



TEST REPORT

Date: 2011-08-16

Report No.: 68.870.11.002.01F

Applicant:

Maxin Technology Limited
Block C, East Xueziwei Industrial Zone, Yabian, Shajing,
Shenzhen, China

Description of Samples:

Model name: 2.4GHz Keyboard
Brand name: maxin
Model No.: KEY-602G, KEY-5106MG, KEY-656MG, KEY-616MG, KEY-601G, KEY-614G
FCCID: ZVL-602G

Date Samples Received:

2011-07-21

Date Tested:

2011-07-22 to 2011-08-02

Investigation Requested:

FCC Part 15 Subpart C, Section 15.249

Conclusions:

The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.

Remarks:

Tested and Checked by:

Approved by:-

A blue ink signature of John Zhi, written in a cursive style.

A blue ink signature of Nicolas Cheng, written in a cursive style.

John Zhi
Project Engineer
Wireless & Telecom department

Nicolas Cheng
Project Manager
Wireless & Telecom department

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1.0 General Details

1.1 Test Laboratory

Neutron Engineering Inc.
EMC Laboratory registered by FCC with
FCC Registration Number: 538587

Test By: 
Ares Liu

1.2 Applicant Details

Applicant

Maxin Technology Limited

Block C, East Xueziwei Industrial Zone, Yabian, Shajing,
Shenzhen, China

Manufacturer

Shenzhen Maxin Industry Co., Ltd

Block C, East Xueziwei Industrial Zone, Yabian, Shajing,
Shenzhen, China

1.3 Equipment Under Test [EUT]

Description of EUT

Model Name:	2.4GHz Keyboard
Brand Name:	maxin
Model Number:	KEY-602G, KEY-5106MG, KEY-656MG, KEY-616MG, KEY-601G, KEY-614G
FCCID:	ZVL-602G
Rating:	1.5 VDC (1*AA Battery)
Antenna Type:	Integral
Operated Frequency:	2405-2476MHz
No. of Channel:	32
Accessories and Auxiliary Equipment:	None
EUT Exercising Software:	None

As per Client Declaration, the circuit design, PCB Layout, shielding and interface of KEY-602G, KEY-5106MG, KEY-656MG, KEY-616MG, KEY-601G, KEY-614G are identical, the purpose of different model number is designed for different buyers only. So we applied KEY-602G as a representative model to perform all testing.

General Operation of EUT

The Equipment Under Test (EUT) is a wireless keyboard operated at 2405-2476 MHz which Data transfer to its associated receiver.

1.4 Equipment Modification

No modification was made to the tested unit by TÜV SÜD China Ltd.

1.5 Related Submittal(s) Grants

This is a single application of certification for this transmitter.

2.0 Technical Details

2.1 Investigations Requested

Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR
[Codes of Federal Regulations] Part 15: 2009 and ANSI C63.4: 2003 for FCC
Verification.

2.2 Test Standards and Results Summary Tables

EMISSION Results Summary				
Test Condition	FCC Test Requirement	Test Result		
		Pass	Failed	N/A
Field Strength of Fundamental and Harmonics	Part 15.249 (a),(e)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spurious Radiated Emission	Part 15.249 (d) Part 15.209 Part 15.205	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Out of Band Emissions	Part 15.249 (d)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bandwidth Measurement	Part 15.215 (c)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conducted Emission	Part 15.207	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note: N/A - Not Applicable

3.0 Test Methodology

3.1 Radiated Emission

The sample was placed 0.8m above the ground plane on a standard emission test site *. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

*On a standard emission test site with a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Registration Number: 538587.

3.2 Field Strength Calculation

The field strength at 3 m was established by adding the meter reading of the spectrum analyzer to the factors associated with antenna correction factor, cable loss, preamplifiers and filter attenuation.

The equation is expressed as follow:

$$\begin{aligned} \text{FS} &= \text{R} + \text{System Factor} \\ \text{System Factor} &= \text{AF} + \text{CF} + \text{FA} - \text{PA} \end{aligned}$$

Where FS = Net Field Strength in dBuV/m at 3 meters.

R = Reading of Spectrum Analyzer / Test Receiver in dBuV.

AF = Antenna Factor in dB.

CF = Cable Attenuation Factor in dB.

FA = Filter Attenuation Factor in dB.

PA = Preamplifier Factor in dB.

FA and PA are only be used for the measuring frequency above 1 GHz.

3.3 Conducted Emissions

The EUT was placed on a non-metallic table 0.8m above the horizontal metal reference plane and 0.4m from a vertical ground plane which is connected to the horizontal metal ground plane. Meanwhile, the AC main of EUT was connected to the distance of 0.8m line impedance stabilization network (LISN) during measurement.

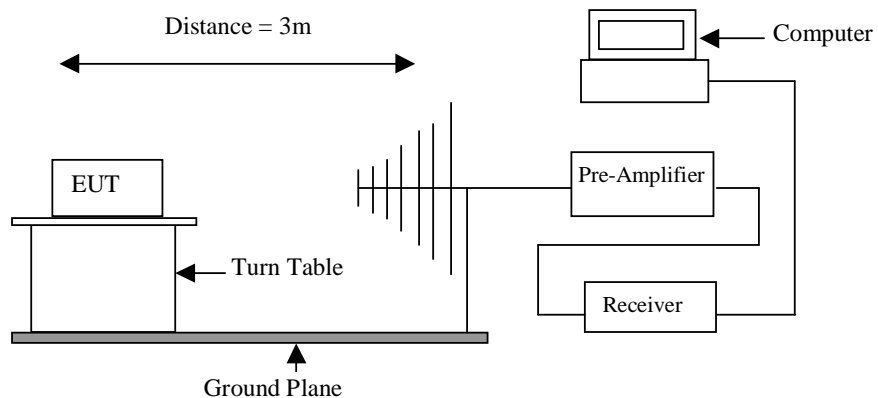
Initial measurements were performed in quasi-peak and average detection modes by the test receiver, any emissions recorded within 30dB of the relevant limit lines were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

4.0 **Test Results**

4.1 **Field Strength of Fundamental and Harmonics**

Test Requirement:	FCC part 15 section 15.249(a)(e)
Test Method:	ANSI C63.4:2003
Test Date:	2011-07-22
Mode of Operation:	Transmitting mode.
Detector Function:	Quasi-peak (Below 1000 MHz) Average and Peak (Above 1000 MHz)
Measurement BW:	120 kHz (Below 1000 MHz) 1 MHz (Above 1000 MHz)

Test Setup:



