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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 2
FCC Part 15, Subpart E

Model: Botvac D7 Connected

IC CERTIFICATION #:	12757A-LVJPJ
FCC ID:	2ABSSLVJPJ
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-4
PROJECT NUMBER:	JD105849 / PR068739
REPORT DATE:	October 26, 2017
REISSUE DATE:	November 9, 2017
FINAL TEST DATES:	September 25, 26 and 27 and October 11, 2017
TOTAL NUMBER OF PAGES:	67

A2LA ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	October 26, 2017	First release	-
1	November 9, 2017	Added test site correlation statement.	Deniz Demirci

TABLE OF CONTENTS

SCOPE

An electromagnetic emissions test has been performed on the Neato Robotics model Botvac D7 Connected, pursuant to the following rules:

RSS-Gen Issue 4 " General Requirements for Compliance of Radio Apparatus"
RSS 247 Issue 2 "Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices"
FCC Part 15, Subpart E requirements for UNII Devices

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 General UNII Test Procedures KDB789033 D02 v01r04

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.

National Technical Systems - Silicon Valley is accredited by the A2LA, certificate number 0214.26, to perform the test(s) listed in this report, except where noted otherwise.

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. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification. Class II devices are required to meet the appropriate technical requirements but are exempt from certification requirements.

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 D7 Connected complied with the requirements of the following regulations:

RSS 247 Issue 2 "Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices"
FCC Part 15, Subpart E requirements for UNII Devices

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 D7 Connected and therefore apply only to the tested sample. The sample was selected and prepared by Pawel Orzechowski of Neato Robotics.

DEVIATIONS FROM THE STANDARDS

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

TEST RESULTS SUMMARY

UNII / LELAN DEVICES

OPERATION IN THE 5.15 – 5.25 GHZ BAND – MOBILE AND PORTABLE CLIENT DEVICE

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.407 (a) (1) (iv)	RSS-247 6.2.1.1	Output Power	n20: 9.1 mW (9.6 dBm) (Max eirp: 10.7 mW)	24 dBm (250 mW) e.i.r.p.(RSS):22.5 dBm (10 + 10*Log(B)	Complies
15.407 (a) (1) (iv)	RSS-247 6.2.1.1	Power Spectral Density	n20: -5.0 dBm/MHz	11 dBm/MHz (10 dBm/MHz for Canada))	Complies
15.407(b) (1) / 15.209	RSS-247 6.2.1.2	Spurious Emissions above 1 GHz	All emissions below the -27 dBm/MHz limit	Refer to the limits section (p20) for restricted bands, all others -27 dBm/MHz EIRP	Complies

REQUIREMENTS FOR ALL U-NII/LELAN BANDS

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.407	RSS-247 6.1	Modulation	Systems uses OFDM techniques	Digital modulation is required	Complies
15.407(b) (6) / 15.209	RSS-247 6.2.1 (2)	Spurious Emissions below 1 GHz	31.2 dBµV/m @ 222.08 MHz (-12.3 dB)	Refer to page 21	Complies
15.31 (m)	RSS-247 6.4 (1) RSS-Gen 6.8	Channel Selection	Emissions tested at outermost and middle channels in each band	Device was tested on the top, bottom and center channels in each band	N/A
15.407 (c)	RSS-247 6.4 (2)	Operation in the absence of information to transmit	Operation is discontinued in the absence of information	Device shall automatically discontinue operation in the absence of information to transmit	Complies
15.407 (g)		Frequency Stability	Frequency stability is better than 10 ppm.	Signal shall remain within the allocated band	Complies
15.407 (h1)	RSS-247 6.2.2 (1) 6.2.3 (1)	Transmit Power Control	TPC is not required as the device operates at 5150 – 5250 MHz only.	The U-NII device shall have the capability to operate with a mean EIRP value lower than 24 dBm (250 mW)	N/A
15.407 (h2)	RSS-247 6.3	Dynamic frequency Selection (device with radar detection)	Device does not operate in either 5470 – 5725 or 5250 – 5350 MHz bands.		N/A
	RSS-247 6.4 (5)	User manual information	Indoor use only. Refer to manual for details	Warning regarding Tilt angle for EIRP compliance, Indoor use for 5150-5250 MHz band and Radar are primary user of some bands	Complies

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Integral antenna	Unique or integral antenna required	Complies
15.407 (b) (6)	RSS-Gen Table 3	AC Conducted Emissions	43.4 dBµV @ 0.175 MHz (-21.3 dB)	Refer to page 19	Complies
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	User Manual	Integral antenna	Statement for products with detachable antenna	Complies
-	RSS-Gen 8.4	User Manual	Refer to user manual	Statement for all products	Complies
-	RSP-100 RSS-Gen 6.6	Occupied Bandwidth	17.8 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
Conducted emission of receiver	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 D7 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 September 25, 2017 and tested on September 25, 26 and 27 and October 11, 2017. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Neato Robotics	Botvac D7 Connected	Robotic Vacuum cleaner	WTD14514-C4EDBA8605A9	FCC ID: 2ABSSLVJPJ IC: 12757A-LVJPJ
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 (chip) with maximum 0.7 dBi gain at 5 GHz operating range.

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
DELL	Latitude	Laptop	-	-

Note: The computer was used to configure the EUT for radio testing. It was not connected to the EUT during the radiated emission 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 4	US0027	2845B-4	41039 Boyce Road Fremont, CA 94538-2435

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. The results from testing performed in this chamber have been correlated with results from an open area test site. 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 C63.10-2013. 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

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4-2014 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4-2014.

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

A loop antenna is used below 30 MHz. 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. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.10-2013 specifies that the test height above ground for table mounted devices shall be 80 centimeters for testing below 1 GHz and 1.5 m for testing above 1 GHz. 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 C63.10-2013, 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 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.

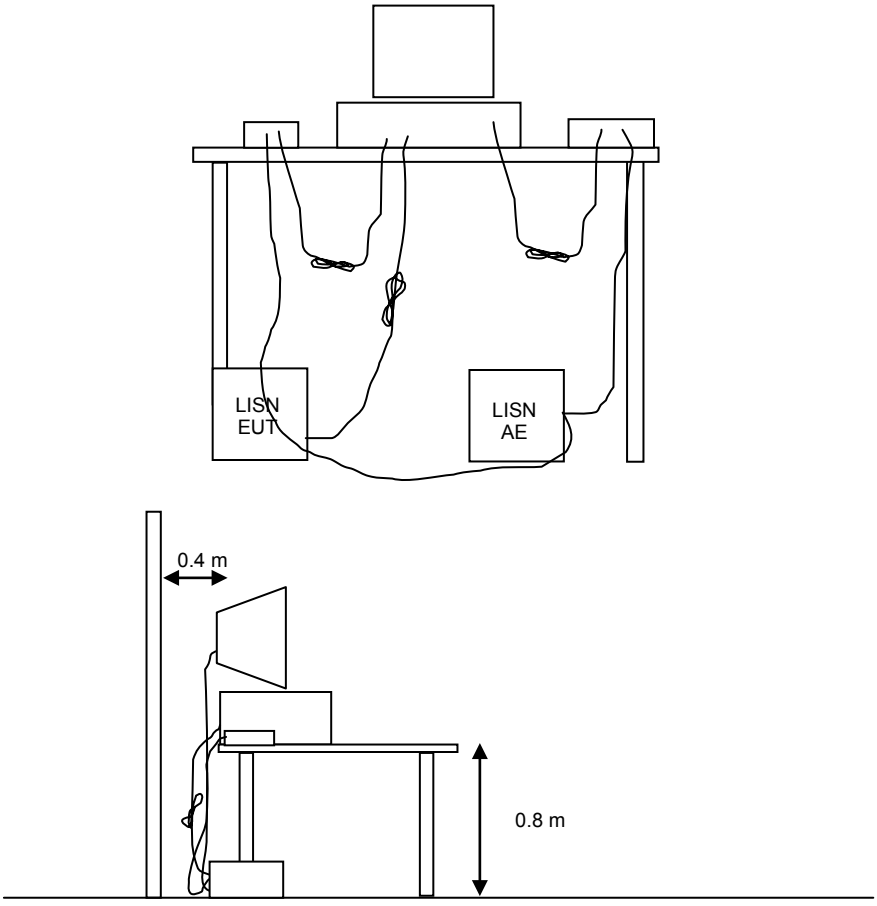


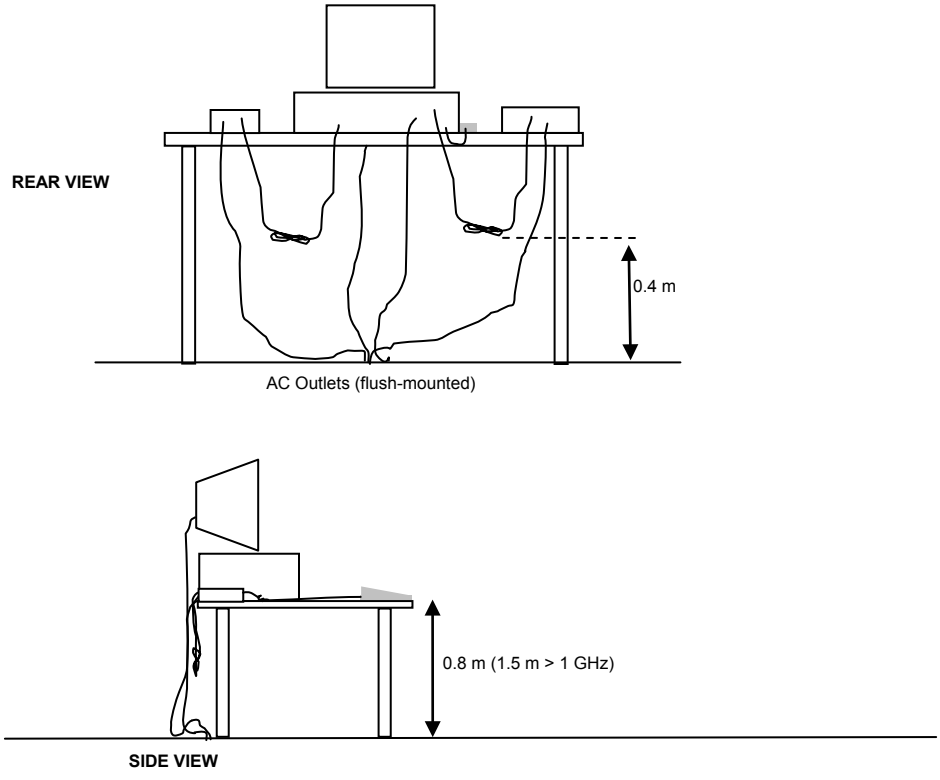
Figure 1 Typical Conducted Emissions Test Configuration

RADIATED EMISSIONS

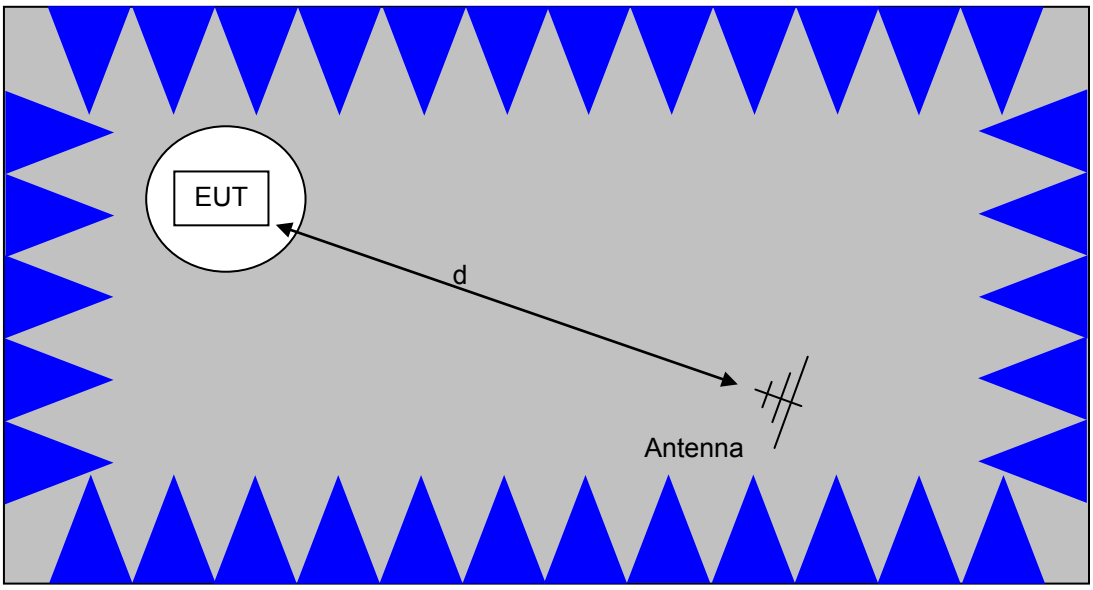
A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied (for measurements above 30 MHz) 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 (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). 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.

When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.

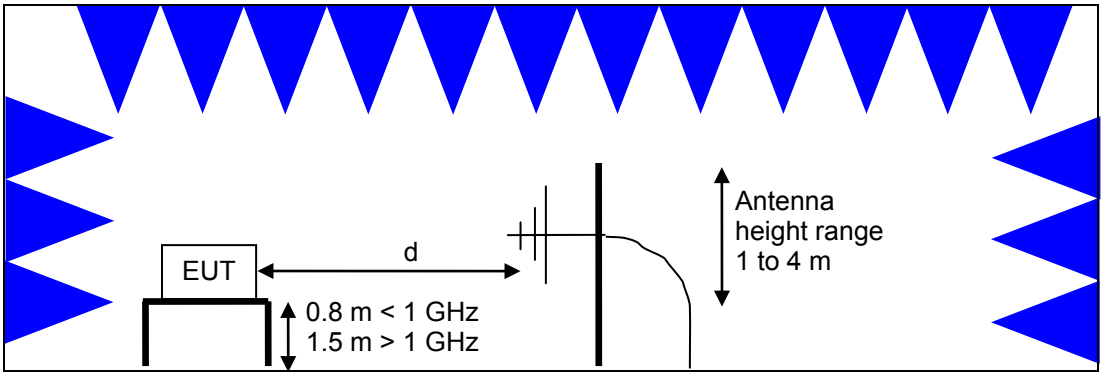


Typical Test Configuration for Radiated Field Strength Measurements



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.

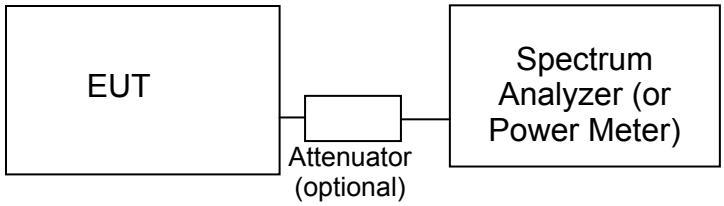
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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 C63.10-2014 and RSS-Gen Issue 4.

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	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

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

FCC 15.407 (a) OUTPUT POWER LIMITS

The table below shows the limits for output power and output power density. For the 5250-5350 and 5470-5725 MHz bands, 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
5150 – 5250	1 Watt (30 dBm)	17 dBm/MHz
5250 – 5350 and 5470-5725	250 mW (24 dBm)	11 dBm/MHz
5725 – 5825	1 Watt (30 dBm)	30 dBm/500 kHz

For system using antennas with gains exceeding 6dBi, the output power and power spectral density limits are reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5825 MHz band may use antennas with gains of up to 23dBi without this limitation. If the gain exceeds 23dBi then the output power limit of 1 Watt is reduced by 1dB for every dB the gain exceeds 23dBi.

