

FCC PART 15.249

MEASUREMENT AND TEST REPORT

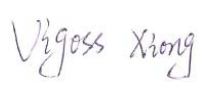
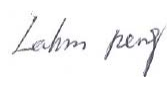

FOR

Shenzhen Star Sources Electronic Technology Co., Ltd.

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

District, Shenzhen, China

FCC ID: ZJEST-MKB699W

Report Concerns: Original Report	Equipment Type: 2.4GHz Wireless Keyboard
Model:	<u>ST-MKB699W</u>
Report No.:	<u>STR12048147I</u>
Test Date:	<u>2012-04-17 to 2012-04-27</u>
Issue Date:	<u>2012-05-04</u>
Tested By:	<u>Vigoss Xiong / Engineer</u> 
Reviewed By:	<u>Lahm Peng / EMC Manager</u> 
Approved & Authorized By:	<u>Jandy so / PSQ Manager</u> 
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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 E.U.T

Items	Description
EUT Description:	2.4GHz Wireless Keyboard
Trade Name:	/
Model No.:	ST-MKB699W
Adding Models:	ST-MKB698W, ST-MKB690W, ST-MKB898W
Rated Voltage:	DC 3 V
Frequency Range:	2408-2474MHz
Antenna Type:	Integral Antenna
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. The others models listed in the report have different plastic case appearance and color of ST-MKB699W without circuit and electronic construction changed, declared by the manufacturer.

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.

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.

1.4 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 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.

1.6 Accessories Equipment List and Details

Description	Manufacturer	Model	Serial Number
/	/	/	/

1.7 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
§15.203	Antenna Requirement	Compliant
§15.207 (a)	Conducted Emission	N/A
§15.205	Restricted Band of Operation	Compliant
§15.209	Radiated Emission	Compliant
§15.215 (a)	Field Strength	Compliant
§15.215 (d)	Out of Band Emission	Compliant
§15.215 (c)	Emission of Bandwidth	Compliant

3. §15.203 - ANTENNA REQUIREMENT

3.1 Standard Applicable

According to FCC 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. §15.205, §15.209, §15.249 (a)- 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 ± 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

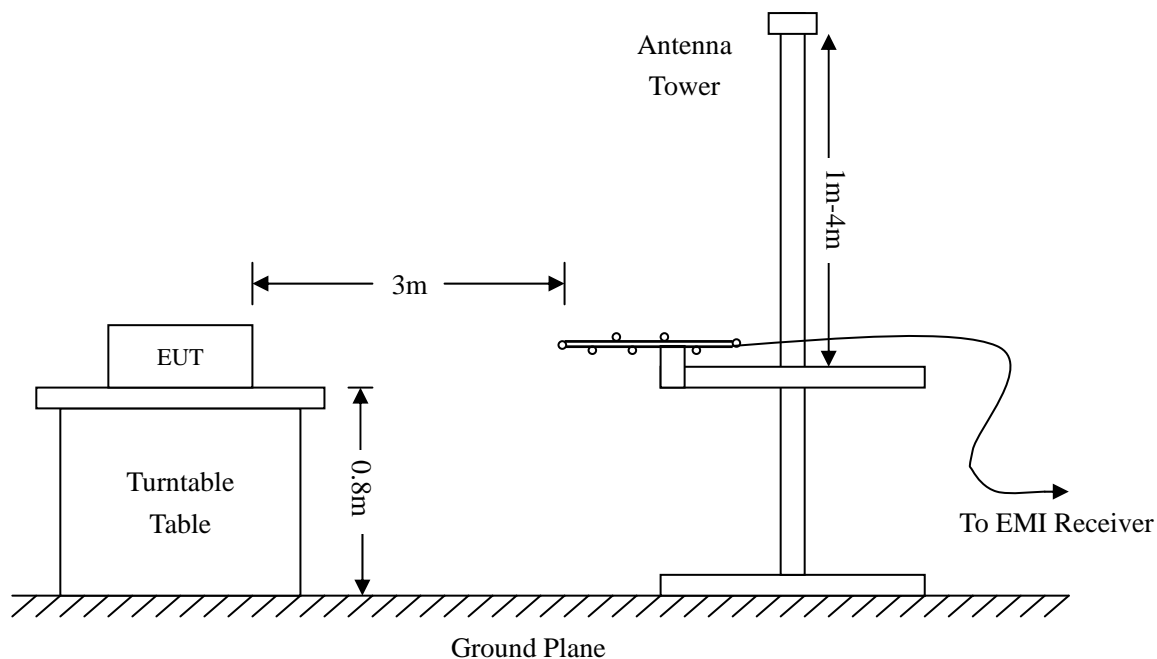
Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Spectrum Analyzer	R&S	FSP	836079/035	2012-03-28	2013-03-27
EMI Test Receiver	R&S	ESVB	825471/005	2012-03-28	2013-03-27
Pre-amplifier	Agilent	8447F	3113A06717	2012-03-28	2013-03-27
Pre-amplifier	Compliance Direction	PAP-0118	24002	2012-03-28	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 -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

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

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:

-5.99 dBμV at 887.6099 MHz in the Vertical polarization, High Channel, 9 kHz to 25 GHz, 3Meters