Results: PASS

Field Strength of Fundamental and Harmonics									
Channel	Value	Emissions Frequency	E-Field Polarity	Reading	System Factor	Field Strength at 3m	Limit	Delta to Limit	Remarks
		MHz		dBμV/m	dB	dBμV/m	dBμV/m	dBμV/m	
1	PK	2405.00	V	57.25	31.56	88.81	114	-25.19	Fund.
	AV	2405.00		16.35	31.56	47.91	94	-46.09	Fund.
1	PK	2405.00	H	57.42	31.56	88.98	114	-25.02	Fund.
	AV	2405.00		16.52	31.56	48.08	94	-45.92	Fund.
16	PK	2439.00	V	55.17	31.62	86.79	114	-27.21	Fund.
	AV	2439.00		14.27	31.62	45.89	94	-48.11	Fund.
16	PK	2439.00	H	57.18	31.62	88.80	114	-25.20	Fund.
	AV	2439.00		16.28	31.62	47.90	94	-46.10	Fund.
32	PK	2476.00	V	55.91	31.69	87.60	114	-26.40	Fund.
	AV	2476.00		15.01	31.69	46.70	94	-47.30	Fund.
32	PK	2476.00	H	55.93	31.69	87.62	114	-26.38	Fund.
	AV	2476.00		15.03	31.69	46.72	94	-47.28	Fund.
1	PK	4810.00*	V	55.05	5.79	60.84	74	-13.16	Harmonic
	AV	4810.00*		14.15	5.79	19.94	54	-34.06	Harmonic
1	PK	4810.00*	H	51.12	5.79	56.91	74	-17.09	Harmonic
	AV	4810.00*		10.22	5.79	16.01	54	-37.99	Harmonic
16	PK	4878.00*	V	56.92	6.16	63.08	74	-10.92	Harmonic
	AV	4878.00*		16.02	6.16	22.18	54	-31.82	Harmonic
16	PK	4878.00*	H	52.07	6.16	58.23	74	-15.77	Harmonic
	AV	4878.00*		11.17	6.16	17.33	54	-36.67	Harmonic
32	PK	4952.00*	V	56.15	-5.05	51.10	74	-22.90	Harmonic
	AV	4952.00*		15.25	-5.05	10.20	54	-43.80	Harmonic
32	PK	4952.00*	H	50.34	-1.71	48.63	74	-25.37	Harmonic
	AV	4952.00*		9.44	-1.71	7.73	54	-46.27	Harmonic

Note : - Result data graphs are shown at P.12 - 17 for reference.

- Average factor is applied, where AV=Peak+ Average factor

Average factor in dB = 20 log (duty cycle)

When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long the specification for output field strengths in accordance with the FCC rules specify measurements with an average detector.

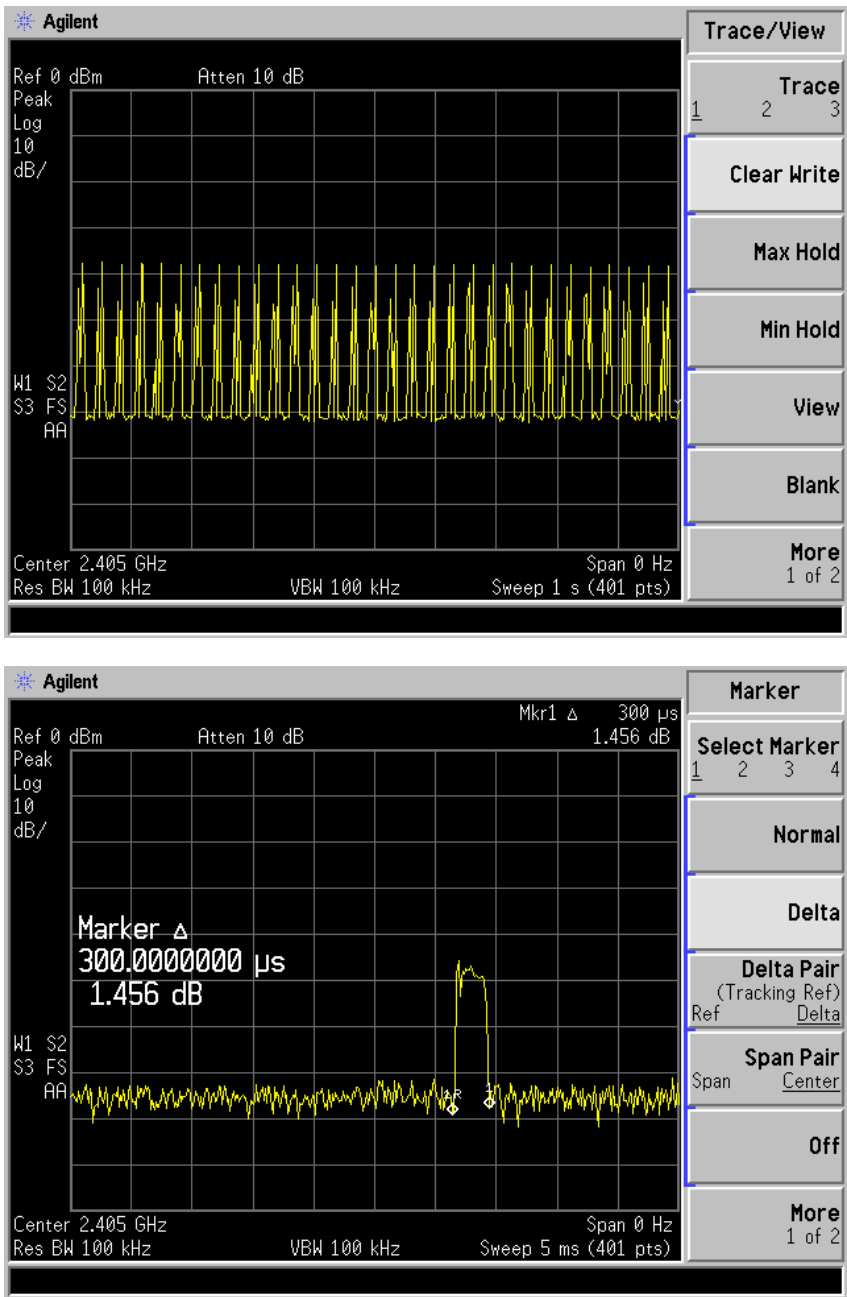
The duty cycle is the total signal on time per one transmission.

Effective period of the cycle per 100ms = (3 x 0.300ms) / 100ms
= 0.90ms / 100ms

Duty cycle = 0.009

Therefore, the averaging factor is 20 log (0.009)
= -40.9 dB.

Refer to the following graph for the detail.



Remark : - (*) Radiated emissions which fall in the restricted bands as defined in Section 15.205(a).

- Calculated measurement uncertainty: $\pm 5.0\text{dB}$

Limits of Field Strength for Fundamental and Harmonics Frequency [Section 15.249 (a)]:

Fundamental Frequency [MHz]	Field Strength of Fundamental		Field Strength of Harmonics	
	[mV/m]	[dB μ V/m]	[μ V/m]	[dB μ V/m]
2400 – 2483.5	50	94(Average)	500	54(Average)

Compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector.