OUTPUT POWER LIMITS –LELAN DEVICES

The table below shows the limits for output power and output power density defined by RSS 247. 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
5150 – 5250	200 mW (23 dBm) or 10 + 10Log(B) eirp	10 dBm/MHz eirp
5250 – 5350 and 5470 - 5725	250 mW (24 dBm)[2] 1W (30 dBm) eirp	11 dBm/MHz
5725 – 5825	1 Watt (30 dBm) 4W eirp	30 dBm/500 kHz

Fixed point-to-point applications using the 5725 – 5825 MHz band may use antennas with gains of up to 23dBi without this limitation. If the gain exceeds 23dBi then the output power limit of 1 Watt is reduced by 1dB for every dB the gain exceeds 23dBi.

SPURIOUS EMISSIONS LIMITS –UNII and LELAN DEVICES

The spurious emissions limits for signals below 1 GHz are the FCC/RSS-Gen general limits. For emissions above 1 GHz, signals in restricted bands are subject to the FCC/RSS-Gen general limits. All other signals have a limit of –27 dBm/MHz, which is field strength of 68.3 dBuV/m/MHz at a distance of 3 m. For devices operating in the 5725-5850 MHz bands under the LELAN/UNII rules, the limit within 10 MHz of the allocated band is increased to –17dBm/MHz.

[2] If EIRP exceeds 500mW the device must employ TPC

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
Radiated Band edge Measurement, 25-Sep-17					
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	1756	7/8/2017	7/8/2018
Radiated Emissions, 1,000 - 25,000 MHz, 25-Sep-17					
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Hewlett Packard	Spectrum Analyzer (SA40) Blue 9 kHz - 40 GHz	8564E (84125C)	1393	4/10/2017	4/10/2018
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1683	5/17/2017	5/17/2018
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	8/31/2017	8/31/2018
A. H. Systems	Purple System Horn, 18-40GHz	SAS-574, p/n: 2581	2160	8/18/2017	8/18/2018
Radiated Emissions, 1,000 - 25,000 MHz, 26-Sep-17					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Hewlett Packard	Spectrum Analyzer (SA40) Blue 9 kHz - 40 GHz	8564E (84125C)	1393	4/10/2017	4/10/2018
HP / Miteq	SA40 B Head HF preAmplifier, 18-40 GHz (w/1393)	TTA1840-45-5P-HG-S	1620	2/13/2017	2/13/2018
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1683	5/17/2017	5/17/2018
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	8/31/2017	8/31/2018
A. H. Systems	Purple System Horn, 18-40GHz	SAS-574, p/n: 2581	2160	8/18/2017	8/18/2018
Radiated Emissions, 1,000 - 40,000 MHz, 26-Sep-17					
Hewlett Packard	High Pass filter, 8.2 GHz (Blu System)	P/N 84300-80039 (84125C)	1392	5/10/2017	5/10/2018
Micro-Tronics	Band Reject Filter, 5150-5350 MHz	BRC50703-02	2239	8/23/2017	8/23/2018
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Hewlett Packard	Spectrum Analyzer (SA40) Blue 9 kHz - 40 GHz	8564E (84125C)	1393	4/10/2017	4/10/2018
HP / Miteq	SA40 B Head HF preAmplifier, 18-40 GHz (w/1393)	TTA1840-45-5P-HG-S	1620	2/13/2017	2/13/2018
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1683	5/17/2017	5/17/2018
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	8/31/2017	8/31/2018
A. H. Systems	Purple System Horn, 18-40GHz	SAS-574, p/n: 2581	2160	8/18/2017	8/18/2018

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Radiated Emissions, 30 - 1,000 MHz, 26-Sep-17					
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1548	10/12/2016	10/12/2018
Com-Power	Preamplifier, 30-1000 MHz	PA-103	1632	3/8/2017	3/8/2018
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	1756	7/8/2017	7/8/2018
Radiated Emissions, 9kHz - 30 MHz, 26-Sep-17					
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	1756	7/8/2017	7/8/2018
EMCO	Magnetic Loop Antenna, 9 kHz-30 MHz	AL-130	3003	8/9/2016	8/9/2018
Conducted Emissions - AC Power Ports, 26-Sep-17					
EMCO	LISN, 10 kHz-100 MHz	3825/2	1293	6/20/2017	6/20/2018
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1594	8/18/2017	8/18/2018
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	1756	7/8/2017	7/8/2018
RF Power measurements, 27-Sep-17					
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	3/10/2017	3/10/2018
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts (w/ 20 dB pad, SN BJ5155)	NRV-Z32	1536	4/19/2017	4/18/2018
Agilent Technologies	USB Average Power Sensor	U2001A	2442	1/5/2017	1/5/2018
Antenna Port measurements, 27-Sep-17					
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/22/2017	5/22/2018
Agilent Technologies	USB Average Power Sensor	U2001A	2442	1/5/2017	1/5/2018
Radio Antenna Port (Power and Spurious Emissions), 09-Oct-17					
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	3/10/2017	3/10/2018
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts (w/ 20 dB pad, SN BJ5155)	NRV-Z32	1536	4/19/2017	4/18/2018
Agilent Technologies	USB Average Power Sensor	U2001A	2442	1/5/2017	1/5/2018
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/22/2017	5/22/2018
Radiated Emissions, 1000 - 25,000 MHz, 09-Oct-17					
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	1/17/2017	1/17/2018
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	9/29/2016	9/29/2018
HP / Miteq	SA40 R Head HF preAmplifier, 18-40 GHz (w/1148)	TTA1840-45-5P-HG-S	1145	9/8/2017	9/8/2018
Hewlett Packard	Spectrum Analyzer (SA40) Red 30 Hz -40 GHz	8564E (84125C)	1148	10/31/2016	11/1/2017
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	8/4/2017	8/4/2019
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2249	5/17/2017	5/17/2018

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Frequency Stability, 11-Oct-17					
Watlow	Temp Chamber (w/ F4 Watlow Controller)	F4	2170	7/7/2017	7/7/2018
Rohde & Schwarz	Signal Analyzer 20 Hz - 26.5 GHz	FSQ26	2327	6/24/2017	6/24/2018

Appendix B Test Data

T105971 Pages 27 – 66

Client:	Neato Robotics	Job Number:	JD105849
Product	Botvac D7 Connected	T-Log Number:	T105971
System Configuration:		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	
Emissions Standard(s):	RSS-247, FCC 15.247, FCC 15E	Class:	B
Immunity Standard(s):		Environment:	

EMC Test Data

For The

Neato Robotics

Product

Botvac D7 Connected

Date of Last Test: 10/26/2017

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	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 a GATED average 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: 2017-1613
Driver: 4.0.0.1389.0

Date of Test: 9/25/2017
Test Engineer: Deniz Demirci
Test Location: FT Ch#4
Config. Used: 1
Config Change: None
EUT Voltage: Battery operated

Mode	Data Rate	Power (dBm)	Power setting
802.11n 20 MHz	6.5	**9.6**	
	13	9.4	
	19.5	9.2	
	26	9.3	
	39	9.2	
	52	9.3	
	58.5	9.2	
	65	9.3	
	78	9.2	

Note : Power setting - the software power setting used during testing, included for reference only.

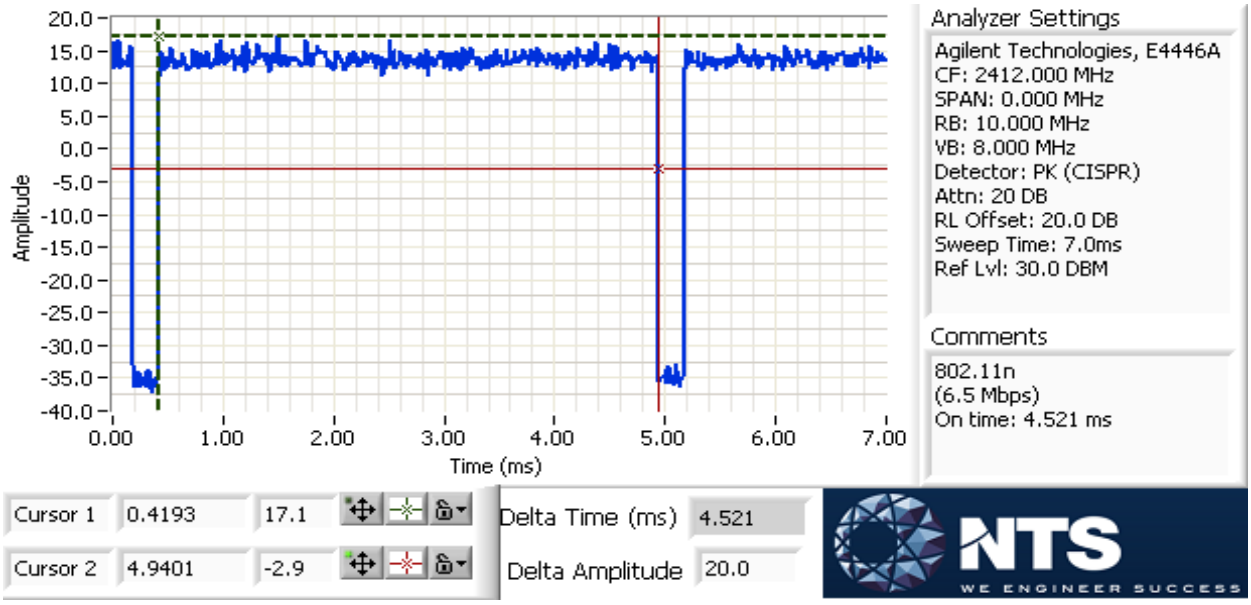
Duty Cycle

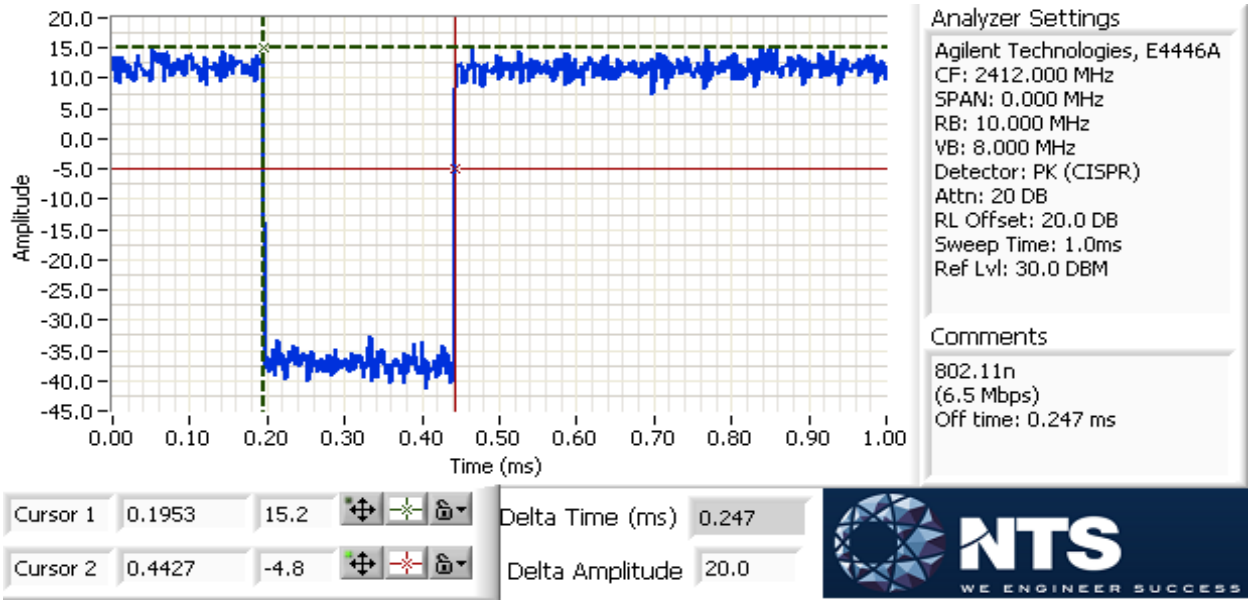
Duty cycle measurements performed on the worse case data rate for power.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
n20	6.5 Mbps	94.8%	Yes	4.521	0.2	0.5	221

* 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:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A





Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

RSS-247 (LELAN) and FCC 15.407(UNII)
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.

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	Power, 5150 - 5250MHz	15.407(a) (1), (2), (3) RSS-247 6.2	Pass	n20: 9.1 mW (9.6 dBm)
1	PSD, 5150 - 5250MHz	15.407(a) (1), (2), (3) RSS-247 6.2	Pass	n20: -5.0 dBm/MHz
1	26 dB Bandwidth	15.407 (Information only)	-	> 20 MHz for all modes
1	99% Bandwidth	RSS 210 (Information only)	N/A	n20: 17.8 MHz
2	Antenna Conducted - Out of Band Spurious	15.407(b) -27 dBm/MHz	Pass	All emissions below the -27 dBm/MHz limit

General Test Configuration

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators and cables used.

Ambient Conditions:

Temperature: 24.3 °C
Rel. Humidity: 41 %

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	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.

Procedure Comments:

Measurements performed in accordance with FCC KDB 789033

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11n20	MCS0	0.95	Yes	4.521	0.2	0.5	221

Sample Notes

Sample S/N: 2017-1613
Driver: 4.0.0.1389.0

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Run #1: Bandwidth, Output Power and Power Spectral Density - MIMO Systems

Date of Test: 9/27/2017 Config. Used: 1

Test Engineer: Rafael Varelas Config Change: None

Test Location: Fremont EMC Lab #4A EUT Voltage: Battery operated

Note 1:	Output power measured using gated average power meter. (method PM-G in ANSI C63.10).
Note 1:	Constant Duty Cycle < 98%. Output power measured using a spectrum analyzer (see plots below). RBW=1MHz, VB=3 MHz, Span > OBW, # of points in sweep ≥ 2*span/RBW, RMS detector, trace average 100 traces (at least 100 traces, increase the number to get true average), power averaging on and power integration over the OBW. Tthe measurements were adjusted by adding 0.2 dB. This is based on 10log(1/x), where x is the duty cycle. (method SA-2 of ANSI C63.10)
Note 2:	Measured using the same analyzer settings used for output power.
Note 3:	For RSS-247 the limit for the 5150 - 5250 MHz band accounts for the antenna gain as the maximum eirp allowed is 10dBm/MHz. The limits are also corrected for instances where the highest measured value of the PSD exceeds the average PSD (calculated from the measured power divided by the measured 99% bandwidth) by more than 3dB by the amount that the measured value exceeds the average by more than 3dB.
Note 4:	99% Bandwidth measured in accordance with C63.10 - RB between 1-5 % of OBW and VB ≥ 3*RB, Span between 1.5 and 5 times OBW.
Note 5:	For MIMO systems the total output power and total PSD are calculated from the sum of the powers of the individual chains (in linear terms). The antenna gain used to determine the EIRP and limits for PSD/Output power depends on the operating mode of the MIMO device. If the signals on the non-coherent between the transmit chains then the gain used to determine the limits is the highest gain of the individual chains and the EIRP is the sum of the products of gain and power on each chain. If the signals are coherent then the effective antenna gain is the sum (in linear terms) of the gains for each chain and the EIRP is the product of the effective gain and total power.

