Test Report

AIR-RM3010L-UXK9 and AIR-RM3010L-y-K9

(where y= A,B,D,N,T and Z)

FCC ID: 102094
IC: 2461B-102094

2.4 GHz Bluetooth Radio

Antenna Gain = 2dBi

Against the following Specifications:

CFR47 Part 15.247 SUBPART C

Industry Canada RSS-210 Issue 8

India - G.S.R. 45 (E)

Taiwan - LP0002

Australia/New Zealand - AS/NZS 4268

Cisco Systems
170 West Tasman Drive
San Jose, CA 95134

Test Engineer: _____
Date: 7/8/2015

This test report has been electronically authorized and archived using the CISCO Engineering Document Control system.

Section 1: Overview

1.1 Test Summary

The samples were assessed against the tests detailed in section 3 under the requirements of the following specifications:

Emission	Immunity
CFR47 Part 15.247 RSS210	N/A

The specifications listed above represent actual tests performed to demonstrate compliance against the specifications and basic standards listed on the front cover of this report. This list is not a one to one match to the front cover for one or more of the following reasons.

1. Basic standards call up many different test phenomena specifications such as the 61000-4-X series. The basic standards define which elements and levels shall be applied from these specifications and as such it is not appropriate to list the individual specifications on the front cover.
2. A Standard listed on the front cover may be required in a particular country but is not appropriate for the particular technologies included in the equipment under test. E.g. You cannot test a DC product to the mains Harmonics requirements in EN61000-3-2. See section 3.2.
3. Test results against a particular standard or specification may be included in a different test report. See section 3.2 for an EDCS reference of this data.
4. Where appropriate, Cisco may have substituted a later revision of a basic standard to those referenced in the specification on the front sheet of this test report. This decision was based upon improved test methodology and repeatability and/or where the newer revision represented a more stringent test.
5. Where relevant, testing has been carried out to the requirements of both EN and IEC Specifications. This was possible because of the similarities of the test methods involved and the Cisco EMC test procedures.
6. Testing may have been performed to an equivalent test that satisfies the requirements of the standards and specifications listed on the front cover of the report. See section 3.2.
7. Where radiated emissions testing has been performed to EN55022/CISPR22 the additional requirements of VCCI: V- 3/2006.04, EN55022: 1994 +A1/2 and CAN/CSA- CISPR 22-02 have also been evaluated unless otherwise stated.
8. Testing to the requirements of CFR47 Part 15 was performed against the CISPR22 limits. The results are therefore deemed satisfactory evidence of compliance with Industry Canada Interference Causing Equipment Standard ICES-003.
9. Where assessment has been performed to CISPR24, all the applicable test requirements may have not been covered. Refer to the results section for the tests performed.

Notes:

1) Where a specification listed on the front cover of this report has deviations from the basic standards listed above, the additional technical requirements of the specification were also assessed.
2) Where appropriate, Cisco may have substituted a later revision of a basic standard to those referenced in the specification on the front sheet of this test report. This decision was based upon improved test methodology and repeatability and/or where the newer revision represented a more stringent test.
3) Where relevant, testing has been carried out to the requirements of both EN and IEC Specifications. This was possible because of the similarities of the test methods involved and the Cisco EMC test procedures.

Section 2: Assessment Information

2.1 General

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on the samples submitted. The testing was performed by and for the use of Cisco systems Inc:

With regard to this assessment, the following points should be noted:

a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results due to production and measurement tolerances.

b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.

c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).

d) All testing was performed under the following environmental conditions:

Temperature	15°C to 35°C (54°F to 95°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 75*%

*[Where applicable] For ESD testing the humidity limits used were 30% to 60% and for EFT/B tests the humidity limits used were 25% to 75%.

e) All AC testing was performed at one or more of the following supply voltages:
110V 60 Hz (+/-20%)
220V 50 Hz (+/-20%)

2.2 Date of testing

02/20/2015 – 02/25/2015

2.3 Report Issue Date

03/02/2015

Cisco uses an electronic system to issue, store and control the revision of test reports. This system is called the Engineering Document Control System (EDCS). The actual report issue date is embedded into the original file on EDCS. Any copies of this report, either electronic or paper, that are not on EDCS must be considered uncontrolled

2.4 Testing facilities

This assessment was performed by:

Testing Laboratories

Cisco Systems, Inc.,	Cisco Systems, Inc.
4125 Highlander Parkway	170 West Tasman Drive
Richfield, OH 44286	San Jose, CA 95134
USA	USA

Testing - Certificate Number : 1178-01

Test Engineers

Bud Chiller

2.5 Equipment Assessed (EUT)

AIR-RM3010L-UXK9 s/n FOC18341979 in an AIR-CAP3602I host AP s/n FTX1637GJL4

2.6 EUT Description

The EUT is an 802.15.4 Bluetooth transceiver which is part of a module to be used in a host AP and operates in the 2.400-2.4835 GHz ISM band. Channel spacing is 2 MHz. The radio utilizes an internal omni-directional antenna with a maximum gain of 2 dBi.
There is only one modulation type which is GFSK and one data rate of 1Mbps.

Section 3: Sample Details

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing.

3.1 Sample Details

Sample No.	Equipment Details	Part Number	Manufacturer	Hardware Rev.	Firmware Rev.	Software Rev.	Serial Number
S01	EUT	AIR-RM3010L	Cisco Systems	NA	NA	NA	FOC18341979
S02	Host AP	AIR-CAP3602I	Cisco Systems	NA	NA	NA	FTX1637GJL4

3.2 System Details

System #	Description	Samples
1	EUT	S01
2	Host AP	

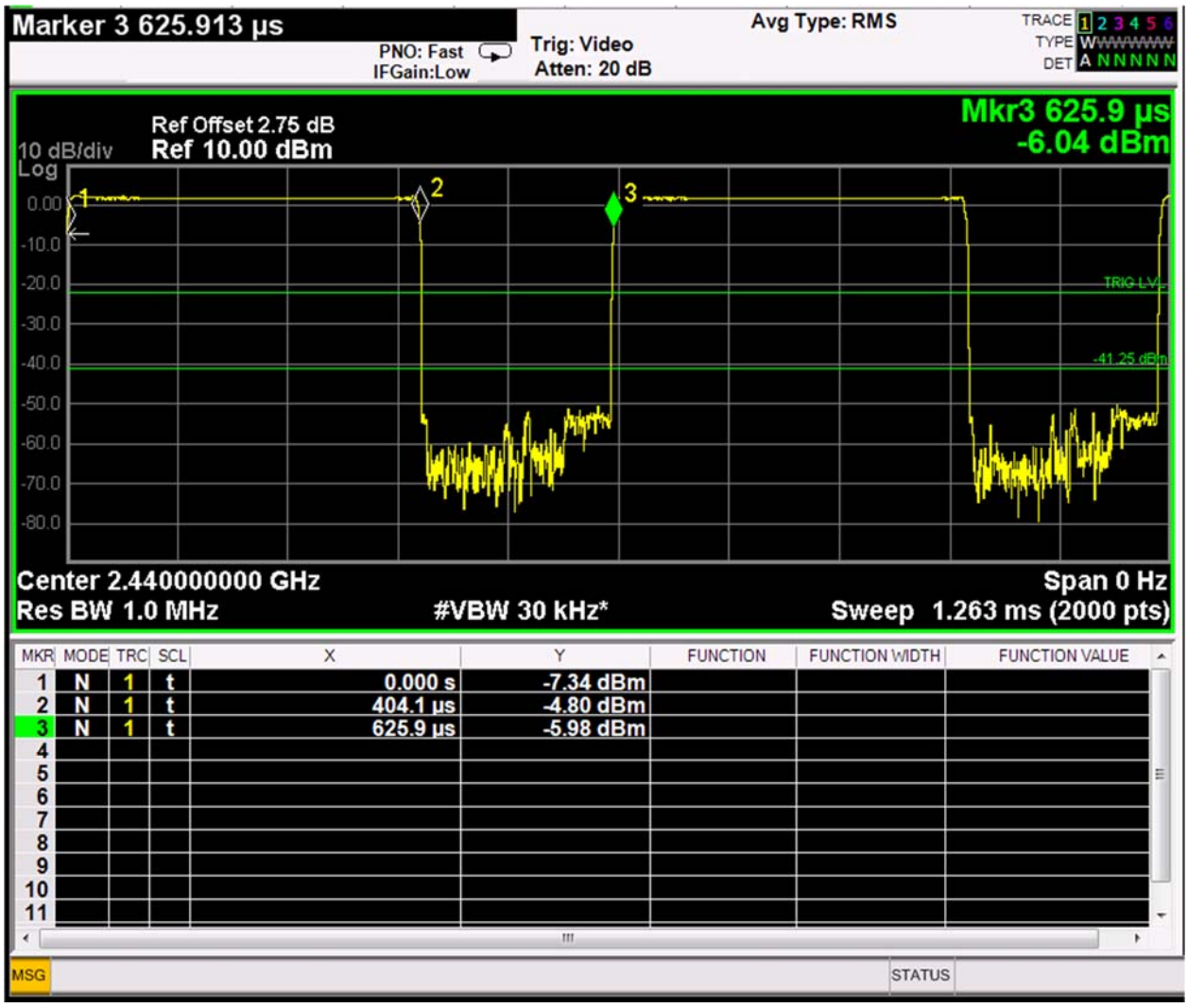
3.3 Mode of Operation Details

Mode#	Description	Comments
1	Continuous Transmitting	Modulation Type-GFSK at 1Mbps @64% duty cycle

Duty Cycle

Duty Cycle = (Tx on / (Tx on + Tx off)) = 404.1us / 625.9us = .641 or 64.1%

Duty Cycle correction = 10 Log (1 / Duty Cycle) = 10 Log (1 / .641) = 10(0.193) = **1.93 dB**



Appendix A: Emission Test Results

Testing Laboratory: Cisco Systems, Inc., 4125 Highlander Parkway, Richfield, OH, USA

Target Maximum Channel Power

The following table details the maximum supported Total Channel Power for all operating modes.

	Maximum Channel Power (dBm)		
	Frequency (MHz)		
Operating Mode	2402	2440	2480
GFSK, 1Mbps	0	0	0

6dB Bandwidth

FCC 15.247(a)(2) / IC RSS-210 A8.2 (a): Systems using digital modulation techniques may operate in the 2400-2483.5MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.

Connect the antenna port(s) to the spectrum analyzer input. Using the spectrum analyzer Channel Bandwidth mode, configure the spectrum analyzer as shown below (enter all losses between the transmitter output and the spectrum analyzer).

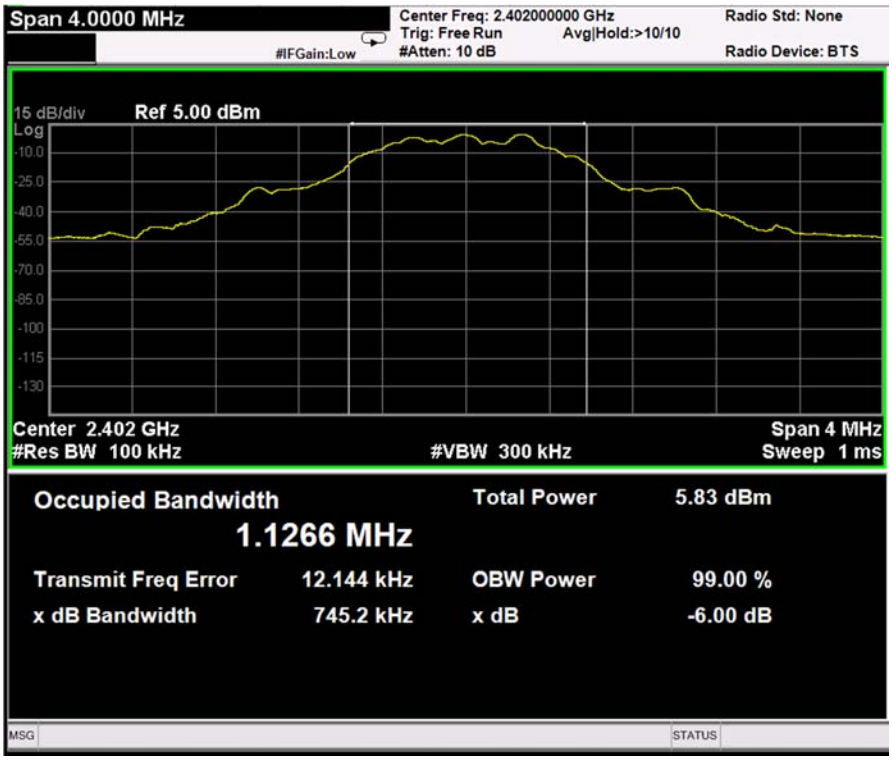
Center Frequency:	Frequency from table below
Span:	2 x Nominal Bandwidth
Reference Level:	5 dBm
Attenuation:	10 dB
Sweep Time:	5 s
Resolution Bandwidth:	100 kHz
Video Bandwidth:	300 kHz
X dB Bandwidth:	6 dB
Detector:	Peak
Trace:	Single

Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit(MHz)	Margin(MHz)