Limit Requirement under Section 15.249 (e) :

According to section 15.249 (e), for frequencies above 1000MHz, the above field strength limits is based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20dB under any condition of modulation.

Limit for Radiated Emission [Section 15.209]:

Frequency (MHz)	Field Strength [μ V/m]	Field Strength [dB μ V/m]
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

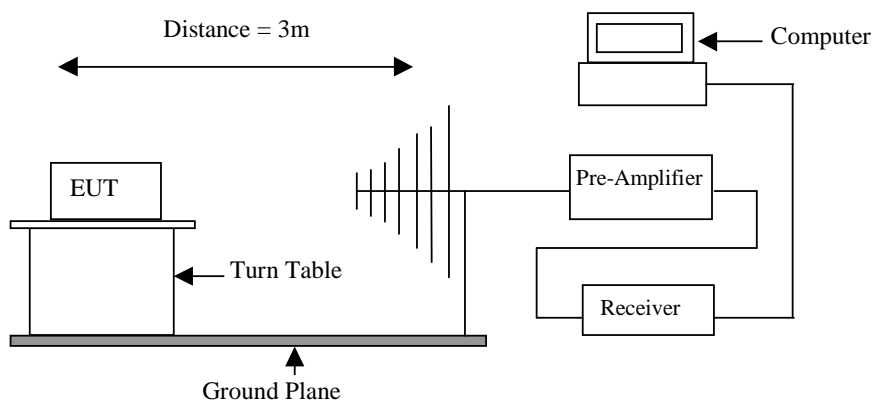
Radiated emissions, which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209.

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

4.2 Spurious Radiated Emission

Test Requirement:	FCC part 15 section 15.249(d), 15.209
Test Method:	ANSI C63.4:2003
Test Date:	2011-07-22
Mode of Operation:	Transmitting mode.
Detector Function:	Quasi-peak (Below 1000 MHz) Average and Peak (Above 1000 MHz)
Measurement BW:	120 kHz (Below 1000 MHz) 1 MHz (Above 1000 MHz)

Test Setup:



Results: PASS

Spurious Radiated Emissions								
Channel	Value	Emissions Frequency	E-Field Polarity	Reading	System Factor	Field Strength at 3m	Limit	Delta to Limit
		MHz		dBμV/m	dB	dBμV/m	dBμV/m	dBμV/m
16	QP	37.76*	H	31.75	-14.36	17.39	40.00	-22.61
16	QP	108.57*	H	34.73	-23.98	10.75	43.50	-32.75
16	QP	160.95	H	31.03	-21.13	9.90	43.50	-33.60
16	QP	307.42	H	37.07	-17.20	19.87	46.00	-26.13
16	QP	535.37	H	30.59	-11.28	19.31	46.00	-26.69
16	QP	727.43	H	30.22	-7.93	22.29	46.00	-23.71
16	QP	38.73	V	36.18	-15.05	21.13	40.00	-18.87
16	QP	61.04	V	35.80	-25.84	9.96	40.00	-30.04
16	QP	108.57*	V	40.46	-23.98	16.48	43.50	-27.02
16	QP	539.25	V	30.21	-11.15	19.06	46.00	-26.94
16	QP	692.51	V	30.58	-7.63	22.95	46.00	-23.05
16	QP	830.25	V	29.91	-5.42	24.49	46.00	-21.51

Note: - No further spurious emissions found between 30MHz and lowest internal used / generated frequency.
- Result data graphs are shown at P.12 - 19 for reference.

Remark : - (*) Radiated emissions which fall in the restricted bands as defined in Section 15.205(a).
- Calculated measurement uncertainty: ±5.0dB.

Limit of Outside of the Specified Bands [Section 15.249 (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 section 15.209, whichever is the lesser attenuation.

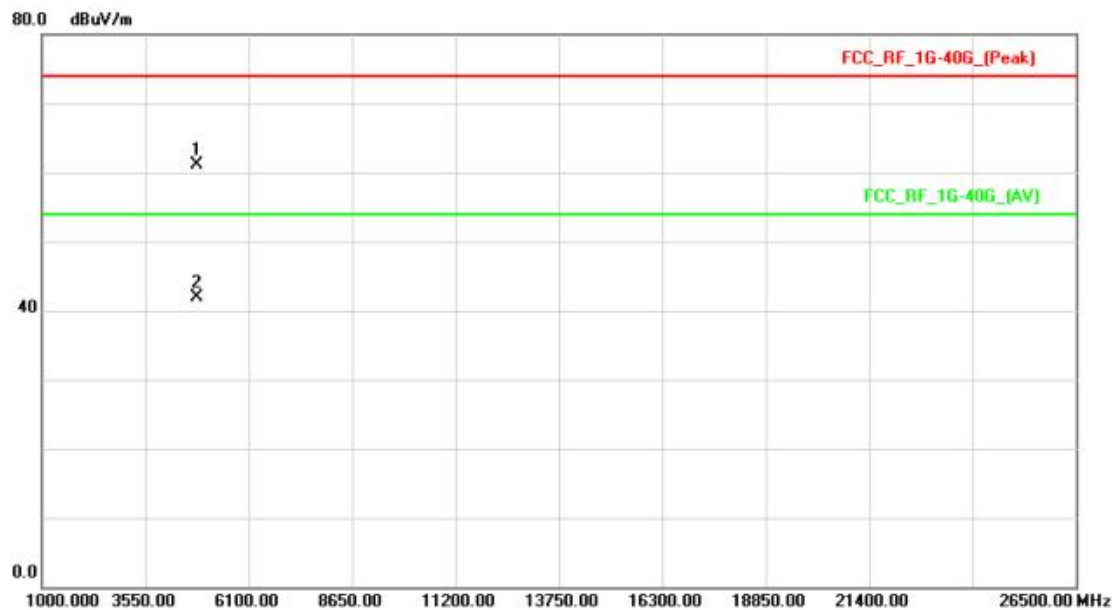
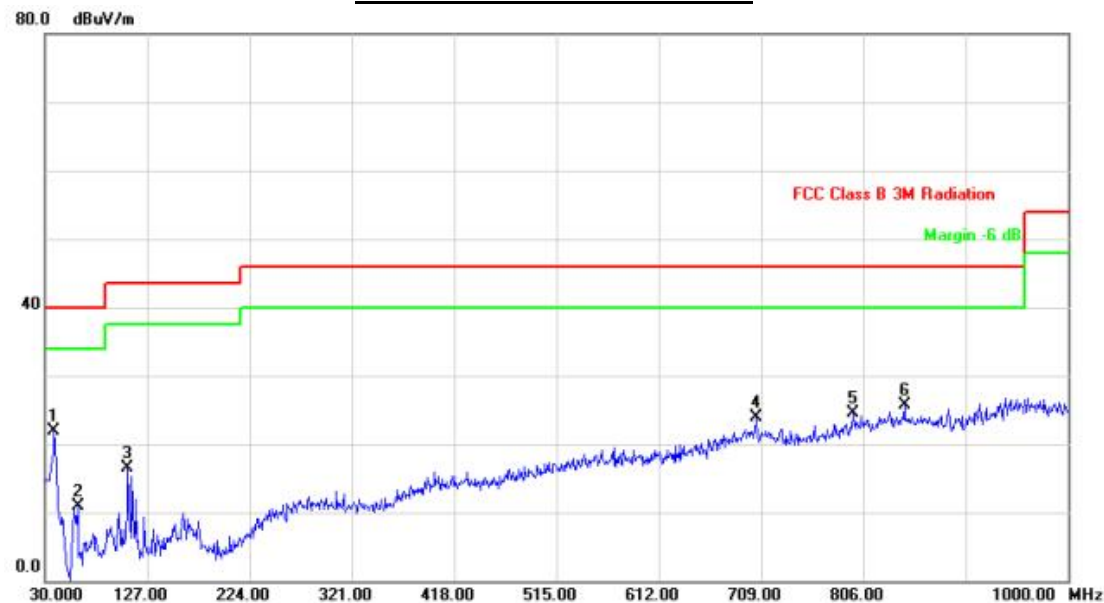
Limit for Radiated Emission [Section 15.209]:

Frequency (MHz)	Field Strength [μV/m]	Field Strength [dBμV/m]
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

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.

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

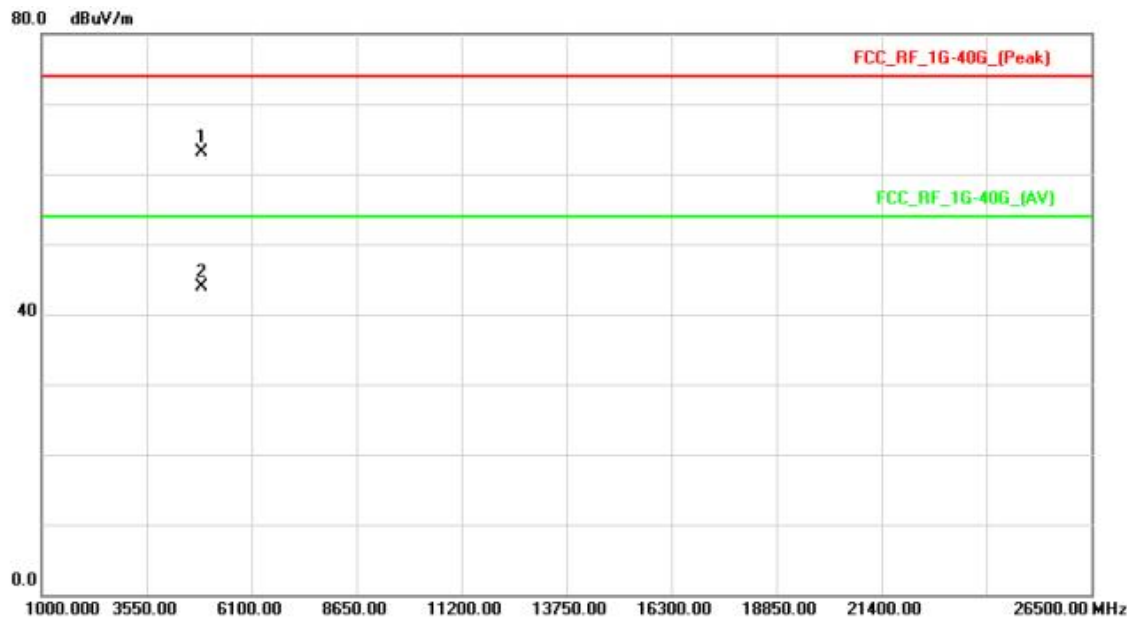
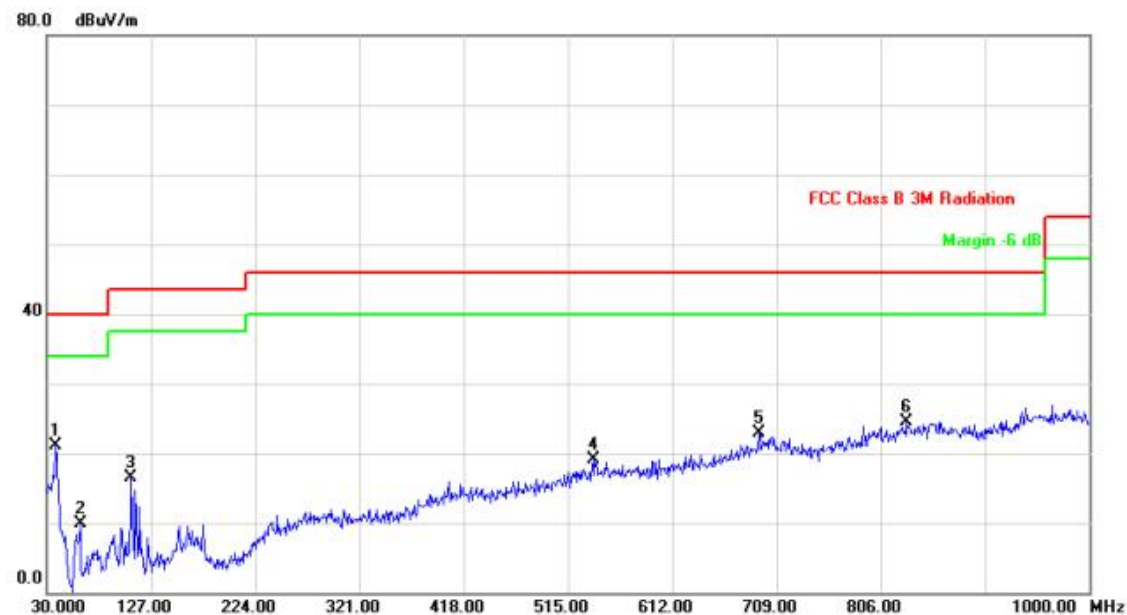
Vertical Polarization of Channel 1



