

FCC Part 15C Measurement and Test Report


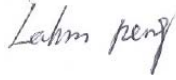

For

Shenzhen Star Sources Electronic Technology Co., Ltd.

Room 2316, A Building Century Holiday Plaza, North Shennan RD, Nanshan

District, Shenzhen, China

FCC ID: ZJEST-248

FCC Rules:	<u>FCC Part 15.249</u>
Product Description:	2.4GHz Wireless Mouse
Tested Model:	<u>ST-248</u>
Report No.:	<u>STR12068081I</u>
Tested Date:	<u>2012-06-12 to 2012-06-18</u>
Issued Date:	<u>2012-06-19</u>
Tested By:	<u>Jason Jiang / Engineer</u> 
Reviewed By:	<u>Lahm Peng / EMC Manager</u> 
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Prepared By:	

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Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by SEM.Test Compliance Service Co., Ltd

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	Shenzhen Star Sources Electronic Technology Co., Ltd.
Address of applicant:	Room 2316, A Building Century Holiday Plaza, North Shennan RD, Nanshan District, Shenzhen, China
Manufacturer:	Shenzhen Star Sources Electronic Technology Co., Ltd.
Address of manufacturer:	Room 2316, A Building Century Holiday Plaza, North Shennan RD, Nanshan District, Shenzhen, China

General Description of EUT	
Product Name:	2.4GHz Wireless Mouse
Trade Name:	/
Model No.:	ST-248
Adding Model(s):	ST-282, ST-285
Rated Voltage:	DC 1.5V Battery
<p><i>Note: The test data is gathered from a production sample, provided by the manufacturer. The other models listed in the report (ST-282, ST-285) only the appearance and name are different of ST-248 without circuit and electronic construction changed, declared by the manufacturer</i></p>	

Technical Characteristics of EUT	
Frequency Range:	2402-2477MHz
Max. Field Strength:	75.34 dBuV/m (at 3m distance)
Modulation:	GFSK
Quantity of Channels:	24
Antenna Type:	PCB Antenna
Antenna Gain:	0 dBi
Device Category:	Portable Device

1.2 Test Standards

The following report is prepared on behalf of the Shenzhen Star Sources Electronic Technology Co., Ltd. in accordance with FCC Part 15, Subpart B, Subpart C, and section 15.107, 15.203, 15.205, 15.207, 15.209 and 15.249 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.107,15.203, 15.205, 15.207, 15.209 and 15.249 of the Federal Communication Commissions 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 Test Methodology

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

1.4 Test Facility

- **FCC – Registration No.: 994117**

SEM.Test Compliance Services Co., Ltd. EMC Laboratory 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 Registration is 994117.

- **Industry Canada (IC) Registration No.: 7673A**

The 3m Semi-anechoic chamber of SEM.Test Compliance Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 7673A.

- **CNAS Registration No.: L4062**

Shenzhen SEM.Test Electronics Service Co., Ltd. is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L4062. All measurement facilities used to collect the measurement data are located at 3/F, Jinbao Commerce Building, Xin'an Fanshen Road, Bao'an District, Shenzhen, P.R.C (518101)

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Low Channel	2402MHz
TM2	Middle Channel	2442MHz
TM3	High Channel	2477MHz

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 15.203	Antenna Requirement	Compliant
§ 15.207(a)	Conducted Emission	N/A*
§ 15.209(a)(f), §15.249(a)	Radiated Spurious Emissions	Compliant
§15.249(d)	Out of Band Emission	Compliant
§15.215(c)	Emission Bandwidth	Compliant

* The EUT work with an alkaline battery, the conducted emission is not applicable.

3. Antenna Requirements

3.1 Standard Applicable

According to FCC Part 15.203, 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. Radiated Emissions

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 ± 5.10 dB.

4.2 Standard Applicable

According to §15.249(a), 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 fundamental (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

(d) 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 in §15.209, whichever is the lesser attenuation.

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

4.3 Test Equipment List and Details

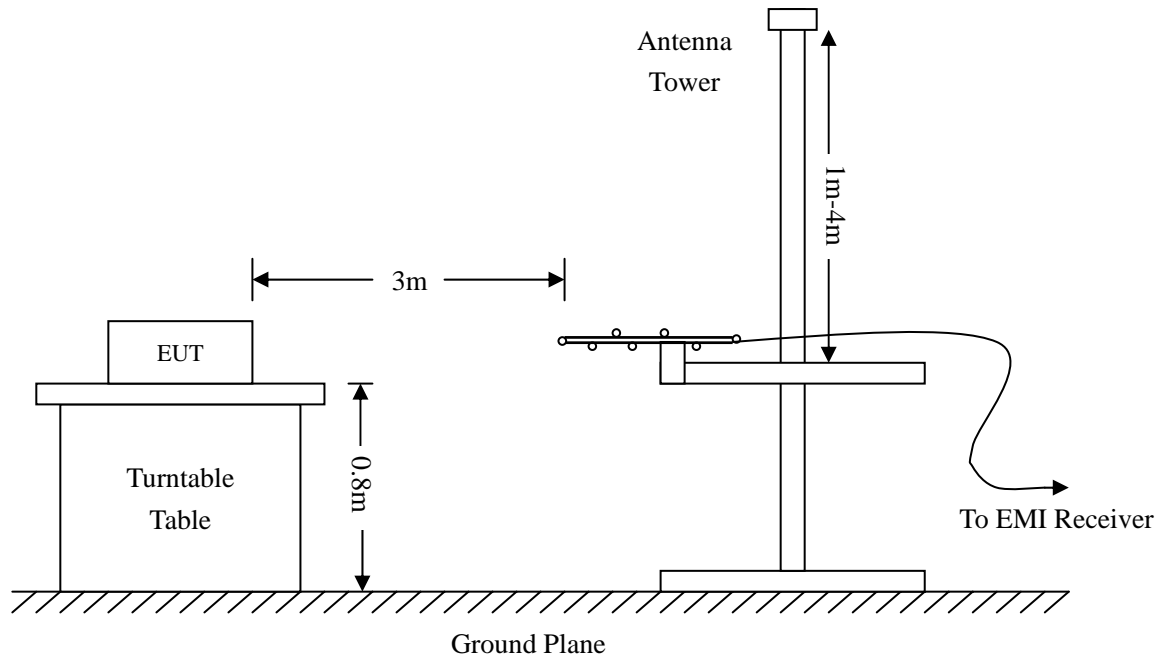
Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Spectrum Analyzer	R&S	FSP	836079/035	2012-03-28	2013-03-27
EMI Test Receiver	R&S	ESVB	825471/005	2012-03-28	2013-03-27
Pre-amplifier	Agilent	8447F	3113A06717	2012-03-28	2013-03-27
Pre-amplifier	Compliance Direction	PAP-0118	24002	2012-03-28	2013-03-27
Trilog Broadband Antenna	SCHWARZBECK	VULB9163	9163-333	2012-02-25	2013-02-24
Horn Antenna	ETS	3117	00086197	2012-02-25	2013-02-24
Loop Antenna	SCHWARZECK	HFRA 5165	9365	2012-02-25	2013-02-24

