Gakkiku Technology Company
Flat B, 5/F., Selwyn Factory Building,
No. 404 Kwun Tong Road,
Kwun Tong, Kowloon,
Hong Kong
Tel: (852) 8113 2281
Fax: (852) 2797 0192
Email: info@gakkiku.com

Test Report

Applicant	Scientific Toys Ltd.
Address	Rm. 1108, 11/F., Block B, New Mandarin Plaza, 14 Science Museum Road, TST East, Kowloon, Hong Kong
FCC ID Number	FCC ID: BY32188-24GR
Brand Name(s)	None
Model Number(s)/ Catalog Number(s)	21882, 6001056, 6001071, BY32188-24GR
Product Description	2.408-2.460 GHz Wireless R/C Device - TX Portion
Operating Frequency	2.408-2.460 GHz
Rules/Standards	Part 15.249 of the FCC Rules
Received Date	24th June, 2014
Tested Date	25th June, 2014
Approved by	Dick Chan (Director of Gakkiku)
Tested by	Lahm Peng (Engineer of Shenzhen SEM.Test)
Signed by	Jandy So (Manager of Shenzhen SEM.Test)
Report Number	GKK201406240C
Test Results	☒ PASSED ☐ FAILED

GENERAL

The report is written by Gakkiku Technology Company. The tested device complies with the general approval requirements of the FCC Rules and the Industry Canada as identified in this test report.

TEST LOCATION

The tested device was tested at the test site of the Shenzhen SEM.Test Technology Co., Ltd., 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, 518101, Guangdong, China. The FCC Recognized 2.948 Listed Test Firm Registration Number is 934118. The Industry Canada IC OATS Filing Number/Assigned Code is 11464A.

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	Scientific Toys Ltd.
Address of applicant:	Rm. 1108, 11/F., Block B, New Mandarin Plaza, 14 Science Museum Road, TST East, Kowloon, Hong Kong
Manufacturer:	Scientific Toys Ltd.
Address of manufacturer:	Rm. 1108, 11/F., Block B, New Mandarin Plaza, 14 Science Museum Road, TST East, Kowloon, Hong Kong

General Description of EUT

Item	Description
Product Description:	2.408-2.460 GHz Wireless R/C Device - TX Portion
Brand Name(s):	/
Model Number(s)/ Catalog Number(s):	21882, 6001056, 6001071, BY32188-24GR
Power Source:	DC 9.6V Rechargeable Battery Pack
Output Power:	<0dBm
Frequency Range:	2.408-2.460 GHz
No. of Channel:	/
Channel Separation:	/
Antenna Type:	Integral Antenna
Size:	9.9x6.1x3.0 cm
For more information refer to the circuit diagram form and the user's manual.	

The test data is gathered from a production sample, provided by the manufacturer.

1.2 Test Standards

The following report is prepared on behalf of the Scientific Toys Ltd. in accordance with Part 15 Subpart B and Subpart C of the FCC Rules, and Part 15.249, 15.107, 15.203, 15.205, 15.207 and 15.209 of the FCC Rules.

The objective is to determine compliance with Part 15 Subpart C of the FCC Rules, and Part 15.249, 15.107, 15.203, 15.205, 15.207 and 15.209 of the FCC Rules.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which results in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Related Submittal(s)/Grant(s)

No Related Submittal(s).

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI Standards C63.4-2003, American National Standard Institute for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted according to the Operating Instructions and let the EUT keep transmitting.

1.5 Test Facility

FCC Recognized 2.948 Listed Test Firm Registration Number: 934118

EMC Laboratory of the Shenzhen SEM.Test Technology Co., Ltd. has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files and the FCC Recognized 2.948 Listed Test Firm Registration Number is 934118.

Industry Canada IC OATS Filing Number/Assigned Code: 11464A

The 3 Meter Semi-Anechoic Chamber of the Shenzhen SEM.Test Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Industry Canada IC OATS Filing Number/Assigned Code (11464A).

1.6 EUT Exercise Software

The EUT exercise program used during the testing was designed to exercise the system components. The test software is started while the whole system is on.

1.7 Accessories Equipment List and Details

Manufacturer	Description	Model	Serial Number
N/A	Tact switch	N/A	N/A
N/A	2 units of 5 cm-long wires (unshielded and without core) which connect between GND and 4th pin of U5	N/A	N/A
N/A	1 unit of 3 mm-size Green LED and 2 units of 5 cm-long wires (unshielded and without core) which connect between 11th pin of U5 to to LED anode and LED cathode to GND	N/A	N/A

1.8 EUT Cable List and Details

Cable Description	Length (M)	Shielded/ Unshielded	With Core/ Without Core
/	/	/	/

2. SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
Part 15.203	Antenna Requirement	Compliant
Part 15.107(a)	Conducted Emission	N/A
Part 15.205	Restricted Band of Operation	Compliant
Part 15.209	Radiated Emission	Compliant
Part 15.249(a)	Field Strength	Compliant
Part 15.249(d)	Out of Band Emission	Compliant

3. Part 15.203 - ANTENNA REQUIREMENT

3.1 Standard Applicable

According to Part 15.203 of the FCC Rules, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

3.2 Test Result

This product has an integral antenna, fulfill the requirement of this section.

4. Part 15.249(a), 15.205 & 15.209 - RADIATED EMISSION

4.1 Measurement Uncertainty

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement is ±3.0 dB.

4.2 Standard Applicable

According to Part 15.249(a) of the FCC Rules, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field strength of fundamental (milli-volts/meter)	Field strength of harmonics (micro-volts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in Part 15.35 of the FCC Rules for limiting peak emissions apply.

EMISSIONS RADIATED OUTSIDE OF THE SPECIFIED FREQUENCY BANDS, EXCEPT FOR HARMONICS, SHALL BE ATTENUATED BY AT LEAST 20 dB BELOW THE LEVEL OF THE FUNDAMENTAL OR TO THE GENERAL RADIATED EMISSION LIMITS UNDER PART 15.209 OF THE FCC RULES, WHICHEVER IS THE LESSER ATTENUATION.

Emissions that fall in the restricted bands (Part 15.205 of the FCC Rules) must be less than 54dBuV/m otherwise the spurious and harmonics must be attenuated by at least 20dB.