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

Plot of Radiation Emissions Test

Radiated Disturbance

EUT: 2.4GHz Wireless Keyboard

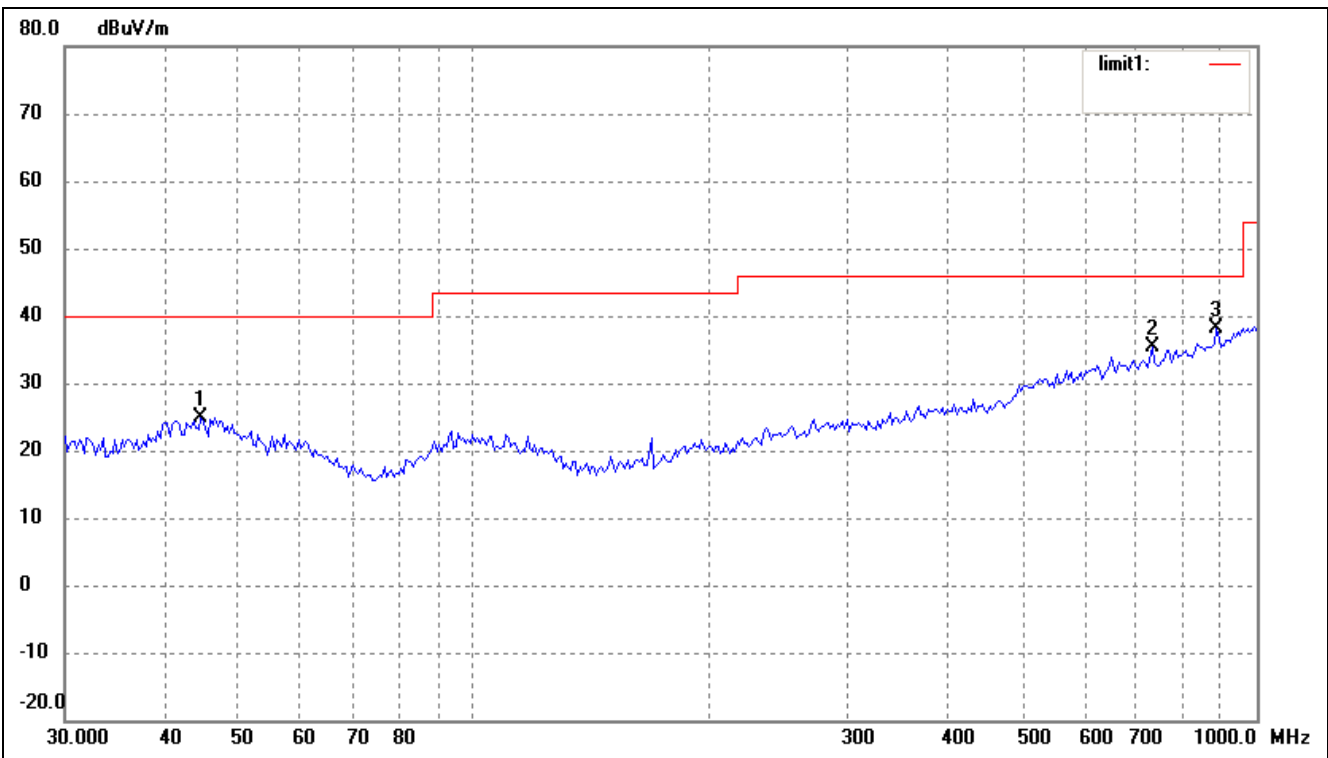
M/N: ST-MKB699W

Operating Condition: Transmitting below 1GHz

Test Specification: Horizontal & Vertical

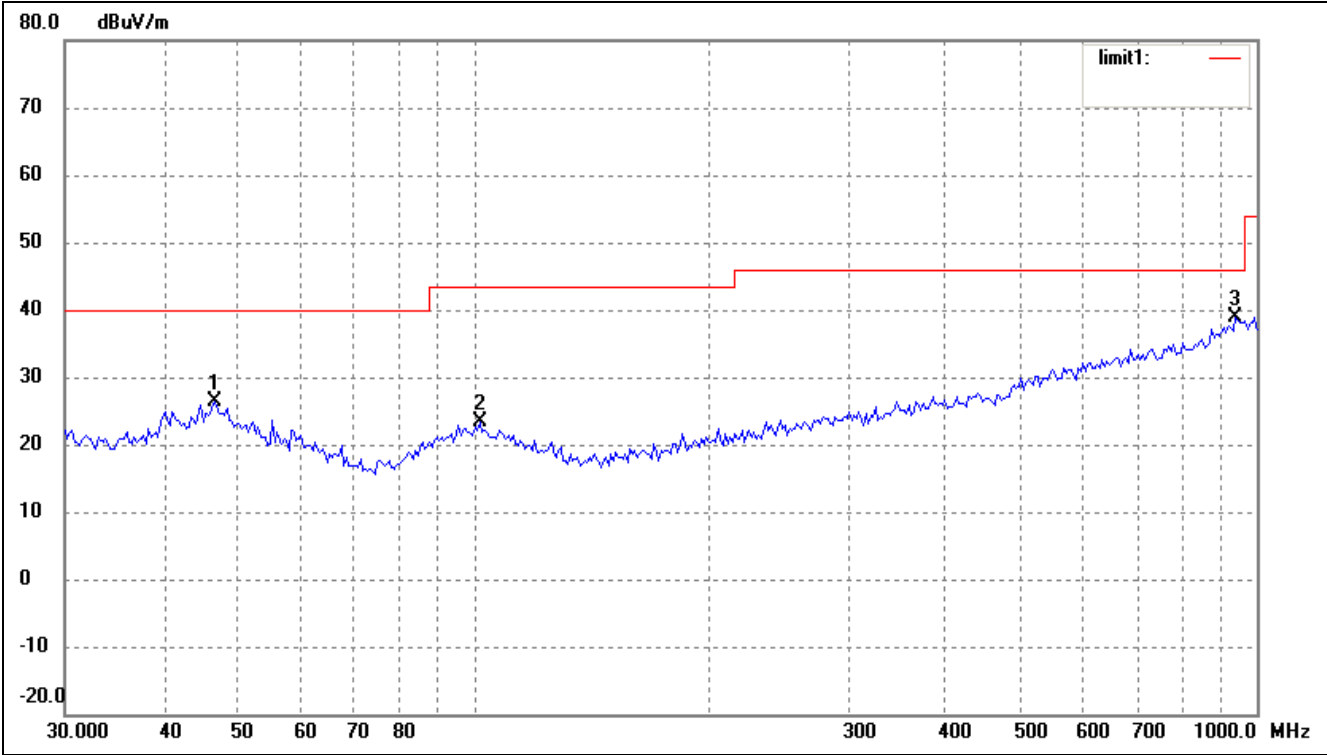