4.4 Test Procedure

The setup of EUT is according with per ANSI C63.4-2003 measurement procedure. The specification used was with the FCC Part 15.205 15.249(a) and FCC Part 15.209 Limit.

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:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dB μ V means the emission is 6dB μ V below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15C Limit}$$

4.6 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	60 %
ATM Pressure:	1012 mbar

4.7 Summary of Test Results/Plots

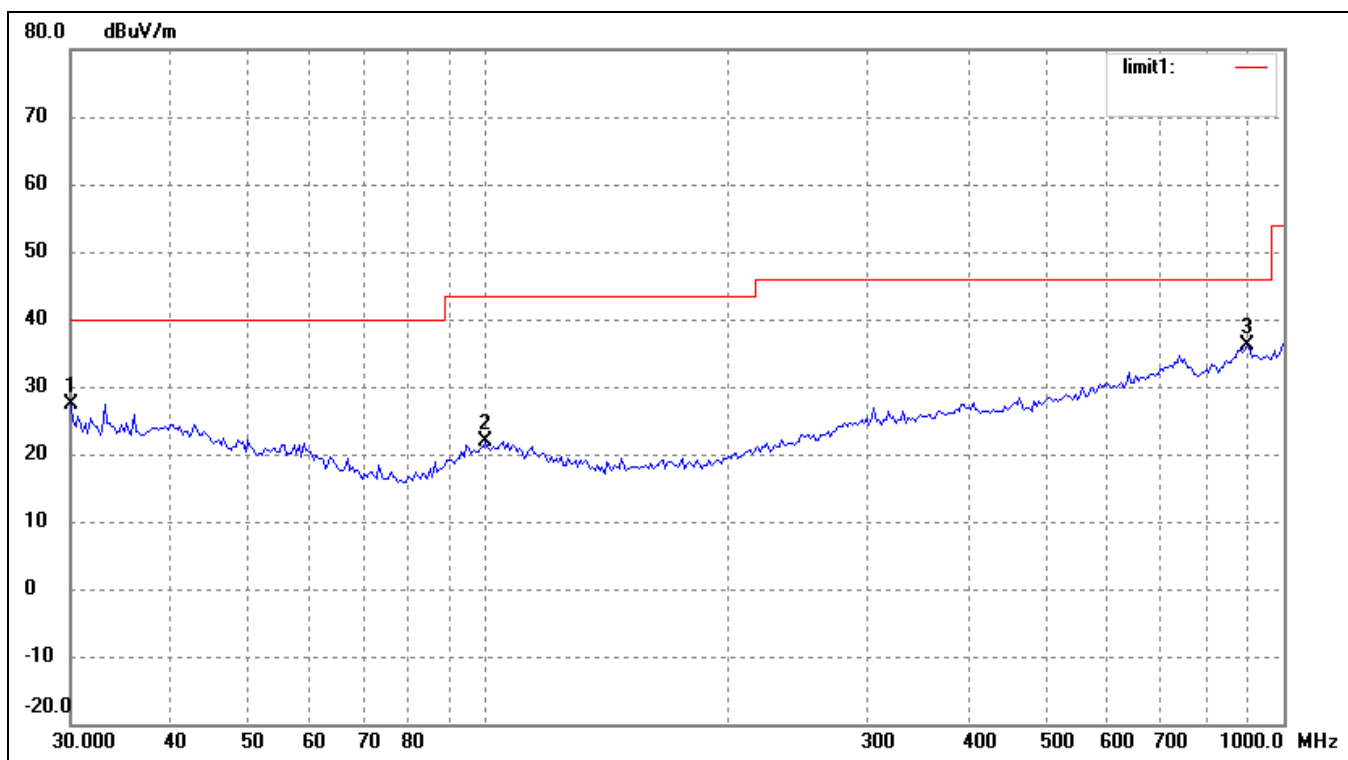
According to the data below, the FCC Part 15.205, 15.209 and 15.249 standards, and had the worst margin of:

-9.50 dB μ V at 893.8567 MHz in the Horizontal polarization, High Channel, 9 kHz to 25 GHz, 3Meters

Plot of Radiated Emissions Test Data (30MHz to 1GHz)