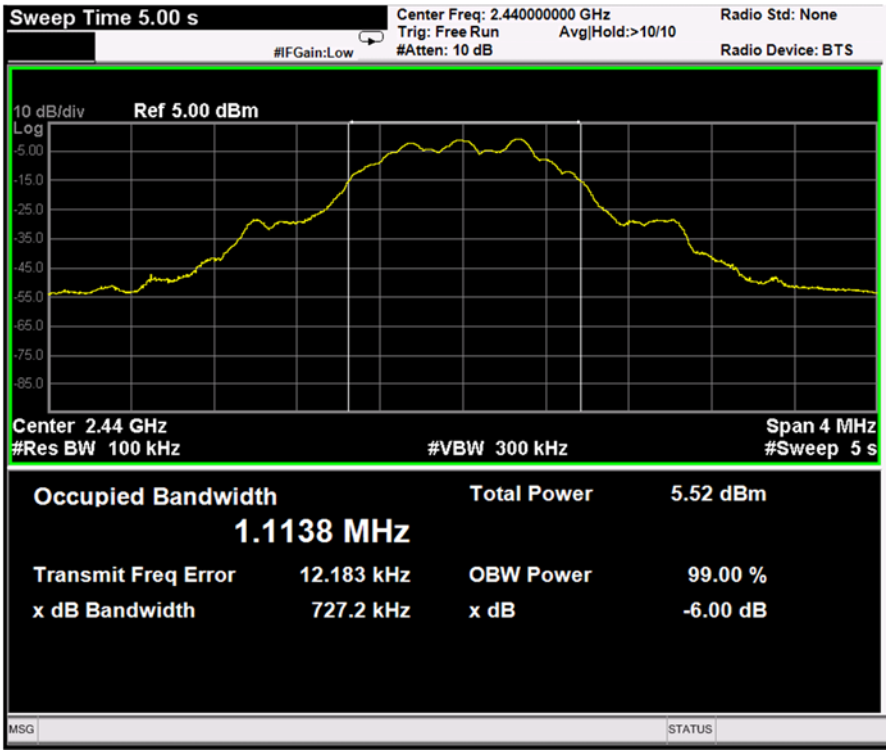
Place the radio in continuous transmit mode. View the transmitter waveform on the spectrum analyzer, and record the pertinent measurements:

2402	**0.745**	**0.5**	**0.245**
2440	**0.727**	**0.5**	**0.272**
2480	**0.719**	**0.5**	**0.719**

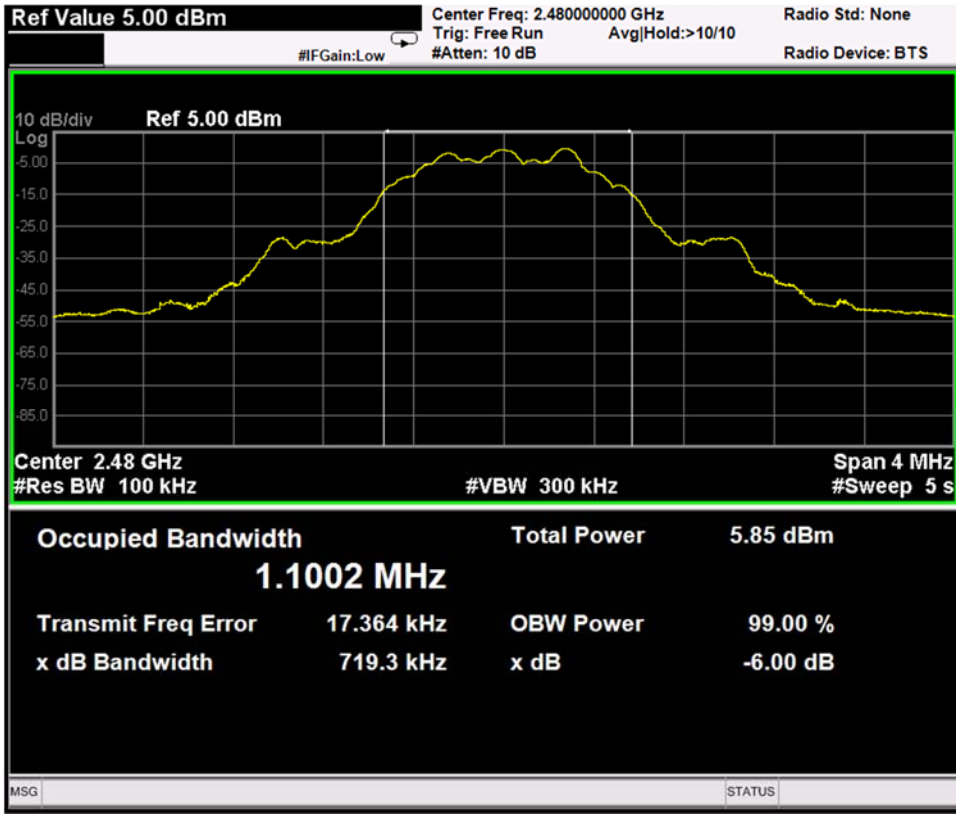
Low Channel 2402 MHz



Mid Channel 2440 MHz



Upper Channel 2480 MHz



99% Bandwidth

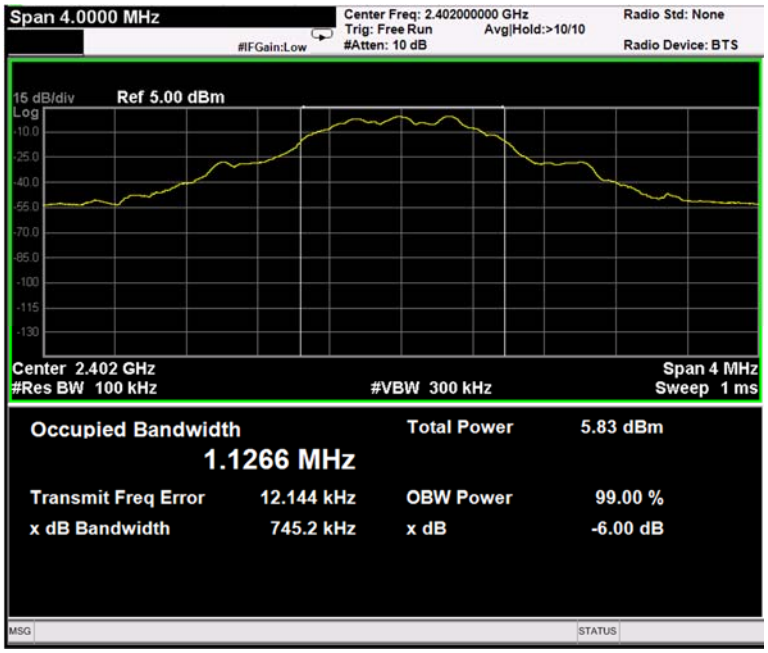
Connect the antenna port(s) to the spectrum analyzer input. Using the spectrum analyzer Channel Bandwidth mode, configure the spectrum analyzer as shown below (enter all losses between the transmitter output and the spectrum analyzer).

Center Frequency:	Frequency from table below
Span:	2 x Nominal Bandwidth
Reference Level:	5 dBm
Attenuation:	10 dB
Sweep Time:	5 s
Resolution Bandwidth:	1%-3% of 26 dB Bandwidth
Video Bandwidth:	≥Resolution Bandwidth
X dB Bandwidth:	26 dB
Detector:	Peak
Trace:	Single

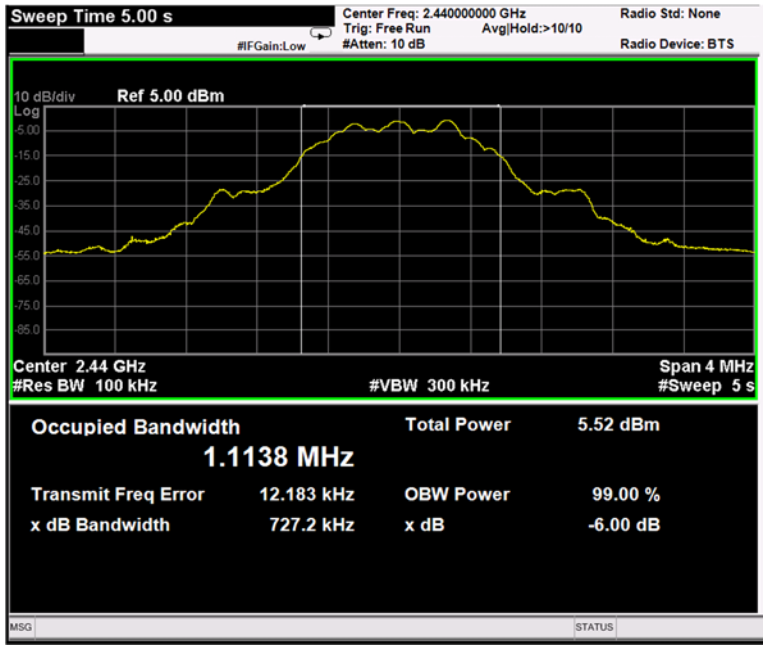
Place the radio in continuous transmit mode. View the transmitter waveform on the spectrum analyzer, and record the pertinent measurements:

Frequency (MHz)	99% Bandwidth(MHz)
2402	1.13
2440	1.12
2480	1.10

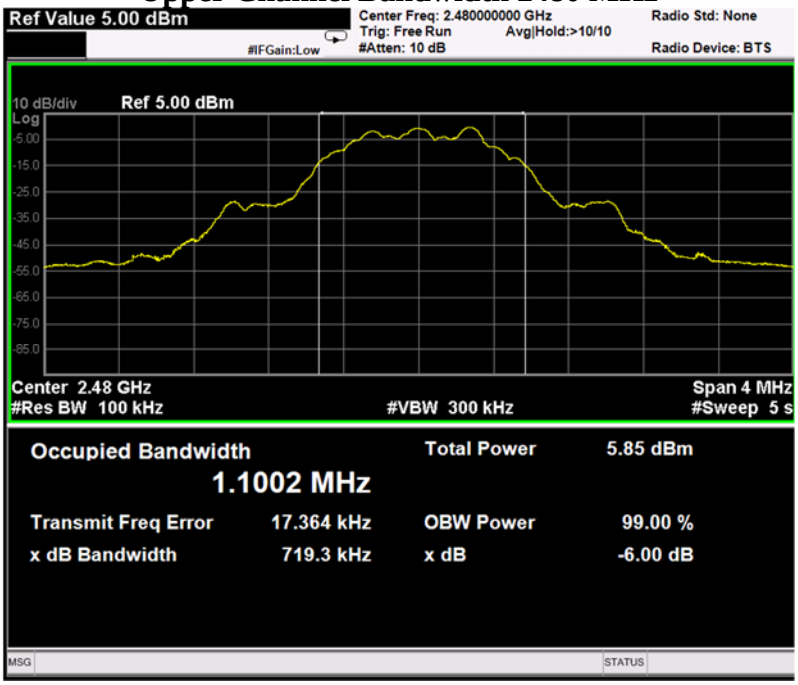
Low Channel Bandwidth 2402 MHz



Mid-Channel Bandwidth 2440 MHz



Upper Channel Bandwidth 2480 MHz



Output Power

FCC 15.247(b) / IC RSS-210 A8.4: The maximum conducted output power of the intentional radiator for systems using digital modulation in the 2400-2483.5 MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum supported antenna gain is 2dBi therefore the limit is 30 dBm.

Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below.

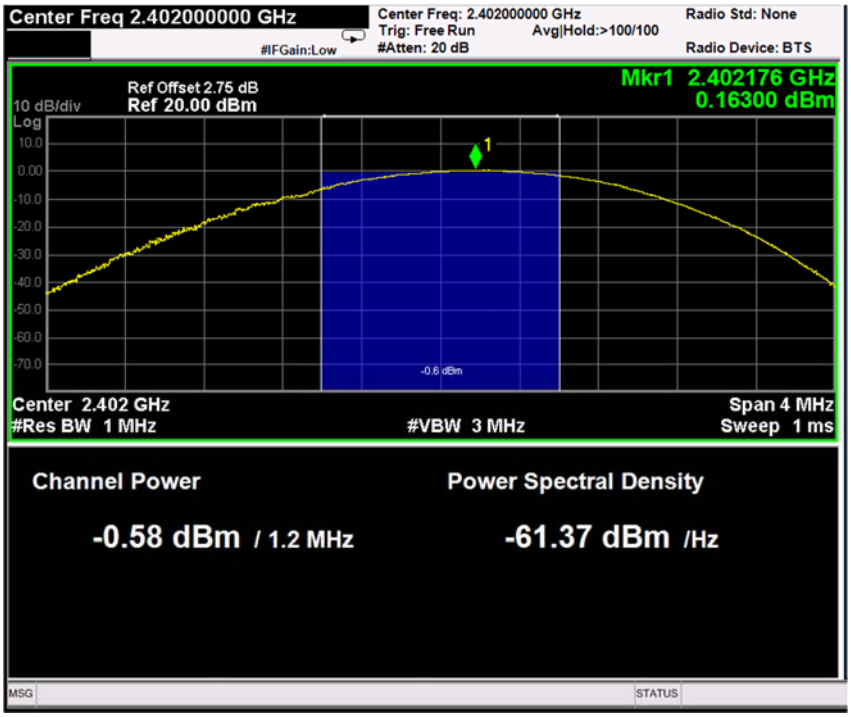
Enable "Channel Power" function of analyzer	
Center Frequency:	Frequency from table below
Span:	4 MHz (must be greater than 99% bandwidth, adjust as necessary)
Ref Level Offset:	Cable Loss .75 dB, Duty Cycle Correction 2 dB= 2.75 dB
Reference Level:	5 dBm
Attenuation:	20 dB
Sweep Time:	100ms, Single sweep
Resolution Bandwidth:	1 MHz
Video Bandwidth:	3 MHz
Detector:	Sample
Trace:	Trace Average 100 traces in Power Averaging Mode
Integration BW:	=99% BW from 99% Bandwidth Data

After averaging 100 traces of the transmitter waveform on the spectrum analyzer, record the spectrum analyzer Channel Power.

