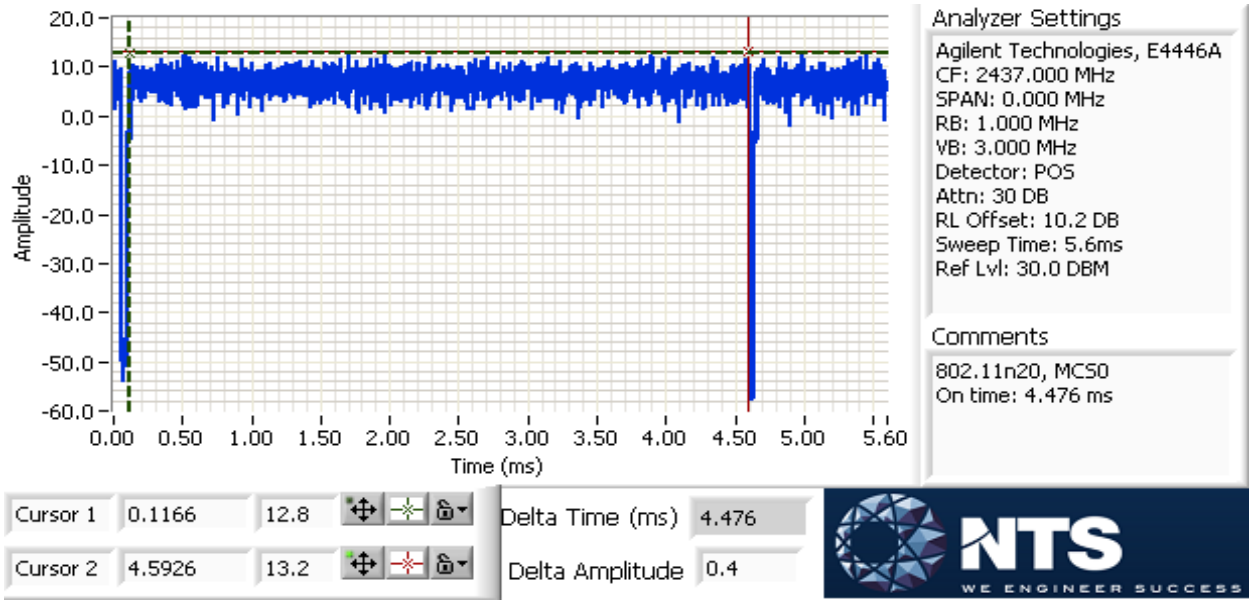
802.11g

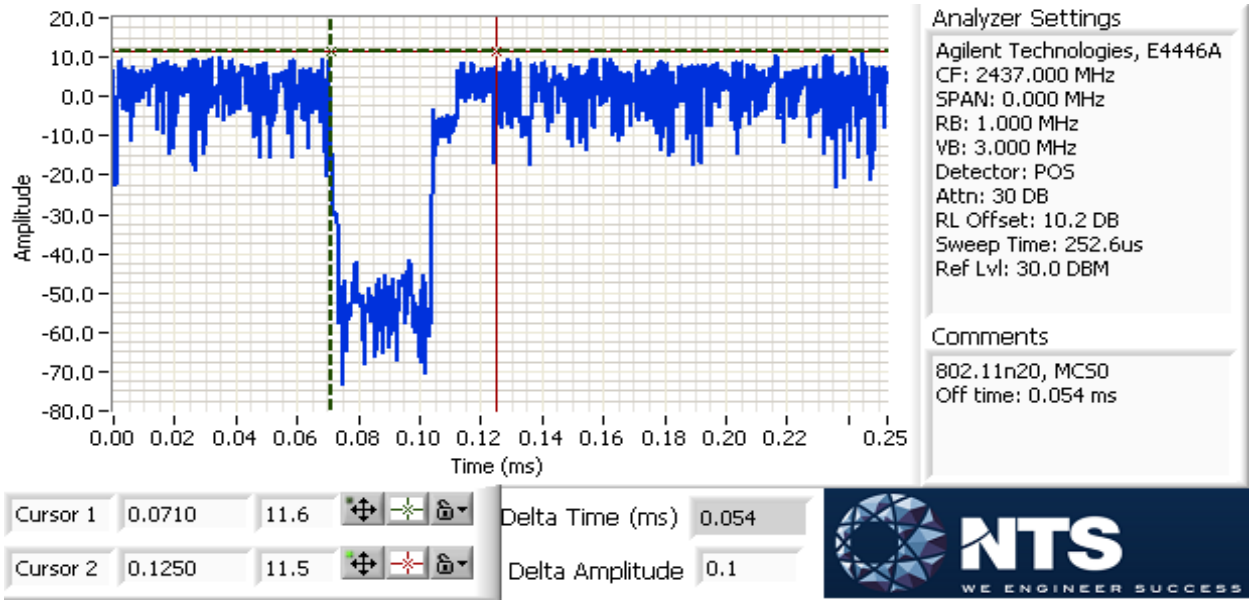




Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

802.11n 20 MHz





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

RSS 247 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 20-22 °C

Rel. Humidity: 30-35 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
1	b	1 - 2412 MHz	17500 debug	17500 debug	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	51.2 dBµV/m @ 2388.6 MHz (-2.8 dB)
	b	11 - 2462 MHz	17500 debug	17500 debug	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	48.5 dBµV/m @ 2485.7 MHz (-5.5 dB)
2	g	1 - 2412 MHz	15500 debug	15500 debug	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	73.1 dBµV/m @ 2388.9 MHz (-0.9 dB)
	g	11 - 2462 MHz	15500 debug	15500 debug	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	52.8 dBµV/m @ 2483.5 MHz (-1.2 dB)
3	n20	1 - 2412 MHz	14500 debug	14500 debug	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	73.0 dBµV/m @ 2388.2 MHz (-1.0 dB)
	n20	11 - 2462 MHz	14500 debug	14500 debug	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	72.9 dBµV/m @ 2484.0 MHz (-1.1 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: DVT2_022

WLAN Driver: MCP-8.0.1.47_Rel

WLAN Firmware: PLT 8.9.0.1.38

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074
Peak measurements performed with: RBW = 1 MHz, VBW = 3 MHz, peak detector, max hold, auto sweep time
Unless otherwise stated/noted, emission has duty cycle ≥ 98% and was measured using RBW = 1 MHz, VBW = 10 Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	5.5	0.96	Yes	5.867	0.2	0.3	170
11g	6.0	0.99	Yes	5.361	0.0	0.0	10
n20	6.5	0.99	Yes	4.476	0.0	0.0	10

Measurement Specific Notes:

Note 1:	Emission has duty cycle ≥ 98%, average measurement performed: RBW = 1 MHz, VBW = 10 Hz, peak detector, linear averaging, auto sweep,
Note 2:	Emission has constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW>1/T but not less than 10Hz, peak detector, linear averaging, auto sweep,max hold 50*1/DC traces.

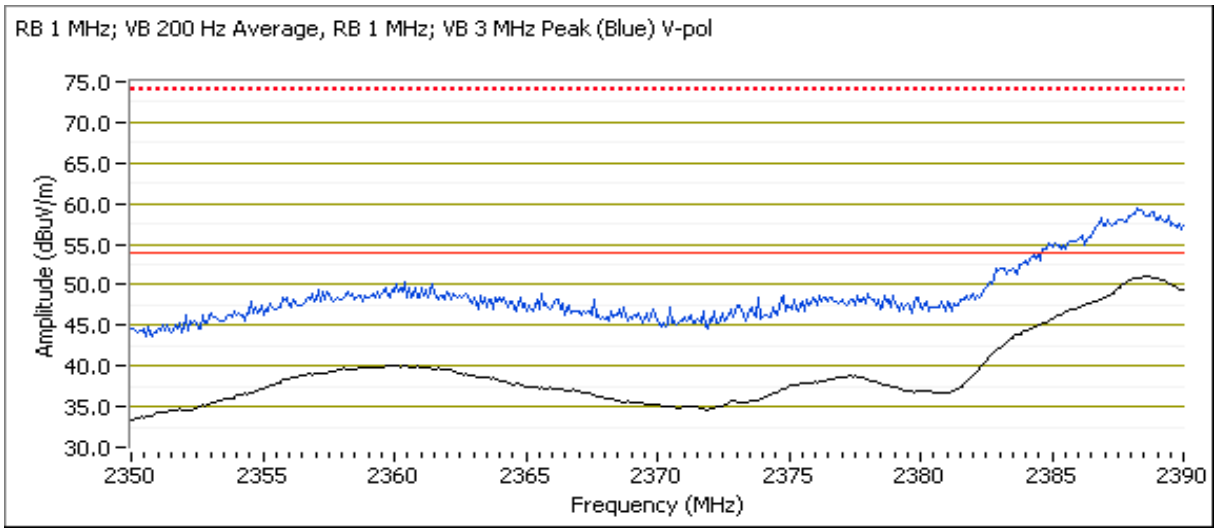
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Date of Test: 05/09/16 Config. Used: 1
Test Engineer: Deniz Demirci Test Location: FT CH #3

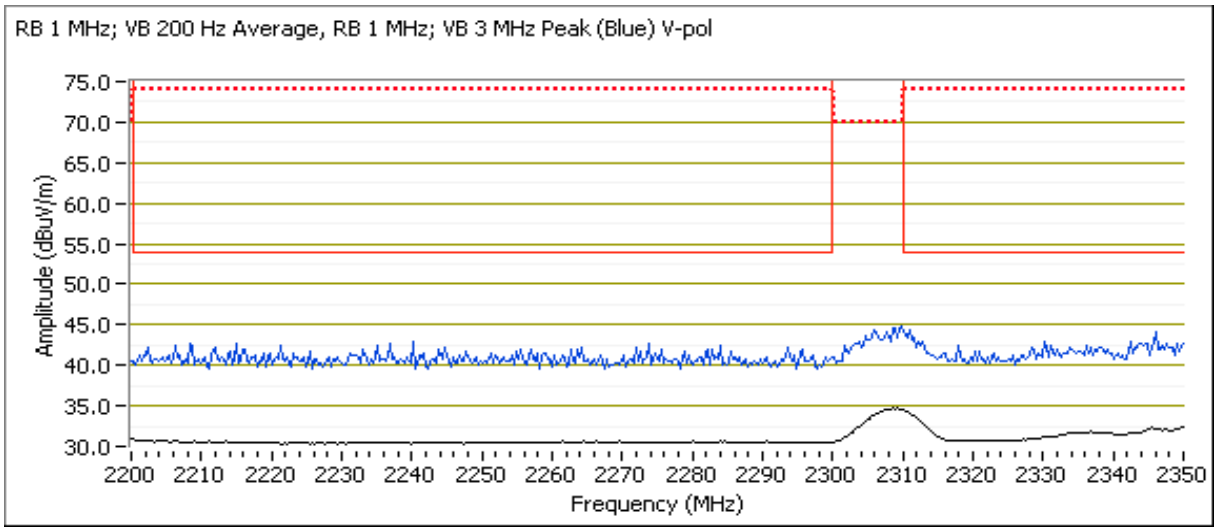
Run #1: Radiated Bandedge Measurements
Channel: 1 Mode: b Power: 17500 (debug)
Tx Chain: Main Data Rate: 5.5 Mbps

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2388.640	51.2	V	54.0	-2.8	AVG	132	2.1	Note 2.POS; RB 1 MHz; VB: 200 Hz
2388.960	59.5	V	74.0	-14.5	PK	132	2.1	POS; RB 1 MHz; VB: 3 MHz
2388.640	50.3	H	54.0	-3.7	AVG	50	2.5	Note 2. POS; RB 1 MHz; VB: 200 Hz
2388.640	58.3	H	74.0	-15.7	PK	50	2.5	POS; RB 1 MHz; VB: 3 MHz



Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

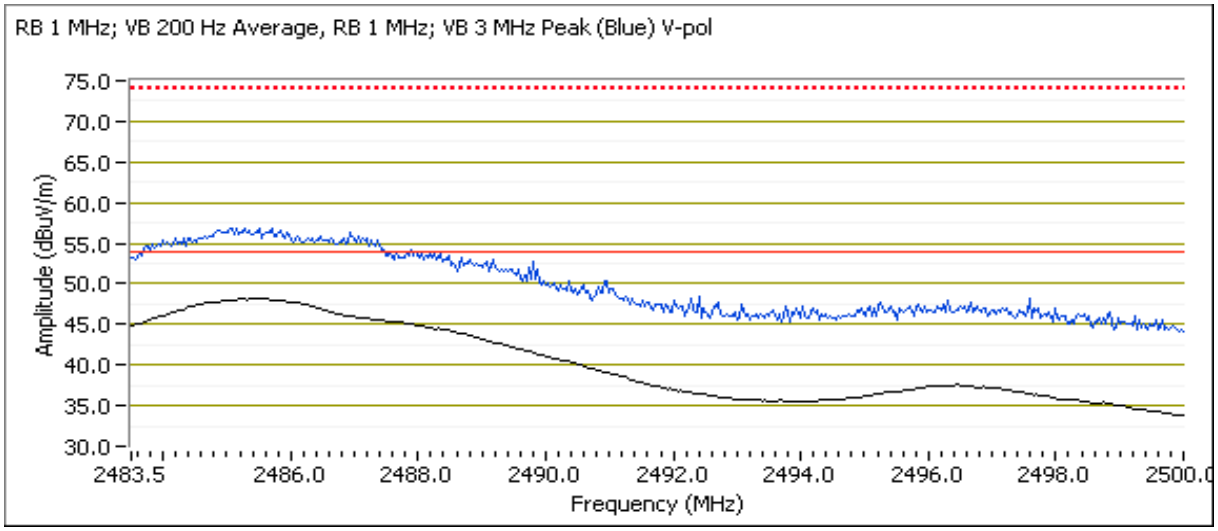


Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

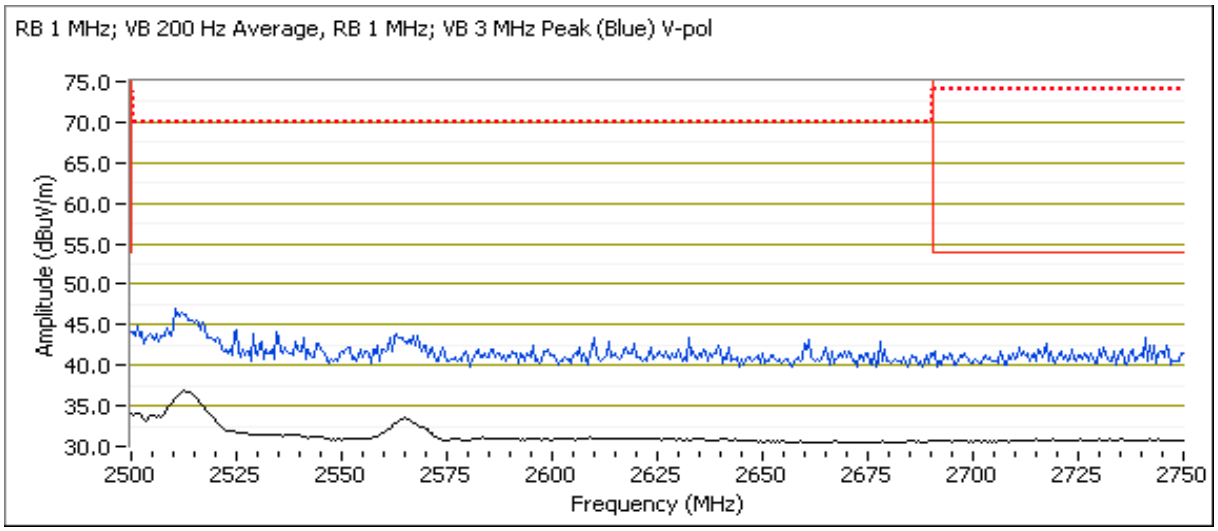
Channel: 11 Mode: b Power: 17500 (debug)
Tx Chain: Main Data Rate: 5.5 Mbps

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2485.650	48.5	V	54.0	-5.5	AVG	132	2.2	Note 2 POS; RB 1 MHz; VB: 200 Hz
2485.020	56.9	V	74.0	-17.1	PK	132	2.2	POS; RB 1 MHz; VB: 3 MHz
2485.190	48.1	H	54.0	-5.9	AVG	53	2.4	Note 2 POS; RB 1 MHz; VB: 200 Hz
2485.720	56.8	H	74.0	-17.2	PK	53	2.4	POS; RB 1 MHz; VB: 3 MHz



Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A



Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

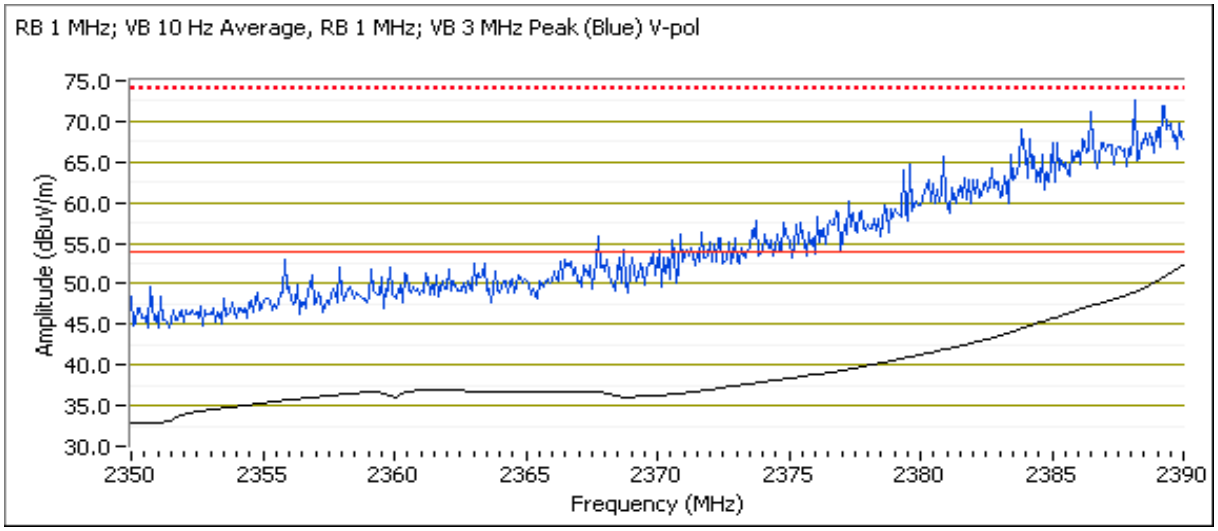
Run #2: Radiated Bandedge Measurements

Channel: 1 Mode: g Power: 15500 (debug)

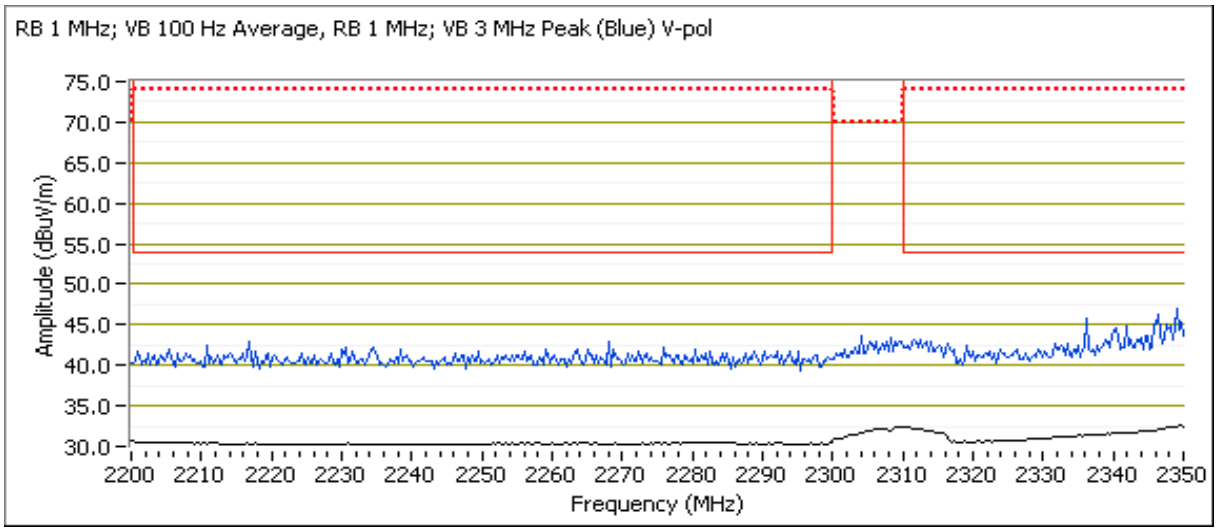
Tx Chain: Main Data Rate: 6 Mbps

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2388.940	73.1	V	74.0	-0.9	PK	131	2.3	POS; RB 1 MHz; VB: 3 MHz
2390.000	52.2	V	54.0	-1.8	AVG	131	2.3	Note 1, POS; RB 1 MHz; VB: 10 Hz
2385.670	72.6	H	74.0	-1.4	PK	56	2.5	POS; RB 1 MHz; VB: 3 MHz
2390.000	51.8	H	54.0	-2.2	AVG	56	2.5	Note 1, POS; RB 1 MHz; VB: 10 Hz



Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

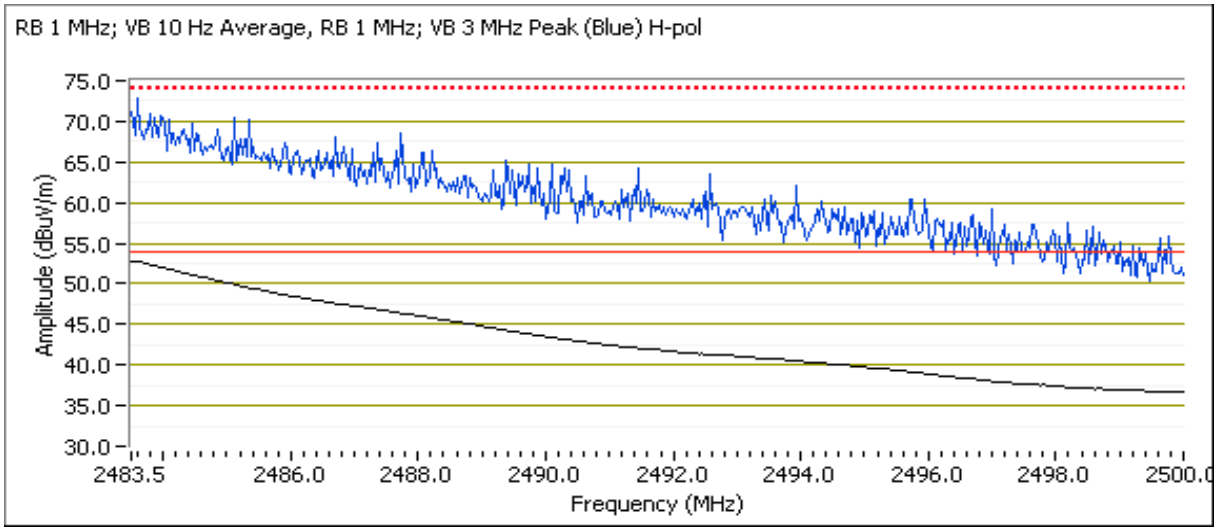


Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

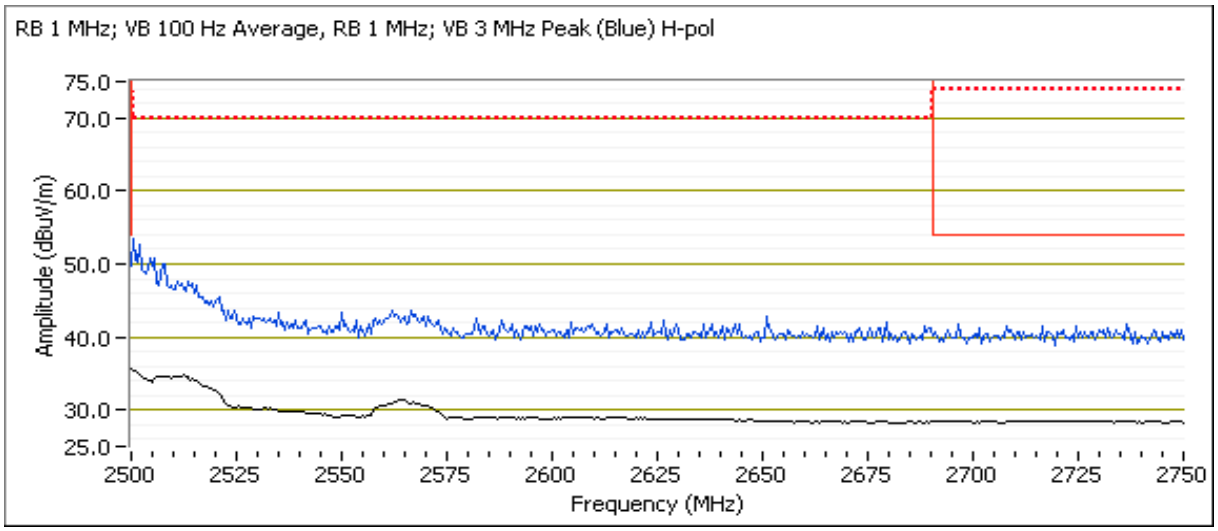
Channel: 11 Mode: g Power: 15500 (debug)
Tx Chain: Main Data Rate: 6 Mbps

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.500	52.8	H	54.0	-1.2	AVG	79	1.5	Note 1, POS; RB 1 MHz; VB: 10 Hz
2483.500	52.4	V	54.0	-1.6	AVG	135	2.2	Note 1, POS; RB 1 MHz; VB: 10 Hz
2483.670	72.0	H	74.0	-2.0	PK	79	1.5	POS; RB 1 MHz; VB: 3 MHz
2484.190	71.0	V	74.0	-3.0	PK	135	2.2	POS; RB 1 MHz; VB: 3 MHz



Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A



Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

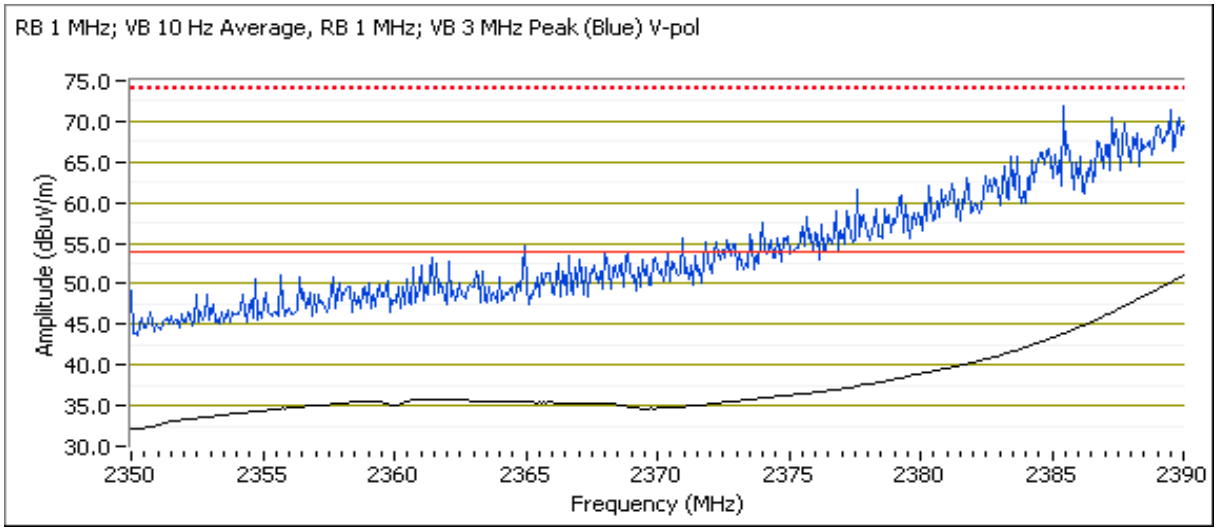
Run #3: Radiated Bandedge Measurements

Channel: 1 Mode: n20 Power: 14500 (debug)

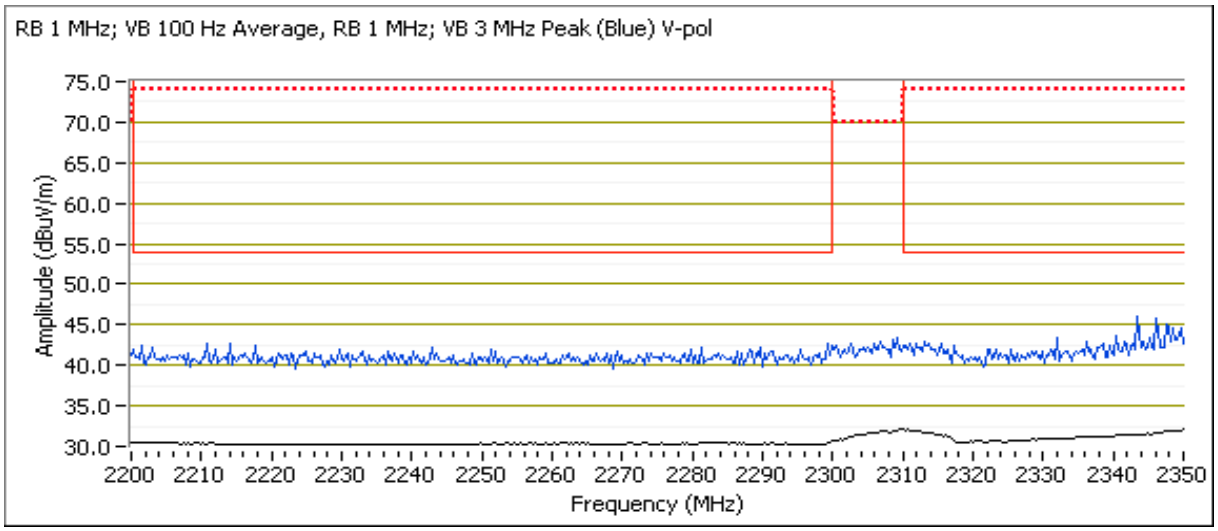
Tx Chain: Main Data Rate: MCS0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2388.160	73.0	V	74.0	-1.0	PK	131	2.3	POS; RB 1 MHz; VB: 3 MHz
2389.360	72.7	H	74.0	-1.3	PK	64	1.1	POS; RB 1 MHz; VB: 3 MHz
2390.000	50.9	V	54.0	-3.1	AVG	131	2.3	Note 1, POS; RB 1 MHz; VB: 10 Hz
2390.000	50.7	H	54.0	-3.3	AVG	64	1.1	Note 1, POS; RB 1 MHz; VB: 10 Hz



Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

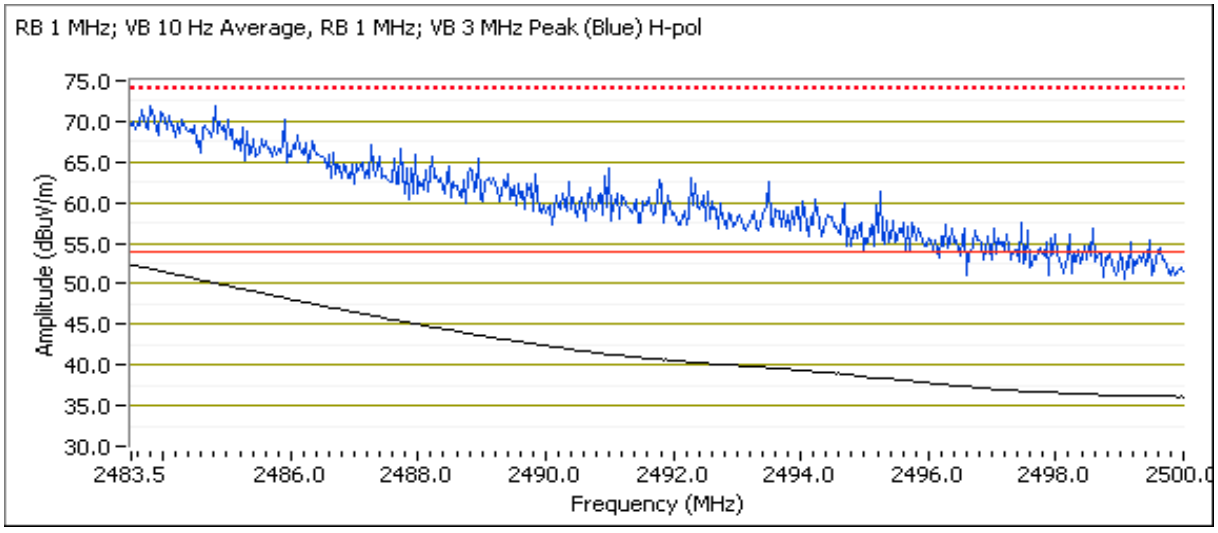


Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

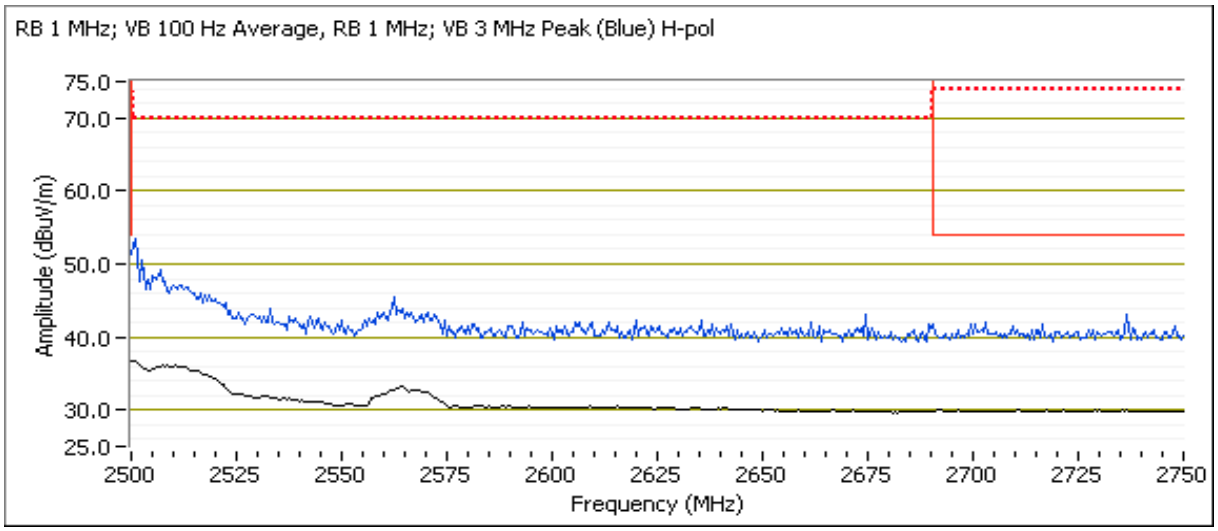
Channel: 11 Mode: n20 Power: 14500 (debug)
Tx Chain: Main Data Rate: MCS0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.970	72.9	H	74.0	-1.1	PK	82	1.0	POS; RB 1 MHz; VB: 3 MHz
2484.330	72.7	V	74.0	-1.3	PK	127	2.0	POS; RB 1 MHz; VB: 3 MHz
2483.550	52.2	H	54.0	-1.8	AVG	82	1.0	Note 1, POS; RB 1 MHz; VB: 10 Hz
2483.500	51.7	V	54.0	-2.3	AVG	127	2.0	Note 1, POS; RB 1 MHz; VB: 10 Hz



Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A



Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

RSS 247 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 20-22 °C

Rel. Humidity: 30-35 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
1	b	1 - 2412 MHz	17500 debug	17500 debug	Radiated Emissions, 30 MHz - 25 GHz	FCC Part 15.209 / 15.247(c)	42.2 dBµV/m @ 4818.7 MHz (-11.8 dB)
	b	6 - 2437 MHz	17500 debug	17500 debug	Radiated Emissions, 30 MHz - 25 GHz	FCC Part 15.209 / 15.247(c)	43.7 dBµV/m @ 4879.2 MHz (-10.3 dB)
	b	11 - 2462 MHz	17500 debug	17500 debug	Radiated Emissions, 30 MHz - 25 GHz	FCC Part 15.209 / 15.247(c)	41.1 dBµV/m @ 4929.2 MHz (-12.9 dB)
Scans on center channel in two OFDM modes to determine the worst case mode.							
2	g	6 - 2437 MHz	15500 debug	15500 debug	Radiated Emissions, 30 MHz - 25 GHz	FCC Part 15.209 / 15.247(c)	34.8 dBµV/m @ 4878.3 MHz (-19.2 dB)
	n20	6 - 2437 MHz	14500 debug	14500 debug	Radiated Emissions, 30 MHz - 25 GHz	FCC Part 15.209 / 15.247(c)	34.1 dBµV/m @ 4874.1 MHz (-19.9 dB)
Measurements on low and high channels in worst-case OFDM mode.							
3	g	1 - 2412 MHz	15500 debug	15500 debug	Radiated Emissions, 30 MHz - 25 GHz	FCC Part 15.209 / 15.247(c)	35.0 dBµV/m @ 4821.7 MHz (-19.0 dB)
	g	11 - 2462 MHz	15500 debug	15500 debug	Radiated Emissions, 30 MHz - 25 GHz	FCC Part 15.209 / 15.247(c)	35.1 dBµV/m @ 4924.2 MHz (-18.9 dB)

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: DVT2_022
WLAN Driver: MCP-8.0.1.47_Rel
WLAN Firmware: PLT 8.9.0.1.38

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074
Peak measurements performed with: RBW=1 MHz, VBW=3 MHz, peak detector, max hold, auto sweep time
Unless otherwise stated/noted, emission has duty cycle ≥ 98% and was measured using RBW=1 MHz, VBW=10 Hz, peak detector, linear average mode, auto sweep time, max hold.
2.4GHz band reject filter used

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	5.5	0.96	Yes	5.867	0.2	0.3	170
11g	6.0	0.99	Yes	5.361	0.0	0.0	10
n20	6.5	0.99	Yes	4.476	0.0	0.0	10

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 20 dB below the level of the fundamental and measured in 100 kHz.
Note 3:	Emission has duty cycle ≥ 98%, average measurement performed: RBW = 1 MHz, VBW = 10 Hz, peak detector, linear averaging, auto sweep,
Note 4:	Emission has constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW>1/T but not less than 10Hz, peak detector, linear averaging, auto sweep,max hold 50*1/DC traces.