Low Channel

Horizontal:



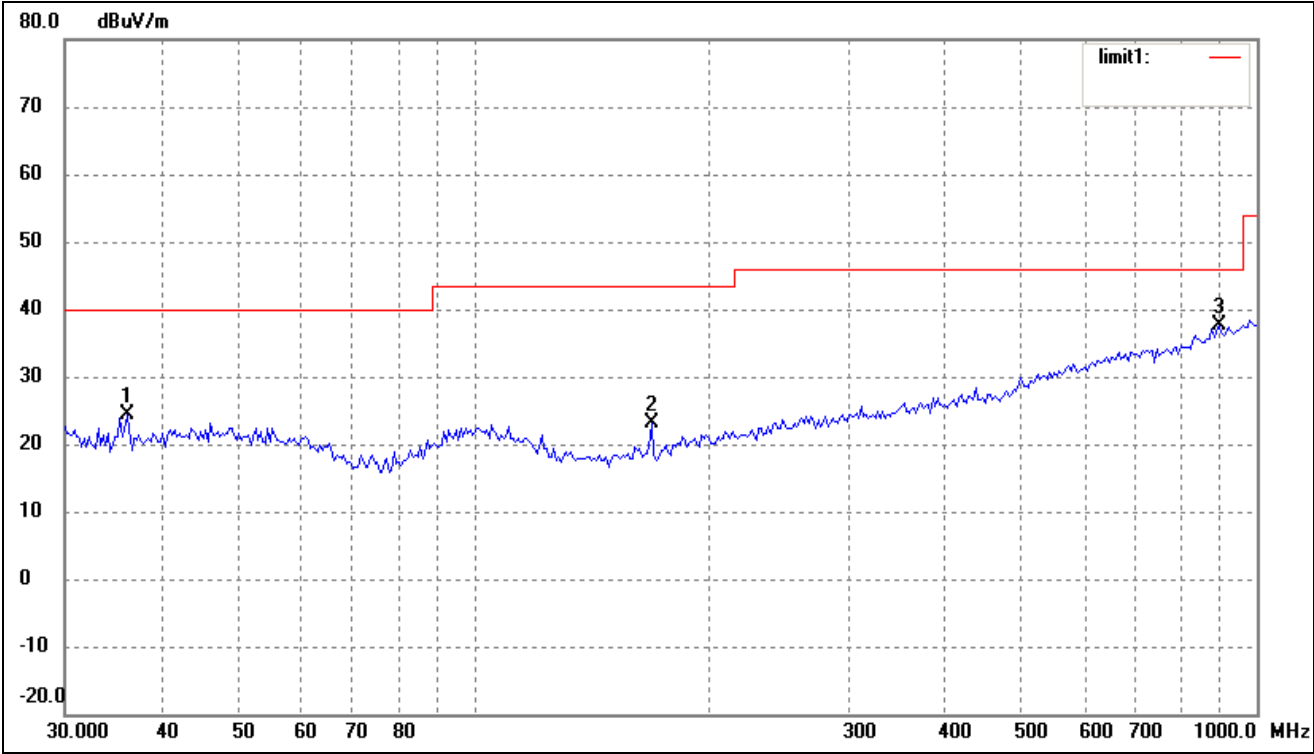
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (°)	Height (cm)	Remark
1	44.7434	16.78	8.22	25.00	40.00	-15.00	145	100	peak
2	734.4913	17.47	18.02	35.49	46.00	-10.51	96	100	peak
3	887.6099	17.34	20.67	38.01	46.00	-7.99	359	100	peak

Vertical:



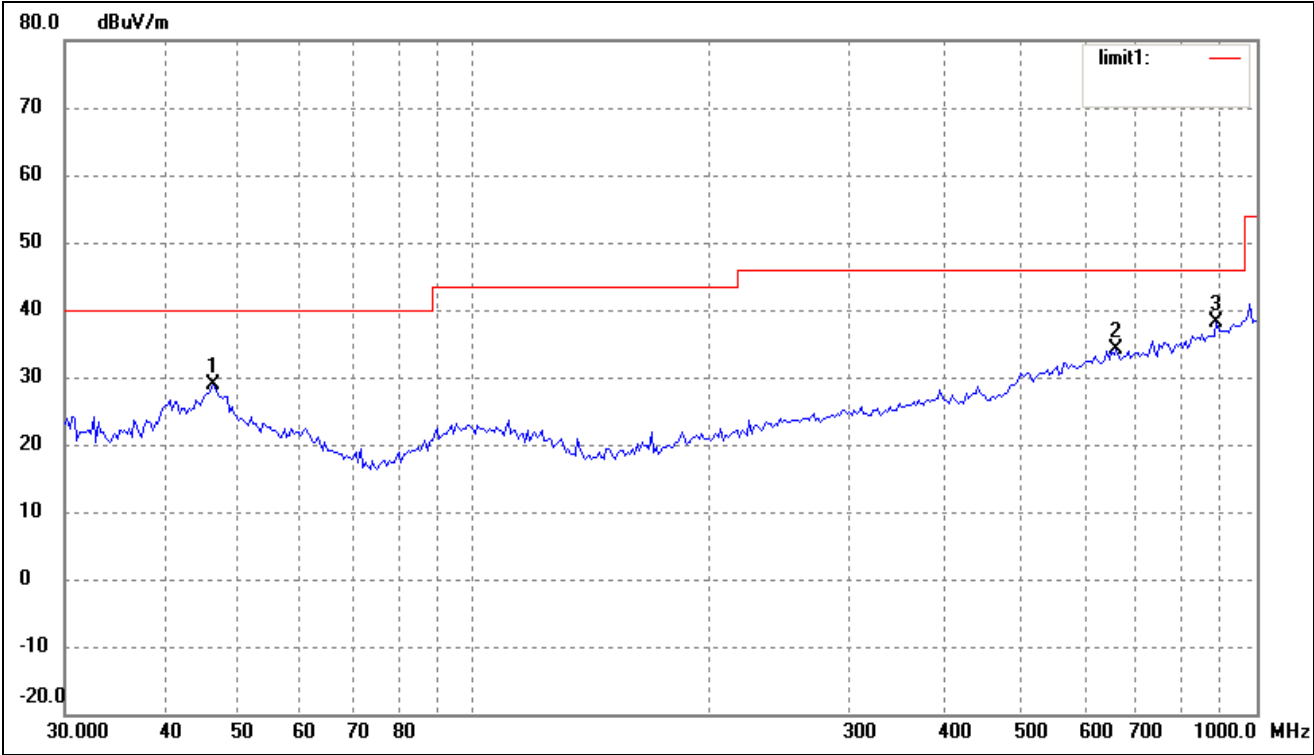
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(°)	(cm)	
1	46.6664	18.15	8.14	26.29	40.00	-13.71	315	100	peak
2	101.6443	15.01	8.29	23.30	43.50	-20.20	76	100	peak
3	938.8326	17.23	21.61	38.84	46.00	-7.16	359	100	peak

Middle Channel
Horizontal:



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(°)	(cm)	
1	36.0007	17.34	7.05	24.39	40.00	-15.61	359	200	peak
2	168.4138	18.39	4.84	23.23	43.50	-20.27	359	200	peak
3	893.8567	16.79	20.78	37.57	46.00	-8.43	359	200	peak

