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Prüfbericht - Nr.: *Test Report No.:*	**19660190 001**	**Seite 1 von 27** *Page 1 of 27*
Auftraggeber: *Client:*	**Nimble Wireless** **1220 Corte Zafiro** **San Marcos CA92069** **United States**	
Gegenstand der Prüfung: *Test item:*	**Toucan -N5**	
Bezeichnung: *Identification:*	**N5-501-C**	**Serien-Nr.:** *Serial No.* **Engineering Sample**
Wareneingangs-Nr.: *Receipt No.:*	**1803092520**	**Eingangsdatum:** *Date of receipt:* **11.08.2015**
Prüfort: *Testing location:*	**Refer Page 4 of 27 for test facilities**	
Prüfgrundlage: *Test specification:*	**FCC Part 15, Subpart C** **ANSI C63.10-2013**	
Prüfergebnis: *Test Result:*	**Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).** *The test items passed the test specification(s).*	
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland (India) Pvt. Ltd.** 82/A, 3rd Main, West Wing, Electronic City Phase 1 Hosur Road, Bangalore – 560 100. India **FCC Registration No.: 176555**	

geprüft / *tested by:*			**kontrolliert** / *reviewed by:*		
16.09.2015	Vinay N Sr. Engineer	Vinay.N	18.09.2015	Raghavendra Kulkarni Senior Manager	Kulkarni
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges / *Other Aspects:* **FCC ID : 2AFSO-N5-501-C,**
Contains FCC ID: R5Q-LISAC200A

Abkürzungen:				***Abbreviations:***			
	P(ass)	=	***entspricht Prüfgrundlage***		***P(ass)***	=	***passed***
	F(ail)	=	***entspricht nicht Prüfgrundlage***		***F(ail)***	=	***failed***
	N/A	=	***nicht anwendbar***		***N/A***	=	***not applicable***
	N/T	=	***nicht getestet***		***N/T***	=	***not tested***

Test Result Summary

Clause	Test Item	Result
FCC 15.247(b) (3)	Maximum Conducted Peak Output Power	Pass
FCC 15.247(a) (2)	6dB Bandwidth	Pass
FCC 15.247(e)	Power Spectral Density	Pass
FCC 15.247(d)	Band-edge compliance	Pass
FCC 15.209	Spurious Radiated Emissions	Pass
FCC 15.205	Restricted Bands of Operation	Pass
FCC 15.207	Conducted Emissions on a.c Power lines	Pass

Note: Conducted measurements are done according to the procedure given in KDB No. **558074 D01 DTS Meas Guidance v03r02**

Content

List of Type and Measurement Instruments

TÜV Rheinland (India) Pvt. Ltd, Bangalore

Equipment	Manufacturer	Model Name	Serial Number	Calibration Due Date	Periodicity
Spectrum Analyser	Agilent Technologies	E4407B	US41192772	15.04.2016	Yearly
EMI Test Receiver	Rohde & Schwarz	ESU 40	100288	20.06.2016	Yearly
Broadband Antenna	Frankonia	ALX-4000	ALX-4000-806	22.06.2016	Yearly
Active Loop Antenna	Frankonia	LAX-10	LAX-10-800	22.06.2016	Yearly
Broadband Horn Antenna	Frankonia	HAX-18	HAX18-802	22.06.2016	Yearly
Emission Horn Antenna	ETS Lindgren	116706	00107323	22.06.2016	Yearly

Testing Facilities:

1) TUV Rheinland (India) Private Limited
No. 108, West Wing
Electronic city Phase I
Bangalore – 560100

General Product Information

Product Function and Intended Use

Used to monitor sensors and location of field assets and report data back to user application.

Ratings and System Details

Operating Frequency	2400MHz – 2483.5MHz
No. of channels	16
Channel Spacing	5MHz
Modulation	DSSS
Transmitted Power	19.11dBm
Data Rate	250 kbps
Antenna Type	PCB Inverted F Antenna
Number of antenna	1
Antenna Gain	2dBi
Supply Voltage	5V DC
Dimensions	74 x 74 x 16.6 mm
Environmental	Temp: : -30C to +60C

Test Conditions:

Voltage: 5 V DC

Environmental conditions:

Temperature: +23 º C **RH:** 62%

Test Set-up and Operation Mode

Principle of Configuration Selection

Transmission was enabled with highest possible duty cycle on low, mid and high channel.

Test Operation and Test Software

Test software was used to enable the transmission with highest possible duty cycle and channels in 2.4 GHz band on the EUT for the tests in this report.

Special Accessories and Auxiliary Equipment

- None

Countermeasures to achieve EMC Compliance

- None

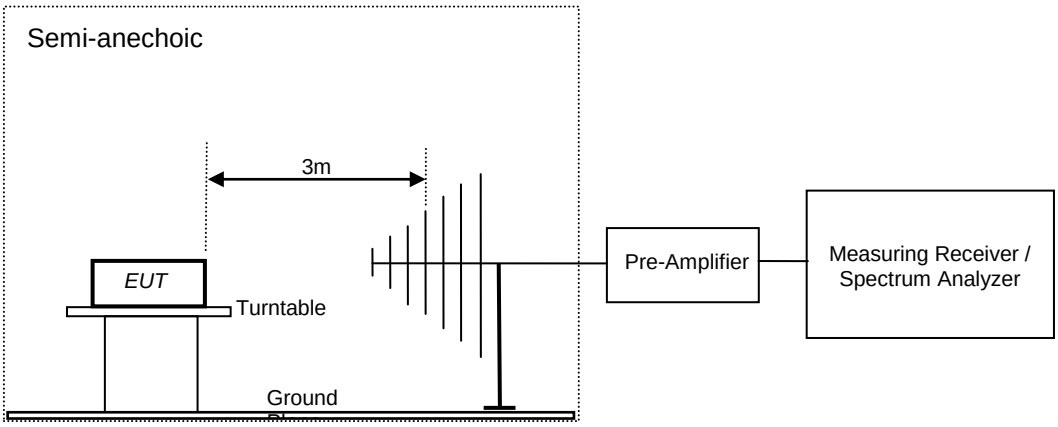
Table of carrier frequencies

Frequency Band	Channel No.	Frequency (MHz)
2400-2483.5 MHz	11	2405
	12	2410
	13	2415
	14	2420
	15	2425
	16	2430
	17	2435
	18	2440
	19	2445
	20	2450
	21	2455
	22	2460
	23	2465
	24	2470
	25	2475
	26	2480

Test Methodology

Radiated Emission Test

The radiated emission measurement was performed according to the procedures in ANSI C63.10-2013. The equipment under test (EUT) was placed at the middle of the 80 cm high turntable for measurements below 1GHz and at 150cm high turntable for measurements above 1GHz, and the EUT is 3 meters far from the measuring antenna. The turntable was rotated 360° for obtaining the maximum emission. The height of the measuring antennas was scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained. The measurement above 1000MHz was performed by horn antenna. The measurement below 30MHz was performed by loop antenna.
The EUT was rotated around the X-, Y-, and Z-Axis and the results from worst case axis are recorded.



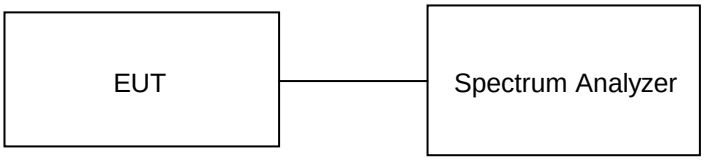
Test Results

Maximum Conducted Peak Output Power **Section 15.247(b) (3)**

Result **Pass**

Test Specification	FCC Part 15 Subpart C
Measurement Bandwidth (RBW)	1 MHz
Requirement	<1 watt (30dBm).