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

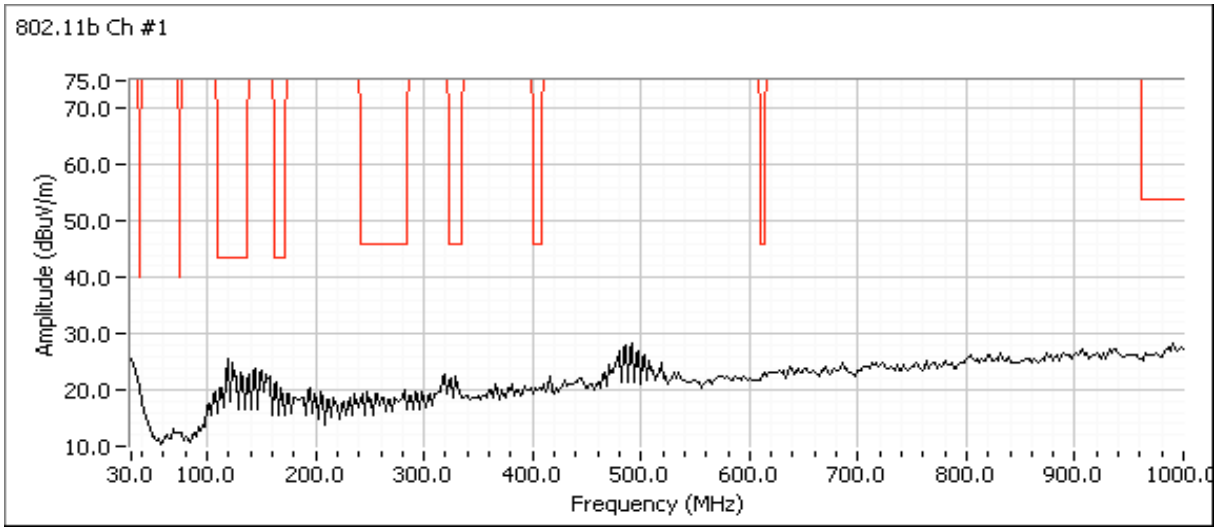
Date of Test: 5/9/2016, 5/10/2016 Config. Used: 1
Test Engineer: Deniz Demirci / R. Varelas Test Location: FT CH #3, #5

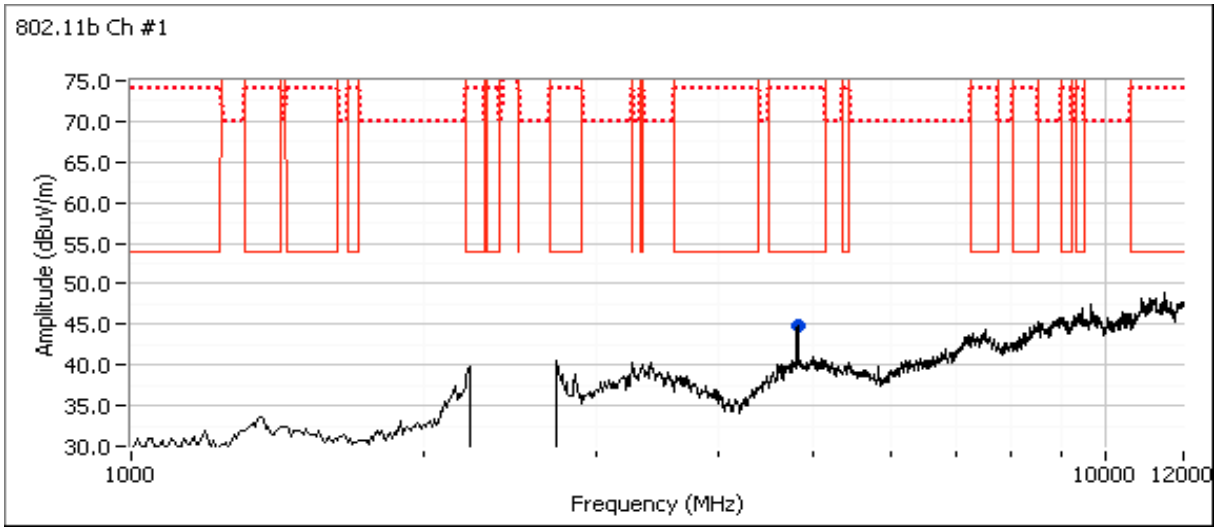
Run #1: Radiated Spurious Emissions, 30 - 25000 MHz. Operating Mode: 802.11b

Run #1a: Low Channel
Channel: 1 Mode: b Power: 17500 (debug)
Tx Chain: Main Data Rate: 1 Mbps

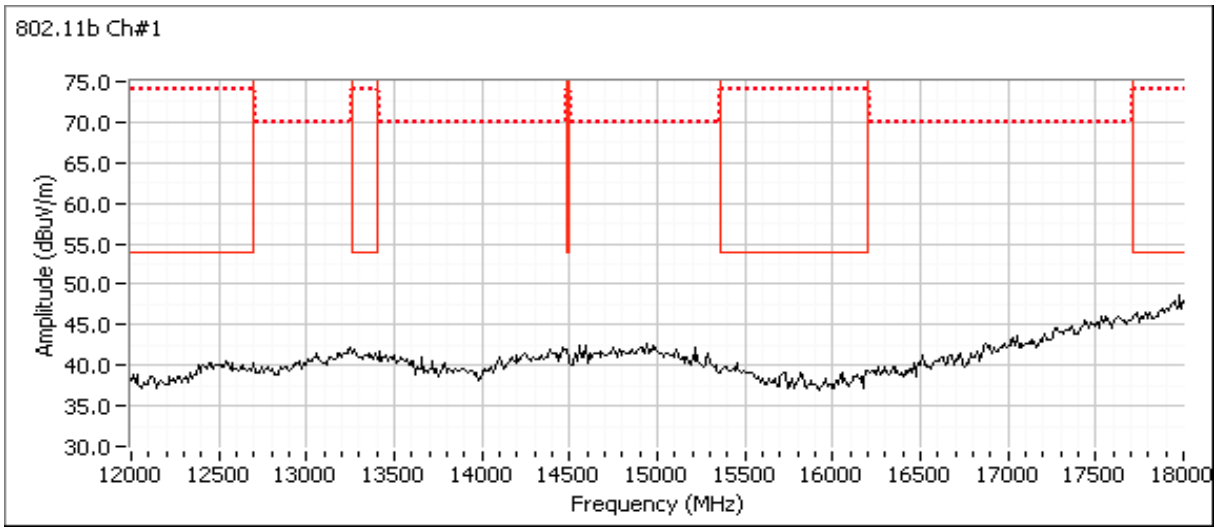
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4818.700	42.2	V	54.0	-11.8	AVG	331	1.7	Note 4, RB 1 MHz;VB 300 Hz;Peak
4818.700	50.8	V	74.0	-23.2	PK	331	1.7	RB 1 MHz;VB 3 MHz;Peak

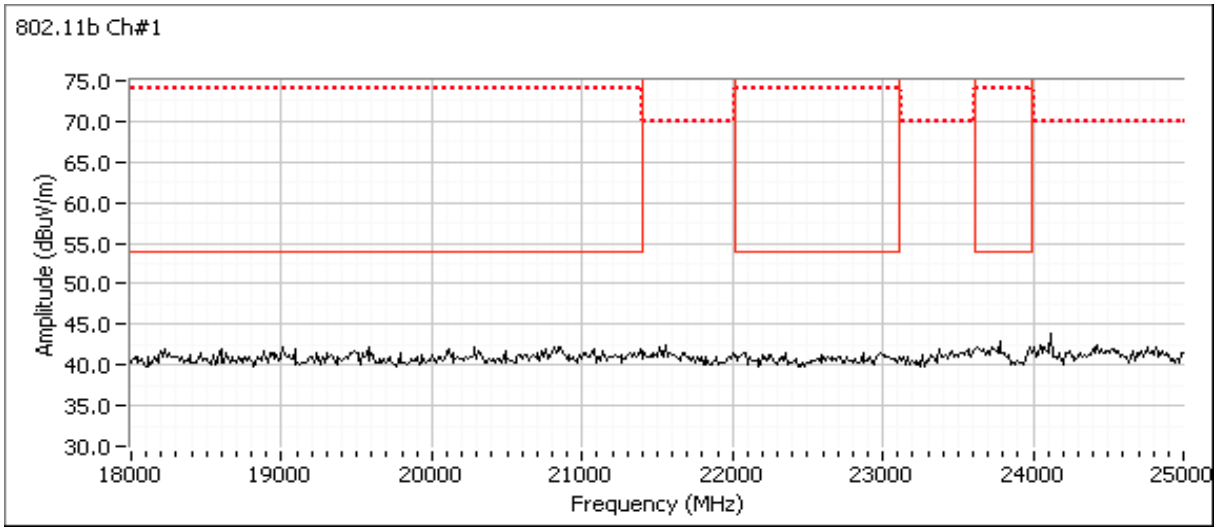
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

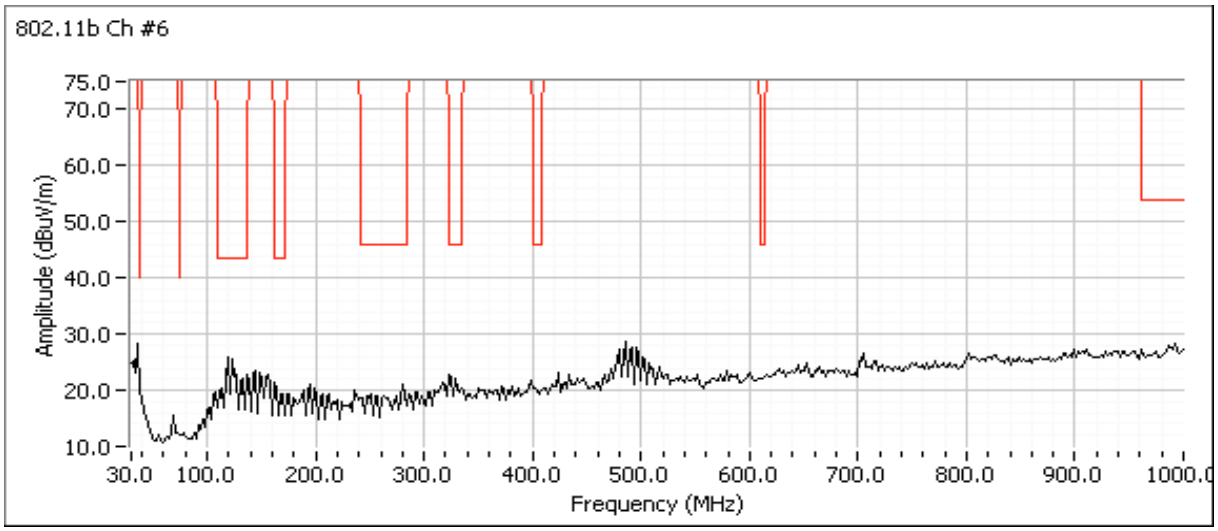
Run #1b: Center Channel

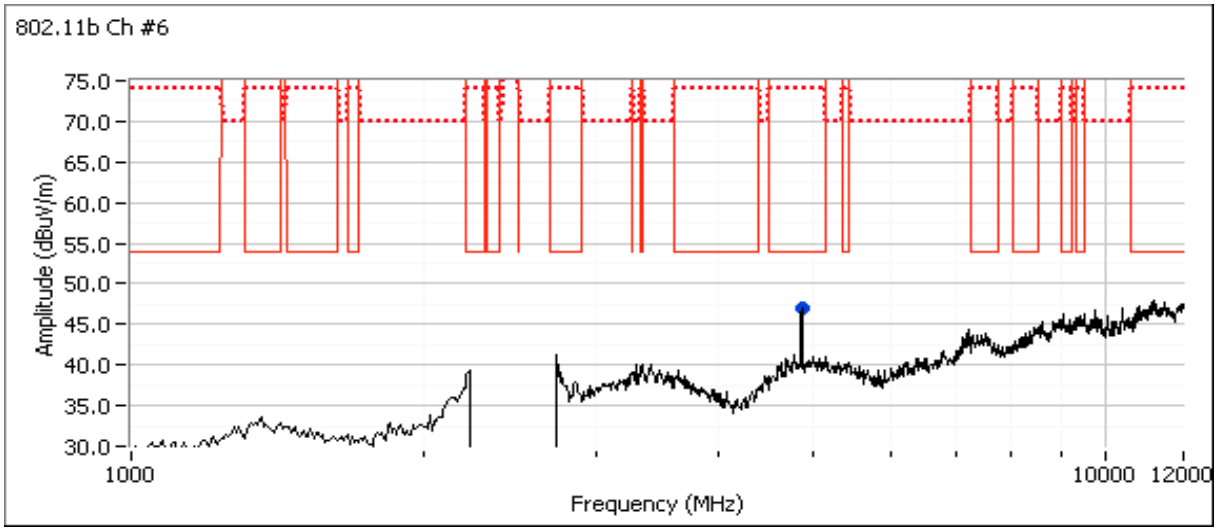
Channel: 6 Mode: b Power: 17500 (debug)

Tx Chain: Main Data Rate: 1 Mbps

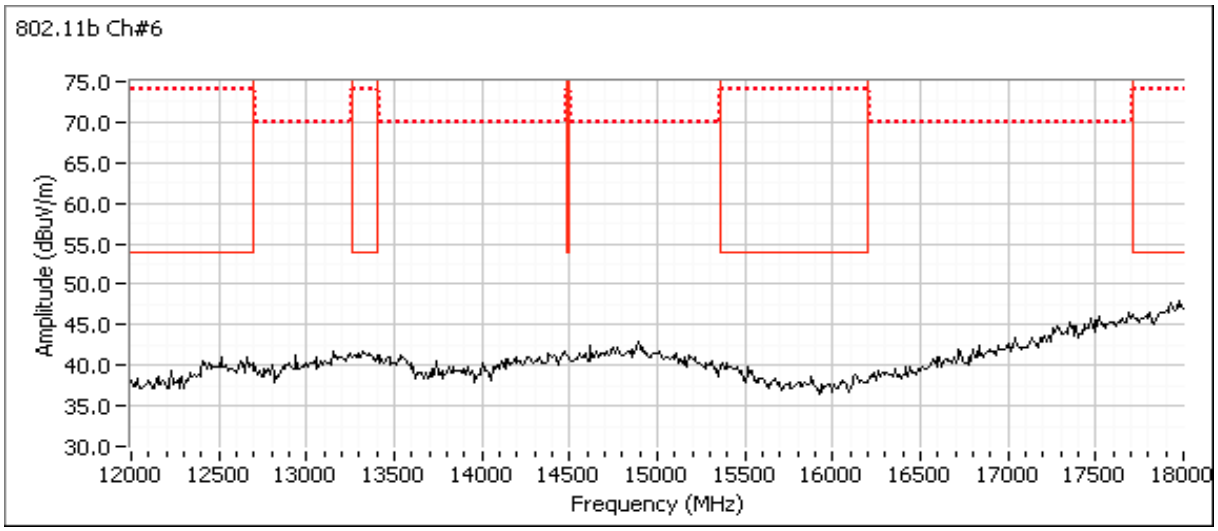
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4879.200	43.7	V	54.0	-10.3	AVG	334	1.7	Note 4, RB 1 MHz;VB 300 Hz;Peak
4879.670	51.8	V	74.0	-22.2	PK	334	1.7	RB 1 MHz;VB 3 MHz;Peak

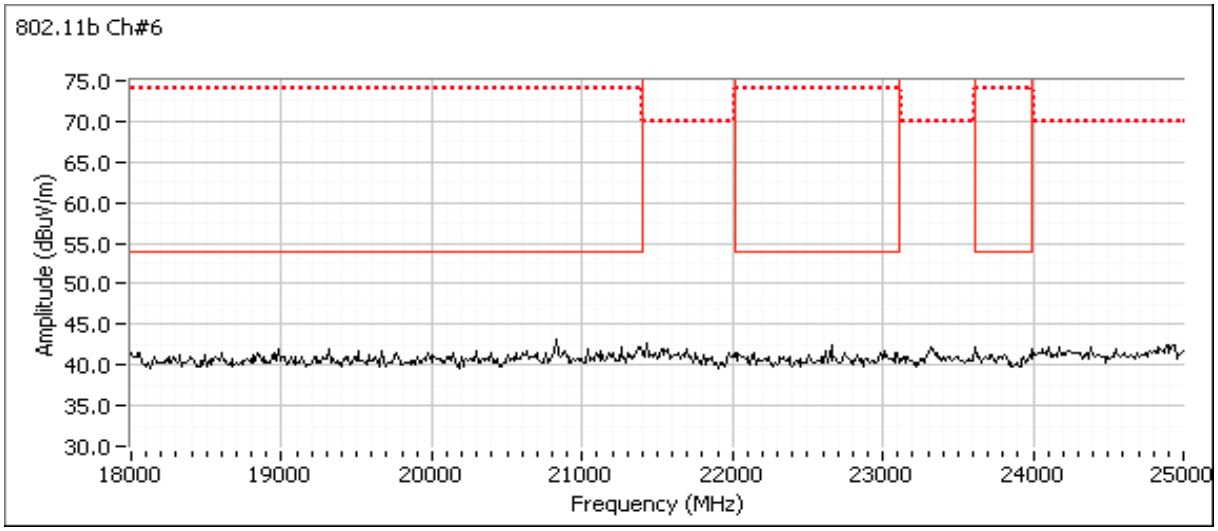
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

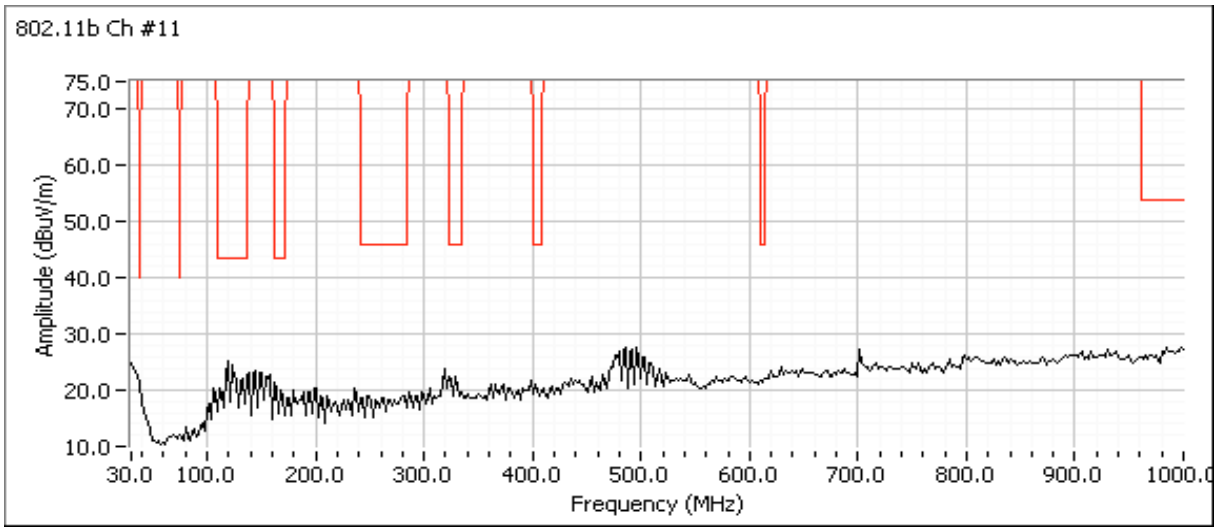
Run #1c: High Channel

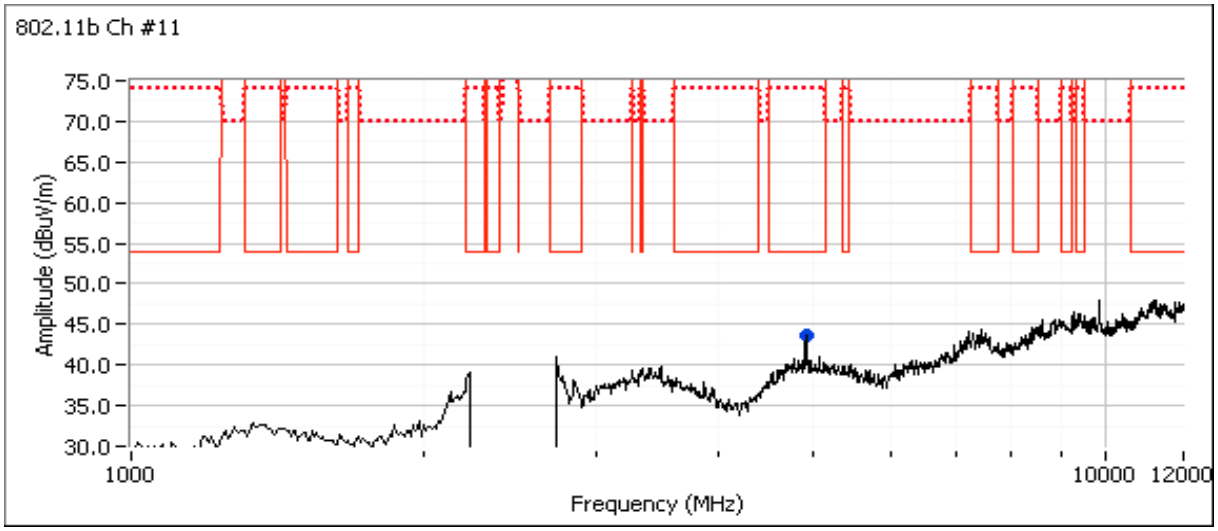
Channel: 11 Mode: b Power: 17500 (debug)