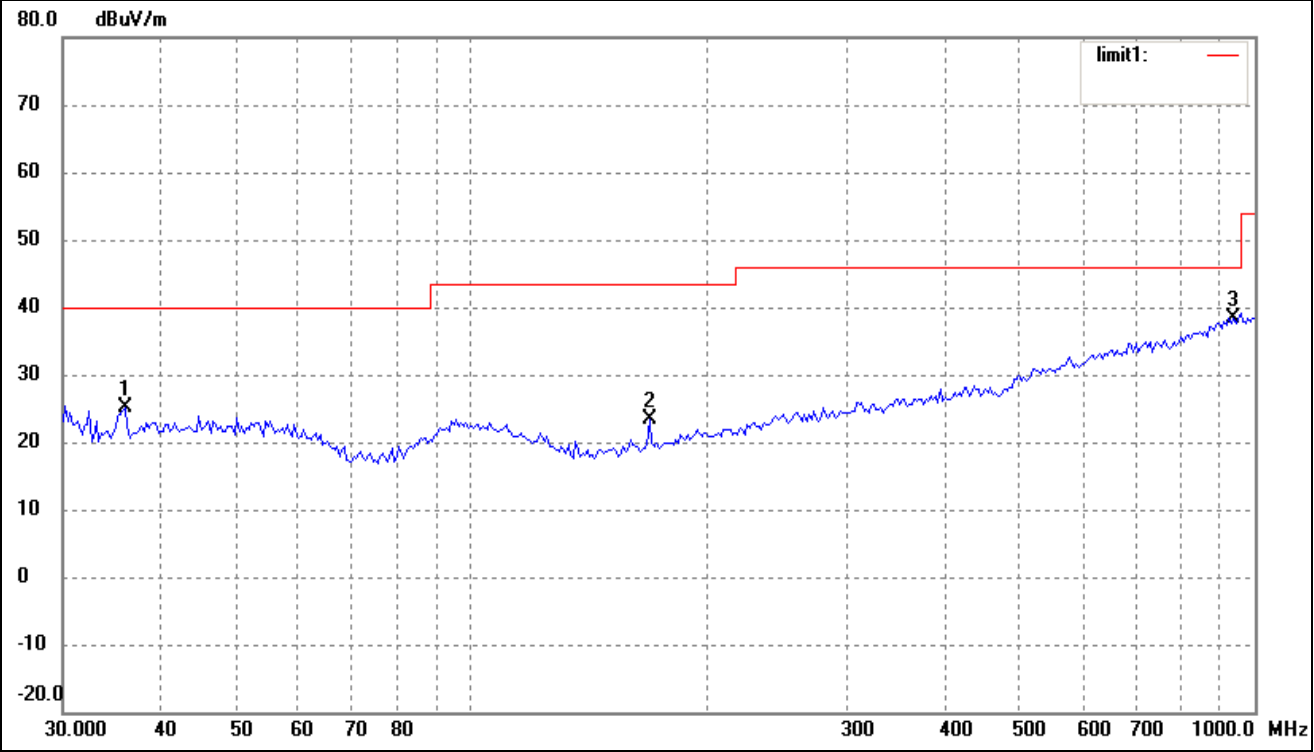
Vertical:



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(°)	(cm)	
1	46.3402	20.68	8.16	28.84	40.00	-11.16	359	100	peak
2	661.1505	16.90	17.18	34.08	46.00	-11.92	359	100	peak
3	887.6099	17.34	20.67	38.01	46.00	-7.99	359	100	peak

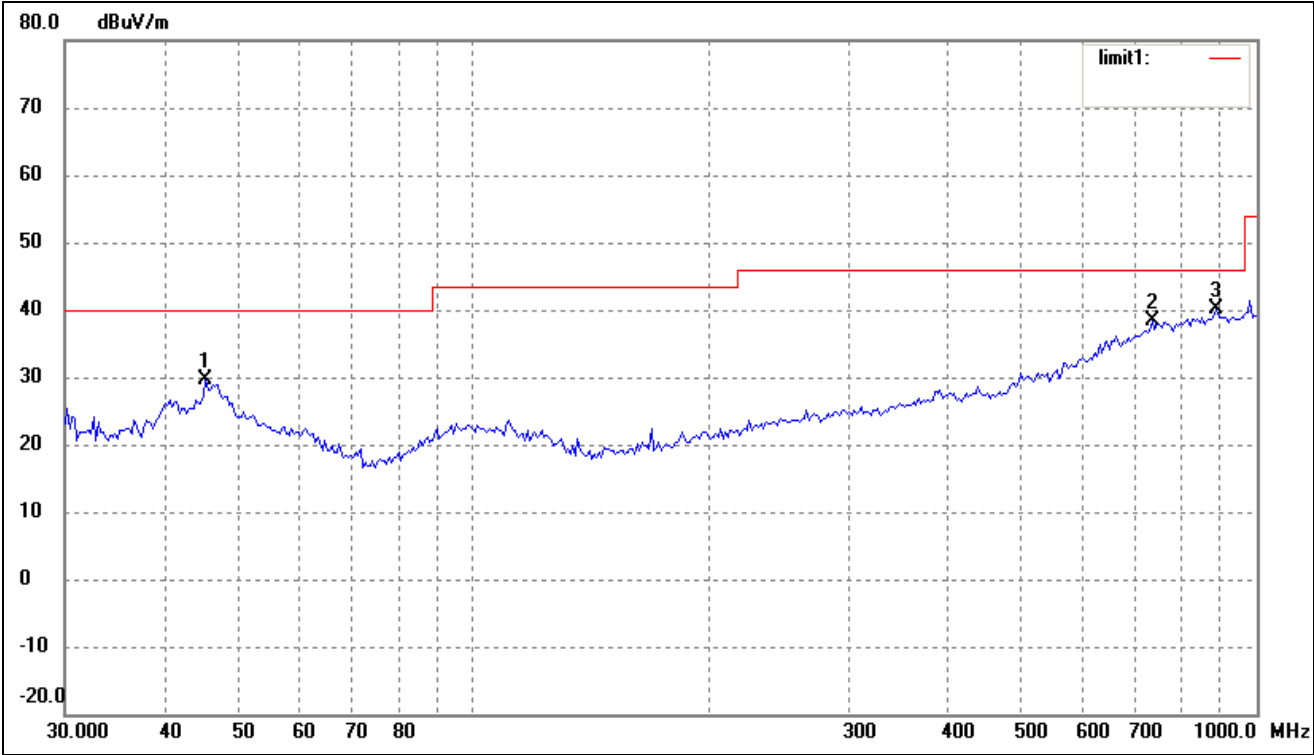
High Channel

Horizontal:



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(°)	(cm)	
1	36.0007	18.13	7.05	25.18	40.00	-14.82	359	200	peak
2	168.4138	18.43	4.84	23.27	43.50	-20.23	359	200	peak
3	938.8326	16.88	21.61	38.49	46.00	-7.51	359	200	peak

Vertical:



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(°)	(cm)	
1	45.3755	21.34	8.21	29.55	40.00	-10.45	359	100	peak
2	734.4913	20.47	18.02	38.49	46.00	-7.51	359	100	peak
3	887.6099	19.34	20.67	40.01	46.00	-5.99	359	100	peak

Spurious Emission Above 1GHz

Frequency MHz	Detector	Meter Reading dBuV	Direction Degree	Polar H / V	Antenna Loss dB	Cable loss dB	Amplifier dB	Correction Amplitude dBuV/m	Limit dBuV/m	Margin dB
Low Channel 2408MHz										
2408	PK	79.00	360	H	29.1	3.7	34	77.80	114	-36.20
2408	PK	67.64	360	V	29.1	3.7	34	66.44	114	-47.56
2408	AV	63.62	360	H	29.1	3.7	34	62.42	94	-31.58
2408	AV	52.35	360	V	29.1	3.7	34	51.15	94	-42.85
4816	PK	35.97	360	H	34.1	5.2	33	42.27	74	-31.73
4816	PK	38.62	360	V	34.1	5.2	33	44.92	74	-29.08
4816	AV	23.18	360	H	34.1	5.2	33	29.48	54	-24.52
4816	AV	26.43	360	V	34.1	5.2	33	32.73	54	-21.27
Middle Channel 2440MHz										
2440	PK	80.93	360	H	29.1	3.7	34	79.73	114	-34.27
2440	PK	74.66	360	V	29.1	3.7	34	73.46	114	-40.54
2440	AV	64.09	360	H	29.1	3.7	34	62.89	94	-31.11
2440	AV	57.98	360	V	29.1	3.7	34	56.78	94	-37.22
4880	PK	33.18	360	H	34.1	5.2	33	39.48	74	-34.52
4880	PK	34.00	360	V	34.1	5.2	33	40.30	74	-33.70
4880	AV	22.43	360	H	34.1	5.2	33	28.73	54	-25.27
4880	AV	21.60	360	V	34.1	5.2	33	27.90	54	-26.10
High Channel 2474MHz										
2474	PK	81.19	360	H	29.1	3.7	34	79.99	114	-34.01
2474	PK	71.86	360	V	29.1	3.7	34	70.66	114	-43.34
2474	AV	65.77	360	H	29.1	3.7	34	64.57	94	-29.43
2474	AV	56.61	360	V	29.1	3.7	34	55.41	94	-38.59
4948	PK	34.94	360	H	34.1	5.2	33	41.24	74	-32.76
4948	PK	34.68	360	V	34.1	5.2	33	40.98	74	-33.02
4948	AV	23.80	360	H	34.1	5.2	33	30.10	54	-23.90
4948	AV	22.98	360	V	34.1	5.2	33	29.28	54	-24.72

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..

5. §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 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

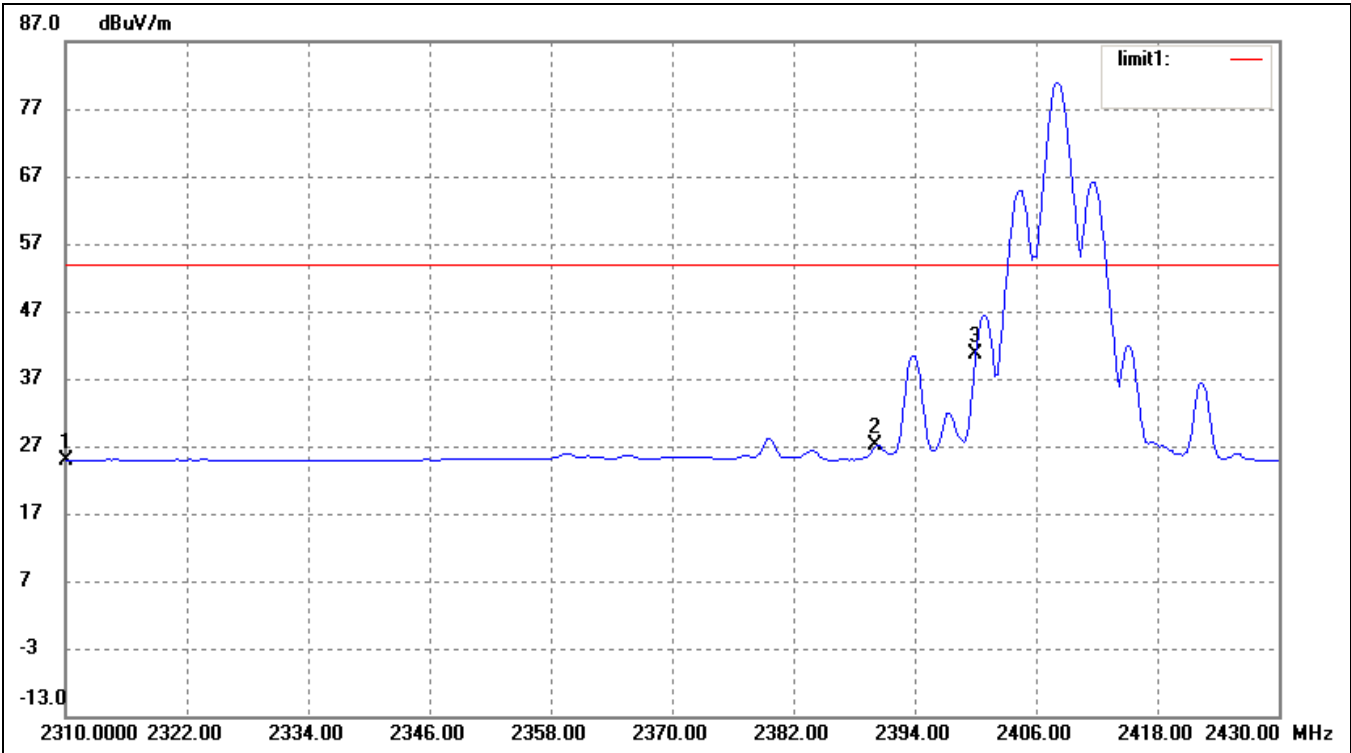
Temperature:	24 °C
Relative Humidity:	60 %
ATM Pressure:	1012 mbar