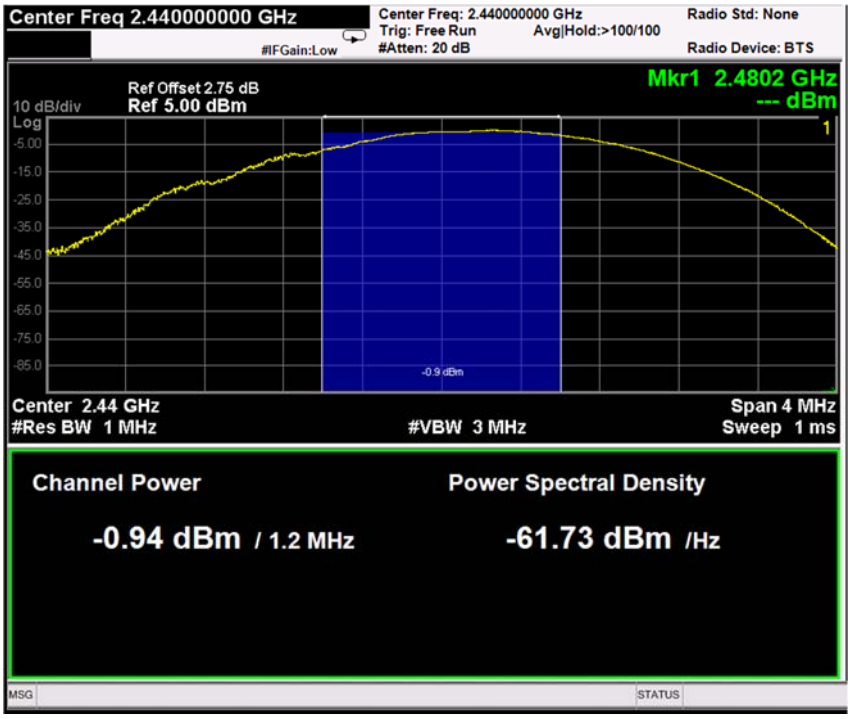
Frequency (MHz)	Power(dBm)	Limit (dBm)	Margin (dB)
2402	-0.58	30	30.58
2440	-0.94	30	30.94

2480	**-0.64**	**30**	**30.64**

Channel Power 2402 MHz



Channel Power 2440 MHz



Channel Power 2480 MHz

Power Spectral Density

15.247 (e) / IC RSS-210 A8.2: For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

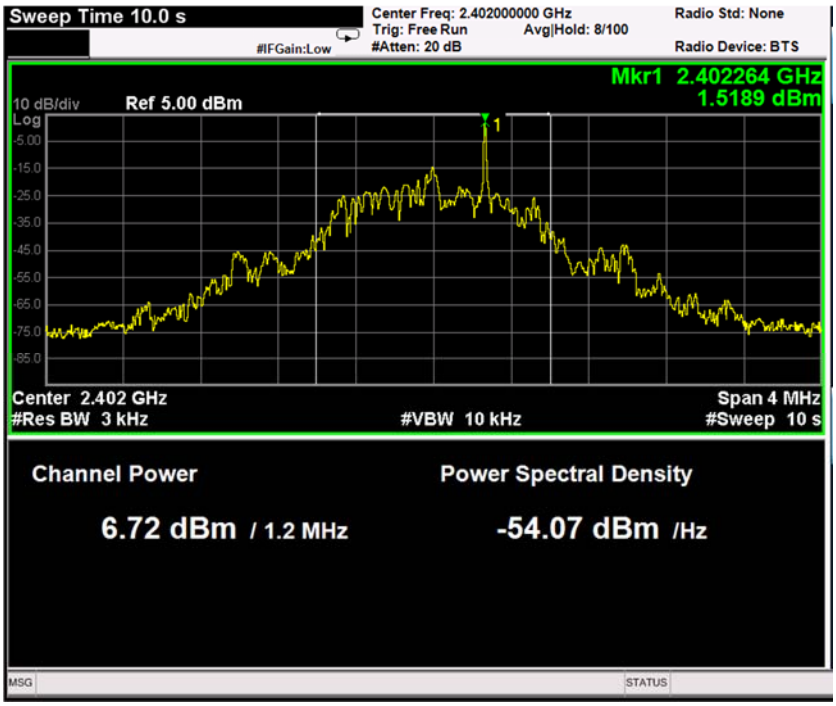
Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below.

Center Frequency:	Frequency from table below
Span:	4 MHz
Ref Level Offset:	Correct for attenuator and cable loss.
Reference Level:	5 dBm
Attenuation:	20 dB
Sweep Time:	10s
Resolution Bandwidth:	3 kHz
Video Bandwidth:	10 kHz
Detector:	Peak
Trace:	Single
Marker:	Peak Search

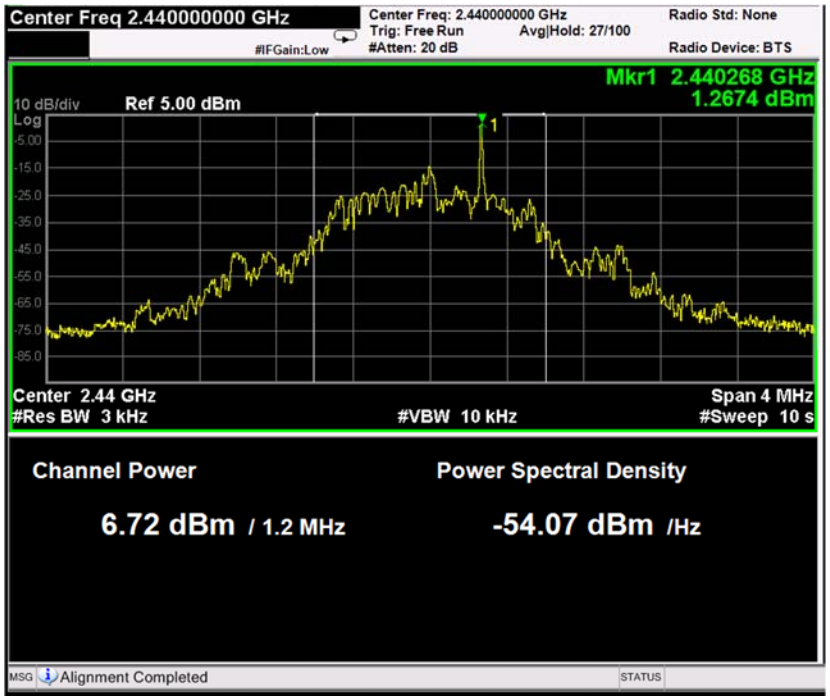
Record the Marker value.

Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
2402	1.52	8	6.48
2440	1.27	8	6.73
2480	1.57	8	6.43

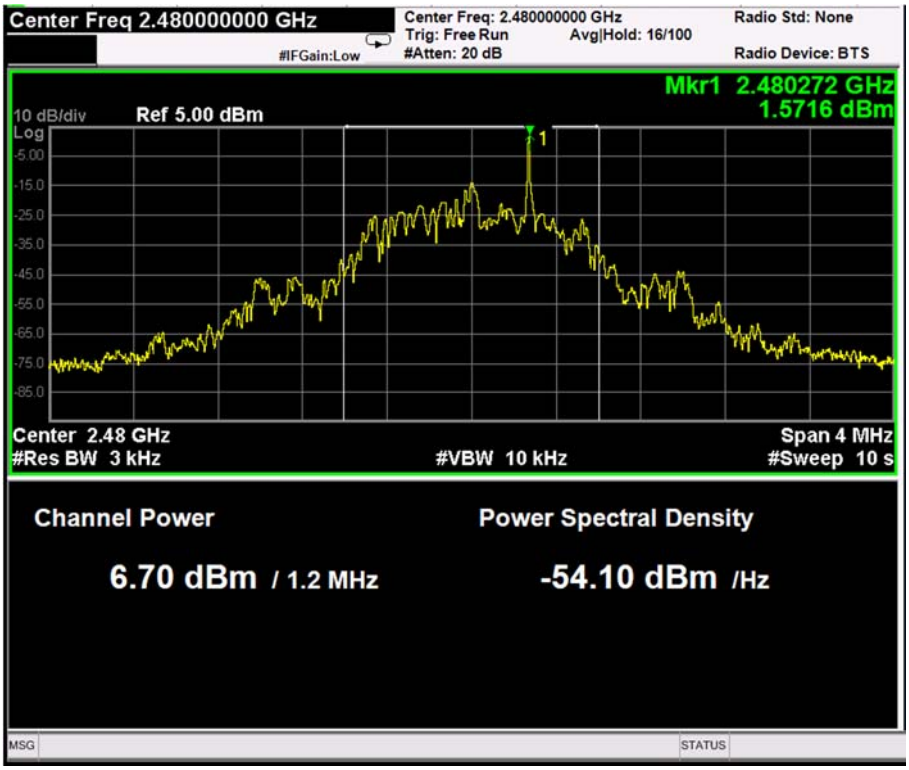
PSD 2402 MHz



PSD 2440 MHz



PSD 2480 MHz



Conducted TX Spurious Emissions

15.247 (d)/ IC RSS-210 A8.5: In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer).

Span:	30 MHz-26 GHz
Reference Level:	5 dBm
Attenuation;	10 dB
Sweep Time:	5s
Resolution Bandwidth:	100 kHz
Video Bandwidth:	300 kHz
Detector:	Peak
Trace:	Single
Marker:	Peak

Record the marker waveform peak to spur difference

Frequency (MHz)	Conducted Spur Delta (dBm)	Limit (dBc)	Margin (dB)
2402	-46.6	>30	16.6
2440	-47.5	>30	17.5
2480	-49.8	>30	19.8

Lower Channel Tx Spurs

Mid-Channel Channel Tx Spurs

Upper Channel Tx Spurs

Conducted Bandedge

15.205: Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Use the procedures in 558074 D01 DTS Meas Guidance v0 to substitute conducted measurements in place of radiated measurements.

Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Be sure to enter all losses between the transmitter output and the spectrum analyzer.

Reference Level:	110 dBuV
Attenuation:	10 dB
Sweep Time:	Coupled
Resolution Bandwidth:	1MHz
Video Bandwidth:	3 MHz for peak, 10 Hz for average
Detector:	Peak

Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= -41.25 dBm (54dBuV @3m)
2) Peak plot (Vertical and Horizontal), Limit = -27 dBm (74dBuV @3m)

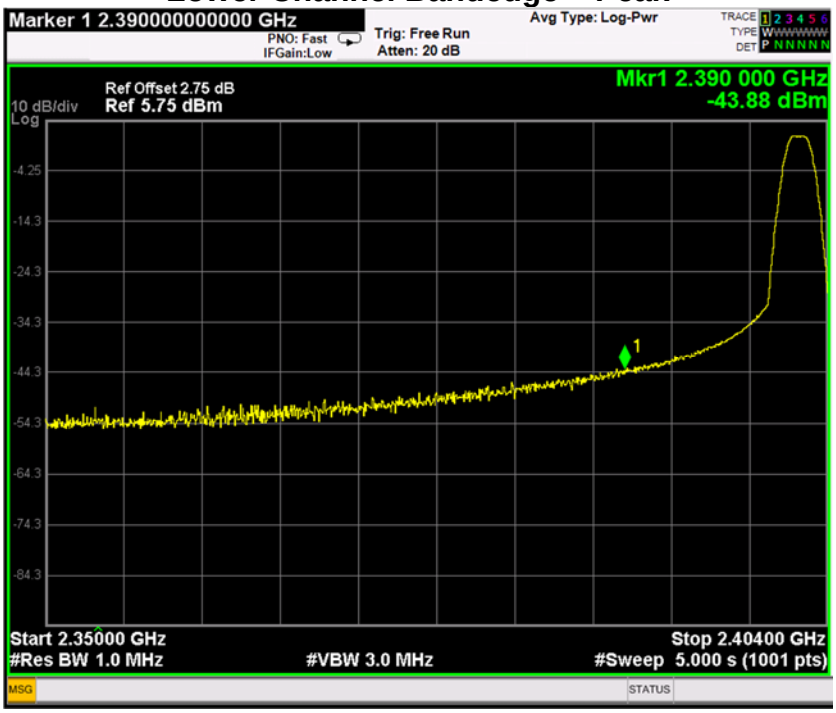
Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands.

Frequency (MHz)	Band Edge Level (dBuV/m)	Antenna Gain (dBi)	Total (dBm)	Average Limit (dBm)	Margin (dB)
2402	-66.40	2	-64.40	-41.25	25.15
2480	-64.77	2	-62.77	-41.25	21.52

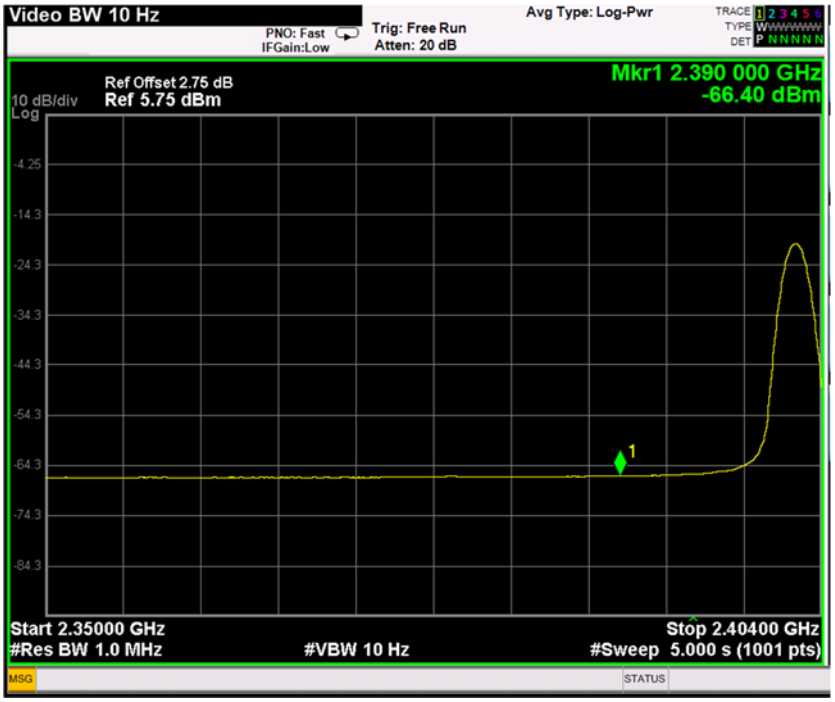
Frequency (MHz)	Band Edge Level (dBuV/m)	Antenna Gain (dBi)	Total (dBm)	Peak Limit (dBm)	Margin (dB)