Tx Chain: Main Data Rate: 1 Mbps

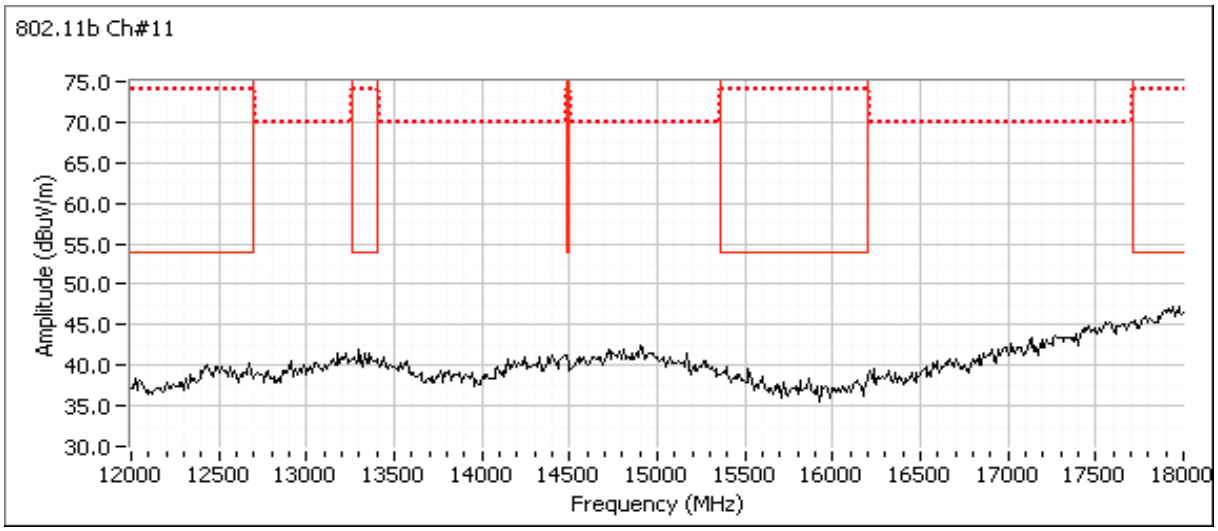
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4929.200	41.1	V	54.0	-12.9	AVG	310	1.6	Note 4, RB 1 MHz;VB 300 Hz;Peak
4918.800	50.1	V	74.0	-23.9	PK	310	1.6	RB 1 MHz;VB 3 MHz;Peak

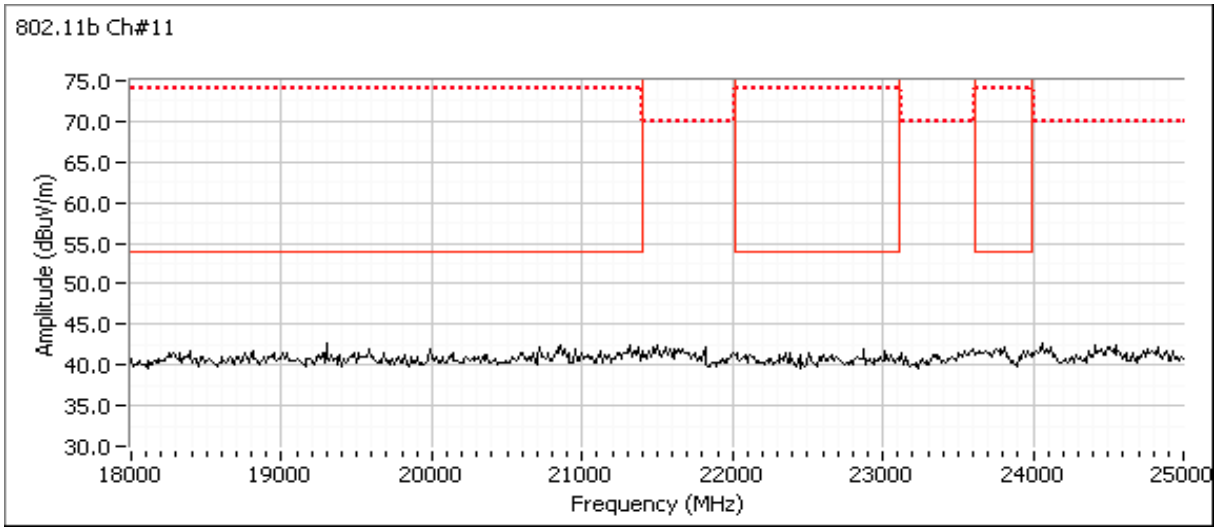
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Run #2: Radiated Spurious Emissions, 30 - 25000 MHz. Operating Mode: OFDM

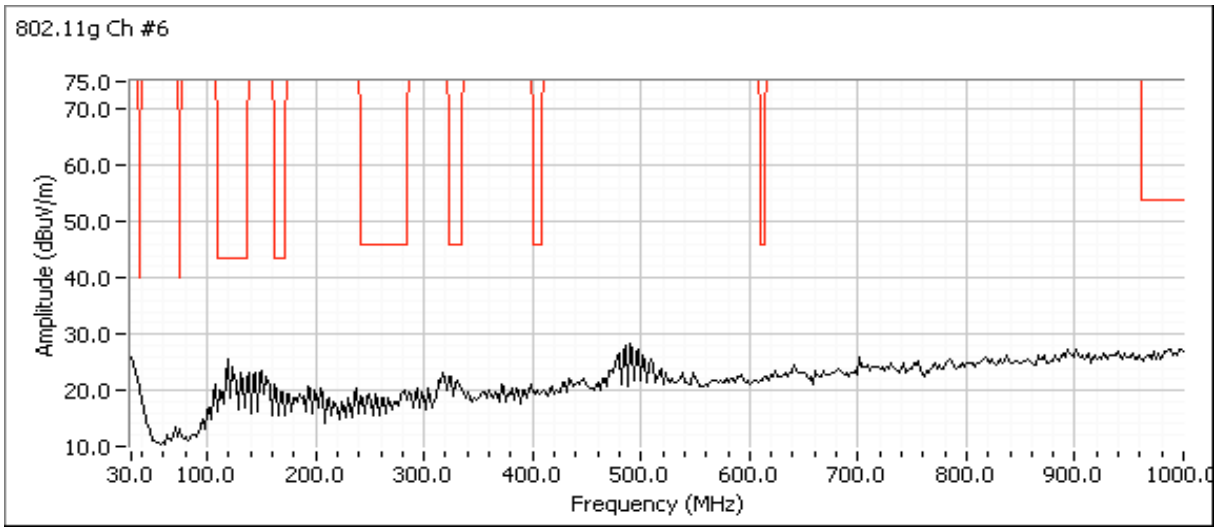
Run #2a: Center Channel

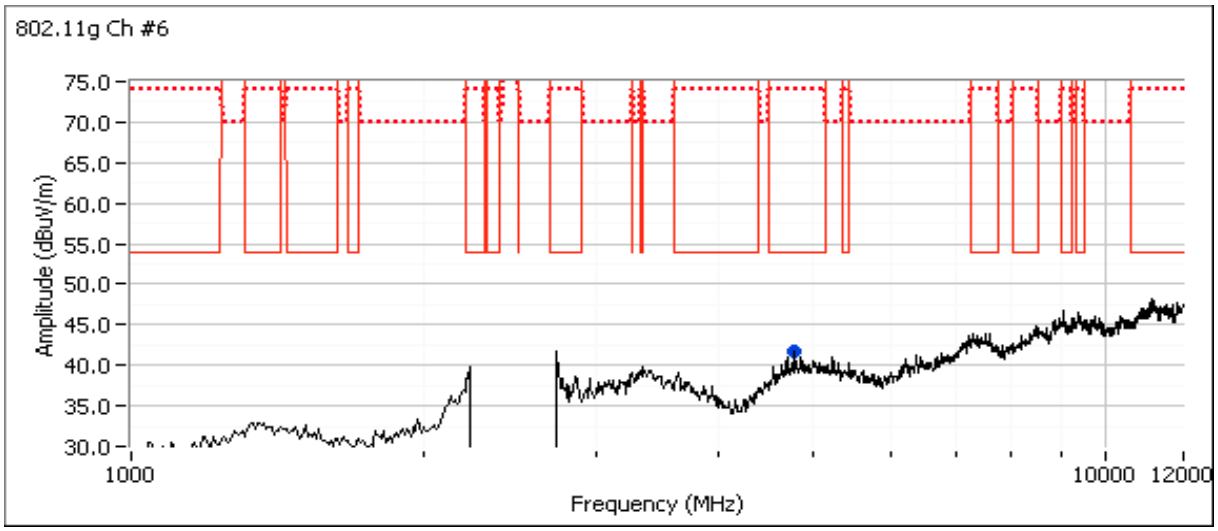
Channel: 6 Mode: g Power: 15500 (debug)

Tx Chain: Main Data Rate: 6 Mbps

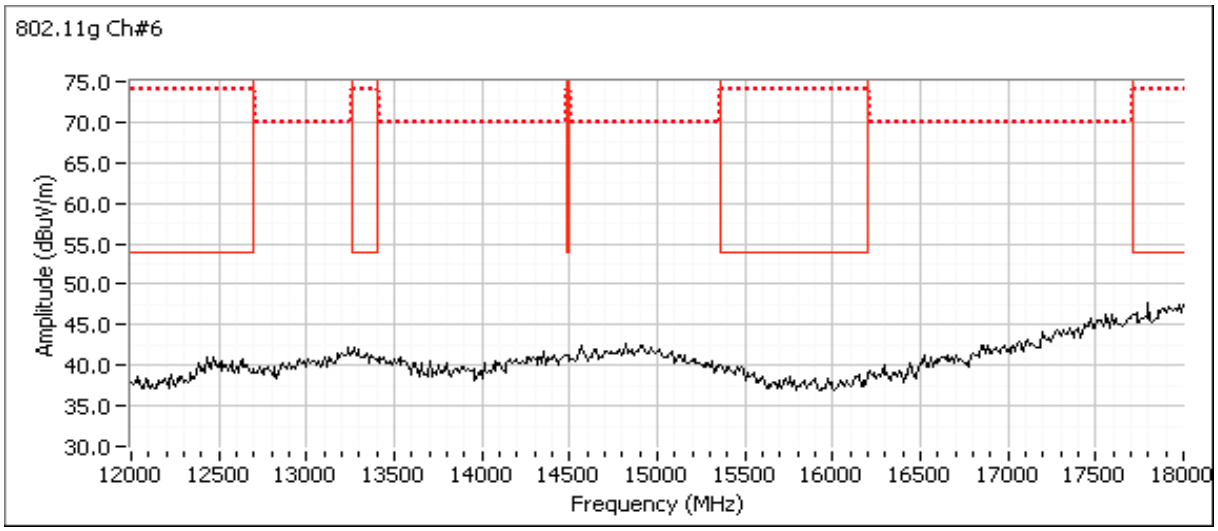
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4878.340	34.8	V	54.0	-19.2	AVG	257	1.7	Note 3, RB 1 MHz;VB 10 Hz;Peak
4889.240	47.3	V	74.0	-26.7	PK	257	1.7	RB 1 MHz;VB 3 MHz;Peak

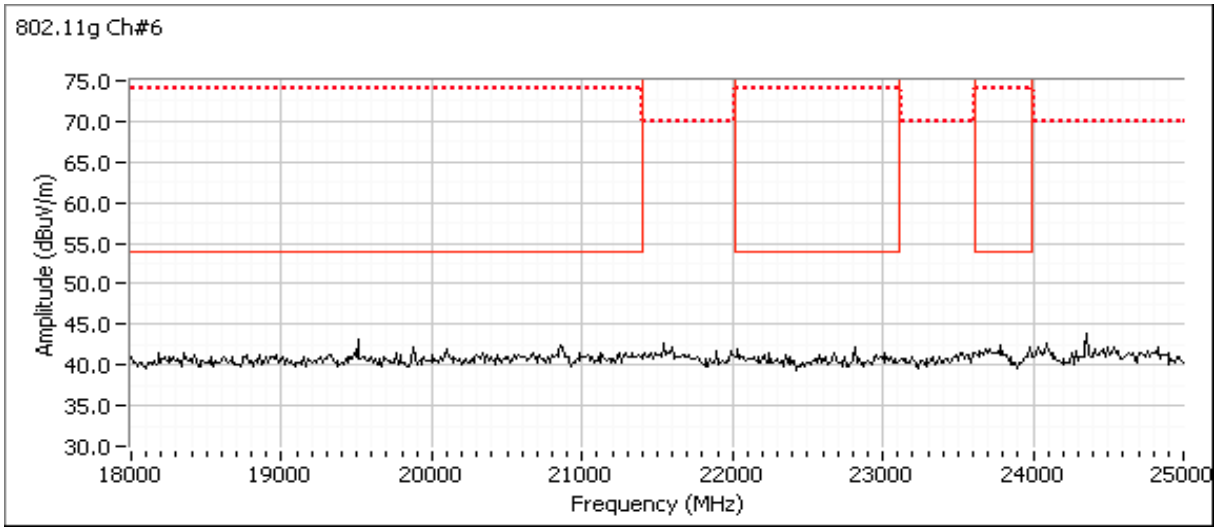
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

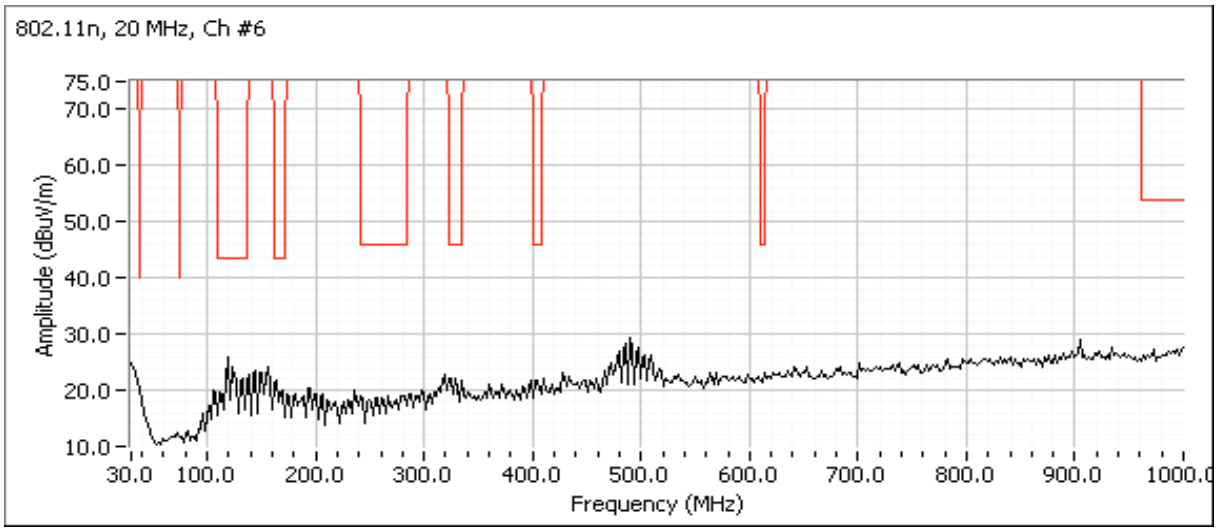
Run #2b: Center Channel

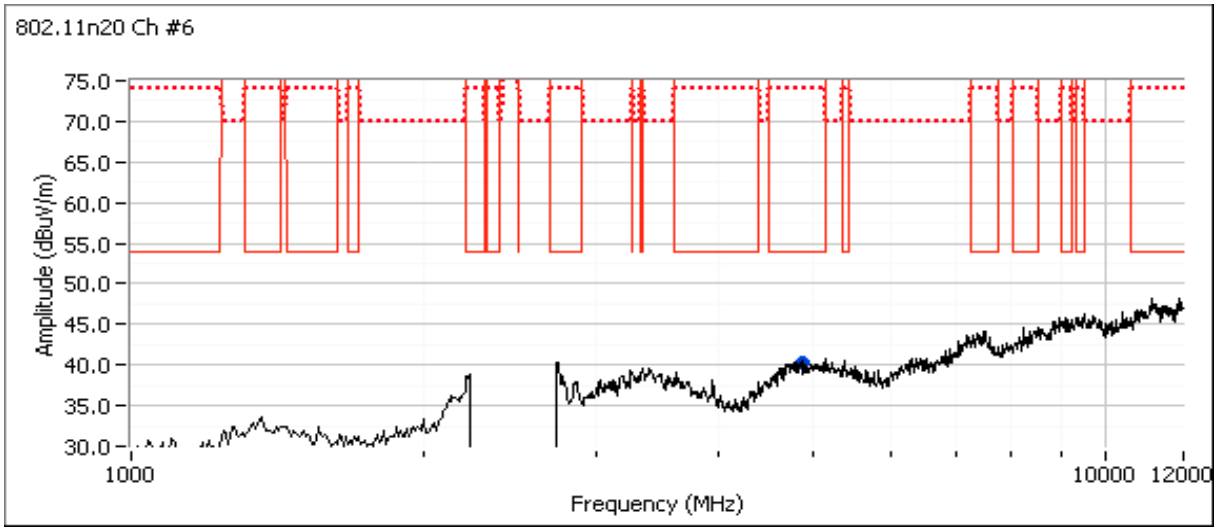
Channel: 6 Mode: n20 Power: 14500 (debug)

Tx Chain: Main Data Rate: MCS0

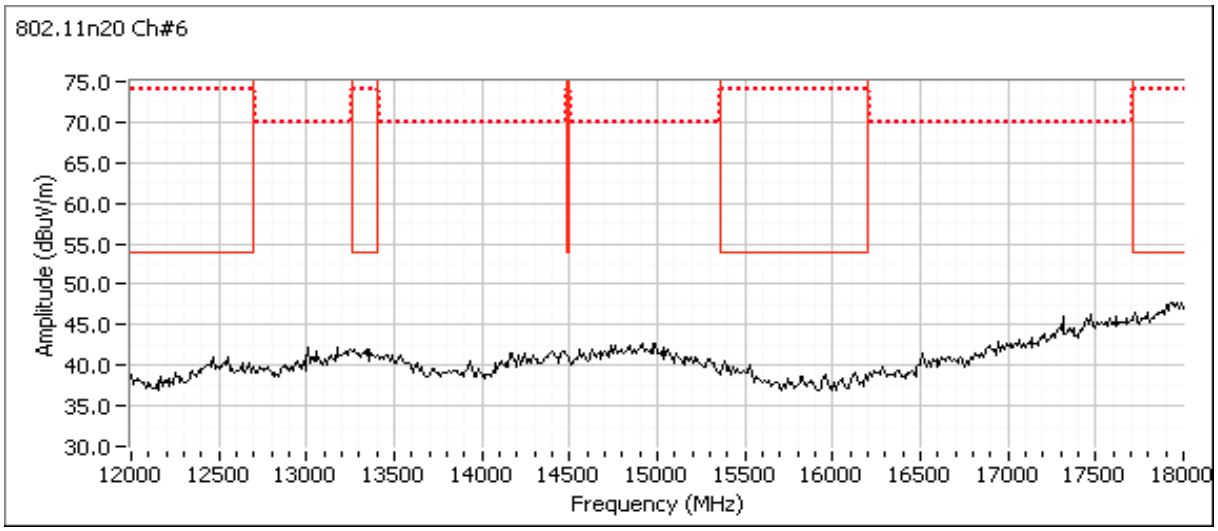
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4874.100	34.1	H	54.0	-19.9	AVG	96	2.1	Note 3, RB 1 MHz;VB 10 Hz;Peak
4876.600	47.1	H	74.0	-26.9	PK	96	2.1	RB 1 MHz;VB 3 MHz;Peak