5.5 Summary of Test Results/Plots

Frequency MHz	Limit dBuV	Result
Low Edge	<54	Pass
High Edge	<54	Pass

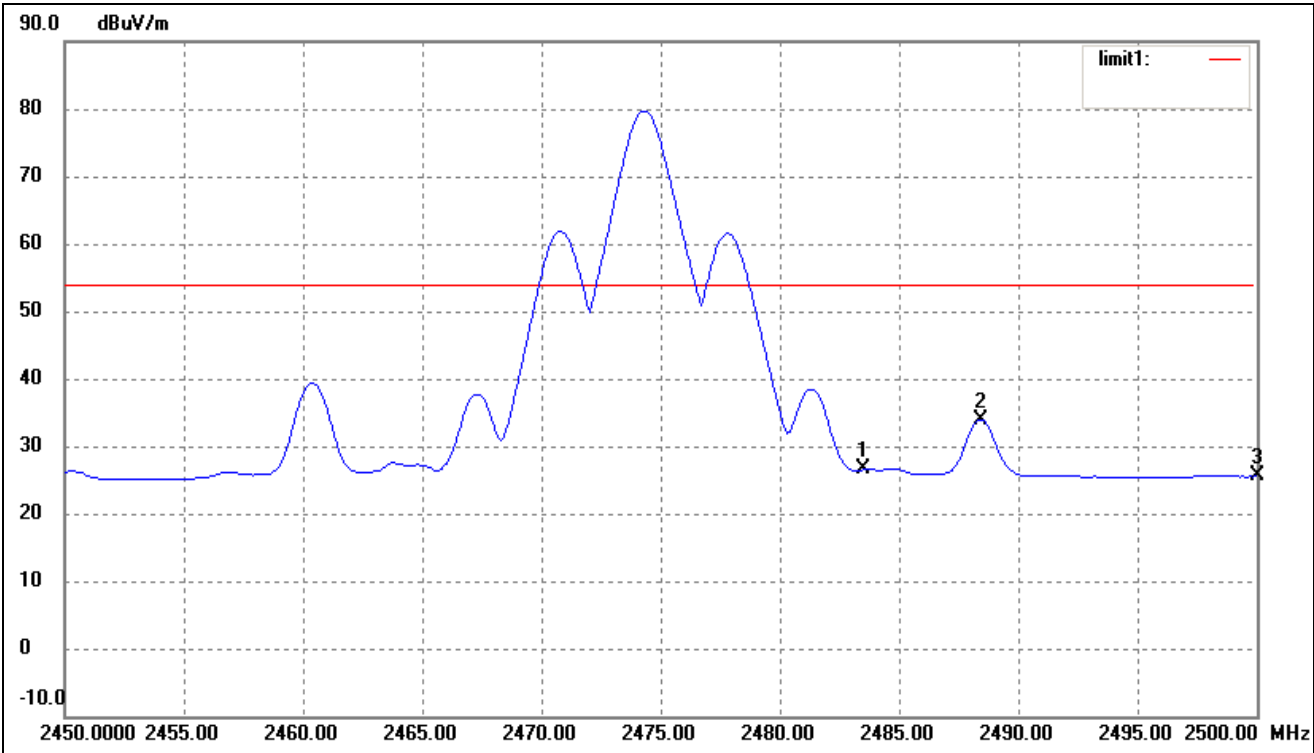
The edge emissions are below the FCC 15.209 Limits. Please refer to the test plots below.