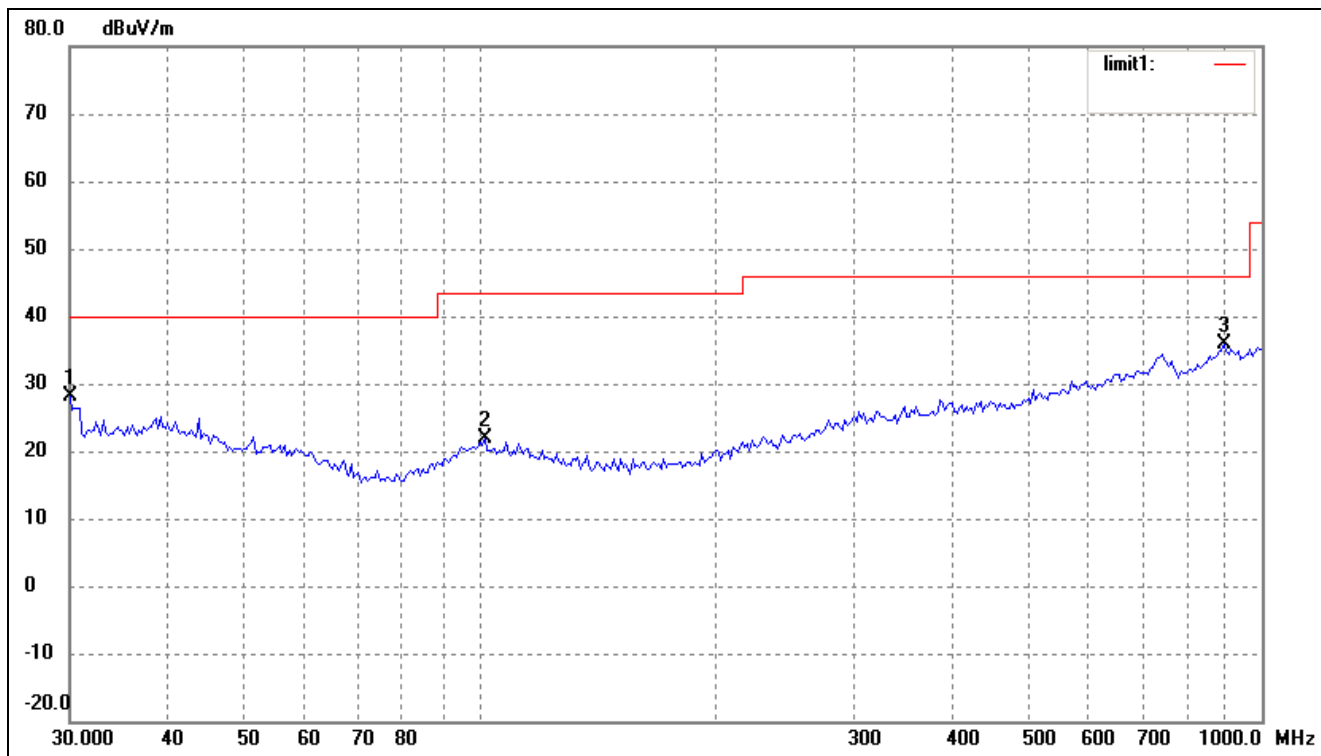
EUT: 2.4GHz Wireless Mouse
 Tested Model: ST-248
 Operating Condition: Transmitting Low Channel (2402MHz)
 Comment:

Test Specification: Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (°)	Height (cm)	Remark
1	30.0000	19.45	8.04	27.49	40.00	-12.51	264	100	peak
2	99.5281	15.20	6.72	21.92	43.50	-21.58	113	200	peak
3	900.1474	16.67	19.38	36.05	46.00	-9.95	287	100	peak

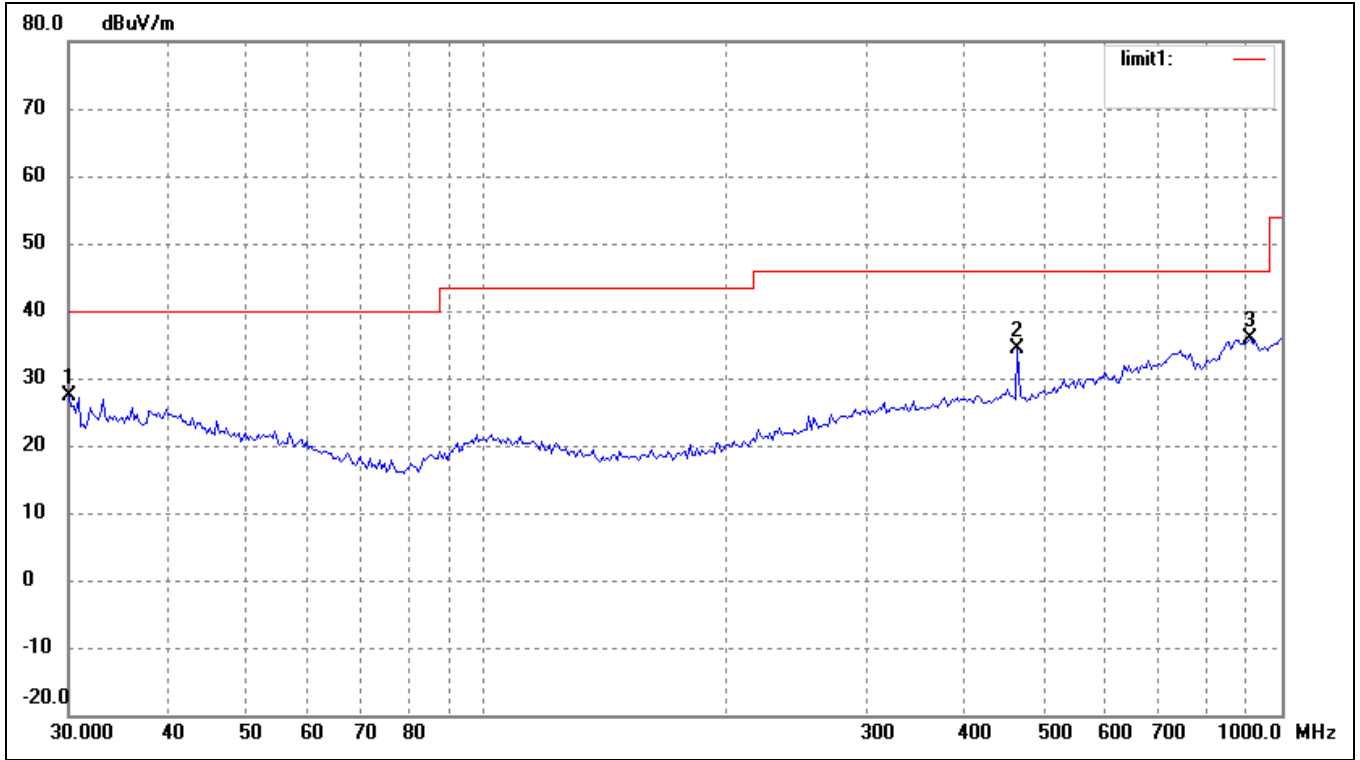
Test Specification: Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (°)	Height (cm)	Remark
1	30.0000	20.04	8.04	28.08	40.00	-11.92	234	100	peak
2	101.6443	15.17	6.67	21.84	43.50	-21.66	118	100	peak
3	893.8567	16.70	19.27	35.97	46.00	-10.03	164	100	peak