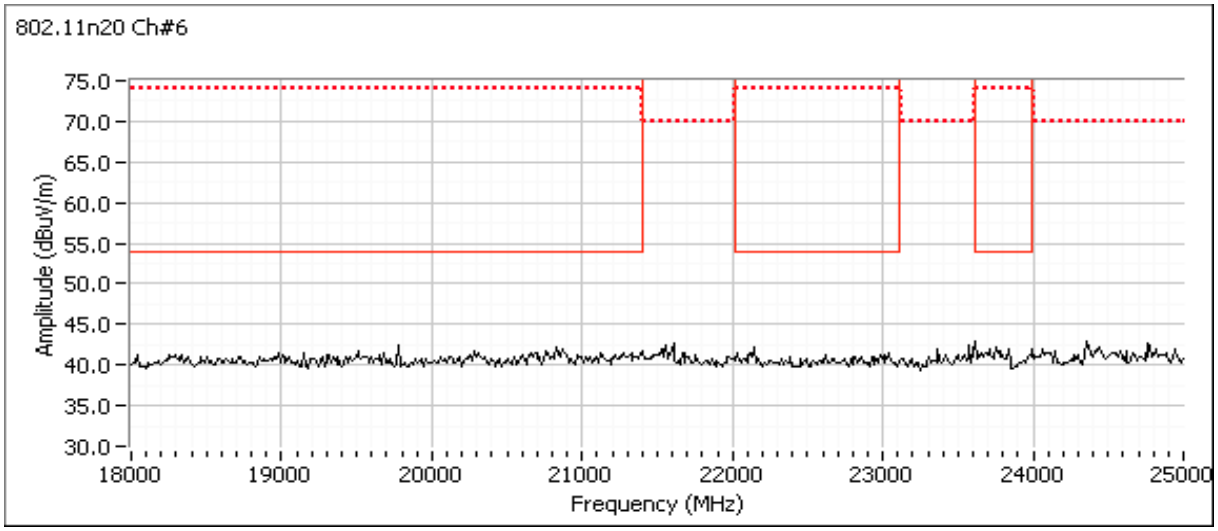
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Run #3: Radiated Spurious Emissions, 30 - 25000 MHz. Operating Mode: Worse case from Run #2

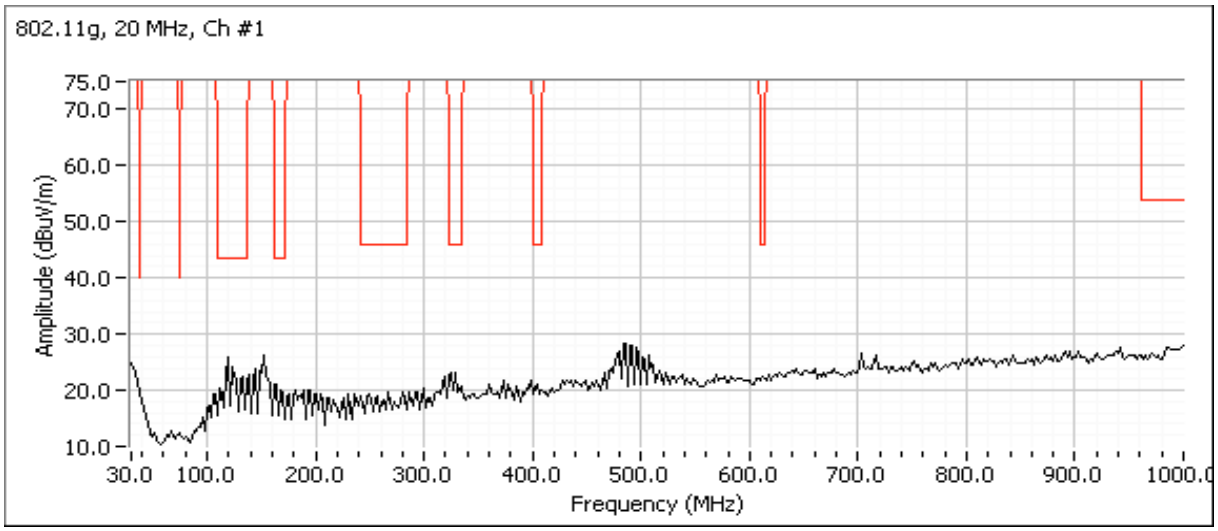
Run #3a: Low Channel

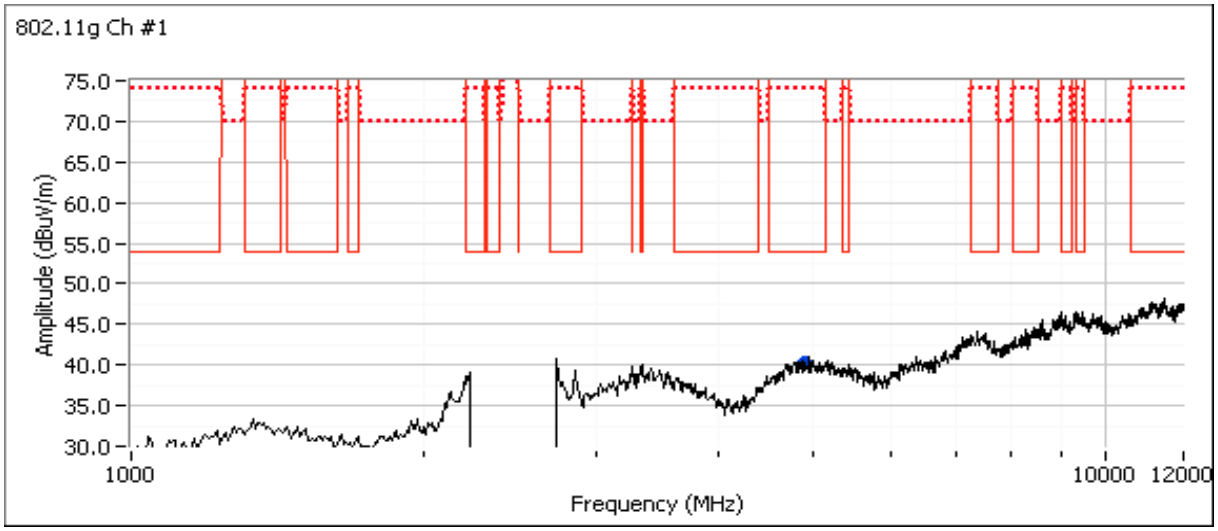
Channel: 1 Mode: g Power: 15500 (debug)

Tx Chain: Main Data Rate: 6 Mbps

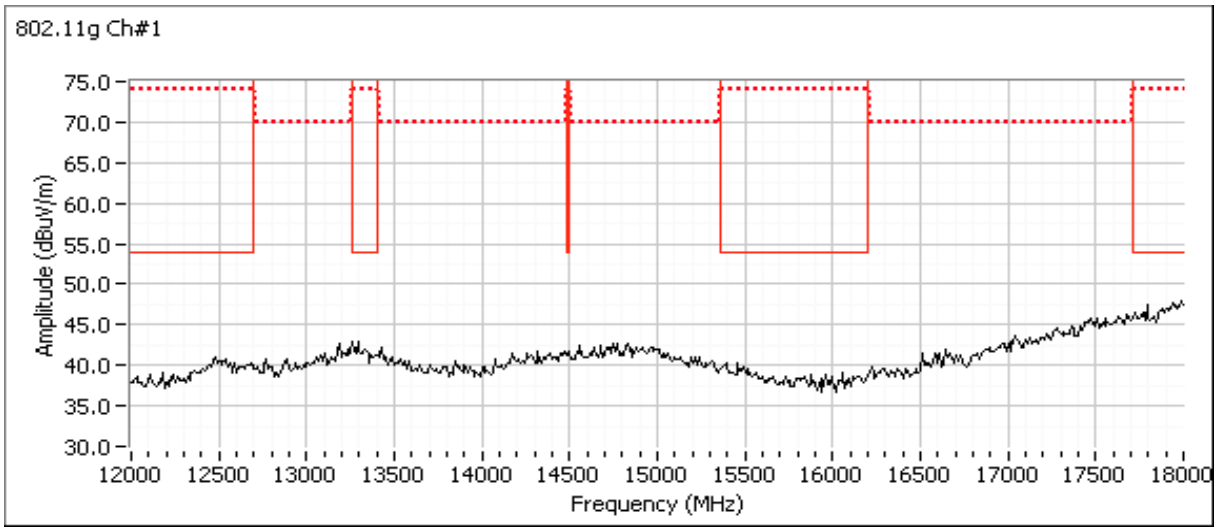
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4821.670	35.0	V	54.0	-19.0	AVG	98	1.0	Note 3, RB 1 MHz;VB 10 Hz;Peak
4831.310	47.3	V	74.0	-26.7	PK	98	1.0	RB 1 MHz;VB 3 MHz;Peak

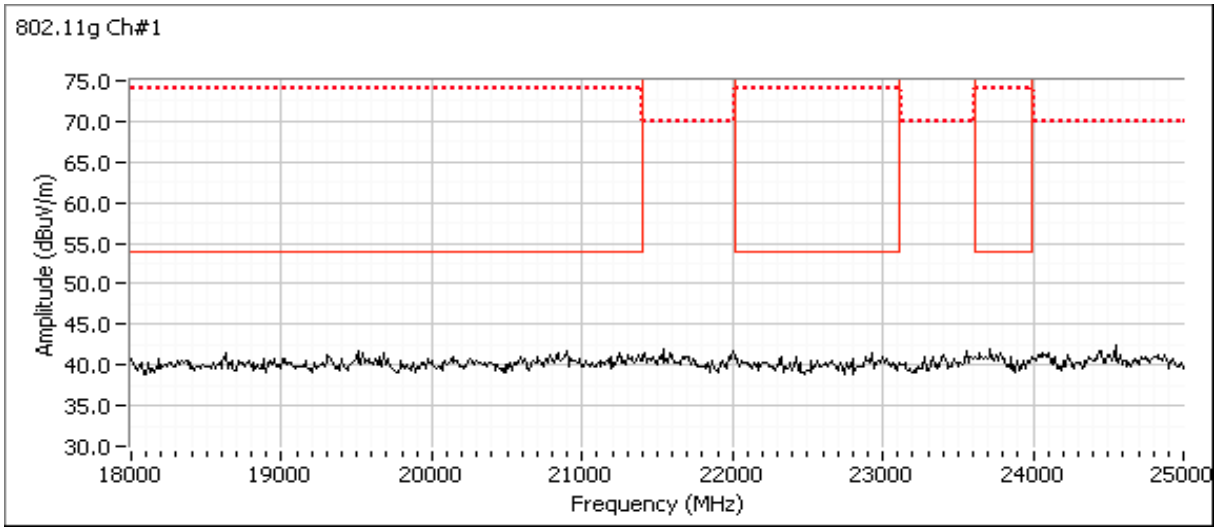
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

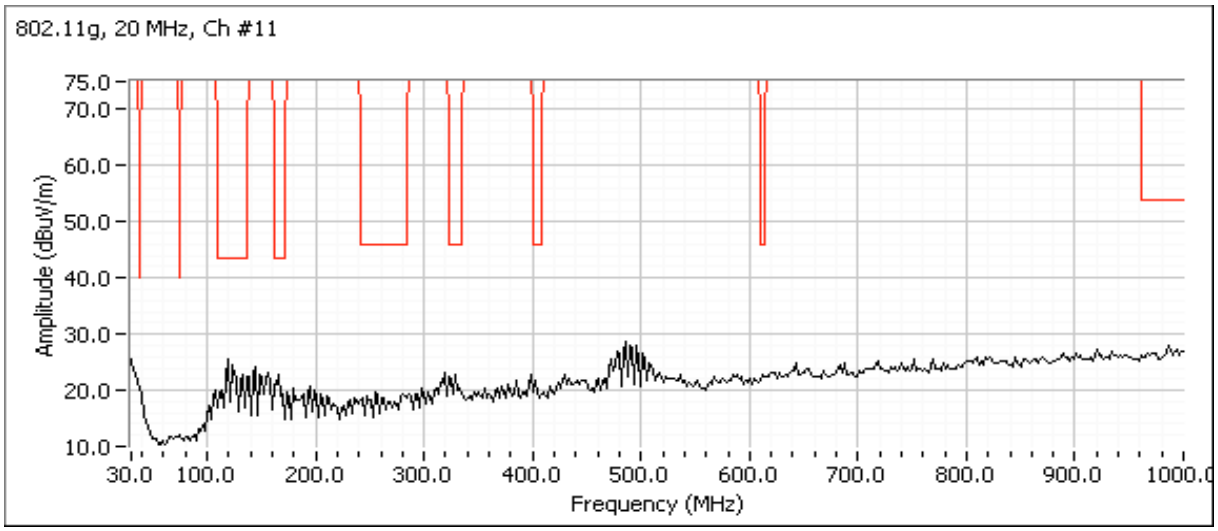
Run #3b: High Channel

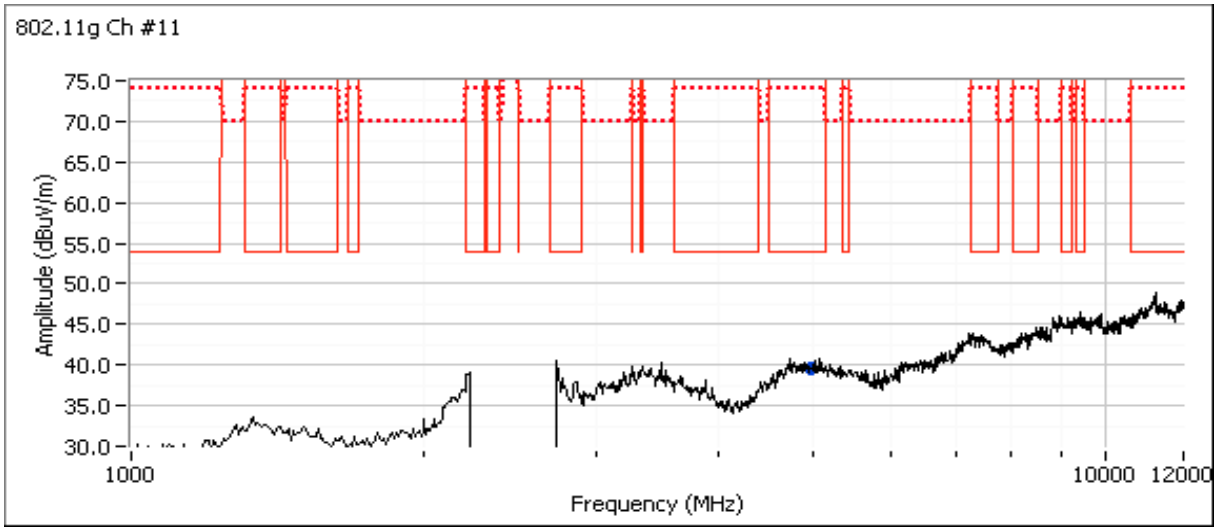
Channel: 11 Mode: g Power: 15500 (debug)

Tx Chain: Main Data Rate: 6 Mbps

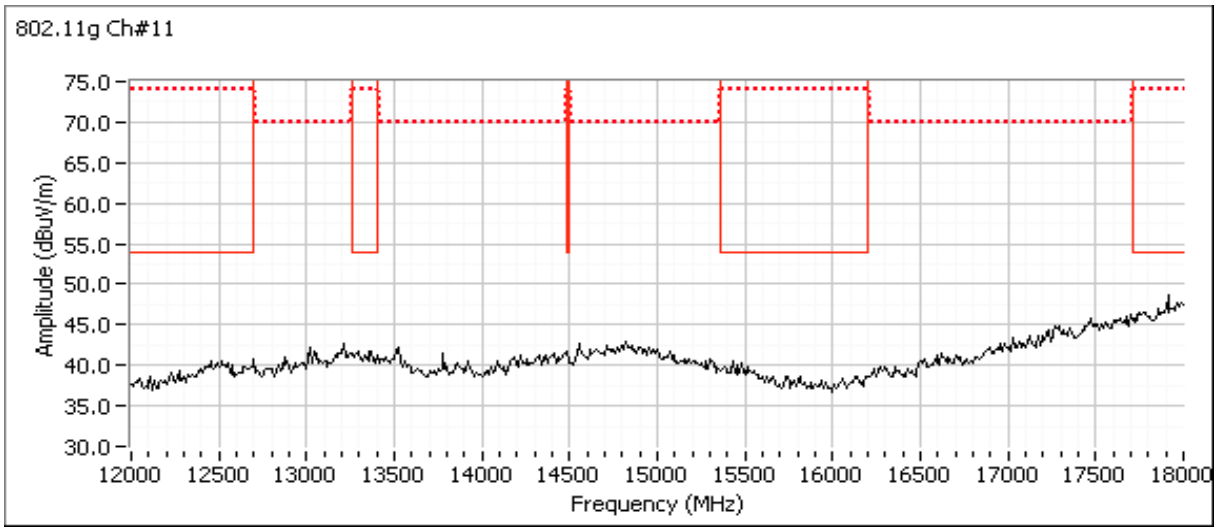
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4924.150	35.1	V	54.0	-18.9	AVG	146	1.0	Note 3, RB 1 MHz;VB 10 Hz;Peak
4922.860	46.9	V	74.0	-27.1	PK	146	1.0	RB 1 MHz;VB 3 MHz;Peak

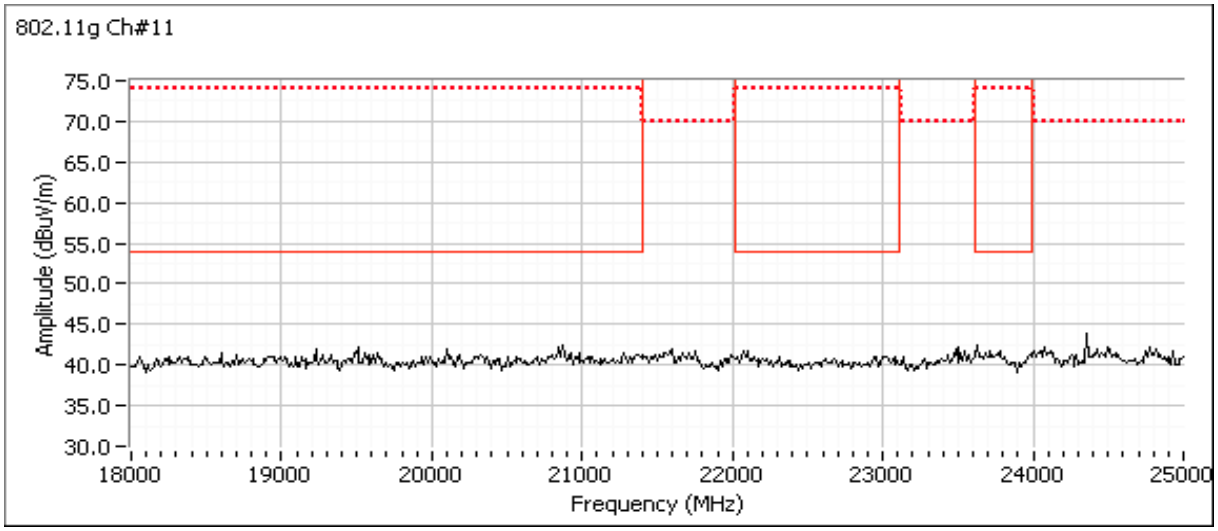
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

RSS 247 and FCC 15.247 (DTS) Antenna Port Measurements

Power, PSD, Bandwidth and Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT was connected to the spectrum analyzer or power meter via a suitable attenuator. All measurements were made on a single chain.

All measurements have been corrected to allow for the external attenuators used.