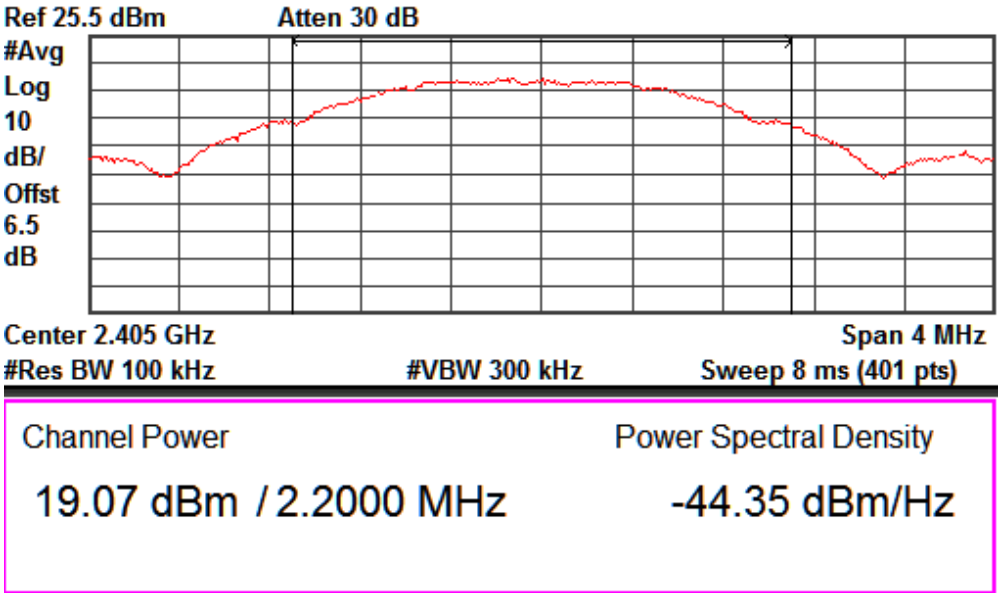
Test Method:



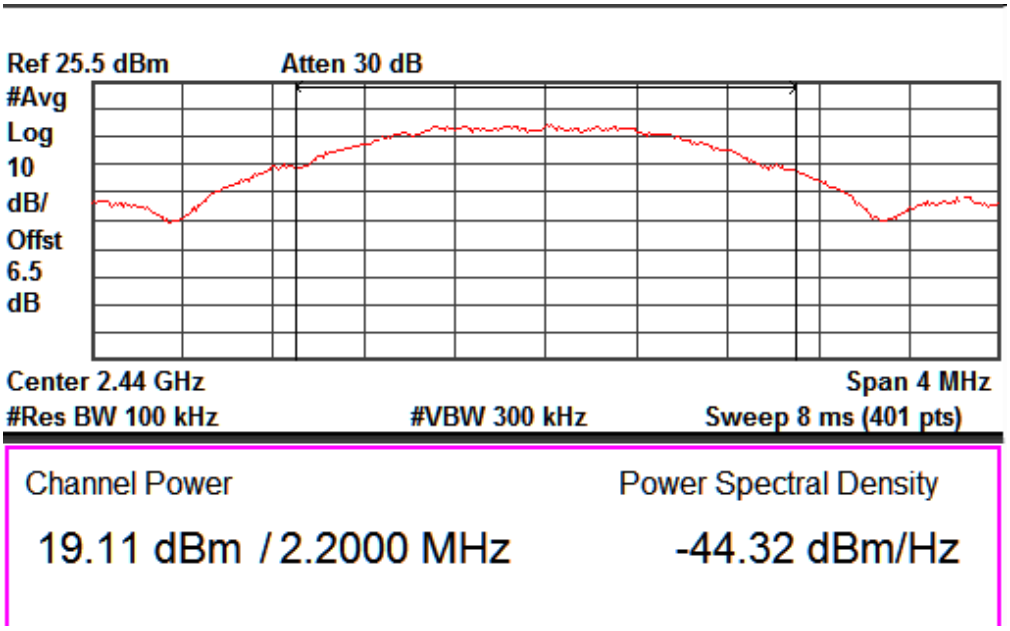
Test Result:

Attenuator: 6dB
Cable Loss: 0.5 dB

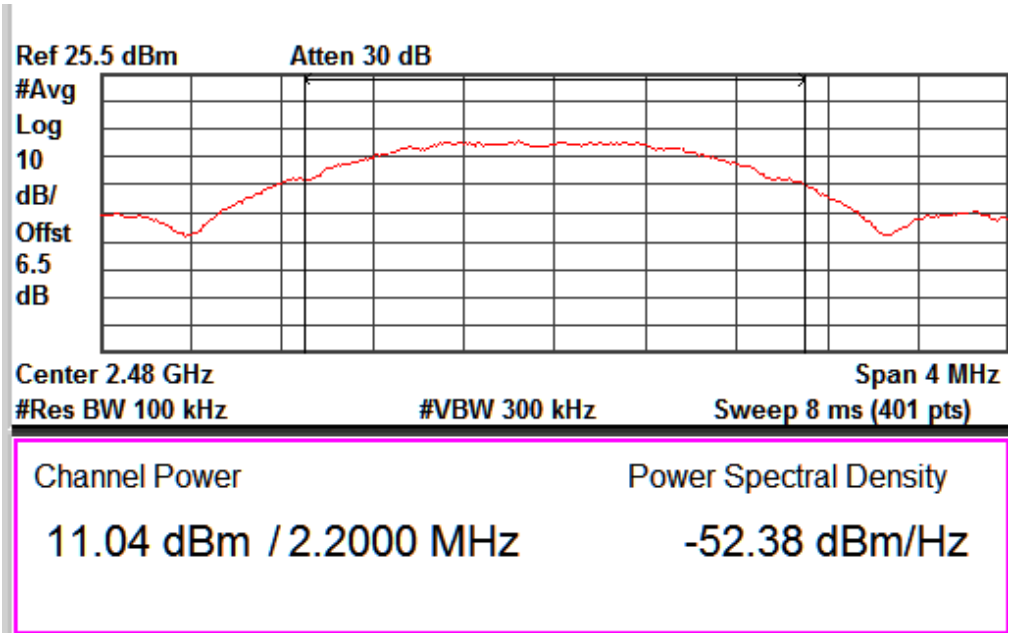
Frequency (MHz)	Total Output power (dBm)	Limit (dBm)
2405	19.07	30.00
2440	19.11	30.00
2480	11.04	30.00



Channel Frequency: 2405 MHz



Channel Frequency: 2440 MHz



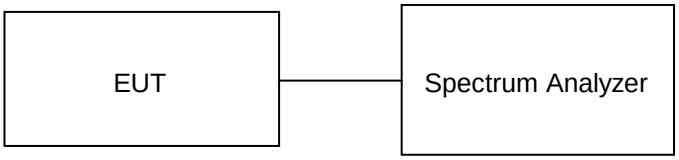
Channel Frequency: 2480 MHz

Power Spectral Density **Section 15.247(e)**

Result **Pass**

Test Specification	FCC Part 15 Section 15.247 (e)
Detector Function	Peak
Requirement	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