4.3 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Spectrum Analyzer	R&S	FSP	836079/035	2014-05-28	2015-05-27
EMI Test Receiver	R&S	ESVB	825471/005	2014-05-28	2015-05-27
Pre-amplifier	Agilent	8447F	3113A06717	2014-05-28	2015-05-27
Pre-amplifier	Compliance Direction	PAP-0118	24002	2014-05-28	2015-05-27
Trilog Broadband Antenna	SCHWARZBECK	VULB9163	9163-333	2014-05-24	2015-05-23
Horn Antenna	ETS	3117	00086197	2014-05-24	2015-05-23
Horn Antenna	ETS	3116B	00088203	2014-05-24	2015-05-23
Loop Antenna	SCHWARZECK	HFRA 5165	9365	2014-05-24	2015-05-23

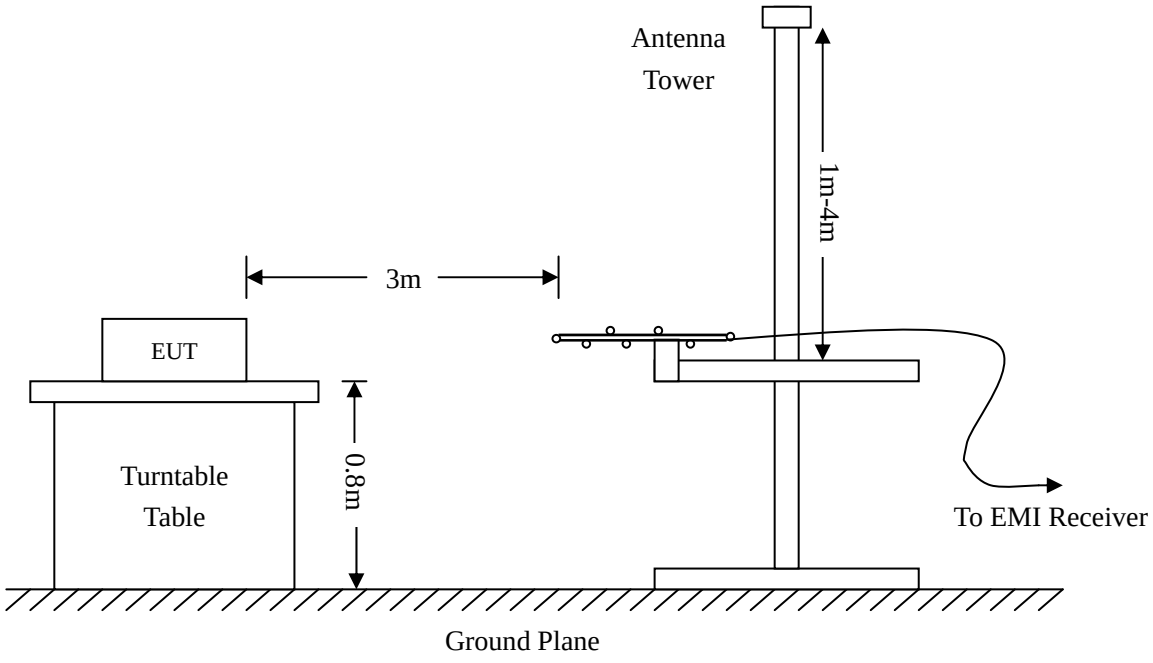
Statement of Traceability: All calibrations have been performed per the NVLAP requirements traceable to the NIST.

4.4 Test Procedure

The setup of EUT is according with per ANSI Standards C63.4-2003 measurement procedure. The specification used was with the limits of Part 15.249(a), 15.205 and 15.209 of the FCC Rules. The radiated emissions were investigated by rotating the EUT through the three (3) orthogonal planes as mandated in ANSI Standards C63.4-2003.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm



4.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Ant. Factor + Cable Loss – Ampl. Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit for Part 15 of the FCC Rules. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Limit of Part 15 of the FCC Rules

4.6 Environmental Conditions

Temperature:	26 °C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

4.7 Summary of Test Results/Plots

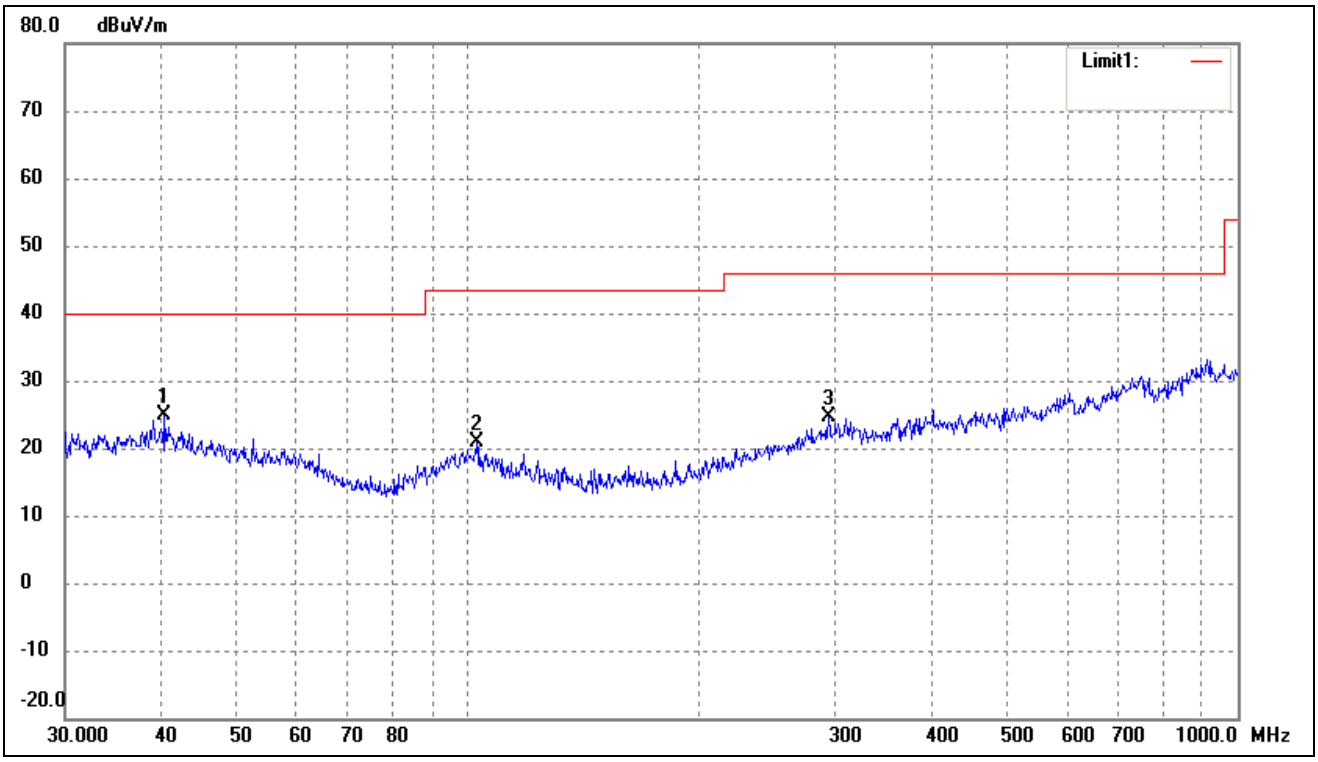
According to the data below, the standards of Part 15.249, 15.205 and 15.209 of the FCC Rules, and had the worst margin of:

Note: This EUT was tested in 3 orthogonal positions and the worst case position data was reported.