2402	**-43.88**	**2**	**-41.88**	**-27**	**14.88**
2480	**-35.00**	**2**	**-33.00**	**-27**	**6.0**

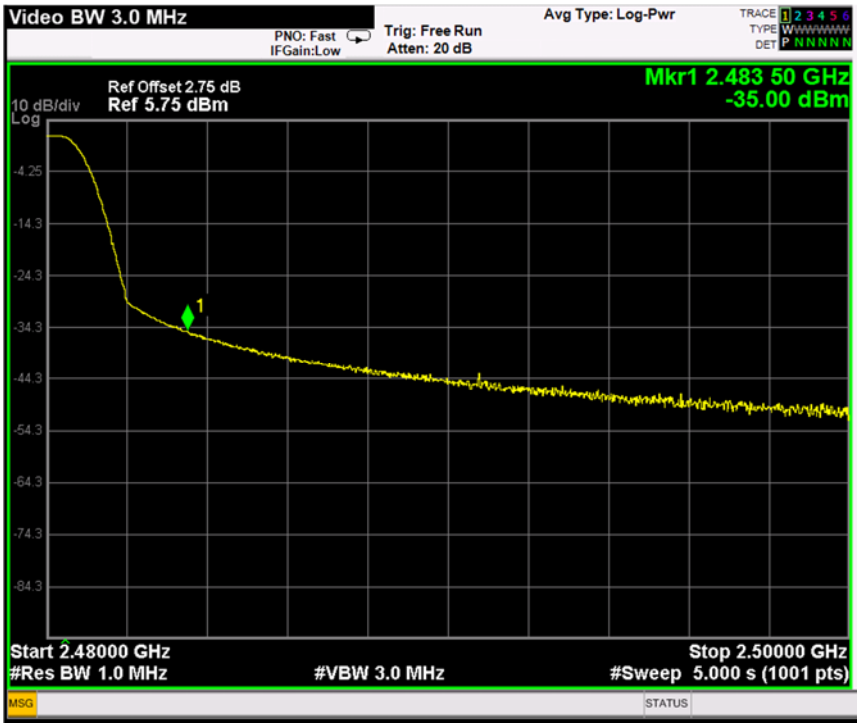
Lower Channel Bandedge – Peak



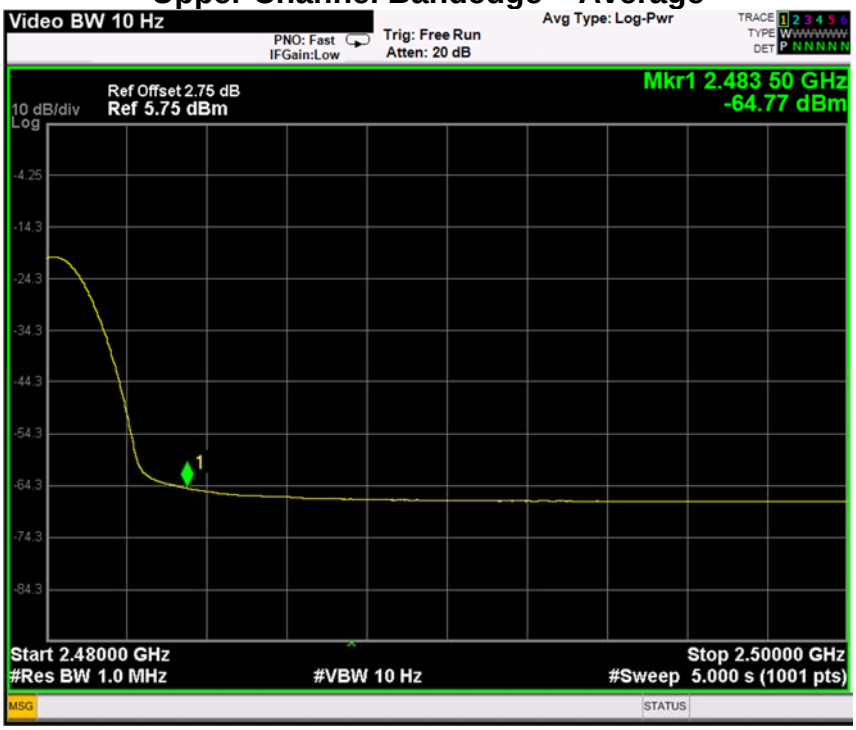
Lower Channel Bandedge – Average



Upper Channel Bandedge – Peak



Upper Channel Bandedge – Average



Conducted Spurious Emissions

15.205 / RSS-210 2.7: Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Use the procedures in 558074 D01 DTS Meas Guidance v0 to substitute conducted measurements in place of radiated measurements.

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

Span:	1GHz – 18 GHz
Reference Level:	80 dBuV
Attenuation:	10 dB
Sweep Time:	Coupled
Resolution Bandwidth:	1MHz
Video Bandwidth:	1 MHz for peak, 10 Hz for average
Detector:	Peak

Terminate the access Point RF ports with 50 ohm loads.

Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= -41.25 dBm (54dBuV @3m)
2) Peak plot (Vertical and Horizontal), Limit = -27 dBm (74dBuV @3m)

Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands.

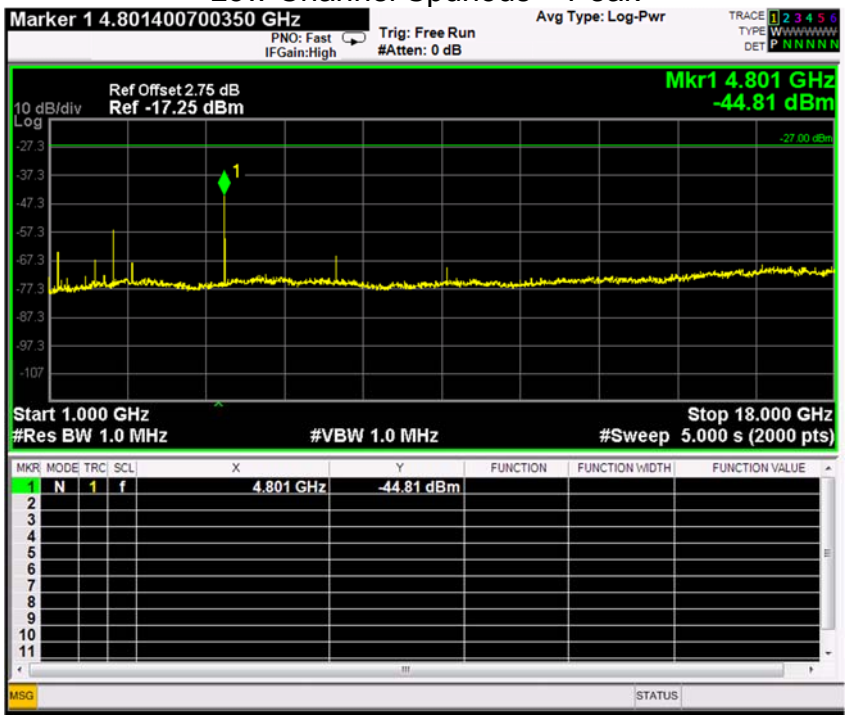
This report represents the worst case data for all supported operating modes and antennas. There are no measurable emissions above 18 GHz.

Frequency (MHz)	Spurious Emission Level (dBm)	Peak Limit (dBm)	Margin (dB)
2402	-44.81	-27	17.81
2440	-50.37	-27	23.37
2480	-47.17	-27	20.17

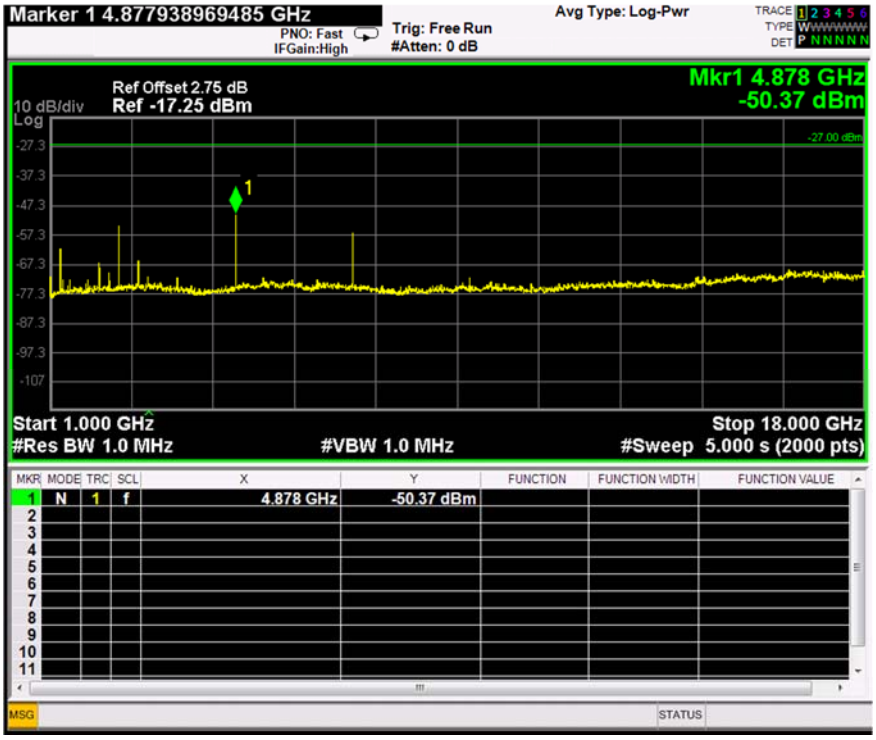
Frequency (MHz)	Spurious Emission Level (dBm)	Average Limit (dBm)	Margin (dB)
2402	-57.60	-41.25	16.35