Ambient Conditions:

Temperature: 20-22 °C
Rel. Humidity: 30-45 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	-	-	Output Power	15.247(b)	Pass	16.8 dBm
2	-	-	Power spectral Density (PSD)	15.247(d)	Pass	-1.3 dBm/ 10 kHz
3	-	-	Minimum 6 dB Bandwidth	15.247(a)	Pass	9.6 MHz
3	-	-	99% Bandwidth	RSS Gen	-	802.11b: 14.9 MHz 802.11g: 17.7 MHz 802.11n: 18.3 MHz
4	-	-	Spurious emissions	15.247(b)	Pass	> -20 dBc

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074, ANSI C63.10 and RSS-Gen

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	5.5	0.96	Yes	5.867	0.2	0.3	170
11g	6.0	0.99	Yes	5.361	0.0	0.0	10
n20	6.5	0.99	Yes	4.476	0.0	0.0	10

Sample Notes

Sample S/N: 001
WLAN Driver: MCP-8.0.1.47_Rel
WLAN Firmware: PLT 8.9.0.1.38

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Run #1: Output Power

Date of Test: 5/11/2016 — Config. Used: 1
Test Engineer: Deniz Demirci — Config Change: None
Test Location: FT Lab #4a — EUT Voltage: 14.4

Mode: 11b

Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W	Output Power (dBm)[3]	Output Power mW
17500	2412	16.8	47.9	-2.7	Pass	14.1	0.026		
17500	2437	16.8	47.9	-2.7	Pass	14.1	0.026		
17500	2462	16.8	47.9	-2.7	Pass	14.1	0.026		

Mode: 11g

Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W	Output Power (dBm)[3]	Output Power mW
15500	2412	14.1	25.7	-2.7	Pass	11.4	0.014		
15500	2437	14.1	25.7	-2.7	Pass	11.4	0.014		
15500	2462	14.1	25.7	-2.7	Pass	11.4	0.014		

Mode: n20

Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W	Output Power (dBm)[3]	Output Power mW
14500	2412	13.1	20.4	-2.7	Pass	10.4	0.011		
14500	2437	13.1	20.4	-2.7	Pass	10.4	0.011		
14500	2462	13.1	20.4	-2.7	Pass	10.4	0.011		

Note 1:	Output power measured using a peak power meter, spurious limit is -20 dBc.
Note 2:	Power setting - the software power setting used during testing, included for reference only.

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Run #2: Power spectral Density

Mode: 11b

Power Setting	Frequency (MHz)	PSD (dBm/10 kHz) Note 1	Limit dBm/3 kHz	Result
17500	2411.6000	-1.4	8.0	Pass
17500	2436.9500	-1.3	8.0	Pass
17500	2460.8000	-1.5	8.0	Pass

Mode: 11g

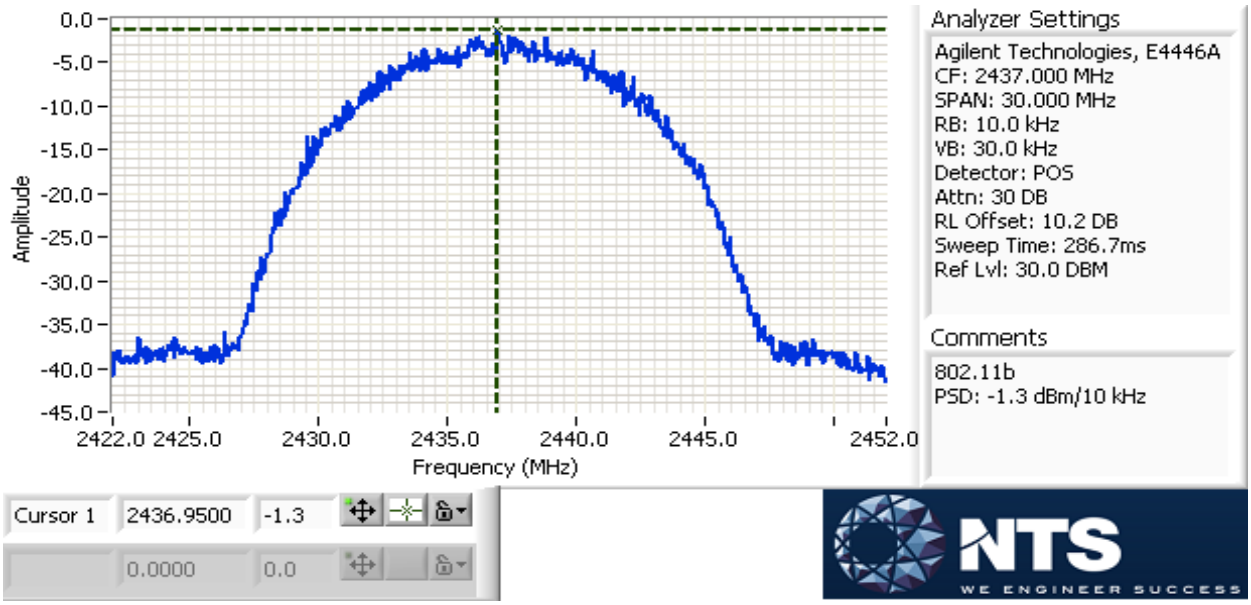
Power Setting	Frequency (MHz)	PSD (dBm/10 kHz) Note 1	Limit dBm/3 kHz	Result
15500	2413.8500	-5.4	8.0	Pass
15500	2437.6000	-4.2	8.0	Pass
15500	2462.3500	-5.1	8.0	Pass

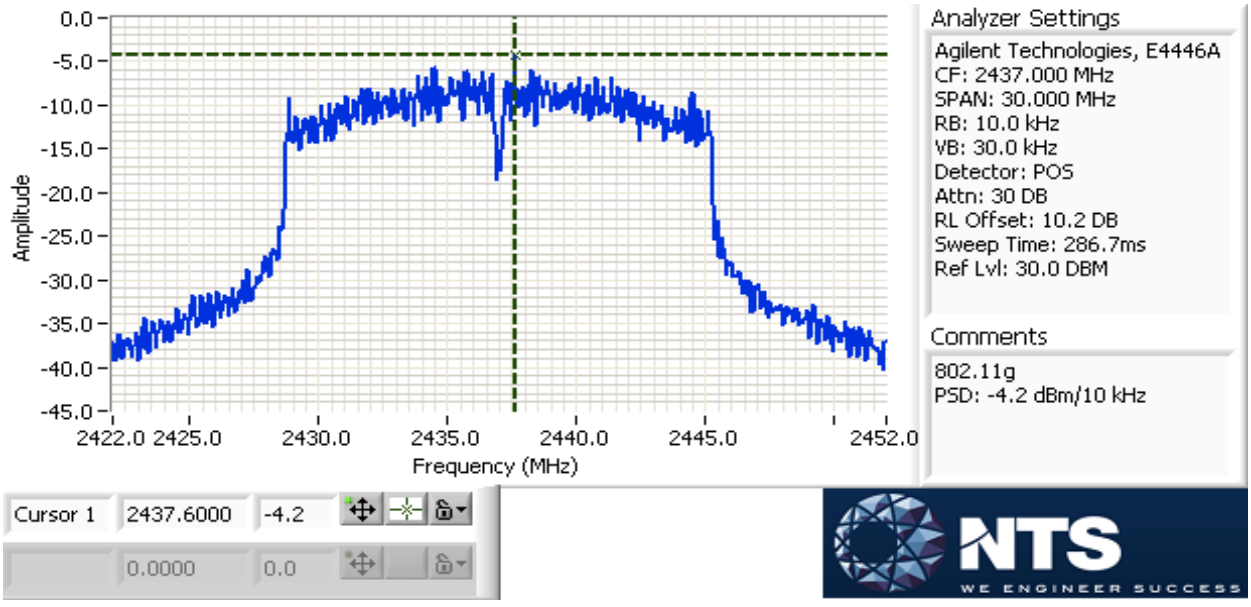
Mode: n20

Power Setting	Frequency (MHz)	PSD (dBm/10 kHz) Note 1	Limit dBm/3 kHz	Result
14500	2416.7	-6.0	8.0	Pass
14500	2438.5	-7.0	8.0	Pass
14500	2462.95	-6.1	8.0	Pass

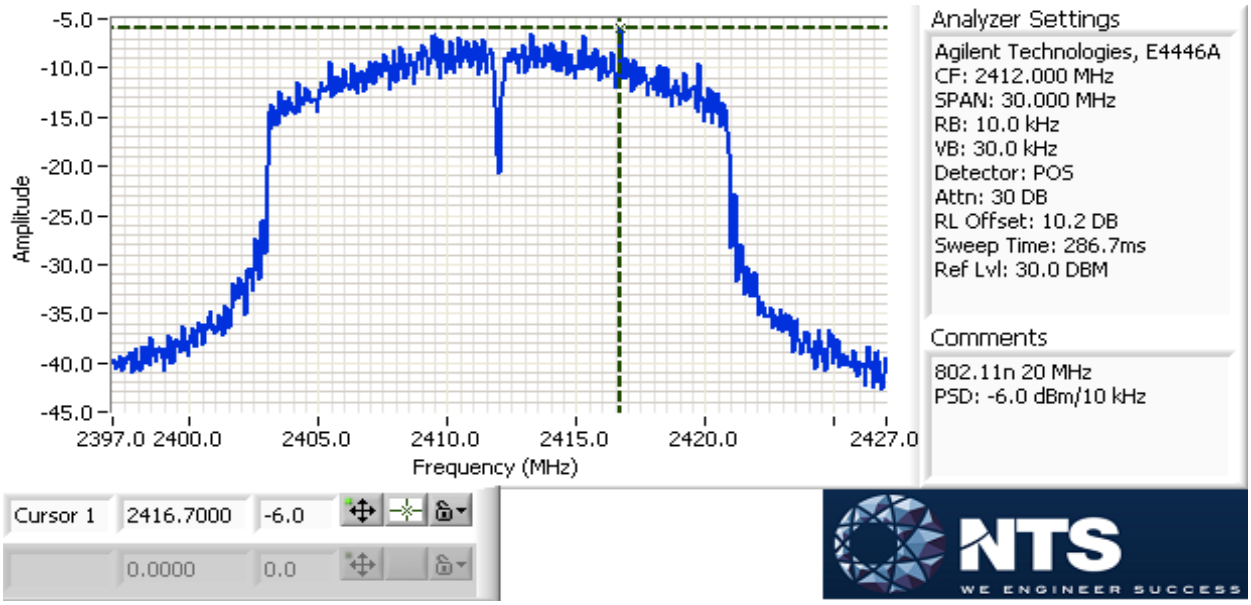
Note 1:	Test performed per method PKSPD, in KDB 558074. Power spectral density measured using: 3 kHz ≤ RBW ≤ 100 kHz, VBW=3*RBW, peak detector, span = 1.5*DTS BW, auto sweep time, max hold.

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A



Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Run #3: Signal Bandwidth

Mode: 11b

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (MHz)	
		6dB	99%	6dB	99%
17500	2412	10.4	14.9	0.1	0.3
17500	2437	9.60	14.8	0.1	0.3
17500	2462	9.60	14.8	0.1	0.3

Mode: 11g

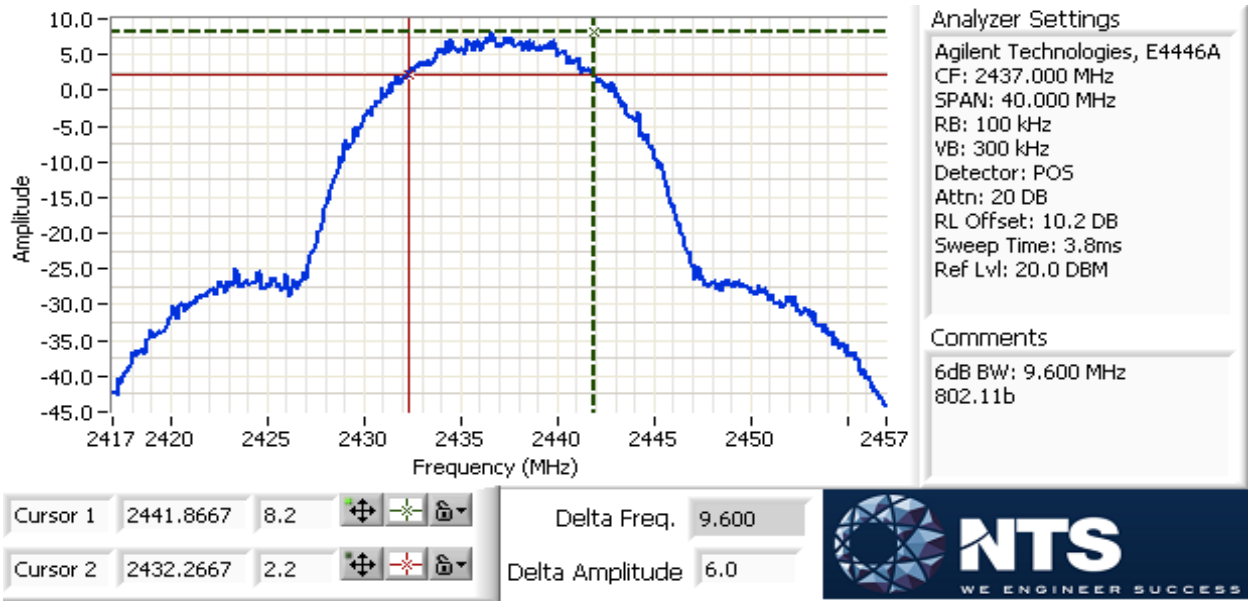
Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (MHz)	
		6dB	99%	6dB	99%
15500	2412	15.0	17.2	0.1	0.3
15500	2437	15.1	17.7	0.1	0.3
15500	2462	15.0	17.7	0.1	0.3

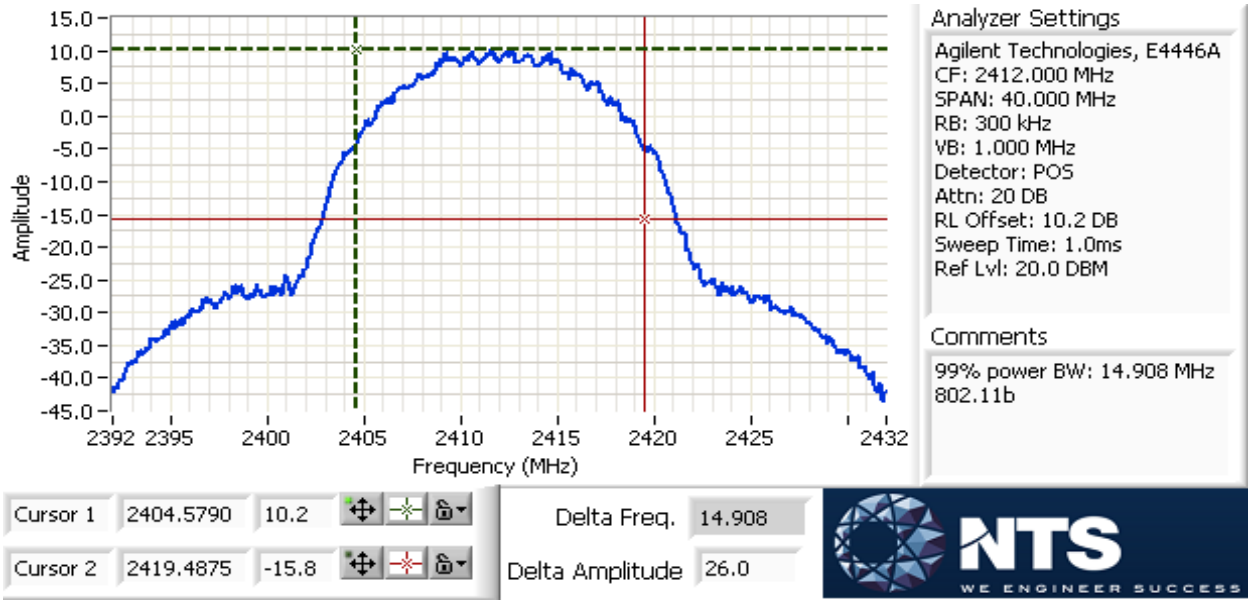
Mode: n20

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (MHz)	
		6dB	99%	6dB	99%
14500	2412	15.1	17.9	0.1	0.3
14500	2437	15.1	18.3	0.1	0.3
14500	2462	15.1	18.3	0.1	0.3

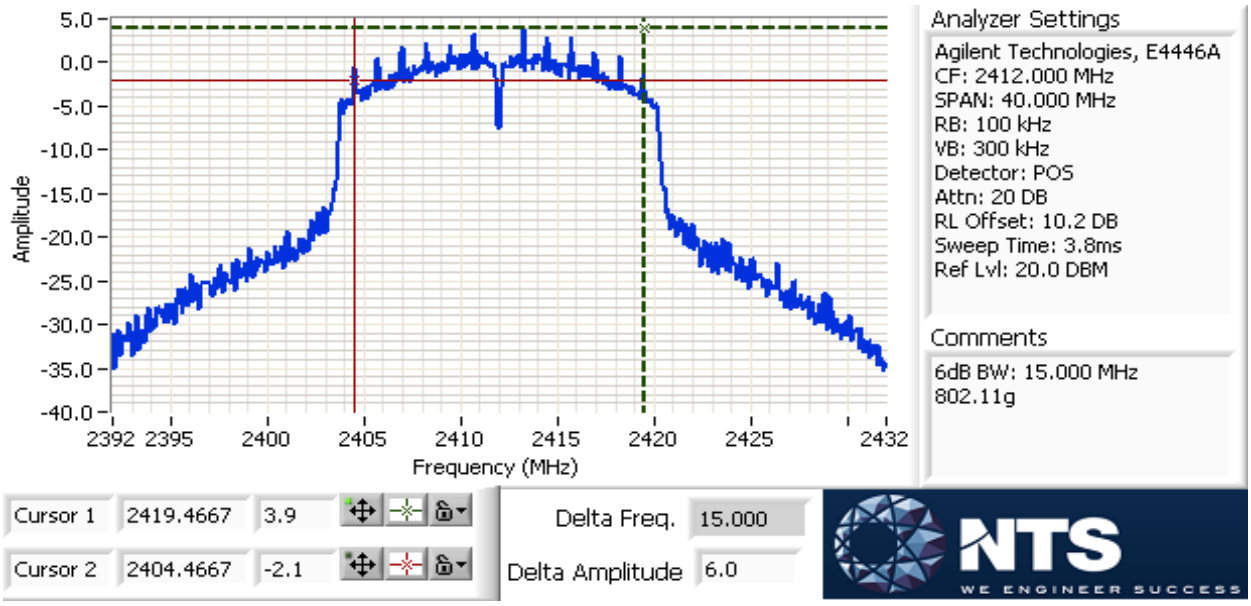
Note 1:	DTS BW: RBW = 100 kHz, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time. 99% BW: RBW = 1-5% of 99% BW, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time.
Note 2:	Graphs indicate worst case results.