Plot of Radiation Emissions Test

Radiated Disturbance
Product Description: 2.408-2.460 GHz Wireless R/C Device - TX Portion
Model Number(s)/Catalog Number(s): 21882, 6001056, 6001071, BY32188-24GR
Operating Condition: Transmitting below 1 GHz (Lowest Channel: 2408 MHz)
Test Specification: Horizontal & Vertical
Power Source: DC 9.6V Rechargeable Battery Pack

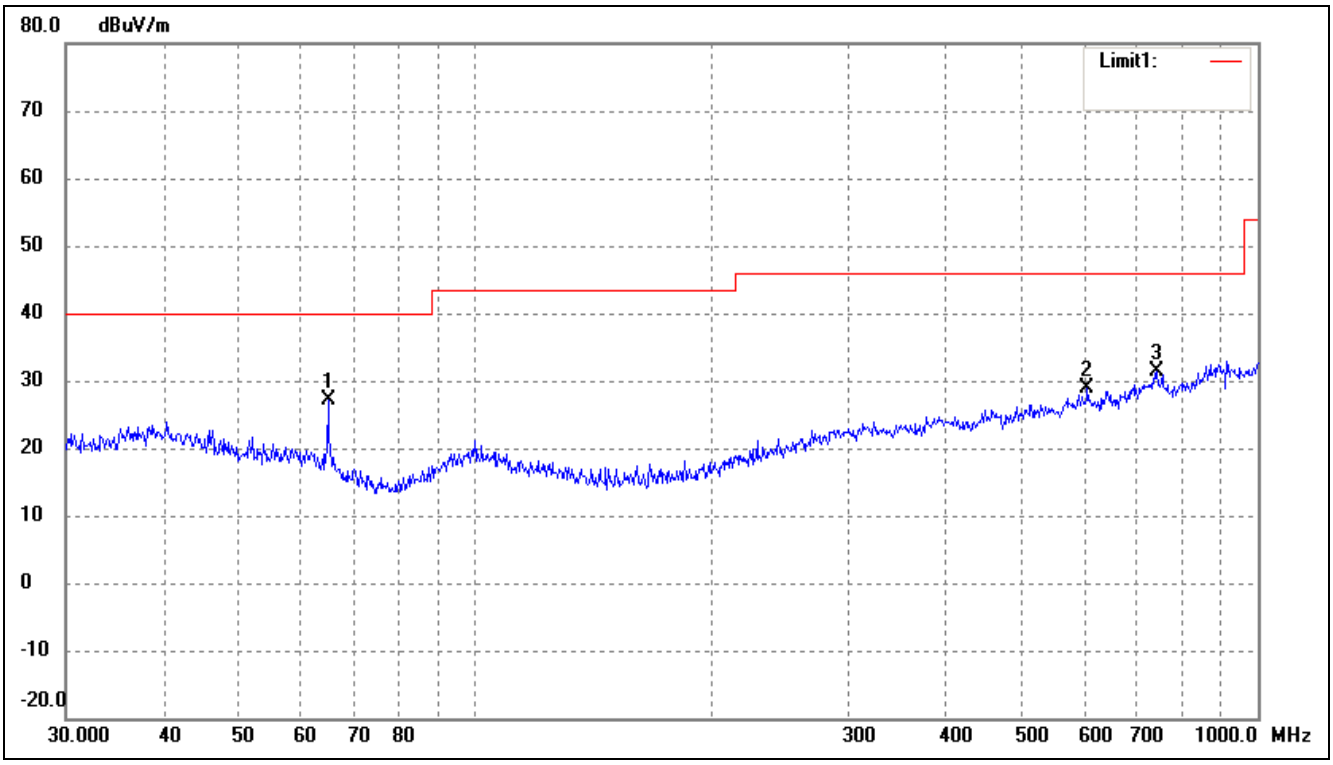
Horizontal:



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	(°)	(cm)	
1	40.4172	17.64	7.21	24.85	40.00	-15.15	251	100	Peak
2	102.7192	15.13	5.85	20.98	43.50	-22.52	314	100	Peak
3	294.1137	15.74	8.94	24.68	46.00	-21.32	47	100	Peak

Note: Emissions attenuated more than 20 dB below the permissible value are not reported.

Vertical:



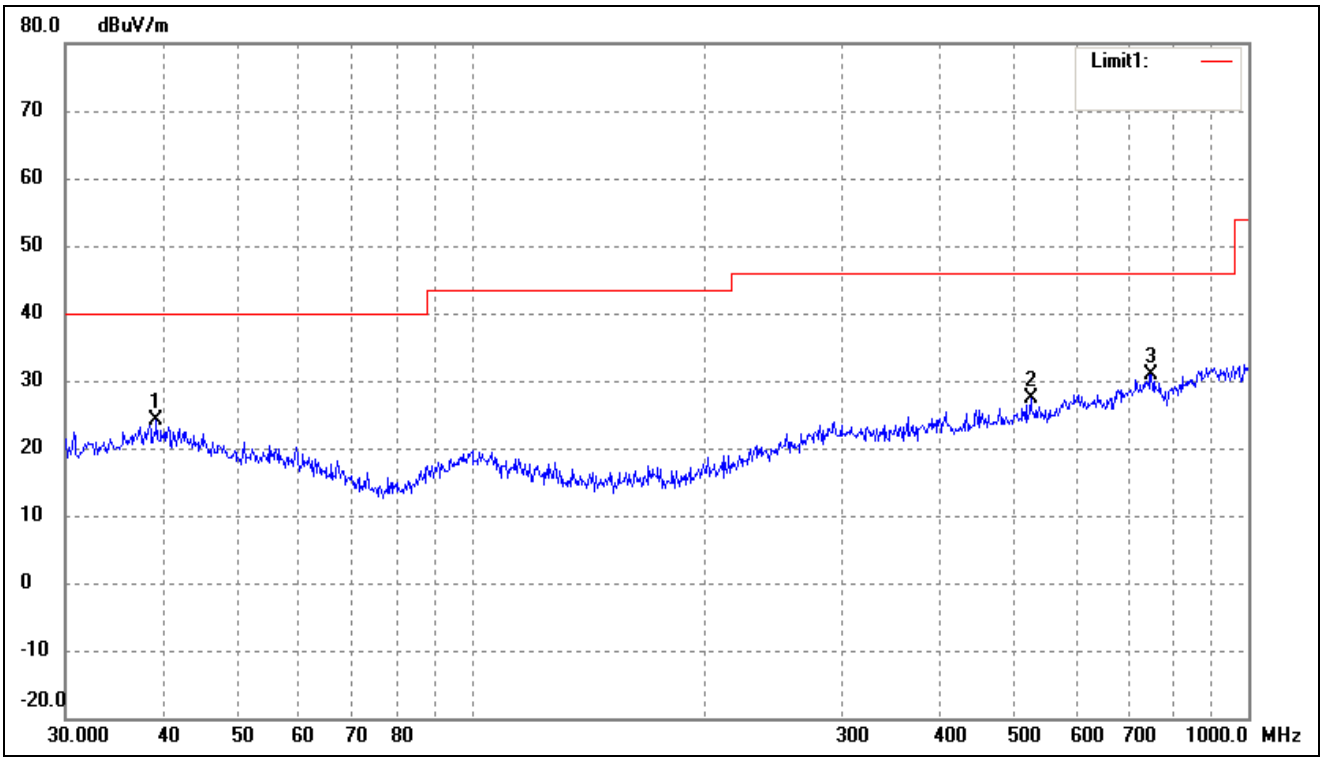
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	(°)	(cm)	
1	64.8865	23.37	3.82	27.19	40.00	-12.81	314	100	Peak
2	605.6592	15.97	12.92	28.89	46.00	-17.11	75	100	Peak
3	742.2587	16.03	15.45	31.48	46.00	-14.52	39	100	Peak