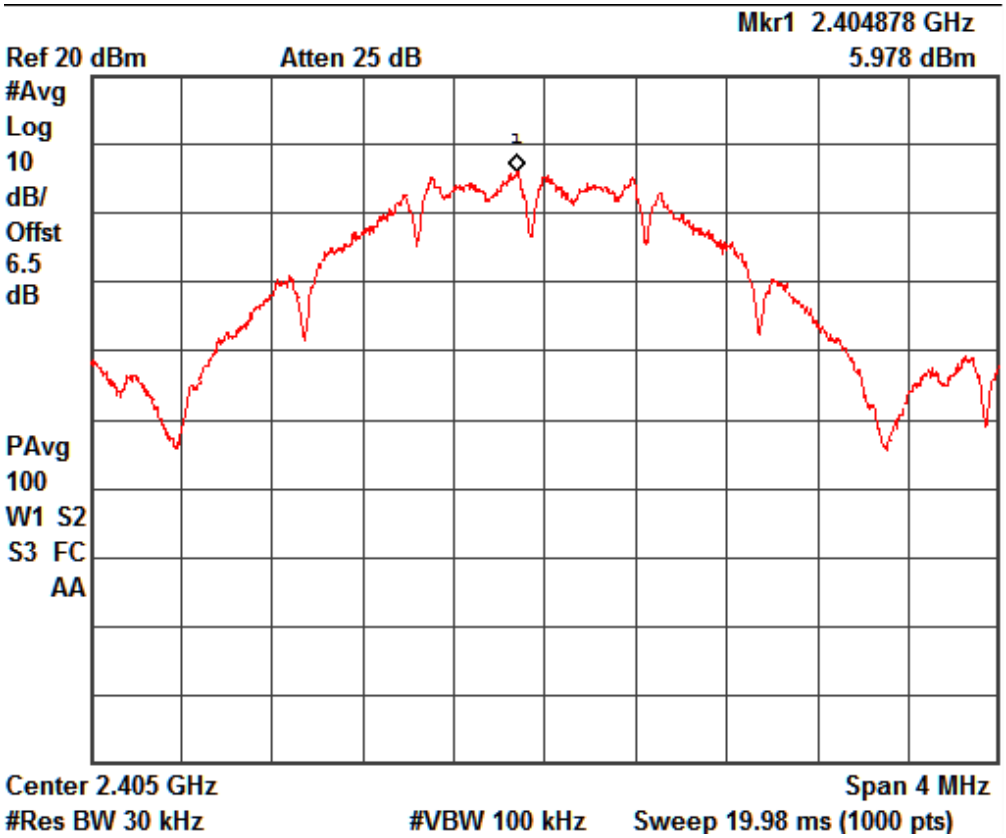
Test Method:



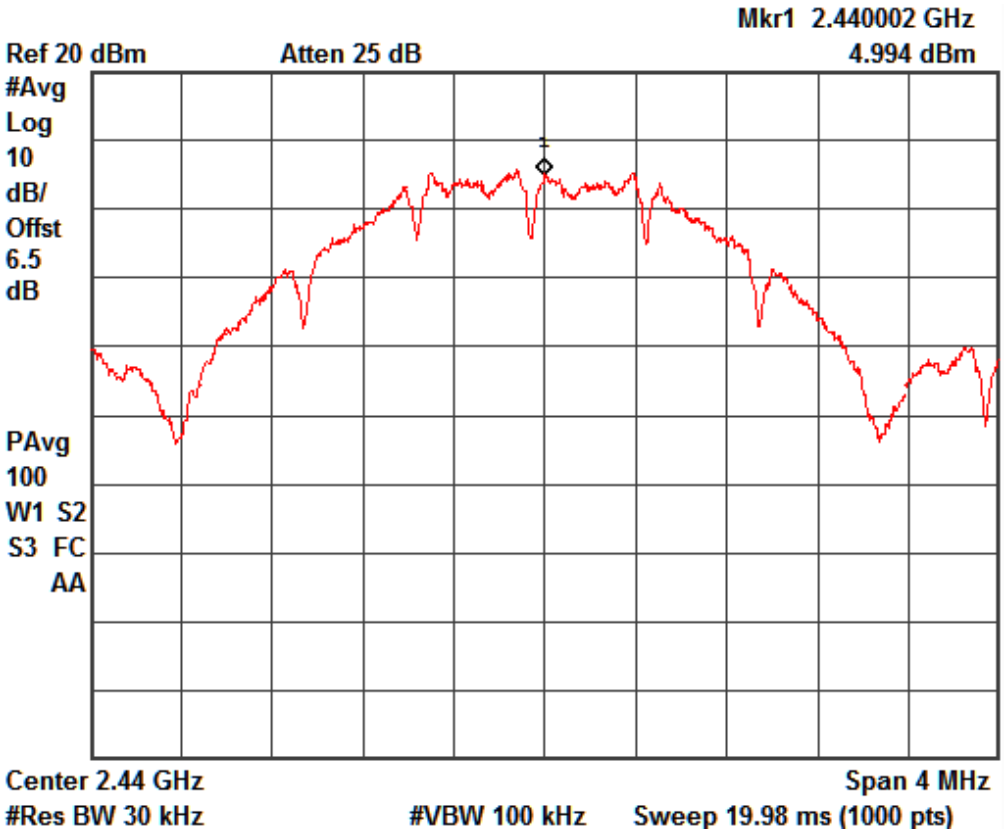
Test Result:

Attenuator: 6dB
Cable Loss: 0.5 dB

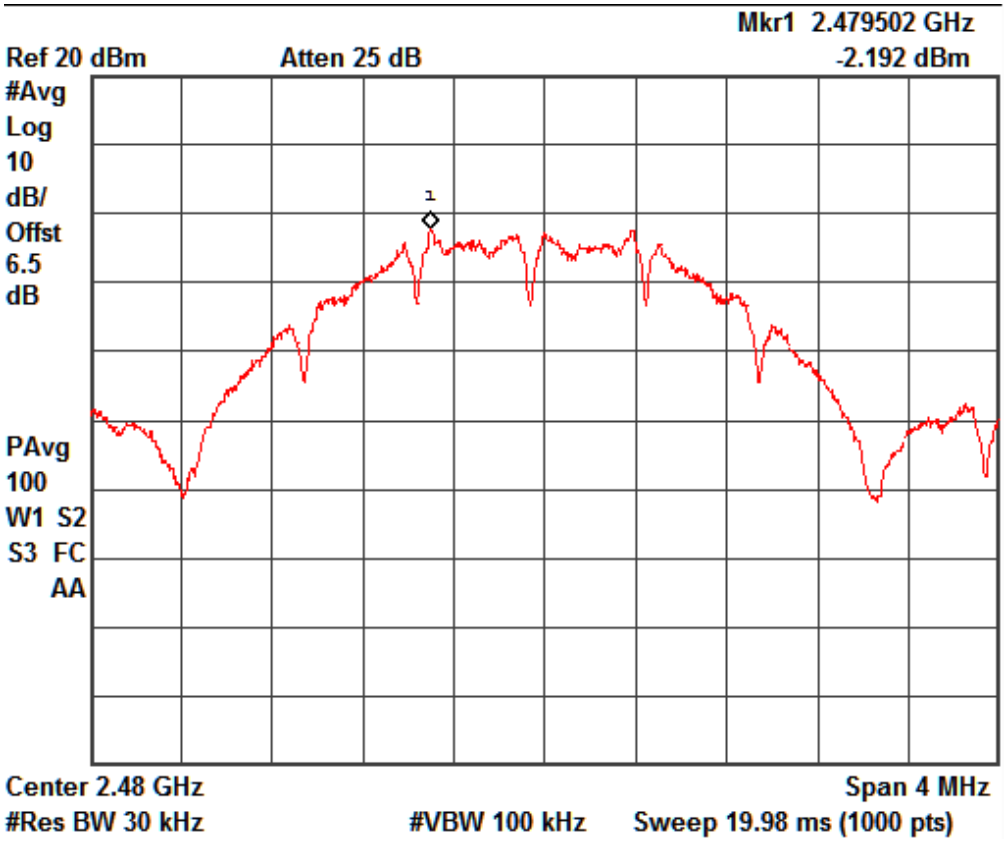
Frequency (MHz)	Total PSD (dBm)	Limit (dBm)
2405	5.97	8.00
2440	4.99	8.00
2480	-2.19	8.00



Channel Frequency: 2405 MHz



Channel Frequency: 2440 MHz



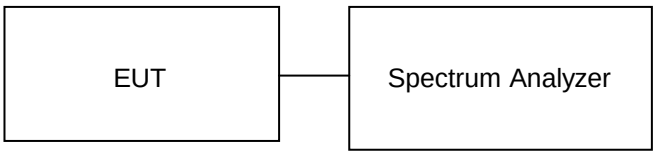
Channel Frequency: 2480 MHz

6 dB Bandwidth **Section 15.247(a)(2)**

Result **Pass**

Test Specification FCC Part 15 Section 15.247 (a) (2)
Requirement The minimum 6 dB bandwidth shall be at least 500 kHz.