2440	**-57.74**	**-41.25**	**16.49**
2480	**-57.43**	**-41.25**	**16.18**

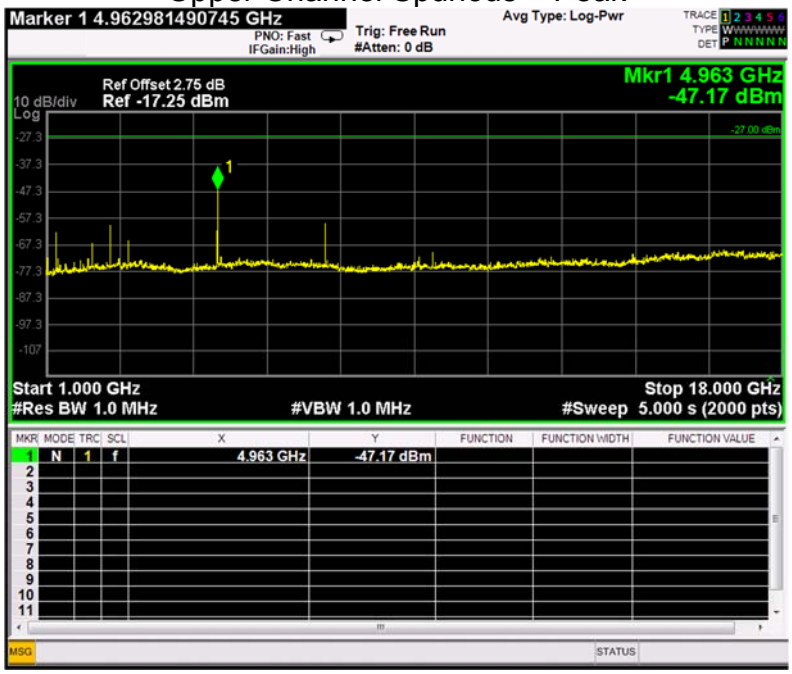
Low Channel Spurious – Peak



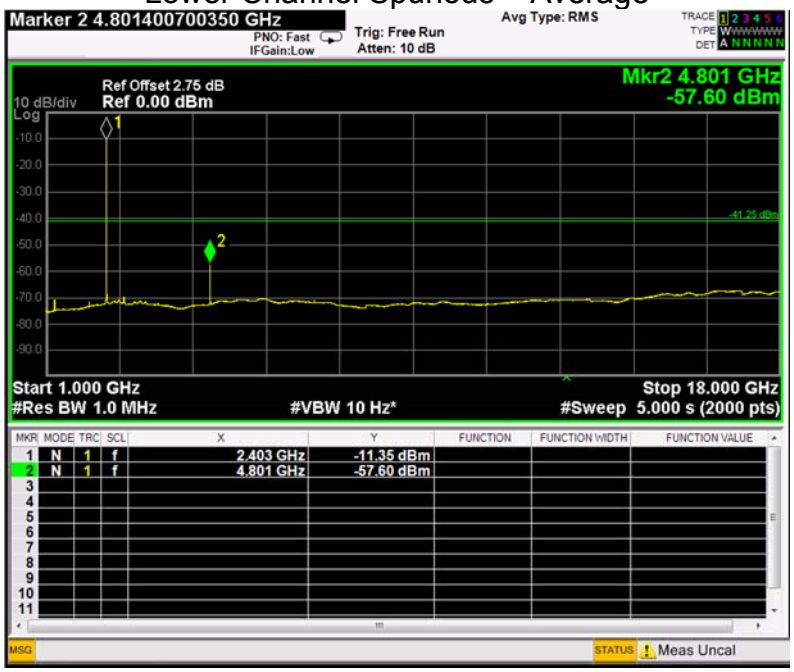
Mid-Channel Spurious – Peak



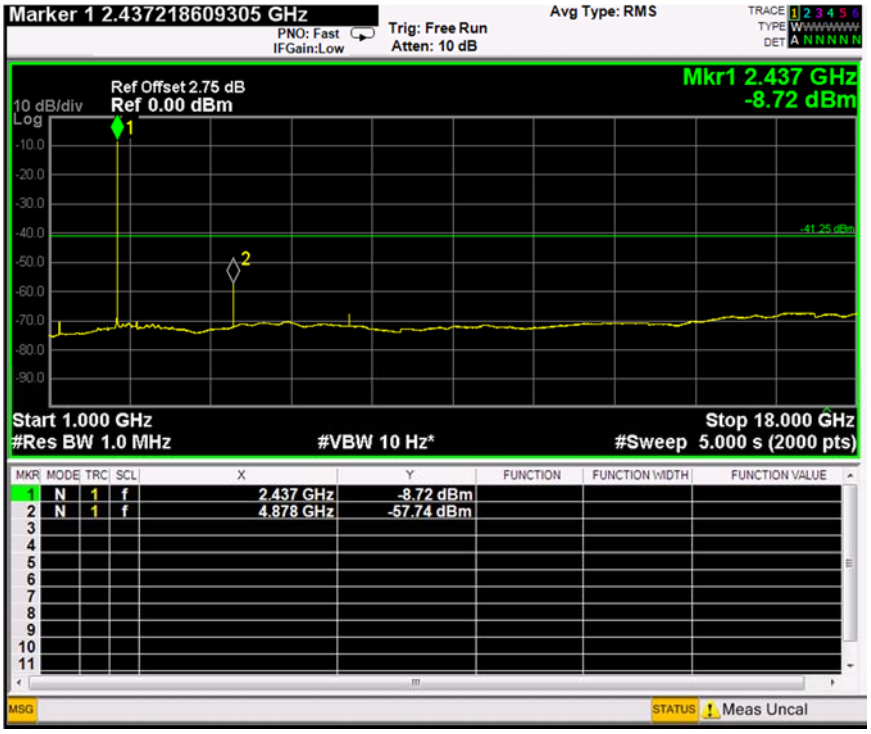
Upper Channel Spurious – Peak



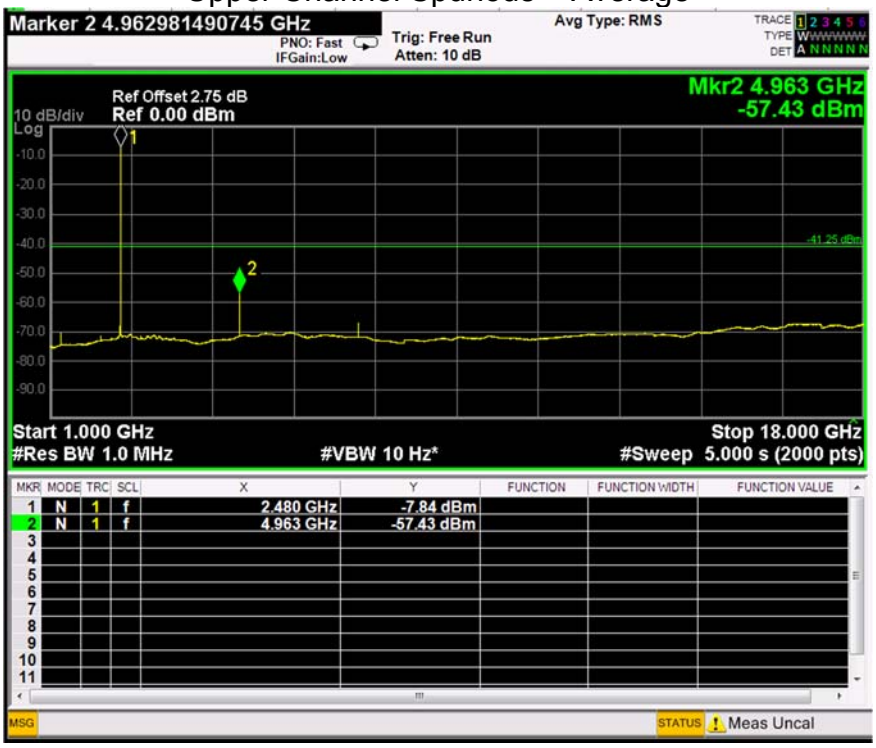
Lower Channel Spurious – Average



Mid-Channel Spurious – Average

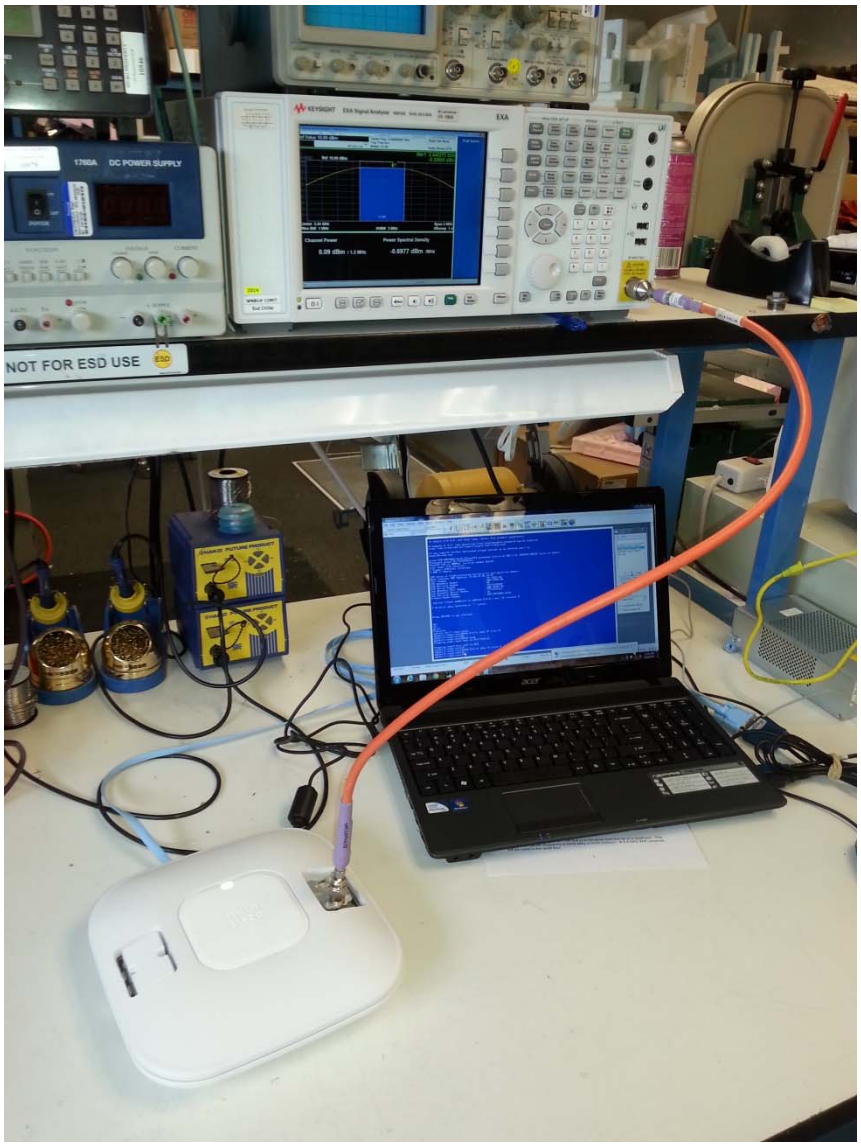


Upper Channel Spurious – Average



Appendix B: Test Equipment Used to perform conducted tests

Equip CIS#	Manufacturer	Model	Description	Last Cal	Next Due
53633	Keysite	N9010A	Spectrum Analyzer	10/2014	10/2015
32307	Micro-Tronics	BRM50702-02	2.4-2.5GHz Notch Filter, COM-517	10/2014	10/2015
43676	Megaphase	SF18 S1S1 36	36 inch RF Cable, COM-594	9/2014	9/2015



Conducted Test Setup

Appendix C: Radiated Emissions

Testing Laboratory

Cisco Systems, Inc.,
170 West Tasman Drive
San Jose, CA 95134,
USA

Registration Numbers for Industry Canada

Cisco System Site	Site Identifier
Building P, 10m Chamber	Company #: 2461N-2
Building P, 5m Chamber	Company #: 2461N-1
Building I, 5m Chamber	Company #: 2461M-1

Test Engineers

Jose Aguirre

Transmitter Radiated Spurious Emissions

FCC 15.209; RSS-Gen 6.13, 8.9 Issue 4

FCC 15.209: The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the table specified in the table in FCC§15.209(a).

RSS-Gen 6.13: In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:
(a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

RSS-Gen 8.9: Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Radiated emissions which fall in the restricted bands, as defined in FCC Section 15.205(a) and RSS-Gen Section 8.10, must also comply with the radiated emission limits specified in FCC Section 15.209(a) and RSS-Gen Section 8.9.

15.209 (a)/RSS Gen 8.9: Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (uV/meter)	Field strength (dBuV/meter)	Measurement distance (meters)
30-88	100**	40 Qp	3
88-216	150**	43.5 Qp	3
216-960	200**	46 Qp	3
Above 960	500	54 Av / 74 Pk	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-

806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

Test Procedure

Ref. C63.10-2009 section 6.5 & 6.6

Test Procedure
1. Using Vasona software, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). 2. Place the radio in continuous transmit mode. Maximize Turntable (find worst case table angle) and maximize Antenna (find worst case height). 3. Use the peak marker function to determine the maximum amplitude level. 4. Center marker frequency and perform final measurement in Quasi-peak (≤ 1Ghz) and Average (above 1 GHz) 4. Record at least 6 highest readings for the worst case operating mode.

Ref. C63.10-2009 section 4 / CISPR16-1-1

Test Parameters
Span = Entire frequency range or segment if necessary. Reference Level = 80 dBuV RBW = 100 kHz (less than or equal to 1 GHz); 1 MHz (above 1 GHz) VBW ≥ 3 x RBW Detector = Peak & Quasi-Peak (frequency range 30 MHz to 1 GHz); Peak & Average (frequency range above 1 GHz); Changing VBW to 10 Hz for average measurement Sweep Time = Couple

. The system was evaluated up to 26 GHz but there were no measurable emissions above 10 GHz.
. These data represent the worst case mode data for all supported operating modes and antennas.

- For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.
- Above 1000 MHz, measurements shall be performed using an average detector with a minimum resolution bandwidth of 1 MHz.

Note2: The data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements

Recorded Test Data:

TX Spurious Emissions Test Result Tables for 802.15 (Ch0 /Pk/Qp)

Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30.0 MHz - 1.0 GHz
Comments on the above Test Results	TX Channel 0 (2402 MHz) – with GFSK LE modulation – 1 Mbps

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Detector	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
31.455	-1.06	0.33	20.42	19.69	Quasi Max	V	166	285	40	-20.31	Pass
625.023	16.17	1.56	19.34	37.07	Quasi Max	H	105	228	46	-8.93	Pass
767.982	9.04	1.77	20.8	31.6	Quasi Max	V	107	226	46	-14.4	Pass
485.228	14.4	1.38	17.53	33.31	Quasi Max	V	155	202	46	-12.69	Pass
57.808	11.28	0.45	7.6	19.33	Quasi Max	V	127	344	40	-20.67	Pass
375.01	12.83	1.2	14.94	28.98	Quasi Max	V	127	138	46	-17.02	Pass

TX Spurious Emissions Test Result Tables for 802.15 (Ch18 /Pk/Qp)

Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30.0 MHz - 1.0 GHz
Comments on the above Test Results	TX Channel 18 (2442 MHz) – with GFSK LE modulation – 1 Mbps

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Detector	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail

30.485	0.28	0.32	21.15	21.75	Quasi Max	V	162	215	40	-18.25	Pass
625.025	13.36	1.56	19.34	34.26	Quasi Max	V	105	169	46	-11.74	Pass
768.019	11.97	1.77	20.8	34.53	Quasi Max	V	105	186	46	-11.47	Pass
485.223	15.27	1.38	17.53	34.17	Quasi Max	V	145	199	46	-11.83	Pass
375.005	15.06	1.2	14.94	31.2	Quasi Max	V	100	118	46	-14.8	Pass
58.615	12.95	0.46	7.67	21.08	Quasi Max	V	120	161	40	-18.92	Pass

TX Spurious Emissions Test Result Tables for 802.15 (Ch39 /Pk/Qp)

Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30.0 MHz - 1.0 GHz
Comments on the above Test Results	TX Channel 39 (2480 MHz) – with GFSK LE modulation – 1 Mbps

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
768.019	12.12	1.77	20.8	34.69	Quasi Max	V	103	184	46	-11.31	Pass
625.025	14.2	1.56	19.34	35.1	Quasi Max	V	112	146	46	-10.9	Pass
485.223	13.85	1.38	17.53	32.75	Quasi Max	V	173	197	46	-13.25	Pass
375.005	14.41	1.2	14.94	30.55	Quasi Max	V	108	131	46	-15.45	Pass
30.485	0.07	0.32	21.15	21.54	Quasi Max	V	172	300	40	-18.46	Pass
58.615	12.02	0.46	7.67	20.15	Quasi Max	V	145	251	40	-19.85	Pass

TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch0 /Peak)

Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1.0 GHz - 18.0 GHz
Comments on the above Test Results	TX Channel 0 (2402 MHz) – with GFSK modulation – 1 Mbps

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Detector	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
4804.32	45.29	4.24	-2.85	46.68	Peak.	H	150	50	74	-27.32	Pass
4804.539	43.71	4.24	-2.85	45.1	Peak.	V	150	355	74	-28.9	Pass
7204.93	43.88	5.12	-2.04	46.96	Peak.	H	150	50	74	-27.04	Pass
7204.93	44.51	5.12	-2.04	47.59	Peak.	V	150	355	74	-26.41	Pass
9607.156	42.41	6.05	3.14	51.6	Peak.	V	150	355	74	-22.4	Pass
9607.656	41.94	6.05	3.14	51.13	Peak.	H	150	50	74	-22.87	Pass
12010	41.5	6.7	4.6	52.8	Peak.	H	150	360	74	-21.2	Pass
12010	40.2	6.7	4.6	51.5	Peak.	V	150	360	74	-22.5	Pass

TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch0 /Average)

Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1.0 GHz - 18.0 GHz (Average)
Comments on the above Test Results	TX Channel 0 (2402 MHz) – with GFSK modulation – 1 Mbps