Note: Emissions attenuated more than 20 dB below the permissible value are not reported.

Plot of Radiation Emissions Test

Radiated Disturbance
Product Description: 2.408-2.460 GHz Wireless R/C Device - TX Portion
Model Number(s)/Catalog Number(s): 21882, 6001056, 6001071, BY32188-24GR
Operating Condition: Transmitting below 1 GHz (Near Middle Channel: 2442 MHz)
Test Specification: Horizontal & Vertical
Power Source: DC 9.6V Rechargeable Battery Pack

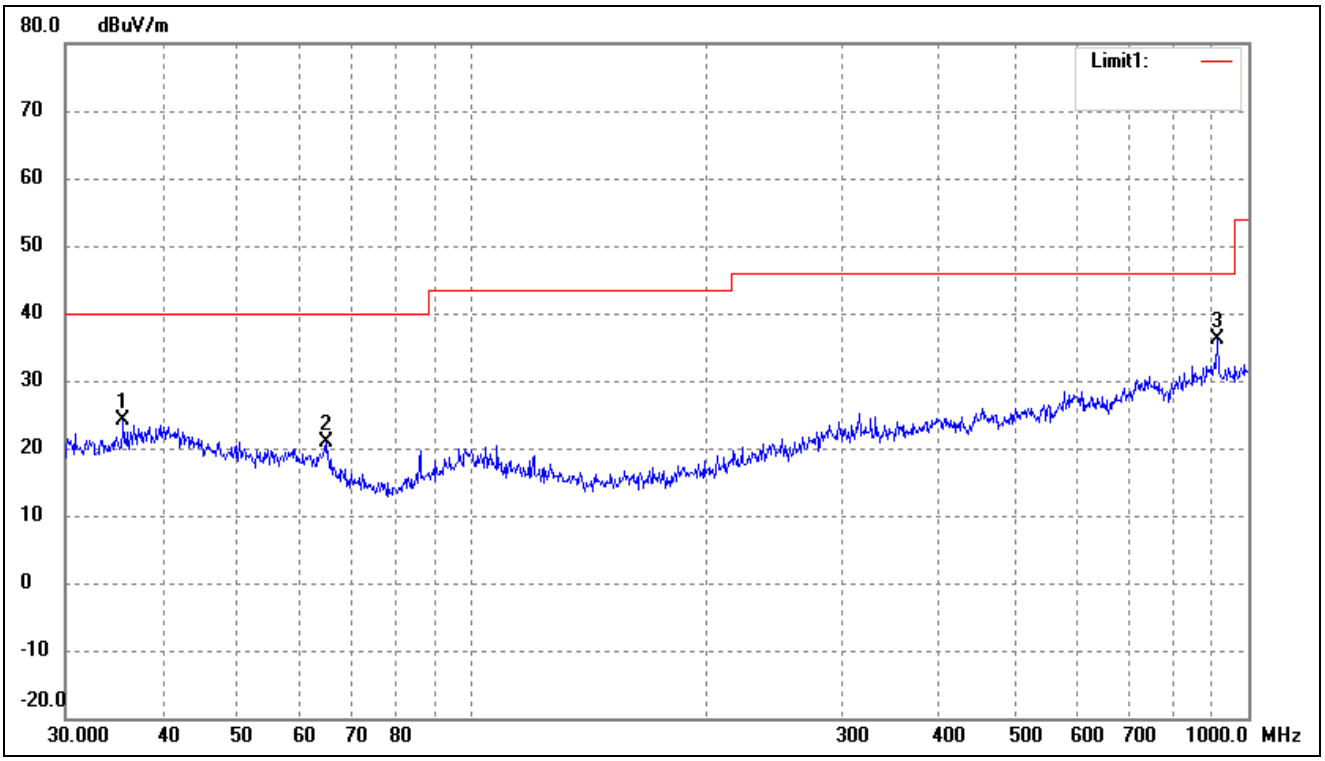
Horizontal:



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	(°)	(cm)	
1	39.2991	16.95	7.06	24.01	40.00	-15.99	255	100	Peak
2	524.5541	16.08	11.36	27.44	46.00	-18.56	35	100	Peak
3	750.1083	16.79	14.10	30.89	46.00	-15.11	174	100	Peak

Note: Emissions attenuated more than 20 dB below the permissible value are not reported.

Vertical:



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	(°)	(cm)	
1	35.6240	15.65	8.49	24.14	40.00	-15.86	214	100	Peak
2	64.8865	17.01	3.82	20.83	40.00	-19.17	26	100	Peak
3	912.8620	19.60	16.62	36.22	46.00	-9.78	47	100	Peak

Note: Emissions attenuated more than 20 dB below the permissible value are not reported.