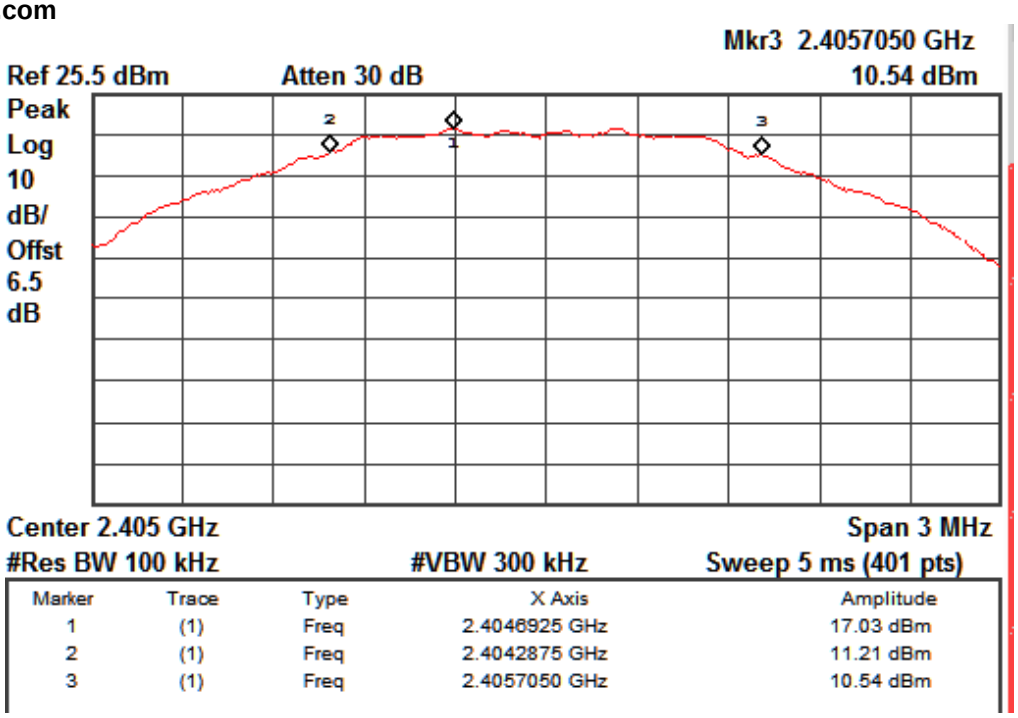
Test Method:



Test Result:

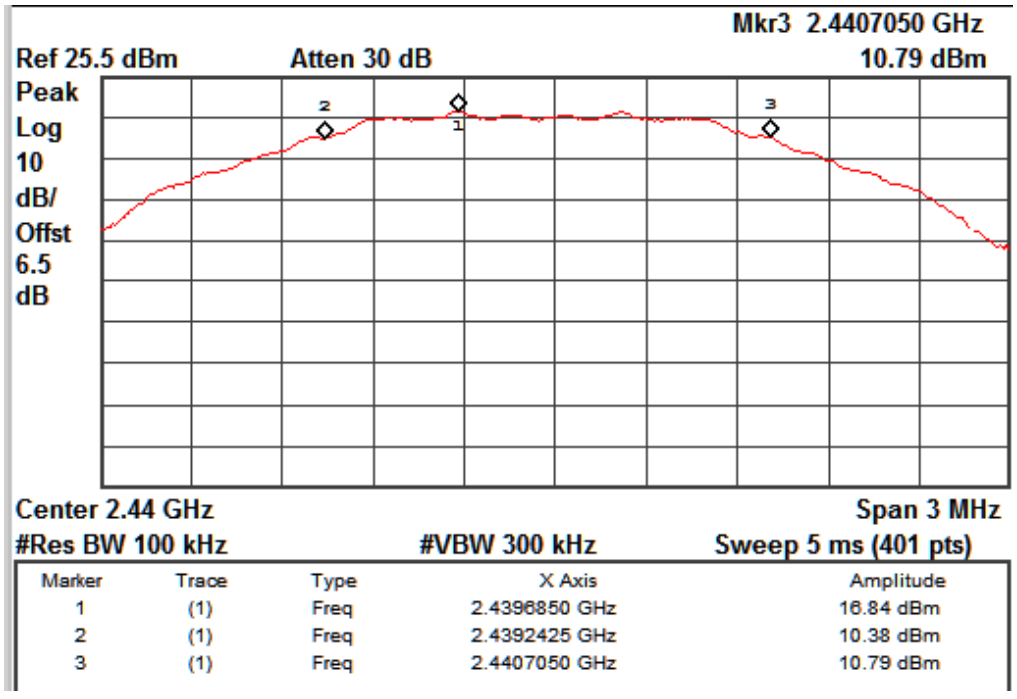
Attenuator: 6dB
Cable Loss: 1.00 dB

Carrier Frequency (MHz)	Lower Frequency (MHz)	Upper Frequency (MHz)	6 dB Bandwidth (MHz)	OBW (MHz)
2405	2404.2875	2405.7050	1.41	2.14
2440	2439.2425	2440.7050	1.46	2.19
2480	2479.1825	2480.7050	1.52	2.26



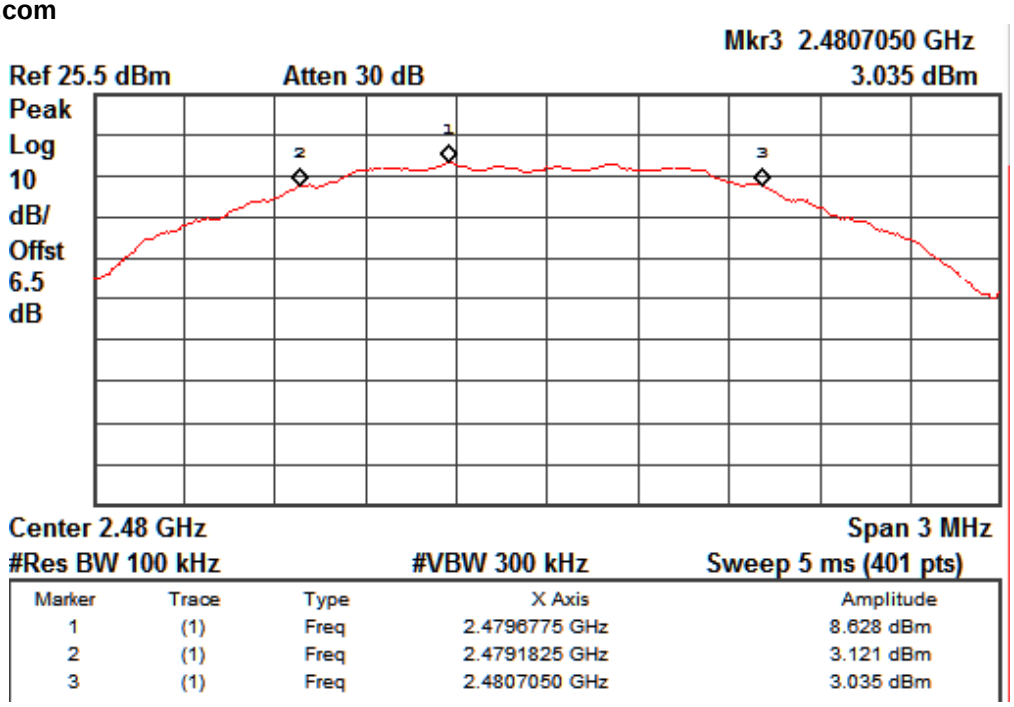
Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.4046925 GHz	17.03 dBm
2	(1)	Freq	2.4042875 GHz	11.21 dBm
3	(1)	Freq	2.4057050 GHz	10.54 dBm