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Detector	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail

4804.468	36.36	4.24	-2.85	37.75	Average.	H	150	284	54	-16.25	Pass
4804.543	34.53	4.24	-2.85	35.92	Average.	V	150	360	54	-18.08	Pass
7204.93	32.71	5.12	-2.04	35.79	Average.	H	150	284	54	-18.21	Pass
7204.477	33.16	5.12	-2.05	36.23	Average.	V	150	360	54	-17.77	Pass
9607.156	30.27	6.05	3.14	39.46	Average.	H	150	284	54	-14.54	Pass
9607.656	30.46	6.05	3.14	39.65	Average.	V	150	360	54	-14.35	Pass
12010	31	6.7	4.6	42.3	Average.	H	150	360	54	-11.7	Pass
12010	31.4	6.7	4.6	42.7	Average.	V	150	360	54	-11.3	Pass
5117.5	40.22	4.33	-2.54	42.01	Average.	V	150	0	54	-11.99	Pass

TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch18 /Peak)

Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1.0 GHz - 18.0 GHz
Comments on the above Test Results	TX Channel 18 (2442 MHz) – with GFSK modulation – 1 Mbps

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Detector	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
4884.141	42.39	4.28	-2.79	43.88	Peak.	V	150	36	74	-30.12	Pass
7326.101	40.79	5.18	-1.84	44.14	Peak.	V	150	36	74	-29.86	Pass
9767.547	41.56	6.06	3.38	51	Peak.	V	150	36	74	-23	Pass
4884.263	43.6	4.28	-2.79	45.09	Peak.	H	150	307	74	-28.91	Pass
7328.728	46.1	5.18	-1.78	49.51	Peak.	H	150	307	74	-24.49	Pass
9767.764	38.9	6.06	3.38	48.34	Peak.	H	150	307	74	-25.66	Pass
12210.625	39.6	6.7	4.2	50.56	Peak.	H	150	360	74	-23.44	Pass
12209.375	39.5	6.7	4.2	50.51	Peak.	V	150	360	74	-23.49	Pass

TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch18 /Average)

Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1.0 GHz - 18.0 GHz (Average)
Comments on the above Test Results	TX Channel 18 (2442 MHz) – with GFSK modulation – 1 Mbps

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Detector	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail

4884.641	33.76	4.28	-2.79	35.25	Average.	V	150	39	54	-18.75	Pass
7326.101	32.16	5.18	-1.84	35.51	Average.	V	150	39	54	-18.49	Pass
9767.984	30.47	6.06	3.38	39.91	Average.	V	150	39	54	-14.09	Pass
4884.732	36.01	4.28	-2.79	37.5	Average.	H	150	304	54	-16.5	Pass
7326.197	35.47	5.18	-1.83	38.82	Average.	H	150	304	54	-15.18	Pass
9767.764	32	6.06	3.38	41.44	Average.	H	150	304	54	-12.56	Pass
12210.084	29.13	6.72	4.23	40.09	Average.	H	150	360	54	-13.91	Pass
12210.117	29.3	6.7	4.2	40.23	Average.	V	150	360	54	-13.8	Pass
5117.5	40.22	4.33	-2.54	42.01	Average.	V	150	0	54	-11.99	Pass

TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch39 /Peak)

Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1.0 GHz - 18.0 GHz
Comments on the above Test Results	TX Channel 39 (2480 MHz) – with GFSK modulation – 1 Mbps

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Detector	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
4959.094	42.96	4.28	-2.87	44.36	Peak.	V	150	33	74	-29.64	Pass
7443.188	43.41	5.26	-0.75	47.92	Peak.	V	150	33	74	-26.08	Pass
9920	40.9	6.09	3.92	50.91	Peak.	V	150	33	74	-23.09	Pass
4960.375	43.3	4.28	-2.86	44.72	Peak.	H	150	310	74	-29.28	Pass
7449.594	43.63	5.26	-0.85	48.04	Peak.	H	150	310	74	-25.96	Pass
9923.75	41.42	6.09	3.91	51.42	Peak.	H	150	310	74	-22.58	Pass
12399.925	42.05	6.76	3.88	52.7	Peak.	H	150	360	54	-1.3	Pass
12400.013	41.85	6.76	3.88	52.5	Peak.	V	150	360	54	-1.5	Pass

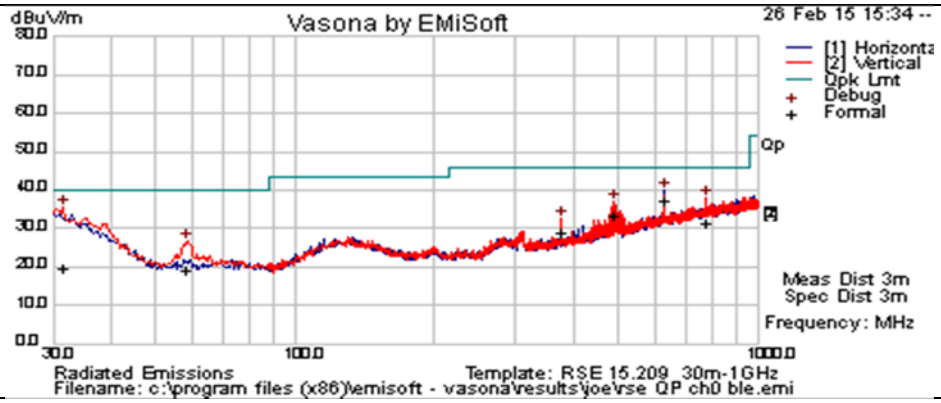
TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch39 /Average)

Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1.0 GHz - 18.0 GHz (Average)
Comments on the above Test Results	TX Channel 39 (2480 MHz) – with GFSK modulation – 1 Mbps

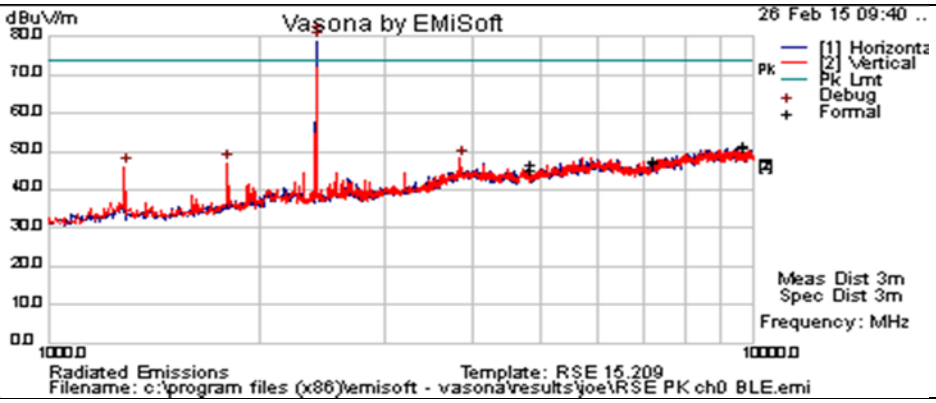
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Detector	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail

3840.625	41.25	3.82	-1.88	43.2	Average.	V	150	0	54	-10.81	Pass
4960.375	32.84	4.28	-2.86	34.26	Average.	H	150	313	54	-19.74	Pass
4960.688	34.05	4.28	-2.85	35.48	Average.	V	150	29	54	-18.52	Pass
7443.188	34.46	5.26	-0.75	38.97	Average.	V	150	29	54	-15.03	Pass
7449.594	33.28	5.26	-0.85	37.69	Average.	H	150	313	54	-16.31	Pass
9920	31.57	6.09	3.92	41.58	Average.	V	150	29	54	-12.42	Pass
9923.75	32.83	6.09	3.91	42.83	Average.	H	150	313	54	-11.17	Pass
5117.5	40.22	4.33	-2.54	42.01	Average.	V	150	0	54	-11.99	Pass
12400.151	30.51	6.76	3.88	41.16	Average.	H	150	360	54	-12.84	Pass
12400.093	30.9	6.8	3.9	41.53	Average.	V	150	360	54	-12.47	Pass

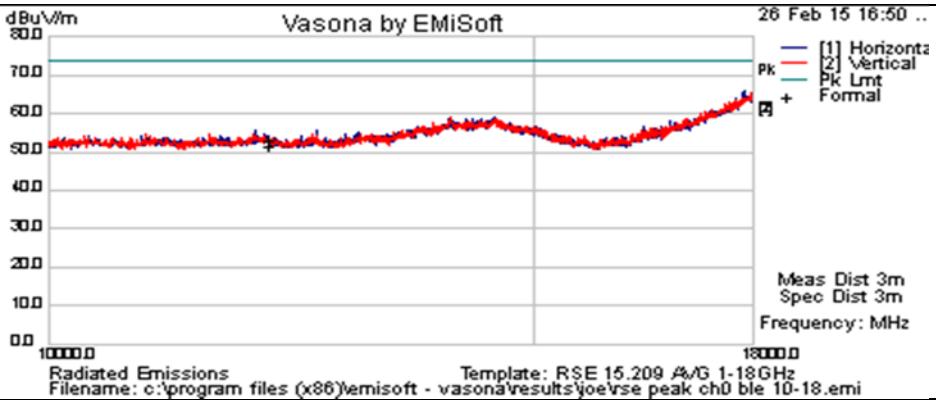
Graphical Test Results



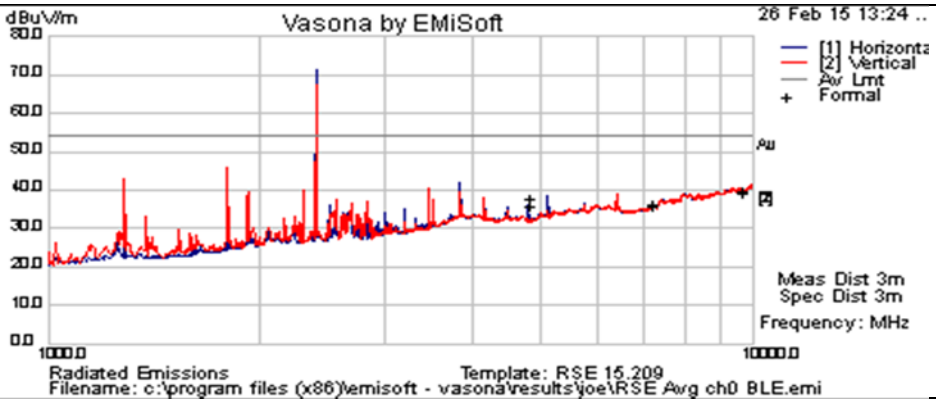
TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch0 /Peak/QP)
Radiated Tx Spurious Emissions 30MHz to 1GHz



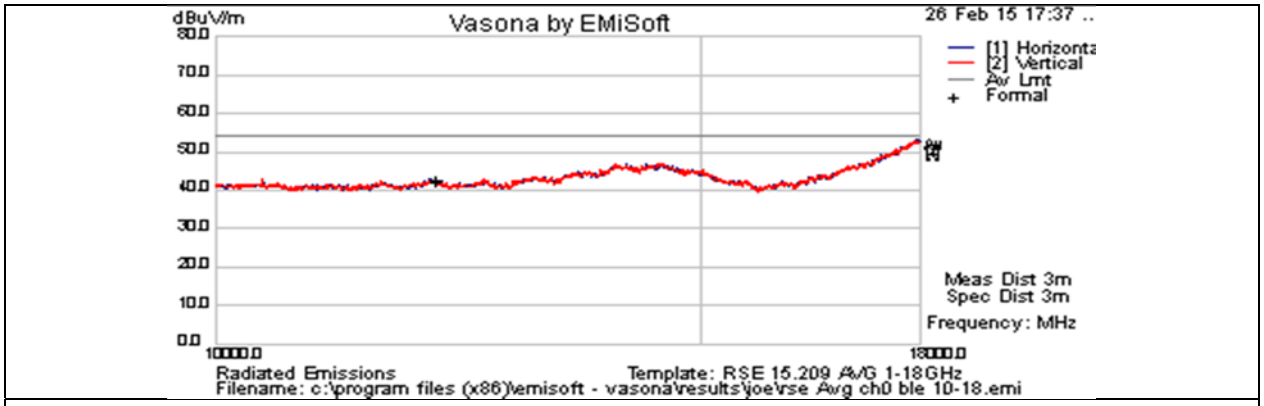
TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch0 /Peak)
Radiated Tx Spurious Emissions 1GHz to 10GHz



TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch0 /Peak)
Radiated Tx Spurious Emissions 10GHz to 18GHz

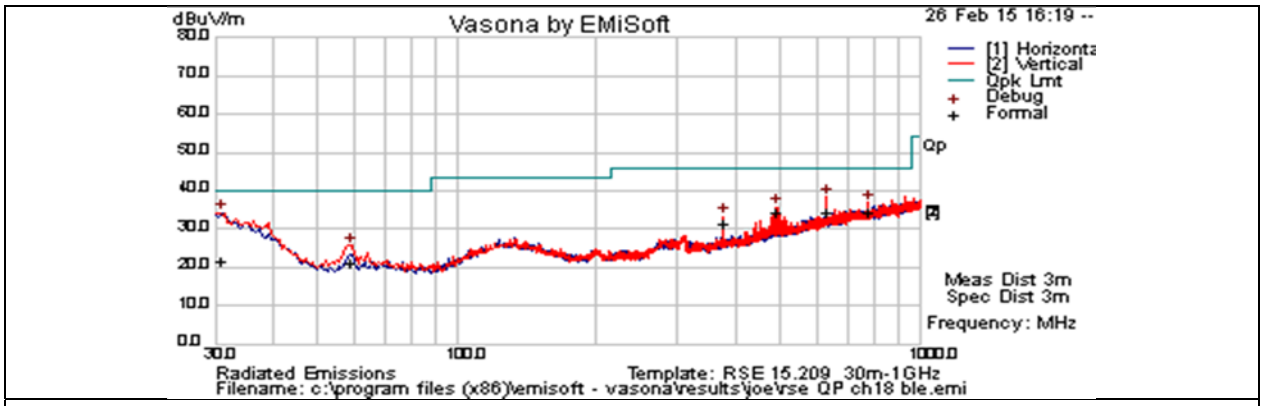


TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch0 /Average)
Radiated Tx Spurious Emissions 1GHz to 10GHz