Plot of Radiation Emissions Test

Radiated Disturbance

Product Description: 2.408-2.460 GHz Wireless R/C Device - TX Portion

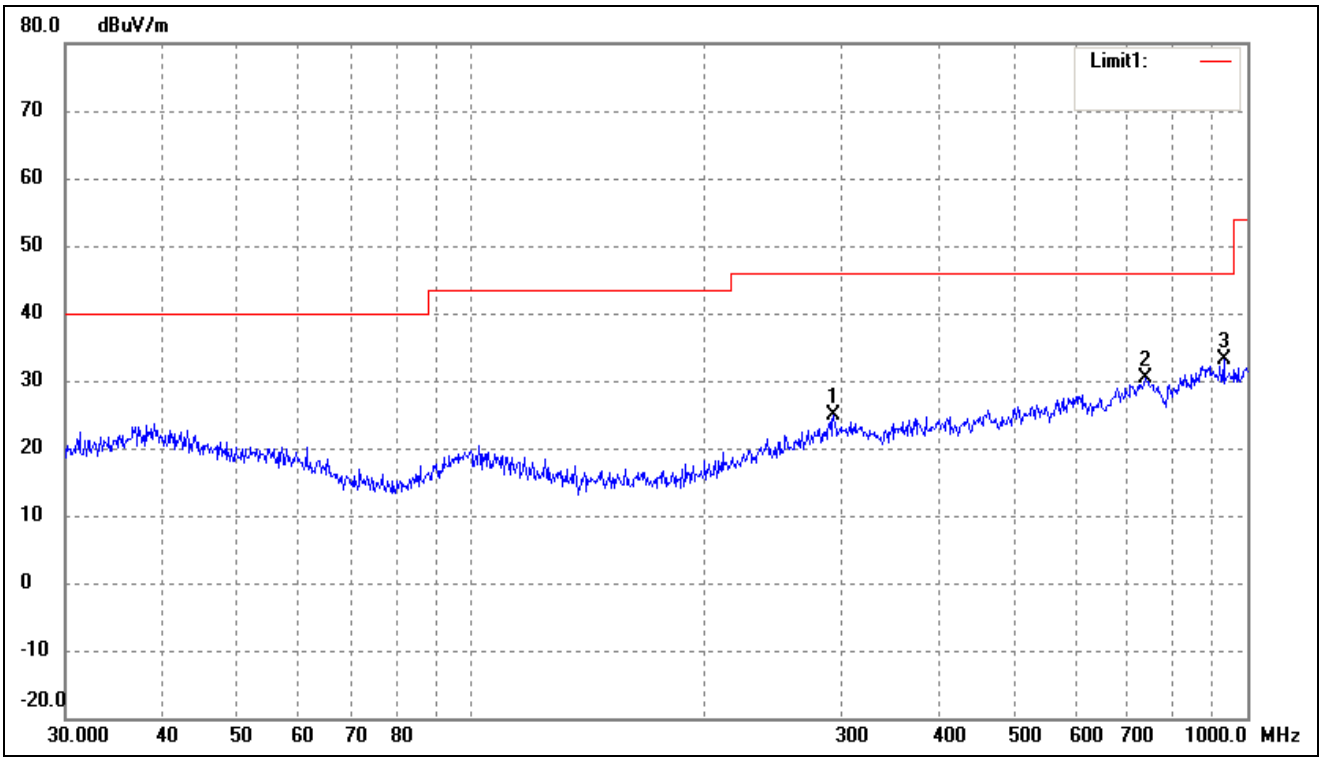
Model Number(s)/Catalog Number(s): 21882, 6001056, 6001071, BY32188-24GR

Operating Condition: Transmitting below 1 GHz (Highest Channel: 2460 MHz)

Test Specification: Horizontal & Vertical

Power Source: DC 9.6V Rechargeable Battery Pack

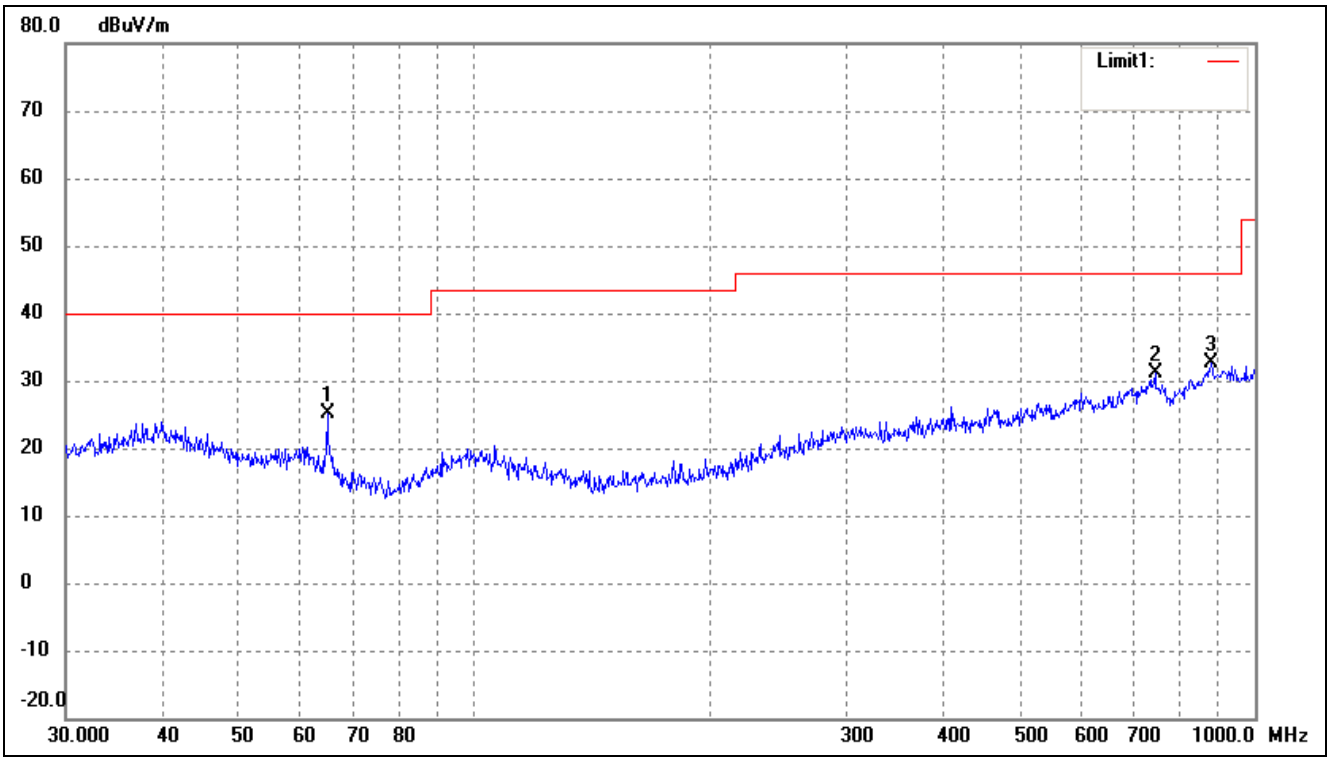
Horizontal:



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	(°)	(cm)	
1	293.0842	16.10	8.90	25.00	46.00	-21.00	154	100	Peak
2	739.6605	16.95	13.53	30.48	46.00	-15.52	39	100	Peak
3	932.2715	16.74	16.32	33.06	46.00	-12.94	54	100	Peak

Note: Emissions attenuated more than 20 dB below the permissible value are not reported.