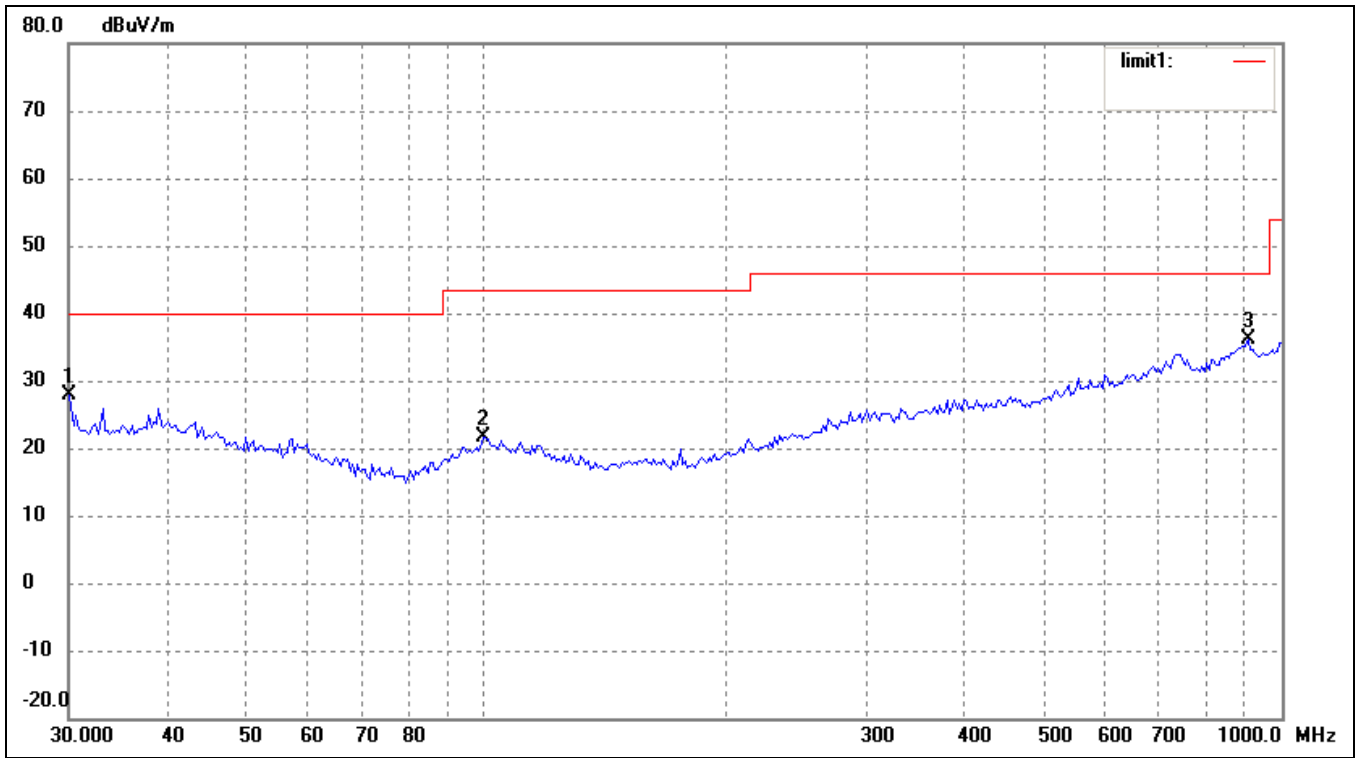
Plot of Radiated Emissions Test Data (30MHz to 1GHz)

EUT: 2.4GHz Wireless Mouse
 Tested Model: ST-248
 Operating Condition: Transmitting Low Channel (2442MHz)
 Comment:
 Test Specification: Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (°)	Height (cm)	Remark
1	30.0000	19.31	8.04	27.35	40.00	-12.65	162	100	peak
2	465.5994	22.79	11.69	34.48	46.00	-11.52	200	100	peak
3	912.8620	16.84	18.93	35.77	46.00	-10.23	152	100	peak

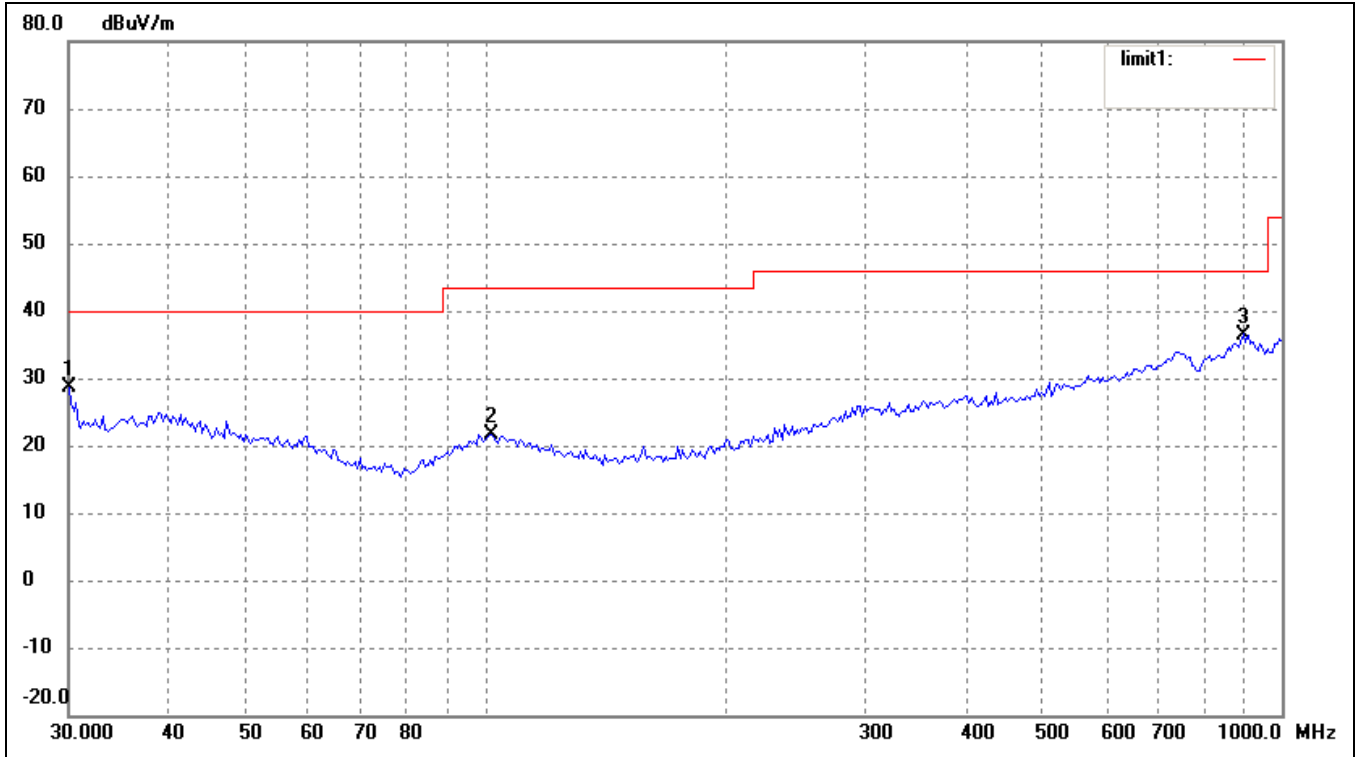
Test Specification: Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (°)	Height (cm)	Remark
1	30.0000	19.80	8.04	27.84	40.00	-12.16	240	100	peak
2	99.5281	14.91	6.72	21.63	43.50	-21.87	187	100	peak
3	906.4824	16.93	19.15	36.08	46.00	-9.92	220	100	peak