FCC UNII-1 Limits		Pwr	PSD	
	Outdoor AP	30	17	FCC only
	Indoor AP	30	17	
X	Station (e.g. Client)	24	11	
	Outdoor AP (>30° Elv.)	21	-	EIRP

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

SISO Device - 5150-5250 MHz Band - FCC

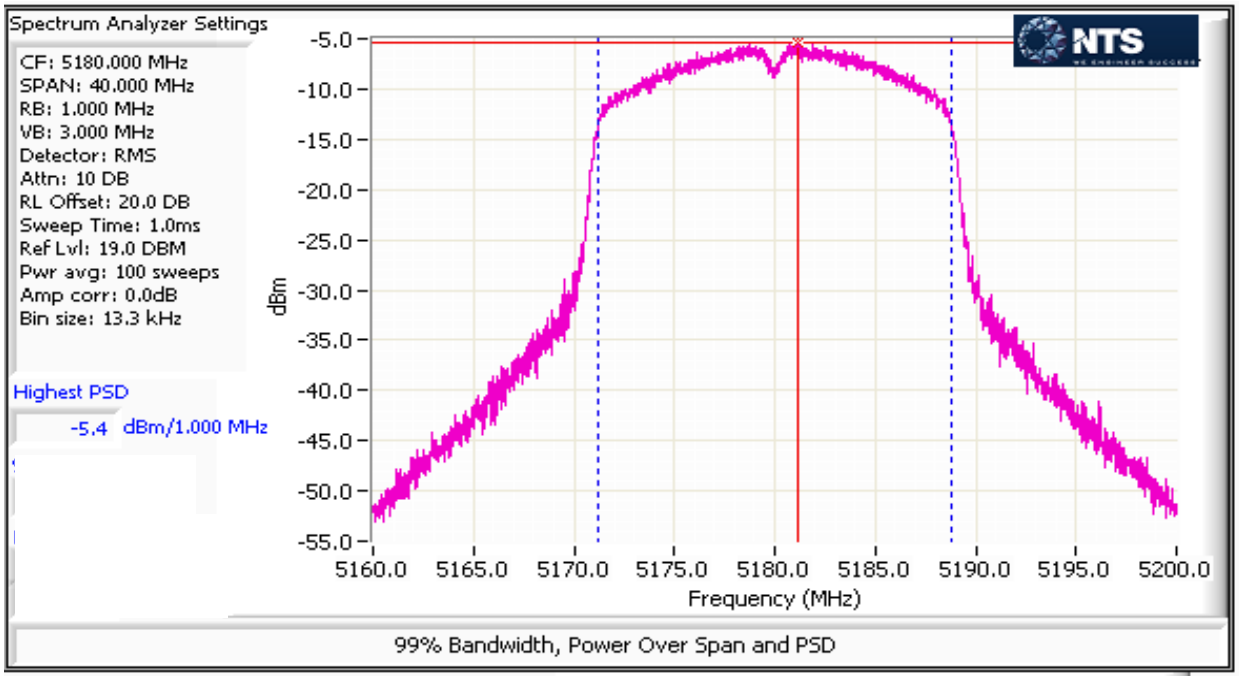
Antenna Gain (dBi): 0.7 Max EIRP: 10.7 mW 10.3 dBm

Frequency (MHz)	Software Setting	26 dB BW (MHz)	Duty Cycle %	Output Power[1] dBm			PSD[2] dBm/MHz			Result
				Measured	Calculated	Limit	Measured	Calculated	Limit	
802.11n 20 MHz										
5180		24.8	95.0	9.2	9.2	24.0	-5.4	-5.2	11.0	Pass
5200		24.7	95.0	9.5	9.5	24.0	-5.2	-5.0	11.0	Pass
5240		23.7	95.0	9.6	9.6	24.0	-5.3	-5.1	11.0	Pass

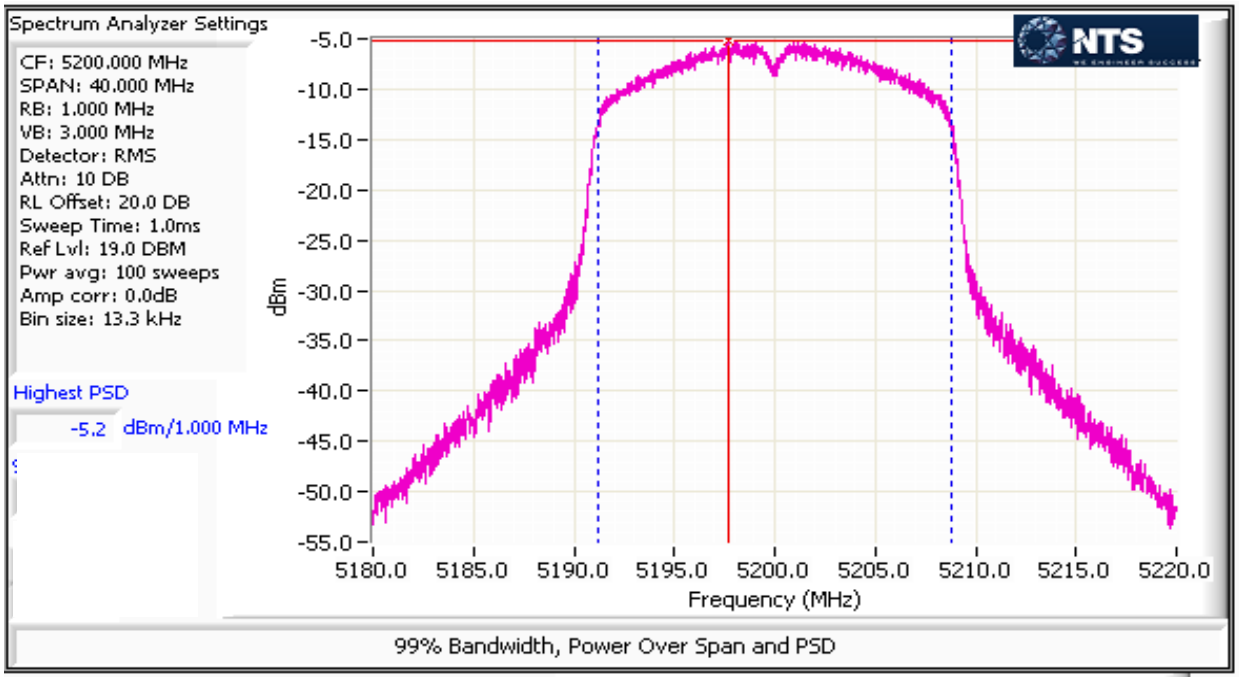
SISO Device - 5150-5250 MHz Band - ISED Canada

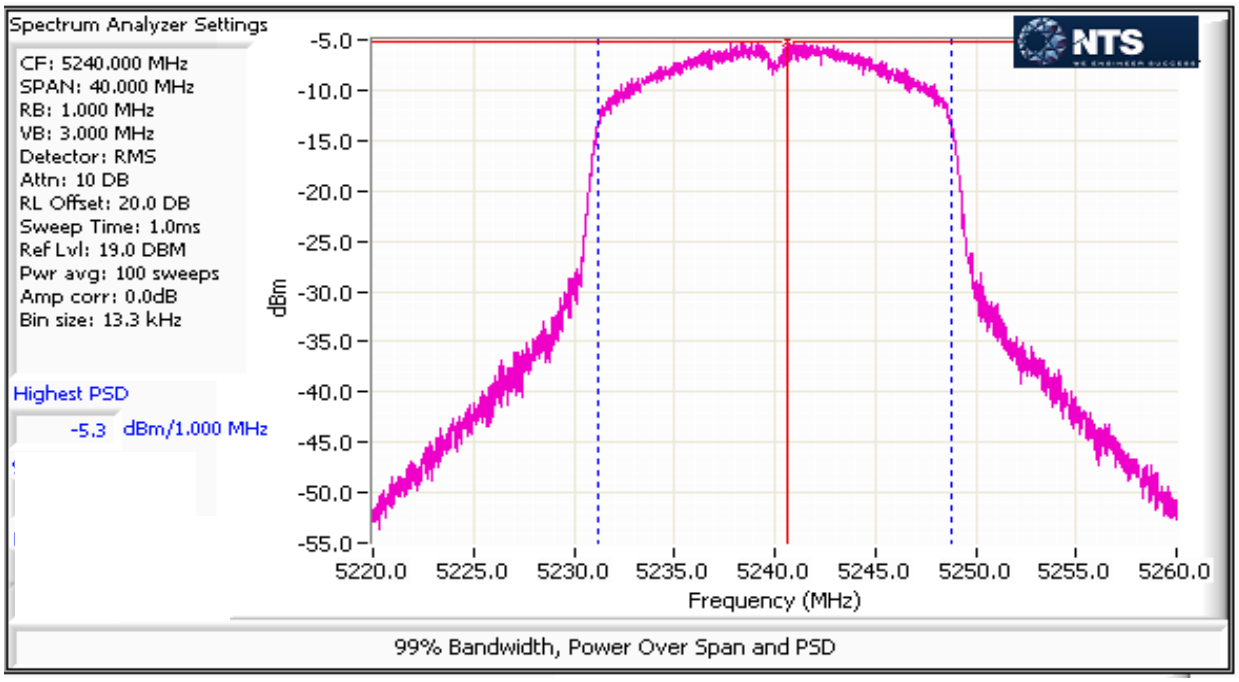
Antenna Gain (dBi): 0.7 Max EIRP: 10.7 mW 10.3 dBm

Frequency (MHz)	Software Setting	99% BW (MHz)	Duty Cycle %	Output Power[1] dBm (EIRP)			PSD[2] dBm/MHz (EIRP)			Result
				Measured	Calculated	Limit	Measured	Calculated	Limit[3]	
802.11n 20 MHz										
5180		17.8	95.0	9.9	9.9	22.5	-5.4	-5.2	9.3	Pass
5200		17.8	95.0	10.2	10.2	22.5	-5.2	-5.0	9.3	Pass
5240		17.8	95.0	10.3	10.3	22.5	-5.3	-5.1	9.3	Pass

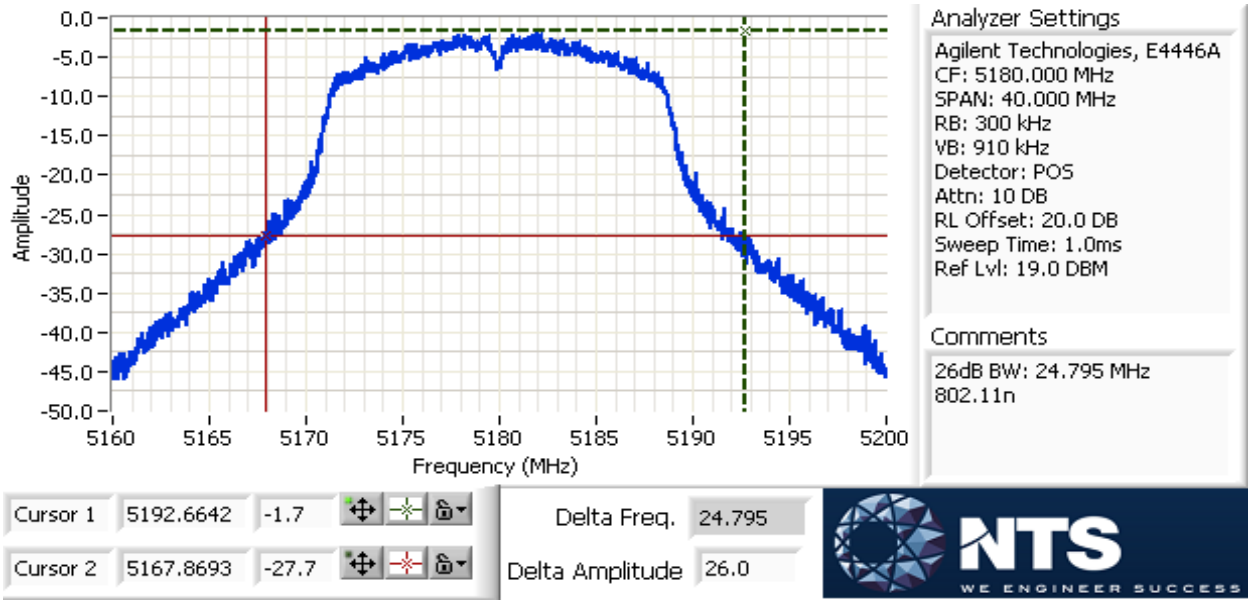


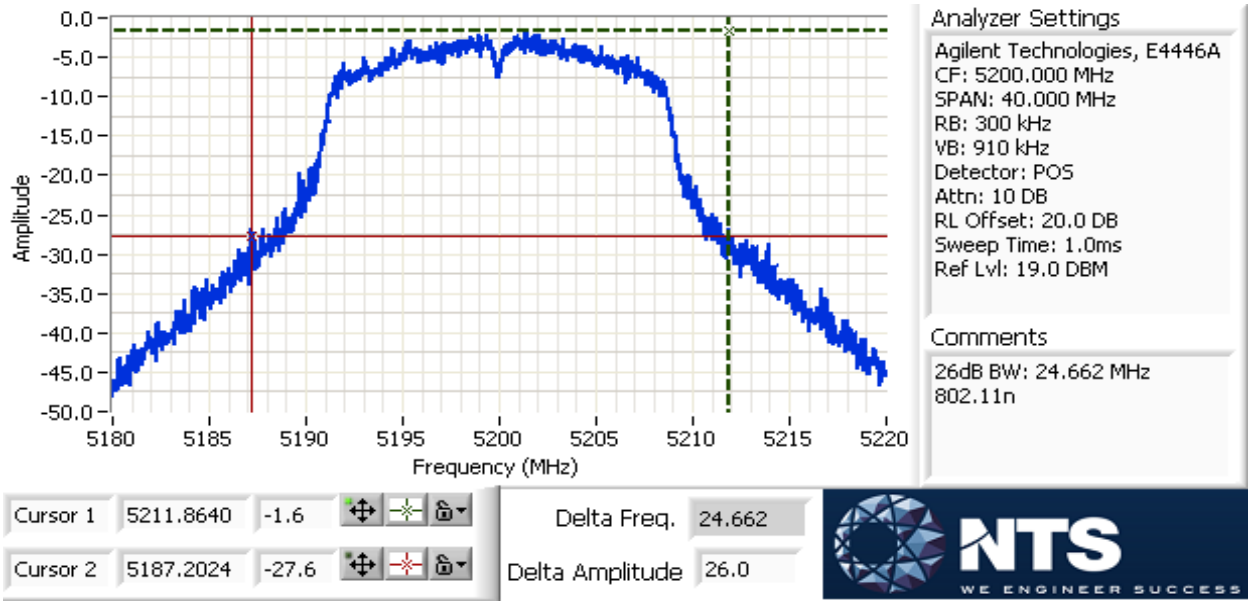
Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A