Channel frequency: 2405 MHz

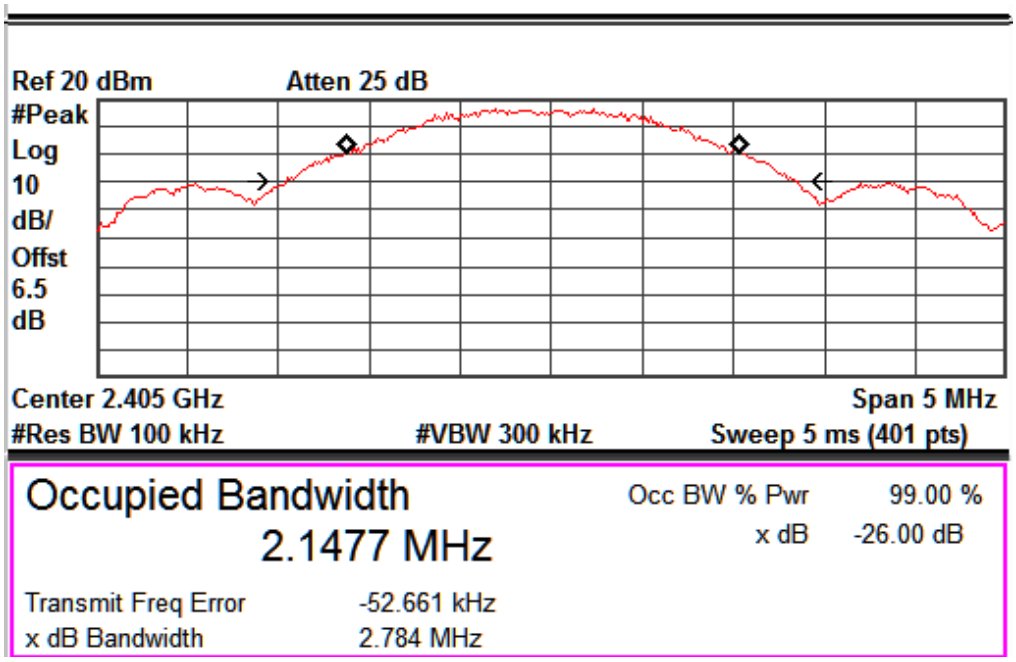


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.4396850 GHz	16.84 dBm
2	(1)	Freq	2.4392425 GHz	10.38 dBm
3	(1)	Freq	2.4407050 GHz	10.79 dBm

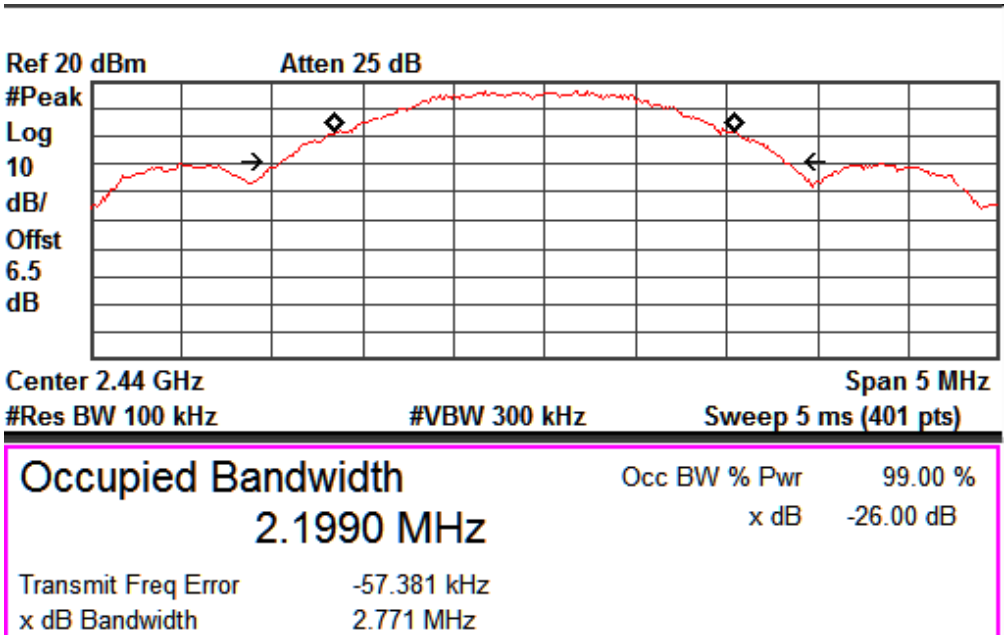
Channel frequency: 2440 MHz



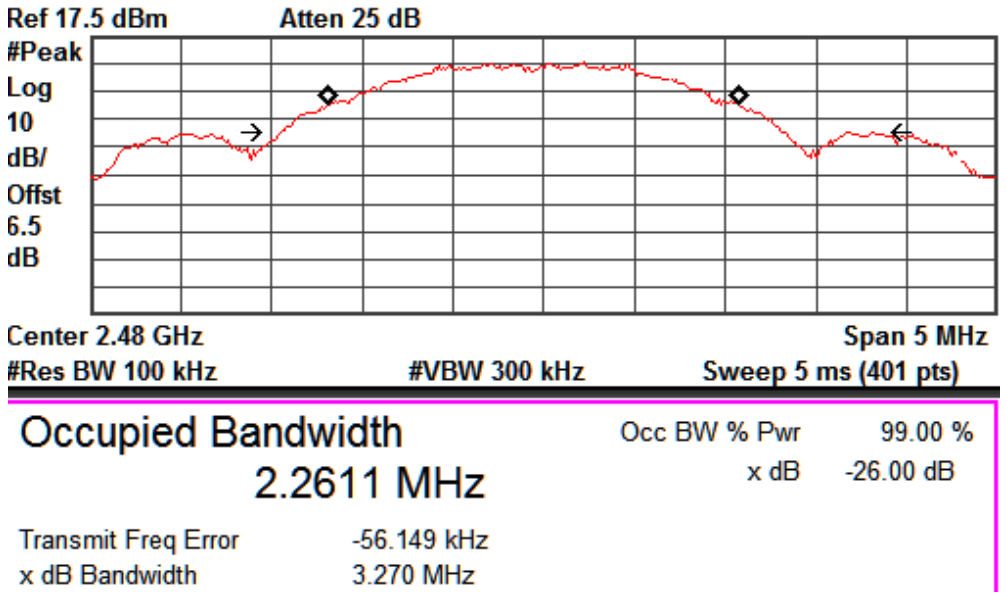
Channel frequency: 2480 MHz



OBW Channel frequency: 2405 MHz



OBW Channel frequency: 2440 MHz



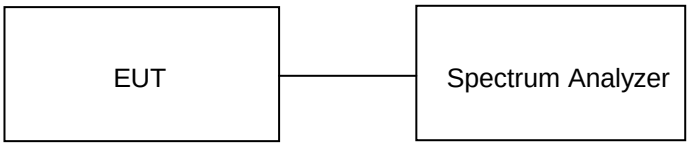
OBW Channel frequency: 2480 MHz

Band-edge Compliance **Section 15.247(d)**

Result **Pass**

Test Specification	FCC Part 15 Section 15.247(d)
Detector Function	Peak
Requirement	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that Contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, and provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph Shall be 30 dB instead of 20 dB.