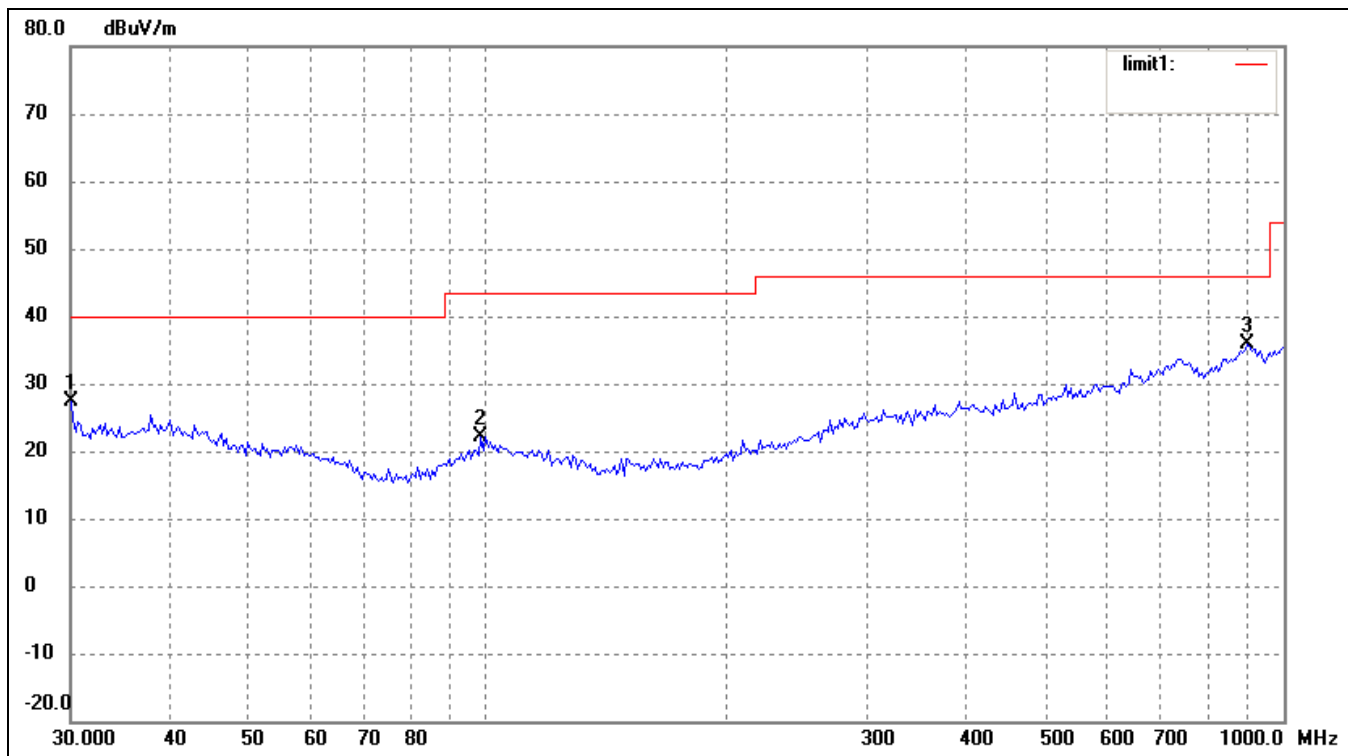
Plot of Radiated Emissions Test Data (30MHz to 1GHz)

EUT: 2.4GHz Wireless Mouse
 Tested Model: ST-248
 Operating Condition: Transmitting Low Channel (2477MHz)
 Comment:
 Test Specification: Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (°)	Height (cm)	Remark
1	30.0000	20.48	8.04	28.52	40.00	-11.48	162	100	peak
2	101.6443	15.01	6.67	21.68	43.50	-21.82	200	100	peak
3	893.8567	17.23	19.27	36.50	46.00	-9.50	254	120	peak

Test Specification: Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (°)	Height (cm)	Remark
1	30.0000	19.35	8.04	27.39	40.00	-12.61	240	100	peak
2	98.1419	15.71	6.39	22.10	43.50	-21.40	187	100	peak
3	900.1474	16.39	19.38	35.77	46.00	-10.23	220	100	peak