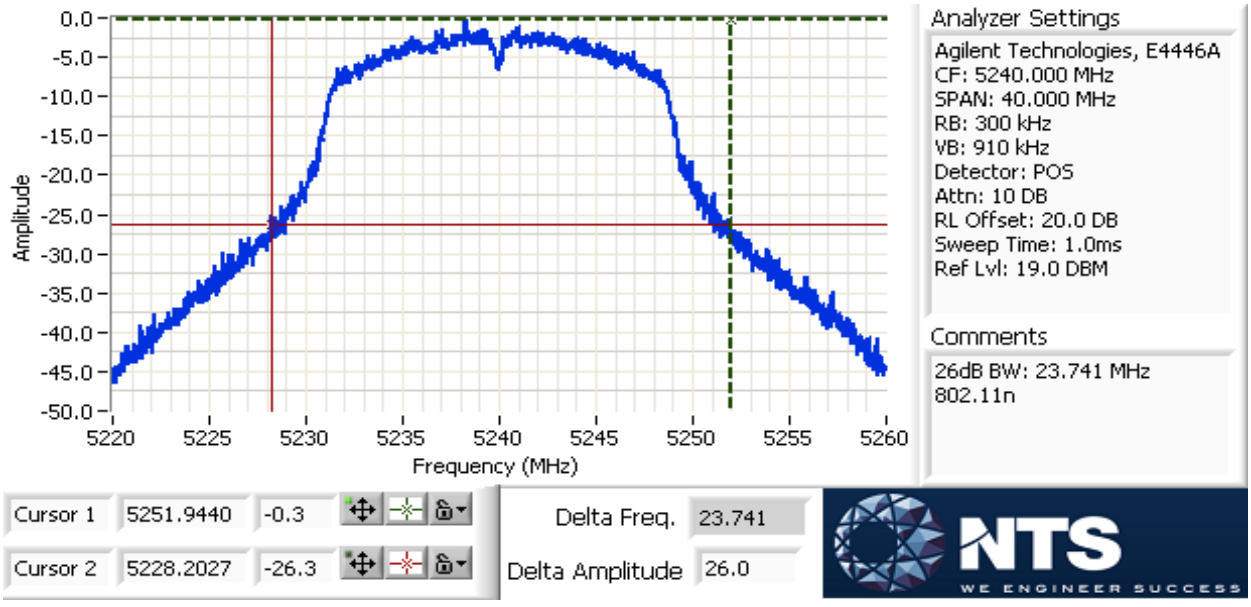


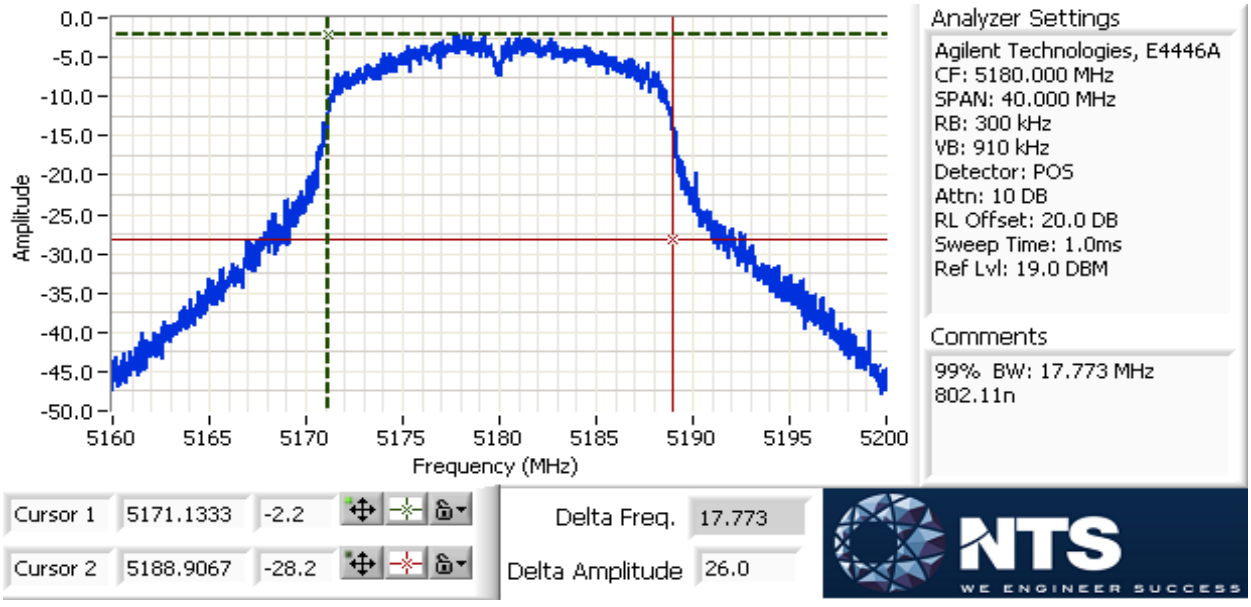
Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A



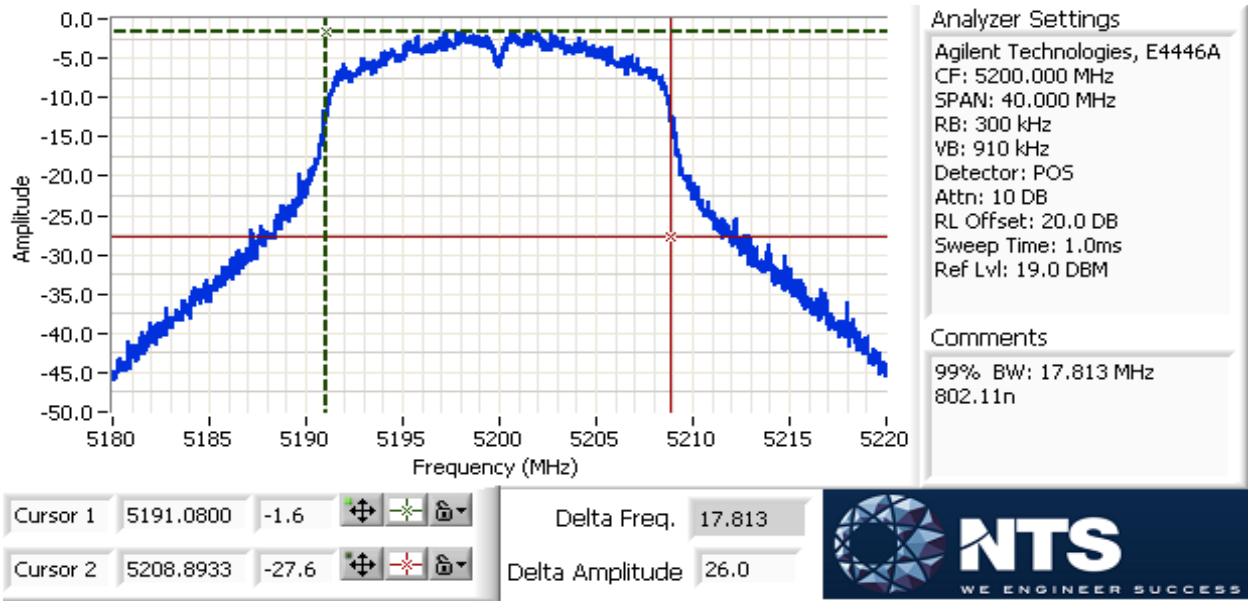


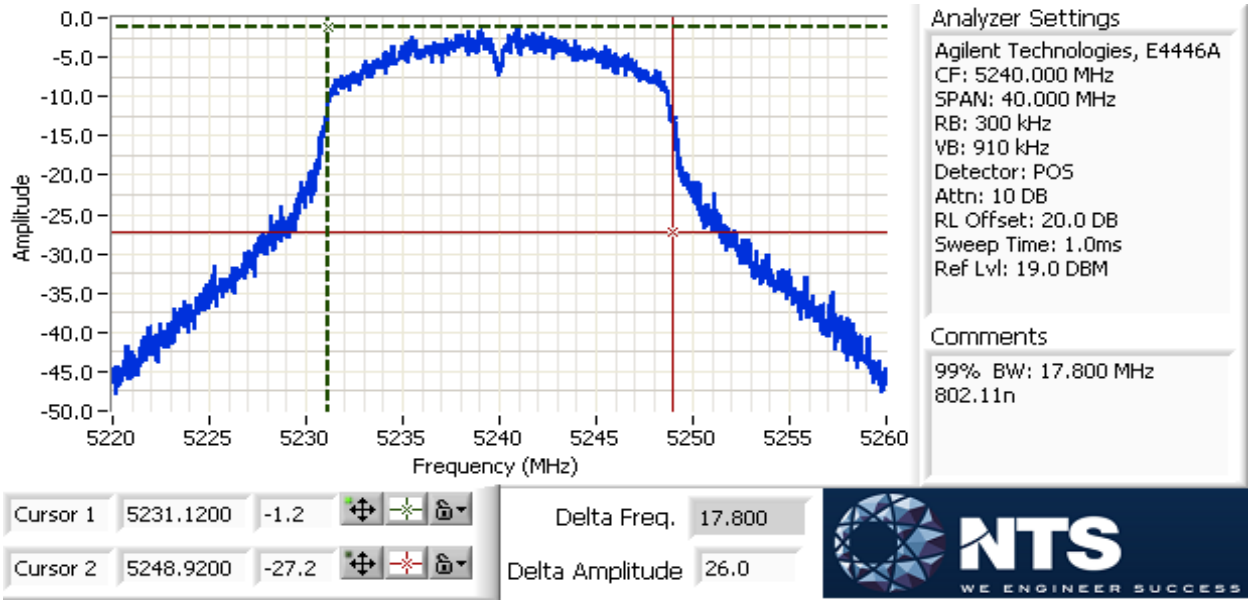
Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A





Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A





Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Run #2: Out Of Band Spurious Emissions - Antenna Conducted

Date of Test: 9/27/2017 Config. Used: 1

Test Engineer: Rafael Varelas Config Change: None

Test Location: Fremont EMC Lab #4A EUT Voltage: Battery operated

MIMO Devices: Antenna gain used is the effective gain calculated in the power section of this data sheet. The plots were obtained for each chain individually and the limit was adjusted to account for all chains transmitting simultaneously

Number of transmit chains:	1		
Maximum Antenna Gain:	3.0	dBi	
Spurious Limit:	-27.0	dBm/MHz eirp	
Adjustment for 1 chains:	0.0	dB adjustment for multiple chains.	
Limit Used On Plots [Note 1]:	-30.0	dBm/MHz	Peak Limit (RB=VB=1MHz)

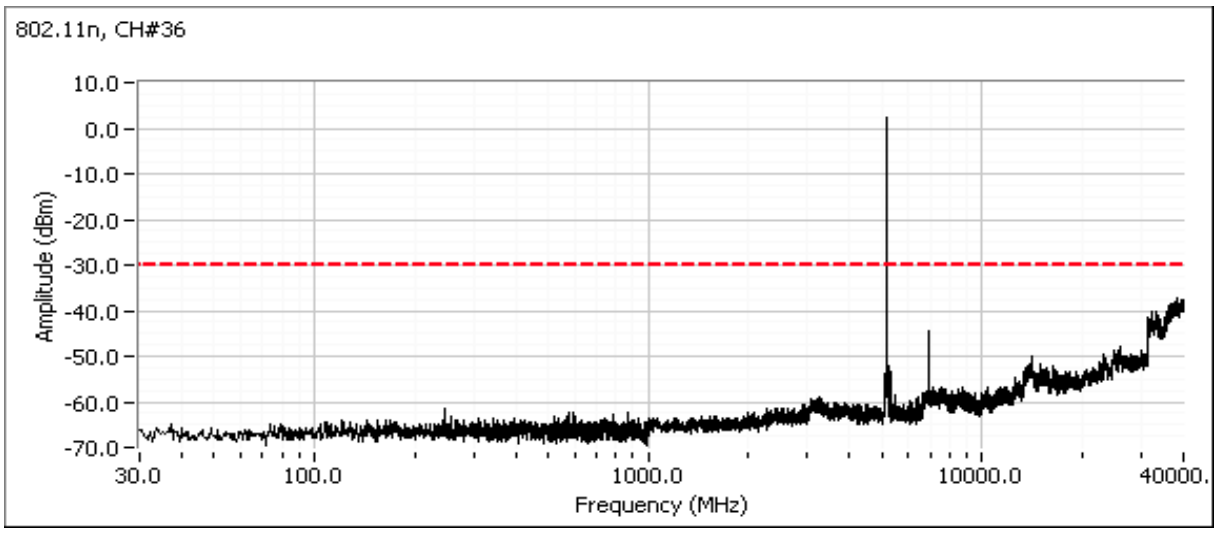
Note 1:	The -27dBm/MHz limit is an eirp limit. The limit for antenna port conducted measurements is adjusted to take into consideration the maximum antenna gain (limit = -27dBm - antenna gain). Radiated field strength measurements for signals more than 50MHz from the bands and that are close to the limit are made to determine compliance as the antenna gain is not known at these frequencies.
Note 2:	All spurious signals below 1GHz are measured during digital device radiated emissions test.
Note 3:	Signals within 10MHz of the 5.725 or 5.825 Band edge are subject to a limit of -17dBm EIRP
Note 4:	If the device is for outdoor use then the -27dBm eirp limit also applies in the 5150 - 5250 MHz band.
Note 5:	Signals that fall in the restricted bands of 15.205 are subject to the limit of 15.209.

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

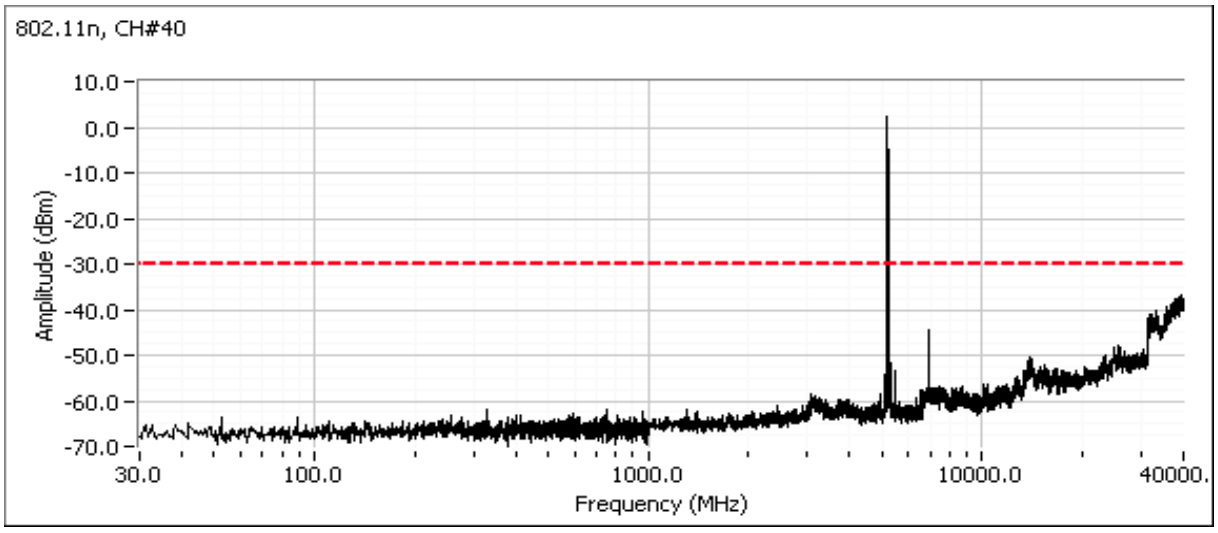
Plots Showing Out-Of-Band Emissions (RBW=VBW=1MHz)

Low channel, 5150 - 5250 MHz Band

Compliance with the radiated limits for the restricted band immediately below 5150MHz is demonstrated through the radiated emissions tests.