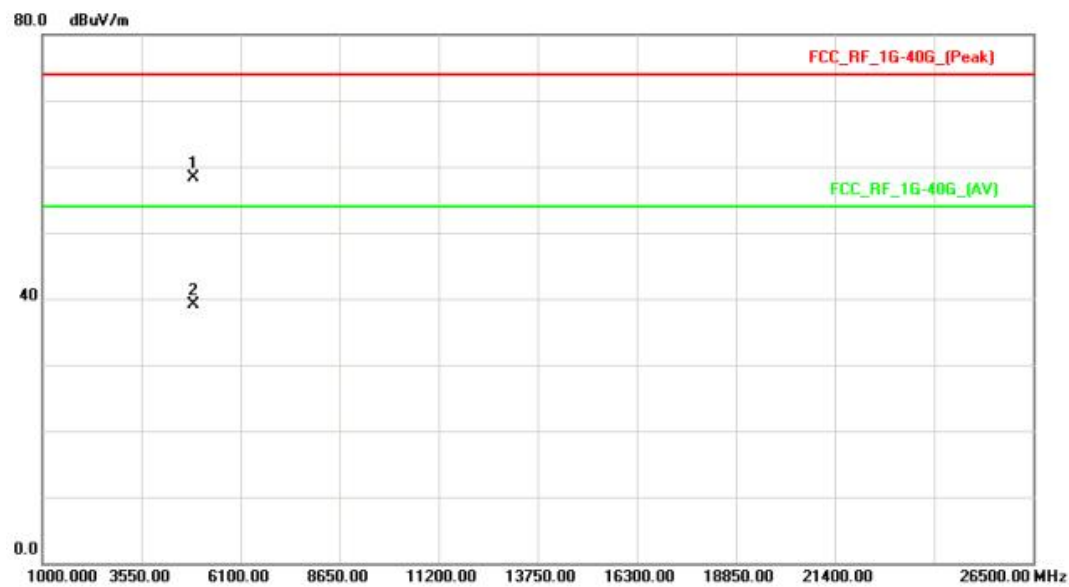
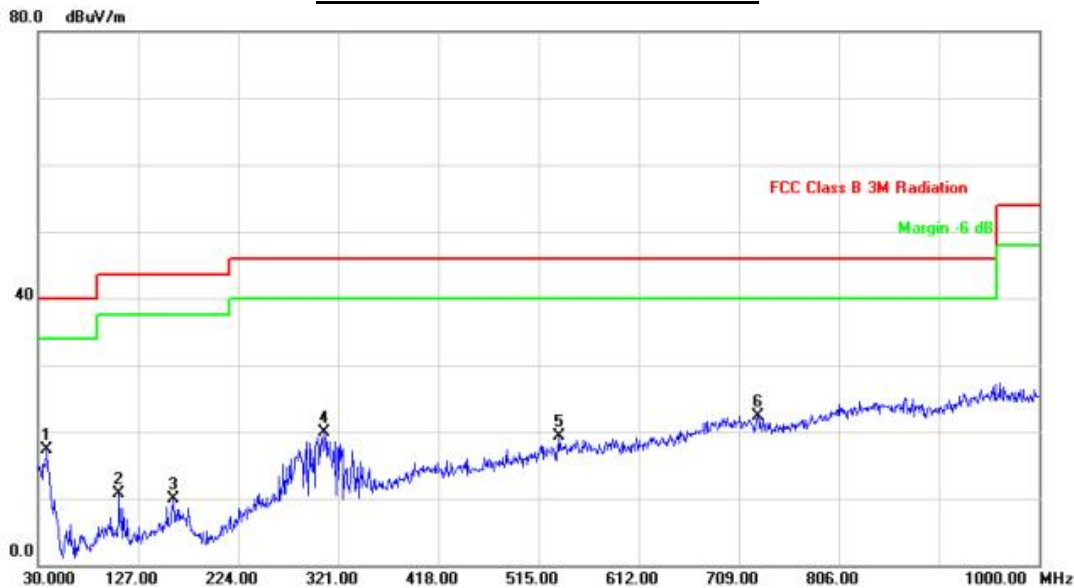
Horizontal Polarization of Channel 1