Spurious Emissions Above 1GHz

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2402MHz							
2402	80.28	-11.75	68.53	114.00	-45.47	H	PK
4804*	55.44	-3.92	51.52	74.00	-22.48	H	PK
7206	35.02	2.20	37.22	54.00	-16.78	H	PK
2402	78.50	-11.75	66.75	94.00	-27.25	H	AV
4804*	37.79	-3.92	33.87	54.00	-20.13	H	AV
7206	48.08	2.15	50.23	74.00	-23.77	H	AV
2402	87.09	-11.75	75.34	114.00	-38.66	V	PK
4804*	55.26	-3.92	51.34	74.00	-22.66	V	PK
7206	47.39	2.20	49.59	74.00	-24.41	V	PK
2402	85.77	-11.75	74.02	94.00	-19.98	V	AV
4804*	37.74	-3.92	33.82	54.00	-20.18	V	AV
7206	35.05	2.20	37.25	54.00	-16.75	V	AV
Middle Channel-2442MHz							
2442	85.09	-11.77	73.32	114.00	-40.68	H	PK
4884*	53.65	-3.71	49.94	74.00	-24.06	H	PK
7326*	34.75	2.26	37.01	54.00	-16.99	H	PK
2442	84.22	-11.77	72.45	94.00	-21.55	H	AV
4884*	37.54	-3.71	33.83	54.00	-20.17	H	AV
7326*	47.83	2.20	50.03	74.00	-23.97	H	AV
2442	87.03	-11.77	75.26	114.00	-38.74	V	PK
4884*	54.91	-3.71	51.20	74.00	-22.8	V	PK
7326*	47.26	2.23	49.49	74.00	-24.51	V	PK
2442	85.55	-11.77	73.78	94.00	-20.22	V	AV
4884*	37.92	-3.71	34.21	54.00	-19.79	V	AV
7326*	34.79	2.20	36.99	54.00	-17.01	V	AV

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2477MHz							
2477	85.07	-11.78	73.29	114.00	-40.71	H	PK
4954*	54.24	-3.50	50.74	74.00	-23.26	H	PK
7431*	48.36	2.07	50.43	74.00	-23.57	H	PK
2477	83.93	-11.78	72.15	94.00	-21.85	H	AV
4954*	37.31	-3.50	33.81	54.00	-20.19	H	AV
7431*	34.83	2.20	37.03	54.00	-16.97	H	AV
2477	86.6	-11.78	74.82	114.00	-39.18	V	PK
4954*	53.54	-3.50	50.04	74.00	-23.96	V	PK
7431*	46.96	2.26	49.22	74.00	-24.78	V	PK
2477	85.06	-11.78	73.28	94.00	-20.72	V	AV
4954*	37.19	-3.50	33.69	54.00	-20.31	V	AV
7431*	34.79	2.20	36.99	54.00	-17.01	V	AV

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

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

“” frequency falling into the § 15.205 restricted band*

5. 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 in §15.209, 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	2012-03-28	2013-03-27
EMI Test Receiver	R&S	ESVB	825471/005	2012-03-28	2013-03-27
Pre-amplifier	Agilent	8447F	3113A06717	2012-03-28	2013-03-27
Pre-amplifier	Compliance Direction	PAP-0118	24002	2012-03-28	2013-03-27
Trilog Broadband Antenna	SCHWARZBECK	VULB9163	9163-333	2012-02-25	2013-02-24
Horn Antenna	ETS	3117	00086197	2012-02-25	2013-02-24

5.3 Test Procedure

As the radiation test, set the Lowest and Highest Transmitting Channel, observed the outside band of 2400MHz to 2483.5MHz, than mark the higher-level emission for comparing with the FCC rules.

5.4 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	60 %
ATM Pressure:	1012 mbar