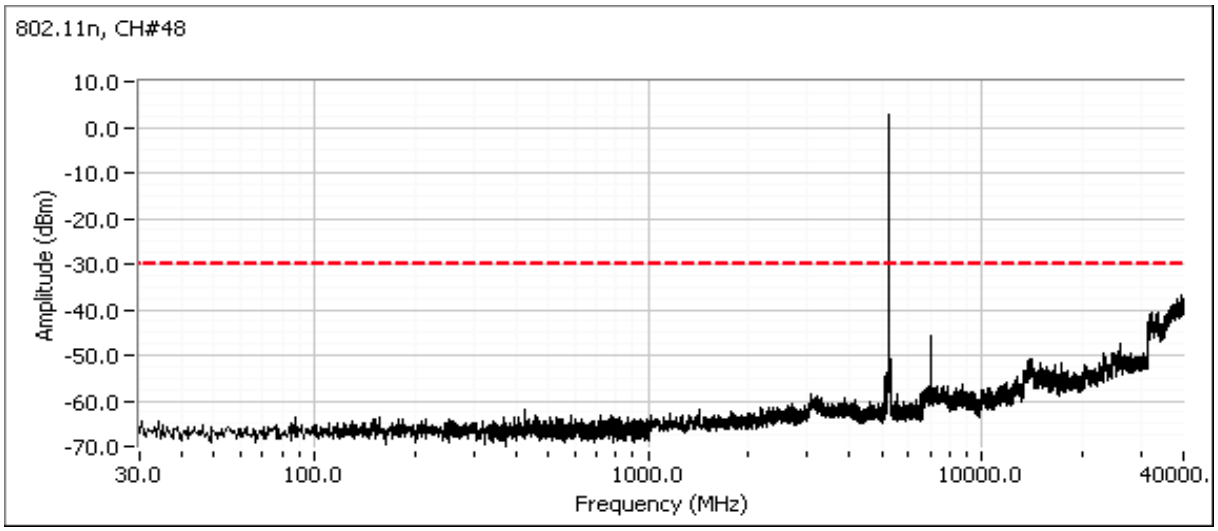


Center channel, 5150 - 5250 MHz Band



Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

High channel, 5150 - 5250 MHz Band



Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

RSS-247 and FCC 15.407 (UNII) 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: 22.4 °C
Rel. Humidity: 38 %

Summary of Results

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
20MHz Bandwith Modes							
1	n20	36 - 5180 MHz			Restricted Band Edge at 5150 MHz	15.209	38.9 dBµV/m @ 5131.6 MHz (-15.1 dB)
1	n20	48 - 5240 MHz			Restricted Band Edge at 5350 MHz	15.209	39.5 dBµV/m @ 5383.6 MHz (-14.5 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:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 789033
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=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold 50 traces. (method VB of KDB 789033)

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11n20	MCS0	0.95	Yes	4.521	0.2	0.5	221

Sample Notes

Sample S/N: DVT2_036 (945-0270)
Firmware: 0.4.0.0.1389.0

Measurement Specific Notes:

Note 1:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector). Per KDB 789033 2) c) (i), compliance can be demonstrated by meeting the average and peak limits of 15.209, as an alternative.
Note 2:	Emission has a duty cycle ≥ 98%, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces (method AD of KDB 789033)
Note 3:	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 (method VB of KDB 789033)
Note 4:	Emission has a duty cycle < 98%, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100*1/DC traces, measurement corrected by Pwr correction factor (method AD of KDB 789033)
Note 5:	Plots of the average and peak bandedge do not account for any duty cycle correction. Refer to the tabular results for final measurements.

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Run #1: Radiated Bandedge Measurements, 5150-5250MHz

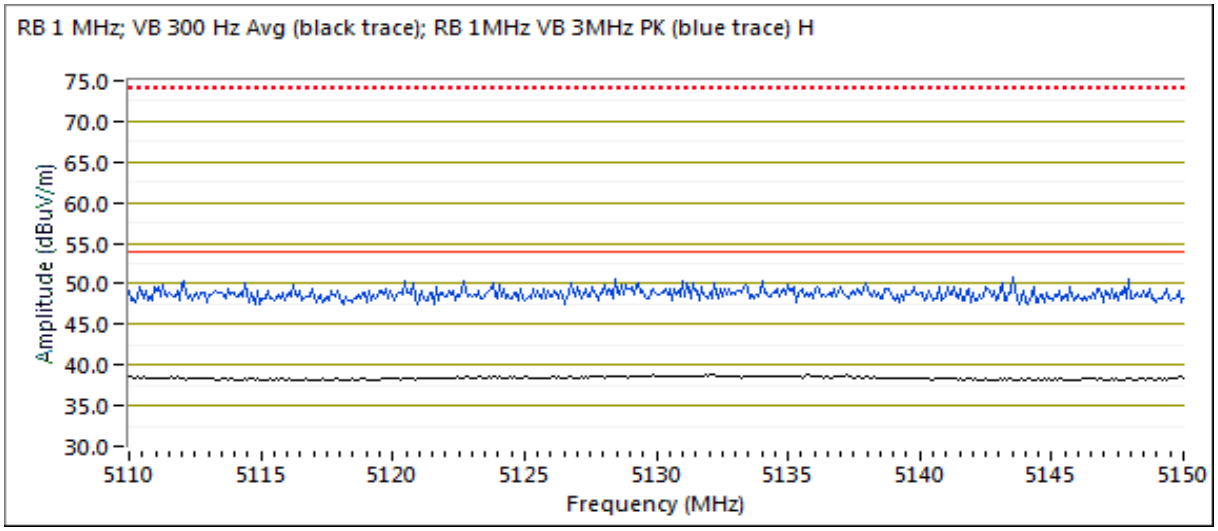
Date of Test: 9/26/2017 0:00
Test Engineer: Rafael Varelas
Test Location: Fremont Chamber #4

Config. Used: 1
Config Change: None
EUT Voltage: Battery operated

Channel: 36 - 5180 MHz
Tx Chain: Main
Mode: n20
Data Rate: MCS0

5150 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5131.560	38.9	V	54.0	-15.1	Avg	256	1.0	POS; RB 1 MHz; VB: 300 Hz
5110.480	50.9	V	74.0	-23.1	PK	256	1.0	POS; RB 1 MHz; VB: 3 MHz
5129.560	38.9	H	54.0	-15.1	Avg	30	2.2	POS; RB 1 MHz; VB: 300 Hz
5144.070	51.2	H	74.0	-22.8	PK	30	2.2	POS; RB 1 MHz; VB: 3 MHz

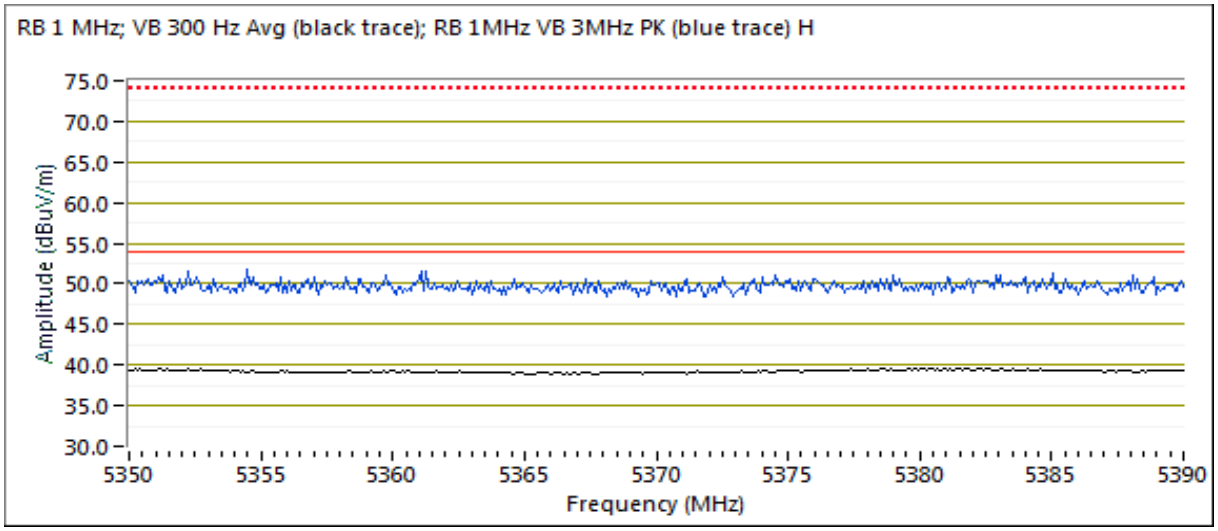


Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Channel: 48 - 5240MHz
Tx Chain: Main
Mode: n20
Data Rate: MCS0

5350 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5383.590	39.5	V	54.0	-14.5	Avg	248	2.3	POS; RB 1 MHz; VB: 300 Hz
5387.600	52.4	V	74.0	-21.6	PK	248	2.3	POS; RB 1 MHz; VB: 3 MHz
5350.080	39.5	H	54.0	-14.5	Avg	106	2.3	POS; RB 1 MHz; VB: 300 Hz
5387.270	51.2	H	74.0	-22.8	PK	106	2.3	POS; RB 1 MHz; VB: 3 MHz



Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

RSS-247 and FCC 15.407 (UNII) 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: 22.4 °C
Rel. Humidity: 38 %

Summary of Results

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
1	n20	36 - 5180 MHz			Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	50.8 dBµV/m @ 20719.9 MHz (-3.2 dB)
	n20	40 - 5200 MHz			Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	46.6 dBµV/m @ 20800.0 MHz (-7.4 dB)
	n20	48 - 5240 MHz			Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	52.6 dBµV/m @ 20959.9 MHz (-1.4 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:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 789033
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 50 traces. (method VB of KDB 789033)

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11n20	MCS0	0.95	Yes	4.521	0.2	0.5	221

Sample Notes

Sample S/N: DVT2_036 (945-0270)
Firmware: 0.4.0.0.1389.0

Measurement Specific Notes:

Note 1:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector). Per KDB 789033 2) c) (i), compliance can be demonstrated by meeting the average and peak limits of 15.209, as an alternative.
Note 2:	Emission has a duty cycle ≥ 98%, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces (method AD of KDB 789033)
Note 3:	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 (method VB of KDB 789033)
Note 4:	Emission has a duty cycle < 98%, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100*1/DC traces, measurement corrected by Pwr correction factor (method AD of KDB 789033)

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Run #1, Radiated Spurious Emissions, 1,000 - 40,000 MHz. Operation in the 5150-5250 MHz Band

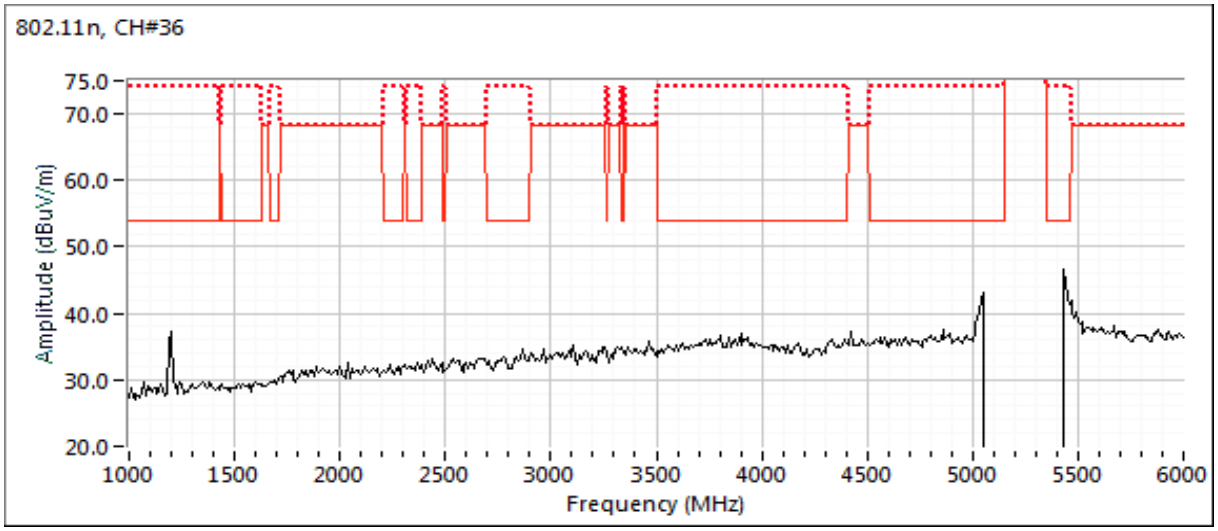
Date of Test: 9/26/2017 0:00
Test Engineer: Rafael Varelas
Test Location: Fremont Chamber #4
Config. Used: 1
Config Change: None
EUT Voltage: Battery operated

Run #1a: Low Channel

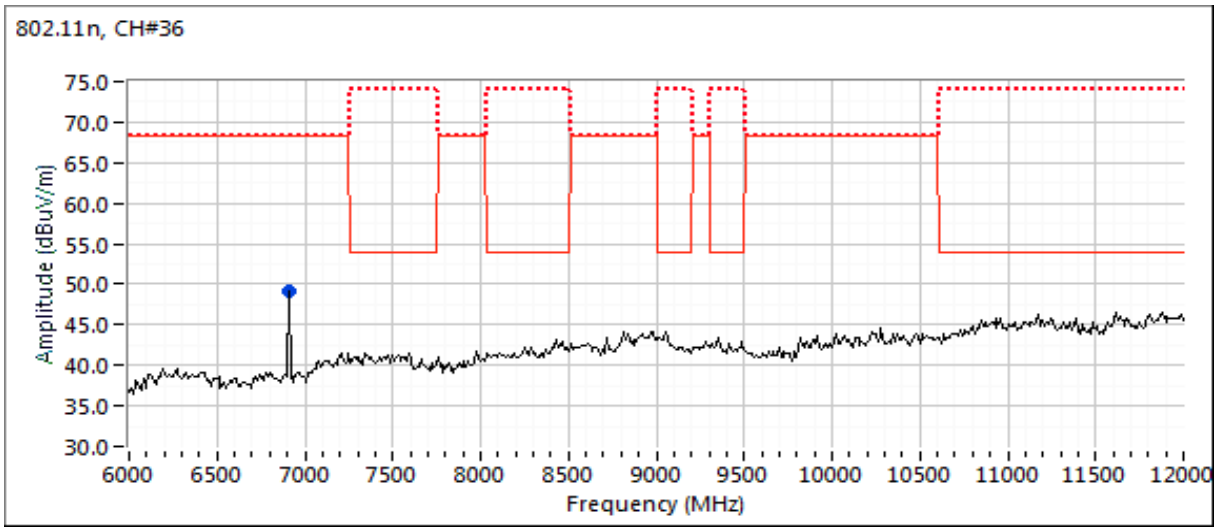
Channel: 36
Tx Chain: Main
Mode: 11n20
Data Rate: MCS0

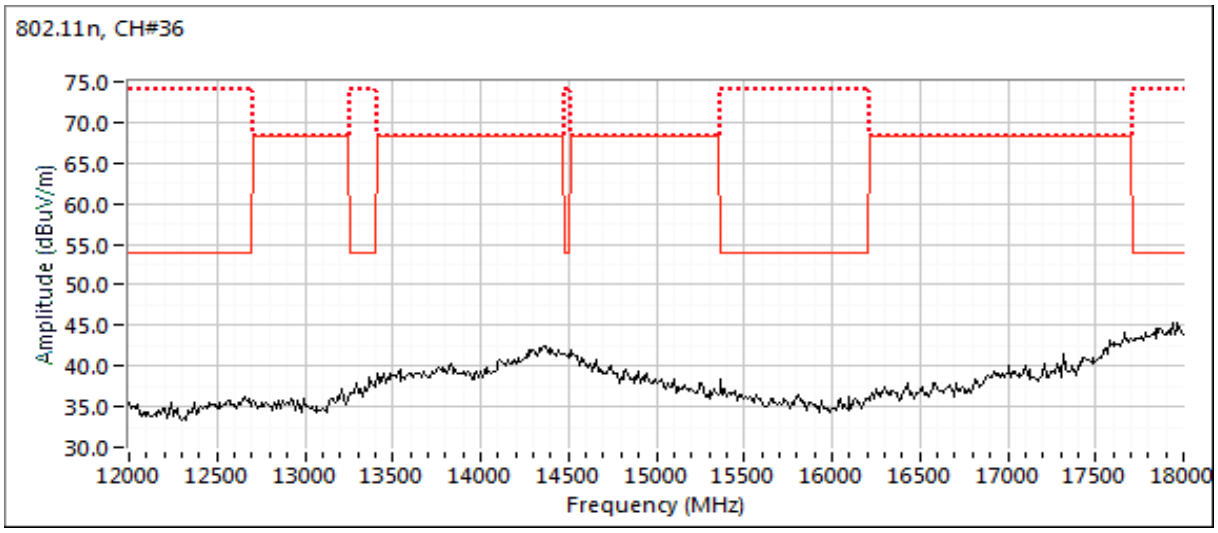
Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
20719.900	50.8	V	54.0	-3.2	Avg	43	1.6	RB 1 MHz;VB 300 Hz;Peak
6906.540	53.2	V	68.3	-15.1	PK	52	2.1	RB 1 MHz;VB 3 MHz;Peak
25899.810	50.5	V	68.3	-17.8	PK	55	1.6	RB 1 MHz;VB 3 MHz;Peak
20719.790	55.4	V	74.0	-18.6	PK	43	1.6	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector).