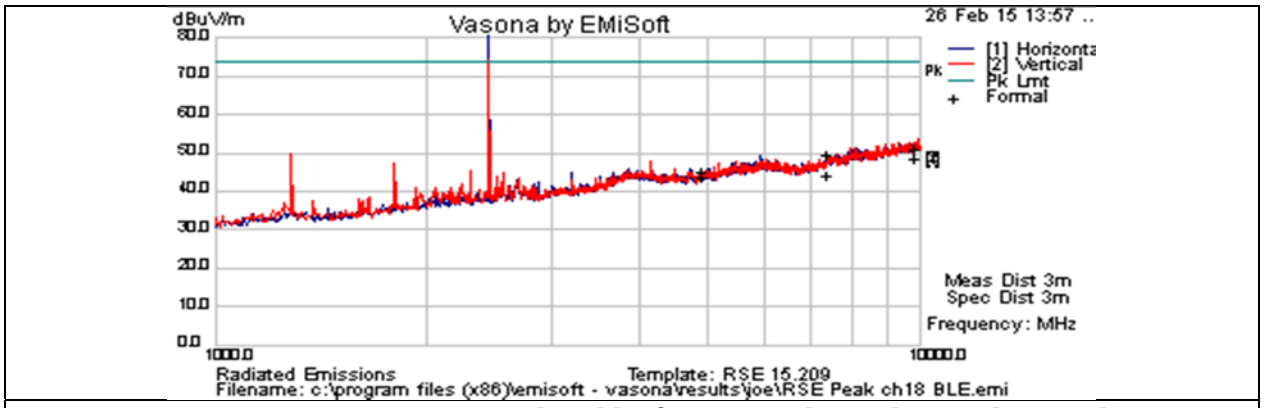


TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch0 /Average)
Radiated Tx Spurious Emissions 10GHz to 18GHz

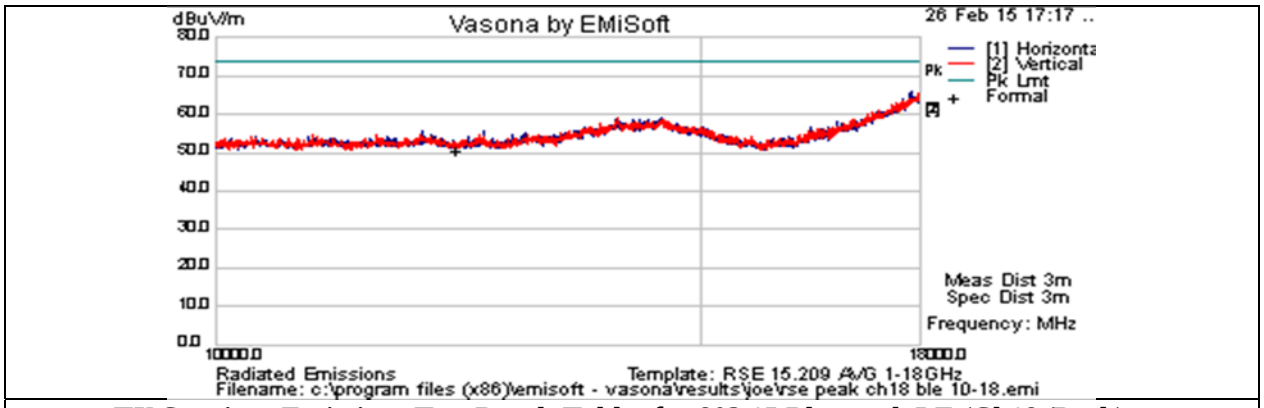
No Emissions seen above 10GHz



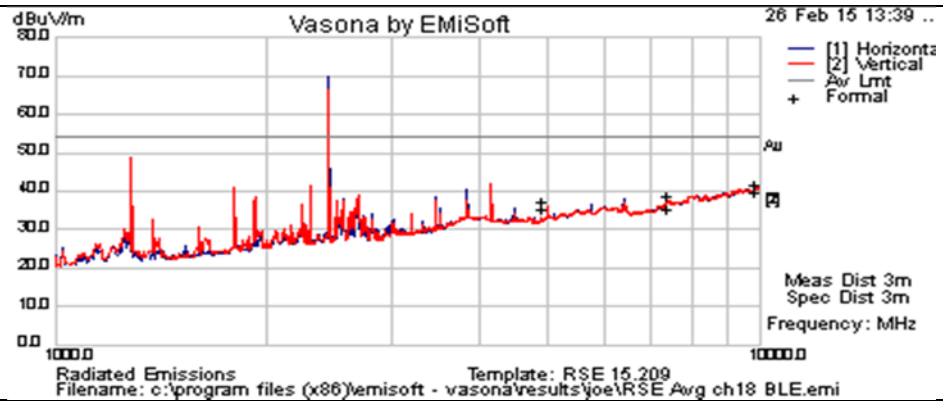
TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch18 /Peak/QP)
Radiated Tx Spurious Emissions 30MHz to 1GHz



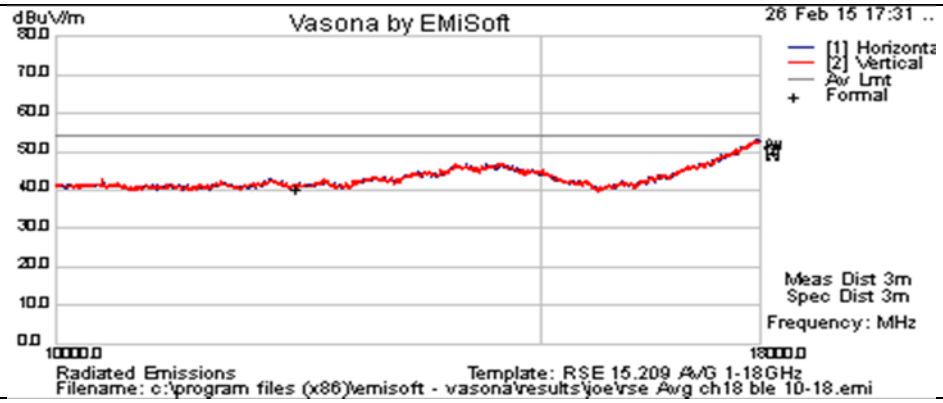
TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch18 /Peak)
Radiated Tx Spurious Emissions 1GHz to 10GHz



TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch18 /Peak)
Radiated Tx Spurious Emissions 10GHz to 18GHz

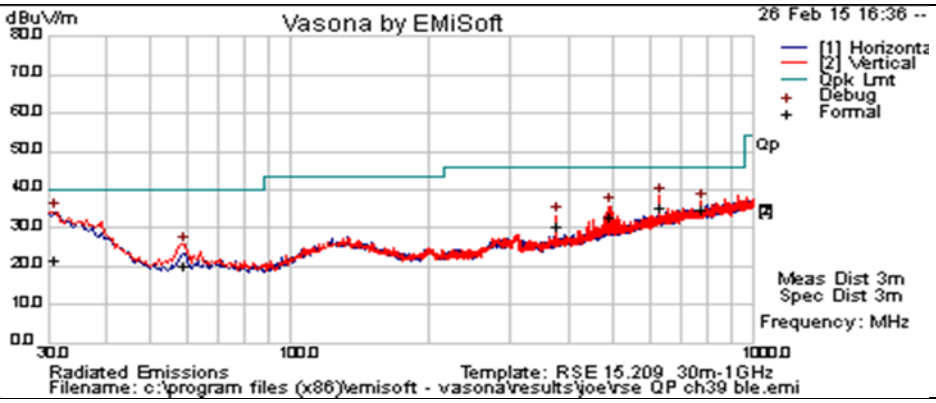


TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch18 /Average)
Radiated Tx Spurious Emissions 1GHz to 10GHz

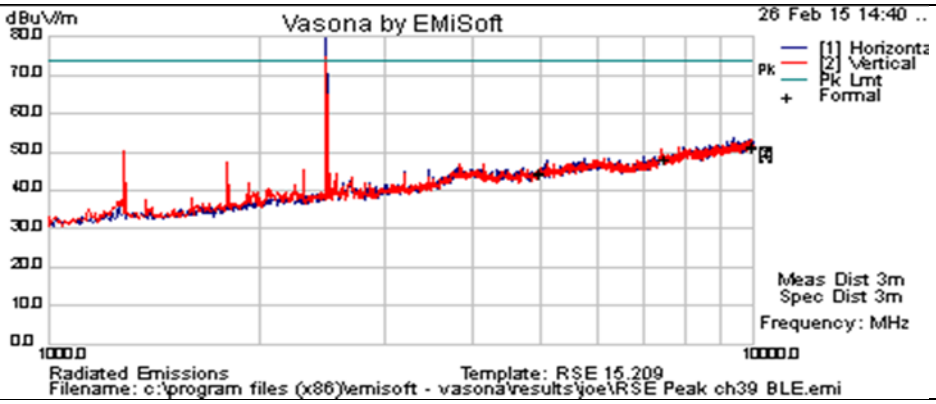


TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch18 /Average)
Radiated Tx Spurious Emissions 10GHz to 18GHz

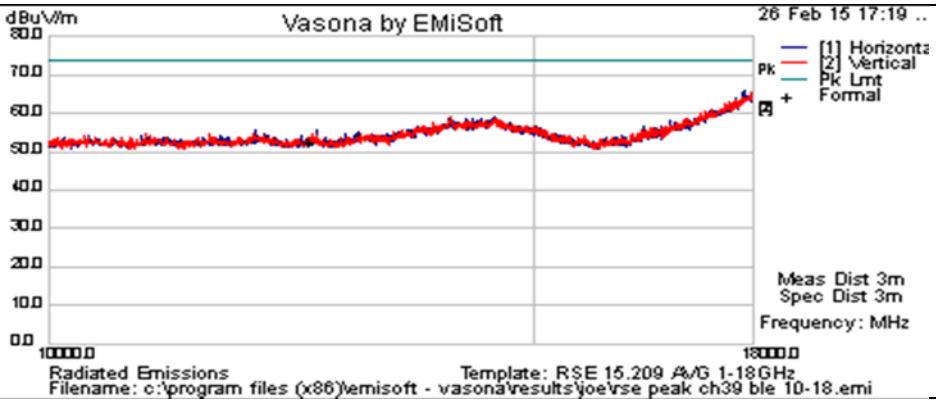
No emissions seen above 10GHz



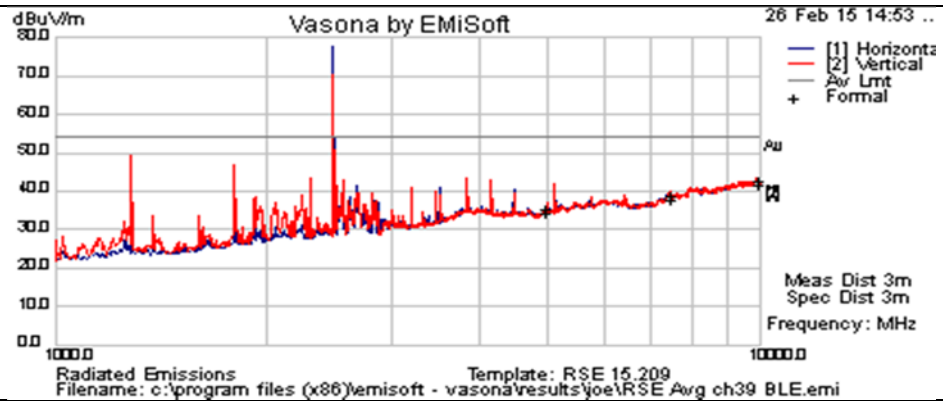
TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch39 /Peak/QP)
Radiated Tx Spurious Emissions 30MHz to 1GHz



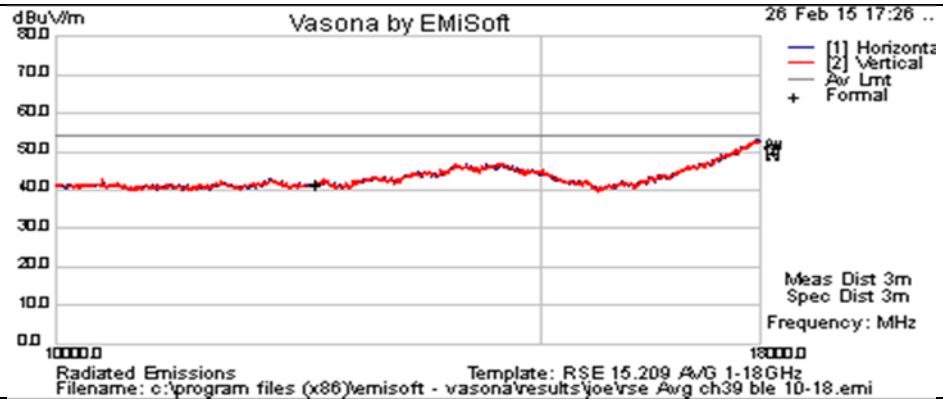
TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch39 /Peak)
Radiated Tx Spurious Emissions 1GHz to 10GHz



TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch39 /Peak)
Radiated Tx Spurious Emissions 10GHz to 18GHz



TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch39 /Average)
Radiated Tx Spurious Emissions 1GHz to 10GHz



TX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch39 /Average)
Radiated Tx Spurious Emissions 10GHz to 18GHz

No emissions seen above 10GHz

Receiver Radiated Spurious Emissions

RSS-Gen 5 / 7.1: The receiver shall be operated in the normal receive mode near the mid-point of the band in which the receiver is designed to operate. And spurious emissions from the receivers shall not exceed the radiated limits shown in the table 2 in section 7.1.2 of RSS-Gen.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator frequency, intermediate or carrier frequency), or 30 MHz, whichever is higher, to at least 3 times the highest turntable or local oscillator frequency whichever is higher, without exceeding 40 GHz.