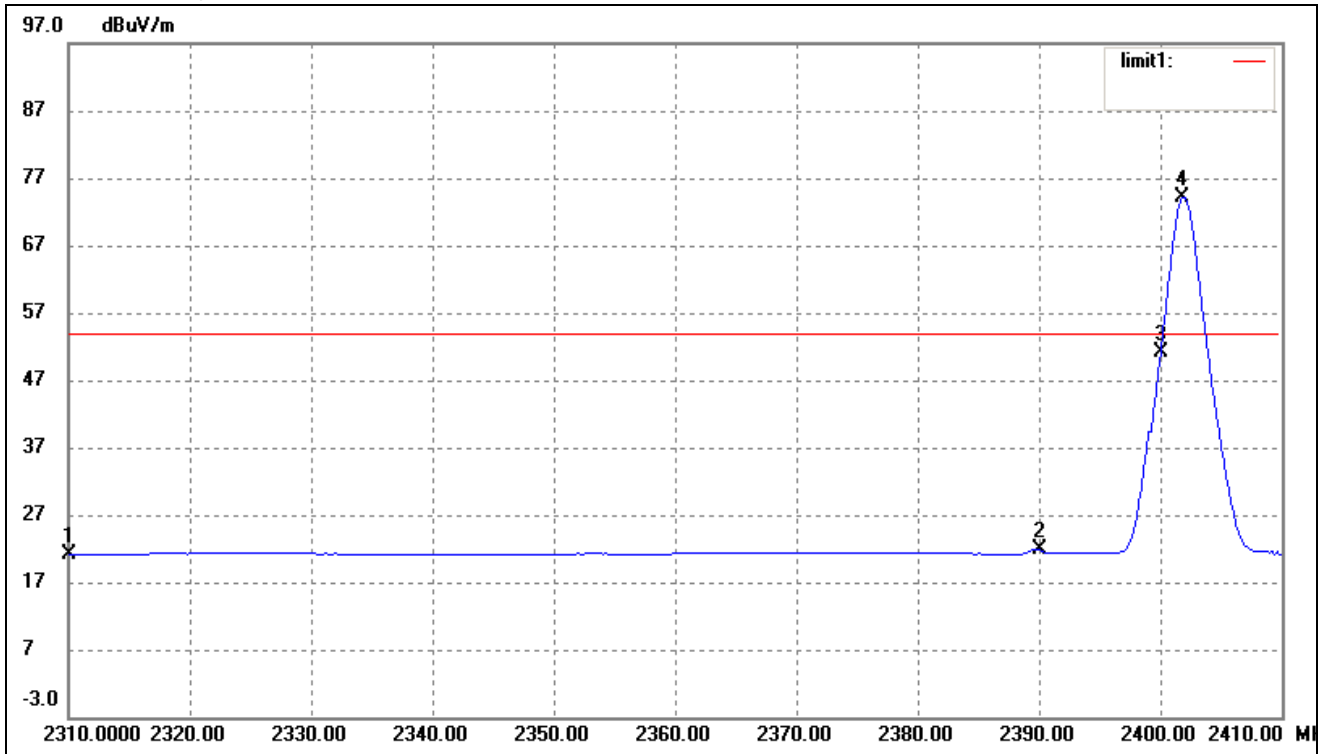
5.5 Summary of Test Results/Plots

Test mode	Frequency	Limit	Result
	MHz	dBuV / dBc	
Lowest	2310.00	<54 dBuV	Pass
	2390.00	<54 dBuV	Pass
	2400.00	<54 dBuV	Pass
Highest	2483.50	<54 dBuV	Pass
	2500.00	<54 dBuV	Pass

The edge emissions are below the FCC 15.209 Limits or complies with the 15.249(d) requirements.

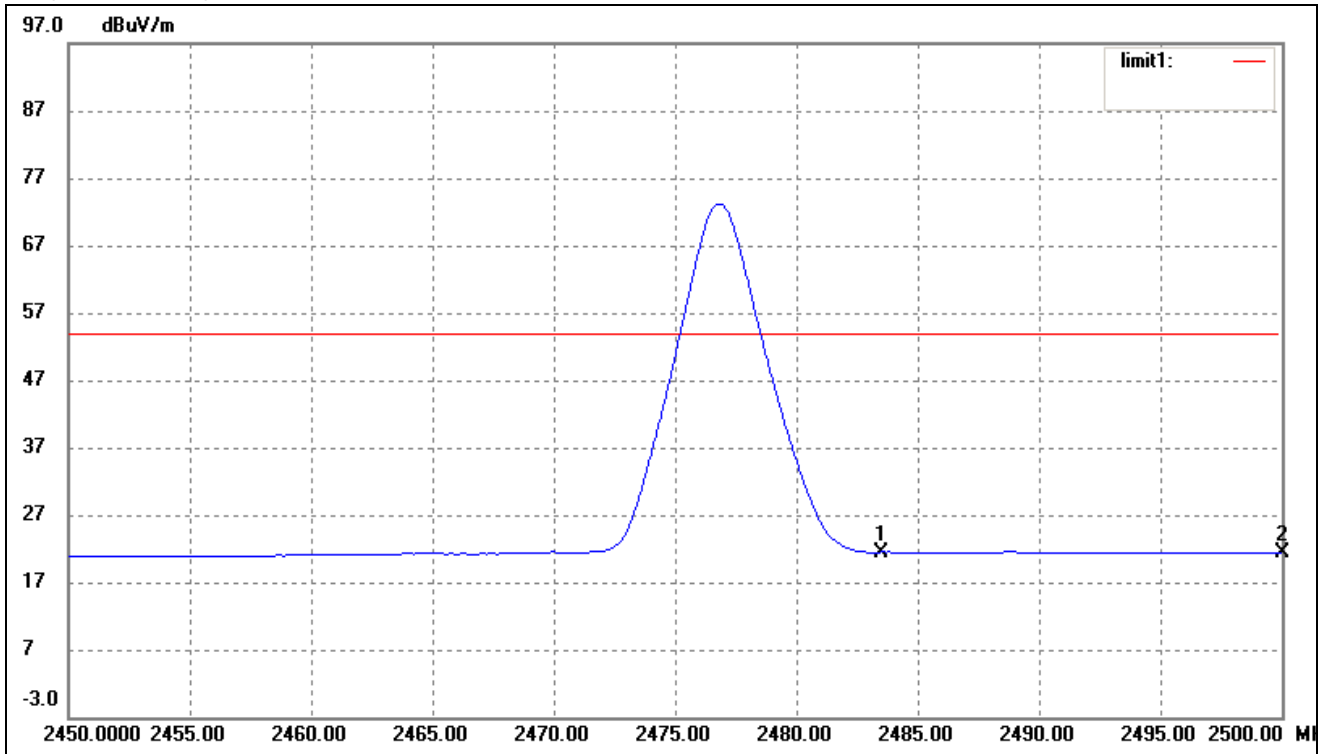
Please refer to the test plots as below.

Lowest Bandedge



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000*	32.74	-11.72	21.02	54.00	-32.98	Ave Detector
	2310.000*	47.10	-11.72	35.38	74.00	-38.62	Peak Detector
2	2390.000*	33.57	-11.75	21.82	54.00	-32.18	Ave Detector
	2390.000*	47.70	-11.75	35.95	74.00	-38.05	Peak Detector
3	2400.000	62.90	-11.75	51.15	54.00	-2.85	Ave Detector
	2400.000	64.41	-11.75	52.66	74.00	-21.34	Peak Detector
4	2402.000	85.76	-11.75	74.01	/	/	Ave Detector

Highest Bandedge



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500*	33.28	-11.78	21.50	54.00	-32.50	Ave Detector
	2483.500*	44.53	-11.78	32.75	74.00	-41.25	Peak Detector
2	2500.000*	33.05	-11.78	21.27	54.00	-32.73	Ave Detector
	2500.000*	46.26	-11.78	34.48	74.00	-39.52	Peak Detector

“*” frequency falling into the § 15.205 restricted band

6. Emission Bandwidth

6.1 Standard Applicable

According to 15.215 (c), 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	2012-03-28	2013-03-27
Attenuator	ATTEN	ATS100-4-20	/	2012-03-28	2013-03-27

6.3 Test Procedure

According to the ANSI 63.4-2003, 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 = 1MHz, centered on a transmitting channel

RBW \geq 1% 20dB Bandwidth, VBW \geq 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