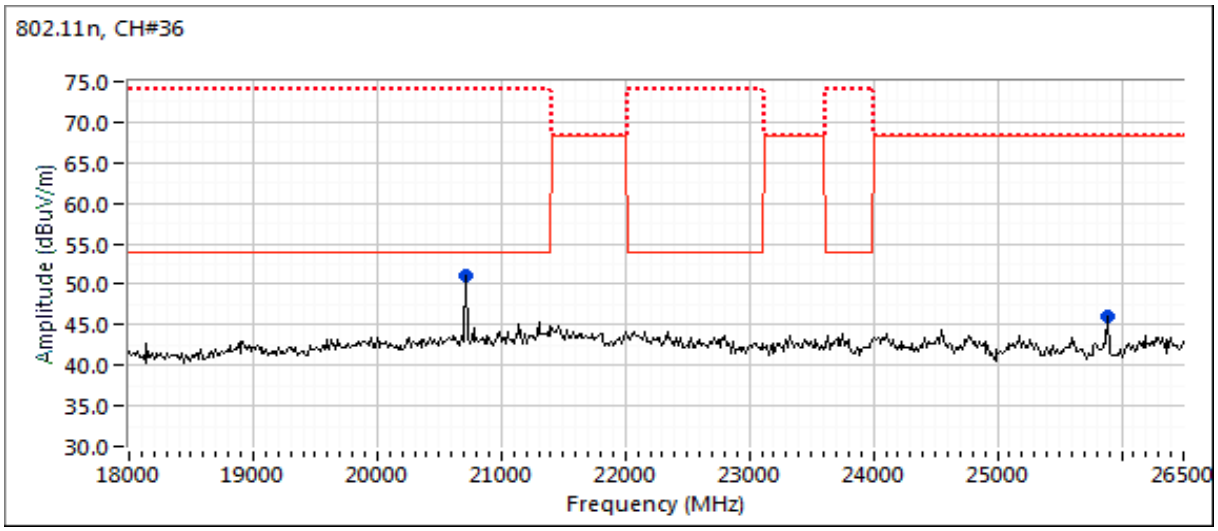


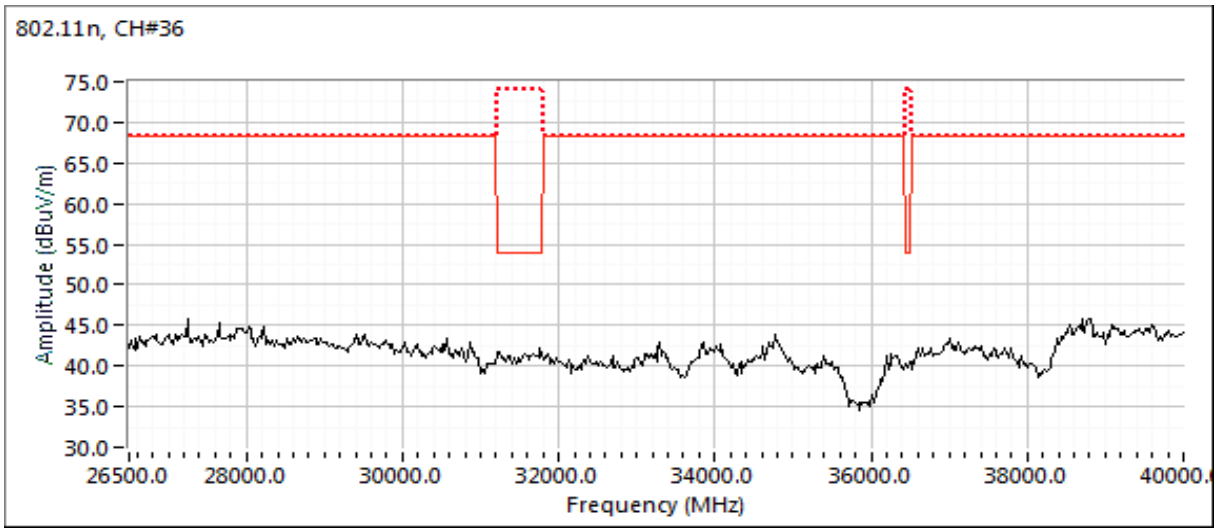
Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A





Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A





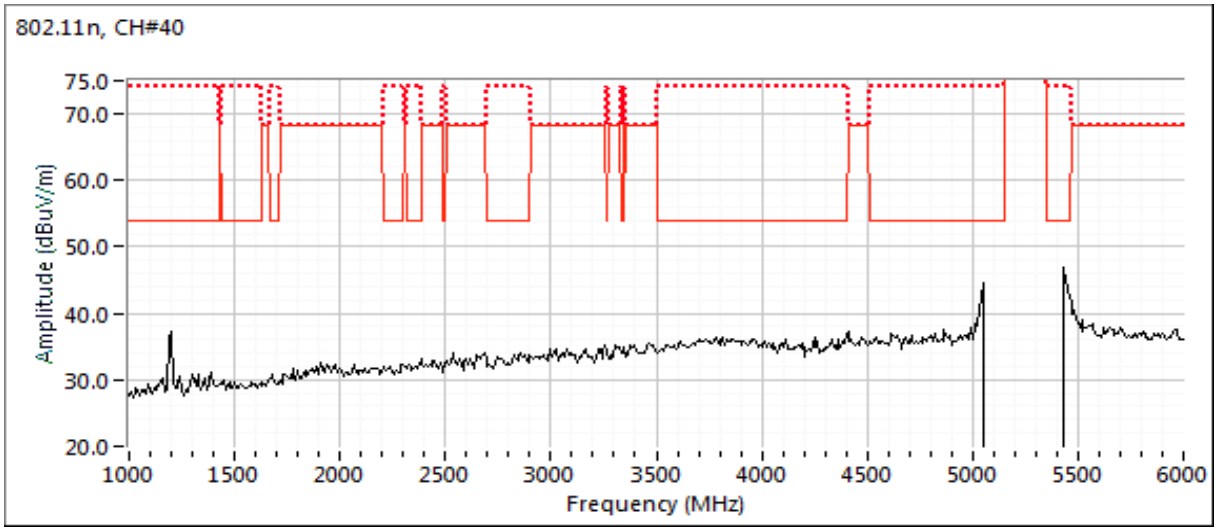
Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Run #1b: Center Channel

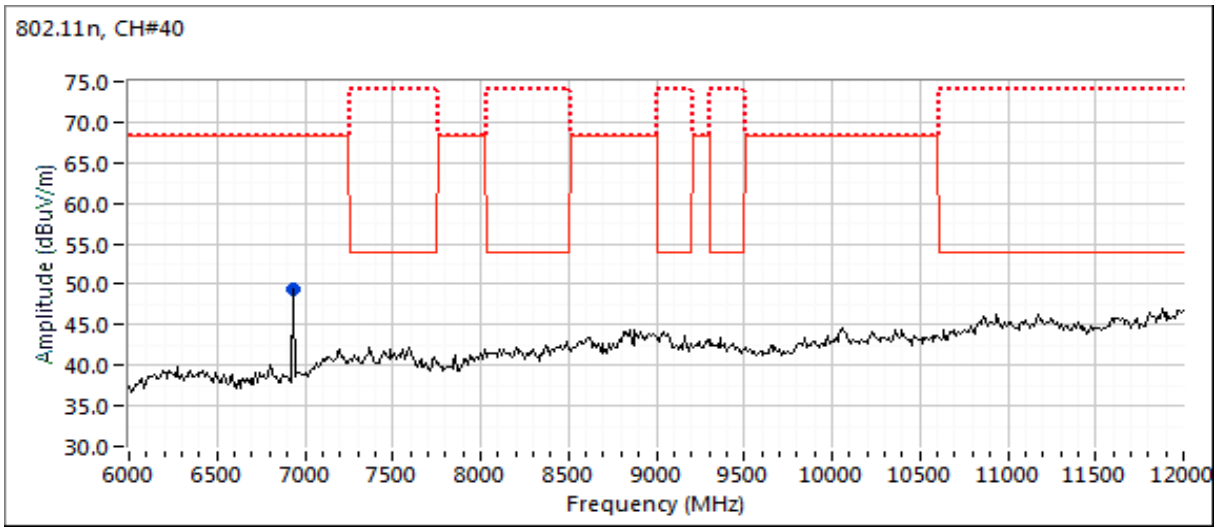
Channel: 40 Mode: 11n20
Tx Chain: Main Data Rate: MCS0

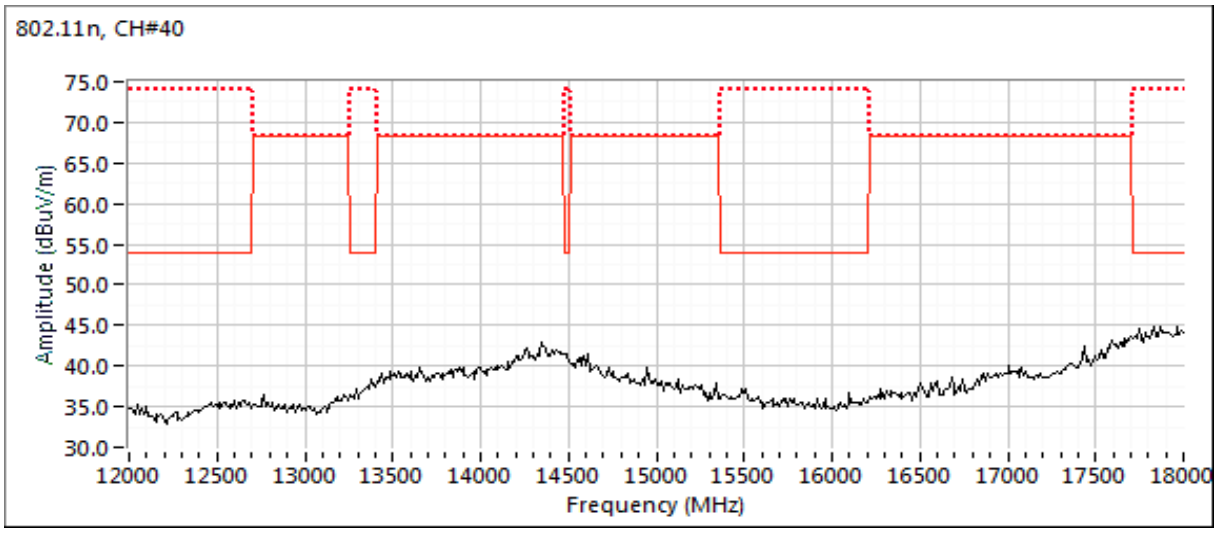
Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
20799.950	46.6	V	54.0	-7.4	Avg	323	1.8	RB 1 MHz;VB 300 Hz;Peak
6933.200	53.8	V	68.3	-14.5	PK	64	1.9	RB 1 MHz;VB 3 MHz;Peak
20799.840	53.5	V	74.0	-20.5	PK	323	1.8	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector).

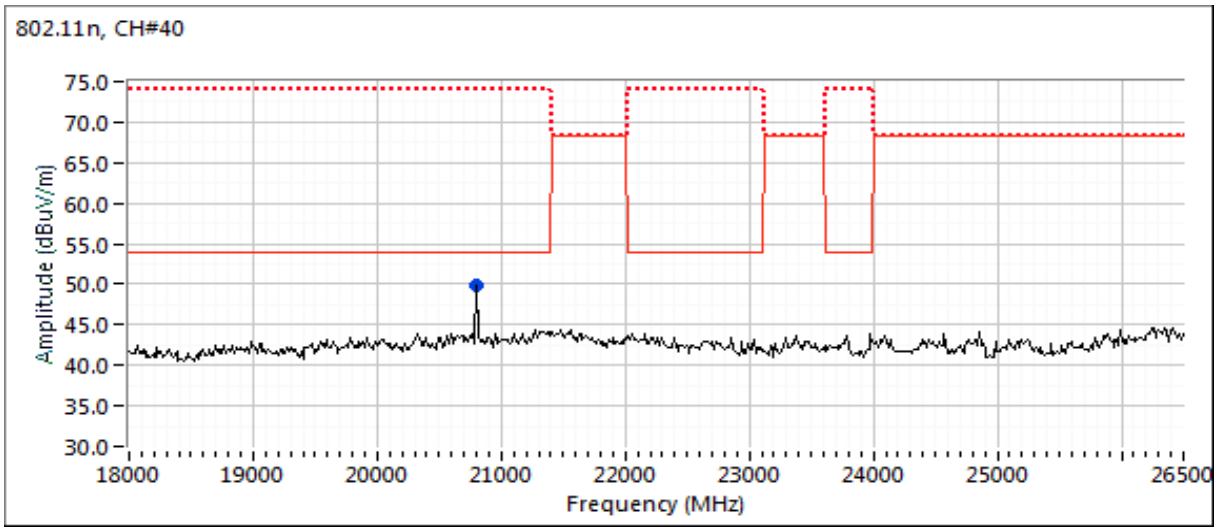


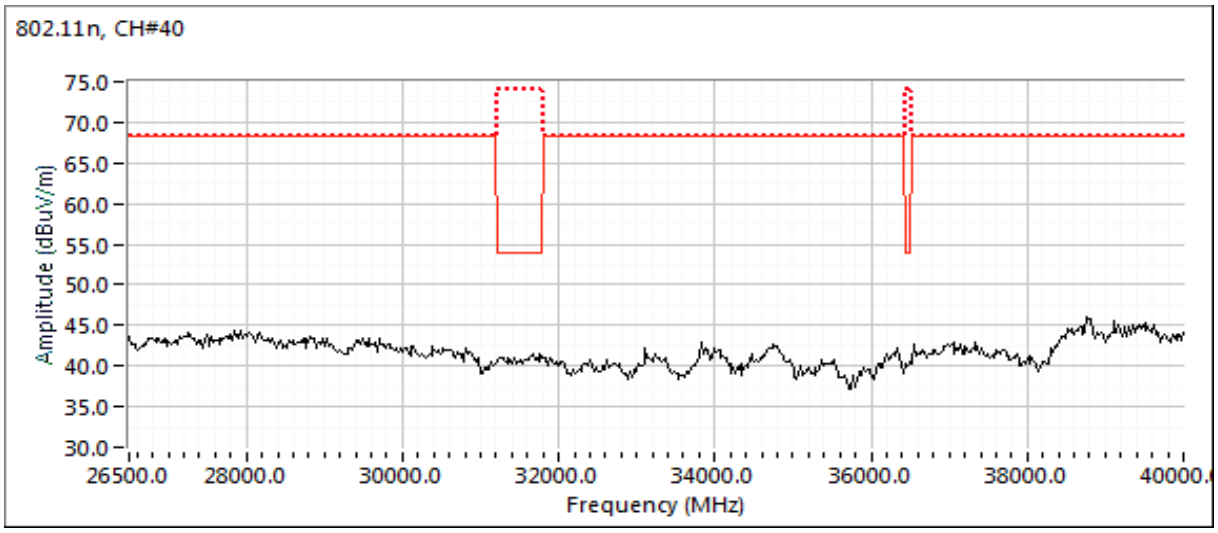
Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A





Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A





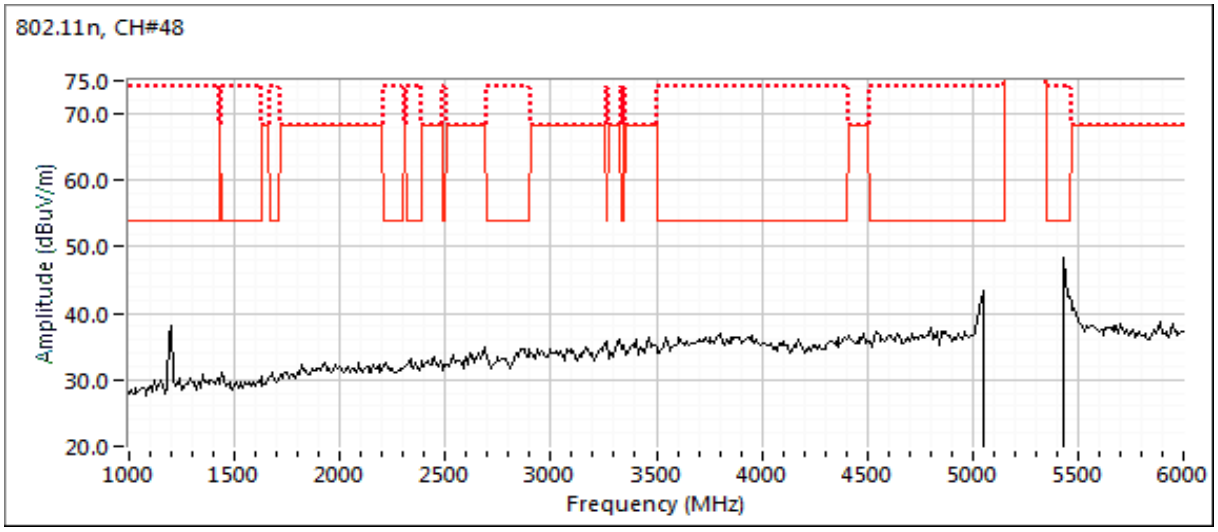
Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Run #1c: High Channel

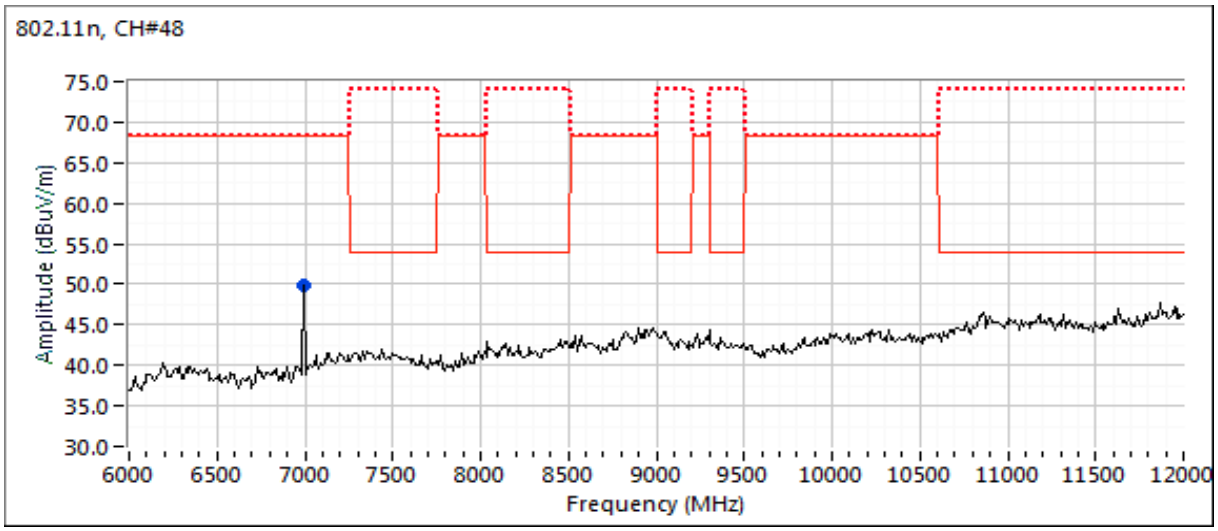
Channel: 48 Mode: 11n20
Tx Chain: Main Data Rate: MCS0

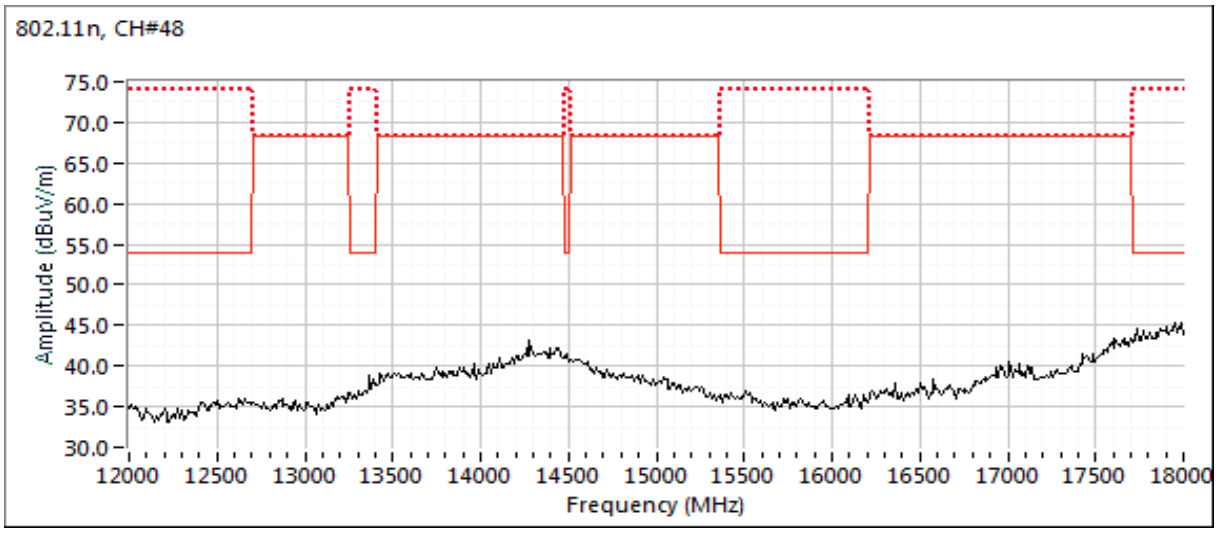
Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
20959.930	52.6	V	54.0	-1.4	Avg	47	1.5	RB 1 MHz;VB 300 Hz;Peak
6986.710	52.9	V	68.3	-15.4	PK	71	1.5	RB 1 MHz;VB 3 MHz;Peak
20959.980	56.6	V	74.0	-17.4	PK	47	1.5	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector).

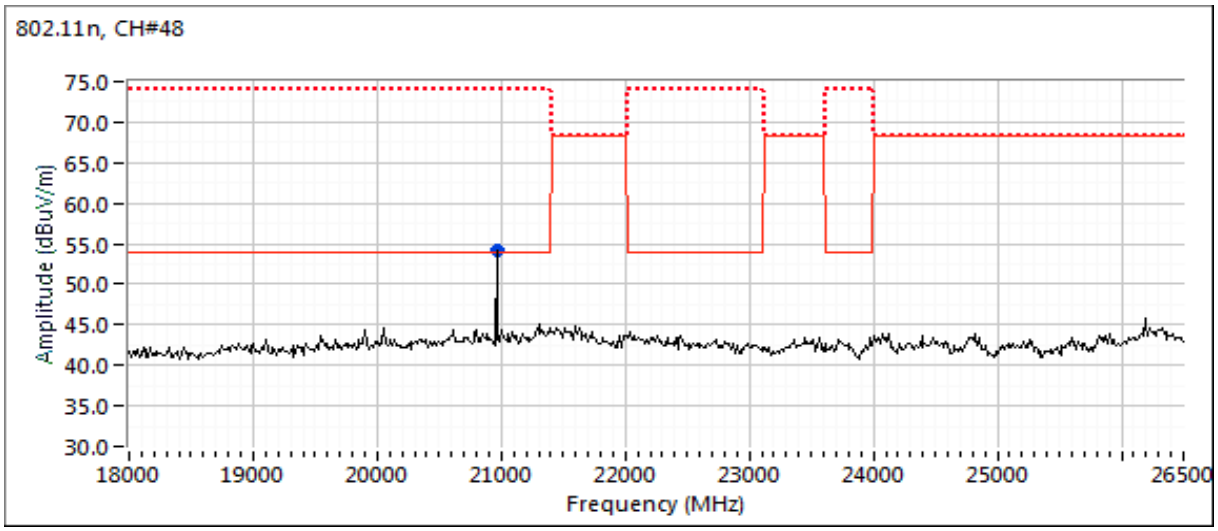


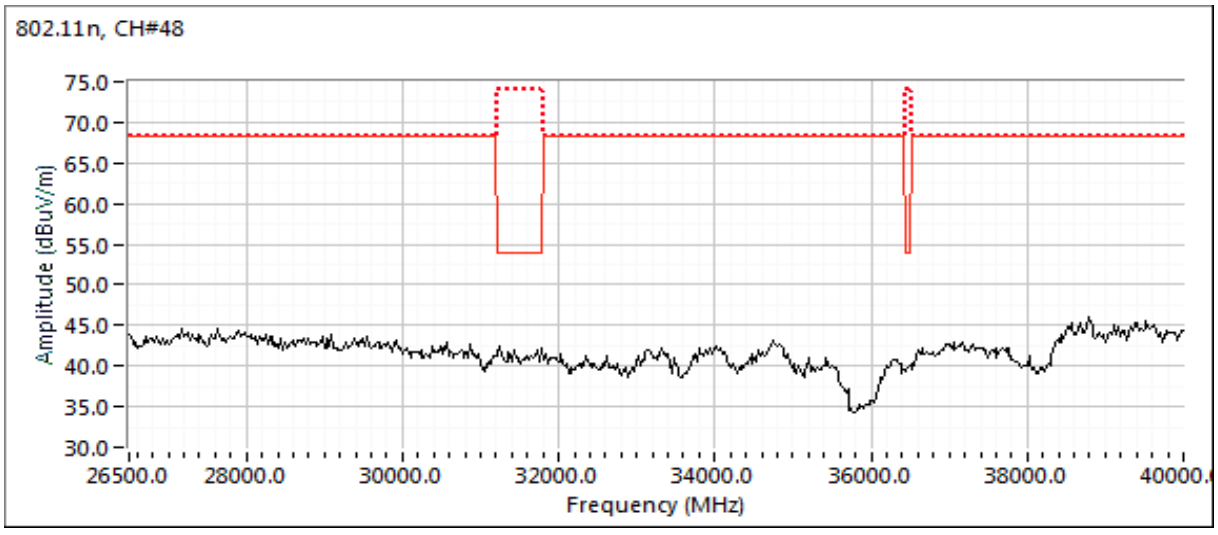
Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A





Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A





Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	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: 21-24 °C
Rel. Humidity: 35-40 %

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	6 - 2437MHz			Radiated Emissions, 9 kHz - 1 GHz	FCC Part 15.209 / 15.247(c)	29.2 dBµV/m @ 399.60 MHz (-14.3 dB)
2	n20	40 - 5200 MHz			Radiated Emissions, 9 kHz - 1 GHz	FCC Part 15.209 / 15.247(c)	31.2 dBµV/m @ 222.08 MHz (-12.3 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:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Sample Notes

Sample S/N: DVT2_036 (945-0270)
Firmware: 0.4.0.0.1389.0

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	1 Mbps	0.98	Yes	12.461	0	0	10
n20	MCS0	0.95	Yes	4.521	0.2	0.5	221

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 30dB below the level of the fundamental and measured in 100kHz.
Note 3:	Emission has a duty cycle ≥ 98%, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces
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, trace average 100 traces, measurement corrected by Linear voltage correction factor
Note 5:	Emission has constatnt duty cycle < 98%, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces, measurement corrected by Pwr correction factor
Note 6:	Emission has non constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW> 1/T, peak detector, linear average mode, sweep time auto, max hold. Max hold for 50*(1/DC) traces
Note 7:	Emission has non constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW> 1/T, RMS detector, sweep time auto, max hold. Max hold for 50*(1/DC) traces

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Run #1: Radiated Spurious Emissions, 9 kHz - 1000 MHz.

Date of Test: 9/26/2017 0:00
Test Engineer: Rafael Varelas
Test Location: FT Ch#4

Config. Used: 1
Config Change: None
EUT Voltage: Battery operated

Run #1a: Center Channel - Operating Mode: 802.11b

Channel: 6
Tx Chain: Main

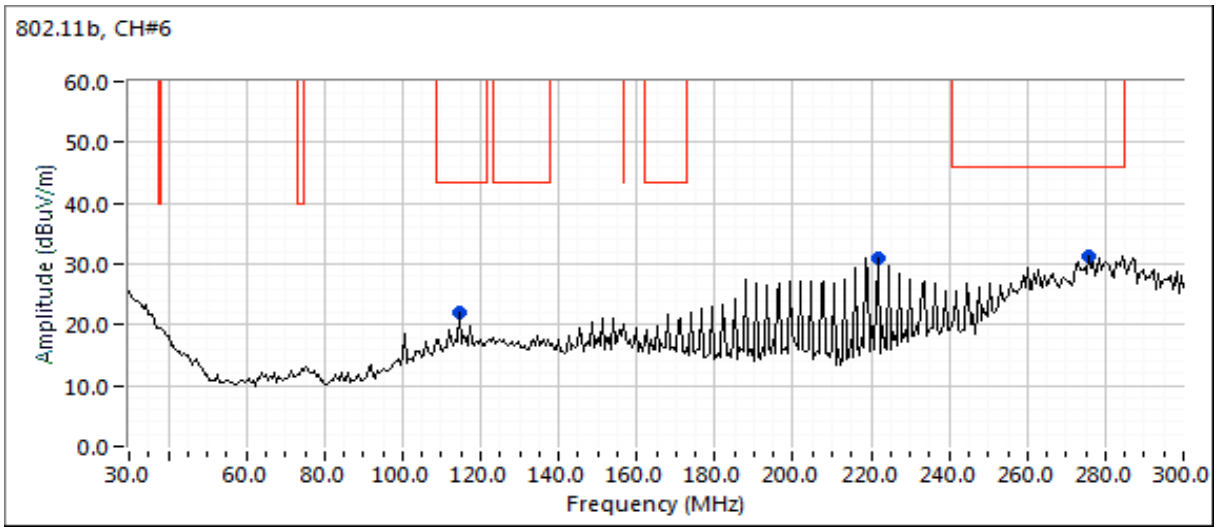
Mode: b
Data Rate: 1 Mbps

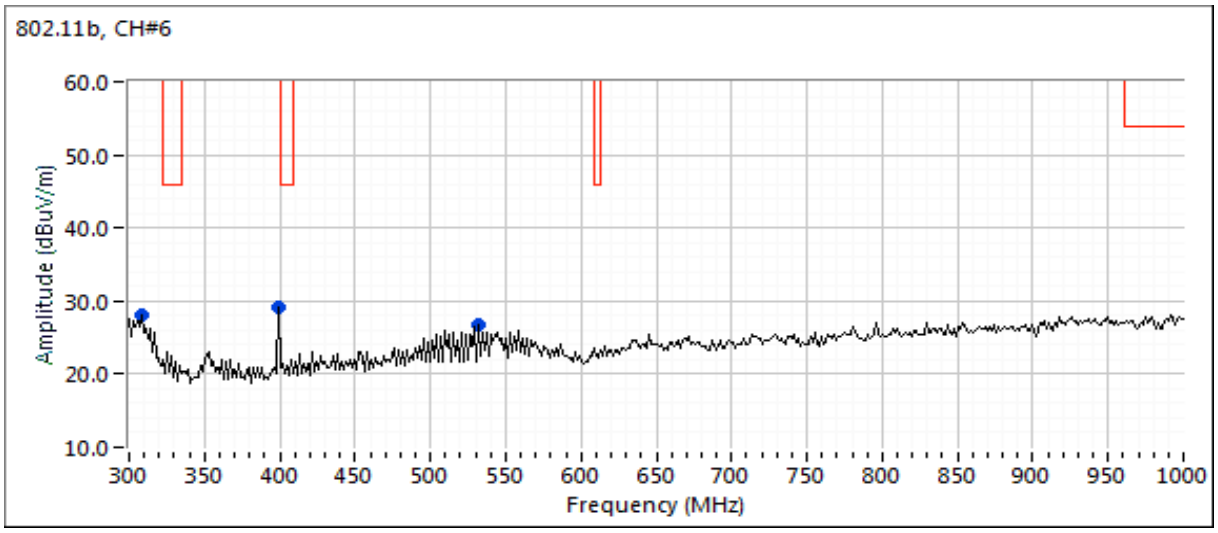
Setting:

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
399.599	29.2	H	43.5	-14.3	Peak	195	1.0	Note 1
275.651	31.2	V	46.0	-14.8	Peak	14	1.0	
222.084	31.1	V	46.0	-14.9	Peak	18	1.0	Note 1
308.417	28.1	H	43.5	-15.4	Peak	345	1.0	Note 1
531.463	26.8	H	43.5	-16.7	Peak	32	1.5	Note 1
114.409	21.9	V	43.5	-21.6	Peak	296	3.0	

Note: Scans made between 9 kHz - 30 MHz and there were no significant emissions in this frequency range

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A





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Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

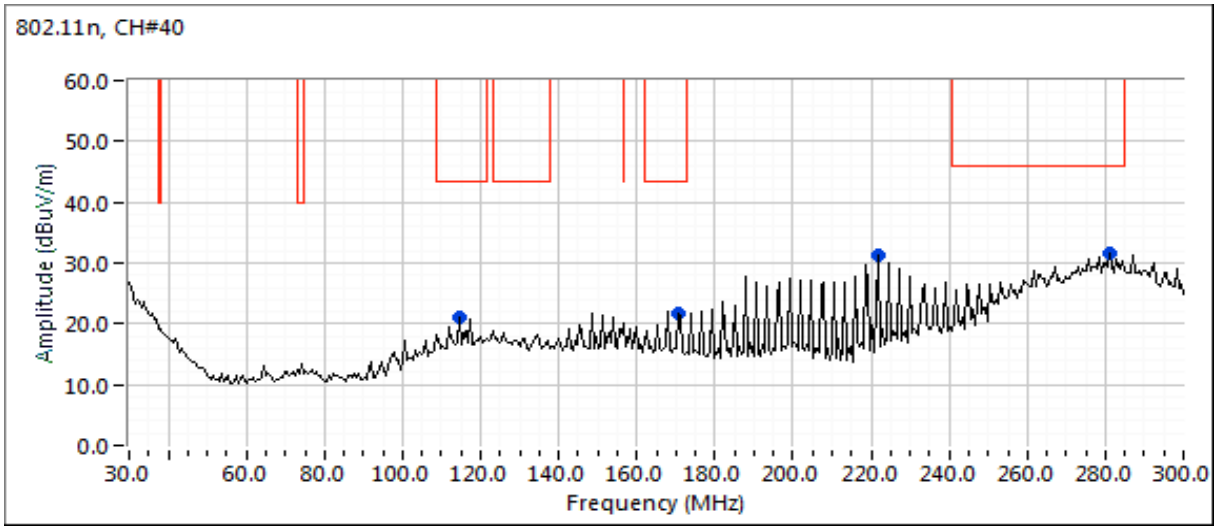
Run #1b: Center Channel - Operating Mode: 802.11n20

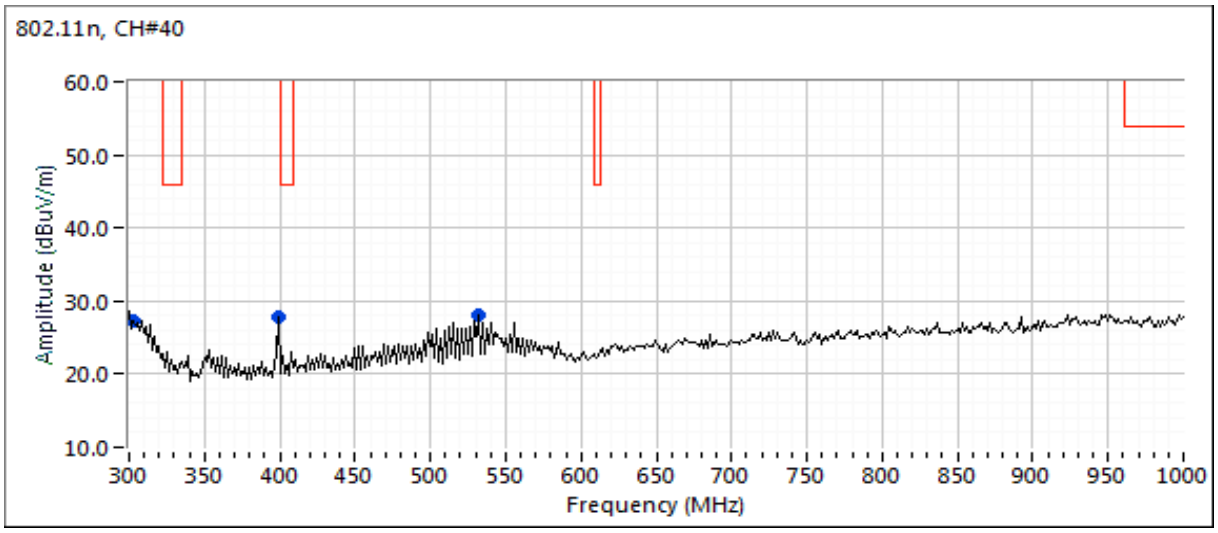
Channel: 40 Mode: n20 Setting:
Tx Chain: Main Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
222.084	31.2	V	43.5	-12.3	Peak	20	1.0	Note 1
281.062	31.5	V	46.0	-14.5	Peak	20	1.0	
531.463	28.1	V	46.0	-17.9	Peak	21	1.5	Note 1
399.599	27.9	V	46.0	-18.1	Peak	214	1.0	Note 1
302.806	27.3	H	46.0	-18.7	Peak	46	1.0	Note 1
170.681	21.8	H	43.5	-21.7	Peak	2	1.0	
114.409	21.2	V	43.5	-22.3	Peak	290	1.5	

Note:	Scans made between 9 kHz - 30 MHz and there were no significant emissions in this frequency range

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A





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Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

FCC Part 15 - Frequency Stability

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

All measurements are made with the EUT's rf port connected to the measurement instrument via an attenuator. All amplitude measurements are adjusted to account for the attenuation between EUT and measuring instrument. For frequency stability measurements the EUT was placed inside an environmental chamber.

Ambient Conditions:

Temperature: 24 °C

Rel. Humidity: 38 %

Run #			Test Performed	Limit	Pass / Fail	
1			Frequency Stability	Stays in band	Pass	9.4 ppm

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:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	N/A

Run #1: Frequency Stability

Date of Test: 10/11/2017
Test Engineer: Mehran Birgani
Test Location: Lab#4

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

Nominal Frequency: 5180 MHz

Frequency Stability Over Temperature

The EUT was soaked at each temperature for a minimum of 30 minutes prior to starting the transmitter and making the measurements to ensure the EUT and chamber had stabilized at that temperature.

Temperature	Frequency Measured	Drift	
(Celsius)	(MHz)	(Hz)	(ppm)
0	5180.013840	13840	2.7
10	5180.001420	1420	0.3
20	5179.963077	-36923	-7.1
30	5179.970731	-29269	-5.7
40	5179.957750	-42250	-8.2
50	5179.951500	-48500	-9.4
	Worst case:	-42250	-9.4

Frequency Stability Over Input Voltage

Nominal Voltage is 14.4 Vdc.

Voltage	Frequency Measured	Drift	
(DC)	(MHz)	(Hz)	(ppm)
12.24	5179.963067	-36933	-7.1
16.56	5179.963089	-36911	-7.1
	Worst case:	-36933	-7.1

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	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: 9/26/2017
Test Engineer: Rafael varelas
Test Location: Fremont Chamber #4
Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

For tabletop equipment, the EUTwas located on a wooden table inside the semi-anechoic chamber, 40 cm from a vertical coupling plane and 80cm from the LISN.

Ambient Conditions:

Temperature: 22.4 °C
Rel. Humidity: 38 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power, 120V/60Hz	Class B	Pass	43.4 dBµV @ 0.175 MHz (-21.3 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.

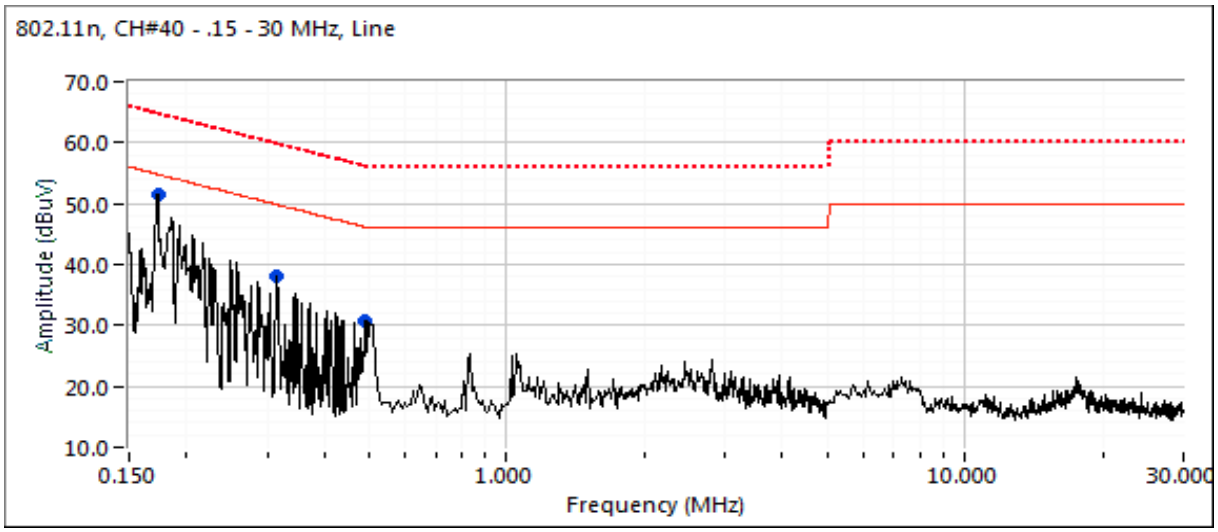
Sample Notes

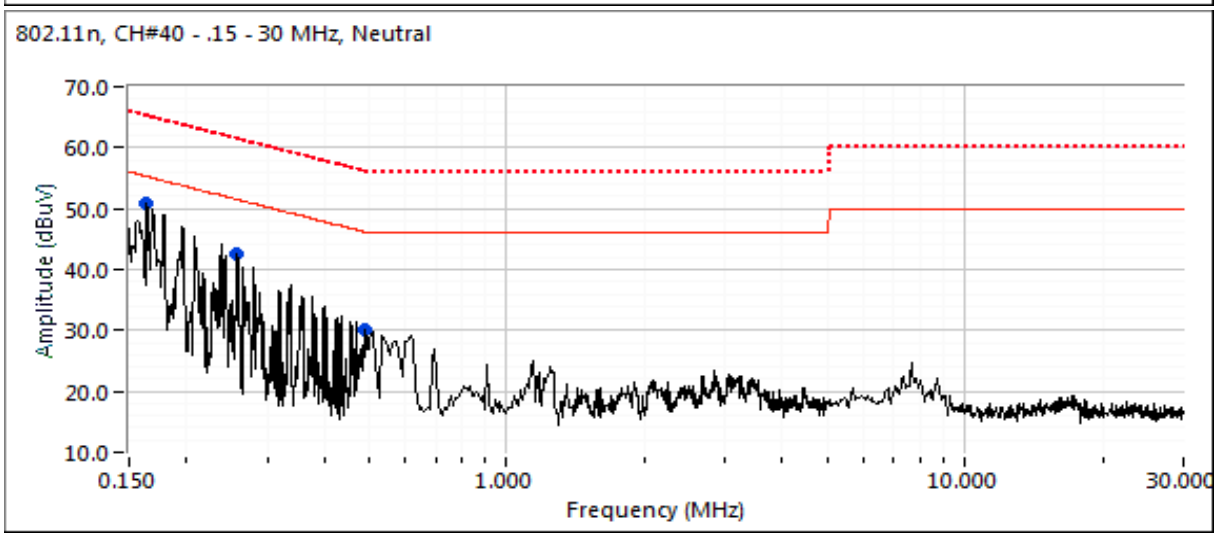
Sample S/N: DVT2_036 (945-0270)
Firmware:-4.0.0.1389.0

Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz

802.11n20 Ch #40, transmitting continuously. Battery charging.





Client:	Neato Robotics	Job Number:	JD105849
Model:	Botvac D7 Connected	T-Log Number:	T105971
		Project Manager:	Christine Krebill
Contact:	Pawel Orzechowski	Project Coordinator:	-
Standard:	RSS-247, FCC 15.247, FCC 15E	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	
0.175	51.5	Line 1	54.8	-3.3	Peak	
0.316	38.2	Line 1	49.8	-11.6	Peak	
0.494	30.7	Line 1	46.1	-15.4	Peak	
0.165	50.7	Neutral	55.3	-4.6	Peak	
0.258	42.6	Neutral	51.5	-8.9	Peak	
0.492	30.2	Neutral	46.1	-15.9	Peak	

Final quasi-peak and average readings

Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.175	43.4	Line 1	64.7	-21.3	QP	QP (1.00s)
0.165	43.5	Neutral	65.2	-21.7	QP	QP (1.00s)
0.258	34.2	Neutral	61.5	-27.3	QP	QP (1.00s)
0.492	27.9	Neutral	56.1	-28.2	QP	QP (1.00s)
0.492	17.5	Neutral	46.1	-28.6	AVG	AVG (0.10s)
0.494	26.6	Line 1	56.1	-29.5	QP	QP (1.00s)
0.494	16.2	Line 1	46.1	-29.9	AVG	AVG (0.10s)
0.316	28.8	Line 1	59.8	-31.0	QP	QP (1.00s)
0.175	23.1	Line 1	54.7	-31.6	AVG	AVG (0.10s)
0.165	21.3	Neutral	55.2	-33.9	AVG	AVG (0.10s)
0.258	16.0	Neutral	51.5	-35.5	AVG	AVG (0.10s)
0.316	12.2	Line 1	49.8	-37.6	AVG	AVG (0.10s)

End of Report

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