Lowest Bandedge



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	32.44	-7.51	24.93	54.00	-29.07	Ave Detector
	2310.000	46.06	-7.51	38.55	74.00	-35.45	Peak Detector
2	2390.000	34.35	-7.34	27.01	54.00	-26.99	Ave Detector
	2390.000	47.24	-7.34	39.90	74.00	-34.10	Peak Detector
3	2400.000	47.87	-7.31	40.56	54.00	-13.44	Ave Detector
	2400.000	53.38	-7.31	46.07	74.00	-27.93	Peak Detector

Highest Bandedge



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	33.67	-7.13	26.54	54.00	-27.46	Ave Detector
	2483.500	47.74	-7.13	40.61	74.00	-33.39	Peak Detector
2	2488.410	40.93	-7.11	33.82	54.00	-20.18	Ave Detector
	2488.310	50.02	-7.11	42.91	74.00	-31.09	Peak Detector
3	2500.000	32.59	-7.08	25.51	54.00	-28.49	Ave Detector
	2500.000	46.16	-7.08	39.08	74.00	-34.92	Peak Detector

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

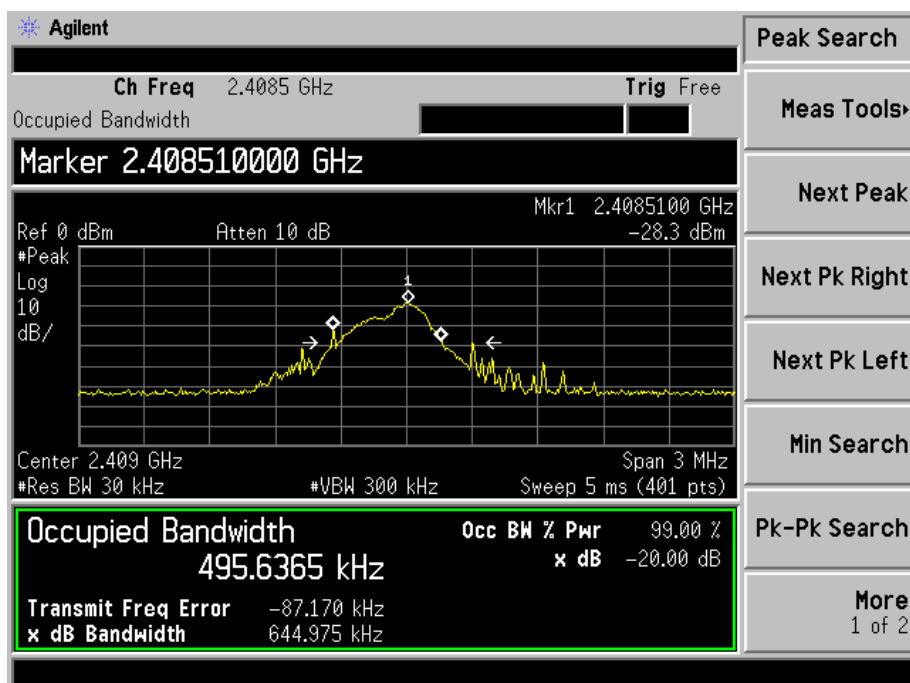
Temperature:	25 °C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

6.5 Summary of Test Results/Plots

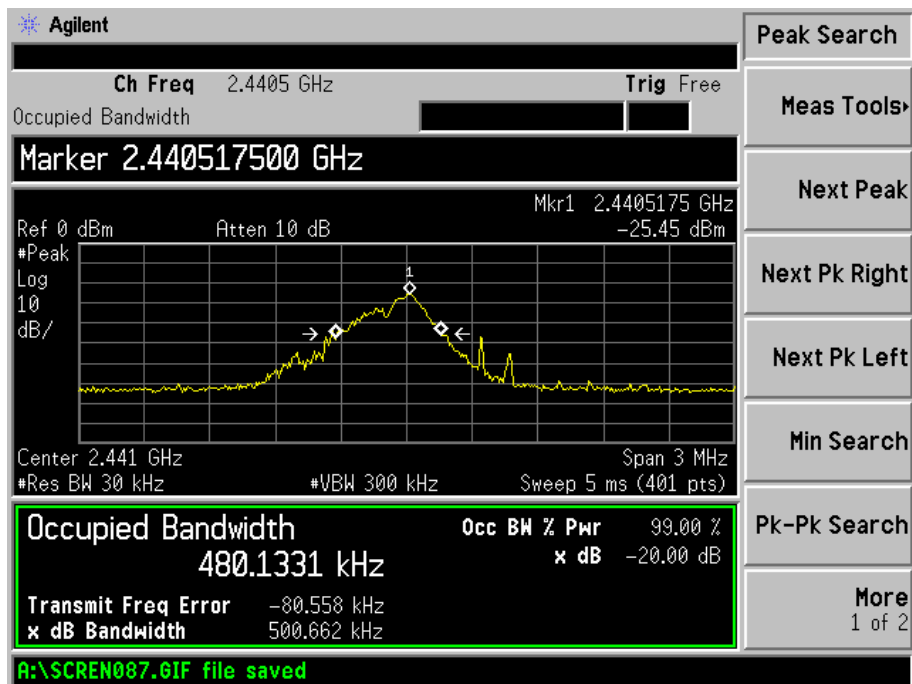
Channel	Frequency MHz	20dB Bandwidth kHz	99% Bandwidth kHz
Low Channel	2402	644.975	495.6365
Middle Channel	2442	500.662	480.1331
High Channel	2477	644.602	548.7046

Please refer to the following test plots

Low Channel:



Middle Channel:



High Channel:



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