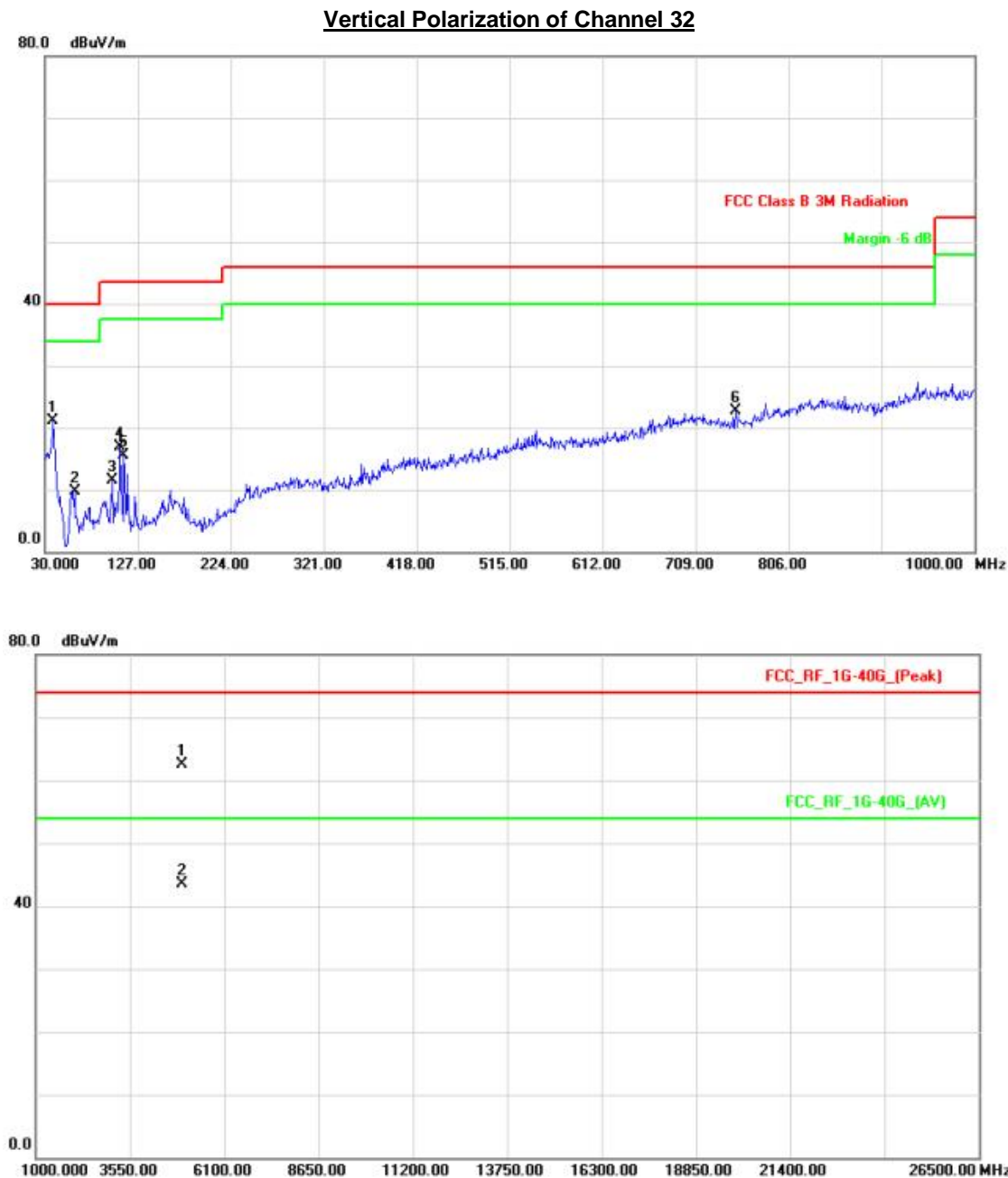


Vertical Polarization of Channel 16

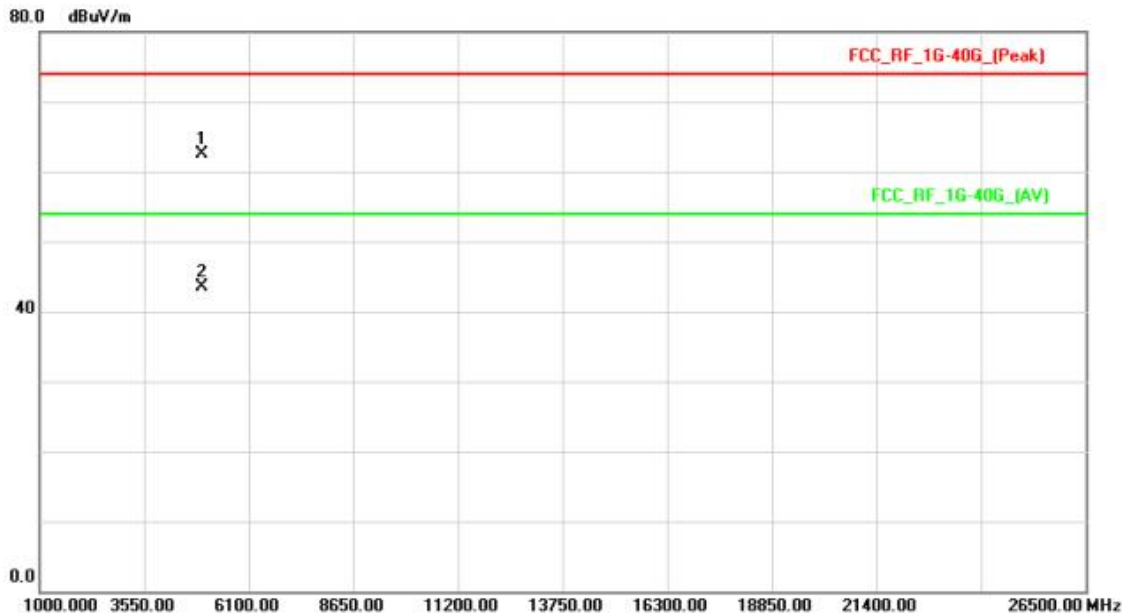
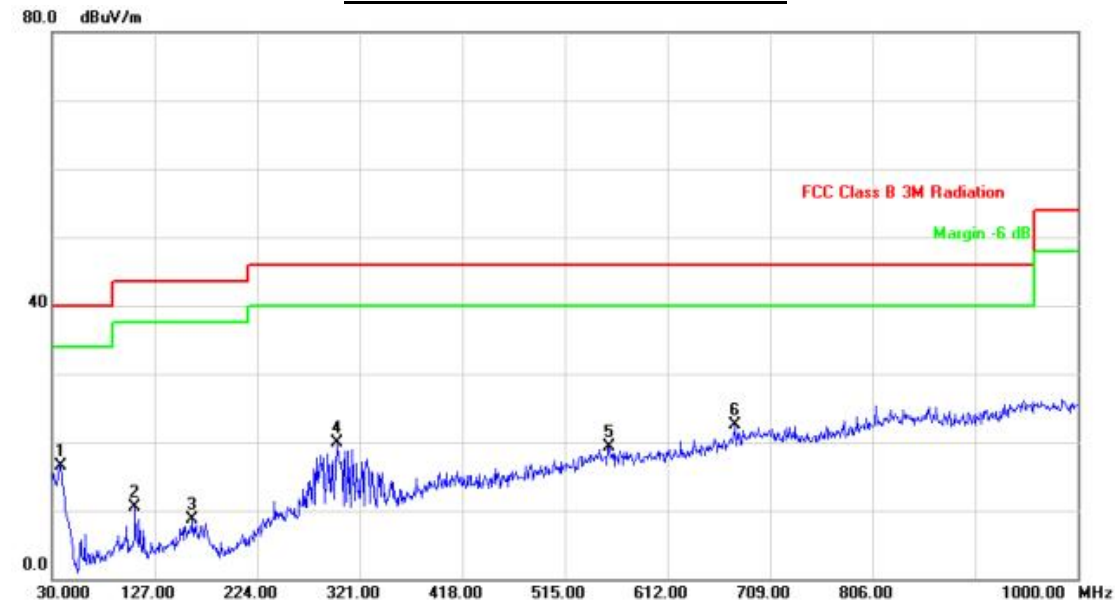


Horizontal Polarization of Channel 16





Horizontal Polarization of Channel 32



4.3 Out of Band Emissions

Test Requirement:	FCC part 15 section 15.249 (d)
Test Method:	ANSI C63.4:2003
Test Date:	2011-07-22
Mode of Operation:	Transmitting mode.
Detector Function:	Peak

Results: PASS

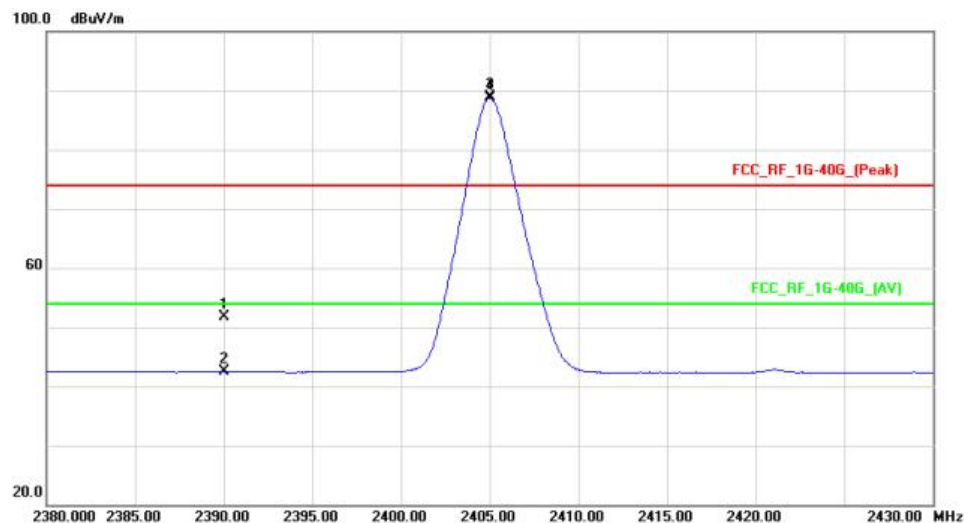
Refer to the data graph, the lower and higher edge of the specified frequency bands fulfill the general radiated emission limits in section 15.209. Therefore, the EUT meets the requirement of section 15.249 (d).