Vertical:



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	(°)	(cm)	
1	64.8865	21.21	3.82	25.03	40.00	-14.97	153	100	Peak
2	744.8661	15.81	15.33	31.14	46.00	-14.86	347	100	Peak
3	878.3214	15.78	16.78	32.56	46.00	-13.44	152	100	Peak

Note: Emissions attenuated more than 20 dB below the permissible value are not reported.

Spurious Emission above 1 GHz

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Lowest Channel: 2408 MHz							
2408	68.85	-3.50	65.35	114	-48.65	H	Peak
2408	55.77	-3.50	52.27	94	-41.73	H	Average
4816	51.58	0.55	52.13	74	-21.87	H	Peak
4816	39.23	0.55	39.78	54	-14.22	H	Average
7224	46.8	3.68	50.48	74	-23.52	H	Peak
7224	34.49	3.68	38.17	54	-15.83	H	Average
2408	77.02	-3.50	73.52	114	-40.48	V	Peak
2408	64.23	-3.50	60.73	94	-33.27	V	Average
4816	51.6	0.55	52.15	74	-21.85	V	Peak
4816	40.24	0.55	40.79	54	-13.21	V	Average
7224	46.33	3.68	50.01	74	-23.99	V	Peak
7224	32.98	3.68	36.66	54	-17.34	V	Average
Near Middle Channel: 2442 MHz							
2442	68.16	-3.41	64.75	114	-49.25	H	Peak
2442	56.68	-3.41	53.27	94	-40.73	H	Average
4884	50.6	0.66	51.26	74	-22.74	H	Peak
4884	37.32	0.66	37.98	54	-16.02	H	Average
7326	46.74	3.76	50.50	74	-23.5	H	Peak
7326	33.17	3.76	36.93	54	-17.07	H	Average
2442	75.86	-3.41	72.45	114	-41.55	V	Peak
2442	64.14	-3.41	60.73	94	-33.27	V	Average
4884	50.3	0.66	50.96	74	-23.04	V	Peak
4884	37.7	0.66	38.36	54	-15.64	V	Average
7326	45.1	3.76	48.86	74	-25.14	V	Peak
7326	33.17	3.76	36.93	54	-17.07	V	Average

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Highest Channel: 2460 MHz							
2460	69.33	-3.37	65.96	114	-48.04	H	Peak
2460	57.45	-3.37	54.08	94	-39.92	H	Average
4920	49.68	0.71	50.39	74	-23.61	H	Peak
4920	37.05	0.71	37.76	54	-16.24	H	Average
7380	48.2	3.81	52.01	74	-21.99	H	Peak
7380	35.94	3.81	39.75	54	-14.25	H	Average
2460	77.85	-3.37	74.48	114	-39.52	V	Peak
2460	64.97	-3.37	61.60	94	-32.4	V	Average
4920	49.55	0.71	50.26	74	-23.74	V	Peak
4920	37.3	0.71	38.01	54	-15.99	V	Average
7380	45.87	3.81	49.68	74	-24.32	V	Peak
7380	33.87	3.81	37.68	54	-16.32	V	Average

Note: Testing is carried out with frequency range 9 kHz to the tenth harmonics, which above 5th Harmonics are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.

The measurements greater than 20 dB below the limit from 9 kHz to 30 MHz.

5. Part 15.249(b) - OUT OF BAND EMISSIONS

5.1 Standard Applicable

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits under Part 15.209 of the FCC Rules, whichever is the lesser attenuation.

5.2 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Spectrum Analyzer	R&S	FSP	836079/035	2014-05-28	2015-05-27
EMI Test Receiver	R&S	ESVB	825471/005	2014-05-28	2015-05-27
Pre-amplifier	Agilent	8447F	3113A06717	2014-05-28	2015-05-27
Pre-amplifier	Compliance Direction	PAP-0118	24002	2014-05-28	2015-05-27
Trilog Broadband Antenna	SCHWARZBECK	VULB9163	9163-333	2014-05-24	2015-05-23
Horn Antenna	ETS	3117	00086197	2014-05-24	2015-05-23
Spectrum Analyzer	Agilent	E4402B	US41192821	2014-05-24	2015-05-23
Attenuator	ATTEN	ATS100-4-20	/	2014-05-24	2015-05-23

Statement of Traceability: All calibrations have been performed per the NVLAP requirements traceable to the NIST.

5.3 Test Procedure

As the radiation test, set the Lowest and Highest Transmitting Channel, observed the outside band of 2400MHz to 2438.5MHz, than mark the higher-level emission for comparing with the FCC Rules.

5.4 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	54%
ATM Pressure:	1012 mbar