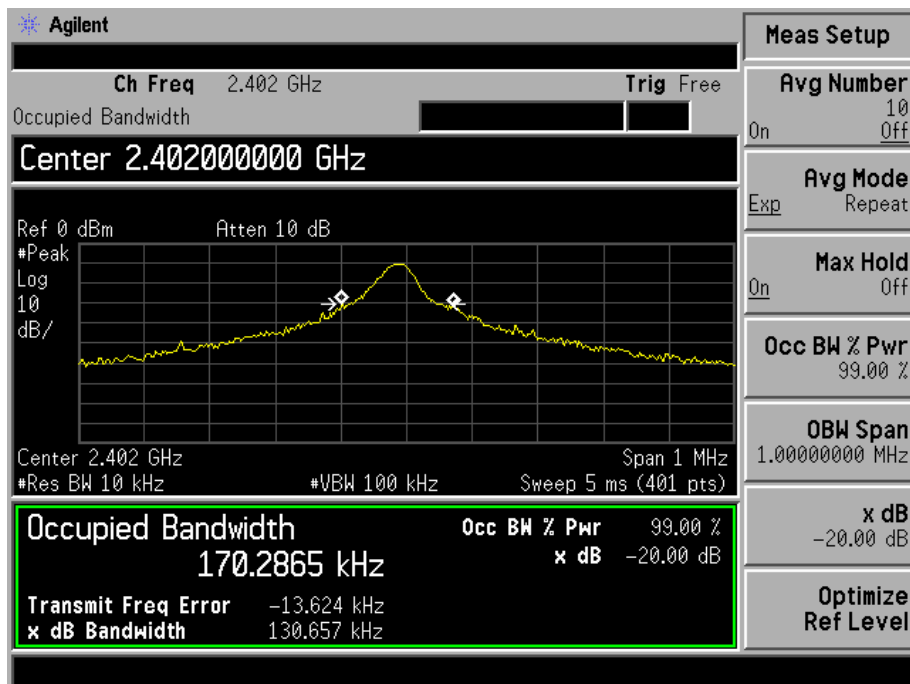
Temperature:	25 °C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

6.5 Summary of Test Results/Plots

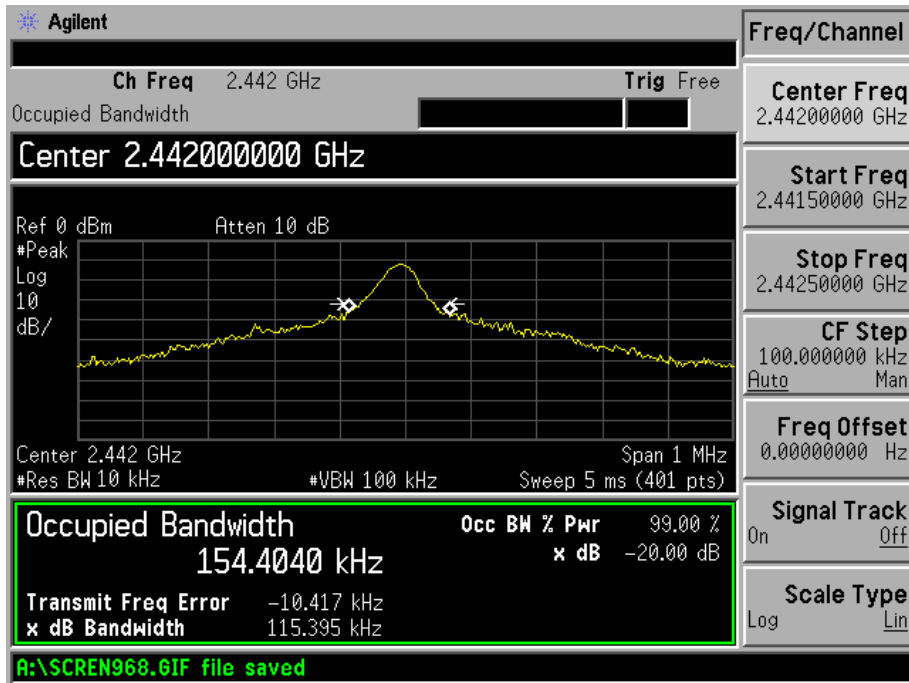
Channel	Frequency MHz	20dB Bandwidth kHz	99% Bandwidth kHz
Low Channel	2402	130.657	170.2865
Middle Channel	2442	115.395	154.4040
High Channel	2477	200.424	291.2097

Please refer to the following test plots

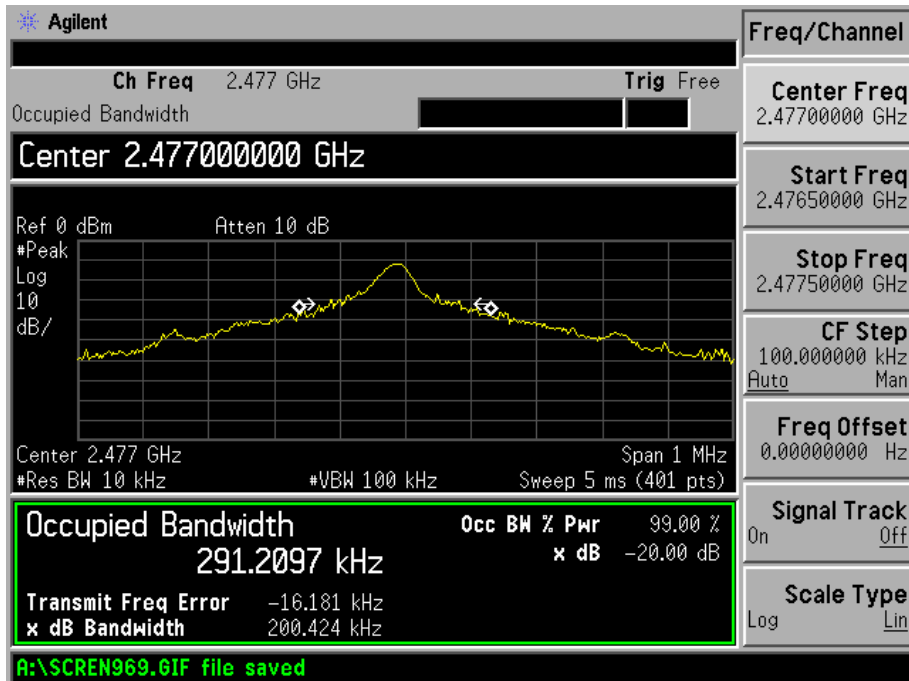
Low Channel:



Middle Channel:



High Channel:



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