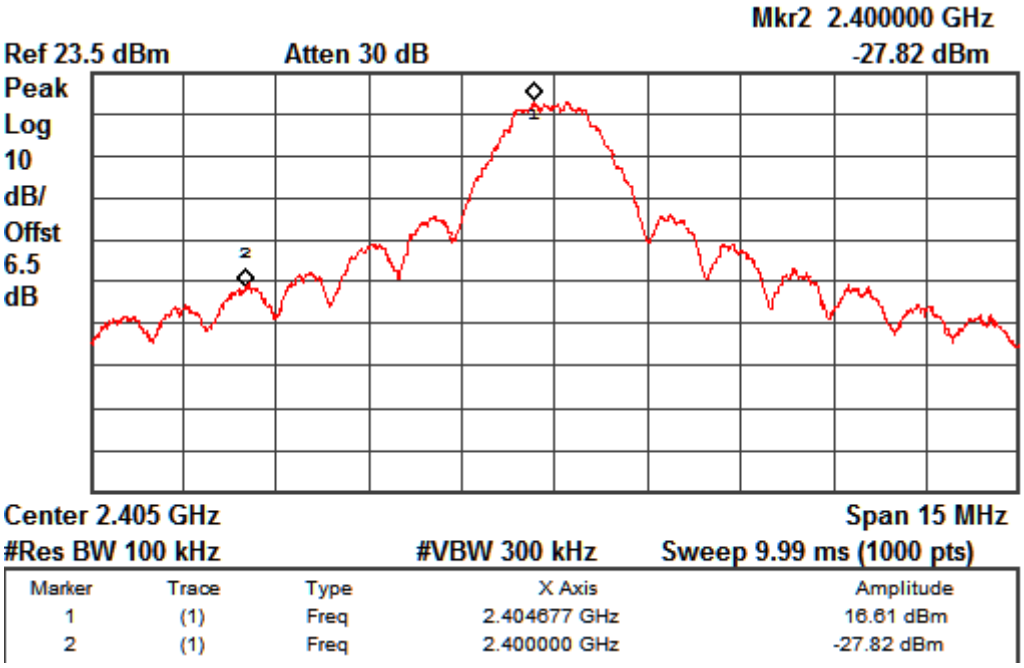
Test Method:



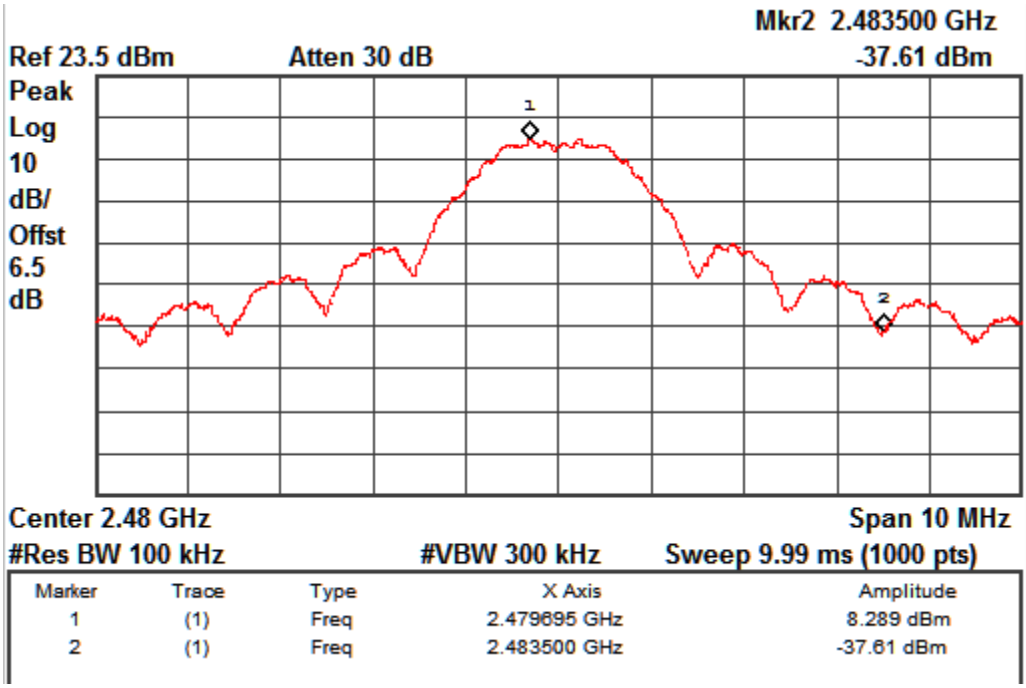
Test Result:

Attenuator: 6dB
Cable Loss: 0.5 dB

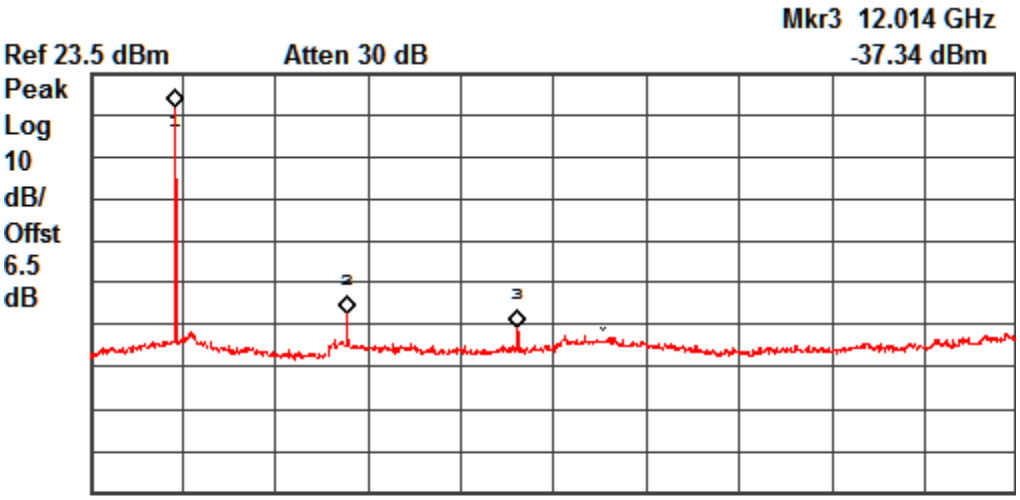
Channel	Fundamental Frequency (MHz)	Value at Band Edge		Limit (dBc)
		Frequency (MHz)	Value (dBc)	
Low	2405	2400.00	-44.43	-30.00
High	2480	2483.50	-45.89	-30.00