For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. Above 1000 MHz, measurements shall be performed using an average detector with a minimum resolution bandwidth of 1 MHz.

As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater than the applicable CISPR quasi-peak bandwidth or 1 MHz bandwidth, respectively.

Table 2: Radiated Limits of Receiver Spurious Emissions

Frequency (MHz)	Field strength (uV/meter)*	Field strength (dBuV/meter)	Measurement distance (meters)
30-88	100	40 Qp	3
88-216	150	43.5 Qp	3
216-960	200	46 Qp	3
Above 960	500	54 Av / 74 Pk	3

*****Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 6.5.

Test Procedure

Ref. C63.10-2009/2009 section 6.5 & 6.6

Test Procedure
1. Using Vasona software, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). 2. Place the radio in continuous Receiver mode. Maximize Turntable (find worst case table angle) and maximize Antenna (find worst case height). 3. Use the peak marker function to determine the maximum amplitude level. 4. Center marker frequency and perform final measurement in Quasi-peak (≤ 1Ghz) and Average (above 1GHz) 5. Record at least 6 highest readings.

Ref. C63.10-2009/2009 section 4 / CISPR16-1-1

Test Parameters
Span = Entire frequency range or segment if necessary. Reference Level = 80 dBuV RBW = 100 kHz (less than or equal to 1 GHz); 1 MHz (above 1 GHz) VBW ≥ 3 x RBW Detector = Peak & Quasi-Peak (frequency range 30 MHz to 1 GHz); Peak & Average (frequency range above 1 GHz); Changing VBW to 10 Hz for average measurement Sweep Time = Couple

Recorded Test Data:

RX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (RX / Quasi-Peak)

Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Receiver Spurious Emissions
Frequency Range	30MHz - 1GHz
Comments on the above Test Results	RX Mode Channel 18 (2442 MHz) – with GFSK modulation – 1 Mbps

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Detector	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
625.025	12.47	1.56	19.34	33.37	Quasi Max	V	105	322	46	-12.63	Pass
768.019	10.2	1.77	20.8	32.77	Quasi Max	H	101	218	46	-13.23	Pass
486.796	12	1.4	17.6	31	Quasi Peak.	H	101	257	46	-15	Pass
375.005	13.94	1.2	14.94	30.09	Quasi Max	H	17	135	46	-15.91	Pass
30.485	-2.77	0.32	21.15	18.7	Quasi Max	V	125	229	40	-21.3	Pass
58.615	10.71	0.46	7.67	18.84	Quasi Max	H	106	105	40	-21.16	Pass

RX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (RX / Peak)

Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Receiver Spurious Emissions
Frequency Range	1GHz - 18GHz (Peak)
Comments on the above Test Results	RX Mode Channel 18 (2442 MHz) – with GFSK modulation – 1 Mbps

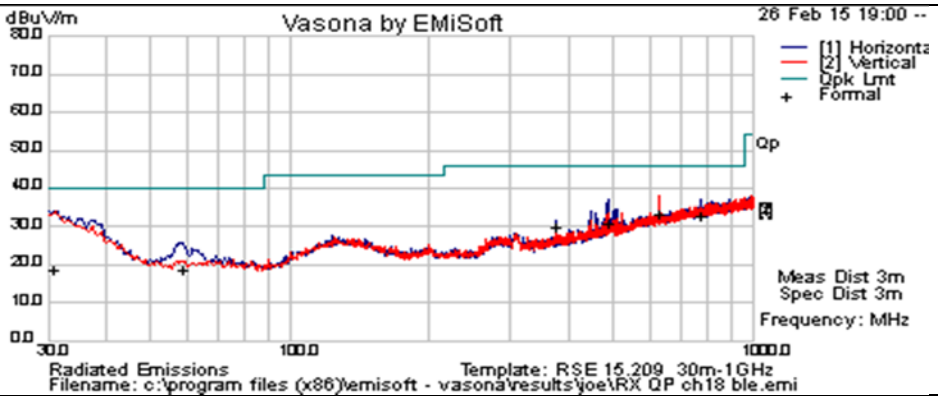
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Detector	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1276.25	57	2.3	-7.3	51.99	Peak.	V	153	162	74	-22.02	Pass
1796.875	49.1	2.7	-6.1	45.71	Peak.	V	155	135	74	-28.29	Pass
1924.375	45	2.8	-5.8	41.88	Peak.	V	139	45	74	-32.12	Pass
2413.125	47.6	3.1	-5.2	45.41	Peak.	V	144	178	74	-28.59	Pass
3836.875	46.4	3.8	-2.7	47.49	Peak.	H	120	323	74	-26.51	Pass
5770.625	52.2	4.5	-3.8	52.85	Peak.	V	170	354	74	-21.15	Pass

RX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (RX / Average)

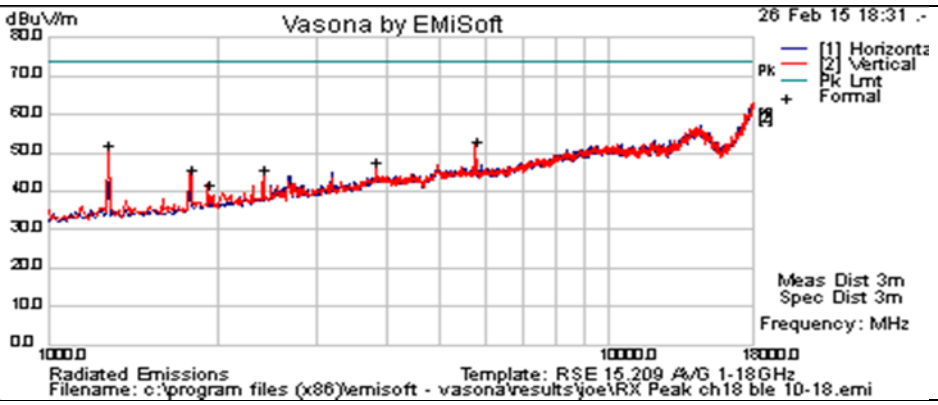
Subtest Date:	26-Feb-2015
Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Title	Receiver Spurious Emissions
Frequency Range	1GHz - 18GHz (Average)
Comments on the above Test Results	RX Mode Channel 18 (2442 MHz) – with GFSK modulation – 1 Mbps

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Detector	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1280.086	56	2.3	-7.3	51	Average.	V	152	168	54	-3	Pass
1791.992	49.9	2.7	-6.2	46.47	Average.	V	155	138	54	-7.53	Pass
3836.875	42.9	3.8	-2.7	43.98	Average.	V	144	142	54	-10.02	Pass
3199.375	42.2	3.6	-3.9	41.82	Average.	H	153	136	54	-12.18	Pass
5122.5	40.7	4.3	-3.4	41.62	Average.	H	139	168	54	-12.38	Pass
4155.625	39.8	4.1	-3.4	40.58	Average.	V	158	171	54	-13.42	Pass

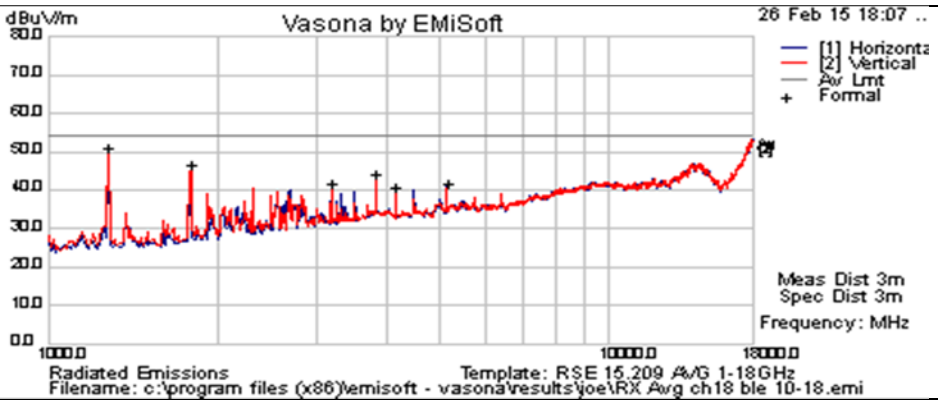
Graphical Test Results :



RX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch18 /Peak/QP)
Radiated Rx Spurious Emissions 30MHz to 1GHz



RX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch18 /Peak)
Radiated Rx Spurious Emissions 1GHz to 18GHz



RX Spurious Emissions Test Result Tables for 802.15 Bluetooth LE (Ch18 /Average)
Radiated Rx Spurious Emissions 1GHz to 18GHz

Appendix D: Test Equipment/Software Used to perform Radiated tests

Test Equipment List					
Equip No	Model	Manufacturer	Description	Cal Date	Next Cal
CIS045723	TH0118	Cisco	Mast Mount Preamplifier Array, 1-18GHz	1-Apr-14	1-Apr-15
CIS018313	8447D	HP	RF Preamplifier	28-Apr-14	28-Apr-15
CIS008342	RG-214	Times Microwave Systems	4 ft RG-214 Cable	22-May-14	22-May-15
CIS030562	UFB311A-1-0950-504504	Micro-Coax	RF Coaxial Cable, to 18GHz, 95 in	25-Jun-14	25-Jun-15
CIS035284	3117	ETS-Lindgren	Double Ridged Waveguide Horn Antenna	16-Sep-14	16-Sep-15
CIS008447	NSA 10m Chamber	Cisco	NSA 10m Chamber	14-Oct-14	14-Oct-15
CIS030652	JB1	Sunol Sciences	Combination Antenna, 30MHz-2GHz	5-Nov-14	5-Nov-15
CIS030571	UFB311A-1-3510-504504	Micro-Coax	Rf Coaxial Cable to 18GHz	15-Dec-14	15-Dec-15
CIS041929	iBTHP-5-DB9	Newport	5 inch Temp/RH/Press Sensor w/20ft cable	20-Dec-14	20-Dec-15
CIS047300	N9038A	Agilent Technologies	MXE EMI Receiver 20Hz to 26.5 Ghz	13-Jan-15	13-Jan-16
CIS043124	Above 1GHz Site Cal	Cisco	Above 1GHz Cispr Site Verification	15-Jan-15	15-Jan-16
CIS051642	Sucoflex 106PA	Huber+Suhner	RF N Type Cable 8.5m	10-Feb-15	10-Feb-16
CIS021116	UFB311A-0-3540-520520	Micro-Coax	RF Coaxial Cable, to 18GHz, 354 in	18-Feb-15	18-Feb-16
CIS020975	UFB311A-0-1344-520520	Micro-Coax	RF Coaxial Cable, to 18GHz, 134.4 in	18-Feb-15	18-Feb-16
CIS049549	50CB-015	JFW	GPIB Control Box		

CIS047246	TH0118-PS	Cisco	Power Supply for TH0118 1-18GHz Preamplifier		
CIS003003	83731B	HP	Synthesized Signal Generator	12-Mar-14	12-Mar-15
CIS041979	1840	Cisco	18-40GHz EMI Test Head/Verification Fixture	9-Jul-14	9-Jul-15
CIS037236	50CB-015	JFW	GPIB Control Box		
CIS027233	CNE V	York	Comparison Noise Emitter		

Software Used for Testing
1. Vasona File version 5.073, 5.089 2. Winsoft Radio Automation Software version 1.2

Maximum Permissible Exposure (MPE) Calculations

15.247: U-NII devices are subject to the radio frequency radiation exposure requirements specified in Sec. 1.1307(b), Sec. 2.1091 and Sec. 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a ``general population/uncontrolled'' environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

Given

E=√(30*P*G)/d and S=E^2/3770

where

E=Field Strength in Volts/meter
P=Power in Watts
G=Numeric Antenna Gain
d=Distance in meters
S=Power Density in mW/cm^2

Combine equations and rearrange the terms to express the distance as a function of the remaining variables:

d=√((30*P*G)/(3770*S))

Changing to units of power in mW and distance in cm, using:

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

yields

d=100*√((30*(P/1000)*G)/(3770*S))
d=0.282*√(P*G/S)

where

d=Distance in cm
P=Power in mW
G=Numerica Antenna Gain
S=Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P(mW)=10^(P(dBm)/10) G(numeric)=10^(G(dBi)/10)

yields

d=0.282*10^((P+G)/20)/√S Equation (1)

and

s=((0.282*10^((P+G)/20))/d)^2 Equation (2)

where

d=MPE distance in cm
P=Power in dBm
G=Antenna Gain in dBi

S=Power Density in mW/cm^2

Equation (1) and the measured peak power are used to calculate the MPE distance. Note that for mobile or fixed location transmitters such as an access point, the minimum separation distance is 20 cm even if the calculations indicate that the MPE distance may be less.

S=1mW/cm^2 maximum. The highest supported antenna gain is 6 dBi (9dBi with beamforming). Using the peak power levels recorded in the test report along with Equation 1 above, the MPE distances are calculated as follows.

Frequency (MHz)	Power Density (mW/cm^2)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	Limit (cm)	Margin (cm)
2402	1	-0.6	2	**0.33**	20	19.67
2440	1	-1.0	2	**0.32**	20	19.68
2480	1	-0.6	2	**0.33**	20	19.67

MPE Calculations

To maintain compliance, installations will assure a separation distance of at least 20cm.

Using Equation 2, the MPE levels (s) at 20 cm are calculated as follows:

Frequency (MHz)	MPE Distance (cm)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)	Limit (mW/cm^2)	Margin (mW/cm^2)
2402	20	-0.6	2	**0.00**	1	1.00
2440	20	-1.0	2	**0.00**	1	1.00
2480	20	-0.6	2	**0.00**	1	1.00