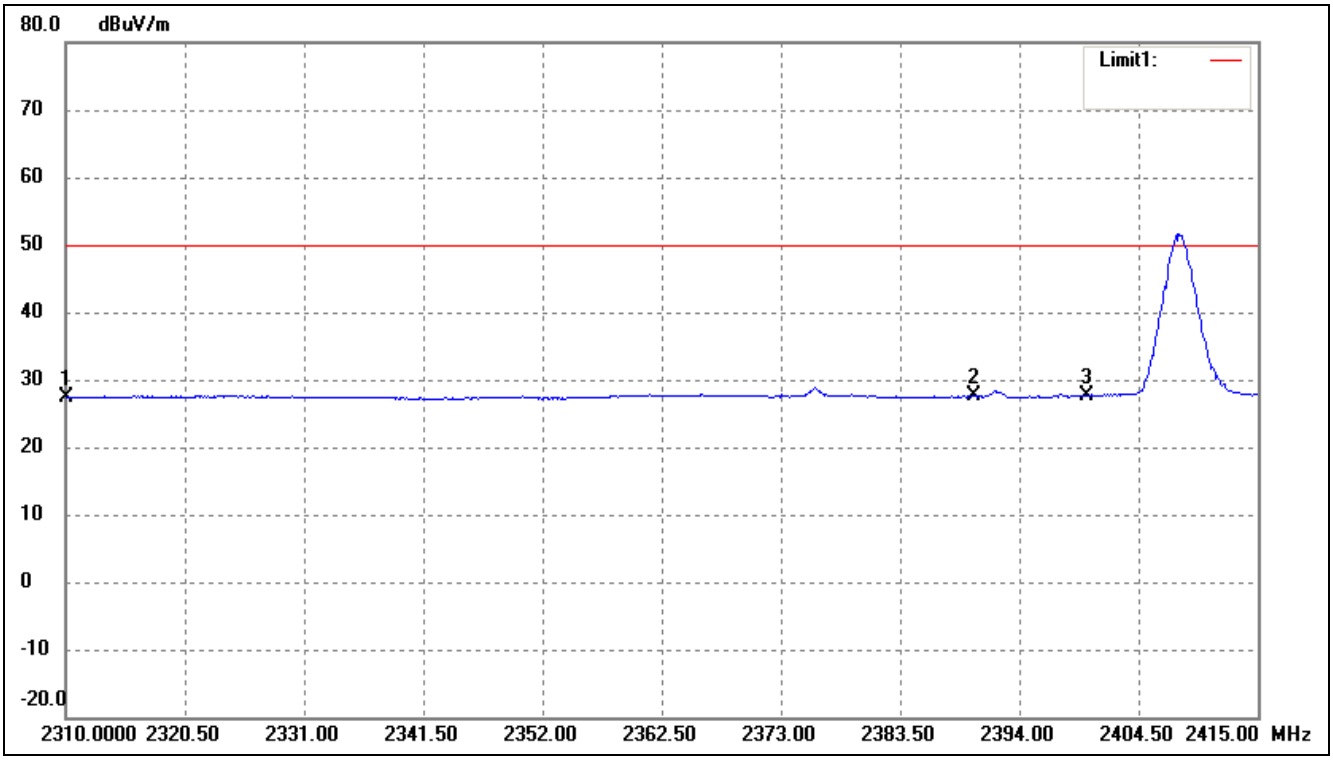
5.5 Summary of Test Results/Plots

Frequency (MHz)	Emission (dBµV/m)	Limit (dBµV/m)
2390.0	35.60	54
2400.0	51.75	54
2483.5	46.89	54

Test Result Pass

Refer to the attached plots.

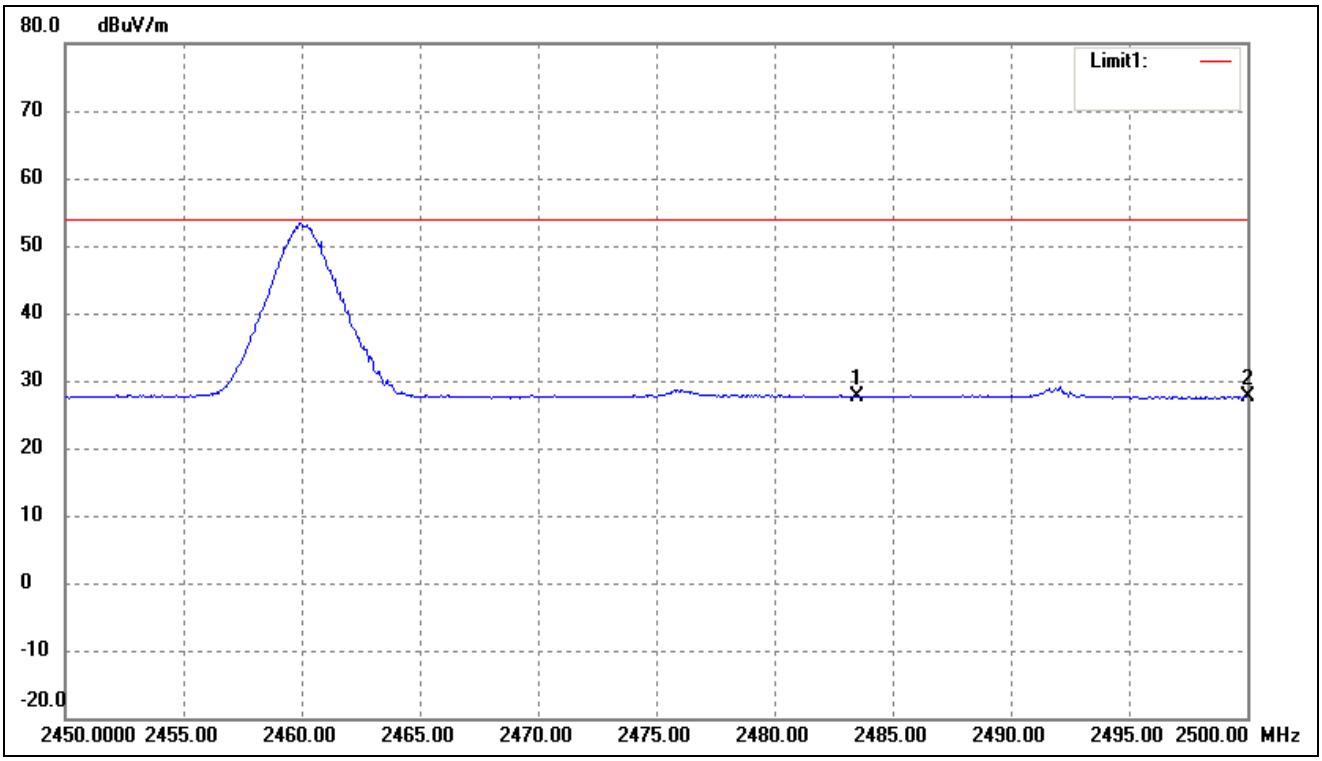
Lower Bandedge



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2310.000	31.07	-3.71	27.36	50.00	-22.64	Average
	2310.000	44.37	-3.71	40.66	74.00	-33.34	Peak
2	2390.000	31.19	-3.54	27.65	50.00	-22.35	Average
	2390.000	45.81	-3.54	42.27	74.00	-31.73	Peak
3	2400.000	31.06	-3.51	27.55	50.00	-22.45	Average
	2400.000	52.74	-3.51	49.23	74.00	-24.77	Peak

Note: Emissions attenuated more than 20 dB below the permissible value are not reported.

Upper Bandedge



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	30.97	-3.33	27.64	54.00	-26.36	Average
	2483.500	44.09	-3.33	40.76	74.00	-33.24	Peak
2	2500.000	30.84	-3.28	27.56	54.00	-26.44	Average
	2500.000	43.98	-3.28	40.70	74.00	-33.30	Peak

Note: Emissions attenuated more than 20 dB below the permissible value are not reported.

6. Emission Bandwidth

6.1 Standard Applicable

According to Part 15.215 (c) of the FCC Rules, intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

6.2 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Spectrum Analyzer	Agilent	E4402B	US41192821	2014-05-28	2015-05-27
Attenuator	ATTEN	ATS100-4-20	/	2014-05-28	2015-05-27

6.3 Test Procedure

According to the ANSI Standards C63.4-2003, the emission bandwidth test method as follows:

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Set span = 1 MHz, centered on a transmitting channel
RBW ≥1% 20 dB Bandwidth, VBW ≥RBW
Sweep = auto
Detector function = Peak
Trace = max hold
All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 20dB down and 99% bandwidth of the emission.