Limit for Out of Band Emissions [Section 15.249 (d)]

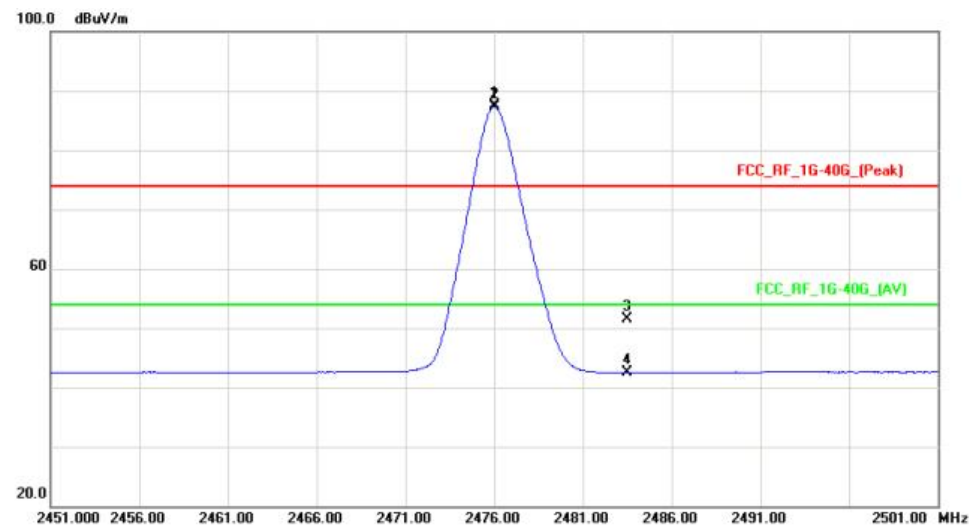
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in section 15.209, whichever is the lesser attenuation.

Test Result: Result data graph is shown at the next pages for reference.

Lowest Channel



Highest Channel



4.4 Bandwidth Measurement

Test Requirement:	FCC part 15 section 15.215 (c)
Test Method:	ANSI C63.4:2003
Test Date:	2009-11-18
Mode of Operation:	Transmitting mode.
Detector Function:	Peak

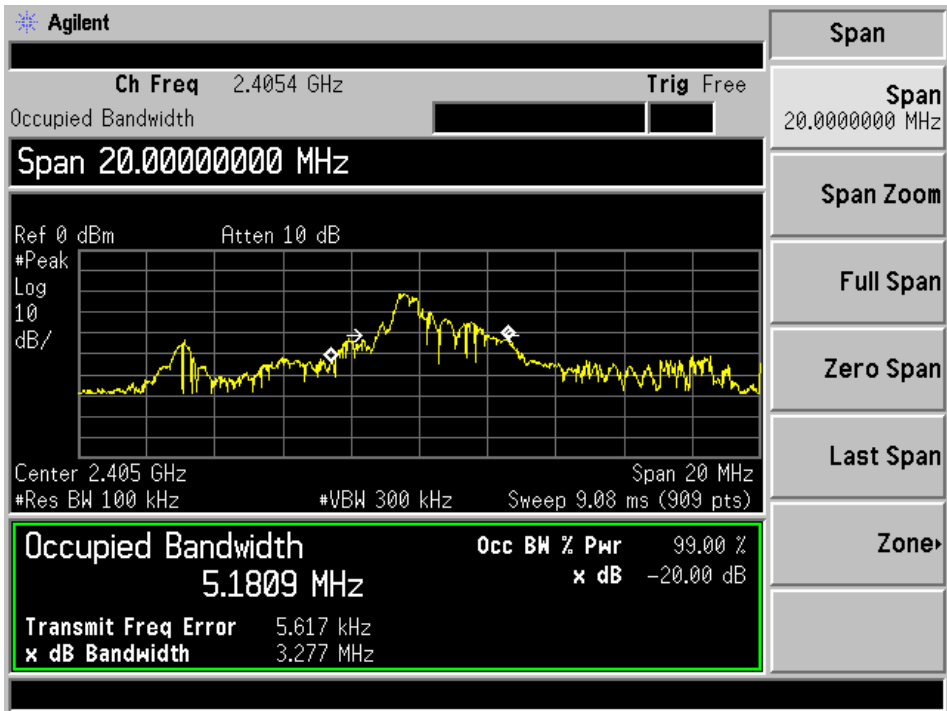
Results: PASS

Refer to the data graph, the 20dB points of Channel 1, Channel 16 and Channel 32 are 3.277MHz, 2.895MHz and 2.052MHz. All channels within the operation bandwidth when equipment is operated. Therefore, the EUT meets the requirement of section 15.215(c).

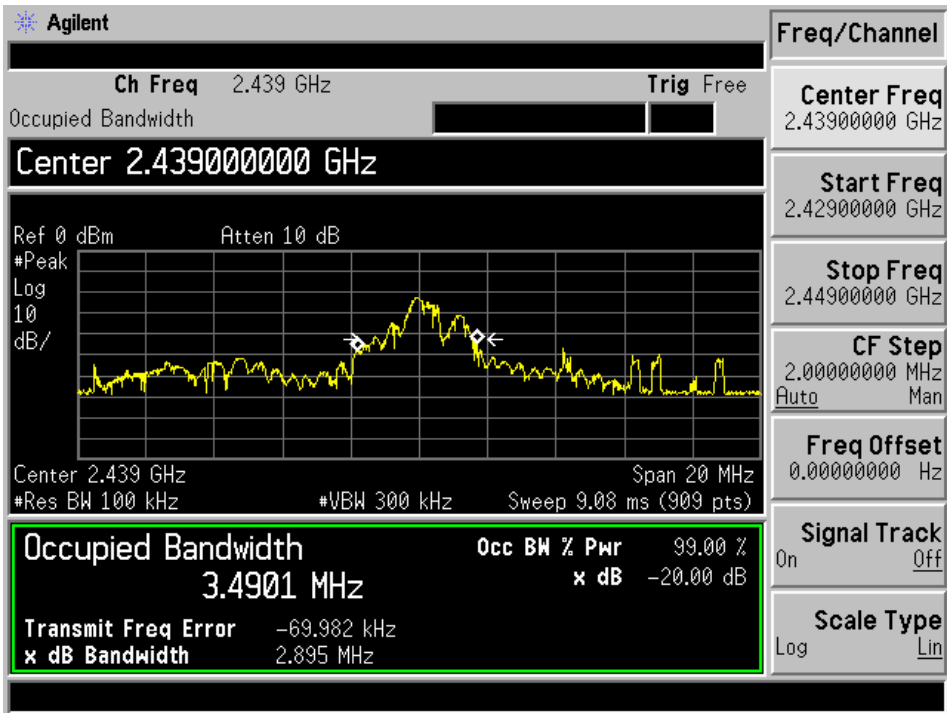
Limit for Bandwidth [Section 15.215 (c)]

The 20dB bandwidth of the emission shall be within the frequency band designated in the rule section under which the equipment is operated.