Channel frequency: 2405 MHz

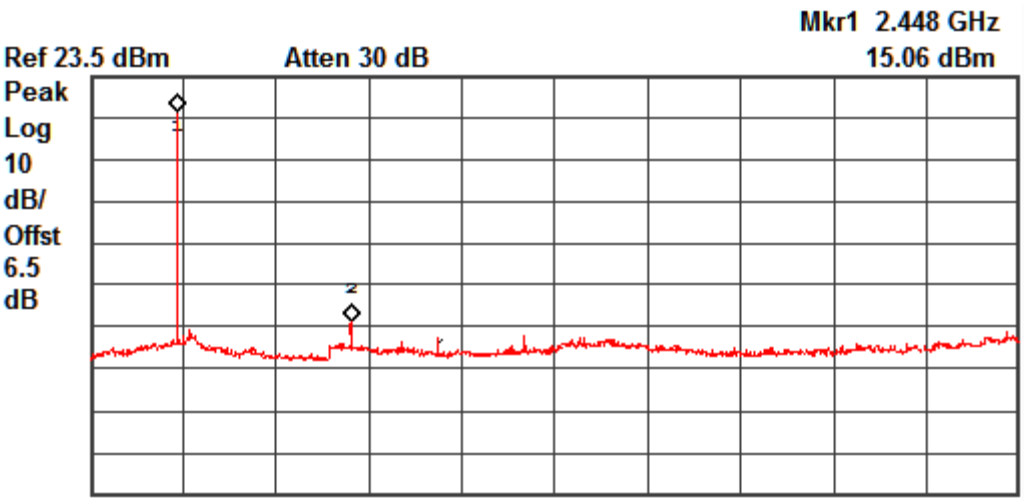


Channel frequency: 2480 MHz



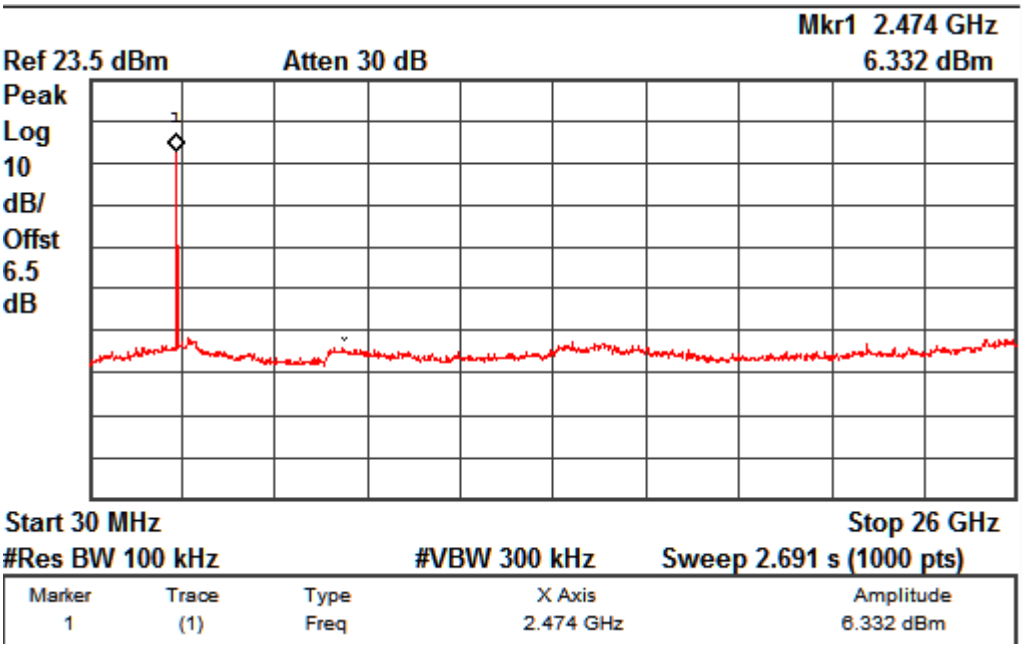
Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.396 GHz	15.57 dBm
2	(1)	Freq	7.205 GHz	-33.88 dBm
3	(1)	Freq	12.014 GHz	-37.34 dBm

Channel frequency: 2405 MHz



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.448 GHz	15.06 dBm
2	(1)	Freq	7.335 GHz	-35.28 dBm

Channel frequency: 2440 MHz



Channel frequency: 2480 MHz

Spurious Radiated Emissions and Restricted Bands of Operation **Section 15.209 and 15.205**

Result **Pass**

Test Specification	FCC Part 15 Section 15.209 &15.205
Test Method	ANSI C63.4-2003
Measurement Location	Semi Anechoic Chamber
Measuring Distance	3m
Detection	QP for frequency below 1GHz, Peak and Average for frequency above 1GHz
Requirement	As per the limits mentioned in the bellow table

Limit for Radiated Emission of Section 15.209:

Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Distance of Measurement (m)
0.009 – 0.490	2400/F(kHz)	48.50 – 13.80	300*
0.490 – 1.705	24000/F(kHz)	33.80 – 23.00	30*
1.705 -30	30	29.54	30*
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Remark: * the limit shows in the table above of frequency range 0.009 – 0.490, 0.490 – 1.705 MHz and 1.705-30MHz is at 300 meter, 30 meter and 30 meter range respectively, which corresponds to 88, 50 – 53.80, 53.80 – 43.00 and 49.5dBμV/m at 3m range by extrapolation calculation and the measurement of loop antenna.

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 result:

Test Results below 1GHz

Antenna Polarization	Frequency (MHz)	Emission (dBuV/m)	Limit (dBuV/m)	Margin (dB)
V	43.03	31.74	40.00	-8.26
	107.56	29.64	43.50	-13.86
H	117.78	31.68	43.50	-11.82
	130.27	31.83	43.50	-11.67

Test Results above 1GHz - Zigbee

Fundamental Frequency (MHz)	Antenna Polarization	Spurious Emission (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2405	H	2390(Pk)	42.8	74	-31.2
		2390(Av)	28.23	54	-25.77
		2405(Pk)	96.61	*	-
		2405(Av)	93.92	*	-
		4810 (Pk)	52.2	74	-21.8
		4810 (Av)	41.22	54	-12.78
		7215 (Pk)	57.28	74	-16.72
		7215 (Av)	46.03	54	-7.97
	V	2390(Pk)	52.48	74	-21.52
		2390(Av)	48.42	54	-5.58
		2405(Pk)	107.24	*	-
		2405(Av)	104.37	*	-
		4810 (Pk)	51.79	74	-22.21
		4810 (Av)	40.55	54	-13.45
		7215 (Pk)	58.11	74	-15.89
		7215 (Av)	45.26	54	-8.74
2440	H	2440(Pk)	93.56	*	-
		2440(Av)	90.66	*	-
		4880(Pk)	52.42	74	-21.58
		4880 (Av)	41.32	54	-12.68
		7320(Pk)	56.83	74	-17.17
		7320(Av)	45.93	54	-8.07

	V	2440(Pk)	105.89	*	-
		24400(Av)	103.11	*	-
		4880(Pk)	50.82	74	-23.18
		4880 (Av)	40.92	54	-13.08
		7320(Pk)	58.28	74	-15.72
		7320(Av)	45.92	54	-8.08
2480	H	2480 (Pk)	83.59	*	-
		2480 (Av)	80.5	*	-
		2483.5(Pk)	50.46	74	-23.54
		2483.5(Av)	41.21	54	-12.79
		4960(Pk)	52.41	74	-21.59
		4960(Av)	39.26	54	-14.74
	V	2480 (Pk)	96.61	*	-
		2480 (Av)	93.51	*	-
		2483.5(Pk)	62.72	74	-11.28
		2483.5(Av)	53.29	54	-0.71
		4960(Pk)	52.12	74	-21.88
		4960(Av)	40.16	54	-13.84

* - --> Fundamental Frequency
Pk--> Peak Detector
Av--> Average Detector

Test Results GSM 850 &1900

Antenna Polarization	Spurious Emission (MHz)	Emission (dBm)	Limit (dBm)
V	1649.4	-58.31	-13
	1670.8	-57.95	-13
	1696.2	-60.25	-13
	3702.2	-63.45	-13
	3740.4	-62.91	-13
	3818.0	-63.75	-13
H	1649.4	-58.94	-13
	1670.8	-58.87	-13
	1696.2	-61.05	-13
	3702.2	-64.35	-13
	3740.4	-63.19	-13
	3818.0	-63.99	-13

Conducted Emission Test on a.c. Power Line **Section 15.207**

Result **Pass**

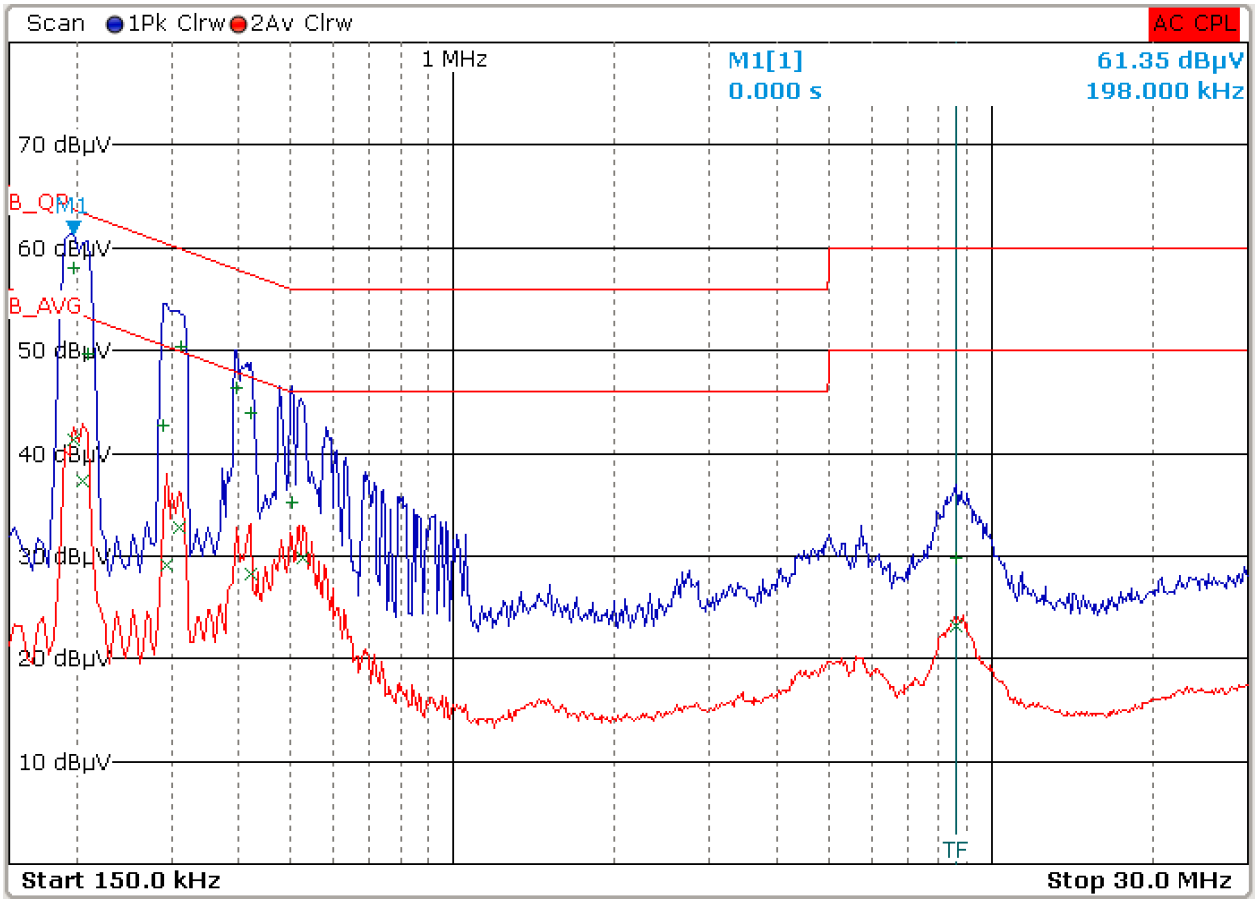
Test Specification	:	FCC Part 15 Section 15.207
Test Method	:	ANSI C63.10-2013
Testing Location	:	Screened room
Measurement Bandwidth	:	9kHz
Frequency Range	:	150kHz – 30MHz
Supply Voltage	:	120VAC 60Hz