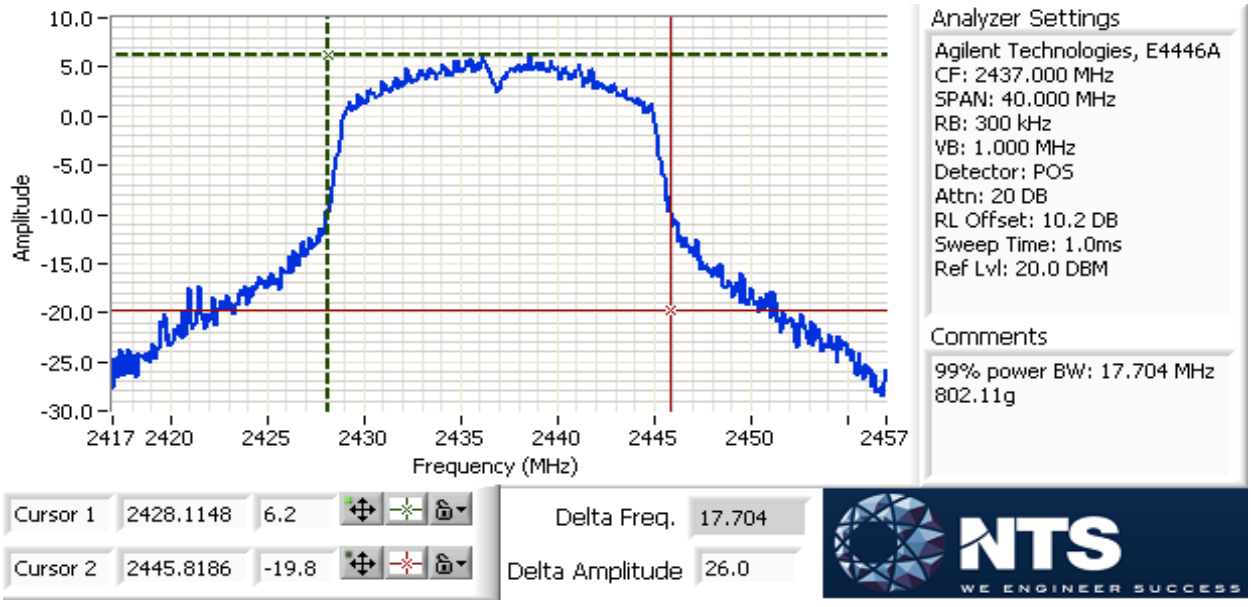
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A



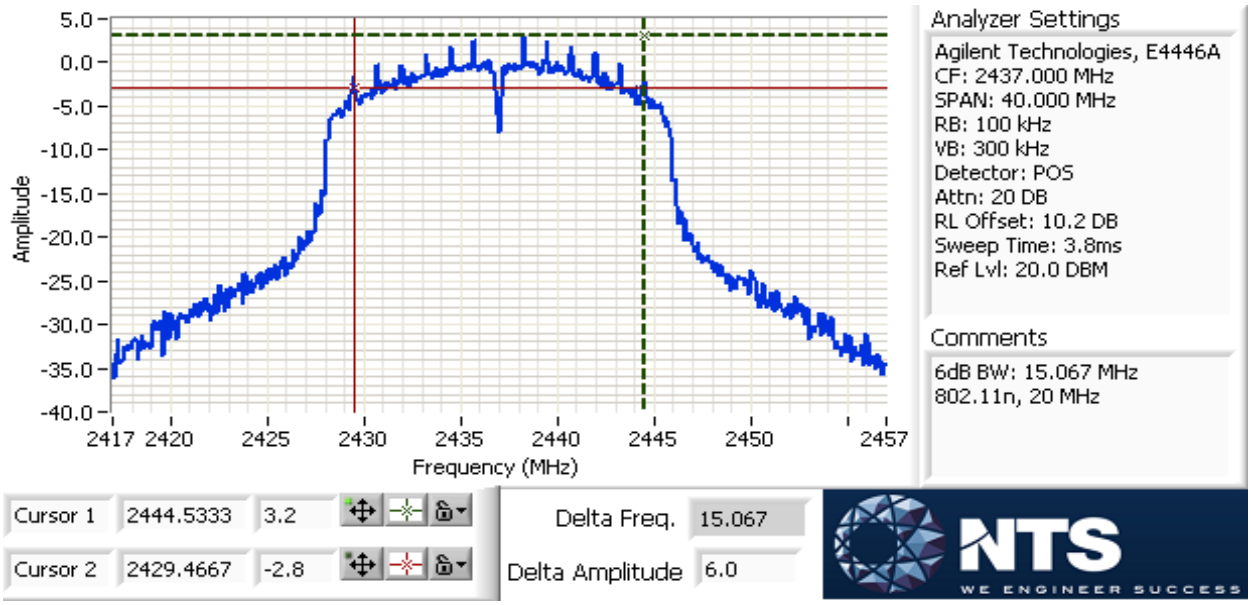


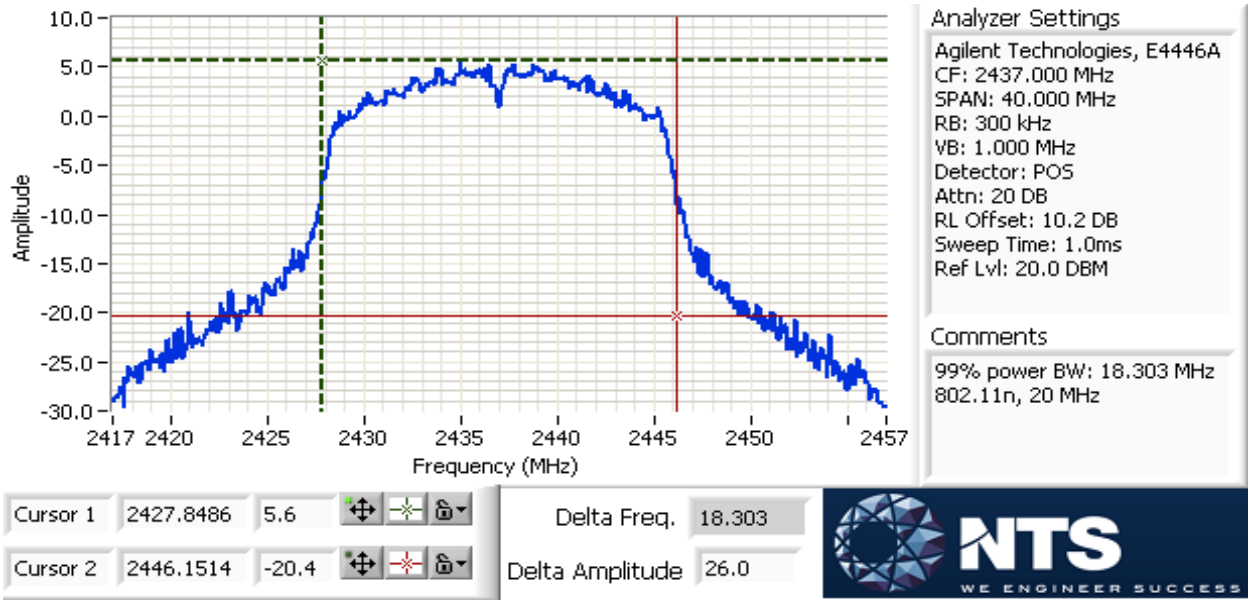
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Run #4a: Out of Band Spurious Emissions

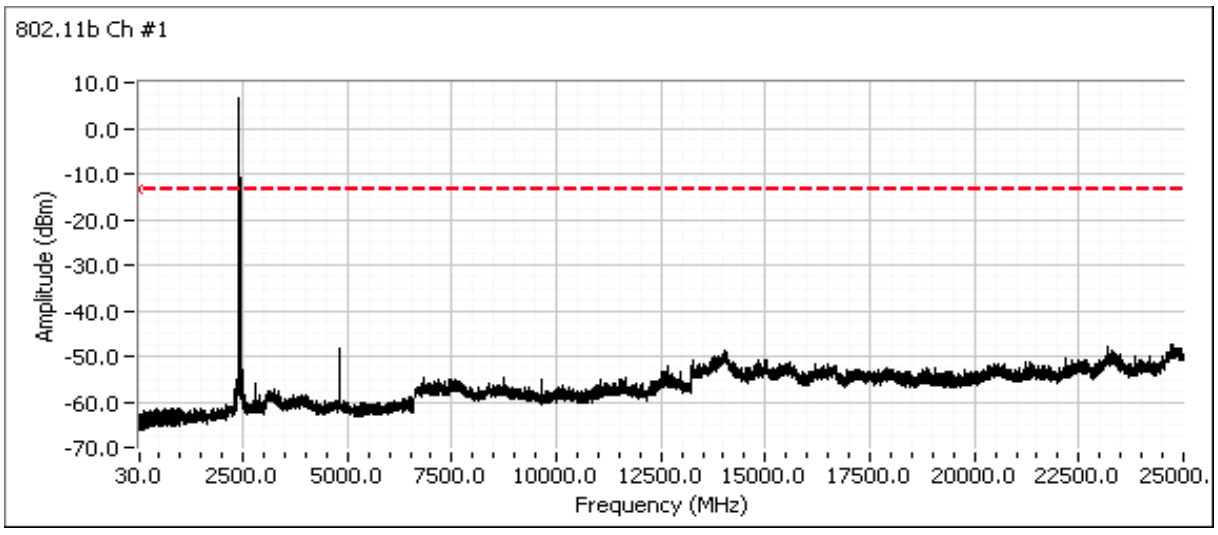
Date of Test: 5/12/2016
Test Engineer: Deniz Demirci
Test Location: FT Lab #4a

Config. Used: 1
Config Change: None
EUT Voltage: 14.4

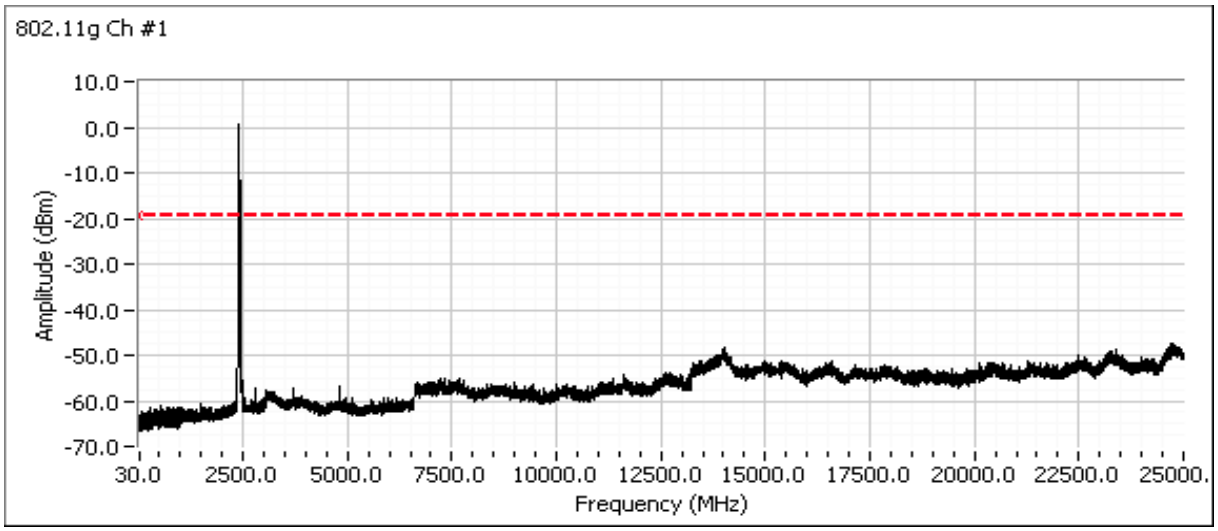
Frequency (MHz)	Power Setting	Mode	Limit	Result
2412	FCC	b/g/n	-20 dBc	Pass
2437	FCC	b/g/n	-20 dBc	Pass
2462	FCC	b/g/n	-20 dBc	Pass

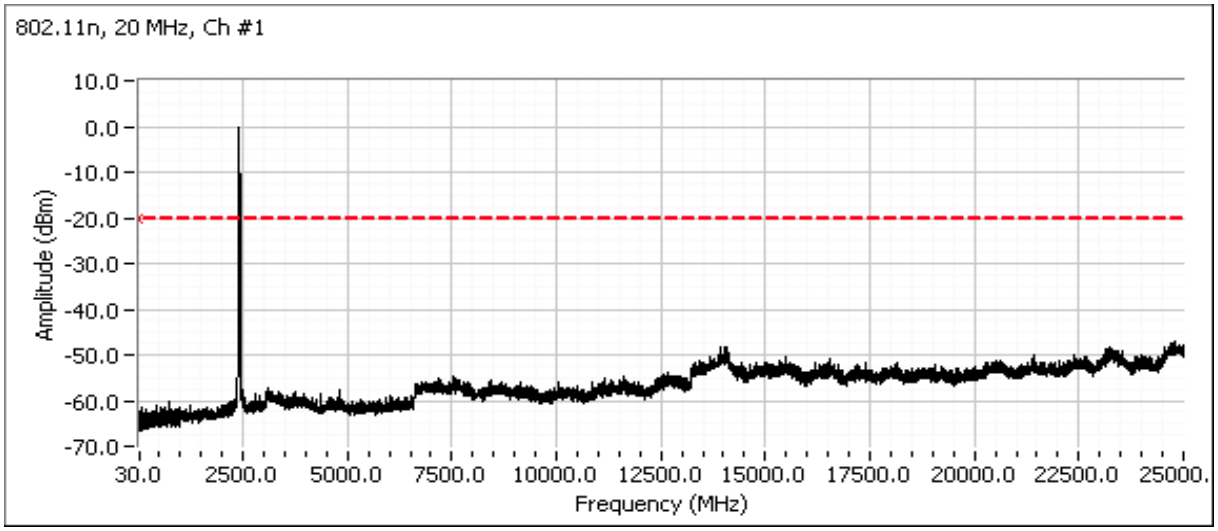
Note 1:	Tests performed per KDB 558074 v03r03 section 11.0. with RBW = 100 kHz, VBW = 3xRBW, peak detector.

Plots for low channel



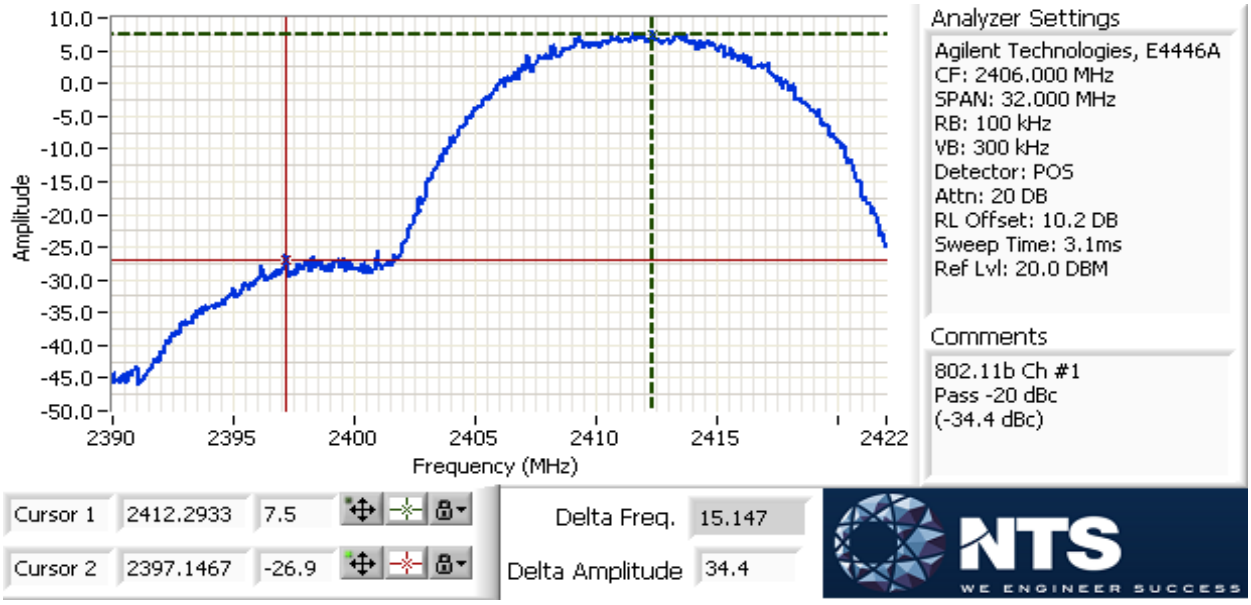
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

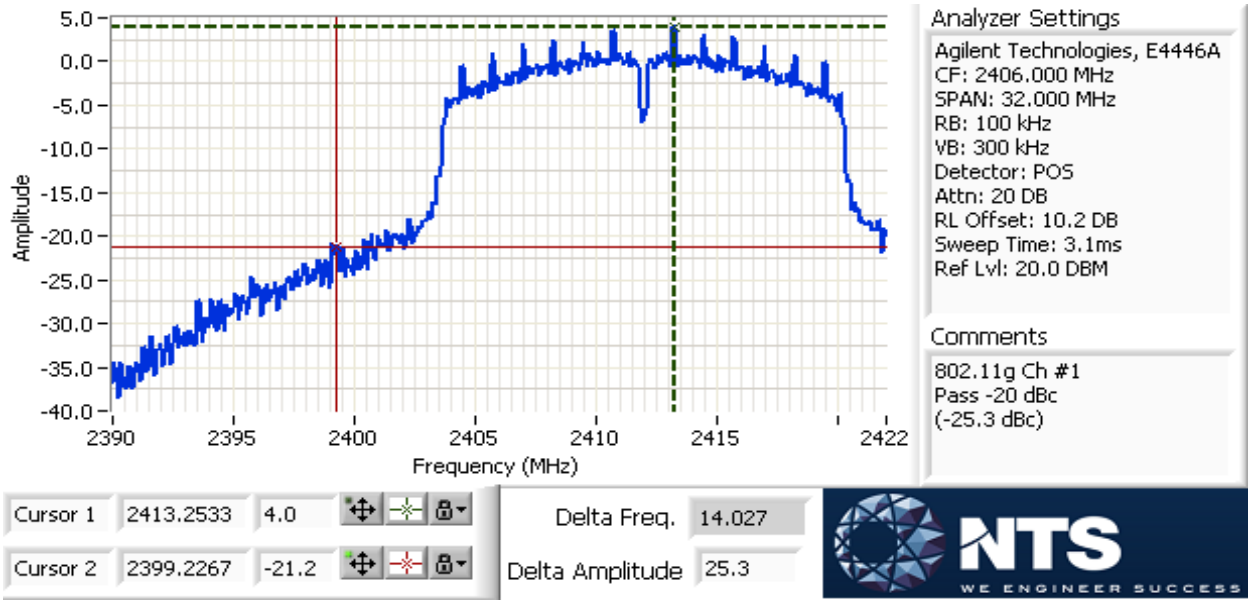




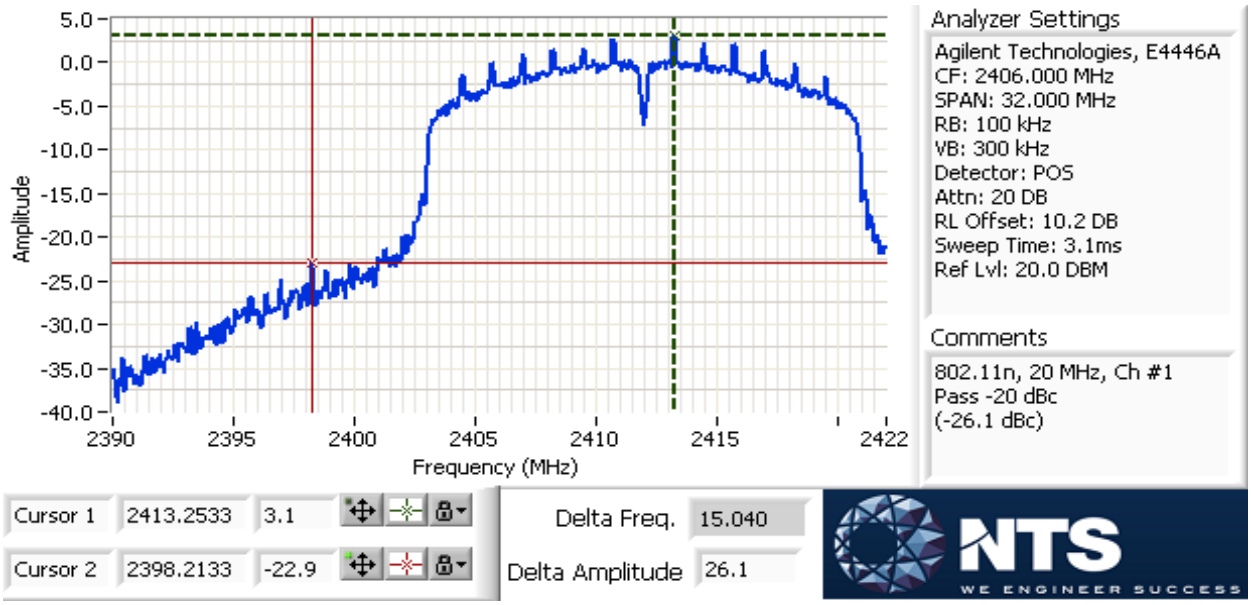
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Additional plot showing compliance with -20 dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.