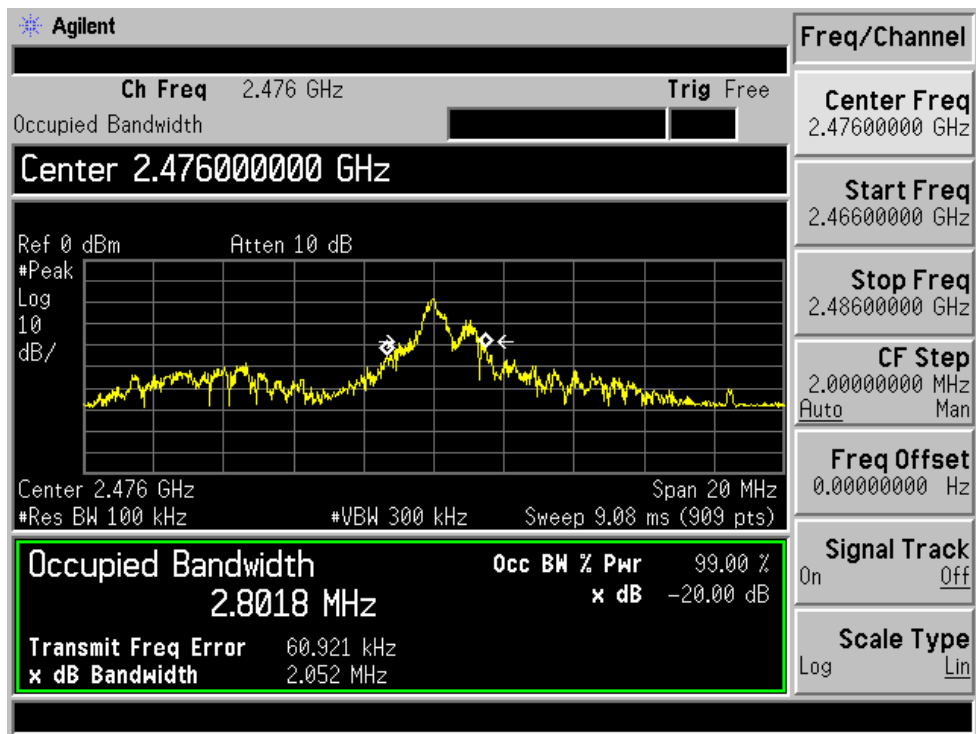
Test Result: Result data graph is shown at the next pages for reference.



Channel 1 – 20 dB point, Bandwidth 3.277MHz



Channel 16 – 20 dB point, Bandwidth 2.895MHz

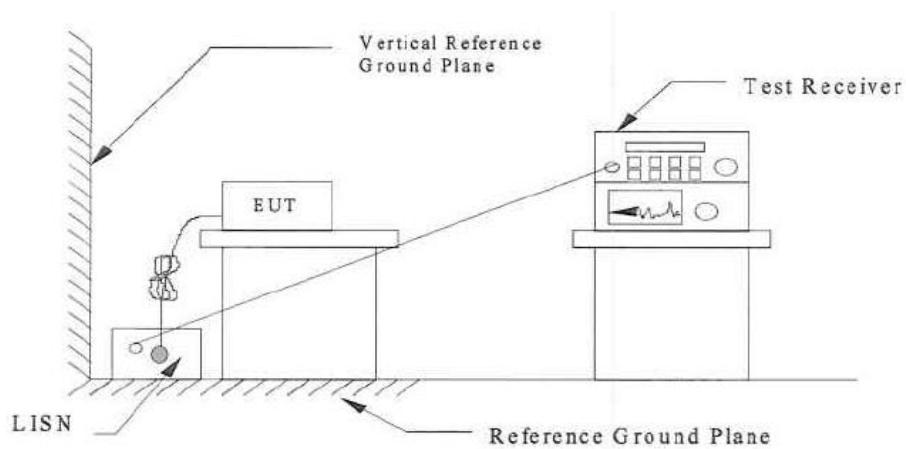


Channel 32 – 20 dB point, Bandwidth 2.052MHz

4.5 Conducted Emissions (0.15MHz to 30MHz)

Test Requirement:	FCC part 15 Section 15.207 Class B
Test Method:	ANSI C63.4:2003
Test Date:	---
Mode of Operation:	---
Detector Function:	Quasi-peak, average
Measurement BW:	9 kHz

Test Setup:



Results: N/A

Remark: - EUT is the battery operate product, no AC port test.

- Calculated measurement uncertainty: $\pm 2.8\text{dB}$

Limits for Conducted Emission [Section 15.207]:

Frequency Range [MHz]	Quasi-Peak Limit [dB μ V]	Average Limit [dB μ V]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.

5.0 List of Measurement Equipment

Radiated Emission and Out of Band Emissions

Description	Manufacturer	Model no.	Serial no.	Last cal	CAL due
Horn Antenna	EMCO	3115	9605-4803	Jul.13.2011	Jul.14.2012
Antenna	EMCO	3142C	00066464	Jul.13.2011	Jul.14.2012
Amplifier	Agilent	8449B	3008A02584	May.25.2011	May.26.2012
Test Receiver	R&S	ESCI	100382	May.25.2011	May.26.2012
Test Cable	N/A	C-01_CB03	N/A	May.25.2011	May.26.2012
Controller	CT	SC100	N/A	May.25.2011	May.26.2012
Test Cable	Huber+Suhner	SUCOFLEX_1 5m_4m	N/A	May.25.2011	May.26.2012
Coaxial Cable 50ohm	Rosenberger	RTK081-05S- 10m	LA2-001- 10M/002	May.25.2011	May.26.2012
RF Communications Test Set	HP	8920B	US36492628	May.25.2011	May.26.2012

Conducted Emission

Description	Manufacturer	Model no.	Serial no.	Last cal	CAL due
LISN	EMCO	3816/2	00052765	May.25.2011	May.26.2012
LISN	R&S	ENV216	100087	May.25.2011	May.26.2012
Test Cable	N/A	C_17	N/A	May.25.2011	Mar.26.2012
EMI TEST RECEIVER	R&S	ESCS30	826547/022	May.25.2011	May.26.2012
50Ω Terminator	SHX	TF2-3G-A	08122902	May.25.2011	May.26.2012

Remarks:

CM Corrective Maintenance

N/A Not Applicable or Not Available