Limit of section 15.207

Frequency of emission (MHz)	QP Limit (dBµV)	AV Limit (dBµV/m)
0.15 – 0.5	66 – 56*	56 – 46*
0.5 – 5	56	46
5 – 30	60	50

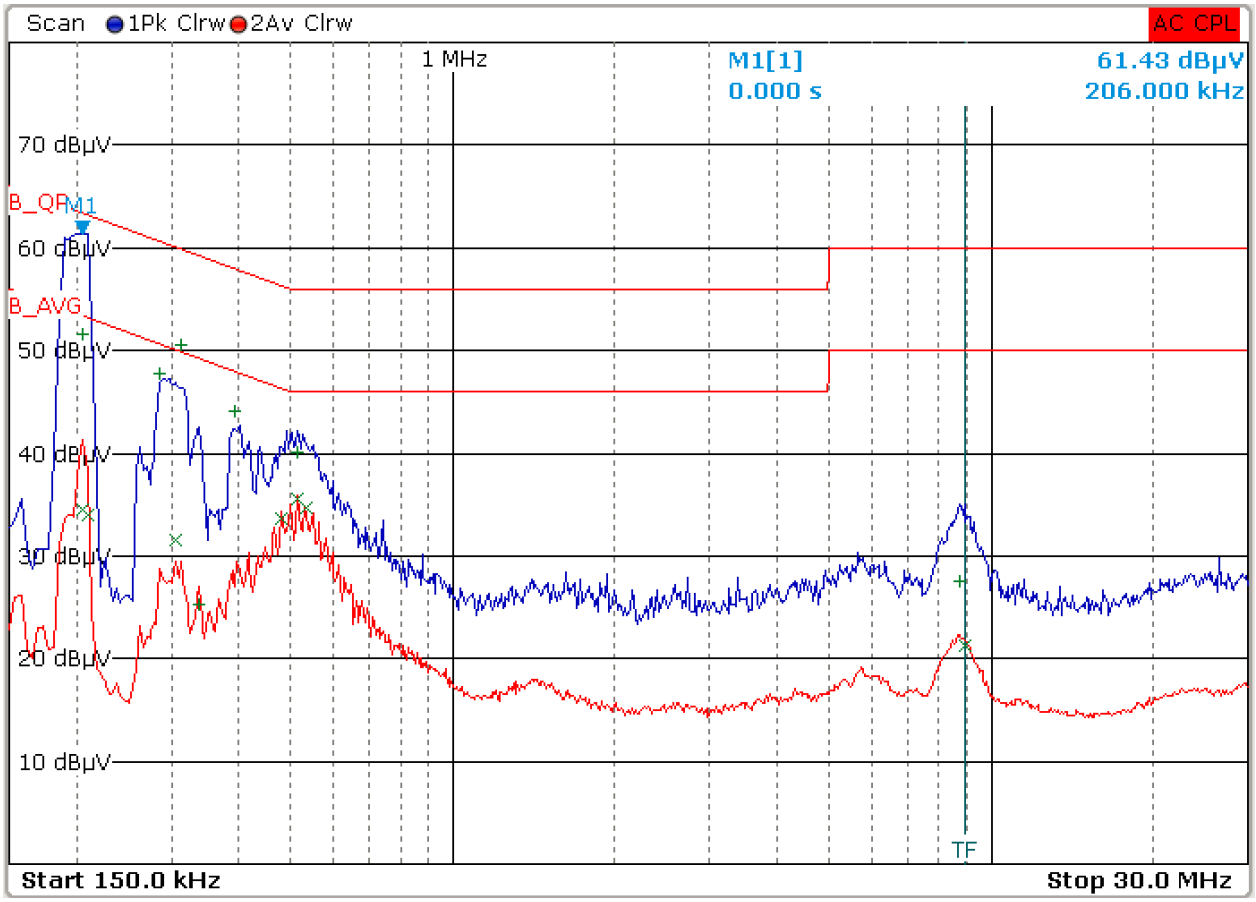
* Decreases with the logarithm of the frequency

Test Result:
Mode: Positive



Trace	Frequency	Level (dBµV)	Phase	Detector	Delta Limit/dB
1	198.000000000 kHz	57.97		Quasi Peak	-5.72
2	198.000000000 kHz	41.32		Average	-12.37
2	206.000000000 kHz	37.29		Average	-16.08
1	210.000000000 kHz	49.74		Quasi Peak	-13.47
1	290.000000000 kHz	42.67		Quasi Peak	-17.85
2	294.000000000 kHz	29.09		Average	-21.32
2	310.000000000 kHz	32.77		Average	-17.20
1	314.000000000 kHz	50.29		Quasi Peak	-9.57
1	398.000000000 kHz	46.42		Quasi Peak	-11.48
1	422.000000000 kHz	43.98		Quasi Peak	-13.43
2	422.000000000 kHz	28.28		Average	-19.13
1	502.000000000 kHz	35.22		Quasi Peak	-20.78
2	526.000000000 kHz	29.76		Average	-16.24
1	8.602000000 MHz	29.77		Quasi Peak	-30.23
2	8.606000000 MHz	23.11		Average	-26.89

Mode: Negative



Trace	Frequency	Level (dBµV)	Phase	Detector	Delta Limit/dB
1	206.000000000 kHz	51.58		Quasi Peak	-11.79
2	206.000000000 kHz	34.52		Average	-18.85
2	210.000000000 kHz	33.99		Average	-19.22
1	286.000000000 kHz	47.80		Quasi Peak	-12.84
2	306.000000000 kHz	31.56		Average	-18.52
1	314.000000000 kHz	50.51		Quasi Peak	-9.35
1	338.000000000 kHz	25.34		Quasi Peak	-33.91
1	394.000000000 kHz	44.18		Quasi Peak	-13.80
2	482.000000000 kHz	33.71		Average	-12.59
1	514.000000000 kHz	40.10		Quasi Peak	-15.90
2	514.000000000 kHz	35.64		Average	-10.36
2	534.000000000 kHz	34.61		Average	-11.39
1	8.738000000 MHz	27.60		Quasi Peak	-32.40
2	8.934000000 MHz	21.23		Average	-28.77