6.4 Environmental Conditions

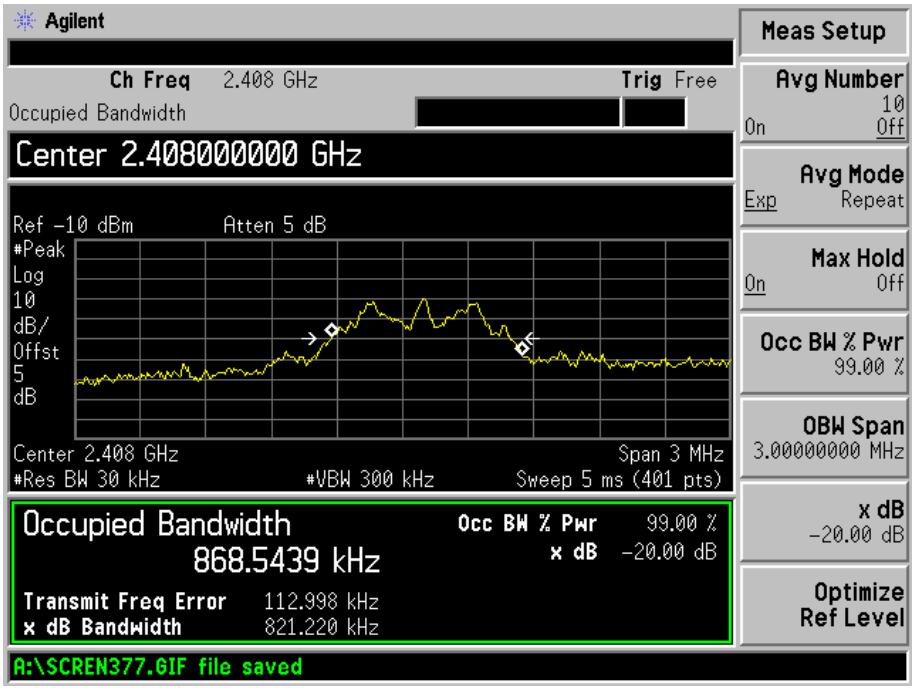
Temperature:	25 °C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

6.5 Summary of Test Results/Plots

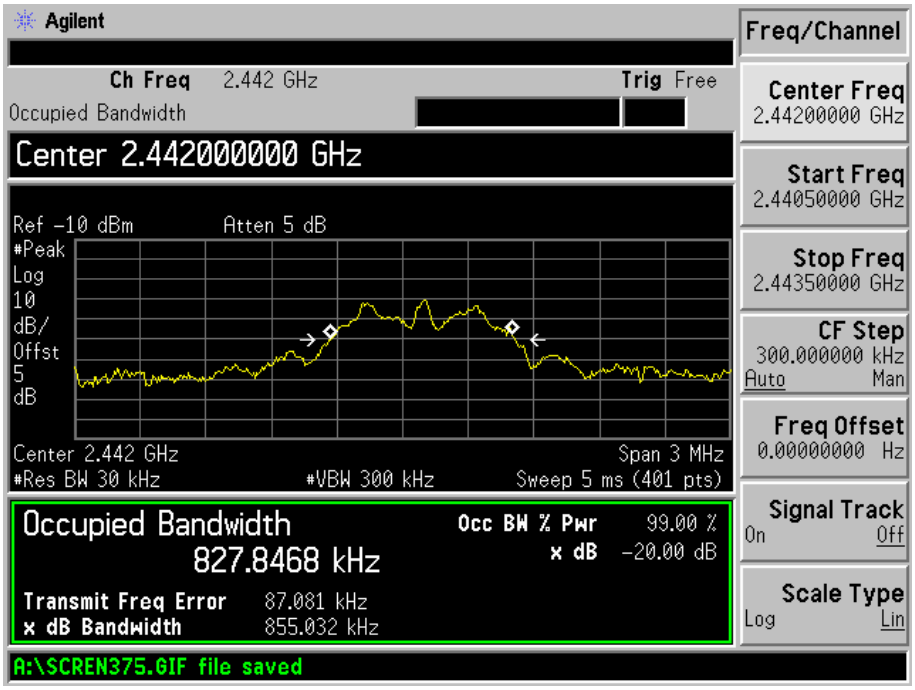
Channel	Frequency MHz	20dB Bandwidth kHz	99% Bandwidth kHz
Lowest Channel	2408	821.220	868.5439
Near Middle Channel	2442	855.032	827.8468
Highest Channel	2460	865.640	833.6224

Please refer to the following test plots

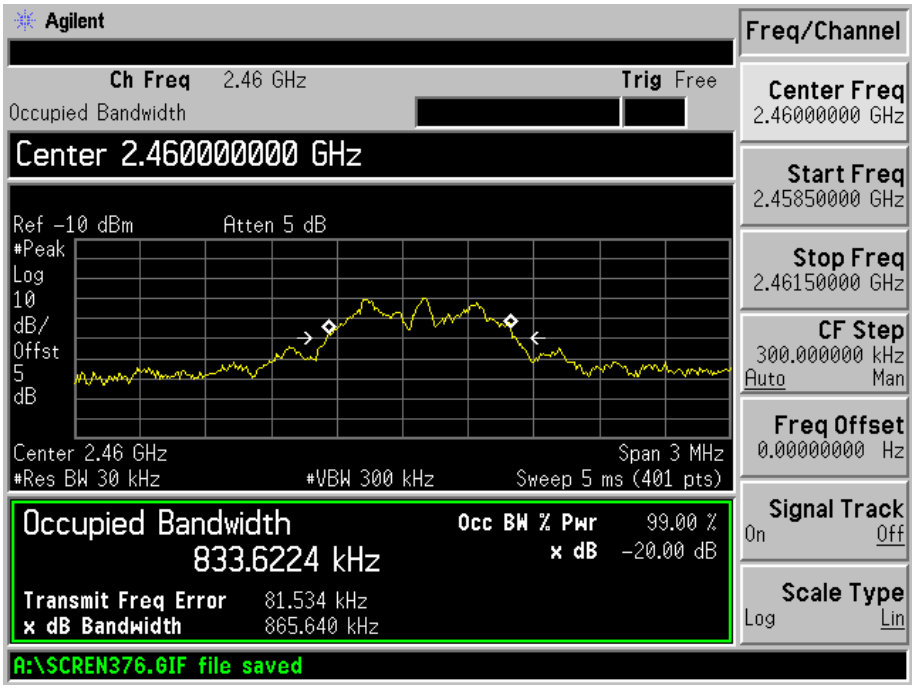
Lowest Channel:



Near Middle Channel:



Highest Channel:



******* END OF REPORT *******