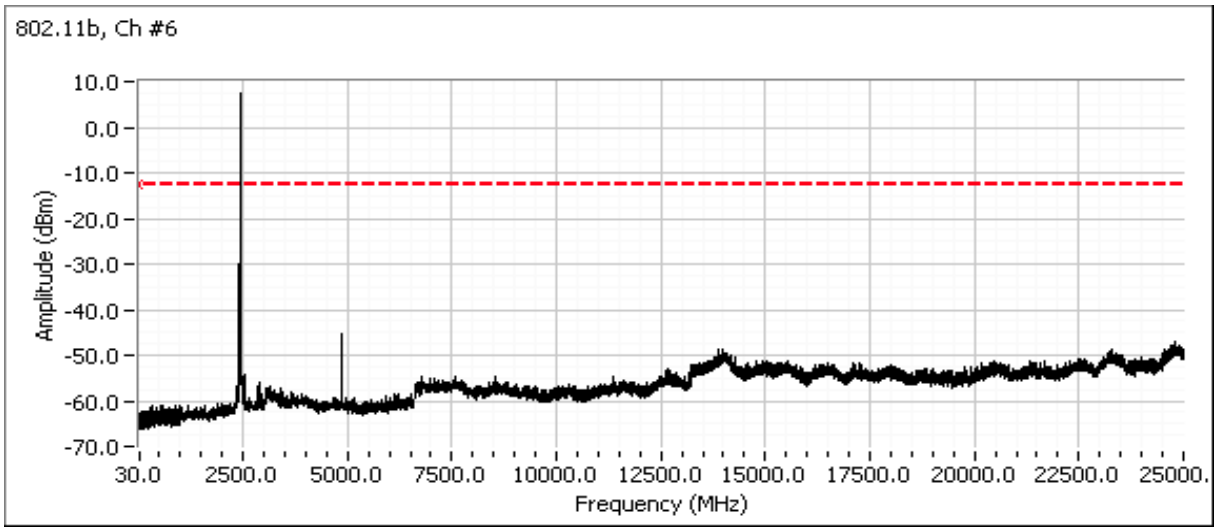


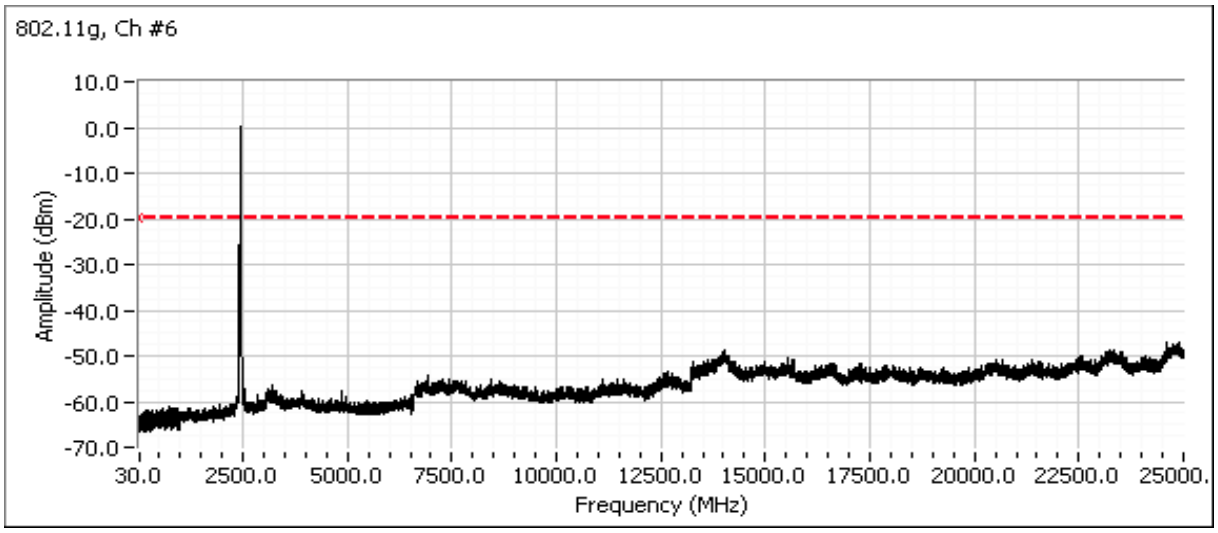
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A



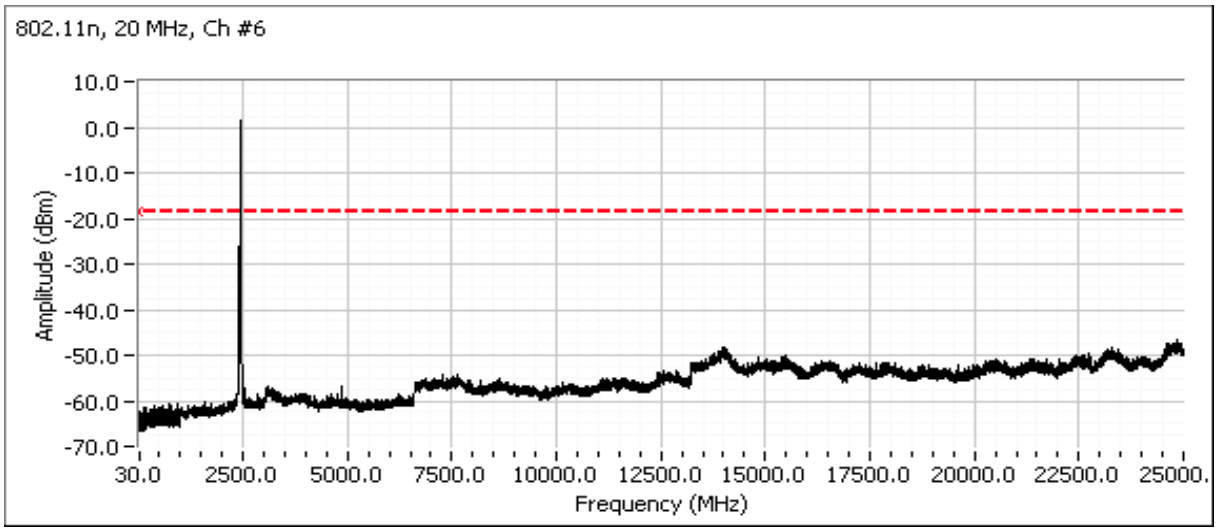
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Plots for center channel



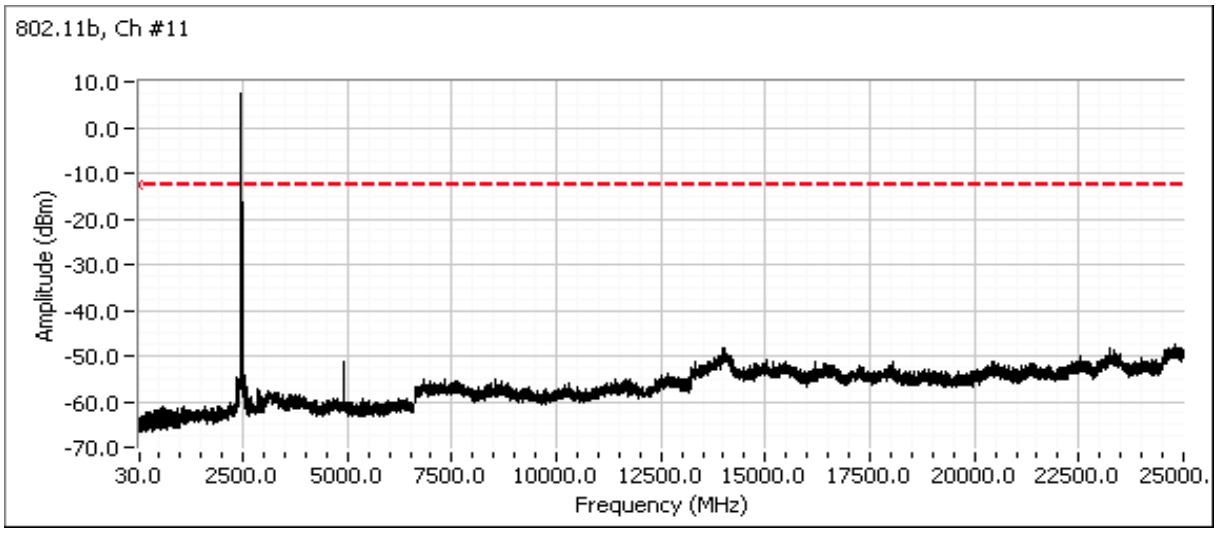


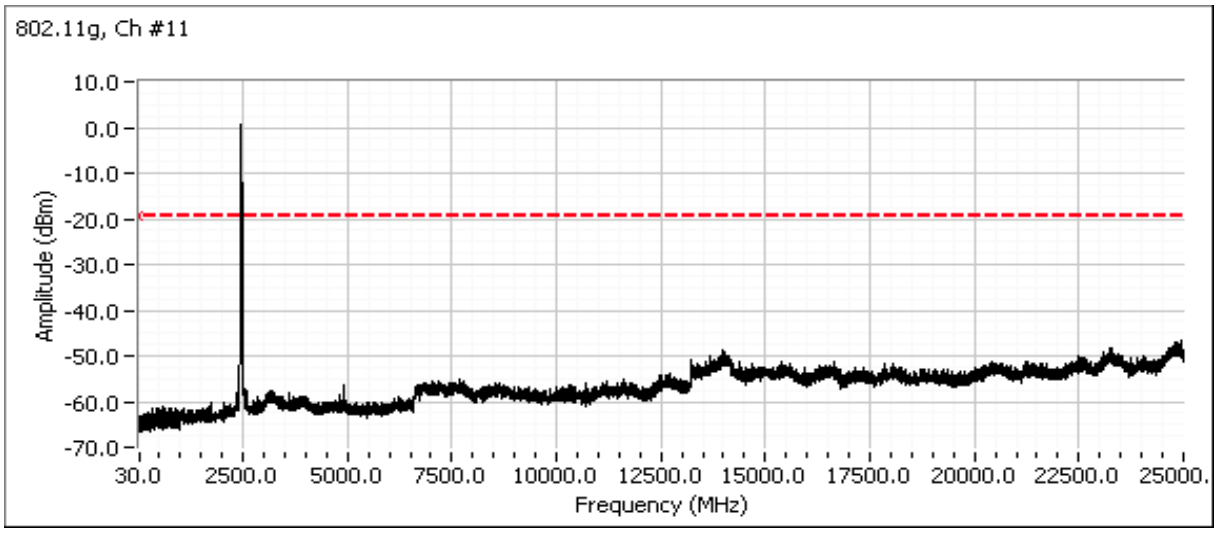
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A



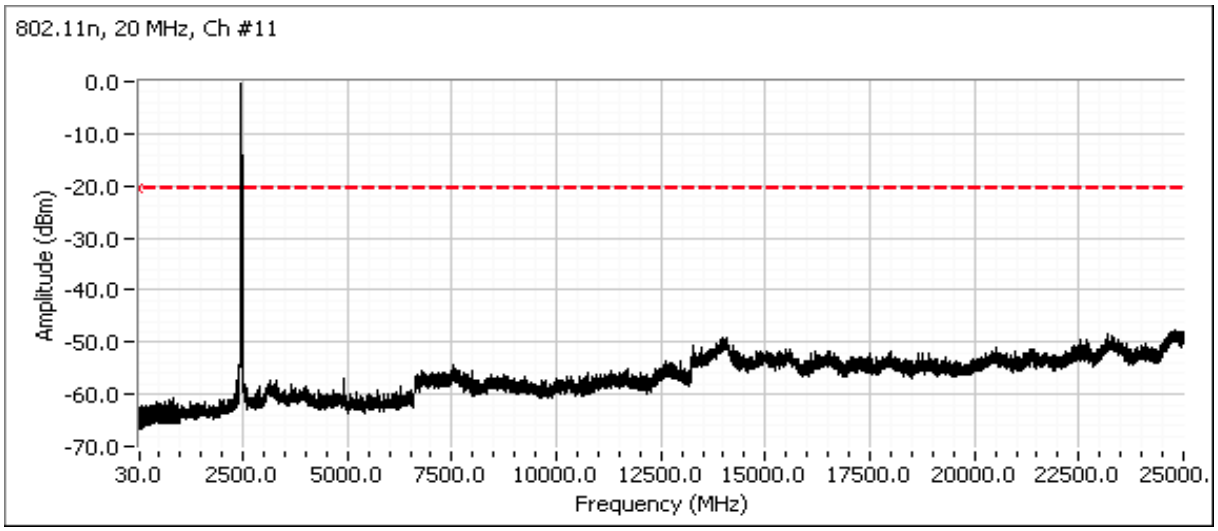
Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A

Plots for high channel





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	N/A



Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	B

Conducted Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 5/18/2016
Test Engineer: Deniz Demirci
Test Location: FT Ch #5

Config. Used: 1
Config Change: None
EUT Voltage: 120 V/60 Hz

General Test Configuration

The EUT was located on a table inside the semi-anechoic chamber, 40 cm from a vertical coupling plane and 80 cm from the LISN. No remote support equipment was used.

Ambient Conditions:

Temperature: 20-22 °C
Rel. Humidity: 30-35 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power, 120 V/60 Hz	Class B	Pass	52.5 dBµV @ 0.178 MHz (-12.1 dB)

Modifications Made During Testing

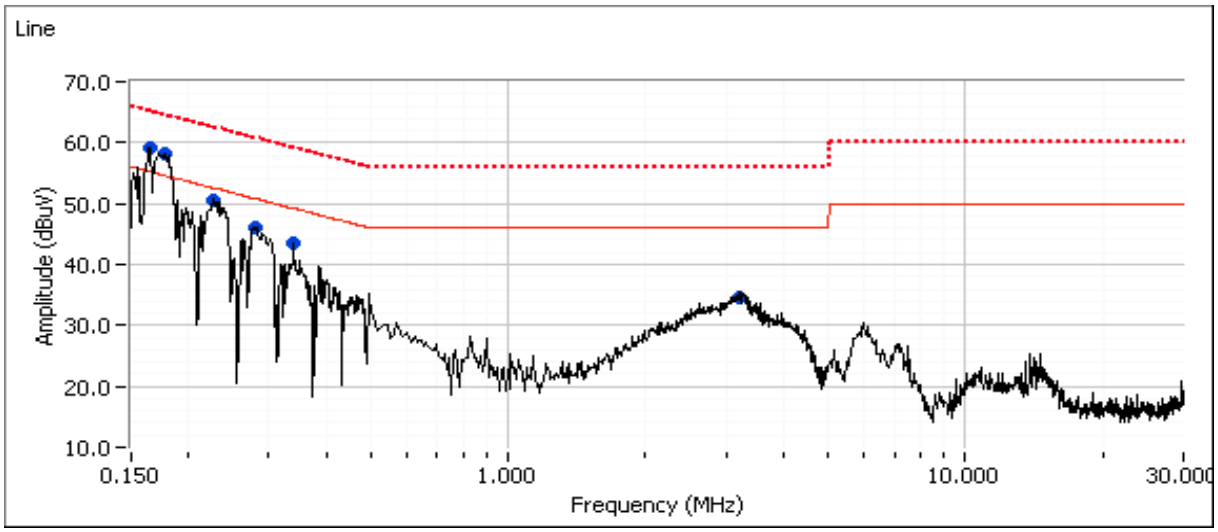
No modifications were made to the EUT during testing

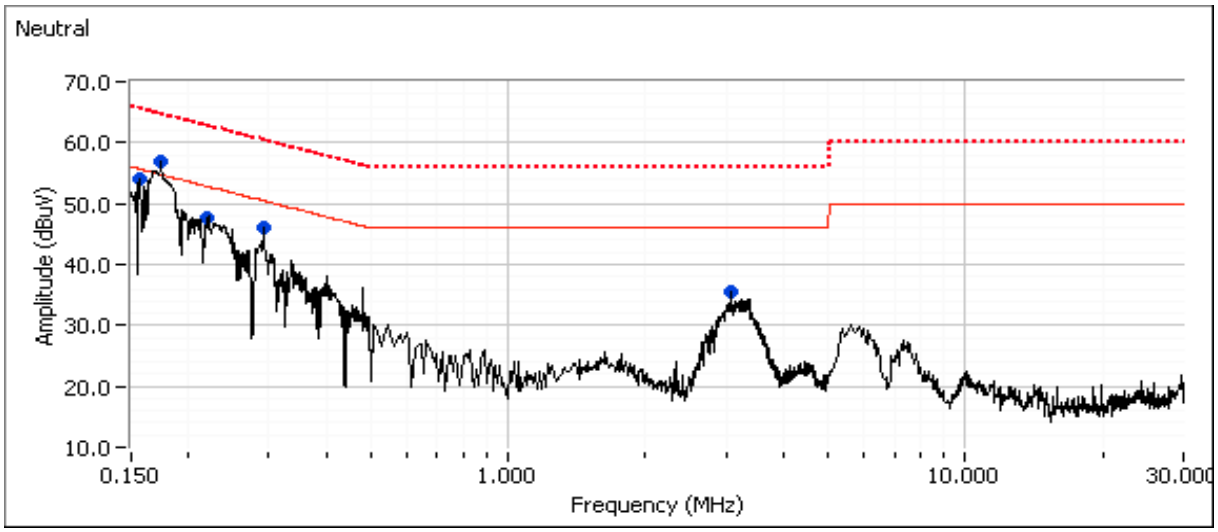
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30 MHz, 120 V/60 Hz
Battery Charging (Delta Power charger w 2 p plug), 802.11b continuously transmitting at Ch #6, at maximum rated power.





Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	B

Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.165	*59.2*	*Line 1*	*55.2*	*4.0*	*Peak*	
0.178	*58.1*	*Line 1*	*54.6*	*3.5*	*Peak*	
0.228	*50.4*	*Line 1*	*52.5*	*-2.1*	*Peak*	
0.279	*46.1*	*Line 1*	*50.8*	*-4.7*	*Peak*	
0.339	*43.5*	*Line 1*	*49.2*	*-5.7*	*Peak*	
3.223	*34.5*	*Line 1*	*46.0*	*-11.5*	*Peak*	
0.174	*56.8*	*Neutral*	*54.8*	*2.0*	*Peak*	
0.220	*47.7*	*Neutral*	*52.8*	*-5.1*	*Peak*	
0.292	*46.0*	*Neutral*	*50.5*	*-4.5*	*Peak*	
0.156	*53.9*	*Neutral*	*55.7*	*-1.8*	*Peak*	
3.070	*35.5*	*Neutral*	*46.0*	*-10.5*	*Peak*	

Client:	Neato Robotics	Job Number:	JD101609
Model:	Botvac D3/D5 Connected	T-Log Number:	T101649
		Project Manager:	Christine Krebill
Contact:	Matt Tenuta	Project Coordinator:	-
Standard:	FCC 15.247, RSS 247	Class:	B

Final quasi-peak and average readings

Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.178	52.5	Line 1	64.6	-12.1	QP	QP (1.00s)
0.165	52.5	Line 1	65.2	-12.7	QP	QP (1.00s)
0.173	51.5	Neutral	64.8	-13.3	QP	QP (1.00s)
0.228	45.4	Line 1	62.5	-17.1	QP	QP (1.00s)
0.178	36.1	Line 1	54.6	-18.5	AVG	AVG (0.10s)
0.157	45.9	Neutral	65.6	-19.7	QP	QP (1.00s)
0.280	40.3	Line 1	60.8	-20.5	QP	QP (1.00s)
0.173	33.9	Neutral	54.8	-20.9	AVG	AVG (0.10s)
0.292	39.0	Neutral	60.5	-21.5	QP	QP (1.00s)
0.220	40.6	Neutral	62.8	-22.2	QP	QP (1.00s)
0.165	30.8	Line 1	55.2	-24.4	AVG	AVG (0.10s)
0.339	34.7	Line 1	59.2	-24.5	QP	QP (1.00s)
3.214	31.1	Line 1	56.0	-24.9	QP	QP (1.00s)
0.228	26.9	Line 1	52.5	-25.6	AVG	AVG (0.10s)
3.214	20.1	Line 1	46.0	-25.9	AVG	AVG (0.10s)
0.292	23.8	Neutral	50.5	-26.7	AVG	AVG (0.10s)
3.073	27.7	Neutral	56.0	-28.3	QP	QP (1.00s)
3.073	16.1	Neutral	46.0	-29.9	AVG	AVG (0.10s)
0.280	19.7	Line 1	50.8	-31.1	AVG	AVG (0.10s)
0.339	16.2	Line 1	49.2	-33.0	AVG	AVG (0.10s)
0.220	19.4	Neutral	52.8	-33.4	AVG	AVG (0.10s)
0.157	19.6	Neutral	55.6	-36.0	AVG	AVG (0.10s)

End of Report

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